



# San Juan Island National Historical Park Vegetation Classification and Mapping Project Report

Natural Resource Report NPS/NCCN/NRR—2012/603



**ON THE COVER**

Red fescue (*Festuca rubra*) grassland association at American Camp, San Juan Island National Historical Park.  
Photograph by: Joe Rocchio

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# **San Juan Island National Historical Park Vegetation Classification and Mapping Project Report**

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## Executive Summary

The National Park Service (NPS) Vegetation Inventory Program (VIP) is an effort to classify, describe and map existing vegetation of national park units for the NPS Nature Resource Inventory and Monitoring Program. The Washington Natural Heritage Program (WNHP), working in cooperation with the North Coast and Cascades Network (NCCN), has completed a vegetation classification and map of San Juan Island National Historical Park (SAJH). Every vegetation type within the park was classified and mapped to at least the NVC Alliance level. Many types were classified and mapped to the Association level of the NVC.

Classification data collection occurred simultaneously with field-based mapping. Collection of new data occurred in 171 plots and was designed to fill known gaps in the existing classification, to document the occurrence of known associations, and to identify previously unrecognized associations.

A vegetation key was developed to enable future users to identify plant associations or alliance types in the field (Appendix B). New or edited summary descriptions (Appendix B) were written for all plant association or alliance types.

There were 49 alliances classified as occurring within SAJH. Forested alliances accounted for 31%, shrubland/herbaceous alliances totaled 67%, and the single sparse alliance accounted for 2% of the total number of alliances. An additional nine map units were used for Cultural and Non-vegetated cover types. Three “Alliance” level units were documented for cultural vegetation including one unit for Agromorphic and two units for Developed vegetation classes. There were also an additional six map units identified for non-vegetated cover types. Nearly 43% of the vegetation alliances were classified as ruderal types, indicating that past land use has resulted in numerous novel vegetation types dominated by non-native vegetation or combinations of native species with no similar type existing in ‘natural’ landscapes.

The most frequent alliance and the alliance covering the greatest area (317.3 ha or 784.2 acres) is the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance. The *Symphoricarpos albus* Pacific Coast Shrubland Alliance was the most frequent and most abundant shrub alliance. The *Holcus lanatus* - *Poa pratensis* - *Elymus repens* Provisional Ruderal Alliance dominated the herbaceous areas (104.8 ha or 259.1 acres).

The validation and accuracy assessment process are external to development of the map and provides a neutral evaluation of the map and were accomplished by Rex Crawford, WNHP ecologist who played no role in the mapping project prior to these tasks. Validation and accuracy assessment took place at 354 sample points.

The accuracy assessment at the alliance-level has an overall accuracy of  $82.0 \pm 5.2\%$  (90% confidence intervals). The Kappa index was  $82.1\% \pm 3.5\%$  (90% C.I.). This meets the accuracy requirement of 80% established by the National Park Service Vegetation Inventory Program.

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The previous efforts to map and describe the vegetation of SAJH done by D. Peterson, J. Agee and B. Larson contributed to this current mapping work.

G. Kittel of NatureServe and J. Kagan of the Oregon Biodiversity Information Center contributed to the classification, particularly in resolving treatment of ruderal and *Leymus mollis* - dominated areas.

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## Acronyms

AA - Accuracy Assessment

ArcGIS™ - A group of geographic information system (GIS) software products produced by ESRI

ESRI - Environmental Systems Research Group

FGDC - Federal Geographic Data Committee

GIS - geographic information system

GPS - Global Positioning System

LiDAR - Light Imaging Detection and Ranging

NAD - North American Datum

NAIP - National Agricultural Imagery Program

NCCN - North Coast and Cascades Network

NPS - National Park Service

NVC - National Vegetation Classification

NVCS - National Vegetation Classification Standard

SAJH - San Juan Islands National Historical Park

TNC - The Nature Conservancy

USDA - United States Department of Agriculture

USGS - United States Geological Survey

VIP - Vegetation Inventory Program (National Park Service)

WNHP - Washington Department of Natural Resources' Natural Heritage Program



# 1.0 Introduction

## 1.1 Project Overview

### 1.1.1 Background

San Juan Island National Historical Park (SAJH) was established in 1966 and encompasses 709 ha (1,752 acres). The park preserves the sites of the American and English camps, and commemorates the historic events that occurred in the camps from 1853 to 1871 including the Pig War of 1859. The park also protects significant natural habitats and resources essential to the cultural landscapes, including shoreline and intertidal habitat, wetlands, marine lagoons, grasslands, oak woodlands and forests of varying ages and condition. Management of these natural resources is an integral component of preserving and providing interpretation of the historical resources at SAJH. Restoration and maintenance of natural systems and processes is also a management goal of the park (NPS 2008).

A key management goal for SAJH is to “emphasize the connections and interrelationships between the park’s natural and cultural resources” and includes “providing opportunities for visitors to understand the importance of the park’s natural resources in defining the cultural landscapes and influencing the settlement and historic events of San Juan Island” (NPS 2008). A key resource for park staff to implement management objectives is an accurate vegetation inventory and map which would significantly increase the ability of National Park Service (NPS) staff to communicate to the public the overall diversity of the park and the details of the habitats found therein. The inventory and map would also greatly assist in resource management planning. Lastly, a vegetation map would provide an important baseline against which change in vegetation can be compared.

Previous research described and mapped vegetation types occurring within SAJH (Agee 1984, 1987; Holmes 1998; Peterson 2002). These efforts provided managers with a good understanding of vegetation resources at SAJH. However, those classifications and maps were often too coarse relative to management needs, were not cross-walked to the most recent version of the U.S. National Vegetation Classification (FGDC 2008), and/or did not comprehensively address all existing vegetation types. This project addresses those information gaps by building on the previous mapping work, expanding it to all vegetation resources within the park, and creating products that meet National Park Service Vegetation Inventory and Mapping Program standards.

### 1.1.2 Project Scope and Products

As part of a national effort to develop baseline inventory information on the status of existing natural resources, the NPS is developing vegetation maps for all the National Park units in the NCCN. The NCCN parks contain a wide range of vegetation types. SAJH preserves the sites of the American and British camps on the island as well as a broad range of habitats, from intertidal marshes to evergreen forest. The Washington Department of Natural Resources’ Natural Heritage Program (WNHP) collaborated with the NCCN to develop a vegetation classification and vegetation map for SAJH.

The SAJH vegetation inventory and mapping project was a collaborative endeavor between the NPS’s NCCN Inventory and Monitoring Program and the WNHP. NatureServe has also played a role. NCCN staff generated the initial proposal for project funding. WNHP was selected

as a partner for the classification analysis because of their extensive work to develop classifications of native plant communities throughout Washington State. WHNP staff are experienced in all phases of development of vegetation classifications and employ the same national system of classification used by the NPS. WHNP was responsible for identifying data gaps, collecting and analyzing field data, updating the existing vegetation classification, and mapping vegetation types. WHNP independently conducted the validation and accuracy assessment for the map. NCCN provided project oversight and also assisted with the accuracy assessment by developing random sampling points. NatureServe provided periodic input regarding vegetation classification issues.

SAJH is split into two spatially distinct units: English Camp, located in the northwest portion of San Juan Island, and American Camp, located at the southern tip of San Juan Island. During the course of the project, NPS added an additional unit adjacent and south of the English Camp, called Mitchell Hill. All three units were included in the spatial scope of the project.

In addition to this report, the project deliverables include: (1) vegetation classification and key; (2) vegetation map according to NPS standards; (3) an accuracy assessment of map classes; and (4) GIS layers depicting the vegetation map and map class accuracy.

## **1.2 National Park Service Vegetation Inventory Program**

The NPS Vegetation Inventory Program (VIP) is an effort to classify, describe, and map existing vegetation of national park units as part of generating baseline data products for the NPS Natural Resources Inventory and Monitoring Program. The U.S. Geological Survey (USGS) Vegetation Characterization Program lends a cooperative role in the NPS VIP. This landmark program is both the first to provide national-scale descriptions of vegetation and the first to create national vegetation standards for its data products. Its goal is to meet specific information needs identified by the NPS along with additional cooperative projects. The vegetation mapping program is an important part of the NPS Inventory and Monitoring Program, a long-term effort to develop baseline data more than 280 national park units that have a natural resource component. For more information visit Vegetation Inventory Program (VIP) website at: <http://science.nature.nps.gov/im/inventory/veg/index.cfm>.

Program activities are based on peer-reviewed, objective science. Comprehensive vegetation information is provided at national and regional levels, while also serving local management needs of individual parks. Stringent quality control procedures ensure that products are accurate and consistent for initial inventory purposes and replicable for monitoring purposes. The spatially enabled digital products produced by the program are available on the World Wide Web.

Program scientists have developed data collection procedures for classification, mapping, accuracy assessment, and use of existing data. Program products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata, and national standards for spatial accuracy and data transfer. Standards include a minimum mapping unit of 0.5 hectares and classification accuracy of 80% for each map class. Nature Serve, an important partner in the USGS-NPS Vegetation Mapping program, is the caretaker of the National Vegetation Classification System, which is used by the program to classify vegetation communities.

A report of project methods and results is provided at completion of individual projects. Project results include a rich set of data and information for each park project. A comprehensive list can be found here: <http://biology.usgs.gov/npsveg/about.html>.

### **1.3 The National Vegetation Classification Standard**

The Federal Geographic Data Committee National Vegetation Classification (NVC) standard is used for this project (FGDC 1997; FGDC 2008). The NVC evolved from work conducted primarily by The Nature Conservancy (TNC), NatureServe, and the Natural Heritage Program network over more than two decades (Grossman et al. 1998). The structure of the NVC is based in part on an earlier international vegetation classification developed by the United Nations Educational, Cultural, and Scientific Organization (UNESCO 1973, Driscoll et al. 1984). Use of a standardized classification system helps to ensure data compatibility throughout the National Park Service and other agencies. The FGDC Vegetation Subcommittee continues to keep the NVC standard current and relevant. Substantial revisions to the upper levels of the NVC hierarchy were adopted by the FGDC in February 2008 (FGDC 2008).

Vegetation classification systems attempt to recognize and describe repeating assemblages of plants in similar habitats. The NVC is a hierarchical system. The first iteration of the NVC consisted of seven levels defined by both physiognomic characters and floristic criteria. The five upper levels (class, subclass, group, subgroup, and formation) were primarily based on physiognomic features. Physiognomic features have broad geographic perspective while floristic units have utility in local and site-specific applications (Grossman et al. 1998). Upper, physiognomic levels contain physical, structural, and environmental characteristics identifiable from satellite imagery, aerial photography, or ground observations. In contrast to the upper levels, differences in floristic composition distinguished the two lowest levels of the 1997 NVC, alliance and association.

The 2008 FGDC standard substantially revised the 1997 hierarchy and was used for this project. As stated in the 2008 standard (FGDC 2008):

“The revised hierarchy addresses the following issues, among others: a) uses vegetation criteria to define all types (de-emphasizing abiotic criteria, such as hydrologic regimes in wetland types), b) provides a clear distinction between natural and cultural vegetation wherever these can be observed from broad growth form patterns (rather than combining natural and cultural vegetation initially and separating them at lower levels), c) for natural wherever these can be vegetation, defines the upper levels based on broad growth form patterns that reflect ecological relationships (rather than detailed structural criteria, which are more appropriate lower down in the hierarchy), d) provides a new set of middle-level natural units that bridge the large conceptual gap between alliance and formation, e) integrates the physiognomic and floristic hierarchy levels based on ecologic vegetation patterns, rather than developing the physiognomic and floristic levels independently and then forcing them into a hierarchy, f) provides detailed standards for plot data collection, type description and classification, data management and peer review of natural vegetation, and g) for cultural vegetation provides an independent set of levels that addresses the particular needs of cultural vegetation.”

The 2008 NVC hierarchy consists of eight levels, organized into three upper levels extracted from levels 1 through 5 in the 1997 standard, three middle levels not in the 1997 levels, and the

same two lower levels as in the 1997. The FGDC 2008 standard fully discusses the rationale and criteria of each hierarchy level which are summarized in Table 1 ([http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS\\_V2\\_FINAL\\_2008-02.pdf](http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf)). In general, dominant growth form is more important in upper levels and diagnostic species and composition are more important in lower levels. The new middle levels consider biogeographic and mesoclimatic factors along with diagnostic species and life forms.

The alliance and association levels of the revised hierarchy are essentially the same as the 1997 FGDC hierarchy. However, the distinctions between these two lower levels and the levels above have been clarified. The 2008 standard provides the following expanded definitions (FGDC 2008):

**Alliance:** A vegetation classification unit of low rank (7<sup>th</sup> level) containing one or more associations, and defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation (Jennings et al. 2006). Alliances reflect regional to sub-regional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes.

**Association:** A vegetation classification unit of low rank (8<sup>th</sup> level) defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions and physiognomy (Jennings et al. 2006). Associations reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

NatureServe coordinates plant association data for the NPS vegetation mapping projects. Associations are added to the NVC and older concepts are refined as new data become available. Modifications to the NVC hierarchy are currently managed by NatureServe.

**Table 1.** Summary, criteria and rationale for National Vegetation Classification System hierarchy.

Hierarchy Level	Criteria
Upper: Physiognomy plays a predominant role.	
<i>L1 - Formation Class</i>	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and/or substrate or aquatic conditions.
<i>L2 - Formation Subclass</i>	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate or aquatic conditions.
<i>L3 - Formation</i>	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.
Middle: Both floristics and physiognomy play a significant role.	
<i>L4 - Division</i>	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant taxa that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
<i>L5 - Macrogroup</i>	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
<i>L6 - Group</i>	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes
Lower: Floristics plays a predominant role.	
<i>L7 - Alliance</i>	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate substrates, hydrology, moisture/nutrient factors, and disturbance regimes.
<i>L8 - Association</i>	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

#### 1.4 Nomenclature and Naming Conventions

Species nomenclature follows the Integrated Taxonomic Information System, which receives its plant species information from USDA PLANTS (USDA 2011).

The nomenclature of vegetation types is not to be confused with the nomenclature of plant taxa, even though species names are used in the names of associations and alliances. Jennings et al. (2006) describe the naming convention for alliances and associations:

a. Alliance or association nomenclature shall contain both scientific and English common names, e.g., *Quercus garryana* Woodland Alliance as well as Oregon White Oak Woodland Alliance.

The relevant dominant and diagnostic species that are useful in naming a type should be selected from the tabular summaries of the types. Dominant and diagnostic species should include at least one from the dominant stratum (layer) of the type.

b. For alliance and mid-level unit names, taxa from subordinate layers should be used sparingly.

c. Among the taxa that are chosen to name the type, those occurring in the same stratum or growth form (tree, shrub, herb, nonvascular, floating, submerged) are separated by a hyphen ( - ), and those occurring in different strata are separated by a slash ( / ). Diagnostic taxa occurring in the uppermost stratum are listed first, followed successively by those in lower strata. The order of taxon names within stratum or growth form generally reflects decreasing levels of dominance, constancy, or other measures of diagnostic value.

d. Association or alliance names include the name of the level of the hierarchy that the unit is placed in (e.g., *Quercus garryana* Woodland Alliance).

e. In cases where diagnostic taxa are unknown or in question, a more general term is currently allowed as a “placeholder” (e.g., *Salix hookeriana* / *Carex* spp. Shrubland Association).

f. The least possible number of taxa is used in a name. Up to five species may be necessary to define associations in some regions that contain very diverse vegetation with relatively even dominance and variable total composition. For alliances and other levels, no more than three species shall be used.



## 2.0 Study Area

### 2.1 Location

San Juan Island National Historical Park is located on San Juan Island, the second largest island in the San Juan archipelago, a series of islands in northwest Washington between the southern tip of Vancouver Island, British Columbia and the United States mainland (Figure 1).

San Juan National Historical Park is split into two spatially distinct units: English Camp (214 ha or 529 acres), located in the northwest portion of San Juan Island, and American Camp (495 ha or 1,223 acres), located at the southern tip of San Juan Island. During the course of the project, NPS added an additional unit adjacent and south of English Camp, called Mitchell Hill (125 ha or 309 acres). All three units were included in the spatial scope of this project.

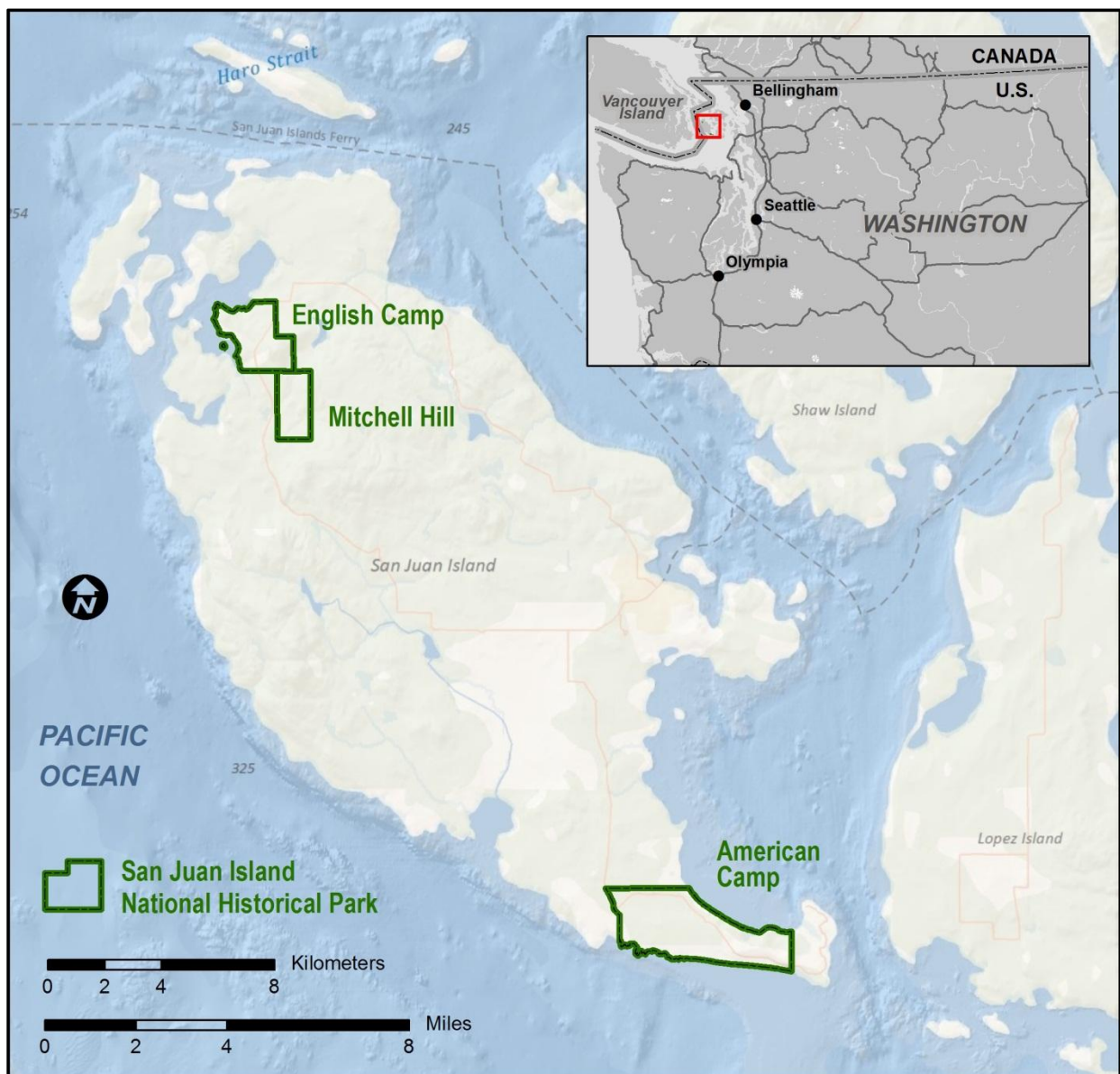


Figure 1. Location of San Juan Island National Historical Park.

## **2.2 Climate**

Climatic conditions on San Juan Island are affected by the island's location within the rain shadow of the Olympic Mountains. The prevailing southwesterly winds of the region lose moisture as they make their way over the Olympic Mountains producing much drier conditions in areas located to the northeast of the Olympic Mountains. The rain shadow's effects are most intense on the northeastern portion of the Olympic peninsula and in the San Juan Islands. Aspect also affects local climatic conditions. For example, south to west aspects are exposed to summer-drying winds while north slopes are sheltered from such conditions and are often more moist (Agee 1987).

Precipitation varies significantly on San Juan Island, with higher precipitation in the north part of the island where the rainshadow effect subsides. Most precipitation occurs in between October and April while the driest months are July and August. Average rainfall on the south side of the island near American Camp is 19 inches while the more northerly English Camp unit receives 29 inches of average annual precipitation (NPS 2008). Most precipitation occurs as rainfall but occasional snowfall occurs.

Average annual maximum temperature in the nearby Olga, Washington weather station is 13.9° C (57° F) while the average minimum is 4.8° C (42.4° F). In winter, the average temperature is 5° C (41.0° F) and the average daily minimum temperature is 2.1° C (35.8° F). In summer, the average temperature is 15.2° C (59.4° F) and the average daily maximum temperature is 20.5° C (68.9° F). The sun shines 62 percent of the time in summer and 28 percent in winter (NRCS 2009).

In summary, the maritime environment and location of San Juan Island within the rainshadow results in short, cool and dry summers while winters are mild and moderately dry.

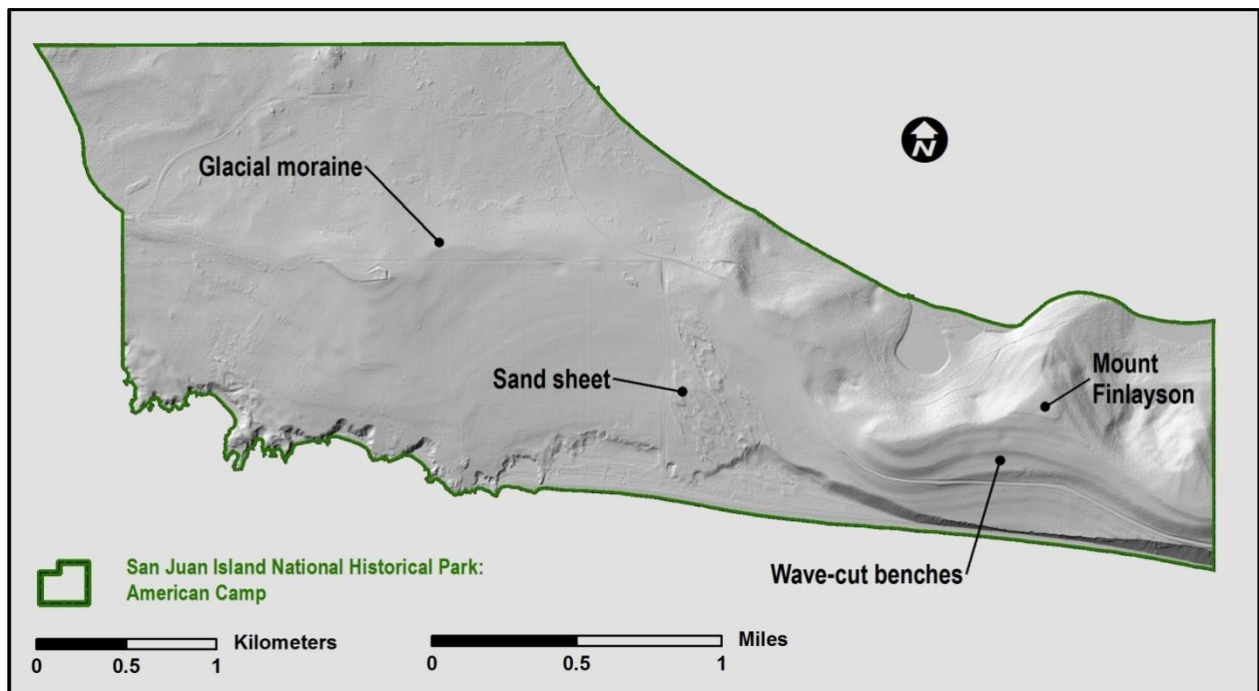
## **2.3 Geology and Topography**

### **2.3.1 Geology**

The San Juan Archipelago, which consists of approximately 473 islands during low tide or 428 islands at high tide, is the result of two key geological processes: (1) accretion of small microcontinents to the mainland and (2) glaciation (NPS 2008). San Juan County is on the continent side of the subduction margin between the Juan de Fuca and North American plates (NRCS 2009). Over 80 million years ago, small landmasses moved eastward along the Juan de Fuca plate and collided with coastline and were forced upwards against the continental plate (NPS 2008). The collision resulted in a series of horizontal thrust faults which have their western edge in the San Juan Islands (Alt and Hyndman 1995). The massive rock sheets that have moved along these thrust faults (called nappes) consist of igneous rocks (including pillow basalts, gabbro diorite, quartz diorite, and andesites) and rocks derived from sediments laid down on the ocean floor, including muddy sandstones, chert, and limestone (Alt and Hyndman 1995).

During the Pleistocene Epoch, at least four glaciations occurred in the region. The most recent ice sheet, the Cordilleran ice sheet, covered San Juan Island between 18,200 and 13,300 years ago and flowed south-southwest from Canada across the northern Puget lowland (NRCS 2009). This ice sheet reached a maximum thickness of 4,000 feet over San Juan County about 17,700 years ago. As the glaciers advanced they carved bays and channels and rounded more resistant

rock (NPS 2008). As the glaciers melted and retreated, debris of various sizes were deposited as glacial moraines and outwash plains (NPS 2008). Most of San Juan County is covered with glaciomarine and glacial outwash deposits. Glacial deposits on the San Juan Islands are relatively thin in comparison deposits on the mainland (NPS 2008). The depth of these deposits varies from approximately 20 feet or less at English Camp to nearly 100 feet at American Camp (NPS 2008). Mount Finlayson, located in the southern part of the island at American Camp, is part of a glacial moraine formed from glacial till and outwash sand that extends from Mount Finlayson west through the middle of the American Camp unit (Figure 2). Other notable features at American Camp are the terraces which extend along the south slope of Mount Finlayson which provide evidence of isostatic uplifting of the crust following glaciations (Figure 2; NRCS 2009). During the last glacial maximum, the immense weight of the overlying ice depressed the crust 300-400 feet. As the glaciers retreated and the ice melted, the crust “rebounded” and left a series of stranded marine terraces in the vicinity of Mount Finlayson (NRCS 2009). As this process occurred, ocean waves cut benches in the shorelines. Thus, the series of benches observed at Mount Finlayson reflect the emergence of this landscape over the course of approximately 13,500 years (NPS 2008).



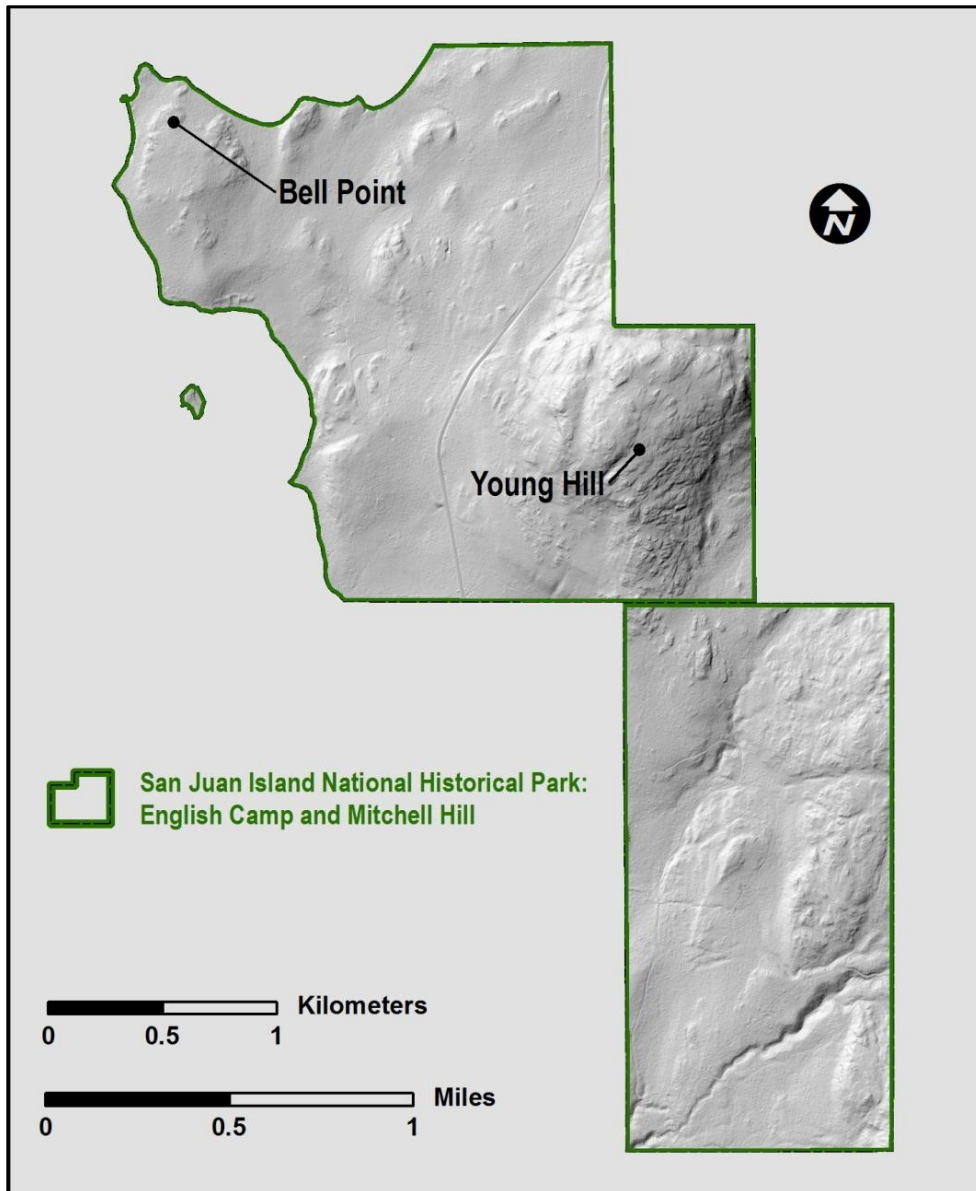
**Figure 2.** Topography of American Camp.

### **2.3.2 Topography**

The topography of San Juan Island is the result of a complex geologic history. Thrust-fault orogeny created steep, rocky hills and glaciers modified the hills and formed glacial drift plains and valleys. The elevation of San Juan Island is mostly less than 400 feet although occasional steep slopes and rock bluffs occur (NPS 2008). At 1,036 feet, Mount Dallas is the highest point on the island and is located between English and American camps.

The topography varies greatly between English and American camps. Sand sheets, moraine deposits, beaches, rocky outcrops, lagoons, and the 290 feet high Mount Finlayson characterize

the topography of American Camp (Figure 2). Long gravelly beaches interspersed with rock outcrops, bluffs, and sandy coves are found along the southern shoreline of American Camp while gravelly beaches and lagoons are found along the northern shoreline (NPS 2008). Rocky outcrops also occur in the northwestern portion of American Camp. English Camp is located on the northwest corner of the island and most of the unit is somewhat level with a gradual rise from the shoreline. Rocky outcrops are scattered throughout the area. Bell Point lies between Garrison and Westcott bays and contains rocky outcrops. The beaches at English Camp are short and either gravel or mud. Topography changes dramatically in the eastern portion of English Camp where Young Hill rises abruptly to 650 feet (Figure 3). The hilly topography continues south into the Mitchell Hill unit, which contains a mostly rolling landscape.



**Figure 3.** Topography of English Camp and Mitchell Hill.

## **2.4 Soils**

San Juan Island soils are primarily derived from glacial drift, glacial outwash, dense glaciomarine deposits, and colluvium from marine metasedimentary rock (NRCS 2009). Glacial outwash is better sorted and of a coarser texture than glacial drift. Both drift and outwash often overlie dense glaciomarine deposits which are finer-textured material (NRCS 2009). Marine metasedimentary-derived colluvium occurs on hillslopes as rock fragments and sandy soils. Many soils have a densic or cemented horizon of glaciolacustrine sediment which restrict water and root movement resulting in seasonally wet or wetter soils. In areas of more relief or those associated with coarse glacial sediment, soils are often well drained.

Most soils at American Camp are at least 15 feet deep while very shallow soils and bedrock occur along the coastline. Gravelly to cobbly, excessively drained soils occur in the prairie and slopes of Mount Finlayson (NPS 2008). Sites with a densic horizon near the soil surface result in seasonally wet soils in scattered locations around American Camp.

Soils at English Camp are shallow to moderately deep. Seasonally wet soils (associated with densic horizons) are found in low gradient areas. On Young Hill, well-drained gravelly soil occurs between outcrops. Soils on the north side of Young Hill are cobbly and well-drained while those on the south slope have a dark surface horizon suggesting the area was historical dominated by grassland or open woodlands (NPS 2008).

## **2.5 Hydrology and Water Resources**

Runoff, evapotranspiration, and groundwater recharge are primary components to the hydrologic cycle on San Juan Island. Due to the prevalence of rock outcrops, shallow soils and impervious soil layers across much of the island, runoff is proportionally high with between 11 to 45 percent of annual rainfall resulting in runoff (NPS 2008). Conversely, groundwater recharge occurs where soils are well-drained and deep such as at American Camp. Evapotranspiration loss occurs mostly in summer months when vegetation growth is vigorous and precipitation is minimal (NPS 2008). Rates of evapotranspiration on San Juan Island vary but have been estimated to be between 45-49 percent of average annual rainfall (NPS 2008). The interaction of runoff, groundwater recharge, and evapotranspiration results in the remaining water that occurs in local aquifers, wetlands, and streams.

There are no significant sources of surface freshwater within San Juan National Historical Park (Holmes 1998). However, there are small springs, seeps, intermittent streams, and other wetland areas scattered throughout the park. Holmes (1998) identified 35 wetlands in the park, with 26 occurring at American Camp and nine at English Camp. Many wetlands occur where surface water seasonally ponds due to the presence of an underlying impervious soil horizon. Other wetlands occur around sites where groundwater discharge occurs (e.g., seeps and springs). There are also a few intermittent streams that occur in the park. The only perennial stream is located at Mitchell Hill. The most significant surface water resources in the park are three tidal lagoons located along the north shore of American Camp's Griffin Bay (First, Jakle's and Third lagoons). These wetlands are temperate marine lagoons, which are uncommon features along the northwest Pacific coast (Holmes 1998).

Holmes (1998) documented 37.2 ha (91.9 acres) of wetlands (or 5% of land cover) within the park. He documented 32 ha (79.2 acres) of wetlands at American Camp and noted that they

consisted of a total of 16.2 ha (40.5 acres) of palustrine forested, 3.4 ha (8.5 acres) of palustrine scrub shrub, 2.7 ha (6.7 acres) of palustrine emergent, 0.1 ha (0.3 acres) of palustrine aquatic bed, and 0.2 ha (0.6 acres) of palustrine unconsolidated bottom. The lagoons consisted of 4.1 ha (10.1 acres) of subtidal unconsolidated bottom, 3.9 ha (9.72 acres) of intertidal emergent, and 1.2 ha (2.9 acres) of intertidal unconsolidated shore (Holmes 1998).

The 5.1 ha (12.7 acres) of wetlands occurring at English Camp were all palustrine and included 3.2 ha (8.0 acres) forested, 0.1 ha (0.3 acres) scrub shrub, and 1.8 ha (4.4 acres) emergent (Holmes 1998).

## **2.6 Land Use and Settlement History**

The first evidence of humans on San Juan Island dates back 7,000 to 9,000 years ago from a bluff above South Beach at American Camp where spear points were discovered (NPS 2008). Until about 1,500 to 2,500 years ago, the island was likely only seasonally used by native peoples for hunting, fishing, and gathering of food and other resources. Archaeologists postulate that human population on San Juan Island then increased and began to occupy the island permanently (NPS 2008). By the time of European contact just over 200 years ago, the native people of San Juan Island and nearby areas were primarily members of Central Coast Salish tribes. These tribes exhibited seasonal patterns of moving between islands and the mainland and from larger winter villages to smaller camps in other seasons (NPS 2008).

Three villages were located in northern San Juan Island near Lonesome Cove, Mitchell Bay, and Garrison Bay, which is within the English Camp unit of the park. Four small camps were noted by early surveyors along the western shore of the island (NPS 2008). Other than one small house, no camps or villages were reported at the south end of the island during early explorations of the area (NPS 2008).

Native peoples gathered food, hunted local fauna, and fished local waters. One significant methods of fishing was the use of underwater reef nets that were used to catch migrating salmon off the island shoreline (NPS 2008). Native peoples are known to have burned prairie and oak woodlands to encourage the production of food resources such as camas as well as to maintain open habitat for deer and other animals they hunted (NPS 2008).

The Spanish are the first known Europeans to have explored the San Juan Islands with Manuel Quimper sailing through the area in 1790 followed by Francisco Eliza the following year. Eliza is thought to have given the San Juan Islands their name (NPS 2008). In 1790, Spain and Great Britain agreed to joint exploration and occupation of the Salish Sea region. Captain George Vancouver explored the region in 1792. In 1841, U.S. Navy Lt. Charles Wilkes charted the San Juan Islands based largely on previous surveys conducted by Quimper, Vancouver, Eliza, and Galiano (NPS 2008). In 1846, the Oregon Treaty was signed and delineated the 49<sup>th</sup> North Parallel as the boundary between British and American possessions in the West but left the boundary between Vancouver Island and the mainland ambiguous leaving ownership of the San Juan Islands in dispute (NPS 2008).

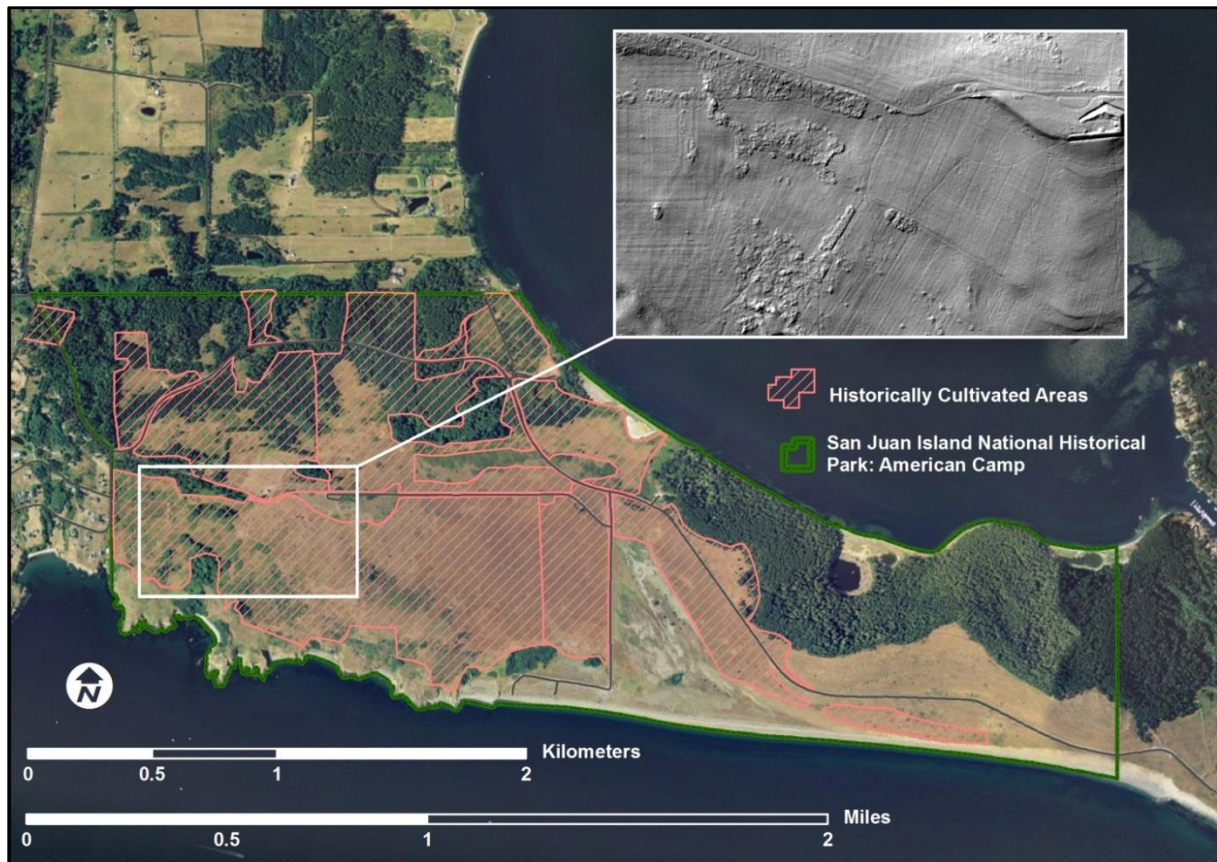
Exploitation of the San Juan Islands by Euro-American settlers began as early as 1840 with timber harvesting. The Hudson Bay Company established a seasonal fishing station on San Juan Island in 1850 and then a permanent agricultural station, called the Belle Vue Sheep Farm, on the

southern end of San Juan Island (and within American Camp unit) in 1853 (NPS 2008). The farm supported a herd of 4,500 sheep and contained houses, barns, outbuildings, fenced pastures, and more than 40.5 ha (100 acres) of cultivated land (NPS 2008). In the 1850's residents of San Juan Island included a few Belle Vue Farm employees and about 25 Americans. In 1859, one of the Americans shot a black boar that was disturbing his potato patch. The boar belonged to the Belle Vue Farm and subsequent disputes about the incident led to the Pig War. The Americans established a military camp in the south end of the island (i.e. American Camp) in 1859 while the British established an encampment at the north end of the island (present day site of English Camp) in 1860. The activities associated with these encampments had a significant impact on the natural resources of these site, with major alterations to soils, hydrology, and vegetation occurring. The Pig War ended in 1872 when the boundary between British and American holdings was finalized, giving the San Juan Islands to the Americans (NPS 2008).

After the military abandoned these posts, both camps were sold to private individuals. At American Camp, homesteaders continued to farm and graze the landscape. In 1951, the Washington State Parks and Recreation Commission acquired five acres (2 ha) of the historic camp site. The Crook family acquired English Camp in 1875 and farmed and worked the landscape until 1963 when the family transferred ownership of the site to Washington State Parks and Recreation Commission. In 1966, the San Juan National Historical Park was created and both the English and American camp sites were transferred from Washington State Parks and Recreation Commission to the National Park Service.

The extent of disruption to local topography and soils from past land use is visible using recent Light Detection and Ranging (LiDAR) data (Puget Sound Lidar Consortium 2011). Using LiDAR, observable past or current land use signatures are activities that have physically disturbed the soils such as plow lines, roads, mounds, soil pits, etc. Using this data source, cultivated areas were mapped for all three units of the park and are shown in Figures 4 and 5. The cultivated map for English Camp agrees with areas identified as cultivated by Agee (1984). Plow lines were visible over a significant portion of American Camp (Figure 4) whereas they were more limited at English Camp/Mitchell Hill (Figure 5). This doesn't suggest English Camp or Mitchell Hill had less impact from past land use, only that physical disruption of the soil profile appears to be less extensive. Logging was likely a significant impact at all three units (NPS 2008).

In the late 1800's, the European rabbit (*Oryctolagus cuniculus*) was introduced onto San Juan Island. European rabbits are an invasive species that will eat almost any vegetation. Because the native vegetation on San Juan Island is not adapted to grazing, the effect of rabbit herbivory has been a decrease in native species and an increase in non-native species (NPS 2008). The European rabbit became abundant on the islands by 1930's and its large numbers resulted in large areas of denuded ground, which are typically taken advantage of by nonnative plant species. The digging of warrens (underground system of burrows) has also altered soil-water relationships in areas where rabbit populations are abundant, such as the grasslands of American Camp. The rabbit population plummeted in the 1980s and has fluctuated since. The current population is estimated to be fewer than 1,500 rabbits (NPS 2008).



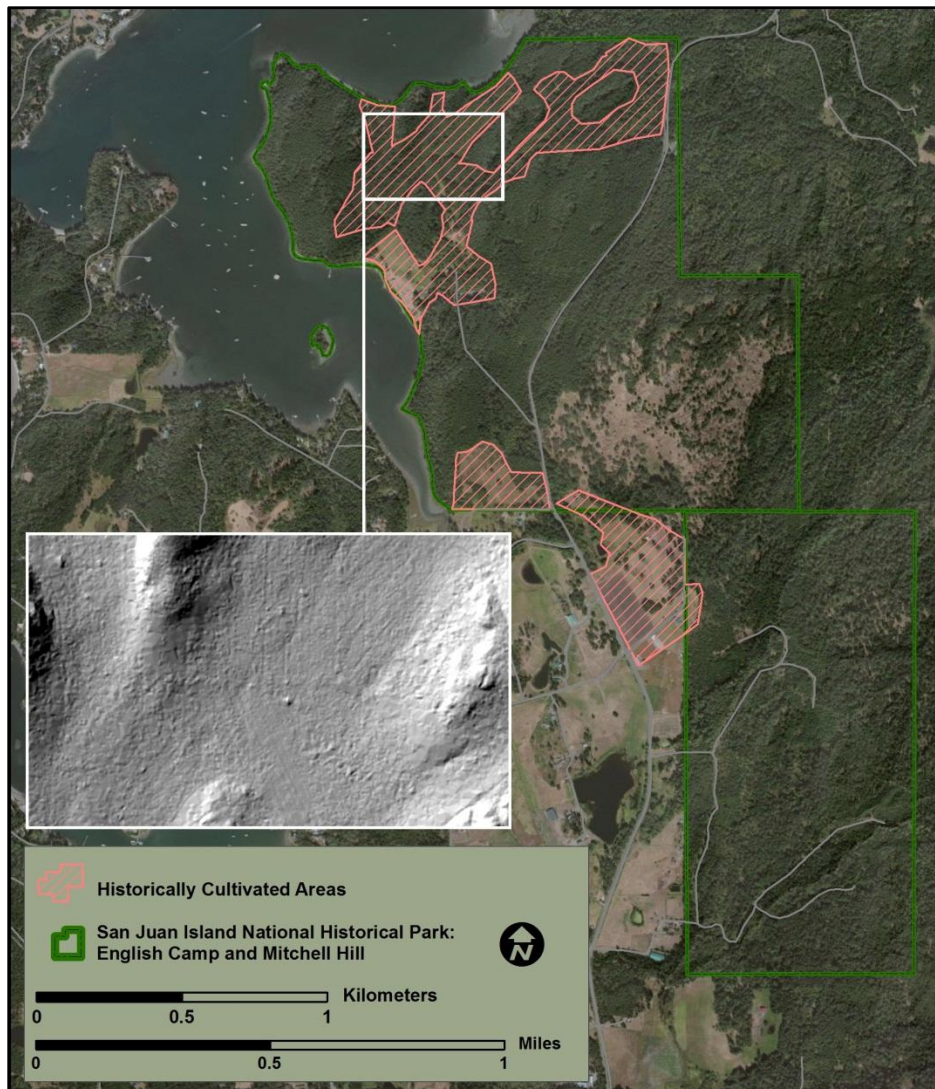
**Figure 4.** Historically cultivated areas within American Camp. Inset shows visible plow lines from LiDAR indicating where past cultivation occurred. These plow lines were the primary indicators used to delineate the cultivated areas.

## 2.7 Vegetation

### 2.7.1 American Camp Vegetation

Grasslands dominate a significant portion of American Camp including the central portion and south slopes of Mount Finlayson (Figure 6). Historically, most of these grasslands consisted of native prairie vegetation, but past agricultural and grazing activities have eliminated native species from the majority of the area (especially the native bunchgrasses). Most of the small pockets of remaining native prairie vegetation occur in areas that are too rocky for farming or sites where grazing was the predominant land use. Roemer's fescue (*Festuca idahoensis* ssp. *roemerii*), red fescue (*F. rubra* ssp.), California oatgrass (*Danthonia californica*), foothill sedge (*Carex tumulicola*), common camas (*Camassia quamash* ssp. *maxima*), great camas (*C. leichtlinii*), field chickweed (*Cerastium arvense*), western buttercup (*Ranunculus occidentalis*), chocolate lily (*Fritillaria lanceolata*), and many-flowered wood rush (*Luzula multiflora*) are common in the relict prairie stands. The remaining portion of the former prairie is now occupied by pasture grasses, annual grasses (especially *Bromus* spp.) and other non-native species such as velvet grass (*Holcus lanatus*), bentgrass (*Agrostis* ssp.), quackgrass (*Elymus repens*), Kentucky bluegrass (*Poa pratensis*), Canada thistle (*Cirsium arvense*), and Himalayan blackberry (*Rubus armeniacus*).





**Figure 5.** Historically cultivated areas within English Camp and Mitchell Hill. Inset shows visible plow lines from LiDAR indicating where past cultivation occurred. These were the primary indicators used to delineate the cultivated areas.

Patches of Sitka brome (*Bromus sitchensis*) and blue wildrye (*Elymus glaucus*), both native species, are common near the prairie-forest ecotone at the summit of Mount Finlayson as well as in the grasslands embedded within the forest matrix in the northwest corner of American Camp. Some formerly cultivated areas have been invaded by dense stands of Douglas-fir (*Pseudotsuga menziesii*), shore pine (*Pinus contorta* ssp. *contorta*), and red alder (*Alnus rubra*).

Dry forests of Douglas-fir and Pacific madrone (*Arbutus menziesii*) with an understory of snowberry (*Symphoricarpos albus*), oceanspray (*Holodiscus discolor*), salal (*Gaultheria shallon*), and baldhip rose (*Rosa gymnocarpa*) are found in the northwest corner of American Camp (Figure 7). The north slopes of Mount Finlayson (the northeast corner of American Camp) are dominated by relatively moist forests of Douglas-fir, grand fir (*Abies grandis*), western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*) with salal and sword fern (*Polystichum munitum*) being common in the understory.



**Figure 6.** Land cover of the American Camp Unit.

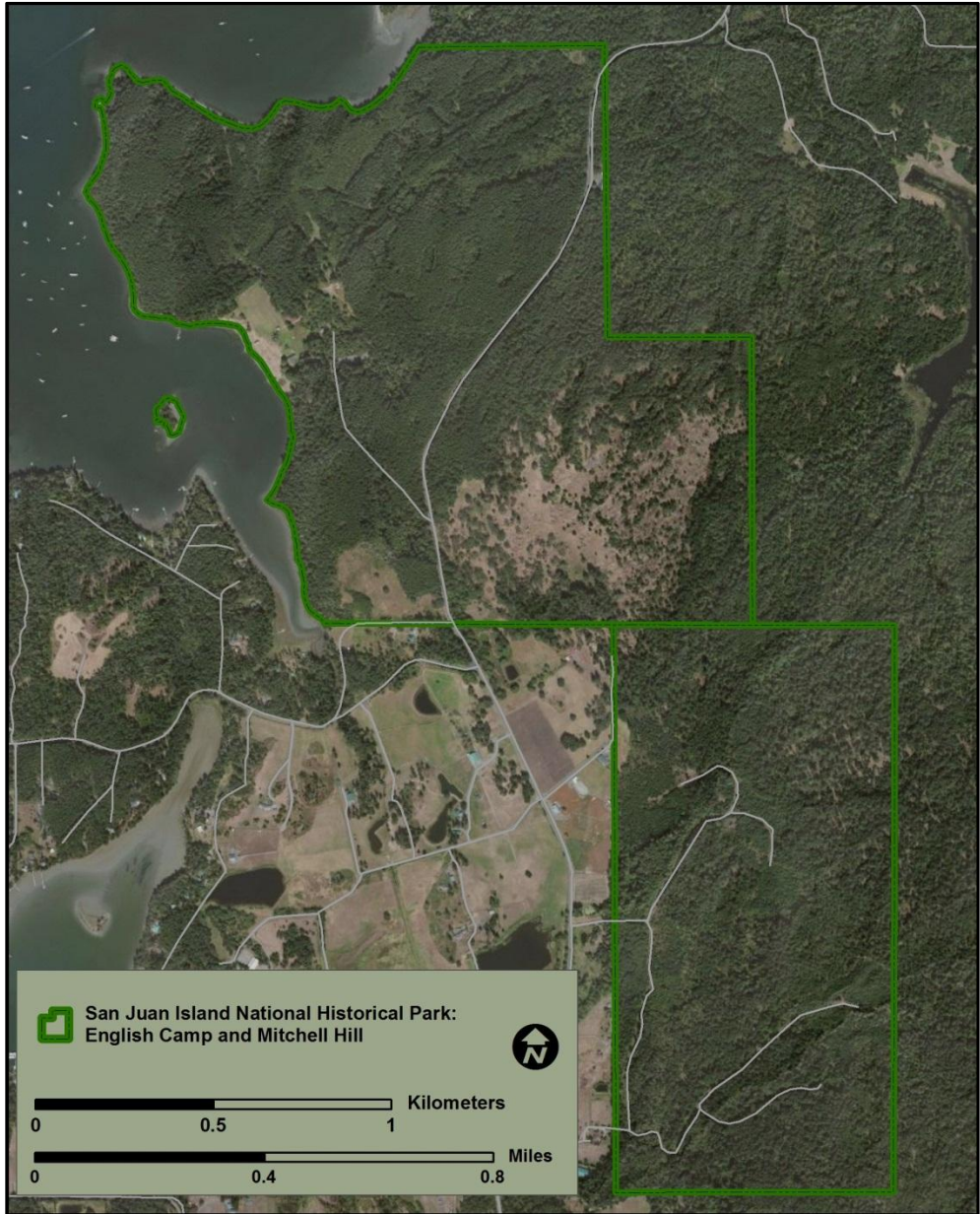
Freshwater wetland vegetation varies from forested swamps, shrub swamps and herbaceous wet meadows or marshes. Red alder, western redcedar, and cottonwood (*Populus balsamifera* ssp. *trichocarpa*), western crabapple (*Malus fusca*), Hooker’s willow (*Salix hookeriana*), and Scouler’s willow (*S. scouleri*) are common trees found in forested wetlands. Skunkcabbage (*Lysichiton americanus*) and slough sedge (*Carex obnupta*) are common understory species in these wetlands. Hooker’s willow, salmonberry (*Rubus spectabilis*), thimbleberry (*R. parviflorus*), and Nootka rose (*Rosa nutkana*) dominate the seeps/springs in the southern portion of American Camp. English hawthorn (*Crataegus monogyna*), black hawthorn (*Crataegus douglasii*), Nootka rose, Baltic rush (*Juncus arcticus* ssp. *littoralis*), slough sedge, and common rush (*Juncus effusus*) are dominant in disturbed wetlands along an east-west trending ditch in the west-central portion of American Camp and in area near 4<sup>th</sup> of July Beach.

The lagoons are dominated by concentric rings of vegetation with pickleweed (*Salicornia virginica*) occurring in the most saline areas. Saltgrass (*Distichlis spicata*), spear saltbush (*Atriplex patula*), marsh Jaumea (*Jaumea carnosa*), and seaside arrowgrass (*Triglochin maritima*) are common in areas adjacent to, or sometimes in conjunction with, pickleweed. Pacific silverweed (*Argentina egedii* ssp. *egedii*), Baltic rush, red fescue, and saltmeadow rush (*Juncus gerardii* var. *gerardii*) are common in brackish or less saline areas.

### **2.7.2 English Camp and Mitchell Hill Vegetation**

Forest vegetation predominates over the majority of both the English Camp and Mitchell Hill units (Figure 7). Forest composition varies according to soil depth, soil drainage, and aspect. The western portion of English camp is dominated by a matrix of relatively mesic mixed conifer forest (Douglas-fir, bigleaf maple (*Acer macrophyllum*), grand fir, western hemlock, and western redcedar) with salal dominating the understory. Dry forests dominated by Douglas-fir and Pacific madrone are found on shallow soils and near rock outcrops scattered throughout the forest matrix of the relatively flat western part of English Camp. Baldhip rose, oceanspray, snowberry, and

western fescue (*Festuca occidentalis*) are common understory species. These dry forests are also found around the base of Young Hill and in the northern section of Mitchell Hill.



**Figure 7.** Land cover of the English Camp and Mitchell Hill units.

Lowland areas of the northwest portion of English Camp were previously cultivated or logged extensively and are now dominated by a mixture of red alder and dense stands of Douglas-fir with occasional western redcedar and shore pine. Many of these areas appear to have an impervious soil layer that creates seasonally wet soils resulting in a mesic understory consisting of salmonberry, snowberry, swordfern, and English hawthorn.

Steep north slopes of Young Hill (central portion of English Camp) are protected from southerly winds and receive very little direct sunlight and consequently support mesic forest types similar

to those found on the north slope of Mount Finlayson where western redcedar, grand fir, bigleaf maple, and western hemlock are dominant. These forest types are also common at Mitchell Hill, especially in the western and central portion of that unit.

Garry oak (*Quercus garryana*) woodlands are found on the west and south-facing side of Young Hill. Encroaching Douglas-fir trees were recently removed and fire reintroduced into these relict stands in order to begin restoration of the historical structure and composition of these once-open woodlands. Young Hill also supports extensive areas of grasslands on west and south-facing aspects, shallow soils and rock outcrops. Annual nonnative bromes (*Bromus diandrus*, *B. hordeaceus*, and *B. sterilis*) and tall oatgrass (*Arrhenatherum elatius*) have displaced most of the native vegetation in these grasslands. The steep slopes of Young Hill have very little native remnant prairie or 'bald' vegetation remaining. At the summit of Young Hill, very small patches of bald vegetation dominated by Roemer's fescue, long stolon sedge (*Carex inops*), blue wildrye, common and great camas, seablush (*Plectritis congesta*), and shooting star (*Dodecatheon hendersonii*) can still be found around inaccessible outcrops.

Only a few freshwater wetlands occur at English Camp and most have an abundance of nonnative species. A large forested seep flows from the parking lot at English Camp down to the parade ground on the shores of Garrison Bay. There are a few forested swamps within the Mitchell Hill unit where western redcedar dominates along with salmonberry and skunkcabbage. There is also an entrenched perennial stream in the Mitchell Hill unit that runs east to southwest across the southern portion of that unit.

## **2.8 Previous Vegetation Studies**

Previous vegetation studies within San Juan National Historical Park have primarily focused on forest ecosystems (Agee 1984, 1987; Peterson 2002). Wetlands have also been inventoried in the park (Holmes 1998) and American Camp grasslands also received some attention (Rochefort and Bivin 2010). Although not focused within park boundaries, the vegetation work conducted in the Puget Trough by Chappell (2006a, 2006b) is relevant to this project.

Based on historical photos, documents, soil types, and tree ages, Agee (1984) described vegetative patterns before, during, and after the historical period (1850 to 1870) for both American and English camps. Agee (1987) provided a more detailed analysis and map of contemporary forest communities. Potential vegetation and succession, fuel characteristics and distribution of each forest type were discussed. Non-forested vegetation types were not addressed. Holmes (1998) inventoried and mapped wetlands within the park using the Cowardin classification (Cowardin et al. 1979). Species lists for each wetland were provided and divided into 'dominant' or 'not-dominant' categories. Peterson (2002) developed a field-based vegetation classification and map as well as a fuels database. This effort focused on forested vegetation and cross-walked Agee's forest types into NVC associations. Non-forested vegetation types were mapped as cover types and no effort was made to cross-walk them to NVC associations. Rochefort and Bivin (2010) conducted a classification of grassland vegetation at American Camp. Their vegetation types were locally defined and not based on, or cross-walked to, the NVC. Rocchio and Crawford (2009) listed the NVC plant associations known or likely to occur within the park based on previous research or suitable ecological environments.

All of these studies provide a template upon which this project was initiated especially for forested communities which have previously received much attention. However, only minimal information about the characteristics of non-forested, semi-natural, and cultural vegetation types and their distribution within the park was available from these resources.



## 3.0 Classification of Vegetation Types

### 3.1 Methods

The vegetation classification was primarily based on existing national, regional, and local vegetation classifications. The small extent of the park allowed classification data collection to occur simultaneously with field-based mapping. This section provides an overview of the methods and results of classifying vegetation. The next section will provide a similar overview for the vegetation mapping.

#### 3.1.1 Use of Previously collected Data

The methods used in this project were designed to build upon the existing vegetation classification efforts in the Pacific Northwest. The project incorporates and re-evaluates: 1) legacy data from previous vegetation studies (Peterson 2002, Chappell 2006a and 2006b; Rochefort and Bivin 2010) and 2) new data (classification and observation plots) collected during the course of this project. Collection of new data was designed to fill known gaps in the existing classification, to document the occurrence of known associations, and to identify previously unrecognized associations.

The legacy data used included Peterson (2002) and Rochefort and Bivin (2010). Considering most forested polygons were successfully classified according to Chappell (2006a, 2006b), the Peterson (2002) data set was rarely needed for analysis. Rochefort and Bivin's (2010) data set proved useful for classifying ruderal and native grassland communities and was especially helpful for identifying locations of native vegetation. Although the community types identified in Rochefort and Bivin (2010) were not based on the NVC classification, conceptually they often overlapped with existing NVC types or provided useful data for determining provisional types.

Rochefort and Bivin's (2010) plot data were used to assist in classifying herbaceous vegetation at American Camp. That data set, which included 424 4x4m plots, was combined with plot data collected for this project to help discern herbaceous vegetation types that were not successfully keyed with existing resources such as Chappell (2006a, 2006b). Plot data from Peterson (2002) were rarely used since most native forest types were successfully keyed to an existing classification type using Chappell (2006b).

#### 3.1.2 Field Sampling

##### Preliminary Polygons

Prior to conducting field visits, existing vegetation maps (Rochefort and Bivin, Peterson 2002), soils maps (NRCS 2009), wetland locations (Holmes 1998, USFS 2008), and 2008 NAIP 6-inch color orthophotos were used to delineate preliminary polygons using ArcGIS™ 9.3.1. Each polygon was assigned a "GIS\_Poly" code. For some areas, preliminary polygons were hard to draw and therefore were targets for field sampling.

Hardcopy maps of the preliminary polygons were produced using ArcGIS™ at 1:2600 scale for non-forested vegetation and 1:1900 scale for forested vegetation. The maps were used to delineate boundaries of vegetation types in the field. As preliminary polygons were visited in the field, they were assigned to previously defined associations when possible. Each polygon was initially typed using one of the following keys: (1) Plant Associations of Balds and Bluffs of

Western Washington (Chappell 2006a) and (2) Upland Plant Associations of the Puget Trough Ecoregion, Washington (Chappell 2006b). Each polygon was assigned a “Field\_Poly” identifier as a quick way to code vegetation types. The majority of native (not ruderal) forest and grassland vegetation types encountered in the park were successfully keyed using these two resources. The WNHP state vegetation classification was reviewed for possible matches for types not identifiable using the Chappell (2006a, 2006b) keys. The WNHP classification includes citations of all plant associations described in Washington.

If no applicable association was identified in the Chappell (2006a, 2006b) keys or the WNHP classification, then a classification or observation plot was established.

### Classification/Observation Plots

Classification or observation plots were established only in those areas not readily identifiable with known plant associations or alliances. These plots were primarily targeted in non-forested areas, especially grasslands and wetland types.

Classification plot data collection methods combined guidance from the NPS Vegetation Mapping Program Field Methods for Vegetation Mapping (TNC and ESRI 1994) and WNHP data collection protocols. Data were collected from a fixed radius plot, the size of which depended on vegetation structure. Forest plots had an area of 400 m<sup>2</sup>, shrub plots were 100 m<sup>2</sup> and dwarf shrub, herbaceous and sparse plots were 50 m<sup>2</sup>. Within the classification plots, a suite of variables including aspect, slope, elevation, GPS location, hydrological regime, disturbance, physiognomy, and strata data were collected when appropriate.

Plant association names were recorded when possible. For undescribed types, a preliminary name was assigned. The core of the classification plot data is the ocular species list. Crown cover (in classes) was recorded for all species seen in the plot. Cover of bryophytes was recorded when cover was greater than 1%. Bryophytes growing on logs were excluded from cover estimates. Cover classes were as follows:

P: present 1: trace 2: 0—<1% 3: 1—<2% 4: 2—<5% 5: 5—<10% 6: 10—<25% 7: 25—<50% 8: 50—<75% 9: 75—<95% 10: >95%.

Observation plots were established in areas which keyed out well using existing classifications. Data collected at observation plots were limited to species composition and cover and GPS location.

### **3.1.3 Data Analysis and Product Development**

Plot data were entered into a Microsoft Excel spreadsheet. Plots from stands not identifiable as an existing type were sorted into clusters according to floristic indicators and environmental characteristics. Plot data within clusters were then compared using tabular analysis to determine similarity. Provisional associations were then assigned to each plot. The provisional associations were added to the vegetation classification arranged according to the revised NVC hierarchy (Appendix A).

A vegetation key was developed to enable future users to identify plant associations or alliance types in the field (Appendix B). New or edited summary descriptions (Appendix B) were written for all plant association or alliance types (alliance descriptions were only written if no



corresponding plant association was identified in the park). Following the initial vegetation mapping field season (2010) and prior to the accuracy assessment field work (2011), NPS staff tested and provided feedback on the vegetation keys and descriptions. WNHP met with NPS staff to discuss their observations resulting in a modified and improved vegetation key and descriptions.

#### **3.1.4 Standardizing Vegetation Nomenclature**

In order to standardize plant association names across the various classifications, NatureServe (2010) and Meidinger et al. (2005) were used as the plant association nomenclature reference for this project. NatureServe (2010) was the primary default, however if names identified in Meidinger et al. (2005) had not yet been incorporated into NatureServe Explorer (NatureServe 2010), then names identified in Meidinger et al. (2005) were accepted. NatureServe (2010) has synthesized plant association names across the North American continent. However, their data can be out of date due to the continual development of new data sources. Meidinger et al. (2005) quantitatively compared plant associations from southeastern Alaska south to southwestern Oregon. Data sets of previously defined plant associations were collected into a single database and then compared with similarity indices and constancy/cover tables. Regional ecologists reviewed the analyses and made proposals for combining and naming plant associations on this rangewide scale. Most of these new names are recognized by NatureServe (2010) but many have yet to be entered into their online database, NatureServe Explorer.

Association names are assigned codes. Names accepted by NatureServe have an association code that begins as “CEGLXXXXXX”. Association codes from Meidinger et al. (2005) names begin with “PNWCOAST\_XXX”. An “Association Status” code is also assigned to each association in the classification spreadsheet. Associations identified in NatureServe (2010) or Meidinger et al. (2005) are indicated as “Existing”. Those associations recognized within the WNHP state classification, but not by NatureServe (2010) or by Meidinger et al. (2005) are identified as “Preliminary” associations for this project. New types derived from this project are indicated in this report as “Provisional”.

#### **3.1.5 Conservation Rank**

A global and state conservation status ranking system developed by NatureServe and the Natural Heritage programs is used to estimate conservation priorities (<http://www.natureserve.org/explorer/ranking.htm>). The ranking system facilitates a quick assessment of an entity’s rarity. For this project, only plant associations are assigned a conservation rank. Each plant association is assigned both a global (G) and state (S) rank on a scale of 1 to 5. Global ranks are assigned through a collaborative process involving both NatureServe and Natural Heritage Program scientists. State ranks are assigned by scientists within the Natural Heritage Program with the proviso that state rank cannot be rarer than indicated by the global rank.

A rank of G1 indicates critical imperilment on a global basis; the species (or plant association) is at great risk of extinction. S1 indicates critical imperilment within a particular state, regardless of its status elsewhere. A number of factors, such as the total range, the number of occurrences, severity of threats, and resilience contribute to the assignment of global and state ranks. The information supporting these ranks is developed and maintained by Natural Heritage Programs

and NatureServe. Global and state ranks are presented in the association descriptions (Appendix B).

Uncertainty in conservation rank is expressed as a Range Rank. For example, G2G3 indicates a range of uncertainty such that there is a roughly equal chance of G2 or G3 and other ranks are less likely. A rank of GU expresses that a rank is unable to be assigned due to a lack of information or due to conflicting information about status or trends. When the taxonomic distinctiveness of an association is questionable, it is assigned a rank of GQ in combination with a standard numerical G rank, for example G3Q.

Ranking for this project considered any previous ranking effort for the association or synonym listed by NatureServe, WNHP or heritage programs in adjacent states or provinces.

Global Rank definitions (similar definitions apply at the state-scale for State Ranks):

- G1** Critically imperiled - At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- G2** Imperiled - At high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors.
- G3** Vulnerable - At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors.
- G4** Apparently secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
- G5** Secure - Common; widespread and abundant.

These ranks are modified by other codes such as:

**G#G# Range Rank**—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. Ranges cannot skip more than one rank.

**GNR** Unranked—Global rank not yet assessed.

**GH** Presumed Eliminated— Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration.

**?** Inexact Numeric Rank—e.g., G2?

**Q** Questionable taxonomy—Taxonomic distinctiveness of this entity at the current level is questionable.

The global and state ranks provide natural resource managers a prioritization scheme for determining which associations are most unique within a park (e.g., G1/G2 or S1/S2) and consequently which are most threatened from management activities.

### **3.1.6 Taxonomic Treatments**

The primary regional source for species identification is Hitchcock and Cronquist (1973). The standard for the NatureServe IVC/NVC plant association names is Kartesz, J.T. (1999). The 2008 FGDC states: “Nomenclature for vascular plant taxa used in scientific type names should follow the accepted name in USDA PLANTS or ITIS...” with reference to version. For this report, species are synonymized according to USDA PLANTS (March 2011). When the USDA PLANTS name differs from Hitchcock and Cronquist (1973) in association descriptions, the latter appears in parenthesis preceded with an “=”, for example, *Maianthemum (=Smilacina) stellatum* and *Agrostis pallens (=diegoensis)*. Following NatureServe nomenclatural protocol, when taxa are considered equivalent indicators and/or their field identification easily confused, the entities are included in parenthesis. For example, *Achlys triphylla* and *Achlys californica* are combined and listed as *Achlys (californica, triphylla)*.

## **3.2 Results**

### **3.2.1. Plot Data Used for Classification**

The distribution of the 167 plots collected for this project is shown in Table 2. Nearly all plot data collected were in the form of observation plots. This was due to the fact that most polygons were successfully typed using existing vegetation keys and descriptions (Chappell 2006a, 2006b), thus rigorous classification plot data was not needed for most types. Herbaceous types were not well documented by previous vegetation studies thus more often required classification plot data (Table 2). Observation plot data was often used to confirm vegetation types that were keyed in the field but also provided data for classifying undocumented vegetation types.

### **3.2.2 Ruderal Types**

The most challenging vegetation types to classify were the ruderal alliances. This is due to two primary reasons: (1) lack of sufficient classification data and (2) the dynamic nature of ruderal areas. Little to no regional classification data exists for ruderal vegetation types. Due to limited project resources, data collection was prioritized toward the natural vegetation types within the park thus limiting the collection of park-specific ruderal classification data. Furthermore, many of the ruderal vegetation types are very dynamic and can change or express themselves very differently year to year due to varying climatic and biological processes (i.e. dynamics of rabbit populations). Given these limitations, ruderal vegetation type were classified and mapped at the alliance level. Some of these types, especially those with annual species (i.e. San Juan Islands Ruderal Forbs and Graminoids Alliance and *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Alliance) are likely to be very dynamic, with composition and relative of abundance of species fluctuating as climatic conditions and disturbance regimes change. The mapped locations of the ruderal types are less likely to be problematic compared to their classification. Ruderal vegetation can be more strongly related to the type, duration and frequency of past human activity rather than underlying environmental variables which often get homogenized in such areas. Recognizing these possible shortcomings with ruderal alliances, the ruderal Groups or Macrogroups should still provide useful units for assisting park staff with management decisions.

**Table 2.** Plot data at San Juan Island National Historical Park collected for mapping and classification.

	Number of Classification Plots	Number of Observation Plots	Total Number of Plots
<b>Forest/Woodland</b>		<b>67</b>	<b>67</b>
<i>(Acer macrophyllum, Alnus rubra)</i> Riparian Forest Alliance		5	5
<i>(Alnus - Fraxinus - Populus) / Lysichiton americanus</i> Deciduous Swamp Woodland Alliance		2	2
<i>(Tsuga heterophylla - Picea sitchensis - Thuja plicata - Abies) / Lysichiton americanus</i> Alliance		2	2
<i>Acer macrophyllum (Pseudotsuga menziesii)</i> Forest Alliance		3	3
<i>Alnus rubra - (Picea sitchensis, Tsuga heterophylla)</i> Forest and Woodland Alliance		4	4
<i>Alnus rubra - Pseudotsuga menziesii</i> Provisional Ruderal Alliance		10	10
<i>Alnus rubra / Crataegus monogyna / Carex obnupta</i> Provisional Ruderal Alliance		1	1
<i>Alnus rubra / Nonnative Grasses</i> Provisional Ruderal Alliance		3	3
<i>Prunus emarginata</i> Provisional Ruderal Alliance		2	2
<i>Pseudotsuga menziesii - (Arbutus menziesii)</i> Forest and Woodland Alliance		11	11
<i>Pseudotsuga menziesii - Pinus contorta</i> Provisional Ruderal Alliance		3	3
<i>Pseudotsuga menziesii / Nonnative Grasses</i> Provisional Ruderal Alliance		6	6
<i>Quercus garryana</i> Woodland Alliance		3	3
<i>Thuja plicata - (Abies grandis)</i> Hypermaritime Forest Alliance		3	3
<i>Thuja plicata - (Abies grandis)</i> Maritime Forest Alliance		7	7
<i>Tsuga heterophylla - Pseudotsuga menziesii / (Holodiscus discolor)</i> Forest		2	2
<b>Herbaceous</b>	<b>13</b>	<b>67</b>	<b>80</b>
<i>Equisetum (arvense, variegatum, hyemale, telmateia)</i> Semipermanently Flooded Herbaceous Alliance		2	2
<i>Festuca rubra - Calamagrostis nutkaensis</i> Coastal Headland Herbaceous Alliance	2	2	4
<i>Leymus mollis - Festuca rubra</i> Herbaceous Alliance	7	13	20
<i>Schedonorus phoenix</i> Provisional Ruderal Alliance		1	1
<i>(Bromus sterilis - Cirsium arvense - Teesdalia nudicaulis)</i> Provisional Ruderal Alliance		3	3
<i>(Juncus balticus - Juncus effusus)</i> Herbaceous Alliance		2	2
<i>Agrostis (capillaris, stolonifera)</i> Provisional Ruderal Alliance		1	1
<i>Arrhenatherum elatius</i> Provisional Ruderal Alliance		2	2
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Alliance	1	3	4
<i>Bromus sitchensis - Elymus glaucus</i> Provisional Ruderal Alliance	1	7	8
<i>Camassia quamash</i> Herbaceous Alliance		1	1
<i>Carex inops</i> Herbaceous Alliance		1	1
<i>Carex leporina</i> Ruderal Wet Meadow Alliance			
<i>Carex obnupta</i> Seasonally Flooded Herbaceous Alliance		1	1
<i>Carex tumulicola</i> Alliance	1	3	4
<i>Cirsium arvense</i> Provisional Ruderal Alliance		1	1

**Table 2.** Plot data at San Juan Island National Historical Park collected for mapping and classification (continued).

	Number of Classification Plots	Number of Observation Plots	Total Number of Plots
<i>Elymus repens</i> Provisional Ruderal Alliance		1	1
<i>Equisetum arvense</i> - Mixed Graminoid Provisional Ruderal Alliance		1	1
<i>Festuca roemerii</i> - <i>Agrostis pallens</i> - <i>Koeleria macrantha</i> Herbaceous Alliance	1	6	7
<i>Festuca roemerii</i> Provisional Ruderal Alliance		1	1
<i>Holcus lanatus</i> - <i>Poa pratensis</i> Provisional Ruderal Alliance		4	4
<i>Juncus gerardii</i> Provisional Ruderal Alliance		1	1
<i>Oenanthe sarmentosa</i> Herbaceous Alliance		2	2
<i>Phalaris arundinacea</i> Provisional Ruderal Alliance		1	1
<i>Plectritis congesta</i> Herbaceous Alliance		1	1
<i>Poa pratensis</i> Provisional Ruderal Alliance		2	2
<i>Salicornia virginica</i> Tidal Herbaceous Alliance		2	2
<i>Schedonorus pratensis</i> Provisional Ruderal Alliance		2	2
<b>Nonvascular</b>		<b>1</b>	<b>1</b>
<i>Racomitrium canescens</i> Alliance		1	1
<b>Shrubland</b>	<b>2</b>	<b>20</b>	<b>22</b>
<i>Cornus sericea</i> Shrubland Alliance		1	1
<i>Crataegus (douglasii, monogyna)</i> - <i>Rosa nutkana</i> Provisional Ruderal Alliance		7	7
<i>Crataegus douglasii</i> Pacific Coast Alliance		2	2
<i>Malus fusca</i> Seasonally Flooded Shrubland Alliance		2	2
<i>Rubus armeniacus</i> Provisional Ruderal Alliance		1	1
<i>Rubus spectabilis</i> Shrubland Alliance		1	1
<i>Salix hookeriana</i> Seasonally Flooded Shrubland Alliance		1	1
<i>Symphoricarpos albus</i> Shrubland Alliance		3	3
<b>Sparse</b>		<b>1</b>	<b>1</b>
Sand Dune Sheet (with inclusions of <i>Leymus mollis</i> / <i>Abronia latifolia</i> (CEGL001796))		1	1
<b>Total</b>	<b>15</b>	<b>152</b>	<b>167</b>

### 3.2.3 Vegetation Classification Summary

The final classification for San Juan Island National Historical Park is presented in Appendix A.

In total, there were 49 alliances classified as occurring within San Juan Island National Historical Park (Table 3). Forested alliances accounted for 31%, shrubland/herbaceous alliances totaled 67%, and the single sparse alliance accounted for 2% of the total number of alliances.

Three “alliance” level units were documented for cultural vegetation including one unit for Agromorphic and two units for Developed vegetation classes. No plant associations were classified for the Cultural and Developed vegetation types. There were also an additional six non-vegetated cover types.

**Table 3.** Number of plant associations within each class, macrogroup, and alliance.

<b>Class/Macrogroup/Alliance</b>	<b>Number of Associations</b>
<b>1 Forest &amp; Woodland (Mesomorphic Tree Vegetation)</b>	<b>15</b>
<i>Californian - Vancouverian Foothill &amp; Valley Forest &amp; Woodland Macrogroup</i>	5
<i>Pseudotsuga menziesii - (Arbutus menziesii) Forest and Woodland Alliance</i>	4
<i>Quercus garryana Woodland Alliance</i>	1
<b>Vancouverian Flooded &amp; Swamp Forest Macrogroup</b>	<b>5</b>
<i>(Acer macrophyllum, Alnus rubra) Riparian Forest Alliance</i>	2
<i>(Alnus - Fraxinus - Populus) / Lysichiton americanus Deciduous Swamp Woodland Alliance</i>	2
<i>(Tsuga heterophylla - Picea sitchensis - Thuja plicata - Abies) / Lysichiton americanus Alliance</i>	1
<b>Vancouverian Lowland &amp; Montane Rainforest Macrogroup</b>	<b>5</b>
<i>Acer macrophyllum (Pseudotsuga menziesii) Forest Alliance</i>	n/a
<i>Alnus rubra - (Picea sitchensis, Tsuga heterophylla) Forest and Woodland Alliance</i>	1
<i>Thuja plicata - (Abies grandis) Maritime Forest Alliance</i>	2
<i>Tsuga heterophylla - Pseudotsuga menziesii / (Holodiscus discolor) Forest Alliance</i>	2
<b>Western North American Ruderal Flooded &amp; Swamp Forest Macrogroup</b>	<b>n/a</b>
<i>Alnus rubra / Nonnative Grasses Provisional Ruderal Flooded Forest Alliance</i>	n/a
<i>Alnus rubra / Carex obnupta Provisional Ruderal Flooded Forest Alliance</i>	n/a
<i>Prunus emarginata Provisional Ruderal Flooded Forest Alliance</i>	n/a
<b>Western North American Ruderal Forest &amp; Plantation Macrogroup</b>	<b>n/a</b>
<i>Alnus rubra - Pseudotsuga menziesii Provisional Ruderal Alliance</i>	n/a
<i>Pseudotsuga menziesii - Pinus contorta Provisional Ruderal Alliance</i>	n/a
<i>Pseudotsuga menziesii / Nonnative Grasses Provisional Ruderal Alliance</i>	n/a
<b>2 Shrubland &amp; Grassland (Mesomorphic Shrub &amp; Herb Vegetation)</b>	<b>22</b>
<b>Cool Pacific Coastal Beach, Dune &amp; Bluff Vegetation Macrogroup</b>	<b>3</b>
<i>Leymus mollis - Festuca rubra Herbaceous Alliance</i>	3
<b>North American Pacific Coastal Salt Marsh Macrogroup</b>	<b>1</b>
<i>Salicornia virginica Tidal Herbaceous Alliance</i>	1
<b>Southern Vancouverian Lowland Grassland &amp; Shrubland Macrogroup</b>	<b>8</b>
<i>Camassia quamash Herbaceous Alliance</i>	1
<i>Carex inops Herbaceous Alliance</i>	1
<i>Carex tumulicola Alliance</i>	1
<i>Festuca roemerii - Agrostis pallens - Koeleria macrantha Herbaceous Alliance</i>	1
<i>Festuca rubra - Calamagrostis nutkaensis Coastal Headland Herbaceous Alliance</i>	2
<i>Plectritis congesta Herbaceous Alliance</i>	1
<i>Symphoricarpos albus Pacific Coast Shrubland Alliance</i>	1

**Table 3.** Number of plant associations within each class, macrogroup, and alliance (continued).

<b>Class/Macrogroup/Alliance</b>	<b>Number of Associations</b>
<b>Western North American Lowland Freshwater Wet Meadow &amp; Marsh Macrogroup</b>	<b>10</b>
<i>(Juncus balticus - Juncus effusus)</i> Herbaceous Alliance	2
<i>Carex obnupta</i> Seasonally Flooded Herbaceous Alliance	1
<i>Cornus sericea</i> Shrubland Alliance	1
<i>Crataegus douglasii</i> Pacific Coast Shrubland Alliance	1
<i>Equisetum (arvense, variegatum, hyemale, telmateia)</i> Semipermanently Flooded Herbaceous Alliance	1
<i>Malus fusca</i> Seasonally Flooded Shrubland Alliance	1
<i>Oenanthe sarmentosa</i> Herbaceous Alliance	1
<i>Rubus spectabilis</i> Shrubland Alliance	1
<i>Salix hookeriana</i> Seasonally Flooded Shrubland Alliance	1
<b>Western North American Ruderal Wet Meadow &amp; Marsh Macrogroup</b>	<b>n/a</b>
<i>Carex leporina</i> Ruderal Wet Meadow Alliance	n/a
<i>Crataegus monogyna</i> / Mixed Forbs & Graminoids Provisional Ruderal Wet Shrubland Alliance	n/a
<i>Equisetum arvense</i> - Mixed Graminoid Provisional Ruderal Wet Meadow Alliance	n/a
<i>Juncus gerardii</i> Provisional Ruderal Wet Meadow Alliance	n/a
<i>Schedonorus pratensis</i> Provisional Ruderal Wet Meadow Alliance	n/a
<b>Southern Vancouverian Lowland Ruderal Grassland &amp; Shrubland Macrogroup</b>	<b>n/a</b>
<i>Agrostis (capillaris, stolonifera)</i> Provisional Ruderal Alliance	n/a
<i>Arrhenatherum elatius</i> Provisional Ruderal Alliance	n/a
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Alliance	n/a
<i>Bromus sitchensis - Elymus glaucus</i> Provisional Ruderal Alliance	n/a
<i>Festuca roemerii</i> Provisional (Restoration) Ruderal Alliance	n/a
<i>Holcus lanatus - Poa pratensis - Elymus repens</i> Provisional Ruderal Alliance	n/a
<i>Leymus mollis ssp. mollis - Holcus lanatus</i> Provisional Ruderal Alliance	n/a
<i>Rubus armeniacus</i> Provisional Ruderal Alliance	n/a
San Juan Islands Ruderal Forbs and Graminoids Alliance	n/a
<i>Schedonorus phoenix</i> Provisional Ruderal Alliance	n/a
<b>6 Nonvascular &amp; Sparse Vascular Rock Vegetation (Lithomorphic Vegetation)</b>	<b>1</b>
<b>Vancouverian Cliff, Scree &amp; Rock Vegetation Macrogroup</b>	<b>1</b>
<i>Racomitrium canescens</i> Nonvascular Alliance	1
<b>Total Number of Natural/Semi-natural Plant Associations</b>	<b>38</b>
<b>7 Agricultural Vegetation (Agromorphic Vegetation)</b>	<b>1</b>
<b>Temperate and Tropical Orchard</b>	<b>1</b>
Fruit Orchard	1
<b>8 Developed Vegetation (Hortomorphic Vegetation)</b>	<b>2</b>
<b>Other Urban / Built Up Vegetation</b>	<b>1</b>
Ornamental Trees	1
<b>Temperate and Tropical Lawn</b>	<b>1</b>
Mowed Lawn	1

**Table 3.** Number of plant associations within each class, macrogroup, and alliance (continued).

<b>Class/Macrogroup/Alliance</b>	<b>Number of Associations</b>
<b>Non-vegetated Map Units</b>	<b>6</b>
<i><b>Aquatic: Natural Waterbodies, Snow and Ice</b></i>	<b>1</b>
Open Water	1
<i><b>Terrestrial Artificial Surfaces &amp; Associated Areas</b></i>	<b>1</b>
Parking Lot/Buildings	1
<i><b>Terrestrial Bare Areas</b></i>	<b>4</b>
Drift logs	1
Road/Parking lots	1
Sand Dune Sheet (with inclusions of <i>Leymus mollis</i> / <i>Abronia latifolia</i> (CEGL001796))	1
Terrestrial Bare Areas	1
<b>Total Number of Map Units (Association + Cultural/Non-vegetated Types)</b>	<b>47</b>

Nearly 43% of the natural/semi-natural vegetation alliances were classified as ruderal types, indicating that past land use at SAJH has resulted in numerous novel vegetation types dominated by non-native vegetation or combinations of native species with no similar type existing in ‘natural’ landscapes (Table 4). No plant associations were classified for ruderal alliances.

**Table 4.** Number of natural and ruderal alliances by class

	<b>Number of Alliances</b>
<b>1 Forest &amp; Woodland (Mesomorphic Tree Vegetation)</b>	<b>15</b>
Ruderal Alliances	6
Natural Alliances	9
<b>2 Shrubland &amp; Grassland (Mesomorphic Shrub &amp; Herb Vegetation)</b>	<b>33</b>
Ruderal Alliances	15
Natural Alliances	18
<b>6 Nonvascular &amp; Sparse Vascular Rock Vegetation (Lithomorphic Vegetation)</b>	<b>1</b>
Natural Alliance	1
<b>Total Number of Alliances</b>	<b>49</b>

### **3.2.4 Imperiled Plant Associations**

Twenty five associations occurring in the park are considered critically imperiled (G1, G1G2, GNRS1, GNRS1Q, GNRSH) or imperiled (G2, G2?, G2G3, G2G3?, GNRS2) (Table 5). Mitchell Hill supports the least (6) while American Camp supports the most (17) imperiled (i.e., critically imperiled and imperiled) associations.



**Table 5.** Imperiled plant associations found at San Juan Island National Historical Park. Global and State conservations ranks are the same. G1- Critically imperiled, G2 -Imperiled, G3 -Vulnerable, G4 - Apparently secure , G5 -Secure, ? - uncertainty with rank, NR- no rank, Q- questionable taxonomy, H- assumed eliminated. Associaton code- N/A – none assigned.

Plant Association	Global Conservation Status Rank	Habitat	American Camp	English Camp	Mitchell Hill	Association Code
<i>Festuca rubra</i> - ( <i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i> ) Herbaceous Vegetation	G1	Bald/bluff	X			CEGL003347
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation	G1	Coastal sand dunes/spits	X			CEGL003290
<i>Festuca rubra</i> Stabilized Dune Herbaceous Vegetation	G1	Coastal sand dunes/spits	X			CEGL001774
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest	G1	Dry forest	X			CEGL000460
<i>Thuja plicata</i> - <i>Abies grandis</i> / <i>Polystichum munitum</i> Forest	G1G2	Mesic forest	X	X	X	CEGL000468
<i>Thuja plicata</i> / <i>Gaultheria shallon</i> Forest	G1G2	Mesic forest	X	X	X	CEGL000475
<i>Quercus garryana</i> / <i>Symphoricarpos albus</i> / <i>Carex inops</i> Woodland	G2	Oak woodland		X		CEGL003358
<i>Populus tremuloides</i> / <i>Carex obnupta</i> Forest	G2	Wetland	X			CEGL003371
<i>Festuca rubra</i> Coastal Headland Herbaceous Vegetation	G2	Bald	X			CEGL001567
<i>Salix hookeriana</i> - ( <i>Salix sitchensis</i> ) Shrubland	G2	Wetland	X			CEGL003387
<i>Leymus mollis</i> ssp. <i>mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation	G2?	Coastal sand dunes/spits	X			CEGL001796
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	G2G3	Dry forest		X	X	CEGL000436
<i>Pseudotsuga menziesii</i> / <i>Rosa gymnocarpa</i> - <i>Holodiscus discolor</i> / <i>Festuca occidentalis</i> Forest	G2G3	Dry forest	X	X	X	PNWCOAST_127 (CEGL000456)
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest	G2G3?	Dry forest		X	X	PNWCOAST_160
<i>Cornus sericea</i> Pacific Shrubland	G3S2	Wetland	X			CEGL005301
<i>Malus fusca</i> - ( <i>Salix hookeriana</i> ) / <i>Carex obnupta</i> Shrubland	G3S2	Wetland	X			CEGL003294
<i>Salicornia virginica</i> - <i>Distichlis spicata</i> - <i>Triglochin maritima</i> - ( <i>Jaumea carnosa</i> ) Herbaceous Vegetation	G3S2	Wetland	X	X		CEGL003366
<i>Tsuga heterophylla</i> - ( <i>Thuja plicata</i> - <i>Alnus rubra</i> ) / <i>Lysichiton americanus</i> - <i>Athyrium filix-femina</i> Forest	G3?S2	Wetland			X	PNWCOAST_275
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	GNR S1	Dry/mesic forest	X	X		PNWCOAST_152

**Table 5.** Imperiled plant associations Found at San Juan Island National Historical Park Global and State conservations ranks are the same. G1- Critically imperiled, G2 -Imperiled, G3 -Vulnerable, G4 - Apparently secure , G5 -Secure, ? - uncertainty with rank, NR- no rank, Q- questionable taxonomy, H- assumed eliminated. Associaton code- N/A – none assigned. (continued).

<b>Plant Association</b>	<b>Global Conservation Status Rank</b>	<b>Habitat</b>	<b>American Camp</b>	<b>English Camp</b>	<b>Mitchell Hill</b>	<b>NatureServe Association Code</b>
<i>Carex tumulicola</i> Herbaceous Vegetation	GNR S1Q	Prairie	X			N/A
<i>Plectritis congesta</i> Herbaceous Bald	GNR S1Q	Bald		X		N/A
<i>Camassia quamash</i> - <i>Triteleia hyacinthina</i> Herbaceous Bald	GNR S1S2	Bald/wetland		X		N/A
<i>Carex inops</i> - <i>Eriophyllum lanatum</i> Herbaceous Bald	GNR S2	Bald		X		N/A
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> / <i>Melica subulata</i> Forest	GNR S2	Dry/mesic forest		X		PNWCOAST_153
<i>Festuca roemerii</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous Vegetation	GNR SH	Prairie	X			N/A
<b>Total</b>			<b>17</b>	<b>12</b>	<b>6</b>	

Three of the imperiled associations are found in the beach/shoreline environment at American Camp. *Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation is found on coastal spits and sandy beach berms while *Festuca rubra* Stabilized Dune Herbaceous Vegetation and *Leymus mollis* ssp. *mollis* - *Abronia latifolia* Herbaceous Vegetation occur on coastal sand dunes and upper beaches.

A number of associations associated with the Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group were identified as being imperiled. The lone prairie association, *Festuca roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation, is functionally extinct as a landscape-scale ecosystem but small remnants still exist in scattered locations at American Camp. Historically, this association likely dominated the dry portions of the American Camp prairie but was decimated by past agriculture activities. Numerous imperiled bald associations are also found within the park, with most occurring on Young Hill at English Camp or along the coastal bluff along the south shore of American Camp.

Four imperiled associations associated with the Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest and Woodland Group are found in the park. These dry forests occupy more area than any other forest type in the park, with the imperiled *Pseudotsuga menziesii* / *Rosa gymnocarpa* - *Holodiscus discolor* / *Festuca occidentalis* Forest being most abundant.

The globally imperiled *Quercus garryana* / *Symphoricarpos albus* / *Carex inops* Woodland association (Californian-Vancouverian Deciduous Oak Woodland Group) is found at Young Hill at English Camp. The occurrences of this type at SAJH are degraded and have a predominant nonnative understory and little to no *Carex inops* in the stands. Two imperiled dry-mesic forest associations in the North Pacific Maritime Douglas-fir-Western Hemlock Forest Group are found at American Camp (north side of Mount Finlayson) and English Camp, although they are more abundant at English Camp where they occur west of West Valley road down to the shores of Garrison Bay. Two imperiled mesic associations from the North Pacific Maritime Western Redcedar-Western Hemlock Forest Group are found at each unit of the park. These associations are the moistest upland forest types in the park and are relatively abundant within the Mitchell Hill unit, in the convex portions of the north slopes of Mount Finlayson at American Camp, and at English Camp.

Seven imperiled wetland associations from the Vancouverian Freshwater Coastal Marsh & Meadow & Marsh Group, Vancouverian Lowland Riparian & Wet Slope Shrubland Group, North Pacific Hardwood-Conifer Swamp Group, and Temperate Pacific Tidal Salt & Brackish Marsh Group (e.g., lagoons) are found in the park. One of the more interesting types is the *Camassia quamash* - *Triteleia hyacinthina* Seasonally Flooded Herbaceous bald which occurs in seasonally wetland depressions on bedrock and within in balds (Figure 8). Only a few small patches of this type were located at the top of Young Hill. A rare rush (either *Juncus kelloggii* or *Juncus tiehmii* - identification pending, although both are state rare plants) was found in this association in the park. These areas appear to receive occasionally trampling from hikers and equestrian users. Such activities could degrade the ecological condition of these sites via trampling of plants and disruption of the hydrology via direct disturbance of the shallow soils in these areas.



**Figure 8.** *Camassia quamash* - *Triteleia hyacinthina* Seasonally Flooded Herbaceous Bald type appears as green patches in rocky bald.

### 3.3 Conclusions

Past classification efforts at SAJH emphasized forested and grassland vegetation at American Camp. This project addressed data gaps for non-forested vegetation types and synthesized the results of previous classification efforts with the most recent version of the NVC. Every vegetation type within the park was classified and mapped to at least the NVC Alliance level (49 in total). Many types were classified to the Association level of the NVC (47 associations were classified).

Ruderal types are often more strongly related to the type, duration and frequency of past human activity rather than underlying environmental variables. Consequently, ruderal vegetation was a challenge for classification due to the dynamic nature of such areas and due to the limited amount of data available for analysis. Nonetheless, the ruderal Groups or Macrogroups should still provide useful units for assisting park staff with management decisions.

The classification revealed that SAJH supports 25 imperiled plant associations. SAJH supports some of the last remaining occurrences of many of these associations.

## 4.0 Mapping Vegetation Types

### 4.1 Methods

This section describes the approach used for mapping SAJH vegetation to the alliance or association level using the vegetation classification discussed previously. Alliances are vegetation classification units containing one or more associations and are defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation. The alliance is the mapping standard for NPS projects. Due to the small scale of the park and field-based mapping approach (see below), WNHP mapped to the plant association scale whenever possible. The Association is the finest unit of the NVC and is defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions and physiognomy (Jennings et al. 2006). Associations reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

As noted above, the small extent of the park allowed classification data collection to occur simultaneously with field-based mapping. Thus, some of the discussion below is repeated from the classification section since many of the mapping field protocols were conducted in tandem with those for classification.

#### 4.1.1 Preliminary Mapping

Prior to conducting field visits, existing vegetation maps (Rochefort and Bivin, Peterson 2002), soils maps (NRCS 2009), wetland locations (Holmes 1998; National Wetland Inventory maps), and 2007 NAIP 6-inch color orthophotos, provided by the NPS, were used to delineate preliminary polygons using ArcGIS™ 9.3.1. Each polygon was assigned a “GIS\_Poly” code. Some areas were difficult to map without field verification.

#### 4.1.2 Field Sampling

Hardcopy maps of the preliminary polygons were produced using ArcGIS™ at 1:2600 scale for non-forested vegetation and 1:1900 scale for forested vegetation. The maps were used to delineate boundaries of vegetation types in the field. As preliminary polygons were visited in the field, they were assigned to previously defined associations when possible. Each polygon was initially typed using one of the following keys: (1) Plant Associations of Balds and Bluffs of Western Washington (Chappell 2006a) and (2) Upland Plant Associations of the Puget Trough Ecoregion, Washington (Chappell 2006b). Each polygon was assigned a “Field\_Poly” identifier as a quick way to code vegetation types (cross-walk between “GIS\_Poly” and “Field\_Poly” is found in the geodatabase that accompanies this report). The majority of native (not ruderal) forest and native grassland vegetation types encountered in the park were successfully keyed using these two resources. The WNHP state vegetation classification was reviewed for possible matches for types not identifiable using the Chappell (2006a, 2006b) keys. The WNHP classification includes citations of all plant associations described in Washington.

If no applicable association was identified in the Chappell (2006a, 2006b) keys or the WNHP classification, then a classification or observation plot was established

When necessary, polygons were redrawn in the field on the hardcopy maps to more accurately reflect vegetative patterns.

#### 4.1.3 Finalization of Vegetation Map

Field-based modifications to the preliminary vegetation polygons as well as classification assignments to each polygon were incorporated into a draft vegetation map using ArcGIS™. Polygons were digitized at the same scale of hardcopy field maps (1:2,600 scale for non-forested types and 1:1,900 for forested types). During the spring of 2011, NPS and WNHP staff conducted a field verification of the draft map. Feedback from the verification resulted in some boundary and classification changes. A final vegetation map was drafted based on these modifications and used for the vegetation map accuracy assessment.

#### 4.2 Vegetation Map Summary

A total of 544 polygons were mapped in the park. The number of polygons and total area of each alliance and association are shown in Tables 6 and 7, respectively.

The most frequent alliance is the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance with 68 polygons followed by the *Symphoricarpos albus* Pacific Coast Shrubland Alliance with 65 polygons. The most frequent herbaceous alliances are the *Holcus lanatus* - *Poa pratensis* - *Elymus repens* Provisional Ruderal Alliance (33 polygons) and *Racomitrium canescens* Nonvascular Alliance (25 polygons) (Table 6).

The alliance with the greatest area is *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance (317.4 ha or 784.2 acres) followed by the *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance (135 ha or 333.6 acres). The next three most abundant alliances are all ruderal and include *Holcus lanatus* - *Poa pratensis* Provisional Ruderal Alliance (104.9 ha or 259.1 acres), *Agrostis (capillaris, stolonifera)* Provisional Ruderal Alliance (60 ha or 148.2 acres), and *Bromus hordeaceus* Provisional Ruderal Alliance (42.5 ha or 105.1 acres). *Leymus mollis* - *Festuca rubra* Herbaceous Alliance is the most abundant natural herbaceous alliance (13 ha or 32.2 acres). *Symphoricarpos albus* Pacific Coast Shrubland Alliance is the most abundant shrubland alliance covering 27.5 ha (68 acres) (Table 6).

Herbaceous and shrub vegetation types are more abundant at American Camp (49% of American Camp total) than both English Camp (5.7%) and Mitchell Hill (2.5%). Ruderal alliances are some of the most abundant types at American Camp and three of the top five most abundant alliances are herbaceous (Table 6). Ruderal alliances account for 52% (271.5 ha or 671 acres) of the total area mapped at American Camp. The most abundant vegetation type at American Camp is the *Holcus lanatus* - *Poa pratensis* Provisional Ruderal Alliance which covers 98.2 ha (244 acres) (18.9% of total). The next most abundant types include *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance (92.7 ha or 229 acres; 17.7%), *Agrostis (capillaris, stolonifera)* Provisional Ruderal Alliance (59.9 ha or 148 acres; 11.5%), *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance (50.6 ha or 125 acres; 9.7%), and *Bromus hordeaceus* Provisional Ruderal Alliance (38.8 ha or 96 acres; 7.5%). The *Symphoricarpos albus* Pacific Coast Shrubland Alliance is the most abundant shrubland alliance, covering 25.5 ha (63 acres).

**Table 6.** Location, frequency, and area of mapped alliances.

USNVC Alliance	American Camp	English Camp	Mitchell Hill	# of Polygons	Total Acres	Total Hectares
( <i>Acer macrophyllum</i> , <i>Alnus rubra</i> ) Riparian Forest Alliance	X	X	X	16	66.0	26.7
( <i>Alnus</i> - <i>Fraxinus</i> - <i>Populus</i> ) / <i>Lysichiton americanus</i> Deciduous Swamp Woodland Alliance	X			3	3.4	1.4
( <i>Juncus balticus</i> - <i>Juncus effusus</i> ) Herbaceous Alliance	X	X		11	3.8	1.6
( <i>Tsuga heterophylla</i> - <i>Picea sitchensis</i> - <i>Thuja plicata</i> - <i>Abies</i> ) / <i>Lysichiton americanus</i> Alliance			X	2	3.0	1.2
<i>Acer macrophyllum</i> - ( <i>Pseudotsuga menziesii</i> ) Forest Alliance		X	X	4	4.4	1.8
<i>Agrostis (capillaris, stolonifera)</i> Provisional Ruderal Alliance	X			5	148.2	60.0
<i>Alnus rubra</i> / Nonnative Grasses Provisional Ruderal Flooded Forest Alliance	X	X		4	13.3	5.4
<i>Alnus rubra</i> - ( <i>Picea sitchensis</i> , <i>Tsuga heterophylla</i> ) Forest and Woodland Alliance		X		1	1.0	0.4
<i>Alnus rubra</i> - <i>Pseudotsuga menziesii</i> Provisional Ruderal Alliance	X	X		18	79.1	32.0
<i>Alnus rubra</i> / <i>Carex obnupta</i> Provisional Ruderal Flooded Forest Alliance	X			2	0.8	0.3
<i>Arrhenatherum elatius</i> Provisional Ruderal Alliance		X		4	14.3	5.8
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Alliance	X	X		21	105.1	42.5
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Provisional Ruderal Alliance	X	X	X	9	8.9	3.6
<i>Camassia quamash</i> Herbaceous Alliance		X		2	0.1	0.0
<i>Carex inops</i> Herbaceous Alliance		X		1	0.2	0.1
<i>Carex leporina</i> Ruderal Wet Meadow Alliance		X		1	0.5	0.2
<i>Carex obnupta</i> Seasonally Flooded Herbaceous Alliance	X			1	0.2	0.1
<i>Carex tumulicola</i> Alliance	X			10	9.3	3.8
<i>Cornus sericea</i> Shrubland Alliance	X			1	0.2	0.1
<i>Crataegus douglasii</i> Pacific Coast Shrubland Alliance	X			2	3.9	1.6
<i>Crataegus monogyna</i> / Mixed Forbs & Graminoids Provisional Ruderal Wet Shrubland Alliance	X			14	16.1	6.5
Drift logs	X			2	4.6	1.9
<i>Equisetum (arvense, variegatum, hyemale, telmateia)</i> Semipermanently Flooded Herbaceous Alliance	X	X		2	1.0	0.4
<i>Equisetum arvense</i> - Mixed Graminoid Provisional Ruderal Wet Meadow Alliance	X	X		5	2.2	0.9
<i>Festuca roemerii</i> - <i>Agrostis pallens</i> - <i>Koeleria macrantha</i> Herbaceous Alliance	X			12	16.3	6.6

**Table 6.** Location, frequency, and area of mapped alliances (continued).

USNVC Alliance	American Camp	English Camp	Mitchell Hill	# of Polygons	Total Acres	Total Hectares
<i>Festuca roemerii</i> Provisional (Restoration) Ruderal Alliance	X			1	1.3	0.5
<i>Festuca rubra</i> - <i>Calamagrostis nutkaensis</i> Coastal Headland Herbaceous Alliance	X			6	4.6	1.9
Fruit Orchard	X	X		2	1.8	0.7
<i>Holcus lanatus</i> - <i>Poa pratensis</i> Provisional Ruderal Alliance	X	X	X	33	259.1	104.8
<i>Juncus gerardii</i> Provisional Ruderal Wet Meadow Alliance	X			1	1.3	0.5
<i>Leymus mollis</i> - <i>Festuca rubra</i> Herbaceous Alliance	X			19	32.2	13.0
<i>Leymus mollis</i> ssp. <i>mollis</i> - <i>Holcus lanatus</i> Provisional Ruderal Alliance	X			19	8.4	3.4
<i>Malus fusca</i> Seasonally Flooded Shrubland Alliance	X			3	3.7	1.5
Mowed Lawn	X	X		9	15.4	6.2
<i>Oenanthe sarmentosa</i> Herbaceous Alliance	X			2	0.5	0.2
Open Water	X			4	10.4	4.2
Ornamental Trees	X			1	0.4	0.1
Parking Lot/Buildings	X	X		3	2.0	0.8
<i>Plectritis congesta</i> Herbaceous Alliance		X		1	0.0	0.0
<i>Prunus emarginata</i> Provisional Ruderal Flooded Forest Alliance	X			2	0.4	0.2
<i>Pseudotsuga menziesii</i> - ( <i>Arbutus menziesii</i> ) Forest and Woodland Alliance	X	X	X	68	784.2	317.4
<i>Pseudotsuga menziesii</i> - <i>Pinus contorta</i> Provisional Ruderal Alliance	X			7	16.7	6.8
<i>Pseudotsuga menziesii</i> / Nonnative Grasses Provisional Ruderal Alliance	X	X		23	36.2	14.6
<i>Quercus garryana</i> Woodland Alliance		X		2	20.5	8.3
<i>Racomitrium canescens</i> Nonvascular Alliance	X	X		25	17.4	7.0
Road/Parking lots	X	X		2	28.1	11.4
<i>Rubus armeniacus</i> Provisional Ruderal Alliance	X	X		5	11.6	4.7
<i>Rubus spectabilis</i> Shrubland Alliance	X			4	1.7	0.7
<i>Salicornia virginica</i> Tidal Herbaceous Alliance	X	X		6	8.1	3.3
<i>Salix hookeriana</i> Seasonally Flooded Shrubland Alliance	X			9	6.7	2.7
San Juan Islands Ruderal Forbs and Graminoids Alliance	X			7	34.6	14.0
Sand Dune Sheet (with inclusions of <i>Leymus mollis</i> / <i>Abronia latifolia</i> (CEGL001796))	X			5	7.7	3.1



**Table 6.** Location, frequency, and area of mapped alliances (continued).

<b>USNVC Alliance</b>	<b>American Camp</b>	<b>English Camp</b>	<b>Mitchell Hill</b>	<b># of Polygons</b>	<b>Total Acres</b>	<b>Total Hectares</b>
<i>Schedonorus phoenix</i> Provisional Ruderal Alliance	X	X		10	11.4	4.6
<i>Schedonorus pratensis</i> Provisional Ruderal Wet Meadow Alliance	X	X		4	2.4	1.0
<i>Symphoricarpos albus</i> Pacific Coast Shrubland Alliance	X	X	X	65	68.0	27.5
Terrestrial Bare Areas	X			1	0.8	0.3
<i>Thuja plicata</i> - ( <i>Abies grandis</i> ) Maritime Forest Alliance	X	X	X	34	333.6	135.0
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / ( <i>Holodiscus discolor</i> ) Forest Alliance	X	X		8	91.3	36.9
<b>Total</b>				<b>544</b>	<b>2328.5</b>	<b>942.3</b>

**Table 7.** Location, frequency, and area of mapped associations.

<b>USNVC Association</b>	<b>American Camp</b>	<b>English Camp</b>	<b>Mitchell Hill</b>	<b># of Polygons</b>	<b>Total Acres</b>	<b>Total Hectares</b>
<i>Acer macrophyllum</i> / <i>Rubus spectabilis</i> Forest			X	2	6.3	2.5
<i>Alnus rubra</i> / <i>Polystichum munitum</i> Forest		X		1	1.0	0.4
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest	X	X	X	13	59.4	24.1
<i>Camassia quamash</i> - <i>Triteleia hyacinthina</i> Herbaceous Bald		X		2	0.1	0.0
<i>Carex inops</i> - <i>Eriophyllum lanatum</i> Herbaceous Bald		X		1	0.2	0.1
<i>Carex obnupta</i> Herbaceous Vegetation	X			1	0.2	0.1
<i>Carex tumulicola</i> Herbaceous Vegetation	X			10	9.3	3.8
<i>Cornus sericea</i> Pacific Shrubland	X			1	0.2	0.1
<i>Crataegus douglasii</i> / <i>Rosa nutkana</i> Shrubland	X			2	3.9	1.6
<i>Equisetum telmateia</i> Herbaceous Vegetation	X	X		2	1.0	0.4
<i>Festuca roemerii</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous Vegetation	X			12	16.3	6.6
<i>Festuca rubra</i> - ( <i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i> ) Herbaceous Vegetation	X			4	4.3	1.7
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation	X			3	1.1	0.4
<i>Festuca rubra</i> Coastal Headland Herbaceous Vegetation	X			2	0.3	0.1
<i>Festuca rubra</i> Stabilized Dune Herbaceous Vegetation	X			4	5.7	2.3
<i>Juncus balticus</i> var. <i>balticus</i> Pacific Coast Herbaceous Vegetation	X			10	3.5	1.4

**Table 7.** Location, frequency, and area of mapped associations (continued).

USNVC Association	American Camp	English Camp	Mitchell Hill	# of Polygons	Total Acres	Total Hectares
<i>Juncus effusus</i> var. <i>brunneus</i> Pacific Coast Herbaceous Vegetation		X		1	0.3	0.1
<i>Leymus mollis</i> ssp. <i>mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation	X			12	25.4	10.3
<i>Malus fusca</i> - ( <i>Salix hookeriana</i> ) / <i>Carex obnupta</i> Shrubland	X			3	3.7	1.5
<i>Oenanthe sarmentosa</i> Herbaceous Vegetation	X			2	0.5	0.2
<i>Plectritis congesta</i> Herbaceous Bald		X		1	0.0	0.0
<i>Populus balsamifera</i> spp. <i>trichocarpa</i> / <i>Cornus sericea</i> / <i>Carex obnupta</i> Forest	X			2	3.0	1.2
<i>Populus tremuloides</i> / <i>Carex obnupta</i> Forest	X			1	0.4	0.2
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	X	X		6	80.4	32.5
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> / <i>Melica subulata</i> Forest		X		2	10.9	4.4
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest		X	X	11	58.1	23.5
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest		X	X	1	4.2	1.7
<i>Pseudotsuga menziesii</i> / <i>Rosa gymnocarpa</i> - <i>Holodiscus discolor</i> / <i>Festuca occidentalis</i> Forest	X	X	X	37	580.6	234.9
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest	X			19	141.4	57.2
<i>Pyrus malus</i> Orchard	X			1	0.8	0.3
<i>Quercus garryana</i> / <i>Symphoricarpos albus</i> / <i>Carex inops</i> Woodland		X		2	20.5	8.3
<i>Racomitrium canescens</i> - ( <i>Selaginella wallacei</i> ) Nonvascular Vegetation	X	X		25	17.4	7.0
<i>Rosa nutkana</i> - <i>Rubus spectabilis</i> Wet Shrubland	X			4	1.7	0.7
<i>Salicornia virginica</i> - <i>Distichlis spicata</i> - <i>Triglochin maritima</i> - ( <i>Jaumea carnosa</i> ) Herbaceous Vegetation	X	X		6	8.1	3.3
<i>Salix hookeriana</i> - ( <i>Salix sitchensis</i> ) Shrubland	X			9	6.7	2.7
<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Pacific Coast Shrubland	X	X	X	65	68.0	27.5
<i>Thuja plicata</i> - <i>Abies grandis</i> / <i>Polystichum munitum</i> Forest	X	X	X	12	127.1	51.5
<i>Thuja plicata</i> / <i>Gaultheria shallon</i> Forest	X	X	X	22	206.5	83.6
<i>Tsuga heterophylla</i> - ( <i>Thuja plicata</i> - <i>Alnus rubra</i> ) / <i>Lysichiton americanus</i> - <i>Athyrium filix-femina</i> Forest			X	2	3.0	1.2
No Association; See Alliance	X	X	X	228	846.9	342.7
<b>Total</b>				<b>544</b>	<b>2328.5</b>	<b>942.3</b>

The most abundant natural herbaceous type was the *Leymus mollis* - *Festuca rubra* Herbaceous Alliance with 12.9 ha (32 acres). Thirty four of 50 alliances (68%) found at American Camp covered less than 1% of the total area.

English Camp is dominated by forest alliances (92% of English Camp total) with the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance being the most abundant of all alliances (210.8 ha or 521 acres; 60.6% of total). *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance (36.7 ha or 90.7 acres; 10.6%) and *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest Alliance (30.8 ha or 76.2 acres; 8.9%) are the next most abundance alliances overall. *Symphoricarpos albus* Pacific Coast Shrubland Alliance is the most abundant shrubland alliance covering 1.2 ha (3 acres) (0.35%). The most abundant herbaceous alliance is the *Racomitrium canescens* Nonvascular Alliance which covers 6.3 ha (15.5 acres) (1.8%), almost entirely on Young Hill. Ruderal alliances account for 36.4 ha (90 acres) (10.5%) at English Camp.

Mitchell Hill, like English Camp, is largely dominated by forest alliances (97% of Mitchell Hill total) with the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance being the most abundant alliance (116 ha or 286.4 acres; 62.8% of total). The next most abundant alliance is the more mesic *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance which occupies 57.2 ha (141.4 acres) or 31% of the total area. Two herbaceous alliances are found at Mitchell Hill, *Holcus lanatus* - *Poa pratensis* - *Elymus repens* Provisional Ruderal Alliance and *Bromus sitchensis* - *Elymus glaucus* Provisional Ruderal Alliance, and account for 4.5 ha (11.2 acres) (2.5%). The *Holcus lanatus* - *Poa pratensis* - *Elymus repens* Provisional Ruderal Alliance is the more abundant of the two and occupies 4.2 ha (10.4 acres) (2.3%), mostly along old roads and trails. These two herbaceous alliances are also the only ruderal alliances found at Mitchell Hill. The only shrubland alliance is the *Symphoricarpos albus* Pacific Coast Shrubland Alliance which covered 0.8 ha (1.9 acres) or 0.42% of the total area.

A total of 316 polygons (599.6 ha or 1,481.6 acres) were classified to the Association level (Table 7). The most frequent plant association was the *Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland which occurred in 65 polygons although most patches of this type are small and in total this association only covers 27.5 ha (68 acres). The *Pseudotsuga menziesii* / *Rosa gymnocarpa* - *Holodiscus discolor* / *Festuca occidentalis* Forest is the next most frequent association (37 polygons) and also the most abundant as it occupies 235 ha (580.6 acres). The next most frequent (22 polygons) and abundant (83.6 ha or 206.5 acres) association is the *Thuja plicata* - *Gaultheria shallon* Forest. Two other associations, *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest and *Thuja plicata* - *Abies grandis* / *Polystichum munitum* Forest, occupy more than 40 ha (100 acres).

Of the 228 polygons (342.7 ha or 846.9 acres) not classified to the association level, many were ruderal types (Table 7). Of natural association types, the *Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland was the most frequent with 65 polygons followed by *Pseudotsuga menziesii* / *Rosa gymnocarpa* - *Holodiscus discolor* / *Festuca occidentalis* Forest with 37 polygons. *Festuca roemeri* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation and *Leymus mollis* ssp. *mollis* - *Abronia latifolia* Herbaceous Vegetation had the most number of polygons (12) of herbaceous natural association types. The *Pseudotsuga menziesii* / *Rosa gymnocarpa* - *Holodiscus discolor* / *Festuca occidentalis* Forest covered more area (235 ha or

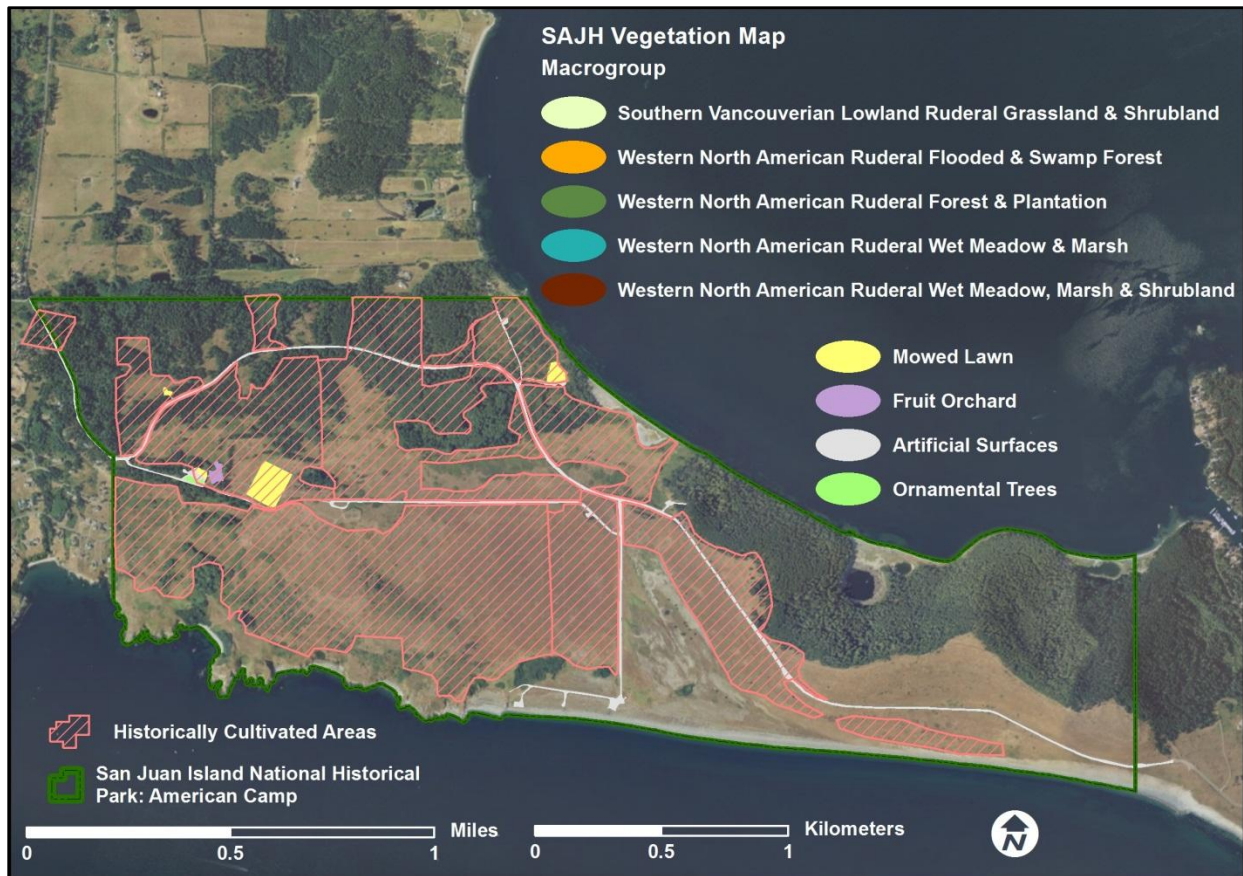
580.6 acres) than any other association in the park. No shrubland or herbaceous association type individually covered more than 70 acres. The most abundant non-forested natural types were the *Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland (68 acres), *Leymus mollis* ssp. *mollis*- *Abronia latifolia* Herbaceous Vegetation (10.3 ha or 25.4 acres), *Racomitrium canescens* - (*Selaginella wallacei*) Nonvascular Vegetation (7 ha or 17.4 acres), and *Festuca roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation (6.6 ha or 16.3 acres).

## 4.3 Vegetation Patterns

### 4.3.1 Vegetation Patterns at American Camp

#### Ruderal Vegetation

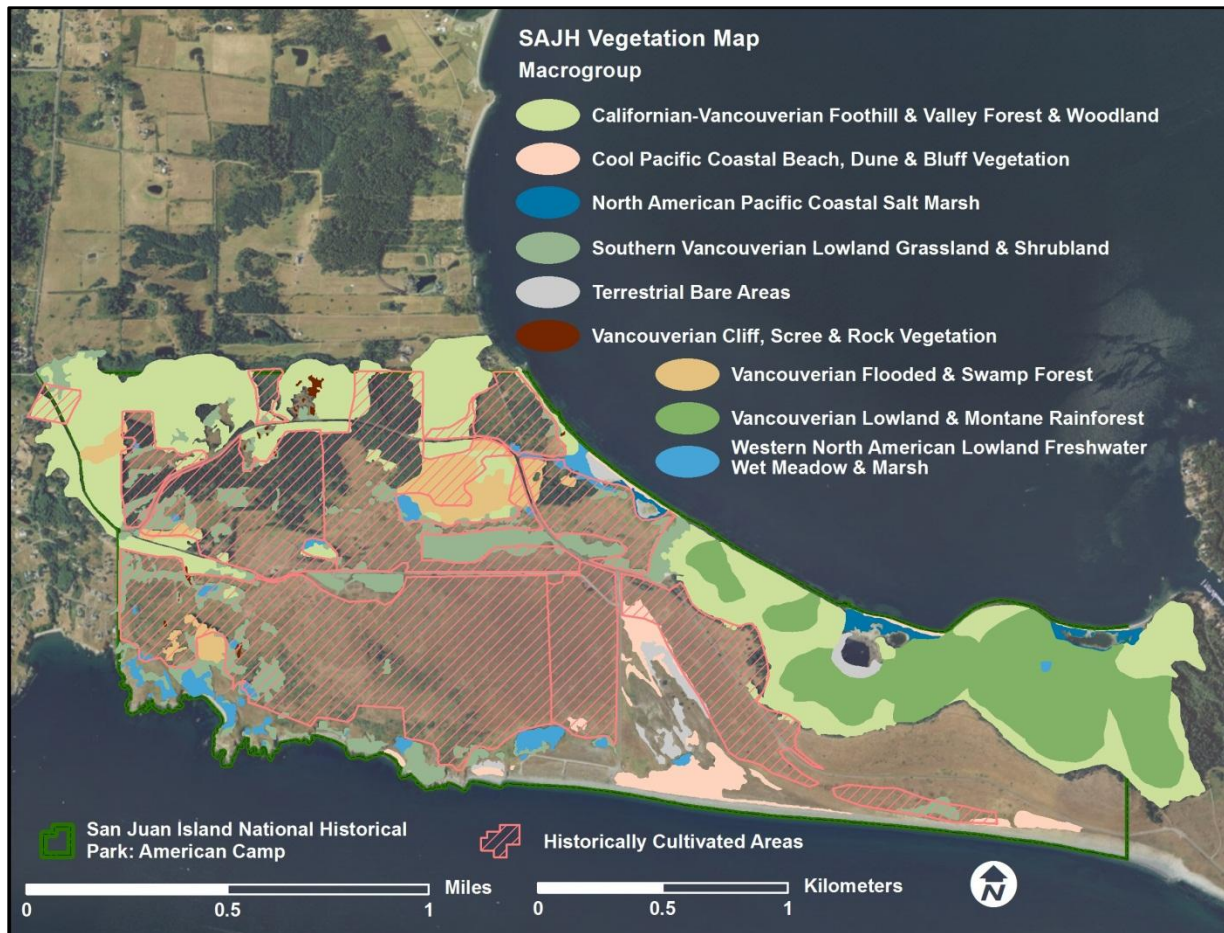
The predominance of ruderal vegetation types, especially at American Camp, reflects the long history of agriculture and intensive grazing that has occurred in this unit of the park (Figure 9). Much of the grassland at American Camp is now dominated by pasture grasses or other nonnative grasses that colonized or were planted in former agriculture fields associated with the Belle Vue Farm. Many of the ruderal vegetation types identified in the park, especially the herbaceous ones, are thought to be very dynamic and may change or express themselves very differently year to year due to climatic and biological processes (i.e. dynamics of nonnative rabbit populations). This is especially true for those ruderal types which have a significant presence of annual species such as the San Juan Islands Ruderal Forbs and Graminoids Alliance and *Bromus* (*diandrus*, *hordeaceus*, *sterilis*) Provisional Ruderal Alliance. Not all areas of ruderal vegetation are the result of historical cultivation activities (as determined by LiDAR investigation). Areas of ruderal vegetation found outside the historically cultivated areas are mostly herbaceous types and are likely a result of past overgrazing or other activities, including possible cultivation that is no longer visible with LiDAR. Conversely, some areas that were historically cultivated now support natural rather than ruderal vegetation types. These areas are shown in Figure 10. Many of these areas are now forested. This incongruence may be the result of coarse mapping of cultivated areas, may reflect different intensities, duration, or time since these areas were cultivated, or the result of successful regeneration of native vegetation that now resemble natural plant associations.



**Figure 9.** Intersection of ruderal alliances and historically cultivated areas at American Camp.

### Native Upland Grassland and Nonvascular Vegetation

Native upland grassland associations at American Camp primarily occur as small remnants that escaped cultivation or intensive grazing (Figure 11). All of the native grassland types are considered imperiled associations (Figure 12). Small remnants of imperiled native prairie vegetation (mostly *Festuca roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation) can still be found at American Camp, mostly around and north of the Redoubt area. These pockets of native prairie escaped cultivation probably due to the shallow and/or rocky nature of their soils or their proximity to rock outcrops. In the western portion of American Camp, the imperiled *Carex tumulicola* Herbaceous Vegetation dominates mesic areas and appear to be mesic native prairie remnants. *Carex tumulicola* has been observed in many locations on Whidbey Island and San Juan Island and may have been a significant component to native prairies prior to European settlement (Chappell and Caplow 2004). *Carex tumulicola* is known to be a very tolerant species, capable of withstanding overgrazing, mowing, and trampling (Wilson et al. 2008). The frequent stands of this association in the park occur near wetlands or in areas which are seasonally moist. Some stands support a mix of wetland and upland species are clearly more mesic than the *Festuca roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation remnants. The *Carex tumulicola* stands may have historically been more diverse wet prairie or mesic transitional grasslands from dry prairie to wetland.



**Figure 10.** Intersection of native communities and historically cultivated areas at American Camp.

Currently the *Carex tumulicola* Herbaceous Vegetation Association is not considered a wet prairie type and is included upland Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group. In addition, almost all of the stands of this association occur in previously plowed areas thus it is difficult to determine whether this association is a novel type that colonized following agricultural activities or whether this association reflects a remnant native prairie type that has been able to withstand many years of human-induced disturbances.

The *Festuca rubra* - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation is an imperiled coastal bluff association found along the bluffs of South Beach at American Camp (Figure 12). Only nine fair to good integrity occurrences are known in Washington. It was probably more extensive historically but has been lost and/or degraded due to invasion and increase of non-native species, invasion of trees and shrubs with lack of fire, development, and recreational impacts.

Three associations within the *Leymus mollis* - *Festuca rubra* Herbaceous Alliance (*Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation, *Festuca rubra* Stabilized Dune Herbaceous Vegetation, *Leymus mollis* ssp. *mollis*- *Abronia latifolia* Herbaceous Vegetation) are found throughout the sand sheet, in old dunes and sandy soils, sand spits, and along the beach at American Camp (Figure 12). Exotic species invasions (e.g., *Ammophila arenaria*), recreation

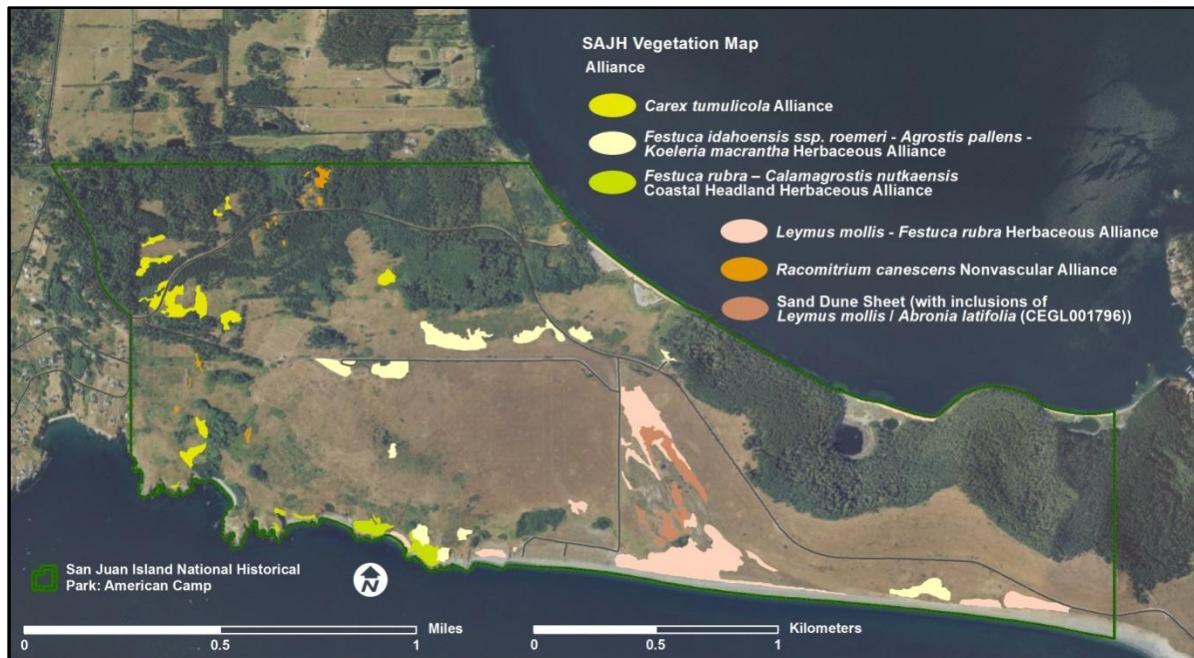


Figure 11. Location of native upland grassland and nonvascular alliances at American Camp.

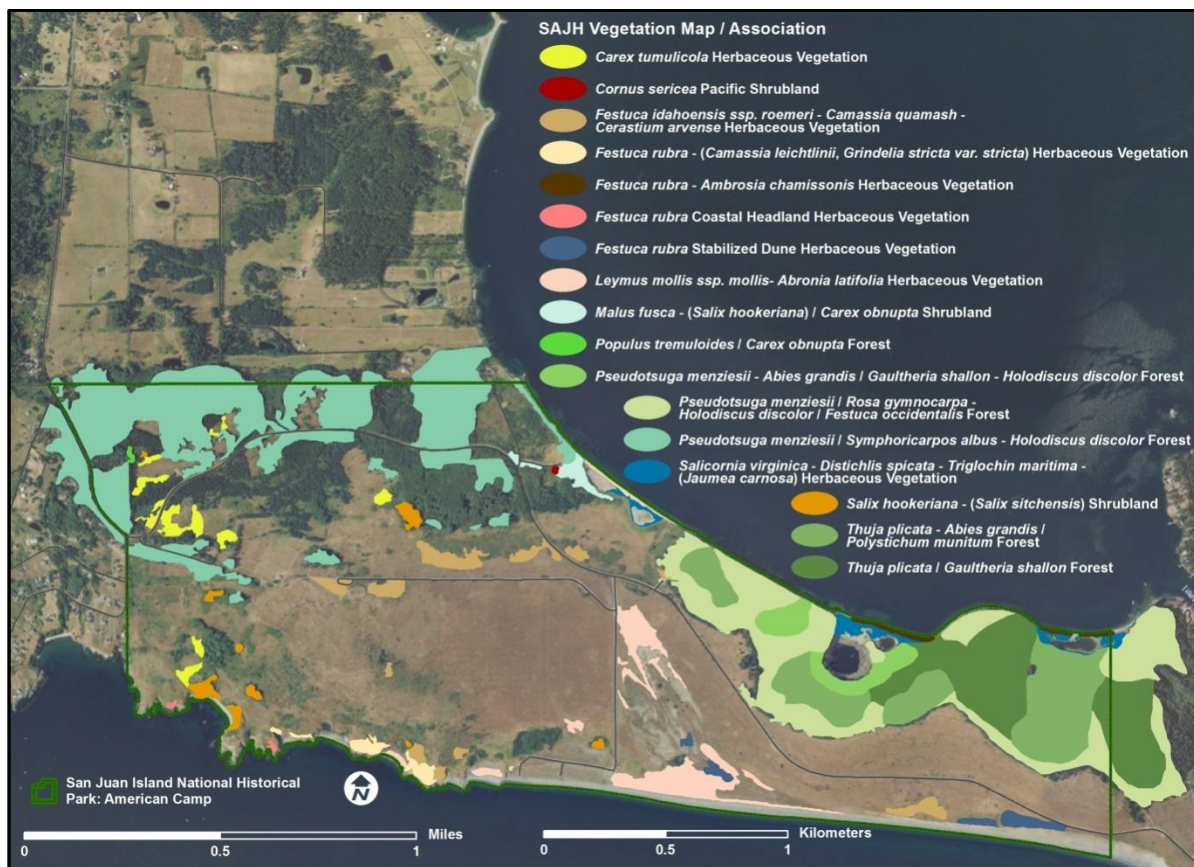


Figure 12. Location of imperiled plant associations at American Camp.

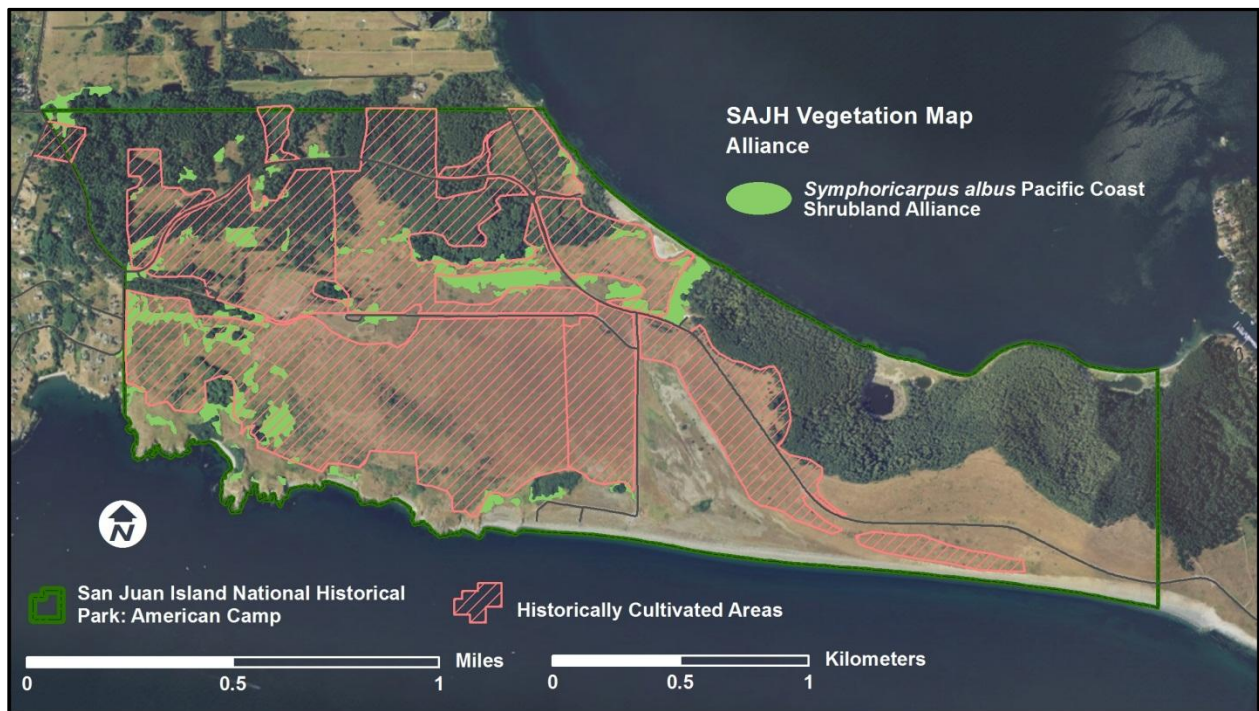
activities, natural succession, alteration of coastal geomorphic processes, and development have all contributed to the loss and degradation of all three associations.

Rock outcrops are often dominated by the *Racomitrium canescens* Nonvascular Alliance (Figure 11).

#### Native Upland Shrubland Vegetation

The only native upland shrubland vegetation mapped at American Camp is the *Symphoricarpos albus* Pacific Coast Shrubland Alliance (*Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland association) (Figure 13). This association is frequently found throughout San Juan Island in disturbed environments and around the perimeter of forest vegetation. Within the park, this association is mostly found in previously cultivated areas but does occur in transitional areas between grassland and forests. The frequency of this association within cultivated areas may suggest this is a ruderal type. On the other hand, given that both *Symphoricarpos albus* and *Rosa nutkana* are native species it is possible that this association is an early seral type that is intermediate between grassland and forested vegetation. However, even if it is a native, seral association, it is likely that this association is more abundant today than historically due to anthropogenic disturbances.

There are no upland imperiled shrubland associations at American Camp (Figure 12).



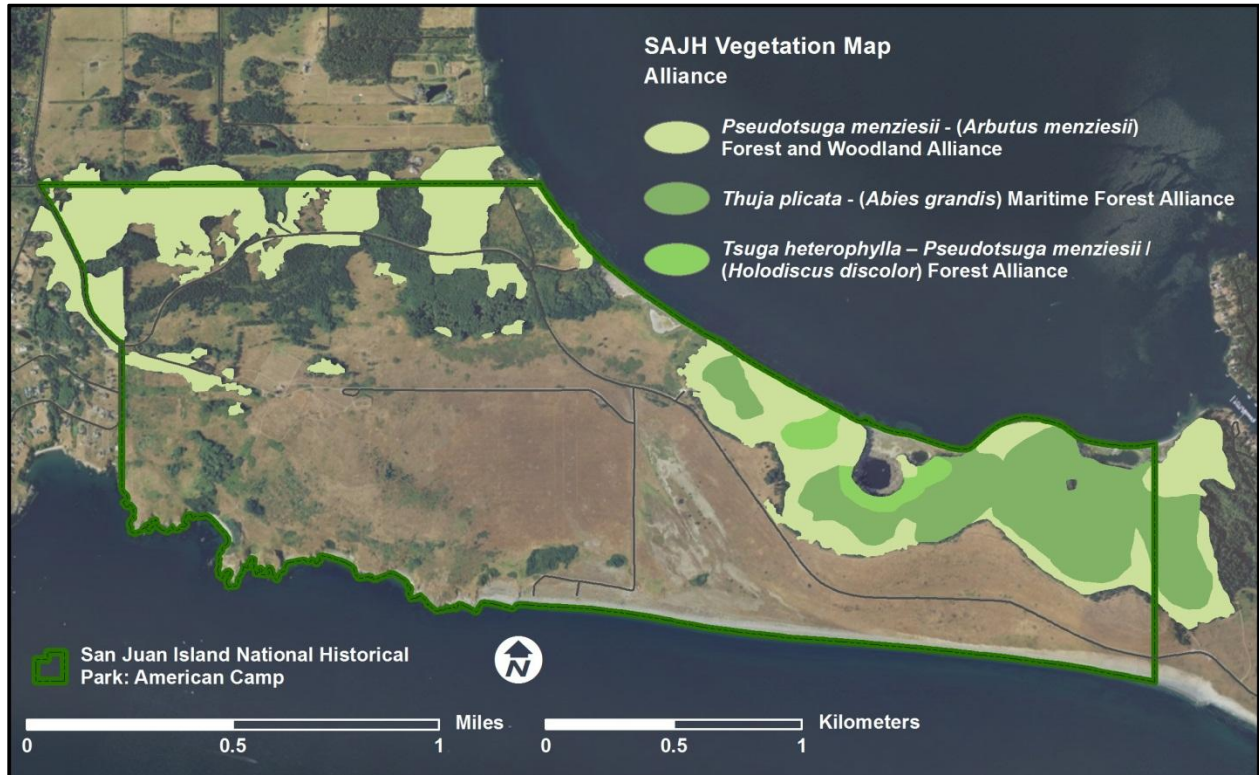
**Figure 13.** Location of native upland shrubland alliance and historically cultivated areas at American Camp.

#### Native Upland Forest Vegetation

Forest vegetation types at American Camp are limited to the north side of Mount Finlayson and northwest portion of American Camp (Figure 14). The most mesic forest types are found on the



north side of Mount Finlayson where exposure to direct solar radiation and wind is minimal. The relatively dry forest alliance occurs in the northwest portion of American Camp, mostly behind the glacial moraine (Figure 3), on glacial drift and coarse outwash.



**Figure 14.** Location of native upland forest alliances at American Camp.

All of the forest associations at American Camp are considered imperiled (Figure 12). Most of these associations are restricted to areas within the Olympic Mountains rainshadow and have experienced significant impacts from logging and conversion to development and agriculture. Almost the entire north side of Mount Finlayson is dominated by imperiled forest associations, two of which are the most mesic types found in the park (e.g. *Thuja plicata* types; Table 7). The imperiled *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest covers much of the northwest portion of American Camp (Figure 12). This forest type is restricted to the Olympic rainshadow and has a significant tall shrub component relative to the other associations in the Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest and Woodland Group which are found at the park.

#### Native Wetland Vegetation

The distribution of native wetland herbaceous and woody vegetation at American Camp is shown in Figures 15 and 16, respectively. Herbaceous wetland types are uncommon and mostly found in seeps at the base of bluffs along South Beach (*Juncus balticus* - *Juncus effusus* Herbaceous Alliance) or in lagoons (*Salicornia virginica* Tidal Herbaceous Alliance).

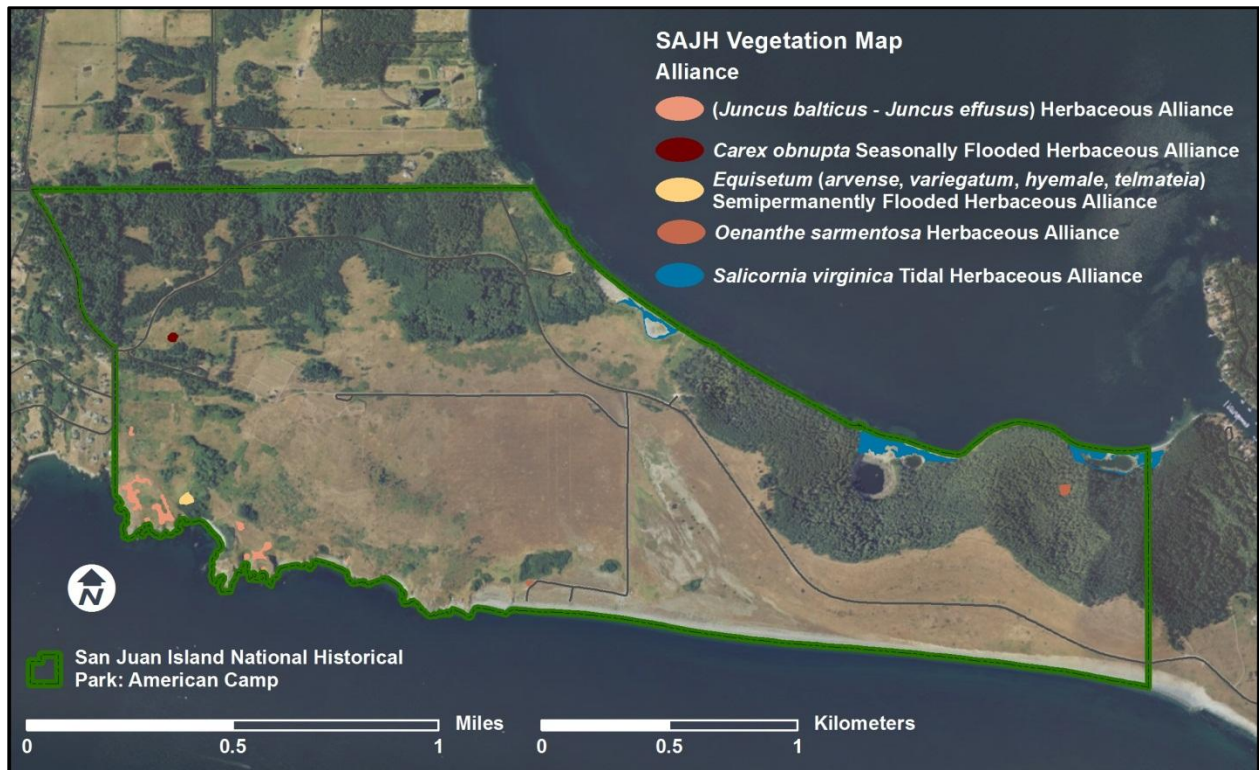


Figure 15. Location of native wetland herbaceous alliances at American Camp.

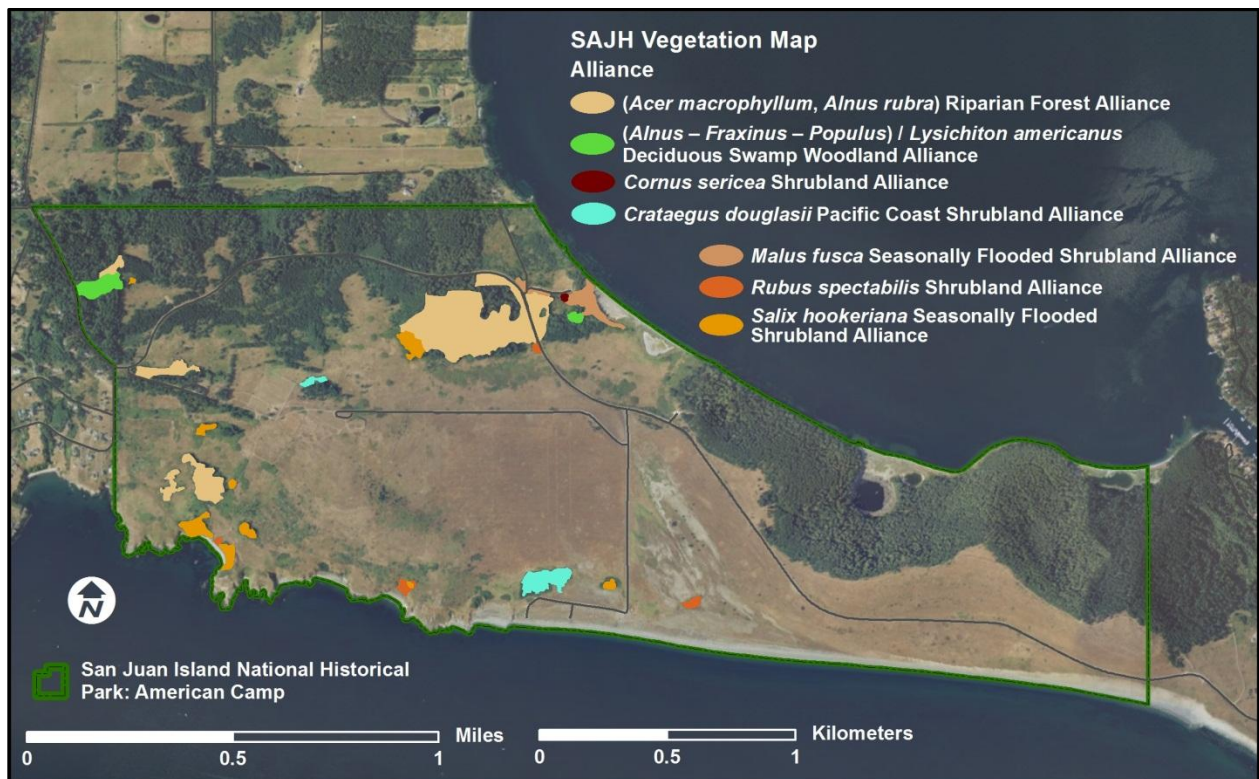


Figure 16. Location of native wetland woody alliances at American Camp.

Only one of the herbaceous wetland associations is imperiled (*Salicornia virginica* - *Distichlis spicata* - *Triglochin maritima* - (*Jaumea carnosa*) Herbaceous Vegetation) and is located in the lagoons along the north shoreline of American Camp (Figure 15).

Native woody wetland vegetation are concentrated in the western portion of American Camp at seeps along South Beach or in areas with seasonally high water tables due to impermeable glaciolacustrine sediments which tend to pond water in the spring and early summer (Figure 16; NRCS 2009). The *Rubus spectabilis* Shrubland Alliance and *Crataegus douglasii* Pacific Coast Shrubland Alliance occur in seeps with seasonal or permanent groundwater discharge. *Salix hookeriana* Seasonally Flooded Shrubland Alliance occurs in both seeps and areas with perched seasonally high water tables. All the other woody wetland alliances occur in areas with seasonally high water tables due to a relatively shallow underlying impermeable soil layer.

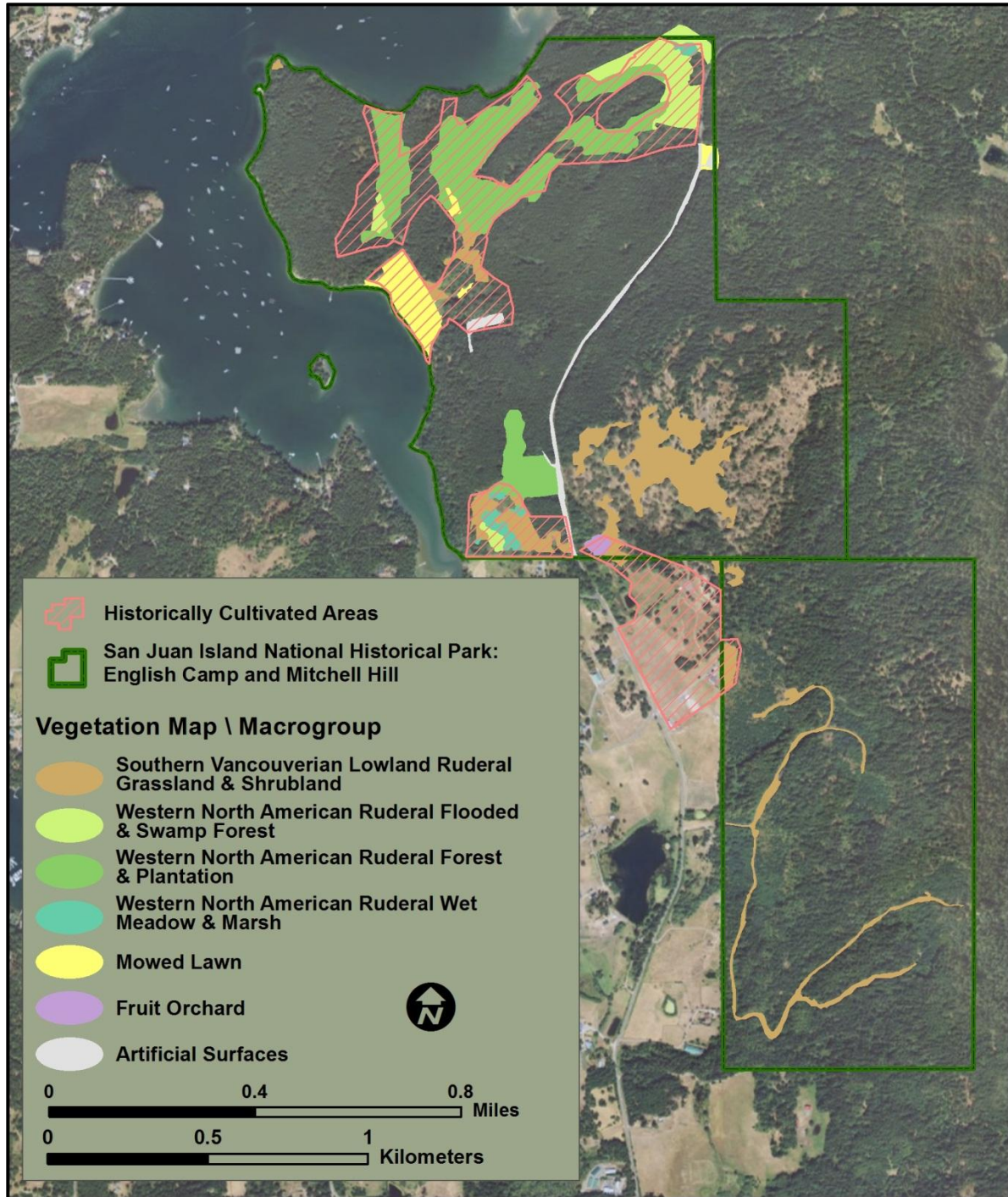
Four of the native woody wetland associations are considered imperiled, including the *Populus tremuloides* / *Carex obnupta* Forest, *Salix hookeriana* - (*Salix sitchensis*) Shrubland, *Cornus sericea* Shrubland, and *Malus fusca* - (*Salix hookeriana*) / *Carex obnupta* Shrubland (Figure 16).

#### **4.3.2 Vegetation Patterns at English Camp and Mitchell Hill**

##### Ruderal Vegetation

Although English Camp and Mitchell Hill have experienced significant human impacts (NPS 2008) they are of different nature than those experienced at American Camp (e.g. less cultivation and more logging) resulting in less area of ruderal vegetation types (Figure 17). Almost all of the ruderal vegetation in those two units is located within historically cultivated areas. The most expansive area of ruderal vegetation outside of historical cultivation is in the southwest corner of English Camp in the forests to the north of the large wet meadow and grassland. Agee (1987) described the forest type in this area as one that established after logging 50 to 85 years before present. The trajectory of the recovering vegetation in this area does not resemble vegetation type found in analogous natural environments elsewhere. There is also a significant area of ruderal vegetation on the slopes of Young Hill. These areas are dominated by the *Arrhenatherum elatius* Provisional Ruderal Alliance and the *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Alliance. These vegetation types are likely the result of overgrazing that has allowed aggressive nonnative annual bromes and tall oatgrass (*Arrhenatherum elatius*) to establish and thrive. Tall oatgrass may have also been planted as forage for livestock or invaded from nearby areas that were planted for this purpose (i.e. the meadow to the west of Young Hill).

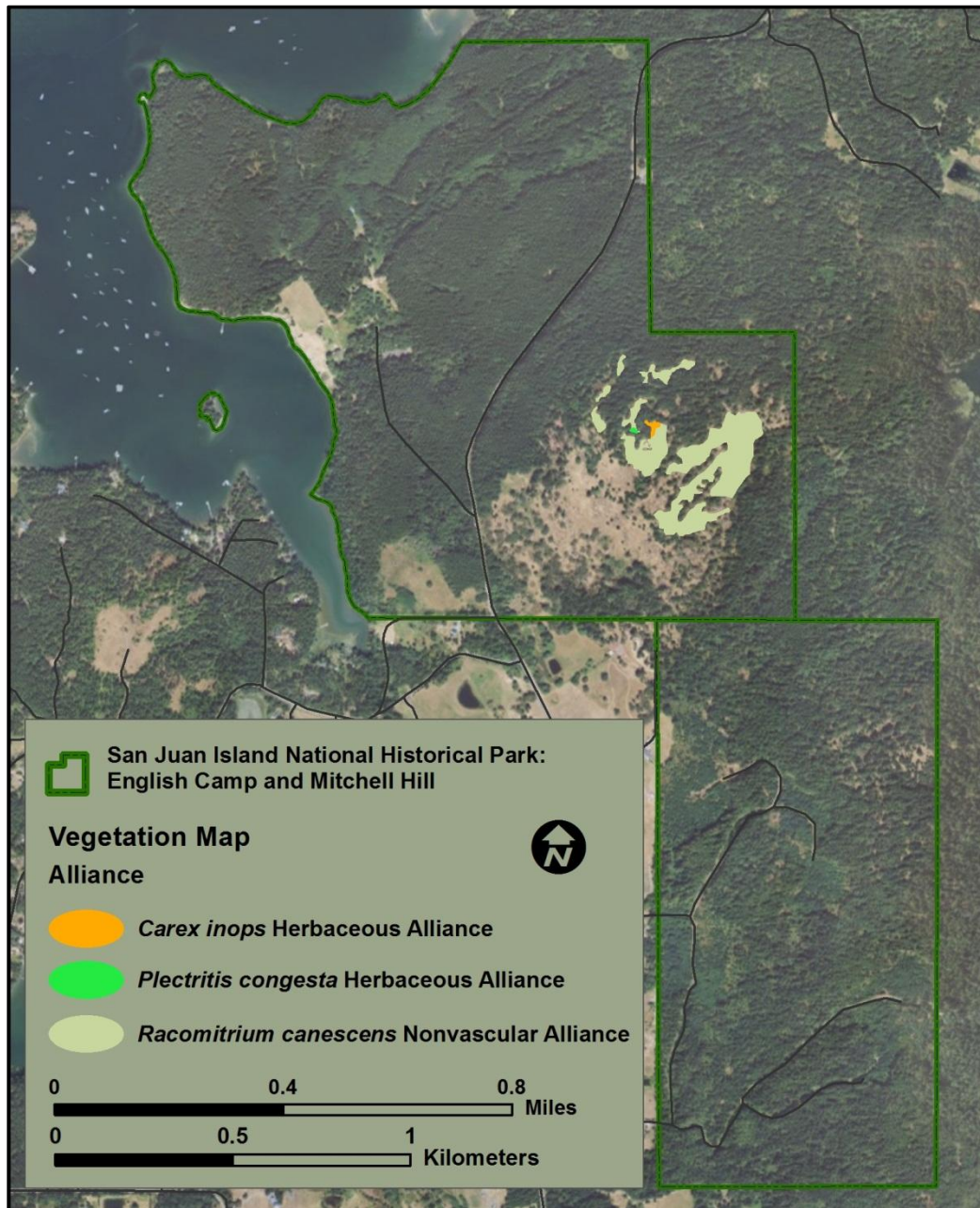
Ruderal vegetation types at Mitchell Hill are limited to trails and old roads and a small portion of a cleared meadow in the northwest corner of the unit. There are, however, some early seral forest types that occupy relatively recently (e.g., 15-50 years ago) logged areas.



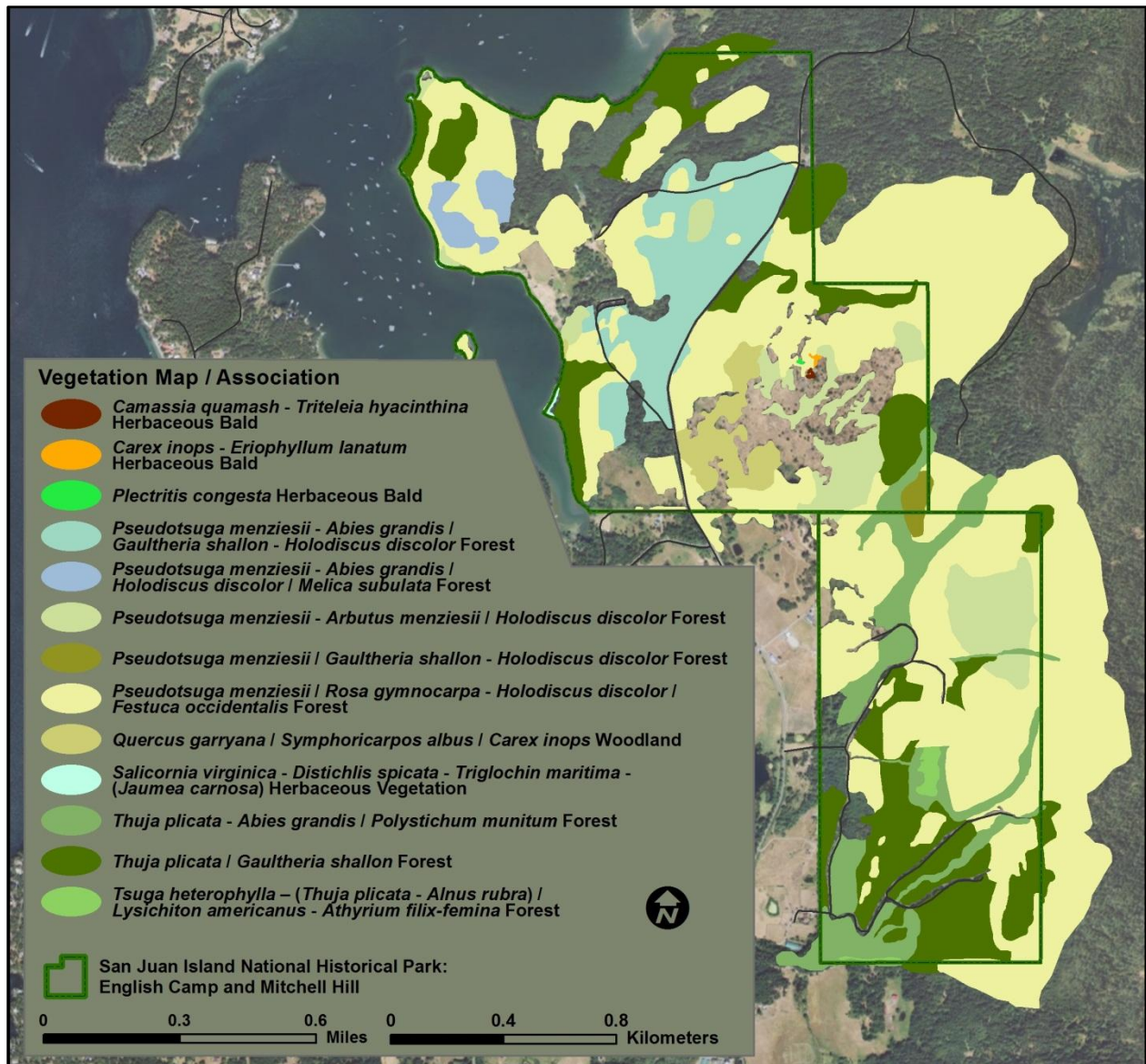
**Figure 17.** Intersection of historically cultivated areas with ruderal vegetation types at English Camp and Mitchell Hill.

### Native Upland Grassland and Nonvascular Vegetation

Only a few very small patches of native grassland remain at English Camp and none occur at Mitchell Hill (Figure 18). The remaining grassland areas are dominated by ruderal vegetation types (see discussion above). The native upland grasslands at English Camp occur on the top of Young Hill in relatively protected areas around the periphery of rock outcrops. The types include the imperiled *Carex inops* - *Eriophyllum lanatum* Herbaceous Bald and *Plectritis congesta* Herbaceous Bald, both of which are found in a few small, relatively mesic patches near the edges of balds (Figure 18).



**Figure 18.** Location of native upland grassland and nonvascular alliances at English Camp and Mitchell Hill.

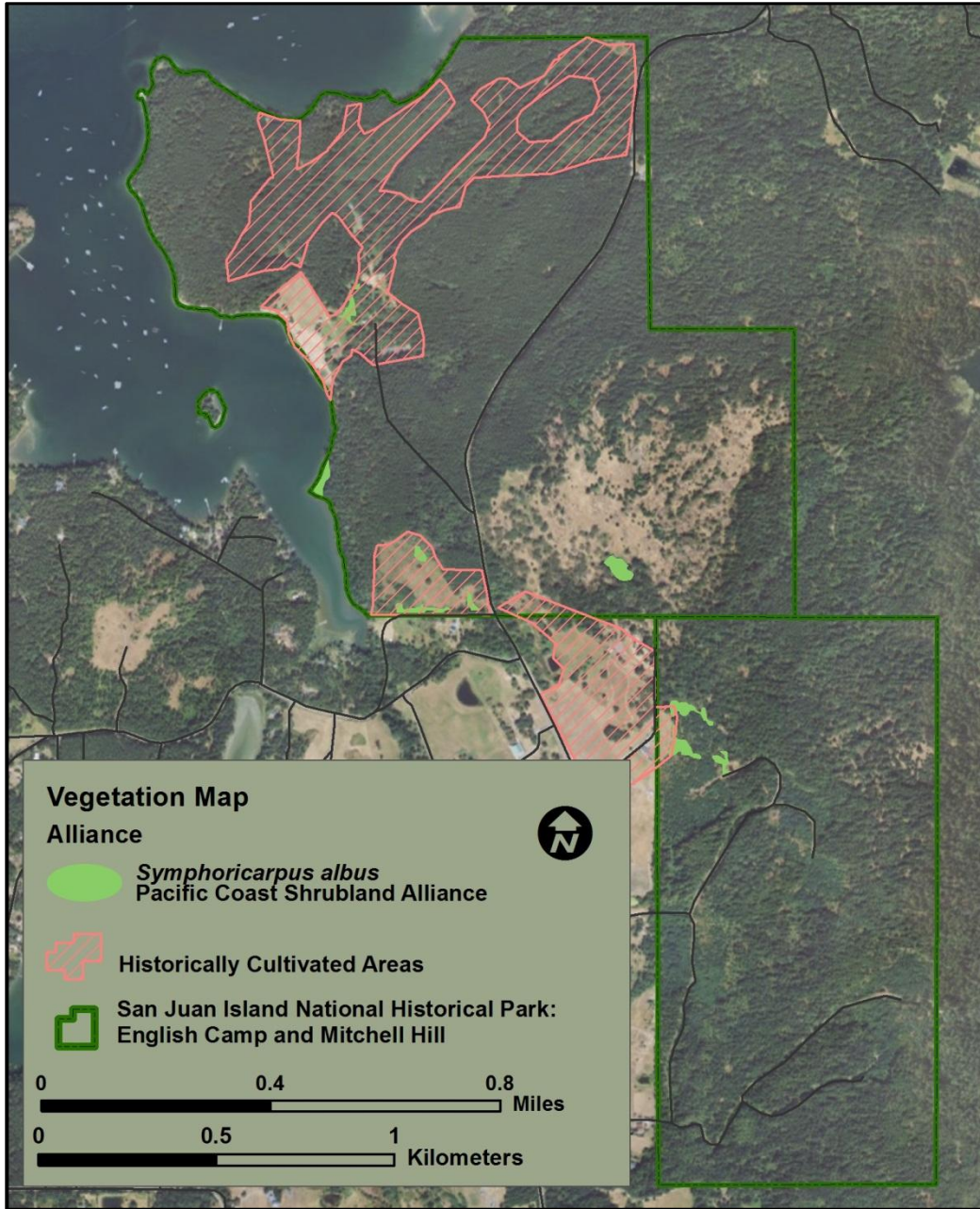


**Figure 19.** Imperiled plant associations at English Camp and Mitchell Hill.

Very few occurrences of either association are known in Washington and most are small. Both associations are threatened by invasion from nonnative species, roadbuilding, trampling, and activities association with timber harvesting. Many areas of the rock outcrops on Young Hill are dominated by the *Racomitrium canescens* Nonvascular Alliance (Figure 18).

Native Upland Shrubland Vegetation

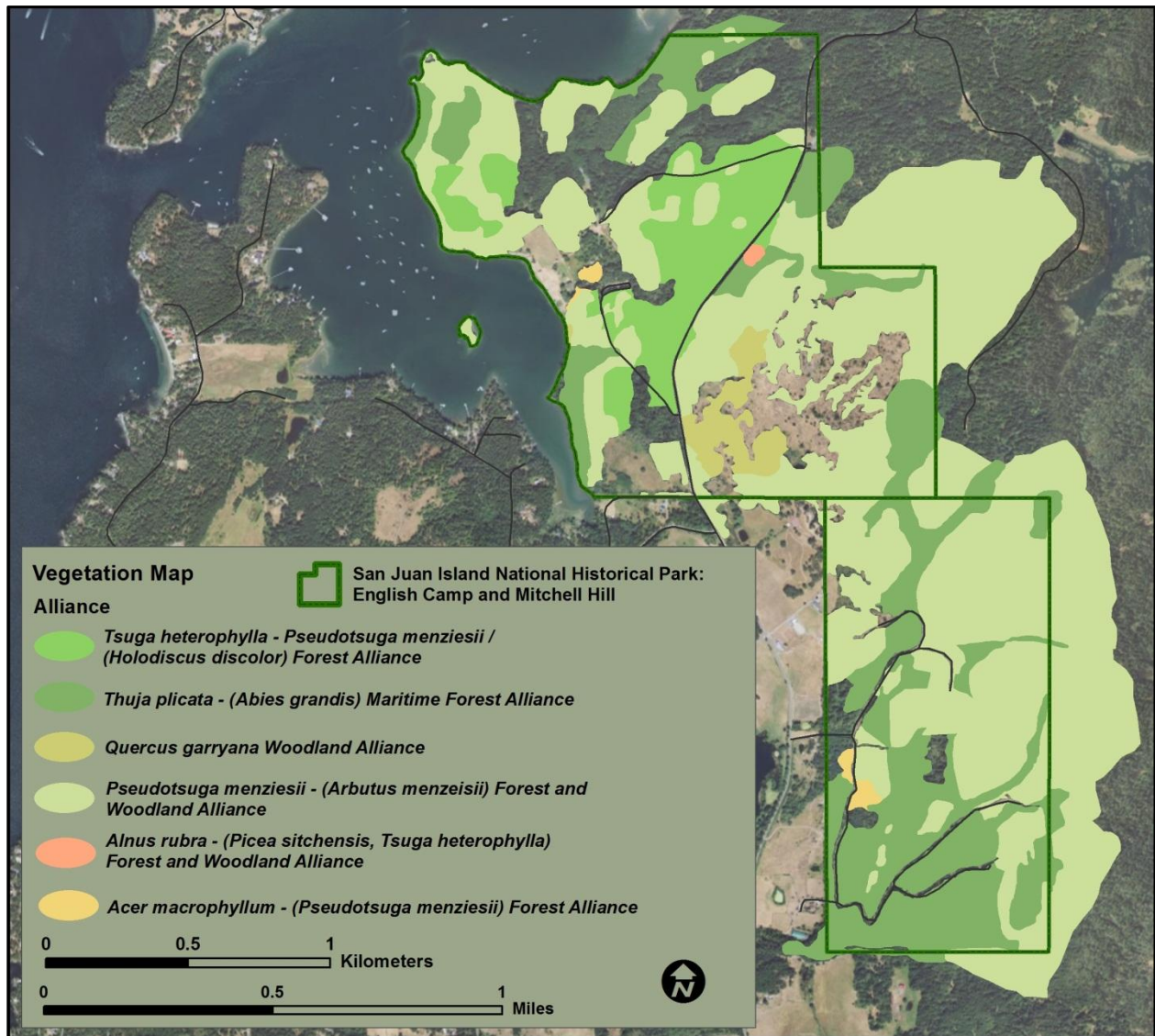
The *Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland (*Symphoricarpos albus* Pacific Coast Shrubland Alliance) is the only native upland shrubland type found at English Camp or Mitchell Hill (Figure 20). As at American Camp, this association tends to occur in areas that were previously cultivated but can occur in ‘natural’ settings near the edges of forests.



**Figure 20.** Location of native upland shrubland alliance at English Camp and Mitchell Hill.

### Native Upland Forest Vegetation

Forest alliances occupy almost the entire area of English Camp and Mitchell not covered in ruderal vegetation (Figure 21). The *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance is the most abundance forest type at English Camp and Mitchell Hill. This alliance occurs on shallow or rocky, coarse soils and, other than oak woodlands, represent the driest forest types in the park. The most mesic forest types are in the *Thuja plicata* - (*Abies grandis*) Forest Alliance which is extensive at Mitchell Hill in low-lying flats and at English Camp in protected sites on north or eastern slopes and in low-lying flats. The *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Forest Alliance occupies a large area at English Camp and the *Quercus garryana* Woodland Alliance covers a large section of the western side of Young Hill.



**Figure 21.** Location of native upland forest alliances at English Camp and Mitchell Hill.



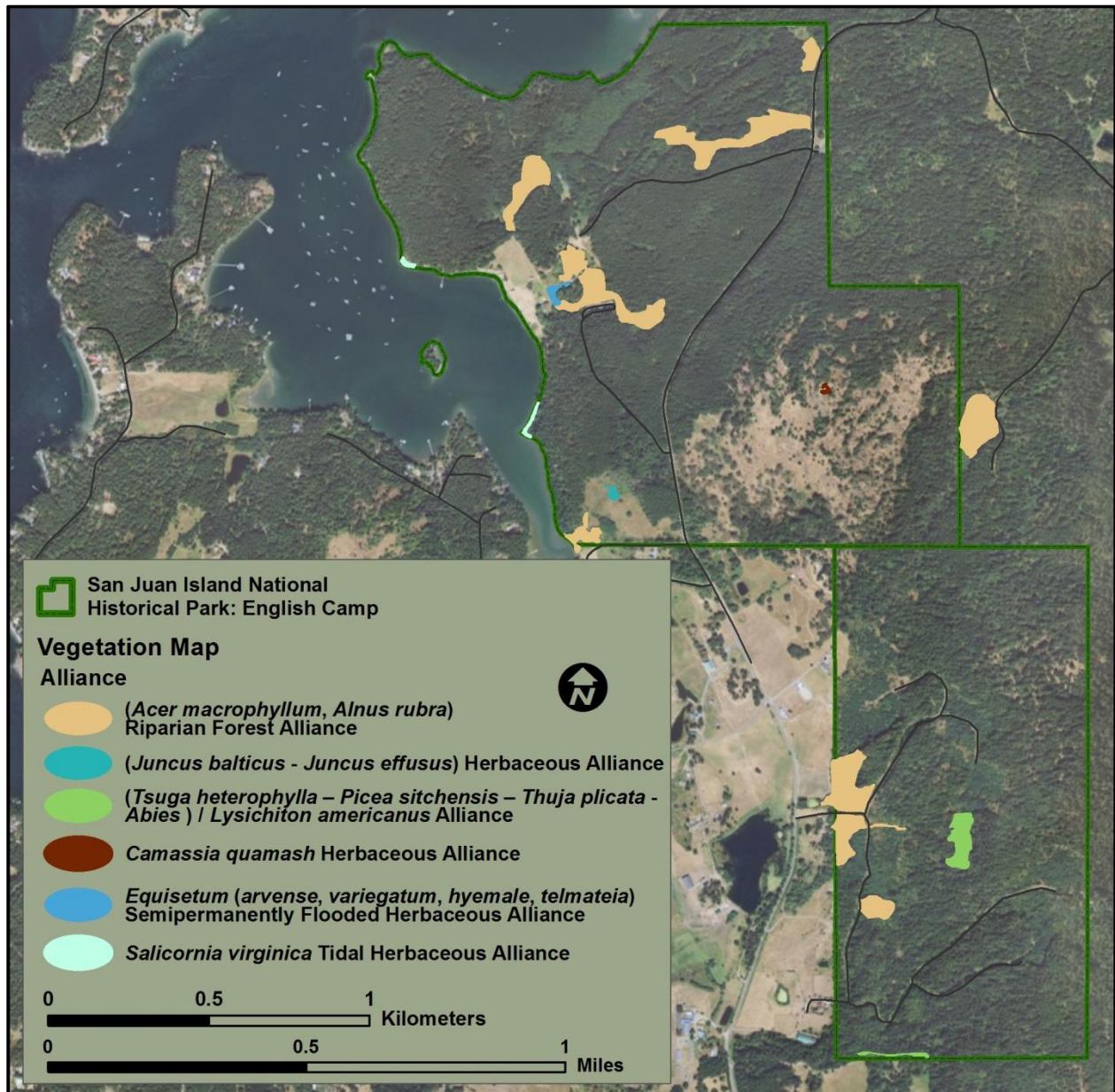
All of the forest types except the *Alnus rubra* - (*Picea sitchensis* - *Tsuga heterophylla*) Forest and Woodland Alliance, are imperiled associations (Figure 23). The imperiled *Pseudotsuga menziesii* / *Rosa gymnocarpa* - *Holodiscus discolor* / *Festuca occidentalis* Forest occupies more area than any other vegetation type in both units. This association is mostly restricted to the areas within the Olympic rainshadow and to a relatively specific environmental range with those areas that consists of shallow or very rocky, well-drained soils on steep or upper slopes with southerly aspects. In addition, few occurrences not significantly altered by past timber harvest are known in the lowlands. At English Camp and Mitchell Hill it is very extensive and found in areas with shallow or coarse soils. Other abundant imperiled forest associations include the *Thuja plicata* / *Gaultheria shallon* Forest and *Thuja plicata* - *Abies grandis* / *Polystichum munitum* Forest. Both of these forest types represent the most mesic upland forest types in the park. The latter association is mostly limited to seasonally wet soils within the Mitchell Hill unit that remain moist through the growing season. Both associations are limited to areas within the Olympic rainshadow and have been greatly reduced in size and extent by development and agriculture and most remaining stands have experience past logging. Four other imperiled forest association occurs with English Camp and Mitchell Hill.

The imperiled *Quercus garryana* / *Symphoricarpos albus* / *Carex inops* Woodland Association, which occurs on the west slope of Young Hill (Figure 19), is of special interest to restoring the historical landscape at English Camp (NPS 2008). In general, oak woodlands are quite rare in the Puget Trough due to development, invasion of nonnative species, and encroachment of *Pseudotsuga menziesii* due to fire suppression. This particular association is only known from the Puget Lowland of western Washington and the Georgia Basin of southwestern British Columbia at low elevations. There are probably 20-40 viable occurrences and a relatively small but unknown global area in a small range. It has been degraded and continues to decline in extent and condition through a combination of exotic species invasions, overgrazing, tree invasion with fire suppression, fragmentation, and residential conversion. There are now only a very small number of highly viable occurrences remaining and are continually threatened by numerous stressors. NPS staff at SAJH has initiated a series of prescribed burns to restore the relatively open understories typical for this oak community and to reduce encroachment of *Pseudotsuga menziesii*.

#### Native Wetland Vegetation

Four herbaceous and two forested native wetland alliances are found at English Camp and Mitchell Hill (Figure 22). The most frequent and abundant type is the (*Acer macrophyllum* - *Alnus rubra*) Riparian Forest Alliance, which occupies seasonally wet areas associated with streams or seasonally perched water tables. The other forested type is the (*Tsuga heterophylla* - *Picea sitchensis* - *Thuja plicata* - *Abies*) / *Lysichiton americanus* Coniferous Swamp Woodland Alliance which corresponds to the imperiled *Tsuga heterophylla* - (*Thuja plicata* - *Alnus rubra*) / *Lysichiton americanus* - *Athyrium filix-femina* Forest is a hardwood- conifer swamp which occurs in two locations at Mitchell Hill. It occurs in perennially saturated soils and is sensitive to changes in hydrology or water quality and logging disturbance. Off-trail activities (e.g. especially mountain biking) is common at Mitchell Hill and could pose a threat to this association by disrupting soils and trampling vegetation. Herbaceous alliances are found at seeps at English Camp and along the shorelines. The latter type is the imperiled *Salicornia virginica* - *Distichlis spicata* - *Triglochin maritima* - (*Jaumea carnosa*) Herbaceous Vegetation which occurs in very narrow strips along the shoreline of Garrison and Westcott bays. This is the same

association that is predominant at the American Camp lagoons. The seeps are dominated by *Equisetum* (*arvense*, *laevigatum*, *hyemale*, *telmateia*) Semipermanently Flooded Herbaceous Alliance and the (*Juncus balticus* - *Juncus effusus*) Herbaceous Alliance.



**Figure 22.** Location of native wetland alliances at English Camp and Mitchell Hill.

The fourth herbaceous alliance is the imperiled *Camassia quamash* - *Triteleia hyacinthina* Herbaceous Bald which is found in a few small patches near the top of Young Hill in bedrock depressions that are seasonally wet. These depressions appear to fill with water during winter and spring months and dry out by the end of summer. The water remains long enough that a mixture of wetland and upland species are present. As noted earlier, a rare rush (either *Juncus kelloggii* or *Juncus tiehmii*—identification pending, although both are state rare plants) was

found in this association within the park. As with the other bald types, this association is threatened by invasion from nonnative species, road building, trampling, and activities association with timber harvesting. The Young Hill occurrence of this association occurs in an area which appears to receive a lot of hiking and equestrian use. Directing such activities away from this association may be needed to ensure the long-term viability of this association and the rare plant.

#### **4.3.3 Conclusions**

Every vegetation type with the park was classified and mapped to at least the NVC Alliance level. Many types were classified and mapped to the Association level of the NVC.

Although ruderal types were challenging to classify due to a lack of sufficient classification data and the dynamic nature of ruderal areas, alliance-level units of ruderal vegetation were classified and mapped. The mapped locations of the ruderal types are less likely to be problematic compared to their classification. Native grasslands, shrubland, forest, and wetland vegetation types were also mapped to the alliance and in many cases the Association level providing a wall-to-wall map of vegetation types in the park.



## 5.0 Accuracy Assessment

NPS guidelines for vegetation inventory and mapping projects require 1) validation of thematic accuracy of map products and 2) a formal accuracy assessment (NPS 2009; Lea and Curtis 2010). Validation is “a process of more limited sampling whose objective is to determine whether a final draft map meets an acceptably minimal threshold in order to proceed to the thematic accuracy assessment of individual map classes” (Lea and Curtis 2010). The purpose of validation is “to assess whether the map, as a whole, has met minimal thematic accuracy requirements” (NPS 2009). A minimum accuracy rate of 60% is the default threshold for validation (NPS 2009). Additionally, validation points can provide information for the mapping project to modify or revise map or classifications. The validation process is external to development of the map and provides a neutral evaluation of the map. Validation sampling and evaluation was accomplished by Rex Crawford, WNHP ecologist who played no role in the mapping project prior to validation.

The purpose of the accuracy assessment (AA) is “to inform users of the limitations of the individual vegetation map classes and of the relationship of the errors (confusion) between classes” (Lea and Curtis 2010). In contrast to validation, overall map accuracy is derived from the process of evaluating individual map classes and is not intended for map revision. The AA provides users of the final map information that clarifies errors and limitations of the map and classes. The accuracy requirement is 80% established by the NPS VIP. The AA is also an external and neutral process that was accomplished by Rex Crawford, WNHP ecologist, who did not play role in the mapping project prior to the validation phase.

### 5.1 Methods

#### 5.1.1 Sampling Points

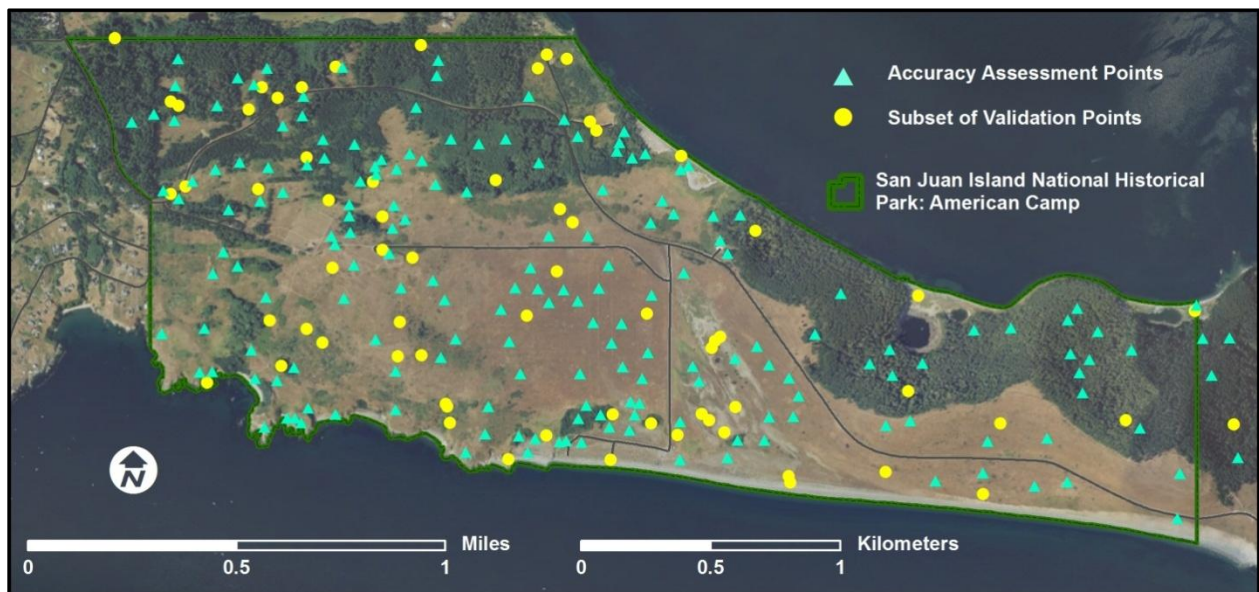
Point locations were provided by NCCN-NPS staff following protocols in Lea and Curtis (2010). The points were derived from the vegetation polygons, provided and described by NPS GIS staff, as follows. Version 4 sajh\_vegetation\_map.gdb was used to create sample points for each alliance class. Points were placed at the center of each polygon. Following the recommendations in Lea and Curtis, 2010, forest polygons were buffered 28 meters from their boundary towards their interior. Non-forest polygons were buffered 18 meters from their boundary towards their interior.

Once generated, center-points were manually moved in smaller polygons in order to best accommodate a 56m plot diameter for forest polygons and a 36 meter plot diameter for non-forest polygons. Larger polygons that could accommodate multiple plots were assigned multiple points. As many sample points as possible were created that would fit inside a polygon without overlap among the 56 or 36 meter diameter buffers. Linear polygons that were not wide enough for a plot were manually assigned one sampling point.

Coordinates (UTM, zone 10N, NAD 1983) were generated for each sampling point. Each point was uniquely labeled with park code (SAJH), the verification acronym (VR), the buffer size (meters), and a unique identification number based on an assigned random number.

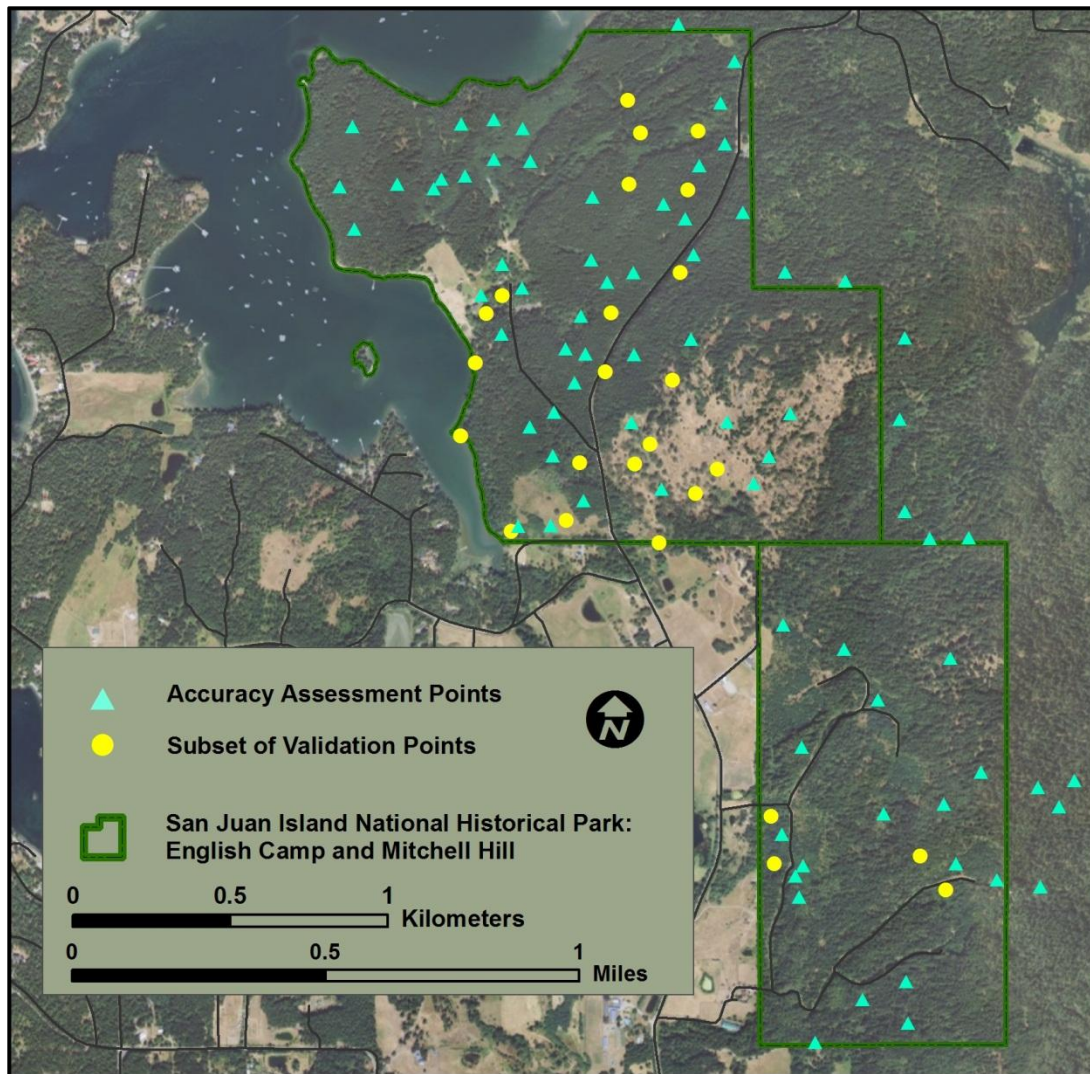
Five alliances did not have sufficient sample points to meet recommended sample size. For four alliances, additional points were manually added. The *Festuca roemerii* Provisional (Restoration) Ruderal Alliance polygons were too small to accommodate more than three points for accuracy assessment purposes.

The objective of validation sampling is to assess the overall accuracy of the map and as such it requires fewer samples than sampling for thematic accuracy assessment that focuses on accuracy of individual map classes. Validation points were drawn from the pool of 1157 sample points as outlined above, to proportionally represent mapped classes. Validation sampling was performed between June 27 and July 15, 2011 in which 101 validation points were sampled (Figures 23 and 24). Sample points were located using ArcPad on Mobile Mapper 10 or on Hewlett Packard iPAQ. Aerial imagery, road and trails and topographic layer were used in the field to assist in locating validation points. A polygon layer of mapped vegetation classes with labels was available during validation sampling. Validation points that are not used to alter the final map spatially or thematically can be applied to the accuracy assessment (Lea and Curtis 2010).



**Figure 23.** Distribution of accuracy assessment points (blue) and subset of validation points (yellow) used for accuracy assessment at American Camp, San Juan Island National Historical Park

Accuracy Assessment (AA) sampling took place between July 25 and August 5, 2011 at 258 sample points drawn from the pool of sample points outlined above. Final AA points for evaluation included 96 validation points not used to revise the final map or classification. This resulted in a total number of 354 sample points used in the AA analysis, with the 96 validation points representing 27% of the total. Figures 23 and 24 illustrate the distribution of the 96 validation points and the 258 accuracy assessment points in the park. The 354 AA points sampled were located using ArcPad on Mobile Mapper 10 or on Hewlett Packard iPAQ. Aerial imagery, road and trails and topographic layer were used in the field to assist in locating both AA and Validation points. A polygon layer of mapped vegetation classes was not available during AA point location and sampling.



**Figure 24.** Distribution of accuracy assessment points (blue) and subset of validation points (yellow) used for accuracy assessment at English Camp and Mitchell Hill, San Juan Island National Historical Park.

### **5.1.2 Field Protocol and Office Procedure**

After navigating to a pre-determined point, AA or Validation, a 28 meter radius plot for forest and woodlands or 18 meter radius plot for shrublands and grasslands was centered on the point. If the point appeared such that a circular plot would significantly encompass two or more NVC Formation Classes (forest/woodland, shrubland/grassland, sparsely vegetated), the point was moved so that a single Formation Class was assessed by the plot. When the point appeared on a linear feature (i.e. shoreline communities, dunes, etc.) the sample shape or area was adjusted to sample the appropriate Formation Class area; typically rectangular in shape. Information gathered at each plot included: date, easting, northing, positional accuracy, shape/size of observation area, plant association or alliance page number in “*Key and Descriptions of Plant Associations of San Juan National Historical Park version 06/22/2011*” (an early draft of Appendix B), problems with classification identification, alternative association, comments, and estimated cover of species in listed in the “*Key to Plant Associations of San Juan National Historical Park version 06/22/2011*”.

The field data was first reviewed for data entry errors, then assigned the proper NVC association/alliance call based on recorded data with classification descriptions, and entered into an Excel spreadsheet. The analysis of map accuracy included the following:

- An initial comparison of AA alliance and alternate association/alliance calls with map-polygon labels was done in a spreadsheet. A match of either the primary or alternate classification with map-polygon label was accepted as a correct call.
- Questionable field calls of AA plots due to heavy cover of vegetation limiting full plot access and other questions in adequacy of plot information were evaluated. Four AA points were eliminated from analysis based on this evaluation.
- Errors of inclusion occurred when the map-polygon was smaller than the AA plot or where multiple map-polygons, usually in the same NVC Formation Class, appeared in a single AA plot. Five AA points were eliminated from analysis based on this evaluation.
- The final comparison of the 354 plots originally collected was reduced to 345 for the AA analysis of the map. The number of sample points provided for each type and the actual number sampled appears in Table 8.

**Table 8.** Number of sample points for alliances used in accuracy assessment and validation, San Juan Island National Historical Park. AA = accuracy assessment.

USNVC Alliance	Total Hectares of Class	Total AA Points Provided	Validation used as AA Pts	Sampled Field AA Pts
<i>Pseudotsuga menziesii</i> - ( <i>Arbutus menziesii</i> ) Forest and Woodland Alliance	317.6	30	4	28
<i>Agrostis capillaris</i> - <i>Holcus lanatus</i> - <i>Poa pratensis</i> Mesic Ruderal Grassland Alliance	169.9	65	10	64
<i>Thuja plicata</i> - ( <i>Abies grandis</i> ) Maritime Forest Alliance	135.0	30	4	30
<i>Pseudotsuga menziesii</i> - ( <i>Alnus Rubra</i> ) / <i>Schedonorus phoenix</i> Ruderal Forest Alliance	53.4	34	10	30
<i>Bromus hordeaceus</i> Dry Ruderal Grassland Alliance	52.5	37	11	35
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / ( <i>Holodiscus discolor</i> ) Forest	36.9	23	3	24
<i>Symphoricarpus albus</i> Pacific Coast Shrubland Alliance	27.5	17	4	17
( <i>Acer macrophyllum</i> , <i>Alnus rubra</i> ) Riparian Forest Alliance	26.7	16	4	16
<i>Ammophila</i> ( <i>arenarea</i> , <i>breviligulata</i> )- <i>Leymus mollis</i> Dune Ruderal Herbaceous Alliance	17.4	14	4	12
<i>Leymus mollis</i> - <i>Festuca rubra</i> Herbaceous Alliance	13.0	8	3	9
<i>Quercus garryana</i> Woodland Alliance	8.3	5	4	5
<i>Racomitrium canescens</i> Nonvascular Alliance	7.0	5	0	4
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> - <i>Agrostis pallens</i> - <i>Koeleria macrantha</i> Herbaceous Alliance	6.6	5	4	5
<i>Crataegus monogyna</i> - <i>Rosa nutkana</i> Ruderal Wet Shrubland Alliance	6.5	5	4	5
<i>Alnus rubra</i> / <i>Dactylis glomerata</i> Ruderal Flooded Forest Alliance	5.9	6	4	6



**Table 8.** Number of sample points for alliances used in accuracy assessment and validation, San Juan Island National Historical Park. AA = accuracy assessment (continued).

USNVC Alliance	Total Hectares of Class	Total AA Points Provided	Validation used as AA Pts	Sampled Field AA Pts
<i>Rubus armeniacus</i> Ruderal Alliance	4.7	5	4	5
<i>Carex tumulicola</i> Alliance	3.8	5	0	5
<i>Salicornia virginica</i> Tidal Herbaceous Alliance	3.3	5	4	5
Sand Dune Sheet (with inclusions of <i>Leymus mollis</i> / <i>Abronia latifolia</i> (CEGL001796)	3.1	5	4	5
<i>Salix hookeriana</i> Seasonally Flooded Shrubland Alliance	2.7	5	4	5
<i>Festuca rubra</i> - <i>Calamagrostis nutkaensis</i> Coastal Headland Herbaceous Alliance	1.8	4	0	3
<i>Carex leporina</i> - <i>Equisetum arvense</i> - <i>Schedonorus pratensis</i> Ruderal Wet Meadow Alliance	1.8	4	0	3
<i>Acer macrophyllum</i> ( <i>Pseudotsuga menziesii</i> ) Forest Alliance	1.8	4	1	6
<i>Crataegus douglasii</i> Pacific Coast Shrubland Alliance	1.6	3	0	3
( <i>Juncus balticus</i> - <i>Juncus effusus</i> ) Herbaceous Alliance	1.5	3	0	2
<i>Malus fusca</i> Seasonally Flooded Shrubland Alliance	1.5	3	0	3
( <i>Alnus</i> - <i>Fraxinus</i> - <i>Populus</i> ) / <i>Lysichiton americanus</i> Deciduous Swamp Woodland Alliance	1.4	3	0	3
( <i>Tsuga heterophylla</i> - <i>Picea sitchensis</i> - <i>Thuja plicata</i> - <i>Abies</i> ) / <i>Lysichiton americanus</i> Alliance	1.2	2	0	1
<i>Rubus spectabilis</i> Shrubland Alliance	0.67	2	0	2
<i>Juncus gerardii</i> Ruderal Brackish Wet Meadow Alliance	0.54	2	0	1
<i>Equisetum</i> ( <i>arvense</i> , <i>variegatum</i> , <i>hyemale</i> , <i>telmateia</i> ) Semipermanently Flooded Herbaceous Alliance	0.41	1	0	1
<i>Alnus rubra</i> - ( <i>Picea sitchensis</i> , <i>Tsuga heterophylla</i> ) Forest and Woodland Alliance	0.41	1	1	2
<i>Oenanthe sarmentosa</i> Herbaceous Alliance	0.21	0	0	0
<i>Carex inops</i> Herbaceous Alliance	0.09	0	0	0
<i>Cornus sericea</i> Shrubland Alliance	0.09	0	0	0
<i>Carex obnupta</i> Seasonally Flooded Herbaceous Alliance	0.07	0	0	0
<i>Camassia quamash</i> Herbaceous Alliance	0.04	0	0	0
<i>Plectritis congesta</i> Herbaceous Alliance	0.01	0	0	0

### 5.1.3 Analysis

Sampled data were entered into a database to develop a contingency table that calculates individual class accuracy and overall accuracy (Lea and Curtis 2010). The contingency table or matrix displays the frequency of agreements and disagreements and is used to calculate accuracies of each map class. Users' accuracy is the probability that a location is the class indicated on the map and represents errors of commission. Producers' accuracy is conditional on the "true vegetation class" in the field as determined by the AA (Lea and Curtis 2010) and represents errors of omission. Users' accuracies are important to users going to a particular mapped location for a particular reason. Producers' accuracies estimate the true areas of types that may have been missed in mapping and could be important to people interested in the true area a type occupies, such as types of conservation interest. These accuracies or errors are

represented in contingency tables with a large quantity of information. “The rows represent the predicted value for each of the polygons (the map) and the columns represent the reference or accuracy assessment point. All correct map values will be summed in the principal diagonal. The sum of the principal diagonal divided by the total number of sample points provides the overall map accuracy. The individual map accuracies metrics also include the total number of samples (n) and a confidence interval with a 90% two-sided limit” (Salas et al. 2011).

For this project, classification results from field validation and accuracy assessment points were entered into programmed spreadsheets provided by NPS Vegetation Inventory web site (<http://science.nature.nps.gov/im/inventory/vg/index.cfm>). The programmed spreadsheets performed computations of data into the contingency tables summarized in Appendix C that displays the users’ accuracy (summary of rows) and producers’ accuracy (summary of columns) for each alliance assessed for this project within its higher NVC classes.

## 5.2 Results

### 5.2.1 Validation

Vegetation classified at the alliance level was mapped correctly at 76 of the 101 validation points, giving an overall accuracy of  $76.2 \pm 5.1\%$ . The Kappa index (which corrects for correct classifications occurring by chance) was  $74.3\% \pm 7.3\%$  (90% C.I.). Five of 101 validation points were used to modify the vegetation map. The remaining 96 validation points were used in the accuracy assessment.

### 5.2.2 Accuracy Assessment

The primary purpose of the thematic accuracy assessment is to inform users of the limitations of individual vegetation map classes and of the relationship of the errors (confusion) between classes in the map project (Lea and Curtis 2010). Of the 345 points used in the accuracy assessment, vegetation classified at the Alliance-level was mapped correctly at 282 points, giving an overall accuracy of  $82.0 \pm 5.2\%$  (90% confidence intervals) (Table 9). The Kappa Index (which corrects for correct classifications occurring by chance) was  $82.1\% \pm 3.5\%$  (90% C.I.). This meets the accuracy requirement of 80% established by the National Park Service Vegetation Inventory Program. Table 9 also illustrates how overall accuracy increases at higher NVC levels, for example, to  $86.8\% \pm 4.6\%$  at the Division-level (Kappa  $88\% \pm 3.4\%$ ).

**Table 9.** Overall accuracy and Kappa values at four National Vegetation Classification (NVC) levels at San Juan Island National Historical Park. Values calculated by a worksheet developed by Lea and Curtis (2010).

NVC level	Alliance	Group	Macrogroup	Division
Overall Accuracy	82%	83%	84%	87%
<i>Lower Limit, 90% Confidence interval</i>	77%	78%	79%	82%
<i>Upper Limit, 90% Confidence interval</i>	87%	88%	88%	91%
Kappa (K):	82%	83%	85%	88%
<i>Lower Limit, 90% Confidence interval, K</i>	79%	79%	81%	85%
<i>Upper Limit, 90% Confidence interval, K</i>	86%	86%	88%	91%

### **5.2.3 User's and Producers Accuracy (Errors of Commission and Omission)**

#### 4.2.3.1 Higher NVC Accuracy

In general, higher levels of the NVC provided higher mapping accuracy. Of the nine NVC Divisions mapped, only the Western North American Warm Temperate Forest Division with a users' accuracy (errors of commission) of  $75.6\% \pm 13.4\%$  was below 80% accuracy requirement although its upper 90% confidence interval exceeded 80%. Overall, the Division-level provides good representation of forest/non-forest and wetland/upland distinctions. Of the thirteen Macrogroups mapped, the Californian-Vancouverian Foothill & Valley Forest & Woodland, Vancouverian Flooded & Swamp Forest, and Western North American Ruderal Wet Meadow & Marsh Macrogroups have users' accuracies below 80% but each Macrogroup's upper 90% confidence interval did exceed 80% (Appendix C). Overall, the Macrogroup-level continues good representation of forest/non-forest and wetland/upland distinctions and provides good distinction between ruderal and natural vegetation.

Of the 18 Groups mapped, the following have users' accuracies below 80% and each Group's upper 90% confidence interval exceeds 80% (Appendix C): Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest & Woodland, North Pacific Maritime Western Red-cedar - Western Hemlock Forest, North Pacific Lowland Riparian Forest & Woodland, North Pacific Maritime Lowland Hardwood-Conifer Swamp, and Western North American Ruderal Wet Meadow & Marsh Groups. Two Groups, the North Pacific Maritime Douglas-fir - Western Hemlock Forest and North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Groups users' accuracies were below 80% and each upper 90% confidence interval did not exceed 80% (Appendix C). The former Group was mis-matched with the Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest & Woodland Group (of 24 mapped polygons six points were different Groups) and the closely related (same Macrogroup) North Pacific Maritime Western Red-cedar - Western Hemlock Forest Group (of 24 mapped polygons five points were different Groups) both representing differences in dominant cover of conifer species. Of eight plots in the latter Group, three were in the same Macrogroup representing differences in key tree species cover, one in the same Division misrepresenting riparian and upland and two misrepresenting a natural Group as a ruderal Group.

In general, upland ruderal vegetation has higher users' accuracy (forest 97% grassland/shrubland 83%) than wetland/riparian ruderal vegetation (forest 91%; wet meadow 60%) and forest vegetation higher accuracy than grassland/shrubland vegetation. Ten of the 34 upland ruderal forest AA points mapped as the Vancouverian Ruderal Forest and Plantation Group were identified as different alliances: seven were different alliances in the same group, two were in the Vancouverian Ruderal Flooded & Swamp Forest Group and one in a natural forest riparian group. There were ten AA plots representing errors of commission in upland ruderal forest (seven other ruderal alliances, a ruderal swamp forest, a natural swamp forest and a natural upland forest) and five commission AA errors in ruderal swamp forest (three natural forest swamp and two upland ruderal forest). Ruderal forest mapping appears to be reliable.

Of the 117 AA points in the Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group, seven mapped as another alliance in the same group, four in an upland grassland/shrubland group, five in upland Coastal Sand Dune group and two in a ruderal wet meadow group. There were only eight AA plots representing errors of commission in upland

ruderal grassland/shrubland (six other ruderal alliances, a natural grassland/shrub and a natural sparsely vegetation site) and five commission AA errors in ruderal swamp forest (three natural forest swamp and two upland ruderal forest). Of the ten AA pts in the Western North American Ruderal Wet Meadow & Marsh Group, three were located in a natural upland grassland/shrubland group, and one in a natural riparian/wet slope group. There were only two AA plots representing errors of commission in this wetland ruderal grassland/shrubland group and both were classified as upland ruderal grassland/shrublands types. Ruderal upland grassland mapping appears to be reliable although individual alliances maybe are less so (Appendix C). Ruderal wetland grassland/shrubland is somewhat less reliable in distinguishing upland from wetland.

#### 5.2.3.1 Alliance Accuracy

Twenty-three of 32 alliances in the AA meet the user's accuracy requirement of 80% established by the National Park Service Vegetation Inventory Program. Of the nine alliances with lower accuracy only two have an upper 90% confidence interval that did not exceed 80% (Appendix C). The following details those alliance-level map classes not meeting the required user's accuracy.

*Acer macrophyllum* (*Pseudotsuga menziesii*) Forest Alliance: The users' accuracy was 17% (of 6 mapped polygons 5 AA points were different alliances) with a 90% confidence interval of 0-50%. The two points in disagreement were mapping less conifer than recorded, (*Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest, *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliances) that were logged and planted and had higher conifer cover in small size classes than hardwood, one point with mapping *Acer macrophyllum* instead of *Alnus rubra* as a ruderal upland *Acer macrophyllum* (*Pseudotsuga menziesii* - (*Alnus Rubra*) / *Schedonorus phoenix* Ruderal Forest Alliance, and two errors were caused by key tree species cover estimates or confusion with identifying planted vegetation and by mapping upland instead of riparian (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance.

*Crataegus monogyna* - *Rosa nutkana* Ruderal Wet Shrubland Alliance: The users' accuracy was 40% (of 5 mapped polygons 3 AA points were a different alliance) with a 90% confidence interval of 0-86%. Errors were caused by mapping wet shrubland instead of dry shrubland even though the associated habitat and wet site species better fit the mapped alliance. *Crataegus monogyna* was present at two locations but with insufficient cover apparently due to severe browsing that represents a classification description error.

*Alnus rubra* - (*Picea sitchensis*, *Tsuga heterophylla*) Forest and Woodland Alliance: The users' accuracy of this rare alliance was 50% (of 2 mapped polygons 1 AA point was a different alliance) with a 90% confidence interval of 0-100%. It was identified as the *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance due to conifer dominance. Error was caused by mapping riparian instead of upland.

*Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest Alliance: The users' accuracy was 54% (of 24 mapped polygons 11 AA points were different alliances) with a 90% confidence interval of 35-73%. Errors are split between the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance (6 points) that mapped cool temperate trees instead of *Pseudotsuga menziesii* and the *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance that

contained high cover of *Thuja plicata*, *Polystichum munitum* and occasional *Mahonia nervosa*. Errors were caused by mapping Maritime forest instead of *Thuja plicata* Rainforest forest.

(*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance: The users' accuracy was 63% (6 of 16 points mapped as different alliances) with a 90% confidence interval of 39-86%. Three AA locations classified as the *Alnus rubra* / *Dactylis glomerata* Ruderal Flooded Forest Alliance differing in key indicator species and two AA classified as the upland *Alnus rubra* - (*Picea sitchensis*, *Tsuga heterophylla*) Forest and Woodland Alliance and one was the *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance differing in key understory indicator species.

(*Alnus* - *Fraxinus* - *Populus*) / *Lysichiton americanus* Deciduous Swamp Woodland Alliance: The users' accuracy was 67% (of 3 mapped polygons one AA point was a different alliance) with a 90% confidence interval of 5-100%. The disagreement was classified as the *Pseudotsuga menziesii* - (*Alnus Rubra*) / *Schedonorus phoenix* Ruderal Forest Alliance and the error was caused by mapping riparian instead of upland.

*Festuca rubra* - *Calamagrostis nutkaensis* Coastal Headland Herbaceous Alliance: The users' accuracy was 67% (of 3 mapped polygons one AA point was a different alliance) with a 90% confidence interval of 5-100%. The error was mapping a mesic grassland instead of the *Leymus mollis* - *Festuca rubra* Herbaceous Alliance indicated by perennial dune vegetation.

*Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance: The users' accuracy was 71% (of 28 mapped polygons 8 AA points were different alliances) with a 90% confidence interval of 56-87%. Five errors were caused by mapping warm temperate forest instead of the cool temperate *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest and three errors caused by mapping warm temperate forest the cool temperate *Thuja plicata* - (*Abies grandis*) Maritime Forest Alliances indicated by *Abies grandis* and *Thuja plicata*.

*Bromus hordeaceus* Dry Ruderal Grassland Alliance: The users' accuracy was 77% (8 of 35 points mapped as different alliances) with a 90% confidence interval of 64-90%. Three errors were caused by mapping ruderal dry grassland instead of the *Leymus mollis* - *Festuca rubra* Herbaceous Alliance indicated by native perennial dune vegetation, two instead of the *Ammophila (arenarea, breviligulata)* - *Leymus mollis* Dune Ruderal Herbaceous Alliance indicated by ruderal perennial dune vegetation, one instead of the *Agrostis capillaris* - *Holcus lanatus* - *Poa pratensis* Mesic Ruderal Grassland Alliance indicated by ruderal mesic perennial grassland, one instead of the *Festuca idahoensis ssp. roemeri* - *Agrostis pallens* - *Koeleria macrantha* Herbaceous Alliance, and one instead of the *Festuca rubra* - *Calamagrostis nutkaensis* Coastal Headland Herbaceous Alliance, both indicated by native mesic perennial grasslands.

Only two alliances did not have a users' accuracy 80% or greater and the upper 90% confidence interval did not exceed 80% users' accuracy: the *Acer macrophyllum* (*Pseudotsuga menziesii*) Forest and *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest alliances. Lumping the former alliance with the *Alnus rubra* - (*Picea sitchensis*, *Tsuga heterophylla*) Forest and Woodland Alliance into the North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group still yields a users' accuracy of 38% (8 points mapped as different alliances) with a 90%

confidence interval of 3-72%. It appears that this hardwood variation within the mesic lowland forests of the Park may not be adequately represented in the classification or mapping.

Almost half (11) of the 24 AA points *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest Alliance were errors of mapping cool temperate forest instead of *Pseudotsuga menziesii* warm temperate forest or instead of *Thuja plicata* rainforest forest alliances due to cover or sometimes presence or absence of key indicator trees in the plot. This Alliance and its higher level Group are transitional between the Western North American Cool and Warm Temperate Forest subclasses (Appendix C) that may either be incompletely described or distinguished in the key used for the AA.

Seven of the nine alliances mapped with users' accuracy less than 80% were forest alliances. In general, most forest assessment errors were differences in tree species abundance at the assessment points that could represent variation within mapped polygons. Similar to forests, grassland and shrubland alliances assessment errors were due to differences in species abundance at the assessment points that could represent variation within mapped polygons.

Twenty-three of 32 alliances in the AA meet the producers' accuracy (errors of omission) of 80%, Appendix C. The following details those nine alliances.

*Alnus rubra* - (*Picea sitchensis*, *Tsuga heterophylla*) Forest and Woodland Alliance: The producers' accuracy of this rare alliance was 5.8% (2 of 3 AA points mapped as a different alliance) with a 90% confidence interval of 5.3-6.2%. Both errors were to the (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance because of the absence of understory wetland indicators.

*Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest Alliance: The producers' accuracy was 26% (6 of 16 points mapped as different alliances) with a 90% confidence interval of 23-29%. Five errors are attributed to the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance because of high cover of *Abies grandis* and one error to the *Acer macrophyllum* (*Pseudotsuga menziesii*) Forest Alliance because of conifer dominance.

*Carex leporina* - *Equisetum arvense* - *Schedonorus pratensis* Ruderal Wet Meadow Alliance: The producers' accuracy was 26.2% (2 of 5 points mapped as different alliances) with a 90% confidence interval of 26.2-26.2%. Both errors are *Agrostis capillaris* - *Holcus lanatus* - *Poa pratensis* Mesic Ruderal Grassland Alliance associated with patches of *Schedonorus pratensis*.

*Alnus rubra* / *Dactylis glomerata* Ruderal Flooded Forest Alliance: The producers' accuracy was 36% (5 of 10 points mapped as different alliances) with a 90% confidence interval of 36-37%. Three errors are attributed to (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance due to low cover of *Acer macrophyllum* and high cover of *Carex obnupta* or high cover of *Pseudotsuga menziesii* and two errors attributed to *Pseudotsuga menziesii* - (*Alnus Rubra*) / *Schedonorus phoenix* Ruderal Forest Alliance due to high conifer cover and location on upland.

*Festuca rubra* - *Calamagrostis nutkaensis* Coastal Headland Herbaceous Alliance: The producers' accuracy was 45.1% (1 of 3 points mapped as different alliance) with a 90%

confidence interval of 44.9-45.3%. The error is the *Bromus hordeaceus* Dry Ruderal Grassland Alliance because cover of *Festuca rubra* and site location.

*Carex tumulicola* Alliance: The producers' accuracy was 53.3% (1 of 5 points mapped as different alliance) with a 90% confidence interval of 53.0-53.5%. The error is the *Agrostis capillaris* - *Holcus lanatus* - *Poa pratensis* Mesic Ruderal Grassland Alliance because of dominance of *Schedonorus phoenix*.

*Leymus mollis* - *Festuca rubra* Herbaceous Alliance: The producers' accuracy was 61.92% (6 of 15 points mapped as different alliances) with a 90% confidence interval of 61.90 - 61.94%. Three errors are attributed to the *Bromus hordeaceus* Dry Ruderal Grassland Alliance because of high cover of indicator perennial grasses, two errors as the *Ammophilla (arenarea, breviligulata)* - *Leymus mollis* Dune Ruderal Herbaceous Alliance because of *Abronia latifolia*, and an error as the *Festuca rubra* - *Calamagrostis nutkaensis* Coastal Headland Herbaceous Alliance due to dune indicators.

*Thuja plicata* - (*Abies grandis*) Maritime Forest Alliance: The producers' accuracy was 75% (11 of 40 points mapped as different alliances) with a 90% confidence interval of 74-76%. Four errors are attributed to the *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest Alliance because of *Thuja plicata* cover and understory rainforest indicators, three errors as *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance because of cool temperate forest indicators and one to *Alnus rubra* - (*Picea sitchensis*, *Tsuga heterophylla*) Forest and Woodland Alliance and one to *Acer macrophyllum* (*Pseudotsuga menziesii*) Forest Alliance because of conifer dominance and one to (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance because of upland indicators.

*Festuca idahoensis ssp. roemerii* - *Agrostis pallens* - *Koeleria macrantha* Herbaceous Alliance: The producers' accuracy was 78% (1 of 5 points mapped as different alliances) with a 90% confidence interval of 77-78%. The error is attributed to the *Bromus hordeaceus* Dry Ruderal Grassland Alliance because of high cover of native grasses.





## 6.0 Conclusions

We developed a vegetation classification of plant alliances and associations and a map of alliances for SAJH. This vegetation classification (Appendix B) reflects the most current and comprehensive vegetation classification for the park. The field keys and descriptions provide in this report deliver to NPS staff and researchers the tools necessary to distinguish vegetation in a consistent manner.

The SAJH vegetation classification is based on existing vegetation, which is a philosophical shift from describing and mapping vegetation based on potential vegetation relative to bioclimatic zones that has predominated in this region. The map generated here now represents the best available vegetation map for the park.

There were 49 alliances classified as occurring within SAJH. Forested alliances accounted for 31%, shrubland/herbaceous alliances totaled 67%, and the single sparse alliance accounted for 2% of the total number of alliances. An additional nine map units were used for Cultural and Non-vegetated cover types. Three “Alliance” level units were documented for cultural vegetation including one unit for Agromorphic and two units for Developed vegetation classes. There were also an additional six map units identified for non-vegetated cover types. Nearly 43% of the vegetation alliances were classified as ruderal types, indicating that past land use has resulted in numerous novel vegetation types dominated by non-native vegetation or combinations of native species with no similar type existing in ‘natural’ landscapes.

The most frequent alliance and the alliance covering the greatest area (317.3 ha or 784.2 acres) is the *Pseudotsuga menziesii* - (*Arbutus menziesii*) Forest and Woodland Alliance. The *Symphoricarpos albus* Pacific Coast Shrubland Alliance was the most frequent and most abundant shrub alliance. The *Holcus lanatus* - *Poa pratensis* - *Elymus repens* Provisional Ruderal Alliance dominated the herbaceous areas (104.8 ha or 259.1 acres).

Vegetation classified at the Alliance-level was mapped correctly with an overall accuracy of 82.0 ± 5.2% (90% confidence intervals) and increases at higher NVC levels to 86.8% ± 4.6% at the Division-level. Twenty-three of 32 Alliances in the AA (72%) meet the user’s accuracy requirement of 80% established by the National Park Service Vegetation Inventory Program. Of the nine alliances only two did not have a users’ accuracy 80% or greater or the upper 90% confidence interval did not exceed 80% users’ accuracy: the *Acer macrophyllum* (*Pseudotsuga menziesii*) Forest and *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest Alliances. It appears that the hardwood variation within the mesic lowland forests of the Park may not be adequately represented in the classification or mapping. In general, forest assessment errors were differences in tree species abundance at the assessment points that could represent variation within mapped polygons. Similar to forests, grassland and shrubland alliances assessment errors were due to differences in species abundance at the assessment points that could represent variation within mapped polygons.

The classification and vegetation map not only provides park managers information for land use decisions, but also informs park visitors, guides research and will serve as a baseline against which to evaluate future vegetation change.



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# Appendix A: Vegetation Classification for San Juan Island National Historical Park

<b>1 Forest &amp; Woodland (Mesomorphic Tree Vegetation) Class</b>
<b>1.C Temperate Forest Subclass</b>
1.C.1 Warm Temperate Forest Formation
<b>1.C.1.c Western North American Warm Temperate Forest Division</b>
Californian-Vancouverian Foothill & Valley Forest & Woodland Macrogroup
<b>Californian-Vancouverian Deciduous Oak Woodland Group</b>
<i>Quercus garryana</i> Woodland Alliance
<i>Quercus garryana</i> / <i>Symphoricarpos albus</i> / <i>Carex inops</i> Woodland
<b>Vancouverian Dry Coastal &amp; Lowland Forest &amp; Woodland Group</b>
<i>Pseudotsuga menziesii</i> - ( <i>Arbutus menziesii</i> ) Forest and Woodland Alliance
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest
<i>Pseudotsuga menziesii</i> / <i>Rosa gymnocarpa</i> - <i>Holodiscus discolor</i> / <i>Festuca occidentalis</i> Forest
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest
Vancouverian Lowland & Montane Rainforest Macrogroup
<b>North Pacific Maritime Douglas-fir - Western Hemlock Forest Group</b>
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / ( <i>Holodiscus discolor</i> ) Forest Alliance
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> / <i>Melica subulata</i> Forest
1.C.2 Cool Temperate Forest Formation
<b>1.C.2.b Western North American Cool Temperate Forest Division</b>
Vancouverian Lowland & Montane Rainforest Macrogroup
<b>North Pacific Maritime Douglas-fir - Western Hemlock Forest Group</b>
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / ( <i>Holodiscus discolor</i> ) Forest Alliance
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> / <i>Melica subulata</i> Forest
<b>North Pacific Maritime Western Red-cedar - Western Hemlock Forest Group</b>
<i>Thuja plicata</i> - ( <i>Abies grandis</i> ) Maritime Forest Alliance
<i>Thuja plicata</i> - <i>Abies grandis</i> / <i>Polystichum munitum</i> Forest
<i>Thuja plicata</i> / <i>Gaultheria shallon</i> Forest
<b>North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group</b>
<i>Acer macrophyllum</i> ( <i>Pseudotsuga menziesii</i> ) Forest Alliance
<i>Alnus rubra</i> - ( <i>Picea sitchensis</i> , <i>Tsuga heterophylla</i> ) Forest and Woodland Alliance
<i>Alnus rubra</i> / <i>Polystichum munitum</i> Forest
Western North American Ruderal Forest & Plantation Macrogroup
<b>Vancouverian Ruderal Forest and Plantation Group</b>
<i>Pseudotsuga menziesii</i> - ( <i>Alnus rubra</i> ) - <i>Schedonorus phoenix</i> Ruderal Forest Alliance
<i>Alnus rubra</i> - <i>Pseudotsuga menziesii</i> Provisional Ruderal Association

<i>Pseudotsuga menziesii</i> - <i>Pinus contorta</i> Provisional Ruderal Association
<i>Pseudotsuga menziesii</i> / Nonnative Grasses Provisional Ruderal Association
1.C.3 Temperate Flooded & Swamp Forest Formation
<b>1.C.3.c Western North American Flooded &amp; Swamp Forest Division</b>
Vancouverian Flooded & Swamp Forest Macrogroup
<b>North Pacific Lowland Riparian Forest &amp; Woodland Group</b>
( <i>Acer macrophyllum</i> , <i>Alnus rubra</i> ) Riparian Forest Alliance
<i>Acer macrophyllum</i> / <i>Rubus spectabilis</i> Forest
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest
<b>North Pacific Maritime Lowland Hardwood-Conifer Swamp Group</b>
( <i>Alnus</i> - <i>Fraxinus</i> - <i>Populus</i> ) / <i>Lysichiton americanus</i> Deciduous Swamp Woodland Alliance
<i>Populus balsamifera</i> spp. <i>trichocarpa</i> / <i>Cornus sericea</i> / <i>Carex obnupta</i> Forest
<i>Populus tremuloides</i> / <i>Carex obnupta</i> Forest
( <i>Tsuga heterophylla</i> - <i>Picea sitchensis</i> - <i>Thuja plicata</i> - <i>Abies</i> ) / <i>Lysichiton americanus</i> Alliance
<i>Tsuga heterophylla</i> - ( <i>Thuja plicata</i> - <i>Alnus rubra</i> ) / <i>Lysichiton americanus</i> - <i>Athyrium filix-femina</i> Forest
Western North American Ruderal Flooded & Swamp Forest Macrogroup
<b>Vancouverian Ruderal Flooded &amp; Swamp Forest Group</b>
<i>Alnus rubra</i> / <i>Dactylis glomerata</i> Provisional Ruderal Flooded Forest Alliance
<i>Alnus rubra</i> / Nonnative Grasses Provisional Ruderal Flooded Forest Association
<i>Alnus rubra</i> / <i>Carex obnupta</i> Provisional Ruderal Flooded Forest Association
<i>Prunus emarginata</i> Provisional Ruderal Flooded Forest Association
<b>2 Shrubland &amp; Grassland (Mesomorphic Shrub &amp; Herb Vegetation) Class</b>
<b>2.C Temperate &amp; Boreal Shrubland &amp; Grassland Subclass</b>
2.C.1 Temperate Grassland, Meadow & Shrubland Formation
<b>2.C.1.a Vancouverian &amp; Rocky Mountain Grassland &amp; Shrubland Division</b>
Southern Vancouverian Lowland Grassland & Shrubland Macrogroup
<b>Southern Vancouverian Shrub &amp; Herbaceous Bald, Bluff, &amp; Prairie Group</b>
<i>Carex inops</i> Herbaceous Alliance
<i>Carex inops</i> - <i>Eriophyllum lanatum</i> Herbaceous Bald
<i>Carex tumulicola</i> Alliance
<i>Carex tumulicola</i> Herbaceous Vegetation
<i>Camassia quamash</i> Herbaceous Alliance
<i>Camassia quamash</i> - <i>Triteleia hyacinthina</i> Herbaceous Bald
<i>Festuca idahoensis</i> ssp. <i>roemeri</i> - <i>Agrostis pallens</i> - <i>Koeleria macrantha</i> Herbaceous Alliance
<i>Festuca idahoensis</i> ssp. <i>roemeri</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous
<i>Festuca rubra</i> - <i>Calamagrostis nutkaensis</i> Coastal Headland Herbaceous Alliance
<i>Festuca rubra</i> - ( <i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i> ) Herbaceous Vegetation
<i>Festuca rubra</i> Coastal Headland Herbaceous Vegetation
<i>Plectritis congesta</i> Herbaceous Alliance
<i>Plectritis congesta</i> Herbaceous Bald
<i>Symphoricarpos albus</i> Pacific Coast Shrubland Alliance



<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Pacific Coast Shrubland
Southern Vancouverian Lowland Ruderal Grassland & Shrubland Macrogroup
<b>Southern Vancouverian Lowland Ruderal Grassland &amp; Shrubland Group</b>
<i>Agrostis capillaris</i> - <i>Holcus lanatus</i> - <i>Poa pratensis</i> Mesic Ruderal Grassland Alliance
<i>Agrostis (capillaris, stolonifera)</i> Mesic Ruderal Grassland Association
<i>Holcus lanatus</i> - <i>Poa pratensis</i> - Mesic Ruderal Grassland Association
<i>Schedonorus phoenix</i> Mesic Ruderal Grassland Association
<i>Ammophila (arenaria, breviligulata)</i> - <i>Leymus mollis</i> Dune Ruderal Herbaceous Alliance
<i>Leymus mollis ssp. mollis</i> - <i>Holcus lanatus</i> Dune Ruderal Grassland Association
San Juan Islands Ruderal Dune Forbs and Graminoids Herbaceous Association
<i>Bromus hordeaceus</i> Dry Ruderal Grassland Alliance
<i>Arrhenatherum elatius</i> Dry Ruderal Grassland Association
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Dry Ruderal Grassland Association
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Dry Ruderal Grassland Association
<i>Festuca idahoensis ssp. roemerii</i> Ruderal (Restoration) Grassland Association
<i>Rubus aremniacus</i> Ruderal Shrubland Alliance
2.C.3 Temperate & Boreal Scrub & Herb Coastal Vegetation Formation
<b>2.C.3.b Pacific North American Coast Scrub &amp; Herb Vegetation Division</b>
Cool Pacific Coastal Beach, Dune & Bluff Vegetation Macrogroup
<b>North Pacific Maritime Coastal Sand Dune Scrub &amp; Herb Vegetation Group</b>
<i>Leymus mollis</i> - <i>Festuca rubra</i> Herbaceous Alliance
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation
<i>Festuca rubra</i> Stabilized Dune Herbaceous Vegetation
<i>Leymus mollis ssp. mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation
2.C.5 Temperate & Boreal Freshwater Wet Meadow & Marsh Formation
<b>2.C.5.b Western North American Freshwater Wet Meadow &amp; Marsh Division</b>
Western North American Lowland Freshwater Wet Meadow & Marsh Macrogroup
<b>Vancouverian Freshwater Coastal Marsh &amp; Meadow Group</b>
( <i>Juncus balticus</i> - <i>Juncus effusus</i> ) Herbaceous Alliance
<i>Juncus balticus var. balticus</i> Pacific Coast Herbaceous Vegetation
<i>Juncus effusus var. brunneus</i> Pacific Coast Herbaceous Vegetation
<i>Carex obnupta</i> Seasonally Flooded Herbaceous Alliance
<i>Carex obnupta</i> Herbaceous Vegetation
<i>Equisetum (arvense, variegatum, hyemale, telmateia)</i> Semipermanently Flooded Herbaceous Alliance
<i>Equisetum telmateia</i> Herbaceous Vegetation
<i>Oenanthe sarmentosa</i> Herbaceous Alliance
<i>Oenanthe sarmentosa</i> Herbaceous Vegetation
<b>Vancouverian Lowland Riparian &amp; Wet Slope Shrubland Group</b>
<i>Cornus sericea</i> Shrubland Alliance
<i>Cornus sericea</i> Pacific Shrubland
<i>Crataegus douglasii</i> Pacific Coast Shrubland Alliance

<i>Crataegus douglasii</i> / <i>Rosa nutkana</i> Shrubland
<i>Malus fusca</i> Seasonally Flooded Shrubland Alliance
<i>Malus fusca</i> - ( <i>Salix hookeriana</i> ) / <i>Carex obnupta</i> Shrubland
<i>Rubus spectabilis</i> Shrubland Alliance
<i>Rosa nutkana</i> - <i>Rubus spectabilis</i> Wet Shrubland
<i>Salix hookeriana</i> Seasonally Flooded Shrubland Alliance
<i>Salix hookeriana</i> - ( <i>Salix sitchensis</i> ) Shrubland
Western North American Ruderal Wet Meadow & Marsh Macrogroup
<b>Western North American Ruderal Wet Meadow &amp; Marsh Group</b>
<i>Carex leporina</i> - <i>Equisetum arvense</i> - <i>Schedonorus pratensis</i> Ruderal Wet Meadow Alliance
<i>Carex leporina</i> Ruderal Wet Meadow Association
<i>Schedonorus pratensis</i> Provisional Ruderal Wet Meadow Association
<i>Equisetum arvense</i> - Mixed Graminoid Provisional Ruderal Wet Meadow Association
<i>Crataegus monogyna</i> - <i>Rosa nutkana</i> Ruderal Wet Shrubland Alliance
<i>Crataegus monogyna</i> / Mixed Forbs & Graminoids Provisional Ruderal Wet Shrubland Association
<i>Juncus gerardii</i> Ruderal Brackish Wet Meadow Alliance
<i>Juncus gerardii</i> var. <i>gerardii</i> Ruderal Brackish Wet Meadow Association
2.C.6 Salt Marsh Formation
<b>2.C.6.c Temperate &amp; Boreal Pacific Coastal Salt Marsh Division</b>
North American Pacific Coastal Salt Marsh Macrogroup
<b>Temperate Pacific Tidal Salt &amp; Brackish Marsh Group</b>
<i>Salicornia virginica</i> Tidal Herbaceous Alliance
<i>Salicornia virginica</i> - <i>Distichlis spicata</i> - <i>Triglochin maritima</i> - ( <i>Jaumea carnosa</i> ) Herbaceous
<b>6 Nonvascular &amp; Sparse Vascular Rock Vegetation (Lithomorphic Vegetation) Class</b>
<b>6.B Mediterranean, Temperate &amp; Boreal Nonvascular &amp; Sparse Vegetation Subclass</b>
6.B.2 Temperate & Boreal Cliff, Scree & Rock Vegetation Formation
<b>6.B.2.b Western North American Temperate Cliff, Scree &amp; Rock Vegetation Division</b>
Vancouverian Cliff, Scree & Rock Vegetation Macrogroup
<b>Vancouverian Cliff, Massive Bedrock and Rock Outcrop Group</b>
<i>Racomitrium canescens</i> Nonvascular Alliance
<i>Racomitrium canescens</i> - ( <i>Selaginella wallacei</i> ) Nonvascular Vegetation
<b>7 Agricultural Vegetation (Agromorphic Vegetation) Class</b>
<b>7.1 Woody Agricultural Vegetation Subclass</b>
7.1.A. Woody Horticultural Crop Formation
<b>7.1.A.1 Orchard Division</b>
Temperate and Tropical Orchard Macrogroup
<b>Fruit Orchard Group</b>
Fruit Orchard Alliance
<i>Pyrus malus</i> Orchard
<b>8 Developed Vegetation (Hortomorphic Vegetation) Class</b>
<b>8.1. Herbaceous &amp; Woody Developed Vegetation Subclass</b>

8.1.A. Developed (Close cropped) Formation
<b>8.1.A.1 Lawn Division</b>
Temperate and Tropical Lawn Macrogroup
<b>Cool season, Warm season, Dry season Lawn Group</b>
Mowed Lawn Alliance
8.1.B. Other Developed Urban / Built Up Vegetation Formation
<b>8.1.B.1 Other Urban / Build Up Vegetation Division</b>
Other Urban / Built Up Vegetation Macrogroup
<b>Ornamental Trees Group</b>
Ornamental Trees Alliance
<b>Non-vegetated Map Units</b>
<b>Cultural</b>
Terrestrial Artificial Surfaces & Associated Areas
Parking Lot/Buildings
Terrestrial Bare Areas
Road/Parking lots
<b>Natural</b>
AQUATIC: Natural Waterbodies, Snow and Ice
Open Water
Terrestrial Bare Areas
Drift logs
Sand Dune Sheet (with inclusions of <i>Leymus mollis</i> / <i>Abronia latifolia</i> (CEGL001796))
Terrestrial Bare Areas



## **Appendix B: Vegetation Key and Descriptions**

As part of the SAJH vegetation classification, mapping, and inventory projects, local plant alliance descriptions and lists of associations were collated or described where new or provisional alliances were present. This Appendix provides a key to the alliances and associations inventoried at SAJH. Following the key, plant association descriptions are presented. The units are alphabetized as they appear in the key within physiognomic category and by dominance type in forest associations. Each association description summary includes; scientific name, common name, NatureServe code when present, acronym, selected national vegetation hierarchy, classification confidence, range in Washington, environmental features, United States Fish and Wildlife wetland classification, vegetation description, state conservation rank, rank justification, comments, and plant association synonyms in previous classifications.



## Introduction

This document contains the field key and descriptions of plant associations found at San Juan National Historical Park. Cultural types of vegetation are not described here.

## Plant Association and Alliance Key

This key will aid in the identification of plant associations occurring at San Juan National Historical Park. However, some types were only classified or mapped to the Alliance level. Alliances are indicated in the key.

The following explains features and application of the key in the field.

1. Select a relatively uniform area of vegetation and topography to key out. A representative plot is a simple way to examine a stand, just be sure the plot represents the stand of interest.
2. "Present" means the species is typically found on a representative plot, i.e. it regularly occurs in the stand. "Prominent" means the species occurs with 3-15% cover
3. If the stand or plot meets the criteria in a line, then read to the right or (if blank) to the next indented line down. If the stand or plot does not meet the criteria, then go to the next line down that is not indented from the current line.
4. Some associations or alliances key to multiple different lines. For associations that may be distinguished by any one of a number of different characteristics, the criteria are broken into multiple lines so as to avoid excessive and confusing use of "and" and "or" statements. Go to the next line down if the criteria are not met.
5. Percentage values refer to crown cover, that is, the vertical projection below the entire crown of the plant, do not subtract for spaces between leaves and branches
6. "+" = add the crown cover of each of the species indicated, e.g. 7+22 = 29% cover, overlap between the species gets counted twice. One species may be absent.
7. Wetland associations located or possibly located in one or all the parks appear in Appendix B and are referenced in the physiognomic section of the key.
8. The key is not the classification. After you have keyed out a stand, always read the association description of vegetation composition, geographic distribution, and physical environment. If it sounds like it fits in most regards, you have made a correct identification. If there are multiple inconsistencies between the stand and the description, the key probably was incorrect. In this case, you probably need to try the key again and follow slightly different leads or identify the stand by reading the descriptions.

## Key to Physiognomic Categories: (page numbers refer to key)

Site dominated by sand; vegetation cover is mostly absent OR inclusions of small patches/sparse cover of *Leymus mollis*, *Abronia latifolia* present .....  
**Sand Dune Sheet (with inclusions of *Leymus mollis* / *Abronia latifolia* (not described here)**

Trees > 25%

Deciduous broadleaf trees clearly > canopy cover than conifer trees .....  
..... **Key to Deciduous Forest Types p. 2**

Conifer trees approximately equal in canopy cover or > than deciduous broadleaf trees .....  
..... **Key to Conifer & Broadleaf Evergreen Forest and Woodland Types, p. 3**

Shrubs > 25% ..... **Key to Shrubland Types, p. 4**

Herbaceous Vegetation > 25%

Site occurs in a landform where surface water accumulates or groundwater discharges (e.g. marsh, wet meadow) or water table near, at, or above soil surface for significant portion of growing season; soil very moist to saturated, although may be dry in late summer/early fall; organic soils may be present; Characteristic species include *Carex obnupta*, *Juncus arcticus* ssp. *littoralis*, *J. effusus*, *Oenanthe sarmentosa*, *Equisetum* spp.  
..... **Key to Herbaceous Wetland Vegetation, p. 4**

Site occurs in an upland environment (steep slopes, rocky and/or well-drained soils, other areas where surface and/or groundwater do not affect vegetation); may be near early melting snowbeds; soils are rarely saturated (and if so, only in early spring) but can be moist; organic soils or even organic soil horizons not present;..... **Key to Herbaceous Upland Vegetation p. 5**

Herbaceous Vegetation < 25%..... **Key to Nonvascular & Sparse Vascular Vegetation Types p. 6**

## Key to Deciduous Forest Types

*Quercus garryana* >25% or >50% of total tree cover ..... **QUEGAR/SYMALB/CARINO, p. 13**

*Populus tremuloides* > 25%..... **POPTRE/CAROBN, p. 30**

*Populus balsamifera* > 25%

*Cornus sericea*, *Malus fusca*, *Maianthemum dilatatum* or *Carex obnupta* > 10%  
..... **POPBAL/CORSER/CAROB, p. 29**

*Prunus emarginata* > 25% ..... **PRUEMA Ruderal, p. 34**

*Acer macrophyllum* dominant or co-dominant with *Pseudotsuga menziesii*

*Equisetum telmateia* > 25%..... **ACEMAC/RUBSPE, p. 27**

*Rubus spectabilis* > 10% and *Equisetum telmateia* present ..... **ACEMAC/RUBSPE, p. 27**

*Pseudotsuga menziesii* prominent to co-dominant, ..... **ACEMAC-(PSEMEN) Alliance, p. 22**

*Alnus rubra* dominant or co-dominant with *Pseudotsuga menziesii*

*Pseudotsuga menziesii* absent or < 5%

Young/regenerating *Alnus rubra* present; nonnative grasses prominent; disturbed upland forests ..... **ALNRUB-PSEMEN Ruderal, p. 24**

*Carex obnupta* >25%..... **ALNRUB/CAROBN Ruderal, p. 32**



- Nonnative species predominant; Equisetum spp., Carex obnupta, Juncus spp., Geum macrophyllum or other wetland species present; .....  
 ..... **ALNRUB/Nonnative Grasses Ruderal, p. 33**  
 Polystichum munitum >10% and site is not a wetland/riparian/see **ALNRUB/POLMUN, p. 23**  
 Rubus spectabilis > 25%; Symphoricarpos albus may be co-dominant  
 ..... **ALNRUB/RUBSPE, p. 28**  
 Rubus spectabilis > 10%; mix of mesic and wet species present; Pseudotsuga menziesii, Thuja plicata, Sambucus racemosa, Juncus spp., Equisetum telmateia, etc. ....  
 ..... **ALNRUB/Nonnative Grasses Ruderal, p. 33**
- Pseudotsuga menziesii > 5%  
 Polystichum munitum ..... **ALNRUB/POLMUN, p. 23**  
 Young Alnus rubra and Pseudotsuga menziesii present; nonnative grasses prominent; disturbed upland forests ..... **ALNRUB-PSEMEN Ruderal, p. 24**

## Key to Conifer & Broadleaf Evergreen Forest and Woodland Types

- Thuja plicata or Tsuga heterophylla > 10%  
 Lysichiton americanus > 5% wetland ..... **TSUHET-(THUPLI-ALNRUB)/LYSAME-ATHFIL, p. 31**  
 Polystichum munitum >25% (dense stands of THUPLI may have less); MAHNER absent;  
 ..... **THUPLI-ABIGRA/POLMUN, p. 20**  
 Mahonia nervosa + Gaultheria shallon > 1% ..... **THUPLI/GAUSHA, p. 21**
- Abies grandis > 10% or dominates tree regeneration  
 Gaultheria shallon > 10% ..... **PSEMEN-ABIGRA/GAUSHA-HOLDIS, p. 18**  
 Festuca occidentalis > 1% ..... **PSEMEN-ABIGRA/HOLDIS/MELSUB, p. 19**  
 Acer macrophyllum and Pseudotsuga menziesii prominent to co-dominant; Symphoricarpos albus + Rosa nutkana >25% ..... **ACEMAC-(PSEMEN) Alliance, p. 22**
- Arbutus menziesii > 20%  
 Recently logged stands (<20 years); young Pseudotsuga menziesii present and Holodiscus discolor >20%; rocky ground ..... **regenerating PSEMEN/HOLDIS-ROSGYM/FESOCC, p. 16**  
 Lonicera hispidula and/or Festuca occidentalis >1% ..... **PSEMEN-ARBMEN/HOLDIS, p. 14**
- Pinus contorta ssp. contorta > 10% ..... **PSEMEN-PINCON Ruderal, p. 26**
- Pseudotsuga menziesii > 10%  
 Pinus contorta ssp. contorta > Alnus rubra ..... **PSEMEN-PINCON Ruderal, p. 26**  
 Recently logged stands (<20 years); young Arbutus menziesii present and Holodiscus discolor >20%; rocky ground ..... **regenerating PSEMEN/HOLDIS-ROSGYM/FESOCC, p. 16**  
 Young Alnus rubra present; nonnative upland grasses prominent; disturbed upland forests .....  
 ..... **ALNRUB-PSEMEN Ruderal, p. 24**
- Alnus rubra >10% to co-dominant and Equisetum spp., Carex obnupta, Juncus spp., Geum macrophyllum or other wetland species present; nonnative species predominant; .....  
 ..... **ALNRUB/Nonnative Grasses Ruderal, p. 33**  
 Rubus spectabilis > 10%; mix of mesic and wet species present; Pseudotsuga menziesii, Alnus rubra >10% to co-dominant and Thuja plicata, Sambucus racemosa, Juncus spp., Equisetum telmateia, present ..... **ALNRUB/Nonnative Grasses Ruderal, p. 33**  
 Mahonia aquifolium and Quercus garryana or Juniperus maritima present .....  
 ..... **PSEMEN-ARBMEN/HOLDIS, p. 14**  
 Gaultheria shallon > 10% ..... **PSEMEN/GAUSHA-HOLDIS, p. PSEMEN/GAUSHA-HOLDIS15**  
 Symphoricarpos albus and Holodiscus discolor each >10% ..... **PSEMEN/SYMALB-HOLDIS, p. 17**  
 Rosa gymnocarpa, Holodiscus discolor, or Festuca occidentalis >1% .....  
 ..... **PSEMEN/HOLDIS-ROSGYM/FESOCC, p. 16**

Nonnative grasses (*Agrostis* spp., *Poa pratensis*, *Holcus lanatus*, *Schedonorus phoenix*, *Elymus reprens*, *Dactylis glomerata*) dominate understory; *Rubus armeniacus* may be abundant .....  
..... **PSEMEN/Nonnative Grasses Ruderal, p. 25**

## Key to Shrubland Types

- Cornus sericea* dominant, little else present ..... **CORSER, p. 61**
- Crataegus monogyna* dominant or co-dominant with *Rosa nutkana*; herbaceous wetland species present..... **CRAMON/Mixed Forb & Graminoids Ruderal, p. 69**
- Malus fusca* >25; *Carex obnupta* and/or *Oenanthe sarmentosa* dominant in understory; *Salix hookeriana* is present to codominant ..... **MALFUS-(SALHOO)/CAROBN, p. 63**
- Salix hookeriana* dominant, *Rubus spectabilis* may be present, especially along edges  
..... **SALHOO-(SALSIT), p. 65**
- Symphoricarpos albus* >50% or co-dominant with *Rosa nutkana*..... **SYMALB-ROSNUT, p. 41**
- Rosa nutkana* >50%  
*Rubus spectabilis* co-dominant ..... **ROSNUT-RUBSPE, p. 64**  
*Crataegus douglasii* co-dominant; *Sambucus racemosa* present..... **CRADOU-ROSNUT, p. 62**  
*Crataegus monogyna* co-dominant; herbaceous wetland species present .....  
..... **CRAMON/Mixed Forbs & Graminoids Provisional Ruderal, p. 69**  
*Rosa nutkana* is the only shrub present or co-dominant with *Symphoricarpos albus*  
..... **SYMALB-ROSNUT, p. 41**
- Rubus armeniacus* dominant; may be in scattered in patches but is clearly the dominant shrub; nonnative grasses are abundant; open grasslands or wetland edge **RUBARM Ruderal Alliance, p. 51**

## Key to Wetland Herbaceous Vegetation Types

- Salicornia virginica* and *Distichlis spicata* dominant ..... **SALVIR-DISSPI-TRIMAR-(JAUCAR), p. 71**
- Camassia quamash* and *Triteleia hyacinthina* dominant; small, wet patches among rock outcrops .....  
..... **CAMQUA-TRIHYA, p. 55**
- Carex leporina* dominant; *Juncus ensifolius* >10% ..... **CARLEP, p. 66**
- Juncus gerardii* var. *gerardii* dominant ..... **JUNGERGER Ruderal, p. 70**
- Equisetum telmateia* dominant ..... **EQUTEL, p. 57**
- Equisetum arvense* co-dominant with native and nonnative grasses .....  
..... **EQUARVE-Mixed Graminoid Ruderal, p. 67**
- Juncus effusus* dominant and clearly > *J. balticus* ..... **JUNEFF, p. 59**
- Juncus arcticus* ssp. *littoralis* dominant and > *J. effusus* ..... **JUNBALBAL, p.58**
- Oenanthe sarmentosa* dominant (*Glyceria elata* may be prominent)..... **OENSAR, p. 60**
- Carex obnupta* and *Poa trivialis* co-dominate..... **CAROBN, p. 55**

*Crataegus monogyna* and *Rosa nutkana* present to co-dominant; herbaceous wetland species present..... **CRAMON/Mixed Forbs & Graminoids Provisional Ruderal, p. 69**

*Schedonorus pratensis* dominant, *Carex aurea*, ..... **SCHPRA (=FESPRA) Ruderal, p. 68**

## Key to Upland Herbaceous Vegetation Types

*Carex inops* >25%

*Festuca idahoensis* ssp. *roemerii* <5%; bryophyte cover >75%, near rock outcrops; shaded by adjacent trees; **CARINO-ERILAN, p. 35**

*Festuca idahoensis* ssp. *roemerii* >5%; *Arctostaphylos uva-ursi* present and *Danthonia californica* >10%, **FESROE-(CERARV-KOEMAC), p. 37**

*Camassia quamash* and *Triteleia hyacinthina* dominant; small, wet patches among rock outcrops **CAMQUA-TRIHYA, p. 55**

*Quercus garryana* >10% **QUEGAR/SYMALB/CARINO, p. 13**

*Mahonia aquilifolium* and *Quercus garryana* or *Juniperus maritima* present **PSEMEN-ARBMEN/HOLDIS, p. 14**

*Rubus armeniacus* dominant; may be in scattered in patches but is clearly the dominant shrub; nonnative grasses are abundant **RUBARM Ruderal, p. 51**

*Leymus mollis* >25%

*Abronia latifolia* >5% **LEYMOL-ABRLAT, p. 54**

*Lathyrus japonicus* present and *Festuca rubra* absent **LEYMOL-ABRLAT, p. 54**

*Festuca rubra* present to co-dominate ..... **FESRUB Stabilized Dune, p. 52**

*Holcus lanatus* > 25%..... **LEYMOL-HOLAN Ruderal, p. 45**

*Festuca rubra* >5% and *Ambrosia chamissonis* and *Lepidium virginica* var. *menziesii* present to co-dominant ..... **FESRUB-AMBCHA, p. 53**

*Festuca idahoensis* ssp. *roemerii* > 10%

*Festuca idahoensis* ssp. *roemerii* was planted (restoration area); few other species present ..... **FESROE Ruderal, p. 50**

*Arctostaphylos uva-ursi* present and *Danthonia californica* >10%, ..... **FESROE-(CERARV-KOEMAC), p. 37**

*Festuca idahoensis* ssp. *roemerii* >50% ..... **FESROE-(CERARV-KOEMAC), p. 37**

*Festuca rubra* >50%;

Located on steep bluff along coast; *Calstegia soldanella*, *Spergularia macrotheca*, or *Plantago maritima* var. *californica* present..... **FESRUB Coastal Headland, p. 39**

*Cerastium arvense* and *Bromus sitchensis* present OR *Abronia latifolia* and *Lupinus littoralis* present ..... **FESRUB Stabilized Dune, p. 52**

*Festuca rubra* >10% (sometimes patchy)

*Grindelia stricta* var. *stricta* >5% ..... **FESRUB-(CAMLEI,GRISTR), p. 38**

Located on steep bluff along coast; *Calstegia soldanella*, *Spergularia macrotheca*, or *Plantago maritima* var. *californica* present..... **FESRUB Coastal Headland, p. 39**

None of the above ..... **Move to next line in key**

*Carex tumulicola* >50%..... **CARTUM, p. 36**

- Bromus sitchensis + Elymus glaucus >25%; nonnative grasses are co-dominant;  
..... **BROSIT-ELYGLA Ruderal, p. 49**
- Bromus diandrus (=Bromus rigidus) >50%; B. hordeaceus, and/or B. sterilis are often co-dominant and occurs on shallow soils, steep slopes and warm aspects .....  
..... **BRO(DIA,HOR,STE) Dry Ruderal, p. 48**
- Arrhenatherum elatius is dominant (>75%) ..... **ARRELA Ruderal, p. 46**
- Schedonorus phoenix (=Festuca arundinacea) dominant and > Holcus lanatus and Poa pratensis .....  
..... **SCHPHO (=FESARU) Ruderal, p. 44**
- Agrostis (stolonifera and/or capillaris) dominant and clearly > cover than other grasses.....  
..... **AGR(CAP,STO), Ruderal, p. 42**
- Holcus lanatus co-dominates with Leymus mollis ..... **LEYMOL-HOLAN Ruderal, p. 45**
- Holcus lanatus, Poa pratensis, and Elymus repens may individually dominate but more typically co-dominate with each other; numerous other pasture grasses typically present (Schedonorus phoenix, Agrostis sp. Dactylis glomerata); species diversity is higher than other nonnative grassland types .....  
..... **HOLLAN-POAPRA-ELYREP Mesic Ruderal, p. 43**
- Dominated by weedy natives (Amsinckia menziesii, Lupine spp., Pteridium aquilinum) and invasive nonnative forbs and graminoids (Cirsium arvense, Teesdalia nudicaulis, Erodium cicutarium, Sisymbrium altissimum, Hypochaeris radicata, Vulpia spp. Aira spp., Bromus sterilis, Holcus lanatus).  
..... **San Juan Islands Ruderal Forbs and Graminoids, p. 46**

## Key to Bryophyte and Lithomorphic Sparse Vegetation Types

- Racomitrium canescens dominant; Selaginella wallacei, when present, is prominent to co-dominant; Polytrichum juniperinum and other moss species (e.g., Dicranum spp.) often present; vascular species are mostly annuals (Bromus diandrus (=Bromus rigidus), Vulpia bromoides (=Festuca bromoides), Aira caryophyllea, A. praecox) and limited to cracks and periphery of rock outcrops .....  
..... **RACCAN-(SELWAL), p. 72**
- Carex inops >25% near rock outcrops; shaded by adjacent trees;  
..... **CARINO-ERILAN, p. 35**

## Plant Community Descriptions

Plant association descriptions are alphabetized as they appear in the key within physiognomic category and by dominance type in forest associations. Each association description summary includes scientific name, common name, NatureServe code when present, acronym, selected national vegetation hierarchy, classification confidence, range in Washington, environmental features, U.S.F.W.S. wetland classification, vegetation description, state conservation rank, rank justification, comments, and plant association synonyms in previous classifications.

Plant association scientific name uses the naming conventions in the NVC (FDGC 2008). Plant species in the name are dominant (cover the greatest area) and diagnostic or differential (found consistently in some vegetation types but not others). At least one species from the dominant and/or uppermost stratum is included in each name. A hyphen ("-") indicates species occurring in the same stratum. A slash ("/") indicates species occurring in different strata. Species that occur in the uppermost stratum are listed first, followed successively by those in lower strata. Order of species names generally reflects decreasing levels of dominance, constancy, or indicator value.

The following terms are used to describe the distribution and abundance of individual species within each plant association.

Dominant – clearly the most abundant species in a well-developed stratum of vegetation

Co-dominant – one of two to four species that share dominance in a well-developed stratum of vegetation (usually percent cover is in the range of 5 or 10 to 50 percent)

Prominent – species has cover in the range of about 3 to 15 percent

Present – species found on plot with less than about 3 percent cover

Usually – more than 60% of the time or 60% of plots

Sometimes – 40-60% of the time

Occasionally – 10-40% of the time

Well-developed layer – stratum of vegetation typically >10% cover

The NatureServe Code indicates the current classification status of the association in the NatureServe NVC. That field includes the following:

1. Codes starting with CEGL appear on NatureServe (November 2008) explorer (<http://www.natureserve.org/explorer/index.htm>) and represent associations accepted as global associations.
2. Codes starting with PNW represent new associations and revisions to NatureServe from the coastal forests correlation project (Meidinger et al. 2005). Codes are assigned by NatureServe (2005).
3. "Preliminary" indicates associations that are usually represented by five or more plots and may appear in regional or state plant community classification literature. Some preliminary associations have less than five plots but are supported in the literature.
4. "Provisional" indicates a potential association that usually has fewer than five plots and no literature support. They represent known or likely cover and dominance types or low confidence plant associations. Provisional types are included in this report to provide a placeholder that is categorized in higher NVC hierarchy levels for mapping purposes.

Acronyms are plant association scientific names listed by the first three letters of the genus and the species. Acronyms cross-reference to the dichotomous key and to synthesis tables in Appendix C.

The national vegetation hierarchy levels in the description include Macrogroup, Group and Alliance. This is the first application of the 2008 NVC hierarchy (FGDC 2008) to a NPS classification and consequently, the hierarchical organization of the associations in this report is expected to change. The arrangement listed below reflects the hierarchical status developed by NatureServe and partners as of April 15, 2011. Future changes in the classification hierarchy will be available from NatureServe (<http://www.natureserve.org/explorer/index.htm>) as modified.

Synonym lists plant associations or plant community types with more, less, or equivalent concept. Full citations are in the Reference cited.

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***Quercus garryana* / *Symphoricarpos albus* / *Carex inops* Woodland Association**

Oregon White Oak / Snowberry / Long-stolon Sedge Association

**Acronym:** QUEGAR / SYMALB / CARINO

**NatureServe Code:** CEGL003358

**Macrogroup:** Californian-Vancouverian Foothill and Valley Forest & Woodland

**Group:** Californian-Vancouverian Deciduous Oak Woodland Group

**Alliance:** *Quercus garryana* Woodland

**Range:** This association occurs in the Gulf Islands and southeastern Vancouver Island, British Columbia, south in the Puget Lowland as far as Lewis County, Washington. It is concentrated primarily in the Gulf Islands, Vancouver Island, the San Juan Islands, and the southern Puget Sound area. It is very rare elsewhere.

**SAJH Distribution:** English Camp

**Plots:** SAJH (3); Chappell (2004)

**SAJH Distribution:** English Camp

**Environmental Description:** Sites occupied are relatively dry and range from deep, gravelly glacial outwash plains to soils that are shallow to bedrock. Prior to European settlement, this association was probably strongly influenced by anthropogenic fires, and sites occupied today may have had a very different species composition in the past. Fires helped maintain the dominance of oak over conifers, but also probably kept the shrub layer from dominating the understory on the sites where the type now exists. These sites are dry to very dry and appear to be relatively nutrient-rich. Most common on flats or sunny aspects (south to west), but does occur on other aspects as well.

**Vegetation Description:** This deciduous broad-leaved woodland or forest is dominated by *Quercus garryana* and frequently has significant amounts of the evergreen conifer *Pseudotsuga menziesii* (mean 8% cover when present) in the canopy or subcanopy. The understory is dominated by deciduous shrubs, mostly *Symphoricarpos albus* 0.5-1.0 m tall (mean 44% cover), with significant amounts of the taller *Amelanchier alnifolia*, *Oemleria cerasiformis*, or *Holodiscus discolor* often present. The graminoids *Carex inops*, *Poa pratensis* (exotic), *Melica subulata*, and *Elymus glaucus* are usually present in small to moderate amounts, with *Carex* more common in the south and *Melica* more common in the north. Other understory species often present include the short-shrubs *Mahonia aquifolium* and *Rubus ursinus*, and the forbs *Galium aparine* and *Lathyrus nevadensis*. Many other forbs occur less frequently. This association is distinguished from similar ones by >10% cover of *Symphoricarpos albus*, along with >1% cover of *Elymus glaucus* or *Carex inops*, combined cover of <1% for *Polystichum munitum*, *Circaea alpina*, *Maianthemum stellatum*, and *Claytonia sibirica*, and <25% cover of *Pseudotsuga menziesii*. *Arbutus menziesii* is prominent in one of the SAJH stands. No *Carex inops* was observed in the SAJH occurrences; however *Symphoricarpos albus* was consistently over 10% (although at times patchy). Although *Arrhenatherum elatius* dominates the herbaceous understory of the SAJH occurrences, *Elymus glaucus* was over 1% in two of the three stands. Other species prominent in the SAJH examples include *Juniperus maritima*, *Marah oregana*, *Galium aparine*, *Mahonia aquifolium*, and *Bromus carinatus*. In addition to *Arrhenatherum elatius*, numerous other nonnative species are present such as *Bromus diandrus*, *Hypochaeris radicata*, *Aira caryophylla*, *Poa pratensis*, and *Dactylis glomerata*.

**USFWS Wetland System:** Not applicable.

**Comments:** Most of the occurrences in SAJH are degraded, with very little *Carex inops* remaining. Nonnative grasses are abundant.

**Conservation Rank:** G2S2

**Rank Justification:** This woodland association is only known from the Puget Lowland of western Washington and the Georgia Basin of southwestern British Columbia at low elevations. There are probably 20-40 viable occurrences and a relatively small but unknown global acreage in a small range. It has been degraded and continues to decline in extent and condition through a combination of exotic species invasions, overgrazing, tree invasion with fire suppression, fragmentation, and residential conversion. There are now only a very small number of highly viable occurrences, and multiple threats continue in the very altered landscape in which it occurs.

**Synonyms:**

*Quercus garryana* / *Symphoricarpos* / *Carex inops*, Chappell and Crawford 1997  
Numerous community types from: Erickson 1996 and Erickson and Meidinger 2007  
*Quercus garryana* - *Erythronium*, Roemer 1972



***Pseudotsuga menziesii* - *Arbutus menziesii* / *Holodiscus discolor* Forest Association**

Douglas-fir - Madrone / Oceanspray Forest Association

**Acronym:** PSEMEN-ARBMEN/HOLDIS

**NatureServe Code:** PNWCOAST\_160

**Macrogroup:** Californian-Vancouverian Foothill and Valley Forest & Woodland

**Group:** Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest and Woodland Group

**Alliance:** *Pseudotsuga menziesii*-(*Arbutus menziesii*) Forest and Woodland

**Range:** Occurs primarily in the Olympic Mountains rainshadow, including San Juan and portions of Clallam, Jefferson, Island, Skagit, and Whatcom counties. Also occurs in King and southeastern Thurston counties and in southwestern BC.

**SAJH Distribution:** English Camp

**Plots:** SAJH (3); Chappell (2004)



**Environmental Description:** These sites are typically very dry (some of the driest sites that support forests in the ecoregion) and appear to be poor to medium in relative nutrient status. It is found most frequently on sunny slopes adjacent to saltwater. Soils are shallow to bedrock (outcrops often visible on plot), but also on glacial till, glacial outwash, and glacial drift sands. Usually found on moderate to steep slopes, especially southwestern aspects. More frequent in dry climatic areas (Olympic Mountains rainshadow).

**Vegetation Description:** Stands are dominated or co-dominated by *Arbutus menziesii* and *Pseudotsuga menziesii*. *Arbutus menziesii* often forms a subcanopy below taller Douglas-fir. *Holodiscus discolor*, *Lonicera hispida*, and *Symphoricarpos albus* are usually present and often prominent to co-dominant. *Rosa gymnocarpa* and *Festuca occidentalis* are usually prominent. The latter may dominate in heavily browsed stands. *Mahonia aquifolium*, *Lonicera ciliosa*, and *Elymus glauca* are also frequent. Several forbs may be present but usually not in very large amounts.

**USFWS Wetland System:** Not applicable.

**Comments:** At SAJH, this type is only found at English Camp and is located near rock outcrops or where soils are very thin. It is often found adjacent to balds or the *Pseudotsuga menziesii*/*Holodiscus discolor*-*Rosa gymnocarpa*/*Festuca occidentalis* Forest.

**Conservation Rank:** G2G3S2?

**Rank Justification:** There are estimated to be no more than 25 relatively high quality occurrences (13 currently known). Most examples are small, or degraded by development, logging, or non-native plant species. Development, non-native species, and fungal diseases are threats. Most examples are small, or degraded by development, logging, or non-native plant species. Development, non-native species, and fungal diseases are threats.

**Synonyms:**

*Arbutus menziesii*-*Pseudotsuga menziesii*; Romer 1972

*Pseudotsuga menziesii*-*Arbutus menziesii*-*Vicia americana*; Fonda and Bernardi 1976

*Pseudotsuga menziesii*-*Arbutus menziesii*-*Lonicera hispida*; Chappell, 1997 and Chappell and Giglio 1999

*Pseudotsuga menziesii*-*Arbutus menziesii*/ *Holodiscus discolor*-*Lonicera hispida*; Chappell 2006b

***Pseudotsuga menziesii* / *Gaultheria shallon* - *Holodiscus discolor* Forest Association**

Douglas-fir / Salal -Oceanspray Forest Association

**Acronym:** PSEMEN/GAUSHA-HOLDIS

**NatureServe Code:** CEG000436

**Macrogroup:** Californian-Vancouverian Foothill and Valley Forest & Woodland

**Group:** Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest and Woodland Group

**Alliance:** *Pseudotsuga menziesii*-(*Arbutus menziesii*) Forest and Woodland

**Range:** This association occurs in the eastern and northeastern Olympic Mountains and the adjacent Puget Lowlands.

**SAJH Distribution:** English Camp

**Plots:** SAJH (1); Chappell (2004); Crawford et al. (2009)

**Environmental Description:** This association occurs at low to middle elevations in dry climatic areas within the Olympic Mountains' rainshadow. Aspects are more commonly south to west. The association occurs most frequently on soils that are relatively shallow such as on glacial outwash, glacial till, other parent materials with high gravel or stone content, and/or on bedrock.

**Vegetation Description:** Stands are dominated by *Pseudotsuga menziesii* with little to no *Tsuga heterophylla* or *Thuja plicata*. *Arbutus menziesii* can be prominent. The understory is dominated by *Gaultheria shallon*. *Holodiscus discolor* can be abundant and is diagnostic in the Olympic Mountains. *Polystichum munitum* may be present, but always with under 5% cover. Other frequently occurring species are *Festuca occidentalis*, *Rosa gymnocarpa*, *Rubus ursinus*, and *Mahonia* (= *Berberis*) *nervosa*.

**USFWS Wetland System:** Not applicable.

**Comments:** Only one stand of this type was located at SAJH (English Camp.)

**Conservation Rank:** S2

**Rank Justification:** Few occurrences of relatively good quality remain. Most examples have been altered by past timber harvest.

**Synonyms:**

Mixed Coniferous Forest; Rust 1992

*Pseudotsuga menziesii*/*Gaultheria shallon* Community; Fonda and Bernardi 1976

*Pseudotsuga menziesii*/*Gaultheria shallon*-*Holodiscus discolor*; Chappell 2006b

*Pseudotsuga menziesii*/*Gaultheria shallon*-*Holodiscus discolor* Association; Chappell 1997

*Pseudotsuga menziesii*/*Gaultheria shallon*-*Holodiscus discolor* Forest; Chappell 2001

*Pseudotsuga menziesii*/*Gaultheria shallon*-*Vaccinium ovatum* Association; Chappell 1997



***Pseudotsuga menziesii* / *Holodiscus discolor* - *Rosa gymnocarpa* / *Festuca occidentalis* Forest Association**

Douglas-fir / Oceanspray-Baldhip Rose / Western Fescue Forest Association

**Acronym:** PSEMEN/HOLDIS-ROSGYM/FESOCC

**NatureServe Code:** CEGLO00456

**Macrogroup:** Californian-Vancouverian Foothill and Valley Forest & Woodland

**Group:** Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest and Woodland Group

**Alliance:** *Pseudotsuga menziesii*-(*Arbutus menziesii*) Forest and Woodland

**Range:** This association occurs below 180 m (600 feet) elevation primarily in the northern portion of the Puget Lowland, Washington (Clallam, Jefferson, San Juan, Island, Skagit), and in the Gulf Islands (and possibly southeastern Vancouver Island), and very rarely in the southern Puget Lowland.

**SAJH Distribution:** American Camp, English Camp, Mitchell Hill

**Plots:** SAJH (2); Chappell (2004); Crawford et al. (2009)

**Environmental Description:** This association occurs at low to middle elevations on steep slopes or upper slope positions with southerly aspects. Sites have shallow or very rocky, well-drained soils. Topographic positions are dry.

**Vegetation Description:** This forest, or occasionally woodland, is dominated by *Pseudotsuga menziesii*. A variable-density tall-shrub layer (2-6 m tall) is usually present and is dominated by *Holodiscus discolor*. Occasionally *Acer circinatum* or *A. glabrum* is prominent. *Taxus brevifolia* can be abundant and character species may be sparsely represented in some examples of this association. Shorter shrubs are also variable in their cover and always include *Rosa gymnocarpa*. *Mahonia* (= *Berberis*) *nervosa* and *M. aquifolium* are usually present, the former sometimes co-dominant. *Symphoricarpos hesperius* (= *mollis*) is frequent and sometimes prominent in the Olympics. The herb layer is typically dominated by short grasses, especially *Festuca occidentalis*, *Festuca subuliflora*, and *Melica subulata*. Other frequent herbs include *Achlys* (*californica*, *triphyllo*), *Bromus vulgaris*, *Osmorhiza berteroi*, *Pteridium aquilinum*, *Rubus ursinus*, *Adenocaulon bicolor*, *Fragaria vesca*, *Linnaea borealis*, and *Trientalis borealis* ssp. *latifolia*. *Polystichum munitum* is frequently present but never prominent.

**USFWS Wetland System:** Not applicable.

**Comments:** This is one of the most common forest types at SAJH. It is very abundant at English Camp and Mitchell Hill and found on the north side of Mt. Finlayson at American Camp.

**Conservation Rank:** G2G3S2

**Rank Justification:** This association has a restricted geographic range and relatively specific environmental range. Few occurrences not significantly altered by past timber harvest are known in the lowlands. Lower foothill occurrences are less disturbed and more abundant.

**Synonyms:**

Forested Rock Outcrop; Rust 1992

*Pseudotsuga menziesii*/*Holodiscus discolor*/*Melica subulata* Association; Chappell 1997

*Pseudotsuga menziesii*/*Holodiscus discolor*-*Rosa gymnocarpa* Association; Henderson et al. 1989

*Pseudotsuga menziesii*/*Holodiscus discolor*-*Rosa gymnocarpa*-NWW; Henderson et al. 1989

*Pseudotsuga menziesii*/*Holodiscus discolor*-*Rosa gymnocarpa*-WA; Chappell 2006b

*Pseudotsuga menziesii*/*Rosa gymnocarpa*/*Festuca occidentalis* Association; Chappell 1997

*Pseudotsuga menziesii*-*Arbutus menziesii*/*Holodiscus discolor*-*Symphoricarpos albus*, Agee 1987 (<->)



## ***Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest Association**

Douglas-fir / Common Snowberry - Oceanspray Forest Association

**Acronym:** PSEMEN/SYMALB-HOLDIS

**NatureServe Code:** CEGLO00460

**Macrogroup:** Californian-Vancouverian Foothill and Valley Forest & Woodland

**Group:** Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest and Woodland Group

**Alliance:** *Pseudotsuga menziesii*-(*Arbutus menziesii*) Forest and Woodland

**Range:** This association occurs primarily in the northern Puget Sound basin, an area in the rainshadow of the Olympic Mountains.

**SAJH Distribution:** American Camp

**Plots:** SAJH (3); Chappell (2004)

**Environmental Description:** The climate in this rainshadow is drier than surrounding coastal mountain areas, with average annual precipitation ranging from as low as 46 cm in the San Juan Islands to 75 cm in the Puget lowlands, with a pronounced summer dry season. Temperatures are strongly moderated by oceanic influence. This association occurs on flat or gently sloping sites, generally below 155 feet elevation, and often only a few meters above sea level. Less commonly it occurs on mid to upper convex slopes, where topographic moisture is limited. Soils are derived from glacial deposits or bedrock, well-drained, and texturally are loamy sands to sandy loams, with weakly developed profiles. Glacial till deposits are sometimes quite shallow and overlay bedrock which is exposed in places.

**Vegetation Description:** This is a forest association dominated by the tall needle-leaved evergreen tree *Pseudotsuga menziesii*. Very occasionally, the conifers *Abies grandis* or *Thuja plicata* occur in the canopy or suppressed in the understory. Other trees may include the broad-leaved evergreen *Arbutus menziesii*. The understory is primarily composed of a 1- to 3-m tall shrub layer of broad-leaved deciduous species. The tall shrub *Holodiscus discolor* averages 44% cover, while the short shrubs *Symphoricarpos albus* and *Rosa gymnocarpa* codominate the lower shrub layer, with average covers of 19% and 11%, respectively. The herbaceous layer ranges from sparse to moderate in cover, with a mix of perennial grasses and forbs. Grasses typically present include *Festuca occidentalis*, *Bromus vulgaris*, and *Melica subulata*, and the forbs *Trientalis borealis* ssp. *latifolia* and *Clinopodium douglasii* (= *Satureja douglasii*). Moss cover varies, but can be moderate in some stands. A well-developed tall-shrub layer 2-6 m tall is dominated by *Holodiscus discolor*. A shrub layer 0.5-1.5 m tall is dominated by *Symphoricarpos albus* and to a lesser extent *Rosa gymnocarpa*. An often diverse herbaceous layer usually has *Bromus vulgaris*, *Festuca occidentalis*, *Melica subulata*, *Galium aparine*, *Fragaria vesca*, *Clinopodium douglasii* (= *Satureja douglasii*), *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Sanicula crassicaulis*, and *Trientalis borealis* ssp. *latifolia* (= *Trientalis latifolia*). This association typically occurs on moderately dry sites, usually on glacial drift, and mostly in a very dry climatic zone where annual precipitation is less than 30 inches. This association is distinguished from similar ones by >10% cover of *Symphoricarpos albus*, combined with <10% cover of *Gaultheria shallon*, *Tsuga heterophylla*, *Thuja plicata*, and *Abies grandis*, <20% cover of *Arbutus menziesii*, and <5% cover of *Polystichum munitum*.

**USFWS Wetland System:** Not applicable.

**Comments:** G1S1

**Rank Justification:** This community has a restricted natural range in the rainshadow of the Olympic Mountains of Washington and occurs in a very specific environment. There are a few occurrences that occupy a small total acreage. Very few of the occurrences are good quality because of logging and fragmentation. There has been significant decline in the area of this community due to conversion to development and agriculture. Threats continue especially in the form of development and fragmentation.

### **Synonyms:**

*Pseudotsuga menziesii* / *Symphoricarpos albus*, Fonda and Bernardi 1976

*Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor*, Chappell 1997

*Pseudotsuga menziesii* - (*Abies grandis*)/ *Symphoricarpos albus* - *Holodiscus discolor*, Chappell 2001

*Pseudotsuga menziesii*-*Arbutus menziesii*/*Holodiscus discolor*-*Symphoricarpos albus*, Agee 1987 (<=>)

*Pseudotsuga menziesii* - *Pinus contorta* ssp. *contorta* / *Holodiscus discolor* - *Symphoricarpos albus*, Agee 1987 (<=>)



***Pseudotsuga menziesii* - *Abies grandis* / *Gaultheria shallon* - *Holodiscus discolor* Forest Association**

Douglas-fir - Grand Fir / Salal - Oceanspray Forest Association

**Acronym:** PSEMEN-ABRGRA/GAUSHA-HOLDIS

**NatureServe Code:** PNWCOAST\_152

**Macrogroup:** Vancouverian Lowland & Montane Rainforest Macrogroup

**Group:** North Pacific Maritime Douglas-fir - Western Hemlock Forest Group

**Alliance:** *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest

**Range:** In Washington, this association occurs in the San Juan Islands, islands in western Skagit County, northern and central Whidbey Island, and possibly the far northeastern Olympic Peninsula. It probably also occurs in adjacent British Columbia on the Gulf Islands and southeastern Vancouver Island, but is recognized as part of a broader unit there.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (0); Chappell (2004)

**Environmental Description:** This association is limited to dry climatic areas and occurs on moderately dry and relatively nutrient-poor sites. Most stands are within 1 mile of saltwater shorelines. Slopes are usually gentle and occasionally moderate in steepness. Aspect is variable. The association is often found on parent materials consisting of glacial till but also includes glacial drift without a restrictive layer. Stony or gravelly loams are the most typical soil types. Fire is the primary natural disturbance. Old-growth stands show evidence of past low- to moderate-severity fire.

**Vegetation Description:** *Pseudotsuga menziesii* dominates the upper canopy. *Abies grandis* can be a co-dominant. *A. grandis* dominates tree regeneration or a lower canopy layer. *Picea sitchensis* is occasionally prominent. *Thuja plicata* is sometimes present in small amounts. *Gaultheria shallon* dominates the understory while *Holodiscus discolor* usually forms a prominent to co-dominant tall shrub layer. *Rosa gymnocarpa* and *Rubus ursinus* are usually present. The herb layer is poorly developed. *Festuca occidentalis*, *Pteridium aquilinum* var. *pubescens*, and *Polystichum munitum* are usually present in small amounts. The absence of fire results in *Abies grandis* increasing and *Pseudotsuga menziesii* decreasing, although *P. menziesii* still remains prominent after hundreds of years. Some of these stands may have been *P. menziesii* savannas prior to fire suppression. Depending on seed sources, *Arbutus menziesii* or *Pinus contorta* ssp. *contorta* could regenerate abundantly on these sites after a major disturbance and persist until sometime in the middle of the sere.

**USFWS Wetland System:** Not applicable.

**Comments:** Within SAJH, this association is concentrated west of West Valley road down to the English Camp parking lot. It is also found on the north side of Mount Finlayson at American Camp.

**Conservation Rank:** GNR51.

**Rank Justification:** There are less than five high-quality occurrences known in Washington. Most occurrences have been displaced or degraded by development. The vast majority of extant stands have been significantly impacted by past timber harvest. Development is an ongoing threat. The type has a limited geographic range.

**Synonyms:**

*Pseudotsuga menziesii* - *Thuja plicata* / *Gaultheria shallon* - *Holodiscus discolor*, Chappell 1997

*Pseudotsuga menziesii* - *Abies grandis* / *Gaultheria shallon*, Chappell 2006b

*Pseudotsuga menziesii* - *Arbutus menziesii* / *Holodiscus discolor* - *Symphoricarpos albus*, Agee 1987 (<>)

*Pseudotsuga menziesii* - *Abies grandis* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor*, Agee 1987 (<>)





***Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* / *Melica sublata* Forest Association**

Douglas-fir - Grand Fir / Oceanspray / Alaska Oniongrass Forest Association

**Acronym:** PSEMEN-ABRGRA/HOLDIS/MELSUB

**NatureServe Code:** PNWCOAST\_153

**Macrogroup:** Californian - Vancouverian Foothill and Valley Forest & Woodland

**Group:** North Pacific Maritime Douglas-fir - Western Hemlock Forest Group

**Alliance:** *Tsuga heterophylla* - *Pseudotsuga menziesii* / (*Holodiscus discolor*) Forest

**Range:** Known only from San Juan County.

**SAJH Distribution:** English Camp

**Plots:** SAJH (1); Chappell (2004)

**Environmental Description:** This association is limited to dry climatic areas and occurs on dry sites which appear to be poor to medium in nutrients. It is most commonly found on upper, gentle to moderate slopes. Parent materials are glacial till or residuum. Soils are likely to be somewhat shallow.



**Vegetation Description:** *Pseudotsuga menziesii* dominates the upper canopy. *Abies grandis* is always present and often dominates tree regeneration. *Pseudotsuga menziesii* can also be numerous. The shrub layer is usually sparse to moderate in density. *Rosa gymnocarpa* and *Lonicera hispidula* are always present and *Holodiscus discolor*, *Rubus ursinus*, and *Symphoricarpos albus* are common. *Festuca occidentalis* and *Melica subulata* are usually prominent to co-dominant. *Festuca occidentalis* is always present. *Trientalis borealis* ssp. *latifolia* (occasionally prominent), *Bromus vulgaris*, *Galium aparine*, *G. triflorum*, *Osmorhiza berteroi*, *Pteridium aquilinum* var. *pubescens* (occasionally prominent), *Polystichum munitum*, and *Goodyera oblongifolia* are usually present. Fire is the primary natural disturbance. *Abies grandis* is expected to increase over time in the absence of disturbance. Evidence suggests that many of these stands were *Pseudotsuga menziesii* savannas prior to fire suppression and have increased dramatically in tree density since pre-Western settlement.

**USFWS Wetland System:** Not applicable.

**Comments:** At SAJH, this plant association is found at English Camp, northwest of the parade ground that sits on the shores of Garrison Bay.

**Conservation Rank:** G1S1

**Rank Justification:** There are very few good condition occurrences and the association occupies small areas and a small geographic range. Though it is rare and local, this type may be more common than it was during the pre-Western settlement era because of increases in area due to fire suppression and succession.

**Synonyms:**

*Pseudotsuga menziesii* - *Abies grandis* / *Festuca occidentalis*, Chappell 2006b

*Pseudotsuga menziesii*-*Abies grandis*-*Tsuga heterophylla*/*Gaultheria shallon*-*Holodiscus discolor*, Agee 1987 (<>)

## ***Thuja plicata* - *Abies grandis* / *Polystichum munitum* Forest Association**

Western Redcedar - Grand fir / Swordfern Forest Association

**Acronym:** THUPLI-ABGGRA/POLMUN

**NatureServe Code:** CEGLO00468

**Macrogroup:** Vancouverian Lowland and Montane Rainforest

**Group:** North Pacific Maritime Western Red-cedar-Western Hemlock Forest

**Alliance:** *Thuja plicata* - (*Abies grandis*) Maritime Forest

**Range:** In Washington this association is known to occur only in San Juan, western Skagit, and far eastern Clallam (Sequim area) counties. It is possible in northern Island and northeastern Jefferson counties. It also occurs in adjacent British Columbia on the Gulf Islands and southeastern Vancouver Island.

**SAJH Distribution:** American Camp, Mitchell Hill

**Plots:** SAJH (3); Chappell (2004)



**Environmental Description:** Stands of this association are relatively small and are restricted to moderately moist sites within the dry climatic conditions of the northern Puget Trough (i.e. the rainshadow of the Olympic Mountains and Vancouver Island.) The climate is drier than surrounding coastal mountain areas, with average annual precipitation ranging from as low as 46 cm in the San Juan Islands to 90 cm in the Puget Lowlands, with a pronounced summer dry season. Valleys where these forests are found are protected from the dry summer winds and have relatively low summer temperatures. Soils are loamy sands to sandy loams, with weakly developed profiles, and soil moisture is high most of the year.

**Vegetation Description:** These tall conifer forests are dominated by *Thuja plicata* and *Abies grandis*. *Pseudotsuga menziesii* is often present as scattered large individuals in the upper canopy, and may be codominant in some stands, but is never regenerating. *Tsuga heterophylla* is occasionally present with low cover. Tree regeneration is relatively sparse, with the dominant trees each averaging 64 saplings and seedlings per hectare. Stands that have been disturbed by logging often have an abundant tree subcanopy and shrubby layer of the seral, broad-leaved deciduous trees *Acer macrophyllum* and *Alnus rubra*. These deciduous species are not present in undisturbed stands. The understory is strongly dominated by the perennial fern *Polystichum munitum*, which averages 43% cover and often the fronds have a 2-m spread. Scattered individuals of several shrub species also occur, such as *Symphoricarpos albus* and *Vaccinium parvifolium*, but none have greater than 2% cover. Mosses are abundant on logs and average 15% cover. Diagnostic of this forest association is the dominance of *Thuja plicata* and *Abies grandis* in the tree canopy and *Polystichum munitum* in the understory.

**USFWS Wetland System:** Not applicable.

**Comments:** This is the moistest upland forest type at San Juan National Historical Park. It is relatively abundant within the Mitchell Hill tract and is also found in the convex portions of the north slopes of Mount Finlayson at American Camp.

**Conservation Rank:** G1G2 S1

**Rank Justification:** This association has a restricted natural range within the rainshadow of the Olympic Mountains and Vancouver Island and occurs in a very specific environment. It was probably never common. There are few occurrences and they occupy a small acreage. Very few of the occurrences are good quality because of logging and fragmentation. There has been significant decline in the area of this community due to conversion to development and agriculture.

**Synonyms:**

*Thuja plicata* - *Abies grandis* / *Polystichum munitum* Fonda and Bernardi 1976

*Thuja plicata* - *Abies grandis* / *Polystichum munitum* Chappell 1997

*Thuja plicata* - *Abies grandis* / *Polystichum munitum* Chappell 2006b

*Pseudotsuga menziesii*-*Abies grandis*-*Tsuga heterophylla*/*Polystichum munitum*, Agee 1987 (<>)

### ***Thuja plicata* / *Gaultheria shallon* Forest Association**

Western Redcedar / Salal Forest Association

**Acronym:** THUPLI/GAUSHA

**NatureServe Code:** CEGLO00475

**Macrogroup:** Vancouverian Lowland and Montane Rainforest

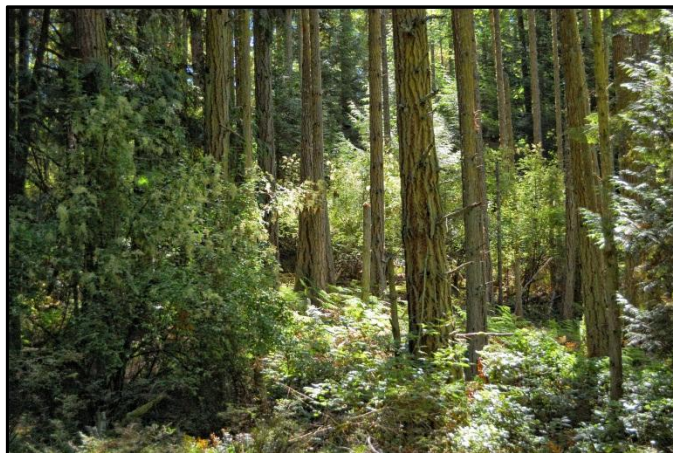
**Group:** North Pacific Maritime Western Red-cedar-Western Hemlock Forest

**Alliance:** *Thuja plicata* - (*Abies grandis*) Maritime Forest

**Range:** In Washington, this association occurs only in the Olympic rainshadow area of San Juan, western Skagit, western Whatcom, eastern Clallam, northeastern Jefferson, and central to northern Island counties. It also occurs in adjacent British Columbia on the Gulf Islands and southeastern Vancouver Island.

**SAJH Distribution:** English Camp, Mitchell Hill

**Plots:** SAJH (4); Chappell (2004)



**Environmental Description:** The rainshadow climate is drier than surrounding coastal mountain areas, with average annual precipitation ranging from as low as 46 cm in the San Juan Islands to 75 cm in the Puget lowlands, with a pronounced summer dry season. Temperatures are strongly moderated by oceanic influence. This association occurs primarily on north-facing slopes of the San Juan Islands, and on easterly slopes of the Olympics. These sites are moderately dry to mesic and appear to be relatively nutrient-poor. Sites are typically gently to moderately sloping. Aspect is more often northerly or easterly. Mid to upper slopes are most frequent. In these sheltered sites, winds are slight, temperatures are cooler, and summer soil moisture is higher. Soils are derived from glacial till or residuum, but also include colluvium and glacial outwash, and are well-drained, and texturally are loamy sands to sandy loams, with weakly developed profiles. Elevations are less than 215 m.

**Vegetation Description:** This is an evergreen needle-leaved tall forest dominated by *Thuja plicata*, *Abies grandis*, and/or *Pseudotsuga menziesii*. *Abies grandis* is present in 83% of stands, and *Thuja plicata* in 61% of stands. If the conifer *Tsuga heterophylla* is present, it has less than 5% cover. The broad-leaved deciduous tree *Salix scouleriana* is often present in the lower canopy with low cover, along with the needle-leaved evergreen *Taxus brevifolia*. Tree regeneration is dominated by *Thuja plicata* or *Abies grandis*. The dense shade of the canopy results in a patchy and sometimes open understory typically lacking an herbaceous layer. However, *Polystichum munitum* is usually present in small amounts (<5% cover). The low broad-leaved evergreen shrub *Gaultheria shallon* dominates the understory averaging 48% cover. The tall broad-leaved deciduous shrub *Holodiscus discolor* may be codominant in some stands, and averages 11% cover. Other shrubs may be present, such as the low evergreen *Mahonia nervosa*.

**USFWS Wetland System:** Not applicable.

**Comments:** This association is one of the moistest upland forest types in San Juan National Historical Park. It is most abundant within the Mitchell Hill tract and English Camp. A few stands occur on the north side of Mount Finlayson at American Camp.

**Conservation Rank:** G1G2 S1

**Rank Justification:** This community has a restricted natural range in the rainshadow of the Olympic Mountains and Vancouver Island and occurs in a specific environment. Very few good-quality occurrences remain because of logging and fragmentation. There are only 8 high-quality occurrences known in Washington. There has been significant decline in the area of this community due to conversion to development and agriculture, with development threats continuing currently. The vast majority of stands have been significantly impacted by past timber harvest.

**Synonyms:**

*Thuja plicata* - *Pseudotsuga menziesii* / *Gaultheria shallon*, Fonda and Bernardi 1976

*Pseudotsuga menziesii* - *Thuja plicata* / *Gaultheria shallon* - *Holodiscus discolor*, Chappell 1997

*Pseudotsuga menziesii* - *Thuja plicata* - (*Abies grandis*) / *Gaultheria shallon*, Chappell 2006b

*Pseudotsuga menziesii* - *Abies grandis* - *Tsuga heterophylla*/*Gaultheria shallon* - *Holodiscus discolor*, Agee 1987 (<>)

## ***Acer macrophyllum*-(*Pseudotsuga menziesii*) Forest Alliance**

Bigleaf Maple - (Douglas-fir) Forest Alliance

**Acronym:** ACEMAC-(PSEMEN)

**NatureServe Code:** A.NCCN-019

**Macrogroup:** Vancouverian Lowland and Montane Rainforest

**Group:** North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest

**Alliance:** *Acer macrophyllum*-(*Pseudotsuga menziesii*) Forest

**Range:** This alliance occurs along the Pacific Coast from southwestern Oregon to northwestern Washington, and into the lowland valleys of the Puget Trough and Willamette Valley. In SAJH, it is found in a few disturbed locations.

**SAJH Distribution:** English Camp, Mitchell Hill

**Plots:** SAJH (2); Chappell (2004)

**Environmental Description:** This maritime-influenced region receives annual precipitation ranging from 75-400 cm, mostly as winter rain. Vegetation within this alliance usually occurs along low-elevation (0-1000 m) valley slopes and lower mountain slopes, often forming a seral community in moist coniferous forests. Small-patch (<2 acres) deciduous forests at low elevations (<1000m), often surrounded by coniferous forest, on landslides and other steep slopes, common in cleared forests near human development and on the edges of farm fields and pastures.

**Vegetation Description:** This alliance is usually found within *Tsuga heterophylla* - *Thuja plicata* forests, but also grows within *Pseudotsuga menziesii* forests. This mix of deciduous and evergreen trees, dominated by *Acer macrophyllum* and *Pseudotsuga menziesii*, occurs on sites that were burned or on old hillslope landslides or inactive debris aprons. Soils can be rocky. This alliance is also common in cleared forests near human development and on the edges of farm fields and pastures. Communities within this alliance may represent early seral communities within the major coniferous forests of the region, which have been favored by past logging or other disturbances. Communities are usually strongly dominated by *Acer macrophyllum*, which forms a diffuse canopy. Some conifers, such as *Pseudotsuga menziesii*, *Tsuga heterophylla*, *Thuja plicata*, *Picea sitchensis*, or *Abies grandis*, may be present and can usually be found growing in the understory or as occasional canopy trees. Deciduous trees, such as *Alnus rubra*, *Cornus nuttallii*, and *Betula papyrifera* (which is sometimes codominant in northwestern Washington), may also be present in the tree stratum. The forest understory is usually species-rich and well-developed compared to adjacent conifer forests in the same area. Common shrub species in stands of this alliance include *Acer circinatum* (which is always present), *Sambucus racemosa* var. *melanocarpa*, *Rubus spectabilis*, *Rubus parviflorus*, *Gaultheria shallon*, *Vaccinium membranaceum*, and *Mahonia nervosa*. The herbaceous layer is often well-developed, with ferns being the most important component. Species include *Polystichum munitum*, *Athyrium filix-femina*, and *Pteridium aquilinum*.

**USFWS Wetland System:** Not applicable.

**Comments:**

**Conservation Rank:** Not applicable.

**Rank Justification:** This association is associated with past disturbances.

**Synonyms:**



## ***Alnus rubra* / *Polystichum munitum* Forest Association**

Red Alder / Swordfern Forest Association

**Acronym:** ALNRUB/POLMUN

**NatureServe Code:** CEGLO00638

**Macrogroup:** Vancouverian Lowland and Montane Rainforest

**Group:** North Pacific Red Alder-Bigleaf Maple-Doug fir Forest

**Alliance:** *Alnus rubra*-(*Picea sitchensis*-*Tsuga heterophylla*) Forest and Woodland

**Range:** This association is described from the Puget Lowlands, Mount Rainier and the Olympic Mountains.

**SAJH Distribution:** English Camp

**Plots:** SAJH (3); Crawford et al. (2009)

**Environmental Description:** This association occurs on upland slopes (varying steepness) usually with mesic, well-drained soils. It is not associated with riparian landforms, rather it is result of succession after fires, logging, landslides or slope failures.



**Vegetation Description:** This forest association is dominated by *Alnus rubra*. The herb layer is always dominated by *Polystichum munitum*. Other frequently occurring species include *Claytonia* (= *Montia*) *sibirica*, *Athyrium filix-femina*, *Anaphalis margaritacea*, and *Tellima grandiflora*. If present, a well-developed shrub layer is usually dominated by *Rubus spectabilis*.

**USFWS Wetland System:** Not applicable.

**Comments:** Only two occurrences of this association occur at SAJH and are located at English Camp.

**Conservation Rank:** G4S4

**Rank Justification:** This association occurs in a wide range and is associated with past disturbances.

**Synonyms:**

*Alnus rubra*/*Polystichum munitum*; Chappell 2006b Puget, Chappell 2001

*Alnus rubra*/*Polystichum munitum*-*Pteridium aquilinum*/*Eurynchium oregonum* Community Type; del Moral and Long 1977

*Alnus rubra*-*Tsuga heterophylla*/*Polystichum munitum* Community; Agee 1987

### ***Alnus rubra* - *Pseudotsuga menziesii* Ruderal Forest Association**

Red Alder - Douglas-fir Provisional Ruderal Forest Association

**Acronym:** ALNRUB-PSEMEN Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Forest & Plantation

**Group:** Vancouverian Ruderal Forest and Plantation

**Alliance:** *Pseudotsuga menziesii* - (*Alnus rubra*) / *Schedonorus phoenix* Ruderal Forest Alliance

**Range:** This alliance is likely widespread throughout western Washington.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (9)

**Environmental Description:** This ruderal association mostly found on previously plowed sites. A few stands near the south end of English Camp may not have been plowed although they appear to have been heavily disturbed from historical logging.

**Vegetation Description:** Composition is predominantly native species, however they reflect a novel type of associates with no natural analogue. Mostly young *Pseudotsuga menziesii* and *Alnus rubra* trees are present in the overstory. *Pinus contorta* ssp. *contorta* and *Thuja plicata* are occasionally present. *Rubus ursinus*, *R. spectabilis*, *Symphoricarpos albus*, and *Crataegus monogyna* are almost always present in the shrub layer. The herbaceous understory is variable and includes *Agrostis stolonifera*, *Schedonorus phoenix*, *Galium aparine*, *Bromus vulgaris*, *Polysticum munitum*, *Elymus glaucus*, and *Dactylis glomerata*.

**USFWS Wetland System:** Not applicable.

**Comments:**

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Alnus rubra* - *Pseudotsuga menziesii* / *Symphoricarpos albus*, Agee 1987 (><)



***Pseudotsuga menziesii* / Nonnative Grasses Provisional Ruderal Forest Association**

Douglas-fir - Nonnative Grasses Provisional Ruderal Forest Association

**Acronym:** PSEMEN/Nonnative Grasses Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Forest & Plantation

**Group:** Vancouverian Ruderal Forest and Plantation

**Alliance:** *Pseudotsuga menziesii* - (*Alnus rubra*) / *Schedonorus phoenix* Ruderal Forest Alliance

**Range:** Most likely limited to dry climatic areas within western Washington and southern British Columbia.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (3)

**Environmental Description:** This ruderal type occurs in areas which were previously plowed and dominated by nonnative grasses and are now experiencing invasion of *Pseudotsuga menziesii*.



**Vegetation Description:** Young and sapling *Pseudotsuga menziesii* occurs sporadically. *Pinus contorta* ssp. *contorta* and *Abies grandis* are also present in some stands. This type varies from the *Pseudotsuga menziesii* - *Pinus contorta* ssp. *contorta* Provisional Ruderal Alliance in that tree density is much less, *Pinus contorta* ssp. *contorta* is less prominent, and nonnative grasses are more important. Shrubs include *Rubus ursinus* and *R. armeniacus*. Nonnative grasses include *Holcus lanatus*, *Agrostis capillaris*, *Poa pratensis*, *Schedonorus phoenix*, and *Elymus repens*. Native species such as *Pteridium aquilinum*, *Bromus vulgaris*, and *Polystichum munitum* are occasionally present.

**USFWS Wetland System:** Not applicable.

**Comments:** Within SAJH, this type is found in previously plowed areas in the northwest corner of English Camp and at American Camp. Some occurrences at American Camp were planted.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland w/ tree regeneration, Agee 1987 (<>)

Mesic Grassland w/ shrubs and tree regeneration, Agee 1987 (<>)

Xeric Grassland with Shrub Islands, Agee 1987 (<>)

***Pseudotsuga menziesii* - *Pinus contorta* ssp. *contorta* Provisional Ruderal Forest Association**

Douglas-fir - Lodgepole Pine Provisional Ruderal Forest Association

**Acronym:** PSEMEN-PINCON Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Forest & Plantation

**Group:** Vancouverian Ruderal Forest and Plantation

**Alliance:** *Pseudotsuga menziesii* - (*Alnus rubra*) / *Schedonorus phoenix* Ruderal Forest Alliance

**Range:** Most likely limited to dry climatic areas within western Washington and southern British Columbia.

**SAJH Distribution:** American Camp

**Plots:** SAJH (3)

**Environmental Description:** This ruderal type occurs on rocky or shallow soil sites which have experience prior disturbance. Some areas were previously plowed while others appear to have been logged and cleared of rocks for cultivation but were unlikely to have been tilled for any great length of time.



**Vegetation Description:** *Pseudotsuga menziesii* and *Pinus contorta* ssp. *contorta* are always present and dominate the canopy. *Alnus rubra* is sometime present. *Abies grandis* is also sometimes found regenerating. Agee (1987) notes that most stands are 60-80 years old. *Crataegus monogyna*, *Rubus ursinus*, *Symphoricarpos albus*, and *Rosa nutkana* are typical shrub species. *Bromus carinatus*, *B. vulgaris*, *Poa pratensis*, and *Schedonorus phoenix* (= *Festuca arundinacea*) are typical herbaceous species. Some stands are too dense to support a substantial understory.

**USFWS Wetland System:** Not applicable.

**Comments:** At SAJH, this type is only found in the northwest corner of American Camp.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Pseudotsuga menziesii* - *Pinus contorta* ssp. *contorta* / *Holodiscus discolor* - *Symphoricarpos albus*, Agee 1987 (<->)



## ***Acer macrophyllum* / *Rubus spectabilis* Forest Association**

Bigleaf Maple / Salmonberry Forest Association

**Acronym:** ACEMAC/RUBSPE

**NatureServe Code:** CEG000561

**Macrogroup:** Vancouverian Flooded & Swamp Forest Forest

**Group:** North Pacific Lowland Riparian Forest and Woodland

**Alliance:** (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance

**Range:** This association occurs in the Cascade and Olympic Mountains.

**SAJH Distribution:** Mitchell Hill

**Plots:** SAJH (1); Crawford et al. (2009)

**Environmental Description:** This low elevation to foothill association appears mostly on riparian floodplains, terraces or moist soils (seeps). It can occur on moist upland sites as early seral vegetation.

**Vegetation Description:** This closed broadleaf forest is dominated by *Acer macrophyllum* with occasional *Alnus rubra*. *Picea sitchensis*, *Tsuga heterophylla* and *Thuja plicata* can be present to prominent but in aggregate never exceeds broadleaf tree cover. *Rubus spectabilis* and/or *Ribes bracteosum* dominates the shrub understory with few other shrub species present. However, *Acer circinatum* can form an upper tall-shrub layer. *Polystichum munitum* and *Tolmiea menziesii* can be prominent to dominant in the herb layer. *Claytonia* (=Montia) *sibirica*, *Circaea alpina*, *Carex deweyana*, and *Melica subulata* are other frequent herbs. At SAJH, *Acer macrophyllum* forms a continuous canopy with scattered *Alnus rubra* present. Understory shrubs include *Rubus spectabilis*, *R. ursinus*, and *Symphoricarpos albus*. Herbaceous species include *Polystichum munitum* and *Equisetum telmateia*

**USFWS Wetland System:** Palustrine.

**Comments:** There is one occurrence of this type at SAJH and it is located in a seep on the Mitchell Hill piece.

**Conservation Rank:** G4 S4

**Rank Justification:** This association occurs within a narrow geographic and ecologic range. It is currently recognized as a natural vegetation type that may be altered by logging.

**Synonyms:**

*Acer macrophyllum*/*Rubus spectabilis* Community Type; Douglas 1971

*Acer macrophyllum*/*Rubus spectabilis* Forest; Chappell and Crawford 2005



## ***Alnus rubra* / *Rubus spectabilis* Forest Association**

Red Alder / Salmonberry Forest Association

**Acronym:** ALNRUB/RUBSPE

**NatureServe Code:** CEGLO00639

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Lowland Riparian Forest and Woodland

**Alliance:** (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance

**Range:** This association occurs throughout western Washington.

**SAJH Distribution:** American Camp, English Camp, Mitchell Hill

**Plots:** SAJH (4); Crawford et al. (2009)

**Environmental Description:** This low to mid-elevation, forested riparian/wetland association occupies riparian terraces, streambanks, floodplains, moist toe slopes, as well as the transitional edges of depressional wetlands.

**Vegetation Description:** *Alnus rubra* dominates the tree canopy. The well-developed shrub layer is dominated by *Rubus spectabilis* and/or co-dominated by *Ribes bracteosum*. *Acer circinatum* can be abundant. Herbs are usually present and can be diverse. *Athyrium filix-femina*, *Circaea alpina*, *Claytonia* (= *Montia*) *sibirica*, *Tiarella trifoliata*, *Tolmiea menziesii*, *Polystichum munitum*, *Carex deweyana*, and *Oxalis oregana* are some of the most common forbs and ferns. At SAJH, *Alnus rubra* is always present and dominates the canopy. *Acer macrophyllum* is sometimes present and prominent. Shrubs include *Rubus spectabilis*, *R. ursinus*, and *Symphoricarpos albus* are usually present. *Rosa nutkana* is sometimes present. Herbaceous species composition was variable in SAJH stands. *Equisetum telmateia*, *Polystichum munitum*, *Dactylis glomerata*, and *Athyrium filix-femina* were usually present. Other species encountered included *Lysichiton americanus*, *Cirsium arvense*, *Schedonorus phoenix*, *Taraxacum officinale*, *Agrostis stolonifera*, *Poa pratensis*, *Elymus glaucus*, *E. repens*, and *Holcus lanatus*.

**USFWS Wetland System:** Palustrine.

**Comments:** Stands on steep unstable slopes or in upland disturbed areas are included in the *Alnus rubra*/*Polystichum munitum* association (CEGL000638). This type occurs at scattered location throughout both English and American Camp in low ground where seasonal moisture is high or near seeps. The largest occurrences are at American Camp.

**Conservation Rank:** G4G5 S4S5

**Rank Justification:** This association occurs within a limited range and environment with few threats.

**Synonyms:**

*Alnus rubra*/*Rubus spectabilis* Association; Murray 2000

*Alnus rubra*/*Rubus spectabilis* community type; Kunze 1994

*Alnus rubra*/*Rubus spectabilis* Forest; Chappell and Crawford 2005, Chappell 1999

*Alnus rubra*/*Rubus spectabilis*/*Athyrium filix-femina* Community; Peter 2000

*Alnus rubra*/*Rubus spectabilis*/*Oxalis* spp. community; Diaz & Mellon 1996

*Alnus rubra*/*Rubus spectabilis*/*Tolmiea menziesii* community; Diaz & Mellon 1996

*Alnus rubra*-*Populus trichocarpa*/*Polystichum munitum* Community Type; Mycek 1994

*Alnus rubra*-*Populus trichocarpa*/*Rubus spectabilis* Community; Agee 1987



***Populus balsamifera* spp. *trichocarpa* / *Cornus sericea* / *Carex obnupta* Forest Association**

Black Cottonwood / Red-osier Dogwood / Slough Sedge Forest Association

**Acronym:** POPBALTRI/CORSER/CAROBN

**NatureServe Code:** CEGLO02844

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Hardwood-Conifer Swamp

**Alliance:** (*Alnus* - *Fraxinus* - *Populus*) / *Lysichiton americanus* Deciduous Swamp Woodland Alliance

**Range:** This association occurs in the Georgia Basin of coastal British Columbia and southward to the San Juan Islands and Puget Trough of western Washington.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This small-patch forest community occurs on level sites with strongly fluctuating water tables where the water table is at or above the soil surface in winter months, gradually lowering to well below the surface in the driest months of the year. Soils range from subhygric to subhydic and are usually rich (to medium) in nutrients. Soils are variably textured with variable amounts of clay, silt and sand. These sites occur at elevations from 0 to 150 m. This is a mid- to late-successional edaphic forest community. Stand-replacing events were likely infrequent. Within mature and old forests, small gaps result from the death of single trees or small groups of trees due to windthrow, root-rots, bark beetles, or other insect and disease pests. Too few occurrences remain to determine more specifically the stand dynamics of this ecosystem type.



**Vegetation Description:** The overstory of this deciduous plant community has high cover of *Populus balsamifera* and often with moderate cover of *Abies grandis* and/or *Alnus rubra*. High cover of shrubs, including *Cornus sericea* (= *Cornus stolonifera*), *Symphoricarpos albus*, *Malus fusca*, and *Oemleria cerasiformis*, and low to moderate cover of *Frangula purshiana* (= *Rhamnus purshiana*), sometimes with low to moderate cover, *Philadelphus lewisii*, *Rubus spectabilis*, and other species result in a dense shrub layer. Moderate to high cover of *Carex obnupta* often predominates in the herb layer. Low to moderate cover of *Carex deweyana*, *Polystichum munitum*, *Rubus ursinus*, and *Maianthemum dilatatum* also characterizes the herb layer. The moderately well-developed but floristically simple moss layer is dominated by high cover of *Eurhynchium praelongum*, often with low cover of *Leucolepis acanthoneuron*.

**USFWS Wetland System:** Palustrine.

**Comments:** There is one occurrence of this association at SAJH, located in the western end of American Camp.

**Conservation Rank:** GNR

**Rank Justification:**

**Synonyms:**

CDF mm /14, Green and Klinka. 1994

## ***Populus tremuloides* / *Carex obnupta* Forest Association**

Aspen / Slough Sedge Forest Association

**Acronym:** POPTRE/CAROBN

**NatureServe Code:** CEGLO03371

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Hardwood-Conifer Swamp

**Alliance:** (*Alnus* - *Fraxinus* - *Populus*) / *Lysichiton americanus* Deciduous Swamp Woodland Alliance

**Range:** This association is found in the Willamette Valley, Puget Trough, and possibly the lower Fraser River valley and southeastern Vancouver Island.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This type is often found in floodplains and depressions. Hydrological regime ranges from seasonal flooded to saturated soils. Seasonal flooding is from precipitation, but summer drying precludes formation of peat.

**Vegetation Description:** The tree layer is dominated by *Populus tremuloides* with up to 50% cover. The shrub layer includes *Spiraea douglasii* and *Salix hookeriana* with covers of 80 and 10%, respectively. The sparse herb layer is dominated by only *Carex obnupta* with very low cover. In Oregon, the moss layer has up to 98% cover by *Sphagnum mendocinum*. Large expanses of swamp vegetation once occurred in the northern Willamette and Tualatin valleys, and this association may have been part of it. *Populus tremuloides* still occurs in a number of low-elevation sites in Clackamas, Multnomah and Washington counties, Oregon, but most are on uplands that do not support wetland vegetation; it becomes very rare at low elevations south of Clackamas County. These wetlands are thought to be more frequent in western Washington and perhaps extend to southwestern British Columbia but have not been sampled adequately. *Spiraea douglasii* and other species of *Sphagnum* have been observed in some stands in Washington. Despite the abundance of *Spiraea douglasii* in this association, *Carex obnupta* is used here to distinguish these low-elevation occurrences west of the Cascade Range from some *Populus tremuloides* / *Spiraea douglasii* stands reported from east of the Cascades. The occurrence at SAJH differs from that described by Christy (2004) in having much higher cover of *Carex obnupta* (nearly continuous cover of the understory) and very little bryophyte cover. *Spiraea douglasii* and *Rosa nutkana* were prominent to co-dominant shrub species.

**USFWS Wetland System:** Palustrine.

**Comments:** At SAJH, the single occurrence of this association occurs at the downstream end of a depressional wetland which is located at the head of a large cottonwood gallery forest in the northwest corner of American Camp.

**Conservation Rank:** G2 S?

**Rank Justification:** Limited geographic range.

**Synonyms:**

*Populus tremuloides* / *Carex obnupta*, Christy 2004

Photo Not Available

***Tsuga heterophylla* - (*Thuja plicata* - *Alnus rubra*) / *Lysichiton americanus* - *Athyrium filix-femina*  
Forest Association**

Western Hemlock - (Western Redcedar - Red Alder) / Skunkcabbage - Lady Fern Forest Association

**Acronym:** TSUHET-(THUPLI-ALNRUB)/LYSAME-ATHFIL

**NatureServe Code:** CEGLO02670

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Hardwood-Conifer Swamp

**Alliance:** (*Tsuga heterophylla* - *Picea sitchensis*-*Thuja plicata*- *Abies*) / *Lysichiton americanus* Coniferous Swamp Woodland Alliance

**Range:** This forested wetland association occurs in the lowlands throughout western Washington, except perhaps on the outer coastal plain of the Olympic Peninsula.

**SAJH Distribution:** Mitchell Hill

**Plots:** SAJH (2); Crawford et al. (2009)

**Environmental Description:** This type occurs exclusively on poorly drained sites that are saturated or seasonally flooded. Soils are saturated throughout the growing season and are often organic (muck or woody peat), but may also be mineral.

**Vegetation Description:** The semi-open to dense forest canopy is dominated by *Tsuga heterophylla*, *Thuja plicata*, and/or *Alnus rubra*. Either *Tsuga heterophylla* or *Thuja plicata* are always at least co-dominant. *Picea sitchensis*, *Pseudotsuga menziesii* or *Abies amabilis* are sometimes present in lesser abundance. Tree regeneration is generally dominated by *Tsuga heterophylla*. The shrub layer varies from sparse to well-developed. *Rubus spectabilis* is usually the most abundant species. *Acer circinatum* is sometimes prominent. The herb layer is well-developed and dominated or co-dominated by *Lysichiton americanus*. *Athyrium filix-femina* is usually present to prominent. The understory is characterized by at least 5% cover of *Lysichiton americanus*, relatively low abundance of *Gaultheria shallon*, and the presence to prominence of *Rubus spectabilis* or *Athyrium filix-femina*. Species composition within the SAJH occurrences included an overstory dominated by *Thuja plicata* with *Alnus rubra* being prominent. *Rubus spectabilis* was the dominant shrub. Herbaceous species included *Lysichiton americanus*, *Polystichum munitum*, *Calamagrostis canadensis*, *Athyrium filix-femina*, *Galium aparine*, *Veronica americana*, and *Equisetum arvense*.

**USFWS Wetland System:** Palustrine.

**Comments:** Two occurrences of this association are found at SAJH, both within the Mitchell Hill unit.

**Conservation Rank:** S2S3

**Rank Justification:** This association occurs only in wetlands. It is sensitive to changes in hydrology or water quality and to logging disturbance.

**Synonyms:**

CWH dm /12; Green and Klinka 1994

CWH xm 1 /12; Green and Klinka 1994

CWH xm 2 /12; Green and Klinka 1994

*Thuja plicata*/*Athyrium filix-femina* Association; Murray 2000

*Thuja plicata*-*Tsuga heterophylla*/*Lysichiton americanum* community type; Kunze 1994, p34,94

*Tsuga heterophylla*-(*Thuja plicata*-*Alnus rubra*)/*Lysichiton americanus*-*Athyrium filix-femina* Forest; Chappell and Crawford 2005

*Tsuga heterophylla*/*Lysichiton americanus*-NWW; Henderson et al. 1989, Henderson et al. 1992

*Tsuga heterophylla*/*Lysichiton americanus*-PNW; McCain and Diaz 2002b, Topik et al. 1986, Halverson et al. 1986

*Tsuga heterophylla*/*Lysichiton americanum* Association; Henderson et al. 1992, Topik et al. 1986



***Alnus rubra* / *Carex obnupta* Ruderal Flooded Forest Association**

Red Alder / Slough Sedge Ruderal Forest Association

**Acronym:** ALNRUB/CAROBN Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Flooded & Swamp Forest

**Group:** Vancouverian Ruderal Flooded & Swamp Forest

**Alliance:** *Alnus rubra* / *Dactylis glomerata* Ruderal Flooded Forest Alliance

**Range:**

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This type occurs in a seep that appears to have been previously plowed.

**Vegetation Description:** *Alnus rubra* dominates the overstory. *Rubus spectabilis* (~10% cover), *R. ursinus*, *R. armeniacus*, *Symphoricarpos albus*, and *Crataegus monogyna* comprise a relatively open shrub layer. *Carex obnupta* dominates the understory.

**USFWS:** Palustrine

**Comments:** Within SAJH, there are two occurrences of this type at American Camps in relatively wet areas that had been previously plowed.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland with tree regeneration, Agee 1987 (<>)  
*Pseudotsuga menziesii* / grass, Agee 1987 (<>)



## ***Alnus rubra* / Nonnative Grasses Ruderal Flooded Forest Association**

Red Alder / Nonnative Grasses Ruderal Flooded Forest Association

**Acronym:** ALNRUB/Nonnative Grasses Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Flooded & Swamp Forest

**Group:** Vancouverian Ruderal Flooded & Swamp Forest

**Alliance:** *Alnus rubra* / *Dactylis glomerata* Ruderal Flooded Forest Alliance

**Range:**

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (2)

**Environmental Description:** This type occurs in areas that have been previously plowed and have elevated soil moisture levels in spring and early summer, such as seeps.



**Vegetation Description:** *Alnus rubra* is always a dominant overstory species while *Pseudotsuga menziesii* and *Thuja plicata* are occasionally present. *Rubus ursinus* and *Symphoricarpos albus* are always present. Other shrub species include *Rubus armeniacus*, *R. spectabilis*, *R. laciniatus*, *Rosa nutkana*, and *Sambucus racemosus*. *Agrostis stolonifera*, *Poa pratensis*, and *Equisetum telmateia* are always present. The nonnative grasses *Agrostis stolonifera*, *Poa pratensis*, and/or *Schedonorus pratensis* (= *Festuca pratensis*) dominate the understory. Other herbaceous species present include *Carex obnupta*, *Cirsium vulgare*, *Geum macrophyllum*, *Dactylis glomerata*, *Galium aparine*, *Polystichum munitum*, *Bromus vulgaris*, *Elymus glaucus*, *Pteridium aquilinum*, *Adenocaulon bicolor*, *Festuca subuliflora*, *Juncus acuminatus*, *Ranunculus repens* var. *repens*, and *Schedonorus pratensis*.

**USFWS:** Palustrine

**Comments:** Within SAJH, there are four occurrences of this type at both American and English Camps. All occurrences occur on previously plowed areas.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland with tree regeneration, Agee 1987 (<>)  
*Pseudotsuga menziesii* / grass, Agee 1987 (<>)

## ***Prunus emarginata* Ruderal Flooded Forest Association**

Bitter Cherry Ruderal Flooded Forest Association

**Acronym:** PRUEMA Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Flooded & Swamp Forest

**Group:** Vancouverian Ruderal Flooded & Swamp Forest

**Alliance:** *Alnus rubra* / *Dactylis glomerata* Ruderal Flooded Forest Alliance

**Range:**

**SAJH Distribution:** American Camp

**Plots:** SAJH (2)

**Environmental Description:** This type occurs in areas that have been previously plowed or physically disturbed and have elevated soil moisture levels in spring and early summer.

**Vegetation Description:** The two occurrences at SAJH (both at American Camp) have a dense canopy of *Prunus emarginata*. Understory shrubs include *Rubus ursinus*, *R. armeniacus*, *R. parviflorus*, *Rosa nutkana*, and *Symphoricarpos albus*. Herbaceous species present include *Bromus sitchensis*, *Dactylis glomerata*, *Poa pratensis*, *Urtica dioica*, and *Tellima grandiflora*.

**USFWS:** Palustrine

**Comments:** Both stands at America Camp occur in areas that were previously plowed. Given the intensive land use history of these sites these stands are considered ruderal types.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland with tree regeneration, Agee 1987 (<>)

*Pseudotsuga menziesii* - *Pinus contorta* ssp. *contorta* / *Holodiscus discolor* - *Symphoricarpos albus*, Agee 1987 (<>)





## ***Carex inops* - *Eriophyllum lanatum* Herbaceous Vegetation Association**

Long-stolon Sedge - Woolly Sunflower Herbaceous Vegetation Association

**Acronym:** CARINO-ERILAN

**NatureServe Code:** Preliminary

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Carex inops* Herbaceous Vegetation Alliance

**Range:** Occurs in the western Columbia River Gorge of Washington and in the northern Puget Trough. It is known from Skamania, Whatcom, and San Juan counties. Small occurrences may be present elsewhere in the Puget Trough.

**SAJH Distribution:** English Camp

**Plots:** SAJH (1); Chappell (2006a)

**Environmental Description:** This association occupies small to large patches within balds. In the Puget Trough, it is found along the edges of balds, in the Columbia Gorge, it occurs as larger patches in the interior of balds as well. The association occurs on sites that appear to be relatively mesic and are often located near the edges of balds where shading from adjacent trees is substantial. Slopes are moderate to steep and face south to west. Upper slope positions appear most typical, with mid-slopes also represented. The SAJH occurrence occurs on relatively flat portion of the balds/ rock outcrops near the top of Young Hill. The adjacent forest provides shading across much of the stand.



**Vegetation Description:** This association is dominated by graminoids or a mix of graminoids and forbs. *Carex inops* is always dominant or co-dominant. *Achillea millefolium* and *Eriophyllum lanatum* are almost always present and often prominent; however, neither species was found in the SAJH occurrence. Other species that can be prominent to co-dominant include *Mahonia aquifolium*, *Phlox diffusa*, *Bromus carinatus*, *Elymus glaucus*, *Allium cernuum*, *Festuca rubra*, *Koeleria macrantha*, *Cerastium arvense*, *Trifolium microcephalum*, *Lathyrus nevadensis*, *Senecio integerrimus*, *Microseris laciniata*, *Lupinus argenteus* ssp. *argenteus* var. *laxiflorus*, and *Fragaria virginiana*. Frequently occurring species are *Luzula (comosa, multiflora)*, *Koeleria macrantha*, *Penstemon subseratus*, *Cerastium arvense*, and *Microseris laciniata*. Non-native *Poa pratensis* is co-dominant on one of our plots, *Rumex acetosella* is prominent on another. Species composition of the SAJH occurrence varied from above with native composition including *Elymus glaucus*, *Camassia quamash* ssp. *maxima*, and nearly continuous carpet of bryophytes. Nonnative species in the SAJH occurrence included *Hypochaeris radicata*, *Holcus lanatus*, *Rumex acetosella*, and *Anthoxanthum odoratum*.

### **USFWS:**

**Comments:** It is not clear whether the difference in composition (other than dominance of *Carex inops*) of the SAJH occurrence from other stands of this type reflects type variation or whether the SAJH merits separate classification.

**Conservation Rank:** GNRS1S2

**Rank Justification:** There are only two occurrences of large size. There are probably quite a few very small ones. Potential threats include invasion and increase of non-native species, tree and/or shrub invasion, road-building, timber harvest, and recreational impacts.

**Synonyms:** This association has not been previously described in the literature.

## ***Carex tumulicola* Herbaceous Vegetation Association**

Foothill Sedge Herbaceous Vegetation Association

**Acronym:** CARTUM

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Carex tumulicola* Herbaceous Alliance

**Range:** The range of this provisional association is uncertain. It may have been a significant component in coastal prairie sites prior to European settlement since there are few other native graminoids with potential to have significant cover (Chappell and Caplow 2004).

**SAJH Distribution:** American Camp

**Plots:** SAJH (3);

**Environmental Description:** Within SAJH, this association is found in moist to very moist site; typically seeps or adjacent to forested or herbaceous wetlands. Most sites where this association occurs (within SAJH) have experience previously plowing and/or grazing.

**Vegetation Description:** *Carex tumulicola* is a clear dominant in this type. *Equisetum arvense* was co-dominant in one occurrence. Other prominent native species that are usually present include *Pteridium aquilinum*, *Bromus sitchensis*, *Rubus ursinus*, *Symphoricarpos albus*, and *Rosa nutkana*. Prominent native species that are sometime present include *Elymus trachycaulus*, *E. glaucus*, *Fragaria virginiana*, and *Poa trivialis*. Other native species present include *Ribes lacustre*, *Juncus ensifolius*, *J. acuminatus*, *J. effusus*, *Leymus mollis*, *Danthonia californica*, *Galium aparine*, and *Gamochaeta purpurea*. *Holcus lanatus*, *Poa pratensis*, and *Festuca rubra* ssp. *rubra* are abundant nonnatives that are usually present. *Anthoxanthum odoratum* was co-dominant in one occurrence. *Cirsium arvense*, *Vicia hirsuta*, and *V. sativa* are always present while *Myosotis laxa*, *Bromus diandrus* (= *Bromus rigidus*), and *Rumex acetosella* are usually present. *Cirsium vulgare*, *Crataegus monogyna*, *Dactylis glomerata*, *Geranium molle*, *Leucanthemum vulgare*, *Plantago lanceolata*, *Rubus armeniacus*, *Schedonorus phoenix*, *Taraxacum officinale* ssp. *officinale*, and *Trifolium dubium* were sometimes present.

**USFWS:** Not applicable.

**Comments:** Historically, it is possible that this association was the dominant grassland type in the moist portions of the American Camp prairie. However, due to this association occurring in previously plowed areas this may be a novel (native) association type, in which case it would be placed within the Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group.

**Conservation Rank:** GUSUQ

**Rank Justification:** Not enough information is known about this association historical extent and relationship to historical range of variability of native prairies.

**Synonyms:**

Dry Grassland, Rust 1992 (<>)

Mesic Grassland with shrubs, Agee 1987 (<>)

Mesic Grassland with shrubs and tree regeneration, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)



***Festuca idahoensis* ssp. *roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation Association**

Roemer's Fescue - Blue Camas - Field Chickweed Herbaceous Vegetation Association

**Acronym:** FESROE-CAMQUA-CERARV

**NatureServe Code:** Preliminary

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Festuca idahoensis* ssp. *roemerii* - *Agrostis pallens* - *Koeleria macrantha* Herbaceous Alliance

**Range:** This association occurs as tiny remnants of formerly larger prairies on Whidbey Island, Island Co., San Juan Island, San Juan Co., and the Quimper Peninsula, Jefferson Co. There are 11 distinct patches of this association within SAJH, most of which are very degraded.

**SAJH Distribution:** American Camp

**Plots:** SAJH (19); Rochefort and Bivin (2009); Chappell (2004)

**Environmental Description:** This association only occurs only in the rainshadow of the Olympic Mountains on sites that appear to be moderately dry. This type is found on gentle slopes or flats, part of rolling or planar glacial landforms. Soils may be deep sandy loam outwash or somewhat shallow gravelly loam glacial till. Historically these sites were maintained as open prairie by indigenous burning practices. *Pseudotsuga menziesii* is able to establish on these sites in the absence of fire. The shrubs *Symphoricarpos albus* and *Rosa nutkana* are frequent and tend to increase over time in the absence of fire. These sites are likely to convert to shrublands or coniferous woodlands or forest without fire. Within SAJH, most sites occur in areas that do not appear to have been plowed and are most abundant adjacent and to the northeast of the Redoubt at American Camp.

**Vegetation Description:** This grassland association is dominated or co-dominated by the bunchgrass *Festuca idahoensis* ssp. *roemerii*. *Carex inops* or *C. tumulicola* are typically prominent. *Camassia quamash* is always present and sometimes very prominent. *Ranunculus occidentalis*, *Pteridium aquilinum* and *Cerastium arvense* are also consistently present. The shrubs *Symphoricarpos albus*, *Mahonia aquifolium*, and *Rosa nutkana* are often present. Other native species found in the SAJH occurrences include *Triteleia grandiflora*, *Luzula multiflora* var. *multiflora*, *Fritillaria lanceolata*, *Galium aparine*, *Zigadenus venenosus*, *Anaphalis margaritacea*, *Koeleria macrantha*, *Sisyrinchium idahoensis*, *Elymus glaucus*, *E. trachycaulus* ssp. *trachycaulus*, *Danthonia californica*, *Brodiaea coronaria* ssp. *coronaria*, *Bromus sitchensis*, *Rubus ursinus*, and *Fragaria virginiana*. Non-native *Poa pratensis* is consistently prominent to co-dominant. *Holcus lanatus* is always present in the SAJH occurrences. Within the SAJH occurrences *Aira caryophyllea*, *A. praecox*, *Bromus diandrus* (= *Bromus rigidus*), *Hypochaeris radicata*, *Cirsium arvense*, *C. vulgare*, *Rumex acetosella*, *Vicia sativa*, *V. hirsuta*, *Taraxacum officinale* ssp. *officinale*, *Trifolium dubium*, *Teesdalia nudicaulis* and *Rubus armeniacus* are other nonnative species present in this association. The occurrence of this association north of the American Camp visitor center had the following mesic species: *Carex pachystachya*, *C. aurea*, *Geum macrophyllum*, and *Crataegus douglasii*.

**USFWS:** Not applicable.

**Comments:** Historically, this association likely dominated the dry portions of the American Camp prairie. This association is functionally extinct as an intact ecosystem. However, it retains value as a seed source and template for restoration of northern Puget Sound dry prairies. The occurrence north of the American Camp visitor center could be part of the *Carex tumulicola* association as it was more mesic than other occurrences and had an abundance of *Carex tumulicola* and other mesic indicator species present.

**Conservation Rank:** GNRSH

**Rank Justification:** Known from only three tiny non-functional remnants of formerly large prairies. It was probably much more extensive historically. All three sites are protected and can be used as seed sources for restoration of largely extirpated prairies.

**Synonyms:**

Dry Grassland, Rust 1992 (<>)

*Festuca idahoensis* ssp. *roemerii*, Rochefort and Bivin 2009

Mesic Grassland with shrubs and tree regeneration, Agee 1987 (<>)

Xeric grassland, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)



***Festuca rubra* - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation Association**

Red fescue - (Great Camas, Oregon Gumweed) Herbaceous Vegetation Association

**Acronym:** FESRUB-(CAMQUA, GRISTR)

**NatureServe Code:** CEGLO03347

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Festuca rubra* - *Calamagrostis nutkaensis*  
Coastal Headland Herbaceous Alliance

**Range:** Within Washington this association occurs in San Juan County, on western Whidbey Island (Island Co.), and islands of western Skagit and western Whatcom counties. It probably occurred historically, and could still occur rarely, in northeastern Clallam and northeastern Jefferson counties. It also occurs in the adjacent Georgia Basin of British Columbia.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1); Chappell (2006a, 2006b)

**Environmental Description:** This association only occurs only in the rainshadow of the Olympic Mountains near saltwater shorelines, either on shallow soils over bedrock (balds) or on steep bluffs composed of glacial deposits. These sites appear to be relatively dry to moderately dry and found on slopes which range from nearly flat to very steep. South to west aspects are most frequent, with occasional occurrence on other aspects. Topographic position is highly variable. Slope shape is most often convex or undulating. Soils on the glacial bluffs are very sandy and/or gravelly in texture. Small rock outcrops are often present within the association on the shallow-soiled sites. Surficial geology includes sedimentary, metasedimentary, and metavolcanic rocks, as well as glacial outwash and drift. Within SAJH, this association only occurs at American Camp within areas that appear to have not been previously plowed. However, they appear to have been impacted by historical grazing practices.

**Vegetation Description:** This association is dominated by grasses or a mix of grasses and forbs. Native varieties of *Festuca rubra* are always dominant or co-dominant (formerly known as *Festuca rubra* var. *littoralis* Vasey ex Beal). *Camassia leichtlinii* is sometimes prominent to co-dominant. The state rare plant, *Ranunculus californicus*, is present in this type. Other frequent herbaceous species include *Grindelia stricta*, *Cerastium arvense*, *Achillea millefolium*, *Allium acuminatum*, and *Luzula (comosa, multiflora)*. *Lomatium nudicaule* is occasionally prominent. Frequent non-native species include *Hypochaeris radicata*, *Bromus hordeaceus* (= *Bromus mollis*), *Holcus lanatus*, *Aira caryophylla*, *Aira praecox*, *Bromus rigidus*, *Rumex acetosella*, and *Plantago lanceolata*. Additional native species observed in the occurrences at SAJH include *Hypericum scouleri* ssp. *scouleri*, *Danthonia californica*, *Pteridium aquilinum*, *Brodiaea coronaria* ssp. *coronaria*, and *Lupinus microcarpus* var. *scopulorum*. Additional nonnative species observed in the SAJH occurrences include *Cirsium arvense*, *Bromus diandrus* (= *Bromus rigidus*), and *Crepis capillaris*.

**USFWS:** Not applicable.

**Comments:** Historically, this association may have dominated sites with shallow soils near the edge of bluffs along South Beach of American Camp.

**Conservation Rank:** G1S1

**Rank Justification:** There are nine known occurrences in Washington of fair to good integrity. It was probably more extensive historically. Threats include invasion and increase of non-native species, invasion of trees and shrubs with lack of fire, development, and recreational impacts.

**Synonyms:**

Bedrock Bluff, Rust 1992 (<>)

*Festuca rubra* - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*), Chappell 2006a, 2006b

Xeric grassland with shrub islands, Agee 1987 (<>)



***Festuca rubra* Coastal Headland Herbaceous Vegetation Association**

Red fescue Coastal Headland Herbaceous Vegetation Association

**Acronym:** FESRUB Coastal Headland

**NatureServe Code:** CEGLO01567

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Festuca rubra* - *Calamagrostis nutkaensis* Coastal Headland Herbaceous Alliance

**Range:** This coastal headland grassland association is found along the Pacific Northwest coast, from central Oregon north to the Puget Sound region.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1);

**Environmental Description:** This association occurs in a strongly maritime climate, with persistent onshore (westerly) winds, high annual precipitation, and moderate temperatures. Summer months typically are relatively dry. This association occupies coastal headlands on extreme sites, usually with moderate to steep slopes of southerly aspects. These headlands are composed of bedrock of conglomerates (Washington) and basalts (Oregon). The soils can be derived from colluvium or sands, are usually shallow and well-drained, and often have a significant component of gravels. Persistent strong winds, salt spray, and the shallow soils are important factors in the maintenance of these grasslands. Sites in the San Juan Islands differ slightly in that they occur in a dry climatic region (rainshadow of the Olympic Mountains) and occur steep slopes of coastal bluffs which are exposed to chronic exposure to salt spray and aerosols.

**Vegetation Description:** This association is poorly described, but has recently been the subject of inventory efforts in Washington. It is an herbaceous community dominated by the perennial grass *Festuca rubra*, and with a rich forb component. *Festuca rubra* forms large, loose clumps from long, slender rhizomes, and has cover ranging from as low as 10% to over 70%. Associated perennial grasses may include *Elymus glaucus*, *Festuca idahoensis*, *Danthonia californica*, *Calamagrostis nutkaensis*, and *Koeleria macrantha*. Important forbs include *Artemisia suksdorfii*, *Camassia leichtlinii*, *Viola adunca*, *Erigeron glaucus*, *Achillea millefolium*, *Eriophyllum lanatum*, and *Solidago canadensis*. *Hypericum scouleri* ssp. *scouleri*, *Pteridium aquilinum*, *Calystegia soldanella*, *Lupinus littoralis*, *Spergularia macrotheca* var. *macrotheca*, and *Plantago maritima* var. *californica* were other native species present in the SAJH occurrences. Trees from nearby forested areas may invade in the absence of fire; these include the conifers *Pseudotsuga menziesii*, *Pinus contorta* ssp. *contorta*, and *Picea sitchensis*, and the broad-leaved *Quercus garryana* or *Arbutus menziesii*. Most, if not all, stands of this association are dominated by introduced and exotic species as a result of severe impacts from livestock grazing. Common species of this type include the grasses *Holcus lanatus*, *Bromus hordeaceus* (= *Bromus mollis*), *Agrostis gigantea* (= *Agrostis alba*), *Aira praecox*, and *Poa pratensis*, and the forbs *Senecio jacobaea*, *Trifolium repens*, and *Cirsium* spp. At SAJH, *Bromus diandrus* (= *Bromus rigidus*), *Aira caryophyllea*, and *Vicia sativa* were also present.

**USFWS:** Not applicable.

**Comments:** This association typically occurs on the outer coast and thus the concept of this type needs to be expanded. Alternatively, in the San Juan Islands this type may represent a different association reflecting drier climatic conditions. Historically this association may have dominated most steep slopes of coastal bluffs along the western edge of South Beach at American Camp.

**Conservation Rank:** G2S2

**Rank Justification:** This association has a naturally restricted range, being found on coastal headlands from Tomales Bay, California, north to the southern coast of Washington. Although the presence of this type in the San Juan Islands would be a range extension, it would not affect the conservation rank. This type occurs as small patches in a mosaic of grassland, shrubland and forest communities. Most sites have been heavily impacted by livestock grazing and by invasion of exotic grasses and forbs.

**Synonyms:**

Exposed Grassland, Rust 1992 (<>)

*Festuca rubra* (Coastal Headland), Bourgeron and Engelking 1994

*Festuca rubra* - *Armeria maritima* Coastal Headland Grassland, Kagan 2001

Xeric grassland with shrub islands, Agee 1987 (<>)



***Plectritis congesta* Herbaceous Vegetation Association**

Showy *Plectritis* Herbaceous Vegetation Association

**Acronym:** PLECON

**NatureServe Code:** Preliminary

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Plectritis congesta* Herbaceous Alliance

**Range:** This association occurs in the western Columbia River Gorge, Skamania County, in foothills of southeastern Thurston County, in the San Juan Islands, and on the northern Olympic Peninsula, Clallam County. It may also occur in the Georgia Basin of British Columbia.

**SAJH Distribution:** English Camp

**Plots:** SAJH (1); Chappell (2006a)



**Environmental Description:** This association typically occupies small patches within balds on sites that appear to be relatively mesic to moist. Slopes are gentle to steep, facing southeast to west. Topographic position includes benches and upper slopes. Slope shape is undulating or convex. Soil texture is loam. Soil depth is shallow, less than 20 cm on all plots. Recorded elevation ranges from near sea level to 525 m.

**Vegetation Description:** This association type is dominated by forbs, or less frequently by a mixture of forbs and grasses. *Plectritis congesta* is always dominant or co-dominant. *Triteleia hyacinthina* is prominent to co-dominant in all our plots. *Camassia leichtlinii* is co-dominant on one of our plots and at one additional site, both of which are in the San Juan Islands. *Carex inops*, *Festuca rubra*, *Elymus glaucus*, *Camassia quamash*, and *Collinsia grandiflora* are at least occasionally prominent. *Achillea millefolium*, *Lotus micranthus*, *Selaginella wallacei*, and *Trifolium willdenowii* are usually present. Non-native species are relatively abundant in this association and sometimes co-dominant. *Aira caryophyllea*, *Aira praecox*, *Bromus hordeaceus*, *Holcus lanatus*, *Hypericum perforatum*, and *Hypochaeris radicata* are the most common of them. The SAJH occurrence had few species but *Plectritis congesta* dominated over a nearly continuous carpet of bryophytes, with *Camassia quamash* ssp. *maxima* and *Dodecatheon hendersonii* being prominent. *Elymus glaucus* and *Holcus lanatus* were also present.

**USFWS:** Not applicable.

**Comments:** The SAJH occurrence was a very small patch found near the edge of a larger bald. Other smaller patches (too fine for mapping) were observed in nearby balds but seemed to be limited to bald edges or other places where trampling from recreation was minimal.

**Conservation Rank:** GNR1Q

**Rank Justification:** There are five known occurrences in Washington. Potential threats include invasion and increase of non-native species, road-building, timber harvest, and recreational impacts. Recreation impacts, specifically trampling, seems to limit this association to areas where such activities are minimal or don't occur.

**Synonyms:** This association has not been previously described.

***Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland Association**

Common Snowberry - Nootka Rose Pacific Coast Shrubland Association

**Acronym:** SYMALB-ROSNUT

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Grassland & Shrubland

**Group:** Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group

**Alliance:** *Symphoricarpos albus* Pacific Coast Shrubland Alliance

**Range:** In Washington, this association is known to occur in the Olympic rainshadow area of the San Juan Islands. It may also occur in western Skagit, western Whatcom, eastern Clallam, northeastern Jefferson, and central to northern Island County. It also likely occurs in adjacent British Columbia on the Gulf Islands and southeastern Vancouver Island.



**SAJH Distribution:** American Camp, English Camp, Mitchell Hill

**Plots:** SAJH (1)

**Environmental Description:** Within SAJH, this association is most often found within areas that have been previously plowed. It is also commonly found in the ecotone between forested and herbaceous associations.

**Vegetation Description:** *Symphoricarpos albus* and *Rosa nutkana* typically co-dominant this association, although some stands are dominated by only one of these species. *Rubus ursinus* can be also be co-dominant. The understory is sparse due to the density of shrubs. When present, native species in the understory include *Pteridium aquilinum* and *Bromus sitchensis*. Nonnative species commonly found include *Rubus armeniacus*, *Schedonorus phoenix*, *Holcus lanatus*, *Hypochaeris radicata*, *Cirsium vulgare*, *Dactylis glomerata*, *Poa pratensis*, *Rumex acetosella*, and *Vicia sativa*.

**USFWS:** Not applicable.

**Comments:** This is a very abundant type at American Camp. Due to its association with highly disturbed sites it might be better classified as a Ruderal association. However, because the dominant shrubs thrive in disturbed environments and the presumed presence of such sites historically (although with less abundance), this type was classified as a provisional native association until more data is collected.

**Conservation Rank:** GUSUQ

**Rank Justification:** Historically, this type was likely less abundant and restricted to the edges of prairies or balds. Fire suppression has allowed these shrublands to increase on the large prairies (e.g., American Camp) and fragmentation and logging of forests have increased the abundance of this community.

**Synonyms:**

Cold-deciduous shrubland, Agee 1987 (<>)

Mesic Grassland w/ shrubs, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)

## ***Agrostis (capillaris, stolonifera) Mesic Ruderal Grassland Association***

Bentgrass Mesic Ruderal Grassland Association

**Acronym:** AGR (CAP, STO) Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Agrostis capillaris* - *Holcus lanatus* - *Poa pratensis* Mesic Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** American Camp

**Plots:** SAJH (9); Rochefort and Bivin (2009)

**Environmental Description:** Occurs in sandy soils that have been previously plowed. Some areas are located in a large rabbit warren and thus have experienced recent soil disturbance.

**Vegetation Description:** *Agrostis capillaris* and *A. stolonifera* are dominant across this type. *Rumex acetosella*, *Aira caryophyllea*, *Holcus lanatus*, *Hypochaeris radicata*, *Teesdalia nudicaulis*, and *Vicia sativa* are prominent. *Aira praecox* is usually present.

**USFWS:** Not applicable.

**Comments:** This type occupies the large area at American Camp that was previously plowed and where the large rabbit warren occurs. There is also a large occurrence east of the sand sheet.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Agrostis capillaris*, Rochefort and Bivin, 2009 (<->)

*Agrostis stolonifera*, Rochefort and Bivin, 2009 (<->)

Xeric grassland with shrub islands, Agee 1987 (<->)

Sparsely vegetated sand flats, Agee 1987 (<->)





***Holcus lanatus* - *Poa pratensis* - *Elymus repens* Mesic Ruderal Grassland Association**

Velvet Grass - Bluegrass - Quackgrass Mesic Ruderal Grassland Association

**Acronym:** HOLLAN-POAPRA-ELYREP Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Agrostis capillaris* - *Holcus lanatus* - *Poa pratensis* Mesic Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** American Camp, English Camp, Mitchell Hill

**Plots:** SAJH (7); Rochefort and Bivin (2009)

**Environmental Description:** Soils have been disturbed due to past a plowing. Plow lines are still visible in many areas.

**Vegetation Description:** This is a widespread ruderal type that is comprised of a variety of mesic nonnative pasture grasses. The most constant and abundant species include *Holcus lanatus*, *Poa pratensis*, *Agrostis capillaris*, *Schedonorus phoenix*, *Elymus repens*, and *Dactylis glomerata*. *Elymus glaucus*, *Carex inops*, and *Bromus sitchensis* were common native grass species present. Other species present included *Bromus diandrus* (= *Bromus rigidus*), *B. hordeaceus*, *Hypochaeris radicata*, *Festuca rubra* ssp. *rubra*, *Centaureum erythraea*, *Cerastium arvense*, *Leymus mollis*, *Cirsium arvense*, *C. vulgare*, *Heracleum maximum*, *Pteridium aquilinum*, *Trifolium pratense*, *Vicia hirsuta*, *V. sativa*, *Rumex acetosella*, *Rosa nutkana*, and *Symphoricarpos albus*.

**USFWS:** Not applicable.

**Comments:** This mesic ruderal grassland is found in previously plowed areas of both American and English Camp. Vegetation around roads and trails at Mitchell Hill and near the camp area at English Camp are also classified as this type. It is the most extensive grassland type at American Camp.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Bromus sitchensis* - *Bromus hordeaceus* - *Poa pratensis*, Rochefort and Bivin 2009 (<>)

*Elymus repens*, Rochefort and Bivin 2009

*Holcus lanatus*, Rochefort and Bivin 2009 (<>)

*Leymus mollis* - *Holcus lanatus*, Rochefort and Bivin 2009 (<>)

*Poa pratensis*, Rochefort and Bivin 2009 (<>)

Xeric grassland, Agee 1987 (<>)

Mesic Grassland w/ tree regeneration, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)



### ***Schedonorus phoenix* Mesic Ruderal Grassland Association**

Meadow Fescue Mesic Ruderal Grassland Association

**Acronym:** SCHPHO Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Agrostis capillaris* - *Holcus lanatus* - *Poa pratensis* Mesic Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (0);

**Environmental Description:** Soils have been disturbed due to past a plowing and/or grazing.

**Vegetation Description:** *Schedonorus phoenix* (= *Festuca arundinacea*) is often the only species occurring in these stands and is always the clear dominant species. *Holcus lanatus* and *Poa pratensis* can be present.

**USFWS:** Not applicable.

**Comments:** This type is found at American Camp mostly within the former native prairie.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Xeric grassland, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)



## ***Leymus mollis* - *Holcus lanatus* Dune Ruderal Grassland Association**

American Dunegrass - Velvet Grass Dune Ruderal Grassland Association

**Acronym:** LEYMOL-HOLLAN Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Ammophila (arenaria, breviligulata)* - *Leymus mollis* Dune Ruderal Herbaceous Alliance

**Range:** This ruderal type is mostly found near the shoreline on the bluffs of South Beach at American Camp and in the Old Town Lagoon area.

**SAJH Distribution:** American Camp

**Plots:** SAJH (5)

**Environmental Description:** This association occurs in sandy areas, likely stabilized dunes or coarse glacial outwash. Most stands are thought to have experienced plowing or severe grazing in the past. These sites may have previously been active sand dunes that were stabilized by *Leymus mollis* and *Holcus lanatus*.

**Vegetation Description:** This vegetation type is thought to be the result of overgrazing. *Leymus mollis* is co-dominant with *Holcus lanatus*. *Poa pratensis*, *Cirsium arvense*, *Rubus ursinus*, and *Galium aparine* are often prominent. Other species present include *Bromus diandrus*, *Cirsium vulgare*, *Pteridium aquilinum*, *Rumex acetosella*, *Bromus sitchensis*, *Vicia sativa*, *V. hirsuta*, *Cerastium arvense*, *Urtica dioica*, *Rosa nutkana*, and *Symphoricarpos albus*. *Leymus mollis* has a different appearance in these stands as compared to its normal habitat along the upper beach—the leaves are softer, are yellow-green rather than bluish-green, and rarely flower.

**USFWS:** Not applicable.

**Comments:**

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Leymus mollis* - *Holcus lanatus*, Rochefort and Bivin, 2009 (<->)



## San Juan Islands Ruderal Forbs and Graminoids Dune Herbaceous Association

San Juan Islands Ruderal Forbs and Graminoids Dune Herbaceous Association

**Acronym:** SAJH Ruderal Herb

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Ammophila (arenaria, breviligulata) - Leymus mollis* Dune Ruderal Herbaceous Alliance

**Range:**

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This ruderal type is found in areas that have experienced recent soil disturbance or on sandy soils that have been exposed to physical disturbances such as grazing. It is primarily found in the sand sheet and beach areas of American Camp.

**Vegetation Description:** Species composition of this type reflects a variety of invasive annual and perennial species such as *Bromus sterilis*, *Erodium cicutarium*, *Agrostis capillaris*, *Cirsium arvense*, *Sisymbrium altissimum*, *Teesdalia nudicaulis*, *Holcus lanatus*, *Hypochaeris radicata*, *Taraxacum officinale*, *Rumex acetosella*, *Trifolium dubium*, and *Vulpia bromoides* (= *Festuca bromoides*). Native species include *Abronia latifolia* and *Amsinckia menziesii*. *Lupinus littoralis* and *Pteridium aquilinum* can be dominant in some areas. Dominant species in this type appears to vary annually (which is why only a common name is assigned). It is probable that the occurrences of this type in the sand sheet area were previously part of the *Leymus mollis* ssp. *mollis* - *Abronia latifolia* plant association before being exposed to human-induced disturbances.

**USFWS:** Not applicable.

**Comments:** This type is found at American Camp primarily in the large sand sheet where past grazing seems to have occurred. It is also found in areas which have experience recent soil disturbances (e.g. abandoned restoration areas).

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Lupinus littoralis* - *Bromus rigidus*, Rochefort and Bivin 2009 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)

Sparsely vegetated sand flats, Agee 1987 (<>)



## ***Arrhenatherum elatius* Dry Ruderal Grassland Association**

Tall Oatgrass Dry Ruderal Grassland Association

**Acronym:** ARRELA Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Bromus hordeaceus* Dry Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** English Camp

**Plots:** SAJH (1)

**Environmental Description:** This type occurs on sites with shallow or gravelly, sandy loam soils. At least two stands were previously plowed.

**Vegetation Description:** *Arrhenatherum elatius* is the dominant species while *Cirsium arvense* and *Elymus repens* are often co-dominant. *Marah oregana*, *Galium aparine*, *Poa pratensis* and *Rubus ursinus* are prominent.

**USFWS:** Not applicable.

**Comments:** This type is limited to English Camp at the western base of Young Hill and west of West Valley Road near the park boundary.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland w/ tree regeneration, Agee 1987 (<>)



***Bromus (diandrus, hordeaceus, sterilis) Dry Ruderal Grassland Association***

Ripgut Brome, Soft Brome, Poverty Brome Dry Ruderal Grassland Association

**Acronym:** BRO (DIA, HOR, STE) Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Bromus hordeaceus* Dry Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (1)

**Environmental Description:** This type occurs on dry sites as a result of shallow or sandy, coarse textured soils and/or south-facing aspects. Most occurrences are located along the south shore of American Camp and are exposed to drying winds that appear to desiccate the sites by early summer. These sites have been previously disturbed by grazing and/or historical plowing.



**Vegetation Description:** Vegetation composition is primarily composed of nonnative annual species such as *Bromus diandrus* (= *Bromus rigidus*), *B. hordeaceus*, *B. sterilis*, and *Aira caryophyllaea*. Other species present include *Hypochaeris radicata* and *Pteridium aquilinum*.

**USFWS:** Not applicable.

**Comments:** This dry ruderal grassland typically has gone to seed and vegetation begins to dry by early summer.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Agrostis capillaris*, Rochefort and Bivin, 2009 (<>)

*Bromus sitchensis* - *Bromus hordeaceus* - *Poa pratensis*, Rochefort and Bivin 2009 (<>)

*Holcus lanatus*, Rochefort and Bivin 2009 (<>)

Mesic Grassland, Agee 1987 (<>)

Sparsely vegetated sand flats, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)

## ***Bromus sitchensis* - *Elymus glaucus* Dry Ruderal Grassland Association**

Alaska Brome - Blue Wildrye Provisional Ruderal Association

**Acronym:** BROSIT-ELYGLA Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Bromus hordeaceus* Dry Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** American Camp, Mitchell Hill

**Plots:** SAJH (8); Rochefort and Bivin (2009)

**Environmental Description:** The occurrences at American Camp occur in formerly plowed areas embedded within forests or in shallow soil sites near rock outcrops that have experienced past stress, presumably from grazing.



**Vegetation Description:** *Elymus glaucus* and/or *Bromus sitchensis* dominate or co-dominate this type along with numerous non-native species. *Bromus diandrus* (= *Bromus rigidus*), *Poa pratensis*, *Pteridium aquilinum*, *Rumex acetosella*, *Carex tumulicola*, *Holcus lanatus*, *Vicia sativa*, *Plantago lanceolata*, *Trifolium dubium*, *Galium aparine*, *Hypochaeris radicata*, *Arrhenatherum elatius*, and *Hypericum scouleri* are usually present. Occasional shrubs include *Holodiscus discolor*, *Symphoricarpos albus*, *Rosa nutkana*, and *Mahonia aquifolium*. Rock outcrops are present in some stands.

**USFWS:** Not applicable.

**Comments:** This type appears very similar to the *Holcus lanatus*-*Poa pratensis*-*Elymus repens* Ruderal grassland except with a higher cover of *Bromus sitchensis* and/or *Elymus glaucus* (collectively >25%). There is some uncertainty about whether this is a ruderal type. *Bromus sitchensis* and *Elymus glaucus* are both native species that occur along forest edges and in native grasslands. They have been observed elsewhere in the Puget trough as occurring in stands within mostly degraded prairies (Chappell 2006a). Given the predominance of this type within previously cultivated and co-dominance of non-native species, this type was considered ruderal. Additional information may suggest this is in fact a natural prairie/bald type.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

*Bromus sitchensis* - *Bromus hordeaceus* - *Poa pratensis*, Rochefort and Bivin 2009 (<>)

Cold-deciduous shrubland, Agee 1987 (<>)

Mesic Grassland w/shrubs, Agee 1987 (<>)

Mesic Grassland w/ tree regeneration, Agee 1987 (<>)

*Pseudotsuga menziesii* - *Acer macrophyllum* / Grass, Agee 1987 (<>)

*Pseudotsuga menziesii* - *Quercus garryana* - *Arbutus menziesii* / Grass, Agee 1987 (<>)

*Pseudotsuga menziesii* / Grass, Agee 1987 (<>)

***Festuca idahoensis* ssp. *roemerii* Ruderal (Restoration) Grassland Association**

Roemer's Fescue Ruderal (Restoration) Grassland Association

**Acronym:** FESROE (Restoration)

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Bromus hordeaceus* Dry Ruderal Grassland Alliance

**Range:**

**SAJH Distribution:** American Camp

**Plots:** SAJH (0)

**Environmental Description:** This stand was located in a restoration plot.

**Vegetation Description:** Planted rows of *Festuca idahoensis* ssp. *roemerii*.

**USFWS:** Not applicable.

**Comments:** This stand was considered ruderal due to the fact that planted *Festuca idahoensis* ssp. *roemerii* is the only native species present. If long-term restoration efforts succeed in reestablishing composition typical of a *F. roemerii* prairie then this stand could be reclassified into that type.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Xeric grassland with shrub islands, Agee 1987 (<>)





### ***Rubus armeniacus* Ruderal Shrubland Alliance**

Himalayan Blackberry Shrubland Association

**Acronym:** RUBARM Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Group:** Southern Vancouverian Lowland Ruderal Grassland & Shrubland

**Alliance:** *Rubus armeniacus* Ruderal Shrubland Alliance

**Range:**

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (0)

**Environmental Description:** Soils have been disturbed due to past a plowing.

**Vegetation Description:** *Rubus armeniacus* is the dominant shrub while a variety of pasture grasses may be found in the herbaceous understory with *Poa pratensis*, *Agrostis* spp., *Bromus* spp., and *Holcus lanatus* being the most common. The *Rubus* patches range from being dense to scattered.

**USFWS:** Not applicable.

**Comments:** This type is found in previously plowed areas of American Camp.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Xeric grassland, Agee 1987 (<>)

Xeric grassland with shrub islands, Agee 1987 (<>)



## ***Festuca rubra* Stabilized Dune Herbaceous Vegetation Association**

### Red Fescue Stabilized Dune Herbaceous Vegetation Association

**Acronym:** FESRUB Stabilized Dune

**NatureServe Code:** CEG001774

**Macrogroup:** Cool Pacific Coastal Beach, Dune & Bluff Vegetation

**Group:** North Pacific Maritime Coastal Sand Dune Scrub & Herb Vegetation

**Alliance:** *Leymus mollis* - *Festuca rubra* Herbaceous Alliance

**Range:** This association is found in the sand dunes that exist in scattered localities along the northern Pacific coast, primarily in northern Oregon and Washington.

**SAJH Distribution:** American Camp

**Plots:** SAJH (5)

**Environmental Description:** This association occurs where the movement of sand is generally slight to moderate, such as on sheltered sand plains, old blowouts or deflation plains. It is especially well-developed on deflation plains where moisture is ample, but without standing water. Within SAJH, this type is found on old beach deposits or sandy glacial outwash near the coast.

**Vegetation Description:** This association is a sparse to moderately dense, herbaceous association dominated by perennial grasses and forbs. The grass *Festuca rubra* is commonly present and spreading by long rhizomes. This association is rich in forb species. Most of the species occurring in the association are not found in unstabilized dune forms. Other species common to this grassland include *Cardionema ramosissimum*, *Hypochaeris radicata*, *Lupinus littoralis*, *Polygonum paronychia*, *Polypodium glycyrrhiza* and *Solidago simplex* var. *spathulata* (= *Solidago spathulata*). Other native species occasionally present in the SAJH occurrences of this association include *Leymus mollis*, *Rubus ursinus*, *Abronia latifolia*, *Lupinus littoralis*, *Bromus sitchensis*, *Pteridium aquilinum*, *Cerastium arvense*, *Lathyrus japonicus* var. *maritimus*, and *Luzula multiflora* var. *multiflora*. Nonnative species are abundant in the SAJH occurrences with *Holcus lanatus*, *Poa pratensis*, and *Cirsium arvense* almost always present and abundant. Other nonnative species present include *Bromus diandrus* (= *Bromus rigidus*), *Dactylis glomerata*, *Aira caryophyllea*, *Vicia hirsuta*, *V. villosa* ssp. *villosa*, *Geranium molle*, *Rumex acetosella*, *Taraxacum officinale*, *Holosteum umbellatum*, *Hypochaeris radicata*, and *Rubus armeniacus*.

**USFWS:** Not applicable.

**Comments:** This type is found at American Camp mostly outside of areas that were previously plowed and occur near the coast, albeit sometimes on bluffs above the beach.

**Conservation Rank:** G1S1

**Rank Justification:** This association is restricted to a few scattered localities within the mosaic of habitats in Pacific Northwest coastal dune systems, primarily in Oregon and southern Washington. The habitat requirements are very specific requiring dune areas where sand movement is generally slight to moderate, such as on sheltered sandplains, old blowouts and deflation plains. This association is severely threatened throughout its range by off road vehicle (ORV) activity, development and exotic species especially *Ammophila arenaria* (European beachgrass) encroachment.

**Synonyms:**

*Leymus mollis* - *Holcus lanatus*, Rochefort and Bivin, 2009 (<>)

*Lupinus littoralis* - *Bromus rigidus*, Rochefort and Bivin, 2009 (<>)

*Festuca rubra* (Stabilized Dune Grasslands), Bourgeron and Engelking 1994

*Festuca rubra* Herbaceous Vegetation, Christy, Kagan, and Wiedemann 1998

Xeric grassland with shrub islands, Agee 1987 (<>)



## ***Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation Association**

Red Fescue - Beach Bursage Herbaceous Vegetation Association

**Acronym:** FESRUB-AMBCHA

**NatureServe Code:** CEGLO03290

**Macrogroup:** Cool Pacific Coastal Beach, Dune & Bluff Vegetation

**Group:** North Pacific Maritime Coastal Sand Dune Scrub & Herb Vegetation

**Alliance:** *Leymus mollis* - *Festuca rubra* Herbaceous Alliance

**Range:** This association is found on coastal spits and sandy beach berms in the Puget Lowlands of Washington. It may also occur rarely on the Oregon coast, and may have formerly occurred in British Columbia.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This association is typically found on portions of the spit/berm that are relatively stabilized and not exposed to the full force of wind and waves.

**Vegetation Description:** The association is dominated by the grass *Festuca rubra*, in relatively open to fully closed stands. The forbs *Grindelia stricta* and *Ambrosia chamissonis* are sometimes subdominant and almost always present. The community is typically relatively diverse in composition, with several other salt-tolerant species often present. It is distinguished by the dominance of *Festuca rubra* and the presence of *Ambrosia chamissonis*, as well as its habitat of coastal spits or berms. *Festuca rubra*, *Ambrosia chamissonis*, *Atriplex patula* ssp. *patula* and *Lepidium virginicum* var. *menziesii* were also dominant in the SAJH occurrences. Other native species in the SAJH stands include *Elymus trachycaulus*, *Honckenya peploides* ssp. *major*, *Grindelia stricta* var. *stricta*, *Hordeum jubatum*, and *Distichlis spicata*. Nonnative species present in the SAJH occurrences include *Bromus diandrus* (= *Bromus rigidus*), *B. sterilis*, *Cirsium vulgare*, *Dactylis glomerata*, *Hypochaeris radicata*, *Juncus gerardii* var. *gerardii*, and *Plantago lanceolata*.

**USFWS:** Not applicable.

**Comments:** This type is found at American Camp at the upper portion of the beach at First and Jake's lagoons.

**Conservation Rank:** G1S1

**Rank Justification:** There are estimated to be 6-10 minimally viable occurrences of this association, and they cover a small area. This association has probably declined very significantly from its historic extent. Few of the occurrences have good viability. Exotic species invasions, natural succession, alteration of coastal geomorphic processes, and development have all contributed to its loss and degradation and continue to pose very significant threats.

**Synonyms:**

*Elymus mollis* - *Festuca rubra*, Kunze 1994 (?)

*Festuca rubra* Herbaceous Vegetation, Kunze 1994 (?)

*Festuca rubra* - *Grindelia integrifolia*, Kunze 1994 (?)



## ***Leymus mollis* - *Abronia latifolia* Herbaceous Vegetation Association**

American Dune Grass - Yellow Sand-verbena Herbaceous Vegetation Association

**Acronym:** LEYMOL-ABRLAT

**NatureServe Code:** CEGLO01796

**Macrogroup:** Cool Pacific Coastal Beach, Dune & Bluff Vegetation

**Group:** North Pacific Maritime Coastal Sand Dune Scrub & Herb Vegetation

**Alliance:** *Leymus mollis* - *Festuca rubra* Herbaceous Alliance

**Range:** This community is known from coastal dunes of northern California to British Columbia.

**SAJH Distribution:** American Camp

**Plots:** SAJH (7)

**Environmental Description:** This association is found on sand hummocks and foredunes in areas of incessant onshore winds, salt spray, and shifting sands. Desiccation is a major factor; and many of the species are succulent. The sand dunes are loose and easily transported, constantly burying the plants. Most of the species occurring here are stimulated to grow by burying, trapping sand until hummocks up to 5 m are formed. The hummocks are then wind-eroded, to form elsewhere. Dune sands are very poor soils. There is no accumulation of organic matter, and nutrients are so low as to be immeasurable. Because of rapid drainage and the high rainfall, salinity is not an important factor in these soils, even on areas just above the beach.

**Vegetation Description:** This association is a sparse grassland occurring on the upper strand and foredunes. Total cover is 10-50%. Plant species composing this community are perennial grasses up to 70 cm tall, including *Leymus mollis* ssp. *mollis* (= *Elymus mollis*) and *Poa macrantha*. Low, often succulent, perennial forbs and subshrubs are also common, including *Abronia latifolia*, *Calystegia soldanella* (= *Convolvulus soldanella*), *Glehnia littoralis* ssp. *leiocarpa* (= *Glehnia leiocarpa*), and *Lupinus littoralis*. These species are adapted to the constant desiccating winds, salt spray and shifting sands. Most of them are 'hummock builders,' trapping sand until hummocks up to 5 m in height are formed, which then erode. Other native species present in the SAJH occurrences include *Ambrosia chamissonis*, *Lathyrus japonicus*, *Poa confinis*, *Carex macrocephala*, *Grindelia stricta* var. *stricta*, *Hypericum scouleri* ssp. *scouleri*, *Festuca rubra*, *Amsinckia menziesii*, and *Pteridium aquilinum*. Abundant nonnative species in the SAJH stands include *Cirsium arvense*, *Bromus sterilis*, *B. diandrus*, *Aira caryophyllea*, *A. praecox*, *Holosteum umbellatum*, and *Rumex acetosella*.

**USFWS:** Not applicable.

**Comments:** Within SAJH, this association only occurs at American Camp. One occurrence is found along the upper part of the beach near Old Town Lagoon while the remaining stands of this association occur throughout the large sand flat and along South Beach. The stands along the upper part of the beach look are linear and in these areas *Leymus mollis* has a robust appearance with glaucous and abrasive leaves. The other stands consist of small patches where *Leymus mollis* has more cover and appears yellow-green with softer leaves.

**Conservation Rank:** G2?S2

**Rank Justification:** Actively-moving sand and salt spray are requirements. The few remaining occurrences are small and degraded by non-native species and loss of sand movement. Despite its large range, this community is ranked high because so few high-quality occurrences remain, so few are protected, and the condition of existing occurrences continues to decline. This association used to be widespread, but has been almost completely replaced by an introduced beachgrass, *Ammophila arenaria*.

### **Synonyms:**

*Abronia latifolia*, Rochefort and Bivin 2009 (<>)

*Cakile maritime* - *Bromus sterilis*, Rochefort and Bivin 2009 (<>)

*Leymus mollis* - *Holcus lanatus*, Rochefort and Bivin 2009 (<>)

*Lupinus littoralis* - *Bromus rigidus*, Rochefort and Bivin 2009 (<>)

*Leymus mollis* - *Lathyrus japonicus*, WNHP 2004

*Leymus mollis* ssp. *mollis* Herbaceous Vegetation, Christy, Kagan, and Wiedemann 1998

*Elymus mollis* - *Abronia latifolia*, Bourgeron and Engelking 1994

*Elymus mollis* - *Abronia latifolia*, Wiedemann 1984



## ***Camassia quamash* - *Triteleia hyacinthina* Seasonally Flooded Herbaceous Vegetation Association**

Common Camas - White Fool's Onion Seasonally Flooded Herbaceous Vegetation Association

**Acronym:** CAMQUA-TRIHYA

**NatureServe Code:** Preliminary

**Macrogroup:** Western North American Lowland Freshwater Wet Meadow & Marsh

**Group:** Vancouverian Freshwater Coastal Marsh & Meadow & Marsh

**Alliance:** *Camassia quamash* Seasonally Flooded Herbaceous Alliance

**Range:** This association occurs in the western Columbia River Gorge, Skamania County, in the southern Puget Trough of Clark County (Vancouver Lowlands), in foothills of southeastern Thurston County, and possibly elsewhere in the Puget Trough. It also occurs in the Willamette Valley of Oregon and possibly in the Georgia Basin of British Columbia.

**SAJH Distribution:** English Camp

**Plots:** SAJH (1)

**Environmental Description:** This association occupies small patches within balds on sites that appear to be very moist to wet. They are very moist to wet in the spring then become much drier later in the season. The seasonal water is perched on top of bedrock. Soils are consistently very shallow, with a maximum depth of about 15 cm. Outcrops are usually not present within the association, but often directly adjacent to it. Aspect is southeast to west-southwest. Slopes are gentle to moderate in steepness in and around the Puget Trough, and steep (60-90%) in the Columbia Gorge. Slope position is mostly middle to upper slopes, with one plot on a broad ridgetop (the SAJH occurrence is another on a ridgetop). Microtopography is most often concave (capturing water), though it can be straight, undulating, or convex. Recorded elevation ranges from 100 m to 560 m. Surficial geology is composed of basalt, andesite, and volcanoclastic rocks.



**Vegetation Description:** This vegetation type is typically dominated by forbs. *Camassia quamash* is always dominant or co-dominant. All but one of our plots were co-dominated by *Triteleia hyacinthina*. *Prunus vulgaris* is usually prominent. *Leptosiphon bicolor*, *Festuca idahoensis* ssp. *roemerii*, and *Mimulus guttatus* are occasionally prominent. *Zigadenus venenosus*, *Mimulus guttatus* and *Madia gracilis* are usually present. The non-native species *Aira caryophyllea*, *Bromus hordeaceus*, *Holcus lanatus*, *Hypochaeris radicata*, and *Sherardia arvensis* are frequent and often prominent. The SAJH occurrence is a small patch located on Young Hill and is dominated by *Camassia quamash*, with *Triteleia hyacinthina* prominent to co-dominant. The bryophyte layer is dense. Nonnative species are very abundant and includes *Aira caryophyllea*, *A. praecox*, *Hypochaeris radicata*, *Juncus tenuis*, *Rumex acetosella*, and *Vulpia bromoides*. A rare rush (either *Juncus kelloggii* or *Juncus tiehmi*—identification pending, although both are state rare plants) occurs in the SAJH occurrence.

**USFWS:** Palustrine

**Comments:**

**Conservation Rank:** GNRS1S2

**Rank Justification:** There are five known occurrences in Washington. Potential threats include invasion and increase of non-native species, road-building, timber harvest, and recreational impacts.

**Synonyms:**

## ***Carex obnupta* Herbaceous Vegetation Association**

Slough Sedge Herbaceous Vegetation Association

**Acronym:** CAROBN

**NatureServe Code:** CEGLO03313

**Macrogroup:** Western North American Lowland Freshwater Wet Meadow & Marsh

**Group:** Vancouverian Freshwater Coastal Marsh & Meadow & Marsh

**Alliance:** *Carex obnupta* Seasonally Flooded Herbaceous Alliance

**Range:** Throughout western Washington and Oregon.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This association is found in isolated depressions with internal drainage, peatlands, shrub swamps, ancient marine terraces, and deflation plains. The SAJH occurrence occurs in a shallow depression that is seasonally saturated due to seasonally elevated water table or groundwater seepage.



**Vegetation Description:** This association is heterogeneous and difficult to segregate into meaningful types. Stands range from species-rich assemblages to monotypes, and dense to depauperate stands, the latter with only bare mud or sphagnum between the plants. Tussocks may be 15 cm in diameter, closely spaced and 3-9 dm (1-3 feet tall), or 9 dm (3 feet) in diameter, 0.9-1.8 m (3-6 feet) apart and growing up to 1.8 m (6 feet) tall. Trees are mostly peripheral, and *Alnus rubra* and *Fraxinus latifolia* are the primary species but have low constancy and cover. Fourteen species of shrubs are reported, with *Rubus ursinus* having the highest constancy of only 11%. Other shrubs with significant patches include *Rosa pisocarpa*, *Rosa gymnocarpa*, and *Corylus cornuta*. More than 80 species have been recorded from the herb layer, *Carex obnupta* being most abundant with average cover of 66% and ranging from 20-99%. Other species in the herb layer with significant patches include *Athyrium filix-femina*, *Rorippa nasturtium-aquaticum*, *Oenanthe sarmentosa*, *Lysichiton americanus*, *Veronica americana*, *Carex exsiccata*, *Myosotis laxa*, and *Carex cusickii*. At SAJH, *Poa trivialis* co-dominates. Other species present include *Rubus ursinus*, *Argentina egedii* ssp. *egedii*, *Eleocharis palustris*, *Ranunculus flammula*, and *Danthonia californica*.

**USFWS:** Palustrine

**Comments:** Found at American Camp.

**Conservation Rank:** G4S4

**Rank Justification:** This association is relatively common throughout its range.

**Synonyms:**

*Carex obnupta*, Christy 2004

*Carex obnupta*, Murray 2000

*Carex obnupta*, Kunze 1994

*Carex obnupta* Seasonally Flooded Herbaceous Vegetation, Christy, Kagan, and Wiedemann 1998

## ***Equisetum telmateia* Herbaceous Vegetation Association**

Giant Horsetail Herbaceous Vegetation Association

**Acronym:** EQUDEL

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Lowland Freshwater Wet Meadow & Marsh

**Group:** Vancouverian Freshwater Coastal Marsh & Meadow & Marsh

**Alliance:** *Equisetum* (*arvense*, *variegatum*, *hyemale*, *telmateia*) Semipermanently Flooded Herbaceous Alliance

**Range:** This association has been documented on San Juan Island and in one plot in western Oregon.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (2)

**Environmental Description:** The two occurrences at SAJH are both found in seeps. The occurrence at English Camp is in a seep at the base of a slope while the American Camp occurrence is in saturated soil upslope of a stand of *Salix hookeriana*. The plot in western Oregon was from a beaver pond complex where soils were a mix of textures.

**Vegetation Description:** Within SAJH, this association is dominated by *Equisetum telmateia* var. *braunii*. *Poa trivialis*, *Urtica dioica*, *Carex tumulicola*, *Rubus ursinus*, *Equisetum arvense*, *Galium aparine*, *Heracleum maximum*, and *Lysichiton americanus* are usually prominent. Nonnative species present and sometimes co-dominant include *Holcus lanatus*, *Poa pratensis*, *Phalaris arundinacea*, *Cirsium arvense*, *C. vulgare*, *Schedonorus phoenix*, *Vicia sativa*, *V. hirsuta*, and *Dactylis glomerata*.

**USFWS:** Palustrine

**Comments:** This association is poorly described. It may be a disturbance-induced association.

**Conservation Rank:** GUSUQ

**Rank Justification:**

**Synonyms:**

*Equisetum telmateia*, Murray 2000



***Juncus arcticus ssp. littoralis* Pacific Coast Herbaceous Vegetation Association**

Baltic Rush Herbaceous Vegetation Association

**Acronym:** JUNBALBAL

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Lowland Freshwater Wet Meadow & Marsh

**Group:** Vancouverian Freshwater Coastal Marsh & Meadow & Marsh

**Alliance:** (*Juncus arcticus ssp. littoralis* - *Juncus effusus*) Herbaceous Alliance

**Range:** This association is known to occur on San Juan Island of Washington State. It is likely found throughout the dry climatic region of western Washington and southwestern British Columbia and Gulf Islands. It may occur elsewhere in western Washington.

**SAJH Distribution:** American Camp

**Plots:** SAJH (2)



**Environmental Description:** This association occurs in seeps or areas where the water table is close enough the surface that capillary action keeps the soils moist through the summer. It is found in the upper or toe slopes of steep, coastal bluffs as well as a few areas just above bluff edge. The association is most abundance in the extreme southwest corner of American Camp where a large seep is likely present.

**Vegetation Description:** *Juncus arcticus ssp. littoralis* dominates the association. *Juncus effusus*, *Pteridium aquilinum*, *Cerastium arvense*, and *Bromus sitchensis* are usually prominent to co-dominant. Nonnative species such as *Poa pratensis*, *Cirsium arvense* and *Vicia sativa* are usually present. In one stand, *Poa pratensis*, *Cirsium arvense*, *Holcus lanatus*, and *Galium aparine* were co-dominant with native species.

**USFWS:** Palustrine

**Comments:** With SAJH, this association is located in the southwestern corner of American Camp. This is a poorly described association.

**Conservation Rank:** GUSUQ

**Rank Justification:**

**Synonyms:**

*Juncus arcticus ssp. littoralis* - *Schedonorus pratensis* - *Juncus effusus*, Rochefort and Bivin 2009 (<>)



***Juncus effusus* var. *brunneus* Herbaceous Wet Meadow Vegetation Association**

Soft Rush Herbaceous Wet Meadow Vegetation Association

**Acronym:** JUNEFF

**NatureServe Code:**

**Macrogroup:** Western North American Lowland Freshwater Wet Meadow & Marsh

**Group:** Vancouverian Freshwater Coastal Marsh & Meadow & Marsh

**Alliance:** (*Juncus arcticus* ssp. *littoralis* - *Juncus effusus*) Herbaceous Alliance

**Range:** This association is reported from the vicinity of the Point Reyes National Seashore, as well as from the Puget Trough region of Washington and British Columbia. Information about its global range is not available without additional inventory. Other stands of *Juncus effusus* have been identified from Humboldt County to Monterey County, California. However, there has been no systematic sampling of these stands to identify floristic affinities.

**SAJH Distribution:** English Camp

**Plots:** SAJH (0)

**Environmental Description:** This association is generally thought of as a disturbance type resulting from grazing, but some occurrences suggest that it is native in some places because they are unlikely to have ever been heavily grazed. Vegetation fitting the general description of this association has been identified in coastal wetlands throughout much of California. *Juncus effusus* var. *brunneus* is the common coastal variety that is likely to compose most of these stands (Hickman 1993). Slopes and depressions are likely settings.

**Vegetation Description:** This association is widespread at a variety of elevations but is especially abundant at low elevations in western Oregon and Washington. Trees are nearly absent but may include *Alnus rubra*, *Fraxinus latifolia*, *Quercus garryana*, or conifers peripheral to the wetland. Eight shrub species are recorded, with *Salix sitchensis* being most abundant, but their cover is negligible. The herb layer includes about 60 different species, with *Juncus effusus* being most abundant with an average cover of 52% and ranging from 20 to 85%. *Juncus ensifolius* (= *Juncus xiphioides* var. *triandrus*) is a consistent associate but has very low cover, while *Hypericum anagalloides* is much more abundant but present with slightly lower constancy. Other species occurring in significant patches include *Scirpus microcarpus*, *Equisetum arvense*, *Oenanthe sarmentosa*, and *Athyrium filix-femina*, and five species are exotics. Old pastures at low elevations may also have large amounts of *Ranunculus repens*. The SAJH occurrences are dominated by *Juncus effusus* var. *brunneus* with *Juncus ensifolius*, *Carex leporina*, *Equisetum arvense*, *Holcus lanatus*, and *Poa pratensis* being prominent to present.

**USFWS:** Palustrine

**Comments:** The SAJH occurrence occurs in an area previously plowed and likely grazed.

**Conservation Rank:** G5S5

**Rank Justification:** Stands are of limited extent and limited to within a few kilometers of the coast, but are expected to be found to be common.

**Synonyms:**



## ***Oenanthe sarmentosa* Herbaceous Vegetation Association**

Water Parsley Herbaceous Vegetation Association

**Acronym:** OENSAR

**NatureServe Code:** CEG003319

**Macrogroup:** Western North American Lowland Freshwater Wet Meadow & Marsh

**Group:** Vancouverian Freshwater Coastal Marsh & Meadow & Marsh

**Alliance:** *Oenanthe sarmentosa* Herbaceous Alliance

**Range:** This association has been documented on San Juan Island and in western Oregon. It is thought to range from Oregon to British Columbia.

**SAJH Distribution:** American Camp

**Environmental Description:** The two occurrences at SAJH are both found in depressions where standing water occurs in spring and early summer. As described in Oregon, these sites are flooded early in the season and dry down in summer although the soil remains moist.

**Vegetation Description:** Within SAJH, this association is dominated by *Oenanthe sarmentosa*. *Glyceria elata* co-dominated one occurrence. *Carex obnupta* and *Urtica dioica* were present in one occurrence each.

**USFWS:** Palustrine

**Comments:** This association is poorly described. It may be a disturbance-induced association.

**Conservation Rank:** G4SU

**Rank Justification:**

**Synonyms:**

*Oenanthe sarmentosa*, Christy 2004



## ***Cornus sericea* Pacific Coast Shrubland Association**

Red-Osier Dogwood Shrubland Association

**Acronym:** CORSER

**NatureServe Code:** CEGLO05301

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Lowland - Montane Riparian and Wet Slope Shrubland

**Alliance:** *Cornus sericea* Temporarily Flooded Shrubland Alliance

**Range:** This type is based on a single plot in the North Cascades and one on San Juan Island. It may occur infrequently in riparian areas, as it is a widespread though rather uncommon, riparian community in western Washington.

**SAJH Distribution:** American Camp

**Plots:** SAJH (0)

**Environmental Description:** This association occurs in riparian floodplains and wetlands. This NOCA plot appears on shallow sloping, stabilized talus at 700 m (2292 ft) elevation. Duff and litter cover the rocky soil surface on a moist topographic position. The occurrence at SAJH was part of a larger wetland complex which experiences seasonal groundwater and surface water inputs.

**Vegetation Description:** *Cornus sericea* (=stolonifera) dominates, but otherwise the global type is variable in composition. The sampled vegetation in both stands is a thick shrubland dominated by *Cornus sericea* (=stolonifera).

**USFWS Wetland System:** Palustrine.

**Comments:** This is considered to be a provisional association that encompasses all *Cornus sericea*-dominated shrublands.

**Conservation Rank:** S3S4Q

**Rank Justification:** This provisional association occurs throughout Washington in somewhat localized sites. Direct or indirect alteration of hydrology resulting from road construction, timber harvest, and other land uses are threats.

**Synonyms:**

*Cornus sericea* ssp. *sericea*/*Lysichiton americanus* Association; Murray 2000

*Cornus stolonifera*; Wooten and Morrison 1995

*Cornus stolonifera* association; Diaz & Mellon 1996

*Cornus stolonifera*/Mesic Forb Association; Kovalchik 2001



### ***Crataegus douglasii* - *Rosa nutkana* Shrubland Association**

Black Hawthorn - Nootka Rose Shrubland Association

**Acronym:** CRADOU-ROSNUT

**NatureServe Code:** Provisional

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Lowland - Montane Riparian and Wet Slope Shrubland

**Alliance:** *Crataegus douglasii* Pacific Coast Shrubland Alliance

**Range:** This association is known to occur on San Juan Island of Washington State. It may be found throughout the dry climatic region of western Washington and southwestern British Columbia and Gulf Islands.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** This association appears to be associated with seasonal seeps. At the largest occurrence at SAJH, discharging groundwater was observed in three separate locations. The largest flow toward the western side is about 30-50 meters in length 0.5 m wide and 2-5 cm (Holmes 1998).

**Vegetation Description:** *Crataegus douglasii* and *Rosa nutkana* co-dominate this association. Very few other species are present but included *Rubus spectabilis*, *Sambucus racemosa*, and *Urtica dioica*.

**USFWS Wetland System:** Palustrine.

**Comments:** This association occurs at American Camp in two locations, both of which are seasonal seeps.

**Conservation Rank:** GUSUQ

**Rank Justification:** Additional data are needed to confirm this association.

**Synonyms:**



***Malus fusca* - (*Salix hookeriana*) / *Carex obnupta* Shrubland Association**

Oregon Crabapple - (Coastal Willow) / Slough Sedge Shrubland Association

**Acronym:** MALFUS-(SALHOO)/CAROBN

**NatureServe Code:** CEGLO03294

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Lowland - Montane Riparian and Wet Slope Shrubland

**Alliance:** *Malus fusca* Seasonally Flooded Shrubland Alliance

**Range:** This association is known from Washington and British Columbia.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** At SAJH, this association occurs in seasonally wet areas which receive surface flow and potentially some seasonal groundwater discharge.



**Vegetation Description:** At SAJH, this association is a mix of *Malus fusca*, *Alnus rubra*, and *Salix scouleri*, and *S. hookeriana*. In the largest occurrence at SAJH, *Salix scouleri* forms a conspicuous overstory while *Malus fusca* and *Salix hookeriana* are dominant in the sub-canopy. *Rubus spectabilis* is the dominant shrub in this stand with *Oenanthe sarmentosa* and *Stachys cooleyae* common in the understory. Other shrubs found in this type at SAJH include *Crataegus douglasii*, *C. monogyna* (nonnative), *Rosa nutkana*, *Ribes divaricatum*, *Rubus ursinus*, and *Lonicera involucrata*. *Malus fusca* and *Rosa nutkana* co-dominated some of the occurrences. *Urtica dioica*, *Athyrium filix-femina*, *Galium trifidum*, *Tellima grandiflora*, *Ranunculus sp.*, *Rumex sp.*, *Pteridium aquilinum*, and various *Carex* and *Juncus* species are also found in this association.

**USFWS Wetland System:** Palustrine.

**Comments:** This association is found near the 4<sup>th</sup> of July beach parking area at American Camp.

**Conservation Rank:** G3S3?

**Rank Justification:**

**Synonyms:**

*Malus fusca*-*Salix* spp. /*Carex obnupta*, Banner et al. 1986 (?)

*Pyrus fusca* - *Salix hookeriana* / *Carex obnupta*, Kunze 1994

## ***Rosa nutkana* - *Rubus spectabilis* Wet Shrubland Association**

Salmonberry Wet Shrubland Association

**Acronym:** RUBSPE

**NatureServe Code:** CEGLO03472

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Lowland - Montane Riparian and Wet Slope Shrubland

**Alliance:** *Rosa nutkana* - *Rubus spectabilis* Shrubland Alliance

**Range:** Currently only described from San Juan Island. It is likely to occur throughout the dry climatic areas (rainshadow of Olympic Mtns) of western Washington and British Columbia.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** At SAJH, this type is found at seeps near the coastline. Groundwater discharge occurs in winter through late spring/early summer. One stand, almost entirely dominated by *Rubus spectabilis*, is located adjacent to a large *Alnus rubra*/*Rubus spectabilis* stand and may be an extension of that type rather than this community.

**Vegetation Description:** The SAJH occurrences are co-dominated by *Rubus spectabilis* and *Rosa nutkana*. *Sambucus racemosa*, *Ribes* sp. and *Rubus parviflorus* are also prominent. The understory is sparse due to dense shrub cover but *Urtica dioica*, *Equisetum arvense*, and *Cirsium arvense* (nonnative) were observed.

**USFWS Wetland System:** Not applicable.

**Comments:** Additional data is needed to determine whether the SAJH occurrences of this type are a range extension of the CEGLO03472 *Rubus spectabilis* shrubland, a low elevation variant of the *Rubus parviflorus*-*Rubus spectabilis* Provisional Association described in Crawford et al. (2009), or a distinct type.

**Conservation Rank:** G4S?

**Rank Justification:**

**Synonyms:**

*Rubus parviflorus*-*Rubus spectabilis*, Crawford et al. 2009 (?)



## ***Salix hookeriana* - (*Salix sitchensis*) Shrubland Association**

Hooker's Willow - (Sitka Willow) Shrubland Association

**Acronym:** SALHOO-(SALSIT)

**NatureServe Code:** CEGL003387

**Macrogroup:** Vancouverian Flooded & Swamp Forest

**Group:** North Pacific Lowland - Montane Riparian and Wet Slope Shrubland

**Alliance:** *Salix hookeriana* Seasonally Flooded Shrubland Alliance

**Range:** Known from western Oregon and Washington. It is widespread in the Willamette Valley, along the Columbia River, and at lower elevations in the Cascade Range.

**SAJH Distribution:** American Camp

**Plots:** SAJH (1)

**Environmental Description:** According to Christy (2004), this association occurs in depressions in floodplains and potholes in basalt scablands of western Oregon and Washington. At SAJH, it is found in seeps or areas where there is a seasonally high water table.

**Vegetation Description:** The association is comprised of clonal shrub swamps of the inland morphotype of *Salix hookeriana* that was previously called *Salix piperi*. Shrub swamps of this species occur in two phases determined by composition of the herb layer. Stands are typically dense thickets and are either monotypes of *Salix hookeriana* or have admixtures of *Salix sitchensis* and/or *Spiraea douglasii*. In two plots from northwestern Oregon, *Salix hookeriana* has an average cover of 78% and ranging from 65-90%. The SAJH occurrences are co-dominated by *Salix hookeriana* and *Rubus spectabilis*. *Rosa nutkana* and *Rubus armeniacus* (nonnative) are also prominent. The herbaceous understory is sparse due to the density of shrubs but *Urtica dioica* and *Equisetum arvense* along with nonnative species such as *Cirsium arvense* and *Dactylis glomerata*.

**USFWS Wetland System:** Not applicable.

**Comments:** This association is found in the western portion of American Camp in seeps or areas where seasonally high water tables occur.

**Conservation Rank:** G2S?

**Rank Justification:** More information is needed regarding the distribution of this association within Washington.

**Synonyms:**

*Salix hookeriana* - (*Salix sitchensis*), Christy 2004

*Salix hookeriana*, Shephard 1995 (?)

*Salix hookeriana*, Boggs 2000 (?)



### ***Carex leporina* Ruderal Wet Meadow Association**

Oval Broom Sedge Ruderal Herbaceous Association

**Acronym:** CARLEP Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Group:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Alliance:** *Carex leporina* - *Equisetum arvense* - *Schedonorus pratensis* Ruderal Wet Meadow Alliance

**Range:** Found in a previously plowed and grazed area wet meadow at English Camp.

**SAJH Distribution:** English Camp

**Plots:** SAJH (1)

**Environmental Description:** Occurs in a previously plowed and grazed site.

**Vegetation Description:** *Carex leporina* dominates a portion of a previously plowed and grazed (presumably) meadow in the southwest corner of English Camp. The meadow is comprised of three different plant associations, differentiated mostly by dominant species.

*Juncus ensifolius* and *Symphoricarpos albus* are also

prominent in this type. Other species present include *Juncus effusus*, *Poa pratensis*, *Rosa nutkana*, *Rubus ursinus*, *Taraxacum officinale*, *Cirsium arvense*, *C. vulgare*, *Geum macrophyllum*, *Epilobium ciliatum*, *Gamochaeta purpurea*, and *Juncus acuminatus*.

**USFWS:** Palustrine

**Comments:** Although *Carex leporina* is a native species, this association is assumed to be the result of previous human-induced activities (plowing and grazing).

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**





## ***Equisetum arvense* - Mixed Graminoid Ruderal Wet Meadow Association**

Common Horsetail - Mixed Graminoid Ruderal Wet Meadow Association

**Acronym:** EQUARV-Mixed Graminoid Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Group:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Alliance:** *Carex leporina* - *Equisetum arvense* - *Schedonorus pratensis* Ruderal Wet Meadow Alliance

**Range:** This type is documented from one location at SAJH.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (1)

**Environmental Description:** This type occurs in a large seasonal seep that had been previously plowed. Soils are saturated in May but dry considerably by July.

**Vegetation Description:** This type is dominated by a mix of native and nonnative species. Prominent native species include *Equisetum arvense*, *Carex praticola*, *Deschampsia caespitosa*, *Juncus effusus*, and *J. ensifolius*. Other native species present include *Carex tumulicola*, *Alnus rubra* (saplings), *Spiraea douglasii*, *Geum macrophyllum* and *Juncus acuminatus*. *Alopecurus pratensis* is a dominant nonnative species. *Poa pratensis*, *Holcus lanatus*, *Agrostis stolonifera*, and *Phalaris arundinacea* are other nonnative species present.

**USFWS:** Palustrine

**Comments:** Due to past plowing of this area the resulting mix of species is novel relative to 'natural' analogues and thus is included as a ruderal type. With SAJH, this association is located in the southwestern corner of English Camp.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland w/ shrubs, Agee 1987 (<>)



## ***Schedonorus pratensis* Ruderal Wet Meadow Association**

Meadow Fescue Provisional Ruderal Wet Meadow Association

**Acronym:** SCHPRA Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Group:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Alliance:** *Carex leporina* - *Equisetum arvense* - *Schedonorus pratensis* Ruderal Wet Meadow Alliance

**Range:** This type is documented from two locations at SAJH.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (2)

**Environmental Description:** This type occurs in seasonally saturated soils which have been previously plowed and/or heavily grazed.

**Vegetation Description:** This ruderal type supports a diversity of native and nonnative species. *Schedonorus pratensis* (= *Festuca pratensis*) is the dominant nonnative species. *Holcus lanatus* can be co-dominant. Other nonnatives present include *Poa pratensis*, *Hypochaeris radicata*, *Plantago lanceolata*, *Vicia sativa*, *Taraxacum officinale* ssp. *officinale*, *Centaureum erythraea*, *Cirsium vulgare*, and *Crataegus monogyna*. Native species present include *Rosa nutkana*, *Rubus ursinus*, *Symphoricarpos albus*, *Prunella vulgaris*, *Pteridium aquilinum*, *Carex aurea*, *C. pachystachya*, *C. praticola*, *C. tumulicola*, *Danthonia californica*, *Fragaria virginiana*, *Juncus arcticus* ssp. *littoralis*, *Luzula multiflora* var. *multiflora*, *Sisyrinchium idahoensis*, and *Cerastium arvense*.

**USFWS:** Palustrine

**Comments:**

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland w/ shrubs, Agee 1987 (<>)



## ***Crataegus monogyna* / Mixed Forbs & Graminoids Ruderal Wet Shrubland Association**

English Hawthorn / Mixed Forbs & Graminoids Ruderal Wet Shrubland Association

**Acronym:** CRA(DOU,MON)-ROSNUT Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Group:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Alliance:** *Crataegus monogyna* - *Rosa nutkana*  
Ruderal Wet Shrubland Alliance

**Range:** This type is documented from American Camp within SAJH.

**SAJH Distribution:** American Camp

**Plots:** SAJH (5)

**Environmental Description:** This type occurs in seasonally to permanently saturated soils which have been previously plowed and/or heavily grazed.

**Vegetation Description:** This ruderal type supports a diversity of native and nonnative species. *Crataegus monogyna* (nonnative) and *Rosa nutkana* are always present and often the dominant species. *Crataegus douglasii* is sometimes present. Other native species sometimes present include *Geum macrophyllum*, *Juncus effusus*, *J. acuminatus*, *J. balticus* var. *balticus*, *Pteridium aquilinum*, *Rubus ursinus*, *Symphoricarpos albus*, *Salix scouleriana*, *S. lasiandra*, *Pinus contorta* ssp. *contorta*, *Pseudotsuga menziesii*, *Carex obnupta* (can be co-dominant), *Argentina egedii* ssp. *egedii*, and *Malus fusca*. *Alnus rubra*, *Carex praticola*, *Salix hookeriana*, and *Equisetum arvense* are occasionally present. *Holcus lanatus*, *Ranunculus repens* var. *repens*, and *Anthoxanthum odoratum* are nonnative species that are sometimes present while *Agrostis stolonifera*, *Phalaris arundinacea*, *Cynosurus cristatus*, *Poa pratensis*, and *Schedonorus pratensis* (= *Festuca pratensis*) are occasionally present. Numerous other native and nonnative species can be present. This type is distinguished from *Crataegus douglasii* - *Rosa nutkana* by the predominance of *Crataegus monogyna* and nonnative wetland species.

**USFWS:** Palustrine

**Comments:** This type occurs along the major east-west ditch which runs through American Camp north of the visitor center and south of Cattle Point Road. This type is also found in the large seep located near 4<sup>th</sup> of July Beach parking lot area.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland w/ shrubs, Agee 1987 (<>)



***Juncus gerardii* var . *gerardii* Ruderal Brackish Wet Meadow Association**

Mud Rush Ruderal Brackish Wet Meadow Association

**Acronym:** JUNGERGER Ruderal

**NatureServe Code:** Provisional

**Macrogroup:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Group:** Western North American Ruderal Wet Meadow, Marsh & Shrubland

**Alliance:** *Juncus gerardii* var. *gerardii* Ruderal Brackish Wet Meadow Alliance

**Range:** This type is documented from one location at SAJH.

**SAJH Distribution:** American Camp

**Environmental Description:** This type occurs around the periphery of a *Distichlis-Salicornia* salt marsh. The site is saturated and appears to less saline than the *Distichlis-Salicornia* site. Soils are likely brackish in nature.

**Vegetation Description:** *Juncus gerardii* var. *gerardii* and *Juncus arcticus* ssp. *littoralis* co-dominate the stand at SAJH. *Argentina egedii* ssp. *egedii*, *Galium triflorum*, *Leymus mollis*, *Festuca rubra* var. *littoralis*, *Cerastium arvense*, and *Achillea millefolium* are other native species present. Nonnative species present included *Poa pratensis*, *Holcus lanatus*, *Agrostis stolonifera*, *Elymus repens*, *Cirsium vulgare*, *Vicia sativa*, and *Rumex crispus*.

**USFWS:** Palustrine

**Comments:** With SAJH, this association is located at Old Town Lagoon.

**Conservation Rank:**

**Rank Justification:**

**Synonyms:**

Mesic Grassland w/ shrubs, Agee 1987 (<>)



***Salicornia virginica* - *Distichlis spicata* - *Triglochin maritima* - (*Jaumea carnosa*) Herbaceous Vegetation Association**

Virginia Glasswort - Inland Saltgrass - Seaside Arrow-grass - (Marsh Jaumea) Herbaceous Vegetation Association

**Acronym:** SALVIR-DISSPI-TRIMAR-(JAUCAR)

**NatureServe Code:** CEGLO03366

**Macrogroup:** North American Pacific Coastal Salt Marsh

**Group:** Temperate Pacific Tidal Salt & Brackish Marsh

**Alliance:** *Salicornia virginica* Tidal Herbaceous Alliance

**Range:** Known from Washington State and thought to occur in British Columbia.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (1)

**Environmental Description:** This association occurs in euhaline (>30 ppt), low tidal terraces.

**Vegetation Description:** This association is co-dominated by *Salicornia virginica*, *Distichlis spicata*, *Jaumea carnosa*, and *Triglochin maritima*. *Atriplex patula* ssp. *patula* and *Plantago maritima* var. *juncooides* are prominent. *Hordeum jubatum*, *Argentina egedii* ssp. *egedii*, *Spergularia canadensis*, and *Polypogon monspeliensis* are sometimes present.

**USFWS:** Palustrine

**Comments:** This association is found at both English and American Camps. At English Camp it occurs along shorelines of Garrison Bay. At American Camp, the association is found at Old Town, Jake's and Third lagoons.

**Conservation Rank:** G3S?

**Rank Justification:** Additional information is needed to determine the distribution and current extent of this association.

**Synonyms:**

*Salicornia virginica* - *Distichlis spicata* - *Triglochin maritima* - (*Jaumea carnosa*) Herbaceous Vegetation, Kunze 1984

*Distichlis spicata*-*Salicornia virginica*, Burg et al. 1980 (<>)

*Jaumea carnosa*-*Distichlis spicata*, Burg et al. 1980 (<>)



## ***Racomitrium canescens* - (*Selaginella wallacei*) Nonvascular Vegetation Association**

Racomitrium moss - (Wallace's Spike-moss) Herbaceous Vegetation Association

**Acronym:** RACMIT-(SELWAL)

**NatureServe Code:** Provisional

**Macrogroup:** Vancouverian Cliff, Scree & Rock Vegetation

**Group:** Vancouverian Cliff, Massive Bedrock and Rock Outcrop

**Alliance:** *Racomitrium canescens* Nonvascular Alliance

**Range:** This association is known to occur on San Juan Island of Washington State. It is found throughout the dry climatic region of western Washington and southwestern British Columbia and Gulf Islands.

**SAJH Distribution:** American Camp, English Camp

**Plots:** SAJH (1)

**Environmental Description:** This association occurs on rocky outcrops and balds and is limited to growing on rock surfaces or very shallow soils on warm exposures.



**Vegetation Description:** *Racomitrium canescens* dominates this association. *Selaginella wallacei* is typically present in stands that have not been too disturbed by human activity and when so is typically prominent to co-dominant. *Polytrichum juniperinum* and other moss species (e.g., *Dicranum* spp.) are often present. Overall, vascular plant cover is sparse and, when present, limited to rock cracks, very shallow soil, or around the periphery of rock outcrops. However, vascular plant cover in these specific areas can be greater than 25% but because of the very small scale of those patches, they have been mapped as part of this association. Vascular species present are mostly nonnative and include *Aira caryophylla*, *A. praecox*, *Bromus diandrus* (= *Bromus rigidus*), *B. hordeaceus*, *Festuca rubra* ssp. *rubra*, *Holcus lanatus*, *Hypochaeris radicata*, *Rumex acetosella*, and *Vicia sativa*. Native species occasionally present include *Carex inops*, *Mahonia aquifolium*, and *Rubus ursinus*. Some of the large rock outcrops on Young Hill mapped as this type may contain other plant associations described in this document, namely the *Camassia quamash* - *Triteleia hyacinthina* Seasonally Flooded Herbaceous Vegetation Association and the *Carex inops* - *Eriophyllum lanatum* Herbaceous Vegetation Association.

**USFWS:** Not applicable.

**Comments:** This association is found at both English and American Camps. It is limited to rock outcrops on Young Hill at English Camp and in the western portion of America Camp. Polygons mapped as this association may contain areas of >25% cover of vascular species in swales between rock outcrops or in cracks or depressions of the rock themselves. They are included with this concept due to the scale of mapping possible in this project. This association is somewhat similar to the *Selaginella wallacei* - *Festuca (roemerii, saximontana, brachyphylla)* Herbaceous Vegetation identified in Crawford (2009), except the latter occurs at higher elevations. A similar association is described in British Columbia as *Quercus garryana* - *Racomitrium* - *Selaginella wallacei* (Erickson and Meidinger 2007).

**Conservation Rank:** GNRSNR

**Rank Justification:** Most occurrences are naturally small. Many are likely to have been abundance nonnative vascular species present growing in rock cracks or around the periphery of this association. Most impacts are likely the result of grazing and recreation.

**Synonyms:**

*Quercus garryana* - *Racomitrium* - *Selaginella wallacei*, Erickson and Meidinger 2007 (><)

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## **Appendix C: Contingency Table of Alliances Mapped at San Juan National Historical Park Arranged into the National Vegetation Classification**

The contingency table or matrix displays the frequency of agreements and disagreements and is used to calculate accuracies of each map class. Values in cells are the number of Accuracy Assessment (AA) points of the alliance in the row that occurred in a polygon mapped as the alliance in the column, such that 100% accuracy would have all values in the diagonal. Users' accuracy and 90% confidence intervals (CI) appear in the final columns and Producers' accuracy and 90% confidence intervals appear in the last rows. Alliances are arranged into the National Vegetation Classification hierarchy displaying how mismatched AA points appear within different levels of the NVC. Higher level classification unit Users' accuracy and 90% confidence intervals appear in the final columns and Producers' accuracy and 90% confidence intervals appear in the last rows. Table codes for NVC classes are:

Subclasses-6.B Mediterranean, Temperate & Boreal Nonvascular & Sparse Vegetation (NSV), Terrestrial Bare Areas (TBA)

Divisions-1.C.1.c Western North American Warm Temperate Forest (WTF), 1.C.2.b Western North American Cool Temperate Forest (CTF), 1.C.3.c Western North American Flooded & Swamp Forest (FSF), 2.C.1.a Vancouverian & Rocky Mountain Grassland & Shrubland (VRGS), 2.C.3.b Pacific North American Coast Scrub & Herb Vegetation (CSH), 2.C.5.b Western North American Freshwater Wet Meadow & Marsh (FWM), 2.C.6.c Temperate & Boreal Pacific Coastal Salt Marsh (CSM), 6.B.2.b Western North American Temperate Cliff, Scree & Rock Vegetation (CSR), Terrestrial Bare Areas (TBAd)

Macrogroups-Californian-Vancouverian Foothill & Valley Forest & Woodland (CVF), Vancouverian Lowland & Montane Rainforest (LMF), Western North American Ruderal Forest & Plantation (RFP), Vancouverian Flooded & Swamp Forest (VFSF), Western North American Ruderal Flooded & Swamp Forest (RFSF), Southern Vancouverian Lowland Grassland & Shrubland (LGS), Southern Vancouverian Lowland Ruderal Grassland & Shrubland (LRGS), Cool Pacific Coastal Beach, Dune & Bluff Vegetation (CBDB), Western North American Lowland Freshwater Wet Meadow & Marsh (LFWM), Western North American Ruderal Wet Meadow & Marsh (RWM), North American Pacific Coastal Salt Marsh (CSMm), Vancouverian Cliff, Scree & Rock Vegetation (CSRm), Terrestrial Bare Areas (TBAm)

Groups-Californian-Vancouverian Deciduous Oak Woodland Group (DOW), Vancouverian Dry Coastal & Lowland (Douglas-fir, Shore Pine, Madrone) Forest & Woodland Group (CLF), North Pacific Maritime Douglas-fir - Western Hemlock Forest Group (DHF), North Pacific Maritime Western Red-cedar - Western Hemlock Forest Group (CHF), North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group (AMD), Vancouverian Ruderal Forest and Plantation Group (RFPg), North Pacific Lowland Riparian Forest & Woodland Group (LRF), North Pacific Maritime Lowland Hardwood-Conifer Swamp Group (LHCF), Vancouverian Ruderal Flooded & Swamp Forest Group (RFSFg), Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie Group (BBP), Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group (LRGSg), North Pacific Maritime Coastal Sand Dune Scrub & Herb Vegetation Group (CSD),

Vancouverian Freshwater Coastal Marsh & Meadow Group (FCMM), Vancouverian Lowland Riparian & Wet Slope Shrubland Group (LRWS), Western North American Ruderal Wet Meadow & Marsh Group (RWMg), Temperate Pacific Tidal Salt & Brackish Marsh Group (SBM), Vancouverian Cliff, Massive Bedrock and Rock Outcrop Group (CBO), Terrestrial Bare Areas (TBAG).





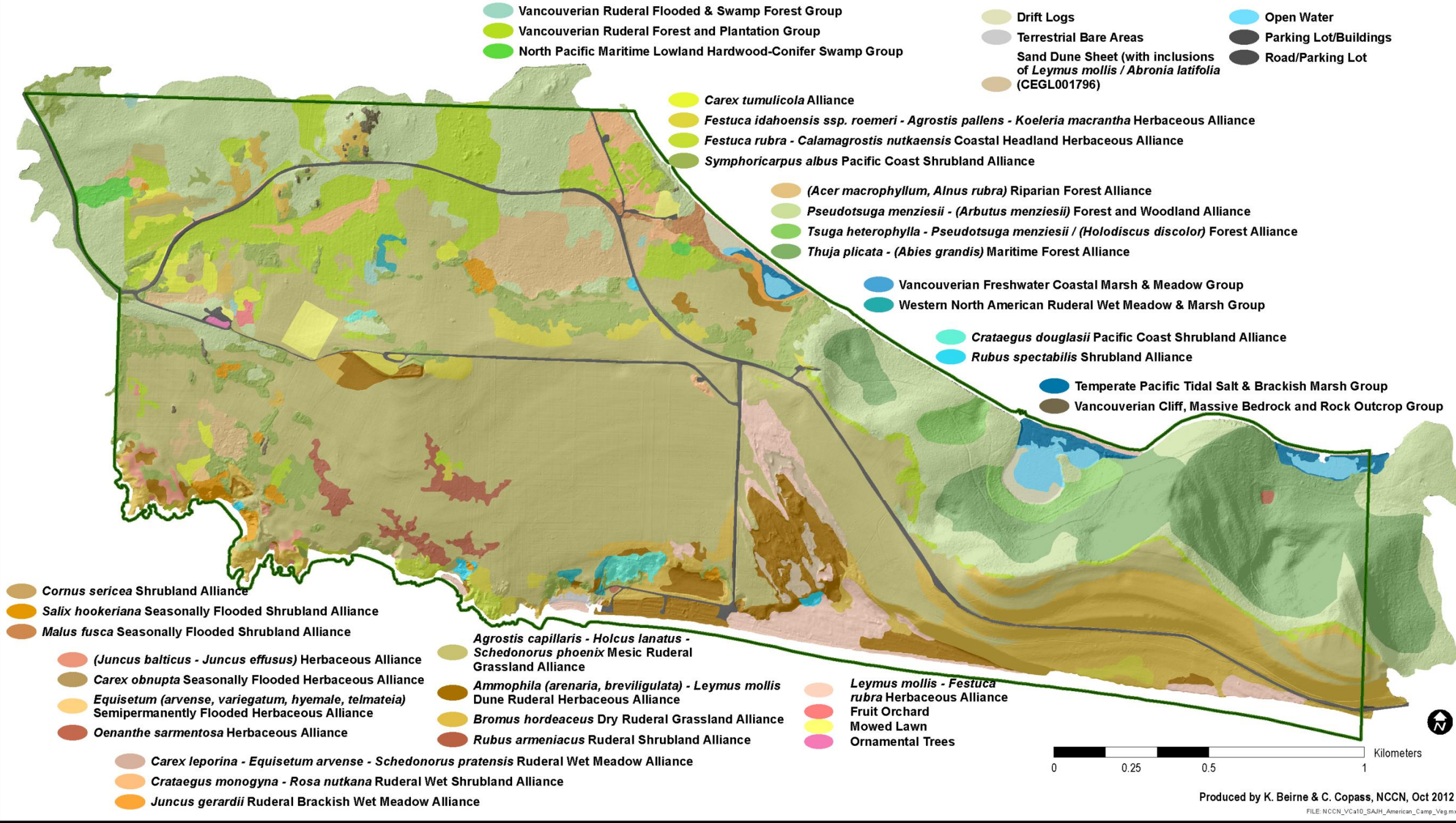
## **Appendix D: Vegetation Maps of San Juan Island National Historical Park**







# Vegetation Map



D-3

Figure D-1. Vegetation map of American Camp.



# Vegetation Map

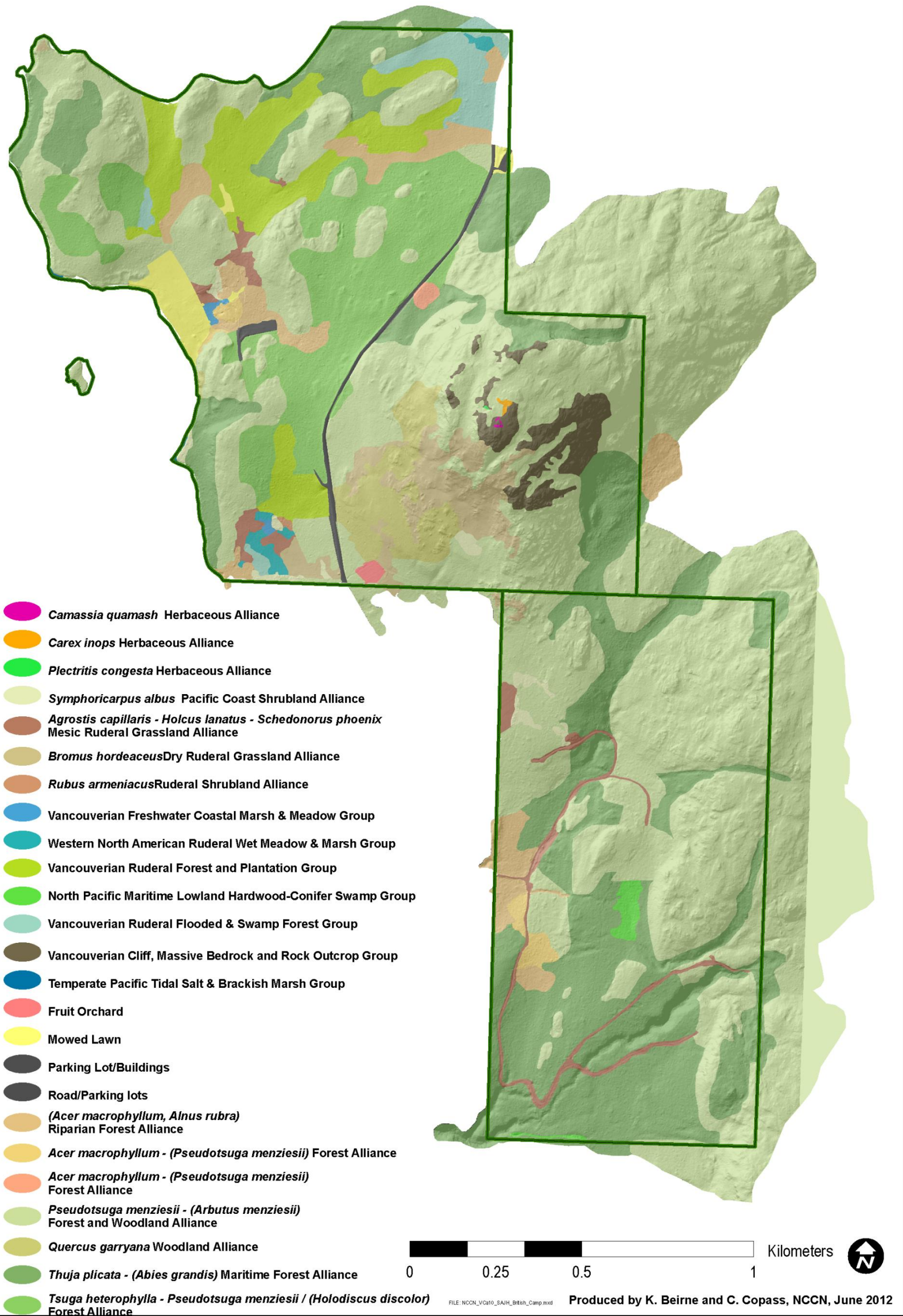


Figure D-2. Vegetation map of English Camp and Mitchell Hill

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 438/118224, December 2012

**National Park Service**  
**U.S. Department of the Interior**



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