United States
Department of
Agriculture

Forest Service

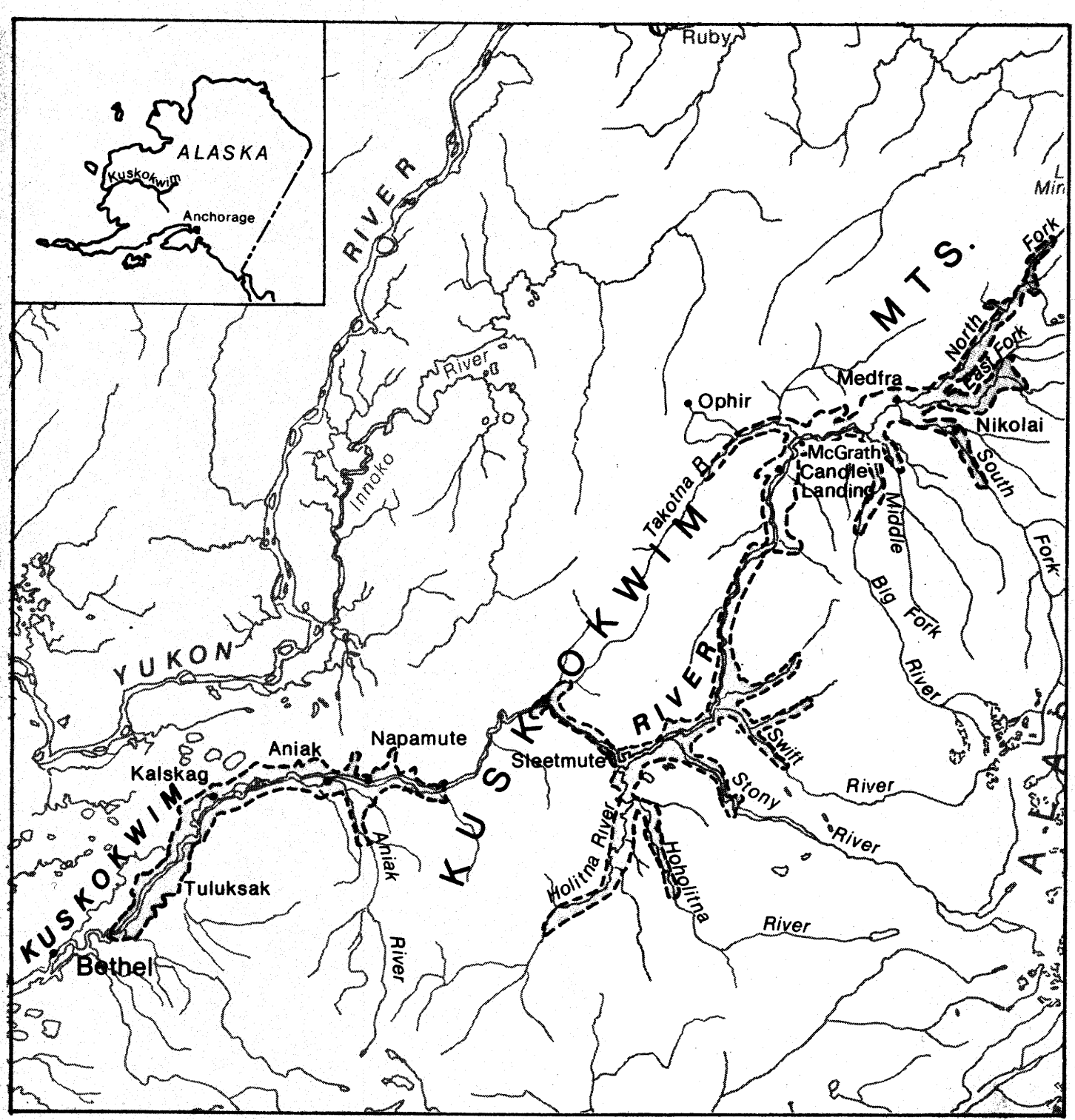
Pacific Northwest
Forest and Range
Experiment Station

Resource Bulletin
PNW-87

December 1979

Timber Resources of the Kuskokwim Flood Plain and Adjacent Upland

Karl M. Hegg and Harold Sieverding



Prepared by
Alaska Forest Survey Project
Juneau, Alaska

O. Keith Hutchison, Project Leader
Ronald M. Dippold, Photo Interpretation and Field Supervisor
Dennis Murphy, Assistant Field Supervisor

Field Crew:

Forest Survey Project	Bureau of Land Management	Alaska Department of Lands
Karl M. Hegg	Harold Johnson	Larry Trowbridge
Ronald M. Dippold	Duncan Gilchrist	
Dennis Murphy	George Hudak	
	Paul Anderson	

Office Compilation:

John M. Berger, Supervisor and staff (Portland)

The successful completion of this study was made possible through the generous assistance of the Bureau of Land Management in providing aerial photography, personnel, funds, and transportation.

Metric Conversions

1 acre	= 0.4047 hectare
1 hectare	= 2.47 acres
1 cubic foot	= 0.0283 cubic meter
1 cubic meter	= 35.3145 cubic feet
1 cubic foot per acre	= 0.06997 cubic meter per hectare
1 cubic meter per hectare	= 14.29 cubic feet per acre
20 cubic feet per acre	= 1.3994 cubic meter per hectare
1 square foot basal area per acre	= 0.2296 square meter per hectare
1 square meter per hectare	= 4.356 square feet per acre

TIMBER RESOURCES OF THE KUSKOKWIM RIVER FLOOD PLAIN AND ADJACENT UPLANDS

Reference Abstract

Hegg, Karl M., and Harold Sieverding.
1979. Timber resources of the Kuskokwim River flood plain and adjacent uplands. USDA For. Serv. Resour. Bull. PNW-87, 40 p., illus.

The first intensive forest inventory of the Kuskokwim River flood plains and adjacent uplands was conducted in 1967. A commercial forest area of 252.5 thousand acres (102.2 thousand hectares) was identified with a growing-stock volume of 343.0 million cubic feet (9.7 million cubic meters). A noncommercial stratum was also examined that had substantial standing volume but did not qualify as commercial forest land. This stratum contained 70.4 thousand acres (28.5 thousand hectares) with a volume of 65.9 million cubic feet (1.9 million cubic meters).

Keywords: Timber resources, statistics (forest), forest surveys, Alaska (Kuskokwim River Valley).

Research Summary
Resource Bulletin PNW-87
1979

The forest inventory of the Kuskokwim River inventory unit was a joint effort of the Forest Service, U.S. Department of Agriculture, and the Bureau of Land Management, U.S. Department of Interior. Data was gathered to meet the needs of the National Forest Survey and for management planning.

Aerial photography was acquired by the Bureau of Land Management and the Forest Service in 1965-1966. Preliminary field investigation was made in 1966 and interpretation of photos completed in early 1967. Field plot work was finished in 1967 and data processing in 1972.

Final inventory results show that 252.5 thousand acres (102.2 thousand hectares) of the 1,231.2 thousand-acre (498.3 thousand hectares) inventory unit were classed as commercial forest land. The commercial forests have a total cubic volume of 343 million cubic feet (9.7 million cubic meters) and a total sawtimber volume of 1,111.8 million board feet. An additional 65.9 million cubic feet (1.9 million cubic meters) are found on 70.4 thousand acres (28.5 thousand hectares) of forest land with substantial standing volume but not meeting the growth criteria for commercial forest land. The effects of climate, soils, and flooding are discussed and how these factors bear on the differing growth and regeneration characteristics noted in the upper and lower blocks of this inventory unit. Data is presented for the two blocks illustrating those differences.

Past and present uses of the forest are noted including comments on the recreation potential, subsistence use, and land conflicts. A maximum allowable cut is calculated with commentary on factors reducing the cut and the effect of adjacent high volume noncommercial stands. Problems that may be encountered in developing internal and external timber markets are cited and the conclusion drawn that the Kuskokwim timber resource should continue to be managed for local needs.

HIGHLIGHTS

	Thousand acres	Thousand hectares
Total Kuskokwim River unit area:	1,231.2	498.3
with forests on	874.3	353.8
with nonforest on	215.8	87.3
with noncensus water on	57.0	23.1
with census water on	84.1	34.1
Forested area:		
commercial forest land	252.5	102.2
noncommercial forest land		
more than 800 cubic feet per acre	70.4	28.5
less than 800 cubic feet per acre	551.4	223.1
Commercial forest composition:		
sawtimber	158.6	64.2
poletimber	69.9	28.3
seedling/sapling	16.7	6.8
nonstocked	7.3	2.9

Inventory unit volumes	Thousand cubic feet [1/]	Thousand cubic meters [1/]	Thousand board feet [2/]	Thousand cubic meters [3/]
Total net volume	343,014.5	9 713.1	1,111,844.1	6 774.8
Total gross volume	370,821.6	10 500.5	1,211,735.0	7 036.9
Annual net growth	4,476.2	126.8	29,394.6	100.0
Annual net mortality	382.6	10.8	1,103.9	7.2

[1/] Volume of roundwood in live trees 5.0-inch d.b.h. and larger.

[2/] Net volume, International 1/4-inch rule.

[3/] Volume in roundwood in softwood trees 9.0-inch d.b.h. and larger and hardwood trees 11.0-inch d.b.h. and larger.

CONTENTS

TABLES

These data for the total Kuskokwim unit have been compiled for forest land producing 20 cubic feet or more per acre per year. Data tables for the upper and lower Kuskokwim blocks are available upon request.

Volume data herein is for cubic feet or board feet International 1/4-inch rule.

INTRODUCTION

This resource bulletin presents the findings of the first intensive forest inventory of lands adjacent to the Kuskokwim River, Alaska, although the Kuskokwim valley was inventoried in its entirety as part of a statewide reconnaissance inventory in 1957-1962[1/] (Hutchison 1967). This earlier inventory was statistically valid for the entire State but not for individual drainages and thus is considered inadequate for management planning.

The impetus of the Kuskokwim inventory was indirectly provided in 1963 by a timber sale proposal covering most of the Kuskokwim. This established a definite and pressing need for more reliable information of the area. The Bureau of Land Management (BLM), U.S. Department of Interior, subsequently delineated the most accessible areas adjacent to the river and contracted for aerial photography. Complete photocoverage was obtained by 1966.

The inventory of the Kuskokwim River unit was conducted as a cooperative effort by the U.S. Department of Interior, Bureau of Land Management, and the Forestry Sciences Laboratory, U.S. Forest Service (Juneau). Photointerpretation and fieldwork were cooperatively shared by the two agencies. Supervision and editing of plot records was done by the Forestry Sciences Laboratory. Data processing was handled by the Pacific Northwest Forest and Range Experiment Station at Portland.

Unlike the Susitna Valley inventory (Hegg 1970), a comparison between the extensive and intensive inventories cannot be made. The area being reported comprises but 5 percent of the original subunit of the statewide inventory. Undoubtedly there is additional commercial forest land in the remaining 95 percent of the Kuskokwim drainage. Eventually, using new techniques in sampling and remote sensing, we plan to complete the inventory for the entire drainage.

PHYSICAL DESCRIPTION

Geographical Location

This inventory unit of 1,231,180 acres occupies a small part of the 26-1/2 million-acre Kuskokwim drainage system (fig. 1). The Kuskokwim drainage

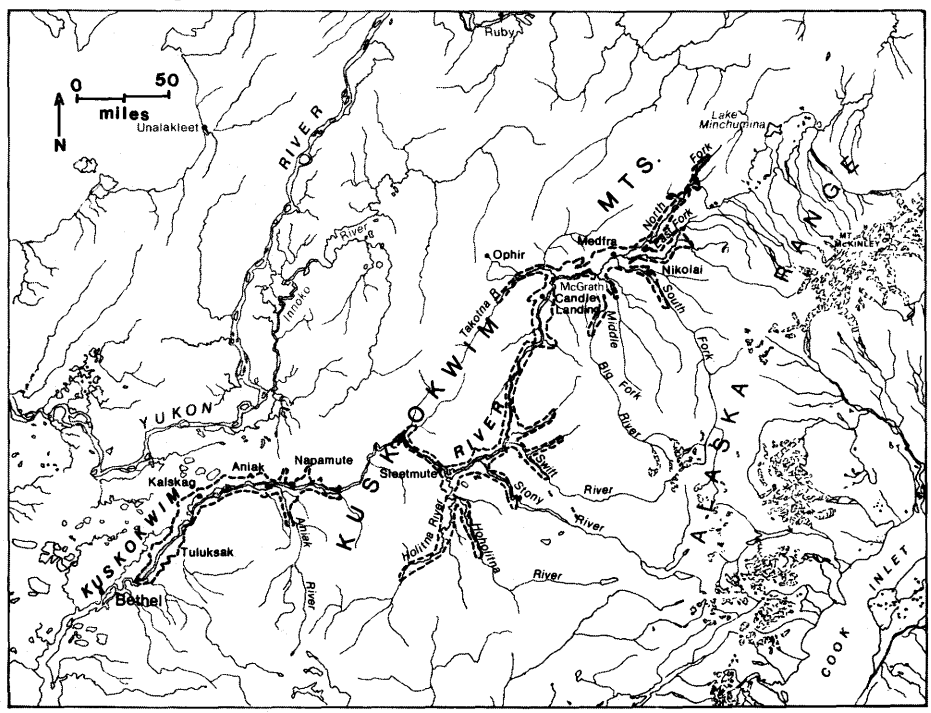


Figure 1.--The shaded areas are the 1,231,180 acre Kuskokwim inventory unit. On the right are Mt. McKinley and the Alaska Range. On the left is the Yukon River.

[1/] Wilson, Richard C. 1957. Working plan for the forest survey of interior Alaska, USDA For. Serv. Div. For. Econ. Res., Washington, D.C. Unpublished.

lies to the west of the Alaska Range with a majority of its waters coming from those mountains. On the west and northwest, the Kuskokwim River is bounded by the Kuskokwim Mountains and has its headwaters in those mountains about 120 miles southwest of Fairbanks. An overall view of the Kuskokwim River and Mountains is shown in figure 2.

Figure 2.--The Kuskokwim Mountains, extending from tide water northward and with elevations to 4,400 feet, shields the Kuskokwim drainage from the cold maritime influence of the Bering Sea.

The general flow of the Kuskokwim is southwest with a current of 5 to 6 miles per hour in the upper reaches, but slowing to 3 to 5 miles per hour as it becomes broader or more winding downstream. Faster water is found in many of the tributaries, but with the exception of the Swift River, they become sinuous winding rivers compounded by cut-off meanders and oxbow lakes long before they reach the Kuskokwim.

The inventory unit includes only those lands within about 5 miles of the navigable waters of the Kuskokwim and its tributaries. Although the unit stretches only 300 airline miles, we estimate that about 800 to 1,000 miles of river are actually included in the inventory area.

Soils and Drainage

Thick moraine, alluvial, and eolian deposits of unconsolidated silts, sands, gravels, and organic deposits cover most of the area inventoried (Fernald 1955). In only a few instances, in the hills flanking the west bank of the Kuskokwim, are sandstone, limestone, and shale bedrock cliffs exposed (Fernald 1960).

The soils that have developed from this parent material are predominately the subarctic brown podzolics and alluvials (Kellog and Nygard 1951). In a more temperate climate these soils would be fairly productive. In this area, however, growth is severely restricted since the entire Kuskokwim basin is underlain by continuous to discontinuous permafrost (material that has a temperature lower than 32° F and is not subject to seasonal thawing) (Ferrians 1965). Only on moderate- to well-drained sites adjacent to the river or on south-facing slopes is the soil warm enough for tree growth comparable to that of the lower latitudes.

The better drained soils are adjacent to the river and are subjected to periodic flooding and silting. This annual deposition provides the mineral soil needed for good regeneration, but it has drawbacks. The deposited soil is usually fine silt with a high water-holding capacity which, with additional layers, means impeded drainage. And as the inner bend river bank continues building, earlier deposits are left far removed from the main stream and its influence in maintaining drainage and permafrost depth. The naturally slow water movement in this fine-textured soil slows even more as permafrost moves closer to the surface and contributes to the change from commercial forest land to noncommercial and finally to nonforest (Viereck 1970).

The floods that deposit most of the mineral soil are usually caused by ice damming during the spring breakup. As a provider of mineral seedbeds, these floods are favorable; but they also have a detrimental effect on existing stands. As the ice moves downriver after the breakup of an ice dam, standing trees are heavily abraded and uprooted thus reducing the quality and quantity of the resource (fig. 3).

Climate

The climate of the Kuskokwim basin can be best described as continental. Summers are fairly wet--over half of the total (18- to 23-inch) precipitation occurs then--and winters are long, cold, and dry. Winter temperatures in the minus 50° to 60° F range are not uncommon (minimum recorded -64° F). The January

Figure 3.--Spring breakup on the Kuskokwim brings ice dams, flooding, siltation, bank erosion, and tree uprooting and abrasion.

average daily minimum at McGrath is a minus 8°, the July monthly average is a +58.7° F (U.S. Dep. of Commerce Weather Bureau 1965). The last killing frost usually occurs in late May, the first fall frost in late August or early September, a frost-free season of about 100 to 105 days.

A striking feature of these northern latitudes (61° to 64° north) are the long daylight and twilight hours. This reaches the extremes of nearly continuous daylight (sun and twilight) during May, June, and July. A considerable lengthening of the day by twilight is caused by the sun's shallow angle as it crosses the northern latitudes. Not only does the sun take a longer time (compared to temperate latitudes) to rise and set, but this low angle also increases the atmospheric refraction of the sun's rays and extends the twilight period (Johnson and Hartman 1969).

Despite these long days, the actual amount of solar radiation is no more than that received in more southern locations since the same features (shallow angle and refraction) that extend daylight also combine to reduce the acutal energy received (Johnson and Hartman 1969). By comparison, the northern part of the contiguous United States (International Falls, Minnesota) has an average growing season of 107 days, but a July monthly average of 67.5° or 9° higher than McGrath's 58.7° F (U.S. Department of Agriculture 1941).

FOREST DESCRIPTION

Land Capability Classification

Commercial forest land, noncommercial forest land, nonforest land, and water were the land types recognized in this inventory. Definitions of all these classes and other terms used are found in the appendix.

Forest Survey classifies forest land on the basis of mean annual increment (MAI). MAI is the volume, in cubic feet, that 1 acre of forest land is producing or capable of producing in 1 year. An increment of 20 cubic feet per acre per year is the minimum to qualify as commercial forest land.

Forest land producing less than 20 cubic feet per acre annually is classed as noncommercial. Preliminary observations and experiences in other areas, however, caused us to question this blanket noncommercial classification. We had noted many areas with stands carrying potentially marketable volumes that did not meet the commercial forest land minimum and felt this area needed sampling. This we did on the Kuskokwim and are calling this class operable noncommercial. To qualify for this operable category, the stand must have 800 cubic feet ($22.65M^3$) of volume--equivalent to about nine cords per acre. In many areas of the U.S. and Canada, pulp logging occurs in stands of only 3 cords per acre; and we feel that under the present economics of logging and marketing in Alaska that 9 cords might be a prudent operating level. Figure 4 illustrates an operable noncommercial stand of the lower Kuskokwim.

Figure 4.--Operable noncommercial stands are difficult to identify except by knowledge of the area and an understanding of the conditions leading to slow growth. This stand of white spruce on the lower Kuskokwim has a gross volume of 1,580 cubic feet per acre and a mean annual increment of 12 cubic feet.

The distinction between this stand and one with commercial potential can be determined only by onsite growth measurements.

Forest Location

The Kuskokwim Mountain Range (illustrated in figure 2) bisects the inventory area effectively creating two individual blocks that we have called the upper and lower Kuskokwim (fig. 1 map). This mountain range probably is the indirect cause of differing stand characteristics of the two blocks. The upper Kuskokwim lies east of these mountains and has a true continental climate. Tree growth and vegetation appear normal for the latitude.

The lower Kuskokwim lies to the west of the Kuskokwim range and is an area of gentle gradients and low hills. Cold air movement from the Bering Sea, ice covered several months of the year, gives the unshielded lower Kuskokwim area a cold maritime climate. Under these conditions, tree height growth in the area appears to stagnate and regeneration is nearly nonexistent. The elevational limit of tree growth in the lower Kuskokwim is also severely restricted with only occasional stunted trees found above 500 feet. This block includes what is probably the westernmost extension of commercial tree growth on the North American Continent although stands of noncommercial timber and scattered trees are found as far west as Bethel at the mouth of the Kuskokwim and on the Seward Peninsula to within 50 miles of Nome.

Distribution of the total area by land class for the two blocks is shown in table 1.

Table 1--*Area by productivity, land class, and block, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Land/operability class	Block		
	Total	Upper	Lower
Commercial	252.5	234.8	17.7
Noncommercial			
Operable[1/]	70.4	42.0	28.4
Inoperable[2/]	551.4	328.4	223.0
Nonforest	215.8	95.6	120.2
Noncensus water	57.0	42.4	14.6
Census water	84.1	49.1	35.0
Total	1,231.2	792.3	438.9

[1/] Operable noncommercial forest land is defined as areas presently carrying a gross volume of more than 800 cubic feet per acre.

[2/] Inoperable noncommercial forest land is defined as areas supporting a gross volume of less than 800 cubic feet per acre.

The proportions of commercial forest land within each block are in direct relation to the miles of river in each block since the best sites are adjacent to flowing water. The lower Kuskokwim has only one major tributary, the Aniak, whereas the upper Kuskokwim is fed by the Tonzona, the North, South, and Middle Forks of the Kuskokwim, the Big River, the Takotna, the Swift, the Stony, and the Holitna-Hoholitna Rivers.

The upper Kuskokwim block includes 64 percent of the area and 69 percent of the forest land (93 percent of the commercial and 60 percent of noncommercial forest land).

The areas included in the inventory area are close to the river system (all field plots with the exception of about five were within 3 miles of the river). This does not mean that we have sampled all easily accessible or all of the forest land in the Kuskokwim drainage. We believe there are considerable acreages of commercial forest land scattered throughout the remaining 25 million acres of this drainage. A more complete inventory of this area will be considered following completion of the remaining inventory units of interior Alaska.

Intermixed with the commercial forest acreages are substantial areas of the operable noncommercial forest land. A total of 70.4 thousand acres of this type are distributed fairly uniformly throughout the inventory area (table 1). Generally this type is found just behind the commercial forest fringe on river meanders, although on the lower Kuskokwim commercial forests are mostly restricted to river islands with the operable noncommercial occupying the river meander alluvium. A typical lower Kuskokwim stand of this type is illustrated in figure 4.

Forest Stocking - Commercial

Stocking is determined by numbers of trees and their spacing. It is a measure of the proportion of the site that is occupied by various classes of trees (desirable, acceptable, cull) and other vegetative cover. For the Kuskokwim this picture is one of medium- to well-stocked stands of growing stock trees. Seventy-six percent of the commercial forest area is in this category; 12.2 percent is overstocked with 11.5 percent of the area in poorly stocked and understocked classes. Although this 11.5 percent understocked area will represent a management problem, it is not nearly as serious as the Susitna Valley where 35 percent of the area was so affected (Hegg 1970).

While the above discussion is applicable to the upper Kuskokwim stands, on the lower block other serious problems were observed. Commercial and operable noncommercial forest areas appear to be undergoing gradual site deterioration. Very little regeneration was observed even where seedbeds were favorable. It appears that the coincidence of good seed years and a favorable seedbed (caused by flooding) are not as frequent as needed.

We cannot back these observations with facts but the stand situation in that area seems to fit the above premise. Most white spruce in the lower Kuskokwim are about 200 years old with only a thin scattering of younger age trees. Openings created by dying trees were being filled in by alder brush as illustrated in figure 5. This was the case even where fresh layers of silt were found. Zasada has advanced the premise that marginal spruce stands may have wide intervals between good seed years and this may be part of the problem in western Alaska (Zasada 1970, 1972).

Figure 5.--A ground view of figure 4 illustrating heavy brush competition and low tree vigor.

Forest Area Condition

Stocking is also interpreted by area condition (see terminology for definitions). Area condition is a procedure by which

the stand is classified into management opportunity categories. The first three management classes refer to managing for sawtimber, the next two would include smallwood management as well. These categories give the land manager an overall view of the need for management intensities. On the Kuskokwim, the view is fair since but 2.9 percent of the commercial forest area is in the first three classes (table 2). If smallwood is the objective, then at least 24 percent of the area is in good condition (classes 10-50) and perhaps class 60 would also be considered satisfactorily stocked for smallwood management. Twenty two percent of the commercial area rates as needing treatment to improve stocking using the smallwood management criteria. Treatment, of course, requires understanding of the effects and economics of the various management tools. This understanding, except from extrapolation from other areas, is almost totally lacking for Alaska.

Table 2--*Proportion of commercial and operable noncommercial forest land by area condition class, Kuskokwim River, Alaska, 1967*[1/]

Condition Class	Commercial forest land	Operable noncommercial forest land
	-Percent-	
10	.9	0.0
20	0.0	0.0
30	2.0	0.0
40	5.2	10.8
50	15.7	22.5
60	54.3	33.8
70	21.9	32.9
Total	100.0	100.0

[1/] Actual acreages can be found in table 16.

NONCOMMERCIAL FORESTS

Inoperable Forests

Although we extended our inventory into the noncommercial forest area, we really examined only the best of this class. The inoperable noncommercial acreage was checked only when a photo-point reexamined in the second stage of our sample was thought to be commercial or noncommercial operable forest land, thus needing a ground check. On the upper Kuskokwim block, noncommercial stands are in the main composed of black spruce and tamarack with occasional stands of aspen and birch on droughty sand dunes adjacent to the river. As portrayed by figure 6, these are areas of small, short trees with a high number of stems per acre.

Figure 6.--Although this scene may not appear to be significantly different than that of figures 4 and 5, volume per acre was but 440 cubic feet. Tree height was the major difference. This stand averages only 33 feet versus 54 feet in the operable stand.

The lower Kuskokwim noncommercial stands also have this type of stand characteristics but with fewer stems per acre. These stands are usually on side hills adjacent to the river and are mainly birch (fig. 7). They occur on what are apparently burned over areas and the trees were found to be extremely short (15 to 30 feet) in relation to their diameters (5 to 8 inches) and age (50 to 60 years).

The volume of timber in the noncommercial stands can only be an estimate. We know the stand average to be between 0 and 799 cubic feet. At an

Figure 7.--Cold winds from the Bering Sea may be the major reason for the slow growth of this birch stand. Diameters are 4 to 8 inches, maximum height of 30 feet with an age range of 50 to 70 years.

average volume of 300 cubic feet per acre, the 551.4 thousand acres of noncommercial forest land would carry 165.4 million cubic feet of timber.

Operable Noncommercial Forests

The stand size distribution, shown in table 3, is only for sawtimber and poletimber. Our 800-cubic foot minimum for operable noncommercial forest land essentially eliminates the seedling-sapling and nonstocked classes as they would rarely have the minimum standing volume.

The acreages of sawtimber and poletimber in the two blocks confirm our impressions of the area. The upper Kuskokwim noncommercial stands appeared to have more stems per acre than commercial stands and this is shown in the high proportion of poletimber stands. The lower Kuskokwim stands appear to be overmature and stagnant. Generally, this would mean larger diameters with fewer stems per acre and a high proportion of sawtimber stands.

Table 3--*Area of operable noncommercial forest land, by stand-size class, by forest type, and by block, Kuskokwim River, Alaska, 1967*[1/]

(Thousand acres)

Stand-size class	BLOCK Upper	Lower	Total
Sawtimber	14.8	17.9	32.7
Poletimber	27.2	10.5	37.7
Forest type			
Balsam poplar	2.6	--	2.6
Black spruce	2.6	--	2.6
Paper birch	18.3	2.8	21.1
White spruce	18.5	25.6	44.1

[1/] Additional tabular data for operable noncommercial stands can be found in the tables at the back of this publication.

The significant difference between blocks by species distribution is the overwhelming dominance of white spruce in the lower block as compared to the balance between birch and white spruce in the upper block. White spruce seems to be the only one of our four commercial species that can grow successfully to any size under the adverse conditions of the lower Kuskokwim. Although balsam poplar may have wider area distribution, it rarely reaches merchantable size at the extremes of its range, but assumes a shrub characteristic; whereas white spruce maintains tree form until its range limit is reached.

About 60 percent of operable noncommercial forest area of 73,390 acres is in the upper Kuskokwim block, and the proportions of hardwoods, softwoods, poletimber, and sawtimber occur in the upper block in roughly the same ratio. Cubic-foot volume per acre is considerably higher on the upper Kuskokwim (1,056 vs. 760) but board-foot volumes per acre are reversed (1,785 vs. 2,130), reflecting the high proportion of sawtimber stands on the lower Kuskokwim.

Growth in these noncommercial operable stands averages 12.9 and 6.5 cubic feet per acre per year for the upper and lower blocks respectively. Annual softwood increment totals 427 thousand cubic feet and hardwood increment 297 thousand cubic feet.

COMMERCIAL FOREST LAND

Area

Commercial forests cover 252.5 thousand acres or about 20 percent of the inventory unit. This acreage, as shown in table 4, is mostly in the upper block. With this concentration of commercial forest land in the upper block, it follows that most of the discussion in this report applies to that area. However, the lower block use and potential cannot be dismissed since in the past 10 years or so most of the cutting and milling has occurred in that area. This lower block of timber is closest to Bethel--the only market on the river of any consequence.

The concentration of timber in the upper block is a result of the river flow rates and patterns as well as climate. The upper Kuskokwim originates in the northernmost part of the Kuskokwim Mountains a little over a 100 miles west-southwest of Fairbanks. Although relatively fast flowing, it is a very meandering river, with the meander loops growing more and more exaggerated until it swings west and cuts through the Kuskokwim Mountains on its way to the Bering Sea. The lower Kuskokwim is a relatively straight-flowing river except for a stretch of islands and meanders below Aniak. Consequently, there is more active cutting and filling with new soil and good drainage on the upper reaches of the river and this is where most of the better forests are found.

Table 4--*Area of commercial forest land by stand-size class, by softwoods and hardwoods, and by block, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Stand-size class	Upper			Lower		
	Total	Softwood	Hardwood	Total	Softwood	Hardwood
Sawtimber	142.6	111.4	31.2	16.0	13.1	2.9
Poletimber	69.9	21.1	48.8	0.0	0.0	0.0
Seedling-sapling	16.7	1.9	14.8	0.0	0.0	0.0
Nonstocked	5.6	0.0	5.6	1.7	0.0	1.7
Total	234.8	134.4	100.4	17.7	13.1	4.6

Harsh climatic conditions undoubtedly limit hillside growth on the lower block where most stands growing away from river drainage influence are stunted (fig. 7). On the upper block with its milder climate, hillside stands rivaling bottomland stands are found at numerous locations. Starting from the north, areas with extensive stands are: the East Fork Hills (unfortunately just outside the inventory area), a range of hills on the north side of the river between Medfra and McGrath, and from McGrath to Stony River stands are found on favorable aspects (figs. 9, and 10) on the west side of the river.

Figure 8.--Loops, meanders, and oxbows are typical of most of the Kuskokwim River east of the Kuskokwim Range.

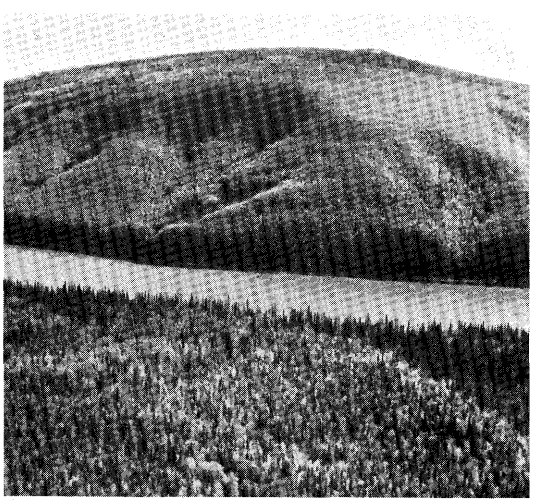


Figure 9.--Hillsides with other than northerly exposures have the potential for commercial forest growth. This view of a hill south of McGrath shows almost complete forest cover--some with commercial potential.

Figure 10.--A ground view of a commercial site located on the hill slope shown in figure 9.

These differing growing conditions are also reflected in the stand-size structure shown in table 4. The upper block has a normal distribution for natural stands whereas the lower block is completely without poletimber or seedling-sapling stands. Although we may have missed seeing or sampling these size classes, we feel this deficiency to be a true picture for the lower Kuskokwim.

Current regeneration studies in the Fairbanks area will probably be directly applicable to the upper block of the Kuskokwim as soils and climate do not differ appreciably. If good seed years are sporadic but predictable, it would seem that adjustments in cutting cycles or emphasis on seedbed preparation prior to a good seed year might become part of a silvicultural practice aimed at white spruce regeneration.

This concern with regeneration could well be ignored if white spruce loses its preferred status in the market and management shifts to hardwood instead. Wildfires have in the past burned extensive areas in this drainage, although most burns lie outside of the present inventory area. Table 4 shows 5,600 nonstocked acres in the upper block, most of which is fire origin. After fire, we usually can expect an immediate regeneration of hardwoods.

Cubic-Foot Volume

As could be expected from the foregoing area descriptions, a majority of the commercial volume is also concentrated in the upper block. Total unit volume is 343.0 million cubic feet, 93 percent of which, or in nearly the same proportion as commercial forest land occurrence, is found in the upper area (table 5).

Tree measurement data were collected concurrently at the inventory field sample locations, and volume equations were developed specifically for this inventory unit (Dippold and Farr 1971). Cubic- and board-foot volumes in this publication are expanded from those equations.

Softwood volume, most of which is in the white spruce type, comprises over 70 percent of the total unit volume and, as seen in table 4, also makes up a significant portion of the hardwood type volume.

The effects of concentrating our efforts in the river bottom stands are strikingly apparent in per acre volume comparisons. The reconnaissance inventory reported an average of 1,500 board feet per acre for the interior area. For the Kuskokwim unit this per acre average is 4,400 board feet with averages of 1,200 feet and 6,700 feet for hardwood and softwood types respectively.

Total unit sawtimber volume is 1.1 billion board feet (table 6). The white spruce type has about 80 percent of this

Table 5--*Net cubic volume of growing stock on commercial forest land by local forest type and by softwood and hardwood, Kuskokwim River, Alaska, 1967*

(Thousand cubic feet)

Forest type	Species group		
	Total	Softwood	Hardwood
Spruce	247,908.7	214,703.6	33,205.1
Birch	57,066.3	24,622.2	32,444.1
Balsam poplar	38,039.5	8,256.8	29,782.7
Total	343,014.5	247,582.6	95,431.9

Table 6--*Net board-foot volume on commercial forest land by forest type, and by softwood and hardwood species groups, Kuskokwim River, Alaska, 1967*

(Thousand board feet)

Forest type	Species group		
	Total	Softwood	Hardwood
White spruce	889,387.1	855,202.9	34,184.2
Paper birch	104,511.6	92,404.9	12,106.7
Balsam poplar	117,945.4	39,403.5	78,541.9
Total	1,111,844.1	987,011.3	124,832.8

sawtimber volume and as a species makes up about 90 percent. The hardwood species would become increasingly important in a small wood economy because of their characteristics of prolific seeding and sprouting. With their naturally shorter rotation more fiber can be produced per acre over time (Farr 1967, Gregory and Haack 1965).

Forest Types

Classification by forest type at a field plot location is based on the species forming a plurality of the live-tree stocking. The photointerpretation strata are adjusted by the field plot corrections and an expansion factor is calculated for the adjusted strata to develop forest type tables (table 7).

WHITE SPRUCE

White spruce in the Kuskokwim Valley occurs as an essentially pure type with but a minor hardwood component. Average volume per acre in this type is about 1,700 cubic feet, about one-fifth of which is composed of hardwoods. Average net board-foot volume is about 6,700 feet per acre with a maximum of 18,000 feet in sampled strata. Volumes per acre in the upper block are about 400 cubic feet per acre higher than those in the lower block. Figures 4 and 6 are aerial views of stands typical of the two blocks and illustrate the stocking differences and the related volume levels.

On both the upper and lower blocks, white spruce occupies a subclimax position. While white spruce is the climax "commercial species," it is eventually replaced by black spruce which in time becomes nonforest (Viereck 1970). This successional trend for the Kuskokwim is illustrated by figure 11. The rivers are constantly depositing on their inner bends. Willow and sometimes balsam poplar are the pioneer species with dense bands of willow being the normal development. Balsam poplar develops under the willow and eventually overtops it. As the willow begins dying out, white spruce invades the opening and over time outgrows or overtops the balsam poplar. During this time, permafrost has been moving closer to the surface and, with the increasing insulating litter and moss layer, white spruce is eventually frozen out and replaced by black spruce or brush and muskeg.

Although the best stands of white spruce and balsam poplar are mostly found on inner bends of the river (fig. 12), extensive commercial white spruce stands were also noted on south- and southwest-facing slopes on the hills between Medfra and McGrath and less continuous stands from Vinasale to the Stony River area. West of the Kuskokwim Mountains, the spruce stands found within a 20-mile

Table 7--*Area of commercial forest land by forest type and by block, Kuskokwim River, Alaska, 1967*

Forest type	Block		
	Total	Upper	Lower
White spruce	147.6	134.5	13.1
Paper birch	58.2	58.2	0.0
Balsam poplar	39.4	36.5	2.9
Nonstocked	7.3	5.6	1.7
Total	252.5	234.8	17.7

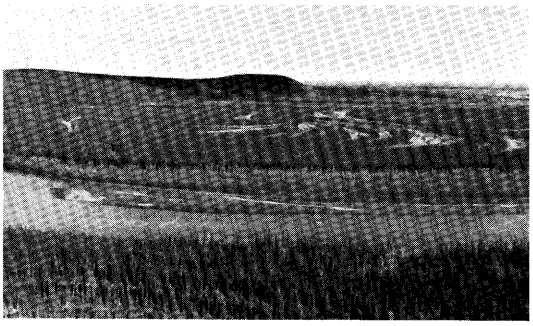


Figure 11.--Successional patterns from primary willow through forest land to nonforest bogs are shown in this view of a large sweeping bend in the Kuskokwim.

Figure 12.--White spruce with diameter to 24 inches d.b.h. were found in this spruce-birch stand near Medfra.

radius of Aniak are but marginally commercial.

Growing-stock volume in the white spruce type is 248 million cubic feet, about 70 percent of the total unit growing-stock volume (table 7). Volume of sawtimber is 889 million feet or 80 percent of the total sawtimber volume (table 6). The diameter group distribution, (table 8) shows white spruce species rather than type distribution. The proportions of white spruce volume by species and by type are nearly the same and probably have a comparable diameter group distribution.

Table 8--*Proportions of total cubic- and board-foot volumes for white spruce on commercial forest land by diameter groups, Kuskokwim River, Alaska, 1967*

Kind of volume	Diameter groups (inches)				
	5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21.0+
	- - - - - - - - -Percent- - - - - - - -				
Cubic foot--growing stock trees[1/]	18.5	37.9	29.3	11.2	3.1
Cubic foot--sawtimber[2/]	--	46.5	35.9	13.8	3.8
Board foot[3/]	--	42.1	38.1	15.4	4.4

[1/] Includes the total cubic volume distribution of this species.

[2/] Represents cubic volume in sawtimber-sized trees only.

[3/] Represents the distribution of board feet (Int 1/4") by diameter classes.

BALSAM POPLAR

On freshly deposited river alluviam, balsam poplar and willow are the primary invader species, but more commonly balsam poplar is found coming in under the willow. The aerial view in figure 13 illustrates the successional stages. In the Kuskokwim drainage the better stands are found in the upper block, particularly in the McGrath area and upriver and, except for a few instances, balsam poplar is confined to alluvial areas. Figure 14 illustrates one of these stands. As shown in tables 8 and 9, balsam poplar does not on the average attain as large diameters as white spruce.

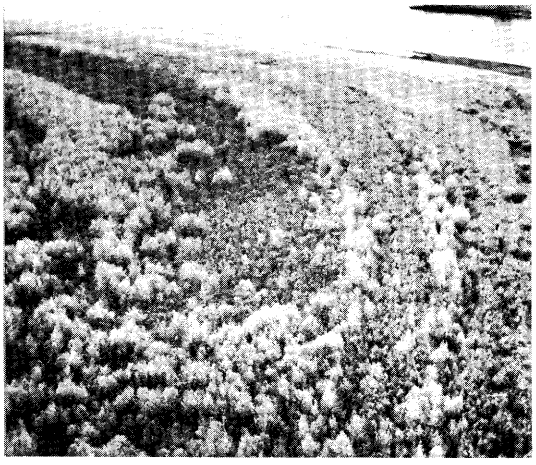


Figure 13.--This low level view of successional stages in cottonwood is unusual in its total absence of spruce and of continuing brush competition. With this condition, this site may never produce a commercial spruce crop but continue degrading to nonforest.

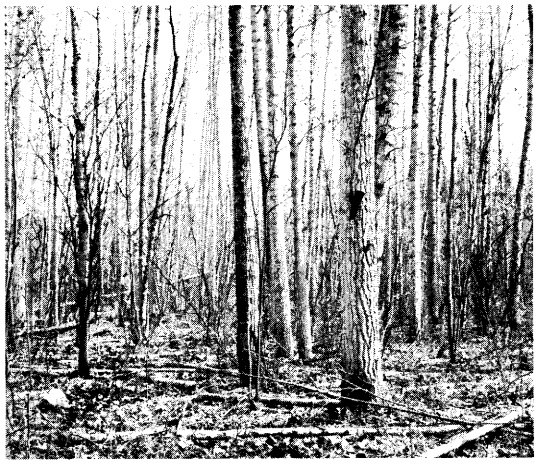


Figure 14.--Balsam poplar stands on the Kuskokwim are generally well stocked. This stand has 173 square feet of basal area per acre, average diameter of 9.6 inches, average total height of 66 feet, and a volume of 3,300 cubic feet per acre.

Table 9--*Proportions of total cubic- and board-foot volumes for balsam poplar on commercial forest land by diameter groups, Kuskokwim River, Alaska, 1967*

Kind of volume	Diameter groups (inches)				
	5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21.0+
	- - - - - - - -Percent- - - - - - - - -				
Cubic foot--growing stock trees[1/]	46.0	23.8	25.4	4.3	.5
Cubic foot--sawtimber[2/]	--	44.2	47.0	7.9	.9
Board foot[3/]	--	42.5	47.5	8.8	1.2

[1/] Includes the total cubic volume distribution of this species.

[2/] Represents cubic volume in sawtimber-sized trees only.

[3/] Represents the distribution of board feet (Int 1/4") by diameter classes.

Nearly half of the total cubic-foot volume is in pole-sized trees, and less than 5 percent is in trees with 17.0-inch d.b.h. and over. This relationship also holds for sawtimber-sized trees where over 90 percent of the volume is in trees less than 17.0 inches in diameter.

Total volume in the balsam poplar type is 38 million cubic feet or 118 million board feet which equals about 11 percent of the total unit volume. The majority of this volume is found in the upper block.

PAPER BIRCH

Nearly all valley bottom stands of the birch type have large proportions of spruce and balsam poplar. Only on the hillsides, in particular the area from McGrath to Stony River, did we note relatively pure stands of birch or birch with balsam poplar and quaking aspen in mixture (fig. 10). Considerable areas of birch type were noted in back of the balsam poplar and spruce meander bands, but most of these stands were very marginally productive.

The upper block contains all of the birch-type commercial forest acreage and volume. The birch stands of the lower Kuskokwim were all noncommercial. The 58,200 acres in the commercial birch type carry 57.1 million cubic feet or 104.5 million board feet of volume. Most birch volume is in the smaller diameter classes as shown in the species volume distribution table 10.

The concentration of volume in the smaller diameter classes illustrates the impracticality of planning a purely sawtimber harvest in the birch type. However, as mentioned previously, regeneration of birch is quite rapid and with seedbed preparation two rotations of pulp-size birch might be grown before a comparable spruce stand would reach sawtimber size.

Table 10--*Proportions of total cubic- and board-foot volumes for paper birch on commercial forest land by diameter groups, Kuskokwim River, Alaska, 1967*

Kind of volume	Diameter groups (inches)				
	5.0-6.9	9.0-12.9	13.0-16.9	17.0-20.9	21.0+
	- - - - - - - -Percent- - - - - - - -				
Cubic foot--growing stock trees[1/]	87.6	9.1	3.3	0.0	0.0
Cubic foot--sawtimber[2/]	--	73.0	27.0	0.0	0.0
Board foot--[3/]	--	71.4	28.6	0.0	0.0

[1/] Includes the total cubic volume distribution of this species.

[2/] Represents cubic volume in sawtimber-sized trees only.

[3/] Represents the distribution of board feet (Int 1/4") by diameter classes.

Quality-Log Grade

WHITE SPRUCE

White spruce was graded under "Official Grading Rules for Northern Hardwood and Softwood" (Northern Hemlock and Hardwood Manufacturers Association 1959). A relatively high 10 percent of the spruce volume is in grade 1 and 2 logs (requiring a 16-inch and a 12-inch small-end scaling diameter respectively) with 74 percent in grade 3 (requiring an 8-inch scaling diameter)(table 11). Although most trees failed to qualify for the upper two log grades because of small size, limbiness, a characteristic of white spruce in Alaska, also contributed heavily to degrade.

The volume in grade 1 and 2 logs is 97.8 million board feet or about 660 feet per acre for the type. We believe that most of this higher grade material is concentrated in the stands above McGrath.

BALSAM POPLAR AND BIRCH

Birch and cottonwood were graded according to "Hardwood Log Grades for Standard Lumber" (Forest Products Laboratory 1959). The specifications for these grades are correlated closely with specifications for hardwood lumber grades. Grade 1 logs require a 13-inch and grade 2, an 11-inch inside-bark, small-end scaling diameter, requiring trees of 16- and 14-inch d.b.h. and larger, respectively, to meet these minimum diameters. This is assuming a 1-inch bark thickness and a 2-inch taper in 16 feet.

Under this criteria, none of the birch qualifies for grade 1 and only 4 percent for grade 2. Balsam poplar is a little better with 5 percent and 28 percent of the total species volume qualifying as grade 1 and 2 respectively. The volume in hardwood grades 1 and 2, however, represents less than 3 percent of the total unit volume or, assuming it all to be in hardwood types, less than 350 board feet per acre. As a species it is probably safe to assume that birch could not attain a use level equal to balsam poplar and white spruce. Views of felled trees in figures 15 and 16 show the quality to be expected in balsam poplar and white spruce.

Growth

Net annual growth of the Kuskokwim stands is 4.5 million cubic feet and 29.4 million board feet. This represents a growth rate of 1.3 percent of the net cubic-foot growing-stock volume and 2.6 percent of the net board-foot volume. These growth rates are significantly lower than those for other areas we have inventoried.

Table 11--*Proportions of sawtimber, net board-foot volume by species and by quality class, Kuskokwim River, Alaska, 1967*

Log Grade	White spruce	Balsam poplar	Paper birch	Total volume proportion
	- - - - - - - - - - - - Percent - - - - - - - - - - - -			
1	0.5	4.8	0.0	0.8
2	9.5	28.1	4.2	10.9
3	74.0	52.6	74.5	72.2
1/4	16.0	14.5	21.3	16.1
Total	100.0	100.0	100.0	100.0

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

Figure 15.--A 12-inch balsam poplar felled for volume table construction. This species is generally self pruning. Degrade is usually caused by failure to meet minimum size requirements for log grade 1 and 2.

Figure 16.--This spruce sawtimber stand displays the combination of limbiness and small size that contributes to the high proportion of volume in the lower log grade.

A comparison of growth rates by species does not appear significant as both spruce and birch are about the same and balsam poplar a little higher. Inspection by d.b.h. classes (table 12) shows the most rapid growth rate in the 5.0- to 6.9-inch d.b.h. class, with a general leveling out through the remainder of the diameter classes. Unfortunately, ingrowth (total volumes of trees moving into the 5.0-inch class) complicates this picture. Without ingrowth, the actual growth of trees in the 5.0- to 6.9-inch d.b.h. class is only slightly higher than the larger diameter classes.

Table 12--*Rate of growth as a percent of net cubic growing-stock volume, by species and diameter classes, Kuskokwim River, Alaska, 1967*

Species	All diameters	Diameter classes								
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21+
		Percent								
White spruce	1.25	4.4	1.1	1.2	1.1	1.0	.9	1.1	.5	1.0
Paper birch	1.15	2.1	.9	.5	1.0	.7	--	--	--	--
Balsam poplar	1.86	4.0	1.8	1.3	1.6	1.9	1.9	3.7	0.7	1.0
All species	1.30	3.4	1.1	1.1	1.2	1.1	1.0	1.3	0.7	1.0

Earlier discussions about the effect of low stocking, inhibiting vegetation, and overmature stands were concerned mostly with the present stand volume. This same discussion can also apply to growth. Holes in the stand and overmature conditions show in the 17.8 mean annual increment rate for all commercial forest lands. If the data were available for the better stocked stands, it is quite likely the actual mean annual increment for those stands would exceed 20 cubic feet per acre.

Volume Loss--Defect

Field estimates were made of the amount of rough or rotten material in the tree. The use of log volume distribution tables and our practice of felling trees for volume table construction at each plot enabled us to make reasonably accurate estimates of volume loss caused by defect.

As an example of on-the-ground knowledge gained through tree felling: when balsam poplar is found growing in anything less than the dominant or codominant crown position, there will be substantial amounts of decay--even though there are no surface indicators. White spruce also showed few indicators of rot. Figure 17 is an example of a tree appearing to be sound but having heart rot. We were able to determine, through tree sectioning that this type of decay usually does not extend more than 4 to 6 feet up the bole. Common decay organisms causing extensive damage include *Fomes igniarius* and *F. applanatus* in birch, aspen, and cottonwood; *Polyporus resinosus* in birch; and *F. pini* and *Peridermium coloradense* in spruce (Kimmey and Stevenson 1957).

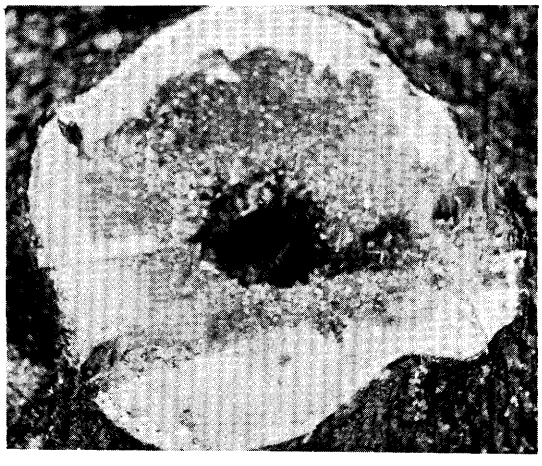


Figure 17.--No evidence of decay was externally visible on this white spruce. Fortunately this type of rot usually extends up the bole less than 6 feet.

The importance of loss caused by roughness and decay can be seen by comparing appendix tables 15 and 16. Board-foot reductions from gross volume amount to 7, 18, and 19 percent of spruce, balsam poplar, and birch respectively. This is a total volume loss of 100 million board feet.

Volume Loss--Mortality

Estimating the number of years since a tree died seems to be quite subjective and variable. The mortality rate for all Kuskokwim stands is but 0.1 percent of the net cubic-foot growing-stock volume. Actual annual volume loss was 382.6 thousand cubic feet and 956.4 thousand board feet. The mortality rate for the Kuskokwim is much less than that of the Susitna Valley (Hegg 1970) and but one-tenth of the rate for similar areas in the continental U.S. (U.S. Department of Agriculture Forest Service 1965). Future remeasurements should improve on these estimates, although in the Susitna Valley several plots have been remeasured and the calculated mortality rate is not significantly different from previous estimates (File letter March 8, 1972, 4810 2-1.0, Forestry Sciences Laboratory, Anchorage, Alaska).

ALLOWABLE CUT

Definitive knowledge of ownership and management objectives, as well as the timber resource itself, are prerequisites to allowable cut determination. The ownership and management responsibility of the forest lands along the Kuskokwim River will be constantly changing during the ensuing few years because of continuing State land selections and the Alaska Native Claims Settlement Act. Management objectives cannot be outlined, except in a broad sense, until definitive knowledge of the other resource values (recreation, wildlife, fisheries, etc.) are obtained. Because of these and other unknowns, any estimate of allowable cut must be tentative.

The Kuskokwim drainage contains both commercial and noncommercial forest lands. By definition, to be commercial a stand must be capable of producing wood fiber at an annual rate of at least 20 cubic feet per acre. Although this standard is somewhat arbitrary, it serves to delineate those lands on which sustained yields are most feasible.

One class of forest land that deserves mention is the "operable noncommercial." These are the areas presently having more than 800 gross cubic feet of volume per acre, but do not meet the "commercial" standard of 20 cubic feet per acre annual growth. Put another way, these lands contain a "sufficient" volume for logging, but likely will not produce and grow at a rate sufficient for prudent sustained yields. Additonal research is needed on the silvics of these stands before any truly informed judgments can be made relative to their sustained yield characteristics. The "White Spruce Silvicultural Study," headed by the U.S. Forest Service, Institute of Northern Forestry and principally funded by the Bureau of Land Management should provide some of this needed information.

The allowable cut calculation for the commercial forest lands is a conditioned one because none of the "take-outs" for watershed protection, fisheries and game habitat, recreation, esthetics, etc. have been determined through comprehensive land use planning. Until such plans are formulated, the allowable cut is tentative and subject to change as need is determined.

An annual allowable cut of 4.6 million cubic feet (16.3 million board feet) would be possible for the Kuskokwim River drainage if all the commercial forest land were committed to timber production and economically accessible. Under existing log export restrictions it is questionable if any of this resource would be economically accessible for external markets. The total allowable cut was calculated using the following formula:

$$\text{Annual cut} = \frac{\text{Present commercial forest land volume} + \text{MAI}}{\text{Rotation}}$$

Where: MAI = net annual growth and rotation was taken from empirical yield tables (122 years).

A number of differing formulas are available to make estimates of annual cuts. One of these, the Kemp formula, has been used in Alaska in the past because of its ease of application with available Forest Survey data. This formula is marginally applicable to the Kuskokwim because it is usually applied in areas where there is a surplus of timber beyond rotation age. The volume obtained using the Kemp formula is approximately 6.05 million cubic feet (21.5 million board feet) or about 30 percent above that calculated with the MAI formula.

The interior forest allowable cut volumes reported by the U.S. Forest Service in 1967 were computed using the Kemp formula (Hutchison 1967). The crossover between the above calculations and the 1967 report is poor at best because the latter data is not statistically accurate for the Kuskokwim alone.

FOREST USES

Timber Products

The forests along the Kuskokwim River have provided the essentials of life--food, heat, shelter--to natives since the time of first human habitation. Early white settlers came to this valley in search of furs and gold. Prior to 1900, wood use was for heat and logs for building cabins. The gold stampede in 1908 resulted in a dramatic increase in the number of people using the forest resources of the region (Berg 1965). Fuelwood to fire the boilers of the increased river-steamer activity, timbers for use in the mines, fuel for the mine steam-donkey engines, logs for building, and fuelwood for heat are uses that dramatically increased during this period. By 1914 the gold stampede was over and the use of the region's forests decreased (Berg 1965).

Several small portable sawmills are located in the area and have intermittently produced rough lumber for local use (fig. 18). Bureau of Land Management files[3/] show 19 sales containing 897 MBF were made during the 4 years of 1965-1968. During this same period, 14 free-use permits containing 83 MBF were issued.

3/ Bureau of Land Management files on timber sales located at the Anchorage District Office.

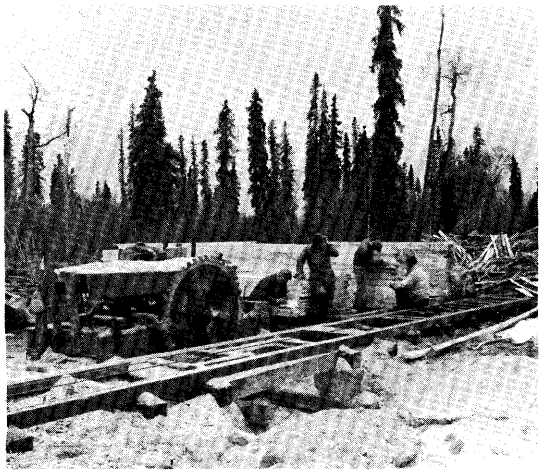


Figure 18.--The Nelson Brothers sawmill above Aniak. Although this operation is in an area of marginal commercial forest land, it is sited here because of relative proximity of markets.

At present, the principal use of the Kuskokwim timber resource is for fuel--8 to 12 cords of wood are required for each cabin heated because of the long, cold winters. This use is decreasing due to the increased use of fuel-oil heaters. In addition, logs for houses (fig. 19), poles for fish-drying racks, fish wheels, and dog sleds come from the forests. A recent sale of 311 MBF of white spruce was made by the BLM with a local sawmill. This sale is located about 18 miles above Stony River.

Economic incentives for large-scale development of the Kuskokwim timber resources were lacking until early 1963 when an Alaskan corporation applied to the Bureau of Land Management for purchase of 715 million board feet, Scribner log scale, of white spruce over a 20-year period. This corporation had established a market in Japan for round logs and intended to export all that would be cut.[4/] The application was not approved by BLM on the grounds that the Kuskokwim valley could not sustain a cut of this magnitude. Statistically accurate information was lacking, however, prompting BLM to cooperate with the U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, in an inventory of the forest resources of this valley so that an accurate determination of sustainable allowable cuts could be made.

[4/] Bureau of Land Management, Anchorage District Timber Sale File No. LS/N 031740.

Figure 19.--Because of availability, cost, and good insulation value many homes in the Aniak area are built of these three-sided logs.

Recreation

Recreation use of the Kuskokwim Valley is presently confined to fly-in sport fishing and hunting. Several of the clearwater streams feeding the Kuskokwim River support sport fish populations.

A road system roughly following the Kuskokwim River has been considered in some long range planning. Actual construction is probably 20 or more years away. If such a road is constructed, the recreation use of the Kuskokwim area will undoubtedly increase.

Livelihood and Subsistence Use

The wildlife and fish resources in the past were the foundation of the economy of the region. The Natives depended upon these resources for food, clothing, and cash income. Today, the need for cash is being satisfied in part by seasonal employment, and more frequently individual families tend to depend upon the resources as a secondary rather than a primary source of food and income (Federal Field Committee 1968). Although an important amount of their subsistence comes from the environment, they purchase the bulk of their food needs from stores (Federal Field Committee 1968).

Timber harvesting operations, if properly executed, should not degrade the opportunities for subsistence use of fish and wildlife resources of the Kuskokwim drainage. With proper attention to season of logging, cutting methods, cutting boundaries, and equipment employed, the subsistence uses should at least be maintained.

Conflicts (a brief summation)

Identification of potential land uses that would conflict with the utilization of a renewable resource like timber requires a time and space discussion. Alternative uses, to be in conflict, must demand land use not only for the same acre, but also at the same time. For example, timber could be totally harvested now from the same acres that in the future would be developed for intensive recreation use, provided that the intended recreation development is far enough into the future to allow stand reestablishment. Obviously, the regeneration characteristics of the species in question must be known as the time frame for recreation development.

Logging practices that tended to degrade or destroy fisheries habitat along the several freshwater streams would seriously affect the existing fisheries resource (fig. 20). These areas should be identified so that future activities can be carried on with full recognition of these other values.

Subsistence use of the Kuskokwim Valley is not particularly compromised by timber harvest. Fuelwood needs can be accommodated adjacent to towns and villages and subsistence fisheries and hunting can be protected and enhanced.

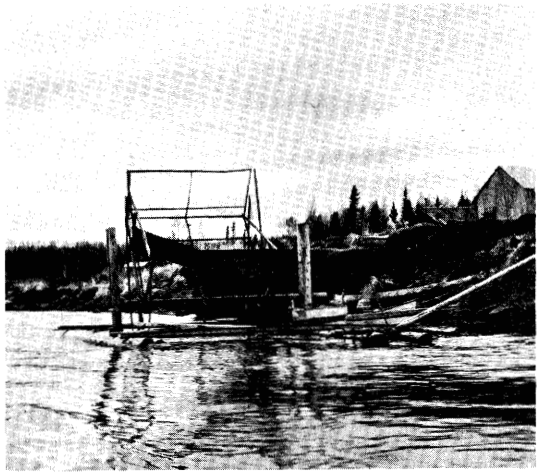


Figure 20.--The movement of the river current operates this fish wheel at Medfra. Salmon swimming upriver are caught in the bail and automatically transferred to a holding box.

Kuskokwim Timber--Present and Future Interest

The Alaska Native Claims Settlement Act has effectively curtailed any potential timber harvesting activities of substance along the Kuskokwim River. Small sales such as the contract for 311 MBF above Stony River have been allowed by the Native groups. The timber involved has been used to satisfy internal demand.

A recent study indicates that the total of the annual local demand along the upper Kuskokwim River is approximately 2 million board feet.[5/] The unavailability of dried,

[5/] Kay Koweluk, Local market demand for timber products in the middle Yukon and upper Kuskokwim Rivers, 26 p. Fed. Field Comm. for Dev. Plann. in Alaska. Anchorage. 1970. Unpublished.

surfaced, and graded native lumber and the unreliability of supply has influenced purchasers to prefer imported brand-name Douglas-fir for construction grade or better, kiln dried and surfaced, for their construction purposes. This preference would be temporary if native material were available and could meet construction specifications and timetables (see footnote 5).

Utilization

In order to capture some share of the local and export markets for timber products, suppliers must be competitive in price, supply, and quality with alternative sources. Most sawmills depend on regular and large volume production for profits. For local markets, a lack of economies of size can be partly or wholly offset by the transportation advantage local mills enjoy over external suppliers.

The Kuskokwim Market

One of the impediments to the development of lumber produce manufacturing as a viable economic base in the Kuskokwim is the large investment required on the part of the millowners to produce finished dimensional lumber for a relatively small market. In the past, project construction, such as the Bethel Housing project, had requirements for kiln-dried dressed lumber for typical 2 x 4 framed-wall construction. These requirements make it very difficult for local manufacturers to supply a project.

The Kuskokwim Forest Resource Committee has recommended that future project house designs be planned with a greater use of local materials fitting the manufacturing capabilities of the local sawmill operations (Federal Field Committee 1968). The use of three-sided house logs in place of conventional 2 x 4 framed walls is cited as an example. This would greatly increase the local manufacturers share of the local market.

Another necessity for increasing the local share of the Kuskokwim market is a dependable method of moving products to market. At present, the only economical transportation for timber products is the river barges. Service is restricted to the ice-free months. Even then, low water can curtail operations because of shoals and sandbars.

One new development that may have potential for providing year-round transportation for the Kuskokwim is the Air Cushion Vehicle (ACV). Several companies are working to develop ACV's with payload capacities of 100 tons, ranges of up to 1,000 miles, and speeds up to 60 mph. The transportation costs per ton-mile are not well known yet because of the newness of this mode of transportation, but the developers are optimistic that it will be competitive.[6/]

The Export Market

Local enterprises that have difficulty competing for a larger share of a Kuskokwim market are faced with even larger obstacles in trying to capture a share of export markets, mainly because of transportation costs. The greatest potential external market for forest products from the Kuskokwim probably is Japan.

Assuming a market exists in Japan for cants produced by mills in the Kuskokwim drainage, and further that a net[7/] allowable cut of 12 million board feet per year would be allowed by the managing agencies, we can analyze the potential of this area to compete for this external market by comparing it to the existing situation in Haines, Alaska, where cants are presently sawn for shipment to Japan. As noted earlier however, local mills would also have to solve transportation problems to Bethel plus maintaining a steady flow of material.

The timber resources of the Kuskokwim drainage, to compete with the other sources of supply for a share of the cant market in Japan, would have to be available at similar f.o.b. dock prices. Transportation of logs or cants down the Kuskokwim River from McGrath to Bethel (the closest potential large ship port) in rafts towed by tugs would cost about $20.00 per MBF, plus bundling and rafting. Movement via air cushion vehicle at 6 cents per ton-mile[8/] would cost about $43.00 per

---

[6/] Testimony before the Alaska Transportation Commission, Anchorage, Alaska, January 1971, Docket No. 70-364-ACV.

[7/] Net refers to the 16.3 million board feet allowable cut referred to elsewhere in this report less the "take-outs" necessary to protect other resource values.

[8/] Testimony before the Alaska Transportation Commission, Anchorage, Alaska, January 1971, Docket No. 70-364-ACV.

MBF plus loading and unloading costs. Logging, sawmilling, fixed and miscellaneous costs would add an additional $25.00 to $50.00 per MBF. Difficulty in obtaining economics of scale in the milling and logging operations when only 12 MMBF of timber (assumed) are available per year will likely push these costs toward the higher range of figures. Unless product prices increase significantly, these factors plus the harsh environment-inflicted costs will make capture of a share of the cant market questionable. Thus, the future use of the forests of the Kuskokwim drainage may be confined to supplying local demands. The small annual allowable cut and the high cost of the factors of producing to supply any external market in relation to alternate sources forces this conclusion.[9/]

SURVEY METHODS

The estimates of area and timber volumes are based on a double sampling procedure (Bickford 1952). Enough points to satisfy specific levels of statistical precision were uniformly distributed on aerial photographs. At each of these photo points, 1 acre was classified by land type, forest type, and volume strata. A subsample was drawn from all land types and reexamined. All points in the subsample which were originally classified as commercial forest land as well as any other points questionably classified were visited on the ground.

[9/] Harold P. Sieverding, Economist, Bureau of Land Management, Alaska State Office, Anchorage.

For the Kuskokwim unit we interpreted 6,452 photopoints and reexamined 122 noncommercial and nonforest points. This reexamination served as a substitute ground check and yielded eight questionable points which, with the 162 commercial forest and operable noncommercial points, totaled 170 locations actually checked on the ground. The ground plot was located at the exact point established on the photo. At each ground location, a 10-point cluster of plots was measured. A 40 basal-area factor gauge was used to select sample trees at each point for detailed measurements of size and vigor. Through data processing procedures, the total sample and the individual tree volumes were expanded to obtain the various data needed or specified on area and volume. The tables herein depart from the standard Forest Survey tables, however, with addition of a noncommercial forest category called "operable." During the initial inventory of interior Alaska, we found that much noncommercial forest land had relatively high per-acre volume. When more intensive inventories were begun in the mid-1960's, we and our cooperators agreed that some of this noncommercial strata had potential value as a commercial wood supply. By extrapolation, from cutting minimums of 3 cords per acre used in the Lake States and Canada, we established 9 cords or 800 cubic feet per acre as a prudent level for Alaska. This threefold increase in the minimum economic operating level should help compensate for the higher production and shipping costs in Alaska.

SAMPLING ERROR

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

TABLE OF SAMPLING ERROR

Specified base area and volume	Design sampling error	Sampling error achieved	Sampling error of total volume or area reported
	Percent		
Area:			
Commercial forest land, per million acres	3.0	3.0	7.0
Noncommercial forest land, per million acres	10.0	6.0	6.0
Volume:			
Commercial forest land, per billion cubic feet	5.0	5.0	8.0
Commercial forest land, growth per billion cubic feet	5.0	1.0	9.0

For the Kuskokwim River unit, we are reporting 343,014,000 cubic feet of growing-stock volume ± 8.0 percent. If repeated samples were taken of this population, the chances are two in three that this sample is one of the samples for which the true value is contained within the sample confidence interval (315,573,000 to 370,455,000).

PRINCIPAL TREE SPECIES OF INTERIOR ALASKA[10/]

Softwoods:	
Black spruce	*Picea mariana* (Mill.) B.S.P.
White spruce	*Picea glauca* (Moench) Voss
Tamarack	*Larix laricina* (Du Roi) K. Koch
Hardwoods:	
Black cottonwood	*Populus trichocarpa* Torr. & Gray
Balsam poplar	*Populus balsamifera* L.
Paper birch	*Betula papyrifera* Marsh.
Quaking aspen	*Populus tremuloides* Michx.

TERMINOLOGY[11/]

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 class--Area condition class provides a general stratification of commercial forest land by management opportunity class as indicated by the stocking or area controlled by tree and cover class.

Code

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.

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 for desirable trees.

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.

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.

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.

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.

70 Areas less than 60 percent stocked with desirable trees and with less than 60-percent stocking with growing-stock trees. Stands in this category generally have little prospect for improved desirable tree or growing-stock stocking without treatment such as site preparation and regeneration, etc.

[10/] Scientific names are according to Elbert L. Little, Jr., Checklist of native and naturalized trees of the United States (including Alaska). Agriculture Handbook No. 41, 472 p. USDA Forest Service, Washington, D.C. 1953.

[11/] Terminology from USDA Forest Service, Forest Service Handbook, Title 4813.1, 1967.

Commercial species--Trees presently or prospectively suitable for industrial wood products.

Cull--Portions of a tree that are unusable for industrial wood products, because of rot, form, or other defect.

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.

Noncommercial operable--noncommercial forest land presently carrying a gross volume in excess of 800 cubic feet per acre. Noncommercial inoperable--noncommercial forest land presently carrying a gross volume of less than 800 cubic feet per acre.

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.

Hardwoods--Dicotyledonous trees, usually broad leaved and deciduous. Alaska hardwood species are paper birch, quaking aspen, black cottonwood, and balsam poplar.

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

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

Land area--The area of dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tides), streams, sloughs, estuaries, and canals less than 120 feet in width; and lakes, reservoirs, and ponds less than 1 acre in size.

Log grades--A classification of logs based on external characteristics as indicators of quality or value.

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 the ability to produce 20 cubic feet per acre per year.

Mortality--Number of sound-wood volume 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 defects affecting product use.

Growing-stock volume: The net 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 the point where the central stem breaks into limbs.

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

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 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.

Nonstockable--Areas of forest land not capable of supporting forest growth because of presence of rock, water, etc.

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).

Saw log--A log meeting minimum standards of diameter, length, and defect including logs at least 8 feet long, sound, and straight and with a minimum diameter inside bark for softwoods of 6 inches (8 inches for hardwoods).

Saw-log portion--That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top--The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0-inches d.o.b. for softwoods and 9.0-inches d.o.b. for hardwoods.

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

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

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 species, 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.

Sawtimber stands: Stands at least 16.7 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Poletimber stands: Stands at least 16.7 percent stocked with growing-stock trees of which half or more of this stocking is in poletimber and sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Sapling-seedling stands: Stands at least 16.7 percent stocked with growing-stock trees of which more than half of the stocking is sapling 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 tree of 9.0-inch d.b.h. and larger. Hardwood tree of 11.0-inch d.b.h. and larger.

Poletimber-size tree: Softwood tree of 5.0- to 8.9-inch d.b.h. Hardwood 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.

Upperstem portion--That part of the main stem or fork of sawtimber trees above the saw-log top to a minimum top diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

Water--Bureau of the Census definition: Streams, sloughs, estuaries, and canals more than 1/8 of a statute mile in width; and lakes, reserviors, and ponds more than 40 acres in area.

Water--Forest Survey definition: The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

LITERATURE CITED

Berg, Richard A.
1965. The economic base and development of Alaska's Kuskokwim basin with particular emphasis upon the period 1950-1964. M.S. thesis, University of Alaska, College. 122 p.

Bickford, C. A.
1952. The sampling design used in the forest survey of the northeast. J. For. 50(4):290-293.

Bruce, Donald, and Francis X. Schumacher.
1950. Forest mensuration. McGraw-Hill Book Co., New York. 483 p.

Dippold, Ronald M., and Wilbur A. Farr.
1971. Volume tables and equations for white spruce, balsam poplar, and paper birch of the Kuskokwim River Valley, Alaska. USDA For. Serv. Res. Note PNW-147, 8 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Farr, Wilbur A.
1967. Growth and yield of well-stocked white spruce stands in Alaska. USDA For. Serv. Res. Pap. PNW-53, 30 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Federal Field Committee for Development Planning in Alaska.
1968. Alaska Native and the land. Wash., U.S. Gov. Print. Off. 565 p., illus.

Fernald, Arthur T.
1955. Upper Kuskokwim Valley. p. 130-131. David M. Hopkins, Thor. N. V. Karlstrom and others, Permafrost and ground water in Alaska. Washington, U.S. Geol. Surv. prof. paper 264 - F. pp. 113-146 + 15 pl.

Fernald, Arthur T.
1960. Geomorphology of the Upper Kuskokwim region, Alaska. Wash. U.S. Geol. Surv. Bull. 1071-G:191-279.

Ferrians, Oscar J., Jr.
1965. Permafrost map of Alaska. Wash. U.S. Geol. Surv. Misc. Geologic Investigations, Map I-445.

Gregory, Robert A., and Paul M. Haack.
1965. Growth and yield of well-stocked aspen and birch stands in Alaska. USDA For. Serv. Res. Pap. NOR-2, 28 p. Northern For. Exp. Stn., Juneau, Alaska.

Hegg, Karl M.
1970. Forest resources of the Susitna Valley, Alaska. USDA For. Serv. Resour. Bull. PNW-32, 42 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Hutchison, O. Keith.
1967. Alaska's forest resource. USDA For. Serv. Resour. Bull. PNW-19, 74 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Johnson, Phillip R., and Charles W. Hartman.
1969. Environmental atlas of Alaska. Inst. of Water Resources, Univ. of Alaska, College, Alaska, 111 p.

Kellog, C. E., and I. J. Nygaard.
1951. Exploratory study of the principal soil groups of Alaska. Washington USDA Agric. Res. Admin. Agric. Monogr. 7, 138 p., illus.

Kimmey, J. W., and J. A. Stevenson.
1957. A forest disease survey of Alaska. Plant dis. reptr. Suppl. 247:87-98.

Northern Hemlock and Hardwood Manufacturers Association.
1959. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wis., 12 p.

U.S. Department of Agriculture.
1941. Climate of Alaska, p. 1211-1215. *In* Climate and man Wash., USDA yearbook of agriculture. 1,248 p.

U.S. Department of Agriculture, Forest Service.
1965. Timber trends in the United States. Wash., U.S. For. Serv. For. Resour. Rep. No. 17, 235 p., illus.

U.S. Department of Commerce, Weather Bureau.
1965. Climatic summary of the United States, Supplement for 1951-1960, Alaska. USDC, Weather Bureau, Washington, D.C. Climatography of the United States No. 86-43. 68 p.

U.S. Forest Products Laboratory.
1959. Hardwood log grades for standard lumber; proposals and results, information reviewed and reaffirmed. USDA For. Prod. Lab. Rep. D1737, 66 p., illus. Forest Products Laboratory, Madison, Wis.

Viereck, Leslie A.
1970. Soil temperatures in river bottom stands in interior Alaska. p. 223-233. *In* UNESCO, Ecology of the Subarctic Regions, proc. of the Helsinki Symposium. Paris, France, UNESCO, p. 364.

Zasada, John C.
1970. White spruce cone and seed production in interior Alaska, 1957-1968. USDA For. Serv. Res. Note PNW-129, 11 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Zasada, John C.
1972. Guidelines for obtaining natural regeneration of white spruce in Alaska. USDA For. Serv., 16 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Table 13--*Area of commercial and operable noncommercial forest land, by stand-size classes, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Stand-size class	Commercial	Operable noncommercial[1/]	Total
Sawtimber stands	158.6	32.7	191.3
Poletimber stands	69.9	37.7	107.6
Seedling and sapling stands	16.7	0.0	16.7
Nonstocked areas	7.3	0.0	7.3
Total	252.5	70.4	322.9

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 14--*Area of commercial and operable noncommercial forest land, by board-foot volume classes, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Stand volume per acre[1/]	Commercial	Operable noncommercial[2/]	Total
0 - 799	34.5	7.2	41.7
800 - 1,499	24.0	15.4	39.4
1,500 - 2,999	48.8	37.5	86.3
3,000 - 4,999	58.3	10.3	68.6
5,000 - 6,999	43.3	0.0	43.3
More than 7,000	43.6	0.0	43.6
Total	252.5	70.4	322.9

[1/] Net volume International 1/4-inch rule.

[2/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 15--*Area of commercial and operable noncommercial[1/] forest land, by stand-volume and stand-size classes, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Stand-volume class	Stand-size				
	Non-stocked	Seedling sapling	Poletimber	Sawtimber	Total
Cubic feet					
0 - 299	7.3	10.4	0.0	1.9	19.6
300 - 799	0.0	6.3	31.2	36.1	73.6
800 - 1,499	0.0	0.0	53.8	79.1	132.9
1,500 - 2,199	0.0	0.0	18.2	43.9	62.1
More than 2,200	0.0	0.0	4.4	30.3	34.7
Total	7.3	16.7	107.6	191.3	322.9

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 16--*Area of commercial forest land by area condition class, Kuskokwim River, Alaska, 1967*

Code	Area condition class	Thousand acres
10	Areas 100 percent or more stocked with desirable trees and not overstocked.	2.2
20	Areas 100 percent or more stocked with desirable trees and overstocked.	0.0
30	Areas 60 to 100 percent stocked with desirable trees, and with less than 50 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash, or nonstockable conditions.	5.1
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.	13.1
50	Areas less than 60 percent stocked with desirable trees, but with 100-percent or more stocking with growing-stock trees.	39.7
60	Areas less than 60 percent stocked with desirable trees, but with 60- to 100-percent stocking with growing-stock trees.	137.2
70	Areas less than 60 percent stocked with desirable trees, and with less than 60-percent stocking of growing-stock trees.	55.2
All classes		252.5

Table 17--*Area of commercial forest land, by site class, Kuskokwim River, Alaska, 1967*

Site class[1/]	Thousand acres
Cubic feet[2/]	
50 or more	0.0
20 - 50	252.5
Total	252.5

[1/] Site class is a classification of forest land in terms of inherent capability to grow crops of industrial wood based on fully stocked natural stands.

[2/] Potential yield, mean annual increment.

Table 18--*Area of commercial and noncommercial forest land, by forest type, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Forest type	Commercial	Noncommercial		
		Operable[1/]	Inoperable[2/]	Total
Balsam poplar	39.4	2.6	0.0	42.0
Black spruce	0.0	2.6	519.2	521.8
Nonstocked	7.3	0.0	0.0	7.3
Paper birch	58.2	21.1	19.3	98.6
Quaking aspen	0.0	0.0	1.9	1.9
White spruce	147.6	44.1	11.0	202.7
Total	252.5	70.4	551.4	874.3

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2/] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre.

Table 19--*Area of commercial forest land, by stand-age and stand-size classes, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Stand-age	Stand-size				
	Nonstocked	Seedling-sapling	Poletimber	Sawtimber	Total
Years					
Nonstocked	--	--	--	--	--
1 - 10	0	1.6	0	0	0
10 - 20	0	3.8	0	1.9	5.7
20 - 30	0	3.5	0	0	3.5
30 - 40	0	4.3	0	0	4.3
40 - 50	0	0	1.6	0	1.6
50 - 60	0	0	0	2.6	2.6
60 - 70	1.7	0	16.6	0	18.3
70 - 80	0	0	2.1	4.9	7.0
80 - 90	0	0	4.3	8.6	12.9
90 - 100	5.6	1.6	6.0	3.8	17.0
100 - 120	0	0	10.8	8.9	19.7
120 - 140	0	0	9.3	26.3	35.6
140 - 160	0	0	8.5	16.8	25.3
160 - 180	0	0	4.4	19.1	23.5
180 - 200	0	0	0	15.3	15.3
200 - 300	0	0	0	18.4	18.4
300 and over	0	0	0	2.6	2.6
Mixed ages	0	1.9	6.3	29.4	37.6
Total	7.3	16.7	69.9	158.6	252.5

Table 20--*Area of operable noncommercial*[1/] *forest land, by stand-age and stand-size classes, Kuskokwim River, Alaska, 1967*

(Thousand acres)

Stand-age	Stand-size				
	Nonstocked	Seedling-sapling	Poletimber	Sawtimber	Total
Years					
Nonstocked	--	--	--	--	--
1 - 10	0	0	0	2.6	2.6
10 - 20	0	0	0	0	0
20 - 30	0	0	0	0	0
30 - 40	0	0	0	0	0
40 - 50	0	0	0	0	0
50 - 60	0	0	0	0	0
60 - 70	0	0	1.9	0	1.9
70 - 80	0	0	0	0	0
80 - 90	0	0	0	0	0
90 - 100	0	0	4.9	0	4.9
100 - 120	0	0	4.3	4.3	8.6
120 - 140	0	0	4.9	2.8	7.7
140 - 160	0	0	7.4	8.3	15.7
160 - 180	0	0	2.2	2.8	5.0
180 - 200	0	0	1.9	4.2	6.1
200 - 300	0	0	2.8	4.9	7.7
300 and over	0	0	0	0	0
Mixed ages	0	0	7.4	2.8	10.2
Total	0	0	37.7	32.7	70.4

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 21--*Number of growing-stock trees on commercial forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(Thousand trees)

Diameter class	Balsam poplar	Paper birch	Quaking aspen	White spruce	Total
Inches d.b.h.					
1.0 - 2.9	2,397.8	9,473.8	66.5	8,711.1	20,649.2
3.0 - 4.9	977.9	7,654.8	0.0	6,520.1	15,152.8
5.0 - 6.9	1,097.3	5,977.7	0.0	5,860.7	12,935.7
7.0 - 8.9	1,231.4	3,737.4	133.8	5,092.2	10,194.8
9.0 - 10.9	1,137.1	1,660.8	127.2	3,543.1	6,468.2
11.0 - 12.9	687.5	452.2	0.0	2,812.8	3,952.5
13.0 - 14.9	353.3	125.1	0.0	1,499.3	1,977.7
15.0 - 16.9	132.3	11.4	0.0	846.8	990.5
17.0 - 18.9	29.2	0.0	0.0	360.9	390.1
19.0 - 20.9	18.9	0.0	0.0	153.1	172.0
21.0 - 28.9	2.2	0.0	0.0	88.4	90.6
29.0+	0.0	0.0	0.0	0.0	0.0
Total	8,064.9	29,093.2	327.5	35,488.5	72,974.1

Table 22--*Number of growing-stock trees 5.0-inch d.b.h. and larger on commercial and operable noncommercial forest land, by species and 5-foot height classes, Kuskokwim River, Alaska, 1967*

(Thousand trees)

Height classes	White spruce	Paper birch	Balsam poplar	Quaking aspen	Total
0 - 30	1,596.8	777.7	109.0	0.0	2,483.5
31 - 35	2,092.8	1,190.4	424.4	0.0	3,707.6
36 - 40	3,264.7	2,546.1	675.8	0.0	6,486.6
41 - 45	3,232.1	3,641.2	750.9	43.3	7,667.5
46 - 50	3,752.5	4,290.3	1,013.7	52.4	9,109.9
51 - 55	3,076.4	2,479.6	485.5	72.9	6,114.4
56 - 60	2,881.8	797.6	591.4	98.9	4,369.7
61 - 65	2,106.5	244.2	407.1	39.4	2,797.2
66 - 70	1,923.8	103.4	238.0	49.9	2,315.1
71 - 75	997.8	18.7	96.6	0.0	1,113.1
76 - 80	773.7	0.0	49.8	0.0	823.5
81 - 85	420.3	0.0	2.2	0.0	422.5
86 - 90	185.1	0.0	0.0	0.0	185.1
91 - 95	99.7	0.0	0.0	0.0	99.7
96 - 100	34.0	0.0	0.0	0.0	34.0
100+	18.7	0.0	0.0	0.0	18.7
Total	26,456.7	16,089.2	4,844.4	356.8	47,747.1

Table 23--*Net volume of timber on commercial and operable noncommercial[1/] forest land, by class of timber and softwoods and hardwoods, Kuskokwim River, Alaska, 1967*

(Million cubic feet)

Class of timber	Commercial forest land			Operable noncommercial forest land		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Sawtimber trees:						
Saw-log portion	177.3	27.0	204.3	26.7	1.4	28.1
Upper-stem portion	24.5	2.4	26.9	4.1	0.1	4.2
Total	201.8	29.4	231.2	30.8	1.5	32.3
Poletimber trees	45.8	66.0	111.8	15.3	18.4	33.7
All growing-stock trees	247.6	95.4	343.0	46.1	19.9	66.0
Rough trees	1.7	0.5	2.2	1.7	0.1	1.8
Rotten trees	3.8	7.4	11.2	.8	2.2	3.0
Salvable dead trees	1.0	0.7	1.7	1.8	0.0	1.8
Total	254.1	104.0	358.1	50.4	22.2	72.6

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 24--*Net volume of growing stock on commercial forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(Million cubic feet)

Species	Diameter class (inches at breast height)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-26.9	27.0+	Total
Softwoods:											
White spruce	14.1	31.7	42.7	51.2	41.4	31.1	18.5	9.3	7.6	0.0	247.6
Total	14.1	31.7	42.7	51.2	41.4	31.1	18.5	9.3	7.6	0.0	247.6
Hardwoods:											
Paper birch	14.4	18.6	12.4	5.8	1.9	0.2	0.0	0.0	0.0	0.0	53.3
Balsam poplar	2.5	5.9	9.9	9.5	6.8	3.3	1.1	.6	.2	0.0	39.8
Quaking aspen	0.0	.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Total	16.9	25.3	23.8	15.3	8.7	3.5	1.1	.6	.2	0.0	95.4
Total	31.0	57.0	66.5	66.5	50.1	34.6	19.6	9.9	7.8	0.0	343.0

Table 25--*Net volume of growing stock on commercial and operable noncommercial*[1/] *forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(Million cubic feet)

Species	Diameter class (inches at breast height)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-26.9	27.0+	Total
Softwoods:											
White spruce	20.0	41.0	56.4	59.1	47.4	33.5	19.3	9.3	7.6	0.0	293.6
Total	20.0	41.0	56.4	59.1	47.4	33.5	19.3	9.3	7.6	0.0	293.6
Hardwoods:											
Paper birch	18.8	26.3	17.9	6.5	2.2	.2	0.0	0.0	0.0	0.0	71.9
Balsam poplar	2.5	6.4	10.0	9.6	7.1	3.3	1.1	.6	.2	0.0	40.8
Quaking aspen	.2	.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6
Total	21.5	33.6	29.4	16.1	9.3	3.5	1.1	.6	.2	0.0	115.3
Total	41.5	74.6	85.8	75.2	56.7	37.0	20.4	9.9	7.8	0.0	408.9

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 26--*Net volume of sawtimber on commercial forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
	Million board feet								
Softwoods:									
White spruce	174.1	241.5	211.2	164.7	100.5	51.7	43.3	0.0	987.0
Total	174.1	241.5	211.2	164.7	100.5	51.7	43.3	0.0	987.0
Hardwoods:									
Paper birch	--	20.0	7.0	1.0	0.0	0.0	0.0	0.0	28.0
Balsam poplar	--	41.2	30.1	15.9	5.6	2.9	1.1	0.0	96.8
Total	--	61.2	37.1	16.9	5.6	2.9	1.1	0.0.	124.8
Total	174.1	302.7	248.3	181.6	106.1	54.6	44.4	0.0	1,111.8

Table 27--*Net volume of sawtimber on commercial and operable noncommercial*[1/] *forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
	-Million board feet-								
Softwoods:									
White spruce	226.9	275.8	239.0	176.1	104.7	51.7	43.3	0.0	1,117.5
Total	226.9	275.8	239.0	176.1	104.7	51.7	43.3	0.0	1,117.5
Hardwoods:									
Paper birch	--	22.2	7.7	1.1	0.0	0.0	0.0	0.0	31.0
Balsam poplar	--	41.6	31.7	15.9	5.6	2.9	1.1	0.0	98.8
Total	--	63.8	39.4	17.0	5.6	2.9	1.1	0.0	129.8
Total	226.9	339.6	278.4	193.1	110.3	54.6	44.4	0.0	1,247.3

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 28--*Gross volume of sawtimber on commercial forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
	-Million board feet-								
Softwoods:									
White spruce	180.7	254.6	224.7	181.6	111.4	58.5	47.8	0.0	1,059.3
Total	180.7	254.6	224.7	181.6	111.4	58.5	47.8	0.0	1,059.3
Hardwoods:									
Paper birch	--	24.3	9.1	1.3	0.0	0.0	0 0	0.0	34.7
Balsam poplar	--	48.6	37.3	19.8	6.6	4.3	1.1	0.0	117.7
Total	--	72.9	46.4	21.1	6.6	4.3	1.1	0.0	152.4
Total	180.7	327.5	271.1	202.7	118.0	62.8	48.9	0.0	1,211.7

Table 29--*Gross volume of sawtimber on commercial and operable noncommercial*[1/] *forest land, by species and diameter classes, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
	- - - - - - - - - - - - - - - - Million board feet - - - - - - - - - - - - - - - -								
Softwoods:									
White spruce	235.8	291.1	254.6	194.9	115.5	58.5	47.8	--	1,198.2
Total	235.8	291.1	254.6	194.9	115.5	58.5	47.8	--	1,198.2
Hardwoods:									
Paper birch	--	27.1	9.9	1.3	0.0	0.0	0.0	--	38.3
Balsam poplar	--	49.4	40.0	19.8	6.6	4.3	1.1	--	121.2
Total	--	76.5	49.9	21.1	6.6	4.3	1.1	--	159.5
Total	235.8	367.6	304.5	216.0	122.1	62.8	48.9	--	1,357.7

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 30--*Net volume of sawtimber on commercial forest land, by species and log grade, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Log grade[1/]				Total
	1	2	3	4[2/]	
	- - - - Million board feet - - - -				
Softwoods:					
White spruce	4.7	93.1	725.1	164.1	987.0
Total	4.7	93.1	725.1	164.1	987.0
Hardwoods:					
Paper birch	--	1.1	19.6	7.3	28.0
Balsam poplar	4.4	25.6	47.9	18.9	96.8
Total	4.4	26.7	67.5	26.2	124.8
Total	9.1	119.8	792.6	190.3	1,111.8

[1/] U.S. Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

[2/] Local-use logs.

Table 31--*Net volume of sawtimber on operable noncommercial*[1/] *forest land, by species and log grade, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Log grade[2/]				Total
	1	2	3	4[3/]	
	- - - - -Million board feet- - - - -				
Softwoods:					
White spruce	0.0	2.7	79.9	47.8	130.4
Total	0.0	2.7	79.9	47.8	130.4
Hardwoods:					
Paper birch	0.0	0.0	2.7	.4	3.1
Balsam poplar	0.0	.7	1.1	.2	2.0
Total	0.0	.7	3.8	.6	5.1
Total	0.0	3.4	83.7	48.2	135.5

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2/] U.S. Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Assoc. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[3/] Local-use logs.

Table 32--*Net annual growth of growing stock, by forest land class and species, Kuskokwim River, Alaska, 1967*

(Thousand cubic feet)

Species	Forest land class		
	Commercial	Operable noncommercial[1/]	Total
Softwoods:			
White spruce	3,098.7	427.4	3,526.1
Total	3,098.7	427.4	3,526.1
Hardwoods:			
Paper birch	611.8	282.0	893.8
Balsam poplar	743.2	12.0	755.2
Quaking aspen	22.5	2.9	25.4
Total	1,377.5	296.9	1,674.4
Total	4,476.2	724.3	5,200.5

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 33--*Net annual growth of sawtimber, by forest land classes and species, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Forest land class		
	Commercial	Operable noncommercial[1/]	Total
	- - - - - -Thousand board feet- - - - - -		
Softwoods:			
White spruce	19,699.9	6,053.5	25,753.4
Total	19,699.9	6,053.5	25,753.4
Hardwoods:			
Paper birch	1,947.1	12.5	1,959.6
Balsam poplar	7,747.6	23.1	7,770.7
Total	9,694.7	35.6	9,730.3
Total	29,394.6	6,089.1	35,483.7

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 34--*Annual mortality of growing stock, by species and forest land classes, Kuskokwim River, Alaska, 1967*

(Thousand cubic feet)

Species	Forest land class		
	Commercial	Operable noncommercial[1/]	Total
Softwoods:			
White spruce	268.8	79.1	347.9
Total	268.8	79.1	347.9
Hardwoods:			
Paper birch	53.6	3.1	56.7
Balsam poplar	60.2	0.0	60.2
Total	113.8	3.1	116.9
Total	382.6	82.2	464.8

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 35--*Annual mortality of sawtimber, by species and forest land classes, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Species	Forest land class		
	Commercial	Operable noncommercial[1/]	Total
	- - - - - -Thousand board feet- - - - - -		
Softwoods:			
White spruce	956.4	326.4	1,282.8
Total	956.4	326.4	1,282.8
Hardwoods:			
Paper birch	0.0	9.9	9.9
Balsam poplar	147.5	0.0	147.5
Total	147.5	9.9	157.4
Total	1,103.9	336.3	1,440.2

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 36--*Annual mortality of growing stock on commercial and noncommercial forest land, by cause, and softwoods and hardwoods, Kuskokwim River, Alaska, 1967*

(Thousand cubic feet)

Cause	Commercial forest land			Operable noncommercial[1/] forest land		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Fire	0.0	0.0	0.0	0.0	0.0	0.0
Insects	93.4	0.0	93.4	0.0	0.0	0.0
Disease	23.2	0.0	23.2	0.0	0.0	0.0
Windthrow	0.0	0.0	0.0	64.5	0.0	64.5
Other	36.1	29.8	65.9	14.6	3.1	17.7
Unknown	116.1	84.0	200.1	0.0	0.0	0.0
Total	268.8	113.8	382.6	79.1	3.1	82.2

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

Table 37--*Annual mortality of sawtimber on commercial and noncommercial forest land, by cause, and softwoods and hardwoods, Kuskokwim River, Alaska, 1967*

(International 1/4-inch rule)

Cause	Commercial forest land			Operable noncommercial[1/] forest land		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	- - - - - - - - - - - - Thousand board feet - - - - - - - - - - - -					
Fire	0.0	0.0	0.0	0.0	0.0	0.0
Insects	458.7	0.0	458.7	0.0	0.0	0.0
Disease	0.0	0.0	0.0	0.0	0.0	0.0
Windthrow	0.0	0.0	0.0	326.4	0.0	326.4
Other	125.6	147.5	273.1	0.0	9.9	9.9
Unknown	372.1	0.0	372.1	0.0	0.0	0.0
Total	956.4	147.5	1,103.9	326.4	9.9	336.3

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

GPO 990-478

Hegg, Karl M., and Harold Sieverding.
1979. Timber resources of the Kuskokwim River flood and adjacent uplands. USDA For. Serv. Resour. Bull. PNW-87, 40 p., illus.

The first intensive forest inventory of the Kuskokwim River flood plains and adjacent uplands was conducted in 1967. A commercial forest area of 252.5 thousand acres (102.2 thousand hectares) was identified with a growing-stock volume of 343.0 million cubic feet (9.7 million cubic meters). A noncommercial stratum was also examined that had substantial standing volume but did not qualify as commercial forest land. This stratum contained 70.4 thousand acres (28.5 thousand hectares) with a volume of 65.9 million cubic feet (1.9 million cubic meters).

Keywords: Timber resources, statistics (forest), forest surveys, Alaska (Kuskokwim River Valley)

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.