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ECOLOGICAL INVENTORY:

SITKA NATIONAL HISTORICAL PARK

Prepared for:

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PURPOSE AND USE OF THIS REPORT

This report is designed to meet the objectives specified in Interagency Agreement Number IA 9700-2-9017 between the National Park Service, Alaska Regional Office, and the United States Department of Agriculture (USDA) Forest Service, Tongass National Forest, Chatham Area. These objectives are as follows:

1. To inventory, classify, and map ecosystems of the vascular and non-vascular plant species at Sitka National Historical Park, Battlesite Unit.

2. To develop a forest stand profile/history and provide recommendations on the stand health and potential hazard trees in areas of high visitor use.

3. To compile inventories and prepare a final report in the following formats:
   A. Descriptive reports
   B. Mapping on photographs
   C. Base map with legends.

In order to meet these objectives, an ecological unit inventory was prepared for Sitka National Historical Park. This inventory provides a uniform system for understanding the significant characteristics of the various landforms, vegetation, geology, and soils that occur in the Park and their relationships to one another and to their environments. The inventory evaluates the kinds, extent, location, and quality of these resource components in the Park.

This information may be used by Park personnel to assess resources and make management decisions suitable to specific areas or particular plant or animal species of the Park. Baseline data collected under this Interagency Agreement may be used to compare changes in resources over time.

All maps and information in this inventory were prepared for use by the United States Department of the Interior, National Park Service, Alaska Regional Office.

SETTING OF SITKA NATIONAL HISTORICAL PARK

Introduction

Sitka National Historical Park is located at the mouth of Indian River on Baranof Island. Indian River drains the post-glaciation valley outlined by Mt. Verstovia, Arrowhead Peak, The Sisters, and Gavan Hill, encompassing about 7,800 acres. The Park coastline is on Crescent and Jamestown Bays (Figure 1).

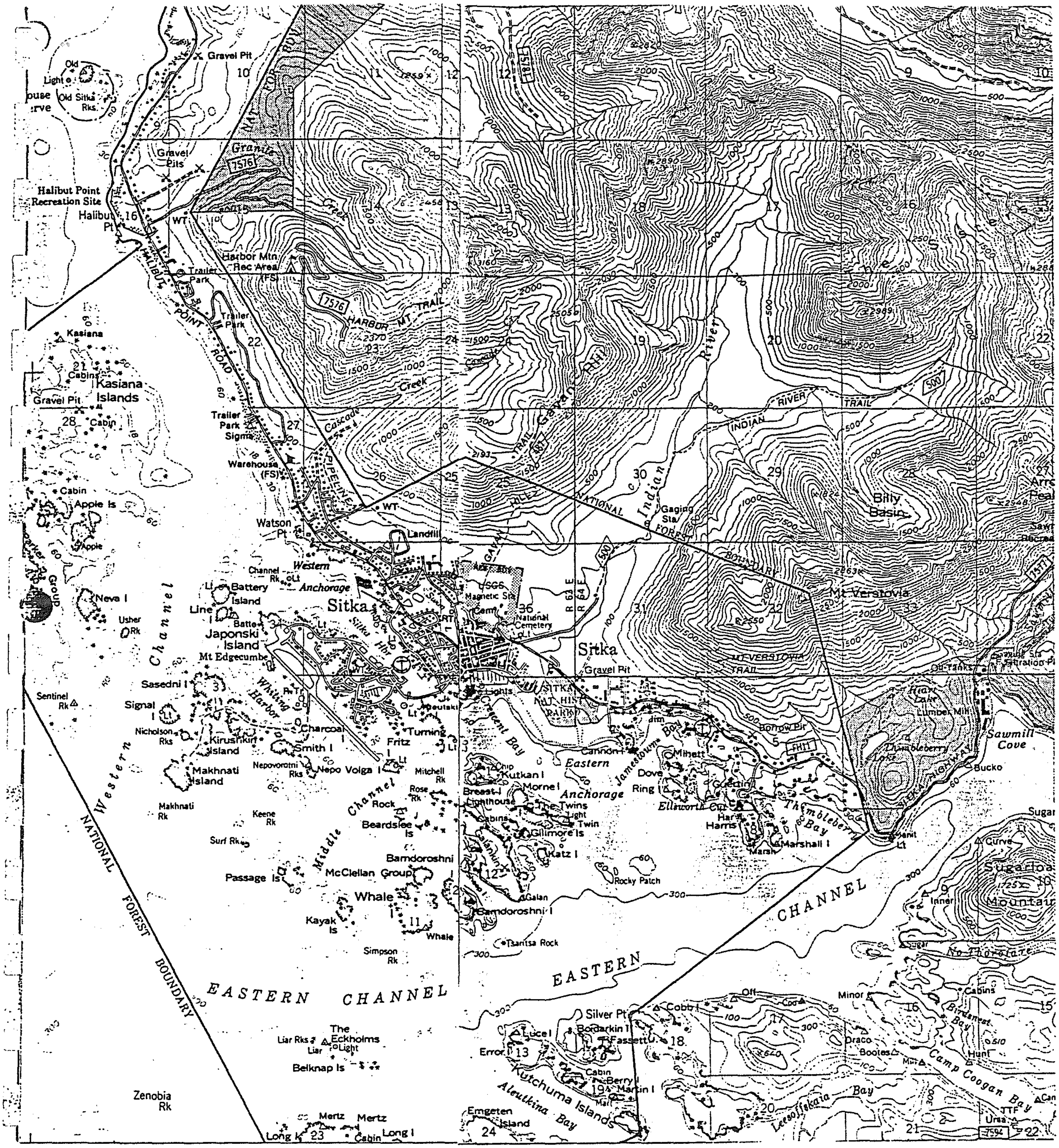


Figure 1. Topographic Map of Area
Source: US Geological Survey, 1975
Scale: 1: 63,360

Baranof Island is one of the most rugged of all the islands in southeast Alaska, with many high peaks and steep slopes. The outer coast is dotted with numerous small islands. The northern part of the island exhibits soil layers of volcanic ash from past eruptions of Mt. Edgecumbe.

Baranof Island is part of the Alexander Archipelago, which comprises all the islands of southeast Alaska, extending from Yakutat Bay to northern Vancouver Island. Baranof Island, and the Sitka National Historical Park, lies within the spruce-hemlock-cedar region of the temperate rainforest biome, which extends south to include the redwoods of coastal northern California.

Temperate rainforest, like the much-publicized tropical rainforest, is a unique ecosystem of limited extent. In North America, it occurs primarily in southeast Alaska and British Columbia. Wildlife is abundant and trees such as Sitka spruce, western and mountain hemlock, and red- and yellow-cedar, are common and tall. Since the region is primarily composed of islands, distribution of animals is uneven. For example, brown bears occur on northern islands of the group, while black bears occur to the south.

Geology/Geomorphology

The following geological discussion represents information contained in four reports by Yehle (1974), Hicks and Shafnos (1965), Mann (1986), and Loney et al. (1975). Each report contains information which supports and complements the others. Landform units of the Park which are mentioned in this section are described fully in the Ecological Unit Descriptions section.

The majority of the Park overlies surficial deposits derived primarily from graywacke, schist, and phyllite. These surficial deposits include alluvium on Indian River's floodplain, estuary, and stream terrace; ablation till on the lateral moraine; and beach sands and gravel on the uplifted beach and uplifted beach meadow. The source rocks for all these deposits are the steep mountain sideslopes and cirque walls, located at the head of Indian River and its tributaries, which were formed during local alpine glaciation.

One small area of the Park (lowlands ecological unit) has volcanic ash overlying finer glacio-marine sediments underlain by graywacke bedrock. Previous research has determined the age of similar ash deposits in the Sitka area by analyzing a buried peat layer immediately under the ash. The age was found to be about 8,500 to 9,000 years B.P. (Before Present).

Glaciation played a major role in development of the landforms of southeast Alaska. Glaciers overran the Alexander Archipelago during the late Wisconsin glaciation, reaching their maximum extent before 14,000 years B.P. and perhaps before 16,000 years B.P. Late Wisconsin ice flowed onto the continental shelf only near major fjord mouths. A widespread marine transgression (the spread of the sea over the land) reaching more than 200 meters above present sea level in the inner fjords of southeast Alaska accompanied the deglaciation that occurred shortly before 13,000 - 14,000 years B.P. A late glacial advance probably occurred between 9,000 and 13,000 years B.P. in this region.

The land mass associated with the Park was all under water during the marine transgressions resulting from deglaciation. The deposits have been worked and reworked many times by wave action and by Indian River since deglaciation. Deglaciation was followed by isostatic rebound (or crustal rebound). This is the upward movement of a land mass responding to the removal of the thick mass of ice from the glacier. Ice thickness may have been as much as 2,750 feet. Since deglaciation, it is estimated that the total rebound to the present time, in the Sitka area, is approximately 35 feet. Rebound is now occurring at the rate of about 0.34 cm/yr based on tidal gauge readings between 1938 and 1972. It should be noted that maximum rebounding is specific to geographic location. Some areas of southeast Alaska have rebounded less than 35 feet, while others have rebounded over 500 feet.

Soil Development

References in this section to soil orders, subgroups, specific soil horizons, epipedons, thickness requirements, etc. are found in United States Department of Agriculture (USDA) Soil Conservation Service (SCS) (1975). Complete soil classifications and descriptions are found in the Soil Descriptions section of this report.

Soils in the Park exhibit, to some extent, the relative ages of each of the landforms. The lateral moraine and the lowlands have soils with the greatest development, suggesting they are the oldest landforms. Soils on the moraine and one soil in the lowlands belong to the soil order Spodosols. Spodosols have a well developed B horizon (or spodic horizon). The B horizon is a subsurface layer of iron and/or humus accumulation. One of the other soils found in the lowlands belong to the order Andisols. Andisols are soils formed in volcanic ash. This soil has a spodic horizon similar to the Spodosols in the moraine and the other Spodosols component of the lowlands. The third soil in the lowlands is a Histosol; in the Park, it is basically organic material over bedrock at depths less than 20 inches. These Histosols are most likely the same age as the Spodosols. They do not develop mineral diagnostic horizons due to the resistant bedrock; however, organic matter accumulates over time.

It is difficult to determine which of the mid-age three landforms is oldest. The soils in the uplifted beach, stream terrace and floodplain all belong to the soil order Inceptisols. They are less developed than the Spodosols in the moraine and lowlands, having a slightly developed B horizon (or cambic horizon). The name Inceptisols implies a soil at its inception or beginning. These are distinguished, however, from Entisols which are the most recent soils (see uplifted beach meadow and estuary soils below). The Inceptisols in the uplifted beach have an umbric epipedon, but do not have a cambic horizon. Those in the stream terrace have an ochric epipedon and a cambic horizon. Those in the floodplain have an umbric epipedon and a cambic horizon. A cambic horizon is a B horizon, but it is not developed to the extent as in the spodic horizon (mentioned above). The umbric epipedon is a mineral surface layer enriched in enough organic matter to give specified dark colors of sufficient thickness. The ochric epipedon is not as dark as the umbric nor does it meet thickness requirements.

It would normally be thought that the soil with the umbric epipedon and a cambic horizon would be the most developed or had the most time to develop. This is the case with the floodplain. The floodplain, however, is lower in topographic position (elevation) than the stream terrace, which suggests the floodplain is younger. The floodplain is also subject to more flooding than the stream terrace (the old floodplain). A possible explanation for the greater soil development in the younger floodplain may be that certain unknown events may have occurred since the flow of Indian River has been altered by rip-rap installation in the Park and by the construction of a small dam upstream from the Park. Alder, which is the dominant plant species on the floodplain, has the ability to fix atmospheric nitrogen which would make this site more productive and hence able to accumulate more organic matter (i.e. soil development). The floodplain also receives extra water and organic matter during flood events which raises the potential for leaching humus into lower soil layers (umbric horizon). We assume, then, that the stream terrace is older than the floodplain. However, the uplifted beach could be the same age as either the stream terrace or floodplain, or it could be younger than both. Based on relative elevations, it is most likely similar in age to the floodplain and younger than the stream terrace.

The youngest landforms are the estuary and beach meadow. The beach meadow is actually part of the uplifted beach, but is still influenced by high tides during storm and extreme tidal activity. Soils in these landforms belong to the soil order Entisols. They are the most recent soils in development and usually have A horizons (mineral surface layers enriched in organic matter) overlying C horizons (layers of parent material or in the case of the Park, layers of sand and/or gravel reworked by stream and tidal influences).

HOW THIS INVENTORY WAS MADE

This ecological unit inventory relies on landform, vegetation, geology, and soils to stratify the landscape into integral units that are natural and reflect ecological processes. Mapping criteria (i.e. features used to set unit boundaries) are either directly observed or inferred from aerial photographs.

The inventory used an interdisciplinary approach to identify resources and ecological units. An ecologist, two soil scientists, a botanist, a silviculturist, a Geographical Information Systems (GIS) specialist, and a biological technician from the USDA Forest Service participated in this effort. Consultation with the National Park Service helped to corroborate findings in the field.

The inventory was completed in three phases. The first phase was pre-mapping, which is a photo-interpretive delineation of ecological units. The second phase involved field verification of these units. The third phase was final mapping, or adjustment of ecological unit boundaries based on the field verification. These phases are described below.

1. Pre-Mapping

The inventory area was pre-mapped on color aerial photographs at a scale of 1:1,200 (1 inch = 100 feet), using mylar overlays. Features visible on the photograph were used to draft preliminary ecological unit boundaries. These features included the following:

A. Landforms

Landforms are broad features of the surface of the earth, such as plateaus, mountains, canyons, valleys or floodplains. They are usually delineated on aerial photographs because they have observable characteristics (e.g. slope, shape). Moreover, other properties can be inferred from the landform type, such as soil depth or soil drainage. Landforms are relatively large in size, and provide a logical permanent physical and locatable land base for further delineation.

Landforms were identified, but not delineated, in pre-mapping on this project since the difference in elevation between adjacent landforms was not readily discernable from the aerial photographs. Descriptions of landforms are found in the Geology/Geomorphology and Ecological Unit Descriptions sections of this report.

B. Vegetation

Vegetation has observable characteristics that may be delineated on aerial photographs. For example, forested areas may be differentiated by features such as tree crown size, canopy closure, and tree height. Disturbed forested areas (e.g. human use, windthrow, or areas disturbed by other natural phenomenon) are mapped according to potential vegetation as extrapolated from adjacent areas and field verification. Descriptions of the vegetation types in the Park are found in the Plant Associations and Communities Descriptions section of this report.

C. Geology

Surficial geology was used to refine the preliminary ecological unit boundaries. Identification of geologic resources was based on known geology of the area, inferred from landform and vegetation characteristics, or observed during field mapping (Phase 2). Geologic descriptions for the Park and portions of the Indian River watershed are found in the Geology/Geomorphology section of this report. The geologic resources are named according to USDA SCS (1992a).

D. Soils

Soil properties are inferred properties, and thus were the last component considered in the pre-mapping process. Soil depth, drainage, texture, and development are all properties inferred from landform, vegetation, and geology. Soil properties were evaluated via a review of relevant literature and through site mapping (Phase 2). The soils are identified, classified, and named according to USDA SCS (1975, 1981, 1984, 1992a, 1992b).

2. Field Verification

After pre-mapping was completed, results were checked in the field and ecological unit boundaries and descriptions were verified or altered as necessary. The field work was conducted by the interdisciplinary team. Representative areas of each ecological unit were visited. Soils and vegetation were observed, unit boundaries checked, and data were collected. Field verification tasks are described below.

A. Soils

Traverses of each preliminary ecological unit were conducted and soil pits were dug to determine what soils were present in each ecological unit delineation or polygon. Representative soils were examined for each major plant association and a detailed soil profile description was made of each representative soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or down to bedrock. Color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, movement and accumulation of iron and aluminum or humus, and other features that enable the soil to be identified were recorded.

After the soil was described, it was assigned a soil taxonomic class (USDA SCS, 1975). Each taxonomic class has characteristics with precisely defined limits which are used as to classify soils systematically. Soil inclusions (or pockets of different soils within an area) were also noted and some were described in detail.

B. Vegetation

Vascular Plant Species Inventory

An inventory of vascular plant species was conducted for the Park. Such an inventory is designed to document the total number of different plant species found in a given location. This information can be used to analyze diversity on the site, to check for presence of rare species or sensitive species which may require special management, or to check for presence of undesirable species. An inventory usually requires field work throughout all seasons of the year, since some plants are only visible for limited periods. Continued plant species inventory work is therefore anticipated for the Park.

An inventory may identify certain species as threatened, endangered, or of special concern. Endangered species are those whose distribution and populations are so restricted that the species is in danger of extirpation from the state or country under consideration. Threatened species are those which are likely to become endangered. Special concern species are those species which may become threatened. "Rare" species may be any of these: rare is a general term applied to species which are uncommon for one reason or another.

An inventory may also identify alien species. Alien plant species are those which have been introduced from a different region. Alien species may compete better in a community than the native species, and may take over areas previously occupied by native species. For this reason, they may be undesirable and require management to prevent their spread. Results of the inventory are shown in the Vascular Plant Species Inventory Section.

Plant Association and Community Analysis

In order to determine which plant associations and communities are present in the Park and to verify pre-mapped types, temporary circular (42-foot radius) plots were placed in representative locations within each of the various ecological unit types. In these plots, all vascular vegetative layers or strata were examined. Measurements included ocular estimation of the percentage of the plot covered by each species (i.e. species abundance) as well as by the total overstory; measurement of tree diameter at breast height (4.5 feet above the ground); and measurement of tree height. Narrow cores were removed from some trees in order to estimate their age. The percent cover data are used to determine plant association as well as stand composition. The diameter and height data are used to determine stand structure. The percent cover data are shown in Appendix 3, arranged by plot number; height and diameter data are summarized in the Plant Associations and Communities Descriptions section.

A plant association is the **potential natural** vegetative community in a given area. It develops in response to environmental factors such as soil, temperature, moisture, light, and nutrient availability. While communities actually grade into one another, the plant association concept divides them into discrete types that repeat themselves across a forest whenever unique environmental needs are met. Thus, the association is a tool, used for inventory and management purposes.

Vegetation in the Park was classified into plant associations based on field work and Martin et al. (1985). For some areas of the Park, plant communities were also examined and described. A plant community is the **existing**, **seral**, relatively homogenous assemblage of plants in a given area, as opposed to the **potential** natural assemblage described by the plant association. For the Park, communities were described in non-forested areas and younger successional landscapes.

Plant associations and communities are named by the dominant species in the vegetation layers. The names typically consist of a tree and a shrub, although there may be two dominants named in each of the tree and shrub strata, and a dominant herb may also be named (e.g. western hemlock/blueberry/skunk cabbage). Names of species in the same vegetative stratum are separated by a dash; those in different strata, by a slash.

3. Final Mapping

Although final mapping and field verification are addressed separately, they occurred simultaneously in the field. If collected data matched the criteria for a particular ecological unit, the preliminary ecological unit boundaries remained the same. If the data did not match, ecological unit boundaries and descriptions were corrected.

Once the mapping was finalized on a large scale aerial photograph used as a basemap, the maps were digitized into a Geographical Information System (GIS). The completed mapping layers were then compared with the base map photo to ensure the accuracy of the digitizing process. Attribute data for each ecological unit were entered into the database to develop Figure 2 (in next section) and the large mylar map accompanying this report. For more information, see the Ecological Unit Map Section of this report.

ECOLOGICAL UNIT DESCRIPTIONS

The following are descriptions of the ecological units found in the Park. An ecological unit is a combination of landform, vegetation type(s), and soils. More detailed descriptions of the landforms, vegetation types, and soils respectively are found in the Geology/Geomorphology, Plant Associations and Communities, and Soils Descriptions sections of this report.

Indian River

The stretch of Indian River within the Park affects other ecological units and extends well beyond Park boundaries. We did not consider it a separate ecological unit for evaluation, but provide brief information on the channel types of Lower Indian River here.

The section of Indian River within the Park is approximately 2100 feet, which extends from the northern park boundary at the road bridge to the marine tidal zone at the south boundary. The first 700 foot section of channel extending from the road bridge to just north of the Park's foot bridge is a Low Gradient Contained channel type (LC1). This is a large, well-contained channel with bedrock control and angular substrate material. An LC1 is a very stable channel type with little probability of channel migration.

The next 600 foot section of stream consists of a Wide Low Gradient Flood Plain channel type (FP5). This is a broad alluvial channel with small rubble to fine gravel substrate. A small flood terrace is situated along the left bank (downstream perspective) of this section. This segment provides the most anadromous spawning habitat of lower Indian River.

The final 800 foot section consists of a Large Estuarine channel type (ES4). Tidal influences regulate the flow regime of this section.

More detailed information on hydrologic charateristics and habitat capability of these channel types is contained in Appendix 2, taken from the Region 10 Channel Type User Guide for the Tongass National Forest, Southeast Alaska.

Estuary

This wetland ecological unit occurs on both sides of Indian River where it enters the ocean between Crescent and Jamestown Bays. The landform is an estuary and it occupies intertidal positions which are subject to flooding daily during high tides. Flooding also occurs from Indian River during periods of high runoff. Unit elevation is less than 5 feet.

This ecological unit is an association of two soils. The soils belong to the Typic Cryaquepts and Typic Cryaquents subgroups and are very deep and poorly drained. They formed in alluvial sands, silts, and gravel from mixed mineralogy, reworked by tidal and river action. Slope is 0 to 5 percent. Percent composition of the soils and accompanying plant communities change when flood events and tidal action rework the sediments.

The Typic Cryaquepts are on the terraces between channels at the more landward portions of the estuary. They are typically gravelly loam in the surface 3 inches. The next layer is very gravelly sandy loam about 10 inches thick overlying very gravelly coarse sand to 60 inches or more, but commonly is stratified extremely gravelly sand to sand. The less frequently flooded nature of these soils allows development of hairgrass and hairgrass-forb plant communities. The hairgrass type occupies about 65% of the unit, with the forb type (sandwort, yarrow, etc.) occupying about 23%. (See Vascular Plant Species List for scientific names). Each of these communities includes graminoids and forbs, with the grasses taller than the forbs.

The Typic Cryaquents are on the seaward boundary of the estuary where tidal action and salinity are strongest. They are typically sand in the surface 5 inches. The next layer is very gravelly coarse sand to 60 inches or more, but commonly is stratified extremely gravelly sand to sand. The salinity and frequent flooding produce growing conditions most suitable to sedges. Consequently, the plant community in this area is a sedge community. It makes up about 12% of the ecological unit.

The plant communities are non-forested, dominated by plants which are salt-tolerant and which can survive periodic to daily inundation, depending on their location in the estuary. There is a variety of plants adapted for these conditions which are found in the Park, ranging from fescue, alkali and hair-grasses to succulents like sandwort. (See the Vascular Plant Species List for specific plant listings.) The variety of plants increases beachward. Towards the permanently flooded zone, the vegetation thins and more bare ground is visible. Here, algal species such as rockweed (<u>Fucus</u>) occur. While there are no shrub or tree strata in this ecological unit, species diversity is high. Productivity in the estuary is also high.

Identification of the estuarine plant communities is based on elevation, the absence of trees and shrubs, and the presence of salt and flooding-tolerant indicator plants such as hairgrass, alkaligrass, goosetongue and sandwort.

Uplifted Beach Meadow

This ecological unit occurs on a small area of the uplifted beach landform. It is on a level to slightly concave position between the beach and higher, forested, uplifted beach. Elevation is less than 10 feet. The unit is subject to saltwater flooding during extreme high tides and storm tides.

Soils in this unit belong to the Typic Cryofluvents subgroup and are very deep and well drained. They formed in beach sand and gravel from mixed mineralogy. Slope is 0 to 5 percent. These soils are typically stratified extremely gravelly coarse sand to loam to 60 inches or more, with little soil material compared to older landscapes within the Park. Soils are similar in the different plant communities and differ only by their amount of flooding or by receiving extra water from adjacent areas.

These young, well-drained soils support two plant communities. In the lowest elevation, more frequently flooded, portion there is a grass-umbel (e.g. cow parsnip, angelica, etc.) meadow, occupying approximately 30% of the unit. This area is slightly concave and receives run-on water from adjacent areas. On the slightly higher areas where the surface is more stable, there is a red alder-spruce/salmonberry community (70%).

Plants in the grass-umbel community must be able to tolerate salt, but to a lesser degree than plants in the estuary, since the meadow does not flood with saltwater on a regular basis. Plants in this community are also sun-loving species, many of which would not survive under a closed or partially closed forest canopy. Due to the well-drained soils and light availability in the grass meadow community, species diversity and productivity are high. Structure is limited to one stratum--forbs--but this includes three height groups: tall umbels, grasses, and ground-level species.

The alder-spruce/salmonberry plant community has lower species diversity but greater structure than the grass meadow. Red alders form the overstory with young spruce below. Salmonberry fills in at a third level. There is a minor forb layer near ground level.

The uplifted beach meadow unit plant communities include species which are able to rapidly colonize the uplifted beach surface with its gravelly soils. The beach meadow is transitional between the forest and the beach and the plant communities show two stages in a succession from beach to southeast Alaska forest.

Uplifted Beach

This ecological unit occurs on areas of the uplifted beach landform. It is on smooth to slightly convex positions between the lateral moraine and the current beach. Elevation is about 10 to 15 feet.

Soils belong to the Salt Chuck series of sandy-skeletal, mixed Entic Cryumbrepts. They are very deep and well drained. They formed in beach gravel and sand from mixed mineralogy. Slope is 0 to 5 percent. They are typically peat, mucky peat, and muck about 5 inches thick overlying the mineral layers. The mineral surface is gravelly loamy sand and gravelly sand about 6 inches thick. The next layer is gravelly and very gravelly coarse sand to depths greater than 40 inches.

Similar soils included in this unit are identical to the Salt Chuck series except they receive sub-lateral flow of water and support devil's club vegetation.

The soils on this stable landform support two plant associations in the western hemlock series. The western hemlock series is identified by the presence of a nearly pure hemlock overstory with occasional spruce. The understory varies between different associations in the series. In this ecological unit in the Park, there are two associations in the hemlock series: hemlock/blueberry (occupying approximately 90% of the unit) and hemlock/devil's club (8%). There is also approximately 2% of an alder plant community in the uplifted beach unit (inclusion).

The hemlock/blueberry association occurs over most of the ecological unit. The hemlock/devil's club association occurs primarily to the northwest of the Fort Site, in an area of hummock and hollow topography. Devil's club is an indicator of wet but aerated soils (Martin et al., 1985) which may occur in this sort of topography.

The alder community occurs on the tip of Park land southeast of the Russian memorial. This area has been disturbed by dredging, dredge spoil deposition, and previous location of a hot asphalt plant. The existing alder grove has colonized this disturbed area and may eventually be succeeded by a western hemlock stand.

The hemlock plant associations are fairly productive since soils are deep and well-drained. In older growth, a multi-layered hemlock overstory occurs above the shrub and conifer sapling layer, with a well-developed forb and fern layer below. Much of the Park, however, is second growth, and shows a relatively uniform height overstory. In areas where the canopy has been opened (e.g. by windthrow), there is a well-developed shrub understory. Under the denser canopies there are only a few shrubs and limited forb and fern layers.

Floodplain

This ecological unit occurs on the Indian River floodplain landform. The floodplain is subject to flooding only during periods of extreme runoff concentrations in the river (possibly once every 20 to 50 years). Elevation is about 5 to 15 feet.

This unit is an association of two soils. The Typic Cryumbrepts are very deep and moderately well drained and occupy about 50% of the unit. They occupy positions with little or no run-on from adjacent areas. These soils are typically peat about 0.5 inch thick overlying the mineral layers. The mineral surface is sandy loam about 7 inches thick. The next layer is stratified extremely gravelly loamy sand to gravelly sandy loam to 40 inches or more.

The Aquic Cryumbrepts are very deep and somewhat poorly drained and also occupy about 50% of the unit. They occupy positions receiving run-on from adjacent areas and sub-lateral flow of water. These soils are typically peat and mucky peat about 1 inch thick overlying the mineral layers. The mineral surface is loam and sandy loam about 6 inches thick. The next layer is loam, gravelly loam, and gravelly sandy loam to 50 inches or more.

Both soils formed in alluvium from mixed mineralogy. Slope is 0 to 5 percent.

Both soils support an red alder-salmonberry plant community which can tolerate the subsurface flooding and drainage conditions found in this unit.

The alder communities (on both sides of Indian River) are early successional communities which have colonized the floodplain soils. Alder typically colonizes disturbed areas such as road or trail edges and floodplains, along with salmonberry. The alder communities exhibit a three-layered structure, with an alder overstory at an even height, a salmonberry understory, and a fairly well-developed, but limited diversity, forb layer at ground level.

The alder communities are transitional to spruce plant associations such as the spruce/devil's club-salmonberry one found on the stream terrace along the exercise trail. Young spruce can be seen developing under the alders, particularly between the exercise trail and Indian River near the estuary. A major flood event could remove the existing alder and conifer regeneration. Following such a disturbance, alder would likely be the first colonizing tree species. Alders play an important role in soil fertilization and development by fixing atmospheric nitrogen to a form usable by most plants.

The alder communities are identified by the absence of a conifer overstory and by the open canopy, rapidly growing, alder stands.

Stream Terrace

This ecological unit occurs on the stream terrace landform along Indian River. It is the old floodplain (now stream terrace) of Indian River. The terrace is rarely subject to flooding anymore, except during periods of high intensity, long duration storms; possibly once every 50 to 100 years. Elevation is about 10 to 20 feet.

The unit is an association of two soils. Each occupies about 50% of the unit. Both are very deep and well drained and vary only by the amount of rocks and sand within the soil. The area is highly dissected with small channels which transmit sub-lateral flow of water derived from runoff from adjacent areas. There are small inclusions where these channels intersect trails and pond water on the soil surface. We could not distinguish the two soils' relative positions since both occupy slightly elevated positions and both occupy the slightly incised channels. The soils formed in alluvium from mixed mineralogy. Slope is 0 to 5 percent.

The coarse-loamy Typic Cryochrepts are typically mucky peat about 1.25 inches thick overlying the mineral layers. The mineral surface is loam and silt loam about 6 inches thick. The next layer is stratified sandy loam to silt loam about 48 inches thick overlying extremely gravelly loamy sand at 54 inches.

The sandy-skeletal Typic Cryochrepts are typically peat, mucky peat, and muck about 3 inches thick overlying the mineral layers. The mineral surface is loam and very fine sandy loam about 4 inches thick. The next layer is stratified extremely gravelly loamy coarse sand to very gravelly fine sandy loam to 40 inches or more.

These soils support three vegetation types, with the hydrologic regime controlling their occurrence. Approximately 5% of the unit is a spruce/devils' club-salmonberry association (inclusion), 30% a hemlock/devil's club, and 65% a hemlock/blueberry plant association.

The spruce association occurs in areas with greater soil water movement, such as where there are old stream channels or hummock and hollow topography. These conditions occur on the east side of Indian River, along the exercise trail. Spruce is able to tolerate these conditions and grow rapidly. The association shows an open canopy with a relatively dense shrub layer. The overstory spruce are frequently taller than hemlocks in adjacent associations.

Devil's club under hemlock is also associated with soil water movement, such as the areas on the west side of Indian River, west of the river trail and south of the bridge, where the terrace abuts the sloping moraine landform. The hemlock/blueberry association occurs in the stream terrace areas without much subsurface water flow.

Portions of the terrace have old growth forest characteristics such as multiple canopy layers and trees of varying diameters. This old growth-like stand occurs in the northeast corner and includes the largest trees in the Park. It includes both hemlock/blueberry and hemlock/devil's club plant associations, with occasional spruce in the overstory, usually taller than the hemlock. The terrace also includes areas of young second growth, where most trees are roughly the same height and diameter. Species diversity on the terrace is limited due to lower light availability under the canopy and to human disturbance of the understory layers.

The plant associations are identified by overstory tree species cover, with at least 15% spruce cover required to name a spruce association. Spruce associations are also identified by site conditions which include some form of perturbation, such as flooding, since disturbance is required to sustain spruce as the dominant tree. At least 5% devil's club cover is present in the devil's club associations.

Moraine

This ecological unit occurs on the lateral moraine landform that lies on both sides of Indian River, oriented parallel to the river. It has the shape and orientation of a lateral moraine, but since it was under water and subject to river and tidal influences, it could be argued that it is the highest elevation of uplifted beach, or a combination of uplifted beach and lateral moraine. The unit is on level to convex positions between areas of the stream terrace and uplifted beach. Summits are 0 to 5 percent slopes with sideslopes of 5 to 10 percent. Elevation is about 15 to 25 feet.

Soils belong to the sandy-skeletal, mixed family of Humic Cryorthods and are very deep and well drained. They formed in glacial till of mixed mineralogy. Slope is 0 to 10 percent. The soils are typically peat, mucky peat, and muck about 8.5 inches thick overlying the mineral layers. The mineral layers are stratified extremely gravelly coarse sand to extremely gravelly loam to 40 inches or more.

These well drained, deep soils support the western hemlock/blueberry plant association. The unit also includes an inclusion (5%) of similar, disturbed soils supporting a spruce/salmonberry community, occurring near the Russian memorial and the old asphalt plant site.

The hemlock stands on the moraine are mostly even-aged, with similar tree heights and diameters. An occasional spruce is found in the overstory, usually taller than the hemlocks. The shrub layer shows its best development in canopy gaps. Species diversity is limited in the hemlock association, due to limited light availability and human disturbance in the Park.

The hemlock plant association is identified by a western hemlock overstory and absence of indicator plants in the understory, such as devil's club or skunk cabbage. The spruce community shows at least 15% spruce overstory and a dense salmonberry understory. It is a successional community, derived from past disturbances and likely to gradually develop into the hemlock type.

Lowlands

This ecological unit occurs above the moraine on the west side of Indian River. The landform is lowlands, actually an area where the lateral moraine and lowlands converge. Note that "lowlands" as used here does not mean a landform with low elevation and an accompanying high water table. Rather, the term is based on the overall landscape position of the landform type. The unit occupies the highest elevation of the landforms in the Park, about 20 to 40 feet.

This unit is an association of three soils. The Humic Cryorthods and Spodic Haplocryands occur on level to gently sloping areas. The McGilvery series of the dysic Lithic Cryofolists occur in one area of a bedrock (graywacke) knob.

The Humic Cryorthods are deep and somewhat poorly drained and occupy about 50% of the unit. They formed in alluvium from glacial till of mixed mineralogy. They are typically mucky peat about 3 inches thick overlying the mineral layers. The mineral surface is loam about 4 inches thick. The next layer is very gravelly silt loam and very gravelly loam about 4 inches thick. The next layer is very gravelly loamy sand and extremely gravelly loamy sand overlying graywacke bedrock at 40 inches.

The Spodic Haplocryands are deep and well drained and occupy about 35% of the unit. They formed in volcanic ash and glacio-marine sediments. They are typically peat, mucky peat, and muck about 13 inches thick overlying the mineral layers. The mineral surface is very fine sandy loam and fine sandy loam about 4 inches thick. The next layer is loamy coarse sand about 27 inches thick. The next layer is silt loam and fine sandy loam about 14 inches thick overlying graywacke bedrock at 45 inches.

The McGilvery soils are shallow and well drained and occupy about 15% of the unit. They formed in organics with thin layers of residuum over bedrock. Slope is 0 to 10 percent. They are typically peat about 11 inches thick. The next layer is sandy loam about 3 inches thick overlying graywacke bedrock at 14 inches.

Included in this unit is a small area of graywacke rock outcrop.

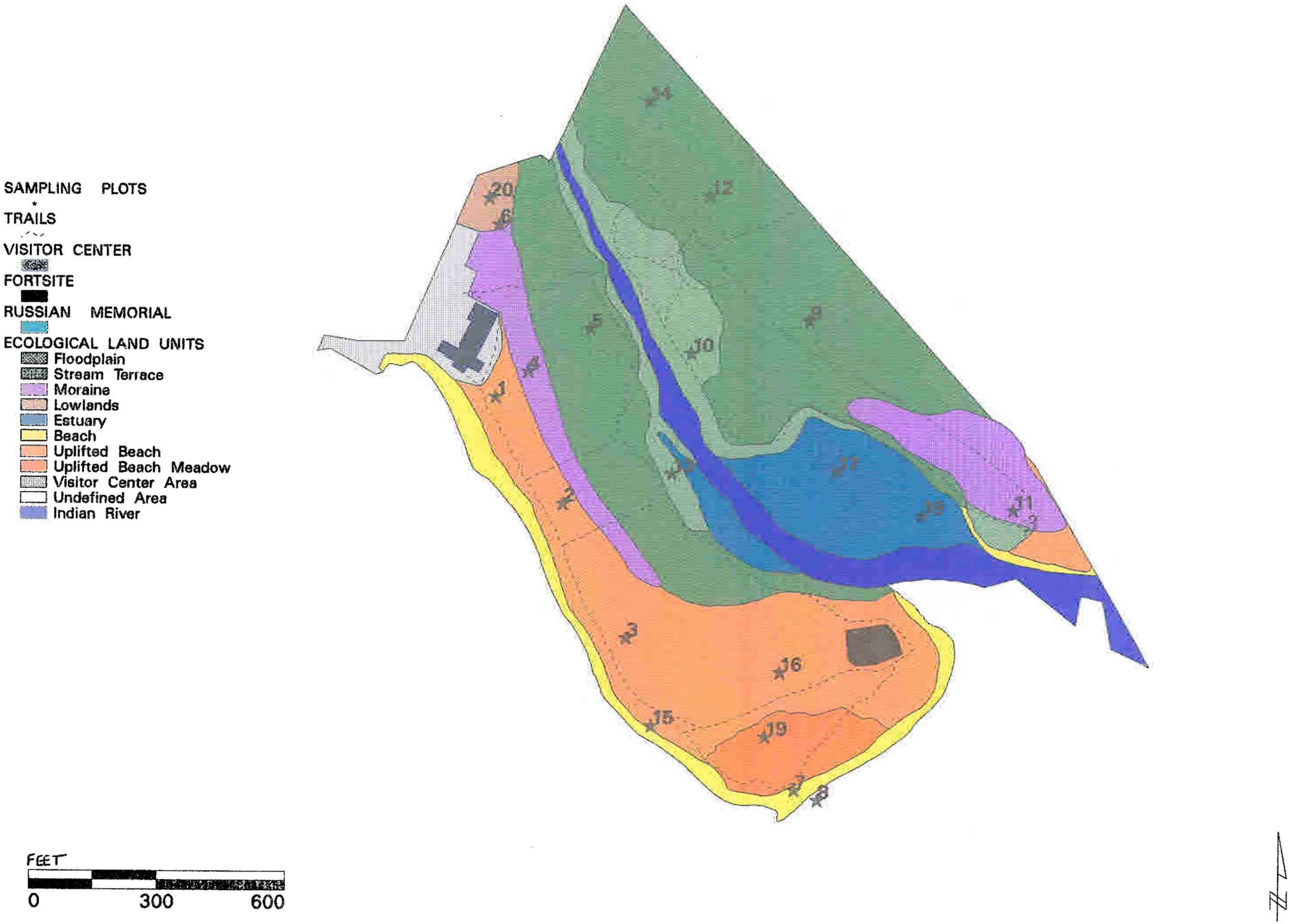
Despite the differences in the three soils, the environment they create supports one vegetation type. The entire lowland unit in the Park is the hemlock/blueberry plant association. This unit is in a disturbed area (where the Sheldon Jackson College cottages used to be), and the trees are younger than those in much of the rest of the

Park. The stand shows even tree heights and diameters, little forb development, and best shrub development in canopy gaps. The association is identified as described above for hemlock/blueberry associations.

Ecological Unit Map

The Ecological Unit Map (Figure 2) shows the boundary of the Park with all the ecological land units described above. Some of these unit boundaries are clearly visible in the field, since they are based on topography. Others are less easily seen. Also noted are the sampling plots where soil pits and/or vegetation plots were described. Trails are indicated by the dashed line and three cultural areas are depicted: the Visitor's Center, the memorial to the Russian sailors, and the old fort site. This map is the same map as the accompanying mylar plot map which can be used as an overlay to the large color aerial photo. The mylar, however, also has the hazard trees identified.

SITKA NATIONAL HISTORICAL PARK: ECOLOGICAL UNIT MAP



SOILS DESCRIPTIONS

The following soil descriptions mainly list soils by their taxonomic classification. This is because these soils have not been correlated to existing soil series due to small acreages. A few of the soils (McGilvery and Salt Chuck) are correlated to existing series. Many of the field soil profiles were similar, so a typical profile was selected and is described here.

Estuary

Soils: Typic Cryaquepts and Typic Cryaquents.

Classification: sandy and sandy-skeletal, mixed families of Typic Cryaquepts and Typic Cryaquents.

Composition: Typic Cryaquepts and similar soils - 88%
Typic Cryaquents - 12%
Contrasting inclusions - none

Parent Material: Alluvial sands, silts, and gravel reworked by tidal action and by Indian River during high flows.

Depth to Impermeable Layer: Greater than 60 inches to bedrock.

Drainage Class: Poorly drained; water table within 20 inches of the soil surface.

<u>Typic Cryaquepts, 0 to 5 percent slopes</u>

Site Relationships: Terraces between channels at the more landward portions of the estuary.

Typical Profile:

A:	0	to	3	inches -	very dark gray (7.5YR 3/1) gravelly loam; weak fine subangular blocky structure; very friable, slightly sticky and nonplastic; 25 percent gravel
Bw1:	3	to	6	inches -	dark reddish brown (5YR 2.5/2) very gravelly sandy loam; weak medium subangular blocky structure; very friable, nonsticky and nonplastic; 40 percent gravel
Bw2:	6	to	13	inches -	very dark grayish brown (10YR 3/2) very gravelly sandy loam; weak medium subangular blocky structure; very friable, nonsticky and nonplastic; 50 percent gravel

C: 13 to 60 inches - very dark gray (7.5YR 3/1) very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; 40 percent gravel

These soils are commonly stratified with layers of sand through extremely gravelly sand. Lenses of silt and organic matter also occur.

<u>Typic Cryaquents, 0 to 5 percent slopes</u>

Site Relationships: Seaward boundaries of estuaries where tidal action and salinity are strongest. Inundated twice daily.
Typical Profile:

C1: 0 to 5 inches - dark gray (7.5YR 4/1) sand; single grain; loose, nonsticky and nonplastic
C2: 5 to 60 inches - dark gray (7.5YR 4/1) very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; 50 percent gravel

These soils are commonly stratified with layers of sand through extremely gravelly sand. Lenses of silt and organic matter also occur.

Uplifted Beach Meadow

Soils: Typic Cryofluvents, 0 to 5 percent slopes.

Classification: sandy-skeletal, mixed Typic Cryofluvents.

Composition: Typic Cryofluvents and similar soils - 100%
Contrasting inclusions - none

Parent Material: Gravel and sand beach deposits.

Depth to Impermeable Layer: Greater than 60 inches to bedrock.

Drainage Class: Well drained; water table at depths greater than 60 inches.

Typical Profile:

A: 0 to 1 inch - black (10YR 2/1) loam; weak fine subangular blocky structure; very friable, slightly sticky and nonplastic; few fine, many very fine roots; 5 percent gravel

C:	1	to 8	inches -	black (5Y 2.5/2) very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; few coarse, medium, and fine, common very fine roots; 40 percent gravel
2C:	8	to 11	inches -	black (5Y 2.5/2) sand; single grain; loose, nonsticky and nonplastic; few medium, common fine and very fine roots; 5 percent gravel
Ab:	11	to 12	inches -	dark brown (10YR 3/3) sandy loam; massive; friable, nonsticky and nonplastic; few medium, common fine and very fine roots; 10 percent gravel
3C1:	12	to 23	inches -	black (5Y 2.5/2) extremely gravelly coarse sand; single grain; loose, nonsticky and nonplastic; few fine and very fine roots; 10 percent cobble, 50 percent gravel
3C2:	23	to 32	inches -	dark olive gray (5Y 2.5/2) very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; few very fine roots; 5 percent cobble, 35 percent gravel
3C3:	32	to 40+	inches -	black (5Y 2.5/2) extremely gravelly coarse sand; single grain; loose, nonsticky and nonplastic; 20 percent cobble, 40 percent gravel

Uplifted Beach

Soils: Salt Chuck gravelly loamy sand, 0 to 5 percent slopes.

Classification: sandy-skeletal, mixed Entic Cryumbrepts

Composition: Salt Chuck and similar soils - 92%
Satlt Chuck, water table phase - 8%

Parent Material: Gravel and sand beach deposits

Depth to Impermeable Layer: Greater than 60 inches to bedrock

Drainage Class: Well drained; water table at depths greater than 60 inches

Typical Profile:

Oi:	4.5	to 3.5	inches -	slightly decomposed organics; dark reddish brown (5YR 2.5/2) peat; common fine and very fine roots
Oe:	3.5	to 2	inches -	moderately decomposed organics; dark reddish brown (5YR 2.5/2) mucky peat; few coarse and medium, common fine and very fine roots

Oa:	2	to	0	inches -	highly decomposed organics; dark reddish brown (5YR 2.5/2) muck; common coarse, medium, fine and very fine roots
A1:	0	to	1	inch -	black (10YR 2/1) gravelly loamy sand; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; common coarse, medium, fine and very fine roots; 30 percent gravel
A2:	1	to	6	inches -	very dark grayish brown (10YR 3/2) gravelly sand; moderate medium subangular blocky structure; very friable, nonsticky and nonplastic; few coarse, common medium, fine and very fine roots; 5 percent cobble, 25 percent gravel
C1:	6	to	11	inches -	black (10YR 2/1) very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; few coarse and medium, common fine and very fine roots; 5 percent cobble, 50 percent gravel
C2:	11	to	16	inches -	black (10YR 2/1) extremely gravelly coarse sand; single grain; loose, nonsticky and nonplastic; few coarse and medium, common fine and very fine roots; 5 percent cobble, 60 percent gravel
C3:	16	to	26	inches -	very dark grayish brown (10YR 3/2) gravelly coarse sand; single grain; loose, nonsticky and nonplastic; few fine and very fine roots; 25 percent gravel
C4:	26	to	40+	inches -	very dark grayish brown (10YR 3/2) gravelly coarse sand; single grain; loose, nonsticky and nonplastic; 5 percent cobble, 20 percent gravel

Floodplain

Soils: Typic Cryumbrepts and Aquic Cryumbrepts

Parent Material: alluvium from mixed sedimentary and metamorphic.

Depth to Impermeable Layer: Greater than 60 inches to bedrock.

Composition: Typic Cryumbrepts - 50%
Aquic Cryumbrepts - 50%
Contrasting inclusions - none

Typic Cryumbrepts, 0 to 5 percent slopes

Site Relationships: Positions with little or no run-on from adjacent areas.

Classification: loamy-skeletal, mixed Typic Cryumbrepts.

Drainage Class: Moderately well drained; water table at 30 to 60 inches of the soil surface.

Typical Profile:

Oi:	0.5	to	0	inches -	slightly decomposed organics; black (10YR 2/1) peat
A:	0	to	3	inches -	very dark grayish brown (10YR 3/2) sandy loam; weak fine subangular blocky structure; very friable, slightly sticky and slightly plastic; few coarse and medium, common fine and very fine roots; 5 percent gravel
Bw:	3	to	7	inches -	dark brown (10YR 3/3) sandy loam; weak medium and fine subangular blocky structure; very friable, slightly sticky and nonplastic; common coarse, medium, fine, and very fine roots; 5 percent cobble, 5 percent gravel
2Bw1:	7	to	13	inches -	very dark grayish brown (10YR 3/2) extremely gravelly loamy sand; moderate fine subangular blocky structure; very friable, nonsticky and nonplastic; moderate coarse, medium, fine, and very fine roots; 15 percent cobble, 50 percent gravel
2Bw2:	13	to	24	inches -	black (10YR 2/1) extremely gravelly sandy loam; moderate medium subangular blocky structure; friable, slightly sticky and nonplastic; few coarse, medium, and fine, common very fine roots; 10 percent cobble, 50 percent gravel
3Bw:	24	to	35	inches -	black (10YR 2/1) gravelly sandy loam; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; few coarse and medium, common fine and very fine roots; 5 percent cobble, 25 percent gravel
4Bw:	35	to	40+	inches -	very dark grayish brown (10YR 2/1) very gravelly sandy loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; few medium and fine roots; 5 percent cobble, 50 percent gravel

Aquic Cryumbrepts, 0 to 5 percent slopes

Site Relationships: Positions receiving run-on from adjacent areas and sub-lateral flow of water.

Classification: coarse-loamy, mixed Aquic Cryumbrepts

Drainage Class: Poorly drained; water table is within 20 inches of the soil surface for at least 2 weeks during the growing season.

Typical Profile:

Oi:	1	to	0.5	inches -	slightly decomposed organics; dark reddish brown (5YR 2.5/2) peat; common medium, fine, and very fine roots
Oe:	0.5	to	0	inches -	moderately decomposed organics; dark reddish brown (5YR 2.5/2) mucky peat; common medium, fine, and very fine roots
A:	0	to	1	inch -	very dark brown (10YR 2/2) loam; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; common fine and very fine roots; 5 percent gravel
Bw1:	1	to	6	inches -	dark brown (10YR 3/3) sandy loam; few fine distinct, dark olive brown (2.5Y 3/4) mottles; moderate coarse subangular blocky structure; very friable, nonsticky and nonplastic; common medium, fine, and very fine roots; 10 percent gravel
Bw2:	6	to	13	inches -	dark brown (10YR 3/3) gravelly loam; common fine prominent, dark red (2.5YR 3/6) and common fine distinct, black (10YR 2/1) mottles; moderate coarse subangular blocky structure; very friable, nonsticky and nonplastic; common medium, fine, and very fine roots; 5 percent cobble, 10 percent gravel
Bw3:	13	to	25	inches -	dark brown (10YR 3/3) loam; many medium prominent, dark reddish brown (5YR 3/3) and many medium distinct, black (10YR 2/1) mottles; strong coarse subangular blocky structure; friable, slightly sticky and slightly plastic; few medium, common fine, and very fine roots; 5 percent gravel
C:	25	to	50+	inches -	very dark grayish brown (10YR 3/2) gravelly sandy loam; many coarse prominent, dark reddish brown (5YR 3/2) and many coarse distinct, black (10YR 2/1) mottles; moderate coarse subangular blocky structure; friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; 5 percent cobble, 10 percent gravel

Stream Terrace

Soils: coarse-loamy and sandy-skeletal Typic Cryochrepts.

Parent Material: Alluvium from mixed sedimentary and metamorphic rocks.

Depth to Impermeable Layer: Greater than 60 inches to bedrock.

Drainage Class: Well drained; water table at depths greater than 60 inches.

Composition: coarse-loamy Typic Cryochrepts - 50%
sandy-skeletal Typic Cryochrepts - 50%
Contrasting inclusions - none

<u>Typic Cryochrepts, 0 to 5 percent slopes</u>

Classification: coarse-loamy, mixed Typic Cryochrepts.

Typical Profile:

Oe:	1.25	to	0	inches -	moderately decomposed organics; black (10YR 2/1) mucky peat; common medium, fine, and very fine roots
A:	0	to	1.5	inches -	dark brown (10YR 3/3) loam; moderate medium subangular blocky structure; friable, sticky and plastic; few coarse and medium, common fine and very fine roots
Bw1:	1.5	to	6	inches -	dark yellowish brown (10YR 4/4) silt loam; moderate coarse subangular blocky structure parting to weak medium subangular blocky; friable, sticky and plastic; few coarse and medium, common fine and very fine roots
Bw2:	6	to	9	inches -	brown (10YR 4/3) very fine sandy loam; moderate coarse subangular blocky structure parting to weak medium subangular blocky; very friable, slightly sticky and slightly plastic; few medium and fine, common very fine roots
BC:	9	to	20	inches -	very dark grayish brown (10YR 3/2) sandy loam; weak coarse subangular blocky structure; very friable, nonsticky and nonplastic; few medium and fine, common very fine roots
C1:	20	to	26	inches -	dark brown (10YR 3/3) silt loam; moderate coarse subangular blocky structure; friable, sticky and plastic; few medium, fine, and very fine roots

C2:	26	to 34	inches -	dark brown (10YR 3/3) silt loam; moderate coarse subangular blocky structure; friable, sticky and plastic; few medium, fine, and very fine roots
C3:	34	to 43	inches -	brown (10YR 4/3) fine sandy loam; moderate coarse subangular blocky structure; very friable, slightly sticky and slightly plastic; few very fine roots
C4:	43	to 54	inches -	dark grayish brown (2.5Y 4/2) sandy loam; weak coarse subangular blocky structure; very friable, slightly sticky and slightly plastic
C5:	54	to 60+	inches -	dark brown (10YR 3/3) extremely gravelly loamy sand; single grain; loose, nonsticky and nonplastic; 5 percent cobble, 60 percent gravel

<u>Typic Cryochrepts, 0 to 5 percent slopes</u>

Classification: sandy skeletal, mixed Typic Cryochrepts.

Typical Profile:

Oi:	3	to 2.25	inches -	slightly decomposed organics; dark reddish brown (5YR 2.5/2) peat; few medium and fine, common very fine roots
Oe:	2.25	to 1.25	inches -	moderately decomposed organics; dark reddish brown (5YR 2.5/2) mucky peat; few medium and fine, common very fine roots
Oa:	1.25	to 0	inches -	highly decomposed organics; black (10YR 2/1) muck; few medium and fine, common very fine roots
A:	0	to 1	inch -	very dark grayish brown (10YR 3/2) loam; moderate medium subangular blocky structure; friable, nonsticky and nonplastic; few coarse, common medium, fine, and very fine roots; 5 percent gravel
E:	1	to 1.25	inches -	dark grayish brown (2.5Y 4/2) loam; moderate fine subangular blocky structure; friable, nonsticky and nonplastic; few coarse, common medium, fine, and very fine roots; 5 percent gravel
Bw:	1.25	to 4	inches -	brown (10YR 4/3) very fine sandy loam; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; common coarse, medium, fine, and very fine roots; 5 percent gravel

2Bw: 4 to 8 inches - dark yellowish brown (10YR 4/4) very gravelly fine sandy loam; common fine faint brown (7.5YR 4/4) mottles; weak thick platy structure parting to moderate coarse subangular blocky; friable, slightly sticky and slightly plastic; common coarse, medium, fine, and very fine roots; 40 percent gravel

2C1: 8 to 16 inches - brown (10YR 4/3) extremely gravelly coarse sandy loam; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; few coarse, medium, fine, and very fine roots; 15 percent cobble, 50 percent gravel

2C2: 16 to 25 inches - olive brown (2.5Y 4/3) extremely gravelly coarse sandy loam; single grain; loose, nonsticky and nonplastic; few fine and very fine roots; 85 percent gravel

2C3: 25 to 40+ inches - olive brown (2.5Y 4/3) extremely gravelly loamy coarse sand; single grain; loose, nonsticky and nonplastic; few very fine roots; 80 percent gravel

Moraine

Soils: Spodosols (as this soil is) have been reclassified based upon The International Committee on Spodosols recommendation about 1 year ago. The new classification is not encompassed in the entire taxonomic classification legends at the present time, so the old and new classifications are given.

Classification: sandy-skeletal, mixed Humic Cryorthods (old classification); sandy-skeletal, mixed Typic Humicryods (new classification).

Composition: Humic Cryorthods and similar soils - 95%
Similar soils with physical disturbance - 5%

Parent Material: Glacial till of mixed mineralogy.

Depth to Impermeable Layer: Greater than 60 inches to bedrock.

Drainage Class: Well drained; water table at depths greater than 60 inches.

Typical Profile:

Oi: 8.5 to 8 inches - slightly decomposed organics; dark reddish brown (5YR 2.5/2) peat

Oe: 8 to 7 inches - moderately decomposed organics; black (10YR 2/2) mucky peat; few medium, common fine and very fine roots

Oa: 7 to 0 inches - highly decomposed organics; dark reddish brown (5YR 2.5/2) muck; common coarse, medium, fine, and very fine roots

E: 0 to 2 inches - grayish brown (2.5Y 5/2) extremely gravelly sandy loam; very friable, nonsticky and nonplastic; moderate fine subangular blocky structure; few coarse and medium, common fine and very fine roots; 65 percent gravel

Bh: 2 to 9 inches - black (10YR 2/1) extremely gravelly loam; weak fine granular structure; friable, slightly sticky and slightly plastic; few medium, common fine and very fine roots; 70 percent gravel

Bhs: 9 to 18 inches - dark brown (7.5YR 3/2) extremely gravelly sand; single grain; loose, nonsticky and nonplastic; few fine and very fine roots; 80 percent gravel

C1: 18 to 26 inches - dark brown (7.5YR 3/2) extremely gravelly coarse sand; single grain; loose, nonsticky and nonplastic; 60 percent gravel

C2: 26 to 40+ inches - dark brown (7.5YR 3/2) extremely gravelly coarse sand; single grain; loose, nonsticky and nonplastic; 80 percent gravel

Lowlands

Soils: Humic Cryorthods, Spodic Haplocryands, and McGilvery.

Composition: Humic Cryorthods - 50%
Spodic Haplocryands - 35%
McGilvery peat - 15%
Rock outcrop - less than 1%

Humic Cryorthods, 0 to 10 percent slopes.

Classification: sandy-skeletal, mixed Humic Cryorthods (old).
sandy-skeletal, mixed Typic Haplocryods (new).

Parent Material: Alluvium from glacial till of mixed mineralogy.

Depth to Impermeable Layer: 40 to 60 inches deep to bedrock.

Drainage Class: Somewhat poorly drained; water table between 20 and 30 inches of the soil surface.

Typical Profile:

Oe: 3 to 0 inches - moderately decomposed organics; dark reddish brown (5YR 2.5/2) mucky peat

E:	0	to	1	inch	- dark gray (10YR 4/1) loam; moderate thick platy structure; friable, slightly sticky and slightly plastic; common coarse, many medium, fine, and very fine roots; 10 percent gravel
Bh:	1	to	4	inches	- black (10YR 2/1) loam; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; common coarse, many medium, fine, and very fine roots; 10 percent gravel
2E:	4	to	6	inches	- light gray (7.5YR 7/1) very gravelly silt loam; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; few coarse and medium, common fine and very fine roots; 40 percent gravel
2Bh:	6	to	8	inches	- black (7.5YR 2.5/1) very gravelly loam; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; few medium, common fine and very fine roots; 40 percent gravel
2Bhs:	8	to	14	inches	- dark brown (7.5YR 3/2) very gravelly loamy sand; single grain; loose, nonsticky and nonplastic; 40 percent gravel
2Bs:	14	to	40	inches	- reddish brown (5YR 4/4) extremely gravelly loamy sand; single grain; loose, nonsticky and nonplastic; 60 percent gravel
R:			40	inches	- hard graywacke bedrock

Spodic Haplocryands, 0 to 10 percent slopes

Classification: medial Spodic Haplocryands.

Parent Material: Volcanic ash in the upper 31 inches of the mineral soil over fine glacio-marine sediments over bedrock (graywacke).

Depth to Impermeable Layer: 40 to 60 inches to bedrock.

Drainage Class: Well drained; no water table above the bedrock.

Typical Profile:

Oi:	13	to	11	inches	- slightly decomposed organics; very dusky red (2.5YR 2.5/2) peat; many fine and very fine roots
Oe:	11	to	5	inches	- moderately decomposed organics; very dusky red (10R 2.5/2) mucky peat; common coarse, many medium, fine, and very fine roots

Oa:	5	to	0	inches -	highly decomposed organics; very dusky red (10R 2.5/1) muck; common coarse, many medium, fine, and very fine roots
E:	0	to	1.5	inches -	gray (5YR 6/1) very fine sandy loam; moderate medium and fine subangular blocky structure; friable, slightly sticky and nonplastic; few medium, many fine and very fine roots
Bh:	1.5	to	4	inches -	dark reddish brown (5YR 2.5/2) fine sandy loam; moderate medium and fine subangular blocky structure; friable, slighty sticky and nonplastic; common fine and very fine roots
Bhs:	4	to	11	inches -	dark reddish brown (5YR 3/3) loamy coarse sand; moderate fine subangular blocky structure; firm, nonsticky and nonplastic; common fine and very fine roots; 10 percent fine gravel
C:	11	to	18	inches -	very dark grayish brown (2.5Y 3/2) gravelly loamy coarse sand; massive (slightly compacted) parting to single grain; firm, nonsticky and nonplastic; 25 percent fine gravel
B'hs:	18	to	31	inches -	dark reddish brown (5YR 3/3) loamy coarse sand; weak fine subangular blocky structure; firm, nonsticky and nonplastic; 10 percent fine gravel
2C1:	31	to	34	inches -	dark olive gray (5Y 3/2) silt loam; massive; firm, sticky and plastic
2C2:	34	to	45	inches -	dark olive gray (5Y 3/2) fine sandy loam; massive; firm, slightly sticky and nonplastic
R:			45	inches -	hard graywacke bedrock

<u>McGilvery peat, 0 to 10 percent slopes</u>

Classification: dysic Lithic Cryofolists.

Parent Material: Organics over residuum from graywacke bedrock.

Depth to Impermeable Layer: 4 to 20 inches from the soil surface.

Drainage Class: Well drained; no water table above the bedrock.

Typical Profile:

Oi1:	0	to	1	inch -	slightly decomposed organics and live mosses; very dusky red (2.5YR 2/2) peat
Oi2:	1	to	11	inches -	slightly decomposed organics; very dusky red (2.5YR 2/2) peat; many coarse, medium, and fine roots

C:	11	to	14	inches -	dark gray (10YR 4/1) sandy loam; weak fine subangular blocky structure; friable, slightly sticky and nonplastic; many coarse, medium, and fine roots
R:			14	inches -	hard graywacke bedrock

PLANT ASSOCIATIONS AND COMMUNITIES DESCRIPTIONS

The plant association and plant community are vegetation units which transcend ecological unit boundaries. For example, the most common association in the Park, the western hemlock/blueberry association, occurs on several landforms and ecological units. Boundaries between communities (seral vegetation) or associations (potential natural, that is, "climax" vegetation) may be gradual or distinct, but each association and community occurs in the Park as a homogenous entity. Each vegetation type occurring in a significant portion of the Park is described in this section. Quantitative information is presented for the major types in the Park.

Western Hemlock/Blueberry (Tsuga heterophylla/Vaccinium spp.)

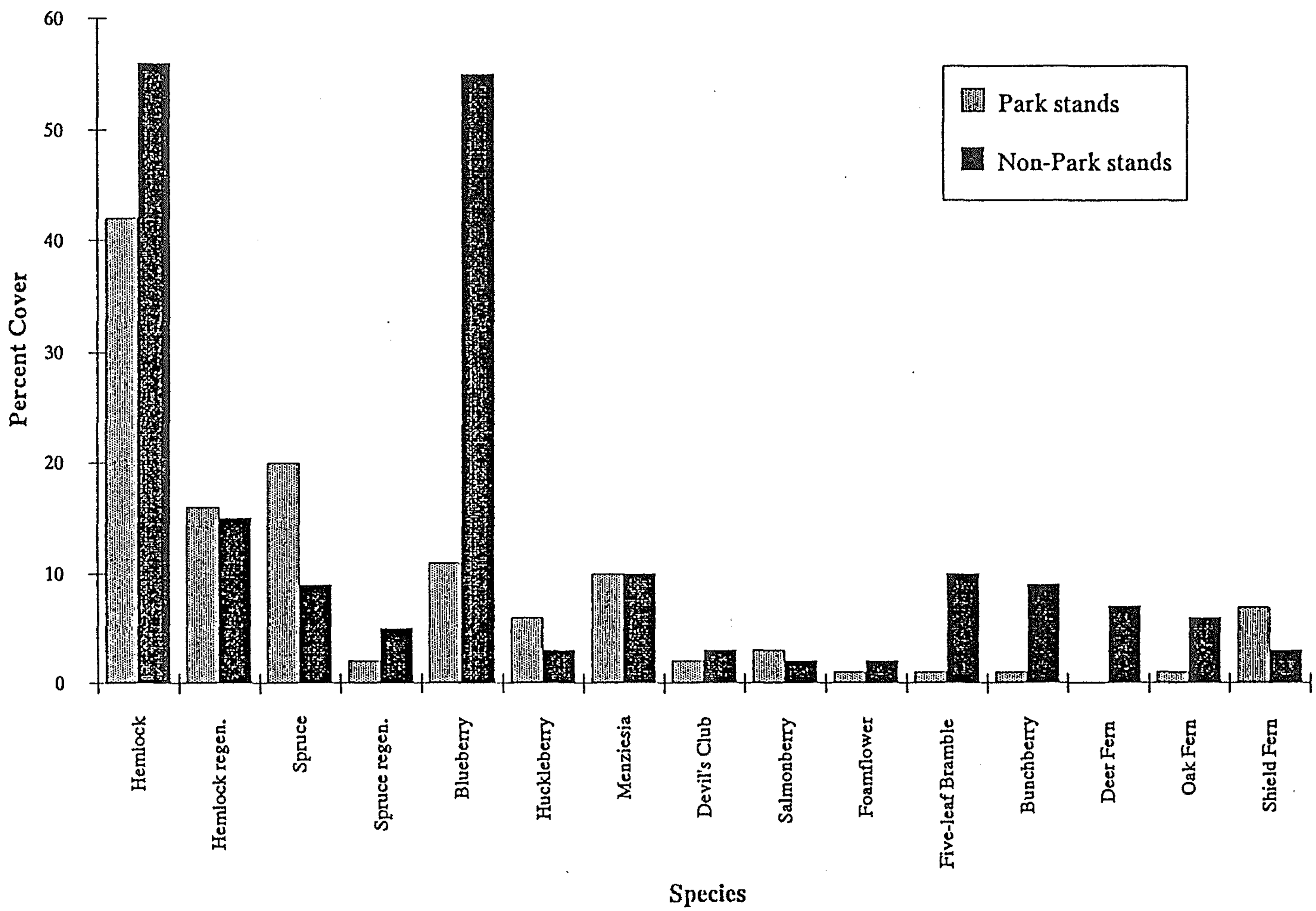
The western hemlock/blueberry association is one of the most abundant forest types in northern southeast Alaska. It occurs from near sea level to just below the cold mountain hemlock zone on mostly steeper hill and mountain slope landforms (Martin et al., 1993, in preparation).

Western hemlock dominates in this moderately productive, closed canopy, forest type. Sitka spruce is commonly a minor part of the overstory. Blueberry, red huckleberry, rusty menziesia, and western hemlock regeneration (young trees) dominate the understory. Bunchberry, foamflower and five-leaf bramble occur in canopy gaps. Deer, oak and shield fern may be present.

As stated in the Ecological Unit Descriptions Section, this association occurs over several landforms and much of the Park. It is found on all the stable landforms including the moraine, the lowlands, the uplifted beach, and parts of the stream terrace.

Figure 3 compares the percent of ground covered by various species in the western hemlock/blueberry plant association in the Park with values typical of this association in unmanaged, old growth stands across the Chatham Area of the Tongass National Forest. As shown, the Park association is depauperate in blueberry and low-growing plants such as five-leaf bramble and deer and oak ferns, as compared to unmanaged stands. Average overall canopy cover in this association in the Park is 64%.

Figure 3. Percent Cover Comparisons for Western Hemlock/Blueberry Associations



While percent cover allows comparison of composition of stands, it is also important to consider constancy. This is a measure of how frequently the species occurs in the plant association. For example, a species has a constancy of 100 if it occurs in every stand of the association. A species may have high cover but low constancy, making it a poor indicator of the type. Table 1 compares constancy values for species in the hemlock/blueberry association in the Park with old growth stands outside the Park. The Park is lacking in some of the common undergrowth species of this association; this is probably due to human impacts on vegetation.

TABLE 1. COMPARATIVE CONSTANCY VALUES FOR HEMLOCK/BLUEBERRY

Species	Park N = 9 plots Constancy	Non-Park N = 88 plots Constancy
Western Hemlock	100	100
Hemlock regeneration	100	100
Sitka Spruce	100	70
Spruce regeneration	22	65
Blueberry	100	100
Red Huckleberry	100	14
Devil's Club	56	53
Salmonberry	56	40
Menziesia	89	89
Foamflower	78	52
Five-leaf Bramble	67	98
Bunchberry	11	97
Deer Fern	0	67
Oak Fern	56	68
Shield Fern	100	63

The structure of hemlock/blueberry stands in the Park may be compared with structure in 88 stands of old growth sampled in the Chatham Area of the Tongass National Forest. In the Park, hemlock trees averaged 24 inches in diameter (at 4.5 feet above the ground, that is, diameter at breast height, dbh; 34 trees, standard deviation 7.8). In non-Park stands, average hemlock dbh was 19.5 inches (std. dev. 4.5). Spruce trees in the Park are also larger, averaging 28.8 inches dbh (48 trees, std. dev. 11.1) vs. 23.9 inches dbh (std. dev. 8.3).

Tree heights are also greater in the Park than in the old growth stands. In the Park, hemlock trees averaged 107 feet (23 trees, std. dev. 28.3) and spruce trees averaged 120 feet (28 trees, std. dev. 14.4). In non-Park stands, hemlock trees averaged 83.9 feet (std. dev. 13.4) and spruce trees averaged 93.5 feet (std. dev. 21). The larger size trees may be due to the good drainage available in the Park. However, a larger sample size would be needed to confirm the trend.

Understory structure in the Park is shown by blueberry height: of 10 plots in the Park, blueberry (Vaccinium alaskaense and V. ovalifolium) averaged 3.9 feet (std. dev. 0.91). Outside the Park, blueberry height averaged 3.1 (std. dev. 1.0). As mentioned, blueberry cover in the Park is lower than that of non-Park stands. The increased height is probably related to lack of browsing by deer.

In non-Park stands, deer appear to play an important role in understory dynamics in this plant association. This is especially true on warmer wintering areas close to saltwater, on southerly aspects, and along exterior island coastlines. Blueberry cover may be less than 5% and shrubs less than one-half foot tall during prolonged periods of high deer densities (Martin et al., 1993, in prep.)

In the Park, however, deer use of vegetation appears to be minimal, probably due to the frequent presence of people and dogs. Red huckleberry (Vaccinium parvifolium) is a preferred deer species and is usually less abundant than Alaska and early blueberry (V. alaskaense, V. ovalifolium). In the Park, the huckleberry is more abundant (6.2% average cover vs. 5.2% for the combined other species). The huckleberry also exhibits a greater average height: 4.3 feet vs. 3.8 feet.

Following disturbance (e.g. windthrow), western hemlock usually regenerates densely. Cover of blueberry and other shrubs in young (developing) stands may be high until the canopy closes, limiting light availability for underlying layers of vegetation.

The Park includes stands of the hemlock/blueberry association in various stages of development, due to human impacts and windthrow events. For example, there is a young second growth stand on both sides of Indian River south of the bridge, between the two cross trails on the west side and at a comparable location on the east side of the river. Old blown-down trees suggest that a major storm event probably damaged the stand and allowed colonization by the young hemlocks visible today. There is a somewhat older second growth stand in the northwest corner of the Park, where the Sheldon Jackson College cottages were previously located (in the lowlands ecological unit).

Western Hemlock/Devil's Club (Tsuga heterophylla/Oplopanax horridum)

As in the hemlock/blueberry association, western hemlock is also dominant in the hemlock/devil's club association. The devil's club association is generally more productive than the blueberry type however. There may be occasional spruce in the overstory.

The understory is dominated by devil's club. Salmonberry may also occur, usually at less than 5% cover, and there may be limited amounts of blueberry and menziesia. Foamflower and ferns dominate the herb layer (Martin et al., 1993 in prep.)

In the Park, this plant association occurs in the uplifted beach and stream terrace ecological units. As mentional earlier, the devil's club association occurs in areas of subsurface water movement, since devil's club is an indicator of such wet but aerated soils (Martin et al., 1993 in prep.).

In non-Park stands of the hemlock/devil's club association, hemlocks are usually at least 110 feet tall. The canopy is typically closed, but gaps are frequent (Martin et al., 1993 in prep.). There is a multi-layered canopy due to hemlock regeneration of various sizes. In the Park, this association is similar in structure to the hemlock/blueberry association described above.

In non-Park stands, the hemlock/devil's club association is usually not subject to extensive wildlife use. In the Park, wildlife use is also limited.

Sitka Spruce/Devil's Club-Salmonberry (*Picea sitchensis/Oplopanax horridum-Rubus spectabilis*)

In southeast Alaska, the spruce/devil's club-salmonberry association is common along low elevation valley bottoms (Martin et al., 1993, in prep.). In the Park, the pockets of this association probably indicate areas of soil water movement, such as in old channels of Indian River.

Sitka spruce dominates in this productive, moderately open canopy, forest type. Mature western hemlock trees may be abundant in a layer below the spruce. Hemlock and spruce regeneration is common. Devil's club and salmonberry dominate the understory. Blueberry may also occur. Forbs and ferns are abundant in areas where the understory is not disturbed by pets, people, and past Park practices. This association occurs on the stream terrace.

Figure 4 compares cover values for the spruce association, as found in the Park, with values typical of this association across the Chatham Area of the Tongass National Forest. As shown, the Park association is somewhat depauperate in the understory shrub, forb, and fern layers.

Table 2 compares constancy for representative species of this plant association in Park stands and non-Park stands. Again, the lack of development of the undergrowth species is probably related to human use of the Park.

Figure 4. Percent Cover Comparisons for Sitka Spruce/Devils' Club-Salmonberry Associations

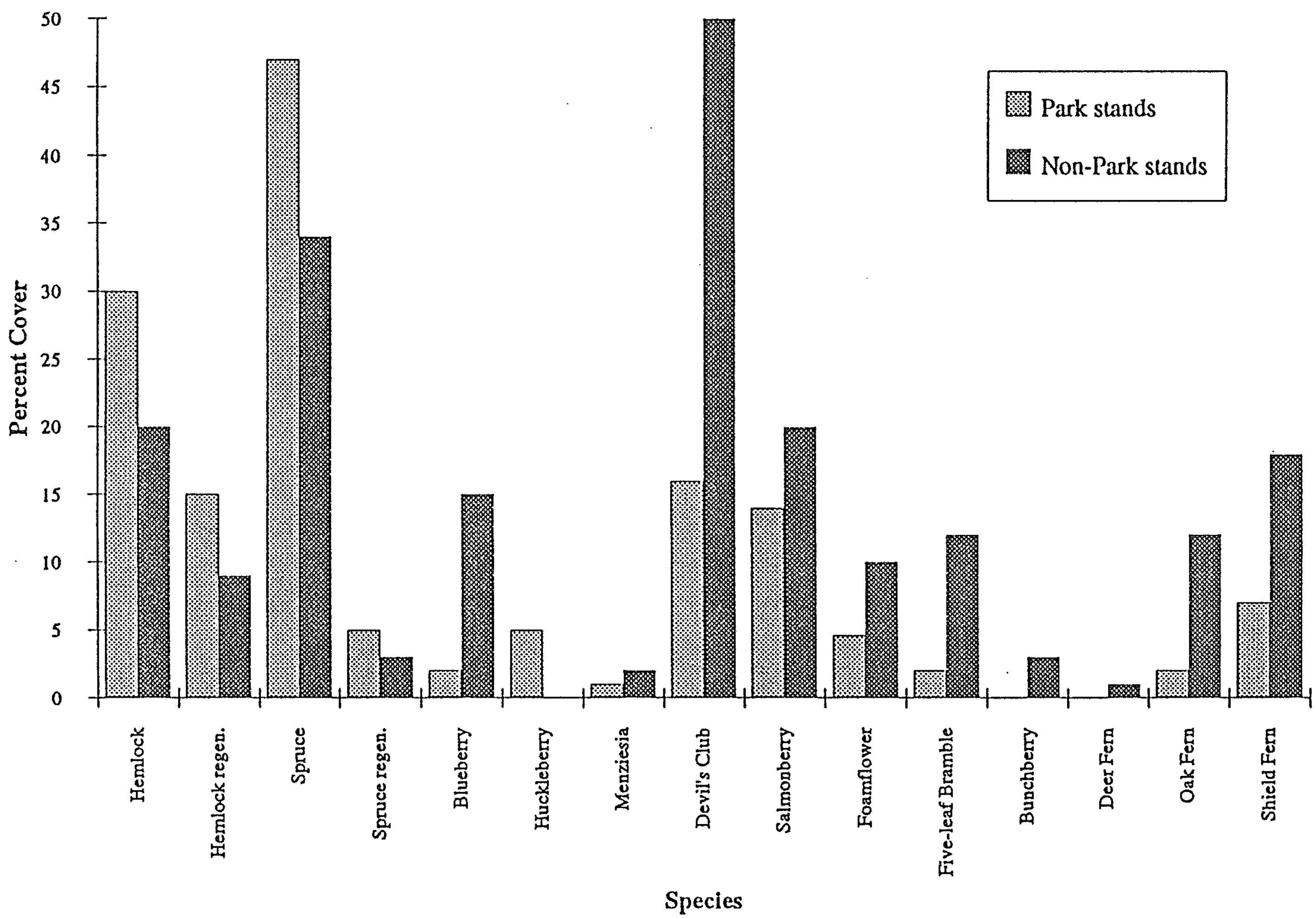


TABLE 2. COMPARATIVE CONSTANCY VALUES FOR SPRUCE/D. CLUB-SALMONBERRY

Species	Park N = 3 plots Constancy	Non-Park N = 5 plots Constancy
Western Hemlock	67	100
Hemlock regeneration	100	100
Sitka Spruce	100	100
Spruce regeneration	67	60
Blueberry	33	100
Huckleberry	67	0
Devil's Club	100	100
Salmonberry	100	100
Menziesia	33	40
Foamflower	100	100
Five-leaf Bramble	67	80
Bunchberry	0	100
Deer Fern	0	20
Oak Fern	67	100
Shield Fern	67	80

In non-park stands, brown bear tracks, diggings, and droppings are abundant, especially when this type occurs along a salmon stream (Martin et al., 1993, in prep.). Bears are rarely found in the Park. Bald eagles may utilize large spruce trees in the Park for nesting and roosting. Deer do not appear to have an important influence on understory vegetation.

Sitka Spruce/Salmonberry (Picea sitchensis/Rubus spectabilis)

Sitka spruce dominates the canopy in this productive, open canopy, forest type. Hemlock may also occur in the overstory. The understory is dominated by salmonberry, and devil's club may be present in minor amounts (DeMeo, 1989).

This plant community is successional in the Park, originating from past disturbances. It is likely to be replaced by a hemlock type. The community is very similar to the spruce/devil's club-salmonberry association.

Red Alder/Salmonberry (Alnus rubra/Rubus spectabilis)

This plant community is composed of fast-growing, relatively dense, red alder with a canopy closure of approximately 65%. The understory includes salmonberry and elderberry with small amounts of currant, devil's club, menziesia, and hemlock and spruce regeneration, and shows more than 50% cover. Forb and fern layers are not well developed. Exposed sand and gravel areas may be present.

As stated in the Ecological Unit Descriptions section, this community occurs on the geologically young floodplain unit. The red alder/salmonberry community is usually considered to be a successional stage on floodplains or other recently disturbed, unstabilized surfaces (e.g. landslide areas). With time and stabilization of the surface, the alder is expected to be succeeded by another plant association, typically a spruce association in southeast Alaska.

The alder communities play a valuable role in soil fertility since they fix nitrogen and help to stabilize active sites.

Red Alder (*Alnus rubra*)

This plant community consists of a dense, rapid-grown, open canopy, alder grove, probably due to site history and human disturbance. As mentioned, this grove occurs on the tip of land by the Russian memorial. There are some young hemlocks and salmonberry starting to colonize the understory. However, it is probable that heavy recreational use of this area will limit development of the forb, fern and shrub layers.

Red Alder-Sitka Spruce/Salmonberry (*Alnus rubra-Picea sitchensis/Rubus spectabilis*)

This plant community occurs as a successional stage on the beach meadow landform. It shows a mixed alder and spruce overstory, with the alders generally taller. Salmonberry dominates the understory. There is limited ground cover.

Grass-Umbel

The grass-umbel plant community occurs on the uplifted beach meadow landform and is a non-forested, successional community. It includes tall umbelliferous plants such as cow parsnip and angelica above a grass layer. A few forbs occur under the grass canopy. The plants in this community are sun-loving, able to tolerate inundation by salt water during storm events.

Estuarine Communities

The estuarine plant communities are productive, one-stratum, wetland types. As stated in the Ecological Unit Descriptions section, there are hairgrass, hairgrass-forb, and sedge communities. Each of these primarily includes salt and flooding tolerant species.

The hairgrass types exhibit a grass canopy above yarrow or ground-covering species like sandwort. They occur at mid-elevation positions in the estuary. Landward, the proportion of forbs increases. Although the estuary species are productive in terms of annual biomass, there is bare ground visible in the communities and periodic plant loss and regrowth.

The sedge community occurs in the most frequently flooded portion of the estuary. The sedges are abundant, dense, and highly productive.

VASCULAR PLANT SPECIES INVENTORY

In late summer 1992, field surveys were conducted at the Sitka National Historical Park to identify all vascular plants. (The inventory did not include non-vascular plants such as mosses, algae, or lichens.) All parts of the Park were examined, and every plant encountered during the searches was identified. The resulting information was compiled into the following preliminary checklist. Since detailed surveys were not conducted during the spring and early summer, many plants were probably overlooked. Additions to the checklist should be made as needed, after future surveys.

For each plant the following information is included:

scientific name,
family,
common name,
brief habitat information,
life form.

The list is arranged alphabetically by genus and species. Scientific and common names generally follow Welsh (1974) and Hitchcock and Cronquist (1973). In several cases the local common name is listed rather than the published name. Many plants have no common name, hence there are some gaps in this category.

Habitat information is general. Very commonly occuring species in the Park and those introduced to the area since Russian contact (i.e. alien plants) are so marked in the habitat category.

Life form is a grouping of various types of plants according to their general form:

P = pteridophytes (ferns and allies),
G = grass-like plants,
F = forbs, (non-woody plants that die back each year),
S = shrubs, (low woody plants, generally under 10 feet),
T = trees, (tall woody plants, generally over 10 feet).

In some cases there is an indistinct difference between herb and shrub or shrub and tree.

VASCULAR PLANT SPECIES LIST FOR SITKA NATIONAL HISTORICAL PARK

Species (Family)	Vernacular Name	Habitat	Life Form
Achillea (Asteraceae)			
millefolium			
var. borealis	Yarrow	open areas, beach meadows, common	F
Agrostis (Poaceae)			
alaskana	Alaska bentgrass	meadows	G
exarata	Spike redtop	meadows, open areas, common	G
Alnus (Betulaceae)			
crispa			
ssp. sinuata	Sitka alder	forest edge along beaches, common	S
rubra	Red alder	forest edge, common	T
Angelica (Apiaceae)			
genuflexa	Bent-leaved angelica	wet areas, beaches, meadows	F
lucida	Sea coast angelica	wet areas, beaches, meadows	F
Aquilegia (Ranunculaceae)			
formosa	Western columbine	beach meadows, forest edge	F
Arabis (Cruciferae)			
lyrata			
var. kamchatica	Kamchatica rockcress	wet rocky places, open areas	F
Arceuthobium (Loranthaceae)			
tsugense	Dwarf mistletoe	parasitic on western hemlock, abundant	F
Aruncus (Rosaceae)			
sylvester	Goatsbeard	forest edges, meadows, streambanks	F
Athyrium (Polypodiaceae)			
filix-femina	Lady Fern	open forests, open areas, common	P
Atriplex (Chenopodiaceae)			
patula	Spearscale	beaches	F
Barbarea (Cruciferae)			
orthoceras	Wintercress	open or disturbed areas, meadows	F
Blechnum (Polypodiaceae)			
spicant	Deer fern	forest, forest edge, common	P
Boschniakia (Orobanchaceae)			
rossica	Ground-cone	forest edge, parasitic on alder root	F
Bromus (Poaceae)			
pacificus	Pacific brome	open areas, beach meadows	G

Species (Family)	Vernacular Name	Habitat	Life Form
Calamagrostis (Poaceae)			
canadensis			
var. langsdorffii	Bluejoint reedgrass	meadows, upper beach meadows, common	G
Calypso (Orchidaceae)			
bulbosa	Fairy slipper orchid	mossy forest, forest near beach	F
Capsella (Cruciferae)			
bursa-pastoris	Shepherd's purse	disturbed areas, introduced	F
Cardamine (Cruciferae)			
oligosperma			
var. kamtschatica	Little western bittercress	open areas	F
Carex (Cyperaceae)			
gmelinii	Gmelin sedge	meadows, near beaches	G
lyngbyei	Lyngbye sedge	upper beaches, common	G
macrochaeta	Long-awn sedge	open wet areas	G
mertensii	Mertens sedge	open areas, meadows, common	G
Castilleja (Scrophulariaceae)			
unalaschcensis	Yellow paintbrush	upper beach meadows	F
Cerastium (Caryophyllaceae)			
beeringianum	Bering chickweed	meadows, open areas	F
Claytonia (Portulacaceae)			
sibirica	Siberian spring-beauty	open areas, meadows, common	F
Cochlearia (Cruciferae)			
officinalis	Scurvy-grass	beaches, upper beach meadows, common	F
Conioselinum (Apiaceae)			
pacificum	Western hemlock-parlsey	meadows, upper beach meadows	F
Coptis (Ranunculaceae)			
asplenifolia	Fern-leaf goldthread	wet forested areas	F
Coptis (Ranunculaceae)			
trifolia	Trifoliate goldthread	wet forested areas	F
Corallorhiza (Orchidaceae)			
mertensiana	Merten's coral-root	forest	F
Cornus (Cornaceae)			
canadensis	Bunchberry	forest, forest edge, abundant	F
Cystopteris (Polypodiaceae)			
fragilis	Fragile-fern	forests, wet rocks, common	P

Species (Family)	Vernacular Name	Habitat	Life For
Deschampsia (Poaceae)			
beringensis	Bering hairgrass	upper beach meadows, common	G
caespitosa	Tufted hairgrass	upper beach meadows, common	G
Dryopteris (Polypodiaceae)			
austriaca	Spinulose shield-fern	forest, forest edge, common	P
Elymus (Poaceae)			
hirsutus	Northern ryegrass	forest edge, meadows	G
mollis	Beach rye	upper beaches, common	G
Epilobium (Onagraceae)			
adenocaulon	Northern willow-herb	meadows, open or disturbed areas	F
angustifolium	Fireweed	open areas, meadows, common	F
Fauria (Menyanthaceae)			
crista-galli	Deer cabbage	wet meadows	F
Equisetum (Equisetaceae)			
arvense	Meadow horsetail	wet areas, open areas, common	P
Festuca (Poaceae)			
rubra	Red fescue	open areas, meadows, upper beaches	G
Fritillaria (Liliaceae)			
camschatcensis	Chocolate lily	beaches, meadows, common	F
Galium (Rubiaceae)			
aparine	Cleavers	upper beach meadows, open areas	F
trifidum	Small bedstraw	open areas	F
triflorum (2)	Sweet-scented bedstraw	forest edge, open areas	F
Geranium (Geraniaceae)			
erianthum	Northern geranium	upper beach meadows, common	F
Geum (Rosaceae)			
macrophyllum	Large-leaf avens	open areas, disturbed areas, common	F
Glaux (Primulaceae)			
maritima	Sea milkwort	beaches	F
Goodyera (Orchidaceae)			
oblongifolia	Menzies' rattlesnake plantain	forests	)
Gymnocarpium (Polypodiaceae)			
dryopteris	Oak-fern	forests, open forest, common	I
Heracleum (Apiaceae)			
lanatum	Cow parsnip	meadows, upper beach meadows, common	

Species (Family)	Vernacular Name	Habitat	Life Form
Honkenya (Caryophyllacae)			
peploides			
var. major	Sea-beach sandwort	upper beaches, common	F
Hordeum (Poaceae)			
brachyantherum	Meadow barley	upper beach meadows	G
Juncus (Juncaceae)			
arcticus			
var. balticus	Arctic rush	upper beaches, beach meadows	G
bufonius	Toad rush	open areas, disturbed areas	G
Lathyrus (Fabiaceae)			
japonicus			
var. glaber	Beach pea	sandy beaches, upper beach meadows	F
Ligusticum (Apiaceae)			
scoticum			
ssp. hultenii	Hulten sea-lovage	beaches, common	F
Listera (Orchidaceae)			
cordata	Heart-leaved twayblade	forest	F
Luzula (Juncaceae)			
campestris			
var. minor	Field woodrush	grassy areas, open areas, common	G
parviflora	Small flowered woodrush	forests, meadows, common	G
Lysichitum (Araceae)			
americanum	Yellow skunk cabbage	poorly drained areas, common	F
Maianthemum (Liliaceae)			
dilatatum	Deerberry	forest, forest edge, common	F
Malaxis (Orchidaceae)			
monophyllos			
var. monophyllos	White adder's tongue	upper beach meadows	F
Malus (Rosaceae)			
fusca	Oregon crab apple	forest edge, above beaches	T
Matricaria (Asteraceae)			
matricarioides	Pineapple weed	waste places, open areas, introduced	F
Menziesia (Ericaecae)			
ferruginea			
var. ferruginea	Rusty menziesia	forests, common	S
Mimulus (Scrophulariaceae)			
guttatus	Yellow monkey-flower	wet areas, along streams, common	F
Moehringia (Caryophyllaceae)			
lateriflora	Blunt-leaved sandwort	meadows, open areas	F

Species (Family)	Vernacular Name	Habitat	Life Form
Moneses (Pyrolaceae)			
uniflora	Single delight	forests, common	F
Oplopanax (Araliaceae)			
horridum	Devil's Club	forest, forest edge, common	S
Osmorhiza (Apiaceae)			
chilensis	Chile sweet-cicely	forest, forest edge	F
purpurea	Sitka sweet-cicely	forest, forest edge	F
Phleum (Poaceae)			
pratense	Timothy	meadows, open areas, introduced	G
Picea (Pinaceae)			
sitchensis	Sitka spruce	forests, common	T
Plantago (Plantaginaceae)			
macrocarpa (4)	Seashore plantain	beach meadows, estuaries	F
major	Common plantain	disturbed areas, introduced	F
maritima (2)			
var. juncoides	Goose-tongue	upper beaches	F
Poa (Poaceae)			
palustris	Fowl bluegrass	meadows, disturbed areas, introduced	G
Polypodium (Polypodiaceae)			
glycyrrhiza	Licorice fern	forests, rock outcrops, upper beaches	P
Potentilla (Rosaceae)			
anserina			
var. grandis	Common silverweed	upper beaches, beach meadows, common	F
villosa	Villous cinquefoil	beaches, beach rocks, common	F
Prenanthes (Asteraceae)			
alata	Rattlesnake root	wet open areas, beaches, common	F
Puccinellia (Poaceae)			
nutkaensis	Pacific alkaligrass	beaches, below high tide, common	G
Ranunculus (Ranunculaceae)			
repens	Creeping buttercup	waste places, introduced, common	F
uncinatus	Bongard's buttercup	meadows, open areas	F
Rhinanthus (Scrophulariaceae)			
crista-galli	Rattlebox	meadows, disturbed areas	F
Ribes (Grossulariaceae)			
bracteosum	Stink currant	open forest, forest edge	S
laxiflorum	Trailing black currant	open forest, forest edge	S

Species (Family)	Vernacular Name	Habitat	Life Form
Rubus (Rosaceae)			
parviflorus	Western thimbleberry	forest edge, beach fringe	S
pedatus	Five-leaf bramble	forest, common	F
spectabilis	Salmonberry	forest edge, open areas, common	S
Rumex (Polygonaceae)			
acetosella	Sheep sorrel	upper beaches, disturbed areas	F
Sagina (Caryophyllaceae)			
crassicaulis	Beach pearlwort	beaches	F
Salix (Salicaceae)			
sitchensis	Sitka willow	open areas, gravelly areas	S
Sambucus (Caprifoliaceae)			
racemosa			
var. arborescens	Pacific red elderberry	forest edge, open areas	S
Sorbus (Rosaceae)			
sitchensis	Sitka mountain-ash	forest edge, open areas	T
Spergularia (Caryophyllaceae)			
canadensis			
var. canadensis	Canada sand-spurry	beaches	F
Stellaria (Caryophyllaceae)			
calycantha	Northern starwort	meadows	F
crispa	Crisp starwort	meadows	F
Streptopus (Liliaceae)			
amplexifolius	Clasping twisted-stalk	forests, forest edge, common	F
roseus			
var. curvipes	Rosy twisted-stalk	forests	F
streptopoides	Kruhsea	forests	F
Taraxacum (Asteraceae)			
officinale	Common dandelion	disturbed areas, meadows, introduced	F
Thelypteris (Polypodiaceae)			
phegopteris	Beech fern	forests	P
Tiarella (Saxifragacae)			
trifoliata	Trifoliate foamflower	forest, forest edge, meadows, abundant	F
Trientalis (Primulaceae)			
europea	Arctic starflower	forests, forest edge	F
Trifolium (Leguminosae)			
repens	White clover	open areas, introduced	F
Triglochin (Juncaginaceae)			
maritimum	Maritime arrowgrass	beaches, estuary	F

Species (Family)	Vernacular Name	Habitat	Life Form
Trisetum (Poaceae)			
cernuum	Nodding oatgrass	forests, meadows, open areas	G
Tsuga (Pinaceae)			
heterophylla	Western Hemlock	forests, abundant	T
Vaccinium (Ericaceae)			
alaskaense	Alaska blueberry	open areas, open forest, abundant	S
ovalifolium	Early blueberry	open areas, open forest, abundant	S
parvifolium	Red huckleberry	open areas, forest, abundant	S
vitis-idaea	Mountain cranberry	upper beach meadows	S
Veronica (Scrophulariaceae)			
serpyllifolia			
var. humifusa	Thyme-leaf speedwell	open areas, disturbed areas	F
Vicia (Fabiaceae)			
gigantea	Giant vetch	beaches, meadows, common	F
Viola (Violaceae)			
glabella	Stream violet	wet areas in forest, forest edges	F

DISTURBANCE AND DISEASE IMPACTS ON VEGETATION

Disturbance and Plant Communities

Vegetation communities in Sitka National Historical Park have been subject to considerable disturbance. Historically, portions of the Park may have been logged, and portions were cleared for trails, structures, and possibly for gardens (T. Stone, G. Griffin, pers. commun, 11/92). Other human-related disturbance factors include the following:

- trail construction and maintenance;
- understory clearing by jail inmates (stopped in 1920's according to Park staff);
- gravel dredging and spoils deposition;
- stream stabilization work and road construction for project;
- use of Park for defense--Tlingit-Russian battle and WWII machine gun pits;
- asphalt plant and tailings deposition;
- Sheldon Jackson College cottages;
- Sawmill Creek Road;
- fallen timber sawing and clearing throughout Park in the past;
- trimming in interpretive and recreational areas of Park;
- use of Park by hikers, joggers, fishermen, etc.

These factors have limited the development of classic old growth on the Park site, and have influenced the plant communities visible today. In addition, natural disturbance factors such as wind, disease, and salt spray also affect the vegetation in the Park.

Examples of disturbed areas have been discussed, such as the alder grove near the Russian grave memorial and the younger stands of hemlock--the dark woods--on both sides of Indian River south of the bridge.

Also as discussed, parts of the Park appear to have been less affected than others by human disturbance. The northeastern part has more old growth characteristics (multiple canopy layers, large-limbed trees, snags, old coarse woody debris on the ground) than the rest of the Park. However, old cut stumps in this area is evidence that selective logging occurred (e.g. by the Navy during the war effort).

Two large spruce trees may be seen in the northeast corner of the Park (one near Sawmill Creek Road, one near the exercise trail) which are estimated to be 400 to 500 years old (B. Dougan, USDA Forest Service, pers. comm., 11/92). Both are open-grown, as evidenced by their branching patterns. Both have broken tops. When intact, they probably resembled (or may have been among) the large trees which were admired and given names in the Park's historical records. Both trees are too large to allow their age to be determined by removing a narrow core and counting annual growth rings, the standard method for determining tree age. However, they represent the oldest tree generation remaining in the Park.

In order to determine approximate ages for some of the Park's trees, cores were removed from several hemlocks and spruces. The overstory in most of the Park was found to range in age from 100 to 125 years. On the northwest side of the Park near the maintenance shed, on the lowlands ecological unit, there is a pocket of younger trees, ranging in age from 60 to 90 years.

The Park also includes young--seedling and sapling--trees. These typically occur in gaps where overstory trees have fallen. Gap formation and subsequent colonization by shrubs and trees is an important, natural aspect of forest development. Gaps contribute to the mosaic of vegetation types in the forest, maintaining diversity.

TREE DISEASES, DECAYS AND ABIOTIC ABNORMALITIES IN THE PARK

Numerous organisms such as fungi live in antagonistic equilibrium with trees. In a healthy forest ecosystem, trees are vulnerable at each phase of their growth cycle to various organisms that can weaken or kill them. Climatic fluctuations enhance or inhibit the success of many disease organisms. Also, climate affects the rate at which decomposers can break down dying or dead trees. Locally, the cool temperatures and wet conditions slow the process of decomposition, leaving stumps and logs intact for long periods of time.

Following is a brief discussion of the more common and visible tree diseases, insect infestations and decay agents currently found in Sitka National Historical Park. Unless otherwise noted, all information contained in this portion of the report was provided by USDA (1985) and B. Dougan (USDA Forest Service, pers. commun., 1992).

Spruce Aphid - Homoptera: Aphididae

The spruce aphid is a naturally-occurring plant pest which affects all species of spruce but is most damaging to Sitka spruce and, in particular, to spruce occurring along saltwater or other stressed environments. Defoliation caused by aphids is evident on many Sitka spruce trees throughout the Park (and throughout Sitka), with varying degrees of "browning" or needle loss. The trees in the Park along Sawmill Creek Road show considerable aphid damage. These trees may have been subject to greater damage since they are probably stressed by their location adjacent to the open roadway and pollution from local sources.

Partial or complete needle loss with occasional subsequent mortality can result from severe aphid infestations, which are associated with mild winters. Weakened trees can also be attacked and killed by bark beetles whose populations build up in adjacent windthrow gaps. Natural epidemic aphid populations will generally only last a few years as competition for food or a severe winter returns their numbers to previous low levels. Plant pathologists or forest health specialists can estimate the likely size of aphid populations in the spring of the year, assisting resource managers in planning for possible tree mortality.

When the aphid populations are not at peak levels, tree defoliation is usually minor, and trees can recover in subsequent years. The aphid population fluctuations are a natural occurrence, as is aphid damage. Aphid damage, however, can be exacerbated in trees which are stressed by natural or human actions.

Hemlock Dwarf Mistletoe - Arceuthobium tsugense

Dwarf mistletoe is a parasitic, seed bearing plant that is common on western hemlock in Sitka National Historical Park. The roots of the mistletoe grow inside live plant tissues, occurring as a feeding structure in the cambial area of swollen tree tissues. Dwarf mistletoe interferes with tree hormones causing increased growth in the hemlock tissues that are infected. This results in branch or twig swellings, large disfiguring burls on main bole infections, and, most noticeably, "witches' brooms" or branch proliferations. A heavy infestation by mistletoe will reduce tree vigor, thereby reducing height and diameter growth, making infected trees more susceptible to insects and other disease. Severely infected trees may die.

Root Diseases

Two kinds of root disease are present in Sitka National Historical Park which affect all the tree species present. Each plays an important role in the decay of old growth or of fallen timber.

Annosus Root Disease - Heterobaasidion annosum

Annosus root disease causes root and butt rot of old growth, particularly on western hemlock. Losses are due to butt rot, windthrow caused by rotted roots, growth loss and tree mortality.

Armillaria Root Disease or Shoestring Rot - Armillaria sp.

Shoestring root rot functions as a decomposer of down wood and can quickly colonize root systems of recently dead or dying trees. Armillaria is rarely a main cause of tree death, but will contribute to mortality in stressed trees. This type of root rot infects all tree species in Alaska.

Decays

Red Belt Fungus - Fomitopsis pinicola

Among the many kinds of decay fungi present in the Park, red belt fungus may be the most commonly seen type. It infects both spruce and hemlock through wounds. The fruiting body is a perennial conk with a characteristic red outer margin, a grey to blackish upper surface and a light buff underside. This fungus causes a brown cubical heart rot and sap rot which eventually interferes with the normal growth of a tree. Many of the other decays only affect heartwood of living or dead trees or sapwood of dead trees, therefore not affecting normal growth of live trees, except where the structural weakening of a trees causes windthrow or tree breakage.

Animals, Abiotic and Unknown Factors Influencing Trees

Large animals have a minor impact on trees and vegetation in the Park. During winter deer will occasionally browse there.

Abiotic factors include air pollution, storms, and soil nutrient deficiencies. Large patches of windthrown trees are the most evident example of abiotic factors acting in the Park. The open wind channels created by the bay and Sawmill Creek Road result in high wind damage events associated with storms.

Hemlock fluting (the deeply incised vertical grooves and ridges on western hemlock) is prevalent among trees of the Park. The exact causes of fluting are unknown but are suspected to be genetic in origin, as well as influenced by site conditions. In southeast Alaska, fluting is especially prevalent in coastal stands following disturbance (Julin and Farr, 1989). Fluting becomes less obvious with age, as trees increase in diameter and the flutes become overgrown. Fluting does not usually kill the tree and may make it more windfirm (Julin and Farr, 1989).

HAZARDOUS TREE IDENTIFICATION

Hazardous tree identification was based on information provided by a Forest Service Silviculturist leading to the system outlined below. (B. Dougan, pers. commun., 1992)

A live tree or standing dead tree (snag) that may reasonably be expected to fall towards a Park trail or facility in the foreseeable future was identified as hazardous. Selection of potentially hazardous trees within the Park was based on the following considerations: 1) Trees with an exaggerated lean due to wind stress or the impact of another falling tree; 2) A large dead branch or tree with a split crown that is dead or weakened by cracking at the crotch of the tree; 3) A tree near an obvious blowdown zone that is vulnerable to high winds or storm events; 4) A dead or dying tree with obvious signs of rot that could cause the tree to break; 5) A stump, snag or log near trails that could further fall or collapse in the course of decomposition, or that could be pushed or shaken, causing breakage and falling pieces.

Three categories of hazard tree were designated: 1) Snags or dying trees that are somewhat weakened by rot and should be monitored for future removal. 2) Snags vulnerable to wind breakage now that should be considered for removal. 3) Snags or stumps that are hazardous and should be removed.

A total of 13 hazard trees were identified. The majority are relatively small snags near trails that may break. However, in some areas of the Park, during high winds even sound trees are vulnerable to breakage or blowdown.

The locations of the hazard trees are given in a GIS layer of the map accompanying this report and on the 2 maps on pages 53 and 54 of this report. Approximate locations are given below. The trees have also been marked in the field and shown to Park staff.

Tree No.	Hazard rating	Location/Description
1	2	40 feet N of Merrill Rock; snag; 20 feet tall, 8 inches DBH
2	2	Totem trail, halfway between visitor center and first cross trail, 15 feet E of trail; spruce snag; 70 feet tall
3	1	Totem trail, 100 feet N of first cross trail from visitor center; hemlock snag; 60 feet tall on E edge of trail
4	3	Totem trail, going west from fort site, just before first branch to left on left side of trail, 10 feet off trail; spruce snag 40 feet tall, 5 inches DBH
5	3	Within triangle formed by access trails to beach meadow from totem trail, 6 feet off trail; 50 feet tall; 5 inches DBH
6	3	Within triangle as above, western-most side, 16 feet tall; 7 inches DBH
7	2	Same as above; snag along edge of trail.
8	2	Near first branch to right off totem trail heading South from Visitor Center, in triangle formed by access trails; rotten snag 40 ft. tall; 8 inches DBH; grown together with living tree
9	1	Near Russian Soldier Memorial on branch trail to beach/estuary; dying stem of a split spruce(split at 8 ft., large tree);large scar at base and decay evident; 70 feet tall
10	2	Exit bridge, E side of Indian River, left hand trail, near portable restroom; leaning alder, 25 feet tall; 5 inches DBH
11	3	Across from road to Raptor Center, near walking/bike trail (probably outside surveyed Park boundary); large stump, rotten and leaning
12	2	Within triangle mentioned in #5(along main totem trail), snag, 15 feet tall, 11 inches DBH.
13	2	Just across trail from #12, snag, 25 feet tall, 11 inches DBH.

SITKA NATIONAL HISTORICAL PARK: HAZARD TREE LOCATIONS

HAZARD TREES

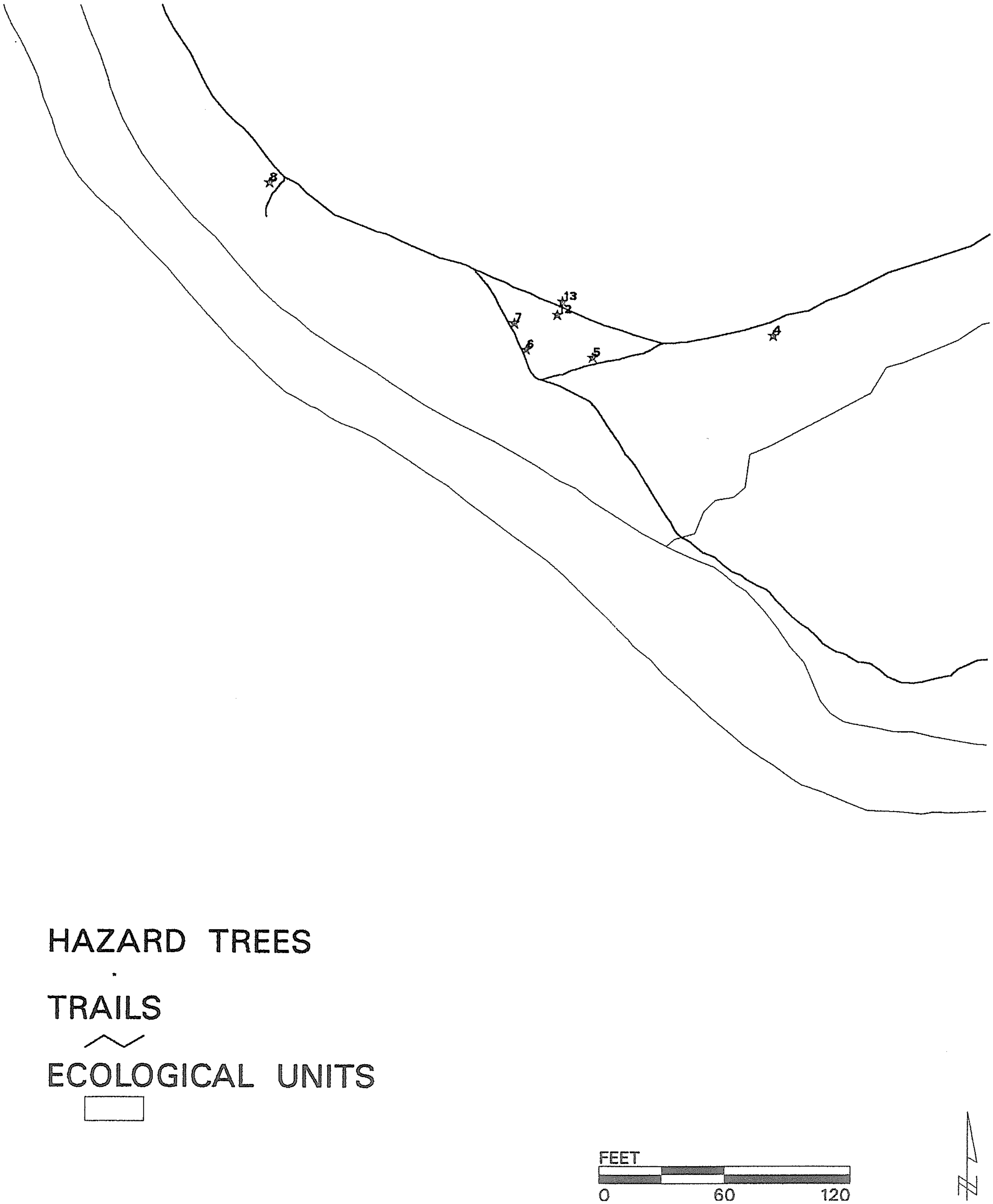
TRAILS

ECOLOGICAL UNITS

FEET

0 300 600

SITKA NATIONAL HISTORICAL PARK: HAZARD TREE LOCATIONS



LITERATURE CITED

DeMeo, T. 1989. Preliminary Forest Plant Association Management Guide: Ketchikan Area, Tongass National Forest. USDA Forest Service, Ketchikan, AK.

Dougan, B. 1992. Consultation at Sitka National Historical Park, Forester/Silviculturist for the USDA Forest Service, Sitka, AK.

Gabriel, H.W. and S.S. Talbot. 1984. Glossary of Landscape and Vegetation Ecology for Alaska. U.S. Dept. of the Interior, BLM-Alaska Technical Report 10.

Hamilton, T.D., K.M. Reed and R.W. Thorson (eds.). 1986. Wisconsin and Holocene Glaciation of SE Alaska. Alaska Geologic Society.

Hawley and Parsons. 1980. Glossary of Selected Geomorphic and Geologic Terms.

Hicks, S. and W. Shofnos. 1965. The Determination of Land Emergence from Sea Level Observations in Southeast Alaska. U.S. Coast and Geodetic Survey. Journal of Geophysical Research, 70(14).

Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA.

Julin, K.R. and W.A. Farr. 1989. Stem Fluting of Western Hemlock in Southeast Alaska. USDA Forest Service Bulletin, Juneau, AK.

Loney, R.A., D.A. Brew, L.J.P. Muffler, and J.S. Pomeroy. 1975. Reconnaissance Geology of Chichagof, Baranof, and Kruzof Islands, Southeastern Alaska. Geological Survey Professional Paper 792. U. S. Government Printing Office, Washington, D. C.

Mann, D.H. 1986. Glaciation in Alaska, the Geologic Record. In Hamilton et al. (eds.), Wisconsin and Holocene Glaciation of Southeast Alaska.

Martin, J.R., W.R. Brady, and J.M. Downs. 1985. Preliminary Forest Plant Associations (Habitat Types) of Southeast Alaska: Chatham Area, Tongass National Forest. USDA Forest Service, Sitka, AK.

Martin, J.R., W.R. Brady, J.M. Downs, K. LaBounty, and S. Trull. 1993 in prep. Forest Plant Associations of Southeast Alaska: Chatham Area, Tongass National Forest. USDA Forest Service, Sitka, AK.

Yehle, L.A. 1974. Reconnaissance Engineering Geology of Sitka and Vicinity, Alaska, with Emphasis on Evaluation of Earthquake and Other Geologic Hazards. U. S. Geologic Preliminary Survey.

U.S. Dept. of Agriculture, Soil Conservation Service. 1992a. National Soils Handbook.

U.S. Dept. of Agriculture, Soil Conservation Service. 1992b. National Soil Taxonomy Handbook.

U.S. Dept. of Agriculture, Soil Conservation Service. 1985. National Soils Handbook, USDA Soil Conservation Service.

U.S. Dept. of Agriculture, Soil Conservation Service. 1984. Appendix 2, Alaska Soil Drainage Classes. USDA Soil Conservation Service, Alaska.

U.S. Dept. of Agriculture, Soil Conservation Service. 1981. Soil Survey Manual, Chapter 4: Examination and Description of Soils in the Field

U.S. Dept. of Agriculture, Soil Conservation Society. 1975. Soil Taxonomy - A Basic System of Soil Classification for Making and Interpreting Soil Surveys. USDA Soil Conservation Service; Agriculture Handbook No. 436, U.S. Government Printing Office, Washington D.C.

USDA. 1985. Insects and Diseases of Alaskan Forests. USDA Forest Service; Alaska Region Report No. 181, U.S. Printing Office, Washington D.C.

Welsh, S.L. 1974. Anderson's Flora of Alaska and Adjacent Parts of Canada. Brigham Young Univ. Press, Utah.

APPENDIX 1. GLOSSARY OF LANDFORM AND GEOLOGIC TERMS

GLOSSARY OF LANDFORM AND GEOLOGIC TERMS

Sources: National Soils Handbook, 1985, USDA Soil Conservation Service
Glossary of Landscape & Vegetation Ecology for Alaska, Gabriel, Herman W., and Talbot, Stephen S.,1984, U.S. Department of the Interior, BLM-Alaska Technical Report 10.

Alien species - Plant or animal species other than what occur naturally, introduced intentionally or unintentionally by human actions.

Alluvial - Materials transported by moving water or resultant deposits attributed to stream processes.

Alluvial plain - Flood plains or deltas resulting from recent or past water influence.

Alluvium - Sediment deposits from rivers and streams. A combination of flood events and channel erosion leaves a series of terraces, often far removed from the current channel.

Association, soil - Soil types associated in a geographically repeating pattern which is defined as a single mapping unit.

Crown - Upper living foliage of a tree.

Crown class - A system of differentiation among trees in a stand bases on crown size and relation to other trees in the stand. Standard crown classes are: open grown, dominant, codominant, intermediate, and overtopped (or suppressed).

D.b.h. (diameter breast high) - The diamter of a tree, measured outside the bark, at 4.5 feet (1.37 m) above average ground level.

Dominance - A measure of the influence a plant species exerts in a community based on its relative mass, cover and basal area compared with other species or the total 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 a 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 of nearly the same age, usually with no more than 10-20 years difference.

Forb - An herb other than a graminoid.

Glacial till - Unsorted materials deposited by glacial activity which may consist of clay, silt, sand, various sized gravels, rocks and boulders.

Glaciofluvial deposits - Any material moved by glaciers then sorted and redeposited by moving water, thus forming various types of stratified deposits.

Graminoid - A plant of the grass family with a characteristic "wheat" like inflorescence. Often confused with sedges.

Holocene - The second phase of the Quaternary Period of geologic time, extending from the end of the Pleistocene Epoch (about 10 to 12 thousand years ago) to the present.

Isostatic rebound - Continental uplift following periods of glaciation which is caused by the removal of the immense weight of the ice pushing the continental crust down into the heated, more plastic material making up the mantle.

Leaching - The removal of soluable material from a soil horizon in solution by percolating water.

Lowland - Low lying land near sea-level or relatively flat terrain contrasted by local mountains

Moraine (glacial, geological) - Residual accumulations of glacial materials, often with a topographic form reflecting the type of deposition that occured.

Moraine (lateral) - A ridge like moraine formed along the side of a valley glacier, composed of the rock and sediment eroded by the glacier or mass wasting events.

Muck - Mostly decomposed organic matter with a higher mineral component than peat and a darker color.

Old-growth stand - Not synonymous with ancient forest and is distinguished on the basis of stand characteristics rather than age of trees. Components of old growth stands are: a multilayered canopy, with a wide range in size and age of trees, large standing dead snags, fallen logs and woody debris.

Quaternary - Includes the Recent and Pleistocene periods of the Cenozoic geologic era, which began one million years ago.

Regeneration - New growth of trees, whether planted or sprouting naturally; also refers to the new growth itself.

Second growth - A forest stand that has grown in after the removal of a previous forest by fire, timber harvest or other causes.

Sedge - Perennial (rarely annual) grass-like herbs of wet and marshy places. Distinguished from grasses or rushes by flowering structure, lack of nodes on stem, and usually triangular stem shape.

Series (Plant association or Soil) - A taxanomic grouping that reflects higher order commonalities such as same dominant tree species or same basic soil horizons and characteristics. Variations occur in the shrub or herb layer; for soils in the texture and percent coarse fragments.

Snag - A standing dead tree.

Soil profile - An exposed vertical section of soil on which soil descriptions are based. Usually a soil profile is revealed by digging a soil pit down to parent material.

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:** 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:** 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 or a histic epipedon or colors as above within 20 inches of surface.
>
> **Somewhat Poorly Drained:** 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:** 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 distinct layer that has developed from soil forming processes and can be distinguished from other horizons by properties such a soil color, texture, and structure.

APPENDIX 2. CHANNEL TYPE INFORMATION

LARGE ESTUARINE CHANNEL

Channel Mapping Symbol: ES4 (Formerly E1)

PHYSICAL CHARACTERISTICS

GEOGRAPHIC SETTING: The ES4 channels are associated with estuarine deltas of moderate to large drainage basins of inland bays and inlets.

CHANNEL STRUCTURE

Stream Gradient: < or = 2%, mean = 1%

Incision Depth: <5 m (16.5 ft)

Bankfull Width: >10 m (33 ft), mean at upstream end = 23 m

Dominant Substrate: Gravel to cobble

Stream Bank Composition: Alluvium

Sideslope Length/Angle: Flat estuarine landform associated

Channel Pattern: Single to multiple channel, normally single at the apex of the fan with channel branching at the terminus.

Drainage Basin Area: 10-30 mi^2

RIPARIAN VEGETATION

The ES4 riparian plant communities are dominated by grass and sedge communities. The Sitka spruce series (25%) and the western hemlock series (15%) are also significant beach fringe communities.

Cover	Plant Series	Cover	Plant Association
59%	Nonforested		
23%	Sitka Spruce	15%	Blueberry
14%	Western Hemlock	11%	Blueberry

CHANNEL TYPE PHASES: ES4.3 - LARGE SUBSTRATE PHASE has larger material, cobble/small boulder size range. Available spawning habitat is somewhat less than is typical for this channel type.

MANAGEMENT CONSIDERATIONS

HYDROLOGIC FUNCTION

The ES4 streams are depositional channels subject to tidal influences. Stream energy is low due to wide, low gradient channels. Gravel and sand bars tend to be stable bed features, except during extreme flow events. Large woody debris can significantly influence channel structure. Debris accumulations are important in forming pool habitat in ES4 channels.

These channels are always accessible to anadromous species. Generally, high quality substrate provides high available spawning area (ASA, 22%). Spawning pink and chum salmon will frequent ES4 channels in high densities. Although pool development is minimal (3% of water surface area), rearing coho salmon will move downstream from the mainstem in the summer to rear here (ARA 7%). Pink and chum salmon fry may temporarily remain in the ES4 system prior to moving seaward.

RIPARIAN MANAGEMENT CONSIDERATIONS

Riparian Management Concerns For:	
Large Woody Debris	MODERATE
Sediment Retention	HIGH
Stream Bank Sensitivity	HIGH
Sideslope Sensitivity	N/A
Flood Plain Protection Need	HIGH
Culvert Fish Passage	N/A

Sediment deposition is a dominant process in estuarine deltas, therefore, sediment retention in ES4 channels is high. These channels are very sensitive to intrusion of fine sediments into spawning beds. The effect of cumulative sediment impacts from upstream watershed disturbance is a major management concern.

Stream bank sensitivity is high due to high amounts of fine unconsolidated alluvium in ES4 stream banks. Bank erosion can be a significant source of fine sediment in these channels.

Protection of estuarine wetland and flood plain vegetation is an important management concern for ES4 channels and associated riparian areas. These intertidal wetlands provide extremely important habitat for waterfowl, furbearers, and a wide variety of aquatic species.

These are Value Class I streams.

Riparian Management Opportunities:	
Sport Fish Potential	HIGH
Enhancement Opportunities	Large Wood

ES4 channel segments have excellent sport fishing opportunities. Foot access is good from the beach and also from small boats at high tide. Primary species of interest are Dolly Varden char, coho, and pink salmon.

Large woody debris fish enhancement projects may be an option in ES4 channels. These structures can be used to improve cover and available pool habitat for adult spawners and rearing juvenile fish. Structures must be designed and anchored to withstand extreme tides.

LOW GRADIENT CONTAINED CHANNEL
Channel Mapping Symbol: LC1 (Formerly C2)

PHYSICAL CHARACTERISTICS

GEOGRAPHIC SETTING: LC1 channels are normally situated in broad valley bottoms largely composed of lowlands landforms. Hills and mountainslopes may abut one bank of the LC1 channel type. Lateral channel migration is generally controlled by frequent bedrock outcrops along streambanks.

CHANNEL STRUCTURE
Channel Gradient: <2%, mean = 1%
Incision Depth: <10 m (33 ft), mean = 4 m (13 ft)
Bankfull Width: >10 m (33 ft), mean = 16 m (54 ft)
Dominant Substrate: Coarse gravel to bedrock
Stream Bank Composition: Bedrock or mixed
Sideslope Length: <20 m (66 ft), mean = 10 m (33 ft)
Sideslope Angle: Mean = 30% (20 degrees)
Channel Pattern: Single, linear channel, rectangular pattern
Drainage Basin Area: 5-20 mi^2

RIPARIAN VEGETATION
The riparian plant communities are dominantly western hemlock series (43%), with the Sitka spruce series (12%) and the mixed conifer series (15%) being significant. The LC1.7 phase is dominated by the western hemlock-red cedar series.

Cover	Plant Series	Cover	Plant Association
43%	Western Hemlock	23%	Blueberry
15%	Mixed Conifer	7%	Blueberry/Skunk Cabbage
12%	Sitka Spruce	6%	Blueberry
12	Western Hemlock-Red Cedar	4%	Blueberry/Salal/Skunk Cab.

CHANNEL TYPE PHASES
LC1.7 - GLIDE PHASE of LC1 channels have consistently lower gradient stream reaches than is typical for LC1 channels. This phase tends to occur where channel base level is controlled by a downstream feature such as resistant bedrock outcrops or a lake inlet or outlet.

LC1.8 - MORAINE PHASE channels have bank control from glacial moraine deposits. Stream substrate has a larger boulder component, and sideslope stability may be lower than is typical for LC1 channels.

MANAGEMENT CONSIDERATIONS

HYDROLOGIC FUNCTION

LC1 channels store and transport sediment. Stream substrate is predominantly bedrock and larger boulder and cobble material, intermingled with pockets of gravel or cobble sized material. Silt, sand and fine gravels are typically flushed through LC1 channels. During high flow events, which are well contained by the stable upper banks, fines to cobble size materials are mobilized and transported downstream. Large woody debris volumes are relatively low in these channels. Where large woody debris accumulations do occur, significant amounts of coarse to fine gravels and sand can be retained.

AQUATIC HABITAT CAPABILITY

LC1 channels are frequently accessible to anadromous species, however partial or complete barriers can occur at bedrock knickpoints. These channels are frequently used by spawning pink, chum, and steelhead species, and occasionally by coho. Spawning areas are limited due to the predominately large substrates. LC1 channels may have limited rearing potential, except in areas of large woody debris accumulations. Steelhead and resident Dolly Varden frequently use boulder-pool habitat in these channels for rearing. LC1 channels provide extensive overwintering habitat for steelhead trout.

RIPARIAN MANAGEMENT CONSIDERATIONS

Riparian Management Concerns For:	
Large Woody Debris	LOW
Sediment Retention	LOW
Stream Bank Sensitivity	LOW
Sideslope Sensitivity	MODERATE
Flood Plain Protection	NEGLIGIBLE
Culvert/Fish Passage	LOW

Inchannel woody debris accumulations have limited influence on channel form and habitat capability due to the large degree of bedrock control. Large debris enters the channel primarily from stream sideslopes. High flows in these well contained channels tend to move all but the most stable wood accumulations downstream or push debris to channel margins.

Stream banks are generally stable due to bedrock influence. Sideslopes can be susceptible to mass wasting erosion in areas with higher than average sideslope angles, or in channel segments with weathered bedrock, glacial till, or volcanic ash parent materials.

These are generally classified as Value Class I streams.

Riparian Management Opportunities:	
Sport Fish Potential	MODERATE
Enhancement Opportunities	Large Wood, Barrier Modification

Sport fishing opportunities are generally limited to bedrock scour pools and pools below water falls. Primary species of interest include steelhead, Dolly Varden, and pink salmon.

Opportunities exist for increasing limited rearing and spawning area by anchoring large pieces of wood in LC1 channels. Bedrock falls and cacades can be obstructions to upstream fish migration. Barrier modification may also be an enhancement opportunity.

WIDE LOW GRADIENT FLOOD PLAIN CHANNEL

Channel Mapping Symbol: FP5 (Formerly C3)

PHYSICAL CHARACTERISTICS

GEOGRAPHIC SETTING: FP5 channels are usually found in broad valley bottoms of large to very large watersheds. Normally, these channels have extensive valley flood plains and river terraces. Smooth meander bends, numerous overflow side channels, extensive gravel bars, and large clumps of log jams are characteristic of this channel type.

CHANNEL STRUCTURE

Channel Gradient: <2%, mean = 1%
Incision Depth: < or = 3 m (10 ft), mean = 2 m (6.5 ft)
Bankfull Width: >20 m (66 ft), mean = 38 m (108 ft)
Dominant Substrate: Sand to cobble
Stream Bank Composition: Alluvium
Sideslope Length/Angle: Flat, flood plain landform associated
Channel Pattern: Single to multiple channels, sinuous
Drainage Basin Area: 15-30 mi^2

RIPARIAN VEGETATION

The FP5 riparian communities are dominated by the Sitka spruce series (49%), the western hemlock series (23%), and nonforested communities (23%). The nonforested communities and the Sitka spruce series dominate the FP5.3 channel type phase (54% and 38%). Both nonforested communities (44%) and the Sitka spruce series (28%) are common riparian communities in the FP5.4 channel type phase.

Cover	Plant Series	Cover	Plant Association
49%	Sitka Spruce series	11%	Devil's Club
23%	Nonforested		
23%	Western Hemlock	14%	Blueberry
2%	Mixed Conifer Series	2%	Blueberry

CHANNEL TYPE PHASES

FP5.3 - LARGE SUBSTRATE PHASE has greater stream power than the typical FP5 and is a more efficient sediment transport system. Substrate has a larger mean diameter in the typical FP5 channel.

FP5.4 - MUSKEG PHASE includes riparian vegetation consisting of muskeg and meadow interspersed with individual trees and some forest. This is an alluvial channel with significantly greater sediment transport than Palustrine Process Group channels that often have similar riparian plant communities.

FP5.5 - FORELAND OUTWASH FORESTED PHASE are alluvial channels that are strongly influenced by groundwater recharge from shallow aquifers. This phase is restricted to coastal foreland landforms. Sitka spruce communities dominate the riparian vegetation.

FP5.6 - FORELAND OUTWASH SHRUB PHASE are groundwater fed, coastal foreland channels, with predominantly nonforested riparian plant communities.

FP5.9 - BEDROCK INFLUENCE PHASE have mixed bank control associated with occasional bedrock outcrops.

MANAGEMENT CONSIDERATIONS
HYDROLOGIC FUNCTION

The FP5 channels function as sediment deposition systems. Low gradient, poor flow containment, and fine sized substrate are indicative of low stream power. Substrate consists mainly of sand to small cobble size particles. Short term storage of fine sediment is characteristic of FP5 channels. These fine sediment deposits are typically mobilized during high flow events. Small side channels dissecting the FP5 flood plain are a common feature.

FP5 channels are heavily used by spawning king, chum, and pink salmon, and steelhead trout because of the abundance of high quality spawning gravels. These channels get only moderate use by spawning coho salmon which prefer smaller channels. All freshwater rearing species make frequent use of these channels because rearing habitat is readily available, primarily in association with side channels, off-channel pools, and stream segments having large woody debris accumulations. Overwintering habitat in these channels is provided in off-channel slough areas and pools associated with LWD.

RIPARIAN MANAGEMENT CONSIDERATIONS

Riparian Management Concerns For:	
Large Woody Debris	HIGH
Sediment Retention	HIGH
Stream Bank Sensitivity	HIGH
Sideslope Sensitivity	N/A
Flood Plain Protection	HIGH
Culvert/Fish Passage	N/A

Maintaining future sources of woody debris is an important consideration in FP5 channels. Natural LWD volumes are moderately high, but generally inchannel wood accumulations are less stable than in smaller C1 channels due to higher flood flows in FP5 channel types.

Retention of fine sediment (sand, gravel) is high in FP5 channels, therefore these channels may be sensitive to cumulative sediment inputs from headwater sources. Excessive sediment loads can degrade spawning gravel quality and, in extreme cases, can disrupt sediment transport equilibrium and channel stability. Removal or disturbance of stream bank vegetation can accelerate bank erosion and the subsequent loss of undercut bank rearing habitat.

Flood plain protection is a very important management consideration for FP5 channels because of off-channel features which contribute to juvenile fish rearing habitat. These off-channel flood plain features include small spring fed tributaries, sloughs, beaver pond complexes, and side channels.

The location of stream crossing structures is an important consideration due to the large size and natural instability of the channels and associated flood plains. Large multi-span bridges are often required to cross these channels. Roadways traversing flood plain tributaries must provide for juvenile fish migration through culverts.

Riparian Management Opportunities:

Sport Fish Potential	HIGH
Enhancement Opportunities	Large Wood, Fry Stocking, Spawning Channels

The FP5 channels can offer excellent sport fish opportunities where easy beach access exists. Species of primary interest include Dolly Varden char, steelhead and cuttthroat trout, and coho, pink, and king salmon. Small boat access into these channels can be good depending on the amount and distribution of large debris jams. Angling is best in deep meander pools and along undercut banks.

A variety of fish habitat enhancement opportunities exists in FP5 channels. Large wood may be limiting along FP5 reaches. Addition of large wood along channel margins can be successful if the structures are well anchored to the stream bank. Fry stocking programs can be implemented to take advantage of under utilized rearing habitat. Spawning channel construction is a potential enhancement option where adequate groundwater upwelling is present.

APPENDIX 3. VEGETATION PLOT INFORMATION

VEGETATION PERCENT COVER DATA : SITKA NATIONAL HISTORICAL PARK

*Stratum refers to layer of vegetation: 1 = overstory tree, 2 = understory, 3 = tall shrub, 4 = low shrub, 5 = forb, 6 = graminoid, 7 = fern, 8 = moss, 9 = lichen, other

**Species = first 2 letters of genus followed by first 2 letters of species epithet. Where species undetermined, first 5 letters of genus are used. See Vascular Plant Species List. "All" indicates data for all species in given stratum.

Plot Number	Stratum*	Species**	% Cover
1	1	PISI	25
1	1	TSHE	50
1	1	ALL	60
1	2	TSHE	8
1	3	MEFE	10
1	3	OPHO	1
1	3	RUSP	2
1	3	SARA	2
1	3	SOSI	0.5
1	3	VACCI	7
1	3	VAPA	4
1	5	MADI2	30
1	5	MOUN	1.5
1	5	RUPE	2
1	5	STAM	2
1	5	STRO	1
1	5	TITR	2
1	5	UNKNOWN	1
1	6	LUZUL	Trace
1	6	UNKNOWN	Trace
1	7	DRAU2	3
1	7	GYDR	1
1	7	THPH	1
2	1	PISI	10
2	1	TSHE	40
2	1	ALL	45
2	2	TSHE	45
2	3	MEFE	25
2	3	SARA	0.5
2	3	VACCI	4
2	3	VAPA	7
2	5	MADI2	7

Plot Number	Stratum*	Species**	% Cover
2	5	STST	1
2	5	RUPE	Trace
2	5	STAM	2
2	5	STRO	2
2	5	TITR	1
2	5	COME	1
2	7	DRAU2	4
2	7	GYDR	1
3	1	PISI	10
3	1	TSHE	45
3	2	TSHE	4
3	3	MEFE	16
3	3	OPHO	1
3	3	SOSI	0.5
3	3	VACCI	7
3	3	VAPA	110
3	5	MADI2	35
3	5	MOUN	Trace
3	5	RUPE	Trace
3	5	STAM	2
3	5	STRO	1
3	5	TITR	Trace
3	7	ATFI	2
3	7	DRAU2	12
3	7	GYDR	Trace
4	1	PISI	25
4	1	TSHE	35
4	1	ALL	65
4	2	TSHE	3
4	3	MEFE	15
4	3	RUSP	4
4	3	VACCI	10
4	3	VAPA	10
4	3	ALL	40
4	5	MADI2	25
4	5	MOUN	1
4	5	RUPE	3
4	5	STAM	3
4	5	STRO	1
4	5	TITR	2
4	5	ALL	50

Plot Number	Stratum*	Species**	% Cover
4	7	ATFI	3
4	7	DRAU2	25
4	7	GYDR	1
4	7	ALL	30
5	1	PISI	50
5	1	TSHE	25
5	1	ALL	55
5	2	TSHE	5
5	3	MEFE	1
5	3	OPHO	35
5	3	RIBES	1
5	3	RUSP	6
5	3	SARA	1
5	3	SOSI	1
5	3	VACCI	2
5	3	VAPA	3
5	3	ALL	65
5	5	MADI2	20
5	5	MOUN	1
5	5	RUPE	3
5	5	STAM	1
5	5	STRO	1
5	5	TITR	3
5	5	ALL	50
5	7	ATFI	10
5	7	DRAU2	4
5	7	GYDR	1
5	7	ALL	40
6	1	PISI	30
6	1	TSHE	40
6	1	ALL	70
6	2	PISI	3
6	2	TSHE	10
6	2	ALL	12
6	3	MEFE	5
6	3	RUSP	1
6	3	VACCI	7
6	3	VAPA	4
6	3	ALL	20
6	5	COAS	1
6	5	COTR2	Trace

Plot Number	Stratum*	Species**	% Cover
6	5	COCA	1
6	5	MADI2	2
6	5	MOUN	1
6	5	RUPE	2
6	5	STAM	2
6	5	STRO	1
6	5	STST	Trace
6	5	TITR	1
6	5	ALL	10
6	7	ATFI	1
6	7	DRAU2	4
6	7	THPH	1
6	7	ALL	5
7	2	PISI	1
7	3	ALSI	1
7	3	RUSP	1
7	3	SOSI	1
7	5	ACMI	1
7	5	EPILO	1
7	5	GALIU	6
7	5	HELA	3
7	5	FRCA	1
7	5	ARLY	Trace
7	5	TAOF	2
7	5	POAN	1
7	5	TRIFO	1
7	5	RARE	1
7	5	LAJO	2
7	5	COPA	5
7	5	HOPE	10
7	6	AGROS	1
7	6	DESCH	1
7	6	ELMO	35
7	6	FERU	1
7	6	HOBR	1
8	5	ATPA	2
8	5	PLMA2	4
8	5	COOF	3
8	5	GLMA	1
8	6	PUNU	70
8	9	FUCUS	40

Plot Number	Stratum*	Species**	% Cover
9	1	PISI	7
9	1	TSHE	65
9	1	ALL	85
9	2	TSHE	10
9	3	OPHO	4
9	3	RUSP	7
9	3	VACCI	1
9	3	VAPA	1
9	3	ALL	15
9	5	MADI2	2
9	5	MOUN	1
9	5	STAM	1
9	5	STST	1
9	5	TITR	3
9	5	ALL	7
9	6	LUCA	1
9	7	ATFI	6
9	7	DRAU2	4
9	7	ALL	10
10	1	ALRU	65
10	3	RIBES	1
10	3	RUSP	20
10	3	SARA	25
10	3	ALL	45
10	5	MADI2	7
10	5	OSMOR	2
10	5	STAM	2
10	5	STST	1
10	5	TITR	6
10	5	VIGL	2
10	5	ALL	20
10	7	ATFI	4
11	1	PISI	9
11	1	TSHE	55
11	1	ALL	65
11	2	TSHE	10
11	3	MEFE	3
11	3	SOSI	1
11	3	VACCI	1
11	3	VAPA	3
11	3	ALL	7

Plot Number	Stratum*	Species**	% Cover
11	5	MADI2	1
11	7	DRAU2	1
12	1	PISI	30
12	1	TSHE	25
12	2	PISI	1
12	2	TSHE	25
12	3	MEFE	6
12	3	OPHO	2
12	3	RUSP	1
12	3	SOSI	1
12	3	VACCI	7
12	3	VAPA	2
12	5	MADI2	3
12	5	MOUN	1
12	5	RUPE	1
12	5	STAM	1
12	5	STST	1
12	5	TITR	1
12	7	ATFI	1
12	7	DRAU2	8
12	7	GYDR	1
13	1	ALRU	65
13	2	PISI	4
13	2	TSHE	2
13	3	MEFE	1
13	3	OPHO	1
13	3	RIBES	1
13	3	RUSP	50
13	3	SARA	5
13	3	SOSI	1
13	3	ALL	65
13	5	MADI2	1
13	5	OSMOR	1
13	5	STAM	1
13	5	STRO	1
13	5	TITR	1
13	5	VIGL	1
13	5	ALL	6
13	7	ATFI	1
13	7	DRAU2	1
13	7	ALL	2

Plot Number	Stratum*	Species**	% Cover
14	1	PISI	30
14	1	TSHE	35
14	2	PISI	5
14	2	TSHE	5
14	3	OPHO	6
14	3	RUSP	35
14	3	SARA	2
14	5	FACR	4
14	5	MOUN	1
14	5	RUPE	1
14	5	STAM	2
14	5	STRO	1
14	5	STST	1
14	5	TITR	10
14	7	ATFI	10
14	7	DRAU2	10
14	7	GYDR	2
15	1	PISI	60
15	2	PISI	4
15	2	TSHE	35
15	3	OPHO	6
15	3	RUSP	1
15	3	VAPA	7
15	5	MADI2	1
15	5	MOUN	1
15	5	PRAL	1
15	5	STRO	1
15	5	TITR	1
15	5	COME	1
15	5	GOOB	1
16	1	PISI	35
16	1	TSHE	20
16	1	ALL	55
16	2	TSHE	25
16	3	MEFE	2
16	3	OPHO	2
16	3	VACCI	3
16	3	VAPA	15
16	3	ALL	22
16	5	MADI2	7
16	5	STAM	1

Plot Number	Stratum*	Species**	% Cover
16	5	STRO	2
16	7	DRAU2	1
17	5	ACMI	1
17	5	LISC	1
17	5	COOF	1
17	5	ATPA	Trace
17	5	PLMA2	2
17	5	HOPE	5
17	5	POAN	4
17	5	CONIO	1
17	6	ELMO	2
17	6	HOBR	1
17	6	DESCH	35
17	6	FERU	50
17	6	ALL	88
18	5	HOPE	3
18	5	PLMA2	30
18	5	POAN	1
18	6	CALY	2
18	6	PUNU	5
18	6	DESCH	20
18	6	ELMO	1
18	9	FUCUS	6
19	2	ALRU	2
19	2	PISI	3
19	3	SOSI	1
19	3	VACCI	1
19	5	EPAN	8
19	5	GATR	1
19	5	HELA	5
19	5	MAMO	Trace
19	5	TRIFO	Trace
19	5	LISC	Trace
19	5	ANGEL	Trace
19	5	EPAD	1
19	5	ACMI	1
19	5	GEMA	1
19	5	RANUN	2
19	5	VIGI	20
19	5	UMBEL	2
19	5	COPA	Trace

Plot Number	Stratum*	Species**	% Cover
19	6	POPA	1
19	6	AGROS	1
19	6	CACA	5
19	6	BRSI	4
19	6	ELMO	20