



Ebey's Landing National Historical Reserve Vegetation Classification and Mapping Project

Natural Resource Report NPS/NCCN/NRR—2016/1127





ON THIS PAGE

Photograph of *Distichlis spicata*-(*Salicornia virginica*) Herbaceous Vegetation Association near Crockett Lake, Ebey's Landing National Historical Reserve.

Photograph by: Tynan Ramm-Granberg

ON THE COVER

Photograph of Perego's Lake and seaside bluffs, Ebey's Landing National Historical Reserve.

Photograph by: Tynan Ramm-Granberg

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Photo 1. Mapping a *Schedonorus phoenix* community at Ebey's Landing National Historical Reserve, Washington.

Executive Summary

This report presents a vegetation classification, inventory, and map of plant associations found across the entirety of Ebey's Landing National Historical Reserve. The classification, keys, and descriptions in the report will allow Reserve stakeholders to consistently identify and distinguish vegetation types within the Reserve and inform management decisions. The vegetation maps provided within the report represent the best available maps of existing (not potential) vegetation for the Reserve.



Photo 2. Steep bluffs along Puget Sound.

During the vegetation classification of Ebey's Landing National Historical Reserve, we inventoried 51 alliances or associations, of which 31% were forests and woodland communities, 57% were shrublands and herbaceous types, and 10 % were agricultural or developed types. The long and varied history of human land use at Ebey's Landing National Historical Reserve has resulted in ruderal classification for nearly one third of the forest, woodland, shrubland, and herbaceous types. Ruderal types are dominated by novel combinations of native and non-native vegetation due to human disturbance.

The Reserve is home to seventeen plant associations considered critically imperiled or imperiled in the state of Washington, or globally. These communities include dry forests or woodlands restricted to a limited range in the rain shadow zone of the Puget Sound basin, remnant and restoration prairie types, rare wetlands, a salt marsh type, and a fen.

Each vegetation type within the Ebey's Landing National Historical Reserve was mapped to at least the alliance level and most were mapped at the association level of the National Vegetation Classification system. The map shows that the Reserve is 59% cultural or unvegetated, roughly split between the pasture and agricultural fields map class and the combined high and low density housing map classes. A third of the Reserve is forest and woodlands. Two forest types, *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest and *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest contribute a majority of the forest cover. The *Symphoricarpos albus* - *Rosa nutkana* is the largest shrubland association, with much of that cover in the form of hedgerows. The largest non-ruderal herbaceous type is the *Distichlis spicata* - (*Salicornia virginica*) Herbaceous Vegetation Association, found ringing several of the lagoons and lakes. Map accuracy assessment focused on the natural vegetation types. Overall map accuracy is 81.1%.

The vegetation inventory and map provide contemporary tools for the multiple stakeholders in the Reserve. They can be used to inform a wide variety of management decisions, as well as interpret for residents of and visitors to the Reserve both the unbroken continuity and the change in the vegetation and land cover of this unique rural landscape.

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Acronyms

AA - Accuracy Assessment

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

DEM - Digital Elevation Model

EBLA - Ebey's Landing National Historical Reserve

ESRI - Environmental Systems Research Group

FGDC - Federal Geographic Data Committee

GIS - Geographic Information System

GPS - Global Positioning System

LiDAR - Light Imaging Detection and Ranging

NAIP - National Agricultural Imagery Program

NCCN - North Coast and Cascades Network

NPS - National Park Service

NVC - National Vegetation Classification

SAJH - San Juan Islands National Historical Park

USDA - United States Department of Agriculture

VIP - Vegetation Inventory Program (National Park Service)

WNHP - Washington Department of Natural Resources' Natural Heritage Program

Introduction

Project Overview

Background

Ebey's Landing National Historical Reserve (the Reserve) is located on Whidbey Island in the northern end of Puget Sound of Washington State. The Reserve was established in 1978 "in order to preserve and protect a rural community which provides an unbroken historical record from nineteenth century exploration and settlement in Puget Sound to the present time." The Reserve encompasses three state parks, the town of Coupeville, historic homes and farmsteads as well as diverse plant communities and habitats including remnant prairies, steep coastal bluffs, and forests found only within the dry Olympic rain shadow zone of Washington State.

Ebey's Landing National Historical Reserve was the first such Reserve established in the National Park System. Although the Reserve is a unit of the National Park System, its management differs from traditional NPS units in that it uses a cooperative management strategy, bringing together private and public resources to support the shared concept of the historical reserve as a mechanism for preserving a rural landscape. Most of the land in the Reserve is privately owned, with the rest a combination of local, state, and federal ownership. Instead of a traditional park superintendent, oversight of the Reserve is managed by a nine-member board of volunteers representing the four governmental partners. Although the National Park Service (NPS) was never intended to become a primary landowner within the Reserve, the NPS holds conservation or scenic easements on approximately 2,000 acres (809 ha), owns over 680 acres in fee, and is authorized to protect lands through additional acquisitions from willing sellers. The responsibilities of the NPS include operations, managing federal lands, cultural and natural resource management and protection, interpretation, and facility maintenance. The Reserve has access to support and services provided by the NPS to all national park units. In support of the unique role that the NPS has in management of the Reserve, the Vegetation Inventory Program offered to provide a comprehensive inventory and map of vegetation resources within the entire Reserve.

National Park Service Vegetation Inventory Program

The National Park Service (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. 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 National Park Service 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 for more than 270 national park units that have a natural resource component. For more information visit the VIP website at:
<http://science.nature.nps.gov/im/inventory/veg/index.cfm>.

Program scientists have developed data collection procedures for classification, mapping, accuracy assessment, and the 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 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://science.nature.nps.gov/im/inventory/veg/products.cfm>.

National Vegetation Classification Standard

The Federal Geographic Data Committee National Vegetation Classification (NVC) standard is used for this project (FGDC 1997, FGDC 2008). Vegetation classification systems describe repeating assemblages of plants that are found within similar habitats. The NVC is a hierarchical system which consists of eight levels. The three upper levels (Class, Subclass and Formation) are defined primarily by physiognomy with increasing influence of global macroclimate factors. Within the three middle levels (Division, Macrogroup and Group), combinations of increasingly narrow dominant and diagnostic plant species reflect biogeographical differences in climate, substrate and disturbance regime (Jennings et al. 2006). The lowest two levels (Alliance and Association) are driven primarily by species level differences at the subregional and local level and are the target levels of the NVC for NPS mapping projects. Appendix A provides additional information about the NVC.

Nomenclature and Naming Conventions

Species nomenclature in the National Vegetation Classification System follows the Integrated Taxonomic Information System, which receives its plant species information from USDA PLANTS (USDA 2011). Plant systematics continues to be reshaped by genetic studies, and the names of many species remain in flux. In this report, we may occasionally use a less recent species name for the sake of clarity if that taxon is still widely known by that convention. In such cases, synonyms are provided parenthetically after the species name (e.g. *Rubus armeniacus* (=bifrons)).

Conservation Rank

A global and state conservation status ranking system developed by NatureServe and the Natural Heritage programs describes the rarity of each plant community (<http://www.natureserve.org/explorer/ranking.htm>). 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 the Natural Heritage Program. State ranks are assigned by the Natural Heritage Program. Conservation rank is further explained in Appendix A and the conservation ranks are provided for each plant association as part of their description in Appendix B.

Ruderal and Provisional Plant Communities

The term “Ruderal” is used to describe plant communities (e.g. *Rubus armeniacus* Ruderal Shrubland) found in areas with a history of intensive land use. These vegetation communities are characterized by species that benefit from either natural or anthropogenic disturbance and typically contain a large percentage of non-native, invasive plants. Ruderal types may appear natural, but contain combinations of species not typically found together in undisturbed areas. Species composition in ruderal communities is often more strongly related to the type, duration and intensity of human activity than to typical environmental drivers. Ruderal types can pose a challenge for mapping, because plot sampling and classification work on ruderal types is relatively limited in comparison to natural types. In addition, ruderal types can be dynamic and express different characteristics year to year (Rocchio et al. 2012). Ruderal vegetation is sometimes referred to as “semi-natural.”

The term “Provisional” indicates a potential or proposed association that usually has fewer than five plots and generally no literature support other than recent NPS mapping efforts (Rocchio et al. 2012, Crawford et al. 2009). Provisional types are included in this report with the expectation that they will be evaluated for inclusion in the NVC.

Project Scope and Products

The Reserve covers over 18,119 acres (7,333 ha), including 14,137 acres (5,721 ha) of land and 3,982 acres (1,611 ha) of open salt water (Penn Cove). Private ownership of the majority of the Reserve poses significant challenges for an inventory of this nature. While the scope of the vegetation inventory project encompasses all of the Reserve, due to limited access we focused the field sampling on areas that are managed for their natural resources, an estimated 2,076 acres (840 ha). Where possible, larger tracts of forest, woodland, and shrubland located on private property were surveyed from their edges and, or from public roads.

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.

This report is organized sequentially into the following sections: Study Area, Classification of Vegetation Types, Mapping of Vegetation Types, Accuracy Assessment, Conclusion, Literature Cited, and Appendices. The report study methods and results were separated and presented in three sections: Classification of Vegetation Types, Mapping of Vegetation Types, and Accuracy Assessment.

Study Area

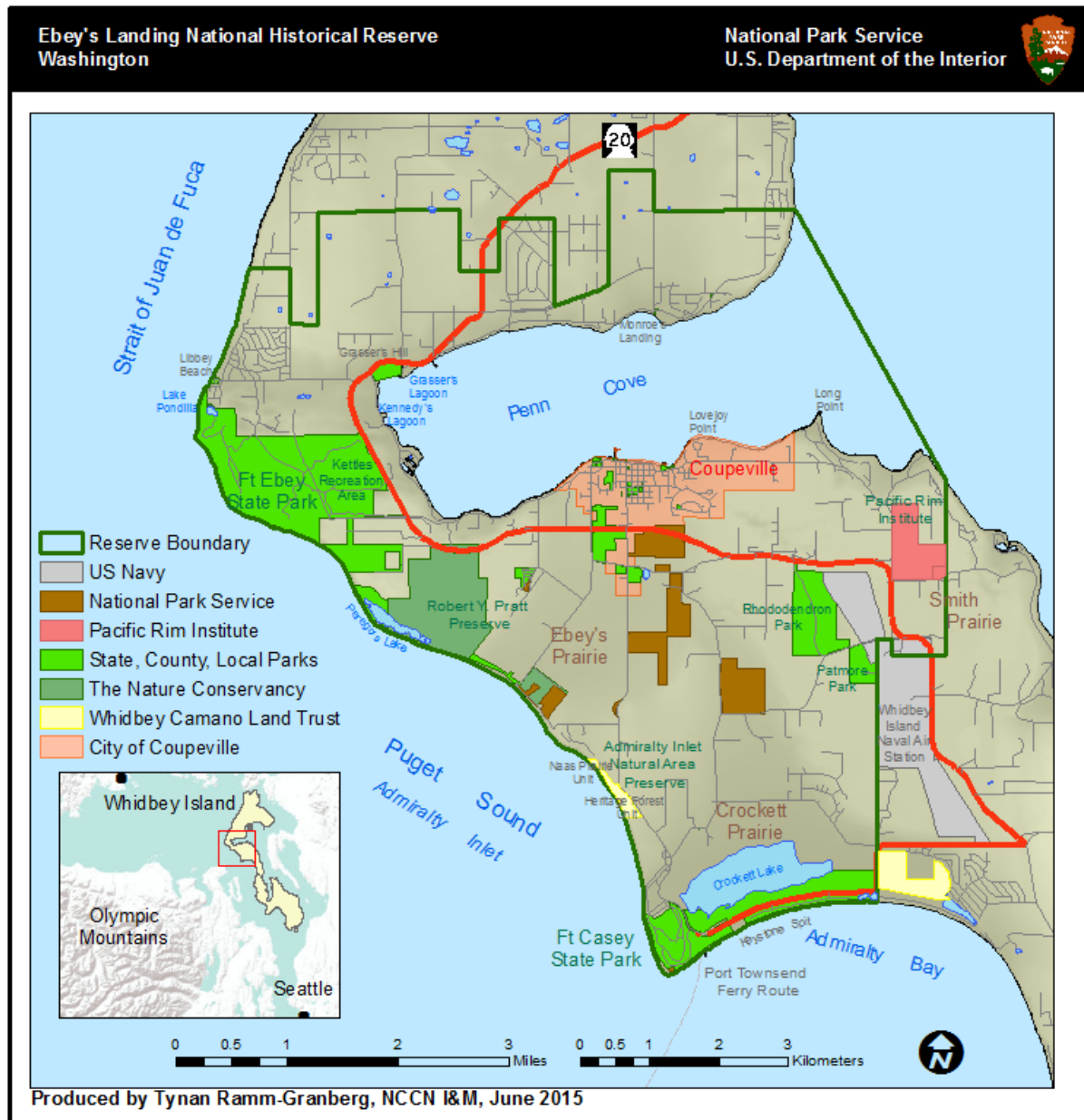


Figure 1. Location of Ebey's Landing National Historical Reserve, Washington.

Location

Ebey's Landing National Historical Reserve is located just north of the midpoint of Whidbey Island, in Washington State. Whidbey, the largest island in the state, lies about 30 miles north of Seattle and marks the junction of Puget Sound and the Strait of Juan de Fuca (Figure 1). Deception Pass separates the island from the mainland and the San Juan Islands lie just to the north. The Reserve spans the narrowest part of the island, where Penn Cove incises deeply into the island from the east, forming an isthmus.

Climate

The climate of Whidbey Island is strongly maritime-influenced--no point within the Reserve is further than 2.5 miles (4 km) from Puget Sound, the Strait of Juan de Fuca, or Penn Cove. Despite this proximity to the sea, the Reserve is one of the driest areas in western Washington. The Olympic Mountains to the west create a strong rain shadow effect, stripping much of the moisture from storms coming in off the Pacific Ocean. The average annual rainfall in Coupeville is only 21 inches (53 cm). Approximately 80% of that rain comes in the form of high frequency, low intensity storms during the months of October through May (NPS 2006).

While the proximity to water does not lead to an abundance of rain at the Reserve, it does have a moderating influence on temperatures. The mean annual temperature is a mild 50° F (10° C), with average highs of 58° F (14° C) and lows of 42° F (6° C). July sees average highs of 72° F (22° C) and lows of 51° F (11° C), while January drops to 45° F (7° C) and 34° F (1° C) respectively (WRCC 2015).

Geology and Topography

The Reserve's landscape is the result of a complex geologic history. Multiple advances and retreats of the Juan de Fuca and Puget lobes of the Cordilleran ice sheet formed the major surface features (NPS 2006). The last period of glacial advance reached its maximum extent approximately 14,500 years ago, covering present-day Coupeville with an estimated 4,500 ft (1,400 m) of ice. The final glacial retreat left deposits of unsorted, unstratified, and unconsolidated boulder-clay layers referred to as Vashon till. This sediment was deposited directly beneath the glaciers and not reworked by subsequent meltwater. Vashon till covers most of the upland areas of the Island today at a thickness of 3 feet (1 m) to approximately 175 feet (50 m). Also left behind by the glaciers were large deposits of proglacial outwash sands--sediments that were removed or "washed out" from underneath a glacier by meltwater streams and deposited beyond the ice front. These outwash sands are found at the lowest elevations of Whidbey Island and are overlain by till, which was later overlain by glacial-marine drift gravels (Graham 2011). Drift is the general term applied to all mineral materials that at one time were in contact with glacial ice or were transported by glacial meltwater.

Continental glacial retreat left many other imprints on the land. The kettle holes and kettle ponds steep-walled depressions in excess of 200 feet deep located northwest of Coupeville (Figure 2) -- were formed by large blocks of ice marooned within the glacial outwash which left depressions when they melted. A glacial outwash terrace created the gentle concave landform that is now Ebey's Prairie (Figures 1 and 2, Larrabee 2011). The highest points in the Reserve are made of marine sediments that are now high and dry due to post-glacial rebounding of the earth's surface and changes in sea level. No bedrock is exposed within the Reserve, though isolated outcroppings can be found to the north near Deception Pass (Larrabee 2011).

Today, elevations within the Reserve range from sea level to 200 feet (600 m). The western side of the Reserve is a narrow shoreline strip that ends abruptly at steep slopes and cliffs. These slopes grade generally to the east to the low lying prairies. The Kettles and outwash terrace are clearly visible in bare earth Lidar images (Figure 2). Topography also plays a significant role in soil

moisture and the development of plant communities. For example, flat areas of the Reserve underlain by dense sediments tend to have seasonally high water tables (USDA 2010).

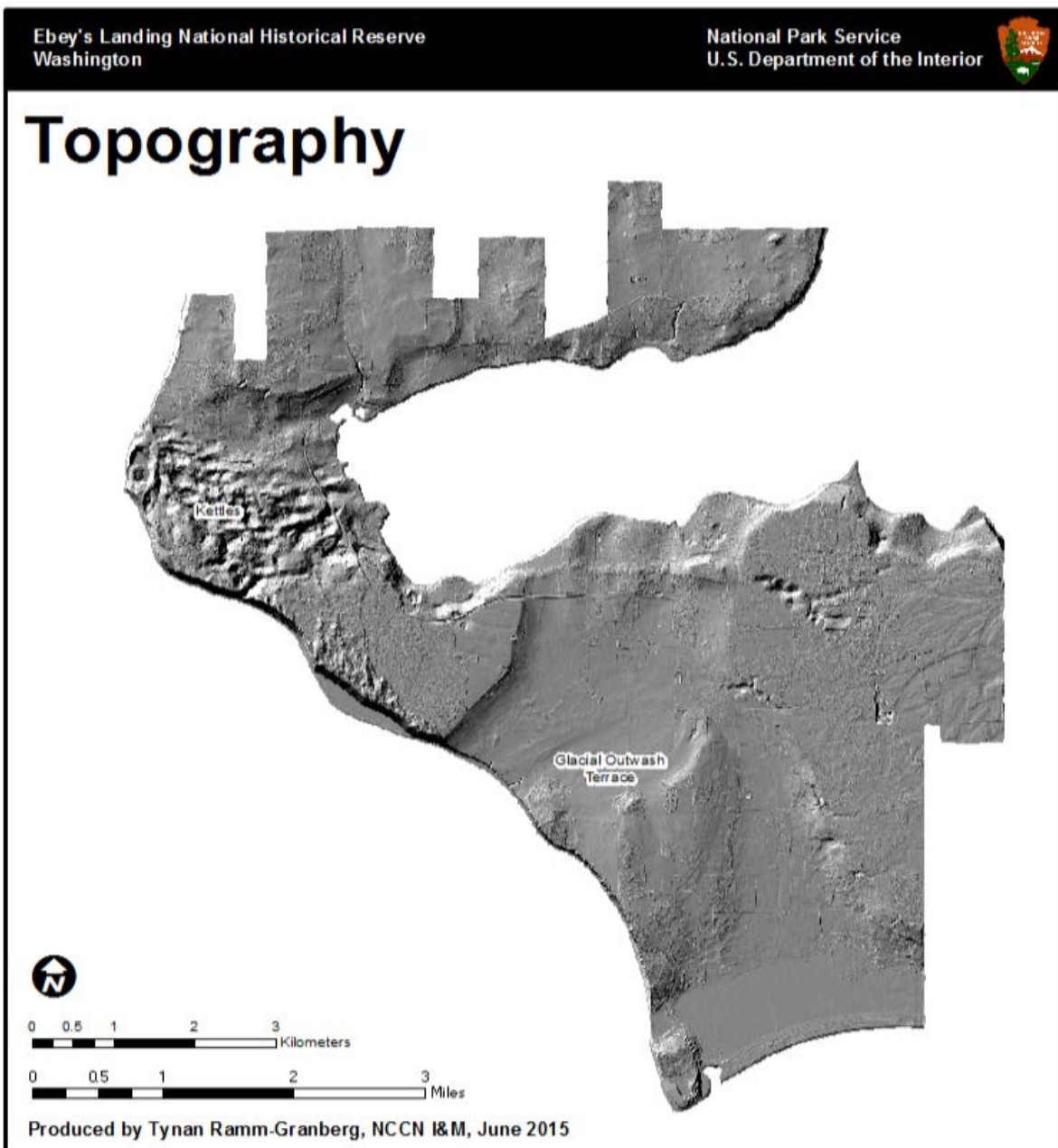


Figure 2. Lidar-derived Digital Elevation Model showing the topography of Ebey's Landing National Historical Reserve, Washington, in shaded relief.

Soils

A soil survey was conducted between 2005 and 2010 by the NPS Soil Inventory and Monitoring Program, in collaboration with the USDA Natural Resources Conservation Service and Whidbey Island Conservation District (USDA 2010) (Figure 3). Soils in the Reserve have resulted largely from

glaciation and subsequent topographic changes. Soils that formed in consolidated glacial sediment cover 52% of the Reserve (Figure 3). Most of the remaining soils formed in unconsolidated glacial sediment. Unconsolidated soil types tend to be droughty, while the consolidated (and often finer-textured) soils hold water closer to the surface, but may also restrict plant roots. Organic and tidal soils cover 5% of the Reserve. These are wetland soils (Beaches, Dugualla soils, Endoaquens, and Tidal soils).

The Ebey, Coveland, and Coupeville series are interesting soil types because they were probably covered by shallow estuaries or bays immediately after the glaciers receded. This inundation provided rich organic matter, but also limited decomposition due to the associated anaerobic conditions. When the areas covered by these soil types rebounded above sea level, seasonally high water tables continued to preserve much of the organic content. Research also indicates that these soils (along with the Snakelum and San Juan series) exist in former grasslands that were primary targets of Native American burning, resulting in thick, dark-colored surface layers (Weiser and Lepofsky 2009, USDA 2010). Despite existing in dry, unconsolidated conditions, the Snakelum and San Juan series actually have fairly high water holding capacities, due to the abundant organic material left behind by grassland communities.

In some areas of the Reserve--notably the western bluffs (Indianola series) and Ebey's Prairie (Ebey series)--significant amounts of postglacial aeolian material have accumulated (USDA 2010). These windblown soil particles can extend deep into the soil profile. The sandy soils of the western bluffs, combined with their hot, southwestern aspect, result in the driest grasslands found in the Reserve (usually dominated by ripgut brome (*Bromus diandrus*)).

Soil Origins

While glaciation and subsequent topographic changes are the main determinant of soil type, biological factors driven by the dominant vegetation type during soil formation also leave a detectable legacy. The soils formed in dense glacial sediment can be further divided by origin into grassland soils (Coveland, Coupeville, Townsend) and forest soils (Mitchellbay, Zylstra, Sucia, Sholander) (Figure 4). The soils formed in unconsolidated glacial sediment can be similarly divided into grassland soils (San Juan, Snakelum, Ebey) and forest soils (Hoypus, Keystone, Everett). This analysis allows the soil type to be a proxy for historic vegetation.

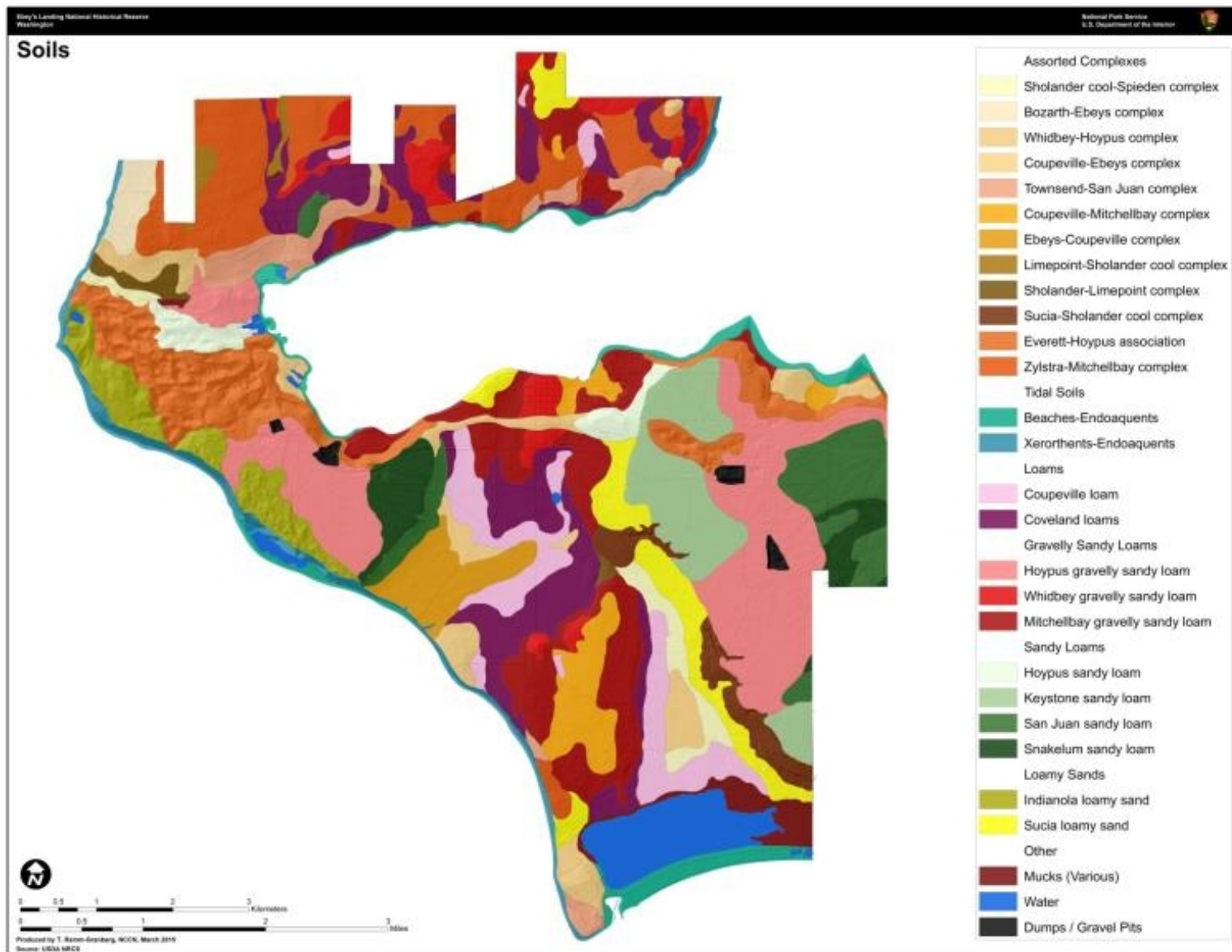


Figure 3. Soil types of Ebey's Landing National Historical Reserve, Washington.

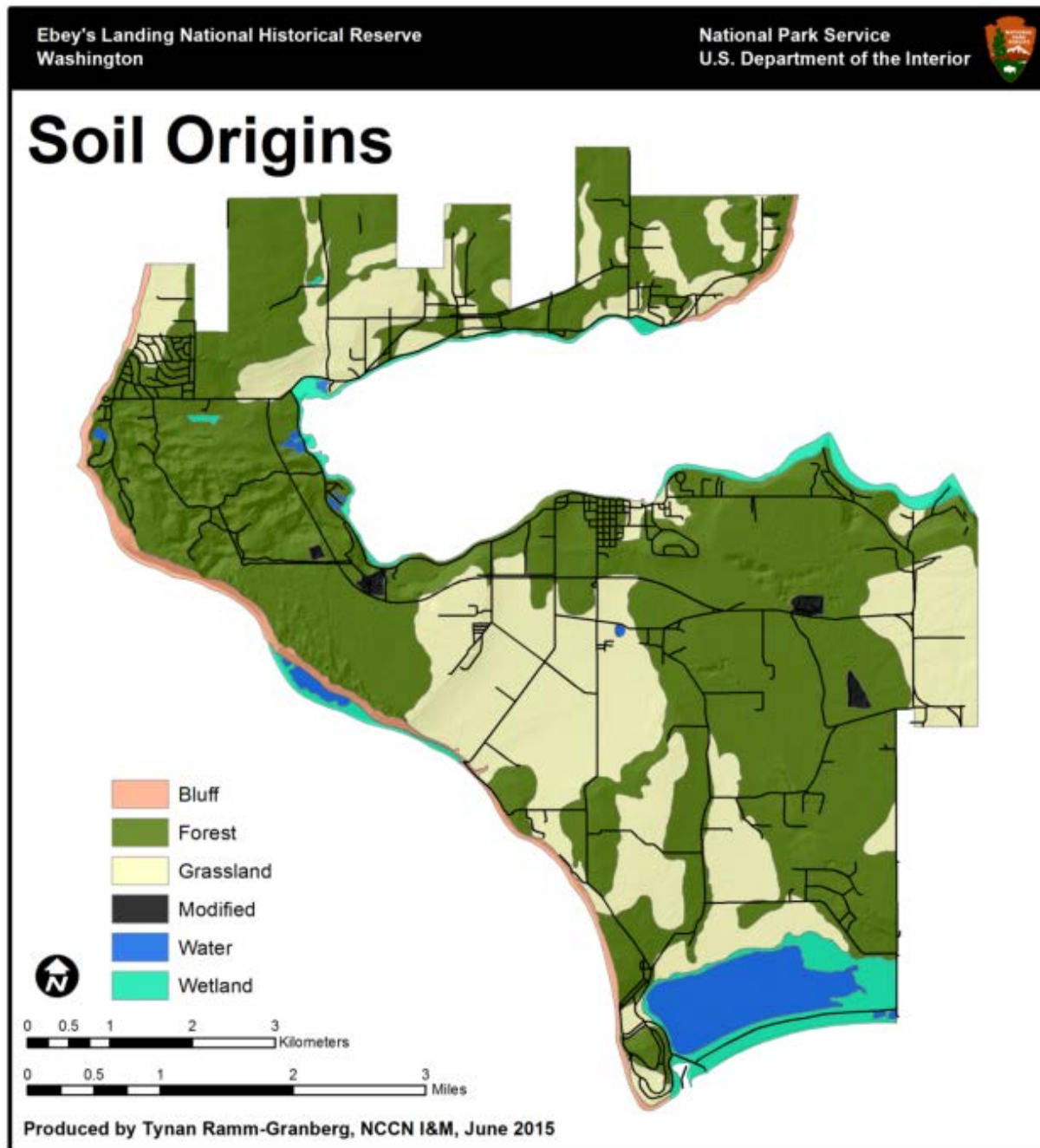


Figure 4. Soil types of Ebey's Landing National Historical Reserve, Washington, grouped by origin.

Hydrology and Water Resources

Prior to the installation of drainage ditches, drainage tiles, and fill by EuroAmerican farmers, Ebey's Prairie was divided by a broad riparian corridor (Larrabee 2011). The saturated, aquifer-recharging soils of those marshes and seasonal ponds are now gone. One marsh remnant and an artificially straightened seasonal stream (Ebey's Creek) remain on the prairie. Additionally, significant but highly disturbed wetland areas still exist at Crockett Lake, along with small patches near Monroe Landing and near Lake Pondilla (Figure 5).



Water Resources

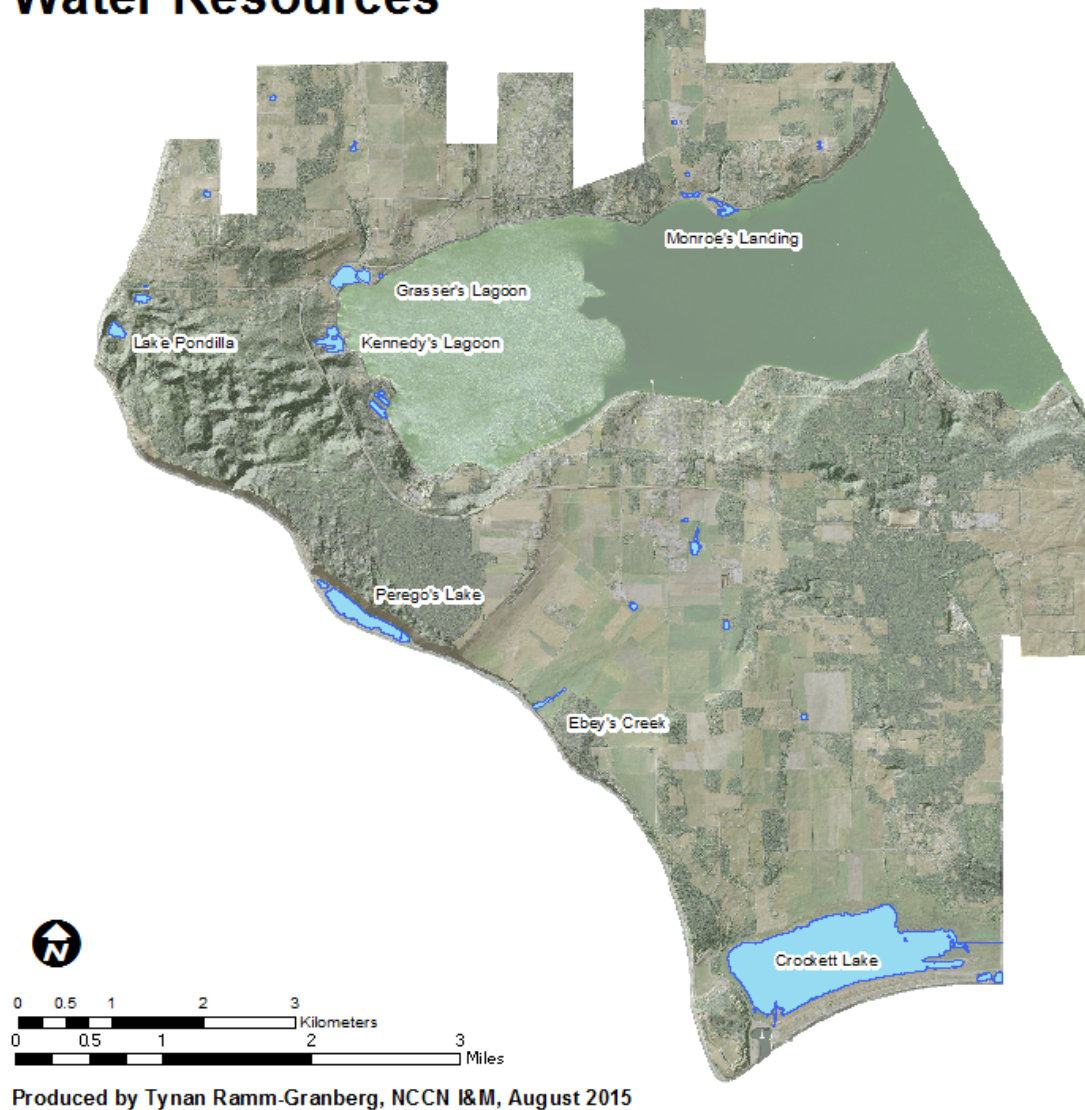


Figure 5. Bodies of water at Ebey's Landing National Historical Reserve, Washington. Includes ponds, lakes, lagoons, and artificially impounded water.

Groundwater resources on Whidbey Island consist of a mostly continuous sea-level freshwater aquifer, found between 30 ft (10 m) above and 180 ft (60 m) below sea level, and smaller, sporadic aquifers at shallower depths (Cline et al. 1982). With the county's population increasing from 11,079 people in 1950 to 79,275 in 2014--and projected continued growth (US Census Bureau 2015)--these resources are not expected to keep up with future demand (Larrabee 2011).

Penn Cove

Penn Cove is a 4 mile (6.4 km) estuarine inlet jutting into the east side of the Reserve, with the town of Coupeville on its south shore (Figure 1). It is yet another sign of the continental glaciers that once covered Whidbey Island. While most of the Puget Lowlands have a north-south orientation, the east-west orientation of Penn Cove indicates to some that it did not exist prior to glacial recession (Carlstad 1992). Others attribute the Cove's unique orientation to a glacial readvance with a southwestern flow direction (Dethier et al. 1995). As with many geomorphological features of the Reserve dating of Penn Cove has been facilitated by radiocarbon analysis of marine shells found in exposures along its shores (Dethier et al. 1995). Today, Penn Cove is influenced by fluvial forcing from major rivers draining the mainland. Most flow comes via the Skagit River, but contributions are also made by the Stillaguamish and Snohomish Rivers (Klinger et al. 2007). The Cove is home to a productive shellfish aquaculture operation.

Perego's Lake, Grasser's Lagoon, and Kennedy's Lagoon

Some of the rarest plant associations found in the Reserve occur along saline and brackish lagoons. The lagoons are separated from the open sea by accumulations of sand and gravel pushed up parallel to shore by waves, tides, and wind (Larrabee 2011). Some of these barriers completely block the lagoons from the sea except during periodic overflow events (Perego's Lake) while others are incomplete and allow for twice daily inundations with the tide (Grasser's Lagoon).

Perego's Lake (also known as Perego's Lagoon) is the largest of the three lagoons and also the most saline, as it receives the least freshwater discharge (Klinger et al. 2007). It is located along Admiralty Inlet, between Point Partridge (Fort Ebey) and Ebey's Landing. On the landward side, Perego's Lake is bordered by tall bluffs that feature some of the Reserve's best remaining examples of native upland grasslands (Figure 1). Seaward, the lake is bounded by a narrow spit of sand and gravel that supports dune vegetation such as American dunegrass (*Leymus mollis*) and beach bursage (*Ambrosia chamissonis*). Some fish have been reported in the lagoon, but the water itself is primarily characterized by dense algal blooms (Klinger et al. 2007).

Grasser's and Kennedy's Lagoons are relatively small and both are found near the northwest corner of Penn Cove (Figure 1). The hydrology of Kennedy's Lagoon is impacted by Madrona Way, a major road that traverses its barrier spit, as well as a tidal gate. It is the most developed of the lagoons, with significant residential constructions on its shores--much of its riparian vegetation has been replaced by lawns. Both Kennedy's and Grasser's Lagoons are reportedly important areas for salmonid recruitment (Klinger et al. 2007).

Lake Pondilla

Lake Pondilla is located in Fort Ebey State Park in the densely forested northwestern region near Point Partridge (Figure 1). The lake occupies a depression, or kettle, formed as glacial ice melted at the end of the last glaciation. Many dry kettles remain in the area to the south, but Lake Pondilla is the only remaining pond. Recreational fishing for bass occurs in the lake.

Crockett Lake

Crockett Lake was a historically large (600 + acres / 240+ ha) tidal lagoon, separated from Admiralty Bay by a wide sandy bar (Figure 1). Mudflats around its margins were influenced by water level changes due to regular tidal and seasonal cycles and the lagoon probably had a regular flushing of seawater at higher tides, resulting in only minor changes in salinity. Tidal gates were installed in 1948 in an effort to drain the lake and the surrounding marshlands. This effort reduced the lake to about 10 acres (4 ha) and agriculture expanded into the former marshlands. Beginning in 1974, the drains were allowed to remain open and the lake grew. At the present time the tidal gates are still in place, and although the lands around the lake are not in agricultural use, the water levels are managed such that natural water flow is inhibited (Roehl 1986). Today, the shores of Crockett Lake are home to a diverse array of ruderal saltmarsh vegetation types.

Land Use and Settlement History

Late Holocene-Historic Period

Projectile points found at Ebey's Prairie dating back as far as 10,000 years before present tie Coast Salish people to this landscape. The projectile points would have been used for hunting game on the forage-rich prairies. Starting from about 3,400 years before present, the variety of both artifacts and features such as rock hearths increase in the archeologic record, indicating that the prairie was getting more use and a wider variety of uses beyond hunting. At the same time, paleobotanical evidence shows an increase in plant species typically found in open, non-forested habitats. This suggests that people were actively maintaining the prairies for target plants used to supplement a meat-and-fish diet with carbohydrates, fiber, minerals, and vitamins (Heusser and Heusser 1981, Weiser 2006). Burning was necessary to keep trees from encroaching on the prairie because the generally cool, wet climate trend during this period would have favored tree establishment (Weiser 2006). The non-prairie areas likely featured open oak savannahs or woodlands and conifer forests. Records from the historic period document permanent dwellings of the Skagit Tribe in Penn Cove and groups of Snohomish Tribe villages in or near the Reserve. S'Clallum displaced the Skagits on Ebey's Prairie in the 1840s and introduced potato cultivation.

Settlement and Expansion

The prairies at the Reserve were described by the British captain George Vancouver in 1792:

“The surrounding country, for several miles in most points of view, presented a delightful prospect, consisting chiefly of spacious meadows; elegantly adorned with clumps of trees; among which the oak bore a very considerable proportion in size from four to six feet in circumference...the soil principally consisted of a rich, black vegetable mould, lying on a sandy or clayey substratum; the grass of an excellent quality grew to a height of three feet, and the ferns, which in the sandy soil, occupied the clear spots, were nearly twice as high” (Vancouver and Vancouver 1798).

The first map depicting Ebey's Prairie is from The United States Exploring Expedition of 1841 and in this chart the coastal margins of the Reserve appears as a grassy and marshy opening (Figure 6, NOAA 2015).



Figure 6. First map depicting Ebey's Prairie and other parts of the Ebey's Landing National Historical Reserve, Washington (United States Exploring Expedition of 1841).

The spectacular setting, favorable climate, and pre-cleared lands of Whidbey Island attracted settlers from the earliest waves of westward expansion. Isaac Stevens, an early Washington governor, noted “On this island is considerable quantity of prairie land which at an early day was taken up by the settlers” (Stevens 1860). The large prairie, long maintained by the Salish and spotted by Vancouver, was claimed by Isaac Ebey in 1850, and all other prairies were claimed within the next few years under the 1850 Donation Claim Land Act. By 1859, because of the prairies, there was more land under cultivation in the Reserve than in most of the rest of the region (Kellogg 1934) due to the intensive work required in most areas to fell trees and remove enormous stumps. The camas (*Camassia quamash*), bracken ferns (*Pteridium aquilinum*), and hosts of other native plants that had been cultivated for centuries were turned over for grains and potatoes. Although the transition from native-cultivated prairie to EuroAmerican-cultivated prairie was quicker than from forest to prairie, this quote from an 1853 letter from Col W. Crockett Sr. to family in Virginia suggests that cultivating the prairie was not without its challenges:

“It takes time to get the land subdued and the wild nature out of it...the land here is quite hard to get into cultivation. There is one plant on these plains that is very much in the way. That is fenon [bracken]. I have never found it in any other country but this

and the whole country is covered with it on the plains where I am now living. I would suppose its average height to be about three feet and in many places it is as thick as a hemp pack. There is such a bed of roots in the ground that it requires a very good plow and about four or five yoke of cattle and from the information that I have on the subject I am inclined to the opinion that it will take three or four years to subdue it” (Cook 1973).

The forested areas were described in 1853 by early settler Calista Leach as, “densely wooded with firs dripping down to the tide-regulated beaches” (Cook 1973). Before settlement, large ungulate herds combined with more frequent fire regimes maintained a larger proportion of open oak savannahs than found today. Stand structure data indicates that most present day oaks on Whidbey Island date from the period of peak subsistence hunting by EuroAmerican settlers: roughly 1850-1910 (MacDougall 2008). Deer and Elk were nearly extirpated from the island during this time period. At the same time, forested areas of the Reserve were rapidly converted, with the first of several lumber companies opening in 1856. By 1900 most of the wooded areas were logged or had been burned (White 1980). EuroAmerican displacement of native peoples on Whidbey Island was complete.

Modern Times

The population continued to steadily grow on Whidbey through the early half of the 20th century, with extremely rapid growth occurring between 1940 and 1960, as post-war economic development in the Puget Sound inspired many to build second homes and cabins in rural areas with recreation opportunities (McKinley 1993). Farmland and waterfront acreage decreased in this period. The eight-year effort to create the reserve began with a rezoning request in 1970 by the Smiths, the contemporary owners of the northwestern half of the original Isaac Ebey claim. Retirement-aged and faced with large debt, they sought to convert the northwestern section of that property from farmland to high density condominiums. Their request became a call to action for local conservation and preservation groups who began to focus intensely on a management plan for conserving the open space and preserving a historic district that had been created in 1973. A modern view of the land cover of the Reserve can be seen in Figure 7.



Land Cover



Figure 7. Land Cover Ebey's Landing National Historical Reserve, Washington (2013 National Agricultural Imagery Program).

Vegetation

Previous Vegetation Studies

Chris Chappell and Rex Crawford of the Washington Natural Heritage Program (WNHP) conducted an inventory at Fort Ebey State Park and nineteen other state parks in 1992. The WNHP did not

recommend any Natural Forest Areas or Natural Area Preserves at Fort Ebey State Park, but did suggest the need for additional inventory.

In 2000, under contract from the National Park Service, Steve Erickson compiled GPS locations of plant sightings within the Reserve dating back to 1897 (Erickson 2000). Rochefort (2010) conducted a vascular plant inventory between 2002 and 2005, focusing on the large natural areas. This project compiled existing data sets in combination with new botanical forays to document and verify 374 vascular plants at the Reserve. Approximately 84% of species were forbs and graminoids. Of those, 38% were considered exotic.

In 2001, the Washington State Parks and Recreation Commission hired Kathryn Beck and Joseph Arnett to provide a preliminary survey of vegetation communities at Fort Ebey and Fort Casey State Parks (Beck and Arnett 2001). The surveyors visited distinct vegetation polygons marked on high-resolution aerial photographs and characterized the plant communities using published WNHP keys and descriptions. These surveys proved useful for planning sampling targets for the current project and helped to corroborate some of the mapping. Beck and Arnett returned in 2003 to conduct rare plant surveys at Fort Casey and Fort Ebey State Parks, including the federally listed (Threatened) and State-listed (Endangered) golden paintbrush (*Castilleja levisecta*) at Fort Casey State Park (Beck and Arnett 2003). Additional vegetation surveys by Chappell and Caplow (2004) in golden paintbrush habitat at what is now the Naas Prairie Unit of the Admiralty Inlet Natural Area Preserve (owned by Widbey Camano Land Trust) near Fort Casey State Park identified numerous native species. Subsequently, Naas Prairie and the Camp Casey Heritage Forest (owned by Seattle Pacific University) were successfully recommended by the Natural Heritage Program and the Natural Heritage Advisory Council for Natural Area Preserve status. Research and restoration efforts surrounding golden paintbrush are ongoing within the Reserve, with monitored augmentations and reintroductions at the Naas Prairie Unit, Smith Prairie (owned by the Pacific Rim Institute), and at Ebey's Landing National Historical Reserve (Arnett et al. 2007, Lawrence and Kaye 2011).

Classification of Vegetation Types

Methods

We developed the vegetation classification presented in this report primarily from previously collected data. A limited amount of additional plot-based classification sampling was conducted in conjunction with the mapping process.

Previously Collected Data - Draft Classification

The vegetation mapping project began with an evaluation of existing vegetation data available for the Reserve, as well as vegetation classification data from previous mapping efforts in the region.

The WNHP, through a cooperative agreement, developed a list of plant associations likely to occur in the Reserve (Rocchio and Crawford, 2009). We derived additional information from regional classification work:

- Survey of plant associations at Fort Ebey and Fort Casey State Parks (Beck and Arnett 2001)
- San Juan Island National Historical Park Vegetation Classification and Mapping Project Report (Rocchio et al. 2012)
- Lewis and Clark National Historic Park Vegetation Classification and Mapping Project Report (Kagan et al. 2012)
- Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks (Crawford et al. 2009)
- Coastal Forests Correlation Project (Meidinger et al. 2005)
- Upland Plant Associations of the Puget Trough Ecoregion, Washington (Chappell 2006)

The vegetation data and GIS layers from Beck and Arnett (2001) directed the sampling at the state park properties, although the layers were coarser than the scale of this project. We relied heavily on plant association descriptions from the San Juan Island report (Rocchio et al. 2012). The primary divergences from the SAJH classification occur among the forest types. The report from Lewis and Clark was used rarely and mostly as a comparison against other resources. The classification for Mount Rainier, North Cascades, and Olympic National Parks--with its greater diversity of forest associations from diverse climatic zones in the region--was used along with Chappell's classification to fill in these gaps. Most of the remaining associations were identified in NVC Hierarchy 30 (USNVC 2015), the most up-to-date version of the NVC available at the time, and verified by the WNHP.

Field Sampling

The field portion of the mapping project consisted of two primary elements: vegetation classification and field-based mapping. Due to the relatively small size of the Reserve, the vegetation classification portion of the project was accomplished concurrently with field mapping, with sampling located within and referenced to the mapped polygons of vegetation and other features.

We conducted an initial scouting trip by car and foot to quickly survey the range of variability in the Reserve. We then revised the draft list of potential vegetation associations (Rocchio and Crawford 2009) and identified additional vegetation zones areas that were not currently represented in the draft list, or that could prove challenging to classify due to reasons such as access.

Two types of data were collected to identify and classify the vegetation associations present at Ebey's Landing: classification plots and observation points. We conducted classification plot sampling within mapped polygons that could not be attributed clearly with an existing plant association. We also sampled representative classification plots in order to contribute additional plot data to the regional representation of these types. The information collected in classification plots included: land unit or park, GPS location (UTM), site description, photos in each cardinal direction, association call and confidence level, source of the association, alternate association call, complete list of species (divided into trees > 5 m, trees < 5 m, shrubs, graminoids, forbs, ferns, mosses/liverworts, and lichens) and percent cover of each, and average diameter at breast height (DBH) of each tree species present.

Observation points were less detailed than classification points. We used observation points primarily to document the locations of plant associations taken from the evolving draft list (compiled from existing data sources and classification plots). Observation points were useful for ascertaining the environmental and floristic variability of these associations. At each observation point we recorded the plant association, an alternate association if needed, and made brief notes. Photos were taken of particularly characteristic locations or of locations that did not fit well into existing types. Observations points comprise the majority of field data collected (Figure 8).

Data Analysis and Product Development

Observation and classification plot data were entered into a geodatabase (ArcGIS 10.2). Additionally, classification data were entered into an Access database. Plots from stands that did not readily fit into one of the plant associations from the draft classification were compared against descriptions, stand tables, and photos from the regional classification sources mentioned above. Site visits were conducted with WNHP personnel in a few areas, particularly ruderal stands. If no existing association seemed to fit, stands were assigned provisional plant association and/or alliance names (e.g. *Lonicera involucrata* Provisional Wet Shrubland or *Festuca rubra* Provisional Ruderal Alliance) and assigned a place within NVC Hierarchy 30 with the assistance of WNHP personnel (USNVC 2015, Appendix A).

When the classification was complete, we developed a physiognomic and floristic key for identifying plant associations and/or alliances in the field (Appendix B). Summary descriptions were written for new provisional plant associations and alliances, and descriptions for existing plant associations were revised to reflect how they are expressed at the Reserve. NPS staff tested the key and provided feedback prior to the accuracy assessment field work.



Observation and Classification Points

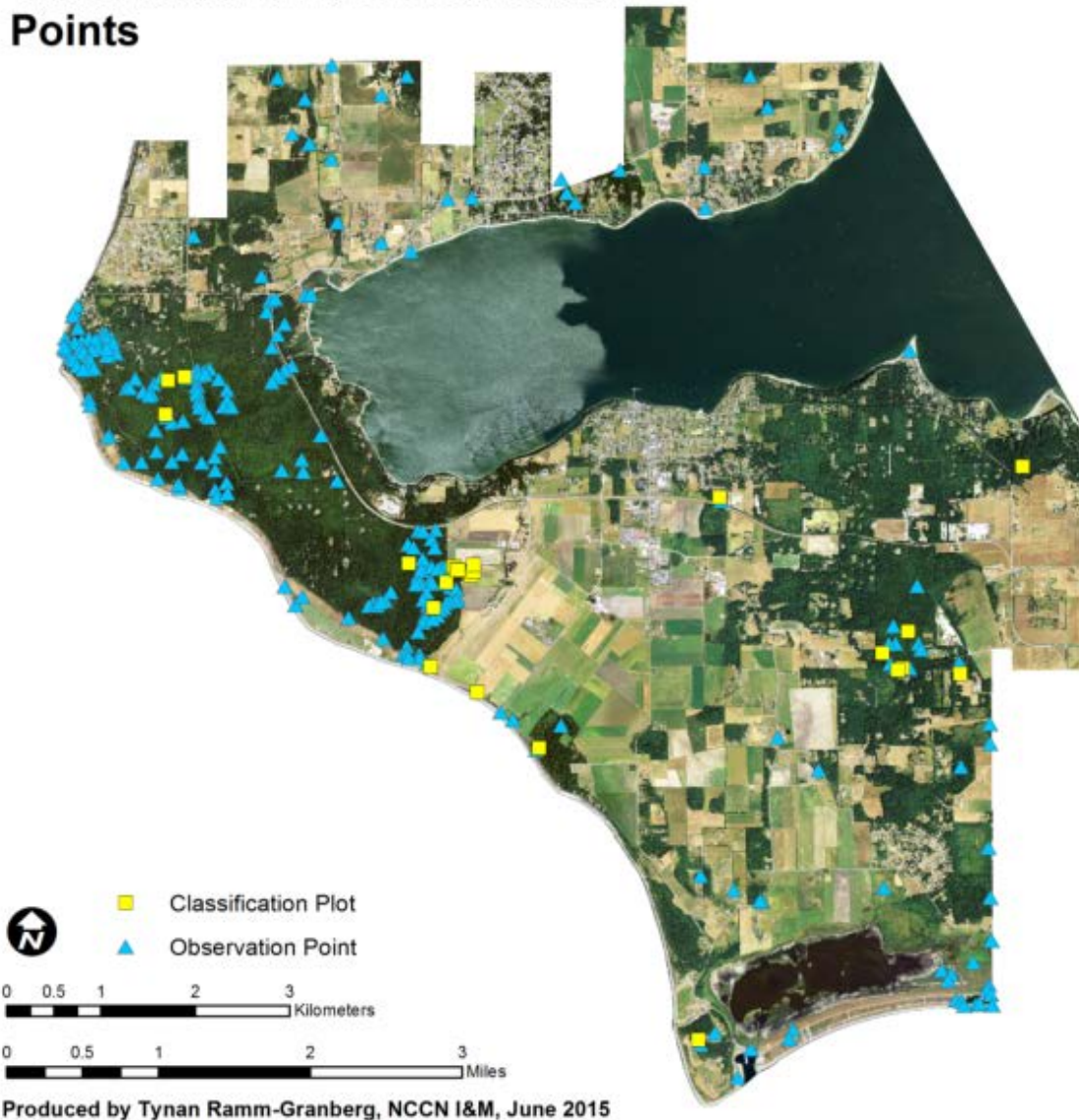


Figure 8. Location of observation and classification points established in Ebey's Landing National Historical Reserve, Washington. Note that observations not associated with specific GPS points (such as broader map annotations) are not displayed here.

Standardizing Vegetation Nomenclature

NVC Hierarchy 30 provided the reference for all plant association and hierarchy names. WNHP personnel reviewed these names to ensure standardization. Nomenclature for plant associations and alliances not yet incorporated into Hierarchy 30 were borrowed from their source documents. While

many of these associations have been recognized by NatureServe, only a few have been entered into their online database at the time of this project.

Classification Results

Plot Data Used for Classification

The spatial distribution of classification plots and observation points is shown in Figure 8. Because most of the vegetation could be successfully identified with combinations of existing vegetation keys and descriptions (Rocchio et al. 2012, Crawford et al. 2009, etc.), most of data collected were in the form of observation points or map annotations of large polygons. Detailed classification data were primarily collected to help differentiate among very similar forest types. The number of classification and observation points per NVC type are listed in Table 1.

Table 1. Number of plots sampled within each association/map class at Ebey's Landing National Historical Reserve, Washington (alliance is listed if vegetation type was classified only to alliance level).

Association, Alliance, or Map Class	Classification Plots	Observation Plots	Total
<i>Agrostis (gigantea, stolonifera)</i> Ruderal Herbaceous Vegetation		1	1
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest		1	1
<i>Alnus rubra</i> / <i>Sambucus racemosa</i> / <i>Urtica dioica</i> Provisional Ruderal Forest	1	9	10
<i>Argentina egedii</i> - <i>Juncus balticus</i> Herbaceous Vegetation		1	1
Beach and Drift Logs Map Class		1	1
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Herbaceous Vegetation	2	3	5
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Provisional Ruderal Alliance		1	1
<i>Carex macrocephala</i> Herbaceous Vegetation		2	2
<i>Cytisus scoparius</i> Ruderal Shrubland		4	4
<i>Distichlis spicata</i> - (<i>Salicornia virginica</i>) Herbaceous Vegetation		4	4
Ebey's Landing Provisional Ruderal Woodland Association	2	3	5
<i>Epilobium hirsutum</i> Provisional Ruderal Herbaceous Vegetation		1	1
<i>Equisetum telmateia</i> Herbaceous Vegetation		1	1
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous Vegetation		1	1
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> Provisional (Restoration) Ruderal Alliance		1	1
<i>Festuca rubra</i> - (<i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i>) Herbaceous Vegetation		2	2
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation		1	1
<i>Festuca rubra</i> Provisional Ruderal Herbaceous Vegetation		1	1
High Density Housing Map Class		1	1
Impounded Water Map Class		1	1
<i>Juncus balticus</i> var. <i>balticus</i> Pacific Coast Herbaceous Vegetation		1	1

Table 1. Number of plots sampled within each association/map class at Ebey's Landing National Historical Reserve, Washington (alliance is listed if the vegetation type was classified only to alliance level) (continued).

Association, Alliance, or Map Class	Classification Plots	Observation Plots	Total
<i>Juncus gerardii</i> var. <i>gerardii</i> Ruderal Brackish Wet Meadow		1	1
Lagoon Map Class		1	1
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> / <i>Sphagnum</i> spp. Shrubland		1	1
<i>Leymus mollis</i> ssp. <i>mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation		3	3
<i>Lonicera involucrata</i> Provisional Wet Shrubland		1	1
Low Density Housing Map Class		2	2
<i>Malus fusca</i> - (<i>Salix hookeriana</i>) / <i>Carex obnupta</i> Shrubland		1	1
Mowed Lawn Provisional Alliance		2	2
<i>Nuphar polysepala</i> Herbaceous Vegetation		3	3
Parking Lot and Buildings Map Class		2	2
Pasture and Agricultural Field Provisional Alliance		1	1
<i>Phragmites australis</i> Western North American Temperate Ruderal Herbaceous Vegetation		1	1
<i>Picea sitchensis</i> / <i>Gaultheria shallon</i> Forest		4	4
<i>Prunus emarginata</i> Ruderal Flooded Forest Association	1	1	2
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> - <i>Symphoricarpos albus</i> Forest	3	2	5
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest		1	1
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Depauperate</i> Undergrowth Forest		1	1
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> / <i>Polystichum munitum</i> Forest	1	24	25
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	2	40	42
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Rhododendron macrophyllum</i> - <i>Vaccinium ovatum</i> - <i>Gaultheria shallon</i> Forest	3	50	53

Table 1. Number of plots sampled within each association/map class at Ebey's Landing National Historical Reserve, Washington (alliance is listed if vegetation type was classified only to alliance level) (continued).

Association, Alliance, or Map Class	Classification Plots	Observation Plots	Total
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	1	8	9
<i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> - <i>Rosa gymnocarpa</i> / <i>Festuca occidentalis</i> Forest	1	9	10
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest	2	15	17
Recently Harvested (Not-Replanted) Provisional Alliance		1	1
Recently Harvested (Replanted) Provisional Alliance		1	1
Road / Parking lots Map Class		2	2
<i>Rosa nutkana</i> - <i>Rubus spectabilis</i> Wet Shrubland		1	1
<i>Rubus armeniacus</i> Ruderal Shrubland		1	1
<i>Salix hookeriana</i> - (<i>Salix sitchensis</i>) Shrubland		1	1
<i>Salix lucida</i> ssp. <i>lasianдра</i> / <i>Urtica dioica</i> spp. <i>gracilis</i> Woodland		1	1
<i>Schedonorus phoenix</i> Provisional Ruderal Herbaceous Vegetation		1	1
<i>Schoenoplectus acutus</i> Pacific Coast Herbaceous Vegetation		1	1
<i>Schoenoplectus maritimus</i> Tidal Herbaceous Vegetation		1	1
<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Shrubland	2	7	9
Temperate Conifer Forest Plantation Provisional Alliance		1	1
Terrestrial Bare Areas Map Class		1	1
<i>Tsuga heterophylla</i> - (<i>Pseudotsuga menziesii</i> - <i>Thuja plicata</i>) / <i>Polystichum munitum</i> - <i>Athyrium filix-femina</i> Forest	2	7	9
<i>Typha latifolia</i> Pacific Coast Herbaceous Vegetation		1	1
Total	23	243	266

Ruderal Types

All new associations developed for the Reserve are ruderal types. This reflects the lack of regional classification data for these types because most classification work has focused on documentation of natural areas. Our understanding of the ruderal types presented in this report would benefit from future investigations into the nature, duration, and frequency of the disturbances that caused them.

Vegetation Classification Summary

The full classification for Ebey's Landing National Historical Reserve is presented in Appendix A. Fifty-one vegetation types were classified to the alliance or association level (Table 2). Forests and Woodlands accounted for 31% of the vegetated alliances/associations. Shrub and Herb vegetation totaled 57%, Agricultural and Developed Vegetation accounted for 10%, and the single Aquatic Vegetation type amounted to 2% of the total number of types.

Table 2. Number of plant associations within each class, macrogroup, and alliance at Ebey's Landing National Historical Reserve, Washington.

Class/Macrogroup/Alliance	Number of Associations
1 Forest & Woodland	16
Vancouverian Lowland and Montane Rainforest Macrogroup	10
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / <i>Cornus unalaschensis</i> Mesic Forest Alliance	2
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> Dry Forest Alliance	3
<i>Tsuga heterophylla</i> - <i>Picea sitchensis</i> / <i>Rhytidadelphus loreus</i> Forest Alliance	1
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> - <i>Arbutus menziesii</i> Forest and Woodland Alliance	4
Vancouverian Flooded & Swamp Forest Macrogroup	3
<i>Salix lucida</i> Temporarily Flooded Woodland Alliance	1
(<i>Acer macrophyllum</i> , <i>Alnus rubra</i>) Riparian Forest Alliance	1
(<i>Picea sitchensis</i> , <i>Tsuga heterophylla</i>) - (<i>Alnus rubra</i>) Riparian Forest Alliance	1
Vancouverian Ruderal Flooded & Swamp Forest Macrogroup (Provisional)	3
<i>Alnus rubra</i> / <i>Dactylis glomerata</i> Ruderal Flooded Forest Alliance	3
2 Shrub & Herb Vegetation	29
Southern Vancouverian Lowland Grassland & Shrubland Macrogroup	3
<i>Festuca roemerii</i> - <i>Agrostis pallens</i> - <i>Koeleria macrantha</i> Herbaceous Alliance	1
<i>Festuca rubra</i> - <i>Calamagrostis nutkaensis</i> Coastal Headland Herbaceous Alliance	1
<i>Symphoricarpos albus</i> Pacific Coast Provisional Shrubland Alliance	1
Western North American Ruderal Wet Shrubland, Meadow & Marsh	2
<i>Poa pratensis</i> - <i>Agrostis gigantea</i> - <i>Agrostis stolonifera</i> Ruderal Herbaceous Alliance	1
<i>Epilobium hirsutum</i> Provisional Ruderal Alliance	1

Table 2. Number of plant associations within each class, macrogroup, and alliance at Ebey's Landing National Historical Reserve, Washington (continued).

Class/Macrogroup/Alliance	Number of Associations
Western North American Ruderal Grassland & Shrubland Macrogroup	7
<i>Cytisus scoparius</i> Ruderal Shrubland Alliance	1
<i>Bromus hordeaceus</i> Provisional Ruderal Alliance	1
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Provisional Ruderal Alliance	1
<i>Festuca idahoensis</i> ssp. <i>roemeri</i> Provisional (Restoration) Ruderal Alliance	1
<i>Rubus armeniacus</i> Provisional Ruderal Alliance	1
<i>Schedonorus phoenix</i> Provisional Ruderal Alliance	1
<i>Festuca rubra</i> Provisional Ruderal Alliance	1
Pacific Coastal Beach & Dune Vegetation Macrogroup	3
<i>Poa macrantha</i> - <i>Leymus mollis</i> - <i>Festuca rubra</i> Sand Dune Herbaceous Alliance	2
<i>Carex macrocephala</i> Herbaceous Alliance	1
North Pacific Bog & Fen Macrogroup	1
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> Dwarf-shrub Fen Alliance	1
Western North American Lowland Freshwater Wet Meadow & Marsh Macrogroup	10
<i>Rosa nutkana</i> - <i>Rubus spectabilis</i> Shrubland Alliance	1
<i>Malus fusca</i> Shrubland Alliance	1
<i>Salix (hookeriana, sitchensis)</i> - <i>Spiraea douglasii</i> Flooded Shrubland Alliance	1
<i>Typha</i> spp. Western Herbaceous Emergent Alliance	1
<i>Schoenoplectus (acutus, tabernaemontani)</i> - <i>Typha latifolia</i> Provisional Herbaceous Alliance	1
<i>(Juncus balticus - Juncus effusus)</i> Provisional Herbaceous Alliance	1
<i>Equisetum (arvense, variegatum, hyemale, telmateia)</i> Semipermanently Flooded Herbaceous Alliance	1
<i>Phragmites australis</i> Semipermanently Flooded Herbaceous Alliance	1
<i>Juncus gerardii</i> Provisional Ruderal Wet Meadow Alliance	1
<i>Lonicera involucrata</i> Provisional Wet Shrubland Alliance	1
North American Pacific Coastal Salt Marsh	3
<i>Distichlis spicata</i> Pacific Coast Tidal Herbaceous Alliance	1
<i>Argentina egedii</i> - <i>Juncus balticus</i> Tidal Herbaceous Alliance	1
<i>Schoenoplectus maritimus</i> - <i>Schoenoplectus californicus</i> Tidal Herbaceous Alliance	1
5 Aquatic Vegetation	1
Western North American Freshwater Aquatic Vegetation	1

Table 2. Number of plant associations within each class, macrogroup, and alliance at Ebey's Landing National Historical Reserve, Washington (continued).

Class/Macrogroup/Alliance	Number of Associations
<i>Nuphar polysepala</i> Western Aquatic Herbaceous Alliance	1
7 Agricultural & Developed Vegetation	5
Conifer Plantation	3
Recently Harvested (Not-Replanted) Provisional Alliance	1
Recently Harvested (Replanted) Provisional Alliance	1
Temperate Conifer Forest Plantation Provisional Alliance	1
Cultivated Pasture & Hay Grass	1
Pasture and Agricultural Field Provisional Alliance	1
Cool-Season Lawn	1
Mowed Lawn Alliance	1
Non-vegetated	8
High Density Housing Map Class	1
Low Density Housing Map Class	1
Parking Lot and Buildings Map Class	1
Road / Parking lots Map Class	1
Impounded Water Map Class	1
Lagoon Map Class	1
Beach and Drift Logs Map Class	1
Terrestrial Bare Areas Map Class	1
Total	59

Over 30% of the non-agricultural/non-developed vegetation types were classified as ruderal types (Table 3). The long and varied history of human land use and exotic plant introductions in the Reserve has brought about many disturbed types dominated by non-native vegetation and/or assemblages of native species not seen in “natural” settings.

Table 3. Number of natural and ruderal associations/alliances by class at Ebey's Landing National Historical Reserve, Washington.

Class	Number of Associations/Alliances
1 Forest & Woodland	16
Ruderal Associations	3
Natural Associations	13
2 Shrub & Herb Vegetation	29
Ruderal Associations	11
Natural Associations	18
5 Aquatic Vegetation	1
Ruderal Associations	0
Natural Associations	1

Imperiled Plant Associations

Seventeen plant associations found within the Reserve are considered critically imperiled (G1S1) or imperiled (G2S2) in the state of Washington and/or globally (Table 4). Nine are forests or woodlands, four are grassland associations of coastal bluffs or dunes, two are freshwater wetlands, one is a salt marsh type, and one is a fen.

Four of the Forest Associations are within the *Pseudotsuga menziesii* - *Abies grandis* - *Arbutus menziesii* Forest and Woodland Alliance: *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* (G1S1), *Pseudotsuga menziesii* / *Gaultheria shallon* - *Holodiscus discolor* (G2G3S2), *Pseudotsuga menziesii* / *Holodiscus discolor* - *Rosa gymnocarpa* / *Festuca occidentalis* (G2G3S2), and *Pseudotsuga menziesii* - *Arbutus menziesii* / *Holodiscus discolor* (G1G2QS2?). These forests are characteristic of dry, rain shadow-influenced areas of Puget Sound, which have experienced extensive logging and fragmentation by development. The *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest is the most abundant. Although the total area it covers is nearly 600 acres (243 ha) it occurs in small patches isolated by agricultural land and housing developments.

Three other critically imperiled or imperiled dry forest associations are commonly found within the Reserve are classified within the *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance. They include *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* (G2S2), *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* (G2G3S2S3), and *Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* - *Symphoricarpos albus* (G1G2QS2?) Forests. The *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest Association is particularly widespread. It covers over 1300 acres (526 ha) at Fort Ebey State Park and at Island County's Kettles Recreation Area, and Rhododendron Park.

The remaining two critically imperiled or imperiled forest associations are very localized. The *Salix lucida* ssp. *lasiandra* / *Urtica dioica* spp. *gracilis* Woodland (G2S1S2) occupies 1.4 acres (0.6 ha) in

a small wetland east of Coupeville. This association lies within the *Salix lucida* Temporarily Flooded Woodland Alliance. From the *Tsuga heterophylla* - *Picea sitchensis* / *Rhytidiadelphus loreus* Forest Alliance, the *Picea sitchensis* / *Gaultheria shallon* Forest Association (GNRS2S3) covers about 10 acres (4 ha) of fog-influenced coastal forest at Fort Ebey State Park.

Some of the most distinctive vegetation types in the Reserve are the coastal headland and herbaceous dune associations. *Carex macrocephala* Herbaceous Vegetation (G1S1), within the *Carex macrocephala* Herbaceous Alliance, has less than thirty occurrences in northwestern Washington and coastal British Columbia. There are two occurrences in the Reserve, covering about 0.5 total acres (0.2 ha). These communities are dependent on very specific abiotic factors and are confined to sandy beach berms, spits, and coastal dunes that are washed over occasionally by storms. Two other critically imperiled or imperiled herbaceous associations were also found on sandy beach margins, the *Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation (G1S1) and *Leymus mollis* - *Abronia latifolia* Herbaceous Vegetation (G2?S2) Associations. Both are in the *Poa macrantha* - *Leymus mollis* - *Festuca rubra* Sand Dune Herbaceous Alliance. *Leymus mollis* - *Abronia latifolia* occupies nearly 20 acres (8 ha) in narrow strips along the coast. Behind those strips, on coastal headlands, *Festuca rubra* - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation (G1S1) in the *Festuca rubra* - *Calamagrostis nutkaensis* Coastal Headland Herbaceous Alliance covers another 19 acres (8 ha). This association is highly fragmented and imperiled by invasion of the *Bromus* (*diandrus*, *hordeaceus*, *sterilis*) Ruderal Grassland Association, which thrives on the sandy bluffs.

Three imperiled wetland/fen shrublands were identified at the Reserve, two of which are at Lake Pondilla. The *Ledum groenlandicum* - *Kalmia microphylla* / *Sphagnum* spp. Shrubland Association (G4S2), in the *Ledum groenlandicum* - *Kalmia microphylla* Dwarf-shrub Fen Alliance, covers the small fen (5 acres / 2 ha) adjoining the lake. A very small patch (0.2 acres / 0.1 ha) of *Malus fusca* - (*Salix hookeriana*) / *Carex obnupta* Shrubland (G3S2) borders that fen. This association falls within the *Malus fusca* Shrubland Alliance. At Crockett Lake there are small patches of *Salix hookeriana* - (*Salix sitchensis*) Shrubland (G2S2), from the *Salix* (*hookeriana*, *sitchensis*) - *Spiraea douglasii* Flooded Shrubland Alliance, totaling over 8 acres (3 ha).

One Washington State-imperiled herbaceous salt marsh type was found: *Distichlis spicata* - (*Salicornia virginica*) Herbaceous Vegetation (G4S2). It occupies 65 acres (26 ha), primarily at Crockett Lake. It is not imperiled globally.

Table 4. Imperiled plant associations found at Ebey's Landing National Historical Reserve, Washington.

Plant Association	Conservation Rank		Habitat
	Global ²	State ¹	
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest	G1	S1	Dry Forest
<i>Festuca rubra</i> - (<i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i>) Herbaceous Vegetation	G1	S1	Coastal Bluffs
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation	G1	S1	Dunes
<i>Carex macrocephala</i> Herbaceous Vegetation	G1	S1	Dunes
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest	G1G2Q	S2?	Dry Forest
<i>Salix lucida</i> ssp. <i>lasiandra</i> / <i>Urtica dioica</i> spp. <i>gracilis</i> Woodland	G2	S1S2	Wet Woodland
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Rhododendron macrophyllum</i> - <i>Vaccinium ovatum</i> - <i>Gaultheria shallon</i> Forest	G2	S2	Mesic Forest
<i>Salix hookeriana</i> - (<i>Salix sitchensis</i>) Shrubland	G2	S2	Wetland
<i>Leymus mollis</i> ssp. <i>mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation	G2?	S2	Dunes
<i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> - <i>Rosa gymnocarpa</i> / <i>Festuca occidentalis</i> Forest	G2G3	S2	Dry Forest
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	G2G3	S2	Dry Forest
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	G2G3	S2S3	Mesic Forest
<i>Malus fusca</i> - (<i>Salix hookeriana</i>) / <i>Carex obnupta</i> Shrubland	G3	S2	Wetland
<i>Tsuga heterophylla</i> - (<i>Pseudotsuga menziesii</i> - <i>Thuja plicata</i>) / <i>Polystichum munitum</i> - <i>Athyrium filix-femina</i> Forest	G3?	S3	Mesic Forest
<i>Argentina egedii</i> - <i>Juncus balticus</i> Herbaceous Vegetation	G3G4	SNR	Salt Marsh
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> / <i>Sphagnum</i> spp. Shrubland	G4	S2	Fen
<i>Distichlis spicata</i> - (<i>Salicornia virginica</i>) Herbaceous Vegetation	G4	S2	Salt Marsh
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> - <i>Symphoricarpos albus</i> Forest	GNR	S2	Mesic Forest
<i>Picea sitchensis</i> / <i>Gaultheria shallon</i> Forest	GNR	S2S3	Coastal Forest

¹State conservation rankings assigned by Washington Natural Heritage Program. ²Global rankings assigned by NatureServe.

Conclusions

Previous classification work at Ebey's Landing National Historical Reserve and in the region laid the groundwork for the results presented in this report. This project addressed data gaps by sampling more intensively on previously documented State Parks property using the most up-to-date NVC hierarchy, as well as extending the vegetation inventory across a wide range of landholders within the Reserve. All 51 vegetation types were classified to the alliance level of the NVC and most to the association level (44). Of these types, seventeen plant associations were identified as critically imperiled or imperiled at the state or global level.



Photo 3. Common camas (*Camassia quamash*) within a remnant of *Festuca idahoensis* ssp. *roemeri* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation at the Pacific Rim Institute (photograph courtesy of Robert Pelant).

Mapping Vegetation Types

Methods

The following section outlines the approach used for mapping the vegetation of the Reserve to the alliance or association level. The mapping was conducted using the vegetation classification described above. The classification and mapping occurred simultaneously and in an iterative fashion. A draft vegetation map was created using eCognition Developer 8 (Definiens 2009). Field data to support mapping were collected in either classification or observation points.

The alliance level of the NVC hierarchy is the mapping standard for NPS projects. Alliances are classification units defined by a characteristic range of species, habitat, and physiognomy, with diagnostic species typically found in the uppermost dominant stratum of vegetation. The relatively small size of the Reserve facilitated a field-based mapping approach, so all data were collected at the association level. Associations are the lowest (finest scale) unit of the NVC. They are defined by specific sets of diagnostic species, species composition, physiognomy, and habitat conditions reflecting local-scale differences in substrate, hydrology, and disturbance.

Preliminary Map

To develop a draft map for field sampling, we used eCognition software to divide spectral data for the Reserve into 18,428 initial polygons (Figure 9). The spectral data used by eCognition to create polygon boundaries was 1 m resolution aerial imagery from the 2011 National Agriculture Imagery Program (NAIP) along with LIDAR height data available for the Reserve. Initial polygons ranged in area from 0.005 to 47 acres (22 to 192,972 m²).

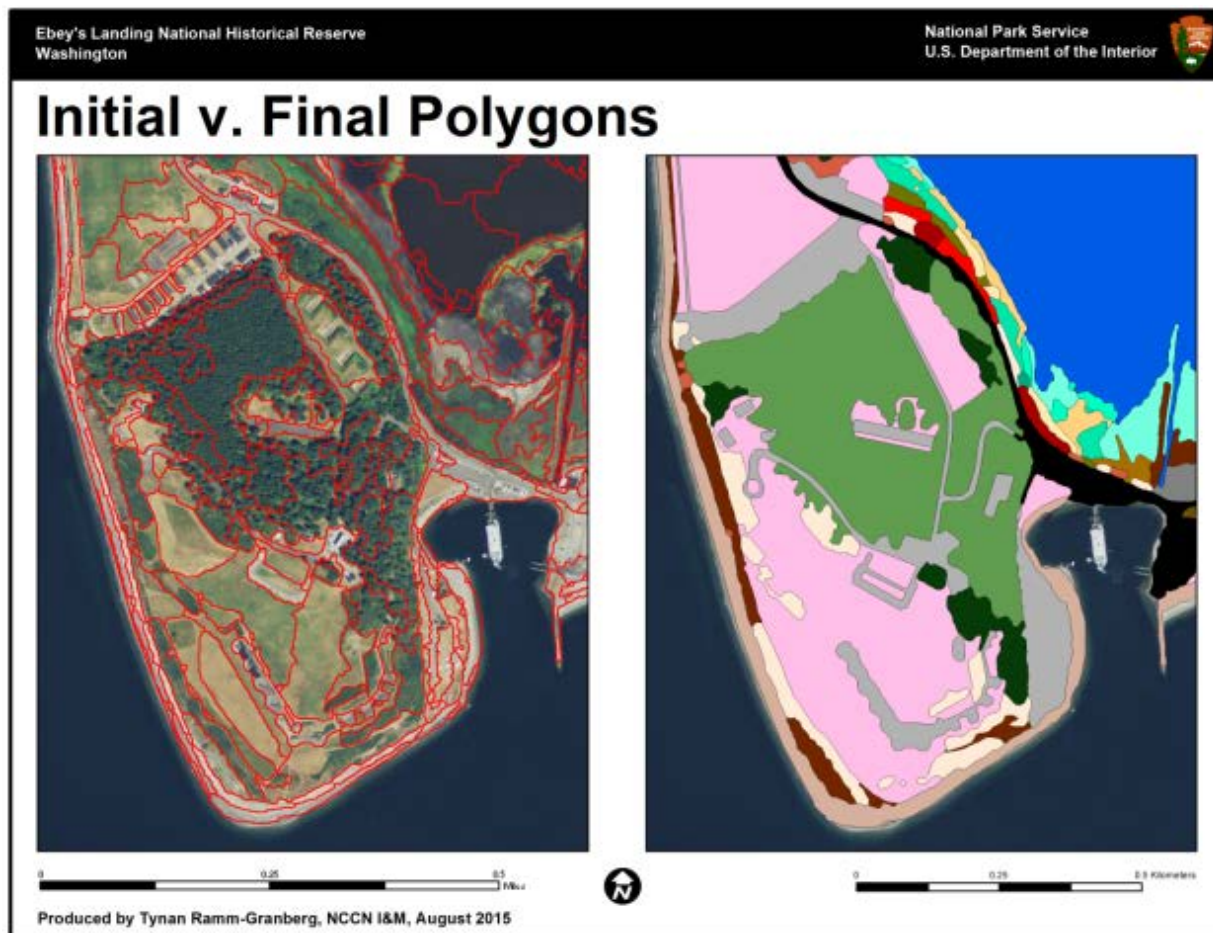


Figure 9. Comparison of initial eCognition-derived polygons and final mapped vegetation polygons (Fort Casey State Park, Washington).

Field Sampling

Before undertaking the field work, the Reserve was divided into 220 field maps at 1:300 scale. We conducted field sampling in the fall of 2013 and spring of 2014 starting with the forested portions of state, county, and NPS properties. Visits to herbaceous areas were made as late into the spring as possible to facilitate the identification of grass species.

The primary methods for mapping field sampling followed the classification of vegetation types for classification sampling and observation sampling (see Methods in Classification Vegetation Types). With sampling observation points, polygons that lay along or near existing trails were visited and assigned association calls (along with brief notes, photos, and an alternate call, if needed). We often visited particularly large polygons multiple times at different areas of the polygon and we recorded each intersection as a separate observation point. The multiple observations were used to divide polygons when the associations varied, often at a transition point denoted by annotation on the field map. We made observations of more obvious associations (such as small forest patches, pastures, homogeneous grasslands, or shrublands) from a distance, whether from a road or trail. In this way, we could still attribute polygons that fell on private property, or were inaccessible. In many cases—

particularly for agricultural, herbaceous, or shrubland communities that were clearly visible on the NAIP imagery—it was more efficient to simply sketch in the boundaries of plant associations by drawing on the field maps. The maps were labeled in the field with short abbreviations indicating which associations were being represented. If necessary, additional notes were taken in the form of an observation point. Field maps were also annotated with approximate transitions between forest communities, if they did not coincide with polygon boundaries.

A limited number of novel map classes were created to describe plant associations that did not fit into existing national or regional vegetation classifications and to describe certain abiotic types such as impounded water, roads and parking lots.

Finalization of Vegetation Map

In the office, we attributed every polygon we visited with association or map class label using ArcMap 10.2 (ESRI 2013). If it was uncertain whether the association call was appropriate for the full extent of a large polygon (this happened primarily in forested areas), an observation point was placed to denote the association call for only the sampled portion of the polygon. The polygon was later attributed when the full extent had been visited and confirmed, or if all surrounding polygons ended up with the same association.

Some polygons were never visited, either because they lay in unobservable portions of private property or on steep seaside cliffs. In most cases, a justifiable association call could be made for these polygons based on imagery interpretation, the DEM, and the association designations given to nearby observable vegetation patches.

Creating the vegetation map was an iterative process. Polygons with the same association calls, alternate association calls, and notes were merged to form single polygons. As the mapping proceeded, associations that were not found at the Reserve were deleted from the draft list of associations and new associations were added. Priority areas that needed return field visits were identified during the digitizing process. Highways and major byways were digitized as polygons, while minor roads and driveways were merged with nearby residential zones. Polygons were checked against updated 2013 NAIP imagery that became available during the course of the project. We updated polygons that had changed between the 2011 and 2013 imagery, usually due to new housing developments. To finalize the appearance of the polygon boundaries, we used a PAEK (Polynomial Approximation with Exponential Kernel) algorithm (Kraak et al. 1996) with a 10 m tolerance to smooth the rough edges of the initial polygons.

To check the final polygon attributes we followed a standard procedure: 100 random points were created within the Reserve boundary. The polygon in which each point fell (as well as neighboring polygons) was checked against annotations on the field map and checked that the polygon boundaries reflected the actual landscape. Each vegetation association was highlighted in ArcMap and observed at a Reserve-wide scale to ensure that the extent and specific locations of each association agreed with the field surveyor's notes. Every tenth line on the field observation data sheets was checked against the final digitizing feature class to ensure that the described polygon had been placed in and merged with the appropriate vegetation association.

Vegetation Map Summary

The final Ebey's Landing National Historical Reserve vegetation map consisted of 1,891 polygons (Figure 10). The number of polygons and total area of each association, map class, or alliance are shown in Table 5. To facilitate analysis, we divided the Reserve into 6 subunits, roughly coinciding with landscape features, roads, or land management boundaries (Figure 11); these same subunits are used in Table 5. Data summaries include impounded water but do not include Penn Cove in area calculations.

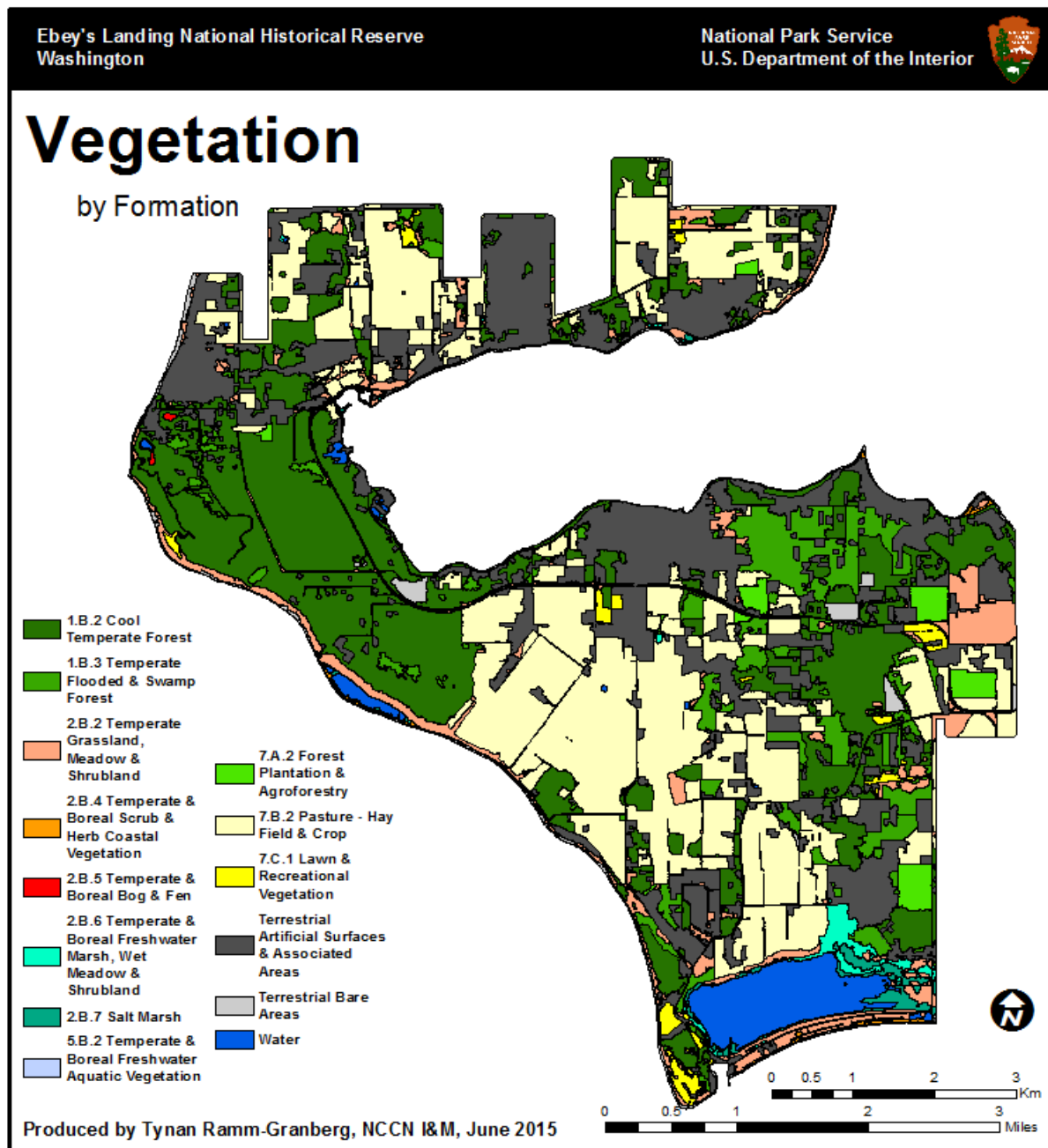


Figure 10. Vegetation of Ebey's Landing National Historical Reserve, Washington, grouped by the Formation Level of the National Vegetation Classification.

The most frequent vegetation types found in the Reserve are the *Symphoricarpos albus* - *Rosa nutkana* Shrubland Association (436 polygons) and *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation Association (105 polygons). The unvegetated Low Density Housing Map Class is also very common (345 polygons). The most frequent forested associations are the *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest (90 polygons) and Ebey's Landing Provisional Ruderal Woodland Associations (79 polygons).

The Reserve is 59% cultural or unvegetated (8,549 acres / 3,460 ha), 32% forest and woodland (4,663 acres / 1,887 ha), 5% herbaceous (746 acres / 302 ha) and 3% shrubland (422 acres / 171 ha). The top three types by area are all within the cultural and/or unvegetated map class and include; Pasture and Agricultural Field Provisional Alliance (3,905 acres / 1,580 ha), Low Density Housing Map Class (1,788 acres / 723 ha), and High Density Housing Map Class (1,358 acres / 549 ha). From the forest and woodland class, the *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest association covers the greatest area (1,313 acres / 531 ha), followed by *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest (995 acres / 403 ha)--both forest types are within the *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance. *Symphoricarpos albus* - *Rosa nutkana* is the largest shrubland association, covering 337 acres (136 ha), and the *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation Association is the herbaceous type with the largest area (212 acres / 86 ha). The largest non-ruderal herbaceous type is the *Distichlis spicata* - (*Salicornia virginica*) Herbaceous Vegetation Association, totaling 65 acres (26 ha).

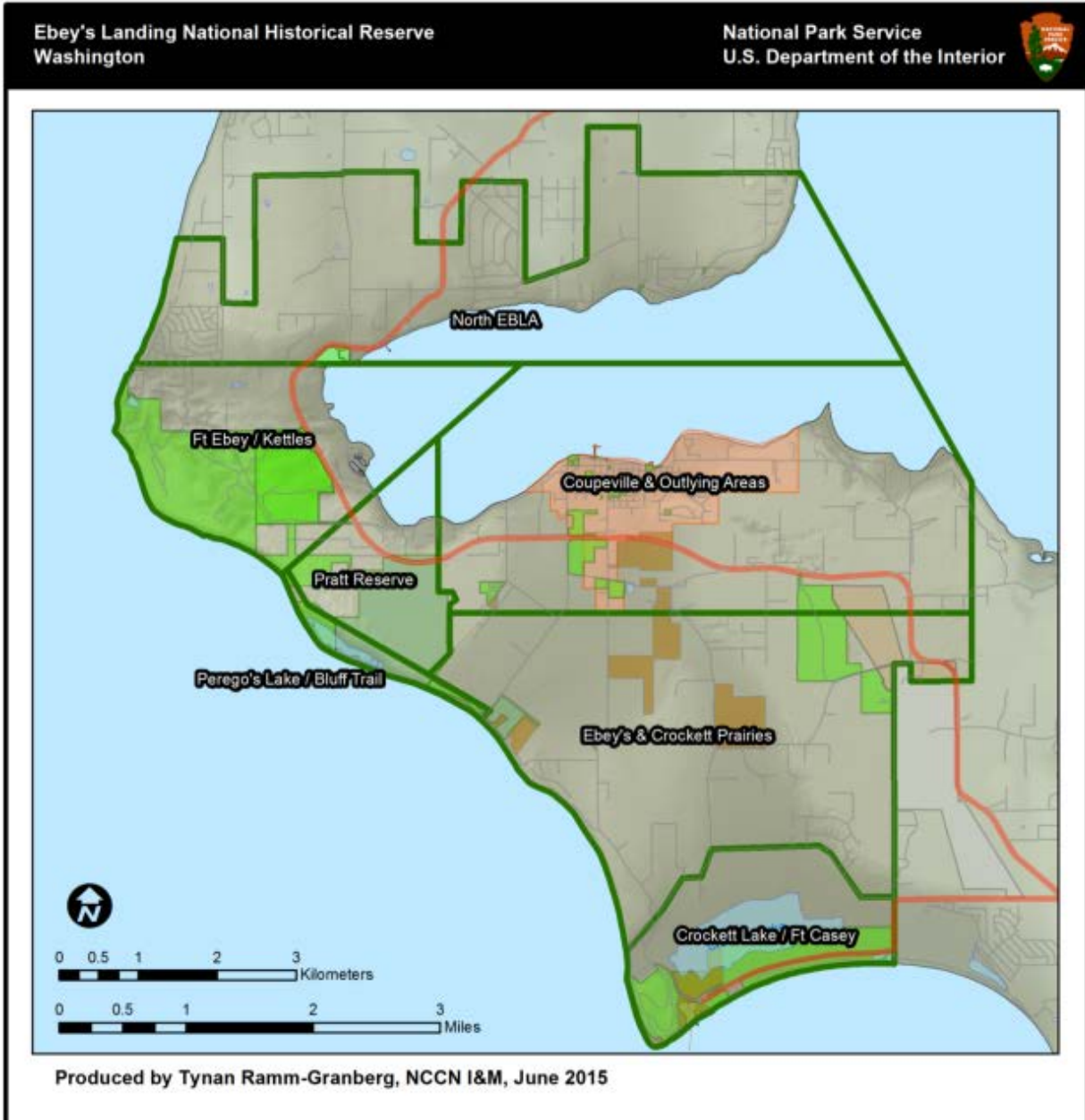


Figure 11. Subunits of Ebey's Landing National Historical Reserve, Washington.

Individual maps for each of the subunits in Figure 11 are presented in Appendix C. Summaries of the distribution of map classes for each of the subunits are included below (Table 5).

Table 5. Location, frequency, and area of mapped associations and map classes by subunit (see Figure 11) at Ebey's Landing National Historical Reserve, Washington.

Association, Alliance, or Map Class	North EBLA	Ft Ebey / Kettles	Pratt Reserve	Perego's Lake / Bluff Trail	Coupeville & Outlying Areas	Ebey's & Crockett Prairies	Crockett Lake / Ft Casey	# of Polygons	Percent of total area	Total Area (acres)	Total Area (ha)
<i>Agrostis (gigantea, stolonifera)</i> Ruderal Herbaceous Vegetation	X						X	15	0.34%	48.2	19.5
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest		X			X	X		7	0.23%	32.4	13.1
<i>Alnus rubra</i> / <i>Sambucus racemosa</i> / <i>Urtica dioica</i> Provisional Ruderal Forest		X	X		X	X	X	34	3.67%	517.9	209.6
<i>Argentina egedii</i> - <i>Juncus balticus</i> Herbaceous Vegetation				X			X	13	0.07%	10.1	4.1
Beach and Drift Logs Map Class	X	X		X	X	X	X	33	0.93%	131.5	53.2
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Herbaceous Vegetation	X	X	X	X	X	X	X	105	1.50%	211.8	85.7
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Provisional Ruderal Alliance				X		X		1	<0.01%	0.2	0.1
<i>Carex macrocephala</i> Herbaceous Vegetation				X			X	2	<0.01%	0.5	0.2
<i>Cytisus scoparius</i> Ruderal Shrubland		X	X					20	0.24%	33.2	13.4
<i>Distichlis spicata</i> - (<i>Salicornia virginica</i>) Herbaceous Vegetation	X			X			X	41	0.46%	65.0	26.3
Ebey's Landing Provisional Ruderal Woodland Association	X		X		X	X	X	79	2.34%	329.7	133.4
<i>Epilobium hirsutum</i> Provisional Ruderal Herbaceous Vegetation							X	2	0.04%	5.5	2.2
<i>Equisetum telmateia</i> Herbaceous Vegetation							X	5	0.01%	1.7	0.7
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous Vegetation					X			1	0.02%	2.6	1.0

Table 5. Location, frequency, and area of mapped associations and map classes by subunit (see Figure 11) at Ebey's Landing National Historical Reserve, Washington (continued).

Association, Alliance, or Map Class	North EBLA	Ft Ebey / Kettles	Pratt Reserve	Perego's Lake / Bluff Trail	Coupeville & Outlying Areas	Ebey's & Crockett Prairies	Crockett Lake / Ft Casey	# of Polygons	Percent of total area	Total Area (acres)	Total Area (ha)
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> Provisional (Restoration) Ruderal Alliance					X	X		4	0.98%	137.5	55.6
<i>Festuca rubra</i> - (<i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i>) Herbaceous Vegetation				X			X	12	0.13%	18.6	7.5
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation				X			X	9	0.06%	8.3	3.4
<i>Festuca rubra</i> Provisional Ruderal Herbaceous Vegetation							X	6	0.20%	28.5	11.6
High Density Housing Map Class	X				X	X		51	9.63%	1,357.5	549.4
Impounded Water Map Class	X	X			X	X	X	18	2.92%	412.2	166.8
<i>Juncus balticus</i> var. <i>balticus</i> Pacific Coast Herbaceous Vegetation	X					X	X	11	0.24%	33.8	13.7
<i>Juncus gerardii</i> var. <i>gerardii</i> Ruderal Brackish Wet Meadow							X	2	<0.01%	0.1	0.05
Lagoon Map Class		X		X				6	0.35%	49.1	19.9
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> / <i>Sphagnum</i> spp. Shrubland		X						2	0.03%	4.9	2.0
<i>Leymus mollis</i> ssp. <i>mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation	X			X	X		X	16	0.14%	19.7	8.0
<i>Lonicera involucrata</i> Provisional Wet Shrubland							X	3	0.02%	2.2	0.9
Low Density Housing Map Class	X	X	X		X	X	X	345	12.68%	1787.5	723.4
<i>Malus fusca</i> - (<i>Salix hookeriana</i>) / <i>Carex obnupta</i> Shrubland		X						1	<0.01%	0.2	0.1
Mowed Lawn Alliance	X	X			X	X	X	34	1.06%	150.0	60.7

Table 5. Location, frequency, and area of mapped associations and map classes by subunit (see Figure 11) at Ebey's Landing National Historical Reserve, Washington (continued).

Association, Alliance, or Map Class	North EBLA	Ft Ebey / Kettles	Pratt Reserve	Perego's Lake / Bluff Trail	Coupeville & Outlying Areas	Ebey's & Crockett Prairies	Crockett Lake / Ft Casey	# of Polygons	Percent of total area	Total Area (acres)	Total Area (ha)
<i>Nuphar polysepala</i> Herbaceous Vegetation		X						1	0.01%	1.9	0.8
Parking Lot and Buildings Map Class	X	X			X	X	X	19	0.27%	37.5	15.2
Pasture and Agricultural Field Provisional Alliance	X				X	X	X	94	27.70%	3,904.6	1,580.1
<i>Phragmites australis</i> Western North American Temperate Ruderal Herbaceous Vegetation							X	1	<0.01%	0.1	0.04
<i>Picea sitchensis</i> / <i>Gaultheria shallon</i> Forest		X						5	0.07%	9.7	3.9
<i>Prunus emarginata</i> Ruderal Flooded Forest Association			X					1	0.01%	1.0	0.4
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> - <i>Symphoricarpos albus</i> Forest	X				X	X	X	26	1.85%	260.5	105.4
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest		X			X			7	0.25%	35.0	14.1
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Depauperate</i> Undergrowth Forest			X					1	0.01%	1.9	0.7
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> / <i>Polystichum munitum</i> Forest		X	X		X	X		17	7.06%	994.8	402.6
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	X	X	X		X	X		67	2.23%	313.8	127.0
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Rhododendron macrophyllum</i> - <i>Vaccinium ovatum</i> - <i>Gaultheria shallon</i> Forest		X	X		X	X		22	9.32%	1,313.2	531.4

Table 5. Location, frequency, and area of mapped associations and map classes by subunit (see Figure 11) at Ebey's Landing National Historical Reserve, Washington (continued).

Association, Alliance, or Map Class	North EBLA	Ft Ebey / Kettles	Pratt Reserve	Perego's Lake / Bluff Trail	Coupeville & Outlying Areas	Ebey's & Crockett Prairies	Crockett Lake / Ft Casey	# of Polygons	Percent of total area	Total Area (acres)	Total Area (ha)
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest	X	X			X			18	0.65%	91.9	37.2
<i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> - <i>Rosa gymnocarpa</i> / <i>Festuca occidentalis</i> Forest			X			X		3	0.37%	52.1	21.1
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest	X	X	X		X	X		90	4.25%	598.4	242.2
Recently Harvested (Not-Replanted) Provisional Alliance					X	X		4	0.50%	70.8	28.6
Recently Harvested (Replanted) Provisional Alliance	X				X	X		3	0.26%	36.0	14.6
Road / Parking lots Map Class						X		10	1.78%	250.5	101.4
<i>Rosa nutkana</i> - <i>Rubus spectabilis</i> Wet Shrubland	X	X	X		X		X	4	0.01%	1.3	0.5
<i>Rubus armeniacus</i> Ruderal Shrubland	X			X	X	X	X	61	0.17%	24.0	9.7
<i>Salix hookeriana</i> - (<i>Salix sitchensis</i>) Shrubland	X						X	7	0.06%	8.1	3.3
<i>Salix lucida</i> ssp. <i>lasiandra</i> / <i>Urtica dioica</i> spp. <i>gracilis</i> Woodland					X			4	0.01%	1.4	0.6
<i>Schedonorus phoenix</i> Provisional Ruderal Herbaceous Vegetation	X			X	X	X	X	26	0.27%	38.6	15.6
<i>Schoenoplectus acutus</i> Pacific Coast Herbaceous Vegetation	X				X		X	12	0.26%	36.8	14.9
<i>Schoenoplectus maritimus</i> Tidal Herbaceous Vegetation							X	15	0.26%	37.1	15.0
<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Shrubland	X	X	X	X	X	X	X	436	2.39%	337.1	136.4

Table 5. Location, frequency, and area of mapped associations and map classes by subunit (see Figure 11) at Ebey's Landing National Historical Reserve, Washington (continued).

Association, Alliance, or Map Class	North EBLA	Ft Ebey / Kettles	Pratt Reserve	Perego's Lake / Bluff Trail	Coupeville & Outlying Areas	Ebey's & Crockett Prairies	Crockett Lake / Ft Casey	# of Polygons	Percent of total area	Total Area (acres)	Total Area (ha)
Temperate Conifer Forest Plantation Provisional Alliance					X	X		6	0.67%	93.9	38.0
Terrestrial Bare Areas Map Class	X	X		X	X	X	X	26	0.64%	89.8	36.3
<i>Tsuga heterophylla</i> - (<i>Pseudotsuga menziesii</i> - <i>Thuja plicata</i>) / <i>Polystichum munitum</i> - <i>Athyrium filix-femina</i> Forest		X				X	X	11	0.25%	34.9	14.1
<i>Typha latifolia</i> Pacific Coast Herbaceous Vegetation	X				X	X	X	16	0.12%	17.5	7.1

Vegetation Patterns

Lagoon, Lake, Dune, and Marsh Vegetation

The brackish marshes, freshwater lakes, and lagoons of the Reserve support unique wetland plant communities that cover 332 acres (134 ha) (Figure 12). Lake Pondilla, a kettle pond at Fort Ebey State Park, is the only naturally impounded fresh water found within the Reserve. It features the only *Nuphar polysepala* Herbaceous Vegetation community, which rings the lake's edges. A *Ledum groenlandicum* - *Kalmia microphylla* / *Sphagnum* spp. Shrubland dominates the fen just to the south of the lake and also covers an infilled lake a short distance to the northeast. The Lake Pondilla *Ledum* patch is bordered by the Reserve's only documented occurrence of *Malus fusca* - (*Salix hookeriana*) / *Carex obnupta* Shrubland.

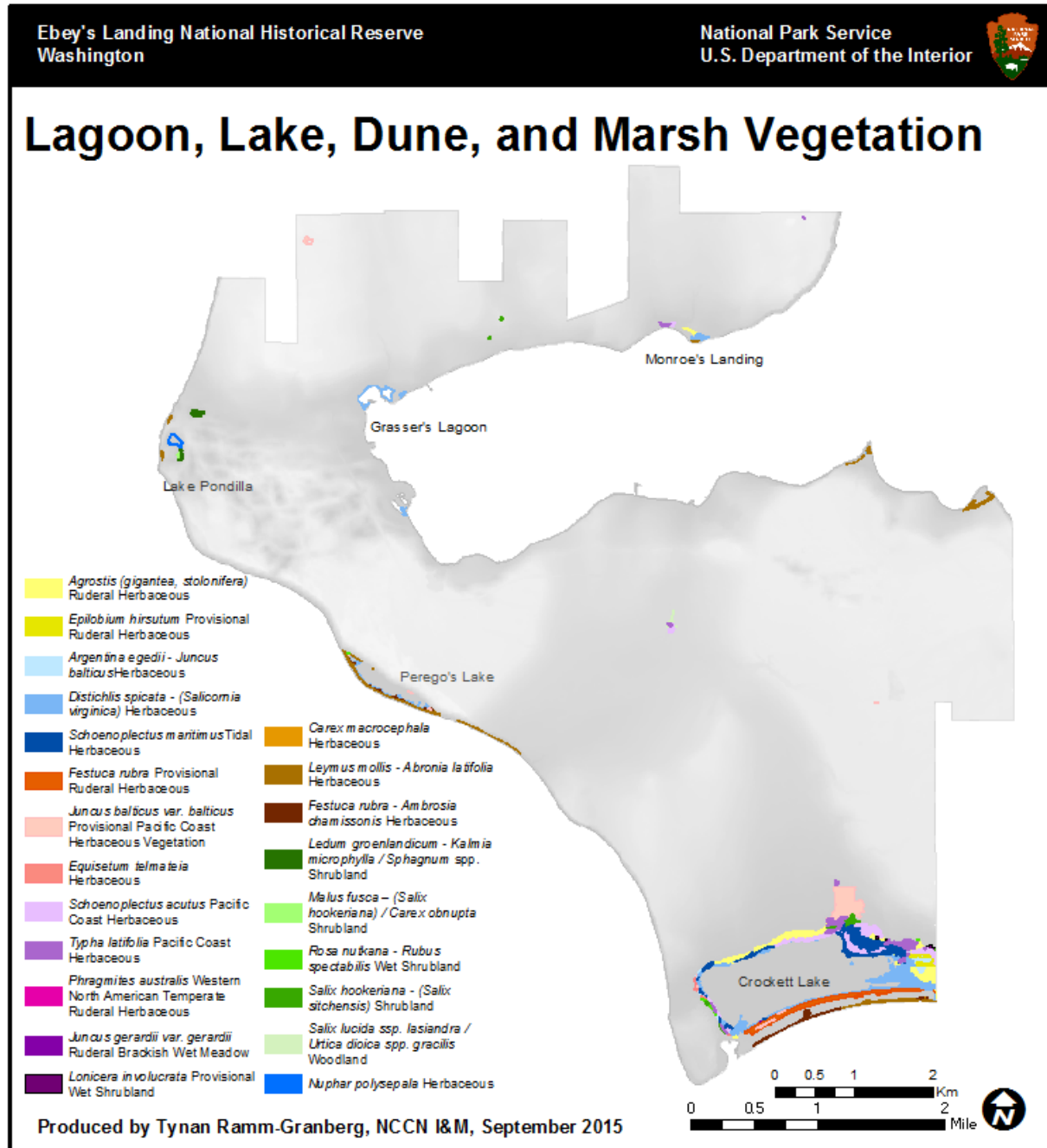


Figure 12. Wetland and dune vegetation of Ebey's Landing National Historical Reserve, Washington.

In the Reserve, lagoons form the hubs around which wetland plant communities take shape (Figure 12). These communities vary based on interconnected variables of inundation frequency, soil salinity, soil stability, and elevation. Many of these variables are in turn influenced by whether the lagoon retains an open channel to the sea, fills only from periodic overtopping events, or is managed by artificial tidal gates. Nearest the water, *Distichlis spicata*-(*Salicornia virginica*) Herbaceous Vegetation (an imperiled association in Washington) is typically found. This community covers large areas when the slope from the water's edge is gentle, particularly on the eastern shores of Crockett

Lake--an area that was part of the Lake before the installation of tidal gates. The salinity and moisture gradients mentioned above are complicated at Crockett Lake by a tangled history of development and agriculture, with the surrounding wetlands forming a matrix of both native and invasive-dominated ruderal communities. Native *Typha (latifolia, angustifolia)*, *Schoenoplectus maritimus*, *Schoenoplectus acutus*, and *Argentina egedii* - *Juncus balticus* Herbaceous Vegetation Associations are interspersed with non-native *Phragmites australis*, *Epilobium hirsutum*, and *Agrostis (gigantea, stolonifera)* Ruderal Vegetation Associations. Further from the lake, to the northeast, wetland and mesic shrubs start to appear, with *Lonicera involucrata* Shrublands and *Rubus Armeniacus* Ruderal Shrublands. *Rosa nutkana* - *Rubus spectabilis* and *Salix hookeriana* - (*Salix sitchensis*) Shrublands are limited to the inflection point between the relatively flat lakebed and the neighboring road grade.

The other lagoons in the Reserve feature less vegetative diversity. At Grasser's Lagoon--a small body of water on the north side of Penn Cove that becomes a mudflat at low tide--there is a steep enough slope up to the neighboring roadway that the *Distichlis* - *Salicornia* type gives way directly to mesic *Schedonorus phoenix* Ruderal Herbaceous Vegetation within a few meters. Perego's Lake, located between the coastal bluffs and Admiralty Inlet, is closed off from the sea and only refilled by unusually large waves or storm surges. The strip of *Distichlis* at Perego's is surrounded by *Argentina egedii* - *Juncus balticus* Herbaceous Vegetation. At the small lagoon near Monroe's Landing, the lagoon is filled with drift logs and mats of *Agrostis (gigantea, stolonifera)* Ruderal Herbaceous Vegetation, with *Distichlis* creating a low, vegetated strip between the lagoon and Penn Cove.

All of these lagoons, including Crockett Lake, are buffered from the ocean by sandy to pebbly spits lined with drift logs. On these narrow strips, *Leymus mollis* - *Abronia latifolia* Herbaceous Vegetation grows amid and just behind the logs. Often strips of *Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation or small patches of *Carex macrocephala* Herbaceous Vegetation lie just behind the *Leymus* (all three are imperiled associations), but these can be highly degraded by invading non-native grasses, or even completely replaced by ruderal associations like *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation. The spit at Crockett Lake was artificially raised in the 1970s in anticipation of a housing development that was later cancelled. While the vegetation communities were saved from replacement by houses, the new height of the spit has reduced the frequency of overtopping storm events. This in turn has allowed colonization of the spit by *Symphoricarpos albus* - *Rosa nutkana* Shrublands that are gradually replacing the imperiled herbaceous communities (Steve Erickson pers. comm.).

Wetlands within the Reserve that are not associated with lakes or lagoons are restricted to small, isolated depressions. These tend to be dominated by woody associations such as the *Salix lucida* ssp. *lasianдра* / *Urtica dioica* or *Salix hookeriana* - (*Salix sitchensis*) Shrublands, although patches with standing water may include significant amounts of *Typha (latifolia, angustifolia)* and/or *Schoenoplectus acutus* Herbaceous Vegetation.

The *Festuca rubra* Provisional Ruderal Alliance provides an example of the difficulties of differentiating degraded native types from ruderal associations. This alliance covers a long strip on the south shore of Crockett Lake. It is possible that this sites represents a degraded *Festuca rubra*-

(*Argentina egedii*) community, as it is positioned in a high salt marsh setting directly abutting a *Distichlis spicata* - (*Salicornia virginica*) community. However, no *Argentina egedii* was observed. This area was originally attributed as *Festuca rubra* - *Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation due to the red fescue (*Festuca rubra*) dominance and presence of gumweed (*Grindelia stricta*), but the ecological setting at these locations is far removed from the dry headlands currently thought to be characteristic of that type. Further research is necessary to determine if this type is found elsewhere in the Puget Sound lowlands, or if it represents a singular consequence of the unique disturbance history at Crockett Lake. The difficulty in differentiating native red fescue from the non-native, introduced subspecies adds to uncertainty regarding this provisional alliance (Chappell and Caplow 2003).

Upland Grassland Vegetation

The grasslands include some of the rarest plant associations found within the Reserve, as well as some of the most common ones (Figure 13). The prairies of the Reserve were the primary attraction for early settlers, and these unique communities have been nearly completely replaced by farmland, housing, or invading shrublands. Soils surveys of the Reserve indicate that native, non-ruderal, upland grasslands may have once covered as much as 4,314 acres (1,746 ha). However, currently upland grasslands occupy just 21.2 acres (8.5 ha) and only two significant, reasonably pristine prairie remnants occur within the Reserve. One of the remnants is a 2.6 acre (1 ha) patch labeled *Festuca idahoensis* ssp. *roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation located at Smith Prairie, within the Pacific Rim Institute. The remnant has a high cover of native species, but also a significant cover of invasive species, with at least 37 different non-native species documented within its boundary. This native prairie community has been effectively extirpated as a functional system within the Puget Sound region. With that in mind, these patches serve as a seed source and inspiration for continued prairie restoration efforts throughout the area.

The other remnant prairie is in the *Festuca rubra* - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation Association. A 1.5 acre patch found at the Naas Unit of the Admiralty Inlet Natural Area Preserve located on the bluffs above Perego's Lake was labeled with this type due to the high cover of *Festuca rubra* ssp. *mediana* as well as many other native species. Only nine occurrences of fair to good integrity of this Association are known in Washington, including this one. Other examples of more degraded quality can be found on the bluffs at Fort Ebey. While still subjected to historical grazing--along with continuing non-native plant invasions and fire exclusion--this association may persist to a greater extent than the *Festuca idahoensis* ssp. *roemerii* - *Camassia quamash* - *Cerastium arvense* Herbaceous Vegetation Association because the steep bluffs have acted as a refugia for a type that was previously distributed to a broader range of habitats. Historically fire may have played a role in maintaining this type, accidental fires on the bluffs due to fireworks and beach fires have and could continue to negatively impact this rare community (M. Sheehan, pers. comm). Although currently restricted to dry bluff settings, Chappell and Caplow (2003) and others have posited a mesic expression of the type.

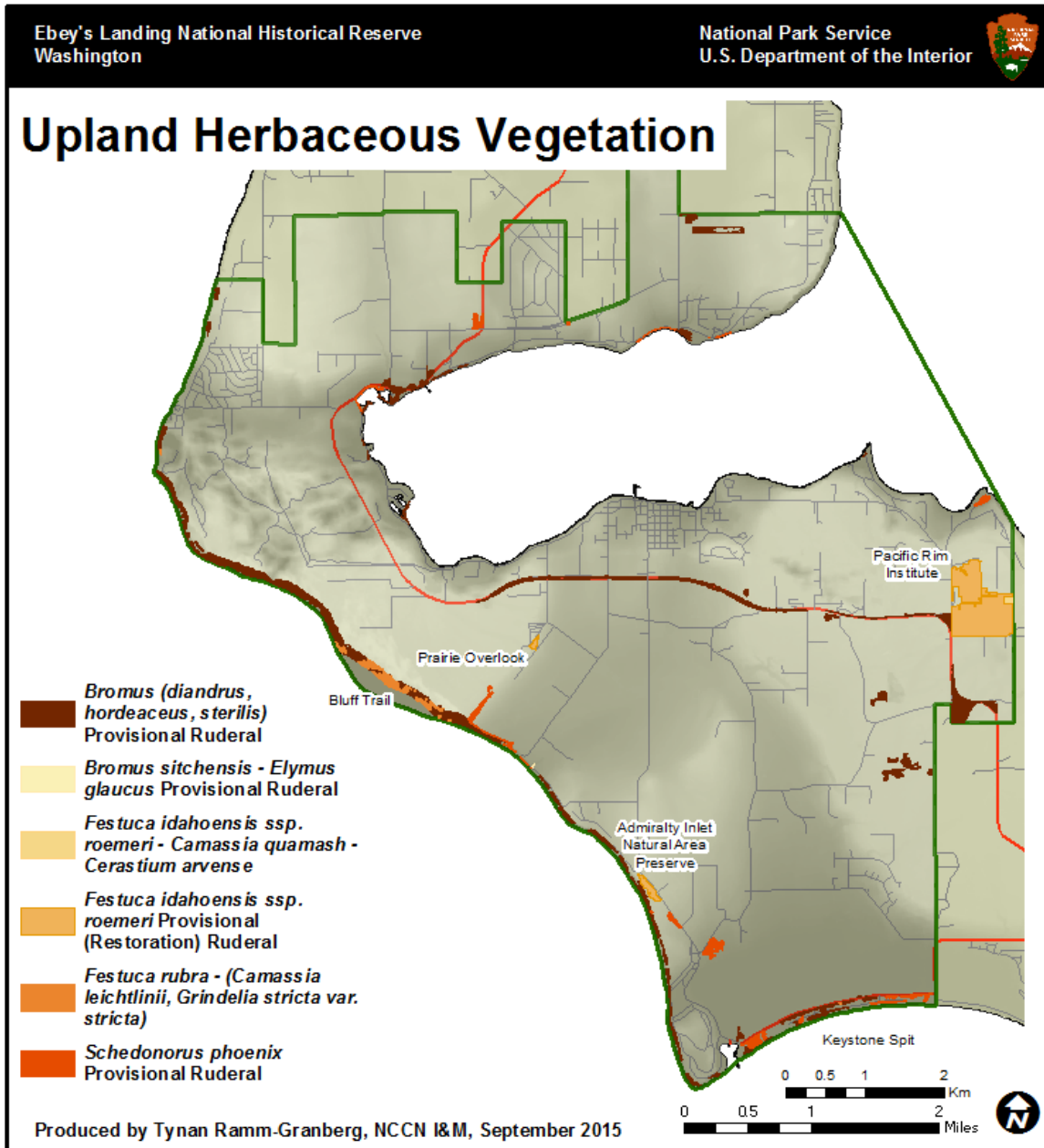


Figure 13. Upland herbaceous areas of Ebey's Landing National Historical Reserve, Washington.

Ruderal types dominated by non-native grasses are far more frequent than the *Festuca*-dominated associations. Tall fescue (*Schedonorus phoenix* (= *arundinaceus*)) was originally introduced as a pasture grass and now dominates the mesic *Schedonorus phoenix* Provisional Ruderal Herbaceous Vegetation Association. Within the Reserve, it is common in old, fallow fields and on the edges of fields under active cultivation. *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation occurs on drier sites and is much more common than the *Schedonorus* type. *Bromus*-dominated community covers the majority of the steep bluffs along the Strait of Juan de Fuca, where it has probably replaced *Festuca rubra* - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation, though patches of red fescue remain. Those patches are conspicuous

because they form miniature terraces--the perennial bunch grasses are far more effective at preventing erosion on the sandy bluffs than the annual invasives. *Bromus*-dominated grasslands are also common along highway rights-of-way throughout the Reserve, where they intergrade with the mesic *Schedonorus* type. Dwarfing all other grassland associations in terms of area is the Pasture and Field Provisional Alliance, which includes all of the agricultural land in the Reserve.

Upland Shrubland Vegetation

Upland shrublands occupy a total of 394.2 acres (159.5 ha) within the Reserve (Figure 14). Nearly 42 of those acres (16.9 ha) come in the form of long, narrow hedgerows. Upland shrublands do not include the EBLA Ruderal Provisional Woodland type, characterized by open tree canopies with a high average cover of shrubs in the understory.

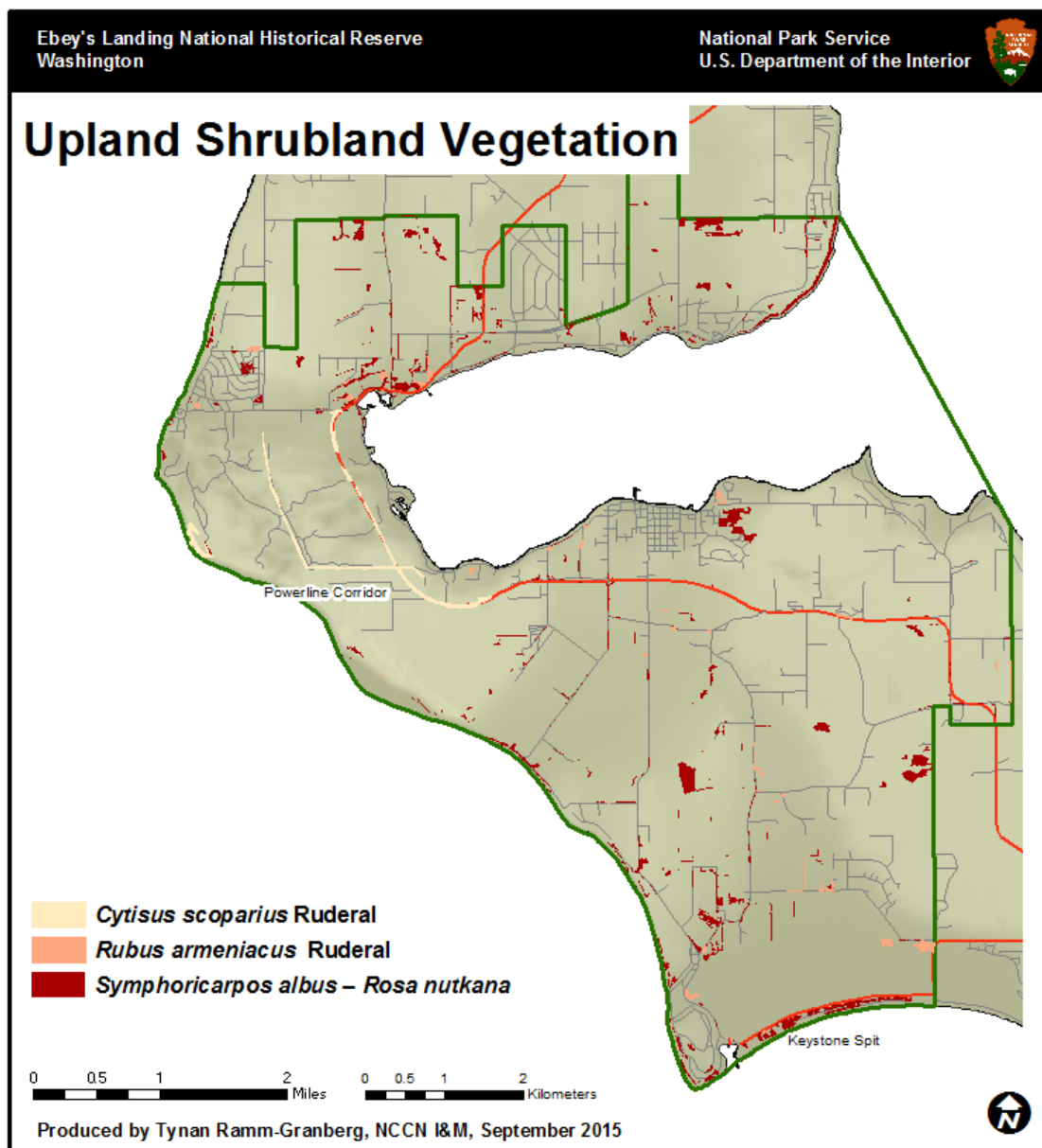


Figure 14. Upland shrubland areas of Ebey's Landing National Historical Reserve, Washington.

The only native upland shrubland association in the Reserve is the *Symphoricarpos albus* - *Rosa nutkana* Shrubland. Historically, this association was probably limited in distribution by Native American burning. Now it is widely distributed, occupying not only windblown bluffs and hedgerows, but also colonizing disturbed areas around development and invading fallow agricultural land and remnant grasslands. The shrublands that occupy former prairies may still have diverse native herbaceous species, like aspen fleabane (*Erigeron speciosus*), Pacific woodrush (*Luzula comosa*), and foothill sedge (*Carex tumulicola*), in their understory. Competing with this native shrubland are those dominated by well-known invasive species. *Cytisus scoparius* Ruderal Shrublands are well-established in the center of the reserve, in power line corridors and along Highway 20. *Rubus armeniacus* Ruderal Shrublands are more widely distributed through the Reserve, on the edges of human development, but each patch rarely occupies more than a few hundred square yards.

Forest Vegetation

There are currently 4,708 acres (1,905 ha) of forest and woodland in the Reserve (Figure 15), while soil surveys indicate that forests once covered approximately 8,495 acres (3,438 ha) (Figure 16, Table 6). Most of those formerly-forested acres have been developed for housing and small farms. All of the remaining forests have a history of logging, agriculture, or both, though the time-since-disturbance varies widely across the landscape. Despite the long history of disturbance, the Reserve contains several rare dry forest types that are found only within the rain shadow of the Olympic Mountains.



Forest Vegetation

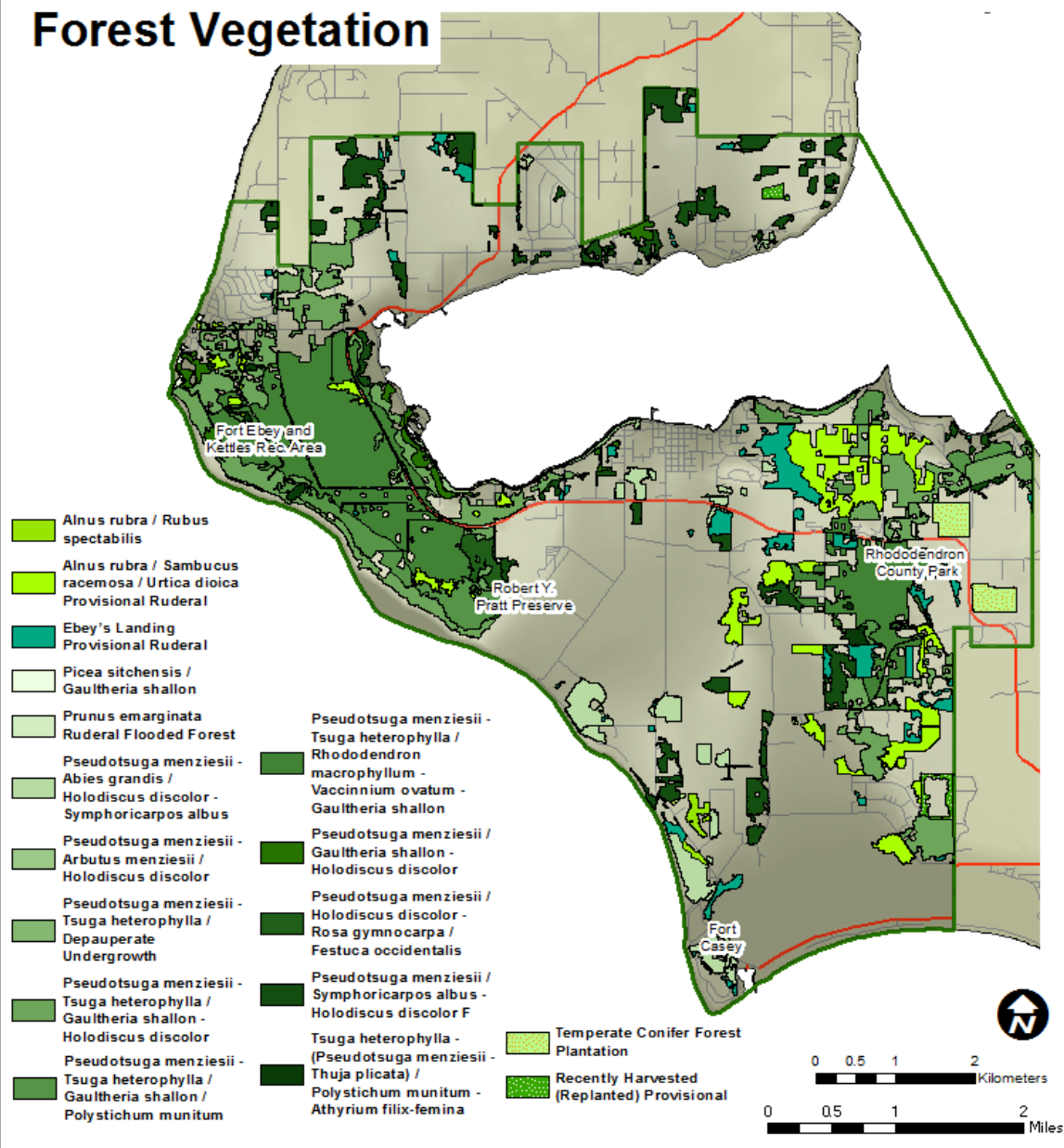


Figure 15. Forest vegetation of Ebey's Landing National Historical Reserve, Washington.



Non-Forest Vegetation

on Soils of Forest Origin

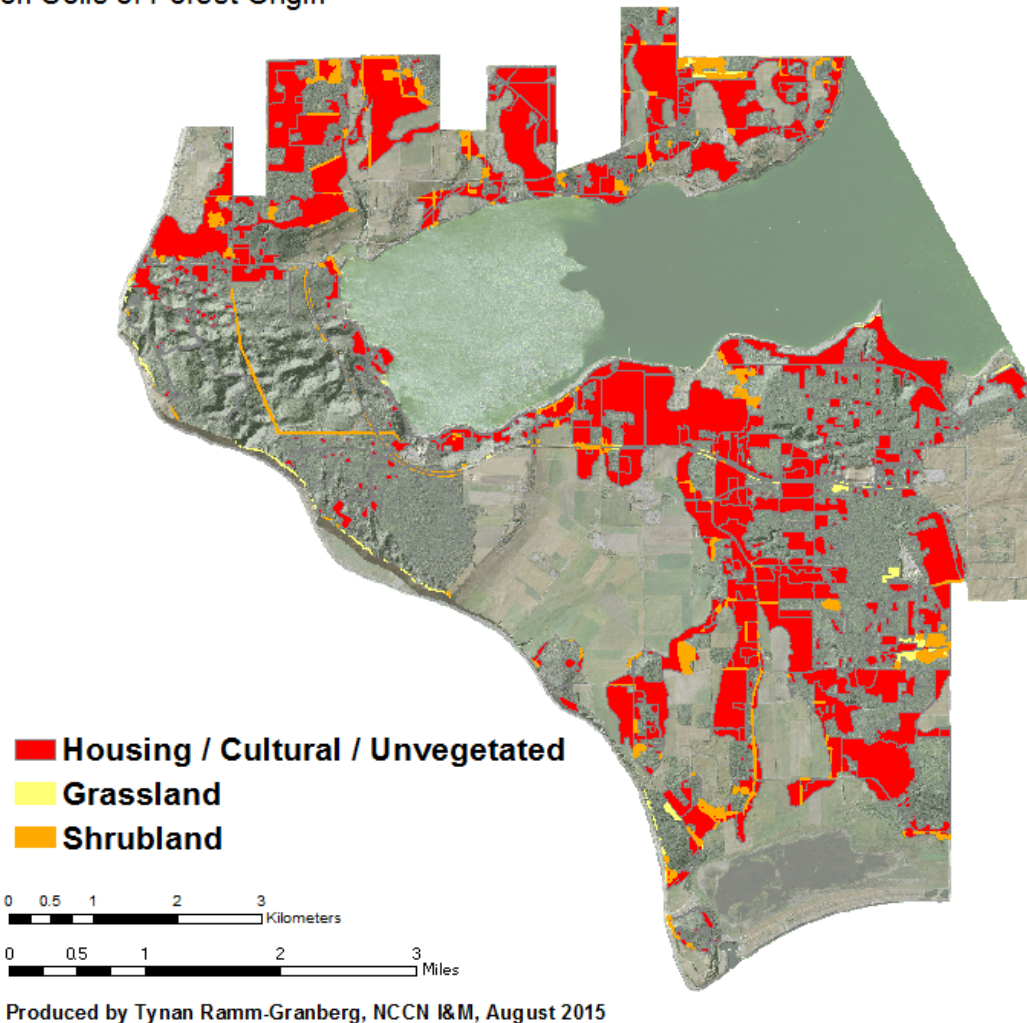


Figure 16. Non-forest vegetation present on soils of forest origin of Ebey's Landing National Historical Reserve, Washington.

Table 6. Non-forested associations and map classes found on soils of forest origin of Ebey's Landing National Historical Reserve, Washington.

Association	Type	Area on Forest Soil (ha)	Area on Forest Soil (acres)	% of Non-forested Forest Soils
High Density Housing Map Class	Cultural / Unvegetated	1367.4	413.9	15.9%
Low Density Housing Map Class	Cultural / Unvegetated	1850.5	481.9	21.5%
Mowed Lawn Alliance	Cultural / Unvegetated	150.0	26.5	1.7%
Parking Lots and Buildings Map Class	Cultural / Unvegetated	37.5	7.4	0.4%
Pasture and Agricultural Field Provisional Alliance	Cultural / Unvegetated	3992.8	553	46.5%
Roads and Parking Lots Map Class	Cultural / Unvegetated	261.5	59.3	3.0%
Terrestrial Bare Areas Map Class	Cultural / Unvegetated	94.3	5.8	1.1%
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Herbaceous Vegetation Association	Grassland	221.2	17.8	2.6%
<i>Festuca rubra</i> - (<i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i>) Herbaceous Vegetation Association	Grassland	18.6	0.1	0.2%
<i>Leymus mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation Association	Grassland	19.9	0.3	0.2%
<i>Schedonorus phoenix</i> Provisional Ruderal Herbaceous Vegetation Association	Grassland	38.6	1.3	0.4%
<i>Cytisus scoparius</i> Ruderal Shrubland Association	Shrubland	33.2	9.9	0.4%
<i>Rubus armeniacus</i> Ruderal Shrubland Association	Shrubland	25.5	3.0	0.3%
<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Pacific Coast Shrubland Association	Shrubland	346.4	63.6	4.0%
<i>Distichlis spicata</i> - (<i>Salicornia virginica</i>) Herbaceous Vegetation Association	Wetland	66.1	0.1	0.8%
<i>Juncus balticus</i> var. <i>balticus</i> Provisional Pacific Coast Herbaceous Vegetation Association	Wetland	33.8	0.7	0.4%
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> / <i>Sphagnum spp.</i> Shrubland Association	Wetland	4.9	2.0	0.1%
<i>Malus fusca</i> - (<i>Salix hookeriana</i>) / <i>Carex obnupta</i> Shrubland Association	Wetland	0.2	0.1	<0.1%
<i>Rosa nutkana</i> - <i>Rubus spectabilis</i> Wet Shrubland Association	Wetland	1.3	0.005	<0.1%
<i>Salix hookeriana</i> - (<i>Salix sitchensis</i>) Shrubland Association	Wetland	8.1	0.2	0.1%
<i>Typha latifolia</i> Pacific Coast Herbaceous Vegetation Association	Wetland	18	0.04	0.2%
		8590	1647	

The largest continuously forested area within the Reserve lies on the western end of Penn Cove (Figure 15). Nearest to the Cove, the imperiled *Pseudotsuga menziesii* - *Arbutus menziesii* / *Holodiscus* Forest Association can be found here on a strip of rocky outcroppings interspersed by houses. Inland and upslope from the cove, madrone (*Arbutus menziesii*) becomes less common and salal (*Gaultheria shallon*) increases in abundance, quickly transitioning into a belt of *Pseudotsuga menziesii* / *Gaultheria shallon* - *Holodiscus discolor* Forest; as western hemlock (*Tsuga heterophylla*) becomes prominent, this transitions into *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest. This type occupies more mesic conditions than the dry *Pseudotsuga menziesii* / *Gaultheria shallon* - *Holodiscus discolor* Forest Association, and contains little or no madrone. At the top of the slope, along Highway 20, lies the largest forest patch found within the Reserve. This large patch of *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest Association occupies over 900 acres (364 ha) of this central isthmus, covering nearly the entirety of the Kettles Recreation Area and most of Fort Ebey State Park. In addition, this association makes up most of--the appropriately named--Rhododendron County Park, where some of the largest trees in the Reserve are found.

Continuing westward, a strip of *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest occupies the area near the bluffs along the Strait of Juan de Fuca. Rhododendron-dominated understories are always at least 200 m from saltwater within the Reserve. In particularly foggy, moist areas, there are small patches of *Picea sitchensis* / *Gaultheria shallon* Forest--rare incursions of seasonal rain forest in the Olympic rain shadow. Other moist conifer forest types, like the *Tsuga heterophylla* - (*Pseudotsuga menziesii* - *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest Association, are limited to a few shallow depressions.

Moving north of the isthmus, *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest dominates until Grasser's Hill. From that point north and east, the forests are nearly entirely in the *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest Association. The forests in this part of the Reserve are much smaller, fragmented, and occupy flat landscape positions.

South of the isthmus, in the Robert Y. Pratt Preserve (owned by The Nature Conservancy), the dominant *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest transitions to large areas of *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* and *Pseudotsuga menziesii* / *Holodiscus discolor* - *Rosa gymnocarpa* / *Festuca occidentalis* Forests. This is the only area in which the latter association is found within the Reserve. *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest, on the other hand, also covers the north-facing slopes along the southern shores of Penn Cove. Those forests shift to the *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest Association as the slopes flatten out further from Penn Cove. This association continues to dominate most of the forested areas within private lands east of Crockett Prairie, excluding Rhododendron County Park.

The *Pseudotsuga menziesii* - *Abies grandis* / *Symphoricarpos albus* - *Holodiscus discolor* Forest Association is entirely limited to gentle slopes on the southern end of the Reserve, including the forests at Fort Casey State Park, the Heritage Forest Unit of the Admiralty Inlet Natural Area Preserve (owned by Whidbey Camano Land Trust). The forest south of Camp Casey is regrowing after being cleared away during the establishment of the fort in the 1890s. These forests resemble the *Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* / *Melica subulata* forests found at SAJH, but have significantly greater cover of mesic and moist indicator species, such as foamflower (*Tiarella trifoliata*), salmonberry (*Rubus spectabilis*), and western sword fern (*Polystichum munitum*).

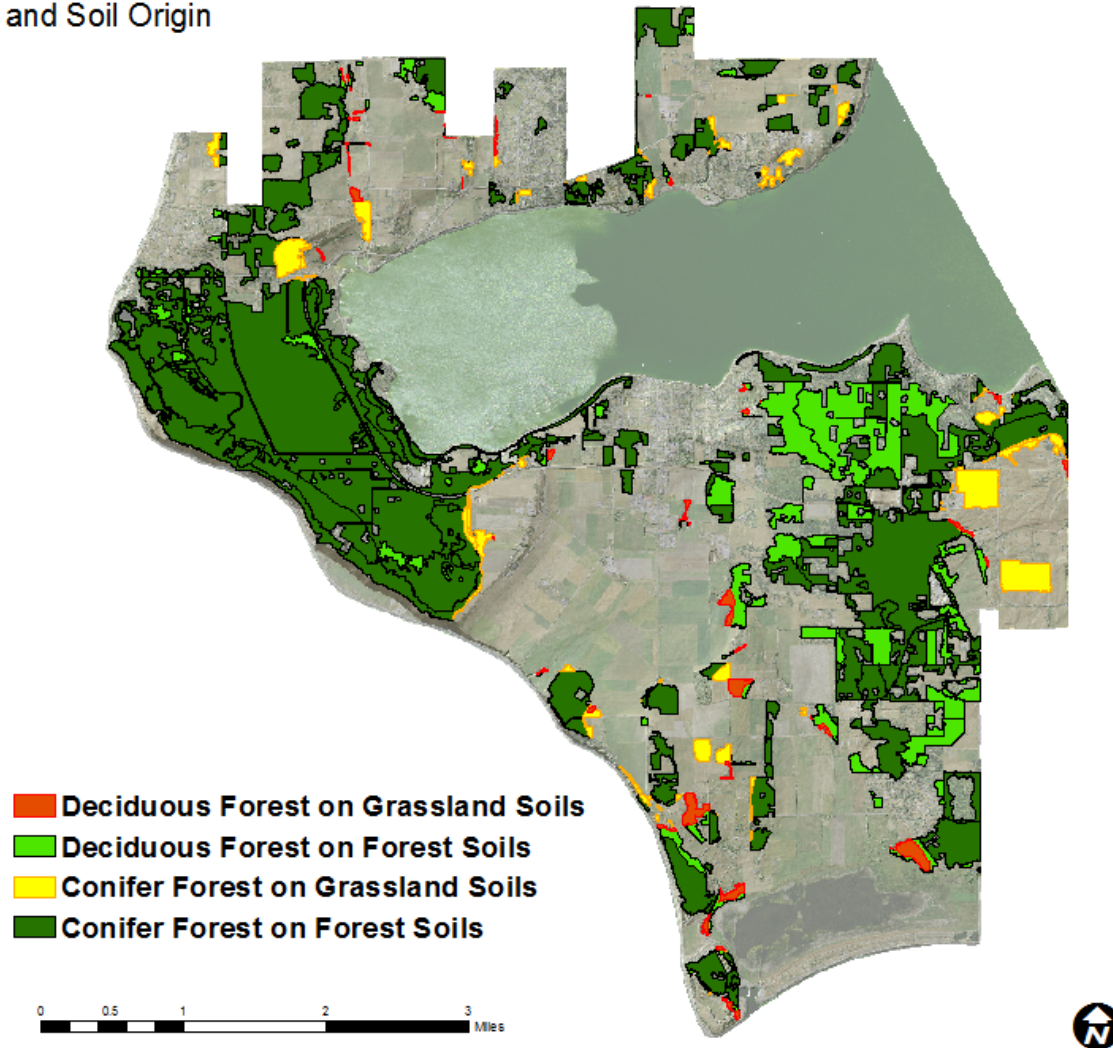
Deciduous forests within the Reserve include the *Salix lucida* ssp. *lasiandra* / *Urtica dioica* spp. *gracilis* Woodland Association, *Alnus rubra* / *Rubus spectabilis* Forest Association, *Alnus rubra* / *Sambucus racemosa* / *Urtica dioica* Provisional Forest Association, and EBLA Ruderal Woodland Alliance. The *Salix lucida* ssp. *lasiandra* / *Urtica dioica* spp. *gracilis* Woodland Association is a borderline shrubland that was only found around the edges of a single wet depression dominated by broad-leaf cattail (*Typha latifolia*) and common tule (*Schoenoplectus acutus*), just southeast of Coupeville. It is somewhat imperiled, due to its vulnerability to alterations in the water table. While *Alnus rubra* / *Rubus spectabilis* and *Alnus rubra* / *Sambucus racemosa* / *Urtica dioica* are both classified within the (*Acer macrophyllum*, *Alnus rubra*) Riparian Forest Alliance, the former occurs on much wetter sites and is restricted to low-lying depressions when compared to the latter. It was found in a few pockets near Fort Ebey State Park, as well as a large patch north of Fort Casey State Park. The *Alnus rubra* / *Sambucus racemosa* / *Urtica dioica* Provisional Forest Association was created to describe a unique assemblage found repeatedly throughout the Reserve. It occupies mesic to moist landscape positions that are usually flat or at the base of gentle toe slopes. Another provisional type created during the classification process at Ebey's Landing is the EBLA Ruderal Alliance. It can be found throughout the Reserve wherever mesic to moist disturbed areas have been left long enough to develop woody vegetation.

Figure 17 and Table 7 presents the soil origins of the forested associations found in the Reserve. Ninety-eight percent of the area planted as conifer plantations (either for timber or christmas trees) is located on grassland soil, accounting for 27% (92 acres / 37.2 ha) of the total forested area on those soils. It's notable that these plantations are not located in areas that were previously logged and then replanted. *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest accounts for another 25% (86.7 acres / 35.1 ha) of forested grassland soil. The largest such patches occur at ecotones between mesic conifer forests and large grasslands like Smith Prairie and Ebey's Prairie, where a combination of tree encroachment and edge effect (greater sunlight penetration) produces drier forests. Other significant incursions of forests on grassland soil can be found at Grasser's Hill (*Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest) and in the forest patches that separate Ebey's and Crockett Prairies (*Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* - *Symphoricarpos albus* Forest).



Forest Vegetation

and Soil Origin



Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure 17. Soil origins under currently forested areas at Ebey's Landing National Historical Reserve, Washington.

Table 7. Forested associations found on soils of grassland origin at Ebey's Landing National Historical Reserve.

Association	Type	Total Area (acres)	Total Area (ha)	Acreage on Grassland Soil	Acreage on Grassland Soil	% Acreage on Grassland Soil	% of Forested Grassland Soils	% of Forested Grassland Soils (Excluding Plantations)
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest Association	Deciduous	32.4	13.1	13.2	5.3	40.70%	3.9%	5.3%
<i>Alnus rubra</i> / <i>Sambucus racemosa</i> / <i>Urtica dioica</i> Provisional Ruderal Forest Association	Deciduous	517.9	209.6	32.5	13.1	6.30%	9.5%	13.1%
Ebey's Landing Provisional Ruderal Woodland Association	Deciduous	329.7	133.4	34.2	13.8	10.40%	10.0%	13.7%
<i>Salix lucida</i> ssp. <i>lasiandra</i> / <i>Urtica dioica</i> spp. <i>gracilis</i> Woodland Association	Deciduous	1.4	0.6	0.9	0.4	63.70%	0.3%	0.4%
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> - <i>Symphoricarpos albus</i> Forest Association	Conifer	260.5	105.4	26.0	10.5	10.00%	7.6%	10.4%
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest Association	Conifer	35.0	14.1	4.8	1.9	13.70%	1.4%	1.9%
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest Association	Conifer	994.8	402.6	38.5	15.6	3.80%	11.3%	15.5%
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> / <i>Polystichum munitum</i> Forest Association	Conifer	313.8	127.0	6.0	2.4	1.90%	1.8%	2.4%
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Rhododendron macrophyllum</i> - <i>Vaccinium ovatum</i> - <i>Gaultheria shallon</i> Forest Association	Conifer	1313.2	531.4	0.8	0.3	0.10%	0.2%	0.3%
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest Association	Conifer	91.9	37.2	0.1	0.04	0.10%	0.03%	0.04%
<i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> - <i>Rosa gymnocarpa</i> / <i>Festuca occidentalis</i> Forest Association	Conifer	52.1	21.1	5.2	2.1	10.00%	1.5%	2.1%

Table 7. Forested associations found on soils of grassland origin (continued).

Association	Type	Total Area (acres)	Total Area (ha)	Acreage on Grassland Soil	Acreage on Grassland Soil	% Acreage on Grassland Soil	% of Forested Grassland Soils	% of Forested Grassland Soils (Excluding Plantations)
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest Association	Conifer	598.4	242.2	86.7	35.1	13.4%	25.4%	34.8%
Temperate Conifer Forest Plantation Group	Conifer	93.9	38.0	92.0	37.2	98.0%	27.0%	---
Total				340.9				

Summary

Ebey's Landing National Historical Reserve represents a matrix of cultural, ruderal, and natural vegetation types (Figure 18). Each vegetation type within the park was mapped to at least the NVC alliance level and most were mapped at the association level. Ruderal types proved challenging to classify and map because the disturbance and recovery trajectories of these communities are generally unknown. The vegetation classification for San Juan National Historical Park (Rocchio et al. 2012) proved invaluable in this regard. Several vegetation types described in this report, such as the *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation Association, constitute additional samples of types originally proposed in the SAJH report. Provisional ruderal types described for the first time in this report were frequently inspired by similar assemblages at SAJH. The exact classification of these types is a subject for additional research. Additional regional sampling may tell us whether these types are found elsewhere, represent variations of existing plant associations, or are unique to the Reserve.



Natural v. Ruderal Vegetation

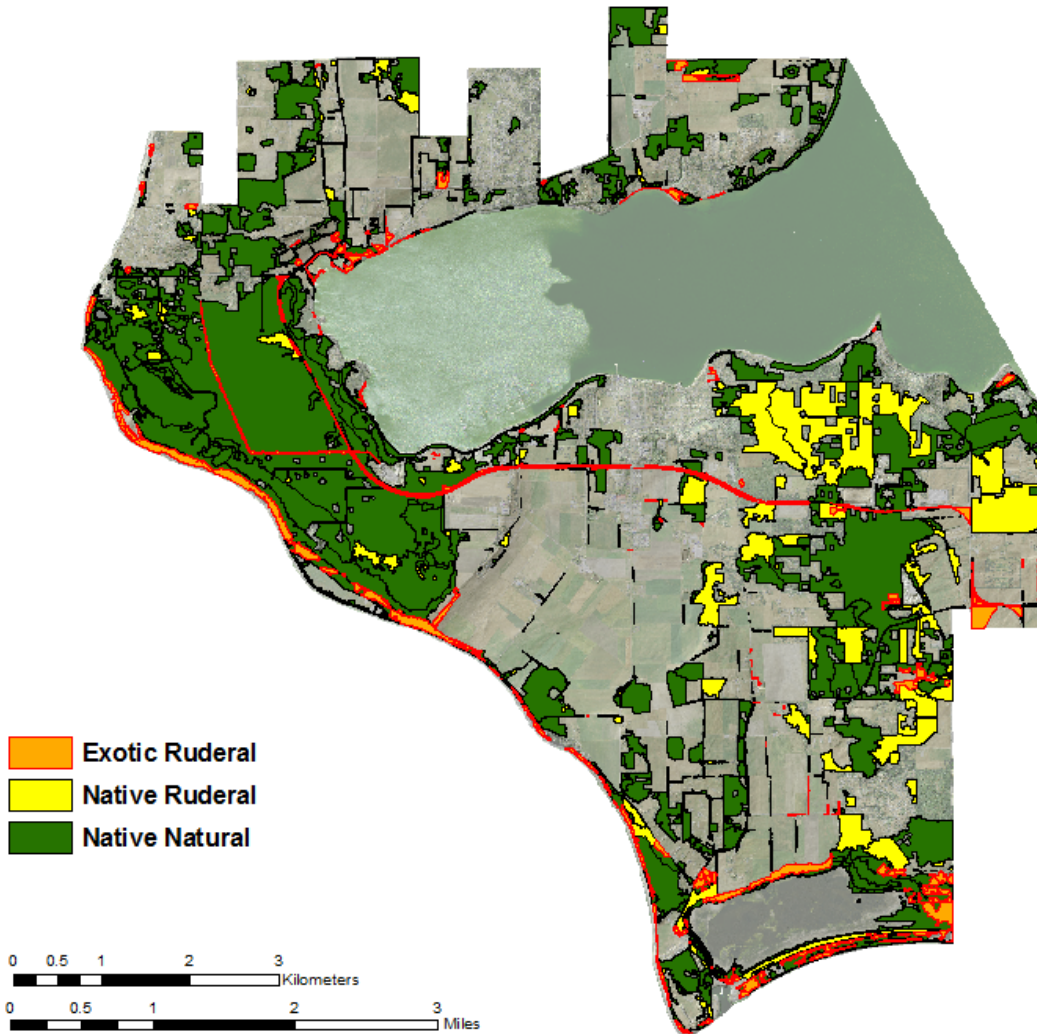


Figure 18. Natural and ruderal plant communities at Ebey's Landing National Historical Reserve. Most "Native Ruderal" communities contain large numbers of exotic species, but are dominated by native plants.

Accuracy Assessment

The purpose of an accuracy assessment is to assess and document the reliability of the map. An accuracy assessment provides information about the limitations of individual map classes and the confusion (or relationship of the errors) between map classes. The NPS mapping standard for accuracy is an overall and per class accuracy of 80%. Overall map accuracy is defined as “the proportion of the total area (all individual map classes pooled) that is correctly mapped, or equivalently, the probability that a random point in the target area is classified correctly by the map.” Accuracy is determined by sampling representative sites within each map class and independently assessing the vegetation class of these sites directly in the field. Matches between map class and field-selected class are considered “correctly” mapped sites.

Methods

The accuracy assessment methods and analyses for Ebey’s Landing mapping followed current National Park Service VIP standards (Lea and Curtis, 2010).

Sampling Points

To generate sampling points from the vegetation polygons, classified vegetation polygons of Ebey’s Landing National Historical Reserve were buffered 28 to 18 m from their edges, depending on map class type. Target assessment points were placed at the center of each polygon. The assessment plot diameter was scaled by map class: plots in forested polygons had 56 m plot diameters and non-forested plots had 36 m diameters. Larger polygons that could accommodate multiple plots were assigned multiple target assessment points. A third group of polygons had geometries that were small and/or linear and were assigned points manually.

Coordinates were generated for each sampling point. Each target point was labeled with the park code (EBLA), the buffer size, and a random, unique identification number. 1146 sampling points were generated.

Scope of Inference

Following NPS guidance, the AA sampling excluded 19 of the 51 map classes (Table 8). Only map classes that could contain five or more sample points were used. Seven vegetated types were too small in area to be included in the AA. Twelve cultural or unvegetated types were also excluded.

Table 8. Map classes excluded from the accuracy assessment for Ebey's Landing National Historical Reserve.

Map Class	Total Area (acres)	Total Area (ha)
<i>Vegetated</i>	3.4	1.4
Rosa nutkana - Rubus spectabilis Wet Shrubland	1.3	0.5
Prunus emarginata Provisional Ruderal Flooded Forest Alliance	1.0	0.4
Carex macrocephala Herbaceous Vegetation	0.5	0.2
Malus fusca - (Salix hookeriana) / Carex obnupta Shrubland	0.2	0.1
Bromus sitchensis - Elymus glaucus Provisional Ruderal Alliance	0.2	0.1
Juncus gerardii Provisional Ruderal Wet Meadow Alliance	0.1	0.04
Phragmites australis Temperate Semi-natural Herbaceous Vegetation	0.1	0.04
<i>Cultural / Unvegetated</i>	8321.8	3367.7
Pasture and Agricultural Field Provisional Alliance	3904.6	1580.1
Low Density Housing Map Class	1787.5	723.4
High Density Housing Map Class	1357.5	549.4
Impounded Water Map Class	412.2	166.8
Road/Parking Lots Map Class	250.5	101.4
Mowed Lawn Alliance	150	60.7
Beach and Drift Logs Map Class	131.5	53.2
Temperate Conifer Forest Plantation Group	93.9	38.0
Terrestrial Bare Areas Map Class	89.8	36.3
Recently Harvested (Not Replanted)	70.8	28.7
Parking Lot/Buildings	37.5	15.2
Recently Harvested (Replanted)	36.0	14.6

Field Protocol

Accuracy assessment field teams were assembled from experienced NCCN vegetation staff. Teams were given a thorough introduction to the association and map class descriptions and keys (Appendix B). The teams navigated to accuracy assessment sampling locations using a combination of field maps and sampling points loaded into a Garmin GPSMap62. Because of the complicated nature of accessing properties on the Reserve, field sampling was facilitated--but not performed--by the project coordinators. At each sampling point, the association or map class was recorded, as well as an alternate selection. Pictures were taken from plot center. The top five species were recorded in the following strata: overstory and understory trees, shrubs, and herbs. Notes were taken as needed. Field data were collected in late March, early April, and late May in order to capture phenological phases important for keying out herbaceous species, particularly grasses. Upon return to the office, the field data were entered into the PLOTS database, a relational database designed to store vegetation inventory field data (<http://science.nature.nps.gov/im/inventory/veg/plots.cfm>).

Analysis

The NPS VIP program provides methodology and a standardized Excel template to facilitate the accuracy assessment analysis (Lea and Curtis, 2010). By understanding the three views of accuracy (total, producer's, and user's accuracy), map users can derive maximum utility from the map and the accuracy assessment. Understanding the varying accuracy of map classes may influence how the map is used.

Kappa Statistic

The overall accuracy is the number of correct accuracy samples divided by the total number of samples. The kappa statistic adjusts this estimate to account for the possibility that the map is correct due to random chance (Pontius and Millones 2011).

Confidence Intervals

The measures of accuracy are statistical estimates for a true, albeit unknown, accuracy. Therefore, it is helpful to describe the error surrounding the estimate using a confidence interval. The width of the confidence interval is determined mainly by sample size. Map classes with a higher sample sizes will have smaller confidence intervals and map classes with smaller sample sizes will be unavoidably less precise, with wider confidence intervals.

Producer's and User's Accuracy

The producer's accuracy refers to the probability that the land cover of an area on the ground is assigned that class on the map. In other words: If you go to a location on the ground and look at the assigned mapped class for that spot, is the map correct? The user's accuracy refers to the probability that a point on the map labeled as a certain land cover class matches that class in reality. From a user's perspective, if you use the map to navigate to a specific class, does it actually end up being that class when you get to that location and assess the vegetation? The producer's and user's accuracies for a given map class are rarely the same. The producer's accuracy is a measure of the accuracy of the mapping effort; the user's accuracy provides helpful guidance to those using the map in various applications.

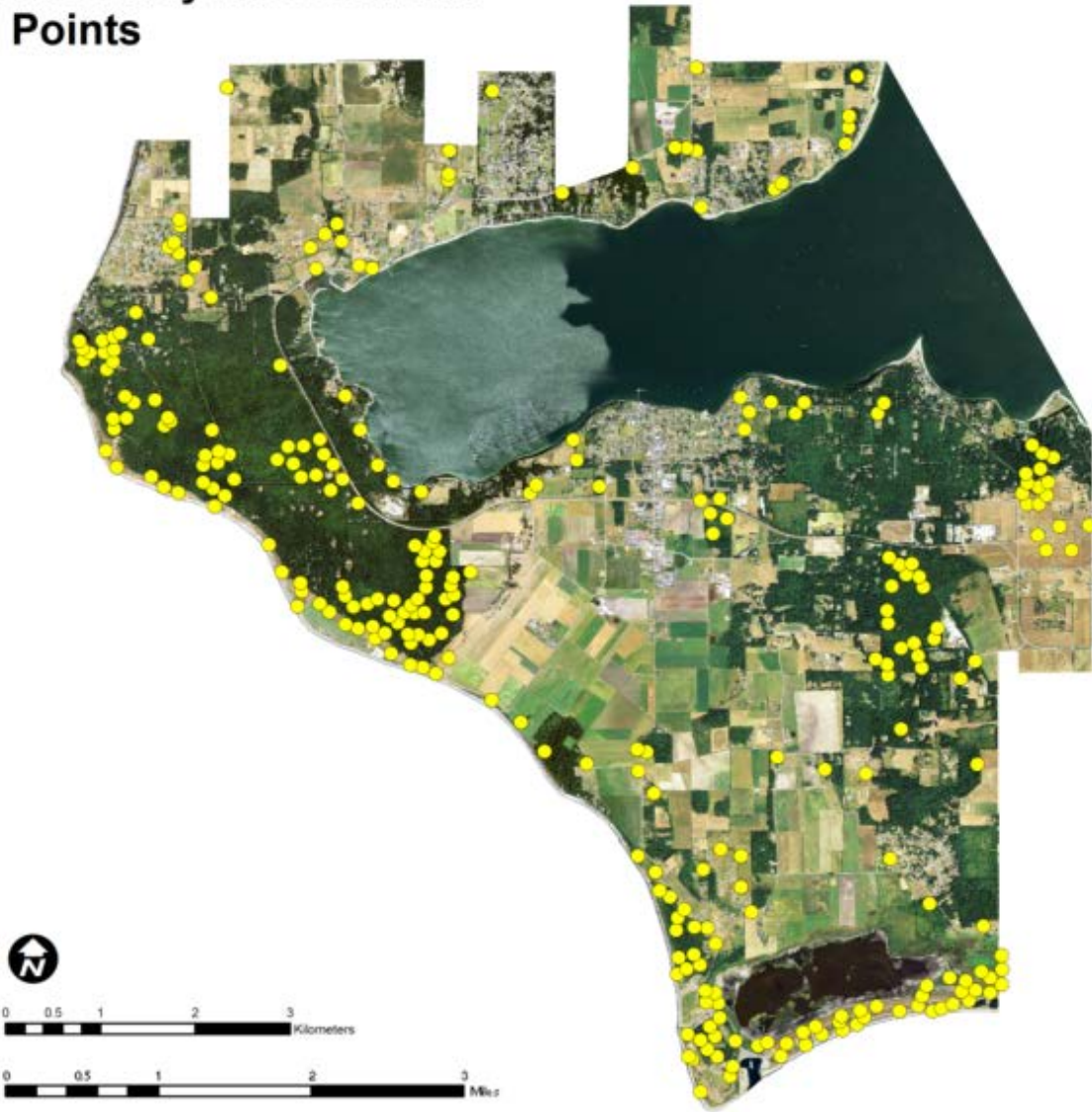
Results

Accuracy Assessment

The field sampling generated 583 accuracy assessment points (Figure 19). Only classes with five or more potential sampling sites were included in the AA sample set; however, challenges with access--particularly with map classes found on private land--limited the final sample size for five; we included these in the results because they do not significantly affect the overall accuracy. Overall map accuracy of pooled classes is 82.1%, meeting NPS standards (Table 9). The Kappa statistic is slightly lower at 80.3% (Table 9). Appendix C presents the contingency matrix for the assessment, organized by the NVC hierarchy.



Accuracy Assessment Points



Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure 19. Accuracy assessment sample points at Ebey's Landing National Historical Reserve, Washington.

Table 9. Map accuracy and confidence intervals assessed at the alliance, group, macrogroup and division levels of the National Vegetation Classification Hierarchy at Ebey's Landing National Historical Reserve.

	NVC Hierarchy Level			
	Alliance	Group	Macrogroup	Division
Overall Accuracy	82.1%	86.8%	93.7%	94.4%
Lower Limit, 90% confidence interval	77.9%	83.3%	91.3%	92.0%
Upper Limit, 90% confidence interval	86.2%	90.4%	96.1%	96.7%
Kappa (K)	80.3%	84.6%	91.1%	91.8%
Lower Limit, 90% confidence interval	76.1%	80.5%	87.7%	88.4%
Upper Limit, 90% confidence interval	84.5%	88.6%	94.5%	95.2%

Alliance and Association Accuracy

Even though all forested areas were initially mapped at the association level, we were unable to achieve 80% accuracy for five associations. These associations were assessed at the alliance level. They included three of the four associations within the *Pseudotsuga menziesii* - *Abies grandis* - *Arbutus menziesii* Forest and Woodland Alliance and two associations within the *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance. Associations in both of these alliances share many overlapping dominant and diagnostic species. When using the key to associations, presence of either western hemlock or grand fir (*Abies grandis*) in the canopy is an important determining factor, so varying detection or visual estimations of cover of these species has a significant impact on accuracy. The patchy distribution and varying cover of other important species, particularly shrub species, also contributed to confusion among these forested associations. For example, a few large pacific rhododendrons near plot center can significantly influence whether the site keyed to a *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest or a *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest.

Errors from the producer's perspective

The eight classes below failed to meet the threshold of 80% producer's accuracy; their upper confidence intervals (CI) also failed to surpass 80% (Table 10).

Tsuga heterophylla - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest – Sixty five of the 76 samples for this class were correct, resulting in a producer's accuracy of 62% (CI 60-64%). The primary source of error came from areas that had been mapped as *Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* - *Symphoricarpos albus* Forest, but did not appear to have grand fir in the canopy when sampled during the AA. Without grand fir, these sites keyed to *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest instead, which is contained within the *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance. Additionally, there was one sample each in 5 other forest associations, including a red alder (*Alnus rubra*) stand.

Pseudotsuga menziesii - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest - The producer's accuracy for this type was 67% (CI 66-68%). Six of 22 points were mapped as a

different association, five of which were in the *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance. The dominant and diagnostic species of the *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Association (contained within the *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance) and the *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Association are quite similar. Both can have significant salal, but the primary distinction is the prominence of western sword fern. Dense second-growth stands of *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum*, like those found in the Reserve, commonly have sparse understories with salal and western sword fern as the most abundant species. When the understory is so depauperate, the importance of individual plant sightings becomes increasingly large. If sword fern fades out for a small stretch of ground and there is still salal around, it is more likely to key the sample point to the *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest Association.

Alnus rubra / *Rubus spectabilis* Forest - Low accuracy for this class is likely due to a small sample size. Producer's accuracy was 49% (CI 48-50%). Of the two sampled plots, one was mapped correctly and one was determined to be the Ebey's Landing Provisional Ruderal Woodland, which can also have high red alder cover, but is more disturbed in nature and characterized by a diverse mix of shrubs other than salmonberry.

Tsuga heterophylla - (*Pseudotsuga menziesii* - *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest - Producer's accuracy for this class was 46% (CI 46-46%). Four of the six plots were mapped correctly. Confusion occurred between *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest (areas with little or no lady fern (*Athyrium filix-femina*) cover) and also *Alnus rubra* / *Rubus spectabilis* Forest (this class can include significant red alder cover).

Festuca rubra - (*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation – Two of the three plots were mapped correctly, resulting in a producer's accuracy of 63%. This class was confused with the *Bromus* (*diandrus*, *hordeaceus*, *sterilis*) Provisional Ruderal Herbaceous Vegetation which is also found on the coastal bluffs. Since the polygons on steep bluffs were approximated from imagery or viewed with binoculars in some cases, this error makes sense. Additional error may be due to the timing of the AA sampling, as diagnostic native forbs may have been inconspicuous due to phenology (particularly when viewed from a distance).

Symphoricarpos albus - *Rosa nutkana* Pacific Coast Shrubland - Producer's accuracy for this class was 77% (CI 76-77%). Confusion occurred between this class and forested associations in two plots and between the potentially very similar Ebey's Landing Provisional Ruderal Woodland in one plot. These native shrublands are often successional in nature, with trees gradually encroaching and shading out the shrubs. The delineation between shrubland and woodland can be difficult to make when digitizing.

Rubus armeniacus Ruderal Shrubland -Producer's accuracy was 30%, with one of the three samples mapped correctly and one each confused with Ebey's Landing Provisional Ruderal Woodland and

the *Symphoricarpos albus* - *Rosa nutkana* Pacific Coast Shrubland in hedgerow form. Because of interest within the Reserve in controlling this weed, we attempted to delineate patches of Himalayan blackberry (*Rubus armeniacus*). However, low sample size and the tendency for these three types to form small patch matrices led to low map accuracy.

Schedonorus phoenix Ruderal Herbaceous Vegetation - Three out of five samples for this type were mapped correctly, resulting in a producer's accuracy of 60%. Perhaps not surprisingly, errors included confusion with the *Bromus* (*diandrus*, *hordeaceus*, *sterilis*) Provisional Ruderal and *Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation types. There are significant grey areas between these three types, as both the brome and red fescue types can contain significant tall fescue. The three types probably grade together based on moisture, disturbance, and soil gradients. Grass phenology may also contribute to producer's error for this class.

Errors from the user's perspective

Of the 27 alliances or associations mapped, nine failed to meet the 80% user's accuracy standard. The upper confidence interval of the nine that failed included 80% (Table 10).

Pseudotsuga menziesii - *Arbutus menziesii* / *Holodiscus discolor* Forest - User's accuracy was 67% (CI 27-100%). One sample was the similar forest type *Pseudotsuga menziesii* / *Gaultheria shallon* - *Holodiscus discolor* Forest (which can also contain prominent madrone), and one sample was the shrub type *Symphoricarpos albus* - *Rosa nutkana*. This class is found ringing the south side of Penn Cove in primarily private land where access for both field sampling and accuracy assessment was challenging.

Pseudotsuga menziesii - *Abies grandis* - *Arbutus menziesii* Forest and Woodland - The majority of error for this class (3/5) arose from areas mapped as *Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest, which does not contain prominent grand fir. AA crews found notably high cover of grand fir upon their sampling visits and therefore assigned these locations to the *Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* - *Symphoricarpos albus* Forest.

Pseudotsuga menziesii - *Tsuga heterophylla* / *Depauperate Undergrowth* Forest - Although it was found to be correct within the one mapped polygon, it was also detected in another location, suggesting that this type may be undermapped. It may occur in additional small patches within the forest matrix where the forest was entirely removed through clearing or fire and has now grown back.

Alnus rubra / *Rubus spectabilis* Forest - User's accuracy was 50% (CI 0-100%) with a very low sample size. One AA plot was correct and one was the moist conifer forest *Tsuga heterophylla* - (*Pseudotsuga menziesii* - *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest, which can also contain prominent red alder and salmonberry.

Ebey's Landing Provisional Ruderal Woodland - User's accuracy was 70% for this type. Confusion occurred between this type, two other deciduous associations, and the *Rubus armeniacus* Ruderal Shrubland. The Ebey's Landing Provisional Ruderal Woodland is an inherently heterogeneous mix of dominant overstory and understory types that was created as a catchall for diverse, disturbed sites that did not fit cleanly into other categories. Of the incorrectly mapped samples, three were primarily

conifer forests keyed out as *Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* - *Symphoricarpos albus* Forests, one was the deciduous *Alnus rubra* / *Rubus spectabilis* Forest, and two were shrubland types (*Rubus armeniacus* and *Symphoricarpos albus* - *Rosa nutkana*). All of those dominant species can be contained to varying degrees within appropriately mapped Ebey's Landing Provisional Ruderal Woodlands.

Rubus armeniacus Ruderal Shrubland - User's accuracy of this class was 50%. Of the two assessment plots, one was correct and one was an Ebey's Landing Provisional Ruderal Woodland. This type is often found in small patches or very narrow hedgerows that fall outside the purview of the accuracy assessment.

Schedonorus phoenix Ruderal Herbaceous Vegetation - Three of five samples for this type were mapped correctly, for a user's error of 60%. Sites were confused with *Bromus* (*diandrus*, *hordeaceus*, *sterilis*) Provisional Ruderal Herbaceous Vegetation in two plots. As noted above, these two types frequently grade into one another.

Festuca rubra - *Ambrosia chamissonis* Herbaceous Vegetation - User's accuracy was 50% (1 of 2) with one sample accurately mapped and the other turning out to be mesic *Schedonorus phoenix* Ruderal Herbaceous Vegetation upon sampling.

Table 10. Producer's and user's accuracy assessment for Ebey's Landing National Historical Reserve (LL= Lower Limit, UL= Upper Limit, CI=Confidence Interval).

Association or Alliance	Sample Size	Producer's Accuracy			User's Accuracy			Max Sample Size
		Acc.	LL 90% CI	UL 90% CI	Acc.	LL 90% CI	UL 90% CI	
<i>Pseudotsuga menziesii</i> - <i>Arbutus menziesii</i> / <i>Holodiscus discolor</i> Forest	4	100%	100%	100%	67%	27%	100%	6
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> - <i>Arbutus menziesii</i> Forest and Woodland	38	67%	65%	69%	79%	67%	92%	172
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> Dry Forest	76	92%	90%	94%	83%	75%	90%	476
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / Depauperate Undergrowth Forest	1	100%	100%	100%	50%	0%	100%	1
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> / <i>Polystichum munitum</i> Forest	23	58%	57%	60%	84%	68%	100%	65
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest	2	49%	48%	50%	50%	0%	100%	5
<i>Tsuga heterophylla</i> - (<i>Pseudotsuga menziesii</i> - <i>Thuja plicata</i>) / <i>Polystichum munitum</i> - <i>Athyrium filix-femina</i> Forest	6	46%	46%	46%	80%	41%	100%	8
<i>Alnus rubra</i> / <i>Sambucus racemosa</i> / <i>Urtica dioica</i> Provisional Ruderal Forest	12	89%	87%	91%	83%	61%	100%	100
Ebey's Landing Provisional Ruderal Woodland	17	81%	79%	82%	70%	51%	89%	74
<i>Prunus emarginata</i> Ruderal Flooded Forest	0	0%	0%	0%	0%	0%	25%	0
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous Vegetation	1	100%	100%	100%	50%	0%	100%	1
<i>Festuca rubra</i> - (<i>Camassia leichtlinii</i> , <i>Grindelia stricta</i> var. <i>stricta</i>) Herbaceous Vegetation	3	64%	64%	64%	100%	75%	100%	8
<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Pacific Coast Shrubland	29	88%	87%	88%	93%	83%	100%	65
<i>Cytisus scoparius</i> Ruderal Shrubland	3	100%	100%	100%	100%	83%	100%	5
<i>Bromus</i> (<i>diandrus</i> , <i>hordeaceus</i> , <i>sterilis</i>) Provisional Ruderal Herbaceous Vegetation	22	87%	86%	87%	90%	76%	100%	54

Table 10. Producer's and user's accuracy assessment for Ebey's Landing National Historical Reserve (LL= Lower Limit, UL= Upper Limit, CI=Confidence Interval) (continued).

Association or Alliance	Sample Size	Producer's Accuracy			User's Accuracy			Max Sample Size
		Acc.	LL 90% CI	UL 90% CI	Acc.	LL 90% CI	UL 90% CI	
<i>Festuca idahoensis</i> ssp. <i>roemer</i> i Provisional (Restoration) Ruderal	11	100%	100%	100%	100%	95%	100%	32
<i>Rubus armeniacus</i> Ruderal Shrubland	3	30%	29%	30%	50%	0%	100%	6
<i>Schedonorus phoenix</i> Provisional Ruderal Herbaceous Vegetation	5	60%	60%	61%	60%	14%	100%	9
<i>Festuca rubra</i> Provisional Ruderal	5	100%	100%	100%	100%	90%	100%	5
<i>Agrostis (gigantea, stolonifera)</i> Ruderal Herbaceous Vegetation	2	100%	100%	100%	100%	75%	100%	9
<i>Epilobium hirsutum</i> Provisional Ruderal Herbaceous Vegetation	1	100%	100%	100%	100%	50%	100%	2
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation	1	100%	100%	100%	50%	0%	100%	1
<i>Leymus mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation	2	100%	100%	100%	100%	75%	100%	4
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> / <i>Sphagnum spp.</i> Shrubland	1	100%	100%	100%	100%	50%	100%	2
<i>Juncus balticus</i> var. <i>balticus</i> Provisional Pacific Coast Herbaceous Vegetation	1	100%	100%	100%	100%	50%	100%	7
<i>Schoenoplectus acutus</i> Pacific Coast Herbaceous Vegetation	1	0%	0%	0%	0%	0%	0%	7
<i>Typha latifolia</i> Pacific Coast Herbaceous Vegetation	0	0%	0%	0%	0%	0%	50%	2
<i>Argentina egedii</i> - <i>Juncus balticus</i> Herbaceous Vegetation	3	100%	100%	100%	100%	83%	100%	4
<i>Distichlis spicata</i> - (<i>Salicornia virginica</i>) Herbaceous Vegetation	10	100%	100%	100%	100%	95%	100%	12
<i>Nuphar polysepala</i> Herbaceous Vegetation	1	100%	100%	100%	100%	50%	100%	1

Conclusions

This report synthesizes regional vegetation classifications, previous local mapping efforts, and newly collected field data to create the first vegetation classification and map of plant associations covering the entirety of Ebey's Landing National Historical Reserve. The classification, keys, and descriptions in Appendix B will allow Reserve stakeholders, researchers, and the public to identify and distinguish vegetation types across the Reserve. The vegetation maps provided within the report and Appendix C represent the best available maps of existing (not potential) vegetation for the Reserve.

The vegetation classification for the Reserve contains 51 alliances or associations, of which 31% were forests and woodland communities, 57% were shrublands and herbaceous types, and 10 % were agricultural or developed types. The long and varied history of human land use at Ebey's resulted in classification of nearly a third of the forest, woodland, shrubland, and herbaceous types as ruderal many dominated by novel combinations of native and non-native vegetation.

The Reserve also hosts seventeen plant associations considered critically imperiled or imperiled in the state of Washington, or globally. These communities include dry forests or woodlands found in a limited range restricted to the rain shadow zone of the Puget Sound basin, remnant and restoration prairie types, rare wetlands, a salt marsh type, and a fen.

Each vegetation type within the park was mapped to at least the alliance level and most were mapped at the association level of the National Vegetation Classification system. The Reserve is 59% cultural or unvegetated, roughly split between the pasture and agricultural fields map class and the combined high and low density housing map classes. A third of the Reserve is forest and woodlands. Two forest types, *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest and *Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest contribute a majority of the forest cover. The *Symphoricarpos albus* - *Rosa nutkana* is the largest shrubland association, with much of that cover in the form of hedgerows. The largest non-ruderal herbaceous type is the *Distichlis spicata* - (*Salicornia virginica*) Herbaceous Vegetation Association, a salt marsh type found ringing several of the lagoons and lakes.

Map accuracy assessment focused on the natural vegetation types. Overall map accuracy is 81.1%. Twenty-one of the 29 classes assessed met the threshold of 80% producer's accuracy. Twenty of the 29 classes assessed met the threshold of 80% user's accuracy. Lower accuracy resulted from a variety of challenges, including low sample sizes, similar dominant and diagnostic species leading to confusion among associations in different alliances, patchy understory shrub distributions, and canopy tree species overlooked during the mapping but detected during the assessment.



Photo 4. Connecting path from Prairie Overlook to the Bluff Trail (photograph by Tynan Ramm-Granberg).

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Appendix A: Vegetation Classification for Ebey's Landing National Historical Reserve

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 that are found within 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 2008 FGDC standard substantially revised the original NVC 1997 hierarchy and was used for this project. The changes most relevant to this project include: A clear distinction between natural and cultural vegetation at higher levels in the hierarchy, a new set of middle level units, and a new set of levels that address the unique characteristics of cultural vegetation (FGDC 2008).

The 2008 NVC hierarchy consists of eight levels. 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. Three upper levels (Class, Subclass and Formation) are defined primarily by physiognomy with increasing influence of global macroclimate factors. Within the three middle levels (Division, Macrogroup and Group), combinations of increasingly narrow dominant and diagnostic plant species reflect biogeographical differences in climate, substrate and disturbance regime. The lowest two levels (Alliance and Association) are driven primarily by species level differences at the subregional and local level. The FGDC 2008 standard fully discusses the rationale and criteria of each hierarchy level which are summarized in Table A-1 (http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf).

Alliance and Association are the target levels of the NVC for NPS mapping projects. The 2008 standard provides the following expanded definitions (FGDC 2008):

Alliance: A vegetation classification unit of low rank (7th 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 (8th 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. The Washington State Heritage Program (WNHP) is also a primary partner on creating and tracking plant associations.

Table A-1. Summary, criteria and rationale for U.S. National Vegetation Classification Hierarchy

Hierarchy Level	Criteria
Upper: Physiognomy plays a predominant role.	
L1 – Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and/or substrate or aquatic conditions.
L2 - Formation Subclass	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.
L3 – Formation	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.	
L4 – Division	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.
L5 – Macrogroup	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.
L6 – Group	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.	
L7 – Alliance	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.
L8 – Association	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

Nomenclature and Naming Conventions

Species nomenclature in the National Vegetation Classification System follows the Integrated Taxonomic Information System, which receives its plant species information from USDA PLANTS (USDA 2011). Plant systematics continues to be reshaped by genetic studies and the names of many species remain in flux. In this report, we may occasionally use a less recent species name for the sake of clarity if that taxon is still widely known by that convention. In such cases, synonyms are provided parenthetically after the species name (e.g. *Rubus armeniacus* (=bifrons)).

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.

The term “Ruderal” is used to describe plant communities (e.g. *Rubus armeniacus* Ruderal Shrubland) found in areas with a history of intensive land use. These vegetation communities are characterized by species that benefit from either natural or anthropogenic disturbance and typically contain a large percentage of non-native, invasive plants. Ruderal types may appear natural, but contain combinations of species not typically found together in undisturbed areas. Species composition in ruderal communities is often more strongly related to the type, duration and intensity

of human activity than to typical environmental drivers. Ruderal types can pose a challenge for mapping, because plot sampling and classification work on ruderal types is relatively limited in comparison to natural types. In addition, ruderal types can be dynamic and express different characteristics year to year (Rocchio et al. 2012). Ruderal vegetation is sometimes referred to as “semi-natural.”

The term “Provisional” indicates a potential or proposed association that usually has fewer than five plots and generally no literature support other than recent NPS mapping efforts (Rocchio et al. 2012, Crawford et al. 2009). Provisional types are included in this report with the expectation that they will be evaluated for inclusion in the NVC.

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 occurrences), very steep declines, or other factors.

G2 Imperiled - At high risk of extinction or elimination due to very restricted range, very few occurrences, steep declines, or other factors.

G3 Vulnerable - At moderate risk of extinction or elimination due to a restricted range, relatively few occurrences, 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.

1 Forest to Open Woodland
1.B Temperate & Boreal Forest
1.B.2 Cool Temperate Forest
1.B.2.Nd Vancouverian Cool Temperate Forest Division
Vancouverian Lowland and Montane Rainforest Macrogroup
North Pacific Maritime Douglas-fir - Western Hemlock Forest Group
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / <i>Cornus unalaschkensis</i> Mesic Forest Alliance
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / Depauperate Undergrowth Forest
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> / <i>Polystichum munitum</i> Forest
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> Dry Forest Alliance
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> / <i>Holodiscus discolor</i> - <i>Symphoricarpos albus</i> Forest
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> - <i>Holodiscus discolor</i> Forest
<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Rhododendron macrophyllum</i> - <i>Vaccinium ovatum</i> - <i>Gaultheria shallon</i> Forest

North Pacific Western Hemlock - Sitka Spruce - Western Red-cedar Seasonal Rainforest Group
<i>Tsuga heterophylla</i> - <i>Picea sitchensis</i> / <i>Rhytidadelphus loreus</i> Forest Alliance
<i>Picea sitchensis</i> / <i>Gaultheria shallon</i> Forest
Southern Vancouverian Dry Douglas-fir - Madrone Woodland Group
<i>Pseudotsuga menziesii</i> - <i>Abies grandis</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>Holodiscus discolor</i> - <i>Rosa gymnocarpa</i> / <i>Festuca occidentalis</i> Forest
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> Forest
1.B.3 Temperate Flooded & Swamp Forest
1.B.3.Ng Vancouverian Flooded & Swamp Forest Division
Vancouverian Flooded & Swamp Forest Macrogroup
North Pacific Lowland Riparian Forest & Woodland Group
(<i>Acer macrophyllum</i> , <i>Alnus rubra</i>) Riparian Forest Alliance
<i>Alnus rubra</i> / <i>Rubus spectabilis</i> Forest
<i>Salix lucida</i> Temporarily Flooded Woodland Alliance
<i>Salix lucida</i> ssp. <i>lasiandra</i> / <i>Urtica dioica</i> spp. <i>gracilis</i> Woodland
North Pacific Maritime Hardwood-Conifer Swamp Group
(<i>Picea sitchensis</i> , <i>Tsuga heterophylla</i>) - (<i>Alnus rubra</i>) Riparian Forest Alliance
<i>Tsuga heterophylla</i> - (<i>Pseudotsuga menziesii</i> - <i>Thuja plicata</i>) / <i>Polystichum munitum</i> - <i>Athyrium filix-femina</i> Forest
Vancouverian Ruderal Flooded & Swamp Forest Macrogroup (Provisional)
North Pacific Ruderal Riparian and Swamp Forest Group
<i>Alnus rubra</i> / <i>Dactylis glomerata</i> Ruderal Flooded Forest Alliance
<i>Alnus rubra</i> / <i>Sambucus racemosa</i> / <i>Urtica dioica</i> Provisional Ruderal Forest
Ebey's Landing Provisional Ruderal Woodland
<i>Prunus emarginata</i> Ruderal Flooded Forest
2 Shrubland & Grassland
2.B Temperate & Boreal Grassland & Shrubland
2.B.2 Temperate Grassland, Meadow & Shrubland
2.B.2.Na Western North American Grassland & Shrubland Division
Southern Vancouverian Lowland Grassland & Shrubland Macrogroup
Southern Vancouverian Shrub & Herbaceous Bald, Bluff & Prairie Group
<i>Festuca roemerii</i> - <i>Agrostis pallens</i> - <i>Koeleria macrantha</i> Herbaceous Alliance
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> - <i>Camassia quamash</i> - <i>Cerastium arvense</i> Herbaceous Vegetation
<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>Symphoricarpos albus</i> Pacific Coast Provisional Shrubland Alliance
<i>Symphoricarpos albus</i> - <i>Rosa nutkana</i> Pacific Coast Shrubland
Western North American Ruderal Grassland & Shrubland Macrogroup
Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group

<i>Bromus hordeaceus</i> Provisional Ruderal Alliance
<i>Bromus (diandrus, hordeaceus, sterilis)</i> Provisional Ruderal Herbaceous Vegetation
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Provisional Ruderal Alliance
<i>Bromus sitchensis</i> - <i>Elymus glaucus</i> Provisional Ruderal Alliance
<i>Cytisus scoparius</i> Ruderal Shrubland Alliance
<i>Cytisus scoparius</i> Ruderal Shrubland
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> Provisional (Restoration) Ruderal Alliance
<i>Festuca idahoensis</i> ssp. <i>roemerii</i> Provisional (Restoration) Ruderal Alliance
<i>Festuca rubra</i> Provisional Ruderal Alliance
<i>Festuca rubra</i> Provisional Ruderal Alliance
<i>Rubus armeniacus</i> Provisional Ruderal Alliance
<i>Rubus armeniacus</i> Ruderal Shrubland
<i>Schedonorus phoenix</i> Provisional Ruderal Alliance
<i>Schedonorus phoenix</i> Provisional Ruderal Herbaceous Vegetation
Western North American Ruderal Wet Shrubland, Meadow & Marsh Macrogroup
Western North American Ruderal Wet Shrubland, Meadow & Marsh
<i>Epilobium hirsutum</i> Provisional Ruderal Alliance
<i>Epilobium hirsutum</i> Provisional Ruderal Herbaceous Vegetation
<i>Poa pratensis</i> - <i>Agrostis gigantea</i> - <i>Agrostis stolonifera</i> Ruderal Herbaceous Alliance
<i>Agrostis (gigantea, stolonifera)</i> Ruderal Herbaceous Vegetation
2.B.4 Temperate & Boreal Scrub & Herb Coastal Vegetation
2.B.4.Nb Pacific North American Coast Scrub & Herb Vegetation Division
Pacific Coastal Beach & Dune Vegetation Macrogroup
North Pacific Maritime Coastal Scrub & Herb Beach & Dune Group
<i>Carex macrocephala</i> Herbaceous Alliance
<i>Carex macrocephala</i> Herbaceous Vegetation
<i>Poa macrantha</i> - <i>Leymus mollis</i> - <i>Festuca rubra</i> Sand Dune Herbaceous Alliance
<i>Festuca rubra</i> - <i>Ambrosia chamissonis</i> Herbaceous Vegetation
<i>Leymus mollis</i> - <i>Abronia latifolia</i> Herbaceous Vegetation
2.B.5 Temperate & Boreal Bog & Fen
2.B.5.Na North American Bog & Fen Division
North Pacific Bog & Fen Macrogroup
North Pacific Bog & Acidic Fen Group
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> Dwarf-shrub Fen Alliance
<i>Ledum groenlandicum</i> - <i>Kalmia microphylla</i> / <i>Sphagnum</i> spp. Shrubland
2.B.6 Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
2.B.6.Nb Western North American Freshwater Shrubland, Wet Meadow & Marsh Division
Western North American Lowland Freshwater Wet Meadow & Marsh Macrogroup
Vancouverian Freshwater Wet Meadow & Marsh Group
(<i>Juncus balticus</i> - <i>Juncus effusus</i>) Provisional Herbaceous Alliance
<i>Juncus balticus</i> var. <i>balticus</i> Provisional Pacific Coast Herbaceous Vegetation

<i>Equisetum (arvense, variegatum, hyemale, telmateia)</i> Semipermanently Flooded Herbaceous Alliance
<i>Equisetum telmateia</i> Herbaceous Vegetation
<i>Schoenoplectus (acutus, tabernaemontani) - Typha latifolia</i> Provisional Herbaceous Alliance
<i>Schoenoplectus acutus</i> Pacific Coast Herbaceous Vegetation
<i>Typha spp.</i> Western Herbaceous Emergent Alliance
<i>Typha latifolia</i> Pacific Coast Herbaceous Vegetation
Vancouverian Wet Shrubland Group
<i>Malus fusca</i> Shrubland Alliance
<i>Malus fusca - (Salix hookeriana) / Carex obnupta</i> Shrubland
<i>Rosa nutkana - Rubus spectabilis</i> Shrubland Alliance
<i>Rosa nutkana - Rubus spectabilis</i> Wet Shrubland
<i>Salix (hookeriana, sitchensis) - Spiraea douglasii</i> Flooded Shrubland Alliance
<i>Salix hookeriana - (Salix sitchensis)</i> Shrubland
Western North American Ruderal Wet Shrubland, Meadow & Marsh Group
<i>Juncus gerardii</i> Provisional Ruderal Wet Meadow Alliance
<i>Juncus gerardii var. gerardii</i> Ruderal Brackish Wet Meadow
<i>Lonicera involucrata</i> Provisional Wet Shrubland Alliance
<i>Lonicera involucrata</i> Provisional Wet Shrubland
<i>Phragmites australis</i> Semipermanently Flooded Herbaceous Alliance
<i>Phragmites australis</i> Western North American Temperate Ruderal Herbaceous Vegetation
2.B.7 Salt Marsh
2.B.7.Nc Temperate & Boreal Pacific Coastal Salt Marsh Division
North American Pacific Coastal Salt Marsh Macrogroup
Temperate Pacific Tidal Salt & Brackish Marsh Group
<i>Argentina egedii - Juncus balticus</i> Tidal Herbaceous Alliance
<i>Argentina egedii - Juncus balticus</i> Herbaceous Vegetation
<i>Distichlis spicata</i> Pacific Coast Tidal Herbaceous Alliance
<i>Distichlis spicata - (Salicornia virginica)</i> Herbaceous Vegetation
<i>Schoenoplectus maritimus - Schoenoplectus californicus</i> Tidal Herbaceous Alliance
<i>Schoenoplectus maritimus</i> Tidal Herbaceous Vegetation
5 Aquatic Vegetation
5.B Freshwater Aquatic Vegetation
5.B.2 Temperate & Boreal Freshwater Aquatic Vegetation
5.B.2.Na North American Freshwater Aquatic Vegetation Division
Western North American Freshwater Aquatic Vegetation Macrogroup
Western North American Temperate Freshwater Aquatic Bed
<i>Nuphar polysepala</i> Western Aquatic Herbaceous Alliance
<i>Nuphar polysepala</i> Herbaceous Vegetation
7 Agricultural & Developed Vegetation
7.A Woody Agricultural Vegetation
7.A.2 Forest Plantation & Agroforestry

7.A.2.1 Forest Plantation Division
Conifer Plantation Macrogroup
Temperate Conifer Forest Plantation Group
Recently Harvested (Not-Replanted) Provisional Alliance
Recently Harvested (Replanted) Provisional Alliance
7.B Herbaceous Agricultural Vegetation
7.B.2 Pasture - Hay Field & Crop
7.B.2.1 Cultivated Pasture & Hay Field Division
Cultivated Pasture & Hay Grass Macrogroup
Tropical & Temperate Cultivated Pasture & Hay Field Group
Pasture and Agricultural Field Provisional Alliance
7.C Herbaceous & Woody Developed Vegetation
7.C.1 Lawn & Recreational Vegetation
7.C.1.1 Lawn & Recreational Grassland Division
Cool-Season Lawn Macrogroup
Cool-Season Open Lawn Group
Mowed Lawn Alliance
Non-vegetated
Cultural
Terrestrial Artificial Surfaces & Associated Areas
High Density Housing Map Class
Low Density Housing Map Class
Parking Lot and Buildings Map Class
Road / Parking Lots Map Class
Natural
Aquatic: Natural Waterbodies, Snow and Ice
Impounded Water Map Class
Lagoon Map Class
Terrestrial Bare Areas
Beach and Drift Logs Map Class
Terrestrial Bare Areas Map Class

Appendix B: Map Class Key and Descriptions

Introduction

This Appendix provides a key to the alliances and associations inventoried at Ebey's Landing National Historical Reserve. It combines a traditional association key and descriptions with a generalized key to those map classes that are not included in the National Classification System (e.g., residential areas). Following the key, plant association descriptions are presented. The units are organized as they appear in the National Vegetation Classification (USNVC 2015). 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 and Map Class Key

These details will aid in using the key for identification of plant associations and map classes occurring at Ebey's Landing National Historical Reserve.

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. As you read through the key, if the stand or plot meets the criteria in a line, proceed to further criteria indented below. If there are no further criteria below, read the description for the associated vegetation type. 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 can be reached through multiple lines in the key. 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. The key is not the classification. After you have keyed out an area, always read the association or map class description, which covers vegetation composition, geographic distribution, and physical environment. If the description captures the area in most regards, you have made a correct identification. If there are multiple inconsistencies between the area 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 Forested and Woodland Types.

The area has greater than 25% tree canopy cover (trees greater than 5 m tall). Deciduous or mixed-deciduous/conifer ruderal woodlands may sometimes have less canopy cover (as low as 20%), but still possess greater than 25% total tree cover.

Broadleaf trees dominate the tree canopy layer or codominate with conifers. Dominant tree species include evergreen *Arbutus menziesii* or deciduous *Alnus rubra*, *Salix lucida ssp. lasiandra*, and *Prunus emarginata*.

Salix lucida ssp. lasiandra dominates a tall shrubland/woodland on the edge of freshwater marsh. *Urtica dioica* dominates a moist herb layer. Dry shrubs like *Symphoricarpos albus* and *Rosa nutkana* are absent or minor.

..... ***Salix lucida ssp. lasiandra* / *Urtica dioica* Woodland, p. 28**

Arbutus menziesii dominates the tree canopy layer, typically with greater than 20% cover, or may codominate with *Pseudotsuga menziesii*. *Holodiscus discolor* dominates a tall shrub layer, with *Symphoricarpos albus* dominating a shorter layer. *Gaultheria shallon* is absent or low in cover. Limited to coastal strips along Penn Cove.

..... ***Pseudotsuga menziesii* - *Arbutus menziesii* / *Holodiscus discolor* Forest, p. 17**

Alnus rubra dominates or codominates the tree canopy layer.

Tsuga heterophylla, *Pseudotsuga menziesii*, and/or *Thuja plicata* codominate the tree canopy layer. *Tiarella trifoliata* and/or *Athyrium filix-femina* are present throughout the plot, occupying greater than 1% total cover and exceeding cover from *Gaultheria shallon*. *Rubus spectabilis* may be present, but does not occupy greater than 10% cover. *Sambucus racemosa* may dominate the shrub layer in some areas.

..... ***Tsuga heterophylla* - (*Pseudotsuga menziesii* - *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest, p. 30**

Sambucus racemosa dominates a tall shrub layer, or codominates with *Holodiscus discolor*. Moist-site indicator shrubs such as *Rubus spectabilis* are minor or absent. The herbaceous layer has few, if any, ferns and is characteristically dominated by *Urtica dioica*. *Pseudotsuga menziesii* frequently codominates in the tree canopy layer and *Abies grandis* and/or *Tsuga heterophylla* may also be present.

..... ***Alnus rubra* / *Sambucus racemosa* / *Urtica dioica* Provisional Forest, p. 31**

Rubus spectabilis and/or *Rubus parviflorus* dominate a well-developed moist shrub layer that far exceeds the cover of ferns. Tree canopy cover is nearly all *Alnus rubra*, with few conifers.

..... ***Alnus rubra* / *Rubus Spectabilis* Forest, p. 29**

Prunus emarginata dominates an open woodland. Total canopy cover may be as little as 10%, but *Prunus emarginata* cover exceeds 25% of that total. *Sambucus racemosa* and *Holodiscus discolor* dominate a dense tall shrub layer that may approach 100% cover. The herbaceous layer is characteristically moist, with prominent *Carex spp.*, such as *Carex leptopoda*. *Urtica dioica* may be prominent. *Alnus rubra* is absent.

..... ***Prunus emarginata* Provisional Ruderal Flooded Forest, p. 32**

Not as above. Area is an open ruderal woodland or shrubland with a mixture of *Alnus rubra*, *Prunus emarginata*, and/or *Pseudotsuga menziesii*. Tree cover may be less than 25%. The diverse shrub layer consists of *Salix scouleriana*, *Salix lucida*, *Salix hookeriana*, *Malus fusca*, *Symphoricarpos albus*, *Rosa nutkana*, *Spiraea douglasii*, and/or a variety of weeds such as *Rubus armeniacus* (= *R.*

discolor). Herbaceous species have little or no cover. Typically found in areas that have been previously disturbed by human activity.

..... **Ebey's Landing Provisional Ruderal Woodland, p. 33**

Conifers dominate the tree canopy layer. Dominant tree species include *Pseudotsuga menziesii*, *Picea sitchensis*, *Tsuga heterophylla*, *Thuja plicata*, and/or *Abies grandis*.

Area is a managed plantation or has recently been logged.

Area consists of even-aged conifers (*Pseudotsuga menziesii* or *Pinus contorta*) planted in rows. Vegetation is either nonexistent or regularly mowed.

..... **Temperate Conifer Forest Plantation, p. 66**

Area was recently clearcut for timber and replanted with *Pseudotsuga menziesii* seedlings. A variety of weed species such as *Rubus armeniacus* (= *R. discolor*) and exotic grasses may be present.

..... **Recently Harvested (Replanted), p. 67**

Area was recently clearcut for timber or development and not replanted. A variety of weed species such as *Rubus armeniacus* (= *R. discolor*) and exotic grasses may be present.

..... **Recently Harvested (Not Replanted), p. 68**

Picea sitchensis is prominent to dominant in the tree canopy layer, typically with greater than 10% cover. *Pseudotsuga menziesii* is usually codominant. *Gaultheria shallon* forms a dense shrub layer. Restricted to narrow bands along Strait of Juan de Fuca

..... ***Picea sitchensis* / *Gaultheria shallon* Forest, p. 27**

Tsuga heterophylla or *Thuja plicata* are prominent to dominant in the tree canopy and subcanopy layers, typically with greater than 10% cover. *Pseudotsuga menziesii* almost always codominates.

Rhododendron macrophyllum forms a variable-density tall shrub layer, typically with greater than 10% cover, but sometimes as low as 5%. *Holodiscus discolor* is usually prominent to codominant in the tall shrub layer. *Gaultheria shallon* forms a lower shrub layer and *Vaccinium ovatum* is occasionally present.

..... ***Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum* - *Gaultheria shallon* Forest, p. 23**

Polystichum munitum is the dominant herbaceous species, typically with greater than 10% cover, but sometimes as low as 2% when understory vegetation is sparse. Other ferns may also codominate.

Tiarella trifoliata and/or *Athyrium filix-femina* are present, occupying greater than 1% total cover and exceeding cover of *Gaultheria shallon*. Other moist-site indicator species such as *Rubus spectabilis* and *Dryopteris expansa* are frequently present. *Sambucus racemosa* occasionally dominates the tall shrub layer. *Thuja plicata* and *Alnus rubra* are common in the tree canopy layer.

..... ***Tsuga heterophylla* - (*Pseudotsuga menziesii* - *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest, p. 30**

Gaultheria shallon is the dominant shrub in a variable density shrub layer. *Holodiscus discolor* frequently codominates. Shrub cover may be sparse and combined *G. shallon* and *Polystichum munitum* cover may be as little as 3%. Moist-site indicators such as *Rubus spectabilis* and *Dryopteris expansa* are absent.

..... ***Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest, p. 22**

Gaultheria shallon dominates a variable density low shrub layer. *Holodiscus discolor* is present and characterizes the tall shrub layer. *Linnaea borealis* often forms a persistent carpet. *Vaccinium ovatum* or *V. parvifolium* may be present. *Rhododendron macrophyllum* is characteristically absent.

..... ***Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest, p. 26**

Not as described above. Total understory vascular plant cover is less than 5%. Trees are small in height and diameter and form a dense thicket. Site may be recovering from fire or other disturbance.

..... ***Pseudotsuga menziesii* - *Tsuga heterophylla* / Depauperate Forest, p. 21**

Abies grandis is prominent to codominant (with *Pseudotsuga menziesii*), typically with greater than 5% tree canopy cover. *Arbutus menziesii* is absent. Shrubs are diverse, but dominated by *Holodiscus discolor*. *Sambucus racemosa* and *Symphoricarpos albus* may contribute significant cover. Herbs are also diverse, commonly including *Polystichum munitum*, *Tiarella trifoliata*, *Galium triflorum*, *Melica subulata*, *Bromus vulgaris*, and *Festuca occidentalis*.

..... ***Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* - *Symphoricarpos albus* Forest, p. 24**

Pseudotsuga menziesii dominates the tree canopy cover, always with greater than 25% cover. *Picea sitchensis* is absent. *Tsuga heterophylla*, *Abies grandis*, and *Thuja plicata* may be present in small amounts, particularly in the understory, but never prominent. *Holodiscus discolor* usually dominates a tall shrub layer, with at least 5% total cover.

Arbutus menziesii codominates the tree canopy layer, typically with greater than 20% cover. Beneath the *Holodiscus discolor*, *Symphoricarpos albus* dominates a shorter shrub layer. *Gaultheria shallon* is absent or minor. Limited to strips along Penn Cove.

..... ***Pseudotsuga menziesii* - *Arbutus menziesii* / *Holodiscus discolor* Forest, p. 17**

Gaultheria shallon is prominent to dominant in the shrub layer, with greater than 5% cover and typically much more. *Arbutus menziesii* may be present in the canopy and/or prominent in the subcanopy. Limited to dry, well-drained sites near Lake Pondilla, Ft Ebey gun battery, and near Penn Cove.

..... ***Pseudotsuga menziesii* / *Gaultheria shallon* - *Holodiscus discolor* Forest, p. 18**

Symphoricarpos albus dominates a short shrub layer, usually with at least 10% cover. *Holodiscus discolor* codominates in a taller layer. *Arbutus menziesii* may be present in the canopy and/or subcanopy, but never codominates with *Pseudotsuga menziesii*. *Gaultheria shallon* is absent or low in cover.

..... ***Pseudotsuga menziesii* / *Symphoricarpos albus* - *Holodiscus discolor* Forest, p. 20**

Festuca occidentalis, *Bromus vulgaris*, *Melica subulata*, or other native grasses dominate a well-developed herbaceous layer. *Polystichum munitum* is present to codominant, typically with greater than 5% cover. Shrub cover is minimal, aside from an open tall shrub layer dominated by *Holodiscus discolor*. Combined cover of *Gaultheria shallon* and *Symphoricarpos albus* is typically less than 5%. *Rosa gymnocarpa* is often present in small amounts.

..... ***Pseudotsuga menziesii* / *Holodiscus discolor* - *Rosa Gymnocarpa* / *Festuca occidentalis* Forest, p. 19**

Key to Shrubland Types.

Canopy tree cover (trees greater than 5 m tall) is less than 25% and shrub cover is greater than 25%. In most cases, trees are entirely absent.

Ledum groenlandicum is prominent to dominant. A very open tree canopy of *Tsuga heterophylla* and/or *Picea sitchensis* may be present. *Vaccinium oxycoccos*, *Spiraea douglasii*, *Kalmia microphylla*, *Carex obnupta*, and *Carex utriculata* may also be present and *Sphagnum* mosses are high in cover.

.....***Ledum groenlandicum* - *Kalmia microphylla* / *Sphagnum* spp. Shrubland, p. 51**

Rubus spectabilis dominates a dense shrub layer. *Rosa nutkana* may be present. Limited to a few moist depressions and fencelines.

.....***Rosa nutkana* - *Rubus spectabilis* Shrubland, p. 52**

Lonicera involucrata dominates a patchy shrub layer on moist substrate. *Rubus armeniacus* (= *R. discolor*) may also be present. Found in matrixes with *Schoenoplectus acutus*, *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), and *Typha latifolia* east of Crockett Lake.

.....***Lonicera involucrata* Provisional Wet Shrubland, p. 61**

Salix hookeriana and/or *S. sitchensis* dominate a tall shrubland. Frequently found on the margins of fresh water marshes. *S. lucida* ssp. *lasiandra*, *Alnus rubra*, and *Rubus spectabilis* may be present in small amounts.

.....***Salix hookeriana* - (*Salix sitchensis*) Shrubland, p. 54**

Rosa nutkana and/or *Symphoricarpos albus* dominate a dense short shrub layer, commonly in hedgerows. *Rubus armeniacus* (= *R. discolor*) and *Spiraea douglasii* may be present, but never exceed the cover of *R. nutkana* and *S. albus*. Herbaceous cover is usually low, but weedy species such as *Dactylis glomerata*, *Schedonorus phoenix* (= *S. arundinaceus*), and *Anthriscus caucalis* may colonize the edges.

.....***Symphoricarpos albus* - *Rosa nutkana* Shrubland, p. 38**

Cytisus scoparius dominates a shrub layer of variable density in anthropogenically disturbed areas, often along roadways and power line corridors. *Gaultheria shallon* and *Holodiscus discolor* may codominate in patches and *Ulex europaea* is sometimes present. The herbaceous layer consists primarily of nonnative grasses such as *Bromus diandrus* (= *B. rigidus*), *B. hordeaceus* (= *B. mollis*), and *Schedonorus phoenix* (= *S. arundinaceus*). Invasive forbs such as *Anthriscus caucalis* are also common.

.....***Cytisus scoparius* Ruderal Shrubland, p. 39**

Malus fusca dominates a tall shrubland along the margins of a marsh or peatland. *Carex obnupta* is present and always occupies over 1% cover.

.....***Malus fusca* - (*Salix hookeriana*) / *Carex obnupta* Shrubland, p. 53**

Rubus armeniacus (= *R. discolor*) dominates a dense shrub layer in disturbed areas, often near development or in hedgerows. *Symphoricarpos albus* and *Rosa nutkana* may be present, but *R. armeniacus* (= *R. discolor*) provides the vast majority of cover.

.....***Rubus armeniacus* Ruderal Shrubland, p. 43**

Not as above. Area is an open ruderal woodland/shrubland with a mixture of tree-form *Salix* spp., *Alnus rubra*, *Prunus emarginata*, and/or *Pseudotsuga menziesii*. Tree cover may exceed 25%. The diverse shrub layers consists of *Salix scouleriana*, *Salix lucida*, *Salix hookeriana*, *Malus fusca*, *Symphoricarpos albus*, *Rosa nutkana*, *Spiraea douglasii*, and/or a variety of weeds such as *Rubus armeniacus* (= *R. discolor*). Herbaceous species have little or no cover. Typically found in areas that have been previously disturbed by human activity.

.....**Ebey's Landing Provisional Ruderal Woodland, p. 33**

Key to Wetland Herbaceous Types.

Canopy tree cover (trees greater than 5 m tall) and shrub cover are each less than 25%. Herbaceous plants occupy greater than 25% cover.

Vegetation occurs in shallow waters of pond or lake.

Nuphar polysepala is the only plant with significant cover at the surface. Found at Lake Pondilla.
.....***Nuphar polysepala* Herbaceous Vegetation, p. 65**

Vegetation occurs in a tidal salt flat or brackish to freshwater wet marsh. Most of these associations are limited to the areas surrounding Crockett Lake, Perego's Lake, and Grasser's Lagoon.

If *Festuca rubra* is dominant, skip to the Upland Herbaceous key (p. 7)

Agrostis sp. dominates the herbaceous layer. *Poa pratensis* ssp. *pratensis* may be prominent to codominant. Other nonnative species characteristic of disturbed sites may be common, including *Epilobium hirsutum*, *Conium maculatum*, *Anthriscus caucalis*, *Brassica rapa*, *Cirsium arvense*, and *Solanum dulcamara*. *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), *Distichlis spicata*, and *Salicornia virginica* may be present in small amounts at sites that border salt marshes (Crockett Lake). At Monroe Landing, *Agrostis stolonifera* forms a near-monoculture on floating drift logs in a lagoon.
.....***Agrostis (gigantea, stolonifera)* Ruderal Herbaceous Vegetation, p. 46**

Juncus balticus var. *balticus* (= *J. arcticus* ssp. *littoralis*) dominates the herbaceous layer in moist pastures or along lake margins. *Festuca rubra*, *Cerastium fontanum*, *Anthriscus caucalis*, *Rumex* sp., *Rubus armeniacus* (= *R. discolor*), *Geum macrophyllum*, *Dactylis glomerata*, and many other species may be present, but rarely prominent.
.....***Juncus balticus* var. *balticus* Pacific Coast Herbaceous Vegetation, p. 55**

Juncus gerardii dominates the herbaceous layer with few other species present. Very limited in extent; found near Crockett Lake.
.....***Juncus gerardii* var. *gerardii* Ruderal Brackish Wet Meadow, p. 56**

Equisetum telmateia dominates the herbaceous layer with few other species present. Limited to small patches 300 to 3000 meters square.
.....***Equisetum telmateia* Herbaceous Vegetation, p. 56**

Schoenoplectus acutus dominates a dense, tall herbaceous layer. Few other species are present, though *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), *Typha latifolia*, and *Solanum dulcamara* are common. Common in ditches near Crockett Lake.
.....***Schoenoplectus acutus* Herbaceous Vegetation, p. 57**

Phragmites australis dominates a dense, tall herbaceous layer above a lower layer of *Salicornia virginica*. Currently limited to one patch west of Crockett Lake.
.....***Phragmites australis* Ruderal Herbaceous Vegetation, p. 59**

Argentina egedii ssp. *egedii* (= *Potentilla pacifica*) dominates a short herbaceous layer with few other species, though *Juncus balticus* var. *balticus* (= *J. arcticus* ssp. *littoralis*), *Epilobium hirsutum*, *Poa pratensis*, and *Urtica dioica* may be present.
.....***Argentina egedii* - *Juncus balticus* Herbaceous Vegetation, p. 62**

Schoenoplectus maritimus (= *Bolboschoenus maritimus*) dominates the herbaceous layer. *Schoenoplectus acutus*, *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), and *Salicornia virginica* are frequently present.

..... ***Schoenoplectus maritimus* Tidal Herbaceous Vegetation, p. 64**

Typha latifolia dominates a dense, tall herbaceous layer with few other species present.

..... ***Typha latifolia* Pacific Coast Herbaceous Vegetation, p. 58**

Epilobium hirsutum dominates the herbaceous layer. *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*) and *Urtica dioica* may be present to prominent. Currently limited to a patch east of Crockett Lake.

..... ***Epilobium hirsutum* Provisional Ruderal Herbaceous Vegetation, p. 47**

Salicornia virginica and/or *Distichlis spicata* dominates a short herbaceous layer, typically closer to the waterline than any other vegetation. *Triglochin maritima* and *Jaumea carnosa* may also be present in small amounts

..... ***Distichlis spicata* - (*Salicornia Virginica*) Herbaceous Vegetation, p. 63**

Key to Upland Herbaceous Types.

Area is a headland, stabilized dune, prairie remnant, or mesic-to-dry ruderal grassland.

Bromus sitchensis dominates the herbaceous layer.

..... ***Bromus sitchensis* - *Elymus glaucus* Provisional Ruderal Alliance, p. 41**

Carex macrocephala is prominent to dominant, occupying greater than 5% cover; typically on the leeward side of stabilized dunes. A high percentage of bare substrate is usually present.

..... ***Carex macrocephala* Herbaceous Vegetation, p. 50**

Leymus mollis dominates a tall herbaceous layer, usually interspersed with drift logs on narrow coastal strips. Associate species include *Lathyrus japonicus*, *Ambrosia chamissonis*, *Abronia latifolia*, and *Schedonorus phoenix* (= *S. arundinaceus*).

..... ***Leymus mollis* - *Abronia latifolia* Herbaceous Vegetation, p. 48**

Festuca idahoensis ssp. *roemerii* is prominent to dominant, usually occupying at least 15% cover.

Active restoration work is taking place to remove nonnative species and promote native species such as *Camassia quamash*, *C. leichtlinii*, and *Cerastium arvense*. Found at the Prairie Overlook, the Naas Natural Area Preserve, and a large portion of the Pacific Rim Institute property.

..... ***Festuca idahoensis* ssp. *roemerii* Provisional (Restoration) Ruderal Alliance, p. 42**

Camassia quamash, *Carex inops*, *C. tumulicola*, or *Cerastium arvense* are present in the herbaceous layer. Other native species such as *Triteleia grandiflora*, *Fritillaria lanceolata*, or *Zigadenus venenosus* (= *Toxicoscordion venenosum*) may be present.

..... ***Festuca idahoensis* ssp. *roemerii* - *Camassia quamash* - *Cerastium arvense*
Herbaceous Vegetation, p. 36**

Festuca rubra is prominent to dominant, usually occupying at least 15% cover. Nonnative grasses such as *Bromus diandrus* (= *B. rigidus*) and *B. hordeaceus* (= *B. mollis*) may be codominant and many other weeds may be present, but native species like *Camassia leichtlinii*, *Grindelia* spp., *Cerastium arvense*, *Zigadenus venenosus* (= *Toxicoscordion venenosum*), *Ambrosia chamissonis*, *Lathyrus japonicus*, or *Pteridium aquilinum* are always present, as well.

Lathyrus japonicus, *Abronia latifolia*, or *Ambrosia chamissonis* are present. *Lomatium nudicaule* is common. Found only on stabilized dunes and beach gravels inland of drift logs and/or *Leymus mollis* strips.

.....***Festuca rubra* - *Ambrosia Chamissonis* Herbaceous Vegetation, p. 49**

Camassia leichtlinii, *Grindelia* spp., *Cerastium arvense*, *Allium acuminatum*, *Luzula (comosa, multiflora)*, *Pteridium aquilinum*, or *Zigadenus venenosus* (= *Toxicoscordion venenosum*) are present.. Found only on steep bluffs along the Strait of Juan de Fuca.

.....***Festuca rubra* - (*Camassia leichtlinii*) - *Grindelia stricta* var. *stricta*) Herbaceous Vegetation, p. 36**

Native and/or nonnative varieties of *Festuca rubra* dominate the herbaceous layer, but few other native species are present. *Grindelia stricta*, *Salicornia virginica*, and *Distichlis spicata* may be present in small amounts. Found on rocky soils in high saltmarsh settings near Crockett Lake.

.....***Festuca rubra* Provisional Ruderal Alliance, p. 45**

Bromus diandrus (= *B. rigidus*), *B. hordeaceus* (= *B. mollis*), or *B. tectorum* dominate a diverse grassland, typically on steep headlands or highway rights-of-way, but occasionally on flat, well-drained sites near salt water. *Vulpia myuros*, *Schedonorus phoenix* (= *S. arundinaceus*), *Poa pratensis*, *Hypochaeris radicata*, *Anthriscus caucalis*, *Vicia sativa*, *Vicia hirsuta*, and many other nonnative species may provide significant cover.

.....***Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation, p. 40**

Schedonorus phoenix (= *S. arundinaceus*) or *S. pratensis* dominates a tall ruderal grassland. Often found on the margins of agricultural fields; typically in flatter, moister settings than the *Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Alliance. *Poa pratensis* and many other nonnative species may be present, but *Bromus diandrus* (= *B. rigidus*), *B. hordeaceus* (= *B. mollis*), and *B. tectorum* are absent or nearly so.

.....***Schedonorus phoenix* Provisional Ruderal Herbaceous Vegetation, p. 44**

Vegetation occurs on actively cultivated or pastured agricultural land. Vegetation cover may be less than 25% in recently tilled fields and these areas may also contain some buildings.

.....**Pasture and Agricultural Field, p. 69**

Key to Cultural and Nonvegetated Types.

Natural or ruderal vegetation occupies less than 25% cover. Area is primarily covered by artificial surfaces or landscaping.

Housing developments and landscaping cover the area.

Area is covered primarily by buildings (including commercial structures and houses) on small lots without large tracts of forest, lawn, or agricultural land separating them. Includes landscaping, secondary roads, driveways, and small parking lots.

.....**High Density Housing, p. 72**

Area is covered primarily by buildings (including houses, agricultural out-buildings and barns) on large lots with large tracts of forest, lawn, or agricultural land separating them. Includes landscaping, secondary roads, and driveways.

.....**Low Density Housing, p. 71**

Mowed lawns (not associated with neighboring buildings) cover the area, primarily parade grounds at the Forts.

..... **Mowed Lawn, p. 70**

Non-residential, non-commercial buildings and parking lots, such as those found at state parks, cover the area.

..... **Parking Lot/Buildings, p. 73**

A major road or highway covers the area.

..... **Road/Parking Lots, p. 75**

Key to Sparse and Abiotic Types.

Area is not covered by human development or vegetation greater than 25% cover.

Water inundates the area.

Water is fresh and/or water levels are artificially managed

..... **Impounded Water, p. 77**

Water is brackish to salty and water levels are not artificially managed

..... **Lagoon, p. 78**

Area adjacent to coast, sand, pebbles, cobbles cover the area, drift logs can be prominent.

..... **Beach/Drift Logs, p. 74**

Area is unvegetated; includes quarries and gravel pits that may contain less than 25% ruderal species such as *Cytisus scoparius*. Also includes eroding seaside bluffs with minimal vegetation.

..... **Terrestrial Bare Areas, p. 76**

Descriptions

Plant association and alliance descriptions are presented in the hierarchical order of the National Vegetation Classification, or NVC (FDGC 2008). Each description summary uses the following template:

Scientific name
Common name

The plant association scientific name and common name use 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. Parentheses in the Association title indicate dominant species which may be absent entirely. 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. The order of the species names generally reflects decreasing levels of dominance, constancy, or indicator value.

Acronym:

Acronyms are plant association scientific names listed by the first three letters of the genus and the species.

Code:

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

1. Codes starting with CEGl appear on NatureServe Explorer (<http://www.natureserve.org/explorer/index.htm>) and represent associations accepted as global associations. For some associations in this report CEGl codes were not able to be found in Explorer but were found in VegBank (<http://vegbank.org>) and were still used.
2. Codes starting with PNW represent new associations and proposed revisions to the NVC from the Coastal Correlation Project (Meidinger et al. 2005).
3. "Provisional" indicates a potential association that usually has fewer than five plots and generally no literature support other than recent NPS mapping efforts (Rocchio et al. 2012, Crawford et al. 2009). Provisional types are included in this report with the expectation that they will be evaluated for inclusion in the NVC.

Macrogroup:

Group:

Alliance:

For each association, the Macrogroup, Group and Alliance hierarchical status as of either Hierarchy27 or Hierarchy30 are listed. Future changes and revisions are expected to these labels and will be available from NatureServe (<http://www.natureserve.org/explorer/index.htm>).

Range:

Describes the distribution of the association with an emphasis on range within Washington State.

EBLA Distribution:

Specific locations at Ebey's Landing National Historical Reserve where this type has been observed.

Plots:

Indicates the number of NPS-collected classification plots supporting this type from this work, classification work at San Juan National Historical Reserve (SAJH; Rocchio et al. 2012) and combined work at Mount Rainier, North Cascades and Olympic National Parks, which was

summarized in the Crawford et al. (2009) report. Descriptions that were carried over from the SAJH report also refer to the Chappell (2006b) report- this information was retained.

Environmental Description:

Provides, where available, generalized information about climate setting, soil type, topographic setting, landscape position, moisture condition, elevation, slope, aspect, disturbance history, human influence and other abiotic features that influence plant species and community occurrence on the landscape.

Vegetation Description:

The following terms are used in a consistent fashion within the vegetation descriptions 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

Codominant – one of two to four species that share dominance in a well-developed stratum of vegetation (usually percent cover is in the range of 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

USFWS Wetland System:

Classes include: Palustrine, Lacustrine

Comments:

This field was used to provide additional information about the association at EBLA, to help track species and taxonomic updates, and to provide supplemental guidance in distinguishing similar vegetation types.

Conservation Rank:

Assigned G for Global Rank and S for State Rank and number 1-5 for decreasing imperilment. NR = Not Ranked, Q = Questionable taxonomy, GU= Unable to be ranked due to lack of or conflicting information, ? = uncertainty in the ranking, H= presumed eliminated.

Rank Justification:

Notes to support rank choice.

Synonyms

Lists plant associations or plant community types with similar or equivalent concept in previous classifications. Full citations are in the Reference section of this appendix.

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

Douglas-fir - Madrone / Oceanspray Forest

Acronym: PSEMEN-ARBMEN/HOLDIS

NatureServe Code: PNWCOAST_160

Macrogroup: Vancouverian Lowland and Montane Rainforest

Group: Southern Vancouverian Dry Douglas-fir - Madrone Woodland Group

Alliance: *Pseudotsuga menziesii* - *Abies grandis* - *Arbutus menziesii* Forest and Woodland Alliance

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



EBLA Distribution: Limited to a narrow strip along Penn Cove.

Plots: Chappell (2006b); Rocchio et al. 2012 (3)

Environmental Description: This association is found in dry climatic areas (Olympic Mountains rainshadow). Sites appear to be poor to medium in relative nutrient status on shallow soils are shallow to bedrock (outcrops often visible on plot), and also on glacial till, glacial outwash, and glacial drift sands. Usually found on moderate to steep slopes, sunny slopes adjacent to saltwater and frequently with southwestern aspects.

Vegetation Description: Stands are dominated or codominated by *Arbutus menziesii* and *Pseudotsuga menziesii*. *Arbutus menziesii* often forms a subcanopy below taller Douglas-fir. *Holodiscus discolor*, *Lonicera hispid*a, and *Symphoricarpos albus* are usually present and are often prominent to codominant. *Rosa gymnocarpa* and *Festuca occidentalis* are usually prominent. The latter may dominate in heavily browsed stands. At EBLA, *Gaultheria shallon* may occur, but never in large amounts. *Mahonia aquifolium*, *Lonicera ciliosa*, and *Elymus glauca* are also frequent. Other forbs rarely provide significant cover.

USFWS Wetland System: Not applicable.

Comments: In the Park's Management Plan it is stated that the high cover of *Arbutus* in these stands was due to them being augmented through planting. However no documentation or citation to support this suggestion has been located, and the cover of *Arbutus* is within the natural range found for this type.

Conservation Rank: G1G2Q3S2?

Rank Justification: Although the EBLA occurrences increase the number sampled in this region, there are few relatively high quality occurrences of this type documented in the region. Most examples are small, or degraded by development, logging, or nonnative plant species. *Arbutus* faces threats due to fungal canker and fire suppression.

Synonyms:

Pseudotsuga menziesii-*Arbutus menziesii*/*Holodiscus discolor* Forest; Rocchio et al. 2012

Arbutus menziesii-*Pseudotsuga menziesii*; Romer 1972

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

Pseudotsuga menziesii-*Arbutus menziesii*/*Lonicera hispid*a; Chappell, 1997 and Chappell and Giglio 1999

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

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

Douglas-fir / Salal - Oceanspray Forest

Acronym: PSEMEN/GAUSHA-HOLDIS

NatureServe Code: CEGLO00436

Macrogroup: Vancouverian Lowland and Montane Rainforest

Group: Southern Vancouverian Dry Douglas-fir - Madrone Woodland Group

Alliance: *Pseudotsuga menziesii* - *Abies grandis* - *Arbutus menziesii* Forest and Woodland Alliance

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

EBLA Distribution: Isolated patches at Ft. Ebey State Park; forms a band between PSEMEN-ARBMEN/VICAME and PSEMEN-TSUHET/GAUSHA-HOLDIS along Penn Cove.

Plots: EBLA (1); Rocchio et al. 2012 (1); Chappell (2006b); Crawford (2009)

Environmental Description: This association occurs at low to middle elevations in dry climatic areas within the rainshadow of the Olympic Mountains. 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: These are stands with dry site conditions 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. *Polystichum munitum* may be present, but always with under 5% cover (typically much less at EBLA) . Other frequently occurring species are *Festuca occidentalis*, *Rosa gymnocarpa*, *Rubus ursinus*, and *Mahonia nervosa*.

USFWS Wetland System: Not applicable.

Comments:

Conservation Rank: G2G3S2

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

Synonyms:

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

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

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

Pseudotsuga menziesii/*Gaultheria shallon*-*Holodiscus discolor*; Crawford et al. 2009

Pseudotsuga menziesii/*Gaultheria shallon*-*Holodiscus discolor* Forest; Rocchio et al. 2012



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

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

Acronym: PSEMEN/HOLDIS-ROSGYM/FESOCC

NatureServe Code: Cegl000456

Macrogroup: Vancouverian Lowland and Montane Rainforest

Group: Southern Vancouverian Dry Douglas-fir - Madrone Woodland Group

Alliance: *Pseudotsuga menziesii* - *Abies grandis* - *Arbutus menziesii* Forest and Woodland Alliance

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.



EBLA Distribution: Observed in one patch in the eastern section of the Robert Y. Pratt Preserve.

Plots: Rocchio et al. 2012 (2); Chappell (2006b); Crawford (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*. Shorter shrubs are also variable in their cover, but usually include *Rosa gymnocarpa*. *Mahonia nervosa* and *M. aquifolium* may be present, the former sometimes codominant. *Symphoricarpos hesperius* (= *mollis*) is frequent and sometimes prominent in the Olympics. The herb layer is typically dominated by short grasses, especially *Bromus vulgaris* and *Festuca occidentalis*. At EBLA, other frequent herbs include *Melica subulata*, *Rubus ursinus*, *Adenocaulon bicolor*, *Linnaea borealis*, and *Trientalis borealis* ssp. *latifolia*. *Polystichum munitum* is frequently present and occasionally prominent at EBLA.

USFWS Wetland System: Not applicable.

Comments: At EBLA, this association occurs on very flat sites and is distinguished from similar types by its open shrub layer containing <5 % cover of *Gaultheria shallon* and >1 % *Rosa gymnocarpa*, along with the presence of >10% cover of native grasses.

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:

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

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

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

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

Pseudotsuga menziesii/*Holodiscus discolor*-*Rosa gymnocarpa*/*Festuca occidentalis*; Crawford et al. 2009

Pseudotsuga menziesii/*Holodiscus discolor*-*Rosa gymnocarpa*/*Festuca occidentalis* Forest; Rocchio et al. 2012

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

Douglas-fir / Common Snowberry - Oceanspray Forest

Acronym: PSEMEN/SYMALB-HOLDIS

NatureServe Code: CEGLO00460

Macrogroup: Vancouverian Lowland and Montane Rainforest

Group: Southern Vancouverian Dry Douglas-fir - Madrone Woodland Group

Alliance: *Pseudotsuga menziesii* - *Abies grandis* - *Arbutus menziesii* Forest and Woodland Alliance

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

EBLA Distribution: Many small, flat forest patches in the north and east of EBLA key to this type.

Plots: EBLA (2); Rocchio et al. 2012 (3); Chappell (2006b)

Environmental Description: The climate in this rainshadow is drier than surrounding coastal mountain areas, with low average annual precipitation (<30 inches) and a pronounced summer dry season. Temperatures are strongly moderated by oceanic influence. This association occurs on flat or gently sloping sites, at low 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: These stands are dominated by *Pseudotsuga menziesii*. Other trees that may occur in the canopy include the broad-leaved evergreen *Arbutus menziesii* and occasionally *Abies grandis*. A very well-developed tall-shrub layer is dominated by *Holodiscus discolor* and *Sambucus racemosa* is often prominent. A well-developed shorter shrub layer is dominated by *Symphoricarpos albus* and to a lesser extent *Rosa gymnocarpa* and *Rosa nutkana*. Trailing *Lonicera hispidula* is frequently present. *Polystichum munitum* and *Linnaea borealis* may be present in small, isolated, moist depressions. An often diverse herbaceous layer may include *Bromus vulgaris*, *Festuca occidentalis*, *Melica subulata*, *Galium aparine*, *Fragaria vesca*, *Sanicula crassicaulis*, *Mycelis muralis*, and *Trientalis borealis* ssp. *latifolia* (= *Trientalis latifolia*). Moss cover varies, but can be moderate in some stands.

USFWS Wetland System: Not applicable.

Comments: 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*.

Conservation Rank: 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 /*Holodiscus discolor*-*Symphoricarpos albus*; Chappell 2006b

Pseudotsuga menziesii/*Symphoricarpos albus*-*Holodiscus discolor* Forest; Rocchio et al. 2012



***Pseudotsuga menziesii* - *Tsuga heterophylla* / Depauperate Undergrowth Forest**

Douglas-fir - Western hemlock / Depauperate Undergrowth Forest

Acronym: PSEMEN-TSUHET/Dep.

NatureServe Code: Preliminary

Macrogroup: Vancouverian Lowland and Montane Rainforest

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

Alliance: *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Cornus unalaschkensis* Mesic Forest Alliance

Range: This association has been identified from lowland locations throughout the region.

EBLA Distribution: Limited to one patch at Robert Y. Pratt Preserve.

Plots: Crawford (2009)

Environmental Description: This association is found across a wide range of environments, elevations and topographic settings. Most stands represent a stagnation phase of stand development following disturbance by fire or debris flows.

Vegetation Description: This association is characterized by a dense canopy of *Pseudotsuga menziesii*. *Tsuga heterophylla* and/or *Thuja plicata* can be prominent. The primary feature of this association is little to no vascular plant understory. The cover of non-vascular plants can be nearly continuous in some expressions of this type.

USFWS Wetland System: Not applicable.

Comments: These communities are distinguished by a lack of vascular plant diversity, understory development and indicator vascular species. However, they are prevalent in the region. At EBLA, the one documented patch contains only *Pseudotsuga menziesii* in the canopy, over a carpet of moss.

Conservation Rank: GNRS3S4

Rank Justification: This association is relatively widespread in the lowlands and mountains of western Washington.

Synonyms:

Tsuga heterophylla/Depauperate; Henderson et al. 1989

Pseudotsuga menziesii-*Tsuga heterophylla*/Depauperate; Crawford et al. 2009



***Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* / *Polystichum munitum* Forest**

Douglas-fir - Western Hemlock / Salal / Sword Fern Forest

Acronym: PSEMEN-TSUHET/GAUSHA/POLMUN

NatureServe Code: PNWCOAST_182

Macrogroup: Vancouverian Lowland and Montane Rainforest

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

Alliance: *Tsuga heterophylla* - *Pseudotsuga menziesii* / *Cornus unalaschkensis* Mesic Forest Alliance

Range: This association occurs on the western slopes of the Cascades and on the eastern Olympic Peninsula. It is absent from the outer coastal strip and infrequent to rare on the western side of the Olympic Mountains.



EBLA Distribution: Inland from the Puget Sound, primarily south of the Kettles. Comprises most of the southern half of the Robert Y. Pratt Preserve, as well as the areas east of Coupeville that slope towards Penn Cove.

Plots: EBLA (1); Crawford (2009)

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. At EBLA, this association often occurs on gentle to moderately steep, north-facing slopes.

Vegetation Description: The canopy is dominated by *Pseudotsuga menziesii* or a mixture with *Tsuga heterophylla*. *Thuja plicata* is often present. *Tsuga heterophylla* typically dominates tree regeneration and always has over 10% total cover. The moderate to dense shrub layer is dominated by *Gaultheria shallon*. *Vaccinium parvifolium*, and *Mahonia* (= *Berberis*) *nervosa* are usually present and often prominent to codominant. The variably dense herb layer is dominated by *Polystichum munitum*, which always occupies over 3% cover. *Blechnum spicant* is absent. Dense second-growth forest stands, like those found at EBLA, commonly have sparse understories with *Gaultheria shallon* and *Polystichum munitum* as the most abundant species. *Holodiscus discolor* frequently forms a prominent tall shrub layer at EBLA.

USFWS Wetland System: Not applicable.

Comments: This association is distinguished from similar ones by >10% cover of *Polystichum munitum* or < 5% cover of *Gaultheria shallon* and *Polystichum munitum* >1%.

Conservation Rank: GNRS4

Rank Justification: This association is widespread in the lowlands, Cascades, and in the Olympics in western Washington.

Synonyms:

Pseudotsuga menziesii-*Tsuga heterophylla*/*Gaultheria shallon*/*Polystichum munitum*; Chappell 2006b
Pseudotsuga menziesii-*Tsuga heterophylla*/*Gaultheria shallon*/*Polystichum munitum*; Crawford et al. 2009

***Pseudotsuga menziesii* - *Tsuga heterophylla* / *Rhododendron macrophyllum* - *Vaccinium ovatum*
- *Gaultheria shallon* Forest**

Douglas-fir - Western Hemlock/ Rhododendron - Huckleberry - Salal Forest

Acronym: PSEMEN-TSUHET/RHOMAC-VACOVAT-GAUSHA

NatureServe Code: CEG002615

Macrogroup: Vancouverian Lowland and Montane Rainforest

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

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

Range: This association occurs below 460 m (1500 ft.) in west-central portions of the Puget Lowland, including the Kitsap Peninsula, Whidbey Island and the northeastern Olympic Peninsula.



EBLA Distribution: Comprises the majority of the forested lands at Ft. Ebey State Park, Kettles Recreation Area, Rhododendron County Park, and the surrounding private lands. It is the largest plant association by area within the Reserve.

Plots: EBLA (3); Chappell (2006b)

Environmental Description: This association typically occurs on moderately dry, very nutrient-poor sites including soil parent materials of gravelly glacial till or outwash, or basalt bedrock. At EBLA, it can occur on any slope or aspect.

Vegetation Description: This is an evergreen needle-leaved forest dominated by *Pseudotsuga menziesii* and *Tsuga heterophylla*, the former usually taller and more abundant, the latter usually dominating tree regeneration. *Thuja plicata* is usually present and sometimes codominant, and *Pinus monticola* is present in about half the plots collected elsewhere, but absent at EBLA. The understory is dominated by the evergreen broad-leaved shrubs *Rhododendron macrophyllum* (2-4 m tall), *Vaccinium ovatum*, and *Gaultheria shallon*, and may be sparse or dense depending on tree density, though *Vaccinium ovatum* is frequently absent or low in cover at EBLA. Other frequent species are *Pteridium aquilinum*, *Mahonia nervosa*, and *Vaccinium parvifolium*. Herbaceous species are typically found in very small amounts.

USFWS Wetland System: Not applicable.

Comments: This association is distinguished from similar ones by >10% cover of *Tsuga heterophylla* or *Thuja plicata*, >5% cover of *Rhododendron macrophyllum*, usually with *Vaccinium ovatum*, combined with <3% cover of *Polystichum munitum*.

Rank: G2S2

Rank Justification: This association is found in a limited range within the Puget Lowland, with few good quality occurrences remaining due to logging and fragmentation.

Synonyms:

Pseudotsuga menziesii-*Tsuga heterophylla*/Rhododendron macrophyllum-Vaccinium ovatum WA;
Chappell 2006b

***Pseudotsuga menziesii* - *Abies grandis* / *Holodiscus discolor* / *Symphoricarpos albus* Forest**

Douglas-fir - Grand Fir / Oceanspray - Snowberry Forest

Acronym: PSEMEN-ABIGRA/HOLDIS-SYMALB

NatureServe Code: PNWCOAST_153

Macrogroup: Vancouverian Lowland and Montane Rainforest

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

Alliance: *Tsuga heterophylla* – *Pseudotsuga menziesii* / *Holodiscus discolor* Dry Forest Alliance

Range: Known only from near Sequim in Clallam County, San Juan County, and Whidbey Island. May also occur in southern BC.

EBLA Distribution: Southern portion of the Reserve, primarily in fragmented patches along Puget Sound.

Plots: EBLA (3); Rocchio et al. 2012 (1); Chappell (2006b)

Environmental Description: Sites are moderately dry and appear to be nutrient rich. Sites are all located in dry climates at low elevations and are concentrated in areas with very low mean annual precipitation. It is most commonly found on plains or short, gentle to moderate slopes. Parent materials are glacial till, glacial outwash or residuum. Soils are likely to be somewhat shallow.

Vegetation Description: *Pseudotsuga menziesii* dominates the upper canopy. *Tsuga heterophylla* is always low in cover and frequently absent. *Abies grandis* is always present and often dominates tree regeneration. *Pseudotsuga menziesii* may also regenerate abundantly. The variable shrub layer is usually sparse, but may be dense at moister sites. *Rosa gymnocarpa* and *Lonicera hispidula* are always present and *Holodiscus discolor*, *Prunus emarginata*, *Rubus spectabilis*, *Rubus ursinus*, and *Symphoricarpos albus* are common. *Oemleria cerasiformis* is prominent to dominant at some sites. *Festuca occidentalis* and *Melica subulata* are usually prominent to codominant in the herb layer. *Tiarella trifoliata*, *Trientalis borealis* ssp. *latifolia*, *Bromus vulgaris*, *G. triflorum*, *Pteridium aquilinum* var. *pubescens* (occasionally prominent), and *Polystichum munitum* 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: One of the largest stands of this association at EBLA is found at Ft. Casey State Park, where the forest is regenerating in areas previously cleared for the original fort. Stands at EBLA appear to be moister than synonymous stands at SAJH, with greater abundance of moist-site indicators like *Rubus spectabilis* and *Tiarella trifoliata* and even small patches of *Maianthemum dilatatum* (limited to coastal bluff edges). Grass cover, while usually present, is quite variable in abundance. Some more work may be needed to confirm whether this type should be separated into wet and dry types and resolve lingering confusion in the nomenclature. Chappell (2006) identified PSEMEN-ABIGRA/FESOC and PSEMEN-ABIGRA/HOLDIS/POLMUN as separate types. However NatureServe combined these two them under the name PSEMEN-ABIGRA/SYMALB/MELSUB, after which Chappell's notes indicate the name was to be changed to PSEMEN-ABIGRA/HOLDIS-SYMALB.

Conservation Rank: G1?S1

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*/*Holodiscus discolor*/*Melica subulata* Forest; Rocchio et al. 2012

Pseudotsuga menziesii-*Abies grandis*/*Holodiscus discolor*/*Polystichum munitum*; Chappell 2006b

Pseudotsuga menziesii-*Abies grandis*/*Symphoricarpos alba*/*Melica subulata* Forest; NatureServe

***Pseudotsuga menziesii* - *Tsuga heterophylla* / *Gaultheria shallon* - *Holodiscus discolor* Forest**

Douglas-fir - Western Hemlock / Salal - Oceanspray Forest

Acronym: PSEMEN-TSUHET/GAUSHA-HOLDIS

NatureServe Code: PNWCOAST_184

Macrogroup: Vancouverian Lowland and Montane Rainforest

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

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

Range: This association occurs in the rainshadow of the Olympic Mountains and possibly in the western Cascades.

EBLA Distribution: Forms a consistent strip along the Strait of Juan de Fuca from Ft. Ebey through the Robert Y. Pratt Preserve. Another strip is found upslope from the western edge of Penn Cove. Large patches west of Grasser's Hill and southeast of Long Point.

Plots: EBLA (1); Chappell (2006b),

Environmental Description: Sites are at low to occasionally moderate elevations on shallow or rocky, well-drained soils, mostly on southerly or westerly aspects.

Vegetation Description: The canopy is dominated by *Pseudotsuga menziesii* or a mixture of that species and *Tsuga heterophylla*. *Thuja plicata* is often present and sometimes prominent to codominant. *Tsuga heterophylla* dominates tree regeneration and typically occupies over 10% total cover. The well-developed shrub layer is always dominated by *Gaultheria shallon*. *Holodiscus discolor* is always present and usually has over 2% cover. *Mahonia nervosa* (= *Berberis*) is usually prominent. *Rosa gymnocarpa* and *Symphoricarpos hesperius* are usually present. The herb layer is often sparse, due to the dense shrub layer, with *Linnaea borealis*, *Trientalis borealis* ssp. *latifolia*, *Festuca occidentalis*, and *Polystichum munitum* most common.

USFWS Wetland System: Not applicable.

Comments: At EBLA, these stands have little *Symphoricarpos hesperius* and often have significant inclusions of low shrub cover.

Conservation Rank: G2G3S2S3

Rank Justification: The range of this association is somewhat restricted in the Puget Lowland and in the Olympic Mountains. Low elevations sites which occur outside protected areas are likely logged or developed.

Synonyms:

Pseudotsuga menziesii-*Abies grandis*-*Tsuga heterophylla*/*Gaultheria shallon*-*Holodiscus discolor*; Agee 1987

Pseudotsuga menziesii-*Tsuga heterophylla*/*Gaultheria shallon*-*Holodiscus discolor*; Chappell 2006b
Tsuga heterophylla/*Gaultheria shallon*-*Holodiscus discolor*; Henderson et al. 1989



***Picea sitchensis* / *Gaultheria shallon* Forest**

Sitka Spruce / Salal Forest

Acronym: PICSIT/GAUSHA

NatureServe Code: CEGLO00401

Macrogroup: Vancouverian Lowland and Montane Rainforest

Group: North Pacific Western Hemlock - Sitka Spruce - Western Redcedar Seasonal Rainforest

Alliance: *Tsuga heterophylla* - *Picea sitchensis* / *Rhytidadelphus loreus* Forest Alliance

Range: The association occurs on the coastal plain of the western Olympic Peninsula and on coastal bluff areas of Whidbey Island.

EBLA Distribution: 2 narrow, fog-influenced strips on the bluffs along the far western margin of Ft. Ebey State Park.

Plots: Crawford (2009)

Environmental Description: This forest or woodland association occurs on well-drained, sloping sites, often on or near coastal bluffs.

Vegetation Description: The canopy is dominated by *Picea sitchensis*. *Tsuga heterophylla*, *Pseudotsuga menziesii*, or *Thuja plicata* is often present to occasionally codominant. The dense shrub layer is dominated or codominated by *Gaultheria shallon*. *Rubus spectabilis* is sometimes codominant and *Vaccinium ovatum*, if present, is low in cover. The herb layer varies in density. *Blechnum spicant*, *Maianthemum dilatatum*, and *Polystichum munitum* are present in most stands.

USFWS Wetland System: Not applicable.

Comments: *Rubus spectabilis* and *Blechnum spicant* were not observed within stands at EBLA.

Conservation Rank: GNRS2S3

Rank Justification: This association occurs within a limited geographic range and sites can be threatened by timber harvesting and development.

Synonyms:

Picea sitchensis/*Gaultheria shallon*-*Rubus spectabilis*; Christy et al. 1998

Picea sitchensis/*Gaultheria shallon*; Crawford et al. 2009



***Salix lucida* ssp. *lasiandra* / *Urtica dioica* spp. *gracilis* Woodland**

Pacific Willow / California Nettle Woodland

Acronym: SALLUC/URTDIO

NatureServe Code: CEG003409

Macrogroup: Vancouverian Flooded & Swamp Forest

Group: North Pacific Lowland Riparian Forest & Woodland

Alliance: *Salix lucida* Temporarily Flooded Woodland Alliance

Range: Coastal and river areas from the Columbia River north through the Puget Lowlands.

EBLA Distribution: Limited to one occurrence in a shallow drainage just southeast of Coupeville.

Plots:

Environmental Description: Occurs around shallow lakes and ponds, and along low-gradient streams. Found in moist depressions surrounding *Typha latifolia* and *Schoenoplectus acutus* wetlands at EBLA.

Vegetation Description: This community type is dominated by *Salix lucida* ssp. *lasiandra* (= *Salix lasiandra*). Other shrubs are patchy and include *Cornus sericea*, *Sambucus racemosa* and *Salix sitchensis*. Because of a history of grazing and proximity to development areas, the herb layer is usually dominated by exotic species. The abundance of other species is typically low, but may include *Urtica dioica* and *Galium aparine*.

USFWS Wetland System: Palustrine

Comments:

Conservation Rank: G2S1S2

Rank Justification: This association is found in a limited range and is vulnerable to alteration of the water table.

Synonyms:

Salix lasiandra/Urtica dioica; Kunze 1994

Salix lucida ssp. *lasiandra/Urtica dioica* spp. *gracilis*; Christy 2004



***Alnus rubra* / *Rubus spectabilis* Forest**

Red Alder / Salmonberry Forest

Acronym: ALNRUB/RUBSPE

NatureServe Code: CEGLO00639

Macrogroup: Vancouverian Flooded & Swamp Forest

Group: North Pacific Lowland Riparian Forest & Woodland

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

Range: This alliance is widespread throughout western Washington.

EBLA Distribution: Small drainages near Ft. Ebey and a large patch east of the Naas Prairie Unit of the Admiralty Inlet Natural Area Preserve.

Plots: Rocchio et al. 2012 (4); Crawford (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 codominated 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 leptopoda*, and *Oxalis oregana* are some of the most common forbs and ferns. At EBLA, *Rubus parviflorus* frequently codominates the shrub layer. *Polystichum munitum* may also dominate the herbaceous layer in stands with more open shrub layers, or in transition areas to neighboring, sloping conifer forests. *Acer circinatum* and *Oxalis oregana* are absent.

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). The photo included here was taken during the winter, when *Rubus spectabilis* shrubs had shed their leaves.

Conservation Rank: G4G5 S4S5

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

Synonyms:

Alnus rubra/*Rubus spectabilis*; Murray 2000

Alnus rubra/*Rubus spectabilis*; Kunze 1994

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

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

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

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

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

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

Alnus rubra/*Rubus spectabilis*; Crawford et al. 2009



***Tsuga heterophylla* - (*Pseudotsuga menziesii* - *Thuja plicata*) / *Polystichum munitum* - *Athyrium filix-femina* Forest**

Bigleaf Western Hemlock - (Douglas-fir - Western Redcedar)/ Swordfern-Lady fern Forest

Acronym: TSUHET-(PSEMEN-THUPLI)/POLMUN-ATHFIL

NatureServe Code: CEG002627
(PNWCOAST_265)

Macrogroup: Vancouverian Flooded & Swamp Forest

Group: North Pacific Maritime Hardwood-Conifer Swamp

Alliance: (*Picea sitchensis*, *Tsuga heterophylla*) - (*Alnus rubra*) Riparian Forest Alliance

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



EBLA Distribution: Concave areas and drainages within Ft. Ebey State Park and Rhododendron County Park.

Plots: EBLA (2); Crawford (2009)

Environmental Description: This association occurs at low elevations. Sites are usually on lower or toe slopes or riverine terraces. Soils are moist and often deep.

Vegetation Description: The canopy is dominated by a variable mixture of *Tsuga heterophylla*, *Pseudotsuga menziesii*, and/or *Thuja plicata*. *Tsuga heterophylla* or *Thuja plicata* always occupy at least 10% total cover and dominate tree regeneration. *Acer macrophyllum* or *Alnus rubra* are sometimes prominent, but never dominant. A well-developed tall-shrub layer dominated by *Acer circinatum* is often present. Shorter shrubs are usually sparse but often include *Rubus spectabilis* (an important indicator for the type) and *Vaccinium parvifolium*. The herb layer is always dominated by ferns, particularly *Polystichum munitum*, which grows taller and more densely than in other settings. Frequent herbs that are indicative of the association are *Athyrium filix-femina*, *Tiarella trifoliata*, *Blechnum spicant*, *Gymnocarpium dryopteris* and *Dryopteris expansa* (= *austriaca*), one or more of which is sometimes prominent. Other frequent herbs include *Achlys triphylla* and *Clintonia uniflora*. At EBLA, *Acer macrophyllum*, *Acer circinatum*, *Achlys triphylla* and *Clintonia uniflora* are absent and *Gaultheria shallon* is often present, but always greatly exceeded by *Polystichum munitum*, *Athyrium filix-femina*, and *Rubus spectabilis*.

USFWS Wetland System: Not applicable.

Comments: This association is distinguished by the relative abundance of wet to moist-site indicator herbs, the presence of *Rubus spectabilis*, or the high percent cover of *Polystichum munitum* and *Athyrium filix-femina*.

Conservation Rank: G3S3

Rank Justification: This association occurs within a narrow environmental range in the mountains of western Washington and has been impacted by logging

Synonyms:

Tsuga heterophylla-(*Pseudotsuga menziesii*)/*Polystichum munitum*-*Dryopteris expansa*; Chappell 2006b

Tsuga heterophylla/Polystichum munitum/*Tiarella trifoliata*; Mycek 1994

Tsuga heterophylla/Polystichum munitum-*Tiarella trifoliata*; Henderson et al. 1989

Tsuga heterophylla-(*Pseudotsuga menziesii*-

Thuja plicata)/Polystichum munitum-*Athyrium filix-femina*; Crawford et al. 2009

***Alnus rubra* / *Sambucus racemosa* / *Urtica dioica* Provisional Ruderal Forest**
Red alder / Elderberry / Nettle Provisional Ruderal Forest

Acronym: ALNRUB/SAMRAC/URTDIO

NatureServe Code: Provisional

Provisional Macrogroup: Vancouverian Ruderal
Flooded & Swamp Forest Macrogroup

Provisional Group: North Pacific Ruderal Riparian
and Swamp Forest

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

Range: This provisional association is identified
from locations in Ebey's Landing National Historical
Reserve, although it is likely to occur in other
locations within the region.

EBLA Distribution: This provisional forest type was
observed throughout the portion of the reserve south of Ft. Ebey State Park.

Plots: EBLA (1)

Environmental Description: This association appears limited regionally to dry climatic areas within the Olympic rainshadow. At EBLA, it is found in low, flat topographic settings that would be seasonally wet or riparian under other climate regimes, often at the inflection points of gentle slopes. Sites may be relatively nutrient-rich or, due to the flat topography and dry climate may have soils that are less moist than other associations in this Alliance.

Vegetation Description: These are *Alnus rubra* stands of varying age, frequently with codominant *Pseudotsuga menziesii* in the canopy. *Tsuga heterophylla*, *Thuja plicata*, and *Abies grandis* may be present, but rarely prominent. Shrub cover is variable in density, but characterized by a tall shrub layer dominated by *Sambucus racemosa*. *Holodiscus discolor* is often codominant. *Rubus spectabilis* and *Rubus ursinus* may be present in small amounts. The herbaceous layer is always dominated by *Urtica dioica*, which is often dense and continuous. Many other herbs may be found in small amounts, such as *Carex leptopoda*, *Galium triflorum*, *Claytonia sibirica*, *Tiarella trifoliata*, and *Ranunculus repens*. When present, *Polystichum munitum* cover is negligible.

USFWS Wetland System: Not applicable

Comments: This type is distinguished from *Alnus rubra*/*Polystichum munitum* forests (CEGL000063) by <10% cover of *Polystichum munitum* and presence of a tall shrub layer. It is distinguished from *Alnus rubra*/*Rubus spectabilis* forests by having <10% cover of *Rubus spectabilis* and generally fewer wet site indicators. Evidence suggests that these stands may develop in nutrient-rich and relatively well-drained soils in areas that were previously disturbed. They may represent previously forested lands that were cleared for agriculture or other uses during settlement and have since converted back to forest.

Conservation Rank:

Rank Justification: This association has not been previously described

Synonyms:



***Prunus emarginata* Ruderal Flooded Forest**

Bitter Cherry Ruderal Flooded Forest

Acronym: PRUEMA Ruderal

NatureServe Code: Provisional

Provisional Macrogroup: Vancouverian Ruderal Flooded & Swamp Forest Macrogroup

Provisional Group: North Pacific Ruderal Riparian and Swamp Forest

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

Range: This type has been identified in San Juan and Island Counties of Washington State

EBLA Distribution: One patch on the edge of the Robert Y. Pratt Preserve.

Plots: EBLA (1); Rocchio et al. 2012 (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: This association was identified at American Camp, SAJH, in a site which featured a dense canopy of *Prunus emarginata*. Understory shrubs in those stands included *Rubus ursinus*, *R. armeniacus*, *R. parviflorus*, *Rosa nutkana*, and *Symphoricarpos albus*. Herbaceous species present at SAJH included *Bromus sitchensis*, *Dactylis glomerata*, *Poa pratensis*, *Urtica dioica*, and *Tellima grandiflora*. At EBLA, the canopy is open, with most of the *Prunus emarginata* occurring within a dense shrub layer with codominant *Holodiscus discolor* and *Sambucus racemosa*. The herb layer is moderately developed, with *Carex leptopoda*, *Urtica dioica*, *Galium aparine*, and *Ranunculus occidentalis* most abundant.

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. The one stand at EBLA occurs next to a large agricultural field and likely was also previous disturbed.

Conservation Rank:

Rank Justification:

Synonyms:

Prunus emarginata Ruderal Flooded Forest Association; Rocchio et al. 2012



Ebey's Landing Provisional Ruderal Woodland

Ebey's Landing Provisional Ruderal Woodland

Acronym: EBLA Ruderal

NatureServe Code: Provisional

Provisional Macrogroup: Vancouverian Ruderal
Flooded & Swamp Forest Macrogroup

Provisional Group: North Pacific Ruderal Riparian
and Swamp Forest

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

Range: Although this association was described
from Ebey's Landing, it is likely widespread
throughout western Washington.

EBLA Distribution: Disturbed areas near human
habitation throughout the Reserve.

Plots: EBLA (2)

Environmental Description: This ruderal association occurs in previously disturbed areas. Locations are often moist to flooded ditches and toeslopes, but also large flat expanses. This type is often found adjacent to agricultural lands and may form wide hedgerows along fencelines.

Vegetation Description: Composition is predominantly native species, however they reflect a novel group of diverse associates with no natural analogue. Patches are typically dominated by tree-form willows *Salix scouleriana*, *Salix hookeriana*, and/or *Salix lucida* ssp. *lasiandra* (though the latter two are less common). *Alnus rubra* and *Prunus emarginata* are frequently codominant and more mature stands may contain significant cover from *Pseudotsuga menziesii*. *Rubus armeniacus* is usually prominent in the shrub layer. Other frequent shrubs include *Rosa nutkana*, *Symphoricarpos albus*, *Spiraea douglasii*, *Rubus spectabilis*, *Rubus parviflorus* and *Malus fusca*. Occasionally, drier sites have significant *Gaultheria shallon* and *Holodiscus discolor*, but retain the tall willow layer and diverse array of associate shrubs. The shrub layer is usually too thick for substantial herb cover, but *Urtica dioica*, *Dactylis glomerata*, *Schedonorus phoenix* (= *S. arundinaceus*), and *Equisetum* spp. are common on the edges.

USFWS Wetland System: Not applicable

Comments: This type is distinguished from other *Salix*-dominated types primarily by the abundance and diversity of associate species, as well as the presence to codominance of *Alnus rubra*, *Pseudotsuga menziesii*, *Prunus emarginata*, or *Rubus armeniacus*. Future research may allow division of this provisional type based on moisture gradients.

Conservation Rank:

Rank Justification: This ruderal association has not been previously described

Synonyms:



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

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

Acronym: FESIDAROE-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.



EBLA Distribution: Limited to one small remnant patch on Pacific Rim Institute property.

Plots: Rocchio et al. 2012 (19)

Environmental Description: This association only occurs in the rainshadow of the Olympic Mountains, on sites that appear to be moderately dry. It is found on gentle slopes or flats as 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 EBLA, the only known site is being actively burned to exclude shrubs.

Vegetation Description: This grassland association is dominated or codominated 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. Additional native species consistently found in the EBLA occurrence include *Lupinus polycarpus*, *Lomatium nudicaule*, *Triteleia grandiflora*, *Luzula multiflora* var. *multiflora*, *Fritillaria lanceolata*, *Galium aparine* *Zigadenus venenosus* (= *Toxicoscordion venenosum*), *Elymus glaucus*, *E. trachycaulus* ssp. *trachycaulus*, *Danthonia californica*, *Brodiaea coronaria* ssp. *coronaria*, *Bromus sitchensis*, and *Fragaria virginiana*. Nonnative *Poa pratensis* and *Holcus lanatus* are present in the EBLA occurrence, along with *Aira caryophyllea*, *Bromus diandrus* (= *B. rigidus*), *Hypochaeris radicata*, *C. vulgare*, *Rumex acetosella*, *Vicia sativa*, *V. hirsuta*, *Taraxacum officinale* ssp. *officinale*, and *Trifolium dubium*

USFWS: Not applicable.

Comments: Historically, this association likely dominated the dry portions of prairie of the Puget Sound lowlands. 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. Most of the areas at EBLA that have not been developed or plowed have instead converted to *Symphoricarpos albus* – *Rosa nutkana* shrubland due to the absence of regular burning. These shrublands sometimes retain a significant number of native prairie herbs. *Festuca idahoensis* ssp. *roemerii* is now known as *Festuca roemerii*.

Conservation Rank: GNRSH

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

Synonyms:

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

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

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

Acronym: FESRUB-(CAMLEI, GRISTR)

NatureServe Code: Cegl003347

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.



EBLA Distribution: Degraded patches exist on coastal bluff at Ft Ebey and along Keystone Spit. Larger patches with more native character can be found along the Bluff Trail, and within the Naas Prairie Unit of the Admiralty Inlet Natural Area Preserve.

Plots: Rocchio et al. 2012 (1); Chappell (2006a,b)

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. 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. At EBLA, this association primarily occurs on steep bluffs that have been impacted by historical grazing, but have not been plowed, however it is also found on flatter, mesic sites.

Vegetation Description: This association is dominated by grasses or a mix of grasses and forbs. Native varieties of *Festuca rubra* are always dominant or codominant (formerly known as *Festuca rubra* var. *littoralis* Vasey ex Beal). *Camassia leichtlinii* is sometimes prominent to codominant. The state rare plant, *Ranunculus californicus*, is present in this type, but was not observed at EBLA. Other frequent herbaceous species include *Grindelia stricta*, *Cerastium arvense*, *Achillea millefolium*, *Allium acuminatum*, and *Luzula (comosa, multiflora)*. *Lomatium nudicaule* is occasionally prominent. Frequent nonnative species include *Hypochaeris radicata*, *Bromus hordeaceus* (= *B. mollis*), *Holcus lanatus*, *Aira caryophyllea*, *Aira praecox*, *Bromus diandrus* (= *B. rigidus*), *Rumex acetosella*, and *Plantago lanceolata*. Additional native species observed in the occurrences at EBLA include *Opuntia fragilis*, a prickly pear cactus found only on dry bluffs in the San Juans, Whidbey Island and few other areas in the rainshadow of the Olympic Mountains. *Lupinus bicolor* and *Pteridium aquilinum* are often high in cover. Additional nonnative species observed in the EBLA include *Trifolium dubium*, *Marrubium vulgare*, and *Poa pratensis*.

USFWS: Not applicable.

Comments: This association has largely been replaced by the *Bromus (diandrus, hordeaceus, sterilis)* Ruderal Grassland Association on coastal bluffs at EBLA, but substantial tracts with a high percentage of native species still remain along the Bluff Trail.

Conservation Rank: G1S1

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

Synonyms:

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

Festuca rubra—(*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation; Rocchio et al. 2012

***Symphoricarpos albus* – *Rosa nutkana* Pacific Coast Shrubland**

Common Snowberry – Nootka Rose Pacific Coast Shrubland

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 and central to northern Island County. It may also occur in western Skagit, western Whatcom, eastern Clallam, and northeastern Jefferson Counties. It also likely occurs in adjacent British Columbia on the Gulf Islands and southeastern Vancouver Island.



EBLA Distribution: Widely distributed in hedgerows, on windblown bluffs, and in ruderal patches.

Plots: EBLA (2); Rocchio et al. 2012 (1)

Environmental Description: Within EBLA, 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. It is the most common association that comprises the Hedgerows at EBLA.

Vegetation Description: *Symphoricarpos albus* and *Rosa nutkana* typically codominate this association, although many occurrences are dominated by only one or the other. *Rubus ursinus* is sometimes prominent and *Spiraea douglasii* may be present in hedgerows occurring in ditches. 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* (= *phoenix*), *Holcus lanatus*, *Hypochaeris radicata*, *Cirsium vulgare*, *Dactylis glomerata*, *Poa pratensis*, *Rumex acetosella*, *Conium maculatum*, *Anthriscus sylvestris*, *Anthriscus caucalis*, *Brassica rapa*, and *Vicia sativa*.

USFWS: Not applicable.

Comments: Although an association with the same name exists in NatureServe explorer, it is a Rocky Mountain type in origin and shares little with this concept. This shrubland is one of the most abundant types at EBLA. Due to its fidelity to highly disturbed sites, it might be better classified as a Ruderal association. However, because the dominant shrubs thrive in disturbed environments, as well as the presumed presence of such sites historically--though with less abundance--this type was classified as a provisional native association until more data can be collected. Non-hedgerow occurrences of this association have probably expanded due to the exclusion of fire, replacing remnant prairie types in the process. Less dense occurrences often retain a large number of native species, such as *Seriocarpus rigidus*(= *Aster curtisii*), *Allium cernuum*, *Plectritis congesta*, *Lupinus littoralis*, *Dodecatheon hendersonii*, *Erigeron speciosus*, *Luzula (comosa, multiflora)*, *Carex tumulicola*, and *Triteleia hyacintha*. The large patches on Keystone Spit are likely there due to the artificial raising of the spit in the lead-up to development (later averted). Storm surges no longer overtop the spit to inundate the area with salt water.

Conservation Rank: GUSUQ

Rank Justification: Historically, this type was likely less abundant and restricted to the edges of prairies or balds. Fire suppression, fragmentation and logging of forests have likely increased the abundance of this shrubland community.

Synonyms:

Symphoricarpos albus – *Rosa nutkana* Shrubland; Rocchio et al. 2012

***Cytisus scoparius* Ruderal Shrubland**

Scotch Broom Ruderal Shrubland

Acronym: CYTSCO Ruderal

NatureServe Code: CEGLO03045

Macrogroup: Western North American Ruderal Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal Grassland & Shrubland

Alliance: *Cytisus scoparius* Ruderal Shrubland Alliance

Range: This association is widespread in Western Washington.

EBLA Distribution: Powerline corridors through Ft Ebey State Park and Kettles Recreation Area, highway right-of-ways, and small patches on coastal bluffs.

Plots:

Environmental Description: This association occurs in disturbed areas such as recently logged sites, roadsides, and powerline corridors.

Vegetation Description: This moderately dense to dense shrubland is dominated by the introduced species *Cytisus scoparius*. *Gaultheria shallon* and *Holodiscus discolor* may codominate in patches and *Rubus armeniacus* (= *R. discolor*) is often present. The herbaceous layer consists of nonnative grasses such as *Bromus diandrus* (= *B. rigidus*), *Bromus hordeaceus* (= *B. mollis*), and *Schedonorus phoenix* (= *S. arundinaceus*). Invasive forbs such as *Anthriscus caucalis* are also common.

USFWS: Not applicable.

Comments:

Conservation Rank:

Rank Justification:

Synonyms:



***Bromus (diandrus, hordeaceus, sterilis)* Provisional Ruderal Herbaceous Vegetation**

Ripgut Brome, Soft Brome, Poverty Brome Provisional Ruderal Herbaceous Vegetation

Acronym: BRO (DIA,HOR,STE) Ruderal

NatureServe Code: Provisional

Macrogroup: Western North American Ruderal
Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal
Grassland & Shrubland

Alliance: *Bromus hordeaceus* Provisional Ruderal
Alliance

Range: Has been identified in San Juan and Island
Counties.

EBLA Distribution: Widespread, but primarily on
steep coastal bluffs and highway right-of-ways.

Plots: EBLA (2); Rocchio et al. 2012 (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 Puget Sound 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 is primarily composed of nonnative annual grasses such as *Bromus diandrus* (= *B. rigidus*), *B. hordeaceus* (= *B. mollis*), *Vulpia myuros*, and *Aira caryophyllea*. Other species present may include *Holcus lanatus*, *Hypochaeris radicata*, *Poa pratensis*, *Schedonorus phoenix* (= *S. arundinaceus*), *Anthriscus caucalis*, *Vicia sativa*, *Vicia hirsuta*, *Vicia tetrasperma*, *Erodium cicutarium*, *Marrubium vulgare*, *Silene vulgaris*, *Poa bulbosa*, *Amsinckia menziesii*, and *Artemisia campestris*. *Festuca rubra* may be present, but rarely prominent.

USFWS: Not applicable.

Comments: This dry ruderal grassland typically goes to seed and vegetation begins to dry by early summer. It is distinguished from the *Schedonorus phoenix* Ruderal Grassland by the dominance of *Bromus hordeaceus* (= *B. mollis*) or *Bromus diandrus* (= *B. rigidus*). It is distinguished from the *Festuca rubra* - (*Camassia leichtlinii* - *Grindelia strica*) type by having < 15% cover of *Festuca rubra* and generally fewer native species. It typically occupies drier landscape positions.

Conservation Rank:

Rank Justification:

Synonyms:

Bromus sitchensis–*Bromus hordeaceus*–*Poa pratensis*; Rochefort and Bivin 2009 (< >)
Bromus (diandrus, hordeaceus, sterilis) Dry Ruderal Grassland; Rocchio et al. 2012



***Bromus sitchensis* - *Elymus glaucus* Provisional Ruderal Alliance**

Alaska Brome - Blue Wildrye Provisional Ruderal Alliance

Acronym: BROSIT-ELYGLA Ruderal

NatureServe Code: Provisional

Macrogroup: Western North American Ruderal
Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal
Grassland & Shrubland

Alliance: *Bromus sitchensis* - *Elymus glaucus*
Provisional Ruderal Alliance

Range: Identified in San Juan and Island Counties

EBLA Distribution: Limited to one occurrence near
a seasonal stream at Ebey's Ferry House.

Plots: Rocchio et al. 2012 (8)



Environmental Description: The occurrences at American Camp in SAJH are 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 codominate this type along with numerous nonnative species. *Bromus diandrus* (= *B. 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. At EBLA, *Bromus sitchensis* clearly dominates, but the associate species are less diverse and much more mesic to moist in character, with *Equisetum telmateia* prominent.

USFWS: Not applicable.

Comments: At SAJH, 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 codominance of nonnative species, this type was considered ruderal. Additional information may suggest this is in fact a natural prairie/bald type. At EBLA, the one *Bromus sitchensis*-dominated patch is found in a moist, highly disturbed drainage between *Symphoricarpos albus* – *Rosa nutkana* shrublands.

Conservation Rank:

Rank Justification:

Synonyms:

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

Bromus sitchensis-*Elymus glaucus* Dry Ruderal Grassland; Rocchio et al. 2012

***Festuca idahoensis* ssp. *roemer*i Provisional (Restoration) Ruderal Alliance**

Roemer's Fescue Provisional (Restoration) Ruderal Alliance

Acronym: FESIDAROE Restoration

NatureServe Code: Provisional

Macrogroup: Western North American Ruderal
Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal
Grassland & Shrubland

Alliance: *Festuca roemer*i Provisional (Restoration)
Ruderal Alliance

Range: This type has been sampled in restoration
areas at SAJH and EBLA

EBLA Distribution: Pacific Rim Institute, and one
small patch near the Robert Y. Pratt Preserve.

Plots:

Environmental Description: This stand was located in a restoration plot.

Vegetation Description: Planted areas of *Festuca idahodensis*

USFWS: Not applicable.

Comments: This stand was considered ruderal due to the fact that planted *Festuca idahoensis* ssp. *roemer*i is the only native species present. If long-term restoration efforts succeed in reestablishing composition typical of a *F. roemer*i prairie then this stand could be reclassified into that type.

Conservation Rank:

Rank Justification:

Synonyms:

Festuca idahoensis ssp. *roemer*i Ruderal (Restoration) Grassland; Rocchio et al. 2012



***Rubus armeniacus* Ruderal Shrubland**

Himalayan Blackberry Ruderal Shrubland

Acronym: RUBARM Ruderal

NatureServe Code: Provisional

Macrogroup: Western North American Ruderal Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal Grassland & Shrubland

Alliance: *Rubus armeniacus* Ruderal Alliance

Range: Widespread in Western Washington

EBLA Distribution: Scattered throughout the reserve on the margins of development. Largest patches are northeast of Crockett Lake and east of Grasser's Hill.



Plots:

Environmental Description: Many sites have soils that have been disturbed by past plowing. May invade hedgerows and occur in nearly any disturbed area on a variety of substrates and moisture conditions ranging from well drained to mesic-moist.

Vegetation Description: *Rubus armeniacus* (= *R. discolor*) is the dominant shrub and often forms dense stands. A variety of pasture grasses may be found in the herbaceous understory, with *Poa pratensis*, *Dactylis glomerata*, and *Holcus lanatus* most common. *Urtica dioica* and *Equisetum hyemale* may be present when this shrubland occurs in moist depressions and ditches. *Rubus armeniacus* is typically dense, but the prevalence of other nonnative plants increases in occurrences where the shrub layer is scattered.

USFWS: Not applicable.

Comments: *Rubus armeniacus* is now known as *Rubus bifrons*. Although *Rubus discolor* has often been treated as a synonym of *R. armeniacus* in our region, it is actually a synonym of *R. ulmifolius*, another nonnative species present but not nearly as common as *R. armeniacus* in Washington.

Conservation Rank:

Rank Justification:

Synonyms:

Rubus armeniacus Ruderal Shrubland; Rocchio et al. 2012

***Schedonorus phoenix* Provisional Ruderal Herbaceous Vegetation**

Meadow Fescue Provisional Ruderal Herbaceous Vegetation

Acronym: SCHPHO Ruderal

NatureServe Code: Provisional

Macrogroup: Western North American Ruderal
Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal
Grassland & Shrubland

Alliance: *Schedonorus phoenix* Provisional
Ruderal Alliance

Range: Identified at American and British Camp on
San Juan Island, also occurring at Ebey's Landing.

EBLA Distribution: Occasional in fallow pastures,
moist roadside areas, and Keystone Spit.

Plots:

Environmental Description: Soils have been disturbed due to past plowing and/or grazing. On Keystone Spit, disturbance is from the raising of the spit prior to development.

Vegetation Description: *Schedonorus phoenix* (= *S. arundinaceus*) is often the only species occurring in these stands and is always clearly the dominant species. *Holcus lanatus*, *Poa pratensis*, *Brassica rapa*, *Elymus repens*, *Anthoxanthum odoratum*, *Dactylis glomerata*, and *Vicia sativa* are often present in lesser amounts. When present, annual grasses such as *Bromus diandrus* (= *B. rigidus*) and *Bromus hordeaceus* (= *B. mollis*) never have substantial cover.

USFWS: Not applicable.

Comments: Sites likely occur in areas that were formerly native prairie. *Schedonorus phoenix* is now known as *Schedonorus arundinaceus*. These sites are differentiated from other ruderal grasslands by generally lower diversity, low cover of annual grasses, and mesic landscape positions.

Conservation Rank:

Rank Justification:

Synonyms:

Schedonorus phoenix Mesic Ruderal Grassland; Rocchio et al. 2012



***Festuca rubra* Provisional Ruderal Alliance**

Red Fescue Provisional Ruderal Alliance

Acronym: FESRUB Ruderal

NatureServe Code: Provisional

Macrogroup: Western North American Ruderal Grassland & Shrubland

Group: Southern Vancouverian Lowland Ruderal Grassland & Shrubland

Alliance: *Festuca rubra* Provisional Ruderal Alliance

Range: Known to occur at Ebey's Landing. Likely to occur in other extensively disturbed areas of the Puget Sound lowlands.

EBLA Distribution: Keystone Spit.

Plots:



Environmental Description: Occurs in a transitional zone between high salt marsh and upland or dune vegetation. Soils are moist, but rocky and shallow, and have been disturbed due to past plowing and/or grazing. On Keystone Spit, further disturbance comes from pre-development raising of the spit and artificial fluctuations in the water level of Crockett Lake.

Vegetation Description: *Festuca rubra* dominates this grassland community, forming nearly continuous cover. *Grindelia stricta* is typically present in small amounts, but other native associate species characteristic of *Festuca rubra* communities (*Lathyrus japonicus*, *Ambrosia chamissonis*, *Cerastium arvense*, etc.) are absent. Nonnative grasses *Aira caryophyllaea*, *Bromus diandrus* (= *B. rigidus*), *Bromus hordeaceus* (= *B. mollis*), *Schedonorus phoenix* (= *S. arundinaceus*), *Lamium purpureum*, *Cerastium fontanum*, and other weeds may have significant cover, but always less than *Festuca rubra*. *Salicornia virginica* and *Distichlis spicata* may be present in small amounts.

USFWS: Not applicable.

Comments: It is unclear whether the variety of *Festuca rubra* present at these sites is native or introduced. It is possible that these sites represent degraded *Festuca rubra*-(*Argentina egedii*) communities, based on their position in a high salt marsh setting directly abutting *Distichlis spicata*-(*Salicornia virginica*) communities. However, no *Argentina egedii* was observed. It may also be a very degraded example of the *Festuca rubra*-*Ambrosia chamissonis* type (the moist setting makes this unlikely). This area was originally attributed as *Festuca rubra*-(*Camassia leichtlinii*, *Grindelia stricta* var. *stricta*) Herbaceous Vegetation due to the *Festuca rubra* dominance and presence of *Grindelia stricta*. It is unclear whether the ecological setting should be restricted to dry headlands currently characteristic of this type or if it was historically also found in mesic prairies. Further research is necessary to determine if this type is found elsewhere in the Puget Sound lowlands, or if it represents a singular consequence of the unique disturbance history at Crockett Lake.

Conservation Rank:

Rank Justification:

Synonyms:

***Agrostis (gigantea, stolonifera)* Ruderal Herbaceous Vegetation**

(Redtop, Creeping Bentgrass) Ruderal Herbaceous Vegetation

Acronym: AGR (GIG, STO) Ruderal

NatureServe Code: CEG001558

Macrogroup: Western North American Ruderal Wet Shrubland, Meadow & Marsh

Group: Western North American Ruderal Wet Shrubland, Meadow & Marsh

Alliance: *Poa pratensis* - *Agrostis gigantea* - *Agrostis stolonifera* Ruderal Herbaceous Alliance

Range: Identified at American and British Camp on San Juan Island, also occurring at Ebey's Landing.

EBLA Distribution: Found in a flooded backwater at Monroe's Landing and surrounding Crockett Lake.



Plots: Rocchio et al. 2012 (9)

Environmental Description: Typically found in mesic areas such as riparian floodplains and seasonally flooded wetlands. Sites are typically flat to gently sloping with soils that are moist to temporarily wet. May occur in sandy soils that have been previously plowed. At EBLA, this association was found in two distinct environments. At one location, the grasses were found rooted on floating logs in a lagoon at Monroe Landing. The other population was found growing on salt marsh peat and rich organic, post-agricultural soils near Crockett Lake. At SAJH, this association was primarily found in upland settings.

Vegetation Description: The vegetation is characterized by a moderate to dense perennial graminoid layer dominated by introduced forage species. *Agrostis capillaris* and *A. stolonifera* are dominant across this type. Other herbaceous species or shrubs may occur, but generally less than 10% cover. At EBLA, *Agrostis stolonifera* dominates, with significant cover provided by other nonnatives such as *Poa pratensis* ssp. *pratensis*, *Cirsium vulgare*, *Epilobium hirsutum*, *Conium maculatum*, *Anthriscus caucalis*, *Solanum dulcamara*, and *Brassica rapa*. *Salicornia virginica* and *Distichlis spicata* may be prominent in sites near Crockett Lake.

USFWS: Not applicable.

Comments: This grass did not produce mature inflorescence while fieldwork was taking place, so the identification is uncertain. *Agrostis stolonifera* was settled upon due to the habitat, leafy stolons, ligules generally longer than wide and > 4 mm long, and the presence of past year's inflorescences that appeared more dense than *Agrostis gigantea* or *Agrostis capillaris*. All three species were formerly included under the name *Agrostis alba*. At Crockett Lake, these forage grasses may be a remnant from the lake drainage and conversion to farmland in the late 1940s and 50s.

Conservation Rank:

Rank Justification:

Synonyms:

Agrostis (capillaris, stolonifera) Mesic Ruderal Grassland; Rocchio et al. 2012

***Epilobium hirsutum* Provisional Ruderal Herbaceous Vegetation**

Hairy Willowherb Ruderal Herbaceous Vegetation

Acronym: EPIHIR Ruderal

NatureServe Code:

Macrogroup: Western North American Ruderal
Wet Shrubland, Meadow & Marsh

Group: Western North American Ruderal Wet
Shrubland, Meadow & Marsh

Alliance: *Epilobium hirsutum* Provisional Ruderal
Alliance

Range:

EBLA Distribution: Two large patches east of
Crockett Lake

Plots:

Environmental Description: Flat sites, seasonally flooded with brackish water.

Vegetation Description: *Epilobium hirsutum* forms a tall near-monoculture. *Urtica dioica*, *Poa pratensis*,
and *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*) are present in small amounts.

USFWS: Palustrine

Comments: This association has not been previously described

Conservation Rank:

Rank Justification:

Synonyms:



***Leymus mollis* - *Abronia latifolia* Herbaceous Vegetation**

American Dune Grass - Yellow Sand-Verbena Herbaceous Vegetation

Acronym: LEYMOL-ABRLAT

NatureServe Code: CEGLO01796

Macrogroup: Pacific Coastal Beach & Dune Vegetation

Group: North Pacific Maritime Coastal Scrub & Herb Beach & Dune

Alliance: *Poa macrantha* - *Leymus mollis* - *Festuca rubra* Sand Dune Herbaceous Alliance

Range: This community is known from coastal dunes of northern California to British Columbia.

EBLA Distribution: Narrow strips at Monroe's Landing, Lovejoy Point, Long Point, Libbey Beach, Perego's Lake, and Keystone Spit.

Plots: Rocchio et al. 2012 (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. At EBLA, the substrate typically consists of pebbles and cobbles and the vegetation usually co-occurs with extensive stretches of beached drift logs.

Vegetation Description: This association is a sparse grassland occurring on the upper strand and foredunes of beaches. Total vegetative cover is 10-50%. This community is composed of 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*. Other native species present in the EBLA and SAJH occurrences include *Ambrosia chamissonis*, *Lathyrus japonicus*, *Poa confinis*, *Carex macrocephala*, *Grindelia stricta*, *Hypericum scouleri* ssp. *scouleri*, *Festuca rubra*, *Amsinckia menziesii*, and *Pteridium aquilinum*. Abundant nonnative species in those occurrences include *Cirsium arvense*, *Bromus sterilis*, *B. diandrus*, *Aira caryophyllea*, *A. praecox*, *Holosteum umbellatum*, *Schedonorus phoenix* (= *S. arundinaceus*) and *Rumex acetosella*.

USFWS: Not applicable.

Comments:

Conservation Rank: G2?S2

Rank Justification: Actively-moving sand and salt spray are requirements. The few remaining occurrences are small and degraded by nonnative species and loss of sand movement. Despite its large range, this community is ranked high because so few high-quality occurrences remain, so few of those are protected, and their condition continues to decline. This association used to be widespread, but has been almost completely replaced by an introduced beachgrass, *Ammophila arenaria*.

Synonyms:

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

Leymus mollis – *Abronia latifolia* Herbaceous Vegetation, Rocchio et al. 2012



***Festuca rubra* - *Ambrosia chamissonis* Herbaceous Vegetation**

Red Fescue - Beach Bursage Herbaceous Vegetation

Acronym: FESRUB-AMBCHA

NatureServe Code: CEGLO03290

Macrogroup: Pacific Coastal Beach & Dune Vegetation

Group: North Pacific Maritime Coastal Scrub & Herb Beach & Dune

Alliance: *Poa macrantha* - *Leymus mollis* - *Festuca rubra* Sand Dune 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.



EBLA Distribution: Found inland of *Leymus mollis* strips at Perego's Lake and Keystone Spit.

Plots: Rocchio et al. 2012 (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: This association is dominated by the grass *Festuca rubra*, in relatively open to fully closed grasslands. The forbs *Grindelia stricta* and *Ambrosia chamissonis* are sometimes codominant and almost always present. The community is 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 along coastal spits and berms. At SAJH, *Atriplex patula* ssp. *patula* and *Lepidium virginicum* var. *menziesii* are codominant with *Festuca rubra* and - native *Elymus trachycaulus*, *Honckenya peploides* ssp. *major*, *Grindelia stricta*, *Hordeum jubatum*, *Juncus gerardii* var. *gerardii* and *Distichlis spicata* were also present. Nonnative species present in the SAJH occurrences include *Bromus diandrus* (= *B. rigidus*), *Bromus sterilis*, *Cirsium vulgare*, *Dactylis glomerata*, *Hypochaeris radicata*, and *Plantago lanceolata*. Occurrences at EBLA typically had codominant *Lathyrus japonicus* and *Grindelia stricta*, but little *Ambrosia chamissonis*. *Plectritis congesta*, *Allium cernuum*, *Lupinus littoralis*, and *Lomatium nudicaule* were common associates. Invasive annual grasses such as *Bromus diandrus* (= *B. rigidus*) and *Bromus hordeaceus* (= *B. mollis*) are often prominent.

USFWS: Not applicable.

Comments: The largest example at EBLA is gradually being replaced by *Symphoricarpos albus* – *Rosa nutkana* shrubland.

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 – *Ambrosia chamissonis* Herbaceous Vegetation; Rocchio et al. 2012

***Carex macrocephala* Herbaceous Vegetation**

Large-Head Sedge Herbaceous Vegetation

Acronym: CARMAC

NatureServe Code: CEGL003368

Macrogroup: Pacific Coastal Beach & Dune Vegetation

Group: North Pacific Maritime Coastal Scrub & Herb Beach & Dune

Alliance: *Poa macrantha* - *Leymus mollis* - *Festuca rubra* Sand Dune Herbaceous Alliance

Range: The northern Puget Lowlands area of Washington and on the eastern side of Vancouver Island and the Queen Charlotte Islands in British Columbia

EBLA Distribution: Found in one patch on Keystone Spit and another patch near Perego's Lake.

Plots:

Environmental Description: This association is found on coastal sand spits, sandy beach berms, or associated with small dune systems. It typically occurs on relatively flat microsites, where it is protected from the highest wind and wave energy, but is washed over or inundated briefly during storms. The substrate is sand and the vegetation is typically open (20-50% cover) with much exposed sand.

Vegetation Description: The graminoid *Carex macrocephala* is always dominant, sometimes with few other species present. Small amounts of other strand-associated species (e.g., *Abronia latifolia*, *Ambrosia chamissonis*, and *Calystegia soldanella*) often occur. There is usually a large amount of bare substrate.

USFWS:

Comments: No other association is dominated by *Carex macrocephala*, with less than 5% cover of any other species.

Conservation Rank: G1S1

Rank Justification: This association has estimated 15-30 occurrences, covering a small area in a limited range of northwestern Washington and coastal British Columbia. It is dependent on very specific abiotic factors, being confined to spits, sandy beach berms, and coastal dune systems on open sand flats or troughs that are washed over intermittently by storms. Spits and sandy beaches, at least in the southern portion of its range (Vancouver Island and Washington), have been degraded by, and continue to be threatened by, invasion of exotic species, recreational development and impacts, and alteration of coastal geomorphologic processes

Synonyms:

Carex macrocephala; Kunze 1984

Carex macrocephala; Kagan 2004



***Ledum groenlandicum* - *Kalmia microphylla* / *Sphagnum* spp. Shrubland**

Bog Labrador-tea - Alpine Laurel / Peatmoss Species Shrubland

Acronym: LEDGRO-KALMIC/SPHAG

NatureServe Code: CEGLO03414

Macrogroup: North Pacific Bog & Fen

Group: North Pacific Bog & Acidic Fen

Alliance: *Ledum groenlandicum* - *Kalmia microphylla* Dwarf-shrub Fen Alliance

Range: This association occurs throughout the lowlands of western Washington, primarily in areas with past glaciation.

EBLA Distribution: South of Lake Pondilla

Plots: Crawford (2009)

Environmental Description: This association occurs at low elevations in depressions, on slopes, surrounding lakes or ponds, or associated with flat floodplains. Water tables are often at or near the surface for much of the growing season, and organic decomposition is slow. The substrate is moderately quaking to firm peat mats. Well-developed hummocks are common.



Vegetation Description: *Ledum groenlandicum* and/or *Kalmia microphylla* form a dense, short shrub layer. Other dwarf-shrubs frequently present are *Vaccinium oxycoccos*, as well as *Gaultheria shallon*. A variety of herbaceous species may occur, the most frequent are usually *Drosera rotundifolia* and *Comarum palustre* (= *Potentilla palustris*). *Sphagnum* spp. dominate the ground cover, often forming hummocks. *Carex obnupta* dominates the herbaceous layer on the edges of the one occurrence at EBLA, transitioning to *Carex utriculata* towards the center. Understory *Picea sitchensis* and *Tsuga heterophylla* are present and *Spiraea douglasii* is prominent in the shrub layer. *Juncus effusus* ssp. *pacificus* and *Lysichiton americanum* are present in the herbaceous layer and the moss *Pleurozium schreberi* dominates on the dry hummocks.

USFWS: Palustrine

Comments: The Washington Natural Heritage Program has proposed a number of more narrowly defined fen types. One such transitional poor fen/bog association that might better represent the plot at EBLA is the *Ledum groenlandicum* / *Carex utriculata* / *Sphagnum* spp. type. The abundance of *Carex* indicates that groundwater/surface water still has the primary influence on vegetation patterns. The presence of *Spiraea douglasii* is also an indicator of a transitional (from fen to bog) association.

Conservation Rank: G4S2

Rank Justification: This bog/poor fen association occurs within a narrow ecological range with sites occurring on protected lands. Sites off protected areas are often threatened by hydrologic changes created by various land uses.

Synonyms:

Kalmia occidentalis-*Ledum groenlandicum*-*Vaccinium oxycoccos*/*Sphagnum* spp. variant; Kunze 1994

Kalmia occidentalis-*Ledum groenlandicum*/*Carex rostrata* variant; Kunze 1994

Ledum groenlandicum/*Carex rostrata* variant; Kunze 1994

Ledum groenlandicum/*Sphagnum* spp. variant; Kunze 1994

Ledum groenlandicum-*Gaultheria shallon*/*Sphagnum* spp. variant; Kunze 1994

Kalmia occidentalis/*Sphagnum* spp. variant; Kunze 1994

Ledum groenlandicum-*Kalmia microphylla*/ *Sphagnum* spp; Crawford et al. 2009

Ledum groenlandicum-*Kalmia microphylla*/ *Sphagnum*; MacKenzie

***Rosa nutkana* - *Rubus spectabilis* Wet Shrubland**

Nutka Rose - Salmonberry Wet Shrubland

Acronym: ROSNUT-RUBSPE

NatureServe Code: CEGLO03472

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Vancouverian Wet Shrubland

Alliance: *Rosa nutkana* - *Rubus spectabilis*
Shrubland Alliance

Range: Currently described from San Juan and Whidbey Islands. It is likely to occur throughout the dry climatic areas (rainshadow of Olympic Mtns) of western Washington and British Columbia.

EBLA Distribution: One small strip along Engle Road, near Ft. Casey State Park.



Plots:

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. At EBLA, the one occurrence is located at the inflection point between a road embankment and a flat, brackish wetland.

Vegetation Description: *Rubus spectabilis* and *Rosa nutkana* dominate the shrub layer, though *Rosa nutkana* may be absent. *Sambucus racemosa*, *Ribes sp.* and *Rubus parviflorus* may be prominent. The understory is sparse due to dense shrub cover but *Urtica dioica*, *Equisetum arvense*, *Equisetum telmateia*, *Brassica rapa*, and *Cirsium arvense* may be observed.

USFWS:

Comments: Further data still needs to be collected to determine whether the SAJH and EBLA occurrences of this type are a range extension of the CEGLO003472 *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: G4SNR

Rank Justification: More information is needed regarding the distribution of this association within Washington

Synonyms:

Rubus parviflorus-*Rubus spectabilis*; Crawford et al. 2009

Rosa nutkana-*Rubus spectabilis* Wet Shrubland; Rocchio et al 2012

***Malus fusca* – (*Salix hookeriana*) / *Carex obnupta* Shrubland**

Oregon Crabapple - (Coastal Willow) / Slough Sedge Shrubland

Acronym: Malfus-(SALHOO)/CAROBN

NatureServe Code: Cegl003294

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Vancouverian Wet Shrubland

Alliance: *Malus fusca* Shrubland Alliance

Range: This association is known from Washington and British Columbia.

EBLA Distribution: One small patch south of Lake Pondilla

Plots: Rocchio et al. 2012 (1)

Environmental Description: This association occurs in seasonally wet areas within both coniferous and deciduous dominated forests 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 scouleriana*, and *S. hookeriana*. In the largest occurrence at SAJH, *Salix scouleriana* 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. *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 SAJH stand. In the one occurrence at EBLA, *Malus fusca* dominates a tall shrubland on the margins of a freshwater bog. Extremely tall *Gaultheria shallon* forms a thicket beneath and *Carex obnupta* dominates the herbaceous layer.

USFWS Wetland System: Palustrine.

Comments: The association may have been more widespread historically, as large expanses of swamp vegetation once occurred. These wetlands have not been sampled adequately; more information is needed to fully define this association.

Conservation Rank: G3S2

Rank Justification:

Synonyms:

Pyrus fusca -*Salix hookeriana*/*Carex obnupta*; Kunze 1994

Malus fusca/*Carex obnupta*; Christy 2004

Salix hookeriana-*Malus fusca*/*Carex obnupta*-*Lysichiton americanum*; Christy et al 1998

Malus fusca-(*Salix hookeriana*)/*Carex obnupta* Shrubland; Rocchio et al. 2012



***Salix hookeriana* - (*Salix sitchensis*) Shrubland**

Hooker's Willow - (Sitka Willow) Shrubland

Acronym: SALHOO-(SALSIT)

NatureServe Code: CEGLO03387

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Vancouverian Wet Shrubland

Alliance: *Salix* (*hookeriana*, *sitchensis*) - *Spiraea douglasii* 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.

EBLA Distribution: Ditches near Crockett Lake, as well as small depressions in the northern end of the Reserve.

Plots: Rocchio et al. 2012 (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 and EBLA, 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*. 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 codominated 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*. Occurrences at EBLA are quite similar to those at SAJH, with the additional presence of *Rubus parviflorus*, *Equisetum telmateia*, *Salix lucida* ssp. *lasiandra*, and *Alnus rubra*.

USFWS Wetland System: Not applicable.

Comments:

Conservation Rank: G2S?

Rank Justification: More information is needed regarding the distribution of this association within Washington.

Synonyms:

Salix piperi-*Salix sitchensis*; Kunze 1994

Salix hookeriana-(*Salix sitchensis*); Christy 2004

Salix hookeriana; Shephard 1995

Salix hookeriana; Boggs 2000

Salix hookeriana-(*Salix sitchensis*) Shrubland; Rocchio et al. 2012



***Juncus balticus* var. *balticus* Provisional Pacific Coast Herbaceous Vegetation**

Baltic Rush Herbaceous Vegetation

Acronym: JUNBALBAL

NatureServe Code: Provisional

Provisional Macrogroup: Western North American Lowland Freshwater Wet Meadow & Marsh

Provisional Group: Vancouverian Freshwater Wet Meadow & Marsh

Provisional Alliance: (*Juncus balticus* - *Juncus effusus*) Provisional Herbaceous Alliance

Range: This association is known to occur on San Juan Island and Whidbey Island in 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.



EBLA Distribution: Found primarily in a large field north of Crockett Lake.

Plots: Rocchio et al. 2012 (2)

Environmental Description: This association occurs along lake margins, in seeps, or in areas where the water table is close enough to 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. At EBLA, the largest occurrence is found in a moist, presumably agricultural field.

Vegetation Description: *Juncus balticus* (= *J. arcticus* ssp. *littoralis*) dominates the association. *Juncus effusus*, *Pteridium aquilinum*, *Cerastium arvense*, and *Bromus sitchensis* are usually prominent to codominant in other areas. Nonnative species such as *Poa pratensis*, *Cirsium arvense* and *Vicia sativa* are usually present. At EBLA, *Rumex* spp., *Rubus armeniacus*, *Geum macrophyllum*, *Dactylis glomerata*, and many other weedy species are present, but rarely prominent.

USFWS: Palustrine

Comments: This is a poorly described association. *Juncus balticus* var. *balticus* is also known as *Juncus arcticus* ssp. *littoralis*. The EBLA occurrence could represent a ruderal *Juncus balticus* type, given its occurrence on (presumably) plowed land and the occurrence of numerous nonnative species.

Conservation Rank: GUSUQ

Rank Justification: More information is needed regarding the distribution of this association within western Washington

Synonyms:

Juncus arcticus ssp. *littoralis*–*Schedonorus pratensis*–*Juncus effusus*, Rochefort and Bivin 2009 (<>)
Juncus arcticus ssp. *littoralis* Pacific Coast Herbaceous Vegetation; Rocchio et al. 2012

***Equisetum telmateia* Herbaceous Vegetation**

Giant Horsetail Herbaceous Vegetation

Acronym: EQUTEL

NatureServe Code: Provisional

Provisional Macrogroup: Western North American Lowland Freshwater Wet Meadow & Marsh

Provisional Group: Vancouverian Freshwater Wet Meadow & Marsh

Provisional Alliance: *Equisetum* (*arvense*, *variegatum*, *hyemale*, *telmateia*) Semipermanently Flooded Herbaceous Alliance

Range: This association was previously documented on San Juan Island and in one plot in western Oregon.

EBLA Distribution: Limited to narrow strips in the wetland margins surrounding Crockett Lake.

Plots: Rocchio et al. 2012 (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. At EBLA, this association is found in disturbed areas at the inflection point between road embankments and fresh to salt marshes.

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 at SAJH include *Holcus lanatus*, *Poa pratensis*, *Phalaris arundinacea*, *Cirsium arvense*, *C. vulgare*, *Schedonorus phoenix*, *Vicia sativa*, *V. hirsuta*, and *Dactylis glomerata*. At EBLA, only *Urtica dioica* and *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*) were consistently present amid the *Equisetum telmateia*.

USFWS: Palustrine

Comments: This association is poorly described. It may be a disturbance-induced association.

Conservation Rank: GUSUQ

Rank Justification: More information is needed regarding the distribution of this association within western Washington

Synonyms:

Equisetum telmateia, Murray 2000

Equisetum telmateia, Rocchio et al. 2012



***Schoenoplectus acutus* Pacific Coast Herbaceous Vegetation**

Hardstem Bulrush Pacific Coast Herbaceous Vegetation

Acronym: SCHACU

NatureServe Code: CEGLO01840

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Vancouverian Freshwater Wet Meadow &
Marsh

Alliance: *Schoenoplectus (acutus,*
tabernaemontani) - *Typha latifolia* Provisional
Herbaceous Alliance

Range: Found mostly in the interior western U.S.
ranging from the Puget Sound of Washington to
Montana south to California, Nevada and Utah

EBLA Distribution: One small patch near Monroe's
Landing and large swathes near Crockett Lake.



Plots:

Environmental Description: Stands occur along low-gradient, meandering, usually perennial streams, river floodplain basins, and around the margins of ponds and shallow lakes especially in backwater areas. Some sites are flooded most of the year with about 1 m of fresh to somewhat saline or alkaline water. Other sites, however, dry up enough in late summer to where the water table drops below the ground surface, though the soils are still partially saturated. Soils are generally deep, organic, often alkaline, poorly drained and fine-textured, but range in soil textures from sand to clay to organic muck. The soils may be normal or saline. At EBLA, this association occurs primarily in seasonally flooded, brackish wetlands near Crockett Lake, as well as permanently flooded ditches.

Vegetation Description: Vegetation is characterized by a dense tall herbaceous vegetation layer 1-3 m tall that is dominated by *Schoenoplectus acutus* (= *Scirpus acutus*), often occurring as a near monoculture. Associated species at other locations include low cover of *Mentha arvensis*, *Polygonum amphibium*, *Sagittaria latifolia*, and species of *Carex*, *Eleocharis*, *Rumex*, and *Typha*. Early in the growing season or at permanently flooded sites, aquatic species such as *Potamogeton* spp. and *Lemna minor* may be present to abundant. Stands of this association contain no tree or shrub layer, but a few sites have been invaded by the introduced shrub *Tamarix* spp. At EBLA, *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), *Typha latifolia*, and nonnative *Solanum dulcamara* are the most common associate species.

USFWS: Palustrine

Comments: This association appears to be somewhat variable in flood regime. Stands described by Kunze (1994) from western Washington were permanently flooded with shallow water (about 1 m deep). Additional research is needed to determine differences between Arid West and Pacific Coast versions of this community.

Conservation Rank: G5SNR

Rank Justification:

Synonyms:

Scirpus acutus; Kunze 1994

***Typha latifolia* Pacific Coast Herbaceous Vegetation**

Broadleaf Cattail Herbaceous Vegetation

Acronym: TYPLAT

NatureServe Code: CEGLO02010

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Vancouverian Freshwater Wet Meadow &
Marsh

Alliance: *Typha* spp. Western Herbaceous
Emergent Alliance

Range: This association is widespread across the
western United States and western Great Plains

EBLA Distribution: Flooded areas near Crockett
Lake and Monroe's Landing.

Plots:

Environmental Description: This widespread community is found along streams, rivers, canals, and the banks of ponds and lakes. Elevations range from near sea level to 2000 m. Sites are typically very level. The soil is saturated or flooded for much of the year from freshwater sources such as springs or streams. The alluvial soils have variable textures ranging from sand to clay and usually with a high organic content.

Vegetation Description: This community is dominated by hydrophytic macrophytes, especially *Typha latifolia* or *Typha angustifolia*, which grow approximately 2-3 m tall. *Typha latifolia* and *Typha angustifolia* often form dense, near-monotypic stands (70-98% cover), almost to the exclusion of other species. In some stands the two *Typha* species are codominant. Other species typical of wetlands may be found in lesser amounts in this community; among these are shallower water emergents such as *Carex* spp., *Eleocharis macrostachya*, *Eleocharis palustris*, *Glyceria* spp., *Juncus balticus* var. *balticus* (= *J. arcticus* ssp. *littoralis*), *Juncus torreyi*, *Mentha arvensis*, *Schoenoplectus acutus*, and *Veronica* spp. In deeper water, *Lemna minor*, *Potamogeton* spp., *Sagittaria* spp., *Azolla filiculoides*, and other aquatics may be present in trace amounts. At EBLA, *Typha latifolia* is always dominant (*T. angustifolia* was not observed). Other herbs are rare, though *Schoenoplectus acutus*, *Urtica dioica*, and *Phalaris arundinacea* were sometimes present.

USFWS: Palustrine

Comments: *Typha angustifolia* is considered nonnative in Washington and can be invasive.

Conservation Rank: G5S5

Rank Justification:

Synonyms:

Typha latifolia; Kunze 1994



***Phragmites australis* Western North American Temperate Ruderal Herbaceous Vegetation**

Common Reed Western North America Temperate Ruderal Herbaceous Vegetation

Acronym: PHRAUS

NatureServe Code: CEG001475

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Western North American Ruderal Wet
Shrubland, Meadow & Marsh

Alliance: *Phragmites australis* Semipermanently
Flooded Herbaceous Alliance

Range: This reed marsh type is found across the
west-temperate regions of the United States and
Canada.

EBLA Distribution: One pitch on the western edge
of Crockett Lake.



Plots:

Environmental Description: This association is widespread in the western U.S. and Canada. Elevation ranges from near sea level to 2000 m. Stands occur in temporarily to semipermanently flooded marshes, ditches, impoundments, pond and lake margins, swales, and wet meadows that often have been disturbed by human activity. Sites are usually saturated or flooded during the growing season, but the soil surface may dry out in late summer. Soils are often fine-textured silts and clays.

Vegetation Description: The vegetation is often variable as *Phragmites australis* will invade into existing natural or ruderal communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* with few or no other vascular plants present. Stands have a dense, 1- to 3-m tall herbaceous layer dominated by the perennial graminoid *Phragmites australis*, usually with at least 50% absolute cover. In other areas associated graminoids include *Agrostis stolonifera*, *Carex* spp., *Typha latifolia*, *Juncus balticus* var. *balticus* (= *J. arcticus* ssp. *littoralis*), *Agrostis gigantea*, *Elymus canadensis*, *Equisetum* spp., *Hordeum jubatum*, *Muhlenbergia asperifolia*, *Schoenoplectus acutus* (= *Scirpus acutus*), and *Sporobolus contractus*. Forbs are diverse and provide low cover; those commonly present include *Ambrosia acanthicarpa*, *Conyza canadensis*, *Glycyrrhiza lepidota*, *Eurybia glauca* (= *Aster glaucodes*), *Iva acerosa* (= *Oxytenia acerosa*), *Iva axillaris*, *Mentha arvensis*, *Solidago canadensis*, and *Taraxacum officinale*. Introduced species such as *Lepidium latifolium* and *Cirsium arvense* may be present and compete well against *Phragmites australis* in disturbed sites. At EBLA, the only other species occurring beneath the dominant *Phragmites australis* are *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), *Distichlis spicata*, and *Salicornia virginica*.

USFWS: Palustrine

Comments: There is a native genotype of *Phragmites australis* that occurs in North America. In our region, that genotype is primarily found in eastern Washington, with only one example present west of the Cascades (on the Olympic peninsula). The population at Crockett Lake has been confirmed as the exotic genotype.

Conservation Rank: G5SNR

Rank Justification:

Synonyms:

***Juncus gerardii* var. *gerardii* Ruderal Brackish Wet Meadow**

Mud Rush Ruderal Brackish Wet Meadow

Acronym: JUNGERGER

NatureServe Code: Provisional

Macrogroup: Western North American Lowland
Freshwater Wet Meadow & Marsh

Group: Western North American Ruderal Wet
Shrubland, Meadow & Marsh

Alliance: *Juncus gerardii* Ruderal Wet Meadow
Alliance

Range: This type is documented from one location
at SAJH and has also been sampled at EBLA.

EBLA Distribution: Observed in one patch on the
south shore of Crockett Lake.

Plots: Rocchio et al. 2012 (1)

Environmental Description: This type occurs around the periphery of a *Distichlis-Salicornia* salt marsh. The site is saturated and appears to be less saline than the area dominated by *Salicornia* and *Distichlis*. Soils are likely brackish in nature.

Vegetation Description: *Juncus gerardii* var. *gerardii* dominates the area sampled at EBLA, with *Juncus balticus* var. *balticus* (= *J. arcticus* ssp. *littoralis*) codominating 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 that may be present. Nonnative species present included *Bromus diandrus* (= *B. rigidus*), *Poa pratensis*, *Holcus lanatus*, *Vicia sativa*, and *Rumex crispus*.

USFWS: Palustrine

Comments:

Conservation Rank:

Rank Justification: More information is needed regarding the distribution of this association within Washington

Synonyms:

Juncus gerardii var. *gerardii* Ruderal Brackish Wet Meadow; Rocchio et al. 2012



***Lonicera involucrata* Provisional Wet Shrubland**

Four-line Honeysuckle Provisional Shrubland

Acronym: LONINV

NatureServe Code: Provisional

Macrogroup: Western North American Temperate Lowland Freshwater Wet Meadow & Marsh

Group: Vancouverian Wet Shrubland

Alliance: *Lonicera involucrata* Provisional Wet Shrubland Alliance

Range: Island County, may occur elsewhere in Western Washington.

EBLA Distribution: Northeast of Crockett Lake

Plots:

Environmental Description: This provisional association occurs on soils saturated with fresh to brackish water.

Vegetation Description: *Lonicera involucrata* dominates a patchy, tall (2-3 m) shrub layer. *Rubus armeniacus* may be present, but never prominent. *Schoenoplectus acutus*, *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), and *Typha latifolia* are present and may form extensive communities of their own in the surrounding wetlands.

USFWS Wetland System: Not applicable.

Comments: This provisional association is proposed due to the consistent dominance of *Lonicera involucrata* and low to nonexistent cover of other shrubs. Further research is necessary to determine if this community is found elsewhere in western Washington, or if it represents a unique vestige of the complicated disturbance history of Crockett Lake.

Conservation Rank:

Rank Justification: This association has not been previously documented

Synonyms:



***Argentina egedii* - *Juncus balticus* Herbaceous Vegetation**

Pacific Silverweed - Baltic Rush Herbaceous Vegetation

Acronym: ARGEGE-JUNBAL

NatureServe Code: CEGLO03382

Macrogroup: North American Pacific Coastal Salt Marsh

Group: Temperate Pacific Tidal Salt & Brackish Marsh

Alliance: *Argentina egedii* - *Juncus balticus* Tidal Herbaceous Alliance

Range: Known from Washington State and thought to occur in British Columbia.

EBLA Distribution: Margins of Crockett Lake

Plots:



Environmental Description: This association is a high intertidal marsh that occurs in Washington's Puget Lowland. It is reported to occur primarily on silty substrates or peat soils and relatively low salinity

Vegetation Description: The dense herbaceous vegetation is dominated by *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*). Other species that are frequently present and that can be locally codominant include *Juncus balticus* var. *balticus* (= *J. arcticus* ssp. *littoralis*), *Epilobium hirsutum*, *Poa pratensis*, and *Urtica dioica*.

USFWS: Palustrine

Comments: This is a poorly described association. *Argentina egedii* ssp. *egedii* is also known as *Potentilla pacifica* and *Potentilla anserina* ssp. *pacifica*. This association is distinguished from other Washington salt marsh associations by the dominance of *Argentina egedii* ssp. *egedii* and the low cover of *Salicornia virginica* and *Distichlis spicata*. It often forms a matrix with *Salicornia virginica*, *Schoenoplectus acutus*, and *Typha latifolia*-dominated types, probably based on water levels and soil salinity. *Juncus balticus* var. *balticus* is also known as *Juncus arcticus* ssp. *littoralis*.

Conservation Rank: G3G4SNR

Rank Justification: This association is likely limited to few viable occurrences in a limited range and has likely declined significantly from presettlement extent due to conversion of salt marshes to other uses.

Synonyms:

Agrostis alba-*Juncus balticus*-*Potentilla pacifica*; Kunze and Cornelius 1982

Agrostis alba-*Juncus balticus*-*Potentilla pacifica*; Kunze 1984

***Distichlis spicata* - (*Salicornia virginica*) Herbaceous Vegetation**

Inland Saltgrass - Virginia Glasswort Herbaceous Vegetation

Acronym: DISSPI-(SALVIR)

NatureServe Code: CEGLO03356

Macrogroup: North American Pacific Coastal Salt Marsh

Group: Temperate Pacific Tidal Salt & Brackish Marsh

Alliance: *Distichlis spicata* Pacific Coast Tidal Herbaceous Alliance

Range: Known from Washington State and thought to occur in British Columbia.

EBLA Distribution: Widespread around Crockett Lake, Perego's Lake, and Grasser's Lagoon.

Plots:

Environmental Description: This association occurs in euhaline (>30 ppt), low tidal terraces.

Vegetation Description: This association is codominated by *Salicornia virginica* and *Distichlis spicata*, though *Salicornia virginica* may sometimes form dense monocultures. *Atriplex patula* ssp. *patula*, *Puccinellia nuttalliana*, and *Plantago maritima* var. *juncooides* may be prominent, along with nonnative *Aira caryophylla* and *Cardamine hirsuta*. *Hordeum jubatum*, *Argentina egedii* ssp. *egedii*, *Spergularia canadensis*, and *Polypogon monspeliensis* are sometimes present. When present, *Jaumea carnosa* and *Triglochin maritima* provide little cover.

USFWS: Palustrine

Comments:

Conservation Rank: G4S2

Rank Justification:

Synonyms:

Distichlis spicata-(*Salicornia virginica*); Kagan et al. 2004



***Schoenoplectus maritimus* Tidal Herbaceous Vegetation**

Cosmopolitan Bulrush Tidal Herbaceous Vegetation

Acronym: SCHMAR

NatureServe Code: CEG003287

Macrogroup: North American Pacific Coastal Salt Marsh

Group: Temperate Pacific Tidal Salt & Brackish Marsh

Alliance: *Schoenoplectus maritimus* - *Schoenoplectus californicus* Tidal Herbaceous Alliance

Range:

EBLA Distribution: Margins of Crockett Lake

Plots:



Environmental Description: At EBLA, this association occurs in brackish wetlands that are irregularly flooded by tides.

Vegetation Description: The vegetation is characterized by dominant *Schoenoplectus maritimus* (= *Scirpus maritimus*, *Bolboschoenus maritimus*), with few other associated species. Shallow, open (often brackish) water and bare mud are often present. *Schoenoplectus acutus*, *Argentina egedii* ssp. *egedii* (= *Potentilla pacifica*), and *Salicornia virginica* are sometimes present, but never prominent.

USFWS: Not applicable.

Comments: Like many salt marsh species, *Schoenoplectus maritimus* occurs in both coastal and inland salt marshes that are ecologically different. Inland types dominated by *Schoenoplectus maritimus* occur in eastern Washington and throughout much of the intermountain west. *Schoenoplectus maritimus* is now known as *Bolboschoenus maritimus*. Other than the *Distichlis spicata* - (*Salicornia virginica*) type, this plant association is the nearest to the shoreline of Crockett Lake.

Conservation Rank: G4SUQ

Rank Justification:

Synonyms:

Scirpus maritimus; Bourgeron and Engelking 1994

***Nuphar polysepala* Herbaceous Vegetation**

Pond-lily Herbaceous Vegetation

Acronym: NUPPOL

NatureServe Code: CEG002001

Macrogroup: Western North American Freshwater Aquatic Vegetation

Group: Western North American Temperate Freshwater Aquatic Bed

Alliance: *Nuphar polysepala* Western Aquatic Herbaceous Alliance

Range: This association occurs in the Western Olympic Peninsula and northern lowlands of the Puget Trough.

EBLA Distribution: Lake Pondilla



Plots:

Environmental Description: This association is composed of floating aquatic vegetation. It occurs on permanently flooded ponds and lakes. Soils are usually organic, ranging from muck to peat. Stands have been observed where water levels fluctuate, leaving *Nuphar* dry and exposed. Sites with this association can also completely fill smaller ponds or may be only as large as the water depth allows and are part of a larger mosaic of other freshwater emergent marsh communities.

Vegetation Description: This aquatic association is characterized by the dominance of *Nuphar polysepala* (= *Nuphar lutea* ssp. *polysepala*; = *Nuphar polysepalum*), which is the often the only species present. Cover is continuous, intermittent, or open. Other aquatic and emergent herbs present may include *Menyanthes* spp., *Potamogeton* spp., *Glyceria* spp., *Eleocharis* spp., *Carex* spp. (especially *Carex obnupta*), *Equisetum* spp., *Typha* spp., and *Lemna* spp. Many of these associates are in shallower, adjacent water.

USFWS: Lacustrine

Comments:

Conservation Rank: G5SNR

Rank Justification:

Synonyms:

Nuphar polysepalum; Kunze 1994

Nuphar lutea; Crawford et al. 2009

Temperate Conifer Forest Plantation Group

Temperate Conifer Forest Plantation Group

Acronym: Conifer Plantation

Macrogroup: Conifer Plantation

Group: Temperate Conifer Forest Plantation

Alliance: Temperate Conifer Forest Plantation

Range:

EBLA Distribution: Small plots near the Naas Natural Area Preserve, but primarily north of the Outlying Landing Field.

Plots:

Environmental Description: Flat areas densely planted with conifers for seed or timber. Area between trees has been treated with herbicide and/or regularly mowed. Some patches may have been previously plowed for agriculture before being planted with trees.

Vegetation Description: Vegetation consists of dense monocultures of planted *Pseudotsuga menziesii* or *Pinus contorta*. When present, associate vegetation consists solely of frequently mowed nonnative turf grasses. Some stands have no vegetation at all and abundant tree litter accumulation.

USFWS: Not applicable.

Comments: These sites are differentiated from the Recently Harvest (Replanted) type by the absence of understory vegetation and the active management for timber or seeds.



Recently Harvested (Replanted) Provisional Alliance

Recently Harvested (Replanted) Provisional Alliance

Acronym: Harvested (Replanted)

Macrogroup: Conifer Plantation

Group: Temperate Conifer Forest Plantation

Alliance: Recently Harvested (Replanted)
Provisional Alliance

Range: Widespread in Western Washington

EBLA Distribution: Along Keystone Hill Road;
North of Scenic Heights Road

Plots:

Environmental Description: Area has been clearcut for timber and replanted. Some patches may have previously been plowed for agriculture before the most recent crop of trees.



Vegetation Description: Tree cover consists of a dense monoculture of young, even-aged *Pseudotsuga menziesii*. These sites have not been treated with herbicide, so shrub cover is a diverse and abundant mix of *Symphoricarpos albus*, *Rosa nutkana*, *Rubus armeniacus* (= *R. discolor*), and others. Herbs are similarly diverse and usually dominated by nonnative annual grasses like *Bromus diandrus* (= *B. rigidus*), but many others may be present.

Comments: This type is differentiated from Temperate Conifer Forest Plantation alliance by the presence of understory shrubs and herbs (no herbicide has been applied). It is separated from the Recently Harvested (Not Replanted) type because the area has been replanted with *Pseudotsuga menziesii*. These sites have been logged within the past 20 years. The largest patch appears to have been planted to protect a viewshed. It surrounds a large area of clearcut land that was not replanted.

Recently Harvested (Not Replanted) Provisional Alliance

Recently Harvested (Replanted) Provisional Alliance

Acronym: Harvested (Not Replanted)

Macrogroup: Conifer Plantation

Group: Temperate Conifer Forest Plantation

Alliance: Recently Harvested (Not Replanted)
Provisional Alliance

Range: Widespread in Western Washington

EBLA Distribution: Along Keystone Hill Road; Hwy 20 East of Coupeville; East of Ft. Ebey State Park

Plots:

Environmental Description: Area has been clearcut for timber or development and not replanted. Some patches may have previously been plowed for agriculture before the most recent crop of trees.



Vegetation Description: These areas are characterized as recently disturbed patches without consistent vegetation. Large amounts of exposed ground are common. *Rubus armeniacus* (= *R. discolor*), *Symphoricarpos albus*, *Cytisus scoparius*, shrub-form *Alnus rubra*, and *Salix scouleriana* may be present in varying amounts, along with *Bromus hordeaceus* (= *B. mollis*), *Cirsium vulgare*, *Hypochaeris radicata*, and other rapidly colonizing ruderal species. Debris left over from the logging and clearing of the area is frequent.

USFWS: Not applicable.

Comments: These sites--logged within the past 20 years--are differentiated from the Recently Harvested (Replanted) type by the absence of planted *Pseudotsuga menziesii*. They are differentiated from the EBLA Ruderal Woodland type by having < 20 % cover of trees and generally sporadic vegetation. If cleared for development, these locations will eventually fall into the Low Density Housing or High Density Housing types. If left to their own devices, these areas may grow into *Rubus armeniacus* Ruderal Shrublands, *Cytisus scoparius* Ruderal Shrublands, *Symphoricarpos albus* - *Rosa nutkana* Shrublands, or EBLA Ruderal Woodlands.

Pasture and Agricultural Field Provisional Alliance

Pasture and Agricultural Field Provisional Alliance

Acronym: Pasture

Macrogroup: Cultivated Pasture & Hay Grass

Group: Tropical & Temperate Cultivated Pasture & Hay Field

Alliance: Pasture and Agricultural Field Provisional Alliance

Range: Widespread in Western Washington

EBLA Distribution: Throughout the Reserve

Environmental Description: Flat or gently sloping areas actively managed for agricultural purposes.

Vegetation Description: This is the largest vegetation type found at Ebey's Landing and includes a wide variety of agricultural crop species in rotation. This includes row crops such as cabbage, potatoes, and beets, but consists mostly of unirrigated pastureland and hay fields. Temporarily fallow fields may have high covers of *Schedonorus phoenix* (= *S. arundinaceus*), *Dactylis glomerata*, *Anthoxanthum odoratum*, and *Marrubium vulgare*.

USFWS: Not applicable.

Comments: This type includes cultivated land that is currently plowed and unvegetated, as well as stray agricultural outbuildings, but does not include hedgerows or landscaping, such as manicured shrubs. It frequently contains species common to ruderal types, like *Dactylis glomerata*, but is distinguished from the ruderal grassland types by being actively managed for agricultural use, whether in cultivation or pasture. The evidence of active use also distinguishes the Pasture and Field type from the Low Density Housing areas, although the two map classes are frequently adjacent.



Mowed Lawn Alliance

Mowed Lawn Alliance

Acronym: Mowed Lawn

Macrogroup: Cool-Season Lawn

Group: Cool-Season Open Lawn

Alliance: Mowed Lawn Alliance

EBLA Distribution: Ft Ebey and Ft Casey State Parks; Camp Casey; Landing Strips; Athletic fields on outskirts of Coupeville

Description: Areas not associated with housing developments, but are planted with turf grasses and mowed. Nonnative turf grasses are the dominant species present, forming large swathes of lawn that are frequently mowed. Weeds such as *Hypochaeris radicata* and *Taraxacum officinale* may be present.

Comments: Areas assigned to the Mowed Lawn type include large and contiguous areas of mowed turf grass; including parade grounds, grassy landing strips, equestrian centers, and athletic fields. This type is ***not*** used to denote landscaping around homes. It is differentiated from the Low Density Housing and High Density Housing types, which may include small areas of mowed lawns, by the absence of any buildings.



Low Density Housing Map Class

Low Density Housing Map Class

Acronym: Low Density Housing

Macrogroup: Terrestrial Artificial Surfaces & Associated Areas

Group: Terrestrial Artificial Surfaces & Associated Areas

Alliance: Low Density Housing Map Class

EBLA Distribution: Throughout the Reserve

Description: This cultural type consists of large parcels covered by houses, lawns, landscaping, and driveways. Houses may be surrounded by barns and small outbuildings. Lots are typically separated by large tracts of forest, lawn, or agricultural land.

Comments: This type is separated from the High Density Housing type by the more distant neighboring houses. There are usually fewer than 0.4 houses/ha. Arterial roads through Low Density Housing areas were classified separately into the Road and Parking Lots type, but secondary roads within the developments were not.



High Density Housing Map Class

High Density Housing Map Class

Acronym: High Density Housing

Macrogroup: Terrestrial Artificial Surfaces & Associated Areas

Group: Terrestrial Artificial Surfaces & Associated Areas

Alliance: High Density Housing Map Class

EBLA Distribution: Coupeville and other dense housing developments throughout the Reserve

Description: This cultural type consists of small lots covered with houses, commercial structures, landscaping, and small lawns. Houses are in close proximity to one another and are not separated by large tracts of forest, lawn, or agricultural land.

Comments: This type is separated from the Low Density Housing type by the proximity of neighboring houses. There are usually greater than 3 houses/ha. Arterial roads through High Density Housing areas were classified separately into the Road and Parking Lots type, but secondary roads within the developments were not.



Parking Lots and Buildings Map Class

Parking Lots and Buildings Map Class

Acronym: Parking Lots / Buildings

Macrogroup: Terrestrial Artificial Surfaces & Associated Areas

Group: Terrestrial Artificial Surfaces & Associated Areas

Alliance: Parking Lots and Buildings Map Class

EBLA Distribution: State Parks, Camp Casey, Gun Range

Description: Non-residential, non-commercial buildings and adjoining parking lots.

Comments: This type is differentiated from Low Density and High Density Housing because it does not contain homes or businesses. It does include structures such as the historic bunkers at Ft. Casey. It is differentiated from the Roads and Parking Lots Map Class because the parking lots here are associated with buildings.



Beach and Drift Logs Map Class

Beach and Drift Logs Map Class

Acronym: Beach / Logs

Macrogroup: Terrestrial Bare Areas

Group: Terrestrial Bare Areas

Alliance: Terrestrial Bare Areas

EBLA Distribution: Tidal areas surrounding the edge of the Reserve.

Description: An unvegetated strip of sand and pebbles bounded by Puget Sound / Penn Cove on one side and drift logs on the other.



Roads and Parking Lots Map Class

Roads and Parking Lots Map Class

Acronym: Roads / Parking Lots:

Macrogroup: Terrestrial Artificial Surfaces & Associated Areas

Group: Terrestrial Artificial Surfaces & Associated Areas

Alliance: Road / Parking Lots Map Class

EBLA Distribution: Throughout the Reserve

Description: Paved arterial roads and parking lots.

Comments: Secondary roads that did not pass completely through Low Density or High Density Housing areas were classified with those types. Arterial roads were classified with this map class. Similarly, parking lots and driveways associated with businesses or homes were classified with housing types, while parking lots at state parks or near other natural areas were placed in this map class. This type is differentiated from the Parking Lots and Buildings Map Class because the parking lots included here are not associated with any buildings.



Terrestrial Bare Areas Map Class

Terrestrial Bare Areas Map Class

Acronym: Terrestrial Bare Areas

Macrogroup: Terrestrial Bare Areas

Group: Terrestrial Bare Areas

Alliance: Terrestrial Bare Areas

EBLA Distribution: Throughout the Reserve, primarily coastal bluffs and the gravel pits.

Plots:

Description: Non-vegetated areas with exposed rock, gravel, cobbles and a variety of other rocky substrates, or a mix of rock, soil and a very low percentage of vegetation.

Comments: Mostly used to describe steep, eroding coastal bluffs, but this map class also includes the gravel pits and quarries found within the Reserve.



Impounded Water Map Class

Impounded Water Map Class

Acronym: Impounded Water

EBLA Distribution: Throughout the Reserve; Crockett Lake makes up most of the total area.

Description: Areas of naturally forming and artificially impounded water. Includes stock ponds and fresh to brackish lakes.

Comments: This type is differentiated from *Nuphar polysepala* Herbaceous Vegetation by having < 25% vegetative cover. It is differentiated from the Lagoon Map Class by artificial management of water levels or by containing fresh water. Crockett Lake was formally a large, natural lagoon, but has since been altered by the installation of tidal gates and the raising of Keystone Spit. For the purposes of this project it was placed in the Impounded Water Map Class.



Lagoon Map Class

Lagoon Map Class

Acronym: Lagoon

EBLA Distribution: Limited to one location along the Strait of Juan de Fusca and another on the edge of Penn Cove.

Description: Natural saltwater lagoons that are periodically replenished by overtopping events.

Comments: This type is differentiated from the Impounded Water Map Class by containing brackish to salty water combined with no artificial management of water levels. Despite its name, Grasser's Lagoon is not included in this map class because it is not impounded (it completely drains to the sea on a daily basis). Crockett Lake was formally a large, natural lagoon, but has since been altered by the installation of tidal gates and the raising of Keystone Spit. For the purposes of this project it was placed in the Impounded Water Map Class.



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Appendix C: Vegetation Maps of Ebey's Landing National Historical Reserve

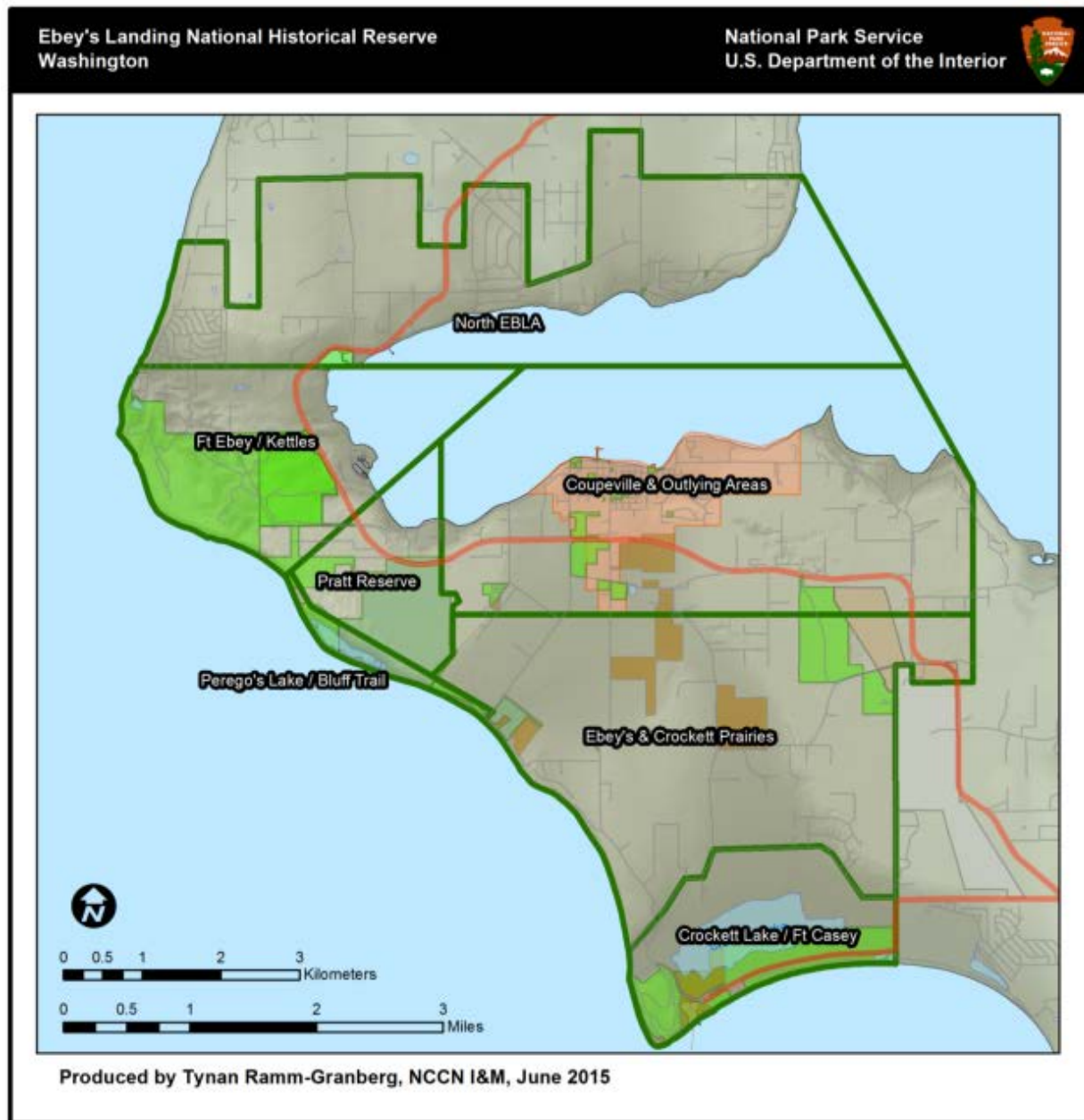
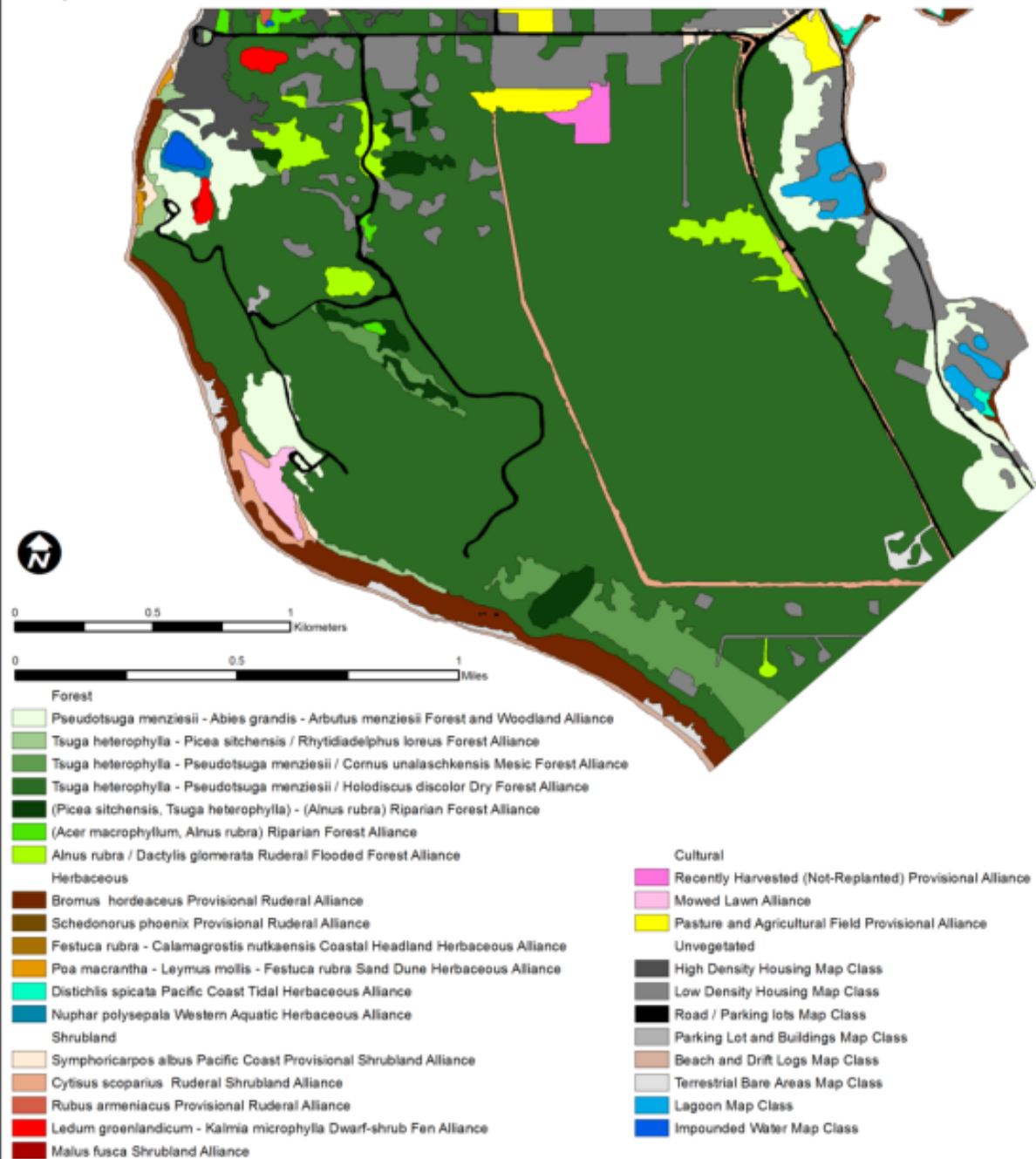


Figure C-1. Subunits of Ebey's Landing National Historical Reserve, Washington.



Vegetation (Fort Ebey / Kettles)

by Alliance



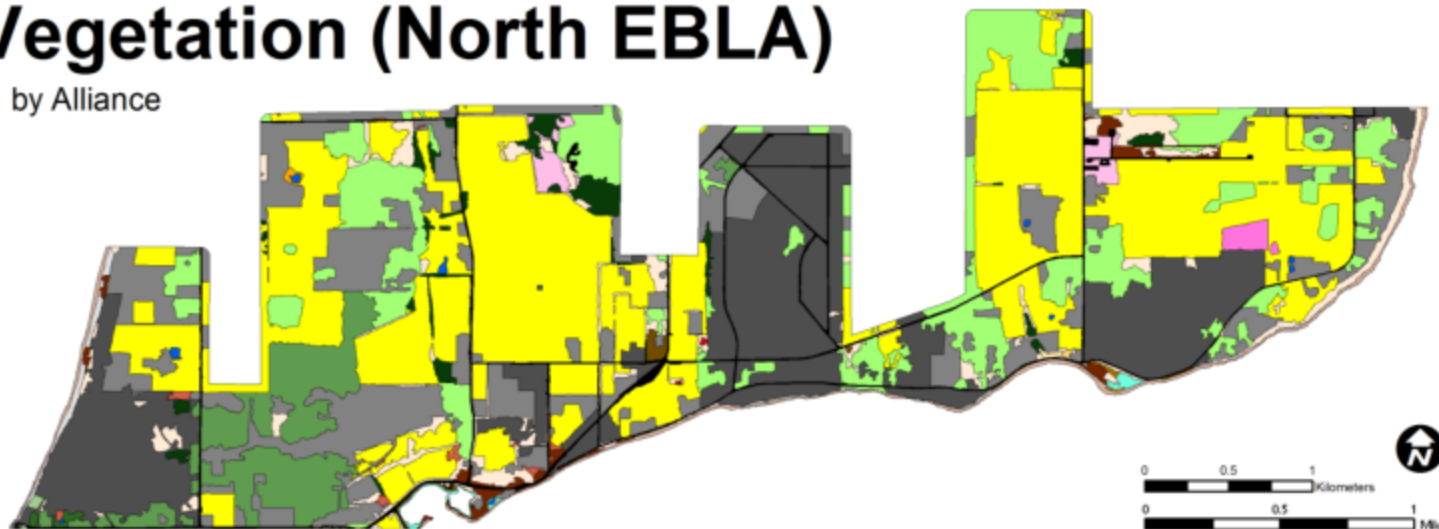
Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure C-2. Vegetation of Fort Ebey State Park, Kettles Recreation Area, and western Penn Cove coast.



Vegetation (North EBLA)

by Alliance



- | | |
|--|---|
| Forest | Shrubland |
| ■ <i>Pseudotsuga menziesii</i> - <i>Abies grandis</i> - <i>Arbutus menziesii</i> Forest and Woodland Alliance | ■ <i>Symphoricarpos albus</i> Pacific Coast Provisional Shrubland Alliance |
| ■ <i>Tsuga heterophylla</i> - <i>Picea sitchensis</i> / <i>Rhytidadelphus loreus</i> Forest Alliance | ■ <i>Cytisus scoparius</i> Ruderal Shrubland Alliance |
| ■ <i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> / <i>Holodiscus discolor</i> Dry Forest Alliance | ■ <i>Rubus armeniacus</i> Provisional Ruderal Alliance |
| ■ (<i>Acer macrophyllum</i> , <i>Alnus rubra</i>) Riparian Forest Alliance | ■ <i>Salix</i> (<i>hookeriana</i> , <i>sitchensis</i>) - <i>Spiraea douglasii</i> Flooded Shrubland Alliance |
| ■ <i>Alnus rubra</i> / <i>Dactylis glomerata</i> Ruderal Flooded Forest Alliance | Cultural |
| Herbaceous | ■ Recently Harvested (Replanted) Provisional Alliance |
| ■ <i>Bromus hordeaceus</i> Provisional Ruderal Alliance | ■ Mowed Lawn Alliance |
| ■ <i>Schedonorus phoenix</i> Provisional Ruderal Alliance | ■ Pasture and Agricultural Field Provisional Alliance |
| ■ <i>Poa pratensis</i> - <i>Agrostis gigantea</i> - <i>Agrostis stolonifera</i> Ruderal Herbaceous Alliance | Unvegetated |
| ■ <i>Poa macrantha</i> - <i>Leymus mollis</i> - <i>Festuca rubra</i> Sand Dune Herbaceous Alliance | ■ High Density Housing Map Class |
| ■ (<i>Juncus balticus</i> - <i>Juncus effusus</i>) Provisional Herbaceous Alliance | ■ Low Density Housing Map Class |
| ■ <i>Schoenoplectus (acutus, tabernaemontani)</i> - <i>Typha latifolia</i> Provisional Herbaceous Alliance | ■ Road / Parking lots Map Class |
| ■ <i>Typha</i> spp. Western Herbaceous Emergent Alliance | ■ Parking Lot and Buildings Map Class |
| ■ <i>Distichlis spicata</i> Pacific Coast Tidal Herbaceous Alliance | ■ Beach and Drift Logs Map Class |
| | ■ Terrestrial Bare Areas Map Class |
| | ■ Impounded Water Map Class |

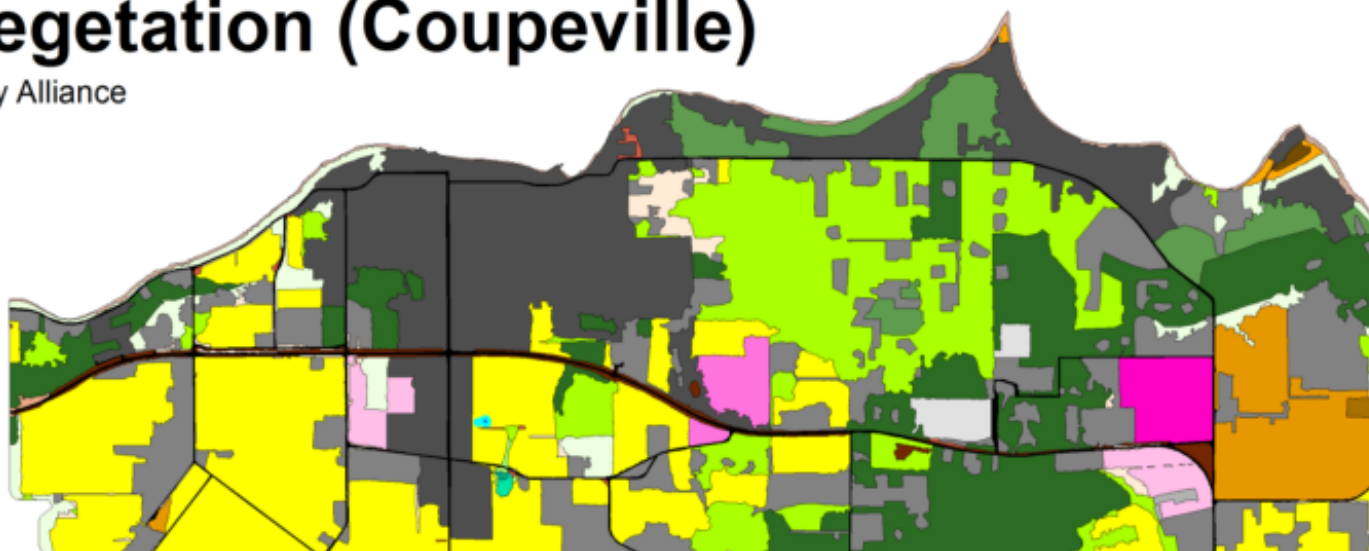
Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure C-3. Vegetation of Northern Ebey's Landing.



Vegetation (Coupeville)

by Alliance



- | | |
|--|---|
| Forest | Cultural |
| Pseudotsuga menziesii - Abies grandis - Arbutus menziesii Forest and Woodland Alliance | Temperate Conifer Forest Plantation Group |
| Tsuga heterophylla - Pseudotsuga menziesii / Comus unalaschensis Mesic Forest Alliance | Recently Harvested (Not-Replanted) Provisional Alliance |
| Tsuga heterophylla - Pseudotsuga menziesii / Holodiscus discolor Dry Forest Alliance | Mowed Lawn Alliance |
| Salix lucida Temporarily Flooded Woodland Alliance | Pasture and Agricultural Field Provisional Alliance |
| Alnus rubra / Dactylis glomerata Ruderal Flooded Forest Alliance | Unvegetated |
| Shrubland | High Density Housing Map Class |
| Symphoricarpos albus Pacific Coast Provisional Shrubland Alliance | Low Density Housing Map Class |
| Cytisus scoparius Ruderal Shrubland Alliance | Road / Parking lots Map Class |
| Rubus armeniacus Provisional Ruderal Alliance | Parking Lot and Buildings Map Class |
| Herbaceous | Beach and Drift Logs Map Class |
| Festuca roemerii - Agrostis pallens - Koeleria macrantha Herbaceous Alliance | Terrestrial Bare Areas Map Class |
| Bromus hordeaceus Provisional Ruderal Alliance | Impounded Water Map Class |
| Festuca idahoensis ssp. roemerii Provisional (Restoration) Ruderal Alliance | |
| Schedonorus phoenix Provisional Ruderal Alliance | |
| Poa macrantha - Leymus mollis - Festuca rubra Sand Dune Herbaceous Alliance | |
| Distichlis spicata Pacific Coast Tidal Herbaceous Alliance | |
| Schoenoplectus (acutus, tabernaemontani) - Typha latifolia Provisional Herbaceous Alliance | |
| Typha spp. Western Herbaceous Emergent Alliance | |



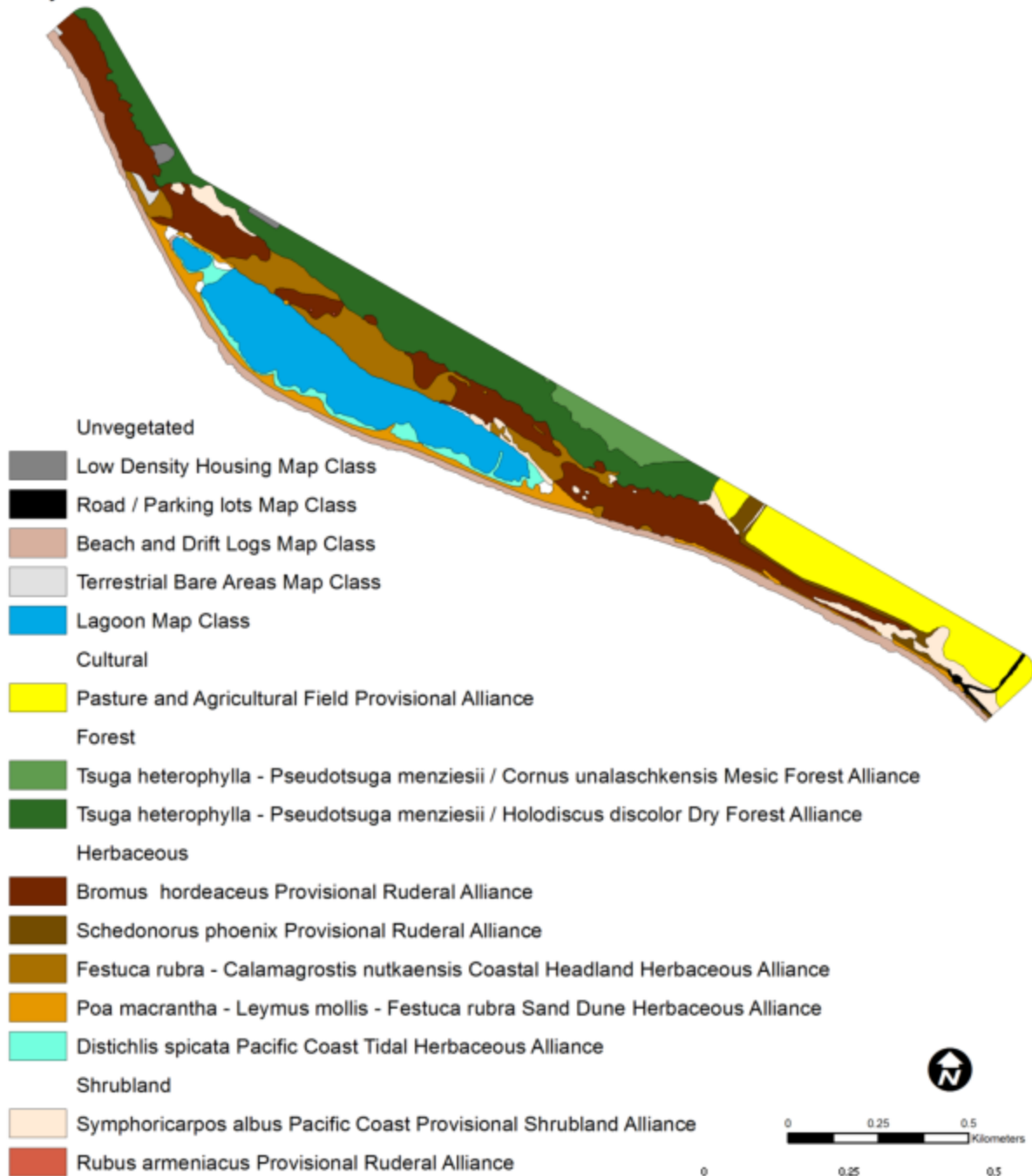
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Figure C-4. Vegetation of Coupeville, Smith Prairie, and adjacent areas.



Vegetation (Perego's Lake)

by Alliance



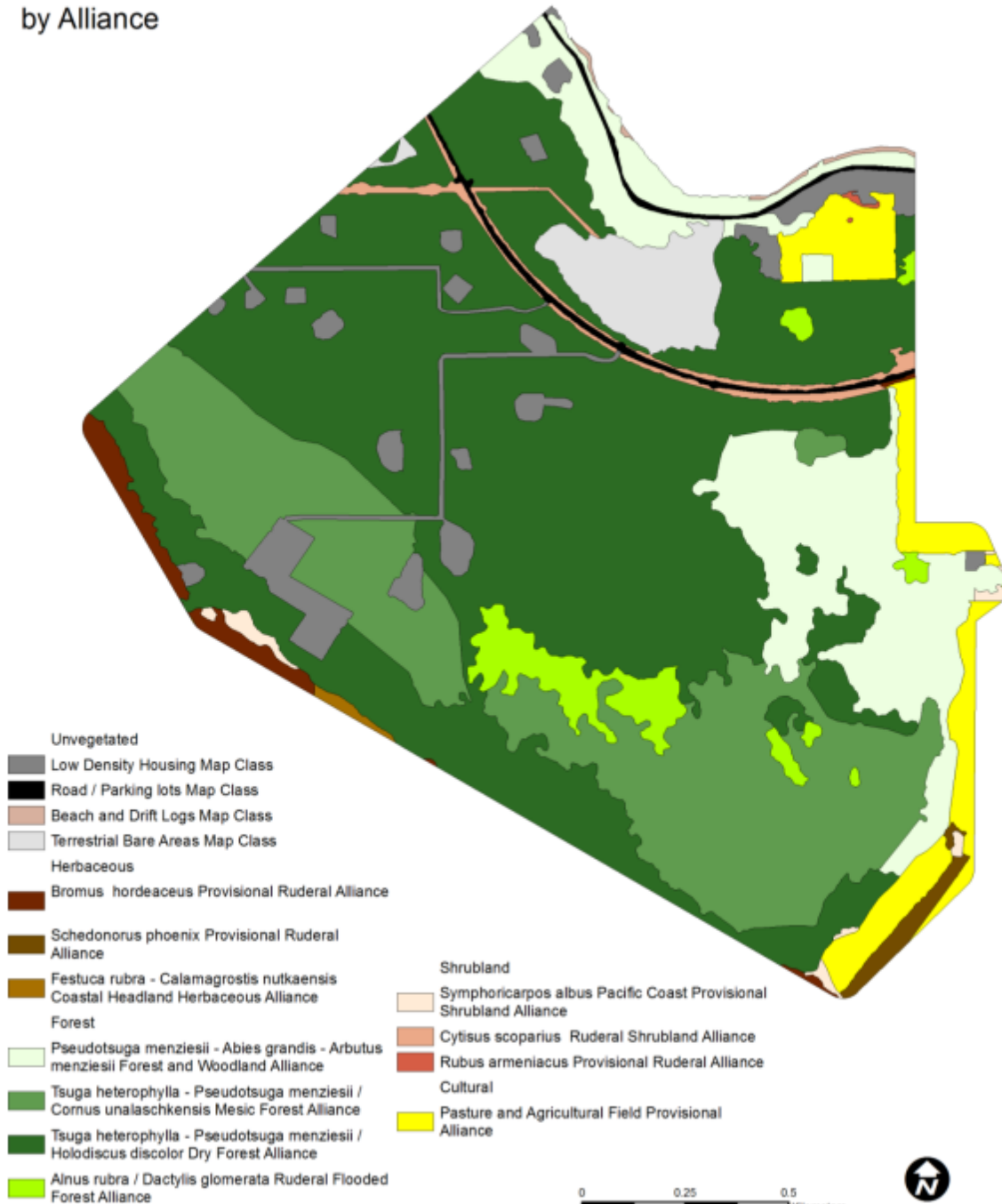
Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure C-5. Vegetation of Perego's Lake and the Bluff Trail.



Vegetation (Pratt Reserve)

by Alliance

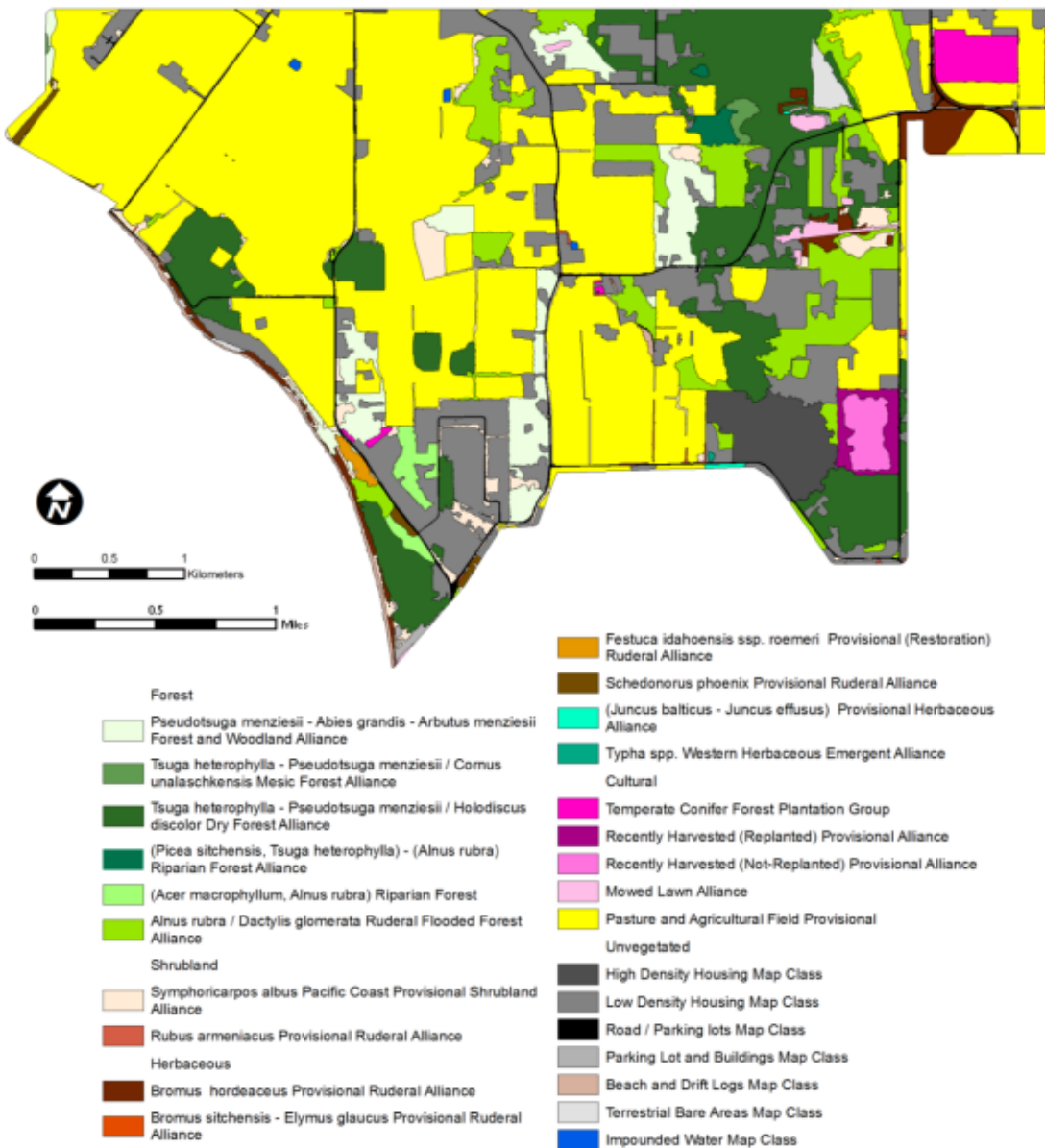


Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure C-6. Vegetation of the Robert Y. Pratt Reserve and surrounding areas.



Vegetation by Alliance (Ebey's & Crockett Prairies)



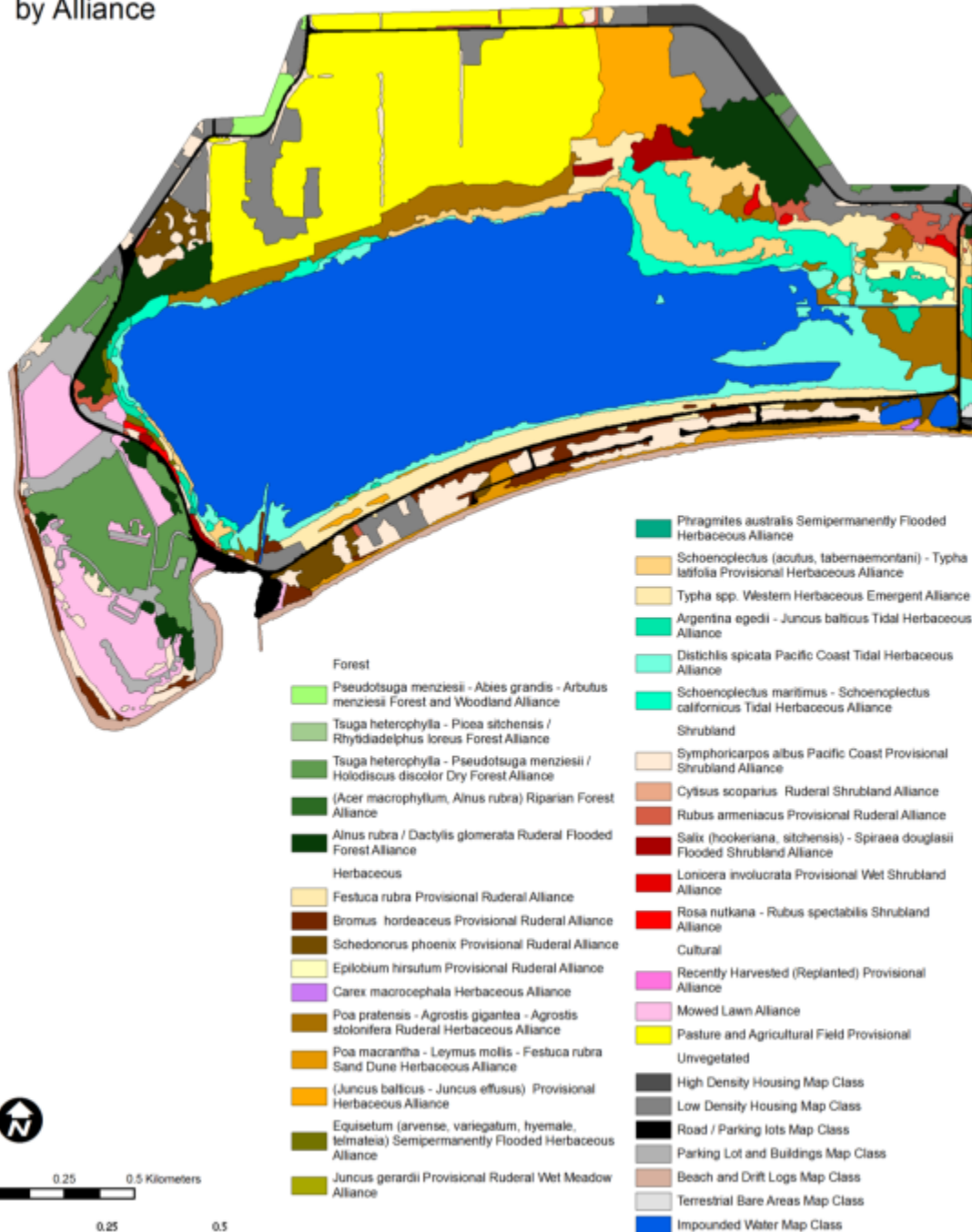
Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure C-7. Vegetation of Ebey's and Crockett Prairies.



Vegetation (Crockett Lake)

by Alliance



Produced by Tynan Ramm-Granberg, NCCN I&M, June 2015

Figure C-8. Vegetation of Crockett Lake and Fort Casey.

Appendix D: Accuracy Assessment Contingency Table for Map Classes at Ebey’s Landing National Historical Reserve 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. User’s 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 User’s accuracy and 90% confidence intervals appear in the final columns and Producer’s accuracy and 90% confidence intervals appear in the last rows.

[illegible]

Figure D-1. Contingency table of associations and alliances mapped at Ebey's Landing National Historical Reserve, grouped by the National Vegetation Classification system hierarchy. CI = Confidence Interval.

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 484/131371, February 2016

National Park Service
U.S. Department of the Interior



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