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THE FOREST-LAND OWNERS OF PENNSYLVANIA

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Abstract

Seventy-eight percent of Pennsylvania's 15.9 million acres of commercial forest land is in the hands of 490,100 private owners. Landowner information is, therefore, an essential component in obtaining a thorough understanding of Pennsylvania's forest resources. Eighty-six percent of these owners are individuals. A large majority, 63 percent of these owners, live within a mile of their nearest tract and 86 percent own only one tract. Slightly more than half have held woodland for more than 10 years. Forest industries hold only 8 percent of the privately owned forest land. Benefits other than timber production are most important to most landowners, 75 percent have never harvested timber. Slightly more than half of the private owners permit some form of recreational use of their land by the public.

COVER PHOTO

AN AERIAL VIEW IN SCHUYLKILL COUNTY, PENNSYLVANIA

THE FOREST-LAND OWNERS OF PENNSYLVANIA

CONTENTS

HIGHLIGHTS

- Seventy-eight percent (12.5 million acres) of Pennsylvania's commercial forest land is in private ownerships.

- Thirty-seven percent of the owners hold more than 10 acres each and account for 82 percent of the private forest land.

- Eighty-six percent of the owners are individuals.

- Slightly more than half of the private landowners, holding 66 percent of the forest land, permit some form of recreational use of their land by the public.

- Forest industries own 8 percent of the privately held forest land.

- Benefits other than timber production are most important to Pennsylvania landowners.

- Seventy-five percent of the owners have never harvested timber.

INTRODUCTION

DECISIONS CONCERNING our renewable forest resources are vital to the social and economic well-being of society. Good decisionmaking requires a thorough knowledge of the resource base and the factors affecting it. This report, when combined with the most recent inventory of Pennsylvania's forest resources[1], will provide a significant portion of this information.

The Pennsylvania forest survey provides estimates of forest area and timber volume by broad owner categories as well as information on other forest values. This report describes the attitudes of typical forest-land owners, their reasons for owning forest land and their views toward timber harvesting, forest management, and recreational uses of their land.

This information will be useful to public agencies when planning and organizing forestry and related programs, to forest industry wishing to locate available supplies of timber, and to others wishing to learn more about the characteristics of forest-land owners. Seventy-eight percent of the 15.9 million acres of commercial forest land in Pennsylvania is in private hands. Landowner information is an essential component in obtaining a thorough understanding of Pennsylvania's forest resources.

The data presented here are based on a sample of forest-land owners. The results have been statistically expanded to estimate the total population of private forest-land owners and the acreage they own. Users of this report are advised to read the definitions of terms and the discussion of the study design and sampling errors included in the Appendix. Tables supporting conclusions found in the text are also contained in the Appendix.

[1]Powell, Douglas S., and Thomas Considine, Jr. 1980. The forest resources of Pennsylvania. (In Process.)

THE FOREST-LAND OWNERS

An estimated 490,100 private owners hold 12,452,800 acres of commercial forest land in Pennsylvania. Sixty-three percent of these owners hold less than 10 acres each and collectively control only 8 percent of the private forest land. Another 600 owners, holding 1,000 or more acres each, own 20 percent of the privately owned commercial forest land (Fig. 1).

The average private forest land ownership is 25 acres. If ownerships of less than 10 acres are excluded, the average rises to 63 acres. The average size of holding varies considerably among the geographic units, ranging from 11 acres in the Southeastern Unit to 55 acres in the Allegheny Unit (Fig. 2).

Eighty-six percent of the private owners are individuals, collectively holding 69 percent of the privately owned commercial forest land. Two percent of the owners are corporations and they hold just over 2.2 million acres, 18 percent of the privately owned forest land. The remaining 12 percent of the commercial forest land is held by partnerships, undivided estates, clubs, and associations.

Thirty percent of Pennsylvania's individually owned forest land (2½ million acres) is held by business owners, executives, professionals

Figure 1.—Distribution of private ownerships, by size class of ownership.

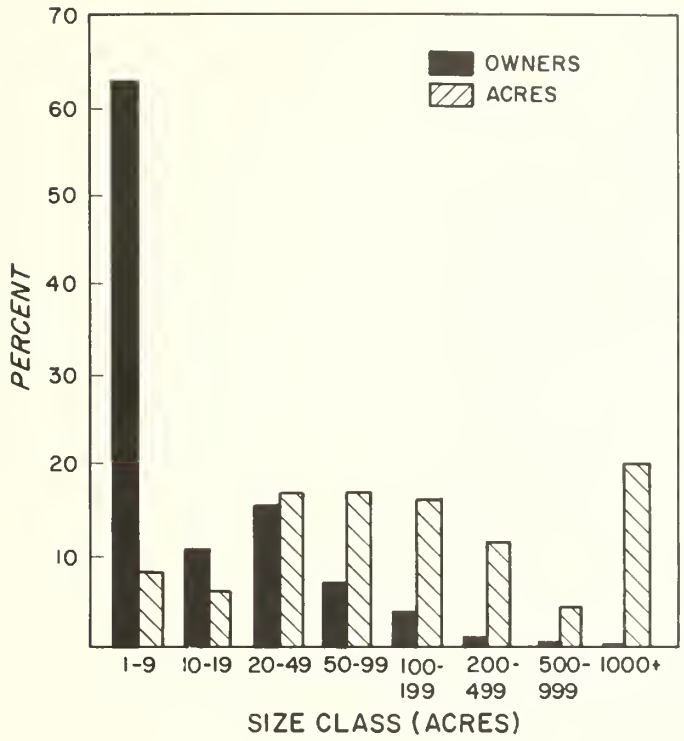


Figure 2.—Relative distribution of private forest-land owners and private commercial forest land in Pennsylvania for each geographic unit.

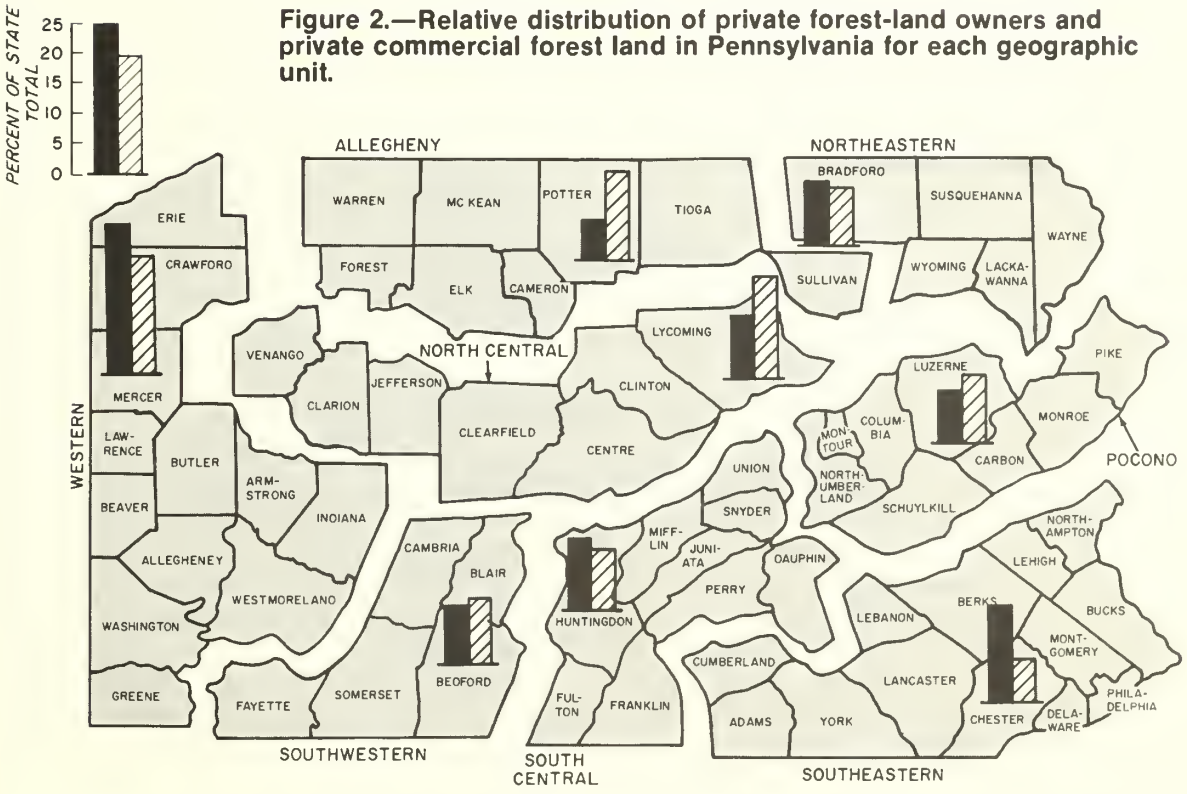
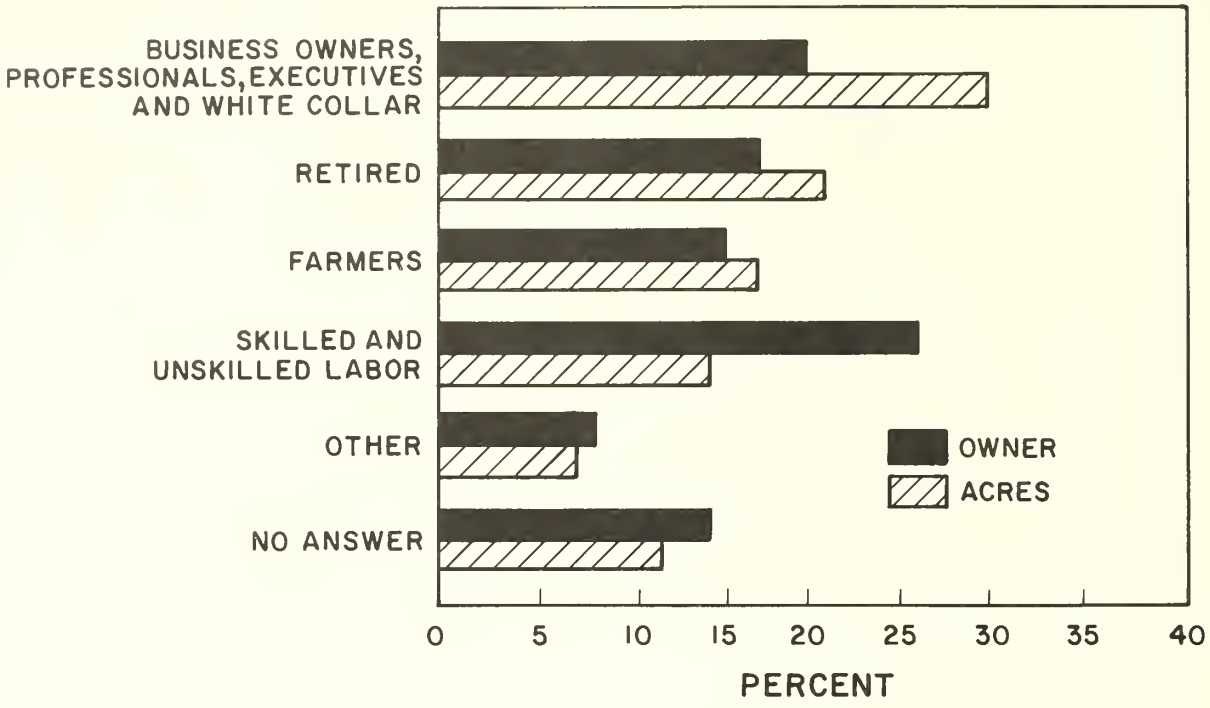


Figure 3.—Distribution of individual ownerships, by owner occupation.



and white collar workers (Table 6, Fig. 3). These owners are particularly numerous in the Allegheny and North Central units.

As in other states, retired people own a significant portion of Pennsylvania's forest land. There are an estimated 72,100 retired owners holding 21 percent of the state's individually owned forest land. As might be expected, a majority of the forest land is held by owners over 45 years old, almost half being held by owners between 45 and 64 years of age.

Woodland acreage in farms is declining, particularly since 1959 (Gingrich 1978), but farmers still hold a significant portion of Pennsylvania's forest land, 1.5 million acres. Our estimates of farmers owning woodland are based on what the respondents to our questionnaire listed as their primary occupation. The classification "farmer" does not include owners who are part-time or retired farmers. An additional 2 million acres of woodland are owned by part-time farmers and corporate farms.

Skilled and unskilled laborers, housewives, and miscellaneous other private owners collectively represent 34 percent of the individual owners and hold 22 percent of the individually held forest land.

Other information provides us with a general description of Pennsylvania's individual forest-land owners (Tables 7-16). Thirty-two percent of the owners are educated beyond high school while 24 percent have 8 years or less of formal education. Twenty-one percent of the owners did not indicate an income class for our survey. Of those that did, 60 percent had a gross income of less than $15,000 per year and hold 52 percent of the related forest land. Only 16 percent reported spending most of their early life (first 12 years) in a city with a population greater than 10,000. A large majority, 63 percent of the owners, live within a mile of their nearest tract of woodland and 86 percent own only one tract. Slightly more than half of the individual owners have held woodland for more than 10 years. These owners hold 65 percent of the individually owned commercial forest land.

CORPORATE AND OTHER OWNERS

There are an estimated 9,000 corporations owning just over 2.2 million acres of forest land in Pennsylvania. Excluding owners of less than 10 acres, the average corporate holding is 323 acres. A large portion of the corporate ownership is in the Allegheny Unit, where corporations own 783,800 acres or 41 percent of the privately owned forest land. More than half of this is forest industry land.

As is expected, forest industries hold a larger amount of the corporate-owned forest land than any other type of corporation. We estimate that 100 forest industry owners collectively hold 651,300 acres of forest land. However, even with the addition of 312,800 acres of noncorporate forest industry land, this represents only 8 percent of Pennsylvania's privately owned commercial forest land. Pennsylvania's forest industry lands are primarily located in the Allegheny and North Central units.

Real estate corporations hold 13 percent of the 2.2 million acres of corporate held forest land and are a particularly important ownership component in the Pocono Unit.

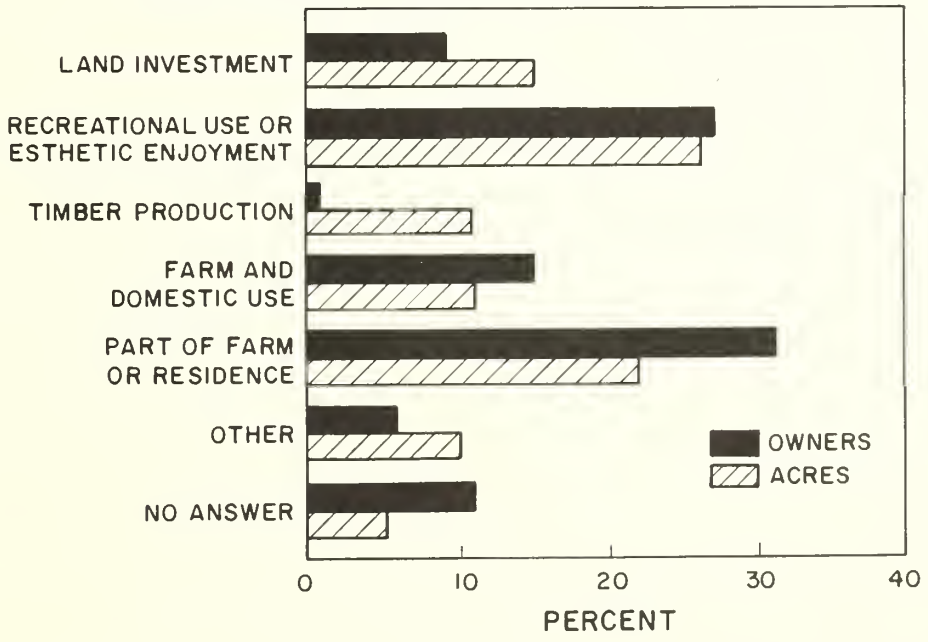
Nonforest industries collectively hold 29 percent of the corporate-held forest land. Many of these companies are primarily interested in the subsurface materials (coal, oil, natural gas) located within their boundaries. The remaining corporate acreage is held by nonindustrial firms, corporate farms, public utilities, and sports and recreation clubs. Other owners of forest land are partnerships, undivided estates, and noncorporate sports and recreation clubs.

Sports and recreation clubs are an important ownership component, holding over 600,000 acres or 5 percent of Pennsylvania's privately owned forest land. Much of this acreage, 556,000 acres, is held by hunting and fishing clubs, most having held forest land for more than 10 years.

OWNER OBJECTIVES

Land values continue to increase throughout the country. Land investment is often thought of as a hedge against inflation. However, only 9 percent of the private landowners, holding 15 percent of the forest land, listed land investment as their primary reason for holding forest land (Fig. 4, Tables 17-23).

Figure 4.—Distribution of private ownerships, by primary reason for owning forest land.



Thirteen percent of the owners believe that an increase in land value was the most important benefit derived from their land during the past 5 years, and 16 percent expect land value increase to be the most important benefit during the next 5 years. As a group, these owners hold larger than average-size tracts.

Land value increase accrues to all landowners to some extent. Landowners might not list this as a primary reason for holding forest land because they do not realize this benefit until they sell their land (and many do not plan to sell) or because values other than monetary gains are more important reasons for holding woodland. This view also influences timber production.

Only 1 percent of all landowners hold forest land primarily for timber production. However, their average holding is 443 acres, much larger than that for landowners with other primary reasons for owning woodland. These data include forest industry landowners; few nonindustrial private landowners hold forest land primarily for timber production. In the Allegheny Unit, 42 percent of the privately owned forest land is held primarily for timber production, most of which is held by forest industry.

Another 2 percent of the landowners listed timber production as their secondary reason for owning woodland. Adding the acreage held by these landowners to that held primarily for timber production, we find that 3 percent of the landowners holding just over 2 million acres hold land with timber production in mind.

A significant portion (30 percent) of the nonindustrial private forest-land owners believes the primary reason for owning forest land is that it is simply part of a farm or residence. This indicates that these owners have no firm objective in mind. Another 15 percent of the owners believe that farm or domestic use is the most important reason for owning forest land. These owners consider their woodlot as a source of fenceposts, fuelwood, and similar products. In general, these groups hold slightly smaller than average-size tracts.

Either recreation or esthetic enjoyment is the primary reason why 27 percent of the owners hold forest land. More owners listed esthetic enjoyment as the primary benefit derived in the last 5 years and the most important benefit during the next 5 years than any other benefit.

WHO HARVESTS TIMBER AND WHY

Throughout our survey we found that owners holding larger areas of forest land are more likely to have harvested in the past and have a higher probability of harvesting in the future (Tables 24, 25, 28-37). This is probably due to the tendency of larger owners to look at their land as an income-producing asset and to economies of scale in harvesting larger parcels. The average-size holding for timber harvesters is 53 acres compared with an average of 25 acres for all private landowners.

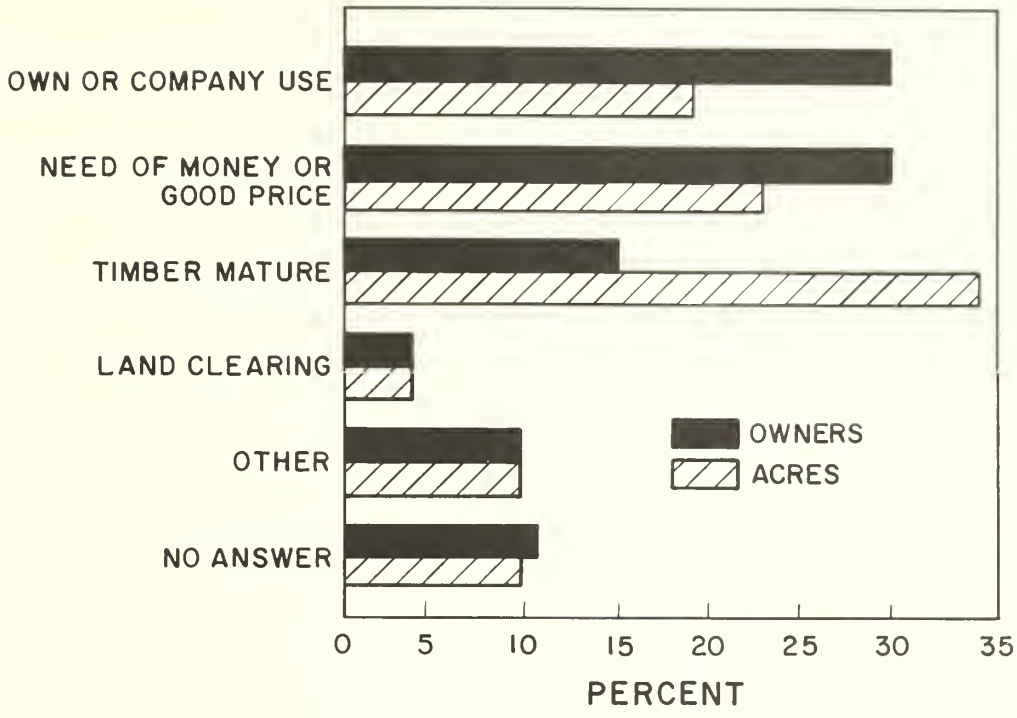
In general, landowners who are farm oriented have a greater tendency to harvest timber than others. Many of these owners harvest timber for their own use. No significant relationships between timber harvesting and other owner characteristics were detected in our survey. In all, 25 percent of Pennsylvania's private forest-land owners, holding just over 6.5 million acres, have harvested timber.

Thirty percent of the harvesters indicated that they did so for their own or company use (Fig. 5). On the average, individual owners in this group own smaller parcels than the average harvester, while corporations harvesting for their own use hold larger tracts. Of course, this is weighted heavily by the large holdings of forest industries. As fuelwood use becomes more popular, we expect to see more individuals, many with small parcels, cutting firewood for their own use.

Another 30 percent indicated that they harvested because they needed the money or were offered a good price. Individuals that harvested because they were offered a good price (4 percent of the individuals harvesting timber) hold considerably larger than average-size tracts. By contrast, those who harvested because they needed the money own smaller than average tracts.

Fifteen percent of the private owners har-

Figure 5.—Distribution of private forest-land owners who have harvested timber, by reason for harvesting.



vesting timber did so because they felt the timber was mature. These owners hold 34 percent of the land held by harvesters and hold considerably more forest land than the average harvester.

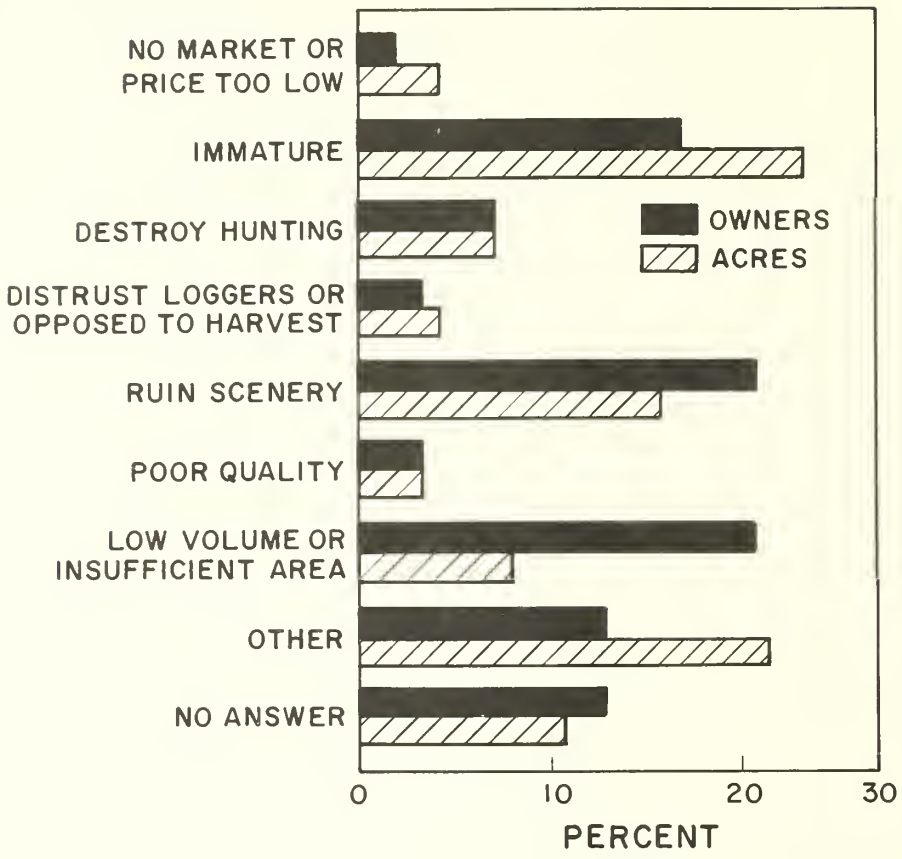
The remaining harvesters did so for land clearing, timber salvage, cultural treatment, or for other reasons. It is interesting to note that few (less than 0.5 percent) harvested timber for the purpose of cultural treatment. Many forest landowners in Pennsylvania have no desire or are unable to invest time or money in cultural operations. Many have little knowledge of forestry and the benefits achievable through forestry investment.

Why many owners have not harvested

Seventy-five percent of the private forest-land owners in Pennsylvania have never harvested timber. These owners hold 5.9 million acres, 47 percent of the privately owned commercial forest land. The average held by nonharvesters is 16 acres, approximately one-third of the average area held by harvesters. Owners holding more than half of this acreage indicate that they may harvest sometime in the future (Tables 26-30).

Almost 1.5 million acres, 25 percent of the forest land held by nonharvesters, was not

Figure 6.—Distribution of private forest-land owners who have not harvested timber, by reason for not harvesting.



harvested because the owners believed the timber was immature (Fig. 6). Twenty-one percent of this land is held by owners who indicate that they will never harvest timber, some because they will not own the land when the timber matures.

The most frequently cited reason for not harvesting was that timber harvesting would ruin the scenery. These owners hold 16 percent of the forest land held by nonharvesters and in general hold smaller tracts, averaging 12 acres. Almost half of this acreage is held by owners who indicated thay may harvest sometime; but very few of these owners plan to harvest within the next 10 years. Those that do hold an average of 55 acres.

Another 13 percent of the nonharvesting owners indicated they did not harvest because their holdings were too small. These owners hold an average of only 3 acres, generally too small for an economical logging operation. Owners holding 7 percent of the land not harvested for this reason plan to harvest timber within the next 10 years. However, these owners hold an average of 45 acres. Similarly, low volume was given as the reason for not harvesting by 8 percent of the nonharvesting owners holding an average of 11 acres. Eleven percent of this land is held by owners who plan to harvest within the next 10 years. These owners hold an average of 178 acres.

Lack of a market or low prices were reasons given by landowners holding 4 percent of the nonharvester acreage. Eighty-five percent of this land is held by owners who indicated they will harvest in the future, perphaps when prices or market conditions improve.

Distrust of loggers, opposition to timber harvesting, or that harvesting would destroy hunting values were reasons given by 10 percent of the landowners for not harvesting. It is interesting that 75 percent of Pennsylvania's hunting and fishing clubs have never harvested timber because they believe hunting values would be destroyed. Clubs holding two-thirds of the unharvested club acreage have indicated that they may harvest sometime in the future. Most clubs that expressed a desire to harvest within the next 10 years hold considerably larger acreages.

Poor timber quality, land tied up in estate, or plans to sell the land were among the reasons given by other owners for not harvesting timber.

Looking at future intentions of forest-land owners we see that many of these reasons do not preclude future harvesting. As the cost of living rises, many landowners may look to harvesting as an additional income source. Similarly, with the increasing economic scarcity of fossil fuels, many landowners are looking to their woodlots as a source of fuelwood. As we have seen throughout our analysis, landowners holding small parcels generally are not interested in harvesting timber. However, firewood harvesting may change this attitude for many. This change in attitude will have a significant impact on Pennsylvania's forests; whether it would be favorable or not would depend on the harvesting methods used.

As landowner interest in cutting timber develops, sound forestry advice and good logging practices must be applied. We have seen that timber production is not a major goal for most landowners; they will easily become disenchanted if they are not satisfied with the results of harvesting.

HOW MUCH TIMBER IS AVAILABLE

It is difficult to estimate how much of the timber on privately owned forest land is or will be available for harvesting. This will be influenced by how one defines availability and by assumptions used to develop the estimate. Changing industrial, market, and social conditions limit the time for which the estimate is useful.

To aid in estimating future timber availability, we asked the sampled owners when they plan to harvest timber and what percent of their woodland they believed they would never harvest timber from. To form the basis of our estimate we must assume that those owners indicating that they plan to harvest timber during the next 10 years will do so. To obtain a better grasp of the situation these owners were divided into three groups: forest industry, nonindustrial private forest ownerships (NIPF's) under 500 acres, and NIPF's over 500 acres.

There are an estimated 700 forest industry landowners holding 964,100 acres of woodland in Pennsylvania. These owners indicate that 96 percent or 930,100 acres are available for timber harvesting. Current average annual growth for Pennsylvania's forest land is estimated to be 34.85 ft^3 per acre per year. (Considine and Powell 1980). Assuming that this growth is available for harvesting, 32,414,000 ft^3 of wood will be available for timber products each year from forest industry lands.

Almost half of the NIPF's holding more than 500 acres of commercial forest land each plan to harvest timber within the next 10 years. These owners hold 1,192,900 acres of woodland and indicate that 90 percent or 1,070,900 acres are available for timber harvesting at some future date, not necessarily during the next 10 years. Again, assuming that these owners will, on the average, harvest annual growth from their woodland, 37,320,900 ft^3 of wood will be available for timber products each year.

We estimate that an additional 38,000 NIPF's holding less than 500 acres each plan to harvest timber during the next 10 years. These owners indicate that 1,380,300 acres or 91 percent of their woodland is available for timber harvesting. This type of owner has harvested an average of 425.5 ft^3 per acre from their woodland in the past. Assuming this volume will be harvested from their available acreage during the next 10 years, 58,731,800 ft^3 per year will be harvested by these owners.

In total, 128,466,700 ft^3 of timber should

be made available each year by private owners that plan to harvest timber during the next 10 years. In 1976, forest industries used 166,054,000 ft^3 of timber from Pennsylvania's forests (Bones and Sherwood 1979). Slight increases are expected during the next few years. Adding the volume that will be made available from public forest land, it would seem that there will be an adequate supply of timber for Pennsylvania's forest industry. This view is further strengthened by the estimated 167,600 owners holding 5,415,400 acres of commercial forest land that indicate they may harvest sometime in the future.

FOREST MANAGEMENT ON PRIVATE LANDS

Harvesting practices

Forty-four percent of the landowners who harvested timber chose the area or trees to be harvested. (Table 38). These owners control 2,267,600 acres, 35 percent of the privately owned forest land held by harvesters. An additional 6 percent of the harvesters were involved with a buyer or forester in selecting the timber for harvest. Foresters were involved in only 4 percent of the cases; however, these ownerships include 24 percent of the acreage held by harvesters. Average holdings of landowners who selected the timber themselves was 42 acres, in combination with a forester, 151 acres, and by a forester alone, 341 acres. It is not surprising that foresters would be involved in harvesting larger parcels, particularly since these data include the holdings of large forest industries that employ foresters.

Twenty-six percent of the harvesters allowed the buyer to select the timber and another 5 percent allowed the buyer to participate in the decision. Together, these owners hold 27 percent of the land held by harvesters in Pennsylvania and in general hold smaller than average-size harvested tracts. Where the buyer is involved in selecting the timber to cut, an inherent conflict of interest may arise between the buyer's desire for merchantable timber and the landowner's objectives. In some cases their goals may be the same--maximum profit today. But in many cases landowners have not realized their expectations simply because the harvest was planned by someone with different goals. Similar problems can result with respect to the professional forester who, in his desire to do a good job silviculturally, may fail to meet the landowner's objectives. However, many foresters do understand the landowner's goals and will help him attain them.

Diameter-limit cutting, where only trees above a certain diameter are removed, was the most common method of selection used. This method was used by owners of over 2 million acres, one-third of the land held by harvesters. This method is most frequently used when the buyer is involved in the timber selection. It is easy to administer and allows the landowner some control over what will be cut.

Selection, where only preselected marked trees are removed, was used by harvesters owning almost 2 million acres. This method allows greater flexibility but requires more effort to administer. It was most commonly used when landowners or foresters selected the timber to be harvested.

Clearcutting was used by 10 percent of the harvesting landowners as a cutting method; another 3 percent removed trees as part of a land clearing operation.

Twenty-seven percent of the landowners did not know the harvesting method used or did not answer this question. The remaining owners used a combination of methods or other selection procedures.

PRODUCTS HARVESTED

As expected, the product most frequently harvested was sawlogs. Owners holding 78 percent of the land held by harvesters cut sawlogs (Tables 39-40). Pulpwood was cut by owners holding one-third of the land owned by harvesters. A majority of this land is located in the Allegheny, North Central and South Central units. These two major products were primarily responsible for Pennsylvania's increasing timber harvest (Bones and Sherwood 1979).

It is interesting that one-third of the own-

ers, holding one-half of the acreage held by harvesters, cut more than one product from their woodland. Products harvested included veneer logs, posts, pilings, mine timbers, turnery bolts, and Christmas trees.

FORESTRY ASSISTANCE

When asked whom they would contact for forestry assistance, half of the owners indicated they did not know and another 25 percent did not respond to the question. Together, these owners hold 63 percent of the privately owned forest land (Table 41). Thus further supports the view that a great majority of the landowners in Pennsylvania are simply not interested in actively managing their woodland.

Fourteen percent of the landowners would contact the Pennsylvania Bureau of Forestry, Department of Environmental Resources, for forestry assistance. The remaining landowners would contact various other offices or individuals for forestry advice.

An estimated 28,000 owners, 6 percent of all landowners, indicated that they have received some forestry assistance (Table 42). These owners hold 24 percent of Pennsylvania's commercial forest land. General forest management assistance was received by 9,400 owners holding 1.1 million acres. Other owners received assistance with timber marking, timber stand improvement, planting, timber evaluation, surveying, and other forestry services. It is important to note that these data include services received by forest industries from their own foresters.

RECREATION

Slightly more than half of the private landowners, holding 66 percent of the forest land, permit some form of recreational use of their land by the public (Tables 43-44). Hunting is the use most frequently permitted. Forty-seven percent of the landowners holding 7.3 million acres permit the public to hunt on their land. Hiking is permitted by 20 percent of the landowners holding 41 percent of the forest land. Picnicking, camping, fishing, and snowmobiling were among other uses permitted by many landowners. Owners have been generally apprehensive in permitting picnicking or camping due to the possible site degradation that often accompanies these activities.

Thirty-four percent of the landowners do not permit public use on their 3.2 million acres. However, 4.2 million acres are posted to control hunting or trespass. This indicates that some land is open to some public use even though it is posted. Many landowners will permit public use, if asked, even though their land is posted.

Why do landowners post their land? Thirty-nine percent of the owners that posted did so to control hunting (Table 45). In general, these owners hold smaller than average-size parcels. Other owners posted to prevent abuse of their property, for safety reasons, to protect against liability, or to control public access. Landowners posting to protect themselves from liability own considerably larger acreages than owners posting for other reasons.

LANDOWNER INTERESTS

To understand more about owner interest and motivation, we asked owners to list the conservation-oriented organizations in which they are active, and the conservation oriented publications they receive (Tables 46-47). Answers to these questions will also help identify a medium of communication to forestland owners. As shown earlier, most landowners do not even know which agency they would contact for forestry assistance. Many programs to aid landowners are not well accepted simply because owners are unaware of a program's existence.

We estimate that 25 percent of the owners holding one-third of the individually owned forest land are members of farm- or conservation-related organizations. More landowners (8 percent) are members of the National Wildlife Federation than of any other organization.

An estimated 53 percent of the individual landowners holding two-thirds of the individually owned forest land subscribe to a farm

or conservation related publication. Highest in circulation was Pennsylvania Game News, which was received by 25 percent of the individual landowners, holding one-third of the forest land. Next was Pennsylvania Farmer, received by 19 percent of the landowners, followed by Field and Stream with 10 percent. However, these landowners hold only 4 and 5 percent, respectively, of the individually owned forest land.

CONSERVATION QUIZ

To gain insight into woodland owners' knowledge of conservation and forestry, we asked our respondents to indicate whether each of the 10 statements listed below was true or false. The responses considered correct are those that a professional conservationist would give. Owners were encouraged to check "don't know" rather than guess. Additional information, including numbers of owners and acres owned by statement and response is found in Table 48.

Statement

1. Conservation means that natural resources should be used wisely.
2. Once a forest is cut it will not grow back unless planted.
3. Sustained yield is an important forestry objective.
4. Clearcutting is always bad forestry.
5. All forest land in the United States is managed.
6. Selective logging is always good forestry.
7. Commercial forest land is forest land that is owned by wood-using industries.
8. An ecosystem is any complex of living organisms together with their environment.
9. A virgin forest is any forest of old or large trees.
10. Stumpage price is the price paid for standing timber.

Responses to the first statement indicate that most landowners have at least a fundamental understanding of conservation. This statement had the highest correct response rate of all 10 questions.

At least 26 percent of the owners do not realize that a forest will grow back naturally after harvesting. Landowners are also quite confused over whether or not clearcutting is "bad" forestry. Only 34 percent of the individual landowners answered this statement correctly. From the forester's point of view, clearcutting is not always "bad" forestry anymore than selective logging is always "good" forestry. Only 9 percent of the landowners would answer statement number 6 correctly, realizing that selective logging is not always "good" forestry.

Twenty-one percent of the landowners realize that commercial forest land does not mean only land that is owned by wood-using industries. Commercial forest land by our definition is forest land that is capable of producing crops of industrial wood (more than 20 ft^3/acre/year) and is not withdrawn from timber production.

Few owners answered the question on stumpage price incorrectly, however, 40 percent did not know. This term is used widely by timber buyers and loggers.

Statement number 8 was designed so that only persons with a detailed knowledge of conservation would be expected to give the correct response. Only 2 percent of the owners responded incorrectly and 51 percent indicated that they did not know. This supports the view that most owners did not guess at answers and made a sincere effort when given the quiz.

This quiz indicates that many landowners do not understand certain forestry concepts and terms. As expected, owners of larger tracts were more likely to give correct responses than owners of small tracts.

CONCLUSION

Nonindustrial private forest-land owners usually hold land for reasons other than timber production. Land value increase accrues to all landowners but for most it is not of primary importance. The vast majority of these landowners are not wealthy and for most, forest land represents a significant portion of their assets; yet they continue to hold the land, receiving little monetary income from it. This indicates that they place a high value on nonmonetary forest benefits. However, more than 9 million acres of woodland are held by owners who indicate that they may harvest sometime. The supply of timber that we estimate will be made available should be adequate in filling the needs of Pennsylvania's forest industries in the near future. Increased harvesting by owners using the wood for their own use, particularly fuelwood, may impinge upon the supply available to the forest industries. However, much more timber can be produced through increased forest management.

As living costs rise and fossil fuel supplies dwindle, more landowners will look to their woodland as a source of income and fuelwood. Landowners will need to be made aware of the options and the spectrum of benefits that forestry has to offer.

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APPENDIX

Study method

The sampling scheme used in this study was derived from the sampling design used in the forest survey by the Northeastern Station. Resources Evaluation field crews attempted to obtain the correct name and mailing address of the owner of each of the 1,697 privately owned forested field plots in the state. These plots are uniformly distributed within each survey unit. The field crews obtained usable addresses of owners for more than 90 percent of the field plots. In addition, a list of municipal water authorities and private water utilities containing 189 addresses was obtained. Of these, 38 were determined to be private owners of commercial forest land. A total of 1,539 questionnaires were sent to owners of commercial forest land in Pennsylvania, 1,161 were returned with usable information.

The questionnaire was developed from several earlier ownership studies and it has been revised as the study has progressed through the Northeastern States. The mailing for Pennsylvania was conducted in two parts. Questionnaires for the eastern half of the state were mailed in January 1977, and those for the western half in November 1977. The mailing consisted of the questionnaire and a cover letter that explained the purpose of the survey. Approximately 2 weeks after the first mailing, a postcard was sent to each addressee to remind those who had not responded to return the questionnaire, and to thank those who had returned theirs. One week later, nonrespondents were mailed a second copy of the questionnaire and the cover letter plus a second letter urging their cooperation. Approximately 1 month later, 326 owners had responded in the eastern half of the state and 492 in the western half of the state. Then a 100-percent field canvass of nonrespondents was undertaken by personnel with the Bureau of Forestry, Pennsylvania Department of Environmental Resources. This resulted in an additional 343 usable questionnaires. The 1,161 questionnaires represent 1,271 of the privately owned forested field plots or 75 percent.

The probability that a forest-land owner will be sampled depends on the rate of sampling and the acreage of commercial forest land he owns. Each unit in Pennsylvania had a different rate of sampling. There were also different rates of success in persuading nonrespondents to reply. Both the survey rate of sampling and the success rate of the follow-up affect the probability that an owner will be included in the final tabulation.

The total acreage of commercial forest land in private ownerships was obtained from the forest survey. To calculate the area represented by each plot, the total area of privately owned commercial forest land in each unit was divided into two strata based on photo interpretation of the plot. The area in each strata was divided by the number of field plots represented by the valid questionnaires. The private water companies represented the acreage of forest land they actually owned because these companies were from a complete list and did not have to have a forested field plot to be included in our survey.

Since the sampling scheme is essentially the one used for the forest survey, there is a low probability of inclusion for owners of small parcels of woodland. To estimate the total number of persons who own commercial forest land in Pennsylvania, it was necessary to weight the number of owners obtained in the samples. This procedure can be stated as:

$$N = \frac{CFL_p}{N_r} \sum \frac{1}{A_1}$$

N = estimated number of private owners in the sampling strata.

CFL_p = the acres of commercial forest land in the sampling strata.

N_r = number of respondents in the sampling strata.

A_1 = acres owned by the individual respondent.

The ΣN then equals the estimated number of private owners in the state. This is an unbiased estimate of the total number of persons who own commercial forest land in Pennsylvania.

The data were edited, processed, and compiled by computer, using FINSYS-2, a generalized computer system (Barnard 1978).

Because this study encompasses eight sampling units with two sampling strata per unit, and the private water companies are scattered throughout the state, data have been aggregated to the Resources Evaluation units. The following tabulation shows the pertinent data for each unit.

Unit	*No. of usable questionnaires*	*No. of survey plots*	*Average acreage per plot*
Western	193	195	12,438
Allegheny	157	240	7,992
North Central	182	197	10,598
Southwestern	140	139	9,563
Northeastern	134	138	8,971
Pocono	138	150	9,317
Southeastern	110	107	8,030
South Central	107	115	10,410
All units	1,161	1,281	9,721

Sampling errors

Sampling errors were calculated for the estimated total number of forest-land owners in each unit and for the combined total. The sampling error for the number of acres of commercial forest land in private ownership was calculated as part of the forest survey. The user of these data is cautioned that, as the size of our estimate decreases in relation to the total unit estimate, the sampling error, expressed as a percent of the estimate, increases drastically.

The inclusion of small woodland parcels (fewer than 10 acres) in the study population substantially increases the sampling error for the estimated number of owners.

Unit	Sampling error		
	Private commercial forest land	Owners of private commercial forest land	Owners holding 10 or more acres
	Percent		
Western	±2.5	±17.6	± 7.5
Allegheny	±1.3	±16.1	±13.2
North Central	±1.3	±18.8	±11.3
Southwestern	±2.2	±29.3	±11.6
Northeastern	±2.4	±26.4	± 8.4
Pocono	±1.2	±30.2	±13.7
Southeastern	±3.5	±13.0	±11.6
South Central	±1.4	±24.4	±12.2
Total	±0.7	± 7.8	± 4.1

NE FOREST EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE

OMB 40-R-3941

NORTHEASTERN WOODLAND OWNERSHIP STUDY

State _____

County _____

Plot _____

Please complete the following questions to the best of your knowledge. Where actual data are not available please use your best estimate. Please be assured your answers will be held strictly confidential. If you do not now own woodland please answer questions 1 and 2 and return the questionnaire.

1. How much land do you now own? (Include woodlands, pasture, cropland, etc., but exclude individual house lots.) Acres_____

2. Of all of the land you own how much is woodland? Acres_____ or percent____

3. Is all of the woodland you own in one state?

   Yes _____ What state?_____

   No _____ My woodlands are in more than one state as follows:

   _____ acres in _____ (state)

   _____ acres in _____ (state)

   _____ acres in _____ (state

   _____ acres in _____ (state)

4. How many individual tracts or parcels of woodland do you own? Number_____

5. In what year did you first acquire woodland? Year _____

6. How did you acquire the major portion of the woodland you now own?

Purchase	1.	_____
Inheritance	2.	_____
Other	3.	_____

7. In which one of the following ownership categories does the major portion of your woodland holdings fall? (Please check only one.)

		Check one
Individual (include husband and wife)	1.	_____
Joint ownership	2.	_____
Undivided estate	3.	_____
Partnership	4.	_____
Corporation	5.	_____
Club or association	6.	_____
Other	7.	_____

8. If the ownership is a partnership, corporation, club, or association, what is the nature of the business or organization? Or, if woodland is part of an active farm, write in the word "farm" in the space below.

_____

Please indicate the title of the person completing this questionnaire.

---

9. What is the approximate road mileage from your home to your nearest and furthest tract of woodland? (For businesses or organizations consider "home" to mean place of business, or location of organization.)

Miles to the nearest tract (enter zero if you live on the tract). _____

Miles to the furthest tract. _____

10. How many times have you or your representative visited your nearest and furthest tract of woodland in the last 12 months?

Number of visits to the nearest tract _____

Number of visits to the furthest tract _____

11. Which statement most accurately describes your woodland?

Check one

a. Most of the trees are sugar (hard) maple, beech, and yellow birch. _____

b. Most of the trees are red (soft) maple, elm, and ash. _____

c. Most of the trees are oaks, hickories, gums, and yellow-poplar. _____

d. Most of the trees are pines. _____

e. Most of the trees are softwoods other than pines. _____

f. None of the above apply. Please describe your woodland briefly: _____

_____

g. I do not know what kinds of trees are on my land. _____

12. Which statement most accurately describes average size of the trees in your woodland?

Check one

a. The average tree is 5 inches in diameter or smaller. _____

b. The average tree is between 5 and 12 inches in diameter. _____

c. The average tree is 12 inches in diameter or larger. _____

d. I don't know how big the trees are. _____

13. Have you ever harvested timber or trees from your land?

Yes 1._____ No. 2._____

NOTE: IF YOU HAVE NEVER HARVESTED TIMBER OR TREES FROM YOUR WOODLAND SKIP TO QUESTION 23.

14. In what year did the most recent timber harvest take place? _____

15. What percent of your woodland was involved in the most recent timber sale? _____

16. What percent, if any, of your woodland do you feel you would never harvest timber from? _____

17. What products were harvested? (Check as many as apply.)

		Check			Check
Sawlogs	1.	_____	Mine timbers	6.	_____
Veneer logs or bolts	2.	_____	Christmas trees	7.	_____
Pulpwood	3.	_____	Other (please specify)_____	8.	_____
Turnery bolts	4.	_____	Don't know what products were harvested	9.	_____
Posts, poles, or piling	5.	_____			

18. Please indicate amounts of products harvested.

Product	Amount	Unit of measure
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

19. How were your trees selected for harvesting? (Please check only the method that accounted for the greatest volume, if more than one method was used.)

	Check one
Selection (only preselected market trees were removed).	1. _____
Diameter limit (only trees over a minimum diameter were removed). Please indicate minimum diameter _____	2. _____
Clearcutting (most or all of the trees on a given area were removed).	3. _____
Land clearing (trees were harvested incidental to clearing the land for a use other than woodland).	4. _____
Other (please specify) _____	5. _____
Don't know method used.	6. _____

20. Who selected the area or trees to be harvested?

	Check one
1. Landowner	_____
2. Forester	_____
3. Friend or neighbor	_____
4. Timber buyer or logger	_____
5. Combination of _____ and _____	_____

21. If you did not have the assistance of a forester in the harvesting of your timber, do you now wish you had?

	Check
Yes	_____
If yes, why _____	_____
No	_____
No feeling either way	_____

22. Why did you harvest timber at the time that you did? (Check only the one reason you consider most important.)

		Check one
Felt timber was mature	1.	_____
Offered a good price	2.	_____
Land clearing	3.	_____
Needed money	4.	_____
Needed timber for own use	5.	_____
Timber harvest for company use (industry only)	6.	_____
Other (please specify) _____	7.	_____

23. If you have never harvested timber or trees from your land, why not? (Please check only the reason you consider most important).

		Check one
Woodland immature - timber too small	1.	_____
No market for timber	2.	_____
Price offered or prevailing market price too low	3.	_____
Value of land for hunting would be destroyed	4.	_____
Selling or plan to sell the land	5.	_____
Scenery would be destroyed	6.	_____
Land tied up in estate	7.	_____
Distrust of loggers	8.	_____
Opposed to timber harvesting	9.	_____
Poor quality timber	10.	_____
Not enough volume	11.	_____
Logging would create a fire hazard	12.	_____
Insufficient area to harvest	13.	_____
Other (please specify) _____	14.	_____

24. Do you plan to harvest timber from your woodlands in:

		Check one
Next 5 years	1.	_____
5 to 10 years	2.	_____
Possibly at some future date	3.	_____
Never plan to harvest	4.	_____

25. Have you ever sought the assistance of a forester for advice or help in managing your woodland?

Yes _____ Please indicate the nature of assistance. _____

_____

No _____

26. What office, agency, or individual would you contact for forestry assistance? (If you don't know, please write in "don't know.")

_____

27. Why do you own woodland? (Please rank in order of importance those items that are applicable, with number 1 the most important.)

	Rank
Land investment (hope to sell all or part of my woodland at a profit).	____
Recreation (hunting, camping, fishing, etc.).	____
Timber production (growing timber or other forest products for sale).	____
Farm or domestic use (source of forest products for own use, i.e., firewood, fence posts, etc.).	____
Aesthetic enjoyment (the desire to have woodland and "green space" around my home).	____
Part of the farm (the woodland is part of the farm but serves no useful function in the farm operation).	____
Part of my residence.	____
Other (please specify) _____	____

28. Which of the following do you feel were the most important benefits you derived from your woodland in the last 5 years? (Please rank in order of importance those items that are applicable, with number 1 the most important.)

	Rank
Increase in land value (investment).	____
Recreation (hunting, fishing, camping, etc.).	____
Income from the sale of timber.	____
Aesthetics (just enjoy woodland, wildlife, and the general satisfaction of owning "green space").	____
Farm and domestic use.	____
Other (please specify) _____	____

29. Which of the following do you feel will be the most important benefits you expect to derive from your woodland in the next 5 years? (Please rank in order of importance those items that are applicable, with number 1 the most important.)

	Rank
Increase in land value (investment).	_____
Recreation (hunting, camping, etc.).	_____
Income from sale of timber.	_____
Aesthetics (just enjoy woodland, wildlife, and the general satisfaction of owning "green space").	_____
Farm or domestic use.	_____
Other (please specify) _____	_____

30. Is the general public, other than your family and immediate circle of friends, permitted to use your woodland for any of the following?

		Check
Public use not permitted	1.	_____
Public use permitted:		
Hiking	2.	_____
Picnicking	3.	_____
Camping	4.	_____
Fishing (check only if fishing is available)	5.	_____
Hunting	6.	_____
Snowmobiling	7.	_____
Other (please specify)	8.	_____

31. Is you land posted?

No _____, go to next question.

Yes_____, why is it posted? _____

32. Have you been approached to sell all or part of your woodland in the last five years?

Yes _____ No _____

33. Are you an active member of any of the following organizations? (Please check those you are a member of.)

		Check
American Forestry Association	1.	_____
Ohio Forestry Association	2.	_____
Pennsylvania Forestry Association	3.	_____
Isaak Walton League	4.	_____
Audubon Society	5.	_____
Natural History Society	6.	_____
National Wildlife Federation	7.	_____
A Sportsman's Club	8.	_____
A Garden Club	9.	_____
National Farmer's Organization	10.	_____
The Grange	11.	_____
The American Tree Farm Program	12.	_____
The Sierra Club	13.	_____
Any other organizations similar to those listed above (Please specify)_____	14.	_____
No, I don't hold membership in any of the above.	15.	_____

34. Do you or any member of your household subscribe to any of the following magazines? (Please check those that apply.)

		Check
Tree Farm News	1.	_____
American Forests	2.	_____
National Wildlife	3.	_____
Forest Farmer	4.	_____
Ohio Woodlands	5.	_____
Pennsylvania Forests	6.	_____
Pennsylvania Game News	7.	_____
Audubon Magazine	8.	_____
National Parks and Recreation	9.	_____
Field and Stream	10.	_____
Sports Afield	11.	_____
Kentucky Farmer	12.	_____
Agway Cooperator	13.	_____
Ranger Rick Nature Magazine	14.	_____
Our Heritage	15.	_____
Forests and People	16.	_____
Ohio Farmer	17.	_____
Maryland Conservation	18.	_____
West Virginia Conservation	19.	_____
Pennsylvania Farmer	20.	_____
Any other magazine similar to those listed above (Please specify) _____	21.	_____
No, I don't subscribe to any of the above magazines.	22.	_____

35. Please indicate whether each of the following statements is true or false. If you feel you don't know, don't guess, please check "Don't Know" column.

	True	False	Don't Know
a. Conservation means that natural resources should be used wisely.	____	____	____
b. Once a forest is cut it will not grow back unless planted.	____	____	____
c. Sustained yield is an important forestry objective.	____	____	____
d. Clearcutting is always bad forestry.	____	____	____
e. All forest land in the United States is managed.	____	____	____
f. Selective logging is always good forestry.	____	____	____
g. Commercial forest land is forest land that is owned by wood-using industries.	____	____	____
h. An ecosystem is any complex of living organisms together with their environment.	____	____	____
i. A virgin forest is any forest of old or large trees.	____	____	____
j. Stumpage price is the price paid for standing timber.	____	____	____

The following questions are asked to classify responses on the basis of information about the owner personally. Again, we would remind you that the answers to these questions, and to any other questions on this questionnaire are strictly confidential. All answers will be compiled in such a manner that it will be impossible to identify any individual reply.

These questions do not pertain to and should not be answered by corporations and organizations.

If the woodland is owned by more than one person, the following questions should be answered for the person to whom the questionnaire is addressed.

36. During the first 12 years of the owner's life where did he live most of the time?

		Check one
In a city with a population of 100,000 or more	1.	_____
In a city with a population of 10,000 to 99,999	2.	_____
In a town or city with a population of less than 10,000	3.	_____
In a rural area	4.	_____
On a farm	5.	_____

37. What is the sex of the owner?

Male _____ Female _____

38. What is the age of the owner?

		Check one
Under 25	1.	_____
25-44	2.	_____
45-64	3.	_____
65 and over	4.	_____

39. How many years of formal education has the owner completed?

		Check one
Grades 1- 8	1.	_____
Grades 9-12	2.	_____
Has some schooling beyond high school (business technical school, or some college)	3.	_____
Has a bachelor's degree or equivalent	4.	_____
Has some graduate work	5.	_____
Holds a master's degree	6.	_____
Holds a doctoral degree	7.	_____

40. What is the primary occupation of the owner? _____

41. In which category would the owner's personal gross income from all sources fall?

		Check one
Less than $10,000	1.	_____
$10,000 to $14,999	2.	_____
$15,000 to $19,999	3.	_____
$20,000 to $24,999	4.	_____
$25,000 to $29,999	5.	_____
$30,000 or more	6.	_____

42. Comments?

Definition of terms

Average annual net growth of growing stock. The change (resulting from natural causes) in volume of sound wood in sawtimber and poletimber trees during the period between surveys, divided by the length of the period. Components of annual net growth of growing stock include the increment in net volume of trees present at the beginning of the period minus cull increment (the net volume of trees that became rough or rotten during the period).

Board foot. A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent. By Resources Evaluation convention, softwoods less than 9.0 inches in dbh and hardwoods less than 11.0 inches in dbh do not contain board-foot volume.

Clearcutting. The method of regenerating timber in which the area is cut clear in the literal sense of the word; virtually all the trees, large and small, are removed. The term is often erroneously applied to any type of cutting in which all the merchantable timber is removed and all that is not merchantable is left standing.

Commercial forest land. Forest land that is producing or capable of producing crops of industrial wood (more than 20 ft^3/acre/year) and that is not withdrawn from timber utilization. (Industrial wood is all roundwood products except fuelwood.)

Diameter limit. The method of regenerating timber in which all trees above a specified diameter are removed.

Forest industries. Companies or individuals operating wood-using plants.

Forest land. Land that is at least 16.7 percent stocked (contains at least 7.5 ft^2 of basal area) by forest trees of any size, or that formerly had such tree cover and is not currently developed for nonforest use. (Forest trees are woody plants that have a well-developed stem and usually are more than 12 feet in height at maturity.) The minimum area for classification of forest land is 1 acre.

Growing-stock trees. Live trees of commercial species that are classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees.

Growing-stock volume. Net volume, in ft^3, of growing-stock trees that are 5.0 inches in dbh or larger, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Private commercial forest land. All commercial forest land other than that owned by federal, state, or local governments or their agencies.

Pulpwood. Any log from which woodpulp is to be made; usually measured in bolts of 4, 5, or 8 feet, and somewhat smaller in diameter than sawlogs or veneer logs.

Sawlog. Any log from which lumber is to be sawed.

Sawtimber trees. Live trees of commercial species: (a) that are of the following minimum diameter at breast height: softwoods, 9.0 inches and hardwoods 11.0 inches, and (b) that contain at least one 12-foot or two noncontiguous 8-foot merchantable sawlogs, and that meet regional specifications for freedom from defect.

Sawtimber volume. Net volume in board feet, International 1/4-inch rule, of merchantable sawlogs in live sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Selection system. The method of regenerating timber in which trees of all sizes are harvested. However, in practice, frequently only the oldest or largest trees in a stand are harvested. Trees are taken singly or in small groups, but the entire stand is never cleared completely in a single operation.

Softwoods. Coniferous trees, usually evergreen, with needles or scalelike leaves.

Stand. A growth of trees on forest land.

Timber removals. The volume of growing-stock or sawtimber trees harvested or killed in logging or in cultural operations such as timber stand improvement, land clearing, or changes in land use.

Timber salvage. Removals of down, damaged, or diseased trees.

Veneer log. Any log from which veneer is to be made, by peeling (rotary cutting) or slicing.

INDEX TO TABLES

Table 1.—Estimated number of private owners and acres of commercial forest land owned, by size class and geographic unit, Pennsylvania, 1978

Size class (acres)	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
1-9	73,000	60	15,900	45	33,600	62	33,900	68	34,400	67
10-19	12,600	10	7,800	22	2,800	5	2,600	5	5,300	10
20-49	24,800	20	5,600	16	9,300	17	6,500	13	5,000	10
50-99	7,600	6	3,400	10	5,100	9	4,100	8	4,000	8
100-199	3,400	3	1,300	4	2,500	5	2,200	4	2,200	4
200-499	700	1	900	3	900	2	700	2	600	1
500-999	100	W	100	W	200	W	100	W	100	W
1,000+	W	W	100	W	200	W	100	W	W	W
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
1-9	241,400	10	81,600	4	133,800	6	76,000	6	100,100	8
10-19	161,400	7	93,800	5	32,400	2	28,600	2	69,700	6
20-49	749,300	31	175,900	9	289,000	14	199,800	15	160,600	13
50-99	497,000	21	229,100	12	334,300	16	275,800	21	269,800	22
100-199	399,500	16	175,400	9	323,500	15	294,900	22	263,800	21
200-499	178,900	7	215,000	11	274,600	13	190,600	14	200,800	16
500-999	51,800	2	87,700	5	119,200	6	57,100	4	55,100	4
1,000+	146,200	6	859,600	45	581,100	28	206,500	16	118,100	10
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

(continued)

Table 1.—continued

Size class (acres)	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
1-9	20,700	54	60,700	76	37,700	65	309,900	63
10-19	5,200	14	9,000	11	8,900	16	54,200	11
20-49	6,500	17	8,100	10	5,400	9	71,200	15
50-99	3,000	8	2,000	2	3,600	6	32,800	7
100-199	1,700	4	500	1	1,600	3	15,400	3
200-499	600	2	100	W	700	1	5,200	1
500-999	200	1	W	W	W	W	800	W
1,000+	100	W	W	W	100	W	600	W
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
1-9	53,900	4	230,000	27	111,200	9	1,028,000	8
10-19	63,200	5	120,900	14	115,500	10	685,500	6
20-49	207,300	15	233,900	27	157,600	13	2,173,400	17
50-99	207,200	15	112,900	13	236,900	20	2,163,000	17
100-199	228,200	16	72,700	9	210,100	18	1,968,100	16
200-499	187,400	13	16,500	2	184,800	15	1,448,600	12
500-999	124,900	9	2,000	W	31,500	3	529,300	4
1,000+	325,500	23	70,300	8	149,600	12	2,456,900	20
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 2.—Number of private owners and acres of commercial forest land owned, and number of owners who have harvested timber and acres owned, by ownership class, Pennsylvania, 1978

Ownership class	All owners		Owners who have harvested timber	
	Number	Acres owned	Number	Acres owned
Forest industry[a]	700	964,100	600	946,500
Farmer[b]	158,400	3,512,700	63,800	2,041,100
Miscellaneous:				
Individual[c]	279,600	5,190,300	46,600	2,034,300
Corporate	8,400	1,446,700	1,200	853,900
Other	43,000	1,339,000	10,300	669,200
Total private	490,100	12,452,800	122,500	6,545,000

[a]Includes unincorporated forest industry.
[b]Includes lands owned by part-time farmers and corporations engaged in agriculture.
[c]Includes joint ownerships.

Table 3.—Estimated number of private owners and acres of commercial forest land owned, by form of ownership, percent of harvesters, percent of acres owned by harvesters, and geographic unit, Pennsylvania, 1978

Form of ownership	All private owners		Acres owned		Harvesters	Acres owned by harvesters
	Number	*Percent*	*Number*	*Percent*	*Percent*	*Percent*
			WESTERN			
Individual[a]	112,900	92	1,951,000	80	22	34
Corporation	1,700	2	231,600	10	W	4
Partnership	1,400	1	76,700	3	W	1
Other[b]	6,200	5	166,200	7	1	3
Total	122,200	100	2,425,500	100	23	42
			ALLEGHENY			
Individual	30,400	87	876,500	46	24	24
Corporation	500	1	783,800	41	1	39
Partnership	200	1	76,600	4	W	3
Other	4,000	11	181,200	9	3	6
Total	35,100	100	1,918,100	100	28	72
			NORTH CENTRAL			
Individual	47,200	86	1,350,200	64	24	33
Corporation	2,600	5	330,100	16	W	10
Partnership	1,100	2	118,600	6	W	3
Other	3,700	7	289,000	14	1	11
Total	54,600	100	2,087,900	100	25	57

(continued)

Table 3.—continued

Form of ownership	All private owners		Acres owned		Harvesters	Acres owned by harvesters
	Number	*Percent*	*Number*	*Percent*	*Percent*	*Percent*
			SOUTHWESTERN			
Individual	47,700	95	1,027,200	77	21	37
Corporation	400	1	159,300	12	W	9
Partnership	1,600	3	95,200	7	W	2
Other	500	1	47,600	4	W	2
Total	50,200	100	1,329,300	100	21	50
			NORTHEASTERN			
Individual	48,500	94	982,300	79	23	40
Corporation	1,200	2	128,300	10	W	6
Partnership	900	2	54,600	5	2	4
Other	1,000	2	72,800	6	W	2
Total	51,600	100	1,238,000	100	25	52
			POCONO			
Individual	32,100	84	769,900	55	19	22
Corporation	1,800	5	420,400	30	1	14
Partnership	3,500	9	72,600	5	1	3
Other	600	2	134,700	10	W	3
Total	38,000	100	1,397,600	100	21	42
			SOUTHEASTERN			
Individual	65,100	81	643,200	75	18	26
Corporation	500	1	80,900	9	W	5
Partnership	10,100	12	38,400	5	W	2
Other	4,700	6	96,700	11	4	7
Total	80,400	100	859,200	100	22	40
			SOUTH CENTRAL			
Individual	38,700	67	957,700	80	29	48
Corporation	300	W	71,500	6	W	3
Partnership	W	W	10,500	1	W	1
Other	19,000	33	157,500	13	8	8
Total	58,000	100	1,197,200	100	37	60
			TOTAL			
Individual	422,600	86	8,558,000	69	22	33
Corporation	9,000	2	2,205,900	18	W	12
Partnership	18,800	4	543,200	4	1	3
Other	39,700	8	1,145,700	9	2	5
Total	490,100	100	12,452,800	100	25	53

[a] Includes joint ownerships.
[b] Includes undivided estates, clubs, associations, etc.
(W) Less than 0.5 percent or fewer than 50 owners.

Table 4.—Estimated number of private owners and acres of commercial forest land owned, by size class and form of ownership, Pennsylvania, 1978

Size class (acres)	Individual[a]		Partnership		Corporation		Club		Other[b]	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
1-9	269,900	64	12,400	66	2,200	25	23,800	80	1,600	16
10-19	47,300	11	1,700	9	700	8	2,000	7	2,300	22
20-49	61,500	15	2,400	13	1,700	19	2,000	7	3,700	36
50-99	27,400	6	1,200	6	2,000	22	800	3	1,400	14
100-199	12,300	3	600	3	1,200	13	500	2	800	8
200-499	3,500	1	300	1	700	8	400	1	300	3
500-999	500	W	100	1	200	2	W	W	100	1
1,000+	200	W	100	1	300	3	W	W	W	W
Total	422,600	100	18,800	100	9,000	100	29,500	100	10,200	100
					ACRES OWNED					
1-9	905,300	11	32,700	6	10,800	1	71,200	14	8,000	1
10-19	605,600	7	18,600	4	9,100	W	20,900	4	31,300	5
20-49	1,867,200	22	66,600	12	63,600	3	72,600	14	103,400	17
50-99	1,818,700	21	74,100	14	139,400	6	47,400	9	83,400	13
100-199	1,564,200	18	75,700	14	155,300	7	59,300	11	113,600	18
200-499	977,700	11	87,900	16	180,900	8	108,500	21	93,600	15
500-999	304,000	4	50,000	9	115,600	5	19,900	4	39,800	7
1,000+	515,300	6	137,600	25	1,531,200	70	121,400	23	151,400	24
Total	8,558,000	100	543,200	100	2,205,900	100	521,200	100	624,500	100

[a]Includes joint ownerships.
[b]Includes undivided estates, trusts, etc.
(W) Less than 0.5 percent or fewer than 50 owners.

Table 5.—Estimated number of business owners and acres of commercial forest land owned, by incorporated and unincorporated businesses, Pennsylvania, 1978

Nature of business	Incorporated				Unincorporated			
	Number	*Percent*	*Acres*	*Percent*	*Number*	*Percent*	*Acres*	*Percent*
Real estate	1,400	15	286,500	13	100	W	58,400	1
Forest industry	100	1	651,300	30	600	W	312,800	3
Other industry	2,000	22	638,900	29	200	W	46,700	W
Nonindustrial business	1,600	18	129,900	6	1,200	W	59,100	1
Farm	500	6	53,500	2	157,900	33	3,459,100	34
Sport/recreation club	2,500	28	139,200	6	27,900	6	473,600	4
Public utility	W	W	153,800	7	—	—	—	—
Other	900	10	152,800	7	293,200	61	5,837,200	57
Total	9,000	100	2,205,900	100	481,100	100	10,246,900	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 6.—Estimated number of individual owners and acres of commercial forest land owned, by occupation and geographic unit, Pennsylvania, 1978

Occupation	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Professional	10,300	9	4,200	14	1,300	3	1,300	3	2,300	5
Executive	9,100	8	3,700	12	11,900	25	900	2	600	1
Retired	26,800	24	1,600	5	9,600	21	4,000	9	4,300	9
White collar	600	W	4,900	16	2,900	6	2,900	6	1,600	3
Skilled laborer	21,000	18	2,700	9	9,800	21	4,900	10	1,500	3
Unskilled laborer	1,900	2	3,100	10	2,500	5	6,300	13	16,200	33
Housewife	8,900	9	600	2	1,000	2	600	1	12,300	25
Farmer	25,600	22	3,100	10	3,500	7	2,900	6	5,300	11
Other	900	1	2,300	8	3,400	7	2,400	5	300	1
No answer	7,800	7	4,200	14	1,300	3	21,500	45	4,100	9
Total	112,900	100	30,400	100	47,200	100	47,700	100	48,500	100
					ACRES OWNED					
Professional	263,600	13	85,800	10	140,200	10	66,600	7	54,600	6
Executive	289,200	15	142,200	16	230,800	17	104,700	10	100,000	10
Retired	356,400	18	112,100	13	295,500	22	266,400	26	251,600	26
White collor	38,400	2	114,300	13	64,700	5	66,500	6	69,700	7
Skilled laborer	191,700	10	86,900	10	140,200	10	85,600	8	51,500	5
Unskilled laborer	89,500	4	45,000	5	43,100	3	57,100	6	81,900	8
Housewife	131,100	7	25,200	3	86,300	7	66,500	6	36,400	4
Farmer	383,400	20	118,200	13	140,200	10	142,700	14	254,700	26
Other	38,300	2	36,500	4	47,500	4	19,000	2	9,100	1
No answer	169,400	9	110,300	13	161,700	12	152,100	15	72,800	7
Total	1,951,000	100	876,500	100	1,350,200	100	1,027,200	100	982,300	100

(continued)

Table 6. — continued

Occupation	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
Professional	900	3	2,000	3	2,300	6	24,600	6
Executive	1,100	4	6,000	9	2,300	6	35,600	6
Retired	2,300	7	10,600	16	12,900	33	72,100	17
White collar	900	3	7,200	11	3,100	8	24,100	6
Skilled laborer	13,600	42	11,700	18	4,300	11	69,500	16
Unskilled laborer	5,100	16	4,300	7	800	2	40,200	10
Housewife	400	1	900	2	500	1	25,200	6
Farmer	1,300	4	11,200	17	11,000	29	63,900	15
Other	100	W	—	—	—	—	9,400	2
No answer	6,400	20	11,200	17	1,500	4	58,000	14
Total	32,100	100	65,100	100	38,700	100	422,600	100
				ACRES OWNED				
Professional	82,900	11	64,500	10	84,000	9	842,200	10
Executive	114,000	15	102,900	16	84,000	9	1,167,800	14
Retired	155,400	20	104,800	16	258,300	27	1,800,500	21
White collar	52,800	7	24,200	4	63,000	6	493,600	6
Skilled laborer	63,200	8	72,600	11	84,000	9	775,700	9
Unskilled laborer	82,900	11	32,300	5	42,000	4	473,800	5
Housewife	20,700	3	16,100	3	48,200	5	430,500	5
Farmer	94,300	12	137,100	21	210,000	22	1,480,600	17
Other	10,400	1	—	—	—	—	160,800	2
No answer	93,300	12	88,700	14	84,200	9	932,500	11
Total	769,900	100	643,200	100	957,700	100	8,558,000	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 7.—Estimated number of individual owners and acres of commercial forest land owned, by age class and geographic unit, Pennsylvania, 1978

Age class (years)	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		WESTERN		
Under 25	2,500	2	12,800	1
25-44	22,900	20	332,300	17
45-64	43,900	39	957,000	49
65+	36,500	33	530,600	27
No answer	7,100	6	118,300	6
Total	112,900	100	1,951,000	100
		ALLEGHENY		
Under 25	100	W	9,100	1
25-44	9,500	31	179,900	20
45-64	15,100	50	481,100	55
65+	1,200	4	145,300	17
No answer	4,500	15	61,100	7
Total	30,400	100	876,500	100
		NORTH CENTRAL		
Under 25	6,500	14	21,600	2
25-44	7,600	16	241,600	18
45-64	23,200	49	558,600	41
65+	8,800	19	399,000	29
No answer	1,100	2	129,400	10
Total	47,200	100	1,350,200	100
		SOUTHWESTERN		
Under 25	—	—	—	—
25-44	3,000	6	123,700	12
45-64	19,600	41	409,000	40
65+	3,800	8	323,300	31
No answer	21,300	45	171,200	17
Total	47,700	100	1,027,200	100
		NORTHEASTERN		
Under 25	—	—	—	—
25-44	15,200	31	151,500	15
45-64	24,900	52	567,000	58
65+	5,900	12	209,200	21
No answer	2,500	5	54,600	6
Total	48,500	100	982,300	100
		POCONO		
Under 25	—	—	—	—
25-44	1,800	6	72,500	10
45-64	24,300	76	448,700	58
65+	3,600	11	186,500	24
No answer	2,400	7	62,200	8
Total	32,100	100	769,900	100

(continued)

Table 7. — continued

Age class (years)	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
	SOUTHEASTERN			
Under 25	600	1	8,000	1
25-44	16,000	25	153,200	24
45-64	27,700	42	272,300	43
65+	13,900	21	169,300	26
No answer	6,900	11	40,400	6
Total	65,100	100	643,200	100
	SOUTH CENTRAL			
Under 25	—	—	—	—
25-44	9,400	24	189,000	20
45-64	12,800	33	420,100	44
65+	16,200	42	327,600	34
No answer	300	1	21,000	2
Total	38,700	100	957,700	100
	ALL INDIVIDUAL OWNERS			
Under 25	9,700	2	51,500	W
25-44	85,400	20	1,443,700	17
45-64	191,500	46	4,113,800	48
65+	89,900	21	2,290,800	27
No answer	46,100	11	658,200	8
Total	422,600	100	8,558,000	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 8.—Estimated number of individual owners and acres of commercial forest land owned, by years of formal education, Pennsylvania, 1978

Education level	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
0-8 years	100,600	24	1,687,800	20
9-12 years	133,600	32	2,549,600	30
1-4 years of college	104,800	25	2,512,500	29
More than 4 years of college	30,600	7	999,900	12
No answer	53,000	12	808,200	9
Total	422,600	100	8,558,000	100

Table 9.—Estimated number of individual owners and acres of commercial forest land owned, by annual income class and geographic unit Pennsylvania, 1978

Income class	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		WESTERN		
Under $10,000	46,300	41	645,600	33
$10,000-$14,999	34,100	30	255,600	13
$15,000-$19,999	3,100	3	166,100	9
$20,000-$24,999	5,500	5	156,700	8
$25,000-$29,999	1,700	1	38,300	2
$30,000+	12,300	11	429,800	22
No answer	9,900	9	258,900	13
Total	112,900	100	1,951,000	100
		ALLEGHENY		
Under $10,000	5,800	19	175,400	20
$10,000-$14,999	7,700	25	140,600	16
$15,000-$19,999	5,900	20	143,300	16
$20,000-$24,999	300	1	26,300	3
$25,000-$29,000	1,000	3	34,300	4
$30,000+	2,700	9	194,800	22
No answer	7,000	23	161,800	19
Total	30,400	100	876,500	100
		NORTH CENTRAL		
Under $10,000	17,900	38	284,700	21
$10,000-$14,999	6,200	13	226,400	17
$15,000-$19,999	4,700	10	140,200	11
$20,000-$24,999	1,900	4	79,800	6
$25,000-$29,999	2,300	5	43,200	3
$30,000+	9,000	19	273,900	20
No answer	5,200	11	302,000	22
Total	47,200	100	1,350,200	100
		SOUTHWESTERN		
Under $10,000	8,600	18	351,900	34
$10,000-$14,999	2,100	5	114,200	11
$15,000-$19,999	11,500	24	95,000	9
$20,000-$24,999	1,100	2	104,600	10
$25,000-$29,000	400	1	28,500	3
$30,000+	1,100	2	123,700	12
No answer	22,900	48	209,300	21
Total	47,700	100	1,027,200	100
		NORTHEASTERN		
Under $10,000	11,100	23	309,300	31
$10,000-$14,999	4,000	8	78,800	8
$15,000-$19,999	10,300	21	75,700	8
$20,000-$24,999	700	2	54,600	6
$25,000-$29,999	1,400	3	63,700	6
$30,000+	4,900	10	227,400	23
No answer	16,100	33	172,800	18
Total	48,500	100	982,300	100

(continued)

Table 9.—continued

Income class	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		POCONO		
Under $10,000	9,500	30	248,700	32
$10,000-$14,999	3,900	12	95,300	12
$15,000-$19,999	12,200	38	124,400	16
$20,000-$24,999	400	1	20,700	3
$25,000-$29,000	100	W	10,400	1
$30,000+	600	2	103,600	14
No answer	5,400	17	166,800	22
Total	32,100	100	769,900	100
		SOUTHEASTERN		
Under $10,000	8,100	13	88,700	14
$10,000-$14,999	10,300	16	120,900	19
$15,000-$19,999	6,300	10	64,500	10
$20,000-$24,999	200	W	8,100	1
$25,000-$29,999	4,800	7	24,200	4
$30,000+	17,200	26	207,800	32
No answer	18,200	28	129,000	20
Total	65,100	100	643,200	100
		SOUTH CENTRAL		
Under $10,000	19,000	49	369,500	39
$10,000-$14,999	7,100	18	147,100	15
$15,000-$19,999	2,500	6	105,000	11
$20,000-$24,999	3,700	10	73,500	8
$25,000-$29,000	1,100	3	31,500	3
$30,000+	800	2	94,500	10
No answer	4,500	12	136,600	14
Total	38,700	100	957,700	100
		ALL INDIVIDUAL OWNERS		
Under $10,000	126,300	30	2,473,800	29
$10,000-$14,999	75,400	18	1,178,900	14
$15,000-$19,999	56,500	13	914,200	11
$20,000-$24,999	13,800	3	524,300	6
$25,000-$29,999	12,800	3	274,100	3
$30,000+	48,600	12	1,655,500	19
No answer	89,200	21	1,537,200	18
Total	422,600	100	8,558,000	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 10.—Estimated number of individual owners and acres of commercial forest land owned, by early life environment[a] for harvesters and nonharvesters, Pennsylvania,1978

Early life environment	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
	HARVESTERS			
City over 100,000	3,300	1	219,300	3
City 10,000-99,999	6,200	1	217,500	2
Town or city under 10,000	11,500	3	466,700	5
Rural area	17,900	4	836,900	10
On a farm	59,500	14	1,924,400	23
No answer	9,800	3	406,100	5
Total	108,200	26	4,070,900	48
	NONHARVESTERS			
City over 100,000	30,200	7	435,100	5
City 10,000-99,999	28,800	7	499,200	6
Town or city under 10,000	31,900	7	670,800	8
Rural area	88,200	21	1,061,000	12
On a farm	92,100	22	1,387,500	16
No answer	43,200	10	433,500	5
Total	314,400	74	4,487,100	52
	ALL INDIVIDUAL OWNERS			
City over 100,000	33,500	8	654,400	8
City 10,000-99,999	35,000	8	716,700	8
Town or city under 10,000	43,400	10	1,137,500	13
Rural area	106,100	25	1,897,900	22
On a farm	151,600	36	3,311,900	39
No answer	53,000	13	839,600	10
Total	422,600	100	8,558,000	100

[a]First 12 years.

Table 11.—Estimated number of individual owners and acres of commercial forest land owned, by early life environment[a] and geographic unit, Pennsylvania, 1978

Early life environment	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
	WESTERN			
City over 100,000	5,500	5	191,700	10
City 10,000-99,999	4,500	4	187,000	10
Town or city under 10,000	5,800	5	242,800	12
Rural area	45,200	40	484,200	25
On a farm	40,100	36	663,100	34
No answer	11,800	10	182,200	9
Total	112,900	100	1,951,000	100
	ALLEGHENY			
City over 100,000	1,000	3	46,200	5
City 10,000-99,999	400	1	35,400	4
Town or city under 10,000	1,100	4	51,500	6
Rural area	13,100	43	324,000	37
On a farm	10,600	35	361,000	41
No answer	4,200	14	58,400	7
Total	30,400	100	876,500	100
	NORTH CENTRAL			
City over 100,000	3,000	7	75,500	6
City 10,000-99,999	1,300	3	86,300	6
Town or city under 10,000	3,900	8	241,600	18
Rural area	5,400	11	278,200	21
On a farm	32,100	68	485,300	36
No answer	1,500	3	183,300	13
Total	47,200	100	1,350,200	100
	SOUTHWESTERN			
City over 100,000	2,400	5	18,900	2
City 10,000-99,999	700	1	66,600	6
Town or city under 10,000	6,600	14	142,500	14
Rural area	9,700	20	247,400	24
On a farm	7,000	15	380,500	37
No answer	21,300	45	171,300	17
Total	47,700	100	1,027,200	100
	NORTHEASTERN			
City over 100,000	13,700	28	127,400	13
City 10,000-99,999	5,800	12	100,000	10
Town or city under 10,000	10,300	21	97,000	10
Rural area	4,300	9	109,100	11
On a farm	11,200	23	433,600	44
No answer	3,200	7	115,200	12
Total	48,500	100	982,300	100

(continued)

Table 11. — continued

Early life environment	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
	POCONO			
City over 100,000	600	2	51,800	7
City 10,000-99,999	12,100	38	124,400	16
Town or city under 10,000	4,300	13	146,100	19
Rural area	1,200	4	104,600	13
On a farm	11,900	37	291,200	38
No answer	2,000	6	51,800	7
Total	32,100	100	769,900	100
	SOUTHEASTERN			
City over 100,000	5,600	9	48,400	8
City 10,000-99,999	7,900	12	64,500	10
Town or city under 10,000	4,900	8	111,000	17
Rural area	21,500	33	161,300	25
On a farm	16,500	25	201,600	31
No answer	8,700	13	56,400	9
Total	65,100	100	643,200	100
	SOUTH CENTRAL			
City over 100,000	1,700	4	94,500	10
City 10,000-99,999	2,300	6	52,500	5
Town or city under 10,000	6,500	17	105,000	11
Rural area	5,700	15	189,100	20
On a farm	22,200	57	495,600	52
No answer	300	1	21,000	2
Total	38,700	100	957,700	100
	ALL INDIVIDUAL OWNERS			
City over 100,000	33,500	8	654,400	8
City 10,000-99,999	35,000	8	716,700	8
Town or city under 10,000	43,400	10	1,137,500	13
Rural area	106,100	25	1,897,900	22
On a farm	151,600	36	3,311,900	39
No answer	53,000	13	839,600	10
Total	422,600	100	8,558,000	100

[a] First 12 years.

Table 12.—Estimated number of owners and acres of commercial forest land owned, by tenure and ownership class, Pennsylvania, 1978

Tenure of ownership (years)	Forest industry	Individual	Other corporation	Other	Total
		OWNERS			
Under 5	W	86,200	1,700	4,500	92,400
5-9	400	68,100	2,900	11,300	82,700
10-24	100	114,900	1,400	22,100	138,500
25-49	100	98,000	1,200	10,800	110,100
50+	W	10,200	300	2,900	13,400
No answer	100	44,700	1,400	6,800	53,000
Total	700	422,100	8,900	58,400	490,100
		ACRES OWNED			
Under 5	9,500	1,132,600	146,900	113,800	1,402,800
5-9	114,100	1,236,200	130,300	171,500	1,652,100
10-24	326,600	2,671,600	219,800	268,500	3,486,500
25-49	419,800	2,429,700	295,400	448,900	3,593,800
50+	52,400	344,500	405,000	351,900	1,153,800
No answer	41,600	522,200	357,200	242,700	1,163,700
Total	964,000	8,336,800	1,554,600	1,597,300	12,452,700

(W) Less than 0.5 percent or fewer than 50 owners.

Table 13.—Estimated number of individual owners and acres of commercial forest land owned, by tenure of ownership and geographic unit, Pennsylvania, 1978

Tenure of ownership (years)	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		WESTERN		
Under 5	12,500	11	327,500	17
5-9	19,800	18	332,200	17
10-24	34,100	30	599,200	31
25-49	37,800	33	497,000	25
50+	3,500	3	89,500	5
No answer	5,200	5	105,600	5
Total	112,900	100	1,951,000	100
		ALLEGHENY		
Under 5	4,600	15	93,000	10
5-9	7,700	26	166,300	19
10-24	6,900	22	234,900	27
25-49	5,700	19	305,700	35
50+	900	3	34,300	4
No answer	4,600	15	42,300	5
Total	30,400	100	876,500	100
		NORTH CENTRAL		
Under 5	18,200	39	198,400	15
5-9	3,400	7	140,200	10
10-24	10,500	22	435,700	32
25-49	10,500	22	381,800	28
50+	3,300	7	86,200	7
No answer	1,300	3	107,900	8
Total	47,200	100	1,350,200	100
		SOUTHWESTERN		
Under 5	19,800	41	133,200	13
5-9	4,600	10	133,100	13
10-24	4,500	9	304,400	30
25-49	6,800	14	342,400	33
50+	300	1	19,000	2
No answer	11,700	25	95,100	9
Total	47,700	100	1,027,200	100
		NORTHEASTERN		
Under 5	7,700	16	81,900	8
5-9	14,400	30	133,300	14
10-24	19,700	41	385,000	39
25-49	4,100	8	291,100	30
50+	1,400	3	36,400	4
No answer	1,200	2	54,600	5
Total	48,500	100	982,300	100

(continued)

Table 13. — continued

Tenure of ownership (years)	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		POCONO		
Under 5	2,100	7	73,600	9
5-9	1,800	6	114,000	15
10-24	17,300	54	321,200	42
25-49	4,900	15	198,900	26
50+	100	W	10,400	1
No answer	5,900	18	51,800	7
Total	32,100	100	769,900	100
		SOUTHEASTERN		
Under 5	15,700	24	119,100	19
5-9	10,400	16	96,800	15
10-24	11,000	17	153,200	24
25-49	17,300	27	193,500	30
50+	300	W	16,100	2
No answer	10,400	16	64,500	10
Total	65,100	100	643,200	100
		SOUTH CENTRAL		
Under 5	5,600	15	115,500	12
5-9	6,300	16	178,600	19
10-24	11,000	28	273,100	29
25-49	10,900	28	306,500	32
50+	400	1	52,500	5
No answer	4,500	12	31,500	3
Total	38,700	100	957,700	100
		ALL INDIVIDUAL OWNERS		
Under 5	86,200	20	1,142,200	14
5-9	68,400	16	1,294,500	15
10-24	115,000	27	2,706,700	32
25-49	98,000	23	2,516,900	29
50+	10,200	3	344,400	4
No answer	44,800	11	553,300	6
Total	422,600	100	8,558,000	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 14.—Estimated number of private owners and acres of commercial forest land owned, by distance from residence to nearest tract and by geographic unit, Pennsylvania, 1978

Distance from residence (miles)	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
0-1	89,800	73	21,900	62	35,200	65	31,400	63	26,200	51
2-5	7,300	6	1,700	5	1,700	3	2,600	5	300	1
6-15	2,600	2	700	2	2,200	4	1,600	3	9,600	18
16-25	700	1	1,600	5	1,100	2	—	—	300	1
26-50	3,100	3	100	W	700	1	100	W	500	1
Over 50	6,800	5	3,800	11	6,100	11	3,100	6	12,500	24
No answer	11,900	10	5,300	15	7,600	14	11,400	23	2,200	4
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
0-1	1,322,900	55	1,044,800	55	974,900	47	760,900	57	830,800	67
2-5	230,000	10	181,200	9	267,400	13	142,700	11	63,700	5
6-15	250,900	10	310,200	16	166,100	8	95,100	7	72,800	6
16-25	59,200	2	32,100	2	86,300	4	—	—	27,300	2
26-50	97,500	4	40,100	2	64,700	3	57,100	4	27,300	2
Over 50	242,800	10	216,100	11	347,300	16	114,100	9	133,300	11
No answer	222,200	9	93,600	5	181,200	9	159,400	12	82,800	7
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

(continued)

Table 14. — continued

Distance from residence (miles)	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
0-1	19,100	50	55,400	69	28,300	49	307,300	63
2-5	1,900	5	3,500	4	2,200	4	21,200	4
6-15	13,200	35	6,600	8	1,100	2	37,600	8
16-25	300	1	4,700	6	3,600	6	12,300	2
26-50	100	W	3,200	4	600	1	8,400	2
Over 50	2,200	6	—	—	20,800	36	55,300	11
No answer	1,200	3	7,000	9	1,400	2	48,000	10
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
0-1	668,500	48	586,700	68	562,900	47	6,752,400	54
2-5	145,100	10	69,200	8	128,700	11	1,228,000	10
6-15	93,300	7	102,900	12	94,500	8	1,185,800	10
16-25	41,400	3	24,200	3	42,000	3	312,500	2
26-50	51,800	4	32,300	4	48,200	4	419,000	3
Over 50	176,200	12	—	—	257,800	22	1,487,600	12
No answer	221,300	16	43,900	5	63,100	5	1,067,500	9
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 15.—Estimated number of private owners and acres of commercial forest land owned, by number of tracts and geographic unit, Pennsylvania, 1978

No. of tracts	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
1	102,500	84	29,500	84	42,500	78	44,800	89	47,200	91
2	13,400	11	3,600	10	8,700	16	2,600	5	2,500	5
3 or more	6,300	5	2,000	6	3,400	6	2,800	6	1,900	4
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
1	1,461,300	60	709,800	37	965,000	46	705,700	53	722,500	58
2	378,700	16	197,500	10	375,300	18	247,300	19	197,000	16
3 or more	585,500	24	1,010,800	53	747,600	36	376,300	28	318,500	26
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

No. of tracts	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
1	34,000	90	70,200	87	51,200	88	421,900	86
2	2,300	6	6,800	9	3,600	6	43,500	9
3 or more	1,700	4	3,400	4	3,200	6	24,700	5
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
1	868,400	62	562,500	66	785,000	66	6,780,200	54
2	190,500	14	113,900	13	157,500	13	1,857,700	15
3 or more	338,700	24	182,800	21	254,700	21	3,814,900	31
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

Table 16.—Estimated number of private owners and acres of commercial forest land owned, by distance from tracts, Pennsylvania, 1978

Distance (miles)	Owners of 1 tract	Owners of more than 1 tract	
		Distance to:	
		Nearest tract	Farthest tract
	OWNERS		
0-1	261,100	46,200	30,800
2-5	14,200	7,000	13,500
6-15	33,300	4,300	8,000
16-25	12,000	300	2,500
26-50	7,300	1,100	1,700
Over 50	50,200	5,100	9,200
No answer	43,800	4,200	2,500
Total	421,900	68,200	68,200
	ACRES OWNED		
0-1	3,666,200	3,086,200	1,168,800
2-5	512,900	715,100	838,300
6-15	385,500	800,300	687,200
16-25	221,700	90,800	441,500
26-50	242,600	176,400	558,800
Over 50	1,075,900	411,700	1,647,200
No answer	675,400	392,100	330,800
Total	6,780,200	5,672,600	5,672,600

Table 17.—Estimated number of private owners and acres of commercial forest land owned, by primary reason for owning, for harvesters and nonharvesters, Pennsylvania, 1978.

Primary reason for owning	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Land investment	7,600	1	894,600	7
Recreational use	13,500	3	784,300	7
Timber production	2,500	1	1,373,800	11
Farm and domestic use	28,900	6	841,300	6
Esthetic enjoyment	8,100	2	417,300	4
Part of farm	35,500	7	1,011,200	8
Part of residence	17,600	3	372,000	3
Other	3,800	1	587,300	5
No answer	5,000	1	263,200	2
Total	122,500	25	6,545,000	53
		NONHARVESTERS		
Land investment	36,500	8	1,021,500	8
Recreational use	47,500	9	1,148,000	9
Timber production	700	W	44,100	W
Farm and domestic use	42,700	9	564,600	5
Esthetic enjoyment	67,000	13	756,900	6
Part of farm	40,500	9	756,200	6
Part of residence	54,600	12	570,800	5
Other	27,200	5	659,500	5
No answer	50,900	10	386,200	3
Total	367,600	75	5,907,800	47
		ALL PRIVATE OWNERS		
Land investment	44,100	9	1,916,100	15
Recreational use	61,000	12	1,932,300	16
Timber production	3,200	1	1,417,900	11
Farm and domestic use	71,600	15	1,405,900	11
Esthetic enjoyment	75,100	15	1,174,200	10
Part of farm	76,000	16	1,767,400	14
Part of residence	72,200	15	942,800	8
Other	31,000	6	1,246,800	10
No answer	55,900	11	649,400	5
Total	490,100	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 18.—Estimated number of private owners and acres of commercial forest land owned, by primary and secondary reason for owning, Pennsylvania, 1978

Reason for owning	Primary reason		Secondary reason	
	Number	*Percent*	*Number*	*Percent*
		OWNERS		
Land investment	44,100	9	21,300	4
Recreational use	61,000	12	26,400	5
Timber production	3,200	1	7,700	2
Farm and domestic use	71,600	15	43,100	9
Esthetic enjoyment	75,100	15	57,500	12
Part of farm	76,000	16	14,500	3
Part of residence	72,200	15	34,200	7
Other	31,000	6	4,200	1
No secondary reason given	---Not applicable---		225,300	46
No answer	55,900	11	55,900	11
Total	490,100	100	490,100	100
		ACRES OWNED		
Land investment	1,916,100	15	709,800	6
Recreational use	1,932,300	16	1,325,400	11
Timber production	1,417,900	11	618,000	5
Farm and domestic use	1,405,900	11	858,000	7
Esthetic enjoyment	1,174,200	10	1,162,300	9
Part of farm	1,767,400	14	528,100	4
Part of residence	942,800	8	376,500	3
Other	1,246,800	10	429,300	3
No secondary reason given	---Not applicable---		5,796,000	47
No answer	649,400	5	649,400	5
Total	12,452,800	100	12,452,800	100

Table 19.—Estimated number of private owners and acres of commercial forest land owned, by primary reason for owning and expected time of future harvest, Pennsylvania, 1978

Primary reason for owning	Expected time of future harvest						No answer		Total	
	Next 10 years		Indefinite		Never					
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Land investment	4,500	12	22,000	13	16,600	7	1,000	2	44,100	9
Recreational use	5,100	13	22,500	14	29,500	12	3,900	9	61,000	12
Timber production	1,600	4	1,500	1	100	W	W	W	3,200	1
Farm and domestic use	12,300	32	37,000	22	20,100	8	2,200	5	71,600	15
Esthetic enjoyment	2,800	7	19,200	11	53,100	22	—	—	75,100	15
Part of farm	6,000	15	36,600	22	30,000	13	3,400	7	76,000	16
Part of residence	4,900	13	19,200	11	42,600	18	5,500	12	72,200	15
Other	900	2	6,400	4	22,900	10	800	2	31,000	6
No answer	700	2	3,200	2	23,800	10	28,200	63	55,900	11
Total	38,800	100	167,600	100	238,700	100	45,000	100	490,100	100
					ACRES OWNED					
Land investment	629,700	18	857,200	16	348,300	14	80,900	9	1,916,100	15
Recreational use	435,100	12	932,600	17	423,300	16	141,300	16	1,932,300	16
Timber production	1,248,500	35	136,700	3	12,800	W	19,900	2	1,417,900	11
Farm and domestic use	294,600	8	824,700	15	231,000	9	55,600	7	1,405,900	11
Esthetic enjoyment	160,500	5	508,500	9	505,200	20	—	—	1,174,200	10
Part of farm	299,600	8	1,075,300	20	282,200	11	110,300	13	1,767,400	14
Part of residence	80,000	2	478,200	9	330,200	13	54,400	6	942,800	8
Other	353,800	10	499,200	9	322,600	12	71,200	8	1,246,800	10
No answer	87,000	2	103,000	2	118,200	5	341,200	39	649,400	5
Total	3,588,800	100	5,415,400	100	2,573,800	100	874,800	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 20.—Estimated number of private owners and acres of commercial forest land owned, by primary reason for owning and geographic unit, Pennsylvania, 1978

Primary reason for owning	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Land investment	4,000	3	3,200	9	3,200	6	2,700	5	20,000	39
Recreational use	10,100	8	4,400	12	6,900	13	2,400	5	5,300	10
Timber production	1,500	1	300	1	500	1	500	1	100	W
Farm and domestic use	23,400	19	6,500	19	10,000	18	4,300	9	5,500	11
Esthetic enjoyment	11,200	9	4,000	11	4,900	9	6,500	13	3,600	7
Part of farm	22,700	19	5,000	14	9,300	17	2,000	4	8,000	16
Part of residence	24,200	20	5,100	15	9,500	17	10,000	20	4,900	9
Other	18,000	15	1,100	3	3,900	7	600	1	2,300	4
No answer	7,100	6	5,500	16	6,400	12	21,200	42	1,900	4
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
Land investment	353,100	15	192,600	10	349,400	17	256,700	19	172,800	14
Recreational use	279,700	11	231,300	12	364,500	17	190,300	14	209,200	17
Timber production	115,000	5	803,100	42	226,500	11	76,100	6	45,500	4
Farm and domestic use	365,900	15	130,300	7	172,500	8	190,300	14	118,300	9
Esthetic enjoyment	301,900	12	139,500	7	155,300	7	76,000	6	109,200	9
Part of farm	460,100	19	102,300	5	241,600	12	142,700	11	357,700	29
Part of residence	191,700	8	63,300	3	140,200	7	133,200	10	78,800	6
Other	239,700	10	161,900	9	297,700	14	102,300	8	101,000	8
No answer	118,400	5	93,800	5	140,200	7	161,700	12	45,500	4
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

(continued)

Table 20. — continued

Primary reason for owning	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
Land investment	1,200	3	4,200	5	5,600	10	44,100	9
Recreational use	5,000	13	5,700	7	21,200	36	61,000	12
Timber production	W	W	W	W	300	1	3,200	1
Farm or domestic use	5,300	14	9,500	12	7,100	12	71,600	15
Esthetic enjoyment	12,300	33	22,400	28	10,200	17	75,100	15
Part of farm	5,000	13	16,000	20	8,000	14	76,000	16
Part of residence	2,400	6	11,500	14	4,600	8	72,200	15
Other	2,700	7	1,400	2	1,000	2	31,000	6
No answer	4,100	11	9,700	12	—	—	55,900	11
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
Land investment	272,700	20	102,900	12	215,900	18	1,916,100	15
Recreational use	310,900	22	104,800	12	241,600	20	1,932,300	16
Timber production	20,700	1	12,800	1	118,200	10	1,417,900	11
Farm and domestic use	134,700	10	104,800	12	189,100	16	1,405,900	11
Esthetic enjoyment	145,100	10	161,300	19	85,900	7	1,174,200	10
Part of farm	146,100	10	159,400	19	157,500	13	1,767,400	14
Part of residence	94,300	7	104,800	12	136,500	12	942,800	8
Other	231,700	17	60,000	7	52,500	4	1,246,800	10
No answer	41,400	3	48,400	6	—	—	649,400	5
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 21.—Estimated number of private owners and acres of commercial forest land owned, by primary benefit derived in the last 5 years and primary benefit expected in the next 5 years, for harvesters and nonharvesters, Pennsylvania, 1978

Primary benefit	Derived in last 5 years				Expected in next 5 years			
	Private owners		Acres owned		Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				HARVESTERS				
Recreational use	15,300	3	946,600	8	15,100	3	926,000	7
Sale of timber	13,800	3	1,480,000	12	4,700	1	1,309,800	11
Land value increase	18,200	4	1,296,500	10	16,700	3	1,326,100	11
Esthetic enjoyment	26,700	5	923,200	7	27,200	6	971,300	8
Farm and domestic use	36,800	8	954,300	8	39,100	8	994,900	8
Other	5,900	1	578,000	5	13,100	3	594,300	5
No answer	5,800	1	366,400	3	6,600	1	422,600	3
Total	122,500	25	6,545,000	53	122,500	25	6,545,000	53
				NONHARVESTERS				
Recreational use	64,400	13	1,190,300	9	69,700	14	1,105,300	9
Sale of timber	—	—	—	—	3,400	1	174,900	1
Land value increase	46,500	9	1,247,300	10	59,400	13	1,435,000	11
Esthetic enjoyment	124,200	26	1,638,100	14	104,000	21	1,485,600	12
Farm and domestic use	53,500	11	704,100	5	46,600	9	658,700	5
Other	20,100	4	494,900	4	27,700	5	460,200	4
No answer	58,900	12	633,100	5	56,800	12	588,100	5
Total	367,600	75	5,907,800	47	367,600	75	5,907,800	47
				ALL PRIVATE OWNERS				
Recreational use	79,700	16	2,136,900	17	84,800	17	2,031,300	16
Sale of timber	13,800	3	1,480,000	12	8,100	2	1,484,700	12
Land value increase	64,700	13	2,543,800	20	76,100	16	2,761,100	22
Esthetic enjoyment	150,900	31	2,561,300	21	131,200	27	2,456,900	20
Farm and domestic use	90,300	19	1,658,400	13	85,700	17	1,653,600	13
Other	26,000	5	1,072,900	9	40,800	8	1,054,500	9
No answer	64,700	13	999,500	8	63,400	13	1,010,700	8
Total	490,100	100	12,452,800	100	490,100	100	12,452,800	100

Table 22.—Estimated number of private owners and acres of commercial forest land owned by primary benefit expected in the next 5 years and expected time of future harvest, Pennsylvania, 1978

Primary benefit	Expected time of future harvest								Total	
	Next 10 years		Indefinite		Never		No answer			
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Recreational use	3,600	9	48,000	29	29,400	12	3,800	8	84,800	17
Sale of timber	3,400	9	4,700	3	—	—	—	—	8,100	2
Land value increase	10,300	26	30,600	18	34,300	14	900	2	76,100	16
Esthetic enjoyment	5,700	15	38,300	23	85,800	36	1,400	3	131,200	27
Farm and domestic use	7,700	20	33,900	20	39,700	17	4,400	10	85,700	17
Other	7,300	19	6,200	4	21,700	9	5,600	13	40,800	8
No answer	800	2	5,900	3	27,800	12	28,900	64	63,400	13
Total	38,800	100	167,600	100	238,700	100	45,000	100	490,100	100
					ACRES OWNED					
Recreational use	439,100	12	1,057,400	19	422,400	16	112,400	13	2,031,300	16
Sale of timber	1,270,700	35	214,000	4	—	—	—	—	1,484,700	12
Land value increase	788,600	22	1,392,000	26	479,000	19	101,500	12	2,761,100	22
Esthetic enjoyment	308,700	9	1,178,800	22	906,900	35	62,500	7	2,456,900	20
Farm and domestic use	279,900	8	929,000	17	345,100	13	99,600	11	1,653,600	13
Other	390,600	11	333,200	6	250,100	10	80,600	9	1,054,500	9
No answer	111,200	3	311,000	6	170,300	7	418,200	48	1,010,700	8
Total	3,588,800	100	5,415,400	100	2,573,800	100	874,800	100	12,452,800	100

Table 23.—Estimated number of private owners and acres of commercial forest land owned, by primary benefit expected in the next 5 years and geographic unit, Pennsylvania, 1978

Primary benefit	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Recreational use	21,200	17	4,100	12	11,200	21	2,300	5	11,900	23
Sale of timber	2,000	2	400	1	3,400	6	600	1	500	1
Land value increase	21,200	17	8,100	23	8,500	16	5,500	11	11,500	22
Esthetic enjoyment	27,700	23	12,300	35	10,000	18	8,500	17	10,200	20
Farm and domestic use	25,000	21	3,500	10	4,600	8	4,800	10	11,700	23
Other	13,800	11	1,100	3	9,700	18	7,300	14	2,800	5
No answer	11,300	9	5,600	16	7,200	13	21,200	42	3,000	6
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
Recreational use	275,000	11	230,200	12	401,200	19	180,800	14	218,300	18
Sale of timber	127,800	5	763,000	40	291,200	14	85,600	6	72,800	6
Land value increase	626,200	26	270,300	14	418,400	20	333,000	25	254,700	21
Esthetic enjoyment	595,900	25	286,400	15	323,500	16	247,100	18	272,700	22
Farm and domestic use	391,400	16	123,900	6	183,300	9	171,200	13	236,600	19
Other	175,800	7	127,600	7	239,500	11	130,800	10	91,900	7
No answer	233,400	10	116,700	6	230,800	11	180,800	14	91,000	7
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

(continued)

Table 23. — continued

Primary benefit	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
Recreational use	4,300	11	7,600	10	22,200	38	84,800	17
Sale of timber	200	1	200	W	800	1	8,100	2
Land value increase	3,500	9	11,500	14	6,300	11	76,100	16
Esthetic enjoyment	13,400	35	34,000	42	15,100	26	131,200	27
Farm and domestic use	7,600	20	16,400	21	12,100	21	85,700	17
Other	4,600	12	200	W	1,300	2	40,800	8
No answer	4,400	12	10,500	13	200	1	63,400	13
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
Recreational use	321,300	23	120,900	14	283,600	24	2,031,300	16
Sale of timber	20,700	2	37,000	4	86,600	7	1,484,700	12
Land value increase	376,300	27	161,300	19	320,900	27	2,761,100	22
Esthetic enjoyment	219,700	16	320,600	37	191,000	16	2,456,900	20
Farm and domestic use	186,500	13	119,100	14	241,600	20	1,653,600	13
Other	200,600	14	35,800	4	52,500	4	1,054,500	9
No answer	72,500	5	64,500	8	21,000	2	1,010,700	8
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 24.—Estimated number of private owners who have harvested timber and acres of commercial forest land owned, by reason for harvesting and form of ownership, Pennsylvania, 1978

Reason for harvesting	Forest industry	Miscellaneous ownership			Total
		Individual[a]	Corporate	Other[b]	
		HARVESTERS			
Timber mature	400	16,200	300	1,900	18,800
Good price	—	4,600	300	500	5,400
Land clearing	—	2,400	200	2,300	4,900
Needed money	—	29,300	W	1,600	30,900
Own use or company use	100	35,100	100	1,900	37,200
Timber salvage	—	2,700	—	200	2,900
Cultural treatment	—	100	100	W	200
Other	W	5,000	W	3,700	8,700
No answer	100	12,300	200	900	13,500
Total	600	107,700	1,200	13,000	122,500
		ACRES OWNED			
Timber mature	350,000	1,235,500	400,600	245,600	2,231,700
Good price	—	281,500	55,200	99,900	436,600
Land clearing	—	158,100	63,300	70,100	291,500
Needed money	—	860,400	9,500	141,700	1,011,600
Own use or company use	490,000	678,100	52,700	50,700	1,271,500
Timber salvage	—	84,100	—	64,000	148,100
Cultural treatment	—	30,400	8,100	10,500	49,000
Other	45,600	220,100	88,000	108,600	462,300
No answer	60,900	311,000	198,800	72,000	642,700
Total	946,500	3,859,200	876,200	863,100	6,545,000

[a] Includes joint ownership.

[b] Includes partnerships, undivided estates, clubs, associations, etc.

(W) Less than 0.5 percent or fewer than 50 owners.

Table 25.—Estimated number of private owners who have harvested timber and acres of commercial forest land owned, by reason for harvesting and geographic unit, Pennsylvania, 1978

Reason for harvesting	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					HARVESTERS					
Timber mature	4,900	17	2,200	23	2,300	17	2,200	20	1,000	8
Good price	1,500	5	200	2	1,100	8	400	4	200	2
Land clearing	1,600	6	400	4	100	1	100	1	1,100	8
Needed money	4,300	15	3,900	40	7,600	57	6,600	62	2,100	16
Own/company use	9,300	33	1,300	13	1,000	8	200	2	8,100	62
Timber salvage	1,500	5	—	—	500	3	100	1	—	—
Cultural treatment	—	—	—	—	100	1	—	—	100	W
Other	3,300	12	600	6	200	2	W	W	200	2
No answer	1,800	7	1,200	12	500	3	1,100	10	200	2
Total	28,200	100	9,800	100	13,400	100	10,700	100	13,000	100
					ACRES OWNED					
Timber mature	292,500	29	572,600	42	522,000	44	171,200	26	160,600	25
Good price	89,500	9	45,700	3	69,000	6	57,100	7	36,400	6
Land clearing	97,500	9	16,100	1	64,700	5	19,000	3	36,400	6
Needed money	166,100	16	137,700	10	187,600	16	161,800	25	178,900	28
Own/company use	161,400	16	378,400	28	97,100	8	76,100	12	136,500	21
Timber salvage	38,400	4	—	—	53,900	4	19,000	3	—	—
Cultural treatment	—	—	—	—	10,800	1	—	—	9,100	1
Other	102,200	10	115,400	8	75,500	6	19,000	3	27,300	4
No answer	70,200	7	109,900	8	116,500	10	140,300	21	55,200	9
Total	1,017,800	100	1,375,800	100	1,197,100	100	663,500	100	640,400	100

(continued)

Table 25. — continued

Reason for harvesting	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				HARVESTERS				
Timber mature	900	11	1,400	8	3,900	18	18,800	15
Good price	W	W	800	5	1,200	6	5,400	5
Land clearing	100	1	1,100	6	400	2	4,900	4
Needed money	1,900	24	3,800	22	700	3	30,900	25
Own/company use	4,500	56	7,300	41	5,500	25	37,200	30
Timber salvage	100	1	700	4	—	—	2,900	3
Cultural treatment	—	—	W	W	W	W	200	W
Other	500	6	400	2	3,500	16	8,700	7
No answer	100	1	2,200	12	6,400	30	13,500	11
Total	8,100	100	17,700	100	21,600	100	122,500	100
				ACRES OWNED				
Timber mature	165,800	28	88,700	26	258,300	36	2,231,700	34
Good price	43,700	7	32,200	9	63,000	8	436,600	7
Land clearing	20,700	4	16,100	5	21,000	3	291,500	4
Needed money	41,500	7	64,500	19	73,500	10	1,011,600	16
Own/company use	155,400	27	85,400	25	181,200	25	1,271,500	19
Timber salvage	20,700	4	16,100	5	—	—	148,100	2
Cultural treatment	—	—	8,100	2	21,000	3	49,000	1
Other	51,800	9	8,100	2	63,000	9	462,300	7
No answer	82,600	14	26,000	7	42,000	6	642,700	10
Total	582,200	100	345,200	100	723,000	100	6,545,000	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 26.—Estimated number of private owners who have not harvested timber and acres of commercial forest land owned, by reason for not harvesting and form of ownership, Pennsylvania, 1978

Reason for not harvesting	Forest industry	Miscellaneous ownership			Total
		Individual[a]	Corporate	Other[b]	
		OWNERS			
Timber immature	W	50,100	3,200	9,700	63,000
No market	—	1,900	W	—	1,900
Price too low	—	3,400	300	400	4,100
Destroy hunting	—	11,800	500	15,000	27,300
Selling the land	—	4,000	700	2,800	7,500
Ruin scenery	—	73,600	1,200	2,500	77,300
Land in estate	—	500	—	1,000	1,500
Distrust loggers	—	1,800	—	300	2,100
Opposed to harvest	—	7,400	—	100	7,500
Poor quality	—	6,700	200	2,100	9,000
Low volume	—	28,200	100	300	28,600
Fire hazard	—	200	—	—	200
Insufficient area	—	43,300	200	5,500	49,000
Other	100	36,900	900	3,200	41,100
No answer	—	44,700	400	2,400	47,500
Total	100	314,500	7,700	45,300	367,600
		ACRES OWNED			
Timber immature	9,500	1,188,200	102,200	163,500	1,463,400
No market	—	58,300	10,400	—	68,700
Price too low	—	151,000	26,800	10,800	188,600
Destroy hunting	—	293,500	46,700	86,000	426,200
Selling the land	—	122,700	97,500	53,400	273,600
Ruin scenery	—	773,200	97,400	55,600	926,200
Land in estate	—	30,000	—	73,300	103,300
Distrust loggers	—	95,600	—	18,800	114,400
Opposed to harvest	—	113,700	—	10,500	124,200
Poor quality	—	103,800	74,000	21,900	199,700
Low volume	—	277,300	21,600	21,900	[illegible]
Fire hazard	—	10,400	—	—	[illegible]
Insufficient area	—	111,900	8,100	34,600	[illegible]
Other	8,000	654,800	117,400	85,700	[illegible]
No answer	—	493,200	76,300	98,200	[illegible]
Total	17,500	4,477,600	678,400	734,200	5,907,700

[a] Includes joint ownership.

[b] Includes partnerships, undivided estates, clubs, associations, etc.

(W) Less than 0.5 percent or fewer than 50 owners.

Table 27.—Estimated number of private owners who have not harvested timber and acres of commercial forest land owned, by reason for not harvesting and geographic unit, Pennsylvania, 1978

Reason for not harvesting	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					NONHARVESTERS					
Timber immature	13,000	14	6,900	27	17,200	42	2,600	6	6,100	16
No market	300	W	—	—	—	—	300	1	—	—
Price too low	1,300	2	100	W	800	2	800	2	—	—
Destroy hunting	3,900	4	400	2	2,600	6	500	1	200	W
Selling the land	300	W	—	—	200	W	W	W	600	1
Ruin scenery	10,100	11	3,000	11	5,000	12	1,200	3	23,500	61
Land in estate	—	—	—	—	300	1	W	W	100	W
Distrust loggers	900	1	200	1	500	1	300	1	W	W
Opposed to harvest	1,700	2	400	2	—	—	3,200	8	1,900	5
Poor Quality	2,000	2	—	—	3,000	7	400	1	400	1
Low volume	12,900	14	2,300	9	1,500	4	1,100	3	1,400	4
Fire hazard	—	—	—	—	—	—	—	—	—	—
Insufficient area	25,600	27	3,500	14	6,500	16	2,400	6	300	1
Other	16,300	17	2,400	10	1,300	3	4,600	12	1,400	4
No answer	5,700	6	6,100	24	2,300	6	22,100	56	2,700	7
Total	94,000	100	25,300	100	41,200	100	39,500	100	38,600	100
					ACRES OWNED					
Timber immature	365,900	26	148,000	27	258,800	29	209,300	32	109,100	18
No market	12,800	1	—	—	—	—	19,000	3	—	—
Price too low	59,200	4	9,100	2	43,200	5	19,000	3	—	—
Destroy hunting	127,800	9	27,400	5	64,700	7	28,600	4	18,200	3
Selling the land	51,100	4	—	—	10,700	1	9,500	1	45,500	8
Ruin scenery	268,400	19	93,800	17	86,200	10	66,600	10	145,500	24
Land in estate	—	—	—	—	25,900	3	9,500	1	18,200	3
Distrust loggers	20,800	1	26,300	5	21,500	2	28,600	4	9,100	2
Opposed to harvest	38,300	3	11,900	2	—	—	19,000	3	36,400	6
Poor quality	25,600	2	—	—	41,000	5	28,600	4	27,300	4
Low volume	102,200	7	44,600	8	43,200	5	19,000	3	24,200	4
Fire hazard	—	—	—	—	—	—	—	—	—	—
Insufficient area	25,600	2	17,100	3	21,600	2	9,500	1	9,100	2
Other	212,500	15	105,700	20	133,800	15	95,000	15	100,100	17
No answer	97,500	7	58,400	11	140,200	16	104,600	16	54,900	9
Total	1,407,700	100	542,300	100	890,800	100	665,800	100	597,600	100

Total	1,407,700	100	542,300	100	890,800	100	665,800	100	597,600	100

Reason for not harvesting	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				NONHARVESTERS				
Timber immature	2,100	7	10,500	17	4,600	13	63,000	17
No market	100	W	1,200	2	—	—	1,900	1
Price too low	100	W	—	—	1,000	3	4,100	1
Destroy hunting	2,600	9	2,400	4	14,700	40	27,300	7
Selling the land	3,300	11	2,100	3	1,000	3	7,500	2
Ruin scenery	11,800	40	15,300	24	7,400	20	77,300	21
Land in estate	700	2	200	W	200	1	1,500	W
Distrust loggers	—	—	200	W	—	—	2,100	1
Opposed to harvest	—	—	200	W	100	W	7,500	2
Poor quality	300	1	2,800	5	100	W	9,000	3
Low volume	600	2	8,700	14	100	W	28,600	8
Fire hazard	200	1	—	—	—	—	200	W
Insufficient area	1,000	3	8,200	13	1,500	4	49,000	13
Other	1,000	3	9,300	15	4,800	13	41,100	11
No answer	6,100	21	1,600	3	900	3	47,500	13
Total	29,900	100	62,700	100	36,400	100	367,600	100

	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				ACRES OWNED				
Timber immature	115,000	14	78,700	15	178,600	38	1,463,400	25
No market	20,700	3	16,200	3	—	—	68,700	1
Price too low	10,400	1	—	—	47,800	10	188,700	3
Destroy hunting	82,900	10	24,100	5	52,500	11	426,200	7
Selling the land	114,000	14	32,300	6	10,500	2	273,600	5
Ruin scenery	115,000	14	112,900	22	37,800	8	926,200	16
Land in estate	31,100	4	8,100	2	10,500	2	103,300	2
Distrust loggers	—	—	8,100	2	—	—	114,400	2
Opposed to harvest	—	—	8,100	2	10,500	2	124,200	2
Poor quality	32,100	4	24,100	5	21,000	5	199,700	3
Low volume	20,700	3	56,400	11	10,500	2	320,800	5
Fire hazard	10,400	1	—	—	—	—	10,400	W
Insufficient area	10,400	1	40,300	7	21,000	5	154,600	3
Other	93,200	11	62,600	12	63,000	13	865,900	15
No answer	159,500	20	42,100	8	10,500	2	667,700	11
Total	815,400	100	514,000	100	474,200	100	5,907,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 28.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	17,300	4	2,611,300	21
5-10 years	5,600	1	428,500	4
Indefinite	50,000	10	2,549,500	20
Never	33,900	7	549,200	5
No answer	15,700	3	406,500	3
Total	122,500	25	6,545,000	53
		NONHARVESTERS		
Next 5 years	11,500	2	263,600	2
5-10 years	4,400	1	285,400	2
Indefinite	117,600	24	2,865,900	23
Never	204,800	42	2,024,600	16
No answer	29,300	6	468,300	4
Total	367,600	75	5,907,800	47
		ALL PRIVATE OWNERS		
Next 5 years	28,800	6	2,874,900	23
5-10 years	10,000	2	713,900	6
Indefinite	167,600	34	5,415,400	43
Never	238,700	49	2,573,800	21
No answer	45,000	9	874,800	7
Total	490,100	100	12,452,800	100

Table 29.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Western Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	5,500	4	204,200	8
5-10 years	2,400	2	89,500	4
Indefinite	12,900	11	562,800	23
Never	7,000	6	135,800	6
No answer	400	W	25,500	1
Total	28,200	23	1,017,800	42
		NONHARVESTERS		
Next 5 years	1,100	1	63,900	3
5-10 years	800	1	63,900	3
Indefinite	33,300	27	736,400	30
Never	54,100	44	484,300	20
No answer	4,700	4	59,200	2
Total	94,000	77	1,407,700	58
		ALL PRIVATE OWNERS		
Next 5 years	6,600	5	268,100	11
5-10 years	3,200	3	153,400	7
Indefinite	46,200	38	1,299,200	53
Never	61,100	50	620,100	26
No answer	5,100	4	84,700	3
Total	122,200	100	2,425,500	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 30.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Allegheny Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	1,100	3	942,700	49
5-10 years	1,500	4	84,700	4
Indefinite	5,300	15	257,800	14
Never	1,400	4	34,200	2
No answer	500	2	56,400	3
Total	9,800	28	1,375,800	72
		NONHARVESTERS		
Next 5 years	800	2	34,300	2
5-10 years	900	3	51,500	3
Indefinite	3,100	9	218,300	11
Never	15,900	45	180,900	9
No answer	4,600	13	57,300	3
Total	25,300	72	542,300	28
		ALL PRIVATE OWNERS		
Next 5 years	1,900	5	977,000	51
5-10 years	2,400	7	136,200	7
Indefinite	8,400	24	476,100	25
Never	17,300	49	215,100	11
No answer	5,100	15	113,700	6
Total	35,100	100	1,918,100	100

Table 31.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, North Central Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	2,000	4	605,900	29
5-10 years	200	W	43,100	2
Indefinite	8,000	15	440,300	20
Never	3,100	6	53,900	3
No answer	100	W	53,900	3
Total	13,400	25	1,197,100	57
		NONHARVESTERS		
Next 5 years	5,500	10	43,100	2
5-10 years	300	1	43,100	2
Indefinite	13,400	24	455,100	22
Never	20,400	37	241,600	12
No answer	1,600	3	107,900	5
Total	41,200	75	890,800	43
		ALL PRIVATE OWNERS		
Next 5 years	7,500	14	649,000	31
5-10 years	500	1	86,200	4
Indefinite	21,400	39	895,400	42
Never	23,500	43	295,500	15
No answer	1,700	3	161,800	8
Total	54,600	100	2,087,900	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 32.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Southwestern Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	800	2	186,100	14
5-10 years	200	W	76,100	6
Indefinite	4,100	8	306,100	23
Never	400	1	38,100	3
No answer	5,200	10	57,100	4
Total	10,700	21	663,500	50
		NONHARVESTERS		
Next 5 years	100	W	28,500	2
5-10 years	500	1	47,600	3
Indefinite	11,400	23	380,400	29
Never	16,400	33	142,700	11
No answer	11,100	22	66,600	5
Total	39,500	79	665,800	50
		ALL PRIVATE OWNERS		
Next 5 years	900	2	214,600	16
5-10 years	700	1	123,700	9
Indefinite	15,500	31	686,500	52
Never	16,800	34	180,800	14
No answer	16,300	32	123,700	9
Total	50,200	100	1,329,300	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 33.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Northeastern Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	700	1	151,700	12
5-10 years	400	1	36,400	3
Indefinite	4,100	8	343,100	28
Never	7,000	13	63,700	5
No answer	800	2	45,500	4
Total	13,000	25	640,400	52
		NONHARVESTERS		
Next 5 years	100	W	9,100	1
5-10 years	800	2	27,300	2
Indefinite	18,500	36	309,300	25
Never	18,600	36	233,700	19
No answer	600	1	18,200	1
Total	38,600	75	597,600	48
		ALL PRIVATE OWNERS		
Next 5 years	800	1	160,800	13
5-10 years	1,200	3	63,700	5
Indefinite	22,600	44	652,400	53
Never	25,600	49	297,400	24
No answer	1,400	3	63,700	5
Total	51,600	100	1,238,000	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 34.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Pocono Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	300	1	193,500	14
5-10 years	100	W	32,500	2
Indefinite	4,600	12	221,400	16
Never	2,700	7	83,000	6
No answer	400	1	51,800	4
Total	8,100	21	582,200	42
		NONHARVESTERS		
Next 5 years	W	W	10,400	1
5-10 years	1,000	3	41,500	3
Indefinite	4,900	13	295,200	21
Never	23,100	61	354,300	25
No answer	900	2	114,000	8
Total	29,900	79	815,400	58
		ALL PRIVATE OWNERS		
Next 5 years	300	1	203,900	15
5-10 years	1,100	3	74,000	5
Indefinite	9,500	25	516,600	37
Never	25,800	68	437,300	31
No answer	1,300	3	165,800	12
Total	38,000	100	1,397,600	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 35.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Southeastern Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	4,300	5	135,500	15
5-10 years	600	1	24,200	3
Indefinite	3,600	4	96,700	11
Never	5,400	7	56,500	7
No answer	3,800	5	32,300	4
Total	17,700	22	345,200	40
		NONHARVESTERS		
Next 5 years	3,100	4	32,300	4
5-10 years	—	—	—	—
Indefinite	23,100	29	255,300	30
Never	30,700	38	202,300	23
No answer	5,800	7	24,100	3
Total	62,700	78	514,000	60
		ALL PRIVATE OWNERS		
Next 5 years	7,400	9	167,800	19
5-10 years	600	1	24,200	3
Indefinite	26,700	33	352,000	41
Never	36,100	45	258,800	30
No answer	9,600	12	56,400	7
Total	80,400	100	859,200	100

Table 36.—Estimated number of private owners and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, South Central Unit, Pennsylvania, 1978

Expected time of future harvest	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
		HARVESTERS		
Next 5 years	2,600	4	191,700	16
5-10 years	200	W	42,000	3
Indefinite	7,400	13	321,300	27
Never	6,900	12	84,000	7
No answer	4,500	8	84,000	7
Total	21,600	37	723,000	60
		NONHARVESTERS		
Next 5 years	800	2	42,000	3
5-10 years	100	W	10,500	1
Indefinite	9,900	17	215,900	18
Never	25,600	44	184,800	16
No answer	W	W	21,000	2
Total	36,400	63	474,200	40
		ALL PRIVATE OWNERS		
Next 5 years	3,400	6	233,700	19
5-10 years	300	W	52,500	W
Indefinite	17,300	30	537,200	45
Never	32,500	56	268,800	23
No answer	4,500	8	105,000	9
Total	58,000	100	1,197,200	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 37.—Estimated number of private owners and acres of commercial forest land owned, by size class and expected time of future harvest, Pennsylvania, 1978

Size class (acres)	Expected time of future harvest						No answer		Total	
	Next 10 years		Indefinite		Never					
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
1-9	13,000	3	74,700	15	187,700	38	34,500	7	309,900	63
10-19	4,000	1	23,500	5	25,200	5	1,500	W	54,200	11
20-49	12,200	2	39,900	8	14,800	4	4,300	1	71,200	15
50-99	4,500	1	17,400	3	8,000	2	2,900	1	32,800	7
100-199	3,200	1	8,700	2	2,200	W	1,300	W	15,400	3
200-499	1,200	W	2,900	1	700	W	400	W	5,200	1
500-999	300	W	300	W	100	W	100	W	800	W
1,000+	400	W	200	W	W	W	W	W	600	W
Total	38,800	8	167,600	34	238,700	49	45,000	9	490,100	100
					ACRES OWNED					
1-9	51,100	W	283,600	2	593,200	5	100,100	1	1,028,000	8
10-19	53,200	1	317,100	3	298,000	2	17,200	W	685,500	6
20-49	354,900	3	1,214,600	9	477,300	4	126,600	1	2,173,400	17
50-99	299,500	2	1,153,900	9	518,900	4	190,700	2	2,163,000	17
100-199	433,700	4	1,088,700	9	281,300	2	164,400	1	1,968,100	16
200-499	362,100	3	783,700	6	203,100	2	99,700	1	1,448,600	12
500-999	184,200	1	198,900	2	93,800	1	52,400	W	529,300	4
1,000+	1,850,100	15	374,900	3	108,200	1	123,700	1	2,456,900	20
Total	3,588,800	29	5,415,400	43	2,573,800	21	874,800	7	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 38.—Estimated number of private owners who have harvested timber and acres of commercial forest land owned, by method of selecting timber and individual selecting timber, Pennsylvania, 1978

Method of selecting timber	Landowner	Forester	Buyer	Landowner and forester	Landowner and buyer	Other	No answer	Total
				HARVESTERS				
Selection	11,200	2,400	6,000	200	600	300	200	20,900
Diameter limit	9,600	1,000	15,200	200	4,000	800	W	30,800
Clearcutting	8,700	400	3,200	200	100	—	100	12,700
Land clearing	3,300	W	100	–	200	400	W	4,000
Other	10,000	—	800	100	W	100	100	11,100
Combination of methods	7,100	200	500	300	1,400	100	—	9,600
Don't know	2,100	—	6,100	—	400	500	100	9,200
No answer	1,400	100	500	—	—	—	22,200	24,200
Total	53,400	4,100	32,400	1,000	6,700	2,200	22,700	122,500
				ACRES OWNED				
Selection	475,700	1,091,600	229,700	32,100	40,900	59,600	31,100	1,960,700
Diameter limit	769,000	167,400	770,100	40,800	242,300	65,800	10,800	2,066,200
Clearcutting	316,000	87,700	115,500	30,700	9,500	—	8,100	567,500
Land clearing	118,300	12,800	20,300	—	19,400	10,500	10,800	192,100
Other	179,100	—	20,800	17,100	10,800	10,600	8,000	246,400
Combination of methods	206,200	28,900	31,500	30,300	8,100	18,600	—	323,600
Don't know	150,700	—	183,700	—	37,000	41,700	20,300	433,400
No answer	52,600	9,400	44,300	—	—	—	648,800	755,100
Total	2,267,600	1,397,800	1,415,900	151,000	368,000	206,800	737,900	6,545,000

(W) Less than 0.5 percent or fewer than 50 owners.

Table 39.—Estimated number of private owners and acres of commercial forest land owned, by timber product harvested, forest industry, and nonindustrial private land owners (size class of ownership), Pennsylvania, 1978

Timber product	Forest industry		Nonindustrial private landowners						Total	
			1-49 acres		50-499 acres		500+ acres			
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					Owners					
Sawlogs	500	83	54,500	56	17,500	71	700	88	73,200	60
Veneer	100	17	4,200	4	2,400	10	100	12	6,800	6
Pulpwood	400	67	8,400	9	5,700	23	300	38	14,800	12
Turnery bolts	—	—	900	1	200	1	W	W	1,100	1
Posts, poles, pilings	W	W	15,600	16	3,600	15	100	12	19,300	16
Mine timbers	100	17	4,800	5	1,500	6	W	W	6,400	5
Christmas trees	W	W	4,700	5	1,200	5	W	W	5,900	5
Other	W	W	15,800	16	2,500	10	W	W	18,300	15
Don't know	—	—	3,100	3	1,000	4	W	W	4,100	3
No answer	100	17	19,200	20	1,900	8	100	12	21,300	17
Total[a]	600	100	96,600	100	24,500	100	800	100	122,500	100
					ACRES OWNED					
Sawlogs	885,600	94	883,100	64	2,004,200	75	1,307,200	85	5,080,100	78
Veneer	684,800	72	118,400	9	309,100	12	422,100	27	1,534,400	23
Pulpwood	696,500	74	113,200	8	690,400	26	708,000	46	2,208,100	34
Turnery bolts	—	—	8,000	1	30,700	1	121,700	8	160,400	2
Posts, poles, pilings	257,700	27	248,800	18	369,500	14	303,200	20	1,179,200	18
Mine timbers	52,100	6	68,600	5	185,600	7	162,900	11	469,200	7
Christmas trees	47,400	5	44,800	3	141,400	5	54,000	4	287,600	4
Other	194,300	21	155,900	11	205,900	8	45,600	3	601,700	9
Don't know	—	—	69,000	5	101,100	4	9,500	1	179,600	3
No answer	60,900	6	178,900	13	213,600	8	190,200	12	643,600	10
Total[a]	946,500	100	1,377,100	100	2,680,500	100	1,540,900	100	6,545,000	100

[a]Items do not add to totals because some owners harvested more than one product.

(W) Less than 0.5 percent or fewer than 50 owners.

Table 40.—Estimated number of private owners and acres of commercial forest land owned, by timber product harvested and geographic unit, Pennsylvania, 1978

Timber product	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Sawlogs	16,700	59	6,400	65	10,200	76	8,300	78	5,000	38
Veneer	2,100	7	1,700	17	300	2	1,000	9	400	3
Pulpwoods	800	3	1,000	10	1,200	9	5,900	55	1,600	12
Turnery bolts	—	—	900	9	200	1	—	—	W	W
Posts, poles, pilings	11,400	40	1,800	18	200	1	1,400	13	1,300	10
Mine timbers	2,500	9	—	—	W	W	1,100	10	200	2
Christmas trees	500	2	W	W	600	4	300	3	200	2
Other	6,100	22	600	6	1,000	7	100	1	3,300	25
Don't know	500	2	—	—	1,700	13	800	7	W	W
No answer	2,300	8	2,000	20	300	2	500	5	4,100	31
Total[a]	28,200	100	9,800	100	13,400	100	10,700	100	13,000	100
					ACRES OWNED					
Sawlogs	752,600	74	1,244,500	90	996,500	83	437,600	66	473,100	74
Veneer	153,300	15	725,400	53	215,700	18	199,800	30	69,700	11
Pulpwood	92,800	9	720,700	52	485,300	41	180,700	27	197,100	31
Turnery bolts	—	—	119,000	9	32,300	3	—	—	9,100	1
Posts, poles, pilings	284,500	28	349,800	25	86,300	7	142,700	22	87,900	14
Mine timbers	115,000	11	—	—	53,900	5	171,200	26	27,300	4
Christmas trees	67,200	7	9,100	1	47,400	4	38,100	6	6,000	1
Other	102,300	10	256,500	19	53,900	5	9,400	1	45,500	7
Don't know	25,500	2	—	—	47,400	4	47,600	7	9,100	1
No answer	91,000	9	75,900	5	73,400	6	102,300	16	73,400	12
Total[a]	1,017,800	100	1,375,800	100	1,197,100	100	663,500	100	640,400	100

(continued)

Table 40. — continued

Timber product	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS			
Sawlogs	5,200	64	11,500	65	9,900	46	73,200	60
Veneer	100	1	900	5	300	1	6,800	6
Pulpwood	500	6	1,300	7	2,500	12	14,800	12
Turnery bolts	—	—	—	—	—	—	1,100	1
Posts, poles, pilings	900	11	600	3	1,700	8	19,300	16
Mine timbers	2,600	32	W	W	W	W	6,400	5
Christmas trees	300	4	400	2	3,600	17	5,900	5
Other	1,100	14	4,700	27	1,400	6	18,300	15
Don't know	300	4	100	1	700	3	4,100	3
No answer	1,900	23	3,700	21	6,500	30	21,300	17
Total[a]	8,100	100	17,700	100	21,600	100	122,500	100
					ACRES OWNED			
Sawlogs	406,400	70	262,700	76	506,700	70	5,080,100	78
Veneer	51,800	9	53,100	15	65,600	9	1,534,400	23
Pulpwood	168,000	29	77,300	22	286,200	40	2,208,100	34
Turnery bolts	—	—	—	—	—	—	160,400	2
Posts, poles, pilings	41,400	7	37,000	11	149,600	21	1,179,200	18
Mine timbers	62,200	11	8,100	2	31,500	4	469,200	7
Christmas trees	51,800	9	12,800	4	55,200	8	287,600	4
Other	51,800	9	40,300	12	42,000	6	601,700	9
Don't know	10,400	2	8,100	2	31,500	5	179,600	3
No answer	113,700	19	34,100	10	79,800	11	643,600	10
Total[a]	582,200	100	345,200	100	723,000	100	6,545,000	100

[a]Items do not add to total because some owners harvested more than one product.

(W) Less than 0.5 percent or fewer than 50 owners.

Table 41.—Estimated number of private owners and acres of commercial forest land owned, by agency that owners would contact for forestry assistance, Pennsylvania, 1978

Agency	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
State forestry	14,900	12	3,800	11	13,800	25	2,600	5	5,400	10
Soil Conservation Service	2,900	2	—	—	W	W	100	W	1,100	2
Forest Service	4,700	4	1,900	5	400	1	100	W	300	1
Agricultural Stabilization and Conservation Service	17,400	14	—	—	W	W	—	—	500	1
Consultant or industry forester	W	W	2,000	6	W	W	300	1	700	1
Extension service	2,000	2	600	2	500	1	100	W	3,400	7
Other	800	1	1,100	3	500	1	100	W	W	W
Don't know	46,100	38	14,300	41	27,100	50	22,600	45	32,000	62
No answer	33,400	27	11,400	32	12,300	22	24,300	49	8,200	16
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
State forestry	383,400	16	430,500	22	407,700	19	218,800	16	230,300	17
Soil Conservation Service	72,000	3	—	—	32,300	1	28,500	2	36,400	3
Forest Service	76,700	3	170,600	9	75,500	4	9,500	1	45,500	4
Agricultural Stabilization and Conservation Service	92,800	3	—	—	10,800	1	—	—	45,500	4
Consultant or industry forester	38,300	2	312,900	16	58,200	3	47,600	4	72,800	6
Extension Service	76,700	3	22,100	1	79,800	4	38,100	3	42,400	4
Other	38,300	2	88,000	5	151,000	7	9,500	1	9,100	1
Don't know	1,263,800	52	500,200	26	828,200	40	542,200	41	491,200	40
No answer	383,500	16	393,800	21	444,400	21	435,100	32	264,800	21
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

(continued)

Table 41. — continued

Agency	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
State forestry	3,900	10	15,000	19	7,600	13	67,000	14
Soil Conservation Service	300	1	600	1	3,700	6	8,700	2
Forest Service	—	—	—	—	200	W	7,600	1
Agricultural Stabilization and Conservation Service	200	1	—	—	—	—	18,100	4
Consultant or industry forester	400	1	W	W	100	W	3,500	1
Extension service	10,600	28	1,800	2	2,200	4	21,200	4
Other	200	1	400	W	W	W	3,100	W
Don't know	14,100	37	49,100	61	34,500	60	239,800	49
No answer	8,300	21	13,500	17	9,700	17	121,100	25
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
State forestry	333,800	24	169,300	20	220,600	18	2,394,400	19
Soil Conservation Service	41,500	3	8,100	1	31,500	3	250,300	2
Forest Service	—	—	—	—	10,500	1	388,300	3
Agricultural Stabilization and Conservation Service	31,100	2	—	—	—	—	180,200	1
Consultant or industry forester	51,800	4	37,000	4	92,800	8	711,400	6
Extension Service	31,100	2	40,300	5	63,000	5	393,500	3
Other	10,400	1	16,100	2	10,500	1	332,900	3
Don't know	479,700	34	439,700	51	652,700	54	5,197,700	42
No answer	418,200	30	148,700	17	115,600	10	2,604,100	21
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 42.—Estimated number of private owners who have received forestry assistance and acres of commercial forest land owned, by type of assistance, Pennsylvania, 1978

Type of assistance	Assisted owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
Timber marking	5,000	1	366,600	3
Timber stand improvement	3,200	1	269,700	2
Tree planting	2,000	W	128,300	1
Timber sales administration	200	W	176,500	1
Insect and disease control	400	W	37,500	W
Timber evaluation	2,400	1	208,000	2
Surveying	1,400	W	113,100	1
General forest management	9,400	2	1,063,200	9
Other	600	W	101,800	1
Service not specified	5,000	1	783,400	6
Total receiving assistance[a]	28,100	6	2,934,500	24

[a] Individual items do not add to total because some owners have received more than one type of assistance.
(W) Less than 0.5 percent or fewer than 50 owners.

Table 43.—Estimated number of private owners and acres of commercial forest land owned, by type of public use permitted, Pennsylvania, 1978

Type of public use	Private owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
Hiking	95,800	20	5,094,400	41
Picnicking	55,900	11	3,149,900	25
Camping	44,500	9	2,296,000	18
Fishing	24,300	5	2,793,500	22
Hunting	231,200	47	7,323,500	59
Snow mobiling	81,900	17	3,513,000	28
Other	8,400	2	649,500	5
All types[a]	256,500	52	8,270,200	66
Public use not permitted	167,800	34	3,219,700	26
No answer	65,800	14	962,900	8
Total	490,100	100	12,452,800	100

[a] Columns do not add to total because some owners permit more than one type of public use.

for public recreational use and geographic unit, Pennsylvania, 1978

Public Use	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Permitted	79,800	65	25,400	72	35,500	65	17,200	34	20,800	40
Not permitted	34,200	28	4,400	13	12,800	23	12,000	24	29,000	56
No answer	8,200	7	5,300	15	6,300	12	21,000	42	1,800	4
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
Permitted	1,714,400	71	1,546,800	81	1,386,900	66	894,000	67	721,600	58
Not permitted	599,200	25	218,500	11	573,700	28	256,900	19	470,000	38
No answer	111,900	4	152,800	8	127,300	6	178,400	14	46,400	4
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

Public use	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
Permitted	13,400	35	27,200	34	37,200	64	256,500	52
Not permitted	20,100	53	40,900	51	14,400	25	167,800	34
No answer	4,500	12	12,300	15	6,400	11	65,800	14
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
Permitted	645,700	46	438,300	51	922,500	77	8,270,200	66
Not permitted	591,700	42	320,600	37	189,100	16	3,219,700	26
No answer	160,200	12	100,300	12	85,600	7	962,900	8
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

Table 45.—Estimated number of private owners and acres of commercial forest land owned, by reason for posting and geographic unit, Pennsylvania, 1978

Reason for posting	Western		Allegheny		North Central		Southwestern		Northeastern	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
					OWNERS					
Abuse of property	2,200	2	600	2	700	1	1,000	2	3,600	7
Safety	15,300	12	3,000	9	300	1	1,500	3	500	1
Liability	600	W	100	W	100	W	—	—	100	W
Control access	2,100	2	1,400	4	6,400	12	300	1	2,400	5
Control hunting	10,400	9	800	2	8,800	16	500	1	11,600	22
Reason not specified	500	W	300	1	4,600	8	600	1	9,200	18
All reasons	31,100	25	6,200	18	20,900	38	3,900	8	27,400	53
Land not posted	85,200	70	23,800	68	33,100	61	25,400	50	23,000	45
No answer	5,900	5	5,100	14	600	1	20,900	42	1,200	2
Total	122,200	100	35,100	100	54,600	100	50,200	100	51,600	100
					ACRES OWNED					
Abuse of property	89,500	4	57,600	3	118,600	6	95,100	7	172,800	14
Safety	140,600	6	127,000	7	53,900	2	57,100	4	18,200	1
Liability	25,600	1	158,400	8	75,500	4	—	—	9,100	1
Control access	110,300	4	105,100	6	192,000	9	28,500	2	188,000	15
Control hunting	110,300	4	138,400	7	183,400	9	66,600	5	197,000	16
Reason not specified	38,400	2	43,400	2	53,900	2	76,100	6	63,700	5
All reasons	514,700	21	629,900	33	677,300	32	323,400	24	648,800	52
Land not posted	1,811,800	75	1,151,500	60	1,304,900	63	837,000	63	488,200	40
No answer	99,000	4	136,700	7	105,700	5	168,900	13	101,000	8
Total	2,425,500	100	1,918,100	100	2,087,900	100	1,329,300	100	1,238,000	100

(continued)

Table 45. — continued

Reason for posting	Pocono		Southeastern		South Central		State total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
				OWNERS				
Abuse of property	3,600	10	11,000	14	3,500	6	26,200	5
Safety	500	1	6,200	8	6,900	12	34,200	7
Liability	W	W	100	W	—	—	1,000	W
Control access	2,600	7	2,700	3	300	W	18,200	4
Control hunting	11,600	31	19,000	23	1,000	2	63,700	13
Reason not specified	2,000	5	3,800	5	500	1	21,500	5
All reasons	20,300	54	42,800	53	12,200	21	164,800	34
Land not posted	13,800	36	30,400	38	45,000	78	279,700	57
No answer	3,900	10	7,200	9	800	1	45,600	9
Total	38,000	100	80,400	100	58,000	100	490,100	100
				ACRES OWNED				
Abuse of property	103,600	8	86,800	10	73,600	6	797,600	6
Safety	62,200	4	64,500	7	37,700	3	561,200	5
Liability	33,300	2	16,100	2	—	—	318,000	3
Control access	332,600	24	48,400	6	52,500	4	1,057,400	8
Control hunting	124,300	9	127,100	15	126,000	11	1,073,100	9
Reason not specified	62,200	4	40,300	5	42,000	4	420,000	3
All reasons	718,200	51	383,200	45	331,800	28	4,227,300	34
Land not posted	561,600	40	432,100	50	827,600	69	7,414,700	60
No answer	117,800	9	43,900	5	37,800	3	810,800	6
Total	1,397,600	100	859,200	100	1,197,200	100	12,452,800	100

(W) Less than 0.5 percent or fewer than 50 owners.

Table 46.—Estimated number of individual owners and acres of commercial forest land owned, by conservation-related organization membership, Pennsylvania, 1978

Organization	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
American Forestry Association	3,600	1	253,100	3
Audubon Society	12,400	3	410,200	5
Natural History Society	11,900	3	92,600	1
National Wildlife Federation	35,500	8	806,500	9
A Sportsman's Club	28,200	7	1,008,100	12
A Garden Club	3,500	1	184,200	2
A Farmer's Organization	41,900	10	957,800	11
The Sierra Club	700	W	70,200	1
American Tree Farm Program	1,400	W	192,100	2
Other	12,300	3	788,800	9
Organization member	105,700	25	2,739,900	32
Nonmember	258,100	61	5,254,700	61
No answer	58,800	14	563,400	7
Total[a]	422,600	100	8,558,000	100

[a]Columns do not add to total because some owners belong to more than one organization.
(W) Less than 0.5 percent or fewer than 50 owners.

Table 47.—Estimated number of individual owners and acres of commercial forest land owned, by conservation-oriented publications they receive, Pennsylvania, 1978

Publication	Individual owners		Acres owned	
	Number	*Percent*	*Number*	*Percent*
American Forests	3,600	1	253,100	3
National Wildlife	35,500	8	806,500	9
Pennsylvania Forests	5,700	1	197,500	2
Pennsylvania Game News	104,100	25	2,786,600	33
Audubon	12,400	3	410,200	5
Field and Stream	41,100	10	381,500	4
Sports Afield	20,400	5	402,200	5
Agway Cooperator	35,300	8	387,400	5
Pennsylvania Farmer	80,900	19	341,700	4
Other	84,100	20	2,092,300	24
Subscriber	224,800	53	5,386,600	63
Nonsubscriber	140,000	33	2,618,500	31
No answer	57,800	14	552,900	6
Total[a]	422,600	100	8,558,000	100

[a]Columns do not add to total because some owners subscribe to more than one publication.

Table 48.—Estimated number of individual owners and acres of commercial forest land owned, by statement and response to statement in conservation quiz, Pennsylvania, 1978

Statement number	Correct answer	Percent correct	Response to statement				All responses
			True	False	Don't know	No answer	
			INDIVIDUAL OWNERS				
1	True	80	339,900	5,300	24,000	53,400	422,600
2	False	58	78,100	247,000	31,800	65,700	422,600
3	True	54	229,200	14,200	107,700	71,500	422,600
4	False	34	127,200	142,200	83,700	69,500	422,600
5	False	66	9,400	279,700	64,400	69,100	422,600
6	False	9	238,200	37,400	67,700	79,300	422,600
7	False	21	159,000	87,500	106,700	69,400	422,600
8	True	30	128,600	7,300	214,500	72,200	422,600
9	False	36	135,300	150,700	68,300	68,300	422,600
10	True	41	174,300	11,500	169,300	67,500	422,600
			ACRES OWNED				
1	True	85	7,266,900	46,400	437,300	807,400	8,558,000
2	False	67	1,165,400	5,750,200	735,500	906,900	8,558,000
3	True	60	5,176,700	162,400	2,119,600	1,099,300	8,558,000
4	False	38	2,415,300	3,253,600	1,875,900	1,013,200	8,558,000
5	False	73	120,100	6,212,600	1,215,700	1,009,600	8,558,000
6	False	14	5,101,500	1,240,900	1,258,300	957,300	8,558,000
7	False	22	3,273,000	1,850,500	2,335,800	1,098,700	8,558,000
8	True	32	2,719,900	139,600	4,471,800	1,226,700	8,558,000
9	False	42	2,766,800	3,587,600	1,214,000	989,600	8,558,000
10	True	52	4,442,300	402,800	2,746,300	966,600	8,558,000

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Birch, Thomas W., and Donald F. Dennis.
1980. The forest-land owners of Pennsylvania.
Northeast For. Exp. Stn., Broomall, Pa.
90 p. (USDA For. Serv. Res. Bull. NE-66.

A statistical analytical report of a mail canvass of private commercial forest-land owners in Pennsylvania. The study was conducted in conjunction with the third forest survey of Pennsylvania by the USDA Forest Service. Discussed are landowner characteristics, attitudes, and intentions of owners regarding reasons for owning, recreational use, timber management and harvesting, etc.

923.9(748)

Keywords: Available timber, harvesting, forestry assistance, recreation

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Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
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**Northeastern
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Resource
Bulletin NE-68

Forest Statistics for Ohio — 1979

Donald D. Dennis
Thomas W. Birch

Forest Statistics for Ohio - 1979

ONALD F. DENNIS and THOMAS W. BIRCH, Research oresters, Resources Evaluation unit, ortheastern Forest Experiment Station, USDA orest Service, Broomall, Pa.

Contents

reword

e third inventory of Ohio was directed by rl E. Mayer, Resources Evaluation unit leader. seph E. Barnard was responsible for inventory sign and sample selection. John R. Peters pervised the aerial-photo interpretation and ta collection by field crews. He was assisted Mark A. Cooper, III. The other field personl were: Raymond F. Brainard, Karen J. Sykes, ward H. Uebler, Richard H. Widmann, Judy L. ory, Gerard A. Fontaine, Arthur L. Gaffrey, egory E. Baker, Herman J. Bailey, John E. yle, Randy L. DeMarco, Carla J. Derby, Philip Emery, Ellen M. Eshchuk, Robert C. Guth, ederick J. Harris, Stanley E. Jones, Kenneth Maleski, Pam McIntosh, Keelin Reardon, Scott lxton, Lois Schimmel, Laurie L. Shortess, Roy Siefert, Michael A. Steiner, Richard R. ylor, Stephen T. Warner and Eric L. Wunz.

vid R. Dickson, Nancy M. Veronesi and Thomas Frieswyk applied FINSYS (Forest INventory Stem), a generalized data processing system, the specific data needs of the Ohio inventry, and produced summary tables for the state, graphic sampling units, and counties. Thomas Birch was instrumental in assuring that the ea estimates were consistent with those from e two previous inventories, as well as in uping the proper counties for detailed area d volume information. Teresa M. Bowers sisted in the inventory design by performing l calculations necessary for sampling-size termination and plot selection. She was sponsible for the coordination of keypunching d other data preparation tasks. Anne M. ley helped prepare and balance the statisti- tables in this report.

Robert L. Nevel and Eric H. Wharton with the assistance of Robert B. Redett, Ohio Department of Natural Resources, Division of Forestry, collected and compiled the data on timber products output and timber removals.

Carmela M. Hyland was responsible for administrative and secretarial services. Catherine A. Logan typed this report.

Introduction

The USDA Forest Service inventories the forest resources of the Nation for assessment and plannng activities authorized by the Renewable Resources Planning Act (RPA) of 1974 and the Renewable Resources Research Act of 1978. These inventories are conducted periodically in each state. Results from two previous inventories conducted in Ohio were reported in 1954 and 1970. This report presents the forest resource data from the third inventory, conducted in 1977-79, a cooperative effort of the Ohio Department of Natural Resources, Division of Forestry; the Wayne-Hoosier National Forest; and the Northeastern Forest Experiment Station. Data from the most recent inventory of the Wayne National Forest were updated to the present inventory date; the Resources Evaluation unit at the Northeastern Forest Experiment Station conducted an inventory on all other land, developed the summaries of resource data, and prepared this report.

The 1977-79 inventory conducted by the Resources Evaluation project followed a sampling procedure that utilized aerial photography, partial remeasurement of ground samples from earlier inventories, and new ground sample locations. In Ohio this required remeasuring 2,759 plots, classifying 79,752 points on aerial photographs into land-use and cubic foot volume classes, and establishing 2,128 new ground measurement locations as a subsample of the photo points. The data collected were summarized according to the Sampling with Partial Replacement (SPR) design by the FINSYS computer system developed by the Northeastern Forest Experiment Station.

The resurvey of Ohio's forest resources included several companion studies and considerable analysis. Analytical reports discussing the results of the reinventory, past trends, future supply potential, and the private forest-land owner are being prepared. A publication describing Ohio's primary forest products industry is available. The forest area and timber volume statistics shown in this report are summaries of the information collected. Other information or additional summaries may be developed. If interested in additional publica-

tions or more resource data, contact the Resources Evaluation Project, USDA Forest Service, 370 Reed Road, Broomall, PA 19008 (phone 215-461-3037).

Highlights

Forest area

Ohio is 27 percent forested. Ninety-seven percent of the forest land, 6.9 million acres, is classified as commercial forest land; a 5.5 percent increase since the 1968 inventory.

The oak-hickory forest type group dominates Ohio, occupying 62 percent of the commercial forest land.

Twenty-eight percent of Ohio's commercial forest land is in stands with more than 5,000 board feet per acre.

Timber volume

Ohio's growing stock volume is 6.4 billion cubic feet, averaging 924 cubic feet per acre. Total growing stock volume has increased by 48 percent since 1968.

Sawtimber volume is 20.4 billion board feet, averaging 2,952 board feet per acre. Sawtimber volume has also increased by 48 percent since 1968.

Timber growth and removals

Net growth has been 3 times greater than removals for the period between surveys.

In 1978, removals pressure has been highest in the oaks and hickories, but still only half the net growth has been removed.

Reliability of the Estimates

Much of the data in this report were based on a carefully designed sample of forest conditions throughout the state. However, since we did not measure every tree or every acre in the state, the data are estimates. The effectiveness of the estimating procedure is judged by two important measures: accuracy and precision. Accuracy describes the closeness of a sample estimate to the true value, or how much is really there. Precision refers to the variation among repeated sample estimates. We are chiefly interested in the accuracy of the survey, but in most instances we can only measure its precision.

Although accuracy cannot be measured exactly, it can be checked. Drafts of the resource report are submitted to outside experts familiar with the resources in Ohio. Should questions arise, the data are reviewed and reanalyzed to resolve differences. The data are also compared with those provided by other agencies. Also, great care was taken in setting up the sample, field personnel were carefully trained, and both office and field work checked.

Because of the care exercised in the survey process, our estimates of precision afford a reasonable measure of the survey's adequacy. The precision of each estimate is described by its sampling error. Some sampling errors appear in this report, others are available on request.

Here is an example of how to use sampling errors: The estimate of total growing stock volume for Ohio is 6,394.3 million cubic feet. It has an associated sampling error of 1.3 percent, or 83.1 million cubic feet. This means that if there are no errors in procedure and we repeated the survey in the same way, the odds are 2 to 1 (66 percent probability) that the resulting estimate of growing stock volume would be between 6,311.2 and 6,477.4 million cubic feet, or 6,394.3 $\pm$ 83.1 million cubic feet. Similarly there is a 95 percent probability (19 to 1) that the estimate would be within 6,394.3 $\pm$ 166.2 million cubic feet.

Estimates are most precise or reliable at the state level; state estimates have the smallest sampling errors, followed by unit estimates and then county estimates. For example, our estimate of growing stock volume for the state has an associated sampling error of 1.3 percent; the sampling error for the South-Central Unit is 2. percent; and the sampling error for Adams count is 6 percent. Thus, county-level estimates are often considerably less reliable than unit or state-wide estimates. In general, as the size of an estimate decreases in relation to the total, the sampling error, expressed as a percent of the estimate, increases.

Since the 1968 survey, some definitions and procedures have changed as the result of refinements and improvements in forest inventory and data processing techniques. As a consequence, before any comparisons with the most recent information can be made, the published estimat from the previous survey must be adjusted somewhat. The adjusted area figures are shown in Table 67.

Growing stock volume adjustments are reflected in the following figures (in millions of cubic feet):

Species group	1968	1979	Change (1968-1979)
All softwoods	116.3	274.9	+158.6
Select white oaks	614.2	795.8	+181.6
Select red oaks	324.1	377.5	+ 53.4
Chestnut oak	261.0	326.5	+ 65.5
Other red oaks	447.7	560.6	+112.9
Hickory	499.8	604.7	+104.9
Hard maple	248.5	448.9	+200.4
Soft maple	235.5	364.5	+129.0
Yellow-poplar	275.3	489.2	+213.9
Elm	252.6	248.9	- 3.7
Other hardwoods	1,051.7	1,902.8	+851.1
All hardwoods	4,210.4	6,119.4	+1,909.0
All species	4,326.7	6,394.3	+2,067.6

Sawtimber volume adjustments are reflected in the following figures (in millions of board feet, International 1/4-inch rule):

Species group	1968	1979	Change (1968-1979)
Softwoods	341.2	886.3	+545.1
Hardwoods	13,474.9	19,529.6	+6,054.7
All species	13,816.1	20,415.9	+6,599.8

TO COMPARE 1979 AREA AND VOLUME ESTIMATES WITH COMPARABLE ESTIMATES FOR 1968, USE THE FIGURES IN TABLE 67 AND THE ABOVE FIGURES RATHER THAN THOSE PUBLISHED PREVIOUSLY.

To compare more detailed information than that provided above, simple arithmetic will be required to derive the proper figure for 1968. For example, to compare the 1968 data on growing stock volume in sawtimber stands with the 1979 data, take the published data for 1968 found in Table 15, of Kingsley and Mayer (1970), 2,427.5 million cubic feet. This represents 58.1 percent of the total growing stock volume of 4,180.9 million cubic feet. To obtain the adjusted 1968 figure, multiply this proportion by the recalculated 1968 total growing stock volume. The calculation is: (0.581)(4326.7) = 2,513.8 million cubic feet.

This figure can then be compared with the 1979 estimate, 4,207.6 million cubic feet. Contact the Resources Evaluation unit at the Northeastern Forest Experiment Station if you need additional assistance.

LIST OF TABLES

State level

Area

Number of trees

Table 1.--Land area by land class, Ohio, 1979

Land class	Area		
		Thousand Acres	Percent
Commercial forest land		6,917.1	26
Noncommercial forest land:			
Productive reserved	119.4		1
Urban	40.5		W
Unproductive	43.1		W
Total noncommercial		203.0	1
Total forest land		7,120.1	27
Nonforest land:			
Cropland[a]	10,977.8		42
Pasture[a]	2,154.4		8
Other[b]	5,976.2		23
Total nonforest		19,108.4	73
Total land area[c]		26,228.5	100

[a]Source: U.S. Dep. Commer., Bur. Census, 1980. 1978 Census of Agriculture, preliminary report. AC78-P-39-000. p.1.
[b]Includes swampland, industrial and urban areas, other nonforest land, and 80,500 acres classed as water by Resources Evaluation standards, but defined by the Bureau of the Census as land.
[c]U.S. Dep. Commer., Census, County and City Data Book, 1972.
W-Less than 0.5 percent

Table 2.--Land area by geographic unit and land class, Ohio, 1979

(In thousands of acres)

Geographic unit	Forest land					Nonforest land	All land
	Commercial	Productive-reserved	Urban	Unproductive	Total		
South-Central	1,601.3	24.8	.2	.5	1,626.8	1,680.7	3,307.5
Southeastern	1,247.7	14.5	-	2.2	1,264.4	811.1	2,075.5
East-Central	1,657.7	12.2	-	24.2	1,694.1	1,713.3	3,407.4
Northeastern	1,240.4	44.0	31.8	15.5	1,331.7	3,783.1	5,114.8
Southwestern	470.2	15.0	6.9	-	492.1	4,319.5	4,811.6
Northwestern	699.8	8.9	1.6	.7	711.0	6,800.7	7,511.7
Total	6,917.1	119.4	40.5	43.1	7,120.1	19,108.4	26,228.5

Table 3.--Area of commercial forest land by ownership class and geographic unit, Ohio, 1979

(In thousands of acres)

Ownership class	South-Central	South-eastern	East-Central	North-eastern	South-western	North-western	Total
National Forest	68.2	78.3	12.8	-	-	-	159.3
Other federal	-	-	0.3	14.6	0.4	0.1	15.4
State	110.4	42.6	16.9	13.8	2.1	9.7	195.5
County and Municipal	0.1	-	25.2	10.4	2.4	3.9	42.0
Total public	178.7	120.9	55.2	38.8	4.9	13.7	412.2
Corporate[a]	162.3	153.0	245.2	98.5	31.8	24.9	715.7
Other private[b]	1,260.3	973.8	1,357.3	1,103.1	433.5	661.2	5,789.2
Total private	1,422.6	1,126.8	1,602.5	1,201.6	465.3	686.1	6,504.9
Total, all ownerships	1,601.3	1,247.7	1,657.7	1,240.4	470.2	699.8	6,917.1

[a]Includes all forest industry lands.
[b]Includes all farmer owned lands.

Table 4.--Area of commercial forest land by stand-size and ownership class, Ohio, 1979

(In thousands of acres)

Stand-size class	National Forest	Other public	Corporate[a]	Other private[b]	All ownerships
Sawtimber stands	87.6	158.8	227.8	2,480.4	2,954.6
Poletimber stands	47.2	31.4	134.8	1,324.5	1,537.9
Sapling-seedling stands	21.2	52.5	331.7	1,803.1	2,208.5
Nonstocked areas	3.3	10.2	21.4	181.2	216.1
Total	159.3	252.9	715.7	5,789.2	6,917.1

[a]Includes all forest industry lands.
[b]Includes all farmer owned lands.

Table 5.--Area of commercial forest land by geographic unit and stand-size class, Ohio, 1979

(In thousands of acres)

Geographic unit	Sawtimber stands	Poletimber stands	Sapling-seedling stands	Nonstocked areas	All classes
South-Central	738.9	348.2	440.8	73.4	1,601.3
Southeastern	537.9	285.4	391.9	32.5	1,247.7
East-Central	614.6	315.7	690.6	36.8	1,657.7
Northeastern	471.1	317.5	402.5	49.3	1,240.4
Southwestern	223.8	94.8	127.5	24.1	470.2
Northwestern	368.3	176.3	155.2	-	699.8
Total	2,954.6	1,537.9	2,208.5	216.1	6,917.1

Table 6.--Area of commercial forest land by stand-volume class and geographic unit, Ohio, 1979

(In thousands of acres)

Geographic unit	Stand volume per acre (board feet)[a]			All classes
	Fewer than 1,500	1,500-5,000	More than 5,000	
South-Central	510.3	511.7	579.3	1,601.3
Southeastern	457.2	466.7	323.8	1,247.7
East-Central	713.0	589.3	355.4	1,657.7
Northeastern	506.5	428.2	305.7	1,240.4
Southwestern	140.7	174.0	155.5	470.2
Northwestern	206.0	251.8	242.0	699.8
Total, all units	2,533.7	2,421.7	1,961.7	6,917.1

[a]International 1/4-inch rule.

Table 7.--Area of commercial forest by stocking-percent class of all live trees, and geographic unit, Ohio, 1979

(In thousands of acres)

Geographic unit	Stocking class (all live trees)[a]				All classes
	Over-stocked (130%+)	Fully stocked (100%-129%)	Medium stocked (60%-99%)	Poorly stocked (0%-59%)	
South-Central	330.8	892.5	268.0	110.0	1,601.3
Southeastern	286.5	622.3	262.9	76.0	1,247.7
East-Central	280.0	757.3	524.4	96.0	1,657.7
Northeastern	231.0	633.0	312.0	64.4	1,240.4
Southwestern	66.4	212.5	136.8	54.5	470.2
Northwestern	178.4	322.1	195.2	4.1	699.8
Total	1,373.1	3,439.7	1,699.3	405.0	6,917.1

[a]100 percent stocking equals approximately 75 square feet of basal area per acre.

Table 8.--Area of commercial forest by stocking-percent class of growing-stock trees, and geographic unit, Ohio, 1979
(In thousands of acres)

Geographic unit	Stocking class (growing-stock trees)[a]				All classes
	Over-stocked (130%+)	Fully stocked (100%-129%)	Medium stocked (60%-99%)	Poorly stocked (0%-59%)	
South-Central	147.8	664.7	579.3	209.5	1,601.3
Southeastern	62.6	444.9	511.4	228.8	1,247.7
East-Central	31.9	422.5	818.2	385.1	1,657.7
Northeastern	71.1	391.3	560.7	217.3	1,240.4
Southwestern	5.9	143.7	202.0	118.6	470.2
Northwestern	84.8	221.8	321.4	71.8	699.8
Total	404.1	2,288.9	2,993.0	1,231.1	6,917.1

[a]100 percent stocking equals approximately 75 square feet of basal area per acre.

Table 9.--Area of commercial forest land by potential site productivity and ownership classes, Ohio, 1979

(In thousands of acres)

Potential site productivity class[a]	National Forest	Other public	Corporate[b]	Other private[c]	All ownerships
120 - 165	10.2	78.7	12.3	496.1	597.3
85 - 119	44.7	75.9	159.7	1,497.5	1,777.8
50 - 84	85.0	65.6	435.3	3,063.1	3,649.0
20 - 49	19.4	32.7	108.4	732.5	893.0
Total	159.3	252.9	715.7	5,789.2	6,917.1

[a]Potential growth in cubic feet per acre per year.
[b]Includes all forest industry lands.
[c]Includes all farmer owned lands.

Table 10.--Area of commercial forest land by geographic unit and potential site productivity class, Ohio, 1979

(In thousands of acres)

Geographic unit	Potential site productivity class[a]				All classes
	120-165	85-119	50-84	20-49	
South-Central	152.8	441.5	813.2	193.8	1,601.3
Southeastern	36.3	360.3	702.5	148.6	1,247.7
East-Central	176.8	431.3	813.8	235.8	1,657.7
Northeastern	188.6	366.9	558.1	126.8	1,240.4
Southwestern	28.9	55.1	312.0	74.2	470.2
Northwestern	13.9	122.7	449.4	113.8	699.8
Total	597.3	1,777.8	3,649.0	893.0	6,917.1

[a]Potential growth in cubic feet per acre per year.

Table 11.--Area of commercial forest land by forest type and forest-type group, Ohio, 1979

Forest type and forest-type group	Area	Sampling error
	Thousand acres	Percent
Red pine	41.0	42
White pine	124.9	31
Total white/red pine group	165.9	25
Shortleaf pine	15.6	100
Virginia pine	74.9	27
Eastern redcedar	36.7	32
Pitch pine	12.7	71
Total hard pine group	139.9	20
Shortleaf pine/oak	7.3	100
Other oak/pine	12.2	100
Total oak/pine group	19.5	71
Post, black, or bear oak	133.5	24
Chestnut oak	251.3	16
White oak	341.5	14
Northern red oak	116.2	26
Scarlet oak	16.2	79
White oak/red oak/hickory	1,076.0	8
Yellow-poplar	457.0	12
Sweetgum/yellow-poplar	25.4	100
Black locust	411.0	13
Black walnut	99.2	29
Sassafras/persimmon	287.2	16
Hawthorn/reverting field	348.7	16
Red Maple/central hardwoods	284.7	17
Mixed central hardwoods	408.4	13
Total oak/hickory group	4,256.3	3
Black ash/American elm/red maple	607.1	11
River birch/sycamore	51.9	36
Cottonwood	27.9	49
Willow	49.5	39
Sugarberry/American elm/green ash	15.3	71
Total elm/ash/red maple group	751.7	10
Sugar maple/beech/yellow birch	613.2	10
Black cherry	280.9	17
Red maple/northern hardwoods	165.0	24
Mixed northern hardwoods	447.6	13
Total northern hardwoods group	1,506.7	6
Aspen	77.1	33
Total aspen/birch group	77.1	33
State total	6,917.1	1.0

Table 12.--Area of commercial forest land by forest-type group and ownership class, Ohio, 1979

(In thousands of acres)

Forest-type group	National Forest	Other public	Corporate[a]	Other private[b]	All ownerships
White/red pine group	9.4	17.4	43.0	96.1	165.9
Hard pine group	10.0	-	25.7	104.2	139.9
Oak/pine group	6.1	-	-	13.4	19.5
Oak/hickory group	125.5	129.9	404.1	3,596.8	4,256.3
Elm/ash/red maple group	1.7	13.2	110.3	626.5	751.7
Northern hardwoods group	6.4	92.4	132.6	1,275.3	1,506.7
Aspen/birch group	.2	-	-	76.9	77.1
Total	159.3	252.9	715.7	5,789.2	6,917.1

[a]Includes all forest industry lands.
[b]Includes all farmer owned lands.

Table 13.--Area of commercial forest land by forest-type group and stand-size class, Ohio, 1979

(In thousands of acres)

Forest-type group	Saw-timber stands	Pole-timber stands	Sapling-seedling stands	Non-stocked areas	All stands
White/red pine group	50.1	46.8	46.6	22.4	165.9
Hard pine group	48.3	29.0	62.6	-	139.9
Oak/pine group	8.6	9.9	1.0	-	19.5
Oak/hickory group	1,918.8	954.5	1,227.7	155.3	4,256.3
Elm/ash/red maple group	274.3	164.2	288.7	24.5	751.7
Northern hardwoods group	647.6	315.4	529.8	13.9	1,506.7
Aspen/birch group	6.9	18.1	52.1	-	77.1
Total	2,954.6	1,537.9	2,208.5	216.1	6,917.1

Table 14.--Area of commercial forest land by forest-type group and geographic unit, Ohio, 1979

(In thousands of acres)

Forest-type group	South-Central	South-eastern	East-Central	North-eastern	South-western	North-western	Total
White/red pine group	17.1	40.2	60.2	23.3	5.9	19.2	165.9
Hard pine group	77.8	49.8	.6	-	11.7	-	139.9
Oak/pine group	10.4	8.7	.4	-	-	-	19.5
Oak/hickory group	1,258.4	978.7	1,015.6	402.9	248.5	352.2	4,256.3
Elm/ash/red maple group	76.6	65.4	164.5	182.5	96.1	166.6	751.7
Northern hardwoods group	160.9	104.8	379.3	591.9	108.0	161.8	1,506.7
Aspen/birch group	.1	.1	37.1	39.8	-	-	77.1
Total	1,601.3	1,247.7	1,657.7	1,240.4	470.2	699.8	6,917.1

Table 15.--Number of live trees on commercial forest land by tree and diameter classes, softwoods and hardwoods, Ohio, 1979 (In thousands of trees)

Diameter class (inches at breast height)	Softwoods			Hardwoods		
	Growing-stock	Rough and rotten	Total	Growing-stock	Rough and rotten	Total
5.0 - 6.9	20,417	2,911	23,328	219,423	59,415	278,838
7.0 - 8.9	11,203	626	11,829	142,722	25,253	167,975
9.0 - 10.9	-	-	-	95,019	12,438	107,457
Total poletimber	31,620	3,537	35,157	457,164	97,106	554,270
9.0 - 10.9	6,504	217	6,721	-	-	-
11.0 - 12.9	3,169	36	3,205	53,432	8,316	61,748
13.0 - 14.9	1,230	24	1,254	34,362	3,717	38,079
Total small sawtimber	10,903	277	11,180	87,794	12,033	99,827
15.0 - 16.9	372	-	372	20,937	2,248	23,185
17.0 - 18.9	42	35	77	12,865	1,276	14,141
19.0 - 20.9	69	-	69	7,822	786	8,608
21.0 - 28.9	11	-	11	9,150	1,529	10,679
29.0 and larger	-	6	6	1,357	604	1,961
Total larger sawtimber	494	41	535	52,131	6,443	58,574
Total, all classes	43,017	3,855	46,872	597,089	115,582	712,671

Table 16.--Number of growing-stock trees on commercial forest land by species and diameter class, Ohio, 1979

(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	1,122	275	235	175	30	-	-	13	-	-	1,850
White and red pine	5,864	5,519	2,005	1,190	167	80	-	-	-	-	14,825
Virginia pine	4,202	3,623	2,392	862	408	89	24	14	-	-	11,614
Other softwoods	9,229	1,786	1,872	942	625	203	18	42	11	-	14,728
Total softwoods	20,417	11,203	6,504	3,169	1,230	372	42	69	11	-	43,017
Soft maples[a]	25,504	13,485	7,088	3,175	1,644	898	570	310	464	89	53,227
Hard maples	16,941	11,084	7,906	4,413	2,438	1,607	965	634	440	50	46,478
Hickory	22,468	18,436	11,644	6,110	4,026	2,154	1,012	533	403	5	66,791
Beech	4,274	3,971	2,815	2,385	837	707	346	453	749	120	16,657
White ash	19,316	12,694	8,208	3,918	2,835	1,462	1,140	448	487	63	50,571
Black walnut	3,275	3,949	2,563	1,185	993	550	196	164	39	-	12,914
Yellow-poplar	8,798	7,884	6,035	3,922	2,427	1,911	1,054	529	746	48	33,354
Sycamore	1,724	1,574	1,618	1,068	587	367	233	209	219	62	7,661
Aspen	11,739	7,388	3,383	2,097	641	299	107	15	108	80	25,857
Black cherry	11,703	9,431	6,952	3,244	1,846	975	227	297	190	17	34,882
Select white oaks[b]	13,844	11,430	8,441	5,402	5,138	3,473	2,569	1,506	1,622	219	53,644
Select red oaks[c]	6,277	4,740	3,847	2,190	1,982	1,303	925	721	1,043	271	23,299
Chestnut oak (and post)	4,322	4,364	3,909	3,844	2,233	1,502	641	422	426	57	21,720
Other red oaks[d]	8,652	6,835	5,411	4,038	3,252	2,041	1,770	1,042	1,502	186	34,729
Black locust	6,880	3,894	3,071	978	570	289	113	-	49	12	15,856
Elm	26,139	10,742	5,359	2,076	926	284	296	144	150	-	46,116
Other hardwoods	27,567	10,821	6,769	3,387	1,987	1,115	701	395	513	78	53,333
Total hardwoods	219,423	142,722	95,019	53,432	34,362	20,937	12,865	7,822	9,150	1,357	597,089
Total, all species	239,840	153,925	101,523	56,601	35,592	21,309	12,907	7,891	9,161	1,357	640,106

[a]Includes red and silver maple.
[b]Includes white, swamp white, bur, and chinkapin oak.
[c]Entirely northern red oak.
[d]Includes scarlet, shingle, pin, and black oak.

Table 17.--Net volume of timber on commercial forest land by class of timber, softwoods and hardwoods, Ohio, 1979

Class of timber	Softwoods	Hardwoods	All species	Sampling error of total
	Million cubic feet			Percent
Sawtimber trees:				
Sawlog portion	146.2	3,232.2	3,378.4	2
Upper-stem portion	22.3	725.9	748.2	2
All sawtimber trees	168.5	3,958.1	4,126.6	2
Poletimber trees	106.4	2,161.3	2,267.7	3
All growing stock trees	274.9	6,119.4	6,394.3	1
Rough trees	10.1	396.4	406.5	5
Rotten trees	.9	95.9	96.8	12
Total, all timber	285.9	6,611.7	6,897.6	1.2

Table 18.-- Net volume of timber on commercial forest land by geographic unit and class of timber, Ohio, 1979

Geographic unit	Growing-stock trees			Rough trees	Rotten trees	All trees	Sampling error[a]
	Poletimber	Sawtimber	Total				
	Million cubic feet						Percent
South-Central	624.3	1,261.3	1,885.6	79.8	27.1	1,992.5	2.3
Southeastern	400.1	723.0	1,123.1	69.4	10.7	1,203.2	2.2
East-Central	464.9	727.7	1,192.6	102.7	21.0	1,316.3	2.6
Northeastern	424.0	637.8	1,061.8	84.0	24.7	1,170.5	3.2
Southwestern	138.5	346.0	484.5	32.0	7.8	524.3	6.0
Northwestern	215.9	430.8	646.7	38.6	5.5	690.8	5.9
Total	2,267.7	4,126.6	6,394.3	406.5	96.8	6,897.6	1.2

[a]For volume of all trees.

Table 19.--Net volume of growing stock and sawtimber on commercial forest land by geographic unit and stand-size class, Ohio, 1979

Geographic unit	Sawtimber stands	Poletimber stands	Sapling-seedling stands	Nonstocked areas	All classes	Sampling error of total
			GROWING STOCK			
			Million cubic feet			Percent
South-Central	1,297.3	420.4	167.1	0.8	1,885.6	2.3
Southeastern	736.0	265.8	120.7	.6	1,123.1	2.2
East-Central	729.6	307.2	155.3	.5	1,192.6	2.7
Northeastern	634.3	314.5	111.7	1.3	1,061.8	3.2
Southwestern	350.3	92.9	39.1	2.2	484.5	6.1
Northwestern	460.1	149.8	36.8	-	646.7	6.1
Total	4,207.6	1,550.6	630.7	5.4	6,394.3	1.3
Sampling error of total (percent)	3	7	8	51	1.3	
			SAWTIMBER			
			Million board feet[a]			Percent
South-Central	4,811.6	798.4	353.6	3.1	5,966.7	2.9
Southeastern	3,002.9	572.7	257.3	-	3,832.9	2.9
East-Central	2,612.0	628.2	382.4	-	3,622.6	3.2
Northeastern	2,301.3	527.6	205.0	-	3,033.9	4.5
Southwestern	1,412.5	172.8	103.0	-	1,688.3	7.9
Northwestern	1,938.4	266.7	66.4	-	2,271.5	8.0
Total	16,078.7	2,966.4	1,367.7	3.1	20,415.9	1.7
Sampling error of total (percent)	2	9	10	101	1.7	

[a] International 1/4-inch rule.

Table 20.--Net volume of growing stock and sawtimber on commercial forest land by geographic unit and ownership class, Ohio, 1979

Geographic unit	National Forest	Other public	Corporate[a]	Other private[b]	Total
			GROWING STOCK (Million cubic feet)		
South-Central	88.3	217.8	125.1	1,454.4	1,885.6
Southeastern	101.3	44.4	120.4	857.0	1,123.1
East-Central	16.6	28.3	145.6	1,002.1	1,192.6
Northeastern	-	26.7	93.2	941.9	1,061.8
Southwestern	-	1.5	22.0	461.0	484.5
Northwestern	-	18.1	20.2	608.4	646.7
Total	206.2	336.8	526.5	5,324.8	6,394.3
			SAWTIMBER (Million board feet)[c]		
South-Central	279.6	878.9	327.3	4,480.9	5,966.7
Southeastern	321.0	217.7	434.6	2,859.6	3,832.9
East-Central	52.5	38.0	433.2	3,098.9	3,622.6
Northeastern	-	94.3	236.7	2,702.9	3,033.9
Southwestern	-	6.6	82.7	1,599.0	1,688.3
Northwestern	-	85.7	69.3	2,116.5	2,271.5
Total	653.1	1,321.2	1,583.8	16,857.8	20,415.9

[a]Includes all forest industry lands.
[b]Includes all farmer owned lands.
[c]International 1/4-inch rule.

Table 21.--Net volume of growing stock and sawtimber on commercial forest land by forest-type group, softwoods, and hardwoods, Ohio, 1979

Forest-type group	Growing stock			Sawtimber		
	Softwoods	Hardwoods	All species	Softwoods	Hardwoods	All species
	Million cubic feet			Million board feet[a]		
White/red pine group	72.7	32.6	105.3	183.1	86.3	269.4
Hard pine group	106.9	25.6	132.5	350.0	72.7	422.7
Oak/pine group	6.5	5.6	12.1	16.5	13.3	29.8
Oak/hickory group	71.2	4,156.8	4,228.0	283.1	13,691.4	13,974.5
Elm/ash/red maple group	6.2	507.3	513.5	24.1	1,414.1	1,438.2
Northern hardwoods group	11.4	1,350.7	1,362.1	29.5	4,188.2	4,217.7
Aspen/birch group	-	40.8	40.8	-	63.6	63.6
Total	274.9	6,119.4	6,394.3	886.3	19,529.6	20,415.9

[a]International 1/4-inch rule.

Table 22.--Net volume of growing stock and sawtimber on commercial forest land by forest-type group and geographic unit, Ohio, 1979

Forest-type group	South-Central	South-eastern	East-Central	North-eastern	South-western	North-western	Total
			GROWING STOCK (Million cubic feet)				
White/red pine group	-	10.3	67.8	12.1	2.1	13.0	105.3
Hard pine group	65.7	55.6	-	-	11.2	-	132.5
Oak/pine group	6.7	5.4	-	-	-	-	12.1
Oak/hickory group	1,559.0	916.9	765.2	387.4	249.1	350.4	4,228.0
Elm/ash/red maple group	60.3	43.8	86.9	113.4	94.2	114.9	513.5
Northern hardwoods group	193.9	91.1	237.7	543.1	127.9	168.4	1,362.1
Aspen/birch group	-	-	35.0	5.8	-	-	40.8
Total	1,885.6	1,123.1	1,192.6	1,061.8	484.5	646.7	6,394.3
			SAWTIMBER (Million board feet)[a]				
White/red pine group	-	7.6	216.2	24.8	3.1	17.7	269.4
Hard pine group	190.6	182.1	-	-	50.0	-	422.7
Oak/pine group	19.2	10.6	-	-	-	-	29.8
Oak/hickory group	4,922.5	3,278.1	2,358.9	1,233.9	938.7	1,242.4	13,974.5
Elm/ash/red maple group	151.6	118.0	235.8	299.1	243.0	390.7	1,438.2
Northern hardwoods group	682.8	236.5	748.1	1,476.1	453.5	620.7	4,217.7
Aspen/birch group	-	-	63.6	-	-	-	63.6
Total	5,966.7	3,832.9	3,622.6	3,033.9	1,688.3	2,271.5	20,415.9

[a] International 1/4-inch rule.

Table 23.-- Net volume of growing stock on commercial forest land by species and diameter class, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	2.1	1.4	1.6	2.4	0.4	-	-	0.7	-	-	8.6
White and red pine	12.8	24.0	17.4	16.6	3.3	2.2	-	-	-	-	76.3
Virginia pine	12.7	23.5	28.0	14.4	9.3	2.9	0.8	.9	-	-	92.5
Other softwoods	17.9	12.0	22.8	17.3	16.2	7.3	.7	2.3	1.0	-	97.5
Total softwoods	45.5	60.9	69.8	50.7	29.2	12.4	1.5	3.9	1.0	-	274.9
Soft maples[a]	53.8	69.8	63.5	45.7	33.4	25.0	19.9	12.9	27.6	12.9	364.5
Hard maples	37.9	58.6	75.2	71.1	53.0	49.1	36.4	31.0	29.5	7.1	448.9
Hickory	47.0	100.6	113.4	97.1	87.2	64.3	40.4	26.1	27.7	.9	604.7
Beech	9.0	18.8	26.9	33.4	17.1	17.8	13.3	21.1	50.0	15.5	222.9
White ash	40.0	66.4	79.3	60.4	63.5	44.6	47.0	20.4	33.3	9.1	464.0
Black walnut	6.1	21.3	25.6	17.2	19.6	15.1	6.6	6.8	2.2	-	120.5
Yellow-poplar	22.5	47.9	67.8	72.3	61.8	68.8	47.3	31.3	62.1	7.4	489.2
Sycamore	3.7	8.7	18.7	17.1	12.1	11.1	9.5	11.0	16.7	11.2	119.8
Aspen	26.3	41.8	32.6	31.6	15.5	9.9	4.0	.9	10.9	14.3	187.8
Black cherry	23.7	49.7	65.4	45.7	39.6	27.4	8.5	13.1	11.9	1.9	286.9
Select white oaks[b]	28.0	64.0	80.9	83.6	114.0	109.7	102.8	71.1	113.3	28.4	795.8
Select red oaks[c]	15.4	27.2	37.0	33.7	43.6	39.6	34.9	32.2	73.8	40.1	377.5
Chestnut oak (and post)	10.7	27.6	41.4	61.2	51.1	48.1	25.9	21.0	30.9	8.6	326.5
Other red oaks[d]	18.2	38.8	53.9	62.5	70.1	62.1	68.9	52.1	105.3	28.7	560.6
Black locust	15.1	21.2	29.4	14.8	11.7	7.4	4.0	-	2.7	1.1	107.4
Elm	52.8	53.9	49.4	31.3	20.1	9.1	12.1	7.3	12.9	-	248.9
Other hardwoods	55.0	53.9	65.5	52.9	42.4	33.3	24.4	19.9	34.1	12.1	393.5
Total hardwoods	465.2	770.2	925.9	831.6	755.8	642.4	505.9	378.2	644.9	199.3	6,119.4
Total, all species	510.7	831.1	995.7	882.3	785.0	654.8	507.4	382.1	645.9	199.3	6,394.3

[a] Includes red and silver maple.
[b] Includes white, swamp white, bur, and chinkapin oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, pin, and black oak.

Table 24.-- Net volume of sawtimber on commercial forest land by species and diameter class, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	8.5	10.6	2.0	-	-	3.1	-	-	24.2
White and red pine	83.2	92.1	15.7	9.9	-	-	-	-	200.9
Virginia pine	140.2	79.3	51.0	15.7	4.3	5.1	-	-	295.6
Other softwoods	116.0	94.7	88.4	42.7	3.8	13.7	6.3	-	365.6
Total softwoods	347.9	276.7	157.1	68.3	8.1	21.9	6.3	-	886.3
Soft maples[b]	-	212.1	167.4	126.1	106.4	61.6	144.1	59.7	877.4
Hard maples	-	303.0	256.0	244.2	187.7	153.1	143.6	34.2	1,321.8
Hickory	-	422.6	438.1	330.9	213.0	138.0	143.4	4.9	1,690.9
Beech	-	169.9	96.0	96.8	67.7	114.5	273.0	84.8	902.7
White ash	-	246.8	295.7	219.0	232.6	101.4	169.7	42.1	1,307.3
Black walnut	-	74.7	97.3	67.7	34.3	29.2	10.1	-	313.3
Yellow-poplar	-	337.8	331.6	379.2	252.9	170.6	336.7	42.1	1,850.9
Sycamore	-	74.1	60.4	56.5	47.1	55.5	82.2	53.7	429.5
Aspen	-	142.1	82.6	52.4	21.4	4.7	54.7	86.0	443.9
Black cherry	-	187.7	184.8	126.8	43.0	63.4	53.4	10.3	669.4
Select white oaks[c]	-	370.1	546.1	562.9	533.3	353.4	577.1	135.8	3,078.7
Select red oaks[d]	-	159.4	228.9	219.6	182.6	179.2	389.2	211.0	1,569.9
Chestnut oak (and post)	-	266.7	241.3	238.2	124.7	97.4	156.5	42.2	1,167.0
Other red oaks[e]	-	270.3	349.5	313.9	368.7	269.9	562.9	148.2	2,283.4
Black locust	-	66.8	52.5	32.8	20.6	-	12.4	4.4	189.5
Elm	-	135.4	92.6	42.2	58.9	34.4	62.1	-	425.6
Other hardwoods	-	206.4	190.5	160.3	119.0	95.1	181.6	55.5	1,008.4
Total hardwoods	-	3,645.9	3,711.3	3,269.5	2,613.9	1,921.4	3,352.7	1,014.9	19,529.6
Total, all species	347.9	3,922.6	3,868.4	3,337.8	2,622.0	1,943.3	3,359.0	1,014.9	20,415.9

[a] International 1/4-inch rule.
[b] Includes red and silver maple.
[c] Includes white, swamp white, bur, and chinkapin oak.
[d] Entirely northern red oak.
[e] Includes scarlet, shingle, pin, and black oak.

Table 25.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	24.2
White and red pine	2.0	7.9	148.1	42.9	200.9
Virginia pine	6.0	30.1	259.5	-	295.6
Other softwood	-	-	-	-	365.6
Total softwoods	8.0	38.0	407.6	42.9	886.3
Soft maples	54.6	158.2	410.3	254.3	877.4
Hard maples	127.7	290.5	686.5	217.1	1,321.8
Hickory	124.1	386.6	750.7	429.5	1,690.9
Beech	51.6	111.0	407.6	332.5	902.7
White ash	227.1	395.5	506.7	178.0	1,307.3
Black walnut	21.5	91.8	154.3	45.7	313.3
Yellow-poplar	350.8	378.3	787.7	334.1	1,850.9
Sycamore	68.5	103.8	204.1	53.1	429.5
Aspen	57.6	58.4	201.5	126.4	443.9
Black cherry	60.5	99.2	357.1	152.6	669.4
Select white oaks	574.1	737.7	1,129.4	637.5	3,078.7
Select red oaks	419.6	405.8	564.5	180.0	1,569.9
Chestnut oak (and post)	221.1	270.2	526.0	149.7	1,167.0
Other red oaks	337.9	500.9	752.2	692.4	2,283.4
Black locust	5.1	27.8	110.5	46.1	189.5
Elm	53.5	71.1	210.2	90.8	425.6
Other hardwoods	141.1	218.5	507.5	141.3	1,008.4
Total hardwoods	2,896.4	4,305.3	8,266.8	4,061.1	19,529.6
Percent of hardwood in each grade	15	22	42	21	100
Hardwood sampling error (in percent)	4	3	2	3	1.8

[a] International 1/4-inch rule.
[b] Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c] These species are not divided into standard-lumber grades.

Table 26.--Sampling errors for major number of trees and timber-volume classes, Ohio, 1979

(In percent)

Item	Number of trees (Table 16)	Growing-stock volume (Table 23)	Sawtimber volume (Table 24)
Species			
Eastern red cedar	39	32	36
White and red pine	30	27	32
Virginia pine	23	23	26
Other softwoods	28	21	24
Soft maples	8	8	11
Hard maples	8	8	10
Hickory	7	6	8
Beech	15	11	11
White ash	8	7	8
Black walnut	11	9	12
Yellow-poplar	10	8	9
Sycamore	16	14	16
Aspen	15	14	19
Black cherry	9	8	10
Select white oaks	8	7	7
Select red oaks	9	8	9
Chestnut oak (and post)	9	12	12
Other red oaks	9	8	8
Black locust	15	15	22
Elm	10	9	15
Other hardwoods	8	8	9
Dbh class (inches)			
5.0 to 6.9	4	5	-
7.0 to 8.9	4	4	-
9.0 to 10.9	3	4	18
11.0 to 12.9	4	4	4
13.0 to 14.9	4	4	3
15.0 to 16.9	5	4	4
17.0 to 18.9	5	5	4
19.0 to 20.9	6	5	5
21.0 to 28.9	6	6	5
29.0+	9	16	9

Table 27.--Components of average annual net change of growing stock and sawtimber on commercial forest land, by softwoods and hardwoods, Ohio, 1968-1978

Component	Softwoods	Hardwoods	All species
	GROWING STOCK (Million cubic feet)		
Accretion[a]	11.1	248.8	259.9
Ingrowth[b]	8.4	76.8	85.2
Gross growth	19.5	325.6	345.1
Cull increment	1.1	17.5	18.6
Mortality	1.9	46.0	47.9
Net growth	16.5	262.1	278.6
Removals	2.1	88.5	90.6
Inventory change	14.4	173.6	188.0
	SAWTIMBER (Million board feet)[c]		
Accretion	8.3	552.0	560.3
Ingrowth	61.4	707.3	768.7
Gross growth	69.7	1,259.3	1,329.0
Cull increment	3.0	83.8	86.8
Mortality	9.9	222.8	232.7
Net growth	56.8	952.7	1,009.5
Removals	7.2	402.3	409.5
Inventory change	49.6	550.4	600.0

[a]Growth on initial growing stock inventory including trees that were subsequently cut.
[b]Volume of trees that became 5.0 inches dbh or larger during the period between inventories.
[c]International 1/4-inch rule.

Table 28.--Annual net growth, removals, and mortality of growing stock and sawtimber on commercial forest land, by species, Ohio, 1978

Species	Growing stock			Sawtimber		
	Net growth	Timber removals	Mortality	Net growth	Timber removals	Mortality
	Million cubic feet			Million board feet[a]		
Total softwoods	25.0	4.5	3.0	80.9	7.2	14.2
Soft maple	17.4	3.7	.6	30.0	16.7	2.1
Hard maple	27.0	4.4	1.4	85.3	21.8	5.5
Hickory	17.7	7.7	2.8	80.7	26.5	13.5
Beech	11.3	4.4	.9	45.5	29.1	6.4
Yellow poplar	30.6	6.6	.5	131.9	37.9	1.0
Select white oaks	31.4	13.6	3.4	153.8	66.1	18.3
Select red oaks	12.7	7.7	1.4	79.2	38.5	10.1
Chestnut and post oak	13.2	6.9	3.5	67.4	28.4	15.2
Other red oaks	25.6	14.7	3.9	135.7	68.9	28.4
Ash, black cherry, black walnut	47.9	7.8	7.1	133.3	30.5	19.9
Other hardwoods	54.7	9.5	26.1	97.2	37.9	123.8
Total hardwoods	289.5	87.0	51.6	1,040.0	402.3	244.2
Total, all species	314.5	91.5	54.6	1,120.9	409.5	258.4

[a]International 1/4-inch rule.

Table 29.--Output of timber products, by source of material, softwoods and hardwoods, Ohio, 1978[a]

Product and species group	Standard units	Output from roundwood		Output from manufacturing residues		Total output	
		Number of units	Thousand cubic feet	Number of units	Thousand cubic feet	Number of units	Thousand cubic feet
Sawlogs							
Softwood	Mbf[b]	5,696	877	-	-	5,696	877
Hardwood	Mbf	316,117	46,398	-	-	316,117	46,398
Total	Mbf	321,813	47,275	-	-	321,813	47,275
Veneer logs and bolts							
Softwood	Mbf	-	-	-	-	-	-
Hardwood	Mbf	7,716	1,133	-	-	7,716	1,133
Total	Mbf	7,716	1,133	-	-	7,716	1,133
Pulpwood							
Softwood	Std cords[c]	4,422	374	300	26	4,722	400
Hardwood	Std cords	247,424	21,029	119,500	10,158	366,924	31,187
Total	Std cords	251,846	21,403	119,800	10,184	371,646	31,587
Cooperage logs and bolts							
Softwood	Mbf	-	-	-	-	-	-
Hardwood	Mbf	7,037	1,033	-	-	7,037	1,033
Total	Mbf	7,037	1,033	-	-	7,037	1,033
Posts (round and split)							
Softwood	M pieces	1,302	814			1,302	814
Hardwood	M pieces	-	-	-	-	-	-
Total	M pieces	1,302	814	-	-	1,302	814
Mine timbers (round)							
Softwood	Mft^3	83	83	-	-	83	83
Hardwood	Mft^3	927	927	-	-	927	927
Total	Mft^3	1,010	1,010	-	-	1,010	1,010
Other[d]							
Softwood	Mft^3		66		12		78
Hardwood	Mft^3		1,312		4,138		5,450
Total	Mft^3		1,378		4,150		5,528

Table 29.-- continued

Product and species group	Standard units	Output from roundwood		Output from manufacturing residues		Total output	
		Number of units	Thousand cubic feet	Number of units	Thousand cubic feet	Number of units	Thousand cubic feet
Total industrial products							
Softwood	Mft^3		2,214		38		2,252
Hardwood	Mft^3		71,832		14,296		86,128
Total	Mft^3		74,046		14,334		88,380
Fuelwood							
Softwood	std cords[e]	-	-	1,263	101	1,263	101
Hardwood	std cords	169,703	13,576	74,737	5,979	244,440	19,555
Total	std cords	169,703	13,576	76,000	6,080	245,703	19,656
All products[f]							
Softwood	Mft^3		2,214		139		2,353
Hardwood	Mft^3		85,408		20,275		105,683
Total	Mft^3		87,622		20,414		108,026

[a]Source of data: Nevel and Redett, 1980.
[b]International 1/4-inch rule.
[c]Rough wood basis, includes both production from roundwood and chips from manufacturing residues, equivalent to 85 ft^3 of solid wood.
[d]Includes guardrails, handle stock, metallurgical wood and wood fiber products.
[e]Rough wood basis, includes both production from roundwood and chips from manufacturing residues, equivalent to 80 ft^3 of solid wood.
[f]Does not include 140,000 cubic feet of softwood and 6,792,000 cubic feet of hardwood residues used for livestock bedding and farm and horticultural mulch.

Table 30.--Output of roundwood products, softwoods and hardwoods, Ohio, 1978[a]

(In thousands of cubic feet)

Product and species group	Growing-stock trees[b]			Rough and rotten trees[b]	Salvable dead trees[b]	Other sources[c]	All sources
	Poletimber	Sawtimber	Total				
			PRINCIPAL INDUSTRIAL PRODUCTS				
Sawlogs							
Softwood	-	814	814	-	-	63	877
Hardwood	270	41,463	41,733	1,163	647	2,855	46,398
Total	270	42,277	42,547	1,163	647	2,918	47,275
Veneer logs and bolts							
Softwood	-	-	-	-	-	-	-
Hardwood	7	1,054	1,061	-	-	72	1,133
Total	7	1,054	1,061	-	-	72	1,133
Pulpwood							
Softwood	150	181	331	-	24	19	374
Hardwood	6,368	10,952	17,320	318	342	3,049	21,029
Total	6,518	11,133	17,651	318	366	3,068	21,403
			MISCELLANEOUS INDUSTRIAL PRODUCTS				
Cooperage logs and bolts							
Softwood	-	-	-	-	-	-	-
Hardwood	6	961	967	-	-	66	1,033
Total	6	961	967	-	-	66	1,033
Piling							
Softwood	-	1	1	-	-	-	1
Hardwood	-	1	1	-	-	-	1
Total	-	2	2	-	-	-	2
Poles							
Softwood	1	3	4	-	-	1	5
Hardwood	2	3	5	-	-	1	6
Total	3	6	9	-	-	2	11
Posts (round and split)							
Softwood	247	424	671	12	13	118	814
Hardwood	-	-	-	-	-	-	-
Total	247	424	671	12	13	118	814
Mine timbers (round)							
Softwood	-	77	77	-	-	6	83
Hardwood	281	483	764	14	15	134	927
Total	281	560	841	14	15	140	1,010
Other							
Softwood	18	31	49	1	1	9	60
Hardwood	395	680	1,075	20	21	189	1,305
Total	413	711	1,124	21	22	198	1,365

Table 30.-- continued

(In thousands of cubic feet)

Product and species group	Growing-stock trees[b]			Rough and rotten trees[b]	Salvable dead trees[b]	Other sources[c]	All sources
	Poletimber	Sawtimber	Total				
			TOTAL INDUSTRIAL PRODUCTS				
Softwood	416	1,531	1,947	13	38	216	2,214
Hardwood	7,329	55,597	62,926	1,515	1,025	6,366	71,832
Total	7,745	57,128	64,873	1,528	1,063	6,582	74,046
			NONINDUSTRIAL PRODUCTS				
Fuelwood[c]							
Softwood	-	-	-	-	-	-	-
Hardwood	1,979	3,404	5,383	e	4,419	3,774	13,576
Total	1,979	3,404	5,383	e	4,419	3,774	13,576
			ALL PRODUCTS				
Softwood	416	1,531	1,947	13	38	216	2,214
Hardwood	9,308	59,001	68,309	1,515	5,444	10,140	85,408
Total	9,724	60,532	70,256	1,528	5,482	10,356	87,622

[a]Source of data: Nevel and Redett, 1980.
[b]On commercial forest land.
[c]Includes trees less than 5.0 inches in diameter, tree tops and limbs from commercial forest areas, o any material from noncommercial forest land or nonforest land such as fence rows and suburban areas.
[d]Source of roundwood products from personal communication with Paul Wheeling, Economic and Statistic Service, Broomall, Pa., 1981.
[e]Included under salvable dead trees.

Table 31.--Timber removals from growing stock and sawtimber on commercial forest land, by item, softwoods and hardwoods, Ohio, 1978[a]

Item	Growing stock			Sawtimber		
	Softwoods	Hardwoods	All species	Softwoods	Hardwoods	All species
	--------Thousand cubic feet--------			------Thousand board feet[b]------		
Roundwood products:						
Sawlogs	814	41,733	42,547	3,725	219,292	223,017
Veneer logs and bolts	-	1,061	1,061	-	5,574	5,574
Pulpwood	331	17,320	17,651	1,223	65,342	66,565
Cooperage logs and bolts	-	967	967	-	5,083	5,083
Piling	1	1	2	4	4	8
Poles	4	5	9	11	11	22
Posts	671	-	671	1,600	-	1,600
Mine timbers	77	764	841	352	2,555	2,907
Other	49	1,075	1,124	117	2,565	2,682
Fuelwood	-	5,383	5,383	-	20,308	20,308
All products	1,947	68,309	70,256	7,032	320,734	327,766
Logging residues	110	13,631	13,741	89	47,132	47,221
Land clearing[c]	24	3,199	3,223	86	14,612	14,698
Land reclassification	-	4,328	4,328	-	19,768	19,768
Total removals	2,081	89,467	91,548	7,207	402,246	409,453

[a]Source of data: Nevel and Redett, 1980.
[b]International 1/4-inch rule.
[c]Unused portion.

Table 32.--Volume of unused residues from primary manufacturing plants, by industry and type of residue, softwoods and hardwoods, Ohio, 1978[a]

(In thousands of cubic feet)

Species group and type of residue	Lumber	Veneer and plywood	Other[b]	All industries
Softwoods				
Coarse	4	-	-	4
Fine	19	-	-	19
Total	23	-	-	23
Hardwoods				
Coarse	922	-	375	1,297
Fine	2,921	-	149	3,070
Total	3,843	-	524	4,367
All species				
Coarse	926	-	375	1,301
Fine	2,940	-	149	3,089
Total	3,866	-	524	4,390

[a]Source of data: Nevel and Redett, 1980.
[b]Includes 83,000 cubic feet of cooperage residues.

Table 33.--Number of growing-stock trees on commercial forest land by species and diameter class, South-Central Unit, Ohio, 1979
(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	1,122	275	235	175	30	-	-	13	-	-	1,850
White and red pine	3	34	20	31	-	-	-	-	-	-	88
Virginia pine	2,242	1,677	809	258	214	57	-	14	-	-	5,271
Other softwoods	2,789	939	991	553	301	123	2	-	1	-	5,699
Total softwoods	6,156	2,925	2,055	1,017	545	180	2	27	1	-	12,908
Soft maples[a]	4,862	2,762	1,602	519	466	254	104	43	34	-	10,646
Hard maples	4,614	3,546	2,192	1,599	692	561	257	139	143	18	13,761
Hickory	6,130	4,950	2,994	1,790	919	796	307	123	94	5	18,108
Beech	716	503	301	276	140	3	4	33	112	8	2,096
White ash	2,930	2,245	1,199	790	423	193	259	46	82	5	8,172
Black walnut	142	504	737	240	140	101	35	24	-	-	1,923
Yellow-poplar	3,611	1,605	1,720	1,296	717	661	439	287	272	14	10,622
Sycamore	458	316	371	289	122	80	84	32	37	10	1,799
Aspen	1,513	69	-	73	-	-	-	-	-	5	1,660
Black cherry	1,022	861	139	197	170	89	41	20	-	8	2,547
Select white oaks[b]	5,824	4,736	3,451	2,020	2,152	1,658	822	405	376	29	21,473
Select red oaks[c]	1,245	880	916	416	430	291	260	114	242	92	4,886
Chestnut oak (and post)	2,755	3,529	2,394	2,276	1,373	849	383	272	233	32	14,096
Other red oaks[d]	3,204	1,741	1,569	1,567	1,021	899	490	325	353	31	11,200
Black locust	1,396	546	421	29	81	62	18	-	11	-	2,564
Elm	2,669	1,960	1,005	302	93	35	46	42	37	-	6,189
Other hardwoods	9,092	3,549	1,940	852	535	356	152	72	126	15	16,689
Total hardwoods	52,183	34,302	22,951	14,531	9,474	6,888	3,701	1,977	2,152	272	148,431
Total all species	58,339	37,227	25,006	15,548	10,019	7,068	3,703	2,004	2,153	272	161,339

[a] Includes red and silver maple.
[b] Includes white, swamp white, bur, and chinkapin oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, pin, and black oak.

Table 34.-- Net volume of growing stock on commercial forest land by species and diameter class, South-Central Unit, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	2.1	1.4	1.6	2.4	0.4	-	-	0.7	-	-	8.6
White and red pine	-	.2	.2	.5	-	-	-	-	-	-	.9
Virginia pine	7.3	11.9	10.7	4.5	5.2	2.0	-	.9	-	-	42.5
Other softwoods	6.0	7.8	13.2	10.9	9.1	4.7	0.1	-	0.1	-	51.9
Total softwoods	15.4	21.3	25.7	18.3	14.7	6.7	0.1	1.6	0.1	-	103.9
Soft maples[a]	11.4	17.2	15.9	9.3	11.3	8.3	3.9	2.0	2.7	-	82.0
Hard maples	10.1	20.0	22.6	28.0	17.3	19.3	11.6	7.8	10.0	2.4	149.1
Hickory	13.9	32.3	33.0	31.6	23.3	26.2	13.1	6.9	8.2	.9	189.4
Beech	1.8	2.8	3.3	4.7	3.2	.1	.2	2.4	9.2	1.3	29.0
White ash	7.6	14.1	13.1	13.3	10.8	7.0	11.5	2.0	5.5	.6	85.5
Black walnut	.2	3.7	8.1	4.0	3.4	3.4	1.3	1.1	-	-	25.2
Yellow-poplar	9.7	11.3	21.2	26.1	20.5	24.9	21.7	17.1	23.1	2.2	177.8
Sycamore	1.0	2.2	4.1	5.0	3.0	3.2	3.8	1.4	3.0	2.6	29.3
Aspen	4.0	.6	-	1.0	-	-	-	-	-	.9	6.5
Black cherry	2.4	5.7	1.4	2.7	4.4	3.3	1.7	1.5	-	1.0	24.1
Select white oaks[b]	12.7	28.8	36.6	34.5	50.8	55.3	35.2	21.1	28.0	4.1	307.1
Select red oaks[c]	3.2	6.2	9.8	7.0	10.8	10.2	11.4	6.1	19.2	15.1	99.0
Chestnut oak (and post)	7.0	22.8	27.3	38.5	33.1	28.1	15.3	13.8	16.3	4.0	206.2
Other red oaks[d]	6.7	12.3	18.3	26.0	25.5	29.3	21.0	18.0	26.9	4.8	188.8
Black locust	3.0	3.1	4.4	.4	1.9	1.6	.4	-	.6	-	15.4
Elm	7.0	11.5	11.3	4.6	2.7	1.0	1.9	2.1	3.2	-	45.3
Other hardwoods	21.4	20.5	19.0	14.3	12.8	11.3	6.3	4.2	9.7	2.5	122.0
Total hardwoods	123.1	215.1	249.4	251.0	234.8	232.5	160.3	107.5	165.6	42.4	1,781.7
Total, all species	138.5	236.4	275.1	269.3	249.5	239.2	160.4	109.1	165.7	42.4	1,885.6

[a] Includes red and silver maple.
[b] Includes white, swamp white, bur, and chinkapin oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, pin, and black oak.

Table 35.-- Net volume of sawtimber on commercial forest land by species and diameter class, South-Central Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	8.5	10.6	2.0	-	-	3.1	-	-	24.2
White and red pine	.8	2.2	-	-	-	-	-	-	3.0
Virginia pine	56.4	24.5	29.0	10.4	-	5.1	-	-	125.4
Other softwoods	67.1	58.9	48.8	26.1	0.6	-	0.5	-	202.0
Total softwoods	132.8	96.2	79.8	36.5	0.6	8.2	0.5	-	354.6
Soft maples[b]	-	42.8	55.6	44.0	22.1	9.4	15.3	-	189.2
Hard maples	-	109.1	80.5	87.9	60.3	38.4	48.0	10.5	434.7
Hickory	-	129.8	114.3	127.7	58.6	35.0	43.7	4.9	514.0
Beech	-	18.2	19.0	.3	.7	14.2	46.0	5.9	104.3
White ash	-	51.1	49.9	36.0	54.4	10.7	25.1	3.8	231.0
Black walnut	-	17.9	15.8	16.2	5.9	3.4	-	-	59.2
Yellow-poplar	-	113.5	106.8	134.1	110.3	86.6	122.8	10.5	684.6
Sycamore	-	17.9	15.4	16.8	19.4	7.9	15.7	12.2	105.3
Aspen	-	4.7	-	-	-	-	-	2.4	7.1
Black cherry	-	11.4	23.4	17.1	9.4	10.9	-	5.5	77.7
Select white oaks[c]	-	143.0	239.6	267.2	175.2	94.8	132.6	14.5	1,066.9
Select red oaks[d]	-	31.7	53.4	51.9	56.8	32.0	92.6	76.0	394.4
Chestnut oak (and post)	-	157.9	153.0	129.5	70.3	59.5	74.3	17.6	662.1
Other red oaks[e]	-	103.9	125.6	144.7	107.4	88.3	135.0	22.3	727.2
Black locust	-	1.5	9.0	6.4	1.2	-	2.0	-	20.1
Elm	-	17.8	11.5	3.5	8.7	10.5	16.0	-	68.0
Other hardwoods	-	53.4	52.4	53.5	27.1	20.3	47.3	12.3	266.3
Total hardwoods	-	1,025.6	1,125.2	1,136.8	787.8	521.9	816.4	198.4	5,612.1
Total, all species	132.8	1,121.8	1,205.0	1,173.3	788.4	530.1	816.9	198.4	5,966.7

[a] International 1/4-inch rule.
[b] Includes red and silver maple.
[c] Includes white, swamp white, bur, and chinkapin oak.
[d] Entirely northern red oak.
[e] Includes scarlet, shingle, pin, and black oak.

Table 36.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, South-Central Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	24.2
White and red pine	-	-	2.3	0.7	3.0
Virginia pine	6.0	27.5	91.9	-	125.4
Other softwoods[c]	-	-	-	-	202.0
Total softwoods	6.0	27.5	94.2	0.7	354.6
Soft maples	4.0	46.1	99.9	39.2	189.2
Hard maples	45.7	86.8	242.5	59.7	434.7
Hickory	60.1	140.4	224.0	89.5	514.0
Beech	5.3	26.5	54.6	17.9	104.3
White ash	41.7	70.4	91.3	27.6	231.0
Black walnut	6.6	20.4	27.2	5.0	59.2
Yellow-poplar	183.1	145.8	270.9	84.8	684.6
Sycamore	16.8	20.0	58.5	10.0	105.3
Aspen	-	-	6.3	.8	7.1
Black cherry	12.4	10.2	39.4	15.7	77.7
Select white oaks	159.4	304.6	433.9	169.0	1,066.9
Select red oaks	111.9	114.7	133.8	34.0	394.4
Chestnut oak (and post)	116.4	148.9	311.6	85.2	662.1
Other red oaks	94.5	208.5	250.5	173.7	727.2
Black locust	-	5.1	11.8	3.2	20.1
Elm	17.2	18.5	22.7	9.6	68.0
Other hardwoods	49.2	62.1	121.0	34.0	266.3
Total hardwoods	924.3	1,429.0	2,399.9	858.9	5,612.1
Percent of hardwood in each grade	16	26	43	15	100
Hardwood sampling error (in percent)	8	5	4	5	3.0

[a]International 1/4-inch rule.
[b]Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c]These species are not divided into standard-lumber grades.

Table 37.--Sampling errors for major number of trees and timber-volume classes, South-Central Unit, Ohio, 1979

(In percent)

Item	Number of trees (Table 33)	Growing-stock volume (Table 34)	Sawtimber volume (Table 35)
Species			
Eastern red cedar	39	32	36
White and red pine	100	99	98
Virginia pine	40	35	38
Other softwoods	44	37	36
Soft maples	18	18	29
Hard maples	13	15	20
Hickory	12	11	15
Beech	25	23	28
White ash	15	15	19
Black walnut	24	20	27
Yellow-poplar	22	16	16
Sycamore	33	23	25
Aspen	76	54	59
Black cherry	27	25	34
Select white oaks	12	11	12
Select red oaks	17	13	14
Chestnut oak (and post)	19	16	17
Other red oaks	17	12	13
Black locust	29	27	37
Elm	20	18	28
Other hardwoods	15	15	23
Dbh class (inches)			
5.0 to 6.9	8	8	-
7.0 to 8.9	6	7	-
9.0 to 10.9	6	6	34
11.0 to 12.9	7	6	7
13.0 to 14.9	7	6	6
15.0 to 16.9	9	7	7
17.0 to 18.9	10	9	9
19.0 to 20.9	11	10	10
21.0 to 28.9	11	10	10
29.0+	21	21	21

Table 38.--Number of growing-stock trees on commercial forest land by species and diameter class, Southeastern Unit, Ohio, 1979
(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	1,328	949	134	44	-	-	-	-	-	-	2,455
Virginia pine	1,960	1,821	1,305	431	131	17	10	-	-	-	5,675
Other softwoods	3,719	607	783	352	252	80	16	-	1	-	5,810
Total softwoods	7,007	3,377	2,222	827	383	97	26	-	1	-	13,940
Soft maples[a]	3,936	1,347	723	233	154	87	42	3	9	7	6,541
Hard maples	2,504	1,386	635	506	288	199	94	91	11	6	5,720
Hickory	4,145	2,644	2,181	833	631	244	149	94	30	-	10,951
Beech	922	200	306	488	206	159	71	80	27	13	2,472
White ash	2,208	917	972	158	26	94	68	26	6	4	4,479
Black walnut	867	400	227	224	201	59	-	8	7	-	1,993
Yellow-poplar	2,646	2,584	1,767	1,070	826	626	211	123	165	22	10,040
Sycamore	669	211	499	142	116	47	26	45	23	4	1,782
Aspen	2,119	1,582	757	478	124	118	13	-	-	-	5,191
Black cherry	651	1,159	541	161	115	38	15	26	16	5	2,727
Select white oaks[b]	1,601	2,008	2,222	1,343	1,329	814	652	257	246	40	10,512
Select red oaks[c]	1,346	1,557	539	537	392	293	168	149	213	40	5,234
Chestnut oak	585	513	973	1,098	534	374	177	113	116	12	4,495
Other red oaks[d]	1,392	998	913	596	597	420	286	221	208	26	5,657
Black locust	655	275	287	155	44	57	14	-	-	-	1,487
Elm	2,392	1,693	986	187	216	-	68	23	7	-	5,572
Other hardwoods	5,611	1,901	2,227	672	379	240	85	55	39	-	11,209
Total hardwoods	34,249	21,375	16,755	8,881	6,178	3,869	2,139	1,314	1,123	179	96,062
Total, all species	41,256	24,752	18,977	9,708	6,561	3,966	2,165	1,314	1,124	179	110,002

[a]Includes red and silver maple.
[b]Includes white, bur, and chinkapin oak.
[c]Entirely northern red oak.
[d]Includes scarlet, shingle, and black oak.

Table 39.-- Net volume of growing stock on commercial forest land by species and diameter class, Southeastern Unit, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	2.8	4.5	1.4	0.6	-	-	-	-	-	-	9.3
Virginia pine	5.4	11.0	14.1	7.0	2.7	0.5	0.3	-	-	-	41.0
Other softwoods	7.0	2.9	8.5	6.0	5.7	2.6	.6	-	0.1	-	33.4
Total softwoods	15.2	18.4	24.0	13.6	8.4	3.1	0.9	-	0.1	-	83.7
Soft maples[a]	7.5	7.2	6.3	3.9	3.4	3.0	1.3	0.2	0.5	1.1	34.4
Hard maples	6.1	7.6	6.4	7.4	6.5	6.0	3.8	4.8	1.0	.8	50.4
Hickory	8.9	15.6	21.5	13.9	14.5	7.3	5.7	4.9	2.2	-	94.5
Beech	1.8	1.1	3.1	7.1	4.2	4.9	2.9	3.9	2.0	1.4	32.4
White ash	5.2	4.6	9.2	2.2	.5	3.1	2.8	1.2	.7	.6	30.1
Black walnut	1.2	2.1	2.3	3.3	4.0	1.8	-	.4	.4	-	15.5
Yellow-poplar	6.5	15.3	18.8	18.5	20.2	21.2	10.3	7.8	14.7	3.8	137.1
Sycamore	1.2	1.0	5.7	2.4	2.9	1.7	1.0	2.7	1.9	.3	20.8
Aspen	5.7	9.4	7.6	7.9	3.1	3.6	.7	-	-	-	38.0
Black cherry	1.7	6.5	5.0	2.1	2.7	1.2	.7	1.3	.9	.3	22.4
Select white oaks[b]	4.3	12.5	22.1	22.5	30.7	27.0	26.5	11.9	17.3	4.4	179.2
Select red oaks[c]	3.9	9.5	5.3	8.5	8.9	9.1	6.9	7.5	16.2	4.9	80.7
Chestnut oak	1.4	2.4	9.8	16.2	11.4	11.1	7.4	5.5	7.7	1.9	74.8
Other red oaks[d]	3.4	5.8	9.0	10.2	14.0	13.3	12.4	11.6	15.2	3.0	97.9
Black locust	1.4	1.6	2.9	2.4	1.0	1.3	.5	-	-	-	11.1
Elm	6.2	9.4	8.9	3.3	4.7	-	2.9	1.3	.8	-	37.5
Other hardwoods	12.2	10.8	21.6	11.4	9.4	7.6	3.5	3.2	2.9	-	82.6
Total hardwoods	78.6	122.4	165.5	143.2	142.1	123.2	89.3	68.2	84.4	22.5	1,039.4
Total, all species	93.8	140.8	189.5	156.8	150.5	126.3	90.2	68.2	84.5	22.5	1,123.1

[a] Includes red and silver maple.
[b] Includes white, bur, and chinkapin oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, and black oak.

Table 40.-- Net volume of sawtimber on commercial forest land by species and diameter class, Southeastern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-
White and red pine	6.3	2.4	-	-	-	-	-	-	8.7
Virginia pine	67.8	38.7	14.5	3.4	1.8	-	-	-	126.2
Other softwoods	45.0	34.1	32.7	16.5	3.1	-	0.6	-	132.0
Total softwoods	119.1	75.2	47.2	19.9	4.9	-	0.6	-	266.9
Soft maples[b]	-	21.5	19.8	17.0	7.1	0.8	2.8	7.1	76.1
Hard maples	-	33.3	34.7	32.7	18.9	25.3	4.8	2.5	152.2
Hickory	-	65.0	72.4	41.7	32.9	28.1	12.1	-	252.2
Beech	-	37.1	25.9	27.2	14.6	21.9	11.7	7.7	146.1
White ash	-	12.2	1.8	15.5	13.7	5.2	1.7	3.3	53.4
Black walnut	-	15.7	24.2	8.5	-	1.5	2.8	-	52.7
Yellow-poplar	-	91.1	112.0	122.6	57.5	46.9	88.4	23.6	542.1
Sycamore	-	13.7	15.6	8.0	5.7	15.1	9.6	1.8	69.5
Aspen	-	36.1	18.5	19.5	4.2	-	-	-	78.3
Black cherry	-	8.4	14.0	4.7	3.4	6.1	5.1	1.9	43.6
Select white oaks[c]	-	104.0	161.4	152.9	144.2	66.2	93.5	24.5	746.7
Select red oaks[d]	-	39.7	49.8	51.2	37.0	46.1	91.8	25.3	340.9
Chestnut oak	-	78.3	58.6	64.5	39.4	30.4	43.8	9.3	324.3
Other red oaks[e]	-	52.0	73.5	71.1	69.9	60.0	85.1	15.4	427.0
Black locust	-	10.0	4.6	6.9	2.4	-	-	-	23.9
Elm	-	14.1	22.8	-	14.8	5.2	3.5	-	60.4
Other hardwoods	-	43.9	43.9	37.5	19.8	16.3	15.2	-	176.6
Total hardwoods	-	676.1	753.5	681.5	485.5	375.1	471.9	122.4	3,566.0
Total, all species	119.1	751.3	800.7	701.4	490.4	375.1	472.5	122.4	3,832.9

[a] International 1/4-inch rule.
[b] Includes red and silver maple.
[d] Entirely northern red oak.
[e] Includes scarlet, shingle, and black oak.

Table 41.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, Southeastern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	-
White and red pine	-	-	6.5	2.2	8.7
Virginia pine	-	-	126.2	-	126.2
Other softwoods[c]	-	-	-	-	132.0
Total softwoods	-	-	132.7	2.2	266.9
Soft maples	8.4	14.4	39.6	13.7	76.1
Hard maples	10.1	39.4	78.4	24.3	152.2
Hickory	18.5	57.9	113.3	62.5	252.2
Beech	1.8	18.4	78.9	47.0	146.1
White ash	6.7	13.6	23.7	9.4	53.4
Black walnut	-	19.5	26.5	6.7	52.7
Yellow-poplar	68.4	113.8	246.1	113.8	542.1
Sycamore	10.3	18.8	31.2	9.2	69.5
Aspen	-	14.1	44.3	19.9	78.3
Black cherry	4.5	7.3	25.6	6.2	43.6
Select white oaks	113.5	187.3	282.6	163.3	746.7
Select red oaks	88.6	92.5	131.0	28.8	340.9
Chestnut oak	57.0	80.9	147.1	39.3	324.3
Other red oaks	88.2	122.3	142.0	74.5	427.0
Black locust	-	1.9	15.0	7.0	23.9
Elm	4.4	5.8	30.7	19.5	60.4
Other hardwoods	14.6	40.1	104.4	17.5	176.6
Total hardwoods	495.0	848.0	1,560.4	662.6	3,566.0
Percent of hardwood in each grade	14	24	44	18	100
Hardwood sampling error (in percent)	10	6	5	7	3.6

[a]International 1/4-inch rule.
[b]Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c]These species are not divided into standard-lumber grades.

Table 42.--Sampling errors for major number of trees and timber-volume classes, Southeastern Unit, Ohio, 1979

(In percent)

Item	Number of trees (Table 38)	Growing-stock volume (Table 39)	Sawtimber volume (Table 40)
Species			
Eastern red cedar	-	-	-
White and red pine	84	90	100
Virginia pine	28	33	38
Other softwoods	40	35	37
Soft maples	18	18	33
Hard maples	16	16	20
Hickory	14	13	19
Beech	20	21	24
White ash	22	21	32
Black walnut	27	28	37
Yellow-poplar	16	15	19
Sycamore	36	32	38
Aspen	28	25	33
Black cherry	21	23	33
Select white oaks	12	11	12
Select red oaks	14	11	13
Chestnut oak	17	18	20
Other red oaks	16	14	16
Black locust	38	52	78
Elm	19	19	29
Other hardwoods	16	19	26
Dbh class (inches)			
5.0 to 6.9	8	9	-
7.0 to 8.9	7	7	-
9.0 to 10.9	6	6	29
11.0 to 12.9	7	7	9
13.0 to 14.9	7	6	6
15.0 to 16.9	10	9	8
17.0 to 18.9	10	9	8
19.0 to 20.9	13	12	11
21.0 to 28.9	16	14	13
29.0+	19	52	19

Table 43.--Number of growing-stock trees on commercial forest land by species and diameter class, East-Central Unit, Ohio, 1979

(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	1,720	2,095	1,108	933	103	21	-	-	-	-	5,980
Virginia pine	-	-	-	-	-	-	-	-	-	-	-
Other softwoods	385	150	59	2	1	-	-	-	-	-	597
Total softwoods	2,105	2,245	1,167	935	104	21	-	-	-	-	6,577
Soft maples[a]	6,853	3,103	2,231	1,159	492	251	205	101	131	29	14,555
Hard maples	2,486	1,788	1,700	535	356	168	200	132	21	11	7,397
Hickory	3,519	2,486	1,817	874	604	292	75	93	38	-	9,798
Beech	958	769	544	655	201	340	51	168	260	47	3,993
White ash	2,843	1,171	1,384	379	392	179	122	60	65	14	6,609
Black walnut	1,074	1,228	436	217	62	84	75	44	11	-	3,231
Yellow-poplar	2,121	2,439	1,886	1,354	724	517	359	105	175	5	9,685
Sycamore	308	470	52	67	-	72	41	38	21	15	1,084
Aspen	2,665	2,499	1,546	1,194	413	69	18	4	4	3	8,415
Black cherry	3,243	2,952	1,729	1,297	735	335	38	98	93	-	10,520
Select white oaks[b]	2,942	1,252	649	501	511	197	352	162	187	38	6,791
Select red oaks[c]	1,618	1,362	1,034	607	314	193	157	71	152	54	5,562
Chestnut oak	768	322	457	431	124	173	18	-	11	-	2,304
Other red oaks[d]	683	1,305	1,150	672	837	298	455	167	247	48	5,862
Black locust	3,198	1,906	1,532	619	362	130	64	-	10	12	7,833
Elm	6,858	3,150	1,427	910	217	91	140	49	52	-	12,894
Other hardwoods	3,358	1,632	826	426	203	171	60	57	45	-	6,778
Total hardwoods	45,495	29,834	20,400	11,897	6,547	3,560	2,430	1,349	1,523	276	123,311
Total, all species	47,600	32,079	21,567	12,832	6,651	3,581	2,430	1,349	1,523	276	129,888

[a]Includes red and silver maple.
[b]Entirely white oak.
[c]Entirely northern red oak.
[d]Includes scarlet, shingle, pin and black oak.

Table 44.-- Net volume of growing stock on commercial forest land by species and diameter class, East-Central Unit, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	3.2	10.6	9.6	13.1	2.1	0.4	-	-	-	-	39.0
Virginia pine	-	-	-	-	-	-	-	-	-	-	-
Other softwoods	.8	1.0	.7	-	-	-	-	-	-	-	2.5
Total softwoods	4.0	11.6	10.3	13.1	2.1	0.4	-	-	-	-	41.5
Soft maples[a]	13.7	14.6	18.5	14.6	8.9	6.0	6.7	3.2	8.6	3.5	98.3
Hard maples	7.0	8.3	16.1	8.0	6.9	5.3	7.8	6.3	1.3	1.9	68.9
Hickory	7.7	13.1	17.5	13.5	12.3	9.0	3.1	4.1	2.6	-	82.9
Beech	1.7	3.3	5.8	9.4	3.7	8.3	1.8	6.7	16.9	6.7	64.3
White ash	5.0	6.6	12.9	5.3	8.5	5.3	5.6	3.5	3.8	2.3	58.8
Black walnut	3.2	7.4	4.3	3.0	1.3	1.8	2.6	1.6	.8	-	26.0
Yellow-poplar	5.3	15.0	21.4	24.4	17.4	19.3	13.3	5.6	12.3	.6	134.6
Sycamore	.9	1.9	.5	1.2	-	2.4	1.5	2.5	1.6	1.8	14.3
Aspen	7.3	16.6	15.4	17.8	9.9	3.1	.6	.2	.4	.2	71.5
Black cherry	7.4	14.1	17.2	18.8	14.7	8.3	1.3	3.9	5.6	-	91.3
Select white oaks[b]	5.6	6.8	5.6	6.9	9.5	5.5	12.6	6.4	11.7	3.1	73.7
Select red oaks[c]	4.6	7.3	9.8	8.6	6.4	6.1	5.4	3.3	11.2	8.2	70.9
Chestnut oak	1.6	2.4	3.6	5.8	2.3	5.7	.5	-	.6	-	22.5
Other red oaks[d]	1.2	6.3	9.3	10.1	15.8	8.3	16.6	7.5	14.8	8.0	97.9
Black locust	6.7	10.9	14.0	9.3	7.3	3.5	2.4	-	.6	1.1	55.8
Elm	15.3	15.3	13.9	13.7	4.5	2.8	5.7	2.4	3.6	-	77.2
Other hardwoods	5.8	6.6	7.0	6.1	3.7	5.1	2.3	3.0	2.6	-	42.2
Total hardwoods	100.0	156.5	192.8	176.5	133.1	105.8	89.8	60.2	99.0	37.4	1,151.1
Total, all species	104.0	168.1	203.1	189.6	135.2	106.2	89.8	60.2	99.0	37.4	1,192.6

[a] Includes red and silver maple.
[b] Entirely white oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, pin and black oak.

Table 45.-- Net volume of sawtimber on commercial forest land by species and diameter class, East-Central Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-
White and red pine	45.7	73.5	9.0	2.0	-	-	-	-	130.2
Virginia pine	-	-	-	-	-	-	-	-	-
Other softwoods	2.1	.2	.1	.1	0.1	-	0.1	-	2.7
Total softwoods	47.8	73.7	9.1	2.1	0.1	-	0.1	-	132.9
Soft maples	-	66.8	44.1	26.0	37.6	15.7	44.9	15.0	250.1
Hard maples	-	37.8	35.9	27.6	44.3	31.4	5.0	11.0	193.0
Hickory	-	61.6	59.5	45.2	16.2	19.3	13.6	-	215.4
Beech	-	49.3	20.7	46.5	9.3	34.7	93.8	35.6	289.9
White ash	-	20.9	40.8	24.4	27.9	20.5	19.8	9.6	163.9
Black walnut	-	10.3	6.6	6.6	14.4	7.2	2.9	-	48.0
Yellow-poplar	-	120.4	92.5	104.8	74.9	33.4	69.8	3.5	499.3
Sycamore	-	5.7	-	11.6	7.6	12.9	9.2	8.4	55.4
Aspen	-	80.1	53.2	15.5	3.4	.7	1.7	.9	155.5
Black cherry	-	81.2	68.6	38.8	6.0	18.1	25.4	-	238.1
Select white oaks	-	32.7	40.1	31.2	64.6	29.7	57.3	13.1	268.7
Select red oaks	-	42.1	30.8	35.0	26.9	18.8	66.0	45.8	265.4
Chestnut oak (and post)	-	26.3	11.0	28.5	1.8	-	3.4	-	71.0
Other red oaks	-	45.6	75.1	39.4	86.1	37.0	74.4	45.2	402.8
Black locust	-	44.9	32.9	15.0	13.4	-	3.4	4.4	114.0
Elm	-	63.0	22.6	12.3	27.4	11.9	19.9	-	157.1
Other hardwoods	-	23.9	18.5	24.9	8.8	11.3	14.7	-	102.1
Total hardwoods	-	812.6	652.9	533.3	470.6	302.6	525.2	192.5	3,489.7
Total, all species	47.8	886.3	662.0	535.4	470.7	302.6	525.3	192.5	3,622.6

[a] International 1/4-inch rule.
[b] Includes red and silver maple.
[c] Entirely white oak.
[d] Entirely northern red oak.
[e] Includes scarlet, shingle, pin and black oak.

Table 46.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, East-Central Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	-
White and red pine	-	6.2	85.4	38.6	130.2
Virginia pine	-	-	-	-	-
Other softwoods[c]	-	-	-	-	2.7
Total softwoods	-	6.2	85.4	38.6	132.9
Soft maples	22.1	43.7	127.0	57.3	250.1
Hard maples	20.8	45.0	94.9	32.3	193.0
Hickory	10.1	44.6	98.4	62.3	215.4
Beech	19.5	28.5	149.8	92.1	289.9
White ash	19.0	50.7	75.5	18.7	163.9
Black walnut	9.8	8.1	24.4	5.7	48.0
Yellow-poplar	70.8	88.8	227.2	112.5	499.3
Sycamore	19.6	15.4	17.1	3.3	55.4
Aspen	4.3	9.0	95.8	46.4	155.5
Black cherry	14.7	32.1	148.9	42.4	238.1
Select white oaks	43.3	53.0	111.1	61.3	268.7
Select red oaks	88.9	60.2	89.9	26.4	265.4
Chestnut oak	15.3	8.3	34.0	13.4	71.0
Other red oaks	69.1	69.9	173.1	90.7	402.8
Black locust	2.9	15.8	70.5	24.8	114.0
Elm	15.4	26.5	86.0	29.2	157.1
Other hardwoods	14.9	16.7	52.8	17.7	102.1
Total hardwoods	460.5	616.3	1,676.4	736.5	3,489.7
Percent of hardwood in each grade	13	18	48	21	100
Hardwood sampling error (in percent)	10	6	5	6	3.6

[a] International 1/4-inch rule.
[b] Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c] These species are not divided into standard-lumber grades.

Table 47.--Sampling errors for major number of trees and timber-volume classes, East-Central Unit, Ohio, 1979

(In percent)

Item	Number of trees (Table 43)	Growing-stock volume (Table 44)	Sawtimber volume (Table 45)
Species			
Eastern red cedar	-	-	-
White and red pine	41	40	43
Virginia pine	-	-	-
Other softwoods	100	93	92
Soft maples	16	15	20
Hard maples	19	16	20
Hickory	17	13	14
Beech	22	19	19
White ash	17	18	23
Black walnut	23	20	28
Yellow-poplar	18	13	14
Sycamore	34	33	42
Aspen	26	27	32
Black cherry	13	13	17
Select white oaks	19	15	18
Select red oaks	17	14	18
Chestnut oak	43	48	50
Other red oaks	18	14	14
Black locust	23	22	30
Elm	17	16	24
Other hardwoods	19	17	22
Dbh class (inches)			
5.0 to 6.9	8	8	-
7.0 to 8.9	8	7	-
9.0 to 10.9	7	7	46
11.0 to 12.9	9	7	8
13.0 to 14.9	9	7	8
15.0 to 16.9	10	9	9
17.0 to 18.9	11	11	10
19.0 to 20.9	12	12	12
21.0 to 28.9	12	12	11
29.0+	20	20	19

Table 48.--Number of growing-stock trees on commercial forest land by species and diameter class, Northeastern Unit, Ohio, 1979
(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	1,817	428	377	105	53	59	-	-	-	-	2,839
Virginia pine	-	-	-	-	-	-	-	-	-	-	-
Other softwoods	1,825	90	-	35	31	-	-	42	9	-	2,032
Total softwoods	3,642	518	377	140	84	59	-	42	9	-	4,871
Soft maples[a]	8,234	4,801	1,261	676	308	164	159	68	158	27	15,856
Hard maples	4,743	3,756	2,223	1,155	654	355	170	173	171	15	13,415
Hickory	2,443	1,842	1,247	875	540	149	67	56	63	-	7,282
Beech	735	1,631	1,010	687	247	129	131	122	198	12	4,902
White ash	4,271	4,117	1,727	687	779	295	265	100	199	27	12,467
Black walnut	778	307	174	81	30	119	17	31	-	-	1,537
Yellow-poplar	420	758	325	202	140	49	16	14	134	-	2,058
Sycamore	-	151	47	64	24	-	19	16	27	15	363
Aspen	4,998	2,395	786	170	53	25	-	11	19	5	8,462
Black cherry	5,873	2,993	3,862	1,109	668	440	105	82	61	4	15,197
Select white oaks[b]	1,028	1,944	1,354	747	646	397	258	279	212	37	6,902
Select red oaks[c]	1,360	666	896	450	359	227	92	125	213	28	4,416
Chestnut oak	111	-	47	-	24	-	-	-	-	-	182
Other red oaks[d]	2,448	1,764	1,087	487	342	246	263	185	375	35	7,232
Black locust	895	428	475	114	55	40	17	-	28	-	2,052
Elm	3,917	984	684	363	65	24	-	-	12	-	6,049
Other hardwoods	3,522	1,485	756	770	332	63	102	35	138	22	7,225
Total hardwoods	45,776	30,022	17,961	8,637	5,266	2,722	1,681	1,297	2,008	227	115,597
Total, all species	49,418	30,540	18,338	8,777	5,350	2,781	1,681	1,339	2,017	227	120,468

[a]Includes red and silver maple.
[b]Includes white, swamp white, and bur oak.
[c]Entirely northern red oak.
[d]Includes scarlet, shingle, pin, and black oak.

Table 49.-- Net volume of growing stock on commercial forest land by species and diameter class, Northeastern Unit, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	5.1	2.0	3.8	1.7	1.0	1.8	-	-	-	-	15.4
Virginia pine	-	-	-	-	-	-	-	-	-	-	-
Other softwoods	3.1	.3	-	.4	.7	-	-	2.3	0.8	-	7.6
Total softwoods	8.2	2.3	3.8	2.1	1.7	1.8	-	2.3	0.8	-	23.0
Soft maples[a]	17.8	23.6	10.8	9.8	5.8	4.2	5.7	2.9	8.1	5.8	94.5
Hard maples	9.3	19.0	20.9	18.5	13.9	11.2	6.1	8.7	11.7	2.0	121.3
Hickory	5.0	11.0	13.8	14.2	12.6	4.9	3.0	2.3	4.3	-	71.1
Beech	1.9	8.3	9.8	8.9	5.2	3.4	4.7	5.9	11.5	1.6	61.2
White ash	8.9	21.3	17.7	11.1	17.9	9.7	10.8	5.0	13.7	3.8	119.9
Black walnut	1.0	1.4	2.0	.9	.6	3.1	.6	1.1	-	-	10.7
Yellow-poplar	1.0	4.1	3.8	3.3	3.2	1.8	.7	.8	12.0	-	30.7
Sycamore	-	1.2	.6	1.1	.6	-	.8	.8	2.8	2.8	10.7
Aspen	8.5	11.1	6.5	2.6	1.4	.6	-	.7	2.9	.7	35.0
Black cherry	10.8	15.8	36.5	15.9	13.9	12.2	3.6	3.6	4.1	.6	117.0
Select white oaks[b]	1.8	9.6	12.1	10.5	14.0	11.3	11.1	14.2	14.7	5.3	104.6
Select red oaks[c]	2.5	2.9	8.2	6.8	8.4	7.0	3.2	6.2	14.0	4.0	63.2
Chestnut oak	.4	-	.4	-	.6	-	-	-	-	-	1.4
Other red oaks[d]	5.2	10.3	11.6	6.9	7.1	6.8	10.0	9.5	28.7	4.6	100.7
Black locust	1.6	2.4	4.7	1.7	.9	1.0	.7	-	1.5	-	14.5
Elm	6.3	4.0	6.2	4.8	1.2	.8	-	-	1.0	-	24.3
Other hardwoods	6.0	6.3	7.6	11.6	6.4	1.9	4.2	2.0	8.7	3.3	58.0
Total hardwoods	88.0	152.3	173.2	128.6	113.7	79.9	65.2	63.7	139.7	34.5	1,038.8
Total, all species	96.2	154.6	177.0	130.7	115.4	81.7	65.2	66.0	140.5	34.5	1,061.8

[a] Includes red and silver maple.
[b] Includes white, swamp white, and bur oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, pin, and black oak.

Table 50.-- Net volume of sawtimber on commercial forest land by species and diameter class, Northeastern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-
White and red pine	17.4	9.4	5.3	7.9	-	-	-	-	40.0
Virginia pine	-	-	-	-	-	-	-	-	-
Other softwoods	-	1.5	3.7	-	-	13.7	5.1		24.0
Total softwoods	17.4	10.9	9.0	7.9	-	13.7	5.1	-	64.0
Soft maples[b]	-	42.9	26.0	18.3	27.9	12.8	40.9	24.5	193.3
Hard maples	-	80.5	60.8	57.3	29.1	39.6	58.9	10.2	336.4
Hickory	-	58.8	57.7	22.9	15.2	9.3	19.2	-	183.1
Beech	-	47.0	26.2	16.1	23.3	29.5	61.7	8.7	212.5
White ash	-	45.1	76.5	43.2	51.0	24.1	68.7	19.1	327.7
Black walnut	-	3.9	1.9	13.0	3.1	3.9	-	-	25.8
Yellow-poplar	-	12.8	18.0	9.6	3.5	3.7	55.7	-	103.3
Sycamore	-	5.8	3.1	-	3.3	3.9	11.9	12.5	40.5
Aspen	-	12.1	5.7	2.7	-	4.0	9.3	1.3	35.1
Black cherry	-	60.8	60.3	54.4	17.8	15.0	17.3	2.9	228.5
Select white oaks[c]	-	47.1	64.1	55.6	51.7	66.3	72.0	23.0	379.8
Select red oaks[d]	-	33.8	47.5	40.1	19.4	31.4	69.7	19.7	261.6
Chestnut oak	-	-	2.4	-	-	-	-	-	2.4
Other red oaks[e]	-	25.7	37.4	36.0	56.1	57.0	162.2	24.1	398.5
Black locust	-	6.5	3.8	4.5	3.6	-	7.0	-	25.4
Elm	-	20.5	4.7	3.7	-	-	5.4	-	34.3
Other hardwoods	-	46.3	30.1	9.0	21.8	11.3	51.1	12.1	181.7
Total hardwoods	-	549.6	526.2	386.4	326.8	311.8	711.0	158.1	2,969.9
Total, all species	17.4	560.5	535.2	394.3	326.8	325.5	716.1	158.1	3,033.9

[a]International 1/4-inch rule.
[b]Includes red and silver maple.
[c]Includes white, swamp white, and bur oak.
[d]Entirely northern red oak.
[e]Includes scarlet, shingle, pin, and black oak.

Table 51.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, Northeastern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	-
White and red pine	2.0	1.0	36.6	0.4	40.0
Virginia pine	-	-	-	-	-
Other softwoods[c]	-	-	-	-	24.0
Total softwoods	2.0	1.0	36.6	0.4	64.0
Soft maples	9.0	27.9	80.1	76.3	193.3
Hard maples	36.3	68.1	172.1	59.9	336.4
Hickory	1.1	30.0	79.4	72.6	183.1
Beech	1.5	12.4	76.7	121.9	212.5
White ash	54.8	96.6	121.5	54.8	327.7
Black walnut	-	8.2	12.0	5.6	25.8
Yellow-poplar	25.2	23.9	36.8	17.4	103.3
Sycamore	12.7	9.1	15.4	3.3	40.5
Aspen	2.1	4.3	17.3	11.4	35.1
Black cherry	19.7	32.3	111.3	65.2	228.5
Select white oaks	74.4	88.4	107.1	109.9	379.8
Select red oaks	47.4	78.4	106.7	29.1	261.6
Chestnut oak	-	1.8	.5	.1	2.4
Other red oaks	51.6	33.5	70.1	243.3	398.5
Black locust	2.2	5.0	9.7	8.5	25.4
Elm	3.3	2.7	16.6	11.7	34.3
Other hardwoods	24.1	25.4	96.7	35.5	181.7
Total hardwoods	365.4	548.0	1,130.0	926.5	2,969.9
Percent of hardwood in each grade	12	19	38	31	100
Hardwood sampling error (in percent)	15	8	6	8	4.7

[a]International 1/4-inch rule.
[b]Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c]These species are not divided into standard-lumber grades.

Table 52.--Sampling errors for major number of trees and timber-volume classes, Northeastern Unit, Ohio, 1979

(In percent)

Item	Number of trees (Table 48)	Growing-stock volume (Table 49)	Sawtimber volume (Table 50)
Species			
Eastern red cedar	-	-	-
White and red pine	55	49	59
Virginia pine	-	-	-
Other softwoods	82	65	86
Soft maples	17	15	19
Hard maples	16	15	20
Hickory	21	20	23
Beech	30	23	23
White ash	18	14	14
Black walnut	34	28	35
Yellow-poplar	37	38	47
Sycamore	62	58	63
Aspen	29	25	49
Black cherry	15	16	19
Select white oaks	25	26	28
Select red oaks	24	18	21
Chestnut oak	100	100	100
Other red oaks	21	21	23
Black locust	47	38	52
Elm	24	24	38
Other hardwoods	17	18	21
Dbh class (inches)			
5.0 to 6.9	9	10	-
7.0 to 8.9	8	8	-
9.0 to 10.9	8	8	66
11.0 to 12.9	7	7	10
13.0 to 14.9	10	9	10
15.0 to 16.9	12	10	10
17.0 to 18.9	15	13	13
19.0 to 20.9	15	15	14
21.0 to 28.9	13	14	12
29.0+	22	23	22

Table 53.--Number of growing-stock trees on commercial forest land by species and diameter class, Southwestern Unit, Ohio, 1979
(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	-	245	38	-	-	-	-	-	-	-	283
Virginia pine	-	125	278	173	63	15	14	-	-	-	668
Other softwoods	511	-	39	-	40	-	-	-	-	-	590
Total softwoods	511	370	355	173	103	15	14	-	-	-	1,541
Soft maples[a]	233	453	308	167	132	60	-	45	78	13	1,489
Hard maples	919	446	460	258	209	107	112	15	61	-	2,587
Hickory	2,314	836	392	441	209	101	43	61	24	-	4,421
Beech	123	52	79	-	43	17	-	27	81	18	440
White ash	2,179	1,730	1,239	732	364	277	240	89	96	13	6,959
Black walnut	135	587	235	183	315	107	69	57	21	-	1,709
Yellow-poplar	-	-	96	-	20	19	29	-	-	7	171
Sycamore	289	291	504	204	122	74	14	34	60	18	1,610
Aspen	-	180	186	97	-	22	12	-	16	16	529
Black cherry	119	469	394	266	74	73	28	24	20	-	1,467
Select white oaks[b]	444	378	164	203	199	143	188	140	156	25	2,040
Select red oaks[c]	-	136	80	117	132	45	23	35	39	13	620
Chestnut oak	103	-	38	39	178	106	63	37	66	13	643
Other red oaks[d]	164	295	172	196	68	99	66	44	92	40	1,236
Black locust	549	601	264	61	28	-	-	-	-	-	1,503
Elm	3,563	1,199	598	257	149	23	15	30	42	-	5,876
Other hardwoods	2,134	1,695	525	362	225	80	47	58	77	13	5,216
Total hardwoods	13,268	9,348	5,734	3,583	2,467	1,353	949	696	929	189	38,516
Total, all species	13,779	9,718	6,089	3,756	2,570	1,368	963	696	929	189	40,057

[a]Includes red and silver maple.
[b]Includes white, swamp white, bur, and chinkapin oak.
[c]Entirely northern red oak.
[d]Includes scarlet, pin, and black oak.

Table 54.-- Net volume of growing stock on commercial forest land by species and diameter class, Southwestern Unit, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	-	0.7	0.3	-	-	-	-	-	-	-	1.0
Virginia pine	-	.6	3.2	2.9	1.4	0.4	0.5	-	-	-	9.0
Other softwoods	1.0	-	.4	-	.7	-	-	-	-	-	2.1
Total softwoods	1.0	1.3	3.9	2.9	2.1	0.4	0.5	-	-	-	12.1
Soft maples[a]	0.6	2.3	3.1	2.4	2.5	1.5	-	2.8	5.5	1.3	22.0
Hard maples	2.2	2.7	4.4	4.5	4.5	3.2	3.9	.7	3.5	-	29.6
Hickory	4.5	4.0	4.1	7.7	4.2	3.1	2.1	3.8	1.3	-	34.8
Beech	.2	.3	.6	-	.8	.3	-	1.3	5.1	1.8	10.4
White ash	4.6	9.2	12.1	12.7	8.3	9.1	10.2	4.0	7.4	1.8	79.4
Black walnut	.2	3.3	2.7	3.3	6.5	3.3	2.1	2.6	1.0	-	25.0
Yellow-poplar	-	-	1.1	-	.5	.6	1.3	-	-	.8	4.3
Sycamore	.6	2.0	6.7	4.1	2.7	2.2	.7	1.5	4.2	3.7	28.4
Aspen	-	1.2	2.1	1.4	-	.9	.8	-	1.1	2.0	9.5
Black cherry	.3	3.6	3.7	4.1	2.1	2.4	1.2	1.0	1.3	-	19.7
Select white oaks[b]	1.1	2.3	1.2	2.7	4.4	4.3	8.9	7.8	17.7	4.5	54.9
Select red oaks[c]	-	.7	.8	1.8	2.8	1.2	.7	1.8	2.9	2.3	15.0
Chestnut oak	.3	-	.3	.7	3.7	3.2	2.7	1.7	6.3	2.7	21.6
Other red oaks[d]	.2	1.1	1.8	2.8	1.3	2.9	2.9	2.1	8.7	7.3	31.1
Black locust	1.9	2.7	2.7	1.0	.6	-	-	-	-	-	8.9
Elm	6.7	6.1	4.5	4.1	3.0	.9	.6	1.5	4.3	-	31.7
Other hardwoods	4.4	8.2	6.8	5.7	5.3	2.3	1.5	3.5	6.2	2.2	46.1
Total hardwoods	27.8	49.7	58.7	59.0	53.2	41.4	39.6	36.1	76.5	30.4	472.4
Total, all species	28.8	51.0	62.6	61.9	55.3	41.8	40.1	36.1	76.5	30.4	484.5

[a] Includes red and silver maple.
[b] Includes white, swamp white, bur, and chinkapin oak.
[c] Entirely northern red oak.
[d] Includes scarlet, pin, and black oak.

Table 55.-- Net volume of sawtimber on commercial forest land by species and diameter class, Southwestern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-
White and red pine	1.3	-	-	-	-	-	-	-	1.3
Virginia pine	16.0	16.1	7.5	1.9	2.5	-	-	-	44.0
Other softwoods	1.8	-	3.1	-	-	-	-	-	4.9
Total softwoods	19.1	16.1	10.6	1.9	2.5	-	-	-	50.2
Soft maples[b]	-	11.2	13.7	8.1	-	15.9	27.9	6.1	82.9
Hard maples	-	19.7	23.4	16.5	19.0	3.0	15.6	-	97.2
Hickory	-	34.6	18.4	16.6	12.5	21.9	6.4	-	110.4
Beech	-	-	4.2	.9	-	7.2	26.8	10.0	49.1
White ash	-	54.1	42.2	47.9	53.6	19.7	40.2	6.3	264.0
Black walnut	-	13.8	30.2	14.1	10.9	13.2	4.4	-	86.6
Yellow-poplar	-	-	2.3	3.3	6.7	-	-	4.5	16.8
Sycamore	-	16.0	10.9	9.9	3.1	6.8	19.0	18.8	84.5
Aspen	-	5.6	-	5.1	3.6	-	5.4	12.3	32.0
Black cherry	-	16.5	9.6	11.8	6.4	3.9	5.6	-	53.8
Select white oaks[c]	-	11.8	19.9	22.6	54.4	44.1	96.2	19.1	268.1
Select red oaks[d]	-	7.3	12.8	5.9	3.0	7.1	14.5	11.6	62.2
Chestnut oak	-	4.2	16.3	15.7	13.2	7.5	35.0	15.3	107.2
Other red oaks[e]	-	12.3	6.1	13.9	14.6	10.7	47.3	36.8	141.7
Black locust	-	3.9	2.2	-	-	-	-	-	6.1
Elm	-	16.3	12.6	4.7	2.5	6.8	17.3	-	60.2
Other hardwoods	-	22.9	20.2	10.9	6.4	15.5	29.4	10.0	115.3
Total hardwoods	-	250.2	245.0	207.9	209.9	183.3	391.0	150.8	1,638.1
Total, all species	19.1	266.3	255.6	209.8	212.4	183.3	391.0	150.8	1,688.3

[a] International 1/4-inch rule.
[b] Includes red and silver maple.
[c] Includes white, swamp white, bur, and chinkapin oak.
[d] Entirely northern red oak.
[e] Includes scarlet, pin, and black oak.

Table 56.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, Southwestern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	-
White and red pine	-	0.7	0.5	0.1	1.3
Virginia pine	-	2.6	41.4	-	44.0
Other softwoods[c]	-	-	-	-	4.9
Total softwoods	-	3.3	41.9	0.1	50.2
Soft maples	11.1	14.5	31.8	25.5	82.9
Hard maples	3.6	31.8	46.4	15.4	97.2
Hickory	12.9	23.1	42.1	32.3	110.4
Beech	5.2	8.4	23.6	11.9	49.1
White ash	62.0	73.7	94.3	34.0	264.0
Black walnut	5.1	24.4	46.1	11.0	86.6
Yellow-poplar	3.3	6.0	2.8	4.7	16.8
Sycamore	4.1	21.8	42.1	16.5	84.5
Aspen	4.3	9.6	4.5	13.6	32.0
Black cherry	6.2	11.1	28.5	8.0	53.8
Select white oaks	84.8	54.5	75.9	52.9	268.1
Select red oaks	10.8	16.2	27.3	7.9	62.2
Chestnut oak	32.4	30.3	32.8	11.7	107.2
Other red oaks	17.5	32.1	53.6	38.5	141.7
Black locust	-	-	3.5	2.6	6.1
Elm	6.1	7.6	33.5	13.0	60.2
Other hardwoods	9.3	27.2	59.6	19.2	115.3
Total hardwoods	278.7	392.3	648.4	318.7	1,638.1
Percent of hardwood in each grade	17	24	40	19	100
Hardwood sampling error (in percent)	15	10	9	11	8.3

[a]International 1/4-inch rule.
[b]Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c]These species are not divided into standard-lumber grades.

Table 57.--Sampling errors for major number of trees and timber-volume classes, Southwestern Unit, Ohio, 1979

(In percent)

Item	Number of trees (Table 53)	Growing-stock volume (Table 54)	Sawtimber volume (Table 55)
Species			
Eastern red cedar	-	-	-
White and red pine	100	101	102
Virginia pine	80	81	80
Other softwoods	76	63	72
Soft maples	35	32	32
Hard maples	26	29	35
Hickory	25	19	28
Beech	44	31	30
White ash	20	17	22
Black walnut	24	21	23
Yellow-poplar	56	51	52
Sycamore	34	34	39
Aspen	47	34	43
Black cherry	23	24	35
Select white oaks	25	18	18
Select red oaks	47	32	33
Chestnut oak	48	46	45
Other red oaks	34	35	39
Black locust	39	41	80
Elm	30	27	44
Other hardwoods	24	23	29
Dbh class (inches)			
5.0 to 6.9	15	17	-
7.0 to 8.9	13	14	-
9.0 to 10.9	11	13	83
11.0 to 12.9	11	11	14
13.0 to 14.9	12	11	13
15.0 to 16.9	13	11	12
17.0 to 18.9	16	14	15
19.0 to 20.9	16	15	15
21.0 to 28.9	19	17	15
29.0+	26	48	25

Table 58.--Number of growing-stock trees on commercial forest land by species and diameter class, Northwestern Unit, Ohio, 1979
(In thousands of trees)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	996	1,768	328	77	11	-	-	-	-	-	3,180
Virginia pine	-	-	-	-	-	-	-	-	-	-	-
Other softwoods	-	-	-	-	-	-	-	-	-	-	-
Total softwoods	996	1,768	328	77	11	-	-	-	-	-	3,180
Soft maples[a]	1,386	1,019	963	421	92	82	60	50	54	13	4,140
Hard maples	1,675	162	696	360	239	217	132	84	33	-	3,598
Hickory	3,917	5,678	3,013	1,297	1,123	572	371	106	154	-	16,231
Beech	820	816	575	279	-	59	89	23	71	22	2,754
White ash	4,885	2,514	1,687	1,172	851	424	186	127	39	-	11,885
Black walnut	279	923	754	240	245	80	-	-	-	-	2,521
Yellow-poplar	-	498	241	-	-	39	-	-	-	-	778
Sycamore	-	135	145	302	203	94	49	44	51	-	1,023
Aspen	444	663	108	85	51	65	64	-	69	51	1,600
Black cherry	795	997	287	214	84	-	-	47	-	-	2,424
Select white oaks[b]	2,005	1,112	601	588	301	264	297	263	445	50	5,926
Select red oaks[c]	708	139	382	63	355	254	225	227	184	44	2,581
Chestnut oak	-	-	-	-	-	-	-	-	-	-	-
Other red oaks[d]	761	732	520	520	387	79	210	100	227	6	3,542
Black locust	187	138	92	-	-	-	-	-	-	-	417
Elm	6,740	1,756	659	57	186	111	27	-	-	-	9,536
Other hardwoods	3,850	559	495	305	313	205	255	118	88	28	6,216
Total hardwoods	28,452	17,841	11,218	5,903	4,430	2,545	1,965	1,189	1,415	214	75,172
Total, all species	29,448	19,609	11,546	5,980	4,441	2,545	1,965	1,189	1,415	214	78,352

[a]Includes red and silver maple.
[b]Includes white, swamp white, bur, and chinkapin oak.
[c]Entirely northern red oak.
[d]Includes scarlet, shingle, pin, and black oak.

Table 59.-- Net volume of growing stock on commercial forest land by species and diameter class, Northwestern Unit, Ohio, 1979

(In millions of cubic feet)

Species	Diameter class (inches at breast height)										All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-	-	-
White and red pine	1.7	6.0	2.1	0.7	0.2	-	-	-	-	-	10.7
Virginia pine	-	-	-	-	-	-	-	-	-	-	-
Other softwoods	-	-	-	-	-	-	-	-	-	-	-
Total softwoods	1.7	6.0	2.1	0.7	0.2	-	-	-	-	-	10.7
Soft maples[a]	2.8	4.9	8.9	5.7	1.5	2.0	2.3	1.8	2.2	1.2	33.3
Hard maples	3.2	1.0	4.8	4.7	3.9	4.1	3.2	2.7	2.0	-	29.6
Hickory	7.0	24.6	23.5	16.2	20.3	13.8	13.4	4.1	9.1	-	132.0
Beech	1.6	3.0	4.3	3.3	-	.8	3.7	.9	5.3	2.7	25.6
White ash	8.7	10.6	14.3	15.8	17.5	10.4	6.1	4.7	2.2	-	90.3
Black walnut	.3	3.4	6.2	2.7	3.8	1.7	-	-	-	-	18.1
Yellow-poplar	-	2.2	1.5	-	-	1.0	-	-	-	-	4.7
Sycamore	-	.4	1.1	3.3	2.9	1.6	1.7	2.1	3.2	-	16.3
Aspen	.8	2.9	1.0	.9	1.1	1.7	1.9	-	6.5	10.5	27.3
Black cherry	1.1	4.0	1.6	2.1	1.8	-	-	1.8	-	-	12.4
Select white oaks[b]	2.5	4.0	3.3	6.5	4.6	6.3	8.5	9.7	23.9	7.0	76.3
Select red oaks[c]	1.2	.6	3.1	1.0	6.3	6.0	7.3	7.3	10.3	5.6	48.7
Chestnut oak	-	-	-	-	-	-	-	-	-	-	-
Other red oaks[d]	1.5	3.0	3.9	6.5	6.4	1.5	6.0	3.4	11.0	1.0	44.2
Black locust	.5	.5	.7		-	-	-	-	-	-	1.7
Elm	11.3	7.6	4.6	.8	4.0	3.6	1.0	-	-	-	32.9
Other hardwoods	5.2	1.5	3.5	3.8	4.8	5.1	6.6	4.0	4.0	4.1	42.6
Total hardwoods	47.7	74.2	86.3	73.3	78.9	59.6	61.7	42.5	79.7	32.1	636.0
Total, all species	49.4	80.2	88.4	74.0	79.1	59.6	61.7	42.5	79.7	32.1	646.7

[a] Includes red and silver maple.
[b] Includes white, swamp white, bur, and chinkapin oak.
[c] Entirely northern red oak.
[d] Includes scarlet, shingle, pin, and black oak.

Table 60.-- Net volume of sawtimber on commercial forest land by species and diameter class, Northwestern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Diameter class (inches at breast height)								All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+	
Eastern red cedar	-	-	-	-	-	-	-	-	-
White and red pine	11.7	4.6	1.4	-	-	-	-	-	17.7
Virginia pine	-	-	-	-	-	-	-	-	-
Other softwoods	-	-	-	-	-	-	-	-	-
Total softwoods	11.7	4.6	1.4	-	-	-	-	-	17.7
Soft maples[b]	-	26.9	8.2	12.7	11.7	7.0	12.3	7.0	85.8
Hard maples	-	22.6	20.7	22.2	16.1	15.4	11.3	-	108.3
Hickory	-	72.8	115.8	76.8	77.6	24.4	48.4	-	415.8
Beech	-	18.3	-	5.8	19.8	7.0	33.0	16.9	100.8
White ash	-	63.4	84.5	52.0	32.0	21.2	14.2	-	267.3
Black walnut	-	13.1	18.6	9.3	-	-	-	-	41.0
Yellow-poplar	-	-	-	4.8	-	-	-	-	4.8
Sycamore	-	15.0	15.4	10.2	8.0	8.9	16.8	-	74.3
Aspen	-	3.5	5.2	9.6	10.2	-	38.3	69.1	135.9
Black cherry	-	9.4	8.9	-	-	9.4	-	-	27.7
Select white oaks[c]	-	31.5	21.0	33.4	43.2	52.3	125.5	41.6	348.5
Select red oaks[d]	-	4.8	34.6	35.5	39.5	43.8	54.6	32.6	245.4
Chestnut oak	-	-	-	-	-	-	-	-	-
Other red oaks[e]	-	30.8	31.8	8.8	34.6	16.9	58.9	4.4	186.2
Black locust	-	-	-	-	-	-	-	-	-
Elm	-	3.7	18.4	18.0	5.5	-	-	-	45.6
Other hardwoods	-	16.0	25.4	24.5	35.1	20.4	23.9	21.1	166.4
Total hardwoods	-	331.8	408.5	323.6	333.3	226.7	437.2	192.7	2,253.8
Total, all species	11.7	336.4	409.9	323.6	333.3	226.7	437.2	192.7	2,271.5

[a] International 1/4-inch rule.
[b] Includes red and silver maple.
[c] Includes white, swamp white, bur, and chinkapin oak.
[d] Entirely northern red oak.
[e] Includes scarlet, shingle, pin, and black oak.

Table 61.--Net volume of sawtimber on commercial forest land by species and standard-lumber log grade, Northwestern Unit, Ohio, 1979

(In millions of board feet)[a]

Species	Grade 1	Grade 2	Grade 3	Grade 4[b]	All classes
Eastern red cedar[c]	-	-	-	-	-
White and red pine	-	-	16.8	.9	17.7
Virginia pine	-	-	-	-	-
Other softwoods[c]	-	-	-	-	-
Total softwoods	-	-	16.8	.9	17.7
Soft maples	-	11.6	31.9	42.3	85.8
Hard maples	11.2	19.4	52.2	25.5	108.3
Hickory	21.4	90.6	193.5	110.3	415.8
Beech	18.3	16.8	24.0	41.7	100.8
White ash	42.9	90.5	100.4	33.5	267.3
Black walnut	-	11.2	18.1	11.7	41.0
Yellow-poplar	-	-	3.9	.9	4.8
Sycamore	5.0	18.7	39.8	10.8	74.3
Aspen	46.9	21.4	33.3	34.3	135.9
Black cherry	3.0	6.2	3.4	15.1	27.7
Select white oaks	98.7	49.9	118.8	81.1	348.5
Select red oaks	72.0	43.8	75.8	53.8	245.4
Chestnut oak	-	-	-	-	-
Other red oaks	17.0	34.6	62.9	71.7	186.2
Black locust	-	-	-	-	-
Elm	7.1	10.0	20.7	7.8	45.6
Other hardwoods	29.0	47.0	73.0	17.4	166.4
Total hardwoods	372.5	471.7	851.7	557.9	2,253.8
Percent of hardwood in each grade	16	21	38	25	100
Hardwood sampling error (in percent)	15	10	9	13	7.9

[a] International 1/4-inch rule.
[b] Grade 4 applies only to white pine. For hardwoods the volumes in this column are for construction logs.
[c] These species are not divided into standard-lumber grades.

Table 62.--Sampling errors for major number of trees and timber-volume classes, Northwestern Unit, Ohio, 1979

(In percent)

Item	Number of trees (Table 58)	Growing-stock volume (Table 59)	Sawtimber volume (Table 60)
Species			
Eastern red cedar	-	-	-
White and red pine	78	70	101
Virginia pine	-	-	-
Other softwoods	-	-	-
Soft maples	34	39	36
Hard maples	37	35	43
Hickory	20	15	20
Beech	55	45	54
White ash	18	15	21
Black walnut	31	26	30
Yellow-poplar	71	73	104
Sycamore	50	43	46
Aspen	42	37	45
Black cherry	38	26	37
Select white oaks	28	23	24
Select red oaks	36	35	36
Chestnut oak	-	-	-
Other red oaks	37	37	41
Black locust	00	81	-
Elm	29	32	77
Other hardwoods	33	22	25
Dbh class (inches)			
5.0 to 6.9	14	16	-
7.0 to 8.9	16	16	-
9.0 to 10.9	12	12	101
11.0 to 12.9	14	13	15
13.0 to 14.9	14	12	14
15.0 to 16.9	14	12	12
17.0 to 18.9	17	16	17
19.0 to 20.9	18	18	16
21.0 to 28.9	22	21	18
29.0+	29	30	27

Table 63.--Land area by county, geographic unit, and land class, Ohio 1979

County and geographic unit	Forest land			Nonforest land	Total land[b]	Proportion commercial[c]
	Noncommercial[a]	Commercial				
		Public	Private			
	Thousand acres					Percent
Adams	4.1	11.9	182.1	177.6	375.7	52
Brown	.1	.2	82.3	231.0	313.6	26
Clermont	3.8	.8	92.8	195.7	293.1	32
Gallia	.1	10.6	161.3	129.4	301.4	57
Highland	2.3	2.2	62.7	284.2	351.4	18
Jackson	1.9	5.2	167.5	93.6	268.2	64
Lawrence	3.6	51.6	161.8	74.8	291.8	73
Pike	2.0	10.0	167.3	104.2	283.5	63
Ross	3.0	22.5	146.3	267.9	439.7	38
Scioto	4.6	63.7	198.5	122.3	389.1	67
South-Central Unit	25.5	178.7	1,422.6	1,680.7	3,307.5	48
Athens	2.7	13.5	178.3	128.1	322.6	59
Hocking	3.1	26.5	141.9	97.9	269.4	63
Meigs	.7	2.3	185.0	91.0	279.0	67
Morgan	1.7	4.7	130.2	132.2	268.8	50
Perry	3.0	23.3	125.0	111.1	262.4	57
Vinton	3.0	24.6	165.0	70.4	263.0	72
Washington	2.5	26.0	201.4	180.4	410.3	55
Southeastern Unit	16.7	120.9	1,126.8	811.1	2,075.5	60
Belmont	4.2	3.4	176.6	157.6	341.8	53
Carroll	.4	3.9	111.3	134.0	249.6	46
Coshocton	.1	5.2	162.1	192.3	359.7	47
Guernsey	5.4	1.1	163.7	167.7	337.9	49
Harrison	.6	9.9	132.5	113.6	256.6	55
Holmes	9.5	.2	77.0	184.7	271.4	28
Jefferson	.9	4.0	130.4	127.7	263.0	51
Monroe	.9	14.6	172.6	103.7	291.8	64
Muskingum	4.3	8.4	176.1	227.9	416.7	44
Noble	9.5	3.1	139.3	102.8	254.7	56
Tuscarawas	.6	1.4	160.9	201.3	364.2	45
East-Central Unit	36.4	55.2	1,602.5	1,713.3	3,407.4	49
Ashland	0.4	2.7	49.8	218.5	271.4	19
Ashtabula	4.6	-	187.9	255.5	448.0	42
Columbiana	2.8	1.8	128.5	208.7	341.8	38
Cuyahoga	34.2	-	-	257.6	291.8	0
Erie	.4	.5	18.4	149.7	169.0	11
Geauga	6.4	2.0	122.2	129.9	260.5	48
Huron	.7	1.0	37.6	278.7	318.0	12
Lake	3.7	.7	39.7	103.7	147.8	27
Lorain	1.6	.1	44.5	270.6	316.8	14
Mahoning	2.2	1.0	68.8	193.6	265.6	26
Medina	1.4	.2	58.0	212.4	272.0	21
Portage	6.6	11.1	79.1	220.0	316.8	28
Richland	.4	3.2	60.8	253.0	317.4	20
Stark	.3	1.2	61.5	305.6	368.6	17
Summit	5.4	7.1	50.2	198.4	261.1	22
Trumbull	20.0	5.0	136.2	227.9	389.1	36
Wayne	.2	1.2	58.4	299.3	359.1	17
Northeastern Unit	91.3	38.8	1,201.6	3,783.1	5,114.8	24

Table 63.-- continued

County and geographic unit	Forest land			Nonforest land	Total land[b]	Proportion commercial[c]
	Noncommercial[a]	Commercial				
		Public	Private			
	Thousand acres					Percent
Butler	4.6	0.2	32.2	264.4	301.4	11
Clark	.1	W	17.2	240.0	257.3	7
Clinton	1.9	.4	16.1	244.0	262.4	6
Darke	.1	.1	28.9	358.1	387.2	7
Fairfield	.6	.1	49.0	273.5	323.2	15
Fayette	.4	.2	9.5	248.5	258.6	4
Franklin	.5	.4	24.4	319.0	344.3	7
Greene	1.9	.5	20.9	242.3	265.6	8
Hamilton	4.1	.3	45.4	215.2	265.0	17
Licking	.8	.3	105.6	332.3	439.0	24
Madison	.5	.1	9.2	286.5	296.3	3
Miami	.1	W	14.7	245.7	260.5	6
Montgomery	2.1	.6	23.2	267.9	293.8	8
Pickaway	.5	.3	15.9	305.9	322.6	5
Preble	1.9	.7	26.5	244.2	273.3	10
Warren	1.8	.7	26.6	232.0	261.1	10
Southwestern Unit	21.9	4.9	465.3	4,319.5	4,811.6	10
Allen	0.1	W	13.2	249.1	262.4	5
Auglaize	W	0.1	17.4	238.5	256.0	7
Champaign	.4	.2	15.0	260.9	276.5	5
Crawford	W	.6	24.2	233.8	258.6	10
Defiance	.6	1.4	41.6	220.1	263.7	16
Delaware	1.4	1.0	38.8	246.8	288.0	14
Fulton	.6	1.0	27.6	231.3	260.5	11
Hancock	.2	.3	28.2	311.8	340.5	8
Hardin	.1	.7	26.5	271.6	298.9	9
Henry	.6	.6	16.7	248.3	266.2	6
Knox	.2	.5	85.3	253.8	339.8	25
Logan	.5	.4	28.0	265.5	294.4	10
Lucas	.6	.9	24.4	193.6	219.5	12
Marion	1.3	.6	21.2	236.1	259.2	8
Mercer	.1	W	16.1	268.0	284.2	6
Morrow	1.3	1.0	38.0	217.6	257.9	15
Ottawa	.1	.1	7.3	159.5	167.0	4
Paulding	.7	.8	22.7	242.7	266.9	9
Putnam	.1	W	12.7	298.2	311.0	4
Sandusky	.2	.2	11.2	250.2	261.8	4
Seneca	.2	.3	28.2	323.9	352.6	8
Shelby	.4	.5	34.3	225.9	261.1	13
Union	.4	.2	15.0	262.2	277.8	5
Van Wert	.1	W	10.9	250.8	261.8	4
Williams	.7	1.7	48.6	218.4	269.4	19
Wood	.3	.2	16.7	379.0	396.2	4
Wyandot	W	.4	16.3	243.1	259.8	6
Northwestern Unit	11.2	13.7	686.1	6,800.7	7,511.7	9
All counties	203.0	412.2	6,504.9	19,108.4	26,228.5	26

[a]Includes productive-reserved, urban, and unproductive forest land.
[b]Source: U.S. Dep. Commer., Census, County and City Data Book, 1972.
[c]Percentage of total land area that is in commercial forest.
W-Less than 500 acres.

Table 64.--Area of commercial forest land by county, geographic unit and stand-size class, Ohio, 1979

County[a] and geographic unit	Sawtimber stands	Poletimber stands	Other stands	All classes	Sampling error[b]
	Thousand acres				Percent
Adams	69.7	50.2	74.1	194.0	5
Brown	34.5	14.0	34.0	82.5	10
Clermont	34.1	8.5	51.0	93.6	4
Gallia	35.5	54.7	81.7	171.9	6
Highland	35.2	8.2	21.5	64.9	6
Jackson	65.3	21.1	86.3	172.7	4
Lawrence	86.9	39.6	86.9	213.4	3
Pike	118.6	29.4	29.3	177.3	2
Ross	103.7	29.0	36.1	168.8	4
Scioto	155.4	93.5	13.3	262.2	2
South-Central Unit	738.9	348.2	514.2	1,601.3	1.3
Athens	81.5	50.5	59.8	191.8	4
Hocking/Perry	144.8	64.0	107.9	316.7	2
Meigs	70.9	43.2	73.2	187.3	4
Morgan/Washington	159.5	76.7	126.1	362.3	5
Vinton	81.2	51.0	57.4	189.6	4
Southeastern Unit	537.9	285.4	424.4	1,247.7	2.0
Belmont	76.5	20.4	83.1	180.0	4
Carroll	48.4	37.5	29.3	115.2	8
Coshocton	60.8	52.9	53.6	167.3	3
Guernsey	54.7	33.6	76.5	164.8	6
Harrison	67.3	15.3	59.8	142.4	9
Holmes	59.0	10.5	7.7	77.2	9
Jefferson	44.8	30.8	58.8	134.4	6
Monroe	85.4	42.7	59.1	187.2	5
Muskingum	70.0	26.0	88.5	184.5	5
Noble	4.2	20.7	117.5	142.4	10
Tuscarawas	43.5	25.3	93.5	162.3	7
East-Central Unit	614.6	315.7	727.4	1,657.7	2.0
Ashland/Richland	62.1	31.0	23.4	116.5	7
Ashtabula	54.1	50.7	83.1	187.9	3
Columbiana	29.9	33.0	67.4	130.3	4
Cuyahoga	-	-	-	-	-
Erie/Huron	13.3	33.9	10.3	57.5	16
Geauga/Lake	77.5	23.3	63.8	164.6	7
Lorain/Medina	43.8	17.3	41.7	102.8	11
Mahoning	41.9	13.6	14.3	69.8	6
Portage/Summit	58.3	13.1	76.1	147.5	14
Stark/Wayne	41.5	58.9	21.9	122.3	10
Trumbull	48.7	42.7	49.8	141.2	8
Northeastern Unit	471.1	317.5	451.8	1,240.4	2.8
Butler/Hamilton	32.7	19.5	25.9	78.1	15
Clark/Darke/Miami	43.5	5.2	12.2	60.9	11
Clinton/Greene/ Montgomery/Preble/Warren	47.1	24.4	44.7	116.2	14
Fairfield/Licking	87.2	33.4	34.4	155.0	6
Fayette/Franklin/Madison/ Pickaway	13.3	12.3	34.4	60.0	21
Southwestern Unit	223.8	94.8	151.6	470.2	5.5

Table 64.-- continued

County[a] and geographic unit	Sawtimber stands	Poletimber stands	Other stands	All classes	Sampling error[b]
	Thousand acres				Percent
Allen/Auglaize/Mercer/ Putnam/Van Wert	42.2	18.3	9.9	70.4	19
Champaign/Logan/Shelby/Union	41.1	52.5	-	93.6	15
Crawford/Hardin/Wyandot	34.3	11.6	22.8	68.7	17
Defiance/Fulton/Henry/Lucas Paulding/Williams	99.0	37.5	51.5	188.0	7
Delaware/Marion/Morrow	66.6	-	34.0	100.6	10
Hancock/Ottawa/Sandusky/ Seneca/Wood	46.8	24.7	21.2	92.7	15
Knox	38.3	31.7	15.8	85.8	6
Northwestern Unit	368.3	176.3	155.2	699.8	4.6
All counties	2,954.6	1,537.9	2,424.6	6,917.1	1.0

[a]Multi-county groupings are used for counties with too few forested field plots or with other sampling anomalies. This is done in order to minimize sampling errors when presenting more detailed county-level data.
[b]For commercial forest land.

Table 65.--Area of commercial forest land by county, geographic unit and major forest type, Ohio, 1979
(In thousands of acres)

County[a] geographic unit	Softwood types[b]	Oak types[c]	Elm/ash red maple types	Northern hardwood types[d]	All types
Adams	30.3	126.5	7.3	29.9	194.0
Brown	-	40.8	13.9	27.8	82.5
Clermont	-	51.1	25.5	17.0	93.6
Gallia	21.1	131.6	12.7	6.5	171.9
Highland	-	56.7	-	8.2	64.9
Jackson	26.1	128.6	4.7	13.3	172.7
Lawrence	10.5	193.0	.2	9.7	213.4
Pike	-	170.5	-	6.8	177.3
Ross	-	126.9	7.4	34.5	168.8
Scioto	6.9	243.1	4.9	7.3	262.2
South-Central Unit	94.9	1,268.8	76.6	161.0	1,601.3
Athens	1.4	162.4	21.2	6.8	191.8
Hocking/Perry	28.1	224.3	18.6	45.7	316.7
Meigs	18.8	145.1	5.4	18.0	187.3
Morgan/Washington	41.6	272.7	20.2	27.8	362.3
Vinton	.1	182.9	-	6.6	189.6
Southeastern Unit	90.0	987.4	65.4	104.9	1,247.7
Belmont	-	100.8	19.4	59.8	180.0
Carroll	6.3	62.6	2.0	44.3	115.2
Coshocton	7.1	121.4	7.9	30.9	167.3
Guernsey	7.0	98.3	34.0	25.5	164.8
Harrison	7.6	90.2	15.3	29.3	142.4
Holmes	10.5	25.5	10.1	31.1	77.2
Jefferson	-	82.8	7.2	44.4	134.4
Monroe	10.4	139.7	.2	36.9	187.2
Muskingum	-	139.0	25.7	19.8	184.5
Noble	4.2	56.5	34.9	46.8	142.4
Tuscarawas	7.7	99.2	7.8	47.6	162.3
East-Central Unit	60.8	1,016.0	164.5	416.4	1,657.7
Ashland/Richland	7.8	15.5	23.2	70.0	116.5
Ashtabula	-	72.3	25.2	90.4	187.9
Columbiana	-	64.5	-	65.8	130.3
Cuyahoga	-	-	-	-	-
Erie/Huron	-	-	13.3	44.2	57.5
Geauga/Lake	-	16.0	8.0	140.6	164.6
Lorain/Medina	-	17.3	16.3	69.2	102.8
Mahoning	7.1	42.6	13.6	6.5	69.8
Portage/Summit	-	48.5	28.1	70.9	147.5
Stark/Wayne	8.4	55.1	33.7	25.1	122.3
Trumbull	-	71.1	21.1	49.0	141.2
Northeastern Unit	23.3	402.9	182.5	631.7	1,240.4
Butler/Hamilton	-	39.3	19.3	19.5	78.1
Clark/Darke/Miami	-	26.7	12.2	22.0	60.9
Clinton/Greene/ Montgomery/Preble/Warren	6.3	49.8	36.4	23.7	116.2
Fairfield/Licking	11.3	89.6	11.3	42.8	155.0
Fayette/Franklin/Madison/ Pickaway	-	43.1	16.9	-	60.0
Southwestern Unit	17.6	248.5	96.1	108.0	470.2

Table 65.-- continued

(In thousands of acres)

County[a] geographic unit	Softwood types[b]	Oak types[c]	Elm/ash red maple types	Northern hardwood types[d]	All types
Allen/Auglaize/Mercer/ Putnam/Van Wert	-	50.6	19.8	-	70.4
Champaign/Logan/Shelby/Union	-	53.9	-	39.7	93.6
Crawford/Hardin/Wyandot	-	45.5	11.6	11.6	68.7
Defiance/Fulton/Henry/Lucas Paulding/Williams	3.3	105.9	45.6	33.2	188.0
Delaware/Marion/Morrow	-	24.2	34.6	41.8	100.6
Hancock/Ottawa/Sandusky/ Seneca/Wood	-	30.8	26.4	35.5	92.7
Knox	15.9	41.3	28.6	-	85.8
Northwestern Unit	19.2	352.2	166.6	161.8	699.8
All counties	305.8	4,275.8	751.7	1,583.8	6,917.1

[a]Multi-county groupings are used for counties with too few field plots or with other sanpling anomalies. This is done to minimize sampling errors when more detailed county-level data are presented.
[b]Includes white/red pine and hard pine groups.
[c]Includes oak/pine and oak/hickory groups.
[d]Includes northern hardwoods and aspen/birch groups.

Table 66.--Net volume of growing stock and sawtimber on commercial forest land by county, geographic unit, and major species group, Ohio, 1979

County[a] and geographic unit	Oaks	Other	Total	Sampling error	Oaks	Other	Total	Sampling error
	Million cubic feet			Percent	Million board feet			Percent
Adams	89.8	139.0	228.8	6	300.7	405.7	706.4	8
Brown	23.5	49.6	73.1	14	89.7	129.7	219.4	17
Clermont	12.3	78.3	90.6	10	51.9	242.3	294.2	12
Gallia	64.4	106.4	170.8	9	221.2	242.9	464.1	12
Highland	18.5	53.1	71.6	12	71.4	156.8	228.2	14
Jackson	50.9	110.0	160.9	8	177.2	347.1	524.3	9
Lawrence	81.1	161.2	242.3	8	277.6	454.5	732.1	9
Pike	95.6	123.8	219.4	6	343.9	374.6	718.5	8
Ross	99.6	122.3	221.9	7	361.6	363.5	725.1	9
Scioto	265.4	140.8	406.2	5	955.4	399.0	1,354.4	6
South-Central Unit	801.1	1,084.5	1,885.6	2.3	2,850.6	3,116.1	5,966.7	2.9
Athens	81.2	85.0	166.2	5	324.2	243.3	567.5	6
Hocking/Perry	83.6	199.7	283.3	5	328.1	600.7	928.8	6
Meigs	53.3	90.9	144.2	5	212.9	280.1	493.0	7
Morgan/Washington	130.0	208.0	338.0	5	592.4	596.5	1,188.9	6
Vinton	84.5	106.9	191.4	5	381.3	273.4	654.7	7
Southeastern Unit	432.6	690.5	1,123.1	2.2	1,838.9	1,994.0	3,832.9	2.9
Belmont	24.5	102.4	126.9	8	100.0	307.1	407.1	9
Carroll	31.7	54.3	86.0	10	95.5	131.0	226.5	13
Coshocton	20.0	114.0	134.0	8	86.6	309.5	396.1	9
Guernsey	32.0	81.3	113.3	8	130.2	211.9	342.1	9
Harrison	23.0	55.0	78.0	12	70.9	138.3	209.2	15
Holmes	12.0	60.3	72.3	10	33.6	209.3	242.9	12
Jefferson	21.4	83.9	105.3	9	72.3	224.0	296.3	12
Monroe	30.8	145.1	175.9	7	126.2	482.0	608.2	8
Muskingum	29.6	104.4	134.0	8	129.4	276.7	406.1	10
Noble	8.9	56.9	65.8	11	49.3	141.2	190.5	13
Tuscarawas	31.1	70.0	101.1	10	113.9	183.7	297.6	12
East-Central Unit	265.0	927.6	1,192.6	2.7	1,007.9	2,614.7	3,622.6	3.2
Ashland/Richland	19.4	90.4	109.8	11	58.4	232.7	291.1	15
Ashtabula	42.4	99.3	141.7	9	199.7	185.8	385.5	14
Columbiana	26.0	59.0	85.0	9	90.1	141.5	231.6	14
Cuyahoga	-	-	-	-	-	-	-	-
Erie/Huron	21.0	46.7	67.7	14	60.6	127.6	188.2	20
Geauga/Lake	9.0	148.1	157.1	9	36.1	425.1	461.2	12
Lorain/Medina	12.2	82.9	95.1	12	45.9	221.4	267.3	17
Mahoning	24.4	38.5	62.9	10	100.4	103.4	203.8	14
Portage/Summit	37.5	94.7	132.2	10	155.5	256.8	412.3	13
Stark/Wayne	23.9	69.0	92.9	12	121.8	159.9	281.7	15
Trumbull	54.1	63.3	117.4	7	173.8	137.4	311.2	12
Northeastern Unit	269.9	791.9	1,061.8	3.2	1,042.3	1,991.6	3,033.9	4.5
Butler/Hamilton	17.1	58.7	75.8	19	83.1	146.0	229.1	28
Clark/Darke/Miami	16.9	45.6	62.5	19	60.2	147.0	207.2	25
Clinton/Greene/ Montgomery/Preble/Warren	27.0	112.8	139.8	12	139.6	380.7	520.3	14
Fairfield/Licking	40.0	114.8	154.8	9	170.2	356.3	526.5	12
Fayette/Franklin/Madison/ Pickaway	21.6	30.0	51.6	20	126.1	79.1	205.2	21
Southwestern Unit	122.6	361.9	484.5	6.1	579.2	1,109.1	1,688.3	7.9

Table 66.-- continued

County[a] and geographic unit	Oaks	Other	Total	Sampling error	Oaks	Other	Total	Sampling error
	Million cubic feet			Percent	Million board feet			Percent
Allen/Auglaize/Mercer/ Putnam/Van Wert	26.2	58.5	84.7	18	127.4	173.9	301.3	25
Champaign/Logan/Shelby/Union	9.9	59.9	69.8	14	49.0	195.6	244.6	17
Crawford/Hardin/Wyandot	16.2	56.2	72.4	18	80.0	183.4	263.4	23
Defiance/Fulton/Henry/Lucas/ Paulding/Williams	43.2	107.8	151.0	13	161.7	348.4	510.1	18
Delaware/Marion/Morrow	8.2	74.4	82.6	17	42.2	249.9	292.1	24
Hancock/Ottawa/Sandusky/ Seneca/Wood	27.8	69.4	97.2	17	128.2	191.1	319.3	21
Knox	37.7	51.3	89.0	14	191.6	149.1	340.7	17
Northwestern Unit	169.2	477.5	646.7	6.1	780.1	1,491.4	2,271.5	8.0
All counties	2,060.4	4,333.9	6,394.3	1.3	8,099.0	12,316.9	20,415.9	1.7

[a]Multi-county groupings are used for counties with too few field plots or with other sampling anomalies. This is done to minimize sampling errors when more detailed county-level data are presented.

Table 67.--Area of commercial forest land by county and geographic unit, Ohio, 1968 and 1979

County[a] and geographic unit	1968	1979[b]	Change	Change	Sampling Error for 1968
	--------Thousand acres--------			--------Percent------	
Adams	197.2	194.0	- 3.2	- 2	4
Brown	74.6	82.5	+ 7.9	+11	11
Clermont	85.1	93.6	+ 8.5	+10	7
Gallia	164.6	171.9	+ 7.3	+ 4	2
Highland	75.8	64.9	-10.9	-14	18
Jackson	148.1	172.7	+24.6	+17	6
Lawrence	199.0	213.4	+14.4	+ 7	6
Pike	180.6	177.3	- 3.3	- 2	2
Ross	172.4	168.8	- 3.6	- 2	6
Scioto	262.7	262.2	- .5	W	3
South-Central Unit	1,560.1	1,601.3	+41.2	+ 2.6	1.9
Athens	215.1	191.8	-23.3	-11	7
Hocking	178.8	168.4	-10.4	- 6	7
Meigs	182.3	187.3	+ 5.0	+ 3	3
Morgan	118.6	134.9	+16.3	+14	7
Perry	120.6	148.3	+27.7	+23	9
Vinton	197.1	189.6	- 7.5	- 4	7
Washington	238.6	227.4	-11.2	- 5	5
Southeastern Unit	1,251.1	1,247.7	- 3.4	- .3	2.4
Belmont	173.1	180.0	+ 6.9	+ 4	4
Carroll	105.2	115.2	+10.0	+10	8
Coshocton	171.8	167.3	- 4.5	- 3	8
Guernsey	156.4	164.8	+ 8.4	+ 5	9
Harrison	148.5	142.4	- 6.1	- 4	10
Holmes	72.3	77.2	+ 4.9	+ 7	10
Jefferson	126.8	134.4	+ 7.6	+ 6	8
Monroe	178.5	187.2	+ 8.7	+ 5	8
Muskingum	172.2	184.5	+12.3	+ 7	6
Noble	136.6	142.4	+ 5.8	+ 4	11
Tuscarawas	144.2	162.3	+18.1	+13	7
East-Central Unit	1,585.6	1,657.7	+72.1	+ 4.5	2.5
Ashland/Richland	95.9	116.5	+20.6	+21	14
Ashtabula	192.2	187.9	- 4.3	- 2	8
Columbiana	118.0	130.3	+12.3	+10	11
Cuyahoga	-	-	-	-	-
Erie/Huron	59.2	57.5	- 1.7	- 3	30
Geauga/Lake	119.3	164.6	+45.3	+38	23
Lorain/Medina	95.3	102.8	+ 7.5	+ 8	18
Mahoning	61.2	69.8	+ 8.6	+14	19
Portage/Summit	131.1	147.5	+16.4	+13	21
Stark/Wayne	121.6	122.3	+ .7	+ 1	12
Trumbull	136.0	141.2	+ 5.2	+ 4	12
Northeastern Unit	1,129.8	1,240.4	+110.6	+ 9.8	5.0

Table 67.-- continued

County[a] and geographic unit	1968	1979[b]	Change	Change	Sampling Error for 1968
	Thousand acres			Percent	
Butler/Hamilton	73.9	78.1	+ 4.2	+ 6	24
Clark/Darke/Miami	53.9	60.9	+ 7.0	+13	17
Clinton/Greene/ Montgomery/Preble/Warren	103.0	116.2	+13.2	+13	19
Fairfield/Licking	120.3	155.0	+34.7	+29	19
Fayette/Franklin/Madison/ Pickaway	61.7	60.0	- 1.7	- 3	24
Southwestern Unit	412.8	470.2	+57.4	+13.9	9.5
Allen/Auglaize/Mercer/ Putnam/Van Wert	58.1	70.4	+12.3	+21	29
Champaign/Logan/Shelby/Union	86.4	93.6	+ 7.2	+ 8	26
Crawford/Hardin/Wyandot	63.0	68.7	+ 5.7	+ 9	31
Defiance/Fulton/Henry/Lucas Paulding/Williams	145.5	188.0	+42.5	+29	15
Delaware/Marion/Morrow	95.2	100.6	+ 5.4	+ 6	14
Hancock/Ottawa/Sandusky/ Seneca/Wood	77.6	92.7	+15.1	+19	21
Knox	89.6	85.8	- 3.8	- 4	17
Northwestern Unit	615.4	699.8	+84.4	+13.7	7.7
All counties	6,554.8	6,917.1	+362.3	+ 5.5	1.6

[a]Multi-county groupings are used for counties with too few field plots or with other sampling anomalies. This is done to minimize sampling errors when more detailed county-level data are presented.
[b]For sampling errors for 1979 area, see Table 64.
W-Less than 0.5 percent.

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APPENDIX

Definition of terms

Accretion. The estimated net growth of growing-stock trees that were measured during the previous inventory, divided by the length of the period between surveys. It includes the growth on trees that were cut during the period, plus those trees that died and were used.

Annual mortality trend-level. The estimated mortality of growing stock or sawtimber for a specific year (1978 for Ohio) based on average rates of diameter growth and mortality for the period. This estimate is consistent with the average annual change during the period between surveys and with the current inventory.

Annual net growth trend-level. The estimated mortality of growing stock or sawtimber for a specific year (1978 for Ohio) based on average rates of diameter growth and mortality for the period. This estimate is consistent with the average annual change during the period between surveys and with the current inventory.

Annual removals trend-level. The estimated removals of growing stock or sawtimber for a specific year (1978 for Ohio) obtained from a trend line for the period. This line is established by fitting a curve to actual removals data for several years during the period. The actual removals for the year given can vary from the trend estimate because of fluctuations in market conditions and other factors.

Average annual net growth. The change, resulting from natural causes, in growing-stock or sawtimber volume of sound wood in growing-stock or sawtimber trees during the period between surveys, divided by the length of the period. Components of average annual net growth include the increment in net volume of trees that are present at the beginning of the period and that survive to the end (accretion), plus average annual ingrowth, minus average annual mortality, and minus the net volume of trees that became rough or rotten during the period (cull increment).

Average annual removals. The net growing-stock or sawtimber volume of trees harvested or killed in logging, cultural operations (such as timber stand improvement), or land clearing, and also the net growing-stock or sawtimber volume of trees neither harvested nor killed but growing on land that was reclassified from commercial forest land to noncommercial forest land during the period between surveys. This volume is divided by the length of the period.

Board foot. A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent.

Coarse residues. Manufacturing residues suitable for chipping, such as slabs, edgings, and veneer cores.

Commercial forest land. Forest land producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and not withdrawn from timber utilization.

Commercial species. Tree species presently or prospectively suitable for industrial wood products. Excludes species of typically small size, poor form, or inferior quality, such as hawthorn and sumac.

County and municipal lands. Lands owned by counties and local public agencies or municipalities or leased to them for 50 years or more.

Cull increment. The net volume of growing-stock trees on the previous inventory that became rough or rotten trees in the current inventory, divided by the length of the period between surveys.

Diameter at breast height (dbh). The diameter outside bark of a standing tree measured at 4-1/2 feet above the ground.

Farmer-owned lands. Lands owned by farm operators, whether part of the farmstead or not. Excludes land leased by farm operators from nonfarm owners.

Federal lands. Lands (other than National Forests) administered by Federal agencies.

Fine residues. Manufacturing residues not suitable for chipping, such as sawdust and shavings.

Forest industry lands. Lands owned by companies or individuals operating primary wood-using plants.

Forest land. Land at least 10 percent stocked with trees of any size or that formerly had such tree cover and is not currently developed for nonforest use. The minimum area for classification of forest land is 1 acre.

Forest type. A classification of forest land based on the species forming a plurality of live-tree stocking. The many forest types in Ohio were combined into the following major forest-type groups:

a. White/red pine--forests in which white pine or red pine, singly or in combination, make up a plurality of the stocking; in Ohio common associates include yellow-poplar, red maple, oak, black walnut and black cherry.

b. Hard pine--forests in which Virginia, shortleaf, or pitch pines or eastern redcedar, singly or in combination make up a plurality of the stocking; in Ohio common associates include red maple, oak, white or red pine, white ash, black walnut, and sycamore.

c. Oak/pine--forests in which hardwoods (usually hickory or oak) make up a plurality of the stocking but where shortleaf or Virginia pine or eastern redcedar make up 25 to 50 percent of the stocking.

d. Oak/hickory--forests in which upland oaks, hickory, yellow-poplar, black locust, black walnut, sweetgum, sassafras, persimmon, or red maple (when associated with central hardwoods), singly or in combination, make up a plurality of the stocking and in which shortleaf or Virginia pines, or eastern redcedar make up less than 25 percent of the stocking; in Ohio common associates include white ash, sugar maple, and black cherry.

e. Elm/ash/red maple--forests in which elm, river birch, sycamore, willow, cottonwood, or red maple (when growing on wet sites), singly or in combination, make up a plurality of the stocking; in Ohio common associates include white ash, sugar maple, oak, hickory, yellow-poplar, and black cherry.

f. Northern hardwoods--forests in which sugar maple, beech, yellow birch, black cherry, or red maple (when associated with northern hardwoods), singly or in combination, make up a plurality of the stocking; in Ohio common associates include white ash, hickory, yellow-poplar, white oak, and red oaks.

g. Aspen/birch--forests in which aspen is a plurality of the stocking; in Ohio common associates include red maple, black cherry, red oaks, and beech.

Growing-stock trees. Live trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees.

Growing-stock volume. Net volume, in cubic feet of growing-stock trees 5.0 inches dbh and larger, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem, or to the point where the central stem breaks into limbs. Net volume equals gross volume, less deduction for cull.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Industrial wood. All roundwood products except fuelwood.

Ingrowth. The estimated net volume of growing stock trees that became 5.0 inches dbh or larger during the period between inventories, divided by the length of the period between surveys.

International 1/4-inch rule. A log rule, or formula, for estimating the board-foot volume of logs. The mathematical formula is:

$$(0.22D^2 - 0.71D)(0.904762)$$

for 4-foot sections, where D = diameter inside bark at the small end of the section. This rule is used as the USDA Forest Service Standard Log rule in the eastern United States.

Land area. (a) Bureau of Census: The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than 1/8 statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area. (b). Resources Evaluation: same as (a) except that the minimum width of streams, etc., is 120 feet, and the minimum size of lakes, etc., is 1 acre

Logging residues. The unused portions of growing-stock trees harvested or killed in the process of logging.

Manufacturing plant residues. Wood materials that are generated when round timber (roundwood) is converted into wood products. This includes slabs, edgings, trimmings, bark, miscuts, sawdust, shavings, veneer cores and clippings, and pulp screening. If these residues are used, they are referred to as plant byproducts.

Miscellaneous private lands. Privately owned lands other than forest-industry and farmer-owned lands.

Mortality. The estimated net volume of growing-stock trees on the previous inventory that died from natural causes before the current inventory, divided by the length of the period between surveys.

National Forest lands. Federal lands legally designated as National Forests or purchase units and other lands administered as part of the National Forest System by the USDA Forest Service.

Noncommercial forest land. Productive-reserved, urban, and unproductive forest land.

Noncommercial species. Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land. Land that has never supported forests, or land formerly forested but now in nonforest use such as cropland, pasture, residential areas, and highways.

Nonstocked areas. Commercial forest land that is stocked with less than 10 percent of minimum full stocking with growing-stock trees.

Plant byproducts. Wood products, such as pulp chips, recycled from manufacturing plant residues.

Poletimber stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees, with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of poletimber exceeds that of sawtimber.

Poletimber trees. Live trees of commercial species meeting regional specifications of soundness and form and at least 5.0 inches in dbh, but smaller than sawtimber trees.

Productive-reserved forest land. Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas tree production.

Primary wood manufacturing plant. A plant that converts round timber into wood products such as woodpulp, lumber, veneer, cooperage, and dimension products.

Pulpwood. Roundwood converted into 4- or 5-foot lengths or chips, and chipped plant byproducts that are prepared for manufacture into woodpulp.

Rotten trees. Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough trees. (a) The same as rotten trees, except that rough trees do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees of noncommercial species.

Roundwood products. Logs, bolts, total tree chips, or other round timber generated by harvesting trees for industrial or consumer uses.

Saplings. Live trees 1.0 through 4.9 inches dbh.

Sapling-seedling stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in saplings or seedlings or both.

Sawlog. A log meeting regional standards of diameter, length, and defect, including a minimum 8-foot length and a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods. (See specifications under Log Grade Classification.)

Sawlog portion. That part of the bole of a sawtimber tree between the stump and the sawlog top; that is, the merchantable height.

Sawlog top. The point on the bole of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches diameter outside bark (dob) for softwoods and 9.0 inches dob for hardwoods.

Sawtimber stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

Sawtimber trees. Live trees of commercial species at least 9.0 inches dbh for softwoods or 11.0 inches for hardwoods containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

Sawtimber volume. Net volume in board feet, International 1/4-inch rule, of sawlogs in sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Seedlings. Live trees less than 1.0 inch dbh that are expected to survive.

Site class. A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Classifications are based on the mean annual growth of growing-stock trees attainable in fully stocked natural stands at culmination of mean annual increment.

Softwoods. Coniferous trees, usually evergreen and having needles or scalelike leaves.

Stand. A group of forest trees growing on forest land.

Stand-size class. A classification of forest land based on the size class (that is, seedlings, saplings, poletimber, or sawtimber) of growing-stock trees in the area.

Standard cord. A unit of measure for stacked bolts of wood, encompassing 128 cubic feet of wood, bark, and air space. Fuelwood cord estimates can be derived from cubic-foot estimates of growing stock by applying an average factor of 80 cubic feet of solid wood per cord. For pulpwood, a conversion of 85 cubic feet of solid wood per cord is used because of the more uniform character of pulpwood.

State lands. Lands owned by the State or leased to the State for 50 years or more.

Stocking. The degree of occupancy of land by trees, measured by basal area and/or number of trees in a stand compared to the basal area and/or number of trees required to fully use the growth potential of the land (or the stocking standard). In the eastern United States this standard is 75 square feet of basal area per acre for trees 5.0 inches dbh and larger, or its equivalent in numbers of trees per acre for seedlings and saplings.

Two categories of stocking are used:

All live trees - these are used to classify forest land and forest types.

Growing-stock trees - these are used to classify stand-size classes.

Timber products. Manufacturing plant byproducts and roundwood (round timber) products harvested from growing-stock trees on commercial forest land; from other sources, such as cull trees, salvable dead trees, limbs, tops, and saplings; and from trees on noncommercial forest and nonforest lands.

Timber removals. The growing-stock or sawtimber volumes of trees removed from the inventory for roundwood products, plus logging residues, volume destroyed during land clearing, and volume of standing trees growing on land that was reclassified from commercial forest land to noncommercial forest land. (See Table 29).

Trees. Woody plants that have well-developed stems and are usually more than 12 feet in height at maturity.

Unproductive forest land. Forest land that is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions.

Unused manufacturing residues. Plant residues that are dumped or destroyed and not recovered for plant byproducts.

Upper-stem portion. That part of the main stem or fork of a sawtimber tree above the sawlog top to a diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

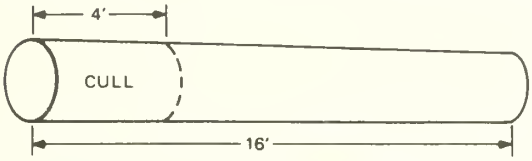
Urban forest land. Noncommercial forest land within urban areas that is completely surrounded by urban development (not parks), whether commercial, industrial, or residential.

LOG-GRADE CLASSIFICATION

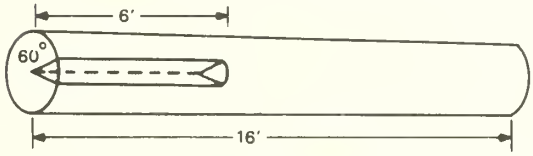
Log grades are a classification of logs based on external characteristics as indicators of quality or value. The log-grade standards and grading systems for softwoods and hardwoods used in this forest survey are shown in the following specifications:

Methods of determining scaling deduction.

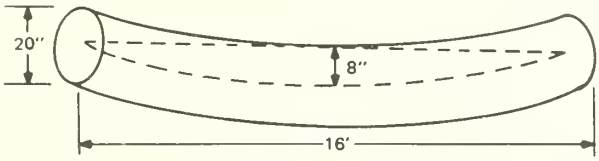
(Examples based on a 16-foot log with 20-inch scaling diameter)



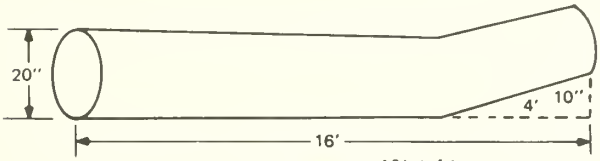
Defect section (rule 1): Percent deduction = $\frac{4}{16}$ = 25%



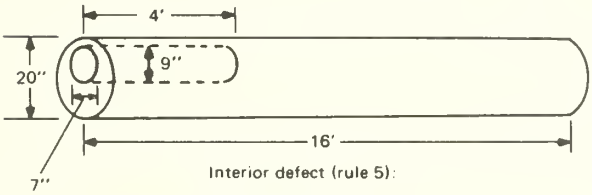
Defect section (rule 2): Percent deduction = $\left(\frac{6}{16}\right)\left(\frac{60}{360}\right)$ = 6-1/4%



Sweep (rule 3): Percent deduction = $\frac{8 \cdot 2}{20}$ = 30%



Crook (rule 4): Percent deduction = $\left(\frac{10}{20}\right)\left(\frac{4}{16}\right)$ = 12-1/2%



Interior defect (rule 5):

Percent deduction = $\frac{(8)\ (10)}{(20-1)^2} \times \frac{4}{16}$ = 5-5/9%

In practice each elipse axis can be divided by (20−1)

Thus $\frac{8}{19}$ = .4, $\frac{10}{19}$ .5, and (.4) (.5) $\left(\frac{4}{16}\right)$ = 5%

From: Grosenbaugh, L.R. 1952. Shortcuts for cruisers and scalers. U.S. Dep, Agric. For. Serv. South. For Exp. Stn. Occas Pap. 126.

STANDARD GRADES FOR HARDWOOD FACTORY LUMBER LOGS

Grading Factors		Log grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & Uppers				Butts & uppers
Scaling diameter, inches		13-15[a]	16-19	20+	11+[b]	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear cuttings[c] of each of 3 best faces[d]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than ¼ of end in sound defects	15%			30%				50%
	For logs with more than ¼ of end in sound defects	10%			20%				35%
Maximum scaling	deduction	40%[e]			50%[f]				50%

End defects although not visible in standing trees, are important in grading cut logs. Instructions for dealing with this factor are contained in Forest Prod. Lab. Rpt. D 1737.

[a]Ash and basswood butts can be 12 inches if they otherwise meet requirements for small #1's.
[b]Ten-inch logs of all species can be #2 if they otherwise meet requirements for small #1's.
[c]A clear cutting is the portion of a face, extending the width of the face, that is free of defects.
[d]A face is ¼ of the surface of the log as divided lengthwise.
[e]Otherwise #1 logs with 41-60% deductions can be #2.
[f]Otherwise #2 logs with 51-60% deductions can be #3.

From: Vaughan, C. L., A. C. Wollin, K. A. McDonald, and E. H. Bulgrin. 1966. Hardwood log grades for standard lumber. USDA For. Serv. Res. Pap. FPL-63.

STANDARD SPECIFICATIONS FOR HARDWOOD CONSTRUCTION LOGS.[a]

Position in tree		Butt & upper
Min. diameter, small end		8 inches +
Min. length, without trim		8 feet
Clear cuttings		No requirements.
Sweep allowance, absolute		1/4 diameter small end for each 8 feet of length.
Sound surface defects	Single knots	Any number, if no one knot has an average diameter above the callus in excess of 1/3 of log diameter at point of occurrence.
	Whorled knots	Any number if sum of knot diameters above the callus does not exceed 1/3 of log diameter at point of occurrence.
	Holes	Any number provided none has a diameter over 1/3 of log diameter at point of occurrence, and none extends over 3 inches into included timber.[b]
Unsound surface defects		Same requirements as for sound defects if they extend into included timber.[b] No limit if they do not.
End defects	Sound	No requirements.
	Unsound	None allowed; log must be sound internally, but will admit 1 shake not to exceed 1/4 the scaling diameter and a longitudinal split not extending over 5 inches into the contained timber.

[a]These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only non-factory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, then it may be necessary to subdivide the class into grades.
[b]Included timber is always square, and dimension is judged from small end.

From: Rast, E. D., D. L. Sonderman, and G. L. Gammon. 1973. A guide to hardwood log grading (Revised). USDA For. Serv. Gen. Tech. Rep. NE-1.

EASTERN WHITE PINE SAWLOG GRADE SPECIFICATIONS

GRADING FACTOR	LOG GRADE 1	LOG GRADE 2	LOG GRADE 3	LOG GRADE 4
(1) MINIMUM SCALING DIAMETER (inches)	14[1]	6	6	6
(2) MINIMUM LOG LENGTH (feet)	10[2]	8	8	8
(3) MAXIMUM WEEVIL INJURY (number)	None	None	2 injuries[3]	No limit
(4) MINIMUM FACE REQUIREMENTS	Two full length or four 50% length good faces.[4] (In addition, log knots on balance of faces shall not exceed size limitations of grade 2 logs.)	No GOOD FACES REQUIRED. Maximum diameter of log knots on three best faces: SOUND RED KNOTS not to exceed 1/6 scaling diameter and 3 inch maximum; DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/12 scaling diameter and 1½ inch maximum	SOUND RED KNOTS not to exceed 1/3 scaling diameter and 5 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/6 scaling diameter and 2½ inch maximum.	Includes all logs not qualifying for No. 3 or better and judged to have at least one-third of their gross volume in sound wood suitable for manufacture into standard lumber
(5) MAXIMUM SWEEP OR CROOK ALLOWANCE (percent)	20	30	40	66⅔
(6) MAXIMUM TOTAL SCALING DEDUCTION (percent)	50	50	50	66⅔

After the tentative log grade is established from face examination, the log will be reduced in grade whenever the following defects are evident

(7) CONKS, PUNK KNOTS, AND PINE BORER DAMAGE ON BARK SURFACE[5]

Degrade one grade if present on one face.
Degrade two grades if present on two faces.
Degrade three grades if present on three or more faces

(8) LOG END DEFECTS. RED ROT, RING SHAKE, HEAVY STAIN AND PINE BORER DAMAGE OUTSIDE HEART CENTER OF LOG[5]

Consider log as having a total of 8 quarters (4 on each end) and degrade as indicated below
Degrade one grade if present in 2 quarters of log ends.
Degrade two grades if present in 3 or 4 quarters of log ends.
Degrade three grades if present in 5 or more quarters of log ends

[1]12 and 13 inch logs with four full length good faces are acceptable
[2]8 foot logs with four full length good faces are acceptable
[3]8 foot No. 3 logs limited to one weevil injury
[4]Minimum 50% length good face must be at least 6 feet
[5]Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log to be degraded below grade 4 if net scale is at least one-third gross log scale

From: Ostrander, M. D., and R. L. Brisbin, 1971. Sawlog grades for eastern white pine. USDA For. Serv. Res. Pap. NE-205.

SOUTHERN PINE SAWLOGS

Grade 1. Logs with 3 or 4 clear faces.[1] Code 1.

Grade 2. Logs with 1 or 2 clear faces. Code 2.

Grade 3. Logs with no clear faces. Code 3.

After the tentative log grade is established from above, the log will be degraded one grade for each of the following, except that no log can be degraded below grade 3.

1. *Sweep.* Degrade any tentative 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one third (1/3) the diameter inside bark at small end. This is the final grade if there is no evidence of heart rot.

2. *Heart rot.* Degrade any tentative 1 or 2 log one grade if conk, massed hyphae, or other evidence of advanced heart rot is found anywhere in it.

[1] A face is one-fourth of the circumference in width extending full length of the log. Clear faces are those free of: knots measuring more than one-half inch in diameter, overgrown knots of any size, holes more than one-fourth inch in diameter. The faces may be rotated if necessary to obtain the maximum number of clear ones.

From: Schroeder, J. G., R. A. Campbell, and R. C. Rodenbach. 1968. Southern pine sawlogs for yard and structural lumber. USDA For. Serv. Res. Pap. SE-39.

Commercial tree species of Ohio

Scientific Name[a]	Common Name	Occurrence[b]
Softwoods		
Juniperus virginiana	eastern redcedar	c
Picea abies	Norway spruce	vr
Pinus echinata	shortleaf pine	r
P. resinosa	red pine	vr
P. rigida	pitch pine	r
P. strobus	eastern white pine	r
P. sylvestris	Scotch pine	vr
P. virginiana	Virginia pine	c
Thuja occidentalis	northern white-cedar	vr
Tsuga canadensis	eastern hemlock	r
Hardwoods		
Acer nigrum	black maple	r
A. rubrum	red maple (soft)	vc
A. saccharinum	silver maple	c
A. saccharum	sugar maple (hard)	vc
Aesculus glabra	Ohio buckeye	vr
Betula alleghaniensis	yellow birch	r
B. lenta	sweet birch (black)	r
B. nigra	river birch	vr
Carya spp.	hickory	vc
Castanea dentata	American chestnut	vr
Celtis occidentalis	hackberry	r
Cornus florida	flowering dogwood	c
Diospyros virginiana	common persimmon	r
Fagus grandifolia	American beech	c
Fraxinus americana	white ash	vc
F. nigra	black ash	r
F. pennsylvanica	green ash	r
F. quadrangulata	blue ash	vr
Gleditsia triacanthos	honeylocust	r
Gymnocladus dioicus	Kentucky coffeetree	vr
Juglans cinerea	butternut	r
J. nigra	black walnut	c
Liquidambar styraciflua	sweetgum (red gum)	r
Liriodendron tulipifera	yellow-poplar (tulip tree)	vc
Magnolia spp.	magnolia spp.	vr
Magnolia acuminata	cucumber tree	vr
Nyssa sylvatica	blackgum (black tupelo)	c
Platanus occidentalis	American sycamore	c
Populus balsamifera	balsam poplar	vr
P. deltoides	eastern cottonwood	r
P. grandidentata	bigtooth aspen	c
P. tremuloides	quaking aspen	r
Prunus serotina	black cherry	vc
Quercus alba	white oak	vc
Q. bicolor	swamp white oak	c
Q. coccinea	scarlet oak	c
Q. imbricaria	shingle oak	r
Q. macrocarpa	bur oak	r
Q. muehlenbergii	chinkapin oak	r
Q. palustris	pin oak	c
Q. prinus	chestnut oak	c
Q. rubra	northern red oak	c
Q. stellata var. *stellata*	post oak	r

Tree species continued

Q. velutina	black oak	c
Robinia pseudoacacia	black locust	c
Salix spp.	willow spp.	r
Sassafras albidum	sassafras	c
Tilia spp.	basswood	c
Ulmus spp.	elm	vc

[a] Names according to: Little, Elbert L., Jr. 1979. Checklist of United States trees (native and naturalized). For. Serv., U.S. Dep. Agric. Agric. Handb. 541. Washington, D.C., 375 p.

[b] Occurrence is based on the frequency of tally of commercial species 5.0 inches dbh or larger on forest survey field plots: vr - very rare (<0.05%), r - rare (0.05 to 0.49%), c - common (0.5 to 4.9%), and vc - very common (>5.0%).

Metric equivalents of units used in this report

1 acre = 4,046.86 square meters or 0.404686 hectares
1,000 acres = 404.686 hectares
1,000,000 acres = 404,686 hectares
1,000 board feet = 3.48 cubic meters[a]
1 cubic foot = 0.028317 cubic meters
1,000 cubic feet = 28.317 cubic meters
1,000,000 cubic feet = 28,317 cubic meters
1 cord (wood, bark, and airspace) = 3.6246 cubic meters
1 cord (solid wood, pulpwood) = 2.4069 cubic meters
1 cord (solid wood, other than pulpwood) = 2.2654 cubic meters
1,000 cords (pulpwood) = 2,406.9 cubic meters
1,000 cords (other products) = 2,265.4 cubic meters
1 inch = 2.54 centimeters or 0.0254 meters
1 foot = 30.48 centimeters or 0.3048 meters
Breast height = 1.4 meters above ground level
1 mile = 1.609 kilometers
1 square foot = 929.03 square centimeters or 0.0929 square meters
1 square foot per acre basal area = 0.229568 square meters per hectare

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[a] Although 1,000 board feet is theoretically equivalent to 2.36 cubic meters, this is true only when a board foot actually has a volume 1/12 of a cubic foot. The International 1/4-inch log rule is used by the USDA Forest Service in the East to estimate the product potential in board feet. The reliability of the estimate, using a conversion, will vary with the size of the log measure. The conversion given here, 3.48 cubic meters, is based on the cubic volume of a log 16 feet long and 15 inches in diameter inside bark (dib) at the small end. This conversion could be used for average comparisons when accuracy of 10 percent is acceptable. Because the board foot unit is not a true measure of wood volume and since products other than dimension lumber are increasingly important, this unit may eventually be replaced by the cubic meter.

☆U.S. GOVERNMENT PRINTING OFFICE: 1981-703-011/35

Dennis, Donald F., and Thomas W. Birch. Forest Statistics for Ohio--1979. Broomall, PA: Northeast. For. Exp. Stn.; 1981; USDA For. Serv. Resour. Bull. NE-68. 79 p.

A statistical report on the third forest survey of Ohio conducted in 1978 and 1979. Statistical findings are based on data from remeasured and new 10-point variable-radius plots. The current status of forest-land area, timber volume, and annual growth and removals is presented. Timber products output by timber industries, based on a 1978 updated canvass of manufacturers is presented.

ODC 905.1(748)

Keywords: Forest survey, area, volume, growth, removals, counties.

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United States
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**Northeastern Forest
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An Analysis of Pennsylvania's Forest Resources

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Abstract

This report presents an analysis of the results of the third forest survey of Pennsylvania as well as trends that have occurred since the previous surveys. Topics include forest area by ownership, stand size, and forest type; timber volume by species, location, and quality; biomass; timber products output for sawlogs, pulpwood, and fuelwood; timber's role in the state's economy; and growth and removals. Forest area, volume, and growth and removals are projected through 2008. Nontimber forest resources and uses—water, soil, minerals, fish, wildlife, and recreation—are discussed and related to each other and to the timber resource. Also identified are forest management opportunities for increasing the production of major forest resources and enhancing the benefits derived from Pennsylvania's forests.

Foreword

This analysis of Pennsylvania's forest resources draws upon the results of three forest inventories conducted by the Resources Evaluation Unit of the Northeastern Forest Experiment Station, USDA Forest Service, in cooperation with the Pennsylvania Bureau of Forestry, Department of Environmental Resources. Additional information and data, especially for nontimber forest resources, were provided by a variety of agencies and organizations including the Bureau of Resources Programming, the Bureau of State Parks, and the Bureau of Surface Mine Reclamation, Department of Environmental Resources, the Bureau of Economic Development of the Pennsylvania Department of Commerce, the Pennsylvania Governor's Office of State Planning and Development; the Pennsylvania Game Commission; the Pennsylvania Fish Commission; The Pennsylvania State University; the USDA Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Department of Energy; the Pennsylvania Forestry Association; and the Western Pennsylvania Conservancy.

A tremendous amount of data was collected during the preparation of this report. The authors analyzed only what they believed were the most important aspects of Pennsylvania's forest resources. Much additional data are available and further analyses are possible. Should you require additional information, contact Resources Evaluation, USDA Forest Service, Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008 (telephone: 215-461-3037)

Cover photo

The Allegheny Mountains and the West Branch of the Susquehanna River from Hyner View (Clinton County). Note that the ridges are similar in elevation, which is characteristic of a dissected plateau.

An Analysis of Pennsylvania's Forest Resources

Contents

Highlights

This report covers many items related to the past, present, and future conditions of the many forest resources in Pennsylvania. The following are a few of the more important highlights; the reader will find more detailed discussions and analyses in the sections that follow.

- From 1965 to 1978 total forest land increased slightly while commercial forest land area decreased by about 2 percent.

- Forest industries and State agencies showed increases in commercial forest-land acreage, most of this coming from the largest ownership group—miscellaneous private—which showed a loss of more than 1 million acres.

- Pennsylvania's forests are maturing. There are more sawtimber stands and fewer poletimber stands.

- Growing-stock volume increased by 22 percent and sawtimber volume by 48 percent from 1965 to 1978. These increases are the result of a bulge of timber volume moving from smaller to larger diameter classes.

- Red maple maintained its standing as the species with the most growing-stock volume; because most of this volume is in small trees, red maple was a distant second to northern red oak in sawtimber volume.

- Sugar maple growing-stock volume rose by 60 percent between surveys, the largest percentage increase among the major species. Maples will continue to increase more than oaks.

- The aboveground green weight of all live trees 5.0-inches in diameter at breast height (dbh) and larger is 1.3 billion tons. Twenty-three percent of this is topwood and branchwood, and the utilization of this resource can be greatly expanded.

- Hardwood sawlog quality has improved. In 1965, 28 percent of the hardwood sawtimber volume was Grade 2 or better material. By 1978, this figure had risen to 37 percent. Increasing average tree size is the most important reason for the improvement.

- The total output of timber products from all sources was 212.5 million cubic feet in 1976, a 21-percent increase over 1964's output.

- Sawlogs continue to dominate timber products output, but pulpwood production accounts for an increasingly larger share of the output.

- Annual hardwood mortality increased by 60 percent between inventories, largely as a result of heightened insect and disease attacks in the oak forest types.

- Thirty-year projections (1978 to 2008) indicate a slightly declining commercial forest-land base, a slowing of the increase in growing-stock inventory, and a steadily decreasing growth-to-removals ratio.

- Forests provide valuable protection for many of Pennsylvania's watersheds.

- Forty-four percent of Pennsylvania's area is covered by soils with very good to excellent potential for growing trees.

- Increased activity in oil and gas exploration and extraction and strip mining of coal will have both negative and positive impacts on forest resources.

- Pennsylvania's streams and ponds support about 170 species of fish most of which depend on quality water and protection provided by forest land.

- More than 230 of the bird and mammal species in Pennsylvania are at least partially dependent on forested environments.

- Much of the booming demand for outdoor recreation in Pennsylvania is satisfied by publicly owned forest land. Many millions of acres of privately owned forest land are available for some public recreation, but they are presently underutilized.

- Many forest management opportunities are available to the private Pennsylvania forest-land owner. There are opportunities for enhancing single benefits such as wood production, wildlife habitat, esthetic enjoyment, and recreational or wilderness values, and for enhancing a variety of combinations of these benefits.

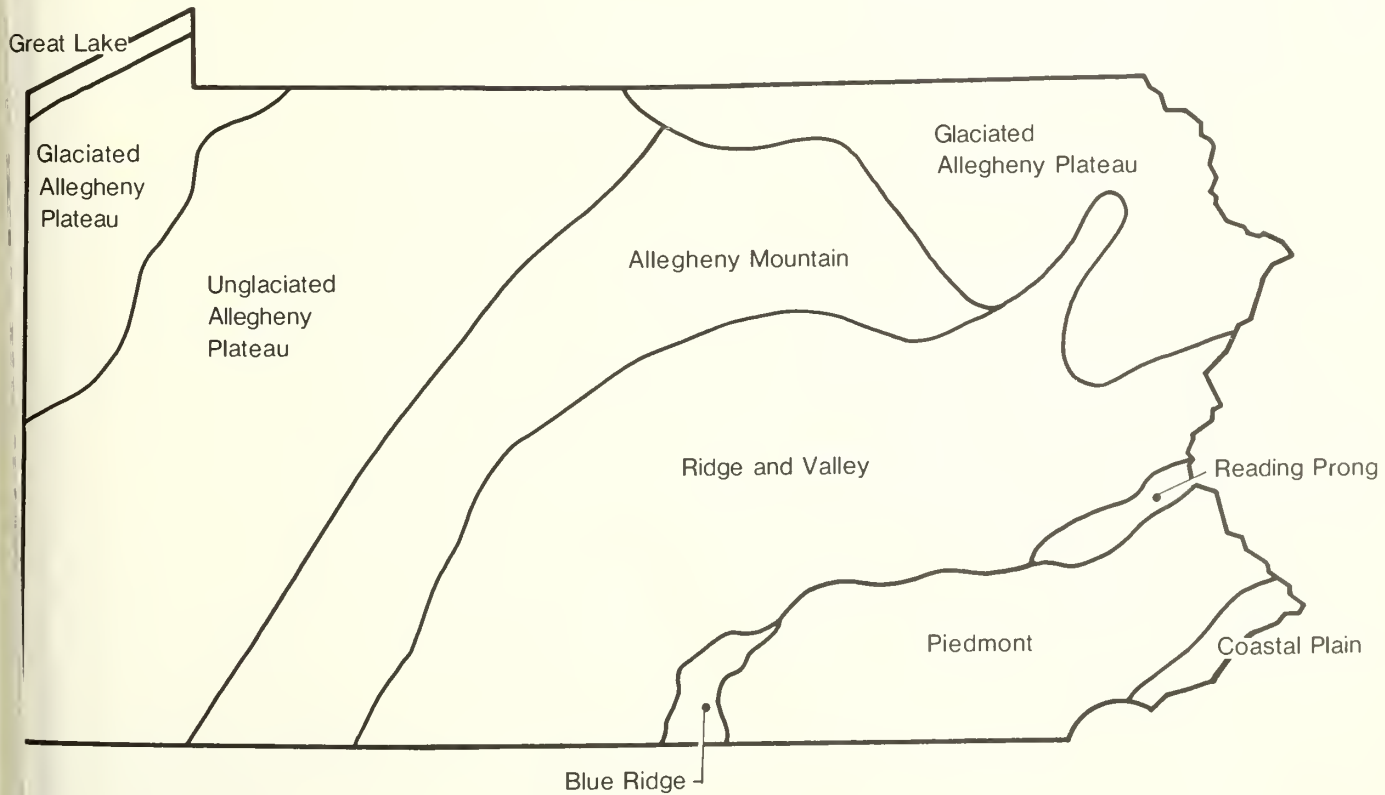
Background

The history of land use and the accompanying development of forestry in Pennsylvania provides background information that is necessary for understanding the present condition and trends of the state's forest resources.

Before the first settlement of Europeans in the early 17th century, Pennsylvania was sparsely populated with Indian tribes, who cleared little land. Except for such clearings and a few natural meadows and savannahs, the area now known as Pennsylvania was covered with virgin forests. In the northern plateau areas, the forests consisted of white pine and hemlock mixed with beech and sugar maple. White oak, American chestnut, hickory, and chestnut oak were dominant in the southern areas (Braun 1950).

These magnificent stands, some believed to have contained more than 100,000 board feet per acre, were seen as obstacles to settlement. As land clearing began in the southeast corner of his province, William Penn, in 1681, directed the colonists to "leave one acre of trees for every five acres cleared." Most settlers, anxious to establish farms and develop their fertile land, paid little attention to Penn's foresighted attempt to conserve the forest resources. After all, the climate and soils were favorable, fires were rare, streams ran full and clear without dangerous flooding, and the timber stretched on seemingly forever. Why not clear all of the land? The consequences of such an attitude became painfully clear to Pennsylvanians over 200 years later.

As the population increased, the Coastal Plain and Piedmont physiographic regions, with their fertile soils, level to rolling topography, and relatively long growing seasons, could no longer support Pennsylvania's settlers. Pioneers moved up the river valleys, into the Ridge and Valley region (Fig. 1), and cleared the more level and fertile valleys. Anthracite coal was discovered in east-central Pennsylvania early in the 1760's, and forests were cleared to get at this valuable fuel. Despite such activity, the state was still 75 percent forested 200 years after the first settlers became established.



gure 1.—The physiographic regions of Pennsylvania (adapted
om Fenneman 1938).

Aerial view of the Ridge and Valley region of Centre and Clinton Counties.

Western Pennsylvania Conservancy

The Industrial Revolution led to the end of Pennsylvania's old-growth forests as the logger and farmer teamed up—the former to fell the timber, the latter to convert the land to agricultural use. The mining industry required much wood for timbers. Charcoal was needed to fire the iron furnaces. The tanning industry required tons of hemlock bark. Logs were removed for construction lumber, railroad ties, shingles, barrel staves, lath, furniture, tool handles, and other products. Timber utilization was very complete (Marquis 1975). By 1850, the center of logging in America had shifted from Maine and New York into Pennsylvania. Between 1850 and 1870, the Commonwealth led all states in sawtimber production.

During the 1800's and early 1900's, timber harvesting in Pennsylvania consisted of removing most merchantable trees from the area being logged. This uncontrolled logging ranged from high grading, where only the best trees were taken, to complete removal of all trees. The forests were exploited,

Felling trees and peeling the bark for use in tanning leather was arduous labor at the turn of the century.

Pennsylvania Bureau of Forestry

and no consideration was given to the desirability of adequate regeneration following cutting (Nelson et al. 1975).

This heavy logging was followed by repeated fires, and after each one came poorer soil conditions, higher runoff, and the production of poorer quality timber. Because of the unique market for small timber used as props and lagging in mines, many of these second-growth stands, especially in the anthracite region of east-central Pennsylvania, were repeatedly cut when the trees reached pole size.

From 1850 to 1920 most of Pennsylvania's magnificent old-growth forests were reduced to areas where hillsides were bare and streams were muddy and prone to flash flooding. Some wildlife species that were once abundant became scarce, and boom towns were becoming ghost towns. An estimated 10 million acres of prime forest land were converted to other uses, primarily agriculture. Of the forest land that was left, more than 5 million acres were barren and unproductive, while many more were poorly stocked with trees. Most of the woodland areas were unproductive, unattractive, and unregulated (Illick 1923a). Common sights on the landscape were blackened snags, bramble thickets, and scrub oak barrens.

As a result, many people became concerned and organized an effort to restore the forests in some measure. In 1886, the Pennsylvania Forestry Association was founded to secure and maintain a due proportion of forest area throughout the state. In 1895, the Pennsylvania Bureau of Forestry was established primarily to put out fires but also to establish State Forest Reserves. Dr. Joseph T. Rothrock was instrumental in initiating many such programs and is most deserving of the title "Father of Pennsylvania Forestry."

As the loggers moved into West Virginia, the Lake States, and beyond, and as wildfires were

Logging, fires, and erosion left many hillsides denuded in central Pennsylvania (Costello Cut, Potter County, 1918).

Pennsylvania Bureau of Forestry

brought under control, the forests began to recover. Tax sales made thousands of acres of cutover forest land available at low cost. The State took advantage of this and in 1898 made the initial purchase of 39,277 acres of today's 2-million-acre State Forest System. In the mid-1920's, the Federal Government began buying land for the Allegheny National Forest. Forest-land acreage slowly increased as marginal cropland and pasture were abandoned, and as farmers moved to the cities where industries were gearing up for wartime production.

Pennsylvania's forests were gradually recovering and developing much better than many people had anticipated. Good stands of second-growth timber became established on most of the cutover areas (Nelson et al. 1975). Returning with the trees were more stable watersheds, abundant and varied populations of fish and wildlife, and areas ideally suited for outdoor recreation.

While the forests have made a remarkable comeback in the last 80 years, many impacts on the forest resources have been less than favorable. During the early part of the century, one of Pennsylvania's most common and valuable hardwoods, the American chestnut, was wiped out by a devastating blight. Only small trees, originating as sprouts from the old roots, can be found in Penn's Woods today. Also, during the last decade, insect pests such as the oak leafroller, oak leaftier, and the gypsy moth have defoliated millions of acres of forest land and caused extensive mortality. Coal mining, especially surface mining in the western bituminous fields, is disturbing thousands of acres of forest land annually, sometimes adversely affecting many forest resources.

Penn's Woods are continually changing. Some changes are subtle and gradual, others are obvious and occur over a short period. Without quantifying and assessing the condition of the many resources of the forest, we are unable to see where we have been, where we are, and where we are going. We need this information if we are to plan for the future. This is where forest surveys come into the picture.

Forest Surveys of Pennsylvania

To keep abreast of current forest conditions and to monitor resource trends and project future resource supplies, Resources Evaluation (formerly Forest Survey) of the Northeastern Forest Experiment Station, USDA Forest Service, has inventoried the forest resources of Pennsylvania on three occasions. The first forest survey was conducted over a 5-year period (1949-54) and resulted in statistical data dated 1955 (Ferguson 1958). The second survey was conducted in 1963-65 with a 1965 survey date (Ferguson 1968). The most recent survey was made in 1976 and 1977 with a survey date of 1978. All of these surveys were conducted in cooperation with the Pennsylvania Bureau of Forestry.

The results of the latest survey have been published in 76 statistical tables (Considine and Powell 1980). This report is a detailed analysis of the third survey and draws heavily on much of the data presented in the statistical report. A copy of the statistical report may be useful in following the analysis more closely. Comparisons between the third survey and either of the two previous surveys forms the basis of the trend and projection analyses.

Since the first survey, demands on the forests of Pennsylvania have increased dramatically. Demand for timber products has risen, interest in game and nongame wildlife has expanded, recreational use has become heavier, and demands on the water resource, much of which is directly linked to the forests, have increased and broadened. Due to the increasing pressures on the state's forests, the forest surveys have increased in scope and complexity. This report, for instance, includes an expanded analysis of the nontimber forest resources and some of their myriad interactions.

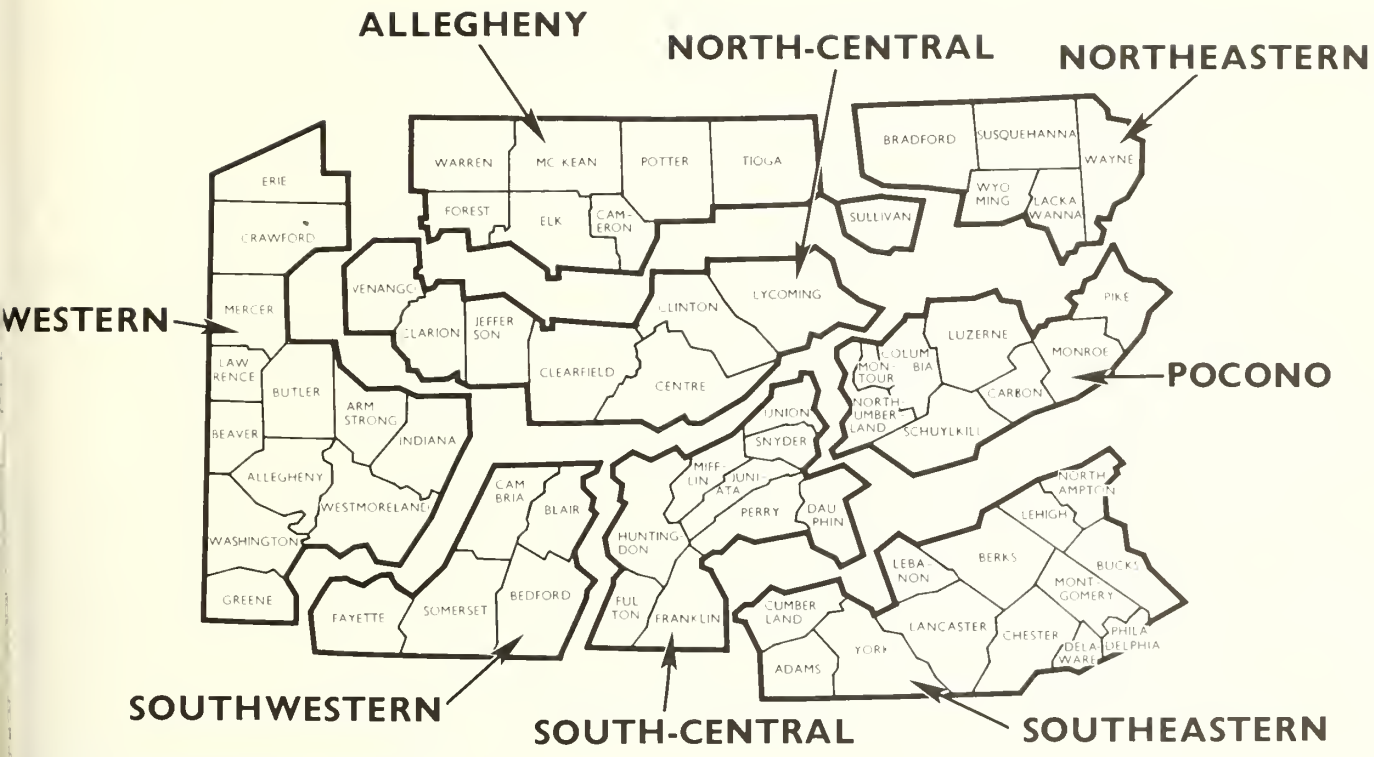
Eight Geographic Units

To provide better quality regional information, Pennsylvania was divided into eight geographic sampling units (Fig. 2). An attempt was made to define areas with homogeneous forest conditions. Since these unit boundaries are identical to those of the 1965 survey, we can make some comparisons of inventories and analyze certain trends for comparable areas of the state. Since the number of remeasured plots was small in relation to the number of new plots established in 1978, data on growth, removals, and mortality for the remeasured plots are presented for six geographic units. The six units coincide with the eight units except that the North-Central and Allegheny Units are combined into one unit, as are the Northeastern and Pocono Units. Analysis and comparison of geographic unit data for forest area, timber volume, and growth and removals are found in those particular sections of this report.

Before getting into these analyses, a brief description of these different regions of Pennsylvania with some basic resource and population statistics may be helpful. Data for total population and population density are based on preliminary information of the 1980 census of population obtained from the Philadelphia Office of the Bureau of Census in January 1981. The source of rural population data is the U.S. Department of Commerce (1972); estimates of per capita income are from the U.S. Department of Commerce (1980).

Pennsylvania

Counties: 67
Land area: 28,778,240 acres
Commercial forest: 55 percent of land area
Net volume per acre of commercial forest land: 1,366 cubic feet
Population: 11,807,984
Rural population: 29 percent
Population density: 262.6 per square mile
Per capita income: $5,622



igure 2.—The eight geographic sampling nits of Pennsylvania.

'estern Unit

ounties: 12
and area: 5,606,400 acres
ommercial forest: 45 percent of nd area
et volume per acre of commercial rest land: 867 cubic feet
opulation: 3,204,996
ural population: 27 percent
opulation density: 365.9 per uare mile
r capita income: $5,736

This is the largest of the eight its. Farm and forest land uses are i erspersed throughout, except in te greater Pittsburgh metropolitan ea. Farm land is more productive i the northern counties, which v re glaciated. The volume per acre c forest land is the lowest of any u t. The Western Unit also has the g atest concentration of bitumi- n s coal fields in the state.

Southwestern Unit

Counties: 5
Land area: 2,636,800 acres
Commercial forest: 61 percent of land area
Net volume per acre of commercial forest land: 1,206 cubic feet
Population: 606,316
Rural population: 54 percent
Population density: 147.2 per square mile
Per capita income: $4,800

This unit contains some of the most rugged mountainous terrain in the state. Mt. Davis in Somerset County, with an elevation of 3,213 feet above sea level, is the highest point in Pennsylvania. The famed Laurel Highlands are located in this unit, and forest recreation, especially skiing, is very popular.

Allegheny Unit

Counties: 8
Land area: 3,993,600 acres
Commercial forest: 82 percent of land area
Net volume per acre of commercial forest land: 1,906 cubic feet
Population: 213,233
Rural population: 69 percent
Population density: 34.2 per square mile
Per capita income: $4,582

This unit is characterized by hilly terrain, and has a relatively short growing season. It contains the Allegheny National Forest and substantial amounts of State-owned forest land. The area is famous for its black cherry production. It is the most heavily forested unit and has the highest volume per acre of all units. White-tailed deer populations are generally high throughout this

region. Total human population and density is lowest, as is per capita income. The greatest proportion of people is in rural areas.

North-Central Unit

Counties: 7
Land area: 4,028,800 acres
Commercial forest: 71 percent of land area
Net volume per acre of commercial forest land: 1,302 cubic feet
Population: 509,604
Rural population: 56 percent
Population density: 81.0 per square mile
Per capita income: $4,665

This unit is heavily forested, but has more farm and other nonforest land than the Allegheny Unit. The western half of the unit contains major bituminous coal fields, many of which are being surface mined. The forest composition is transitional, being influenced from the north by the Allegheny/northern hardwoods and from the south by the more central oak-dominated forests.

South-Central Unit

Counties: 9
Land area: 2,953,600 acres
Commercial forest: 56 percent of land area
Net volume per acre of commercial forest land: 1,447 cubic feet
Population: 570,918
Rural population: 54 percent
Population density: 123.7 per square mile
Per capita income: $5,118

The most dominating feature of this unit is the ridge and valley landform pattern, which bends around from the south to the northeast. The prominent ridges are nearly parallel and often extend unbroken for many miles. The often steep slopes are generally forested, broken occasionally by rock outcrops and barren talus-strewn areas. The valleys between the ridges are used primarily for agriculture, which highlights the contrasts in the physical features.

Northeastern Unit

Counties: 5
Land area: 2,287,360 acres
Commercial forest: 59 percent of land area
Net volume per acre of commercial forest land: 1,349 cubic feet
Population: 386,387
Rural population: 40 percent
Population density: 108.1 per square mile
Per capita income: $4,712

This rather heavily forested unit is the smallest in total land area. It lies in the glaciated part of the Allegheny Plateau, and thus has many small natural lakes, ponds, and swamps. This, plus its relatively low population density, makes it one of the prime areas for black bear in the state. Agricultural land use is also important, though Lackawanna County contains Scranton and its suburban communities as well as some disturbed anthracite mining areas.

Pocono Unit

Counties: 8
Land area: 2,748,160 acres
Commercial forest: 60 percent of land area
Net volume per acre of commercial forest land: 1,088 cubic feet
Population: 814,044
Rural population: 38 percent
Population density: 189.6 per square mile
Per capita income: $4,669

This unit contains the major anthracite coal fields of the country. The western part is more agricultural while the eastern part is more forested. This area is recovering more slowly than the remainder of the state from the repeated and heavy logging and fires during the early 1900's. The current low volume per acre reflects this slow recovery. As its name suggests, this unit contains the area commonly referred to as the Pocono Mountains. This forested region has many glacial lakes and because of its location receives heavy year-round recreation use by the more urban residents of southeastern Pennsylvania, northern New Jersey, and southeastern New York.

Southeastern Unit

Counties: 13
Land area: 4,523,520 acres
Commercial forest: 22 percent of land area
Net volume per acre of commercial forest land: 1,653 cubic feet
Population: 5,502,486
Rural population: 18 percent
Population density: 778.5 per square mile
Per capita income: $6,021

This large unit contains the least amount of forest land, both in total and as a percentage, of all eight units. Its volume per acre is high, however, attributable in part to a long history of relatively low levels of timber removals. The forests are dominated by oak cover types. Farms and built-up or urban areas cover most of the area. This part of the state has the most prime agricultural land and the highest population, population density (due primarily to Philadelphia and its influence), and per capita income. The land is generally level to gently rolling with few hills of any distinction. It has the longest growing season in the state.

Forest Area

The total area of Pennsylvania is 29,013,120 acres. This makes it the 33rd largest state in the Nation, but second only to New York in the Northeast. Subtracting 234,880 acres of inland water (large lakes, reservoirs, and rivers) leaves a total land area of 28.8 million acres. Nearly 1 million acres, or 42 percent of the land area, is in nonforest land use. More than 6.4 million acres are either cropland or pasture. The remaining 5.6 million acres are in urban or built-up land, roads, rights-of-way, small bodies of water, or other nonforest use.

The most common land cover is forest, accounting for 16.8 millio

Residents of Philadelphia and other urban centers depend on the outlying forests for wood products, outdoor recreation, clean air and water, and many other important benefits.

Pennsylvania State
Department of Commerce

Pasture, cropland, and forest land account for 81 percent of Pennsylvania's land area. The present arrangement and distribution of these land uses in the state creates outstanding wildlife habitat, both in quantity and quality.

Western Pennsylvania Conservancy

acres or 58 percent of the state's land area. Forest land is classified as either noncommercial or commercial. Noncommercial forest land covers about 900,000 acres in Pennsylvania, and is composed of productive reserved, unproductive, and urban forest land. Urban forest land is a relatively new classification that describes land that could be considered commercial forest land except that it is surrounded by residential, commercial, or industrial developments. Noncommercial forest land, while accounting for only 3 percent of the state's land area, and from which little or no timber will be harvested, is nevertheless very important—especially to the urban and suburban residents of Pennsylvania. All publicly owned parks with forest land are considered productive reserved and, along with urban forest land, provide much of the green space that is becoming more precious for a majority of the state's population.

Commercial forest land, the land class that our survey was designed for, accounts for the remaining 15.9 million acres of forest land, and makes up 55 percent of Pennsylvania's land base. Table 1 in the Appendix includes a detailed breakdown of the forest land by county, type of forest land, and ownership.

Trends

To discuss trends in forest area, we need to have the best estimates for at least two points in time. We could take the previously published estimates (for 1955 and 1965) and compare them with the 1978 estimate. However, in calculating the 1978 area estimate of commercial forest, we used a new technique that resulted in better county-level statistics. Part of this technique entailed recalculating estimates from 1955 and 1965 so that the basis for all three survey estimates was consistent. The recalculations yielded different but, we believe, better estimates of commercial forest land for 1955 and 1965. Comparable estimates of forest land for the three survey dates are:

Forest land	*1955*	*1965*	*1978*
		Acres	
Commercial	15,607,500	16,230,900	15,923,700
Noncommercial	97,000	354,000	902,200
Total	15,704,500	16,584,900	16,825,900

Forest area has changed dramatically since the time William Penn established the colony of "Penn's Woods" (Fig. 3). Historical records indicate that nearly all of the state was forested 300 years ago. As more and more settlers moved in and cleared land for farming, the forest area declined. Toward the end of the 19th century, the clearing of forest land for timber picked up momentum; by the early 20th century, forest land area was at its lowest point. Much of the logged-over land was burned over and eroded so badly that it was considered to be barren land.

Creation of Wild and Natural Areas is the major reason for the decline in commercial forest land administered by the Bureau of Forestry.

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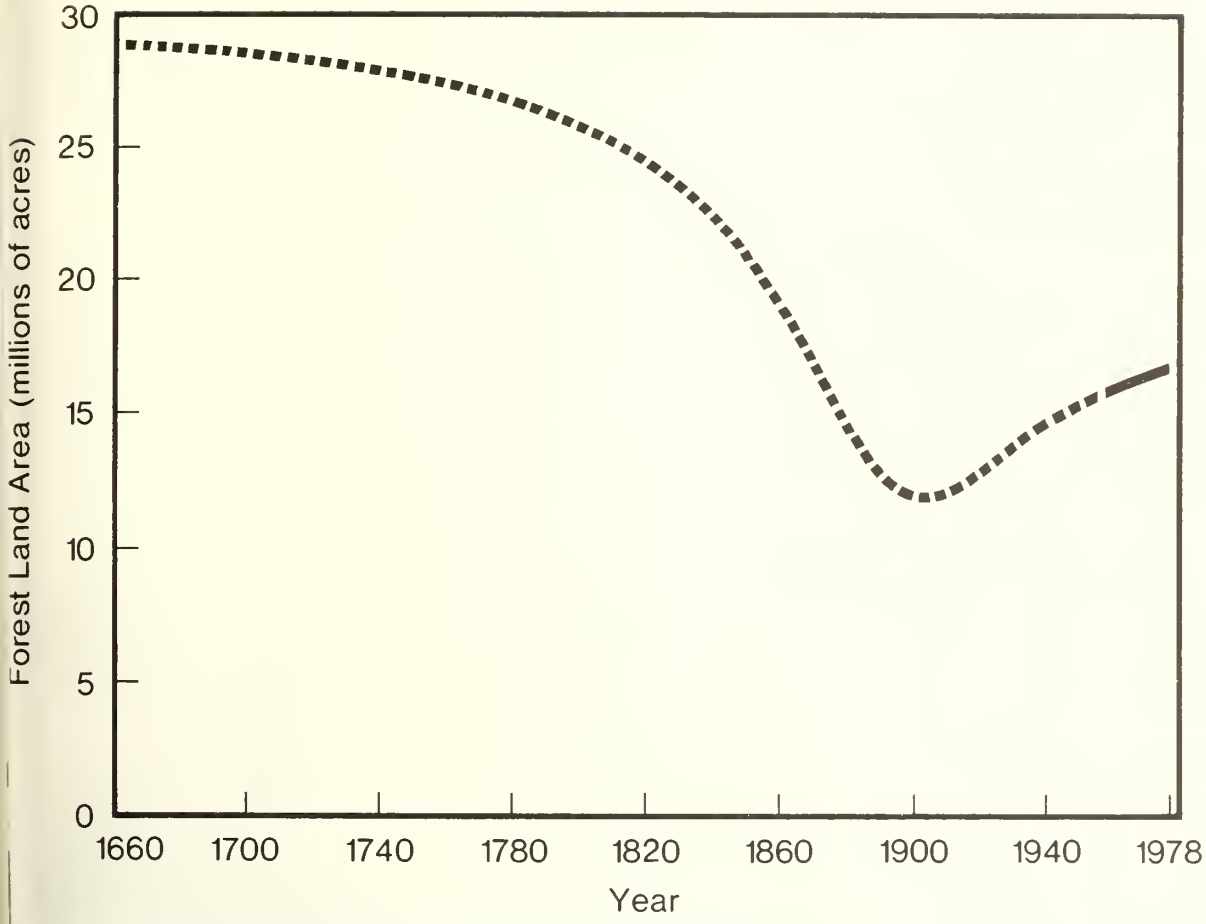

Figure 3.—Probable decline and rise of forest-land area in Pennsylvania, 1660 to 1978 (Sources: Illick 1923b; Ferguson 1958; Ferguson 1968; Considine and Powell 1980).

Then, as the last of the big trees were felled and as people had no need for additional cleared land, the area of forest land stopped declining. As nature began to reclaim the ravaged hillsides and as many marginal farms were abandoned, the area of forest land began its gradual climb to its present level.

During the period from 1965 to 1978, acreage shifted in and out of various land use classes. The net effect of these changes was that forest land increased slightly—by 241,000 acres or 1 percent. Noncommercial forest land acreage rose by 548,200 acres in the 13-year period. Much of this increase occurred on State-owned forest land where newly acquired land and previously owned land were classified as productive reserved (State parks and Wild and Natural Areas) or as unproductive forest land.

The net effect for commercial forest land, on the other hand, was a slight drop of about 300,000 acres or 2 percent between 1965 and 1978. This change is the net effect of losses to other land uses exceeding gains from other land uses (Fig. 4). Over this period, we estimate that commercial forest land gained about 300,000 acres, about three-quarters of this from agricultural land (old fields and pastures) reverting to forest. But in other areas throughout the state, about 600,000 acres of commercial forest land were being cleared, flooded, developed, or reclassified to noncommercial use. Nearly 60 percent of this land was classified as "urban and other." In a separate evaluation of land clearing in Pennsylvania between 1957 and 1971, we found that commercial forest land was converted to a number of urban and other land uses. The largest of these was rights-of-way (roads, pipelines, and powerlines) followed by housing (both single and multifamily), mining (primarily surface coal mines), industrial-commercial, public recreation, and other in that order. Nearly 25 percent of the loss (150,000 acres) was the result of public agencies reclassifying commercial forest land to a noncommercial use. Approximately 70,000 acres went into agricultural land while another 30,000 were flooded to make ponds or reservoirs.

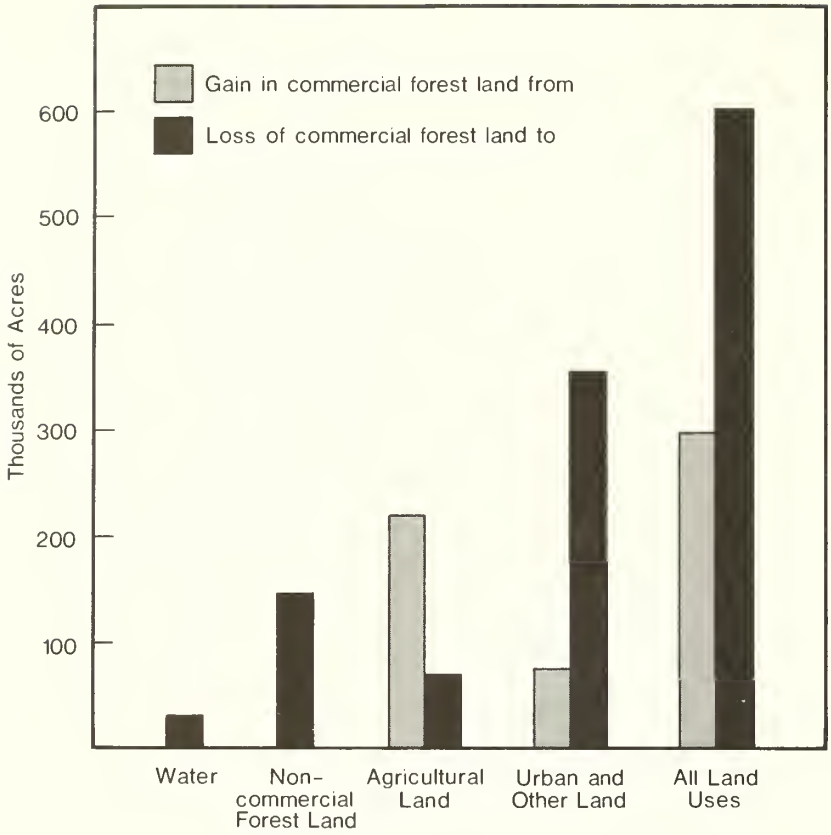

Figure 4.—Gain and loss of commercial forest land in Pennsylvania from 1965 to 1978.

Abandoned farmland is the major sourc of new forest land in Pennsylvania.

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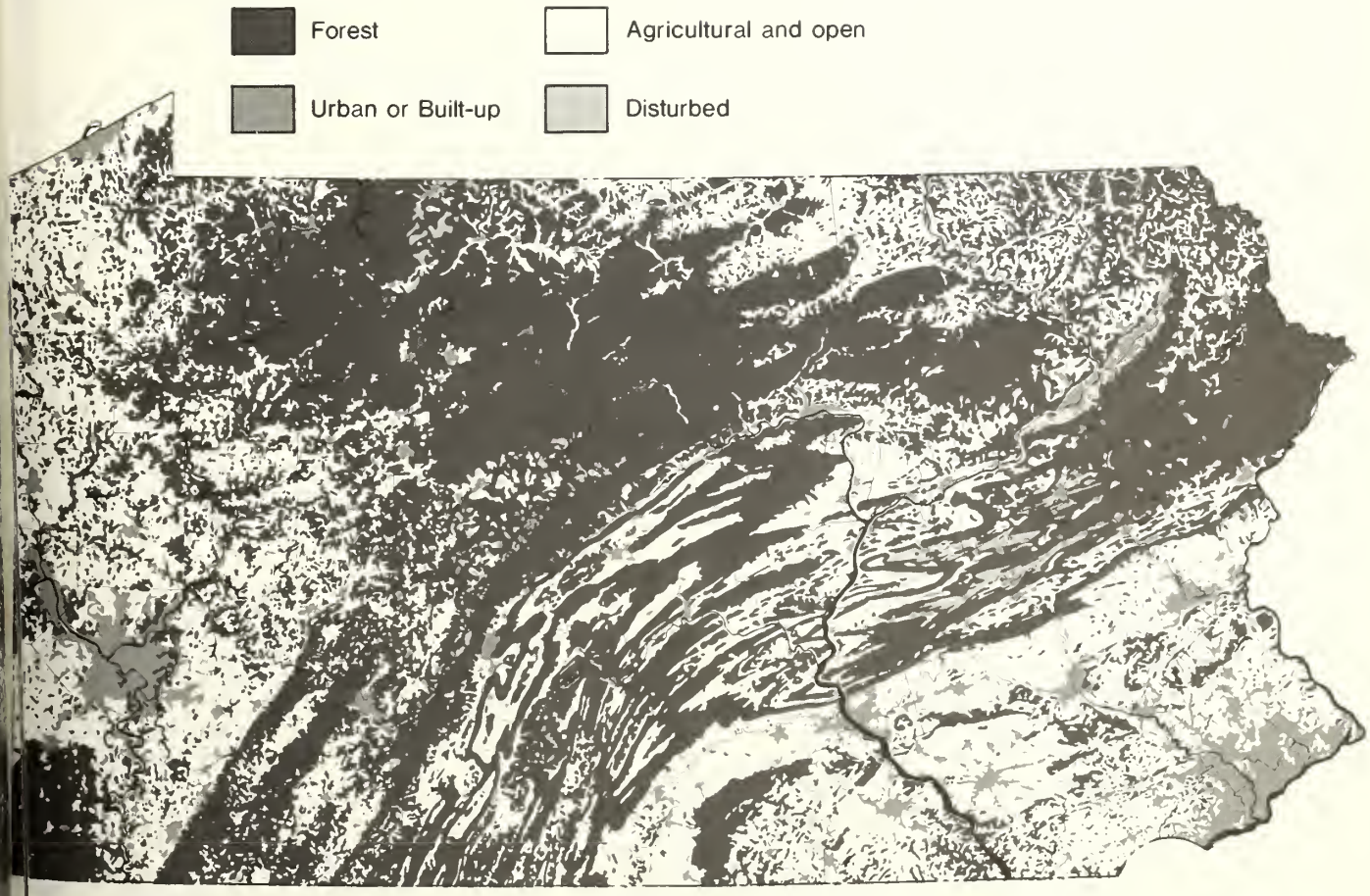
With land use patterns varying across the state (Fig. 5), it is not surprising that the change in commercial forest acreage has varied between the geographic units:

Unit	Commercial forest land		Change
	1965	1978	
	- - - - Thousand acres - - - -		Percent
Western	2,522.6	2,534.3	+ 0.5
Southwestern	1,709.7	1,597.1	– 6.6
Allegheny	3,325.4	3,282.2	– 1.3
North-Central	2,900.6	2,859.8	– 1.4
South-Central	1,721.4	1,642.0	– 4.6
Northeastern	1,220.7	1,357.3	+ 11.2
Pocono	1,763.7	1,656.7	– 6.1
Southeastern	1,066.8	994.3	– 6.8
All units	16,230.9	15,923.7	– 1.9

The Western Unit maintained its forest area over this period. Any decrease in forest area due to expansion of urban and built-up land around Pittsburgh and other urban areas was offset by a corresponding increase in forest area from marginal farmland and reclaimed surface mines.

The Northeastern Unit showed the largest absolute and percentage change, registering the only significant gain of commercial forest acreage. Our data indicate that this was primarily due to the reversion of abandoned agricultural land.



igure 5.—Generalized land use map of Pennsylvania for the early 1970's
ource: Pennsylvania Land Policy Project 1975).

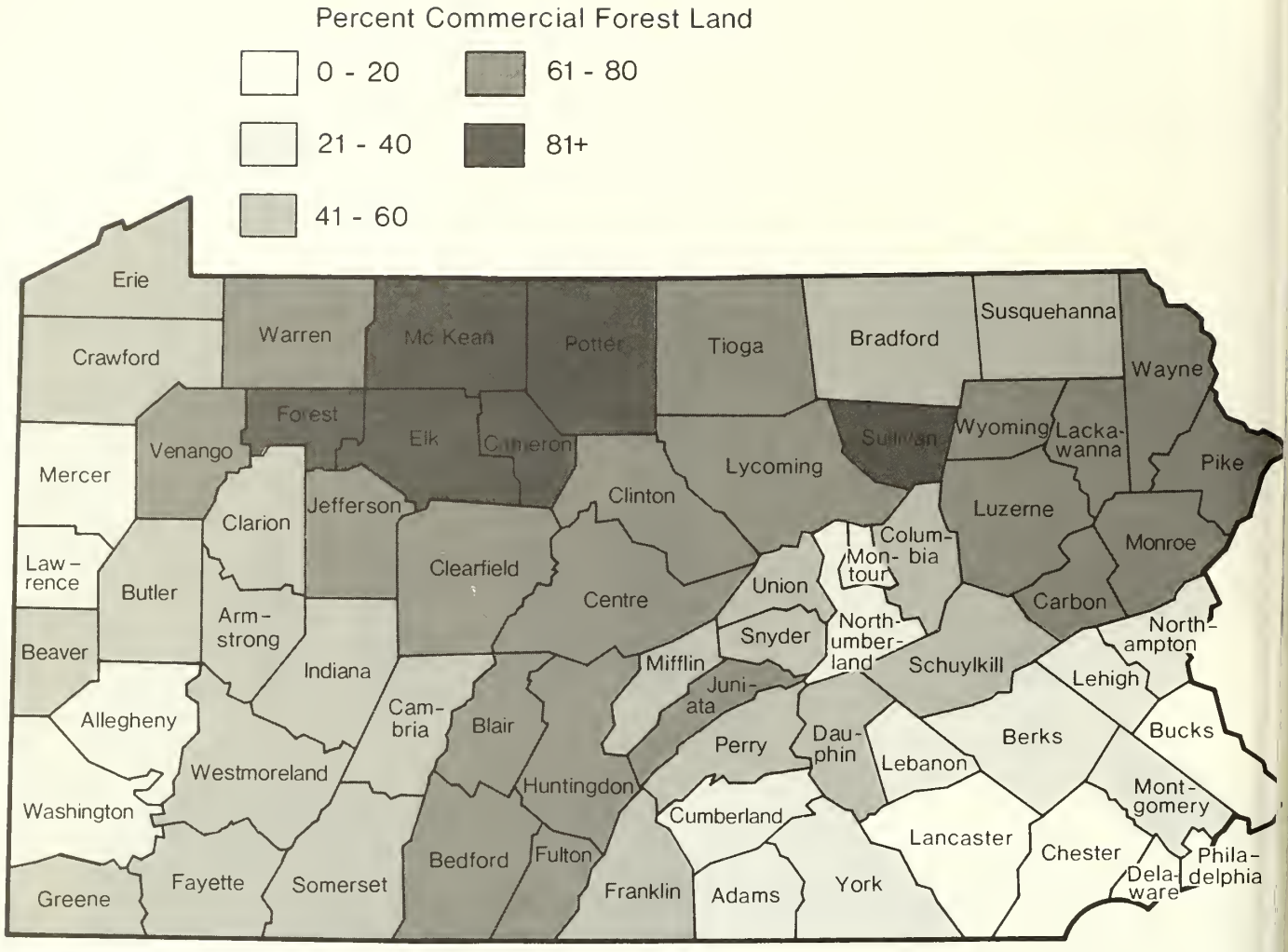


Figure 6.—Distribution of commercial forest land in Pennsylvania, 1978.

The distribution of commercial forest land by county (Fig. 6) shows the highest concentration of forests in the northern and central parts of the state. The Allegheny National Forest, most of the State Forests, and most of the State Game Lands are found in these counties. Because of the relative lack of development and the abundance of forest land with its associated resources and opportunities, the highlands of this area have received special attention. The Pennsylvania Department of Environmental Resources (DER) has developed general management guidelines for the "North Central High Mountain Area" since it is one of the few large remote forested regions remaining between the east coast megalopolis and the Chicago-Detroit-Cleveland urban complex of the Midwest. The Western Pennsylvania Conservancy has proposed a regional strategy for conserving the unique natural assets of this area while promoting needed economic development. A forum of interested parties has recently been set up to address this proposal.

The more sparsely forested counties are in southeastern and extreme western Pennsylvania (Fig. 6). These areas match the urban and agricultural counties shown in Figure 5 quite well. When used together, these two maps provide a good but general picture of the distributio and extent of the important land use in the state.

Ownership

Fully one-fourth—4.2 millic acres—of Pennsylvania's forest lar is publicly owned. This is the grea est proportion and acreage in publ holdings of any state in the Nort east. The Pennsylvania Bureau Forestry manages 2 million acres State Forests for such diverse ben fits as timber products, wildlife hat tat, outdoor recreation, water, ar minerals. The other large multipl use manager is the USDA Forest Se vice, which administers the 489,0

Certain areas of north-central Pennsylvania are covered with unbroken expanses of forests.

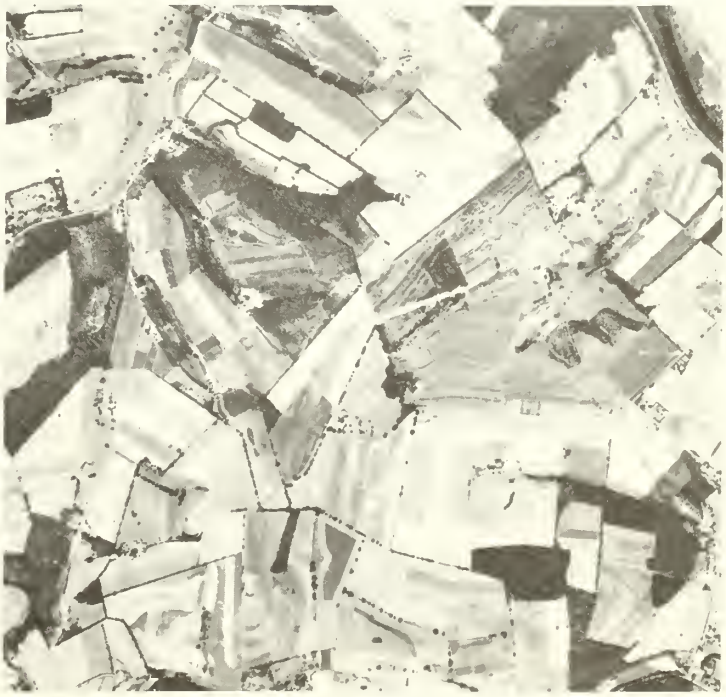
Western Pennsylvania Conservancy

acres of forest land in the Allegheny National Forest. The Pennsylvania Game Commission manages 1.1 million acres of forest in State Game Lands primarily to improve wildlife habitat. In this process, numerous other forest resources are enhanced. The remaining public forest land is held by diverse organizations, many of which provide forest recreation (State Parks) or plentiful fresh water (municipal watersheds).

Nearly 83 percent of the public forest land is classified as commercial forest. The remaining 17 percent is noncommercial forest land, which means that as a result of either its location, low productivity, or administrative designation, this acreage cannot provide a sustained yield of timber crops. Nearly all of the noncommercial forest land is publicly owned.

Seventy-five percent of the forest land is in private hands. Nearly 99 percent of this land, or 12.5 million acres, is commercial forest land. The heaviest concentrations of privately

Forest land, the darker shades in this aerial view, is relegated to relatively small and scattered tracts in southeastern Pennsylvania (Berks County).



Agricultural Stabilization and Conservation Service

owned commercial forest land are in the western and eastern parts of the state (Fig. 7). The private lands are held by an estimated 490,100 owners. In an ownership study conducted in conjunction with this forest survey, the characteristics and attitudes of these diverse owners were assessed and analyzed (Birch and Dennis 1980). This study showed that 86 percent of the private landowners are individuals (as opposed to partnerships, corporations, clubs, etc.), most of whom live within a mile of their woodland. The average size holding of individual owners is 20.3 acres. Only a little more than one-half of the private landowners have held their land for more than 10 years. Benefits other than timber production are more important to most landowners; 75 percent have never harvested timber from their land. The average forest holding of these owners is only 16.1 acres. About one-half of the private owners, holding about one-fifth of the private commercial forest land, indicate that they never plan to harvest timber from their woodland. Slightly more than one-half allow some form of recreational use of their land by the public.

The trends in ownership of commercial forest land are shown in Figure 8. Most of the changes have occurred since 1965. Farmer, State, Federal, and County and Municipal ownership have been relatively constant over the 23-year period. State Forests and State Game Lands have been expanding as a result of active land acquisition policies, but the rise in commercial forest acreage has been slight since 1965 due to the reclassification of forest land to noncommercial forest land by the Pennsylvania Bureau of Forestry. Forest industry holdings have more than

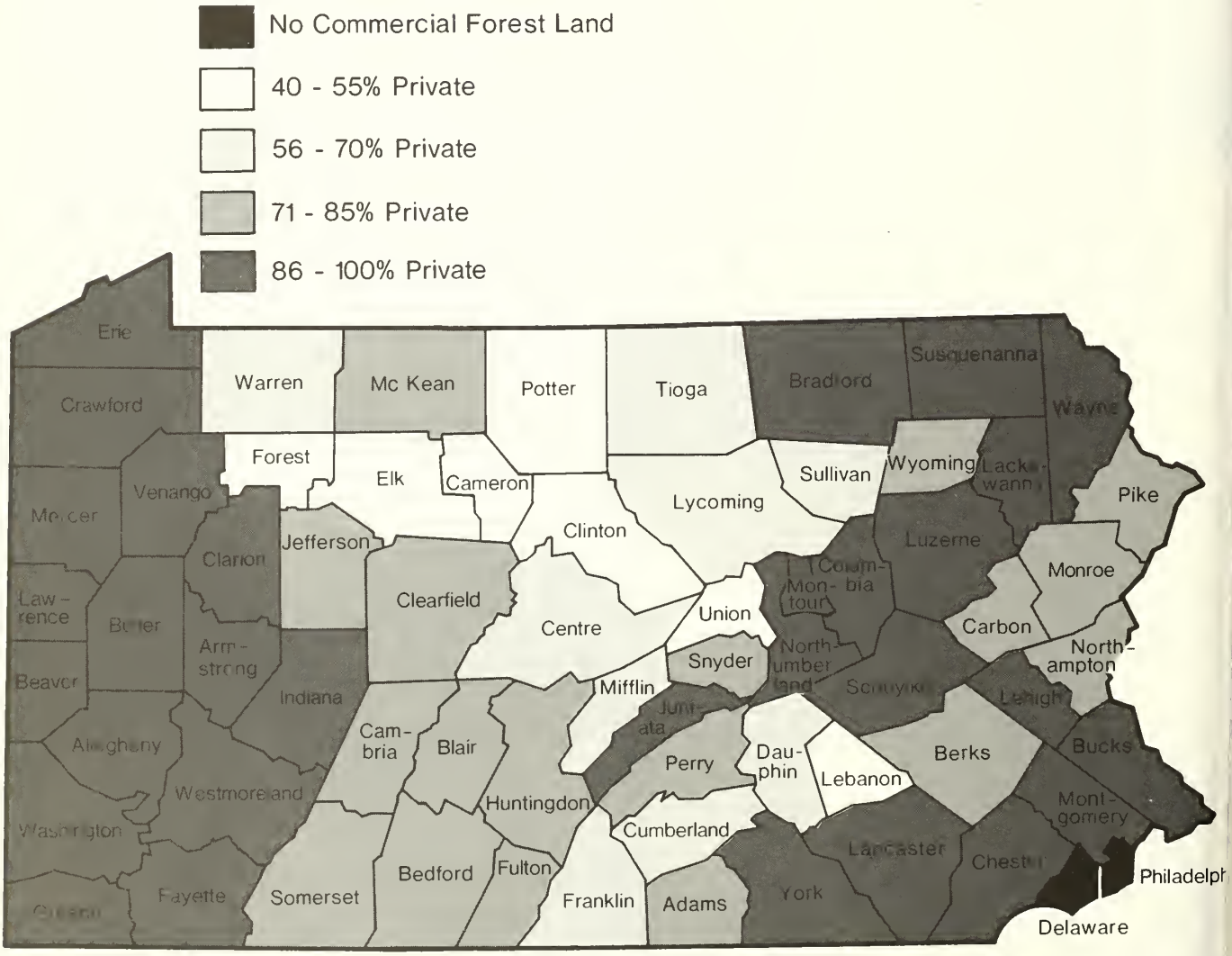
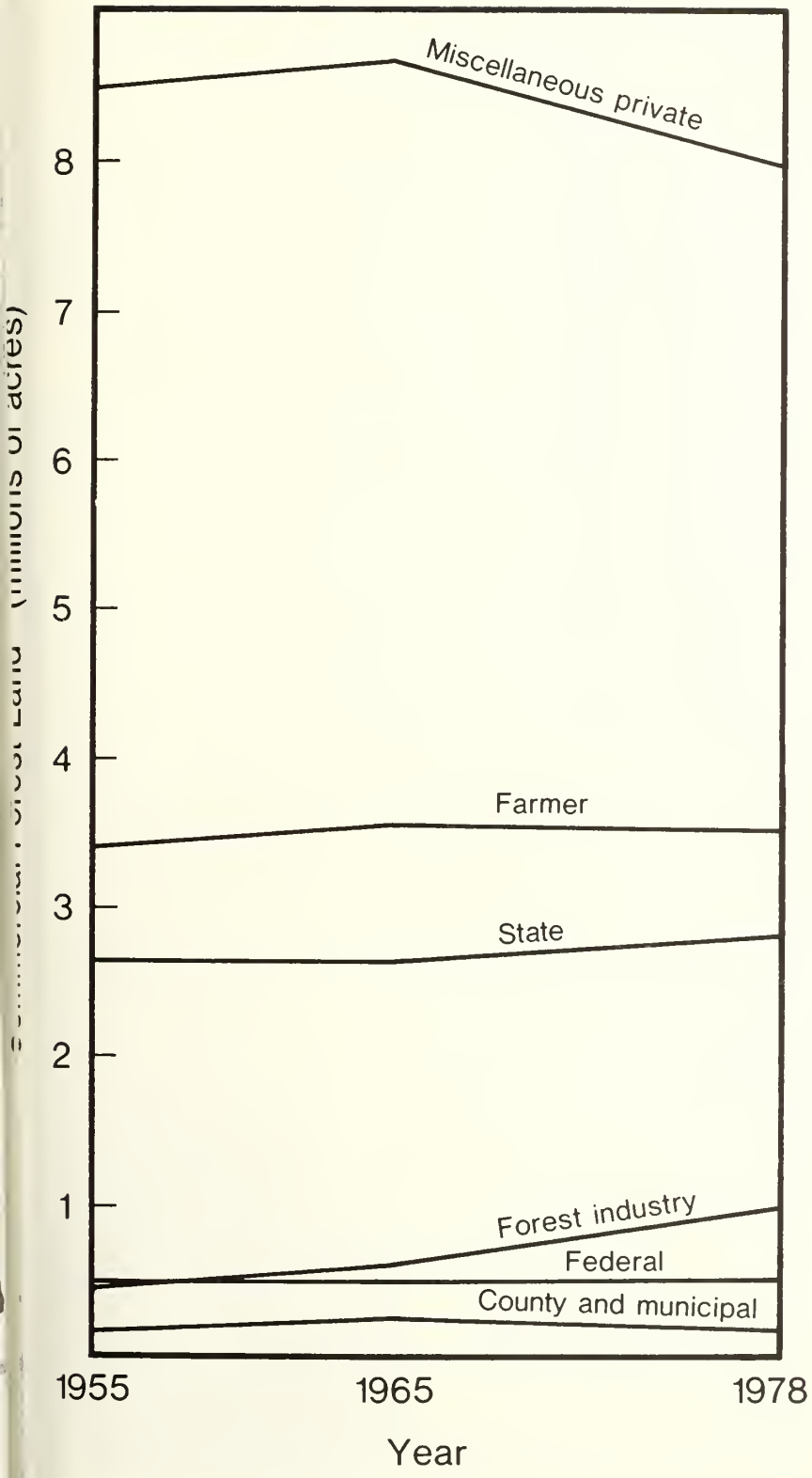


Figure 7.—Distribution of privately owned commercial forest land, by county.



ure 8.—Trends in ownership of com-
rcial forest land.

doubled since 1955. These industries are consolidating their holdings as well as expanding to obtain a more productive and reliable timber base. Nearly all of the increases in State and forest industry holdings have been at the expense of the miscellaneous private landowner category. This category, while still far and away the most dominant, is the only one that showed a substantial decrease since 1965. In addition to purchases by State agencies and forest industries, the miscellaneous private landowners are the ones most likely to lose commercial forest land to such nonforest uses as highways, rights-of-way, shopping centers, and housing developments.

Stand Size

Over the 13-year period from 1965 to 1978, the stand-size composition (i.e., sawtimber stands, poletimber stands, sapling-seedling stands, and nonstocked areas) has shifted toward a more mature distribution (Fig. 9). The 1965 inventory showed that sawtimber stands dominated with 44 percent, followed by poletimber stands (35 percent), sapling-seedling stands (19 percent), and nonstocked areas (2 percent). By 1978, the gap between the sawtimber and poletimber proportions had widened. Many poletimber stands had matured into sawtimber stands to more than offset any change in sawtimber stands to smaller stand sizes.

The share of the commercial forest base in sapling-seedling stands has changed little over the 13 years, remaining at or near 20 percent. These stands usually originate from abandoned agricultural land that has reverted to forest, or from forest land that was extensively cut over, regenerated naturally, and is now in an early stage of development. The stability of sapling-seedling stand's percentage indicates that as much land is coming into this class by the previously mentioned processes as is moving out into the poletimber-size class. This stability suggests that the combined effect of agricultural reversion and clearcutting intensity has remained relatively constant over this period for the state as a whole.

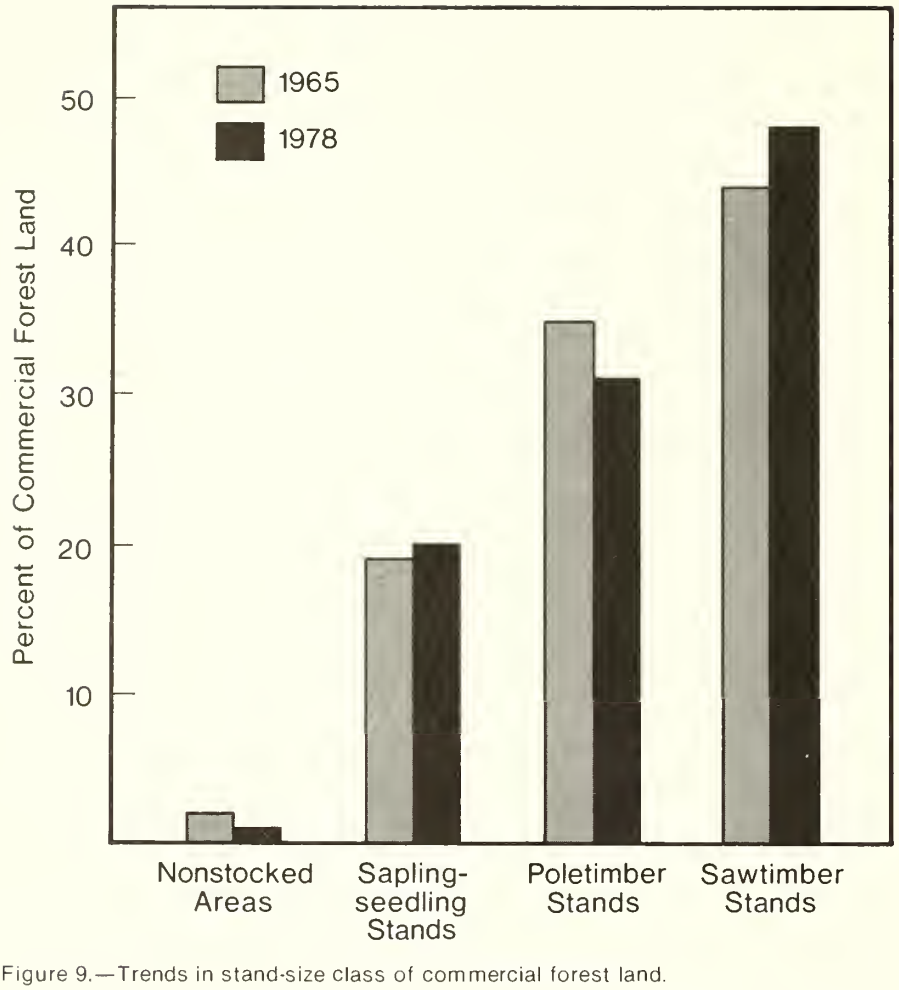


Figure 9.—Trends in stand-size class of commercial forest land.

Over the last 60 years or so, the acreage of nonstocked areas has been declining, and by 1978 was about 200,000 acres. This low figure attests to the fact that cleared land in Pennsylvania does not remain barren for long. Seedlings, seedling sprouts, and stump sprouts, responding to abundant water, nutrients, and light, usually reclaim the land within a couple of years.

In a regulated hardwood forest, that is, an intensively managed forest that produces a steady and continual supply of sawlogs, one suggested optimum distribution of stand sizes is 50 percent in sawtimber, 30 percent in poletimber, and 20 percent in sapling-seedling stands (Liscinsky 1978). On a statewide basis, these percentages are now at 48, 31, and 19 respectively, indicating a favorable situation for the hardwood timber resource, and one that favors many wildlife species as well. This stand-size distribution has not, however, resulted from intensive forest management—only a small fraction of Pennsylvania's forests have received such treatment. The current situation is the result of a combination of arbitrary cuttings, abandonment of farmland, and natural forces. These have occurred in the absence of any concerted and unified effort by the forest-land owners of the state. The decline of wildfires, due largely to fire control efforts of the Bureau of Forestry, also has contributed to this maturing stand-size distribution.

However, among the geographic units there is considerable variation in stand-size distribution, reflecting the past cutting histories and markets for the forests in these areas. As shown in Figure 10, the proportion of commercial forest land in sawtimber stands ranged from 32 percent in the Pocono Unit to 69 percent in the Southeastern Unit. Poletimber stands ranged from 14 percent in the Southeastern Unit to 40 percent in the Northeastern Unit, and sapling-seedling stands and nonstocked areas ranged from only 9 percent in the Allegheny Unit to 33 percent in the Western Unit.

For an explanation of how past management has affected the stand-size distribution, let's look at two adjacent but very different units—Pocono and Southeastern. The Pocono Unit has the lowest concentration of sawtimber stands in the state and, consequently, relatively high proportions of poletimber and other stands. At the turn of the 19th century, iron ore was discovered in this region, and furnaces were built to process the ore into iron. These furnaces initially required steady supplies of charcoal to fuel them, and this charcoal came from the abundant hardwood (mainly oak) resource. Heavy and frequent cuttings were made through the early 19th century. Then anthracite coal was recognized as the better fuel. The forests, however, were still cut frequently as they now supplied the thousands of mine timbers needed for the construction and expansion of the underground mines. The heavy cutting through the 19th century and early into the 20th century left the forests with few sawtimber stands but many sapling-seedling and poletimber stands. As the demand for charcoal and mine timber dropped and was eventually replaced by a less intense demand for sawlogs and pulpwood, the resource began to recover and mature. Recent trends indicate the proportion of sapling-seedling stands is decreasing and that sawtimber stands are increasing. But with poletimber stands still dominating, the resource is still several decades away from a distribution more favorable for sustained timber yield.

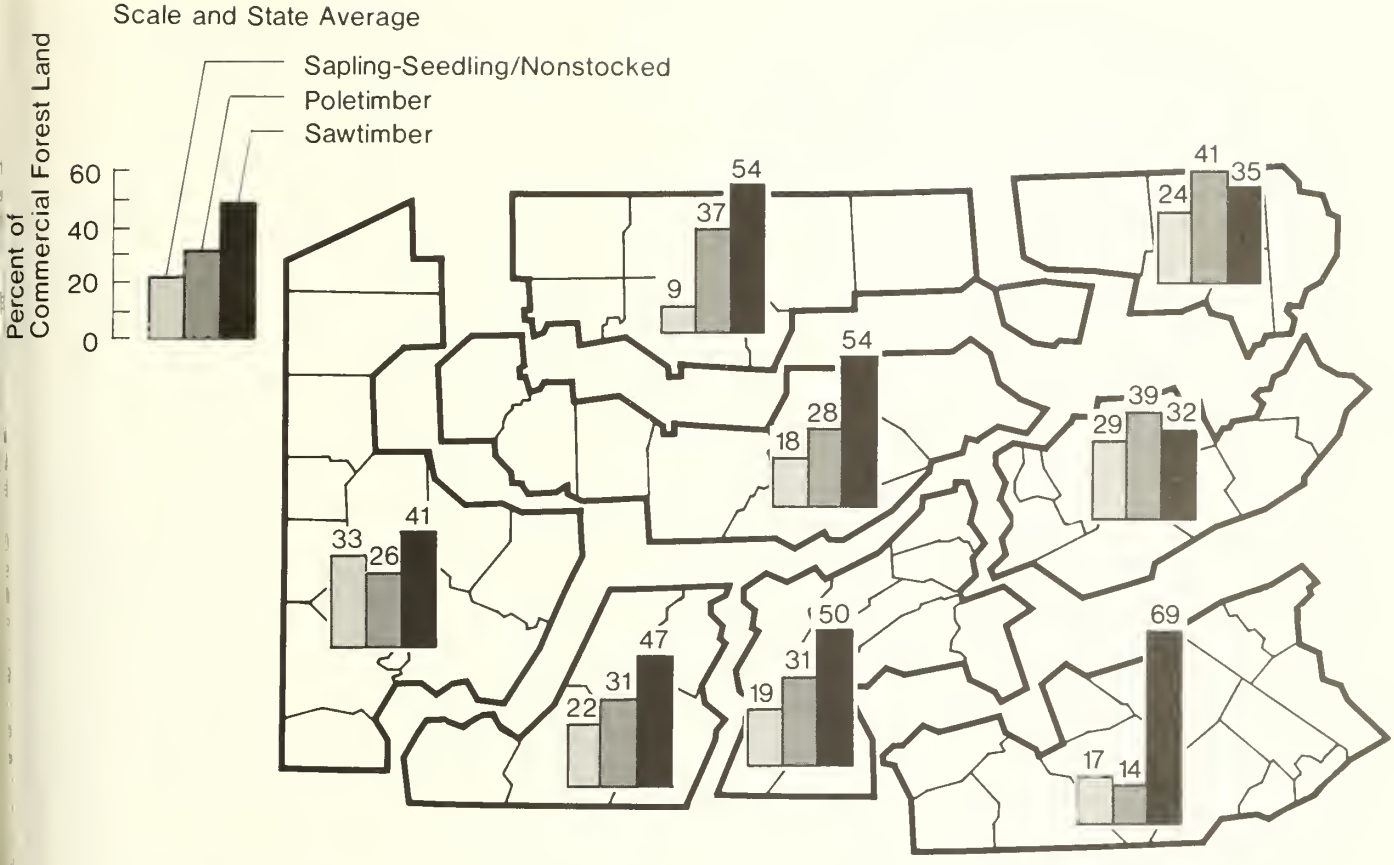


Figure 10.—Stand-size distribution, by geographic unit, 1978.

The Southeastern Unit, just to ıe south, has a much different tand-size distribution (Fig. 10). Here, awtimber stands account for nearly) percent of the commercial forest ınd, with the remainder divided rela- vely evenly between poletimber and ther stands. This region was the rst area in the state to be settled. ıe old-growth timber stands were eared for farming, and by the early)th century most of the best agricul- ral lands had been identified and ere in pasture or cropland. A rela- vely small fraction of the land was left in a forested condition, so forest industries turned their attention to the more northern and western areas, where timber was cheaper and more plentiful. In this region, 86 percent of the commercial forest land is in private hands, and the average private holding is only 11 acres (Birch and Dennis 1980). Under such circumstances, heavy cutting often is not desired by the landowner. This is especially true of clearcutting, which would create sapling-seedling stands. These are some of the reasons why sawtimber stands have dominated the southeastern forests for many decades, and trends indicate that the proportion of poletimber and other stands is continuing to decline.

Since sawtimber stands have special significance in that they provide a variety of benefits to forest users, it is useful to know which counties have especially high concentrations of this resource. While north-central counties such as Lycoming, Centre, and McKean have the greatest areas of sawtimber

Oak-hickory sawtimber stands account for about 4 million acres of forest land in Pennsylvania.

Western Pennsylvania Conservancy

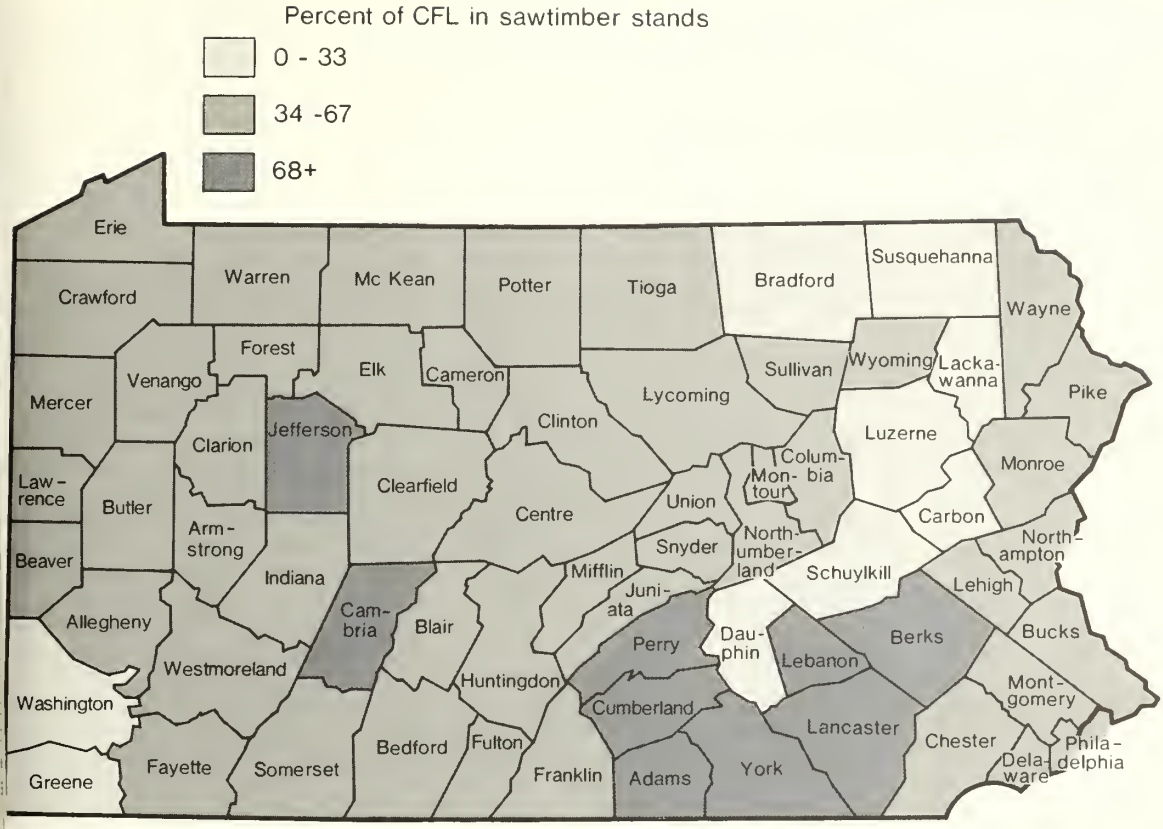
stands, it is in counties such as Adams, Cumberland, and York where sawtimber stands dominate the commercial forest land (Fig. 11). These three southern counties combined have 276,600 acres of sawtimber stands, but sawtimber stands account for 78 percent of the commercial forest in these counties. Centre County, on the other hand, has 283,500 acres of sawtimber stands, but these stands represent only 56 percent of the county's commercial forest land. As a comparison of Figures 6 and 11 shows, a county need not be heavily forested to contain a high concentration of sawtimber stands. This has significance for buyers of large hardwood sawlogs, recreation planners seeking older growth forests for parks, and birdwatchers looking for screech owls, Carolina chickadees, or hairy woodpeckers, which dwell in mature oak forests.

The five large ownership classes in Pennsylvania show some interesting differences in stand-size distribution (Fig. 12). The Allegheny National Forest has the greatest proportion of poletimber (40 percent) and a low proportion of sapling-seedling and nonstocked areas (5 percent). Since the USDA Forest Service began to manage this land, 250,000 to 300,000 acres have received some sort of management treatment. Of these treatments, the ratio of thinnings to regeneration cuts has been roughly 5 to 1 (personal communication, Joel Hockinson, Allegheny National Forest). Regeneration cuts, which would produce sapling-seedling stands, are occurring at an annual rate of 1,000 acres. These management activities, as well as multiple-use policies, have favored retaining a heavy proportion of the Forest in poletimber and sawtimber stands. Since most of the stands are 50 to 70 years old, future inventories of the Forest will probably show a sizable shift of poletimber stands into sawtimber stands.

The State Forest distribution shows the greatest percentage in sawtimber stands (74) and the lowest percentages of poletimber (23) and other (3) stands. Much State Forest land is similar to Allegheny National Forest land, especially as regards past history and current management. Part of the explanation for the difference between the National Forest and the State Forest distribution is that State Forest lands contain a higher proportion of oak types than the National Forest. The oak types in Pennsylvania generally were cut earlier than the northern hardwoods types, and are therefore more mature. This leads to more sawtimber stands in the oak areas than in the northern hardwood areas.

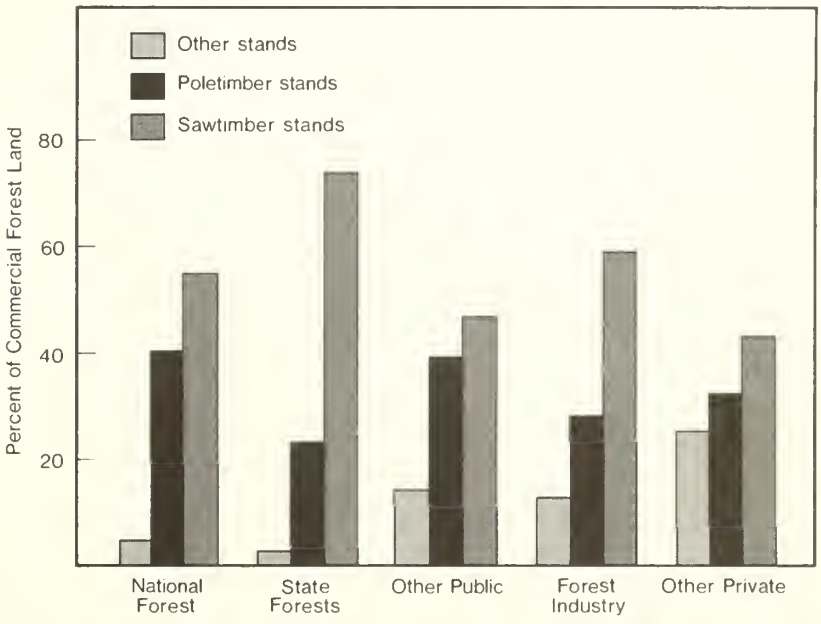
The other public group is dominated (83 percent) by State Game Lands. The management goal on these lands is to enhance the habitat for all species of wildlife. To achieve this goal, the Pennsylvania Game Commission is increasing the diversity of habitats through a judicious use of cutting. While sawtimber stands still dominate, poletimber stands are a close second (Fig. 12). Also, the Game Commission often acquires lands that have been logged and that may be in a smaller stand-size condition. This also helps explain why over one-half of the Game Commission's forest land is in poletimber stands, sapling-seedling stands, or nonstocked areas.

Forest industry is an ownership group that uses varied approaches to woodland management. Some indus-



gure 11.—Sawtimber stand-size distribution, by county, 1978.

Figure 12.—Stand-size distribution, by ownership class.



tries manage their forest land intensively to produce large quantities of timber products. Management and harvesting practices vary according to the product needed. Other industries rely on private forests for their timber. They may practice only low-cost, extensive management on their own lands, keeping them in timber for insurance or investment purposes, or both. These varied approaches have resulted in sawtimber stands accounting for nearly 60 percent and poletimber stands accounting for 28 percent of forest industry forest land. The dominance of sawtimber stands is not surprising since they are the most valuable stands and provide the many timber products that Pennsylvania's forest industries need.

The other private landowners have a hodgepodge of management plans, ranging from no plan at all, to one that is kept in the back of the owner's mind, to one that is formalized in writing. Looking at these diverse lands from a statewide perspective, the proportion of sawtimber stands is the lowest while the proportion of sapling-seedling stands and nonstocked areas is the highest (Fig. 12). This condition may be attributable to more reversion of nonforest land to forest land, heavier cutting of sawtimber stands, and/or more prolonged regeneration periods compared with those of other ownership groups. Few other private landowners manage their land primarily for timber products, but many have cut timber because they believed it was mature or they needed the money and were offered a good price (Birch and Dennis 1980). Many landowners, when they feel that their timber is large enough to have any commercial value, will cut their woodlands without giving much thought to regenerating these stands. In certain areas where the deer populations are so high that they prevent adequate regeneration, new stands may stay in a nonstocked or seedling condition for an abnormally long period. In fact, the other private group not only has the highest percentage of other stands but also has more than 200,000 acres (nearly 100 percent of the state's total) of nonstocked areas.

Looking at the stand-size distribution, we can gain some insight into the impact forest-land ownership on Pennsylvania's forest resources. Stand-size has some obvious implications for timber products, but also is an important indicator of the forest's ability to provide wildlife habitat and recreation opportunities, and to protect soil and water resources. Different owners and/or managers have different perspectives on the mix of these values that forests should produce. This variety of approaches to forest management has contributed largely to the diverse stand-size distributions (Fig. 12) and to the rich mixture of conditions and opportunities that characterize the commercial forest land of Pennsylvania.

Forest Type

Pennsylvania's commercial forest land is composed of 33 forest types, based on plurality of species stocking. Twenty-one of these are relatively uncommon, accounting for only 11 percent of the total commercial forest area. Seventy-eight percent of this forest land base is in 10 types. Individually, these range from 5 to 15 percent of the forest area.

To simplify the discussion, the 33 types can be assigned to 9 forest-type groups. Two of these groups—oak/hickory and northern hardwoods—dominate Pennsylvania's forests, so much so that the other seven groups together only account for 13.2 percent of the commercial forest land (Fig. 13).

The geographic location of Pennsylvania is the primary reason why these two forest-type groups dominate. Oak/hickory forests prevail throughout the Midwest and the Mid-Atlantic regions in moderately dry to moist temperate climates. The soils generally are well-drained and unglaciated. The northern hardwoods (maple/beech/birch) prevail in glaciated regions such as New England, New York, and the Great Lake States. They tolerate cooler and moister conditions than oaks. Pennsylvania encompasses conditions that favor either forest-type group and a broad and ill-defined transition zone where there is considerable mixing and interspersion of the forest types that make up these two groups. The average number of days without a killing frost seems important in separating these groups, and in Pennsylvania the boundary approximates the 140-day lines highlighted in Figure 14, with oaks generally dominating in

Top Ten Forest Types

	Thousand acres	*Percent of total*
1. Sugar maple/beech/yellow birch	2,413	15
2. Chestnut oak	1,817	11
3. Black cherry	1,394	9
4. Red maple/northern hardwoods	1,324	8
5. Mixed northern hardwoods	1,180	7
6. Northern red oak	943	6
7. Mixed central hardwoods	941	6
8. Red maple/central hardwoods	869	6
9. White oak/red oak/hickory	856	5
10. Post, black, or bear oak	772	5
Total	12,509	78

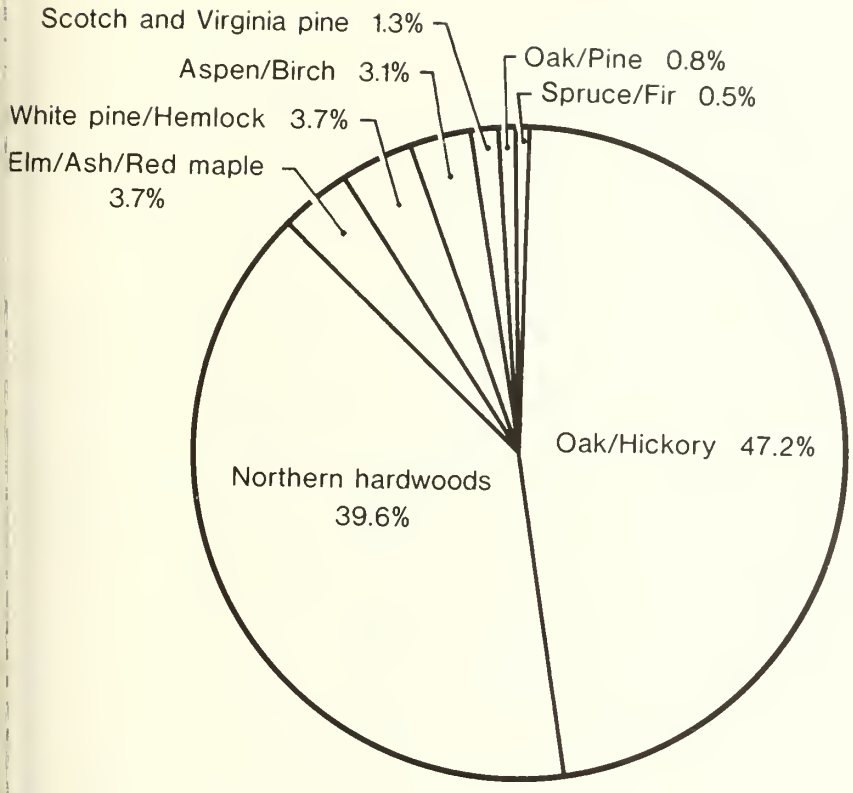


Figure 13.—Percentage of commercial forest-land area, by major forest-type group, Pennsylvania, 1978 (the oak/gum group amounts to less than 0.1 percent).

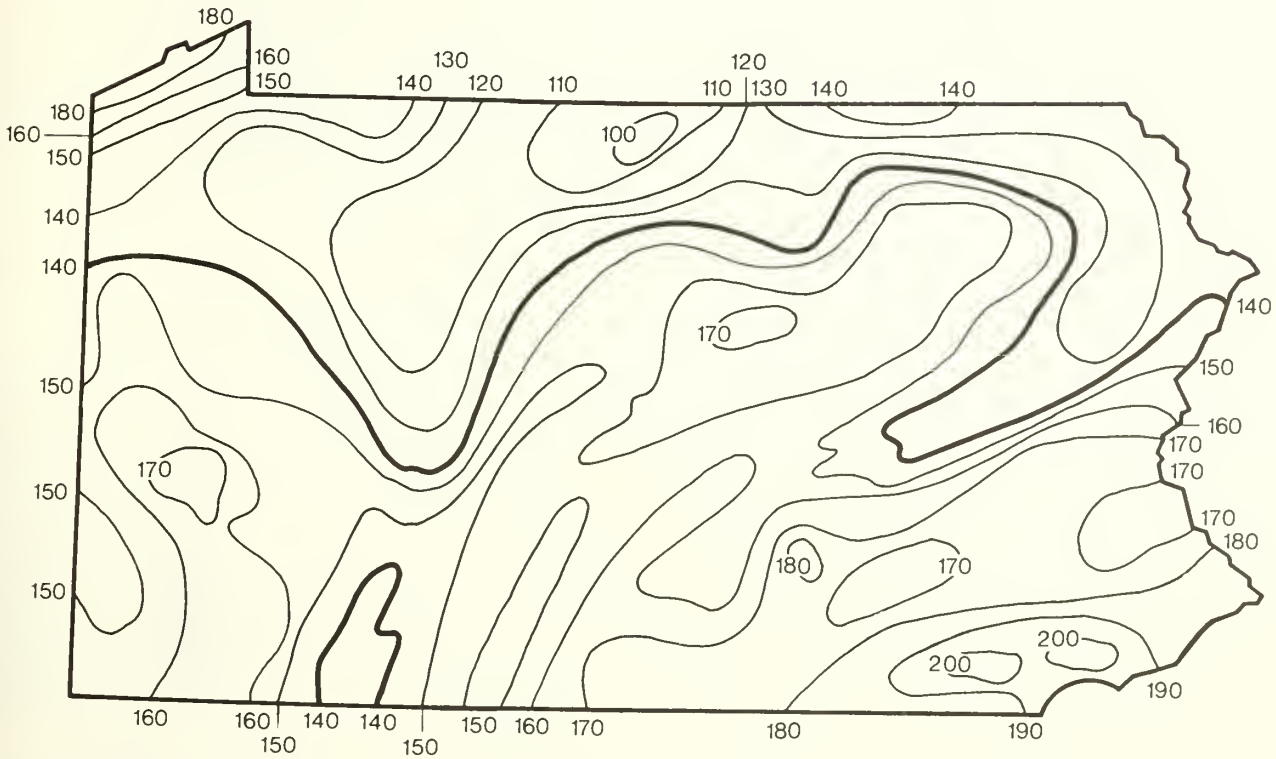


Figure 14.—The average number of days without a killing frost (Source: Cunningham et al. 1977).

areas with more frost-free days. The cutting practices and fires earlier in this century did not favor the reestablishment of softwood stands (especially white pine and hemlock), and lowland conditions that would support elm/ash/red maple or oak/gum stands are uncommon.

The most abundant type group is oak/hickory. This group accounts for the majority of the commercial forest acreage in the North-Central (54 percent) and the Southwestern (58 percent) Units, and dominates the South-Central, Pocono, and Southeastern Units (72 percent). The nine oak/hickory types account for 7.5 million acres of commercial forest land. Within this type group, the most common type is chestnut oak with 1.8 million acres. Sawtimber stands dominate the group with 53 percent while poletimber stands are next with 30 percent, followed by other stands with 17 percent. Besides the white pine and hemlock type group, oak/hickory has the highest percentage of sawtimber stands, an indication that this is one of the more mature forest-type groups in the state.

The other major forest-type group, northern hardwoods, accounts for 6.3 million acres and dominates the forests of the Allegheny (69 percent), Northeastern (64 percent), and Western (44 percent) Units. The sugar maple/beech/yellow birch forest type is most prevalent with 2.4 million acres. The black cherry type accounts for 1.4 million acres and, from a timber perspective, is the most valuable type in Pennsylvania. The stand-size distribution of the northern hardwoods type group is similar to the statewide average, with 46 percent in sawtimber stands. Two ownership classes, National Forest and forest industry, are dominated (70 and 55 percent, respectively) by northern hardwoods. This is expected since all of the Allegheny National Forest and over half of the forest industry woodlands are located in the Allegheny Unit.

The other forest-type groups, while accounting for only 13 percent (2.1 million acres) of the commercial forest land area, are important in enriching the variety of forest conditions in Pennsylvania. The evergreen hemlock, pine, and spruce stands provide both a welcome contrast to an otherwise drab winter landscape and valuable wildlife cover for a variety of species. Where markets exist, these types also provide valuable timber products.

Old-growth hemlock stands are rare in Penn's Woods today (Tionesta Scenic Area, McKean County).

Since the last survey (Ferguson 1968), the definition of our forest types has changed so significantly that comparisons of the 1978 data presented here or in the statistical report (Considine and Powell 1980) with those from previous surveys are not valid and should not be attempted.

Timber Volume

Although Pennsylvania's commercial forest-land base decreased slightly since the last survey, timber volumes have generally increased. Between 1965 and 1978, growing-stock volume increased from 17.9 to 21.8 billion cubic feet, a gain of nearly 22 percent. Similar increases were also reported in recent surveys of West Virginia (Bones 1978) and Kentucky (Kingsley and Powell 1977), where the forests that were cut over during the early part of the century continue to grow back.

Pennsylvania forests also experienced a sizeable increase in sawtimber volume, from 31.3 to 46.4 billion board feet—a 48-percent increase. The magnitude of the sawtimber volume increase is larger than those observed in the neighboring states, in part because Pennsylvania was logged over before those states.

There are a number of factors that help explain the sizeable growing-stock and proportionately larger sawtimber increase, the most important of which is that Penn's Woods are maturing. A significant portion of the trees have reached large poletimber or small sawtimber size—a time in the life of trees when annual growth rates are high. While the amount of timber volume grown in a given year is influenced by a host of favorable and unfavorable factors, the annual trend since the last survey has been for successively larger amounts of volume to be added to the growing-stock inventory (see Growth and Removals).

The maturation of the forests may be easily seen in Figures 15 and 16. In Figure 15, the distribution of numbers of growing-stock trees by diameter class, shows proportionately more trees in the 10-inch class and above and proportionately fewer trees in the 6- and 8-inch classes in 1978 than in 1965. Figure 16 shows the growing-stock volumes by diameter class for the two surveys. In essence, a bulge of timber volume which entered the growing stock inventory probably around the time of the first survey in the early 1950's is passing through the diameter classes. This bulge originated in the early decades of this century when most of Pennsylvania's forest lands were logged, often repeatedly. About the same time, large acreages of farmland, mostly of marginal productivity, were abandoned. People were leaving the farms for jobs in the state's rapidly expanding industrial cities. As a result, large blocks of land reverted to woodland within a relatively short time (Fig. 3). It is interesting to note that while the majority of Pennsylvania's volume is in hardwood species, a similarly shaped bulge of pine volume has been observed in some southeastern states (Boyce et al. 1975).

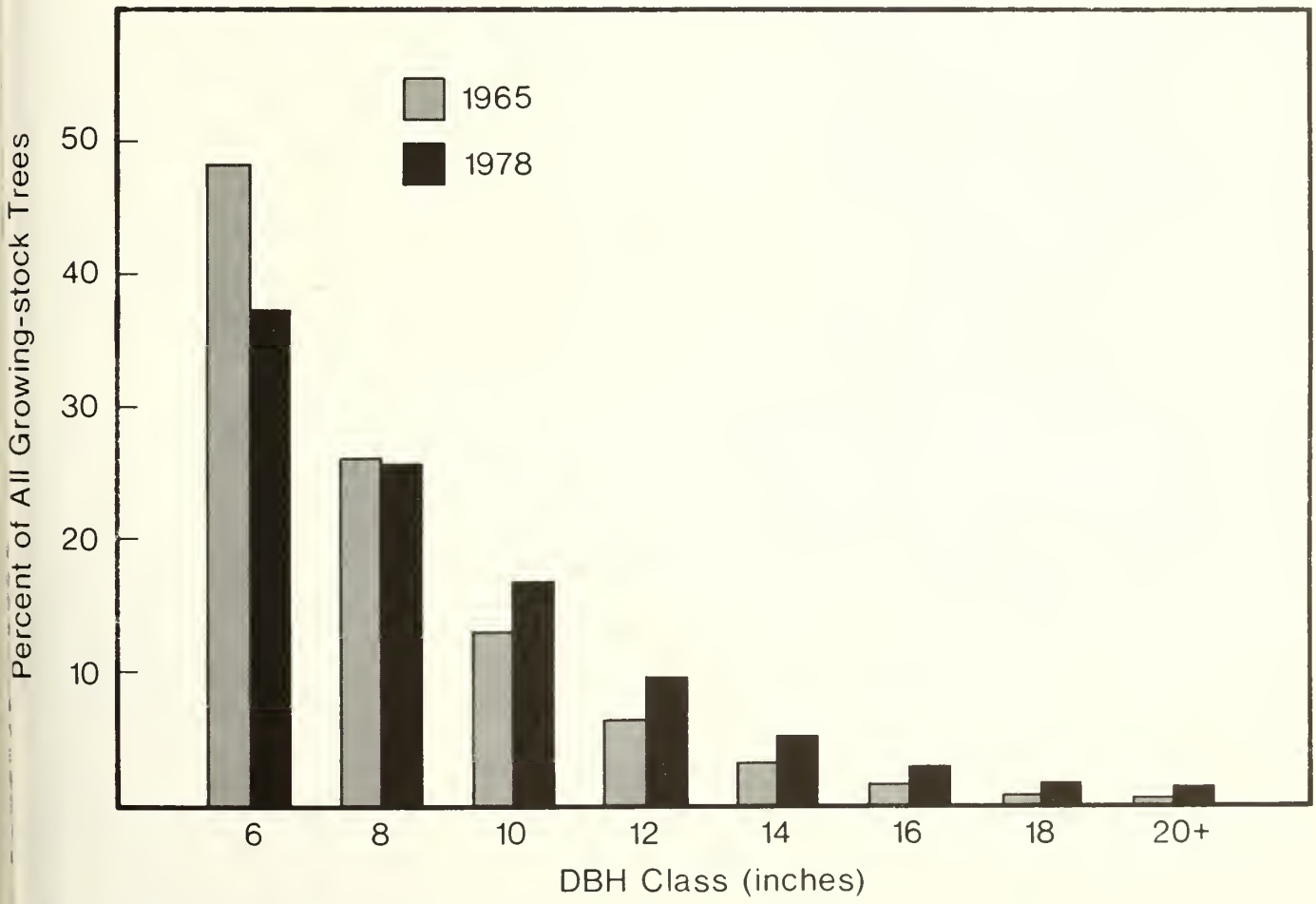


Figure 15.—Distribution of growing-stock trees, by diameter class, Pennsylvania, 1965 and 1978.

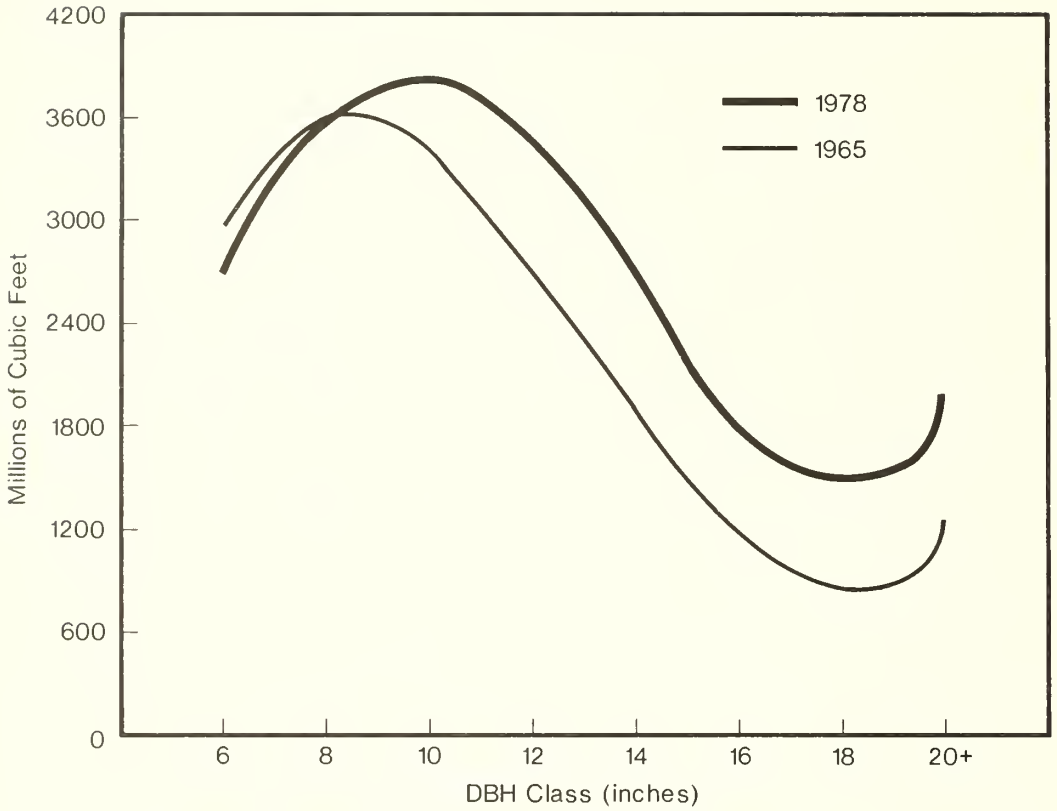


Figure 16.—Net volume of growing stock, by diameter class, Pennsylvania, 1965 and 1978.

Because of the slight decline in commercial forest land while timber volumes were building, the per-acre inventory changes are even more dramatic, especially when examined by ownership classes.

On public lands, growing-stock volume per acre jumped by 53 percent between surveys—from 1,184 to 1,808 cubic feet. The private owners had a much more modest 15-percent increase—from 1,078 to 1,243 cubic feet. The trend in stand-size distribution of commercial forest land for these two ownership groups offers an explanation for the differential volume increases:

Stand size	*Public*		*Private*	
	1965	*1978*	*1965*	*1978*
	Percent			
Sawtimber	44	61	44	44
Poletimber	45	32	32	31
Sapling-seedling	10	7	22	23
Nonstocked areas	1	—	2	2
Total	100	100	100	100

Private ownerships had and have a much larger portion of their land in sapling-seedling and nonstocked stands. These low-volume stands have pulled down overall averages. Also, the stand-size distribution on the surface has changed little over 13 years. But what the balance really means is that the harvesting and other losses of sawtimber stands kept pace with the ingrowth from pole to sawtimber. Harvesting of these sawtimber stands reduced volume buildups.

The stand-size distribution on public lands is different from private lands. Harvesting did not keep up with the maturing stands. This allowed a sizeable increase in sawtimber stands and a resulting higher increase in volume. The increase o

sawtimber stands on public lands should not be a surprise. Public lands usually are managed for a variety of uses, timber being one of many. Timber management is usually for high-quality sawtimber, which requires long rotations. This means that compared with private lands, proportionately fewer sawtimber stands were cut on public lands. However, we anticipate higher harvesting levels on public lands over the next few decades. Volume per acre increases should be smaller, reflecting this rise in removals.

Pennsylvania's Top Ten

Species	Million cubic feet	Percent of total
1. Red maple	3,370	15
2. Northern red oak	2,598	12
3. Chestnut oak	2,058	10
4. Sugar maple	1,991	9
5. Black cherry	1,892	9
6. White oak	1,368	6
7. Beech	901	4
8. Black oak	890	4
9. White ash	880	4
10. Hemlock	872	4
Total	16,820	77

Species

Pennsylvania is dominated by hardwoods. In fact, Pennsylvania has more hardwood growing-stock volume than any other state in the country (USDA For. Serv. 1980c). Pennsylvania's growing-stock volume is 92 percent hardwood—20 billion cubic feet—and 8 percent softwood—1.8 billion cubic feet. These proportions have not changed since the 1965 survey, though their totals increased by 22 and 24 percent, respectively.

Not all species within these two groups performed equally. In order to discuss species' changes in more detail, we grouped the 64 commercial tree species encountered in our survey into nine groups. Each group has at least 1 billion cubic feet of growing-stock volume. Eight of these groups, with relatively few species in each, will be discussed in decreasing order of dominance: red maples, northern red oak, chestnut oak, sugar maple, black cherry, softwoods, select white oaks, and other oaks. The ninth group, other hardwoods, will be discussed last, even though it has the most volume.

Red maples. This group includes red and silver maple. Red maple accounts for over 99 percent of this group's growing-stock volume. Red maple has the largest volume of any species in the state (see box), a position it also held in 1965. It has 15 percent of the growing-stock volume, but 19 percent of all growing-stock trees. This indicates that most of the volume is in smaller trees. Seventy-one percent of red maple trees are less than 9 inches in dbh. This is why it is a distant second to northern red oak in sawtimber volume. The following shows the percentage of growing-stock trees on commercial forest land in 1978, by species and diameter class.

Species	Diameter class (inches at breast height)										
	5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–28.9	29.0 +	All classes
White and red pines	41	24	17	8	3	3	2	1	1	W	100
Hemlock	43	24	12	10	5	3	1	1	1	W	100
Select white oaks	33	26	18	10	6	3	2	1	1	W	100
Northern red oak	25	21	19	14	8	6	3	2	2	W	100
Other oaks	23	22	19	14	10	5	4	1	2	W	100
Chestnut oak	33	29	18	10	5	3	1	1	W	W	100
Sugar maple	38	29	15	9	5	2	1	1	W	W	100
Red maples	45	26	15	8	4	1	1	W	W	W	100
Beech	39	23	16	9	6	3	2	1	1	W	100
White ash	36	22	18	11	6	4	2	1	W	W	100
Black cherry	29	26	20	12	6	4	2	1	W	W	100
Aspen	43	30	18	6	2	1	W	W	W	W	100
All species	37	26	17	9	5	3	1	1	1	W	100

W—Less than 0.5 percent

Red maple is one of the few species that has growing-stock volume in all nine of Pennsylvania's forest-type groups (see Table 2 in the Appendix). Red maple is the most voluminous species in the elm/ash/red maple and northern hardwoods type groups. One-third of red maple's volume is in the oak/hickory type group, where its volume is almost as high as the select white oaks and other oak species groups. In the white pine and hemlock and oak/pine type groups, red maple is the most voluminous hardwood species. All of this attests to the wide variety of sites that red maple grows on and the wide variety of species associated with it.

Between surveys, red maple's volume increased by about one-third. A number of factors helped red maple hold its top position in growing-stock volume and even increase its lead over red oak. The species is opportunistic and aggressive (Powell and Erdmann 1980). American elm, which used to be the dominant species in the elm/ash/red maple type group, has been decimated by the rapid spread of Dutch elm disease. Red maple replaced many of the dead elms, and is now the dominant species in this wet-site type group.

In the northern hardwood type group, red maple has done well for several reasons. First, it grows rapidly in Pennsylvania's northern region. Second, though it has recently become a preferred timber species, red maple for many years was not as preferred as black cherry, yellow birch, and sugar maple. This allowed timber volumes to build. Finally, and probably most important, since many of the forest stands in the northern counties originated about the same time, we are seeing a discernible successional trend. After the original harvesting, fast-growing, shade-intolerant species like black cherry grew rapidly. Red maple, which is more shade tolerant and slower growing, did not do as well initially but is now gaining on cherry. Since the red maple resource is not yet mature, it is likely to show sizeable increases for several decades, but coming on strong is an even more shade-tolerant species—sugar maple (personal communication, Dave Marquis, USDA Forest Service).

In the oak/hickory type group, heavy oak mortality from several insect pests created openings in the stands that red maple exploited. Other opportunities for red maple's expansion were created from harvesting the more desirable oaks for sawtimber and pulpwood.

Although red maple occurs in every county in the state, it is concentrated in the northern counties. With 40 percent of its growing-stock volume in the Allegheny Unit, 18 percent in the North-Central Unit, and 12 percent in the Northeastern Unit, red maple has 70 percent of its volume in 20 northern and northeastern counties.

Ten percent of all live red maple trees are cull—twice the proportion found in the select oaks. There are by far more rotten red maple trees than rotten trees of any other species, and rough trees outnumber rotten trees by about 25 percent.

Northern red oak. This valuable species has the second highest growing-stock and highest sawtimber volume in the state. Red oak has 12 percent of the total growing-stock volume and 8 percent of the growing-stock trees, indicating that more of its volume is in larger trees.

In fact, the distribution of growing-stock trees by diameter class points out interesting differences between red oak and several other species, notably red maple and aspen. Red oak has a much lower proportion of trees in the 5.0- to 6.9-inch diameter class than maple and aspen. This seems to indicate a future problem for red oak. While red oak is longer lived than many species and may need fewer small trees to sustain a given sawtimber level (Merritt 1979), there is concern about the long-term prospect for the oak resource. Regeneration failures have been documented and efforts to stimulate regeneration generally have been successful (Marquis et al. 1976).

The short-term prospect for the resource is good. Growing-stock volume increased by 11 percent between surveys. Although this was a lower percentage increase than the maples and cherry showed, the inventory still increased by 264 million cubic feet.

Northern red oak is the most voluminous species in the oak/hickory type group (Table 2). Eighty-four percent of its volume is in this type group. It is also the oak most often associated with the northern hardwoods, aspen/birch, and white pine and hemlock type groups. These type groups are most common in areas north of central Pennsylvania.

Red oak growing-stock volume is concentrated in the central portions of the state. Forty percent of the volume is in the North-Central and Allegheny Units, while another 30 percent is split between the Southwestern and South-Central Units.

For the state as a whole, 5 percent of all live northern red oak trees are cull. There are about 1½ times as many rough as rotten trees.

Chestnut oak. This species currently has 10 percent of the state's growing-stock volume and ranks third among all species. This volume represents a gain of 8 percent since 1965. Chestnut oak is concentrated mostly in the ridge and valley physiographic region (Fig. 1). Over 40 percent of its volume is in the South-Central and Pocono Units. Befitting its reputation as a species of generally low quality, chestnut oak has proportionately nearly twice as many cull trees as do the select white oaks and northern red oak. Rough trees outnumbered rotten trees by two to one.

The following shows the percent distribution of growing-stock volume in 1978, by species, across the geographic units of Pennsylvania.

Species	Western	Southwestern	Allegheny	North-Central	South-Central	Northeastern	Pocono	Southeastern	All units
				Percent					
White pine	4	4	10	30[a]	18	18	11	5	100
Hemlock	5	6	30[a]	26	5	17	10	1	100
Select white oaks	12	8	10	26[a]	15	4	16	9	100
Northern red oak	9	15	17	24[a]	15	7	7	6	100
Chestnut oak	1	14	8	18	25[a]	3	17	14	100
Black oak	9	11	6	16	21	2	11	24[a]	100
Sugar maple	11	7	54[a]	10	2	13	3	W	100
Red maples	8	7	40[a]	18	4	12	8	3	100
Beech	9	5	52[a]	9	1	15	6	3	100
White ash	12	5	30[a]	11	14	9	5	14	100
Yellow-poplar	23	8	11	9	12	W	6	31[a]	100
Black cherry	18	9	53[a]	10	1	6	2	1	100
All species	10	9	29[a]	17	11	8	8	8	100

[a] Unit where largest species volume occurred.
W—Less than 0.5 percent.

Sugar maple. The volume of sugar maple rose by about 60 percent between inventories, the largest percentage increase among the major species. Sugar maple ranks fourth in the state with 9 percent of the growing-stock volume. It also has 9 percent of the growing-stock trees. Unlike red maple, sugar maple's volume is almost wholly concentrated in the northern hardwood type group. About 7 percent of all live trees are cull, with the number of rough and rotten trees nearly equal.

The dramatic increase in sugar maple volume is related directly to the progression of forest succession in the state. Over half of sugar maple's volume is in the Allegheny Unit and over half of its volume increase occurred there. Therefore, a discussion of the trends in this unit will highlight the reasons for the statewide increase. Many forests in this unit are second growth and originated from heavy cutting 50 to 90 years ago. Since that time, the natural progression of stand development has dictated which species would grow fastest and predominate.[1] Fast-growing, shade-intolerant species like black cherry had the first growth spurts and big increases in volume. Cherry had more volume than sugar maple during the first and second inventories—a situation that is now reversed.

Sugar maple is slower growing than cherry and red maple and was overtopped by their growth. Development of sugar maple's timber volumes has taken longer because of its slower growth and has been helped because timber harvesting has been light relative to timber inventory. Sugar maple's development under undisturbed conditions has also been observed in upland stands in other states (Schlesinger 1976). In those stands that are not heavily disturbed, sugar maple will continue to show significant increases for several decades.

Black cherry. Pennsylvania is the center of the black cherry supply for the world. A valuable sawtimber and veneer species, black cherry ranks fifth in the state for growing-stock volume and third for sawtimber. It has 9 percent of the growing-stock volume and seven percent of the growing-stock trees, indicating, as with red oak, that its volume tends to be on larger trees.

[1] Marquis, David A. The effect of past cutting history on the structure, species composition, and development of present-day Allegheny hardwood forests. USDA For. Serv., Northeast. For. Exp. Stn., Broomall, PA (Manuscript submitted to Forest Science).

A superlative old-growth black cherry in Tionesta Scenic Area (McKean County).

Eighty-five percent of cherry's volume is in the northern-hardwood type group, though some volume is found in all the other type groups. While black cherry's geographic range includes all of Pennsylvania, most of its volume is in counties situated within the Allegheny Plateau (Fig. 1). The Allegheny Unit covers a portion of the Plateau, and this is where cherry reaches its optimum development. Over half of its growing-stock volume and nearly 60 percent of its sawtimber volume are found there.

Black cherry was rare in the virgin forests of Pennsylvania, even on the Plateau (Hough and Forbes 1943). Logging and burning of the woods around the early part of this century created the openings that species like cherry needed to grow rapidly and become more abundant. So cherry became a major component of many second-growth forests.

As the Allegheny Plateau forests have matured, the species composition has shifted. Fifty to ninety years of growth has allowed species that grow slower than cherry, like red and sugar maple, to increase substantially in volume. The cherry resource is more mature and has more sawtimber in the Allegheny Unit than the two maples, even though the maples have more growing-stock volume.

Softwoods. In this hardwood-dominated state, softwoods are a minor timber resource. Hemlock is the most abundant softwood, accounting for nearly half of all the softwood growing-stock volume, yet representing only 4 percent of the total growing-stock volume. It is the only softwood among the 10 major timber species. Nearly three-quarters of hemlock's volume is concentrated in the Allegheny, North-Central, and Northeastern Units where cool, moist growing conditions favor its presence. Hemlock volumes rose by more than 20 percent between inventories.

White pine is the second most abundant softwood, accounting for about one-third of the volume. Two-thirds of the white pine volume is concentrated in the North-Central, Northeastern, and South-Central Units.

Although softwoods accounted for about three-quarters of Pennsylvania's lumber production around the turn of this century, they made up nowhere near that proportion of the State's timber inventory. Heavy cutting and fires depleted the softwood resource early in the century, and in some areas white pine and hemlock were virtually eliminated from the forests (Marquis 1975).

With fire protection and the forest's natural regrowth, the softwood volume is gradually increasing. As recently as the period between 1956 and 1965, increases in hardwood volume (on a percentage basis) exceeded softwood increases. Between 1965 and 1978, however, softwoods had a higher percentage increase in growing-stock volume (24 percent than hardwoods (22 percent). In growth of softwoods into growing stock was an important component of this recent increase. Many softwood plantations established in the 1930's and 1940's have developed to the stage where they could be considered merchantable. The relatively low demand for timber products from softwood and the absence of insect and disease attacks in recent years also contributed to the increase.

As with the hardwood species, softwoods are not restricted to a particular forest-type group. One should not assume that all or nearly all of the white pine and hemlock growing stock volume is in the white pine and hemlock type group. The names of the type groups generally indicate species with a plurality of stocking

(see the definitions of forest types in the Appendix). In the case of white pine, half of its growing-stock volume is in the white pine and hemlock type group. Hemlock, however, has only 28 percent of its volume in that group. White pine and hemlock are by far the major species in that type group, but they are also common associates in other type groups. In fact, 60 percent of all softwood growing-stock volume is in hardwood type groups.

Several softwoods are found in Pennsylvania, predominantly in the Pocono and Northeastern Units, which are of little economic value due to their very limited occurrence but are of high interest ecologically. These species—spruce, balsam fir, and larch—are characteristic of the boreal forest, usually found far to the north in Maine and Canada. Now in Pennsylvania they cover only a fraction of the area they once did. They are stands typical perhaps of an era when Pennsylvania's climate was colder and glaciers covered portions of the state. Boreal species were once more common than many of the species prevalent today.

Select white oaks. In Pennsylvania, this commercially valuable group includes three species: white, swamp white, and bur oaks. Nearly all the volume in this group is in white oak. This group ranks sixth in growing-stock volume. Over one-quarter of the volume in this group is in the North-Central Unit, with another one-third split between the Pocono and South-Central Units. This was the only major species or species group to show a decline in volume between inventories. The decline was not significant and was not evenly spread across all units; in fact, some units gained in volume. The largest declines were in the North-Central and Allegheny Units. During the period between inventories portions of these units were hit very hard by a number of insect and disease attacks. The select white oaks in these units seem to have suffered greatly as their mortality and cull increment were very high in relation to their gross growth. For the state as a whole, about 5 percent of all live select white oak trees are cull, evenly split between the rough and rotten categories.

Other oaks. Seven oaks (black, scarlet, pin, shingle, southern red, post, and willow) make up this diverse group, though black and scarlet oaks dominate the growing-stock volume (98 percent). Black oak alone ranks eighth in the state with 4 percent of the volume. Almost one-quarter of the volume in this group is located in the South-Central Unit. Growing-stock volume is up 7 percent since the last inventory.

Other hardwoods. This diverse group accounts for the remainder of the hardwood volume—5.4 million cubic feet. It includes beech, white ash, yellow-poplar, sweet birch, hickory, and aspen. On the whole, they are distributed around the state, though certain species tend to be concentrated in particular units. For example, nearly one-third of the yellow-poplar volume is in the Southeastern Unit, and over one-half of the beech volume is in the Allegheny Unit.

Geographic Units

The quantity and quality of the timber resources in Pennsylvania's eight geographic units are quite variable. A brief look at each unit, ranked by their average cubic foot volume per acre, will highlight their unique characteristics (Fig. 17).

Allegheny Unit. This unit is Pennsylvania's premier forested area. It is 84 percent forested. In 1965 and 1978 it had the highest growing-stock total and per acre volumes of any unit (Fig. 17). Per acre growing-stock volumes are 15 percent above the next highest unit and 120 percent over the lowest unit. This is an area of active forest management by the forest industries and public agencies, who own nearly 60 percent of the commercial forest land.

The following shows the percent distribution of growing-stock volume in 1978, by species, within each geographic unit in Pennsylvania. Note that red maple, sugar maple, and black cherry account for 55 percent of the inventory in the Allegheny Unit.

					Percent				
White pine	1	1	1	4	4	5	3	2	2
Hemlock	2	3	4	6	2	8	5	W	4
Other softwoods	4	1	1	2	2	2	4	2	2
Select white oaks	8	6	2	10	9	3	12	8	6
Northern red oak	10	20 [a]	7	16 [a]	17	10	11	9	12
Chestnut oak	1	15	3	10	21 [a]	4	19 [a]	18 [a]	9
Black oak	4	5	1	4	8	1	5	13	4
Sugar maple	10	7	17	5	2	14	4	W	9
Red maples	12	13	22 [a]	16 [a]	6	21 [a]	15	7	16
Beech	4	2	7	2	W	8	3	2	4
White ash	5	2	4	3	5	4	2	7	4
Yellow-poplar	6	2	1	1	3	W	2	11	3
Black cherry	15 [a]	9	16	5	1	6	2	1	9
Other hardwoods	18	14	14	16	20	14	13	20	16
All species	100	100	100	100	100	100	100	100	100

[a] Species with largest volume in unit
W—Less than 0.5 percent

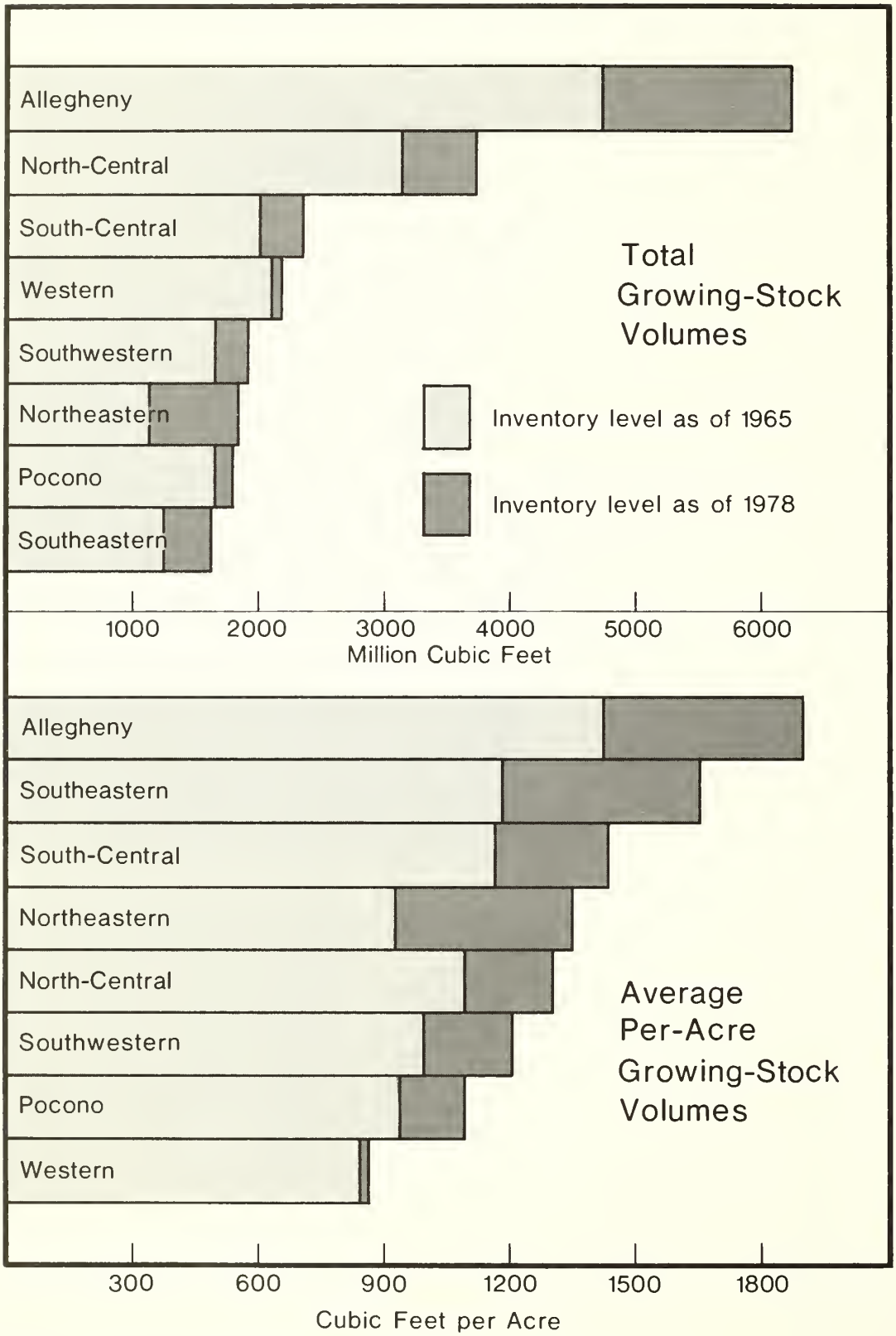


Figure 17.—Total and average per-acre growing-stock volumes by geographic unit, Pennsylvania, 1965 and 1978.

Six major species (hemlock, sugar maple, red maple, beech, white ash, and black cherry) have more volume in this unit than in any other (see page 27).

Southeastern Unit. This unit ranks second in volume per acre, a position it also held during the previous survey. At first glance this is surprising since this unit is the least forested and most densely populated. These factors influence the volume total, which is the lowest among all units. But there is plenty of volume on the acres that are forested. Nearly 70 percent of the commercial forest land is in sawtimber-size stands. The great majority of the forest land is privately held and in small parcels. Timber harvesting pressure is relatively light. This allowed timber volumes to climb rapidly. Since these increases were on a declining land base, the per acre changes were much more substantial than total volume changes.

Timber volumes are more evenly distributed among species in this unit than in the Allegheny Unit. A variety of oaks, notably chestnut and black oak, account for over 50 percent of the volume. Black oak and yellow-poplar reach their maximum volume here.

South-Central Unit. This unit ranks third in both volume per acre and total volume. In 1965 the unit held the same position in volume per acre but was one notch lower in total volume. Its percentage gains in per-acre and total volume were in the middle of the range established by the units.

As in the Southeastern Unit, oaks are the largest species group for timber volume. Chestnut oak and northern red oak are the principals in this group, which accounts for over 5 percent of the volume. Chestnut oak's maximum volume is in this unit.

Northeastern Unit. This unit is fourth in volume per acre and sixth in total volume, but had the largest percentage gains of any unit for both categories. In 1965 this unit ranked seventh in per-acre volume and last in total volume. In contrast to nearly all the other units, the total volume percentage gain was larger than the per-acre change because this unit had a significant increase in its commercial forest-land base. Since additions to the forest land base had to be sapling-seedling stands with low volume, the overall per-acre average was pulled down.

Much like the Allegheny Unit, the major species in the Northeastern Unit are northern hardwoods. Red and sugar maples account for over one-third of the volume. Beech, black cherry, and white ash make up another one-fifth. Proportionately, the Northeastern Unit has more softwood than the other units.

North-Central Unit. This unit ranks fifth in volume per acre but second in total volume. This low per-acre average is in sharp contrast to the Allegheny Unit, its northern neighbor. Several factors seem to explain this difference. First, the species composition of the two units is quite different. Four oaks account for over 40 percent of the North-Central's volume, while in the Allegheny Unit they account for only 13 percent. The insect and disease attacks that occurred in the North-Central Unit were directed mostly against oaks. Undoubtedly, these attacks contributed to lower volumes on many acres, lowering overall per-acre volume.

Second, the black cherry component of the resource is much lower in the North-Central Unit than the Allegheny Unit—5 versus 16 percent. Other factors being equal, stands with a significant component of black cherry have much higher volumes per acre than others. Thus, the Allegheny Unit, with its higher concentrations of black cherry, is expected to have higher per-acre volumes.

Third, the stand-size distribution of the North-Central Unit is such that it has twice as many acres of sapling-seedling stands as the Allegheny Unit. Strip mining has recently been heavy in the western half of this unit. Reclaimed strip mines that have been planted with trees or have reverted to forest are usually still in an early stage of development. These sapling-seedling stands have low volumes in relation to poletimber and sawtimber stands and, like the insect-ravaged stands, tend to lower the average per acre volume.

Southwestern Unit. This unit ranks sixth in per-acre volume and fifth in total volume. Its percentage increases were below almost all the other units. The most probable cause for the low increases is the heavy timber harvesting pressure the unit receives. Based on its timber inventory, this unit was cut more heavily for sawlogs and pulpwood than any other. This means the growth rate, which was near the state average, was not large enough to allow timber volumes to accumulate very much.

The South-Central Unit is the only unit that has more sawmills per million board feet of sawtimber inventory than the Southwestern Unit. But the Southwestern Unit has proportionately more large sawmills than any other unit. Nearly 40 percent of its sawmills have an annual production capability of more than 1 million board feet. Sawtimber harvest has been heavy in part because of concentrations of valuable species like red oak. Pulpwood harvest has been heavy because a number of pulpmills either were or are located in or near this unit. Currently, only one pulpmill is active in the unit but several more are close by in neighboring counties or in Maryland. In the 1960's there were three pulpmills in this unit alone.

The species mix of this unit is interesting. Both oaks and northern hardwoods are well distributed. Oaks, with northern red oak dominating, account for about one-half of the growing-stock volume. Northern hardwoods make up another one-third. This high percentage of northern hardwoods does not occur in the neighboring South-Central Unit. The Southwestern Unit with its higher elevations provides a more suitable environment for the northern species. This unit serves as a bridge connecting the northern units of Pennsylvania and the mountains of West Virginia where northern species dominate.

Pocono Unit. This unit ranks seventh in per-acre and total volume. It has had repeated heavy timber cutting and many fires (see Forest Area). Its forests have been recovering, but the commercial forest-land base and its timber volumes are currently being reduced by recreational developments. Nearly 30 percent of the commercial forest land is in sapling-seedling stands, and it is only one of two units that have less area in sawtimber-size stands than poletimber. Oaks and red maples account for about two-thirds of the timber volume.

Western Unit. This unit sits at the bottom of the per-acre volume scale. It ranks fourth in total volume, but this is only because of its relatively large forest-land base. Fully one-third of its commercial forest land, the highest proportion of any unit, is in sapling-seedling stands or in nonstocked areas. These are very low-volume conditions. This unit also has the highest proportion of cull trees among all live ones; more than one in five is rough or rotten. These cull trees contribute nothing to growing-stock volumes but occupy valuable growing space. The following shows the numbers of cull, growing-stock, and live trees in each geographic unit that are more than 5 inches in dbh (1978).

Total and per-acre volume increases in the Western Unit were negligible. This unit is not particularly active for timber removals, though there is quite a bit of strip mining.

This unit has a high degree of species diversity. Oaks and maples each account for about one-fifth of the volume. Black cherry has the highest volume in the unit (see page 29), but as an indication of the unit's timber quality, over one-half of the state's cull black cherry trees are found here.

Biomass

Most of the discussion of timber volumes in this report concerns net growing-stock and sawtimber volumes. However, these volumes are by no means the state's total wood resource. Rather, they represent a segment of the wood resource bounded by specific size, species, merchantability, and locational characteristics. In light of the potential energy and nontimber benefits from the woods, it is worthwhile to examine some of the other components of total timber volume.

It was not practical for Resources Evaluation to estimate Pennsylvania's total timber volume. To do so would have required calculating timber volumes on nonforest and noncommercial forest land in addition to commercial forest land. While we estimated the area in these land classes, we were not charged with developing timber volume estimates for nonforest and noncommercial forest land.

On commercial forest land, volumes were not calculated for trees less than 5 inches in dbh or for noncommercial species. The commercial species above 5 inches in dbh were segregated into growing stock, rough, and rotten categories based on form and soundness. For these trees, estimates of gross and net cubic- and board-foot volume were developed.

The gross growing-stock volume for all live trees above 5 inches in dbh to a 4-inch top, on commercial forest land, is estimated at 25.6 billion cubic feet. The estimated net volume for all commercial species is 23.6 billion cubic feet. This includes the net volume in rough and rotten trees—1.8 billion cubic feet. When the net volume in cull trees is deducted, the net volume in growing-stock trees is 21.8 billion cubic feet. So the net growing-stock volume is 85 percent of the gross volume in all live trees. Fifteen percent of the gross all live volume on commercial forest land is

Geographic unit	*Cull*	*Growing stock*	*All live*	*Proportion in cull trees*
		Thousands of trees		*Percent*
Western	64,178	248,626	312,804	21
Southwestern	43,718	191,451	235,169	19
Allegheny	81,613	540,607	622,220	13
North-Central	46,409	365,088	411,497	11
South-Central	26,853	200,774	227,627	12
Northeastern	29,177	189,115	218,292	13
Pocono	31,240	225,258	256,498	12
Southeastern	19,318	128,552	147,870	13
All units	342,506	2,089,471	2,431,977	14

in noncommercial species and the unmerchantable portion of growing-stock and cull trees.

Another way of examining the relationship between the growing-stock and cull portions of the inventory is to use the number of trees on Pennsylvania's commercial forest land. Fourteen percent of all live trees 5 inches in dbh and larger are classified as rough and rotten. One in seven hardwoods is cull, while only 1 in 10 softwoods is cull. Compared with 1965, this shows a reduction in the proportion of culls.

Pennsylvania is better off than nearly all of its northeastern neighbors in the proportion of cull trees in the timber resource. Only three northeastern states—Connecticut, Delaware, and New Jersey—have lower proportions of cull trees than Pennsylvania, while 10 others have a higher proportion. Two states—Vermont and New York—have, proportionately, about twice as much cull as Pennsylvania. Fire, insect and disease attacks, and timber harvesting systems where only the best trees are removed have been historically linked with increasing cull proportions in the woods. In recent times, increased protection from fires and pests, and the use of more sound silvicultural practices, have helped bring about an increase in the quality and vigor of the woods. Ways to further improve the quality of the state's forests are discussed later in this report (see Forest Management Opportunities).

The foregoing discussions of growing-stock and cull volumes exclude an increasingly important component of the timber base—the portion of a tree other than the main stem. Until recently, the merchantable bole (or main stem) was the source of nearly all forest products. Generally decreasing tree size and increases in extraction and processing costs have prompted many wood-using firms to consider using more of the aboveground portion of the tree. It has been shown that tree crowns and small trees can be used for domestic and industrial fuel, chips or particles in composite board products, fiber for pulp and paper products, mulch in agriculture, and as a bulking agent in municipal sludge composting.

As part of a national effort to quantify the aboveground biomass on commercial forest land, estimates of live green weight were developed for Pennsylvania's trees. The results are shown in Table 3. The estimates are not complete in several respects. No data are included for the Allegheny National Forest, and estimates for seedlings and saplings do not include State Forest lands.

Despite these limitations, several interesting findings emerge from the data. Most significant is the amount of wood contained in tops and branchwood and in seedlings and saplings. There are an estimated 962.1 million tons of wood in the merchantable bole of growing-stock and cull trees. Tops and branches from these trees have 294 million tons of wood, 31 percent of the merchantable bole total. Growing-stock trees, being of better form and vigor, usually have proportionately less biomass in tops and branches than cull trees.

Certain species yield proportionately more biomass from tops and branches than others. Age-class distributions, stocking levels, and branching characteristics strongly influence a particular species' top and branchwood production. For growing-stock trees, top and branchwood weight as a proportion of merchantable stem weight ranges from 13 percent for basswood and yellow-poplar to 28 percent for northern red oak. Shade-tolerant species like sugar maple, beech, and hemlock generally have proportions closer to that of northern red oak (between 24 and 27 percent). Shade-intolerant species like black locust, white ash, and black cherry tend to have proportions closer to those of yellow-poplar and basswood (16 and 17 percent, respectively).

Our estimate of seedling and sapling biomass is 192.9 million tons (Table 3). This is a conservative estimate because it does not include seedlings and saplings on State Forest land (these data were not available). But even this conservative estimate exceeds the weight of all cull trees by 68 percent and is 20 percent of the merchantable bole total for growing-stock and cull trees.

The feasibility of using these different sources of biomass varies. The merchantable bole is the portion most intensively utilized, now, and this is likely to continue. The amount of wood in seedlings and saplings approaches the amount in top and branchwood but might be harder to utilize because of high extraction costs and the desirability of protecting young stands. We can be certain of two things: (1) there is much more wood in the forest than we report as commercial timber volume, and (2) more of this wood will be utilized in coming years.

Sawlog Quality

In assessing the sawtimber resource, sawlog quality is very important. Pennsylvania has an estimated 4.3 billion board feet of softwood sawtimber. Only 2.1 billion board feet, the pines, were graded into standard-lumber grades. Of the graded volume, only 4 percent was Grade 1, and 13 percent was Grade 2. The remainder, 1.7 billion board feet, was in Grade 3. Yellow pines were of slightly better quality than the white and red pines, mostly due to the fact that yellow pines are allowed lower diameter limits for grade classification.

Pennsylvania's hardwood sawtimber volume of 42.1 billion board feet dwarfs the softwood resource by nearly a 10 to 1 ratio. Hardwood quality is not comparable with softwood quality because standards differ. Fifteen percent of the hardwood volume is Grade 1, 21 percent in Grade 2, 48 percent in Grade 3, and 16 percent in tie and timber. This is an improvement over 1965 when Grade 1 was 9 percent and Grade 2 was 19 percent.

An important contributor to the improvement in hardwood quality is, again, the maturing of forests. To become Grade 1 material a hardwood tree must attain a minimum dbh of

about 15.5 inches. Young, small sawtimber trees may qualify in every way but diameter, so the maturing process is important. Currently, 51 percent of the hardwood sawtimber volume is in trees over 15 inches in dbh—an improvement over 1965 when only 45 percent was over 15 inches. Perhaps more important than this increase for all hardwoods is the increase in commercially valued species. Red oak currently has 61 percent of its sawtimber volume in trees over 15 inches, up from 55 percent, and black cherry has 52 percent of its volume in trees over 15 inches, up from 42 percent.

Besides this natural process, a much smaller contribution to this increase in sawlog quality might be attributable to the efforts of forest managers and landowners who are managing their forests for high-quality sawtimber. More activity of this nature is probably occurring on lands owned by forest industries or administered by public agencies than on lands in the miscellaneous private sector.

Timber Products Output

Data on the output of timber products in Pennsylvania were collected in a primary timber industry survey in 1976. The data reflect the production for this particular point in time, and thus may not correspond directly to average annual removals for the period between surveys (see Growth and Removals). Additional information can be found in Tables 27 through 29 in "Forest Statistics for Pennsylvania—1978" (Considine and Powell 1980) and in "Pennsylvania Timber Industries—A Periodic Assessment of Timber Output" (Bones and Sherwood 1979).

The total output of timber products from all sources was 212.5 million cubic feet in 1976. This is a 21-percent increase over 1964's output, but was less than the high of 215.1 million in 1962 (Fig. 18). Since 1952, the output of sawlogs and pulpwood has increased while the output of other products has declined. The output of fuelwood generally declined from 1952 until the mid-1970's when it began to climb in response to rising prices for fossil fuels. In 1952, 36 percent of the total output was sawlogs and 16 percent was pulpwood. In 1976, sawlogs and pulpwood were 49 and 36 percent of the output, respectively, showing the decline of most products other than sawlogs and pulpwood.

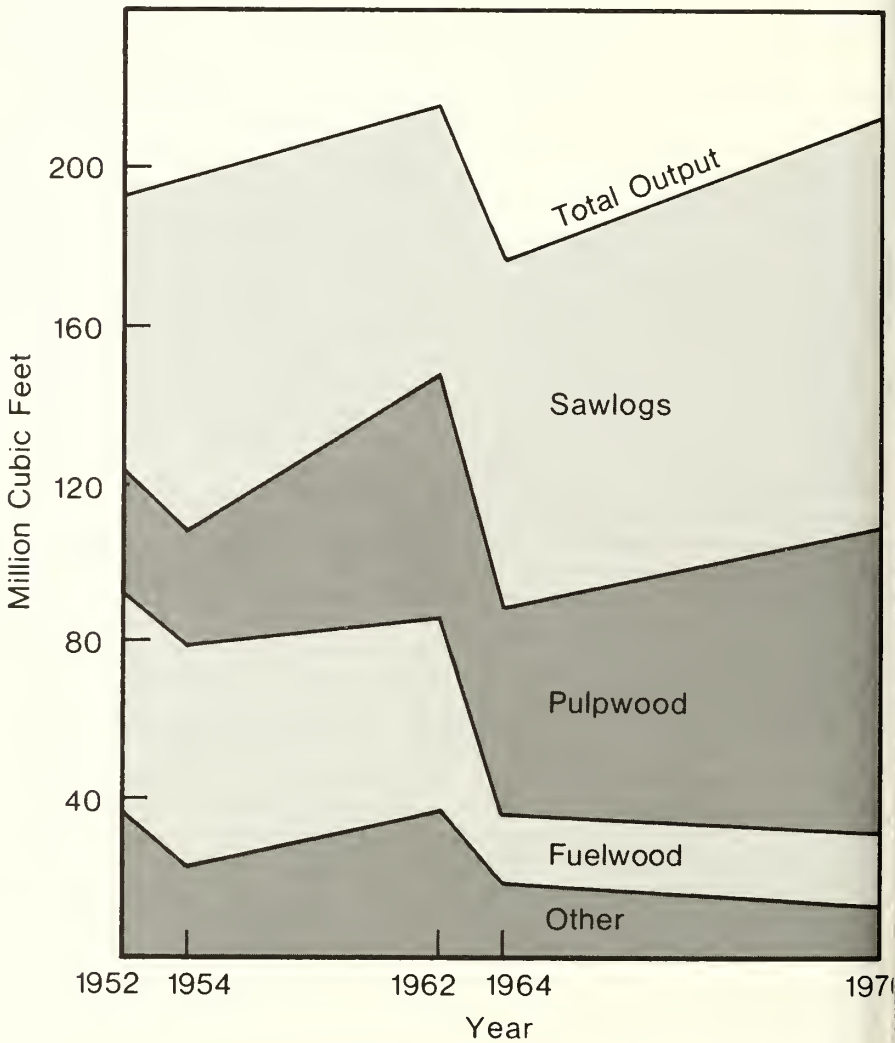


Figure 18.—Timber products output from all sources in Pennsylvania, by selected products and years.

The total output for 1976 can be classified as follows:

Source	Million cubic feet	Percent
Softwood growing stock	11.3	5
Hardwood growing stock	159.2	75
Total growing stock	170.5	80
Other roundwood sources	5.9	3
Total roundwood output	176.4	83
Manufacturing residues	36.1	17
All Sources	212.5	100

The other roundwood sources mentioned include rough and rotten trees, salvable dead trees, trees less than 5 inches in dbh, tree tops and limbs from commercial forest areas, or material from noncommercial forest land or material from nonforest land such as fence rows and suburban areas.

Output from roundwood has increased only by 9 percent since 1964, but output from manufacturing residues increased substantially. In 1964, residues used for timber products amounted to 13.4 million cublic feet, or 8 percent of the total output. In 1976, residues totaled 36.1 million cubic feet—an increase of 169 percent—and accounted for 17 percent of the total output. These figures along with repeated utilization studies (Wharton and Bones 1980) indicate that the recovery of timber for products is improving. In 1966, 79 percent of the growing-stock volume of a harvested tree was recovered for product. By 1977, the recovery rate had increased to 95 percent. Also, more biomass is now being recovered from nongrowing-stock trees and logging residues as these operations have become increasingly profitable. We expect this trend to continue as timber supplies become tighter or as utilization technology improves.

Output from hardwood species was 198.1 million cubic feet in 1976 or 93 percent of the total. This is not surprising in a state that is so dominated by hardwood trees—they account for 92 percent of the total growing-stock volume. This output increased by 36.4 million cubic feet—22 percent—since 1964. Most of this increase—28.7 million cubic feet—was in pulpwood. The output from softwoods in 1976 was 14.5 million cubic feet. Overall, this was only a 2-percent increase from 1964. Within this species group, however, sawlog output rose by 47 percent while pulpwood output dropped by 38 percent. The following tabulation shows the output in 1976, by product.

Product	From roundwood		From residues		Total	
	Million cubic feet	Percent	Million cubic feet	Percent	Million cubic feet	Percent
Sawlogs	103.7	59	—	—	103.7	49
Pulpwood	53.1	30	24.2	67	77.3	36
Fuelwood	10.4	6	9.4	26	19.8	9
Other	9.2	5	2.5	7	11.7	6
Total	176.4	100	36.1	100	212.5	100

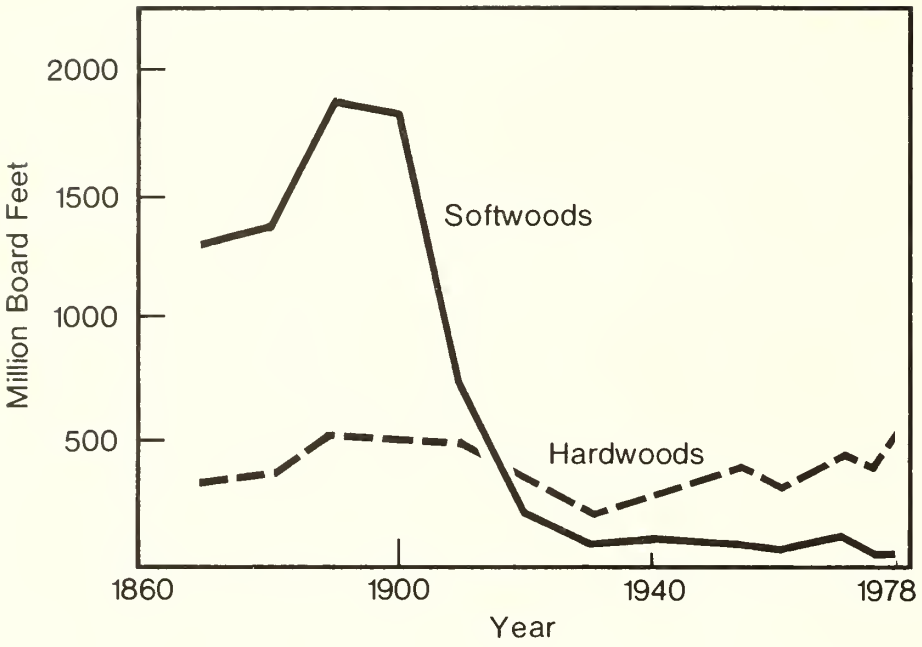
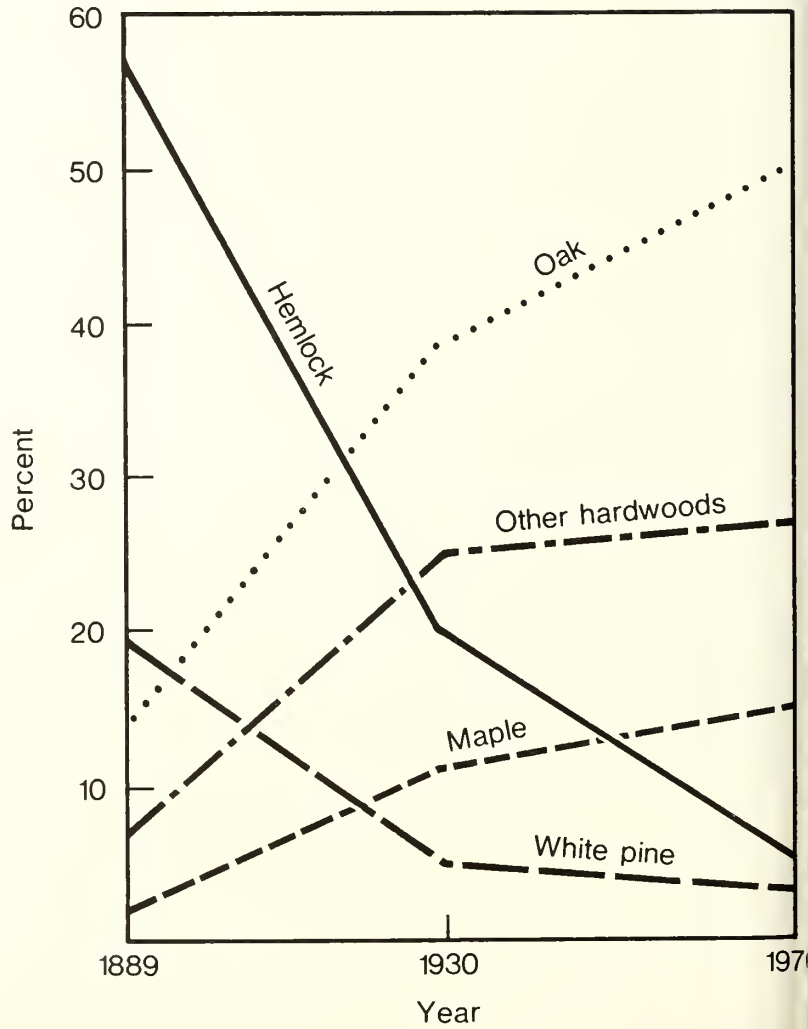


Figure 19.—Lumber production in Pennsylvania for selected years between 1869 and 1978.

Figure 20.—Lumber production for major species groups in Pennsylvania for 1889, 1930, and 1976, in percent.



Lumber and Sawlogs

Sawlogs, which are manufactured into lumber and other sawed products, have dominated the volume of timber harvested for products since the first stand was logged over 300 years ago. By 1860 Pennsylvania led the Nation in lumber production, a position it held through 1870. During these 10 years, annual output was about 2 billion board feet, approximately one-sixth of the Nation's total. Production continued to climb until it reached a peak of 2.5 billion board feet in 1889. By the early 1900's it had dropped to about 300 million board feet, and since then has generally increased to its current level of about 500 million board feet.

Softwoods dominated the industry until about 1910 (Fig. 19). Softwood production then declined until the mid-1920's when it leveled off at about 85 million board feet. Figure 20 shows the trends, in percent, of major species groups from the time of peak production to 1976. In the 1800's, hemlock and white pine were the major species cut for lumber since they were the species with the largest and best trees and since they had established markets. Now there is little softwood volume in the state, so hardwoods naturally dominate lumber production. Various oak species account for 50 percent of the production. Most of this lumber is going into furniture, for which oak has recently established itself as a featured species. Cherry, ash, and maple also are valuable hardwood species, and they account for most of the remaining production.

The number of sawmills continues to decline. In 1947 the number of mills operating in the state stood at a record 2,745 (Bones and Sherwood 1979). By 1954 the number had dropped to 2,379, and by 1964 there were 999 mills. The industry survey showed that there were 740 operating sawmills during 1976. This trend does not indicate a decrease in production, however, since the average production of sawmills has been steadily increasing. Low-production, portable, part-time mills are closing while high-production, stationary, full-time mills are filling the gap (Bones and Sherwood 1979).

Sawlog production still ranks first in Pennsylvania.

International Harvester Co.

. . .but pulpwood production is increasing its share of the state's timber product output.

Keway Manufacturing Company

Pulpwood

Pulpwood production occupies an increasingly larger share of the timber products output of the state (Fig. 18). Pulpwood production increased from 534,400 cords in 1963 to 955,400 cords in 1979—a 79-percent gain. Pulpwood production is made up of output from roundwood and output from manufacturing residues. In 1979, roundwood accounted for 67 percent—636,600 cords. Ninety-five percent of this was from hardwood species. Aspen and yellow-poplar produced 36,600 cords; oak and hickory yielded 277,600 cords; and other hardwoods, mainly maples, beech, and birch, accounted for 288,400 cords. Pine dominated the softwood production, though some hemlock was cut for pulpwood. Since 1963, roundwood output has increased by 26 percent, with hardwood gaining 51 percent and softwoods losing 70 percent.

Of the 318,800 cord-equivalents produced from manufacturing residues in 1979, 94 percent were hardwood. Even though residues made up only 33 percent of the pulpwood production in 1978, this was much greater than the 4 percent share in 1963. During this period they increased over thirteenfold. Improved use of these byproducts by the pulp industry has substituted for the removal of thousands of cords of standing, live timber. Figure 21 shows the trends in pulpwood production over this period for these components.

Between 1963 and 1979, a total of 15 counties in Pennsylvania produced more than 15,000 cords of pulpwood annually. The top 10 counties and their average roundwood production (in cords) for this period are:

1	Clearfield	51,300
2	Bedford	43,400
3	Huntingdon	35,900
4	McKean	32,200
5	Centre	32,000
6	Elk	28,700
7	Clinton	25,000
8	Warren	22,700
9	Lycoming	22,200
10	Susquehanna	19,900

These counties produced more than 5.3 million cords of roundwood from 1963 to 1979, which amounts to 52 percent of the state total.

Fuelwood

Fuelwood is not considered an industrial product, but it ranks third in Pennsylvania as a timber product. Since 1952, when more than 56 million cubic feet of fuelwood were produced, the trend until the mid-1970's was down. A low of 18.2 million was reached in 1964, and by 1976 production was up slightly to 19.8 million cubic feet or 247,175 cords. Hardwoods have dominated, and in 1976 accounted for 97 percent of the state's fuelwood output.

While we do not have statewide data on fuelwood production since 1976, we do know that this production has increased dramatically. Activity on State Forest land may be indicative of what has happened throughout the state. In 1976, 14,000 cords of fuelwood were sold from State Forests, and by 1979 70,000 cords were sold.

As with pulpwood, fuelwood production comes from both roundwood and manufacturing residues. In 1976, 53 percent, or 130,000 cords, was from roundwood sources. The bulk of this went into household heating and cooking. The remaining 47 percent, or 117,175 cords, came from slabs, edgings, and other manufacturing by-products. Most of this was used by wood-based industries to generate heat and electricity for their operations.

The outlook for fuelwood production seems very good (see Forest Management Opportunities). With the rapidly rising prices of natural gas and oil, individuals and businesses are giving greater attention to wood for energy. Hardwoods generally provide more heat per volume unit of wood than softwoods, indicating that Pennsylvania's hardwood-dominated forests can satisfy much of this increased demand.

Other Products

In 1976, output of other industrial products amounted to 11,768,000 cubic feet or 6 percent of the total timber products output. This represents a decline of 36 percent since 1964 and a drop of 49 percent since 1954. In 1964, other products output was 11 percent of the total, and in 1954 its share was 12 percent. So besides declining absolutely, its small fraction of the total timber products output is getting smaller.

The most important product in this group is mine timbers, which represented 39 percent of other products output in 1976. In general, output of this product is declining in Pennsylvania as strip mining increases and deep mining (where the timbers are used) decreases. Also, in the deep mines, timbers are being replaced to some extent by roof bolts which also serve to support the roofs of the mines.

The next largest component of this group is an assortment of many minor products called miscellaneous products. These include wood fiber products; hewn ties; charcoal and chemical wood; handle and bat stock; and excelsior, shingle, and

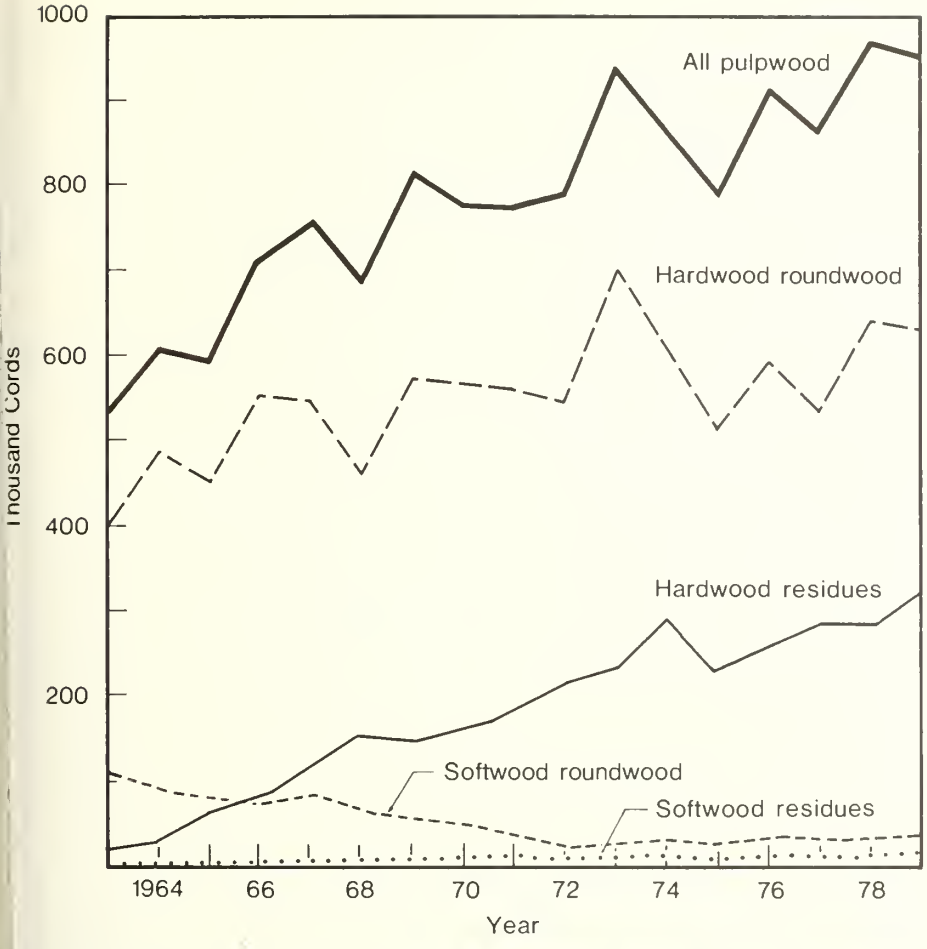


Figure 21.—Pulpwood production in Pennsylvania, by source, 1963-79.

Many Pennsylvanians spend several days a year collecting firewood, often with just a chainsaw and a pickup truck.

Pennsylvania Bureau of Forestry

Large firewood piles are not uncommon backyard sights, especially in rural Pennsylvania.

Western Pennsylvania Conservancy

turnery bolts. In 1976, their output totaled 4.4 million cubic feet or 37 percent of the total for other products.

In 1976, veneer log output was 2.1 million cubic feet (14.7 million board feet) or 18 percent of the other products total. This figure put Pennsylvania in fourth place among the 14 northeastern states, behind Maine, Maryland, and New York (Bones and Dickson 1978). At that time there were four veneer plants operating in the state—three commercial or face veneer plants and one basket veneer plant. Northern red oak led all species, accounting for 54 percent of the production; black cherry was second with 22 percent.

Cooperage and post production make up the remaining other products. In 1976 they accounted for 538,000 (4 percent) and 231,000 (2 percent) cubic feet, respectively. The output of these products has remained relatively stable since 1964. White oak is the premier tight cooperage species since it holds liquids very well. Most of the posts produced in Pennsylvania are from black locust, because this species is very durable and resistant to decay.

Timber's Role in Pennsylvania's Economy

Pennsylvania has a varied group of wood-based industries. Proportionately, these industries are not the major contributors to the state's economy that steel and some other industries are. On a local basis, however, these industries can be very important. And in terms of actual contributions (number of employees, payroll, and value added), Pennsylvania's forest industries compare favorably with or even exceed the contributions of forest industries in states like Maine where these industries are very important.

In 1977, Pennsylvania wood-processing plants produced nearly $4.7 billion worth of products—nearly 6 percent of the state tota (U.S. Dep. Commer., Bur. Census 1979). This figure is somewhat con servative because some furniture and fixture industries, which use wood were not included in the analysis. I was difficult to distinguish the por tion of the product value that was at tributable to timber.

Of the 18,781 manufacturing es tablishments reported by the 197 Census of Manufactures, about 1 percent were wood-based industries Slightly more than a third of these firms were primary processors such as sawmills, veneer mills, and pulp mills. The remaining two-thirds were classed as secondary processors They are a diverse group producing items such as flooring, furniture paneling, pallets, and paper.

Total employment in wood based industries represented slightly more than 4 percent of the state's total manufacturing employment. I

terms of employment, many wood-based industries were small. Over two-thirds of the firms employed fewer than 20 people. Primary firms usually employed fewer people than secondary firms. Payroll for the wood-based industries was in excess of $800 million for 1977, nearly 5 percent of the state's total manufacturing payroll.

In terms of benefits to local communities and to the state, it is important that two-thirds of Pennsylvania's wood-based industries are secondary industries. The additional processing of the wood resource by secondary industries generally creates more value added by production than does processing by primary industries. Value added is the difference between the cost of goods, fuel, and energy used by the firm and the value of the product it sells. For secondary industries, higher levels of value added mean more money is available for wages, salaries, profits, taxes, and depreciation. In short, value added generates funds to help maintain local and regional economies. In 1977, wood-based industries generated almost 6 percent of the state's total value added by manufacture.

Over time, consumer tastes change, economic forces evolve, and the mix and balance of a state's industries adjust to the new demands. Since the second forest survey in 1965, the performance of Pennsylvania's forest industries has been mixed in terms of number of firms, number of employees, real payroll, and real value added (Table 4).

Trend analysis is made difficult because the Bureau of the Census in 1972 reclassified some industries into different groups. Pennsylvania's wood users fall into one of three broad industry groups: Lumber and Wood Products (SIC 24), Furniture and Fixtures (SIC 25), and Paper and Allied Products (SIC 26). SIC is an acronym for Standard Industrial Classification, and represents a grouping of similarly based firms.

The Paper and Allied Products group did better than the other two and is important to the health of Pennsylvania's forest economy. Between 1967 and 1977, this group grew in real dollars (1967 = 100) by more than 9 percent in payroll per employee, and more than 30 percent in value added. In 1977, the Paper and Allied Products group paid more in payroll and generated more value added than the other two groups combined.

Two industries within this group, Papermills and Miscellaneous Converted Paper Products, were responsible for most of the increases in payroll and value added. Paperboard mills and especially paperboard containers and boxes were industries that somewhat offset the sizeable increases of the other firms by their decline in real terms for payroll and value added.

Extensive reclassification of the industries within the Lumber and Wood Products group prevents analysis before 1972 except for the Logging Camps, Log Contractors, and Sawmill industries. The Lumber and Wood Products group includes many of Pennsylvania's primary wood processors, which collectively represent about half of the number of establishments in the group. In terms of employment, the primary processors are small; less than 10 percent employ more than 20 people. While the number of logging camps and log contractors fluctuated widely between 1967 and 1977, the number of sawmills and planing mills declined. During the period the number of larger sawmills increased, which means the loss of smaller mills was higher than the figure of net change show. The decline of smaller mills is a trend seen across much of the Nation.

A secondary processing industry that did well between 1972 and 1977 was Wood Containers. Composed mostly of pallet-making firms, this industry increased in number of establishments by nearly 75 percent, in number of employees by 36 percent, and in value added by 30 percent. There is no doubt that an important factor in the recent success of this industry is its ability to use lower quality hardwoods as a raw material over a range of diameter classes. This is a resource that has been increasing in supply in Pennsylvania since the last forest survey.

The recent success of the pallet industry and portions of the paper industry would seem to be an indication for the future of Pennsylvania's forest industries. Industries that can use a variety of species of different quality will have a greater potential supply of raw material. Many other factors decide whether or not an industry will be successful but, given the projected wood resource outlook for Pennsylvania, those industries that can process a wider selection of trees from Penn's Woods will have a key advantage.

Growth and Removals

Components of Change

There has been a sizeable increase in Pennsylvania's timber volumes between the second and third surveys. To better understand this change, it is necessary to examine the components of inventory change. The difference between average annual net growth and removals is the average amount added to the inventory for each year between the surveys.

Between 1964 and 1977, average annual growing-stock net growth for all species was 555 million cubic feet; average annual removals totaled 255 million cubic feet. This was a growth-removals ratio of nearly 2.2 to 1. The difference between growth and removals was 300 million cubic feet. The ending inventory level is calculated by taking this annual inventory change, multiplying it by the number of years between surveys, and adding the product to the beginning inventory level. For growing stock, the calculation (in million cubic feet) is: (300 X 13) + 17,852 = 21,756. Hardwoods accounted for 90 percent of the growing-stock growth and removals—just about their proportion of the inventory.

Net growth is itself the sum of several components. Net growth is the result of accretion (growth on the

initial inventory), plus ingrowth (growth on trees that become 5 inches in dbh and larger), minus mortality and cull increment (the volume that became rough or rotten). Accretion plus ingrowth is termed gross growth.

Gross growth averaged 700 million cubic feet per year. Three-quarters of gross growth, 520 million cubic feet, was accretion, and the remaining quarter, 180 million cubic feet, was ingrowth. As was discussed in the section on timber volume, Penn's Woods are maturing, long enough that accretion would be expected to exceed ingrowth. Since the state's timber is dominated by hardwoods, it follows that hardwood gross growth was mostly accretion—501 of 641 million cubic feet.

Growing-stock gross growth was reduced by an average of 21 percent annually from mortality and cull increment. While this percentage seems high, it is still better than about half of the 13 other northeastern states. Hardwoods suffered proportionally higher losses of gross growth than softwoods, 22 versus 8 percent. For both hardwoods and softwoods, mortality was more significant than cull increment. Of the average 145 million cubic feet of lost annual hardwood gross growth, 105 were attributable to mortality.

Comparisons of certain published components of net growth estimates between the second and third surveys cannot be made. In the second survey, cull increment was subtracted directly from accretion. This directly affected the estimates of gross growth. In the third survey, estimates of cull increment were developed separately and then subtracted from gross growth, along with mortality, to yield net growth. These two computation methods invalidate comparisons between the estimates of accretion, gross growth, and cull increment.

We can, however, compare estimates for net growth and mortality. Total net growth is currently 60 million cubic feet lower than the estimate from the previous survey. Softwood net growth increased, but hardwood growth declined. Since hardwoods dominate the resource, overall growth declined.

This Clinton County hillside suffered heavy mortality from the oak leafroller and was subsequently clearcut to salvage the timber.

A major contributor to the decline in net growth was mortality. Increased mortality levels for hardwoods, primarily due to insect and disease attacks on oaks, accounted for about two-thirds of the decline in net growth.

Timber removals are, by Resources Evaluation definition, more than timber cut for products (Fig. 22). In 1976, timber product removals (sawlogs, pulpwood, and other products) were about two-thirds of all removals. This proportion is lower than the estimate of 76 percent from the last survey because the total now includes estimates of timber volume lost to land clearing and reclassification of commercial forest land.

Timber lost as logging residues is a significant type of removal. Since the last survey the proportion of timber lost to this cause declined from 24 to 20 percent of the total. Increased stumpage and energy prices and new harvesting technology were important factors in the improved timber utilization trend (Wharton and Bones 1980). Despite the improved utilization, more wood is lost as residues than is cut for pulpwood, so there is room for improvement.

Timber destroyed during land clearing and timber removed from the inventory due to the reclassification of commercial forest land to noncommercial accounted for the remaining removals. Timber lost to reclassification was quite high between surveys, higher than we expect it will be in the future.

While net growth declined, average annual removals increased by 25 percent, from 204 to 255 million cubic feet. This trend was expected. Timber inventories have been rising since the first inventory and forest industries reacted to take advantage of the situation. On a statewide basis, the woods are not in danger of being

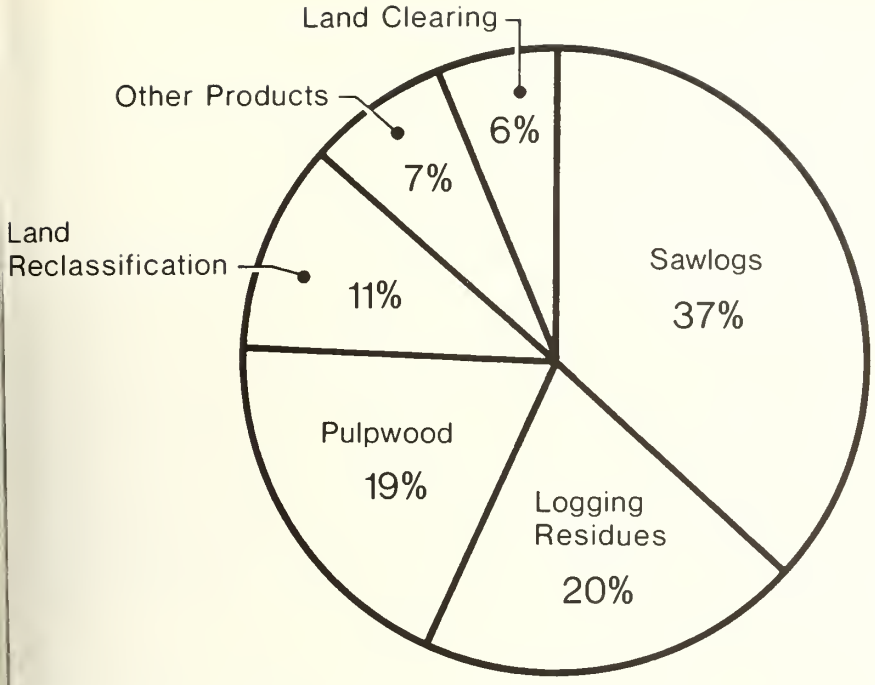


Figure 22.—Distribution of growing-stock removals, by source, Pennsylvania, 1976.

›vercut anytime in the near future ;ince the ratio of growth to removals s greater than 2 to 1.

ieographic Unit Growth and lemovals

The following shows the average nnual growth and removals for 'ennsylvania's units for 1964-77. Due ɔ the distribution of remeasured lots, the Allegheny and North- entral Units were combined into ne, as were the Northeastern and ocono Units.

For all units except the Western Unit, the growth rate is much higher than the removal rate. The Western Unit's growth is the lowest of any unit and barely exceeded removals. The large acreage of sapling-seedling stands and nonstocked areas and the high amount of cull trees kept net growth low. At the other end of the state, the Southeastern Unit, with its low removals pressure and large acreage of sawtimber stands, had the highest growth per acre.

Unit	*Net growth*	*Removals*
	Million cubic feet	
Western	39	34
North-Central	255	98
Southwestern	56	38
Northeastern	95	32
Southeastern	50	21
South-Central	60	32

Trend Changes

Trend-level estimates are another type of growth and removals calculation. They differ from average annual estimates in that they represent growth, removals, and mortality for the last full year of the period between inventories. This is the reason trend-level estimates are often the basis for projections. Additionally, average annual change is based on a simple straight line between the two inventories, while trend change (trend growth minus trend removals) is developed from a compound change function.

When inventories increase between surveys, trend-level change is higher than average annual change. Trend-level net growth of growing-stock for 1977 was 607 million cubic feet versus 555 for average annual. Trend-level removals were 279 million cubic feet versus 255 million cubic feet.

Oaks and maples dominated timber volumes, but had different relationships between growth and removals. Oaks had proportionately low growth and high removals and mortality levels. This resulted in only a slight increase in the oak inventory. In fact, the trend change for oak was only 0.5 percent of its 1978 volume. Northern red oak did somewhat better than the average for all oak, but select white oaks did much worse. They were the only major species or species group among all species that had removals exceeding growth.

In contrast to the oaks, maples had proportionately high growth and low removals and mortality. These proportions left plenty of room for inventory increases; the trend change was 2.5 percent of 1978 timber levels. Sugar maple had the widest margin between growth and removals of any species, 71 million cubic feet.

Black cherry's situation bodes well for the near future. Growth is over three times removals, and the trend change is 2.0 percent or 1978 inventory levels.

Direct comparisons between the current trend level and the previous average annual estimates of species growth and removals are not valid because of the different methods of calculation. However, certain patterns are evident. The most important one as far as species are concerned is that maples are accounting for more of the hardwood growth while the oaks are accounting for less.

Among ownership classes, Pennsylvania's public lands had the highest growth-removals ratio—4.3 to 1. These lands are actively managed but often for nontimber purposes, so timber volumes have been able to accumulate much faster than on private lands. Public lands, with their large proportion of sawtimber stands, are in a good position to provide increasing amounts of quality sawtimber.

Two classes of private owners were analyzed and their growth-removals ratios were similar. Forest industries had a ratio of 1.6 to 1, the lowest of any ownership. They cut more of their timber growth than any ownership, but still had enough of a margin for inventories to build. The other private group had a growth-removals ratio of 1.7 to 1. This group had the lowest growth of any ownership, and supported more harvesting than they are often given credit for.

Timber Outlook

The 13 years since the last survey of Pennsylvania have generally been good ones for the state's forests. The outlook for the state as a whole over the next 30 years is favorable. This estimation is based on projected levels of growing-stock growth, removals, and inventory to 2008:

Resource category	*1978*	*1988*	*1998*	*2008*
	Thousand acres			
Commercial forest land	15,924	15,765	15,608	15,453
	Million cubic feet			
Softwoods				
Growth	61	76	95	119
Removals	30	39	50	63
Inventory	1,767	2,101	2,510	3,015
Hardwoods				
Growth	548	542	537	556
Removals	248	325	423	552
Inventory	19,989	22,636	24,371	25,030
All species				
Growth	609	618	632	675
Removals	278	364	473	615
Inventory	21,756	24,737	26,881	28,045

These projections included a number of assumptions about the change in the commercial forest-land base and future growth and removals rates. Continuing downward pressure on the commercial forest-land base is expected. Agriculture will not be as important a factor in future reductions as moves to reserve or preserve forest lands and the clearing of forest land for nonagricultural purposes like pipeline and transmission line rights-of-way, urban and suburban expansion, and recreational development. Counter-balancing withdrawals will be some increase in forest land due to the abandonment of agricultural (primarily pasture) land. Losses are expected to exceed gains, not by a great deal, but enough that the annual decrease in commercial forest land is projected at 0.1 percent.

Projections for softwoods and hardwoods were developed separately and summed for the total. Projections for each species group were made at the per-acre level and expanded by the commercial forest-land base for the particular year.

Growth projections for hardwoods were based on several assumptions. The first is that the current level of management the resource receives will remain relatively constant. Another important one is that insect (particularly gypsy moth) and disease attacks will continue to plague hardwoods (especially oaks) for at least several decades. This means hardwood growth is projected to stay at 1977 levels for about 20 years. Between the 20th and 30th years, growth will improve as other species fill in gaps created by the insect attacks.

Hardwood removals projections are based on the 1977 trend-level estimate. We project that they will increase at an annual rate of about 2.5 percent. This rate is near the top of the range of possible rate increases suggested by some resource experts. The rate of increase used for projections is higher than the annual rate of increase between the second and third surveys (2.1 percent), because heavier removals pressure is e

pected on the hardwood resource to satisfy increased demand for timber products and fuelwood.

Softwood growth projections also were based on the 1977 trend-level growth estimate. We project the growth will increase at an annual rate of 2.4 percent. This was the rate of increase between the second and third surveys. We used this for projections because softwoods are not expected to have the insect and disease problems that hardwoods will. For the removals projections, we used the 1977 trend-level estimate, and we expect softwood removals to increase at an annual rate of 2.6 percent.

These assumptions and projections indicate a slowing of the increase in growing-stock volumes for softwoods and hardwoods. The slowdown will be more pronounced for hardwoods. Over the next 30 years, softwoods are projected to increase their share of the inventory from 8 to 1 percent. Public agencies in Pennsylvania are committed to maintaining or increasing softwoods on their lands, and forest industries are planting softwoods on some of their lands on an experimental basis.

Hardwood inventories will build, though not as fast as softwoods. Still, hardwood volumes will dwarf softwood volumes in 30 years. The proportionately lower hardwood growth offers many more forest management opportunities than problems for industries and forest managers. Overstocking will probably will become increasingly important in the lower growth rate. On the portion of the commercial forest-land base actually surveyed by Resources Evaluation, about one-half of the area was either fully stocked or overstocked with growing-stock trees. Another 39 percent was medium stocked. With removals projected to lag behind growth, more of the medium stocked and fully stocked stands will move to the overstocked condition, causing a loss of growth potential. This creates thinning opportunities.

The species mix of Penn's Woods is likely to change over the projection period. Not only will softwoods assume a larger share of the inventory, but maples, black cherry, beech, and some low-value oaks should increase.

It is not that these trees, with the exception of black cherry, are receiving excellent management, but that they are less pressured by insects and diseases and today's timber markets. Thus, as man and nature affect certain species in the woods, others are left relatively free to grow.

Certain commercially valuable oaks, notably white and northern red oak, will be subject to continued harvesting pressure and remain vulnerable to insect attack. This is not to suggest that timber volumes of these species will definitely decline, but that they are more likely to increase at slower rates, thus becoming a smaller component of the overall inventory. Aspen and gray birch are intolerant species, valuable for wildlife and pulpwood, that have declined in importance and will continue to do so unless increased management and harvesting reverse this trend.

Penn's Woods will not be static over the next 30 years. New harvesting and product technologies, consumer tastes, insect and disease attacks, multiple-use considerations, and perhaps even climatic changes will emerge and change the forest's character. Pennsylvania's forest managers and planners have an exciting and challenging opportunity to direct and shape some of these changes. These are discussed in the section entitled Forest Management Opportunities.

Nontimber Forest Resources and Uses

So far the emphasis of our analysis has been on the timber resource. Since the passage and implementation of the Resources Planning Act of 1974 and the Renewable Resources Research Act of 1978, Resources Evaluation has expanded its inventory and analysis efforts to provide a more comprehensive assessment of all natural resources associated with forest ecosystems. Recognizing that the forest is much more than trees, there are many forest resources other than wood that are worthy of our attention.

The major nontimber resources or uses of Penn's Woods are water, soil, minerals, fish, wildlife, and recreation (including scenic and esthetic values). While these will each be discussed separately as they relate to forest land in the state, it is not possible to isolate them from each other or from the timber resource. It is the combination and interaction of all resources that make up and define a "forest." Each resource or use is an integral part of the whole, and each one adds to the richness and diversity that make the forests of the Commonwealth so special and important.

Keeping this in mind, let's take a closer look at these other resources and uses and see how and why we consider them essential to an analysis of Pennsylvania's forests.

Water

In any state blessed with plentiful forest land, good water is certainly a major and essential product of the forest. This is especially so in Pennsylvania, where 58 percent of the land is forested. Forested areas serve as reception and storage areas for many of the state's rivers and municipal water supplies. A continued supply of good water is critical because Pennsylvania's economic and social development is dependent on it. While somewhat arbitrary separations of the water and other resources of the state are necessary to facilitate discussion, their interactions and interdependencies should be kept in mind.

Pennsylvania is well endowed with abundant surface and ground waters. Surface waters have received the heaviest pressures—both in withdrawls and on site use. Estimates of ground water supplies indicate a large potential to satisfy future needs but this resource is mostly undeveloped. Given the water shortages Pennsylvania has experienced recently, future development of this resource seems certain.

Pennsylvania's forested streams are natural treasures.

Western Pennsylvania Conservancy

Pennsylvania Bureau of Forestry

Western Pennsylvania Conservanc

Surface waters are generally divided into lakes and rivers. Both the lakes and rivers are important, though their roles are somewhat different. Lake Erie, the oldest and warmest of the Great Lakes, supports a port and much recreation, and forms part of the state's border. Lakes and marshland created by the last period of glaciation are found in the northwest and northeast corners of the state. Conneaut Lake is the largest natural lake in the state and like most of Pennsylvania's natural lakes is of glacial origin. Manmade lakes across the state were built by a variety of private, State, and Federal organizations. In varying degrees they provide a wide range of benefits: water quality control, low-flow augmentation, flood control, hydroelectric power, and numerous recreational activities. More than 185,000 acres of pond and lake surface can be fished and more than 174,000 are suitable for boating (Pa. Off. State Plan. and Dev. 1976).

Development of Pennsylvania's natural resources and the growth of her industries and population have been greatly influenced by three major rivers and their tributaries—the Susquehanna, the Ohio, and the Delaware (Fig. 23). From the time of the earliest settlers until the construction of the modern highway system, the navigability of the rivers and land travel made possible by river valleys opened the way to colonization. The Susquehanna system, covering most of the central and southern sections of the state, drains the largest area—20,831 square miles—and is 58 percent forested. The Ohio River system, primarily a result of the confluence of the Allegheny and Monongahela Rivers, drains 15,639 square miles of Western Pennsylvania and is also 58 percent forested. The Delaware River forms the eastern border of the state and drains 6,278 square miles. Forty-two percent of this river basin is covered with commercial forest land. Together, these three river systems have more than 50,000 miles of surface water, of which 16,000 miles and 4,000 miles are available for fishing and boating, respectively. Small portions of two other river systems, the Genesee and Potomac, drain portions of Pennsylvania. Smaller streams are plentiful throughout the state, especially in the west and north where they often cut deeply into the broad Appalachian Plateau.

While a valuable resource, Pennsylvania's waters are also a vulnerable resource. Currently, the state's waters are indeed quite different from those seen by the early Dutch and Swedish colonists. Settlement came slowly to much of Pennsylvania through the mid-1800's. Forest and water problems were likely few and localized. However, from the mid-1800's into the 1920's a series of events occurred which were to affect the lands and waters for many years.

Increasing immigration and discovery of local energy sources helped swell Pennsylvania's population and power the Industrial Revolution. Farming intensified, industries developed to extract and transport the State's abundant resources of coal and wood, and cities and towns

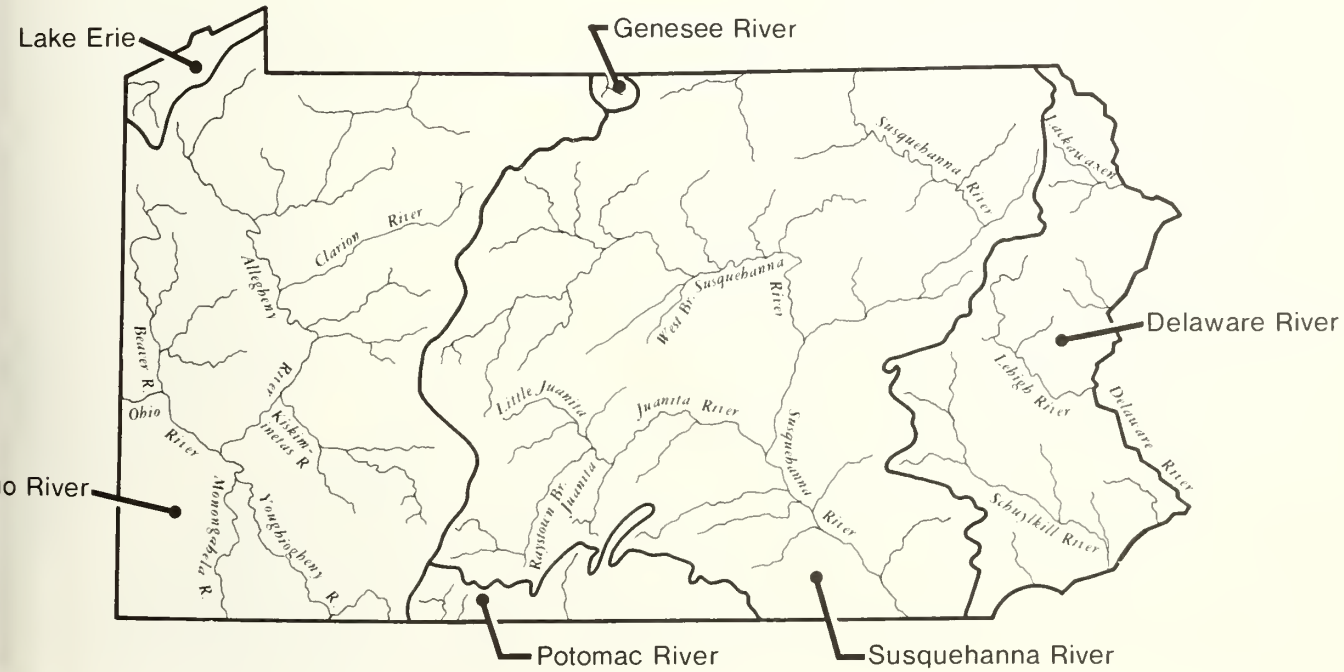


Figure 23.—Drainage basins and major streams of Pennsylvania.

grew. The quality of forests and the waters declined.

Hills and valleys were stripped of their trees, and improper cultivation practices hastened erosion. Large fires were common. Untreated wastes from industries and towns were flushed down the rivers. Results of these abuses were obvious: siltation of river channels, discoloration of previously clear waters, unsuitable drinking water, very high flows during wet seasons, and very low flows during dry seasons. The problems did not go unnoticed, nor would they be solved easily. The immediate profits generated during the boom period belied the economic and social costs that were passed on to subsequent generations. Some of the lands and waters are still polluted as a result of the early shortsightedness.

As lumbering operations moved west and marginal farms were abandoned, nature's tremendous regenerative abilities were evidenced by the "greening up" of many areas. Aided by tree planting and extensive fire protection, the forests grew back vigorously. Stabilization of many watersheds was so improved that by the 1940's forest-related water problems declined in seriousness in relation to those of other sources.

Examining how forests influence and can be managed for water will provide a better understanding of how closely related these two resources are. Forests influence water as it moves from the atmosphere to the stream both above and below ground. Tree and shrub cover first affect precipitation as it falls. Leaves, needles, and branches intercept part of the rain or snow. Some falls or drips through to the forest floor. Another portion of the water is concentrated by stems and branches and flows down the main trunk. The final portion of gross precipitation evaporates from the leaf and stem surfaces directly. The net amount of precipitation reaching the forest floor varies widely, from 0 to 95 percent, depending on the type of precipitation and intensity of the storm (Hewlett and Nutter 1969).

Once the water has reached the forest floor it moves in one of three general ways: evaporation, infiltration, or overland flow. Infiltration, the movement of the water through the soil, is an important process because it serves to reduce overland flow and slow water movement to the stream. Overland flow is not desirable because it is the cause of much erosion and elevated peak flow. The forest floor helps reduce overland flow because it has higher rates of infiltration than does bare soil. The force of falling water is greatly reduced under forest conditions by the layers of vegetation and the organic litter layer. Water hitting the soil with less force causes less of the mineral soil to be dislodged, resulting in clear water for infiltration. Of eight major factors influencing infiltration rates, water quality is often considered the most critical because soil pores are left unblocked, allowing normal drainage. Muddied or clouded water disrupts and blocks soil pores, retarding infiltration and creating potential for overland flow (Hewlett and Nutter 1969).

Certain portions of the water in the soil are subject to use by trees. Most of the water absorbed by the roots moves up through the tree and returns to the atmosphere as water vapor. The transpirational use of water is generally 40 to 60 percent of annual precipitation (personal communication, Howard G. Halverson, USDA Forest Service). However, a relatively large amount of water is still available for water system recharge. Water stored and cleansed by the soil replenishes surface or ground waters with purer water and does so in a slower and more orderly fashion than water yielded by overland flow.

The tempered release of clean water may be the forest's greatest contribution to improving water conditions. Despite the interceptive and absorptive capacities of the forests, floods occur in forested areas. The mean annual precipitation for the state as a whole is approximately 42 inches. Actual precipitation ranges from a low of 36 to a high of 50 inches in some areas, and annual variation may be as much as 10 inches. Snow makes up 7 to 11 inches of the total precipitation, and is heaviest in the northern and mountainous areas. Patterns of distribution are also important. Between 55 and 60 percent of Pennsylvania's precipitation occurs during the spring-summer season mostly in the form of intense rainstorms. Coupled with Pennsylvania's generally steep slopes, characteristically thin mountain soils, and late spring thaws, the seasonality of precipitation has created damaging periodic floods despite the forest cover.

Since the beginning of this century, three management schemes have been used in an attempt to alleviate Pennsylvania's flood problems. Original flood control efforts from 1900 to 1940 centered on reforestation and fire suppression on the many cutover upstream watersheds. Despite the general success of this program, the devastating flood of 1936 vividly demonstrated the need for additional protection.

The next 35 years were characterized by numerous construction projects designed to upgrade water quality and to regulate the quantity of streamflow. Impoundments built during this period varied in size, purpose, and ownership. Many of the large reservoirs were built either by the U.S. Army Corps of Engineers or the State, and often provided significant secondary benefits. Twenty-two of the twenty-five Corps reservoirs completed or due to be completed by 1981 will provide millions of visitors with fishing, boating, water skiing, picnicking, bathing, and other recreational opportunities. Total water surface area of the completed projects is approximately 65,700 acres. Eight of the dams have been put into service since the last survey of Pennsylvania. The State also has several multipurpose reservoirs. Four State Parks use water control impoundments to provide year-round benefits. Pymatuning, the largest of the State controlled lakes with 14,528 surface acres, is unique; it hosts millions of visitors annually, providing valuable winter recreation and serving partly

s a wildlife refuge for migratory vaterfowl.

Throughout the 1970s, mounting concerns over the environmental nd economic impacts of large reser- oir projects caused a reduction in he number being planned and built. Most recently, the controversial ocks Island project has been elimi- ated by the inclusion of the portion f the Delaware River in the National Wild and Scenic Rivers Program. With construction of reservoirs taper- ng off, emphasis on reducing flood amage is shifting to flood plain apping and zoning. Effective super- ision of building on flood plains is n integral downstream component f a basinwide management plan, omplementing the upstream reser- oir and reforestation efforts.

Just as too much water creates roblems, too little also presents se- ous difficulties. In a populous state ke Pennsylvania, certain minimum ows are necessary to satisfy the de- ands of cities, farms, and indus- tries. This point was painfully brought home to many eastern Penn- sylvania communities during the 1980-81 drought in the Delaware River Basin. Two basic forest management options can be used, alone or in com- bination, to influence water yields while maintaining water quality.

Water yield from a forest is re- lated to the cover type. Conifers maintain most of their foliage throughout the year and so have higher interception and evaporation losses. Converting pine stands to hardwoods, which usually are with- out leaves for part of the year, is one method for increasing water yield.

The harvesting system chosen for regeneration also affects water yield, especially during periods of low flow. Generally, cutting more trees per unit of area reduces transpi- ration and makes more water avail- able. Taken to an extreme, the clear- cutting of a forested watershed could significantly increase water yields. Harvesting done without streamside logging and with carefully planned, constructed, and maintained logging roads would have little negative im- pact on water quality.

Cutting streamside vegetation invites physical disruption of the water course as well as the removal of shading trees. Exposing the stream to direct light was found to in- crease summer maximum water tem- peratures as much as 8°F in a central Pennsylvania watershed (Lynch et al. 1975).

Improper road building in- creases stream turbidity drastically until logging is completed. In a West Virginia study of two logged water- sheds, the area having a carefully planned, constructed, and main- tained road system had only 3 times as much turbidity during logging as it did 2 years after logging stopped. The watershed with an uncontrolled road system had 245 times as much turbidity during logging as it did 2

orly maintained logging roads lead to unnecessary soil erosion.

years later (Kochenderfer and Aubertin 1975). The deterioration of water quality is significant not only for humans but also for many forms of aquatic life that have special habitats and narrow limits of tolerance. Dramatic fluctuations in stream temperature, turbidity, speed, and depth adversely affect many stream inhabitants, including important gamefish like trout.

In 1981, the Pennsylvania Forestry Association published a booklet entitled "Timber Harvesting Guidelines." These voluntary guidelines establish recommendations for cutting that would result in minimal disturbance to the land.

The following are guidelines pertaining to water resources:

- Remove only individually selected trees within 50 feet of either side of all perennial streams. Attempt to maintain at least 50 percent of the overhead canopy.
- Locate roads and skid trails as far from watercourses as is practical. The minimum distance between a watercourse and any road and/or skid trail should be 50 feet plus 4 feet for each 1 percent of slope.
- Stream crossings should be avoided if possible.
- Trees cut near streams should not be skidded across the stream.

There are other guidelines that apply to wildlife, logging road construction, and scenic and esthetic values. The booklet is available from the Pennsylvania Forestry Association, 5205 Trindle Road, Mechanicsburg, PA 17055.

Soil

The forest soils of Pennsylvania are a vital but often overlooked forest resource. They directly influence all plant life and hence all wildlife dependent on plants for food and shelter; they exert a strong influence over the quality and quantity of the water resource available to plants and animals; and they dictate which uses of the forest, including recreation, are acceptable. Any discussion of the forest resources, without giving proper attention to this basic, life-giving component of the forest ecosystem would be incomplete.

Soils and trees, naturally, have a very close relationship. Soils provide trees with such essentials as anchorage, water, nutrients, and oxygen for roots. Also, soil provides a medium for mycorrhiza-forming fungi. These fungi increase the absorptive surface area of root systems, which results in improved tree growth and vitality. Trees, on their part, provide organic material from decayed leaves and wood to enrich the upper levels of the soil. Tree roots also often help break up rocks into coarse fragments by growing into cracks and enlarging them as they grow.

To understand productivity of forest soils, a brief discussion of soil formation and soil characteristics is helpful. Parent material is of primary importance. The rock from which a soil develops determines very much what type of soil it will be. In western Pennsylvania, sedimentary rocks occur in horizontal beds. Slopes traverse a variety of sediments that give rise to different soils. Shales, including some limestone and calcareous ones, are most often exposed. Throughout the mountains of central Pennsylvania the sedimentary beds are folded. Erosion has left sandstone ridges oriented in a southwest to northeast direction. The side slopes are colluvium (material that has moved downslope through gravity) or shale. The valleys generally have soils derived from weathered limestone. The two northern corners of the state were glaciated. The glaciers transported and redeposited the material, formed gravel deposits, outwash plains and terraces. Some of these soils have stratified layers of sandy gravel which drain easily. Other glaciated soils are high in coarse fragments, and have fragipans (compact and impermeable subsoil layers). In southeastern Pennsylvania, beyond the Great Limestone (Cumberland-Lebanon-Lehigh) Valley, rocks are mainly sedimentary shales and siltstones. Also, there are several igneous rocks producing boulder-strewn soils that restrict agricultural use (Cunningham et al 1977).

Parent material, as it is influenced by climate, relief, aspect, biological activity, and time, determines what type of soil is created and how productive it will be. For example, topography often directly affects the depth of the soil. Slopes erode near the top, creating shallow soils there while the eroded material is deposited at the toe of the slope, resulting in deeper soils there. In general, deeper soils are more productive than shallow soils. In Pennsylvania, poorly drained (saturated) soils are common along streams, near the lower portions of slopes, and in low topographic positions. Productive soils require an optimum balance between water and air. Poorly drained soils reduce the amount of oxygen available to roots, often reducing plant growth. Such soils are relatively unstable and will not support developments such as roads and recreation facilities.

General statements of soil productivity often must be qualified. What is to be produced is very important. Agricultural crops have different requirements from timber crops. Agricultural crops usually are more demanding of soil, so a soil that is rated only good for such crops may be excellent for growing trees. Forest soils generally are more rocky and less deep than agricultural soils. After hundreds of years of settlement, farming, and logging, the best agriculture soils have been located and in the absence of roads, cities, and other developments, are generally in farm use now. Forest use has replaced farm use on many lands that proved marginally productive for agriculture.

In recognition of the value of soils in determining land use, the Pennsylvania legislature passed Act 319, the Farmland and Forest Land Assessment Act of 1974, commonly known as the Clean and Green Law. This law permits forest-land owners to receive a preferential assessment of their land based on the capabili

of the soil to produce timber crops. Highly productive land can produce more timber, and is taxed at a higher rate because of its greater potential.

Where are the productive soils of Pennsylvania? To answer this question, we went to a general soil map of the state developed by the USDA Soil Conservation Service and the Pennsylvania State University. Although the state has 340 different soil series, the map was developed from 91 soils that account for 63 percent of the state's area. Each soil was rated for its potential to produce forest crops. By assigning a numerical score to each rating we were able to calculate a woodland suitability class for each of the 58 major groupings of soils (associations) in Pennsylvania, based on the proportion of each soil in each association:

Woodland Suitability Class	*Site index (height at age 50)*	*Yield per acre of even aged, fully stocked, natural stands* [a]			
		Age 60		*Age 90*	
	Feet	*Cubic feet* [b]	*Board feet* [c]	*Cubic feet* [b]	*Board feet* [c]
Excellent	85 +	3,700 +	18,600 +	5,200 +	30,950 +
Very good	75 to 84	3,700	18,600	5,200	30,950
Good	65 to 74	3,100	13,900	4,400	24,500
Fair	55 to 64	2,600	9,700	3,650	18,300

[a] Adapted from Schnur 1937.
[b] Entire stem inside bark.
[c] International 1/8-inch rule to a 5-inch top; includes all trees with 16-foot log. International 1/4-inch rule is approximately 10 percent less.

Forest soils with excellent potential cover 2.8 million acres (10 percent of the state); very good soils cover 9.8 million acres (34 percent), good soils 13.8 million acres (48 percent), and fair soils 2.4 million acres (8 percent) (Fig. 24). The best soils occur in the glaciated northwest, in the valleys of the Ridge and Valley Province and the broad Cumberland-Lebanon-Lehigh Valley, and Lancaster County. The very good soils are

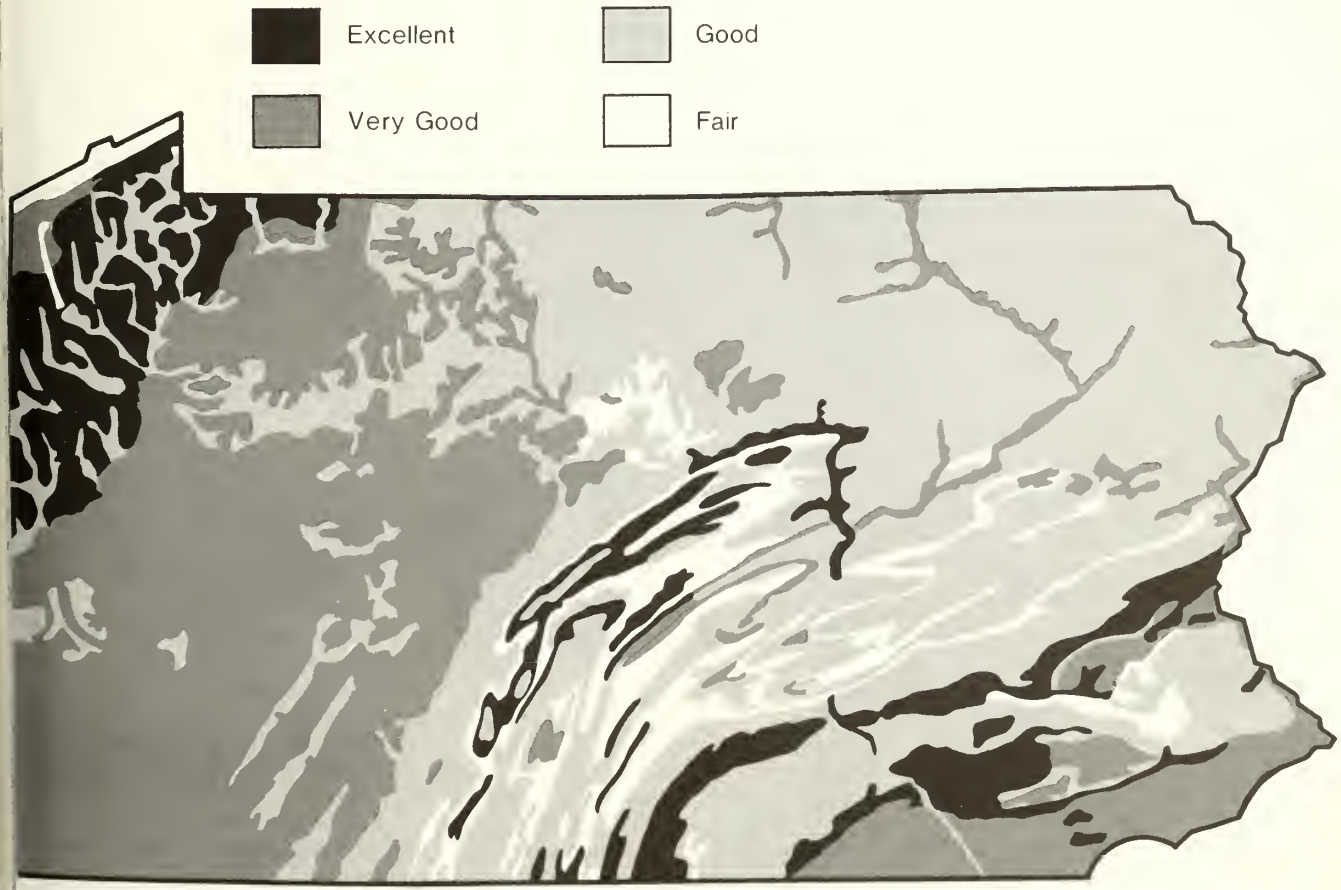


Figure 24.—Distribution of soils in Pennsylvania based on their potential for growing timber.

concentrated in the western half of the state, the northern Susquehanna River drainage, and a strip along the Pennsylvania-Maryland, Delaware, and New Jersey border in the southeast. The good forest soils, which are most prevalent, are concentrated in eastern Pennsylvania. The poorest soils cover the least area and are found in the Lake Erie drainage and the ridges of central Pennsylvania. Of course, there is local variation within these four broad groups. Detailed county data are available from the USDA Soil Conservation Service.

Undisturbed forest cover protects soils very well. Erosion is minimized and compaction is negligible. Disturbance of the forest floor will increase these problems, but to varying degrees. When a forest stand is harvested, for example, the degree of erosion depends more on the logging practices, especially the location, construction, and the use of logging roads, than on the type or extent of the cutting itself (Pennock et al. 1975). Where logging roads are well-planned, constructed, and maintained, erosion will be minimized and usually within a year or two after logging the erosion problem will have disappeared.

To keep soil erosion and stream sedimentation at tolerable levels, the Pennsylvania Department of Environmental Resources (DER) requires an erosion and sedimentation plan where fewer than 25 acres will be disturbed, and an erosion and sedimentation permit where more than 25 acres will be disturbed. For timber sales, DER concludes that 10 percent of the logged area will be disturbed, so a permit is required for a sale area that exceeds 250 acres.

Compaction has two important consequences. When the ability of the soil to absorb water is reduced the potential for runoff and erosion is heightened. Also, if normal drainage and aeration processes are disrupted, seedling establishment, survival, and growth can be significantly reduced. Besides harvesting, heavy recreational use such as camping and hiking can result in compaction. In areas where compaction is likely to occur, hardened surfaces should be installed to protect the soil. Where soils are compacted, use should be discontinued and the soil loosened if possible.

The forest soils of Pennsylvania are vital and dynamic. Though they can be damaged, they yielded today's second-growth forests despite the tremendous stresses of massive logging operations and subsequent fires at the turn of the century. With greater emphasis on soil conservation this resource can continue to benefit the users of Penn's Woods.

This main haul road was seeded and will return to forest land use naturally with no adverse environmental impact.

Pennsylvania Bureau of Forestry

Minerals

Pennsylvania is blessed with a wealth of mineral resources, especially oil, natural gas, and coal, that originated from ancient forests and that are found today beneath thousands of acres of commercial forestland. If they are left in the ground they have no impact on the forest resources above them. However, once we begin to extract them, the forest can be affected significantly.

Oil and gas were formed from the decaying remains of dead plants and very small animals. This material collected at the bottom of lakes, swamps, and seas where it mixed with and was covered by sediment or mud. After hundreds of thousands of years, this heavy overburden exerted pressure and heat which, by processes not well understood, changed the organic matter into droplets of oil and vapors of gas. A

pressure increased, the oil and gas were squeezed out of the thin layers of mud and into sedimentary rocks with cracks and pore spaces (Wagner and Lytle 1968). Mostly sandstones, these rocks are common in western Pennsylvania, so the oil and gas fields of the state generally stretch in a broad band east to a line running from Bedford to Tioga Counties.

The first oil well was drilled south of Titusville in Venango County in 1859, making this the first center of oil production in the world. Production spread and by 1891 the oil industry reached a peak annual production of about 31 million barrels. Pennsylvania led all states in oil production until 1895. While production in 1977 was only 2.7 million barrels, Pennsylvania petroleum is still highly prized for its excellent lubricating characteristics.

Gas production had developed concomitantly with oil but has not fluctuated as much. It reached a high of about 150 billion cubic feet in 1954 and in 1977 production totaled 92 billion cubic feet. Pennsylvania uses almost 5 times more gas than it produces. This has led to many empty gas wells being available for storage of natural gas piped in from other areas. The impact on forests of these storage facilities is less than that of active wells.

When oil and gas wells are developed in forested areas, small clearings, usually 1/4 to 1 acre, are made at the well site. Often accompanying these clearings are roads, which provide access to the wells, electric lines, and pipelines, which transport the product to a pumping or compressing station. Depending on the size of the tract and number of wells, the loss of forest land can be significant. Oil wells are drilled at much closer spacing and occupy proportionately more area than gas wells. The latter, when not associated with oil wells, have less impact on the forest resources.

These impacts can be both negative and positive. Oil and gas development generally is bad from a timber viewpoint because of the loss of productive land and the increased management and logging problems it presents. Wildlife in general would benefit due to increased diversity of habitats. Some recreation would benefit from increased access and the opportunity to see the operations. Activities such as wilderness backpacking would suffer. Effects on soil and water resources are negative: during winter and spring, movement of heavy equipment can dam-

Oil wells can have significant impacts on forest resources.

Western Pennsylvania Conservancy

age roads and compact soil; erosion may increase where the vegetation has been removed and the soil is exposed; and saltwater, oil sludge, and oil leaking from corroded pipes can pollute ground and surface water. Environmental disturbance from oil and gas wells tends to be long lasting on the surface resources.

On the Allegheny National Forest, these mineral resources present a special problem. Every acre of the Forest has oil and gas potential. The value of this potential was recognized before Congress established the Forest in 1923, and subsurface rights were made available only for 2 percent of the area. Because of the way these deeds were written on 260,000 acres, an operator needs no permit to build a road, clear the area, and set up a well. Although oil and gas production in this area peaked years ago, the increased demand for fuel and development of new recovery methods have stimulated the search for these resources. Drilling activities are increasing on the Forest. In 1979, 500 new oil and gas wells were drilled in the Forest—roughly double the number of new wells drilled in any year earlier in the decade. This brought the total number of operating wells in the Forest to more than 5,000. The USDA Forest Service is working with developers so that their operations will have minimal adverse effects. Nevertheless, this unrestricted access on so many acres has precluded several forest uses which would normally be allowed, and has made uncertain the potential realization of long-term forest and land use plans.

Oil and gas development is not as disruptive or as widespread as coal mining. Coal is the most abundant and important of the mineral resources of Pennsylvania. The state's coal reserves are estimated to be 31 billion tons, second only to West Virginia in the Northeast, and fifth in the Nation (U.S. Dep. Energy 1980). Pennsylvania's great reserves of high-quality coal, including coking coal, are responsible for the great iron, steel, chemical, glass, and metal-fabricating industries of the state (Edmunds and Koppe 1968). In 1979, production of 89.2 million tons of bituminous coal ranked third in the Nation behind Kentucky and West Virginia. Pennsylvania is the only state where anthracite coal is mined; production in 1979 totaled 4.8 million tons. In fueling homes and industries, this resource has contributed significantly to the economy of the Commonwealth.

Like oil and gas, coal was also formed from the decayed material of prehistoric forests. Dead trees and ferns fell into swamps, forming a tangled mass of decayed matter called peat. After peat was laid down, the areas sank and were covered with water, sand, and mud. The great pressure from this overburden compressed the peat, forcing out oxygen and hydrogen and leaving the carbon that eventually became coal. All of the economically important coal beds were laid down 300 million years ago during the geologic period that bears the name of the state (Pennsylvanian). Coal seams in Pennsylvania range in thickness from a few inches to 12 feet.

The coal fields of the state are concentrated in the west (Fig. 25). Pennsylvania has three types of bituminous coal (high, medium, and low volatile) and two types of anthracite (semianthracite and anthracite). These five coals grade from west to east, and from high carbon content (88 percent) for high-volatile bituminous coal to very high carbon content (94 percent) for anthracite. The reason for this is that the heat and pressure on these coal beds increased from west to east as the earth's crust folded and buckled to create the Appalachian Mountains. Thus, the coal beds in the western bituminous field are relatively horizontal while those in the eastern anthracite fields often are nearly vertical. As will be discussed later, this affects the type of mining and reclamation of mines in the different coal fields.

The first bituminous coal was mined near Pittsburgh in 1761. Anthracite was discovered and mined near Wilkes-Barre later in that decade. Production of coal peaked at 278 million tons in 1917 and then dropped off between the wars only to exceed 208 million tons in 1944. Coal was king in those years, and nearly all of the production came from deep mines. After World War II, cheaper and cleaner natural gas and oil were substituted for coal, and railroads switched from coal to diesel fuel. Production of coal dipped to a low of 79.7 million tons in 1961. The output of Pennsylvania mines has since risen to its current high of 94 million tons in 1979 (Pa. Dep. Environ. Resour. 1979).

Although the anthracite fields of eastern Pennsylvania underlie about one-quarter million acres of commercial forest land, the impact on forest resources from mining this resource has continued to decline. Production reached a peak of 100 million tons after World War I. Since the last forest survey in 1965, production has dropped by 66 percent to a record low of 4.8 million tons in 1979. Schuylkill and Luzerne Counties account for 79 percent of the current output.

The decline is generally attributed to market problems. Anthracite was used for home space heating and many users simply switched to fuels that were cheaper and easier to use. Anthracite has less sulfur than bituminous coal but still contains too much to be burned in the New York and Philadelphia areas—its primary markets. Particulate air pollution also is a concern in burning anthracite. Air pollution controls now favor bituminous coal. Also, it is more costly to mine anthracite than bituminous coal. Surface mining the steeply inclined seams is expensive, and many deep mines in the area are old and cannot accommodate modern machinery. Miner safety is also a concern that has generated labor problems in these mines.

Most of the anthracite has been mined underground. As the coal was brought out, much refuse material accompanied it. After as much coal was extracted from this material as was economically possible, the culm or slack was dumped into mountainous refuse banks that cover rough

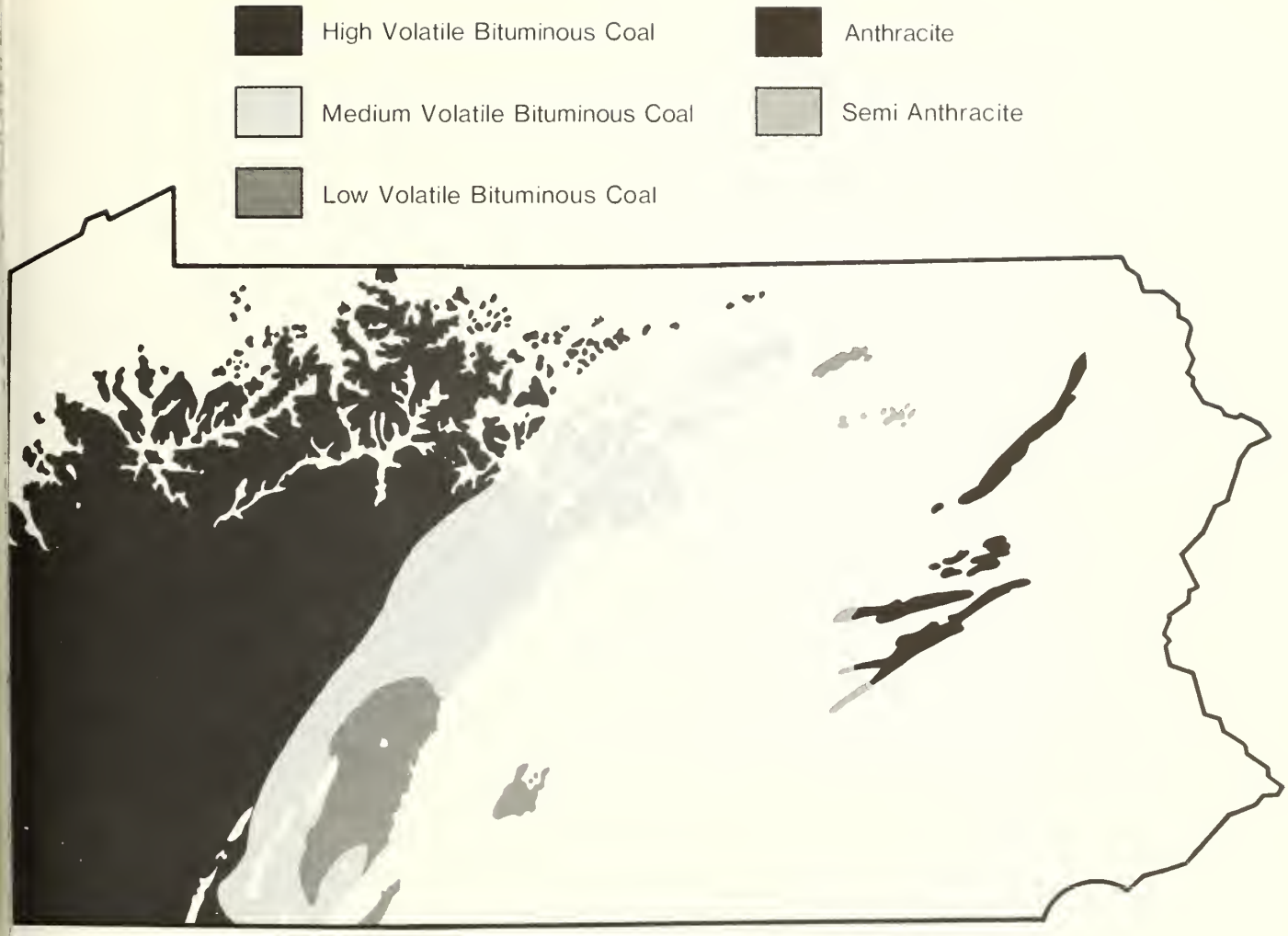


Figure 25.—Distribution of the bituminous and anthracite coal fields in Pennsylvania (Source: Edmunds and Koppe 1968).

2,000 acres, polluting the landscape nd rivers. Because of improved tech- ology (more efficient furnaces that an burn powdered coal) and higher rices for anthracite coal, much more oal is being extracted from this waste" material. Efforts are being nade to reduce these banks by using he leftovers as substitutes for cin- ers on roads, ingredients in cinder- lock mix, road surfacing materials, nd even as potting soil.

Surface mining of anthracite eached a peak of 13.5 million tons in 1948 and fell to 2.9 million tons in 1979. Stripping the often vertical anthracite seams calls for large, open pit or quarry-type operations, creating problems not encountered in bituminous strip mines. After the coal has been removed from the mine, the hole is backfilled with the overburden that was removed at the outset. It is virtually impossible to restore the pit so that it is filled to the rim. The result is much like a basin with sloped highwalls to the rim. Thus, reclamation to the original contour of the land is difficult, and drainage is often changed considerably. An estimated 28,000 acres have been disturbed by anthracite strip mining.

The story of bituminous coal mining and its effect on the forest resources is much different. From 1965 to 1977, 1.2 billion tons were produced, and 39 percent came from surface (strip) mines. In 1965, stripping production was 23.7 million tons, or 30 percent of the total. In 1979, stripping had almost doubled to 45.1 million tons and accounted for 51 percent of the total. Stripping production was near the record high of 46.6

million tons produced in 1977 (Fig. 26). No doubt, this level will be surpassed in the 1980's as the Nation uses more coal to meet its energy needs and as mining technology advances. Of the 25 counties with active strip mines in 1979, 5 accounted for 29 million tons or 64 percent of the strip-mining production. They are Clearfield, Clarion, Somerset, Cambria, and Jefferson. In 1978, Pennsylvania led the Nation in acres mined with 16,283 (U.S. Dep. Energy 1980).

Although the forest resources are most affected by surface mining, significant production still comes from underground mining, which also affects the forests. Areas of major impact are mine openings, storage points, waste dumps, and haul roads. Besides removing small areas from timber production, deep mining can create larger problems for the forest such as soil erosion, acid stream pollution, subsidence, and burning refuse banks. Pennsylvania's Operation Scarlift has corrected some of these problems on abandoned mines, but much work remains. Despite these problems, surface mining has a greater impact on the state's forest resources and warrants the most attention.

The bituminous fields are covered by 5.7 million acres of commercial forest land, 36 percent of the state's total. While not all of this overlies coal seams that can be extracted by stripping, the potential for surface disturbance is great. Mining technology is continually improving, and even now old strip mines are being dug out again as miners go for deeper seams, which were economically unavailable before the advent of huge earthmoving machines and higher coal prices.

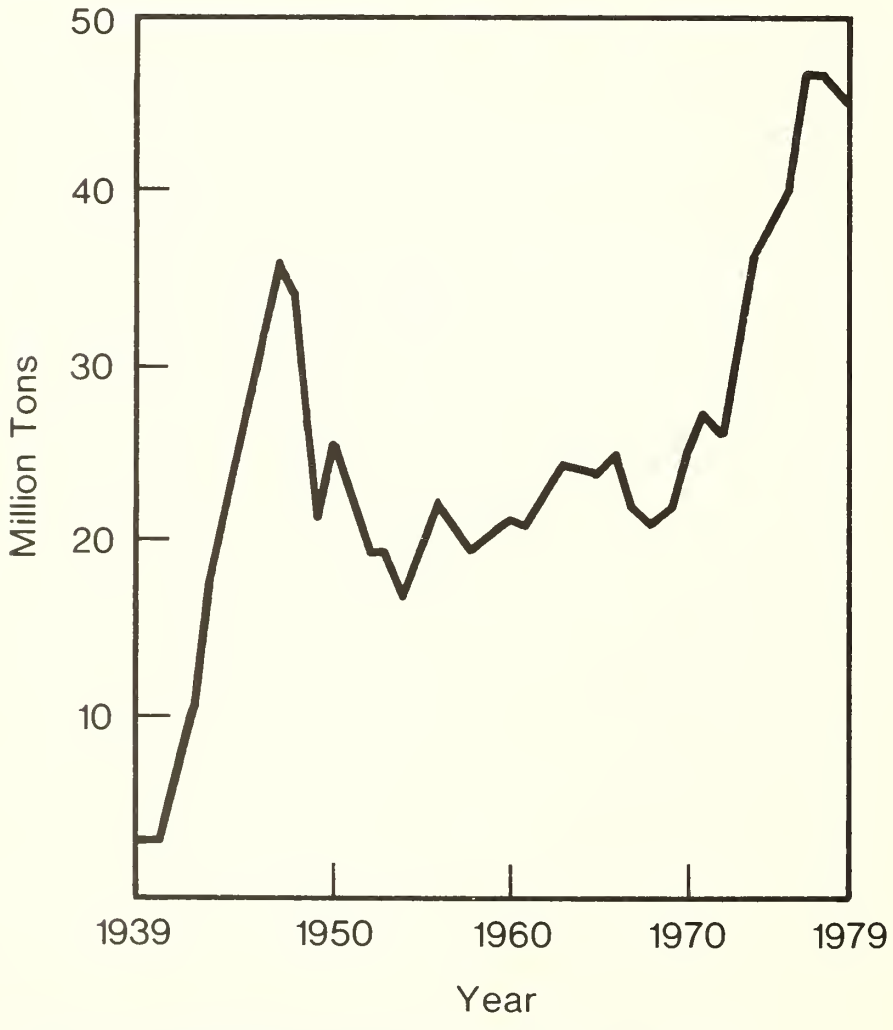


Figure 26.—The production of bituminous coal from strip mines is near the all-time high reached in 1977.

Before 1945, when Pennsylvania became the first state to institute a mine reclamation program, little or no attempt was made to establish vegetation on strip-mined areas. While this left many areas scarred and barren, the effects could have been worse. Overburden from early strip mines was small because large earthmoving equipment was unavailable. Thus, disturbance was not great (compared to today), and topsoil was often available for any reclamation work. Many of these unreclaimed "orphan" mines are being redeveloped, and they will be recalimed and returned to productivity under current regulations. The first reclamation projects occurred in 1919. These were voluntary, and usually entailed planting tree seedlings (conifers) on spoil banks.

From 1945 to 1971, Pennsylvania strip miners operated under the Bituminous Coal Open Pit Mining Conservation Act. During this period an average of less than 10,000 acres were revegetated annually. An estimated 85 percent of reclaimed areas were planted to trees and shrubs, mostly conifers.

In 1971 Pennsylvania enacted the Surface Mining Conservation and Reclamation Act. This act was considered by many as the best in the country. The law has been effective in achieving reclamation of mined areas. One major change, however, was that fewer acres were being planted to trees since grasses were required on all reclaimed sites. The law made tree planting optional except in areas where grasses were not thought to grow well and where slopes were steep enough to need

Strip mining can take land out of forest use when it is reclaimed and revegetated with grass.

stabilizing. Since the law required the op strata of the soil to be saved and eplaced after the mine was back-filled, it seemed that grass and leg-ume establishment would be facili-ated.

In 1971 and 1972, nearly all strip nines were revegetated with grasses nd legumes. But after a few growing seasons, despite fertilization and ther treatments, many sites proved oo harsh and the grasses died. To eep the areas in vegetation, many nines were planted to trees along vith acid- and drought-tolerant rasses. In recent years, 12,000 to 5,000 acres have been reclaimed an-ually. In 1978, 3 million trees were lanted on 3,000 acres, 2,000 of vhich were originally planted to rasses and legumes that failed. Tree lanting on strip mines is making a omeback; the acreage planted to ees doubled every year from 1975 to 978 (Personal communication, Phil ewell, Pennsylvania Department of nvironmental Resources).

Besides having better success with trees, strip-mine operators are finding that tree and grass reclamation costs less than grass and legume reclamation. The most successful species is European white birch, which grows fast and tolerates acidic soils (pH of less than 4). Other popular hardwood reclamation species include black locust, hybrid poplar, and European black alder. In areas where deer populations prevent successful hardwood reclamation (because hardwood seedlings are preferred foods), conifers, especially Japanese larch, are recommended. Scotch, white, Austrian, and red pines are other conifers that have varying success rates for reclamation.

Because Pennsylvania's bituminous coal fields cover a broad range of land uses, terrains and soils, a general statement about land use after strip mining would be unrealistic. For instance, reclaimed areas in the southwest may be used for pasture or for growing hay, while reclaimed areas in the northeastern bituminous coal field (such as Elk County) probably will become forest land. Today, most reclaimed areas will retain the previous general land use. Although it is too early to know the impact of the Federal Surface Mining Control Act of 1977, P.L. 95-87), the new regulations likely will maintain the status quo. Changing the land use of a disturbed area, say from forest land to farmland, requires lengthy explanation and justification. Otherwise, an operator could plant trees and move to another job in a relatively short time. So despite the fact that strip mining is disturbing more forest land each year, it seems that little acreage will be lost from the forest land base due to coal mining.

Administrators of Federal and State laws will work together to ensure that areas disturbed by surface mining are returned to productive use with minimal negative impacts

on the forest resources. Timber, water, soil, wildlife, and recreational use will continue to be affected, often drastically, during the actual mining operation. But when the coal is gone and the land is properly restored, the outlook for these resources should be nearly as good as it was originally.

Fish

We think of fish as a forest resource for many reasons. The main reason is that forests can provide high-quality, silt-free water at levels that are relatively constant. This is essential in providing the basic fish habitat. Fish are sensitive to pollution. In fact, fish are used as indicators of water quality in streams that are being cleaned. Erosion leads to silt in streams, which harms fish by killing insects and other preferred foods, by filling in pools and spawning areas, and by coating their gills, which causes them to suffocate. Well-managed forest land not only provides clean water, but it also provides shade, which keeps water temperatures low enough to sustain viable populations of coldwater fish. Besides helping coldwater game fish, such as trout, forest shade also maintains populations of other smaller nongame fish, some of which may be essential food for larger predatory fish. Forests also support insect populations on which the fish feed. So all fish are dependent on forest land to a certain extent, whether they be game or nongame, coldwater or warmwater.

Stable populations of diverse animal life require habitats that meet their specific needs. With about 170 different species of fish in Pennsylvania, it is not surprising that the state has a variety of aquatic habitats, many of which are in forested settings. The Allegheny National Forest alone supports populations of 71 fish species, six of which acquire special emphasis because their populations are very small. Pennsylvania has more than 45,000 miles of flowing water ranging from headwaters of mountain streams with only brook trout and related species to large rivers supporting 30 or more species (Hoopes 1977). Other surface water includes more than 2,000 impoundments ranging from small farm ponds to reservoirs of thousands of acres; natural lakes, including the glacial lakes of northeast and northwest Pennsylvania; and Lake Erie.

These diverse waters support a wide range of fish life, from tiny minnows that feed on algae and small insects to 55-pound muskellunge that feed on smaller fish. While there are many more species of nongame fish than game fish (including panfish), the latter receive the most attention since catching them is the ultimate goal of more than 1 million fishermen in the state.

Trout fishing dominates the coldwaters of Pennsylvania and is a very popular forest recreational activity. The average trout fisherman spends 10 days afield each year. The three species found in the state are brook trout, which is native; brown trout, which was introduced from Europe; and rainbow trout, which was introduced from California. Trout may be caught in all parts of the state, but are more frequently found in cool, unpolluted freestone and limestone streams and rivers of the mountainous regions. Eighty percent of coldwater fishing occurs on State land, much of which is forested. Salmon also are coldwater fish. Coho and Chinook salmon have been introduced successfully into Lake Erie and its tributary streams. Another salmon, Kokanee, has been introduced to Upper Woods Pond in Wayne County.

Warmwater fishermen spend an average of 12 days a year pursuing a variety of species. Panfish, including bullheads, catfish, crappies, eel, perch, rock bass, and sunfish, are very popular, especially with younger anglers. Bass fishermen are challenged by smallmouth bass, which abound in many streams and rivers such as the Susquehanna, Juniata, and Delaware, and largemouth bass, which are found in hundreds of lakes of all descriptions, including Raystown Lake and Lake Wallenpaupak.

Forested streams often provide excellent trout habitat.

Western Pennsylvania Conservancy

Walleye are next in popularity with the Susquehanna, Delaware and Allegheny Rivers offering the best stream fishing. Pymatuning Reservoir, Lake Wallenpaupack, and numerous smaller lakes also offer good walleye fishing. With the introduction of the Amur pike, Pennsylvania is the only area in the world where one can catch every known member of the pike family (which also includes northern pike, pickerel, and muskellunge). The Delaware also offers exciting fishing when shad make their spring run.

These diverse habitats and healthy populations of so many game fish species have contributed to the increasing popularity of fishing in Pennsylvania. Licenses issued tell the story. In 1965 there were 512,653, and since then the number has risen steadily to 1,004,003 in 1979—a 96-percent increase in 14 years.

The outlook for fishing in the state looks bright due to the work of the Pennsylvania Fish Commission (PFC). A major activity of the PFC is its stocking program. Fishing demand is now so high that if certain streams and lakes were not stocked with fish, the natural populations of game fish would be unable to withstand the pressure, and the quality and quantity of fishing in these waters would drop significantly. The PFC operates 12 fish cultural stations. From July 1, 1979, to June 30, 1980, these hatcheries stocked 54.4 million fish. Fry (very small fish) account for the bulk of these (85 percent), and nearly all are walleye. The others are nearly evenly split between fingerlings (4 to 5 inches long) and adults. Most of the fingerlings are trout and salmon, while nearly all the adults are trout (personal communication, Steve Ulsh, Pennsylania Fish Commission).

Since the average trout released is over 9 inches long, stocking these fish is a major effort. Besides the State hatcheries, two Federal hatcheries (one in the Allegheny National Forest), and 167 cooperative coldwater nurseries run by sportsmen's clubs helped raise trout in 1979. In that year, 800 streams covering 4,920 miles and 90 lakes were stocked. Rainbow and brown trout each accounted for 41 percent of the stocked trout and brook trout accounted for the remaining 18 percent. Many remote and isolated mountain streams receive little fishing pressure and support good populations of native trout. To keep from interfering with these natural strains, these streams are not stocked. Ninety streams in forested settings have been set aside as Wilderness Trout Streams by the PFC (personal communication, Marty Marcinko, Pennsylvania Fish Commission).

The PFC is also involved in other activities. At its Benner Spring Station in Centre County, fish cultural research is conducted in genetics, nutrition, pathology, production statistics, techniques, and mechanization. The PFC also identifies and protects amphibian and reptile species that are threatened or endangered. Recently, the Massasauga rattlesnake was declared an endangered species in Pennsylvania, thus joining two frogs, three salamanders, five turtles, and five fish that have been given special protection. In a cooperative agreement with the Pennsylvania Bureau of Forestry, the PFC has prohibited the removal of reptiles or amphibians from 23 designated Natural Areas in the State Forest System.

Despite the variety of habitats and relatively good populations of many fish species, this resource is not without problems. Water pollution in its myriad forms is the greatest threat to fish. Included are sedimentation, acid mine drainage, petroleum leaks (from pipelines or tankers), industrial wastes, nonpoint-source pollutants from agricultural lands and roads, and possibly acid rain. Also, the loss of shade that results from removing trees from stream banks can present a local problem.

As mentioned previously, undisturbed or well-managed forest land does not contribute to these problems, and in certain instances can alleviate their impact. Forests can be managed for coal, timber, wildlife, and recreation as well as for fish. For instance, strip mines that are properly reclaimed and revegetated with trees will not pollute streams with sediment or acid. Logging operations that leave buffer zones of trees along streams and operations in which roads are properly constructed and maintained will not raise stream temperatures or sediment loads. And although little is known about the effects of acid precipitation on forest ecosystems, forested watersheds might prevent some of this airborne acid from entering streams. Forests can and do provide us with a variety of benefits while simultaneously affecting Pennsylvania's fisheries in many positive and beneficial ways.

In January, 1981 the PFC adopted a policy that shifted the philosophy and mission of the PFC from "recreation first" to "resource first." The aim is "to protect, conserve, and enhance the quality and diversity of the Commonwealth's fishery resource (including reptiles and amphibians) and to provide continued and varied angling opportunity through scientific inventory, classification, and management of that resource." It places a new emphasis on the importance of fish habitat, which is related in many ways to the forest conditions of the State. This policy will be implemented through the 1980's by Project FUTURE.

Wildlife

Wildlife is a renewable resource of great interest to hunters, birdwatchers, photographers, naturalists, and many others. Most wildlife species are closely related to forests at various stages of their lives. About 270 species of birds are found in Pennsylvania during one or more seasons of the year. Of these, 122 depend on forests as their primary habitat, and 54 more use forests at least part of the time. For mammals, 50 of the 60 species in the state use forested habitats extensively, while 7 others are partially dependent on tree-covered areas (Hassinger 1977).

A great variety of wildlife abounds in the Commonwealth be-

cause of the state's favorable climate, topography, land use patterns, and history of sound wildlife management. Forest land amounts to 16.8 million acres and farmland adds another 6.9 million acres of wildlife habitat. That these land uses together account for 82 percent of the land area in the state is significant since nearly all species of wildlife rely on these areas for food and shelter. But another important factor is the physical arrangement and interspersion of farms and forests. The variety of land use patterns leads to diverse habitats which encourage a variety of animal life. For example, the ridge and valley region of central Pennsylvania has broad valleys, which were developed for farming, and ridges, which were left forested. These extensive ridges form long, uninterrupted forested corridors that favor many animals which cannot live in small woodlots isolated by land development. Many other species benefit from the miles of edge where ridges meet farmland as they provide immediate access to both forest and farmland habitats.

Hawk Mountain becomes crowded in September as people seek a good view of the annual raptor migration through the valley.

Western Pennsylvania Conservanc

The arrangement of people is another reason why wildlife is so plentiful. While many animals adapt well to urban and suburban environments, most prefer less intensively developed land uses. Urban development is most heavily concentrated in three major areas (Philadelphia, Pittsburgh, and Wilkes-Barre/Scranton), leaving much undeveloped space for wildlife.

Wildlife can be divided into two broad groups—game and nongame. While most attention is focused on game animals, the nongame group is receiving increasing consideration. In 1981, a bill was introduced into the Pennsylvania General Assembly to allow taxpayers to contribute any or all of their Pennsylvania income tax refund for the purpose of funding increased management of nongame wildlife, and endangered plants, animals, and fish.

In numbers of species, nongame exceeds game by 5 times or more. Songbirds and raptors are perhaps the best known nongame animals. Nongame mammals, such as shrews, moles, mice and rats, are small and often nocturnal, and are rarely seen.

Birdwatching is the most common activity involving nongame animals. Woodpeckers, chickadees, wrens, warblers, sparrows, and herons are but a few of the nongame birds that one may encounter. Though songbirds are most popular, raptors (falcons, hawks, and eagles), owls, and vultures are becoming more popular. The fact that parking space is hard to find on Hawk Mountain (near the border of Schuylkill and Berks Counties) during fall weekends testifies to this.

Threatened and endangered species of wildlife are beginning to receive deserved attention. The Pennsylvania Game Commission (PGC) along with the USDI Fish and Wildlife Service, is determining the status of all species of wild birds and animals in Pennsylvania and developing plans to protect threatened or endangered species. On the Allegheny National Forest the Indiana bat, bog turtle river otter, bobcat, raven, and great blue heron receive special consideration since their populations are very small on the Forest. In the past, market hunting threatened some species with extinction. Today, closely controlled and regulated hunting is an essential tool in wildlife management. The loss of habitat is by far today's most significant threat to wildlife populations.

The largest animal in the state also happens to be a nongame wildlife species—elk. This impressive animal was once common in Pennsylvania but became extinct in the Commonwealth during the mid-1800's. Between 1913 and 1925, some elk were introduced from Yellowstone National Park into northwestern Pennsylvania. The herd had a rough time of it for 50 years—its population in 1974 was only 38. Since then, thanks to the management of the PGC and the Bureau of Forestry, the size of the herd has increased to over 100 animals. Protected from hunting

and located in the remote forests of Elk and Cameron Counties, the herd is responding well to the increased supplies of preferred food (aspen shoots and red oak acorns) that are provided on Game Lands and State Forests. Manipulation of their forested habitat is finally starting to pay off, and the future of these majestic animals is promising in the Commonwealth.

Game animals are those harvested by hunting or trapping. Pennsylvania has been and still is the number one hunting state in the United States. For several years the state has been first nationally in number of hunters and hunting licenses sold in nearly every category and in income derived from license sales. For the 1978-79 hunting season, the PGC issued 1,275,104 hunting licenses, an increase of 34 percent since 1965. Sales of additional specialty licenses are increasing rapidly. In 1979, 238,862 archery licenses were sold, a jump of 208 percent since 1965. Muzzle loader licenses were first issued in 1974. In 1979, 65,321 of these were issued and short-term trends indicate a doubling each year for this fast-growing sport.

One reason why hunting is so popular in Pennsylvania is the great access that hunters have to the land. The PGC manages 268 separate Game Land Tracts in 65 counties, and these contain 1.1 million acres of forest land. State Forests add 2 million acres, and the Allegheny National Forest contributes another 0.5 million forested acres. In addition to this 3 million acres of public forest land available to the hunter, data from our ownership study indicate that owners of another 7.3 million acres of private forest land permit some public hunting on their land. Thus, a substantial amount of forest land is accessible to the hunter. The PGC also works with many farmers through its cooperative farm-game projects and safety zone program. These add about 4 million acres of farmland that the hunter may use.

Access is only the first step to successful hunting. Once you get on the land, there should be sufficient

This State Game Land in the glaciated portion of the Allegheny Plateau (Erie County) provides wetland wildlife habitats that are relatively uncommon in Pennsylvania.

The white-tailed buck is the object of attention for over 1 million hunters in Pennsylvania each fall.

Pennsylvania Bureau of Forestry

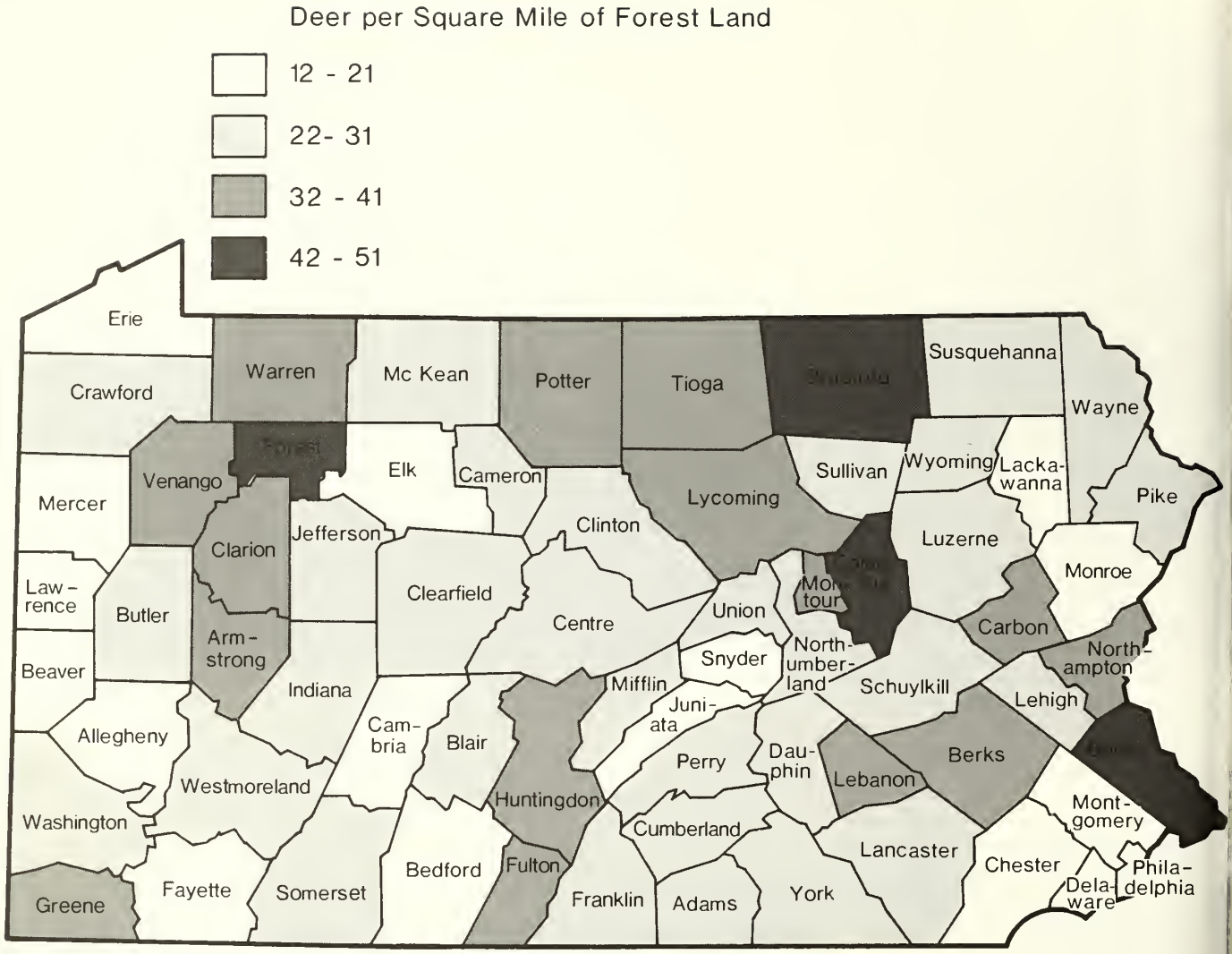


Figure 27.—Densities of white-tailed deer vary considerably between Pennsylvania's counties. (Deer population statistics provided by William K. Shope, Pennsylvania Game Commission).

populations of game animals to provide good hunting. Pennsylvania has good to excellent populations of a variety of game species, most of which are closely tied to the forests of the state. Deer, the most popular game species in Pennsylvania, are found in every county, though densities vary considerably (Fig. 27). Other popular big game animals are wild turkey and black bear. Turkey, which may be hunted in the spring and in the fall, depend on forests in part for food and cover, and are most common in areas with extensive forest land. Black bear, which were not harvested in 1975, 1977, and 1978, are making an excellent comeback. In 1979, 736 were harvested, and in 1980 a near record 921 bears were taken legally. Reproduction and growth rates of bears are very good in Pennsylvania. The PGC has a full-time program of research on and monitoring of this popular animal's activities and population. The highest concentrations of black bear are in the forested regions of north-central and northeastern Pennsylvania.

Other popular game species closely linked to forests are ruffed grouse, gray squirrel, and snowshoe hare. Furbearers associated with woodland include gray and red fox, beaver, and raccoon. Ring-necked pheasant, cottontail rabbit, bobwhite, and mourning dove can be found in brushy seedling and sapling forest stands, but tend more toward agricultural land. Waterfowl, dependent on forests mainly for clean water, are found in marshes and in rivers, ponds, and lakes.

Vild turkeys are elusive big game birds, ınd the state's forests provide them with ssential habitats.

Pennsylvania Game Commission

Ruffed grouse populations have declined as the forests, which were cut over early this century, are maturing.

Pennsylvania Game Commission

e black bear is the largest game ımal in Pennsylvania, and the recent sumption of an annual hunting season this forest dweller has proved very pular.

Pennsylvania Bureau of Forestry

The wood duck is one of the few waterfowl species that live in forested habitats.

Western Pennsylvania Conservancy

Deer, being the most economically important wildlife species living in forests, deserve a closer look. There is no doubt that hunting in Pennsylvania is deer-oriented, and receives considerable attention from the PGC. In 1980, 135,477 deer were reported taken by hunters. Another 26,772 were removed from the highways after being killed by cars and trucks. The PGC estimates that as many as 117,000 more deer were killed by hunters or vehicles, but were not reported or actually picked up. Thousands more were killed by free-running dogs, starvation, or other natural causes. These losses amount to about 40 percent of the deer herd annually, and are necessary to maintain a relatively stable population estimated by the PGC to be about 700,000. The PGC uses a multivariable population model to estimate both the deer population for each county and the number of deer that should be harvested to maintain what the PGC feels is the proper number of deer in each county. We have supplied the PGC with our most recent data on the distribution of forest land by stand-size class, an important component of the population model.

The obvious browse line and lack of understory regeneration are clear signs that deer concentrations are excessive in this area.

While keeping the population near the 700,000 level may be desirable from a hunter's viewpoint, there are many foresters who argue that the herd should be reduced to levels compatible with forest renewal. Besides the costly damage done to vehicles, orchards, crops, and shrubs, the damage to forests is severe in many localities. Browse, the tender shoots, twigs and leaves of trees, is a winter staple of a deer's diet. Since deer generally reach no higher than 6 feet above ground for browse, they feed primarily on seedlings and small saplings. When the deer population of an area exceeds the carrying capacity of the natural range and the available forage, the seedlings needed to regenerate the area to forest cover are destroyed. Growing space that would be used by such commercially valuable species as yellow-poplar, cucumbertree, white ash, and red and sugar maple becomes filled with ferns, grasses, sedges, beech, striped maple, and other nonpreferred browse species (Severinghaus 1978). Parklike stands are created, and though easy to walk through, are difficult to regenerate to commercially desirable stands when cut. Thousands of acres of the Allegheny National Forest are in this condition, and while the problem may be most severe there, it exists in other areas of the state as well.

Besides the negative impact of the deer herd on the future timber resources of these areas, other wildlife resources are being damaged. The large deer herd has reduced populations of snowshoe hare and ruffed grouse in northern Pennsylvania and may be adversely affecting turkeys as they compete for food. Even the deer herd itself may be hurt, as the forests of the future will support only low populations if preferred food is unavailable (Severinghaus 1978).

To resolve this problem, many people have suggested reducing deer populations in these hard-pressed forested areas. In 1978, the Northern Hardwood and Plateau Chapters of the Society of America Foresters recommended that th PGC intensify its deer managemer by (a) using, within county boun aries, deer management units wit similar range conditions, and (b) e tablishing for each management un deer population goals that represe a proper balance between wildlif timber, farm, and other natural r source interests (Journal of Forest 1978). To help determine suc population goals, the USDA Fore Service researchers at Warren, Pen sylvania are attempting to identi the greatest density of deer (numb of deer per square mile) that will a low natural regeneration to develo satisfactorily. Foresters and othe concerned about the forest r sources of Pennsylvania hope that the near future the deer herd will b controlled in these affected areas s that adequate numbers of desirab tree species can be established ar grow naturally.

Besides managing game popul tions by controlling the number hunters, length of season, and ba

Fencing deer out allows the protected area of this 20-year-old clearcut (in the background) to regenerate naturally.

mits, the PGC supplements wild opulations by releasing animals aised on game farms. Currently, ng-necked pheasants and mallard ucks are being produced at six ame farms located throughout the tate. Turkey releases have been hased out, and pheasant production as been increased. Wildlife propa- ation is not as successful as fish opagation because released birds e more susceptible to predation nd disease.

Managing wildlife habitat is the ost basic, enduring, and stable ap- oach to managing wildlife. Be- use of the many animal species in nnsylvania, an overriding manage- ent objective is to maintain a diver- y of habitats that will benefit all ldlife. The arrangement of these bitats also is important. For exam- e, in parts of southeastern Pennsyl- nia, there is sufficient acreage in odlots to provide enough food and elter to support turkey and bear pulations. But because these animals require extensive, uninterrupted blocks or corridors of forest, they do not inhabit this part of the state.

Management for diversity entails protection and manipulation. Protection means setting aside and saving certain habitats that are unique, rare, or endangered, and blocks of forest land that can be arranged for wildlife. This is normally done by public agencies, and the PGC and the Bureau of Forestry have protected thousands of acres, mainly forested, of State Game Lands and State Forests from changes in land use. Examples of protected areas are wintering and nesting grounds for game and nongame species and valuable streamside habitat for furbearers.

Habitat manipulation is a more common management tool available to the thousands of private forestland owners in Pennsylvania. Service foresters employed by the Bureau of Forestry are available to assist landowners in managing their woodland for wildlife and other forest resources. The PGC, Bureau of Forestry, and USDA Forest Service regularly use habitat manipulation to manage the wildlife on the lands that they administer. Habitat manipulation is the key to a cooperative 5-year fish and wildlife management program initiated in 1980 for the Allegheny National Forest by the USDA Forest Service, USDI Fish and Wildlife Service, Pennsylvania Fish Commission, and Pennsylvania Game Commission, and is also the key to wildlife habitat improvement on the 2 million acres of State Forest land.

The objective of habitat manipulation is to provide a variety of habitats within a forested area with regard to species composition and arrangement, amount of edge between different plant communities, size and distribution of openings and type of vegetation in these openings, and size and age classes of trees.

As examples of this, the Bureau of Forestry established the following forest management guidelines: 2 to 5 percent of the area in permanent herbaceous openings; 5 percent of the area in low or high evergreen cover; 10 percent of the area in deciduous food and cover, primarily shoots and buds of new trees (this guideline is for even-age management areas where clearcutting is used); 25 percent of the tree cover in trees mature enough to produce seed (for wildlife food); and protection of large, old trees for their high seed production and cavity nesting sites (Hassinger 1977). They also call for the protection of spring seeps, which are important for turkey and other wildlife species.

Important techniques used to create, maintain, and sometimes restore a variety of habitats and mixed communities are timber cutting; installation of shallow impoundments; stabilization of streambanks; and the planting of trees, shrubs, and herbaceous plants. Timber cutting, whether timber stand improvement (TSI), border cuts, browse cuts, or commercial regeneration harvests, encourages natural regeneration of sprouts and seedlings. The PGC

This gas pipeline right-of-way is maintained in permanent grass cover and provides habitat diversity and an edge effect desirable for many species of wildlife.

bountiful opportunities for management, the resource is not without its problems. Some critical habitats in private ownership are being lost to other land uses. An example is the loss of some of the lowland bear habitat in the Pocono Mountains of northeastern Pennsylvania to home development. Besides this loss, the fact that large forested areas are being subdivided into a variety of non-forest land uses is detrimental to many wildlife species.

Another problem, unregulated motor vehicle access, can adversely affect waterfowl, turkey, great blue heron, raven, deer, bear, and bobcat. The effects include disturbance during nesting and brood rearing seasons, harrassment of deer and turkeys in key wintering areas, and the possibility of overharvesting of some species in local areas.

What is the future of Pennsylvania's wildlife resource? The strong interest and concern for Pennsylvania's wildlife will continue, as will the recent trend of increasing non

operates the Howard Nursery (Centre County), which produces and distributes annually 3 million tree (mostly conifer) and shrub seedlings.

Management of forest land for wildlife can be compatible with management for other forest resources, especially timber. The PGC is conducting research on State Game Land No. 176 (Centre County) to determine the effect of a profitable series of systemized block cuttings on wildlife populations, especially cottontail rabbit and ruffed grouse. The idea is to create four distinct age classes of timber within a relatively small area and then repeat this pattern many times in a large area. Possible advantages are profit from timber, increased rabbit and grouse populations, spreading of the deer browsing pressure to lessen the adverse impact on tree regeneration, and increased populations of non-game species.

Despite the generally good populations of wildlife species and the

This 2-year-old aspen regeneration in a small clearcut will make excellent ruffed grouse habitat (Centre County).

consumptive uses of wildlife (uses other than hunting and trapping). As this occurs, the rate of increase in hunting may level off. Possible reasons for this are continued urbanization of the population, difficulty in finding open land, a decrease in the quality of the sport, an increase in the concentration of hunters, and increasing interest in other forms of recreation (personal communication, Jerry Hassinger, wildlife biologist, Pennsylvania Game Commission). Regardless of the trends in nongame/game interests, the wildlife resource will continue to flourish due to the extent and quality of the forests of Pennsylvania.

Recreation

Recreation is a human need, . . .ideally a change in lifestyle, even only for a few hours or a weekend. is a leisure with a purpose" (Jackson 1978). Outdoor recreation allows relief from daily frustrations and revitalizes the spirit. For many Pennsylvanians, outdoor recreation is a most valuable benefit of forest land.

During the 1950's, recreation nd leisure became important to the conomy of Pennsylvania as people ained more leisure time, money, and reater mobility. Since the second rest survey of Pennsylvania, the ommonwealth has dramatically inreased its efforts to develop the tate's recreation potential. As evinced by the statewide comprehenve outdoor recreation report (Pa. f. State Plan. and Dev. 1976) and its nual updates, the activities of any State agencies in recreation anning are coordinated on a contuing basis.

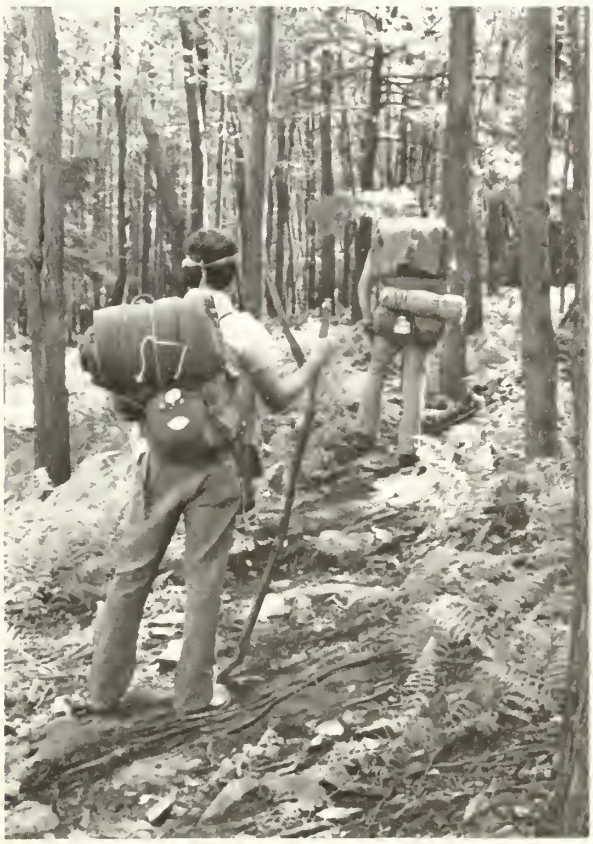
Pennsylvania's climates and ldforms provide the resources to pport a diverse group of year-round reational activities. Of the state's 8 million acres, approximately 10 llion are available for some kind of reational activity. Private owners ntrol more than half of these lands.

While private lands currently reve the most use, they are nonetheles underutilized. Recreational planng to include private lands has historically been difficult because of the large number of owners and the large acreages they control. An estimated 52 percent of Pennsylvania's private forest-land owners controlling 8.3 million acres allow others on some of their lands for a variety of recreational activities. The most frequently allowed activities are hunting, hiking, and snowmobiling (Birch and Dennis 1980). Efforts to coordinate recreation on private lands are increasing as several State agencies develop cooperative programs.

Pennsylvania's State-owned lands are a most important outdoor recreational resource. After the private lands, State lands are the largest source of recreation land. Of the three State agencies most closely connected with outdoor recreation, the Department of Environmental Resources is the largest land owner. Within DER, the Bureau of Forestry administers more than 2 million acres, and the Bureau of State Parks administers approximately 287,000 acres.

The State Forest System operates 20 forestry districts. Although high-quality timber production is an important goal, the multiple-use principles under which the Forests are managed give equal priority to dispersed recreation. Driving for pleasure and hunting are the two most popular activities on State Forests. Recently, however, hiking and cross-country skiing have shown the most growth. More than 2,500 miles of foot trails are available and the Bureau of Forestry, in cooperation with local hiking clubs, is working to develop more. Trails on the State Forests generally

Hikers make good use of the forested trails in Pennsylvania's publicly owned forests.



Pennsylvania Bureau of Forestry

are of two types: long loops (10 to 85 miles long) and short loops, which take 1 to 4 hours to walk. The short loop trails often are interpretive, highlighting unique geologic, scenic, or vegetational features of the forest. Primitive backpack camping is permitted along the long loop trails. Fourteen Wild Areas have been designated where no manmade development is allowed.

The Bureau of State Parks lands are managed to encourage intensive recreation activities. The Bureau has 117 recreational areas; 96 parks, 11 State Forest picnic areas, and 3 environmental education centers. Seven other parks are under development or acquisition. Nearly all of the parks have some forest land which enhances recreational experiences. Water is an important recreational feature of the State Park system. Over half the parks have impoundments of at least 1 acre. These impoundments range from the 1-acre pond at Clear Creek State Park to the 14,528-acre lake at Pymatuning. Numerous other State Parks are near a creek, river, or Lake Erie.

The value of water and trees to the State Parks is reflected in the popularity of activities associated with them. In 1979, picnicking had the greatest number of nontransient visitor days. In descending order, the next most popular activities were swimming, fishing, boating, and overnight camping. In 1979, over 23 million nontransient visitor days were recorded. The total number of visitor days was nearly 38 million, the difference between the two accounted for by transient use—pleasure driving.

Except for the DER, the Pennsylvania Game Commission administers more recreation lands than any other State agency. By mid-1979 they owned 268 tracts totaling 1,207,978 acres. The primary objective on Game Lands is to provide outdoor recreation in the form of sport hunting. Concurrently, they try to provide compatible recreational activities such as birding, hiking, nature photography, fishing, cross-country skiing, and controlled snowmobiling.

Since the last forest survey of Pennsylvania, much of the State's acquisition and development of outdoor recreation facilities has been stimulated by two State bond issues and, to a lesser extent, Federal funding. The program began in 1964 when Pennsylvanians approved a $70 million bond, known as Project 70, to buy recreational lands in counties lacking park land and open space. Until 1964, most State Parks and Game Lands were in remote portions of the state. Project 70 focused on 43 counties where 90 percent of the population lived, but where less than 27 percent of the State lands were. Of the $70 million, $40 million was authorized for the purchase of State Park land and historical sites; $20 million went to local governments on a matching fund basis for parks and open space. The response from the municipalities was positive; to date over 400 projects occupying 163,000 acres have been completed. Another $10 million from Project 70 was shared by the Game and Fish Commission for new lands and access areas to rivers, lakes, and streams (Schellenberg 1978).

Also in 1964, the Federal Land and Water Conservation Fund Act was passed by Congress. Among other actions, this law provided for matching funds to States for the purchase and development of outdoor

Cross-country skiing is becoming very popular in Pennsylvania's forests.

Western Pennsylvania Conservancy

Whitewater rafting on the Youghiogheny River can be a thrilling experience (Ohiopyle State Park, Fayette County).

Western Pennsylvania Conservancy

creation lands. This funding should
e increasingly important in future
ars as current sources of capital
e expended.

Pennsylvania's second bond ref-
endum was passed in 1967. Known
Project 500, it provided $500 mil-
n primarily for the development of
nds purchased under Project 70
d for water quality improvement.
the total, $200 million went for out-
or recreation projects, $200 million
abandoned mine reclamation, and
00 million for sewage plant con-
uction.

Many State Parks have opened
ce 1965 and many of the Parks
der development have been a re-
t of the Project 70 and 500 money.
e Pennsylvania Game Commis-
n's goal for its share of the funds
been to maximize the carrying
acity of wildlife on State Game
nds. So in addition to land pur-
ses, money has been used for
itat improvement, waterfowl de-
opment, access road improve-
nt, and game hatchery reserva-
ns.

The Pennsylvania Fish Commission's policy with Project funding was to improve fishing in all 67 counties. Two new hatcheries were built and 10 existing hatcheries were renovated. These improvements coincided with monies spent on water quality improvement to greatly improve Pennsylvania's fishing.

Capital funding from State bond issues will soon be exhausted. Without these funds, land acquisitions by the State agencies will be more difficult. To meet the anticipated growth in outdoor recreation demand, the DER, Game Commission, and Fish Commission have been working to expand their landowner assistance and cooperative programs. Participating owners receive the benefits of management and protection assistance. Certain programs permit public access to the lands for recreational pursuits. Expansion of the cooperative programs to include more owners of the largest block of potential recreation lands will mean increased recreational opportunities for Pennsylvanians.

Camping has great appeal in Penn's Woods.

Pennsylvania Bureau of Forestry

The Allegheny National Forest accounts for three-fourths of the 650,000 acres of federally managed land and water in Pennsylvania. Located on the scenic Allegheny Plateau in the northwestern corner of the state, the Forest attracts most of its visitors from western Pennsylvania and northeastern Ohio. The Allegheny National Forest is, however, within a day's drive of many major northeastern and Canadian cities, making it accessible to millions of other people.

The most popular activities on the Forest are camping, hunting, mechanized recreational travel, fishing, boating, and picnicking. Most of the developed recreational use and water activities occur on or along the edge of the Allegheny Reservoir, a U.S. Army Corps of Engineers project. In recent years, demand has stabilized for developed recreation and has increased for dispersed activities such as hiking, trailbiking, cross-country skiing, and snowshoeing. The Forest has responded by emphasizing fewer capital-intensive and more resource-based projects in its recreational program. Evidence of this is an increase in trail construction. Roads and trails suitable for snowmobiling and cross-country skiing are being identified and marked.

Two unique features of the Allegheny National Forest are the Hearts Content Tract and Tionesta Scenic and Research Natural Area. The Tionesta is the largest virgin tract of timber between the Smokey Mountains in the South, the Porcupine Mountains in Michigan, and the Adirondacks in New York. The Tionesta has two sections: the 2,018-acre Scenic Area where several trails allow visitors to walk through a virgin hemlock-beech forest; and the 2,113-acre Research Area where scientific study of the ecology of the virgin forest is conducted.

Hearts Content is 122 acres representative of the virgin white pine-hemlock forest that once covered portions of the Allegheny Plateau.

As a result of the USDA Forest Service's second Roadless Area Review and Evaluation (RARE II), two areas in the Allegheny National Forest have been proposed for inclusion in the National Wilderness System. The 9,200-acre Tracy Ridge area and a group of eight islands are awaiting congressional action.

Most other Federal recreation lands contain water impoundments. The USDA Soil Conservation Service has constructed small dams that are turned over to local concerns for management. Army Corps of Engineers dams are usually much larger. Seven of the Corps' projects with recreational facilities are adjacent to a State Park; two projects are adjacent to State Game Lands, and Raystown, the largest reservoir in the state, is mostly within Rothrock State Forest. The National Park Service administers a large outdoor recreation zone—the Delaware Water Gap National Recreation Area. The Tocks Island dam and lake was to be a part of the recreation area, but the river section due to be flooded has been placed into the Wild and Scenic Rivers program.

Pennsylvania is an active participant in the national effort to recognize and protect the special recreational value of portions of our river systems. The Federal effort, authorized by the Wild and Scenic Rivers Act, of 1968, classifies rivers as "wild" (untouched in any way by civilization), "scenic" (basically undeveloped but accessible by roads), or "recreational" (readily accessible, possibly with limited development, and that may have had some impoundment or diversion). Portions of the Allegheny, Delaware, and Youghiogheny Rivers and Pine Creek are under consideration for inclusion in the National System. So far, only a stretch of the upper Delaware River has been given official status.

Pennsylvania expanded the scope of the Federal plan in 1972, by enacting the Pennsylvania Scenic Rivers Act, which included the three Federal classifications and added a fourth—"modified recreational"—where the river can be developed and the flow regulated by low dams. The State system uses public easements granted by landowners along the river to allow access. Citizen committees do most of the work in providing balanced recreational opportunities. Many streams and river sections are being inventoried and evaluated for inclusion in the State System. The Schuylkill River has been designated a Scenic River for almost its entire length. Stoney Creek has been designated a Wild River.

Forest Management Opportunities

Is There a Need to Manage the Forests?

The forests of Pennsylvania today are generally not the result of forest management but of the natural forces that regenerated the land after the extensive cutting and widespread fires that occurred during the early part of this century. The projections that we made for the next 30 years show timber volume continuing to increase under current management levels. The state appears to be adequately endowed with water, fish, wildlife, and recreation resources and opportunities. If most of this can not be attributed to forest management, why should we discuss forest management opportunities?

Part of the answer is that we can be misled by looking only at today's situation or what we may project for timber volume for the relatively near future. While nearly all forest resources are renewable, we must remember how long it takes to renew these resources. Those who consider timber to be a crop, such as hay or corn, should realize that most hardwood stands take 70 to 120 years to reach maturity. Since timber growing takes so long, careful and thoughtful planning and management can help ensure relatively steady, reliable supplies. The 40-year period prior to 1910 included the harvesting of a tremendous amount of timber—a resource that required hundreds of years to accumulate. Many millions of acres of Pennsylvania's forest land will be maturing over the next 20 to 40 years. While a repeat of extensive, exploitive logging is unlikely, it is probable

that much of the mature timber will be harvested.

Presently in many areas of the state, forests that are harvested by clearcutting or killed by insects are not regenerating satisfactorily. Regeneration failures occur in both the Allegheny hardwood (Marquis 1974) and oak (Marquis et al. 1976 and Merritt 1979) areas of Pennsylvania. These failures might mean that no tree cover is revegetating the area; that only undesirable tree species such as striped maple (*Acer pensylvanicum*), pin cherry (*Prunus pensylvanica*), ailanthus (*Ailanthus altissima*), American beech, and black locust are regenerating the site; or that some desirable species are becoming established at unsatisfactory stocking levels. While research is now being conducted on how to keep deer, acorn weevils, rodents, ferns, and other destructive agents from inhibiting the establishment and development of desirable reproduction, these problems demonstrate a need for sound forest management.

Besides the biological factors of time to maturity and regeneration problems there are socioeconomic factors affecting our 30-year timber projections (see Timber Outlook) that point to the need for forest management. For hardwoods we project a 2.8-percent annual increase over the current level of removals. While this is our best estimate, it would certainly be low if greater demands are placed on the resource. Both national and international forces will shape this demand. Pennsylvania's hardwood timber is now reaching a size and quality that is well suited for manufacture into fine furniture. Europeans are very interested in this resource, and, if current trends hold true, may be importing even more oak than they are now (Kingsley and Powell 1979). In fact, a Belgian firm is constructing a secondary manufacturing plant in Lock Haven that will require significant quantities of oak lumber.

Demand for Pennsylvania's hardwoods for fuel by both the commercial and residential sectors no doubt will increase. The state's forests would certainly contribute to the proposed national forest biomass energy program (USDA For. Serv. 1980a). Also, the USDA Forest Service has predicted that at current prices, national demand for softwood will outstrip supply (USDA For. Serv. 1980c). To offset this deficit, greater emphasis may be placed on utilizing hardwoods. These factors, independently or in combination, may result in substantially higher timber removals than we project.

Also, we should keep in mind that the rosy picture painted in our projections is for growing-stock volume for all commercial species growing on all commercial forest land. Much of this timber volume simply will not be available to timber industry given the objectives of today's private landowner, harvesting technology, and market conditions. Many private landowners never intend to cut and sell their timber. Further, much of the timber owned by people willing to cut is located in inaccessible areas, on steep slopes, or along roads or streams where logging would detract from the scenery or damage the water resource. Not all of the projected timber volume will be of the desirable species or size that timber industries need. So any projected surplus of growth over removals may not be the case for timber industries that are seeking economical supplies of specific raw materials. Thus, forest industries are strong advocates of increased levels of forest management on all commercial forest-land ownerships.

Another part of the answer as to why we discuss forest management opportunities is that many forestland owners, regardless of national needs, what is "right" for the forest, or any other external considerations, may wish to enhance the benefits that their forest land can produce for them. Most private landowners see their situation in terms of immediate need; they do not perceive long-term management of forest land for timber to be in their self-interest. Many landowners are interested in the income derived from timber sales or in money saved by providing their own firewood, but they need more than these economic stimulants to motivate them to manage their forests. They need to feel that management would enhance the other benefits derived from owning forest land—benefits such as a diverse songbird population, a scenic view, an unpolluted and productive trout stream, a well-used deer trail, or a solitary retreat where they can find some peace and quiet.

Forest management can be used to enhance these and many other tangible and intangible benefits that landowners perceive to be in their personal interest. For those landowners who have written or unwritten objectives and goals that they wish to realize from their forest land—be they esthetic enjoyment, plentiful wildlife, clean and reliable water supplies, wilderness experiences, or quality sawtimber trees—some discussion of forest management opportunities is desirable.

Because owner objectives are so diverse and the combinations of potential forest benefits so numerous, we will discuss only a few of the more common and applicable management opportunities. However, most of the various resources and benefits are related. Management for a certain benefit or series of benefits usually results in the production of other benefits as well.

Basic Features of Forest Sites

Before looking at opportunities directed at creating or enhancing specific benefits, there are two criteria worth mentioning that have some impact on all of the various opportunities: potential site productivity and size of tract.

Potential site productivity is an estimate of how much timber volume an acre of forest land could produce at the culmination of mean annual increment if it were fully stocked with growing-stock trees. While the four classes that we normally use specify a range of annual growth in cubic feet, we recommend that the four classes be used only as relative indicators of site quality.

Knowing which sites are more productive than others has many uses. From the point of view of forest industry, for example, the better sites will grow more timber in less time with less cost. Highly productive sites would thus receive top priority for management. For owners interested in managing land for diverse wildlife habitats, knowing which areas will react the fastest to cutting or other vegetation manipulation may influence his or her choice of areas to work in as well as the timing. Private landowners of 10 acres or more of contiguous forest land can receive preferential assessment of their land for tax purposes based on their land's productivity (see discussion of Act 317, the Clean and Green Law, under Soils).

Among major ownership groups, forest industry lands have the highest site quality, followed in descending order by other private, National Forest, and other public. One might expect this since forest industries would make a conscious effort to acquire lands with the greatest potential for growing timber. The low ranking of the public agencies, generally the Bureau of Forestry, the Game Commission, and the USDA Forest Service, also is not surprising. Much of the forest land that they administer was purchased in tax sales after it was cut and burned over and found to be of little use. Much of this land occupies hillsides and ridges and generally is less productive than lower slope or bottomland sites.

The five forest-type groups that account for nearly 100 percent of the commercial forest land in the state vary in average site qualities. In order of decreasing potential they are: white and red pine, northern hardwoods, elm/ash/red maple, aspen/birch, and oak/hickory. The major reason for this relates to water as a limiting factor. Many of the white and red pine, northern hardwoods, and elm/ash/red maple types occur either in areas that receive greater than average annual precipitation or on sites where adequate water is available throughout the growing season (e.g., lower slopes, bottomland, and streamsides). The oak/hickory types usually are found on drier sites (e.g., mid to upper slopes and ridges) and therefore, are not as productive.

Site quality also varies from one geographic unit to another. The Western Unit has the best potential followed by the Southwestern, Southeastern, Northeastern, Allegheny, North-Central, South-Central, and Pocono Units. This ranking generally follows the distribution of soils based on their potential for growing timber (see p. 51). This is most interesting because the Western Unit currently has the lowest volume and growth per acre of all of the units. Opportunities for forest management seem to have the greatest potential in that part of the state.

Size of tract is an estimate of the extent of a forested tract of the same general management condition—forest type (softwood versus hardwood) and stand size. Its economic value often depends on the type of forest that one is managing. Some say that any tract less than 50 acres is too small to yield a profitable return, but the owner of a 15-acre tract of high-value timber may not agree.

Certainly, size of tract has many management implications. Some species of wildlife such as black bear require extensive and unbroken areas of forest land. People interested in a wilderness experience will avoid areas that have been split into many small tracts. Watershed management for stable yields of clean water is made easier if most of the watershed is forested. Management for a variety of forest benefits is influenced by size of tract.

Overall, 60 percent of the commercial forest land (excluding State and National Forests) is in tracts of 1 to 50 acres, 20 percent in tracts of 51 to 100 acres, 14 percent in tracts of 101 to 500 acres, and 6 percent in tracts of 500 acres or more. These proportions hold true for sawtimber and poletimber stands, but 84 percent of sapling-seedling stands and nonstocked areas are in tracts of 50 acres or less. This would be expected since most of these stands result from heavy cutting or farm abandonment, and neither tends to occur in large blocks.

Variation between units is great (Fig. 28). At one extreme is the Allegheny Unit with 38 percent of its forest land in tracts over 100 acres. At the other extreme is the Southeastern Unit with only 4 percent of its forest land in tracts over 100 acres. This indicates that access to woodlots probably is good in the southeast, which favors certain kinds of timber harvesting and recreational opportunities, but precludes management for black bear habitat or wilderness experience. Size of tract is helpful in identifying practical forest management opportunities.

Opportunities for Enhancing Various Benefits

Although managing forest land for multiple benefits is most common, (and, usually hard to avoid), to simplify our discussion we will deal individually with some of the principal benefits and identify possible opportunities which forest-land owners can use to increase these benefits.

Wood fiber, whether for saw logs, pulpwood, firewoods, chips, or some other product, is one of Pennsylvania's foremost forest resources. Although net growth is more than twice removals and inventories are increasing each year, there are opportunities to increase timber yields and improve timber quality for those landowners who may wish to do so.

One approach is to increase net growth by reducing cull increment and mortality (the two factors that reduce gross growth to net growth). For the period from 1964 to 1977, the annual loss due to cull increment was 40 million cubic feet and the annual loss due mortality was 105 million cubic feet. Much of this loss is difficult to control, and anything less than intensive forest management will not affect it appreciably. Management can be useful in reducing losses from the three major causes of mortality and cull increment: wild fire, disease, and insect attack.

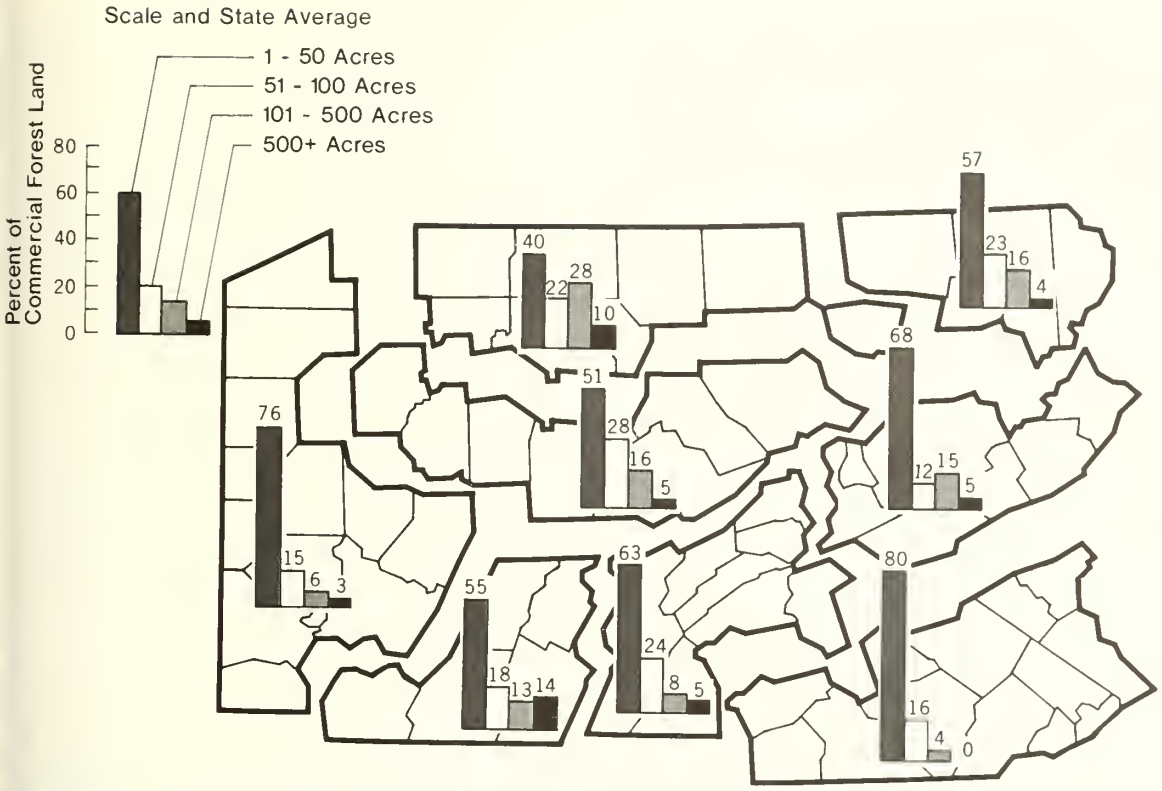


Figure 28.—Size-of-tract distribution in Pennsylvania, by geographic unit (State and National Forest data are not included).

Fire protection has been very successful in the last 60 years (Haines et al. 1978). The total number of forest fires and acres burned decreased, and the number of fires larger than 10 acres fell significantly. Most fires occur in the eastern and south-central counties, but the distribution is not even. The major threat of fire begins in mid-March, peaks in April, and ends in mid-June. There is a second, less severe, fire season that begins in early October and ends in late November. Campfires no longer are the major cause of wildfires in Pennsylvania—incendiarism is. In 1980, 684 fires were set deliberately, and they burned 3,604 acres. This accounted for 35 percent of the 1,860 fires that year, fires which burned a total of 8,562 acres (Pa. For. 1981).

Since most wildfires are caused by man, there are some steps that landowners can take to prevent such fires on their land. One approach is through education—of themselves and the people who may use their forest land. With incendiarism as prevalent as it is, good public relations with neighbors and users is important. Also, the Pennsylvania Forestry Association has established a fund that will pay up to $100 for information leading to the arrest and conviction of anyone who maliciously sets a forest fire in Pennsylvania. A $500 reward is offered by the Bureau of Forestry.

Vigilance is crucial. Owners should learn to recognize and eliminate hazardous conditions, both natural and manmade. Owners can clean out heavy accumulations of dead and fallen trees and remove debris along roads or in use areas. Any burning of debris such as leaves or brush should be done carefully, and only after consulting local forestry officials on fire danger conditions. Debris burning is a major cause of wildfire in Pennsylvania. Roads and trails can be constructed to open inaccessible areas and to serve as barriers to the spread of a fire. Safety strips around public use areas, railroad rights-of-way, public access roads are other means of preventing fire.

Not all fire is harmful to forests. Skilled application of a controlled fire can reduce hazardous accumulations of fuel, help control insects and disease, prepare planting sites, eliminate undesirable plant species, and improve wildlife habitat. Such prescribed burning should be planned and conducted only by people trained in the use of this management tool.

Disease of forest trees contributes much to cull increment and mortality. There are many diseases that infect hardwood species, but the major problems result from heart rots, root rots, and stem cankers. Most diseases enter a tree through an infection court such as a scar, a

branch stub, or a stump. Fire is closely related to disease in that it damages many hardwoods by burning away enough of the bark to create entrances for disease. Decay is common in trees that originated from sprouting high on a stump.

Several management activities can reduce the impact of disease. Maintaining a healthy, vigorous, and fast-growing stand will be beneficial. The faster a tree grows, the sooner open wounds will heal and the shorter time such wounds will be susceptible to attack. Improvement cuts to eliminate diseased trees and thinnings to stimulate growth will help. Eliminating decayed trees and shifting the growth potential to sound trees will result in a higher usable yield of wood volume at the time of final harvest. In selecting a potential crop tree from a group of sprouts, choose the stem that has a low origin (at or below ground level) and is asserting dominance. When cutting trees, keep stumps as low as possible to minimize high-stump sprouting.

Insect pests also create problems in certain areas. In the 1960's, mortality increased in many oak stands in central Pennsylvania after attacks by an oak leaftier, and oak leafrollers, followed by the two-lined chestnut borer. But current concern centers on the gypsy moth.

During the 1970's, gypsy moth populations increased, collapsed, and increased again. Infestation is spreading west through the state, but areas being hit hardest are in central and eastern Pennsylvania. The gypsy moth has been present in 5 million acres of forest land affecting 38 counties. As of 1980 the infested area covered about 36 percent of the total susceptible forest area of mixed oak stands (Nichols 1980). Over a 5-year period (1972 to 1976), the average mortality in gypsy moth infested stands in Pike and Monroe Counties was 13 percent (Gansner and Herrick 1979). Jim Nichols, Division Chief of the Pennsylvania Bureau of Forestry Division of Forest Pest Management, estimates that heavily infested areas have experienced 20 percent mortality over the last 10 years (personal communication). For the state as a whole, our survey data show that annual mortality of oak is only 0.7 percent or about 7 percent over 10 years. This indicates that mortality resulting from gypsy moth damage is not severe statewide. It is, however, a serious problem in local situations, undoubtedly reducing the growth of oak trees that are not killed.

Attempts to control gypsy moth generally have been ineffective. Methods have included spraying and trapping the moth, and releasing predators and parasites that feed on the moth. The main reason why these methods are not working well is that they do not alter the current stand conditions that favor the gypsy moth. Logging followed by fires and the chestnut blight at the turn of the century have created millions of acres of relatively even-aged stands composed primarily of oak.

Gypsy moth is expected to continue to spread across Pennsylvania. The oak forests will continue to lose both growth and standing volume to this insect over the next several decades.

Regulating forest composition through management promises to be a most effective method of protecting forests from gypsy moth (Knight and Heikkenen 1980), as different tree species vary in susceptibility to defoliation. The following is a list of tree species by gypsy moth food preference class (adapted from Houston and Valentine 1977):

Gypsy moth defoliation has turned this late spring scene into one resembling midwinter.

Most preferred

Class 1

Chestnut oak
White oak

Class 2

Black oak
Northern red oak
Scarlet oak

Class 3

Alder
American basswood
Apple
Bigtooth aspen
Gray birch
Paper birch
Post oak
Quaking aspen

Intermediate

Class 4

American beech
American chestnut
American elm
American hornbean
Black cherry
Blackgum
Black walnut
Butternut
Common persimmon
Cucumbertree
Eastern hemlock
Eastern hop-hornbean
Flowering dogwood
Hackberry
Hickory
Pitch pine
Red maple
Red pine
Sassafras
Slippery elm
Sugar maple
Table-Mountain pine
Virginia pine
Witch-hazel

Least preferred

lass 5

lack locust
astern red-cedar
ed spruce
cotch pine
/hite ash
ellow-poplar

Such opportunities obviously are ot appropriate for extensive tracts oak, especially since many sites e particularly well suited to grow- g oak. In such instances, maintain- g good stocking and normal distri- ution of age classes, removing sup- essed and overmature oaks, devel- ping a ground cover of seedlings, d protecting against fire and graz- g should lessen adverse impacts m the gypsy moth.

Sometimes there is little the ndowner can do to reduce mortality on his or her forest land. If the area should sustain heavy mortality and there are markets available, salvaging the dead material before it becomes unusable will allow at least something to be recouped from the loss. There may be difficulties where access to dead material is inadequate or where the dead material is scattered throughout the stand. However, where possible, salvage is an important timber management practice that merits consideration.

Much research has been conducted on the silviculture (the development and care of forests) of oak/hickory, Allegheny hardwood (cherry/maple), and northern hardwood forests (Roach and Gingrich 1968; Sander 1978; Marquis et al. 1975; Roach 1977; Marquis 1979; Bennett and Armstrong 1981; Leak et al. 1969). A basic principal mentioned frequently in this research is that by properly adjusting the stocking of stands, wood production can be maximized on usable trees. The idea is to first eliminate the cull trees from the stand and then to adjust the stocking of the remaining trees so that the stand is growing at its optimal rate, concentrating the full growth potential on the smallest number of trees. This stocking level actually occurs over a relatively broad range of conditions, but for production of high-quality sawtimber trees it is usually in the range that Resources Evaluation calls medium stocking (60 to 99 percent).

In general, the forests of Pennsylvania are at least adequately stocked (Fig. 29). Only about 4 per-

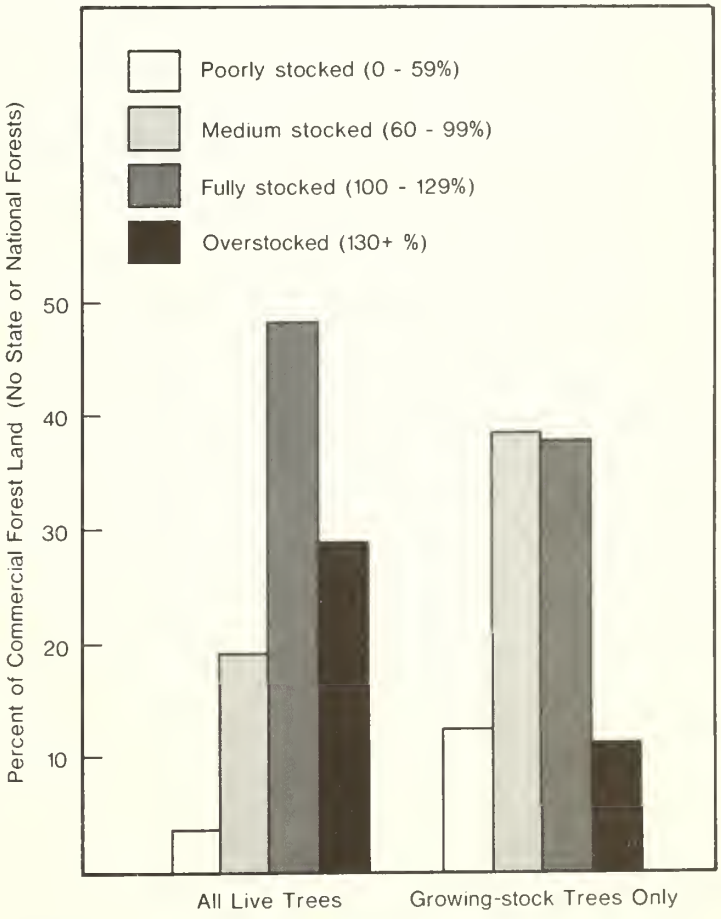


Figure 29.—Comparison of stocking of all live trees versus growing-stock trees only.

cent is poorly stocked, but 77 percent is more than medium stocked. If the cull trees were removed from the stands so that only growing-stock trees were left, medium stocking would immediately improve from 19 to 39 percent of the area (Fig. 29). The proportion of poorly stocked stands would increase to 12 percent, and the proportion of fully and overstocked stands would drop to 49 percent. This identifies cull removal as a forest management practice that can improve the stocking needed for maximum wood production. Total removal of cull trees can adversely affect the wildlife resource, as is discussed later.

After removing the culls, there still remains about 7 million acres of commercial forest land (excluding State and National Forest land) that could be thinned from full or overstocking to medium stocking. This would release the remaining trees to grow faster and yield the landowner some financial return if the thinnings can be marketed as sawlogs, pulpwood, firewood, or some other timber product.

Timber growth on many of the unmanaged forests in the state could be enhanced by some type of planned cutting. For use as lumber, almost one in six live trees over 5 inches in diameter is classed as rough cull or rotten cull. There is more than 1.8 billion net cubic feet of volume in these cull trees alone. This volume is equal to nearly 23 million cords of potential firewood. Even after excluding from this estimate the significant portion of trees that should be left uncut because of their value for wildlife, there remains sizeable fuelwood potential. Besides cull trees there is the potential to recover for fuel the unused material left in the woods after the merchantable trees have been cut and the usuable volume removed, the wood that may be buried or burned onsite as the byproduct of land clearing, and the wood from dead trees that are not needed by wildlife.

Assuming that oil, gas, and coal prices will continue to rise, the use of wood as a renewable alternative fuel will intensify. Pennsylvania's forests are in a favorable position to meet part of this increasing demand. The potential supply of fuelwood seems plentiful, and the production of other forest resources, especially other types of timber products, can be increased substantially if the fuelwood is harvested according to sound forestry practices. So there are opportunities to improve the quality and productivity of Penn's Woods while helping people meet some of their fundamental energy needs.

To gain a general picture of the timber management practices needed in Penn's Woods, our field crews placed each forested ground plot they measured into one of seven recommended treatment classes (see Appendix for treatment class definitions). Statewide, the most common condition was that the stand was growing satisfactorily and required no treatment; these stands covered 5.5 million acres or 40 pe cent of the commercial forest lan excluding State and National Fo ests. The other six classes and the percentages in decreasing impo tance are: timber stand improvemen 16 percent; stand mature and read to be harvested and regenerated, 1 percent; improvement cut, 11 pe cent; stand conversion, 9 percen thinning, 6 percent; and remove cu rent stand and regenerate, 5 percent

There are interesting variation from this statewide average when th same information is shown by ge ographic unit (Fig. 30). For instance in the Northeastern Unit, only 17 pe cent of the stands need no treatmen but 31 percent need thinning. Th South-Central Unit seems relativel well off with 60 percent of its stand needing no treatment. But this un has the greatest proportion needin improvement cuts—17 percent. I the Southwestern Unit, nearly one

Defective trees, such as this beech, take up growing space that healthy trees could be using, yet they provide valuable shelter for cavity-using wildlife species.

Pennsylvania Bureau of Forestry

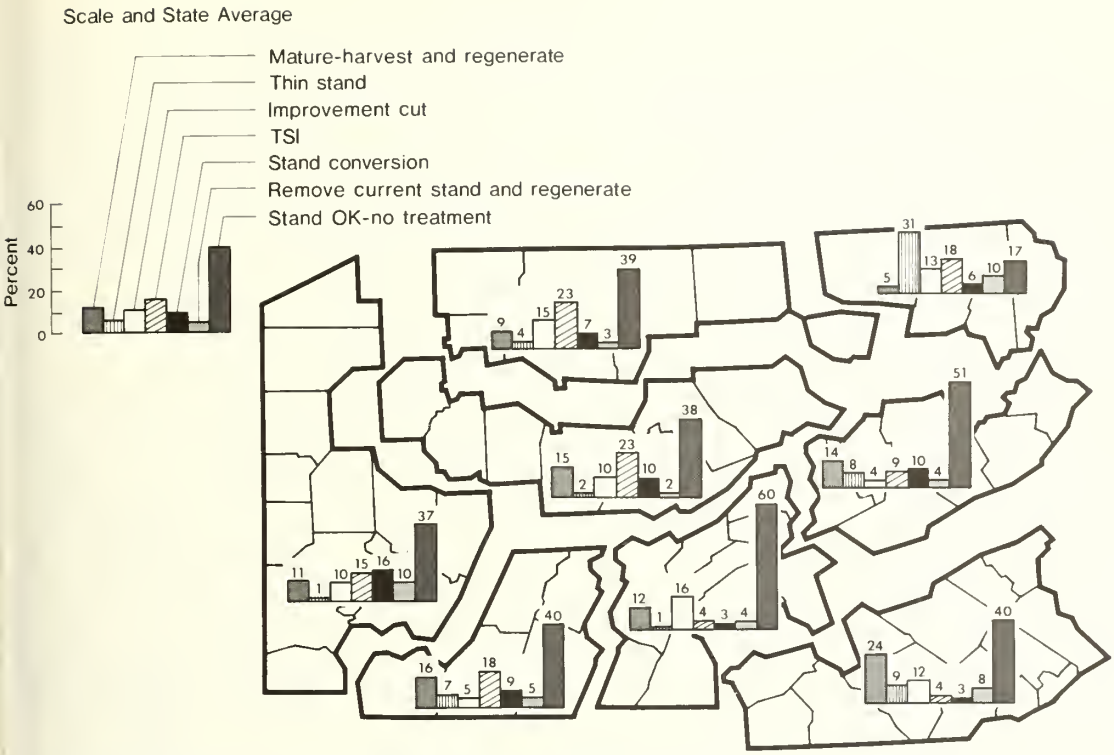


Figure 30.—Percentage of commercial forest land (excluding State and National Forests) in each geographic unit, by recommended treatment class.

fourth of the forests are ready for harvesting; this statistic is supported by the high percentage of sawtimber stands and high volumes per acre that are found in the region. The Allegheny and North-Central Units show the greatest need for TSI.

When the data are organized by forest-type group, "stand in good condition" is the most prevalent class for all type groups. The white and red pine group shows the greatest need for thinning. Many plantations are at the stage where production will stagnate unless the better trees are given more room to grow. Sixteen percent of the oak/hickory stands are mature and ready for regeneration, but only 10 percent of the northern hardwood stands are in this condition. Twenty-one percent of the northern hardwood stands need some TSI. In the aspen/birch group, nearly one-third of the stands could be improved by converting the stand to a more productive forest type. This is indicative of the transitory nature of the aspen/birch types in Pennsylvania.

This discussion of recommended treatment opportunities is no substitute for an on-the-ground inspection by a professional forester. The Bureau of Forestry, USDA Forest Service, USDA Soil Conservation Service, forest industries, and private consultants are some of the most important agencies or people a landowner can turn to for assistance on all aspects of forest management. Our field crews provided this information to portray broad management opportunities for timber production only at this extensive level.

Another important way in which a landowner can increase the amount of wood from his or her land is to strive for greater utilization when trees are cut. This means using the logging residues, such as branches and other wood above the merchantable bole, as much as possible. Material that is unacceptable for pulpwood may be useful for firewood. And if not useful for firewood, perhaps it can be chipped for pulp, fuel, mulch, bedding, or any of the many uses that cellulose has. Often it is not economical to use residues because of high costs of extracting and transporting the material. But over the past few years there has been a growing appreciation by loggers and wood processors of this previously ignored resource, and utilization rates have been improving (Wharton and Bones 1980).

Management practices to enhance wildlife benefits from forest land may be closely related to those used to increase wood production. Growing wood fiber requires periodic cultural treatments. During this cycle of cutting and regeneration, wildlife habitat is affected (see the earlier discussion of habitat manipulation under Wildlife). Timber management

can be compatible with wildlife habitat management (Roach 1974). The landowner could receive income by managing for timber and at the same time enhance the necessary food and shelter requirements for a variety of wildlife species. This dual approach may be particularly appealing to the many hunting and fishing clubs that own approximately 556,000 acres of forest land in Pennsylvania (Dennis and Birch 1980).

This is not to say that all timber cutting is necessarily good for wildlife. The landowner or forest manager concerned with both timber and wildlife needs to be aware of the impacts of timber management on wildlife, and may need to make certain modifications in the usual timber management practices. For example, timber management practices usually are carried out on blocks of forest land or stands, some of which may be too large to maximize habitat diversity. While one 15-acre clearcut may mean low administration costs and good regeneration of desirable shade-intolerant tree species, five 3-acre openings in the forest will do much more to create diversified conditions and more edge for a wide assortment of animal species.

Another possible conflict between timber and wildlife management, and one that has received greater attention with the recent increase in cutting trees for firewood, is the removal of cull or dead trees. From a strict wood production viewpoint, all cull trees should be removed as they are unproductive and take up valuable space that could be used by healthy and rapidly growing trees. Firewood cutters, seeking to assist timber growers, normally use cull and dead trees if they are not too rotten. From the wildlife viewpoint, such trees often provide cavities that are used for nesting, escape, winter cover, and food seeking and storage. Rather than removing these trees, certain actions can be taken to improve and expand this particularly valuable wildlife habitat (Evans and Conner 1979). The trade-offs and values involved in managing woodland for wildlife and firewood were discussed by Carey and Gill (1980).

Rotten cull trees often are good den trees for cavity nesting wildlife. An average acre of Pennsylvania forest land contains about six rotten trees over 5 inches in diameter; the range is four in the Southeastern Unit to nine in the Allegheny Unit. Red maple makes up the greatest proportion of the state's rotten trees with 19 percent, followed by oaks with 16 percent, beech with 10, black locust with 8, sugar maple with 7, and black cherry and sweet birch with 6 each.

There are fewer cull trees now than in 1965. but there are still more

At a time when other food may be scarce, browse from the tops of trees harvested in late fall or winter is especially beneficial to deer.

Pennsylvania Bureau of Forestr

A cavity or hollow at the base of a tree can provide adequate shelter for nesting birds.

Pennsylvania Bureau of Forestry

han enough to support populations f the 33 kinds of birds and 17 mam- al species that make some use of ee cavities and space under loose ark or crevices between surface ots (Hassinger 1980).

There also are opportunities for anagement that favors mature, ast-producing trees. Here is how e major mast-producing species in ennsylvania rank in percentage of umbers of sawtimber trees:

Species	*Percent of all species*
oak	39
black cherry	9
beech	4
hickory	3
Total	55

While it is comforting to realize at such a high percentage of the ate's sawtimber trees are valuable od products for wildlife, there are many stands in which stocking can be increased by sound forest management. Management also can favor other species of trees, shrubs, and vines that many animals depend on for food and cover.

Esthetic enjoyment of forest land is the most important single benefit that private landowners derived in the last 5 years and the one that they expect will be the most important over the next 5 years (Birch and Dennis 1980). Natural stand development, particularly as the trees become relatively large in diameter and height, can produce stands that are scenic and attractive. But there are a variety of management practices that can be applied to forest land to enhance the esthetic enjoyment derived from viewing wooded environments. In fact, managed stands generally have been found to be more attractive than unmanaged stands (Brush 1979).

The aspect of forest esthetics that managers can control most easily is the structure of forest stands. Three-dimensional spaces can be shaped by varying stand density and canopy height. A variety of forest spaces are possible, ranging from open clearings to dense thickets. To produce forests containing an attractive mixture of stands with a variety of sizes, ages, height, and species compositions required some form of even-age management. Timber production and wildlife habitat management are compatible with this approach.

Openings are very important in this type of forest landscape. The number, size, shape, orientation, spacing, and timing of openings leaves the landowner or manager with great flexibility in enhancing the esthetic characteristics of the landscape (USDA For. Serv. 1980b). Generally, the shape of an opening is

more pleasing if it is free form and not geometrical. The edges should be feathered (partial cutting of trees near edge to create a transition in heights between areas) so that the openings will blend well with the surrounding area. It is helpful to retain some residual trees in an opening, either in groups or uniformly across the areas. In some instances it may be important to reduce the visibility of openings (especially during the first year or two until they revegetate satisfactorily) through the use of screening or by taking advantage of the natural topography. In other instances, openings can be used to create or enhance scenic vistas of meadows, lakes, streams, rock formations, or distant views. Roadside or trailside openings can be appropriate for this use.

Another type of landscape which can be created by the selection system of management is an unbroken forest with a high percentage of large trees (18 to 30 inches in dbh) in mixture with smaller trees. Large stems are attractive to many people, but unless they are already present in the stand it will take many decades for them to develop. If timber production also is a goal, the normal age used to select trees for cutting will need to be increased so as to grow trees to larger size before individual stems can be harvested. A minimum of 20 years extension normally is required to achieve a significant increase in the size of hardwoods. This type of landscape should be limited to relatively short segments along vehicular routes to eliminate the almost certain monotony that would otherwise result.

Cutting and logging are effective tools in esthetic forest management, but they also can result in temporarily unsightly conditions. Logging and skid roads should be carefully planned, constructed, maintained, and eventually revegetated unless permanent access is desired. Logging equipment should be compatible with the site conditions. For example, rubber-tired skidders should not be used on compactible soils or during seasons when deep rutting can occur. Also, one can use several treatments to reduce the negative visual impact of logging residues. These include complete removal, chipping, lopping with or without scattering, and piling or yarding with or without burning. Burning should be done only under the strictest controls and must be in conformance with local laws and ordinances.

A scenic overlook can be created by planned cutting of an area or a specific group of trees (Cowans Gap State Park, Fulton County).

Pennsylvania Bureau of Forestry

Property owners can commit all or part of their forest land to scenic easements. An easement is a legal agreement between the owner and a conservation organization. The owner agrees to establish certain restrictions over the property. Examples would be restrictions against the removal of all trees; the use of eased lands as a landfill, a quarry, or a mineral excavation site; and future building construction. The restrictions in each easement agreement reflect the desires of the property owner. The conservation organization agrees to regularly inspect the eased areas for any violation and to ensure that conditions of the agreement are met. Besides the benefits of conservation, easements offer the opportunity to gain benefits through charitable income tax donations and the reduction of inheritance taxes without the sale or loss of land.

Recreation and wilderness management of forest land usually are closely associated with esthetic management since walking or driving through an area is one of the most popular outdoor recreational activities. Hunting, fishing, birdwatching, and outdoor photography are tied to wildlife habitat management.

Opportunities for enhancing recreational or wilderness values are closely related to size, location, and condition of the forested area as well as its proximity to roads and the sights and sounds of man's activities. From the earlier discussion on size of tract, we saw that there are relatively few large, unbroken, tracts of forest land (Fig. 28). Although most lands best suited for wilderness experiences are in State Forests or the Allegheny National Forest and are managed as such by the Bureau of Forestry and the USDA Forest Service, there are some large and remote privately owned forested tracts that could be managed for wilderness values. Such a management strategy is more a matter of managing use (people) than managing the physical resource (Hendee et al. 1978). Smaller and more accessible tracts could be managed for dispersed recreation activities such as hiking, camping, cross-country ski

ing, and snowmobiling. And many landowners find real recreational value in simply managing their woodland for other forest benefits, such as timber or firewood production. The 335 Tree Farmers who manage 576,262 acres of forest land in Pennsylvania can testify to this (personnel communication, Linda Rosenberg, American Forest Institute).

This discussion of forest management opportunities has looked at some of the many ways to enhance wood fiber production, wildlife habitat, esthetics, and recreational experiences, and has mentioned a few of the multiple-benefit combinations that can result. But it has not provided an example of how a landowner can manage his woodland for many different benefits at the same time. One example that serves this purpose well is the woodland management plan that is being implemented in the East Woods tract of the Tyler Arboretum in central Delaware County (Arnold 1979; Montgomery 1980).

This 93-acre tract is a showcase for demonstrating how landowners, through the proper application of silviculture, can integrate timber production with wildlife, esthetic, and recreational values. A management plan was prepared by Bureau of Forestry service forester in conjunction with arboretum officials. The area was inventoried and divided into seven distinct stands—each to be managed for specific objectives. After trees to be removed to meet these objectives were marked, a logger was brought in to harvest sawlogs and firewood. The logging was done following proper environmental guidelines. The sawlogs were sold, the firewood was distributed at a reduced price to members of the arboretum, and the logged areas are now nearly unrecognizable as such. Wood products were removed at a profit, esthetic values were enhanced, wildlife habitats were created or improved, the water quality of the watershed was maintained at a high level, and hiking and interpretive trails were constructed to enable people to see how forest management can provide all of these benefits.

In conclusion, we have identified many of the numerous opportunities that exist for landowners to manage their properties to meet their personal objectives. If our society continues to make increased demands on Pennsylvania's forests, there are many opportunities to manage these renewable forest resources to meet these needs. The Commonwealth's forests are resilient and dynamic. With proper management, they should continue to provide plentiful and desirable uses and benefits that our society has become accustomed to.

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Appendix

Definition of terms

Accretion. The estimated net growth of growing-stock trees that were measured during the previous inventory, divided by the length of the period between surveys. It includes the growth on trees that were cut during the period, plus those trees that died and were used.

Annual mortality trend level. The estimated mortality of growing stock or sawtimber for a specific year (1977 for Pennsylvania) based on average rates of diameter growth and mortality for the period. This estimate is consistent with the average annual change during the period between surveys and with the current inventory.

Annual net growth trend level. The estimated growth of growing stock or sawtimber for a specific year (1977 for Pennsylvania) based on average rates of diameter growth and mortality for the period. This estimate is consistent with the average annual change during the period between surveys and with the current inventory.

Annual removals trend level. The estimated removals of growing stock or sawtimber for a specific year (1977 for Pennsylvania) obtained from a trend line for the period. This line is established by fitting a curve to actual removals data for several years during the period. The actual removals for the year given can vary from the trend estimate because of fluctuations in market conditions and other factors.

Average annual net growth. The change, resulting from natural causes, in growing-stock or sawtimber volume of sound wood in growing-stock or sawtimber trees during the period between surveys, divided by the length of the period. Components of average annual net growth include the increment in net volume of trees that are present at the beginning of the period and that survive to the end (accretion), plus average annual ingrowth, minus average annual mortality, and minus the net volume of trees that became rough or rotten during the period (cull increment).

Average annual removals. The net growing-stock or sawtimber volume of trees harvested or killed in logging, cultural operations—such as timber stand improvement—or land clearing, and also the net growing-stock or sawtimber volume of trees neither harvested nor killed but growing on land which was reclassified from commercial forest land to noncommercial forest land during the period between surveys. This volume is divided by the length of the period.

Board foot. A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent.

Coarse residues. Manufacturing residues suitable for chipping, such as slabs, edgings, and veneer cores.

Commercial forest land. Forest land producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and not withdrawn from timber utilization.

Commercial species. Tree species presently or prospectively suitable for industrial wood products. Excludes species of typically small size, poor form, or inferior quality such as hawthorn and sumac.

County and municipal lands. Lands owned by counties and local public agencies or municipalities or leased to them for 50 years or more.

Cull increment. The net volume of growing-stock trees on the previous inventory that became rough or rotten trees in the current inventory divided by the length of the period between surveys.

Diameter at breast height (dbh). The diameter outside bark of a standing tree measured at 4½ feet above the ground.

Farmer-owned lands. Lands owned by farm operators, whether part of the farmstead or not. Excludes land leased by farm operators from nonfarm owners.

Federal lands. Lands (other than National Forests) administered by Federal agencies.

Fine residues. Manufacturing residues not suitable for chipping such as sawdust and shavings.

Forest industry lands. Land owned by companies or individuals operating primary wood-using plants.

Forest land. Land at least 10 percent stocked with trees of any size or that formerly had such tree cover and is not currently developed for nonforest use. The minimum area for classification of forest land is 1 acre.

Forest type. A classification of forest land based on the species forming a plurality of live-tree stocking. The many forest types in Pennsylvania were combined into the following major forest-type groups:

a. *White pine and hemlock*—forests in which white pine, red pine, or hemlock, singly or in combination comprise a plurality of the stocking in Pennsylvania, common associate

nclude red maple, red oaks, white oaks, beech, black cherry, and aspen.

b. *Spruce/fir*—forests in which spruce, fir, or tamarack, singly or in a combination, comprise a plurality of the stocking; this type is rare and localized in Pennsylvania.

c. *Scotch and Virginia pine*—orests in which Scotch, Virginia, or itch pines or eastern redcedar, singly or in combination, comprise a plurality of the stocking; in Pennsylvania, common associates include white pine, oak, yellow-poplar, and white ash.

d. *Oak/pine*—forests in which ardwoods (usually white, scarlet, hestnut, northern red, or black oaks) omprise a plurality of the stocking ut where Scotch, Virginia, or pitch ines or eastern redcedar comprise 5 to 50 percent of the stocking; in ennsylvania, common associates esides those listed above include d maple, black cherry, and hickory.

e. *Oak/hickory*—forests in hich upland oaks, hickory, yellow-oplar, black walnut, or redmaple hen associated with central hard-oods), singly or in combination, mprise a plurality of the stocking d in which Scotch, Virginia, or tch pines or eastern redcedar com-ise less than 25 percent of the ocking; in Pennsylvania, common sociates include white ash, sweet rch, black cherry, black locust, and gar maple.

f. *Oak/gum*—bottomland for-ts in which wet-site oaks or gums, ngly or in combination, comprise a rality of the stocking; in Pennsyl-nia, our survey encountered only e field plot in this group, and it was minated by swamp white oak and d associates of quaking aspen, ack cherry, red maple, and white h.

g. *Elm/ash/red maple*—forests i which elm, river birch, sycamore, llow, or red maple (when growing wet sites), singly or in combina-n, comprise a plurality of the ocking; in Pennsylvania, common sociates include red oaks, white oaks, hickory, black cherry, white ash, and sugar maple.

h. *Northern hardwoods*—forests in which sugar maple, beech, yellow birch, black cherry, or red maple (when associated with northern hardwoods), singly or in combination, comprise a plurality of the stocking; in Pennsylvania, common associates include white ash, hemlock, sweet birch, northern red oak, basswood, aspen, white oak, white pine, and hickory.

i. *Aspen/birch*—forests in which aspen, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking; in Pennsylvania, common associates include red maple, black cherry, sugar maple, and oak.

Growing-stock trees. Live trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees.

Growing-stock volume. Net volume, in cubic feet of growing-stock trees 5.0 inches and larger in dbh, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem, or to the point where the central stem breaks into limbs. Net volume equals gross volume, less deduction for cull.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Industrial wood. All roundwood products except fuelwood.

Ingrowth. The estimated net volume of growing stock trees that became 5.0 inches or larger in dbh during the period between inventories, divided by the length of the period between surveys.

International ¼-inch rule. A log rule, or formula, for estimating the board-foot volume of logs. The mathematical formula is:

$$(0.22D^2 - 0.71D)(0.904762)$$

for 4-foot sections, where D = diameter inside bark at the small end of the section. This rule is used as the USDA Forest Service Standard Log rule in the Eastern United States.

Land area. (a) Bureau of Census: The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than ⅛ statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area. (b) Resources Evaluation: same as (a) except that the minimum width of streams, etc., is 120 feet, and the minimum size of lakes, etc., is 1 acre.

Logging residues. The unused portions of growing-stock trees harvested or killed in the process of logging.

Manufacturing plant residues. Wood materials that are generated when converting round timber (roundwood) into wood products. This includes slabs, edgings, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and pulp screening. If these residues are used, they are referred to as plant byproducts.

Miscellaneous private lands. Privately owned lands other than forest industry and farmer-owned lands.

Mortality. The estimated net volume of growing-stock trees on the previous inventory that died from natural causes before the current inventory, divided by the length of the period between surveys.

National Forest lands. Federal lands legally designated as National Forests or purchase units and other lands administered as part of the National Forest System by the USDA Forest Service.

Noncommercial forest land. Productive-reserved, urban, and unproductive forest land.

Noncommercial species. Tree species of typically small size, poor form, or inferior quality that normally

do not develop into trees suitable for industrial wood products.

Nonforest land. Land that has never supported forests, or land formerly forested but now in nonforest use such as cropland, pasture, residential areas, and highways.

Nonstocked areas. Commercial forest land that is stocked with less than 10 percent of minimum full stocking with growing-stock trees.

Plant byproducts. Wood products, such as pulp chips, recycled from manufacturing plant residues.

Poletimber stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of poletimber exceeds that of sawtimber.

Poletimber trees. Live trees of commercial species meeting regional specifications of soundness and form and at least 5.0 inches in dbh, but smaller than sawtimber trees.

Productive-reserved forest land. Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas tree production.

Primary wood manufacturing plant. A plant that converts round timber into wood products such as woodpulp, lumber, veneer, cooperage, and dimension products.

Pulpwood. Roundwood converted into 4- or 5-foot lengths or chips, and chipped plant byproducts that are prepared for manufacture into woodpulp.

Rotten trees. Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough trees. (a) The same as rotten trees, except that rough trees do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees of noncommercial species.

Roundwood products. Logs, bolts, or other round timber generated by harvesting trees for industrial or consumer uses.

Saplings. Live trees 1.0 through 4.9 inches in dbh.

Sapling-seedling stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in saplings or seedlings or both.

Sawlog. A log meeting regional standards of diameter, length, and defect, including a minimum 8-foot length and a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods. (See specifications under Log Grade Classification.)

Sawlog portion. That part of the bole of a sawtimber tree between the stump and the sawlog top; that is, the merchantable height.

Sawlog top. The point on the bole of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches diameter outside bark (dob) for softwoods and a 9.0 inches dob for hardwoods.

Sawtimber stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

Sawtimber trees. Live trees of commercial species at least 9.0 inches in dbh for softwoods or 11.0 inches for hardwoods that contain at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and that meet regional specifications for freedom from defect.

Sawtimber volume. Net volume in board feet, International ¼-inch rule, of sawlogs in sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Seedlings. Live trees less than 1.0 inch in dbh that are expected to survive.

Site class. A classification of forest land by inherent capacity to grow crops of industrial wood. Classifications are based on the mean annual growth of growing-stock trees attainable in fully stocked natural stands at culmination of mean annual increment.

Softwoods. Coniferous trees, usually evergreen and having needles or scalelike leaves.

Stand. A group of forest trees growing on forest land.

Stand-size class. A classification of forest land based on the size class (that is, seedlings, saplings, poletimber, or sawtimber) of growing-stock trees in the area.

Standard cord. A unit of measure for stacked bolts of wood, encompassing 128 cubic feet of wood, bark, and air space. Fuelwood cord estimates can be derived from cubic-foot estimates of growing stock by applying an average factor of 80 cubic feet of solid wood per cord. For pulpwood, a conversion of 85 cubic feet of solid wood per cord is used because of the more uniform character of pulpwood.

State lands. Lands owned by the State or leased to the State for 50 years or more.

Stocking. The degree of occupancy of land by trees, measured by basal area and/or number of trees in a stand compared to the basal area and/or number of trees required to fully use the growth potential of the

ınd (or the stocking standard). In the astern United States this standard . 75 square feet of basal area per ɔre for trees 5.0 inches, and larger, ı dbh or its equivalent in numbers of ees per acre for seedlings and sap- ıgs.

Two categories of stocking are sed:

All live trees—these are used to assify forest land and forest types.

Growing-stock trees—these are ıed to classify stand-size classes.

Timber products. Manufacturing ant byproducts and roundwood ound timber) products harvested ɔm growing-stock trees on com- ercial forest land; from other urces, such as cull trees, salvable ad trees, limbs, tops and saplings; d from trees on noncommercial est and nonforest lands.

Timber removals. The growing- ɔck or sawtimber volumes of trees noved from the inventory for ındwood products, plus logging sidues, volume destroyed during d clearing, and volume of standing es growing on land that was re- ssified from commercial forest d to noncommercial forest land.

Treatment class. A class as- ned by the field crews to each for- ed plot, describing the manage- nt treatment necessary to main- ı or improve the condition of the nd. The classes are:

a. *Harvest mature stand and re- ıerate*—The trees appear mature sawlog production, and the stand eady for harvesting and regenera- ı. This treatment includes selec- ı cuts, clearcuts, shelterwood s, and seed tree cuts.

b. *Thin stand*—A cutting made n immature stand to stimulate the rwth of the trees that remain and to ease the total production of the d. Trees removed represent a olus. Thinnings are made after the ling stage, and remove trees ch are not in the dominant posi- in contrast to other intermediate cuts. Generally the stand is even-aged and polesize.

c. *Improvement cutting*—An intermediate, selection cut made primarily to remove trees of undesirable form or species (including damaged, injured, and dead trees) from the stand. Removal of unmerchantable trees will be listed under timber stand improvement.

d. *Timber Stand Improvement (TSI)*—Weeding, clearing, liberation cuts, and other silvicultural practices generally associated with removal of nonmerchantable materials.

e. *Convert stand to another type by thinning and/or planting*—Recommended for stands that are being taken over by undesirable tree species. It may also apply to stands that are understocked by desirable species.

f. *Remove current stand and regenerate*—Stands needing this treatment are not mature but still should be removed and regenerated to improve their productivity. Examples are stands where the optimum growth is past and late-aged stands where the trees have been suppressed. Clearcutting is the most common type of harvesting method used for this situation.

g. *Stand in good condition and on schedule*—Besides stands that are in good condition and would not be improved by any of the above treatments, this treatment class also applies to stands on marginal land that are not in the best condition for wood production.

Trees. Woody plants that have well-developed stems and that usually are more than 12 feet tall at maturity.

Unproductive forest land. Forest land that is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions.

Unused manufacturing residues. Plant residues that are dumped or destroyed and not recovered for plant byproducts.

Upper-stem portion. That part of the main stem or fork of a sawtimber tree above the sawlog top to a diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

Urban forest land. Noncommercial forest land within urban areas that is surrounded by urban development (not parks), whether commercial, industrial, or residential.

Planning and Designing the Survey

Pennsylvania's third forest survey was planned and designed to satisfy national, regional, and state information needs in an efficient manner. This was accomplished in several ways.

Considerable cooperation was sought and achieved among the public agencies managing forest land in the state. Pennsylvania's Bureau of Forestry completed its inventory of State Forests in 1977. The Allegheny National Forest was inventoried in 1974. Resources Evaluation helped design these surveys and was able to ensure that most of the data provided by these surveys were compatible with data provided by our own survey. Working with the Bureau of Forestry and the Allegheny National Forest enabled Resource Evaluation to reduce the land inventoried by more than 2 million acres.

Another method employed to improve the efficiency of the third survey was to use the 1955 and 1965 inventories while capitalizing on the new survey. Stratified double sampling with partial replacement (SPR) was the sampling design used to accomplish this task (Bickford et al. 1963; Barnard 1978). By remeasuring a subsample of the previous surveys, we were able to update the 1955 survey and the 1965 survey area and volume estimates to 1978. Taking these updated inventory estimates and combining them with estimates based only on data from new plots, we developed statistically improved

estimates for forest area and timber volume. The next section on processing provides more detail. For the same cost, SPR yields more statistically accurate estimates than other methods (Barnard 1974).

In developing the estimates for the current survey, a sample was established on aerial photography dating from 1967 to 1971, the most recent photography available. Each aerial photo plot (first phase) was classified into one of several photo-interpretation (PI) strata. The strata were based on land use and, if forested, timber volume. For each stratum a ground plot subsample (second phase) was chosen randomly from the photo plot sample. In Pennsylvania, the photo sample consisted of 79,373 plots. A subsample of 1,743 was selected to be observed on the ground.

Approximately 70 percent of the photo plots established on the ground were photo-interpreted as forested and thus in one of four timber volume classes. Each timber volume stratum was sampled with equal intensity, using a selection rule known as proportional allocation. This represented a change from the second survey when optimal allocation was employed. Under optimal allocation higher timber-volume strata were sampled more heavily.

On the ground, land use was verified, and on the forested plots tree data were recorded. The plots consisted of a cluster of 10 prism points systematically arranged to cover approximately 1 acre. At each point, trees 5 inches in diameter and larger were selected for tally by using a prism with a basal-area factor of 37.5 square feet per acre.

The other sets of independent estimates based on updating the 1955 and 1965 surveys required the remeasurement of 504 ⅕-acre fixed-radius plots originally established during the first survey and 497 10-point plots originally established during the second survey. The fixed-radius plots were measured for the third time and were used in the growth and removals calculations.

Processing the Data

The processing of Pennsylvania's third forest survey represented a major advance in forest area and timber volume calculations because, in many cases, total estimates were developed directly for individual counties in the state. In the past, totals were developed for geographic units and prorated back to the county level. Prorations were based on the stratification, by county, of the photo-interpretation points. Now with the estimates usually developed on a county by county basis, the reliability of these estimates has been improved. This new technique also helps users who wish to analyze trends.

Not all counties had individually estimated totals. Those counties that were too small (less than 60 forested Resources Evaluation ground plots) or that showed too much variation were grouped with one or more nearby counties which could or could not stand alone themselves. The resulting groups of counties were called "supercounties". Data for the supercounties are presented in the county tables at the end of "Forest Statistics for Pennsylvania—1978" (Considine and Powell 1980).

The Northeastern Forest Experiment Station uses the data processing system FINSYS, or Forest Inventory System, developed by Wilson and Peters [2] to process and compile tree and plot information into statistical tables. FINSYS uses the totals developed from two companion programs, AREA and SPeeR, as input along with field data. FINSYS consists primarily of a series of computer programs that edit field-tally data for errors, compile edited data into tables, and print county, geographic unit, and state summary resource estimates in tabular form.

FINSYS has several unique features, one of which is its flexibility. The system is not restricted to the northeastern forest survey but can be used for any large-scale forest inventory. The user specifies what tables are to be produced. While a standard set of tables are produced for our resource report, others can be produced for special information requests.

Another feature of FINSYS is its ability to produce a variance and sampling error for each estimate. These figures provide the user with a measure of the estimate's reliability.

Because Pennsylvania's data came from three sources, the actual processing procedure was very complicated. Not all data were compatible with FINSYS and in some instances had to be processed manually.

Commercial forest area statistics were developed in several stages. First, information from the Resources Evaluation survey was used by the computer program AREA, based on Frayer and Furnival (1967), to produce a total estimate of commercial forest land for each county or supercounty. A current estimate for each county or supercounty was produced for each plot type ⅕-acre remeasured, 10-point remeasured, and 10-point new ground. These three totals were inversely weighted by their variances and combined to form a single, independent total estimate. This combined estimate is statistically more accurate than a single estimate. FINSYS used these county totals and plot data to develop a set of tables of commercial forest land area by county or supercounty. FINSYS then summed these county tables to produce geographic unit and state level tables.

In those counties where State Forest and Allegheny National Forest lands occur, the area data from these ownerships were manually added to the appropriate tables. The Pennsylvania Bureau of Forestry and the National Forest provided us with the necessary updated area data. These data were free from sampling error since all commercial forest land in these ownerships has been mapped and measured without sampling. Because of this, that data could not be

[2] Wilson, R. W.; Peters, R. C. The northeastern forest inventory data processing system. USDA For. Serv. Res. Pap. NE-61 and NE-70 to NE-80.

added to the Resource Evaluation plot data until all automatic data processing had been completed.

Calculation of timber volume estimates followed a different path than did area estimates. A computer program SPeeR, calculated county or supercounty totals based on our plot data. State Forest county totals were developed manually to make them compatible with our totals. They were added to our totals. These combined totals, plus our plot data and State Forest plot data, were used in FINSYS to produce volume tables by county, geographic unit, and state.

National Forest volume data, unlike area data, had to be updated before being added. The Forest was last inventoried in 1974. Growth data from that inventory and removals data from 1974 through 1977 were used to update the necessary volume tables from 1974 to 1978. These were then manually added to the FINSYS tabular output to produce the final volume tables.

Commercial Tree Species of Pennsylvania

Scientific Name [a]	*Common Name*	*Occurrence* [b]
	SOFTWOODS	
Juniperus virginiana	eastern redcedar	vr
Larix laricina	tamarack (eastern larch) [c]	r
Picea abies	Norway spruce [d]	r
P. glauca	white spruce [d]	vr
P. mariana	black spruce	vr
P. rubens	red spruce	vr
Pinus banksiana	jack pine [d]	r
P. echinata	shortleaf pine	vr
P. pungens	Table-Mountain pine	vr
P. resinosa	red pine	c
P. rigida	pitch pine	c
P. strobus	eastern white pine	c
P. sylvestris	Scotch pine [d]	c
P. virginiana	Virginia pine	c
Tsuga canadensis	eastern hemlock	vc
	HARDWOODS	
Acer rubrum	red maple (soft) [c]	vc
A. saccharinum	silver maple	r
A. saccharum	sugar maple (hard) [c]	vc
Betula alleghaniensis	yellow birch	c
B. lenta	sweet birch (black) [c]	c
B. nigra	river birch	vr
B. papyrifera	paper birch (white) [c]	r
Carya spp.	hickory	c
Castanea dentata	American chestnut	vr
Celtis occidentalis	hackberry	vr
Cornus florida	flowering dogwood	r
Diospyros virginiana	common persimmon	vr
Fagus grandifolia	American beech	c
Fraxinus americana	white ash	c
F. nigra	black ash	vr
F. pennsylvanica	green ash	r
Gleditsia triacanthos	honeylocust	vr
Gymnocladus dioicus	Kentucky coffeetree	vr
Ilex opaca	American holly	vr
Juglans cinerea	butternut	r
J. nigra	black walnut	r
Liquidambar styraciflua	sweetgum (red gum) [c]	vr
Liriodendron tulipifera	yellow-poplar (tulip tree) [c]	c
Magnolia acuminata	cucumbertree	r
Nyssa sylvatica	blackgum (black tupelo) [c]	c

Commercial Tree Species (cont.)

Scientific Name	*Common Name*	*Occurrence*
	HARDWOODS	
Platanus occidentalis	American sycamore	r
Populus deltoides	eastern cottonwood	vr
P. grandidentata	bigtooth aspen	c
P. tremuloides	quaking aspen	c
Prunus serotina	black cherry	vc
Quercus alba	white oak	vc
Q. bicolor	swamp white oak	r
Q. coccinea	scarlet oak	c
Q. falcata var. *falcata*	southern red oak	vr
Q. imbricaria	shingle oak	vr
Q. macrocarpa	bur oak	vr
Q. muehlenbergii	chinkapin oak	vr
Q. palustris	pin oak	r
Q. phellos	willow oak	vr
Q. prinus	chestnut oak	vc
Q. rubra	northern red oak	vc
Q. stellata var. *stellata*	post oak	vr
Q. velutina	black oak	c
Robinia pseudoacacia	black locust	c
Salix nigra	black willow	vr
Tilia americana	American basswood	c
Ulmus americana	American elm	c
U. rubra	slippery elm	c
U. thomasii	rock elm	r

[a] Little, Elbert L., Jr. 1979. Checklist of United States trees (native and naturalized). U.S. Dep. Agric., Agric. Handbk. 541. 375 p.
[b] Based on the frequency of tally of commercial species 5 inches or larger in dbh on forest survey field plots: vr: very rare (<0.05 percent); r: rare (0.05 to 0.49 percent); c: common (0.5 to 4.9 percent); and vc: very common (>5.0 percent).
[c] Names in parentheses are other frequently used names.
[d] Species introduced into Pennsylvania.

Table 1.—Pennsylvania's forest land 1978 (in thousands of acres)

County and unit	Commercial forest land						Productive reserved					Urban	Unproductive			Total forest land
	Allegheny National Forest	State Forest	State Game Lands	Other public [a]	Private	Total	Allegheny National Forest	State Forest	Other public	Christmas tree	Total		State Forest	Other	Total	
Allegheny	--	--	1.1	--	128.3	129.4	--	--	22.9	--	22.9	11.5	--	11.4	11.4	175.2
Armstrong	--	--	4.7	1.2	213.9	219.8	--	--	0.5	--	0.5	--	--	--	--	220.3
Beaver	--	--	3.4	0.6	135.0	139.0	--	--	6.8	--	6.8	2.1	--	--	--	147.9
Butler	--	--	7.8	0.1	235.6	243.5	--	--	12.8	--	12.8	0.3	--	--	--	256.6
Crawford	--	--	16.6	1.4	304.3	322.3	--	--	9.3	--	9.3	--	--	10.5	10.5	342.1
Erie	--	--	8.4	0.6	203.1	212.1	--	--	2.2	--	2.2	1.0	--	--	--	215.3
Greene	--	--	8.7	--	205.5	214.2	--	--	1.3	--	1.3	--	--	--	--	215.5
Indiana	--	--	12.2	0.5	287.3	300.0	--	0.4	4.2	--	4.6	--	--	--	--	304.6
Lawrence	--	--	1.7	--	76.0	77.7	--	--	2.5	--	2.5	0.7	--	0.4	0.4	81.3
Mercer	--	--	5.2	0.3	162.6	168.1	--	--	6.0	--	6.0	1.2	--	--	--	175.3
Washington	--	--	5.3	0.7	203.5	209.5	--	--	1.9	--	1.9	2.2	--	--	--	213.6
Westmoreland	--	5.5	11.3	11.5	270.4	298.7	--	3.9	2.6	--	6.5	1.5	--	--	--	306.7
Western Unit	--	5.5	86.4	16.9	2,425.5	2,534.3	--	4.3	73.0	--	77.3	20.5	--	22.3	22.3	2,654.4
Bedford	--	26.3	46.0	0.7	348.7	421.7	--	2.0	10.1	--	12.1	--	2.9	--	2.9	436.7
Blair	--	--	30.6	21.3	157.7	209.6	--	--	3.4	--	3.4	0.3	--	7.9	7.9	221.2
Cambria	--	0.9	27.0	18.8	208.7	255.4	--	0.2	7.7	--	7.9	1.0	0.1	11.3	11.4	275.7
Fayette	--	13.9	19.3	1.3	269.7	304.2	--	0.3	18.4	--	18.7	0.7	0.6	10.9	11.5	335.1
Somerset	--	25.7	29.5	6.5	344.5	406.2	--	2.4	21.1	--	23.5	--	0.3	--	0.3	430.0
Southwestern Unit	--	66.8	152.4	48.6	1,329.3	1,597.1	--	4.9	60.7	--	65.6	2.0	3.9	30.1	34.0	1,698.7
Cameron	--	125.6	12.7	--	102.3	240.6	--	7.7	0.9	--	8.6	--	1.6	--	1.6	250.8
Elk	106.4	69.3	63.9	4.4	218.3	462.3	--	3.4	0.8	--	4.2	0.3	6.1	--	6.1	472.9
Forest	112.8	2.2	7.1	0.3	125.0	247.4	--	--	3.0	--	3.0	--	--	--	--	250.4
McKean	128.8	2.5	21.3	8.6	390.3	551.5	3.0	--	4.3	--	7.3	0.3	0.2	0.3	0.5	559.6
Potter	--	260.8	16.7	1.2	316.8	595.5	--	2.3	0.3	--	2.6	--	2.7	--	2.7	600.8
Sullivan	--	38.0	49.0	2.3	162.1	251.4	--	1.7	0.1	--	1.8	--	0.7	0.3	1.0	254.2
Tioga	--	137.9	19.3	1.9	314.5	473.6	--	8.7	1.9	--	10.6	--	4.4	--	4.4	488.6
Warren	137.0	--	33.5	0.6	288.8	459.9	1.0	--	0.7	--	1.7	--	--	--	--	461.6
Allegheny Unit	485.0	636.3	223.5	19.3	1,918.1	3,282.2	4.0	23.8	12.0	--	39.8	0.6	15.7	0.6	16.3	3,338.9
Centre	--	113.4	58.3	6.8	325.0	503.5	--	8.4	1.0	--	9.4	--	20.5	12.7	33.2	546.1
Clarion	--	--	13.7	--	203.6	217.3	--	--	4.7	--	4.7	0.3	--	--	--	222.3
Clearfield	--	85.4	23.8	4.4	455.5	569.1	--	2.2	0.2	--	2.4	--	7.4	--	7.4	578.9
Clinton	--	183.5	11.3	4.2	230.0	429.0	--	14.3	1.1	--	15.4	--	67.5	0.7	68.2	512.6
Jefferson	--	9.0	32.5	1.9	230.4	273.8	--	--	1.5	--	1.5	--	--	--	--	275.3
Lycoming	--	154.1	38.5	11.2	350.2	554.0	--	6.1	2.0	--	8.1	1.3	34.7	--	34.7	598.1
Venango	--	--	18.7	1.2	293.2	313.1	--	--	9.8	--	9.8	--	--	--	--	322.9

North-Central Unit	--	545.4	196.8	29.7	2,087.9	2,859.8	--	31.0	20.3	--	51.3	1.6	130.1	13.4	143.5	3,056.2
Dauphin	--	7.5	40.5	10.6	91.2	149.8	--	--	7.4	--	7.4	2.7	0.1	--	0.1	160.0
Franklin	--	32.7	14.9	14.8	137.2	199.6	--	3.5	0.2	--	3.7	--	4.2	--	4.2	207.5
Fulton	--	27.8	16.7	--	134.1	178.6	--	1.5	--	--	1.5	--	1.7	--	1.7	181.8
Huntingdon	--	46.7	30.3	7.5	300.5	385.0	--	5.9	18.0	--	23.9	--	15.6	--	15.6	424.5
Juniata	--	9.4	8.1	3.4	132.5	153.4	--	0.1	1.1	--	1.2	--	6.8	--	6.8	161.4
Mifflin	--	44.6	2.7	0.9	114.9	163.1	--	0.3	0.2	--	0.5	--	17.1	--	17.1	180.7
Perry	--	32.1	14.4	--	164.2	210.7	--	3.7	0.7	--	4.4	--	8.6	--	8.6	223.7
Snyder	--	23.3	1.3	0.7	67.1	92.4	--	1.2	--	--	1.2	--	4.2	--	4.2	97.8
Union	--	51.4	0.8	1.7	55.5	109.4	--	5.9	0.1	13.6	19.6	--	8.1	--	8.1	137.1
South-Central Unit	--	275.5	129.7	39.6	1,197.2	1,642.0	--	22.1	27.7	13.6	63.4	2.7	66.4	--	66.4	1,774.5
Bradford	--	3.3	43.4	0.3	333.8	380.8	--	--	0.7	--	0.7	0.6	--	--	--	382.1
Lackawanna	--	4.4	4.3	9.0	170.2	187.9	--	0.1	3.6	--	3.7	3.5	2.0	0.3	2.3	197.4
Susquehanna	--	--	12.6	--	307.4	320.0	--	--	0.3	--	0.3	--	--	0.9	0.9	321.2
Wayne	--	--	11.5	2.9	292.8	307.2	--	--	2.3	--	2.3	--	--	1.0	1.0	310.5
Wyoming	--	--	27.6	--	133.8	161.4	--	--	--	--	--	--	--	1.0	1.0	162.4
Northeastern Unit	--	7.7	99.4	12.2	1,238.0	1,357.3	--	0.1	6.9	--	7.0	4.1	2.0	3.2	5.2	1,373.6
Carbon	--	0.9	25.5	17.3	117.2	160.9	--	--	27.2	--	27.2	--	--	0.7	0.7	188.8
Columbia	--	--	16.4	--	123.0	139.4	--	--	0.9	--	0.9	1.6	--	--	--	141.9
Luzerne	--	--	33.1	4.1	326.3	363.5	--	--	27.4	--	27.4	0.3	--	--	--	391.2
Monroe	--	6.5	35.3	0.8	241.2	283.8	--	2.1	14.5	--	16.6	--	0.2	1.3	1.5	301.9
Montour	--	--	0.2	0.2	23.2	23.6	--	--	--	--	--	0.3	--	--	--	23.9
Northumberland	--	--	9.6	--	103.4	113.0	--	--	0.1	--	0.1	--	--	--	--	113.1
Pike	--	49.6	21.3	--	202.1	273.0	--	9.9	12.9	--	22.8	--	2.5	1.5	4.0	299.8
Schuylkill	--	7.8	22.0	8.5	261.2	299.5	--	--	25.4	21.4	46.8	0.7	0.5	0.7	1.2	348.2
Pocono Unit	--	64.8	163.4	30.9	1,397.6	1,656.7	--	12.0	108.4	21.4	141.8	2.9	3.2	4.2	7.4	1,808.8
Adams	--	19.0	0.1	1.0	83.7	103.8	--	1.0	1.6	--	2.6	--	0.5	--	0.5	106.9
Berks	--	0.9	13.3	7.9	129.5	151.6	--	--	15.5	--	15.5	1.9	0.1	--	0.1	169.1
Bucks	--	--	4.1	--	75.6	79.7	--	--	14.0	--	14.0	8.6	--	0.7	0.7	103.0
Chester	--	--	0.9	2.7	84.0	87.6	--	--	13.7	--	13.7	--	--	--	--	101.3
Cumberland	--	33.7	1.6	0.1	74.2	109.6	--	1.9	1.4	--	3.3	1.0	1.8	--	1.8	115.7
Delaware	--	--	--	--	--	--	--	--	1.9	--	1.9	16.0	--	--	--	17.9
Lancaster	--	--	7.5	0.7	87.9	96.1	--	--	2.4	--	2.4	--	--	--	--	98.5
Lebanon	--	--	20.9	2.7	26.6	50.2	--	--	9.8	--	9.8	--	--	--	--	60.0
Lehigh	--	--	3.4	0.1	49.3	52.8	--	--	0.1	--	0.1	1.4	--	--	--	54.3
Montgomery	--	--	--	0.6	64.9	65.5	--	--	0.5	--	0.5	6.0	--	--	--	72.0
Northampton	--	--	4.0	6.8	45.2	56.0	--	--	2.3	--	2.3	0.3	--	--	--	58.6
Philadelphia	--	--	--	--	--	--	--	--	3.0	--	3.0	2.1	--	--	--	5.1
York	--	--	2.4	0.7	138.3	141.4	--	--	16.7	--	16.7	0.3	--	--	--	158.4
Southeastern Unit	--	53.6	58.2	23.3	859.2	994.3	--	2.9	82.9	--	85.8	37.6	2.4	0.7	3.1	1,120.8
All counties	485.0	1,655.6	1,109.8	220.5	12,452.8	15,923.7	4.0	101.1	391.9	35.0	532.0	72.0	223.7	74.5	298.2	16,825.9

[a] These figures are broken down into ownerships in worksheet titled Pennsylvania—Third Inventory—Public Ownership, July 20, 1978.

Table 2.—Distribution of net growing-stock volume on commercial forest land, by species and forest-type group, Pennsylvania, 1978
(In millions of cubic feet)

Species	Forest-type group									All forest-type groups
	White pine and hemlock	Spruce/ fir	Scotch and Virginia pine	Oak/ pine	Oak/ hickory	Oak/ gum	Elm/ash red maple	Northern hardwoods	Apen/ birch	
White/red pine	322.6	2.2	33.0	7.4	148.4	--	12.4	107.7	7.3	641.0
Virginia pine	--	--	41.4	13.1	14.5	--	1.2	1.4	--	71.6
Other yellow pines	5.7	5.1	34.9	25.2	61.0	--	--	17.1	1.3	150.3
Hemlock	244.4	--	--	--	118.2	--	10.3	497.6	1.2	871.7
Other softwoods	0.6	18.8	2.1	--	1.6	--	1.5	4.5	3.3	32.4
Total softwoods	573.3	26.1	111.4	45.7	343.7	--	25.4	628.3	13.1	1,767.0
Select white oaks [a]	35.7	--	4.2	11.3	1,167.9	6.3	13.4	137.8	5.7	1,382.3
Northern red oak	36.8	--	1.7	12.8	2,192.1	--	24.0	321.7	8.6	2,597.7
Other oaks [b]	8.7	2.1	0.4	13.4	1,165.0	--	14.1	98.3	1.1	1,303.1
Chestnut oak	17.1	--	2.9	7.8	1,964.0	--	4.0	61.2	1.4	2,058.4
Hickory	7.0	--	0.8	1.1	422.8	--	19.5	101.7	3.4	556.3
Yellow birch	12.2	--	--	--	19.2	--	4.7	144.6	0.3	181.0
Sweet birch	17.8	5.5	--	1.8	243.1	--	8.1	445.2	6.6	728.1
Sugar maple	18.4	--	W	--	147.4	--	13.7	1,800.6	10.8	1,990.9
Red maples [c]	96.1	0.9	0.9	13.4	1,150.6	0.6	205.8	1,874.2	27.0	3,369.5
Beech	25.7	--	--	--	76.9	--	6.0	792.1	0.1	900.8
Blackgum	2.0	1.0	W	0.5	83.0	--	6.8	22.8	0.8	116.9
White ash	8.2	1.7	2.4	--	243.0	--	17.1	603.4	3.7	879.5
Aspen	22.9	0.7	1.3	1.4	83.4	3.0	5.5	232.6	129.7	480.5
Basswood	6.7	--	--	--	42.7	--	--	289.8	3.0	342.2
Yellow-poplar	2.3	--	3.2	--	444.8	--	9.9	98.7	--	558.9
Black walnut	0.9	--	--	--	48.4	--	6.1	12.1	--	67.5
Black cherry	23.4	1.6	W	4.9	225.7	1.6	18.1	1,601.2	15.8	1,892.3
Black locust	--	2.1	1.8	--	144.1	--	1.0	30.2	W	179.2
Other hardwoods	11.7	0.7	2.6	3.9	164.8	--	98.4	109.1	12.8	404.0
Total hardwoods	353.6	16.3	22.2	72.3	10,028.9	11.5	476.2	8,777.3	230.8	19,989.1
All species	926.9	42.4	133.6	118.0	10,372.6	11.5	501.6	9,405.6	243.9	21,756.1

[a] Includes white, swamp white, and bur oaks.
[b] Includes scarlet, southern red, shingle, pin, willow, post and black oaks.
[c] Includes 25.8 million cubic feet of silver maple.
W—Less than 50,000 cubic feet.

Table 3.—Aboveground green weight of live trees, by species and source, Pennsylvania[a] (In thousands of tons)

Species	Growing stock			Rough and rotten			Seedlings and saplings[c]
	Merchantable stem[b]	Topwood and branchwood	Total	Merchantable stem[b]	Topwood and branchwood	Total	
White/red pine	22,573.5	5,182.3	27,755.8	1,307.0	382.1	1,689.1	3,504.1
Virginia pine	2,978.2	514.1	3,492.3	209.4	38.7	248.1	861.1
Other yellow pines	6,683.0	2,236.0	8,919.0	157.7	80.2	237.9	2,741.0
Hemlock	30,923.4	11,378.0	42,301.4	4,180.1	1,842.3	6,022.4	4,871.7
Other softwoods	1,376.5	646.9	2,023.4	126.1	73.2	199.3	1,693.0
All softwoods	64,534.6	19,957.3	84,491.9	5,980.3	2,416.5	8,396.8	13,670.9
Select white oaks	59,851.5	19,704.0	79,555.5	2,052.0	2,139.6	4,191.6	4,648.6
Northern red oak	121,891.6	47,307.6	169,199.2	4,163.1	2,581.7	6,744.8	6,963.3
Other oaks	56,938.3	18,800.3	75,738.6	1,693.3	742.8	2,436.1	4,595.7
Chestnut oak	100,584.1	30,517.0	131,101.1	8,353.7	3,492.5	11,846.2	8,761.7
Hickory	29,213.7	6,556.5	35,770.2	1,203.2	387.3	1,590.5	3,658.9
Yellow birch	6,291.9	2,324.3	8,616.2	1,252.3	643.9	1,896.2	1,690.3
Sweet birch	32,296.1	9,105.6	41,401.7	3,956.1	1,487.8	5,443.9	8,100.9
Hard maple	76,950.6	24,814.3	101,764.9	6,240.6	2,606.3	8,846.9	12,114.5
Red maples	116,651.0	33,589.2	150,240.2	10,084.0	3,843.4	13,927.4	37,952.8
Beech	36,999.5	13,199.1	50,198.6	6,674.3	3,422.7	10,097.0	7,077.7
Blackgum	4,899.7	950.0	5,849.7	623.4	203.1	826.5	3,522.4
White ash	33,910.6	6,999.6	40,910.2	2,146.7	651.9	2,798.6	8,175.2
Aspen	14,764.3	3,872.7	18,637.0	636.6	290.0	926.6	6,958.7
Basswood	9,877.0	1,476.6	11,353.6	891.9	153.8	1,045.7	680.0
Yellow-poplar	22,904.6	3,360.4	26,265.0	352.9	81.3	434.2	1,440.7
Black walnut	3,554.0	732.3	4,286.3	484.1	153.2	637.3	1,001.0
Black cherry	62,568.6	13,006.3	75,574.9	7,249.2	1,933.3	9,182.5	15,766.9
Black locust	7,780.5	1,529.0	9,309.5	2,329.6	940.2	3,269.8	2,247.4
Other hardwoods	17,871.1	3,422.4	21,293.5	15,364.2	4,630.3	19,994.5	43,869.7
All hardwoods	815,798.7	241,267.2	1,057,065.9	75,751.2	30,385.1	106,136.3	179,226.4
All species	880,333.3	261,224.5	1,141,557.8	81,731.5	32,801.6	114,533.1	192,897.3

[a] Excludes Allegheny National Forest.
[b] Trees 5 inches and larger in dbh, between a 1-foot stump and a 4-inch top.
[c] Also excludes State Forest estimates.

Table 4.—Pennsylvania's forest industries 1967–77[a]

1972 SIC code	Industry group and industry	Number of establishments			Number of establishments with 20 or more employees			Number of employees (in thousands)			Payroll 1967 dollars[b] (in millions)			Value added by manufacture 1967 dollars[c] (in millions)		
		1967	*1972*	*1977*	*1967*	*1972*	*1977*	*1967*	*1972*	*1977*	*1967*	*1972*	*1977*	*1967*	*1972*	*1977*
24	Lumber and wood products	NA	1,285	1,326	NA	246	245	NA	22.2	20.5	NA	126.7	104.6	NA	269.9	244.0
2411	Logging camps, log contractors	253	197	262	5	6	9	0.8	0.7	1.1	3.0	2.9	5.4	7.1	6.6	14.7
242	Sawmills and planing mills	680	555	480	55	62	61	5.2	4.4	4.7	21.5	23.1	21.0	39.3	45.0	51.6
243	Millwork, plywood, struc. membs.	NA	231	249	NA	80	74	NA	6.7	6.3	NA	38.5	34.0	NA	69.7	69.6
244	Wood containers	NA	66	115	NA	24	32	NA	1.4	1.9	NA	7.1	8.3	NA	12.3	15.9
245	Wood building and mobile homes	NA	52	63	NA	46	45	NA	6.5	4.1	NA	42.4	23.5	NA	110.5	53.8
249	Misc. wood products	NA	184	157	NA	28	22	NA	2.4	2.4	NA	12.7	12.4	NA	25.8	38.0
25	Furniture and fixtures[d]	NA	230	227	NA	99	73	NA	NA	NA	NA	NA	NA	NA	NA	NA
2511	Wood household furniture	NA	108	114	NA	44	34	NA	4.6	3.6	NA	23.3	15.9	NA	41.3	32.3
2517	Wood TV and radio cabinets	NA	4	2	NA	3	1	NA	NA	D	NA	D	D	NA	D	D
2521	Wood office and furniture	13	16	13	6	6	5	0.8	0.7	0.6	4.4	3.8	3.1	8.9	6.6	6.8
2531	Public bldg., related furniture	31	26	19	17	15	7	1.5	NA	0.6	7.8	D	3.3	12.4	D	6.6
2541	Wood Partitions	75	76	79	24	31	26	2.1	NA	1.7	13.0	D	9.9	18.0	D	18.2
26	Paper and allied products	439	429	400	299	282	268	43.6	42.4	40.2	287.4	307.9	289.6	607.9	659.9	802.8
2621	Papermills, except building paper	25	26	23	24	22	21	9.8	9.6	8.6	78.6	82.8	80.3	142.9	153.0	163.1
2631	Paperboard mills	19	20	17	18	17	16	2.5	NA	1.8	19.6	D	14.9	43.2	D	35.3
264	Misc. converted paper products	162	157	160	94	85	89	12.9	12.9	15.0	77.2	89.8	97.7	206.8	244.5	400.3
265	Paperboard containers and boxes	225	219	193	157	151	137	17.9	17.0	14.4	108.3	111.4	93.5	205.2	214.6	192.3
2661	Building paper and board mills	8	7	5	6	7	5	0.5	NA	0.5	3.7	D	3.3	9.7	D	9.4

[a] Source: U.S. Dep. Commer. Bur. Census 1970, 1975, 1979.
[b] Deflated using consumer price index (1967 = 100), Bureau of Labor Statistics.
[c] Deflated using producer price index (1967 = 100), Bureau of Labor Statistics.
[d] Only those industries who clearly use quantities of wood.
NA Data either not available or comparable due to changes in industry classification by the Bureau of Census.
D Data withheld to avoid disclosure for individual manufacturing plants.

Metric Equivalents

1 acre = 4,046.86 square meters or 0.404686 hectares

1,000 acres = 404.686 hectares

1,000,000 acres = 404,686 hectares

1,000 board feet = 3.48 cubic meters [a]

1 cubic foot = 0.028317 cubic meters

1,000 cubic feet = 28.317 cubic meters

1,000,000 cubic feet = 28,317 cubic meters

1 cord (wood, bark, and airspace) = 3.6246 cubic meters

1 cord (solid wood, pulpwood) = 2.4069 cubic meters

1 cord (solid wood, other than pulpwood) = 2.2654 cubic meters

1,000 cords (pulpwood) = 2,406.9 cubic meters

1,000 cords (other products) = 2,265.4 cubic meters

1 ton (short) = 907.1848 kilograms or 0.9071848 metric tons

1,000 tons (short) = 907.1848 metric tons

1 inch = 2.54 centimeters or 0.0254 meters

1 foot = 30.48 centimeters or 0.3048 meters

Breast height = 1.4 meters above ground level

1 mile = 1.609 kilometers

1 square foot = 929.03 square centimeters or 0.0929 square meters

1 square foot per acre basal area = 0.229568 square meters per hectare

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[a] While 1,000 board feet is theoretically equivalent to 2.36 cubic meters, this is true only when a board foot is actually a piece of wood with a volume of 1/12 of 1 cubic foot. The International 1/4-inch log rule is used by the USDA Forest Service in the East to estimate the product potential in board feet. When a conversion is used, the reliability of the estimate will vary with the size of the log measure. The conversion given here, 3.48 cubic meters, is based on the cubic volume of a log 16 feet long and 15 inches in diameter inside bark (dib) at the small end. This conversion could be used for average comparisons when accuracy of 10 percent is acceptable. Since the board-foot unit is not a true measure of wood volume and since products other than dimension lumber are becoming important, this unit may eventually be phased out and replaced with the cubic-meter unit.

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Powell, Douglas S.; Considine, Thomas J., Jr. An analysis of Pennsylvania's forest resources. Broomall, PA: Northeast. For. Exp. Stn.; 1982; USDA For. Serv. Resour. Bull. NE-69. 97p.

A comprehensive analysis of the current status and trends of the forest resources of Pennsylvania. Topics include forest area, timber volume, biomass, timber products, timber's role in the state's economy, growth, and removals. Forest area, volume, growth and removals are projected through 2008. A detailed treatment is given to water, soil, minerals, fish, wildlife, and recreation as they relate to forest resources. Also identified are forest management opportunities for increasing the production of major forest resources and enhancing the benefits derived from Pennsylvania's forests.

ODC(748):905.2—014.

Keywords: Forest survey, trends, projections, area, volume, growth, removals, nontimber forest resources, forest management opportunities.

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The Forest-Land Owners of Ohio—1979

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Abstract

Information about the attitudes and objectives of the private forest-land owners is essential to understanding Ohio's forest resources. Ninety-four percent of Ohio's 6.9 million acres of commercial forest land is in 332,600 private ownerships. Ninety-two percent of these ownerships are individual and joint ownerships. A majority, 66 percent of these owners, live within a mile of the nearest tract and 80 percent own only one tract. Benefits other than timber production are most important to Ohio's landowners, but 43 percent of the ownerships have harvested timber from their land. Harvesting firewood is common among owners that own fewer than 50 acres of forest land. Only 29 percent of the ownership units permit some form of recreational use of their land by the public, these units have 36 percent of the private forest land.

COVER PHOTO: An aerial view of Geauga County, Ohio

The Forest-land Owners
of Ohio -- 1979

Contents

Highlights

Ninety-four percent of Ohio's 6.9 million acres of commercial forest land is in 332,600 private ownerships.

Forty-five percent of the ownerships hold more than 10 acres each; they account for 91 percent of the private forest land.

Ninety-two percent of the ownership units are individual and joint ownerships.

Only 29 percent of the private ownership units, holding 36 percent of the forest land, permit some form of recreational use of their land by the public.

Forest industries own 186,300 acres of forest land.

Benefits other than timber production are most important to Ohio's landowners, but 43 percent of the ownership units have harvested timber from their land.

Introduction

Our forest resources are vital to the social and economic well-being of our society. Good decisionmaking about these resources requires a thorough knowledge of the resource base and the factors affecting it. This paper gives estimates of the number and characteristics of the private forest-land ownerships in Ohio. The attitudes of typical forest-land owners, their reasons for owning forest land, and their views about timber harvesting, forest management, and recreational uses of their land are described. Results of this study, used with the recent Ohio forest resource data (Dennis and Birch 1981, Dennis 1982), will provide information of use to a number of user groups.

Ownership information will be useful to public agencies in planning and evaluating forestry-related programs, to forest industry in procuring timber, and to others interested in learning more about Ohio's diverse forest-land owners. Ownership of a resource such as forest land is the essential connecting link between people and the land. Landowners have legal rights and responsibilities relating to forest land. Rights include those to purchase or sell land, to determine land use, and to decide the type and level of investment. These rights all function within limits allowed or imposed by society. Land ownership fixes responsibility for decisionmaking, establishes a claim on income accruing to land, and determines how wealth in land is distributed (Lewis 1980, Wunderlich 1978).

Who or what is an ownership unit?[1] Owners may be persons, combinations of persons, or legal entities; such as corporations, partnerships, clubs, and trusts. An ownership unit has the control of a parcel or group of parcels of land. Our sampling frame is drawn from the land itself (parcel by parcel), and the owner of record (the apparent owner), is determined. A questionnaire is mailed, and finally an individual responds who has some control of an amount of land (not exclusively the parcel sampled). Therefore, we are measuring ownership units and not individual owners.

The results presented here have been statistically expanded from a sample to estimate the total population of private forest-land ownership units and the acreage they own. Users of this report are advised to read the definitions of terms and the discussion of the study design and sampling errors included in the Appendix. Tables supporting conclusions in the text are also in the Appendix.

[1]This term and others are defined in the appendix.

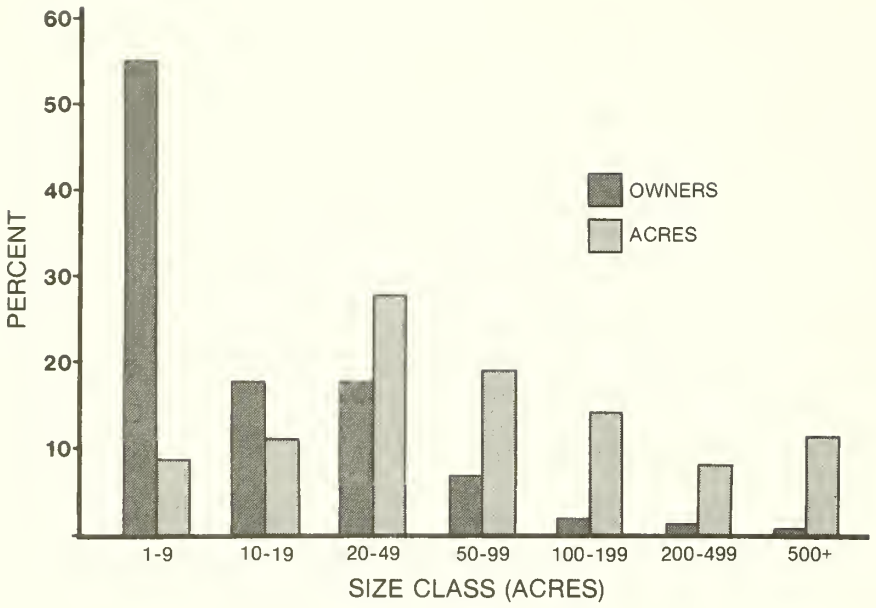

Figure 1.--Distribution of private ownerships, by size class of ownership.

The Forest-Land Ownership Units

An estimated 332,600 private ownership units hold 6,504,900 acres of commercial forest land in Ohio. Fifty-five percent of these ownership units hold less than 10 acres each and collectively control only 9 percent of the private forest land. Another 300 ownership units, holding 500 or more acres each, own 11 percent of the privately owned commercial forest land (Table 2, Fig. 1).

The average private forest land ownership is 20 acres. If ownerships of less than ten acres are excluded, the average rises to 40 acres. The average size of holding varies among the geographic units, from 14 acres in the Northeastern Unit to 34 acres in the Southeastern Unit. The distribution of ownership units and forest land also varies between geographic units (Fig. 2).

Another way of dividing the ownership units into categories is: Forest industry, Farmer-owned, and Miscellaneous private (includes Individual, Corporate, and Other). An estimated 200 Forest industry ownerships have 186,300 acres of forest land. The Farmer-owned category has an estimated 145,900 ownership units with 2,888,900 acres of forest land. The Miscellaneous private category has an estimated 186,500 ownership units with 3,429,700 acres of forest land (Table 2).

Form of ownership is another classification that has been shown to predict intention to harvest timber when combined with size class of ownership. Ninety-two percent of the private ownership units are individuals and joint ownerships (excluding partnerships, undivided estates, corporations, etc.) collectively holding 79 percent (5,159,400 acres) of the privately owned commercial forest land. One percent of the ownership units are corporations and they hold 764,500 acres, 12 percent of the private forest land. The remaining 9 percent of the commercial forest land (581,000 acres) is held by partnerships, undivided estates, clubs, and associations (Table 3).

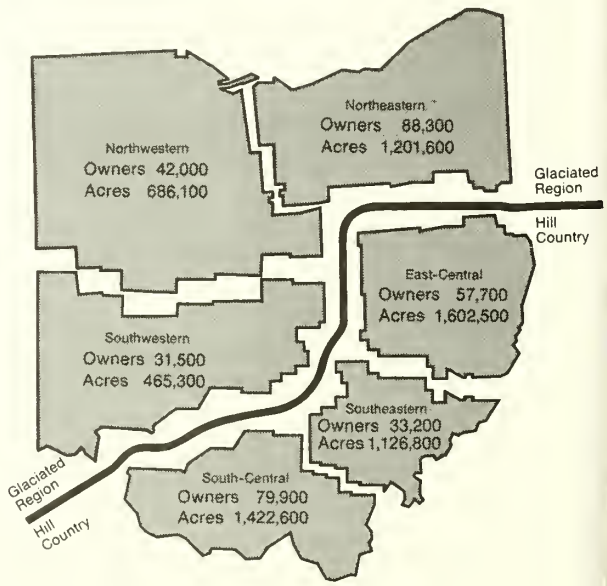

Figure 2.--Distribution of private ownerships, in Ohio by geographic unit.

The distribution by size class of ownership for the individual and joint ownerships differs from that of all owners, with a larger percentage of the area in the smaller size classes. The largest difference is in the 500+ acreage class, where the individual owners hold only 3 percent of the forest land as compared to 11 percent for all owners (Table 4).

Corporate and Other Owners

An estimated 27,400 corporate and other ownership units own 1,345,500 acres of forest land. The 4,500 corporate ownership units have 764,500 acres of forest land; 6,000 partnerships have 243,200 forest acres; and 16,900 undivided estates, clubs, associations, and trusts have 337,800 acres of forest land.

The average corporate owner has 170 acres of forest land. The largest concentrations of corporate lands are in the Southeastern and East-Central units. Over half the corporate forest lands in Ohio are located in these two units.

Corporations engaged in timber-based industries hold 151,200 acres (Table 5). There is an additional 35,100 acres of unincorporated forest industry land. Forest industry lands represent only 3 percent of Ohio's privately owned commercial forest land. Almost all the forest industry ownership is in the three hill country units (South-Central, Southeastern, and East-Central).

An estimated 1,200 nonforest industries collectively hold 40 percent of the corporate forest land. Many of these companies are primarily interested in subsurface materials (coal, oil, natural gas). The remaining corporate acreage is held by real estate firms, nonindustrial businesses, corporate farms, sport and recreation clubs, public utilities, and other corporations.

Characteristics of the Individual Forest-Land Owners

Why study the characteristics of individual owners? Many studies have attempted to predict ownership response from owner characteristics. Occupation, age, residence, date of acquisition, number of tracts, education, and income have all been explored as predictors of harvesting intention (Kingsley 1976, Kingsley and Birch 1977). These characteristics also suggest that individual forest-land owners have a great diversity of backgrounds and abilities. The above characteristics were included for the individual who completed the questionnaire for the individual and joint ownership units.

Twenty-two percent of Ohio's individually owned forest land (1,145,500 acres) is held by professionals, executives (including business owners) and white collar workers (Table 6, Fig. 3). This group owned an average of 19 acres per ownership unit.

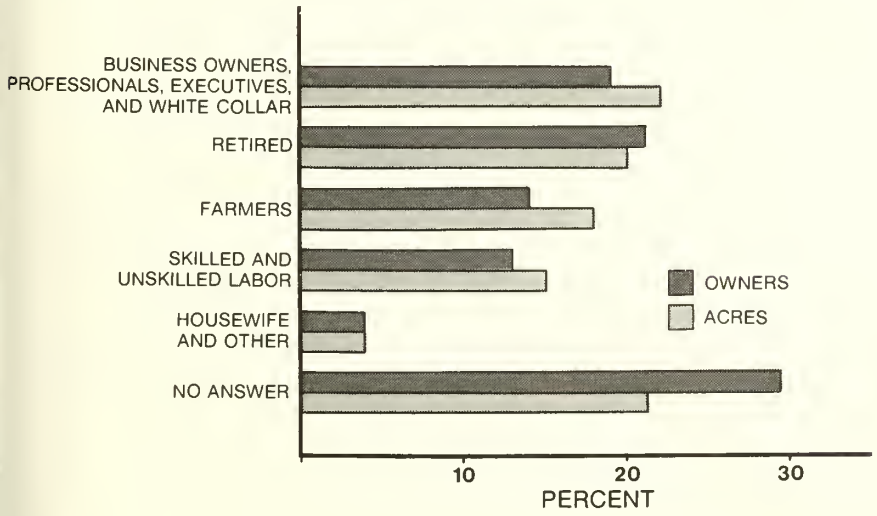

Figure 3.--Distribution of individual ownerships, by owner occupation.

The largest number of individual owners are retired; they hold 20 percent of the individually owned forest land. Over half the individual owners with incomes under $10,000 per year are 65 years old or older.

We estimated that 2,888,900 acres of forest land was "farmer owned". Some of this land was in corporate farms and 917,100 acres was owned by an estimated 41,800 individuals whose primary occupation is farming. Therefore, nearly 2 million acres of forest land are owned by part-time farmers, corporate farms and other farm ownerships such as partnership farms. As a group, farmers are important because they have the highest percentage of owners that intend to cut timber in the next 10 years of any occupation group (Table 7).

Skilled and unskilled laborers, housewives, and other occupations collectively represent 17 percent of the individual owners and hold 19 percent of the individually owned forest land. Owners that did not answer the occupation question make up the remaining 29 percent of the individual owners; they hold 21 percent of the individually owned forest land.

Other information provides us with a general description of Ohio's individual forest-land owners (Tables 8-11). Sixty percent of the owners are over 45 years old and nearly half of these are over 65. Twenty-five percent of the owners are educated beyond high school, while 20 percent have 8 years or less of formal education. Forty-two percent of the owners did not indicate an income class for our survey. Of those that indicated an income class, 56 percent had gross incomes of less than $15,000 per year. Only 10 percent reported spending their first 12 years in a city with a population greater than 10,000. Fifty-five percent spent their first 12 years in a rural area or on a farm.

Indicators of Management Potential

Because of the long time it takes to grow trees, tenure of ownership is important. Most of the corporate (including forest industry) lands were acquired before 1950. This is not the case with other ownerships: forty-five percent of the farmer owned forest land was acquired before 1960, as was 38 percent of the miscellaneous individual forest land (Table 12). Twenty-two percent of the forest land owned by individuals was acquired in the 70's, 22 percent in the 60's, 19 percent in the 50's, 23 percent before 1950, and 14 percent at dates unknown (Table 13, Fig. 4).

Where an owner resides in relation to the forest property and how many scattered tracts an owner has are important to people who deliver various types of forestry assistance. An estimated 66 percent of the ownership units have owners who live on the tract or have business headquarters within 1 mile of their nearest tract. These units hold 59 percent of the forest land (Table 14). Eighty percent of the ownership units own single tracts; they make up 55 percent of the forest land. Many of the corporate ownerships are included in the 5 percent of the ownership units that have three or more tracts and 26 percent of the forest land (Table 15).

An indication of dispersion is obtained when you combine data on number of tracts with distance from nearest and farthest tract (Table 16). For example: of the 66,400 ownership units with more than one tract, 1,500 units have owners living more than 50 miles from their nearest tract and 5,100 units have owners living more than 50 miles from their farthest tract.

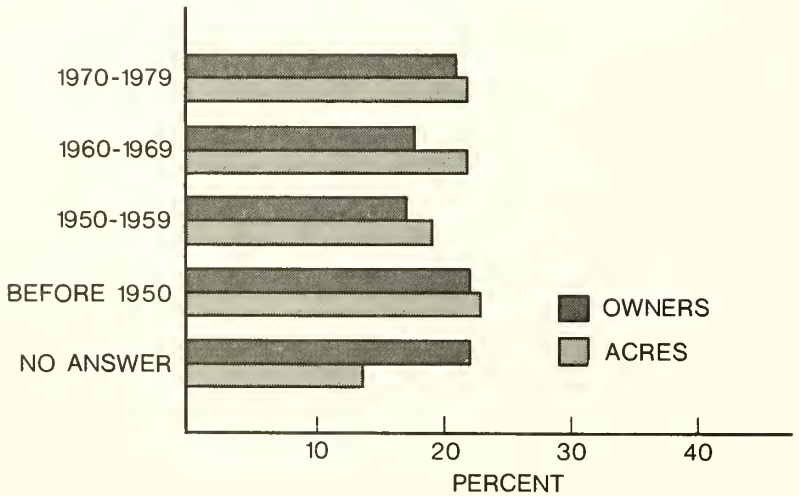

Figure 4.--Distribution of individual ownerships, by year owner first acquired woodland.

Owners Objectives

Forest land offers multiple goods and services, it is not surprising that landowners express diverse reasons for owning. The owners sampled in this study were asked their primary reasons for owning forest land, which benefits were most important in the last 5 years, and which were expected to be most important in the next 5 years.

About 2 percent of the private forest-land ownership units in Ohio (including forest industry) gave timber production as their primary reason for owning woodland (Tables 17-20, Fig. 5). An additional 3 percent gave timber as their second reason. Together these two groups own 701,400 acres of forest land (11 percent).

Among the benefits received in the last 5 years and expected in the next 5 years, income from the sale of timber was ranked most important by 2 percent of the ownership units. These owners own about 500,000 acres of commercial forest land in Ohio (Table 21-23). It is not suprising that there are fewer acres owned by people receiving income from the sale of timber than owned primarily for timber production because income from the sale of timber occurs only during the period when the stand of timber is mature.

Nearly half the ownership units gave "residence" or "part of the farm" as their primary reason for owning forest land. These people own 2,226,000 acres or 34 percent of the private forest land in Ohio. They own an average of 14 acres of forest land, and one can see why many of these owners would want any harvesting done to be esthetically pleasing.

An estimated 25,000 ownership units (7 percent) gave esthetic enjoyment as their primary reason for owning forest land. An additional 5 percent of the ownership units own their forest land for recreational use. Together these two groups own 15 percent of the private forest land. Esthetic enjoyment was the most frequently mentioned benefit that owners derived over the past 5 years and expect in the next 5 years. Statewide, 28 percent of the ownership units holding 23 percent of the private forest land listed this benefit as the most important they had received. In the next 5 years, 27 percent of the ownership units with 20 percent of the forest land expect esthetic enjoyment to be most important. Recreational use was important to 6 percent of the ownership units and 7 percent expect it to be their most important benefit in the next 5 years.

An estimated 38,700 ownership units (12 percent) gave farm or domestic use as their primary reason for owning forest land. A large portion of the 760,300 acres (also 12 percent) in this group are thought of as farm woodlots. These forest lands provide fence posts, firewood, and a substantial portion of the commercial roundwood harvest.

Farm or domestic use as a benefit received in the last 5 years ranked second among ownership units (19 percent) followed by increase in land value (16 percent). In area owned by benefit received, land value increase was second (21 percent) with farm and domestic use third (16 percent).

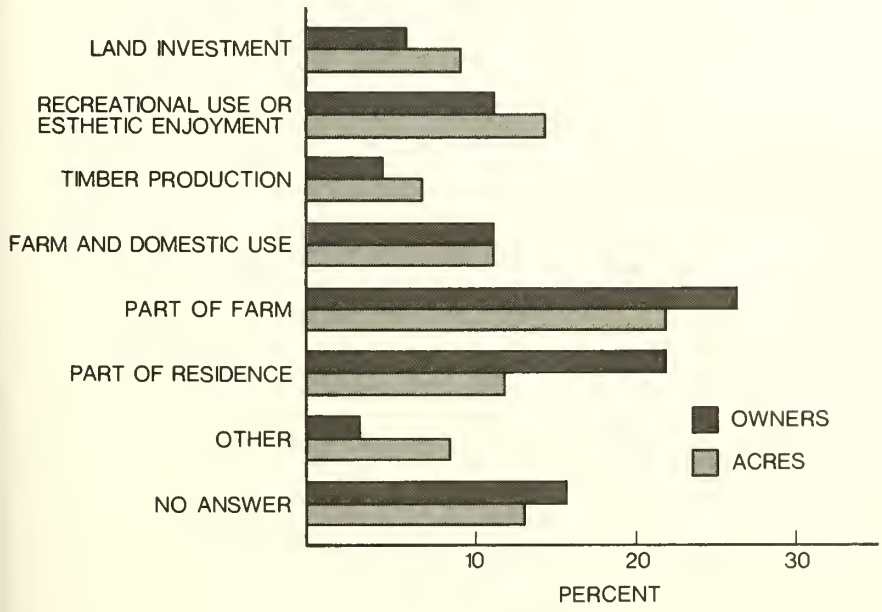

Figure 5.--Distribution of private ownerships, by primary reason for owning forest land.

An estimated 21,900 ownership units (6 percent) with 569,500 acres of forest land (9 percent) gave land investment as their primary reason for owning forest land. Land values have increased throughout the country. Land investment is often thought of as a hedge against inflation. This helps to explain why more than twice as many ownership units felt that land value increase was their most important benefit as gave it as their reason for owning forest land. It also explains why even more ownership units expect it to be their most important benefit in the next 5 years.

The remaining ownership units gave other reasons for owning forest land or did not answer. Many of the ownership units that gave other reasons were interested in mineral production -- primarily coal, oil, and natural gas.

Who Harvests Timber and Why

An estimated 141,700 ownership units (43 percent) have harvested in the past; they own 3,614,000 acres, 56 percent of the private forest land. The owners who have harvested own an average of 25 acres, as compared to the 15-acre average of the owners who have not harvested in the past. However, the size of ownership unit does influence what products are harvested.

What motivated these owners to cut? An estimated 34,300 ownership units (24 percent) who have harvested in the past did so because they felt that their timber was mature. These ownership units have 1,051,100 acres of forest land, 29 percent of the forest land owned by harvesters (Tables 24 and 25, Fig. 6).

Nineteen percent of the harvesters indicated that they cut trees for their own or company use. Of the 600,100 acres owned by these ownership units, 167,900 acres is owned by forest industries. The remaining owners own an average of 16 acres. Many of these owners are cutting firewood for their own use.

Fourteen percent of the ownership units indicated that they harvested because they needed the money or were offered a good price. Individuals that harvested because they were offered a good price hold an average of 75 acres per owner. Those who harvested because they needed the money own an average of 31 acres of forest land.

The remaining harvesters did so for land clearing, timber salvage, cultural treatment, or for other reasons. Only 1 percent of the ownership units harvested for the purpose of cultural treatment.

Why Many Owners Have Not Harvested

Fifty-seven percent of the private forest-land ownership units in Ohio have never harvested timber. These ownership units hold 2,890,900 acres, 44 percent of the privately owned commercial forest land. Over half the owners who have not harvested in the past hold more than half of this acreage; they indicate that they may harvest some time in the future (Tables 28-34).

Twenty-nine percent of the forest land held by nonharvesters (836,900 acres) was not harvested because the owners believed the timber was immature (Tables 26-27, Fig. 7). Twenty-two percent of all private forest land in the state is held by owners who say they will never harvest timber. Current rates of tenure suggest that some of these will sell their land before the timber matures.

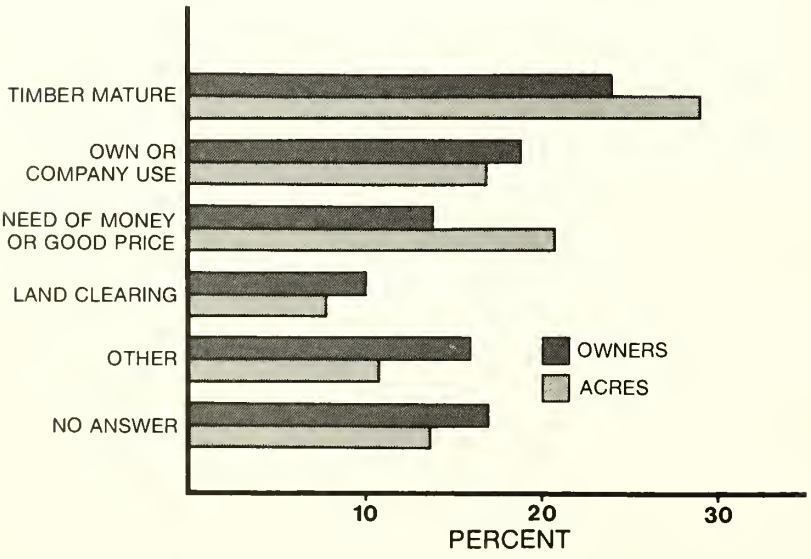

Figure 6.--Distribution of private ownerships who have harvested timber, by reason for harvesting.

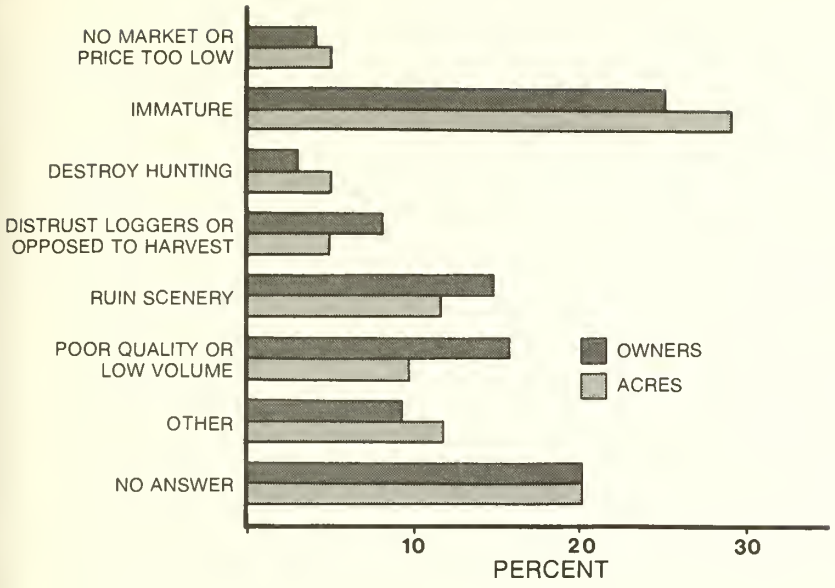

Figure 7.--Distribution of private ownerships who have not harvested timber, by reason for not harvesting.

The next most frequently cited reason for not harvesting was that timber harvesting would ruin the scenery. The ownership units that gave this reason hold 12 percent of the forest land held by nonharvesters, and average 11 acres of forest land per ownership.

Owners who have stands of poor quality timber or low volumes per acre are not likely to find commercial markets for their trees. Ownership units with 10 percent of the forest land owned by nonharvesters felt that their forest land was in this situation.

Lack of a market or low prices were reasons given by landowners holding 5 percent of the nonharvested acreage. Many of these ownerships intend to harvest in the future, perhaps when prices or market conditions improve.

Distrust of loggers, opposition to timber harvesting, or the belief that harvesting would destroy hunting values were reasons given by 11 percent of the nonharvesters. Overall, very few Ohio owners are philosophically opposed to cutting, and the ones that are control a very small percentage of the resource.

How Much Timber Is Available

The answer to the question: "How much timber is available for harvesting from private forest land?" is influenced by how one defines availability and the assumptions from which the estimate is developed. Changes in industrial technology, market conditions, and the general social atmosphere limit the credibility of a long-range estimate.

Two specific questions were asked of sample owners to aid in estimating timber availability: when they plan to harvest timber and what percentage of their woodland they believed they would never harvest timber from. We assumed that as many ownership units will harvest in the next 10 years as said they would. We divided the ownership units into four groups: forest industry, nonindustrial private forest ownerships (NIPF's) over 500 acres, NIPF's with 50-499 acres, and NIPF's with fewer than 50 acres of forest land.

An estimated 200 forest industry landowners hold 186,300 acres of forest land in Ohio. These owners indicate that 98 percent or 182,600 acres are available for timber harvesting. Current average annual growth for Ohio's forest land is estimated to be 40.28 ft^3 per acre per year (Dennis and Birch 1981). Assuming that this growth is available for harvesting, 7,355,100 ft^3 of wood will be available for timber products each year from forest industry lands.

Two-thirds of the NIPF's holding more than 500 acres of commercial forest land plan to harvest timber in the next 10 years. These ownership units hold 407,700 acres of forest land and indicate that 92 percent or 376,000 acres are available for timber harvesting. Again, assuming that these owners will on the average harvest annual growth from their forest land, 15,145,300 ft^3 of wood would be available for timber products each year.

We estimate that 5,800 NIPF's holding between 50 and 499 acres plan to harvest during the next 10 years. These owners indicate that 565,300 acres or 89 percent of their forest land is available for timber harvesting. Using the same assumption of growth, 22,770,300 ft^3 of wood would be available for timber products each year.

The remaining 37,200 ownership units that intend to harvest in the next 10 years own fewer than 50 acres of forest land. These ownerships indicate that 372,500 acres or 82 percent of their forest land is available for timber harvesting. That would give an estimate of 15,004,300 ft^3 of wood available for timber products each year.

In total, 60,275,000 ft^3 of timber should be made available each year by private owners who plan to harvest timber during the next 10 years. In 1978, forest industries used 64,873,000 ft^3 of timber from growing stock in Ohio's forest (Nevel and Redett 1980). Adding the volume that will be made available from public forest land suggests that an adequate volume of timber will be available to Ohio's forest industry if growth remains the same or increases, and if harvesting activities do not increase. This view is reinforced by the 150,400 ownership units holding 3,091,100 acres of commercial forest land who indicate that they may harvest at some time in the future. These ownerships say 84 percent of their land is available, which means that these owners are producing 104,588,000 ft^3 of available timber each year.

Forest Management on Private Lands

Harvesting Practices

Half of the landowners who harvested timber chose the area or trees to be harvested (Table 36). These owners control 1,319,800 acres, 37 percent of the privately owned forest land held by harvesters. An additional 9 percent of the owners who harvested chose the trees for harvest with the assistance of a forester or buyer. The average holding for owners who chose the timber themselves was 19 acres. Owners who chose the timber along with the buyer own an average of 33 acres. The average forest ownership for owners who selected the trees with the help of a forester was 112 acres.

An estimated 6,700 ownerships involved a forester in choosing the area or trees to be harvested. These owners hold 17 percent of the land held by harvesters. Where the forester alone selected the timber for harvest, the average holding was 86 acres of forest land.

Seventeen percent of the harvesters allowed the buyer to select the timber to be harvested from their land. These owners own an average of 29 acres of forest land. When the buyer selects the timber to be cut, there may be conflict between the buyer's objective -- obtaining maximum merchantable timber -- and the landowner's objectives. In some cases the buyer's and seller's goals are the same -- maximum current value. However, many landowners goals have been compromised because they allowed someone else to plan the harvest from their land. A professional forester may also compromise the landowner's objectives by emphasizing silvicultural integrity of the harvest, but foresters do strive to understand the landowner's goals and seek their realization.

Diameter-limit cutting, where only trees above a certain diameter are removed, was the method of selection used by 23,200 owners with 920,500 acres of forest land. This method was frequently used when the buyer was involved in the timber selection. This harvest method is easy to administer and allows the landowner to check what was cut without marking individual trees before the harvest.

Selection, where only preselected marked trees are removed, was used by 35,100 ownership units with 764,200 acres. This method is frequently used on small ownerships where the landowner chooses the trees to be harvested. It may be assumed that this method was favored by the many small owners who harvested firewood. When a forester chooses the timber by selection he or she is most likely to be operating on an ownership of fewer than 50 acres of forest land.

Clearcutting was used on 3,800 ownerships with 336,700 acres of forest land. Some large ownerships that employ foresters used this method. The average holding is 562 acres of forest land.

An estimated 53,300 landowners did not know what harvesting method was used or did not answer the question. The remaining owners used a combination of methods or other selection procedures.

Products Harvested

Sawlogs account for more than half of the volume harvested as industrial roundwood in Ohio (Nevel and Redett 1980). As expected, the product that owners most frequently harvest was sawlogs (Table 37). Size of ownership seems a direct influence on what products are harvested. The forest industry ownerships had all harvested sawlogs. Among the nonindustrial private land owners, those with more than 500 acres of forest land were most likely to have harvested sawlogs, followed by the 50 to 499-acre owners, and lastly the owners of fewer than 50 acres of forest land.

Pulpwood is the second most important industrial roundwood product in Ohio. Only 5 percent of the owners who harvested timber have harvested pulpwood. The larger nonindustrial owners and the forest industry owners were most likely to have harvested pulpwood. They were also most likely to have harvested veneer logs.

An estimated 55,800 ownership units harvested firewood from their 522,900 acres of forest land. Ninety-seven percent of these owners own fewer than 50 acres of forest land; the average firewood harvester has only 9 acres. Fuelwood is not considered an industrial product. The estimated fuelwood harvest was 13,576,000 ft^3 in 1978, but most of this harvest came from non-growing-stock sources. Many of the fuelwood harvesters harvested firewood in conjunction with the harvest of a commercial product.

Nearly one-third of the owners who have harvested, holding 41 percent of the acreage held by harvesters, cut more than one product from their forest land. Other products that were harvested from private forest land in Ohio included posts, poles, piling, cooperage logs, mine timbers, and Christmas trees.

Forestry Assistance

When asked whom they would contact for forestry assistance, 43 percent of the ownership units said they did not know and another 36 percent did not respond to the question. Together these owners hold 66 percent of the privately owned forest land (Table 38). The larger owners (more than 50 acres of forest land) have made the effort to find out where to obtain information about their forest land and forest management, because a larger percentage know whom to contact.

Eleven percent of the landowners have sought some form of forestry assistance. These owners hold 25 percent of the private forest land (Table 39). Owners who harvested timber were more likely to have sought assistance than those who have not.

An estimated 37,700 ownership units, 11 percent of units with 1,180,900 acres, said they would contact the Ohio Department of Natural Resources, Division of Forestry, for forestry assistance. Of these, 15,700 have sought assistance in the past, (Table 40), these owners have 739,600 acres of forest land. Most of the other owners who have sought assistance in the past would contact the Extension Service, Agricultural Stabilization and Conservation Service, or the Soil Conservation Service.

Of the owners who have sought assistance, 13,500 owners holding 618,100 acres received general forest management assistance (Table 41). Other owners received assistance in timber marking, timber stand improvement, tree planting, timber sales administration, timber evaluation, and other forestry services. It is important to note that these data include services received from all sources including forest industries that employ their own foresters.

Recreation

Two thirds of the private forest-land owners, holding 74 percent of the forest land, permit or participate in some form of recreational use of their land (Table 42). Within this recreational base there are three distinct use categories (Figure 8): (1) The owner, the owner's family or immediate circle of friends use the land for recreation and exclude the general public; (2) The owner, the owner's family, or immediate circle of friends recreate and permit the public to recreate; and (3) The owner, the owner's family or immediate circle of friends do not use the land for recreation but do permit the public to use the land for recreation.

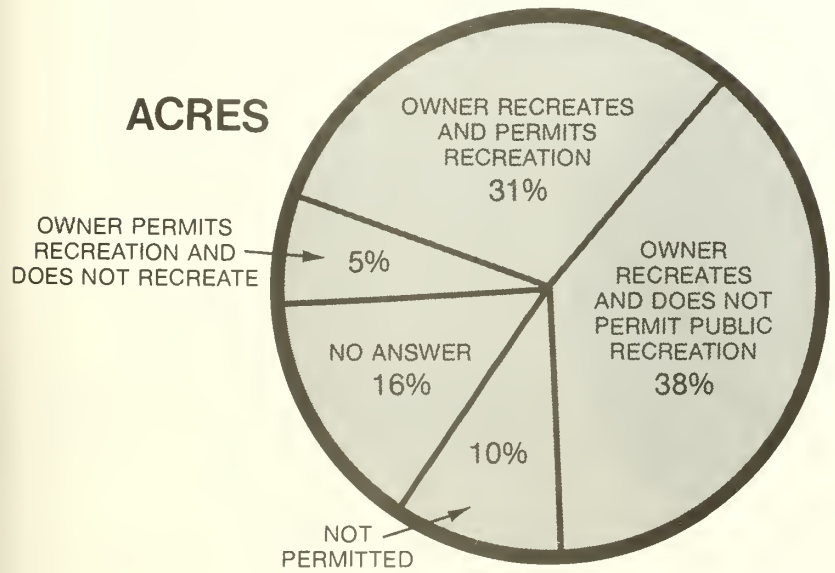

Figure 8.--Distribution of acreage in private ownerships, by availability for recreation.

Recreational use by the owner and the owner's family or immediate circle of friends occurs on the land of 206,200 ownership units with 4,493,700 acres of forest land (Table 43). Hunting is the most frequent form of recreational use on 40 percent of the ownerships with 53 percent of the forest land. Hiking is important on an estimated 108,800 ownerships with 2,602,700 acres of forest land. Picnicking, camping, fishing, and snowmobiling were other recreational uses. Fewer than 20 percent of the owners, their families, or immediate circles of friends use the forest land for these purposes.

An estimated 95,900 ownership units (29 percent) with 2,294,600 acres (35 percent) allow public use of their forest land for recreation (Table 44). Hunting is the most frequent recreational use, permitted by 24 percent of the owners' with 31 percent of the forest land. Hiking is permitted by 10 percent of the landowners holding 17 percent of the forest land. The remaining recreational uses were permitted by fewer than 10 percent of the landowners. Many landowners are apprehensive about permitting picnicking and camping because of possible site degradation.

The amount of forest land available for recreation varies considerably between the different regions in Ohio (Table 45). In general, the more heavily forested Hill Country region has a higher percentage of the forest land available than the more sparsely forested Glaciated region. The forest-land ownerships with more than 500 acres of forest land permit the public to use their land for recreation most frequently (Table 46). Most of the land in these larger ownerships is in the Hill Country region; this is partially responsible for the greater availability of recreation there.

Since hunting was the most frequent recreational use of forest land by the owner, and the use most frequently permitted the public, hunting was allowed by 47 percent of the owners with 59 percent of the forest land (Figure 9). An additional 20 percent of the owners with 17 percent of the land did not respond to the questions. Having forest land unavailable for hunting limits the Ohio Department of Natural Resources, Division of Wildlife, in its management of the wildlife resource.

An estimated 48 percent of the ownership units do not permit public use on their 2,928,900 acres. Only 46 percent of the ownership units that do not allow public use post their land (Table 48). Conversely, the owners of 584,200 acres of forest land post their land but allow some form of public use. The percentage of ownerships that post their land varies considerably from forest survey unit to survey unit but the percentage of forest land posted is fairly uniform between units (Table 49). Ohio law requires written permission for recreational use of private lands, therefore, posting is not required to limit access.

Why do landowners post their land? Many owners post their land to limit or control public access, but that does not necessarily mean that the land is unavailable, as evidenced by the 3,500 ownerships who post and allow some public use of their lands.

An estimated 17,400 ownership units post their land to control hunting. These owners control 405,700 acres of forest land. Other owners post their land to prevent abuse of their property, for safety reasons, or to protect themselves against liability. Landowners that post to protect themselves against liability own larger acreages than owners who post for other reasons.

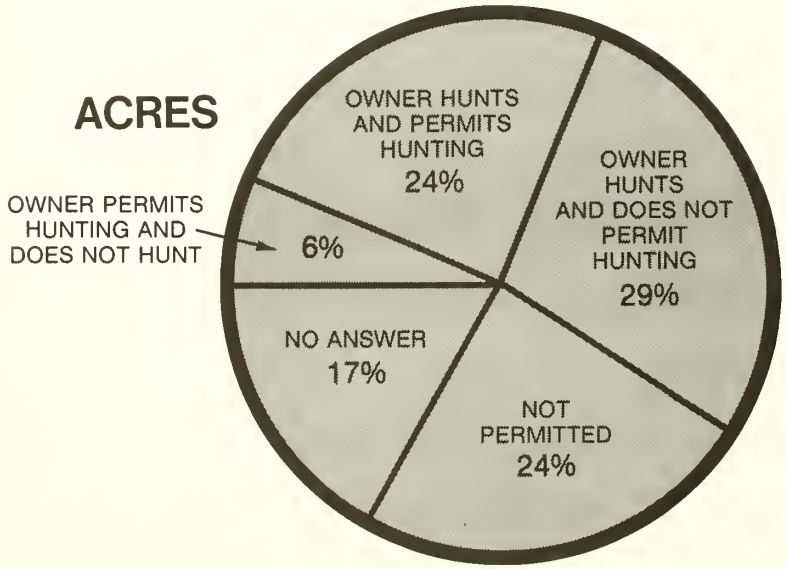

Figure 9.--Distribution of acreage in private ownerships, by availability for hunting.

The group of owners who seem to post heavily are the owners of 50 to 500 acres of forest land (Table 50). Owners of fewer than 50 acres are probably able to control their land without posting. Many owners with more than 500 acres may find controlling access difficult even with posting.

Conclusion

The nonindustrial private forest-land owners usually hold forest lands for reasons other than timber production. Many are turning to their forest land as a source of income and fuelwood. The harvesting of fuelwood may possibly impinge on the supplies of timber available to the forest industries, but this concern is minimized because much more timber is being produced on land controlled by owners who have expressed an interest in timber harvesting than the industry is using.

Forest owners need information on how to achieve their primary objectives for owning forest land. Proper management will optimize production of the products needed by society. The existing delivery system is supplying many owners with the information they need to achieve the spectrum of benefits that forestry has to offer, but many forest-land owners are not seeking or are not being reached by professional foresters.

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Appendix

Study Method

The sampling scheme used in this study was derived from the sampling design used in the forest survey by the Northeastern Station. Resources Evaluation field crews attempted to obtain the correct name and mailing address of the owner of each of the 1,551 privately owned forested field plots in the state. These plots are uniformly distributed within each survey unit. The field crews obtained usable addresses of owners for more than 90 percent of the field plots. A total 1,374 questionnaires were sent to owners of commercial forest land in Ohio; 1,054 (77 percent) were returned with usable information.

The questionnaire was developed from several earlier ownership studies and has been revised as the study has progressed through the Northeastern States. The mailing consisted of the questionnaire and a cover letter that explained the purpose of the survey. Approximately 2 weeks after the first mailing, a postcard was sent to each addressee to remind those who had not responded to return the questionnaire, and to thank those who had returned theirs.

One week later, nonrespondents were mailed a second copy of the questionnaire and the cover letter plus a second letter urging their cooperation. Approximately 1 month later, 706 owners had responded. Then a 100-percent field canvass of nonrespondents was undertaken by personnel of the Ohio Department of Natural Resources, Division of Forestry. This produced an additional 348 usable questionnaires. The 1,054 questionnaires represent 1,125 of the privately owned forested field plots or 73 percent.

The probability that a forest-land owner will be sampled depends on the rate of sampling and the acreage of commercial forest land he owns. Each unit in Ohio had a different rate of sampling. There were also different rates of success in persuading nonrespondents to reply. Both the survey rate of sampling and the success rate of the follow-up affect the probability that an owner will be included in the final tabulation.

The total acreage of commercial forest land in private ownerships was obtained from the forest survey. To calculate the area represented by each plot, the total area of privately owned commercial forest land in each unit was divided by the number of field plots represented by the valid questionnaires.

Since the sampling scheme is essentially the one used for the forest survey, there is a low probability of inclusion for owners of small parcels of forest land. To estimate the total number of persons who own commercial forest land in Ohio, it was necessary to weight the number of owners obtained in the samples. This procedure can be stated as:

$$N = \frac{CFLp}{Nr} \sum \frac{1}{A_1}$$

N = estimated number of private owners in the sampling strata.
CFLp = the acres of commercial forest land in the sampling strata.
Nr = number of respondents in the sampling strata.
A_1 = acres owned by the individual respondents.

The ΣN then equals the estimated number of private owners in the state. This is an unbiased estimate of the total number of persons who own commercial forest land in Ohio.

The data were edited, processed and compiled by computer using FINSYS-2, a generalized computer system (Barnard 1978).

This study encompasses six sampling units. The following tabulation shows the pertinent data for each unit.

Unit	No. of usable questionnaires	No. of survey plots	Average acreage per plot
South-Central	226	244	6,830
Southeastern	199	225	5,008
East-Central	239	265	6,047
Northeastern	207	207	5,805
Southwestern	73	73	6,373
Northwestern	110	111	6,181
All units	1,054	1,125	5,782

Data Accuracy and Reliability

It is important to know the variation associated with estimates contained in this report. Since not every acre and every owner in the state was sampled, the data are estimates. When judging the effectiveness of the estimating procedures we are concerned with two important criteria: first, how accurate is the estimate; and second, how precise or reliable is the estimate. Accuracy is the correspondence between the sample result and the result from a complete count or census using essentially the same definitions and procedure. Reliability is the precision of the statistical estimates. We are chiefly interested in the accuracy of the sample but in most instances we can only measure reliability.

To check the accuracy of the data we had this report reviewed by outside experts. The response level obtained in the study is an attempt to assure accuracy by minimizing nonresponse bias. Beyond the search for accuracy, the reliability of the estimate is given by its sampling error. Sampling errors were calculated for the estimated number of forest-land owners in each cell of the tables. Sampling errors appear in the tables for the most important categories. The sampling error for the number of acres of commercial forest land in private ownership was calculated as part of the forest survey.

Sampling errors provide a means of evaluating survey results; the smaller the sampling error the greater the reliability of the estimate. A statistic with a sampling error of 10 percent is more reliable than one with a sampling error of 20 percent. If an item has a sampling error of 10 percent, chances are 2 out of 3 that an interval constructed to represent a range of 90 to 110 percent of the survey value would contain the true proportion value.

Since the ownership survey was conducted using a land area sample, the estimates of area have smaller sampling errors than the estimates of numbers of owners. Estimates for the state as a whole are more reliable (have the smallest sampling errors); followed by the survey unit estimates.

The inclusion of small forest parcels (fewer than 10 acres) in the study population substantially increases the sampling error for the estimated number of owners.

The sampling errors (in percent) are:

Unit	Private commercial forest land	Owners of private commercial forest land	Owners holding 10 or more acres
South-Central	1.5	16.9	7.9
Southeastern	2.2	19.0	7.8
East-Central	2.1	14.5	7.2
Northeastern	2.9	13.5	6.6
Southwestern	5.6	14.0	11.3
Northwestern	4.7	10.0	7.8
Total	1.1	6.5	3.2

Definition of Terms

Average annual net growth of growing stock. The change (resulting from natural causes) in volume of sound wood in sawtimber and poletimber trees during the period between surveys, divided by the length of the period. Components of annual net growth of growing stock include the increment in net volume of trees present at the beginning of the period minus cull increment (the net volume of trees that became rough or rotten during the period).

Board foot. A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick or its equivalent. By Forest Inventory and Analysis convention, softwoods less than 9.0 inches in dbh and hardwoods less than 11.0 inches in dbh do not contain board-foot volume.

Clearcutting. The method of regenerating timber in which the area is cut clear in the literal sense of the word; virtually all the trees, large and small, are removed. The term is often erroneously applied to any type of cutting in which all the merchantable timber is removed.

Commercial forest land. Forest land that is producing or capable of producing crops of industrial wood (more than 20 ft^3/acre/year) and that is not withdrawn from timber utilization. (Industrial wood is all roundwood products except fuelwood.)

Diameter limit. The method of regenerating timber in which all trees above a specified diameter are removed.

Forest industries. Companies or individuals operating wood-using plants.

Forest land. Land that is at least 16.7 percent stocked (contains at least 7.5 ft^2 per acre of basal area) by forest trees of any size, or that formerly had such tree cover and is not currently developed for nonforest use. (Forest trees are woody plants that have a well-developed stem and usually are more than 12 feet in height at maturity.) The minimum area for classification of forest land is 1 acre.

Growing-stock trees. Live trees of commercial species that are classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees.

Growing-stock volume. Net volume, in ft^3, of growing-stock trees that are 5.0 inches in dbh or larger, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Private commercial forest land. All commercial forest land other than that owned by federal, state, or local governments or their agencies.

Pulpwood. Any log from which woodpulp is to be made; usually measured in bolts of 4, 5, or 8 feet, and somewhat smaller in diameter than sawlogs or veneer logs.

Sawtimber trees. Live trees of commercial species that are (a) at least 9.0 inches in dbh for softwoods or 11.0 inches for hardwoods, and (b) that contain at least one 12-foot or two noncontiguous 8-foot merchantable sawlogs, and that meet regional specifications for freedom from defect.

Sawtimber volume. Net volume in board feet, International 1/4-inch rule, of merchantable sawlogs in live sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Selection system. The method of regenerating timber in which trees of all sizes are harvested. However, in practice, frequently only the oldest or largest trees in a stand are harvested. Trees are taken singly or in small groups, but the entire stand is never cleared completely in a single operation.

Softwoods. Coniferous trees, usually evergreen, with needles or scalelike leaves.

Stand. A growth of trees on forest land.

Timber removals. The volume of growing-stock or sawtimber trees harvested or killed in logging or in cultural operations such as timber stand improvement, land clearing, or changes in land use.

Timber salvage. Removals of down, damaged, or diseased trees.

Veneer log. Any log from which veneer is to be made, by peeling (rotary cutting) or slicing.

NE FOREST EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE

OMB 40-R-3941

NORTHEASTERN WOODLAND OWNERSHIP STUDY

State _____

County _____

Plot _____

Please complete the following question to the best of your knowledge. Where actual data are not available please use your best estimate. Please be assured your answers will be held strictly confidential. If you do not now own woodland, please answer questions 1 and 2 and return the questionnaire.

1. How much land do you now own? (Include woodlands, pasture, cropland, etc., but exclude individual house lots.) Acres_____

2. Of all of the land you own how much is woodland? Acres _____or percent _____.

3. Is all of the woodland you own in one state?

   Yes _____ What state ? _____

   No _____ My woodlands are in more than one state as follows:

   _____ acres in _____ (state)

   _____ acres in _____ (state)

   _____ acres in _____ (state)

   _____ acres in _____ (state)

4. How many individual tracts or parcels of woodland do you own? Number _____

5. In what year did you first acquire woodland? Year _____

6. How did you acquire the major portion of the woodland you now own?

Purchase	1.	_____
Inheritance	2.	_____
Other	3.	_____

7. In which one of the following ownership categories does the major portion of your woodland holdings fall? (Please check only one.)

	Check one
Individual (include husband and wife)	1. _____
Joint ownership	2. _____
Undivided estate	3. _____
Partnership	4. _____
Corporation	5. _____
Club or association	6. _____
Other	7. _____

8. If the ownership is a partnership, corporation, club, or association, what is the nature of the business or organization? Or, if woodland is part of an active farm, write in the word "farm" in the space below.

_____

Please indicate the title of the person completing this questionnaire.

---

9. What is the approximate road mileage from your home to your nearest and furthest tract of woodland? (For businesses or organizations consider "home" to mean place of business, or location of headquarters of the organization.)

Miles to the nearest tract (enter zero if you live on the tract). _____

Miles to the furthest tract. _____

10. How many times have you or your representative visited your nearest and furthest tract of woodland in the last 12 months?

Number of visits to the nearest tract _____

Number of visits to the furthest tract _____

11. Have you ever harvested timber or cleared trees from your land?

Yes 1. _____ No. 2. _____

NOTE: IF YOU HAVE NEVER HARVESTED TIMBER OR CLEARED TREES FROM YOUR WOODLAND SKIP TO QUESTION 19 PAGE 5

12. In what year did the most recent timber harvest take place? _____

13. What percent of your woodland was involved in the most recent timber harvest? _____

14. What products were harvested? (Check as many as apply.)

	Check		Check
Sawlogs	1. _____	Mine timbers	6. _____
Veneer logs or bolts	2. _____	Christmas Trees	7. _____
Pulpwood	3. _____	Other (please specify)_____	8. _____
Turnery bolts	4. _____	Don't know what products were harvested	9. _____
Posts, poles, or piling	5. _____		

15. Please indicate amounts of products harvested.

Product	Amount	Unit of measure
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

16. Who selected the area or trees to be harvested?

	Check one
1. Landowner	_____
2. Forester	_____
3. Friend or neighbor	_____
4. Timber buyer or logger	_____
5. Combination of _____ and _____	_____

17. How were your trees selected for harvesting?

	Check one
Selection (only preselected marked trees were removed).	1._____
Diameter limit (only trees over a minimum diameter were removed). Please indicate minimum diameter _____	2._____
Clearcutting (most or all of the trees on a given area were removed).	3._____
Land clearing (trees were harvested incidental to clearing the land for a use other than woodland).	4._____
Other (please specify) _____	5._____
Combination of _____ and _____	6._____
Don't know method used.	7._____

18. Why did you harvest timber at the time that you did? (Check only the one reason you consider most important.)

	Check one
Felt timber was mature	1. _____
Offered a good price	2. _____
Land clearing	3. _____
Needed money	4. _____
Needed timber for own use	5. _____
Timber harvest for company use (industry only)	6. _____
Timber salvage	7. _____
Cultural treatment	8. _____
Other _____	9. _____

19. If you have never harvested timber or trees from your land, why not? (Please check only the reason you consider most important).

		Check one
Woodland immature - timber too small	1.	_____
No market for timber	2.	_____
Price offered or prevailing market price too low	3.	_____
Value of land for hunting would be destroyed	4.	_____
Selling or plan to sell the land	5.	_____
Scenery would be destroyed	6.	_____
Land tied up in estate	7.	_____
Distrust of loggers	8.	_____
Opposed to timber harvesting	9.	_____
Poor quality timber	10.	_____
Not enough volume	11.	_____
Logging would create a fire hazard	12.	_____
Insufficient area to harvest	13.	_____
Other (please specify) _____	14.	_____

20. Do you plan to harvest timber from your woodland in:

		Check one
Next 5 years	1.	_____
5 to 10 years	2.	_____
Possibly at some future date	3.	_____
Never plan to harvest	4.	_____

21. What percent, if any, of your woodland do you feel you would never harvest timber from? _____ %

22. Have you ever sought the assistance of a forester for advice or help in managing you woodland?

Yes _____ Please indicate the nature of assistance _____

_____

No. _____

23. What office, agency, or individual would you contact for forestry assistance? (If you don't know, please write in "don't know.")

_____

24. Why do you own woodland? (Please rank in order of importance those items that are applicable, with number 1 the most important.)

	Rank
Land investment (hope to sell all or part of my woodland at a profit).	____
Recreation (hunting, camping, fishing, etc.).	____
Timber production (growing timber or other forest products for sale).	____
Farm or domestic use (source of forest products for own use, i.e., firewood, fence posts, etc.).	____
Esthetic enjoyment (the desire to have woodland and "green space" around my home).	____
Part of the farm (the woodland is part of the farm but serves no useful function in the farm operation).	____
Part of my residence.	____
Other (please specify) _____	____

25. Which of the following do you feel were the most important benefits you derived from your woodland in the last 5 years? (Please rank in order or importance those items that are applicable, with number 1 the most important.)

	Rank
Increase in land value (investment).	____
Recreation (hunting, fishing, camping, etc.).	____
Income from the sale of timber.	____
Esthetic enjoyment (just enjoy woodland, wildlife, and the general satisfaction of owning "green space").	____
Farm and domestic use.	____
Other (please specify) _____	____

26. Which of the following do you feel will be the most important benefits you expect to derive from your woodland in the next 5 years? (Please rank in order of importance those items that are applicable, with number 1 the most important.)

	Rank
Increase in land value (investment).	____
Recreation (hunting, camping, etc.).	____
Income from sale of timber.	____
Esthetic enjoyment (just enjoy woodland, wildlife, and the general satisfaction of owning "green space").	____
Farm or domestic use.	____
Other (please specify)	____

27. Do you, your family, or immediate circle of friends use your woodland for any of the following?

		Check
Hiking	1.	____
Picnicking	2.	____
Camping	3.	____
Fishing (check only if fishing is available)	4.	____
Hunting	5.	____
Snowmobiling	6.	____
Other (pleas specify) _____	7.	____

28. Is the general public, other than your family and immediate circle of friends, permitted to use your woodland for any of the following?

		Check
Public use not permitted	1.	____
Public use permitted:		
Hiking	2.	____
Picnicking	3.	____
Camping	4.	____
Fishing (check only if fishing is available)	5.	____
Hunting	6.	____
Snowmobiling	7.	____
Other (please specify) _____	8.	____

29. Is your land posted?

No _____, go to next question.

Yes_____, why is it posted?_____

30. Have you been approached to sell all or part of your woodland in the last five years?

Timber only	1. Yes ____	2. No. ____
Land only	3. Yes ____	4. No. ____
Land and timber	5. Yes ____	6. No. ____

The following questions are asked to classify responses on the basis of information about the owner personally. Again, we would remind you that the answers to these questions, and to any other questions on this questionnaire are strictly confidential. All answers will be compiled in such a manner that it will be impossible to identify any individual reply.

These questions do not pertain to and should not be answered by corporations and organizations.

31. Are you an active member of any of the following organizations? (Please check those you are a member of.)

	Check	
1.	_____	American Forestry Association
2.	_____	Ohio Forestry Association
3.	_____	Pennsylvania Forestry Association
4.	_____	New York Forest Owners Association
5.	_____	Adirondack Mountain Club
6.	_____	Isaak Walton League
7.	_____	Audubon Society
8.	_____	Natural History Society
9.	_____	National Wildlife Federation
10.	_____	A Sportsman's Club: _____
11.	_____	A Garden Club: _____
12.	_____	National Farmer's Organization
13.	_____	The Grange
14.	_____	The American Tree Farm Program
15.	_____	The Sierra Club
16.	_____	League of Ohio Sportsmen
17.	_____	Nature Conservancy
18.	_____	Ohio Conservation Congress
19.	_____	National Rifle Association
20.	_____	Soil Conservation District
21.	_____	Any other organizations similar to those listed above (Please specify) _____
22.	_____	No, I don't hold membership in any of the above.

32. Do you or any member of your household subscribe to any of the following magazines? (Please check those that apply.)

	Check	
1.	_____	Tree Farm News
2.	_____	American Forests
3.	_____	National Wildlife
4.	_____	Forest Farmer
5.	_____	Ohio Woodlands
6.	_____	Pennsylvania Forests
7.	_____	Pennsylvania Game News
8.	_____	Audubon Magazine
9.	_____	National Parks and Recreation
10.	_____	Field and Stream
11.	_____	Sports Afield
12.	_____	Outdoor Life
13.	_____	Agway Cooperator
14.	_____	Ranger Rick Nature Magazine
15.	_____	Our Heritage
16.	_____	Forests and People
17.	_____	Ohio Farmer
18.	_____	Adirondac
19.	_____	The Conservationist
20.	_____	Progressive Farmer
21.	_____	Any other magazine similar to those listed above (Please specify) _____
22.	_____	No, I don't subscribe to any of the above magazines.

33. Please indicate, by circling the letter, whether you agree or disagree with each of the following statements made by other forest landowners. If you feel you don't know or have no opinion on the statement, please circle letter "E", the "don't know" column.

A	B	C	D	E	F	G	H	I	
Very Strongly Agree	Strongly Agree	Agree	Slightly Agree	Don't Know or Neutral	Slightly Disagree	Disagree	Strongly Disagree	Very Strongly Disagree	
A	B	C	D	E	F	G	H	I	a. Conservation means that natural resources should be used wisely.
A	B	C	D	E	F	G	H	I	b. Like any crop the forest needs to be given attention. It needs to be cut when ready and to be given care when needed.
A	B	C	D	E	F	G	H	I	c. Just thinking about our woodland and having it there is nice.
A	B	C	D	E	F	G	H	I	d. Holding on to our forests will become more and more difficult with each succeeding generation.
A	B	C	D	E	F	G	H	I	e. I like the beauty of the forest land the most; we must preserve, not damage it.
A	B	C	D	E	F	G	H	I	f. I can't afford to buy forest land just for hunting and recreation purposes. I need to get more out of it than that.
A	B	C	D	E	F	G	H	I	g. I purchased my forest land primarily for investment to leave it alone and sell later.
A	B	C	D	E	F	G	H	I	h. I suppose I should harvest mature trees; I'd prefer to get the bad ones out, and perhaps cut some posts and firewood.
A	B	C	D	E	F	G	H	I	i. I'd only sell timber if it would definitely improve the forest for wildlife.
A	B	C	D	E	F	G	H	I	j. The country is being denuded; one must do something to preserve the forest land.
A	B	C	D	E	F	G	H	I	k. The biggest management problem is too much conservation.
A	B	C	D	E	F	G	H	I	l. I'm not interested in the least in management for wood production.
A	B	C	D	E	F	G	H	I	m. It is reassuring to know that there is money in my forest in the form of trees in case of emergency.
A	B	C	D	E	F	G	H	I	n. Wildlife isn't really a major factor in the increase or decrease of land value.
A	B	C	D	E	F	G	H	I	o. This forest land is more of a liability; it's not worth keeping in it's present state.
A	B	C	D	E	F	G	H	I	p. Taking out trees destroys the beauty of the forest land.

If the woodland is owned by more than one person, the following questions should be answered for the person to whom the questionnaire is addressed

34. During the first 12 years of the owner's life where did he live most of the time?

	Check one
In a city with a population of 100,000 or more	1. _____
In a city with a population of 10,000 to 99,999	2. _____
In a town or city with a population of less that 10,000	3. _____
In a rural area	4. _____
On a farm	5. _____

35. What is the sex of the owner?

Male _____ Female _____

36. What is the age of the owner?

	Check one
Under 25	1. _____
25-44	2. _____
45-64	3. _____
65 and over	4. _____

37. How many years of formal education has the owner completed?

		Check one
Grades 1 - 8	1.	_____
Grades 9 - 12	2.	_____
Has some schooling beyond high school (business technical school, or some college)	3.	_____
Has a bachelor's degree or equivalent	4.	_____
Has some graduate work	5.	_____
Holds a master's degree	6.	_____
Holds a doctoral degree	7.	_____

38. What is the primary occupation of the owner? _____

39. In which category would the owner's personal gross income from all sources fall?

		Check one
Less than $10,000	1.	_____
$10,000 to $14,999	2.	_____
$15,000 to $19,999	3.	_____
$20,000 to $24,999	4.	_____
$25,000 to $29,999	5.	_____
$30,000 or more	6.	_____

40. Comments?

Index to Tables

Table 1.-Estimated number of private ownership units and acres of commercial forest land owned by size class and geographic unit, Ohio, 1979

Size class	South-Central		Southeastern		East-Central		Northeastern	
Acres	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
1-9	55,300	69	15,600	47	25,200	44	55,100	62
10-19	8,400	10	3,700	11	11,600	20	14,700	17
20-49	9,600	12	8,700	26	12,500	22	14,200	16
50-99	3,800	5	3,200	10	6,000	10	3,100	4
100-199	2,200	3	1,500	5	1,600	3	1,000	1
200-499	500	1	400	1	700	1	200	W
500+	100	W	100	W	100	W	W	W
Total	79,900	100	33,200	100	57,700	100	88,300	100
				ACRES OWNED				
1-9	129,000	9	51,700	5	89,600	6	188,400	16
10-19	111,400	8	46,600	4	140,800	9	188,400	16
20-49	287,200	20	274,100	24	390,300	24	405,700	34
50-99	252,000	18	212,000	19	364,800	23	194,300	16
100-199	275,500	19	201,700	18	211,200	13	125,700	10
200-499	140,600	10	118,900	10	172,800	11	51,600	4
500+	226,900	16	221,800	20	233,000	14	47,500	4
Total	1,422,600	100	1,126,800	100	1,602,500	100	1,201,600	100

Table 1.-continued

Size class	Southwestern		Northwestern		Total		Sampling error
Acres	Number	Percent	Number	Percent	Number	Percent	Percent
			OWNERS				
1-9	16,200	52	16,500	39	183,900	55	12
10-19	8,300	26	13,300	32	60,000	18	8
20-49	5,100	16	10,500	25	60,600	18	5
50-99	1,400	5	1,500	4	19,000	6	6
100-199	400	1	100	W	6,800	2	8
200-499	100	W	100	W	2,000	1	10
500+	-	-	W	W	300	W	14
Total	31,500	100	42,000	100	332,600	100	6.5
			ACRES OWNED				
1-9	70,100	15	81,100	12	609,900	9	
10-19	95,600	21	156,000	23	738,800	11	
20-49	140,200	30	305,600	44	1,803,100	28	
50-99	89,300	19	93,500	13	1,205,900	19	
100-199	51,000	11	18,700	3	883,800	14	
200-499	19,100	4	18,700	3	521,700	8	
500+	-	-	12,500	2	741,700	11	
Total	465,300	100	686,100	100	6,504,900	100	

W-Fewer than 50 owners or less than 0.5 percent.

Table 2.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest, Ohio, 1979

Ownership class	1 - 10 years	Indefinite	Never	No answer	Total
		OWNERS			
Forest industry	100	100	-	-	200
Farmer	28,700	56,700	49,300	11,200	145,900
Miscellaneous:					
Individual	12,600	88,700	67,800	3,900	173,000
Corporate	1,600	900	1,000	200	3,700
Other	400	4,000	5,000	400	9,800
Total private	43,400	150,400	123,100	15,700	332,600
		ACRES OWNED			
Forest industry	167,900	18,400	-	-	186,300
Farmer	641,200	1,518,500	596,900	132,300	2,888,900
Miscellaneous:					
Individual	451,800	1,354,600	706,400	97,600	2,610,400
Corporate	342,600	113,300	62,100	11,400	529,400
Other	62,600	104,700	90,200	32,400	289,900
Total private	1,666,100	3,109,500	1,455,600	273,700	6,504,900

Table 3.-Estimated number of private ownership units and acres of commercial forest land owned, by form of ownership, percent of harvesters, percent of acres owned by harvesters, and geographic unit, Ohio, 1979

Form of ownership	All private owners		Acres owned		Harvesters	Acres owned by harvesters
	Number	Percent	Number	Percent	Percent	Percent
			SOUTH CENTRAL			
Individual	76,000	95	1,138,600	80	35	45
Corporation	500	1	168,500	12	W	11
Other	3,400	4	115,500	8	1	5
Total	79,900	100	1,422,600	100	36	61
			SOUTHEASTERN			
Individual	24,600	74	817,100	73	26	36
Corporation	500	2	183,700	16	1	14
Other	8,100	24	126,000	11	24	8
Total	33,200	100	1,126,800	100	51	58
			EAST-CENTRAL			
Individual	54,600	95	1,235,100	77	39	40
Corporation	700	1	239,400	15	1	14
Other	2,400	4	128,000	8	1	2
Total	57,700	100	1,602,500	100	41	56
			NORTHEASTERN			
Individual	81,000	92	942,800	78	42	37
Corporation	1,100	1	116,100	10	W	6
Other	6,200	7	142,700	12	1	5
Total	88,300	100	1,201,600	100	43	48
			SOUTHWESTERN			
Individual	29,400	93	420,700	90	38	47
Corporation	1,400	5	31,900	7	4	5
Other	700	2	12,700	3	-	-
Total	31,500	100	465,300	100	42	52
			NORTHWESTERN			
Individual	39,600	94	605,100	88	48	50
Corporation	300	1	24,900	4	1	2
Other	2,100	5	56,100	8	3	3
Total	42,000	100	686,100	100	52	55
			TOTAL			
Individual	305,200	92	5,159,400	79	38	41
Corporation	4,500	1	764,500	12	1	10
Other	22,900	7	581,000	9	4	5
Total	332,600	100	6,504,900	100	43	56

W-Fewer than 50 owners or less than 0.5 percent.

Table 4.-Estimated number of private ownership units and acres of commercial forest land owned, by size class and form of ownership, Ohio, 1979

Size class (acres)	Individual		Other		Total	
	Number	Percent	Number	Percent	Number	Percent
			OWNERS			
1-9	169,800	56	14,100	51	183,900	55
10-19	57,100	19	2,900	11	60,000	18
20-49	54,800	18	5,800	21	60,600	18
50-99	16,400	5	2,600	9	19,000	6
100-199	5,500	2	1,300	5	6,800	2
200-499	1,500	W	500	2	2,000	1
500+	100	W	200	1	300	W
Total	305,200	100	27,400	100	332,600	100
			ACRES OWNED			
1-9	558,800	11	51,100	4	609,900	9
10-19	702,300	14	36,500	3	738,800	11
20-49	1,626,600	31	176,500	13	1,803,100	28
50-99	1,044,600	20	161,300	12	1,205,900	19
100-199	708,900	14	174,900	13	883,800	14
200-499	379,000	7	142,700	10	521,700	8
500+	139,200	3	602,500	45	741,700	11
Total	5,159,400	100	1,345,500	100	6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 5.-Estimated number of business ownership units and acres of commercial forest land owned, by incorporated and unincorporated businesses, Ohio, 1979

Nature of business	Incorporated				Unincorporated			
	Number	Percent	Acres	Percent	Number	Percent	Acres	Percent
Real estate	1,400	31	69,400	9	400	W	29,600	1
Forest industry	W	W	151,200	20	200	W	35,100	1
Other industry	1,200	27	308,900	40	100	W	26,800	W
Nonindustrial business	400	9	54,800	7	100	W	5,700	W
Farm	800	18	83,900	11	145,100	44	2,805,000	49
Sport/recreation club	100	2	5,700	1	W	W	23,100	W
Public utility	W	W	85,000	11	-		-	
Other	600	13	5,600	1	182,200	56	2,815,100	49
Total	4,500	100	764,500	100	328,100	100	5,740,400	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 6.--Estimated number of individual owners and acres of commercial forest land owned by occupation and geographic unit, Ohio, 1979

Occupation	South-Central		Southeastern		East-Central		Northeastern	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
Professional	5,000	7	700	3	3,300	6	4,500	5
Executive	900	1	1,700	7	9,000	16	2,900	4
Retired	27,100	36	8,200	33	8,600	16	10,500	13
White collar	6,800	9	900	4	2,900	5	4,200	5
Skilled laborer	4,500	6	1,200	5	2,100	4	5,900	7
Unskilled laborer	1,800	2	3,800	15	6,900	13	4,800	6
Housewife	1,400	2	400	2	500	1	7,300	9
Farmer	6,500	8	2,000	8	3,900	7	15,100	19
Other	100	W	200	1	-		-	
No Answer	21,900	29	5,500	22	17,400	32	25,800	32
Total	76,000	100	24,600	100	54,600	100	81,000	100
				ACRES OWNED				
Professional	117,000	10	62,000	7	114,900	9	62,600	7
Executive	66,000	6	46,400	6	89,400	7	74,000	8
Retired	280,700	25	201,300	24	229,900	19	142,300	15
White collar	99,400	9	41,300	5	63,900	5	56,900	6
Skilled laborer	81,900	7	67,100	8	63,900	5	62,600	7
Unskilled laborer	70,200	6	103,200	13	140,500	11	62,600	7
Housewife	46,800	4	31,000	4	38,300	3	45,500	4
Farmer	233,900	20	82,600	10	166,000	14	170,800	18
Other	5,800	1	5,200	1	-		-	
No Answer	136,900	12	177,000	22	328,300	27	265,500	28
Total	1,138,600	100	817,100	100	1,235,100	100	942,800	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 6.--continued

Occupation	Southwestern		Northwestern		Total		Sampling error
	Number	Percent	Number	Percent	Number	Percent	Percent
			OWNERS				
Professional	2,900	10	2,200	6	18,600	6	20
Executive	3,800	13	4,800	12	23,100	7	31
Retired	1,700	6	7,200	18	63,300	21	19
White collar	900	3	1,600	4	17,300	6	20
Skilled laborer	1,500	5	2,500	6	17,700	6	25
Unskilled laborer	900	3	2,800	7	21,000	7	21
Housewife	800	3	2,400	6	12,800	4	48
Farmer	4,500	15	9,800	25	41,800	14	17
Other	-		-		300	W	74
No Answer	12,400	42	6,300	16	89,300	29	15
Total	29,400	100	39,600	100	305,200	100	7
			ACRES OWNED				
Professional	44,500	11	37,400	6	438,400	8	
Executive	57,300	14	68,500	11	401,600	8	
Retired	63,600	15	130,800	22	1,048,600	20	
White collar	19,100	4	24,900	4	305,500	6	
Skilled laborer	12,700	3	43,600	7	331,800	7	
Unskilled laborer	12,700	3	31,200	5	420,400	8	
Housewife	19,100	4	18,700	3	199,400	4	
Farmer	108,100	26	155,700	26	917,100	18	
Other	-		-		11,000	W	
No Answer	83,600	20	94,300	16	1,085,600	21	
Total	420,700	100	605,100	100	5,159,400	100	

W-Fewer than 50 owners or less than 0.5 percent.

Table 7.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest, and occupation, Ohio 1979

Occupation	1 - 10 years	Indefinite	Never	No answer	Total
		OWNERS			
Professional	2,900	7,400	7,800	500	18,600
Executive	3,200	7,900	10,500	1,500	23,100
Retired	6,800	32,600	22,200	1,700	63,300
White collar	500	11,600	5,000	200	17,300
Skilled laborer	2,200	8,200	6,900	400	17,700
Unskilled laborer	2,500	7,600	10,100	800	21,000
Housewife	300	2,600	9,700	200	12,800
Farmer	13,400	20,400	6,700	1,300	41,800
Other	-	300	-	-	300
No Answer	8,000	43,700	34,600	3,000	89,300
All individuals	39,800	142,300	113,500	9,600	305,200
All others	3,600	8,100	9,600	6,100	27,400
Total	43,400	150,400	123,100	15,700	332,600
		ACRES OWNED			
Professional	106,000	231,200	89,100	12,100	438,400
Executive	118,900	192,700	71,700	18,300	401,600
Retired	164,200	553,600	276,500	54,300	1,048,600
White collar	27,700	195,400	76,700	5,700	305,500
Skilled laborer	47,100	189,600	83,000	12,100	331,800
Unskilled laborer	82,400	215,600	110,300	12,100	420,400
Housewife	22,400	107,300	57,900	11,800	199,400
Farmer	286,700	478,500	114,100	37,800	917,100
Other	-	11,000	-	-	11,000
No Answer	152,700	514,700	364,700	53,500	1,085,600
All individuals	1,008,100	2,689,600	1,244,000	217,700	5,159,400
All others	658,000	419,900	211,600	56,000	1,345,500
Total	1,666,100	3,109,500	1,455,600	273,700	6,504,900

Table 8.-Estimated number of individual owners and acres of commercial forest land owned, by age class and geographic unit, Ohio, 1979

Age class (years)	Individual owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
			SOUTH-CENTRAL		
Under 45	13,400	18	29	269,000	23
45 - 64	14,500	19	41	416,900	37
65+	31,700	42	30	350,900	31
No answer	16,400	21	45	101,800	9
Total	76,000	100	18	1,138,600	100
			SOUTHEASTERN		
Under 45	4,800	20	37	123,800	15
45 - 64	7,400	30	21	340,700	42
65+	9,200	37	33	232,200	28
No answer	3,200	13	29	120,400	15
Total	24,600	100	15	817,100	100
			EAST-CENTRAL		
Under 45	7,600	14	30	166,000	14
45 - 64	23,400	43	30	523,600	42
65+	13,400	24	31	306,500	25
No answer	10,200	19	30	239,000	19
Total	54,600	100	15	1,235,100	100
			NORTHEASTERN		
Under 45	8,300	10	32	130,900	14
45 - 64	25,000	31	17	381,400	40
65+	17,800	22	46	176,500	19
No answer	29,900	37	29	254,000	27
Total	81,000	100	15	942,800	100
			SOUTHWESTERN		
Under 45	4,800	16	32	82,700	20
45 - 64	9,300	32	25	159,000	38
65+	6,300	21	38	114,500	27
No answer	9,000	31	43	64,500	15
Total	29,400	100	15	420,700	100
			NORTHWESTERN		
Under 45	11,300	29	29	118,300	20
45 - 64	15,500	39	20	249,100	41
65+	10,000	25	26	174,400	29
No answer	2,800	7	38	63,300	10
Total	39,600	100	11	605,100	100
			TOTAL		
Under 45	50,200	17	13	890,700	17
45 - 64	95,100	31	12	2,070,700	40
65+	88,400	29	16	1,355,000	26
No answer	71,500	23	18	843,000	17
Total	305,200	100	7	5,159,400	100

Table 9.-Estimated number of individual owners and acres of commercial forest land owned, by years of formal education, Ohio, 1979

Education level	Individual owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
0-8 years	60,300	20	19	735,900	14
9-12 years	90,000	29	13	1,694,900	33
1-4 years of college	63,800	21	13	1,341,100	26
More than 4 years of college	11,700	4	22	425,500	8
No answer	79,400	26	16	962,000	19
Total	305,200	100	7	5,159,400	100

Table 10.-Estimated number of individual owners and acres of commercial forest land owned, by annual income class and geographic unit, Ohio, 1979

Income class	Individual owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
			SOUTH-CENTRAL		
Under $10,000	23,600	31	31	315,800	28
$10,000-$14,999	5,000	7	34	111,100	10
$15,000-$19,999	3,100	4	50	99,400	9
$20,000-$24,999	5,700	7	54	117,000	10
$25,000-$29,999	2,000	3	33	76,000	6
$30,000+	2,200	3	38	124,500	11
No answer	34,400	45	33	294,800	26
Total	76,000	100	18	1,138,600	100
			SOUTHEASTERN		
Under $10,000	10,900	44	30	206,500	25
$10,000-$14,999	2,700	11	31	129,000	16
$15,000-$19,999	2,700	11	50	103,200	13
$20,000-$24,999	1,900	8	69	36,100	4
$25,000-$29,999	600	3	45	41,300	5
$30,000+	800	3	38	67,100	8
No answer	5,000	20	20	233,900	29
Total	24,600	100	15	817,100	100
			EAST-CENTRAL		
Under $10,000	8,900	16	25	255,400	21
$10,000-$14,999	7,000	13	30	146,900	12
$15,000-$19,999	3,400	6	31	115,000	9
$20,000-$24,999	2,100	4	28	102,100	9
$25,000-$29,999	2,300	4	44	63,900	5
$30,000+	1,600	3	31	115,000	9
No answer	29,300	54	28	436,800	35
Total	54,600	100	15	1,235,100	100

Table 10.-continued

Income class	Individual owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
			NORTHEASTERN		
Under $10,000	20,300	25	41	165,100	17
$10,000-$14,999	6,300	8	36	108,200	11
$15,000-$19,999	6,400	8	32	119,500	13
$20,000-$24,999	3,400	4	58	62,600	7
$25,000-$29,999	2,800	3	70	28,500	3
$30,000+	11,400	14	51	130,900	14
No answer	30,400	38	22	328,000	35
Total	81,000	100	15	942,800	100
			SOUTHWESTERN		
Under $10,000	2,300	8	51	44,500	10
$10,000-$14,999	2,500	9	38	63,600	15
$15,000-$19,999	1,600	5	59	31,800	8
$20,000-$24,999	4,200	14	38	57,300	14
$25,000-$29,999	700	2	79	12,700	3
$30,000+	3,800	13	34	76,300	18
No answer	14,300	49	32	134,500	32
Total	29,400	100	15	420,700	100
			NORTHWESTERN		
Under $10,000	6,100	15	40	74,700	12
$10,000-$14,999	3,500	9	34	74,700	12
$15,000-$19,999	3,500	9	41	68,500	12
$20,000-$24,999	7,500	19	30	87,200	15
$25,000-$29,999	2,100	5	39	56,000	9
$30,000+	3,000	8	41	68,500	11
No answer	13,900	35	26	175,500	29
Total	39,600	100	11	605,100	100
			TOTAL		
Under $10,000	72,100	24	17	1,062,000	21
$10,000-$14,999	27,000	9	14	633,500	12
$15,000-$19,999	20,700	7	17	537,400	11
$20,000-$24,999	24,800	8	19	462,300	9
$25,000-$29,999	10,500	3	24	278,400	5
$30,000+	22,800	7	27	582,300	11
No answer	127,300	42	13	1,603,500	31
Total	305,200	100	7	5,159,400	100

Table 11.-Estimated number of individual owners and acres of commercial forest land owned, by early life environment[a], and geographic unit, Ohio, 1979

Early life environment	Individual owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
		SOUTH-CENTRAL			
City over 100,000	2,900	4	43	58,500	5
City 10,000-99,999	1,300	2	37	76,100	7
Town or city under 10,000	3,200	4	48	93,600	8
Rural area	24,500	32	38	200,500	18
On a farm	26,300	35	27	561,400	49
No answer	17,800	23	42	148,500	13
Total	76,000	100	18	1,138,600	100
		SOUTHEASTERN			
City over 100,000	800	3	43	51,600	6
City 10,000-99,999	1,100	4	34	67,100	8
Town or city under 10,000	1,400	6	35	87,700	11
Rural area	5,300	22	37	129,000	16
On a farm	11,400	46	26	351,000	43
No answer	4,600	19	34	130,700	16
Total	24,600	100	15	817,100	100
		EAST-CENTRAL			
City over 100,000	2,000	4	57	38,300	3
City 10,000-99,999	2,500	5	45	108,600	9
Town or city under 10,000	11,200	20	63	121,300	10
Rural area	7,600	14	21	204,300	17
On a farm	19,800	36	19	498,000	40
No answer	11,500	21	28	264,600	21
Total	54,600	100	15	1,235,100	100
		NORTHEASTERN			
City over 100,000	4,800	6	29	113,900	12
City 10,000-99,999	10,600	13	56	85,400	9
Town or city under 10,000	2,500	3	55	45,600	5
Rural area	8,500	11	35	113,800	12
On a farm	24,700	30	27	307,400	33
No answer	29,900	37	29	276,700	29
Total	81,000	100	15	942,800	100
		SOUTHWESTERN			
City over 100,000	1,600	5	54	31,800	7
City 10,000-99,999	600	2	58	25,400	6
Town or city under 10,000	3,500	12	50	44,500	11
Rural area	3,500	12	33	76,400	18
On a farm	9,000	31	22	171,800	41
No answer	11,200	38	39	70,800	17
Total	29,400	100	15	420,700	100

Table 11.-continued

Early life environment	Individual owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
			NORTHWESTERN		
City over 100,000	200	1	99	6,200	1
City 10,000-99,999	1,200	3	53	31,100	5
Town or city under 10,000	3,300	8	45	62,300	10
Rural area	7,100	18	37	87,200	14
On a farm	21,700	55	16	317,600	53
No answer	6,100	15	39	100,700	17
Total	39,600	100	11	605,100	100
			TOTAL		
City over 100,000	12,300	4	19	300,300	6
City 10,000-99,999	17,300	6	36	393,700	7
Town or city under 10,000	25,100	8	31	455,000	9
Rural area	56,500	18	19	811,200	16
On a farm	112,900	37	10	2,207,200	43
No answer	81,100	27	16	992,000	19
Total	305,200	100	7	5,159,400	100

[a]First 12 years.

Table 12.-Estimated number of private ownership units and acres of commercial forest land owned, by date of acquisition and form of ownership, Ohio 1979

Date of acquisition	Corporate[a]	Farmer[b]	Misc. Individual	Misc. Other	Total	Sampling error(%)
			OWNERS			
1970-1979	1,600	29,300	35,800	1,700	68,400	11
1960-1969	700	21,900	34,500	3,200	60,300	17
1950-1959	W	32,100	29,100	700	61,900	17
1940-1949	200	17,800	28,700	200	46,900	20
Prior to 1940	300	15,700	4,900	2,800	23,700	28
No answer	1,100	29,100	40,000	1,200	71,400	18
Total	3,900	145,900	173,000	9,800	332,600	6
			ACRES OWNED			
1970-1979	66,400	534,600	632,200	56,000	1,289,200	
1960-1969	88,000	615,500	602,600	61,500	1,367,600	
1950-1959	46,200	582,500	436,700	55,100	1,120,500	
1940-1949	145,000	438,300	371,100	17,900	972,300	
Prior to 1940	304,900	284,300	169,200	41,200	799,600	
No answer	65,200	433,700	398,600	58,200	955,700	
Total	715,700	2,888,900	2,610,400	289,900	6,504,900	

[a]Includes all forest industry ownerships.
[b]Includes corporate farms.

Table 13.-Estimated number of private ownership units and acres of commercial forest land owned, by date of acquisition and geographic unit, Ohio, 1979

Date of acquisition	Individual owners			Acres owned		All other owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent	Number	Percent	Sampling error(%)	Number	Percent
				SOUTH-CENTRAL						
1970-1979	14,600	19	27	269,000	24	600	15	53	45,100	16
1960-1969	19,000	25	45	286,600	25	500	13	71	29,200	10
1950-1959	15,000	20	48	182,900	16	2,100	54	91	41,800	15
1940-1949	6,700	9	36	157,900	14	100	2	98	10,100	4
Prior to 1940	3,900	5	45	122,800	11	300	8	61	133,700	47
No answer	16,800	22	44	119,400	10	300	8	92	24,100	8
Total	76,000	100	18	1,138,600	100	3,900	100	51	284,000	100
				SOUTHEASTERN						
1970-1979	4,000	16	32	154,800	19	200	2	59	15,500	5
1960-1969	5,000	20	29	216,800	27	1,300	15	55	51,600	17
1950-1959	3,900	16	27	175,500	21	5,500	64	93	51,600	17
1940-1949	4,200	17	37	123,900	15	100	1	98	47,700	15
Prior to 1940	1,000	4	42	56,800	7	1,200	14	87	105,800	34
No answer	6,500	27	46	89,300	11	300	4	62	37,500	12
Total	24,600	100	15	817,100	100	8,600	100	62	309,700	100
				EAST-CENTRAL						
1970-1979	12,100	22	29	229,900	19	300	10	59	25,600	7
1960-1969	13,500	25	29	293,700	24	400	13	42	63,900	17
1950-1959	4,600	9	29	223,500	18	600	19	80	19,200	5
1940-1949	6,700	12	24	185,200	15	500	16	52	117,500	32
Prior to 1940	1,700	3	37	89,400	7	500	16	64	76,600	21
No answer	16,000	29	43	213,400	17	800	26	81	64,600	18
Total	54,600	100	15	1,235,100	100	3,100	100	30	367,400	100

Table 13.-continued

Date of acquisition	Individual owners			Acres owned		All other owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent	Number	Percent	Sampling error(%)	Number	Percent
				NORTHEASTERN						
1970-1979	12,100	15	27	170,800	18	1,800	23	58	45,500	18
1960-1969	8,300	10	24	199,200	21	2,000	28	71	45,500	18
1950-1959	14,500	18	28	170,800	18	800	11	58	22,800	9
1940-1949	18,200	22	45	136,600	15	100	1	72	11,400	4
Prior to 1940	8,800	11	66	68,300	7	1,200	18	88	64,300	25
No answer	19,100	24	33	197,100	21	1,400	19	42	69,300	26
Total	81,000	100	15	942,800	100	7,300	100	30	258,800	100
				SOUTHWESTERN						
1970-1979	8,400	29	26	127,200	30	1,100	52	94	12,700	28
1960-1969	3,000	10	48	57,300	14	700	33	94	12,700	28
1950-1959	5,600	19	41	95,400	23	-	-	-	-	-
1940-1949	5,500	19	49	57,300	14	100	5	75	12,700	28
Prior to 1940	1,300	4	50	31,800	7	200	10	99	6,500	16
No answer	5,600	19	54	51,700	12	-	-	-	-	
Total	29,400	100	15	420,700	100	2,100	100	60	44,600	100
				NORTHWESTERN						
1970-1979	12,000	30	22	168,200	28	1,200	50	70	24,900	31
1960-1969	6,500	17	32	99,600	16	100	4	73	12,500	15
1950-1959	9,200	23	30	130,800	22	100	4	99	6,200	8
1940-1949	4,400	11	28	105,800	18	300	13	99	6,200	8
Prior to 1940	3,600	9	62	43,600	7	-	-	-	-	-
No answer	3,900	10	56	57,100	9	700	29	56	31,200	38
Total	39,600	100	11	605,100	100	2,400	100	40	81,000	100
				TOTAL						
1970-1979	63,200	21	11	1,119,900	22	5,200	19	33	169,300	13
1960-1969	55,300	18	18	1,153,200	22	5,000	18	36	215,400	16
1950-1959	52,800	17	17	978,900	19	9,100	33	61	141,600	10
1940-1949	45,700	15	20	766,700	15	1,200	4	35	205,600	15
Prior to 1940	20,300	7	32	412,700	8	3,400	13	47	386,900	29
No answer	67,900	22	19	728,000	14	3,500	13	29	226,700	17
Total	305,200	100	7	5,159,400	100	27,400	100	23	1,345,500	100

Table 14.-Estimated number of private ownership units and acres of commercial forest land owned, by distance from residence to nearest tract and geographic unit, Ohio, 1979

Distance from residence (miles)	South-Central			Southeastern			East-Central			Northeastern		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
						OWNERS						
0-1	56,800	71	21	21,300	64	27	35,500	61	16	57,900	65	18
2-5	11,100	14	58	1,100	4	40	8,800	15	73	1,900	2	59
6-15	1,300	1	35	4,100	13	64	1,800	3	34	3,300	4	49
16-25	800	1	44	800	2	37	1,600	3	49	700	1	99
26-50	600	1	58	800	2	45	500	1	72	1,500	2	31
Over 50	4,800	6	62	2,400	7	28	1,500	3	32	2,800	3	69
No answer	4,500	6	50	2,700	8	38	8,000	14	25	20,200	23	31
Total	79,900	100	17	33,200	100	19	57,700	100	15	88,300	100	14
						ACRES OWNED						
0-1	947,500	67		599,500	53		868,500	54		718,900	60	
2-5	74,400	5		113,800	10		199,000	12		51,200	4	
6-15	93,500	6		78,100	7		104,800	7		56,900	5	
16-25	46,800	3		59,600	5		56,400	4		5,700	W	
26-50	23,400	2		36,100	3		19,200	1		85,300	7	
Over 50	128,700	9		144,500	13		102,200	6		45,500	4	
No answer	108,300	8		95,200	9		252,400	16		238,100	20	
Total	1,422,600	100		1,126,800	100		1,602,500	100		1,201,600	100	

W-Fewer than 50 owners or less than 0.5 percent.

Table 14.-continued

Distance from residence (miles)	Southwestern			Northwestern			Total		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
				OWNERS					
0-1	22,100	70	17	26,700	64	14	220,300	66	8
2-5	700	2	52	6,600	16	36	30,200	9	31
6-15	1,600	5	67	1,400	3	51	13,500	4	26
16-25	-	-	-	600	1	99	4,500	2	29
26-50	-	-	-	100	W	79	3,500	1	22
Over 50	800	3	81	800	2	52	13,100	4	29
No answer	6,300	20	49	5,800	14	41	47,500	14	17
Total	31,500	100	14	42,000	100	10	332,600	100	6
				ACRES OWNED					
0-1	311,700	67		429,700	62		3,875,800	59	
2-5	38,200	8		87,200	13		563,800	9	
6-15	38,200	8		37,400	5		408,900	6	
16-25	-	-		6,200	1		174,700	3	
26-50	-	-		12,500	2		176,500	3	
Over 50	19,100	4		24,900	4		464,900	7	
No answer	58,100	13		88,200	13		840,300	13	
Total	465,300	100		686,100	100		6,504,900	100	

W-Fewer than 50 owners or less than 0.5 percent.

Table 15.-Estimated number of private ownership units and acres of commercial forest land owned, by number of tracts and geographic unit, Ohio, 1979

Number of tracts	Private owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
		SOUTH-CENTRAL			
1	69,900	87	20	749,500	53
2	6,000	8	22	273,200	19
3 or more	4,000	5	26	399,900	28
Total	79,900	100	17	1,422,600	100
		SOUTHEASTERN			
1	24,500	74	25	531,600	47
2	6,200	19	30	211,600	19
3 or more	2,500	7	20	383,600	34
Total	33,200	100	19	1,126,800	100
		EAST-CENTRAL			
1	42,100	73	18	753,500	47
2	11,700	20	34	281,000	18
3 or more	3,900	7	16	568,000	35
Total	57,700	100	15	1,602,500	100
		NORTHEASTERN			
1	69,300	78	15	796,900	66
2	17,400	20	37	244,800	21
3 or more	1,600	2	29	159,900	13
Total	88,300	100	14	1,201,600	100
		SOUTHWESTERN			
1	26,300	84	17	311,700	67
2	4,100	13	35	108,100	23
3 or more	1,100	3	60	45,500	10
Total	31,500	100	14	465,300	100
		NORTHWESTERN			
1	34,100	81	13	429,700	63
2	5,700	14	24	143,200	21
3 or more	2,200	5	29	113,200	16
Total	42,000	100	10	686,100	100
		TOTAL			
1	266,200	80	8	3,572,900	55
2	51,100	15	16	1,261,900	19
3 or more	15,300	5	11	1,670,100	26
Total	332,600	100	6	6,504,900	100

Table 16.-Estimated number of private ownership units and acres of commercial forest land owned, by distance from tracts, Ohio, 1979

Distance (miles)	Owners of 1 tract	Owners of more than 1 tract	
		Distance to:	
		Nearest tract	Farthest tract
	OWNERS		
0-1	165,600	54,700	40,600
2-5	27,800	2,400	10,000
6-15	9,400	4,100	5,000
16-25	3,800	700	1,500
26-50	2,900	600	900
Over 50	11,600	1,500	5,100
No answer	45,100	2,400	3,300
Total	266,200	66,400	66,400
	ACRES OWNED		
0-1	2,042,500	1,833,300	867,300
2-5	232,800	331,000	533,000
6-15	190,200	218,700	288,400
16-25	109,200	65,500	144,600
26-50	123,200	53,300	175,400
Over 50	297,800	167,100	605,700
No answer	577,200	263,100	317,600
Total	3,572,900	2,932,000	2,932,000

Table 17.-Estimated number of private ownership units and acres of commercial forest land owned, by primary reason for owning, for harvesters and nonharvesters, Ohio, 1979

Primary reason for owning	Private owners		Sampling error	Acres owned	
	Number	Percent	Percent	Number	Percent
		HARVESTERS			
Land investment	11,300	3	58	274,700	4
Recreational use	4,700	1	22	224,400	3
Timber production	2,600	1	24	416,200	7
Farm and domestic use	21,500	7	17	506,300	8
Esthetic enjoyment	6,500	2	23	215,700	3
Part of farm	38,800	12	24	763,300	12
Part of residence	30,000	9	24	372,600	6
Other	3,200	1	33	406,200	6
No answer	23,100	7	30	434,600	7
Total	141,700	43	11	3,614,000	56
		NONHARVESTERS			
Land investment	10,600	3	24	294,800	5
Recreational use	10,800	4	33	248,300	4
Timber production	3,200	1	65	46,200	W
Farm and domestic use	17,200	5	27	254,000	4
Esthetic enjoyment	18,500	5	22	322,600	5
Part of farm	49,700	15	20	681,500	10
Part of residence	41,900	13	27	408,600	6
Other	7,300	2	32	154,400	3
No answer	31,700	9	19	480,500	7
Total	190,900	57	9	2,890,900	44
		ALL PRIVATE OWNERS			
Land investment	21,900	6	32	569,500	9
Recreational use	15,500	5	24	472,700	7
Timber production	5,800	2	37	462,400	7
Farm and domestic use	38,700	12	15	760,300	12
Esthetic enjoyment	25,000	7	17	538,300	8
Part of farm	88,500	27	15	1,444,800	22
Part of residence	71,900	22	18	781,200	12
Other	10,500	3	25	560,600	9
No answer	54,800	16	17	915,100	14
Total	332,600	100	6	6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 18.-Estimated number of private ownership units and acres of commercial forest land owned, by primary and secondary reason for owning, Ohio, 1979

Reason for owning	Primary reason		Secondary reason	
	Number	Percent	Number	Percent
	OWNERS			
Land investment	21,900	6	6,100	2
Recreational use	15,500	5	13,900	4
Timber production	5,800	2	8,100	3
Farm and domestic use	38,700	12	30,600	9
Esthetic enjoyment	25,000	7	35,000	11
Part of farm	88,500	27	16,800	5
Part of residence	71,900	22	13,900	4
Other	10,500	3	2,500	1
No secondary reason given	-	-	150,900	45
No answer	54,800	16	54,800	16
Total	332,600	100	332,600	100
	ACRES OWNED			
Land investment	569,500	9	375,400	6
Recreational use	472,700	7	493,700	8
Timber production	462,400	7	239,000	4
Farm and domestic use	760,300	12	637,900	10
Esthetic enjoyment	538,300	8	526,700	8
Part of farm	1,444,800	22	355,200	5
Part of residence	781,200	12	293,100	4
Other	560,600	9	44,100	1
No secondary reason given	-	-	2,624,700	40
No answer	915,100	14	915,100	14
Total	6,504,900	100	6,504,900	100

Table 19.-Estimated number of private ownership units and acres of commercial forest land owned, by primary reason for owning and expected time of future harvest, Ohio, 1979

Primary reason for owning	Expected time of future harvest									
	Next 10 years		Indefinite		Never		No answer		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
					OWNERS					
Land investment	3,800	9	6,300	4	11,500	9	300	2	21,900	6
Recreational use	3,100	7	10,500	7	1,800	2	100	1	15,500	5
Timber production	1,800	4	1,300	1	2,400	2	300	2	5,800	2
Farm and domestic use	8,300	19	19,200	13	10,000	8	1,200	7	38,700	12
Esthetic enjoyment	1,800	4	11,800	8	11,100	9	300	2	25,000	7
Part of farm	13,000	30	41,500	27	31,000	25	3,000	19	88,500	27
Part of residence	5,200	12	32,500	22	27,100	22	7,100	45	71,900	22
Other	1,700	4	5,700	4	3,100	3	-	-	10,500	3
No answer	4,700	11	21,600	14	25,100	20	3,400	22	54,800	16
Total	43,400	100	150,400	100	123,100	100	15,700	100	332,600	100
					ACRES OWNED					
Land investment	136,700	8	310,500	10	104,400	7	17,900	7	569,500	9
Recreational use	122,600	7	268,000	9	76,400	5	5,700	2	472,700	7
Timber production	349,300	21	75,600	3	18,500	1	19,000	7	462,400	7
Farm and domestic use	215,400	13	384,800	12	117,600	8	42,500	16	760,300	12
Esthetic enjoyment	63,900	4	291,700	9	169,900	12	12,800	5	538,300	8
Part of farm	216,200	13	819,900	26	355,300	25	53,400	19	1,444,800	22
Part of residence	117,300	7	391,400	13	225,300	16	47,200	17	781,200	12
Other	330,800	20	166,000	5	63,800	4	-	-	560,600	9
No answer	113,900	7	401,600	13	324,400	22	75,200	27	915,100	14
Total	1,666,100	100	3,109,500	100	1,455,600	100	273,700	100	6,504,900	100

Table 20.-Estimated number of private ownership units and acres of commercial forest land owned, by primary reason for owning and geographic unit, Ohio, 1979

Primary reason for owning	South-Central			Southeastern			East-Central			Northeastern		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
					OWNERS							
Land investment	4,600	6	40	1,900	6	26	9,000	15	71	2,900	3	39
Recreational use	2,200	3	32	4,900	15	55	3,400	6	50	3,000	3	50
Timber production	2,300	3	84	500	1	41	1,200	2	41	1,300	1	48
Farm and domestic use	13,300	17	34	3,000	9	26	6,300	11	23	6,900	8	29
Esthetic enjoyment	2,800	3	54	2,900	9	50	5,000	9	39	8,600	10	33
Part of farm	30,300	38	35	2,500	8	27	8,700	15	21	23,000	26	29
Part of residence	14,200	18	46	11,400	34	48	11,500	20	35	21,200	24	40
Other	1,900	2	61	1,500	4	52	700	1	37	3,200	4	51
No answer	8,300	10	51	4,600	14	34	11,900	21	29	18,200	21	34
Total	79,900	100	17	33,200	100	19	57,700	100	15	88,300	100	14
					ACRES OWNED							
Land investment	136,200	10		123,900	11		166,000	10		74,000	6	
Recreational use	81,800	6		134,200	12		121,300	8		85,400	7	
Timber production	163,000	11		145,900	13		83,000	5		45,600	4	
Farm and domestic use	157,900	11		123,900	11		204,300	13		142,300	12	
Esthetic enjoyment	99,400	7		77,400	7		108,600	7		108,200	9	
Part of farm	391,800	27		134,200	12		281,000	17		267,500	22	
Part of residence	198,900	14		129,000	11		172,400	11		142,300	12	
Other	79,500	6		106,300	9		219,700	14		98,500	8	
No answer	114,100	8		152,000	14		246,200	15		237,800	20	
Total	1,422,600	100		1,126,800	100		1,602,500	100		1,201,600	100	

Table 20.-continued

Primary reason for owning	Southwestern			Northwestern			Total	
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent
				OWNERS				
Land investment	2,400	8	61	1,100	3	65	21,900	6
Recreational use	W	W	99	2,000	5	44	15,500	5
Timber production	-	-	-	500	1	53	5,800	2
Farm and domestic use	3,900	12	37	5,300	13	43	38,700	12
Esthetic enjoyment	2,300	7	37	3,400	8	36	25,000	7
Part of farm	7,100	23	34	16,900	40	21	88,500	27
Part of residence	7,200	23	38	6,400	15	42	71,900	22
Other	1,700	5	66	1,500	3	57	10,500	3
No answer	6,900	22	48	4,900	12	27	54,800	16
Total	31,500	100	14	42,000	100	10	332,600	100
				ACRES OWNED				
Land investment	44,500	10		24,900	4		569,500	9
Recreational use	6,400	1		43,600	6		472,700	7
Timber production	-	-		24,900	4		462,400	7
Farm and domestic use	50,900	11		81,000	12		760,300	12
Esthetic enjoyment	70,000	15		74,700	11		538,300	8
Part of farm	133,600	29		236,700	34		1,444,800	22
Part of residence	76,300	16		62,300	9		781,200	12
Other	25,500	6		31,100	5		560,600	9
No answer	58,100	12		106,900	15		915,100	14
Total	465,300	100		686,100	100		6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 21.-Estimated number of private ownership units and acres of commercial forest land owned, by primary benefit derived in the last 5 years and primary benefit expected in the next 5 years, for harvesters and nonharvesters, Ohio, 1979

Primary benefit	Derived in last 5 years				Expected in next 5 years			
	Private owners		Acres owned		Private owners		Acres owned	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				HARVESTERS				
Recreational use	7,400	2	232,700	4	11,100	3	279,100	4
Sale of timber	8,100	2	437,000	7	3,200	1	450,900	7
Land value increase	19,500	6	791,700	12	28,000	9	754,100	11
Esthetic enjoyment	34,900	11	726,500	11	27,400	8	560,000	9
Farm and domestic use	35,400	11	616,100	9	39,000	12	698,300	11
Other	3,500	1	309,200	5	3,400	1	297,600	5
No answer	32,900	10	500,800	8	29,600	9	574,000	9
Total	141,700	43	3,614,000	56	141,700	43	3,614,000	56
				NONHARVESTERS				
Recreational use	13,000	4	278,200	4	13,400	4	282,200	5
Sale of timber	-	-	-	-	4,700	1	100,000	1
Land value increase	32,100	10	589,600	9	36,800	11	692,200	11
Esthetic enjoyment	59,500	17	800,900	12	61,400	19	726,300	11
Farm and domestic use	28,500	8	446,800	7	30,900	9	423,400	6
Other	1,800	1	52,800	1	2,500	1	81,000	1
No answer	56,000	17	722,600	11	41,200	12	585,800	9
Total	190,900	57	2,890,900	44	190,900	57	2,890,900	44
				ALL PRIVATE OWNERS				
Recreational use	20,400	6	510,900	8	24,500	7	561,300	9
Sale of timber	8,100	2	437,000	7	7,900	2	550,900	8
Land value increase	51,600	16	1,381,300	21	64,800	20	1,446,300	22
Esthetic enjoyment	94,400	28	1,527,400	23	88,800	27	1,286,300	20
Farm and domestic use	63,900	19	1,062,900	16	69,900	21	1,121,700	17
Other	5,300	2	362,000	6	5,900	2	378,600	6
No answer	88,900	27	1,223,400	19	70,800	21	1,159,800	18
Total	332,600	100	6,504,900	100	332,600	100	6,504,900	100

Table 22.-Estimated number of private ownership units and acres of commercial forest land owned by primary benefit expected in the next 5 years and expected time of future harvest, Ohio, 1979

Primary benefit	Expected time of future harvest								Total	
	Next 10 years		Indefinite		Never		No answer			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
					OWNERS					
Recreational use	3,200	7	16,300	11	4,500	4	500	3	24,500	7
Sale of timber	3,400	8	4,300	3	-	-	200	1	7,900	2
Land value increase	7,800	18	33,400	22	21,500	18	2,100	13	64,800	20
Esthetic enjoyment	8,400	19	36,200	24	38,400	31	5,800	37	88,800	27
Farm and domestic use	14,100	33	30,200	20	22,700	18	2,900	18	69,900	21
Other	900	2	3,000	2	2,000	2	-	-	5,900	2
No answer	5,600	13	27,000	18	34,000	27	4,200	28	70,800	21
Total	43,400	100	150,400	100	123,100	100	15,700	100	332,600	100
					ACRES OWNED					
Recreational use	133,600	8	291,800	9	111,700	8	24,200	9	561,300	9
Sale of timber	448,500	27	96,200	3	-	-	6,200	2	550,900	8
Land value increase	387,700	23	743,300	24	260,800	18	54,500	20	1,446,300	22
Esthetic enjoyment	151,000	9	704,100	23	390,900	27	40,300	15	1,286,300	20
Farm and domestic use	193,000	12	665,700	21	202,400	14	60,600	22	1,121,700	17
Other	209,100	13	123,600	4	45,900	3	-	-	378,600	6
No answer	143,200	8	484,800	16	443,900	30	87,900	32	1,159,800	18
Total	1,666,100	100	3,109,500	100	1,455,600	100	273,700	100	6,504,900	100

Table 23.-Estimated number of private ownership units and acres of commercial forest land owned by primary benefit expected in the next 5 years and geographic unit, Ohio, 1979

Primary benefit	South-Central			Southeastern			East-Central			Northeastern		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
					OWNERS							
Recreational use	4,900	6	61	6,200	19	47	6,900	12	36	3,800	4	43
Sale of timber	2,900	4	66	1,100	3	29	2,100	4	42	800	1	50
Land value increase	19,600	24	43	3,700	11	24	17,400	30	41	14,500	16	42
Esthetic enjoyment	23,300	29	33	11,800	36	47	7,400	13	30	23,900	27	29
Farm and domestic use	16,700	21	39	5,000	15	27	7,400	13	23	20,700	24	32
Other	500	1	58	600	2	70	100	W	65	2,300	3	34
No answer	12,000	15	40	4,800	14	33	16,400	28	23	22,300	25	29
Total	79,900	100	17	33,200	100	19	57,700	100	15	88,300	100	14
					ACRES OWNED							
Recreational use	87,700	6		154,900	14		172,400	11		102,500	8	
Sale of timber	208,100	15		144,800	13		114,900	7		45,500	4	
Land value increase	365,200	26		245,000	21		466,200	29		193,500	16	
Esthetic enjoyment	286,600	20		180,600	16		204,300	13		250,500	21	
Farm and domestic use	263,200	18		154,900	14		223,500	14		216,300	18	
Other	56,900	4		69,000	6		92,000	6		104,200	9	
No answer	154,900	11		177,600	16		329,200	20		289,100	24	
Total	1,422,600	100		1,126,800	100		1,602,500	100		1,201,600	100	

Table 23.-continued

Primary benefit	Southwestern			Northwestern			Total		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
				OWNERS					
Recreational use	1,100	4	96	1,600	4	52	24,500	7	22
Sale of timber	100	W	71	900	2	71	7,900	2	29
Land value increase	5,800	18	33	3,800	9	40	64,800	20	20
Esthetic enjoyment	8,100	26	31	14,300	34	22	88,800	27	14
Farm and domestic use	8,200	26	33	11,900	28	28	69,900	21	15
Other	900	3	58	1,500	4	47	5,900	2	22
No answer	7,300	23	46	8,000	19	27	70,800	21	14
Total	31,500	100	14	42,000	100	10	332,600	100	6
				ACRES OWNED					
Recreational use	12,700	3		31,100	4		561,300	9	
Sale of timber	12,700	3		24,900	4		550,900	8	
Land value increase	95,400	21		81,000	12		1,446,300	22	
Esthetic enjoyment	146,300	31		218,000	32		1,286,300	20	
Farm and domestic use	108,100	23		155,700	23		1,121,700	17	
Other	25,400	5		31,100	4		378,600	6	
No answer	64,700	14		144,300	21		1,159,800	18	
Total	465,300	100		686,100	100		6,504,900	100	

W-Fewer than 50 owners or less than 0.5 percent.

Table 24.-Estimated number of private ownership units who have harvested timber and acres of commercial forest owned, by reason for harvesting and form of ownership, Ohio, 1979

Reason for harvesting	Forest Industry	Miscellaneous ownership			Total	Sampling error(%)
		Individual	Corporate	Other		
		OWNERS				
Timber mature	100	30,200	900	3,100	34,300	20
Good price	-	2,700	100	500	3,300	20
Land clearing	-	13,600	300	300	14,200	27
Needed money	-	15,500	W	600	16,100	22
Own use or company use	100	21,100	100	6,000	27,300	24
Timber salvage	-	12,400	100	200	12,700	48
Cultural treatment	-	700	-	100	800	43
Other	-	8,600	W	200	8,800	72
No answer	W	22,400	1,100	700	24,200	28
Total	200	127,200	2,600	11,700	141,700	11
		ACRES OWNED				
Timber mature	12,600	779,300	171,300	87,900	1,051,100	
Good price	-	163,600	54,600	29,300	247,500	
Land clearing	-	223,900	39,500	34,300	297,700	
Needed money	-	436,700	26,300	34,100	497,100	
Own use or company use	167,900	408,000	6,400	17,800	600,100	
Timber salvage	-	171,400	91,400	5,700	268,500	
Cultural treatment	-	53,800	-	5,200	59,000	
Other	-	66,900	6,800	6,200	79,900	
No answer	5,800	359,800	88,300	59,200	513,100	
Total	186,300	2,663,400	484,600	279,700	3,614,000	

Table 25.-Estimated number of private ownership units who have harvested timber and acres of commercial forest land owned, by reason for harvesting and geographic unit, Ohio, 1979

Reason for harvesting	South-Central			Southeastern			East-Central			Northeastern		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
						HARVESTERS						
Timber mature	2,800	10	29	4,000	24	33	5,500	23	22	11,400	30	52
Good price	1,200	4	29	500	3	44	400	2	51	100	W	99
Land clearing	5,700	20	58	200	1	51	1,200	5	41	4,000	11	37
Needed money	4,500	16	46	3,800	22	37	1,600	7	29	3,900	10	62
Own use or company use	3,600	12	32	6,400	38	81	4,900	21	41	2,700	7	30
Timber salvage	6,800	24	86	W	W	67	500	2	52	3,100	8	50
Cultural treatment	100	W	99	100	1	69	600	2	52	W	W	99
Other	100	W	99	W	W	99	7,200	31	89	900	3	70
No answer	4,100	14	73	1,900	11	43	1,600	7	36	11,500	31	51
Total	28,900	100	26	16,900	100	32	23,500	100	29	37,600	100	23
						ACRES OWNED						
Timber mature	204,700	24		185,800	29		287,400	32		178,200	31	
Good price	105,300	12		41,300	6		57,400	7		5,700	1	
Land clearing	62,600	7		25,800	4		72,900	8		79,700	13	
Needed money	159,500	18		150,200	23		102,200	11		28,500	5	
Own use or company use	186,300	22		124,800	19		102,200	11		74,000	13	
Timber salvage	62,700	7		47,700	7		63,800	7		56,900	10	
Cultural treatment	5,900	1		15,500	2		31,900	4		5,700	1	
Other	12,600	1		5,100	1		31,900	4		11,400	2	
No answer	66,200	8		57,100	9		143,700	16		138,800	24	
Total	865,800	100		653,300	100		893,400	100		578,900	100	

Table 25.-continued

Reason for harvesting	Southwestern			Northwestern			Total	
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent
				HARVESTERS				
Timber mature	4,700	36	50	5,900	27	34	34,300	24
Good price	600	5	62	500	2	60	3,300	3
Land clearing	2,100	16	48	1,000	5	52	14,200	10
Needed money	900	7	58	1,400	6	55	16,100	11
Own use or company use	3,200	24	56	6,500	30	38	27,300	19
Timber salvage	-	-	-	2,300	11	46	12,700	9
Cultural treatment	-	-	-	-	-	-	800	1
Other	100	1	99	500	2	70	8,800	6
No answer	1,500	11	71	3,600	17	40	24,200	17
Total	13,100	100	23	21,700	100	15	141,700	100
				ACRES OWNED				
Timber mature	95,400	39		99,600	26		1,051,100	29
Good price	19,100	8		18,700	5		247,500	7
Land clearing	31,800	13		24,900	7		297,700	8
Needed money	31,800	13		24,900	7		497,100	14
Own use or company use	31,800	13		81,000	21		600,100	17
Timber salvage	-	-		37,400	10		268,500	7
Cultural treatment	-	-		-	-		59,000	2
Other	6,400	3		12,500	3		79,900	2
No answer	25,900	11		81,400	21		513,100	14
Total	242,200	100		380,400	100		3,614,000	100

Table 26.-Estimated number of private ownership units who have not harvested timber and acres of commercial land owned, by reason for not harvesting and form of ownership, Ohio, 1979

Reason for not harvesting	Individual	Corporate	Other	Total	Sampling error(%)
		NONHARVESTERS			
Timber immature	46,500	300	1,700	48,500	16
No market	1,400	-	W	1,400	57
Price too low	5,100	-	100	5,200	33
Destroy hunting	6,300	-	W	6,300	37
Selling the land	1,900	W	1,200	3,100	47
Ruin scenery	27,900	W	600	28,500	29
Land in estate	300	-	200	500	68
Distrust loggers	3,700	-	100	3,800	58
Opposed to harvest	12,100	-	-	12,100	54
Poor quality	2,300	-	W	2,300	37
Low volume	24,500	W	3,200	27,700	34
Fire hazard	300	-	-	300	74
Insufficient area	6,300	-	-	6,300	40
Other	6,600	500	400	7,500	23
No answer	32,600	1,200	3,600	37,400	18
Total	177,800	2,000	11,100	190,900	9
		ACRES OWNED			
Timber immature	734,000	54,100	48,800	836,900	
No market	24,800	-	5,200	30,000	
Price too low	112,700	-	5,200	117,900	
Destroy hunting	149,900	-	6,400	156,300	
Selling the land	47,000	5,700	17,800	70,500	
Ruin scenery	281,500	12,100	39,300	332,900	
Land in estate	11,500	-	5,700	17,200	
Distrust loggers	80,000	-	12,200	92,200	
Opposed to harvest	65,700	-	-	65,700	
Poor quality	71,800	-	5,900	77,700	
Low volume	179,600	5,700	17,300	202,600	
Fire hazard	11,400	-	-	11,400	
Insufficient area	63,900	-	-	63,900	
Other	194,100	48,300	6,400	248,800	
No answer	431,200	33,800	101,900	566,900	
Total	2,459,100	159,700	272,100	2,890,900	

Table 27.-Estimated number of private ownership units who have not harvested timber and acres of commercial forest land owned, by reason for not harvesting and geographic unit, Ohio, 1979

Reason for not harvesting	South-Central			Southeastern			East-Central			Northeastern		
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)
						NONHARVESTERS						
Timber immature	7,000	14	30	2,600	16	52	9,400	27	25	15,700	31	40
No market	-	-	-	W	W	99	300	1	70	600	1	99
Price too low	600	1	54	500	3	66	700	2	66	2,500	5	58
Destroy hunting	2,500	5	80	1,200	7	50	1,100	3	64	100	W	99
Selling the land	1,300	3	76	100	1	99	200	1	62	1,500	3	68
Ruin scenery	10,000	20	65	1,900	12	67	5,800	17	62	6,500	13	40
Land in estate	-	-	-	300	2	99	W	W	99	200	W	99
Distrust loggers	400	1	53	300	2	57	200	1	74	200	W	74
Opposed to harvest	7,300	14	82	200	1	73	1,700	5	67	700	2	99
Poor quality	700	1	58	100	1	99	400	1	79	100	W	99
Low volume	8,200	16	75	3,600	22	72	4,200	12	59	8,600	17	68
Fire hazard	-	-	-	100	1	99	-	-	-	-	-	-
Insufficient area	3,500	7	60	700	4	96	-	-	-	1,000	2	86
Other	1,700	3	55	2,700	16	46	1,400	4	40	1,000	2	40
No answer	7,800	15	53	2,000	12	36	8,800	26	32	12,000	24	27
Total	51,000	100	23	16,300	100	22	34,200	100	16	50,700	100	18
						ACRES OWNED						
Timber immature	175,400	32		85,500	18		228,800	32		170,800	27	
No market	-	-		5,100	1		12,800	2		5,700	1	
Price too low	23,400	4		15,500	3		31,900	4		28,400	4	
Destroy hunting	40,900	8		46,500	10		31,900	4		5,700	1	
Selling the land	23,400	4		5,100	1		19,200	3		22,800	4	
Ruin scenery	58,500	11		56,800	12		44,700	6		91,100	15	
Land in estate	-	-		5,100	1		6,400	1		5,700	1	
Distrust loggers	23,400	4		25,800	6		19,200	3		11,300	2	
Opposed to harvest	11,700	2		10,300	2		25,500	4		5,700	1	
Poor quality	35,100	6		5,100	1		12,800	2		5,700	1	
Low volume	29,200	5		41,400	9		25,500	4		62,700	10	
Fire hazard	-	-		5,100	1		-	-		-	-	
Insufficient area	23,400	4		10,300	2		-	-		11,300	2	
Other	35,100	6		72,300	15		70,200	10		39,800	6	
No answer	77,300	14		83,600	18		180,200	25		156,000	25	
Total	556,800	100		473,500	100		709,100	100		622,700	100	

Table 27.-continued

Reason for not harvesting	Southwestern			Northwestern			Total	
	Number	Percent	Sampling error(%)	Number	Percent	Sampling error(%)	Number	Percent
				NONHARVESTERS				
Timber immature	7,800	42	36	6,000	30	36	48,500	25
No market	500	3	99	-	-	-	1,400	1
Price too low	-	-	-	900	4	77	5,200	3
Destroy hunting	300	1	99	1,100	5	63	6,300	3
Selling the land	-	-	-	-	-	-	3,100	2
Ruin scenery	3,300	18	46	1,000	5	45	28,500	15
Land in estate	-	-	-	-	-	-	500	W
Distrust loggers	-	-	-	2,700	13	81	3,800	2
Opposed to harvest	-	-	-	2,200	11	92	12,100	6
Poor quality	500	3	88	500	3	99	2,300	1
Low volume	800	5	73	2,300	11	49	27,700	15
Fire hazard	-	-	-	200	1	99	300	W
Insufficient area	100	W	99	1,000	5	87	6,300	3
Other	500	3	93	200	1	66	7,500	4
No answer	4,600	25	65	2,200	11	39	37,400	20
Total	18,400	100	22	20,300	100	19	190,900	100
				ACRES OWNED				
Timber immature	95,400	41		81,000	27		836,900	29
No market	6,400	3		-	-		30,000	1
Price too low	-	-		18,700	6		117,900	4
Destroy hunting	6,400	3		24,900	8		156,300	5
Selling the land	-	-		-	-		70,500	2
Ruin scenery	44,500	20		37,300	12		332,900	12
Land in estate	-	-		-	-		17,200	1
Distrust loggers	-	-		12,500	4		92,200	3
Opposed to harvest	-	-		12,500	4		65,700	2
Poor quality	12,700	6		6,300	2		77,700	3
Low volume	12,700	6		31,100	10		202,600	7
Fire hazard	-	-		6,300	2		11,400	W
Insufficient area	6,400	3		12,500	4		63,900	2
Other	12,700	6		18,700	6		248,800	9
No answer	25,900	12		43,900	15		566,900	20
Total	223,100	100		305,700	100		2,890,900	100

Table 28.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Ohio, 1979

Expected time of future harvest	Private owners		Acres owned	
	Number	Percent	Number	Percent
		HARVESTERS		
Next 5 years	22,600	7	995,600	16
5-10 years	6,400	2	294,700	5
Indefinite	67,000	20	1,693,400	26
Never	33,400	10	411,800	6
No answer	12,300	4	218,500	3
Total	141,700	43	3,614,000	56
		NONHARVESTERS		
Next 5 years	6,400	2	233,200	3
5-10 years	8,000	2	142,600	2
Indefinite	83,400	25	1,416,100	22
Never	89,700	27	1,043,800	16
No answer	3,400	1	55,200	1
Total	190,900	57	2,890,900	44
		ALL PRIVATE OWNERS		
Next 5 years	29,000	9	1,228,800	19
5-10 years	14,400	4	437,300	7
Indefinite	150,400	45	3,109,500	48
Never	123,100	37	1,455,600	22
No answer	15,700	5	273,700	4
Total	332,600	100	6,504,900	100

Table 29.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, South-Central Unit, Ohio, 1979

Expected time of future harvest	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Next 5 years	4,100	5	31	296,800	21
5-10 years	600	1	41	52,700	4
Indefinite	17,700	22	39	403,600	28
Never	5,800	7	57	81,900	6
No answer	700	1	48	30,800	2
Total	28,900	36	26	865,800	61
			NONHARVESTERS		
Next 5 years	1,600	2	55	46,700	3
5-10 years	3,200	4	90	23,300	1
Indefinite	23,600	30	38	263,100	19
Never	22,500	28	33	216,400	15
No answer	100	W	99	7,300	1
Total	51,000	64	23	556,800	39
			ALL PRIVATE OWNERS		
Next 5 years	5,700	7	27	343,500	24
5-10 years	3,800	5	77	76,000	5
Indefinite	41,300	52	27	666,700	47
Never	28,300	35	28	298,300	21
No answer	800	1	45	38,100	3
Total	79,900	100	17	1,422,600	100

Table 30.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Southeastern Unit, Ohio, 1979

Expected time of future harvest	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Next 5 years	1,000	3	33	218,100	19
5-10 years	700	2	34	92,800	8
Indefinite	8,400	25	23	268,000	24
Never	1,500	5	44	51,500	5
No answer	5,300	16	98	22,900	2
Total	16,900	51	32	653,300	58
			NONHARVESTERS		
Next 5 years	1,400	5	44	57,100	5
5-10 years	200	1	59	15,600	2
Indefinite	9,100	27	32	258,400	23
Never	5,600	16	37	142,400	12
No answer	-	-		-	-
Total	16,300	49	22	473,500	42
			ALL PRIVATE OWNERS		
Next 5 years	2,400	8	28	275,200	24
5-10 years	900	3	29	108,400	10
Indefinite	17,500	52	20	526,400	47
Never	7,100	21	30	193,900	17
No answer	5,300	16	98	22,900	2
Total	33,200	100	19	1,126,800	100

Table 31.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, East-Central Unit, Ohio, 1979

Expected time of future harvest	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Next 5 years	1,600	3	32	252,800	16
5-10 years	1,300	2	48	70,300	5
Indefinite	9,500	17	16	434,300	26
Never	9,800	17	67	70,300	5
No answer	1,300	2	40	65,700	4
Total	23,500	41	29	893,400	56
			NONHARVESTERS		
Next 5 years	1,300	2	61	83,000	5
5-10 years	400	1	59	31,900	1
Indefinite	15,100	26	20	376,700	24
Never	15,000	26	30	196,700	13
No answer	2,400	4	91	20,800	1
Total	34,200	59	16	709,100	44
			ALL PRIVATE OWNERS		
Next 5 years	2,900	5	33	335,800	21
5-10 years	1,700	3	39	102,200	6
Indefinite	24,600	43	13	811,000	50
Never	24,800	43	32	267,000	18
No answer	3,700	6	60	86,500	5
Total	57,700	100	15	1,602,500	100

Table 32.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Northeastern Unit, Ohio, 1979

Expected time of future harvest	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Next 5 years	8,000	9	72	108,300	9
5-10 years	2,100	2	72	22,800	2
Indefinite	17,400	20	36	292,200	24
Never	8,500	10	27	114,000	9
No answer	1,600	2	43	41,600	4
Total	37,600	43	23	578,900	48
			NONHARVESTERS		
Next 5 years	2,000	2	73	34,000	3
5-10 years	1,300	2	63	34,000	3
Indefinite	21,600	24	30	273,000	23
Never	25,100	28	28	261,700	22
No answer	700	1	58	20,000	1
Total	50,700	57	18	622,700	52
			ALL PRIVATE OWNERS		
Next 5 years	10,000	11	59	142,300	12
5-10 years	3,400	4	50	56,800	5
Indefinite	39,000	44	23	565,200	47
Never	33,600	38	21	375,700	31
No answer	2,300	3	34	61,600	5
Total	88,300	100	14	1,201,600	100

Table 33.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Southwestern Unit, Ohio, 1979

Expected time of future harvest	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Next 5 years	4,300	14	48	57,300	12
5-10 years	100	1	99	6,400	1
Indefinite	3,800	12	26	121,100	26
Never	4,100	13	58	38,200	8
No answer	800	2	65	19,200	5
Total	13,100	42	23	242,200	52
			NONHARVESTERS		
Next 5 years	-	-		-	-
5-10 years	1,300	3	86	12,700	3
Indefinite	5,700	18	34	95,200	21
Never	11,200	36	34	108,100	23
No answer	200	1	99	7,100	1
Total	18,400	58	22	223,100	48
			ALL PRIVATE OWNERS		
Next 5 years	4,300	14	48	57,300	12
5-10 years	1,400	4	79	19,100	4
Indefinite	9,500	30	21	216,300	47
Never	15,300	49	28	146,300	31
No answer	1,000	3	54	26,300	6
Total	31,500	100	14	465,300	100

Table 34.-Estimated number of private ownership units and acres of commercial forest land owned, by expected time of future harvest and by harvesters and nonharvesters, Northwestern Unit, Ohio, 1979

Expected time of future harvest	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Next 5 years	3,600	9	39	62,300	9
5-10 years	1,600	4	44	49,700	7
Indefinite	10,200	24	22	174,200	25
Never	3,700	9	58	55,900	8
No answer	2,600	6	53	38,300	6
Total	21,700	52	15	380,400	55
			NONHARVESTERS		
Next 5 years	100	W	92	12,400	2
5-10 years	1,600	4	57	25,100	4
Indefinite	8,300	20	26	149,700	22
Never	10,300	24	32	118,500	17
No answer	-	-		-	-
Total	20,300	48	19	305,700	45
			ALL PRIVATE OWNERS		
Next 5 years	3,700	9	38	74,700	11
5-10 years	3,200	8	35	74,800	11
Indefinite	18,500	44	16	323,900	47
Never	14,000	33	28	174,400	25
No answer	2,600	6	53	38,300	6
Total	42,000	100	10	686,100	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 35.-Estimated number of private ownership units and acres of commercial forest land owned, by size class and expected time of future harvest, Ohio, 1979

Size class (acres)	Expected time of future harvest									
	Next 10 years		Indefinite		Never		No answer		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
					OWNERS					
1-9	19,800	46	73,400	49	82,200	67	8,500	54	183,900	55
10-19	9,000	21	28,100	19	20,700	17	2,200	14	60,000	18
20-49	8,600	20	32,200	21	16,100	13	3,700	23	60,600	18
50-99	3,100	7	12,100	8	2,900	2	900	6	19,000	6
100-199	2,100	5	3,400	2	1,000	1	300	2	6,800	2
200-499	600	1	1,100	1	200	W	100	1	2,000	1
500+	200	W	100	W	W	W	-	-	300	W
Total	43,400	100	150,400	100	123,100	100	15,700	100	332,600	100
					ACRES OWNED					
1-9	78,100	5	226,800	7	285,600	20	19,400	7	609,900	9
10-19	108,000	7	350,100	11	248,400	17	32,300	12	738,800	11
20-49	268,200	16	943,700	31	477,700	33	113,500	41	1,803,100	28
50-99	206,300	12	747,300	24	195,200	13	57,100	21	1,205,900	19
100-199	273,300	16	438,600	14	138,700	9	33,200	12	883,800	14
200-499	167,800	10	277,900	9	57,800	4	18,200	7	521,700	8
500+	564,400	34	125,100	4	52,200	4	-	-	741,700	11
Total	1,666,100	100	3,109,500	100	1,455,600	100	273,700	100	6,504,900	100

Table 36.-Estimated number of private ownership units who have harvested timber and acres of commercial forest land owned, by method of selecting timber and individual selecting timber, Ohio, 1979

Method of selecting timber	Landowner	Forester	Buyer	Landowner and forester	Landowner and buyer	Other	No answer	Total	Sampling error(%)
				HARVESTERS					
Selection	21,900	4,200	3,800	400	4,000	400	400	35,100	22
Diameter limit	7,600	200	9,700	300	5,200	100	100	23,200	17
Clearcutting	2,300	300	900	W	W	300	-	3,800	26
Land clearing	4,800	-	1,400	-	800	-	900	7,900	24
Other	10,600	-	1,300	W	200	300	-	12,400	50
Combination of methods	3,400	600	500	200	600	700	W	6,000	23
Don't know	10,800	W	5,800	-	500	6,600	200	23,900	36
No answer	9,200	-	400	-	900	100	18,800	29,400	24
Total	70,600	5,300	23,800	900	12,200	8,500	20,400	141,700	11
				ACRES OWNED					
Selection	328,300	128,400	121,000	47,400	91,400	29,700	18,000	764,200	
Diameter limit	333,100	42,700	283,200	17,300	196,300	42,200	5,700	920,500	
Clearcutting	79,300	168,600	53,400	5,800	18,600	11,000	-	336,700	
Land clearing	115,800	-	30,400	-	24,700	-	23,500	194,400	
Other	111,900	-	35,100	6,400	5,700	11,600	-	170,700	
Combination of methods	138,300	109,500	18,400	24,300	30,500	33,900	5,200	360,100	
Don't know	76,000	6,700	121,800	-	18,300	12,200	31,000	266,000	
No answer	137,100	-	23,300	-	19,000	5,800	416,200	601,400	
Total	1,319,800	455,900	686,600	101,200	404,500	146,400	499,600	3,614,000	

Table 37.-Estimated number of private ownership units and acres of commercial forest land owned, by timber product harvested, forest industry, and private land owners (size class ownership), Ohio 1979

Timber product	Forest Industry		Nonindustrial Private Landowners						Total		Sampling error
			1 - 49 acres		50 - 499 acres		500+ acres				
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Percent
					OWNERS						
Sawlogs	200	100	57,600	46	11,000	71	200	100	69,100	49	12
Veneer	W	W	14,400	11	3,000	19	W	W	17,500	12	19
Pulpwood	W	W	4,600	4	2,500	16	100	50	7,200	5	16
Firewood	W	W	54,000	43	1,800	12	W	W	55,800	39	24
Posts, poles, pilings	-		13,600	11	1,700	11	W	W	15,300	11	21
Mine timbers	-		1,700	1	200	1	W	W	2,000	1	80
Christmas trees	-		700	1	500	3	W	W	1,200	1	40
Other	-		800	1	100	1			900	1	67
Don't know	-		3,100	2	100	1	W	W	3,200	2	53
No answer	-		18,200	14	2,000	13	W	W	20,200	14	31
Total[a]	200	100	125,800	100	15,500	100	200	100	141,700	100	11
					ACRES OWNED						
Sawlogs	186,300	100	855,300	58	1,058,400	72	345,700	71	2,445,600	68	
Veneer	146,600	79	215,400	15	292,000	20	167,200	34	821,000	23	
Pulpwood	161,500	87	140,000	9	244,200	17	225,500	46	771,200	21	
Firewood	5,800	3	361,900	25	148,800	10	12,200	3	522,900	14	
Posts, poles, pilings	-		213,600	15	168,000	11	37,100	8	418,600	12	
Mine timbers	-		12,700	1	21,700	1	23,600	5	58,100	2	
Christmas trees	-		17,600	1	58,100	4	6,400	1	82,100	2	
Other	-		18,500	1	17,300	1	-	-	35,800	1	
Don't know	-		27,900	2	18,400	1	5,200	1	51,500	1	
No answer	-		199,500	14	175,600	12	110,800	23	485,900	13	
Total[a]	186,300	100	1,471,500	100	1,471,100	100	485,100	100	3,614,000	100	

[a]Items do not add to totals because some owners harvested more than one product.
W-Fewer than 50 owners or less than 0.5 percent.

Table 38.-Estimated number of private ownership units and acres of commercial forest land owned, by agency that owners would contact for forestry assistance, and size class of ownership, Ohio, 1979

Agency	1 - 49 acres		50 - 499 acres		500 + acres		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
			OWNERS					
State forestry	32,000	10	5,600	20	100	34	37,700	11
Soil Conservation Service	5,900	2	900	3	W	W	6,800	2
Forest Service	1,700	1	600	2	W	W	2,300	1
Agricultural Stabilization and Conservation Service	5,200	2	1,600	6	-		6,800	2
Consultant or industry forester	-		200	1	W	W	200	W
Extension service	10,600	3	1,000	3	W	W	11,600	3
Other	5,200	2	300	1	-		5,500	2
Don't know	131,000	43	10,700	39	100	33	141,800	43
No answer	112,900	37	6,900	25	100	33	119,900	36
Total	304,500	100	27,800	100	300	100	332,600	100
			ACRES OWNED					
State forestry	423,300	13	613,900	23	143,700	19	1,180,900	18
Soil Conservation Service	83,600	3	89,100	3	5,800	1	178,500	3
Forest Service	35,900	1	66,300	3	168,700	23	270,900	4
Agricultural Stabilization and Conservation Service	90,200	3	136,100	5	-		226,300	3
Consultant or industry forester	-		22,000	1	108,400	15	130,400	2
Extension service	89,000	3	76,000	3	17,800	2	182,800	3
Other	51,400	2	28,200	1	-		79,600	1
Don't know	1,468,500	46	954,700	37	95,000	13	2,518,200	39
No answer	909,900	29	625,100	24	202,300	27	1,737,300	27
Total	3,151,800	100	2,611,400	100	741,700	100	6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 39.-Estimated number of private ownership units and acres of commercial forest land owned, by harvesters and nonharvesters, and decision to seek assistance, Ohio, 1979

Assistance	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
			HARVESTERS		
Sought assistance	25,600	8	25	1,177,700	18
No assistance	86,100	26	14	1,867,600	29
No answer	30,000	9	25	568,700	9
Total	141,700	43	11	3,614,000	56
			NONHARVESTERS		
Sought assistance	10,300	3	18	436,900	7
No assistance	146,400	44	11	1,917,900	29
No answer	34,200	10	18	536,100	8
Total	190,900	57	9	2,890,900	44
			TOTAL		
Sought assistance	35,900	11	19	1,614,600	25
No assistance	232,500	70	9	3,785,500	58
No answer	64,200	19	15	1,104,800	17
Total	332,600	100	6	6,504,900	100

Table 40.-Estimated number of private ownership units and acres of commercial forest land owned, by agency that owners would contact for forestry assistance, and decision to seek assistance, Ohio, 1979

Agency	Sought assistance		No assistance		No answer		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
State forestry	15,700	44	21,400	9	600	1	37,700	11
Soil Conservation Service	1,100	3	5,500	2	200	W	6,800	2
Forest Service	700	2	1,600	1	-		2,300	1
Agricultural Stabilization and Conservation Service	3,500	10	3,300	2	-		6,800	2
Consultant or industry forester	100	W	100	W	-		200	W
Extension service	6,200	17	5,400	2	-		11,600	3
Other	500	2	3,100	1	1,900	3	5,500	2
Don't know	5,100	14	132,500	57	4,200	7	141,800	43
No answer	3,000	8	59,600	26	57,300	89	119,900	36
Total	35,900	100	232,500	100	64,200	100	332,600	100
				ACRES OWNED				
State forestry	739,600	46	417,700	11	23,600	2	1,180,900	18
Soil Conservation Service	60,800	4	106,100	3	11,600	1	178,500	3
Forest Service	190,600	12	80,300	2	-		270,900	4
Agricultural Stabilization and Conservation Service	106,500	7	119,800	3	-		226,300	3
Consultant or industry forester	124,600	8	5,800	W	-		130,400	2
Extension service	57,400	3	125,400	3	-		182,800	3
Other	22,900	1	51,000	1	5,700	1	79,600	1
Don't know	144,800	9	2,292,800	61	80,600	7	2,518,200	39
No answer	167,400	10	586,600	16	983,300	89	1,737,300	27
Total	1,614,600	100	3,785,500	100	1,104,800	100	6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 41.-Estimated number of private ownership units who have received forestry assistance and acres of commercial forest land owned, by type of assistance, Ohio, 1979

Type of assistance	Owners assisted		Acres owned	
	Number	Percent	Number	Percent
Timber marking	5,400	2	386,700	6
Timber stand improvement	3,200	1	317,600	5
Tree planting	2,300	1	129,700	2
Timber sales administration	1,000	W	118,700	2
Insect and disease control	100	W	19,200	W
Timber evaluation	2,700	1	230,800	4
Surveying	W	W	11,500	W
General forest management	13,500	4	618,100	10
Other	3,200	1	157,000	2
Service not specified	6,600	2	233,000	4
Total[a]	35,900	11	1,614,600	35

[a]Individual items do not add to total because some owners have received more than one type of assistance.
W-Fewer than 50 owners or less than 0.05 percent.

Table 42.-Estimated number of private ownership units and acres of commercial forest land owned, by availability for recreation, Ohio, 1979

Recreation availability	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
Owner permits recreation and does not recreate	19,000	6	34	284,600	5
Owner recreates and permits recreation	77,000	23	14	2,010,000	31
Owner recreates and excludes others recreation	129,200	39	11	2,483,700	38
Subtotal recreation	225,200	68	8	4,778,300	74
Recreation not permitted	44,200	13	22	664,300	10
No answer	63,200	19	16	1,062,300	16
Total	332,600	100	6	6,504,900	100

Table 43.-Estimated number of private ownership units and acres of commercial forest land owned, by type of recreational use, by the owner, the owner's family, or immediate circle of friends, Ohio, 1979

Recreation by owner family and friends	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
Hiking	108,800	33	11	2,602,700	40
Picnicking	57,800	17	16	1,464,900	23
Camping	32,000	10	13	1,238,400	19
Fishing	24,600	7	14	1,165,300	18
Hunting	133,000	40	10	3,435,200	53
Snowmobiling	12,200	4	24	256,000	4
Other	22,600	7	30	375,500	6
Any recreation[a]	206,200	62	8	4,493,700	69
No answer	126,400	38	12	2,011,200	31
Total	332,600	100	6	6,504,900	100

[a]Columns do not add to total because some owners permit more than one type of use.

Table 44.-Estimated number of private ownership units and acres of commercial forest land owned, by type of public use permitted, Ohio, 1979

Type of public use	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
Hiking	32,000	10	16	1,117,200	17
Picnicking	14,200	4	21	728,000	11
Camping	11,900	4	21	663,000	10
Fishing	10,200	3	24	727,600	11
Hunting	78,900	24	15	1,986,000	31
Snowmobiling	9,500	3	26	359,500	6
Other	3,300	1	47	132,500	2
All types[a]	95,900	29	13	2,294,600	35
Public use not permitted	159,600	48	10	2,928,900	45
No answer	77,100	23	14	1,281,400	20
Total	332,600	100	6	6,504,900	100

[a]Columns do not add to total because some owners permit more than one type of use.

Table 45.-Estimated number of private ownership units and acres of commercial forest land owned, by availability for recreational use and geographic unit, Ohio, 1979

Recreational use	South-Central		Southeastern		East-Central		Northeastern	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
Public use:								
Hiking	10,200	13	4,500	14	5,100	9	3,500	4
Hunting	20,200	25	4,700	15	17,100	30	19,700	22
All types[a]	24,400	30	7,700	23	18,700	32	23,800	27
Pub.use not permitted	40,600	51	20,900	63	22,800	40	41,400	47
No answer	14,900	19	4,600	14	16,200	28	23,100	26
Total	79,900	100	33,200	100	57,700	100	88,300	100
Owner recreation:								
Hiking	22,000	28	12,600	39	16,500	29	30,500	35
Hunting	43,100	54	16,100	50	25,300	44	23,800	27
All types[a]	54,000	68	26,800	81	36,200	63	43,900	50
No answer	25,900	32	6,400	19	21,500	37	44,400	50
Total	79,900	100	33,200	100	57,700	100	88,300	100
				ACRES OWNED				
Public use:								
Hiking	313,400	22	317,500	28	223,400	14	130,900	11
Hunting	500,500	35	423,100	38	445,900	28	290,300	24
All types[a]	529,800	37	501,000	44	522,500	33	358,600	30
Pub.use not permitted	685,100	48	469,700	42	660,300	41	553,900	46
No answer	207,700	15	156,100	14	419,700	26	289,100	24
Total	1,422,600	100	1,126,800	100	1,602,500	100	1,201,600	100
Owner recreation:								
Hiking	601,600	42	542,800	48	536,400	33	444,000	37
Hunting	921,600	65	743,600	66	797,000	50	483,900	40
All types[a]	1,073,600	75	908,800	81	1,020,600	64	705,900	59
No answer	349,000	25	218,000	19	581,900	36	495,700	41
Total	1,422,600	100	1,126,800	100	1,602,500	100	1,201,600	100

[a]Columns do not add to total because some owners permit more than one type of use.

Table 45.- continued

Recreational use	Southwestern		Northwestern		Total	
	Number	Percent	Number	Percent	Number	Percent
			OWNERS			
Public use:						
Hiking	3,300	10	5,400	13	32,000	10
Hunting	4,400	14	12,800	30	78,900	24
All types[a]	5,600	18	15,700	37	95,900	29
Pub.use not permitted	17,900	57	16,000	38	159,600	48
No answer	8,000	25	10,300	25	77,100	23
Total	31,500	100	42,000	100	332,600	100
Owner recreation:						
Hiking	12,700	40	14,500	35	108,800	33
Hunting	6,100	20	18,600	44	133,000	40
All types[a]	16,300	52	29,000	69	206,200	62
No answer	15,200	48	13,000	31	126,400	38
Total	31,500	100	42,000	100	332,600	100
			ACRES OWNED			
Public use:						
Hiking	57,300	12	74,700	11	1,117,200	17
Hunting	114,500	25	211,700	31	1,986,000	31
All types[a]	133,600	29	249,100	36	2,294,600	35
Pub.use not permitted	267,200	57	292,700	43	2,928,900	45
No answer	64,500	14	144,300	21	1,281,400	20
Total	465,300	100	686,100	100	6,504,900	100
Owner recreation:						
Hiking	216,300	46	261,600	38	2,602,700	40
Hunting	159,000	34	330,100	48	3,435,200	53
All types[a]	305,300	66	479,500	70	4,493,700	69
No answer	160,000	34	206,600	30	2,011,200	31
Total	465,300	100	686,100	100	6,504,900	100

[a]Columns do not add to total because some owners permit more than one type of use.

Table 46.-Estimated number of private ownership units and acres of commercial forest land owned, by availability for recreational use and size class, Ohio, 1979

Size of ownership	Public permitted		Not permitted		No answer		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
1 - 49 acres	86,900	26	145,100	43	72,500	22	304,500	91
50 - 499 acres	8,800	3	14,400	5	4,600	1	27,800	9
500+ acres	200	W	100	W	W	W	300	W
Total	95,900	29	159,600	48	77,100	23	332,600	100
				ACRES OWNED				
1 - 49 acres	980,600	15	1,465,100	22	706,100	11	3,151,800	48
50 - 499 acres	832,800	13	1,319,900	21	458,700	7	2,611,400	41
500+ acres	481,200	7	143,900	2	116,600	2	741,700	11
Total	2,294,600	35	2,928,900	45	1,281,400	20	6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

Table 47.-Estimated number of private ownership units and acres of commercial forest land owned, by availability for hunting, Ohio, 1979

Hunting availability	Private owners			Acres owned	
	Number	Percent	Sampling error(%)	Number	Percent
Owner permits hunting and does not hunt	22,000	7	29	415,900	6
Owner hunts and permits hunting	56,900	17	18	1,570,100	24
Owner hunts and excludes others hunting	76,100	23	12	1,865,100	29
Subtotal hunting	155,000	47	10	3,851,100	59
Hunting not permitted	109,700	33	14	1,548,500	24
No answer	67,900	20	15	1,105,300	17
Total	332,600	100	6	6,504,900	100

Table 48.-Estimated number of private ownership units and acres of commercial forest land owned, by reason for posting and use permitted, Ohio, 1979

Reason for posting	Public permitted		Not permitted		No answer		Total		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Sampling error(%)
				OWNERS					
Abuse of property	1,300	1	14,700	9	100	W	16,100	5	38
Safety	100	W	3,100	2	-	-	3,200	1	46
Liability	1,300	1	700	W	-	-	2,000	1	36
Control access	3,500	4	36,400	23	2,100	3	42,000	12	25
Control hunting	2,800	3	12,100	8	2,500	3	17,400	5	25
Reason not specified	3,600	4	6,100	4	2,500	3	12,200	4	28
All reasons	12,600	13	73,100	46	7,200	9	92,900	28	14
Land not posted	82,400	86	79,900	50	22,000	29	184,300	55	9
No answer	900	1	6,600	4	47,900	62	55,400	17	16
Total	95,900	100	159,600	100	77,100	100	332,600	100	6
				ACRES OWNED					
Abuse of property	68,900	3	358,600	12	12,100	1	439,600	7	
Safety	22,200	1	64,400	2	-	-	86,600	1	
Liability	58,300	2	101,500	4	-	-	159,800	3	
Control access	243,700	11	501,800	17	18,100	1	763,600	12	
Control hunting	108,700	5	278,600	10	18,400	2	405,700	6	
Reason not specified	82,400	3	182,400	6	25,000	2	289,800	4	
All reasons	584,200	25	1,487,300	51	73,600	6	2,145,100	33	
Land not posted	1,673,700	73	1,342,700	46	373,300	29	3,389,700	52	
No answer	36,700	2	98,900	3	834,500	65	970,100	15	
Total	2,294,600	100	2,928,900	100	1,281,400	100	6,504,900	100	

W-Fewer than 50 owners or less than 0.5 percent.

Table 49.-Estimated number of private ownership units and acres of commercial forest land owned, by whether land is posted and geographic unit, Ohio, 1979

	South-Central		Southeastern		East-Central		Northeastern	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
Land posted	13,600	17	14,500	44	13,300	23	33,300	38
Land not posted	58,200	73	13,700	41	32,400	56	33,900	38
No answer	8,100	10	5,000	15	12,000	21	21,100	24
Total	79,900	100	33,200	100	57,700	100	88,300	100
				ACRES OWNED				
Land posted	395,300	28	399,100	35	583,600	36	440,000	36
Land not posted	942,400	66	597,400	53	688,600	43	489,500	41
No answer	84,900	6	130,300	12	330,300	21	272,100	23
Total	1,422,600	100	1,126,800	100	1,602,500	100	1,201,600	100

Table 49.-continued

	Southwestern		Northwestern		Total	
	Number	Percent	Number	Percent	Number	Percent
			OWNERS			
Land posted	9,800	31	8,400	20	92,900	28
Land not posted	16,600	53	29,500	70	184,300	55
No answer	5,100	16	4,100	10	55,400	17
Total	31,500	100	42,000	100	332,600	100
			ACRES OWNED			
Land posted	152,700	33	174,400	25	2,145,100	33
Land not posted	260,800	56	411,000	60	3,389,700	52
No answer	51,800	11	100,700	15	970,100	15
Total	465,300	100	686,100	100	6,504,900	100

Table 50.-Estimated number of private ownership units and acres of commercial forest land owned, by size class and whether land is posted, Ohio, 1979

Size of ownership	Land posted		Land not posted		No answer		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
				OWNERS				
1 - 9 acres	51,400	16	99,200	29	33,300	10	183,900	55
10 - 49 acres	31,300	9	70,500	21	18,800	6	120,600	36
50 - 499 acres	10,100	3	14,400	5	3,300	1	27,800	9
500+ acres	100	W	200	W	W	W	300	W
Total	92,900	28	184,300	55	55,400	17	332,600	100
				ACRES OWNED				
1 - 9 acres	146,200	2	332,300	5	131,400	2	609,900	9
10 - 49 acres	734,200	11	1,411,400	22	396,300	6	2,541,900	39
50 - 499 acres	990,300	16	1,289,400	20	331,700	5	2,611,400	41
500+ acres	274,400	4	356,600	5	110,700	2	741,700	11
Total	2,145,100	33	3,389,700	52	970,100	15	6,504,900	100

W-Fewer than 50 owners or less than 0.5 percent.

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Birch, Thomas W. The forest-land owners of Ohio -- 1979. Resour. Bull. NE-74. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1982. 84 p.

A statistical analytical report on a mail canvass of private commercial forest-land owners in Ohio. The study was conducted in conjunction with the third forest survey of Ohio by the USDA Forest Service. It discusses landowner characteristics, attitudes, and intentions of owners regarding reasons for owning, recreational use, timber management, and harvesting.

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Keywords: Available timber, harvesting, forestry assistance, recreation, forest land ownership.

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.

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An Analysis of Ohio's Forest Resources

Donald F. Dennis

The Author

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Abstract

This report includes an analysis of the results of the third survey of Ohio's forest resources and trends that have occurred between surveys. Topics include forest area by ownership, stand size, and forest type; timber volume by species, location, and quality; biomass; timber products output; and growth and removals. Nontimber forest resources and uses—water, soil, coal, recreation, and fish and wildlife—are also discussed. Timber volume is projected over the next 30 years, and forest management opportunities that will improve the condition of Ohio's forests are identified.

Cover photo—Majestic forests such as these are found in Ohio's Hill Region.

An Analysis of Ohio's Forest Resources

Contents

Highlights

Total forest land increased by 7.4 percent (490,000 acres) since 1968; this included a 5.5 percent increase in commercial forest area.

• • •

Ohio's forests are maturing; there are more pole and sawtimber stands now than in 1968.

• • •

Timber volumes also increased significantly—48 percent, since 1968. Net growth has been more than three times removals for the period between surveys.

• • •

Timber quality has improved; sawlog quality has improved, and the percentage of timber considered cull has decreased.

• • •

Even though conditions have improved, forest management opportunities still exist: timber quality and species mix, wildlife habitat, recreational opportunities, and esthetic values can all be improved through forest management.

• • •

Forest Surveys of Ohio

The USDA Forest Service, in cooperation with the Ohio Department of Natural Resources, Division of Forestry, periodically inventories the forest resources of Ohio. Two previous inventories were conducted in Ohio and provide data for 1952 and 1968.

This report presents an analysis of the resource data from Ohio's third forest inventory conducted during 1977-79. Statistical data is published in "Forest Statistics for Ohio—1979" (Dennis and Birch 1981). The statistical report also contains information on inventory procedures and an explanation of methods used to compare results of the periodic inventories. A copy of the statistical report will be useful in following this analysis.

Background

Prehistoric Indians, who we now call Hopewell, were the first known inhabitants of Ohio. These people built burial and effigy mounds and left other remains that describe their culture. Although once a flourishing culture, all that remained when the white man arrived were the mounds and artifacts. Even the Eries, who later occupied the shores of Lake Erie, had been exterminated by the Iroquois before the arrival of the first Europeans. The Iroquois word for fine or good river is Ohio. The Ohio River has played an important role in shaping the state's history.

The French were the first Europeans to see Lake Erie and probably to explore the Ohio River. Louis Jolliet, a fur trader, was on the shores of Lake Erie in 1669, and the French explorer Rene Robert Cavelier is believed to have discovered and explored the Ohio River around this same time. Later, English fur traders arrived from New York, and friction developed between the two Nations. Carolina, Virginia, and Pennsylvania traders appeared in the early 18th century, and rivalry for control of the Ohio River produced the first clashes of the French and Indian War in 1754. The French gained dominance of the Ohio Valley but were ultimately forced to cede the whole northwest to Britain.

Indian troubles plagued the white man and inhibited settlement until after the Revolution when General "Mad Anthony" Wayne won the Battle of Fallen Timbers in the Maumee Valley near Toledo. After this defeat, the Indians accepted the Treaty of Green Ville in 1795, which opened up much of Ohio to white settlement.

At that time, Ohio's vast stretches of forest served as a barrier to agriculture. These forests were primarily old-growth hardwood stands that contained many gigantic trees. Some stands contained as much as 45,000 board feet per acre. Much of the cut timber was wasted but agriculture was emphasized at that time. Later a considerable amount of timber was used to produce charcoal used to fuel iron smelting furnaces and to manufacture various wood products.

Ohio pioneers were somewhat different from those that settled much of the East. They were often people of means who moved to Ohio to improve upon life rather than find opportunity for the first time (Wright 1957). Ohio was primarily an agricultural state, but after the War of 1812 the population grew rapidly and industry began to develop.

The Ohio River provided transportation to southern markets for farm surplus and various manufactured goods, including whiskey barrels, leather and woolen goods, paper, bricks, wagons, furniture, and farm equipment. Canal systems, the National Road (completed to Columbus in 1833), and toll roads constructed by turnpike companies also contributed much to Ohio's economic development. Markets also developed to the north and east and increased considerably with the coming of the railroad. By 1900, Ohio was a thriving manufacturing state, and except during the Depression years, this has continued.

Forests have been a part of Ohio's history. Pioneers often judged an area's desirability for agriculture by the type of forest present. Forests later provided the raw material for fuel and wood products. Today, Ohio's forests still supply many forest industries. They also supply many recreational opportunities, esthetic relief, and natural protection against erosion and water pollution. Forests continue to be important to the physical and emotional well-being of Ohio's residents. This report examines many aspects of Ohio's forest resources.

Pioneers often judged an area's desirability for agriculture by the type of forest present.

Geographic Regions

Ohio was divided into two distinct physiographic regions: The Hill Country covering the southeastern third of the state and the Glaciated Region covering the remainder of the state (Fig. 1).

Much of the Hill Country is part of the Allegheny Plateau and is characterized by hilly terrain, steep, winding valleys; and outcroppings of bedrock. It generally lacks agricultural richness except where rivers have deposited glacial silt enriching the lower valleys. The Hill Country comprises the 28 counties that form the South-Central, Southeastern, and East-Central units.

Figure 1.—Geographic regions and units of Ohio, 1979.

Ohio's Hill Country.

In the Glaciated Region, great ice sheets rounded off hills, filled valleys with fertile soil, and dammed streams creating lakes; many of which later became swamps. It is a region of flat and rolling plains, well suited for agriculture. The Glaciated Region includes the 60 counties that form the Northeastern, Southwestern, and Northwestern units. Much of the northwestern portion was once under Lake Erie and later constituted the Black Swamp area, an obstacle to pioneer settlement. Where drained, this land has become valuable for agriculture. Population density and the resulting pressure of development and urban sprawl are considerably greater in the Glaciated Region than in the Hill Country.

Each geographic region was divided into three geographic units (Fig. 1). These units were identical to those in the 1968 survey, except the 1968 Western Unit was divided into the Northwestern and Southwestern units. A few statistics for Ohio and each of the six units follow. Data for population are from the U.S. Department of Commerce, Bureau of the Census (1980).

Ohio

Counties: 88
Land area: 26,228,500 acres
Commercial forest: 6,917,100 acres (26%)
Per-acre volume of growing stock on commercial forest land: 924 cubic feet
Population: 10,797,419
Population density: 263.5 per square mile

South-Central Unit

Counties: 10
Land area: 3,307,500 acres
Commercial forest: 1,601,300 (48%)
Per-acre volume of growing stock on commercial forest land: 1,178 cubic feet
Population: 515,098
Population density: 99.7 per square mile

Flat rolling plains typify the Glaciated Region.

Southeastern Unit

Counties: 7
Land area: 2,075,500 acres
Commercial forest: 1,247,700 acres (60%)
Per-acre volume of growing stock on commercial forest land: 900 cubic feet
Population: 225,467
Population density: 69.5 per square mile

East-Central Unit

Counties: 11
Land area: 3,407,400 acres
Commercial forest: 1,657,700 acres (49%)
Per-acre volume of growing stock on commercial forest land: 719 cubic feet
Population: 521,993
Population density: 98.0 per square mile

Northeastern Unit

Counties: 17
Land area: 5,114,800 acres
Commercial forest: 1,240,400 acres (24%)
Per-acre volume of growing stock on commercial forest land: 856 cubic feet
Population: 4,370,971
Population density: 546.9 per square mile

Southwestern Unit

Counties: 16
Land area: 4,811,600 acres
Commercial forest: 470,200 acres (10%)
Per-acre volume of growing stock on commercial forest land: 1,030 cubic feet
Population: 3,489,105
Population density: 464.1 per square mile

Northwestern Unit

Counties: 27
Land area: 7,511,700 acres
Commercial forest: 699,800 acres (9%)
Per-acre volume of growing stock on commercial forest land: 924 cubic feet
Population: 1,674,785
Population density: 142.7 per square mile

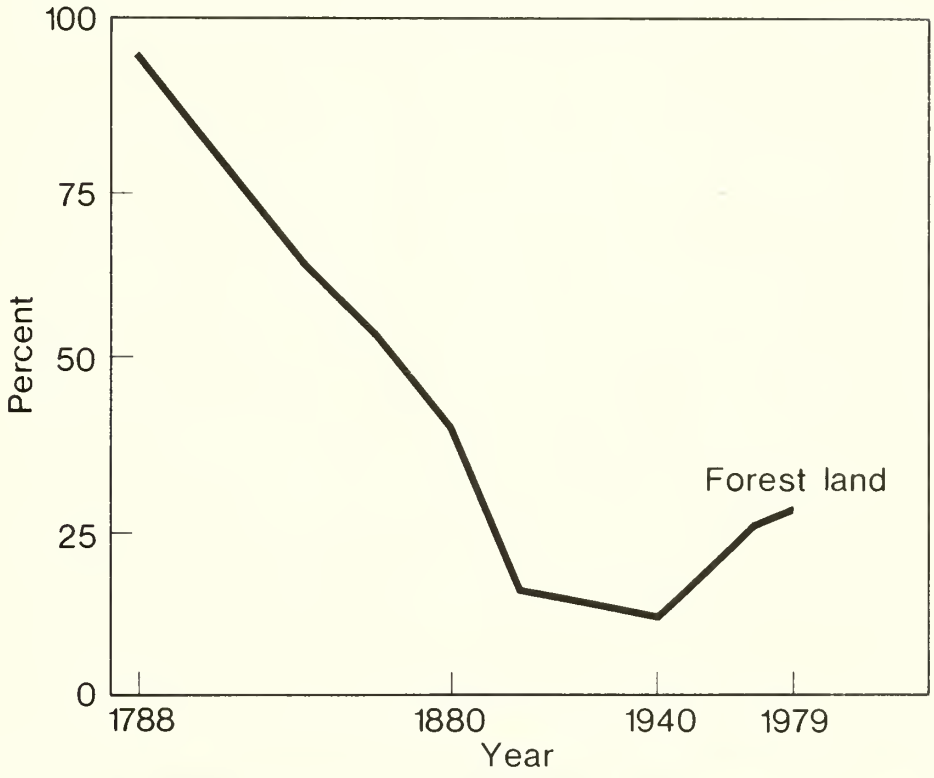
Forest Area

Ohio occupies 26,382,000 acres. This includes 158,000 acres of inland water (large lakes, rivers, and reservoirs) and 26.2 million acres of land. Just over 7.1 million acres, 27 percent, is forested. Most of this, 6.9 million acres, is considered commercial forest land (potentially productive forest land that is not administratively withdrawn from timber harvesting).

The remaining forest land (203,000 acres) falls into one of three categories: productive reserved, urban, or unproductive forest land. This land, though not a large portion of the total, is very important to many of Ohio's residents. Productive reserved forests, which include publicly owned parks and urban forests, provide recreational opportunities, important wildlife habitat, and esthetic relief. These benefits are also provided by trees and small forest stands (less than 1 acre) found on land classified as nonforest.

Before settlement, Ohio was almost entirely forested (Fig. 2). Land clearing, primarily for agriculture, steadily reduced the forest land base to about 15 percent as the 20th century began. This trend slowed significantly but was not reversed until 1940 when only 12 percent of Ohio remained forested. Since then, the forests have been recovering gradually and now occupy 27 percent of the state. This increase in forest land is mainly due to agricultural land reversion. Cropland has decreased approximately 7 percent since the 1968 survey but is still the most prevalent land use, accounting for 42 percent of Ohio's total area.

Figure 2.—Percentage of Ohio's land area in Forest for selected years.



Abandoned farmland that is reverting to forest is the source of most of Ohio's increased forest acreage.

Since our last survey in 1968, total forest land increased by 7.4 percent, almost 490,000 acres. During this same time, commercial forest land increased by 5.5 percent. This change varied across the state (Table 1).

Almost two-thirds of Ohio's commercial forest land is concentrated in the Hill Country, which is more than half forested. The Southeastern Unit clearly has the highest proportion of forest land—60 percent. Two counties, Lawrence and Vinton, are more than 70 percent forested, and six other counties are more than 60 percent forested. Forest land in the Hill Country increased slightly (2.5 percent) since the 1968 survey. This contrasts with the 33 percent increase that occurred between the 1952 and 1968 surveys.

Forest land increased more rapidly in the Glaciated Region (11.7 percent) than in the Hill Country since the 1968 survey. Although forest land is increasing, this is still a relatively open agricultural region. All but 12 of the 60 counties in the Glaciated Region are less than 20 percent forested (Fig. 3).

Forest Ownership

Almost all, 94 percent, of Ohio's commercial forest land is privately owned. Only 412,200 acres are publicly owned (Table 2). The Wayne National Forest includes 159,300 acres of commercial forest land; all of which is in the Hill Country. The state owns an additional 195,500 acres of commercial forest land, more than half of which is located in the South-Central Unit. Other federal and local government agencies hold the remaining 57,400 acres of other public forest land. Although public land is only 6 percent of the commercial forest land, it is quite important to many of Ohio's residents, particularly in providing opportunities for outdoor recreation.

The remaining 6.5 million acres of commercial forest land are held by a myriad of private owners, an estimated 332,600 in all. Ownership data are based on a questionnaire survey of private landowners conducted in conjunction with the forest survey of Ohio. More detailed ownership information may be found in "The Forest-Land Owners of Ohio" (Birch, in press).

Forest industries own 186,300 acres of forest land, 3 percent of the state total. An additional 529,400 acres (8 percent) is held by other corporations, much of which is held by coal companies and public utilities whose primary interest is coal extraction.

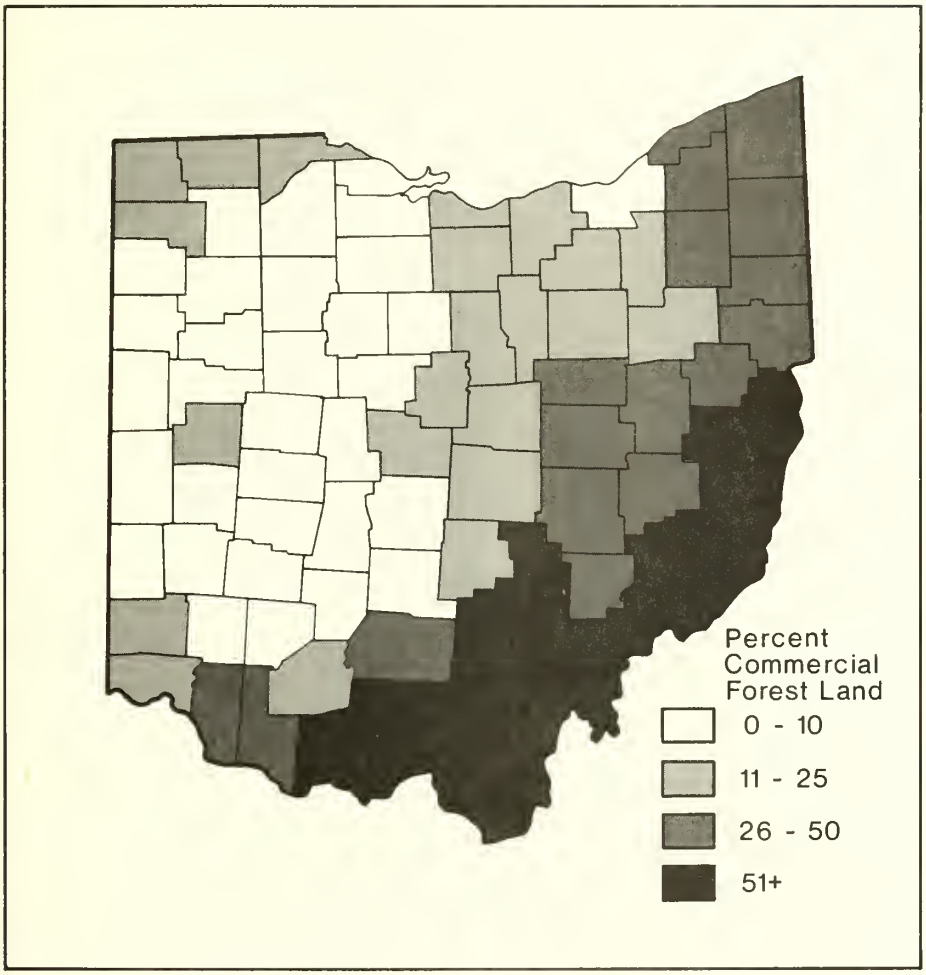
Farmers and other private owners hold the remaining 84 percent, 5.8 million acres, of Ohio's commercial forest land. This acreage is split about evenly between these two groups of owners. Most owners in each group are individuals, as opposed to partnerships, clubs, and other forms of ownerships. An estimated 305,200 individual owners collectively hold 5,159,400 acres of forest land in Ohio. These individuals have diverse occupations: 19 percent are professionals, white collar workers, or executives, 21 percent are retired, and 14 percent are farmers.

Table 1.—Area of commercial forest land by geographic unit and years, Ohio, 1952-79

Unit	1952	1968	1979	Percent change 1968-79
		(Thousand acres)		
		HILL COUNTRY		
South-Central	1,350[a]	1,560[b]	1,601	2.6
Southeastern	965	1,251	1,248	– .2
East-Central	995	1,586	1,658	4.5
Total	3,310	4,397	4,507	2.5
		GLACIATED REGION		
Northeastern	1,004[c]	1,130	1,240	9.7
Southwestern[d]	1,082	413	470	13.8
Northwestern[d]		615	700	13.8
Total	2,086	2,158	2,410	11.7
State total	5,396	6,555	6,917	5.5

[a] 1952 data for Hill Country is from Hutchinson 1954b.
[b] 1968 data for both regions is from Kingsley 1970.
[c] 1952 data for Glaciated Region is from Hutchinson 1954a.
[d] Only aggregate data are available for these two units for 1952.

Figure 3.—Distribution of forest land by percentage of commercial forest land in each county, Ohio, 1979.



Many of the individual forestland owners hold small amounts of forest land. Three-quarters of the owners hold less than 20 acres each and collectively own one-quarter of the individually owned forest land. The remaining 3.9 million acres are held by individuals who own at least 20 acres each and the average holding is approximately 50 acres. These larger holdings are more conducive to forest management. Most owners, however, hold their land for reasons other than timber production. Even if timber production is not their primary interest, owners with larger forest holdings are more likely to harvest timber. Thirteen percent of Ohio's individual owners plan to harvest timber from at least a portion of the million acres they own during the next 10 years.

Table 2.—Area of commercial forest land by forest-type group and ownership class, Ohio, 1979 (In thousands of acres)

Forest-type group	National Forest	Other public	Forest industry	Other corporate	Farmer	Misc. private	Total
White/red pine	9.4	17.4	19.3	23.7	45.7	50.4	165.9
Hard pine	10.0	—	6.8	18.9	61.0	43.2	139.9
Oak/pine	6.1	—	—	—	—	13.4	19.5
Oak/hickory	125.5	129.9	130.2	273.9	1,722.0	1,874.8	4,256.3
Elm/ash/red maple	1.7	13.2	—	110.3	309.8	316.7	751.7
Northern hardwoods	6.4	92.4	22.1	110.5	723.8	551.5	1,506.7
Aspen/birch	.2	—	—	—	26.6	50.3	77.1
Total	159.3	252.9	178.4	537.3	2,888.9	2,900.3	6,917.1

Stand Size

Area in both poletimber- and sawtimber-size stands increased significantly since the last survey (Fig. 4). Much of the reverting agricultural land, that was in the seedling-sapling stage in 1968 is now considered poletimber or in some cases sawtimber-size stands. It is possible for a 1968 seedling-sapling stand to move into the sawtimber category during the 11 years between surveys. For example, sapling stands may contain some poletimber or sawtimber trees, as in a reverting pasture or in a stand that has been severely high-graded or commercially clearcut. These scattered large trees plus trees maturing in the understory may put on enough volume to move this stand into the sawtimber category in just 11 years.

Similar stand-size changes occurred in both regions of Ohio (Fig. 5), though some differences exist. There are porportionately more seedling-sapling stands in the Hill Country, even though most of the cropland reversion since 1968 was in the Glaciated Region. These regional averages are influenced significantly by two units: the Hill Country's East-Central Unit, with the highest proportion of seedling-sapling stands, and the Glaciated Region's Northwestern Unit with the lowest proportion of seedling-sapling stands in the state. In the East-Central Unit, much strip-mined land has been planted with trees, creating stands currently in the seedling-sapling stage. In addition, some cropland that was abandoned due to stripping activities on neighboring land reverted to forest and is now seedling-sapling stands of pioneer species. In addition to having the lowest proportion of seedling-sapling stands, the Northwestern Unit also has the highest proportion of sawtimber stands in the state.

Figure 4.—Area of commercial forest land by stand size, Ohio, 1968 and 1979.

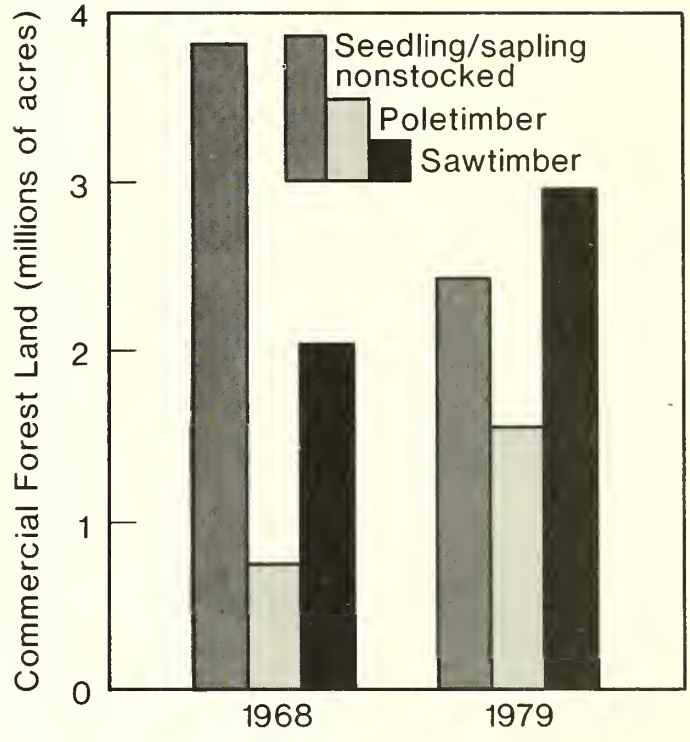


Figure 5.—Area of commercial forest land by stand size and geographic region, Ohio, 1968 and 1979.

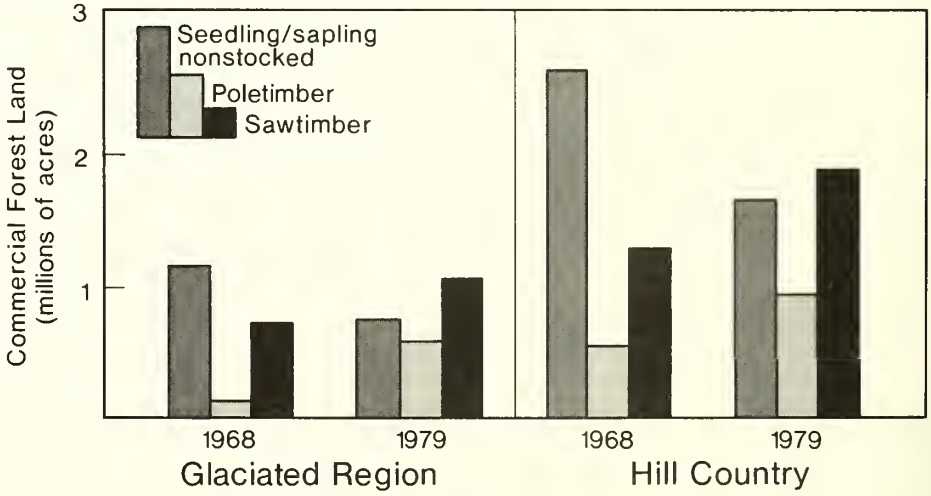


Table 3.—Area of commercial forest land by stand-size and ownership class, Ohio, 1979 (In thousands of acres)

Stand-size class	National Forest	Other public	Forest industry	Other corporate	Farmer	Misc. private	Total
Sawtimber stands	87.6	158.8	72.2	155.6	1,325.0	1,155.4	2,954.6
Poletimber stands	47.2	31.4	19.8	115.0	718.0	606.5	1,537.9
Sapling-seedling stands	21.2	52.5	65.0	266.7	780.2	1,022.9	2,208.5
Nonstocked areas	3.3	10.2	21.4	—	65.7	115.5	216.1
Total	159.3	252.9	178.4	537.3	2,888.9	2,900.3	6,917.1

Compared to other ownerships, public land, both national forest and state, has proportionately more area in sawtimber stands (Table 3). Much of this land has been held in public ownership for a relatively long time allowing stands to reach the sawtimber stage. Large size stands offer many opportunities for outdoor recreation, such as hiking and camping, and also provide habitat for many wildlife species.

The other corporate owner group, which includes coal companies and incorporated public utilities, had the highest proportion of seedling-sapling stands. Half of their holdings are in the seedling-sapling stage. Strip mining has certainly influenced stand development for these ownerships.

Forest Type

Ohio's commercial forest land has been categorized into 32 forest types, combined to form 7 major forest-type groups (Table 4). Three of these groups—oak/hickory, northern hardwoods, and elm/ash/red maple—account for 95 percent of the total forest area (Fig. 6). Softwood forest types, the oak/pine types, and aspen comprise the remaining 5 percent of Ohio's forest area.

Table 4.—Area of commercial forest land by forest type and forest-type group, Ohio, 1979 (In thousands of acres)

Forest type and forest-type group	Area
Red pine	41.0
White pine	124.9
Total white/red pine group	165.9
Shortleaf pine	15.6
Virginia pine	74.9
Eastern redcedar	36.7
Pitch pine	12.7
Total hard pine group	139.9
Shortleaf pine/oak	7.3
Other oak/pine	12.2
Total oak/pine group	19.5
Post, black, or bear oak	133.5
Chestnut oak	251.3
White oak	341.5
Northern red oak	116.2
Scarlet oak	16.2
White oak/red oak/hickory	1,076.0
Yellow-poplar	457.0
Sweetgum/yellow-poplar	25.4
Black locust	411.0
Black walnut	99.2

(Continued)

Table 4 (Cont.)

Forest type and forest-type group	Area
Sassafras/persimmon	287.2
Hawthorn/reverting field	348.7
Red maple/central hardwoods	284.7
Mixed central hardwoods	408.4
Total oak/hickory group	4,256.3
Black ash/American elm/red maple	607.1
River birch/sycamore	51.9
Cottonwood	27.9
Willow	49.5
Sugarberry/American elm/green ash	15.3
Total elm/ash/red maple group	751.7
Sugar maple/beech/yellow birch	613.2
Black cherry	280.9
Red maple/northern hardwoods	165.0
Mixed northern hardwoods	447.6
Total northern hardwoods group	1,506.7
Aspen	77.1
Total aspen/birch group	77.1
State total	6,917.1

Oak/hickory forests prevail throughout the midwest and mid-Atlantic regions. Ohio is no exception, with almost two-thirds of its commercial forest area in oak/hickory forests. The white oak/red oak/hickory type occupies more than a million acres and is clearly the most prevalent forest type in Ohio. It is found across the state on both glaciated and nonglaciated soils with a wide range of moisture conditions.

Significant differences exist between the distribution of forest types in the two regions of Ohio (Fig. 7). Oak/hickory forests are most common in both regions, however, they clearly dominate the Hill Country where they occupy almost three-quarters of the forested area. The yellow-poplar type, an important component of the oak/hickory group, is found almost exclusively in the Hill Country. This type is found on high-quality sites where soils tend to be deep, moist, and well drained. Undeveloped sites well suited to this forest type are rare in the highly agricultural Glaciated Region.

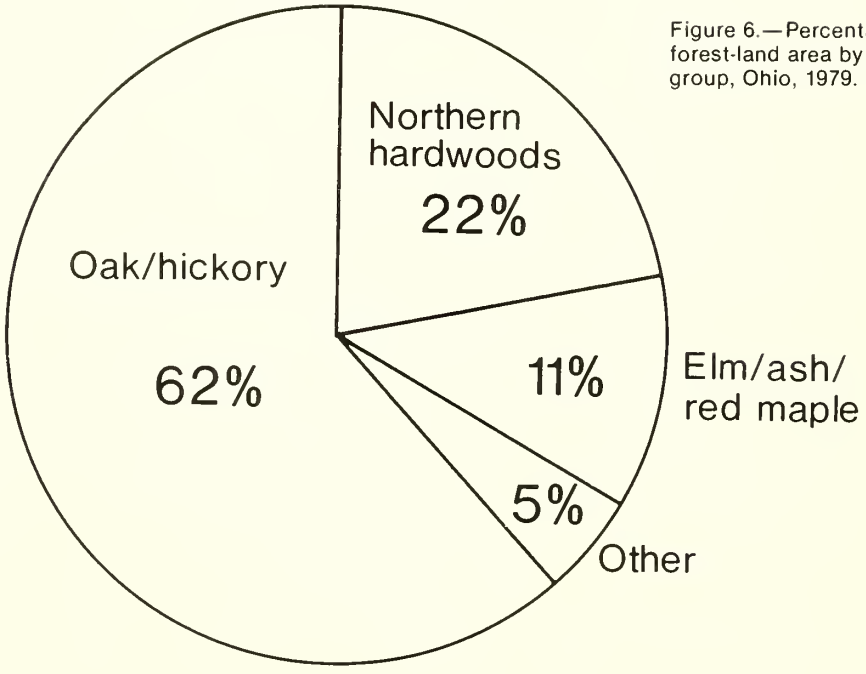
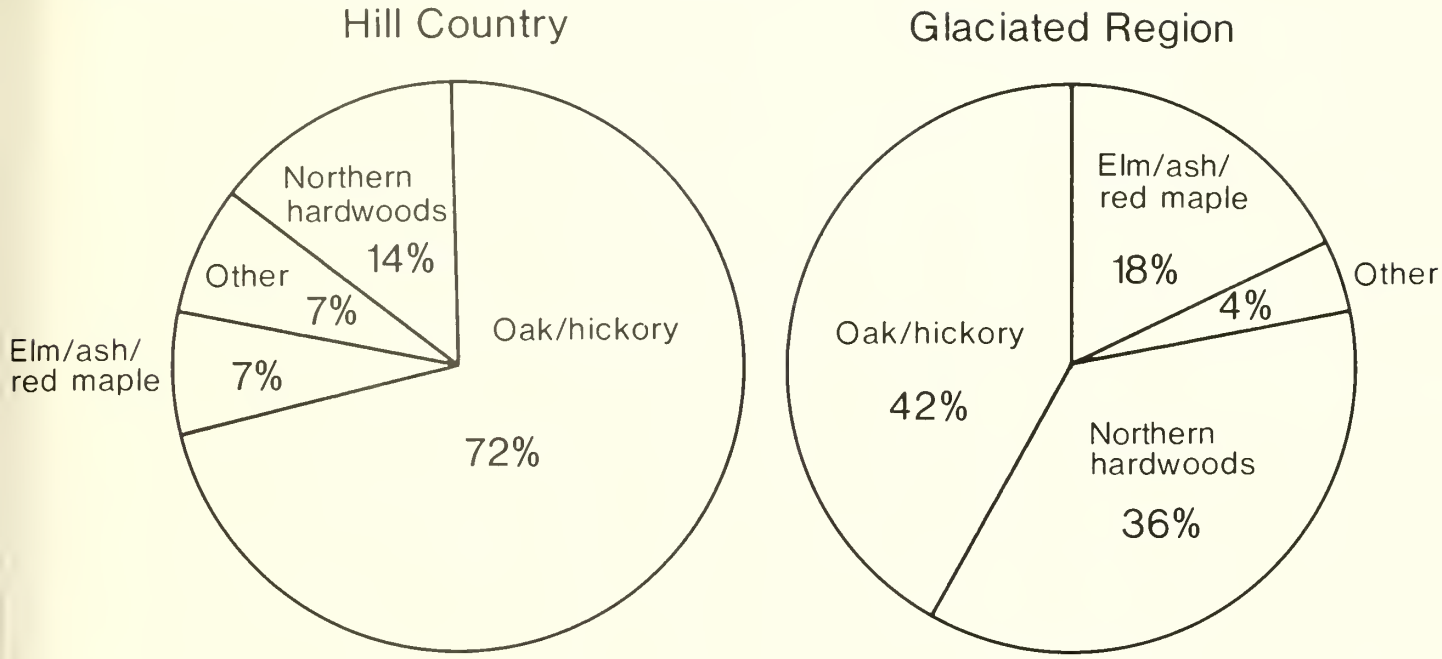


Figure 6.—Percentage of commercial forest-land area by major forest-type group, Ohio, 1979.

Figure 7.—Percentage of commercial forest-land area by major forest-type group and geographic region, Ohio, 1979.

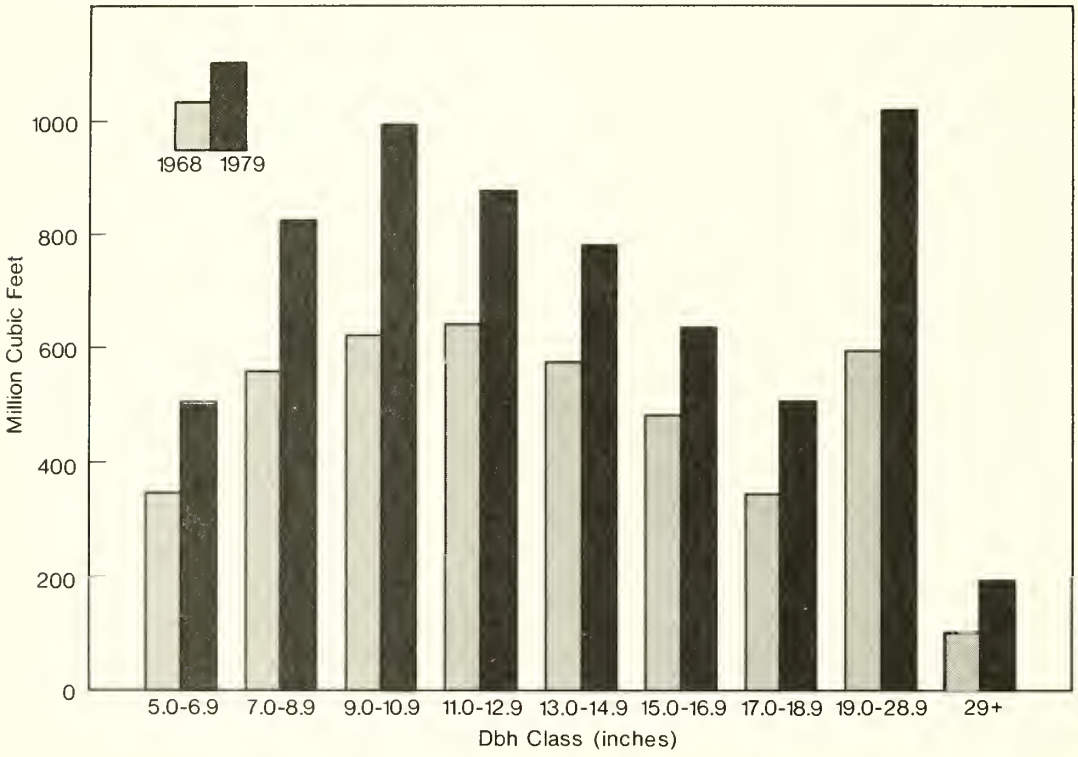


Black locust is frequently used for strip-mine reclamation.

Hawthorn/reverting field and sassafras/persimmon, two early succession forest types, together occupy 15 percent of the state's oak/hickory area. The hawthorn type occurs in both regions and has been greatly increased by human disturbance. It occurs on woodlot margins, old fence lines, old fields, and especially unmanaged pastures. The sassafras/persimmon type, almost exclusively confined to the Hill Country, occurs on upland old fields. Occurrence of these types is closely linked to the abandonment of marginal farmland in Ohio.

More than half the state's area in the black locust forest type, another component of the oak/hickory group, is concentrated in the East-Central Unit where strip mining has been quite active. It is often planted to control erosion and for strip mine reclamation because it provides quick cover and improves site quality (it's a legume), and its light crown encourages establishment of other species. It is also excellent for developing wildlife habitat on spoil banks.

Figure 8.—Distribution of growing-stock volume by diameter class, Ohio, 1968 and 1979.



Statewide, northern hardwoods cover a million and a half acres, almost a quarter of the commercial forest land. More than a third of the Glaciated Region is northern hardwoods compared to 14 percent found in the Hill Country. Compared to oaks, northern hardwoods tolerate cooler and moister conditions and therefore occur more frequently in the more northern Glaciated Region. The sugar maple/beech/yellow birch type is the most common northern hardwood type occupying over 600,000 acres.

The elm/ash/red maple type group is distributed similarly to the northern hardwoods with respect to the two geographic regions. Eighteen percent of the Glaciated Region is elm/ash/red maple compared to 7 percent in the Hill Country. Black ash/American elm/red maple is the principal type in this group and occupies just over 600,000 acres, statewide. This type is found on very moist sites—swamps, gullies, and depressions—and also occurs on glacially derived soils of varying textures where the drainage pattern causes a high water table (Eyre 1980). Conditions that favor this forest type tend to inhibit agricultural development. Much of the better drained land is devoted to farm use in the highly agricultural Glaciated Region.

Stand-size distribution among the major forest-type groups does not vary greatly. In general, the elm/ash/red maple, softwood, and aspen groups are in smaller size stands than the oak/hickory and northern hardwood groups. However, the stand-size variation among the individual forest types varies considerably. Information providing the breakdown of the acreage in the various forest-type groups by type of ownership is presented in Table 2.

Timber Volume

Dramatic Increase

Both growing-stock and sawtimber volumes increased tremendously (48 percent) since the 1968 survey. Growing-stock volume is now 6.4 billion cubic feet, and sawtimber volume is 20.4 billion board feet. Ohio's forests are maturing. Much land that was previously cutover or in agricultural use regenerated to forest and is now in the poletimber stage. Net growth also increased dramatically while timber removals dropped slightly, allowing volumes to build. Forest area supporting stands with more than 5,000 board feet per acre doubled since 1968.

This large volume increase is illustrated by the diameter class distribution of the growing-stock volumes in 1968 and 1979 (Fig. 8).

There was an across the board, volume increase and the overall shapes of the distributions remained similar between surveys. The bulge in the poletimber and small-sawtimber classes was maintained by continued ingrowth from younger stands. Over time, this bulge is expected to shift outward as Ohio's forests continue to mature. Similar bulges in volume have been observed in Pennsylvania and other states where significant cropland reversion or growth on cutover land occurred over a relatively short time.

Although the absolute volume change was greater in the Hill Country, which contains two-thirds of the state's growing-stock and sawtimber volumes, the Glaciated Region has shown a more rapid rate of increase (64 percent) since 1968. Net growth per acre was higher in the Glaciated Region for various reasons. Ingrowth has been a larger portion of gross growth in the Glaciated Region. Because ingrowth is picked up all at once (when the tree becomes 5 inches dbh), it contributes a great deal to percentage increases. Also, mortality and cull increment were a lower percentage of gross growth, and removals pressure has been less in the Glaciated Region, allowing volumes to build at a faster rate.

Generally, the intolerants or pioneer species such as aspen, black locust, black cherry, yellow-poplar, and white ash increased at the fastest rates. This is due to a number of reasons; one of which is their naturally fast growth rates. Many of Ohio's seedling-sapling stands originated on reverting farmland. These stands are now maturing and contributing sizable amounts of ingrowth, which translates into large percentage increases. Another reason for the rapid increase of these species is relatively low removals rates, particularly when compared to the oaks and hickories.

Although not increasing at a rate as fast as the intolerant species, oaks and hickories still dominate in terms of total volume. They have borne the brunt of the removals pressure, but still only half the net growth is being removed.

Quality Has Improved

Ohio's timber quality has improved. Sixteen percent of all trees more than 5 inches dbh are cull (trees that are too rough or rotten to be considered growing stock). This is an improvement since 1968 when 26 percent were classified cull. Three quarters of the cull trees were termed cull because their form was too rough. The remaining trees had too much rotten material to be considered growing stock.

The proportion of the total timber volume (in trees more than 5 inches dbh on commercial forest land) considered cull decreased from 14 percent in 1968 to 7 percent in 1979. This decrease in both number and volume of cull trees indicates a substantial improvement in the condition of Ohio's forests. Many factors influence changes such as these. The vigorous growth stage of the forest, the increased use of fuelwood and other products using lower quality timber, and good forest protection from fire and pests are some of the factors aiding in the improvement of Ohio's timber resource.

Sawlog quality has also improved. The percentage of hardwood sawtimber in grade 1 and 2 material has increased from 33 percent in 1968 to 37 percent in 1979. The volume of grade 1 and 2 material has increased by 2.6 billion board feet. Size is an important criteria in determining sawlog quality. To become Grade 1 material, hardwoods must attain a minimum diameter of approximately 15 inches. As the previously mentioned bulge in volume moves outward into the larger diameter classes, an additional improvement in quality is expected. Many well-formed, young trees will move into the better grades as their size increases. Also, many of the factors that reduced the proportion of rough and rotten trees will enhance sawlog quality as well.

Species

The top 10 species groups in Ohio in 1979 were:

Species	*Percent of total volume*
GROWING STOCK	
Select white oaks	12
Hickory	9
Other red oaks	9
Yellow poplar	8
White ash	7
Hard maple	7
Select red oaks	6
Soft maple	6
Chestnut and post oaks	5
Black cherry	4
SAWTIMBER	
Select white oaks	15
Other red oaks	11
Yellow-poplar	9
Hickory	8
Select red oaks	8
Hard maple	6
White ash	6
Chestnut and post oaks	6
Beech	4
Soft maple	4

Select white oaks. White oak, swamp white oak, bur oak and chinkapin oak are included in this group in Ohio. White oak is by far the most prevalent, accounting for 86 percent of the select white oak growing-stock volume. This commercially valuable group accounts for 12 percent of the growing-stock and 15 percent of the state's sawtimber volumes. Growing-stock volume has increased by 30 percent, and sawtimber volume by 38 per-

cent since the 1968 survey. White oak often becomes dominant in stands because it has the ability to thrive for long periods in the understory and respond quickly to release (Fowells 1965).

Percentage of growing-stock volume by species and diameter class in 1979 is given in Table 5. More than three-quarters of the select white oak volume is in sawtimber-size trees with more than half in trees above 15 inches dbh. White oak is a naturally long-lived tree capable of reaching 150 feet tall and 8 feet in diameter. Sawlog quality is fairly good with 43 percent of the volume in grade 1 or 2, an improvement since 1968. In addition, only 5 percent of the select white oak trees are considered cull.

White oak is found across the state and grows well on a wide range of soils and sites. It ranks first in the Hill Country and third in the Glaciated Region in terms of growing-stock volume. White oak is particularly concentrated in the South-Central Unit where almost 40 percent of its volume is found.

Hickory. Hickory ranked second in growing-stock and fourth in sawtimber volume. Hickory occurs frequently in both regions and is particularly abundant in the Northwestern Unit, where it accounts for 20 percent of the total growing-stock volume. Figure 9 shows growing-stock volume in Ohio by species, in 1968 and 1979.

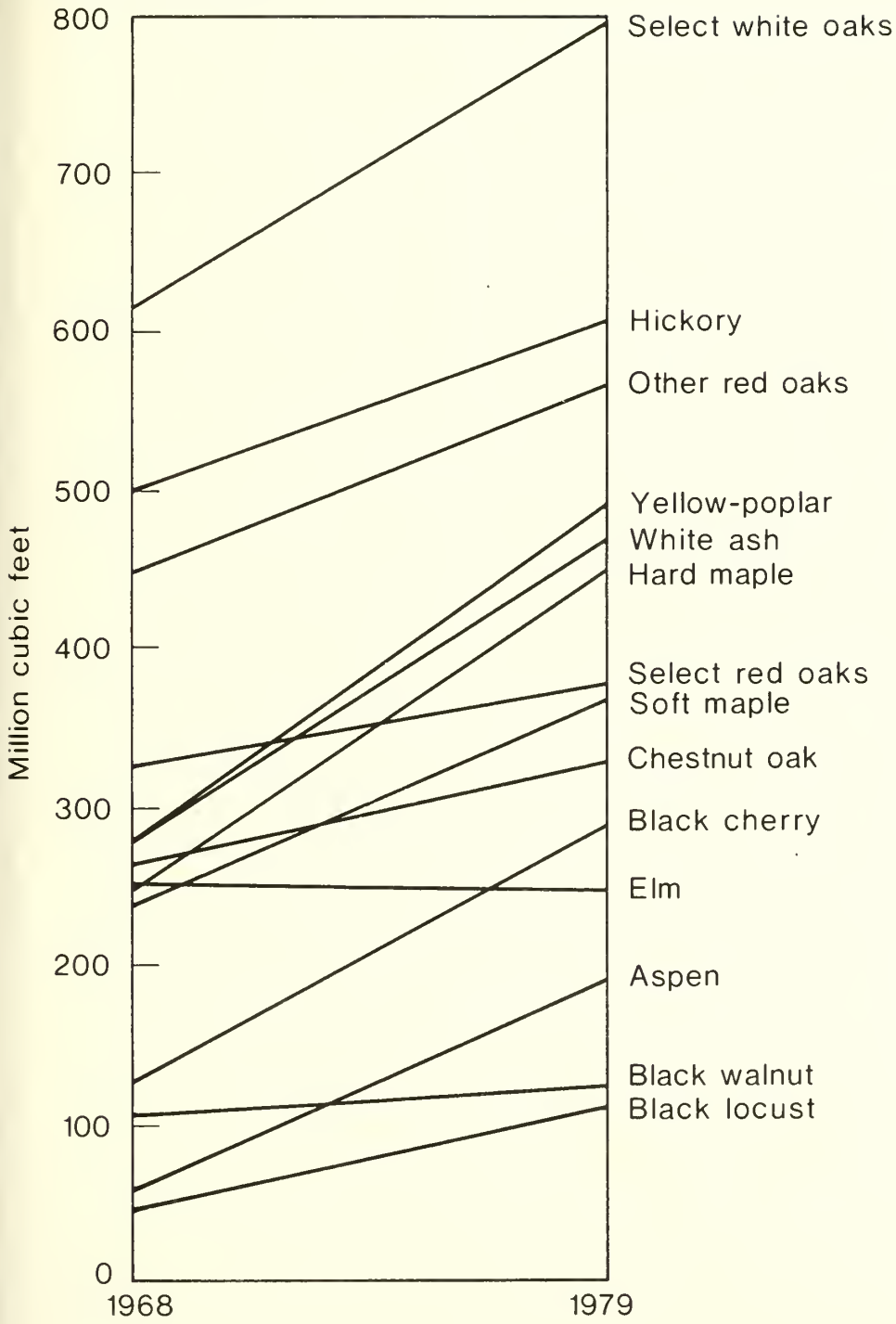
Sawlog quality has improved but still only 30 percent of the sawtimber volume is in grade 1 and 2 material. This is partially explained by its relatively small size when compared to the oaks. Only a quarter of its growing-stock volume is in trees more than 15 inches dbh. Quality should continue to improve as diameters increase. Only 6 percent of all trees are considered cull.

Table 5.—Percent of growing-stock volume by species and diameter class, 1979

Species	Diameter class (inches at breast height)										
	5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–28.9	29+	Total
White and red pine	17	31	23	22	4	3	—	—	—	—	100
Virginia pine	14	25	30	16	10	3	1	1	—	—	100
Other softwoods	19	13	23	18	16	7	1	2	1	—	100
Total softwoods	17	22	25	18	11	5	1	1	W	—	100
Soft maple	15	19	17	12	9	7	5	4	8	4	100
Hard maple	8	13	17	16	12	11	8	7	6	2	100
Hickory	8	17	19	16	14	10	7	4	5	W	100
Beech	4	8	12	15	8	8	6	10	22	7	100
White ash	9	14	17	13	14	10	10	4	7	2	100
Black walnut	5	18	21	14	16	13	5	6	2	—	100
Yellow-poplar	4	10	14	15	13	14	10	6	13	1	100
Sycamore	3	7	16	15	10	9	8	9	14	9	100
Aspen	14	22	17	17	8	5	2	1	6	8	100
Black cherry	8	17	23	16	14	9	3	5	4	1	100
Select white oaks	4	8	10	10	14	14	13	9	14	4	100
Select red oaks	4	7	10	9	12	10	9	9	19	11	100
Chestnut oak (and post)	3	8	13	19	16	15	8	6	9	3	100
Other red oaks	3	7	10	11	13	11	12	9	19	5	100
Black locust	14	20	27	14	11	7	4	0	2	1	100
Elm	21	22	20	12	8	4	5	3	5	—	100
Other hardwoods	14	14	17	13	11	8	6	5	9	3	100
Total hardwoods	8	13	15	14	12	10	8	6	11	3	100
Total all species	8	13	16	14	12	10	8	6	10	3	100

W—Less than 0.5 percent.

Figure 9.—Growing-stock volume in Ohio by species, 1968 and 1979.



Other red oaks. Scarlet oak, shingle oak, pin oak, and black oak are included in this category in Ohio. Black oak, by far the most prevalent, is intermediate in shade tolerance and does very well on dry sites. However, pin oak is a wet-site intolerant species.

Other red oaks rank third in growing-stock and second in sawtimber volume, statewide. They have exhibited a 25 percent increase in growing-stock volume and a 39 percent increase in sawtimber volume while sustaining a relatively high removals rate. Still, 80 percent of its volume is in sawtimber-size trees with half being in trees above 15 inches dbh. Sawlog quality is somewhat poorer for other red oaks than for other oaks despite its high percentage of large trees. But only 4 percent of all other red oaks more than 5 inches dbh are cull.

Yellow-poplar. One of the fast-growing intolerants, yellow-poplar increased its volume significantly since the previous survey. Both growing-stock and sawtimber volume increased by more than 75 percent because yellow-poplar is a naturally fast growing species and experienced relatively low removals pressure and a low mortality rate.

Yellow-poplar is often a pioneer on abandoned farmland or cutover land. It is somewhat demanding in its soil and moisture requirements and is usually found on moderately moist, well-drained, loose textured soils. It rarely grows well in very dry or very wet situations. Almost all of Ohio's yellow-poplar volume is found in the Hill Country. Sites ideally suited for yellow-poplar and not devoted to agriculture are rare in the Glaciated Region.

Yellow-poplar, often a pioneer species on abandoned farmland, has significantly increased in volume.

Very few (3 percent) of the yellow-poplar trees above 5 inches dbh are considered cull. Yellow-poplar is unusually free from disease problems. More than two-thirds of the growing-stock volume is in sawtimber-size trees, and sawlog quality is slightly better than the average for all hardwoods.

White ash. White ash, another fast growing pioneer species that often seeds in on the more fertile abandoned fields, is also gaining volume rapidly. Low removals pressure helped foster a 66 percent increase in growing-stock volume. Unlike yellow-poplar, white ash is concentrated in the Glaciated Region. Much of the white ash volume (43 percent) is in poletimber size trees, which helps to explain its low removals rate. White ash is shade tolerant when young and decreases in tolerance as it gets older. It becomes less common in the larger size classes.

Sawlog quality is fairly good despite its relatively small size; only a third of its volume is in trees above 15 inches dbh. Its single stemmed nature and quick self-pruning characteristics help to improve quality. Twelve percent of the white ash trees above 5 inches dbh were considered cull.

Ash's straight grain, strength, good bending properties, capacity to wear smooth, and high shock resistance make it desirable for many products such as: tool handles, furniture, flooring, millwork and, of course, baseball bats.

Hard maple. Hard maple, almost entirely sugar maple, is a tolerant species that is increasing at a rapid rate. Growing-stock volume increased by 81 percent since 1968. It ranks sixth in both growing-stock and sawtimber volumes. Good seed production and prolific sprouting assure reproduction and its continued existence throughout its range. Sugar maple has also experienced light removals pressure and a low mortality rate, allowing volumes to build.

Sugar maple is a long-lived species, capable of reaching large sizes. Currently about one-third of its volume is in trees more than 15 inches in diameter. If removals pressure remains light, sawtimber volumes will increase significantly. Sawlog quality is below that of the oaks but should improve as diameters increase and approach the oak diameter distribution. Only 8 percent of the hard maples above 5 inches dbh are considered cull, which is split about evenly between rough and rotten trees. Hard maples are found across the state but are most prevelent in the South-Central and Northeastern units.

Select red oaks. Northern red oak was the only select red oak encountered in our survey of Ohio. It is distributed across the state, ranking seventh in growing-stock and fifth in sawtimber volume. Growing-stock volume increased by a modest 16 percent since the previous survey. Removals pressure has been relatively high for this species.

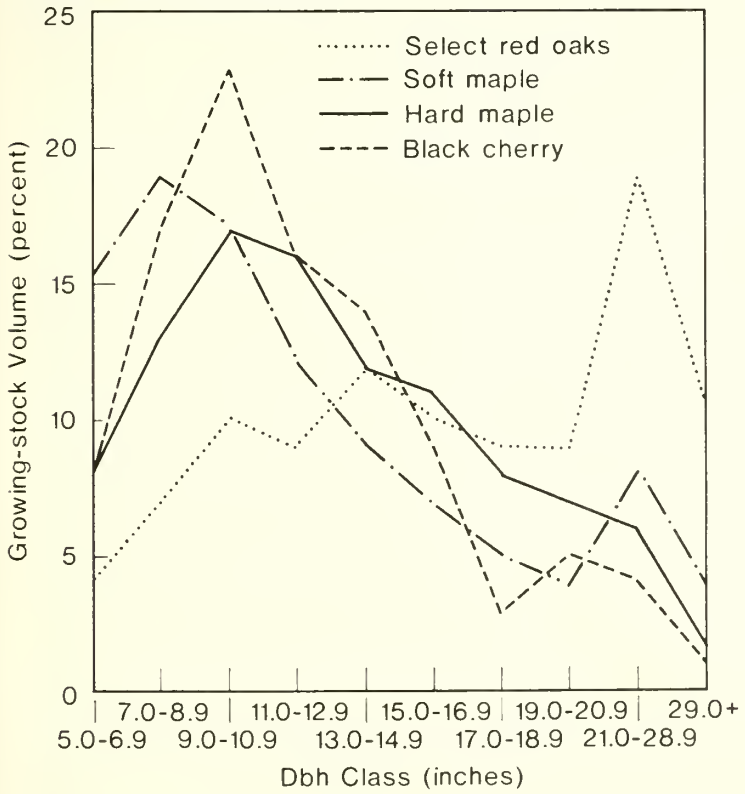
Almost 80 percent of the volume is in sawtimber trees; most volume is in trees above 15 inches dbh. Sawlog quality is quite good with more than half the sawtimber volume in grade 1 or 2 material. Northern red oak develops a tall

straight bole and prunes itself well under forest conditions. This and the high percentage of large trees account for the good sawlog quality. Cull trees comprise only 5 percent of the total number of live northern red oaks, and mortality does not seem to be a problem.

Soft maple. This category is primarily red maple but does include some silver maple. Red maple is found on a wide range of sites and is a component of many forest types. It is found across the state, but three-quarters of its volume is found in three units: the South-Central, East-Central and Northeastern units. Growing-stock volume increased quite rapidly, 55 percent, but sawtimber volume increased by only 18 percent since 1968. Both removals and mortality have been relatively low.

Ohio's red maple diameter distribution is skewed toward the lower diameter classes (Fig. 10). Half of the growing-stock volume is in poletimber and about a quarter is in trees above 15 inches dbh. Small size and the fact that red maple is not a preferred timber species, help explain the low removals rate. Small size also contributes to red maple's poor sawlog quality, only 24 percent is grade 1 or 2. Red maple is relatively short lived, when compared to sugar maple, and is quite susceptible to insect and disease attacks as well as physical damage. So, improvement in quality is not as promising as it is with sugar maple. So far, mortality has not taken a greater toll because most of the red maple is still fairly young.

Figure 10.—Diameter-class distribution for selected species, Ohio, 1979.



Chestnut oak. This group includes a small amount of post oak. Chestnut oak is typically an upland, dry-site oak and is almost exclusively found in the Hill Region. It is particularly concentrated in the South-Central Unit, which accounts for 63 percent of its volume. The rate of growing-stock volume increase has been similar to the other oak groups, and sawtimber increase has been slightly higher. Unlike the other oak groups, chestnut oak volume is concentrated in the large poletimber and small sawtimber classes. The other oaks are generally larger. Chestnut oak is naturally a medium-size species that normally reaches 60 to 80 feet in height and 20 to 30 inches in diameter on good sites.

Sawlog quality is fairly good with 42 percent in grade 1 and 2 material. Chestnut oak is intermediate in tolerance. It self prunes relatively well in forest conditions and will often show excellent form on good sites. Only 7 percent of the chestnut oak trees are cull.

Black cherry. Growing-stock volumes more than doubled since the 1968 survey. Black cherry, often a pioneer species, has a fast natural growth rate. Its diameter distribution is currently skewed toward the smaller classes (Fig. 10) with almost half of the growing-stock volume in poletimber-size trees. Sawlog quality is poor with only 24 percent of

the sawtimber in grade 1 or 2 material. This is partially due to the abundance of small-size trees. One out of five black cherry trees is considered cull.

Three-quarters of Ohio's black cherry volume is found in the Northeastern and East-Central units linking it with Pennsylvania's concentration of black cherry.

Elm. Elm was the only major species group to decline in volume since the previous survey. Growing-stock volume declined very slightly and sawtimber volume declined by almost 40 percent. Dutch Elm Disease, which attacks large elms, was responsible for this decline. Most of the current elm volume is in poletimber-size trees.

Almost a third of the remaining elm sawtimber is in grade 1 or 2 material. Elm is found across the state but is more frequent in the East-Central Unit, which contains about a third of the total growing-stock volume.

Beech. American beech increased moderately in volume—43 percent for growing stock and 22 percent for sawtimber. Sawtimber removals have been quite high for beech, which helps explain its low sawtimber increase.

Beech is a long-lived, shade tolerant species. Three-quarters of the growing-stock volume is in sawtimber-size trees with more than half in trees larger than 15 inches dbh. Despite beech's large size, sawlog quality is poor with only 18 percent in grade 1 or 2 material. Open-grown trees develop short, thick trunks, and epicormic branching is induced by stand cuttings such as hygrading operations, which in the past have left beech in favor of the more desirable timber species. Beech's thin bark makes it highly vulnerable to injury that often leads to rot. These factors will reduce sawlog quality. Beech is found across the state but occurs more frequently in the Glaciated Region.

Natural reproduction of aspen.

Aspen. Both bigtooth and quaking aspen occur, but bigtooth aspen is much more common in Ohio. Aspens are least common in the South-Central Unit and most common in the East-Central Unit. Some aspen has been planted for strip-mine reclamation, but most has come in naturally. It is a pioneer species that may become established quickly on abandoned farmland.

Aspen volume has shown a spectacular increase since 1968. Growing-stock volume has more than tripled, and sawtimber volume has quadrupled. In absolute terms, this increase does not impact the Ohio timber resource because aspen still represents only 3 percent of the total volume. However, it does illustrate change in Ohio—reversion of farmland with the resultant increase in pioneer species.

An increase in aspen is generally good for wildlife. Deer commonly browse on aspen sprouts and leaves. Grouse will also use aspen buds as a major winter food.

Aspen is a fast growing, medium size tree. More than half of its growing-stock volume is currently in poletimber-size trees. Ohio's aspen are generally in good condition with only 2 percent of the trees more than 5 inches dbh considered cull. It is a short-lived species and unless used, may deteriorate rapidly.

Aspen is a soft, lightweight wood with relatively low strength. It does have good nail holding ability and seldom splits when nailed. It is mainly used for pulp products and does make an excellent container wood.

A fine black walnut stands tall.

Black walnut. This highly valued species increased modestly in both growing-stock and sawtimber volumes. These increases occurred primarily in the Glaciated Region. Pure stands of black walnut are rare as this species typically occurs as scattered trees or in small groups within the forest.

Only a quarter of its volume is in trees more than 15 inches in diameter. Black walnut is a fairly long-lived species that can reach large sizes. However, large black walnuts are highly valued for veneer production, and many are cut for this use. Sawlog quality is below that of the oaks which is not surprising since its size is generally smaller than that of the oaks.

Sycamore. Sycamore is a fast-growing, basically wet-site tree, most commonly found on flat land with abundant water. It is sometimes a pioneer on upland old fields but does not grow best on these sites. Sycamore occurs across the state but is more common in the Glaciated Region where it is an important component of the elm/ash/red maple group.

It is a relatively long lived, intermediate to intolerant species capable of reaching very large diameters. Its volume is concentrated in the larger diameter classes in Ohio, similar to that of the oaks. Sycamore's volume increase has roughly paralleled that of the state's total volume.

Black locust. Although still a small portion of the total, black locust doubled its growing-stock volume since 1968. Black locust is a very intolerant species but can adapt to a wide range of conditions when competition is limited. It is a legume and a desirable, frequently used species for strip-mine reclamation. Symbiotic, nitrogen-fixing bacteria, associated with root nodules, increase the nitrogen content of the soil, and its litter decomposes rapidly, recycling nutrients. Black locust volume is concentrated in the East-Central Unit where strip mining has been quite active and much black locust has been planted. Black locust will also encroach on abandoned farmlands by root suckers at rates of up to 10 feet per year.

Most of black locust's growing-stock volume is in poletimber-size trees. Not surprising, sawlog quality is basically poor. About a third of the black locust trees more than 5 inches dbh are cull due mostly to rot. This species is often attacked by the locust borer (*Megacyllene robiniae)*, which weakens the tree and makes it unfit for most commercial uses. Black locust is often used for fencing because of its natural durability and nail holding ability. It is a very dense, strong wood.

Softwoods. Although still a small portion of the total, Ohio's softwood volume more than doubled since 1968. White and red pine are concentrated in the East-Central Unit, which contains half of the states volume of these species. Much of the remaining volume is found in the two northern units. Almost all of the white and red pine volume occurs in plantations, which are currently in the poletimber and small sawtimber stage.

Virginia pine is concentrated in the South-Central and Southeastern units which form the northern boundary of this species' natural range in Ohio. Unlike white and red pine, Virginia pine is primarily of natural origin in Ohio.

Geographic Units

South-Central Unit. This unit has the highest per-acre and total timber volume. The South Central Unit, primarily oak/hickory forests, has more oak, hickory, yellow-poplar, and hard maple than that in any other unit. Stocking levels are quite good with half the commercial forest area fully stocked with

growing-stock trees. Volumes per acre of both growing stock and sawtimber are high for all stand size classes. Sawtimber stands average 6,500 board feet per acre, and scattered sawtimber trees on seedling/sapling stands average 800 board feet per acre. Cull is generally low, only 5 percent of the total timber volume, and quality is high with 42 percent of the sawtimber volume in grade 1 and 2 material.

Southeastern Unit. The Southeastern Unit ranks third in commercial forest area and growing-stock volume and a distant second in sawtimber volume. Per-acre volumes approximate the state average. Select white oak has the most volume and is followed by yellow-poplar. Hickory and the other oaks are also quite common. Just over 80 percent of the unit's growing-stock volume is found in the oak/hickory type group.

East-Central Unit. This unit ranks second in growing-stock and third in sawtimber volumes. Strip-mine activities have had more impact on this unit than on any other area in Ohio. It has the largest acreage of commercial forest land but the lowest volume per acre. Its forests are generally younger than those of other Hill Country units; the proportion of seedling/sapling stands is highest in this unit. This is basically due to strip mining in this unit and to the earlier abandonment of cropland in the more rugged southern Hill Country units.

The East-Central Unit contains half the state's black locust volume. This species is excellent for strip-mine reclamation and was frequently used for that purpose in this unit. Other pioneer species—yellow-poplar, red maple, black cherry, and aspen—are commonly found here. Strip mining activity sometimes causes abandonment of neighboring cropland, allowing the pioneer species to become established. Much of Ohio's white and red pine volume is also found here, primarily in plantations now in the poletimber stage of development.

Northeastern Unit. Although somewhat below the Hill Country units in commercial forest area and total timber volume, the Northeastern Unit clearly leads the Glaciated Region in both categories. It does, however, have lower per-acre volumes than those in the other two glaciated units. Stocking levels are relatively low with only a third of the area fully stocked with growing-stock trees. Much of this unit's volume is presently in poletimber trees. Per-acre volumes will increase as these trees mature. Sawtimber quality is not particularly good but should improve with the increase in tree size.

Compared to other units, the Northeastern Unit has significantly more area and volume in northern hardwood stands. Hard maple, white ash, and black cherry are the growing-stock volume leaders. This unit also contains a large amount of Ohio's red maple and beech volumes.

Southwestern Unit. This unit has the smallest commercial forest area and the lowest timber volume. Per-acre volumes are quite high though; only the South-Central Unit has more volume per acre of forest land. Almost half of the forest is in sawtimber stands averaging 6,300 board feet per acre. Seventy percent of the growing-stock volume is in sawtimber-size trees with much in trees greater than 15 inches dbh. This results in high-quality sawtimber; just over 40 percent of the sawtimber volume is in grade 1 or 2 material. White ash and select white oak are the volume leaders and together account for a third of the unit's sawtimber volume.

Northwestern Unit. More than half of the forest stands in this unit are in the sawtimber stage. Trees are generally large; 64 percent of the unit's growing-stock volume is in sawtimber-size trees. Per-acre volumes, however, are not high. Poletimber and seedling/sapling stands in this unit have relatively low volumes when compared to those in other units.

Hickory leads in both growing-stock and sawtimber volumes. White ash and select white oak are also important species in this unit.

Biomass

The main focal points of our timber inventory are growing-stock and sawtimber volumes on commercial forest land, but these volumes do not include Ohio's total timber volume. Growing-stock volume includes only the net volume in trees 5 inches dbh and larger, from a 1-foot stump to a minimum 4-inch top diameter outside bark or to the point where the central stem breaks into limbs. It does not include volume in cull trees or noncommercial species. Trees occurring on noncommercial or nonforest land are excluded entirely. These excluded volumes may be important to some, but were not within the scope of this survey.

Advances in technology for whole-tree chip harvesting and manufacturing products from chips have enabled operators to use smaller trees, tops, branches, and other nongrowing stock sources to meet wood requirements (see Timber Products). These sources are increasingly sought after for fuelwood to relieve high energy costs for both domestic and industrial use. This has stimulated a need for biomass information. Tables 6 and 7 supply data on the total green weight of aboveground biomass on commercial forest land in Ohio. These data include noncommercial species that are combined with the rough and rotten commercial species.

Just over half (56 percent) of the total biomass is in the merchantable stem portion of growing-stock trees more than 5 inches dbh. The remainder is in tops, branches,

Whole-tree chip harvesting has enabled operators to use smaller trees, tops, branches, and other nongrowing stock sources to meet wood requirements.

small trees, noncommercial species, and the merchantable stem portion of rough or rotten trees. Tops and branches comprise 21 percent of the total biomass. They comprise 24 and 27 percent, respectively, of the biomass found in growing-stock and cull trees. Compared to rough or rotten trees, growing-stock trees, are typically better formed and have proportionately less biomass in tops and branches. However, large trees, which are more likely to be harvested, have proportionately more total biomass in tops and branches. This proportion is 30 percent of the biomass in growing-stock trees 21 inches dbh or more. Tops and branches are a significant source of wood fiber that is available at the logging site.

The bole portion of rough and rotten trees comprises an additional 7 percent of the biomass on commercial forest land in Ohio. Removal and use of this material would improve the condition of the forest by providing more space for establishment and growth of desirable trees.

Table 6.—Total green weight of aboveground biomass on commercial forest land by class of timber and species group, Ohio, 1979

Class of timber	Softwoods	Hardwoods	Total
	(Million green tons)		
Growing stock:			
Merchantable stem	8.1	309.8	317.9
Tops and branches	4.1	95.3	99.4
Total growing stock	12.2	405.1	417.3
Rough and rotten:			
Merchantable stem	0.5	41.1	41.6
Tops and branches	.2	14.9	15.1
Total rough and rotten	0.7	56.0	56.7
Small trees (under 5″ dbh)	2.3	86.7	89.0
Total biomass	15.2	547.8	563.0

Table 7.—Total green weight of aboveground biomass on commercial forest land by class of timber and diameter class, Ohio, 1979

Diameter class (inches)	Growing stock		Rough and rotten		Total	
	Merchantable stem	Tops and branches	Merchantable stem	Tops and branches	Merchantable stem	Tops and branches
	(Million green tons)					
1.0 - 4.9	0	64.1	0	24.9	0	89.0
5.0 - 6.9	28.2	8.8	7.5	2.1	35.7	10.9
7.0 - 8.9	39.1	12.1	6.1	1.8	45.2	13.9
9.0 - 10.9	46.8	13.1	4.9	1.5	51.7	14.6
11.0 - 12.9	41.6	11.3	5.1	1.6	46.7	12.9
13.0 - 14.9	38.1	10.5	3.3	1.0	41.4	11.5
15.0 - 16.9	32.0	9.2	2.5	.9	34.5	10.1
17.0 - 18.9	25.9	8.3	1.8	.7	27.7	9.0
19.0 - 20.9	20.0	6.7	1.3	.5	21.3	7.2
21.0 - 28.9	35.0	13.4	6.6	2.2	41.6	15.6
>28.9	11.2	6.0	2.5	2.8	13.7	8.8
Total	317.9	163.5	41.6	40.0	359.5	203.5

An additional 16 percent (89 million green tons) of the biomass is in trees less than 5 inches dbh. This potential biomass is seldom used due to high extraction costs per unit of volume and the desirability of protecting young stands. However, small trees may be a desirable source of biomass from land-clearing operations if extraction costs are not prohibitive.

The feasibility of utilizing these different sources of biomass varies. As technology improves and energy costs soar, increased use of non-growing stock sources is expected.

Growth and Removals

Average Annual Growth and Removals

The large increase in timber volume that occurred in Ohio since the last survey can be broken down into various components (Table 8). The average annual increase in growing-stock volume was 188 million cubic feet for the 11-year period between surveys. Average annual net growth was 278.6 million cubic feet, and average annual removals were 90.6 million cubic feet. Only one-third of net growth was removed during this period. Removals pressure, though still a relatively low portion of net growth, was higher in the Hill Region.

Net growth can be broken down further: accretion (growth on the initial inventory), ingrowth (trees that became 5 inches dbh during the period), mortality, and cull increment (the volume of growing stock that became rough or rotten). Accretion plus ingrowth equals gross growth.

Table 8.—Components of average annual net change of growing-stock and sawtimber volumes, Ohio, 1967-78

Component	Growing stock	Sawtimber
	(Million cubic feet)	(Million board feet)
Accretion	259.9	560.3
Ingrowth	85.2	768.7
Gross growth	345.1	1,329.0
Cull increment	– 18.6	– 86.8
Mortality	– 47.9	– 232.7
Net growth	278.6	1,009.5
Removals	– 90.6	– 409.5
Net change	188.0	600.0

Gross growth averaged 345 million cubic feet per year, a considerable increase over gross growth between the 1952 and 1968 surveys. Three-quarters of the gross growth was accretion. With many stands moving from the seedling/sapling stage into the poletimber and sawtimber categories, one might expect ingrowth to be a larger component of gross growth than it has been in Ohio. Ingrowth is a small component of gross growth because of the high volumes of scattered poletimber and sawtimber trees found in many seedling/sapling stands. The growth on these larger trees in stands previously classified as seedling/sapling stands is accretion. The relationship between accretion and ingrowth is also illustrated by the large volume increases found across the diameter classes (fig. 8). This relationship is similar for both geographic regions, though the Glaciated Region did show a slightly higher ingrowth proportion (Table 9).

Table 9. Components of average annual net change of growing-stock volume by geographic region, Ohio, 1967-78

Component	Hill Region	Glaciated Region
	(Million cubic feet)	
Accretion	165.6	94.3
Ingrowth	49.2	36.0
Gross growth	214.8	130.3
Cull increment	− 12.5	− 6.1
Mortality	− 31.8	− 16.1
Net growth	170.5	108.1
Removals	− 60.1	− 30.5
Net change	110.4	77.6

Gross growth was reduced about 19 percent by cull increment and mortality over the past 11 years. This percentage may seem high, but Ohio ranks quite favorably when reductions due to cull and mortality in other states in the Northeast are compared. This reduction is also a lower percentage of gross growth than it was between the first and second Ohio surveys. Mortality was about three-quarters of the reduction for both regions.

The average annual increase in sawtimber volume was 600 million board feet. Components of this change were net growth of 1,009.5 million board feet and average annual removals of 409.5 million board feet. Approximately 40 percent of net sawtimber growth was removed over the 11-year period. This ratio of removals to net growth is somewhat higher than that for growing stock because removals concentrate on larger trees.

Gross sawtimber growth averaged 1,329 million board feet annually. Sawtimber ingrowth is the volume in softwood trees that became 9 inches dbh and the volume in hardwood trees that became 11 inches dbh during the period between surveys. The split between sawtimber ingrowth and accretion was quite different than that for growing stock. For sawtimber ingrowth was higher than accretion because of the maturation of a large amount of growing-stock ingrowth experienced before the 1968 survey. The bulge of timber volumes shown in the diameter-class distribution (Fig. 8) is moving into the sawtimber sizes.

Gross sawtimber growth has been reduced by about a quarter due to cull increment and mortality. As with growing stock, sawtimber mortality was much greater than cull increment.

Trend-Level Growth and Removals

So far, we have been concerned with average annual change rates for the period between surveys. Sometimes current change rates are more useful. To satisfy these needs, trend-level change rates are provided.

Trend-level change rates, which are used to estimate current change rates, are developed using a compound change function. It is assumed that the timber inventory has been increasing at a compound rate; that is, a constant change rate applied to a volume that increases yearly. The following estimates as-

sume that the 1978 inventory change and its components are consistent with the trend between surveys (Table 10)

In 1978, trend-level or current net growth was 314.5 million cubic feet of growing stock, while removals were 91.5 million cubic feet. Trend-level net change (net growth less removals) was an increase of 223 million cubic feet. For sawtimber, trend-level net growth was 1,120.9 million board feet, and removals were 409.5 million board feet, indicating a trend-level increase of 711.4 million board feet for 1978.

Timber removals were 29 percent, and mortality was 17 percent of the net growth of growing stock. Sawtimber removals and mortality were somewhat higher, 37 and 23 percent of net sawtimber growth, respectively. These rates differed considerably among the major species.

Oaks and hickories accounted for 41 percent of the 1979 growing-stock volume. They showed below average growth (32 percent of total growth) and, below-average mortality (27 percent of total mortality), and supported a large portion of the removals pressure (55 percent). The oaks and hickories had the highest removals/growth ratio; over half of their net growth was removed. Removals pressure was greatest for northern red oaks and the other red oaks and was least for hickory and the select white oaks. Mortality was highest for chestnut and post oaks, accounting for 15 percent of their gross growth.

Hard maple, white ash, black cherry, and yellow-poplar are growing at a faster rate and have had considerably less removals pressure than the oaks. Only 16 percent of the hard maple net growth of growing stock was removed in 1978. Mortality for hard maple and yellow-poplar has also been very low. Softwoods have also shown high growth rates, low removals pressure, and low mortality. Timber volumes have more than doubled since 1968. Additional information on volume changes may be found in the Timber Volume section of this report.

Timber Products

Timber products output data are based on a canvass of all primary wood-product manufacturers that used wood grown in Ohio. The data reflect production for 1 year, 1978, and therefore may not equate with the average annual removals data in this report. Additional information on timber products may be found in "Forest Statistics for Ohio—1979" (Dennis and Birch 1981) and in "Ohio Timber Industries—A Periodic Assessment of Timber Output" (Nevel and Redett 1980).

The total output of timber products was 108 million cubic feet in

Table 10.—Trend-level annual net growth, removals, and mortality of growing stock on commercial forest land, by species, Ohio, 1978

Species	Net growth	Timber removals	Mortality
	(Million cubic feet)		
Total softwoods	25.0	4.5	3.0
Soft maple	17.4	3.7	.6
Hard maple	27.0	4.4	1.4
Hickory	17.7	7.7	2.8
Beech	11.3	4.4	.9
Yellow-poplar	30.6	6.6	.5
Select white oaks	31.4	13.6	3.4
Select red oaks	12.7	7.7	1.4
Chestnut and post oak	13.2	6.9	3.5
Other red oaks	25.6	14.7	3.9
Ash, black cherry, and black walnut	47.9	7.8	7.1
Other hardwoods	54.7	9.5	26.1
Total hardwoods	289.5	87.0	51.6
Total all species	314.5	91.5	54.6

1978, 10 percent less than the 119.4 million cubic feet produced in 1966 (Table 11). Use of residues increased substantially even though sawlog production, the major source of residues, declined. New technology for manufacturing products from residues, high energy and transportation costs, and environmental concerns associated with residue disposal prompted firms to seek a more efficient use of the timber resource. Many operators also turned to smaller trees and nongrowing stock sources in an effort to fully utilize the available resource. Advances in whole-tree chip harvesting have made this more profitable.

Poletimber trees and other roundwood sources make up a greater portion of the output than they did in 1966. This and increased residue use slackened the pressure on the growing-stock inventory, particularly in the sawtimber sizes. Output derived from growing-stock sources dropped 20 percent, while total output fell only 10 percent since 1966. The proportion of output coming from rough and rotten or dead trees remained stable.

Sawlogs

Sawlog production declined since 1966 but is still the largest use of wood in Ohio (Table 12). At 322 million board feet, it accounts for more than half the state's roundwood output. Most of the small sawmills that arose during the early 1940's have been displaced by large, high-production mills. The number of sawmills decreased from 1,644 in 1947 to 326 in 1978, while sawlog production declined by a relatively small amount.

Oak was the major sawlog species. Its proportion of the total increased since 1966 and now accounts for more than half the sawlog harvest. Twenty-eight percent of the harvest was red oak, and 23 percent was white oak. On the other hand the proportion of maple has declined from 14 percent in 1966 to 9 percent in 1978. This decline helps to explain the large increase in maple volume experienced between the two timber inventories.

Two-thirds of the sawlog harvest came from the Hill Region. This proportion coincides with the distribution of total sawtimber volume and commercial forest land between the regions. Each region is contributing a roughly equivalent sawlog harvest per acre of forest land.

Table 11.—Output of timber products by source of material, Ohio, 1966 and 1978

Source	1966		1978	
	Million cubic feet	*Percent*	*Million cubic feet*	*Percent*
Growing-stock trees:				
Poletimber	7.0	6	9.7	9
Sawtimber	80.4	67	60.5	56
Total growing stock	87.4	73	70.2	65
Rough and rotten trees[a]	1.8	2	1.5	1
Salvable dead trees[a]	6.3	5	5.5	5
Other roundwood sources[b]	9.3	8	10.4	10
Total roundwood output	104.8	88	87.6	81
Manufacturing residues	14.6	12	20.4	19
Total output	119.4	100	108.0	100

[a] On commercial forest land.
[b] Includes trees less than 5.0 inches dbh, tree tops and limbs from commercial forest areas, or any material from noncommercial forest land or nonforest land such as fence rows and suburban areas.

Table 12.—Output of timber products by type of product and source, Ohio, 1978

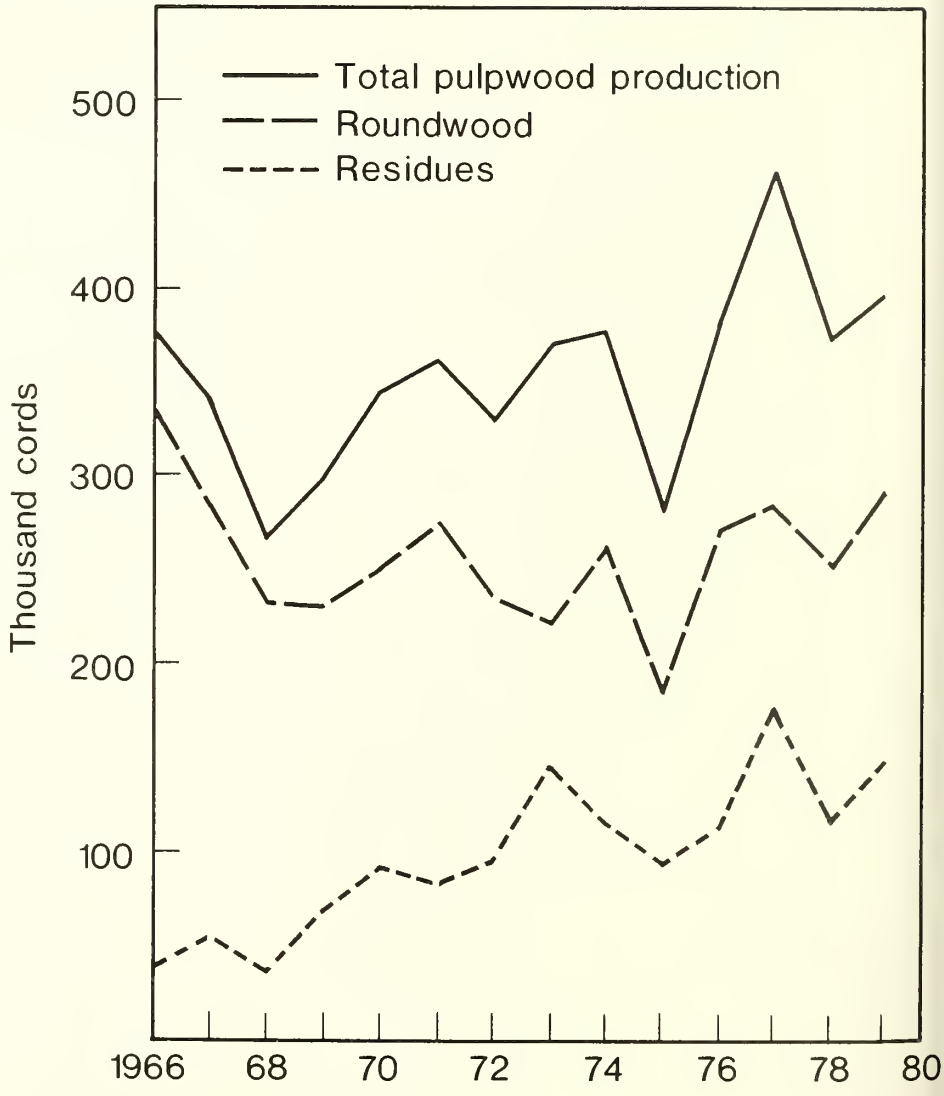
Product	From roundwood	From residues	Total
	(Million cubic feet)		
Sawlogs	47.3	—	47.3
Pulpwood	21.4	10.2	31.6
Fuelwood	13.6	6.1	19.7
Other	5.3	4.1	9.4
Total	87.6	20.4	108.0

Pulpwood

Pulpwood production increased slightly over the past decade, 31.6 million cubic feet (371,600 cords) in 1978 (Nevel and Bones 1978) (Fig. 11). However, the pulpwood harvest actually decreased. The trend is toward the increased use of manufacturing residues, primarily from the sawmill industry, for pulpwood production. Residues accounted for about a third of the 1978 production, up from the 10 percent used in 1966. In 1978, poletimber-size trees and other roundwood sources (Table 11) were a greater portion of the roundwood output than in 1966. Whole-tree chip harvesting made use of these sources more practical.

More than 90 percent of the pulpwood harvest came from the Hill Region. The South-Central Unit dominated with 103,500 cords in 1978. The primary species were oaks and hickory, which together made up 59 percent of the total pulpwood harvest. Softwoods, entirely pine, were only 2 percent, and assorted other hardwoods including maple, beech, and yellow-poplar accounted for the remaining harvest.

Figure 11.—Pulpwood production in Ohio by source, 1966–79.



Fuelwood

High energy costs have focused attention on wood as an alternative fuel. In 1978, fuelwood output increased to 19.7 million cubic feet, 18 percent of Ohio's total timber products output. Almost a third of the fuelwood was from manufacturing residues. This is a lower percentage of the total fuelwood output than that from residues in 1966. More residues are now used for pulpwood or other products and therefore do not find their way into the boiler. The increase in fuelwood output is primarily from roundwood harvesting. Fuelwood harvesting has increased from 8 percent of the roundwood harvest in 1966 to 15 percent in 1978 as more households and businesses turn to wood in an effort to cut fuel costs.

Many homeowners have turned to fuelwood in an effort to cut fuel costs.

Other Products

In 1978, other timber products accounted for 9 percent (9.5 million cubic feet) of Ohio's timber products output. Veneer log production, mostly used to make face veneer for furniture and veneer for wooden containers was 1.1 million cubic feet. White oak accounted for almost half of Ohio's total veneer harvest, much of which was shipped to other states for manufacture.

Cooperage production, mostly white oak staves for bourbon barrels, was just over 1 million cubic feet in 1978. High quality, defect-free bolts are required to manufacture cooperage staves.

A diverse group of other timber products collectively account for the remaining 7 percent of Ohio's timber output. Included in this group are posts, mine timbers, handle stock, metallurgical wood, fiber products, and a few other minor products.

Timber Outlook

We have witnessed an increase in forest-land area and a building of timber inventories over the past few decades. While analysis of what has happened is no small task, predicting the future is questionable at best. Projections are heavily influenced by assumptions that must be made concerning future events and behavior. Timber inventories are affected by a myriad of natural, economic, and sociologic forces, none of which can be known for certain. Education, experience, and consultation played a part in developing the following projections. Assumptions are stated clearly so readers may judge for themselves the likelihood that the projections will come true.

Commercial forest-land area increased over the past few decades, mainly due to reversion of marginal farmland. There was a 21.5 percent increase in commercial forest area between 1952 and 1968, and a 5.5 percent increase between the 1968 and 1979 surveys. The trend is slowing down. Continued increase but at a much reduced rate is expected for the near future. Over the long-term agricultural development, reservation of land for recreation, urban and suburban expansion, strip mining with reclamation to grass, and other factors are expected to offset and perhaps outweigh future gains in the commercial forest base. Therefore, in 30 years, the area of commercial forest is expected to be much the same as it is today. Change in commercial forest area is not expected to significantly influence the projection and will be held constant over the period.

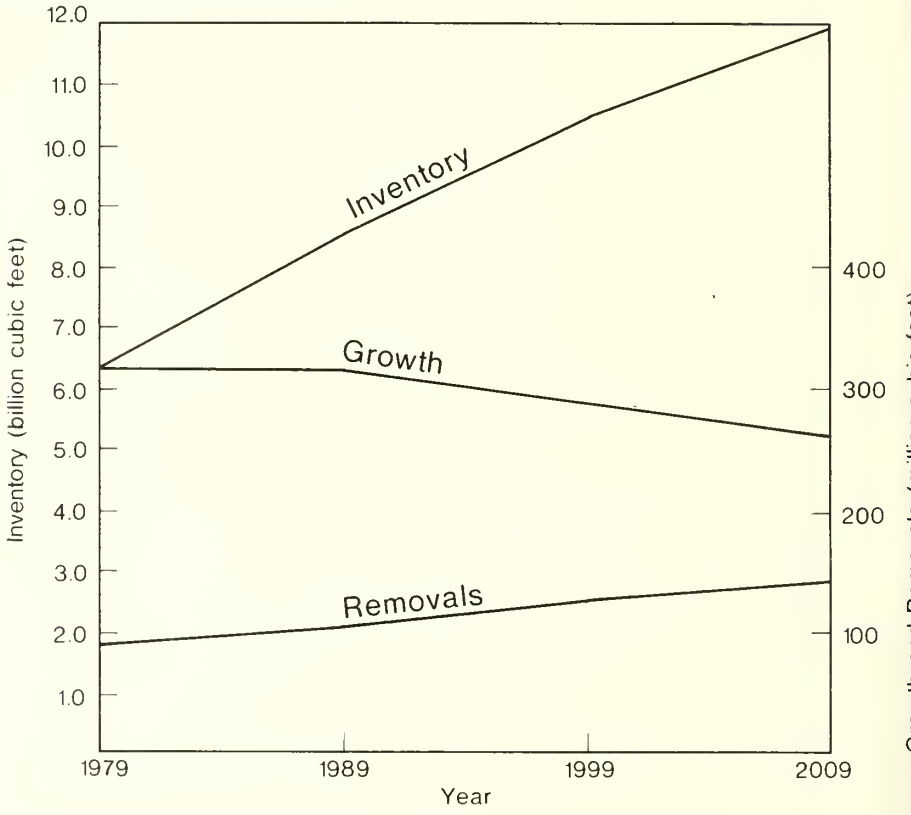
Average annual timber removals were 90.6 million cubic feet between 1968 and 1979. Trend-level removals were 91.5 million cubic feet for 1979. Although removals have decreased since the 1968 survey, they are expected to increase over the long term. We assumed that removals would increase at an annual rate of 1.5 percent over the next 30 years. Removals may increase be-

cause of industrial expansion in response to increasing inventory levels, increased demand for fuelwood, and substitution of wood products for more energy demanding materials.

Net growth is currently estimated to be 314.5 million cubic feet per year, which is an average growth rate of 45 cubic feet per acre for Ohio's commercial forest land. This growth is expected to continue over the next decade and then begin to decline to 38 cubic feet per acre by 2009 as the forest passes through its current stage of vigorous growth. As stands become older, growth will begin to slow and mortality will increase, particularly if the gypsy moth finds its way into Ohio. In 30 years, Ohio's stands are expected to have roughly the same stand-size structure that Pennsylvania has today. Growth is currently 38 cubic feet per acre in Pennsylvania.

In summary, to project the timber outlook we assumed that commercial forest area would not change significantly, removals would increase at 1.5 percent each year, and net growth would remain at present levels over the next decade and then begin to decline over the last 20 years of the projection period. The projection based on these assumptions reveals that inventory levels will build to almost 12 billion cubic feet by 2009 (Fig. 12). Net growth will exceed removals throughout the projection period, however, the margin will decrease as net growth slows and removals increase. Volumes, growth, and removals will be affected differently depending on the region, species, and other variables. Insight into these differences as they pertain to the projection may be obtained through review of other sections of this report.

Figure 12.—Projection of net growth, removals, and volume of growing stock on commercial forest land in Ohio, 1979-2009.



Ohio's Nontimber Forest Resources

Ohio's forests supply many benefits to landowners and citizens other than those related to timber production. Landowner studies show that nontimber values are most important to many landowners. Political activity and growth of organizations that express concern for wildlife, wilderness preservation, water quality, and erosion control illustrate an awareness of the importance of our nontimber resources. Strip-mining activity and participation in outdoor recreation clearly demonstrate the importance of other nontimber forest resources in Ohio.

The forest ecosystem is complex; its resources are interrelated and must be considered in that light. For ease of presentation, however, the different forest resources will be discussed individually.

Soil

Soils are the very foundation of the forest resource. Soils serve as a rooting medium that provides trees and other vegetation with support, water, and nutrients essential for growth. The relative availability of these elements in a particular soil influences the type of vegetation and its growth rate. Soil also provides a medium for many micro and

macro organisms that benefit tree growth. Mycorrhizal fungi extend the effective root zone and increase growth potential. Other symbiotic relationships exist between trees and soil-dwelling organisms.

To understand how soils affect forest stands, a knowledge of soil characteristics and soil formation is helpful. Soil is a dynamic natural body made up of four major components: mineral or parent material, organic matter, water, and air. Its properties have evolved due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief (Brady 1974). Soil formation, particularly weathering of parent material, is a very slow process.

Parent material plays an important role in determining soil characteristics. Ohio is entirely developed upon sedimentary rock: stratified deposits of clay beds, sand, and limestone that were deposited in a prehistoric sea. Generally, the western half of the state is underlain with limestone, while the eastern half is underlain with sandstone and shale. The only igneous and metamorphic rocks found in Ohio were brought in from the north by glacial action. Glaciers transported and deposited much glacial till, which is quite variable, especially as to size of particles. These deposits are called moraines. Ground moraines, fairly level deposits laid down as the ice front retreated, occur over a wide area and are agriculturally very important. Glacially supplied parent materials are geologically fresh. The young soils derived from this parent material are not drastically leached and generally are higher in available nutrients. Drainage is also important in determining the productivity of these soils. Some are made up of stratified layers of sandy gravel that drain easily, while others have fragipans (dense, impermeable layers) that limit drainage. Poorly drained soils may restrict the amount of oxygen available to the roots and limit growth or eliminate certain types of vegetation from the site. Many forest stands occur on land where poor drainage has inhibited or prevented its use for agricultural crops. Very poorly drained soils may be unable to support roads or recreational development.

Plants obtain moisture from the soil for growth and survival. The amount of precipitation retained in the soil against the force of gravity and available to plants depends upon the physical properties of the soil. Texture, structure, and density affect moisture holding ability. A coarse-textured sand will have a low moisture retaining ability, while a fine clay will retain much moisture but may be poorly aerated. Soil depth and structure also affect soil moisture retention.

Vegetation also affects soil development. Leaves and twigs deposited on the soil surface decompose and enrich the upper soil layers. In this way, vegetation returns nutrients from the root zone to the soil surface, which inhibits leaching. Different organic matter distributions exist under grassland and forestland conditions. Much of the organic matter found in grassland soils comes from the annual death of grass roots, while little organic matter is added annually by tree roots.

Good forestry and agricultural practices help eliminate soil erosion such as this.

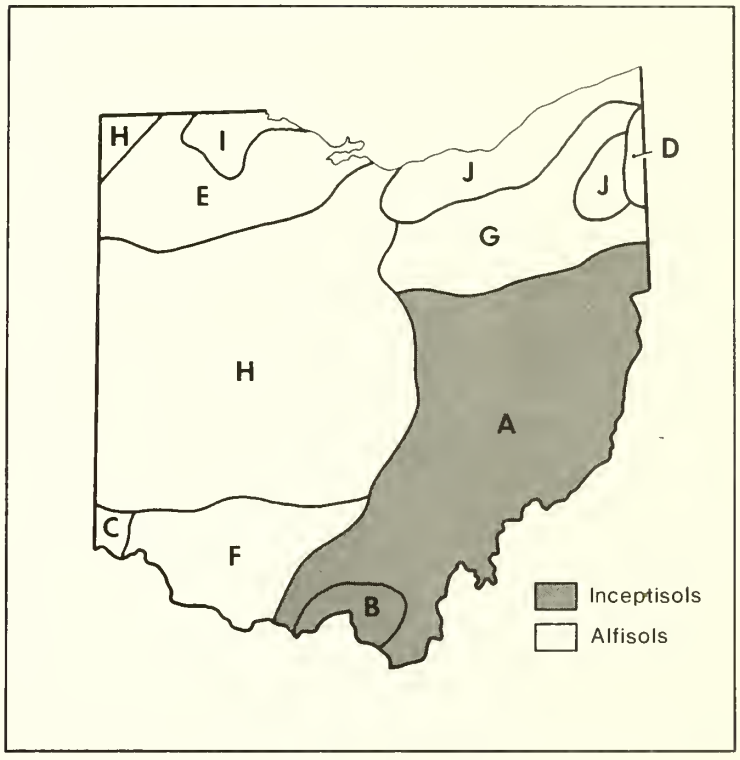
This photo was taken in 1946.

Local soil conditions are highly influenced by topography. Topography influences soil through moisture and temperature relations, soil movement and water movement both over and in the soil. Steeper soils are usually drier with less leaching, less vegetation, lower organic matter content and are shallower than those found on lower slopes and bottomlands. Erosion due to water runoff is also greater on steeper slopes.

Differences in parent material, topography, and other factors affecting soil development can change over relatively short distances. These changes are reflected in vegetative diversity. Local soil conditions may vary considerably, but a generalized soils map can be useful (Fig. 13).

The Hill Region is characterized by Inceptisols, which are immature soils having weakly expressed profile features and retaining close resemblances to the parent material. Clay accumulation is generally absent, hindering moisture retention. These soils are not as productive as the Alfisols found in the Glaciated Region and often have been allowed to reforest following periods of agricultural use.

Figure 13.—The soils of Ohio.



Order: Inceptisols

Suborder: Ochrepts

Great group:

A— Dystrochrepts, steep, plus Hapludalfs and Hapludults, both moderately sloping.

B— Dystrochrepts plus rock land and Hapludults, steep.

C— Eutrochrepts, steep.

D— Fragiochrepts plus Fragiaquepts and Dystrochrepts, moderately sloping.

Order: Alfisols

Sub-order: Aqualfs

Great Group: .

E— Ochraqualfs plus Haplaquepts and Hapludalfs, gently sloping.

Sub-order: Udalfs

Great group:

F— Fragiudalfs plus Fragiaqualfs and Hapludolls, gently sloping to steep.

G— Fragiudalfs plus Ochraqualfs and Fragiaqualfs, gently sloping.

H— Hapludalfs plus Argiudolls, gently sloping.

I— Hapludalfs plus Haplaquolls and Udipsamments, gently sloping.

J— Hapludalfs plus Ochraqualfs, gently sloping.

More productive soils, Alfisols and Ultisols are often found in the bottomland areas of the Hill Country. These soils comprise the region's more productive forest and agriculture land.

Alfisols, which are moist mineral soils that appear to be more strongly weathered than the Inceptisols, characterize the Glaciated Region. These soils are mostly formed in humid areas under native deciduous forests. Alfisols typically have subsurface horizons of clay accumulation. This indicates a high moisture retention ability but may also inhibit drainage. The relatively high base status of these soils indicates high productivity where drainage is not a problem. Ohio's best agricultural soils are Alfisols.

Water

Water is essential for all forms of life. It also provides many recreational opportunities and soothing esthetic qualities as well as industrial and transportation uses. Water can also be devastating. Severe floods and erosion have caused much hardship. Forests play an important role in enhancing water-related benefits and at the same time minimize its destructive effects.

Forest cover helps prevent the devastation caused by floods such as this.

Average annual precipitation is 39 inches in Ohio. Many factors influence what will become of this moisture. Different forms of precipitation vary in their effectiveness in replenishing soil moisture supplies that are available for plant growth. Timing is important. Winter snow and rain come during the season of minimum plant growth. This precipitation does, however, recharge soil moisture bringing it to levels favorable for spring growth. Vegetation also has an effect because it intercepts part of the precipitation, allowing moisture to evaporate directly into the atmosphere and preventing it from reaching the soil. This effect varies considerably depending on the type and amount of vegetation and the severity of the storm. Hardwoods generally intercept less of the year's precipitation than conifers because hardwoods do not retain their foliage during the winter. Also, the relative amount of moisture reaching the soil increases as the amount of precipitation received by a particular storm increases.

Once it reaches the soil surface, precipitation either infiltrates the soil or runs off as surface flow. The relative amounts of each depend upon the form of precipitation and the type and condition of the ground cover and soil layers. Runoff has two serious consequences: not only are plants denied this moisture supply, but valuable topsoil may be lost due to erosion. Erosion is greatly reduced by vegetative cover. Very little erosion typically occurs in an undisturbed forest. Layers of vegetation and the litter layer reduce the force of the rain reaching the soil surface. This reduces the amount of soil particles dislodged by force and carried away. Clear water also infiltrates better because it does not block soil pores. Less surface flow occurs and less soil is carried off in whatever surface flow that does occur under a full vegetative cover.

Much of the moisture retained in the soil is absorbed by tree and plant roots and returned to the atmosphere as water vapor. This transpirational use of water by the forest is generally 40 to 60 percent of the annual precipitation. Transpirational use of water can be altered through changes in the forest cover. Generally, cutting trees reduces transpiration and interception losses and makes more water available to replenish both ground and surface waters. Good harvesting practices are essential if water quality is to be maintained. Poor logging practices, especially with respect to logging roads, can increase stream turbidity drastically. Particular care must be taken along streams; removal of streamside vegetation invites erosion and disruption of the water course. It may also allow sunlight to reach the water surface and raise water temperature. Changes such as these can seriously harm many forms of aquatic life. Carefully planned and executed logging operations can be beneficial in increasing water yield and providing timber products while maintaining water quality.

Water that infiltrates the soil and is not retained in the soil replenishes ground water and eventually surface flows such as streams and lakes. This water is cleaner and more evenly supplied than runoff. Forests, through their tempered release of clean water, do much to improve water quality, reduce flooding, and eliminate erosion.

Ohio has two major drainage basins: Lake Erie, which drains over a quarter of the state, and the Ohio River, which drains the remainder. The divide between the two drainages is a low ridge extending southwest from Trumbull County to Mercer County.

The Lake Erie basin includes 7.5 million acres in Ohio (U.S. Army Corps of Engineers 1979). The Maumee River, which enters the lake at Toledo, is the largest river basin tributary to Lake Erie, draining 4.2 million acres. Other basins draining into Lake Erie are those of the Portage, Sandusky, Huron, Vermilion, Black, Rocky, Cuyahoga, Chagrin, Grand, and Ashtabula rivers. Large metropolitan areas dominate the lake shore. This basin is primarily agricultural and less forested than most other parts of the state. Many streams, particularly in the more level and less forested western area, are sluggish and carry heavy silt loads.

The Ohio River basin includes the remaining 18.7 million acres, which vary more in topography and have more forest cover than those in the Lake Erie basin. The Ohio River forms the entire southern border of Ohio (436 miles). Many industries located along the river depend on it as a water supply and transportation route. The Corps of Engineers began improvement of navigation on the Ohio River in 1825. This work has continued, and today the entire river has been improved by construction of locks and dams to provide a channel depth of 9 feet.

Many other water related construction projects have been completed across the state. Eighty-three of Ohio's 110 lakes are manmade. They serve to improve water quality, aid in flood control, and provide recreational opportunities and other benefits. Although many projects are multipurpose, flood control has been the overriding theme in Ohio. Devastating floods occurred in 1913, 1927, and 1936 following the removal of much of Ohio's forests. These floods quickly indicated the need for flood control projects and the importance of forests in tempering flow.

Coal

Coal is an important resource in Ohio. Bituminous coal production, 43.5 million short tons in 1979, ranks fifth in the nation (U.S. Dep. Energy 1981). Recoverable coal reserves are estimated at just over 1 billion short tons. This represents the quantity of coal that can be recovered from existing coal reserves at reporting mines. Recovery of these reserves will impact the forest resource. Its affect will depend on the mining methods used, reclamation procedures, and other related factors.

One-third of Ohio's coal production is from underground mining concentrated in six counties. Ranked by 1979 production these are: Belmont, Meigs, Harrison, Perry, Monroe, and Vinton counties. Areas of direct impact are mine openings, storage points, waste dumps, and haul roads. While these may be locally significant, they do not have a great impact on the state's total forest resource. Indirect impacts on the forest resource such as soil erosion, disruption of drainage patterns, subsidence, and stream pollution can be severe.

Surface mining, which accounted for two-thirds of Ohio's 1979 coal production, has a much greater impact on the forest resource. Increases in coal demand and improvements in mining technology increase the potential for strip-mine disturbance. Gigantic earth-moving machines can quickly mine large areas and make previously uneconomical operations profitable. Some previously mined areas are being revisited to recover deeper coal seams that could not be economically reached in the past. Surface mining obviously impacts the mining sites by removing the soil and all that exists above it. However, its influence is more widespread. It also influences management on land that has strip-mining potential. Forest management is futile on land that will probably be subjected to surface mining and may be questionable on land that has coal-mining potential. This is further complicated by division of the ownership of mineral rights and land. Mineral rights may and often are held by owners who have little interest in the forest or even in the long-term productivity of the land.

Gigantic earth-moving machines increase the potential for disturbance from strip-mining operations.

Surface mining occurred in 22 eastern counties in 1979 and was particularly concentrated in the East-Central Unit, which accounted for three-quarters of the state's surface mine production. The long-term impact that surface mining will have on the forest resource is determined by the method used to reclaim the land. Fifteen years ago, trees were the primary tool used in reclamation (Kizer 1980). Today only 10 percent of the mining permits show forest land as the postmining land use, and even these may be modified to exclude tree planting. The reasons for this change follow.

A strip-mined area reclaimed to grass in Muskingum County.

The 1972 Ohio Strip Mine Law provided the option of revegetating strip-mined land with a heavy cover (75 percent) of grasses and legumes or a lighter cover (50 to 60 percent) if trees were planted. This law drastically altered reclamation site conditions (Smith 1980). New mining, grading, and topsoil requirements brought about higher soil pH levels, improvements in amounts and availability of nutrients, and a decrease in toxicity levels. The topography became almost entirely traversable by rubber-tired equipment. However, erosion and the resulting sedimentation were still problems. These concerns played a major role in the design of the 1972 law, which allowed for herbaceous cover to combat erosion. Pollution abatement was a prime concern of the 1972 law.

Tree planting became an additional and often unnecessary expense to the operator. The additional grading requirements of the 1972 law caused more soil compaction, which hindered tree planting and survival. Competition from the grasses and legumes needed for erosion control also reduced survival rates for tree seedlings. Repair work required to meet regulations was more complicated for trees than for grasses and legumes. One complication is that tree seedlings must be planted in the spring. Seeing the more rounded contour of the reclaimed land, landowners saw advantages in having grass cover for pasture and forage production. These reasons contributed to the decline of tree planting on reclamation sites. However, reclamation to grassland may cause problems other than those associated with the obvious loss of valuable forest area. Establishment of grasses on very acid soils requires heavy applications of lime and fertilizer (Gebhart 1980). Reapplication is often required to sustain this cover. However, the operators are responsible only until their bond is released and if they do not own the land, will lose interest in it. The landowner may not continue this care, particularly if he or she is not making a profit from the land. If this happens, the cover may begin to thin and subject the soil to erosion.

A few steps have been taken to encourage tree planting. The required vegetative cover may be reduced to 50 percent if trees are planted. Tree survivial is increased with less vegetative cover, and operators have more incentive to plant trees. Also, the Ohio Division of Reclamation is requiring that vegetation remain successful for 5 years. In some areas, this is more difficult for grasses and legumes, so tree planting may be more advantageous in meeting this requirement. Changes in land use from forest to grassland are discouraged by requiring public notice, landowner consent, and impact statements from cooperating agencies. Time is money and operators want to avoid these delays whenever possible. Research is being conducted to overcome some of the technical problems associated with tree planting and survival on reclamation sites. These measures have been somewhat successful in encouraging tree planting. Between 1972 and 1977, only 1 percent of the postmining land use was forest land. Today it is 10 percent.

Many areas have been successfully reclaimed by tree planting. This is evidenced by the rapid increase in black locust stands found in the East-Central Unit. Strip mining will always impact the forest drastically during the mining effort, however, with proper reclamation the long-term outlook for the forest resource can be quite good. One advantage is that preferred species can be planted. On favorable sites, timber production can produce pulpwood in 20 to 25 years and sawlogs in 30 to 40 years (Davis and Davidson 1968). Another advantage is that roads constructed for coal removal can later provide access for management and harvesting of trees and for recreation. All this depends upon a conscientious effort to reclaim the land properly. Government agencies, coal companies, independent operators, and landowners are concerned and should work toward this end.

Recreation

Recreation is defined as a refreshment of strength and spirits after work. It is vital in the tension-filled society in which we live. Forests provide marvelous opportunities for various forms of outdoor recreation. Many of Ohio's residents and landowners consider recreation to be the most important benefit they receive from the forest. Viewing the forest or just knowing it exists provides satisfaction and contentment to many. Some forms of recreation, such as water-related activities or wildlife viewing, may be experienced outside the forest setting but are highly dependent on the forest's influence.

Ohio's outdoor recreation opportunities include hiking, horseback riding, camping, picnicking, hunting, fishing, sightseeing, various winter sports, and a variety of others. There are 19 state forests managed by the Ohio Department of Natural Resources, Division of Forestry, for multiple uses, which certainly include recreation. These forests total 170,000 acres, not all of which are forested. In addition, there are 71 state parks and 100 state wildlife management areas, which also provide recreational opportunities.

The Wayne National Forest is also managed for multiple uses. In 1979, the National Forest received over 360,000 visitor days of outdoor recreational use. Hunting was by far the most popular with 115,000 visitor days, while camping was a distant second with 41,000 visitor days spent in the forest's three camping areas.

Counties and municipalities own an additional 26,000 acres of park land. Much of this land is classified as reserved forest land and is managed primarily for recreational use.

Although it includes many fine recreational sites, public land is only a small portion of Ohio's forest base. Much outdoor recreation occurs on private land. Approximately a third of Ohio's private woodland owners indicated that recreation or esthetic enjoyment was the primary benefit they receive from their forest land. Many landowners, 29 percent, allow some public recreation on at least a portion of the 2.3 million acres they own. Hunting and hiking are the most frequent recreational activities on private land. Private land has a tremendous potential to supply recreational opportunities to Ohio's residents. However, the large number of owners and their diverse interests make planning difficult.

Enjoyment of the forest setting.

Urban Forestry

As previously mentioned, individual trees and small wooded areas often provide recreational opportunities, esthetic relief, and important wildlife habitat, particularly in urban areas. During the past decade, urban forestry has grown rapidly; Ohio currently leads the nation with 35 "Tree City USA" designations. Comprehensive programs designed to educate urban populations on the role of trees and other vegetation in their environment have cultivated an interest in urban forestry. This interest can be an important catalyst in bringing information about environmental programs to the public.

Fish and Wildlife

Fish are dependent on the forests for a clean water supply. Fish are sensitive to pollution and are sometimes used as indicators of water quality. Well-managed forest land reduces erosion, tempers flows, and provides shade that prevents water temperatures from rising above the tolerance limits of coldwater fish. Forests also provide habitat for insect populations upon which fish feed.

Well-managed forest land reduces erosion, tempers flows, and provides shade, helping to make scenes such as this possible.

(Photo by Ron Keil, Ohio Dep. Nat. Resour.)

Black Bullhead.

(Photo by Al Staffan, Ohio Dep. Nat. Resour.)

Ohio has approximately 7,000 miles of fishable streams and rivers and over 200 lakes (personal communication, Clayton Lakes, Ohio Dep. Nat. Resour.). Lake fishing is most popular in Ohio. The vast majority of Ohio's lakes are manmade; there are only 27 natural lakes.

The importance of fishing is illustrated by the sale of over 900,000 licenses in both 1979 and 1980. This figure was expected to reach the 1 million mark by 1981, which would generate well over $7 million in revenue. To help meet the high fishing demand, there are six state and two federal fish hatcheries in Ohio. In 1980, over 26 million fish were stocked into Ohio's fishing waters. These included: walleye, muskellunge, northern pike, channel catfish, trout, Coho salmon, yellow perch, striped bass, largemouth bass, smallmouth bass, and a few others.

As stated earlier, pollution is the biggest threat to fish populations. Sedimentation, acid-mine drainage, industrial waste, and acid rain are but a few of the many threats to high water quality. Forests cause none of these problems and do much to improve water quality and improve habitat for fish and many other forms of aquatic life.

Many wildlife species depend on the forest for food or shelter. Wildlife is generally divided into two groups: game and nongame species. The major game species are white-tailed deer, turkey, fox and gray squirrels, cottontail rabbit, ruffed grouse, pheasant, and various waterfowl. The sale of 460,000 hunting licenses and 215,000 deer licenses in 1980 is evidence of the popularity of this sport in Ohio.

The increase in forest land over the last several decades has been very beneficial to many wildlife species. The white-tailed deer, which had virtually disappeared from Ohio by 1904, is now plentiful across the state. Substantial increases in the

White-tailed deer, now plentiful in Ohio.

(Photo by Al Staffan, Ohio Dep. Nat. Resour.)

An active livetrap and transplant program and improved forest habitat has enabled wild turkey populations to build.

(Photo by Ron Keil, Ohio Dep. Nat. Resour.)

deer herd occurred in recent years. Relatively mild winters, good habitat conditions (reverting fields), and the short 5 day hunting season have contributed to this increase in deer populations. Short hunting seasons create a hit or miss situation influenced by weather conditions. The number of deer hunting licenses has increased from 175,375 to well over 200,000, and the number of antlerless permits issued has increased from 20,400 to 67,660 from 1978 to 1980. During this time, the deer harvest almost doubled, increasing from 22,000 to 40,500. Deer populations are relatively high, and hunting will continue to be popular in Ohio.

Wild turkeys, which disappeared by 1900, also returned. In 1956, wild turkeys were successfully reintroduced in Ohio. An active livetrap and transplant program has helped populations build. Turkeys are found in the eastern part of the state and are more numerous in the southeastern portion. More suitable turkey habitat is provided by large blocks of forest, particularly oak/hickory. These are more common in this portion of the state. Hunting seasons vary by county and may or may not open in a particular county depending upon population estimates. The turkey harvest has more than tripled from 167 in 1978 to 569 in 1981.

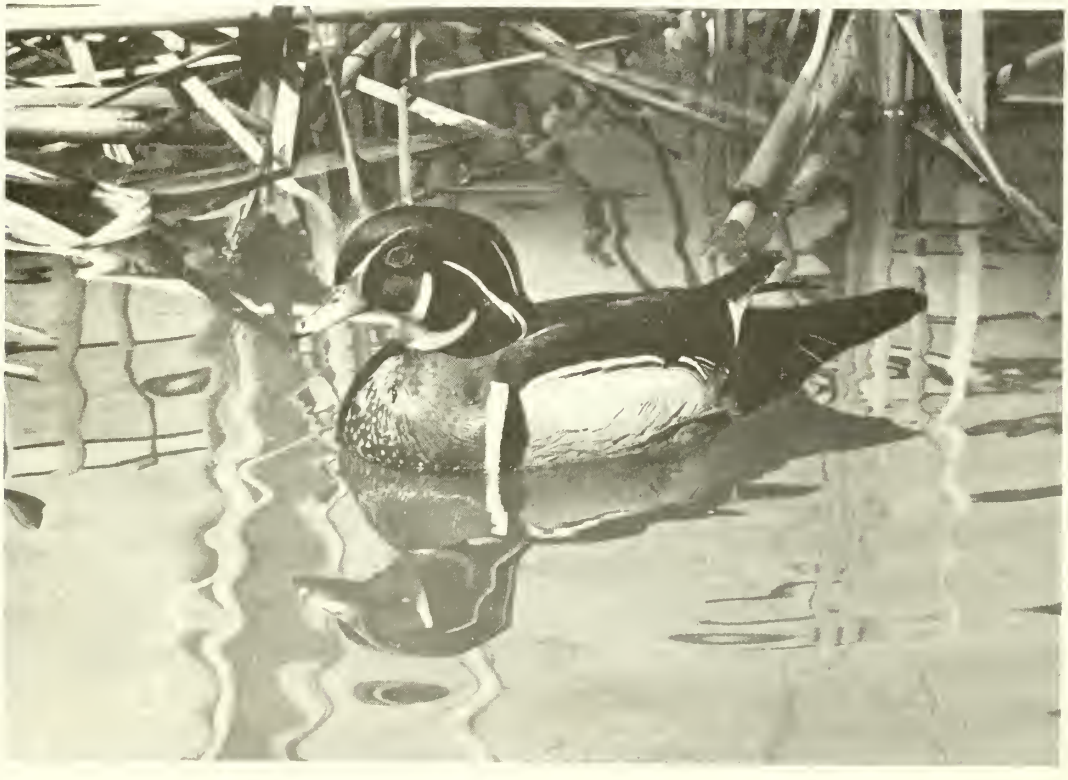
Small game animals such as fox and gray squirrels, cottontail rabbits, ruffed grouse, and pheasants are also quite popular. Squirrel and rabbits are found throughout the state, but grouse are found only in eastern Ohio. Grape thickets and aspen are preferred by grouse. Pheasants are more restricted to the Glaciated Region, preferring more open agricultural areas. They do, however, use forest habitats for cover.

Muskrats are the most popular furbearer, followed closely by fox, in Ohio. Other animals that are trapped for their fur include raccoon and beaver. Beavers, which had virtually disappeared, were trapped and transplanted in the early 1960's and have been increasing, particularly in the Hill Region. Beaver trapping seasons and relatively small harvests have been gradually increasing in recent years. The red fox prefers the more open environment found in the Glaciated Region, while the gray fox is more a woodland creature.

The manner in which strip-mined land is reclaimed greatly influences wildlife habitat and has often been quite beneficial. Strip planting is particularly effective in improving wildlife habitat. Deer are often seen browsing on new growth in reclaimed areas. Turkeys also use reclaimed land as brooding areas. Young turkeys require a high-protein diet consisting mainly of insects, which are more available in cleared areas than in a mature forest. Strip mining and the abandonment of adjacent cropland have encouraged the increase in aspen that occurred in the East-Central Unit. The increase in aspen helps explain the relative abundance of ruffed grouse in that part of the state. However, reclamation of previously forested land with grass can be a significant and detrimental land use change for many forest wildlife species.

Pools and lakes that have developed in strip-mined areas, as well as the many man-made lakes, are good waterfowl habitat. These lakes make excellent stop-over and wintering habitat for ducks and geese. Geese are grazers and like the proximity of grass and water found in these areas. Improved habitat and stocking efforts have led to good progress in developing a Canada goose population. Wood ducks, on the other hand, are closely associated with forest habitat. They prefer swamps and rivers found in wooded areas and build their nests in hollow trees. Hunting pressure, spurred by the desirability of the wood ducks' colorful feathers, and loss of habitat once threatened this species existence in Ohio. Improved habitat and some protective measures have allowed populations to build. The wood duck is now relatively common, particularly in the forested Hill Region.

Wood ducks are closely associated with forest habitat.



(Photo by Al Staffan, Ohio Dep. Nat. Resour.)

Over 300 species of nongame birds are found in Ohio with approximately180 species nesting regularly within the state. Ohio's diversity of forest types and stand sizes is beneficial. Forest types found in Ohio contain many species of trees that form a varied habitat capable of supporting this wide variety of birds. Bird watching and appreciation of these creatures have increased tremendously.

Ohio is a home or stopping place for a few federally listed endangered species (Roth 1981). These include two species of bats: the Indiana bat and Virginia big-eared bat; and three raptors: the bald eagle, American peregrine falcon, and arctic peregrine falcon.

Forest Management Opportunities

The resilience of Ohio's forests has been demonstrated. They have rebounded from past abuses quite well, and volumes are increasing at a rapid rate. Future growth is expected to exceed future removals, and volumes will continue to build. Looking at total timber volumes on a state level, however, does not paint the whole picture.

Part of Ohio's timber volume is not available for harvest. Some because it is currently inaccessible, either due to lack of roads, steep terrain, or other physical barriers. Other timber is held by landowners who are not interested in harvesting any trees. Landowners who indicate they will never harvest timber hold 1.5 million acres of Ohio's commercial forest land. An additional 3.1 million acres is held by owners who indicate they may possibly harvest timber at some future date but do not have definite intentions to do so. Although we do not have an estimate of how much timber is unavailable for harvest due to inaccessibility or landowner attitudes, it is clear that these reasons do preclude some timber from harvesting. This, of course, will change over time, and much of this timber will be available at the right price with changes in ownership or with new logging technology.

Undesirable species, small size, or poor quality also limits the use of Ohio's timber volume for certain industrial uses. Continued removals and increased mortality from insect or disease problems may bring certain species such as oak into short supply. Overall, as far as meeting industrial demands in Ohio, the outlook is good. However, this does not mean that individual landowners or society as a whole will not benefit from improved forest management. There are many benefits that accrue from forest management activities in addition to improved timber output.

A forest management plan that includes harvesting mature timber can be quite beneficial in improving wildlife habitat (Shaw 1970, Roach 1974). Forest management plans may also be developed to tailor harvesting schedules to improve esthetic qualities, recreation opportunities, or water yield. Landowners may be able to obtain financial returns from timber harvesting, while at the same time improve upon other aspects of the forest resource.

Ohio's forests, for the most part, have developed without any effort toward intensive forest management. It is interesting to look a little deeper into the present condition of the forest and into what might be done to improve forest productivity.

Only 6 percent of Ohio's commercial forest land is poorly stocked, that is less than 60 percent of full stocking. However, this includes cull trees; when only growing-stock trees are considered, 18 percent of the land is poorly stocked and an additional 43 percent is only medium stocked (60–99 percent of full stocking). Removal of cull trees, thus providing additional space for growth of the more desirable trees, will improve stocking. Similar reasoning certainly applies to the removal of undesirable species. Much of this material can be used as fuelwood or other products, particularly those made from chips. As mentioned previously, technology for using lower grade material has improved immensely in recent years. Some cull or dead trees, however, should be left standing to provide valuable wildlife habitat. These trees often provide cavities that are used for nesting, winter cover, escape, food seeking and storage, or other uses.

To portray an overall picture of the timber management practices that would be recommended in Ohio, field crews classified each forested plot that they measured into a recommended-treatment class (Table 13). Almost half—3.1 million acres—of Ohio's commercial forest land is on schedule. This class includes land that is in good condition and would not be significantly improved by timber stand improvement cuttings. However, it also includes some marginal land that may not be in the best condition for wood production but because of its low production potential, does not merit any improvement work.

Our crews also estimated that almost 1.5 million acres need some timber stand improvement work if improved timber production is desired. These recommendations include: thinnings to stimulate the growth of the remaining trees and to increase total production, and improvement cuttings to remove trees of undesirable form or species.

Stands on just over 1.1 million acres need to be removed or thinned sufficiently to allow establishment of a new stand either by natural regeneration or planting. This recommendation applies to stands that are being taken over by undesirable species or are sufficiently understocked with desirable species to justify this treatment. It may also apply to stands that are not mature but should be removed to improve productivity. These recommendations are made purely from a timber production standpoint. Many of these stands may provide excellent wildlife habitat or other benefits in their current condition.

The remaining 1.1 million acres are mature and ready for harvest. Of course, it is not desirable or even feasible to harvest all this timber now, but it does indicate the general maturity level of Ohio's forests.

Survey field crews also determined a past-management class for each field plot (Table 13). Approximately two-thirds of the commercial forest land had no evidence of harvesting within the last 25 years. The remaining third had either been clearcut or selectively cut within the last 25 years. Compared to other groups, forest industry did a greater proportion of their harvesting by clearcutting. Farmers cut timber from almost as great a portion of their land but primarily used the selection method, which was also favored by the miscellaneous private group.

In conclusion, net growth is exceeding removals as timber volume builds. Although this trend is expected to continue there is room for improvement. Timber quality and species mix, wildlife habitat, recreational opportunities, and esthetic values can be improved through forest management. This will improve upon the qualiity of life in Ohio.

Table 13.—Area of commercial forest land by past-management class, recommended-treatment class, and ownership, Ohio 1979

(In thousands of acres)

Item	Other public	Forest industry	Other corporate	Farmer	Misc. private	Total
			PAST-MANAGEMENT CLASS			
Clearcut	—	66.7	40.6	166.1	164.0	437.4
Selective cut	81.1	5.9	36.1	944.1	673.8	1,741.0
No evidence harvest—25 yrs	171.8	105.8	460.6	1,778.7	2,050.1	4,567.0
Reserved by owner	—	—	—	—	12.4	12.4
Total	252.9	178.4	537.3	2,888.9	2,900.3	6,757.8
			RECOMMENDED-TREATMENT CLASS			
Harvest mature	90.9	32.2	81.1	466.2	425.5	1,095.9
TSI	53.2	50.9	103.3	552.5	697.2	1,457.1
Stand conversion	25.5	15.3	134.7	434.8	495.5	1,105.8
Stand on schedule	83.3	80.0	218.2	1,435.4	1,282.1	3,099.0
Total	252.9	178.4	537.3	2,888.9	2,900.3	6,757.8

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Appendix

Definition of Terms

Accretion. The estimated net growth of growing-stock trees that were measured during the previous inventory, divided by the length of the period between surveys. It includes the growth on trees that were cut during the period, plus those trees that died and were used.

Annual mortality trend-level. The estimated mortality of growing stock or sawtimber for a specific year (1978 for Ohio) based on average rates of diameter growth and mortality for the period. This estimate is consistent with the average annual change during the period between surveys and with the current inventory.

Annual net growth trend-level. The estimated growth of growing stock or sawtimber for a specific year (1978 for Ohio) based on average rates of diameter growth and mortality for the period. This estimate is consistent with the average annual change during the period between surveys and with the current inventory.

Annual removals trend-level. The estimated removals of growing stock or sawtimber for a specific year (1978 for Ohio) obtained from a trend line for the period. This line is established by fitting a curve to actual removals data for several years during the period. The actual removals for the year given can vary from the trend estimate because of fluctuations in market conditions and other factors.

Average annual net growth. The change, resulting from natural causes, in growing-stock or sawtimber volume of sound wood in growing-stock or sawtimber trees during the period between surveys, divided by the length of the period. Components of average annual net growth include the increment in net volume of trees that are present at the beginning of the period and that survive to the end (accretion), plus average annual ingrowth, minus average annual mortality, and minus the net volume of trees that became rough or rotten during the period (cull increment).

Average annual removals. The net growing-stock or sawtimber volume of trees harvested or killed in logging, cultural operations—such as timber stand improvement—or land clearing, and also the net growing-stock or sawtimber volume of trees neither harvested nor killed but growing on land that was reclassified from commercial forest land to noncommercial forest land during the period between surveys. This volume is divided by the length of the period.

Board foot. A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent.

Coarse residues. Manufacturing residues suitable for chipping, such as slabs, edgings, and veneer cores.

Commercial forest land. Forest land producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and not withdrawn from timber utilization.

Commercial species. Tree species presently or prospectively suitable for industrial wood products. Excludes species of typically small size, poor form, or inferior quality, such as hawthorn and sumac.

County and municipal lands. Lands owned by counties and local public agencies or municipalities or leased to them for 50 years or more.

Cull increment. The net volume of growing-stock trees on the previous inventory that became rough or rotten trees in the current inventory, divided by the length of the period between surveys.

Diameter at breast height (dbh). The diameter outside bark of a standing tree measured at 4-1/2 feet above the ground.

Farmer-owned lands. Lands owned by farm operators, whether part of the farmstead or not. Excludes land leased by farm operators from nonfarm owners.

Federal lands. Lands (other than National Forests) administered by Federal agencies.

Fine residues. Manufacturing residues not suitable for chipping, such as sawdust and shavings.

Forest industry lands. Lands owned by companies or individuals operating primary wood-using plants.

Forest land. Land at least 10 percent stocked with trees of any size or that formerly had such tree cover and is not currently developed for nonforest use. The minimum area for classification of forest land is 1 acre.

Forest type. A classification of forest land based on the species forming a plurality of live-tree stocking. The many forest types in Ohio were combined into the following major forest-type groups:

a. *White/red pine*—forests in which white pine or red pine, singly or in combination, comprise a plurality of the stocking; in Ohio, common associates include yellow-poplar, red maple, oak, black walnut, and black cherry.

b. *Hard pine*—forests in which Virginia, shortleaf, or pitch pines or eastern redcedar, singly or in combination comprise a plurality of the stocking; in Ohio, common asso-

ciates include red maple, oak, white or red pine, white ash, black walnut, and sycamore.

c. *Oak/pine*—forests in which hardwoods (usually hickory or oak) comprise a plurality of the stocking but where shortleaf, Virginia or eastern redcedar comprise 25 to 50 percent of the stocking.

d. *Oak/hickory*—forests in which upland oaks, hickory, yellow-poplar, black locust, black walnut, sweetgum, sassafras, persimmon, or red maple (when associated with central hardwoods), singly or in combination, comprise a plurality of the stocking and in which shortleaf or Virginia pines, or eastern redcedar comprise less than 25 percent of the stocking; in Ohio, common associates include white ash, sugar maple, and black cherry.

e. *Elm/ash/red maple*—forests in which elm, river birch, sycamore, willow, cottonwood, or red maple (when growing on wet sites), singly or in combination, comprise a plurality of the stocking; in Ohio, common associates include white ash, sugar maple, oak, hickory, yellow-poplar, and black cherry.

f. *Northern hardwoods*—forests in which sugar maple, beech, yellow birch, black cherry, or red maple (when associated with northern hardwoods), singly or in combination, comprise a plurality of the stocking; in Ohio, common associates include white ash, hickory, yellow-poplar, white oak, and red oaks.

g. *Aspen/birch*—forests in which aspen comprises a plurality of the stocking; in Ohio, common associates include red maple, black cherry, red oaks, and beech.

Growing-stock trees. Live trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees.

Growing-stock volume. Net volume, in cubic feet of growing-stock trees 5.0 inches dbh and larger, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem, or to the point where the central stem breaks into limbs. Net volume equals gross volume, less deduction for cull.

Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

Industrial wood. All roundwood products except fuelwood.

Ingrowth. The estimated net volume of growing-stock trees that became 5.0 inches dbh or larger during the period between inventories, divided by the length of the period between surveys.

International 1/4-inch rule. A log rule, or formula, for estimating the board-foot volume of logs. The mathematical formula is:

$$(0.22D^2 - 0.71D)\ (0.904762)$$

for 4-foot sections, where D = diameter inside bark at the small end of the section. This rule is used as the USDA Forest Service Standard Log rule in the Eastern United States.

Land area. (a) Bureau of Census: The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than 1/8 statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area. (b) Resources Evaluation: same as (a) except that the minimum width of streams, etc., is 120 feet, and the minimum size of lakes, etc., is 1 acre.

Logging residues. The unused portions of growing-stock trees harvested or killed in the process of logging.

Manufacturing plant residues. Wood materials that are generated when converting round timber (roundwood) into wood products. This includes slabs, edgings, trimmings, bark, miscuts, sawdust, shavings, veneer cores and clippings, and pulp screening. If these residues are used, they are referred to as plant byproducts.

Miscellaneous private lands. Privately owned lands other than forest-industry and farmer-owned lands.

Mortality. The estimated net volume of growing-stock trees on the previous inventory that died from natural causes before the current inventory, divided by the length of the period between surveys.

National Forest lands. Federal lands legally designated as National Forests or purchase units and other lands administered as part of the National Forest System by the USDA Forest Service.

Noncommercial forest land. Productive-reserved, urban, and unproductive forest land.

Noncommercial species. Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land. Land that has never supported forests, or land formerly forested but now in nonforest use such as cropland, pasture, residential areas, and highways.

Nonstocked areas. Commercial forest land that is stocked with less than 10 percent of minimum full stocking with growing-stock trees.

Plant byproducts. Wood products, such as pulp chips, recycled from manufacturing plant residues.

Poletimber stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of

such stocking in poletimber or sawtimber trees or both, and in which the stocking of poletimber exceeds that of sawtimber.

Poletimber trees. Live trees of commercial species meeting regional specifications of soundness and form and at least 5.0 inches in dbh, but smaller than sawtimber trees.

Productive-reserved forest land. Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas tree production.

Primary wood manufacturing plant. A plant that converts round timber into wood products such as woodpulp, lumber, veneer, cooperage, and dimension products.

Pulpwood. Roundwood converted into 4- or 5-foot lengths or chips, and chipped plant byproducts that are prepared for manufacture into woodpulp.

Rotten trees. Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough trees. (a) The same as rotten trees, except that rough trees do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees of noncommercial species.

Roundwood products. Logs, bolts, total tree chips, or other round timber generated by harvesting trees for industrial or consumer uses.

Saplings. Live trees 1.0 through 4.9 inches dbh.

Sapling-seedling stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in saplings or seedlings or both.

Sawlog. A log meeting regional standards of diameter, length, and defect, including a minimum 8-foot length and a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods.

Sawlog portion. That part of the bole of a sawtimber tree between the stump and the sawlog top; that is, the merchantable height.

Sawlog top. The point on the bole of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches diameter outside bark (dob) for softwoods and 9.0 inches dob for hardwoods.

Sawtimber stands. Stands stocked with at least 10 percent of minimum full stocking with growing-stock trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

Sawtimber trees. Live trees of commercial species at least 9.0 inches dbh for softwoods or 11.0 inches for hardwoods containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect.

Sawtimber volume. Net volume in board feet, International 1/4-inch rule, of sawlogs in sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Seedlings. Live trees less than 1.0 inch dbh that are expected to survive.

Site class. A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Classifications are based on the mean annual growth of growing-stock trees attainable in fully stocked natural stands at culmination of mean annual increment.

Softwoods. Coniferous trees, usually evergreen and having needles or scalelike leaves.

Stand. A group of forest trees growing on forest land.

Stand-size class. A classification of forest land based on the size class (that is, seedlings, saplings, poletimber, or sawtimber) of growing-stock trees in the area.

Standard cord. A unit of measure for stacked bolts of wood, encompassing 128 cubic feet of wood, bark, and air space. Fuelwood cord estimates can be derived from cubic-foot estimates of growing stock by applying an average factor of 80 cubic feet of solid wood per cord. For pulpwood, a conversion of 85 cubic feet of solid wood per cord is used because of the more uniform character of pulpwood.

State lands. Lands owned by the State or leased to the State for 50 years or more.

Stocking. The degree of occupancy of land by trees, measured by basal area and/or number of trees in a stand compared to the basal area and/or number of trees required to fully use the growth potential of the land (or the stocking standard). In the Eastern United States this standard is 75 square feet of basal area per acre for trees 5.0 inches dbh and larger, or its equivalent in numbers of trees per acre for seedlings and saplings.

Two categories of stocking are used:

All live trees—these are used to classify forest land and forest types.

Growing-stock trees—these are used to classify stand-size classes.

Timber products. Manufacturing plant byproducts and roundwood (round timber) products harvested from growing-stock trees on commercial forest land; from other sources, such as cull trees, salvable dead trees, limbs, tops and saplings; and from trees on noncommercial forest and nonforest lands.

Timber removals. The growing-stock or sawtimber volumes of trees removed from the inventory for roundwood products, plus logging residues, volume destroyed during land clearing, and volume of standing trees growing on land that was reclassified from commercial forest land to noncommercial forest land.

Trees. Woody plants that have well-developed stems and are usually more than 12 feet in height at maturity.

Unproductive forest land. Forest land that is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions.

Unused manufacturing residues. Plant residues that are dumped or destroyed and not recovered for plant byproducts.

Upper-stem portion. That part of the main stem or fork of a sawtimber tree above the sawlog top to a diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

Urban forest land. Noncommercial forest land within urban areas that is completely surrounded by urban development (not parks), whether commercial, industrial, or residential.

Metric Equivalents

1 acre = 4,046.86 square meters or 0.404686 hectares

1,000 acres = 404.686 hectares

1,000,000 acres = 404,686 hectares

1,000 board feet = 3.48 cubic meters [a]

1 cubic foot = 0.028317 cubic meters

1,000 cubic feet = 28.317 cubic meters

1,000,000 cubic feet = 28,317 cubic meters

1 cord (wood, bark, and airspace) = 3.6246 cubic meters

1 cord (solid wood, pulpwood) = 2.4069 cubic meters

1 cord (solid wood, other than pulpwood) = 2.2654 cubic meters

1,000 cords (pulpwood) = 2,406.9 cubic meters

1,000 cords (other products) = 2,265.4 cubic meters

1 ton (short) = 907.1848 kilograms or 0.9071848 metric tons

1,000 tons (short) = 907.1848 metric tons

1 inch = 2.54 centimeters or 0.0254 meters

1 foot = 30.48 centimeters or 0.3048 meters

Breast height = 1.4 meters above ground level

1 mile = 1.609 kilometers

1 square foot = 929.03 square centimeters or 0.0929 square meters

1 square foot per acre basal area = 0.229568 square meters per hectare

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[a] While 1,000 board feet is theoretically equivalent to 2.36 cubic meters, this is true only when a board foot is actually a piece of wood with a volume of 1/12 of 1 cubic foot. The International 1/4-inch log rule is used by the USDA Forest Service in the East to estimate the product potential in board feet. When a conversion is used, the reliability of the estimate will vary with the size of the log measure. The conversion given here, 3.48 cubic meters, is based on the cubic volume of a log 16 feet long and 15 inches in diameter inside bark (dib) at the small end. This conversion could be used for average comparisons when accuracy of 10 percent is acceptable. Since the board-foot unit is not a true measure of wood volume and since products other than dimension lumber are becoming important, this unit may eventually be phased out and replaced with the cubic-meter unit.

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Dennis, Donald F. **An analysis of Ohio's forest resources**. Broomall, PA: Northeast For. Exp. Stn.; 1983; USDA For. Serv. Resour. Bull. NE-75. 46 p.

A comprehensive analysis of the current status and trends of the forest resources of Ohio. Topics include forest area, timber volume, biomass, timber products, and growth and removals. Forest area, volume, and growth and removals are projected through 2009. Discusses water, soil, minerals, fish, wildlife, and recreation as they relate to forest resources. Also identified are forest management opportunities for increasing the production of major forest resources and enhancing the benefits derived from Ohio's forests.

Keywords: Forest survey, trends, projections, area, volume, growth, removals, nontimber forest resources, forest management opportunities.

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
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