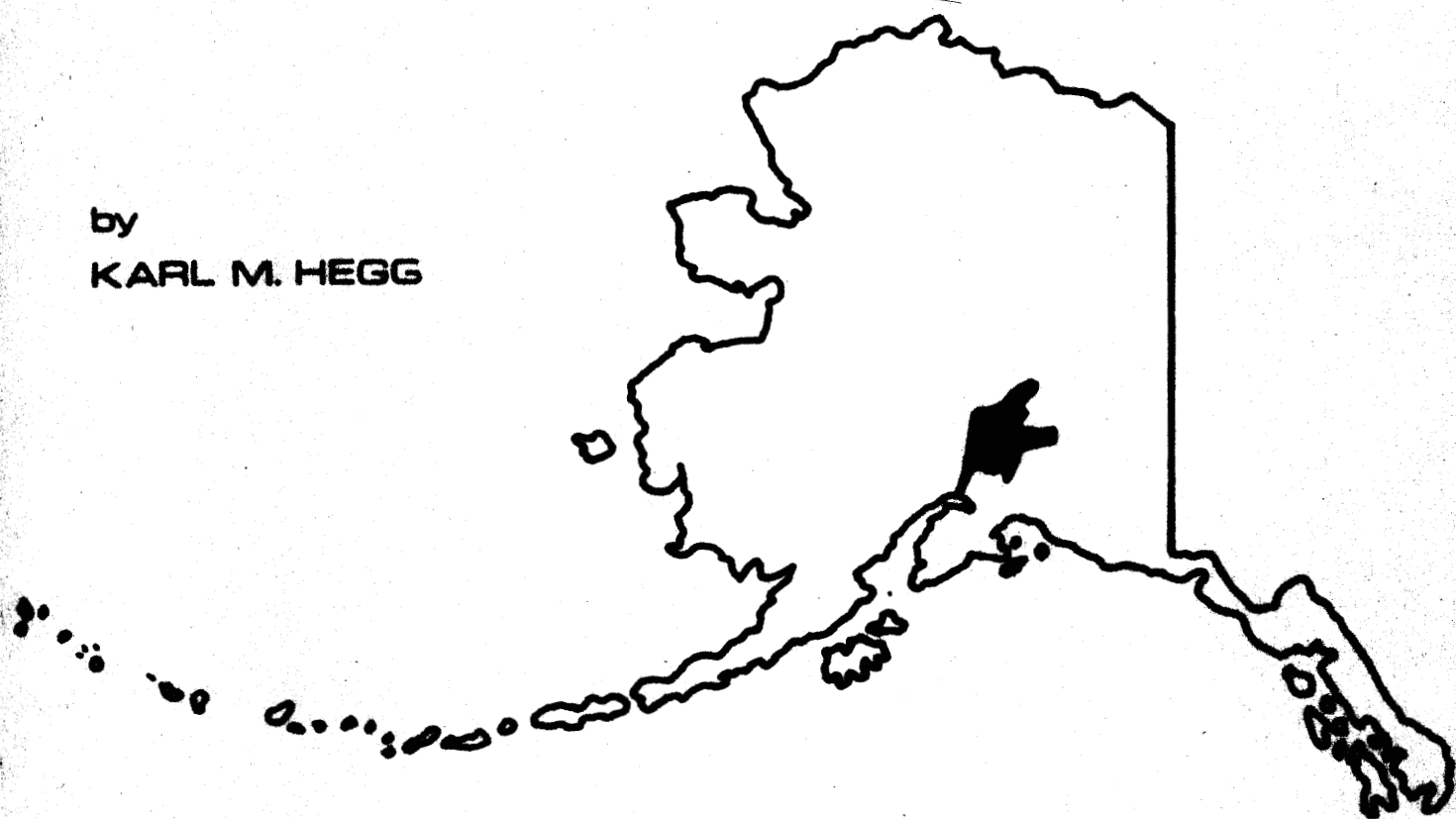


EDITOR'S
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Forest Resources of the Susitna Valley, Alaska

by
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Foreword

This report summarizes the data from the first intensive inventory of the forests in the Susitna Valley, Alaska, conducted during the period 1964-65.

The primary purposes of the inventory were to determine the total area of forested lands, the commercial forest area and timber volume, and the condition and growth of this resource, and to report on these findings. *Board-foot volumes, unless otherwise stated, are derived from the International 1/4-inch log rule* (defined on p. 25.)

Past estimates of timber volumes and forest areas for the Susitna Valley have been based largely on general knowledge or low-intensity cruises and surveys. In 1916, George L. Drake, of the U.S. Forest Service, made a brief reconnaissance trip to the Cook Inlet-Susitna River area and estimated area and volume remarkably close to present estimates. In more recent years, several localized areas have been cruised by the State Branch of Forestry and the Bureau of Land Management. The first extensive inventory of the valley was made by the Forest Survey in 1961 as part of a more generalized inventory of interior Alaska (Hutchison 1967).¹ This inventory was statistically valid for the entire region—not for the individual areas or drainages. Even so, estimates compiled for the Susitna drainage were, with allowance for differing areas encompassed, much the same as we are now reporting.

¹Names and dates in parentheses refer to Literature Cited, p. 22.

Acknowledgments

This forest inventory was a joint effort of the Alaska State Division of Lands, Department of Natural Resources, and the Institute of Northern Forestry, Pacific Northwest Forest & Range Experiment Station, Forest Service, U.S. Department of Agriculture, at Juneau, Alaska. Aerial photo coverage was provided by the State Division of Lands and the U.S. Department of Interior, Bureau of Land Management. Fieldwork was by crews from the State

Division of Lands and the Forest Survey of the Institute of Northern Forestry. Data compilation and reporting has been the responsibility of the Forest Survey. Overall supervision was by O. K. Hutchison, field and office direction by K. M. Hegg, and data processing by J. D. Born. Participants in the fieldwork were: R. M. Dippold, D. Murphy, C. Ellis, J. Spaulding, A. Sundt, and E. Veijalainen.

Contents

	Page
HIGHLIGHTS	1
Forest Area	1
Forest Volume	1
Stand Conditions	1
PHYSICAL DESCRIPTION	1
Geographical Location	1
Physiography	1
Climate	3
Soils	3
FOREST DESCRIPTION	3
Noncommercial Forest Land	3
Subcommercial Forest Land	3
Commercial Forest Land	6
Ownership Patterns	6
Stand Condition	8
Forest Types	10
Quality	15
Growth	17
Volume Loss—Defect	18
Volume Loss—Mortality	18
Allowable Cut	19
Area Use	19
Forest Products	19
Agricultural Uses	21
Recreation	21
LITERATURE CITED	22
APPENDIX	24
Forest Survey Methods	24
Sampling Error	24
Principal Tree Species	24
Terminology	24
Expanded Description of Soils Map Areas	26
Tables	27

List of Tables

Table		Page
1	Distribution of cubic-foot volume by species, Susitna Valley, Alaska, 1965	7
2	Distribution of cubic-foot volume by diameter class, Susitna Valley, Alaska, 1965	7
3	Volume and growth per acre for subcommercial and commercial land classes, Susitna Valley, Alaska, 1965	7
4	Stocking of commercial forest land by vegetation class, Susitna Valley, Alaska, 1965	9
5	Area of commercial forest land by forest type, Susitna Valley, Alaska, 1965	11
6	Net volume of sawtimber by species and quality class, Susitna Valley, Alaska, 1965	15
7	Volume reduction for defect by species and kind of volume, Susitna Valley, Alaska, 1965	18
8	Area by land classes, Susitna Valley, Alaska, 1965	27
9	Area of commercial forest land by forest type and stand-size class, Susitna Valley, Alaska, 1965	27
10	Area of commercial forest land by area condition and occupancy class, Susitna Valley, Alaska, 1965	28
11	Area of commercial forest land by forest type and site class, Susitna Valley, Alaska, 1965	28
12	Number of growing-stock trees on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965	29
13	Net volume of timber on commercial forest land by class of timber and by softwoods and hardwoods, Susitna Valley, Alaska, 1965	30
14	Net volume of growing-stock on commercial forest land by stand-size class and forest type, Susitna Valley, Alaska, 1965	30
15	Net volume of sawtimber on commercial forest land by stand-size class and forest type, Susitna Valley, Alaska, 1965	31

Table		Page
16	Net volume of sawtimber on commercial forest land by forest type and volume class, Susitna Valley, Alaska, 1965	31
17	Net volume of growing-stock on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965	32
18	Net volume of sawtimber on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965	33
19	Net volume of sawtimber on commercial forest land by species and quality class, Susitna Valley, Alaska, 1965	34
20	Gross annual growth of growing stock on commercial forest land by species and forest type, Susitna Valley, Alaska, 1965	35
21	Gross annual growth of sawtimber on commercial forest land by species and by softwoods and hardwoods, Susitna Valley, Alaska, 1965	36
22	Net annual growth of growing-stock on commercial forest land by species and kind of volume, Susitna Valley, Alaska, 1965	37
23	Gross volume of annual mortality of growing stock on commercial forest land by species and by softwoods and hardwoods, Susitna Valley, Alaska, 1965	38
24	Gross volume of annual mortality of sawtimber growing stock on commercial forest land by species and by softwoods and hardwoods, Susitna Valley, Alaska, 1965	39
25	Gross annual mortality of growing stock on commercial forest land by cause and by softwoods and hardwoods, Susitna Valley, Alaska, 1965	40
26	Gross annual mortality of sawtimber growing stock on commercial forest land by cause and by softwoods and hardwoods, Susitna Valley, Alaska, 1965	40
27	Gross volume of growing stock on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965	41
28	Conversion factors, International 1/4-inch to Scribner scale volume	42

Highlights

FOREST AREA

- The Susitna Valley inventory totals 5,610,000 acres (2,270,000 hectares).
- Forests cover 3,200,700 acres (1,295,000 hectares).
- Forest land classed as commercial² totals 1,295,000 acres (524,000 hectares).
- Paper birch type occupies 64 percent of the commercial forest area; spruce, 26 percent; balsam poplar-cottonwood, 9 percent; and aspen, 1 percent.
- Of the commercial forests, 67 percent is classed as sawtimber; 22 percent as poletimber; 10 percent as seedling and sapling stands; and 1 percent is rated nonstocked.

FOREST VOLUME

- Net volume in growing-stock trees totals 1.4 billion cubic feet (40,666,000 cubic meters) or 4.1

billion board feet. An additional 58 million cubic feet of sound wood is in rough and salvable dead trees.

- Sawtimber-size trees have 68 percent and poletimber-size trees 32 percent of the growing-stock volume.
- Cubic-foot volume distribution by species is: paper birch, 42.5 percent; spruce, 31.6 percent; cottonwood, 24.4 percent; and aspen, 1.5 percent.
- Noncommercial stands, comprised largely of small size trees, have about 1 billion cubic feet (28,300,000 cubic meters) or 1 billion board feet of timber.

STAND CONDITIONS

- All commercial stands have a potential increment of 20 to 85 cubic feet per acre per year.
- Rough and rotten trees, inhibiting vegetation, and nonstocked areas occupy 36 percent of the commercial forest land.
- Growth rates are low—total net annual growth is only 2.2 percent of net volume but averages 25 cubic feet per acre per year (1.75 cubic meters per hectare).

²For definitions of terms see "Terminology," p. 24.

Physical Description

GEOGRAPHICAL LOCATION

The Susitna Valley inventory unit lies in south-central Alaska between longitude 147° and 152° W. and latitude 61° and 62°30' N.—an area approximately 70 by 100 miles in extent (fig. 1). Except for Cook Inlet on the south, it is completely surrounded by mountains: the Aleutian and Alaska Ranges on the west and north, and the Talkeetna and Chugach Mountains on the east.

PHYSIOGRAPHY

Underlying bedrock in the basin is primarily from the Tertiary period sediments. Older Jurassic period

granitic intrusives are represented in the Talkeetna Mountains, Mount Susitna, Mount Beluga, and parts of the Alaska Range. Uplifted marine sediments make up other parts of the Alaska Range. During the Pleistocene epoch and up to about 10,000 years ago, glaciers covered most of the present lowland area, and much of the present topography is a result of glacial depositions. These deposits consist of detritus and gravel that have been incised by river erosion in their upper reaches and are interspersed with lakes, muskegs, and bogs on the older bench terraces. Continuing erosion during and since the Pleistocene epoch has resulted in narrow, gradually widening, flood plain terraces along the larger rivers culminating in the broad apron of the Susitna River and the

shallow mud flats of Cook Inlet (Brooks 1911; Capps 1913, 1927,-- p. 141-172, 1929, 1935, 1940; and Capps and Tuck 1933).

Drainage from this area is by the Susitna River and its tributaries: the Yentna-Skwentna-Kahiltna, the Chulitna, the Talkeetna, and the Kashwitna Rivers. All, except the Susitna River, originate in glaciers as fast-flowing streams carrying large loads of gravel, sand, and silt. A second drainage system, the Matanuska-Knik-Chickaloon, with headwaters in the Chugach and Talkeetna Mountains, also drains into the Knik Arm at Cook Inlet. Together, these systems drain a total area of 17 million acres.

CLIMATE

The climate of the valley can be best described as moderate continental, opposed to the subarctic climate of the remainder of interior Alaska. Temperatures are much the same in most of the lowland area. Mean annual temperatures are 32° to 35° F. with the months of June, July, and August having monthly temperature means in excess of 55° F. January temperatures average nearly the same as in southern Minnesota (9° to 14° F.). Mean temperature in July (58° F.) is equal that of Duluth, Minnesota.

Precipitation is also quite uniform over the valley. Four weather recording stations in the valley—Susitna, 20 miles north of the mouth of the Susitna River; Willow, north 40 miles; Talkeetna, north 80 miles; and Skwentna, northwest 50 miles—receive about 30 inches of precipitation annually. Elevations of these stations are less than 350 feet. Only with increasing elevation does this uniformity change—Curry, north 100 miles at 600 feet, has 44 inches of annual precipitation.³

SOILS

Soil studies in the Susitna Valley are largely in the reconnaissance stage. Soil maps are available for the Matanuska Valley and a fairly narrow section of the Susitna River to above Talkeetna, but are generalized elsewhere. The soils of the area as described by Samuel Rieger, Alaska State soil scientist, Soil Conservation Service, in a personal communication:

Basically, the entire region is an association of fairly thin Spodosols (Podzols) developed in loess

(mixed with ash) over coarse drift, Histosols (muskeg), and wet mineral soils. There are some exceptions among the well-drained soils: Entisols (Regosols) in very young loess at the eastern end of the Matanuska Valley and on floodplains of the major rivers, and very shallow stony soils in alpine areas . . .

Figure 2 portrays the distribution of these soil orders. The weak to well-developed Spodosols (areas 2 and 3 on fig. 2) and Entisols (area 1 on fig. 2) support the best forest stands. Good stands are also found growing on the strongly developed Spodosols (area 4), but an open-stocked appearance is more typical. The better stands found on those soils probably reflect the better drainage. A loose relationship between soils and forest type may be seen by comparing the soils map (fig. 2) and the forest-type map (fig. 3). (For expanded descriptions of the associated soil areas, see "Appendix," page 24.)

Forest Description

This first intensive survey of the Susitna Valley classified all forest land by growth capacity. Forest land with a mean annual growth productivity or potential mean annual increment (MAI) of less than 20 cubic feet per acre was classed as noncommercial. The noncommercial forest land was further classified as producing less than 15 cubic feet annually or producing between 15 to 20 cubic feet annually. The latter class is referred to as subcommercial.

NONCOMMERCIAL FOREST LAND

The noncommercial forest area producing less than 15 cubic feet per acre per year totals 1,322,000 acres. These are generally areas of poorly drained lowland black spruce and paper birch, and the subalpine forests of white and black spruce (fig. 4).

The gross volume in these stands is about 500 million cubic feet. There is some local use of wood material from these lands, but as economic timber-producing units they have little value.

SUBCOMMERCIAL FOREST LAND

There are 584,000 acres of subcommercial forest land with the potential of producing at a rate of between 15 and 20 cubic feet per acre per year. This small difference in growth rates could not be determined accurately on the photos and had to be made from ground measurements.

³From "Climatological Data" U.S. Department of Commerce, Environmental Science Services Administration.

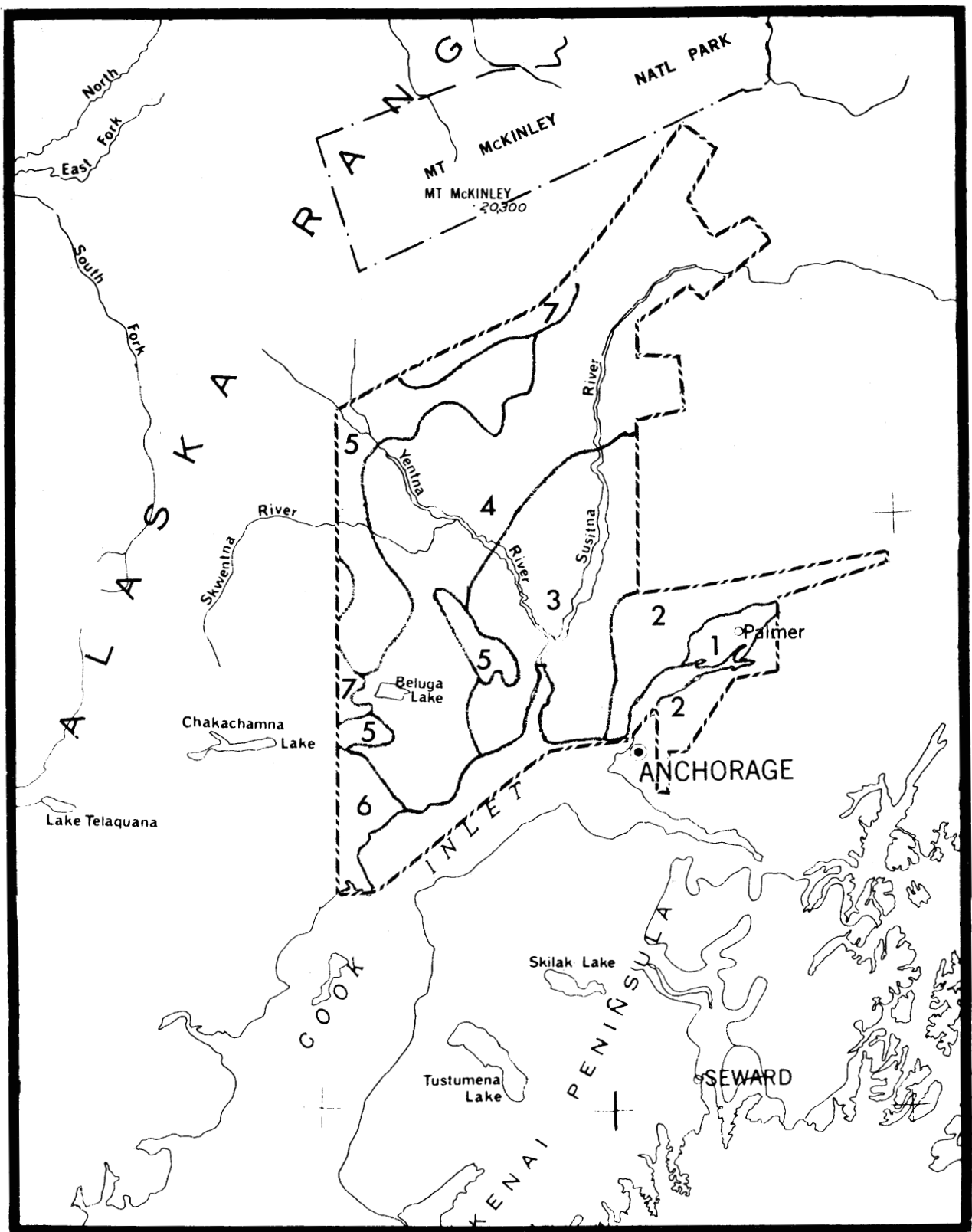


Figure 2.—Generalized soil map of the inventory area: (1) dominantly Entisols (shallow to deep silty soils); (2) weakly developed shallow Spodosols with Aquepts and Histosols; (3) fairly well-developed loessial Spodosols on uplands and Entisols on flood plains with Aquepts and Histosols; (4) strongly developed loessial Spodosols on uplands, Entisols on flood plains and Histosols; (5) Andepts (shallow silty) and thin Spodosols; (6) Aquepts or Aquic Psamments in glacial outflows; (7) rough mountainous land and glaciers.

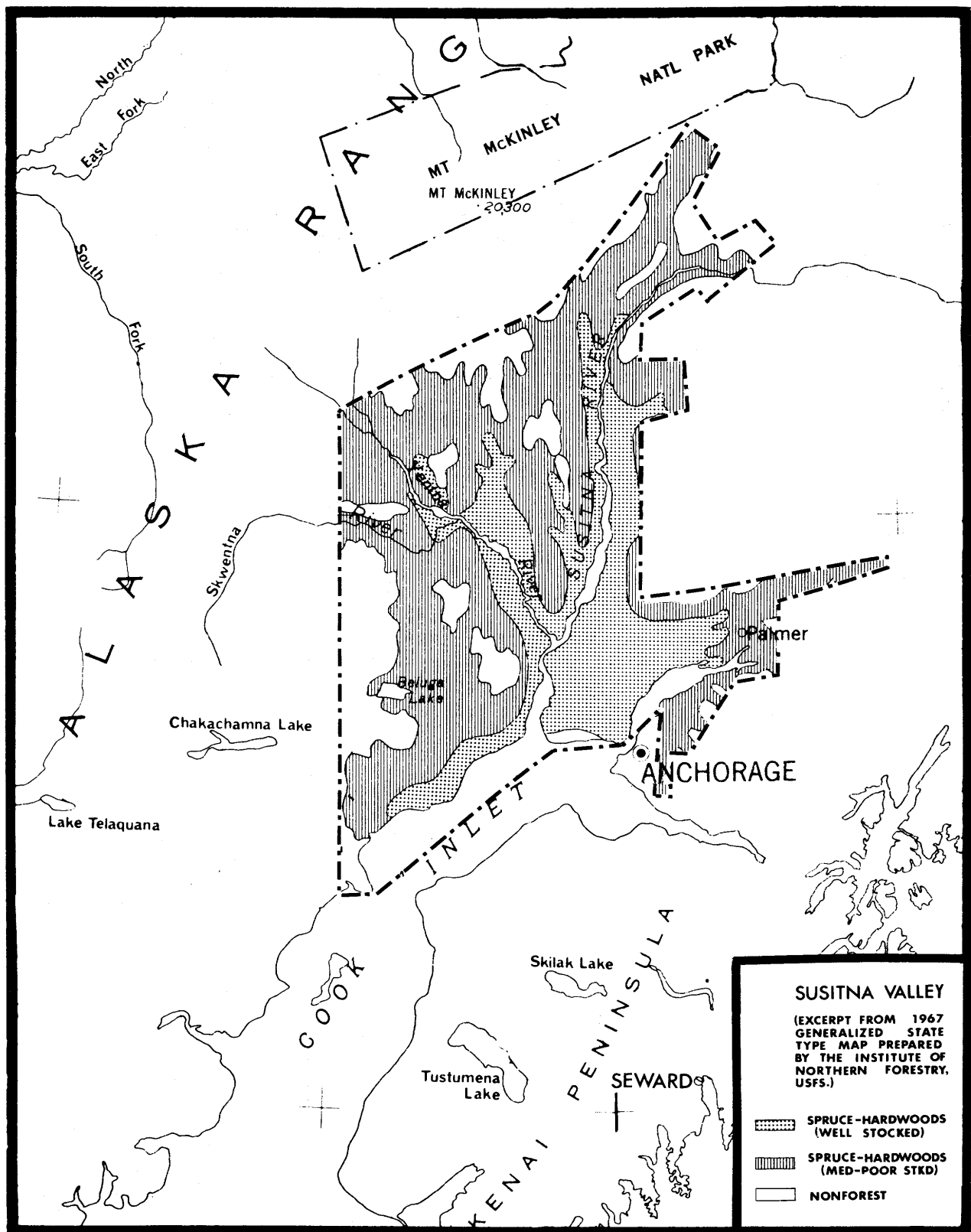


Figure 3.—Forest type map of Susitna Valley.



Figure 4.—This is typical of much of the 1,322,000 acres of noncommercial forest land. Generally these areas are poorly drained and have many stems per acre.

These stands in conjunction with the better stands nearby are potentially harvestable and should be considered in the future management picture. However, these subcommercial data should be used with caution because no sampling errors can be derived for the estimates. Statistical data were produced for stands with more than 15-cubic-foot MAI and more than 20-cubic-foot MAI and are not correctly subtractive.

Nearly all (90 percent) of the subcommercial area and volume is classified as birch type. All of these stands have volumes of less than 5,000 board feet per acre (2,000 cubic feet); about half are classed as sawtimber (softwood >9.0-inch d.b.h. and hardwoods >11.0-inch d.b.h.).

The subcommercial stands have more birch and less spruce and cottonwood than the commercial stands (table 1). Table 2 shows that the trees in subcommercial stands tend to be smaller in diameter than those in commercial stands, and table 3 shows the considerable difference in growth between the two classes.

COMMERCIAL FOREST LAND

Commercial stands total 1,295,000 acres. Most occur below 1,000-foot elevation and within 80 miles of tidewater. This acreage supports 353 million growing-stock trees (live merchantable trees of commercial species 5.0-inch d.b.h. and larger) having a gross volume of 1.7 billion cubic feet and a net volume of 1.4 billion cubic feet. An additional 58

million net cubic feet of sound wood is in rough and salvable dead trees. The cubic- and board-foot volumes were developed using equations from "Volume tables for trees of interior Alaska" (Haack 1963).

The highest volume and most productive stands are on the well-drained river flood plains. Stand composition is chiefly a black cottonwood-balsam poplar mixture. Pleistocene epoch terraces, set back from the major rivers, support the better stands of birch and birch-spruce mixtures. Chief among these are the Talkeetna River, Peters Creek, and Shell Lake-Hewitt Lake stands. Eolian soils of the Matanuska Valley support good stands of birch and the only aspen seen in the valley. Most of the Matanuska stands have developed after fires and are generally pole-sized with occasional sawtimber trees (figs. 5, 6). Scattered elsewhere are pockets of good timber intermixed with black spruce muskegs. Chief among these are the flats around the mouth of the Susitna River, along the western shores of Cook Inlet, and the lowlands between the Susitna and Yentna-Kahiltna Rivers.

Ownership Patterns

Since statehood, Alaska has selected nearly 17 million acres of land. Of this total, 5.1 million acres is in the Susitna Valley. The policy of the State has been to dedicate only certain select areas for forest production. No data are available for the dedicated forest land within the Susitna Valley although about 250,000 acres have been classified throughout the

*Table 1.—Distribution of cubic-foot volume by species,
Susitna Valley, Alaska, 1965*

Class	Spruce	Cottonwood	Birch	Aspen	Total
----- Percent -----					
Subcommercial	17.6	28.4	52.7	1.3	100.0
Commercial	21.1	33.5	43.8	1.6	100.0

*Table 2.—Distribution of cubic-foot volume by diameter class,
Susitna Valley, Alaska, 1965*

Class	Diameter class (inches)							
	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9
----- Percent (cumulative) -----								
Subcommercial	23.5	43.7	61.5	75.4	83.2	86.2	90.0	92.2
Commercial	20.4	40.6	57.2	71.2	79.7	83.5	87.8	90.6

*Table 3.—Volume and growth per acre for subcommercial and commercial land classes,
Susitna Valley, Alaska, 1965*

Class	Net volume per acre		Growth per acre	
	Board feet ¹	Cubic feet	Board feet ¹	Cubic feet
Subcommercial	1,577	794	33	19
Commercial	3,130	1,109	95	25

¹ International 1/4-inch scale.



Figure 5.—Overstocked birch seedlings and saplings established after a fire, Matanuska Valley.



Figure 6.—Pole-size aspen with a white spruce understory, Matanuska Valley.

State. Forest lands not in private ownership and classified for nonforest uses are available for cutting but are not managed as a renewable resource. Volumes and areas shown in this report disregard any ownership breakdown or reserve status and are for all commercial forest lands in the area. Because of the large State ownership in the valley, we can probably assume the data in this report are for State forests with less than 5 percent for private holdings.

Stand Condition

Understocking is a major problem in the forests of this inventory unit. Thirty-six percent of the commercial forest land either is occupied by rough and rotten trees, is nonstocked, or has inhibiting vegetation (table 4). Figures 7, 8, and 9 illustrate this situation. Even well-stocked stands have significant portions of their area occupied by inhibiting vegetation or rough and rotten trees (fig. 10).

Although there are few written records describing forest growth in the valley, various expeditions have noted the parklike conditions—a situation that continues to exist today. But it is difficult to piece together a complete picture of how these stands developed. A comment on tremendous areas of white spruce killed by insects in the 1930's may be a clue to the present low stocking of this species (Capps and Tuck 1933; Capps 1935). There are general comments of repeated fires occurring along the railroad and a large fire in the Matanuska Valley.⁴ A major and continuing contribution to low stocking is that caused by competing grass and brush. Significant portions of the forest area are covered by a luxuriant growth of grass and thick sod. We observed little or

⁴Geo. L. Drake. Birch-spruce forests of the upper Cook Inlet region, Alaska. USDA Forest Serv. (in-Service report). 1920.

*Table 4.—Stocking of commercial forest land by vegetation class,
Susitna Valley, Alaska, 1965*

Measure	Kind of occupancy				
	Desirable trees	Acceptable trees	Rough and rotten trees	Inhibiting vegetation and nonstocked	Total
Thousand acres	429	406	140	320	1,295
Percent	33.2	31.3	10.8	24.7	100.0

Figure 7.—Thousands of acres of openstocked forest land occur at lower elevation. Hiline Lake at 600 feet.



Figure 8.—Tree growth indicates a commercial site although per-acre volumes are low and apparently will remain so. Hiline Lake.





Figure 9.—Close view of short limby trees characteristic of the open-grown type in figure 7.

no tree regeneration on these grassy sites. Stands of alder and willow brush also seem to inhibit tree vegetation although this inhibiting effect does not appear to be as consistent as grass. The inconsistency may be caused by the differing amounts of litter accumulation under the various species of alder and willow. The smothering effect of leaf litter observed by Gregory in his studies of spruce regeneration under birch may be part of the answer (Gregory 1966). Present and future silvicultural management plans should consider the problem of low stocking since it is apparently not new to the Susitna Valley stands.

Up to the present, hardwood logging in the Susitna Valley has been a highly selective operation with only the larger and better trees in a stand being harvested. The remaining smaller or lower quality trees are left standing; and since the ground remains essentially undisturbed, grasses and brush fill the openings. Regeneration is nearly nonexistent, and thus a cull stand is created. A forest management plan requiring clearcutting will probably be the only feasible harvesting practice that will insure adequate regeneration in this area, although selective cutting followed by a controlled burn may also be practical and would



Figure 10.—Cull birch 29 inches in diameter (below fork) in a well-stocked stand—Hewitt Lake.

be more economical. Both of these methods have their drawbacks. Clearcutting, to be economically sound, awaits the establishment of integrated markets accepting the full harvest of the stand, such as veneer, lumber, and chips. The use of fire affects not only the forest but the entire ecological regime and will need considerable study before application in Alaska. Scarification, after clearcutting or selective cutting, is also a possibility when and if economic conditions permit.

Forest Types

Total commercial forest area and volume data are essential to the overall economic evaluation of an area. But to effectively plan the use of this resource, the land or resource manager also needs acreage, volume, and stand-size distribution by forest type.

Classification of forest type was based upon the species forming a plurality of the stocking. In the Susitna Valley, four forest types are recognized. In descending order of acreage they are: birch, spruce, cottonwood, and aspen—with the birch type preponderant and occupying nearly two-thirds of the commercial forest area (table 5).

Table 5.—Area of commercial forest land by forest type,
Susitna Valley, Alaska, 1965

Measure	White spruce	Cottonwood	Aspen	Birch	Total
Thousand acres	334.2	120.4	18.4	822.0	1,295.0
Percent	25.8	9.3	1.4	63.5	100.0

Paper Birch Type Covers 822,000 Acres

Previous estimates of the wide extent of paper birch in the valley have proven to be correct.⁵ Birch stands comprise 64 percent of the commercial forest acreage. Not only does the birch type predominate, but birch is also found in the most varied associations and sites. It occurs as pure stands as well as in mixtures with white spruce, aspen, and cottonwood (fig. 11). A black spruce-birch mixture is also found on many poorly drained areas. The better stands of birch and birch mixtures are located on the east side of the Susitna River, from Goose Bay near Anchorage to just north of Talkeetna. These are the well-known Talkeetna birch stands. Other notable stands are found west of Talkeetna along the Peters Creek road; between the Yentna hills and the Kahiltna River; the southwest slopes of the Yentna hills; around Hewitt Lake just south of the Yentna hills (figs. 11, 12); and on the flood plains at the mouth of the Skwentna River.

Growing-stock volume.—As a type, paper birch occupies two-thirds of the total commercial forest area with a volume of 794 million cubic feet or 55 percent of the total inventory volume of 1,436 million cubic feet.

Stand-size distribution is 64 percent sawtimber, 32 percent poletimber, and 4 percent seedlings and saplings. This is a picture of stands that are essentially near or past their rotational climax and should be shifting to the next ecological step -- white spruce (Lutz 1956). But this does not seem to be happening. The birch-spruce and spruce-birch mixtures appear to be at an arrested successional stage followed by a retrogressional opening-up process which possibly might be the ecological climax. These openings are filling in with grass and brush with virtually no tree regeneration.

⁵ See footnote 4, p. 8.

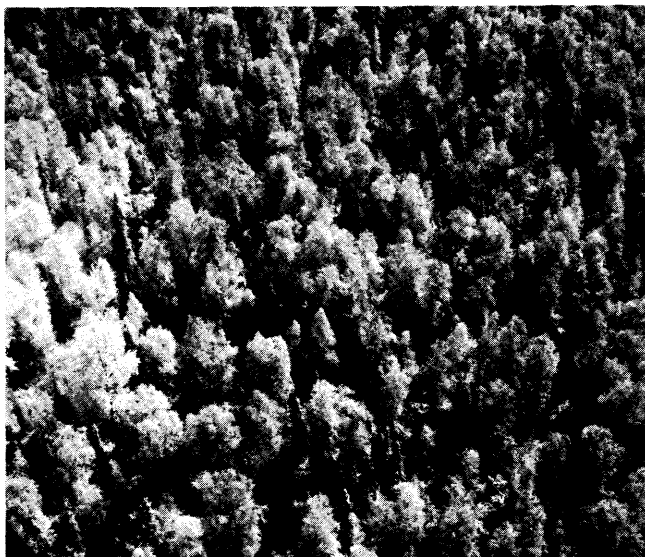


Figure 11.—Aerial view of a good sawtimber stand at Hewitt Lake (400-foot elevation). Composition is: birch 50 percent; cottonwood 35 percent; spruce 15 percent. Medium to well stocked.



Figure 12.—A mixed sawtimber stand of birch and cottonwood at Hewitt Lake.

This open, parklike situation is probably created through the process of decay and the associated decline in tree vigor. The older and bigger trees with large amounts of decayed material in them continue to live and occupy growing space for long periods. A slowly decomposing litter layer builds up underneath where only brush and grass grow. When the tree finally dies, there are no replacements or necessary seedbed conditions for new regeneration. The results are large areas of poorly stocked sawtimber stands. And because of this low-stocking-low-volume situation they are not economical to harvest.

Board-foot volume.—Hardwood board-foot volume includes volume in trees of 11.0-inch d.b.h. and larger to a 9.0-inch top d.o.b. The total volume in the paper birch type is 1,768,376,000 board feet. This represents 44 percent of the total board-foot inventory as compared with the 55-percent proportion of cubic-foot volume.

Birch sawtimber stands, occupying 78 percent of the area in the type, average 2,800 board feet per acre (fig. 13). Overall, this is a realistic picture, but the better stands mentioned previously have higher

volumes. One field plot has a measured net volume of 7,000 board feet per acre, and 5,000 board feet can be expected over extensive areas. Counterbalancing this are the many acres of understocked stands where 1,000 board feet per acre is common.

White Spruce Type Covers 334,000 Acres

Throughout most of interior Alaska, white spruce is dominant in stand composition. In the Susitna Valley, however, the type is in a minority position, occupying 26 percent of the area. The reasons for this are not clear. Possibly, it may be that fires have reduced the white spruce seed source or that the effects of the insect infestation noted in the 1930's are causing a retrogression in the normal succession to the climax white spruce type (Capps 1929, 1935; Capps and Tuck 1933). Considerable study is needed on the problems of regeneration if spruce is to be the preferred species for management.

There are few extensive stands of pure spruce (fig. 14). Spruce usually occurs as an overcanopy with birch (fig. 11). The better stands occur more frequently at slightly higher elevations—400 to 1,200



Figure 13.—Hewitt Lake birch sawtimber. Trees average 12-18 inches in d.b.h. and 60-70 feet in height.

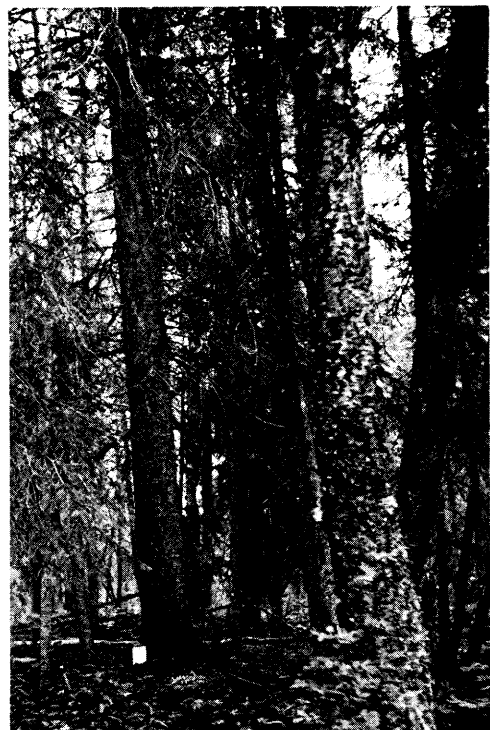


Figure 14.—Pure stands of spruce are rare in the valley. Typically, spruce occurs in mixture with birch (fig. 11). Diameters are 9-16 inches, height 70-85 feet.

feet along the perimeter of the unit—whereas the better birch stands are located at elevations of less than 400 feet.

The spruce type occupies 334,200 acres. Seventy-seven percent of the stands are classed as sawtimber, only 19 percent as poletimber, none as seedling and sapling, and the remainder nonstocked. Although the data list no seedling and sapling stands in the spruce type, this is not a completely true picture. Although neither photo interpretation nor field checks recorded the presence of pure stands of spruce seedlings and saplings, a few stands were seen from the air but not confirmed by a ground visit. Apparently, the 200 ground plots randomly distributed over the 1.3 million acres of commercial forest land failed to sample this stratum.

Growing-stock volume.—As a species, white spruce contributes 454 million cubic feet or nearly one-third of the total inventory growing-stock volume. The spruce type, however, has but 290 million cubic feet or one-fifth of the total volume, probably because the spruce type occupies slightly more adverse sites than hardwoods and commonly occurs in less than majority volume with birch. Our field sample confirmed the former as only one field plot, classed as spruce type, occurred on a lowland site where the better growing sites and higher per-acre volumes are found.

The greater volume per acre in the birch type, 966 cubic feet as compared with 868 cubic feet for the spruce type, is also probably the result of site differences. There is a definite decrease in stand density with increasing elevation, with this decrease probably related to poorer drainage conditions. The soils at higher elevations are less well developed, and there are many areas of heavy, wet claylike soils.

By stand-size class, the cubic-foot growing-stock volume is distributed in this type as follows: sawtimber, 237 million feet; poletimber, 51 million feet; nonstocked, 2 million feet; and seedling and sapling stands, none.

Board-foot volume.—Softwood board-foot volume includes volume in trees 9.0-inch d.b.h. and larger to a 7.0-inch top d.o.b. Approximately one-fourth of the total inventory sawtimber volume is in the spruce type. Of this fourth, 92 percent is in sawtimber stands; 7 percent, in poletimber stands; and 2 percent, in nonstocked stands. Total volume in this type is 984 million board feet. Average volume per acre (heavily weighted by the Lake Beluga stands) is 2,945 board feet. Sawtimber stands average 3,513 board feet and poletimber 1,066 board feet per acre.

Because of their location in the higher elevation periphery of the valley, most of the spruce types must be considered inaccessible or, because of low per-acre volumes, inoperable. The hybrid Sitka spruce-white spruce stands below Beluga Lake and to the coast are an exception, carrying high per-acre volumes, and are easily accessible. Of eight field plots in that area, only one was below the average volume for the spruce type and one plot had a per-acre volume of nearly 15,000 board feet.

Cottonwood Type Covers 120,000 Acres

Two species of cottonwood are found in the valley. They are balsam poplar and black cottonwood. Concentrations of black cottonwood occur on the lower reaches of the Susitna River drainages grading into balsam poplar farther upstream and upland. We could not differentiate between these two species during the inventory, and throughout this report the name "cottonwood" is applied to both.

A primary invader, cottonwood is found on the moraines of the many glaciers feeding into the valley. These primary stands are generally of poor quality. The better stands are found on the islands and flood plains of the major rivers (fig. 15), although excellent stands also occupy upland sites (fig. 12).

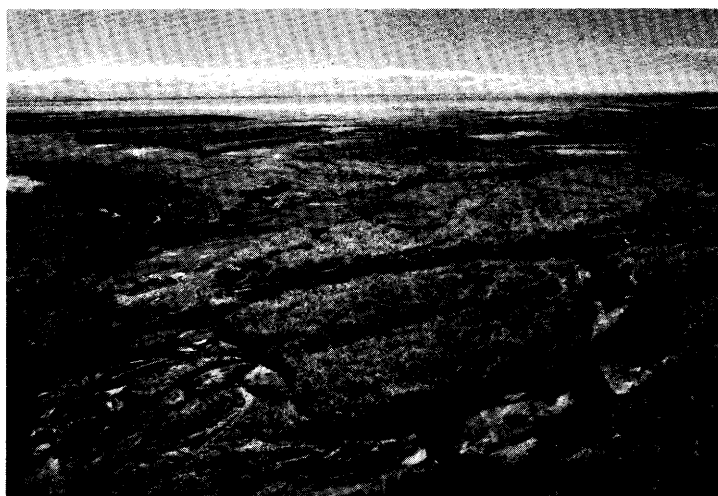


Figure 15.—Cottonwood stands on the flood plains of the lower Susitna River; looking toward Cook Inlet.

Over 90 percent of the cottonwood stands are classed as sawtimber and the remainder as poletimber, with no record of seedling and sapling or nonstocked stands. Again, this is not an accurate picture because seedling and sapling stands were identified in the vicinity of other field plots, but our sample was not of a high enough intensity to sample this stratum.

Growing-stock volume.—Although occupying but 10 percent of the commercial forest area, the cottonwood type has nearly one-fourth of the total growing-stock volume. Nearly all of this volume, 321 million cubic feet out of 331 million, is in sawtimber stands. Perhaps more strikingly, cottonwood comprises 98.6 percent of all the inventory growing-stock volume of trees larger than a 21-inch d.b.h., and 89 percent of the volume of trees larger than a 17-inch d.b.h.

Volumes per acre averaged 2,753 cubic feet, compared with averages of 868 cubic feet for spruce, 966 for birch, and 1,124 for aspen. Sawtimber and poletimber stands averaged 2,929 cubic feet and 953 cubic feet per acre, respectively.

Board-foot volume.—Over 30 percent of the total sawtimber volume occurs in the cottonwood type. This volume totals 1,241 million board feet, of which 99.47 percent is in sawtimber stands.

Volumes per acre are comparatively high, averaging 10,307 board feet for all cottonwood stands. The highest gross volume recorded on a plot location was 34,000 board feet per acre.

At present, cottonwood stands represent the highest potential for economic development of the stands in the valley. They generally are close to the river system, have a high average volume, and may average 20-inch d.b.h. or more, with three or more 16-foot logs. (fig. 16). Some areas may produce even larger trees (fig. 17).

Aspen Type Covers 18,400 Acres

The aspen type occupies a very minor 1.4-percent position in the total commercial forest land. The only aspen tallied was located in the Matanuska Valley, an area that has an extensive fire history. Elsewhere in the survey area, aspen occurs infrequently as a minority species.

Growing-stock volume.—The growing-stock volume in the aspen type is placed at 20,690,000 cubic feet, but the field sample failed to show the distribution of this volume. Our survey tables show all the volume to be in sawtimber stands, but many stands of aspen poles were also noted (fig. 18). The



Figure 16.—Mature stand of cottonwood, 20-28-inch d.b.h., 100 feet in height. Heights to 140 feet have been noted in the area.



Figure 17.—Although diameters of 18-36 inches are common, greater sizes are reached, as evidenced by this 62-inch cottonwood in the foothills of the Alaska Range 100 miles from the mouth of the Susitna River.

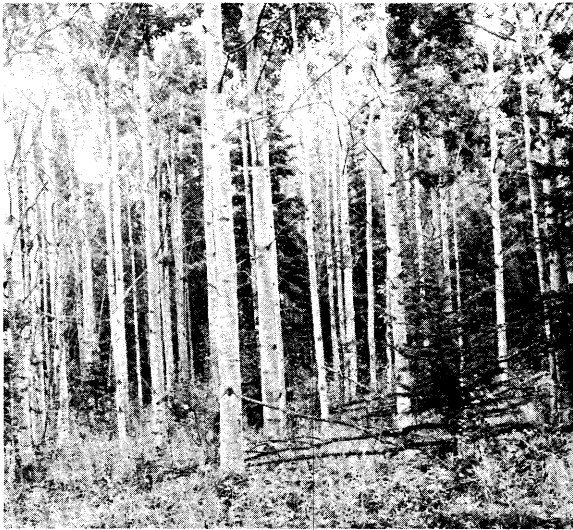


Figure 18.—Aspen poles with a gradually encroaching spruce understory—probably an old burn in the Matanuska Valley.

volume of 2,249 cubic feet per acre shown for this type is based on but one field plot. In actuality, average volume of aspen stands probably would be little different from birch (966 cu. ft. per acre).

Quality

The effect of small-size trees shows markedly in log grade distributions. Although the Susitna Valley supports over 4 billion board feet of sawtimber, only 17 percent of this volume is in grade 2 or better logs (table 6). If the cottonwood volume were excluded, this percentage would drop to 5 percent.

Birch and cottonwood were graded according to "Hardwood Log Grades for Standard Lumber" (Forest Products Laboratory 1953). The specifications for these grades are correlated closely with the specifications for standard hardwood lumber grades. Grade 1 logs require a 13-inch and grade 2, an 11-inch inside-bark, small-end, scaling diameter. Only trees of 16- and 14-inch d.b.h. or larger, respectively, would meet these minimum diameter specifications. This is assuming roughly a 1-inch bark thickness and 2-inch taper in 16 feet. This eliminates 63 percent of the total volume from having grade 1 potential and 47 percent, from grade 2.

Birch

Alaska's paper birch, in particular that of the Susitna Valley, has been the object of numerous studies and cruises. Starting with a 1920 reconnaissance and continuing through cruises and recommendations by the Bureau of Land Management (BLM),

Table 6.—Net volume of sawtimber by species and quality class, Susitna Valley, Alaska, 1965

Log grade	White spruce	Birch	Cottonwood	Aspen	Total	
					Thousand board feet	Percent
----- <i>Thousand board feet</i> -----						
1	--	15,984	177,262	--	193,246	4.78
2	32,726	146,210	321,333	--	500,269	12.34
3	1,605,446	826,026	729,560	19,043	3,180,075	78.44
4 ¹	33,866	88,072	57,996	--	179,934	4.44
	1,672,038	1,076,292	1,286,151	19,043	4,053,524	100.00

¹Grade 4 logs are those below minimum standards for grade 3, but not cull.

the reports have been of small, low-quality, defective trees (figs. 19, 20), chiefly usable as pulp with small amounts being suitable for veneer and furniture stock. Our inventory data confirm this. Estimates obtained from this inventory show only 1.5 percent of the birch volume qualifying as grade 1 logs (fig. 21); 13.6 percent, as grade 2; 76.7 percent, as grade 3; and the remainder as grade 4. For comparison, 42 percent of the Maine paper birch volume is in log grades 1 and 2 (Ferguson and Longwood 1960).

A recent lumber recovery study in the Susitna Valley (Hanks and Swanson 1967) made the following comparison with a similar Minnesota study:

More No. 1 Common lumber was taken from all grades of the Alaska logs. The percentage yield of No. 1 Common and Better for log grades II and III was nearly equal for the two locations. For these same log grades, considerably more grade 3B lumber was present in the Alaska logs. This was, in part, because they contained more rot than those in the Minnesota study. However, it was noted that the Alaska logs exhibited less sweep.



Figure 19.—An overmature birch sawtimber-size tree. Except for evidence of decay this would qualify as a grade 1 saw log.



Figure 20.—A cross section of a birch sawtimber tree showing the extent of decay.

Spruce

Spruce was graded under "Official Grading Rules for Northern Hardwood and Softwood" (Northern Hemlock and Hardwood Manufacturers Association 1959). There were no logs qualifying as grade 1 (which required a 16-inch scaling diameter), only 2 percent as grade 2 (requiring a 12-inch scaling diameter), and the remainder qualified only for grades 3 and 4 (requiring an 8-inch scaling diameter). Most trees failed to have logs in the top two log grades because of small size, although limbiness also contributed heavily to degrade. Apparently this situation is not confined to Alaska, as the 1966 Minnesota survey report had nearly identical findings (Stone 1966).

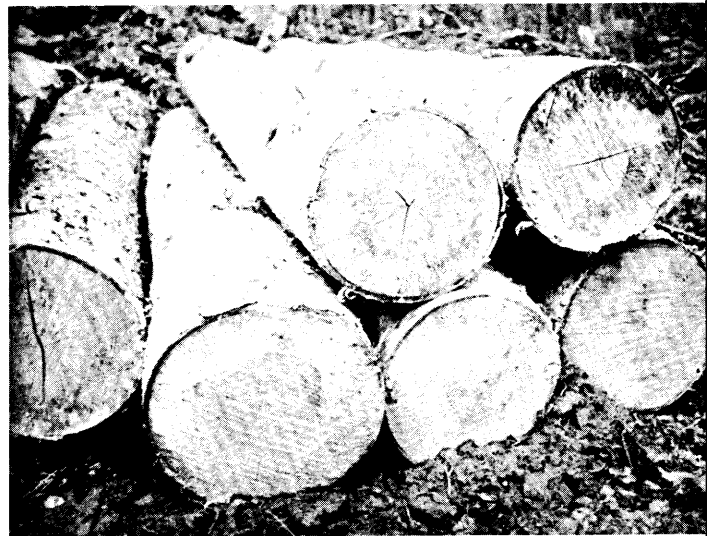


Figure 21.—High quality birch logs from Matanuska Valley area. Scaling diameters are about 11-13 inches.

Cottonwood

Field estimates place 15 percent of the cottonwood volume in grade 1 logs, 25 percent, in grade 2 (fig. 22), and the remainder, in grades 3 and 4. The supply of grade 1 and 2 cottonwood logs totals 500 million board feet; and if this grade volume were uniformly distributed throughout the cottonwood type, there would be 4,000 board feet per acre in these two grades. Most of the cottonwood volume is close to rivers and could possibly be floated to a utilization point, but at present, no economically feasible market exists.

Data were also collected on lumber recovery from cottonwood (Hanks and Swanson 1967). Comparing the Susitna Valley cottonwood with eastern cottonwood, they concluded, "It is evident that the Alaska logs did not produce the amount of high grade lumber found in eastern cottonwood." However, the logs tested were balsam poplar, and it is possible that better recovery might be obtained from black cottonwood.

Growth

Net annual growth in the Susitna Valley totals 32,265,000 cubic feet or 122,636,000 board feet. Expressed as a percent of net growing-stock volume, this is equivalent to 2.25 percent for cubic volume and 3.03 percent for board-foot volume.

Growth rates vary little by species. Cubic-foot growth rates for spruce and birch are nearly identical, aspen a little higher, and cottonwood considerably lower. Board-foot growth rates follow a similar pattern.

Growth potential in the valley is considerably better than is indicated above; but low stocking, cull, and overage trees tend to lower this potential and offer possibilities for improved management. A growth rate of 3 to 4 percent is not beyond reason if the area occupied by cull trees (11 percent) and inhibiting vegetation (24 percent) can be reduced. Even with the present stand structure, the present rate of growth in the valley compares favorably with the 3.2 percent reported in 1965 for the Lake States (USDA Forest Service 1965).

The above discussion of growth applies to commercial stands. Tree growth, however, is not restricted to just those stands. Calculations of actual plot growth, as opposed to predicted growth, indicate



Figure 22.—Grades 1 and 2 cottonwood logs at a small sawmill in the Matanuska Valley.

that half of our ground plot sample in the sub-commercial strata are now producing at a commercial level of more than 20 cubic feet per acre per year.

We have analyzed the growth characteristics of the commercial and subcommercial strata to see the reasons for this disparity. One apparent difference is that trees on sites we have classed as subcommercial are substantially shorter than those on commercial sites. Since we classify on a height-age relationship (Gregory and Haack 1965; Horton and Lees 1961), this explains why these stands were classed sub-commercial. The high growth rate can be explained by the diameter growth (without corresponding height growth) on significantly more trees per acre than are found on commercial sites. However, these noncommercial stands are not capable of sustaining a 20-cubic foot MAI to their rotation age.

It appears that nearly one-half of the 584,000 acres of subcommercial strata have potential for pulp production. The average plot volume of the better field plots in this stratum is 1,410 cubic feet per acre, although board-foot volumes are not nearly so favorable. Perhaps these stands should be considered commercial or merchantable and included in the allowable cut computations for the valley.

Volume Loss—Defect

For this inventory we used defect factors from a cull study made for an earlier inventory.⁶ These factors for all live commercial trees are listed below (table 7).

The same factors were used for cottonwood as for birch since the 1957 study had insufficient data for cottonwood.

Common decay organisms causing extensive damage include *Fomes igniarius* and *F. applanatus* in birch, aspen, and cottonwood; *Polyporus resinatus* in birch; and *F. pini*, *Chrysomyxa ledicola*, and *Peridermium coloradense* in spruce (Kimmey and Stevenson 1957).

The importance of rough and decayed trees in the overall picture can be seen by a comparison of the net and gross volume totals in appendix tables 17 and 27. The total volume reduction due to cull is 16 percent or 271 million cubic feet. By species, there is a 25.3 percent loss in birch, 24.5 percent in aspen, 8.7 percent in cottonwood, and 5.2 percent in spruce. When this is converted to board feet, the unmerchantable volume amounts to about 1 billion board feet—an average of 800 board feet in cull volume on every acre of commercial forest land.

Volume Loss—Mortality

To measure mortality, we had to estimate how long a tree had been dead. This determination was both subjective and variable, and we suspect the mortality volume estimate may be low. Future remeasurements should improve upon our present estimates.

The estimated annual growing-stock volume loss by mortality amounts to 2,464,000 cubic feet. This is 0.6 percent of the net growing-stock volume and about one-third that reported for similar areas (USDA Forest Service 1965). Loss of sawtimber volume totals 9,635,000 board feet. The 4:1 ratio of board feet to cubic feet seems to confirm a higher rate of loss in larger trees since the ratio for total inventory volume is only 3:1.

A theory that may partially account for the low mortality estimate concerns the growth characteristics of birch. Although this species has a pathological rotation of 80-100 years, these trees do not die suddenly. A few leaves are enough to keep these trees in the live category indefinitely. When death does occur, it is very difficult to determine whether the tree died last year or 10 years ago. Our mortality estimates are for trees dying within the past 5 years, and we are not sure we are accurately estimating that interval.

In most cases, cause of death was not specifically identifiable, but age, disease, and weather are believed to be major factors. There is evidence of extensive old burns along the railroad and in several other areas, though in the past decade fire has not been important as a cause of mortality. We did not see any signs of insect damage on any species, although an outbreak of spruce budworm was observed in an adjacent area in 1962. Needle rust was noted on many trees but did not appear to be causing any appreciable damage to the tree. This fungus must reoccur several years in succession to damage or kill a tree (Kimmey and Stevenson 1957).

Table 7.—Volume reduction for defect by species and kind of volume, Susitna Valley, Alaska, 1965

Kind of volume	Birch	Spruce	Cottonwood	Aspen
----- Percent defect -----				
Cubic-foot volume	3	2	3	8
Board-foot volume	25	11	25	40

⁶Dave W. French. Tree measurement and cull factors for the interior of Alaska, 1957. (Unpublished report on file at the Institute of Northern Forestry, Juneau.)

Allowable Cut

An allowable annual cut of 25 million cubic feet (73 million board feet) would be possible for the Susitna Valley if all commercial forest land were economically accessible and committed to timber production. However, in this study no attempt was made to classify the land by accessibility or ultimate use. One economist (Massie 1966) has estimated an allowable cut of 22 million board feet on 200,000 acres, defining accessible land as that within 20 miles of a usable road or railroad. To this might be added a considerable volume accessible by water. This accessible volume is mostly birch and cottonwood.

The total allowable cut was calculated by use of Kemp's formula. This employs an average rotation age for all species and acres by stand-size class. The formula is:

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

where: A = area of sawtimber stands
A₁ = area of poletimber stands
A₂ = area of seedling/sapling stands
A₃ = area of nonstocked stands
R = average rotation age (100 years)
MA = average volume per acre in sawtimber stands

The value obtained compares closely with that obtained by use of Von Mantel's formula applied by species:

where:

$$\text{Annual cut} = \frac{\text{growing-stock volume}}{1/2 \text{ rotation age}}$$

Allowable cut by species would be:

Birch and aspen = 16,530,000 cubic feet
(80-year rotation)
Spruce = 7,510,000 cubic feet
(120-year rotation)
Cottonwood = 7,020,000 cubic feet
(100-year rotation)

Although a program of accelerated cutting, essentially a sanitation cut, would be desirable from a management viewpoint, the present lack of markets dictates a low level of partial cutting from only the best stands. Under this handicap, managing for the future may be an impossible task.

AREA USE

Forest Products

Past utilization of the timber resources in the valley has been light and sporadic. Logs for cabins and pit props during the mining activities of the early 1900's were the first noted commercial use. A peak in use probably was attained in 1915-20 during the construction and early operation of the Alaska Railroad.

Small sawmills have operated at various times. One of the first recorded was at Eklutna in 1916.⁷ Similar operations have continued to now. The largest operation, the Alaska Hardwoods Co. at Wasilla, operated for a few years but closed for economic reasons and has not reopened. Timber cutting in the valley, except for land clearing and domestic fuel, is at a low ebb. Present production is limited to local needs for lumber, house logs, and a few industrial uses (figs. 23, 24, 25, 26). A mill to draw timber from the area served by the railroad is being considered for the Seward area. This operation, possibly coupled with a speciality sawmill and a veneer mill, may aid in the managed utilization of the valley's forest resource. However, this mill is primarily softwood-oriented, and most of the volume in the Susitna Valley is hardwood.

Many factors have, to date, hindered the profitable use of the valley's timber. Lack of markets, small size and low quality of the preferred species, low volume per acre of high-quality material, lack of economical logging and milling operations, and a wet, soggy terrain all contribute. Adaptation of methods used elsewhere in like conditions and the development of an integrated sawmill, veneer mill, and chipping plant operation supplying a pulpmill may be a partial solution. Developing and nurturing a local market is also part of the solution—particularly since lumber products sent to Alaska are subject to high shipping rates. This should give an Alaskan producer some price advantage.

Adaptations and innovations to reduce logging costs are also needed. The timber is small and consequently can be handled by the new highly mechanical log-harvesting equipment; but above all, experienced loggers are needed.

⁷See footnote 4, p. 8.



Figure 23.—An example of industrial use; pallets cut from small-diameter spruce.



Figure 24.—A small two-bedroom home constructed from locally sawn white spruce.



Figure 25.—House logs and lumber cut from cottonwood growing in the Matanuska Valley.

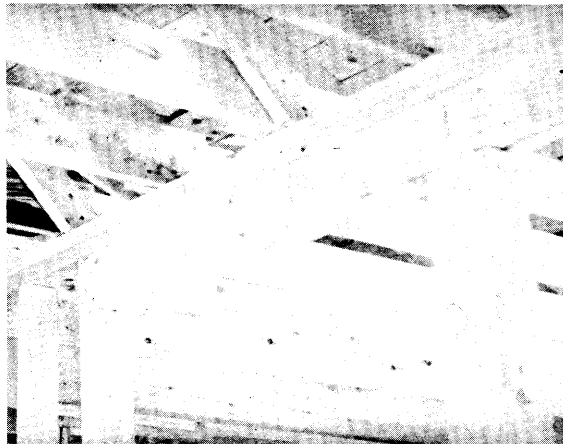


Figure 26.—Interior of house in figure 24. Many knots are evident but do not prevent use as construction lumber.

Agricultural Uses

Estimates of arable land in the Susitna Valley range as high as 1.3 million acres (Bennett and Rice 1915). Balanced against other economic uses of the land, this acreage will probably never be attained. At present, about 10,000 acres are being used for agricultural purposes, most of this in the Matanuska Valley (Kellogg and Nygaard 1951). Extensive homestead clearings are found along the roads in the valley, but these are not presently in agricultural production.

The majority of the timber cut in clearing operations is windrowed and burned—very little enters any commercial market. An integrated mill with an outlet for chips could provide a market for much of this presently unutilized resource.

Recreation

Promotion of summer-homesite sales and leases by the State of Alaska has expanded recreational use to lands previously used only for timber. A large number of the choice lake sites in the vicinity of Anchorage are being developed for recreation and summer homes, as are a number of more distant lake sites accessible only by air (fig. 27). Most of these sites will probably remain untouched by any timber harvesting activities and continue as recreational areas.



Figure 27.—Hilina Lake typifies the areas set aside by the State for summer homesites.

A large number of moose are found in the valley and Dall sheep, mountain goats, and black and grizzly bear are in the foothills and mountains. King, red, silver, and pink salmon all ascend the Susitna River and its tributaries to spawn. These, along with Dolly Varden and the cutthroat and rainbow trout, provide recreational outlets for the hunter, the fisherman, and the photographer. Picture all of this against the backdrop of glaciers and snowcapped mountains topped by Mount McKinley (fig. 28). It is not at all unlikely that income from recreation activities, both direct and esthetic, will continue to surpass timber product values.

Figure 28.—Some of the scenery awaiting the photographer. Mount McKinley with the Kahiltna glacier in the foreground.



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Appendix

FOREST SURVEY METHODS

The estimates of area breakdowns and timber volumes are based on a double sampling procedure (Bickford 1952). Enough points to satisfy specific levels of statistical precision were distributed uniformly on aerial photographs. These points were classified on photos by land and forest types. A subsample was drawn from all land classes and reexamined. Those originally classed as commercial forest land were visited on the ground as well as any points that upon reexamination were questionably classified.

Two hundred plots were visited on the ground and classed as commercial (CFL), subcommercial, non-commercial (NCFL), or nonforest (NF). Complete information was obtained on species, stand composition, tree measurement, growth, and mortality, and each tree was classified for management purposes by use of guides set forth in the Forest Survey Handbook.

These data were machine processed to obtain the various area and volume data needed or specified.

Area was obtained by a dot count on 1:63,360 topographic maps. Photo coverage was provided by the State Division of Lands, the U.S. Bureau of Land Management, and the U.S. Soil Conservation Service.

SAMPLING ERROR

The reliability of the inventory is expressed in terms of relative sampling errors.

		<u>Sampling error achieved</u>
Area	CFL, per million acres	0.07
	NCFL, per million acres	.05
Volume	CFL, per billion cubic feet	.10
	CFL, growth per billion cubic feet	.10

For the Susitna Valley, we are reporting 1,435,935,000 cubic feet of growing-stock volume. If repeated samples were taken of this population, the chances are two times in three that this sample is one of the samples for which the true value is contained within the sample confidence interval.

The Susitna Valley inventory did not meet the specified accuracy standards. The initial field sample

failed to allow for the unexpected changes in photo classification and resulted in sampling errors higher than specified in the Forest Survey Handbook. In view of the current level of timber utilization in the valley, the supplemental fieldwork needed to reduce the error would have been too costly in time and money.

PRINCIPAL TREE SPECIES

Softwoods:

White spruce	<i>Picea glauca</i> (Moench) Voss
Black spruce	<i>Picea mariana</i> (Mill.) B.S.P.

Hardwoods:

Paper birch	<i>Betula papyrifera</i> Marsh.
Black cottonwood	<i>Populus trichocarpa</i> Torr. & Gray
Balsam poplar	<i>Populus balsamifera</i> L.
Quaking aspen	<i>Populus tremuloides</i> Michx.

TERMINOLOGY

Allowable cut.—The volume of timber that would be cut on commercial forest land during a given period under specified management plans for sustained production such as those in effect on National Forests.

Area condition.—The commercial forest area was segregated into six condition classes based on the following definitions:

Class 10.—Areas 100 percent or more stocked with desirable trees and not overstocked. Stands in this category generally do not require any treatment at present to maintain high level of growth.

Class 20.—Areas 100 percent or more stocked with desirable trees and overstocked. Stands in this category need a treatment such as thinning to produce maximum levels of growth of desirable trees.

Class 30.—Areas 60 to 100 percent stocked with desirable trees, and with less than 30 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation slash, or nonstockable conditions. Stands in this category generally have conditions favorable for natural improvement of stocking without special treatment.

Class 40.—Areas 60 to 100 percent stocked with desirable trees and with 30 percent or more of

the area controlled by other trees (or overstocked areas) and/or conditions that ordinarily prevent occupancy by desirable trees. Stands in this category generally have little prospect for improvement in desirable tree stocking without special treatment such as thinning, cull tree removal, etc.

Class 50.—Areas less than 60 percent stocked with desirable trees, but with 100-percent or more stocking with growing stock trees. Stands in this category generally have little prospect for improved desirable tree stocking without special treatment. Stands almost to rotation age would usually not be treated.

Class 60.—Areas less than 60 percent stocked with desirable trees, but with 60- to 100-percent stocking with growing-stock trees. Stands in this category generally have little prospect for improved desirable tree stocking without special treatment such as timber stand improvement or planting.

Cull trees.—Live trees of sawtimber or poletimber size that are unmerchantable for saw logs now or prospectively because of defect, rot, or species.

Rough trees.—Live trees of 5.0-inch and larger d.b.h. that do not contain a saw log now or prospectively primarily because of roughness, poor form, or noncommercial species.

Rotten trees.—Live trees of 5.0-inch and larger d.b.h. that do not contain a saw log now or prospectively primarily because of rot.

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use.

Commercial forest land.—Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. (Note: Areas qualifying as commercial forest land have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood under management.)

Noncommercial forest land.—Unproductive forest land incapable of yielding crops of industrial wood because of adverse site conditions (producing less than 20 cubic feet per acre per year) and productive forest land withdrawn from commercial timber use through statute or administrative regulation. This classification includes *subcommercial forest land* producing between 15 and 20 cubic feet per acre per year.

Forest types.—A classification of forest land based upon the species forming a plurality of the live tree stocking.

Spruce.—Forests in which a plurality of the stand is white spruce. Common associates include birch, aspen, and cottonwood.

Cottonwood.—Forests in which a plurality of the stand is black cottonwood and/or balsam poplar. Common associates include white spruce and birch.

Aspen or birch.—Forests in which a plurality of the stand is aspen and paper birch, singly or in combination. Common associates include black cottonwood and white spruce.

Growing-stock trees.—Sawtimber trees, poletimber trees, saplings, and seedlings; that is, all live trees except cull trees.

Desirable trees.—Growing-stock trees having no serious defects in quality limiting present or prospective use, relatively high vigor, and containing no pathogens that may result in death or serious deterioration before rotation age. They include the type of trees forest managers aim to grow; that is, the trees left in silvicultural cutting or favored in cultural operations.

Acceptable trees.—Trees meeting the specifications for growing stock but not qualifying as desirable trees.

Inhibiting vegetation.—Cover sufficiently dense to prevent establishment of tree seedlings.

International 1/4-inch rule.—A rule used to determine the log volume in board feet (Bruce and Schumacher 1950).

Mean annual increment (MAI).—A measure of the volume of wood, in terms of cubic feet, produced on 1 acre during 1 year. Forest Survey minimum standard for commercial forest land is 20 cubic feet per acre per year.

Mortality.—Number or sound-wood volume of live trees dying from natural causes during a specified period (5 years).

Net annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees during a specified period.

Net annual growth of sawtimber.—The annual change in net board-foot volume of live sawtimber trees during a specified period.

Net volume.—The gross volume of a tree less deductions for rot, sweep, or other defect affecting product use.

Volume of timber.—The volume of sound wood in the bole of growing-stock, cull, and salvable dead trees 5.0 inches and larger in diameter at breast height, from stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

Nonforest land.—Land that does not qualify as forest land. Includes land that has never supported forests and lands formerly forested where forest use is precluded by development for nonforest uses, such as crops, improved pasture, residential areas, and city parks. Also includes improved roads and certain areas of water classified by the Bureau of the Census as land. Unimproved roads, streams, canals, and nonforest strips in forest areas must be more than 120 feet wide; and clearings in forest areas must be more than 1 acre in size, to qualify as nonforest land.

Salvable dead trees.—Standing dead trees that are considered currently or potentially merchantable by regional standards. A poletimber tree must be more than one-half sound; a sawtimber tree more than one-third sound (board measure).

Site classes.—A classification of forest land in terms of inherent capacity to grow crops of industrial wood.

Stocking.—The degree of occupancy of land by trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

Overstocked areas.—Areas where growth of trees is significantly reduced by excessive numbers of trees.

Nonstocked areas.—Commercial forest lands less than 16.7 percent stocked with growing-stock trees.

Stand-size classes.—A classification of forest land based on the size class of the growing stock present; that is, sawtimber, poletimber, or saplings and seedlings.

Tree-size classes.—A classification based on the diameter of the tree at breast height (4-1/2 feet above the ground on the uphill side of the tree):

Sawtimber-size tree:

Softwood. A tree of 9.0-inch d.b.h. and larger.

Hardwood. A tree of 11.0-inch d.b.h. and larger.

Poletimber-size tree:

Softwood. A tree of 5.0- to 8.9-inch d.b.h.

Hardwood. A tree of 5.0- to 10.9-inch d.b.h.

Sapling-size tree. A tree of 1.0- to 4.9-inch d.b.h.

Seedling-size tree. A tree of less than 1.0-inch d.b.h.

EXPANDED DESCRIPTION OF SOILS MAP AREAS

Area 1.⁸ Dominantly Entisols (Bodenburg, Doone, Knik, Susitna). Shallow to moderately deep silty soils. Principal trees are white spruce, paper birch, and quaking aspen. Balsam poplar occurs on flood plains (Susitna series).

Area 2. Weakly developed very shallow to shallow Spodosols (Homestead), Aquepts (Jacobsen, Coal Creek), and Histosols (Salamatof). Principal trees on the Spodosols are white spruce, paper birch, and quaking aspen. On the Aquepts they are black spruce and paper birch. The muskegs (Histosols) are largely treeless, but in places are covered by black spruce.

Area 3. Fairly well-developed Spodosols (Flat Horn, Kashwitna, Nancy) in moderately deep to deep loess on uplands, Entisols (Susitna) on flood plains, Aquepts, and Histosols (Salamatof). Principal trees are white spruce and paper birch on the uplands; spruce, birch, and balsam poplar on the flood plains; and black spruce on poorly drained soils. Note that Spodosols here and in area 4 are bisequal, indicating two major periods of silt deposition.

Area 4. Strongly developed Spodosols (Chulitna, Rabideux) in moderately deep to deep loess on uplands, Entisols (Susitna) on flood plains, and Histosols (Salamatof). Trees are similar to those in area 3. The Histosols are very extensive, making up about 40 percent of the area.

Area 5. Spodosols (Talkeetna) in shallow silty materials immediately above tree line, and very thin Spodosols (no series) in alpine areas. The vegetation on the Spodosols is mostly grasses, forbs, willows, and alder. Alpine tundra covers the higher areas.

Area 6. Aquepts or Aquic Psammments in glacial outflow materials (no series). Largely covered by willows, other shrubs, grasses, and sedges.

Area 7. Rough mountainous land and glaciers.

⁸Numbers refer to soil association areas on soils map (fig. 2).

TABLES

These data have been compiled for forest land producing 20 cubic feet or more per acre per year. Data tables for forest land producing 15 cubic feet or more annually are available upon request.

Volume data herein is for cubic feet or board feet International 1/4-inch scale. Table 28 lists Scribner rule conversion factors by species and 2-inch diameter classes.

Some common metric conversions that can be applied are:

1 cubic meter per hectare	=	14.3 cubic feet per acre
1 cubic foot per acre	=	0.06997 cubic meter
		per hectare
1 cubic meter per hectare	=	35.3145 cubic feet
1 cubic foot	=	0.0283 cubic meter
1 hectare	=	2.47 acres
1 acre	=	0.4047 hectare

Table 8.—Area by land classes, Susitna Valley, Alaska, 1965

(In thousand acres)

Land class	Area
Forest land:	
Commercial (over 20 MAI ¹)	1,295
Subcommercial (15-20 MAI)	584
Noncommercial (under 15 MAI)	1,322
Total	3,201
Nonforest land	2,165 ²
Total land area	5,366 ³

¹MAI—mean annual increment in cubic feet per acre.

²Includes 91,000 acres defined as water by Forest Survey, but as land by the Bureau of Census.

³Total gross area of the unit, adding 244,000 acres of water bodies of more than 40 acres and over 1/8-mile-wide streams classified by the Bureau of Census as water, is 5,610,000 acres.

Table 9.—Area of commercial forest land by forest type and stand-size class, Susitna Valley, Alaska, 1965

(In thousand acres)

Forest type	Sawtimber stands	Poletimber stands	Seedling-sapling stands	Nonstocked areas	Total	Percent
White spruce	258.8	63.2	—	12.2	334.2	25.8
Balsam poplar	109.7	10.7	—	—	120.4	9.3
Quaking aspen	9.2	—	9.2	—	18.4	1.4
Paper birch	490.7	210.4	120.9	—	822.0	63.5
Total	868.4	284.3	130.1	12.2	1,295.0	100.0
Percent	67.0	22.0	10.0	1.0	100.0	

*Table 10.—Area of commercial forest land by area condition and occupancy class,
Susitna Valley, Alaska, 1965
(In thousand acres)*

Area condition class	Growing stock		Rough and cull trees	Inhibiting vegetation	Nonstocked	Nonstockable	Total	Percent
	Desirable	Acceptable						
10	181.4	108.0	21.2	24.7	4.6	2.6	342.5	26.4
20	2.2	3.9	1.0	—	.8	—	7.9	.6
30	140.0	128.1	46.9	43.4	2.3	—	360.7	27.9
40	26.8	57.9	21.1	30.8	—	—	136.6	10.5
50	46.5	64.9	20.6	78.0	.8	—	210.8	16.3
60	32.6	43.1	29.2	127.5	4.1	—	236.5	18.3
Total	429.5	405.9	140.0	304.4	12.6	2.6	1,295.0	100.0
Percent	33.2	31.3	10.8	23.5	1.0	.2	100.0	

*Table 11.—Area of commercial forest land by forest type and site class,
Susitna Valley, Alaska, 1965
(In thousand acres)*

Forest type	Site class ¹		Total	Percent
	20 to 50	50 to 85		
White spruce	334.2	—	334.2	25.8
Cottonwood	78.8	41.6	120.4	9.3
Quaking aspen	18.4	—	18.4	1.4
Paper birch	822.0	—	822.0	63.5
Total	1,253.4	41.6	1,295.0	100.0
Percent	96.8	3.2	100.0	

¹Mean annual increment per acre in cubic feet.

*Table 12.—Number of growing-stock trees on commercial forest land
by diameter class and species, Susitna Valley, Alaska, 1965
(In thousand trees)*

Diameter class ¹	Softwoods			Hardwoods				All species	Percent
	White spruce	Black spruce	Total	Paper birch	Cottonwood	Quaking aspen	Total		
1.0-2.9	27,008	23,892	50,900	72,450	2,501	3,613	78,564	129,464	36.6
3.0-4.9	16,841	5,560	22,401	51,995	3,078	3,726	58,799	81,200	22.9
5.0-6.9	17,887	1,450	19,337	21,914	2,530	2,006	26,450	45,787	12.9
7.0-8.9	15,917	230	16,147	16,833	2,711	746	20,290	36,437	10.3
9.0-10.9	13,291	—	13,291	14,015	1,140	553	15,708	28,999	8.2
11.0-12.9	4,566	—	4,566	9,054	1,147	356	10,557	15,123	4.3
13.0-14.9	2,456	—	2,456	5,087	1,100	47	6,234	8,690	2.5
15.0-16.9	1,474	—	1,474	1,580	724	—	2,304	3,778	1.1
17.0-18.9	302	—	302	456	512	—	968	1,270	.4
19.0-20.9	125	—	125	162	780	—	942	1,067	.3
21.0-22.9	—	—	—	42	507	—	549	549	.2
23.0-24.9	—	—	—	—	305	—	305	305	.1
25.0-26.9	—	—	—	—	263	—	263	263	.1
27.0-28.9	—	—	—	—	251	—	251	251	.1
29.0-30.9	—	—	—	—	124	—	124	124	(2)
31.0-32.9	—	—	—	—	122	—	122	122	(2)
33.0-34.9	—	—	—	—	53	—	53	53	(2)
35.0-36.9	—	—	—	—	—	—	—	—	—
37.0-38.9	—	—	—	—	25	—	25	25	(2)
39.0-40.9	—	—	—	—	15	—	15	15	(2)
41.0 and larger	—	—	—	—	9	—	9	9	(2)
Total	99,867	31,132	130,999	193,588	17,897	11,047	222,532	353,531	100.0
Percent	28.2	8.8	37.0	54.8	5.1	3.1	63.0	100.0	

¹Inches at breast height.

²Less than 0.1 percent.

*Table 13.—Net volume of timber on commercial forest land by class of timber
and by softwoods and hardwoods, Susitna Valley, Alaska, 1965*

(In thousand cubic feet)

Class of timber	Softwoods	Hardwoods	All species	Percent
Sawtimber trees:				
Saw-log portion	284,886	617,148	902,034	60.4
Upper-stem portion	46,377	36,168	82,545	5.5
Total	331,263	653,316	984,579	65.9
Poletimber trees	122,524	328,832	451,356	30.2
All growing-stock trees	453,787	982,148	1,435,935	96.1
Rough trees	315	10,835	11,150	.8
Rotten trees	841	41,482	42,323	2.8
Salvable dead trees	2,036	2,225	4,261	.3
Total, all timber	456,979	1,036,690	1,493,669	100.0
Percent	30.6	69.4	100.0	

*Table 14.—Net volume of growing stock on commercial forest land by stand-size class and forest type,
Susitna Valley, Alaska, 1965*

(In thousand cubic feet)

Stand-size class	White spruce	Cottonwood	Quaking aspen	Paper birch	Total	Percent
Sawtimber	237,393	321,262	20,690	507,767	1,087,112	75.7
Poletimber	51,043	10,200	—	252,798	314,041	21.9
Seedlings and saplings	—	—	—	33,183	33,183	2.3
Nonstocked	1,599	—	—	—	1,599	.1
All classes	290,035	331,462	20,690	793,748	1,435,935	100.0
Percent	20.2	23.1	1.4	55.3	100.0	

*Table 15.—Net volume of sawtimber on commercial forest land by stand-size class and forest type, Susitna Valley, Alaska, 1965
(In thousand board feet)¹*

Stand-size class	White spruce	Cottonwood	Quaking aspen	Paper birch	Total	Percent
Sawtimber	909,067	1,234,439	59,899	1,373,271	3,576,676	88.2
Poletimber	67,341	6,546	—	362,700	436,587	10.8
Seedlings and saplings	—	—	—	32,405	32,405	.8
Nonstocked	7,856	—	—	—	7,856	.2
All classes	984,264	1,240,985	59,899	1,768,376	4,053,524	100.0
Percent	24.3	30.6	1.5	43.6	100.0	

¹International 1/4-inch scale.

*Table 16.—Net volume of sawtimber on commercial forest land by forest type and volume class, Susitna Valley, Alaska, 1965
(In thousand board feet)¹*

Forest type	Stand volume per acre (board feet)			All classes	Percent
	Below 1,500	1,500–5,000	Over 5,000		
White spruce	75,870	566,038	342,356	984,264	24.3
Cottonwood	22,098	65,679	1,153,209	1,240,986	30.6
Quaking aspen	—	—	59,899	59,899	1.5
Paper birch	89,751	1,156,207	522,417	1,768,375	43.6
All types	187,719	1,787,924	2,077,881	4,053,524	100.0
Percent	4.6	44.1	51.3	100.0	

¹International 1/4-inch scale.

Table 17.—Net volume of growing stock on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965
(In thousand cubic feet)

Diameter class ¹	Softwoods			Hardwoods				All species	Percent
	White spruce	Black spruce	Total	Paper birch	Cottonwood	Quaking aspen	Total		
5.0-6.9	39,315	2,565	41,880	51,222	4,864	4,055	60,141	102,021	7.1
7.0-8.9	80,013	631	80,644	90,294	15,514	4,516	110,324	190,968	13.3
9.0-10.9	131,022	—	131,022	139,535	13,370	5,461	158,366	289,388	20.2
11.0-12.9	74,278	—	74,278	141,258	17,170	6,000	164,428	238,706	16.6
13.0-14.9	57,119	—	57,119	113,613	29,235	1,071	143,919	201,038	14.0
15.0-16.9	49,190	—	49,190	46,430	26,141	—	72,571	121,761	8.5
17.0-18.9	13,482	—	13,482	17,637	22,971	—	40,608	54,090	3.8
19.0-20.9	6,172	—	6,172	7,581	47,700	—	55,281	61,453	4.3
21.0-22.9	—	—	—	2,496	37,452	—	39,948	39,948	2.8
23.0-24.9	—	—	—	—	24,839	—	24,839	24,839	1.7
25.0-26.9	—	—	—	—	26,810	—	26,810	26,810	1.8
27.0-28.9	—	—	—	—	27,237	—	27,237	27,237	1.9
29.0-30.9	—	—	—	—	16,421	—	16,421	16,421	1.1
31.0-32.9	—	—	—	—	18,621	—	18,621	18,621	1.3
33.0-34.9	—	—	—	—	9,598	—	9,598	9,598	.7
35.0-36.9	—	—	—	—	—	—	—	—	—
37.0-38.9	—	—	—	—	5,905	—	5,905	5,905	.4
39.0-40.9	—	—	—	—	3,967	—	3,967	3,967	.3
41.0 and larger	—	—	—	—	3,164	—	3,164	3,164	.2
Total	450,591	3,196	453,787	610,066	350,979	21,103	982,148	1,435,935	100.0
Percent	31.4	0.2	31.6	42.5	24.4	1.5	68.4	100.0	

¹Inches at breast height.

Table 18.—Net volume of sawtimber on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965
(In thousand board feet)¹

Diameter class ²	Softwoods			Hardwoods				All species	Percent
	White spruce	Black spruce	Total	Paper birch	Cottonwood	Quaking aspen	Total		
9.0-10.9	685,933	—	685,933	—	—	—	—	685,933	16.9
11.0-12.9	371,159	—	371,159	425,191	42,489	15,955	483,635	854,794	21.1
13.0-14.9	282,125	—	282,125	382,059	100,345	3,088	485,492	767,617	18.9
15.0-16.9	239,384	—	239,384	165,234	98,263	—	263,497	502,881	12.4
17.0-18.9	65,260	—	65,260	65,397	90,436	—	155,833	221,093	5.5
19.0-20.9	28,177	—	28,177	28,745	197,110	—	225,855	254,032	6.3
21.0-22.9	—	—	—	9,666	158,217	—	167,883	167,883	4.1
23.0-24.9	—	—	—	—	105,966	—	105,966	105,966	2.6
25.0-26.9	—	—	—	—	116,550	—	116,550	116,550	2.9
27.0-28.9	—	—	—	—	118,938	—	118,938	118,938	2.9
29.0-30.9	—	—	—	—	72,596	—	72,596	72,596	1.8
31.0-32.9	—	—	—	—	82,941	—	82,941	82,941	2.0
33.0-34.9	—	—	—	—	43,063	—	43,063	43,063	1.1
35.0-36.9	—	—	—	—	—	—	—	—	—
37.0-38.9	—	—	—	—	26,741	—	26,741	26,741	.7
39.0-40.9	—	—	—	—	18,028	—	18,028	18,028	.4
41.0 and larger	—	—	—	—	14,468	—	14,468	14,468	.4
Total	1,672,038	—	1,672,038	1,076,292	1,286,151	19,043	2,381,486	4,053,524	100.0
Percent	41.2	—	41.2	26.6	31.7	0.5	58.8	100.0	

¹International 1/4-inch scale.

²Inches at breast height.

*Table 19.—Net volume of sawtimber on commercial forest land by species and quality class,
Susitna Valley, Alaska, 1965
(In thousand board feet)¹*

Species	Grade 1	Grade 2	Grade 3	Grade 4	Total	Percent
Softwoods:						
White spruce	—	32,726	1,605,446	33,866	1,672,038	41.2
Black spruce	—	—	—	—	—	—
Total	—	32,726	1,605,446	33,866	1,672,038	41.2
Hardwoods:						
Paper birch	15,984	146,210	826,026	88,072	1,076,292	26.6
Cottonwood	177,262	321,333	729,560	57,996	1,286,151	31.7
Quaking aspen	—	—	19,043	—	19,043	.5
Total	193,246	467,543	1,574,629	146,068	2,381,486	58.8
All species	193,246	500,269	3,180,075	179,934	4,053,524	100.0
Percent	4.8	12.3	78.5	4.4	100.0	

¹International 1/4-inch scale.

*Table 20.—Gross annual growth of growing stock on commercial forest land
by species and forest type, Susitna Valley, Alaska, 1965*

(In thousand cubic feet)

Species	White spruce	Cottonwood	Quaking aspen	Paper birch	Total	Percent
Softwoods:						
White spruce	4,845	449	143	4,870	10,307	31.9
Black spruce	61	—	—	250	311	1.0
Total	4,906	449	143	5,120	10,618	32.9
Hardwoods:						
Paper birch	1,290	21	89	13,037	14,437	44.8
Cottonwood	83	5,487	44	973	6,587	20.4
Quaking aspen	—	—	164	459	623	1.9
Total	1,373	5,508	297	14,469	21,647	67.1
All species	6,279	5,957	440	19,589	32,265	100.0
Percent	19.4	18.5	1.4	60.7	100.0	

Table 21.—Gross annual growth of sawtimber on commercial forest land by species and by softwoods and hardwoods, Susitna Valley, Alaska, 1965

(In thousand board feet)¹

Species	Total	Percent
Softwoods:		
White spruce	52,828	43.1
Black spruce	—	—
Total	52,828	43.1
Hardwoods:		
Paper birch	42,192	34.4
Cottonwood	26,769	21.8
Quaking aspen	847	.7
Total	69,808	56.9
All species	122,636	100.0

¹International 1/4-inch scale.

*Table 22.—Net annual growth of growing stock on commercial forest land
by species and kind of volume, Susitna Valley, Alaska, 1965¹
(In thousand feet)*

Species	Kind of volume	
	Cubic feet	Board feet ²
Softwoods:		
White spruce	8,811	45,084
Black spruce	311	—
Total	9,122	45,084
Hardwoods:		
Paper birch	13,551	40,437
Cottonwood	6,552	26,633
Quaking aspen	576	—
Total	20,679	67,070
All species	29,801	112,154

¹Because of the weakness of the mortality data, this table is of low accuracy.

²International 1/4-inch scale.

Table 23.—Gross volume of annual mortality of growing stock on commercial forest land by species and by softwoods and hardwoods, Susitna Valley, Alaska, 1965¹

Species	Thousand cubic feet	Percent
Softwoods:		
White spruce	1,496	60.7
Black spruce	—	—
Total	1,496	60.7
Hardwoods:		
Paper birch	886	36.0
Cottonwood	35	1.4
Quaking aspen	47	1.9
Total	968	39.3
All species	2,464	100.0

¹ Because of the weakness of the mortality data, this table is of low accuracy.

Table 24.—Gross volume of annual mortality of sawtimber growing stock on commercial forest land by species and by softwoods and hardwoods, Susitna Valley, Alaska, 1965¹

Species	Thousand board feet ²	Percent
Softwoods:		
White spruce	7,744	80.4
Black spruce	—	—
Total	7,744	80.4
Hardwoods:		
Paper birch	1,755	18.2
Cottonwood	136	—
Quaking aspen	—	1.4
Total	1,891	19.6
All species	9,635	100.0

¹Because of the weakness of the mortality data, this table is of low accuracy.

²International 1/4-inch scale.

Table 25.—Gross annual mortality of growing stock on commercial forest land by cause and by softwoods and hardwoods, Susitna Valley, Alaska, 1965¹
(In thousand cubic feet)

Cause	Softwoods	Hardwoods	All species	Percent
Insects	695	444	1,139	46.2
Diseases	161	—	161	6.5
Fires	—	158	158	6.4
Weather	103	—	103	4.2
Unknown	537	304	841	34.2
Logging	—	62	62	2.5
All causes	1,496	968	2,464	100.0
Percent	60.0	40.0	100.0	

¹Because of the weakness of the mortality data, this table is of low accuracy.

Table 26.—Gross annual mortality of sawtimber growing stock on commercial forest land by cause and by softwoods and hardwoods, Susitna Valley, Alaska, 1965¹
(In thousand board feet)²

Cause	Softwoods	Hardwoods	All species	Percent
Insects	3,650	587	4,237	44.0
Diseases	979	—	979	10.2
Fires	—	151	151	1.5
Weather	548	—	548	5.7
Unknown	2,567	1,153	3,720	38.6
Logging	—	—	—	—
All causes	7,744	1,891	9,635	100.0
Percent	80.4	19.6	100.0	

¹Because of the weakness of the mortality data, this table is of low accuracy.

²International 1/4-inch scale.

Table 27.—Gross volume of growing-stock on commercial forest land by diameter class and species, Susitna Valley, Alaska, 1965

(In thousand cubic feet)

Diameter class ¹	Softwoods			Hardwoods				All species	Percent
	White spruce	Black spruce	Total	Paper birch	Cottonwood	Quaking aspen	Total		
5.0-6.9	40,117	2,618	42,735	58,846	5,657	4,408	68,911	111,646	6.5
7.0-8.9	82,484	643	83,127	108,709	16,428	5,908	131,045	214,172	12.5
9.0-10.9	140,853	—	140,853	168,961	15,559	5,936	190,456	331,309	19.4
11.0-12.9	79,286	—	79,286	180,518	19,958	8,402	208,878	288,164	16.8
13.0-14.9	59,575	—	59,575	160,336	30,139	3,292	193,767	253,342	14.8
15.0-16.9	51,847	—	51,847	83,341	27,904	—	111,245	163,092	9.6
17.0-18.9	13,757	—	13,757	30,873	27,265	—	58,138	71,895	4.2
19.0-20.9	7,465	—	7,465	15,982	54,450	—	70,432	77,897	4.6
21.0-22.9	—	—	—	5,846	39,513	—	45,359	45,359	2.7
23.0-24.9	—	—	—	—	26,969	—	26,969	26,969	1.6
25.0-26.9	—	—	—	1,771	31,556	—	33,327	33,327	2.0
27.0-28.9	—	—	—	1,359	28,079	—	29,438	29,438	1.7
29.0-30.9	—	—	—	—	18,295	—	18,295	18,295	1.1
31.0-32.9	—	—	—	—	19,197	—	19,197	19,197	1.1
33.0-34.9	—	—	—	—	9,895	—	9,895	9,895	.6
35.0-36.9	—	—	—	—	—	—	—	—	—
37.0-38.9	—	—	—	—	6,088	—	6,088	6,088	.4
39.0-40.9	—	—	—	—	4,089	—	4,089	4,089	.2
41.0 and larger	—	—	—	—	3,262	—	3,262	3,262	.2
Total	475,384	3,261	478,645	816,542	384,303	27,946	1,228,791	1,707,436	100.0
Percent	27.8	0.2	28.0	47.8	22.6	1.6	72.0	100.0	

¹Inches at breast height.

Table 28.—Conversion factors, International 1/4-inch to Scribner scale volume

Diameter class	Spruce	Birch	Cottonwood	Aspen	All species
9.0 – 10.9	0.7976	—	—	—	0.7976
11.0 – 12.9	.8160	0.8000	0.7964	0.8058	.8069
13.0 – 14.9	.8344	.8132	.8423	.8151	.8248
15.0 – 16.9	.8554	.8194	.8526		.8430
17.0 – 18.9	.8719	.8237	.8575		.8518
19.0 – 20.9	.8801	.8259	.8624		.8602
21.0 – 22.9		.8281	.8645		.8624
23.0 – 24.9			.8655		
25.0 – 26.9			.8673		
27.0 – 28.9			.8677		
29.0 – 30.9			.8688		
31.0 – 32.9			.8695		
33.0 – 34.9			.8702		
35.0 – 36.9			—		
37.0 – 38.9			.8710		
39.0 – 40.9			.8713		
41.0+			.8719		
Average	.8205	.8101	.8605	.8073	.8304

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