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Forest Plant Association Management Guide

Chatham Area
Tongass National Forest

FOREST PLANT ASSOCIATION MANAGEMENT GUIDE
Chatham Area, Tongass National Forest

by

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<u>Dedication</u>

Dedicated to the memory of Jim Downs—soil scientist, ecologist, naturalist, "salty dog," and, most of all, friend. Jim died in a helicopter crash while performing a soils investigation. He is sorely missed by all of us.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

PAGE

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF PLANT ASSOCIATIONS

Western Hemlock Series

110 *Tsuga heterophylla*/tall *Vaccinium* spp.
Western hemlock/blueberry

115 *Tsuga heterophylla/Menziesia ferruginea*
Western hemlock/rusty menziesia

120 *Tsuga heterophylla*/tall *Vaccinium* spp./*Dryopteris austriaca*
Western hemlock/blueberry/spinulose shield fern

130 *Tsuga heterophylla*/tall *Vaccinium* spp./*Lysichitum americanum*
Western hemlock/blueberry/skunk cabbage

140 *Tsuga heterophylla*/tall *Vaccinium* spp.-*Oplopanax horridum*
Western hemlock/blueberry-devil's club

160 *Tsuga heterophylla/Oplopanax horridum*
Western hemlock/devil's club

165 *Tsuga heterophylla/Oplopanax horridum*-shallow soils
Western hemlock/devil's club-shallow soils

170 *Tsuga heterophylla/Oplopanax horridum/Lysichitum americanum*
Western hemlock/devil's club/skunk cabbage

Western Hemlock-Yellowcedar Series

210 *Tsuga heterophylla-Chamaecyparis nootkatensis*/tall *Vaccinium* spp.
Western hemlock-yellowcedar/blueberry

220 *Tsuga heterophylla-Chamaecyparis nootkatensis*/tall *Vaccinium* spp./*Lysichitum americanum*
Western hemlock-yellowcedar/blueberry/skunk cabbage

230 *Tsuga heterophylla-Chamaecyparis nootkatensis*/tall *Vaccinium* spp.-*Menziesia ferruginea*
Western hemlock-yellowcedar/blueberry-rusty menziesia

250 *Tsuga heterophylla-Chamaecyparis nootkatensis*/tall *Vaccinium* spp. -*Oplopanax horridum*
Western hemlock-yellowcedar/blueberry-devil's club

Mixed Conifer Series

410 Mixed conifer/tall *Vaccinium* spp.
Mixed conifer/blueberry

420 Mixed conifer/tall *Vaccinium* spp./*Lysichitum americanum*
Mixed conifer/blueberry/skunk cabbage

430 Mixed conifer/tall *Vaccinium* spp./*Fauria crista-galli*
Mixed conifer/blueberry/deer cabbage

440 Mixed conifer/*Lysichitum americanum-Athyrium filix-femina*
Mixed conifer/skunk cabbage-lady fern

491 Mixed conifer/*Cladothamnus pyrolaeflorus*
Mixed conifer/copperbush

LIST OF PLANT ASSOCIATIONS (Continued)

Shore Pine Series

610 *Pinus contorta/Empetrum nigrum*
Shore Pine/crowberry

630 *Pinus contorta/Carex sitchensis*
Shore Pine/Sitka sedge

Mountain Hemlock Series

510 *Tsuga mertensiana*/tall *Vaccinium* spp.
Mountain hemlock/blueberry

525 *Tsuga mertensiana/Cladothamnus pyrolaeflorus-Cassiope* spp.
Mountain hemlock/copperbush-cassiope

530 *Tsuga mertensiana/Cassiope* spp.
Mountain hemlock/cassiope

540 *Tsuga mertensiana*/tall *Vaccinium* spp./*Fauria crista-galli*
Mountain hemlock/blueberry/deer cabbage

Sitka Spruce Series

310 *Picea sitchensis*/tall *Vaccinium* spp.
Sitka spruce/blueberry

320 *Picea sitchensis*/Tall *Vaccinium* spp./*Oplopanax horridum*
Sitka spruce/blueberry-devil's club

330 *Picea sitchensis/Oplopanax horridum*
Sitka spruce/devil's club

335 *Picea sitchensis/Oplopanax horridum-Rubus spectabilis*
Sitka spruce/devil's club/salmonberry

340 *Picea sitchensis/Oplopanax horridum/Lysichitum americanum*
Sitka spruce/devil's club/skunk cabbage

345 *Picea sitchensis/Oplopanax horridum*-upland
Sitka spruce/devil's club-upland

352 *Picea sitchensis-Alnus rubra/Rubus spectabilis*
Sitka spruce-red alder/salmonberry

353 *Picea sitchensis/Alnus sinuata*
Sitka spruce/Sitka alder

360 *Picea sitchensis/Calamagrostis nutkaensis*
Sitka spruce/Pacific reedgrass

370 *Picea sitchensis*/tall *Vaccinium* spp./*Lysichitum americanum*
Sitka spruce/blueberry/skunk cabbage

390 *Picea sitchensis-Tsuga mertensiana*/tall *Vaccinium* spp.
Sitka spruce-mountain hemlock/blueberry

OVERVIEW: HOW TO USE THIS GUIDE

Plant association classifications help us to interpret and manage ecosystems. For example, knowledge of plant association characteristics may allow a fisheries biologist to predict coarse woody debris input to streams; a wildlife biologist to model changes in deer habitat after harvest of logging units; a silviculturalist to assess harvest options based on regeneration potential; or an engineer to plan road locations.

Plant associations, or potential natural vegetation ("climax" plant communities), serve as indicators of site potential. They reflect factors such as climate, hydrology, and soil which influence community composition, structure, and productivity. Sites occupied by a particular plant association typically respond similarly to management. Unless severely disturbed, these sites retain the same vegetative and site potential. The successional sequence for sites with a particular plant association will generally be similar, but pathways and rates can vary with the type and severity of disturbance. For example, development of second growth following logging may be different from that following windthrow of a stand.

The objectives of this plant association guide are as follows:

1) to describe the vegetative and site characteristics of the forest plant associations;
2) to develop management implications for each of the forest plant associations.

In the Forest Service, the use of plant associations to classify the environment grew from the work of Daubenmire (1952, 1966, 1968) in Idaho, Pfister (1977a) in Montana, and Hall (1973) in Oregon. While existing vegetation is identified through periodic inventories—such as timber type mapping—plant associations are identified using an ecological classification of the "climax" plant communities. In this guide, the information provided on the response of vegetation and site to management has been gathered from research done on ecologically similar sites, and from local knowledge of past management of such sites.

On the Tongass National Forest, plant association guides have been developed for the Ketchikan Area (DeMeo et al. 1992) and Stikine Area (Pawuk and Kissinger 1988). This document represents the final version for the Chatham Area, developed from the initial classification and guide by Martin et al. (1985) and Martin (1989). Types described here are also referenced in the Alaska Vegetation Classification (Viereck et al. 1992).

The classification is applicable to most Chatham Area sites from sea level to alpine. This classification is not applicable to Yakutat (see Shephard 1995, in prep., for classification of Yakutat's young landscape) or Lynn Canal. This classification may be used with caution on Admiralty Island and South Baranof Island, since little field verification has occurred in these locations. The classification may also be used for second growth stands if sufficient information is available to estimate probable late seral vegetation.

It should be noted that, although often used as loosely equivalent, the terms "plant association" and "plant community" are not necessarily equivalent. Plant association (PA) is the **potential** natural vegetation on a site whereas the plant community (PC) is the **existing** vegetation on a site. In the Tongass National Forest, the PA is frequently equal to the PC because much of the vegetation is in a late seral condition. However, the PC is typically not equal to the PA for conditions following stand disturbance, or for young landscapes such as recently deglaciated floodplains or uplifted beaches. The user of this guide should bear this distinction in mind. The key to PAs (Chapter 6) applies **only** to late seral vegetation. Too little is known about successional pathways in Southeast Alaska to develop a classification and key for seral communities.

This guide to forested plant associations is designed for field use, planning, and reference. While it includes summary and detailed information, the reader should recognize that the information given represents an approximation covering a large landscape with limited data. Much additional work is needed.

Some of the associations are particularly undersampled, such as the Sitka spruce/Pacific reedgrass, western hemlock-yellowcedar/blueberry-devil's club, shore pine/Sitka sedge, and spruce/devil's club-upland types. We believe these are legitimate vegetation types on the landscape, and that this distinction will be borne out by further sampling. These types received less attention in the original sampling for the following reasons: the reedgrass type occurs in a limited landscape position, the outer coast, with limited access; the Sitka sedge type occurs in areas not given high priority in an investigation emphasizing forest land potential; the cedar and upland spruce types are somewhat limited in extent, and the upland spruce type also presents access limitations and safety hazards to sampling (extremely steep slopes). Future updates should also give more information on the range of natural variability and may include a focus on ecological type classification and non-forest vegetation.

Many factors influence vegetation distribution and growth. Consequently, exceptions will be found to the conclusions and generalizations presented here. This guide should be regarded as a starting point for future projects. For most project level work, field reconnaissance and sampling will be required. The following paragraphs serve as a "road map" to the guide.

Nomenclature

Scientific and vernacular names for indicator plants are provided in each plant association chapter, and a full list is provided in Appendix 1. For simplicity, vernacular names are used in the text unless a scientific name is needed for clarity. Moreover, plant association names may be shortened in the text where applicable; for example, referring to western hemlock-yellowcedar/blueberry as hemlock-cedar/blueberry.

The term "blueberry" is used throughout the text to refer to the two tall blueberry species, *Vaccinium alaskaense* and *V. ovalifolium*, which are difficult to distinguish and are commonly combined for field sampling purposes. Red huckleberry, *V. parvifolium*, is not included in this term, nor are the dwarf blueberry species such as *V. uliginosum* and *V. caespitosum*.

Terms referring to soil characteristics, such as organic, fine-textured, deep, shallow, etc., are used generally and do not necessarily correlate with soil taxonomy usage. For example, "organic" refers to soils with relatively thick organic surfaces, rather than to soils that meet the depth and horizonation requirements of an organic soil classification. Soil series names for this guide are take from the preliminary classification in place at the time of field sampling and have not been updated.

For sample soil profiles and definitions of geologic types, refer to the Chatham Area Integrated Resource Inventory Handbook (1990).

When capitalized, "Area" refers to the Chatham Area; "Region" refers to the Forest Service Alaska region. In lower case, "area" refers to the specific location under discussion, and "region" to Southeast Alaska.

Outline

CHAPTER 1 describes the ENVIRONMENTAL SETTING of Southeast Alaska, including discussion of: topography, geology, and geomorphology; climate; soils; and vegetation. Information included provides a general introduction to Southeast Alaska, as well as presenting more in-depth technical information.

CHAPTER 2 discusses DISTURBANCE AND SUCCESSION in plant communities. Managers may be particularly interested in this section, which describes successional pathways following harvest or windthrow and second growth issues.

CHAPTER 3 introduces CLASSIFICATION AND MAPPING CONCEPTS and describes several hierarchical frameworks in use in the Region.

CHAPTER 4 discusses MANAGEMENT IMPLICATIONS such as silviculture and wildlife habitat concerns.

CHAPTER 5 documents METHODS used in preparing this classification and guide.

CHAPTER 6 is a dichotomous KEY to the FORESTED PLANT ASSOCIATIONS within those portions of the Chatham Area that are currently described; thus the Lynn Canal and Yakutat areas, as well as areas not sampled (see Fig. 1), have been excluded. The key is two-part: first, classifying a stand to series, and then to association within the series. Guidelines for use of the key are provided.

CHAPTERS 7 through 12 are the core chapters which describe PLANT ASSOCIATIONS. To orient the reader, summary descriptions are provided for each series, or group of plant associations with the same overstory. Specific descriptions for each association within the series follow, including photographs (the stake shown in some of these photographs is 5 ft. (1.5 m) tall. Information is provided on vegetation composition and structure, environmental characteristics, and management implications.

Vegetation

Abundance (percent cover) is shown for the dominant plant species, as an average and typical range. Constancy—or frequency of occurrence across all stands used to describe a plant association—is also shown. Indicator species have high constancies. Some common species, like five-leaf bramble, may have a high constancy in more than one series (i.e., ubiquitous species). Appendix 2 shows cover values for full species listings by association.

Structure is also summarized, with height and DBH (Diameter at Breast Height, which is 4.5

feet [1.37 m] above the ground) shown for the sampled trees (that is, trees with basal area above a minimum threshold) in the variable plots. Note that tree heights have been calculated as an average of all sampled trees. This value may include smaller trees, consequently, the height of dominant trees may be 10 to 20 percent higher. The height and diameter information may be useful for estimating relative productivity and habitat quality. Height of dominant shrubs and cover by layers is also shown. See also Chapters 1 and 4 and Appendix 3.

The vegetation data may be used to help confirm identification of stands in the field. Similar associations are also listed to assist the user in correct identification of plant associations.

The typical secondary successional sequence for forest in Southeast Alaska is described in Chapter 2. The opportunity to observe the successional sequence for some of the plant associations is limited since natural disturbance is poorly understood and logging occurs primarily on the more productive sites. Nonetheless, wherever research data has been gathered on the probable vegetation response and types of young growth within successional sequences, such information is provided.

Environmental Characteristics

For each association, environmental information such as typical elevation, landform, and soils characteristics is provided. See also Chapter 4 and Appendix 4.

Management Implications

Management implications specific to each plant association are described, such as productivity and growth limitations, windthrow potential, soil stability, regeneration potential and recommendations, and wildlife habitat. See also Chapter 4 and Appendix 4.

In some cases, special considerations for road or trail construction are listed. The required best management practices (BMPs) for such construction provide guidance for these special circumstances.

Plant associations that meet federal interagency wetland delineation guidelines are identified as forested wetlands (DeMeo et al. 1989) in this section (see also Chapter 4). They may require special management.

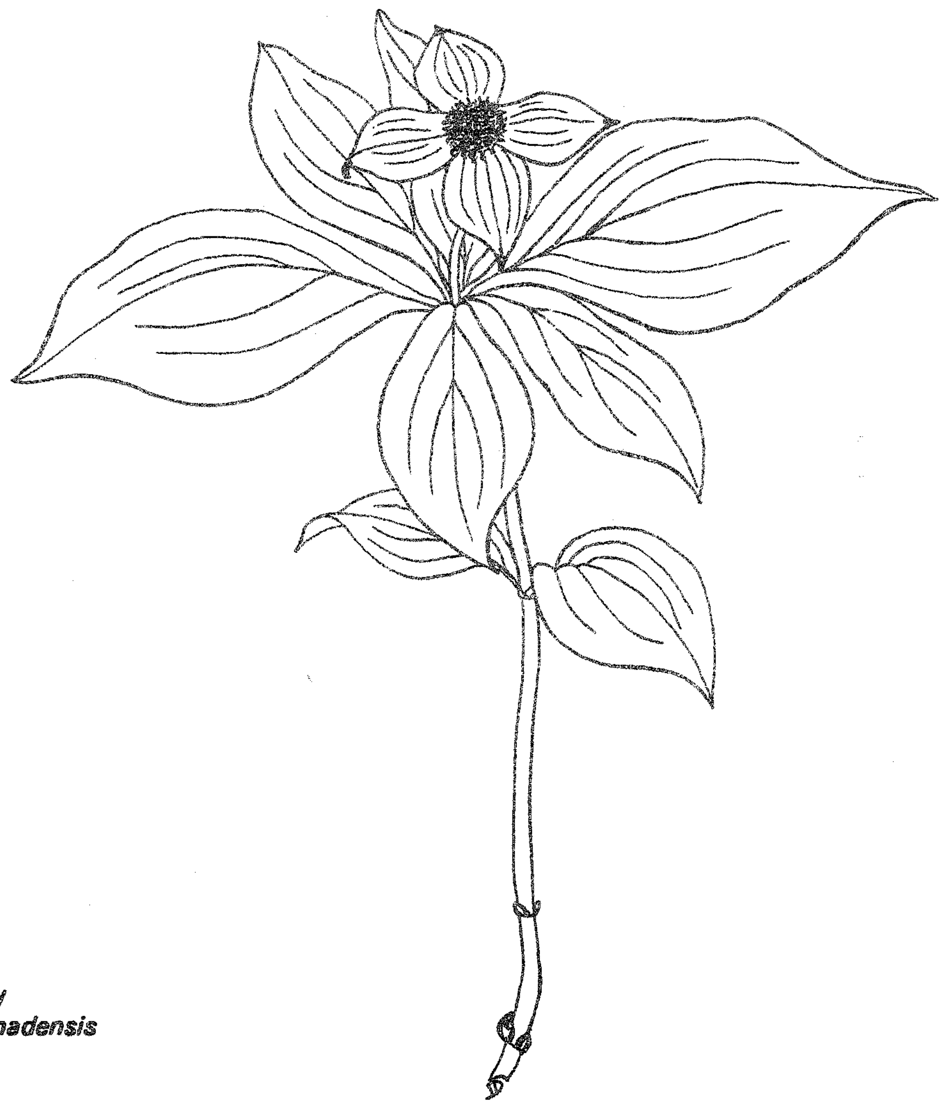
This section also includes information on recreational and subsistence uses of each association. Such information is drawn from the following sources: Robuck 1985 and 1989; Hall and Alaback 1990; DeMeo et al. 1992, as well as from field experience.

A GLOSSARY defining the technical terms used in this guide is also provided.

For those desiring more information than this guide is able to provide, LITERATURE CITED is fully referenced.

APPENDICES follow, providing more detail than is given in the text:

Appendix 1 lists common and scientific names for all plant species mentioned in the guide.
Appendix 2 lists canopy cover for all species recorded for all plant associations.
Appendix 3 lists species and structure data.
Appendix 4 lists environmental and management-related data .
Appendix 5 lists previous plant association codes and those currently in use.
Appendix 6 shows data cards used for field work supporting this classification.



Bunchberry
Cornus canadensis

1
ENVIRONMENTAL SETTING

The Chatham Area of the Tongass National Forest is located in the northern portion of Southeast Alaska (Fig. 1). It covers about 48 percent or 7,950,000 acres (32,170 km^2) of the Forest. Fifty-five percent of the Chatham Area is designated wilderness, national monument, or lands to be managed in a roadless state--Land Use Designations (LUDs) I and II in the USDA FS 1979 Tongass Land Management Plan (TLMP). Admiralty (1,698 mi^2 [4,400 km^2]), Baranof (1,636 mi^2 [4,237 km^2]), Chichagof (2,062 mi^2 [5,341 km^2]) and Kruzof (272 mi^2 [704 km^2]) are the largest islands within the Chatham Area (acreage from USDA FS TLMP unpublished table 1989).

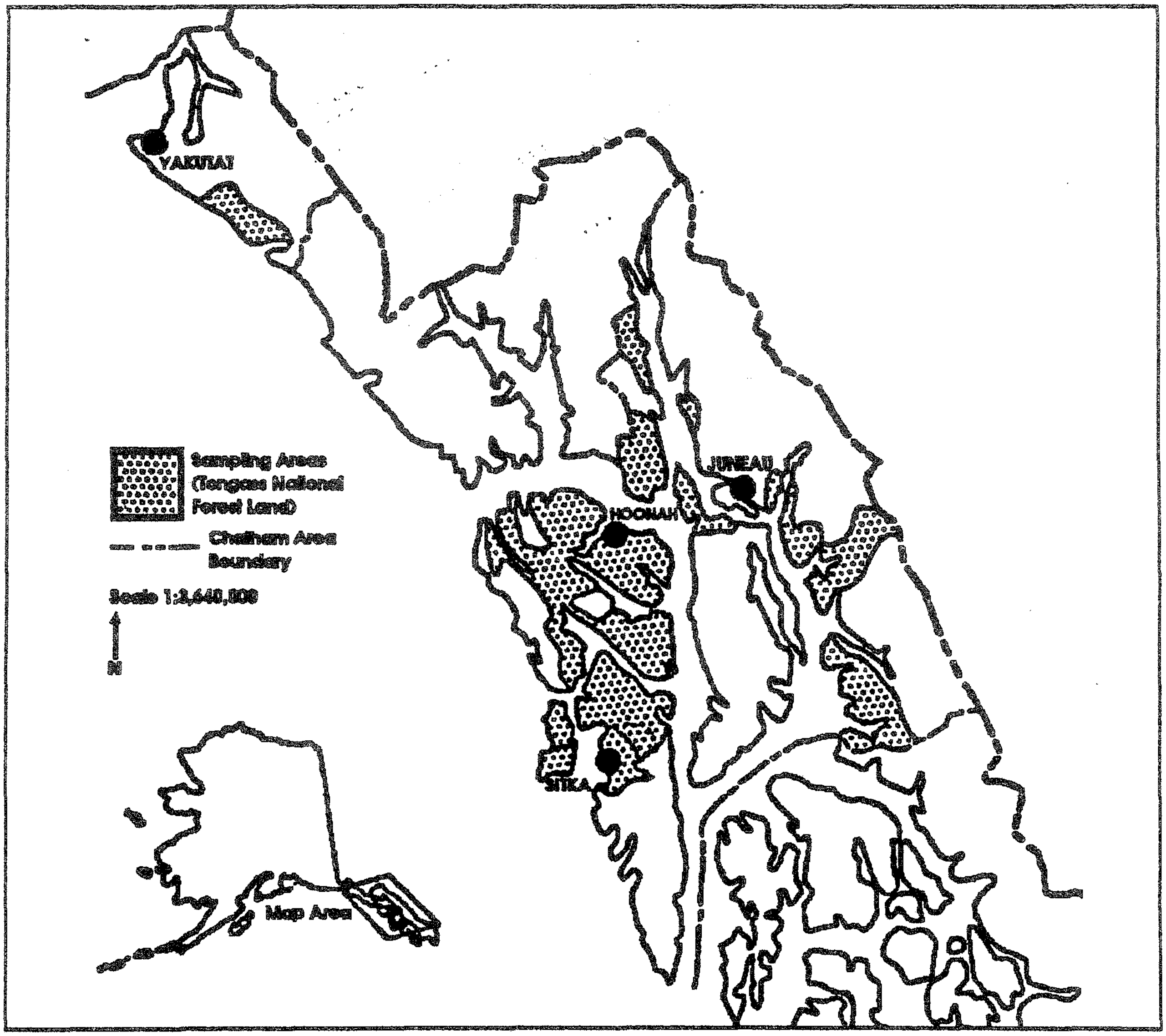


Figure 1. Map of Northern Southeast Alaska Showing Sampling Locations

Topography, Geology, and Geomorphology

The present topography of Southeast Alaska is largely the result of allochthonous terrane accretion, Tertiary uplift, and Pleistocene glaciation. Eight major terranes, or large blocks, are recognized in the region. Five of these originated at a distance from North America, and were moved and accreted to the western continental margin by plate tectonics (Brew 1990). There is not a direct correlation between terranes and islands; for example, Chichagof Island is composed of three different terranes. The terranes are separated by active and inactive faults oriented northwest-southeast or north-south, and in some cases, are further divided by faults (Brew 1990). The channels and straits of Southeast Alaska occupy many of these faults.

The gross topography on the terranes was formed by deformation and metamorphism of thick sequences of interbedded Paleozoic and Mesozoic sediments and volcanics and major igneous intrusions at the end of the Mesozoic era. Northwest-southeast belts of metasedimentary rocks, graywacke, conglomerates, and sandstones dominate Admiralty, Baranof, and Chichagof islands (Harris et al. 1974). In some areas, limestone and marble dominate, such as in a band from Corner Bay to Peninsular Point on Chichagof Island, including Kook Lake, Little Basket Bay, Basket Lake, and the Kennel Creek area (Loney et al. 1963). Much, if not all, of the limestone areas show karst development (Baichtal 1994, unpublished USDA FS report). Igneous rocks such as quartz-diorite, diorite, and granite dominate the coast mountains and occur in a belt trending northwest-southeast through Baranof and Chichagof Islands. A high degree of metamorphism of igneous rocks has occurred along the mainland coast range, resulting in gneisses and schists. Volcanics occur on Kruzof Island and in isolated patches on Chichagof Island (Harris et al. 1974).

Mainland mountains are part of the Coast Range and vary in elevation from 6,000 to 10,000 feet (1,800 to 3,000 m). Mountains on the islands are mostly under 4,000 feet (1,200 m). These terranes have moved vertically in varying amount in the past 25 million years. Admiralty and Kruzof Islands and southwestern Baranof Island have not undergone much change in elevation (-2 to +1.3 miles [-3 to +2 km]), while the St. Elias-Fairweather Range has been uplifted as much as 9 miles (14 km). Eastern Baranof/western Chichagof and Eastern Chichagof Islands have been raised 4 to 5 miles (6 to 8 km) and 2.5 to 4 miles (4 to 6 km) respectively (Brew 1990).

Extensive Pleistocene glaciation modified the topography forming cirque basins, U-shaped valleys, till plains, hanging valleys, outwash plains, and fjords. Mainland ice moved down from continental ice fields via river valleys to cover all but the highest elevations. Faults and lineaments channeled ice flows into valleys, deepening and broadening the existing features. Minimum elevation of ice cover was generally between 2,600 and 3,600 feet (800 and 1,110 m) on islands and 6,500 to 8,200 feet (2,000 to 2,500 m) on the mainland. Maximum retreat of the ice sheet occurred 6,000 to 8,000 years ago when mean annual temperatures were about one degree warmer and precipitation was much less (Goldthwait 1966). Melting of the ice sheet caused sea level to rise, inundating many glacial valleys and depositing marine terraces well above present sea level.

Much of mainland Southeast Alaska is very young, and is still undergoing deglaciation. Uplift of the land caused by isostatic rebound (or readjustment of land depressed by the weight of glacial ice) exposed numerous marine terraces. Past uplift has ranged from 60 to 500 feet (18 to 152 m) as measured by the existence of marine terraces, fossils and beach soils. Isostatic rebound is still occurring in the northern portions of southeastern Alaska. Rates of uplift vary from 0.8 inches (2 cm) per year at Juneau to 1.6 inches (4 cm) per year at Glacier Bay (Hicks and Shofnos 1965).

A post-Wisconsin glacial advance, the Little Ice Age, reached a maximum around 1750 AD. Except for a few advancing glaciers such as the Taku, Brady, Lituya and Hubbard, the current trend is one of retreat (Harris et al. 1974). Active glaciers are largely confined to the mainland. Several high mountain glaciers and ice fields exist on Baranof Island, while few are present on other islands.

Both the islands and the mainland are highly dissected by streams and rivers. Mainland river systems are mostly glacial-fed from the large, nearly continuous ice fields of the Coast Range. Many of these large mainland rivers originate in Canada. In contrast, the island stream systems are generally very short (less than 15 miles [25 km]). Some of these island streams are fed by mountain glaciers (e.g., Glacial River on northeast Baranof Island), but most originate from high surface runoff.

Post-glacial volcanic eruptions are limited to Kruzof Island. Basalt was the first type of magma released by the Mt. Edgecumbe volcanic field, some 600 thousand years ago (ka). Later, basaltic andesite, andesite, dacite, and rhyolite flows occurred. Eruptions occurred as recently as about 4.2 and 5.8 ka (Riehle et al. 1992). A flow deposit dated by a buried tree stump on Kruzof Island occurred about 9 ka (Riehle et al. 1992). Deposits of ash and small ejected rock fragments (lapilli) were windblown as far east as Sitkoh Bay (southeastern Chichagof Island), but are most concentrated on Kruzof, southwestern Chichagof and northwestern Baranof Islands (Harris et al. 1974). Volcanic landforms such as cones, basalt plateaus, and lava plains are common on south Kruzof Island.

Climate

The recent climate of Southeast Alaska is cool maritime, with some continental and glacial influences in the mainland areas. The moderating influence of the Alaska current, an eddy of the Kuroshio Drift, is largely responsible for today's mild climate. Precipitation is abundant and distributed throughout the year, with maximum rainfall occurring in October and minimum in June (Harris et al. 1974). Precipitation is highly variable due to topography, proximity to icefields and the Pacific Ocean, and jetstream influences. High precipitation is caused by the uplift of air masses by the coastal mountains. Coastal regions average 80 to 100 inches (200 to 250 cm) of rain per year and island areas from 150 to 200 inches (400 to 500 cm; Figure 2). Highest precipitation (300 inches [750 cm]) occurs along southern Baranof Island. Less than 50 inches (125 cm) of rain per year is recorded at Gustavus, Haines, and Angoon. Low evapotranspiration due to high humidity, continual cloud cover, and cool temperatures results in precipitation exceeding evapotranspiration throughout the year in most areas. Table 1 shows selected meteorological data for recording stations in the general Chatham Area (Patric and Black 1968).

Mean annual snowfall averages 40 inches (100 cm) at sea level, 100 inches (250 cm) at lower elevations of the islands, and 200 inches (500 cm) on the mountain peaks. Southern Baranof Island and the mainland mountains receive greater than 400 inches (1000 cm) of snow per year. Most snowfall occurs between December and March. Snowfall is highly variable in amount and persistence from year to year, especially at low elevations along the coastline. In general, on northern aspects and the eastern sides of the large islands, snowfall persists longer than on the southern aspects or seaward sides of the islands. During mild winters, especially below 500 feet, coastal low elevation areas may remain snow free.

Table 1. Selected Meteorological Data (1916-66, recording span varying with site).

Site	Elevation		Mean Annual Temperature		Mean Annual Precip.		Actual Evapotransp.	
	(ft.)	(m)	(°F)	(°C)	(in.)	(mm)	(in.)	(mm)
Angoon	35	11	41	5	39	991	21	533
Baranof	20	6	42	6	152	3861	21	533
Chichagof	10	3	42	6	123	3124	21	533
Five Finger Light	70	21	43	6	58	1473	22	559
Gustavus	22	7	41	5	55	1397	21	533
Haines	100	30	40	4	61	1549	19	483
Juneau	72	22	43	6	90	2286	22	559
Juneau Airport	12	4	41	5	55	1397	21	533
Mendenhall	85	26	40	4	94	2388	21	533
Port Alexander	18	5	44	7	169	4293	23	584
Sitka	67	20	43	6	96	2438	23	584
Skagway	18	5	41	5	30	762	17	432
Tenakee	19	6	43	6	68	1727	21	533
Yakutat	28	9	39	4	134	3404	20	508

Prominent low pressure systems cause frequent fall and winter storms which can result in blowdown of forest stands. Prevailing wind direction is usually from the southeast, but wind direction is strongly influenced by local topography.

The growing season, measured as number of days with minimum temperature above 32 °F (0 °C) and maximum temperature above 40 °F (4 °C) varies from 111 days at Gustavus (a site with a more continental type of climate) to 186 days at the Sitka Airport (a site with maximum maritime influence). Average maximum temperatures during the summer growing season range from 55 to 66 °F (13 to 19 °C). Day length varies from 7 hours during the winter to about 18.5 hours during the summer. Summer daily temperature fluctuations are reduced due to long day lengths, continual cloud cover, and resulting low radiational cooling. Daily winter fluctuations are moderated by cloud cover and low sun angle which allow little surface heating (Watson et al. 1971).

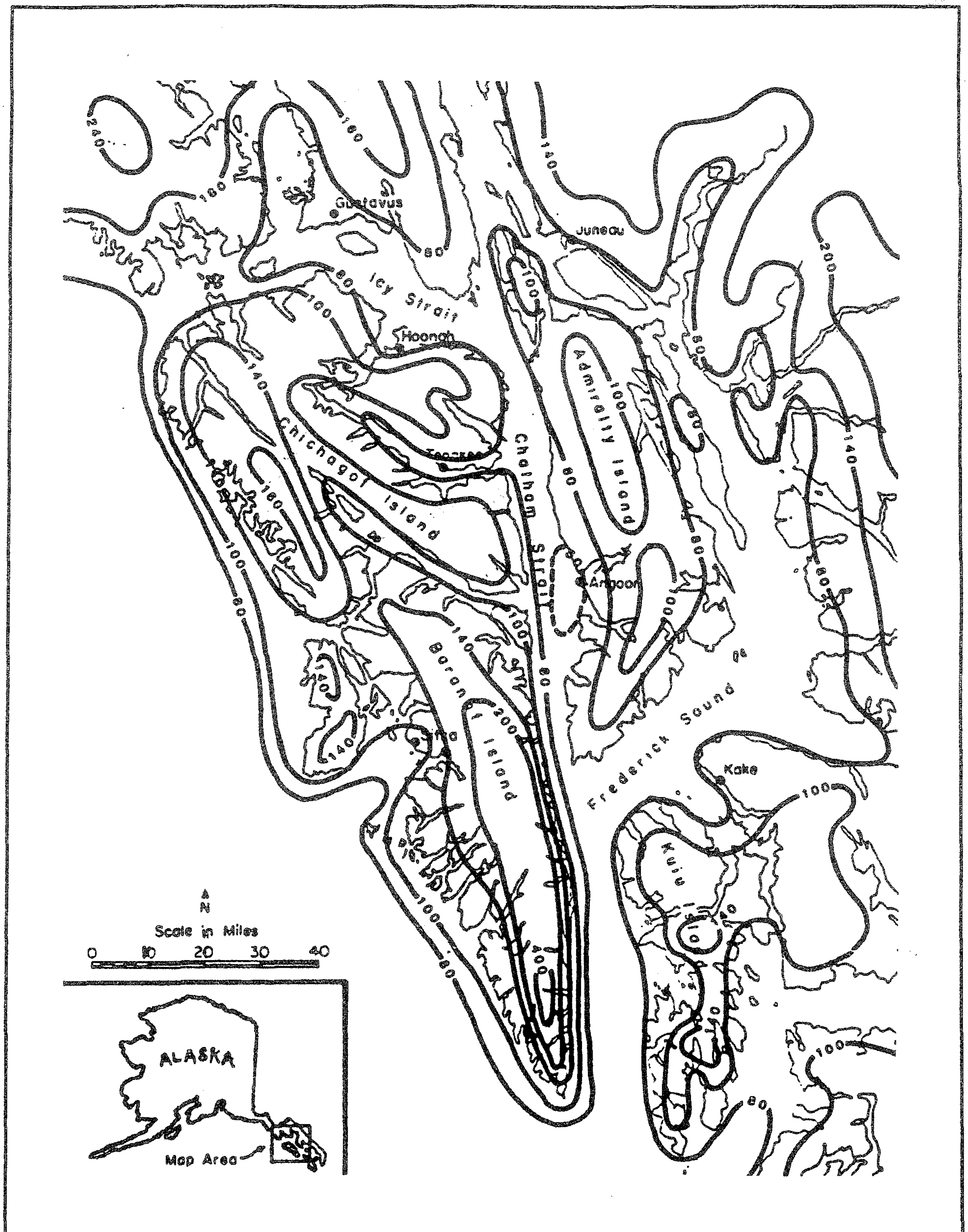


Figure 2. Precipitation Isohyets (mean inches/year) for Study Area

Soils

Soil development has been strongly influenced by climate, parent material, topography and vegetation. Soils in Southeast Alaska have developed from both weathered bedrock and surficial deposits. Residual soils derived from weathered bedrock form in areas which were glacially scoured, recently uplifted above sea level, or eroded due to oversteepened slopes. The role of bedrock in soil development is less important in sites with transported overburdens. Glacial till, alluvial, and colluvial deposits are the most extensive types, with marine clays and volcanic ash common in some areas.

Glacial till varies in depth from 1 foot (0.3 m) on upper slopes to as much as 30 feet (9 m) in side valleys, lower slopes, and footslopes (Swanston 1969). Glacial till is extensive up to 1,500 feet (500 m) elevation in many valleys (Harris et al. 1974).

Soil and hydrologic characteristics are directly related to bedrock or surficial deposit. For example, granitic soils are shallow and, on flatter ground, poorly drained because of the hard, massive structure of the rock (on steeper slopes, these soils drain well laterally). Conversely, extensive fracturing and good subsurface drainage associated with calcareous bedrock results in well drained soils. Fine textured soils formed in marine clays are often poorly drained, and coarse-textured sands in uplifted beaches are well drained.

Low temperatures and high rainfall lower the decomposition rate of organic material, resulting in a thick surface accumulation. These layers are typically 6 to 10 inches (15 to 25 cm) thick and are even deeper on poorly drained sites. In most cases, soil organic matter is not limiting in Southeast Alaska. The organic layer is the major source of soil nutrients, and roots are frequently concentrated in it. Soils are high in organic carbon and iron, but low in available nitrogen and phosphorous. Average soil pH is acidic, typically around 5.0.

The ability of organic material, fine textured soils, and iron oxides to hold water combined with the high rainfall helps to maintain soil moisture levels at field capacity (Harris et al. 1974). Impermeable layers are often associated with volcanic ash or compact till (Harris et al. 1974). They can also develop in stable soil material due to the influence of Spodosol formation (leaching of materials from upper soil layers) if illuvial materials become cemented into a placic horizon (Ugolini and Mann 1979). Paludification often results.

Poorly drained soils form primarily on sites with minimal slope or sites with impermeable layers (Harris et al. 1974). Well drained soils commonly form on moderate to steep slopes without impermeable layers, on coarse textured, frequently disturbed alluvium, or on recently deposited sites with adequate subsurface drainage. Soil moisture is not limiting in Southeast Alaska. Slope, soil drainage, depth to restricting layer, and depth of surface organic material are major influences on plant species' distribution and productivity (Alaback 1982).

n the Chatham Area, the majority of soils are classified as Histosols, Entisols, Inceptisols or Spodosols. Most Histosols form in sites with very poor drainage. Histosols usually support bog and fen ("muskeg") vegetation (Kina soil series) or mixed conifer forest (Kaikli series; Stephens et al. 1970). However, McGilvery soils, consisting of freely drained forest itter, support western hemlock forests. (See Integrated Resource Inventory Handbook

[1990] for more information on soil types.)

Inceptisols and Entisols occur on frequently disturbed sites (estuaries, floodplains, landslides) or on recently deposited material (outwash plains, uplifted beaches). These soils support a variety of vegetation, from estuarine meadows (Typic Cryaquepts and Cryaquents) to highly productive Sitka spruce forests (Tonowek, Bradfield series). Development of some Inceptisols is impeded by poor drainage caused by topographic position or shallow soil depths (Kasiana, Nakwasina series). These soils support mixed conifer forests.

Spodosols develop from a variety of parent materials, but usually support forest vegetation and occur on relatively stable sites. Well drained Spodosols (Kupreanof, Karta, Foad series) support highly productive western hemlock forests and poorly drained Spodosols (St. Nicholas, Sukoi) support low productivity mixed conifer forests, and western hemlock and western hemlock-yellowcedar plant associations in which skunk cabbage is a dominant herb.

Vegetation

The coastal rainforest of Southeast Alaska and adjacent Canada is ecologically unique to North America. The natural vegetation is a mosaic of predominately late seral coniferous forest (about 65 percent of Southeast Alaska is forested [USDA FS 1979]) interspersed with peatlands (muskeg) and shrublands, and with peripheral alpine, estuarine, and beach fringe plant communities. Permanent ice, rock, and persistent snowpack occur in some areas. Differences in the vegetation can largely be explained by varying topo-edaphic conditions, by temperature changes along elevational gradients, and by natural disturbance (see Chapter 2).

Muller (1982) identified a total of 1009 vascular plant species in Southeast Alaska. Forbs are the largest group (618 species), followed by graminoids (217), shrubs (99), pteridophytes (ferns, club mosses, etc.; 52) and trees (23). Geiser (1993) identified 425 lichen species in the region, mainly macrolichens, representing 89 genera. Worley (1972) identified 572 species and varieties of bryophytes in Southeast Alaska: 159 hepatics (liverworts) and 413 mosses. Table 2 describes the relative dominance of plant types within this study.

Indicator Plants

An indicator is a plant whose presence, abundance, or vigor is considered to be indicative of environmental conditions (Gabriel and Talbot 1984), that is, plants of high fidelity. While all plants have evolved within certain environmental parameters, some species have a narrower ecological amplitude and are more site specific than others. These "indicator" plants are used to distinguish and classify the plant associations on the Area. These plants primarily indicate soil drainage, temperature, and disturbance conditions. These site factors normally change gradually within the forest and are reflected in changes in indicator plant constancies.

The abundance of an indicator plant is equally as important as presence or absence when making inferences about a site. Generally, the more abundant a plant within a stand, the more strongly it will represent a particular set of site factors. Table 3 lists common indicator species and the conditions they indicate. This table is based on the USDA Forest Service Plant Indicator Cards (Region 10 Ecologists 1990), Klinka et al. (1989), and Region 10 Ecologists' field experience.

Table 2. Percent Cover of Vegetative Strata by Plant Association

Plant Association	Overstory Trees		Understory Trees		Tall Shrubs		Low Shrubs		Forbs		Ferns		Grasses		Sedges	
	Mean	SD*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
WESTERN HEMLOCK/																
Blueberry/shield fern	72	10	34	65	57	32	1	0	39	25	19	16	2	1	1	0
Blueberry-devil's club	70	14	17	22	59	28			38	17	34	25	1	0	2	1
Devil's club	65	11	35	61	72	32	1	0	35	11	38	29				
Devil's club-shallow soils	62	13	13	13	70	23			33	16	32	21			1	0
Blueberry-menziesia	61	14	61	86	74	37			38	19	31	27			1	0
Blueberry	64	13	46	92	58	27	3	0	39	23	16	16	8	8	1	0
Blueberry/skunk cabbage	55	15	24	26	64	26			61	25	6	5	1	0	1	0
Devil's club/skunk cabbage	56	15	20	11	100	34			74	28	25	25				
WESTERN HEMLOCK-YELLOWCEDAR/																
Blueberry-devil's club**	68	4														
Blueberry-menziesia	66	13	100	154	91	50			57	34	26	20			3	0
Blueberry	62	13	44	71	60	29	1	0	55	43	24	20	1	0	15	0
Blueberry/skunk cabbage	61	14	47	63	52	28			63	28	14	10	3	0	2	1
MIXED CONIFER/																
Blueberry	42	11	77	98	74	46	11	8	38	24	7	11	1	0	1	0
Copperbush	32	12	30	31	64	28	1	0	51	57	10	6			8	10
Blueberry/deer cabbage	29	10	93	109	67	37	21	13	87	44	10	13	19	26	23	24
Blueberry/skunk cabbage	46	15	63	119	68	36	10	9	78	27	11	8	3	5	11	13
Skunk cabbage-lady fern	44	15	32	22	56	9	1	0	100	53	34	26	1	0	5	7
SHORE PINE/																
Crowberry	22	5	23	0	30	0	100	0	56	0	4	0			1	0
Sitka sedge**	30	0														
MOUNTAIN HEMLOCK/																
Blueberry	49	15	30	49	59	28	8	10	36	32	11	9	1	0	1	0
Blueberry/deer cabbage	39	13	12	9	57	26	3	2	58	31	12	9	1	0	1	0
Copperbush-cassiope	28	10	57	11	71	97	46	0	75	5	8	10			3	0
Cassiope	26	10	27	20	39	21	29	17	94	41	7	8	1	0	6	8
SITKA SPRUCE/																
Red alder/salmonberry**	43	16														
Sitka alder	45	20	8	0	100	0			87	0	54	0	1	0		
Devil's club/skunk cabbage	64	13	15	7	65	52			63	47	25	15	1	0	1	0
Devil's club-salmonberry	51	8	13	12	100	24			55	32	28	30				
Devil's club	69	12	5	2	55	32			56	39	74	36				
Blueberry-devil's club	63	13	13	11	100	16			100	69	26	13				
Blueberry	79	6	17	0	39	0			86	0	17	0				
Blueberry/skunk cabbage	60	11	19	0	57	0			100	0	10	0				
Pacific reedgrass**	83	4														
Devil's club-upland	65	9	18	0	69	0			39	0	49	0				
Mountain hemlock/blueberry	53	14	19	13	38	19			51	27	20	19	3	0	3	0

*SD = standard deviation

**Too few sampling sites to calculate all statistics

Table 3. Indicator Species and Conditions Indicated

Trees	
Mountain Hemlock	Cold temperatures, poor drainage
Red Alder	Disturbance, flooding, high light, lower elevation sites
Shore Pine	Poor drainage, peatlands
Sitka Spruce	Disturbance, flooding, salt spray, high light
Western Hemlock	Moderate to good drainage, warmer sites
Yellowcedar	Moderate to poor drainage, often higher elevation than western hemlock
Shrubs	
Bog Laurel	Very poor drainage, peatlands
Cassiope	Cold temperatures, higher elevation
Copperbush	Cold temperatures, poor drainage, snowpack areas
Crowberry	High light
Devil's Club	Water moving through soil profile; locally, loess-derived soils/high nutrient availability
Labrador Tea	Very poor drainage, peatlands
Luetkea	High elevation, snowpack seepage areas
Mountain Heather	High elevation, often snowbank seepage areas
Rusty Menziesia	Restricted drainage, high light
Salmonberry	Soil disturbance, flooding, often early seral sites
Sitka Alder	Soil disturbance, flooding, all elevations in forest zone
Herbs and Ferns	
Deer Cabbage	Cold temperatures, very poor drainage
Lady Fern	Water moving through soil profile; locally, loess-derived soils/high nutrient availability
Pacific Reedgrass	Outer coastal sites; saltspray
Shield Fern	Good drainage, productive site
Skunk cabbage	Saturated soils through growing season
Sitka Sedge	Very poor drainage, moving water in peatlands
Trifol. Goldthread	Very poor drainage, peatlands

Forest Overstory Patterns

Although there are seven evergreen tree species found on the Chatham Area, four predominate. Western hemlock is the dominant and most shade tolerant tree species in Southeast Alaska. Dominance of a site by this species is a good indicator of a relatively well drained, generally stable site. This species does not dominate poorly drained sites. When it does occur on these sites, it often exhibits signs of stress (for example, discoloring, gnarled branches, and defects). Western hemlock is a poor competitor in the colder climate of the subalpine zone where it is replaced by mountain hemlock.

Mountain hemlock exhibits a bimodal distribution. It dominates well drained sites in the subalpine zone and codominates on poorly drained sites. It therefore indicates both a cold climate and/or a poorly drained soil. When it is the dominant species, it usually indicates a cold environment. If it is a codominant, it may be indicating poor soil drainage and cold climate or just the former. Understory indicators are used to distinguish in this case.

Sitka spruce achieves dominance in late seral stands only on a small portion of the landscape. Regeneration primarily takes place on disturbed sites where spruce is able to dominate because of its rapid juvenile growth rate in high light conditions and its high germination rate in mineral soil (Harris and Farr 1974). Disturbance conditions most suitable for spruce are associated with surface and subsurface running water. These conditions usually occur on floodplain and alluvial fan landforms where flooding events vary from infrequent high energy to frequent low energy flooding.

Sitka spruce also dominates coastal sites which receive wind-borne salt spray (Cordes 1972) or periodic inundation by saltwater. Spruce apparently is more salt tolerant than the other tree species. The increased soil nutrients from saltwater (Van der Valk 1974) may be an additional factor favoring spruce dominance on these sites. Lastly, spruce dominates stands along avalanche tracks and on erosional mountain slopes. The degree of stand dominance by spruce appears to be positively correlated to the magnitude of the disturbance regime. However, if soil disturbance is too severe or frequent, alder and salmonberry will dominate.

Yellowcedar (Alaska-cedar) is a good indicator of stable, moderate to marginally productive sites (Hennon 1991). Productivity on these sites is limited by shallow soils and/or poor soil drainage conditions. Yellowcedar is not as shade tolerant as western hemlock, and is thus displaced by it on more productive sites. Yellowcedar seedlings are rare in closed stands and relatively common in open stands. However, cedar occurrence is often sporadic, due to disturbance events, herbivory, seed sources, and interspecific competition. Cedar is a climax codominant with western hemlock on moderately productive sites where light conditions are apparently adequate (especially in canopy gaps) for cedar reproduction. Cedar tolerates poorly drained soils, and thus may have high representation in mixed conifer sites.

Shore pine, a variety of lodgepole pine, occurs on colder or more poorly drained sites, such as on peatland fringes. On northern and more interior portions of the Chatham Area, lodgepole pine and subalpine fir may occur. Western redcedar occurs in limited amount in the southernmost part of the Area.

The late seral forest overstory varies, from single to mixed species stands. For example, mixed conifer stands are dominated by small- to medium-sized mountain and western hemlock and yellowcedar. Shore pine and Sitka spruce may also occur in these stands. Mixed conifer stands are open (canopy cover < 60 percent) and relatively unproductive. Understory light appears to be sufficient for establishment of the more shade-intolerant tree species.

Single species-dominated stands are generally closed and more productive than mixed species stands. Competition for light is probably a major factor affecting seedling establishment and survival in these stands (Alaback 1982). With a few exceptions, single species-dominated stands occur on well drained sites. Exceptions include shore pine sites, where the establishment of all other tree species is limited because of extremely wet, poorly drained soils, and cold, well drained mountain hemlock stands near upper treeline.

The average height of forest stands evaluated for this classification varied from a low of around 25 feet (8 m) in the shore pine series to over 180 feet (55 m) in the Sitka spruce and western hemlock series. Stands to 190 feet (58 m) tall with an average stand diameter at breast height of 58 inches (147 cm) were sampled in the Sitka spruce series.

Gross timber volume typically ranged from 7,000 to 80,000 board feet/acre (Scribner). Gross volumes of sampled stands ranged from 2,400 and 189,000 board feet/acre. (Volume is presented as gross rather than net since there is so much variability in calculation methods for net volume.) Overstory canopy closure ranged from 10 to 95 percent and stand basal area ranged from 20 to 390 square feet/acre. Figure 3 compares average tree height, diameter, and gross volume for the six forest series.

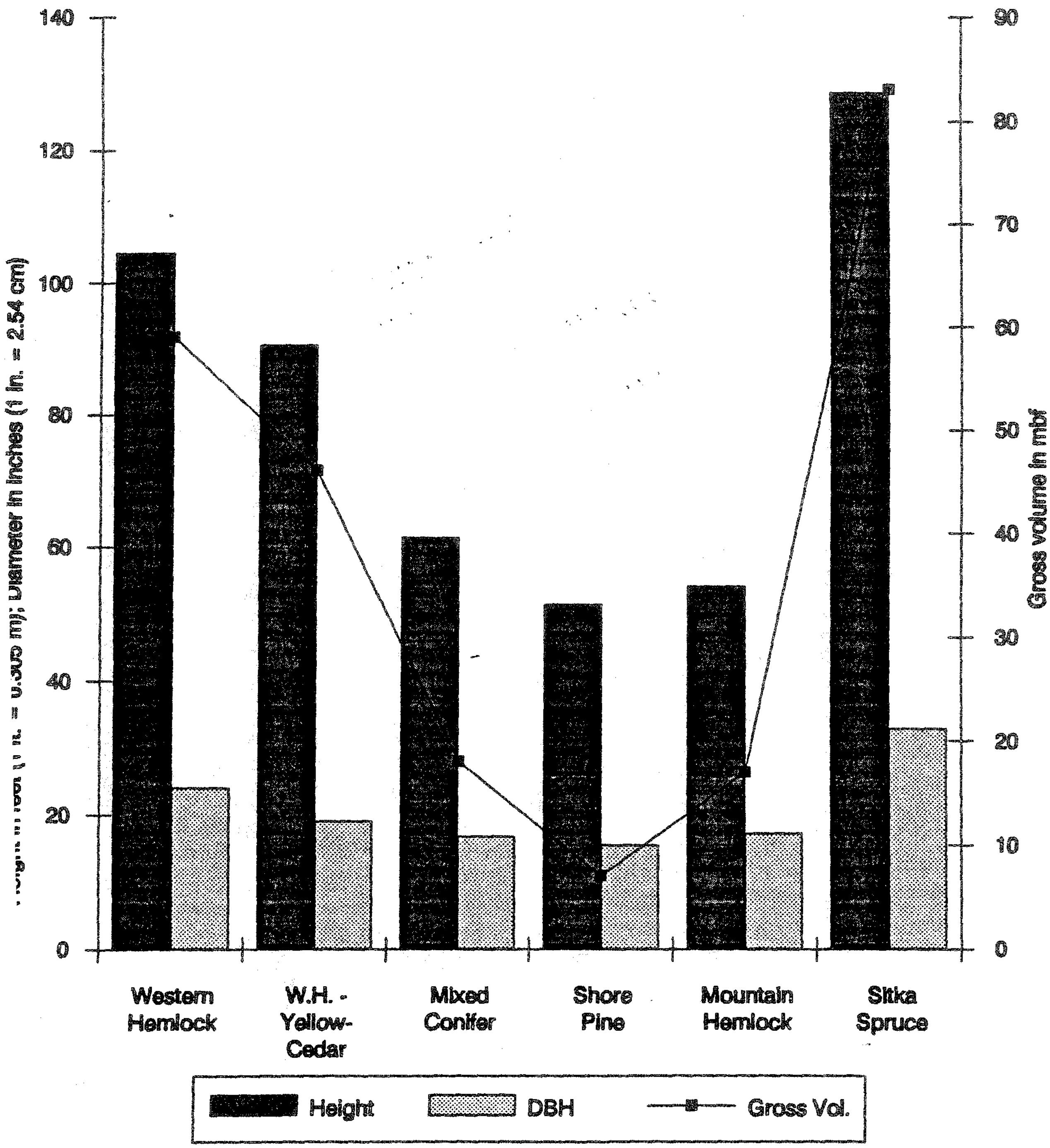
Forest Understory Patterns

The distribution and abundance of plants in the forest understory is highly variable. This variation appears to be related to the heterogeneity of soils (e.g., soil drainage), the distribution of large organic debris as a rooting substrate, the type and amount of natural disturbance, and the amount of light reaching the forest floor. Added influences near upper treeline include temperature, snowpack persistence, and avalanching.

The maximum number of understory vascular plant species found on the sample plots ranges from 16 to 76. These totals may be affected by the number of plots completed in each plant association; it is probable that a greater number of species would be found with increased sampling, especially in the undersampled types. Nonetheless, the trend appears to be that the largest number of species occurs in associations with open overstories on sites near the limits of tree growth. For example, the high number of understory species (76) recorded in the mountain hemlock/cassiope association is likely a result of the complex of poorly drained soils in the cold subalpine zone. Similar levels of both vegetative and environmental diversity occur at peatland (muskeg)/forest ecotones, such as the mixed conifer associations with 54 or more understory species.

Understory shrub composition and height also vary with environmental conditions. The mixed conifer/copperbush association shows the greatest shrub diversity (Table 4), with 18 species,

Figure 3. Average Tree Height, Diameter, and Gross Volume by Forest Series



while the Sitka spruce/Pacific reedgrass association shows the lowest with 2 species. The average height of the shrub layer (Table 5) is typically between 2 to 5 feet. The height of devil's club and Sitka alder understories may exceed 6 and 12 feet, respectively.

The forest understory may be dominated by a single species or by several species. Single species understory dominants include blueberry, devil's club, skunk cabbage, Sitka alder, Pacific reedgrass, and copperbush. Such understories are relatively homogenous, reflecting fairly homogenous soils. Commonly, however, the understory vegetation intergrades with two or more of the above plants, reflecting a complex of soil and site conditions. Blueberry/skunk cabbage, blueberry-devil's club/skunk cabbage, blueberry-devil's club, blueberry/alpine plants, and blueberry/peatland plants are some of the more common understories.

On the Area, blueberry, rusty menziesia, devil's club, and salmonberry are the most widely distributed shrubs. Five-leaf bramble, bunchberry, fern-leaf goldthread and heart-leaved twayblade are the most widely distributed forbs. Deer fern and oak fern are the most common ferns. Non-vascular plants such as mosses, lichens, and liverworts are extremely abundant on the Chatham Area. The four most common understory species are described below. Other understory dominants are discussed in the sections for plant associations in which they occur.

Blueberry (*Vaccinium ovalifolium* and *V. alaskaense*) is the most widely distributed shrub in northern Southeast Alaska, occurring as an understory dominant from sea level through the subalpine zone. This shrub is shade tolerant and may achieve understory dominance in closed late seral western hemlock stands as well as in open mixed conifer stands. Blueberry possesses a broad ecological amplitude for soil and light resources. It dominates well drained, undisturbed sites and poorly drained sites. On poorly drained sites, it appears to favor the better drained, elevated microsites originating from large organic debris or rock outcrops.

Blueberry does not compete well on alluvial soils where the organic horizon is frequently disturbed by flooding, or on exposed mineral surfaces originating from erosion or avalanching. There are also several dwarf blueberry species common in the understory, especially on poorly drained and alpine sites.

Like blueberry, rusty menziesia is most abundant on stable sites. It appears to be less shade tolerant than blueberry. For example, in a closed canopy, western hemlock-dominated overstory with a blueberry/shield fern understory, rusty menziesia is only a minor understory plant (13 percent mean cover) while blueberry is common (53 percent cover). However, menziesia does not compete well in the shorter growing season found in the subalpine zone.

Menziesia is not a preferred deer forage (Hanley et al. 1989). Under heavy foraging by deer on blueberry in stands which have favorable light conditions, the abundance of menziesia appears to increase. Therefore, on occasion, menziesia may serve as an indicator of an over-utilized deer range. However, under extreme browse conditions, both species will be eliminated from the understory.

Devil's club is most abundant on sites with oxygen-rich water moving near or on the surface and exposed mineral soils. These conditions most often occur in riparian ecosystems, but may also occur on lower mountain and footslope positions where subsurface running water concentrates in the rooting layer of the soil—for example, on concave slopes covered by an impermeable parent material such as unfractured bedrock, compact till, or volcanic ash.

TABLE 4. Maximum Number of Species Found per Plant Association, by Vegetative Stratum

Plant Association	Number of species by stratum					TOTAL
	Trees	Shrubs	Forbs	Ferns	Graminoids	
WESTERN HEMLOCK/						
Blueberry/shield fern	4	8	27	9	5	53
Blueberry-devil's club	4	8	22	12	3	49
Devil's club	2	8	17	8	0	35
Devil's club-shallow soils	4	8	18	8	3	41
Blueberry-menziesia	5	5	18	7	2	37
Blueberry	6	9	22	8	4	49
Blueberry/skunk cabbage	5	5	21	8	5	44
Devil's club/skunk cabbage	3	6	17	7	0	33
WESTERN HEMLOCK-YELLOWCEDAR/						
Blueberry-devil's club	3	4	12	5	0	24
Blueberry-menziesia	4	5	21	8	2	40
Blueberry	5	8	24	10	4	51
Blueberry/skunk cabbage	4	5	21	8	3	41
MIXED CONIFER/						
Blueberry	7	13	25	7	10	62
Copperbush	6	18	26	9	7	66
Blueberry/deer cabbage	7	16	25	9	11	68
Blueberry/skunk cabbage	5	15	34	8	9	71
Skunk cabbage-lady fern	5	7	30	6	6	54
SHORE PINE/						
Crowberry	5	15	15	3	6	44
Sitka sedge	4	4	11	1	2	22
MOUNTAIN HEMLOCK/						
Blueberry	5	10	26	7	7	55
Blueberry/deer cabbage	5	10	25	5	7	52
Copperbush-cassiope	5	13	32	7	10	67
Cassiope	5	14	37	8	12	76
SITKA SPRUCE/						
Red alder/salmonberry	4	6	19	6	3	38
Sitka alder	3	7	20	6	1	37
Devil's club/skunk cabbage	4	8	22	10	5	49
Devil's club-salmonberry	3	6	13	5	0	27
Devil's club	2	8	29	9	4	52
Blueberry-devil's club	4	6	23	8	0	41
Blueberry	4	4	11	5	0	24
Blueberry/skunk cabbage	2	5	14	4	1	26
Pacific reedgrass	2	2	7	3	2	16
Devil's club-upland	3	5	14	8	0	30
Mountain hemlock/blueberry	4	8	15	7	2	36

Table 5. Mean Shrub Height by Plant Association*

Plant Association	Sitka Alder		Copperbush		Menziesia		Devil's Club		Currant **		Salmonberry		Blueberry	
	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)
WESTERN HEMLOCK/														
Blueberry/shield fern			5.0	1.5	4.8	1.5	3.1	0.9			2.5	0.8	3.0	0.9
Blueberry-devil's club					4.2	1.3	4.8	1.5	5.0	1.5	4.3	1.3	3.0	0.9
Devil's club					6.0	1.8	5.5	1.7			6.8	2.1	2.3	0.7
Devil's club-shallow soils					4.5	1.4	3.8	1.2	0.5	0.2	3.4	1.0	2.8	0.9
Blueberry-menziesia					5.9	1.8	2.8	0.9			4.2	1.3	2.7	0.8
Blueberry	0.5	0.2			4.7	1.4	2.5	0.8			1.6	0.5	3.2	1.0
Blueberry/skunk cabbage					6.0	1.8	2.3	0.7			6.0	1.8	3.1	0.9
Devil's club/skunk cabbage					5.1	1.6	4.7	1.4	4.0	1.2	3.7	1.1	3.1	0.9
WESTERN HEMLOCK-YELLOWCEDAR/														
Blueberry-devil's club					6.0	1.8	3.0	0.9			4.0	1.2	3.0	0.9
Blueberry-menziesia					5.5	1.7	3.0	0.9	1.5	0.5	1.0	0.3	2.7	0.8
Blueberry			4.5	1.4	4.9	1.5	1.7	0.5			1.9	0.6	3.0	0.9
Blueberry/skunk cabbage					5.9	1.8	2.6	0.8	2.0	0.6	2.1	0.6	3.1	0.9
MIXED CONIFER/														
Blueberry	3.0	0.9			5.9	1.8	4.1	1.2			3.2	1.0	3.8	1.2
Copperbush	8.0	2.4	4.3	1.3	4.0	1.2	6.0	1.8			3.0	0.9	3.2	1.0
Blueberry/deer cabbage			3.3	1.0	4.4	1.3							2.9	0.9
Blueberry/skunk cabbage	12.5	3.8	4.7	1.4	5.8	1.8	2.8	0.9	0.5	0.2	2.5	0.8	3.6	1.1
Skunk cabbage-lady fern					5.4	1.6	3.5	1.1			2.3	0.7	3.5	1.1
SHORE PINE/														
Crowberry			3.5	1.1	6.0	1.8							1.8	0.5
Sitka sedge					8.0	2.4							3.0	0.9
MOUNTAIN HEMLOCK/														
Blueberry	9.7	3.0	2.5	0.8	4.2	1.3	2.4	0.7	1.0	0.3	2.2	0.7	3.3	1.0
Blueberry/deer cabbage			3.5	1.1	3.0	0.9					3.0	0.9	3.4	1.0
Copperbush-cassiope			4.5	1.4	4.3	1.3							2.3	0.7
Cassiope			3.0	0.9	3.3	1.0					0.5	0.2	2.6	0.8
SITKA SPRUCE/														
Red alder/salmonberry													2.8	0.9
Sitka alder	9.0	2.7					6.5	2.0	6.0	1.8	4.0	1.2	2.0	0.6
Devil's club/skunk cabbage	10.0	3.0			5.0	1.5	5.5	1.7			4.7	1.4	2.8	0.9
Devil's club-salmonberry	10.0	3.0			4.0	1.2	5.0	1.5	4.0	1.2	6.3	1.9	2.2	0.7
Devil's club					2.8	0.9	5.4	1.6	5.0	1.5	1.8	0.5	2.0	0.6
Blueberry-devil's club	5.0	1.5			4.7	1.4	4.9	1.5	1.0	0.3	3.3	1.0	3.1	0.9
Blueberry					2.5	0.8		0.0					2.9	0.9
Blueberry/skunk cabbage					4.0	1.2	4.5	1.4			3.5	1.1	2.4	0.7
Pacific reedgrass								0.0					0.5	0.2
Devil's club-upland					2.0	0.6	3.0	0.9					1.0	0.3
Mountain hemlock/blueberry					4.8	1.5	2.8	0.9			4.5	1.4	2.9	0.9

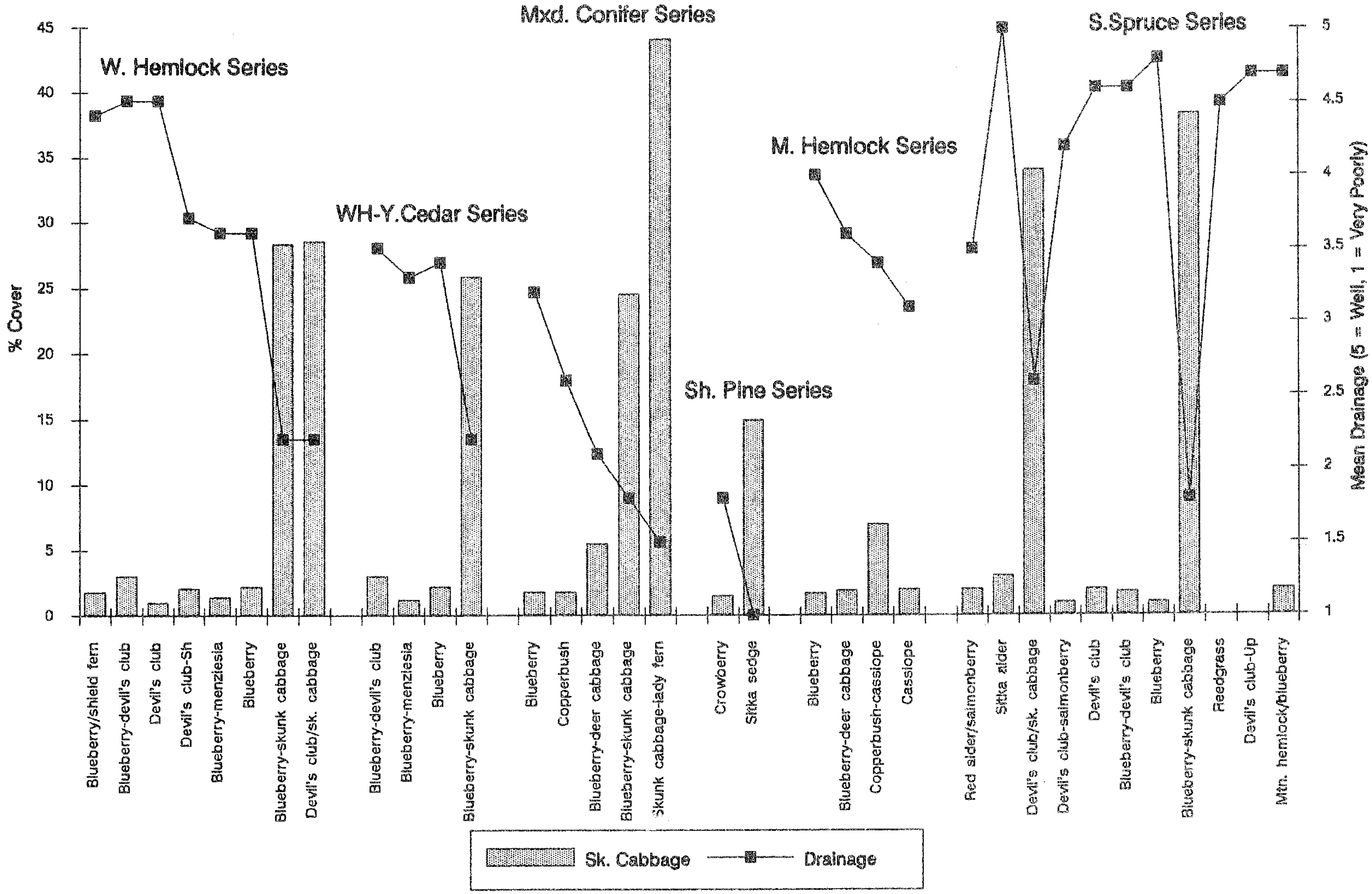
*Recorded to nearest 0.5 ft [0.2 m], that is, class data. Limited sampling.

**Ribes bracteosum, R. lacustre, or R. laxiflorum

Understories dominated by devil's club appear to be more prevalent at the base of larger mountain slopes where more upslope water is likely to accumulate. Devil's club is not typically found growing in or above the subalpine zone. Devil's club is characteristic of a diffuse light, high humidity environment, and, as such, typically dies back in clearcuts. Devil's club appears to indicate soils with high nutrient availability, or loess-derived soils, such as those found along sandy beaches and on islands at the mouth of the Stikine River.

Skunk cabbage is most abundant in soils that are wet for most of the growing season (Figure 4). Such wet conditions occur on small, poorly drained inclusions in otherwise well drained alluvial sites near streams and on poorly drained soils away from streams. Skunk cabbage often occurs in wet microsites within better drained soils, such as root-throw pits. However, skunk cabbage does not compete well on the extremely wet, nutrient-poor soils found in peatlands (muskeg). When it does occur in peatlands, it is usually rooted in better drained, higher nutrient microsites along small streams. Also, skunk cabbage does not compete well in cold subalpine environments.

Figure 4. Skunk Cabbage Mean Cover vs. Drainage by Plant Association



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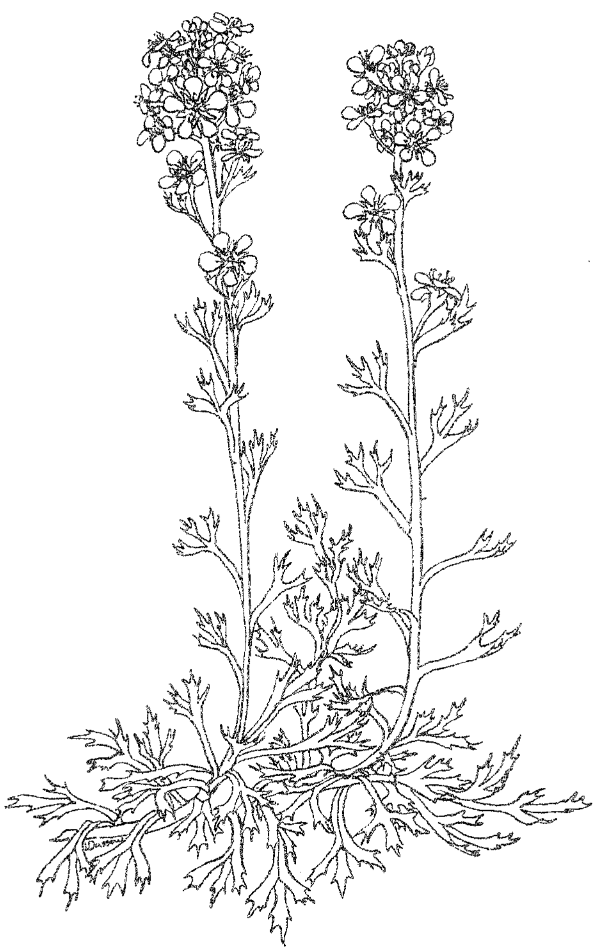


Luetkea
Luetkea pectinata

2
DISTURBANCE AND SUCCESSION

The most common forms of natural disturbance in Southeast Alaska are windthrow, mass wasting, flooding, avalanches, insect infestation, herbivory, frost, and disease. Fires rarely occur due to the cool, wet, marine climate. Relatively frequent, low magnitude natural disturbances maintain the uneven-age structure of the late seral vegetation by creating canopy gaps beneath which seedlings can establish. This type of disturbance usually does not remove all the vegetation (understories remain relatively intact) and occurs at a single- or few-trees scale (Pickett and White 1985).

Windthrow/windsnap is probably the most representative low-intensity natural disturbance in Southeast Alaska (Harris 1989). Treefall gaps in the overstory increase light, growing space, and nutrient resources, allowing existing tree seedlings, saplings, shrubs, and herbs to grow and new ones to establish. Gaps vary in size, which partially determines species composition and recruitment patterns. Larger gaps can be colonized by shade intolerant, fast-growing, species such as Sitka spruce and alder, while smaller gaps may favor more shade tolerant species such as western hemlock. Small gaps may be usurped entirely by lateral growth of surrounding trees. Stumps and windthrown logs often serve as preferred substrates for seedlings, providing nutrients, flood protection, and drier microsites for germination and growth (Harmon 1986, Harmon and Franklin 1989). These "nurse" logs and stumps eventually decompose, often leaving trees with arching or stilted roots.

The rainforest is also subject to infrequent, high-intensity disturbance. Large scale, exogenous disturbance may remove all or part of the vegetation, resulting in earlier seral communities. Stand level windthrow is usually associated with fall and winter storms (Ott 1993). High rainfall and shallow root systems contribute to the susceptibility of Sitka spruce and western hemlock. Blowdown is estimated to account for 27 percent of annual timber volume loss (Harris and Farr 1974). Mass wasting (such as landslides) is prevalent on steep slopes, especially when associated with poorly drained soils such as marine clay, volcanic ash, or compact till parent material. Wildfire is more common in the southern Tongass National Forest where extended, relatively dry periods may occur. Most of the fires in recorded history were caused by human activity (Harris and Farr 1974). The earliest known fire stand is on South Etolin Island and is 300 years old (data on file in Stikine Area Supervisor's Office). Activities such as logging and road building are also common high-intensity disturbance events, which frequently result in even-aged stands.

The revegetation of most of Southeast Alaska has occurred during the past 10,000 years following glacial retreat. Primary succession is still occurring on the mainland and islands where glaciers are presently retreating. This type of succession has been studied at Glacier Bay and on other mainland sites (Cooper 1923, 1939; Lawrence 1951; Stephens et al. 1969) and is currently being studied on uplifted landforms and glacial outwash in Yakutat (Shephard 1995, in prep.).

Studies of primary succession can assist in understanding secondary succession, which occurs following logging, road building, or other high-intensity disturbances. Secondary succession has been studied from both silvicultural and wildlife ecological perspectives. A general sequence describing secondary succession in Southeast Alaska, mainly for lower elevation, moderate- to high-productivity sites, has been described by several researchers, including Alaback (1982), Deal et al. (1991), DeMeo (1991), Harris (1974), Harris and Farr (1974), Kessler (1982), and Schraeder (1992).

For a summary of wildlife and second growth management concerns and a bibliography, see Brown et al. (1992).

The following successional sequence and related issues are drawn from the listed reports. They apply to harvested or naturally disturbed areas where the overstory is completely or partially removed and where all or some understory vegetation remains:

> Following overstory removal, many tree seedlings respond to increased light and space through increased height growth. Seeds present on the forest floor germinate and contribute to the typically dense regeneration. Usually, there is no lack of seeds for hemlock and spruce, although cedar seeds may be poorly dispersed. With the removal of the canopy, soil temperature increases, in turn increasing soil microbiota activity, resulting in relatively greater availability of nutrients for plant growth (absolute nutrient availability depends on parent material, degree of soil development, etc.).
>
> Shrubs and herbs also respond favorably to the increased light, space, and nutrients. Thus, young clearcuts are typically high in understory species biomass, making them valuable forage sites for deer, small mammals, bear, and other wildlife. However, such sites are not generally valuable winter forage sites due to loss of overstory snow interception.
>
> Typically, intense regeneration takes place during the first five years after disturbance. Conifers begin to overtop non-tree species by about 8 to 10 years following overstory removal. By about 15 to 25 years, a dense, "doghair" stand results. At this time, canopy closure limits light penetration to the understory, causing rapid decline of herbs and shrubs (usually within 5 years). During this depauperate stage, the stand understory becomes nearly non-existent, consisting mainly of mosses. Blueberry is restricted to infrequent gaps in the canopy, and the occasional herbs are generally parasitic or saprophytic.
>
> With canopy closure, the site has increased snow interception capability. However, the lack of forage in the understory and the dense stocking render such stands of little value to foraging wildlife. Not only are herbivores limited, but also limited are carnivores such as marten, whose preferred prey species are less common given the depauperate understory. This absence of understory is a major concern for wildlife biologists, because, following harvest, many acres of the forest are being converted to this stage.
>
> After canopy closure, tree growth may remain rapid for 30 to 50 years. Spruce trees often outgrow hemlocks, leading to a two-storied canopy in stands with both species. Competition for light results in the death of some young trees but has no affect on most

shrubs and herbs.

After approximately 130 years, the mature, even-aged forest begins to show understory reintroduction as overstory openings occur and the canopy stratifies vertically. After 250 years, depending on the site, the composition and structure of the stand is usually late seral.

There are exceptions to this general sequence, due to site conditions, disturbance history, and random elements. For example, with slight soil disturbance, hemlock is favored, but with greater disturbance, spruce regeneration is favored, because spruce germinates more readily than hemlock on mineral soil and grows more rapidly.

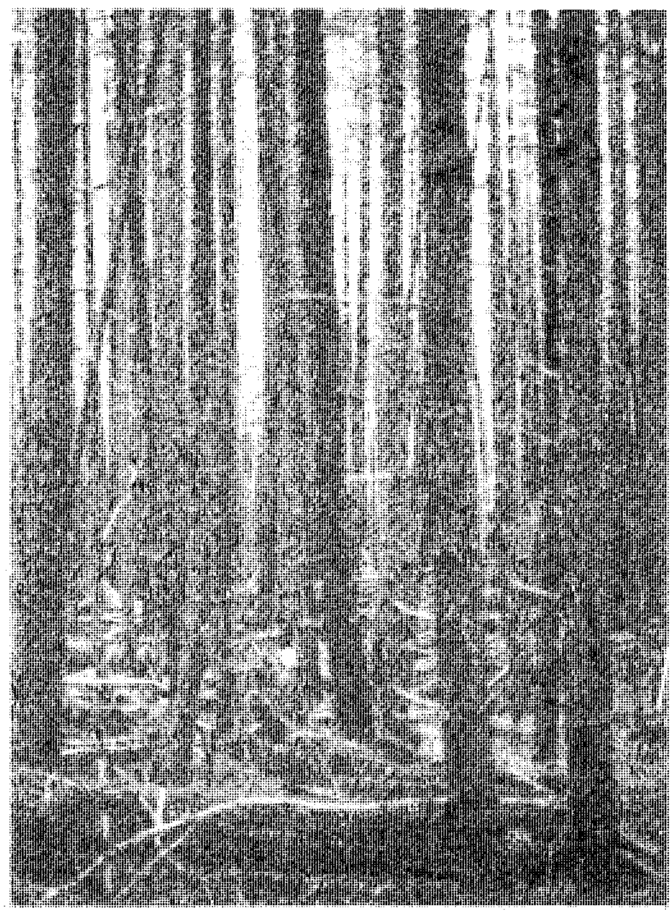
Similarly, lesser disturbance favors blueberry while greater disturbance favors salmonberry and currant. However, severe soil disturbance—for example, removal of the duff layer—may result in sparse or no regeneration, or alder establishment. Alder can outgrow and thereby suppress conifer regeneration for 40 to 60 years. Alder is a strong competitor on alluvial stream terrace sites, (e.g., Tonowek and Tuxekan soils), where salmonberry patches are often dense enough to limit conifer establishment and growth.

Another exception to the sequence, and a difficult area for conifer regeneration, is steep, unstable slopes where landslides occur, often with increased frequency following harvest. Landslides that are severe enough to remove the soil mantle down to till or bedrock force the site back to primary succession. If less severe, secondary succession occurs—at what may be a slower rate than on unaltered sites. Lower portions of the slide tend to revegetate relatively quickly, passing through an alder stage and establishing to spruce.

Other exceptions are immature glacial outwash and uplifted beach soils where conifer regeneration can be limited, and more abundant shrub and forb understories may persist. Conversely, productive calcareous soils allow dense and rapid conifer regeneration, resulting in an especially depauperate understory. Poorly drained, less productive sites produce fewer young trees, resulting in greater shrub and herb biomass. Very poor sites may not show a canopy closure phase. Stands on steeper slopes may develop more abundant understories since more side light is available. North-facing aspects produce microclimate conditions less conducive to tree growth, thereby allowing more light for understory development. Higher elevation sites tend to have fewer, more scattered trees, again leaving more light and space for herb and shrub growth. In general, the better the tree-growing conditions are, the more quickly canopy closure is reached and the faster light becomes limiting in understories.

Managers have several options for treating second growth stands to manipulate succession and enhance timber productivity, wildlife benefits, and other stand attributes, such as structure and composition. The most common option used in Southeast Alaska is precommercial thinning—although pruning, burning, girdling, canopy gap creation, and mechanical disturbance are also options. For more information on these options, their costs and benefits, see Brown et al. (1992) and Russell et al. (1993).

There has been considerable debate on the climax vegetation stage in Southeast Alaska. Much of the debate may be resolved by agreement on time scale and sites discussed. One point of view suggests that on all but steep slopes, the physiographic climax is peatlands (muskeg) because the year-round high precipitation, cool temperatures, and resulting accumulation of organic matter will deteriorate site drainage to the point that tree-size conifers will not grow (i.e., paludification; Zach 1950; Lawrence 1958; Ugolini and Mann 1979). Another view is that forested vegetation is the climax stage, and the peatlands are diminishing in extent. This is based on soil profiles and peat sequences, which suggest that sites that are currently forested once supported peatland vegetation. This hypothesis is supported by the occurrence of forests on flat to gently sloping sites that are well drained (Dachnowski-Stokes 1941; Heusser 1960; Stephens et al. 1969).



Second growth stand developed following windthrow, Tenakee Springs area

3
CLASSIFICATION AND MAPPING CONCEPTS

Classification Concepts

The response of forest vegetation structure, composition, and distribution to changes in the environment may be obvious or subtle. The maritime climate and abundant rainfall make vegetation differences in Southeast Alaska less apparent than in drier climates. For example, the influence of aspect is much less apparent on the Chatham Area than in contiguous United States forests. Any classification is an abstraction representing an attempt to organize the vegetation and environment into categories which appear natural and are useful for management.

This classification is hierarchical and aggregates smaller units into larger ones so that managers can use the information at a variety of scales. This classification uses plant associations and association variants—ecotypes (see below)—as the smallest units. These are aggregated in series by overstory type: western hemlock series, Sitka spruce series, etc.

The classification presented in this guide was developed using the concepts, terminology, and procedures commonly used by ecologists in the western United States. Plant association is used here to mean the "climax" plant community vs. the habitat type, which is the site occupied and identified by the plant association.

When developing a classification, the minimum area used by the investigator influences the number and type of communities observed. Obviously, the absolute minimum size of the associations described here is equal to our plot size (one-tenth acre). However, in most cases the stands sampled to develop this classification were greater than one acre (0.4 ha). We recommend that one acre be used for the smallest area considered for field identification purposes.

Generally the overstory is named for the dominant tree species. In many cases, however, two or more species may dominate the overstory. For example, the separation between the western hemlock and Sitka spruce series is the potential codominance of Sitka spruce and not the absence of western hemlock. In the western hemlock-yellowcedar series, both names are retained to avoid confusion between closely related types.

In two cases—one in the western hemlock series, and one in the Sitka spruce series—similar plant associations occur under two significantly different sets of environmental conditions. In these cases, a variant of the association was added to the classification. These ecotypes are differentiated by the addition of a term to the association name denoting an environmental condition, such as upland or shallow soils.

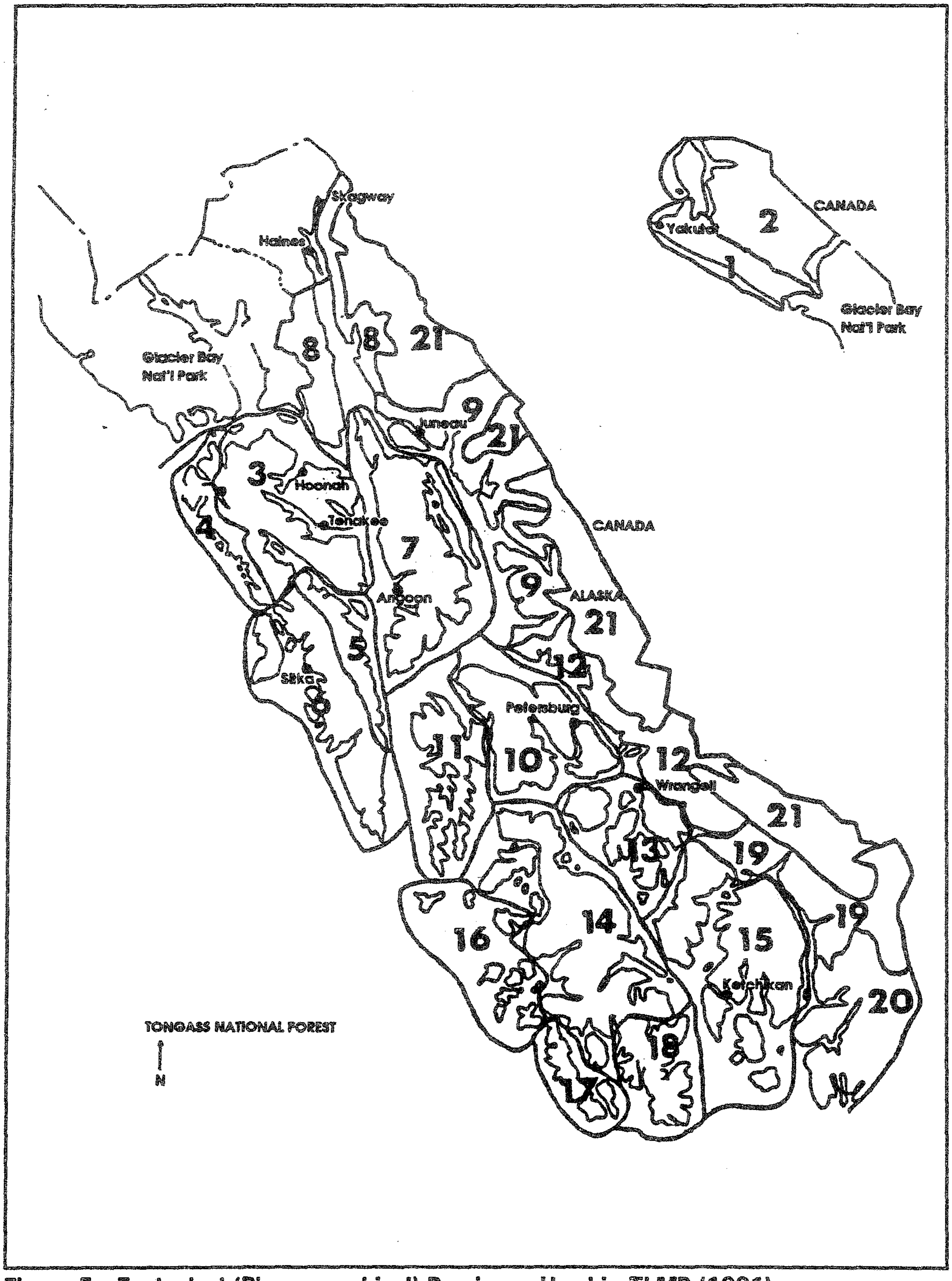


Figure 5. Ecological (Biogeographical) Provinces Used in TLMP (1991).

Classification and Mapping

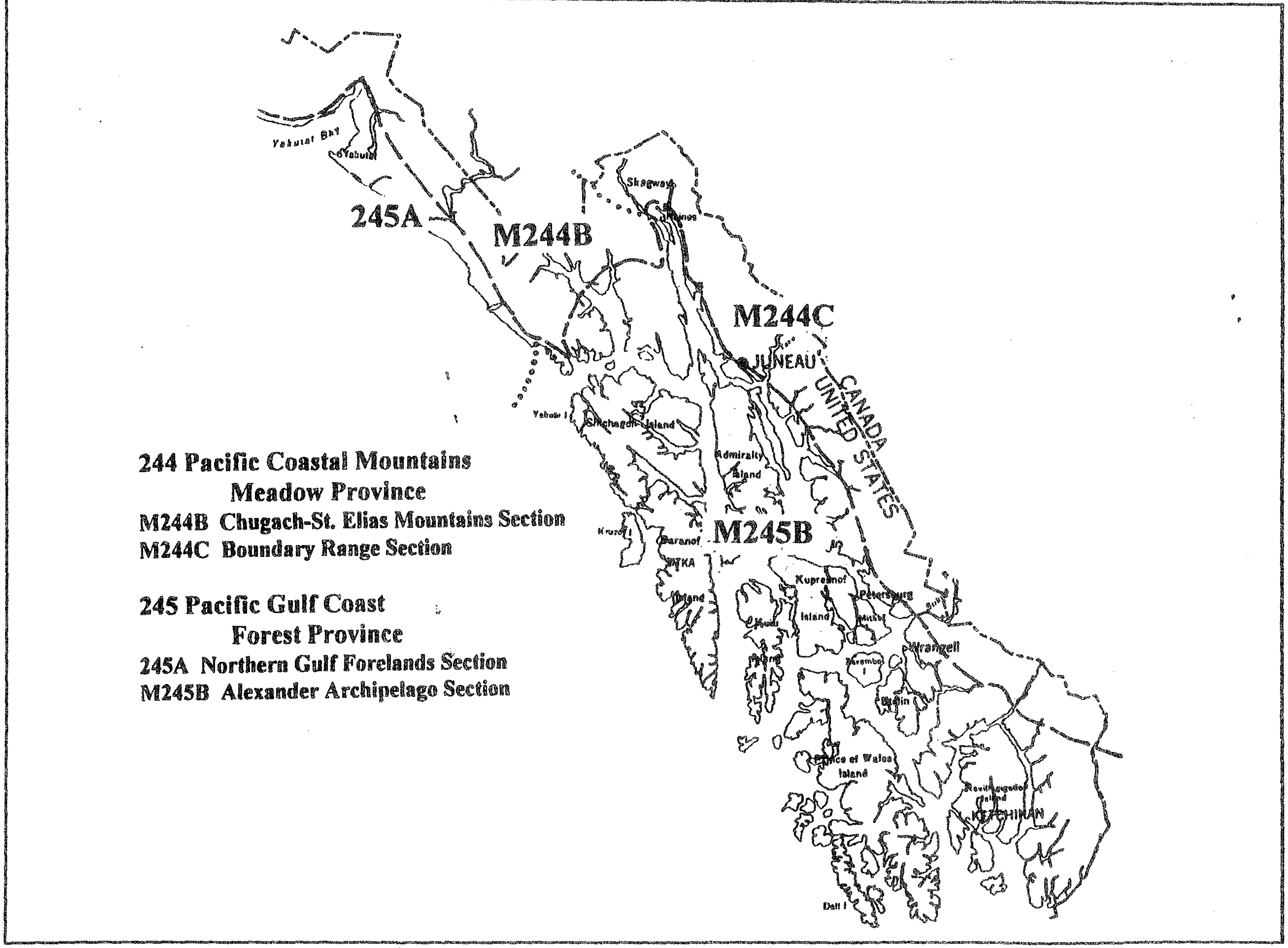
Vegetation classification and mapping are often undertaken at the same time and considered to be almost synonymous. However, classification is here used to describe the process of arranging stands into abstract taxonomic groups (such as the series used in this guide) based on similarities in species composition, structure, or environment. Mapping is an inventory process, identifying where these types occur on the ground. Both classification and mapping are necessary for ecosystem management. Various classification and mapping systems are in use in Southeast Alaska, each with a different emphasis. These frameworks are briefly discussed below to provide an orientation for readers.

Biogeoclimatic classification schemes have been used, for example, in British Columbia (MacKinnon et al. 1992) and for the Ketchikan plant association guide (DeMeo et al. 1992). This system delineates smaller units from larger ones based on environmental factors--primarily climate, followed by soil and vegetation. In the DeMeo et al. system, units are not restricted to a given geographic location (such as one island). Consequently, plant associations have a nearly one-to-one correlation to ecological zones.

Ecological provinces (also based on environmental factors, as well as on plants and animals) have been used, for example, in Tongass land management planning documents (e.g. TLMP Revision, Supplement to DEIS, 8/91). Within the temperate rainforest biome (Pacific Coast--California to Alaska), and the spruce-hemlock-cedar region of that biome, twenty-one provinces have been identified for Southeast Alaska (Fig. 5). Ten of these include Chatham Area lands: Yakutat Forelands (province #1 on Fig. 5); Yakutat/Glacier Bay Upland (2); East Chichagof Island (3); West Chichagof Island (4); East Baranof Island (5); West Baranof Island (6); Admiralty Island (7); Lynn Canal (8); Northern Coast Range (9); and the Icefields Provinces (21). These provinces are physiographic; hence there is not a one-to-one correlation between plant associations and provinces. Rather, a given association may occur in several of the provinces. For example, in this classification several plant associations occur in all the above provinces.

The recent ECOMAP project (National Hierarchical Framework of Ecological Units, USDA FS 1993) also uses biotic and environmental characteristic-based ecological provinces to hierarchically map national forest lands. Under this scheme, as yet in draft stages (10/94), Alaska is first divided into two domains: Polar and Humid Temperate. The Tongass National Forest falls entirely within the latter domain. Within this domain, one division has been identified: Marine. This division, in turn, is split into two provinces and five sections. Of these, the Yakutat Ranger District lies within the Chugach-St. Elias Mountains and Northern Gulf Forelands Sections, and the rest of the Chatham Area is divided among the Chugach-St. Elias Mountains, Boundary Range, and Alexander Archipelago Sections. Further divisions (subsection and below) are yet to be determined. These divisions are also physiographic; hence plant associations do not have a one-to-one correlation to ECOMAP units. Figure 6 shows the ECOMAP sections for Southeast Alaska.

Figure 6. Ecological Sections of Southeastern Alaska



Within the ECOMAP project, smaller units (lower levels of the hierarchy) are to be determined from the bottom up (USDA FS 1993). One possibility for the lower level units is to use the Chatham Area's existing Integrated Resource Inventory (IRI) map units or a grouping of map units. For several years, this system has been developed by Forest Service resource specialists to integrate landform, soils, vegetation, slope, and geology characteristics into discrete map units. The units themselves have been referred to as "common land units (CLU)," "ecological land units (ELU)," "terrestrial ecological units (TEU)," and various other names. For simplicity, the more general term, "map unit," will be used here.

The IRI was designed to provide a uniform and consistent system for mapping resources for management. Field data and aerial photograph interpretations were analyzed to develop a set of map units, each with a description of typical landscape position and slope; soils classification and characteristics; plant association or community classification; percentage composition of soils and vegetation types; and inclusions. These map units may be grouped by landform association into alpine types, mountainslope types, hillslope types, valley bottom types, plains and plateaus types, coastal types, and volcanic types. For more information, refer to the Integrated Resource Inventory Handbook (USDA FS Chatham Area 1990).

A classification and mapping framework that focuses on vegetation is the Alaska Vegetation Classification by Viereck et al. (1992). It has been tentatively adopted by the Region for existing vegetation resource inventory. The next forest inventory may use this framework for mapping existing vegetation—if it proves useful in pilot projects at Crab Bay, Southeast Chichagof Island, and King George, Etolin Island (Stikine Area, USDA FS Region 10 Existing Vegetation Resource Inventory Project 1993). The Viereck et al. classification is not tied to a geographic location within the state.

The Viereck et al. scheme first divides vegetation into three broad formations: Forest, Scrub, and Herbaceous. All plant associations described in this guide fall in the Forest formation. Within this formation (labelled Level 1), there are three divisions: Needleleaf (conifer), Broadleaf, and Mixed Forest. All plant associations in this guide fall within the Needleleaf Forest. Within the Needleleaf Forest, there are three divisions based on a canopy cover gradient: Closed and Open Needleleaf Forest and Needleleaf Woodland, with 60 to 100 percent, 25 to 60 percent, and 10 to 25 percent canopy cover, respectively (<10 percent cover is not considered forested). Figure 7 shows where the plant associations discussed in this guide fit in the Viereck et al. scheme.

With the few exceptions shown, the western hemlock, western hemlock-yellowcedar, and spruce associations fall within the closed forest, the mixed conifer and mountain hemlock associations in the open forest, and the shore pine associations in the woodland.

It is important to note that the Viereck et al. classification is designed for a mix of existing and potential vegetation. By contrast, the Chatham Area guide is for forested plant associations (potential vegetation), and was developed from sampling in late seral communities.

Figure 7. Hierarchy for Forest Associations using Alaska Vegetation Classification*

Biome	**Temperate Rain Forest**
Region	**Spruce-Hemlock-Cedar Temperate Rain Forest**
Level 1 (Formation)	**Forest**
Level 2	**Needleleaf Forest**

Level 3	Closed Needleleaf Forest			
Level 4 (Series)	Western Hemlock	Western Hemlock-Yellow-cedar	Mountain Hemlock	Sitka Spruce
Level 5 (Communities and associations)	WESTERN HEMLOCK/ Blueberry/shield fern Blueberry-devil's club Devil's club Devil's club-shallow soils Blueberry-menziesia Blueberry Blueberry/skunk cabbage Devil's club/skunk cabbage	WESTERN HEMLOCK-YELLOWCEDAR/ Blueberry-devil's club Blueberry-menziesia Blueberry Blueberry/skunk cabbage	MOUNTAIN HEMLOCK/ Blueberry	SITKA SPRUCE/ Devil's club/skunk cabbage Devil's club-salmonberry Devil's club Blueberry-devil's club Blueberry Blueberry/skunk cabbage Pacific reedgrass Devil's club-upland

Level 3	Open Needleleaf Forest			Needleleaf Woodland
Level 4 (Series)	Mixed Conifer	Mountain Hemlock	Sitka Spruce	Shore Pine
Level 5 (Communities and associations)	MIXED CONIFER/ Blueberry Copperbush Blueberry/deer cabbage Blueberry/skunk cabbage Skunk cabbage-lady fern	MOUNTAIN HEMLOCK/ Blueberry/deer cabbage Copperbush-cassiope Cassiope	SITKA SPRUCE/ Red alder/salmonberry Sitka alder Mountain hemlock/blueberry	SHORE PINE/ Crowberry Sitka sedge

*Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. The Alaska Vegetation Classification. General Technical Report PNW-GTR-286. USDA Forest Service. Portland, OR. 278 p.

Depending on resource goals, each of these classification and mapping frameworks addresses a different piece of the landscape puzzle and has different management utility. An additional perspective may be gained by correlating plant associations with general landscape location--such diagrams are shown at the start of each series chapter (chapters 7 to 12) in this guide. These diagrams may be merged into the oversimplified overall diagram below (Fig. 8).

The order of the series chapters relates generally to Figure 8: from drier to wetter, then higher elevation, then disturbance-driven--western hemlock, hemlock-yellowcedar, mixed conifer, shore pine, mountain hemlock, and Sitka spruce series. Within each chapter, the associations are ordered approximately along the dominant gradient for the series: increasing moisture for the western hemlock, hemlock-cedar, mixed conifer, and shore pine series; increasing elevation for the mountain hemlock series; and decreasing disturbance for the spruce series.

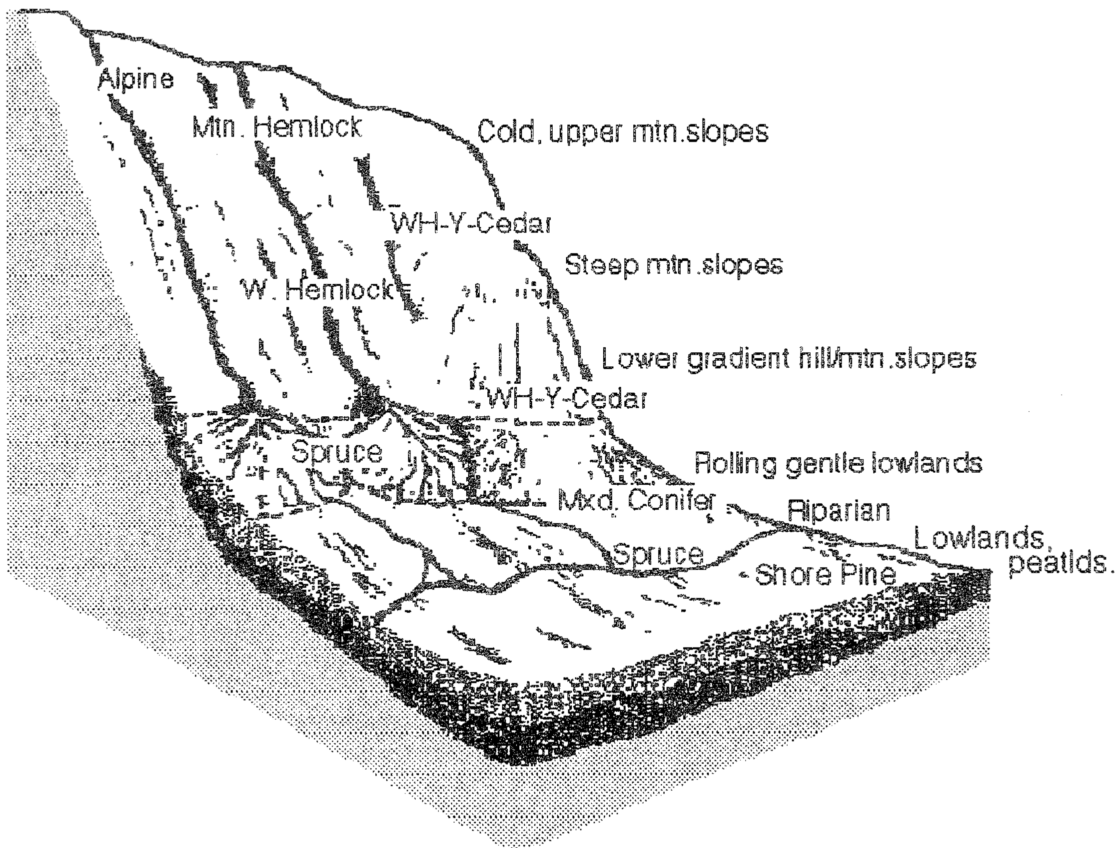
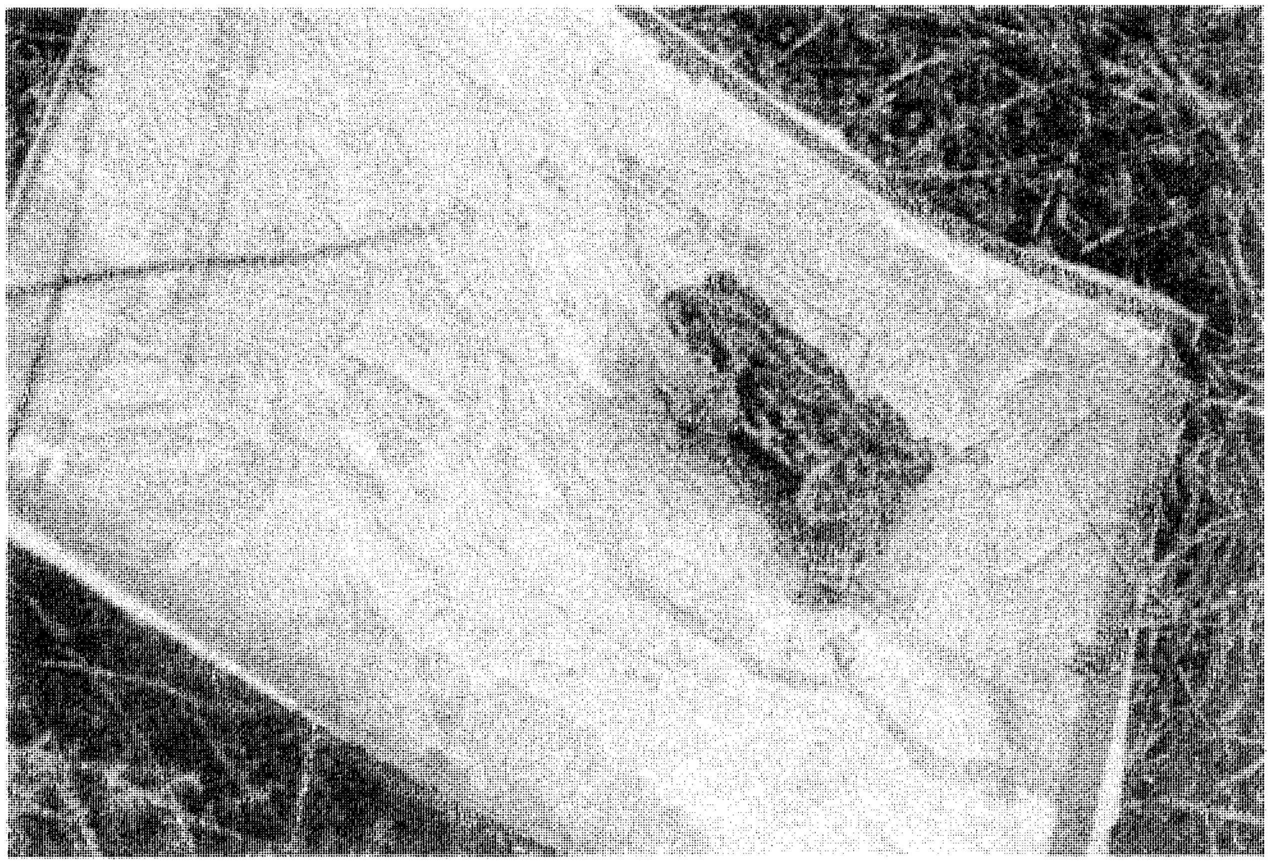


Figure 8. Generalized Landscape Positions for Forest Series.

NOTES:



Boreal Toad
Bufo boreas

4
MANAGEMENT IMPLICATIONS

On the Chatham area, there are a number of ecosystem management issues that involve plant associations. This section briefly discusses those issues and is partially drawn from DeMeo et al. (1992). Related data is included in Appendix 4.

Harvest Unit Planning

Stand structure and species composition data are provided for each plant association and are summarized in Tables 6 and 7. These data may be used with information on sensitivity of soils to disturbance, slope classes, soil drainage, and landforms (given in association descriptions) to plan harvest units.

While clearcutting is the most common harvest method on the Chatham Area, concerns with clearcutting include the following:

1) Clearcutting is outside the range of historic disturbance patterns and processes. Consequences may include loss of biodiversity. When implementing ecosystem management, alternatives that consider natural disturbance processes may be more appropriate.

2) With clearcutting, it is difficult to achieve consistent yellowcedar regeneration, especially where deer populations are high. While cedar silviculture is incompletely understood, there is some evidence that partial cutting may be more effective for perpetuating cedar stands (see Chapter 8).

3) During clearcutting, snags and potential snags are removed. However, availability of snags, especially the softer and more easily excavated spruce and hemlock, is critical for survival of cavity-nesting birds and mammals (Davis et al. 1983; Bull et al. 1990). Retention of snags creates safety concerns, but provides long-term nutrient sources, large woody debris for conifer regeneration, and habitat for cavity nesters, insects, and fungi. Some units can be designed to retain snags in tree "islands" (clusters of trees within the harvest unit), in corridors, on unit edges, and in other relatively windfirm locations to perpetuate ecosystem attributes. See Reserve Tree Guidelines (Reserve Tree Guideline Committee 1992) for more information on snag and green tree retention options.

4) After clearcutting, young growth stands typically have reduced species and structural diversity (Alaback 1982). As discussed in Chapter 2, second growth stands pass through an extended depauperate stage with little understory forage for wildlife. Lack of structural diversity is also associated with reduced songbird populations.

Table 6. Combined Species Forest Structural Data by Plant Association

Plant Association	Tree Height				Diameter (DBH)				Basal Area		Gross Volume	
	Mean		SD*		Mean		SD		Mean	SD	Mean	SD
	(ft.)	(m)	(ft.)	(m)	(in.)	(cm)	(in.)	(cm)	(sq. ft./ac.)		(mbf)	
WESTERN HEMLOCK/												
Blueberry/shield fern	127	39	17	5	31	79	7	18	312	76	79.9	23.6
Blueberry-devil's club	135	41	19	6	34	86	8	20	295	79	82.7	25.7
Devil's club	127	39	23	7	27	69	11	28	270	113	82.8	40.6
Devil's club-shallow soils	87	27	10	3	18	46	9	23	285	84	45.7	16.4
Blueberry-menziesia	92	28	17	5	20	51	5	13	237	79	42.7	15.3
Blueberry	93	28	15	5	23	58	5	13	280	79	49.3	18.5
Blueberry/skunk cabbage	92	28	22	7	21	53	7	18	259	94	47.7	30.6
Devil's club/skunk cabbage	83	25	20	6	18	46	10	25	256	70	39.5	21.6
WESTERN HEMLOCK-YELLOWCEDAR/												
Blueberry-devil's club	85	26	7	2	13	33	15	38	240	0	31.9	0.8
Blueberry-menziesia	97	30	15	5	21	53	6	15	316	87	54.8	24.0
Blueberry	93	28	20	6	23	58	7	18	303	77	49.6	19.1
Blueberry/skunk cabbage	87	27	21	6	19	48	9	23	303	100	46.5	24.8
MIXED CONIFER/												
Blueberry	64	20	14	4	17	43	6	15	194	97	19.3	11.6
Copperbush	56	17	19	6	16	41	7	18	212	115	12.2	9.9
Blueberry/deer cabbage	49	15	13	4	14	36	5	13	165	93	9.8	8.3
Blueberry/skunk cabbage	68	21	15	5	19	48	12	30	235	100	24.5	15.7
Skunk cabbage-lady fern	70	21	13	4	18	46	9	23	212	71	24.9	15.3
SHORE PINE/												
Crowberry	43	13	6	2	13	33	3	8	75	35	4.9	2.7
Sitka sedge**												
MOUNTAIN HEMLOCK/												
Blueberry	73	22	14	4	19	48	6	15	307	102	38.0	12.3
Blueberry/deer cabbage	50	15	14	4	18	46	5	13	233	92	14.9	10.6
Copperbush-cassiope	53	16	19	6	16	41	2	5	112	33	9.8	8.5
Cassiope	41	12	12	4	16	41	5	13	153	68	6.9	7.0
SITKA SPRUCE/												
Red alder/salmonberry**											73.0	0
Sitka alder	162	49	0	0	41	104	0	0	240	0	81.6	0
Devil's club/skunk cabbage	125	38	19	6	31	79	7	18	320	91	71.0	29.5
Devil's club-salmonberry	115	35	25	8	31	79	8	20	320	69	70.7	10.1
Devil's club	136	41	27	8	41	104	13	33	305	97	97.8	37.3
Blueberry-devil's club	139	42	17	5	30	76	16	41	292	57	89.4	30.4
Blueberry	148	45	24	7	36	91	5	13	390	132	114.0	57.7
Blueberry/skunk cabbage	92	28	33	10	22	56	2	5	227	83	37.1	15.1
Pacific reedgrass**											126.4	43.6
Devil's club-upland	137	42	5	2	41	104	15	38	340	198	96.3	36.4
Mountain hemlock/blueberry	104	32	27	8	24	61	12	30	300	123	55.9	26.0

*SD = standard deviation

**Too few sampling sites to calculate statistics

Table 7. Forest Structural Characteristics by Series

Forest Series	Tree Height Mean (ft.)	Tree Height Mean (m)	Tree Height SD (ft.)	Tree Height SD (m)	Diameter (DBH) Mean (in.)	Diameter (DBH) Mean (cm)	Diameter (DBH) SD (in.)	Diameter (DBH) SD (cm)	Gross Volume Mean (mbf)	Gross Volume SD (mbf)
WESTERN HEMLOCK										
Sitka Spruce	105	32	19	6	26	67	5	13	128	75
Western Hemlock	94	29	18	6	22	56	4	11	79	49
Yellow-Cedar	94	29	27	8	21	54	8	19	70	37
Mountain Hemlock	94	29	27	8	23	59	6	16	83	61
WESTERN HEMLOCK-YELLOWCEDAR										
Sitka Spruce	94	29	17	5	21	53	4	10	65	28
Western Hemlock	73	22	16	5	17	42	3	8	36	14
Yellow-Cedar	81	25	4	1	19	48	2	4	40	6
Mountain Hemlock	83	25	19	6	19	48	6	15	52	12
Shore Pine	46	14	5	2	15	38	6	15	10	9
MIXED CONIFER										
Sitka Spruce	67	21	10	3	18	46	5	13	38	27
Western Hemlock	49	15	13	4	13	34	2	6	19	11
Yellow-Cedar	59	18	9	3	15	39	1	3	24	8
Mountain Hemlock	55	17	11	3	15	37	3	7	18	8
Shore Pine	63	19	**		13	33			10	
SHORE PINE SERIES										
Sitka Spruce	50	15			14	36			9	
Western Hemlock	29	9	13	4	10	26	3	8	12	
Yellow-Cedar	34	10			12	31			5	
Mountain Hemlock	36	11			11	27			6	
Shore Pine	46	14	5	2	15	38	6	15	10	9
MOUNTAIN HEMLOCK										
Sitka Spruce	71	22	12	4	21	53	3	7	50	35
Western Hemlock	61	19	29	9	16	40	4	11	24	25
Yellow-Cedar	63	19	15	5	16	41	3	7	20	11
Mountain Hemlock	49	15	15	5	16		2	5	19	8
SITKA SPRUCE										
Sitka Spruce	119	36	21	7	30	76	5	13	181	91
Western Hemlock	93	28	14	4	21	52	3	8	67	29
Yellow-Cedar	50	15			25	64			122	
Mountain Hemlock	73	22	11	3	19	47	1	2	31	14

*SD = standard deviation

**Blanks indicate no standard deviation shown due to limited sample size

5) Extensive clearcutting can also fragment wildlife habitat, and, in extreme cases, could isolate populations and endanger species viability. Placement of tree islands and corridors can ameliorate this problem. Another aspect of fragmentation is the loss of late seral interior stand conditions, not only in the clearcut unit, but potentially in adjoining stands. Interior forest conditions are required for survival of some species, and a minimum patch size is necessary to maintain these conditions.

Alternatives to clearcutting considered in Southeast Alaska include: selection harvest by shovel yarding on gentle slopes; leaving clusters and corridors of trees on midslopes where cable logging systems and windthrow concerns prohibit leaving single trees; and helicopter logging on steep or high elevation slopes when economically feasible (usually if units have a high spruce or cedar component).

Silviculture

Conifer regeneration information is provided for most plant associations and is summarized in Table 8. Regeneration concerns include brush competition, impacts of voles on spruce seedlings, and seedling microsite needs. Silvicultural "prescriptions" may be developed from comparisons among existing vegetation maps and plant association maps—such as those from the Integrated Resource Inventory (IRI).

Soil and Water

Soil erosion is particularly prevalent on steep slopes and on volcanic ash underlain by compact till, which is common on Sitka Ranger District. Slopes and mass wasting concerns are discussed in the plant association sections. The Region 10 Soil and Water Conservation Handbook (FSH 2509.22) provides direction for use of best management practices (BMPs) to control and mitigate soil disturbance and to protect water quality during and after logging or road building.

The Chatham Area IRI Handbook (1990) also provides interpretations on mass movement hazards per map unit, which includes up to three plant associations. Maps showing mass movement high-hazard areas can be generated from the Chatham Area geographic information system (GIS).

Windthrow

Windthrow along harvest unit edges, particularly in riparian areas, can be a major problem. Individual tree blowdown is common throughout the year (see Chapter 2), but stand-level blowdown is usually associated with storms. Thus the storm wind direction (usually southeast) should be considered in windthrow analyses. However, local topography greatly affects windthrow potential. Portions of northwest Baranof and northeast Chichagof Islands have been mapped for wind direction based on tree crown shape (flagging) and blowdown evidence under a cooperative project with Robert Ott of the Forest Sciences Laboratory in Juneau (Ott 1993). Where possible, windthrow potential is discussed in the plant association sections.

Table 8. Estimated Regeneration Potential of Plant Associations

Plant Association	Regeneration Potential*	% Soils Poorly Drained, Very Poorly Drained	Disturbance Indicator Shrubs** (% Cover)	Special Considerations
WESTERN HEMLOCK/				
Blueberry/shield fern	good	3	10	
Blueberry-devil's club	good	2	36	flooding
Devil's club	fair	0	80	flooding
Devil's club-shallow soils	good	13	40	flooding
Blueberry-menziesia	good	15	4	
Blueberry	good	10	7	
Blueberry/skunk cabbage	poor-fair	62	69	ponding, seeps
Devil's club/skunk cabbage	poor	73	57	ponding, seeps
WESTERN HEMLOCK-YELLOWCEDAR/				
Blueberry-devil's club	good	0	28	flooding, cedar browsing
Blueberry-menziesia	good	19	3	cedar browsing
Blueberry	good	10	5	cedar browsing
Blueberry/skunk cabbage	poor-fair	65	4	ponding, seeps, cedar browsing
MIXED CONIFER/				
Blueberry	fair-poor	27	12	shrub competition, ponding, seeps
Copperbush	poor	38	6	ponding, seeps, colder temps.
Blueberry/deer cabbage	poor	70	2	ponding, seeps
Blueberry/skunk cabbage	poor-fair	89	10	ponding, seeps
Skunk cabbage-lady fern	poor	92	20	ponding, seeps
SHORE PINE/				
Crowberry	poor	83	0	wetlands
Sitka sedge	poor	100	0	wetlands
MOUNTAIN HEMLOCK/				
Blueberry	poor-fair	8	12	high elevation, frost
Blueberry/deer cabbage	poor-fair	21	9	high elev., frost and snow impacts
Copperbush-cassiope	poor	14	8	high elev., avalanche, snowpack
Cassiope	poor	33	6	high elevation, avalanche
SITKA SPRUCE/				
Red alder/salmonberry	poor	25	97	floods, shrub competition
Sitka alder	poor	0	98	floods, shrub competition
Devil's club/skunk cabbage	poor-fair	60	91	seeps, voles
Devil's club-salmonberry	fair	20	75	floods, shrub competition
Devil's club	fair	0	67	floods, shrub competition
Blueberry-devil's club	fair-good	0	51	floods
Blueberry	good	0	6	voles
Blueberry/skunk cabbage	fair	80	3	seeps
Pacific reedgrass	fair-good	0	0	saltspray, deer
Devil's club-upland	fair	0	30	slumps, shallow soils
Mountain hemlock/blueberry	poor	0	13	high elevation, snow impacts

*Based on combination of site effects inhibiting conifer regeneration.

**Devil's club, currant, salmonberry

Wildlife

Wildlife biologists and ecologists frequently need to predict wildlife habitat quality, location, and usage, particularly with regard to planned harvest areas and threatened and endangered or subsistence species. Most field data and much of the wildlife research to date has focused on Sitka black-tailed deer. Therefore, information is provided by plant association to show availability of forage (mainly blueberry and herbs for deer; Hanley et al. 1989) and snow interception capability (see Table 9).

Sitka black-tailed deer distribution in Southeast Alaska appears to be limited by winter thermal cover and forage availability (Wallmo and Schoen 1979; Hanley and McKendrick 1985; Schoen et al. 1988; Suring et al. 1992). Thus productive timber stands that intercept much of the snow, maintaining a relatively clear forest floor with available shrubs and herbs (Bunnell and Jones 1984), are valuable winter deer range. However, proximity to saltwater may be a more important factor in deer range (Hanley et al. 1989).

Where possible, information on other species' use of plant associations is also provided, such as for bald eagles and brown bears.

Wetlands

Federal regulations, such as Section 404 of the Clean Water Act and the "Swampbuster" provision of the Food Security Act, require special documentation and permitting for work in jurisdictional wetlands. The U.S. Army Corps of Engineers developed a standardized method for identification and delineation of wetlands. To be classed as a wetland, an area must possess hydrophytic vegetation, hydric soils, and wetland hydrology (U.S. Army Corps of Engineers 1987).

The hydrophytic vegetation criterion is based on the frequency with which vascular plant species are found in wetlands. A national list has been developed showing plant indicator status as obligate wetland species (OBL; >99 percent probability of occurrence in wetlands), facultative wetland species (FACW; 67 to 99 percent probability), facultative species (FAC; 34 to 66 percent probability), facultative upland species (FACU; 67 to 99 percent probability of occurrence in non-wetlands), and obligate upland species (UPL; 99 percent probability of non-wetland occurrence). For an area to meet the hydrophytic vegetation criterion, 50 percent or more of the dominant vegetation in all strata must by classed as OBL, FACW, or FAC.

The hydric soil criterion is based on saturation, ponding, or flooding occurring long enough during the growing season that anaerobic conditions develop in the upper soil. The National Technical Committee for Hydric Soils (1987) has developed criteria to identify hydric soils as well as a national list of hydric soils. Soil morphological characteristics such as mottling and gleying are used to identify soil saturation depth and duration. The wetland hydrology criterion is based on saturation for a significant period during the growing season. Saturation is determined using depth to the water table, soil drainage characteristics, water marks, drift lines, wetland drainage patterns, morphological plant adaptations, other field observations, and historical records.

Subsequent to the Corps of Engineers manual, an interagency committee—that included the Corps, the Environmental Protection Agency, the Fish and Wildlife Service, and the Soil

TABLE 9. Relative Forage Abundance and Snow Interception Capability by Plant Association

Plant Association	% Cover/Constancy of Important Forage Species				Overstory Cover (%)
	Blueberry	Sk. Cabbage	Bunchberry	5-lf. Bramble	
WESTERN HEMLOCK/					
Blueberry/shield fern	53/100	2/11	9/97	10/99	72
Blueberry-devil's club	25/100	3/17	7/96	7/98	70
Devil's club	8/83	1/8	6/67	6/75	65
Devil's club-shallow soils	25/100	2/22	6/100	12/100	62
Blueberry-menziesia	61/100	1/43	14/100	9/100	61
Blueberry	55/100	2/38	9/97	10/98	64
Blueberry/skunk cabbage	42/100	28/100	8/100	8/100	55
Devil's club/skunk cabbage	31/100	29/100	6/100	16/100	56
WESTERN HEMLOCK-YELLOWCEDAR/					
Blueberry-devil's club	51/100	3/50	15/100	15/100	68
Blueberry-menziesia	68/100	1/34	9/100	5/97	66
Blueberry	58/100	2/40	7/98	7/100	62
Blueberry/skunk cabbage	50/100	26/100	7/100	11/100	61
MIXED CONIFER/					
Blueberry	69/100	2/55	9/100	9/100	42
Copperbush	54/100	25/100	10/100	10/100	32
Blueberry/deer cabbage	53/100	6/81	15/81	4/90	29
Blueberry/skunk cabbage	54/100	25/100	10/100	10/100	46
Skunk cabbage-lady fern	36/100	44/100	8/100	6/92	44
SHORE PINE/					
Crowberry	35/86	2/57	15/43	5/57	22
Sitka sedge	63/100	15/100	—	15/100	30
MOUNTAIN HEMLOCK/					
Blueberry	54/100	2/13	4/74	10/98	49
Blueberry/deer cabbage	61/100	2/44	2/69	9/94	39
Copperbush-cassiope	28/93	7/21	6/100	4/86	28
Cassiope	32/100	2/38	17/57	8/90	26
SITKA SPRUCE/					
Red alder/salmonberry	7/75	2/50	1/50	1/75	43
Sitka alder	11/100	3/75	8/50	6/75	45
Devil's club/skunk cabbage	13/100	34/100	6/94	4/100	64
Devil's club-salmonberry	15/100	1/40	3/100	12/80	51
Devil's club	8/85	2/30	3/65	8/85	69
Blueberry-devil's club	36/100	2/24	9/88	12/100	63
Blueberry	39/100	1/25	10/100	9/100	79
Blueberry/skunk cabbage	44/100	39/100	12/100	18/100	60
Pacific reedgrass	1/100	—	15/50	—	83
Devil's club-upland	10/100	—	8/67	6/100	65
Mountain hemlock/blueberry	44/100	2/15	3/100	8/100	53

— = not present

Conservation Service—integrated methods and prepared a new manual with similar methodology for delineation of jurisdictional wetlands (Federal Interagency Committee for Wetland Delineation 1989). Due to various legislative actions, the 1987 method is still the method in use. Correct use of the criteria requires training and experience. See the Corps (1987) or the Interagency (1989) manuals for more information. Federal certification programs are available; consult the Regional Soil Scientist for more information.

Much of Southeast Alaska appears to be wetland, given the abundant moisture. However, some soils, such as alluvial spruce sites, are wet year-round but not saturated. In these cases, the required wetland criteria are not met. In order to address the Regional situation, a wetlands classification was developed by DeMeo et al. (1989). Using the Corps of Engineers methodology, wetland indices were developed for the forested plant associations. Table 10 shows the wetland plant associations identified by DeMeo et al. Similarly, wetland and non-wetland designations were developed for map units on the GIS (see Chatham Area GIS or IRI handbook).

The National Wetlands Inventory (U.S. Fish and Wildlife Service 1988) is currently mapping all of Alaska according to its national system (using Cowardin et al. 1979). Field work and mapping has been conducted in parts of Southeast Alaska, and maps are available for these areas. All of the state is due to be completed by 1995. The National Wetlands Inventory and the Region's GIS mapping may not be adequate to address wetland resource concerns at the project level. Therefore, field verification is usually needed, particularly since non-wetland associations may occur in close conjunction with wetland associations.

Other wetland classification systems are available, for example: A Hydrogeomorphic Classification for Wetlands (US Army Corps of Engineers 1993); Hydrogeologic Classification of Wetlands in Glaciated Regions (Hollands 1987); and the Canadian Wetland Classification System (National Wetlands Working Group 1987). The Channel Type User Guide (Paustian et al. 1992) is a related document, providing information on riparian areas, mainly in terms of channel morphology, hydrologic characteristics and aquatic habitat capability, but also on riparian vegetation and management implications. Plant associations typically occurring near the various channel types are listed. Readers are referred to that document for more information on riparian vegetation, a topic not well addressed in this manual.

Table 10. Wetland Plant Associations

Plant Association	Wetland Status*
Western hemlock/devil's club/skunk cabbage	Wetland
Western hemlock-yellowcedar/blueberry/skunk cabbage	Borderline
Mixed conifer/blueberry/deer cabbage	Wetland
Mixed conifer/blueberry/skunk cabbage	Wetland
Mixed conifer/skunk cabbage-lady fern	Wetland
Shore pine/crowberry	Wetland
Shore pine/Sitka sedge	Wetland

* If not listed, an association is not wetland.

Recreation and Subsistence

With increasing use of Southeast Alaska public lands for recreation and subsistence (hiking, hunting, kayaking, camping, berry picking, wildlife watching, all-terrain vehicle use, etc.), conflicts among resource users are inevitable. Where possible, information is given in each plant association section on recreation and subsistence use. The ability of plant associations to withstand repeated foot traffic without site deterioration is addressed in Table 11.

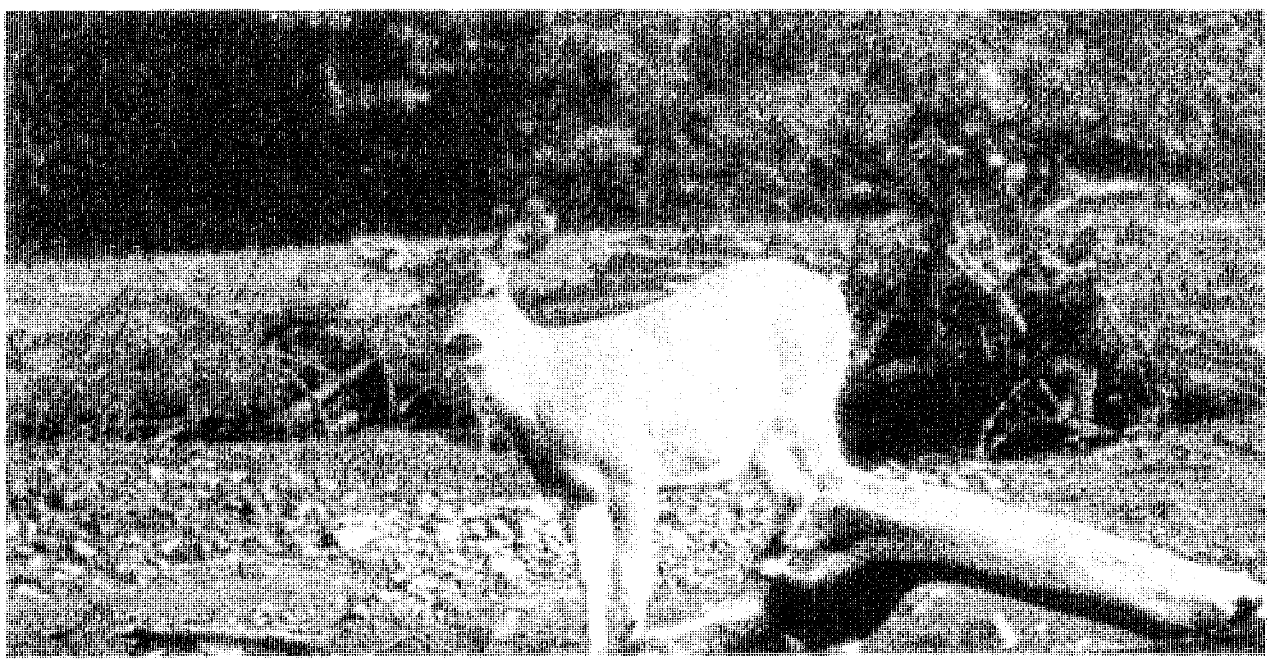


Photo credit: S. Klinger

Table 11. Estimated Trafficability* of Plant Associations, Based on Soils**

Plant Association	% of Association in Each Trafficability Class		
	Low	Moderate	High
WESTERN HEMLOCK/			
Blueberry/shield fern	3	9	87
Blueberry-devil's club	2	7	91
Devil's club		16	84
Devil's club-shallow soils	13	27	60
Blueberry-menziesia	15	30	55
Blueberry	10	40	50
Blueberry/skunk cabbage	62	34	3
Devil's club/skunk cabbage	73	18	9
WESTERN HEMLOCK-YELLOWCEDAR/			
Blueberry-devil's club		50	50
Blueberry-menziesia	19	35	46
Blueberry	10	57	33
Blueberry/skunk cabbage	65	29	6
MIXED CONIFER/			
Blueberry	27	40	33
Copperbush	38	52	10
Blueberry/deer cabbage	70	25	5
Blueberry/skunk cabbage	89	8	3
Skunk cabbage-lady fern	92	7	
SHORE PINE/			
Crowberry	83	17	
Sitka sedge	100		
MOUNTAIN HEMLOCK/			
Blueberry	8	19	73
Blueberry/deer cabbage	21	29	50
Copperbush-cassiope	14	36	50
Cassiope	33	24	43
SITKA SPRUCE/			
Red alder/salmonberry	25	25	50
Sitka alder			100
Devil's club/skunk cabbage	60	13	27
Devil's club-salmonberry	20		80
Devil's club		11	89
Blueberry-devil's club		13	88
Blueberry			100
Blueberry/skunk cabbage	80	20	
Pacific reedgrass			100
Devil's club-upland			100
Mountain hemlock/blueberry		8	92

*Trafficability : the ability of soil to withstand repeated use by foot traffic without site deterioration. High = best resistance to damage; low = least resistance.

**Soils were grouped for trafficability as follows: well and moderately well drained as high; somewhat poorly as moderate; poorly and very poorly as low. Parent material was not considered except for organics.

5
METHODS

Field Procedures

Intensive field sampling supporting this classification was conducted from June to Septembe during 1981-84. Sampling was conducted across the Chatham Area, primarily in watershed designated for multiple resource management (USDA FS 1979; see Fig. 1). Detailed statistica analysis was completed in 1989 (Martin 1989). Field verification and refinement occurre following the draft publication in 1985 (Martin et al. 1985) and has continued to the present

Sample stands were located by a two to three person team consisting of an ecologist, botanist and/or biologist and a soil scientist using color aerial photographs (1:15,540) and fiel exploration. In total, 1,103 forest stands were sampled. Stands were distributed throughou the landscape in order to represent a large range of late seral forest vegetation an environmental conditions.

In general, stands were selected only if the overstory and understory vegetation an environmental conditions appeared to be homogeneous. Attempts were made to sample onl stands which had the general characteristics of late seral vegetation. In addition, edge effects ecotones, windthrow and sites exhibiting atypical vegetation patterns were avoided Consequently, the plant association descriptions provided here do not show the full range o vegetation conditions found on the Chatham Area, but rather show more typical conditions.

Vegetative sampling was conducted on temporary 0.10 acre (375 m^2) circular plots (Pfister e al. 1977a). (Note that current vegetation sampling procedures (Martin and Borchers 1989) us an approximately 0.13 acre [500 m^2 plot] or 42 foot [13 m] radius plot. Other techniques als described here are no longer in use). Each plot was marked with flagging at center and plo radius in four perpendicular locations. The relative **abundance** of all vascular plant species wa estimated by assigning one of seven **canopy cover classes** to each species within the plot Trace (T) = 0 to 1 percent; 1 = 1 to 5 percent; 2 = 5 to 25 percent; 3 = 25 to 50 percent 4 = 50 to 75 percent; 5 = 75 to 95 percent; 6 = 95 to 100 percent. **Dominant species** ar those which cover a significant portion of understory or overstory.

Tree species canopy cover was estimated for three size classes within the plot: >4 in. (10 cm DBH (diameter at breast height, 4.5 feet [1.37 m] above the ground); < 4 in. DBH and > 3 ft (1 m) tall; < 3 ft. tall. Total tree canopy cover (includes all trees > 4 in. DBH) was determine by estimating the percent canopy cover in 5 percent increments in each of the four quarters o the plot and averaging the four values to the nearest 5 percent.

Average height of the dominant mature blueberry (*Vaccinium ovalifolium* or *V. alaskaense* shrubs within each plot was estimated to the nearest 0.5 ft (15 cm). The average height o all other shrub species was estimated for stands sampled in 1983 (see Table 5). Shrub cove was divided into tall and low shrub strata. This was a taxonomic division, not an actual heigh breakdown: cover of those species that usually occur in a taller form was included in the ta shrub stratum, and cover of those species with a low habit was included in the low shrul stratum. Thus blueberry, devil's club, menziesia, salmonberry, highbush cranberry, and elderberry are "tall shrubs", while crowberry, bog laurel, bog blueberry, and mountain cranberry are "low shrubs".

A variable tree plot (Dillworth 1980) was located in the center of the plot for the stands sampled in 1982-83. A 40 basal area factor (BAF) wedge prism was used on most stands. A 20 BAF prism or angle gauge was used to increase to at least five the number of sample trees in less productive stands. The DBH by species for all sample trees was measured to the nearest inch (2.5 cm). Trees less than 5 inches (10 cm) DBH were not counted. The total height of a representative sample tree was measured using a measuring tape and clinometer. Height of the remaining sample trees was estimated to the nearest 5 feet (1.5 m) using the measured tree as a standard. These data are summarized in the plant association descriptions. More information is shown in Chapter 4 and Appendix 3.

Relative use of blueberry by deer was estimated into one of four categories at each plot: no use, light, moderate, or high. Use was considered light if less than 20 percent of the twigs were browsed; moderate if 20 to 60 percent of the twigs were browsed; high if more than 60 percent of the twigs were browsed. Trends in deer use of vegetation types are listed in plant association sections. Stands with high deer use were not included in the plant association analysis because on these sites the deer had heavily impacted the flora—in hindsight, these stands should not have been excluded (Martin 1989).

All plants were identified to species when possible. When species identification was not possible, plants were identified to genus. Voucher specimens were deposited in the USDA Forest Service herbarium in Sitka, Alaska. Due to the difficulty of differentiating between *Vaccinium alaskaense* and *V. ovalifolium* throughout the growing season, the two were only identified to genus. Taxonomic nomenclature follows Muller (1982) which is based on Hulten (1968), Welsh (1974), and Hitchcock and Cronquist (1978).

Percent slope was measured with a clinometer at each sample site. Aspect was measured to the nearest 5 degrees using a compass. Elevation was measured using a pocket altimeter. The landform for each site was determined using mapped landform types. These environmental data are summarized in Chapter 4 and for each association (see also Appendix 4).

A soil profile description (USDA SCS, Soil Survey Staff, 1975) was completed at most of the sample sites. The maximum depth of the soil profile was 100 cm (39 in.) for mineral soil and 120 cm (47 in.) for organic soils. (Note that soils data is given first in metric units rather than English; this is due to the current practice in the Alaska Region of using centimeters for soil depths and English units for vegetation measurements.) The profile was located in what appeared to be a typical site within the sample plot. Often more than one dominant soil type occurred within the sample plot. When this happened, the associated soil was noted but not fully described. The soil within each plot was classified to the family level. The following were also recorded: soil drainage class (well drained, moderately well drained, somewhat poorly drained, poorly drained, very poorly drained); depth of organic matter; depth and type of restricting layer; rooting depth; and parent material. These data are summarized in the plant association descriptions with more information given in Appendix 4.

Data cards used for field work supporting this classification are shown in Appendix 6.

Data Analysis

An initial list of potential plant associations was developed, based solely on field observations. This list was revised following the 1981 field season and again after the 1982 and 1983 field seasons.

Following the 1983 field season, all non-forest data cards (alpine, estuary, bog and fen) were separated from forest cards and removed from the analysis. Forest was defined as having at least 10 percent canopy cover of trees greater than 25 feet (8 m) tall.

Several kinds of stands were eliminated from the data set, including: stands missing data elements; stands from successional communities; and stands where understory vegetation had been severely impacted by deer. A total of 849 stands was used in the subsequent analysis. Data from these stands is stored electronically; the original data cards are also stored at the Chatham Area Supervisor's Office.

Several principal components analysis (PCA) models were used to examine patterns in the composition and relative abundance of plant species. Stepwise discriminant analysis was used as follows: to corroborate patterns identified with PCA, to refine initial groups, to examine relationships between environmental variables, and to develop predictive models. These multivariate statistics and the data analysis process are described in detail in Martin (1989).

Also calculated from data collected by the survey team were the following measures: constancy, which is defined as the frequency of occurrence of a given species with a given plant association--across all stands sampled; and summary statistics such as averages, ranges, and frequency distributions for associated soils, soil characteristics, landform and parent material. Abundance is reported as the average across plots where the species occurred.

Wildlife use of the various plant associations may be predicted from vegetation composition and canopy cover/snow interception capability data. Chapter 4 shows availability of common forage species and canopy cover. Little information is available for use of plant associations by birds, small mammals, or amphibians. Where available, information is provided on these uses.

Abundance for single species in each plant association was determined, as was abundance of vegetative strata. (See Appendix 2 for single species data.) For the strata, abundance was determined by adding individual species values. Therefore, overlap is not accounted for, and the stratum's canopy cover may exceed 100 percent, although all values over 100 percent are listed as 100 percent in this guide. Note that current field practice is to estimate cover of layers separately from that of individual species, and not to include overlap in the estimation. Using this method, cover for a given layer cannot exceed 100 percent.

Trafficability was determined for each plant association based on associated soil characteristics (Chapter 4). Trafficability is defined as the ability of soils to withstand repeated use by foot traffic without site deterioration--in other words, site suitability for recreational trails.

NOTES:

Labrador Tea
Ledum groenlandicum

6
KEYS TO PLANT SERIES AND ASSOCIATIONS

The first step in identification of a plant association is to identify the series, that is, the climax dominant overstory type. Then, understory and environmental indicators can be used to determine the association. There are actually two keys, one for the series, and one for the associations within each series. Both keys are dichotomous, with the two options at each point in the key given the same number. The keys must be followed consecutively, without skipping couplets.

The keys are identification aids and should be used in stands of at least 1 acre (0.4 ha). Ideally, stands should be homogenous, mature vegetation, without ecotones, disturbed areas, overbrowsed conditions, or inclusions. At least 10 percent cover of trees greater than 25 feet (8 m) should be present to consider the site forested. Since the classification was built from samples of late seral forests, the key is not valid in young stands (usually less than 125 years old). However, for cut areas and early seral communities, the user may be able to extrapolate information from adjacent areas.

Overstory and understory cover for indicator species should be determined for a representative 42 foot (13 m) radius plot. Then, the user may work through the key and check the association description to confirm identification. Some sites may be difficult to identify, especially if they are in an environmental transition zone. If the understory is particularly sparse, the relative amounts of indicator species may have to be adjusted downward. Once the user has become well versed with the classification, detailed comparison and use of the key may not be necessary.

Working through the key provides the user with the scientific and vernacular name for the association. The numeric code used for each association is also shown; note that these codes have been revised since the draft plant association guide (Martin 1985 [code changes are shown in Appendix 5]).

Series Key **Code**

1. Shore pine (*Pinus contorta contorta*) canopy cover is at least 10%.
SHORE PINE SERIES 600

1. Shore pine cover is less than 10%.

 2. Mountain hemlock (*Tsuga mertensiana*) cover is at least 5%.

 3. Mountain hemlock is the dominant overstory. Shore pine are always absent. Yellowcedar (*Chamaecyparis nootkatensis*) and western hemlock (*Tsuga heterophylla*) are absent or present in only minor amounts and found at high elevation sites, often near the upper treeline.

 4. Sitka spruce (*Picea sitchensis*) cover is at least 10%. **SITKA SPRUCE-MOUNTAIN HEMLOCK/BLUEBERRY ASSOCIATION** 390

 4. Sitka spruce cover is less than 10%.
 MOUNTAIN HEMLOCK SERIES 500

 3. Yellowcedar and western hemlock codominate with mountain hemlock. Shore pine may be present. Found at low elevation sites.
 MIXED CONIFER SERIES 400

 2. Mountain hemlock cover is less than 5%.

 5. Yellowcedar cover is at least 5%.
 WESTERN HEMLOCK-YELLOWCEDAR SERIES 200

 5. Yellowcedar cover is less than 5%.

 6. Sitka spruce cover is at least 15%.
 SITKA SPRUCE SERIES 300

 6. Sitka spruce cover is less than 15%.
 WESTERN HEMLOCK SERIES 100

Key to Western Hemlock Series

Western hemlock stands are productive forest, typically occurring on moderate to well drained mountainslopes at low to medium elevations. At higher elevations, western hemlock is replaced by mountain hemlock.

	Code
1. Skunk cabbage (*Lysichitum americanum*) cover is at least 3%.	
2. Devil's club (*Oplopanax horridum*) cover is at least 5%. **WESTERN HEMLOCK/DEVIL'S CLUB/SKUNK CABBAGE**	**170**
2. Devil's club cover is less than 5%. **WESTERN HEMLOCK/BLUEBERRY/SKUNK CABBAGE**	**130**
1. Skunk cabbage cover is less than 3%.	
3. Devil's club cover is at least 5%.	
4. Blueberry (*Vaccinium ovalifolium/V. alaskaense*) cover is at least 15%.	
5. Occurs on deep, well drained soils—typically on mid to lower slope positions. Site productivity is high. Trees average 110 to 120 feet tall. **WESTERN HEMLOCK/BLUEBERRY-DEVIL'S CLUB**	**140**
5. Occurs on shallow, well drained, or deep, somewhat poorly drained soils. It typically occurs on mid to upper slope positions on steep slopes, or on V-notch sideslopes. Site productivity is moderate. Trees average 80 to 90 feet tall. **WESTERN HEMLOCK/DEVIL'S CLUB-SHALLOW SOILS**	**165**
4. Blueberry cover is less than 15%. **WESTERN HEMLOCK/DEVIL'S CLUB**	**160**
3. Devil's club is absent or cover is less than 5%.	
6. Shield-fern (*Dryopteris austriaca*) cover is at least 3%. Soils are deep and well drained. Very productive sites usually on mid to lower slopes. Trees average 110 to 115 feet tall. **WESTERN HEMLOCK/BLUEBERRY/SHIELD FERN**	**120**
6. Shield-fern absent or cover is less than 3%. Soils are shallow or somewhat poorly drained. Moderately productive sites. Trees average 80 to 90 feet tall.	
7. Rusty menziesia (*Menziesia ferruginea*) cover is at least 25%. **WESTERN HEMLOCK/MENZIESIA**	**115**
7. Rusty menziesia cover is less than 25%. **WESTERN HEMLOCK/BLUEBERRY**	**110**

Key to the Western Hemlock-Yellowcedar Series

Western hemlock-yellowcedar sites are moderately productive, typically occurring on moderately well drained mountain and hillslopes, usually at somewhat higher elevations or with somewhat poorer drainage than western hemlock sites.

	Code
1. Skunk cabbage (*Lysichitum americanum*) cover is at least 3%. **WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY/SKUNK CABBAGE**	**220**
1. Skunk cabbage cover is less than 3%.	
2. Devil's club (*Oplopanax horridum*) cover is at least 5%. **WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY-DEVIL'S CLUB**	**250**
2. Devil's club cover is less than 5%.	
3. Rusty menziesia (*Menziesia ferruginea*) cover is at least 25%. **WESTERN HEMLOCK-YELLOWCEDAR/MENZIESIA**	**230**
3. Rusty menziesia cover is less than 25%. **WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY**	**210**

Key to the Mixed Conifer Series

Mixed conifer stands are scrubby, typically occurring in areas of restricted drainage such as lowlands, hills, and mountainslope benches.

	Code
1. Deer cabbage (*Fauria crista-galli*) cover is at least 5%, or the combined cover of peatlands (muskeg) associated plants (e.g., trifoliate goldthread [*Coptis trifolia*], crowberry [*Empetrum nigrum*], bog laurel (Kalmia polifolia], Labrador tea ([Ledum groenlandicum], and sedges [*Carex* spp.]) is at least 5%.	
2. Copperbush (*Cladothamnus pyrolaeflorus*) cover is at least 3%. **MIXED CONIFER/COPPERBUSH**	**491**
2. Copperbush cover is less than 3%. **MIXED CONIFER/BLUEBERRY/DEER CABBAGE**	**430**
1. Deer cabbage and other peatlands associated plants absent or their collective cover is less than 5%.	
3. Skunk cabbage (*Lysichitum americanum*) cover is at least 5%.	
4. Lady fern (*Athyrium filix-femina*)cover is at least 5%. **MIXED CONIFER/SKUNK CABBAGE-LADY FERN**	**440**
4. Lady fern is absent or cover is less than 5%. **MIXED CONIFER/BLUEBERRY/SKUNK CABBAGE**	**420**
3. Skunk cabbage cover is less than 5%. **MIXED CONIFER/BLUEBERRY**	**410**

Key to the Shore Pine Series

Shore pine stands are marginally forested, typically occurring as transitions between mixed conifer sites and non-forest peatlands (muskeg) on very poorly drained soils. Shore pine sites usually occur on low elevation flat or gently sloping lowlands.

	Code
1. Tall sedge (*Carex sitchensis*) cover is at least 10%. **SHORE PINE/SITKA SEDGE**	**630**
1. Tall sedge cover is less than 10%. **SHORE PINE/CROWBERRY**	**610**

Key to the Mountain Hemlock Series

Mountain hemlock stands occur at high elevation (usually above 1500 feet), and range from moderately productive forest to scrub forest to krummholz types.

	Code
1. The combined or single species canopy cover of cassiope (*Cassiope mertensiana, C. stelleriana*), heather (*Phyllodoce glanduliflora*) and luetkea (*Luetkea pectinata*) is at least 3%.	
2. Copperbush (*Cladothamnus pyrolaeflorus*) cover is at least 5%. **MOUNTAIN HEMLOCK/COPPERBUSH/CASSIOPE**	**525**
2. Copperbush absent or cover is less than 5%. **MOUNTAIN HEMLOCK/CASSIOPE**	**530**
1. Cassiope, heather, and luetkea absent, or their combined cover is less than 3%.	
3. Deer cabbage (*Fauria crista-galli*) cover is at least 2%. **MOUNTAIN HEMLOCK/BLUEBERRY/DEER CABBAGE**	**540**
3. Deer cabbage cover is less than 2%. **MOUNTAIN HEMLOCK/BLUEBERRY**	**510**

Key to the Sitka Spruce Series

Sitka spruce sites are highly productive, characterized by soil disturbance from water movement and mass wasting. They typically occur at low elevations, on floodplain or alluvial fan land forms, except for the spruce-mountain hemlock association that occurs at high elevations near avalanche zones.

<u>Code</u>

1. Mountain hemlock (*Tsuga mertensiana*) cover is at least 5%.
SITKA SPRUCE-MOUNTAIN HEMLOCK/BLUEBERRY 390

1. Mountain hemlock cover less than 5%.

2. Red alder (*Alnus rubra*) cover is at least 10%.
SITKA SPRUCE-RED ALDER/SALMONBERRY 352

2. Red alder cover is less than 10%.

3. Sitka alder (*Alnus sinuata*) cover is at least 5%.
SITKA SPRUCE/SITKA ALDER 353

3. Sitka alder cover is less than 5%.

4. Devil's club (*Oplopanax horridum*) cover is at least 5%.

5. Occurs on extremely steep slopes (>80%), especially near avalanche tracks.
SITKA SPRUCE/DEVIL'S CLUB-UPLAND 345

5. Occurs on alluvial deposits on gentle slopes near high surface or subsurface water.

6. Salmonberry (*Rubus spectabilis*) cover is at least 15%.
SITKA SPRUCE/DEVIL'S CLUB-SALMONBERRY 335

6. Salmonberry cover is less than 15%.

7. Skunk cabbage (*Lysichitum americanum*) cover is at least 3%.
SITKA SPRUCE/DEVIL'S CLUB/SKUNK CABBAGE 340

7. Skunk cabbage absent or cover is less than 3%.

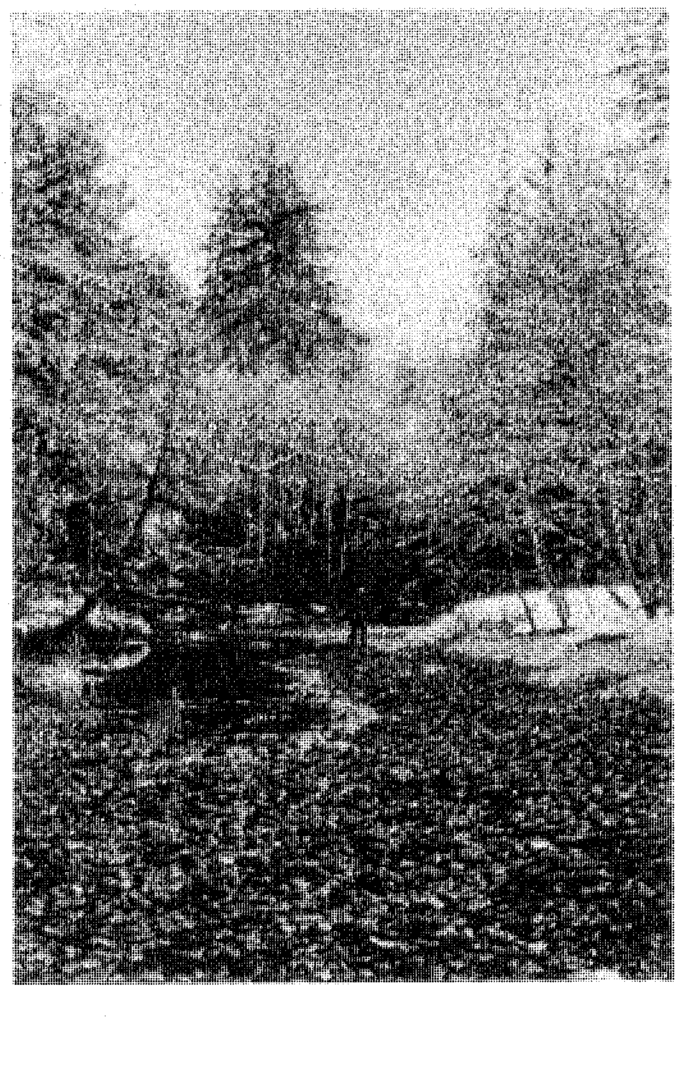
8. Blueberry (*Vaccinium ovalifolim/V. alaskaense*) cover is at least 15%.
SITKA SPRUCE/BLUEBERRY-DEVIL'S CLUB 320

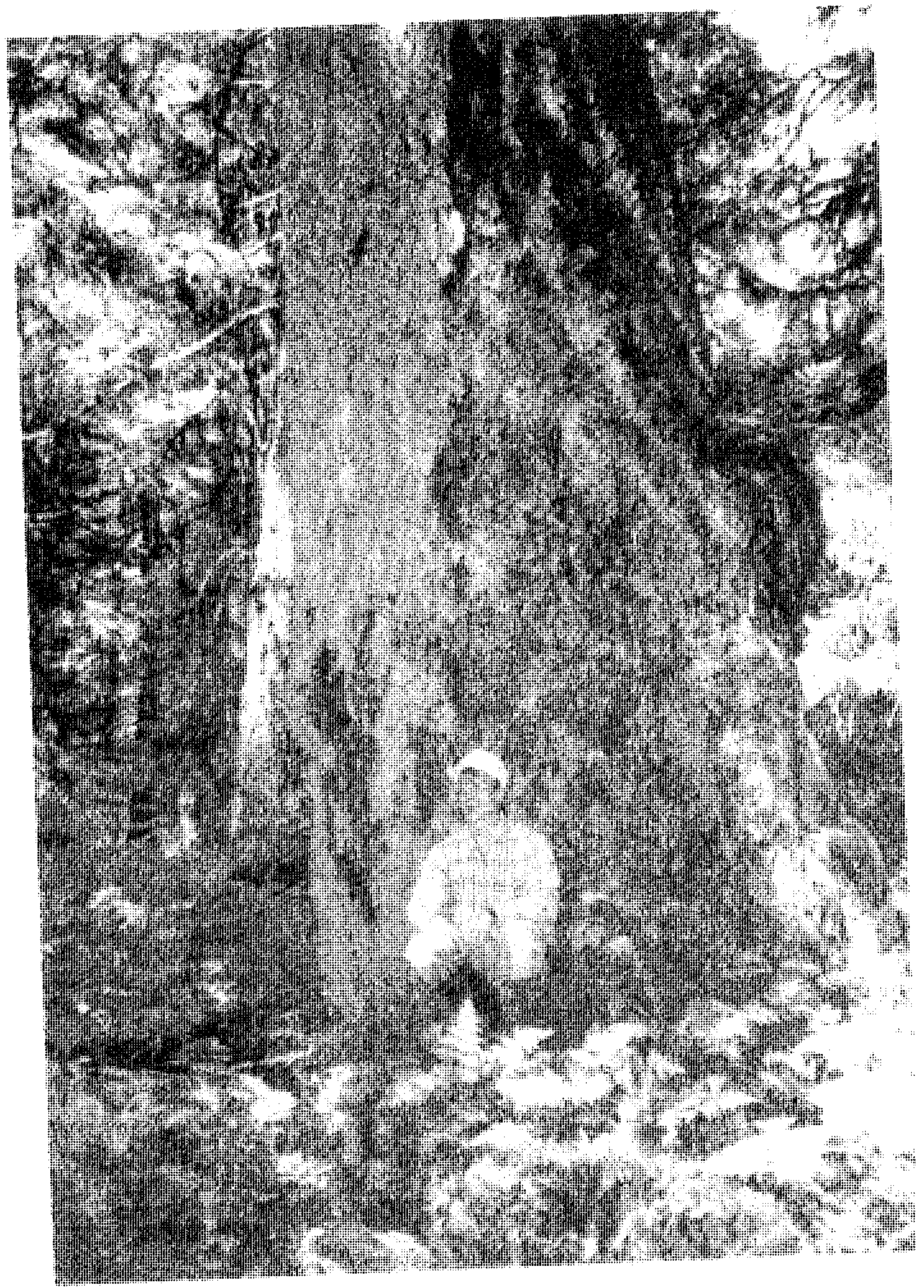
8. Blueberry cover is less than 15%.
SITKA SPRUCE/DEVIL'S CLUB 330

4. Devil's club absent or cover is less than 5%.

Key to Sitka Spruce Associations (Continued)

	Code
9. Skunk cabbage cover is at least 3%. **SITKA SPRUCE/BLUEBERRY/SKUNK CABBAGE**	**370**
9. Skunk cabbage absent or cover is less than 3%.	
10. Pacific reedgrass (*Calamagrostis nutkatensis*) cover is at least 10%. **SITKA SPRUCE/PACIFIC REEDGRASS**	**360**
10. Pacific Reedgrass cover is less than 10%. **SITKA SPRUCE/BLUEBERRY**	**310**





WESTERN HEMLOCK SERIES

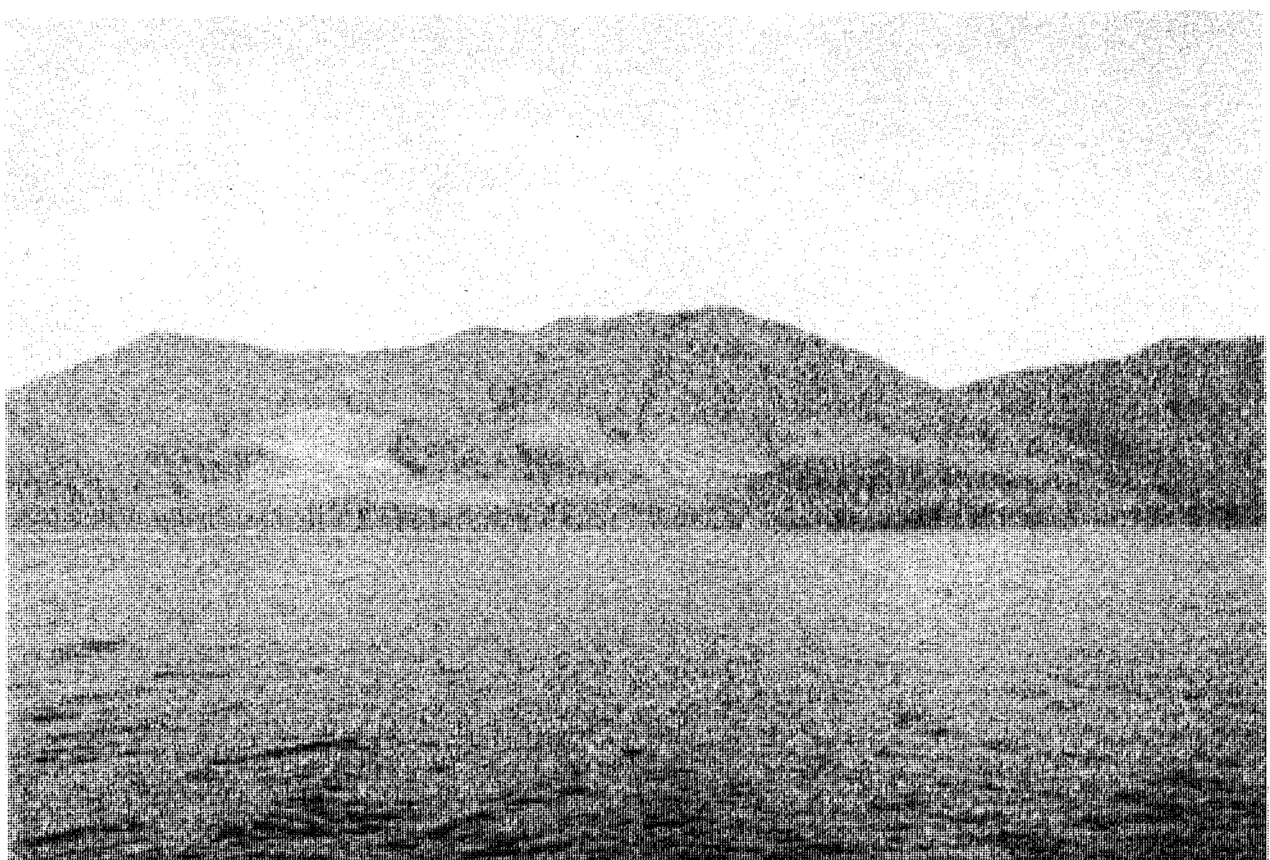


Photo credit: S. Buchanan

7
WESTERN HEMLOCK SERIES

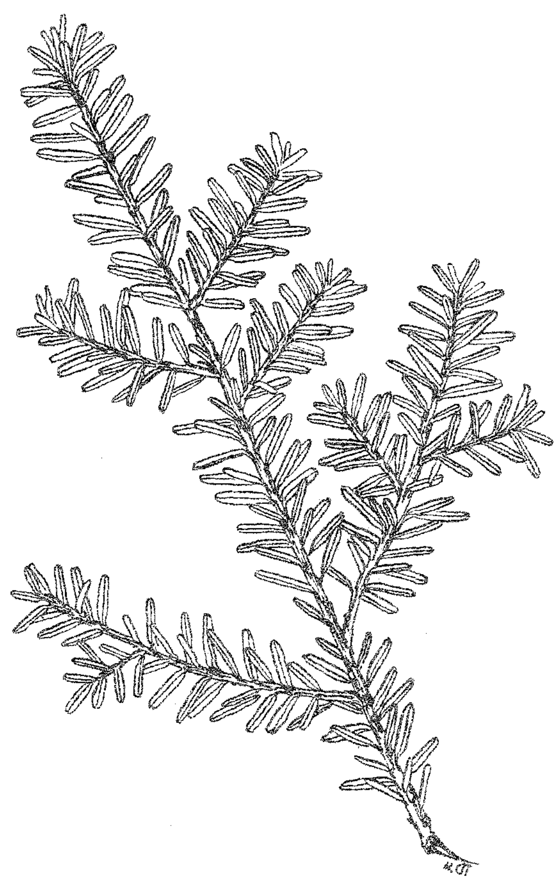
Description

Western hemlock is the most abundant tree species in Southeast Alaska and dominates well drained sites. Sitka spruce is a common associate and may approach 15 percent cover in late seral forests. Although yellowcedar grows best under the site conditions found in this series, the species is not common, mainly due to intense competition from shade-tolerant hemlocks.

Trees commonly exceed 100 feet (30 m) in height and 20 inches (51 cm) in diameter in late seral stands. Hemlocks to 180 feet (55 m) were recorded. In late seral stands, canopy closure of large-branched, deep-crowned hemlocks typically exceeds 60 percent. Understory vegetation is dominated by western hemlock, blueberry, devil's club, and a variety of ferns and forbs.

There are eight associations in the western hemlock series that occur on sites that range from moderately to highly productive. The soils are generally more well drained than in other series and generally not disturbed by surface flooding. Subsurface flooding is common in the devil's club associations. The most productive sites occur on well-drained, colluvial, mountain and footslope landforms. The least productive sites occur on the lower slope gradients where water and organic matter accumulate. Skunk cabbage is a good indicator of these conditions.

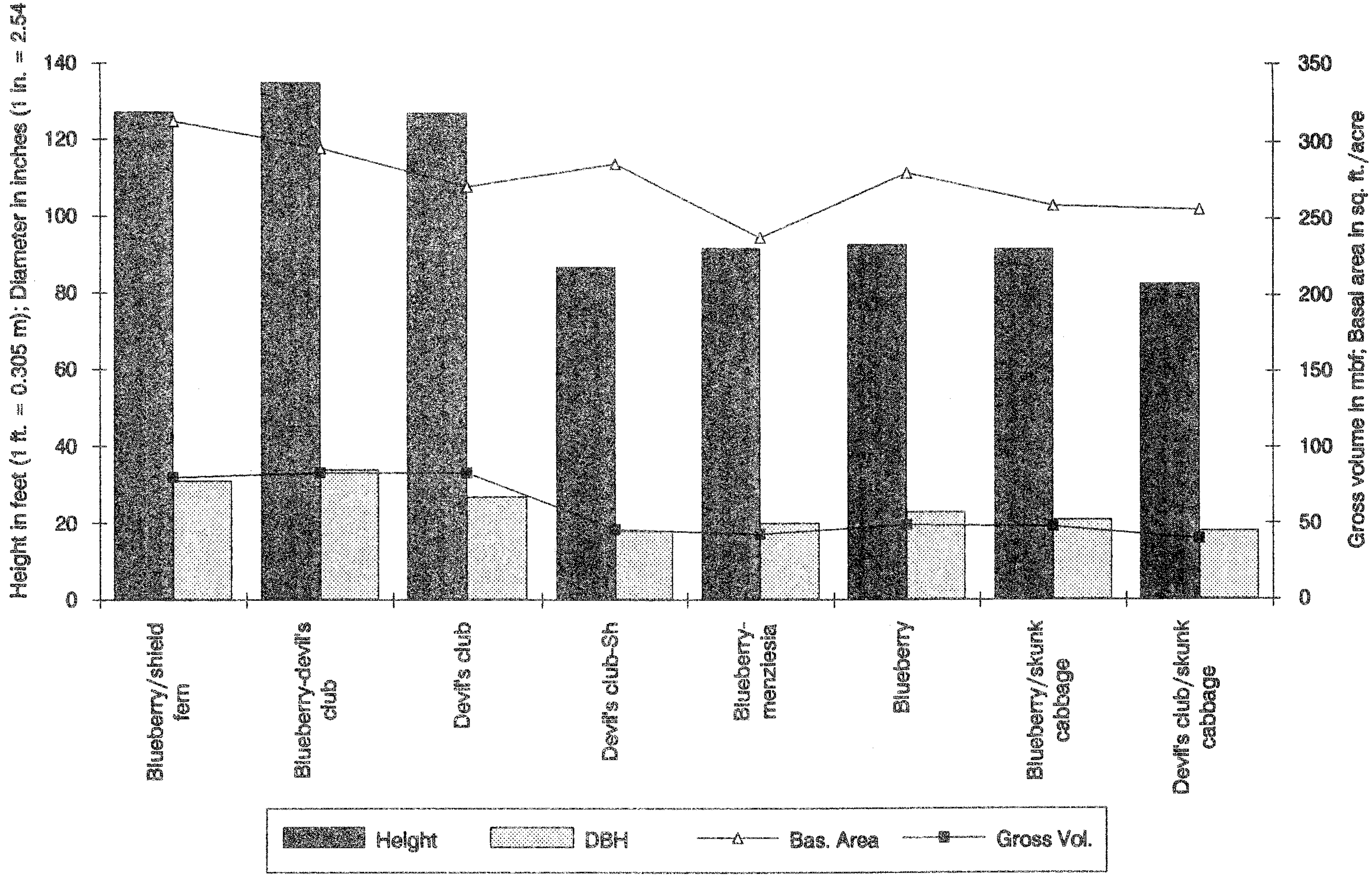
The association descriptions in this chapter are presented in order of increasingly poor drainage, since moisture is the dominant site factor influencing association distribution. Figure 9 compares productivity among the western hemlock associations. In general, increasingly poor drainage corresponds to decreasing tree productivity.



Western Hemlock
Tsuga heterophylla

Gap phase regeneration associated with single tree or small group blowdown typically prevails. Stand-altering exogenous disturbance is less common, but more common in this series than any other. Coarse woody debris is abundant, and serves as an important microsite for conifer regeneration. Mistletoe is common in

Figure 9. Average Tree Structure for Western Hemlock Series



mature to late seral western hemlock associations, particularly at lower elevations (Laurent 1974).

The most productive hemlock associations provide excellent deer winter habitat (Kirchoff et al. 1983; Kirchoff and Schoen 1987; Hanley et al. 1989; Mankowski and Peek 1989). Overall, these western hemlock stands are scattered and represent a small portion of the landscape. Historically, controversy over timber harvest and deer has focused on these western hemlock associations, especially when they occur in prime deer areas, such as near saltwater. Bald eagles frequently use large hemlock and spruce trees for nesting.

Since maintenance of interior forest conditions in these productive stands is related to stand size (Diaz and Apostol 1992), patch size should be considered in management for ecosystem sustainability and for species requiring interior late seral habitat.

Distribution

This series is widely distributed throughout Southeast Alaska. It occurs from the mountain hemlock zone to sea level on sloping, well-drained sites. On the Chatham Area, it is most abundant in the lower precipitation zones on northern Baranof, eastern Chichagof, and Admiralty Islands and the mainland. Figure 10 shows the general landscape position for western hemlock associations.

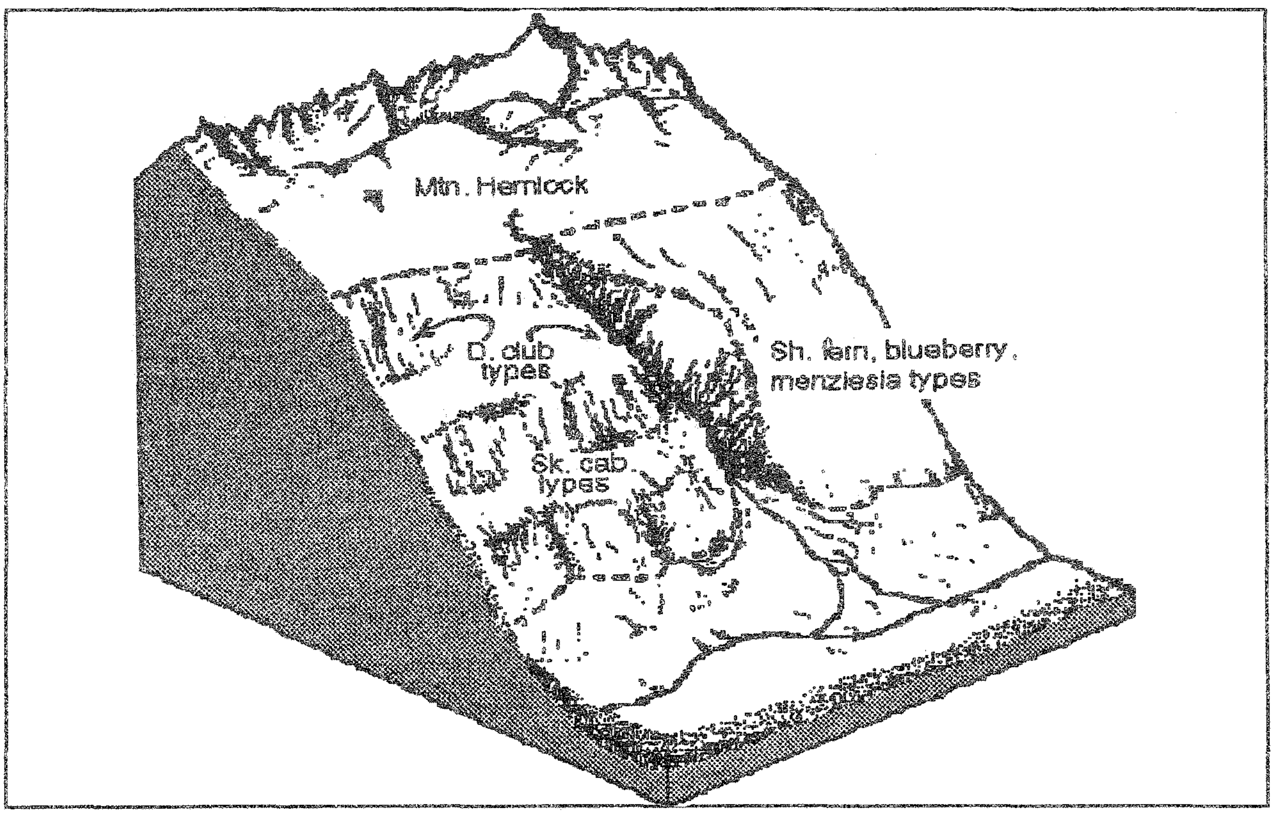


Figure 10. Generalized Landscape Positions for Western Hemlock Associations

Tsuga heterophylla/Vaccinium spp./*Dryopteris austriaca*

VEGETATION

Western hemlock/blueberry/shield fern plant association is one of the most productive, closed canopy forest types in northern Southeast Alaska. Sitka spruce may be a minor part of the overstory in late seral forests. Other tree species are infrequent.

Blueberry and western hemlock dominate the understory. Common well-drained forest herbs, like bunchberry and five-leaf bramble, are most abundant in canopy gaps. Oak and shield fern are usually abundant. Shield fern, a primary indicator of this association, typically exceeds 3 percent cover, but is not always present, presumably due to foraging by deer (Hanley, pers. comm. 1992) and to variations in light and stand age.

Cover of Common Plants (%)
N = 158 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	64	25-90	100
W. Hemlock Regen.	17	1-50	100
Blueberry	53	5-75	100
Menziesia	13	0-25	79
Five-leaf Bramble	10	0-40	99
Bunchberry	9	0-40	97
Oak Fern	7	0-40	84
Shield Fern	6	0-25	88

Similar Associations

This association may be confused with the poorer-drained, less productive wester hemlock/blueberry association. However, trees in the hemlock/blueberry/shield fern type gro\ much larger and shield fern is usually more abundant. The hemlock/blueberry-devil's club typ is also very similar.

Late Seral Stand Structure

Western hemlock trees usually exceed 120 feet (37 m). Hemlocks over 150 feet (46 m) ar common on the best sites. Canopy closure is the highest of all the western hemloc associations (72 percent average). Hemlock seedlings, saplings, suppressed, and intermediat sized trees are abundant, forming a multi-layered canopy.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	127 [39]	17 [5.2]
DBH (in. [cm])	31 [79]	7.4 [19]
Basal Area (sq.ft./ac.)	312	76
Gross Volume (BF/ac.)	79,900	23,600
Cover (%)	72	10
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.0 [0.9]	1.1 [0.3]
Menziesia	4.8 [1.5]	1.5 [0.5]
Cover (%)		
Tall Shrubs	57	32
Forbs	39	25
Ferns	19	16

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	621 [189]	20-1720 [6-524]
Landform		**Frequency (%)**
Mountain-Hillslopes		82
Footslopes/Fans		16
Lowlands		3
Slope Class (%)		**Frequency(%)**
0-15		9
16-35		9
36-55		11
56-75		50
76+		20
	Mean	**Std. Dev.**
Slope Mean (%)	47	24
Soil Parent Material		**Frequency (%)**
Till		10
Residuum		8
Colluvium		50
Alluvium		7
Volcanic		5
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		96
≤ 50 [20]		4
	Mean	**Std. Dev.**
Imp. Layer Depth	74 [29]	31 [12]
Organic Layer Depth	15 [6]	9 [3.5]
Soil Drainage		**Frequency(%)**
Somewhat Poorly		9
Moderately Well		34
Well		54

Common Soil Series: Kupreanof, Vixen, Kwatahein, Remedios, and Sitka.

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/blueberry/shield fern plant association is less common than the hemlock/blueberry association. It occurs from near sea level to mid elevations, usually well below the mountain hemlock zone. The best examples occur on deep, well-drained, colluvial deposits on lower mountain and footslope landforms. The association is also common on steep, well-drained, slopes with deep soils.

Soils are mostly mineral, moderately to well drained, and deep. Over 90 percent of the 115 soil pits sampled were classified as Spodosols. Soils on the steeper slopes drain well laterally. The more common colluvial soils are well drained throughout the soil profile.

MANAGEMENT IMPLICATIONS

The western hemlock/blueberry/shield fern type is one of the most productive plant associations, as reflected by tree height and volume in late seral stands. Western hemlock fluting may occur, especially in fast-growing, coastal stands originating from catastrophic disturbance (Julin and Farr 1989). Windthrow potential is high due to tree heights and shallow rooting systems.

Soils are well-developed and usually stable. However, slope failures are common on slopes greater than 35 percent, especially with volcanic ash sublayers.

Regeneration of western hemlock is abundant and planting is not needed for adequate regeneration following exogenous or endogenous disturbances that do not expose the mineral soil. Brush competition is low and well-drained microsites are abundant.

Blueberry cover remains high following clearcutting (DeMeo 1991) until canopy closure (i.e., stem exclusion stage). Closure and understory exclusion following timber harvest typically occurs within 30 years (Alaback 1982). (See Chapter 2 for more information.)

Windthrow is common, primarily causing single or small group tree-falls. However, recent stand level disturbance examples occur throughout the landscape. Often, these areas are dominated by Sitka spruce. Due to the longevity of spruce, these stands will remain spruce-dominated for hundreds of years.

This association is potentially the most important of the western hemlock series for deer winter habitat due to the abundance of high quality forage and good snow interception capabilities. Browsing by deer on blueberry forage had occurred in most of the sampled stands. Since stands with high deer use were excluded from the data set, the descriptions do not reflect plant composition under these conditions.

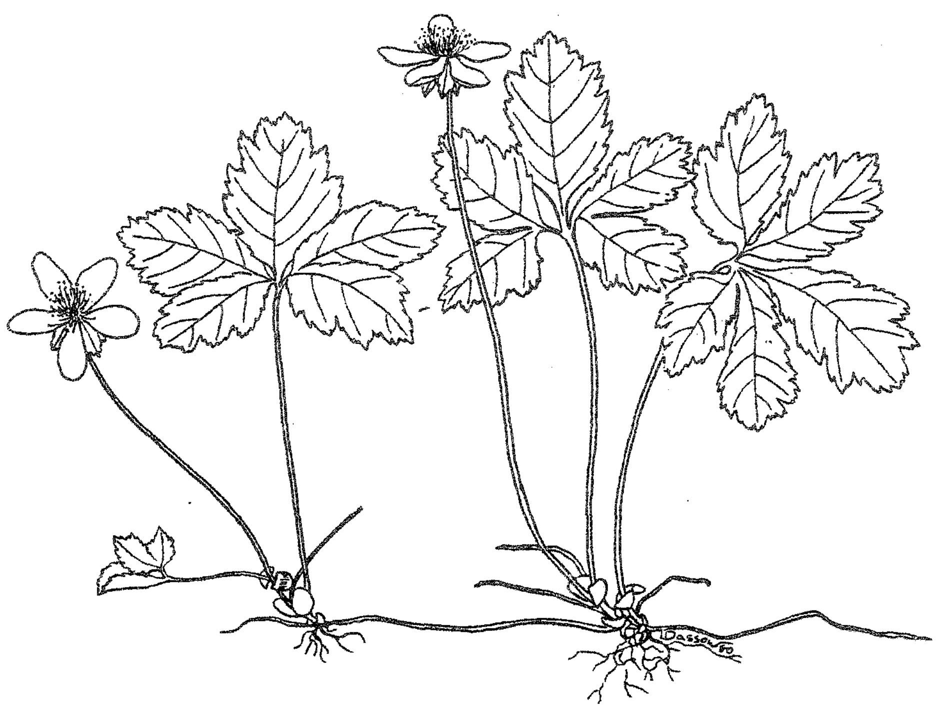
Deer play an important role in understory dynamics in this association, particularly on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Deer use of the buds of shield fern may be high during the winter, causing mortality of these plants (Hanley, pers. comm. 1992). Hence shield fern cover is reduced, making identification of these sites difficult because the primary understory indicator may be uncommon.

Under the severest browse conditions, western hemlock seedlings, blueberry, bunchberry, five-leaf bramble, and fern-leaf goldthread are virtually eliminated. Under long-term, high-deer densities, overstory composition may also be affected, resulting in a shift to a greater spruce component because of preferential browsing on hemlock. Where deer densities cycle regularly, understory recovery occurs. Where deer densities remain high (e.g., due to milder climatic conditions such as on west Chichagof Island), altered understory and overstory vegetation conditions appear to have significantly altered long-term landscape vegetation patterns.

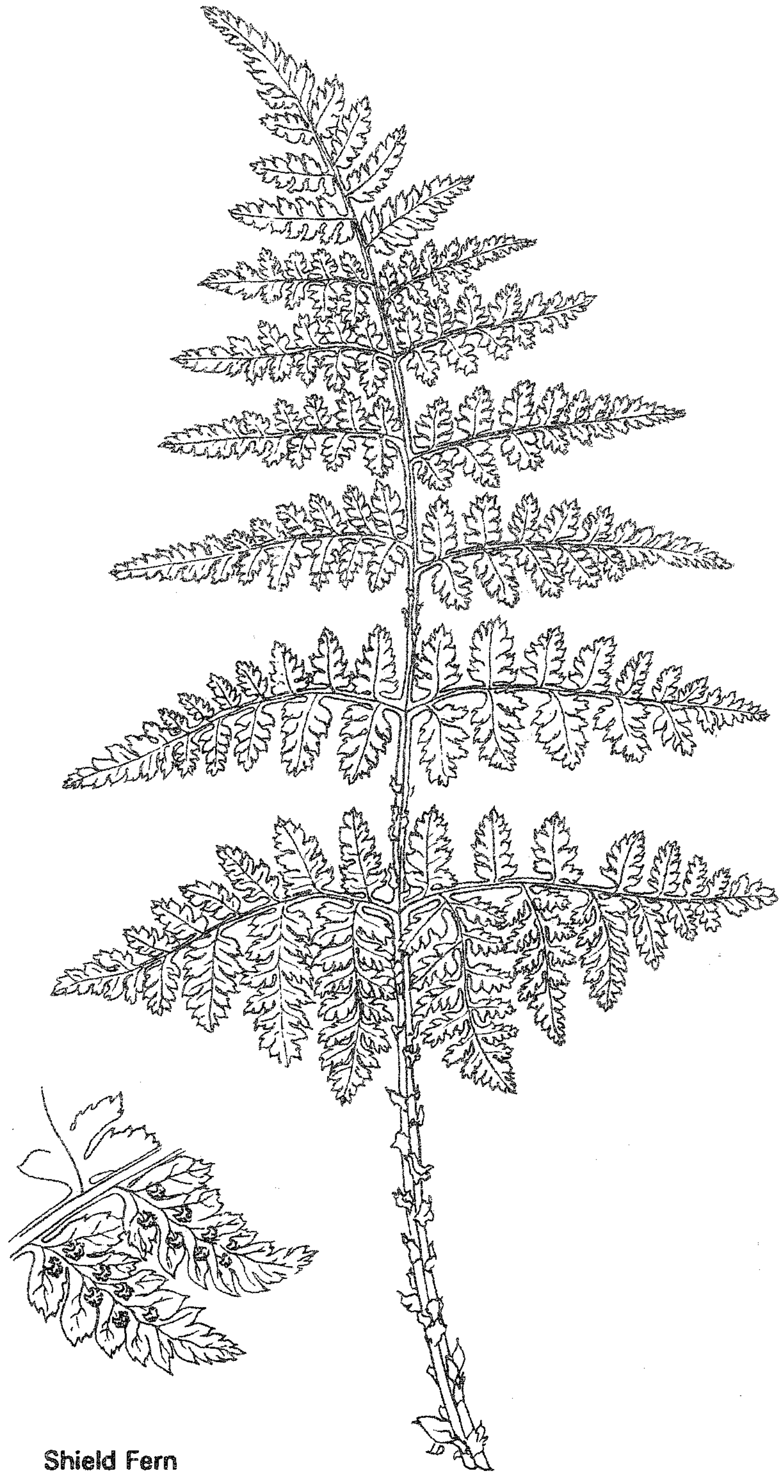
Brown bear sign (diggings, droppings, tracks) is infrequent. This association may provide high quality bald eagle habitat (Sidle et al. 1986). Hemlock and spruce snags may be common and are valuable for cavity nesters. Songbirds may use the fine roots of shield fern to line their nests (Hall and Alaback, 1990 draft).

Soils are well suited for road and trail construction.

Subsistence and recreational uses include collection of shield fern and hemlock bark and pitch (for medicinal and food uses) and berry picking. Since the association provides important deer habitat, hunters may use these areas. Due to the large trees, this association may provide popular hiking spots.



Five-leaf Bramble
Rubus pedatus



Shield Fern
Dryopteris austriaca

Tsuga heterophylla/Vaccinium spp.-Oplopanax horridum

VEGETATION

The western hemlock/blueberry-devil's club plant association is one of the most productive, closed canopy forest types in northern Southeast Alaska. Sitka spruce is commonly a minor part of the overstory in late seral forests. Other tree species rarely occur.

The shrub layer is dominated by blueberry and devil's club. Salmonberry occurs in about half the stands, but is rarely abundant in older stands. In addition to species characteristic of well-drained forests—such as bunchberry and five-leaf bramble—twisted stalk, foamflower and lady fern are common. Fern cover is considerably higher than in any of the other hemlock and blueberry associations.

Cover of Common Plants (%)
N = 48 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	61	25-85	100
W. Hemlock Regen.	10	1-40	100
Blueberry	25	5-75	100
Devil's Club	31	5-75	100
Five-leaf Bramble	7	0-25	98
Foamflower	6	0-40	92
Oak Fern	15	0-40	92
Shield Fern	8	0-40	85

Similar Associations

This type is most similar to hemlock/blueberry/shield fern and hemlock/devil's club. Tree sizes are similar in all of these plant associations. However, understory vegetation and soil characteristics vary considerably from the relatively dry blueberry understory to the flooded devil's club understory.

Late Seral Stand Structure

Western hemlock trees usually exceed 120 feet (37 m). Hemlocks over 150 feet (46 m) are common on the best sites. Canopy closure is the second highest of all the western hemlock associations (70 percent average). Hemlock seedlings, saplings, suppressed, and intermediate size trees are abundant, forming a multi-layered canopy. Devil's club often occurs in a layer above blueberry in canopy openings.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	135 [41]	19 [5.8]
DBH (in. [cm])	34 [86]	8.1 [21]
Basal Area (sq.ft./ac.)	295	79
Gross Volume (BF/ac.)	82,700	25,700
Cover (%)	69	15
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Devil's Club	4.8 [1.5]	0.8 [0.2]
Blueberry	3.0 [0.9]	1.0 [0.3]
Cover (%)		
Tall Shrubs	59	28
Forbs	38	17
Ferns	34	25

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	529 [161]	30-1420 [9-433]
Landform		**Frequency (%)**
Mountainslopes		67
Footslopes/Fans		33
Slope Class (%)		**Frequency (%)**
0-15		9
16-35		24
36-55		2
56-75		46
76+		20
	Mean	**Std. Dev.**
Slope Mean (%)	46	24
Soil Parent Material		**Frequency (%)**
Till		6
Alluvium		12
Colluvium		61
Residuum		6
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		97
≤ 50 [20]		3
	Mean	**Std. Dev.**
Imp. Layer Depth	76 [30]	28 [11]
Organic Layer Depth	12 [4.7]	7 [2.8]
Soil Drainage		**Frequency (%)**
Poorly Drained		2
Somewhat Poorly		7
Moderately Well		28
Well		63
Common Soil Series: Kupreanof, Remedios, Tokeen, and Foad.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/blueberry-devil's club plant association is common throughout the Chatham Area, especially on northern Baranof and eastern Chichagof Islands and the mainland. It occurs from near sea level to mid elevations, usually well below the mountain hemlock zone. The best examples occur on deep, well-drained colluvial deposits on lower mountain and footslope landforms. The association is also common on steep, well-drained slopes with deep soils.

Soils are mostly mineral, moderately to well drained, and deep. Over 90 percent of the 119 soil pits sampled were classified as Spodosols. Soils on the steeper slopes drain well laterally. The more common colluvial soils are well drained throughout the profile.

Flowing subsurface water is abundant in the rooting zone of this plant association, as indicated by the presence of devil's club. This water and associated vegetation may be distributed in narrow drainages or may occur across the slope. When the flowing water occurs in narrow drainages, often the hemlock/blueberry/shield fern plant association occurs on the interfluves.

MANAGEMENT IMPLICATIONS

The hemlock/blueberry-devil's club type is one of the most productive associations, as reflected by tree heights and volumes in late seral stands. Western hemlock fluting may occur, especially in fast growing, coastal stands originating from catastrophic disturbance (Julin and Farr 1989).

Regeneration of western hemlock is fairly abundant but often patchy. Spruce regeneration is also common. Moderate brush competition occurs from salmonberry: if it is present in the stand prior to disturbance, it will greatly increase in abundance following windthrow or harvest. Well-drained microsites are abundant. Planting is not needed for adequate regeneration if the soils are not disturbed following timber harvest.

Blueberry cover remains high, devil's club cover declines, and salmonberry and fern cover increases for at least the first 25 years after clearcutting (DeMeo 1991). The devil's club decline is apparently related to the change in light availability and decreased humidity (Alaback 1992, as cited in DeMeo et al. 1992). Canopy closure and understory exclusion following timber harvest may be somewhat slower on devil's club sites.

Windthrow is common, albeit more frequent at the individual tree level than at the stand level. Stand level examples are scattered throughout the landscape, and are often Sitka spruce-dominated. Due to the longevity of spruce, these stands will remain spruce-dominated for hundreds of years.

Two nearby stands on Mitkof Island, one a hemlock/blueberry/shield fern association and the other a hemlock/blueberry-devil's club, exhibited completely different understory responses 150 years following windthrow. The shield fern site understory is dominated by moss, while the understory of the devil's club site is lush and has returned to a late seral understory condition. Apparently windthrow continued to open the canopy of the devil's club site, and the stocking may have been less dense, allowing more light to the understory. Devil's club sites are more susceptible to windthrow than are other western hemlock associations, due to water moving near the soil surface.

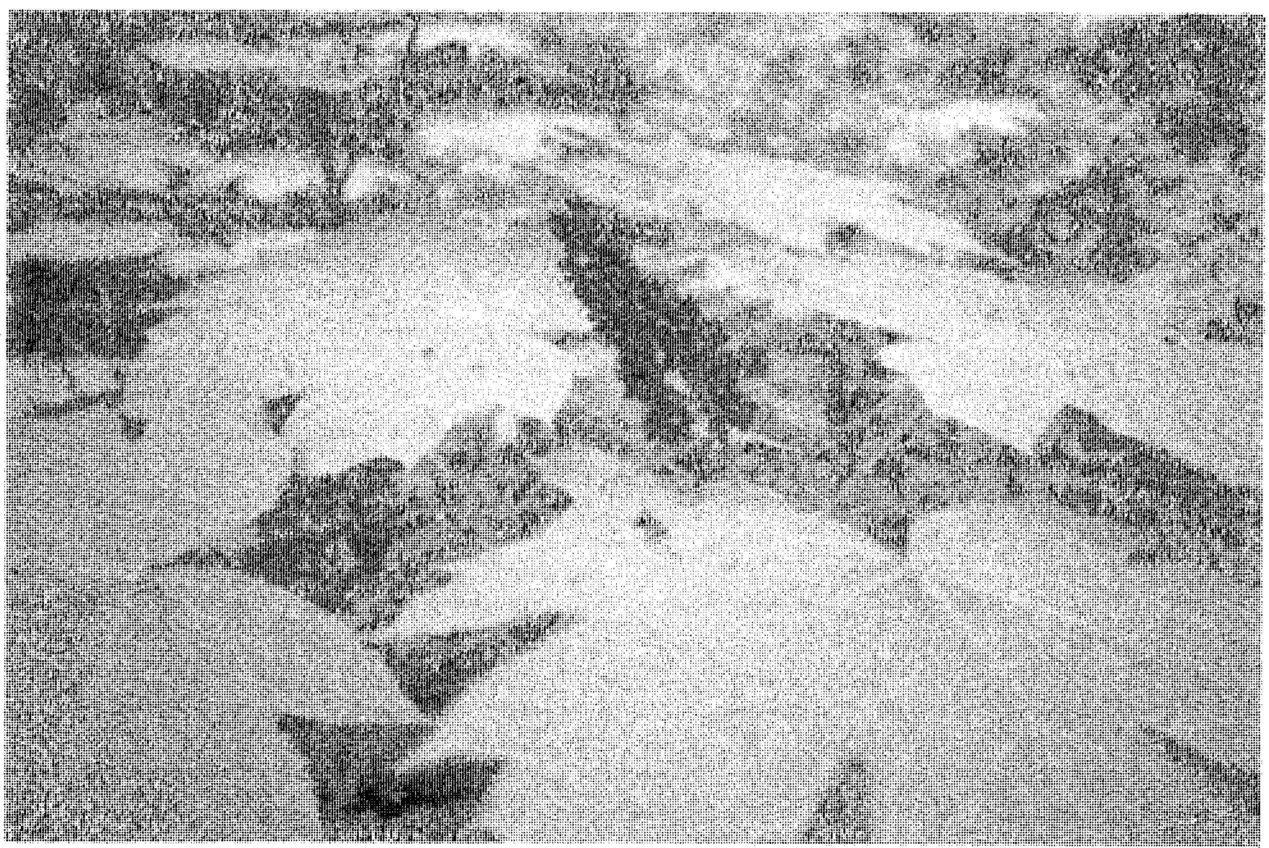
Subsurface flooding from upslope run-off, indicated by devil's club, increases the potential risk of soil disturbances. These disturbances may lead to exposure of mineral soil and invasion of alder. This is likely to occur only in small localized patches. Cross slope roads will intercept more water in these areas of subsurface flooding and road and trail construction techniques may need to be altered. Added soil moisture also increases the risk of mass failure. Abundant devil's club (>25 percent cover) on slopes is a "red flag" for possible problems in locating roads and landings.

The association is potentially important deer winter habitat due to the abundance of high quality forage and good snow interception capabilities. In the spring, deer forage on devil's club buds, reducing overall devil's club cover.

Brown bear signs were detected in only a few stands. In late summer, brown bears may seek out the ripe devil's club fruit (Schoen and Beier 1990).

When located near the coast, the association is frequently used by bald eagles for high quality nesting and roosting sites.

Southeast Alaska natives use this association for collection of devil's club wood for charcoal face paint and for carving fishing lures. Extensive medicinal use is made of inner bark for headache remedies, laxatives, and other uses. Devil's club is the most important plant in traditional Tlingit medicine. In Sitka, there is a case of a cancer cure stemming from use of devil's club medicine.



NOTES:

VEGETATION

This is a productive, closed canopy, western hemlock dominated plant association. Sitka spruce was a minor part of the overstory in about half the sampled stands. Other tree species rarely occur.

The shrub layer is dominated by devil's club. Salmonberry occurs in most stands, but usually does not exceed 5 percent cover. Foamflower and ferns (e.g., oak, shield, and lady) dominate the herbaceous layer. Fern cover in this plant association is the greatest of all the hemlock associations.

Cover of Common Plants (%)
N = 12 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	59	40-85	100
W. Hemlock Regen.	11	1-25	100
Devil's Club	62	25-85	100
Foamflower	10	0-40	83
Oak Fern	27	3-60	100
Shield Fern	13	0-40	83
Lady Fern	7	0-40	67

Similar Associations

This type is most similar to the hemlock/blueberry-devil's club and the Sitka spruce/devil's club associations. Tree sizes are similar in all of these plant associations. However, large Sitka spruce dominate the spruce/devil's club type. Devil's club clearly dominates the understory of the hemlock/devil's club plant association, averaging twice as much as in the blueberry-devil's club association. Blueberry is not abundant, and usually occurs on large mounds of organic debris.

Late Seral Stand Structure

Western hemlock trees usually exceed 110 feet (34 m). While the canopy is closed, large openings often occur. Hemlock seedlings, saplings, suppressed, and intermediate size trees are common, forming a multi-layered canopy.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	127 [39]	23 [7]
DBH (in. [cm])	27 [68]	11 [28]
Basal Area (sq.ft./ac.)	270	113
Gross Volume (BF/ac.)	82800	40600
Cover (%)	65	11
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Devil's Club	5.5 [1.7]	0.7 [0.2]
Cover (%)		
Tall Shrubs	72	32
Forbs	35	11
Ferns	38	29

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	417 [127]	50-1110 [15-338]
Landform		**Frequency (%)**
Mountainslopes		58
Hillslopes		17
Footslopes/Fans		25
Slope Class (%)		**Frequency (%)**
0-15		8
16-35		17
36-55		8
56-75		58
76+		8
	Mean	**Std. Dev.**
Slope Mean (%)	43	25
Soil Parent Material		**Frequency (%)**
Till		28
Colluvium		44
Limestone		14
Sand Dunes		14
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [in.]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	73 [29]	34 [13]
Organic Layer Depth	12 [4.7]	10 [3.9]
Soil Drainage		**Frequency (%)**
Somewhat Poorly		17
Moderately Well		17
Well		67
Common Soil Series: Shakan, Foad, Ulloa, and McGilvery.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/devil's club plant association is less common than the similar hemlock/blueberry-devil's club association. The best examples occur on deep, well-drained, colluvial deposits on footslope landforms which receive an abundance of upslope water. Examples occur from near sea level to usually less than 1000 feet (305 m) elevation.

Flowing subsurface water is abundant in the rooting zone, as indicated by the presence of devil's club. Surface flooding occurs to a lesser extent than in the Sitka spruce/devil's club plant association. The hemlock/devil's club plant association may be distributed in narrow drainages or it may occur across slopes. When it occurs in narrow drainages, often the hemlock/blueberry/shield fern or hemlock/blueberry-devil's club plant associations occur on the interfluves.

Soils are moderately disturbed by subsurface flooding and erosional processes, moderately to well drained, and deep. The amount of organic matter and the depth to an impermeable layer are highly variable, indicating a moderate amount of movement on the slope. Soil disturbance appears to cause increased nutrient availability for plant growth.

MANAGEMENT IMPLICATIONS

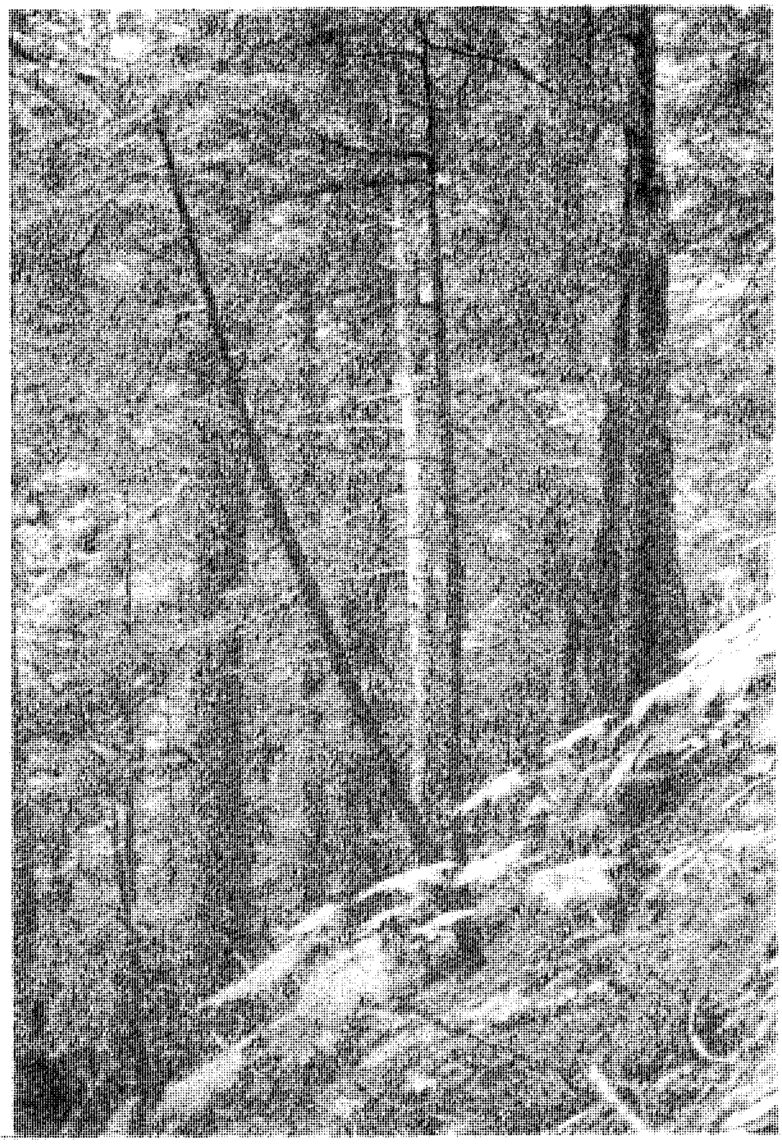
The hemlock/devil's club type is productive, but soils are easily disturbed--providing ideal conditions for alder invasion. Windthrow potential is very high in this association.

Regeneration of western hemlock is variable. Brush competition is moderately high from salmonberry shortly after timber harvest. If tree seedling establishment occurs quickly, hemlock and spruce may outgrow the salmonberry. Tree seedling mortality may be high, however, due to the abundance of ferns. (Dead fronds can block seedlings from light.) Following clearcut harvest, planting may be needed for adequate regeneration. Spruce is recommended for planting; cedar should not be planted on these sites.

Devil's club cover declines, and salmonberry and fern cover increases for at least the first 25 years after clearcutting (DeMeo 1991). Canopy closure and understory dynamics are poorly understood in this plant association. Salmonberry is known to retard tree regeneration, resulting in salmonberry thickets that remain well into the typical stand closure phase of development.

Subsurface flooding from upslope run-off, indicated by devil's club, increases the risk of slope stability and hydrology problems. Cross slope roads or trails will intercept more water on these sites than on blueberry understory sites. Abundant devil's club is a "red flag" for possible problems in locating roads and landings.

Winter deer use of this plant association is limited due to the lack of high quality forage. Brown bear signs were detected in only a few stands. This type provides high quality nest trees for bald eagles. Subsistence uses of these sites are similar to the hemlock/blueberry-devil's club type.



VEGETATION

This hemlock/blueberry-devil's club shallow soils ecotype has similar species composition and canopy cover to the hemlock/blueberry-devil's club type, but has smaller trees and typically occurs on more shallow soils. (The soils, however, do not meet the depth criterion required to be classified as shallow under soil taxonomy.) The canopy is closed, mainly hemlock, although Sitka spruce may be a minor part of the overstory.

The shrub layer is dominated by devil's club and blueberry. Salmonberry occurs in most stands, but usually does not exceed 5 percent cover. Forbs and ferns are abundant.

Cover of Common Plants (%)
N = 32 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	51	40-85	100
W. Hemlock Regen.	14	1-25	100
Devil's Club	32	25-85	100
Blueberry	25	25-85	100
Five-leaf Bramble	12	0-40	100
Oak Fern	13	3-60	94

Similar Associations

This type is most similar to the hemlock/blueberry-devil's club plant association. However, trees are much smaller and general productivity is lower. The type is also similar to the hemlock/devil's club type, but has less devil's club.

Late Seral Stand Structure

Western hemlock trees are usually less than 90 feet (27 m). While the canopy is closed, large openings often occur. Hemlock seedlings, saplings, suppressed, and intermediate size trees are common.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	87 [27]	10 [3]
DBH (in. [cm])	18 [46]	8.8 [22]
Basal Area (sq.ft./ac.)	285	84
Gross Volume (BF/ac.)	45,700	16,400
Cover (%)	63	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.8 [0.9]	1.0 [0.3]
Devil's Club	3.8 [1.1]	1.2 [0.4]
Cover (%)		
Tall Shrubs	70	23
Forbs	33	16
Ferns	32	21

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	649 [198]	40-1610 [12-491]
Landform		**Frequency (%)**
Mountainslopes		74
Hillslopes		19
Alluvial		6
Slope Class (%)		**Frequency (%)**
0-15		3
16-35		3
36-55		13
56-75		52
76+		29
	Mean	**Std. Dev.**
Slope Mean (%)	54	24
Soil Parent Material		**Frequency (%)**
Residuum		23
Colluvium		46
Soil Depth (cm [in.])		
Mineral Soil		Frequency(%)
> 50 [20]		94
≤ 50 [20]		6
	Mean	**Std. Dev.**
Imp. Layer Depth	59 [23]	30 [12]
Organic Layer Depth	18 [7.1]	15 [5.9]
Soil Drainage		**Frequency (%)**
Poorly		10
Somewhat Poorly		27
Moderately Well		30
Well		30
Common Soil Series: Foad, Mosman, and South Bight.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/blueberry-devil's club-shallow soils ecotype is less common than the similar hemlock/blueberry-devil's club association. The best examples occur on severe slopes with shallow soils. The association usually occurs from near sea level to less than 1000 feet (305 m) elevation.

Flowing subsurface water is abundant in the rooting zone and soil erosion is common, as indicated by the presence of devil's club. Surface flooding occurs to a lesser extent than in the Sitka spruce/devil's club plant association. The association may be distributed in narrow drainages or may occur across the slope. When it occurs in narrow drainages, often the hemlock/blueberry/shield fern or hemlock/blueberry-devil's club associations occur on the interfluves.

Soils are moderately disturbed by subsurface flooding and moderately to well drained. The amount of organic matter and the depth to an impermeable layer are highly variable, indicating a moderate amount of movement on the slope.

MANAGEMENT IMPLICATIONS

The hemlock/blueberry-devil's club-shallow soils type is moderately productive, but subject to soil disturbance, exposure of mineral soil, and subsequent invasion by alder. Windthrow potential is very high.

Regeneration of western hemlock is variable, and response is especially patchy on limestone (Ulloa soils). Spruce regeneration is also common. Brush competition is moderately high from salmonberry shortly after timber harvest. If tree seedling establishment occurs quickly, hemlock and spruce may outgrow the salmonberry. Tree seedling mortality may be high, however, due to the abundance of lady fern. (Dead fronds can block seedlings from light.) Following clearcut harvest, planting may be needed for adequate regeneration. Spruce is recommended for planting.

Devil's club cover declines, and blueberry, salmonberry, and fern cover increases for at least the first 25 years after clearcutting (DeMeo 1991). Salmonberry is known to retard tree regeneration, resulting in salmonberry thickets that typically remain well into the canopy closure phase.

Since devil's club indicates sub-surface water flow and erosion, there may be water accumulation and flooding concerns for road and trail construction.

Winter deer use of this type is limited. Tree sizes are less than optimum to provide suitable bald eagle nesting habitat. Isolated large spruce may occur, providing nest sites.

Subsistence uses of this association are similar to the hemlock/blueberry-devil's club association.

VEGETATION

This moderately productive, closed canopy, forest type is dominated by western hemlock. Sitka spruce is commonly a minor part of the overstory. Near the transition to the mountain hemlock zone, or to poorly drained mixed conifer associations, mountain hemlocks may occur.

Blueberry and menziesia dominate the understory with menziesia typically taller than blueberry. Common well-drained forest herbs like bunchberry and five-leaf bramble are abundant. Oak fern is abundant. Shield fern may be present on well-drained, open hummocks, but was absent in more than 66 percent percent of the sampled stands.

Cover of Common Plants (%)
N = 29 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	57	15-85	100
W. Hemlock Regen.	13	1-15	100
Menziesia	44	40-85	100
Blueberry	61	1-95	100
Bunchberry	14	1-40	100
Five-leaf Bramble	9	1-15	100

Similar Associations
The hemlock/blueberry-menziesia plant association is often confused with the poorer draine mixed conifer/blueberry plant association. However, mountain hemlock regeneration is virtuall absent in the western hemlock/blueberry-menziesia association. Currently, no differences i sites have been discovered between this plant association and th hemlock-cedar/blueberry-menziesia plant association. This supports the hypothesis that oth factors may be influencing cedar establishment. Nonetheless, until the ecology of yellowced in Southeast Alaska is better understood, we shall consider these two separate pla associations.

Late Seral Stand Structure
Western hemlock trees rarely exceed 90 feet (27 m). Canopy closure is about 10 percent le than in the more productive hemlock associations. Western hemlock seedlings, sapling suppressed, and intermediate size trees are abundant, forming a multi-layered canopy.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	92 [28]	17 [52]
DBH (in. [cm])	20 [51]	5.0 [13]
Basal Area (sq.ft./ac.)	237	79
Gross Volume (BF/ac.)	42,700	15,300
Cover (%)	61	14
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.7 [0.8]	1.1 [0.3]
Menziesia	5.9 [1.8]	1.4[0.4]
Cover (%)		
Tall Shrubs	74	37
Forbs	38	19
Ferns	31	27

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	501 [153]	50-1420 [15-433]
Landform		**Frequency (%)**
Mountain-Hillslopes		71
Lowlands		24
Footslopes/Fans		5
Slope Class (%)		**Frequency (%)**
16-35		33
36-55		24
56-75		33
76+		10
	Mean	**Std. Dev.**
Slope Mean (%)	39	27
Soil Parent Material		**Frequency (%)**
Compact Till		22
Residuum		14
Colluvium		14
Organic Material		22
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		78
≤ 50 [20]		22
	Mean	**Std. Dev.**
Imp. Layer Depth	50 [20]	32 [13]
Organic Layer Depth	21 [8.3]	16 [6.3]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		10
Somewhat Poorly		30
Moderately Well		25
Well		30
Common Soil Series: Traitors, McGilvery, Partofshikof, and Kushneahin.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/blueberry-menziesia plant association is common. It occurs from below the mountain hemlock zone to sea level on mostly 35 to 75 percent slopes on hill and mountainslope and lowland landforms.

Soils are predominately mineral and somewhat poorly to well drained. Soils on steeper slopes are shallow above bedrock or compact glacial till, but steep enough to drain well laterally. Soils on gentler slopes are frequently deeper, coarse textured colluvium, and able to accommodate excessive water vertically through the profile.

MANAGEMENT IMPLICATIONS

These sites are moderately productive, as reflected by tree heights and gross volumes. Limitations to tree productivity are largely due to less than optimum soil drainage conditions or to shallow soils. Shrub and forb biomass is much greater in this association than in the hemlock/blueberry plant association.

Soils are generally stable and not disturbed by excessive subsurface groundwater flow or flooding, as shown by the abundance of blueberry and the lack of salmonberry, devil's club, and skunk cabbage (indicators of such hydrologic regimes). However, mass wasting is common on volcanic ash soils on slopes steeper than 35 percent.

Regeneration of western hemlock is abundant following logging. Brush competition is moderate and well drained, tree-growing microsites are abundant. Planting is not needed for adequate hemlock regeneration if the soils are not disturbed following timber harvest. Sitka alder may be an important seral shrub if mineral soils are exposed.

Blueberry and menziesia cover remains high following clearcutting (DeMeo 1991) until canopy closure. Closure is not expected to occur as quickly as in other types described by Alaback (1982; see Chapter 2) since most of his study sites were well drained.

Western hemlock fluting is common and appears to be especially prevalent on shallow soils and in coastal stands developing after catastrophic disturbance (Julin and Farr 1989). Windthrow potential is less than in some associations due to lower tree heights and drier soils.

This association is potentially important deer habitat during mild winters. During the deep snow of a severe winter, forage availability is greatly reduced. The association is a potentially important spring/early summer deer habitat due to the abundance of succulent herbs at the lower elevations.

Deer appear to play an important role in understory dynamics in this association, particularly on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Blueberry cover may be less than 5 percent. Plants less than 0.5 ft (0.2 m) tall in areas of prolonged high deer densities are common. Menziesia cover increases on overbrowsed sites since it is not preferred forage, and its height may far exceed the reach of deer. These conditions are common along the outer coast of Chichagof and Kruzof Islands, and on island inner coasts in isolated patches surrounded by water, peatlands, or clearcuts where animals may be concentrated during severe winters. Deer browsing on blueberry had occurred in most of the sampled stands. Since high deer use stands were excluded from the data set, the descriptions do not reflect plant composition under such conditions.

Brown bear sign was uncommon in sampled stands. This association does not provide suitable bald eagle nesting sites (Sidle et al. 1986).

Poorer drained areas, steep slopes, and sensitive soils should be avoided for road and trail construction.

Subsistence uses of this association include collection of berries, hemlock bark and pitch for medicinal and food purposes.

NOTES:

Tsuga heterophylla/*Vaccinium* spp.

VEGETATION

This moderately productive, closed canopy, forest type is dominated by western hemlock. Sitka spruce is commonly a minor part of the overstory. Mountain hemlock may occur in this association near transitions to the mountain hemlock zone or to mixed conifer associations.

Blueberry and western hemlock dominate the understory. Common well-drained forest herbs like bunchberry and five-leaf bramble are most abundant in canopy gaps. Deer and oak fern are usually abundant. Shield fern may occur on well-drained, open hummocks, but is usually absent or less than 2 percent cover.

Cover of Common Plants (%)
N = 88 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	56	25-75	100
W. Hemlock Regen.	15	1-25	100
Blueberry	55	5-75	100
Menziesia	10	0-25	89
Five-leaf Bramble	10	0-25	98
Bunchberry	9	0-25	97
Deer Fern	7	0-25	67
Oak Fern	6	0-25	68

Similar Associations
This plant association is often confused with the better drained, more productive, wester hemlock/blueberry/shield fern association. However, somewhat taller average stand height an more shield fern in the latter type distinguish it from the hemlock/blueberry type. Th hemlock-cedar/blueberry type may also be confused with the hemlock/blueberry type, but i distinguished by cedar in the overstory. While the hemlock/blueberry association is vegetativel different from the hemlock-cedar/blueberry association, the soils of these two associations ar nearly identical. Until the ecology of yellowcedar in Southeast Alaska is better understood, appears best to consider these two separate associations.

Late Seral Stand Structure
Western hemlock trees rarely exceed 100 feet (30 m). Canopy closure is high (average 6 percent), but about 5 percent less than in the more productive hemlock and spruc associations. Seedlings, saplings, suppressed, and intermediate size trees are abundan forming a multi-layered canopy.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	93 [28]	15 [4.6]
DBH (in. [cm])	23 [58]	4.7 [12]
Basal Area (sq.ft./ac.)	280	79
Gross Volume (BF/ac.)	49,300	18,500
Cover (%)	64	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.2 [1.0]	1.0 [0.3]
Menziesia	4.7 [1.4]	1.9 [0.6]
Cover (%)		
Tall Shrubs	58	27
Forbs	39	23
Ferns	16	16

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	677 [206]	30-1680 [9-512]
Landform		**Frequency (%)**
Mountain-Hillslopes		82
Footslopes/Fans		11
Lowlands		7
Slope Class (%)		**Frequency(%)**
0-15		5
16-35		14
36-55		23
56-75		46
76+		12
	Mean	**Std. Dev.**
Slope Mean (%)	44	21
Soil Parent Material		**Frequency (%)**
Compact Till		21
Residuum		9
Colluvium		31
Volcanic		9
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		92
≤ 50 [20]		8
	Mean	**Std. Dev.**
Imp. Layer Depth	57 [22]	32 [13]
Organic Layer Depth	17 [6.7]	12 [4.7]
Soil Drainage		**Frequency (%)**
Somewhat Poorly		40
Moderately Well		27
Well		23
Common Soil Series: Mitkof, Peril, Partofshikof, Wadleigh, and Yakutat.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/blueberry plant association is one of the most abundant forest types in northern Southeast Alaska and is common in middle to southern Southeast Alaska (DeMeo et al. 1992, Martin 1989, and Pawuk and Kissinger 1989). It occurs from near sea level to just below the mountain hemlock zone on mostly steeper hill and mountain slope landforms.

Soils are mostly mineral, somewhat poorly to moderately well drained, and classified as Spodosols. Soils on steeper slopes are shallow above bedrock or compact glacial till, but deep enough to drain well laterally. Soils on gentler slopes are frequently deeper, coarse textured colluvium, able to accommodate excessive water vertically through the profile.

MANAGEMENT IMPLICATIONS

Based on tree heights and gross volumes, these sites are moderately productive. Limitations to tree productivity are largely due to less than optimum soil drainage conditions found either on shallow soils or wet, deeper soils. Western hemlock fluting may occur, and is especially prevalent in coastal stands developing after major disturbance such as windthrow or clearcutting (Julin and Farr 1989). Windthrow potential is high due to tree heights and shallow soils.

Soils are generally stable and not disturbed by excessive subsurface groundwater flow or flooding. Mass wasting is common on volcanic ash soils on slopes steeper than 35 percent.

Natural regeneration of western hemlock is abundant and planting is not needed following logging. Brush competition is low, and well drained microsites are abundant. On mountain slopes, especially on the northern end of the Chatham Area (northern Chichagof Island, Yakutat), Sitka alder will become established on exposed mineral soils. On lower slope positions in the southern portions of the Chatham Area (southern Chichagof Island, Baranof Island), red alder will establish on exposed mineral soils almost immediately.

Blueberry cover remains high following clearcutting (DeMeo 1991) until canopy closure. Field observations of older windthrown stands indicate closure and understory exclusion follows the pattern described by Alaback (1982; see Chapter 2). However, closure is not expected to occur as quickly in the hemlock/blueberry type as in the more productive hemlock associations. Most of Alaback's (1982) study sites were on well drained soils.

The western hemlock/blueberry association is potentially important deer habitat during mild winters. During the deep snow of a severe winter, forage availability is greatly reduced. The association is potentially important spring/early summer deer habitat due to the abundance of succulent herbs at lower elevations.

Deer appear to play an important role in understory dynamics, particularly on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Blueberry cover may be less than 5 percent. Plants less than 0.5 foot (0.2 m) tall in areas of prolonged high deer densities are common. Menziesia cover increases on overbrowsed sites since it is not preferred forage, and its height may far exceeed the reach of deer. These conditions are common along the outer coast of Chichagof and Kruzof Islands, and on island inner coasts in isolated patches surrounded by water, peatlands, or clearcuts where animals may be concentrated during severe winters. Deer browsing on blueberry had occurred in most of the sampled stands. Since high deer use stands were excluded from the data set, the descriptions do not reflect plant composition under such conditions.

Brown bear sign was detected in only a few of the sampled stands. Near the coast, this plant association may provide bald eagle nesting sites; however, larger spruce trees are usually preferred (Sidle et al. 1986).

Hazardous slopes, sensitive soils, and steep landforms should be avoided in road and trail construction.

Subsistence uses include blueberry picking and collection of hemlock bark and pitch for medicinal, food, and dye uses.

This association is very common throughout Chatham Area.

Note well drained, mineral soil

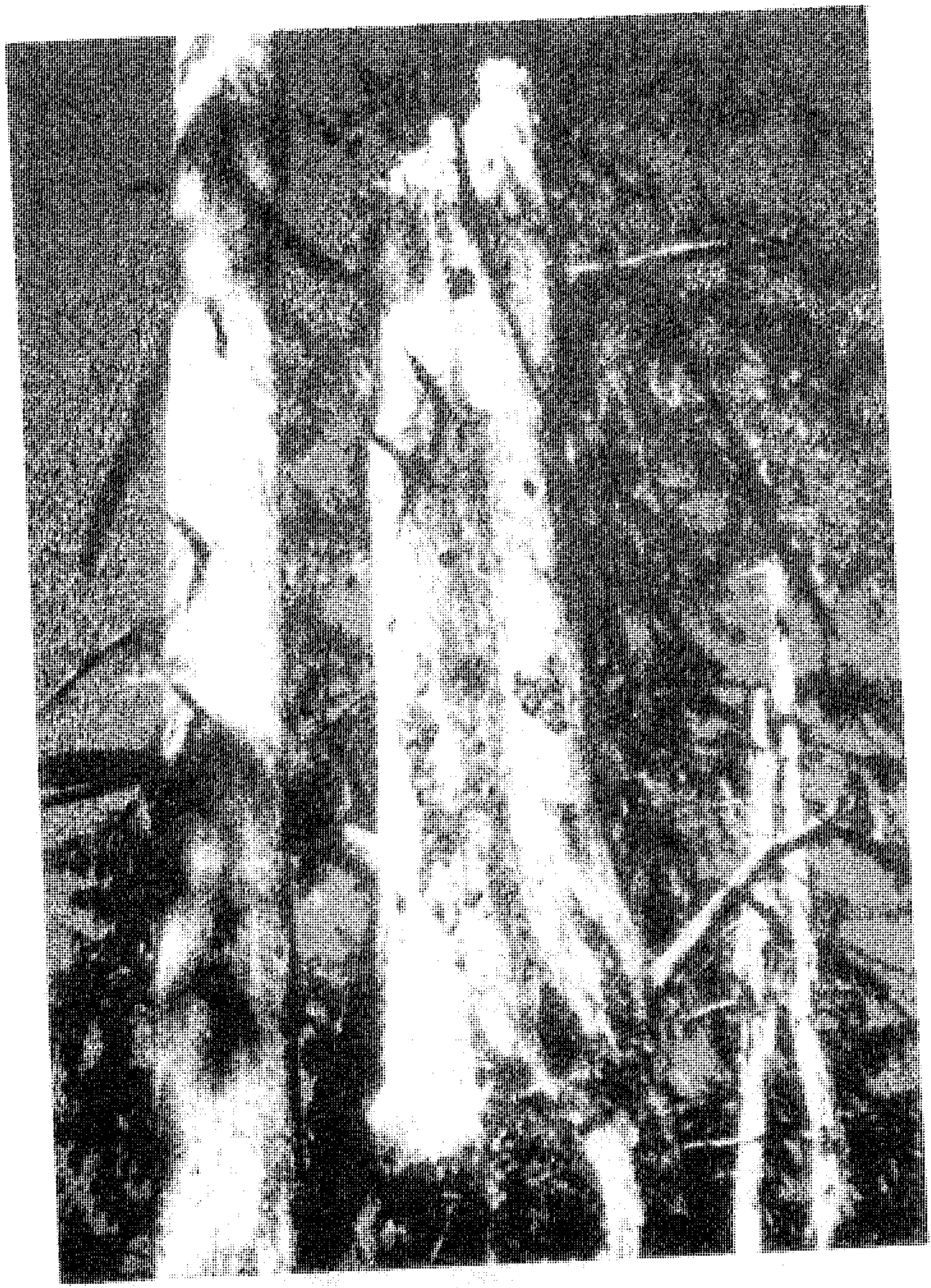
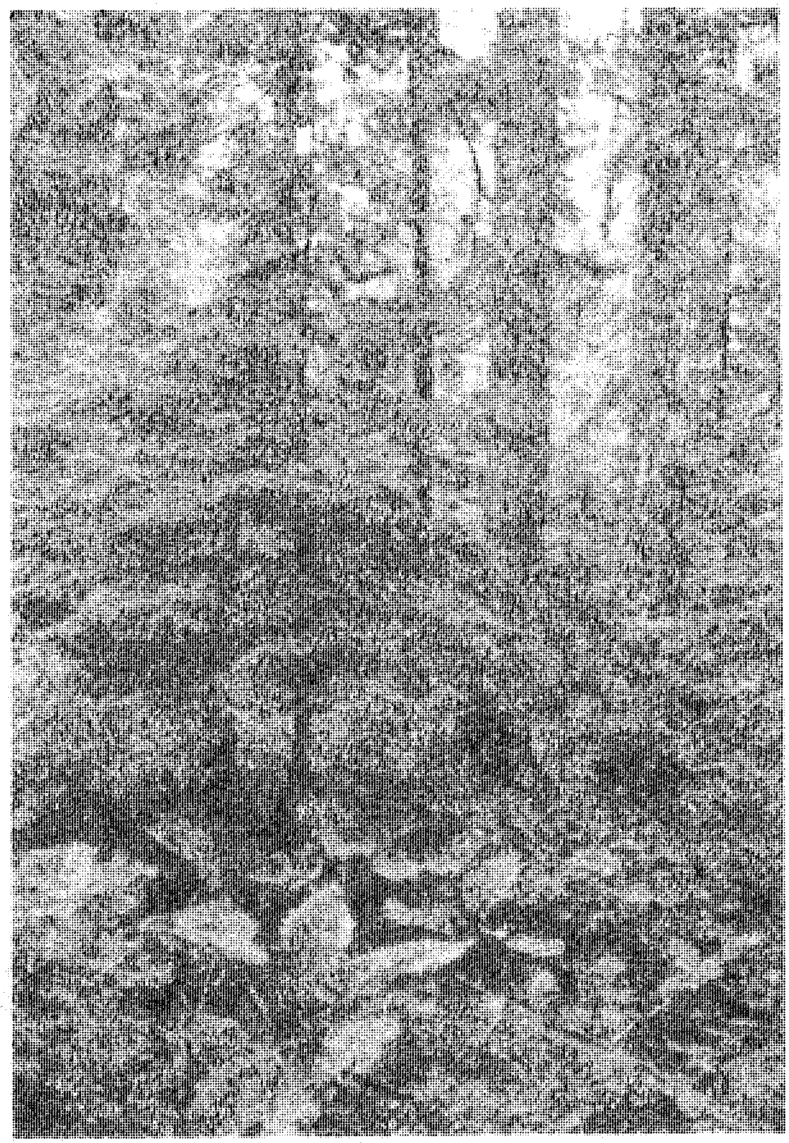


Photo credit: V. Henke



VEGETATION

This moderately productive, more open forest type is dominated by western hemlock. Sitka spruce is commonly a minor part of the overstory. Near the transition to the mountain hemlock zone or to mixed conifer associations, mountain hemlocks may occur.

Blueberry dominates the shrub layer. Menziesia is common, usually taller than blueberry. Skunk cabbage is characteristic, and varied from 3 to 65 percent cover in sample stands.

Cover of Common Plants (%)
N = 31 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	48	15-85	100
W. Hemlock Regen.	17	1-40	100
Blueberry	42	5-85	100
Menziesia	19	0-40	87
Skunk Cabbage	28	3-65	100

Similar Associations

Understory vegetation is very similar to the hemlock-cedar/blueberry/skunk cabbage and the mixed conifer/blueberry/skunk cabbage associations. However, mountain hemlock in the overstory of mixed conifer associations and cedar in hemlock-cedar associations distinguish these sites. Also, the overstory of the mixed conifer association is more open.

While the hemlock/blueberry/skunk cabbage plant association is vegetatively different from the hemlock-cedar/blueberry/skunk cabbage plant association, the soils of these associations are nearly identical. Until the ecology of yellowcedar in Southeast Alaska is better understood, it appears best to consider these two separate plant associations.

Late Seral Stand Structure

Western hemlock trees rarely exceed 90 feet (27 m). Canopy closure is 10 to 15 percent less than in the more productive hemlock associations, i.e., 56 percent average. Seedlings, saplings, suppressed, and intermediate size trees are abundant, forming a multi-layered canopy.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	92 [28]	22 [6.7]
DBH (in. [cm])	21 [53]	6.6 [17]
Basal Area (sq.ft./ac.)	259	94
Gross Volume (BF/ac.)	47,700	30,600
Cover (%)	56	15
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.1 [0.9]	1.1 [0.3]
Cover (%)		
Tall Shrubs	64	26
Forbs	61	25
Ferns	6	5

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	372 [113]	30-1250 [9-381]
Landform		Frequency (%)
Mountain-Hillslopes		45
Lowlands		34
Footslopes/Fans		21
Slope Class (%)		Frequency (%)
0-15		3
16-35		48
36-55		34
56-75		14
	Mean	Std. Dev.
Slope Mean (%)	14	11
Soil Parent Material		Frequency (%)
Compact Till		13
Marine Sediment		19
Colluvium		12
Organic Material		25
Granite		13
Soil Depth (cm [in.])		
Mineral Soil		Frequency (%)
> 50 [20]		90
≤ 50 [20]		10
	Mean	Std. Dev.
Imp. Layer Depth	64 [25]	35 [14]
Organic Layer Depth	33 [13]	35 [14]
Soil Drainage		Frequency (%)
Very Poorly Drained		28
Poorly		34
Somewhat Poorly		34
Well		3
Common Soil Series: South Bight, Yakutat, Karheen, and Sloduc.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/blueberry/skunk cabbage plant association is one of the more common forest types in northern Southeast Alaska. It is also common in middle to southern Southeast Alaska (DeMeo et al. 1992; Pawuk and Kissinger 1989). It occurs from near sea level to the mountain hemlock zone on mostly gentler hill, mountain slope, and lowland landforms.

Skunk cabbage sites are typically a mosaic of poorly-drained depressions with organic soils and raised hummocks with mineral soils. This pit and mound topography may result from ancient windthrow. Skunk cabbage usually occurs in the depressions, and species preferring better drainage occur on the mounds.

MANAGEMENT IMPLICATIONS

These sites are moderately productive, as reflected by tree heights and gross volumes. Limitations to tree productivity are largely due to less than optimum soil drainage conditions associated with the wet organic soils. Trees usually occupy more well drained positions than the microsites with skunk cabbage.

Soils are generally stable and not disturbed by flooding. This association usually occurs on gentler slopes. Where it occurs on slopes over 35 percent, especially on volcanic ash soils, mass wasting is common.

Regeneration of western hemlock is abundant following harvest, although the response is somewhat slower than on the better drained hemlock/blueberry and shield fern sites. Regeneration is unevenly distributed due to the abundance of wet, poorly-drained, microsites associated with skunk cabbage. Brush competition is low. Planting is generally not needed to adequately regenerate these sites following timber harvest. Due to the deep soil organic layer, exposure of mineral soil is less likely than in some other associations.

Blueberry cover remains high following clearcutting until canopy closure. Closure does not occur as quickly as on better drained soils. This association is potentially important deer habitat during mild winters. However, the canopy is more open, resulting in less snow interception. During the deep snow of a severe winter, forage availability is greatly reduced. The association also is potentially important spring/early summer habitat for deer due to the abundance of skunk cabbage.

This plant association is unlikely to provide suitable bald eagle nesting sites (Sidle et al. 1986), since the trees are not as tall as in other associations. Skunk cabbage is an important forage species for bear and geese. Trail and road construction is hampered by wet, skunk cabbage microsites. These areas should be avoided or boardwalks used (for trails).

Southeast Alaska natives used skunk cabbage tubers for food. Leaves were used as all-purpose wraps for steaming fish, forming into cups, and similar uses. Because of this, the plant has been referred to as "Indian wax paper." While the musty odor of the leaves is not imparted to the food, the raw leaves contain calcium oxalate, a lung irritant, and are thus toxic unless specially prepared.

VEGETATION

This is a moderately productive, more open hemlock association. Sitka spruce is nearly always present in the overstory, and approaches 15 percent cover.

The shrub layer is dominated by devil's club and blueberry. Salmonberry occurs in most stands. Forbs and ferns are abundant.

Cover of Common Plants (%)
N = 11 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	45	15-65	100
W. Hemlock Regen.	17	0-38	91
Sitka Spruce	18	1-40	100
Devil's Club	47	15-85	100
Blueberry	31	1-65	100
Salmonberry	8	1-15	100
Skunk Cabbage	29	5-65	100

Similar Associations

This type is most similar to the hemlock/blueberry/skunk cabbage plant association. However, devil's club is abundant in this plant association.

Late Seral Stand Structure

Western hemlock trees are usually less than 85 feet (26 m). While the canopy cover averages 56 percent, blowdown openings are common. Hemlock seedlings, saplings, suppressed, and intermediate size trees are common.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	83 [25]	20 [6.1]
DBH (in. [cm])	18 [46]	10 [25]
Basal Area (sq.ft./ac.)	256	70
Gross Volume (BF/ac.)	39,500	21,600
Cover (%)	56	15
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.1 [0.9]	1.1 [0.3]
Devil's Club	4.7 [1.4]	1.0 [0.3]
Cover (%)		
Tall Shrubs	100	34
Forbs	74	28
Ferns	25	25

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	343 [105]	50-740 [15-226]
Landform		**Frequency (%)**
Mountainslopes		45
Lowlands		18
Footslopes/Fans		18
Slope Class (%)		**Frequency (%)**
16-35		36
36-55		9
56-75		45
76+		9
	Mean	**Std. Dev.**
Slope Mean (%)	26	12
Soil Parent Material		**Frequency (%)**
Residuum		50
Colluvium		25
Alluvium		25
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	67 [26]	33 [13]
Organic Layer Depth	21 [8.3]	12 [4.7]
Soil Drainage		**Frequency (%)**
Very Poorly		27
Poorly		45
Somewhat Poorly		18
Well		9
Common Soil Series: Hofstad, Kasiana, and Wadleigh.		

ENVIRONMENTAL CHARACTERISTICS

The western hemlock/devil's club/skunk cabbage plant association is less common than the similar hemlock/blueberry/skunk cabbage association. The best examples occur on deep, organic soils over colluvium at the base of footslopes. The association occurs from near sea level to usually less than 800 feet (244 m) elevation.

This association appears to be a mosaic of well-drained devil's club microsites and poorer drained skunk cabbage depressions, i.e. mound and pit topography. Soils are mainly poorly to very poorly drained. Surface flooding occurs to a lesser extent than in the Sitka spruce/devil's club plant association.

MANAGEMENT IMPLICATIONS

The hemlock/devil's club/skunk cabbage plant association is moderately productive. Limitations to productivity are due to excessive soil water from upslope drainages. Since the water is moving through these sites, nutrient availability is greater than in sites with lower water turnover rates (e.g., mixed conifer/blueberry/skunk cabbage). Trees usually occupy more well drained positions than the microsites with skunk cabbage. This plant association meets the criteria for forested wetland.

Regeneration of western hemlock is variable due to the abundance of wet microsites. Following clearcut harvest, planting may be needed for adequate regeneration.

Devil's club cover declines while blueberry and fern cover increases for at least the first 25 years after clearcutting (DeMeo 1991). As indicated by the skunk cabbage, there is an abundance of unsuitable tree-growing microsites (Schrader 1992), which affects succession and understory dynamics.

Winter deer use of the plant association is limited due to poor snow interception canopy conditions. However, deer commonly use skunk cabbage in the spring. Brown bear diggings of skunk cabbage are also common.

Vancouver Canada geese utilize the skunk cabbage when this type occurs near goose nesting areas. This plant association is unlikely to provide suitable bald eagle nesting habitat (Sidle et al. 1986).

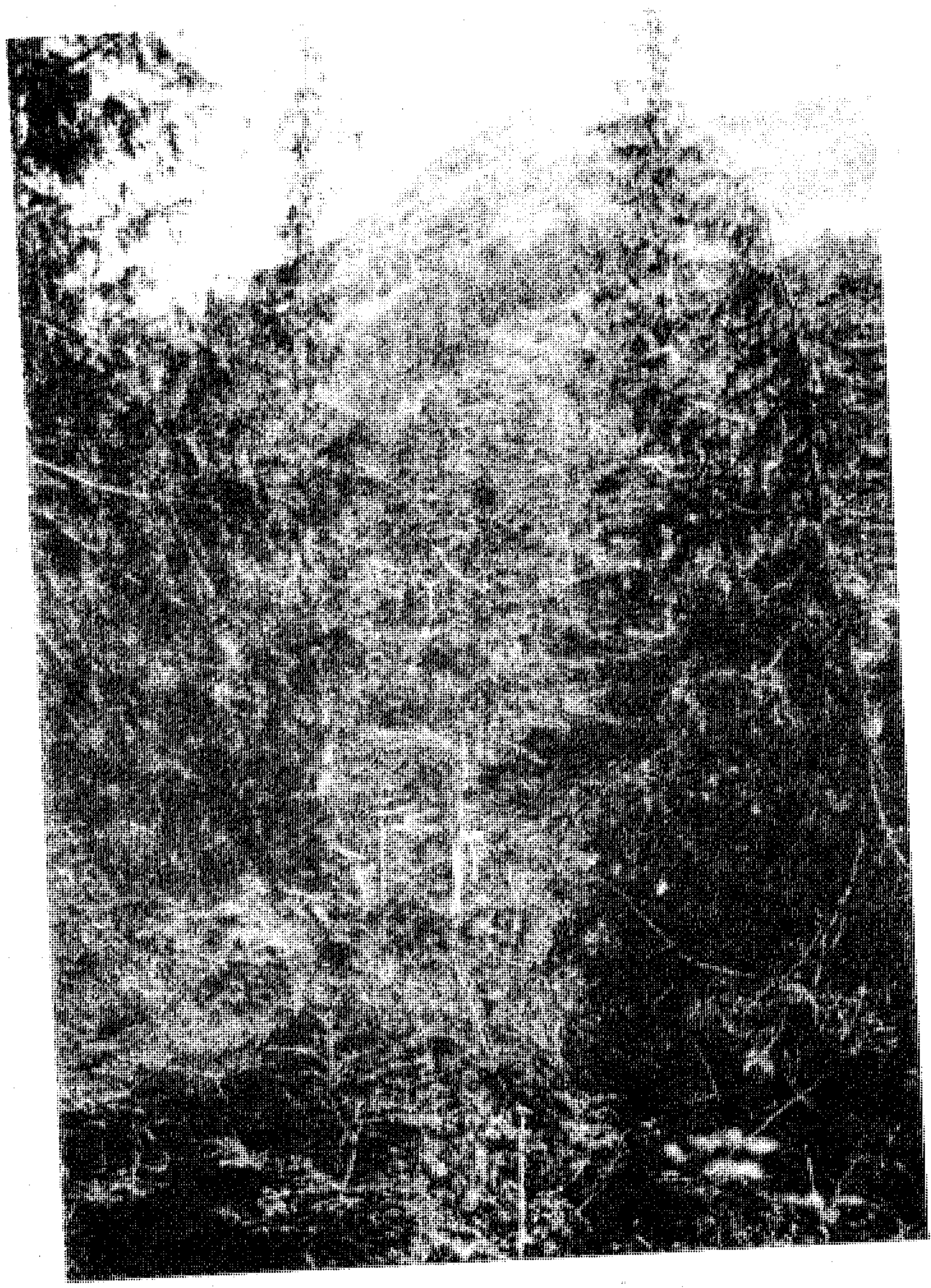
Hemlock/devil's club/skunk cabbage sites are not suitable for shovel yarding due to the wet, "mucky" soils. Windthrow potential is very high, also due to the soil characteristics.

Road and trail construction is difficult on the wet soils. Boardwalks should be used for trails if they cannot be relocated.

Subsistence uses are similar to the hemlock/blueberry/skunk cabbage and devil's club types.

NOTES:

WESTERN HEMLOCK-YELLOWCEDAR SERIES



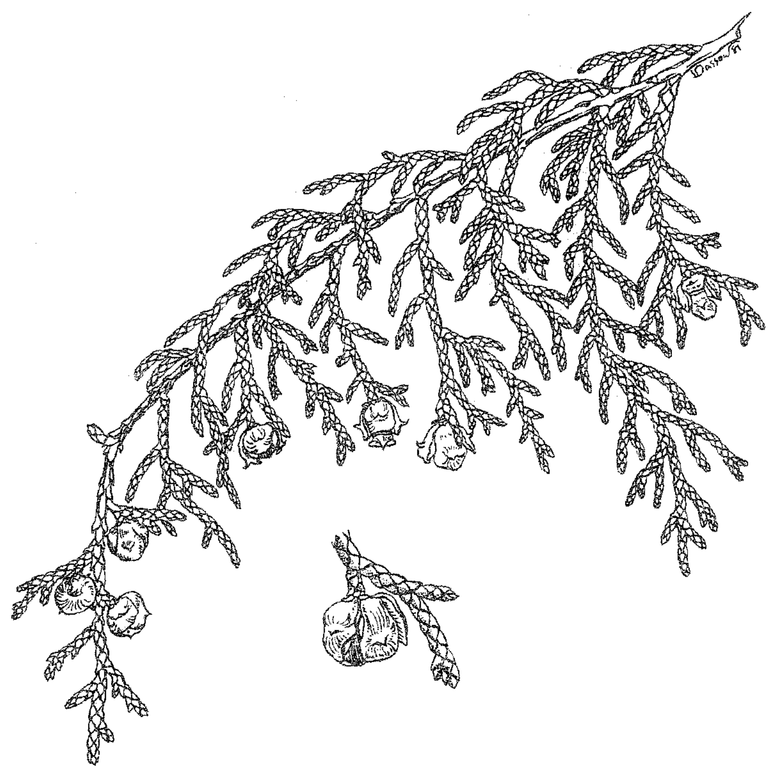
8
WESTERN HEMLOCK-YELLOWCEDAR SERIES

Description

Yellowcedar (Alaska-cedar) is a codominant with western hemlock in stands with moderately open (50 to 70 percent) canopies. Cedar cover typically ranges from 5 to 50 percent; cedar rarely dominates the overstory. Spruce may be a minor overstory component. Mountain hemlock may occur in stands which are transitional to mixed conifer or mountain hemlock stands. The canopy is typically multi-layered. Large branched, deep-crowned hemlocks and cedar, like those found on the best hemlock sites, are less abundant in this series than in the western hemlock series. Heights of sampled dominant and codominant trees varied from 75 to 100 feet (23 to 30 m) and diameters from 15 to 20 inches (38 to 51 cm).

Western hemlock is the dominant understory tree. Cedar regeneration only occurred in about half of the sampled stands and was less abundant than western hemlock regeneration. Nonetheless, we shall retain the hemlock-cedar series classification, at least until more is known about yellowcedar autecology. Cedar seedlings are particularly uncommon in areas of high deer use.

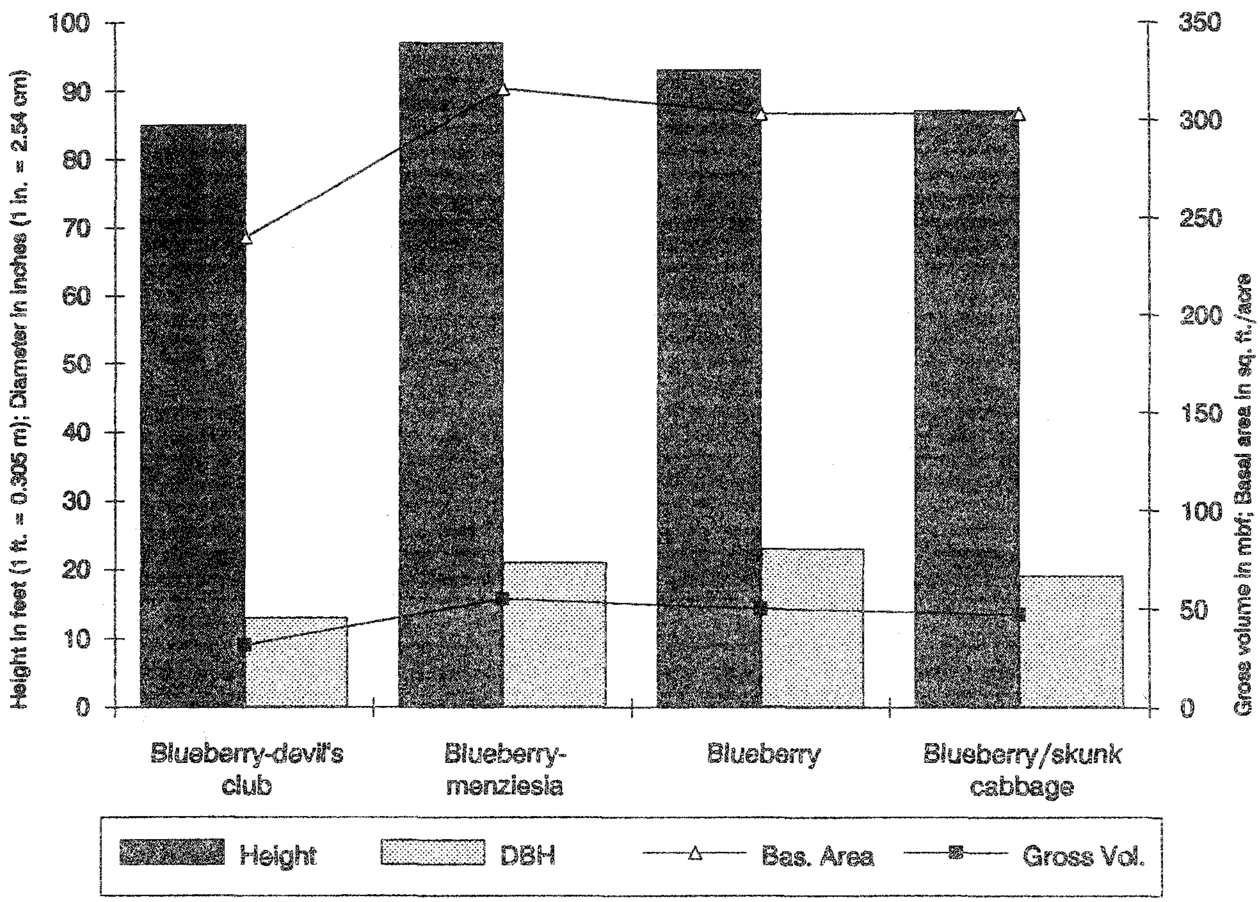
The age of dominant trees often ranges from 150 to well over 300 years. Cedar is long-lived, outliving western hemlock trees by 4 to 6 times. Trees may be more than 1000 years old. Dead tops, bole rot, and other age indicators are common. Arboreal lichens, particularly *Alectoria* species, are less abundant than on mixed conifer sites but are more abundant than on more closed canopy types, such as in the western hemlock series.



Yellowcedar
Chamaecyparis nootkatensis

Shrub canopy cover is usually high (> 50 percent) in late seral stands. Forb cover is usually also high (> 50 percent). Blueberry and rusty menziesia are the most common shrubs, and skunk cabbage, five-leaf bramble, and bunchberry are the most common forbs. Deer fern is the most common fern. Shield fern, common on highly productive sites, is nearly absent in this type.

Figure 11. Average Tree Structure for Western Hemlock-Yellowcedar Series



The four cedar associations are presented in order of increasingly poor soil drainage, since drainage appears to be the dominant environmental factor affecting association distribution. Figure 11 compares tree size among the associations. Although drainage is best in the devil's club type, productivity is greatest in the menziesia type, possibly since the former type is more frequently disturbed.

On non-alluvial, low elevation sites, cedar abundance increases as soil drainage becomes poorer within the hemlock, hemlock-cedar, and mixed conifer series. Poorer drainage results in fewer trees, and therefore more understory light, allowing cedar to survive and reproduce despite competition from western hemlock. Cedar appears to be more tolerant of poor soil drainage conditions than western hemlock.

Medium-sized down woody material is abundant. Due to low decomposition rates, cedar logs and snags—often from cedar die-back—accumulate on these sites (Hennon 1992). Down woody material provides protected, nutrient-rich microsites, important for conifer regeneration, especially in the wet, organic soils of skunk cabbage associations. Down wood also provides fish habitat in small moderate gradient mixed control, high gradient contained, and alluvial fan process group channels (Paustian et al. 1992).

The soils of the hemlock-yellowcedar associations vary from shallow to deep, mineral to organic, and poorly to somewhat poorly drained. Most stands occur on steeper mountain slopes than the mixed conifer associations.

Plant succession is expected to follow the general pattern described in Chapter 2, except canopy closure and other successional stages are expected to take longer than on more well drained sites. For example, a 300 year old fire-origin hemlock-yellowcedar stand on south Etolin Island did not meet the regional old-growth definition (Boughton et al. 1992) due to lack of snags and forbs. Late seral stages may include little or no cedar due to cedar dieback and regeneration anomalies (see below).

Windthrow is common, particularly on shallow, wet soils. Young trees often appear stressed (yellowing needles) due to wet soil and low nutrient conditions.

Deer and bear use the western hemlock-yellowcedar type heavily in spring, especially the skunk cabbage association. Hemlock-cedar sites are used extensively by deer in fall. During deep snow periods, cedar stands are used by deer for forage and bedding sites. Snow interception is less frequent than in more closed forest types.

Interior forest conditions may be less distinct than in more productive forest types such as the western hemlock series. Nonetheless, consideration of the stand size required to maintain interior conditions and to reduce edge effects is important in management for ecosystem sustainability.

Yellowcedar Silviculture and Harvest Concerns

Yellowcedar distribution and regeneration is nonuniform, apparently due to a combination of factors including irregular seed crops, preferential browsing by deer, climate changes, and disease. Across the Forest, yellowcedar appears to be declining in abundance (Hennon et al. 1990a, 1990b). Research on cedar regeneration, silviculture, and abundance is summarized below (after DeMeo et al. 1992; see Hennon 1992 for more information).

Yellowcedar germinates best on mineral soil, but alder and spruce are strong competitors under these conditions. Cedar seed crops are irregular, with several years between good crops (Hennon 1992). Warm and cold stratification is required for good germination (Pawuk 1993). Cedar is slow growing and frequently out-competed by hemlock and alder. Cedar generally competes best on somewhat poorly drained soils—where western hemlock growth is impaired.

Seed sources may be scarce, since cedar abundance is known to be declining (Hennon et al. 1990a, 1990b). Ideally, sources should be near the planting area and within 500 feet (152 m) elevationally (Pawuk, pers. comm. 1994). One hypothesis holds that warmer winter temperatures since the end of the Little Ice Age (about 1850) have resulted in a thinner or less frequent snowpack, reducing insulation for young cedar shoots and roots. Another hypothesis proposed by Martin states that with the warmer winters cedar distribution has been reduced due to increased foraging by deer (Hennon 1992). Patches of dead or dying cedars occur throughout Southeast Alaska, often associated with peatlands. Holsten et al. (1985) note that bark beetles and fungus found on dying and dead trees are not the main cause of tree death. The cause(s) for decline need further research.

Yellowcedar is a very valuable wood, especially on the Asian market where it is valued for its fine grain and similarity to a native cedar, which has been depleted. Yellowcedar is used for temples, coffins, and other ceremonial purposes. In Alaska, yellowcedar is also valued, particularly for artwork—such as totem poles, canoe paddles, and masks—or where longevity is needed in exposed conditions, such as decking and boardwalks. Dead and dying trees are worth salvage logging since much of the wood is often still sound.

Harvest methods influence regeneration and may be manipulated to increase regeneration success. Options were discussed at a conference in Sitka in 1991 (see Current Knowledge of Ecology and Silviculture of Yellowcedar in Southeast Alaska: Information Exchanged at Sitka, Alaska, November 1991 by Paul Hennon 1992). These options were summarized in DeMeo et al. (1992) as follows:

1. *Harvest timing.* Conduct timber harvest at a time to coincide with a heavy cone crop of yellowcedar. When possible, conduct harvest over snow to protect advanced regeneration of yellowcedar.

2. *Group selection.* Harvest that results in small openings (< 2 acres [0.8 ha]) might encourage regeneration by seedfall from perimeter trees. One advantage is the potential to enhance sites for other resources (e.g., wildlife). Disadvantages include costs, possible windthrow losses, and a probable increase in hemlock regeneration. This method may cause too little soil disturbance and create insufficient light to be effective for yellowcedar. The size of the opening might influence success.

3. *Individual tree selection.* As in group selection, this may not result in adequate soil disturbance or increased light to improve regeneration for yellowcedar. It will probably favor hemlock regeneration. Other disadvantages include high costs and the perception of high-grading. An advantage may be the opportunity to leave smaller yellowcedar trees (e.g., pole-size).

4. *Seed tree harvest.* Leave scattered individual yellowcedar trees on a unit while harvesting to ensure seed source. This method has low cost and the advantage of improving visuals and structural diversity of the harvested unit. Also, opportunities exist for genetic improvement, since trees with superior traits can serve as the seed source. There is some concern about blowdown, but trees need only remain standing for several years to contribute to regeneration. It may even be advantageous if some or most seed trees should blow down after several years. Because the crowns of yellowcedar are sparse, these trees may be less likely to blow down than Sitka spruce or western hemlock.

5. *Shelterwood harvest.* This option is similar to method (4) above, but with more trees remaining to protect regenerating trees from drought and frost. In general, however, regenerating yellowcedar do not need protection in the cool moist environment of Southeast Alaska. A protective canopy would probably reduce growth by yellowcedar seedlings due to less light and soil warming, and may favor competition by western hemlock. A protective canopy may also decrease snow on the ground in winter, and thus encourage deer use in the area, resulting in increased browse on yellowcedar seedlings.

6. *Cedar groups or "islands" left in clearcuts.* Again, this is similar to seed tree harvest, but with this method, seed trees are left in groups or "islands" in the unit. This may have advantages that include wind-firmness and preserving wildlife habitat, but would be less effective in distributing seed across the unit.

7. *Clearcut and planting.* This is one technique in which we already have extensive experience. Advantages are that planting yellowcedar can be successful on most sites (given sufficient effort), spacing can be controlled, site preparation can be used, new sites (where yellowcedar did not previously grow) can be established, and there is the potential to control genetic quality. Disadvantages are the efforts associated with seed and cone collection and storage, the expense of producing and planting seedlings, and the potential for increased damage to seedlings caused by animals (over natural regeneration).

8. *Clearcut and no planting.* The size of clearcuts may influence natural regeneration of yellowcedar. Smaller cutting units with relatively greater perimeter/area ratios might receive more seed from adjacent old-growth cedar. More yellowcedar can be left along perimeters by careful unit layout. Advantages include adequate light, low cost, and no need for site preparation. Disadvantages include unpredictable levels of natural regeneration (including virtually no yellowcedar) and little genetic control. The relatively short dispersal distance of yellowcedar seed should be considered if perimeter yellowcedar is relied upon as a seed source.

9. *Burning.* As site preparation, burning increases the ease of planting and thinning, reduces competition by hemlock and other vegetation, reduces hemlock dwarf mistletoe, and increases light, temperature, and nutrients for seedlings. Limited data suggest that planted yellowcedar seedlings perform very well on burned sites. Disadvantages of burning are cost, limited experience with burning techniques on the Tongass, killing of advanced regeneration of yellowcedar and Sitka spruce, and unknown long-term effects on soil nutrients. Limited data suggest burning may increase deer browse on yellowcedar seedlings. Prescribed fire is not recommended because it is not a natural process in current Southeast Alaskan forests.

10. *Other site preparation and yarding.* YUM (yarding of unmerchantable material), tractor and shovel yarding, as well as various slash treatments, can affect soil disturbance, slash levels, and soil surface temperatures. These factors could have both positive and negative effects on naturally regenerated or planted yellowcedar. Limited data from trials at Anita Bay, Etolin Island, suggest that deer browsing on planted yellowcedar seedlings is reduced in areas of heavy slash. Harvesting over snow, as mentioned in

method (1), could preserve yellowcedar advanced regeneration where present (for example, on wet, poorly drained sites).

11. *Favor yellowcedar during thinning.* Most Districts on the Tongass already employ this method. Saplings of yellowcedar have high priority for selection as "leave" trees during precommercial thinning (often around age 15). This method requires yellowcedar saplings on the site, and if natural regenerationis counted on, the number of saplings often is low.

12. *Utilize natural regeneration on low-volume sites.* Natural regeneration, usually in the form of vegetative layering, is common on sites with relatively poor drainage. As these sites receive more harvesting, this method may be used to encourage more cedar in the next stand. Harvest methods to optimize use of natural regeneration on these sites remain poorly understood.

Distribution

The western hemlock-yellowcedar type occurs throughout Southeast Alaska, but appears to be more common in central Southeast. It is more common on the islands than the mainland, and is less common on northern Chichagof Island than on southern Chichagof and Baranof Islands. This type occurs at all elevations below the mountain hemlock zone, usually on sites that are less well drained than western hemlock associations (e.g., somewhat poorly drained soils).

Figure 12 shows the general landscape position for the hemlock-yellowcedar associations.

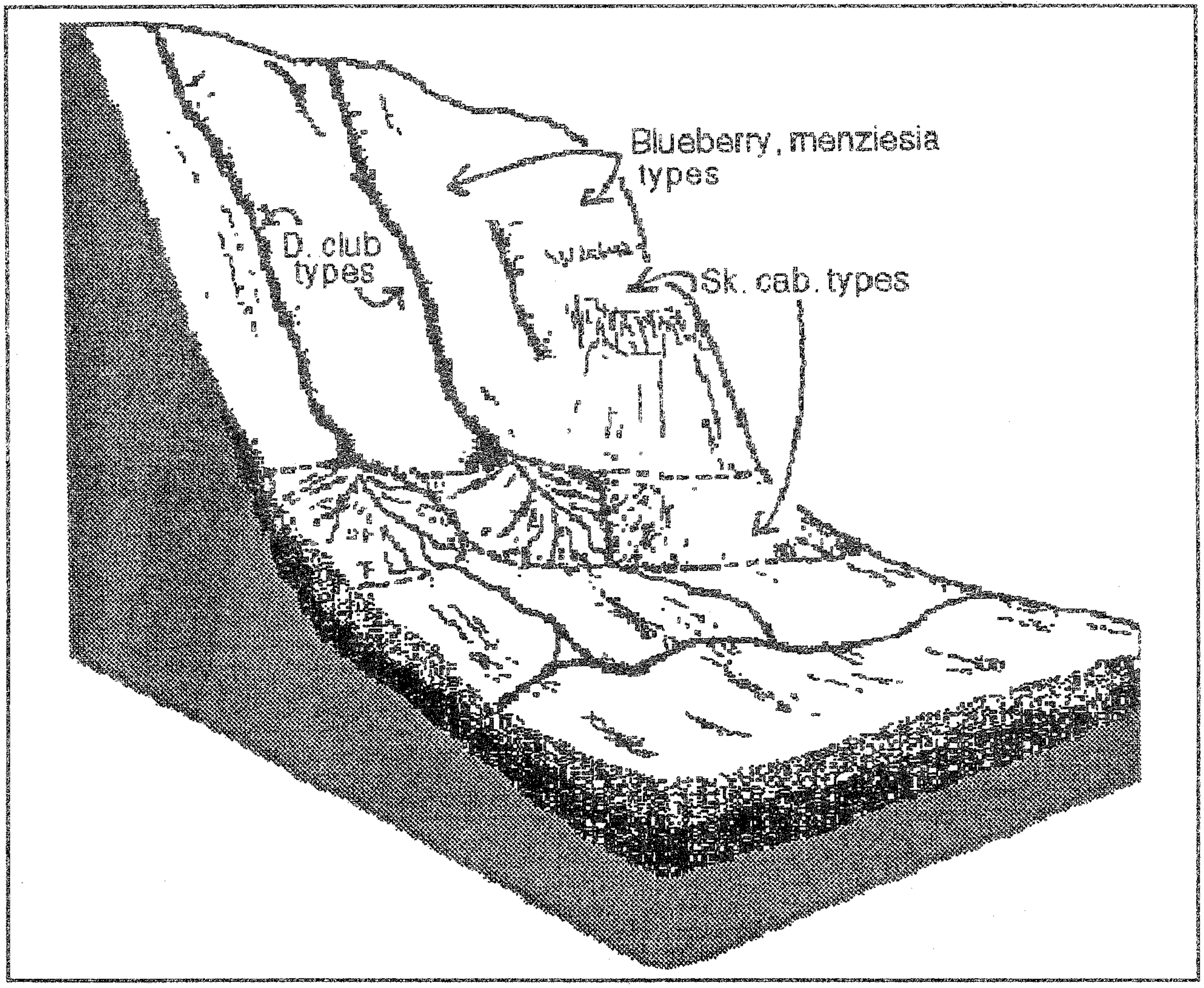


Figure 12. Generalized Landscape Positions for Western Hemlock-Yellowcedar Associations

WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY-DEVIL'S CLUB
Tsuga heterophylla-Chamaecyparis nootkatensis/Vaccinium spp.-
Oplopanax horridum

VEGETATION

This uncommon, moderately productive plant association is dominated by western hemlock and yellowcedar. Although sampling size is limited (see Overview), this association appears to be the only one in the series where the percent cover of cedar exceeds that of hemlock. Sitka spruce is usually a minor part of the overstory. Additional sampling is needed.

Blueberry and devil's club dominate the understory. Hemlock and spruce regeneration is abundant. Yellowcedar regeneration is not abundant and only was found in half the sampled stands. Bunchberry and five-leaf bramble are the most common herbs.

Cover of Common Plants (%)
N = 2 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	27	15-38	100
Yellowcedar	38	25-50	100
Blueberry	51	38-63	100
Devil's Club	27	15-38	100
Bunchberry	15	5-25	100
Five-leaf Bramble	15	5-25	100
Oak Fern	15	5-25	100

Similar Associations

This association is most similar to the western hemlock/blueberry-devil's club-shallow soils type. Cedar in this type separates these associations. The soils of these two associations are very similar. Until the ecology of yellowcedar in Southeast Alaska is better understood, these should be considered as separate plant associations.

Late Seral Stand Structure

Western hemlock and yellowcedar usually do not exceed 100 feet (30 m). Canopy closure is moderate. Understory trees of all sizes are abundant, forming a multi-layered canopy. Down logs and snags, especially rot-resistant cedar, are abundant.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	85 [26]	7.1 [2.2]
DBH (in. [cm])	13 [33]	15 [38]
Basal Area (sq.ft./ac.)	240	0
Gross Volume (BF/ac.)	31,900	800
Cover (%)	68	3.5
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.0 [0.9]	2.1 [0.6]
Devil's Club	3.0 [0.9]	2.8 [0.9]
Menziesia	6.0 [1.8]	0

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	190 [579]	100-280 [30-85]
Landform		Frequency (%)
Mountain slopes		50
Alluvial		50
Slope Class (%)		Frequency (%)
16-35		50
56-75		50
	Mean	Std. Dev.
Slope Mean (%)	34	12
Soil Depth (cm [in.])		
Mineral Soil		Frequency (%)
> 50 [20]		100
	Mean	Std. Dev.
Imp. Layer Depth	75 [30]	35 [14]
Organic Layer Depth	21 [8.3]	0
Soil Drainage		Frequency (%)
Somewhat Poorly		50
Moderately Well		50
Common Soil Series: Karta and Mitkof.		

ENVIRONMENTAL CHARACTERISTICS

This plant association is not common on the Chatham Area. It occurs from near sea level to just below the mountain hemlock zone on mostly steeper mountain slope landforms where drainage is restricted. Soils are mostly mineral, and somewhat poorly to moderately well drained.

MANAGEMENT IMPLICATIONS

These sites are moderately productive, as reflected by tree heights and gross volumes. Surface and subsurface flow occurs as shown by the abundance of devil's club. Mass wasting is common on volcanic ash soils on slopes steeper than 35 percent on Kruzof Island and in the Sitka area. Windthrow is common.

Regeneration of western hemlock and spruce is abundant but regeneration of cedar is uncommon following clearcutting. Establishing yellowcedar is difficult. Hemlock competition, lower (than hemlock) reproductive rates, and browsing by deer appear to be major factors affecting cedar establishment. Maintenance of cedar following clearcutting in areas of high deer densities requires planting and seedling protection. Alternative silvicultural treatments should be considered to increase natural regeneration success. Possibly leaving seed and understory trees may enhance natural regeneration, especially if advanced hemlock regeneration can be retarded with light soil scarification. See the series introduction for more information.

Following clearcutting, blueberry cover is expected to increase and devil's club cover to decrease. Salmonberry and ferns associated with devil's club may also increase. Understory production declines with canopy closure. Closure is expected to occur later on these sites than on the more productive sites described by Alaback (1982). If the soil is severely disturbed, alder will become established on exposed mineral soils. Sitka alder will establish on steep mountain slopes and red alder on gentle footslopes.

This association is potentially important deer habitat during mild to moderate winters. With deep snow, forage availability is greatly reduced. It is potentially important spring/early summer habitat for deer due to the abundance of succulent herbs at lower elevations.

Brown bear sign and suitable bald eagle nest sites are uncommon.

Surface flooding usually associated with v-notches or drainages can create problems for road and landing locations.

Southeast Alaskan natives use this association for collection of yellowcedar. This wood is used in carving, such as for small totem poles, paddles, and dishes. The roots are used for weaving, basket, and hat construction. Yellowcedar is a very valuable wood, and is highly prized on the Asian lumber market. It resembles a Japanese cedar, no longer readily available, which is used for coffins, temples, and other ceremonial purposes.

WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY
Tsuga heterophylla-Chamaecyparis nootkatensis/Vaccinium spp.

VEGETATION

This moderately productive forest type is dominated by western hemlock and yellowcedar. Sitka spruce may be a minor part of the overstory. Mountain hemlock may be present in the association near transitions to the mountain hemlock zone or mixed conifer associations.

Blueberry dominates the understory. Hemlock regeneration is abundant. Yellowcedar regeneration is less abundant, but occurred in 63 percent of the stands sampled. Bunchberry, five-leaf bramble, deer and oak fern are abundant. Shield fern may occur on well drained open ummocks, but is usually absent or less than 2 percent cover.

Cover of Common Plants (%)
N = 55 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	38	15-63	100
Yellowcedar	24	15-38	100
Blueberry	58	15-85	100
Menziesia	12	0-63	93
Deer Fern	11	0-38	95

Similar Associations
This association may be confused with hemlock-cedar/blueberry-menziesia but menziesia is more abundant in the latter type. The hemlock/blueberry type may also be confused with the cedar type; however, the occurrence of cedar in the overstory serves to distinguish them. While the hemlock-cedar/blueberry plant association is vegetatively different from the hemlock/blueberry plant association, the soils of these two associations are very similar. Until the ecology of yellowcedar in Southeast Alaska is better understood, it appears best to consider these separate plant associations.

Late Seral Stand Structure
Western hemlock and yellowcedar usually do not exceed 100 feet (30 m). Canopy closure is moderate. Understory trees of all sizes are abundant, forming a multi-layered canopy. Snags, especially rot-resistant cedar, are abundant. However, the softer hemlock snags are more valuable for cavity nesters.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	93 [28]	20 [6.1]
DBH (in. [cm])	23 [58]	7.0 [18]
Basal Area (sq.ft./ac.)	303	77
Gross Volume (BF/ac.)	49,600	19,100
Cover (%)	63	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.0 [0.9]	1.0 [0.3]
Menziesia	4.9 [1.4]	1.2 [0.4]
Cover (%)		
Tall Shrubs	60	29
Forbs	55	43
Ferns	24	20

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	653 [199]	70-1500 [21-457]
Landform		**Frequency (%)**
Mountain slopes		84
Hillslopes		12
Slope Class (%)		**Frequency (%)**
0-15		2
16-35		6
36-55		31
56-75		51
76+		10
	Mean	**Std. Dev.**
Slope Mean (%)	49	18
Soil Parent Material		**Frequency (%)**
Compact Till		25
Residuum		16
Colluvium		32
Volcanic		12
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		90
≤ 50 [20]		10
	Mean	**Std. Dev.**
Imp. Layer Depth	58 [23]	32 [13]
Organic Layer Depth	17 [6.7]	8 [3.1]
Soil Drainage		**Frequency (%)**
Poorly		10
Somewhat Poorly		57
Moderately Well		20
Well		14
Common Soil Series: Mitkof and Partofshikof.		

ENVIRONMENTAL CHARACTERISTICS

This plant association is common. It occurs from near sea level to just below the mountain hemlock zone on mostly steeper mountainslope landforms where drainage is restricted.

Soils are mostly mineral, somewhat poorly to moderately well drained, and well developed. Soils on steeper slopes are shallow to bedrock or to compact glacial till, but steep enough to drain laterally. Soils on gentler slopes are frequently deeper, coarse-textured colluvium, able to accommodate excessive water vertically through the profile.

MANAGEMENT IMPLICATIONS

These sites are moderately productive, as reflected by tree heights and gross volumes. Limitations to productivity are largely due to less than optimum soil drainage conditions found either on shallow soils or wet, deep organic soils. Windthrow potential is high due to the shallow soils.

Flooding or excessive subsurface flow usually does not occur. However, mass wasting is common on volcanic ash soils on slopes steeper than 35 percent on Kruzof Island and in the Sitka area.

Regeneration of western hemlock is abundant but regeneration of cedar is uncommon following clearcutting. Establishing yellowcedar is difficult. Hemlock competition, lower (than hemlock) reproductive rates, climatic factors, and browsing by deer appear to be major factors affecting cedar establishment. Maintenance of cedar following clearcutting in areas of high deer densities requires planting and seedling protection. Alternative silvicultural treatments should be considered to increase natural regeneration success. Possibly leaving seed and understory trees may enhance natural regeneration, especially if advanced hemlock regeneration can be retarded with light soil scarification. See series introduction for more information.

Following clearcutting, blueberry cover increases, although more slowly than on better-drained sites. Understory production declines with canopy closure. Closure is expected to occur later on these sites than on the more productive sites described by Alaback (1982; see Chapter 2). This prolonging of the shrub phase is due to poorer drainage. If the soil is severely disturbed, alder will become established on exposed mineral soils. Sitka alder will establish on steep mountain slopes and red alder on gentle footslopes.

This association is potentially important deer habitat during mild to moderate winters. With deep snow, forage availability is greatly reduced. The association is potentially important spring/early summer habitat for deer due to the abundance of succulent herbs at lower elevations.

Deer appear to play an important role in forest dynamics, particularly on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Foraging on cedar seedlings has been hypothesized to be a factor in the distribution of cedar (Hennon et al. 1992). Over the Chatham Area, cedar regeneration is not occurring to the level expected, yet late seral stands of yellowcedar are abundant. In many stands along the outer coast of Baranof, Chichagof, and Kruzof Islands and in isolated stands (e.g. Kruzof inner coast), blueberry has been nearly eliminated from the understory by deer.

These isolated stands become increasingly important to deer as surrounding, more highly productive stands are harvested.

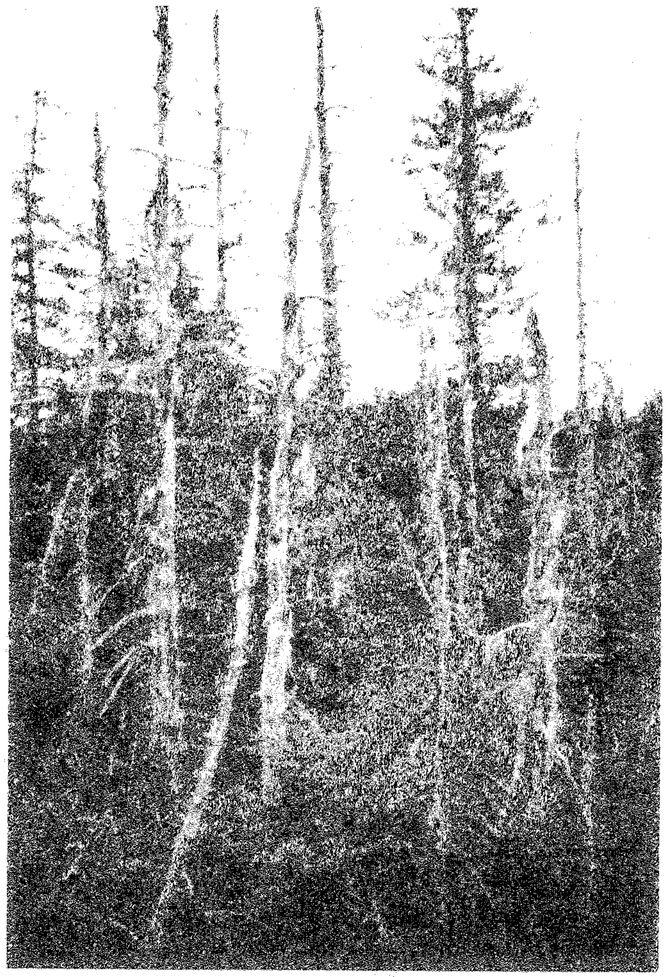
The most striking example of this can be seen at Lindenberg Harbor (north shore, Peril Strait) where a 40+ acre (16 ha) island of this plant association is completely surrounded by a clearcut and the deer concentration within the island is extremely high. Because stands with high vegetation impacts from deer were excluded from the data set, descriptions provided do not reflect plant composition under these conditions. Analysis of these high deer use stands is needed in the future since deer impact on vegetation now appears to be significant and pervasive.

Brown bear foraging and trails and suitable bald eagle nest sites are uncommon.

Road and trail construction in this type is complicated by steep slopes and shallow soils.

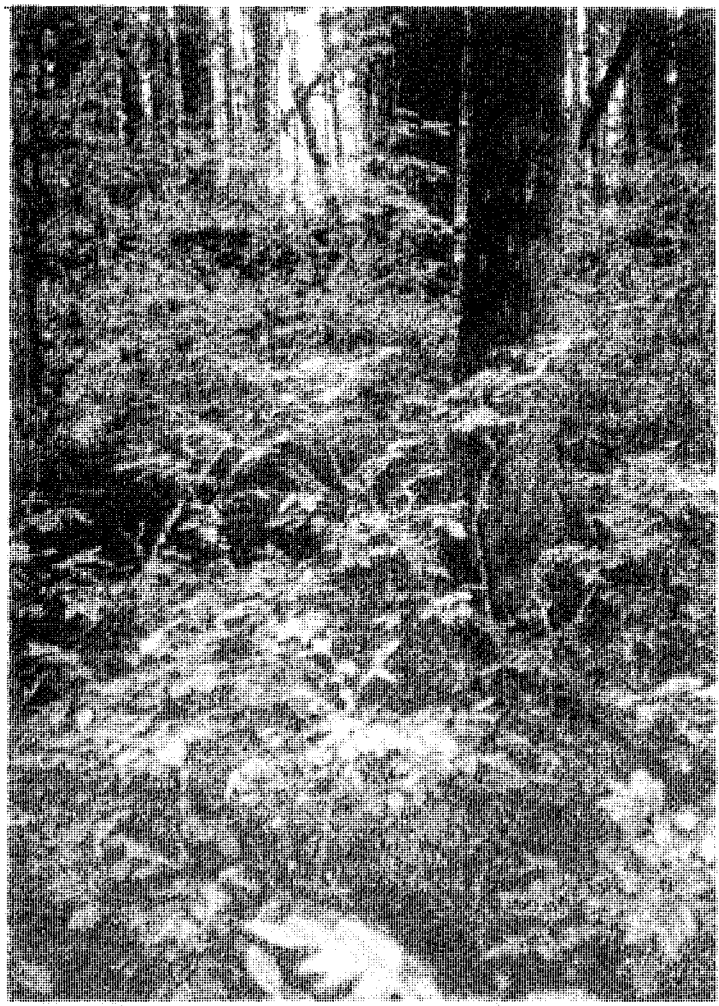
Southeast Alaska natives use this association for collection of yellowcedar.

NOTES:



WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY-MENZIESIA 230

Tsuga heterophylla-Chamaecyparis nootkatensis/Vaccinium* spp.-*Menziesia ferruginea



VEGETATION

This moderately productive forest type is dominated by western hemlock and yellowcedar. Sitka spruce may be a minor part of the overstory. Blueberry and menziesia dominate the understory, with menziesia cover averaging more than double that in the hemlock-cedar/blueberry and devil's club types, and nearly double that of the blueberry/skunk cabbage type.

Hemlock regeneration is abundant. Yellowcedar regeneration is not abundant, occurring in only about half the stands sampled, with spruce regeneration more frequently observed. Bunchberry and five-leaf bramble are the most abundant herbs. Deer and oak fern are abundant, but only occurred in about two-thirds of the sampled stands.

Cover of Common Plants (%)
N = 29 Stands

Species	Mean Cover	Range	Constancy
W. Hemlock	44	15-63	100
Yellowcedar	29	3-63	100
Blueberry	68	38-85	100
Menziesia	42	38-63	100
Oak Fern	13	0-38	69
Deer Fern	7	0-15	69

Similar Associations

This plant association may be confused with hemlock-cedar/blueberry but menziesia cover is greater than 25 percent. The hemlock/blueberry-menziesia plant association is also similar to this type, but the occurrence of cedar in the overstory separates these types. While the hemlock-cedar/blueberry-menziesia plant association is vegetatively different from hemlock/blueberry-menziesia, the soils of these two associations are very similar. Until the ecology of yellowcedar in Southeast Alaska is better understood, it appears best to consider these separate plant associations.

Late Seral Stand Structure

Western hemlock and yellow-cedar trees usually do not exceed 100 feet (30 m). Canopy closure is moderate. Understory trees of all sizes are abundant, forming a multi-layered canopy. Shrub cover is the highest of all associations in this series. Menziesia occurs in a layer above blueberry.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	97 [30]	15 [4.6]
DBH (in. [cm])	21 [53]	6.0 [15]
Basal Area (sq.ft./ac.)	316	87
Gross Volume (BF/ac.)	54,800	24,000
Cover (%)	66	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.7 [0.8]	1.0 [0.3]
Menziesia	5.5 [1.7]	1.0 [0.3]
Cover (%)		
Tall Shrubs	91	50
Forbs	57	34
Ferns	26	20

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	465 [142]	30-940 [9-287]
Landform		**Frequency (%)**
Mountain slopes		73
Hillslopes		19
Slope Class (%)		**Frequency (%)**
16-35		4
36-55		46
56-75		31
76+		19
	Mean	**Std. Dev.**
Slope Mean (%)	52	26
Soil Parent Material		**Frequency (%)**
Compact Till		25
Colluvium		32
Volcanic		13
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		71
≤ 50 [20]		29
	Mean	**Std. Dev.**
Imp. Layer Depth	40 [16]	33 [13]
Organic Layer Depth	20 [7.9]	9 [3.5]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		12
Poorly		8
Somewhat Poorly		35
Moderately Well		27
Well		19
Common Soil Series: McGilvery and Mosman.		

ENVIRONMENTAL CHARACTERISTICS

This plant association is common. It occurs from near sea level to near the mountain hemlock zone, usually on steep mountainslope landforms.

Soils are mostly mineral, somewhat poorly to moderately well drained, well developed, and shallow. Most of the soil pits in this plant association were shallow, while most soils in hemlock-cedar/blueberry were deep.

MANAGEMENT IMPLICATIONS

These sites are moderately productive, as reflected by tree heights and gross volumes. Limitations to productivity are largely due to soils being shallow over bedrock or glacial till. Windthrow potential is high due to the shallow soils.

Soils are not disturbed by flooding or excessive subsurface flow as shown by the abundance of blueberry and the lack of salmonberry, devil's club, and skunk cabbage (indicators of such hydrologic regimes). However, mass wasting is common on volcanic ash soils on slopes greater than 35 percent in the Kruzof Island and Sitka area.

Following clearcutting, regeneration of western hemlock is abundant, but regeneration of cedar is uncommon. Establishing yellowcedar is difficult due to its less effective (than hemlock) reproductive strategy, browsing by deer, and competition from advanced hemlock regeneration. Maintenance of cedar following clearcutting in areas with high deer densities requires planting and seedling protection. Alternative silvicultural treatments should be considered to increase natural regeneration success. Possibly leaving seed and understory trees may enhance natural regeneration, especially if advanced hemlock regeneration can be retarded with light soil scarification. See series introduction for more information.

Blueberry vegetative and fruit production typically increases after clearcutting. If the soil is severely disturbed, alder will become established on exposed mineral soils. Sitka alder will establish on steep mountain slopes and red alder on gentle footslopes.

Understory production declines with canopy closure. Closure is expected to occur later on these sites than on the more productive sites described by Alaback (1982; see Chapter 2). This extension of the shrub phase is due to the poorer drainage and shallow soils.

This association is potentially important deer habitat during mild winters. During deep snow, forage availability is greatly reduced. The association is potentially important spring/early summer habitat for deer due to the abundance of succulent herbs at lower elevations.

Deer appear to play an important role in forest dynamics, particularly on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Foraging on cedar seedlings has been hypothesized to be a factor in the distribution of cedar (Hennon 1992). Over the Chatham Area, cedar regeneration is not occurring to the level expected, yet late seral stands of yellowcedar are abundant. In many stands along the outer coast of Baranof, Chichagof, and Kruzof Islands and in stands isolated by water, peatlands, or timber harvest (e.g., Kruzof inner coast, Todd area of Peril Strait north shore), blueberry has been nearly eliminated from the understory by deer. Since stands with high vegetation impacts from deer were excluded from the data set, descriptions do not reflect plant composition under these conditions.

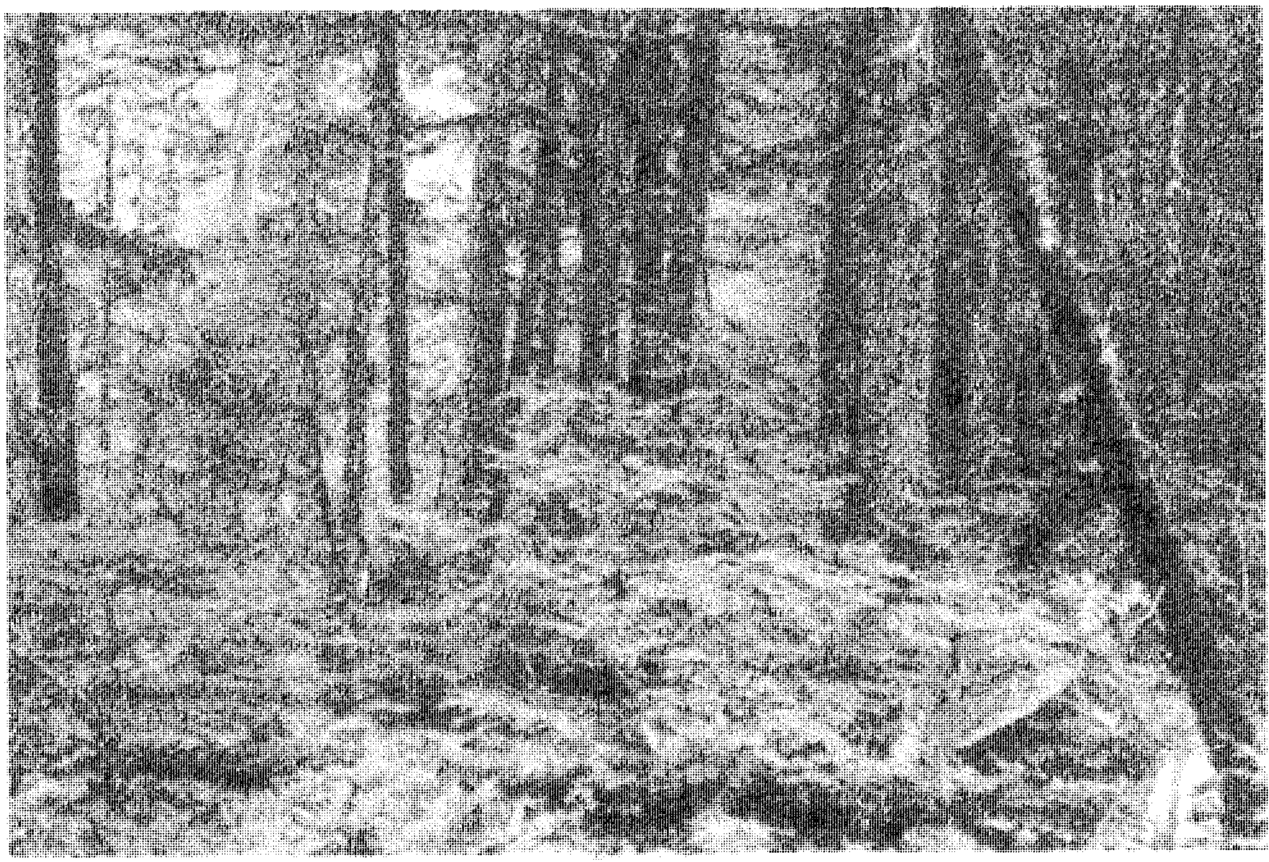
Brown bear sign and suitable bald eagle nest sites are uncommon.

Road and trail construction should mitigate for shallow soils and potential mass wasting.

Recreational and subsistence uses of these sites are limited. They serve as a source for yellowcedar and blueberries.

WESTERN HEMLOCK-YELLOWCEDAR/BLUEBERRY/SKUNK CABBAGE

Tsuga heterophylla-Chamaecyparis nootkatensis/Vaccinium spp./ Lysichitum americanum



VEGETATION

This moderately productive plant association is dominated by western hemlock and yellowcedar. Sitka spruce may be a minor part of the overstory. Mountain hemlock may be present in this association near transitions to the mountain hemlock zone or to mixed conifer associations.

Blueberry and menziesia dominate the understory. Skunk cabbage is characteristic and averaged 26 percent cover in the sampled stands. Hemlock regeneration is abundant. Yellowcedar regeneration is not abundant, and only was found in about two-thirds of the stands sampled.

Cover of Common Plants (%)
N = 17 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	37	15-65	100
Yellowcedar	29	15-85	100
Blueberry	50	15-65	100
Menziesia	23	3-65	100
Skunk Cabbage	26	3-65	100

Similar Associations

This plant association may be confused with mixed conifer/blueberry/skunk cabbage but, in that association, mountain hemlock is more abundant, at least 5 percent. The western hemlock/blueberry/skunk cabbage plant association is also similar to the hemlock-yellowcedar/blueberry/skunk cabbage. The occurrence of cedar in the overstory separates these types. While the cedar association is vegetatively different from hemlock/blueberry/skunk cabbage, the soils of these two associations are very similar. Until the ecology of yellowcedar in Southeast Alaska is better understood, it appears best to consider these separate plant associations.

Late Seral Stand Structure

Western hemlock and yellowcedar usually do not exceed 95 feet (29 m). Canopy closure is moderate. Understory trees of all sizes are abundant, forming a multi-layered canopy. Shrub cover is lower than in the hemlock-cedar/blueberry-menziesia and hemlock-cedar/blueberry plant associations. Fern cover is the lowest of all the hemlock-cedar plant associations. Snags, especially rot-resistant cedar, are abundant. The softer hemlock and spruce snags, however, are preferred by cavity nesters.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	87 [27]	21 [6.4]
DBH (in. [cm])	19 [48]	9.0 [23]
Basal Area (sq.ft./ac.)	303	100
Gross Volume (BF/ac.)	46,500	24,800
Cover (%)	61	14
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.1 [0.9]	1.1 [0.3]
Menziesia	5.9 [1.8]	1.0 [0.3]
Cover (%)		
Tall Shrubs	52	28
Forbs	63	28
Ferns	14	10

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	412 [126]	40-1450 [12-441]
Landform		**Frequency (%)**
Hill-Mountain slopes		53
Footslopes/Fans		35
Lowlands		12
Slope Class (%)		**Frequency (%)**
0-15		6
16-35		41
36-55		35
56-75		18
	Mean	**Std. Dev.**
Slope Mean (%)	28	18
Soil Parent Material		**Frequency (%)**
Compact Till		50
Alluvium		25
Colluvium		12
Volcanic		13
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	67 [26]	33 [13]
Organic Layer Depth	41 [16]	22 [8.7]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		24
Poorly		41
Somewhat Poorly		29
Moderately Well		6
Common Soil Series: Kasiana, Wadleigh, and South Bight.		

ENVIRONMENTAL CHARACTERISTICS

This plant association is abundant. It occurs from sea level to near the mountain hemlock zone on benches or gentle sloping landforms. It is common along the edge of old alluvial fans and floodplains and at the base of footslopes.

Soils are poorly drained as a result of several conditions. Most commonly, compact till or volcanic ash forms an impermeable layer which restricts water movement. On deep soils formed in colluvium or alluvium, excessive water received from neighboring slopes saturates the soil. Since the soils are mostly fine textured and/or organic, moisture is retained. These conditions will vary depending on slope and local precipitation. Skunk cabbage indicates the soil is wet within 50 cm (20 in.) of the surface throughout the growing season.

MANAGEMENT IMPLICATIONS

These sites are moderately productive, as reflected by tree heights and gross volumes. Limitations to productivity include poor soil drainage and the abundance of wet microsites unsuitable for trees. Trees usually occupy the more well drained positions than the microsites with skunk cabbage. Windthrow potential is high due to the wet soils.

While this plant association is not classified as a forested wetland (DeMeo et al. 1989), the index number is borderline. Given the abundance of skunk cabbage and organic soils in this association, wetland status should be determined on a project basis. On benches and lowlands, the association is likely to be wetland while, on slopes, it may be upland.

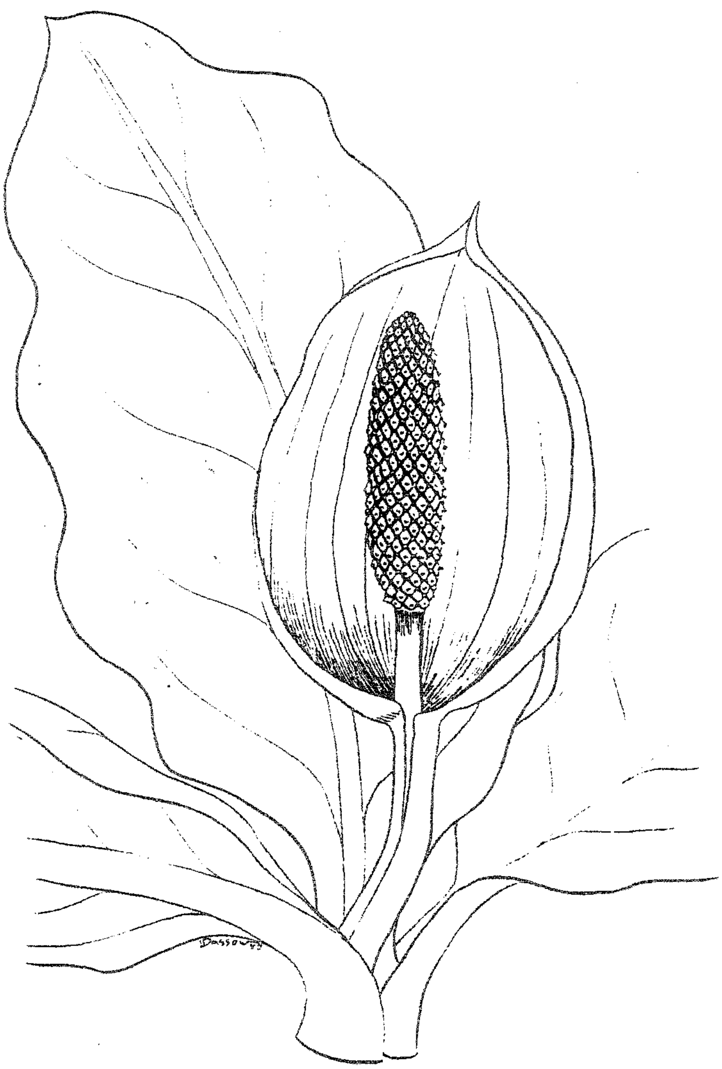
Soils are stable, but on mountainslope benches, water accumulation following storms can trigger a slide. Slides are common on volcanic ash soils on slopes greater than 35 percent in the Kruzof Island and Sitka area.

Following clearcutting, regeneration of western hemlock is abundant, but regeneration of cedar is uncommon. Establishing yellowcedar is difficult due to its less effective (than hemlock) reproductive strategy, browsing by deer, and the typically abundant advanced regeneration of hemlock. Maintenance of cedar following clearcut logging in areas with high deer densities requires planting and seedling protection. Alternative silvicultural treatments should be considered to increase natural regeneration success. Possibly leaving seed and understory trees may enhance natural regeneration, especially if advanced hemlock regeneration can be retarded with light soil scarification. See series introduction for more information.

Following clearcutting, blueberry vegetative and fruit production typically increases. If the soil is severely disturbed, alder will become established on exposed mineral soils. Sitka alder will establish on steep mountain slopes and red alder on gentle footslopes. However, the large accumulation of soil organic matter typical in this association reduces the chance of exposing mineral soils.

Understory production declines with canopy closure. Closure is expected to occur later on these sites than on the more productive sites described by Alaback (1982; see Chapter 2). This extension of the shrub phase is due to the poorer drainage and the abundance of wet, mucky skunk cabbage microsites, which are not suited for conifers.

Deer appear to play an important role in forest dynamics in this association, particularly on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Foraging on cedar seedlings has been hypothesized to be a factor in the distribution of cedar (Hennon 1992). Over the Chatham Area, cedar regeneration is not occurring to the level expected, yet late seral stands of yellowcedar are abundant. In many stands along the outer coast of Baranof, Chichagof, and Kruzof Islands, and in isolated stands (e.g., Kruzof inner coast, Todd area on Peril Strait), blueberry has been nearly eliminated from the understory by deer. Because stands with high vegetation impacts from deer were excluded from the data set, the descriptions provided do not reflect plant composition under these conditions.



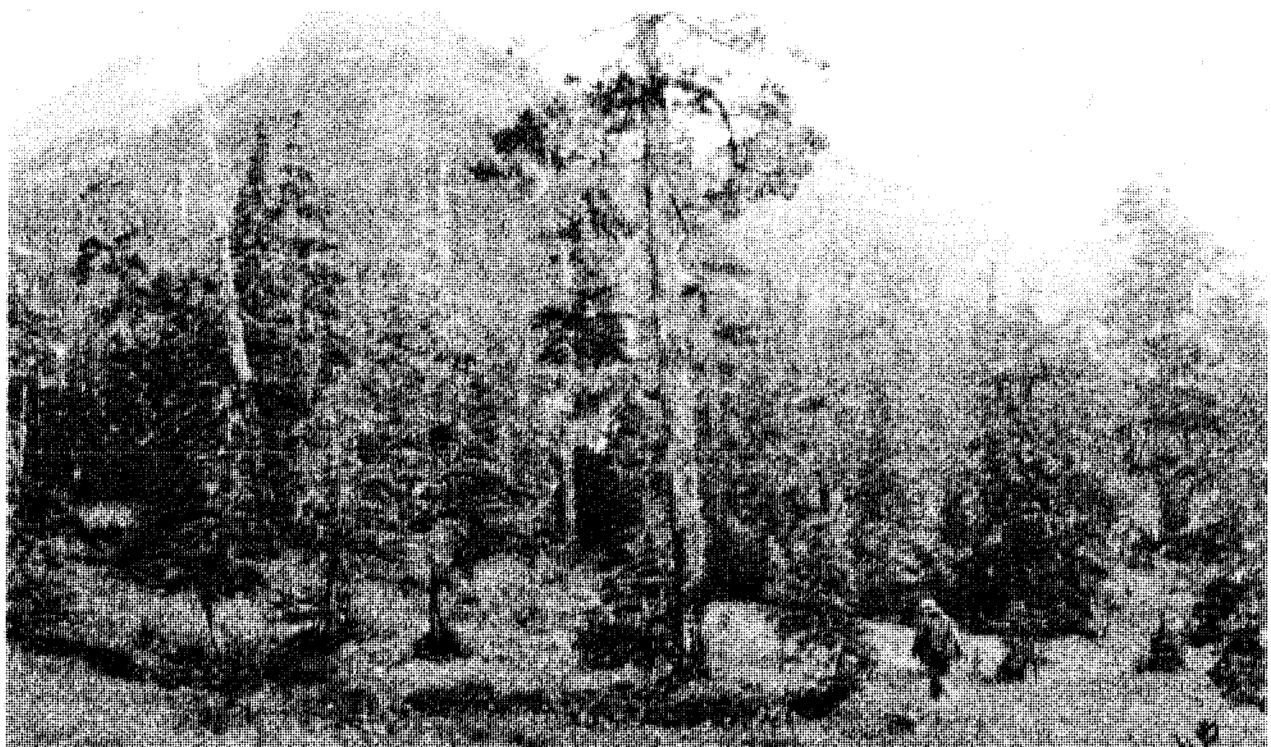
Skunk Cabbage
Lysichitum americanum

This association is potentially important deer habitat during mild winters. With deep snow, forage availability is greatly reduced. The association is important spring habitat for deer and bear due to the abundance of skunk cabbage. Suitable bald eagle nest sites are uncommon.

Road and trail construction success is limited by poor drainage on these sites. Wet skunk cabbage microsites should be avoided. Logging systems should be designed to use as much deflection as possible.

This association is used by Southeast Alaska natives for collection of yellowcedar and skunk cabbage.

MIXED CONIFER SERIES



9
MIXED CONIFER SERIES

Description

Mountain hemlock, yellowcedar, and western hemlock codominate in the typically open, low-stature late seral stands in this series. Shore pine and Sitka spruce occur in small amounts. Sitka spruce may be the tallest species, but usually appears stressed (yellow needles). Red alder is uncommon. Overstory cover ranges from 30 to 50 percent. Multiple canopy layers are common but often indistinguishable due to the openness of the canopy. Heights of dominant and codominant trees vary from 50 to 75 feet (15-23 m) and diameters vary from 15 to 20 inches (38-51 cm). Ages of dominant trees will often range from 150 to well over 300 years. Yellowcedar trees may exceed 1000 years in age. Dead tops, bole rot, and other age indicators are common. Arboreal lichens, particularly *Alectoria* species, are abundant on open grown trees.

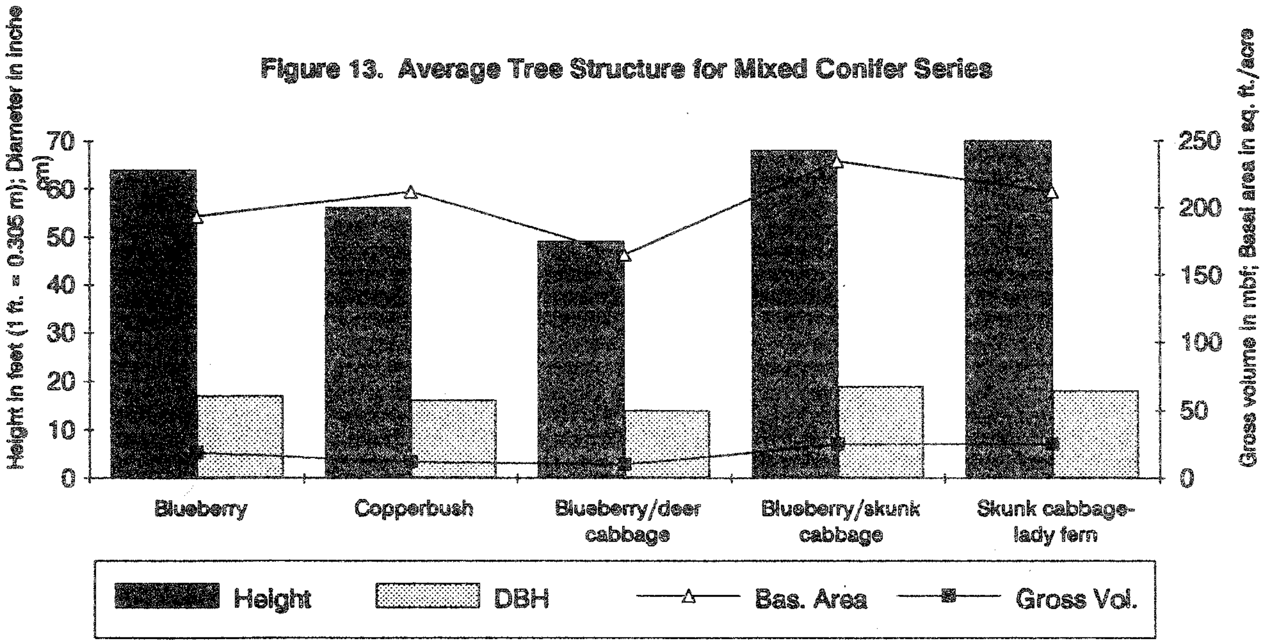
Shrub cover may reach 100 percent. Forb cover is usually greater than 30 percent and on skunk cabbage sites may exceed 75 percent. Blueberry and rusty menziesia are the most common shrubs and skunk cabbage, five-leaf bramble, and bunchberry are the most common forbs. Deer fern is the most common fern. Sedges dominate some of the most open, wet plant associations.

The five associations in this series are presented in order of increasingly poor soil drainage, since soil moisture appears to be the dominant environmental factor affecting association distribution. Figure 13 compares tree sizes among the associations. While the skunk cabbage-lady fern type has the poorest drainage, the soils in these stands are typically a mosaic of moving water areas and stagnant water areas, and trees grow relatively well in the better drained portions of the mosaic. The blueberry/skunk cabbage type also often shows a soil mosaic with best tree growth on the better drained soils.

Because of the shorter tree heights and open canopy in this series, windthrow is infrequent. Down woody material is less common than in more productive associations, and is relatively small. Decomposition rates are slow on the poorly drained soils, especially for cedar. Cedar logs hundreds of years old have been excavated from deep organic soils on these sites. Down wood provides raised, better drained microsites which are extremely important for regeneration of all tree species on these wet soils. Snags are abundant but generally small. Cedar die-back reported by Hennon (1992) is common.

The concept of a mixed species series has been used in the southern Pacific Coast coniferous forest zone where many productive sites remain in a mixed conifer condition due to frequent fires. In Southeast Alaska, mixed conifer forests are generally unproductive and not disturbed by fire. These forests remain open and dominated by a variety of trees due to poor growing conditions.

Figure 13. Average Tree Structure for Mixed Conifer Series



Since stand level blowdown or fire is uncommon and few trees have been harvested in this series, little is known about secondary plant succession. Some anthropogenic fire origin stands occur throughout Southeast Alaska. Observations of fire origin stands in Behm Canal (60 years old), south Etolin Island (300 years old), and at Goddard Hot Springs (70 years old) indicate canopy closure and understory exclusion may only occur in small clumps in these stands. Tree growth on these sites is slow. Hence, a longer time period is expected to achieve late seral conditions. The 300 year old stand on south Etolin Island had only one age and size class of trees. Small scale gaps, formed by normal tree mortality, appear to be the most important disturbance mechanism in this series.

Soils are typically deep and organic. Compact till, shallow unfractured bedrock, concave landforms, volcanic ash, and placic horizons are the primary drainage impeding features. Water storage and slow rates of discharge due to the high organic soils on gentle topography may be important watershed functions provided by these sites.

Deer and bear use this type heavily during the spring, especially the skunk cabbage associations. Down wood may provide fish habitat when the associations occur near streams. Due to limited snow interception by the open canopies, heavy winter use by deer and mountain goats is precluded.

Interior patch conditions associated with closed canopy forest generally do not occur in mixed conifer stands. Indeed, temperature, wind, and humidity cycles may be more extreme (Boughton et al. 1992). Hence in this series, when managing for ecosystem sustainability, maintaining interior late-seral forest conditions is less important. However, stand size considerations in conjunction with other forest types may be important since mixed conifer associations can act as buffers around closed canopy forests.

Distribution

The mixed conifer series is very abundant in Southeast Alaska. On large islands (e.g., Baranof, Kruzof, and Prince of Wales Islands), this series occupies a greater portion of their southern than northern halves. Apparently more rain is intercepted on the southern sides due to an orographic effect as the major southeasterly storms move up the coast. For example, the rainfall on southern Baranof exceeds 200 inches/year, while the rainfall at Hoonah is less than half that. Likewise, there appears to be an west-east gradient with Sitka receiving nearly 100 inches/year and Angoon receiving less than 50 inches/year.

The mixed conifer type occurs below the mountain hemlock series to sea level. It occurs primarily on flat to gently sloping lowlands up to 1500 feet (457 m). To a lesser extent, it occurs on steeper slopes where soils are very shallow over unfractured bedrock, especially in high rainfall areas. Mixed conifer associations often occur in transition zones between more productive forest and non-forested peatlands (muskeg). Figure 14 shows the general landscape position and distribution for the five associations.

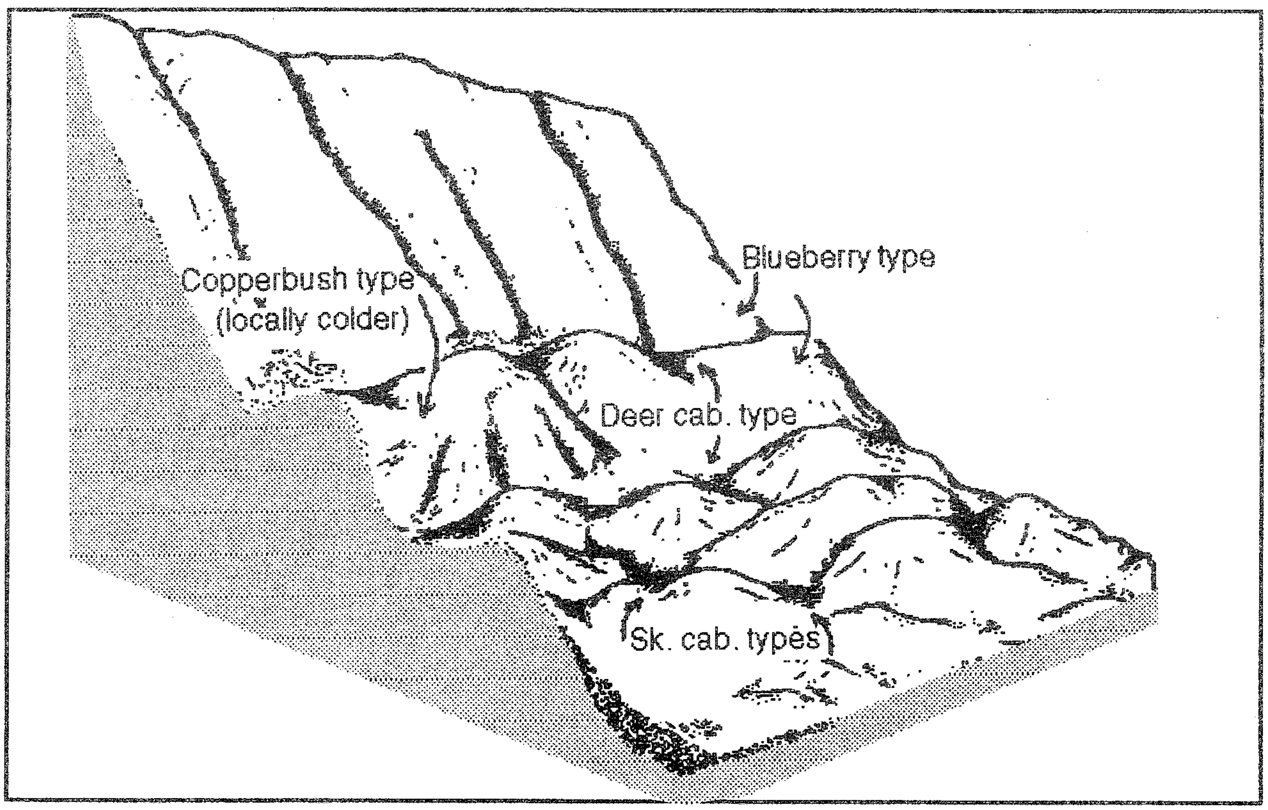
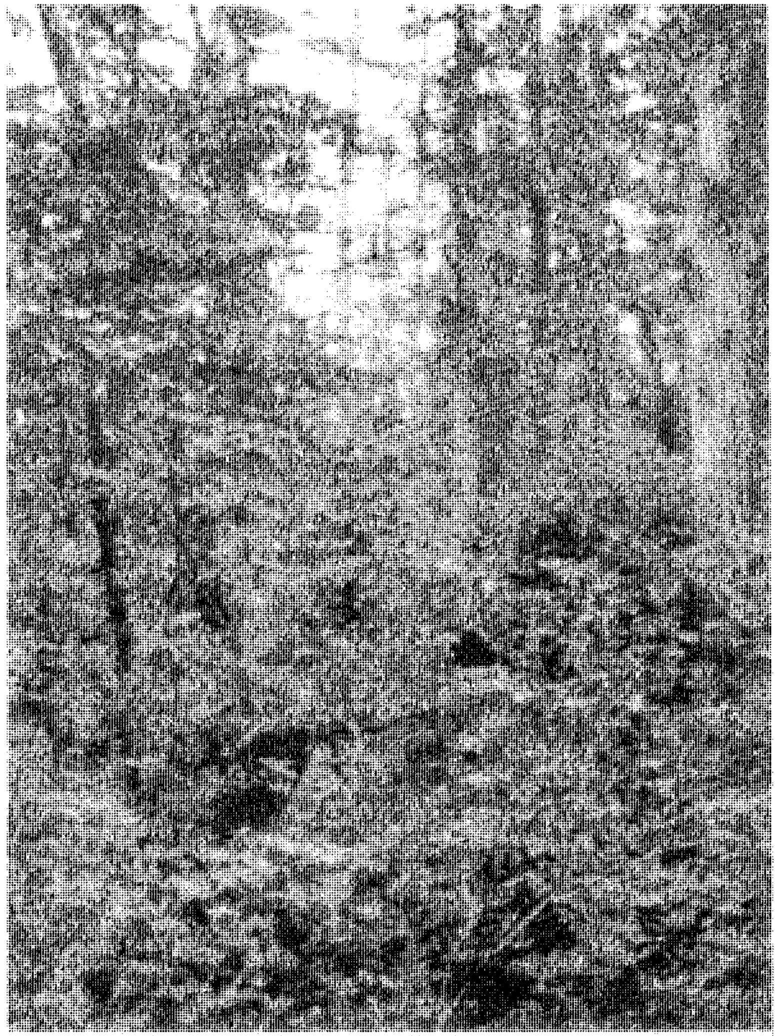


Figure 14. Generalized Landscape Positions for Mixed Conifer Associations



VEGETATION

This plant association features a mix of overstory species. Because the association is found on sites with shallow soils, restricted drainage, or other low productivity conditions, trees do not grow well. Western and mountain hemlock are the most common overstory trees. Yellowcedar is an important overstory tree in about half the stands. Sitka spruce may be a minor component.

Blueberry and menziesia are the dominant shrubs. Western and mountain hemlock regeneration is abundant. Yellowcedar trees occurred in about one-third of the understories sampled. Bunchberry, five-leaf bramble, and fern-leaf goldthread are abundant. Deer fern is the most common fern.

Cover of Common Plants (%)
N = 51 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	19	0-38	94
Mountain Hemlock	18	0-38	88
Yellowcedar	17	0-38	51
Blueberry	69	15-98	100
Menziesia	23	0-63	94

Similar Associations

This type has the best drainage of the mixed conifer associations and may be confused with hemlock-cedar associations. However, the occurrence of mountain hemlock and lower productivity in the mixed conifer associations distinguishes it.

Late Seral Stand Structure

Stand height is usually less than 70 feet (21 m). Understory trees of all heights are abundant, forming a multi-layered canopy. Menziesia usually grows above blueberry.

These stands are open. Shrub cover approaches 100 percent in some stands. Forbs are abundant. Down logs and snags are small, less common than in more dense stands, and mostly decay-resistant yellowcedar.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	64 [20]	14 [4.3]
DBH (in. [cm])	17 [43]	5.9 [15]
Basal Area (sq.ft./ac.)	194	97
Gross Volume (BF/ac.)	19,300	11,600
Cover (%)	42	11
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.8 [1.2]	1.1 [0.3]
Menziesia	5.9 [1.8]	1.4 [0.4]
Cover (%)		
Tall Shrubs	74	46
Low Shrubs	11	8
Forbs	38	24
Ferns	7	11

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	711 [217]	150-1500 [46-457]
Landform		Frequency (%)
Mountainslopes		63
Hillslopes		27
Slope Class (%)		Frequency (%)
0-15		2
16-35		13
36-55		54
56-75		17
76+		15
	Mean	Std. Dev.
Slope Mean (%)	41	23
Soil Parent Material		Frequency (%)
Compact Till		37
Residuum		9
Colluvium		12
Organic Material		12
Volcanic		9
Soil Depth (cm [in.])		
Mineral Soil		Frequency (%)
> 50 [20]		64
≤ 50 [20]		36
	Mean	Std. Dev.
Imp. Layer Depth	37 [15]	31 [12]
Organic Layer Depth	18 [7.1]	10 [3.9]
Soil Drainage		Frequency (%)
Very Poorly Drained		6
Poorly		21
Somewhat Poorly		40
Moderately Well		15
Well		19

Common Soil Series: McGilvery, Isidor, Verstovia, Kasiana, and Partofshikof.

ENVIRONMENTAL CHARACTERISTICS

This plant association is abundant on moderately steep slopes from sea level to near the mountain hemlock zone on mountain and hill landforms.

Soils are generally shallow and drainage is variable. Compact till, bedrock weathered in place (residuum), organics over bedrock, and shallow colluvium are the most common parent materials. Volcanic ash in the Mt. Edgecumbe and Sitka areas is also common.

MANAGEMENT IMPLICATIONS

Productivity is low, limited by poor soils. Windthrow potential is low due to the small stature of mature trees and open canopy.

Soils are stable, but, following large storms mixed conifer sites on steep, shallow soils are subject to failure. Slides are especially common on volcanic ash soils on slopes greater than 35 percent on Kruzof Island and in the Sitka area.

Regeneration of western and mountain hemlock is abundant. On about one-third of the sampled sites, yellowcedar was also abundant. Sitka spruce seedlings occurred in about half the sampled sites, in small amounts. Regeneration growth rates are slow due to poor soils and, occasionally, dense blueberry and menziesia following clearcutting. Regeneration of cedar is uncommon after clearcutting. Establishing yellowcedar can be difficult due to its poor competition with other conifers, erratic seed crops, and browsing by deer (see Chapter 8 introduction).

Following clearcutting, blueberry and menziesia may maintain dominance for at least 30 years. As tree cover increases, understory production is expected to decline but not to the degree seen in the hemlock and hemlock-cedar associations. Overall, the shrub sere persists longer than in the more productive series. Conifer growth is much slower than on well-drained sites.

This association is not considered important deer winter habitat. With deep snow, forage availability is greatly reduced. Deer influence vegetation composition on the warmer wintering areas along the outer west coast of Chichagof, Kruzof, and Baranof Islands. In these areas, blueberry is nearly absent due to overbrowsing by deer. Menziesia, a less preferred forage species, is abundant Hemlock and cedar seedlings are also overbrowsed. These conditions are rare on colder deer wintering areas on the inner coast and mainland.

Suitable bald eagle nest sites are uncommon. River otters prefer this type for natal denning when it occurs within one-half mile of saltwater (Woolington 1984).

Due to the wet and occasionally unstable soils, road and trail construction should be avoided where possible. On some sites, shovel yarding may be an option.

Due to the open nature of these stands, they may be used by hikers, skiers, and hunters. Subsistence uses of the association include berry picking and collection of yellowcedar.

MIXED CONIFER/COPPERBUSH 491

Mixed Conifer/*Cladothamnus pyrolaeflorus*

VEGETATION

This plant association is a mix of open forest and peatland (muskeg) plant species. Mountain hemlock and yellowcedar are the dominant overstory trees. Western hemlock occurred in about half the sampled stands in limited amounts. Spruce is an occasional component. Both western hemlock and spruce are stressed on these sites as indicated by chlorotic (yellowed) needles. Among the stands sampled in the mixed conifer series, this is the only association where shore pine occurred in the overstory.

Copperbush and blueberry are the dominant forest shrubs. Crowberry, mountain cranberry, and bog blueberry are the most common bog-type shrubs. Understory cedar and mountain hemlock are common, while understory western hemlock is less common than in any other mixed conifer association. Deer cabbage and lady fern are the most abundant forb and fern, respectively. Graminoids are abundant.

Cover of Common Plants (%)
N = 22 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	5	0-15	59
Mountain Hemlock	18	0-65	91
Yellowcedar	19	0-40	77
Blueberry	37	3-85	100
Copperbush	28	15-65	100
Deer Cabbage	16	0-65	68

Similar Associations

The mixed conifer/copperbush plant association is most similar to the mountain hemlock/copperbush/ cassiope plant association. However, the mixed conifer/copperbush plant association is distinctive in three ways: 1) it is usually found at lower elevations; 2) mountain hemlock is overstory codominant; and 3) cassiope is not abundant.

Late Seral Stand Structure

Dominant trees are usually less than 60 feet (18 m). Stands are very open. Basal area and tree diameters are low.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	56 [17]	19 [5.8]
DBH (in. [m])	16 [41]	7.2 [18]
Basal Area (sq.ft./ac.)	212	115
Gross Volume (BF/ac.)	12,200	9,900
Cover (%)	32	12
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.2 [1.0]	1.0 [0.3]
Menziesia	4.0 [1.2]	0.6 [0.2]
Cover (%)		
Tall Shrubs	64	28
Forbs	51	57
Ferns	10	6

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	752 [229]	80-1710 [24-521]
Landform		**Frequency (%)**
Mountainslopes		81
Hillslopes		10
Lowlands		10
Slope Class (%)		**Frequency (%)**
0-15		5
16-35		24
36-55		57
76+		14
	Mean	**Std. Dev.**
Slope Mean (%)	41	14
Soil Parent Material		**Frequency (%)**
Compact Till		53
Granite		12
Colluvium		17
Volcanic		12
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		83
≤ 50 [20]		17
	Mean	**Std. Dev.**
Imp. Layer Depth	50 [20]	33 [13]
Organic Layer Depth	18 [7.1]	9 [3.5]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		10
Poorly		29
Somewhat Poorly		52
Moderately Well		10
Common Soil Series: Kasiana and Yakutat.		

ENVIRONMENTAL CHARACTERISTICS

This plant association is common on moderately steep slopes, from sea level to just below the mountain hemlock zone, where it grades into the mountain hemlock/copperbush plant association. This association is most common in low elevation, locally colder areas, as indicated by the abundant copperbush. These conditions are common in the interior of Chichagof and Baranof Islands in upper watershed positions. For example, the plant association is more common in upper Tenakee Inlet on the cooler south side than on the warmer north shore or near the mouth of the inlet.

Soils are somewhat poorly to poorly drained. Organic matter is deep, but less deep than in skunk cabbage or deer cabbage types. Compact till is the most common parent material. Volcanic ash is common in the Mt. Edgecumbe and Sitka area. Few microsites are sufficiently drained to support tree establishment; most trees establish on old logs or stumps.

MANAGEMENT IMPLICATIONS

Productivity is the second lowest of the series. These sites are not suited for timber management due to the poor soils and few suitable tree-growing sites. Windthrow is uncommon due to the open canopy and low stature of the trees.

Due to the abundance of deer cabbage and other forbs, this association is used by deer in the spring, summer, and fall. An abundance of a wide variety of forbs and flowers provide food for many animal species. Brown bear sign is common.

Road and trail construction success is limited by the wet soils and moderately steep slopes.

Copperbush
Cladothamnus pyrolaeflorus

MIXED CONIFER/BLUEBERRY/DEER CABBAGE 430
Mixed Conifer/*Vaccinium* spp./*Fauria crista-galli*

VEGETATION

This plant association is a mix of open forest and peatland (muskeg) plant species. Mountain hemlock and yellowcedar dominate the overstory. Western hemlock and Sitka spruce are common, but are stressed, as indicated by chlorotic (yellowed) needles.

Blueberry and menziesia are the dominant forest shrubs. Crowberry, mountain cranberry, Labrador tea, and bog kalmia are the most common bog-type shrubs. Mountain hemlock is more abundant than western hemlock in the understory. Cedar and spruce occurred in the understory in over two-thirds of the sampled stands. Shore pine occurred only in the understory, and only in 10 percent of the sampled stands. Deer cabbage and bunchberry are the most abundant forbs. Sedges are abundant.

Cover of Common Plants (%)
N = 21 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	7	0-15	86
Mountain Hemlock	10	0-15	86
Yellowcedar	18	0-40	86
Blueberry	53	15-85	100
Menziesia	18	3-40	100
Crowberry	13	0-40	33
Mountain Cranberry	9	0-25	33
Deer Cabbage	20	0-65	90

Similar Associations
This association is most similar to the mountain hemlock/blueberry/deer cabbage plant association. However, mountain hemlock associations usually occur at higher elevations; and low-growing bog shrubs that are common to the mixed conifer association are uncommon in the mountain hemlock association. Within the mixed conifer series, the deer cabbage type is more open and more like peatland (muskeg) than the blueberry or blueberry/skunk cabbage types.

Late Seral Stand Structure
Within this series, the mixed conifer/blueberry/deer cabbage association is the most open and has the lowest tree volume/acre. Dominant trees are usually less than 55 feet (17 m) tall. Tree diameters and basal area are low. Of all the trees in this association, cedar attains the largest stature. Low shrubs, grasses, and sedges are common.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	49 [15]	13 [4.0]
DBH (in. [cm])	14 [36]	4.9 [12]
Basal Area (sq.ft./ac.)	165	93
Gross Volume (BF/ac.)	9,800	8,300
Cover (%)	29	10
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.9 [0.9]	1.0 [0.3]
Menziesia	4.4 [1.3]	1.3 [0.4]
Cover (%)		
Tall Shrubs	67	37
Low Shrubs	21	13
Forbs	87	44
Ferns	10	13
Grasses	19	26
Sedges	23	24

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	469 [143]	100-920 [30-280]
Landform		**Frequency (%)**
Mountainslopes		55
Hillslopes		15
Lowlands		25
Slope Class (%)		**Frequency (%)**
16-35		45
36-55		40
56-75		10
76+		5
	Mean	**Std. Dev.**
Slope Mean (%)	22	16
Soil Parent Material		**Frequency (%)**
Compact Till		39
Compact Ash		11
Colluvium		11
Organic Material		17
Volcanic		16
Soil Depth (cm [in.])		
Mineral Soil		Frequency (%)
> 50 [20]		63
≤ 50 [20]		37
	Mean	**Std. Dev.**
Imp. Layer Depth	45 [18]	37 [15]
Organic Layer Depth	31 [12]	27 [11]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		25
Poorly		45
Somewhat Poorly		25
Moderately Well		5
Common Soil Series: Wadleigh, South Bight, and Kasiana.		

ENVIRONMENTAL CHARACTERISTICS

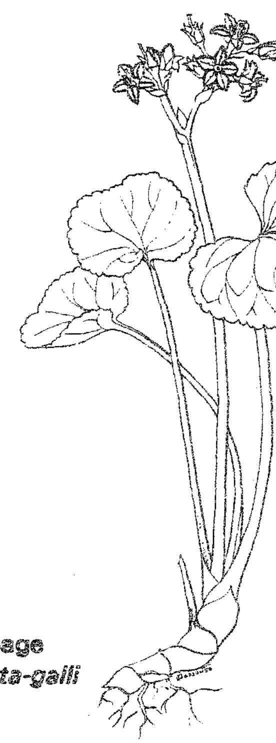
The mixed conifer/blueberry/deer cabbage plant association is abundant. It occurs from sea level to just below the mountain hemlock zone. Compact glacial till and organic matter comprise most of the soil parent material. Volcanic ash is common in the Mt. Edgecumbe and Sitka area.

Soils are poorly drained. Excessive groundwater from neighboring slopes accumulates on these sites. Soils are typically saturated to the surface, as indicated by the abundant sedges. Few well-drained, tree-growing microsites exist; most are on old logs.

MANAGEMENT IMPLICATIONS

Productivity is the lowest in the series. These sites are not suited for timber management due to the poor soils and few suitable tree-growing sites. This association is classified as a forested wetland (DeMeo et al. 1989). Blowdown is uncommon due to the open canopy and low stature of the trees.

Little is known about stand development following clearing in these sites. The only known stand level disturbances are a result of human-caused fires during drought years. Examples of this are the 1930s Goddard Hot Springs (Baranof Island) burn and a late 1600s burn on south Etolin Island. In these examples, canopy closure did not occur, but the forest remained open with shifts occurring in species composition. In some cases, burning appears to make sites more productive. Further investigations should be completed on these burn sites to document post-fire succession.



Deer Cabbage
Fauria crista-galli

This association is good spring, summer, and fall habitat for deer due to the abundance of deer cabbage and other forbs. Yellow-legs and Vancouver Canada geese use these sites for nesting. An abundant and wide variety of fruits and flowers provide food for many animal species. Brown bear sign is common.

Special road and trail construction measures (rock overlay or boardwalk) are required in these sites due to the extremely wet soils and the likelihood of adversely affecting site hydrology. Soils are subject to puddling and are not trafficable.

Recreational and subsistence uses include collection of blueberries, cranberries, and crowberries.

MIXED CONIFER/BLUEBERRY/SKUNK CABBAGE

420

Mixed Conifer/*Vaccinium* spp./*Lysichitum americanum*

VEGETATION

A mix of tree species characterizes this moderately open plant association. Western and mountain hemlock are the most common overstory trees. Yellowcedar was an important overstory tree in about half the sampled stands. Sitka spruce may be a minor part of the overstory.

Blueberry and menziesia are the dominant shrubs. Mountain and western hemlock regeneration occurs in most stands. Sitka spruce regeneration occurred in about two-thirds of the sampled stands and yellowcedar regeneration in about one-third of the stands. Skunk cabbage is the dominant forb.

Cover of Common Plants (%)
N = 63 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	23	0-40	90
Mountain Hemlock	15	0-40	90
Yellowcedar	23	0-40	52
Blueberry	54	15-85	100
Menziesia	22	0-65	94
Skunk Cabbage	25	3-65	100

Similar Associations

The mixed conifer/blueberry/skunk cabbage plant association may be confused with western hemlock/blueberry/skunk cabbage or hemlock-cedar/blueberry/skunk cabbage, but mountain hemlock is much more common in the mixed conifer/blueberry/skunk cabbage association, and stand heights are lower.

Late Seral Stand Structure

Stand height is usually less than 70 feet (21 m). Understory trees of all heights are abundant, forming a multi-layered canopy. Blueberry and menziesia are tall. These stands are open. Shrub cover approaches 100 percent in some stands. Forbs are abundant. Down logs are small. Snags are small but abundant, mostly decay-resistant yellowcedar.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	68 [21]	15 [46]
DBH (in. [cm])	19 [48]	12 [30]
Basal Area (sq.ft./ac.)	235	100
Gross Volume (BF/ac.)	24,500	15,700
Cover (%)	46	15
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.6 [1.1]	0.8 [0.2]
Menziesia	5.8 [1.8]	1.3 [0.4]
Cover (%)		
Tall Shrubs	68	36
Low Shrubs	10	9
Forbs	78	27
Ferns	11	8
Sedges	11	13

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	550 [168]	10-1500 [3-457]
Landform		**Frequency (%**
Mountainslopes		56
Alluvial		11
Lowlands		27
Slope Class (%)		**Frequency (%)**
16-35		43
36-55		37
56-75		21
	Mean	**Std. Dev.**
Slope Mean (%)	23	15
Soil Parent Material		**Frequency (%)**
Compact Till		31
Residuum		6
Colluvium		8
Organic Material		29
Volcanic		6
Soil Depth (cm [in.])		
Mineral Soil		Frequency (%)
> 50 [20]		79
≤ 50 [20]		21
	Mean	**Std. Dev.**
Imp. Layer Depth	52 [20]	35 [14]
Organic Layer Depth	37 [15]	30 [12]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		40
Poorly		49
Somewhat Poorly		8
Moderately Well		2
Well		2
Common Soil Series: Kushneahin, South Bight, Isidor, Helm, and Hofstad.		

ENVIRONMENTAL CHARACTERISTICS

The mixed conifer/blueberry/skunk cabbage plant association is very abundant. It occurs from sea level to near the mountain hemlock zone on benches or on gently sloping mountain and hill landforms. This association is common along the edges of old alluvial fans and floodplains and at the base of footslopes.

Soils are poorly drained as a result of several conditions. Most commonly, compact till or volcanic ash forms an impermeable layer which restricts water movement. On deep soils over colluvium or alluvium, excessive water received from neighboring slopes saturates the soil. Since the soils are mostly fine textured and/or organic, moisture is retained. These conditions vary depending on slope and precipitation zone. Skunk cabbage provides a good indicator that the soil is wet within 50 cm (20 in.) of the surface throughout the growing season, at least within the microsites in which the plants occur. Pit-mound topography is characteristic of these sites.

MANAGEMENT IMPLICATIONS

The productivity of this association is the second best in the series but it is still low. Limitations are due to poor soil drainage. Windthrow potential is low due to the small stature of mature trees, open canopy, and wet soils. This plant association is classified as a forested wetland (DeMeo et al. 1989) due to the abundance of skunk cabbage and to poor soil drainage.

Soils are generally stable, but on mountainslope scarps, storm water accumulation can trigger a slide. Slides are especially common on volcanic ash soils on slopes greater than 35 percent on Kruzof Island and in the Sitka area.

Regeneration of western and mountain hemlock is abundant after clearcutting. Yellowcedar regeneration is limited. Spruce regeneration may be common. Alternative silvicultural treatments should be considered to increase the natural regeneration success of cedar. Possibly leaving seed and understory trees may enhance natural regeneration, especially if advanced hemlock regeneration can be retarded with slight soil scarification (see Chapter 8 introduction).

In the mixed conifer/blueberry/skunk cabbage plant association, deep soil organic matter reduces the chance of exposing mineral soil. Usually, shovel yarding is not recommended on wet sites because of the risks of soil compaction, rutting, sediment release, or mineral soil exposure. However, to harvest these sites, shovel yarding with corduroy pathways has been utilized successfully on the Hoonah Ranger District. Soil compaction tests subsequent to harvest showed no significant damage (J. Russell, pers. comm. 1994).

Following clearcutting, shrub and skunk cabbage cover increases with the increased light. As tree cover increases, understory production is expected to decline but not to the degree seen in the hemlock and hemlock-cedar associations. Canopy closure may occur in small patches but shrub-dominated gaps are expected to persist. The length of time to closure in the small patches will likely be much longer than on well drained sites.

This association is not considered important deer winter habitat. The open canopy intercepts little snow, allowing snow to accumulate and reduce forage availability. Skunk cabbage is heavily used by deer and bear in the spring. Vancouver Canada geese use skunk cabbage during the summer nesting period. River otters use these sites for natal denning when they occur within 1/2 mile of saltwater (Woolington 1984). Suitable bald eagle nest sites are uncommon due to the low tree heights.

Road and trail construction may require special treatment due to the deep, wet soils. If they cannot be relocated, trails should consist of boardwalks.

Recreational uses of these sites are limited. Subsistence uses include collection of yellowcedar and skunk cabbage.

NOTES:

Bog Laurel
Kalmia polifolia

MIXED CONIFER/SKUNK CABBAGE-LADY FERN

Mixed Conifer/Lysichitum americanum-Athyrium filix-femina

VEGETATION

A mix of trees characterizes this moderately open plant association. Western and mountain hemlock are the most common overstory trees. Yellowcedar is an important overstory tree in about two-thirds of the stands. Sitka spruce may codominate, but usually provides less than 10 percent cover.

Blueberry, menziesia, and devil's club are the dominant shrubs. Mountain hemlock and western hemlock dominate the understory. Yellowcedar and spruce regeneration occurred in more than half the stands in limited amounts. Skunk cabbage and lady fern dominate the herbaceous layer. Skunk cabbage is more abundant in this plant association than in any other.

Cover of Common Plants (%)
N = 13 Stands

Species	Mean Cover	Range	Constancy
Western Hemlock	17	3-40	100
Mountain Hemlock	16	0-40	92
Yellowcedar	24	0-40	62
Sitka Spruce	9	0-40	85
Blueberry	36	3-85	100
Menziesia	13	1-50	100
Devil's Club	15	0-40	77
Skunk Cabbage	44	15-85	100
Lady Fern	19	3-50	100

Similar Associations
The mixed conifer/skunk cabbage-lady fern plant association may be confused with western hemlock/blueberry/skunk cabbage or hemlock-cedar/blueberry/skunk cabbage. However, this association is distinguished by much smaller trees, greater skunk cabbage cover, and lady fern cover exceeding 5 percent.

Late Seral Stand Structure
Stand height is usually less than 75 feet (23 m). Understory trees of all heights are abundant, forming a multi-layered canopy. Blueberry and menziesia are tall. These stands are open. Basal area and tree diameters are low. Spruce diameters are larger in this association than in any other in the mixed conifer series. While tree volume/acre is relatively low in this association, it is nonetheless the highest in the series due to the spruce component. Forb cover exceeds 75 percent in most stands.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	70 [21]	13 [4.0]
DBH (in. [cm])	18 [46]	8.9 [23]
Basal Area (sq.ft./ac.)	212	71
Gross Volume (BF/ac.)	24,900	15,300
Cover (%)	44	15
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.5 [1.1]	0.8 [0.2]
Menziesia	5.4 [1.6]	1.1 [34]
Cover (%)		
Tall Shrubs	56	9
Forbs	100	53
Ferns	34	26

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	667 [203]	50-1300 [15-396]
Landform		**Frequency (%)**
Mountainslopes		69
Alluvial		15
Lowlands		15
Slope Class (%)		**Frequency (%)**
0-15		8
16-35		46
36-55		23
56-75		15
76+		8
	Mean	**Std. Dev.**
Slope Mean (%)	23	10
Soil Parent Material		**Frequency (%)**
Compact Till		55
Glacial Marine		11
Colluvium		11
Organic Material		23
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	61 [24]	31 [12]
Organic Layer Depth	31 [12]	13 [5.1]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		54
Poorly		38
Somewhat Poorly		8
Common Soil Series: Kasiana, Hydaburg, Maybeso, Kushneahin, and South Bight.		

ENVIRONMENTAL CHARACTERISTICS

The mixed conifer/skunk cabbage-lady fern plant association is uncommon. It occurs from sea level to mid elevations on benches or on gently sloping mountain, hill, and footslope landforms. It is also found along the edges of old alluvial fans and floodplains and at the base of footslopes. Compact glacial till and organic matter comprise most of the soil parent material.

Soils are poorly to very poorly drained. Excessive groundwater from neighboring slopes accumulates on these sites. The sites are a mosaic of moving and stagnant soil water, with devil's club and lady fern in the areas of moving water. Well-drained tree-growing microsites are limited.

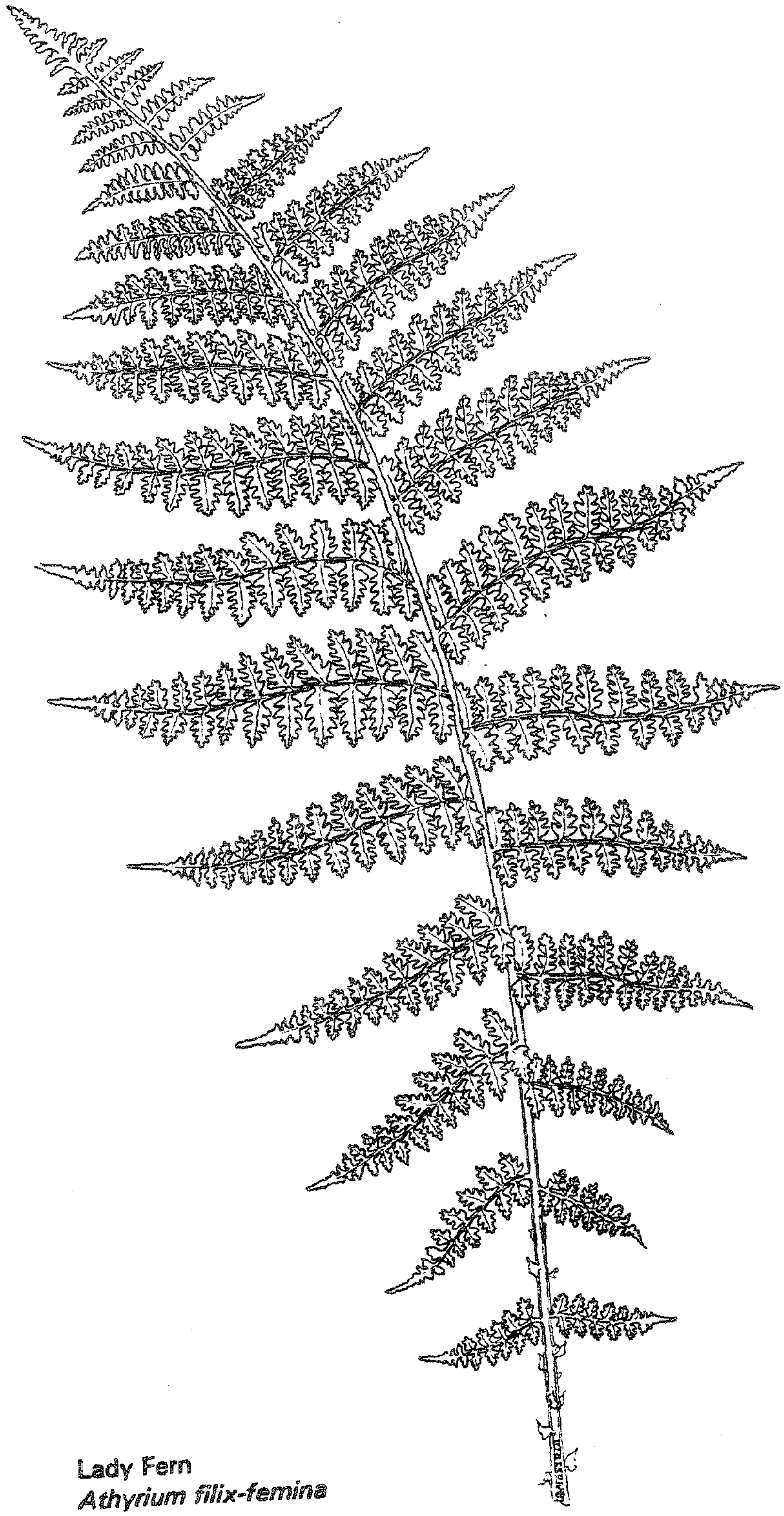
MANAGEMENT IMPLICATIONS

Productivity is limited by poor soil drainage. These sites are marginally suited for timber management due to the poor soils and few well-drained tree-growing sites. Windthrow potential is low due to the small stature of mature trees, open canopy, and wet soils. This plant association is classified as a forested wetland (DeMeo et al. 1989) due to the abundance of skunk cabbage and organic soils.

Following clearcutting, devil's club cover typically declines and salmonberry and lady fern cover increases. Skunk cabbage cover also declines, probably due to sun scalding. Red alder cover may increase since it occurs in some late seral stands of this association. Canopy closure is not expected due to the poor drainage and low productivity. Conifer growth is slow. Further study of succession in this association is needed.

Soils are stable, but on mountainslopes storm water accumulation can trigger slides. Slides are especially common on volcanic ash soils on slopes greater than 35 percent on Kruzof Island and in the Sitka area.

This plant association is not considered important deer winter habitat. It is important spring habitat for deer and bear due to the abundance of skunk cabbage. Vancouver Canada geese use skunk cabbage during the summer nesting period. Suitable bald eagle nest sites are uncommon. Road and trail construction requires special care on these wet soils. Subsistence uses include collection of lady fern roots and fiddleheads for food and medicinal purposes.



Lady Fern
Athyrium filix-femina

SHORE PINE SERIES

Note organic soil

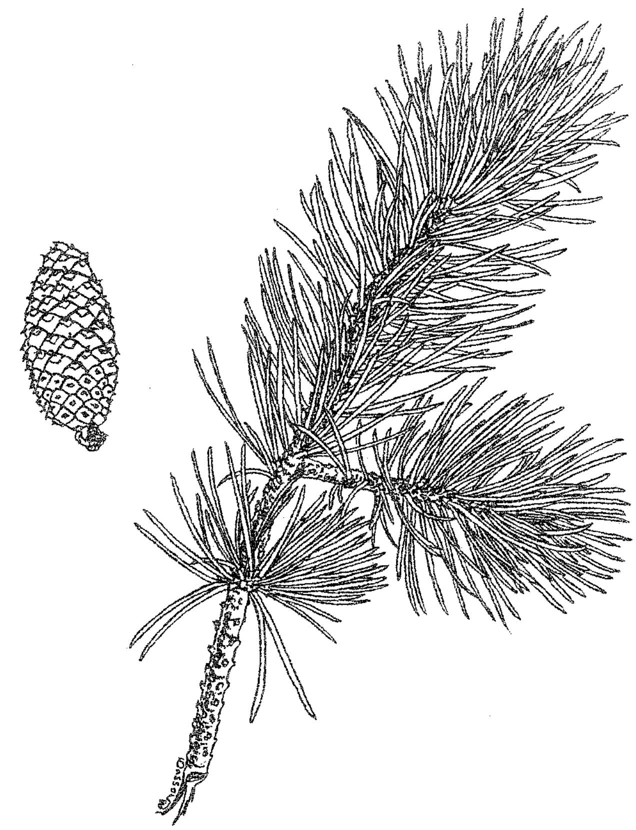
10
SHORE PINE SERIES

Description

Shore pine, mountain hemlock, and yellowcedar may codominate in late seral stands of this series. Shore pine is often the dominant tree and achieves its best stature in these forests. Sitka spruce and western hemlock grow poorly due to very wet soil conditions. Overstory tree cover ranges from 10 to 30 percent and multiple canopy layers are common but often indistinguishable due to the openness of the canopy. Shore pine sites are distinguished from scattered-tree peatlands (muskeg) by having at least 10 percent cover of trees at least 25 feet (7.6 m) tall.

Height of dominant and codominant trees varies from 40 to 60 feet (12 to 18 m) and diameters are usually less than 18 inches (46 cm). Trees are slow growing and, although small, are often quite old (Boughton et al. 1992). Dead tops, bole rot, and other age indicators are common. Arboreal lichens, particularly *Alectoria* species, are abundant on open grown trees.

The two associations in this series are presented in order of increasingly poor drainage, since soil moisture may be the dominant environmental factor affecting association distribution. While both associations are wetlands (DeMeo et al. 1989), there are hydrologic and productivity differences between them. Sampling sizes are small because peatlands were not high priority sampling areas during the field seasons that provided data for this classification. Further work is needed to determine the differences between the associations and to better characterize the types.



Shore Pine
Pinus contorta contorta

Blueberry, menziesia, crowberry, and mountain cranberry are common shrubs. Deer cabbage, skunk cabbage, five-leaf bramble, and both species of goldthread are common. Deer fern and club moss are common. Sedges are abundant.

Snags vary in size and number and are usually shore pine. Fallen snags are the main source of down woody material; consequently down wood is usually scarce (due to the open canopy), well decayed, and often covered by ground vegetation (Boughton et al. 1992).

Decomposition rates are slow, especially for cedar. Cedar logs hundreds of years old have been excavated from deep organic soils on these sites. Down wood provides raised, well-drained microsites, which are the major tree-growing sites.

Little is known about plant succession in this series. Opportunities to study succession are limited, because stand-level windthrow is uncommon, fire rarely occurs, and few trees have been harvested in this zone. Compact till, unfractured bedrock, concave and flat landforms, volcanic ash, and placic horizons are the primary drainage impeding features. Soils are typically deep and organic. Water storage and slow rates of discharge, due to the thick organic soils on gentle topography, may be important watershed factors.

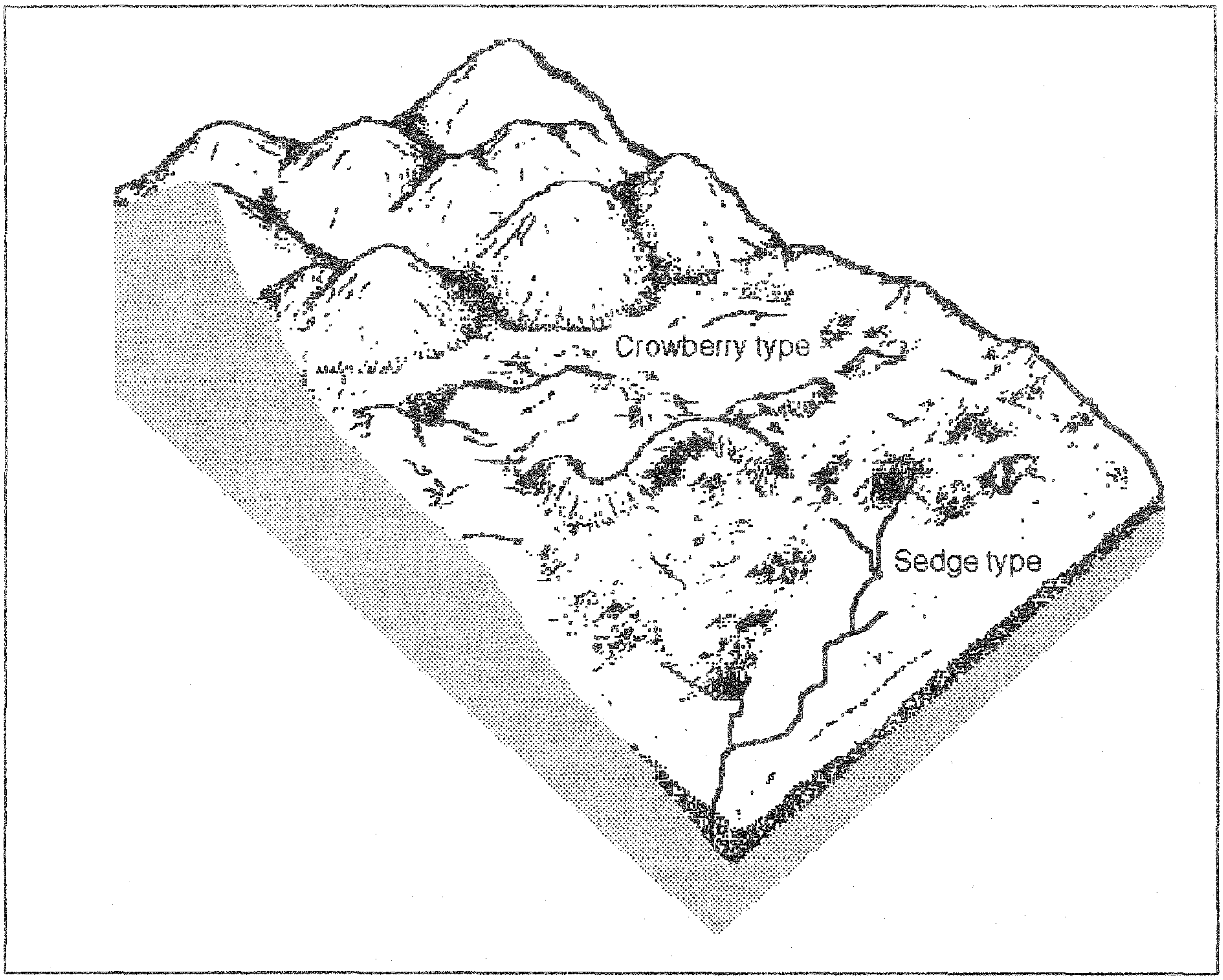


Figure 15. Generalized Landscape Positions for Shore Pine Associations

The interior forest microclimate that is typical of closed canopy associations is not exhibited by these open, shore pine stands. These stands, however, provide edge habitat (Boughton et al. 1992) and diversity in the landscape.

Distribution

Shore pine forests occur throughout Southeast Alaska, but are more common on the southern half of the Tongass National Forest. They are usually associated with mixed conifer forests, between the mixed conifer type and peatlands (muskeg). The associations are usually found on flat to gentle topography at less than 1500 feet (457 m) elevation. Shore pine has a low tolerance for cold conditions, but is highly tolerant of extremely wet soils. Figure 15 shows the general landscape distribution for shore pine associations on the Chatham Area.

Note Yellowlegs perched on tree; shore pine associations provide nesting habitat for this bird

VEGETATION

This open forested wetland is marginally productive. While shore pine averaged 8 percent cover, mountain hemlock cover was greater than shore pine in the seven stands sampled in this type (further sampling is needed). When present, western hemlock may also show greater canopy cover than shore pine. Stunted, shrub form trees are common. Shore pine, cedar, spruce, and both hemlock species may occur in the understory.

Crowberry, blueberry species, and other ericaceous (heath family) shrubs dominate the understory. Shrub diversity is high. Forb abundance is limited, with the dominant species varying among stands. Graminoids are common.

Cover of Common Plants (%)
N = 7 Stands

Species	Mean Cover	Range	Constancy
Mountain Hemlock	12	3-15	100
Yellowcedar	9	0-15	86
Shore Pine	8	3-15	100
Crowberry	47	3-63	100
Blueberry	35	0-63	86
Mountain Cranberry	20	0-38	71
Menziesia	16	1-38	100
Deer Fern	10	0-15	71

Similar Associations

The shore pine/crowberry association could be confused with the shore pine/Sitka sedge association, which is wetter and has more sedge cover. The shore pine/crowberry association may also be confused with low productivity mixed conifer associations. However, the shore pine/crowberry association is distinctive in that shore pine and low shrubs are most abundant, and soils are very wet.

Late Seral Stand Structure

Tree heights are generally less than 50 feet (15 m). Canopy closure is lowest of all the forested plant associations, and tree diameters and basal area are low. Shrub cover is high, with menziesia growing above blueberry. Snags and down logs are not abundant.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	43 [13]	5.5 [1.7]
DBH (in. [cm])	13 [33]	2.7 [6.9]
Basal Area (sq.ft./ac.)	75	35
Gross Volume (BF/ac.)	4,900	2,700
Cover (%)	22	5.2
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	1.8 [0.5]	0.8 [0.2]
Menziesia	6 [1.8]	1.4 [0.4]
Cover (%)		
Tall Shrubs	30	0
Low Shrubs	100	0
Forbs	56	0

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	359 [109]	100-1050 [30-320]
Landform		**Frequency (%)**
Mountainslopes		50
Hillslopes		17
Lowlands		33
Slope Class (%)		**Frequency (%)**
16-35		66
36-55		33
	Mean	**Std. Dev.**
Slope Mean (%)	16	12
Soil Parent Material		**Frequency (%)**
Compact Till		58
Granite		14
Organic Material		14
Volcanic		14
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		67
≤ 50 [20]		33
	Mean	**Std. Dev.**
Imp. Layer Depth	29 [11]	21 [8.3]
Organic Layer Depth	36 [14]	42 [17]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		33
Poorly		50
Somewhat Poorly		17
Common Soil Series: Magnetic, Hofstad, Kushneahin, and Mitkof.		

ENVIRONMENTAL CHARACTERISTICS

The shore pine/crowberry association is common on gently to moderately sloping landforms at elevations of less than 1500 feet (457 m). This association frequently occurs as a transition between non-forested peatlands (muskeg) and low productivity forest types (such as mixed conifer associations).

Soils are organic, moderate to deep, and somewhat poorly to very poorly drained.

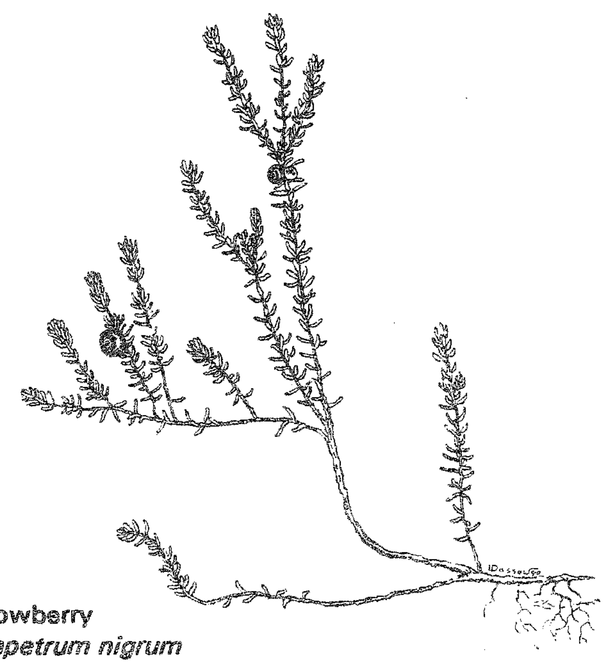
MANAGEMENT IMPLICATIONS

Shore pine sites are classified as wetlands (DeMeo et al. 1989). These sites are unproductive for timber harvest. Near towns, shore pine is harvested for Christmas trees. Many of the harvested trees are more than 100 years old and often only the tops are taken. Because of low growth rates, replacement of harvested Christmas trees is slow.

Stand level disturbances are rare and none were observed on the Chatham Area. Isolated disturbances, probably originating from human-caused fires, have been recorded in central and southern Southeast Alaska. Apparently, fuel moisture can be low in these open vegetation types during extended periods without rain.

This type provides poor deer winter habitat since sparse tree cover provides little protection from snow. During summer and fall, many deer seek higher quality forage in the alpine and subalpine habitats. Deer occupying low elevation sites may use shore pine stands for forage. The sites probably receive highest use in spring when succulent forbs (skunk cabbage, deer cabbage, bunchberry) are common.

Yellow-legs use shore pine sites extensively for nesting when they are near saltwater. Because of insufficient tree size, bald eagles do not nest in this association.



Crowberry
Empetrum nigrum

Soils are generally stable, wet and fairly deep. These conditions complicate trail and road construction. Boardwalks are needed for trails; otherwise, the soil quickly turns to a deep, wet muck. Road construction usually requires extensive rock fill and drainage structures, often altering the hydrologic regime.

Cranberries are abundant and are harvested in fall. Because of their open canopies, shore pine sites also provide hiking, hunting and cross-country skiing areas.

SHORE PINE/SITKA SEDGE **630**
Pinus contorta/Carex sitchensis

VEGETATION

This open forested wetland is marginally productive for timber. Shore pine achieves its best stature in late seral stands in this type; however, western hemlock, mountain hemlock, and Sitka spruce often have greater canopy cover. Typically, shore pine occurs as the main overstory tree while other species occur in a shrub-like growth form.

Blueberry, menziesia, and bog blueberry are abundant. Skunk cabbage, both species of goldthread, and five-finger bramble are common. Sedges dominate the ground surface with Sitka sedge particularly prominent.

Because only one stand of this type was sampled, the following data may not adequately represent vegetative composition. More sampling is needed.

Cover of Common Plants (%)
N = 1 Stand

Species	Mean Cover	Constancy
Shore Pine	3	100
Mountain Hemlock	15	100
Western Hemlock	15	100
Sitka Spruce	15	100
Blueberry	63	100
Menziesia	38	100
Mountain Cranberry	15	100
Sitka Sedge	38	100
Other Sedges	27	100

Similar Associations

The shore pine/Sitka sedge association may be confused with the shore pine/crowberry association. However, the former type is distinguished by an abundance of tall sedge and generally wetter conditions.

Late Seral Stand Structure

Shore pine and spruce trees averaged 60 feet (18 m) in height in the one sampled stand. Canopy closure is low. Stand structure is simple, with a few overstory trees, and with understory trees and shrubs occurring in better drained microsites. Standing water may also occur.

Structure Summary

OVERSTORY	Mean
Height (ft. [m])	60 [18]
DBH (in. [cm])	18 [46]
Basal Area (sq.ft./ac.)	160
Net Volume (BF/ac.)	8,900
Cover (%)	30
UNDERSTORY	**Mean**
Height (ft. [m])	
Blueberry	3 [0.9]
Menziesia	8 [2.4]

ENVIRONMENTAL CHARACTERISTICS

The shore pine/Sitka sedge plant association is expected to be common on flat to gentle slopes at less than 1500 feet (457 m) elevation, perhaps as a transition between non-forested peatlands and low productivity forest types. This association may also occur in close proximity to flowing surface water. Additional sampling is needed.

Soils are organic, deep, very poorly drained (Histosols)—with impermeable layers, such as compact till, beneath. Few tree-growing microsites exist; most are on old logs or stumps.

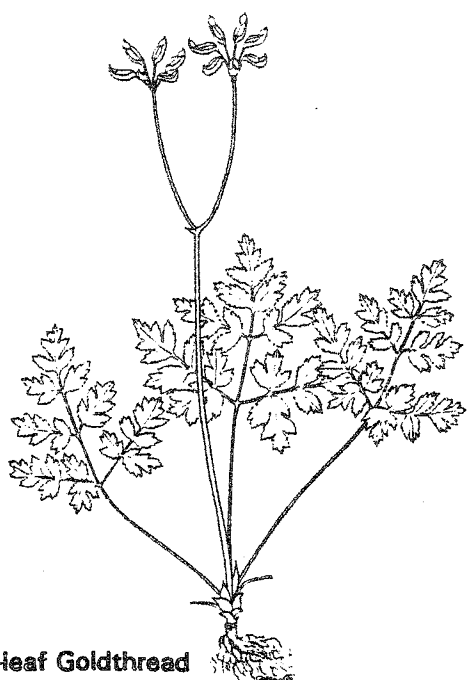
The one sampled stand occurred on flat lowlands at 200 feet (61 m) elevation on very poorly drained Hofstad soils.

MANAGEMENT IMPLICATIONS

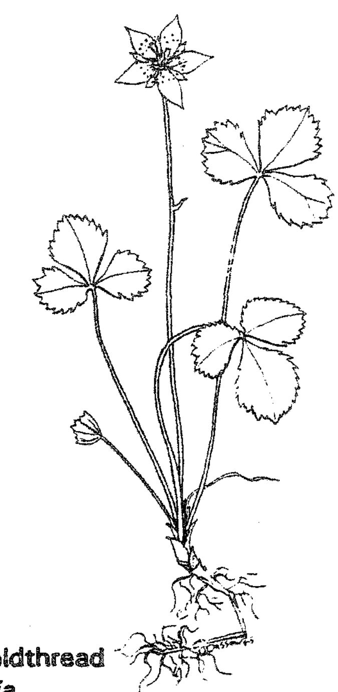
Shore pine sites are classified as wetlands (DeMeo et al. 1989). These sites are unproductive for timber harvest. Near towns, shore pine is harvested for Christmas trees. Stand level tree disturbances are rare.

During winter, this low elevation, open forest type is poor deer habitat, but deer may use these sites in other seasons. Yellow-legs use this type for nesting when it occurs near saltwater. Trees do not reach sufficient size to be used for bald eagle nesting.

Soils are generally stable, wet and fairly deep. These conditions complicate trail and road construction. Boardwalks are needed for trails; otherwise, the soil quickly turns to a deep, wet muck. Road construction usually requires extensive rock fill and drainage structures, often altering the hydrologic regime.

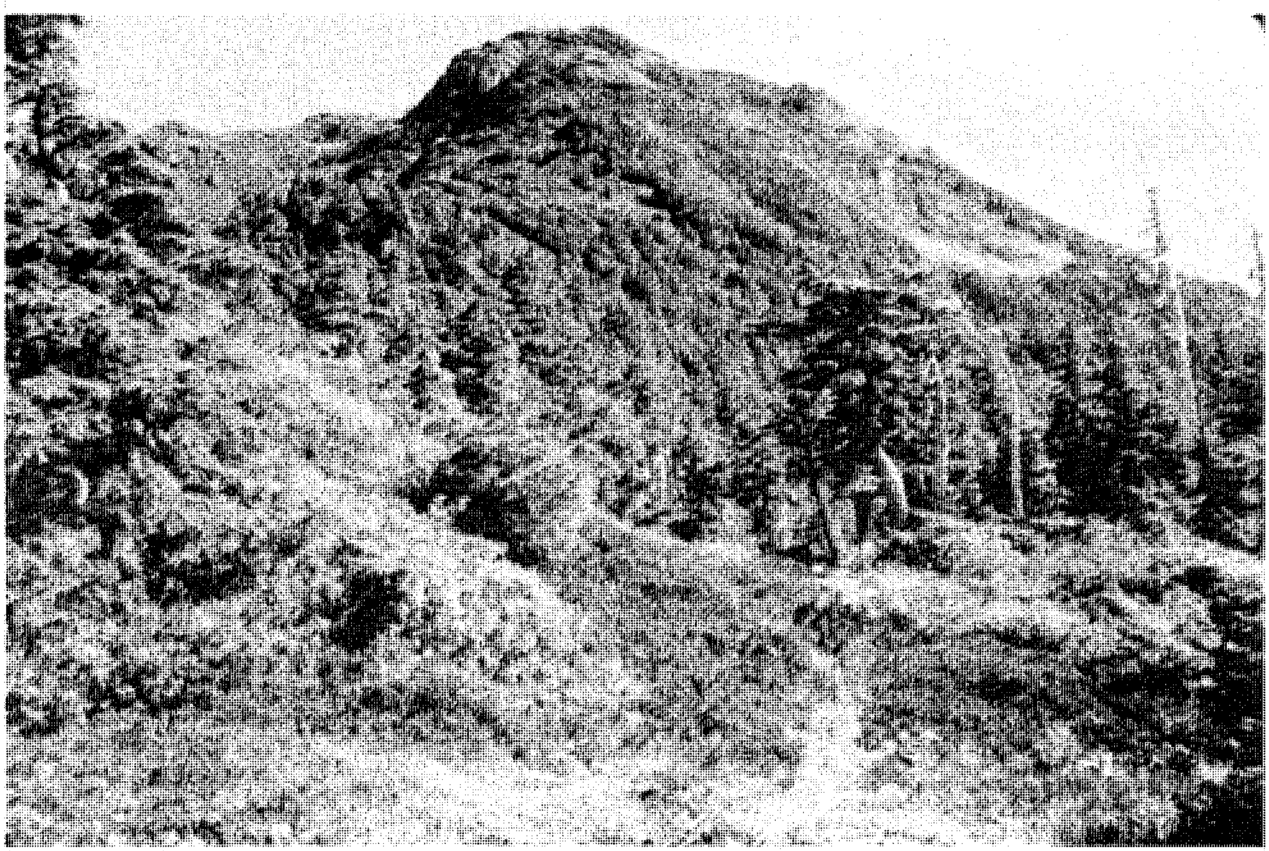


Fern-leaf Goldthread
Coptis asplenifolia



Trifoliate Goldthread
Coptis trifolia

MOUNTAIN HEMLOCK SERIES



11
MOUNTAIN HEMLOCK SERIES

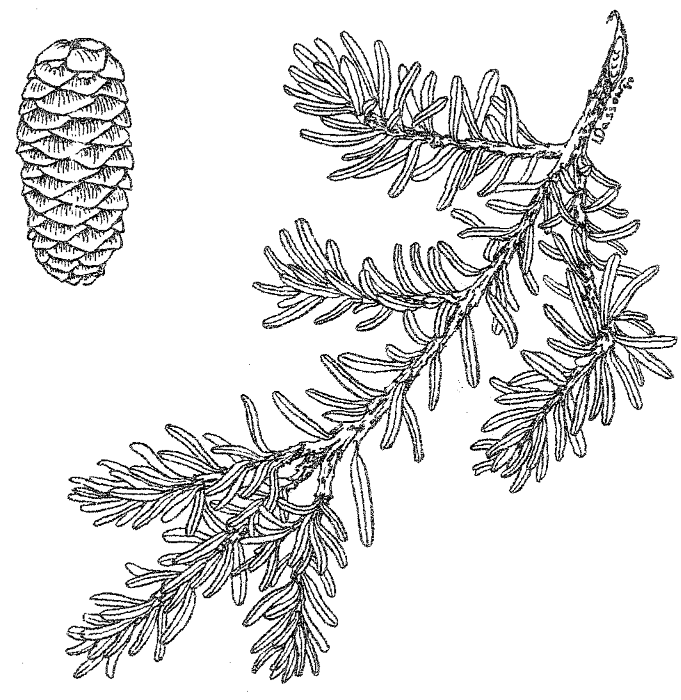
Description

This high elevation, "cold" forest type is defined by the dominance or codominance of mountain hemlock and certain cold-site understory indicators. Sitka spruce is common and may codominate on steep, unstable slopes (see Sitka spruce-mountain hemlock/blueberry association in Chapter 12). Subalpine fir may occur in a few areas, usually on the mainland.

Blueberry, copperbush, cassiope, and heather are the most common shrubs and deer cabbage, five-leaf bramble, and bunchberry are the most common forbs. Deer fern is the most common fern. Sedges may dominate some of the open, wetter plant associations. Arboreal lichens, particularly *Alectoria* species, are abundant on open grown trees.

While some closed canopy stands with more than one tree layer may occur, most often a single canopy layer is encountered. The height of the upper canopy varies from 40 to 70 feet (12 to 21 m), and diameters of the dominant trees range from 10 to 20 inches (25 to 51 cm). Ages of dominant trees will often range from 150 to well over 300 years, with occasional large spruce and cedar well over 450 years.

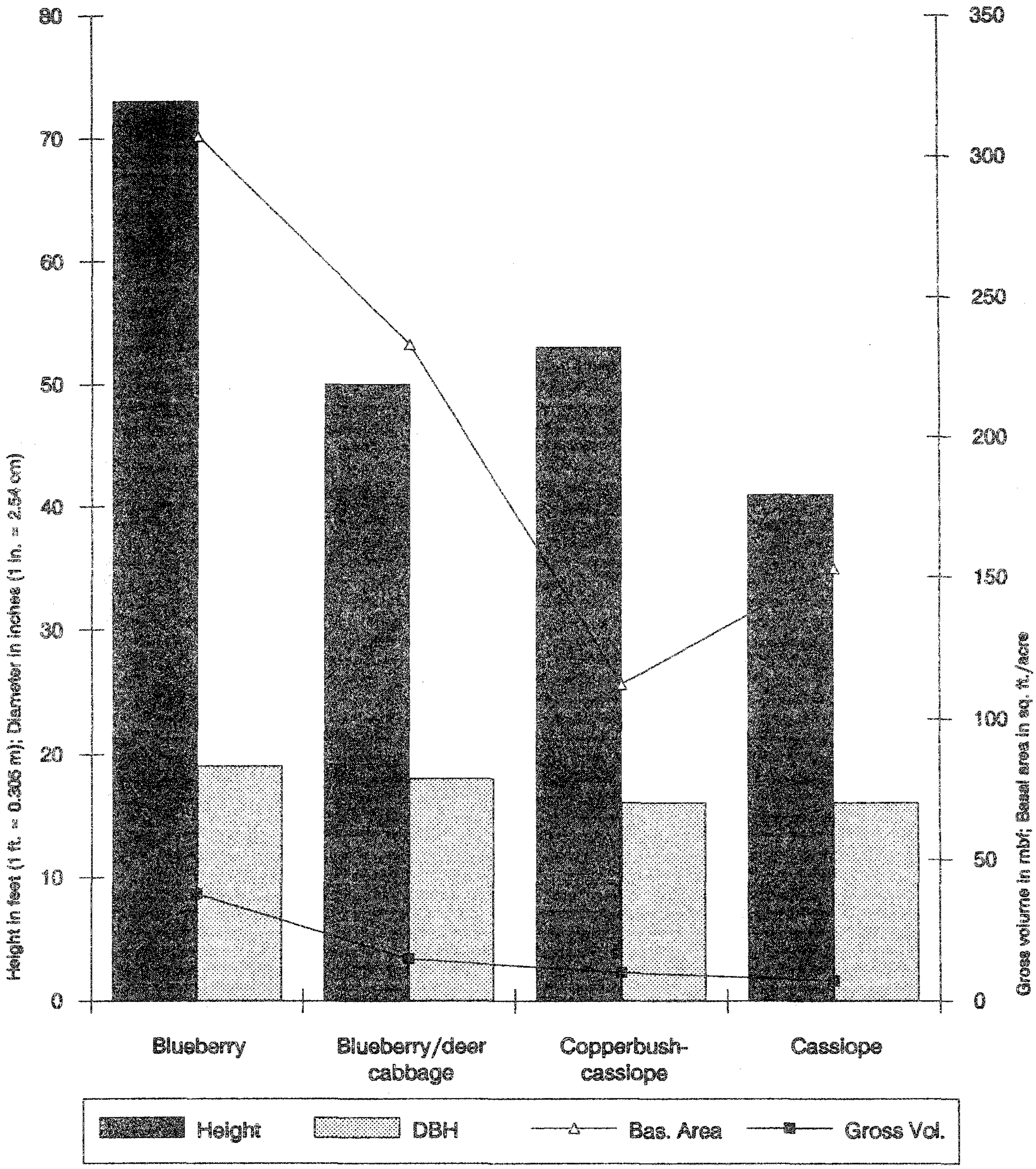
The four associations are presented in order of increasing elevation, since elevation (through its influence on climate and growing degree days) appears to be the dominant environmental factor in the distribution of these associations.



Mountain Hemlock
Tsuga mertensiana

Figure 16 compares productivity among the types. The lower portion of the mountain hemlock zone occurs on steeper, well drained mountainslopes and intergrades with the western hemlock and western hemlock-yellowcedar series and is often only a narrow band. Mountain hemlock/blueberry stands at lower elevations, in close proximity to the western hemlock zone, may be quite productive.

Figure 16. Average Tree Structure for Mountain Hemlock Series



The upper portion of the mountain hemlock zone often occurs on gentler slopes in a wide ecotone. This upper portion (most frequently the mountain hemlock/cassiope type) is park-like and intergrades with alpine tundra along the upper treeline. The mountain hemlock/cassiope association is the most species-rich of all the plant associations in the study area but the lowest in productivity: it is borderline forest, grading into alpine heath, meadow, or rock (see Figure 17).

Wind, avalanches, and mass movement are the primary disturbance processes. Avalanching appears to be the dominant disturbance process in the open "parkland" forests nearest treeline.

Little is known about plant succession in this series in Southeast Alaska. Since fire rarely occurs and few trees have been harvested in this zone, opportunities to study succession are limited. Tree growth is much slower than on warmer, well drained sites at low elevations; therefore, development of late seral conditions is expected to take longer. Regeneration is common in disturbed areas, but trees are slower to respond due to heavy snow damage.

Deer, brown bear, and mountain goats use the mountain hemlock series heavily during the summer and fall, and most of the brown bear denning occurs within this series. Goats may use the series heavily during winter when the association occurs in conjunction with cliffs.

Size and abundance of snags will vary. Decomposition rates are slow in the colder temperatures, yet neither snags nor down wood are abundant because the stands are open and impacted by snow and wind. In high elevation streams, down wood provides habitat for resident trout.

Interior forest conditions like those found in productive forest types at low elevations do not appear to occur in this series. Closed canopy mountain hemlock stands occur primarily in narrow bands often less than 500 feet (152 m) wide. Hence, edge influences predominate. Consequently, stand size may not be as important a factor in maintenance of interior forest late seral conditions in the mountain hemlock series as in more productive series. However, stand size relative to adjacent forest types may be an important consideration for management for ecosystem sustainability.

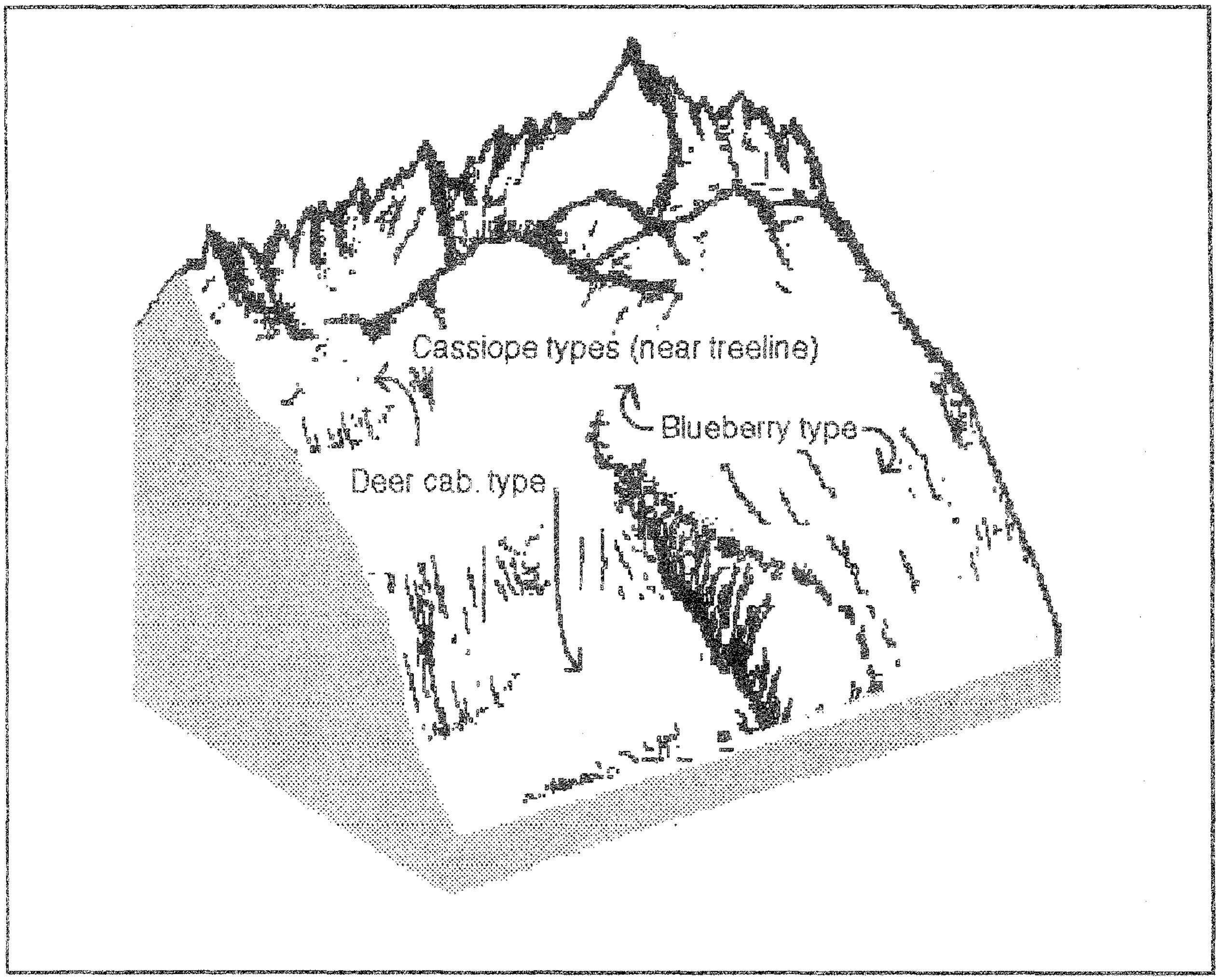


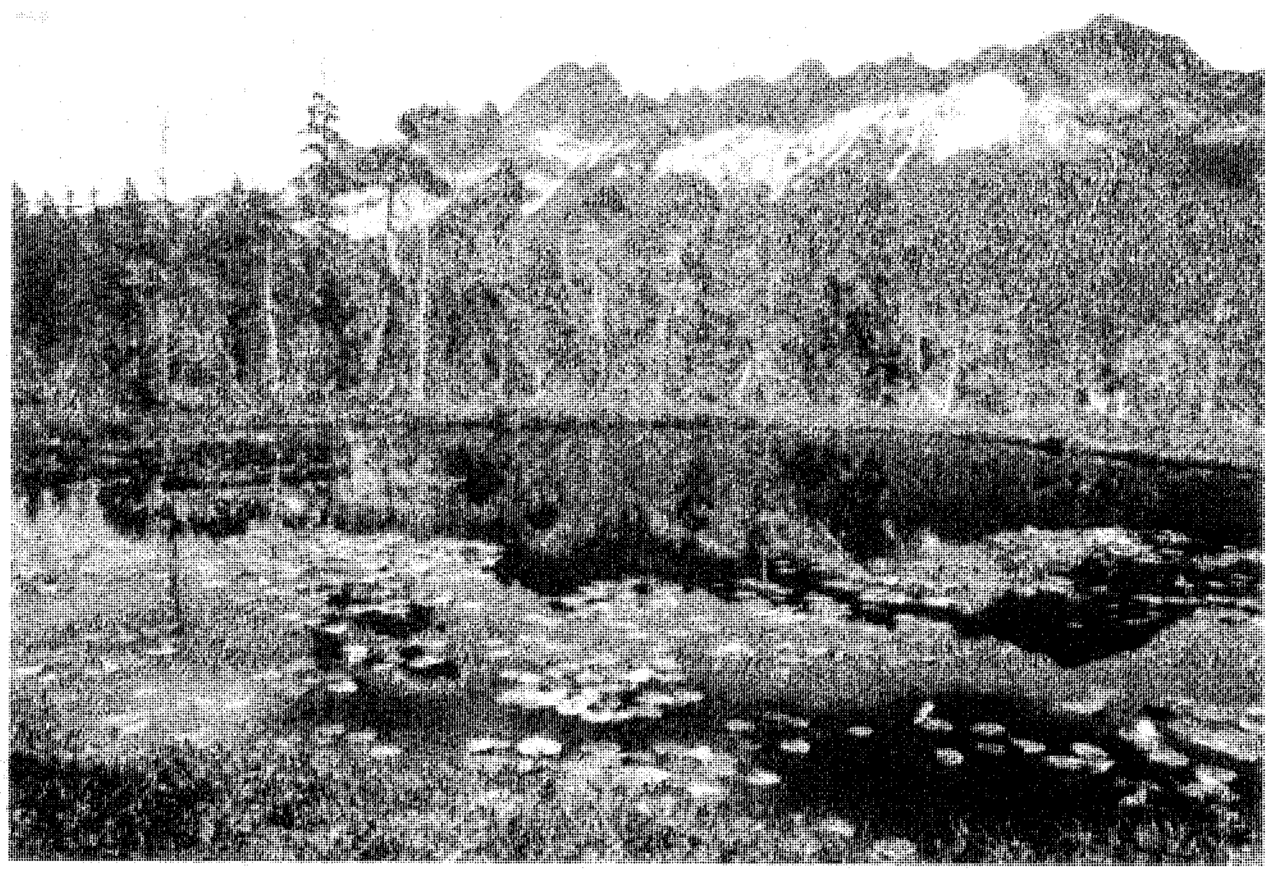
Figure 17. Generalized Landscape Positions for Mountain Hemlock Associations

Distribution

The mountain hemlock series is more abundant in northern than in southern Southeast Alaska, and occurs throughout the Chatham Area. The distribution is highly variable depending on climatic conditions, slope, aspect, topography, soil parent material, and proximity to maritime or continental weather patterns.

The average elevation of this series is near 1500 feet (457 m) with a typical elevation range of 1300 to 1700 feet (396 to 518 m). Stands have been sampled as high as 2500 feet (762 m) on the mainland and as low as 500 feet (152 m) on Chichagof Island.

Aspect and slope influence the lower and upper limits of this zone. For example, the mountain hemlock zone occurs at lower elevations on steep northern slopes than on steep, unshaded southern slopes. Likewise, upper treeline will be higher on steep, but stable, southern slopes than on northern slopes. The mountain hemlock series occurs at lower elevations towards the interior of islands than along the outside of islands. In upper Tenakee Inlet on Chichagof Island, this series occurs at the 500 foot (152 m) level on northern slopes. On the eastern side of Baranof Island, the mountain hemlock zone frequently occurs almost at sea level.



Tsuga mertensiana/Vaccinium spp.

VEGETATION

Mountain hemlock dominates this moderately open forest plant association. Sitka spruce is common. Western hemlock occurs in a narrow transition zone to western hemlock associations on warmer sites. Yellowcedar may occur; shore pine is always absent.

Blueberry is the dominant shrub. Mountain hemlock regeneration is common. Five-leaf bramble and fern-leaf goldthread are the most common forbs. Deer fern is the most common fern.

Cover of Common Plants (%)
N = 46 Stands

Species	Mean Cover	Range	Constancy
Mountain Hemlock	38	15-65	100
Blueberry	54	15-85	100
Five-leaf Bramble	10	0-40	98
Fern-lf Goldthread	5	0-38	80
Deer Fern	8	0-15	78

Similar Associations

In the transition zone from the warm, western hemlock-dominated forests to cold, mountain hemlock-dominated forests, this plant association may easily be confused with mixed conifer/blueberry. However, mountain hemlock cover is usually much greater while western hemlock cover is greater in the mixed conifer types.

Late Seral Stand Structure

Stand height is usually less than 75 feet (23 m). Understory trees of all heights may be abundant, forming a multi-layered canopy. The overstory canopy is moderately open. Shrub cover is usually less than 70 percent. Forbs are abundant.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	73 [22]	14 [4.3]
DBH (in. [cm])	19 [48]	5.9 [15]
Basal Area (sq.ft./ac.)	307	102
Gross Volume (BF/ac.)	38,000	12,300
Cover (%)	49	15
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.3 [1.0]	0.8 [0.2]
Menziesia	4.2 [1.3]	1.4 [4.3]
Cover (%)		
Tall Shrubs	59	28
Low Shrubs	8	9.9
Forbs	36	32
Ferns	11	9

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	1483 [452]	700-2850 [213-869]
Landform		**Frequency (%)**
Mountainslopes		87
Alpine		13
Slope Class (%)		**Frequency (%)**
16-35		7
36-55		33
56-75		22
76+		38
	Mean	**Std. Dev.**
Slope Mean (%)	51	22
Soil Parent Material		**Frequency (%)**
Granite		15
Residuum		18
Colluvium		52
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		81
≤ 50 [20]		19
	Mean	**Std. Dev.**
Imp. Layer Depth	56 [22]	33 [13]
Organic Layer Depth	11 [4.3]	6 [2.4]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		3
Poorly		5
Somewhat Poorly		19
Moderately Well		35
Well		38
Common Soil Series:Calamity, Tokeen, Kupreanof, Foad.		

ENVIRONMENTAL CHARACTERISTICS

This plant association is abundant on moderately steep, cold sites along lower elevations of the mountain hemlock zone. However, elevation varies depending on local conditions. On exposed and warm southerly mountainslopes, upper treeline will be much higher than on steep northerly slopes—or on slopes shaded by nearby topography. Likewise, interior island locations appear to be colder than along the outer coasts, as indicated by mountain glaciers and occurrence of mountain hemlock stands at lower elevations.

Soils are moderately deep and drainage is variable. Bedrock weathered in place (residuum) and shallow colluvium are the most common parent materials.

MANAGEMENT IMPLICATIONS

Productivity is limited by short growing seasons.

Windthrow of individual or small groups of trees is common. Although soils are stable, following severe storms these steep sites are subject to failure (Swanston 1967). Slides are especially common on volcanic ash soils on slopes greater than 35 percent on Kruzof Island and in the Sitka area.

Few sites are available to evaluate successional patterns. Several clearcut stands less than 20 years old occur along the White Alice radar site road behind the City of Hoonah. Mountain hemlock and spruce are abundant but slow to regenerate, and many of the seedlings are deformed, apparently from snow. Blueberry is also abundant. Some 100 year-old blowdown stands were found that had a dense stock of mountain hemlock and spruce but little understory vegetation. On this association, canopy closure is likely to take longer than on associations in warmer areas. Further plant succession work is needed.

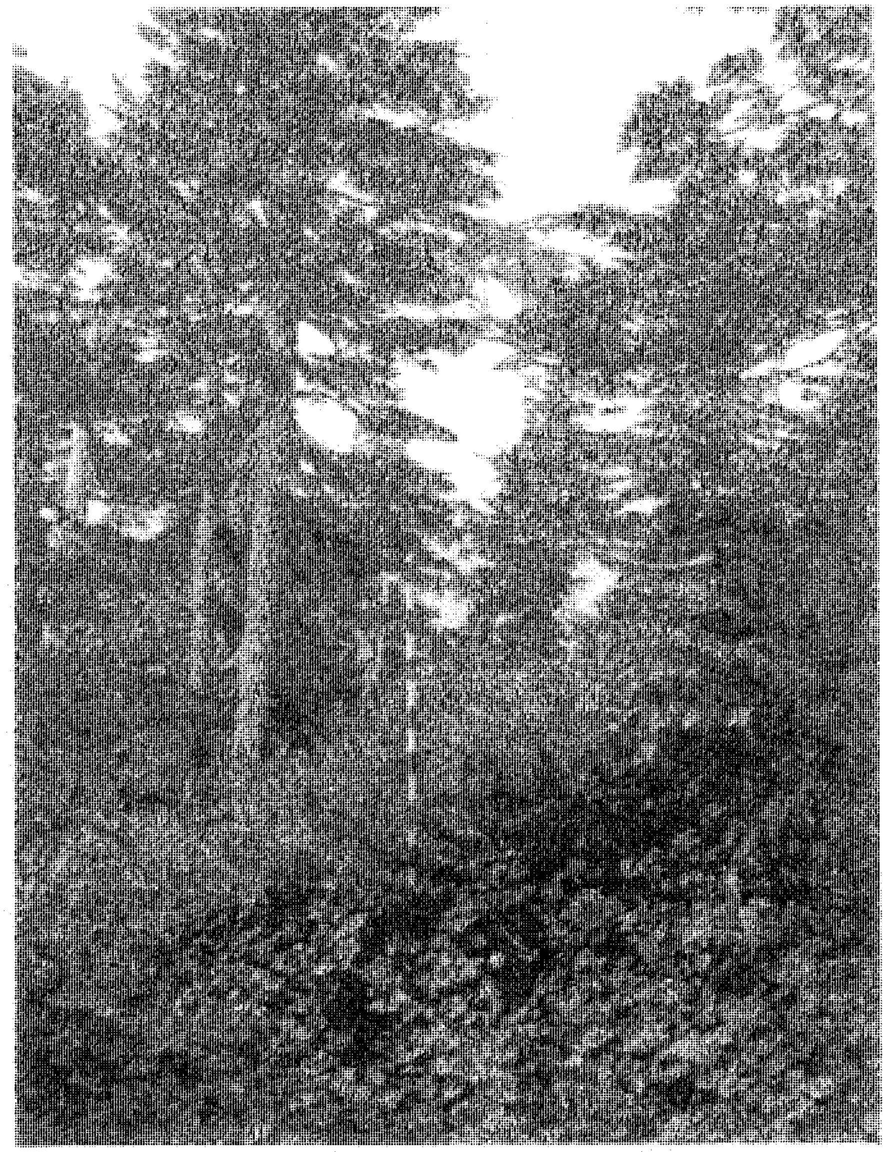
Snow accumulation restricts deer use in winter. Summer and fall use of forbs by deer may be extensive. Deer may also use blueberry. The association does not provide suitable bald eagle nesting sites (Sidle et al. 1986).

These sites are well suited to trail construction. Road construction is limited by steep slopes and unstable soils.

Recreational and subsistence use of these sites is limited.

MOUNTAIN HEMLOCK/BLUEBERRY/DEER CABBAGE 540

Tsuga mertensiana/Vaccinium spp./*Fauria crista-galli*



VEGETATION

This unproductive, open association is dominated by mountain hemlock. Spruce was a minor overstory component in half the sampled stands.

Blueberry dominates the understory. Mountain hemlock regeneration is common. Deer cabbage, fern-leaf goldthread, heart-leaved twayblade, five-leaf bramble, and false hellebore are common forbs. Deer fern is the most frequently occurring fern, but only was found in 75 percent of the stands.

Cover of Common Plants (%)
N = 16 Stands

Species	Mean Cover	Range	Constancy
Mountain Hemlock	35	15-63	100
Sitka Spruce	7	0-15	56
M. Hemlock Regen.	11	1-15	100
Blueberry	61	15-85	100
Five-leaf Bramble	9	0-15	94
Deer Cabbage	7	1-38	100
Fern-lf Goldthread	5	0-15	81
Deer Fern	5	0-15	75

Similar Associations

This type may be confused with the other unproductive mountain hemlock associations—mountain hemlock/copperbush-cassiope and mountain hemlock/cassiope. However, the abundance of cassiope in the latter two serves to distinguish them.

This type may also be confused with mixed conifer/blueberry/deer cabbage. However, western hemlock is common in the mixed conifer type. In this association, western hemlock occurs less frequently as elevation increases and temperatures decrease, being gradually replaced by mountain hemlock.

Late Seral Stand Structure

Mountain hemlock trees rarely exceed 50 feet (15 m). Larger but scattered Sitka spruce trees may occur. Canopy closure is low and the blueberry layer is dense. Forbs are abundant. Snags and down logs are common (Boughton et al. 1992).

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	50 [15]	14 [4.3]
DBH (in. [cm])	18 [46]	5.1 [13]
Basal Area (sq.ft./ac.)	233	92
Gross Volume (BF/ac.)	14,900	10,600
Cover (%)	39	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.4 [1.0]	0.9 [0.3]
Cover (%)		
Tall Shrubs	57	26
Forbs	58	31
Ferns	12	9

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	1602 [488]	1050-2360 [320-719]
Landform		**Frequency (%)**
Alpine		13
Mountainslopes		73
Hillslopes		7
Slope Class (%)		**Frequency (%)**
16-35		7
36-55		40
56-75		20
76+		33
	Mean	**Std. Dev.**
Slope Mean (%)	47	24
Soil Parent Material		**Frequency (%)**
Compact Till		13
Residuum		38
Colluvium		12
Organic Material		13
Metavolcanic		12
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		77
≤ 50 [20]		23
	Mean	**Std. Dev.**
Imp. Layer Depth	41 [16]	25 [9.8]
Organic Layer Depth	12 [4.7]	5 [2.0]
Soil Drainage		**Frequency (%)**
Poorly		21
Somewhat Poorly		29
Moderately Well		21
Well		29
Common Soil Series:Calamity, McGilvery, Traitors, Kupreanof, and Kasiana.		

ENVIRONMENTAL CHARACTERISTICS

The mountain hemlock/blueberry/deer cabbage plant association is common on upper mountain positions on moderate to steep slopes. Soils are variable, poorly to well drained, and generally shallow. Soils may be unstable on the steeper slopes.

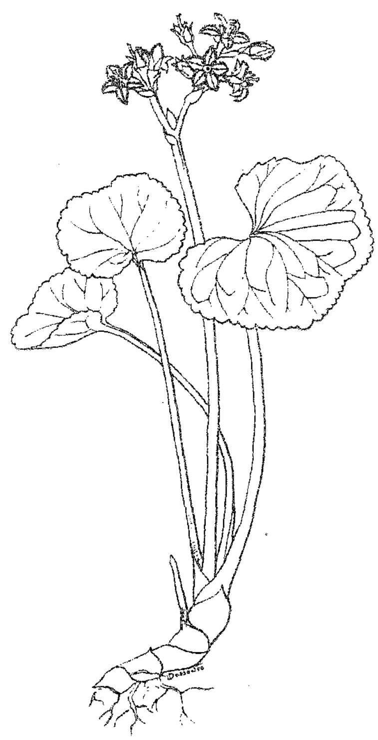
MANAGEMENT IMPLICATIONS

These sites are not used for timber harvest due to their low productivity and the difficulty of accessing them at high elevation. Limited information is available on stand development. Observations along the road to the White Alice radar site behind the City of Hoonah and along Harbor Mountain Road near Sitka indicate tree regeneration is abundant but slow growing and subject to deformation from snow. Both mountain hemlock and spruce regeneration is common.

During summer and fall, these sites provide excellent deer and mountain goat cover, especially during storms. Near upper treeline, succulent forbs are not as abundant as in more open sites; hence summer habitat quality is only moderate. Due to the abundance of blueberry, this type provides good fall deer habitat. Snow accumulation restricts deer use in winter. Brown bear may find suitable denning sites in this type.

These sites are well suited to trail construction. Road construction is limited by steep slopes and unstable soils.

When access is available, these sites are popular with recreationists and provide tasty but scarce blueberries for picking.



Deer Cabbage
Fauria crista-galli

MOUNTAIN HEMLOCK/COPPERBUSH/CASSIOPE 525

***Tsuga mertensiana/Cladothamnus pyrolaeflorus/Cassiope* spp.**

VEGETATION

This open canopy forest type is dominated by mountain hemlock. Yellowcedar was common in 40 percent of the sampled stands. Western hemlock is uncommon.

Copperbush, dwarf blueberry, and starry and Merten's cassiope dominate the shrub layer. Menziesia and mountain heather are common. Mountain hemlock and yellowcedar regeneration is usually present. Forb diversity is the second highest of the mountain hemlock associations, with fern-leaf goldthread, bunchberry, deer cabbage, false hellebore, and five-leaf bramble typically occurring. Fern diversity is also high, with deer fern most common. Sedges are common.

Cover of Common Plants (%)
N = 14 Stands

Species	Mean Cover	Range	Constancy
Mountain Hemlock	22	15-38	100
M. Hemlock Regen.	15	0-63	93
Copperbush	41	0-63	79
Blueberry	28	0-63	93
Mountain Heather	9	0-38	71
Deer Cabbage	19	0-38	86
False Hellebore	7	0-15	79
Bunchberry	6	1-38	100
Deer Fern	10	1-85	100

Similar Associations
This type may be confused with other low productivity mountain hemlock associations, such as the blueberry/deer cabbage type. However, abundant copperbush distinguishes the copperbush-cassiope association.

Late Seral Stand Structure
Mountain hemlock and yellowcedar trees are typically 50 to 60 feet (15 to 18 m) in height. Trees occupy a small portion of the stand and usually occur on isolated, relatively dry microsites. Tree crowns exhibit the typical "krummholz" appearance (twisted, gnarled, flagged) due to cold temperatures, ice scouring, and wind. The canopy is open—essentially woodland. Shrubs are abundant, more so than conifer regeneration. Copperbush is generally taller than blueberry.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	53 [16]	19 [5.8]
DBH (in. [cm])	16 [41]	2.1 [5.3]
Basal Area (sq.ft./ac.)	112	33
Gross Volume (BF/ac.)	9800	8500
Cover (%)	28	10
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.3 [0.7]	1.2 [0.4]
Copperbush	4.5 [1.4]	0.5 [0.2]
Cover (%)		
Tall Shrubs	71	97
Low Shrubs	46	0
Forbs	75	5
Ferns	8	10

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	1575 [480]	1200-2180 [366-664]
Landform		**Frequency (%)**
Mountainslopes		93
Alpine		7
Slope Class (%)		**Frequency (%)**
0-15		7
36-55		43
56-75		21
76+		29
	Mean	**Std. Dev.**
Slope Mean (%)	39	19
Soil Parent Material		**Frequency (%)**
Compact Till		11
Residuum		11
Colluvium		44
Granite		11
Volcanic/Metavolcanic		23
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		72
≤ 50 [20]		27
	Mean	**Std. Dev.**
Imp. Layer Depth	36 [14]	25 [9.8]
Organic Layer Depth	19 [7.5]	14 [5.5]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		14
Somewhat Poorly		36
Moderately Well		36
Well		14
Common Soil Series: Peril, Isidor, Traitors, Tolstoi, Forss, and Verstovia.		

ENVIRONMENTAL CHARACTERISTICS

The mountain hemlock/copperbush-cassiope association is common at high elevations on upper mountainslope positions on moderate to steep slopes. It may also occur at lower elevations where there are cold air drainages or frost pockets. Soil drainage is highly variable depending on microsite conditions. Soils are generally shallow and colluvium is the most common parent material. Cold temperatures, snow, and wet soils limit tree establishment.

MANAGEMENT IMPLICATIONS

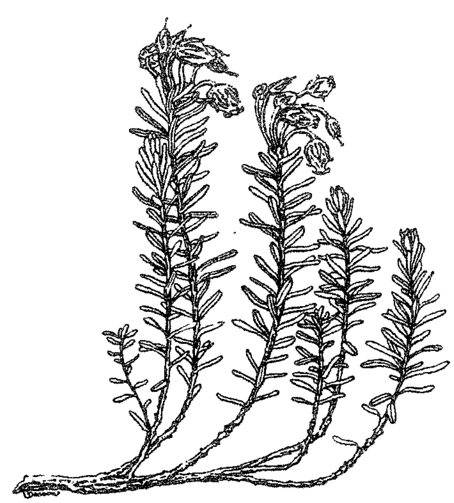
These sites have short trees and an open canopy. Limitations to tree productivity are due to cold temperatures, short growing seasons, snow impacts, and shallow soils. Windthrow potential is low due to the open canopy and short trees. Soils vary widely and may be unstable on steeper slopes. These sites store snow into early summer. Since they occupy a transition zone between alpine and closed forest, they contribute greatly to landscape diversity.

Little successional information is available. Mountain hemlock and yellowcedar regeneration occurs on small, isolated tree "islands." Avalanching and slope failure can cause extensive tree mortality, but individual tree-fall is the most common disturbance. Canopy closure will not occur due to the lack of suitable tree-growing microsites.

These sites provide excellent summer and fall deer, mountain goat, and brown bear foraging habitat. Snow accumulation restricts deer use in winter. Brown bear may find suitable denning sites in this type.

Road and trail construction is hampered by high elevation, steep slopes and unstable soils. Recreational and subsistence use is limited due to difficult access. Good deer hunting may be available before fall frosts.

Copperbush
Cladothamnus pyrolaeflorus



Mountain Heather
Phyllodoce glanduliflora

VEGETATION

This open canopy "parkland" type is dominated by mountain hemlock, and ericaceous (heath family) shrubs such as cassiope, mountain heather, crowberry, blueberry, and copperbush. It is the least productive of the mountain hemlock associations. Forb diversity is the highest of the mountain hemlock associations (37 species), with fern-leaf goldthread, deer cabbage, and five-leaf bramble most common. Fern diversity is also the highest, with deer fern dominating. Sedges and grasses are common.

Cover of Common Plants (%)
N = 21 Stands

Species	Mean Cover	Range	Constancy
Mountain Hemlock	25	15-63	100
M. Hemlock Regen.	16	0-38	95
Blueberry	32	3-63	100
Merten's Cassiope	12	0-63	76
Deer Cabbage	29	0-63	76
Five-leaf Bramble	8	0-15	90
Fern-lf Goldthread	8	0-15	81
Deer Fern	5	0-15	67

Similar Associations
This type may be confused with mountain hemlock/copperbush-cassiope. However, the cassiope type is extremely open, with more abundant ericaceous shrubs and less abundant copperbush. Trees are also shorter than in the copperbush-cassiope type. The association is distinguished from the poorer mixed conifer types by the general absence of western hemlock and occurrence of alpine-type shrubs and forbs.

Late Seral Stand Structure
Mountain hemlock trees are small in diameter and rarely exceed 45 feet (14 m). Canopy closure is minimal; indeed, the association is only marginally forested. Trees occupy a small portion of the stand and usually occur on isolated, well-drained microsites. Tree crowns exhibit a "krummholz" appearance due to cold temperatures and wind. Shrubs are abundant and regenerate at a faster rate than conifers. Forbs, ferns, and graminoids are also abundant.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	41 [12]	12 [3.7]
DBH (in. [cm])	16 [41]	4.8 [12]
Basal Area (sq.ft./ac.)	153	68
Gross Volume (BF/ac.)	6,880	6,970
Cover (%)	26	9.8
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.6 [0.8]	1.1 [0.3]
Cover (%)		
Tall Shrubs	39	21
Low Shrubs	29	17
Forbs	94	41
Ferns	7	8
Sedges	6	8

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	1627 [496]	880-2400 [268-732]
Landform		**Frequency (%)**
Alpine		14
Mountainslopes		71
Slope Class (%)		**Frequency (%)**
16-35		14
36-55		48
56-75		29
76+		10
	Mean	**Std. Dev.**
Slope Mean (%)	26	17
Soil Parent Material		**Frequency (%)**
Compact Till		7
Residuum		36
Colluvium		14
Organic Material		36
Granite		7
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		62
≤ 50 [20]		38
	Mean	**Std. Dev.**
Imp. Layer Depth	39 [15]	32 [13]
Organic Layer Depth	23 [9.1]	26 [10]
Soil Drainage		**Frequency (%)**
Very Poorly Drained		14
Poorly		19
Somewhat Poorly		24
Moderately Well		24
Well		19
Common Soil Series: Calamity, Saook, South Bight, Kina, Isador, and Tolstoi.		

ENVIRONMENTAL CHARACTERISTICS

The mountain hemlock/cassiope plant association is common at high elevations on upper mountainslope positions on moderate to steep slopes. This association may also occur at lower elevations where there are cold air drainages or frost pockets.
Soil drainage is highly variable depending on microsite conditions. Soils are generally shallow. Organic materials and residuum are the most common parent materials. Cold temperatures, snow impacts, and wet soils limit tree establishment.

MANAGEMENT IMPLICATIONS

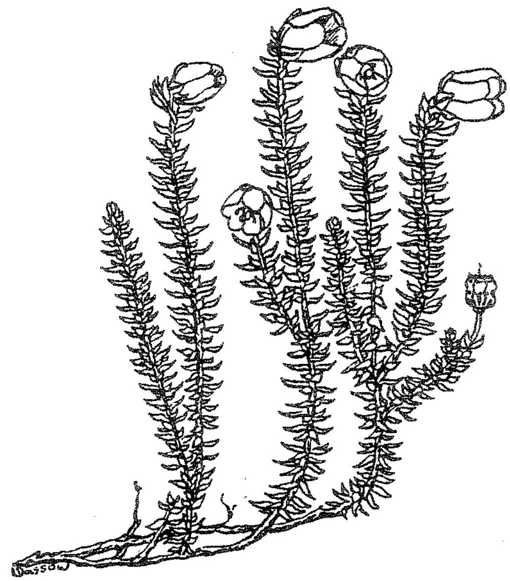
These sites have short trees and an open canopy. Limitations to tree productivity are due to cold temperatures, short growing seasons, snow impacts, and shallow soils. Windthrow potential is low due to the open canopy and short tree heights. Soils vary widely and may be unstable on steeper slopes. These sites store snow well into early summer. Since they occupy a transition zone between alpine and closed forest, they contribute greatly to landscape diversity.

Little sucession information is available. Mountain hemlock and yellowcedar regeneration occurs on small, isolated tree "islands." Avalanching and slope failure can cause extensive tree mortality, but individual tree-fall is the most common disturbance. Canopy closure would not occur due to the lack of suitable tree-growing microsites.

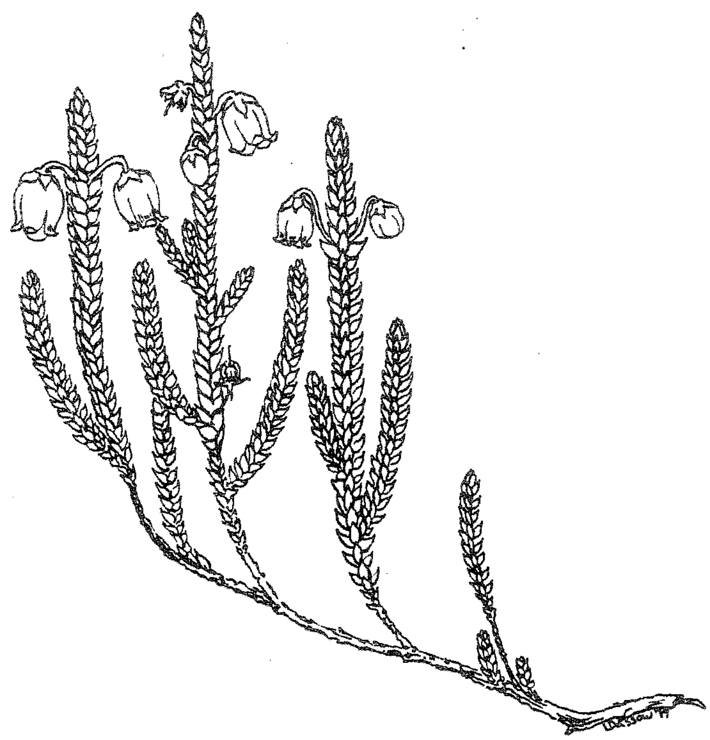
During summer and fall, these sites provide excellent deer, mountain goat, and brown bear foraging habitat. Snow accumulation restricts deer use in winter. Brown bear may find suitable denning sites in this type.

Trail construction provides access to these popular sites, but steep slopes, unstable soils, and fragility of vegetation should be considered. Road construction is unlikely.

Recreational and subsistence use is limited by access, but, where accessible, these sites may be very popular with hikers and berry pickers.

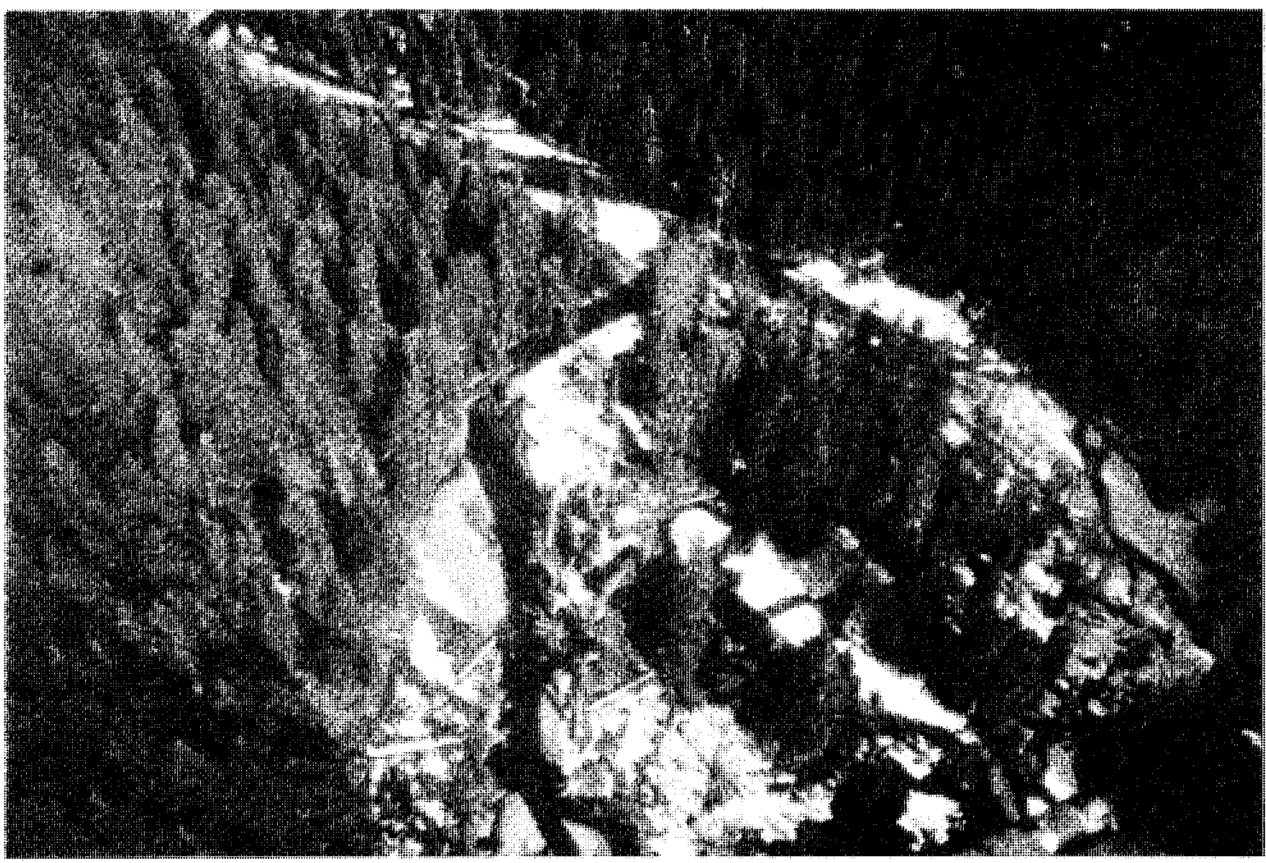


Starry Cassiope
Cassiope stellariana



Merten's Cassiope
Cassiope mertensiana

SITKA SPRUCE SERIES



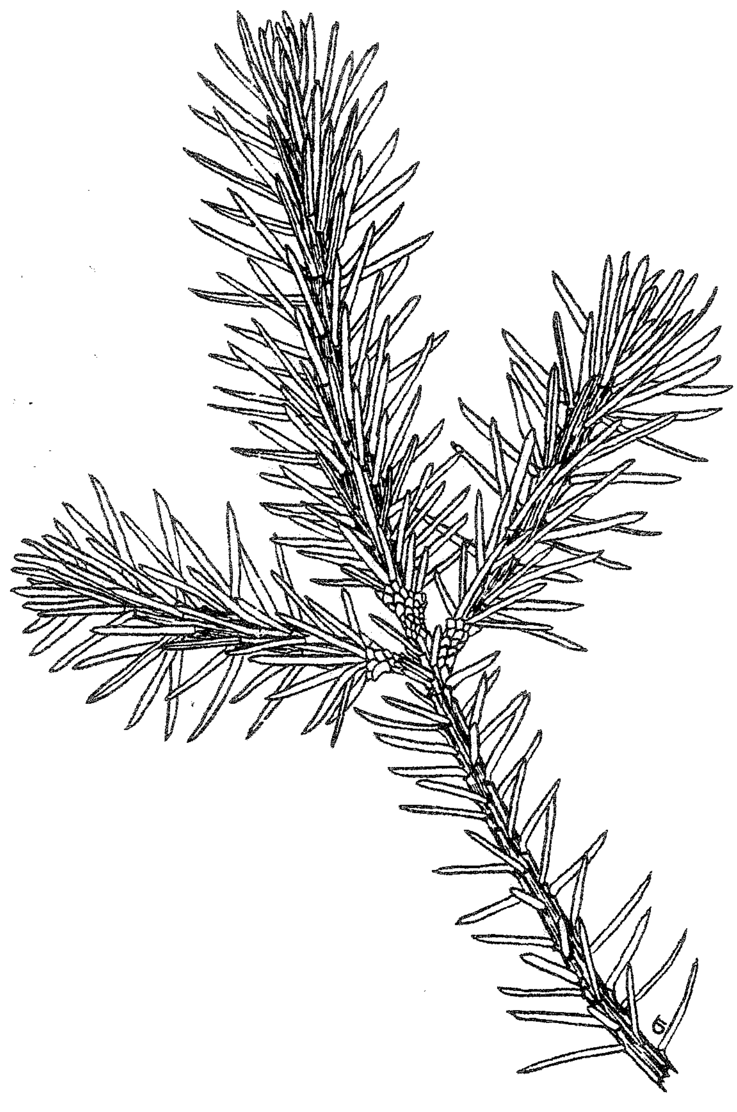
12
SITKA SPRUCE SERIES

Description

This series is noted for the largest Sitka spruce on the Chatham Area. While the associations are similar to the most productive western hemlock associations, spruce is more abundant (> 15 percent cover). Spruce cover may vary from 15 to 100 percent while total canopy cover ranges from 40 to 80 percent.

Mature western hemlock trees usually occupy a second layer below spruce, and hemlock regeneration is abundant in late seral stands. Red alder and cottonwood are occasional overstory components, with cottonwood more common on the mainland. Tree heights typically range from 100 to 150 feet (30 to 46 m), and diameters from 20 to 40 inches (51 to 102 cm). Tall shrub cover may be extensive. Forbs and ferns are abundant in most of the spruce associations.

Sitka spruce usually indicates soil disturbance (such as from surface or subsurface moving water), soil mass movement, and windthrow. In Southeast Alaska on stable upland soils, high rainfall and Spodosol formation cause increased soil acidity, organic matter accumulation, and lower nutrient availability (Farr and Ford 1988). Frequent flooding can disrupt this development. Judging from observations of soil mixing, buried horizons, and mineral deposition in soils sampled in this series, flooding appears to be the most pervasive disturbance factor in the spruce series. These flooded soils often show little soil profile development and are commonly classified as either Entisols or Inceptisols.



Sitka Spruce
Picea sitchensis

The spruce associations with devil's club, salmonberry, and alder occur on these flooding-disturbed sites. However, productive spruce associations also occur on Spodosols (developed soil profiles) such as Tuxekan series soils. The association with the most highly disturbed soils (75 percent of soil pits had no soil development) is the spruce-red alder type.

The least disturbed (15 percent of soil pits had no development) is the spruce/blueberry association. The associations are presented in order of decreasing soil disturbance because that appears to be the dominant environmental factor affecting this series. However, the spruce/Pacific reedgrass association—located on beach fringes where wind and salt spray influence vegetation more than flooding—is presented after the freshwater flooding-related sites. The two non-riparian associations (upland spruce/devil's club and spruce-mountain hemlock/blueberry) are described last.

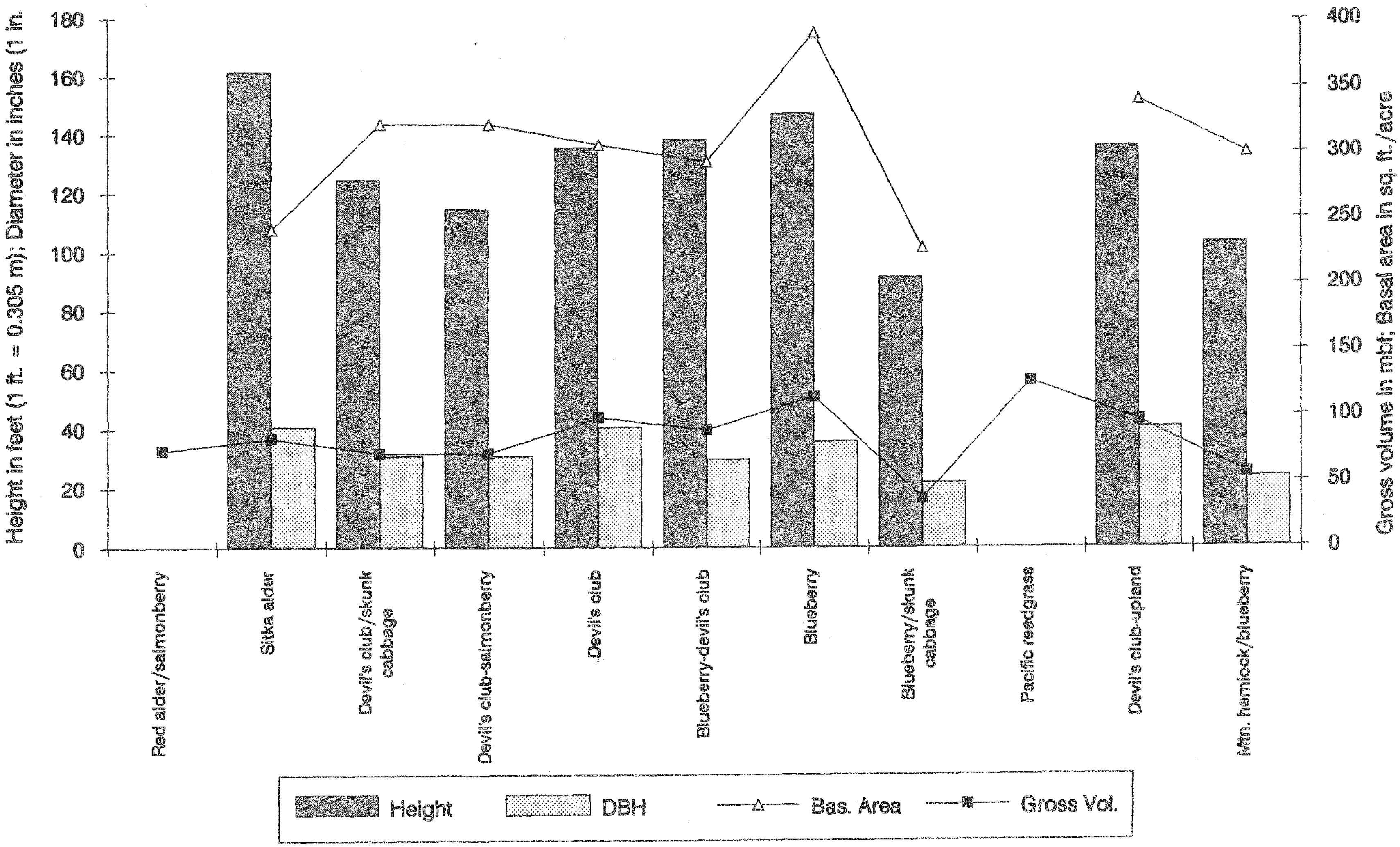
Soil drainage appears to be a secondary factor influencing vegetation composition on alluvial spruce sites. Soil drainage is poor in the spruce/devil's club/skunk cabbage and the spruce/blueberry/skunk cabbage associations. Judging from the abundance of skunk cabbage, these associations occur on soils which are apparently saturated most of the growing season. Observations of water table levels in soil pits dug in this association indicated that the water table is usually within 20 in. (50 cm) of the soil surface. This distance corresponded with the observed rooting depth of skunk cabbage.

Many riparian spruce forests have a mosaic of soil types typical of flooded landforms. This variability can be seen in the vegetation. For example, skunk cabbage often occurs in old, wet backwater channels, while blueberry will occupy mounds and other raised areas. Typically, changes in vegetation and soils occurs gradually, but ecotones may be abrupt, such as when there are distinct upper and lower floodplain terraces. Tuxekan and Tonowek soils are very common in these situations: Tuxekan soils typically occur on stable terraces and interfluves on alluvial fans while Tonowek soils typically occur on unstable floodplains and lower terraces (IRI Handbook 1990). Soil development from the Tonowek soils (Entisols) to the Tuxekan soils (Spodosols) correlates with the vegetation gradient from disturbance-associated salmonberry to stable site blueberry.

Figure 18 compares productivity among the associations. Tree sizes are more variable in this series than in some of the others due to the variety of environmental conditions under which the spruce associations occur. As shown, the blueberry/skunk cabbage type is the least productive.

In the more productive types, very large and valuable spruce trees ("pumpkins") occur. Spruce trees are typically harvested for lumber rather than pulp (as hemlock is), and the best logs are reserved for special uses such as guitar faces. During World War II, many spruce logs were harvested for use in construction of airplanes due to the wood's light but strong characteristics. While this use has disappeared, prime spruce remains in high demand.

Figure 18. Average Tree Structure for Sitka Spruce Series



Down woody material can be abundant and large. Most of the regeneration of hemlock and spruce occurs on logs (Schrader 1992). These sites provide nutrients and protection from flooding. Also, seedlings on these sites avoid competition with mosses on the forest floor (Harmon 1986; Harmon and Franklin 1989). Maintaining adequate levels of down wood is therefore important for long-term tree productivity and, in harvest units, all unmerchantable material should be left on site. Down wood also helps stabilize stream banks and is important for aquatic habitat (see below).

Snags are less common in the spruce series than in most of the other series. Large spruce often develop heart rot and break off before they die (Boughton et al. 1992), resulting in large down wood but not tall standing trunks. Spruce snags are especially valuable for cavity nesters since the wood is soft and easily excavated.

Riparian spruce sites often include high quality anadromous fish streams (class I streams). Maintenance of these world-class salmon fisheries is dependent on protection of aquatic habitat and water quality. Down wood is therefore important in spruce associations adjacent to stream channels—especially in moderate gradient mixed control, high gradient contained, and alluvial fan process groups (Paustian et al. 1992)—where windthrown trees and branches can enter or intersect streams to create pools, protected water, and habitat for resident and anadromous fish. See Channel Type User Guide (Paustian et al. 1992) for more information on channel types with streamside spruce associations. Maintenance of water quality includes prevention of excess sediment input from roading or logging activities.

Riparian spruce sites are also valuable habitat for terrestrial wildlife. Deer use coastal spruce forests extensively. These forests are important travel corridors for deer, bear, and other animals. In some associations, skunk cabbage provides excellent forage. Devil's club berries and salmonberry are abundant in other associations and provide a food source for brown bear and other species. In some areas, brown bears may impact understory composition by foraging and dispersing seeds, such as those of devil's club and salmonberry.

Sitka Spruce Silvicultural and Harvest Concerns

Due to the high value of riparian spruce forests for timber harvest and terrestrial and aquatic wildlife habitat, management conflicts arise. Major riparian resource use concerns are discussed here.

During the 1950s and 1960s, extensive tractor logging exposed mineral soils on flat alluvial spruce sites. Subsequently, alder became established and persists in many of these sites. On Baranof and southern Chichagof Islands, mostly red alder establishes. On northern Chichagof—near the northern edge of the current distribution of red alder and probably due to colder conditions—mostly Sitka alder establishes. Red alder may be found north to Yakutat, but, within the northern end of its zone, Sitka alder appears to replace it locally as sites get colder.

In the early 1900s, alluvial spruce forests were logged with low impact techniques near the mouth of Fish Bay, Baranof Island. These sites regenerated with spruce. Since the early 1970s, cable logging systems have been used on many alluvial sites. These systems have shown to be less destructive to the soils than tractor logging. However, cable logging disturbs flat portions of sites when logs are not fully suspended. Alder will establish immediately on these areas exposed to mineral soil when there is an alder seed source nearby.

Schrader (1992) evaluated conifer regeneration after clearcutting on alluvial spruce sites and found that seedling density was highly variable. Most regeneration occurred on well-decayed logs, and Schrader concluded that availability of such microsites influences regeneration success. Also, salmonberry was found to hinder spruce regeneration on the forest floor. Schrader identified eight early seral vegetation types occurring along moisture and disturbance gradients in the alluvial sites.

Immediate planting of spruce after clearcut harvest may be effective on some sites to establish trees before shrubs and alder take over. If natural regeneration is desired, slash should be removed from the best tree-growing microsites (Schrader 1992). Piling of slash on salmonberry or depressed areas is recommended. On older cut areas dominated by red alder, selective thinning of alder may enhance growth of established conifers. Complete removal of alder is not recommended as a method to accelerate succession since alder provides an important soil fertility function through nitrogen fixation.

Because riparian spruce forests are valued for habitat, in recent years buffer strips of various sizes have been established between timber harvest units and anadromous fish streams. The 1990 Tongass Timber Reform Act (TTRA) made this common practice into law, requiring 100 foot (30 m) wide, no-harvest buffers on both sides of salmon spawning streams or the first 200 feet (60 m) of their tributaries with resident fish. However, the effectiveness of some buffers is limited since partial or complete blowdown may occur (Concannon and DeMeo 1993). Wind direction, soil type, slope, and other environmental factors appear to affect the longevity of trees in buffer strips. Landscape analysis of wind patterns and other ecosystem processes (flooding, erosion, herbivory) should be included in planning for ecosystem sustainability.

Recently, in an effort to conserve declining salmon and steelhead stocks in the Pacific Northwest, the Forest Service and Bureau of Land Management have developed plans for 300 foot (90 m) buffer strips. These interim buffer strips would apply on all fish bearing streams and lakes, as well as on permanently flowing non-fish bearing streams, until research can demonstrate the need for a different size (or no) buffer. (Ponds, wetlands, intermittent streams, and landslide areas are to receive smaller buffer areas). This PACFISH project is slated to occur on public lands in parts of Washington, Oregon, Idaho, and California (USDA FS 1993). Alaska was originally included, but Alaskan Senator Ted Stevens negotiated a different system for Alaska since placement of such buffers on streams as proposed would vastly decrease the commercial timber base in the state (Stevens Press Office 1993). Current Alaskan plans call for 300 foot (90 m) buffers to be placed only on streams that have been identified through watershed analyses as needing such increased protection. PACFISH also calls for watershed analyses (USDA FS 1993), which are likely to occur in the above states as well as in Alaska.

The PACFISH plan is controversial and is still in draft stages. Further research on buffer design and function is necessary to ensure the effectiveness of both TTRA and PACFISH buffers.

Long-tailed voles (*Microtus longicaudus*) caused complete plantation failures of spruce seedlings on spruce plant associations on Chichagof Island (Russell, unpubl. memo 1988). This mortality appears to only occur during localized vole population peaks. Planting should therefore not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

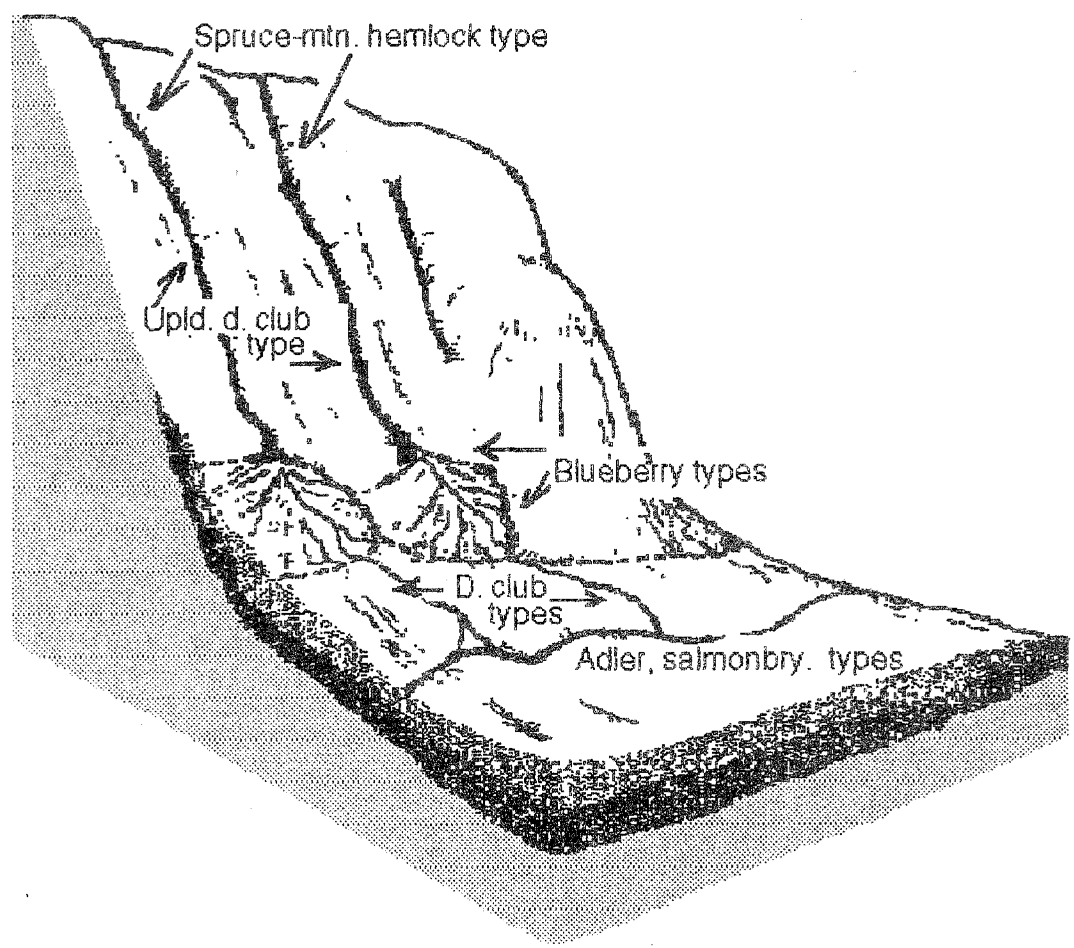


Figure 19. Generalized Landscape Positions for Spruce Associations

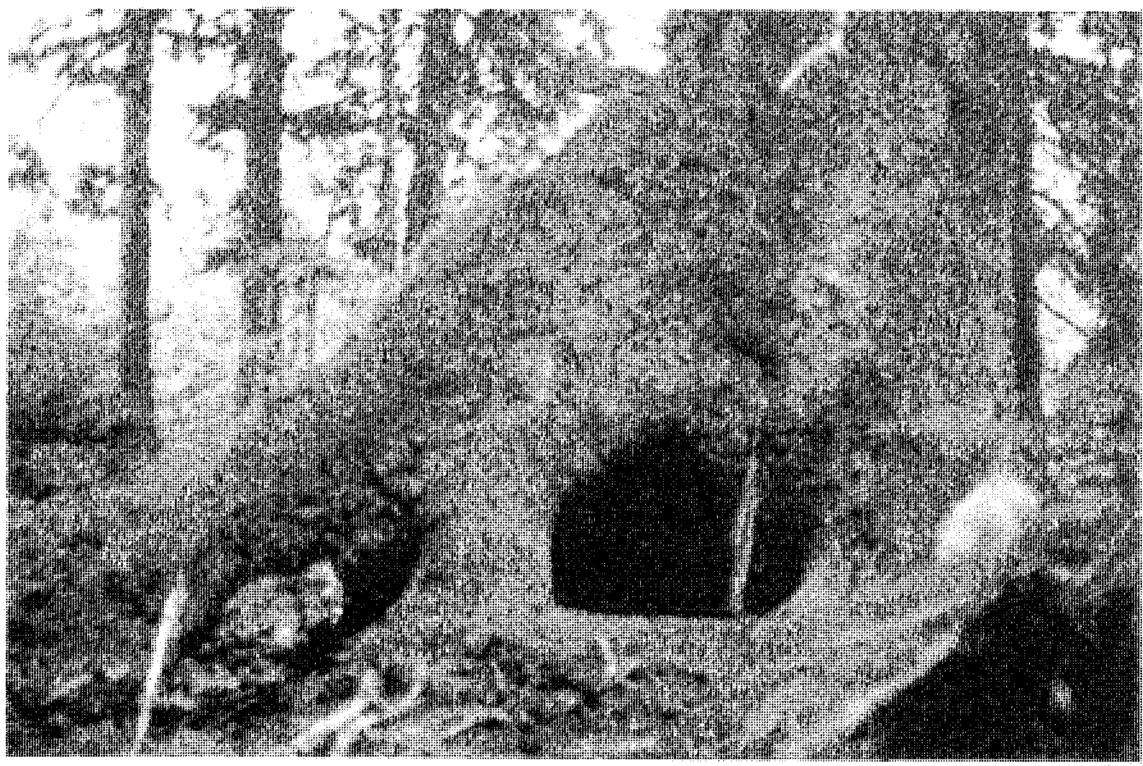
Generally, road and trail construction on flat spruce sites requires minimal rock fill due to the near absence of organic matter over alluvium. (Exceptions may include skunk cabbage sites.) Drainage structures should be designed to minimize changes in hydrology and fish habitat.

Usually, riparian spruce sites are not classified as wetlands because soils are well drained and hydrophytic vegetation is not present (DeMeo et al. 1989).

No information is available on interior forest microclimate in spruce forests. Since stand structure, patch shape, size, and landscape location of spruce forests are different from hemlock forests, the microclimate is likely also different.

Distribution

The spruce series is widely distributed throughout Southeast Alaska. It occurs in disturbed environments including floodplains, coastal beach fringes, and steep erosional slopes. At elevations less than 850 feet (259m), most stands occur on floodplains or alluvial fans (Pawuk and Kissinger 1988; Martin 1989; DeMeo and Martin 1992). Figure 19 shows the general landscape distribution for the spruce series.



Bear den in large spruce, Neka River
Photo credit: B. Zoellick

SITKA SPRUCE-RED ALDER/SALMONBERRY
Picea sitchensis-Alnus rubra/Rubus spectabilis

Photo credit: M. Marshall

VEGETATION

This moderately productive, open canopy forest type is dominated by Sitka spruce and red alder. Hemlock cover is usually less than 15%.

Disturbance species including salmonberry and devil's club dominate the understory. Stink currant cover may be greater than 25%. Hemlock and spruce regeneration is common. Foamflower and lady fern dominate the forb and fern strata.

Exposed stream gravel and sand are common. Further sampling in this type is needed.

Cover of Common Plants (%)
N = 4 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	38	25-50	100
Red Alder	18	3-40	100
Devil's Club	47	5-65	75
Salmonberry	12	5-25	100
Lady Fern	9	1-15	100

Similar Associations

This type may be confused with the Sitka spruce/Sitka alder plant association. However, mature Sitka alder has the growth form of a shrub rather than the tree form shown by mature red alder. Following severe soils disturbance, the association may also be confused with the seral communities found on other spruce associations.

Late Seral Stand Structure

Spruce trees averaged 111 feet (34 m) in the one stand for which tree dimension data was collected. Other observations indicate heights to be highly variable consistent with the highly variable site conditions. Trees over 150 feet (46 m) can be expected.

Red alder tends to occur in clumps in openings in the spruce canopy. Open grown spruce are common, and often have crowns covering more than 50 percent of the bole. Canopy closure is the lowest of all the spruce associations.

Down wood is sparse (Schrader 1992). Salmonberry, stink currant, and devil's club cover in canopy gaps may be 100 percent with plants over 5 feet (1.5 m). Too few stands were sampled to provide shrub heights and cover by lifeform.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	111 [34]	7.8 [2.4]
DBH (in. [cm])	22 [56]	1.6 [41]
Basal Area (sq.ft./ac.)	350	212
Gross Volume (BF/ac.)	73,000	0
Cover (%)	43	16

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	151 [46]	25-260 [7.6-79]
Landform		**Frequency (%)**
Alluvial		100
Slope Class (%)		**Frequency (%)**
0-15		75
36-55		25
	Mean	**Std. Dev.**
Slope Mean (%)	4	5
Soil Parent Material		**Frequency (%)**
Alluvium		100
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	82 [32]	34 [13]
Organic Layer Depth	21 [8.3]	32 [13]
Soil Drainage		**Frequency (%)**
Very Poorly		25
Somewhat Poorly		25
Well		50
Common Soil Series: Bessie.		

ENVIRONMENTAL CHARACTERISTICS

The spruce-red alder/salmonberry plant association is common along island low elevation valley bottom streams, especially those in the floodplain channel-type process group (Paustian et al. 1992). On the mainland, the association is common along the smaller, island-like, typically non-glacial streams. While the association is most common immediately adjacent to larger streams, it also occurs in areas which are highly braided with small streams.

The species mix in this plant association is primarily maintained by frequent flooding. Judging from the lack of soil development and the frequency of exposed mineral soils, these floods are often highly disruptive, causing soil mixing, deposition, tree fall, and movement of organic debris. High water marks (sediment deposits on tree trunks) were observed 2 feet (0.6 m) above the soil surface. Frequent flooding brings in nutrient-rich material, thereby increasing soil fertility.

MANAGEMENT IMPLICATIONS

Tree productivity is moderate. Stocking is generally low and suitable tree growing microsites are limited. Spruce regeneration is restricted to down logs and raised organic debris. Maintenance of large woody debris is critical for long-term conifer productivity.

Clearcutting may cause a long-term, possibly irreversible, shift from coniferous to deciduous forest. Changes in stream course, width, and hydrology from old clearcutting has permanently altered sites in Fish Bay, Rodman Bay, Katlian, and Nakwasina drainages on Baranof Island. Even if harvest occurs with full log suspension, natural disturbance from flooding will favor perpetuation of alder.

Red alder seedlings are abundant for at least 20 to 30 years following clearcut harvest (Schrader 1992). Brush competition is high, especially from salmonberry. Planting of spruce immediately after harvest may be effective on some sites to ensure adequate regeneration. Small diameter slash should be removed from planting sites to enhance survival. If natural regeneration is desired, slash should be removed from potential tree-growing sites (Schrader 1992). Slash piling on wet skunk cabbage microsites or dense salmonberry patches is recommended.

Red alder, salmonberry, and ferns will dominate these sites for at least 50 years following clearcut timber harvest. Stand closure of red alder appears to occur about 30 years after clearcut harvest. While the cover of red alder may be high in these stands, light does not limit understory production (Cordes 1972; Barber 1976; Schrader 1992). Small isolated patches of spruce may exhibit loss of understory vegetation similar to the pattern described for western hemlock forests by Alaback (1982; see Chapter 2). A spruce-red alder/salmonberry stand harvested 70 years ago in the Fish Bay drainage, Baranof Island, is still dominated by red alder. Young spruce are just beginning to approach the height of the alder.

On older cut areas dominated by red alder, selective thinning of alder may enhance growth of established conifers. Because alder provides an important soil fertility function through nitrogen fixation and helps to stabilize these active sites, complete removal of alder is not recommended as a method to accelerate succession.

An attempt to release young spruce trees by removing taller alder trees was made in the Rodman Creek drainage, Baranof Island. Girdling of alder trees with an established salmonberry understory resulted in at least doubling of salmonberry production. Thus, unless spruce regeneration is taller than existing salmonberry, such attempts to release spruce may not be effective. Girdling of 20 to 30 year old alder in the lower Muri Creek drainage, Chichagof Island, caused undesirable deformation of many of the understory spruce trees when the alder eventually fell over. Directional falling is recommended to protect understory trees. With sufficient time, spruce usually will overtop both salmonberry and alder on these sites.

Long-tailed voles (*Microtus longicaudus*) are abundant following timber harvest. During population peaks, complete mortality of planted spruce has occurred in spruce associations one to two years after clearcut harvest on Chichagof Island (Russell, unpubl. memo 1988). Planting should not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

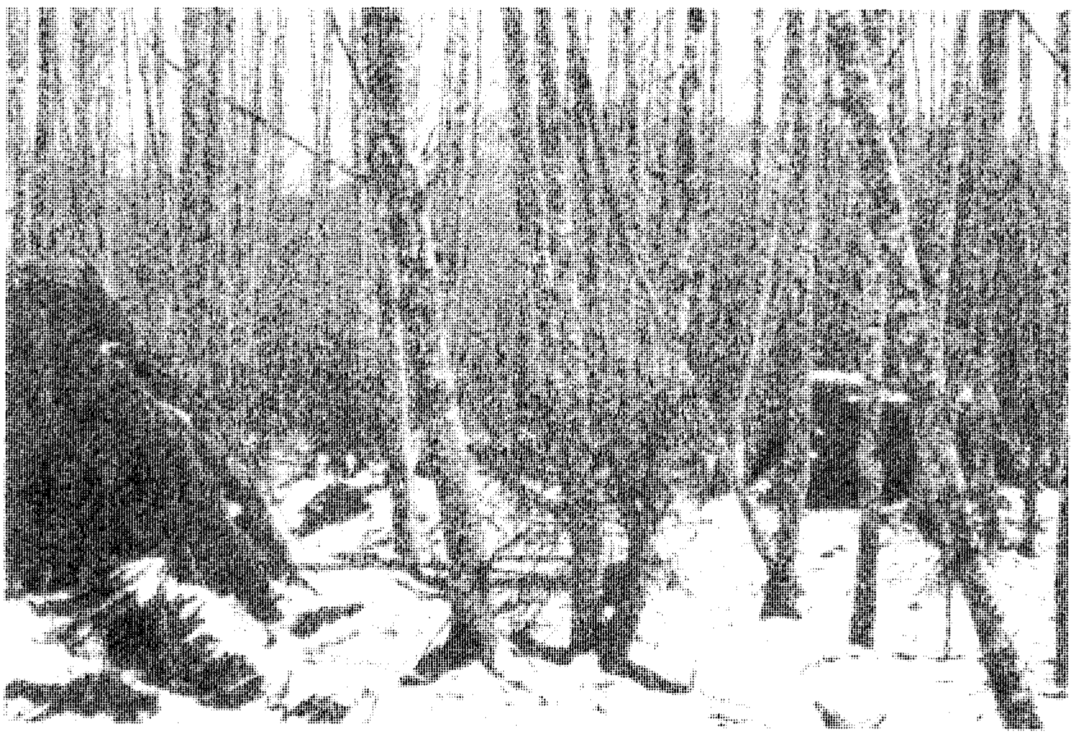
This association is important as a source of coarse woody debris for anadromous fish streams and for stabilizing active alluvial areas. Brown bear sign is abundant, especially when the association occurs along a salmon stream. Salmonberries are abundant and are used by bear during the summer (Schoen and Beier 1990).

The association is not important deer habitat. When it occurs near the coast, bald eagles utilize the largest spruce trees for nesting and roosting.

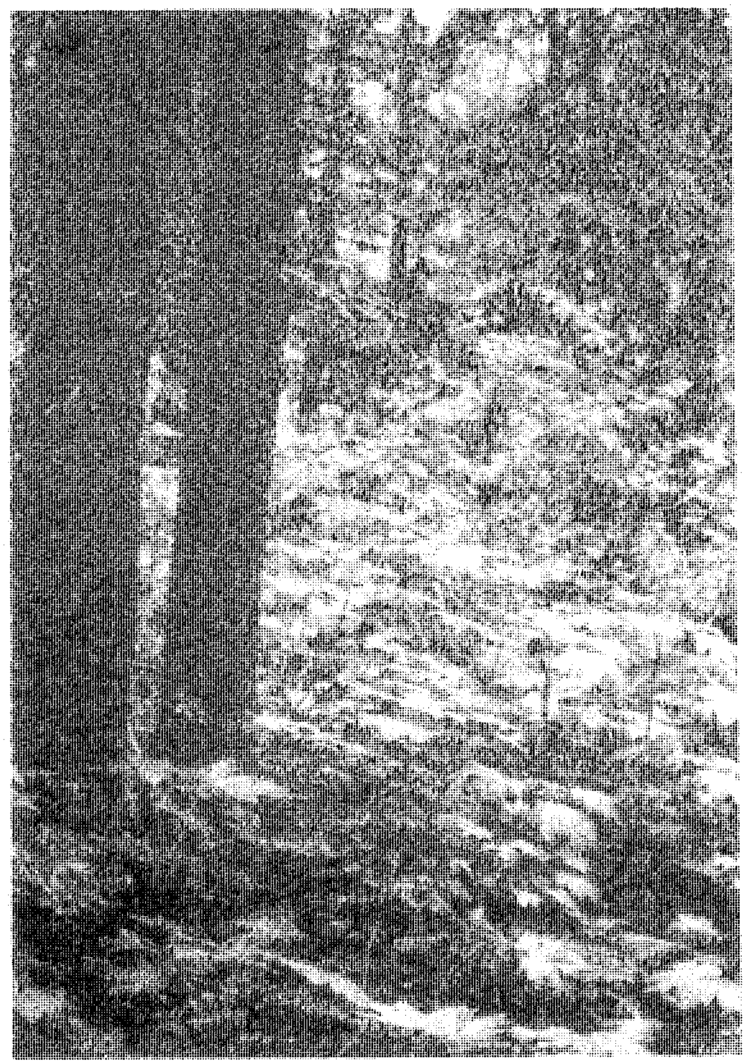
Flooding limits success of trail and road construction. Bank stability may also be a problem.

Recreationists and fishermen may use this association.

Traditional Native Alaskan uses of spruce collected on these sites include pitch for sealant, new buds for food, roots for weaving hats and baskets, and tree trunks for everyday canoes (ceremonial canoes and long-distance ones were usually made of cedar). Subsistence uses also include berry picking and fishing. Alder is often collected for smoking fish and for carving.



Twenty-year old alder stand developed on spruce floodplain following harvest, Pt. Muri



VEGETATION

This moderately productive, open canopy forest type is dominated by Sitka spruce. Western hemlock cover is usually less than 20 percent and was only present in 75 percent of the sampled stands.

Devil's club and Sitka alder dominate the understory. Salmonberry and blueberry are usually present in limited amounts. Stink currant may be greater than 25 percent cover. Hemlock and spruce regeneration is limited. Foamflower, oak fern, and lady fern are abundant. Additional sampling is needed.

Exposed stream gravel and sand are common.

Cover of Common Plants (%)
N = 4 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	32	15-38	100
Sitka Alder	27	10-65	100
Devil's Club	45	15-85	100
Salmonberry	9	1-15	100
Stink Currant	18	1-38	75
Foamflower	12	3-15	100
Oak Fern	15	3-38	100
Lady Fern	12	3-15	100

Similar Associations
This type may be confused with the spruce/red alder plant association. However, mature red alder has a tree growth form rather than the shrub form of Sitka alder. It may also be confused with the seral communities found on other spruce associations following severe soils disturbance.

Late Seral Stand Structure
Spruce trees averaged 162 feet (49 m) in the one stand for which tree dimension data was collected. Other observations indicate heights to be variable consistent with variations in site and disturbance frequency.

Sitka alder tends to occur in clumps in openings in the spruce forest. Open grown spruce are common and often have crowns covering more than 50 percent of the bole. Salmonberry, stink currant, and devil's club cover in canopy gaps may be 100 percent with plants over 5 feet (1.5 m) tall. Down wood is sparse (Schrader 1992).

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	162 [49]	0
DBH (in. [cm])	41 [104]	0
Basal Area (sq.ft./ac.)	240	0
Gross Volume (BF/ac.)	81,600	0
Cover (%)	45	20
UNDERSTORY	**Mean**	**Mean**
Height (ft. [m])		
Devils' Club	6.5 [2.0]	0
Salmonberry	4 [122]	0
Cover (%)		
Tall Shrubs	100	0
Forbs	87	0
Ferns	54	0

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	290 [88]	60-450 [18-137]
Landform		**Frequency (%)**
Alluvial		100
Slope Class (%)		**Frequency (%)**
0-15		100
	Mean	**Std. Dev.**
Slope Mean (%)	0.5	1
Soil Parent Material		**Frequency (%)**
Alluvium		75
Bedrock		25
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	100 [39]	0
Organic Layer Depth	4 [1.6]	1 [0.4]
Soil Drainage		**Frequency (%)**
Well		100
Common Soil Series: Tonowek, Bradfield.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/Sitka alder plant association occurs primarily on northern Chichagof Island, the Chilkat peninsula, Yakutat, and the mainland north of Juneau. It is the only spruce/alder type in Prince William Sound on the Chugach National Forest. It appears to occupy a niche similar to spruce-red alder/salmonberry, but beyond the northern limits of red alder—or within the red alder zone but in locally colder sites. It is common along low-elevation, valley bottom island streams, especially those in the floodplain channel-type process group (Paustian et al. 1992). While it is most common immediately adjacent to larger streams, it also occurs in areas that are highly braided with small streams.

The species mix in this plant association is primarily maintained by frequent flooding. Judging from the lack of soil development and the frequency of exposed mineral soils, these floods are often highly disruptive, causing soil mixing, deposition, tree fall, and movement of organic debris.

Soils are mineral, very deep, well drained, and comprised of alluvial sand and gravel. Soils show little sign of Spodosol formation or development, indicating a high degree of flushing and surface flooding. The amount of surface organic matter in both spruce/alder associations is less than that in any other forest plant association in Southeast Alaska. Since forests in the Southeast Alaska region have the largest accumulations of organic matter in North America (Alexander 1989), soil organic matter is not a limiting factor in soil productivity. The lack of organic matter in the alder plant associations therefore represents a significant difference from other associations. This lack of organic material and consequent mineral soil allows regeneration of alder and spruce rather than hemlock. Soil productivity is maintained by surface and subsurface water-borne nutrients.

MANAGEMENT IMPLICATIONS

Tree productivity is moderate due to lower stocking. Spruce regeneration is unevenly distributed, which can be attributed to the abundance of salmonberry and the lack of raised organic microsites. Dense salmonberry patches will exclude conifer establishment (Tappeiner et al. 1991). As in the spruce-red alder association, spruce regeneration occurs on down logs and raised mineral or other debris (Schrader 1992). Maintenance of large woody debris is critical for long-term conifer regeneration.

Sitka alder, salmonberry, and lady fern dominate these sites until spruce overtops the alder (Schrader 1992). Since Sitka alder has a shrub growth form, it is unlikely that conifers will be excluded from these sites for as long a period as on the spruce-red alder sites. However, similar problems may exist in both spruce/Sitka alder and spruce/red alder clearcut areas due to the high natural rates of disturbance and the sensitivity of these soils. Changes in stream course, stream width, and hydrology due to tree removal may alter the suitability of existing microsites.

Complete removal of alder is not recommended as a method to accelerate succession. Alder provides an important soil fertility function through nitrogen fixation and helps to stabilize active sites. Thinning alder immediately around spruce seedlings may be an effective method to improve the height growth of spruce.

Canopy closure following understory exclusion is likely to only occur in small, dense, isolated patches of spruce. Further work is needed to describe succession in this plant association.

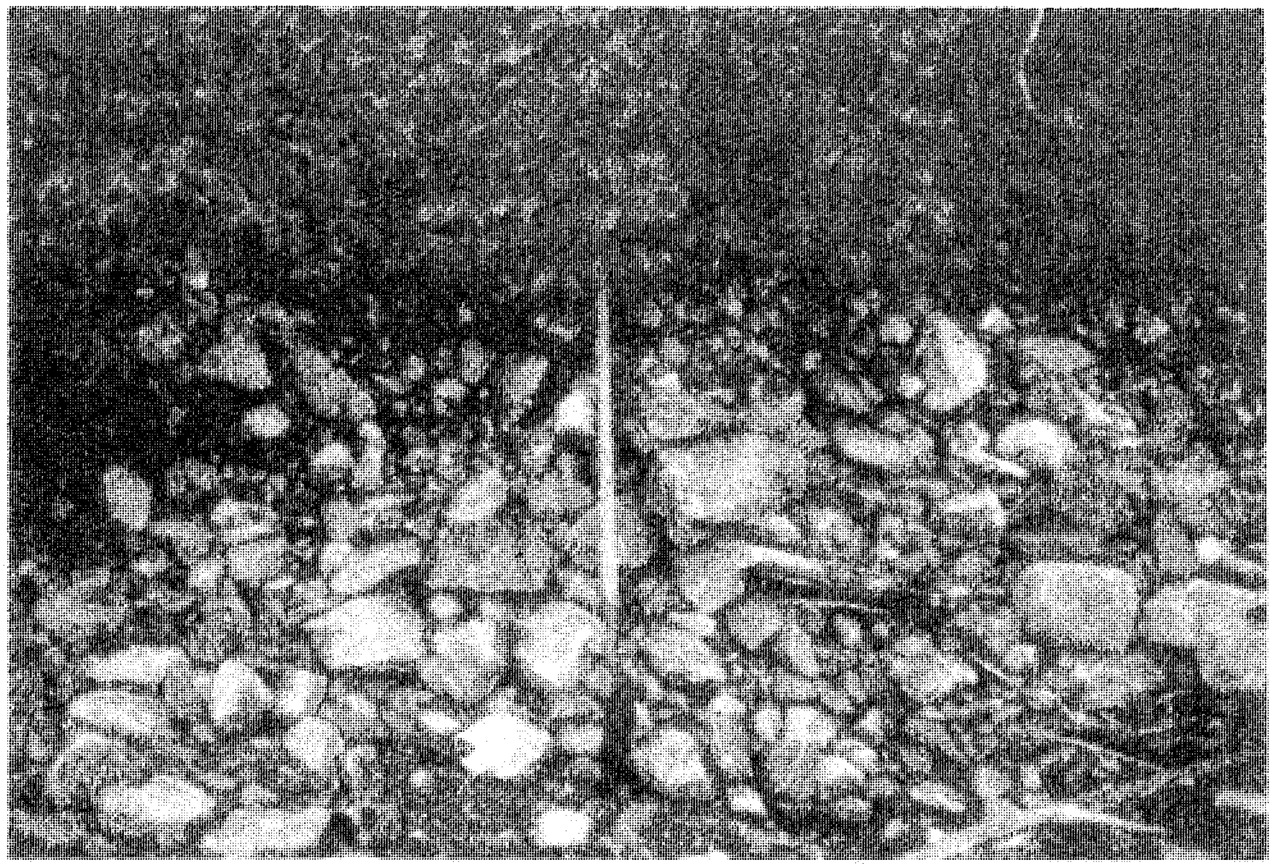
Clearcut logging is not recommended for these sites. Selection harvest is an alternative which may help to maintain soil productivity. However, selection harvest may create windthrow problems and alter the flooding regime. Landscape analysis of disturbance patterns should be included in planning for ecosystem sustainability.

Long-tailed voles (*Microtus longicaudus*) caused complete plantation failures of spruce seedlings on spruce plant associations on Chichagof Island (Russell, unpubl. memo 1988). This mortality appears to only occur during localized vole population peaks. Planting should not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.
Brown bear sign is abundant, especially when this association occurs along salmon streams. Devil's club berries are abundant and are used to a limited extent by bear during the summer (Schoen and Beier 1990).

This plant association is important as a source of coarse woody debris for anadromous fish habitat and for stabilizing active alluvial areas. When the type occurs near the coast, bald eagles utilize the largest spruce trees for nesting and roosting. The association is not important deer habitat.

Trail and road construction should be avoided in riparian areas, and bank stability may be a problem.

Recreationists and fishermen may use the type. Subsistence uses include collection of alder and spruce.



Note alluvial soils

VEGETATION

This productive forest type is dominated by large Sitka spruce. Mature western hemlock trees are abundant in a layer below spruce.

Devil's club and blueberry dominate the shrub layer. Hemlock regeneration is common. Salmonberry was common in about two-thirds of the sampled stands. Skunk cabbage dominates the forb layer. Foamflower is also common. Oak fern and lady fern are the most common ferns.

Cover of Common Plants (%)
N = 16 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	43	15-60	100
Western Hemlock	28	0-60	94
Devil's Club	28	15-85	100
Blueberry	13	3-40	100
Salmonberry	12	0-40	69
Skunk Cabbage	34	15-85	100
Oak Fern	12	1-40	100
Lady Fern	10	0-40	81

Similar Associations

The abundance of skunk cabbage distinguishes this plant association from all others in the spruce series. It may be confused with the hemlock/devil's club/skunk cabbage association, but has more spruce.

Late Seral Stand Structure

Spruce vary in height to over 130 feet (40 m). Hemlock trees to 90 feet (27 m) are common below spruce on undisturbed forest patches. Down wood is common and important for conifer regeneration. Shrub cover usually does not exceed 75 percent due to the abundance of wet skunk cabbage depressions.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	125 [38]	19 [5.8]
DBH (in. [cm])	31 [79]	7.4 [19]
Basal Area (sq.ft./ac.)	320	91
Gross Volume (BF/ac.)	71,000	29,500
Cover (%)	64	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.8 [0.9]	1.2 [0.4]
Devil's Club	5.5 [1.7]	1.7 [0.5]
Cover (%)		
Tall Shrubs	65	52
Forbs	63	47
Ferns	25	15

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	215 [66]	30-500 [9-152]
Landform		**Frequency (%)**
Mountainslopes		94
Slope Class (%)		**Frequency (%)**
0-15		50
16-35		44
	Mean	**Std. Dev.**
Slope Mean (%)	5	9
Soil Parent Material		**Frequency (%)**
Alluvium		63
Colluvium		12
Organic Material		12
Ablation Till		13
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	22 [8.7]	16 [6.3]
Organic Layer Depth	100 [39]	1 [0.4]
Soil Drainage		**Frequency (%)**
Very Poorly		33
Poorly		27
Somewhat Poorly		13
Well		27
Common Soil Series: Kasiana, Kushneahin, Mitkof, South Bight, Tonowek.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/devil's club/skunk cabbage plant association is common on low elevation alluvial, or on mixed alluvial and colluvial landforms, and in the transition zone between footslopes and floodplain landforms. Slopes are less than 15 percent.

Low-intensity surface flooding is common and tends to inundate the skunk cabbage depressions and devil's club areas and to maintain the species mix. Subsurface flooding within 20 in. (50 cm) of the surface keeps the soil saturated throughout the growing season and provides optimum conditions for skunk cabbage.

A mosaic of soils occur in this association. Wet, mucky, poorly drained organic soils occur in depressions, old backwater areas, and along seeps. These sites are dominated by skunk cabbage. Well drained mineral soils occur on raised sites dominated by blueberry and devil's club.

MANAGEMENT IMPLICATIONS

Tree productivity is high, with trees usually occupying the more well drained positions rather than the microsites with skunk cabbage. Stocking is moderate and suitable tree-growing microsites are common.

Soils are sensitive to scarification, but not nearly as sensitive as those in the spruce/devil's club-salmonberry type or those in the blueberry associations in the spruce or hemlock series. On mineral soils that are exposed by ground-disturbing logging practices, alder out competes all other plants.

Clearcutting is not recommended due to soil sensitivity. Also, removal of the overstory leads to reduced transpiration and subsequent increased soil water. Maintenance of large organic material for future tree-growing sites is essential for long-term productivity. This woody debris provides protected, well-drained, and nutrient-rich microsites for tree germination, free from competition with mosses on the forest floor. Selection harvest is an alternative which may help to maintain soil productivity.

Devil's club cover declines and salmonberry, skunk cabbage, and lady fern cover can be expected to increase following clearcutting (Schrader 1992). This is due to brush competition, disturbance regime, and wet soils—particularly following overstory removal. Spruce and hemlock seedlings are more uncommon in this association than in any other association of the series for at least the first 20 to 30 years after harvest.

Canopy closure probably occurs only on small microsites due to the abundance of wet skunk cabbage depressions, which are unsuitable for tree seedlings. Further study of plant succession in this association is needed.

Salmonberry cover is low initially, but greatly increases following harvest. Planting of spruce may be effective on some sites for ensuring adequate regeneration. Ferns may cause some conifer seedling mortality due to dead fronds blocking light to the seedling.

On older cutting areas dominated by red alder, selective thinning of alder may enhance growth of established conifers. Complete removal of alder is not recommended as a method to accelerate succession because alder provides an important soil fertility function through nitrogen fixation and helps to stabilize these active sites.

An attempt to release young spruce trees by removing taller alder trees was made in the Rodman Creek drainage, Baranof Island. Girdling of alder trees with an established salmonberry understory resulted in at least doubling of salmonberry production. Thus, unless spruce regeneration is taller than existing salmonberry, such attempts to release spruce may not be effective. Girdling of 20 to 30 year old alder in the lower Muri Creek drainage, Chichagof Island, caused undesirable deformation of many of the understory spruce trees when the alder eventually fell over. Directional falling is recommended to protect understory trees. With sufficient time, spruce usually will overtop both salmonberry and alder on these sites.

This association is important as a source of coarse woody debris for anadromous fish and for stabilizing active alluvial areas when it occurs near streams, and for providing bear cover and feeding habitat. Brown bear sign is abundant, especially when this association occurs along salmon streams. Devil's club berries and skunk cabbage tubers are used by bear (Schoen and Beier 1990).

When this association occurs near the coast, bald eagles utilize the largest spruce trees for nesting and roosting. Deer forage on skunk cabbage in the spring. Vancouver Canada geese forage on skunk cabbage leaves, especially when the plants are growing next to open wetlands.

Long-tailed voles (*Microtus longicaudus*) are abundant following timber harvest. During population peaks, complete mortality of planted spruce has occurred in spruce associations one to two years after clearcut harvest on Chichagof Island (Russell, unpubl. memo 1988). Planting should therefore not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

Road and trail construction should avoid riparian areas and wet skunk cabbage microsites. Trails may require boardwalks. Road or trail construction can negatively impact site hydrology.

Fishermen travel through this type when it occurs along salmon streams. Subsistence uses include collection of spruce, devil's club, and skunk cabbage.

NOTES:

VEGETATION

This productive, moderately open canopy, forest type is dominated by large Sitka spruce. Mature western hemlock trees are abundant in a layer below spruce.

Devil's club and salmonberry dominate the understory. Blueberry is less abundant and usually occurs on elevated organic microsites. Hemlock and spruce regeneration is common. Foamflower and twisted stalk are the most abundant forbs. Lady fern, oak fern, and shield fern may be abundant. Additional sampling is needed.

Cover of Common Plants (%)
N = 5 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	34	15-63	100
Western Hemlock	20	15-38	100
Devil's Club	50	3-85	100
Salmonberry	20	15-50	100
Blueberry	15	3-38	100
Foamflower	10	1-38	100
Oak Fern	12	3-38	100
Lady Fern	7	1-15	100
Shield Fern	18	0-38	80

Similar Associations

This plant association may be confused with spruce/devil's club; however, salmonberry is much more abundant.

Late Seral Stand Structure

Often more than 150 feet (46m) tall, open grown spruce surrounded by salmonberry are common. Hemlock trees to 100 feet (30 m) are common below spruce in undisturbed forest patches.

Down wood is more abundant than in either of the spruce/alder plant associations. Devil's club and salmonberry cover in canopy gaps may be 100% with plants over 5 feet (1.5 m) tall.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	115 [35]	25 [7.6]
DBH (in. [cm])	31 [79]	7.5 [19]
Basal Area (sq.ft./ac.)	320	69
Gross Volume (BF/ac.)	70,700	10,100
Cover (%)	51	8
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Devil's Club	5.0 [1.5]	0
Salmonberry	6.3 [1.9]	0.4 [0.1]
Blueberry	2.2 [0.7]	1.3 [0.4]
Cover (%)		
Tall Shrubs	100	24
Forbs	55	32
Ferns	28	30

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	312 [95]	100-700 [30-213]
Landform		**Frequency (%)**
Alluvial		100
Slope Class (%)		**Frequency (%)**
0-15		80
16-35		20
	Mean	**Std. Dev.**
Slope Mean (%)	6	11
Soil Parent Material		**Frequency (%)**
Alluvium		100
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	100 [39]	0
Organic Layer Depth	6 [2.4]	4 [1.6]
Soil Drainage		**Frequency (%)**
Somewhat Poorly		20
Moderately Well		20
Well		60
Common Soil Series: Tuxekan, Yakutat.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/devil's club-salmonberry plant association is common along low-elevation, valley bottom island streams; especially those in the floodplain channel-type process group (Paustian et al. 1992). On the mainland, the association is common along the smaller non-glacial streams. While the association is most common near larger streams, it also occurs on highly braided alluvial landforms.

The species mix in this plant association is maintained by frequent, moderately-to-high intensity floods. Judging from the weakly developed mineral soils and the frequency of exposed mineral soils, these floods are often highly disruptive, causing soil mixing, deposition, tree fall, and movement of organic material. High water marks (sediment deposits on tree trunks) have been observed 1 foot (0.3 m) above the soil surface in this plant association. Organic soils occur in old backwater channels.

MANAGEMENT IMPLICATIONS

Tree productivity is high. Stocking is moderate and suitable tree-growing microsites are restricted to raised organic sites. Consequently, leaving large woody debris is important for future conifer regeneration.

Soils are very sensitive to disturbance. Easily exposed mineral soils are excellent sites for alder. Even if harvest occurs with full log suspension, natural disturbance from flooding will favor perpetuation of alder. Selection harvest is an alternative which may help to maintain soil productivity; however, it may increase stand windthrow.

Devil's club cover declines and salmonberry cover increases following clearcutting. Spruce and hemlock seedlings are abundant on organic microsites between dense salmonberry patches (Schrader 1992). Red alder seedlings are common. Dense, closed canopy patches of spruce and hemlock develop 20 to 30 years following clearcut harvest.

Red alder will establish on mineral soils commonly associated with salmonberry. Salmonberry and red alder gaps persist until surrounding conifer patches limit the availability of light. Spruce seedlings in the salmonberry patches are slow to establish. After 30 years, if the soil is not degraded due to poor logging practices, a mixed spruce, alder, and salmonberry stand will develop. After 50 to 80 years, alder will be replaced by spruce.

On older cut areas dominated by red alder, selective thinning of alder may enhance growth of established conifers. Complete removal of alder is not recommended as a method to accelerate succession because alder provides an important soil fertility function through nitrogen fixation. Alder also helps to stabilize these active sites.

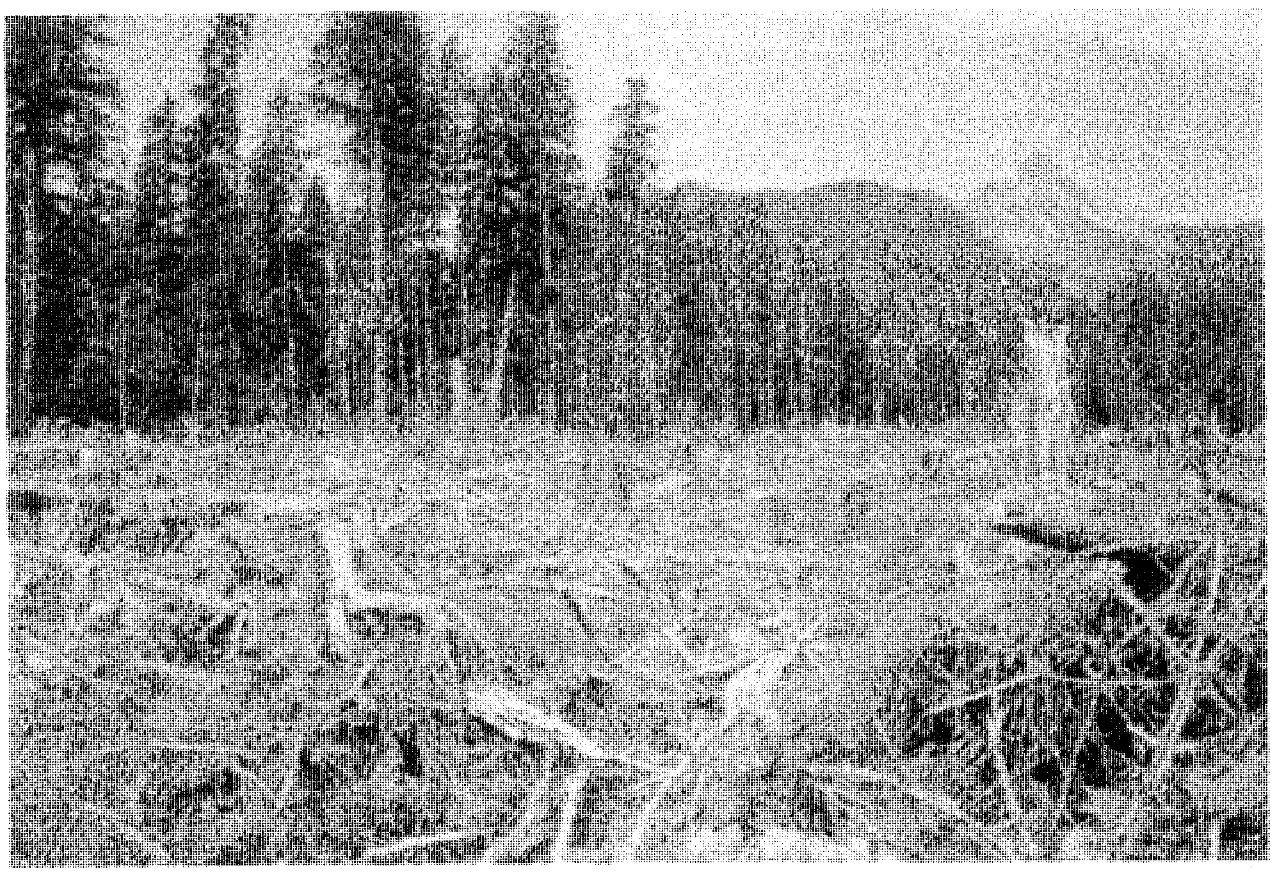
An attempt to release young spruce trees by removing taller alder trees was made in the Rodman Creek drainage, Baranof Island. Girdling of alder trees with an established salmonberry understory resulted in at least doubling of salmonberry production. Thus, unless spruce regeneration is taller than existing salmonberry, such attempts to release spruce may not be effective. Girdling of 20 - 30 year old alder in the lower Muri Creek drainage, Chichagof Island, caused undesirable deformation of many of the understory spruce trees when the alder eventually fell over. Directional falling is recommended to protect understory trees. With sufficient time, spruce usually will overtop both salmonberry and alder on these sites.

This plant association is important as a source of coarse woody debris for anadromous fish stream habitat, for stabilizing active alluvial areas, and for providing bear cover and feeding habitat. Brown bear sign is abundant, especially when this plant association occurs along salmon streams. Devil's club berries are used by bear during the summer as a minor portion of the diet (Schoen and Beier 1990). The association is not important deer habitat. When the association occurs near the coast, bald eagles utilize the largest spruce trees for nesting and roosting.

Long-tailed voles (*Microtus longicaudus*) are abundant following timber harvest. During population peaks, complete mortality of planted spruce has occurred in spruce associations one to two years after clearcut harvest on Chichagof Island (Russell, unpubl. memo 1988). Planting should not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

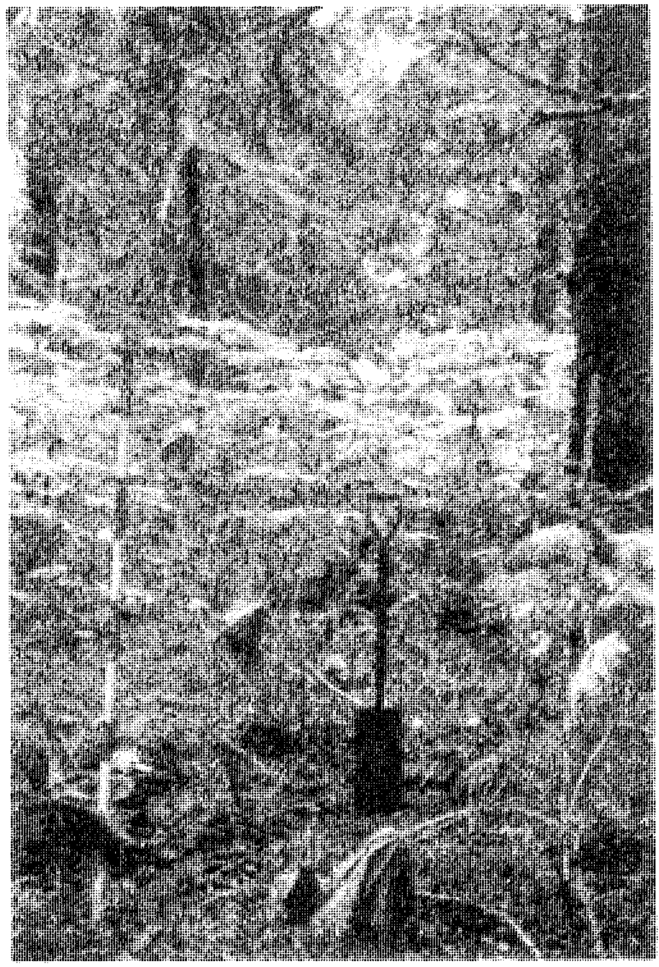
While soils are well drained, flooding limits success of road and trail construction. Roads should be avoided in riparian areas (and are not allowed in TTRA stream buffers).

Fishermen and hikers may use this type when it occurs along streams. Subsistence uses include collection of salmonberries, devil's club, and spruce.



NOTES:

Posting eagle nest tree
Photo credit: B. Hird



Note sandy soils (near shovel)

VEGETATION

This highly productive forest type is dominated by large Sitka spruce. Mature western hemlock trees are abundant in a layer below spruce.

Devil's club dominates the understory. Blueberry is common on elevated organic microsites. Hemlock and spruce regeneration is common. Foamflower is the most common forb and five-leaf bramble is also common. Ferns are abundant and diverse.

Cover of Common Plants (%)
N = 20 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	52	40-85	100
Western Hemlock	25	0-60	90
Devil's Club	57	15-85	100
Foamflower	12	1-85	100
Oak Fern	27	0-60	85
Shield Fern	17	0-85	75
Lady Fern	14	0-85	80

Similar Associations

This plant association may be confused with the spruce/devil's club-salmonberry association; however, salmonberry is abundant in the latter type.

Late Seral Stand Structure

Spruce heights are variable to over 150 feet (46 m). Hemlock trees to 100 feet (30 m) are common below spruce on better drained, undisturbed forest patches. Down wood is more abundant than in either of the spruce/alder or the spruce/devil's club-salmonberry associations. Devil's club cover may be 80 percent with plants over 6 feet (1.8 m).

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	136 [41]	27 [8]
DBH (in. [cm])	41 [104]	13 [33]
Basal Area (sq.ft./ac.)	305	97
Gross Volume (BF/ac.)	97,800	37,300
Cover (%)	69	12
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.0 [0.6]	1.4 [0.4]
Devil's Club	5.4 [1.6]	1.5 [0.5]
Cover (%)		
Tall Shrubs	55	32
Forbs	56	39
Ferns	74	36

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	173 [527]	10-580 [3-177]
Landform		**Frequency (%)**
Alluvial		95
Slope Class (%)		**Frequency (%)**
0-15		60
16-35		30
	Mean	**Std. Dev.**
Slope Mean (%)	11	13
Soil Parent Material		**Frequency (%)**
Alluvium		84
Colluvium		8
Compact Till		8
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	96 [38]	15 [5.9]
Organic Layer Depth	10 [3.9]	5 [2.0]
Soil Drainage		**Frequency (%)**
Somewhat Poorly		11
Moderately Well		16
Well		74
Common Soil Series: Tonowek, Tuxekan, Kupreanof.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/devil's club plant association is common along low elevation streams and alluvial fans.

The presence of devil's club indicates water movement on or near the soil surface. Moderately to high intensity surface flooding is common, often exposing the mineral soils, and maintaining the species mix. Soils are deep, poorly developed, sandy to gravelly, and well drained.

MANAGEMENT IMPLICATIONS

Tree productivity is high. Stocking is moderate (although less than in western hemlock associations) and suitable tree-growing microsites are common. Maintenance of large organic material for future tree-growing sites is essential for long-term productivity.

Soils are sensitive to disturbance, but less so than soils in the spruce/devil's club-salmonberry association. Alder is favored on mineral soils if these are exposed by ground-disturbing logging practices. Due to this sensitivity of the soils, clearcutting is not recommended. Selection harvest is an alternative that may help to maintain soil productivity. However, selection harvest may increase the chance of stand-level windthrow. Landscape level analysis of wind and disturbance patterns should be considered in planning.

Following clearcutting, devil's club cover declines, and salmonberry and fern cover increases. Salmonberry cover is positively correlated with degree of disturbance. Spruce and hemlock seedlings are abundant on organic microsites. Red alder seedlings are also common. If conifers are established immediately, salmonberry usually is not a regeneration problem. However, spruce seedlings in salmonberry patches are slow to establish and may be inhibited by salmonberry for some time. Immediate planting of spruce may be effective in some harvest units. Small diameter slash should be removed from planting sites to enhance seedling survival. If natural regeneration is desired, slash should be removed from best tree-growing microsites (Schrader 1992). Slash piling on salmonberry or depressed areas is recommended. Ferns may also cause some conifer seedling mortality due to blocking of light by dead fronds.

Dense, closed canopy patches of spruce and hemlock develop 20 to 30 years following clearcut harvest—if the soil is not degraded due to poor logging practices. Understory vegetation is nearly eliminated after this time period. Forest development follows the general successional pattern described in Chapter 2.

This plant association is important as a source of coarse woody debris for anadromous fish stream habitat, for stabilizing active alluvial areas, and for providing bear cover and feeding habitat. Brown bear sign is abundant, especially when this plant association occurs along salmon streams. Devil's club berries are used by bear during the summer as a minor portion of the diet (Schoen and Beier 1990). The association is not important deer habitat. When the association occurs near the coast, bald eagles utilize the largest spruce trees for nesting and roosting.

Long-tailed voles (*Microtus longicaudus*) are abundant following timber harvest. During population peaks, complete mortality of planted spruce has occurred in spruce associations one to two years after clearcut harvest on Chichagof Island (Russell, unpubl. memo 1988). Planting should therefore not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

Road and trail construction success may be limited by flooding. Roads should be avoided in riparian areas (and cannot be located within stream buffers under TTRA).

Fishermen may use the type when it occurs along salmon streams. Subsistence uses include collection of spruce and devil's club.

SITKA SPRUCE/BLUEBERRY-DEVIL'S CLUB 320

Picea sitchensis/Vaccinium spp.-*Oplopanax horridum*

VEGETATION

This highly productive forest type is dominated by large Sitka spruce. Mature western hemlock trees are abundant in a layer below spruce. Hemlock and spruce regeneration is common.

Devil's club and blueberry dominate the understory with blueberry mainly on elevated organic microsites. Salmonberry and menziesia are common. Western hemlock regeneration is more abundant than spruce regeneration. Twisted stalk and five-leaf bramble are common forbs. Ferns are varied and abundant.

Cover of Common Plants (%)
N = 17 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	33	15-65	100
Western Hemlock	41	0-65	94
Devil's Club	40	15-85	100
Blueberry	36	15-65	100
Salmonberry	9	0-25	82
Five-leaf Bramble	12	1-40	100
Oak Fern	13	1-40	100
Shield Fern	11	0-40	82

Similar Associations

This plant association may be confused with spruce/devil's club- salmonberry or spruce/devil's club. However, in the former type, salmonberry is more abundant and productivity is lower. Blueberry does not codominate or dominate the spruce/devil's club type understory.

Late Seral Stand Structure

Spruce heights may exceed 160 feet (49 m). Hemlock trees to 120 feet (37 m) are common below spruce on well-drained, undisturbed forest patches, making a two-storied stand. Down wood is more abundant than in either of the spruce/alder or the spruce/devil's club-salmonberry associations. Devil's club and blueberry cover may be 100 percent with plants over 4 feet (1.2 m).

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	139 [42]	17 [5.2]
DBH (in. [cm])	30 [76]	16 [41]
Basal Area (sq.ft./ac.)	292	57
Gross Volume (BF/ac.)	89,400	30,400
Cover (%)	63	13
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	3.1 [0.9]	0.7 [0.2]
Devil's Club	4.9 [1.5]	1.1 [0.3]
Cover (%)		
Tall Shrubs	100	0
Forbs	100	69
Ferns	26	13

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	351 [107]	20-1220 [6.1-372]
Landform		**Frequency (%)**
Alluvial		88
Coastal		6
Slope Class (%)		**Frequency (%)**
0-15		56
16-35		38
	Mean	**Std. Dev.**
Slope Mean (%)	16	14
Soil Parent Material		**Frequency (%)**
Alluvium		67
Colluvium		8
Residuum		17
Compact Till		8
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	86 [34]	28 [11]
Organic Layer Depth	14 [5.5]	8 [3.1]
Soil Drainage		**Frequency (%)**
Somewhat Poorly		13
Moderately Well		19
Well		69
Common Soil Series: Tuxekan, Kupreanof, Tonowek, Peril, and Kasiana.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/blueberry-devil's club plant association is common along low elevation streams, alluvial fans, dissected footslopes, and beach gravel. The species mix in this plant association is primarily maintained by subsurface flooding. Low intensity, surface flooding occurs only during very high stream flows and is primarily restricted to the devil's club patches and depressed areas. Mineral soil is rarely exposed and most soils are well developed Spodosols, indicating that soil mixing is not occurring.

MANAGEMENT IMPLICATIONS

Tree productivity is high. Stocking is moderate and suitable tree-growing microsites are abundant.

Soils are sensitive, but not as sensitive as those in the spruce/devil's club-salmonberry association. Soils are, however, more sensitive than those in blueberry associations in the spruce or hemlock series. Alder is favored on mineral soils, which are easily exposed with ground disturbing logging practices.

Past tractor logging with significant soil disturbance caused changes in stream course, width, and hydrology, which altered sites from coniferous to deciduous forest in Fish Bay, Rodman Bay, Katlian, and Nakwasina drainages on Baranof Island. However, given the stream protection mandated under the 1990 Tongass Timber Reform Act, this situation is unlikely to be repeated. On these sites, shovel yarding is an alternative that may help to maintain soil productivity.

Following clearcutting, devil's club cover declines while salmonberry and blueberry cover increases. Shrub abundance varies with the intensity of disturbance, with greater disturbance favoring salmonberry and currant. Spruce and hemlock seedlings are abundant on organic microsites between dense salmonberry patches (Schrader 1992). Dense, closed canopy patches of spruce and hemlock develop 20 to 30 years following clearcut harvest. However, spruce seedlings in the competitive salmonberry patches are slow to establish and may be inhibited by salmonberry for some time. On some sites, immediate planting of spruce subsequent to clearcut may be effective. Small diameter slash should be removed from planting sites to enhance tree survival. If natural regeneration is desired, slash should be removed from best tree-growing microsites (Schrader 1992). Piling on salmonberry or depressed areas is recommended.

After 30 years, if the soil was not degraded by poor logging practices, a closed stand of spruce with some hemlock develops. Understory vegetation is nearly eliminated. Forest development follows the general successional pattern described in Chapter 2.

This plant association is important as a source of coarse woody debris for stream habitat and for providing bear cover and feeding habitat. Brown bear sign is abundant, especially when this type occurs along salmon streams. Devil's club berries are used by bear during the summer (Schoen and Beier 1990).

When this vegetation type occurs near the coast, bald eagles utilize the largest spruce trees for nesting and roosting. Soft-wooded spruce snags are valuable for cavity nesters. Along coastal alluvial fans and gravel beaches, this association is important deer habitat.

Long-tailed voles (*Microtus longicaudus*) are abundant following timber harvest. During population peaks, complete mortality of planted spruce has occurred in spruce associations one to two years after clearcut harvest on Chichagof Island (Russell, unpubl. memo 1988). Planting should therefore not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

Road and trail construction is limited by occasional flooding. Roads should be avoided in beach and riparian areas. The type is highly valued for fishing, hiking, and outdoor appreciation. Subsistence uses include fishing, berry picking, and collection of spruce or devil's club.

SITKA SPRUCE/BLUEBERRY
Picea sitchensis/Vaccinium spp.

VEGETATION

This highly productive forest type is dominated by large Sitka spruce and western hemlock.

Blueberry is the dominant shrub. Devil's club, salmonberry, and menziesia may also occur. Western hemlock regeneration was more abundant than spruce regeneration, which was not noted in all sampled sites. Bunchberry and five-leaf bramble are the most common forbs. Oak fern was abundant in many of the eight stands sampled in this type. Additional sampling is needed.

Cover of Common Plants (%)
N = 8 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	36	15-63	100
Western Hemlock	45	15-63	100
Blueberry	39	15-63	100
Five-leaf Bramble	9	1-15	100
Fern-lf Goldthread	16	1-38	88
Oak Fern	14	1-38	88

Similar Associations

This plant association may be confused with western hemlock/blueberry/shield fern. Sitka spruce is more common in the spruce type. More importantly, this type is found on alluvial sites while western hemlock types principally occur in the undisturbed upland areas. Other Sitka spruce types may appear similar in the overstory, but will vary in understory species.

Late Seral Stand Structure

Spruce heights vary up to 160 feet (49 m); some trees to 180 feet (55 m) may occur. Hemlock trees to 120 feet (37 m) are common. The overstory is typically closed, and a two-storied canopy with the hemlock in the lower story is common. Down logs are common.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	148 [45]	24 [7.3]
DBH (in. [cm])	36 [91]	4.9 [12]
Basal Area (sq.ft./ac.)	390	132
Gross Volume (BF/ac.)	114,000	57,700
Cover (%)	79	6
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.9 [0.9]	0.4 [0.1]
Cover (%)		
Tall Shrubs	39	0
Forbs	86	0
Ferns	17	0

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	330 [101]	20-650 [18-198]
Landform		**Frequency (%)**
Alluvial		88
Coastal		13
Slope Class (%)		**Frequency (%)**
0-15		50
16-35		50
	Mean	**Std. Dev.**
Slope Mean (%)	13	10
Soil Parent Material		**Frequency (%)**
Alluvium		60
Colluvium		20
Ablation Till		20
Soil Depth (cm [in.])		
Mineral Soil		Frequency (%)
> 50 [20]		86
≤ 50 [20]		14
	Mean	**Std. Dev.**
Imp. Layer Depth	81 [32]	35 [14]
Organic Layer Depth	14 [5.5]	9 [3.5]
Soil Drainage		**Frequency (%)**
Moderately Well		25
Well		75
Common Soil Series: Foad, Kupreanof, Remedios, Vixen, and Yakutat.		

ENVIRONMENTAL CHARACTERISTICS

This association is common where surface flooding rarely occurs, on well drained deep soils that are rich in available nutrients. The organic horizons are well developed. These conditions are common on higher alluvial terraces and on beach gravel immediately adjacent to saltwater. Subsurface flooding appears to enrich the nutrient status for spruce in both alluvial terraces and coastal beaches. Additional nutrients are provided on coastal sites from windblown sand and sea spray (Cordes 1972). Mineral soil is rarely exposed and most soils are well developed Spodosols.

MANAGEMENT IMPLICATIONS

Tree productivity is high, and suitable tree-growing microsites are abundant. The abundant coarse woody debris serves as "nurse" logs for conifer regeneration, providing a rich, well-drained, and protected microsite. In order to maintain adequate woody debris, all unmerchantable material should remain on site. Flat to low slope gradients increase options for prescribing a wider array of harvest treatments. However, care must be used to avoid exposing extensive areas of mineral soil.

During the decades (1950s and 1960s) of extensive tractor (bulldozer) logging, mineral soils on these flat sites were exposed and alder established immediately after logging. Many of these sites are still dominated by alder. In the early 1900s, this plant association was logged with low impact techniques near the mouth of Fish Bay, Baranof Island. These sites regenerated with spruce. Likewise, cable logging systems have shown to be less destructive to the soils than tractor logging. However, cable logging disturbs flat portions of the site when the logs are not suspended. Shovel yarding should be used in these cases.

Blueberry, spruce, and hemlock will dominate the understory for a short time (usually less than 25 years) following clearcutting. After 30 years, if the soil is not degraded by poor logging practices, a closed stand of spruce and western hemlock develops which excludes nearly all other species until the canopy matures. Forest development follows the general successional pattern described in Chapter 2. If mineral soil is exposed and a seed source nearby, alder will readily establish and dominate a site for 30 to 50 years.

On older cut areas dominated by red alder, selective thinning of alder may enhance growth of established conifers. Complete removal of alder is not recommended as a method to accelerate succession because alder provides an important soil fertility function through nitrogen fixation.

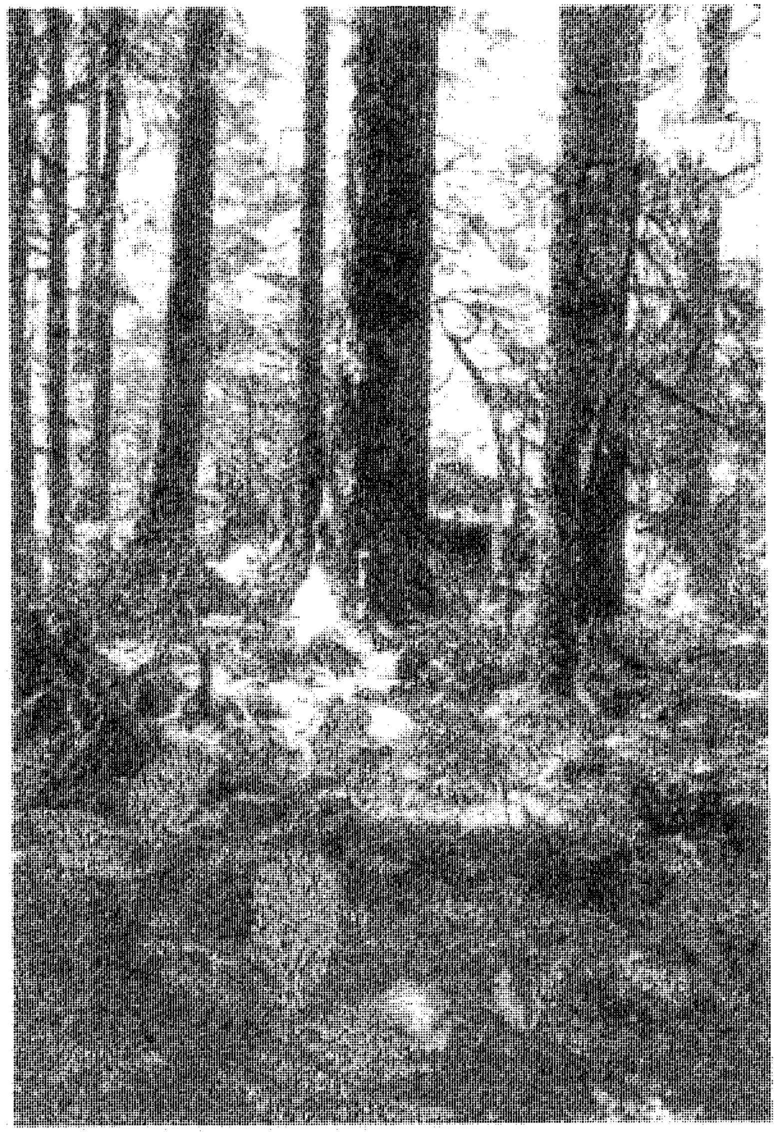
On alluvial fans or beach gravel immediately adjacent to the coast, deer commonly impact understory composition in this type. Near complete reduction in blueberry due to deer foraging is common on many coastal sites. Brown bears use this association for travel and bedding when the type occurs near a salmon stream. This association provides prime bald eagle habitat when it occurs near salt water (Sidle et al. 1986).

Long-tailed voles (*Microtus longicaudus*) may be abundant following timber harvest. During population peaks, complete mortality of planted spruce has occurred in spruce associations from vole predation one to two years after clearcut harvest on Chichagof Island (Russell, unpubl. memo 1988). Planting should therefore not be attempted during peak vole densities. Trapping is recommended just prior to planting to assess the vole population status.

This association is important as a source of coarse woody debris to streams for resident and anadromous fish. Snags are not common but are valuable for cavity nesters.

Road and trail construction on this type is uncomplicated, but care should be taken to avoid exposing mineral soil. It may be necessary to consider flooding impacts on construction. When this association type occurs in riparian areas, roads should be avoided (and are not allowed within prescribed buffers).

This association may be used for recreation. Native Alaskan uses of spruce are described earlier.



VEGETATION

This moderately productive forest type is dominated by Sitka spruce and western hemlock. Western hemlock is often more abundant than spruce, and typically occurs in a layer below it.

Blueberry dominates the shrub layer. Menziesia and hemlock regeneration is common, while spruce regeneration is limited. Skunk cabbage dominates the herbaceous layer while five-leaf bramble, bunchberry and fern-leaf goldthread are also abundant. Ferns were generally uncommon in the sampled stands, although lady fern was abundant in half the stands. Additional sampling is needed.

Cover of Common Plants (%)
N = 4 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	38	38	38100
Western Hemlock	51	38-63	100
Menziesia	18	3-38	100
Blueberry	44	38-63	100
Five-leaf Bramble	18	3-38	100
Skunk Cabbage	39	15-63	100
Fern-lf Goldthread	12	1-15	100
Oak Fern	6	1-15	75

Similar Associations

This plant association may be confused with spruce/devil's club/skunk cabbage, but devil's club is more abundant in the latter association. The spruce/blueberry/skunk cabbage association is also similar to the western hemlock/blueberry/skunk cabbage association. The greater percentage of spruce and its occurrence on flat sites with alluvial and beach soils distinguishes it from the hemlock type.

Late Seral Stand Structure

Spruce heights vary up to 100 feet (30 m); some trees to 120 feet (37 m) may occur. Hemlock trees to 90 feet (27 m) are common. Down logs are common. Blueberry cover may be high with plants over 3 feet (0.9 m).

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	92 [28]	33 [101]
DBH (in. [cm])	22 [56]	1.7 [4.3]
Basal Area (sq.ft./ac.)	227	83
Gross Volume (BF/ac.)	37,100	15,100
Cover (%)	60	11
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.4 [0.7]	0.8 [0.2]
Cover (%)		
Tall Shrubs	57	0
Forbs	100	0
Ferns	10	0

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	393 [120]	125-950 [38-290]
Landform		**Frequency (%)**
Mountainslopes		40
Alluvial		60
Slope Class (%)		**Frequency (%)**
0-15		40
16-35		20
56-75		20
76+		20
	Mean	**Std. Dev.**
Slope Mean (%)	13	10
Soil Parent Material		**Frequency (%)**
Alluvium		50
Organic Material		50
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	98 [39]	4 [1.6]
Organic Layer Depth	38 [15]	42 [17]
Soil Drainage		**Frequency (%)**
Very Poorly		40
Poorly		40
Somewhat Poorly		20
Common Soil Series: Felix and Hydaburg.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/blueberry/skunk cabbage plant association occurs along low elevation streams, alluvial fans, dissected footslopes, and beach gravel. Surface flooding is uncommon, except in skunk cabbage depressions, while subsurface flooding is common on alluvial sites.

MANAGEMENT IMPLICATIONS

Flat to low slope gradients over stable soils increase options for harvest treatments. However, care must be taken to avoid exposing extensive areas of mineral soil. During the decades (1950s, 1960s) of extensive tractor logging, mineral soils on these flat sites were exposed and alder established immediately after logging. Many of these sites are still dominated by alder.

In the early 1900s, this vegetation type was logged with low impact techniques near the mouth of Fish Bay, Baranof Island. These sites regenerated with spruce. Likewise, cable logging systems have shown to be less destructive to the soils than tractor logging. However, cable logging disturbs flat portions of the site when the logs are not fully suspended. Alder can be expected to establish immediately on exposed mineral soil if a seed source is nearby.

Red alder seedlings are common on sites where soil was disturbed during harvest. Western hemlock seedlings are common but spruce seedlings are not. Immediate planting of spruce may be effective after clearcut harvest on some sites. Wet organic microsites with skunk cabbage should be avoided when planting; most established trees occur on more well drained positions. All unmerchantable material should be left on site to maintain adequate levels of woody debris for conifer regeneration.

After 30 or more years, if the soil is not degraded by poor logging practices, a closed stand of spruce and hemlock can be expected to develop. Canopy closure may be less rapid than in other types due to the wet skunk cabbage sites. Understory vegetation is nearly eliminated. Skunk cabbage may continue to exist in low light conditions, but will not be abundant until light levels increase.

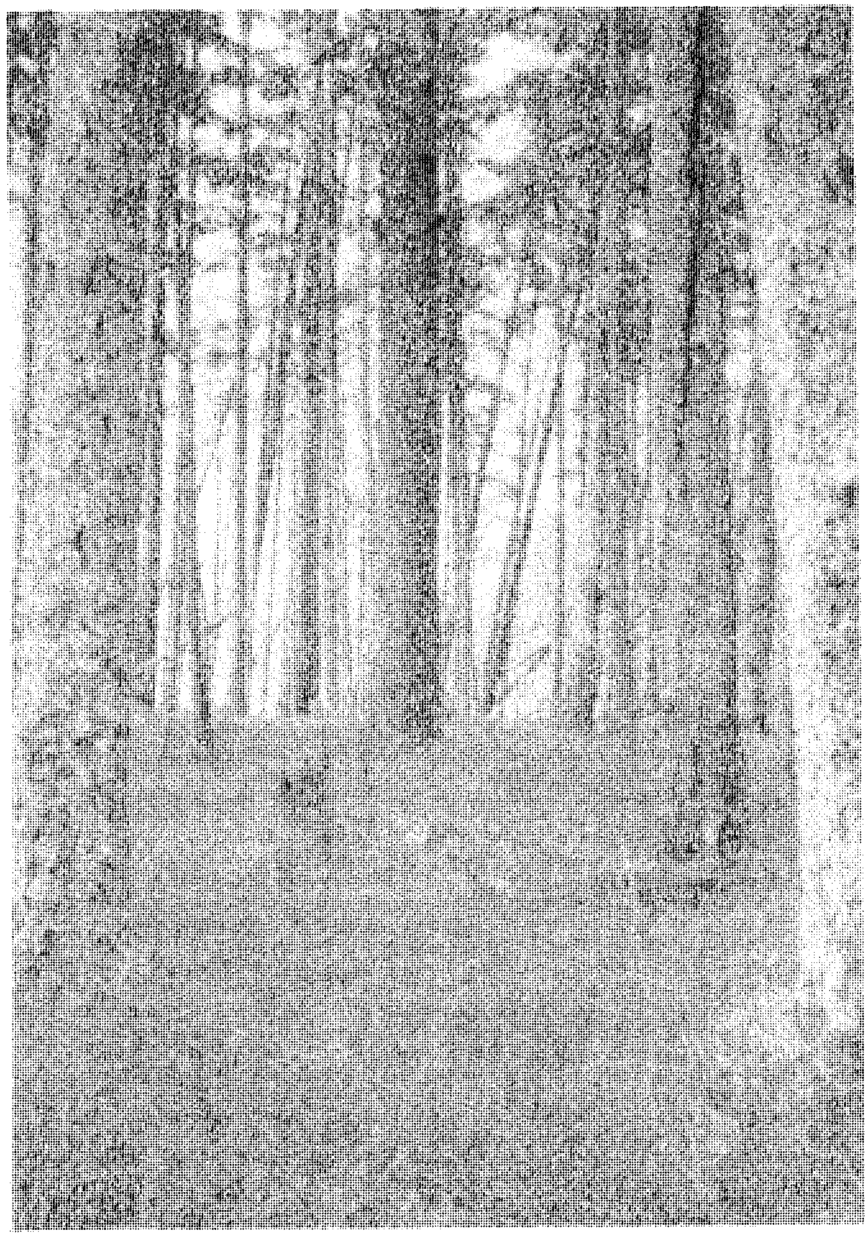
On older cut areas dominated by red alder, selective thinning of alder may enhance growth of established conifers. Complete removal of alder is not recommended as a method to accelerate succession since alder provides an important soil fertility function through nitrogen fixation.

This plant association is important as a source of coarse woody debris for anadromous fish when it occurs next a stream. Brown bear sign, such as tracks, diggings of skunk cabbage, and droppings, are abundant, especially along salmon streams. Near the coast, this association provides bald eagle habitat (Sidle et al. 1986).

Road and trail construction should avoid wet skunk cabbage microsites. Roads should be avoided in riparian areas.

Subsistence uses of this type include collection of berries, skunk cabbage, and spruce. Recreational use may occur when the type is located in a riparian area.

SITKA SPRUCE/PACIFIC REEDGRASS
Picea sitchensis/Calamagrostis nutkatensis



VEGETATION

This moderately productive, closed canopy, forest type is dominated by Sitka spruce and Pacific reedgrass. Western hemlock and blueberry increase and Sitka spruce and Pacific reedgrass decrease with distance from the shore. Conifer regeneration is limited as is shrub cover. Rattlesnake root was abundant in both of the stands sampled in this type, as was beech fern. Additional sampling is needed.

Cover of Common Plants (%)
N = 2 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	85	75-95	100
Western Hemlock	15	0-15	50
Pacific Reedgrass	85	75-95	100
Rattlesnake Root	27	15-38	100
Beech Fern	20	1-38	100

Similar Associations

The saltwater shoreline location and dominance of reedgrass distinguish this association from all others.

Late Seral Stand Structure

Sitka spruce trees rarely exceed 100 feet (30 m). Exposure to high offshore winds likely reduces height potential. Canopy closure is high, but stands are usually not multi-layered, so light to the understory is abundant. Logs and snags are abundant.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	93 [28]	15 [4.6]
DBH (in. [cm])	21 [53]	3.2 [8.1]
Gross Volume (BF/ac.)	126,400	43,600
Cover (%)	83	4

UNDERSTORY	Mean
Height (ft. [m])	
Reedgrass	2.5 [0.7]

ENVIRONMENTAL CHARACTERISTICS

The spruce/reedgrass plant association is found as a narrow fringe along saltwater shorelines. It is well represented in a less than 1/4 mile (400 m) wide band along the outer coast of Chichagof, Baranof, Yacobi, and Kruzof Islands, but also occurs on interior islands and the mainland. Salt spray and periodic inundation of saltwater from Pacific storms favor spruce and reedgrass production.

Soil parent material in sampled stands was volcanic on Kruzof Island near the Mt. Edgecumbe volcano. The association also occurs on residuum in all bedrock types and on beach gravel.

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	58 [18]	10-105 [3-32]
Landform		**Frequency (%)**
Coastal		100
Slope Class (%)		**Frequency (%)**
16-35		50
56-75		50
	Mean	**Std. Dev.**
Slope Mean (%)	28	32
Soil Depth (cm [in.])	**Mean**	**Std. Dev.**
Organic Layer Depth	15 [5.9]	12 [4.7]
Soil Drainage		**Frequency (%)**
Moderately Well		50
Well		50
Common Soil Series: Volcanics.		

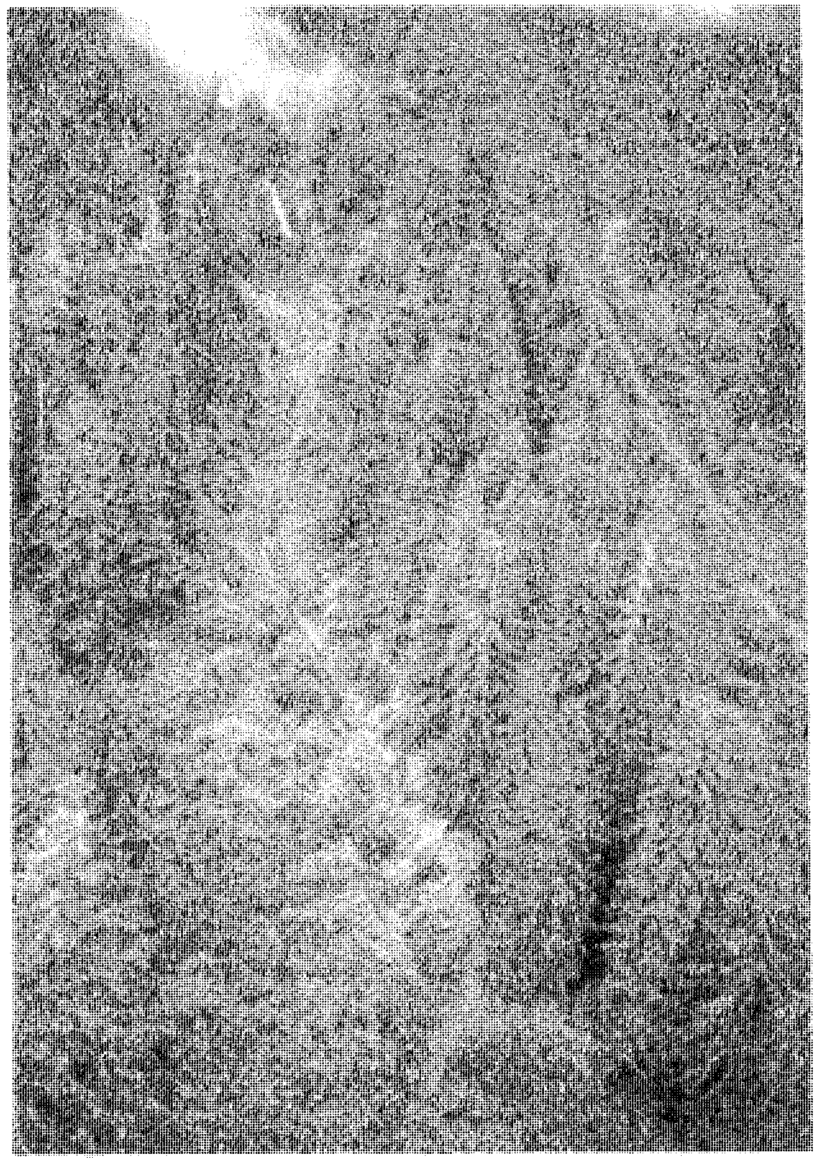
MANAGEMENT IMPLICATIONS

Timber harvest has not occurred in this plant association due to lack of access. Harvest is not expected in the future because the association occurs as a narrow strip along the outside coast. Moreover, beach areas (500 feet [152 m] slope distance inland from mean high tide) are protected from commercial timber harvest.

In addition to its importance as uncommon habitat, this association is highly valuable wildlife habitat for deer, bear, and bald eagles. Brown bear sign is common. Bald eagle nests and roosting trees are abundant due to the close proximity to saltwater. Mink, pine marten, and river otter use is also high due to the close proximity to the marine ecosystem. Deer use the association more as a travel corridor than as a forage site, e.g. for access to kelp foraging.

Small scale wind-throw is common, usually about 100 feet (30 m) in from the beach fringe. Grass dominates the understory in these gaps. Dense stands of young spruce with an understory of moss dominate young beach terraces. These terraces often occur immediately in front of the late seral spruce/reedgrass plant association. No successional studies have been done in this association.

NOTES:



VEGETATION

This moderately productive type is dominated by large Sitka spruce and western hemlock. Mountain hemlock occurred in one-third of the sampled stands.

Devil's club and blueberry dominate the understory. Hemlock regeneration is common. Five-leaf bramble and twisted stalk are the most common forbs while lady fern and oak fern dominate the fern layer.

Cover of Common Plants (%)
N = 3 Stands

Species	Mean Cover	Range	Constancy
Sitka Spruce	30	25-50	100
Western Hemlock	30	5-40	100
Devils' Club	30	25-50	100
Blueberry	10	1-25	100
Lady Fern	6	1-25	100

Similar Associations

The upland spruce-devil's club type is non-alluvial, unlike most of the spruce associations. This type may be confused with the hemlock/blueberry-devil's club type; however, spruce is more abundant and the slopes are usually much steeper. The association may also be confused with the mountain hemlock-Sitka spruce/blueberry plant association, but it occurs at lower elevation and mountain hemlock is not an overstory dominant or codominant.

Late Seral Stand Structure

Spruce heights vary to over 140 feet (43 m). Hemlock trees to 120 feet (37 m) occur in a layer below spruce. Shrub cover usually does not exceed 70 percent and ferns are abundant.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	137 [42]	5 [1.5]
DBH (in. [cm])	41 [104]	15 [38]
Basal Area (sq.ft./ac.)	340	198
Gross Volume (BF/ac.)	96,300	36,400
Cover (%)	65	9
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	1 [0.3]	0.5 [0.2]
Devil's Club	3.0 [0.9]	0
Cover (%)		
Tall Shrubs	69	0
Forbs	39	0
Ferns	49	0

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	823 [251]	380-1700 [116-518]
Landform		**Frequency (%)**
Mountainslopes		67
Hillslopes		33
Slope Class (%)		**Frequency (%)**
76+		100
	Mean	**Std. Dev.**
Slope Mean (%)	112	24
Soil Parent Material		**Frequency (%)**
Colluvium		50
Bedrock		50
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		100
	Mean	**Std. Dev.**
Imp. Layer Depth	77 [30]	40 [16]
Organic Layer Depth	7 [2.8]	4 [1.6]
Soil Drainage		**Frequency (%)**
Moderately Well		33
Well		67
Common soil series: McGilvery and Shakan.		

ENVIRONMENTAL CHARACTERISTICS

The spruce/devil's club-upland plant association is uncommon. It occurs at mid to upper elevations on very steep slopes on mountain and hillslope landforms. Due to safety concerns with the steep slopes, this type has been undersampled. Additional sampling is needed.

Erosional processes and subsurface water moving on these steep slopes appear to maintain conditions suitable for spruce and devil's club. These sites are commonly associated with nearby landslide paths.

Soils are well drained and poorly developed.

MANAGEMENT IMPLICATIONS

Tree productivity is moderate, and well-drained tree-growing microsites are abundant.

Soils are extremely sensitive to disturbance. Slope failures and slumps are common. Depending on location, acreage, and degree of soil disturbance, clearcutting may cause a long-term shift from coniferous forest to Sitka alder-dominated brushfield. Clearcutting is not recommended due to the sensitivity of the soils.

Devil's club cover declines and salmonberry cover increases following clearcutting. Since the soils are unstable, conifer regeneration is unlikely to establish quickly. A brush stage is likely following any harvest, and may persist for a long time. Little is known about succession in this plant association.

Due to the steep slopes and distance from salt water, this association is not good deer winter range.

Roads and trails should be avoided in this type due to the steep slopes and sensitive soils.

Recreational and subsistence uses of this type are minimal.

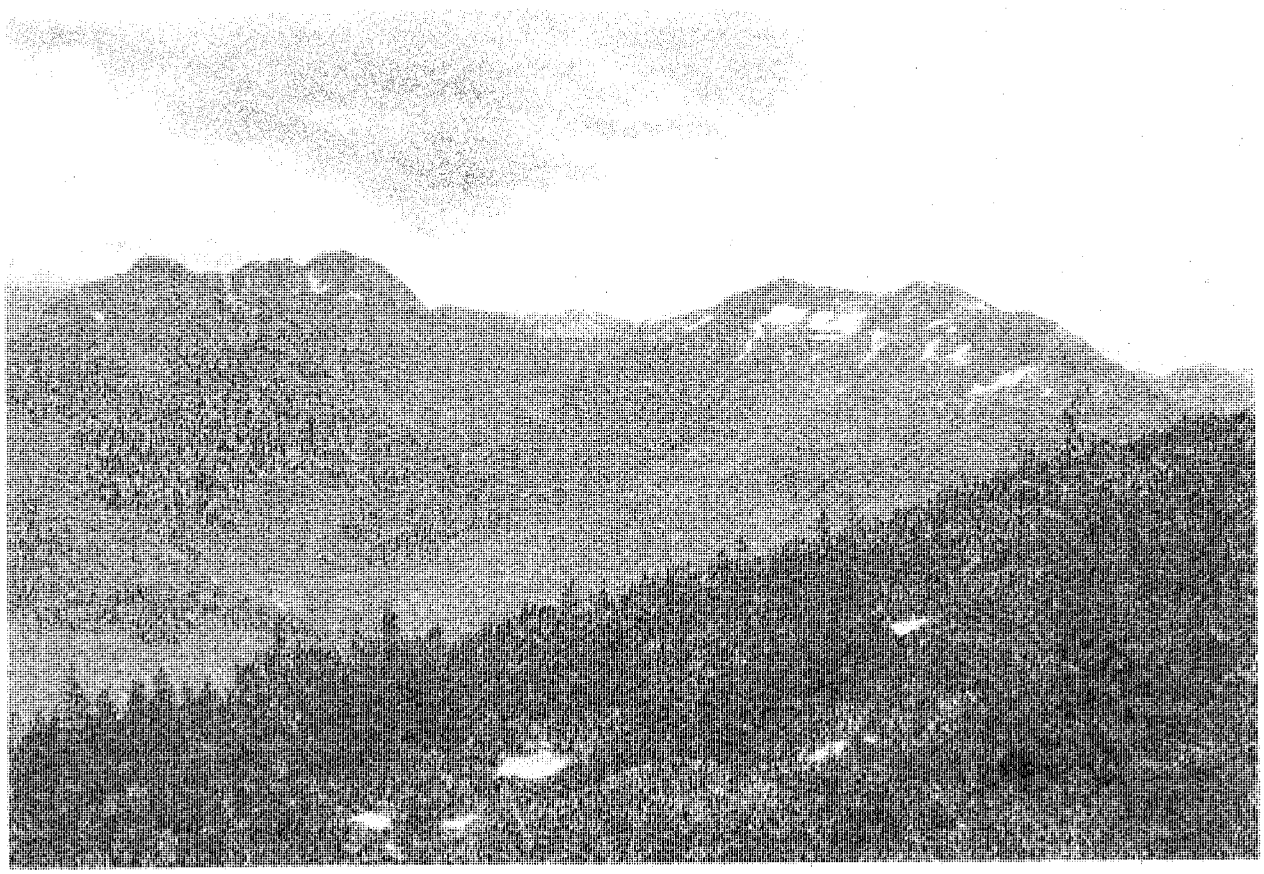


Photo credit: B. Krieckhaus

VEGETATION

This lower productivity, open canopy forest is dominated by Sitka spruce and mountain hemlock. The spruce trees are taller and larger in diameter than the hemlocks. Western hemlock occurred in the overstory in about two-thirds of the sampled stands.

Blueberry and mountain and western hemlock regeneration dominate the understory. Spruce regeneration shows limited cover and was only present in approximately two-thirds of the stands. No shrub species other than blueberry is consistently present, although menziesia and devil's club are common. Bunchberry and five-leaf bramble are common herbs. Shield fern is the most common fern.

Cover of Common Plants (%)
N = 13 Stands

Species	Mean Cover	Range	Constancy
Mountain Hemlock	30	3-63	100
Sitka Spruce	28	15-63	100
W. Hemlock Regen.	9	0-15	92
M. Hemlock Regen.	11	0-15	92
Blueberry	44	15-85	100
Five-leaf Bramble	8	1-15	100

Similar Associations

This plant association is distinguished from other Sitka spruce associations by the abundance of mountain hemlock in the overstory. Also, the association is found at higher elevations, unlike many riparian-associated Sitka spruce types. The spruce-mountain hemlock association may be confused with the mountain hemlock/blueberry type; however, the former type is identified by the abundance of spruce in the overstory on steep erosional slopes.

Late Seral Stand Structure

Spruce trees average 100 feet (30 m) in height, while mountain hemlocks average 20 feet (6 m) shorter. Spruce trees are also larger in diameter than both mountain and western hemlocks. Canopy closure is moderate.

Structure Summary

OVERSTORY	Mean	Std. Dev.
Height (ft. [m])	104 [32]	27 [8]
DBH (in. [cm])	24 [61]	12 [30]
Basal Area (sq.ft./ac.)	300	123
Gross Volume (BF/ac.)	55900	26000
Cover (%)	53	14
UNDERSTORY	**Mean**	**Std. Dev.**
Height (ft. [m])		
Blueberry	2.9 [0.9]	1.0 [0.3]
Cover (%)		
Tall Shrubs	38	19
Forbs	51	27
Ferns	20	19

Landform and Soils Summary

	Mean	Range
Elevation (ft. [m])	1569	1080-2160
Landform		**Frequency (%)**
Mountainslopes		100
Slope Class (%)		**Frequency (%)**
36-55		8
56-75		50
76+		42
	Mean	**Std. Dev.**
Slope Mean (%)	70	18
Soil Parent Material		**Frequency (%)**
Organic Material		29
Colluvium		43
Residuum		14
Ablation Till		14
Soil Depth (cm [in.])		
Mineral Soil		**Frequency (%)**
> 50 [20]		80
≤ 50 [20]		20
	Mean	**Std. Dev.**
Imp. Layer Depth	59 [23]	38 [15]
Organic Layer Depth	11 [4.3]	5 [2.0]
Soil Drainage		**Frequency (%)**
Somewhat Poorly		8
Moderately Well		17
Well		75
Common Soil Series: Kupreanof, McGilvery, Traitors, and Verstovia.		

ENVIRONMENTAL CHARACTERISTICS

The Sitka spruce-mountain hemlock/blueberry plant association is less common than the mountain hemlock/blueberry type. It is found primarily at higher elevations, particularly in transition areas to the mountain hemlock zone on steep slopes.

Soils are mostly mineral and well drained. Due to the steep slopes, mass movement of soils is common. Most sites are on shallow colluvial deposits on mountainslope shoulders.

MANAGEMENT IMPLICATIONS

This association historically has not been used for timber production due to its location at high elevations beyond the reach of road systems. However, timber cutting is approaching these areas, and this vegetation type may be included in future harvest units. Limitations to tree productivity are largely due to steep slopes and disturbance, and to shorter growing seasons at high elevation.

Windthrow, avalanche, snow impacts, and mass wasting are common due to the steep slopes at high elevations. Many stands are older second growth. Analysis of successional patterns is needed.

Regeneration of spruce and hemlock is limited, with both western and mountain hemlock regeneration more abundant than spruce. Brush competition may be high. Snow may damage conifers.

Due to harsh winter conditions and limited protection by the overstory, this type is not important winter deer habitat (Schoen and Kirchoff 1985; Hanley et al. 1989; Suring et al. 1991). During summer and fall, deer forage on the abundant blueberry, forbs, and ferns. Deer also use the type for thermal cover during storms. Brown bear may find suitable winter denning sites in this association (Schoen and Beier 1990).

Limitations to road and trail construction include high elevation and mass wasting potential.

Recreation and subsistence uses of this type are limited.

- LITERATURE CITED
- GLOSSARY

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Abundance - The amount of a plant species occurring on a plot, usually measured as percent canopy cover.

Allochthonous - Refering to materials which originate at a distance from the location where found, such as geologic blocks which have been transported over time.

Alluvium - Sediment deposited by streams and rivers, usually found on terraces above present streams or in the normally flooded bottom land of existing streams.

Alpine - (1) Land above treeline on mountain summits. (2) Vegetation in these areas, typically low shrubs and abundant wildflowers.

Aspect - The direction toward which a slope faces.

Average percent cover - The mean of percent cover values for a species on all available sample plots. For example, if a species occurs on 3 of 10 plots, and its percent cover on each of those plots is 1%, then the average percent cover is (1+1+1)/10 = 0.3%. Average percent cover is a measure of the dominance of a species in a plant community.

Basal area - The cross-sectional area of a tree at breast height (4.5 ft. or 1.37 m above the ground). Basal area is usually reported on an area basis (e.g., total basal area per acre or hectare).

Biodiversity - The sum total of life in an area. Biodiversity is perhaps best divided into structure (e.g., tree sizes), composition (e.g., variety of plant species), and function (e.g., nutrient cycling), at scales ranging from genetic to landscape. Forest managers are directed to consider biodiversity by the National Forest Management Act of 1976, and associated regulations (36 CFR 219).

Biome - Very broad aggregations of ecosystems across the earth's surface. For example, the coastal coniferous forest biome of the Pacific Northwest stretches from northern California to Prince William Sound.

Board foot - A unit of timber volume measurement equal to a piece of wood measuring 12 inches (30 cm) by 12 inches by 1 inch (2.5 cm), usually expressed on an area basis (e.g., 12,000 board feet per acre). Note that mbf = thousands of board feet and mmbf =

millions of board feet. No direct metric equivalent possible.

Breast height - A standard height for measurement of tree diameters: 4.5 feet (1.37 m) above average ground level.

Buffer (strip) - A strip of vegetation left untreated or managed to reduce the impact of a treatment (such as timber harvest) of one area on another. For example, a no-harvest strip retained between a stream and a clearcut unit.

Canopy - (1) More or less continuous cover of branches and foliage formed collectively by crowns of adjacent trees, shrubs, or herbs depending upon the type of vegetation. (2) The percent cover of leaves and branches formed by the tops or crowns of plants as viewed from above.

Canopy closure - In a stand, the progressive reduction of space between tree crowns as they grow and spread laterally. A canopy in which the individual crowns are nearing general contact is termed a close canopy; and having achieved contact, a closed canopy. In general, closure indicates a process, while cover indicates a condition.

Clearcutting - A logging method where all overstory trees are removed from an area.

Climax - The oldest, steady-state plant community that is reached at the end of a successional sequence. Climax forest can be referred to as old growth. In practice, climax conditions can be difficult to define, and some ecologists question the value of the concept.

Codominant - (1) One of several species which dominate a plant community, no one to the exclusion of the others. See dominant and dominance. (2) Trees with crowns forming the general level of the forest canopy and receiving full sunlight from above but comparatively little from the sides; usually with medium sized crowns.

Community - (1) A general term for an assembly of plants living together and interacting among themselves in a specific location, no particular ecological status being implied. (2) A unit of vegetation that is relatively uniform in structure and floristic compositon and consisting of competing plants of one or more species in a common location. The basic unit of vegetation.

Community type - (1) An abstract community, or a group or class of similar abstract communities, that is relatively stable and recurs in similar habitats. Successional status is uncertain. (2) A generalized category comprising a number of similar units of vegetation.

Constancy - The frequency with which a species occurs in a given community type: its site fidelity. For example, if western hemlock is found in 5 of 10 sample plots, its constancy is 50%.

Crown - The upper portion of a tree or shrub, including the branches and foliage.

Crown class - Any class into which the trees forming a stand may be divided on the basis of both their crown development and crown position relative to other trees and the general canopy. Crown classes usually distinguished are: open- grown, dominant, codominant, intermediate, and overtopped (or suppressed).

Crown closure - (1) The closing together of the crowns of trees in a forest as they age and grow. (2) By extension of the term, the projection of all the tree crowns in a crown cover. Expressed as a percent of area.

DBH (diameter at breast height) - The diameter of a tree, measured outside the bark, at 4.5 feet (1.37 m) above average ground level.

Depauperate - Describing an unusually sparse growth of undergrowth plants.

Disturbance - In ecology, any perturbation to a site that alters soil or vegetation; e.g., windthrow.

Diversity - An expression of the variety of species that exists in a community, or of the variety of communities in a landscape. Diversity is a property which varies greatly between communities, and its definition varies between authors.

Dominance - The degree of influence that a plant species exerts over a community as measured by its mass or basal area per unit area.

Dwarf mistletoe - A parasitic flowering plant that affects western hemlock, and, rarely, other tree species. The plant causes the host tree to grow many small branches, forming a "witch's broom". Seeds are forcibly ejected and also carried by birds to infect other trees. Partial harvest which leaves infected residual trees may allow spread of the parasite to younger trees.

Ecology - The science that studies the interactions among organisms and their environment. In this guide, the focus is primarily on vegetation composition and structure.

Ecosystem - A functioning aggregation of organisms and their environment.

Ecosystem management - A Forest Service program focusing on maintenance of natural systems and functions (e.g., water flows, nutrient cycling, and habitat requirements) rather than commodity outputs.

Ecotone - (1) A transition zone between two well-defined plant communities or units of vegetation. (2) Any zone of intergradation or interfingering, narrow or broad, between contiguous types of vegetation including seral stages. Recognition of ecotones may depend on the scale at which one is working.

Entisols - Soils that are very young in geologic terms. Generally, they are poorly, if at all, differentiated into soil horizons. Often found in floodplains and beach areas.

Environment - The surroundings of an organism or community.

Epipedon - A soil horizon that has formed at the surface, requiring at least the dissolution of rock structure and additionally, either darkening by organic matter or lightening caused by eluviation. The epipedon may include both the A and B master horizons; it is a diagnostic horizon used in soil classification.

Even-aged - A stand of trees with individuals originating at nearly the same time and thus having essentially the same age. The maximum difference in age permitted in an even-aged stand is usually 10 to 20 years.

Floodplain - The nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artifically. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the stream. Synonym - bottomland.

Fluting - Stem deformation in western hemlock consisting of longitudinal ripples, seen as a scalloping of the tree circumference in cross section, common in coastal second growth stands. Its cause is unknown.

Fidelity - How closely a plant species is associated with a particular environment. A plant that is found only on cold sites (such as cassiope) shows strong fidelity. A plant found on a variety of sites (such as tall blueberry) shows poor fidelity. Note that constancy is not the same as fidelity: a plant could show 100% constancy in many plant associations (such as blueberry) but have poor fidelity. Species with high fidelity are good indicators of specific site conditions.

Forb - An herb other than a graminoid.

Fluvial - Of or pertaining to rivers; produced by river action.

Frequency - The distribution of individuals of a species in an area, expressed as (number of samples with the species/total number of samples)*100.

Glacial marine - Marine sediments that contain glacial material.

Glacial till - That part of the glacial drift deposited directly by ice with little or no transportation by water. It is generally an unstratified, unconsolidated, heterogeneous mixture of clay, silt, sand, gravel, and sometimes boulders. Till may be found in ground moraines, terminal moraines, medial moraines, and lateral moraines.

Glaciofluvial deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Gradient - Change across the landscape. In Southeast Alaska, the most important gradients affecting vegetation are related to drainage and elevation.

Graminoid - Grass-like plants such as grasses, sedges, rushes, club-rushes, woodrushes, and cottongrass.

Green trees - Trees left in logging units, expected to become snags in the future.

Growing degree day - Day during the growing season when temperatures are sufficient to support plant growth.

Habitat - The particular kind of environment in which a plant or plant community is living, or the environment in which the life needs of a plant, population, or community are supplied.

Habitat type - The potential vegetation of a site integrated with soil and other environmental factors (after Daubenmire 1978).

Herb - Vascular plants that are not woody, at least above ground (e.g., wildflowers, grasses, and sedges).

Hierarchical - In ecosystem classification, an approach that allows integration at all scales from site to landscape (or even regional or biome) levels.

Histosols - Soils made of accumulated organic matter. The degree of decomposition of the organic matter varies. Often found in wetlands.

Hydric - In this document, the term means having wetland characteristics.

Hydric soil - A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions favoring the growth and regeneration of hydrophytic vegetation. Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.

Hydrology - Refering to water regime of an area.

Hydrophytic - Refering to vegetation with wetland characteristics.

Inceptisols - Mineral soils that show initial signs of soil horizon development.

Inclusion - A small percentage of a map unit which exhibits a different soil type or vegetation community from the rest of the unit.

Indicator plant - A plant that occurs with sufficient frequency on an environmental variable (such as soil drainage, light regime, etc.) that it is characteristic of that variable. That is, a species with strong fidelity to the given site condition. See Table 1 for common indicator plants.

Isostatic rebound - Raising of the land surface due to removal of the weight of ice after glacial retreat.

Karst - Limestone or dolomite region showing the sinks, pits, and other features characteristic of subterranean solution and diversion of surface water. Term can refer to the landscape with these features or the features themselves.

Krummholz - Stunted forest found near timberline where tree shape is deformed by wind and weather, from the German for "elfin forest".

Landform - A contiguous, recognizable surface on the landscape, such as lowlands, rolling hills, or mountain summits.

Landscape - A heterogenous area composed of many ecosystems. The forest landscape of Southeast Alaska shows a high degree of heterogeneity, because of the frequent interspersion of peatlands (muskeg) with forest.

Large organic debris (LOD) - Another term for woody debris, such as fallen branches and trees, commonly used in reference to riparian zones. Many streams are dependent on woody debris to maintain their composition and function. LOD is also important in providing conifer regeneration sites. Also called coarse woody debris (CWD).

Leaching - The removal of soluable material from a soil horizon in solution by percolating water.

Marine sediments - Sediments that settled out of the sea and were reworked by currents and tides. Locally, they have been exposed by isostatic rebound.

Mass movement - Catastrophic soil disturbance referring to landslides and avalanches.

Mineral soils - Soils derived from bedrock, alluvium, rock fragments, or till. Note that mineral soils also generally have surface organic layers.

Moraine (glacial, geological) - An accumulation of drift, with an initial topographic expression of its own, built chiefly by the direct action of glacial ice. Examples are end, ground, lateral, recessional, and terminal moraines.

Moraine (lateral) - A ridge-like moraine carried on and deposited at the side margin of a valley glacier. It is composed chiefly of rock fragments derived from valley walls by glacial abrasion and plucking, or mass wasting.

Muck - Highly decomposed organic material in which the original plant parts are not recognizable. Contains more mineral matter and is usually darker in color than peat.

Muskeg - Southeast Alaska vernacular term for several types of peatland. The term is vague and technically incorrect, since it refers to peatlands with a different species composition found in boreal Canada and Interior Alaska. See peatlands.

Non-vascular plant - Plant without a specialized internal vascular system that transports nutrients and water, such as moss.

Non-wetland - Area where vegetation, soil, or hydrology does not show wetland character.

Old growth - A set of late successional forest attributes including variation in canopy layers and tree sizes, plant diversity, gap formation, snags, and woody debris. Old growth age varies. Generally, more productive sites show old growth characteristics at a younger age than do poorer sites. Ages of old growth stands in Southeast Alaska are not well documented but are thought to exceed 200 years as a minimum and range up to 1,000 years. See Boughton et al. 1992 for Regional definitions of old growth forest types.

Organic - Derived from living material.

Overstory - The forest canopy.

Parameter - A characteristic copmponent of a unit that can be defined. A parameter is an intrinsic character; a variable is one measure of it. For example, site productivy is a parameter; tree height is one mesure of it. Vegetation, soils, and hydrology (moisture regime) are the three parameters used for wetland determination.

Parent material - Refers to that great variety of unconsolidated organic and mineral materials in which soils form. Fresh peat and unconsolidated mineral matter are parent material by this concept, but consolidated bedrock is not.

Partial harvest - Refers to logging where trees are left in an area. Includes individual tree selection, group selection, and retention of patches (forest islands).

Peatlands (muskegs) - Non-forest ecosystems of Southeast Alaska characterized by organic soils (peat) and poor soil drainage. Vegetation is typically sedges, sphagnum moss, and short ericaceous shrubs. Peatlands include bogs and fens. Muskeg is the local term for these soggy areas with no or a few scattered, low trees, but this term is discouraged in scientific literature since it is vague and technically does not apply to Southeast peatlands.

Percent cover - Fraction of a site dominated by a species. Equivalent to areal percent cover or canopy cover.

Plant association (PA) - The potential natural vegetative community in a given area, a concept developed for the inventory, mapping and management of vegetative communities. A defined plant association is a discrete type of vegetation, based on the dominant overstory and understory species. Typically, the name consists of a tree and a shrub, but a dominant herb may be named. In a strict sense, a plant association is not integrated with site factors (as is a habitat type).

Plant community - Existing vegetation on a site. May or may not be the climax vegetation type for that site.

Plot - An area of land of any size that is studied or used for experimental purposes. A sample unit in an inventory.

Range - (1) An array of sampled values from minimum to maximum. (2) Habitat, particularly forage, to support mammals. In this document, usually refers to Sitka black-tailed deer.

Regeneration - Renewal of a tree crop, whether by natural or artificial means, also the young crop itself.

Residuals - Trees left in an area that is logged.

Riparian - Pertaining to a streamside environment.

Second growth - A forest which develops following disturbance, such as cutting, windthrow, or fire. Often even-aged. Also called young growth.

Sedge - Perennial (rarely annual) graminoids of wet and marshy places.

Seral - Referring to position of a vegetation community along a sere, e.g. late seral or early seral. Late seral communities are similar to old growth.

Sere - The collection of successional stages from bare ground to climax forest.

Series (soil) - A group of soils having horizons similar in character and arrangement in the soil profile, except for texture of the surface horizon.

Series (vegetation) - Plant associations grouped by overstory vegetation.

Shifting steady-state mosaic - Term used by ecologists to describe the disturbance pattern in some old-growth forests, such as those in Southeast Alaska. Gaps in the forest are continually created by small-scale windthrow. The gaps regenerate and produce a mosaic of tree species and sizes. While the forest is continually changing at small scales, overall, it is a remarkably stable system which shows great resiliency to natural events.

Shrub - A woody perennial plant, often having many stems and commonly found in the understory layer of a forest or in disturbed or open areas.

Silviculture - The art and science of growing trees, providing for forest regeneration, and maintaining forest functions and productivity.

Site productivity - The capability of a specific area to produce biomass.

Snag - Standing dead tree more than 12 feet (3.7 m) tall.

Soil profile - A vertical section through the soil. In practice, a description of a soil profile includes some soil properties that can be determined only by inspecting volumes of soil. A description of a pedon is commonly based on examination of a profile, and the properties of the pedon are projected from the properties of the profile.

Soil drainage classes - In Alaska, soil drainage classes are primarily based on the highest level the water table rises to during the growing season.

Very Poorly Drained: the water table remains at or near the surface a great part of the time. Field evidence of very poor drainage is the presence of a water table above 10 inches for more than 2 weeks out of the growing season, a histic epipedon, or colors indicating saturated or reducing conditions.

Poorly Drained: the soil remains wet much of the time with the water table seasonally near the surface for prolonged intervals. Field evidence of poorly drained soils is the presence of a high water table above 20 inches for more than 2 weeks during the growing season but not above 10 inches for more than 2 weeks; a histic epipedon or colors as above within 20 inches of surface.

Somewhat Poorly Drained: soil is wet for significant periods, but not all of the time usually because of a slowly permeable layer or high water table. Field evidence includes presence of a high water table above 30 inches for more than 2 weeks during the growing season but not above 20 inches for more than 2 weeks or colors as above within 30 inches of the surface.

Moderately Well Drained: profile is wet for a small but significant part of the time usually because of a slowly permeable layer within or immediately below the solum or a relatively high or intermittently high water table. Evidence includes presence of a high water table above 60 inches for more than 2 weeks during the growing season but not above 30 inches for more than 2 weeks or indistinct mottling within 60 inches of the surface.

Well Drained: water is removed from the soil readily but not rapidly. Soils are free of mottling within the usual depth of plant roots. Under natural conditions, soil aeration is not a problem associated with well drained soils. The water table is generally below 60 inches and does not extend above 60 inches for more than 2 weeks during the growing season.

Soil horizon - A layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by soil forming processes. The term layer rather than horizon is used if all of the properties are inherited from the parent material or no judgement is made as to whether the layer is genetic.

Spodic - Soil characteristic of some mineral soils. Relates to zones of leaching and accumulation. Found in high rainfall environments and thus common in Southeast Alaska.

Spodosols - Soils with well developed horizons, including a zone of leaching (E horizon) and a zone where leached materials accumulate (e.g., Bs, Bh, Bsh horizons).

Stand - An aggregation of plants similar in physiognomy, species composition, spatial arrangement, and condition which distinguish it from adjacent communities.

Stratum (vegetation) - A horizontal layer in a plant community in which the plants are of the same lifeform and about the same height, such as the overstory stratum or the fern stratum.

Stump - Standing dead tree less than 12 feet (3.7 m) tall.

Succession - Changes in vegetation and associated animal life that occur over time from disturbance to climax conditions. Succession can be primary, starting with bare rock or soil, or secondary, following disturbance of an established ecosystem.

Terrane - Large geologic block underlying the landscape.

Till (glacial) - Predominantly unsorted and unstratified drift, deposited by and underneath a glacier, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders.

Trafficability - The ability of soils to withstand repeated use by foot traffic without site deterioration, that is, site suitability for hiking trails.

Understory - Vegetation beneath the forest canopy, such as young trees, shrubs, forbs, ferns, mosses.

Upland - (1) Non-wetland in character. (2) Landscape positions not in valley bottoms.

Vascular plant - A plant that has a specialized internal system of vascular tissue for the transport of nutrients and water, which includes the ferns and all the higher order plants.

Vegetation structure - The spatial distribution pattern of life forms in a plant community, especially with regard to their height, abundance, or coverage within the individual layers. The three components of vegetation structure are (a) vertical structure (stratification into layers), (b) horizontal structure (spatial distribution of individuals and species populations), and (c) quantitative structure (abundance of each species).

Wetlands - Areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and fens.

Wetland plant association - Vegetative community with hydric character.

Wetland soil - A soil that has characteristics developed in a reducing atmosphere, which exists when periods of prolonged soil saturation result in anaerobic conditions. Hydric soils that are sufficiently wet to support hydrophytic vegetation are wetland soils.

Wetland vegetation - Plants considered hydric because of a systematic determination. The USDI Fish and Wildlife Service maintains a list of the wetland character of common species, by region of the country.

Windthrow - Trees blown down. Synonymous with blowdown.

Woody debris - Logs and stumps on the forest floor. See also large organic debris.

APPENDICES

APPENDIX 1. SPECIES CODES AND SCIENTIFIC AND VERNACULAR NAMES FOR PLANT SPECIES IN THE ASSOCIATIONS

Species Code	Scientific Name	Vernacular Name
Trees		
ALRU	Alnus rubra	Red alder
CHNO	Chamaecyparis nootkatensis	Yellow-cedar
PICO	Pinus contorta contorta	Shore pine
PISI	Picea sitchensis	Sitka spruce
PYFU	Pyrus fusca	Crabapple
SOSI	Sorbus sitchensis	Sitka mountain ash
TSHE	Tsuga heterophylla	Western hemlock
TSME	Tsuga mertensiana	Mountain hemlock
Shrubs		
ALNUS	Alnus spp.	Alder
ALSI	Alnus sinuata	Sitka alder
ANPO	Andromeda polifolia	Bog rosemary
CAME	Cassiope mertensiana	Mertens cassiope
CASSI	Cassiope spp.	Cassiope
CAST5	Cassiope stelleriana	Starry cassiope
CLPY	Cladothamnus pyrolaeflorus	Copperbush
EMNI	Empetrum nigrum	Crowberry
KAPO	Kalmia polifolia	Bog kalmia
LEGR	Ledum groenlandicum	Labrador tea
LIBO2	Linnaea borealis	Twin-flower
LUPE	Luetkea pectinata	Luetkea
MEFE	Menziesia ferruginea	Rusty menziesia
OPHO	Oplopanax horridum	Devil's club
PHGL	Phyllodoce glanduliflora	Mountain-heather
RIBES	Ribes spp.	Currant
RUPA	Rubus parviflorus	Thimbleberry
RUSP	Rubus spectabilis	Salmonberry
SALIX	Salix spp.	Willow
SARA	Sambucus racemosa	Red elderberry
VAAL	Vaccinium alaskaense	Alaska blueberry
VACA	Vaccinium caespitosum	Dwarf blueberry
VACCI	Vaccinium ovalifolium and V. alaskaense	Blueberry
VAOV	Vaccinium ovalifoluim	Early blueberry
VAOX	Vaccinium oxycoccos	Bog cranberry
VAPA	Vaccinium parvifolium	Red huckleberry
VAUL	Vaccinium uliginosum	Bog blueberry
VAVI	Vaccinium vitis-idaea	Mountain cranberry
VIED	Viburnum edule	Highbush cranberry
Forbs		
ACDE2	Aconitum delphinifolium	Monkshood
ACRU	Actaea rubra	Baneberry
ARSY	Aruncus sylvester	Goatsbeard
ASTER	Aster spp.	Aster
CALE2	Caltha leptosepala	Marshmarigold
CERAS	Cerastium spp.	Chick weed
CIAL	Circaea alpina	Enchanter's nightshade
CLSI	Claytonia sibirica	Siberian spring-beauty
CLUN	Clintonia uniflora	Blue-bead
COAS	Coptis asplenifolia	Fern-leaf goldthread
COCA	Cornus canadensis	Bunchberry dogwood
COME	Corallorhiza mertensiana	Merten's coral-root
COOF	Cochlearia officinalis	Scurvy-grass
COSU3	Cornus suecica	Lapland cornel
COTR2	Coptis trifolia	Trifoliate goldthread
DEGL	Delphinium glaucum	Glaucous larkspur
DODEC	Dodecatheon spp.	Shooting star
DROSE	Drosera spp.	Sundew
EPAL	Epilobium alpinum	Alpine willow-herb
EPGL2	Epilobium glandulosum	Glandular willow-herb
EPILO	Epilobium spp.	Fireweed
EPLA	Epilobium latifolium	Dwarf fireweed
ERPE	Erigeron peregrinus	Subalpine daisy
FACR	Fauria crista-galli	Deer cabbage
FRCA2	Fritillaria camschatcensis	Chocolate lily
GAAP	Galium aparine	Cleavers

Species Code	Scientific Name	Vernacular Name
Forbs, continued		
GAKA	Galium kamtschaticum	Northern wild-licorice
GATR	Galium triflorum	Sweet-scented bedstraw
GATR3	Galium trifidium	Small bedstraw
GECA4	Geum calthifolium	Caltha-leaf avens
GEDO	Gentiana douglasiana	Swamp gentian
GEER	Geranium erianthum	Northern geranium
GEPL	Gentiana platypetala	Alpine gentian
GOOB	Goodyera oblongifolia	Rattlesnake Plantain
HABEN	Habenaria spp.	Bog-orchid
HEGL2	Heuchera glabra	Alpine heuchera
HELA	Heracleum lanatum	Cow parnip
HIGR	Hiericium gracile	Slender hawkweed
HIMO	Hippuris montana	Mountain marestail
HITR	Hieracium triste	Wooly hawkweed
HYMO	Hypopitys monotropa	Pinesap
IRSE	Iris setosa	Wild iris
LAJA	Lathyrus japonicus	Maritime peavine
LAPA	Lathyrus palustris	Marsh peavine
LEPY2	Leptarrhena pyrolifolia	Featherleaf saxifrage
LICA3	Listera caurina	Western twayblade
LICO3	Listera cordata	Heart-leaved twayblade
LYAM	Lysichitum americanum	Yellow skunk cabbage
MADI2	Mainthemum dialatatum	Deerberry
MALAX	Malaxis spp.	Adder's tongue
MITEL	Mitella spp.	Mitrewort
MONTI	Montia spp.	Montia
MOUN	Moneses uniflora	Single delight
OSCH	Osmorhiza chilensis	Chile sweet-cicely
OSPU	Osmorhiza purpurea	Sitka sweet-cicely
PAFI	Parnassia fimbriata	Grass of parnassus
PEFR2	Petasites frigidus	Arctic sweet coltsfoot
PIVU	Pinguicula vulgaris	Common butterwort
PRAL	Prenanthes alata	Rattlesnake root
PYSE	Pyrola secunda	One-sided wintergreen
RANUN	Ranunculus spp.	Buttercup
RUCH	Rubus chamaemorus	Cloudberry
RUPE	Rubus pedatus	Five-leaf bramble
SAFE	Saxifraga ferruginea	Alaska saxifrage
SASI	Sanguisorba sitchensis	Sitka burnet
STELL	Stellaria spp.	Starwort
STREP	Streptopus spp.	Twisted-stalk
SWPE	Swertia perennis	Alpine bog swertia
TITR	Tiarella trifoliata	Trifoliate foamflower
TIUN	Tiarella unifoliata	Unifoliate foamflower
TOGL	Tolfieldia glutinosa	Sticky tofieldia
TREU	Trientalis europea	Arctic starflower
VASI	Valeriana sitchensis	Sitka valerian
VEVI	Veratrum viride	False hellebore
VIOLA	Viola spp.	Violet
Ferns		
ADPE	Adiantum pedatum	Maiden-hair fern
ATFI	Athyrium filix-femina	Fady fern
BLSP	Blechnum spicant	Deer fern
CYFR	Cystopteris fragilis	Fragile fern
DRAU2	Dryopteris austriaca	Spinulose shield fern
EQUIS	Equisetum spp.	Horsetail
GYDR	Gymnocarpium dryopteris	Oak-fern
LYCOP	Lycopodium spp.	Clubmoss
POBR2	Polystichum braunii	Prickly shield-fern
POGL4	Polypodiam glycyrrhiza	Licorice fern
POLO2	Polystichum lonchitis	Holly-fern
POLYS	Polystichum spp.	Holly-fern
PTAQ	Pteridium aquilinum	Western bracken fern
THLI	Thelypteris limbosperma	Mountain wood-fern
THPH	Thelypteris phegopteris	Northern beech-fern

Species Code	Scientific Name	Vernacular Name
Graminoids		
AGROS	*Agrostis* spp.	Bentgrass
CAAN5	*Carex anthoxanthea*	Sedge
CACA	*Calamagrostis canadensis*	Bluejoint
CALE5	*Carex lenticularis*	Sedge
CAMA4	*Carex macrochaeta*	Long-awn sedge
CAME2	*Carex mertensii*	Mertens sedge
CANI2	*Carex nigricans*	Blackish sedge
CANU3	*Calamagrostis nutkaensis*	Pacific Reedgrass
CAPA2	*Carex pachycarpa*	Sedge
CAPA11	*Carex pauciflora*	Few-flowered sedge
CAPL	*Carex pluriflora*	Many-flower sedge
CAREX	*Carex* spp.	Sedge
CASI3	*Carex sitchensis*	Sitka sedge
DEAT	*Deschampsia atropurpurea*	Mountain hairgrass
ERIOP	*Eriophorum* spp.	Cotton grass
FERU	*Festuca rubra*	Red fescue
JUNCU	*Juncus* spp.	Rush
LUPA	*Luzula parviflora*	Small-flowered woodrush
POA	*Poa* spp.	Bluegrass
SCCA2	*Scirpus caespitosus*	Tufted clubrush
TRCE	*Trisetum cernuum*	Nodding oatgrass
TRISE	*Trisetum* spp.	Oatgrass

APPENDIX 2. MEAN CANOPY COVER (%), STANDARD DEVIATION, AND CONSTANCY FOR ALL SPECIES BY PLANT ASSOCIATION

	Sitka Spruce/ Red Alder/ Salmonberry			Sitka Spruce/ Sitka Alder			Sitka Spruce/ Devil's Club-Salmonberry			Sitka Spruce/ Devil's Club			Sitka Spruce/ Blueberry-Devil's Club			Sitka Spruce/ Devil's Club-Upland			Sitka Spruce/ Devil's Club/ Skunk Cabbage		
# OF PLOTS	4			4			5			20			17			3			16		
	*COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
TREES																					
Overstory																					
ALRU	17.8	14.6	100																3.0	.0	6
PISI	38.0	.0	100	32.3	11.5	100	33.8	20.0	100	51.6	14.8	100	32.9	17.9	100	30.3	13.3	100	42.9	15.9	100
SOSI													3.0	.0	6						
TSHE	9.0	6.9	100	11.0	6.9	75	19.6	10.3	100	25.4	18.1	90	41.4	15.0	94	30.3	13.3	100	28.1	16.0	94
TSME	9.0	8.5	50	3.0	.0	25							3.0	.0	6	15.0	.0	33	1.0	.0	6
TREES																					
Understory**																					
PISIL	3.0	.0	25	2.3	1.2	75	1.0	.0	20	2.4	1.0	35	2.0	1.2	24	2.0	1.4	67	4.2	6.1	31
PISIS	1.0	.0	75	1.7	1.2	75	1.7	1.2	60	1.5	.9	65	1.2	.6	71	1.0	.0	67	1.0	.0	56
TSHEL	15.0	.0	25	2.5	1.0	100	7.0	7.3	100	8.4	10.0	80	9.4	6.5	65	15.0	.0	67	13.2	8.9	94
TSHES	1.0	.0	75	1.7	1.2	75	1.7	1.2	60	1.3	.8	90	4.5	5.3	94	1.7	1.2	100	1.3	.7	88
TSMEL	15.0	.0	25	3.0	.0	25	3.0	.0	20							1.0	.0	33	3.0	.0	6
TSMES				3.0	.0	25							1.0	.0	6						
HRUBS																					
ALSI				27.0	24.0	100	2.0	1.4	40	1.0	.0	5							15.0	.0	6
MEFE	1.0	.0	25	3.0	.0	25	2.0	1.4	40	1.7	1.0	45	12.3	16.0	71	15.0	.0	67	6.2	6.1	81
OPHO	47.0	27.7	75	44.5	35.2	100	50.4	31.3	100	56.7	15.4	100	39.8	19.6	100	30.3	13.3	100	28.0	18.9	100
RIBES	38.0	.0	50	18.0	18.7	75	3.0	.0	20	7.3	12.3	45	2.0	1.4	12	1.0	.0	67	5.2	5.6	56
RUSP	11.5	7.0	100	8.5	7.5	100	19.6	10.3	100	2.4	1.6	65	8.7	13.3	82	3.0	.0	33	12.1	14.1	69
SARA	1.0	.0	25							1.0	.0	20							3.0	.0	6
VACCI	7.0	6.9	75	11.3	17.9	100	14.8	14.3	100	8.2	6.7	85	35.8	18.7	100	10.3	8.1	100	13.4	11.2	100
VACCINGT	2.8	.9	100	2.7	.3	75	2.2	1.3	100	2.5	1.2	80	3.2	.8	100	1.0	.5	100	2.8	1.1	100
VAPA													1.0	.0	12				1.0	.0	13
VIED				1.0	.0	25				15.0	.0	5									
ORBS																					
ARSY							1.0	.0	20	1.0	.0	5									
ACRU										1.0	.0	5				3.0	.0	33	1.0	.0	6
CIAL	15.0	.0	25	1.0	.0	50	2.0	1.4	40	14.3	15.7	40	1.4	.9	29	15.0	.0	33	1.0	.0	69
CLSI										1.0	.0	5									
CLUN													3.0	.0	6						
COAS	1.0	.0	75	1.7	1.2	75	2.0	1.2	80	7.0	6.9	15	10.1	15.2	82	2.0	1.4	67	3.0	4.3	63
COCA	1.0	.0	50	8.0	9.9	50	2.6	.9	100	3.2	3.7	65	8.9	12.6	88	8.0	9.9	67	6.2	6.5	94
COME													1.0	.0	6						
EPGL2										1.0	.0	5									
EPILO	1.0	.0	25							1.0	.0	5									
EQUIS	38.0	.0	25	1.0	.0	25				8.0	9.9	10	1.0	.0	6				1.0	.0	44
FACR													1.0	.0	6						
GAKA				1.0	.0	50				1.0	.0	5	1.0	.0	6				1.0	.0	6
GATR	1.0	.0	25	2.0	1.4	50	1.0	.0	20	1.5	1.0	20									
GATR3													1.0	.0	6						
GOOB										1.0	.0	5									
HEGL2				1.0	.0	25										1.0	.0	33	1.0	.0	6
HELA										3.0	.0	5							1.0	.0	6
HYMO													1.0	.0	6						
IRSE				1.0	.0	25															
LICA3										1.0	.0	10							1.0	.0	6
LICO3	1.0	.0	25	1.0	.0	25	1.0	.0	20	1.0	.0	25	1.7	1.0	53				1.4	.9	31
LYAM	2.0	2.0	50	3.0	.0	75	1.0	.0	40	2.0	1.1	30	1.8	1.0	24				34.2	27.5	100
MADI2	3.0	.0	25	3.0	.0	25	2.0	1.4	40	9.7	11.6	50	10.6	15.0	59	1.0	.0	33	1.9	1.1	44
MOUN	1.0	.0	25	1.0	.0	25	1.0	.0	40	1.0	.0	45	1.0	.0	59	1.0	.0	100	1.0	.0	19
OSPU	1.0	.0	25							1.7	1.2	15	1.0	.0	12						
PRAL	1.0	.0	25	8.0	9.9	50				3.7	5.6	30	1.4	.9	29	2.0	1.4	67	1.5	1.0	25
PYSE	1.0	.0	50	1.0	.0	25				1.0	.0	5	1.0	.0	18	1.0	.0	33	1.0	.0	25
RANUN										1.0	.0	10									
RUCH																			3.0	.0	6
RUPE	1.0	.0	75	5.7	8.1	75	12.0	6.0	80	8.0	9.8	85	11.9	11.5	100	5.7	8.1	100	3.6	4.5	100
SAFE																					
SASI																					
STELL										1.0	.0	5									
STREP	7.0	6.9	75	13.3	21.4	75	5.0	5.7	100	5.0	5.6	90	10.1	9.8	100	13.3	21.4	100	4.1	4.9	81
TITR	8.5	7.5	100	12.0	6.0	100	9.6	15.9	100	11.6	18.4	100	7.9	9.7	94	15.0	.0	67	8.8	12.1	100
TIUN				1.0	.0	25				1.0	.0	5	1.0	.0	12	1.0	.0	33			
VASI	1.0	.0	25																1.0	.0	6
VEVI	1.0	.0	25	2.0	1.4	50				1.0	.0	5	15.0	.0	25				1.0	.0	12
VIOLA	1.0	.0	50	1.7	1.2	75	1.0	.0	40	1.7	1.0	45	1.0	.0	25	1.0	.0	33	1.7	1.0	35
FERNS																					
ATFI	8.5	7.5	100	12.0	6.0	100	7.0	7.3	100	14.1	21.4	80	7.1	10.4	76	6.3	7.6	100	10.0	10.5	81
BLSP	1.0	.0	25	3.0	.0	25	1.0	.0	20	1.0	.0	5	2.2	1.1	29	3.0	.0	67	1.0	.0	13
CYFR										1.0	.0	10	1.0	.0	6	1.0	.0	33	1.0	.0	13
DRAU2	3.0	.0	75	2.0	1.4	50	17.8	14.6	80	16.7	22.5	75	10.5	10.0	82	9.0	8.5	67	3.2	3.9	75
GYDR	1.5	1.0	100	14.8	16.5	100	12.4	15.2	100	26.6	22.4	85	13.1	13.3	100	11.0	6.9	100	12.3	11.8	100
LYCOP										1.0	.0	5	1.0	.0	24	1.0	.0	33	2.0	1.0	12
POBR2	2.0	1.4	50	3.0	.0	25													3.0	.0	6
POGL4													1.0	.0	6						
POLYS										1.0	.0	5							15.0	.0	6
THLI	2.0	1.4	50							1.0	.0	5				1.0	.0	33	3.0	.0	6
THPH				2.0	1.4	50	3.0	.0	20	1.7	1.0	30	1.7	1.2	18	9.0	8.5	67	1.7	1.2	19
GRAMINOIDS																					
AGROS																			1.0	.0	6
CAAN5																			1.0	.0	6
CALE2	15.0	.0	25																		
GRASS	3.0	.0	25	1.0	.0	75				1.8	1.4	15							1.0	.0	19
JUNCU																			1.0	.0	6
SCCA2										1.0	.0	5									
SEDGES	15.0	.0	25							1.0	.0	10							1.0	.0	19
TRISE										2.0	1.4	10									

* COVER = % canopy cover; SD = standard deviation; CONS = constancy
**L suffix = <5 in DBH, > 3 ft.; S suffix = < 3 ft.

	Sitka Spruce/ Blueberry			Sitka Spruce/ Blueberry/ Skunk Cabbage			Sitka Spruce/ Pacific Reedgrass			W. Hemlock/ Devil's Club			W. Hemlock/ Blueberry-Devil's Club			W. Hemlock/ Devil's Club-Shallow			W. Hemlock/ Blueberry/ Shield Fern		
# OF PLOTS	8			4			2			12			48			32			158		
TREES	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
Overstory																					
ALRU	2.0	1.4	13																		
CHNO													26.5	16.3	4	3.0	.0	6	11.7	5.7	9
PISI	35.6	20.0	100	38.0	.0	100	85.0	.0	100	11.0	6.2	50	9.7	8.0	69	11.5	10.6	66	11.0	11.0	51
TSHE	44.5	17.2	100	50.5	14.4	100	15.0	.0	50	58.6	13.9	100	60.9	16.4	100	51.3	20.8	100	64.2	16.1	100
TSME										3.0	.0	8	7.0	6.2	13	5.0	4.9	19	8.3	6.3	14
TREES																					
Understory																					
CHNOL													15.0	.0	2	3.0	.0	3	1.9	1.1	4
CHNOS													3.0	.0	2				1.0	.0	2
PISIL				1.0	.0	50				2.0	1.2	33	1.4	.8	21	2.3	1.0	25	2.7	3.4	20
PISIS	3.8	6.3	63	1.0	.0	50	1.0	.0	50	1.3	.8	58	1.1	.5	69	1.2	.6	63	1.7	2.6	56
TSHEL	11.6	15.9	63	9.0	6.9	100				10.0	6.9	67	6.5	7.4	81	10.2	10.1	84	12.9	11.7	92
TSHES	8.3	7.2	100	2.0	1.2	100	1.0	.0	50	1.4	.8	92	3.3	4.3	92	3.8	4.6	91	4.0	4.8	98
TSMEL	1.0	.0	13										5.0	6.7	8	2.0	1.4	6	4.2	4.5	9
TSMES													1.0	.0	6	1.7	1.2	9	1.3	.7	9
SHRUBS																					
ALSI										15.0	.0	8				3.0	.0	3			
CLPY													3.0	.0	2						
LIBO2																			1.0	.0	1
MEFE	1.4	.9	63	17.8	14.6	100	1.0	.0	100	4.6	5.9	42	7.8	9.7	69	6.3	5.6	88	12.6	14.9	79
OPHO	4.0	5.5	75	2.0	1.4	50				62.3	17.4	100	30.8	15.9	100	31.9	18.4	100	2.2	2.4	69
RIBES										1.0	.0	17	2.0	1.4	4	2.0	1.4	6	5.7	8.1	2
RUSP	1.5	1.0	50	1.0	.0	25				1.8	1.0	67	2.9	3.8	52	3.2	3.9	72	1.9	2.6	36
SARA										2.0	1.4	17	1.0	.0	4	1.7	1.2	9	1.0	.0	2
VACCI	38.5	18.2	100	44.3	12.5	100	1.0	.0	100	7.8	6.2	83	25.3	16.0	100	24.7	21.0	100	53.0	23.9	100
VACCINGT	2.9	.4	100	2.3	.9	100	.5	.0	100	2.8	.9	83	3.0	1.0	100	2.8	1.0	100	3.0	1.1	100
VAPA				1.0	.0	25				1.0	.0	17	2.1	1.1	15	7.2	15.1	19	3.8	7.2	20
FORBS																					
ACRU													1.0	.0	2				1.0	.0	1
CIAL										5.5	6.4	33	4.2	5.8	21	1.8	1.1	16	2.0	1.4	1
CLUN										1.0	.0	8	8.4	12.6	19				4.1	5.5	10
COAS	15.6	16.6	88	11.5	7.0	100				2.0	1.1	50	6.0	9.5	96	3.7	4.2	84	5.3	6.2	89
COCA	9.6	12.9	100	12.0	6.0	100	15.0	.0	50	5.8	5.8	67	6.5	8.7	96	5.6	5.6	100	8.8	9.4	97
COME										1.7	1.2	25	1.0	.0	4	1.0	.0	6	1.0	.0	5
EQUIS				3.0	.0	25							1.0	.0	6						
ERPE				1.0	.0	25															
GAKA													1.0	.0	2				1.0	.0	1
GATR				1.0	.0	25				1.0	.0	8							1.0	.0	1
GATR3													1.0	.0	2				1.0	.0	1
HABEN																			1.0	.0	1
HEGL2													1.0	.0	2						
HYMO										1.0	.0	17							1.0	.0	1
LICA3				1.0	.0	25				1.0	.0	17	1.7	1.2	6	1.0	.0	6	1.0	.0	10
LICO3	1.6	1.0	88	2.0	1.4	50	1.0	.0	50	1.3	.8	50	1.7	2.7	58	1.3	.7	47	1.6	1.9	73
LYAM	1.0	.0	25	38.5	19.6	100				1.0	.0	8	3.0	4.9	17	2.1	1.1	22	1.8	3.4	11
MADI2	10.3	8.1	38	2.0	1.4	50	15.0	.0	50	13.6	17.5	58	3.2	4.1	42	3.0	4.1	34	3.2	4.3	34
MONTI																			1.0	.0	1
MOUN	1.0	.0	88	1.0	.0	50	1.0	.0	50	1.0	.0	42	1.1	.4	65	1.0	.0	47	1.1	.4	73
OSCH										3.0	.0	8									
OSPU																1.0	.0	3	1.0	.0	2
PAFI																			1.0	.0	1
PRAL				3.0	.0	25	26.5	16.3	100				1.0	.0	6	1.0	.0	6	2.0	1.4	1
PYSE													2.0	1.4	4	1.4	.9	16	1.0	.0	3
RUPE	8.5	7.0	100	17.8	14.6	100				6.3	6.6	75	7.1	7.4	98	11.9	11.5	100	10.4	9.4	99
STREP	5.9	6.3	88	8.0	9.9	50	2.0	1.4	100	4.2	5.1	100	4.2	5.1	94	4.7	5.8	81	3.8	5.2	95
TITR	9.8	14.8	75	5.7	8.1	75	15.0	.0	50	9.5	11.8	83	5.8	7.4	92	5.8	5.9	91	2.3	4.3	53
TIUN																			1.0	.0	1
VASI																1.0	.0	3			
VEVI	1.0	.0	13										1.0	.0	6	1.0	.0	16	1.3	.8	4
VIOLA	1.3	.7	50							10.2	14.6	50	3.3	4.8	31	2.7	3.7	44	1.3	.7	13
FERNS																					
ADPE	1.0	.0	13							1.0	.0	17	1.0	.0	2				1.0	.0	1
ATFI	1.7	1.2	38	20.5	24.7	50	3.0	.0	50	6.9	12.6	67	9.3	10.0	65	5.4	8.0	78	2.0	2.7	34
BLSP	1.0	.0	25	2.0	1.4	50				1.0	.0	8	6.8	10.4	54	5.0	5.3	75	6.8	9.1	62
CYFR													1.0	.0	4	1.0	.0	3	1.0	.0	2
DRAU2	3.9	5.0	88	3.0	.0	25				13.2	14.3	83	7.6	10.2	85	9.7	10.2	84	6.1	8.6	88
GYDR	13.9	17.2	88	5.7	8.1	75	63.0	.0	50	26.5	22.9	100	15.4	14.2	92	12.9	16.8	94	6.7	9.9	84
LYCOP										1.0	.0	25	1.0	.0	12	1.5	1.0	29	1.2	.6	23
POGL4													1.0	.0	2						
POLO2													1.0	.0	2						
POLYS										1.0	.0	8	2.0	1.4	4						
POSE										3.0	.0	8									
THLI													1.0	.0	8	1.8	1.0	25	1.5	.9	5
THPH							19.5	26.2	100				1.6	1.0	15	1.9	1.1	22	2.3	3.1	13
GRAMINOIDS																					
CACA																			1.0	.0	1
CAME2																			1.0	.0	1
CANU3							85.0	.0	100												
GRASS							85.0	.0	100				1.0	.0	4	1.0	.0	6	3.0	.0	2
LUPA													1.0	.0	6				1.0	.0	1
SEDGES				1.0	.0	25										5.7	8.1	9	1.0	.0	3
TRISE													1.0	.0	2	1.0	.0	3			

	W. Hemlock/ Blueberry			W. Hemlock/ Blueberry-Menziesia			W. Hemlock/ Blueberry/ Skunk Cabbage			W. Hemlock/ Devil's Club/ Skunk Cabbage			WH-Y-Cedar/ Blueberry			WH-Y-Cedar/ Blueberry-Devil's Club			WH-Y-Cedar/ Blueberry/ Skunk Cabbage		
# OF PLOTS	88			29			31			11			55			2			17		
REES	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
Overstory																					
ALRU				3.0	.0	5	15.0	.0	3				1.0	.0	2						
CHNO	2.8	.7	10	6.3	7.6	14	6.0	6.0	13				24.4	13.0	100	38.0	.0	100	28.8	16.9	100
PICO	1.0	.0	1																		
PISI	9.1	6.2	70	7.9	9.7	76	12.6	11.9	71	17.3	7.3	91	7.7	6.2	40	2.0	1.4	100	6.0	5.6	47
SOSI	1.0	.0	1																		
TSHE	55.9	15.4	100	56.8	19.7	100	47.5	20.9	100	45.0	15.8	100	37.5	15.8	100	26.5	16.3	100	36.9	13.3	100
TSME	6.7	5.9	28	6.0	6.0	19	6.0	6.0	13	3.0	.0	45	9.0	6.3	22				7.8	6.6	29
REES																					
Understory																					
CHNOL	2.0	1.1	7				3.0	.0	3				8.7	8.2	58	3.0	.0	50	6.8	6.2	53
CHNOS	1.0	.0	6										3.0	4.2	53	1.0	.0	50	1.0	.0	29
PICOS	1.0	.0	1																		
PISIL	3.7	4.5	35	2.0	1.1	48	4.4	9.3	48	1.7	1.2	27	1.6	.9	31	9.0	8.5	100	1.0	.0	24
PISIS	1.3	.7	65	1.3	.7	67	1.1	.4	68	1.3	.8	55	1.8	2.6	56	2.0	1.4	100	2.6	4.4	59
SOSI	1.0	.0	1																		
TSHEL	12.1	11.5	90	10.0	6.3	95	13.2	12.6	97	13.8	9.7	100	9.5	8.3	96	15.0	.0	100	13.4	8.4	94
TSHES	3.3	3.9	95	2.7	3.0	100	4.0	5.3	90	3.9	4.3	82	3.9	6.3	100	3.0	.0	100	3.2	4.5	100
TSMEL	3.4	4.3	20	3.0	.0	10	2.2	1.1	16	7.0	6.9	27	2.2	1.0	27				8.5	7.5	24
TSMES	1.2	.6	15				5.7	8.1	10	1.0	.0	18	1.5	.9	20				1.0	.0	24
HRUBS																					
ALSI	2.0	1.4	2										2.3	1.2	5						
CLPY	3.0	.0	1										2.0	1.4	4						
LIBO2	1.0	.0	1																		
MEFE	9.5	6.3	89	43.8	13.0	100	19.4	13.2	87	9.4	6.5	100	11.5	10.3	93	15.0	.0	100	22.5	15.0	100
OPHO	2.6	3.4	53	2.8	4.1	52	4.6	10.6	39	47.1	26.4	100	1.6	.9	64	26.5	16.3	100	2.3	1.0	47
RIBES	1.0	.0	1							1.7	1.2	27									
RUSP	1.6	.9	40	1.3	.8	29	2.3	1.0	29	7.7	7.0	100	1.5	.9	31	1.0	.0	50	2.0	1.2	24
SARA										1.0	.0	9	1.0	.0	2						
VACCI	54.9	22.9	100	60.5	25.4	100	41.9	22.7	100	31.2	22.9	100	57.8	22.7	100	50.5	17.7	100	49.5	26.4	100
VACCIMGT	3.1	1.0	100	2.7	1.1	100	3.1	1.1	100	3.1	1.1	100	2.9	1.0	100	3.0	2.1	100	3.0	1.1	100
VAPA	3.2	3.9	14	2.6	.9	24	3.7	5.6	19				1.9	1.0	29				1.0	.0	6
FORBS																					
CIAL							1.0	.0	6	10.3	8.1	27				1.0	.0	50			
CLSI										1.0	.0	9									
CLUN	5.5	5.9	9	5.5	6.4	19	2.0	1.4	6	15.0	.0	9	1.6	1.0	13				2.0	1.4	12
COAS	6.7	6.9	92	5.0	5.0	52	3.5	4.0	97	11.4	15.7	82	8.7	10.0	96	3.0	.0	100	7.9	6.1	100
COCA	9.2	9.4	97	14.4	6.9	100	7.7	9.6	100	5.5	6.1	100	6.9	8.2	98	15.0	.0	100	7.1	6.0	100
COME	1.0	.0	2	1.0	.0	5							1.0	.0	11				1.0	.0	6
EQUIS	1.0	.0	5				3.0	.0	6	1.0	.0	9	1.0	.0	4				1.0	.0	12
ERPE																			1.0	.0	6
FACR	1.0	.0	1	1.0	.0	5													1.0	.0	12
GAKA										1.0	.0	9	1.0	.0	4						
GATR							1.7	1.2	10				1.0	.0	2						
HABEN							1.0	.0	3				1.0	.0	4				1.0	.0	6
HEGL2	1.0	.0	1																		
HIMO													1.0	.0	2						
LICA3	1.0	.0	10	1.0	.0	14	1.0	.0	13				1.0	.0	36	3.0	.0	50	1.0	.0	41
LICO3	1.6	1.9	73	1.1	.5	81	1.9	2.8	81	1.0	.0	36	2.0	2.2	85	1.0	.0	100	1.0	.0	94
LYAM	2.2	2.5	38	1.4	.9	43	28.4	14.2	100	28.6	25.3	100	2.2	3.0	40	3.0	.0	50	25.9	16.4	100
MADI2	2.3	3.1	24	2.8	4.1	52	3.0	3.6	45	2.2	1.1	45	5.0	6.0	44	1.0	.0	50	5.9	6.3	41
MITEL							1.0	.0	3												
MOUN	1.1	.5	56	1.0	.0	62	1.0	.0	45	1.0	.0	27	1.0	.0	45				1.0	.0	41
OSPU	2.0	1.4	2	1.0	.0	5							1.0	.0	2						
PAFI													2.0	1.4	4						
PRAL	1.0	.0	1	1.0	.0	5	1.0	.0	6				1.2	.6	18	1.0	.0	50	1.0	.0	29
PYSE	1.0	.0	8	1.0	.0	5	1.0	.0	6	1.0	.0	9	1.1	.5	29				1.0	.0	18
RUPE	10.1	8.6	98	9.4	13.7	100	8.3	8.4	100	15.8	15.2	100	6.8	7.9	100	15.0	.0	100	10.6	14.7	100
STELL	1.0	.0	1				1.0	.0	3												
STREP	4.9	7.5	84	2.6	3.6	71	1.9	1.0	84	3.0	4.3	91	5.8	5.7	87	3.0	.0	100	2.5	3.5	94
TITR	2.0	2.9	52	1.7	1.0	29	4.0	4.8	45	4.4	5.7	91	2.7	4.1	76	2.0	1.4	100	1.6	1.0	59
TIUN	1.0	.0	1																		
VASI													1.0	.0	2				1.0	.0	6
VEVI	1.7	1.0	10	1.0	.0	10	5.5	6.4	13	1.0	.0	27	1.2	.7	16				1.0	.0	18
VIOLA	1.6	1.0	11	1.0	.0	10	1.5	.9	26	6.3	6.8	55	1.4	.8	20	1.0	.0	50	1.0	.0	12
FERNS																					
ADPE							3.0	.0	3	1.0	.0	9									
ATFI	2.6	3.9	27	3.0	.0	14	5.3	5.9	39	10.1	12.6	73	5.5	9.4	35	1.0	.0	50	1.0	.0	24
BLSP	7.4	7.4	67	5.4	6.2	52	3.1	3.5	45	5.0	6.7	36	10.8	12.2	95	3.0	.0	100	5.9	6.4	94
CYFR													1.0	.0	2						
DRAU2	3.4	5.9	63	1.9	1.1	33	1.5	.9	39	7.3	11.5	91	2.0	2.7	49	3.0	.0	50	1.0	.0	18
GYDR	6.2	9.0	68	15.3	15.7	52	4.2	4.5	48	5.3	11.5	91	10.6	11.9	75	15.0	.0	100	3.2	3.9	71
LYCOP	1.5	.7	28	4.0	2.0	58	1.2	1.0	26				2.0	2.0	36				2.7	8.0	42
POGL4				1.0	.0	10				1.0	.0	9	1.0	.0	4				1.0	.0	12
POLYS	1.0	.0	1				1.0	.0	3				1.0	.0	2						
PTAQ																			3.0	.0	6
THLI	1.0	.0	1										1.0	.0	4				1.0	.0	6
THPH	5.0	6.1	14	1.0	.0	5	1.0	.0	3	1.0	.0	18	2.8	4.0	22	3.0	.0	50			
GRAMINOIDS																					
AGROS	1.0	.0	1																		
CAAN5													1.0	.0	2						
CACA	1.0	.0	1																		
CAMA4													1.0	.0	2						
GRASS	4.6	5.9	8	3.0	.0	5	1.0	.0	9				1.0	.0	7				3.0	.0	6
LUPA							1.0	.0	3												
POA																			3.0	.0	6
SCCA2							3.0	.0	3												
SEDGES	1.0	.0	3	1.0	.0	5	2.0	1.0	6				2.0	1.0	9				2.3	1.2	18
TRISE							1.0	.0	3												

	WH-Y-Cedar/ Blueberry-Menziesia			Mxd Conifer/ Blueberry			Mxd Conifer/ Blueberry/ Skunk Cabbage			Mxd Conifer/ SkunkCabbage-Lady Fern			Mxd Conifer/ Blueberry/ Deer Cabbage			Mxd Conifer/ Copperbush		
# OF PLOTS		29			51			63			13			21			22	
TREES	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
Overstory																		
ALRU				2.0	1.4	4	15.0	.0	2	26.5	16.3	15	15.0	.0	5	1.0	.0	5
CHNO	29.2	18.9	100	16.9	11.7	51	23.2	15.8	52	23.6	11.9	62	18.2	9.6	86	18.9	13.6	77
PICO																1.7	1.2	14
PISI	4.9	5.3	52	4.7	5.2	61	10.0	7.5	71	9.3	11.1	85	4.1	4.7	67	3.7	5.6	27
SOSI				1.0	.0	6							1.0	.0	5	2.0	1.4	9
TSHE	44.2	15.5	100	18.9	12.6	94	22.6	14.7	90	16.6	13.3	100	6.8	6.0	86	4.5	4.7	59
TSME	3.0	.0	17	17.7	11.9	88	14.6	10.9	90	15.8	11.6	92	10.3	6.0	86	18.3	15.0	91
Understory																		
CHNOL	8.4	6.9	48	11.1	14.9	41	8.0	9.0	35	4.3	4.4	62	7.5	6.3	71	10.4	9.5	73
CHNOS	1.4	.9	17	2.6	3.3	33	3.0	4.3	30	2.0	1.1	46	7.5	6.7	57	3.4	4.6	73
PICOS				3.0	.0	2							2.0	1.4	10			
PISIL	3.7	4.4	31	2.0	1.0	51	6.2	7.8	62	2.0	1.1	46	3.2	3.7	62	1.7	1.0	27
PISIS	1.5	.9	69	1.4	.8	59	2.0	3.0	70	1.6	1.0	54	2.9	3.5	76	1.4	.9	41
SOSI				1.0	.0	6							1.0	.0	5	2.0	1.4	9
TSHEL	11.3	9.7	93	9.4	10.8	84	9.5	8.6	76	10.2	6.3	100	6.2	9.5	76	4.8	5.1	50
TSHES	3.4	4.8	100	2.9	3.5	82	3.2	4.1	79	3.2	4.0	85	1.3	.8	86	1.7	1.0	55
TSMEL	3.0	.0	7	7.3	6.2	71	8.5	8.5	83	14.9	10.8	62	10.8	9.1	86	7.4	6.2	82
TSMES	1.0	.0	10	1.6	.9	69	2.0	2.8	78	3.2	4.3	77	2.1	3.2	90	3.6	8.6	82
SHRUBS																		
ALSI				5.5	6.4	8	4.6	5.9	8							3.0	.0	23
CAME				3.0	.0	2							2.0	1.4	10	1.0	.0	5
CASTS				1.0	.0	2							3.0	.0	5	3.0	.0	5
CLPY				2.7	.8	14	7.0	7.3	8				4.0	3.9	48	27.7	15.9	100
EMNI				2.3	1.2	6	1.0	.0	2				12.9	12.8	33	26.4	24.4	23
KAPO													4.2	6.1	24	8.0	9.9	9
LEGR							1.0	.0	5				4.6	5.9	24	1.0	.0	5
LIBO2							1.0	.0	3				1.0	.0	5	1.0	.0	5
LUPE																1.0	.0	5
MEFE	42.3	9.6	100	22.8	18.4	94	22.0	18.2	94	12.9	9.6	100	18.1	15.3	100	8.3	8.8	100
OPHO	1.5	.9	66	2.5	3.4	33	2.1	2.6	48	15.3	16.5	77	1.0	.0	10	1.0	.0	9
PHGL				2.0	1.4	4	15.0	.0	2				6.3	7.6	14	2.2	1.1	23
RIBES							1.0	.0	3	1.0	.0	8						
RUSP	1.3	.8	21	4.4	5.1	33	2.3	2.6	48	3.5	4.8	62	1.4	.9	24	1.9	1.0	50
SARA				1.0	.0	2												
VACA							1.0	.0	2				8.8	16.3	24	9.0	8.5	9
VACCI	67.9	16.0	100	69.3	17.8	100	54.2	21.7	100	35.8	25.6	100	53.1	21.8	100	37.3	21.0	100
VACCINGT	2.6	1.1	100	3.7	1.1	100	3.6	.8	100	3.5	.8	100	2.9	.9	100	3.2	1.1	100
VAPA	1.6	1.0	34	3.4	4.2	20	4.8	5.5	16	3.0	.0	8	1.7	1.2	14	3.0	.0	5
VAUL													3.0	.0	5	15.0	.0	5
VAVI				10.2	6.6	10	9.0	8.5	3				9.3	7.2	33	2.3	1.2	14
VIED							1.0	.0	2	1.0	.0	8						
FORBS																		
ACDE2				1.0	.0	2				1.0	.0	8						
ACRU										1.0	.0	8						
CIAL							6.3	7.6	5	2.3	1.2	23						
CLUN	1.7	1.2	10	2.2	1.1	10	2.0	1.2	6	1.7	1.2	23						
COAS	5.4	5.2	93	7.6	6.1	94	10.0	8.8	100	7.5	6.2	100	9.8	8.8	100	7.5	8.9	100
COCA	9.3	9.9	100	9.2	10.3	100	9.8	7.9	100	7.5	6.2	100	14.8	12.4	81	9.3	9.1	86
COME	1.0	.0	21	1.0	.0	2	1.0	.0	2									
COSU3													14.8	16.5	19	15.0	.0	9
COTR2				1.0	.0	6	1.0	.0	5				1.2	.6	48	1.4	.9	23
DODEC							1.0	.0	2				1.0	.0	5	3.0	.0	5
EPILO							1.0	.0	2	1.0	.0	8						
EQUIS				1.0	.0	2	2.0	1.2	6	1.3	.8	54	3.0	.0	5			
ERPE				1.0	.0	6	2.0	1.1	10	6.3	7.6	23	6.3	6.8	29	1.8	1.1	23
FACR	1.0	.0	3	2.5	1.0	8	5.0	5.8	33	7.5	15.0	46	20.4	16.9	90	16.2	17.5	68
FRCA2																15.0	.0	5
GAAP							1.0	.0	2									
GAKA	1.0	.0	3				1.0	.0	2	1.0	.0	15				1.0	.0	5
GATR							1.0	.0	3	1.0	.0	15				1.0	.0	5
GECA4							1.0	.0	2				1.0	.0	5	1.0	.0	5
GEDO							1.0	.0	3				1.3	.8	29	1.0	.0	9
HABEN	1.0	.0	3	1.0	.0	2	1.0	.0	9	1.0	.0	46	1.0	.0	28	1.0	.0	24
HELA										1.0	.0	8						
HYMO	1.0	.0	3															
LEPY2							1.0	.0	2							1.0	.0	5
LICA3	1.0	.0	52	1.0	.0	20	1.2	.6	16	1.4	.9	38	1.0	.0	10	1.0	.0	18
LICO3	1.5	.9	90	1.4	.8	73	1.3	.8	76	1.2	.7	69	1.3	.7	67	1.2	.6	59
LYAM	1.2	.6	34	1.8	1.0	55	24.6	15.3	100	44.2	24.1	100	5.5	5.5	81	1.8	1.0	77
MADI2	4.0	5.5	55	4.1	5.3	33	2.4	3.1	32	4.4	5.7	77	1.4	.9	24			
MALAX				1.0	.0	2												
MITEL				1.0	.0	2				1.0	.0	23						
MOUN	1.0	.0	45	1.0	.0	16	1.0	.0	22	1.0	.0	8						
OSPU							1.0	.0	2	1.0	.0	8						
PRAL	1.7	1.0	21	3.0	.0	2	4.0	5.5	10	1.0	.0	38	1.0	.0	5			
PYSE	1.0	.0	14	1.4	.8	20	1.6	1.0	11	1.2	.7	69	1.0	.0	24	1.0	.0	27
RUCH							1.0	.0	3				9.0	8.5	10			
RUPE	5.4	5.7	97	8.9	7.4	100	10.1	7.9	100	5.5	5.8	92	3.5	4.2	90	4.3	4.7	91
SASI										1.0	.0	15	1.0	.0	10	1.0	.0	9
STREP	3.1	4.4	93	3.6	6.7	78	5.9	6.1	75	7.4	10.8	92	1.7	1.0	43	4.8	5.9	59
TITR	2.4	3.3	62	1.2	.7	49	3.7	6.5	67	9.1	11.2	85	2.3	1.2	14	1.2	.6	45
TIUN				3.0	.0	2										1.0	.0	5
TREU	1.0	.0	3				1.0	.0	5				1.0	.0	24	1.7	1.0	27
VASI							1.0	.0	2	1.0	.0	23						
VEVI	3.0	.0	7	1.7	1.0	22	3.0	4.0	35	2.6	.8	77	4.8	5.9	43	3.0	3.7	59
VIOLA	1.0	.0	14	1.0	.0	14	1.6	1.0	21	3.9	5.0	54	8.0	9.9	10	3.0	.0	5
FERNS																		
ATFI	1.3	.8	24	2.0	3.5	31	2.6	3.5	48	18.5	12.0	100	5.7	8.1	14	3.2	4.3	45
BLSP	7.2	6.6	69	9.6	11.6	78	6.6	6.2	75	5.3	5.9	92	8.2	9.8	86	11.4	10.7	95
DRAU2	1.7	1.0	41	1.7	1.0	27	1.5	.9	25	1.0	.0	15	1.0	.0	5	1.5	1.0	18
GYDR	13.2	14.0	69	3.8	4.9	39	3.3	3.6	60	8.5	11.6	77	1.5	1.0	19	1.7	1.2	14
LYCOP	2.0	.8	40	1.4	1.1	34	3.0	6.0	34	2.2	1.4	15	1.9	1.1	81	2.0	1.2	46
POGL4	1.0	.0	14				1.7	1.2	5				1.0	.0	5			

	WH-Y-Cedar/ Blueberry-Menziesia			Mxd Conifer/ Blueberry			Mxd Conifer/ Blueberry/ Skunk Cabbage			Mxd Conifer/ SkunkCabbage-Lady Fern			Mxd Conifer/ Blueberry/ Deer Cabbage			Mxd Conifer/ Copperbush		
OF PLOTS	29			51			63			13			21			22		
	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
RNS																		
POLYS																15.0	.0	5
POSE																		
PTAQ													3.0	.0	5	1.0	.0	5
THLI	1.0	.0	3	1.0	.0	2	3.0	.0	2				9.0	8.5	10	2.0	1.4	9
THPH	5.6	6.5	24	1.8	1.1	10	8.5	7.5	6	2.0	1.4	15	6.3	7.6	14	1.0	.0	9
RAMINOIDS																		
AGROS				1.0	.0	2	1.0	.0	2	15.0	.0	8	1.0	.0	5	1.0	.0	5
CAAN5				1.0	.0	4				1.0	.0	8	9.0	8.5	10	3.0	.0	14
CACA													1.0	.0	5	15.0	.0	5
CALES				1.0	.0	2	1.0	.0	2									
CAMA4				1.0	.0	2							9.0	8.5	10			
CAME2							1.0	.0	2	1.0	.0	8						
CANU3				6.0	8.0	4							3.0	.0	5	38.0	.0	5
CAPA2													1.0	.0	5			
CAPL													63.0	.0	5			
CASI3	1.0	.0	3															
ERIOP							1.0	.0	2							1.0	.0	5
FERU							1.7	1.2	5									
GRASS				1.0	.0	12	5.3	6.2	22	5.0	2.0	39	9.6	12.9	44	18.0	18.7	15
LUPA							1.0	.0	3									
POA				1.0	.0	2							1.0	.0	5			
SCCA2				1.0	.0	2							1.0	.0	10			
SEDGE	2.0	1.0	10	2.0	1.0	18	9.5	13.0	49	9.5	12.6	62	17.4	17.1	82	13.4	14.1	59
TRISE				1.0	.0	2	1.0	.0	2	1.0	.0	8						

	Shore Pine/ Crowberry			Shore Pine/ Sitka Sedge			M. Hemlock/ Blueberry			Spruce-M. Hemlock/ Blueberry			M. Hemlock/ Blueberry/ Deer Cabbage			M.Hemlock/ Copperbush-Cassiope			M. Hemlock/ Cassiope		
OF PLOTS	7			1			46			13			16			14			21		
REES	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
Overstory																					
CHNO	8.7	7.6	86				9.0	8.5	4	15.0	.0	8	3.0	.0	6	11.0	6.2	43	7.0	6.9	14
PICO	8.1	6.4	100	3.0	.0	100															
PISI				15.0	.0	100	8.1	8.3	63	27.5	15.6	100	6.6	6.4	56	7.0	6.9	21	2.2	1.1	24
SOSI							1.0	.0	11				1.5	1.0	25	1.0	.0	7	1.4	.9	24
TSHE	12.2	6.3	71	15.0	.0	100	14.3	9.6	43	13.7	19.4	69	3.0	.0	6				5.5	6.4	19
TSME	11.6	5.9	100	15.0	.0	100	37.9	15.6	100	30.2	16.2	100	35.4	14.7	100	21.6	10.8	100	25.0	14.0	100
Understory																					
CHNOL	12.5	14.0	86				9.0	8.5	4	9.0	8.5	15	1.0	.0	6	14.3	12.4	50	9.8	7.2	24
CHNOS	12.6	15.6	71				1.0	.0	4	1.0	.0	8				4.5	7.0	29	14.4	14.7	24
PICOL	2.0	1.1	86																		
PICOS	1.0	.0	57																		
PISIL	1.0	.0	43				2.3	1.0	50	2.3	1.0	69	4.0	5.5	38	1.8	1.1	36	1.8	1.0	38
PISIS	1.0	.0	43	3.0	.0	100	1.1	.5	63	1.2	.7	69	1.3	.7	50	1.0	.0	14	1.0	.0	38
SOSI							1.0	.0	11				1.5	1.0	25	1.0	.0	7	1.4	.9	24
TSHEL	4.6	5.9	71	15.0	.0	100	3.8	3.9	43	7.8	6.4	92	2.3	1.2	19	2.0	1.4	14	2.3	1.2	14
TSHES	2.0	1.2	57	3.0	.0	100	2.0	3.0	48	1.6	1.0	77	1.5	1.0	25				1.0	.0	14
TSMEL	9.0	6.6	86	3.0	.0	100	10.2	10.8	89	7.8	6.4	92	8.0	6.4	100	14.8	17.7	93	11.2	10.9	95
TSMES	6.7	6.5	86	1.0	.0	100	2.3	3.1	85	2.8	4.4	77	2.6	3.7	88	1.4	.8	79	4.6	5.6	90
HRUBS																					
ALSI							3.0	.0	7	3.0	.0	15							1.0	.0	10
ANPO																1.0	.0	7			
CAME	15.0	.0	14										1.0	.0	6	7.7	7.0	64	12.2	16.8	76
CAST5	15.0	.0	14													5.5	5.9	57	13.2	14.3	48
CLPY	17.3	15.3	57				1.4	.9	20				3.0	.0	6	40.6	16.9	79	25.8	32.0	29
EMNI	47.3	22.8	100	1.0	.0	100							1.0	.0	6	19.5	26.2	14	18.7	15.9	29
KAPO	11.3	17.9	57																9.4	7.7	24
LEGR	4.6	5.9	71																		
LIBO2	15.0	.0	14																		
LUPE													4.2	6.1	31	12.0	15.6	36	11.4	12.6	38
MEFE	16.0	16.1	100	38.0	.0	100	5.8	7.8	70	4.8	5.5	77	5.5	6.1	69	6.7	11.1	79	7.7	6.5	57
OPHO							5.3	8.3	57	4.2	5.8	77	3.7	5.6	38	3.8	6.3	36	1.0	.0	14
PHGL	11.3	17.9	57				38.0	.0	4							9.3	11.9	71	15.5	20.3	48
RIBES							1.0	.0	2				3.0	.0	6						
RUSP							2.9	3.8	54	5.7	8.1	23	1.9	1.1	56	4.0	5.5	43	4.2	6.1	24
SARA							1.0	.0	2	3.0	.0	8									
VACA	23.5	17.4	57							1.0	.0	8				7.2	15.1	43	6.1	6.1	33
VACCI	34.5	17.9	86	63.0	.0	100	54.4	22.3	100	43.9	25.7	100	61.0	18.2	100	27.8	22.6	93	31.8	22.2	100
VACCIHGT	2.3	1.0	86	3.0	.0	100	3.3	.8	100	2.8	1.0	100	3.5	.9	100	2.7	.7	79	2.6	1.1	100
VAOX	10.3	8.1	43																		
VAPA	8.0	9.9	29				1.0	.0	4	15.0	.0	8	1.0	.0	6						
VAUL	1.0	.0	14													1.0	.0	7	15.0	.0	5
VAVI	19.6	10.3	71	15.0	.0	100															
FORBS																					
ACDE2																1.0	.0	7			
ARSY							1.0	.0	2							1.0	.0	7			
ASTER																			1.0	.0	5
CERAS																			1.0	.0	5
ACRU										1.0	.0	8									
CIAL							3.0	.0	2												
CLUN																1.0	.0	7			
COAS	2.5	1.0	57	15.0	.0	100	5.2	8.7	80	5.9	11.3	77	4.7	4.6	81	2.5	.9	93	8.3	6.6	81
COCA	15.0	.0	43				4.0	4.2	74	3.0	3.7	100	2.1	1.0	69	6.4	10.3	100	16.7	19.6	57
COSU3	15.0	.0	57	15.0	.0	100													8.0	9.9	10
COTR2	5.7	8.1	43	15.0	.0	100										1.0	.0	7	9.0	8.5	10
DEGL							3.0	.0	2												
DODEC													1.0	.0	13	1.0	.0	14	1.0	.0	5
DROSE																			3.0	.0	5
EPAL													2.0	1.4	13				2.3	1.2	14
EPILO							2.0	1.4	4							2.0	1.4	14	2.0	1.4	10
EPLA													1.0	.0	6						

	Shore Pine/ Crowberry			Shore Pine/ Sitka Sedge			M. Hemlock/ Blueberry			Spruce- M. Hemlock/ Blueberry			M. Hemlock/ Blueberry/ Deer Cabbage			M.Hemlock/ Copperbush- Cassiope			M. Hemlock/ Cassiope		
# OF PLOTS	7			1			46			13			16			14			21		
	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS	COVER	SD	CONS
FORBS																					
EQUIS				1.0	.0	100													1.0	.0	5
ERPE				1.0	.0	100							2.0	1.4	13	1.8	1.0	57	7.0	6.7	38
FACR	30.0	29.2	100	3.0	.0	100	1.9	1.1	15	1.0	.0	8	7.1	9.7	100	19.3	14.9	86	28.8	18.2	76
GATR							1.0	.0	2												
GECA4																1.0	.0	29			
GEDO	1.0	.0	29													2.0	1.4	14	1.0	.0	5
GEER																1.0	.0	7			
HABEN							1.0	.0	2				1.0	.0	6	1.0	.0	36	1.0	.0	5
HEGL2																			1.0	.0	5
HELA										1.0	.0	8				1.0	.0	14			
HIGR													1.0	.0	6						
HIMO							1.0	.0	2				1.0	.0	13				2.5	1.0	19
HYMO							1.0	.0	2												
LICA3	1.0	.0	14				1.0	.0	15				1.0	.0	6	1.0	.0	14			
LICO3	1.0	.0	43	1.0	.0	100	1.2	.6	76	1.8	1.0	77	1.3	.7	94	1.3	.8	43	1.0	.0	71
LYAM	1.5	1.0	57	15.0	.0	100	1.7	1.0	13	2.0	1.4	15	1.9	1.1	44	7.0	6.9	21	2.0	1.1	38
MADI2	1.0	.0	14	3.0	.0	100	1.0	.0	4	3.0	.0	8	1.0	.0	6	1.0	.0	7	1.0	.0	10
MITEL																			1.0	.0	5
MOUN							1.3	.7	17	1.0	.0	31	1.0	.0	6				1.0	.0	5
OSPU							1.0	.0	2				1.0	.0	6				3.0	.0	5
PAFI																			1.0	.0	5
PEFR2																			1.0	.0	5
PIVU																1.0	.0	7			
PRAL							1.0	.0	2				1.0	.0	6	1.0	.0	7	1.0	.0	5
PYSE	1.0	.0	29				1.0	.0	2							1.0	.0	7			
RANUN																			1.0	.0	5
RUCH	1.0	.0	14							1.0	.0	8									
RUPE	5.0	6.7	57	15.0	.0	100	9.6	10.5	98	7.5	6.2	100	8.6	6.2	94	3.5	3.7	86	8.3	6.6	90
SAFE													1.0	.0	6				1.0	.0	5
SASI	1.0	.0	14										1.0	.0	6	1.0	.0	7	2.0	1.4	10
STREP							4.8	8.9	80	6.0	6.3	77	5.8	6.4	63	3.3	4.8	57	4.3	4.4	38
TITR							2.9	3.4	67	2.0	1.1	77	2.1	1.0	69	4.2	6.1	36	8.9	13.8	33
TIUN							2.0	1.1	17				1.0	.0	13	1.0	.0	7	2.3	1.2	14
TOGL																1.0	.0	7			
TREU	1.0	.0	29													1.0	.0	21	1.0	.0	19
VASI							1.7	1.0	13				3.0	.0	6	1.0	.0	14	5.5	6.4	19
VEVI				3.0	.0	100	2.5	3.1	43	8.5	7.5	31	2.8	3.8	81	6.5	6.8	79	8.1	11.1	57
VIOLA							1.3	.7	17	1.0	.0	15				2.0	1.4	14	4.6	5.9	24
FERNS																					
ATFI							8.7	7.0	33	8.0	8.1	31	2.6	.8	63	10.0	21.4	57	3.5	4.8	38
BLSP	9.8	7.2	71				7.8	7.8	78	16.4	9.7	62	5.2	6.0	75	9.9	22.1	100	5.1	5.4	67
DRAU2							3.2	3.7	78	3.2	3.9	92	1.8	1.0	50	1.0	.0	21	1.0	.0	10
GYDR							2.5	3.0	46	5.9	6.3	54	1.4	.9	31	2.5	1.0	29	6.3	7.6	14
LYCOP	4.5	7.0	72	3.0	.0	100	1.0	.0	10	2.0	.0	24	3.0	.0	6	1.0	.0	28	1.0	.0	10
POLYS																1.0	.0	7	1.0	.0	5
PTAQ	9.0	8.5	29																		
THLI							8.5	7.5	9	1.0	.0	8							20.5	24.7	10
THPH							1.4	.9	11	2.0	1.2	31				3.0	.0	14	1.0	.0	5
GRAMINOIDS																					
AGROS	1.0	.0	14										1.0	.0	6	1.0	.0	14	1.0	.0	19
CAAN5																8.0	9.9	14	5.0	6.7	19
CACA																			3.0	.0	10
CAMA4																			8.0	9.9	10
CAME2							1.0	.0	4												
CANI2													1.0	.0	6	1.0	.0	7	8.3	8.1	14
CAPL																			3.0	.0	5
CASI3	5.0	.0	14	38.0	.0	100										1.0	.0	7			
DEAT							1.0	.0	4				1.0	.0	13	1.0	.0	21	1.5	1.0	19
ERIOP	15.0	.0	14										3.0	.0	45	1.9	1.4	63	1.9	1.2	48
GRASS	1.0	.0	14				1.0	.0	13	3.0	.0	8	2.0	1.4	45				1.0	.0	19
JUNCU							1.0	.0	2										1.5	.7	10
LUPA							1.0	.0	7										1.0	.0	5
POA													1.0	.0	13	1.7	1.2	21			
SCCA2	5.0	.0	14													61.5	33.2	14			
SEDGE	6.0	13.9	86	26.5	16.3	100	1.0	.0	13	2.0	1.2	31	6.3	6.8	37	15.3	22.9	100	9.0	8.9	100
TRISE							1.0	.0	2							3.0	.0	7			

APPENDIX 3. HEIGHT, DIAMETER, AND VOLUME DATA FOR TREE SPECIES BY PLANT ASSOCIATION

Table A3-1. Height, Diameter, and Volume Data by Tree Species by Plant Association

Plant Association	Sample Size	Height (ft.)	Height (m)	SD** (ft.)	SD** (m)	Sitka Spruce DBH (in.)	DBH (cm)	SD (in.)	SD (cm)	Gross Vol. (mbf)	SD (mbf)
WESTERN HEMLOCK/											
Blueberry/shield fern	53	117	36	24	7	29	73	10	26	155	116
Blueberry-devil's club	17	126	38	23	7	32	80	13	32	204	188
Devil's club	5	137	42	25	8	36	91	12	30	270	207
Devil's club-shallow soils	9	88	27	27	8	22	56	6	15	76	34
Blueberry-menziesia	8	97	30	14	4	23	59	8	20	79	63
Blueberry	41	94	29	21	6	24	61	8	21	79	59
Blueberry/skunk cabbage	9	96	29	21	6	24	60	14	34	92	120
Devil's club/skunk cabbage	10	88	27	22	7	22	56	6	15	66	43
WESTERN HEMLOCK-YELLOWCEDAR/											
Blueberry-devil's club	1	120	37	0	0	26	66	0	0	100	0
Blueberry-menziesia	10	85	26	16	5	17	44	5	13	32	24
Blueberry	16	89	27	29	9	22	55	6	16	61	42
Blueberry/skunk cabbage	4	85	26	39	12	19	49	8	19	65	38
MIXED CONIFER/											
Blueberry	9	69	21	21	6	19	49	8	21	39	54
Copperbush											
Blueberry/deer cabbage	3	53	16	5	1	11	27	2	5	5	2
Blueberry/skunk cabbage	27	71	22	22	7	19	47	7	17	40	32
Skunk cabbage-lady fern	8	77	24	21	6	23	59	9	22	70	42
SHORE PINE/											
Crowberry											
Sitka sedge	1	50	15	0	0	14	36	0	0	9	0
MOUNTAIN HEMLOCK/											
Blueberry	6	86	26	32	10	24	60	12	30	90	130
Blueberry/deer cabbage	4	63	19	25	7	21	53	8	21	37	37
Copperbush-cassiope											
Cassiope	2	65	20	7	2	18	46	7	18	24	21
SITKA SPRUCE/											
Red alder/salmonberry	1	116	35	0	0	23	59	0	0	98	0
Sitka alder	1	158	48	0	0	37	95	0	0	343	0
Devil's club/skunk cabbage	13	116	35	27	8	27	68	6	15	135	83
Devil's club-salmonberry	3	107	33	10	3	30	76	6	14	182	44
Devil's club	17	137	42	19	6	37	93	11	28	295	188
Blueberry-devil's club	14	138	42	29	9	33	84	8	21	248	179
Blueberry	5	138	42	18	6	33	85	6	14	212	66
Blueberry/skunk cabbage	3	84	26	10	3	24	62	5	11	72	26
Pacific reedgrass	2	103	31	21	6	23	58	2	6	69	29
Devil's club-upland	3	114	35	27	8	34	85	16	40	217	234
Mountain hemlock/blueberry	11	100	31	23	7	27	69	10	26	123	116

*Sample size shown for height and diameter data; it may be different for volume data; **SD = standard deviation

Table A3-1. Height, Diameter, and Volume Data by Tree Species by Plant Association, continued

Plant Association	Western Hemlock										
	Sample Size	Height		SD		DBH		SD		Gross Vol.	SD
		(ft.)	(m)	(ft.)	(m)	(in.)	(cm)	(in.)	(cm)	(mbf)	(mbf)
WESTERN HEMLOCK/											
Blueberry/shield fern	131	112	34	14	4	25	64	5	13	112	60
Blueberry-devil's club	36	118	36	16	5	27	69	5	14	133	67
Devil's club	10	117	36	15	4	29	75	7	18	160	95
Devil's club-shallow soils	18	82	25	12	4	20	51	5	13	49	32
Blueberry-menziesia	20	81	25	12	4	18	45	3	8	36	17
Blueberry	66	84	26	13	4	20	50	5	11	48	28
Blueberry/skunk cabbage	17	85	26	21	6	19	47	5	12	46	34
Devil's club/skunk cabbage	11	74	23	17	5	20	50	6	14	44	35
WESTERN HEMLOCK-YELLOWCEDAR/											
Blueberry-devil's club	2	50	15	21	6	12	31	8	21	22	0
Blueberry-menziesia	29	87	26	15	5	19	47	5	11	48	38
Blueberry	47	81	25	17	5	20	50	5	12	48	27
Blueberry/skunk cabbage	16	77	23	16	5	16	39	3	8	25	13
MIXED CONIFER/											
Blueberry	29	59	18	17	5	14	37	6	14	20	24
Copperbush	4	38	11	30	9	11	28	5	13	14	0
Blueberry/deer cabbage	6	33	10	9	3	10	26	4	10	7	9
Blueberry/skunk cabbage	36	59	18	18	6	14	37	5	11	20	16
Skunk cabbage-lady fern	9	56	17	25	8	16	40	6	15	37	25
SHORE PINE/											
Crowberry	3	38	12	20	6	13	32	6	14	12	10
Sitka sedge	1	20	6	0	0	8	20	0	0		
MOUNTAIN HEMLOCK/											
Blueberry	8	82	25	23	7	19	47	7	17	42	40
Blueberry/deer cabbage											
Copperbush-cassiope											
Cassiope	4	41	12	8	2	13	32	4	9	7	0
SITKA SPRUCE/											
Red alder/salmonberry	1	105	32	0	0	21	53	0	0	56	0
Sitka alder											
Devil's club/skunk cabbage	11	81	25	29	9	17	42	5	12	40	37
Devil's club-salmonberry	3	86	26	18	5	20	50	5	12	50	32
Devil's club	13	97	30	29	9	23	59	8	21	99	82
Blueberry-devil's club	13	114	35	20	6	26	66	4	11	115	46
Blueberry	5	102	31	39	12	20	52	6	15	77	55
Blueberry/skunk cabbage	3	67	20	21	7	17	43	5	12	27	21
Pacific reedgrass	1	82	25	0	0	18	46	0	0	38	0
Devil's club-upland	3	105	32	14	4	23	57	4	10	76	51
Mountain hemlock/blueberry	7	90	27	30	9	21	53	11	27	87	88

Table A3-1. Height, Diameter, and Volume Data by Tree Species by Plant Association, continued

Plant Association	Mountain Hemlock Sample Size*	Height (ft.)	Height (m)	SD (ft.)	SD (m)	DBH (in.)	DBH (cm)	SD (in.)	SD (cm)	Gross Vol. (mbf)	SD (mbf)
WESTERN HEMLOCK/											
Blueberry/shield fern	9	97	30	31	9	21	53	8	20	77	47
Blueberry-devil's club	1	138	42	0	0	35	88	0	0	212	0
Devil's club											
Devil's club-shallow soils	2	83	25	25	8	29	74	1	4	81	38
Blueberry-menziesia	1	120	37	0	0	21	53	0	0	64	0
Blueberry	11	81	25	25	8	22	55	7	19	68	29
Blueberry/skunk cabbage	1	83	25	0	0	21	53	0	0	65	0
Devil's club/skunk cabbage	4	56	17	14	4	16	39	7	17	14	3
WESTERN HEMLOCK-YELLOWCEDAR/											
Blueberry-devil's club											
Blueberry-menziesia	3	80	24	15	5	23	59	9	24	59	49
Blueberry	8	103	31	18	5	21	54	4	9	59	26
Blueberry/skunk cabbage	3	65	20	48	15	12	30	10	25	38	47
MIXED CONIFER/											
Blueberry	25	61	19	17	5	16	41	4	11	21	17
Copperbush	12	51	15	20	6	15	38	5	13	16	15
Blueberry/deer cabbage	8	39	12	14	4	10	25	3	8	6	4
Blueberry/skunk cabbage	30	66	20	19	6	17	43	5	14	29	22
Skunk cabbage-lady fern	11	59	18	20	6	15	39	5	12	20	13
SHORE PINE/											
Crowberry	3	36	11	14	4	11	27	4	10	6	3
Sitka sedge											
MOUNTAIN HEMLOCK/											
Blueberry	24	69	21	15	5	18	46	4	9	28	19
Blueberry/deer cabbage	9	42	13	13	4	15	39	5	11	17	16
Copperbush-cassiope	8	53	16	16	5	18	45	4	10	20	14
Cassiope	11	33	10	13	4	14	36	6	15	10	11
SITKA SPRUCE/											
Red alder/salmonberry											
Sitka alder											
Devil's club/skunk cabbage											
Devil's club-salmonberry											
Devil's club											
Blueberry-devil's club											
Blueberry											
Blueberry/skunk cabbage											
Pacificreed grass											
Devil's club-upland	1	65	20	0	0	18	46	0	0	21	0
Mountain hemlock/blueberry	11	80	24	20	6	19	49	5	12	41	29

Table A3-1. Height, Diameter, and Volume Data by Tree Species by Plant Association, continued

Plant Association	Sample Size	Height (ft.)	Height (m)	SD (ft.)	SD (m)	Yellowcedar DBH (in.)	Yellowcedar DBH (cm)	SD (in.)	SD (cm)	Gross Vol. (mbf)	SD (mbf)
WESTERN HEMLOCK/											
Blueberry/shield fern	11	100	30	11	3	24	62	8	20	82	58
Blueberry-devil's club	1	118	36	0	0	27	69	0	0	101	0
Devil's club											
Devil's club-shallow soils											
Blueberry-menziesia											
Blueberry	5	65	20	35	11	13	32	6	15	29	28
Blueberry/skunk cabbage											
Devil's club/skunk cabbage											
WESTERN HEMLOCK-YELLOWCEDAR/											
Blueberry-devil's club	2	79	24	1	0.4	21	53	3	7	43	7
Blueberry-menziesia	29	86	26	21	6	18	46	5	13	44	28
Blueberry	46	78	24	18	6	19	49	6	14	42	40
Blueberry/skunk cabbage	17	81	25	15	5	17	44	5	11	32	21
MIXED CONIFER/											
Blueberry	18	64	19	15	5	15	39	4	9	21	13
Copperbush	11	53	16	26	8	16	41	9	22	31	63
Blueberry/deer cabbage	14	46	14	15	5	13	34	5	14	13	16
Blueberry/skunk cabbage	24	64	19	16	5	15	38	6	16	23	32
Skunk cabbage-lady fern	7	67	21	12	4	16	40	7	19	30	30
SHORE PINE/											
Crowberry	4	34	10	12	4	12	31	4	10	5	7
Sitka sedge											
MOUNTAIN HEMLOCK/											
Blueberry	1	80	24	0	0	19	48	0	0	31	0
Blueberry/deer cabbage											
Copperbush-cassiope	3	55	17	18	5	15	38	4	11	20	4
Cassiope	1	53	16	0	0	14	36	0	0	9	0
SITKA SPRUCE/											
Red alder/salmonberry											
Sitka alder											
Devil's club/skunk cabbage											
Devil's club-salmonberry											
Devil's club											
Blueberry-devil's club											
Blueberry	1	50	15	0	0	25	64	0	0		
Blueberry/skunk cabbage											
Pacificreed grass											
Devil's club-upland											
Mountain hemlock/blueberry											

Table A3-1. Height, Diameter, and Volume Data by Tree Species by Plant Association, continued

Plant Association	Sample Size	Height (ft.)	Height (m)	SD (ft.)	SD (m)	Shore Pine DBH (in.)	DBH (cm)	SD (in.)	SD (cm)	Gross Vol. (mbf)	SD (mbf)
WESTERN HEMLOCK/											
Blueberry/shield fern											
Blueberry-devil's club											
Devil's club											
Devil's club-shallow soils											
Blueberry-menziesia											
Blueberry											
Blueberry/skunk cabbage											
Devil's club/skunk cabbage											
WESTERN HEMLOCK-YELLOWCEDAR/											
Blueberry-devil's club											
Blueberry-menziesia											
Blueberry	1	80	24	0	0	21	53	0	0	38	0
Blueberry/skunk cabbage											
MIXED CONIFER/											
Blueberry											
Copperbush											
Blueberry/deer cabbage	1	63	19	0	0	13	33	0	0	10	0
Blueberry/skunk cabbage											
Skunk cabbage-lady fern											
SHORE PINE/											
Crowberry	3	43	13	6	2	11	27	1	3	4	1
Sitka sedge	1	50	15	0	0	19	48	0	0	16	0
MOUNTAIN HEMLOCK/											
Blueberry											
Blueberry/deer cabbage											
Copperbush-cassiope											
Cassiope											
SITKA SPRUCE/											
Red alder/salmonberry											
Sitka alder											
Devil's club/skunk cabbage											
Devil's club-salmonberry											
Devil's club											
Blueberry-devil's club											
Blueberry											
Blueberry/skunk cabbage											
Pacific reedgrass											
Devil's club-upland											
Mountain hemlock/blueberry											

APPENDIX 4. ENVIRONMENTAL AND MANAGEMENT IMPLICATIONS RELATED DATA FOR PLANT ASSOCIATIONS

Table A4-1. Frequency of Drainage and Slope Classes by Plant Association

Plant Association	Drainage Class					Total	Slope Class (%)					Total
	Very Poorly	Poorly	Smwt. Poorly	Mod. Well	Well	Occurrences	0-15	16-35	36-55	56-75	76+	Occurrences
WESTERN HEMLOCK/												
Blueberry/shield fern	1	4	15	53	85	158	15	15	17	79	32	158
Blueberry-devil's club		1	3	13	29	46	4	11	1	21	9	46
Devil's club			2	2	8	12	1	2	1	7	1	12
Devil's club-shallow soils	1	3	8	9	9	30	1	1	4	16	9	31
Blueberry-menziesia	2	1	6	5	6	20		7	5	7	2	21
Blueberry	2	6	33	22	19	82	4	12	19	38	10	83
Blueberry/skunk cabbage	8	10	10		1	29	1	14	10	4		29
Devil's club/skunk cabbage	3	5	2		1	11		4	1	5	1	11
Total Occurrences	17	30	79	104	158	388	26	66	58	177	64	391
WESTERN HEMLOCK-YELLOWCEDAR/												
Blueberry-devil's club			1	1		2		1		1		2
Blueberry-menziesia	3	2	9	7	5	26		1	12	8	5	26
Blueberry		5	29	10	7	51	1	3	16	26	5	51
Blueberry/skunk cabbage	4	7	5	1		17	1	7	6	3		17
Total Occurrences	7	14	44	19	12	96	2	12	34	38	10	96
MIXED CONIFER/												
Blueberry	3	10	19	7	9	48	1	6	26	8	7	48
Copperbush	2	6	11	2		21	1	5	12		3	21
Blueberry/deer cabbage	5	9	5	1		20		9	8	2	1	20
Blueberry/skunk cabbage	25	31	5	1	1	63		27	23	13		63
Skunk cabbage-lady fern	7	5	1			13	1	6	3	2	1	13
Total Occurrences	42	61	41	11	10	165	3	53	72	25	12	165
SHORE PINE/												
Crowberry	2	3	1			6		4	2			6
Sitka sedge	1					1		1				1
Total Occurrences	3	3	1	0	0	7	0	5	2	0	0	7
MOUNTAIN HEMLOCK/												
Blueberry	1	2	7	13	14	37		3	15	10	17	45
Blueberry/deer cabbage		3	4	3	4	14		1	6	3	5	15
Copperbush-cassiope	2		5	5	2	14	1		6	3	4	14
Cassiope	3	4	5	5	4	21		3	10	6	2	21
Total Occurrences	6	9	21	26	24	86	1	7	37	22	28	95
SITKA SPRUCE/												
Red alder/salmonberry	1		1		2	4	3		1			4
Sitka alder					4	4	4					4
Devil's club/skunk cabbage	5	4	2		4	15	8	7	1			16
Devil's club/salmonberry		1		1	3	5	4	1				5
Devil's club			2	3	14	19	12	6	1		1	20
Blueberry-devil's club			2	3	11	16	9	6		1		16
Blueberry				2	6	8	4	4				8
Blueberry/skunk cabbage	2	2	1			5	2	1		1	1	5
Pacific reedgrass				1	1	2		1		1		2
Devil's club-upland				1	2	3					3	3
Mountain hemlock/blueberry			1	2	9	12			1	6	5	12
Total Occurrences	8	7	9	13	56	93	46	26	4	9	10	95

Table A4-2. Frequency of Aspect Classes by Plant Association

Plant Association	Sample Size	Flat	N	NE	E	SE	S	SW	W	NW	Range (degrees)
WESTERN HEMLOCK/											
Blueberry/shield fern	158	8	18	16	27	23	16	21	14	15	0-360
Blueberry-devil's club	46	2	8	8	5	5	2	3	5	8	0-350
Devil's club	12	1		3	1	1	2	2	2		0-262
Devil's club-shallow soils	31		4	8	7	1	4	3	2	2	10-360
Blueberry-menziesia	20		1	4	2	4	3	2	4		20-285
Blueberry	83		9	18	15	9	11	11	6	4	10-360
Blueberry/skunk cabbage	29	2	5	4	3	4	3	5	1	2	0-360
Devil's club/skunk cabbage	11		1	1	1	2	1	1	1	3	10-320
TOTAL		13	46	62	61	49	42	48	35	34	
WESTERN HEMLOCK-YELLOWCEDAR/											
Blueberry-devil's club	2				1	1					104-140
Blueberry-menziesia	26		3	4	3	5	5	1	3	2	10-352
Blueberry	51			5	6	10	11	9	6	4	25-330
Blueberry/skunk cabbage	17		2	3	2	3	3		2	2	20-350
TOTAL		0	5	12	12	19	19	10	11	8	
MIXED CONIFER/											
Blueberry	48	1	8	3	3	11	7	7	3	5	0-360
Copperbush	21		4	5	1	3	4	2	2		5-348
Blueberry/deer cabbage	20		5	3		2	4	3	2	1	5-355
Blueberry/skunk cabbage	63	3	9	8	11	5	8	4	7	8	0-360
Skunk cabbage-lady fern	13		1	2		3	1	2	1	3	35-320
TOTAL		4	27	21	15	24	24	18	15	17	
SHORE PINE/											
Crowberry	6	1	1			1	1			2	0
Sitka sedge	1	1									0-360
TOTAL		2	1	0	0	1	1	0	0	2	
MOUNTAIN HEMLOCK/											
Blueberry	45		9	3	4	8	9	8	2	2	5-360
Blueberry/deer cabbage	15		1	3	7	3		1			10-215
Copperbush-cassiope	13	1	2	3	3	2	1			1	0-330
Cassiope	21		4	2	3	2	3	1	4	2	5-340
TOTAL		1	16	11	17	15	13	10	6	5	
SITKA SPRUCE/											
Red alder/salmonberry	4	2			1		1				0-180
Sitka alder	4	3				1					0-140
Devil's club/skunk cabbage	16	9	2	1	1		1	2			0-355
Devil's club-salmonberry	5	3				1		1			0-220
Devil's club	20	10		1	1	2	1	3	1	1	0-295
Blueberry-devil's club	16	3	3		3	4	1	1	1		0-350
Blueberry	8	1	2	1	2			1		1	0-355
Blueberry/skunk cabbage	5	1	1				1	1	1		0-250
Pacific reedgrass	2						1	1			180-236
Devil's club-upland	3						1		2		175-270
Mountain hemlock/blueberry	12		2	3	1	3	2		1		35-360
TOTAL		32	10	6	9	11	9	10	6	2	

Table A4-3. Frequency of Elevation Classes by Plant Association

Plant Association	Sample Size	Elevation Classes (feet) 0-200	201-500	501-1000	1001-1500	1501-2000	2001-3000	Min. (ft.)	Min. (m)	Max. (ft.)	Max. (m)	Mean (feet)	Mean (m)	Std. Dev. (feet)	Std. Dev. (m)
		Elevation Classes (meters) 0-61	61-153	153-305	305-458	458-610	610-915								
WESTERN HEMLOCK/															
Blueberry/shield fern	162	26	41	70	23	2		20	6	1720	525	621	189	375	114
Blueberry-devil's club	48	9	15	22	2			30	9	1420	433	529	161	317	97
Devil's club	12	3	4	4	1			50	15	1110	339	417	127	292	89
Devil's club-shallow soils	31	2	11	12	5	1		40	12	1610	491	649	198	361	110
Blueberry-menziesia	21	4	9	6	2			50	15	1420	433	501	153	360	110
Blueberry	89	9	28	36	12	4		30	9	1680	512	677	206	387	118
Blueberry/skunk cabbage	30	11	11	7	1			30	9	1250	381	372	113	316	96
Devil's club/skunk cabbage	11	4	5	2				50	15	740	226	343	105	233	71
TOTAL		68	124	159	46	7	0								
WESTERN HEMLOCK-YELLOWCEDAR/															
Blueberry-devil's club	2	1	1					100	31	280	85	190	58	127	39
Blueberry-menziesia	27	4	12	11				30	9	940	287	465	142	261	80
Blueberry	54	4	18	26	5			70	21	1500	458	653	199	320	98
Blueberry/skunk cabbage	17	7	6	3	1			40	12	1450	442	412	126	366	112
TOTAL		16	37	40	6	0	0								
MIXED CONIFER/															
Blueberry	51	2	15	25	9			150	46	1500	458	711	217	330	101
Copperbush	22	2	5	8	6	1		80	24	1710	522	752	229	413	126
Blueberry/deer cabbage	21	3	10	8				100	31	920	281	469	143	213	65
Blueberry/skunk cabbage	63	11	20	24	8			10	3	1500	458	550	168	358	109
Skunk cabbage-lady fern	13	2	1	9	1			50	15	1300	397	667	203	344	105
TOTAL		20	51	74	24	1	0								
SHORE PINE/															
Crowberry	6	2	3		1			100	31	1050	320	359	109	355	108
Sitka sedge	1	1						200	61	200	61	200	61	0	0
TOTAL		3	3	0	1	0	0								
MOUNTAIN HEMLOCK/															
Blueberry	47			7	20	13	7	700	214	2850	869	1483	452	434	132
Blueberry/deer cabbage	16				7	6	3	1050	320	2360	720	1602	489	441	135
Copperbush-cassiope	14				8	5	1	1200	366	2180	665	1575	480	270	82
Cassiope	21			2	9	3	7	880	268	2400	732	1627	496	489	149
TOTAL		0	0	9	44	27	18								
SITKA SPRUCE/															
Red alder/salmonberry	4	3	1					25	8	260	79	151	46	98	30
Sitka alder	4	1	3					60	18	450	137	290	88	166	51
Devil's club/skunk cabbage	16	10	6					30	9	500	153	215	66	159	48
Devil's club-salmonberry	5	2	2	1				100	31	700	214	312	95	246	75
Devil's club	20	14	4	2				10	3	580	177	173	53	174	53
Blueberry-devil's club	17	10	3	3	1			20	6	1220	372	351	107	369	113
Blueberry	8	3	3	2				20	6	650	198	330	101	249	76
Blueberry/skunk cabbage	5	2	2	1				125	38	950	290	393	120	335	102
Pacific reedgrass	2	2						10	3	105	32	58	18	67	20
Devil's club-upland	3		2			1		380	116	1700	519	823	251	759	231
Mountain hemlock/blueberry	13				7	5	1	1080	329	2160	659	1569	479	380	116
TOTAL		47	26	9	8	6	1								

Table A4-4. Frequency of Landforms by Plant Association
(see Table A4-5 for key to landform codes)

Plant Association	12	30	31	32	35	36	37	42	43	44	45	51	52	53	61	62	74	Total
	Alpine			Mountainslopes					Hillslopes				Alluvial		Lowlands		Coastal	
WESTERN HEMLOCK/																		
Blueberry/shield fern		3	7	18	29	58		4	3	4	3	10	14	1	1	3		158
Blueberry-devil's club			2	4	8	16				1		3	10	2				46
Devil's club			1	1	3	2			1		1	1	2					12
Devil's club-shallow soils		1	1	3	7	11		1		3	2	2						31
Blueberry-menziesia		1	1	2	2	5		3		1			1		5			21
Blueberry			3	8	12	34	1	3	3		4	3	5	1	6			83
Blueberry/skunk cabbage					1	5		3		2	2	2	3	1	10			29
Devil's club/skunk cabbage				1	1	3		1				1	1		2		1	11
WESTERN HEMLOCK-YELLOWCEDAR/																		
Blueberry-devil's club					1								1					2
Blueberry-menziesia			2	2	3	12		4			1		1				1	26
Blueberry		2	4	4	11	22		2	1	2	1		1		1			51
Blueberry/skunk cabbage				1	2	2		1		3		2	4		2			17
MIXED CONIFER/																		
Blueberry		3	3	4	5	15		5		4	4	3			2			48
Copperbush		1	1			15		1			1				2			21
Blueberry/deer cabbage			1		1	9		1			2		1		4	1		20
Blueberry/skunk cabbage				3	5	27		1		1	2	7			17			63
Skunk cabbage-lady fern					2	7						1	1		2			13
SHORE PINE/																		
Crowberry						3		1							2			6
Sitka sedge																1		1
MOUNTAIN HEMLOCK/																		
Blueberry	6	10	1	3	8	17												45
Blueberry/deer cabbage	2	5			3	3				1						1		15
Copperbush-cassiope	1	5	1	1		6												14
Cassiope	3	3	2		1	9									3			21
SITKA SPRUCE/																		
Red alder/salmonberry													3	1				4
Sitka alder														4				4
Devil's club/skunk cabbage								1				5	6	4				16
Devil's club-salmonberry													4	1				5
Devil's club					1							2	10	7				20
Blueberry-devil's club					1								10	4			1	16
Blueberry												2	5				1	8
Blueberry/skunk cabbage						2							2	1				5
Pacific reedgrass																	2	2
Devil's club-upland		1			1					1								3
Mountain hemlock/blueberry		3		2	3	4												12
TOTAL	12	38	30	57	111	287	1	32	8	23	23	44	85	27	59	6	6	849

Table A4-5. Landform Legend* for the Chatham Area

10 MOUNTAIN SUMMITS LANDFORM ASSOCIATION
- 11 Rugged mountain summits
- 12 Rounded mountain summits
- 13 Snow and ice

30 MOUNTAIN SLOPES LANDFORM ASSOCIATION
- 31 Frequently dissected, deeply incised mountain slopes
- 32 Frequently dissected, shallowly incised mountain slopes
- 35 Infrequently dissected, smooth mountain slopes
- 36 Broken mountain slopes or broken hill slopes
- 37 Mountain slope ravines

40 HILLS LANDFORM ASSOCIATION
- 42 Rolling hills
- 43 Frequently dissected hillslopes
- 44 Infrequently dissected, smooth hillslopes
- 45 Karst topography

50 VALLEY BOTTOM LANDFORM ASSOCIATION
- 51 Infrequently dissected footslopes
- 52 Frequently dissected footslopes and alluvial fans
- 53 Floodplains
- 54 Valley bottom gorges

60 LOWLANDS LANDFORM ASSOCIATION
- 61 Gently sloping lowlands
- 62 Flat lowlands
- 63 Kettle and kame topography
- 64 Outburst floodplains
- 65 Marine terraces

70 COASTAL LANDFORM ASSOCIATION
- 71 Estuaries
- 72 Beaches and dunes
- 73 Wave cut platforms and rock headlands
- 74 Uplifted beaches

*from Chatham Area Integrated Resource Inventory Handbook

Table A4–6. Soil Layer Depths by Plant Association

Plant Association	Total Soil Depth				Organic Layer Depth				Impermeable Layer				Rooting Depth			
	Mean		Std. Dev.		Mean		Std. Dev.		Mean		Std. Dev.		Mean		Std. Dev.	
	(cm)	(in.)	(cm)	(in.)	(cm)	(in.)	(cm)	(in.)	(cm)	(in.)	(cm)	(in.)	(cm)	(in.)	(cm)	(in.)
WESTERN HEMLOCK/																
Blueberry/shield fern	85	33	23	9	15	6	9	4	74	29	31	12	54	21	27	11
Blueberry-devil's club	86	34	23	9	12	5	7	3	76	30	28	11	51	20	21	8
Devil's club	85	33	25	10	12	5	10	4	73	29	34	13	58	23	30	12
Devil's club-shallow soils	73	29	25	10	18	7	15	6	59	23	30	12	55	22	23	9
Blueberry-menziesia	65	26	30	12	21	8	16	6	50	20	32	13	41	16	23	9
Blueberry	74	29	27	11	17	7	12	5	57	22	32	13	45	18	22	9
Blueberry/skunk cabbage	78	31	29	11	33	13	35	14	64	25	35	14	43	17	15	6
Devil's club/skunk cabbage	85	33	25	10	21	8	12	5	67	26	33	13	45	18	12	5
WESTERN HEMLOCK-YELLOWCEDAR/																
Blueberry-devil's club	100	39	0	0	21	8	0	0	75	30	35	14	91	36	0	0
Blueberry-menziesia	61	24	29	11	20	8	9	4	40	16	33	13	36	14	13	5
Blueberry	77	30	25	10	17	7	8	3	58	23	32	13	54	21	25	10
Blueberry/skunk cabbage	77	30	25	10	41	16	22	9	67	26	33	13	49	19	23	9
MIXED CONIFER/																
Blueberry	58	23	29	11	18	7	10	4	37	15	31	12	42	17	17	7
Copperbush	74	29	32	13	18	7	9	4	50	20	33	13	42	17	20	8
Blueberry/deer cabbage	72	28	29	11	31	12	27	11	45	18	37	15	41	16	17	7
Blueberry/skunk cabbage	79	31	29	11	37	15	30	12	52	20	35	14	50	20	18	7
Skunk cabbage-lady fern	89	35	19	7	31	12	13	5	61	24	31	12	62	24	15	6
SHORE PINE/																
Crowberry	79	31	32	13	36	14	42	17	29	11	21	8	39	15	22	9
Sitka sedge	100	39	0	0	28	11	0	0	23	9	0	0	52	20	0	0
MOUNTAIN HEMLOCK/																
Blueberry	64	25	30	12	11	4	6	2	56	22	33	13	45	18	19	7
Blueberry/deer cabbage	58	23	26	10	12	5	5	2	41	16	25	10	47	19	20	8
Copperbush-cassiope	56	22	25	10	19	7	14	6	36	14	25	10	35	14	14	6
Cassiope	54	21	30	12	23	9	26	10	39	15	32	13	40	16	16	6
SITKA SPRUCE/																
Red alder/salmonberry	100	39	0	0	21	8	32	13	82	32	34	13	100	39	0	0
Sitka alder	100	39	0	0	4	2	1	0	100	39	0	0	60	24	21	8
Devil's club/skunk cabbage	97	38	10	4	22	9	16	6	100	39	1	0	52	20	25	10
Devil's club-salmonberry	100	39	0	0	6	2	4	2	100	39	0	0	44	17	26	10
Devil's club	100	39	3	1	10	4	5	2	96	38	15	6	49	19	17	7
Blueberry-devil's club	95	37	13	5	14	6	8	3	86	34	28	11	50	20	21	8
Blueberry	98	39	5	2	14	6	9	4	81	32	35	14	77	30	25	10
Blueberry/skunk cabbage	100	39	0	0	38	15	42	17	98	39	4	2	62	24	38	15
Pacific reedgrass	100	39	0	0	15	6	12	5								0
Devil's club-upland	81	32	33	13	7	3	4	2	77	30	40	16	43	17	52	20
Mountain hemlock/blueberry	76	30	31	12	11	4	5	2	59	23	38	15	79	31	36	14

*100 cm (39 in.) or greater depths listed as 100

APPENDIX 5. CURRENT AND PREVIOUS PLANT ASSOCIATION CODES*

*Associations are listed only if codes differ

Current Code	Plant Association	Previous Code
165	*Tsuga heterophylla/Oplopanax horridum* -shallow soils Western hemlock/devil's club-shallow soils	150
491	Mixed conifer/*Cladothamnus pyrolaeflorus* Mixed conifer/copperbush	490
525	*Tsuga mertensiana/Cladothamnus pyrolaeflorus-Cassiope* spp. Mountain hemlock/copperbush-cassiope	520
540	*Tsuga mertensiana*/tall *Vaccinium* spp./*Fauria crista-galli* Mountain hemlock/blueberry/deer cabbage	512
390	*Picea sitchensis-Tsuga mertensiana*/tall *Vaccinium* spp. Sitka spruce-mountain hemlock/blueberry	511

APPENDIX 6. DATA CARDS USED IN FIELD WORK SUPPORTING THIS CLASSIFICATION

SNUM ________

Tongass National Forest
Plant Association Environment Plot Card - 1

DATE:__________ PLOT #:__________________ AREA:________
GENERAL LOCATION:____
PLANT ASSOCIATION:_______________________________________
SOIL #1:______________________ SOIL #2:_________________
BEDROCK:____________SURFICIAL DEPOSIT:___________________
OBSERVERS:__________________ AIR PHOTO #:________________

SNUM	1	________	STAND #
DIST	2	________	DISTRICT #
TNSP	3	________	TOWNSHIP
RNGE	4	________	RANGE
QSCT	5	________	1/4 SECT
VCU	6	________	VCU (WATERSHED #)
SMU	7	________	SOIL MAP UNIT
TMTP	8	________	TIMBER TYPE
SLPE	9	________	% SLOPE
ASP	10	________	DEGREES
ELEV	11	________	NEAREST 100FT. (ELEVATION ABOVE SEA LEVEL)
LDFM	12	________	LANDFORM CODE
MICR	13	________	SLOPE SHAPE IN PLOT (CX=1,ST=2,CV=3,UND=4)
SDRC	14	________	SOIL DRAINAGE CLASS: 1=VP,2=P,3=SP,4=MW,5=W
SDP	15	________	SOIL DEPTH TO IMPERMEABLE LAYER, IN.
IMPR	16	________	IMPERM. LAYER TYPE: 1=BRK,2=ASH,3=TIL,4=ORST.
OIDP	17	________	Oi DEPTH, IN.
OEDP	18	________	Oe DEPTH, IN.
OADP	19	________	Oa DEPTH, IN.
OMDP	20	________	ORGANIC MATTER DEPTH, TOTAL IN. (to 120 cm.)
MODP	21	________	DEPTH TO MOTTLING, IN. (99 IF DEPTH > PIT)
GRD	22	________	% BARE GROUND
EBRK	23	________	% SURFACE BEDROCK EXPOSED
MBRK	24	________	% SURFACE BEDROCK WITH MOSS OR LITTER
BLDR	25	________	% SURFACE BOULDERS W & W/O MOSS
RTDP	26	________	ROOTING DEPTH; INCHES FROM TOP OF MINERAL
PHOM	27	________	MEAN PH ORGANIC HORIZONS, WEIGHTED AVERAGE
PHRT	28	________	MEAN PH MINERAL HORIZONS W/ROOTS, WGT.AVG.
DOWN	29	________	% DEAD AND DOWN
DBOW	30	________	DEER BROWSING: 0, 1=LIGHT-MOD.,2=HEAVY
TREO	31	________	% OVERSTORY TREE COVER (DOM.,CODOM.,INTER.)
TREU	32	________	% UNDERSTORY TREE COVER (OVERTOPPED,SEED/SAP)
TSHB	33	________	% TALL SHRUB COVER
LSHB	34	________	% LOW SHRUB COVER
FORB	35	________	% FORB COVER
FERN	36	________	% FERN COVER

R10-2060-3 (1/87)

SNUM ________

VARIABLE PLOT

* TALLY 37-49 AFTER COMPLETING VARIABLE PLOT

THGT	37	________	MEAN HEIGHT OF DOMINANTS, FT.
DBA	38	________	DEAD BASAL AREA OF SNAGS >12 FT.
LBA	39	________	LIVE BASAL AREA (#TREES X BAF)
TBA	40	________	TOTAL BASAL AREA (DBA + LBA)
GVOL	41	________	(BF/AC;GROSS SCIRB VOLUME X 100) LEAVE BLANK
WHBA	42	________	TSHE (WH) BASAL AREA
SSBA	43	________	PISI (SS) BASAL AREA
RCBA	44	________	THPL (RC) BASAL AREA
YCBA	45	________	CHNO (YC) BASAL AREA
MHBA	46	________	TSME (MH) BASAL AREA
LPBA	47	________	PICO (LP) BASAL AREA
BAF	48	________	BASAL AREA FACTOR (20, 40 OR 62.5 BAF)
NOTR	49	________	NUMBER OF TREES IN VARIABLE PLOT

	TREE CLASS	SPP	DBH	HGT	PROJ HGT	CRN RATIO	CRN CLASS	COMMENTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

SNUM ______

Tongass National Forest
Plant Association Vegetation Plot Card - 2

DATE: ______ PLOT #: __________ OBSERVERS: ______________

PLANT ASSOCIATION: ______________________________

Plot Radius = 42 feet
4 ft. radius = 1%, 9 ft. radius = 5%, 13 ft. radius = 10%

TREES

	Q	U		
AB__	____	____	ABIES ________	________ FIR
ALRU	____	____	ALNUS RUBRA	RED ALDER
CHNO	____	____	CHAMAECYPARIS NOOTKATENSIS	ALASKA CEDAR
PISI	____	____	PICEA SITCHENSIS	SITKA SPRUCE
PICO	____	____	PINUS CONTORTA	SHORE PINE
POTR	____	____	POPULUS TRICHOCARPA	BLACK COTTONWOOD
TABR	____	____	TAXUS BREVIFOLIA	PACIFIC YEW
THPL	____	____	THUJA PLICATA	WESTERN RED CEDAR
TSHE	____	____	TSUGA HETEROPHYLLA	WESTERN HEMLOCK
TSME	____	____	TSUGA MERTENSIANA	MOUNTAIN HEMLOCK
____	____	____	________	________

TALL SHRUBS

	%	HGT		
ALSI	____	____	ALNUS SINUATA	SITKA ALDER
CLPY	____	____	CLADOTHAMNUS PYROLAEFLORUS	COPPERBUSH
COST	____	____	CORNUS STOLONIFERA	RED OSIER DOGWOOD
GASH	____	____	GAULTHERIA SHALLON	SALAL
MEFE	____	____	MENZIESIA FERRUGINEA	RUSTY MENZIESIA
MYGA	____	____	MYRICA GALE	SWEET GALE
OPHO	____	____	OPLOPANAX HORRIDUM	DEVIL'S CLUB
RI__	____	____	RIBES ________	CURRANT/GOOSEBERRY
RUPA	____	____	RUBUS PARVIFLORUS	THIMBLE BERRY
RUSP	____	____	RUBUS SPECTABILIS	SALMONBERRY
SALIX	____	____	SALIX SPP.	WILLOW
SARA	____	____	SAMBUCUS RACEMOSA	RED ELDERBERRY
SOSI	____	____	SORBUS SITCHENSIS	SITKA MOUNTAIN ASH
VACCI	____	____	VACCINIUM OVAL./ALASKEN.	BLUEBERRY
VAPA	____	____	VACCINIUM PARVIFOLIUM	RED HUCKLEBERRY
VIED	____	____	VIBURNUM EDULE	HIGH BUSH CRANBERRY
____	____	____	________	________
____	____	____	________	________

LOW SHRUBS

	%		
ANPO	______	ANDROMEDA POLIFOLIA	BOG ROSEMARY
CAME	______	CASSIOPE MERTENSIANA	MERTENS CASSIOPE
CAST5	______	CASSIOPE STELLERIANA	STARRY CASSIOPE
EMNI	______	EMPETRUM NIGRUM	CROWBERRY
JUCO	______	JUNIPERUS COMMUNIS	COMMON JUNIPER
KAPO	______	KALMIA POLIFOLIA	BOG KALMIA
LEGR	______	LEDUM GROENLANDICUM	LABRADOR TEA
LUPE	______	LUETKEA PECTINATA	LUETKEA
PHGL	______	PHYLLODOCE GLANDULIFLORA	MOUNTAIN-HEATHER
VACA	______	VACCINIUM CAESPITOSUM	DWARF BLUEBERRY
VAOX	______	VACCINIUM OXYCOCCOS	BOG CRANBERRY
VAUL	______	VACCINIUM ULIGINOSUM	BOG BLUEBERRY
VAVI	______	VACCINIUM VITIS-IDAEA	MOUNTAIN CRANBERRY
____	______	________	________
____	______	________	________

FORBS

	%		
ARNIC	______	ARNICA SPP.	ARNICA
CA__	______	CALTHA ________	MARSH MARIGOLD
CA__	______	CASTILLEJA ________	PAINTBRUSH
CIAL	______	CIRCAEA ALPINA	ENCHANTER'S NIGHTSHADE
CLSI	______	CLAYTONIA SIBIRICA	SIBERIAN SPRING-BEAUTY
CLUN	______	CLINTONIA UNIFLORA	BLUE-BEAD
COAS	______	COPTIS ASPLENIFOLIA	FERN-LEAF GOLDTHREAD
COTR2	______	COPTIS TRIFOLIA	TRIFOLIATE GOLDTHREAD
COCA	______	CORNUS CANADENSIS	BUNCHBERRY DOGWOOD
DODEC	______	DODECATHEON SPP.	SHOOTING STAR
DROSE	______	DROSERA SPP.	SUNDEW
EP__	______	EPILOBIUM ________	FIREWEED
EQUIS	______	EQUISETUM SPP.	HORSETAIL
ERPE	______	ERIGERON PEREGRINUS	SUBALPINE DAISY
FACR	______	FAURIA CRISTA-GALLI	DEER CABBAGE
GA__	______	GALIUM ________	BEDSTRAW
GEDO	______	GENTIANA DOUGLASIANA	SWAMP GENTIAN
GEPL	______	GENTIANA PLATYPETALA	BLUE GENTIAN
GECA4	______	GEUM CALTHIFOLIUM	CALTHA-LEAF AVENS
HA__	______	HABENARIA ________	BOG-ORCHID
HELA	______	HERACLEUM LANATUM	COW PARSNIP
HEGL2	______	HEUCHERA GLABRA	ALPINE HEUCHERA
HIMO	______	HIPPURIS MONTANA	MOUNTAIN MARESTAIL
LIBO2	______	LINNAEA BOREALIS	TWIN-FLOWER
LICA3	______	LISTERA CAURINA	WESTERN TWAYBLADE
LICO3	______	LISTERA CORDATA	HEART-LEAVED TWAYBLADE
LYAM	______	LYSICHITUM AMERICANUM	YELLOW SKUNK CABBAGE
MADI2	______	MAIANTHEMUM DILATATUM	DEERBERRY

FORBS

	%		
MOUN	____	MONESES UNIFLORA	SINGLE DELIGHT
OS__	____	OSMORHIZA ____	SWEET CICELY
PAFI	____	PARNASSIA FIMBRIATA	GRASS OF PARNASSUS
PIVU	____	PINGUICULA VULGARIS	COMMON BUTTERWORT
PRAL	____	PRENANTHES ALATA	RATTLESNAKE ROOT
PY__	____	PYROLA ____	____ WINTERGREEN
RA__	____	RANUNCULUS ____	BUTTERCUP
RUCH	____	RUBUS CHAMAEMORUS	CLOUDBERRY
RUPE	____	RUBUS PEDATUS	FIVE-LEAF BRAMBLE
SA__	____	SANGUISORBA ____	BURNET
SA__	____	SAXIFRAGA ____	SAXIFRAGE
STAM	____	STREPTOPUS AMPLEXIFOLIUS	CLASPING TWISTED-STALK
STRO	____	STREPTOPUS ROSEUS	ROSY TWISTED-STALK
STST	____	STREPTOPUS STREPTOPOIDES	KRUSHEA
TITR	____	TIARELLA TRIFOLIATA	TRIFOLIATE FOAMFLOWER
TOGL	____	TOLFIELDIA GLUTINOSA	STICKY TOFIELDIA
TREU	____	TRIENTALIS EUROPEA	ARCTIC STARFLOWER
VASI	____	VALERIANA SITCHENSIS	SITKA VALERIAN
VEVI	____	VERATRUM VIRIDE	FALSE HELLEBORE
VIGL	____	VIOLA GLABELLA	STREAM VIOLET
VILA	____	VIOLA LANGSDORFFII	ALASKA VIOLET
____	____	____	____
____	____	____	____

SEDGES AND RUSHES

	%		
CA__	____	CAREX ____	SEDGE
CAAN5	____	CAREX ANTHOXANTHEA	NONE
CALE5	____	CAREX LENTICULARIS	NONE
CAME2	____	CAREX MERTENSII	MERTENS SEDGE
CANI2	____	CAREX NIGRICANS	BLACKISH SEDGE
CAPA11	____	CAREX PAUCIFLORA	FEW-FLOWERED SEDGE
CAPL	____	CAREX PLURIFLORA	MANY-FLOWER SEDGE
CASI3	____	CAREX SITCHENSIS	SITKA SEDGE
JUNCU	____	JUNCUS SPP.	RUSH
LU__	____	LUZULA SPP.	____ WOODRUSH
SCCA2	____	SCIRPUS CAESPITOSUS	TUFTED CLUBRUSH
____	____	____	____
SEDGE	____	TOTAL SEDGE COVER	

GRAMINOIDS

	%		
AGROS	____	AGROSTIS SPP	BENTGRASS
CACA	____	CALAMAGROSTIS CANADENSIS	BLUEJOINT
CANU3	____	CALAMAGROSTIS NUTKAENSIS	PACIFIC REEDGRASS
DEAT	____	DESCHAMPSIA ATROPURPUREA	MOUNTAIN HAIRGRASS
ERIOP	____	ERIOPHORUM ____	COTTON GRASS
GRAMI	____	GRAMINOIDS	GRASSES
PHAL	____	PHLEUM ALPINUM	ALPINE TIMOTHY
TRISE	____	TRISETUM SPP.	OATGRASS
____	____	____	____
____	____	____	____
GRAMI	____	TOTAL GRAMINOIDS COVER	

FERNS

	%		
ADPE	____	ADIANTUM PEDATUM	MAIDEN-HAIR FERN
ATFI	____	ATHYRIUM FILIX-FEMINA	LADY FERN
BLSP	____	BLECHNUM SPICANT	DEER FERN
DRAU2	____	DRYOPTERIS AUSTRIACA	SPINULOSE SHIELD FERN
GYDR	____	GYMNOCARPIUM DRYOPTERIS	OAK-FERN
POGL4	____	POLYPODIUM GLYCYRRHIZA	LICORICE FERN
PO__	____	POLYSTICHUM ____	____
POMU	____	POLYSTICHUM MUNITUM	SWORD-FERN
PTAQ	____	PTERIDIUM AQUILINUM	WESTERN BRACKEN FERN
THLI	____	THELYPTERIS LIMBOSPERMA	MOUNTAIN WOOD-FERN
THPH	____	THELYPTERIS PHEGOPTERIS	NORTHERN BEECH-FERN
____	____	____	____
____	____	____	____

CLUB MOSSES AND MOSSES

	%		
LY__	____	LYCOPODIUM ____	CLUBMOSS
LYAN	____	LYCOPODIUM ANNOTINUM	STIFF CLUBMOSS
LYCL	____	LYCOPODIUM CLAVATUM	RUNNING CLUBMOSS
LYSE	____	LYCOPODIUM SELAGO	FIR CLUBMOSS
LYSI	____	LYCOPODIUM SITCHENSE	ALASKAN CLUBMOSS
SPHAG	____	SPHAGNUM SPP.	SPHAGNUM
____	____	____	____
CLUBS	____	TOTAL CLUBMOSSES COVER	____

NOTES: ____________________

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USDA FOREST SERVICE · TONGASS NATIONAL FOREST · CHATHAM AREA · ALASKA

SOIL PROFILE AND ENVIROMENT DESCRIPTION

1. MAPPING UNIT	WATERSHED NO.	CARD NO.	DATE	BY	AIR PHOTO NO.	SITE NO.
2. CLASSIFICATION				LOCATION		USGS QUAD
3. PARENT MATERIAL	BEDROCK	DEPTH TO/TYPE OF IMPERMEABLE LAYER cm	FRACTURING / WEATHERING			
4. LANDFORM	SLOPE %	ASPECT	ELEVATION	SAMPLED / PHOTOGRAPHS		
5. O HORIZON DEPTH	ROOTING DEPTH	SOIL TEMPERATURE	DRAINAGE CLASS	ASSOCIATED DATA CARDS (INITIALS / SITE) mu / wv / /		

6. HORIZON	DEPTH (cm)	1 / COLOR		TEXTURE %clay %sand	STRUCTURE	CONSISTENCE	COARSE FRAGMENTS % vol.	ROOTS	ph	BOUNDARY		
		MATRIX	MOTTLING									
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											

1 / ALL COLORS GIVEN FOR MOIST CONDITIONS UNLESS OTHERWISE INDICATED

7 HORIZON	DEPTH (cm)	COLOR			FIBER CONTENT		BOTANICAL ORIGIN OF FIBER	SODIUM PYROPHOSPHATE	BOUNDARY	MINERAL CONTENT (%)	pH	
		BROKEN	RUBBED	PRESSED	UNRUBBED	RUBBED						
	– – –											
	– – –											
	– – –											
	– – –											
	– – –											

8. EPIPEDON

DIAGNOSTIC HORIZON(S)

CONTROL SECTION AND PARTICLE SIZE

9. FIELD CLASSIFICATION

10. HOW DID THIS SOIL DIFFER FROM MODAL

11. ASSOCIATED COMMUNITY TYPE

NOTES