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Vegetation Resources Inventory of Southwest Alaska: Development and Application of an Innovative, Extensive Sampling Design

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Abstract

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An assessment of the vegetation resources of southwest Alaska was made by using an inventory design developed by the Pacific Northwest Research Station. Satellite imagery (LANDSAT MSS), high-altitude aerial photography, and ground sampling were the major components of the design. Estimates of area for all land cover classes in the southwest region were produced. Additionally, more intensive sampling provided data for estimation of timber resources in the forest land component. Field data collection was conducted from 1991 to 1994, and data compilation progressed through 1995.

Keywords: Vegetation surveys, forest surveys, timber resources, statistics (forest), Alaska (southwest).

Summary

The aim of this inventory was to provide “wall-to-wall” coverage of the unit–to provide at least some ability to describe all land cover classes. The sampling design was a double sample for stratification with proportional allocation. This approach has as its first phase a relatively intensive aerial-photo sample for strata identification, followed by an extensive ground sample for the second phase. Before selection of the photo sample, the inventory unit was divided into independent subpopulations through use of LANDSAT multispectral scanner (MSS) imagery. LANDSAT scenes were classified into six classes: forest, woodland, shrub, herbaceous, barren, and unknown. These classes became the subpopulations. Area control, the fixed area of each subpopulation, was the sum of all pixel areas within a subpopulation.

There were 13,531 aerial-photo plots. These plots were visually interpreted for land cover, and placed into one of seven strata: forest, woodland, shrub, herbaceous, vegetated, barren, and unknown. About 2 percent, or 282, of the aerial-photo plots were selected for ground sampling. Tree measurements were made on forested plots in the second phase of the sample to provide data for derived volume estimates. Estimates of area by land cover class were derived from proportional distribution of photo plots adjusted to ground information.

Contents

Highlights

Land cover	Thousand acres	Thousand hectares
Total southwest Alaska unit:	71,914	29,104
Forest land	16,022	6,484
Nonforest land	50,851	20,579
Non-Census water	260	105
Census water	4,782	1,935
Forested area:		
Producing 20 ft^3 or more m.a.i.--		
Available	522	211
Reserved	7	3
Producing < 20 ft^3 m.a.i.--		
Available	15,191	6,148
Reserved	301	122
Forest land type composition:		
Black spruce	6,442	2,607
Black spruce-tamarack	282	114
Paper birch	1,168	473
Paper birch-spruce	1,135	459
Paper birch-spruce-poplar	37	15
Poplar	610	247
Quaking aspen	35	14
Spruce-birch	1,905	771
Tamarack	551	223
White spruce	3,370	1,364
White spruce-black spruce	488	198

	Growing stock		Sawtimber	
	Thousand cubic feet	Thousand cubic meters	Thousand board feet	Thousand cubic meters
Volumes on timberland				
Net volume	638,790	18,078	1,316,431	9,980
Net annual growth	-206	-6	10,489	80
Annual mortality	13,532	383	37,204	282

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Introduction

This report contains a summary of a vegetation inventory conducted in southwest Alaska during the summers of 1991 to 1994 by personnel of the USDA Forest Service, Pacific Northwest Research Station. Included also are discussions of the inventory design used for this effort contrasted with designs of earlier efforts, and a comparison of current resource estimates with estimates derived from those earlier efforts.

The Southwest Alaska Vegetation Inventory Unit stretches from about 55° north latitude at its southern extreme, near Port Moller, to 64° 30’ at its northernmost point near Fairbanks, and from 151° 30’ west longitude on the east, again, near Fairbanks, to 167° 30’ on the western edge of Nunivak Island (fig.1).

At almost 72 million acres, the Southwest Alaska inventory unit is about 10 million acres larger than Oregon. This area of Alaska is virtually roadless and has only two major communities: Bethel with a population of 4,700 and Dillingham with 2,000 citizens. There are about 5 miles of gravel road outside the Bethel area and Dillingham has about 40 miles. There are no roads between these communities and there is no connection with the rest of the state (Larson 1994.) Figure 2 depicts the state of Alaska with the southwest inventory unit overlaid, to scale, on the lower 48 States.

The vastness of the southwest Alaska inventory unit guarantees that diverse physical characteristics and processes will influence vegetation distribution and growth beyond the steady changes resulting from vegetative succession. Major influences include climate, geology, topography, river erosion, and fire history.

Climate

There are four major climatic zones in Alaska: arctic, maritime, continental, and a transition zone having both maritime and continental influences (fig. 3). The southwest Alaska unit includes three of the four zones: maritime, continental, and transitional. The maritime and continental climates influence most of the area. Regions affected by the transition zone climate are subject to levels of temperature, precipitation, and wind that fall between the extremes of the maritime and continental climates.

The maritime zone, which influences coastal areas of southwest Alaska, is characterized by precipitation ranging from 20 to 70 inches (sometimes less to leeward), relatively small diurnal temperature variations (20 to 50 °F), and winds 10 to 20 knots (100-knot extreme). Cloud and fog frequency and humidity are generally high.

Most of the southwest Alaska inventory unit is considered as interior Alaska and is influenced by transitional and continental climates. The continental climatic regime produces relatively warm summers, with temperatures upwards of the high 60s (°F) , cold winters (-20 to 6 °F), and low precipitation along with low cloudiness and low humidity. Surface winds are generally light compared to the maritime zone, but channeling occurs in mountain valleys, thus producing locally strong winds. The character of the transitional climate reflects its name; mean annual temperatures range from 25 to 35 °F and humidity and cloudiness are less extreme than in the maritime regime but not as low or sparse as in the continental regime. (Climate profiles from Selkregg 1974.)

Physiography

The southwest Alaska unit has a wide variety of physiographic regions ranging from broad, extensive river flood plains to high, rugged mountains. The southwest region of Alaska is geologically quite active because the North American continental and the Pacific sea-floor plates meet there. The major physiographic regions of the unit are the southern Alaska Range and northern Aleutian Range, the Kuskokwim Mountains, the Ahklun Mountains, and the Bristol Bay and Kuskokwim Lowlands (fig. 4).

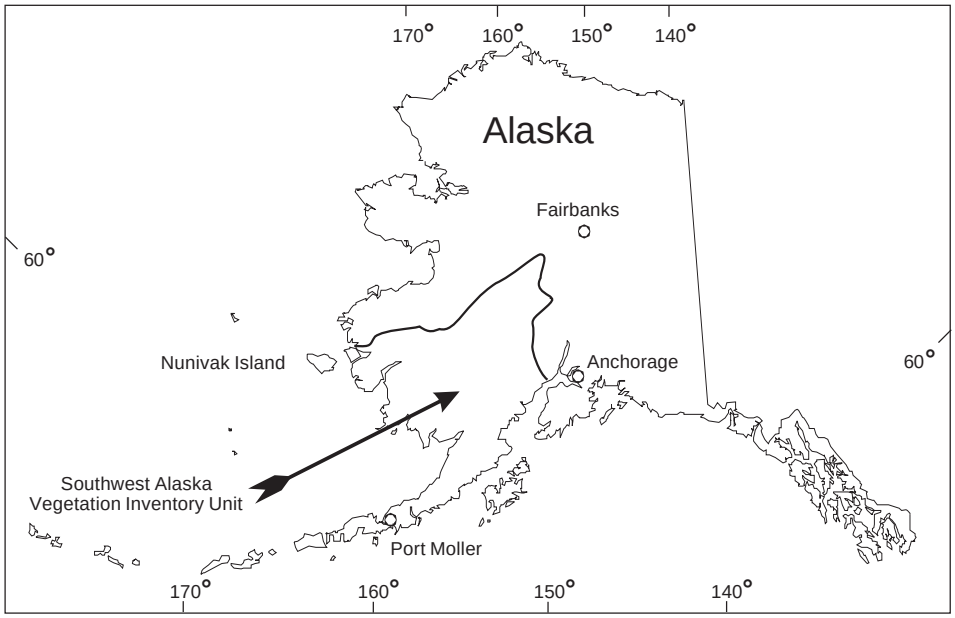

Figure 1—The Southwest Alaska Vegetation Inventory Unit, 1994.

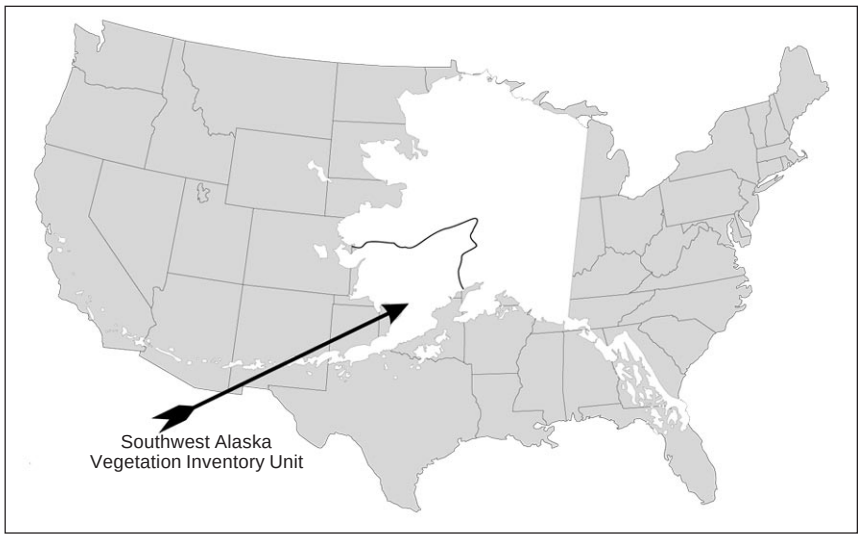

Figure 2—The Southwest Alaska Vegetation Inventory Unit compared with the lower 48 States.

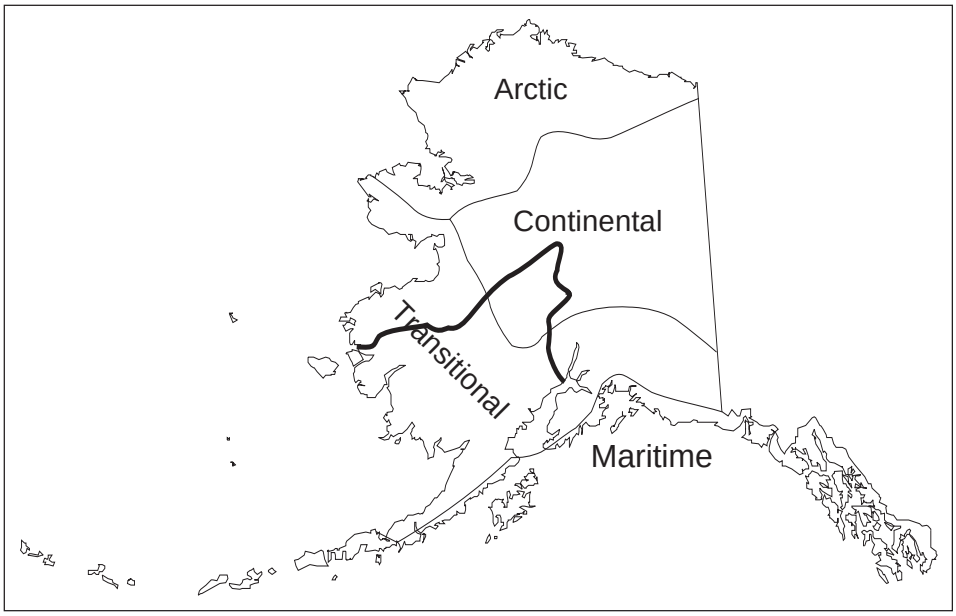

Figure 3—Major climatic regions of Alaska; the Southwest Alaska Vegetation Inventory Unit is delineated by a heavy black line (Johnson and Hartman 1971).

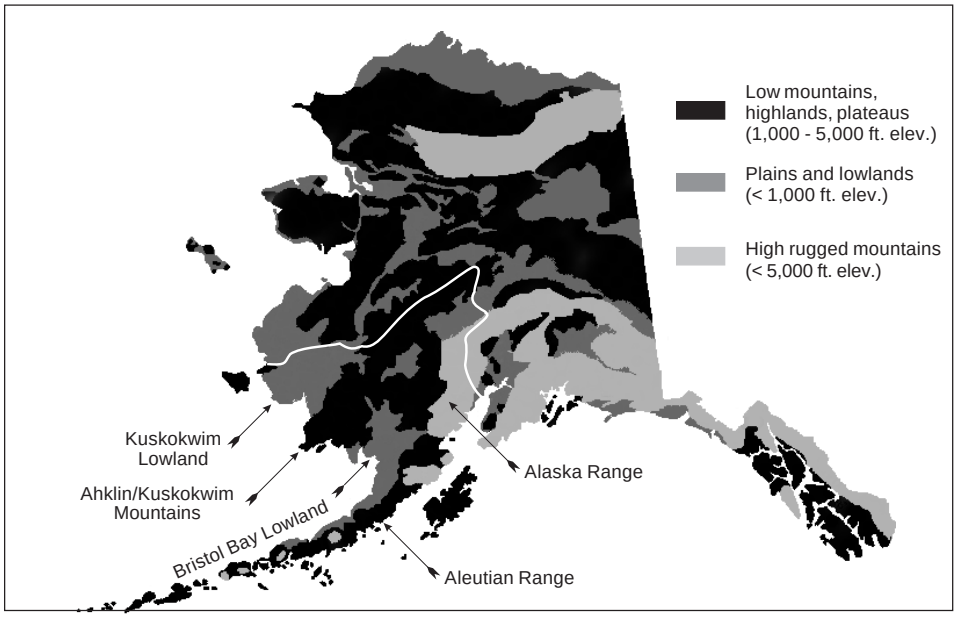

Figure 4—Major physiographic regions of Alaska; Southwest Alaska Vegetation Inventory Unit is delineated by a white line (Johnson and Hartman 1971).

Vegetation

In a land area as large as southwest Alaska, the vegetation types present on the land are quite varied. General vegetation types include upland and bottomland (as in river edges) broadleaf, needleleaf, and mixed forests, lowland needleleaf forests (mostly black spruce), shrub and woodland communities, various tundra types, and barren ground.

On the western end, wet-moist tundra is predominant. Traveling eastward leads to vast areas of lowland black spruce interspersed with productive white spruce and hardwoods. Pockets of alpine tundra and barren areas can be found throughout but are particularly prominent on the eastern edge, which is dominated by the Alaska Range.

Forested areas, specifically the productive forest stands, are generally found along larger river basins, valleys, and lower slopes of mountains. Major factors controlling distribution of forest and other vegetation are soil depth, soil temperature, presence or absence of permafrost, and drying effects of wind, particularly in winter when "physiological drought" can be severe. Physiological drought is reduced plant moisture content caused by factors other than a lack of moisture-supplying precipitation.

The inventory of the southwest Alaska unit was designed to allow at least some estimation of all vegetated and nonvegetated areas. In this sense it was a "wall-to-wall" inventory. For estimates of timber volume or biomass, the focus of the inventory was on the forested component of the landscape; that is, most ground truth information was collected in forested areas.

Inventory Designs: Current and Past

During the last three decades, a number of significant efforts have been made to characterize the vegetative and other land covers of the southwest region of Alaska. The most recent effort is the inventory that is the focus of this report. Selkregg (1974) provided a summary of aerial-photo interpretation performed by Spetzman (1963), but Selkregg's presentation does not specifically address productive capabilities of the forest resource. The productive component of all forest land was estimated by Hutchison (1967), Hegg and Sieverding (1979), and this present inventory. These last three inventories were based on multiple levels of sampling, including at least some ground sampling. Spetzman's estimates depended solely on aerial-photo interpretation. In the following sections, a summary is provided of the sampling designs for the Hutchison, Hegg and Sieverding, and southwest Alaska vegetation inventories.

Current: Southwest Alaska Vegetation Inventory

The aim of this inventory was to provide wall-to-wall coverage of the unit—to provide at least some ability to describe all land cover classes. Multiple goals of maximizing the return on finances and the available staff time in return for quality information regarding areas of concern meant that not all land cover classes within the unit would be described to the same degree of statistical certainty. Thus, major land cover classes were separated to efficiently allocate staff and financial resources.

The sampling design is a double sample for stratification with proportional allocation. This approach has a relatively intensive aerial-photo sample for strata identification as the first phase, followed by an extensive ground sample for the second phase. This allows use of expensive resources in areas where the most information gathering is

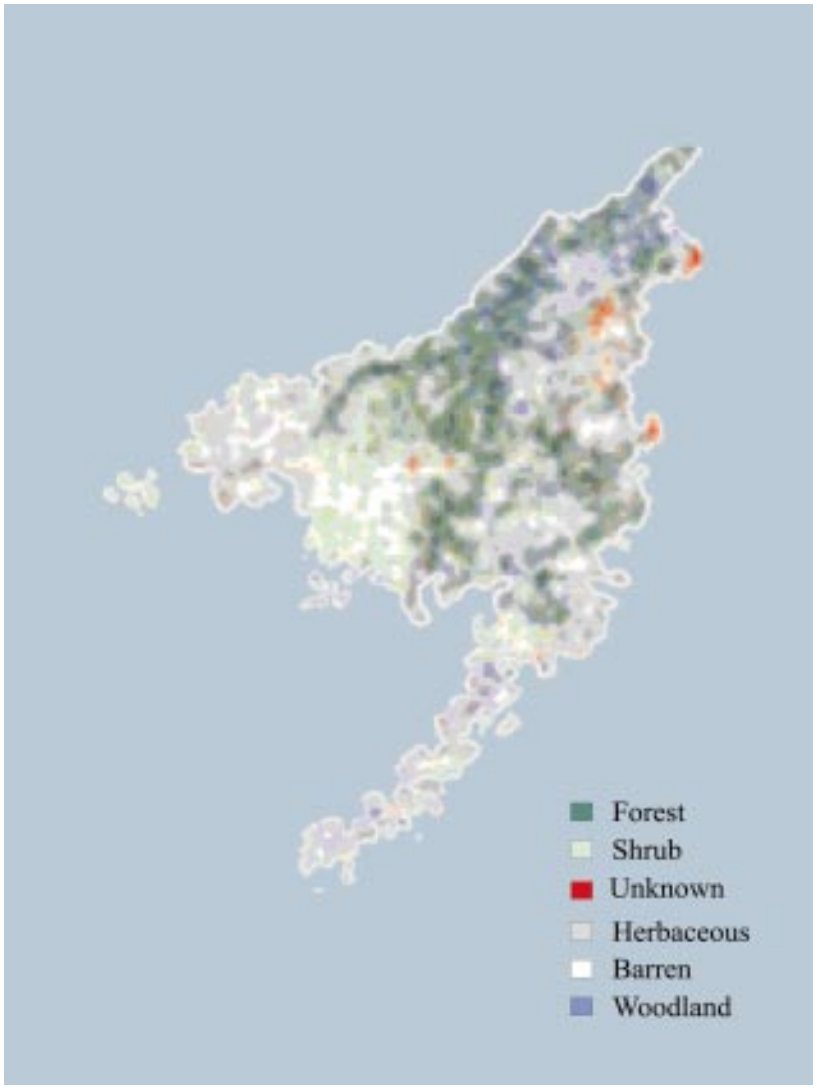

Figure 5—Generalized classification of LANDSAT multispectral imagery of the Southwest Alaska Vegetation Inventory Unit, 1994.

required. Before selection of the photo sample, the inventory unit was divided into independent subpopulations. This division was accomplished through use of LANDSAT multispectral scanner (MSS) imagery. Preliminary classifications of each LANDSAT scene were collapsed from about 15 separate classes into 6 classes. These six classes became the subpopulations: forest, woodland, shrub, herbaceous, barren (which actually includes barren areas, water, ice and snow), and unknown (fig. 5). Area control, the fixed area of each subpopulation, derives from the sum of all pixel areas within a subpopulation.

Table 1—Number of aerial-photo and field plots by subpopulation and aerial-photo sampling stratum, and area by subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994

Aerial-photo stratum	Subpopulation						All sub-populations
	Forest	Woodland	Shrub	Herbaceous	Barren	Unknown	
	Aerial-photo plots/field plots						
Forest	2,360/45	127/2	19/2	28/2		5/2	2,439/53
Woodland	4,319/87	648/12	166/3	70/2		26/2	5,229/106
Shrub	1,646/33	405/8	1,125/23	489/9		166/3	3,831/76
Herbaceous	165/4	63/2	213/4	121/2		47/2	609/14
Vegetated[a]					153/2		153/2
Barren	63/2	12/2	29/2	60/2	379/5	270/5	813/18
Unknown	141/3	55/2	94/2	53/2	536/2	61/2	940/13
All strata	8,594/174	1,310/28	1,646/36	821/19	585/9	575/16	13,531/282
Acres	6,314,473	13,823,760	30,594,489	6,623,568	13,257,718	1,300,500	71,914,508

[a] This stratum applied to the barren subpopulation only.

Within each subpopulation, the coordinates of the northwest corner of the pixels comprising the subpopulation were listed. After the list was randomized, a sample of coordinates was selected. These sampled coordinates became the locations for the aerial-photo sample. There were 13,531 aerial-photo plots (table 1). To ensure that the sample was well distributed over the entire inventory area, photo plots were proportionately allocated to each of the several 1:250,000 USGS topographic map quadrangles covering the inventory unit, according to the percentage of the total subpopulation found in that quadrangle (fig. 6).

Selected coordinates were then located on 1:60,000 color infrared photos with an analytical stereo-photo plotter, visually interpreted for land cover, and placed into one of seven strata: forest, woodland, shrub, herbaceous, vegetated, barren, and unknown. Although there is duplication of names between the subpopulations and the sampling strata, it is important to maintain the statistical distinction between the two. Each of the several subpopulations is an independent sampling unit. The aerial-photo strata are descriptors of land covers within that unit.

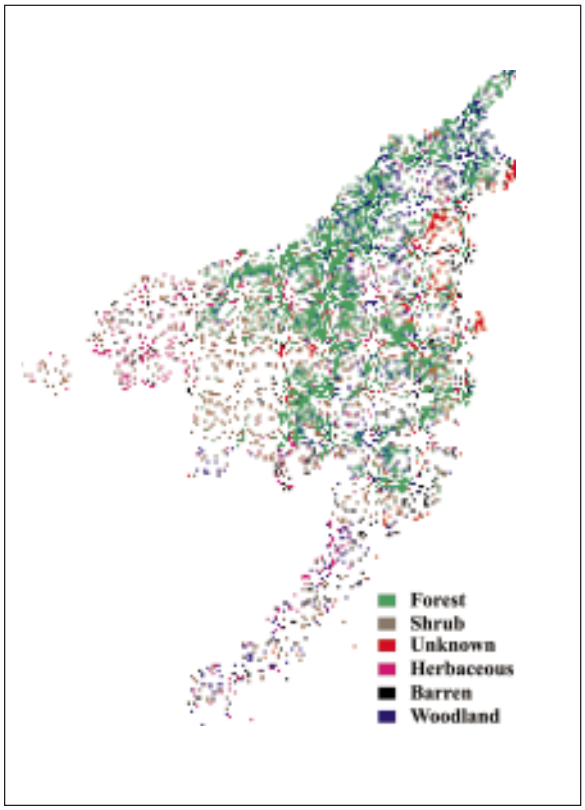

Figure 6—Distribution of aerial-photo plots by subpopulation for the Southwest Alaska Vegetation Inventory Unit.

About 2 percent, or 282, of the aerial-photo plots were selected for ground sampling (table 1). Ground plots were allocated to subpopulations and strata according to the need for information relevant to those land cover classes. Generally, more attention (ground sampling) was given to forested areas. These areas have a higher human-use value and lie along river drainages where most villages and homesteads occur.

Field plots were 5-acre circles. These plots were mapped for land cover-vegetation type and sampled by five points within the circle. There is one point at the center of the circle with the other four cardinally located 208.6 feet from the center.

At each of the five points, trees (if present) were sampled with a variable radius plot (6.25 metric basal area factor). Seedlings and saplings were sampled with a 6.6-foot, fixed-radius plot, also at each of the five points. A horizontal-vertical characterization (HV plot) of vegetation structure was made at the first two points in each vegetation type.

Site index and productivity information were developed from the following sources: for tamarack, white spruce, and black spruce—Farr (1967); for paper birch and quaking aspen—Gregory and Haack (1965); and for balsam poplar and black cottonwood—Yarie and Herman (1982).

Cubic- and board-foot tree volumes were computed from the following volume equations: for cubic- and board-foot volumes of tamarack, white spruce, and black spruce—Dippold and Farr (1971); cubic-foot volume of paper birch, balsam poplar, and black cottonwood—Dippold and Farr (1971); board-foot volume of paper birch, balsam poplar, black cottonwood and quaking aspen—Haack (1963); and cubic-foot volume of quaking aspen—Gregory and Haack (1964).

Past: Hutchison (1967)

This inventory effort was extensive. The design developed was conceived to be a three-phase sample. Under the original, "triple-sample" construct (Hutchison 1967), the first "phase" was an aerial-photo sample. Aerial-photo flight lines were laid out about 30 miles apart, perpendicular to the predominant drainage. The entire flight line pattern was photographed at a nominal scale of 1:5,000. This effort produced 6,979 photos for the southwest region. Near the center of each photo a 0.5-acre, rectangular plot was located and interpreted for land class (productive vs. unproductive forest, nonforest, and water).

The second sample, or phase, consisted of an air-check (low altitude fly-over) of about 10 percent of the aerial-photo sample. This was accomplished by dividing the total flight line length into 10-mile segments and choosing every 10th segment after a random start. Within each segment, all photo locations were checked from the air. There were 718 air-check points in the southwest region.

The third sample, or phase, of the design involved sampling about 10 percent of the air-check locations on the ground. There were 64 such locations in the southwest inventory unit. After ground visitation, all but nine were found to be nonproductive. Ground plots contained 10 fixed-area subplots on which measurements were taken for volume, growth, and timber quality estimation.

Estimates of area by land class were produced by sequential adjustment of proportions by land class. The distribution of ground plots by land class was used to adjust the interpreted proportions of the air-check plots. The adjusted proportions at the air-check level were in turn used to adjust distribution of the aerial-photo plots by land class. Area estimates were the product of these proportions applied to the total area of the unit.

This design was, most accurately, a single-stage cluster sample. The clusters, or primary units, were the random start, systematically selected, 10-mile flight-line segments. The fixed-area plots within the flight-line segments were the secondary units. The sample was single stage in that observations (air check or actual ground visitation) were made for all secondary units within the primary units. To minimize bias in cluster sampling, the population being sampled should be randomly distributed within the clusters. The forested area within all the primary units could not be assumed to be randomly patterned (areas of forest vegetation, particularly the productive component, in interior Alaska, tend to be linearly patterned).

Past: Hegg and Sieverding (1979)

This inventory was focused on those lands within about 5 miles of the navigable waters of the Kuskokwim River and its tributaries. Estimates of area and timber volume were based on a double sampling for stratification procedure. Enough points to satisfy the same specific levels of statistical precision required for the Southwest Alaska Vegetation

Resource Inventory design were uniformly distributed on aerial photographs. At each photo point, 1 acre was classified by land type, forest type, and volume stratum. A subsample was drawn from all land types and reexamined. All points in the subsample originally classified as productive forest land, as well as any other points questionably classified as productive, were visited on the ground.

In application of this design, 6,452 photo points were interpreted. One hundred and seventy locations were visited on the ground. The ground plot was located at the same point established on the photo. At each ground location, a cluster of 10 variable-radius points was established and tree measurements were made.

Resource Estimates
A Historic Perspective

In the various inventory efforts mentioned above ("Inventory Designs: Current and Past") there have been three significant efforts to estimate overall forest land area and three to estimate productive forest land area. The most recent effort for both productive forest land and all forest land in general is the Southwest Alaska Vegetation Resources Inventory. Selkregg (1974) provided an estimate of all forest land as did Hutchison (1967). The productive component of all forest land also was estimated by Hutchison (1967) and Hegg and Sieverding (1979). Table 2 shows a comparison of resource estimates deriving from these various efforts.

Table 2—Historic and current estimates of total forest land and productive forest land derived from similar sample types, southwest Alaska

Forest land class	Thousand acres
Total forest land area (from aerial-photo samples):	
Southwest Alaska Vegetation Inventory Unit (1994)—	
Forest stratum area	3,591
Woodland stratum area	13,720
Total	17,311
Selkregg (1974):	
Bottomland spruce-poplar	3,500
Upland spruce-hardwood	9,300
Lowland spruce-hardwood	6,600
Total	19,400
Hutchison (1967):	
Kuskokwim basin	14,662
Bristol Bay basin	2,741
Total	17,403
Productive forest land area (from ground samples):	
Southwest Alaska Vegetation Inventory Unit (1994)	529
Hutchison (1967)	3,298
Hegg and Sieverding (1979)	252

The estimates for all forest land presented in table 2 were generated with roughly similar estimation tools in that all three were produced by remote sensing procedures only. The southwest Alaska estimate derives from interpretation of 1:60,000 aerial photos, the Selkregg (1974) estimate is a presentation of mapped area estimates produced by Spetzmann (1963) from 1:40,000 aerial photos, and Hutchison's estimate comes from 1:5,000 aerial photos. Spetzmann's effort had little if any ground verification, and Hutchison's estimate relied on actual ground visitation only where it was felt that the forest land was productive. With these caveats in mind, the correspondence of the three estimates for forest land area is remarkable. The range between the maximum and minimum is about 2.7 million acres.

With regard to correspondence of the estimates of productive forest land, Hutchison (1967) likely overestimated productive forest land area. The accuracy of the productive forest area estimate arising from that inventory is questionable for two reasons. First, that inventory relied heavily on aerial-photo interpretation of productive sites. There had been no significant studies of site quality specific to interior Alaska at that time, and at best, it is difficult to estimate, on aerial photos, those sites capable of producing 20 cubic feet (or more) per acre per year. Records show that efforts to identify productive forest land from aerial photography are generally 50 to 60 percent correct in interior Alaska, even though much experience has been gained and a number of site productivity studies have been conducted over the last few decades. Although tree height can be estimated from aerial photos with fair accuracy, tree age is nearly impossible to gauge with any degree of utility. Both measures are needed to estimate site productivity. Classification of forest land in general is less problematic, though, because relative coverage of the ground by tree canopies is the only measure required and is readily obtained from aerial photos. Second, the ground sample was small and not stratified to reduce variance.

Results of the inventory reported by Hegg and Sieverding (1979) relied more heavily on ground information than did Hutchison's. Estimation of productive forest area was improved over the efforts of Hutchison (1967) for two reasons. First, by the time the Hegg and Sieverding effort was initiated, better methods for establishing site productivity had become available (Farr 1967, Gregory and Haack 1965). Second, the entire inventory effort was focused on where productive forest land was most likely to occur; however, the inventory was limited to only the Kuskokwim River flood plain and adjacent uplands. Other river drainages in the southwest Alaska unit were not included. Thus it is not surprising that the estimate of productive forest land for the entire Southwest Alaska Vegetation Resources Unit exceeds the estimate of Hegg and Sieverding.

Area by Subpopulation

Does the name of the subpopulation mean that the entire area represented by the color of that subpopulation on figure 5 is actually covered with the land class referred to by that name? For instance, is the "barren" subpopulation really all barren or water? Not necessarily. Remember, these subpopulations are created by a very general classification of LANDSAT MSS imagery; imagery composed of pixels representing spectral classification of an area about 55 yards square. The spectral classification is reflective of the dominant land cover and cannot accurately be interpreted for minor land cover components that may also be present. Additionally, pixels representing ranges of spectral classes were grouped to create the broad classifications. Thus, each subpopulation will have components other than that represented by the subpopulation name. The

"unknown" subpopulation for instance, is composed of pixels representing clouds, snow, and shadows. To better characterize each subpopulation, aerial-photo and ground plot samples were examined for further information.

Within each subpopulation an aerial-photo sample was taken to further define the components of the subpopulation (see "Inventory Design," above). The entire area of each aerial-photo plot was placed into one of seven strata (forest, shrub, herbaceous, barren, woodland, unknown, vegetated). The "unknown" stratum is for those locations for which land cover could not be interpreted from the photo for a number of reasons, including missing photographs, poor photography, cloud cover, or shadow. The "vegetated" stratum was created for use in the barren subpopulation only. It includes all vegetation types and was created because ground sampling in the barren subpopulation would be negligible.

The seven aerial-photo strata were created to reduce ground-sampling variation. Once again, as in the subpopulations, the strata names represent dominant land cover categories for the plots. Perhaps unfortunately, the names of categories at the various inventory levels are similar but the definitions are not. The names are similar because the dominant land cover stays the same. The definitions change from upper to lower inventory levels because of the information available for categorizing changes.

At the aerial-photo sample level, for example, estimates of tree volumes per unit area can be made; for interior Alaska, this information is not reliable at the satellite level.

Table 3—Aerial-photo estimates of area by subpopulation and aerial-photo sampling stratum, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Subpopulation						All subpopulations
	Forest	Woodland	Shrub	Herbaceous	Barren	Unknown	
	Thousand acres						
Forest	1,661	1,340	353	226	—	11	3,591
Woodland	3,173	6,838	3,085	565	—	59	13,720
Shrub	1,209	4,274	20,911	3,945	—	375	30,714
Herbaceous	121	665	3,959	976	—	106	5,828
Vegetated[b]	—	—	—	—	3,467	—	3,467
Barren	46	127	539	484	8,589	611	10,396
Unknown	104	580	1,747	427	1,201	138	4,198
All strata	6,314	13,824	30,594	6,623	13,258	1,300	71,914

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.
[b] This stratum applied to the barren subpopulation only.

Thus, while the definition of the forest subpopulation at the satellite level depends mainly on species dominance, the forest stratum within the forest subpopulation is further defined by having medium to high per-unit-area wood volumes. Finally, at the ground-sample level, forest must additionally have a certain minimum tree stocking density (16.7 percent).

The aerial-photo plots were then evaluated on the ground by point sampling (Grosenbaugh 1952) to describe the distribution of actual land cover categories within the plot, and, in turn, within the subpopulation. Table 3 lists the area of each subpopulation distributed into the seven aerial-photo strata as a result of the photo interpretation.

Some percentages from the aerial-photo sample (table 3) serve to help understand how well the satellite classification performed:

- 26 percent of the land in the forest subpopulation was photo sampled as forest (76 percent has trees if forest and woodland strata are added together).
- 49 percent of the woodland subpopulation was photo sampled as woodland (59 percent has trees if forest and woodland strata are added together).
- 68 percent of the shrub subpopulation was photo sampled as shrub.
- Only 15 percent of the herbaceous subpopulation was photo sampled as herbaceous.
- 65 percent of the barren subpopulation was photo sampled as barren.

The performance of the satellite classification system was not unexpected. Some of the classes are ones that can be fairly well identified and described through satellite imagery while others were quite variable. Barren, water, and shrub areas, for instance, have less confusion in their respective spectral classifications than some of the other classes. In the forest and woodland subpopulations, increasing variability in the classification becomes apparent. The herbaceous classification is the most variable.

In the sections that follow, information is presented in tables 4-10 that shows the results of the ground sample within each aerial-photo stratum for each subpopulation. The ground sample is the source for final estimates of area by land cover class. The totals across all subpopulations are shown in table 10.

Forest subpopulation—This subpopulation was created in an attempt to include all lands that may have productive forest on them. In this and other subpopulations, the ground sample is a point (not area) sample. It is therefore possible that parts of plots in a given stratum, in this case the forest stratum, would have several ground-sampled land cover types on them. Thus, some acres of forest ground were sampled in the barren or herbaceous strata. Additionally, the ground sample is not always exactly colocated with aerial-photo plots in spite of every effort by field crews to do so. In such cases, the ground plot does not sample exactly the same area delineated by the aerial-photo plot.

Table 4—Area by aerial-photo sample stratum and ground-sample land cover classes, for the forest subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Ground sample land cover					All land cover classes
	Forest	Shrub	Herbaceous	Barren	Water	
	Thousand acres					
Forest	1,609	29	15	—	7	1,661
Woodland	2,765	328	73	—	7	3,173
Shrub	432	733	29	—	15	1,209
Herbaceous	6	91	6	12	6	121
Barren	5	—	—	—	42	46
Unknown	83	21	—	—	—	104
All strata	4,900	1,202	123	12	77	6,314

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Although this subpopulation serves to focus attention on the productive component of all forest land, spectral "confusion" (similarity of spectral reflectance values) causes quite a bit of overlap among forest, woodland, and shrub subpopulations with regard to actual, ground-sampled nonproductive forest. Because of this confusion, only 31 percent of all ground-identified forest land is in this subpopulation (table 4.)

Almost 78 percent of the forest subpopulation does have forest of some type on it; 1.6 million acres in the forest aerial-photo stratum, 2.8 million acres in the woodland stratum, and 526,000 in the remaining strata. Most of the remaining area of the subpopulation is in shrub types (19 percent of the total subpopulation area). In subsequent sections of this report, estimates of productive forest land area, tree volume on that land, and growth and mortality of those trees are presented; it is from the forest subpopulation that those estimates are made.

Table 5—Area by aerial-photo sample stratum and ground-sample land cover classes, for the woodland subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Ground sample land cover					All land cover classes
	Forest	Shrub	Herba-ceous	Barren	Water	
	Thousand acres					
Forest	1,206	—	—	—	134	1,340
Woodland	6,040	684	114	—	—	6,838
Shrub	534	3,098	534	—	107	4,274
Herbaceous	—	665	—	—	—	665
Barren	—	13	63	—	51	127
Unknown	—	290	290	—	—	580
All strata	7,781	4,750	1,002	—	292	13,824

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Woodland subpopulation—Although forest acres were ground sampled in the forest stratum of the woodland subpopulation, this does not necessarily mean that these acres (1.2 million) are high-volume, productive forest land (table 5.) The ground classification "forest" depends only on tree stocking—the density of stems per unit area. Also, there is variability in photo interpretation of volumes per unit area. These acres are areas with only slightly more volume than those in the woodland stratum; as with any "objective" classification system, there will be class members that are only slightly different from another class. There may be small amounts of productive forest land in the forest stratum of this subpopulation, but the sample was not intense enough to describe them.

Confusion at the satellite level between low-density forest (woodland) and shrub land is apparent here. While 56 percent of the subpopulation has trees on it (mostly in woodland—78 percent of the forest ground sample class), 34 percent has a shrub ground sample type. Differences between the spectral reflectance of areas with high densities of large shrubs and areas with relatively lower densities of small trees are not distinct (Winterberger and Larson 1985.) At the aerial-photo level, however, the distinction between woodland and shrub was fairly clearcut, mainly because more visual clues are available to the remote sensing specialist, making plant species identification more accurate.

Table 6—Area by aerial-photo sample stratum and ground-sample land cover classes, for the shrub subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Ground sample land cover					All land cover classes
	Forest	Shrub	Herba-ceous	Barren	Water	
	Thousand acres					
Forest	318	35	—	—	—	353
Woodland	1,646	1,028	411	—	—	3,085
Shrub	727	17,456	2,727	—	—	20,911
Herbaceous	—	3,365	594	—	—	3,959
Barren	—	323	54	—	162	539
Unknown	—	1,572	175	—	—	1,747
All strata	2,691	23,781	3,961	—	162	30,594

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Shrub subpopulation—Based on ground-sample information, almost 78 percent of the "shrub" subpopulation area is indeed shrub land (table 6.) Over the whole southwest Alaska unit, 64 percent of the shrub land is in this subpopulation. The shrub subpopulation also has a significant amount (54 percent) of all herbaceous land cover of the southwest unit. Included in the herbaceous ground sample land cover are sedge-willow and sedge-birch tundra types that could be confused with shrub types, at the satellite level.

Although some forest land was found in this subpopulation, it was characterized by small trees in low-density stands; that is, nonproductive forest. At the satellite level, this type of forest is easily confused with shrub land.

Table 7—Area by aerial-photo sample stratum and ground-sample land cover classes, for the herbaceous subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Ground sample land cover					All land cover classes
	Forest	Shrub	Herba-ceous	Barren	Water	
	Thousand acres					
Forest	135	45	45	—	—	226
Woodland	452	113	—	—	—	565
Shrub	—	3,068	877	—	—	3,945
Herbaceous	—	390	488	—	98	976
Barren	—	194	—	—	290	484
Unknown	—	—	428	—	—	428
All strata	587	3,810	1,838	—	388	6,624

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Herbaceous subpopulation—Satellite image classification of this subpopulation was difficult. The source of classification confusion is the dwarf scrub vegetation type. Spectrally, insufficient separation exists between areas covered predominantly with herbaceous vegetation mixed with some open dwarf scrub, and those covered predominantly with open dwarf scrub mixed with some herbaceous vegetation. Thus, the open dwarf scrub vegetation type will be a significant component of both the shrub and the herbaceous vegetation communities.

The difficulty of accurately classifying the herbaceous vegetation type with satellite imagery is borne out in table 7. Forty-six percent (3.068 million acres) of the herbaceous subpopulation was identified as shrub in both aerial-photo and ground samples.

Table 8—Area by aerial-photo sample stratum and ground-sample land cover class, for the barren subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Ground sample land cover					All land cover classes
	Forest	Shrub	Herba-ceous	Barren	Water	
	Thousand acres					
Forest	—	—	—	—	—	—
Woodland	—	—	—	—	—	—
Shrub	—	—	—	—	—	—
Herbaceous	—	—	—	—	—	—
Vegetated	—	1,734	—	1,734	—	3,467
Barren	—	1,030	—	3,436	4,123	8,589
Unknown	—	360	240	601	—	1,201
All strata	—	3,125	240	5,770	4,123	13,258

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Barren subpopulation—In general, spectral reflectance values comprising this subpopulation indicated either the presence of water, or areas where there was not enough vegetation to provide a strong spectral signature (table 8). As mentioned above, it was recognized that because sparsely vegetated areas might be found within this subpopulation, the “vegetated” aerial-photo stratum was created specifically for this subpopulation. Little ground sampling attention was given to this subpopulation as it is primarily water or at very high altitude with permanent ice and snow, or indeed, barren rock.

Table 9—Area by aerial-photo sample stratum and ground-sample land cover class, for the unknown subpopulation, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Aerial-photo stratum	Ground sample land cover					All land cover classes
	Forest	Shrub	Herba-ceous	Barren	Water	
			Thousand acres			
Forest	10	—	—	—	1	11
Woodland	53	—	—	—	6	59
Shrub	—	350	—	25	—	375
Herbaceous	—	106	—	—	—	106
Barren	—	—	122	489	—	611
Unknown	—	55	—	83	—	138
All strata	63	512	122	596	7	1,301

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Missing subpopulation—Ground samples were taken in this subpopulation (table 9), even though the total area is slightly less than 2 percent of the whole southwest unit, to ensure complete sample coverage of the inventory unit. Because of the small size of this subpopulation and relatively wide representation of ground-sample land covers, no single land cover area estimate is a significant part of the whole.

All subpopulations—Table 10 shows the sum of the totals of tables 4-9. Most (almost 52 percent) of the Southwest Alaska Vegetation Inventory Unit has some sort of shrub vegetation on it. The second most common vegetative cover is forest, which accounts for about 22 percent of the area. The remaining 26 percent of the area is almost equally represented by the herbaceous, barren, and water categories (10, 9, and 7 percent, respectively) .

Table 10—Area by ground-sample land cover classes, for all subpopulations and aerial-photo sampling strata, Southwest Alaska Vegetation Inventory Unit, 1994[a]

Ground sample land cover					
Forest	Shrub	Herba-ceous	Barren	Water	All land cover classes
Thousand acres					
16,022	37,180	7,286	6,378	5,048	71,914

[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Productive Forest Land

The forest subpopulation received most of the ground-sampling effort of this inventory. It is in this subpopulation that productive forest (forest land capable of producing 20 cubic feet, or more, per acre per year at culmination of mean annual increment) was most likely to be found and the sample design was constructed accordingly. It is recognized by the author that terms such as “productive” are entirely subjective. This minimum level of productivity as a classification break point is in use across the Nation and is used here to maintain comparability with other estimates. As a point of reference, the solid wood volume of a cord of firewood is on the order of 95 cubic feet (a cord has 128 cubic feet of space); thus the acres classed productive are, at minimum, producing about 0.20 cord of wood per year.

Appendix tables A1 through A22 provide detailed estimates of various components and breakdowns of productive forest land, such as ownership, areas, and wood volumes.

The forest subpopulation has 6,314,492 acres; of this 529,421 acres are productive (a bit over 8 percent of the subpopulation). As a percentage of all forest land in all subpopulations (16,021,583 acres), the productive component comprises slightly more than 3 percent (or less than 1 percent of the total southwest region). Most of the productive land is timberland; that is, not removed from timber harvest due to administrative statute. An estimated 7,295 acres of productive forest land are reserved. Further discussion will focus on timberland.

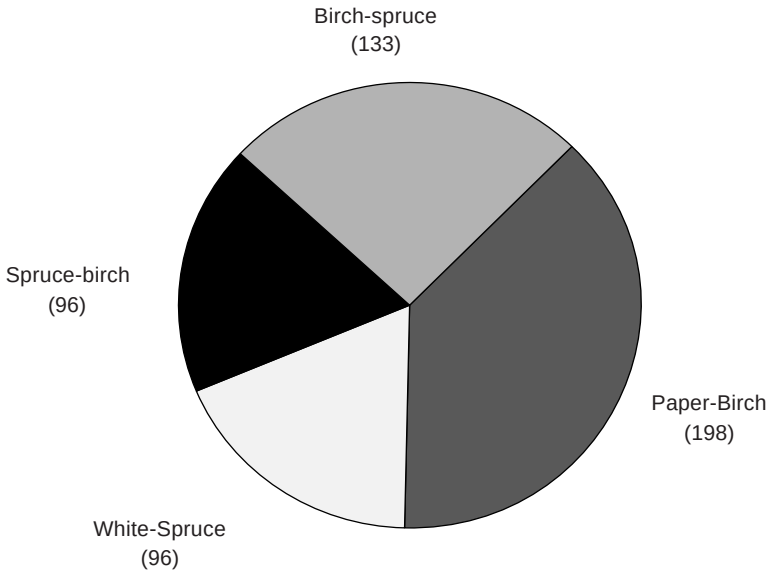

Figure 7—Area of timberland by forest type, Southwest Alaska Vegetation Inventory Unit, 1994 (numbers in parentheses are thousand acres).

Area—Figure 7 shows area of timberland by forest type. Although some forest types, such as paper birch, are identified by a single species name, other species will be present to varying degrees. Forest type names are assigned according to amounts of tree stocking by species (see “Glossary”). Almost 38 percent of the timberland area has paper birch forests on it, white spruce and spruce-birch each cover slightly more than 18 percent of the timberland area, and slightly over 25 percent has birch-spruce forests on it.

The State of Alaska owns over half (279,000 acres or 53 percent) of the timberland, private owners account for 27 percent (140,000 acres), and the Bureau of Land Management (BLM) controls 103,000 acres (20 percent). Table A4 provides a breakdown by owner and forest type.

All the timberland sampled in this inventory was in the lowest productivity class: 20 to 49 cubic feet per acre per year (table A6). It is not surprising therefore, that most of the stands on timberland are composed of poletimber-sized trees. Sixty-two percent of all timberland has poletimber stands on it. Eighteen percent of the timberland area has sawtimber-sized stands and 18 percent has seedling-sapling stands on it. A trace amount of timberland currently is nonstocked (see table A5.)

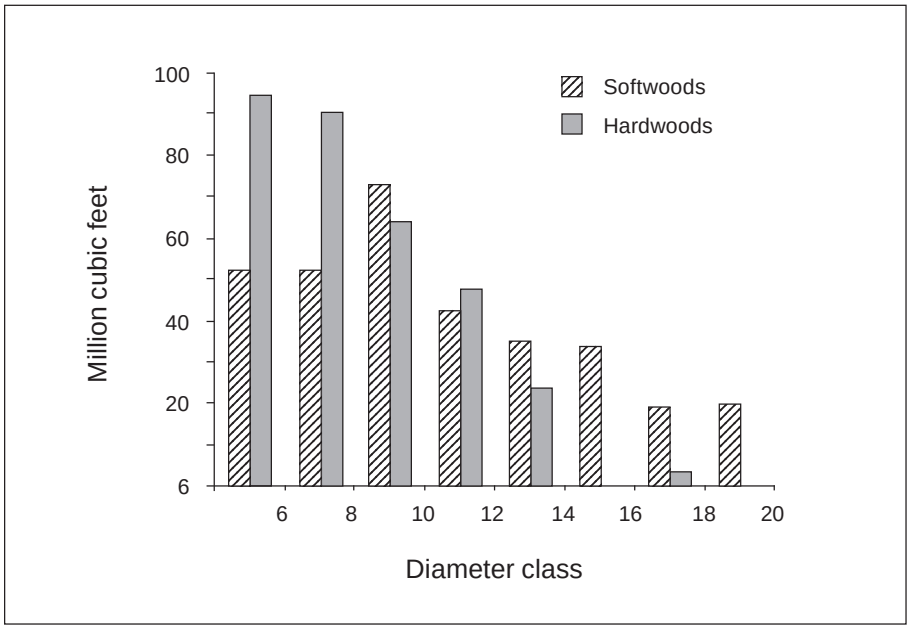

Figure 8—Net cubic-foot volume of growing stock on timberland by species group and 2-inch diameter class, Southwest Alaska Vegetation Inventory Unit, 1994.

Volume—Measurements of tree size, both height and diameter, and estimated defect amounts, made during the ground sampling part of the inventory are used to calculate tree volumes (see “Inventory Designs: Current and Past,” above, for references regarding volume equations). Volumes on timberland are quantified in two ways: by cubic volume and board-foot volume. Tables A10 through A18 provide estimates of detailed breakdowns of volume.

Figure 8 shows softwood and hardwood net cubic foot volumes on timberland. Although not readily apparent from figure 8, total hardwood and softwood volumes are almost equal (318 and 321 million cubic feet, respectively). Almost all (97 percent) the hardwood volume is in paper birch trees; 87 percent of the softwood volume is in white spruce trees (see table A10). Noticeable from figure 8 is that hardwood volume is concentrated in smaller trees than is softwood volume. The softwood volume is more evenly distributed across the diameter classes.

Examining cubic-foot volume distribution by stand size class shows that almost 64 percent of the total cubic-foot volume is in poletimber stands. Sixty-five percent of the poletimber volume is in stands of the paper birch forest type. The remainder is in birch-spruce (17 percent) and spruce-birch (18 percent) forest types (see table A14).

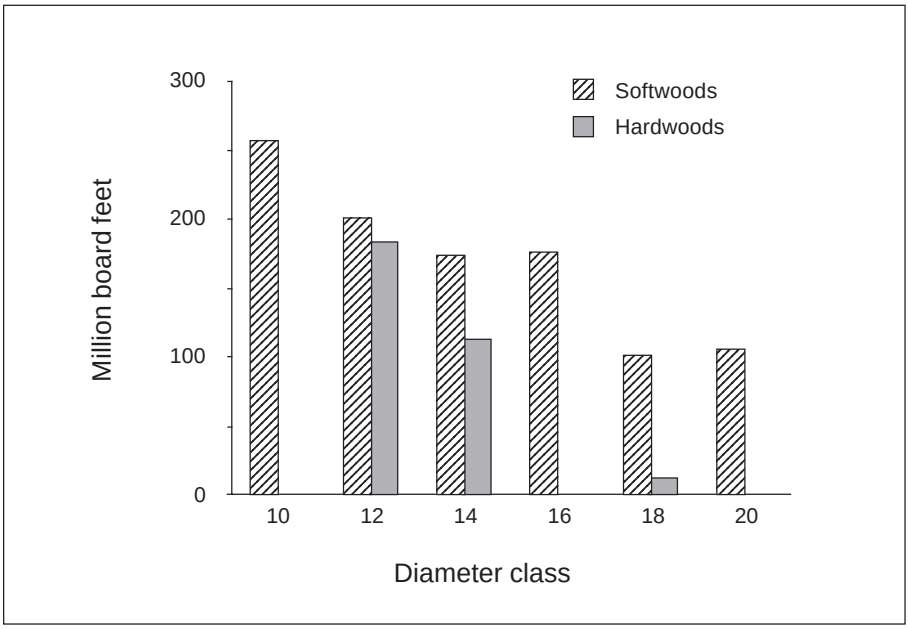

Figure 9—Net board-foot (International 1/4-inch rule) volume of sawtimber on timberland by species group and 2-inch diameter class, Southwest Alaska Vegetation Inventory Unit, 1994.

Net board-foot (International ¼-inch rule) softwood and hardwood volumes, on timberland, by 2-inch diameter class, are shown in figure 9. Board-foot volumes are calculated for sawtimber-sized trees only; this accounts for the difference in ranges of diameter classes between figure 8 and figure 9.

Almost 77 percent of the total net board-foot volume is in softwood trees and all of that softwood sawtimber volume is in white spruce trees. The hardwood net volume component is 94 percent paper birch and 6 percent quaking aspen.

Because most of the net board-foot volume is in white spruce trees and is well distributed across diameter classes, it follows that most of the board-foot volume should be in sawtimber-sized stands. In fact, about 58 percent of this volume is found in sawtimber stands of white spruce and spruce-birch forest types (table A15). Thirty-five percent of the board-foot volume is in poletimber stands (mainly paper birch forest type) and the remainder is mostly in birch-spruce seedling-sapling stands.

Net growth is the volume of growth remaining after mortality has been deducted from gross growth. Tables A19 and A20 show net annual cubic-foot and net annual board-foot (International ¼-inch) growth, respectively. Noticeable is that net annual board-foot growth (10.489 million board feet) is positive, whereas net annual cubic-foot growth (-206 thousand cubic feet) is negative. This difference derives from significant amounts of board-foot ingrowth.

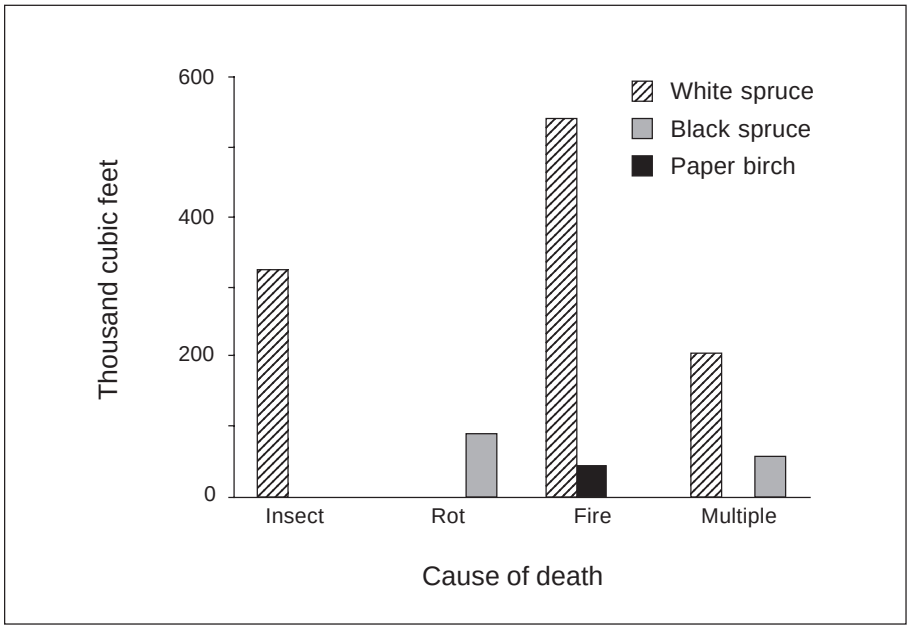

Figure 10—Cubic-foot mortality on timberland by cause of death and tree species, Southwest Alaska Vegetation Inventory Unit, 1994.

Ingrowth is the component of gross growth that accounts for trees not large enough to be counted at the beginning of the measurement period but that became large enough by the end of the period. In first-time measurements such as those taken for this inventory, the measurement period for growth is established from increment cores. When a tree “grows into” a size class, such as sawtimber, the entire volume of the tree is added in as growth. The reason is that, basically, gross growth is the difference between live standing wood volume at the end of the measurement period and live standing wood volume at the beginning of the measurement period. Thus, volume of “new” trees, those that became large enough to be included, is part of the change, or growth, in volume during the measurement period.

In this case, board-foot ingrowth occurred in the 10- and 12-inch diameter classes. Softwood tree species are considered sawtimber sized when they reach 9.0 inches in diameter at breast height (d.b.h.) (10-inch class) and hardwoods must be at least 11.0 inches d.b.h. (12-inch class). Cubic-foot ingrowth also occurred; it is in smaller trees (generally in the 6-inch d.b.h. class), with lower volumes per tree than is the case with sawtimber trees, and therefore is less noticeable. Thus, even though the entire tree volume is ingrowth for board-foot growth, only the annual volume increment (a much smaller amount) is used for cubic-foot growth of the same trees.

Annual cubic- and board-foot mortality on timberland, were about 13.5 and 37.2 million feet, respectively (tables A21-A23). For all growing stock trees, cubic-foot mortality was almost equal to cubic-foot growth, resulting in the slightly negative growth mentioned above. For the sawtimber component of growing stock, however, the significant ingrowth helped offset the mortality and resulted in the net positive growth.

The most influential factor causing tree mortality in the southwest unit was fire (fig. 10). Forty-four percent (5.9 million cubic feet) of the total cubic-foot mortality resulted from fire. Additionally, 24 percent (3.3 million cubic feet) was caused by insects. The insect-caused mortality resulted, in almost equal measure, from attacks by the spruce beetle (*Dendroctonus rufipennis* Kirby) and an engraver beetle (*Ips perturbatus* Eichh.).

Rot as the main cause of mortality was found only in birch trees: about 1 million cubic feet (7 percent of the total). This is not surprising for a number of reasons. Low sampling intensity is partially to blame, though there also are good physiological reasons. Birch trees are susceptible to damage during all stages of their lives. Moose browse on the trees when the trees are young, snow loads cause breakage, and frost cracks are common; all ensure easy access for rot-causing agents.

On the other hand, although spruce trees are not as susceptible to damage from breakage, they are favored targets for insects. Spruce growth rates are less than vigorous in much of interior Alaska (the inventory sample found no sites producing more than 49 cubic feet per acre per year). Slow growth has been shown to be a major risk factor for attack by spruce beetles for instance (Hard and others 1983). Subsequent to field data collection, substantial increases in beetle-caused mortality have been recorded (Holsten and others 1996.) Also, spruce longevity ensures that many of the trees will be affected by fire at some time in their history. Interior Alaska often is subjected to extensive fires (Lutz 1956). The pattern of mortality presented by the estimates derived from the inventory data is not unexpected.

Reliability of Inventory Data

All area and volume statistics reported here are estimates based on sampling and are subject to two types of error. The first is sampling error, which is introduced by using a sample to estimate the whole and from variability of the items being sampled. This type of error is susceptible to a mathematical evaluation of the probability of error. The second type of error derives from mistakes in measurement or judgment, or from limits of method or equipment. The magnitude of this type of error cannot be estimated mathematically, but Forest Inventory and Analysis (FIA) Alaska attempts to minimize it through proper training, supervision, and emphasis on careful work.

The reliability of the inventory is expressed in terms of relative sampling error at the 68-percent confidence level. For the southwest Alaska inventory unit, we estimated 522,126 acres of timberland, ± 23.2 percent, yielding 68-percent confidence limits of 643,259 and 400,993 acres. Area of other forest land was estimated as 15.492 million acres, ± 9.1 percent, yielding 68-percent confidence limits of 14.088 million and 16.896 million acres. Net growing-stock volume was estimated as 638,789,585 cubic feet, ± 26.5 percent, yielding 68-percent confidence limits of 808,068,825 and 469,510,345 cubic feet. Finally, gross annual growth on growing stock was estimated as 13.325 million cubic feet, ± 30.1 percent, yielding 68-percent confidence limits of 17.336 and 9.314 million cubic feet.

These confidence levels mean that with repeated sampling, about 68 percent of the confidence intervals constructed for each sample would capture the true value of the parameter being estimated. As these totals are broken down by forest type, species, tree diameter, and other subdivisions, the possibility of error increases and is greatest for the smallest items.

Glossary

Aerial-photo sampling strata–Sampling categories within subpopulations, created to reduce variance in ground samples. These are land cover categories identifiable on aerial photos. The following are the strata used in the southwest Alaska vegetation inventory:

Forest–Mixed, broadleaf, or needleleaf forests with high or medium per-unit-area timber volumes.

Shrub–Nonforest shrub land cover.

Herbaceous–Nonforest herbaceous land cover.

Barren–Water or barren land.

Woodland–Mixed, broadleaf or needleleaf forests with low per-unit-area timber volumes.

Unknown–Unknown land cover.

Vegetated–Created for the barren subpopulation only; includes any type of existing vegetation.

Census water–Areas of water classed as water by the Bureau of the Census that are at least 40 acres in size and a minimum width of 0.125 mile. (Also see non-Census water.)

Class of timber–A classification of trees as growing stock, cull, and salvable dead. Growing stock trees are subdivided into poletimber and sawtimber trees.

Cull logs–Softwood sawtimber logs with two-thirds or more of the board-foot volume in cull material and hardwood sawtimber logs with one-half or more of the volume in cull material.

Cull material–Portions of a tree unusable for industrial products because of rot, form, or other defect.

Cull trees–Live trees of sawtimber or poletimber size that are not merchantable for saw logs and are unlikely to become merchantable because of defect, rot, or species.

Diameter class–A classification of trees based on diameter of the tree outside bark measured at breast height (d.b.h.), 4.5 feet above the ground. Each 2-inch diameter class is assigned to the appropriate even inch at midpoint. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Forest land–(A ground-sample classification.) Land at least 16.7 percent stocked by live trees of any size, or land formerly having such tree cover and not currently developed for nonforest use. Includes chaparral areas in the Western United States and afforested areas. The minimum area for classification as forest land or subclasses of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to be classified as forest land. Unimproved roads and trails, streams, and clearings in forest areas must be less than 120 feet wide to be classified as forest land. (Also see timberland, other forest land, reserved forest land, and nonforest land.)

Forest types–A classification of forest land based on the species forming a plurality of stocking on the area currently occupied by tree cover. The following summarizes the forest types of southwest Alaska:

Aspen–Forests in which quaking aspen comprises greater than 75 percent of the tree stocking.

Birch-aspen–Forests in which paper birch and quaking aspen each comprise between 25 and 75 percent of the tree stocking.

Birch-spruce–Forests in which paper birch comprises between 50 and 75 percent of the tree stocking and white or black spruce, or a combination, comprises between 25 and 49 percent of the tree stocking.

Birch-spruce-poplar–Forests in which paper birch comprises 25 to 50 percent of the tree stocking, white or black spruce, or a combination, comprises between 25 and 49 percent of the tree stocking, and balsam poplar or black cottonwood, or a combination, comprises between 25 and 49 percent of the tree stocking.

Black spruce–Forests in which black spruce comprises greater than 75 percent of the tree stocking.

Black spruce-tamarack–Forests in which black spruce comprises between 25 and 75 percent of the tree stocking and tamarack comprises between 25 and 75 percent of the tree stocking.

Paper birch–Forests in which paper birch comprises greater than 75 percent of the tree stocking.

Poplar–Forests in which balsam poplar or black cottonwood comprise greater than 75 percent of the tree stocking.

Poplar-aspen–Forests in which balsam poplar or black cottonwood comprises between 25 and 75 percent of the tree stocking and quaking aspen comprises between 25 and 75 percent of the tree stocking.

Poplar-spruce–Forests in which balsam poplar or black cottonwood comprises between 25 and 75 percent of the tree stocking and white spruce or black spruce, or a combination, comprises between 25 and 75 percent of the tree stocking.

Spruce-birch–Forests in which white spruce or black spruce, or a combination, comprises between 50 and 75 percent of the tree stocking and paper birch comprises 25 to 49 percent of the tree stocking.

Tamarack–Forests in which tamarack comprises greater than 75 percent of the tree stocking.

White spruce–Forests in which white spruce comprises more than 75 percent of the tree stocking.

White spruce-black spruce–Forests in which white spruce and black spruce each comprise between 25 and 75 percent of the tree stocking.

Growing stock trees–All live trees except cull trees.

Growing stock volume–Net volume in cubic feet of live sawtimber and poletimber growing stock trees from stump to a minimum 4.0-inch top (of central stem) outside the bark. Net volume equals gross volume less deductions for rot and missing bole sections.

International 1/4-inch rule–The standard board-foot log rule adopted by the USDA Forest Service for the presentation of inventory volume statistics.

Land class–A classification of land by major use, such as timberland, other forest, or nonforest. The minimum size area for classification is 1 acre.

Mean annual increment (m.a.i.)–A measure of the productivity of forest land in terms of the average increase in cubic-foot volume per acre per year. The minimum standard for timberland is the ability to produce 20 cubic feet per acre per year.

Mortality–The number of or the sound wood volume from live trees dying from natural causes during a specified period.

Mortality of growing stock–The volume of sound wood in live sawtimber and poletimber trees dying annually from natural causes during a specified period.

Mortality of sawtimber–The net board-foot volume of sawtimber trees dying annually from natural causes during a specified period.

Net annual growth–The increase in net volume of wood for growing stock trees during a specified year. Components of net annual growth are (a) the increment in net volume of trees alive at the beginning of the specified year, including that on periodic mortality, plus (b) the net volume of trees reaching sawtimber or poletimber size during the year, minus (c) the net volume of trees that died during the year, minus (d) the net volume lost to tree decay during the year.

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

Non-Census water–(A ground-sample classification.) Areas of water classed as land by the Bureau of the Census, but that are 1 to 40 acres in size with a minimum width of 120 feet and a maximum width of 0.125 mile. (Also see Census water.)

Nonforest land–(A ground-sample classification.) 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. Included are lands used for agricultural crops, improved pasture, residential areas, city parks, improved roads, operating railroads and their right-of-way clearings, and pipeline clearings. If intermingled in forest areas, unimproved roads, streams, canals, and nonforest strips must be more than 120 feet wide, and clearings or other areas must be 1 acre or larger to qualify as nonforest land.

Nonstocked land–(A ground-sample classification.) Timberland less than 16.7 percent stocked with growing stock trees.

Other forest land–(A ground-sample classification.) Forest land not capable of producing 20 cubic feet per acre per year or more of wood at culmination of mean annual increment (m.a.i.) and not withdrawn from timber utilization due to administrative statute.

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

Poletimber trees–Growing stock trees greater than 5.0 inches in d.b.h. and less than sawtimber sized.

Productive forest land–(A ground-sample classification.) Forest land producing or capable of producing 20 cubic feet per acre per year or more of wood at culmination of mean annual increment (m.a.i.)

Reserved forest land–Forest land withdrawn from timber utilization through statute or administrative regulation.

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

Sawtimber trees–Growing stock trees at least 11.0 inches in d.b.h. for hardwoods and 9.0 inches for softwoods.

Sawtimber volume–Net volume of sawtimber trees measured in board feet. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule–The common board-foot rule used locally in determining volume of sawtimber.

Seedling and sapling stands–Stands at least 16.7 percent stocked with growing stock trees and with saplings or seedlings comprising more than half this stocking.

Site class–A classification of forest land based on its capacity to grow wood.

Stand age class–A classification of forest land based on the predominant age of trees in a given stand.

Stand size class–A classification of forest land based on the predominant size of timber present: sawtimber, poletimber, or seedlings and saplings.

Stocking–A measure of the area occupied by trees of specified classes. FIA forest inventories consider three categories of stocking: all live trees, growing stock trees, and desirable trees. Stocking of all live trees is used to delineate forest land and forest types. Stocking of growing stock trees is used in classifications of stand size and stand age.

Subpopulation–A grouping of pixels on LANDSAT MSS imagery into broad spectral reflectance categories.

Timberland–(A ground-sample classification.) Forest land producing or capable of producing 20 cubic feet per acre per year or more of wood at culmination of mean annual increment (m.a.i.) and not withdrawn from timber utilization due to administrative statute.

Tree size class–A classification of sawtimber trees, poletimber trees, saplings, and seedlings based on the diameter at breast height.

Volume of growing stock–Volume of sound wood in the bole of live growing stock sawtimber and poletimber trees from stump to a minimum 4.0-inch top outside the bark or to the point where the central stem breaks into limbs.

Names of Trees[1]

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

Metric Equivalents

1 inch = 2.54 centimeters

1 foot = 0.3048 meter

1 mile = 1.609 kilometer

1 acre = 0.4047 hectare

1 cubic foot = 0.0283 cubic meter

20 cubic feet per acre = 1.3994 cubic meters per hectare

References

Dippold, Ronald M.; Farr, Wilbur A. 1971. Volume tables and equations for white spruce, balsam poplar, and paper birch of the Kuskokwim River Valley, Alaska. Res. Note PNW-147. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 8 p.

Farr, Wilbur A. 1967. Growth and yield of well-stocked white spruce stands in Alaska. Res. Pap. PNW-53. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 30 p.

Gregory, Robert A.; Haack, Paul M. 1964. Equations and tables for estimating cubic-foot volume of interior Alaska tree species. Res. Note NOR-6. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 21 p.

Gregory, Robert A.; Haack, Paul M. 1965. Growth and yield of well-stocked aspen and birch stands in Alaska. Res. Pap. NOR-2. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 28 p.

Grosenbaugh, L.R. 1952. Plotless timber estimates…new, fast, and easy. Journal of Forestry. 50(1): 32-37.

Haack, Paul M., Jr. 1963. Volume tables for trees of interior Alaska. Res. Note NOR-5. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 11 p.

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[1] Scientific names are according to Viereck and Little (1972).

Hard, J.S.; Werner, R.A.; Holsten, E.H. 1983. Susceptibility of white spruce to attack by spruce beetles during the early stages of an outbreak in Alaska. Canadian Journal of Forest Research. 13: 678-684.

Hegg, Karl M.; Sieverding, Harold. 1979. Timber resources of the Kuskokwim floodplain and adjacent upland. Resour. Bull. PNW-87. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 40 p.

Holsten, E.H.; Hennon, P.; Wittwer, D.; Matthews, K. 1996. Forest insect and disease conditions in Alaska, 1995. For. Health Mgmt. Rep. R10-TP-61. Juneau, AK: U.S.Department of Agriculture, Forest Service, State and Private Forestry. 40 p.

Hutchison, O. Keith. 1967. Alaska's forest resource. Resour. Bull. PNW-19. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 74 p.

Johnson, Phillip R.; Hartman, Charles W. 1971. Environmental atlas of Alaska, 2d ed. College, AK: Institute of Arctic Environmental Engineering, Institute of Water Resources, University of Alaska.

Larson, Frederic R. 1994. Alaska inventory systems and their application for early detection of bark beetle outbreaks and other forest health conditions. In: Managing forests to meet peoples needs: Proceedings of the 1994 Society of American Foresters-Canadian Institute of Forestry convention; 1994 Sept. 18-22; Anchorage, AK. Bethesda, MD: Society of American Foresters: 117-122.

Lutz, H.J. 1956. Ecological effects of forest fires in interior Alaska. Tech. Bull. 1133. Washington, DC: U.S. Department of Agriculture. 121 p.

Selkregg, Lydia L. 1974. Alaska regional profiles: southwest region. Anchorage, AK: The University of Alaska, Arctic Environmental Information and Data Center. 313 p.

Spetzman, L.A. 1963. Terrain study of Alaska: Part 5. Vegetation. [Place of publication unknown]: U.S. Army, Office of Chief of Engineers. [1 map].

Viereck, Leslie A.; Little, Elbert E, Jr. 1972. Alaska trees and shrubs. Agric. Handb. 410. Washington, DC: U.S. Department of Agriculture. 265 p.

Winterberger, Kenneth C.; Larson, Frederic R. 1985. Multiphase sample of vegetation and related resources using LANDSAT, aerial photo, and ground survey data. In: Remote sensing in forest and resource management: Proceedings of the 10th William T. Pecora memorial remote sensing symposium; 1985 August 20-22; Fort Collins, CO. Falls Church, VA: American Society for Photogrammetry and Remote Sensing.

Yarie, J.; Herman, F.R. 1982. Preliminary site index equations and site quality comparisons for the Tanana River balsam poplar and Susitna River black cottonwood; final report; USDA FS-PNW cooperative agreement with the University of Alaska, Fairbanks. 20 p. On file with: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, Anchorage, AK.

Appendix

Table A1—Area by land class, forestland subpopulation, southwest Alaska, 1994[a]

		Forest land				
Timberland	Reserved productive	Available other forest	Reserved other forest	Total forestland	Nonforest[b]	All land
			Thousand acres			
522	7	15,191	301	16,021	50,851	66,872

[a] Totals may be off due to rounding. Estimates are subject to sampling error.
[b] Does not include area of Census water or non-Census water.

Table A2—Area of reserved productive forest land, and available and reserved other forest land by forest type, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Reserved productive forest land	Available other forest land	Reserved other forest land	All lands
		Thousand acres		
Softwoods:				
Black spruce	—	6,405	36	6,442
Black spruce-tamarack	—	282	—	282
Tamarack	—	551	—	551
White spruce	—	3,179	95	3,274
White spruce-black spruce	—	488	—	488
Total softwoods	—	10,906	132	11,037
Hardwoods:				
Aspen	—	35	—	35
Paper birch	7	911	51	969
Poplar	—	610	—	610
Total hardwoods	7	1,555	51	1,613
Mixed:				
Birch-spruce	—	915	88	1,003
Birch-spruce-poplar	—	37	—	37
Spruce-birch	—	1,779	30	1,809
Total mixed	—	2,731	118	2,849
All types	7	15,191	301	15,499

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A3—Area of timberland by ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Public							Private				
	Other public							Other private			
National Forest	BLM	Indian	Other Federal	State	Municipal	All public	Forest industry	Farmer	Other private	All private	All classes
					Thousand acres						
—	103	—	—	279	—	382	—	—	140	140	522

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A4—Area of timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
		Thousand acres		
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	59	37	96
White spruce-black spruce	—	—	—	—
Total softwoods	—	59	37	96
Hardwoods:				
Aspen	—	—	—	—
Paper birch	103	59	36	198
Poplar	—	—	—	—
Total hardwoods	103	59	36	198
Mixed:				
Birch-spruce	—	66	66	133
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	96	—	96
Total mixed	—	162	66	288
All types	103	279	140	522

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A5—Area of timberland by ownership class and stand-size class, forest land subpopulation, southwest Alaska, 1994[a]

Ownership class	Stand-size class				All classes
	Sawtimber	Poletimber	Seedling-sapling	Nonstocked	
	Thousand acres				
BLM	—	103	—	—	103
State	59	117	95	7	279
Private	37	103	—	—	140
Total	96	324	95	7	522

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A6—Area of timberland by ownership class and cubic-foot site class, forest land subpopulation, southwest Alaska, 1994[a]

Ownership class	Site class (cubic feet)				All classes
	120+	85-119	50-84	20-49	
	Thousand acres				
BLM	—	—	—	103	103
State	—	—	—	279	279
Private	—	—	—	140	140
Total	—	—	—	522	522

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A7—Area of timberland by forest type and stand-size class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Stand-size class				All classes
	Sawtimber	Poletimber	Seedling-sapling	Nonstocked	
	Thousand acres				
Softwoods:					
Black spruce	—	—	—	—	—
Black spruce-tamarack	—	—	—	—	—
Tamarack	—	—	—	—	—
White spruce	59	—	29	7	96
White spruce-black spruce	—	—	—	—	—
Total softwoods	59	—	29	7	96
Hardwoods:					
Aspen	—	—	—	—	—
Paper birch	—	198	—	—	198
Poplar	—	—	—	—	—
Total hardwoods	—	198	—	—	198
Mixed:					
Birch-spruce	—	66	66	—	133
Birch-spruce-poplar	—	—	—	—	—
Spruce-birch	37	59	—	—	96
Total mixed	37	125	66	—	228
All types	96	323	95	7	522

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A8—Number of live trees on timberland by diameter class and species, forest land subpopulation, southwest Alaska, 1994[a]

Diameter class	Softwood species				Hardwood species			All species
	Tamarack	White spruce	Black spruce	Total softwoods	Paper birch	Quaking aspen	Total hardwoods	
Inches	*Thousand trees*							
2	—	18,959	21,253	40,212	80,507	—	80,507	120,719
4	—	8,927	13,281	22,209	25,061	—	25,061	47,270
6	—	9,970	9,964	19,934	40,057	823	40,880	60,814
8	465	8,134	3,450	12,050	16,862	—	16,862	28,912
10	—	7,444	—	7,444	6,436	354	6,790	14,234
12	—	1,993	—	1,993	3,023	295	3,318	5,311
14	—	1,383	—	1,383	971	—	971	2,354
16	—	893	—	893	—	—	—	893
18	—	361	—	361	121	—	121	482
20	—	281	—	281	—	—	—	281
Total	465	58,346	47,949	106,761	173,038	1,472	174,509	281,270

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A9—Number of growing stock trees on timberland by diameter class and species, forest land subpopulation, southwest Alaska, 1994[a]

Diameter class	Softwood species				Hardwood species			All species
	Tamarack	White spruce	Black spruce	Total softwoods	Paper birch	Quaking aspen	Total hardwoods	
Inches	*Thousand trees*							
2	—	18,959	18,904	37,863	56,849	—	56,849	94,712
4	—	8,927	13,281	22,209	22,685	—	22,685	44,893
6	—	9,970	9,964	19,934	40,057	823	40,880	60,814
8	465	8,134	2,394	10,993	15,735	—	15,735	26,728
10	—	7,444	—	7,444	5,430	354	5,784	13,228
12	—	1,993	—	1,993	3,023	295	3,318	5,311
14	—	1,383	—	1,383	971	—	971	2,354
16	—	893	—	893	—	—	—	893
18	—	361	—	361	121	—	121	482
20	—	281	—	281	—	—	—	281
Total	465	58,346	44,543	103,355	144,871	1,472	146,343	249,697

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A10—Net volume of growing stock on timberland by diameter class and species, forest land subpopulation, southwest Alaska, 1994[a]

Diameter class	Softwood species				Hardwood species			All species
	Tamarack	White spruce	Black spruce	Total softwoods	Paper birch	Quaking aspen	Total hardwoods	
Inches	*Thousand cubic feet*							
6	—	23,083	28,481	51,564	91,744	1,587	93,331	144,895
8	2,615	37,581	11,594	51,789	89,452	—	89,452	141,241
10	—	71,789	—	71,789	58,870	4,303	63,174	134,963
12	—	41,608	—	41,608	41,477	5,005	46,482	88,090
14	—	34,186	—	34,186	22,950	—	22,950	57,137
16	—	32,941	—	32,941	—	—	—	32,941
18	—	18,248	—	18,248	2,534	—	2,534	20,782
20	—	18,741	—	18,741	—	—	—	18,741
Total	2,615	278,177	40,075	320,867	307,027	10,896	317,923	638,790

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A11—Net volume of sawtimber on timberland by diameter class and species, forest land subpopulation, southwest Alaska, 1994[a]

Diameter class	Softwood species				Hardwood species			All species
	Tamarack	White spruce	Black spruce	Total softwoods	Paper birch	Quaking aspen	Total hardwoods	
Inches	*Thousand board feet, International ¼-inch rule*							
10	—	256,532	—	256,532	—	—	—	256,532
12	—	199,777	—	199,777	165,594	17,118	182,712	382,489
14	—	173,196	—	173,196	112,522	—	112,522	285,718
16	—	174,959	—	174,959	—	—	—	174,959
18	—	99,895	—	99,895	12,264	—	12,264	112,159
20	—	104,573	—	104,573	—	—	—	104,573
Total	—	1,008,933	—	1,008,932	290,380	17,118	307,498	1,316,431

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A12—Net volume of growing stock on timberland by species and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Species	Ownership class			All owners
	BLM	State	Private	
	Thousand cubic feet			
Softwoods:				
Black spruce	—	40,075	—	40,075
Tamarack	—	—	2,615	2,615
White spruce	29,298	153,362	95,517	278,177
Total softwoods	29,298	193,437	98,132	320,867
Hardwoods:				
Aspen	9,308	—	1,587	10,896
Paper birch	152,266	74,026	80,736	307,027
Total hardwoods	161,574	74,026	82,323	317,923
All species	190,872	267,463	180,455	638,790

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A13—Net volume of sawtimber on timberland by species and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Species	Ownership class			All owners
	BLM	State	Private	
	Thousand board feet, International ¼-inch rule			
Softwoods:				
Black spruce	—	—	—	—
Tamarack	—	—	—	—
White spruce	86,318	475,345	447,270	1,008,933
Total softwoods	86,318	475,345	447,270	1,008,933
Hardwoods:				
Aspen	17,118	—	—	17,118
Paper birch	256,842	15,196	18,342	290,380
Total hardwoods	273,960	15,196	18,342	307,498
All species	360,278	490,542	465,611	1,316,431

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A14—Net volume of growing stock on timberland by forest type and stand-size class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Stand-size class				All classes
	Sawtimber	Poletimber	Seedling-sapling	Nonstocked	
	Thousand cubic feet				
Softwoods:					
Black spruce	—	—	—	—	—
Black spruce-tamarack	—	—	—	—	—
Tamarack	—	—	—	—	—
White spruce	143,731	—	11,290	—	155,021
White spruce-black spruce	—	—	—	—	—
Total softwoods	143,731	—	11,290	—	155,021
Hardwoods:					
Aspen	—	—	—	—	—
Paper birch	—	265,060	—	—	265,060
Poplar	—	—	—	—	—
Total hardwoods	—	265,060	—	—	265,060
Mixed:					
Birch-spruce	—	70,367	24,771	—	95,138
Birch-spruce-poplar	—	—	—	—	—
Spruce-birch	50,178	73,402	—	—	123,581
Total mixed	50,178	143,769	24,771	—	218,719
All types	193,910	408,819	36,061	—	638,790

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A15—Net volume of sawtimber on timberland by forest type and stand-size class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Stand-size class				All classes
	Sawtimber	Poletimber	Seedling-sapling	Nonstocked	
	Thousand board feet, International ¼-inch rule				
Softwoods:					
Black spruce	—	—	—	—	—
Black spruce-tamarack	—	—	—	—	—
Tamarack	—	—	—	—	—
White spruce	632,043	—	9,412	—	641,455
White spruce-black spruce	—	—	—	—	—
Total softwoods	632,043	—	9,412	—	641,455
Hardwoods:					
Aspen	—	—	—	—	—
Paper birch	—	360,278	—	—	360,278
Poplar	—	—	—	—	—
Total hardwoods	—	360,278	—	—	360,278
Mixed:					
Birch-spruce	—	70,615	75,359	—	145,974
Birch-spruce-poplar	—	—	—	—	—
Spruce-birch	136,862	31,862	—	—	168,724
Total mixed	136,862	102,477	75,359	—	314,698
All types	768,905	462,755	84,771	—	1,316,431

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A16—Net volume of growing stock on timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
	Thousand cubic feet			
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	75,951	79,070	155,021
White spruce-black spruce	—	—	—	—
Total softwoods	—	75,951	79,070	155,021
Hardwoods:				
Aspen	—	—	—	—
Paper birch	190,872	43,161	31,017	265,050
Poplar	—	—	—	—
Total hardwoods	190,872	43,161	31,017	265,050
Mixed:				
Birch-spruce	—	24,771	70,367	95,138
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	123,581	—	123,581
Total mixed	—	148,352	70,367	218,719
All types	190,872	267,463	180,455	638,790

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A17—Net volume of sawtimber on timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
	Thousand board feet, International ¼-inch rule			
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	246,459	394,996	641,455
White spruce-black spruce	—	—	—	—
Total softwoods	—	246,459	394,996	641,455
Hardwoods:				
Aspen	—	—	—	—
Paper birch	360,278	—	—	360,278
Poplar	—	—	—	—
Total hardwoods	360,278	—	—	360,278
Mixed:				
Birch-spruce	—	75,359	70,615	145,974
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	168,724	—	168,724
Total mixed	—	244,082	70,615	314,698
All types	360,278	490,542	465,611	1,316,431

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A18—Net volume of sawtimber on timberland by class of timber and species group, forest land subpopulation, southwest Alaska, 1994[a]

Class of timber	Species group		All species
	Softwoods	Hardwoods	
	Thousand cubic feet		
Sawtimber trees:			
Saw-log portion	202,300	53,448	255,747
Upper-stem portion	15,214	18,519	33,733
Total sawtimber	217,514	71,967	289,480
Poletimber trees	103,353	245,956	349,309
All growing stock trees	320,867	317,923	638,790
Sound cull trees	5,130	2,963	8,093
Rotten cull trees	—	4,539	4,539
All live trees	325,997	325,424	651,421
Salvable dead trees	14,143	640	14,783
Total, all timber	340,140	326,064	666,204

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A19—Net annual growth of growing stock on timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
	Thousand cubic feet			
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	891	-1,238	-347
White spruce-black spruce	—	—	—	—
Total softwoods	—	891	-1,238	-347
Hardwoods:				
Aspen	—	—	—	—
Paper birch	969	1,147	835	2,951
Poplar	—	—	—	—
Total hardwoods	969	1,147	835	2,951
Mixed:				
Birch-spruce	—	-5,231	662	-4,569
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	1,759	—	1,759
Total mixed	—	-3,472	662	-2,810
All types	969	-1,434	258	-206

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A20—Net annual growth of sawtimber on timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
	Thousand board feet, International ¼-inch rule			
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	11,137	-2,398	8,969
White spruce-black spruce	—	—	—	—
Total softwoods	—	11,137	-2,398	8,969
Hardwoods:				
Aspen	—	—	—	—
Paper birch	2,186	—	—	2,186
Poplar	—	—	—	—
Total hardwoods	2,186	—	—	2,186
Mixed:				
Birch-spruce	—	-18,098	5,728	-12,371
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	11,705	—	11,705
Total mixed	—	-6,393	5,728	-665
All types	2,186	4,974	3,329	10,489

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A21—Annual mortality of growing stock on timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
	Thousand cubic feet			
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	—	1,766	1,766
White spruce-black spruce	—	—	—	—
Total softwoods	—	—	1,766	1,766
Hardwoods:				
Aspen	—	—	—	—
Paper birch	3,666	—	—	3,666
Poplar	—	—	—	—
Total hardwoods	3,666	—	—	3,666
Mixed:				
Birch-spruce	—	7,500	600	8,100
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	—	—	—
Total mixed	—	7,500	600	8,100
All types	3,666	7,500	2,366	13,532

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A22—Annual mortality of sawtimber on timberland by forest type and ownership class, forest land subpopulation, southwest Alaska, 1994[a]

Forest type	Ownership class			All owners
	BLM	State	Private	
	Thousand board feet, International ¼-inch rule			
Softwoods:				
Black spruce	—	—	—	—
Black spruce-tamarack	—	—	—	—
Tamarack	—	—	—	—
White spruce	—	—	5,132	5,132
White spruce-black spruce	—	—	—	—
Total softwoods	—	—	5,132	5,132
Hardwoods:				
Aspen	—	—	—	—
Paper birch	13,344	—	—	13,344
Poplar	—	—	—	—
Total hardwoods	13,344	—	—	13,344
Mixed:				
Birch-spruce	—	18,728	—	18,728
Birch-spruce-poplar	—	—	—	—
Spruce-birch	—	—	—	—
Total mixed	—	18,728	—	18,728
All types	13,344	18,728	5,132	37,204

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

Table A23—Annual mortality of growing stock on timberland by species and cause of death, forest land subpopulation, southwest Alaska, 1994[a]

Species	Cause of death				All causes
	Insect	Rot	Fire	Multiple	
	Thousand cubic feet				
White spruce	331	—	548	211	1,090
Black spruce	—	—	47	—	47
Paper birch	—	95	—	61	216
All species	331	95	595	272	1,353

— = no data were collected.
[a] Totals may be off due to rounding. Estimates are subject to sampling error.

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van Hees, Willem W.S. 1999. Vegetation resources of southwest Alaska: development and application of an innovative, extensive sampling design. Res. Pap. PNW-RP-507. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 51 p.

An assessment of the vegetation resources of southwest Alaska was made by using an inventory design developed by the Pacific Northwest Research Station. Satellite imagery (LANDSAT MSS), high-altitude aerial photography, and ground sampling were the major components of the design. Estimates of area for all land cover classes in the southwest region were produced. Additionally, more intensive sampling provided data for estimation of timber resources in the forest land component. Field data collection was conducted from 1991 to 1994, and data compilation progressed through 1995.

Keywords: Vegetation surveys, forest surveys, timber resources, statistics (forest), Alaska (southwest).

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