LAND COVER & FOREST VEGETATION

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LAND COVER

Southeast Alaska is widely recognized as the last remaining, largely intact, old-growth rainforest in North America. That simple description belies the complex landcover of the region. Fully one-third of the region is not vegetated at all, but is barren rock, water, and ice. And surprisingly for a rainforest, only about half of the land area supports forest vegetation.

As well-known as it is for its towering forest, Southeast is also known for its majestic mountains, steep rocky fjords, tidewater glaciers, and extensive coastlines. Land cover can be generally described in broad categories of forest, nonforest vegetation, and unvegetated areas primarily of rock and ice.

About two-thirds of Southeast Alaska is vegetated, but not all of that area is forested. Forest vegetation, which covers half of the region (48%) is described in more detail in the following section. About half of the forest, or 27% of Southeast Alaska, is classified as productive old growth (which can include small trees), with 18% of the region classified as timberland. Today, only 3% of all of Southeast Alaska is made up of large-tree timberland, while another 4% of the region (previously in the large-tree or medium-tree timberland category) has been harvested. Forested lands in Southeast Alaska are owned primarily by the US Forest Service (84%) as well as Native Corporations (8%), while smaller amounts are managed by the National Park Service (4%), State of Alaska (2%), Bureau of Land Management (1%), and private landowners (1%). Nonforest vegetation makes up 17% of the region in the form of shrublands and herbaceous lands such as muskeg areas. Unvegetated areas of bare rock, ice, and fresh water make up about one-third of Southeast Alaska (34%). Icefields and glaciers alone cover 20% of Southeast Alaska. Very little of the region is developed into urban areas (<1%). Collectively, nonforest land types cover 11.9 million ac (4.8 million ha), or 52% of the total land area of the region. Federal agencies manage most of the nonforest lands, including the Forest Service (71%) and the Park Service (21%). Minor amounts are managed by the Bureau of Land Management (3%), the state (4%), and Native and private landowners (1%).

FOREST VEGETATION

Where trees grow in Southeast Alaska, a high percentage of that land (84%) falls within the Tongass National Forest and is managed by the US Forest Service. Relatively minor amounts of forestland are owned and managed by other federal agencies (5.6%), state and local government (3.5%) or private landowners (5.7%). We relied primarily on the nationwide Forest Inventory and Analysis (FIA) (van Hees and Mead 2005) to describe the amount, kind, condition, and ownership of vegetation types across the region. This accounting includes all vegetated lands, including forest and nonforest types.

A major theme of any discussion of forest vegetation types must take note of the extraordinary range of productivity across the forested landscape. This is a reflection of the complex soils, drainage patterns, physiography, and weather from island to island across the region.



Old-growth forest on Prince of Wales Island.

Forest growth declines significantly as one moves north through the temperate rainforest of North America (Farr and Harris 1979). In Southeast Alaska, only 37% of the forested land (and 18% of all land) supports what is classified as timberland (van Hees and Mead 2005), or land with at least minimal potential for the commercial harvest of trees. Within timberland, an even smaller percentage supports what can be characterized as valuable timberland, with larger trees and high stand volumes (Hutchison and LaBau 1975, Albert and Schoen 2013). The valuable timberlands are characteristically found at lower elevations, nearer the coast, and along rivers and streams where soils are better drained. Because these sites constitute the most valuable fish and wildlife habitats, and because they have been greatly depleted by past logging (Albert and Schoen 2013), how the Forest Service manages what remains has caused long-standing tension in the region (Nie 2006).

Forest Vegetation Types

Forest vegetation types are those with at least 10% foliar canopy from trees. The main tree species in Southeast Alaska are western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchesis*), western red cedar (*Thuja plicata*), Alaska yellow cedar (*Chamaecyparis nootkatensis*), mountain hemlock (*Tsuga mertensiana*), and lodgepole pine (*Pinus cantorta*).

Western hemlock is the most abundant tree species, comprising 64% of the growing-stock volume on timberlands in the region (Harris and Farr 1974a). It grows widely throughout the region, but shows greatest growth on well-drained, organic soils in valley bottoms and along lower slopes where the largest trees reach 170 ft (52 m) in height and 6 ft (2 m) in diameter (Harris and Farr 1974a). Sitka spruce is the second-most abundant timber species in Southeast Alaska, making up 28% of the growing-stock volume on timberland (Harris and Farr 1974a).

The best spruce stands grow on well-drained mineral soils, especially colluvial deposits at the base of hillsides, and alluvial deposits associated with streams. The largest trees can exceed 10 ft (3 m) in diameter and 200 ft (61 m) in height (Harris and Farr 1974a). Western red cedar is found only in the southern half of the Archipelago (south of Frederick Sound). It occurs primarily at lower elevations on poorly drained organic soils and on shallow soils over bedrock or impermeable till. On productive sites, it can reach heights > 150 ft (46 m) and diameters > 9 ft (3 m) (Harris and Farr 1974a). Alaska yellow cedar occurs in scattered stands throughout the region, and is most abundant on Baranof and Chichagof islands. It is more common on poorer growing sites, as is red cedar, and does not compete well with hemlock and spruce on productive sites. The wood is aromatic, strong, and highly resistant to decay, making it a valuable commercial species, particularly in Japan. The largest trees on productive sites can reach 8 ft (2 m) in diameter, 120 ft (37 m) in height, and may exceed 1,000 years in age. Mountain hemlock occurs throughout Southeast Alaska from sea level to timberline. At lower elevations, it is found on poorer sites and organic soils, where it occurs with spruce, hemlock, cedars, and lodgepole pine in mixed conifer stands. On good growing sites, trees may exceed 100 ft (31 m) in height and 3 ft (1 m) in diameter (Harris and Farr 1974a)

The recognized forest vegetation types in this region are: western hemlock (38% of timberland), western hemlock-Sitka spruce (20%), mixed conifer (13%), western red cedar-hemlock (10%), Sitka spruce (8%), mountain hemlock (5%) and Alaska yellow cedar-hemlock (3%) (van Hees and Mead 2005, Albert and Schoen 2013).

Productive old-growth forest may contain trees that exceed 1,000 years of age; dominant trees typically exceed 300 years of age. If we conservatively define old-growth forests as stands over 200 years of age, then 61% of the timberlands in Southeast Alaska are old growth.



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South Admiralty Island alpine landscape.



FIGURE 3-1 Land cover classes and timberland composition in Southeast Alaska.

An additional 12% are on the verge of becoming old growth, with a stand age between 150 and 200 years (van Hees and Mead 2005). Old growth dominates every forest type in the region but one: Sitka spruce. In part, because of historic logging pressure on Sitka spruce (Harris and Farr 1974a, Mackovjak 2011), the region now has more hectares in younger age classes (50–150 years) than old growth in this forest type (van Hees and Mead 2005).

Different densities of trees on the land have implications for wildlife habitat management, assessment of carbon sequestration, and viability of timber harvest operations, which depend heavily on wood volume, measured in board ft/ac (cubic m/ha) (van Hees and Mead 2005). Across all timber-lands in the region, the forest contains an average net volume of 61,000 board ft/ac (357 m³/ha). Forest types, ranked by volume per acre, are Sitka spruce (88,000 board ft/ac; 513 m³/ha), western hemlock-Sitka spruce, western hemlock, western red cedar, mixed conifer, mountain hemlock, Alaska cedar-hemlock and lodgepole pine (15,000 board ft/ac; 88 m³/ha). High-value timberlands are almost exclusively in spruce, hemlock, and cedar types. Western Hemlock and Sitka spruce together account for 94% of the sawtimber volume in the region (Harris and Farr 1974a).

Alaska cedar-hemlock forest type is the rarest in the region, and it supports the highest plant species diversity (van Hees and Mead 2005). Because of Alaska yellow cedar's strength and natural decay resistance, it is also the region's most valuable commercial species (Hennon et al. 2000). Even dead-standing cedar trees have sufficient value to warrant helicopter-yarding (Donovan 2004). The heavy exploitation of rare cedar types is a significant conservation concern (e.g. Carstensen 2013).

Other vegetation types in the region can be described using the framework of the Alaska Vegetation Classification System (AVCS) developed by Viereck et al. (1992). According to this classification system, needleleaf forest covers the highest proportion of land area (47%), and barren lands account for 31% of the total (van Hees and Mead 2005). Total vegetated land area in Southeast Alaska is estimated at 15.3 million ac (6.2 million ha) compared with 7.7 million ac (3.1 million ha) occurring as barren, ice, or water-covered lands. Figure 3-1 and Table 3-4 summarize land cover and forest vegetation across Southeast Alaska.

Nonforest Vegetation Types

Nonforest vegetation types are defined as lands with >2% foliar cover (otherwise barren) and <10% canopy cover from trees (otherwise forested). Within nonforest vegetation the major types are labeled (under AVCS) as tall scrub, low scrub, dwarf scrub, and herbaceous vegetation.

"Tall scrub" vegetation types occur on 792,000 ac (32,000 ha), and represent 5.2% of the vegetated land area of Southeast Alaska. Within the tall scrub type are subtypes alder (*Alnus spp.*), alder-salmonberry (*Rubus spectablis*), dwarf birch-willow (*Salix spp.*), blueberry-salmonberry (*Vaccinium spp.*), salmonberry, unclassified tall scrub, and willow. Of these, the alder and alder-salmonberry account for 58% and 20% of the tall scrub vegetation type respectively (van Hees and Mead 2005). On private lands, the most common subtype is blueberry-salmonberry (90%) which is typical of the shrub stage that follows 6–25 years after clearcut logging. The high percentage of this subtype is reflective of the recent logging on private lands.

"Low Scrub" vegetation type occurs on 336,000 ac (136,000 ha) and represents 2.2% of the vegetated land area of Southeast Alaska. Within the low scrub type, the main subtypes include ericaceous plants (i.e., muskeg vegetation) (26%), salmonberry-blueberry (17%), copperbush (*Elliottia pyroliflorus*), and sweetgale (*Myrica gale*) (11%) (van Hees and Mead 2005).

"Dwarf Scrub" vegetation type occurs on 505,000 ac (204,000 ha) and represents 3.3% of the vegetated land area of Southeast Alaska. Within the dwarf scrub type, the main subtypes include moss heather (*Cassiope spp.*) (48%), mountainheath (*Phyllodoce spp.*) (23%), and unclassified (1%) (van Hees and Mead 2005).

"Herbaceous" vegetation type occurs on 905,000 ac (366,000 ha) and represents 6% of the vegetated land area of Southeast Alaska. This primarily encompasses vegetation in alpine, subalpine, and estuarine or wetland meadows. Within the herbaceous type, the main subtypes are unclassified herbaceous (63%), fresh sedge marsh (6%), mixed herb (5%), wet sedge (3.5%) and alpine herb (3%) (van Hees and Mead 2005).

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TABLE 3-4 Generalized classification of vegetation and land cover in Southeast Alaska (Albert and Schoen 2007).

		Land Management			
Land Cover	Tongass NF	Glacier Bay NP (acres)	Private / Other (acres)	Totals	
	(acres)			(acres)	(%)
Productive Old Growth Forest					
POG - Large tree	534,516		54,355	588,871	2.7%
POG – Medium tree	3,679,543		456,679	4,334,410	19.8%
POG - Small tree	772,839		110,359	883,874	4.0%
Other Forests	· · ·		·		
Clearcut & 2nd-growth	466,056	200	320,029	786,285	3.6%
Conifer <150yrs	91,333	198,864	6,159	296,356	1.4%
Conifer forest (other)	91,617	134,614	226,373	452,604	2.1%
Deciduous forest	65,170		2,882	68,052	0.3%
Mixed forest	15,256		33	15,289	0.1%
Muskeg forest	1,133,245	0	47,013	1,180,258	5.4%
Muskeg woodland	1,253,607		37,210	1,290,817	5.9%
Sub-alpine forest	1,186,709		8,661	1,195,370	5.5%
Nonforest Vegetation			· · · · ·		
Alpine tundra	540,044	2	4,247	544,293	2.5%
Slide zone	792,633	6	15,371	808,010	3.7%
Shrubland	952,257	112	9,608	961,977	4.4%
Herbaceous	18,667		3,613	22,280	0.1%
Nonforest (other)	186,494	632,374	240,479	1,059,347	4.8%
Freshwater wetlands	I	-	<u> </u>		
Muskeg meadow	252,160		9,418	261,579	1.2%
Emergent wetlands	25,623	4,253	17,753	47,630	0.2%
River bar	20,077	11,797	23,030	54,904	0.3%
Lake	164,683	12,811	27,053	204,547	0.9%
River channel	36,690	60,809	46,678	144,178	0.7%
Coastal wetlands		1	11		
Algal bed	1,361	305	80,704	82,370	0.4%
Rocky shore	4,176	206	34,320	38,703	0.2%
Salt marsh	7,073	2,038	24,348	33,458	0.2%
Sand & gravel beach	10	3,031	2,754	5,795	0.0%
Tide flat	17	1,611	10,948	12,577	0.1%
Unconsolidated sediments	8,633	3,386	99,804	111,824	0.5%
Unvegetated lands			· · · · · ·		
Ice & Snow	2,189,317	1,158,675	248,252	3,596,244	16.4%
Unvegetated	2,299,167	472,273	227,576	2,999,016	13.7%
Urban	749		9,082	9,831	0.0%
Totals	16,789,724	2,697,370	2,404,791	21,891,885	100.0%

CONSERVATION ISSUES

A benchmark for effective conservation is to maintain species and ecological systems within their natural ranges of variability, including geographic distribution and spatial scales necessary to maintain genetic, population, and ecosystem processes (Noss et al. 1997, Poiani et al. 2000). The vast number of species composing the biological diversity of an ecoregion makes it impractical to assess and plan for each individual element of that diversity. Therefore, the most effective approach is to maintain a high percentage of habitat in its natural state.

Southeast Alaska encompasses one of the most significant areas of old-growth temperate rainforest in the world. Much of this region also comprises a unique assemblage of intact coastal watersheds that support abundant populations of fish and wildlife, including many species that have declined or become threatened in the southern portion of their historical ranges (for example, Pacific salmon [Oncorhynchus spp.], brown bear [Ursus arctos], and marbled murrelet [Brachyramphus marmoratus]). Management of terrestrial and aquatic ecosystems in Southeast for diversity, distribution, and abundance of species is critically important for maintaining ecological integrity throughout this ecoregion. As an example, flood plain and karst forest communities represent small but important components of the forest ecosystems of Southeast. We estimate that a significant portion of the rare, large-tree flood plain and karst old growth (>50% in some provinces) has been harvested in Southeast during the last century.

To date, forests of Southeast Alaska have been most greatly affected by social pressures to supply timber and logging jobs. Conservation efforts should additionally consider cumulative impacts to the land base from timber, road-building, mining, development of renewable energy, and urban growth.

MAPPING METHODS

The transboundary land cover classification was put together by Audubon Alaska et al. (2012) which involved collaboration between Alaskan and Canadian government agencies (e.g. US Forest Service, 47

National Park Service, US Fish and Wildlife Service, and British Columbia Ministry of Forests), non-profit organizations (including The Nature Conservancy), and universities (Including Simon Fraser University and University of Alaska Southeast) to pave the way for future cross-border cooperation, research, and large-scale conservation initiatives. Audubon collected, merged, and "cross-walked" attributes for forest vegetation cover types spanning the Southeast Alaska-northern British Columbia region with input from regional forestry experts.

The Forest Inventory conducted by van Hees and Mead (2005) utilized an extensive grid of nearly 4,000 plots, systematically spaced 3 mi (4.8 km) apart, and individually photo-interpreted; all but those in reserved areas (wilderness which precluded helicopter access) were intensively surveyed on the ground. The result is an accurate and precise assessment of the extent of different vegetation types and attributes (tree age, stand volume, understory composition) that cannot be measured or estimated from aerial photos alone. We used this information to describe forest vegetation. Because this is a point sample, however, it does not yield the 100% coverage that a GIS mapping effort requires. For that, we relied on other data to show spatial patterns.

This map contains tree species data from two sources. For Forest Service lands, we used the Tongass National Forest's cover type database. According to the US Forest Service metadata:

CoverType is a photo-interpreted delineation of the Tongass National Forest by land type and timber cover type. Classification of lands was done sequentially: 1) land and water identified; 2) forested and nonforested areas were identified; 3) forested areas were classified by forest type and forest productivity; and 4) productive forest lands were further characterized by volume class, tree size, species composition. The original classifications were based on photo-interpretation of 1:15,840 aerial photographs in 1978. The minimum map unit size is approximately 10 acres [4 hectares], though the average area for forested polygons is 60 acres [24 hectares]. Additionally, CoverType is updated for new stands created through natural events or management activity. The data has also been corrected for errors, as found, that occurred during the attributing and digitizing of the original classification data. (USFS Tongass National Forest Timber Management Staff 2013b)

Outside of the Forest Service lands, we used the vegetation map and classification for southern Alaska and the Aleutian Islands developed by the Alaska Natural Heritage Program (AKNHP). They used 13 mosaicked regional satellite-image and aerial photography maps, converted to a 98 x 98 ft (30 x 30 m) pixel resolution, to create 49 coarse-scale and 388 finer scale vegetation classes (Boggs et al. 2014). Audubon Alaska then used the coarse-scale vegetation classes related to forest vegetation combined with the cover classes in the Forest Service lands to create a single simplified classification scheme, described in the tables below.

Where available, the Forest Service data were used; elsewhere, the AKNHP dataset was used. These were then converted to a common format and merged together.

MAP DATA SOURCES

- Forest Cover: Boggs et al. (2014); USFS Tongass National Forest Timber Management Staff (2013b)
- Glaciers: Arendt (2002); BCGOV FLNRO GeoBC (2008)
- Land Cover: US Forest Service (2016); Audubon Alaska et al. (2012), based on:
 - BC Ministry of Forests: Lands and Natural Resource Operations (2011)
 - BCGOV FOR Forest Analysis and Inventory Branch (2011)
 - Glacier Bay National Park and Preserve (2008)
 - The Nature Conservancy of Alaska (2006).

TABLE 3-5 Framework for crosswalking US Forest Service Cover Type vegetation classes.

Forest Type & Productivity	Audubon Alaska Forest Class	
Cedar	Cedar	
Black Cottonwood (poplar)	Deciduous	
Cottonwood with Sitka Spruce understory	Deciduous	
Red Alder	Deciduous	
Hemlock	Hemlock	
Hemlock-Spruce	Hemlock-Spruce	
Lodgepole Pine	Other	
Black Spruce	Spruce	
Spruce	Spruce	
White Spruce	Spruce	
Low Productivity - Alder	Deciduous	
Low Productivity - Willow	Deciduous	
All other categories	Other	

TABLE 3-6 Framework for crosswalking AKNHP coarse-scale vegetation classes.

Vegetation Class	Audubon Alaska Forest Class	
Western Red Cedar (Woodland-Closed)	Cedar	
Deciduous Forest (Open) (Peatland) (Southern Alaska)	Deciduous	
Deciduous Forest (Open-Closed) (Seasonally Flooded) (Southern Alaska)	Deciduous	
Deciduous Forest (Woodland-Closed) (Southern Alaska)	Deciduous	
Hemlock (Woodland-Closed)	Hemlock	
Hemlock-Sitka Spruce (Woodland-Closed)	Hemlock-Spruce	
Needleleaf Forest (Woodland-Closed) (Southern Alaska)	Other	
Needleleaf Forest (Woodland-Open) (Peatland) (Southern Alaska)	Other	
Needleleaf-Deciduous Forest (Woodland-Closed) (Southern Alaska)	Other	
Sitka Spruce (Open-Closed) (Seasonally Flooded)	Spruce	
Sitka Spruce (Woodland-Closed)	Spruce	
Sitka Spruce-Black Cottonwood (Open-Closed) (Seasonally Flooded)	Spruce	
Sitka Spruce-Black Cottonwood (Wood- land-Closed)	Spruce	
White Spruce or Black Spruce (Open-Closed)	Spruce	
White Spruce or Black Spruce (Woodland)	Spruce	
White Spruce or Black Spruce/Lichen (Wood- land-Open)	Spruce	
White Spruce or Black Spruce-Deciduous (Open- Closed)	Spruce	

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Land Cover

Southeast Alaska is widely recognized as the last remaining, largely intact, old-growth rainforest in North America. That simple description belies the complex landcover of the region. One-third of the region is not vegetated at all, but is barren rock, water, and ice. And surprisingly for a rainforest, only about half of the land area supports forest vegetation. As well-known as it is for its towering forest, Southeast is also known for its majestic mountains, steep rocky fjords, tidewater glaciers, and extensive coastlines. Land cover can be generally described in broad categories of forest (48%), nonforest vegetation (17%), and unvegetated areas (34%) primarily of rock and ice. About half of the forest, or 27% of Southeast Alaska, is classified as productive old growth (POG), which can include small trees. Today, about 3% of all of Southeast Alaska is made up of large-tree POG, while another 4% of the region (previously in the large-tree or mediumtree POG category) has been harvested.

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MAP 3.4

Land Cover Classification^{1,2}

Coniferous Forest: Productive Old Growth **Coniferous Forest: Other** Harvested **Deciduous Forest** Shrubland Herbaceous Non-forested, Other Ice^{3,4} Unvegetated 1. Audubon Alaska et al. 2012, based on: •BC Ministry of Forests: Lands and Natural Resource Operations 2011. •BCGOV FOR Forest Analysis and Inventory Branch 2011. • Glacier Bay National Park and Preserve 2008. •The Nature Conservancy of Alaska 2006. 2. US Forest Service 2016. 3. Arendt 2002. 4. BCGOV FLNRO GeoBC 2008. 50 miles 50 km

Map 3.4: Land Cover

UNITED STATES