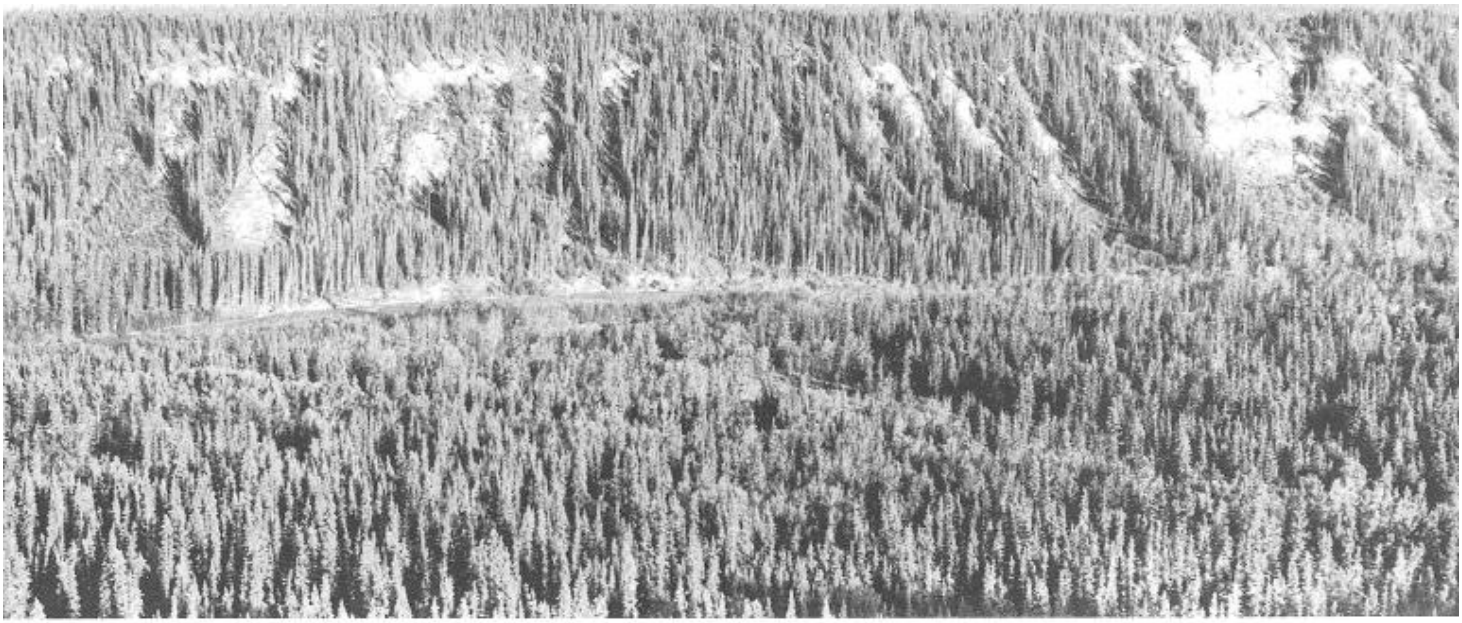

ALASKA'S FOREST RESOURCE

FOREST SERVICE RESOURCE BULLETIN PNW 19
7 - U.S. DEPARTMENT OF AGRICULTURE

INSTITUTE OF NORTHERN FORESTRY, JUNEAU, ALASKA
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

About This File
This file was created by scanning the printed publication.
Misscans identified by the software have been corrected,
however some mistakes may remain.

ACKNOWLEDGMENTS

The Institute of Northern Forestry of the Forest Service, U.S. Department of Agriculture, at Juneau, Alaska, is responsible for Forest Survey work in Alaska. The initial forest inventory being reported here represents the work of many people, and was a joint effort of the Institute and Region 10 of the Forest Service.

We thank the Ketchikan Pulp Co, for its contribution to the inventory of one working circle. We are also grateful to the Bureau of Land Management, U.S. Department of the Interior, and to the State Forester of Alaska and his staff for assistance on special studies which have contributed materially to this report.

We thank the people who provided willing, efficient, and courteous service to our field crews. Special thanks go to the aircraft pilots who took us inhere we needed to go and returned us safely.

U.S. Forest Service Resource Bulletin PNW 19

ALASKA'S FOREST RESOURCE

by

O. Keith Hutchison, Principal Economist

Reprinted 1968

Institute of Northern Forestry, Juneau, Alaska

Pacific Northwest Forest & Range Experiment Station

U. 5. Department of Agriculture

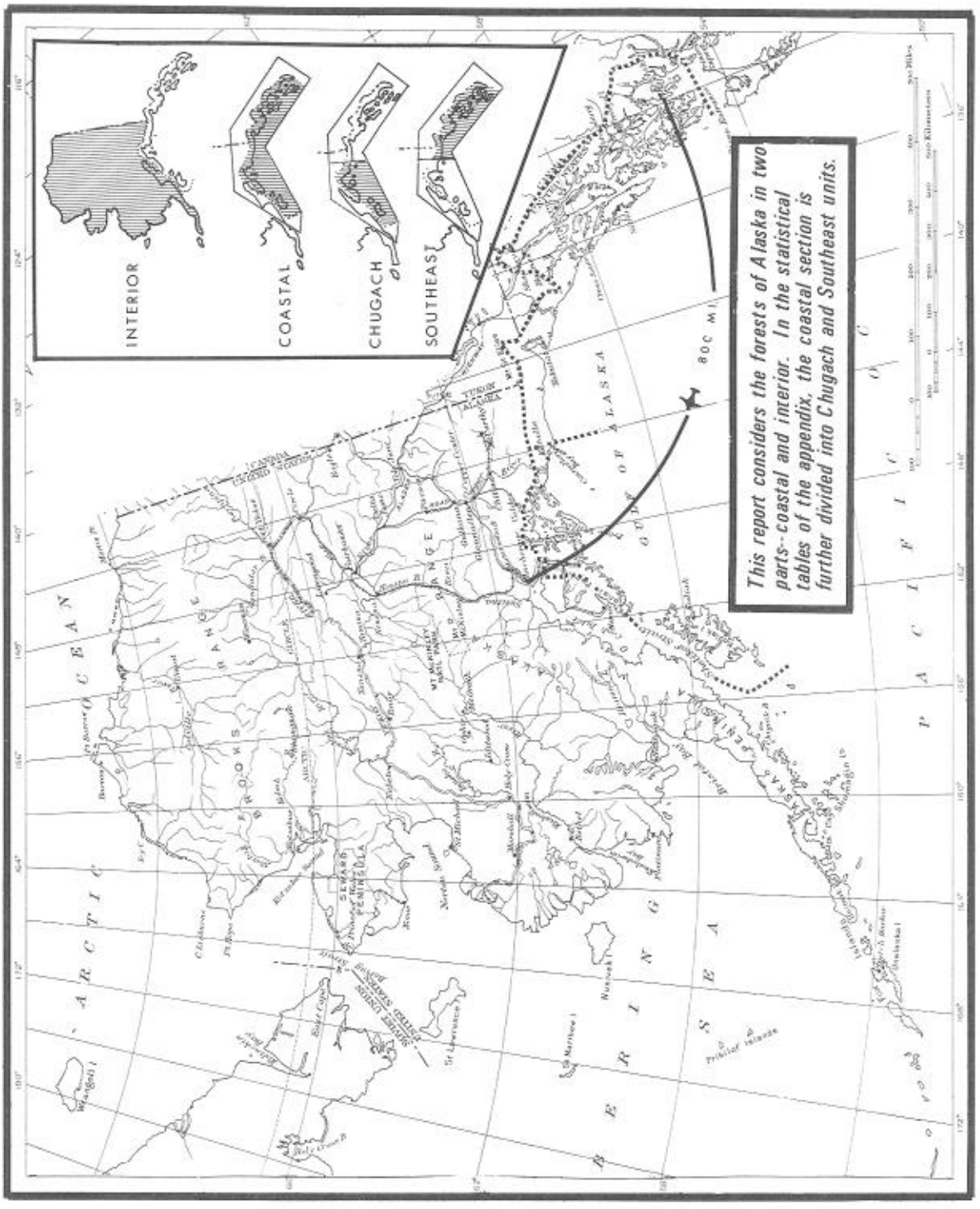

Figure 1. Forest Survey regions in Alaska.

PREFACE

This report presents the results of the first forest inventory of Alaska, made as part of the nationwide Forest Survey authorized by the McSweeney-McNary Act of 1928. Forest inventory work began in Alaska in 1954 after the 83d Congress amended the 1928 Act to include Territories.

Because of recognized regional economic and forest differences, the inventory was planned in two parts - coastal and interior.

The coastal inventory. - *The* survey of coastal Alaskan forests was based on a study of aerial photographs, followed by field *measurements to* check the accuracy of the photo interpretation and to obtain supplemental tree measurements. The sampling technique was designed to determine the commercial forest area within ± 3 percent per million acres and the timber volume within ± 5 percent of the total net board-foot volume in each forest management unit. The 1:40,000 vertical photos and 1:20,000 twin oblique photographs taken in 1948 by the U.S. Navy were used for the southeast part of the region (fig. 1). For the Chugach portion, 1:15,840 vertical photography was used. This photography was contracted for by the U.S. Forest *Service and* completed between 1957 and 1960.

Systematically *selected plots* were interpreted on the photos and sample prints sent to the field for examination. Three 1/5-acre plots were measured at each field location. A summary of the number of plots studied is included with the accuracy statement in the appendix.

The interior inventory.-Suitable aer ial photography was not available for interior Alaska. Because of the large area to be covered, the inventory plan called for photography at a scale of 1:5,000 along flight lines spaced 30 miles apart. About 11,000 lineal miles were photographed from 1958 through 1960 with cameras using infrared film with a minus blue filter.

A 1/2-acre plot was marked near the center of each photo, and classified by land type. All forest plots were studied carefully with a stereoscope to determine the kind, size, and density of the timber. Area estimates by land and forest type were determined from the percentage distribution of aerial photo plots and adjusted by air check and ground subsamples. Timber volume estimates were made from aerial photo stand volume tables. Growth, species, diameter distribution, quality, and mortality data were obtained from mea*surements of* field plots.

Timber utilization. - Estimates of products output for 1961 are from a 100*percent canvass* of the wood-using industries in Alaska. Where significant changes in production are known to have taken place, the output estimates have been adjusted to the dates indicated,

CONTENTS

THE CHANGING SCENES

Alaska's romantic past includes the magnetic lure of gold; the mad stampede to strike it rich; success and heartbreak; men and animals battling snow, ice, spring breakup, insects, and loneliness; dog teams at work and on desperate missions; river steamers battling the Yukon; bush pilots performing miraculous flights; and hordes of salmon taken by traps and seine boats. Places like Skagway, Dawson, Nome, Juneau, and Fairbanks were boom towns. Fortunes were made, gambled, and lost overnight.

The stampede is over, but the lure of wealth remains in forms other than that of the yellow metal of the late 1890's. Orderly development is taking place in Alaska as it did in other Western States with frontier histories. No longer is Alaska merely a remote land of ice, snow, gold, and dog teams. Modern commercial airlines, air taxis, the Alaska Highway, and now a marine highway system serving 14 Alaska ports, make Alaska accessible to almost everyone. However, Alaska is still an enchanting land to the residents and tourists who marvel at its great glaciers, icefields, high peaks, colorful valleys, tumbling streams, variety of wildlife, and extensive forests.

Alaska has many resources with which to build its future. After the gold rush days, salmon packing emerged as the leading industry. It still is, but recently, timber industries have shown the most rapid growth (Rogers and Cooley 1962)' and may soon challenge for the lead.

The forests of Alaska are destined to play an increasing and permanent role in the State's economy. These forests were important in Alaska's early history, but the official records will not show this except in a piecemeal fashion (Lutz 1963). Early Russian exploiters built ships along the coast. Many pilings _ were used to build fishtraps and for cannery foundations. Thousands of cords of wood were cut along the Yukon River and its main tributaries to fuel the river steamers. Most building construction was of logs, and an unknown quantity of wood was burned to thaw the gold-bearing gravel. Many railroad crossties were cut by competing companies in their frantic but futile effort to put a railroad over Thompson Pass from Valdez. In later years, local stands of timber were used to build the Alaska Railroad from Whittier and Seward to Fairbanks. The gold rush era might have failed without the forests. Certainly, hardships would have been greater. The coming importance of the forests is evident from the recently completed forest inventory.

Many terms have been used to describe the great size of Alaska. One writer said that "Alaska has limitless land." Certainly, that is the impression one gets in flying over the State. The total land area credited to Alaska is 365.5 million acres 16 percent of the, total area in the United States. There are another 10 million acres in lakes and streams. In size, Alaska ranks first among the 50 States, being 54 times as large as the smallest State and more than twice as large as Texas.

' Name, and dates in parentheses refer to Literature Cited, p 49.

Alaska has 16 percent of the forest land in the United States, or 119 million acres. This is as much forest land as is found in the States of Montana, Washington, Oregon, and California combined. But the average quality of forest land in Alaska is below that of the other States mentioned. Only 28.2 million acres is considered commercial; that is, capable of producing a minimum of 20 cubic feet of industrial wood per acre annually. Oregon alone has nearly as many acres of commercial forest land.

For forest inventory purposes, the State was treated as two regions - coastal and interior. This division was logical because of topographic, forest, and eco- differences.

COASTAL ALASKA

Coastal Alaska includes a gross land area of 32,926,000 acres. Inland bodies of water up to 40 acres in size account for 371,000 acres of this total. Alabama, Arkansas, and North Carolina each have roughly the same land area, but where these States are mostly one continuous land mass, coastal Alaska is made up of many hundreds of islands and a narrow mainland broken by many fiords and inlets. The islands vary in size from those less than an acre to islands such as Kodiak with a gross area of 2,296,320 acres, Prince of Wales Island with a gross area of 1,618,553 acres, Chichagof with 1,249,724, Admiralty with 1,026,931, and Baranof with 973,530 acres. The widest part of the region is about 150 miles from the Gulf of Alaska to the Canadian border, whereas from Ketchikan to Anchorage via Yakutat is about 800 air miles.

The coastal forests are an extension of the rain belt forests so important in Oregon, Washington, and California. An important difference is that Douglas-fir is not found in Alaska. These forests extend along the Alaskan coast westward to Kodiak Island. Near Ketchikan are stands composed primarily of western hemlock and Sitka spruce (fig. 2), with intermingled small blocks and scattered trees of western redcedar and Alaska-cedar. A few hardwoods, mostly red alder and cottonwood, occur along streams and on slide areas. Mountain hemlock, alpine fir, and Pacific silver fir are found; lodgepole pine, growing mostly as a scrub tree, is found on poorer sites, on and adjacent to muskegs.

Western redcedar is not found north of Frederick Sound. Alaska-cedar also becomes less important northward and westward, but does occur in cedar swamps as far westward as Port Wells on Prince William Sound. Cottonwood appears in the Stikine, Taku, and other mainland valleys, and commercially important volumes are found in the Haines area and on most alluvial bottom lands to the westward (fig. 3). Sitka spruce remains an important component of the stands throughout the coastal region and is the only conifer found on Afognak and Kodiak Islands.

These observations on species composition and distribution may be partially related to changes in longitude and latitude. Other stand composition and tree distribution observations concern interrelated factors of elevation, soil, slope, drainage, and exposure. The topography of this region is steep and rugged. Slopes commonly begin near tidewater and rise to elevations of 2,000 to 3,000 feet within 2 or 3 miles. High points along the boundary with Canada range from about 6,000 to 18,000 feet.

The best stands of timber generally are found near tidewater with stand heights, volume per acre, and quality diminishing progressively up the slope. Timberline usually is reached at elevations of 2,000 to 2,500 feet. Muskegs and poor drainage are common to the region. Commercial hemlock and spruce decline in height, quality, and numbers in proximity to muskegs. Tree growth is sparse within. the muskeg and consists mostly of lodgepole pine in scrub form.

Figure 2.--A Forest Survey crew working in a mature stand of western hemlock and Sitka spruce. Trees in this stand average 30 inches d.b.h. and the stand volume is 117,000 board feet per acre.

NONFOREST AREAS

The 19.7 million acres of nonforest area should be considered briefly to show important interrelationships with the forest area for multiple uses: wildlife habitat, recreation, ' watershed, and production of timber and minerals. It would be impossible to manage effectively either the forest or nonforest area without considering demands upon the other. Almost any wildlife management text will describe the need of birds and animals for habitat interspersion and edge effects. This region of Alaska is especially blessed with such habitat as a natural condition.

The forest land manager also must understand influences that may occur between his actions and the climate and topography.

Heavy snow and rainfall on the upper slopes saturate the soil and, even when soil is held by dense tree growth, slippages often occur. The rugged topography of coastal Alaska results in pronounced variations of mean annual precipitation within relatively short distances -ranging, for example, from 152 inches at Ketchikan to 83 inches at Wrangell, 90 at Juneau, 134 at Yakutat, and 69 at Seward (Watson 1909). The quality of water and fluctuation of runoff at the lower levels greatly influence the productivity of salmon-spawning streams. In planning activities on either the forest or nonforest area, the land managers consider the effects such activities will have upon the whole area.

.

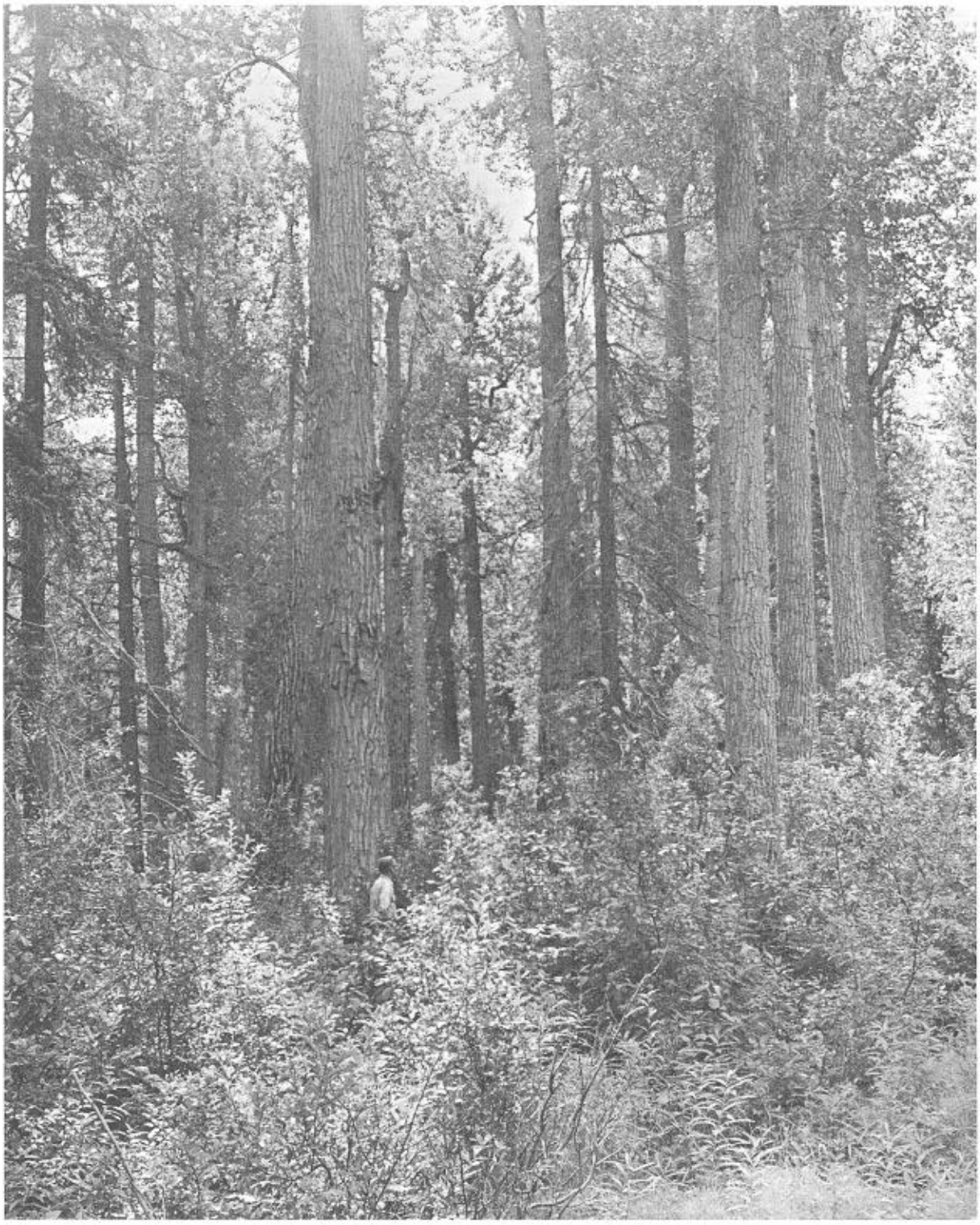

Figure 3.--Black cottonwood, along the Klehini River about 35 miles northwest of Haines, attains 36-inch diameters and 120-foot heights.

FOREST AREAS

The forested area of coastal Alaska is estimated to be 13,247,000 acres. This area includes all land now at least 10 percent stocked with trees.[2]

The area defined as commercial forest land has a minimum of 8,000 board feet[3] of sawtimber per acre, or is capable of producing this amount, and a minimum area of 10 acres. The commercial forest area is 5,749,000 acres (fig. 4). To establish this estimate, the region was divided and sampled in units. Area estimates for these units are given in table 2 (Appendix).

FOREST MANAGEMENT

Ninety-two percent of coastal Alaska, the most productive timberland in the State, is in the National Forests. Because townsites, homesteads, and mining claims account for so little area, they have only very local influence on overall forest management problems and objectives. The State has an important management unit north and west of Haines, and other lands are being selected by the State at Cape Yakataga, on the southern part of the Kenai Peninsula, and in the vicinity of existing towns. Glacier Bay National Monument contains about 179,000 acres of commercial forest land. This land is withheld from timber harvesting activities in order to thoroughly preserve the area's outstanding scenic values.

Although the Forest Service is charged with the land management responsibility of most of this region, other agencies and special interest groups are kept informed of almost every activity and often invited to cooperate in the venture. For example, the Alaska Department of Fish and Game and the U. S. Fish and Wildlife Service are kept advised of timber management decisions and recreation plans which may affect wildlife habitat, salmon-spawning streams, and wildlife harvest. Some of the many shelters and cabins (fig. 5), erected for the use of the public, are located and built cooperatively with the Territorial Sportsman's Association.

The size of forest ownerships can be an important consideration in locating new timber products plants. Where wood users must deal with many owners to obtain a wood supply, managed use resulting in a sustained supply is difficult to arrange. This problem diminishes where individual ownerships are large enough to sustain one or more industries. Then the owner or manager can compute, as does the Forest Service in coastal Alaska, an annual allowable cut in order to assure operators of a managed supply. This does not eliminate competition since the timber is advertised and sold to the highest bidder.

For inventory purposes the coastal forests were divided into units as shown in figures 6 and 7. For management purposes, the Forest Service combines its holdings in these units into working circles and determines an annual allowable cut for each. An actual cut equal to the allowable cut has not been achieved on any of the working circles. Timber management plans, prepared for each of the National Forest working circles, are reviewed and revised at 10-year intervals. The area of commercial forest land in each working circle is

[2] For more exact definitions of Forest Survey terms used in this report a page 54.

[3] Throughout this report, unless otherwise stated, the values given in board feet will be based on the International 1/4-inch rule.

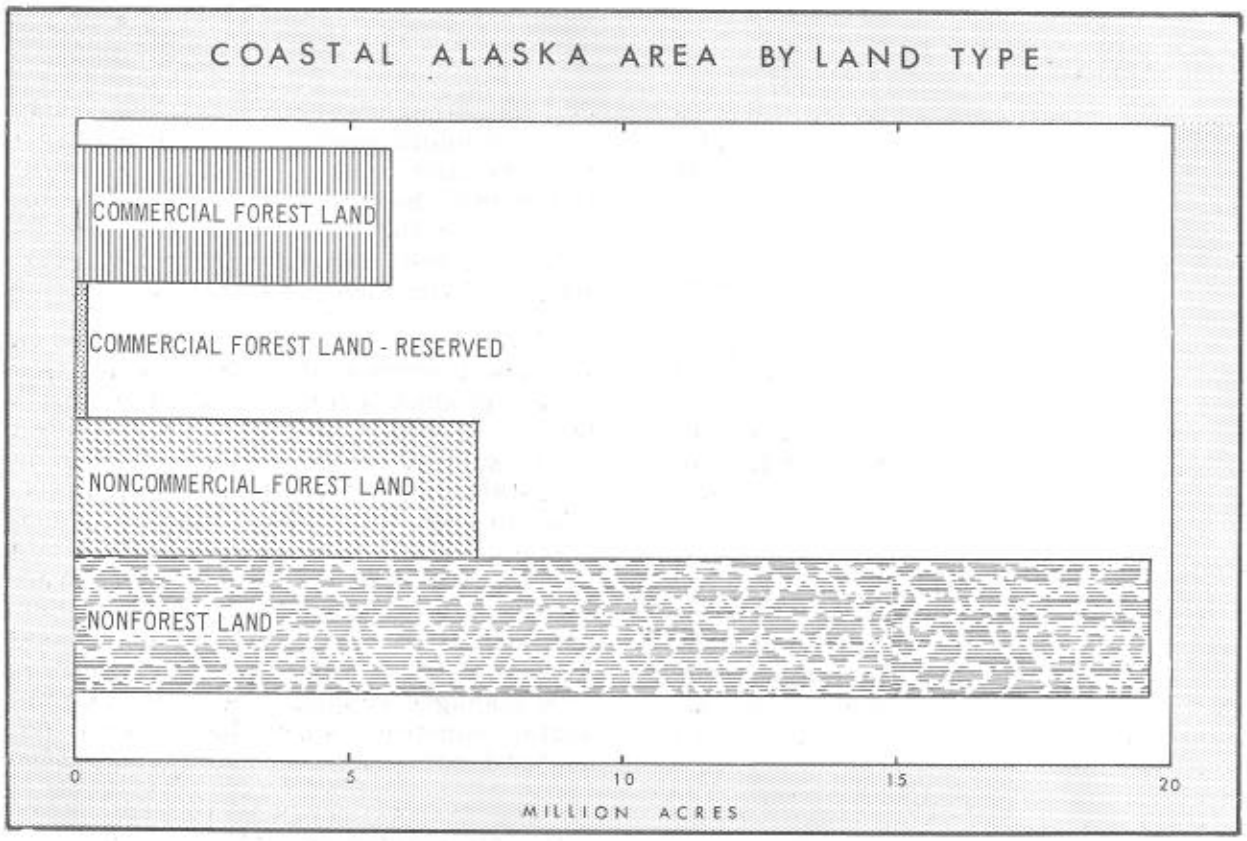

Figure 4.--The coastal land area is 40 percent forested, but only 43 percent of the forest land is of commercial value for timber production.

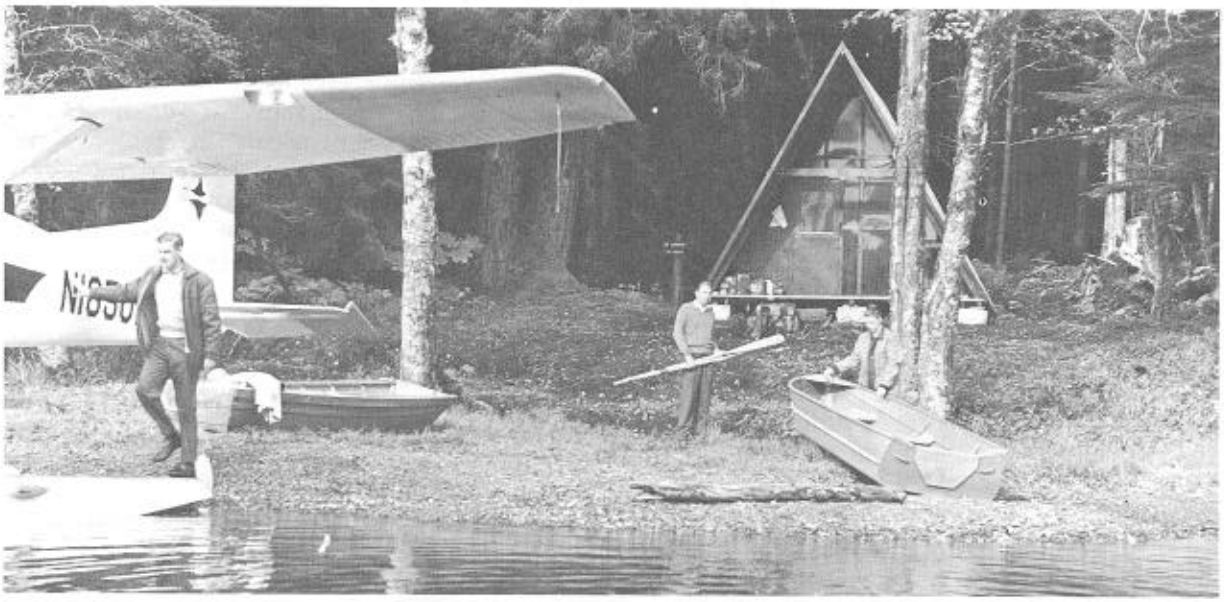

Figure 5.--This cabin, and many others similar to it, has been placed at a scenic, recreation spot for the public to use.

Figure 6.--The shaded areas are management units of the Tongass National Forests.

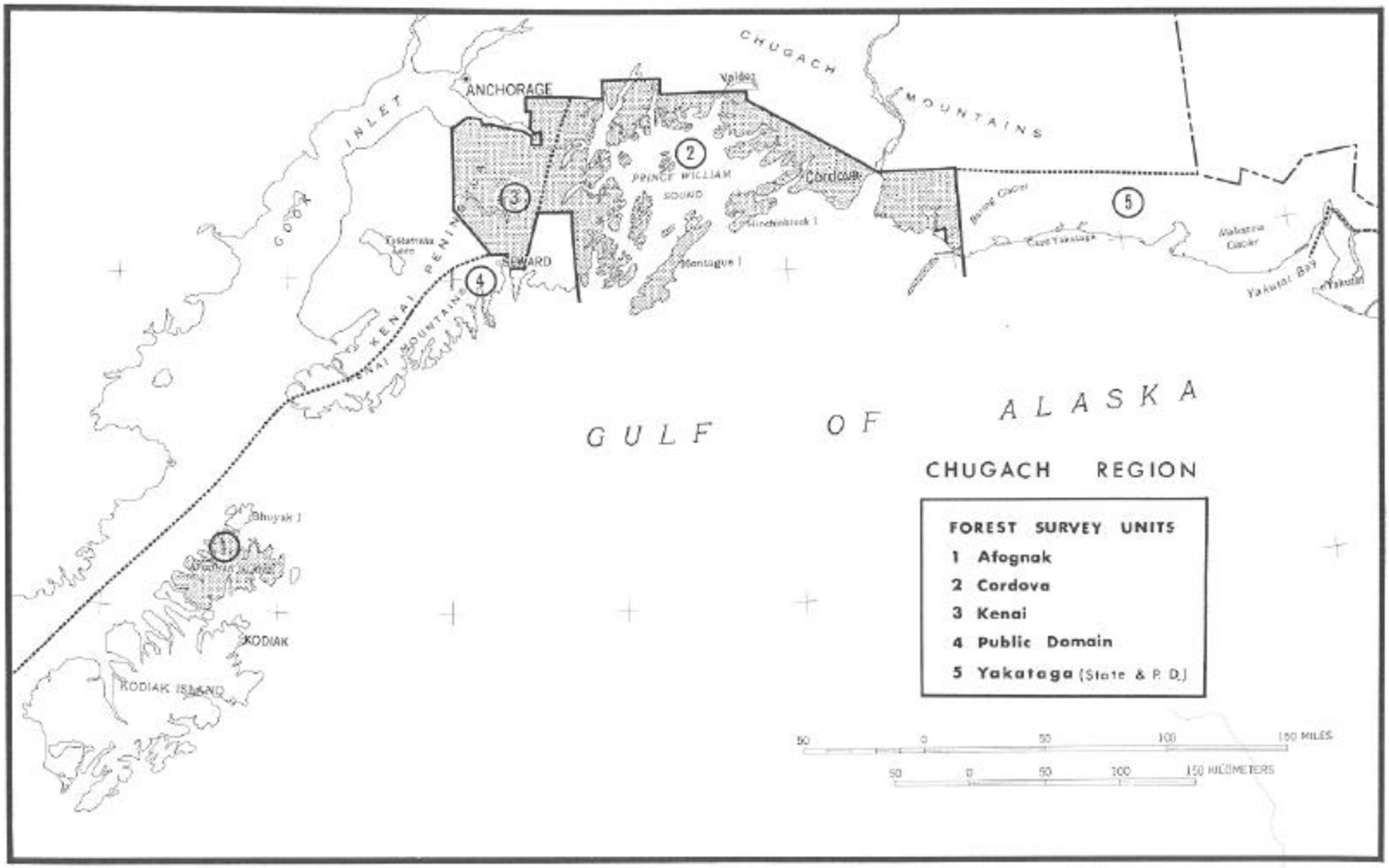

Figure 7.--Most of the shaded areas are management units of the Chugach National Forest.

FOREST AREA BY STAND TYPES

Western hemlock and Sitka spruce forest types together account for 96 percent of the coastal forest area (figs 8). These two species are by far the most important in the State by volume, value, and use. They account for at least 99 percent of the present log production.

Western hemlock is dominant on abort 2.7 million acres. On 1 million acres, Sitka spruce comprises 50 percent or more of the stand volume. On 1.5 million acres, hemlock and spruce are mixed, with spruce making up 30 to 49 percent of the stand.

Some cedar is found in the southeastern part of the region, and hardwoods arc found along some drainages. The area in cedar is about equally divided between western redcedar and Alaska-cedar.

Commercial stands of black cottonwood are found in several localized areas. The Stikine, Taku, Haines, Yakutat, and Seward areas are the more important.

On the Kenai unit, a transition from coastal to interior forest types occurs. Here, the western hemlock-Sitka spruce type is displaced by white spruce and mountain hemlock in mixture with aspen and paper birch.

FOREST AREA BY STAND-SIZE CLASSES

Forest land was separated into commercial and noncommercial classes (fig. 9). Commercial forest land was defined as having a minimum volume of 8,000 board feet per acre or the capacity to produce this volume. In a further classification of commercial forest land, five conditions of stand size were recognized: (1) oldgrowth sawtimber, (2) young-growth sawtimber, (3) poletimber, (4) seedling and sapling, and (5) nonstocked. The first four are related to conditions of stand age or maturity, whereas the fifth is the present lack of land utilization by cony mercial tree species.

These classes are important to the forest manager as well as to those interested in timber harvesting. The old-gromth sac timber stands, for example, are recognized as having reached or passed physiological maturity. They are no longer growing vigorously. Young-growth sawtimber, poletimber, and seedling-sapling stand:, on the other hand, are characterized as vigorous, healthy stands contributing a maximum amount of wood annually through net growth. The old-growth stands are those the forest manager must harvest first in order to increase the overall productivity of the forest. These old-growth stands are also wanted be timber buyers and operators because they usually contain the best quality logs.

Eighty-four percent of coastal Alaska's commercial forest area is classed as oldgrowth sawtimber (fig. 10). Thus, we have 4.8 million acres of forest land which maybe considered beyond the optimum age for harvesting. Currently, about 72,000 acres are being cut annually. Because of the unbalanced conditions of the total forest, the annual volume harvested can exceed the amount being grown for many years before sufficient young stands will be obtained to bring growth and cut into balance.

For the mast part, younger stand sizes occur as scattered, small patches near tidewater. Many of these small tracts were logged earlier because they were easily accessible and possessed high volumes of quality timber. Young stands are also commonly found on areas of windthrow, glacial retreat, land uplift, and stream channel changes. -Many landslides occur on the steep slopes, and these usually restock with forest growth. If these area,. have root restocked satisfactorily, they nee included in the nonstocked stand-size class-

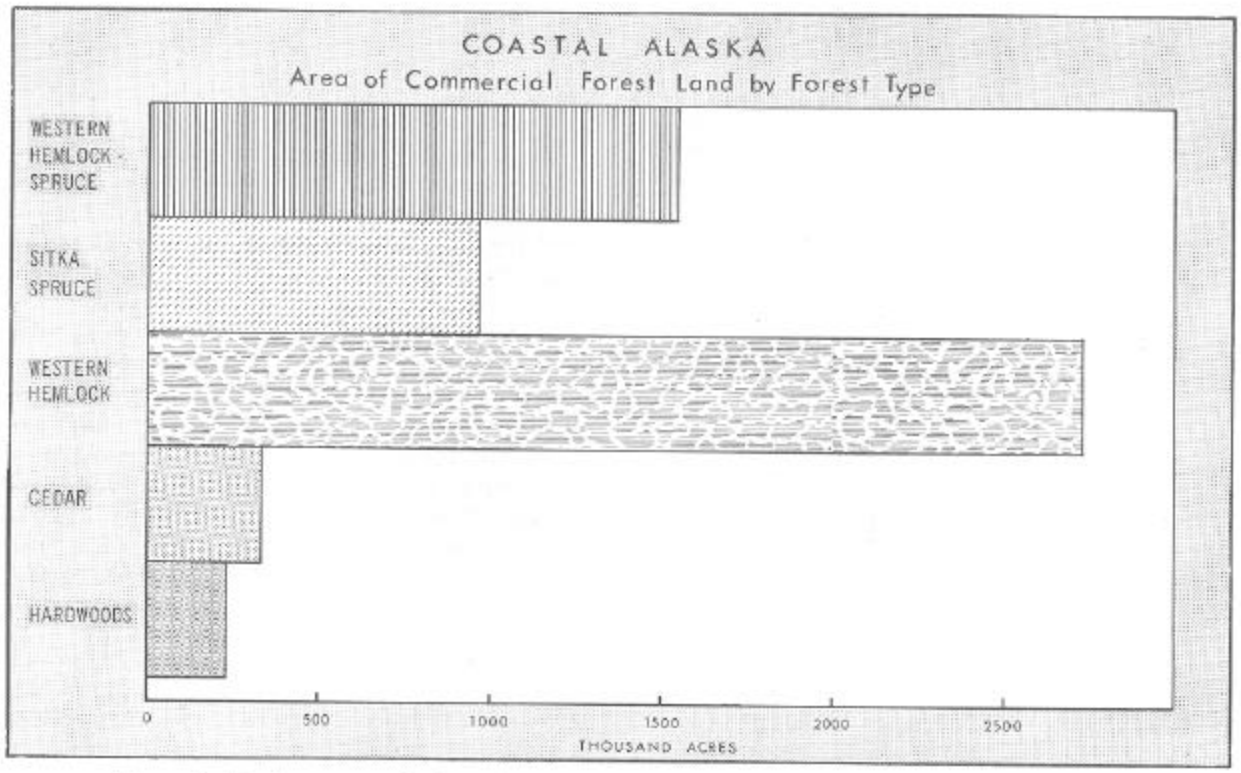

Figure 8.--The forest types of this region are not distinct--the species are intermingled and blended.

Figure 9.--Muskeg areas like this were not included in the commercial forest area.

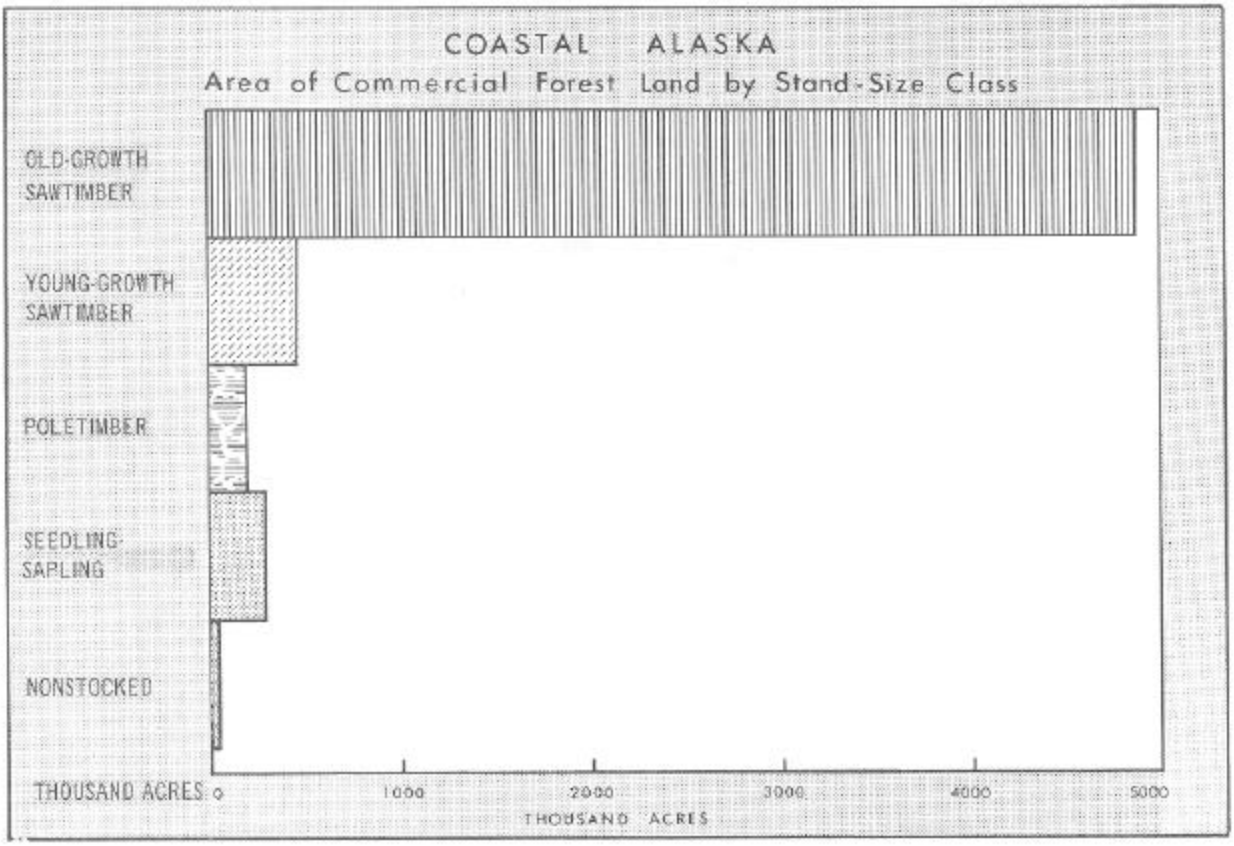

Figure 10.--As the stands become well managed, the old-growth sawtimber area will be replaced by thrifty young-growth sawtimber, poletimber, and seedling-sapling stands.

SAWTIMBER VOLUME

Coastal commercial forests contain a total net volume of 184.7 billion board feet of sawtimber. The importance of this figure depends upon the distribution of volume. Areas supporting high volumes per acre are usually much more operable, economically, than those supporting low volumes per acre.

The coastal commercial forests, with 86 percent of the sawtimber volume in Alaska, average more than 30,000 board feet per acre. The range per acre is from 8,000 to more than 100,000 board feet. These stands are attractive for industrial development, but some competing regions offer as much or more in quantity, quality, and preferred species. The forests of western Oregon and Washington have half the total sawtimber on the Pacific coast, and the preferred industrial species, Douglas-fir, comprises most of the volume. However, the average volume per acre of sawtimber stands in coastal Alaska compares favorably with similar stands in Oregon and Washington. Coastal Alaska has 88 percent of this Nation's total supply of Sitka spruce.

Soils and drainage are so complex and variable in coastal Alaska that the better, stands are not always found on the benches and valley bottoms where they might ordinarily be expected. Muskegs, with the inherent characteristic *of* poor drainage, often occur on locations that otherwise would produce good timber. Most of the good stands of timber are, however, within 2 or 3 miles of tidewater.

The southernmost unit inventoried is the Ketchikan (figure 6) with nearly twice as much sawtimber as any other unit. The Ketchikan unit has a greater total land area and a higher proportion of commercial forest land. The character of the commercial forests changes northward and westward from the Ketchikan unit. Volumes per acre tend to decline, trees are generally of poorer quality, and the stands become more variable and less extensive.

Western hemlock and Sitka ;spruce together account for 94 percent of the boardfoot volume - 106 and 68 billion board feet, respectively *(*fig. 11). Alaska-cedar and western redcedar account for about 4 billion board feet each. Host of the 1.3 billion board *feet of* hardwood is black cottonwood. The remaining 1.2 billion board feet consists of other softwoods, mostly mountain hemlock, white spruce, and lodgepole pine. Although western hemlock comprises most of the volume, the largest and best quality trees available are Sitka spruce. Sitka spruce is rather evenly distributed throughout the four southeastern units, accounting for about 30 percent of the volume. The proportion increases to 80 percent in the Yakutat unit and to 100 percent on Afognak Island.

Most of the volume is in the 21- to 30inch class (fig. 12). More than one-third of the volume is in trees greater than 30 inches d.h.h. (diameter breast height). In general, the spruce is larger than the hemlock. More than 30 percent of the spruce volume is in trees greater than 'd0 inches d.b.h. These trees produce high-quality spruce logs. Such treed are more common on the four southeastern unit. The units front Yakutat westward have smaller tree s. On Ale Afognak Island, the average diameter of all trees is 11.8 inches, and 51 percent of the volume is in the I1-to 20-inch-diameter group.

LOG QUALITY AND TREE DIAMETERS

The stands of coastal Alaska are often described as mature or overmature, of declining quality, and suitable primarily for the manufacture of pulp. Much of this is true, but intermixed in these predominantly pulpwood stands there is presently a good supply of the finest quality Sitka spruce and western hemlock to be found anywhere. To attain full utilization of coastal stands, more attention must be given to determining the supply and value of the high-quality logs and to diverting them to their highest use.

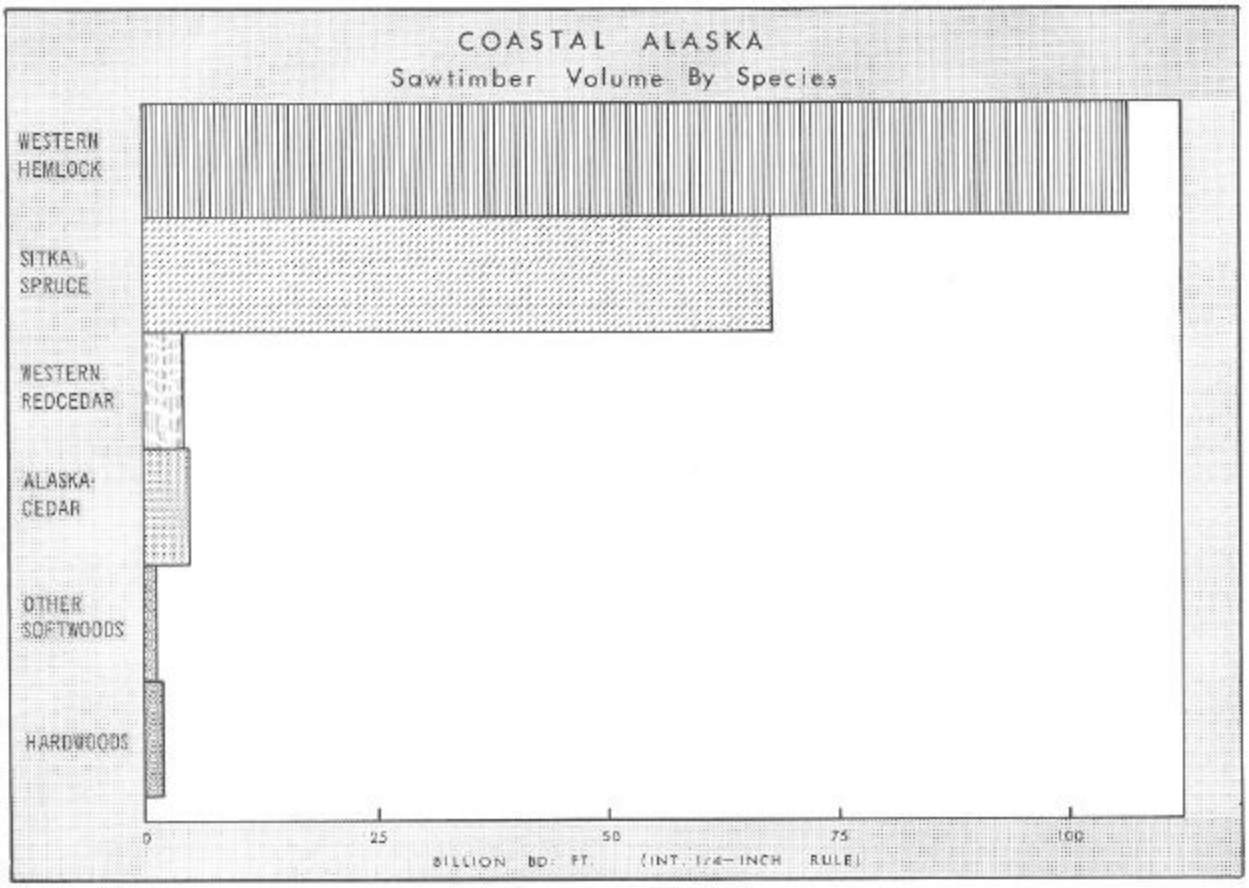

Figure 11.-- Future second-growth stands are expected to have a higher percentage of Sitka spruce volume than is shown here in old-growth stands.

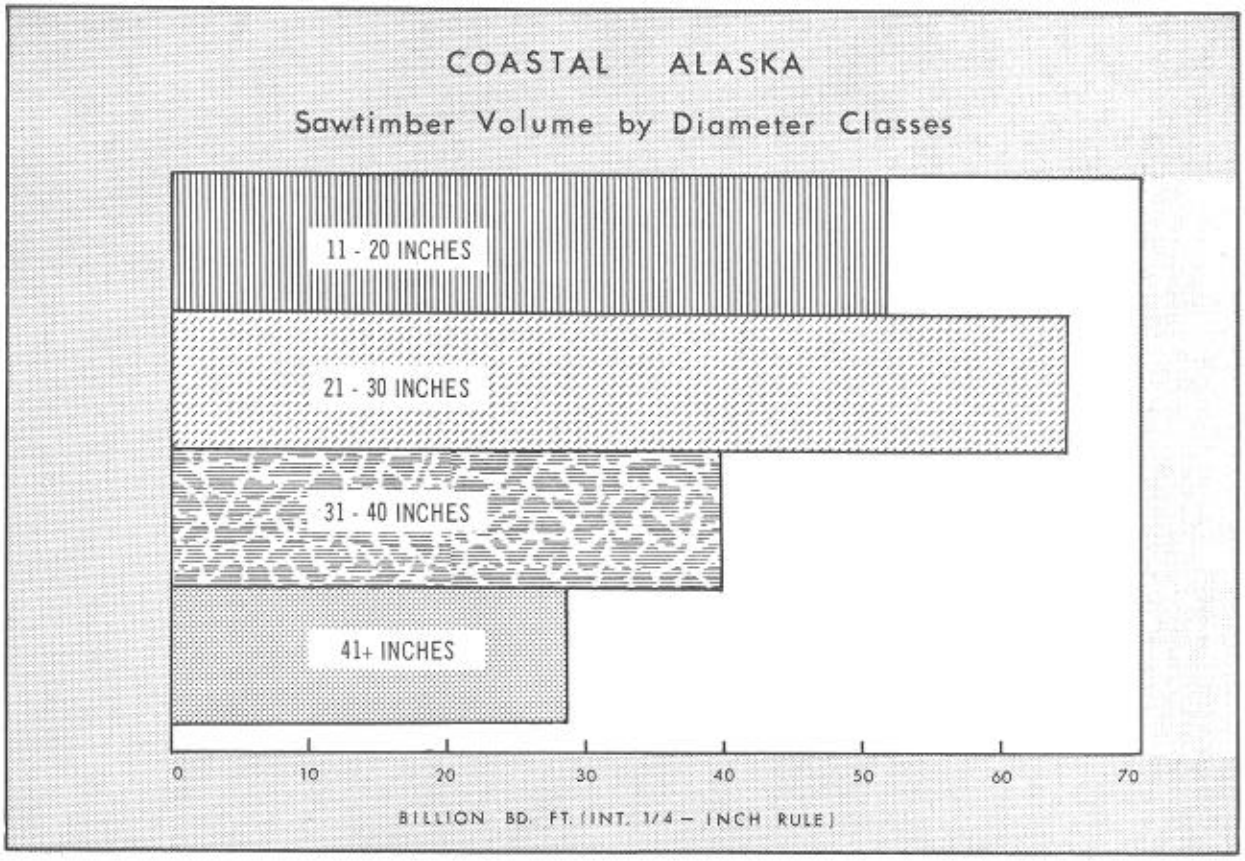

Figure 12.--The highest quality volume--that in trees 30 inches d.b.h. and larger--is in old-growth trees. The second-growth stands are likely to be scheduled for cutting long before they accumulate much volume in trees 30 inches d.b.h. and larger.

For many years, southeast Alaska has produced logs and cants for manufacture of high-quality specialty products. Beginning in World War I (U.S. Forest Service 1954), and especially during World War II, this region supplied much of the high-quality spruce used in the manufacture of aircraft. In this region, 9.3 billion board feet of the spruce are in Select and No. 1 grade logs. Another 5.5 billion board feet of western hemlock are in Peeler and No. 1 grade logs. These logs are desirable for the manufacture of veneer, plywood, and high-quality lumber products. The high-quality volume in the stands amounts to about 5 percent of the total hemlock and 14 percent of the spruce sawtimber volume. Much of this volume no«- is used in the production of dissolving pulp worth $175-$235 a ton. Whether the yield of pulp is greater from these high-quality logs than from lower quality logs is not known. It is known, however, that the supply of timber suitable for veneer, plywood, and other highly valued products is diminishing in all regions.

Log quality is, of course, closely related to tree diameter. Among the larger trees, more high-quality logs can be expected. Select grade Sitka spruce logs must be at least 30 inches in diameter, measured inside the bark at the small end. Peeler and No. 1 grade hemlock logs must measure at least 24 inches.

In southeast Alaska, more than 50 percent of the Sitka spruce sawtimber volume is in trees 31 inches or larger, d.b.h. Twenty-five percent of the volume in these trees is in either Select or No. 1 grade logs. Thirty-nine percent of the hemlock sawtimber volume is in the 21- to 30-inch class and another 30 percent is in trees 31 inches or larger.

If stand quality were evenly distributed throughout the region, logging operators could expect to obtain about 2,500 board feet per acre in grade 1 or better logs. Since the stands are not uniform in quality, anyone interested in high-quality logs will profit by searching for the better stands.

Many of the better stands are being bypassed at present because the cost of reaching them is too great. Many good stands of timber occur as small, isolated pockets behind muskegs, on steep slopes, in side drainages, and in other hard-to-reach places. These stands are likely to remain Unharvested until more favorable logging methods and economic conditions permit their harvest.

The coastal stands of Yakutat , Prince William Sound, Kenai Peninsula, and Afognak Island are significantly poorer in quality than those of the southeast coastal stands. Inventory shows a scattering of western hemlock Peeler logs, but no Select grade Sitka spruce. Less than 5 percent of the sawtimber volume of these species was in the two top grades of logs. The poorer quality of trees in this region is largely attributable to limbs, associated with the poorer stocking of the stands. The trees are not as tall as those found in the southeast and limbs tend to persist even on the first log. Thus, the degrade in lumber that can be produced from these stands will be largely from knots.

In southeast Alaska, there appears to be an opportunity to develop a much more integrated wood-using industry than now exists. Some of the high-quality logs, particularly Sitka spruce, are now sorted from the pulpwood rafts and sold to sawmills, but very few- are processed. Most are cut into cants for export to Japan. Per capita use of plywood and veneer is expected to increase from 64 square feet in 1962 to 97 square feet in 2000. About 75 percent of this demand is expected to be for softwood plywood and veneer (U.S. Forest Service 1965a). Some other softwood plywood and veneer producing areas are facing raw material supply problems (Cowlin and Forster 1965). Alaska has 88 percent of the Sitka spruce and 40 percent of the western hemlock sawtimber in the Pacific Northwest region (U.S. Forest Service 1965a). With so much of the total raw material, Alaska can supply many industries using these species.

GROWTH ESTIMATES

Young-growth stands. - The study of forest growth in the initial inventory was confined to even-aged, young-growth sawtimber and poletimber stands. These stands account for only 578,000 acres, or 10 percent of the commercial forest area. On seventy-eight 1/5-acre plots studied, mean annual increment ranged from 30 to 966 board feet per acre. Lowest boardfoot growth was on stands classified as poletimber, whereas the sawtimber stands produced most. The location producing 966 board feet annually was a well-stocked, 130-year-old stand of hemlock averaging 78,000 board feet of sawtimber per acre. The current annual increment of all coastal young-growth stands totals 379 million board feet or 64 million cubic feet.

Old-growth stands - It was assumed that old-growth sawtimber stands (stands in which more than 50 percent of the volume is in trees at least 150 years old) are neither gaining nor losing volume. Since completion of the inventory, remeasurement of the Juneau and Sitka units has, however, revealed net growth in these units. It is not yet certain whether similar growth will be found in other units, or for how long this net increment may continue before offsetting losses predominate.

Stand conversion. - The present oldgrowth stands are by volume about 57 percent western hemlock and 36 percent Sitka spruce. Studies (Taylor 1934) show that second-growth stands at 75 to 100 years of age will be about 50 percent spruce. This may be a desirable change in stand composition since Sitka spruce brings, in present markets at least, the highest stumpage price.

Studies of second-growth stands (Taylor 1934) indicate that areas now being harvested should produce more than twice as much volume in the next rotation. Eventually, the commercial forest,, of coastal Alaska should sustain about twice the industry being planned for the present old-growth stands.

For economic and silvicultural reasons, forest managers in southeast Alaska prefer clearcutting as a timber harvesting practice (fig. 13). Adequate restocking ordinarily results from seed disseminated from surrounding timber. But if natural seeding should fail, it has been demonstrated that aerial seeding may be used to restock large areas at relatively low cost (Harris 1965). Some alluvial bottom lands may restock slowly and require special handling. These special situations warrant more study.

TIMBER LOSSES AND RISKS

The risk most commonly thought of is fire, but coastal forests are well protected from fire by the climate. Rainfall is heavy and well distributed throughout the seasons so that only a few relatively small fires have occurred. In the present oldgrowth stands of coastal Alaska, fire is not a serious risk.

Field crews have a difficult time assigning the primary cause of tree death. Trees killed by fire and windthrow are generally obvious, but many trees show combinations of causal agents such as disease, insects, a fire scar, and wind damage. Seventeen percent of the dead trees in the inventory sample were windthrown. Another 17 percent were believed to have been killed by insects. Fire accounted for 11 percent of tree mortality, and practically all of this damage was on the Kenai unit (fig. 7) of the Chugach region. Diseases killed 7 percent of the trees, and unknown or combined causes accounted for the remaining 48 percent.

Age seems to be the key factor of risk. At one time, these coastal stands probably were even aged. As disease, insects, wind, ice, etc., took their toll, holes opened in the stands for new growth to enter, and the stands became uneven aged. The stands are still predominantly old and average much more than 150 years. The

Figure 13.--Logging in Maybeso Valley on Prince of Wales Island was nearly completed when this picture was taken in 1959.

change from even-aged to uneven-aged stands is continuing. The annual volume loss from mortality averages 88 board feet on each commercial forest acre of coastal Alaska and totals 503 million board feet. This loss roughly equals the amount being harvested each year.

The above estimates of loss may be conservative. Biased estimates of mortality can result from inability to determine how long trees have been dead. Remeasurement studies showed that annual mortality in old-growth stands on the Juneau unit averaged about 108 board feet per acre annually.

An aerial view of coastal Alaska stands shows many dead tops. Some, but not all, dead tops indicate dead trees. Defoliating insects, the black-headed budworm, *Acleris variana* (Fern.), and the hemlock sawfly, *Neodiprion tsugae* Midd., are endemic throughout the region. High populations of the black-headed budworm attacked millions of acres of western hemlock and Sitka spruce from 1948 to 1955. Many trees died from these attacks; others were damaged, resulting in dead tops; and growth was lost or retarded on all defoliated trees. Scattered insect damage continues and is indicated in the measure of mortality, but there is no measure of the loss resulting from retarded growth.

As stands mature and age, many forms of damage develop in the trees. Decayed wood results from diseases which weaken and eventually kill the trees or hasten the losses attributed to wind and insects. A fifth of the gross volume of merchantable trees in coastal Alaska is unusable because of defects, mostly decayed wood. Defects vary considerably by species. Defective western hemlock amounted to 22 percent of the gross merchantable volume, 51 percent for Alaska-cedar, 9 percent for Sitka spruce, and 53 percent for western redcedar.

Coastal Alaska has 760 million cubic feet (net volume) of sound wood in rotten cull trees. The gross volume of these defective trees is about seven times greater than their net volume of sound wood. Most culls in coastal stands are the result of decay. The volume of wood in sound cull trees amounts to 114 million cubic feet, only one-sixth of the volume in rotten cull trees. Generally, sound cull trees are usable for pulpwood but not for lumber products, whereas rotten cull trees are normally unusable for any- product.

Two common types of wood-decaying fungi are prevalent: brown rot and white rot. Brown rot destroys the cellulose fibers and white rot destroys the lignin content. In the incipient stage of decay, the wood is discolored and softened by both form of decay, though it might still be used for pulp production. Even in an advanced stage of decay, wood attacked by white rot might be used for pulp manufactures although the yield would be reduced. Wood in the typical stage of brown rot is not usable.

ALLOWABLE CUT

Allowable cut is defined as "The volume of wood -which can be cut under management for a given period of time" (Society of American Foresters 1958). In practice, allowable annual cut is usually the planned total cut for a 10-year period divided by 10. Each forest manager computes allowable cut based on his own concept of the factors included in the term "management," such as amount of money invested in management, timber merchantability, accessibility, utilization standards, markets, and operating conditions. Anyone could easily compute an entirely different allowable cut for the same forest by using different definitions for these factors.

A precise allowable cut for all of coastal Alaska cannot be computed from the Forest Survey, for this would require knowledge of management objectives for all areas and ownerships. However, 92 percent of the commercial forest land of coastal Alaska is in two National Forest, and the allowable cut computed for these Forests determines, for practical purpose, the potential commercial development of this region.

The National Forests of Alaska contain about 5,292,000 acres of commercial forest land available for timber harvesting. The allowable annual cut is currently placed at 864 million board feet (Scribner scale). However, only 3.3 million acres (62 percent of the commercial forest land) were classified in the inventory as accessible. Allowable cut was computed for this land. As cheaper and more efficient logging methods are developed, as markets improve, as demand for stumpage increases, and as timber becomes scarcer, more and more of the 2 million acres of presently inaccessible commercial forest land will become economically operable and be brought into the allowable cut Computation. The magnitude of this potential is apparent in the present estimate that inaccessible commercial forest land of southeast Alaska could support an annual cut of 415 million board feet.

The basic criteria used to determine accessibility were as follows: (1) a market must exist, (2) the minimum net volume available to a yarding tree must be at least 500,000 board feet, and (3) a minimum of 16,000 board feet per acre must be available in the area that can be yarded to a protected beach or truck road. Accessibility was provisionally determined from aerial photographs, then checked by sample field observations.

Improved markets for Alaskan timber may increase the allowable cut in future years. Since there is no active market for western redcedar and Alaska-cedar, 7.8 billion board feet in these two species was not included in the initial allowable cut computation. The entire area inventoried as accessible is not yet operable; loggers will reach more area as economic barriers are removed. An adjustment was made to reflect the difference between scaled volume and inventor- volume. Scaled volume is only about 74 percent of inventory volume. The difference between inventory and scaled volume is caused by (1) allowances made for breakage and other residue, (2) use of the 16-foot-log volume table when average scaled length is near 32 feet, and (3) scaling diameters rounded to the last full inch, whereas inventors- volumes are based on rounding diameters to the nearest inch. The allowance for these factors reduces the inventory volume estimate by about 20 percent.

In fiscal year 1964, the timber cut from Alaska's National Forests amounted to 417.4 million board feet (Scribner scale), about 48 percent of the allocable cut. It is expected that with the installation of one more large pulpmill, some green veneer production, and some increased sawmill capacity, the total present allowable cut on National Forest lands will be utilized by 1975.

INTERIOR ALASKA

Interior Alaska includes a gross area of 341,999,000 acres. Although this region has an annual rainfall of only 7 to 30 inches, nearly 3 percent of the area, or 9,414,000 acres, is in lakes 40 acres or larger and streams one-eighth mile or more in width.

This immense area has varied topography, vegetative cover, and climatic conditions. Continuous and discontinuous permafrost (permanently- frozen ground) is found at varying depths throughout the region (fig. 14), and to a great extent determines the vegetative type and growth patterns. Although the annual precipitation indicates a rather dry region, permafrost holds all moisture near the surface; heavy ground cover of grasses, mosses, shrubs, and trees retards surface runoff. Consequently, except on south-facing slopes, plant growth and plant distribution do not appear to be limited by lack of moisture.

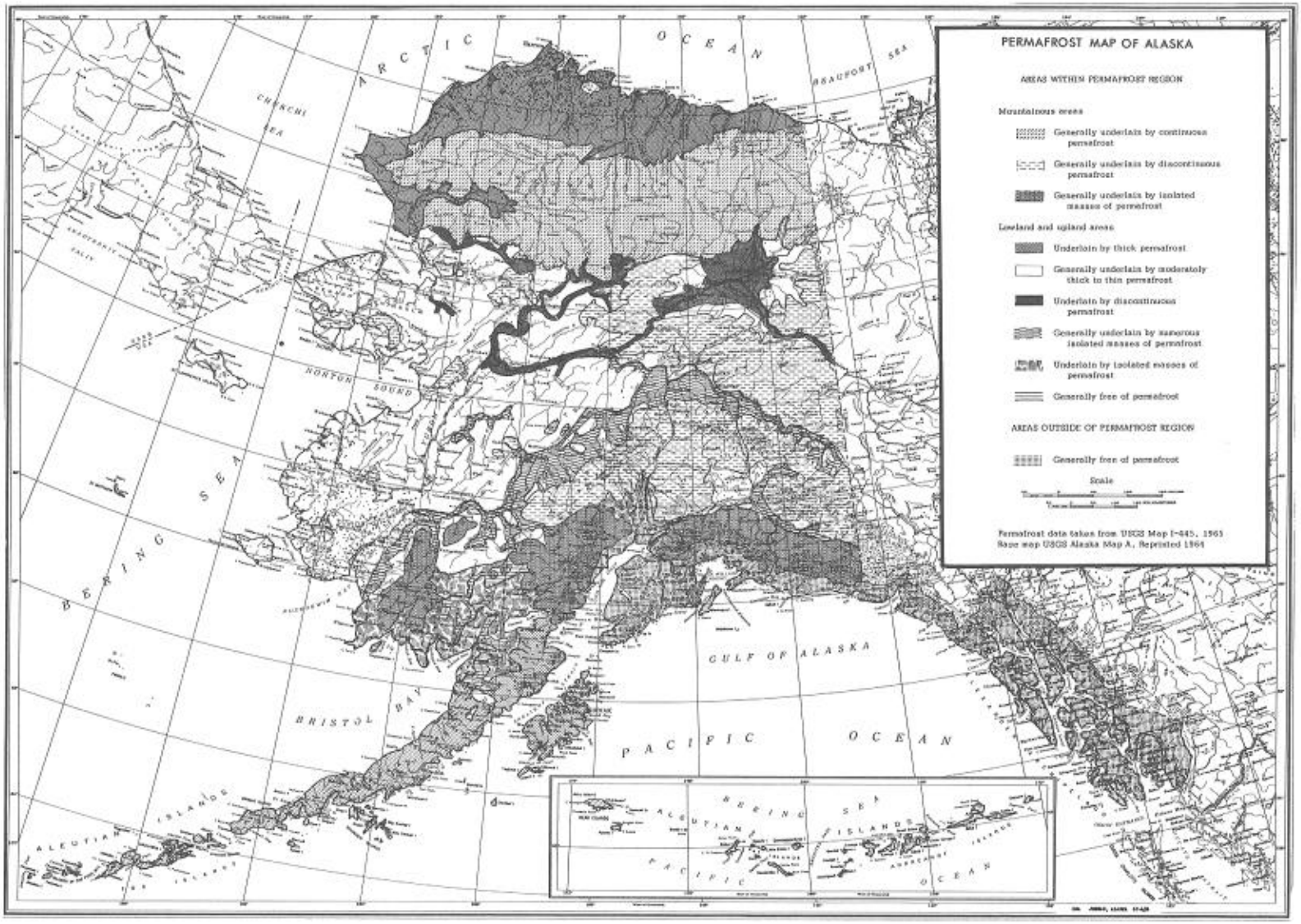

Figure 14.--Throughout much of the interior, permanently frozen ground limits the depth to which plant roots may grow.

FOREST AREAS

Alaska's interior forests cover about 106 million acres, or 32 percent of the total land area (fig. 15). Roughly another third consists of grassland, brush, swamps, and tundra, with a small fraction in agricultural crops. The balance is barren rock or ice and snow, largely- at high elevations. Although the forests extend to the Arctic slope, the better stands are generally confined to the lower slopes and valleys of the larger rivers and their main tributaries.

The principal forested regions include the complex drainages of the Susitna, Copper, Tanana, Yukon, and Kuskokwim Rivers, and the west half of the Kenai Peninsula. These regions contain most of the 22.5 million acres of commercial forest land in the interior. Commercial forest land is capable of producing 20 cubic feet per acre annually of usable wood (see definition on p. 54).

Intermingled with the commercial forest land and extending beyond to western and northern limits of tree growth are 83 million acres of sparse or open woodlands, presently considered noncommercial (fig. 16). Permafrost, high water tables created by impervious claypan soils, and thin soils are important factors responsible for the stunted and sparse tree growth over much of this area. In spite of extremely severe winters and permafrost, forest land extends well into the Brooks Range, primarily along the Porcupine, Chandalar, Koyukuk, and Kobuk Rivers and their tributaries.

FOREST OWNERSHIP

Because of the continuing State land-selection program, the ownership of Alaska's forest land, particularly in the interior, is constantly changing. The Alaska Statehood Act of 1958 provided for the eventual transfer of 103.3 million acres to the State. The State of Alaska will select most of this from lands now administered by the U.S, Bureau of Land Management. Through September 1965, nearly 17 million acres had been selected; of this, 1,686,763 acres had been patented. Only= lands classified as timberlands will be managed for timber production, and much of the forested land being selected by the State is classified for other than timber use. So far, only 262,445 acres are classified as timberlands.

Although 23 Federal agencies own land in Alaska (U.S. Department of the Interior 1964), 99.9 percent of the land is controlled by 6 agencies:

Agency	Percent
Bureau of Land Management	85.4
Forest Service	5.7 (all in the coastal region)
Fish and Wildlife Service	5.2
National Park Service	1.9
Bureau of Indian Affairs	1.1
Army	.6

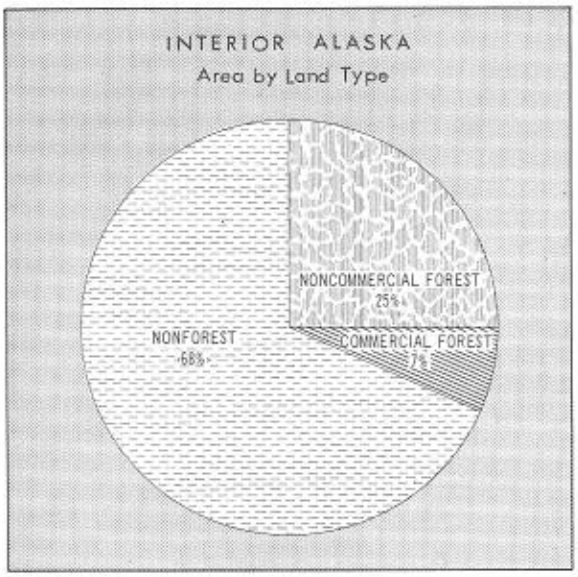

Figure 15.--Twenty-one percent of the interior forest land is commercial.

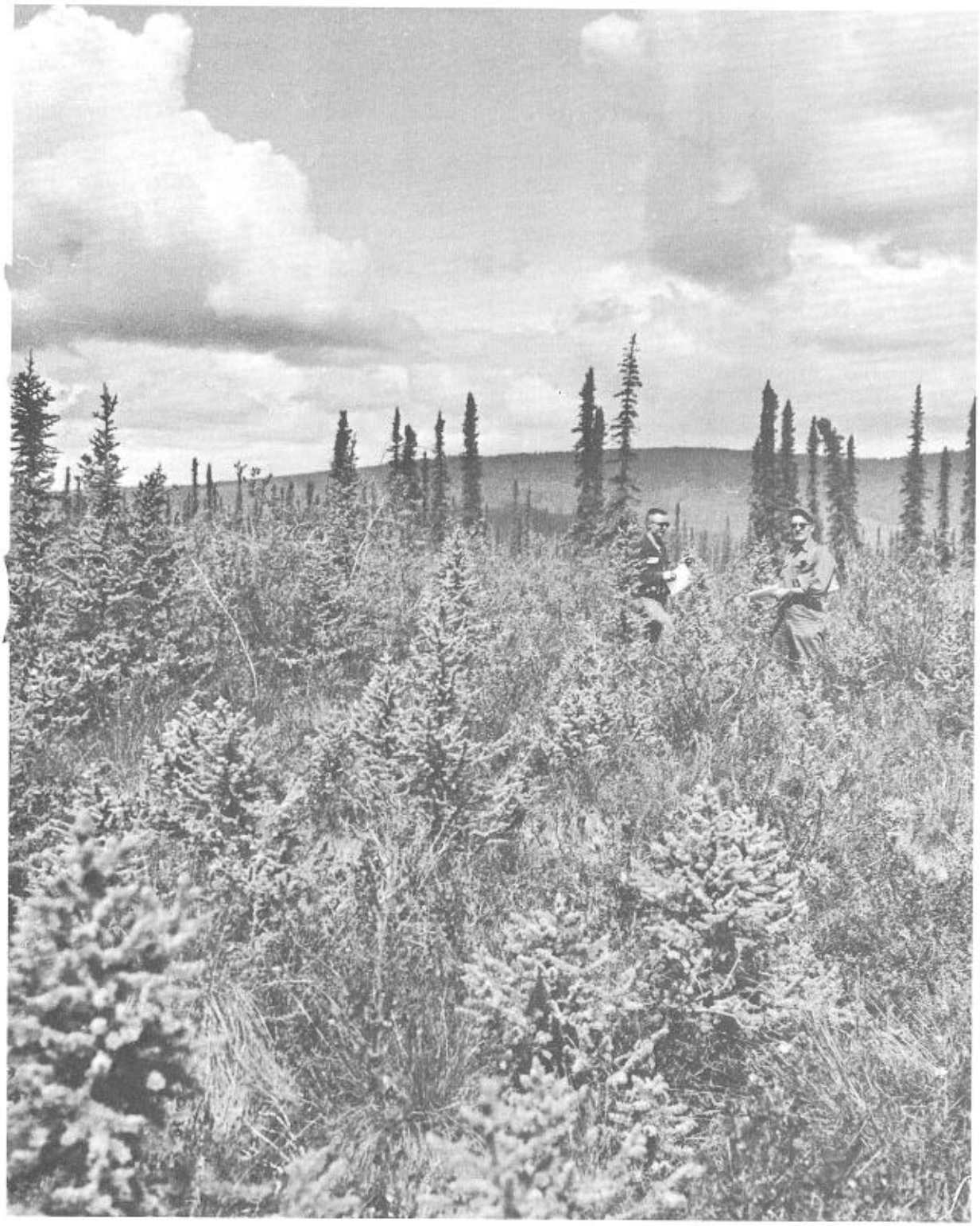

Figure 16.--Areas like this black spruce bog near Northway were classified as noncommercial forest land. Black spruce grows slowly and usually stagnates in very dense sapling stands.

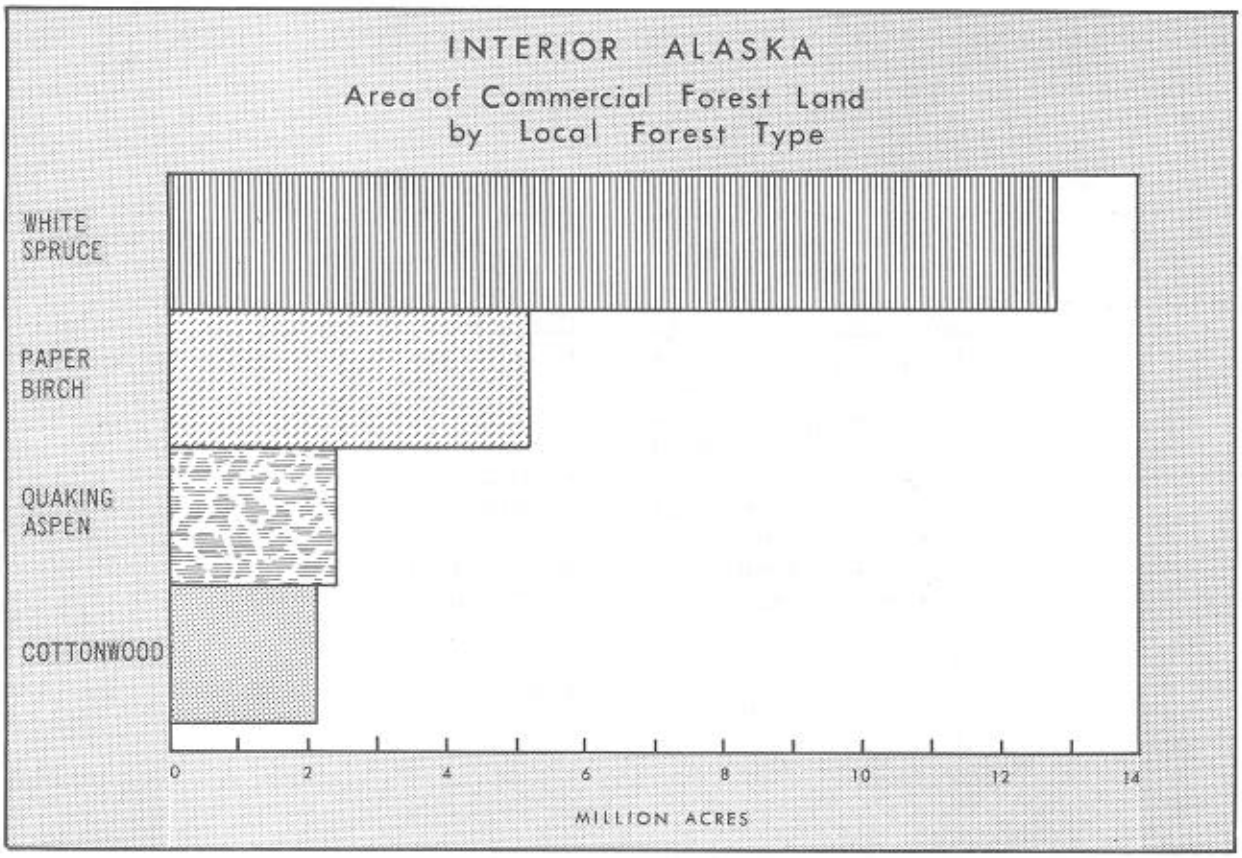

Figure 17.--White spruce is the dominant commercial tree species in the interior. It is found in pure stands and in association with all other species.

After completion of land selection by the State, the Bureau of Land Management will probably retain control of nearly 60 percent of Alaskan land.

Ownership is important to many timber purchasers, for their costs often depend upon the size of timber tracts available. Private owners generally own such small tracts of forest land that the larger, more efficient timber buyers and operators are not interested. Timber in public ownership usually can be offered in amounts to suit the available timber operators.

FOREST AREA BY STAND TYPES

Interior forest types are generally not pure, but are mixtures of the four major commercial species: white spruce, paper birch, aspen, and balsam poplar. However, stands are classified on the basis of predominant species. The spruce type (primarily white spruce) accounts for about 57 percent of the commercial forest land (fig. 17). Paper birch type accounts for 23 percent; aspen, 11 percent; and balsam poplar and cottonwood, 9 percent.

White spruce is generally recognized as the climax tree on most commercial forest sites of the interior. There are 12.8 million acres of this type. The best stands of white spruce (as well as most other species) are found along the welldrained river bottoms. Stands 95 feet tall, 100-200 years old, and averaging 10,000 board feet per acre are found on good alluvial sites (fig. 18). Tree diameters (d.b.h.) in such stands range from 10 to about 24 inches. White spruce matures at 100 to 150 years of age if not damaged or destroyed by fire. If the spruce is destroyed by flue, the sit, is commonly seeded by aspen, birch, or white spruce, or a mixture of these species. Being tolerant of shade, white spruce may come in as an understory; eventually spruce becomes the predominant species in the stand.

Paper birch, including varieties and hybrids, is the predominant species on 5.1 million acres. Paper birch is commonly associated with spruce and aspen. However, it seeds or sprouts as a pure stand following a fire. Birch -natures at 80 to 100 years, rapidly becomes defective, and sometimes is replaced by spruce which has been growing as an understory. Good sites produce stands of birch sawtimber 60 to 80 feet tall with diameters (b.h.) of the larger trees ranging from 12 to 18 inches (fig. 19). The average diameter of such stands will be 8 or 9 inches. Trees that reach 15-18 inches d.b.h. are mature and usually defective (Gregory and Haack 1965).

Quaking aspen also follows fire, either as a pure stand or in mixture with spruce and sometimes with birch. It is the dominant tree on 2.4 million acres. Aspen is a fast-growing tree that matures in 60-80 years and gradually may be replaced ' by spruce. Because of its short life span, aspen normally does not grow to be larger than 10 to 14 inches d.b.h. Stands with trees averaging only 6-8 inches are most common. Aspen is found throughout the interior, especially on south slopes and well-drained benches. Stunted stands can be found in protected swales up to about 3,000-foot elevation.

It is difficult to distinguish between black cottonwood and balsam poplar. The two closely related species have similar appearance and habits. Fortunately-, the two trees have different ranges and seem to overlap only in the Cook Inlet area. The volume reported for the interior contains little black cottonwood, and that reported for coastal Alaska contains little balsam poplar. Balsam poplar may be the most widely distributed tree in the interior where it occurs as the major species on 2.1 million acres. In scrub form, it is found at higher elevations than white spruce (Taylor and Little 1950). It also is found at the western limits of tree growth, and projects farther north into the Brooks Range than other species. Best growth is reached on sandy bottoms of river valleys where trees 80 to 100 feet tall and 24 inches or larger in diameter are found. Balsam poplar trunks are clean and straight and snake high-quality logs (fig. 20).

FOREST AREA BY STAND-SIZE CLASSES

Stand-size classification is one means of measuring the stage of development of our forests. This classification also may indicate commercial importance and the need for certain silvicultural practices. In contrast to the coast with more than 80 percent of the commercial forest land in old-growth sawtimber, 70 percent of the interior commercial forest lands contain immature stands: 39 percent poletimber, 26 percent seedlings and saplings, and 5 percent nonstocked. This amounts to 6.9 million acres of sawtimber, 8.7 million acres of poletimber, 5.8 million acres of seedlings and saplings, and 1.1 million acres nonstocked (fig. 21). These young stands may

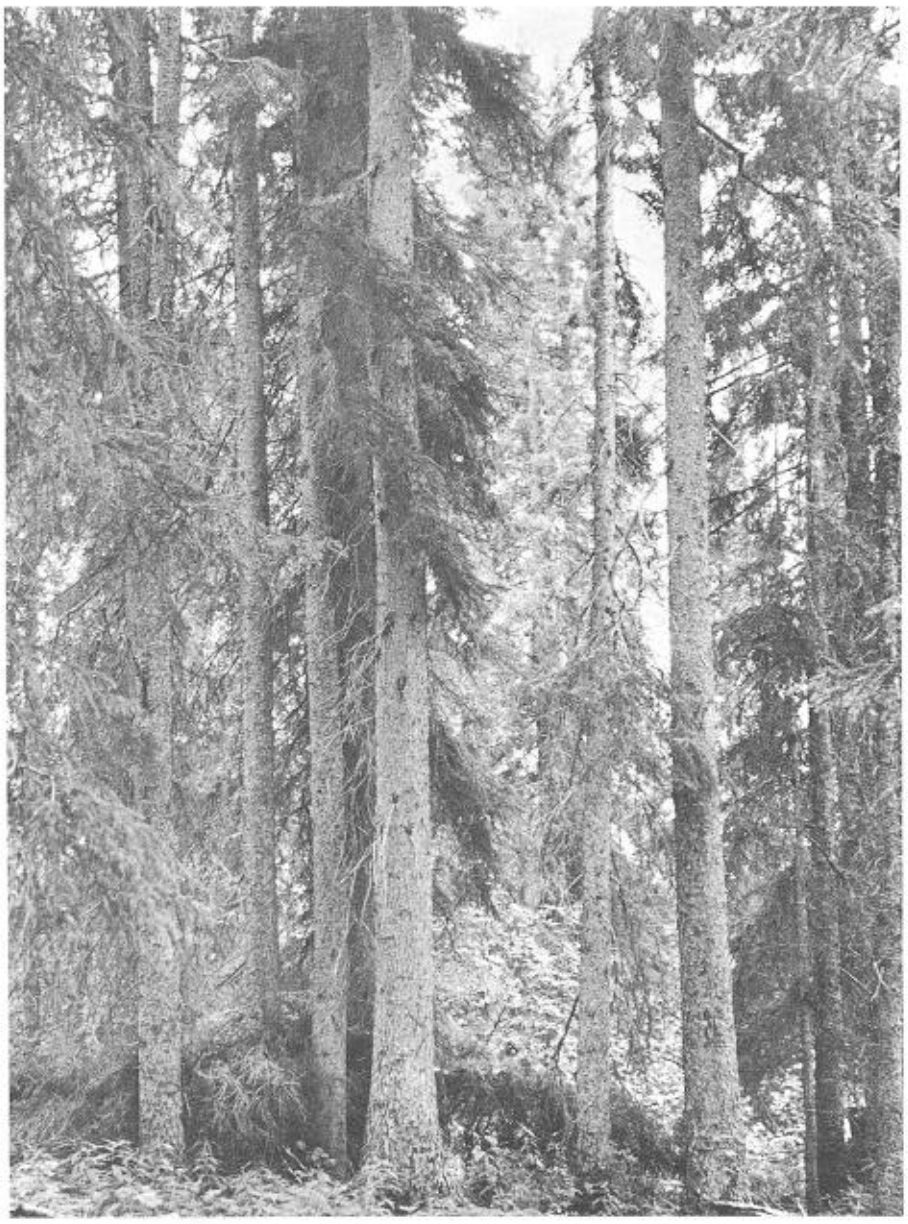

Figure 18.--A climax stand of white spruce, about 215 years old, and 70-80 feet tall. The dominant trees range from 11 to 20 inches d.b.h.

respond to silvicultural practices such as thinning, pruning, and selective harvesting (Barrett 1962), in contrast to coastal oldgrowth sawtimber, the productivity of which is best increased by clearcutting and encouragement of new stands. Coastal stands are being improved by commercial harvesting operations, but to improve interior stands will *require an* investment of labor and money. *Present markets* for interior timber do not encourage investment.

Figure 19.--Stands such as this mature paper birch sawtimber along the Chena Hot Springs road near Fairbanks are neither extensive nor common. Usually these stands develop following a fire, with quaking aspen and white spruce intermingled in the stocking. If the spruce can obtain sufficient light, it will become the major component of the stand as the hardwoods mature and die.

Figure 20.--The dominant trees in this mature stand of balsam poplar are 20 to 28 inches d.b.h., about 95 feet tall, and 170 to 235 years old. Many good stands of balsam poplar may be found along the alluvial bottom lands of the interior.

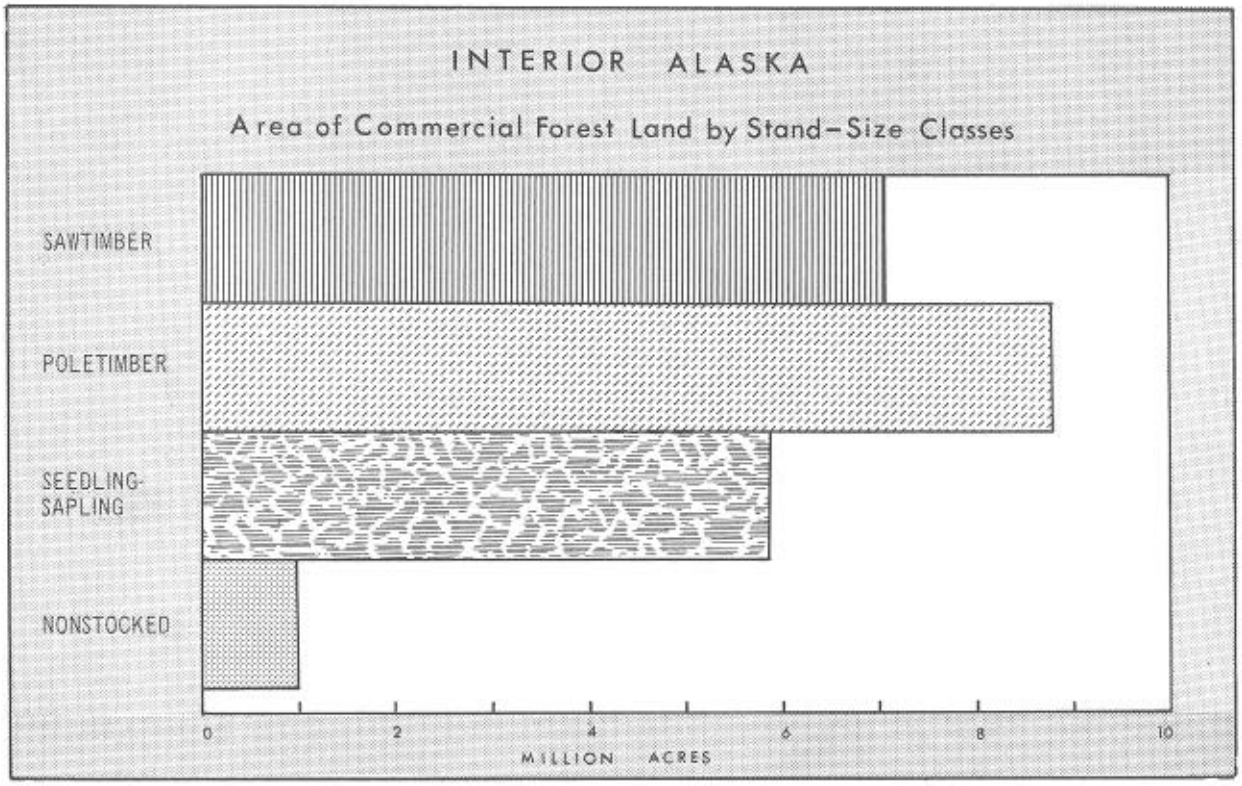

Figure 21.--The past history of the interior probably has much to do with so many acres now being in seedling-sapling and poletimber stand-size classes.

SAWTIMBER VOLUME

Commercial forests of the interior have a total net sawtimber volume of 31 billion board feet. This amounts to an overall average of less than 1,500 board feet per commercial forest acre, but the acreage classed as sawtimber averages 3,270 board feet per acre. In total volume and volume per acre, interior commercial stands are inferior to the coastal stands. This is partly because mans-acres of interior forest are immature, whereas most coastal stands are large mature and overmature sawtimber. But the major differences lie in species composition and growth characteristics (related, of course, to the climatic and edaphic conditions) of the stands involved. The most common interior tree, white spruce, does not grow to be large.

Quaking aspen and paper birch are short-lived trees and do not become large. Balsam poplar and black cottonwood trees become large and grow in stands of 30,00040,000 board feet or more per acre, but such stands are scarce.

Interior stands are similar to some in the Lake States (Minnesota, Michigan, and Wisconsin) and compare favorably with such stands in volume and quality.

Ninety-three percent of the interior sawtimber volume is in trees less than 21 inches d.b.h. (fig. 22). The 10-, 12-, and 14-inch classes account for 63 percent of the board-foot volume, 19, 24, and 20 percent, respectively. The 16-, 18-, and 20inch classes account for 30 percent of the volume. This distribution by diameter classes is similar to that of Wisconsin,

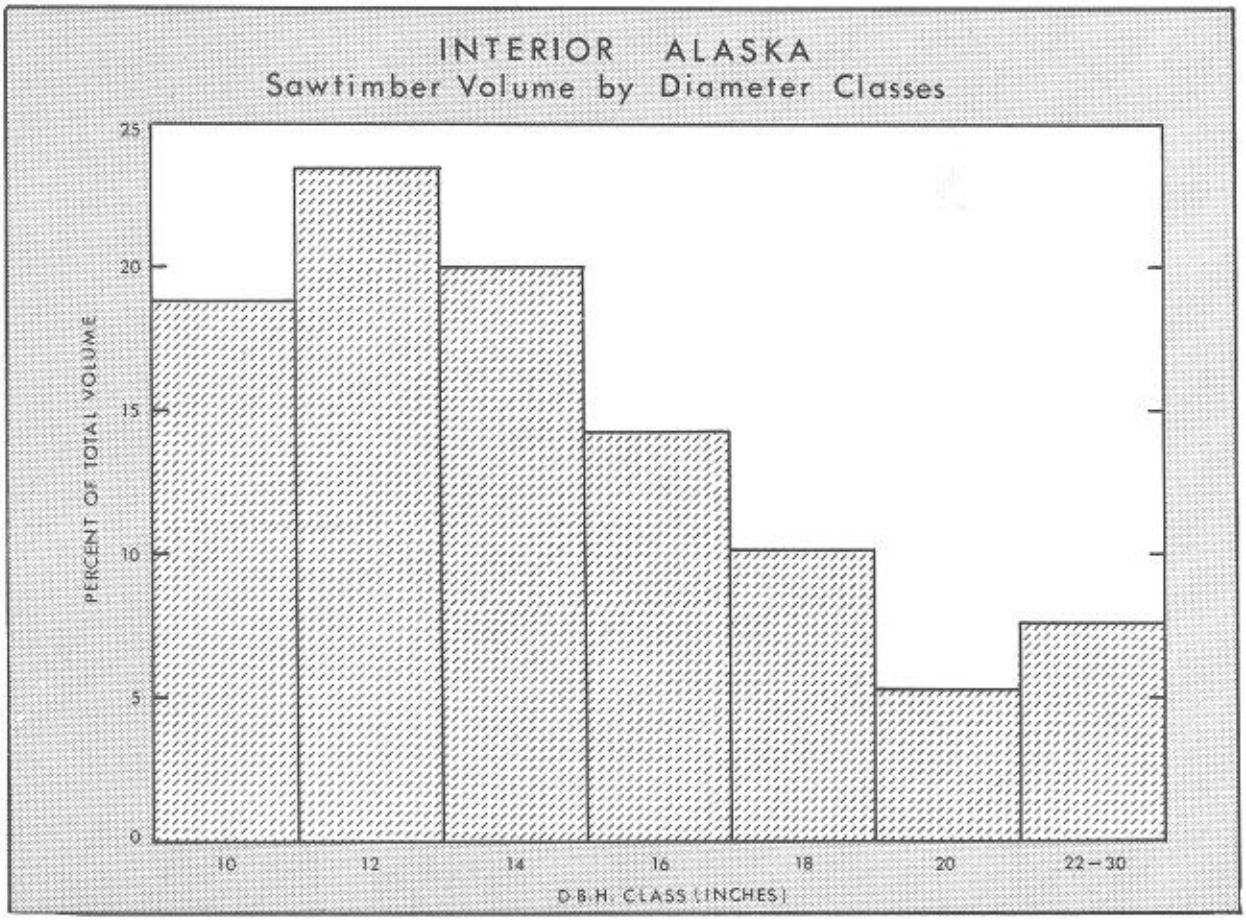

Figure 22.--Trees of the interior are predominantly small.

where the 10-, 12-, and 14-inch classes account for 55 percent of the total sawtimber volume with 33 percent in the 16-, 18-, and 20-inch classes (Stone and Thorne 1961). Very little of the volume is in trees larger than 30 inches in diameter; none 'were measured in the field sample. The southern tip of the Kenai Peninsula has some Sitka spruce in the 20- to 30-inch diameter class. Along streams, some black cottonwood and balsam poplar range up to 30 inches in diameter with an occasional tree over 40 inches. Few quaking aspen and paper birch trees surpass 16 inches in diameter; when they do, they are usually defective.

Sawtimber stands contain 73 percent of the interior's total sawtimber volume, and 26 percent is in the poletimber stands. Less than 1 percent of the sawtimber volume is scattered in seedling-sapling and nonstocked stands.

White spruce accounts for 81 percent of the interior's sawtimber volume (fig. 23). The only Sitka spruce found in the interior is located on the Kenai Peninsula and along the west shore of Cook Inlet. Nine percent of the sawtimher volume is black cottonwood and balsam poplar, 8 percent is paper birch, and 2 percent is quaking aspen. Many of the quaking aspen and paper birch stands (fig. 24) are immature and should produce a higher proportion of sawtimber in the future.

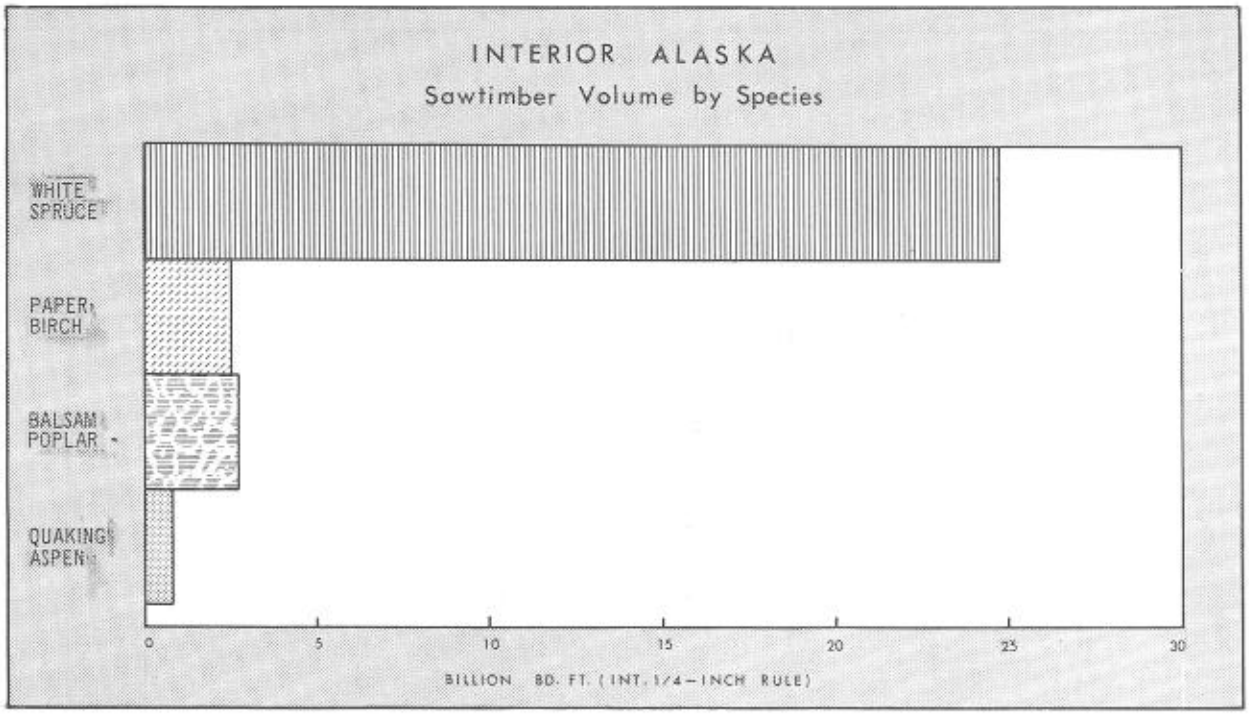

Figure 23.--White spruce is a longer lived tree and more inclined to grow to sawtimber size than either paper birch or quaking aspen. While balsam poplar grows to a larger diameter than any of the other interior species, it is limited in area.

Figure 24.--A well-stocked stand of paper birch poletimber near Chena Hot Springs. The trees are 65 to 70 feet tall and range from 7 to 9 inches d.b.h.

Although the interior stands can produce good logs for lumber and veneer, these stands should not be thought of as potential sawtimber sources. The stand volumes and tree sizes available suggest a pulpwood economy with integrated plants to utilize saw logs for lumber, veneer, and specialty items.

GROWING-STOCK VOLUME

Because most of the interior volume is in small trees, stands are best described by total volume expressed in cubic feet, which gives a more accurate measure of the wood content of small trees. The boardfoot measure is not applied to softwood trees below 9.0 inches d.b.h. or to hardwood trees below 11.0 inches d.b.h. Even in sawtimber stands, much of the interior volume is in trees below these diameters.

The total growing-stock volume in trees 5.0 inches d.b.h. and larger is 14.25 billion cubic feet. Sixty-four percent of this volume is spruce, 21 percent paper birch, 9 percent balsam poplar, and 6 percent quaking aspen. Aspen and birch comprise a higher percent of the growing-stock volume than they do of the sawtimber volume, whereas the reverse is true for spruce (fig. 25) .

The sawtimber stand-size class has a total volume of 9 billion cubic feet in merchantable trees 5.0 inches d.b.h. and larger, averaging 1,326 cubic feet per acre. This is more than 15 cords per acre, equal to or above the average volume available in sawtimber stands of many Eastern States. However, 40 percent of the volume in the sawtimber stand-size class is in poletimber trees.

The poletimber stand-size class has a total of 5 billion cubic feet, 35 percent of the total growing-stock volume (fig. 26). These stands average 576 cubic feet (about 7 cords) per acre. It is likely that in Wisconsin, and perhaps other States as well, many of these stands would be considered operable for pulpwood. There, a managed stand is considered operable if the trees marked for cutting amount to at least 3 cords per acre (Stone and Thorne 1961). Wisconsin, of course, has the advantage of good road networks for access.

Poletimber trees in all stand-size classes comprise 58 percent of the total growingstock volume with the remaining 42 percent being sawtimber (fig. 27). The poletimber trees are of the size and age that responds to forest management practices in other regions. If properly protected and managed, they can produce much greater volumes in future stands. It is entirely possible, however, that future management and economics research might indicate that some stands should be managed on a pulpwood or poletimber rotation. This might result, for instance, from a better understanding of the relationship between permafrost and tree growth.

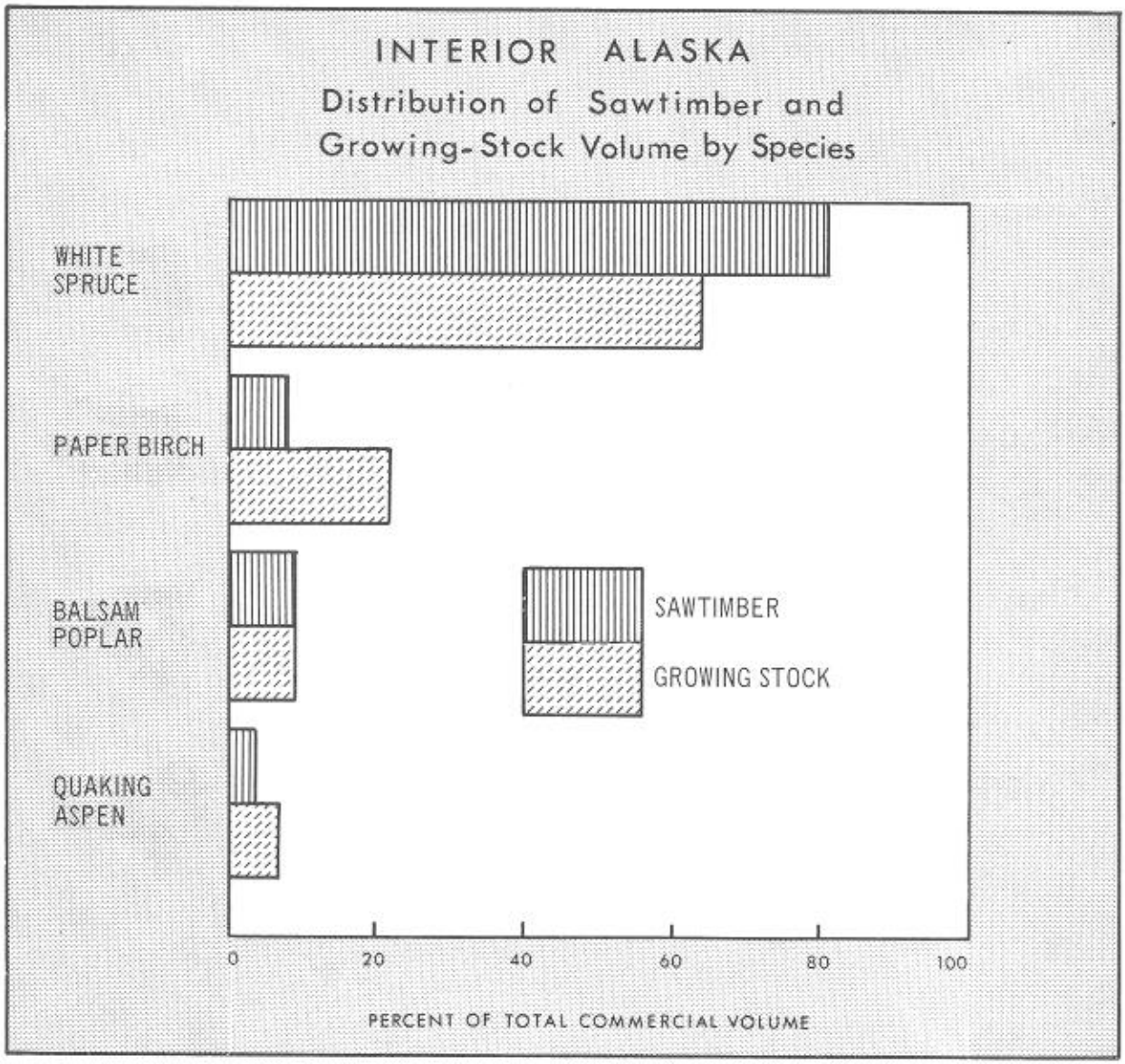

Figure 25.--Birch and aspen reproduce more readily following a fire than does spruce. Alaska's fire history may account for the increase of birch and aspen and the decline of spruce in the growing stock.

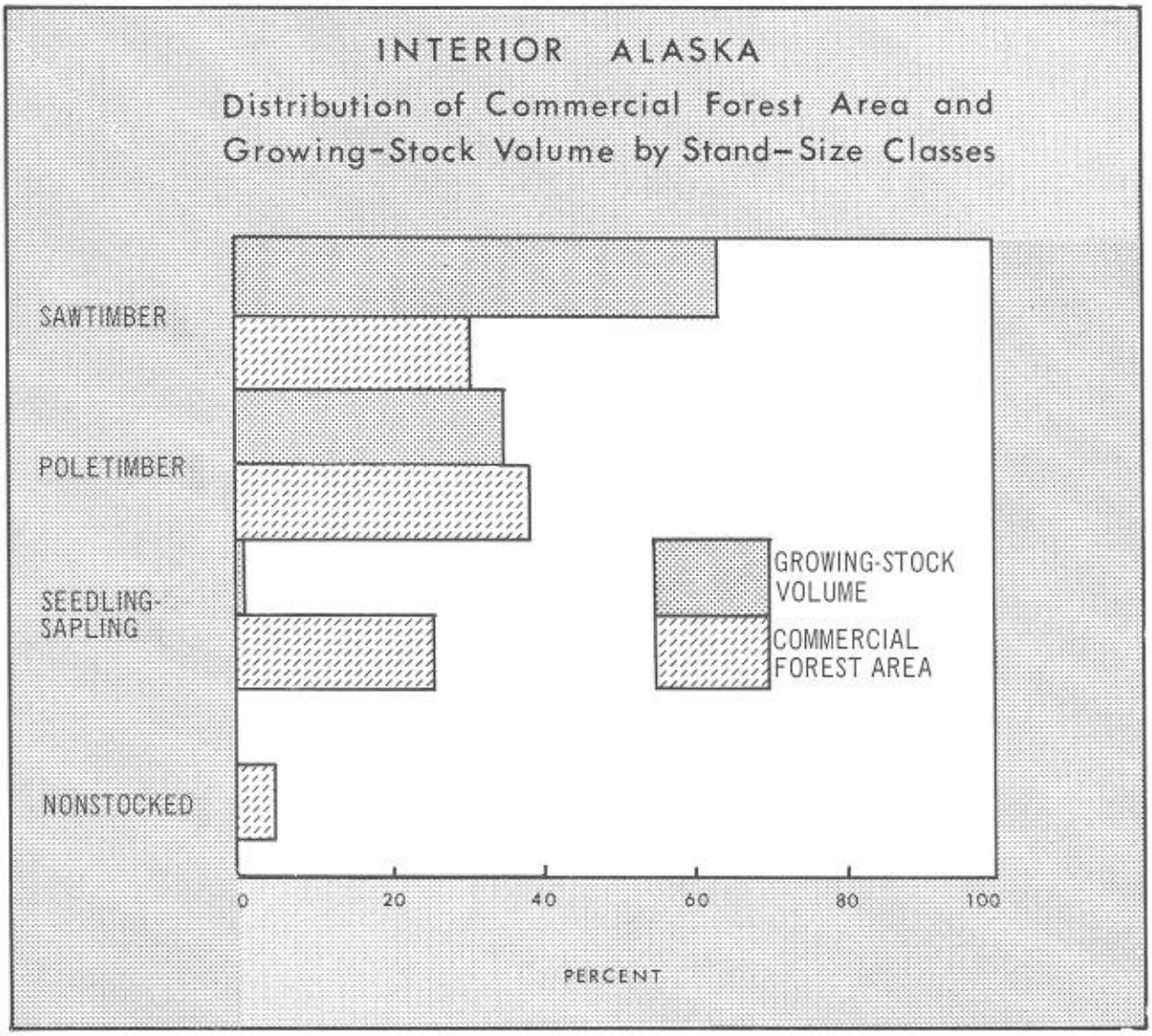

Figure 26.--The poletimber stand-size class has the highest percentage of commercial forest area, but the area in the sawtimber stand-size class contains more volume than all other stand-size classes combined.

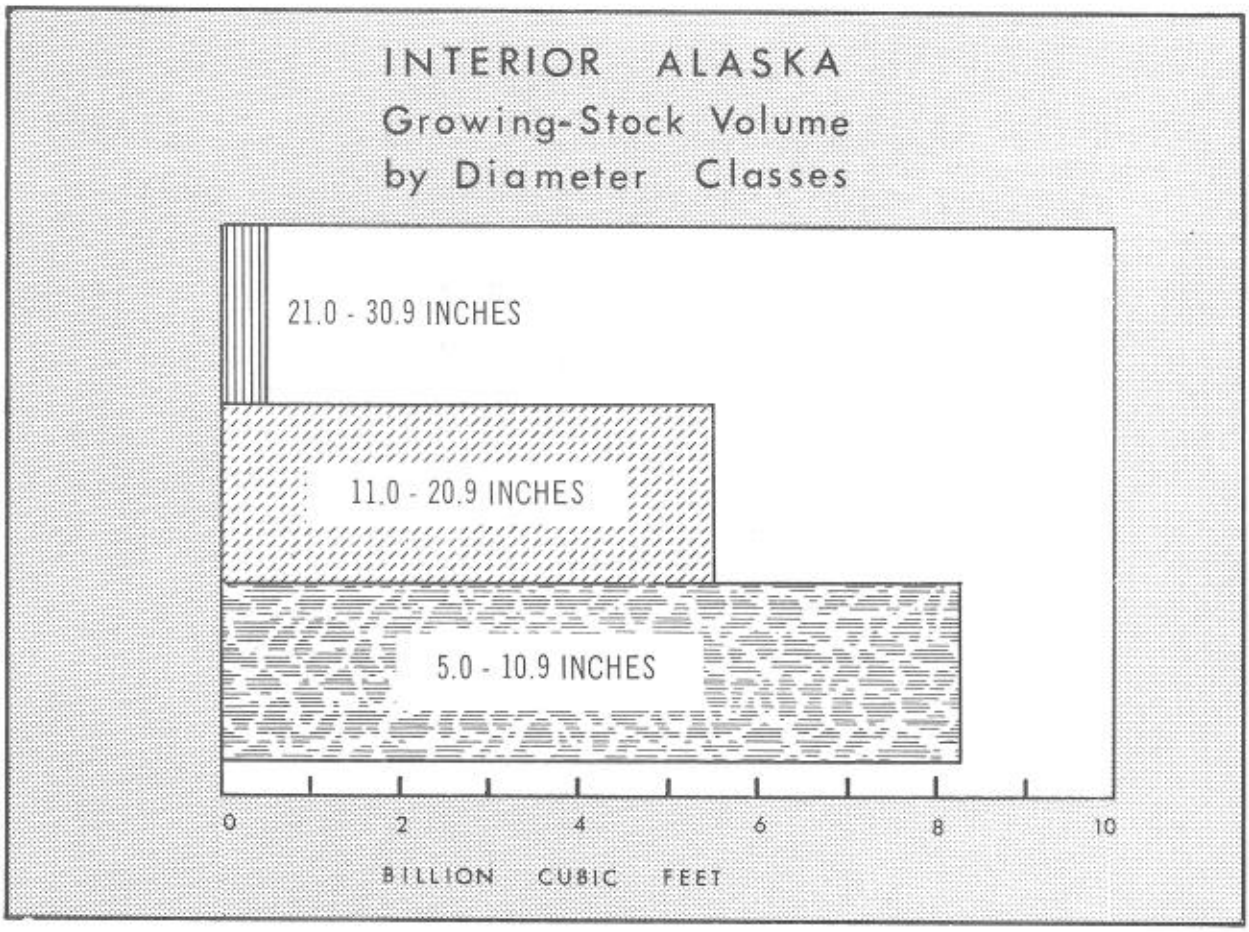

Figure 27.--Because the interior species, particularly paper birch and quaking aspen, mature at a relatively early age, much of the volume in the 5.0- to 10.9-inch class will not grow into a larger class.

LOG QUALITY AND TREE DIAMETERS

A system of grading hardwood logs for sawing into standard factory lumber (Vaughan et al. 1966) was used to estimate the quality of paper birch, balsam poplar, and black cottonwood stands. Although the grading rules do consider other factors than diameter, the distribution of volume by tree diameter classes served well to describe quality for interior Alaska. To qualify above log grade 3, a hardwood log must have a top diameter inside the bark of at least 11 inches. Allowing for bark thickness, the outside diameter would be approximately 12 inches. Hardwood trees will taper about 1 inch from the d.b.h. measurement to the top of the first 16foot log. Thus, only trees 15 inches d.b.h. and larger can have logs that qualify for grade 1, and trees down to 13 inches may have a log that qualifies for grade 2.

Paper birch. - Thirty-four percent of paper birch sawtimber-size trees were large enough to evaluate higher than log grade 3. Log grade 3 accounted for 84.5 percent of the paper birch sawtimber volume. An additional 1.4 percent of the volume was poorer than grade 3 but still merchantable for local use. The desired logs - log grades 1 and 2 - comprised 5.2 and 8.9 percent of the sawtimber volume, respectively.

One mill study has been made in Alaska to determine the lumber recovery of standard hardwood lumber grades that may be expected from graded paper birch logs.[4] The results indicate that grades 1, 2, and 3 paper birch logs may be expected to yield 63, 49, and 24 percent, respectively, in No. 1 common and better lumber (dry tally). If we assume that this stud-, made in 1964 near Wasilla, will apply elsewhere in the interior, then on the average each 1,000 board feet of woods-run saw logs should yield about 280 board feet in No. 1 common and better lumber. Some stands, of course, will yield more high-quality lumber than others. If the objective of an operator should be to harvest only grade 1 and 2 logs, it would be necessary to search many acres to obtain an appreciable supply. Usually only butt logs are of high quality, so selective harvesting would cause many grade 3 logs to be cut and left in the woods.

Cutting operations to supply the current market for birch logs result in deterioration of the stands. Only the best trees and logs are harvested. The landowner has no alternative. Either he sells the timber on terms that' meet the demand or he doesn't sell it. To remove the remaining low-quality trees and restore the stand to a favorable growing condition would require a considerable investment on the part of the landowner.

Quaking aspen. - Specifications prepared for the Lake States (Zasada 1948) were used to estimate aspen quality. By these criteria a minimum-sized sawtimber tree (11.0 inches d.b.h.) might have grade 1 and 2 logs.

Although aspen does not become a large tree in Alaska, it does grow clear and straight. The inventory placed 35.7 percent of the aspen sawtimber volume in grade 1 logs, 17.9 percent in grade 2, 46.0 percent in grade 3, and 0.4 percent in grade 4 or local use. Thus, over 50 percent of the aspen sawtimber volume is in grade 1 and 2 logs, a sharp contrast to the situation in Michigan where 99 percent of the aspen sawtimber is in grade 3 or poorer logs (Findell et al. 1960).

Balsam poplar and black cottonwood- A reliable breakdown of volume by log grades could not be made for these species from the initial study because too few trees were obtained in the sample. However, a quality estimate is available for these species from a recent intensive study of the Susitna Valley. Preliminary findings of this study show 14 percent of the net saw-log volume of merchantable trees in log grade 1, 25 percent in log grade 2, 57 percent in log grade 3, and 4 percent in local use logs.

[4] Report in preparation by the Institute of Northern Forestry, Juneau, Alaska

Because most of the good stands of balsam poplar and black cottonwood are in the Susitna Valley drainage, it would be improper to apply these percentages to the total interior volume of these species. However, the percentage of volume in grade 1 and bade 2 logs (39 percent combined) indicates that cottonwood grows well in interior Alaska. In fact, the better stands appear to compare favorably with good cottonwood stands along the Missouri River drainage. An Iowa report (Thornton and Morgan 1959) shows that 48 percent of the cottonwood (eastern and swamp cottonwood) of that State is in grade 1 and 2 logs.

Although it is difficult to distinguish black cottonwood from balsam poplar, black cottonwood has higher strength properties and appears to be the better saw-log tree. In the interior, black cottonwood occurs only along the lower Susitna Valley drainages in the Cook Inlet area.

White spruce. - The specifications used to estimate the quality of spruce were those of the Northern Hemlock and Hardwood Association (1947). Grade 1 logs must be 16 inches or larger and grade 2 logs at least 12 inches in diameter. In addition, a grade 1 log must be 75 percent clear on each of three faces, whereas a grade 2 must be 50 percent clear on three faces or 75 percent clear on two faces. Because white spruce generally is a small tree with many limbs (fig. 28), most trees could not qualify for high-quality logs. Twenty-nine percent of the sawtimber trees were large enough to consider for at least a grade 2 log.

The results show 1.3 percent of the sawtimber volume in grade 1 logs; 2.1 percent, grade 2; 72.9 percent, grade 3; and 23.7 percent was less than 50 percent sound, but would be suitable for some local uses.

Figure 28.--This stand of white spruce has a total basal area of 180 square feet per acre in trees averaging 9.2 inches d.b.h. The average age is about 170 years, and there are 390 stems per acre. Notice the persistent dead limbs. The trees will not grow to a large enough diameter to overcome a degrade in lumber caused by these limbs.

GROWTH ESTIMATES

All forest area classified as commercial will produce at least 20 cubic feet of -wood per acre annually in poletimber and sawtimber trees that would be merchantable if a market existed. The field sample was too restricted to give a good indication of the upper productivity rating, but we believe that there is very little area, if any, producing more than 50 cubic feet per acre annually. Based on an analysis of radial growth measured on increment cores, the interior commercial stands produce a total of 212 million cubic feet annually.

However, average cubic-foot growth per acre amounts to less than half the productivity (20 cubic feet, mean annual increment) expected on commercial forest land. Stocking on 64 percent of the commercial forest land was rated from 10 to 70 percent. Most of the interior forest land is producing far below capacity.

Sawtimber growth averages about 30 board feet per acre annually. However, most of the board-foot growth occurs in sawtimber and poletimber stands which have an average annual growth, respectively, of 56 and 32 board feet per acre.

A study of well-stocked stands (Gregory and Haack 1965) shows that birch stands at age 90, site index 55, will produce about 2,800 cubic feet per acre in trees 4.5 inches d.b.h. and larger. Aspen with the same site index will produce the same volume in about 70 years.

TIMBER LOSSES AND RISKS

The apparent enemy of the interior forests is fire. During some periods, fire losses have averaged more than 1 million acres a year. Fires which destroy such large areas usually occur in remote regions and are difficult to fight. Often weather changes extinguish fires before ground crews can do the job. Accurate information concerning the total area burned, the types of vegetation destroyed, the amount of timber killed, and other damage appraisal information has been difficult to obtain.

In recent years, the Bureau of Land Management has greatly improved its fire fighting organization in Alaska and has reduced losses from fire. Fires are usually detected when small and are reached rapidly by road units and smokejumpers. Larger fires occur usually in remote areas, primarily in high country where little commercial forest land is found. From a 1964 study" of fires during one recent 5-year period, it appears that most of the .forest area now being burned is of noncommercial quality. Fires that start in tow vegetation usually burn rapidly over the brush, grass, moss, and lichen fuels but tend to slow down when they enter better stands of timber where ground fuels are generally green and wet. The study showed that some fires went out upon entering commercial stands. After burning, commercial forest land regenerated satisfactorily to commercial tree species. There is even evidence that some noncommercial forest areas have regenerated to commercial stands after being burned. Apparently this may happen when fire removes the insulating layers of moss and duff, resulting in warmer soil and lowering of the permafrost zone.

Although the study showed that fire damage to commercial forests was light, this does not imply that damage to other vegetative types was light. On the contrary, many acres of lichen and tundra ranges have been destroyed or seriously damaged.

[5]Unpublished report of the Institute of Northern Forestry, Juneau, Alaska.

Less spectacular than fire, but perhaps more destructive, are the diseases that attack the interior trees. A 1957 study showed that 37 percent of white spruce, 47 percent of paper birch, 78 percent of balsam poplar and cottonwood, and 82 percent of quaking aspen trees had decay in the merchantable stem (fig. 29). Much of this decay entered through fire scars and should be charged against the past fire record. The inventory shows that 6.6 percent of the gross volume of live trees is in trees with so much decay that they are classified as rotten cull trees and 0.6 percent is in sound cull trees. Although a high percentage of the live trees have some rotten defect, over 90 percent of the trees are merchantable. Rotten defects in merchantable trees account for about 3 percent of the cubic-foot and 18 percent of the board-foot volume, a loss of 1,360 million cubic feet and 8 billion board feet.

A 3-percent loss due to rot may appear to be relatively small, but what begins as a small defect in young trees becomes greater as the trees reach sawtimber size and maturity. Rot almost always reduces quality. Rot in the center of a log, although amounting to a very small percentage of the total volume, may make it impossible to hold the log on a lathe and thus mean the difference between a rotary veneer log and just another log for the sawmill.

Tree mortality, to some extent, describes the present stage of development of most interior stands. The mortality of sawtimber-size trees averages 6.4 board feet per acre annually, but the annual loss of all trees 5.0 inches d.b.h. and larger amounts to 3 cubic feet per acre. Most of the mortality, then, is in poletimber. Many young interior stands are dense, tending to be overstocked. The mortality figure shows that a natural thinning process is taking place in the poletimber stands.

ALLOWABLE CUT

Determination of allowable cut require: good knowledge of ownership and management objectives as well as knowledge of resource and productivity levels. Ownership status and land management objectives for the interior are so uncertain that any allowable cut estimate must be tentative.

If the commercial forest area as surveyed could be sustained and managed for timber production on a pulpwood economy, the estimated allowable annual cut on a 100-year rotation, by the Kemp formula," would be about 858 million cubic feet. This would amount to an annual supply of about 4.5 million cords of pulpwood. By comparison, in 1963 the Lake States region (Michigan, Minnesota, and Wisconsin) cut about 3.7 million cords of pulpwood (Horn 1964). This pulpwood was supplied to 54 pulpmills, 49 of them in the Lake States region. Approximately 2 cords of wood are required for each ton of pulp production. Thus, a 500-tons-per-day plant would require about 350,000 cords annually. If the present commercial forest area is continued, interior Alaska could sustain at least 10 pulpmills of the 500-tons-per-day class.

Of course, the interior wood-using economy need not be built entirely on pulpwood production and use. The equivalent annual allowable cut of sawtimber amounts to 900 million board feet. Manv uses of the sawtimber might be developed and integrated with a pulpwood harvest.

There are 83.3 million acres of noncommercial forest land which can meet some of the wood needs. Within the noncommercial class are 4.6 million acres now producing between 15 and 20 cubic feet of wood annually. These 4.6 million acres have a total growing-stock volume of 1.1 billion cubic feet. Included in this growing stock are 2.8 billion board feet of sawtimber.

For basic Kemp formula, see “Appendix, “p.57.

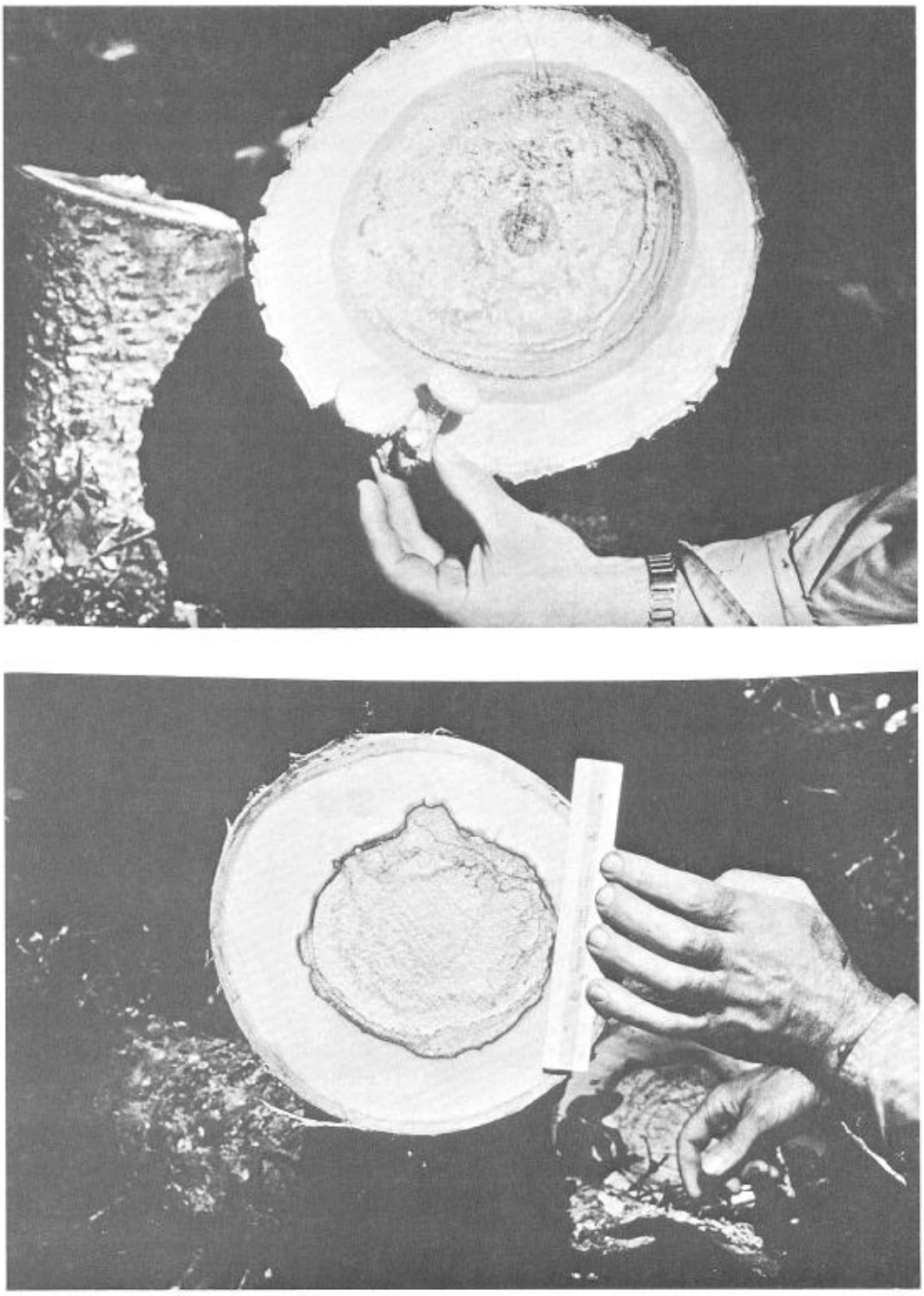

Figure 29.--A, above, shows the fruiting body and the heart rot caused by the fungus Pholiota. *In B, the rot shown is caused by* Fomes igniarius, *shown here in a paper birch log.*

It is not likely that the allowable cut will be harvested in the interior for many years. The total volume of wood available is more than adequate for important industrial uses, but many economic problems must be overcome before the stands can be utilized. To use the interior stands will require more and better markets, the development of more efficient wood-handling equipment than is now in use, more roads, an experienced labor force, and efficient export facilities.

TIMBER PROCESSING AND MARKETING

Wood-using industries of Alaska harvested 398 million board feet of logs in 1961 (Bones 1963) for a stumpage return of about $1 million. After primary processing, the total end-products value was estimated to be $48 million (Rogers and Cooley 1962). Ninety-nine percent of the log volume was obtained from coastal forests. Even more specifically, the National Forests of the coastal region provided 96 percent of the log volume. Other public lands provided about 3 percent, and less than 1 percent came from private ownerships. Western hemlock accounted for 53 percent of the cut and Sitka spruce 46 percent. By 1964, the timber harvest had increased to about 464 million board feet (Scribner log rule) valued at more than $63 million (Alaska State Development Corporation 1965). Few changes took place, however, in the source of supply and use patterns between 1961 and 1964. Chiefly, the existing plants increased their output.

Although scattered cutting operations have been going on since Russia owned Alaska, substantial use of Alaska's forests is just beginning (fig. 30). Choice Sitka spruce logs were harvested and exported for airplane stock during the First and Second World Wars, but installation of the first important wood-processing plant in Alaska did not occur until 1954. At that time, the Ketchikan Pulp Co. began operation with a 525-tons-per-day plant at Ward Cove near Ketchikan. A second mill, the Alaska Lumber & Pulp Co., began operating at Sitka in 1959 with a plant pacity of 460 tons per day (fig. 31). These two plants used 79 percent of the wood harvested in Alaska in 1961. The present combined capacity of these two plants has increased to 1,100 tons per day (U.S. Forest Service 1965b). As a result of a timber sale made late in 1965 by the Forest Service, a third pulpmill may be installed by 1971 increasing the pulp-producing capacity by about 50 percent.

In addition to the pulpmills, there were 87 sawmills, 1 preservative plant, and 2 house-log plants in Alaska in 1961. Only 67 of the sawmills were active. They were distributed as follows:

	Coastal	Interior
Active	30	37
Inactive	6	14
Total	36	51

Some reduction in the number of sawmills seems to be taking place; the Alaska Branch of Forestry reported 57 sawmills in 1966 (Alaska 1966).

The coastal sawmills cut about 70.5 million board feet of lumber in 1961, 96.8 percent of the total lumber production in the State. Although the interior has more sawmills, most are small, portable, and operate erratically to supply local community needs (fig. 32). These interior sawmills operated at about 10 percent of their rated capacity in 1961, whereas coastal mills operated at about 74 percent capacity.

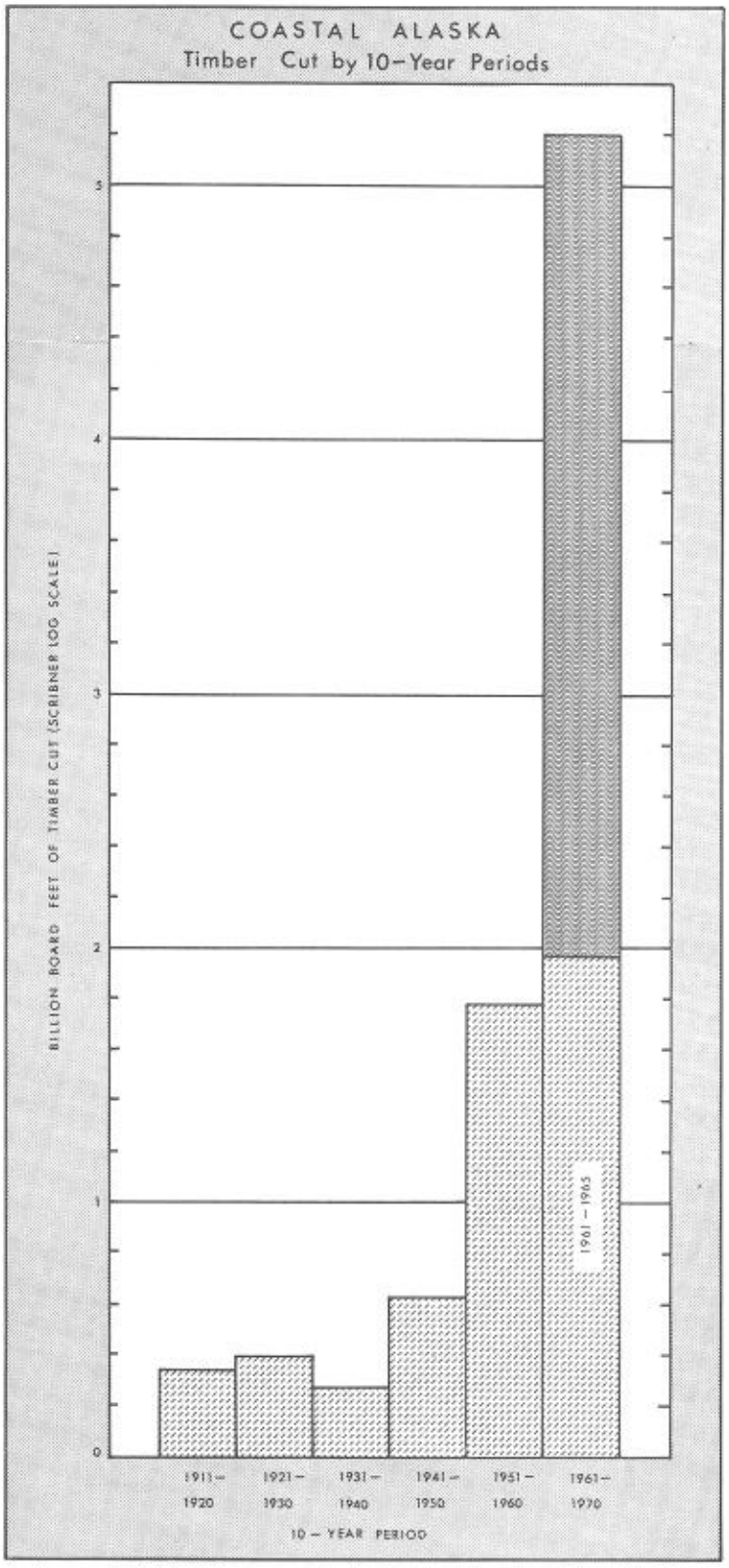

Figure 30.--The timber cut shown here is entirely from National Forests. Long-term sales to the two pulpmills have resulted in a dramatic increase in timber cut during the last 10 years. The cut projected to 1970 is based on recent estimates by the U.S. Forest Service, Region 10.

Figure 31.--The Alaska Lumber & Pulp Co. plant near Sitka.

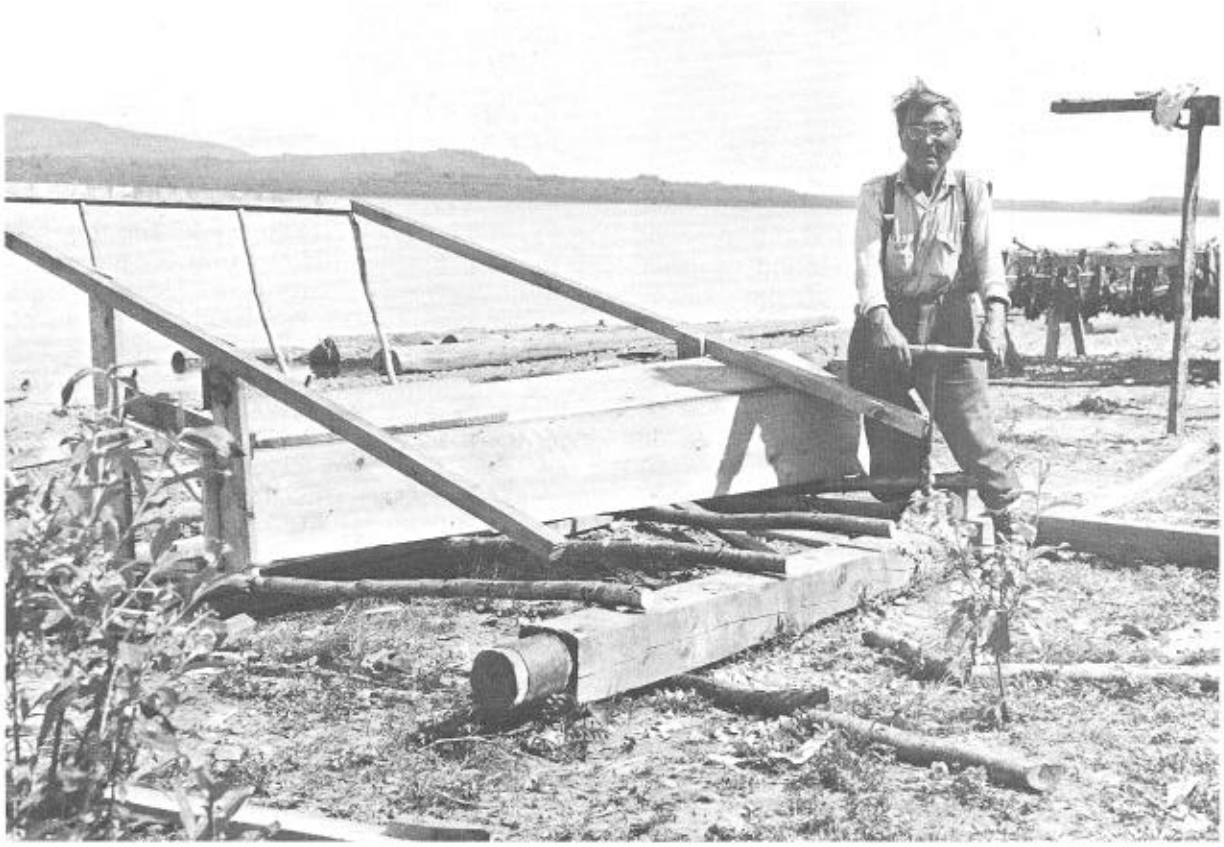

Figure 32.--This resident of Aniak on the lower Kuskokwim River is building a fish wheel from materials obtained locally-- a few boards from a local sawmill and saplings from along the river.

Alaska's wood-using industries depend upon export market;. In 1961, the wood products were distributed as follows:

	Percent
Alaska	7
Other U.S. markets	36
Foreign	57
	100

All of the pulp was exported, 56 percent to foreign markets and 44 percent to other States. About 65 percent of the lumber production was exported also.

Japan continues to be the most important foreign market for Alaska's products, receiving 76 percent of the total exports in 1962, 82 percent in 1963, and 89 percent in 1964. Wood products, primarily pulp and lumber, with a value of $29,708,000, amounted to 83 percent of the total Alaskan export in 1964. Wood products export increased 43 percent over 1962 export, whereas Alaska's total export increased 12 percent in the same period. Pulp exports increased 30 percent in 1964 over 1962 and accounted for 82 percent of the export value of wood products (Alaska University 1965).

In the coastal area, the hemlock-spruce stands are clearcut, primarily to supply the two pulpmills. The best Sitka spruce logs are often sorted from the rafts and either traded or sold to the sawmills. Most of these logs are cut into cants for export (fig. 33). A relatively small volume of standard lumber grades is produced for local markets. The cants are graded in various export grades and shipped to Japan. Fifty-seven percent of Alaska's lumber production went to Japan in 1961 and an even higher percentage since then.

Timber sale contracts made by the Forest Service require primary manufacture of western hemlock and Sitka spruce logs in Alaska. This policy, supporters contend, is responsible for the two pulpmills and several sawmills in Alaska. However, because there is no market for cedar logs in Alaska (fig. 34), the better logs are exported to Japan rather than left in the woods. Whether a local market exists or not, good forest management requires that cedar and other minor species be cut to provide a favorable seedbed for the regeneration of spruce and hemlock.

Alaska's pulpmills and sawmills are primary manufacturing plants. Most of their output must be further processed in secondary plants to obtain products wanted by consumers. Alaska lacks the dry kilns, planning mills, millwork plants, papermills, and plywood plants that could prepare more local timber for local use. The pulp matte leaves Alaska to be manufactured into rayons, plastics, and the multitude of paper products that eventually reach the consumer market.

For some time to come, any substantial industrial development in Alaska, whether primary or secondary processing, must be tied to export markets. Alaska's population dictates this. In 1960, the total population was 226,167 - only 0.4 inhabitant per square mile. Anchorage, the largest city-, had a population of 44,237. In 1962, the per capita consumption of lumber in the Nation was 200 board feet. If Alaskans use lumber at about the same rate, one modern, efficient sawmill could meet Alaska's needs. Per capita consumption of plywood and veneer in the United States was 64 square feet in 1962 - or two 4x8-foot sheets of 3/8-inch-thick plywood. The output of one plywood plant could supply Alaska. The manufacturer of almost any product must cope with the problem of a local market too small to justify the construction of a plant that can compete with production from other States.

Because of higher production costs in Alaska, any industry dependent on a local market may be vulnerable. Local producers of poultry and dairy products find it difficult to compete with products from Seattle. The wood preservative plant that began operation in 1961 closed in 1963 because its chief market, railroad crossties for the Alaska Railroad, was lost to a competitor in the Seattle area.

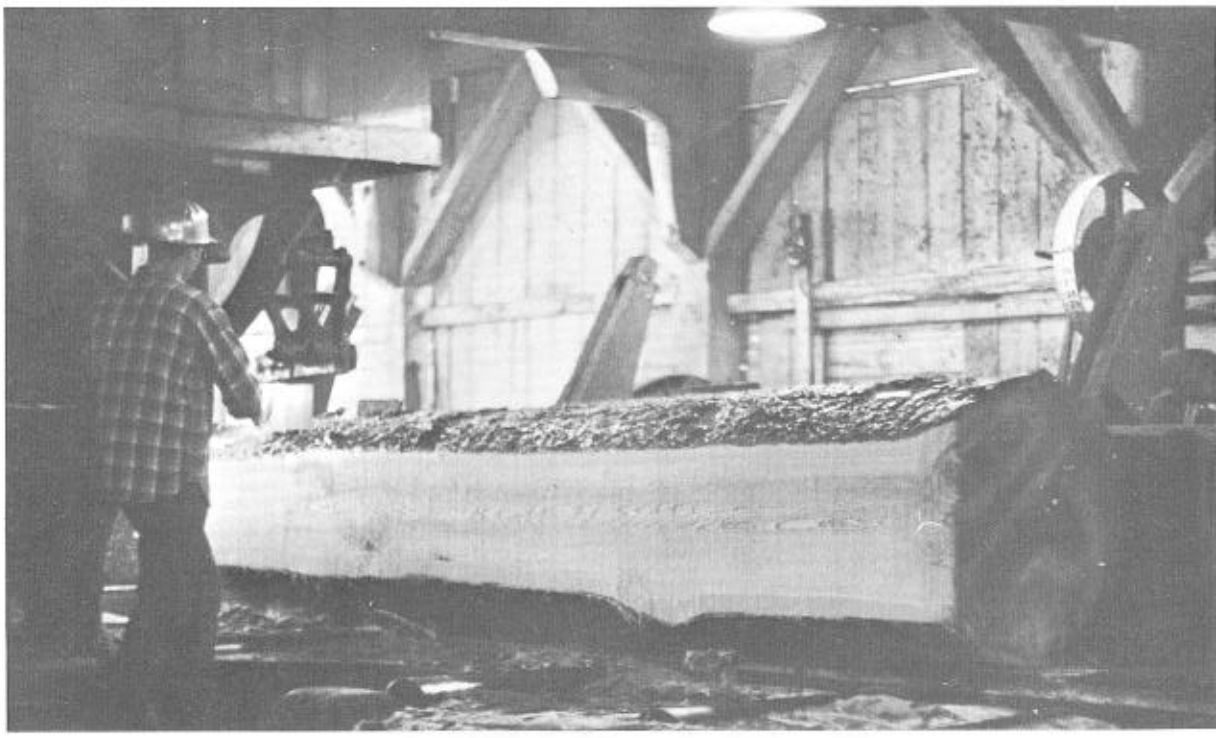

Figure 33.--Large Sitka spruce log being cut into cants (see below) for export to Japan.

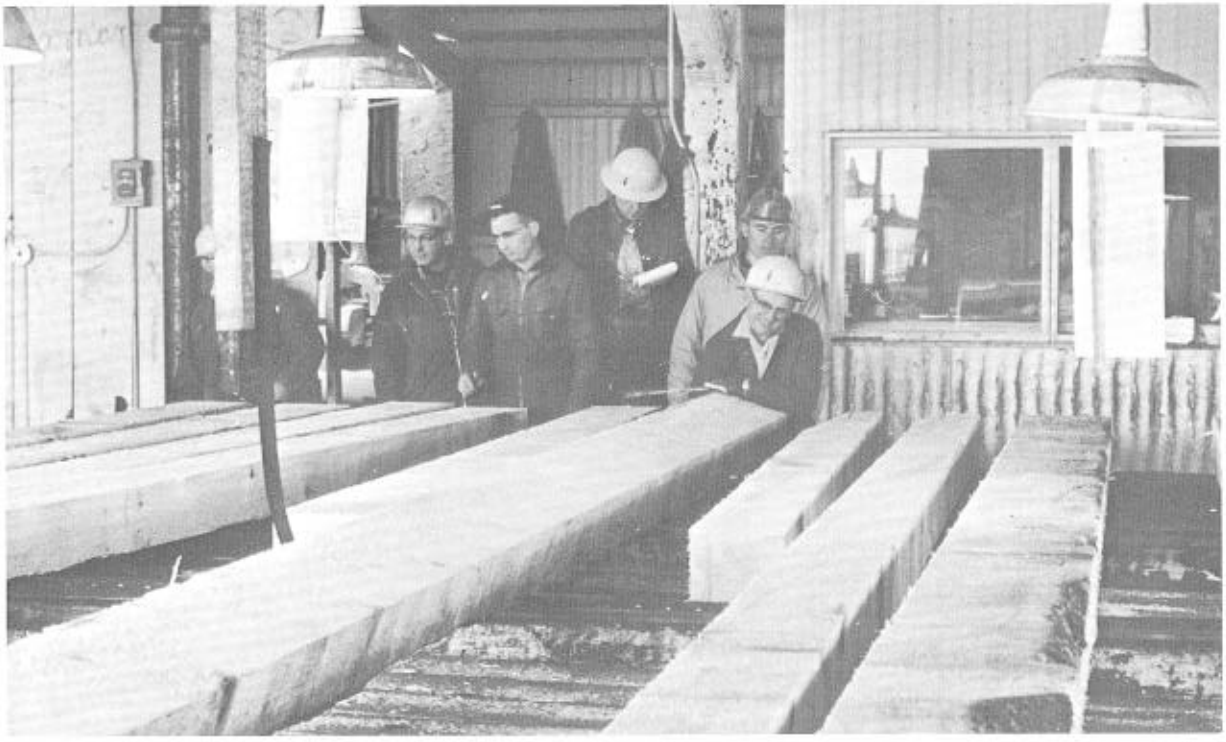

Figure 34.--No quality determination was made of Alaska-cedar, but southeast Alaska stands contain many fine trees such as this. The Alaska-cedar being measured is 4 feet in diameter. It is in a stand at Cape Fanshaw north of Petersburg.

Until pioneering ventures in Alaska are established and competitive, it may be necessary and desirable to protect and encourage them in some manner, Many new ventures have failed in Alaska, and this discourages other investors from trying. Reasons for failure can he traced to such things as poor management, lack of experience, undercapitalization, inadequate market research, high production costs, high marketing costs, inefficient and unsuitable equipment, and insufficient knowledge of available resources. Timber industries in the coastal region hale obtained their stumpage at a minimum cost of $2 and $3 per thousand board feet, but prices are increasing. Average stumpage rates ranged from $2.56 in the first quarter of 1960 to $4.63 in the last quarter. Stumpage rates have been considerably lower than the price of similar stumpage in Oregon and Washington, but what appears to be an advantage in stumpage price is offset by higher logging, transportation, and milling costs.

The transportation problems of Alaska are important and complex. Weans of moving products between Alaska and outside markets are limited. Shipments originating on the Alaska Railroad must transfer to trucks or waterborne vessels to reach outside markets. Truck shipments can travel the long Alaska Highway or transfer to ocean vessels and barges. Some forest products are shipped by rail barge to Prince Rupert, British Columbia, where the sealed cars continue by rail to United States markets. The Jones Act requires that American ships carry all products between American ports. This act, written with the national interest in mind, is believed by some Alaskans to be discriminatory locally. Those taking this view believe that lower rates might be obtained for Alaska by allowing ships of some other countries to compete. Such competition would favor Alaska by reducing the cost of imported goods as well as export costs, thereby reducing costs of production in Alaska which, in turn, would make it possible to export goods to the west coast markets at more competitive prices. Perhaps the steady increase of Alaskan exports to Japan may be attributed, in part at least, to lower shipping costs on Japanese ships.

Local communities and regions benefit greatly from manufacture of logs into products and from a diversified industry. During 1964, the logging, sawmilling, and pulp manufacturing activities in Alaska employed about 2,400 men (Alaska State Development Corporation 1965). This amounted to an average of 5.17 employees for every-million board feet of logs processed. About half of this employment was used in the conversion of the logs into green lumber and pulp (U.S. Bureau of Census 1963). Additional labor inputs that Alaska might strive for are indicated by the following:

Average employment per unit of annual wood input in Oregon and Washington:[1]

Activity	Number of employees
Logging[2]	2.27 (west side)
Sawmilling (green lumber)[3]	1.22 - 1.70
Lumber processing (dry lumber)[3]	2.05 - 2.31
Lumber remanufacture[3]	7.89 - 8.28
Veneer[4]	1.71
Plywood[4]	5.21
Other plywood processing[4]	1.17
Pulp[5]	1.07
Paper and paperboard[5]	1.66
Converted pulp products[5]	4.62

[1] Summarized from Smith and Gedney (1965).
[2] Per million board feet of logs harvested.
[3] Per million board feet of lumber production.
[4] Per million board feet of logs used.
[5] Per thousand cords of pulpwood used.

Very little lumber processing in Alaska goes beyond the green stage. By carrying the processing to dry lumber and to remanufacturing stages, another 10 men could be employed for each million board feet of lumber used. Some logs go into lumber and pulp that might be utilized fox- veneer and plywood. Veneer and plywood plants could provide employment for another eight risen for every million board feet of logs used.

Although the two pulp plants have made important changes in the economy of southeast Alaska, a sufficient timber resource exists for much more development and a much more diversified industry.

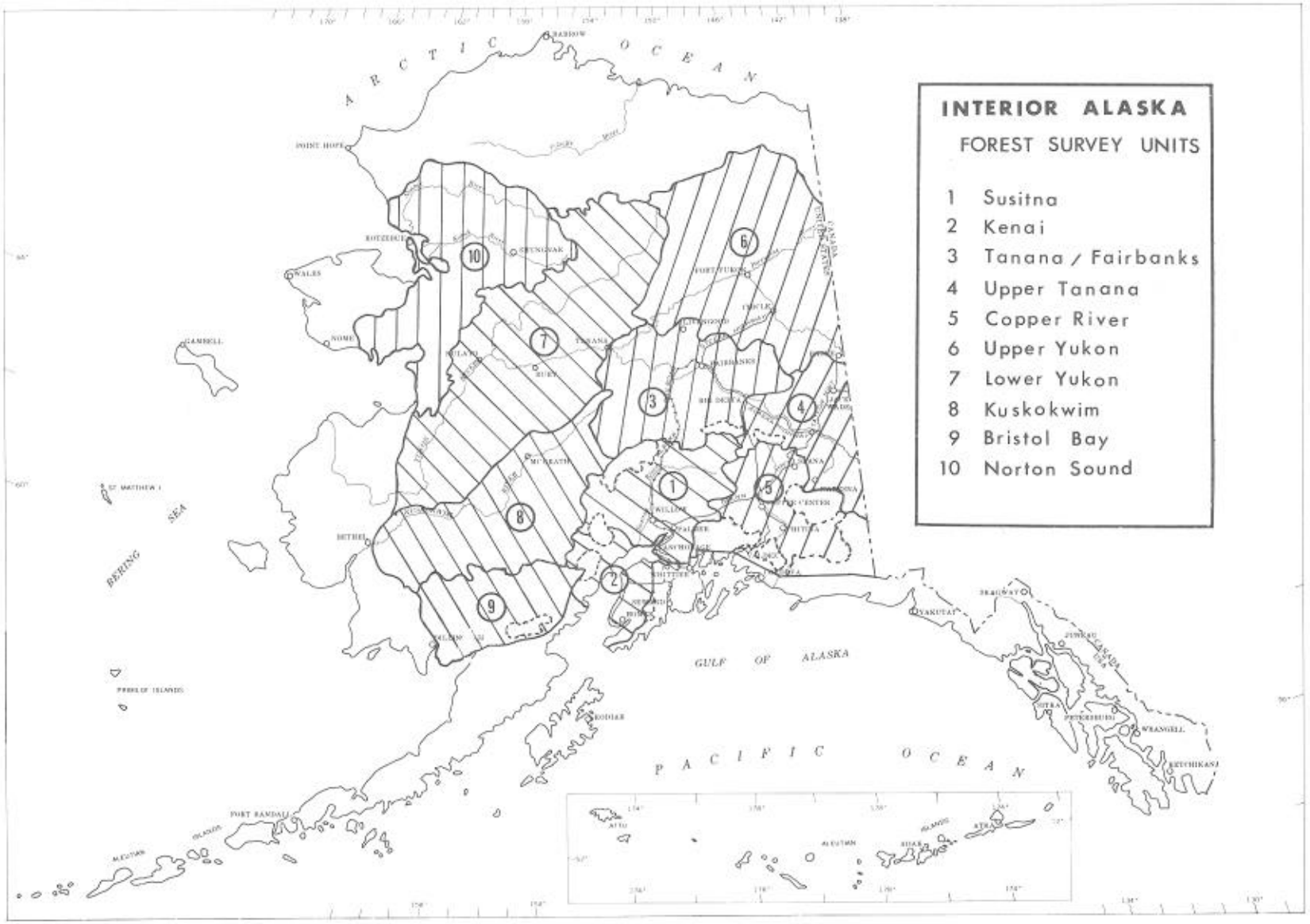

Figure 35.--The exterior boundary of these Forest Survey units indicates the approximate limit of commercial tree growth in the interior. The diagonal lines indicate the approximate location of flight lines to obtain the aerial photography used for the interior forest inventory.

LITERATURE CITED

Alaska. Department of Natural Resources.
1966. Alaska land lines. V. 7, No. 5, 9 PP.

Alaska State Development Corporation.
1965. Annual report - 1965. 60 pp., illus.

Alaska. University.
1965. Alaska - reviews of business and economic conditions. Inst. Bus. Econ. Government Res., v. 11, No. 3, 8 pp.

Barren, John W.
1962 Regional sit silviculture of the United States. 60 pp., illus. New York: The Ronald Press Cc

Bones, James T.
1963. Wood processing in Alaska 1961. North. Forest Exp. Sta. U.S. Forest Seri-. Resource Bull. NOR-1, 14 pp., illus.

Bruce, Donald, and Schumacher, Francis X.
1950. Forest mensuration. 483 pp., illus. New York: McGraw-Hill Rook Co.

Cowlin, Robert W., and Forster, Robert M.
1965. The timber situation and outlook for northwest Oregon. Pacific Northwest Forest & Range Exp. Sta. U.S. Forest Serv. Resource Bull. PNW-12, 56 pp., illus.

Findell, Virgil E., Pfeifer, Ray E., Horn, Arthur G., and Tubbs, Carl H.
1960. Michigan's forest resources. U. S. Forest Serv. Lake States Forest Exp. Sta., Sta. Pap. 82, 4 6 pp., illus.

Gregory, Robert A., and Haack, Paul M.
1965. Growth and yield of well-stocked aspen and birch stands in Alaska. North. Forest Exp. Sta. U.S. Forest Serv. Res. Pap. NOR-2, 28 pp., illus.

Harris, A. S.
1965. Aerial seeding Sitka spruce and western hemlock on a cutover area in southeast Alaska. North. Forest Exp. Sta. U.S. Forest Serv. Res. Note NOR-10, 6 pp., illus.

Horn, Arthur G.
1964. Pulpwood production in the Lake States counties 1963. Lake States Forest Exp. Sta. U.S. Forest Serv. Resource Bull. LS-1, 17 pp., illus.

Lutz, H. J.
1963. Early forest conditions in the Alaska interior - an historical account with original sources. U.S. Forest Seri-., North. Forest Exp. Sta., 74 pp.

Rogers, G. W., and Cooley, R. A.
1962. Alaska's population and economy. State of Alaska Statist. Handb., v. 2, 229 pp., illus.

Smith, Richard C., and Gedney, Donald R.
1965. Manpower use in the wood-products industries of Oregon and Washington 1950-1963. Pacific Northwest Forest & Range Exp. Sta. U.S. Forest Serv. Res. Pap. PNW-28, 48 pp., illus.

Society of American Foresters.
1958. Forest terminology. 97 pp. Washington, D.C.

Stone, Robert N., and Thorne, Harry W.
1961. Wisconsin's forest resources. U.S. Forest Serv. Lake States Forest Exp. Sta., Sta. Pap. 90, 52 pp., illus.

Taylor, R. F.
1934. Yield of second-growth western hemlock-Sitka spruce stands in southeastern Alaska. U.S. Del). Agr. Tech. Poll- 472, 30 pp., illus.

Taylor, Raymond F., and Little, Elbert 1., Jr.
1900. Pocket guide to Alaska trees. U.S. Dep. Agr., Agr. Handb. 5, 63 pp., illus.

Thornton, Philip L., and Morgan, James '1.
1959. The forest resources of Iowa. U. S. Forest Serv. Central States Forest Exp. Sta. Forest Sure. Release 22, 46 pp., illus.

U.S. Bureau of the Census.
1963. 1963 census of manufactures - Alaska. ITC 63(P)-S2, 5 pp.

U.S. Department of the Interior.
1964. Public land statistics. 203 pp., illus.

U.S. Forest Service.
1954. Sitka spruce. Useful trees of the United States, No. 9, 4 pp., illus.

-------- .
1965a. Timber trends in the United States. Forest Resource Rep. 17, 235 pp., illus.

-------- .
1965b. Wood pulpmills in the United States and Canada, 1965. 20 pp., illus.

Vaughan, C. L., Wollin, A. C., McDonald, K. A., and Bulgrin, E. H.
1966. Hardwood log grades for standard lumber. U.S. Forest Sere. Res. Pap. FPL-63, 52 pp., illus.

Watson, C. E.
1959. Climate of Alaska. U.S. Weather Bur. Climates of the States, Climatography of the United States 60-49, 24 pp., illus.

Zasada, Zigmond A.
1948. Aspen lumber grades and characteristics. U.S. Forest Serv. Lake States Forest Exp. Sta. Lake States Aspen Rep. 6, 9 pp.

APPENDIX

FOREST SURVEY METHODS

Coastal Alaska

This region was divided into seven units and inventoried in the following order:

		Year fieldwork completed
1.	Juneau	1955
2.	Sitka	1956
3.	Petersburg	1956
4.	Yakutat	1957
5.	Ketchikan	1957
6.	Cordova and Afognak Island	1961
7.	Kenai	1962

These are administrative units recognized by Region 10 of the U.S. Forest Service. Each unit is further subdivided into administrative blocks for summary tables, but sampling was by the unit. Commercial forest lands outside these units were not inventoried at the same intensity (for sampling intensities see table 26). In some instances, the land and cover types of areas outside these units were determined by interpretation of aerial photos, and the average volume-per-acre estimates for adjacent units were applied.

Area estimates. - A point sampling technique on 100-percent aerial photo coverage was used to obtain the area statistics. Sample plots were systematically located on the effective portion of vertical photographs.

Each photo plot was stereoscopically examined and classified as forest or nonforest. The classification for each photo plot was determined on the basis of the 10-acre area immediately surrounding the plot. Next, the forest plots were classified as commercial or noncommercial. Finally, the commercial forest plots were stratified by accessibility, forest type, stand-size, and density classes. The classified plots for each block were then summarized by stratum.

To determine the accuracy of the office photo classification a sample of photo plots was checked in the field. A predetermined number of photos was selected at random, and all of the plots on each photo, called a cluster, were examined.

Volume estimates. - Some photo plots classified as commercial forest land were randomly selected for field examination. At the field locations, survey crews collected such data as species, diameters, merchantable heights, defect, mortality, stand-size class, forest type, etc., on three plots, each one-fifth acre in size at 2-chain intervals.

Sufficient plots were selected at random to attain a specified level of statistical accuracy. The survey was designed for maximum efficiency in estimating total volume to meet the requirements of the Timber Management Division of Region 10 and the Forest Survey.

Accuracy of the estimates. - Errors which affect the accuracy of the area and volume estimates in this report may arise from two sources:

1. *Nonsampling errors*. - These are human mistakes in judgment, measurement, recording, or arithmetic. There is no practical method of finding out just how often such errors occur. These errors are kept to a minimum, however, by a diligent effort to maintain a high degree of accuracy in the collection and compilation of data and by closely checking all phases of the work.

2. *Sampling errors*. - These errors arise from using sampling procedures rather than making a 100percent inventory. These errors can be measured. They are the only measurable errors involved in computing the reliability of the estimates.

Computed sampling errors of forest area estimates for the major coastal units studied are as follows:

Forest Survey unit	Commercial forest		Noncommercial forest	
	Area	Sampling error	Area	Sampling error
	Thousand acres	Percent	Thousand acres	Percent
Southeast:				
Juneau	820.6	2.5	832.0	2.5
Sitka	540.7	3.3	1,199.5	1.8
Petersburg	1,029.2	2.3	1,327.4	1.9
Ketchikan	1,958.6	1.4	2,297.3	1.3
Yakutat	276.6	4.6	38.6	14.8
Chugach:				
Cordova	335.0	5.0	842.1	2.0
Kenai	189.6	3.0	76.6	5.0
Afognak	230.0	2.2	48.5	6.3
Total	5,377.7	--	6,665.0	--

An additional 271,000 acres of commercial forest land has been estimated by photo interpretation and included in the appendix tables for coastal Alaska. No sampling error- can be computed for this area estimate.

Computed sampling errors of volume estimates of growing stock for the major coastal units studied are as follows:

Forest Survey unit	Total volume		Sampling error of total		Sampling error per million cu. ft.
			Bd. ft.	Cu. ft.	
	MM bd. ft.	MM cu. ft.	Percent		
Southeast:					
Juneau	26,764	5,194.9	4.9	4.6	2.0
Sitka	19,470	3,704.5	5.5	5.6	2.9
Petersburg	36,584	7,021.9	5.1	5.9	2.2
Ketchikan	71,155	13,595.8	4.2	3.5	.9
Yakutat	5,731	1,055.6	10.1	7.9	7.7
Chugach:					
Cordova	8,277	1,728.6	9.5	9.3	7.1
Kenai	1,812	459.4	17.8	15.8	23.3
Afognak	5,873	1,187.2	7.1	6.2	5.7

Each survey unit was sampled separately, and sampling error was computed for the total area and total volume estimates of each. As these total estimates are subdivided in the various tables to give values by stand-size class, forest type, diameter class, species, etc., each further breakdown becomes less accurate.

Inferior Alaska

This region was divided into 10 units (fig. 35) including a gross area of about 229 million acres. Areas outside the boundaries of these units are beyond the limits of tree growth and were not inventoried.

Aerial photography suitable for forest inventory purposes was not available for interior Alaska. Strip photography at a scale of 1:5,000 was flown at 30-mile intervals across the prevailing drainages. A special study was made to determine the type of film that would result in the most desirable prints for photo interpretation, and infrared film exposed with a minus blue filter was chosen. This photographic project was completed in 1960 and resulted in about 11,000 miles of flight lines and 31,000 photographs.

A triple-sample technique was used to determine area and volume. The first sample consisted of interpretation of a 1/2- plot located near the center of each aerial photo. The second sample consisted of an air check of approximately 10 percent of the photo plots. The third sample was drawn from the air-checked plots, and the plots drawn were examined and measured on the ground.

Area estimates. - Land and forest classes were interpreted for the 1/2-acre plot on each of the aerial photos. The proportion of land and forest in the various classes was adjusted by the air-check observations. Area estimates are the product of these proportions applied to the total area in each unit.

Volume estimates. - Gross timber volume estimates were made fox- each forest location using aerial photo stand volume tables. These tables are based on species, stand height, and density. Correction factors were computed for each photo interpreter based on ground plot measurements of stand height and density. Total gross volume estimates are the product of area in the various classes and the adjusted average volumes per acre developed from the photo plots.

Net volumes were obtained by making deductions at the field locations. These deductions were averaged by species and stand classifications and applied to the gross volume estimates.

The sample. - The number of locations studied on photos, from air observation, and by ground measurement were as follows

	Forest Survey unit										
	1	2	3	4	5	6	7	8	9	10	Total
Total photo points	2,412	913	3,595	2,258	1,790	6,441	7,623	4,415	2,564	5,166	37,177
Total air-check points	219	94	331	231	205	657	813	457	261	506	3,774
Total ground plots	23	24	39	21	18	67	66	43	21	33	355

DEFINITION OF TERMS

COASTAL ALASKA

Land Use Classes

Forest land. - Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting influence on the climate or on the water regime; (b) land from which trees have been removed to less than 10-percent stocking, and which has not been developed for other use. (Forested tracts and islands of less than 10 acres and isolated strips of timber less than 120 feet wide are excluded.)

Commerical - Forest land which is (a) producing or capable of producing usable crops of industrial wood (will net a minimum of 8,000 board feet per acre, International 1/4-inch rule) ; (b) economically accessible now or in the foreseeable future; and (c) not withdrawn from timber utilization.

Noncommepcial. - Forest land incapable of producing usable industrial wood because of adverse site conditions or withdrawn for specified purposes.

Unproductive. - Noncommercial forest land which does not no«• support or will not produce a minimum of 8,000 board feet per acre.

Productive. - Forest land capable of producing usable crops of industrial wood, but withdrawn for specified purposes through statute, ordinance, or administrative order.

Nonforest land. - All land not qualifying as forest land. Includes land which has never supported forest growth; land from which the forest has been removed to less than 10-percent stocking and has been developed for other use, such as agricultural, residential, or industrial; all land in thickly populated urban and suburban areas; and water areas under 40 acres classified by the Bureau of the Census as land. Glaciers, icefields, marshland above mean high tide, permanent brush fields, muskegs less than 10 percent stocked to trees of any size, and barren mountain tops are examples of lands which have never supported forest growth.

Forest Types

Forest types are classified on the basis of the species or species group that accounts for the major portion of the stand in terms of net board-foot volume for sawtimber, cubic-foot volume for poletimber, and number of trees for seedling-sapling stands.

Sitka spruce. - Forests in which Sitka spruce is predominant.

Hemlock-Sitka spruce. - Forests in which 50 percent or more of the stand is western hemlock but in -which Sitka spruce makes up 30 to 49 percent of the stand.

Hemlock. - Forests predominantly -western hemlock except when Sitka spruce comprises 30 to 49 percent of the stand.

Hardwood. - Forests predominantly cottonwood or red alder, singly or in combination.

Tree and Stand Classes

Sawtimber trees. - Live trees of commercial species at least 11.0 inches d.b.h. with at least 25 percent of their gross board-foot volume free from rot or other defect and that contain at least one merchantable saw log.

Merchantable saw log. - For softwoods, not less than 16 feet long and contains a minimum of 20 board feet, between a stump height equal to d.b.h. but not exceeding 41/2 feet and a merchantable top equal to 40 percent of d.b.h., except in the case of small trees where the minimum top is 6 inches.

For hardwoods, not less than one 8-foot log to a minimum top of 8 inches d.i.b. for small trees and 40 percent of d.b.h. for large trees. After deductions for defect, a saw log must contain a net scale of at least 33-1/3 percent of the gross.

Upper stem. - The section of the bole or main stein of a sawtimber tree from the merchantable top to a minimum top diameter of 4.0 inches inside the bark.

Poletimber trees. - Live trees 5.0 inches to, but not including, 11.0 inches d.b.h. These trees are of sufficiently good form and condition to indicate that they will grow into merchantable sawtimber trees.

Sapling and seedling trees. - Live trees of commercial species less than 5.0 inches d.b.h. and of sufficiently good form and vigor to indicate that they will grow into merchantable sawtimber trees.

Growing-.stock tees. - All lire trees, except cull trees, of commercial species.

Cull trees. - Live trees 5.0 inches d.b.h. and over that do not qualify as sawtimber or poletimber trees due to poor form, limbiness, rot, or other defect.

Rotten cull trees contain excessive decay.

Sound cull trees have excessive crook, sweep, or large limbs.

Salvable dead trees. - *Standing,* dead, sawtimber-size trees containing at least one merchantable saw log having sound volume equal to at least 50 percent of the gross volume in the tree.

Mortality trees. - *Trees* 5.0 inches d.b.h. and larger which died of natural causes and were not cult trees at the time of death.

Sawtimber stand. - Forest stands in which the minimum volume for coniferous types is 8,000 net board feet (Scribner) per acre in growing-stock trees 11.0 inches d.b.h. and larger. For hardwood sawtimber stands the minimum volume is 4,000 net board feet (,Scribner) per acre.

Old-growth. - *S*awtimber stands in which the majority of volume is in sawtimber trees more than 150 years of age.

Young-growth. - *Saw* timber stands in which the majority of volume is in sawtimber trees less than 150 years of age.

Poletimber stand. - Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger growing-stock trees, and with at least half the minimum stocking in poletimber trees.

Sapling owl seedling *stand.* - Stands not qualifying as either sawtimber or poletimber, but having at least 10-percent stocking of trees of commercial species and with at least half the minimum stocking in seedlings and saplings.

Nonstocked and other areas. - *Com*mercial forest land less than 10 percent stocked with growing-stock trees.

Volume Classes

Sawtimber volume. - The net volume in board feet, International 1/4-inch rule, of merchantable saw logs in live sawtimber trees of commercial species.

Growing-stock volume. - The net volume in cubic feet of sound wood in live sawtimber and poletimber trees of commercial species from the stump to a minimum 4.0-inch top inside the bark.

Total volume. - The net volume in cubic feet of sound wood in live and salvable dead sawtiinber and poletimber t5 trees and in sound and rotten cull trees of commercial species from the stump to a minimum 4.0-inch top inside the bark. Included is the volume of hardwood limbs on sawtimber trees to a minimum diameter of 4.0 inches inside the bark.

Log Grades

Sample western hemlock and Sitka spruce trees were graded in 16-foot log lengths. However, when any 12- or 14-foot section of a log was better than the entire log, the grade of the shorter section was given to the entire log.

The rules used were from the January 1954 edition of Official Log Scaling and Grading Rules for the Puget Sound, Grays Harbor, Southern Oregon, and Northern California Bureaus.

Abbreviations Used

DBH or d.b.h. - Abbreviation for diameter at breast height. This measurement is taken 4 1/2 feet above the ground on the uphill side of the tree.

d.i.b. - Abbreviation for diameter inside the bark. This measurement may be taken at any specified location.

d.o.b. - *Abbreviation* for diameter outside the bark. This measurement may be taken at any specified location.

2-inch diameter class. - If the classes are expressed as 6, 8, 10 inches, etc., this means that the diameters included are from 5.0 through 6.9, 7.0 through 8.9, 9.0 through 10.9, etc.

Stocking Classes

Stocking is a measure of how effectively the area is being utilized by growing stock. No stocking measure was assigned to oldgrowth stands. For young-growth stand,, ocular estimates were made of the crown cover of sawtimber trees on the 40 acres surrounding each plot location. The stocking of poletimber, saplings, and seedlings was based on the number of stems per acre. The following classes and guides were used

Poletimber. —

	Percent stocked
210 or more stems per acre	70
120 to 210 stems per acre	40
30 to 120 stems per acre	10

Saplings and seedlings. -- Stocking was measured on ten 4-milacre circular plots. Two or more established saplings or seedlings were required to stock a 4milacre plot. Stocking of the area was determined by the number of 4-milacrc locations that were stocked. Thus, if six of the ten 4-milacre locations were stocked, the area eras judged to be 60 percent stocked.

Area stocking classes	Percent
Nonstocked	0-10
Poorly stocked	10-39
Medium stocked	40-69
Well stocked	70-100

Volume Measurements

Board foot. - *Aboard* 1 foot long, 1 foot wide, and 1 inch thick. The bark is usually eliminated from this measurement. In practice, the working unit is 1,000 board feet and may be abbreviated to 11I bd. ft., M.B.M., or MBF.

Cubic foot. - A cube 12, inches on a side. The cubic-foot volume of a log or tree is commonly computed by Smalian's formula (Bruce and Schumacher 1950).

International '/4-inch log rule. - A rule used to determine the log volume in board feet (Bruce and Schumacher 1950).

Allowable Cut

"The volume of wood which can be cut under management for a given period of time" (Society of American Foresters 1908).

A number of formulas are available to make this estimate. The Kemp formula is easy to apply with the kind of inventory data available. Usually this formula is applied to areas in which there is a surplus of timber beyond rotation age. The objective is to determine the cut that will achieve an approximately equal distribution of area by age or stand-size classes within a rotation.

The Kemp formula:

$$\text{Annual cut} = \frac{7A + 5A_1 + 3A_2 + A_3}{4R} \quad (MA)$$

A = area of sawtimber stands
A_1 = area of poletimber stands
A_2 = area of seedling and sapling stands
A_3 = nonstocked area
$A+A_1+A_2+A_3$ = total commercial forest land area
4 = number of stand-size classes
R = rotation in years
MA = average volume per acre of current sawtimber stands, the A stratum

INTERIOR ALASKA

Only definitions that differ from coastal Alaska are repeated.

Land Use Classes

Forest land. - Same as for coastal Alaska except that 1 acre was the minimum area classified.

Commercial. - Forest land which is producing or capable of producing crops of industrial wood, in excess of 20 cubic feet per acre of annual growth, and not withdrawn from timber utilization.

Noncommercial. - Same as for coastal Alaska.

Unproductive. - Forest land incapable of producing 20 cubic feet per acre of annual growth in industrial wood.

Forest Types

Classified by the predominance of one or more species; based on gross boardfoot volume for sawtimber stands, cubic foot volume for poletimber stands, and crown cover in seedling and sapling stands.

Spruce. - Spruce, usually white spruce, accounts for 50 percent or more of the volume or crown cover. Associated species are black spruce, paper birch, and balsam poplar.

Birch. - Paper birch accounts for 50 percent or snore of the volume or crown cover. Associated species are quaking aspen, white or black spruce, and balsam poplar.

Aspen. - Quaking aspen accounts for 50 percent or more of the volume or crown cover. Associated species are white or black spruce, and paper birch.

Poplar. - Balsam poplar accounts for 50 percent or more of the volume or crown cover. Associated species may be white spruce and paper birch.

Tree and Stand Classes

Sawtimber trees. - Live softwood trees 9.0 inches d.b.h. or larger and hardwood trees 11.0 inches d.b.h. or larger of commercial species, containing at least one saw log and with boardfoot defect not exceeding two-thirds of the gross log volume.

Merchantable saw log. - For hardwoods, the log must meet the minimum requirements for log grade 4 (tie and timber logs). For softwoods, the log must meet the minimum requirements for grade 3 logs, except that the minimum length is 16 feet.

Upper stem. - The section of the bole or main stem of a sawtimber tree above the merchantable top to a minimum top diameter of 1.0 inches outside the bark, or to the point where the central stem breaks into limbs.

Poletimber trees. - Same as for coastal Alaska, except that for softwoods the d.b.h. range is from 5.0 to 9.0 inches.

Sawtimber .stand. - Stands at least 10 percent stocked with growing-stock trees and with sawtimber trees making up at least 25 percent of the stocking.

Poletimber stand. - Stands at least 10 percent stocked with growing-stock trees, with sawtimber trees making up less than 25 percent of the stocking and poletimber trees plus sawtimber trees making up 50 percent or more.

Volume Classes

Same as for coastal Alaska, with the following exceptions:

1. Stump height used was 1 foot.

2. Merchantable top was the point above which no specified grade of saw log could be obtained (minimum top of 6 inches for softwoods and 8 inches for hardwoods).

3. Total volume was to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

Log Grades

"Hardwood Log Grades for Standard Lumber" (Vaughan et al. 1966) was used for cottonwood and birch.

The log grades used for aspen were from "Aspen Lumber Grades and Characteristics" (Zasada 1948).

The log grades for white spruce were taken from "Specifications for Log Grades of Hardwoods and Softwoods," issued by Northern Hemlock and Hardwood Association in 1947.

Stand Age Classes

Age was not used as a means of classifying interior Alaska stands.

Productivity Rating

Productivity rating for each field location was assigned in the office from an analysis of increment cores taken from sample trees on each plot.

ALASKA

Tree Species

Softwoods

Alaska-cedar *(Chamaecyparis nootkatensis*

Black spruce *Picea mariana)*

Lodgepole pine (Pinus *conto rta)*

Mountain hemlock *(Tsuga mertensiana)*

Pacific silver fir *(Abies amabilis)*

Sitka spruce *(Picea sitchensis)*

Western hemlock *(Tsuga heterophylla)*

Western redcedar *(Thuja plicata)*

White spruce *(Picea glauca)*

Hardwoods

Balsam poplar (Populus *balsamifera)*

Black cottonwood (Populus *trichocarpa)*

Paper birch *(Betula papyrifera)*

Quaking aspen (Populus *tremuloides)*

Red alder *(Alnus rubra)*

Species Groups

Hardwood. - Generally, one of the botanical group of trees that have broad leaves, in contrast to the conifers.

Softwood. - Generally, one of the botanical group of trees that in most cases have needles or scalelike leaves; the conifers.

DETAILED TABLES

The tables that follow have been compiled to show relative importance by region and the State total. No attempt has been made to adjust these regional statistics to a common year for the State total. They were accumulated from 1955-62. Large sampling errors are involved for some of the smaller units included, and the factors of change growth, mortality, decay, cutting-are not known well enough to improve upon the statistics as shown.

If a mean date is desired, 1957 should be used for coastal Alaska and 1962 for the interior.

Table 1.—Area by land classes, Alaska
(Thousand acres)

Land Class	Total Alaska	Coastal	Interior
Commercial forest land	28,218	5,749	22,469
Noncommercial forest land:			
Unproductive	90,633	7,304	83,329
Productive-reserved	200	194	6
Total forest land	119,051	13,247	105,804
Nonforest land[1]	246,430	19,679	226,751
All land[2]	365,481	32,926	332,555

[1] Includes 2,852,000 acres defined as water by Forest Survey but included with land area by Bureau of Census.
[2] From U. S. Bureau of Census, Land and Water Area of the United States, 1950.

Table 2.—Land areas in Alaska, by major class of land and survey unit
(Thousand acres)

Survey unit	Total land area	Forest land				Nonforest
		Total	Commercial	Productive-reserved	Unproductive	
COASTAL						
Southeast:						
Juneau	3,833	1,653	815	6	832	2,180
Sitka	2,433	1,740	541	--	1,199	693
Petersburg	3,287	2,357	1,029	--	1,328	930
Ketchikan	5,566	4,256	1,951	8	2,297	1,310
Yakutat	796	315	276	--	39	481
Haines-Gustavus	924	226	79	1	146	698
Glacier Bay	2,022	359	--	179	180	1,663
Yakataga	3,292	243	174	--	69	3,049
Public domain	1,995	52	19	--	33	1,943
Total southeast	24,148	11,201	4,884	194	6,123	12,947
Chugach:						
Cordova	3,036	1,177	335	--	842	1,859
Kenai	1,259	266	190	--	76	993
Afognak[1]	567	354	276	--	78	213
Kodiak[2]	2,575	81	47	--	34	2,494
Public domain	1,341	168	17	--	151	1,173
Total Chugach	8,778	2,046	865	--	1,181	6,732
INTERIOR						
Interior:						
Susitna	16,490	4,292	2,023	--	2,269	12,198
Kenai	5,665	2,070	1,481	--	589	3,595
Tanana-Fairbanks	20,266	12,989	3,555	6	9,428	7,277
Upper Tanana	13,633	6,746	1,272	--	5,474	6,887
Copper River	16,424	4,431	1,060	--	3,371	11,993
Upper Yukon	36,929	22,557	4,945	--	17,612	14,372
Lower Yukon	44,976	30,005	4,232	--	25,773	14,971
Kuskokwim	26,564	14,662	2,594	--	12,068	11,902
Bristol Bay	12,877	2,741	704	--	2,037	10,136
Norton Sound	31,113	5,311	603	--	4,708	25,802
Total	224,937	105,804	22,469	6	83,329	119,133
Unsurveyed area	107,618	--	--	--	--	107,618
Total Interior	332,555	105,804	22,469	6	83,329	226,751
Total Alaska	365,481	119,051	28,218	200	90,633	246,430

[1] Includes Afognak, Raspberry, Shuyak, and Marmot Islands.
[2] Includes Kodiak and adjacent islands.

Table 3.—Area of commercial forest land, by ownership classes, Alaska
(Thousand acres)

Ownership class	Total Alaska	Coastal	Interior
National Forest	5,292	5,292	0
Other Federal:			
Bureau of Land Management	--	252[1]	(2)
Indian	--	25	(2)
Miscellaneous Federal	--	4	(2)
Total other Federal	--	281	--
State	--	146[1]	(2)
Miscellaneous private	--	30	(2)
All ownerships	28,218	5,749	22,469

[1] Acreage is as of January 1, 1963.
[2] Ownership of interior Alaska commercial forest land not available.

Table 4.—Area of commercial forest land by stand-size class and major survey unit, Alaska
(Thousand acres)

Stand-size class	Total Alaska	Coastal			Interior
		Total	Southeast	Chugach	
Sawtimber stands:					
Old-growth	4,852	4,852	4,238	614	--
Young-growth	7,266	379	242	137	6,887[1]
Total	12,118	5,231	4,480	751	6,887
Poletimber stands	8,873	199	139	60	8,674
Sapling and seedling stands	6,065	259	208	51	5,806
Nonstocked areas	1,162	60	57	3	1,102
Total	28,218[2]	5,749	4,884	865	22,469

[1] Sawtimber stands of the interior were not classified as old- or young-growth.
[2] Productive-reserved lands not included.

Table 5.—Area of commercial forest land, by stand-volume classes for sawtimber and other stand-size classes, Alaska
(Thousand acres)

Stand volumes per acre	Area by stand-size classes				
	All stands	Coastal		Interior	
		Sawtimber stands	Other stands	Sawtimber stands	Other stands
Less than 1,500 board feet	16,452	--	375	--	16,077
1,500 to 5,000 board feet	6,340	--	221	5,455	664
More than 5,000 board feet	5,426	5,153	--	273	--
All classes	28,218	5,153	596	5,728	16,741

Table 6.—Area of commercial forest land by major forest type, dominant species, and major survey unit, Alaska
(Thousand acres)

Major type by dominant species	Total Alaska	Coastal			Interior
		Total	Southeast	Chugach	
Hemlock-Sitka spruce:					
Sitka spruce	960	960	636	324	--
Western hemlock	2,682	2,682	2,682	--	--
Mixed hemlock/spruce	1,545	1,545	1,049	496	--
Cedar	319	319	319	--	--
Total	5,506	5,506	4,686	820	--
Spruce-fir:					
White spruce	12,806	--	--	--	12,806
Aspen-birch:					
Quaking aspen	2,407	--	--	--	2,407
Paper birch	5,140	18	--	18	5,122
Total	7,547	18	--	18	7,529
Hardwoods:					
Cottonwood	2,149	15	--	15	2,134
Mixed hardwoods	210	210	198	12	--
Total	2,359	225	198	27	2,134
Total all types	28,218[1]	5,749	4,884	865	22,469

[1] Productive-reserved lands not included.

Table 7.—Area of commercial forest land, by stocking classes of growing-stock trees and by stand-size classes, Alaska
(Thousand acres)

Stocking class	All stands	Saw-timber stands		Pole-timber stands		Sapling and seedling stands		Non-stocked stands	
		Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
70 percent or more	11,947	4,857	1,896	98	3,168	114	1,814	--	--
40 to 70 percent	12,210	311	4,320	61	4,803	87	2,628	--	--
10 to 40 percent	2,899	63	671	40	703	58	1,364	--	--
Less than 10 percent	1,162	--	--	--	--	--	--	60	1,102
All classes	28,218	5,231	6,887	199	8,674	259	5,806	60	1,102

Table 8.—Area of commercial forest land, by yield and ownership class, Alaska
(Thousand acres)

Annual growth per acre (cu. ft.)	All ownerships	National Forest	Other public	Farmer and misc. private
COASTAL				
120 or more	1,785	1,711	65	9
85 to 120	2,661	2,508	139	14
50 to 85	1,183	977	200	6
Less than 50	120	96	23	1
All classes	5,749	5,292	427	30
INTERIOR				
More than 50	0	0	0	0
Less than 50	22,469	0	22,469[1]	--

[1] Includes an unknown amount in private ownership.

Table 9.—Net volume of timber on commercial forest land, by class of timber, by softwoods and hardwoods, by region, Alaska
(Thousand cubic feet)

Class of timber	All species	Coastal						Interior	
		Total		Southeast		Chugach			
		Softwoods	Hardwoods	Softwoods	Hardwoods	Softwoods	Hardwoods	Softwoods	Hardwoods
Sawtimber trees:									
Saw-log portion	37,520,565	31,969,738	209,815	28,598,999	198,854	3,370,739	10,961	3,987,870	1,353,142
Upper-stem portion	2,063,346	1,384,736	26,464	1,250,139	24,680	134,597	1,784	394,405	257,741
Total	39,583,911	33,354,474	236,279	29,849,138	223,534	3,505,336	12,745	4,382,275	1,610,883
Poletimber trees	10,372,493	2,051,402	63,325	1,671,073	50,916	380,329	12,409	4,781,589	3,476,177
All growing-stock trees	49,956,404	35,405,876	299,604	31,520,211	274,450	3,885,665	25,154	9,163,864	5,087,060
Sound cull trees:									
Sawtimber-size	52,364	37,895	718	32,521	712	5,374	6	9,465	4,286
Poletimber-size	129,517	74,066	1,322	55,171	1,054	18,895	268	12,688	41,441
Total	181,881	111,961	2,040	87,692	1,766	24,269	274	22,153	45,727
Rotten cull trees:									
Sawtimber-size:	817,797	742,611	2,013	711,598	1,926	31,013	87	13,112	60,061
Poletimber-size	348,186	13,968	1,294	9,476	405	4,492	889	33,068	299,856
Total	1,165,983	756,579	3,307	721,074	2,331	35,505	976	46,180	359,917
Salvable dead trees:									
Sawtimber-size	470,086	370,039	--	346,772	--	23,267	--	96,304	3,743
Poletimber-size	12,144	--	--	--	--	--	--	12,144	--
Total	482,230	370,039	--	346,772	--	23,267	--	108,448	3,743
Total, all timber	51,786,498	36,644,455	304,951	32,675,749	278,547	3,968,706	26,404	9,340,645	5,496,447

Table 10.—Net volume of growing stock and sawtimber on commercial forest land, by ownership classes and by softwoods and hardwoods, Alaska

Ownership class	All species	Coastal		Interior[1]	
		Softwoods	Hardwoods	Softwoods	Hardwoods
	Million cubic feet				
Growing stock:					
National Forest	32,867	32,592	275	0	0
Other public	16,903	2,630	22	9,164	5,087
Forest industry	--	--	--	--	--
Farmer and misc. private	186	184	2	--	--
All ownerships	49,956	35,406	299	9,164	5,087
	Million board feet, International ¼-inch rule				
Sawtimber:					
National Forest	169,988	168,815	1,173	0	0
Other public	44,563	13,650	96	--	--
Forest industry	--	--	--	--	--
Farmer and misc. private	963	957	6	--	--
All ownerships	215,514	183,422	1,275	24,949	5,868

[1] No ownership breakdown available beyond National Forest ownership.

Table 11.—Net volume of sawtimber on commercial forest land, by stand-size classes and region, Alaska
(Million board feet)[1]

Stand-size class	Total Alaska	Coastal			Interior
		Total	Southeast	Chugach	
Sawtimber stands:					
Old growth	(2)	173,827	157,764	16,063	(2)
Young growth	(2)	10,043	7,495	2,548	(2)
Total sawtimber	206,400	183,870	165,259	18,611	22,530
Poletimber stands	8,866	709	562	147	8,157
Sapling and seedling stands	92	49	10	39	43
Nonstocked areas	156	69	69	--	87
Total	215,514	184,697	165,900	18,797	30,817
Percent	100.0	--	77.0	8.7	14.3

[1] International ¼-inch rule.
[2] Sawtimber stands in interior Alaska were not broken down into old-growth and young-growth classifications.

Table 12.—Net volume of growing stock on commercial forest land, by species and diameter classes, Alaska
(Thousand cubic feet)

Survey unit and species	Diameter class (inches at breast height)					
	All classes	5.0-10.9	11.0-20.9	21.0-30.9	31.0-40.9	41.0 plus
COASTAL						
Southeast:						
Softwoods:						
Hemlock	20,318,700	1,190,235	5,870,213	7,488,685	4,321,631	1,447,936
Sitka spruce	8,928,394	290,460	1,418,581	2,243,948	2,047,538	2,927,867
Redcedar	1,021,073	55,857	286,815	383,970	188,167	106,264
True fir	67,960	754	15,347	24,671	27,188	--
Other softwoods	1,184,084	133,768	546,903	380,531	100,736	22,146
Hardwoods:						
Cottonwood	234,915	42,380	122,633	60,015	9,887	--
Red alder	35,902	7,727	28,175	--	--	--
Other hardwoods	3,633	810	1,698	1,125	--	--
Total, Southeast	31,794,661	1,721,991	8,290,365	10,582,945	6,695,147	4,504,213
Chugach:						
Softwoods:						
Hemlock	1,250,314	158,176	495,778	418,801	156,945	20,614
Sitka spruce	2,632,449	221,600	982,881	867,950	432,979	127,039
White spruce	2,902	554	2,102	246	--	--
Other softwoods	--	--	--	--	--	--
Hardwoods:						
Cottonwood	20,935	9,203	8,685	2,262	785	--
Birch	4,219	3,206	1,013	--	--	--
Total, Chugach	3,910,819	392,739	1,490,459	1,289,259	590,709	147,653
Total, coastal	35,705,480	2,114,730	9,780,824	11,872,204	7,285,856	4,651,866
INTERIOR						
Softwoods:						
Spruce	9,163,864	4,781,589[1]	3,988,047[2]	394,228	--	--
Hardwoods:						
Birch	2,976,341	2,318,515	657,826	--	--	--
Quaking aspen	894,550	732,759	161,791	--	--	--
Balsam poplar	1,216,169	424,903	685,530	105,736	--	--
Total, interior	14,250,924	8,257,766	5,493,194	499,964	--	--
Total, Alaska	49,956,404	10,372,496	15,274,018	12,372,168	7,285,856	4,651,866

[1] 5.0- to 8.9-inch diameter class.
[2] 9.0- to 20.9-inch diameter class.

Table 13.—Net volume of sawtimber on commercial forest land, by species, diameter class, and region, Alaska
(Million board feet)[1]

Survey unit and species	All classes	Diameter class (inches at breast height)			
		11-20	21-30	31-40	41+
Southeast:					
Sitka spruce	54,198	8,474	13,875	12,655	19,194
Western hemlock	101,483	31,288	40,022	22,415	7,758
Other softwoods	8,999	3,367	3,434	1,495	703
Hardwoods	1,220	741	400	79	--
Total	165,900	43,870	57,731	36,644	27,655
Chugach:					
Sitka spruce	13,350	5,235	4,848	2,519	748
Western hemlock[2]	5,378	2,440	2,070	767	101
Other softwoods	14	13	1	--	--
Hardwoods	55	39	12	4	--
Total	18,797	7,727	6,931	3,290	849
Total:					
Sitka spruce	67,548	13,709	18,723	15,174	19,942
Western hemlock	106,240	33,179	42,020	23,182	7,859
Other softwood	9,634	3,929	3,507	1,495	703
Hardwoods	1,275	780	412	83	--
Total coastal (all species)	184,697	51,597	64,662	39,934	28,504
Interior:					
White spruce and other softwoods	24,949	23,281	1,668	--	--
Paper birch	2,422	2,422	--	--	--
Balsam poplar	2,642	2,228	414	--	--
Quaking aspen	804	804	--	--	--
Total interior	30,817	28,735	2,082	--	--
Total Alaska (all species)	215,514	80,332[3]	66,744	39,934	28,504

[1] International ¼-inch rule.
[2] Includes mountain hemlock.
[3] Includes 7,151 million board feet of softwoods in the 10-inch class (Chugach, 190 million; and interior, 6,961 million bd. ft.).

Table 14.—Volume of sawtimber on commercial forest land, by quality classes for selected species, coastal Alaska
(Million board feet)[1]

Survey unit and species	All classes	Log grade			
		Select and peelers	Grade 1	Grade 2	Grade 3
Southeast:					
Sitka spruce	54,198	2,867	6,011	(2)	45,320
Western hemlock	101,483	1,461	3,684	--	96,338
Total	155,681	4,328	9,695	--	141,658
Chugach:					
Sitka spruce	13,350	--	408	3,991	8,951
Western hemlock	4,757	129	192	1,482	2,954
Mountain hemlock	621	--	--	135	486
Total	18,728	129	600	5,608	12,391
Total coastal	174,409	4,457	10,295	5,608	154,049

[1] International ¼-inch rule.
[2] Grade 2 logs in southeast Alaska were not separated from the grade 3 logs. (Official log scaling and grading rules for the Puget Sound Log Scaling and Grading Bureau, Tacoma, Wash.)

Table 15.—Percentage distribution[1] of sawtimber volume on commercial forest land, by quality classes for selected species, coastal Alaska

Survey unit and species	Total	Log grade			
		Select and peelers	Grade 1	Grade 2	Grade 3
Southeast:					
Western hemlock	100	1.4	3.6	(2)	95.0
Sitka spruce	100	5.3	11.1	--	83.6
Total	100	2.7	6.2	--	91.1
Chugach:					
Sitka spruce	100	--	3.1	29.9	67.1
Western hemlock	100	2.7	4.0	31.2	62.1
Mountain hemlock	100	--	--	21.7	78.3
Total	100	0.8	3.2	29.9	66.1

[1] Based on Scribner volumes.
[2] Grade 2 logs in southeast Alaska were not separated from the grade 3 logs. (Official log scaling and grading rules for the Puget Sound Log Scaling and Grading Bureau, Tacoma, Wash.)

Table 16.—Volume of sawtimber on commercial forest land, by quality classes for selected species, interior Alaska
(Million board feet)[1]

Species	All classes	Log Grade			
		1	2	3	4
White spruce[2]	24,949	334	524	18,178	5,913
Paper birch[3]	2,422	127	216	2,046	33
Quaking aspen[4]	804	287	144	370	3
Balsam poplar[3]	2,642	([5])	878	1,658	106
Total interior	30,817	748	1,762	22,252	6,055

[1] International ¼-inch rule.
[2] Specifications for log grades of hardwoods and softwoods. Northern Hemlock and Hardwood Association.
[3] Hardwood log grades for standard lumber. U.S. Forest Service Research Paper FPL-63.
[4] Aspen lumber grades and characteristics. U.S. Forest Service Lake States Aspen Report No. 6.
[5] A better sample would have put some volume in log grade 1. A later and more intensive inventory of the Susitna valley puts 43 percent of the gross saw-log volume of this species in log grades 1 and 2.

Table 17.—Percentage of distribution of sawtimber volume on commercial forest land, by quality classes for selected species, interior Alaska

Species	Total	Log grade			
		1	2	3	4
White spruce[1]	100	1.3	2.1	72.9	26.7
Paper birch[2]	100	5.2	8.9	84.5	1.4
Black cottonwood and balsam poplar[2]	100[3]	13.7	25.0	56.8	4.5
Quaking aspen[4]	100	35.7	17.9	46.0	.4

[1] Specifications for log grades of hardwoods and softwoods. Northern Hemlock and Hardwood Association.
[2] Hardwood log grades for standard lumber. U.S. Forest Service Research Paper FPL-63.
[3] Percentages based on net volume of merchantable logs studied in the Susitna valley.
[4] Aspen lumber grades and characteristics. U.S. Forest Service Lake States Aspen Report No. 6.

Table 18.—Net volume of salvable dead sawtimber-size trees on commercial forest land, by softwoods and hardwoods, Alaska
(Million board feet)[1]

Species group	Total all Alaska	Southeast	Chugach	Interior
Softwoods	2,657	2,191	123	343
Hardwoods	23	--	--	23
All species	2,680	2,191	123	366

[1] International ¼-inch rule.

Table 19.—Net annual growth and cut of growing stock and sawtimber on commercial forest land, by softwoods and hardwoods, Alaska

Species group	Net annual growth	Timber cut 1961
	Thousand cubic feet	
Coastal:		
Softwoods	63,800[1]	97,446
Hardwoods	(2)	(3)
Interior:		
Softwoods	126,147	1,117
Hardwoods	86,259	(3)
All species	276,206	98,563
	Thousand board feet[4]	
Coastal:		
Softwoods	379,000	617,433
Hardwoods	(2)	(3)
Interior:		
Softwoods	498,218	6,628
Hardwoods	166,686	(3)
All species	1,043,904	624,061

[1] Growth for young-growth (less than 150 years old) stands only.
[2] No growth data available.
[3] Insignificant amounts of hardwoods cut (less than 0.1 percent).
[4] International ¼-inch rule.

Table 20.—Annual mortality of growing stock and sawtimber, on commercial forest land, by species, Alaska

Survey unit and species	Growing stock	Sawtimber
	M cu. ft.	M bd. ft.[1]
Southeast:		
Sitka spruce	12,133	77,880
Hemlock	62,416	381,057
Alaska-cedar	2,535	13,353
Redcedar	656	3,905
Silver fir	46	268
Lodgepole pine	86	562
Total softwoods	77,872	477,025
Black cottonwood	252	448
Total, southeast	78,124	477,473
Chugach:		
Sitka spruce	4,491	19,099
White spruce	73	351
Western and mountain hemlock	1,641	5,934
Total, Chugach	6,205	25,384
Total, coastal	84,329	502,857
Interior:		
White spruce and other softwoods	49,533	120,754
Hardwoods (aspen, birch, balsam poplar)	18,017	22,717
Total, interior	67,550	143,471
Total, all Alaska	151,879	646,328

[1] International ¼-inch rule.

Table 21.—Total output of Alaska's wood processors by product and geographic region, 1961

Survey unit and product		Total output
Coastal:		
Lumber	Million board feet	70.2
Pulp	Thousand air-dry tons	266.5
Poles	Pieces	100.0
Crossties	Pieces	9,352.0
House logs	Thousand lineal feet	3.0
Interior:		
Lumber	Million board feet	2.3
House logs	Thousand lineal feet	293.0
Mining stulls	Thousand lineal feet	25.0

Table 22.—Volume of logs consumed in Alaska by management or ownership source, type of plant, and geographic region, 1961

Survey unit and plant type	Volume		Management or ownership source					
			National Forest	Public domain	Total Federal	State	Private	All ownership
	M cu. ft.	M bd. ft.[1]	Percent					
Coastal:	66,353	394,026	96.3	1.9	98.2	0.2	0.6	99.0
Pulpmills	53,010	314,791	79.1	0	79.1	0	0	79.1
Sawmills[2]	13,342	79,231	17.2	1.9	19.1	.2	.6	19.9
Treating plant	1	4	(3)	0	(3)	0	0	(3)
Interior:	686	4,071	(3)	.6	.6	.1	.3	1.0
Sawmills	656	3,894	(3)	.6	.6	.1	.3	1.0
House logs	30	177	0	(3)	(3)	(3)	--	(3)
Total	67,039	398,097	96.3	2.5	98.8	.3	.9	100.0

[1] International ¼-inch rule. Scribner log rule volumes can be approximated by multiplying International ¼-inch log rule volumes by 0.8518.
[2] Includes 296,000 board feet of cottonwood logs from State lands and 2,348,000 board feet of redcedar from National Forest lands exported in round form.
[3] Less than 0.1 percent.

Table 23.—Volume of logs consumed in Alaska by species, type of plant, and geographic region, 1961

Survey unit and plant type	Volume		Species						
			Western hemlock	Sitka spruce	White spruce	Red-cedar	Paper birch	Cotton-wood	All species
	M cu. ft.	M bd. ft.[1]	Percent						
Coastal:	66,353	394,026	52.6	45.6	0	0.7	0	0.1	99.0
Pulpmills	53,010	314,791	51.6	27.5	0	0	0	0	79.1
Sawmills[2]	13,342	79,231	1.0	18.1	0	.7	0	.1	19.9
Treating plant	1	4	([3])	0	0	0	0	0	([3])
Interior:	686	4,071	0	([3])	0.9	0	0.1	([3])	1.0
Sawmills	656	3,894	0	([3])	9	0	.1	([3])	1.0
House logs	30	177	0	0	([3])	0	0	0	([3])
Total	67,039	398,097	52.6	45.6	.9	.7	.1	.1	100.0

[1] International ¼-inch rule. Scribner log rule volumes can be approximated by multiplying International ¼-inch log rule volumes by 0.8518.
[2] Includes 296,000 board feet of cottonwood logs from State lands and 2,348,000 board feet of redcedar from National Forest lands exported in round form.
[3] Less than 0.1 percent.

Table 24.—Market areas of Alaska's primary wood products, by kind of product and geographic region, 1961

Survey unit and kind of product	Volume	Market area				
		Alaska		Continental United States	Foreign countries	All markets
		Within 100 miles of plant	Over 100 miles from plant			
	M b. m.[1]	Percent				
Coastal:						
Lumber	70,187	2.5	3.7	1.6	11.4	19.2
Export logs	2,435	0	0	0	.6	.6
Pulp	289,908	0	0	34.4	44.8	79.2
Poles	4	(2)	0	0	0	(2)
Crossties	349	.1	0	0	0	.1
House logs	10	(2)	0	0	0	(2)
Total, coastal	362,893	2.6	3.7	36.0	56.8	99.1
Interior:						
Lumber	2,314	.5	.1	(2)	0	.6
House logs	951	.3	(2)	0	0	.3
Mining stulls	93	(2)	0	0	0	(2)
Total, interior	3,358	.8	.1	(2)	0	.9
Total, Alaska	366,251	3.4	3.8	36.0	56.8	100.0

[1] Lumber tally equivalent.
[2] Less than 0.1 percent.

Table 25.—Volume of plant residue from Alaska's sawmills by use, type of residue, and geographic region, 1961

Survey unit and type of residue	Volume	Use				
		Unused	Fuel		Other[1]	All uses
			Industrial	Domestic		
	M cu. ft.	Percent				
Coastal:	3,850	72.9	15.9	0.8	0.3	89.9
Coarse	2,118	32.7	15.9	.8	.1	49.5
Fine	1,732	40.2	0	0	.2	40.4
Interior:	431	6.5	0	3.0	.6	10.1
Coarse	265	3.4	0	2.5	.3	6.2
Fine	166	3.1	0	.5	.3	3.9
Total	4,281	79.4	15.9	3.8	.9	100.0

[1] Other uses include cattle bedding, insulation, and mine shoring.

Table 26.—Sampling intensities of the coastal Alaska forest survey

Survey units	Unit total area	Number of photo points	Acres per photo point	Number of ground plots (CFL)	Acres of CFL	Acres of CFL/plot
SOUTHEAST SUBREGION						
Juneau	3,832,591	5,830	657.39	164	820,558[1]	5,003.4
Petersburg	3,286,606	4,347	756.06	129	1,029,243	7,978.6
Sitka	2,433,280	3,314	734.24	129	540,747	4,191.8
Ketchikan	5,566,080[2]	8,902	625.26	221	1,958,564[3]	8,862.3
Yakutat	795,887	872	912.71	57	276,562	4,852.0
Subtotal	15,914,444	23,265	684.05	700	4,625,674[4]	6,608.1
Outside units:						
Yakutat outside	1,031,406	1,630	632.76	0	19,252	0
Haines-Gustavus	924,385	1,486	622.06	16	80,305	5,019.1
Glacier Bay	2,022,264	3,424	590.61	0	178,956	0
Icefields	963,565	1,686	571.51	0	0	0
Subtotal	4,941,620	8,226	600.73	16	278,513	17,407.1
Subregion total	20,856,064	31,491	662.28	716	4,904,187	6,849.4
PRINCE WILLIAM SOUND SUBREGION						
Cordova	3,035,900	6,124	471.75[5]	74	334,935	4,526.1
Afognak Island	458,800	2,149	213.49	55	230,034	4,182.4
Kenai	1,259,000	5,826	202.98[6]	70	189,593	2,708.5
Subtotal	4,753,700	14,099	321.33[7]	199	754,562	3,791.8
Outside units:						
Kodiak and islands	2,683,497	0	0	0	93,660	0
Yakataga	3,291,824	2,243.58[8]	1,358.37	0	174,022	0
Blying Sound	1,341,391	2,885	464.95	0	16,358	0
Subtotal	7,316,712	5,128.58	1,429.95	0	284,040	0
Subregion total	12,070,412	19,227.58	627.76	199	1,038,602	5,219.1
Total, coastal Alaska	32,926,476	50,718.58	649.19	915	5,942,789	6,494.8

[1] Includes reserved area of 5,846 acres.
[2] Includes 80,964 acres (excluding water area >40 acres) for Annette Island.
[3] Includes reserved area of 8,000 acres.
[4] Includes reserved area of 13,846 acres.
[5] Applies to unit total area less icefield (3,035,900 — 146,900).
[6] Applies to unit total area less icefield (1,259,000 — 76,400).
[7] Applies to unit total area less icefield.
[8] Only 622 photo plots actually used — the rest of the area (rep./1,821.58 points) = icefields.


NATIONAL FOREST SYSTEM
COOPERATIVE FORESTRY
FORESTRY RESEARCH
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

GPO 994 - 814