



Vascular Plant Inventory of San Juan Island National Historical Park

Natural Resource Technical Report NPS/NCCN/NRTR—2010/350



ON THE COVER

View of Mount Baker from the Redoubt at American Camp in San Juan Island National Historical Park Photograph courtesy of San Juan Island National Historical Park

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Abstract

Vascular plant inventories were conducted within San Juan Island National Historical Park between 2001 and 2005. The objectives of the vascular plant inventories were: 1) to compile a vascular plant list for the park, 2) to verify the occurrence of at least 90% of the species through written records or voucher specimens, and 3) to describe prairie communities of American Camp. Native species comprised 67% (268 species) of the total (400) and 70% of all species are perennial. The ratio of annual/biennial to perennial species varies greatly between native species and exotics. Approximately 17% of all native species are annuals or biennials while 57% of exotics are in this category. Three species, *Symphotrichum hallii*, *Crassula connata*, and *Ranunculus californicus*, documented within SAJH are listed as threatened by the Washington Natural Heritage Program.

Prairie plant communities at American Camp were inventoried using 1 m² plots distributed randomly within five herbaceous communities described by Peterson (2002) and polygons that were delineated during the inventory as areas dominated by native species. Surveys were also conducted of soil seed banks to inform development of prescriptions for future restoration programs. Twelve plant communities were described including five that were dominated by native plant species: the *Festuca roemerii* (Roemer's fescue) community, the *Leymus mollis*-*Holcus lanatus* (dune grass-velvet grass), *Juncus balticus*-*Schedonorus pratensis*-*Juncus effuses* (Baltic rush-meadow fescue-lamp rush), *Lupinus littoralis*-*Bromus rigidus* (seashore lupine-ripgut brome), *Bromus sitchensis*-*Bromus hordeaceus*-*Poa pratensis* (Sitka brome-ripgut brome-Kentucky bluegrass), and the *Abronia latifolia* (coastal sand verbena) communities. Five exotic species dominated the seedlings that emerged from soil samples in the greenhouse: *Rumex acetosella*, *Holcus lanatus*, *Myosotis discolor*, *Aira caryophylla*, and *A. praecox*. These species were found in all communities and did not reflect species that dominated the above-ground community.

Acknowledgments

We would like to thank S. Hahn and T. DeKoker for conducting the plant surveys, inventorying the prairie plots, and preparing the herbarium specimens. K. Arzarian collected specimens of species that were in flower after our field season ended. R. Holmes, S. Rodman, S. Hahn, and B. Cunningham conducted the data mining at Western Washington University and University of Washington. K. Frappier and R. Pond were responsible for growing-out the seed bank samples and identifying all seedlings. L. Grace and D. Swinney developed the maps in this report and all the spatial databases associated with the data collected in this project. We would like to thank D. Odion, T. Rodhouse, and C. Thompson for their thoughtful reviews of this report.

Introduction

The National Park Service's primary mission is to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of present and future generations. In 1992, the National Park Service's (NPS) Inventory and Monitoring Program identified a list of candidate elements and processes for initial inventory in all natural resource parks. It also proposed the establishment of prototype inventory and monitoring parks, and outlined national implementation guidelines. The National Parks Omnibus Management Act of 1998 recognized the need for good scientific information to manage parks. The act mandated a "program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources".

Funding acquired through the Natural Resource Challenge (1999) provided the financial resources for National Park Service to initiate Species Inventory Programs focusing on vertebrates and vascular plants. The basic goal of this program is to provide park managers with comprehensive, scientifically-based information about the nature and status of selected biological resources occurring within park boundaries in a form that increases its accessibility and utility for making management decisions, for scientific research, and for educating the public. The inventories will also lay the groundwork necessary for park managers to develop effective monitoring programs and to formulate effective management strategies for resource management and protection. The North Coast and Cascades Network (NCCN) of parks developed a plan to inventory and document vertebrate and vascular plant species in the seven network parks (Figure 1) and initiated this program in 2001 (Rocheftort et al. 2009).

San Juan Island National Historical Park was established in 1966 and encompasses 1,752 acres. The park preserves the sites of the American and English camps, commemorating the historic events that occurred from 1853 to 1871 on the island in connection with the final settlement of the Oregon Territory boundary dispute, including the Pig War of 1859. In addition to the historical buildings and features at both camps, the park contains important prehistoric Indian sites. San Juan Island is located in the rain shadow of the Olympic Mountains and while the island is drier than many other areas in western Washington, there is also considerable variation between American and English Camps. Based on PRISM (Parameter-elevation Regressions on Independent Slopes Model) group data, American Camp receives about 600 mm of precipitation/year while English Camp receives about 800 mm/year (PRISM Climate Group 2005). Although the two camps have many species in common, the relative distribution of forested and non-forested areas is quite different and the vegetation inventory reflects this difference.

In 1999, NCCN natural resource specialists began developing the Inventory Study Plan by gathering existing data and entering it into the NPSpecies database. Based on this initial review of the data, the objectives for each park were developed and incorporated into the Inventory Study Plan (Rocheftort et al. 2009). Based on our initial evaluation of vegetation studies conducted within the park (Agee 1984, 1987, Holmes 1998, Rolph and Agee 1993), we generated a species list of 181 vascular plant species. However, few species on this list were verified with herbarium voucher specimens. These vegetation studies and the on-going vegetation and fuels study (Peterson 2002) provided comprehensive descriptions of forest and

wetland communities, but herbaceous community descriptions were generalized. Based on this foundation, the objectives of the vascular plant inventory were: 1) to compile a vascular plant list for the park, 2) to verify the occurrence of at least 90% of the species through written records or voucher specimens (Rochefort et al.2009), and 3) to describe prairie communities of American Camp.

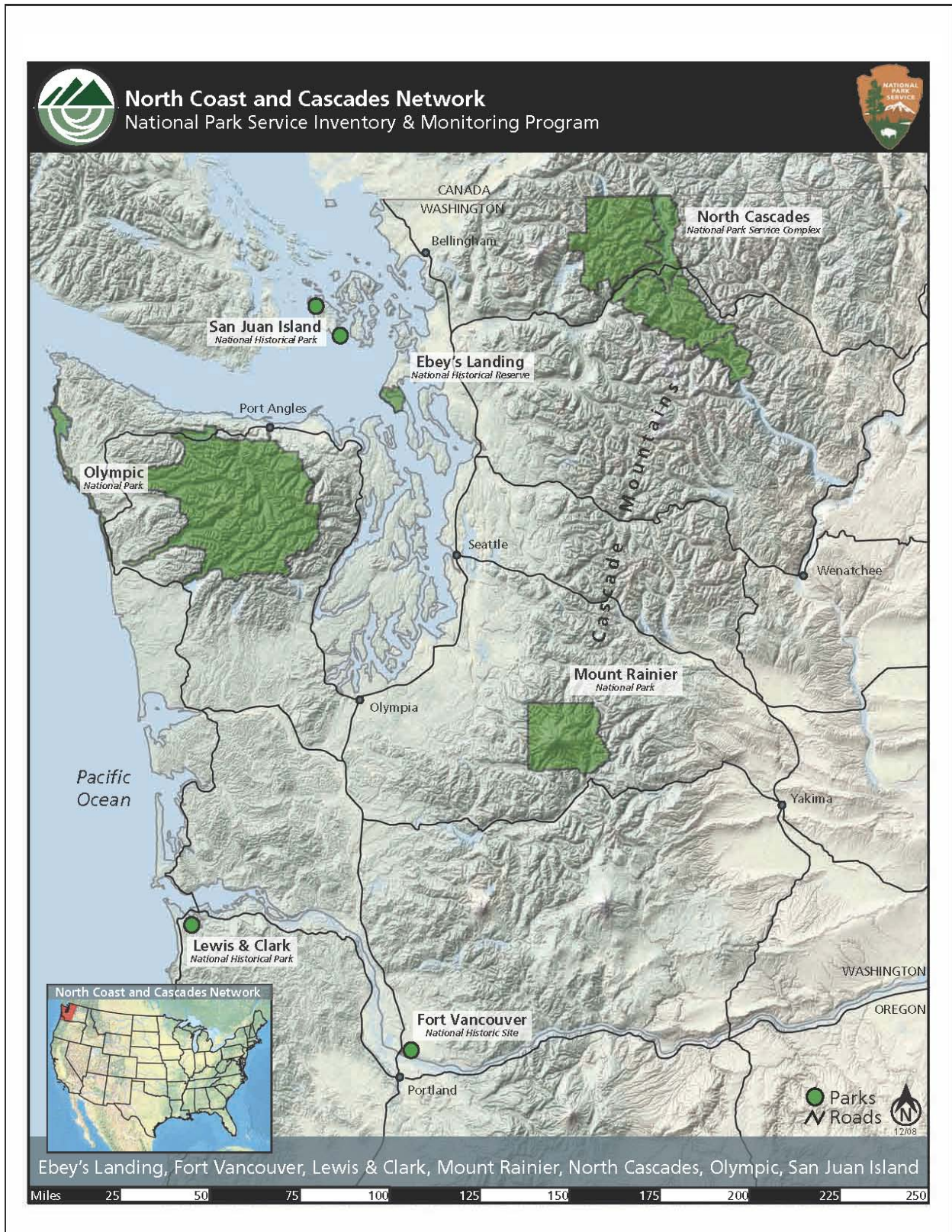


Figure 1. Map of San Juan Island National Historical Park and the North Coast and Cascades Network.

Methods

Data Mining

The first step in the vascular plant inventory was to locate all existing documentation of vascular plants present in the park to develop a draft species list. We utilized four sources of plant data: herbarium collections, written reports on park plant communities, local floras, and expert opinion. Since the park did not have a herbarium, we looked for specimens curated in the University of Washington herbarium. We examined reports by Agee (1984, 1987), Holmes (1998), and Peterson (2002) that were based on field surveys conducted in SAJH. We requested and received species lists from the fire monitoring plots on Young Hill at English Camp from Karen Kopper (NOCA Fire Ecologist). Finally, we added to our draft species list by compiling species listed by the Washington Natural Heritage Program as occurring in San Juan County and species listed by Atkinson and Sharpe (1993) as occurring on San Juan Island. Prior to our first field season, we compiled an initial species list of 684 species and while we suspected this list was probably too high, we felt it was probably best to start with a comprehensive list so that field crews would be prepared for the summer field season.

Field Surveys

Field surveys were conducted for two objectives: verification of the draft species list and description of prairie plant communities at American Camp. Prairie community surveys were conducted as an initial step in the development of long-term monitoring goals and to aid proposed prairie restoration programs. Surveys were designed using maps of vegetation and fuels (Peterson 2002) and wetlands (Holmes 1998) (Tables 1 and 2; Figures 2, 3, 4, and 5). Based on initial field review of the American Camp vegetation maps, we made slight revisions to the attributes of several polygons that are reflected in the maps presented in this report (unpublished data, R. Rochefort, R. Holmes, and C. Copass Thompson). Surveys to verify the draft species list were conducted primarily during the summers of 2001 and 2002 while prairie community surveys were conducted in 2001, 2003, and 2005.

Species Lists

Vegetation and wetland types were used as strata to guide field surveys. Species surveys were conducted on a subset of the park. Three polygons within each mapped vegetation type were randomly selected for species verification surveys. Each polygon was inventoried by two people walking across the polygon in a search pattern. The search pattern was supplemented by the intuitive controlled method (i.e. if the observers noticed microsite variation, they would search that area since our objective was to document all vascular plants species) (Thomas and Carey 1996). During each survey, all species observed were listed and specimens were collected of all species that were in flower or fruit. The specimens were then brought back to the office, dried, and mounted as herbarium specimens. As the field season progressed, it became apparent that the park was small enough to allow surveys of the entire area and additional surveys were conducted in polygons that had not originally been targeted for field surveys.

Table 1. Vegetation communities described and mapped by Peterson (2002).

Community	National Vegetation Classification System
Red alder-cottonwood/salmonberry	<i>Alnus rubra</i> / <i>Rubus spectabilis</i> forest
Red alder-western hemlock/sword fern	<i>Alnus rubra</i> / <i>Polystichum munitum</i> forest
Douglas-fir-grand fir-western hemlock/sword fern	<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Polystichum munitum</i> forest
Douglas-fir-grand fir-western hemlock/salal-ocean spray	<i>Pseudotsuga menziesii</i> - <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> forest
Douglas-fir-Pacific madrone/ocean spray-snowberry	<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> forest
Douglas-fir-lodgepole pine/ocean spray-snowberry	<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Holodiscus discolor</i> forest
Red alder-Douglas-fir/snowberry	<i>Alnus rubra</i> - <i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> forest
Douglas-fir-bigleaf maple/grass	<i>Pseudotsuga menziesii</i> - <i>Acer macrophyllum</i> forest
Douglas-fir-garry oak-Pacific madrone/grass	<i>Pseudotsuga menziesii</i> - <i>Quercus garryana</i> - <i>Arbutus menziesii</i> forest
Douglas-fir-western juniper/grass	<i>Pseudotsuga menziesii</i> - <i>Juniperus scopulorum</i> forest
Douglas-fir/grass	<i>Pseudotsuga menziesii</i> forest
Xeric grassland	Medium-tall temperate grassland
Xeric grassland with shrubs	Medium-tall temperate grassland with cold-deciduous shrubs
Sparse xeric grassland	Sparsely vegetated sand flats
Mesic grassland	Medium-tall temperate grassland
Mesic grassland with shrubs	Medium-tall temperate grassland with cold-deciduous shrubs
Mesic grassland with tree regeneration	Medium-tall temperate grassland with needle-leaved evergreen trees
Mesic grassland with shrubs and tree regeneration	Medium-tall temperate grassland with cold-deciduous shrubs and needle-leaved evergreen trees
Shrubs	Cold-deciduous shrubland
Intertidal salt marsh	<i>Distichlis spicata</i> - <i>Salicornia virginica</i> intertidal salt marsh
Cultivated	Temperate grassland, planted/cultivated, landscaped rural
Sand dune	Sparsely vegetated sand dunes

Table 2. Wetland types identified and mapped by Holmes (1998).

Wetland Type	Number of Wetlands	Average size ac. (s.d.)
Palustrine forested, broadleaved deciduous	18	1.7 (1.7)
Palustrine forested, broadleaved deciduous – partially drained	2	11.7 (15.9)
Palustrine, scrub-shrub broadleaved deciduous	10	1.1 (1.1)
Palustrine, unconsolidated bottom, mud	1	0.55
Palustrine, aquatic bed, floating vascular	1	.31
Palustrine emergent, persistent	22	0.513 (0.7)
Palustrine emergent, persistent– partially drained	2	0.7 (0.6)
Palustrine emergent, nonpersistent	6	0.13 (0.13)
Estuarine, subtidal, unconsolidated bottom, cobbles/gravel	2	5.04 (3.02)
Estuarine, intertidal emergent, persistent	3	3.2 (1.1)
Estuarine, intertidal, unconsolidated shore, cobble/gravel	1	.55

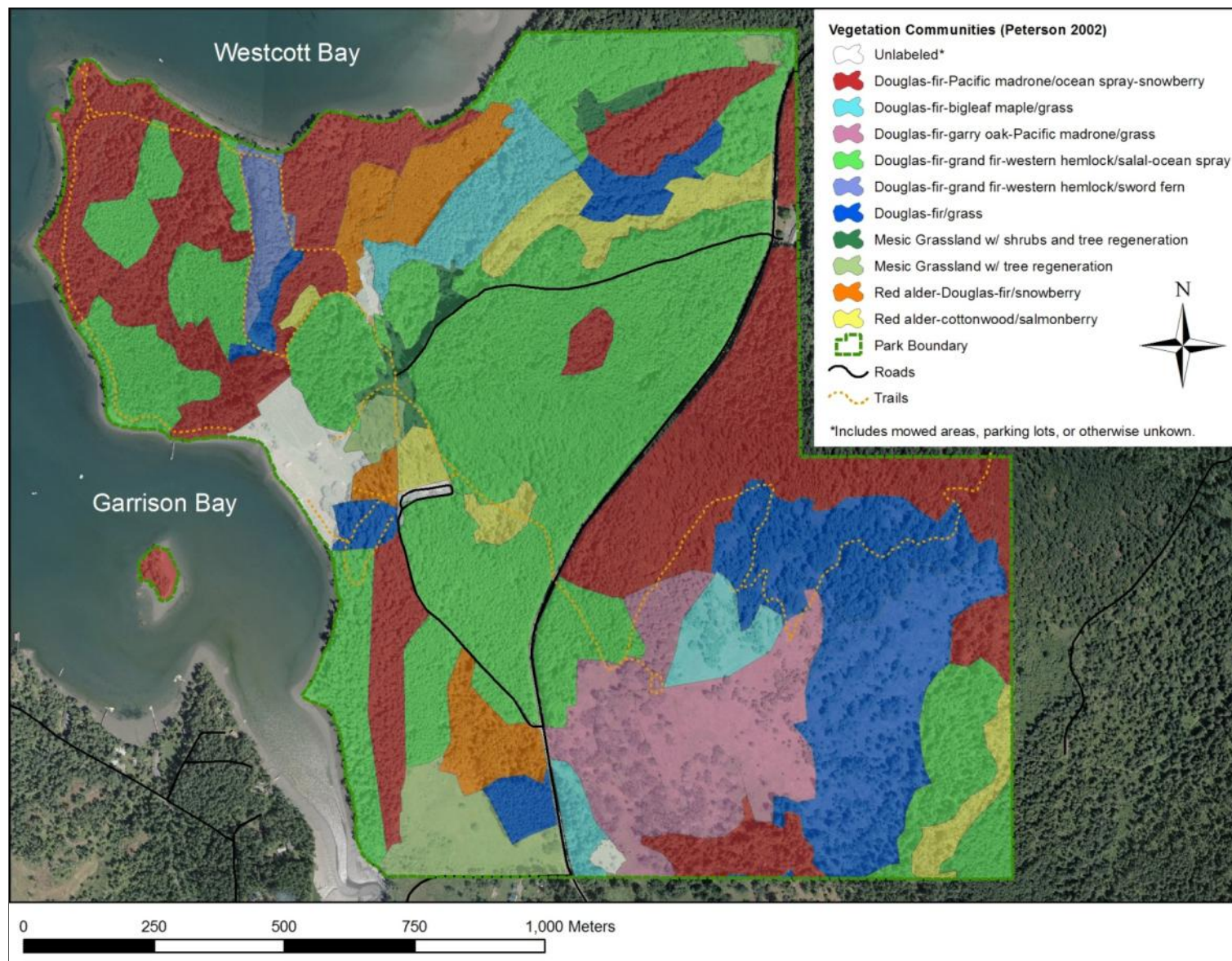


Figure 2. Map of vegetation types at English Camp described by Peterson (2002).

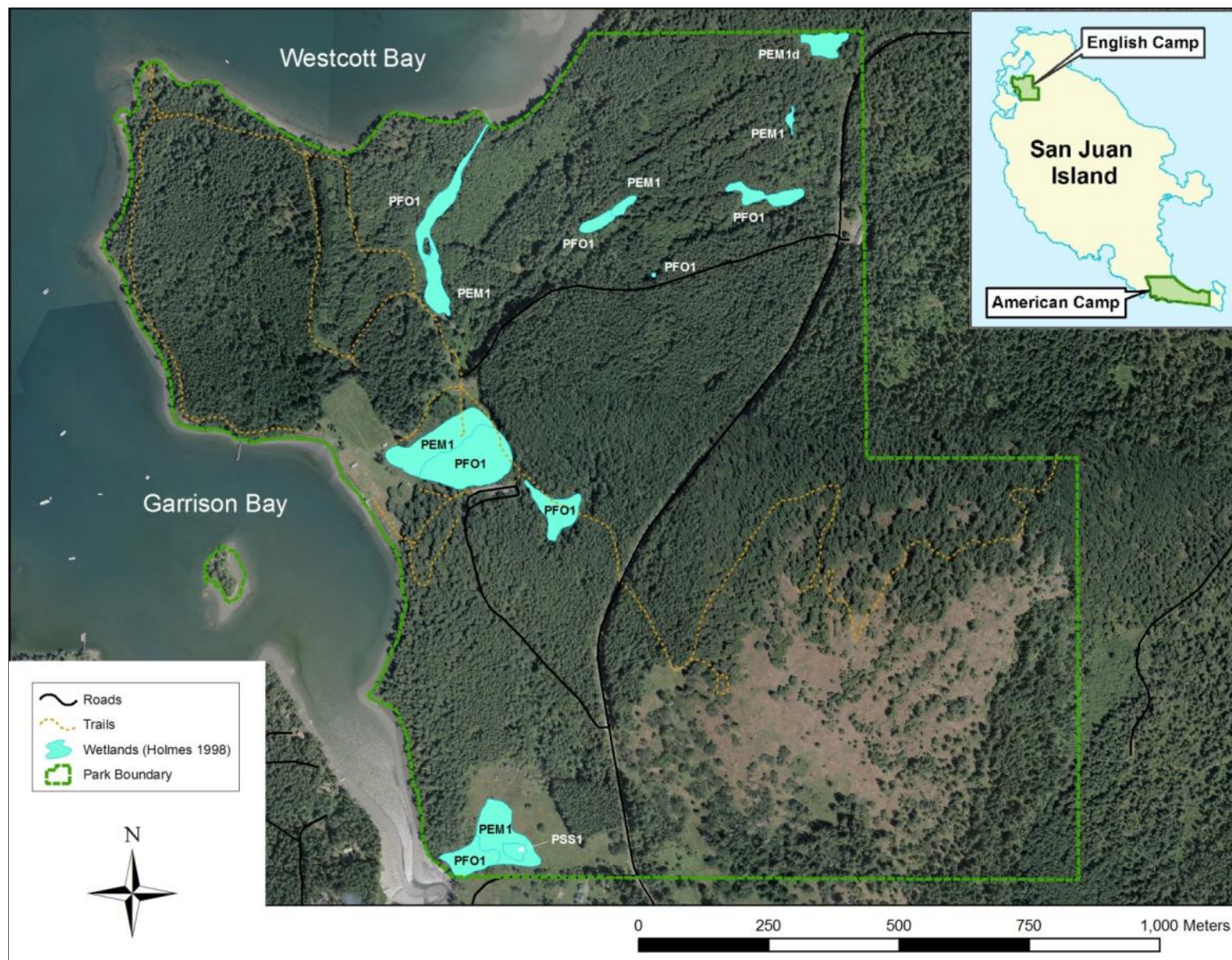


Figure 3. Map of wetlands at English Camp described by Holmes (1998).

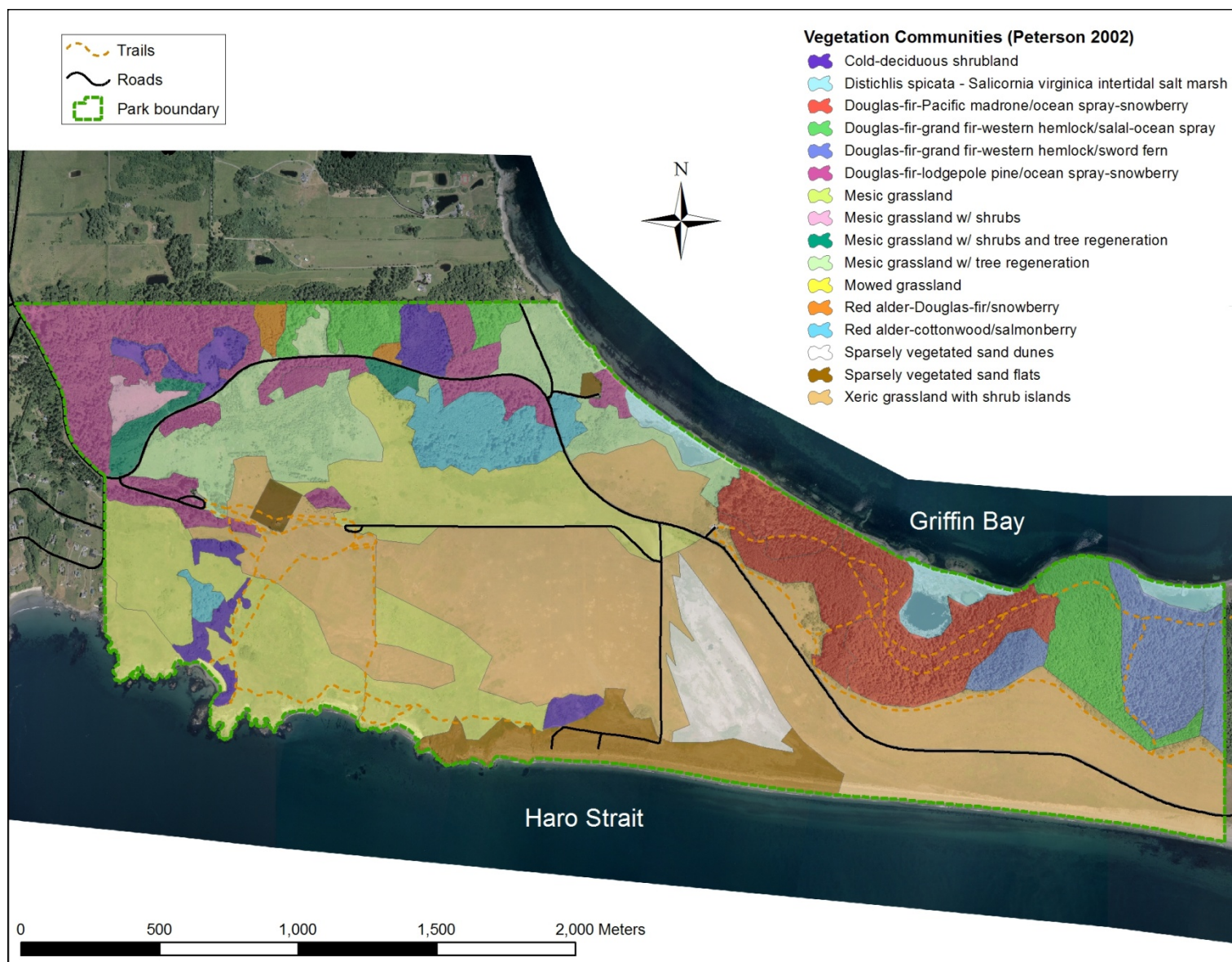


Figure 4. Map of vegetation types at American Camp described by Peterson (2002).

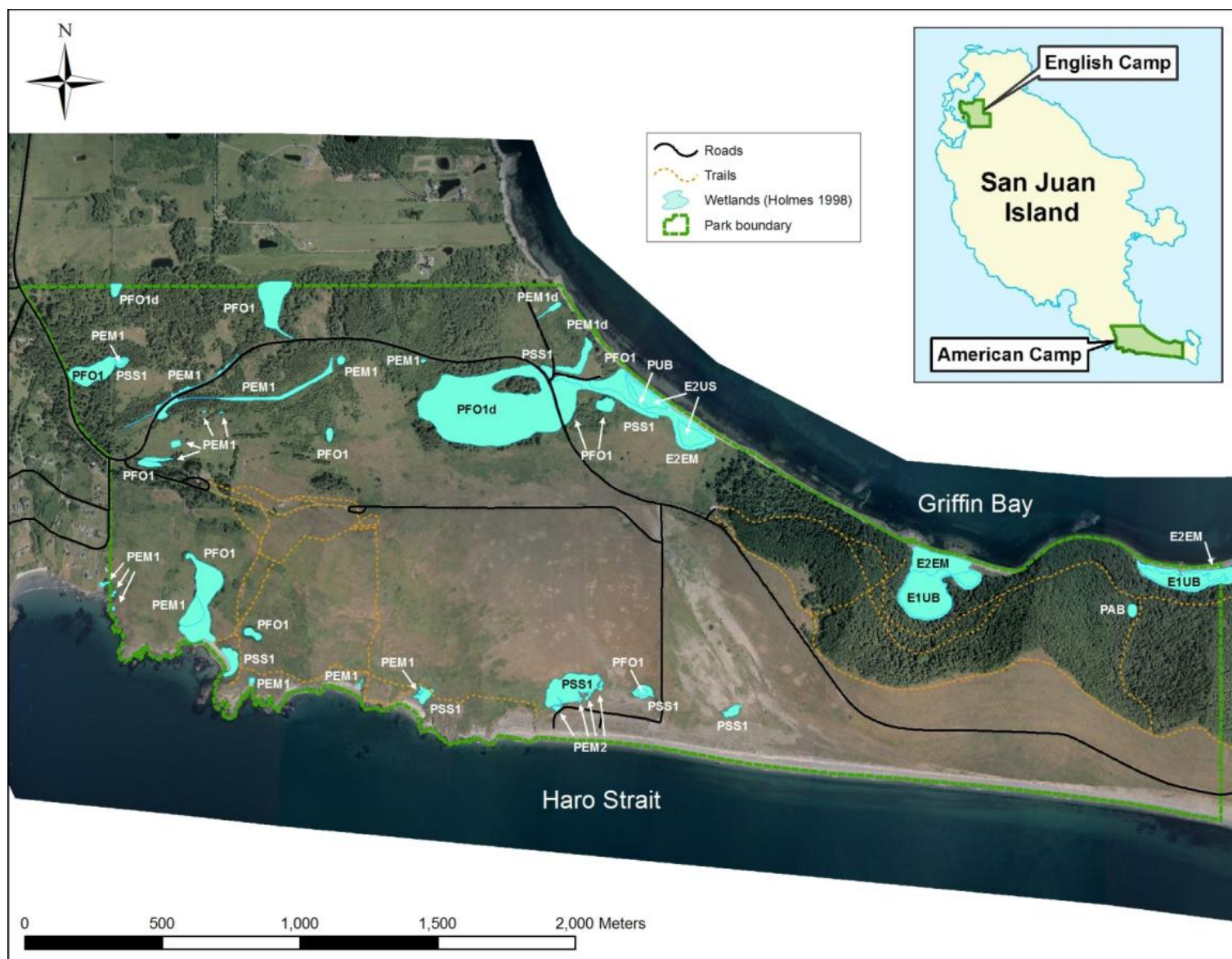


Figure 5. Map of wetlands at American Camp described by Holmes (1998).

Prairie Community Description

Prairie communities were sampled at American Camp using quantitative vegetation plots. Sample sites were randomly distributed within the five herbaceous communities described by Peterson (2002): mesic grasslands (MG, 10 sites), mesic grassland with tree regeneration (MT, 10 sites), sand dunes (SD, 10 sites), sand flats (SF, 11 sites), and xeric grasslands (XG, 22 sites) (Figure 6). Sample sites were selected using a random point generator in ArcView 3.2 (ESRI 1999). At each random point, four 1-m² square plots, located 1 meter from the origin at cardinal points (0, 90, 180, 270 degrees with declination set), were inventoried. In each plot, physical conditions (aspect, elevation, slope, topography, location coordinates) and plant cover were recorded. Plant cover was recorded for all species using cover classes: 1 (>0-5%), 2 (6-25%), 3 (26-50%), 4 (51-75%), 5 (76-95%), 6 (96-100%).

At the conclusion of the 2002 field season, it became apparent that the vegetation maps did not delineate native herbaceous plant communities. During the summer of 2003, we mapped any area within the prairie that was larger than 2 m by 2 m and had more than 50% cover of native herbaceous species. Mapping was conducted using a GeoExplorer3 GPS unit (Trimble Navigation Limited) calibrated to NAD 27. Additionally, at each native patch or polygon, we recorded the native species present, the density of that species (plants per m²), the spatial distribution of the species, and an estimate of the size of the polygon. Spatial distribution and density were recorded to aid potential seed collection for future restoration efforts. Spatial distribution of the plants was described as: regular (evenly distributed), random (scattered individuals), or random aggregated (clumps of plant randomly distributed). In 2005, we randomly distributed up to 3 points within 43 native polygons (points RP 1-43) and inventoried quantitative plots using the same methods as in 2001 (Figures 6,7).

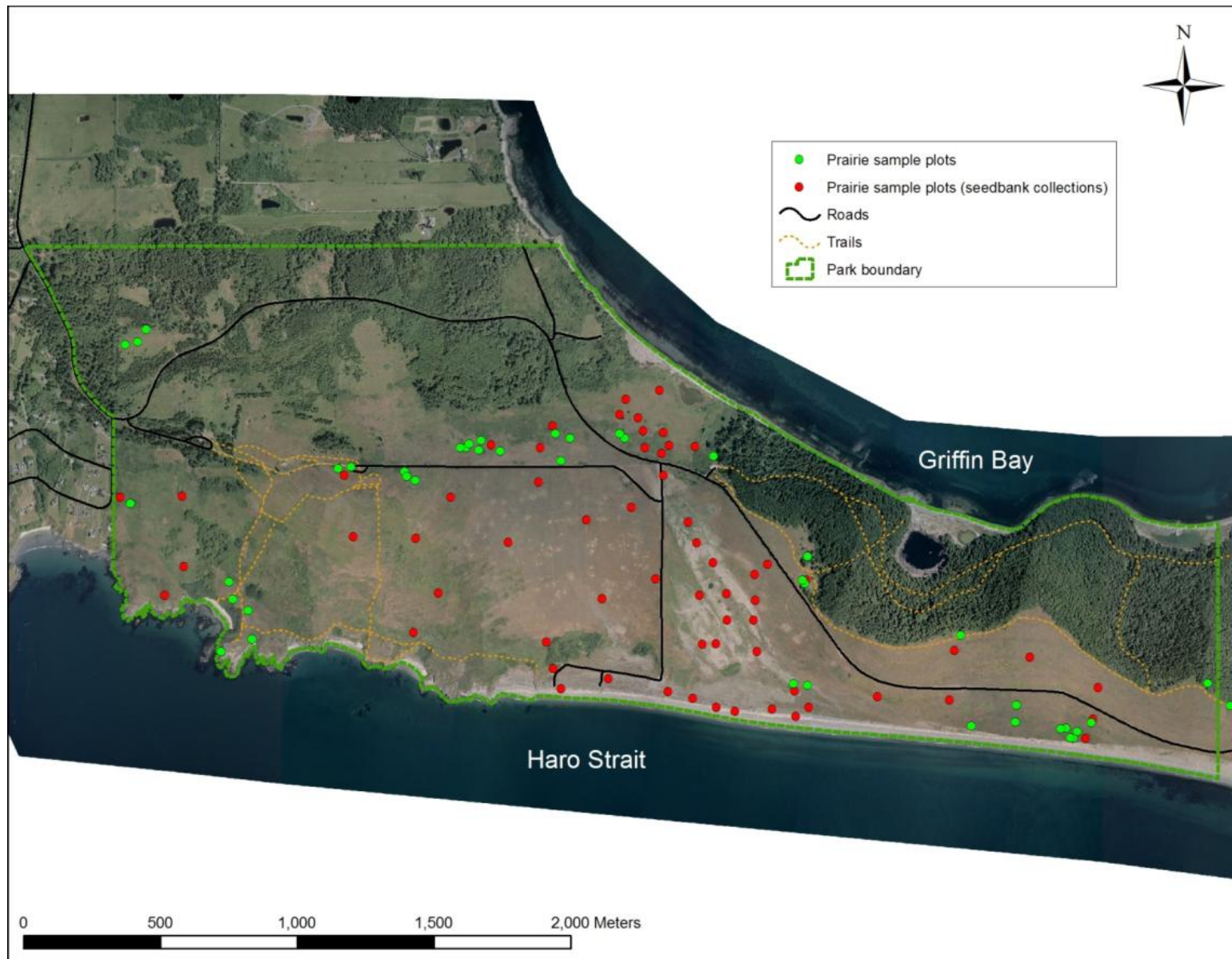


Figure 6. Map of locations of all prairie sample plots. Red circles indicated locations where both inventory and seed bank samples were collected.



Figure 7. Map of native plant polygons delineated by field surveys in the prairies of American Camp.

Seed Bank Surveys

Surveys were also conducted of soil seed banks to inform prescriptions for future restoration programs. During late July and August 2001, after most seeds had been dispersed, we collected four soil samples from 58 prairie community sample sites. The soil samples were distributed in the mapped classes in the following manner: mesic grasslands (10), mesic grassland with tree regeneration (9), sand dunes (10), sand flats (10), and xeric grasslands (19). Soil samples were collected with a tapered bulb planter (6 to 7 cm diameter) to a depth of 7.6 cm; each sample was approximately 268 cm³. The four samples from each collection site were combined in one Ziploc bag. Soil samples were stored at room temperature in open, plastic Ziploc bags through January 2002 when they were transferred to the University of Washington. Soil samples were grown out in the Douglas Research Conservatory greenhouses at the Center for Urban Horticulture, University of Washington (Figures 6, 8). Beginning February 1, 2002, soil samples were filtered using a 4 mm sieve to remove large debris, rocks, and excess vegetation. Half flats (8 x 8 x 2 inch) were filled with 1½ inches of sterile seeding mix comprised of 50% peat and 50% vermiculite. Each soil sample was then mixed into the top ½ inch of the seeding mix, one sample per ½ flat. Flats were watered with clear water four to five times per week. In addition, flats were watered using fertilizer-enriched water one to two times per week. The fertilizer enriched water consisted of Pete's 15-16-17 Peatlite set up at 200 ppm.

The greenhouse temperatures ranged from 60-65 degrees Fahrenheit during the night and 70-75 degrees Fahrenheit during the day. Greenhouse lights were on 14 hours per day starting at 8:00 AM and ending at 10:00 PM.

Seedling emergence began within three weeks of sowing. The species that emerged first were *Bromus sp.*, *Myosotis discolor*, *Rumex acetosella* as well as a couple of *Aster* species. Some samples were transplanted into four-inch pots using greenhouse potting mix comprised of 50% pumice, 35% peat and 15% vermiculite. These specimens were grown to flower to assist with further identification and for herbarium samples.

On May 31, 2002, flats were sprayed with Safer Insecticidal soap due to extensive aphid infestations. This was to ensure the health of the plants that had yet to be identified as well as to ensure good quality of herbarium specimens.

Plant densities were counted as follows: each known species was counted and then either removed after being counted or cut back and marked with a color-coded toothpick. Since *Holcus lanatus* set extensive fibrous roots in the flat, this species was simply cut back and marked with a black tipped toothpick due to the difficulty of removing the plant completely from the flat without disturbing other plants in the flat or losing too much soil. After all species emerged and were counted, flat contents were discarded.



Figure 8. Seed bank samples in the University of Washington greenhouse.

Data Analysis

Species Lists

The final species list was compiled from the initial draft species list, the field survey list, and species verified by herbarium specimens collected during this study. We attempted to collect at least one herbarium voucher specimen of all species that were in flower or fruit during field surveys. Specimens were deposited in the North Cascades National Park curatorial facility in Marblemount, WA.

Prairie Community Description

Analysis of plant community data was conducted with the PC-ORD version 5.06 (McCune and Mefford 2006). Cluster analysis (hierarchical agglomerative) was used to identify plant communities using the Sorensen (Bray-Curtis) distance measure and the flexible beta linkage methods (beta set to -0.25). Multi-response permutation procedure (MRPP) was used to test the hypothesis of no significant difference between groups identified by the cluster analysis. Indicator species analysis was used to enhance the description of plant community groups and select the classification level of the cluster analysis (Dufresne and Legendre 1997).

Seed Bank Surveys

Seedlings were tallied and summed by species for each seed bank sample. Seed bank samples were then classified using the 12 vegetation community categories and average seedling density/square meter and frequency (percent of samples/community) were calculated for each species.

Results

Data Mining

We initially refined our potential list through reviews by Dr. David L. Peterson (USFS) and John Gamon (Washington Natural Heritage Program). Simultaneously, we compiled species lists from the vegetation studies that had been conducted with SAJH and developed a list of 181 species (Agee 1984, 1987, Holmes 1998, Kopper 2001, and Peterson 2002). Our search of the University of Washington herbarium located 40 voucher specimens, 23 of which were not noted in the vegetation studies. This preliminary analysis generated a list of 204 species confirming our expectation that the potential list of 684 species was an overestimate inflated by the addition of all species listed in Atkinson and Sharpe (1993) as occurring on San Juan Island or in habitats we thought might occur within the park. We then reduced our draft species list to the 204 species and added species that were documented through our field surveys and voucher collections.

Field Surveys

Species Lists

We developed a species list of 400 species within SAJH; 327 (82%) species were documented by herbarium specimens and the remaining species were verified by observation during surveys or in the prairie vegetation plots (Table 3; Figures 6, 7, 9, 10; Appendix 1, 2, 3, 4). Native species comprised 67% (268 species) of the total and 70% of all species were perennial. However, the ratio of annual/biennial to perennial varies greatly between native species and exotics.

Approximately 17% of all native species are annuals or biennials while 57% of exotics are in this category. Three species were documented in SAJH that are listed as threatened by the Washington Natural Heritage Program: *Symphotrichum hallii*, *Crassula connata*, and *Ranunculus californicus*.

Table 3. Summary of species documented during the SAJH plant inventory.

Growth form ¹	# of species	Native			Exotic			State Listed	Species Verified by Vouchers		
		Annual	Biennial	Perennial	Annual	Biennial	Perennial		Before inventory	During Inventory	After Inventory
Forb	257	42	2	128	50	11	24	3	24	189	206
Graminoid	84	1	0	49	14	0	20	0	14	63	72
Shrub	28	0	0	24	0	0	4	0	2	23	23
Tree	31	0	0	22	0	0	9	0	0	26	26
Total	400	43	2	223	64	11	57	3	40 (10%)	301 (76%)	327 (82%)

¹ Growth form as listed on USDA Plants. Categories were summarized as follows: Forbs = forb, forb/vine, forb/subshrub, vine, vine/shrub, forb/vine; Graminoid = grass, sedge, rush; Shrub = shrub, shrub/tree, subshrub, subshrub/vine; and Tree = tree, tree/shrub

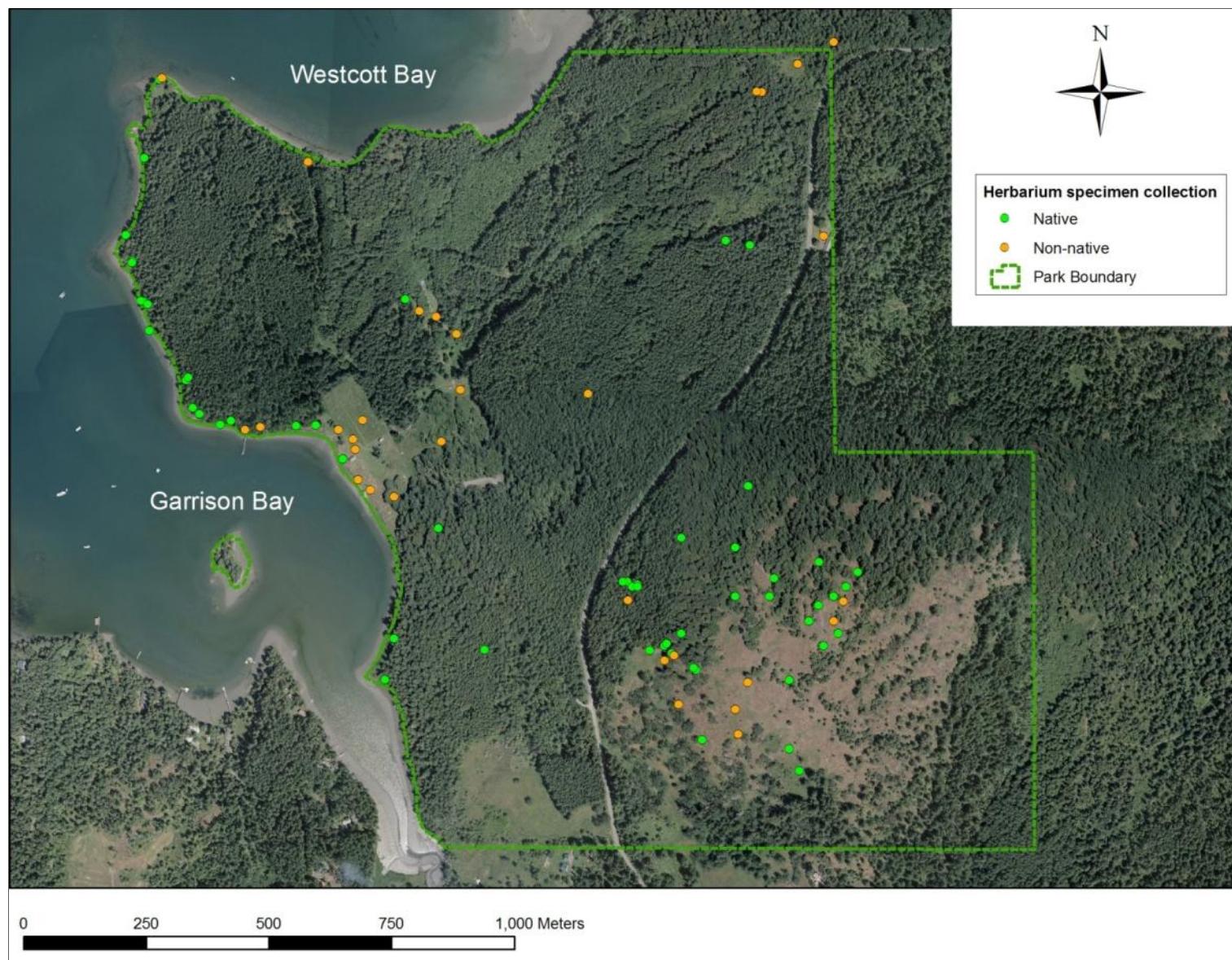


Figure 9. Locations of herbarium specimen collections at English Camp.

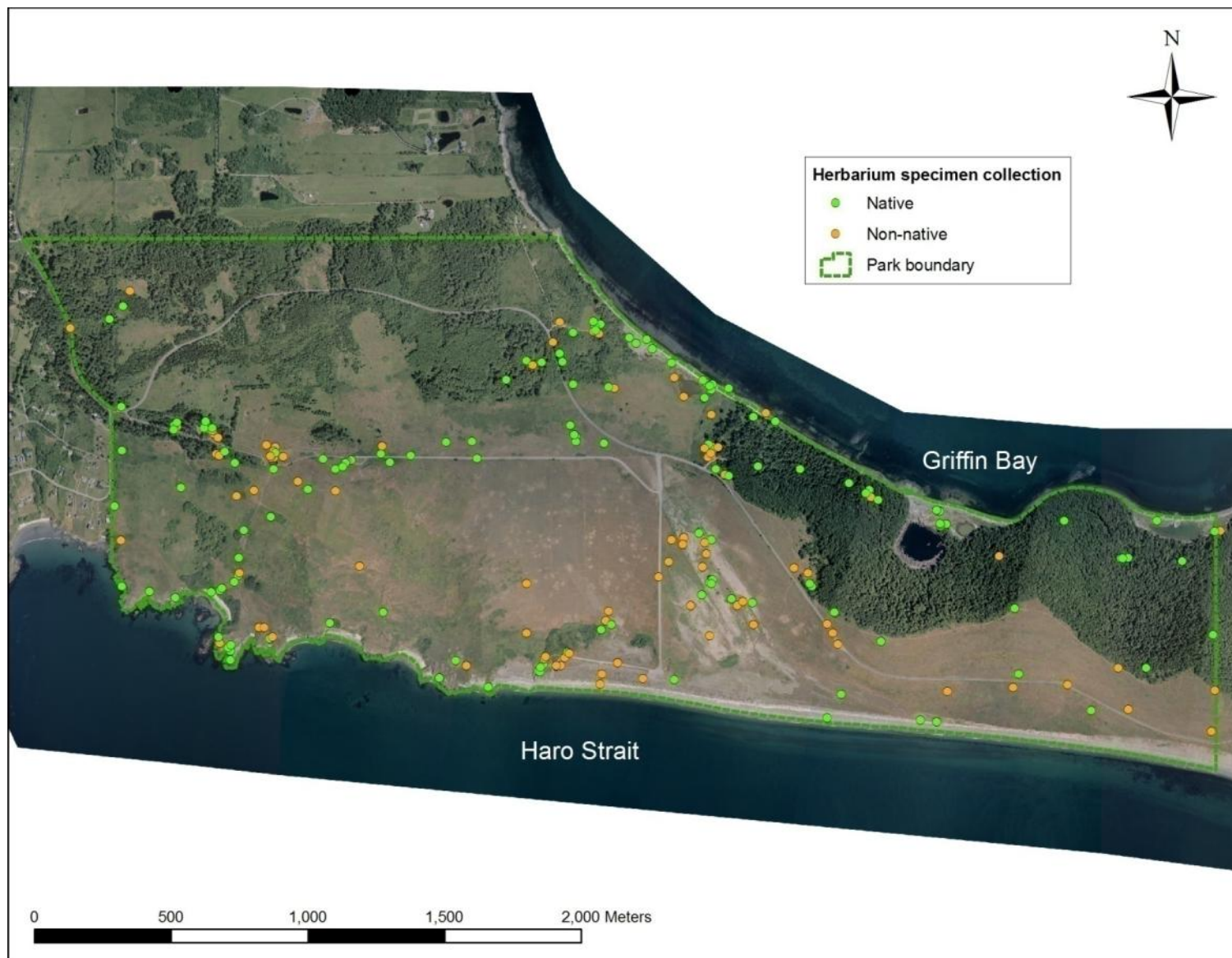


Figure 10. Locations of herbarium specimen collections at American Camp.

Prairie Community Description

We documented 111 species in the 106 vegetation plots; there were 49 exotic species, 60 native species. Two plants were only identified to genus so the origin could not be determined (*Atriplex* spp. and *Silene* spp.). Twenty-one species were documented in at least 20% of the plots (i.e. 21 or more plots; 16 exotic species and 5 native species) and 24 species were only found in one (20 native, 4 exotic). Seven species were found in more than 50% of the plots and all were exotic species: *Rumex acetosella* (75 plots), *Holcus lanatus* (74), *Vicia sativa* (66), *Poa pratensis* (63), *Cirsium arvense* (56), *Hypochaeris radicata* (56), and *Bromus hordeaceus* (51).

Using cluster analysis, we identified 12 vegetation communities (Table 4; Figure 11, 12, 13, Appendix D); MRPP was used to test significance between groups ($T = -37.23$, $p < 0.001$). Sample sizes of vegetation communities (cluster groups) ranged in size from three plots to twenty-one plots. As we conducted the inventory, it became apparent that the strata we utilized from Peterson's study (2002) were based on a broader classification perspective than the plant communities that we were interested in describing. Often, we felt that several plant communities were encompassed within one of sampling strata resulting in small sample sizes within classification groups. Groups with small sample sizes were evaluated to determine if they represented an under-sampled vegetation community (i.e. a result of our sampling strategy) or heterogeneity within a community. If we felt that the classification did describe a frequently observed community, we retained that level of classification despite the small sample size.

Five of the plant communities that we identified were dominated by native plant species: the *Festuca roemerii* (Roemer's fescue) community, the *Leymus mollis*-*Holcus lanatus* (dune grass/velvet grass), *Juncus balticus*-*Schedonorus pratensis*-*Juncus effusus* (Baltic rush-meadow fescue-lamp rush), *Lupinus littoralis*-*Bromus rigidus* (seashore lupine-ripgut brome), *Bromus sitchensis*-*Bromus hordeaceus*-*Poa pratensis* (Sitka brome-ripgut brome-Kentucky bluegrass), and the *Abronia latifolia* (coastal sand verbena) communities. Most of these communities appeared to be on sites where historical use was limited or perhaps less intrusive (i.e. not plowed). The *Abronia latifolia* community was primarily found on the sand dunes and along the beach in the sand flat community identified by Peterson. The *Leymus mollis*-*Holcus lanatus* community was also found on either in the sand dunes or sandy soils interspersed through the mesic grasslands, xeric grasslands, or sand flats (Peterson 2002). The *Festuca roemerii* community was the most diverse of the communities we sampled (Species richness or $S = 18.8/m^2$), but our samples probably underestimated the diversity due to the fact that our sampling (predominantly in June and July) was slightly after the peak flowering period of the forbs (e.g. the lilies such as *Camassia quamash*, *C. leichtlinii*, *Fritillaria affinis*, *Brodiaea coronaria*, *Zigadenus venosus*) and we may have underestimated their cover or presence. The *Juncus balticus*-*Schedonorus pratensis*-*Juncus effusus* community was found primarily on sites close to the coast and in soils that were frequently wet.

The *Holcus lanatus* (velvet grass) community had the largest sample size (21) and included three key native species: *Elymus glaucus* (blue wildrye), *Pteridium aquilinum* (bracken fern) and *Carex inops* (long-stolon sedge). Within the *Holcus* community, *Elymus glaucus* ranged from 0% cover to 77% cover and this community seemed to represent an important native community, dominated by *Elymus*, in various stages of invasion by *Holcus lanatus*. European rabbits (*Oryctolagus cuniculus*) were introduced on San Juan Island in the early 1900s (Hall 1977) and areas where the rabbit populations are concentrated are characterized by patchy vegetation and

warrens (Figures 12, 13a). Our survey occurred when the rabbit population was at a high point and rabbits were visible during our surveys (West 2010). The areas where the rabbits and warrens were most dense were dominated by *Agrostis stolonifera* or *Agrostis capillaris* communities. Areas where rabbits were most active were dominated by annual grasses and forbs such as the *Aira* species and *Teesdalia nudicaulis*. Often *Cirsium arvense* was found growing on the piles of soil outside the rabbit warrens and the perennial grasses (*Holcus lanatus* and *Agrostis* species) appeared to be growing where rabbit activity was low. In general, the *Elymus repens* (quack grass), Roemer's fescue, Sitka brome, and dune grass communities showed little evidence of rabbit activity.

Table 4. Quantitative description of American Camp prairie vegetation communities.

Vegetation Community (no. of plots)	Description	Species Cover (ave % cover)¹	Plots
1. <i>Holcus lanatus</i> (21)	66 species: 29 native, 36 exotic, S = 14.7	Dominant: <i>Holcus lanatus</i> (41) Prominent: <i>Poa pratensis</i> (14.9), <i>Carex inops</i> (11.2), <i>Elymus glaucus</i> (9.8), <i>Pteridium aquilinum</i> (7.3) Usually present: <i>Bromus hordeaceus</i> (4.5), <i>Cirsium arvense</i> (4.0), <i>Hypochaeris radicata</i> (5.0), <i>Rumex acetosella</i> (4.4), <i>Vicia sativa</i> (3.8)	MG 2,4,5, 11; MT 6,7; RP 2,7,13,16,19,30, 31,34; SD 6; XG 36,49,76,8,82,9 5
2. <i>Juncus balticus</i> / <i>Schedonorus pratensis</i> / <i>Juncus effusus</i> (5)	24 species, 14 native 10 exotic, S = 7.8	Codominant: <i>Juncus balticus</i> (24.2), <i>Schedonorus pratensis</i> (20), <i>Juncus effusus</i> (19) Prominent: <i>Carex obnupta</i> (13.6), <i>Oenanthe sarmentosa</i> (10), <i>Cirsium arvense</i> (5.6), <i>Rubus discolor</i> (5.5), <i>Holcus lanatus</i> (4.6) Usually present: <i>Vicia sativa</i> (2.8)	MG 10; RP 32,46, SD 10; XG 10
3. <i>Leymus mollis</i> / <i>Holcus lanatus</i> (7)	37 species, 12 native, 25 exotic, S=13.7	Codominant: <i>Leymus mollis</i> (32.8), <i>Holcus lanatus</i> (22.6) Prominent: <i>Rubus ursinus</i> (12.1), <i>Pteridium aquilinum</i> (10.8), <i>Bromus sitchensis</i> (9.6), <i>Festuca rubra ssp. rubra</i> (8.9) <i>Cirsium arvense</i> (5.4), <i>Aira caryophylla</i> (4.8), <i>Poa pratensis</i> (4.3) Usually present: <i>Sonchus asper</i> (0.4), <i>Vicia hirsuta</i> (2.4), <i>Vicia sativa</i> (1.2)	MG 12; RP 3, 1, 48; SF 1, 7; XG 61
4. <i>Elymus repens</i> (5)	15 species, 2 native, 13 exotic, S= 8.2	Dominant: <i>Elymus repens</i> (58.4) Prominent: <i>Poa pratensis</i> (21), <i>Vicia hirsuta</i> (16.5), <i>Holcus lanatus</i> (12.8), <i>Cirsium arvense</i> (5.8), <i>Vicia sativa</i> (4.8) Usually present: <i>Carex tumilicola</i> (2.6)	MG 13; MT 2, 3, 9, 10
5. <i>Agrostis capillaris</i> (11)	35 species, 12 native, 23 exotic, S = 11.5	Dominant: <i>Agrostis capillaris</i> (66.2) Prominent: <i>Rumex acetosella</i> (10.5), <i>Aira caryophylla</i> (6.9), <i>Holcus lanatus</i> (4.9), <i>Hypochaeris radicata</i> (3.8), <i>Vicia sativa</i> (4.6) Usually present: <i>Aira praecox</i> (3.2)	MG 7, 14; MT 5; RP 39; XG 24, 31, 39,42, 66, 75, 98
6. <i>Festuca roemerii</i> (15)	53 species, 25 native, 28 exotic, S = 18.8	Dominants: <i>Festuca roemerii</i> (57.5) Prominent: <i>Holcus lanatus</i> (13.9), <i>Carex inops</i> (8.0), <i>Vicia sativa</i> (5.6), <i>Pteridium aquilinum</i> (4.9), <i>Rumex acetosella</i> (4.6), <i>Poa pratensis</i> (4.1) Usually present: <i>Aira caryophylla</i> (1.7), <i>Camassia quamash</i> (1.3), <i>Cirsium arvense</i> (1.2), <i>Danthonia californica</i> (2.8), <i>Hypochaeris radicata</i> (2.7), <i>Luzula multiflora</i> (1.5), <i>Rubus ursinus</i> (0.4), <i>Sonchus asper</i> (0.7)	MG 65; RP 1, 5, 9, 14, 15, 24, 26, 27, 28, 35, 38, 42, 45; XG 87

Table 4. Quantitative description of American Camp prairie vegetation communities (continued).

Vegetation Community (no. of plots)	Description	Species Cover (ave % cover)	Plots
7. <i>Poa pratensis</i> (4)	22 species: 9 native, 13 exotic, S = 9.8	<u>Dominant:</u> <i>Poa pratensis</i> (78.4) <u>Prominent:</u> <i>Leymus mollis</i> (10.9), <i>Pteridium aquilinum</i> (10.1), <i>Holcus lanatus</i> (5.3), <i>Bromus hordeaceus</i> (5.0), <i>Cirsium vulgare</i> (3.4) <u>Usually present:</u> <i>Cirsium arvense</i> (2.6), <i>Danthonia californica</i> (0.80), <u>Codominant:</u> <i>Lupinus littoralis</i> (35.0), <i>Bromus rigidus</i> (21.9) <u>Prominent:</u> <i>Pteridium aquilinum</i> (6.4), <i>Rumex acetosella</i> (6.3), <i>Bromus sterilis</i> (5.6), <i>Leymus mollis</i> (4.5), <i>Cirsium arvense</i> (4.4), <i>Hypochaeris radicata</i> (3.8), <i>Festuca roemerii</i> (3.5), <i>Abronia latifolia</i> (3.2)	MT 4,8,11; XG 29
8. <i>Lupinus littoralis</i> / <i>Bromus rigidus</i> (10)	42 species, 14 native 28 exotic, S = 11.5	<u>Codominant:</u> <i>Bromus sitchensis</i> (27.2), <i>Bromus hordeaceus</i> (27.1), <i>Poa pratensis</i> (24.9) <u>Prominent:</u> <i>Vicia sativa</i> (10.4), <i>Bromus rigidus</i> (10.0), <i>Holcus lanatus</i> (6.0), <i>Pteridium aquilinum</i> (6.4), <i>Cirsium arvense</i> (4.1), <i>Hypochaeris radicata</i> (3.5) <u>Usually present:</u> <i>Geranium molle</i> (2.8) <u>Dominant:</u> <i>Abronia latifolia</i> (36.6) <u>Prominent:</u> <i>Leymus mollis</i> (6.4), <i>Bromus sterilis</i> (5.3), <i>Carex macrocephala</i> (4.2), <i>Poa confinis</i> (3.4), <i>Lupinus littoralis</i> (3.0), <i>Rumex acetosella</i> (3.3) <u>Codominant:</u> <i>Cakile maritime</i> (9.8), <i>Bromus sterilis</i> (6.2) <u>Other species:</u> <i>Atriplex</i> spp. (0.2), <i>Lathyrus japonicus</i> (0.2), <i>Leymus mollis</i> (0.2)	RP 4, 6, 10, 17, 20, 21; SD 1, 3, 8; SF 4
9. <i>Bromus sitchensis</i> / <i>Bromus hordeaceus</i> / <i>Poa pratensis</i> (12)	54 species, 16 native, 38 exotic, S=14.9	<u>Dominant:</u> <i>Abronia latifolia</i> (36.6) <u>Prominent:</u> <i>Leymus mollis</i> (6.4), <i>Bromus sterilis</i> (5.3), <i>Carex macrocephala</i> (4.2), <i>Poa confinis</i> (3.4), <i>Lupinus littoralis</i> (3.0), <i>Rumex acetosella</i> (3.3) <u>Codominant:</u> <i>Cakile maritime</i> (9.8), <i>Bromus sterilis</i> (6.2) <u>Other species:</u> <i>Atriplex</i> spp. (0.2), <i>Lathyrus japonicus</i> (0.2), <i>Leymus mollis</i> (0.2)	RP 8, 12, 18, 23, 25, 33, 36, 43, 47; SF 6; XG 17, 47
10. <i>Abronia latifolia</i> (10)	18 species, 6 native, 12 exotic, S= 5.1	<u>Dominant:</u> <i>Abronia latifolia</i> (36.6) <u>Prominent:</u> <i>Leymus mollis</i> (6.4), <i>Bromus sterilis</i> (5.3), <i>Carex macrocephala</i> (4.2), <i>Poa confinis</i> (3.4), <i>Lupinus littoralis</i> (3.0), <i>Rumex acetosella</i> (3.3) <u>Codominant:</u> <i>Cakile maritime</i> (9.8), <i>Bromus sterilis</i> (6.2) <u>Other species:</u> <i>Atriplex</i> spp. (0.2), <i>Lathyrus japonicus</i> (0.2), <i>Leymus mollis</i> (0.2)	RP 49; SD 2, 4, 5, 7, 9; SF 5, 10; SFEX
11. <i>Cakile maritime</i> / <i>Bromus sterilis</i> (4)	5 species, 2 native, 3 exotic, S = 2.0	<u>Dominant:</u> <i>Abronia latifolia</i> (36.6) <u>Prominent:</u> <i>Leymus mollis</i> (6.4), <i>Bromus sterilis</i> (5.3), <i>Carex macrocephala</i> (4.2), <i>Poa confinis</i> (3.4), <i>Lupinus littoralis</i> (3.0), <i>Rumex acetosella</i> (3.3) <u>Codominant:</u> <i>Cakile maritime</i> (9.8), <i>Bromus sterilis</i> (6.2) <u>Other species:</u> <i>Atriplex</i> spp. (0.2), <i>Lathyrus japonicus</i> (0.2), <i>Leymus mollis</i> (0.2)	SF 2, 3, 8, 9
12. <i>Agrostis stolonifera</i> (3)	9 species, 1 native, 8 exotic, S = 4.7	<u>Dominant:</u> <i>Abronia latifolia</i> (36.6) <u>Prominent:</u> <i>Leymus mollis</i> (6.4), <i>Bromus sterilis</i> (5.3), <i>Carex macrocephala</i> (4.2), <i>Poa confinis</i> (3.4), <i>Lupinus littoralis</i> (3.0), <i>Rumex acetosella</i> (3.3) <u>Usually present:</u> <i>Hypochaeris radicata</i> (0.6),	XG 1, 16, 22

¹**Bold** font indicates native species; Dominant: clearly the most abundant species; Codominant: two to four species that share dominance; Prominent: species has cover range of 3 to 15 %, Usually present: cover <3%, but occurs in at least 60% of sampled plots

²S= average species richness/m²

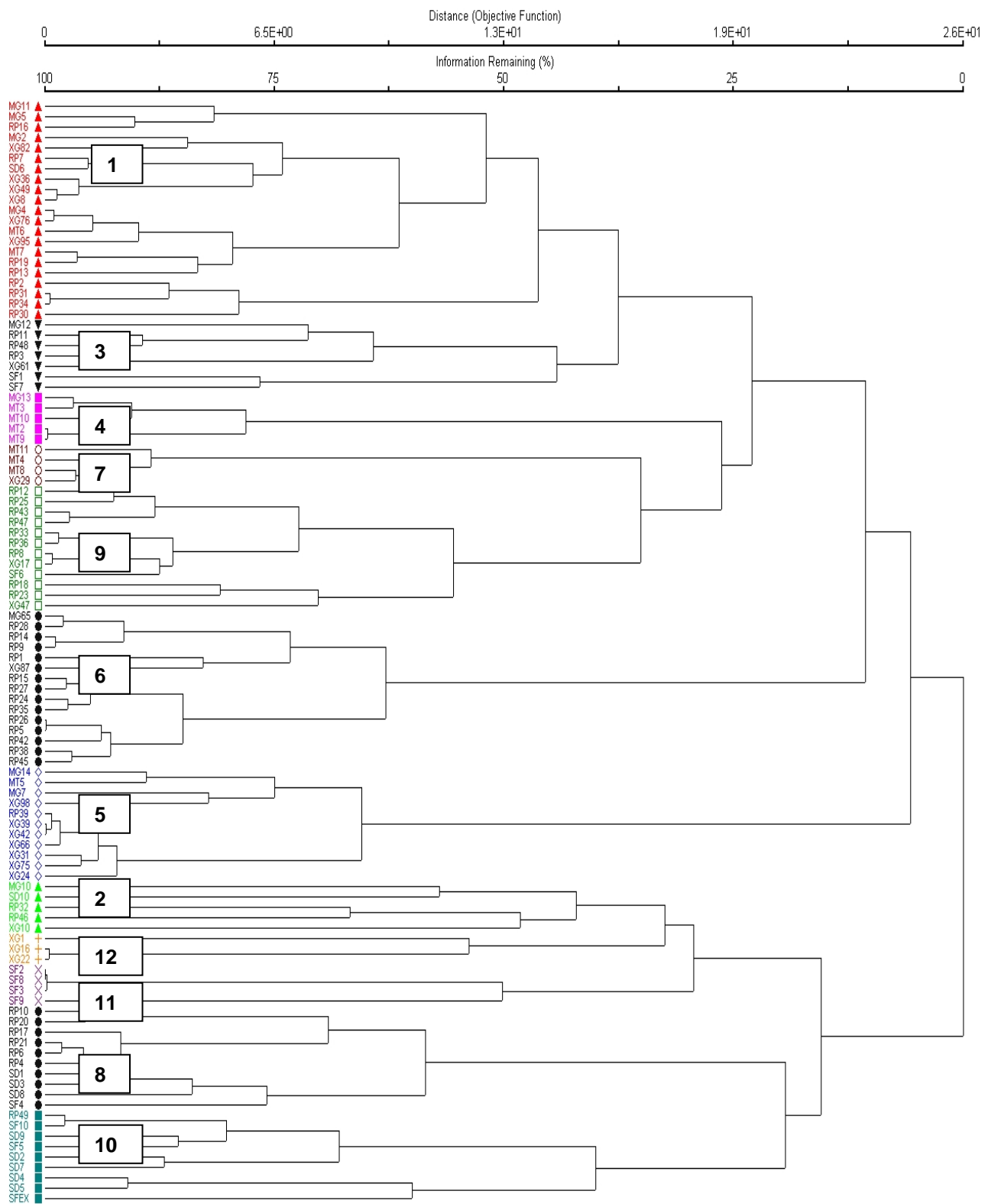


Figure 11. Dendrogram illustrating twelve prairie plant communities described at the American Camp. Numbers in boxes correspond to community numbers in Table 3.

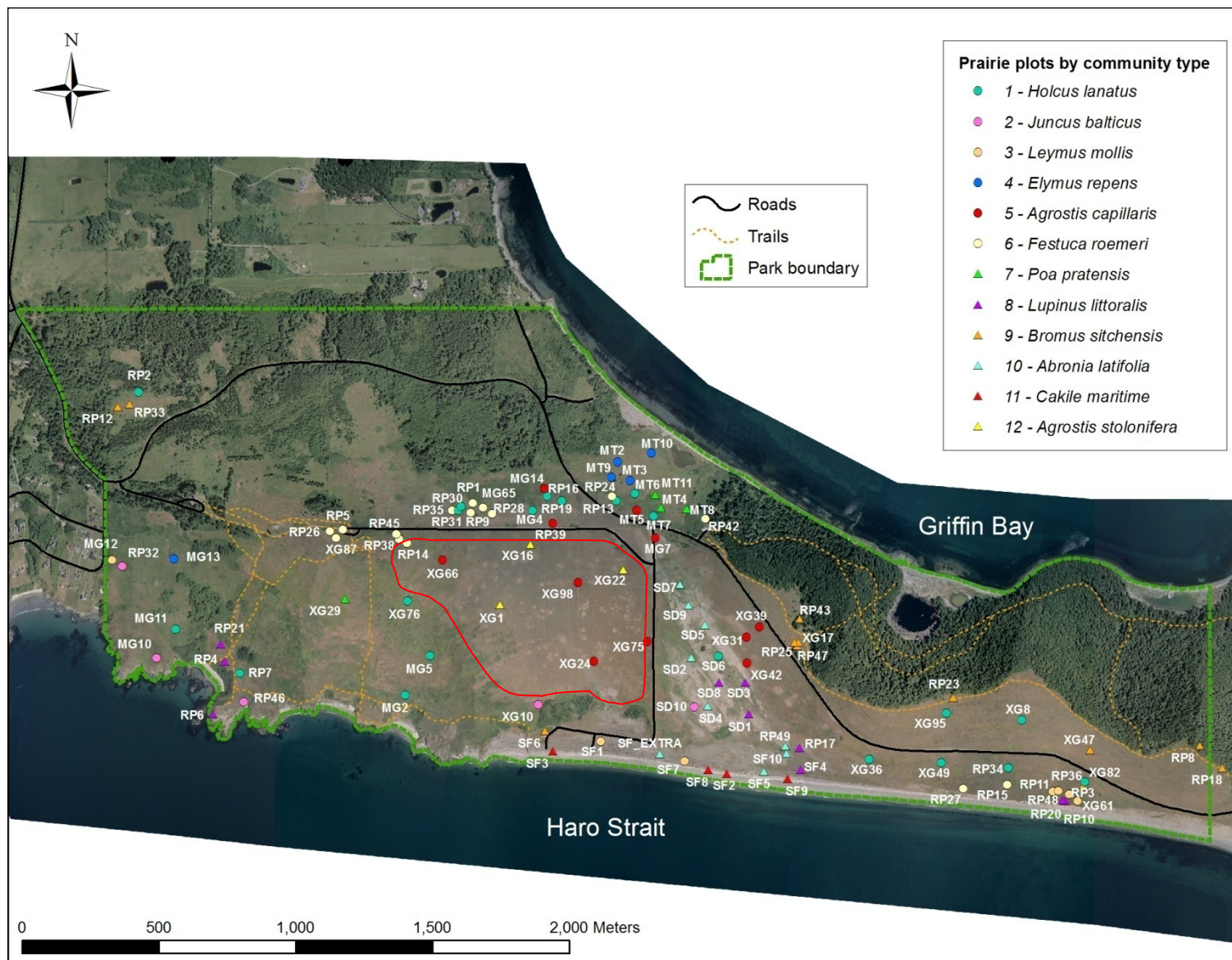


Figure 12. Map showing location of vegetation plots, as assigned to vegetation class; area outlined in red indicating high rabbit activity.

Seed bank Surveys

A total of 3,298 seedlings emerged from 48 of the 58 seed bank samples that we collected; seedlings did not emerge from ten of the samples. Six of the seedlings could only be identified to genus, but the remainder represented 20 exotic species and nine native species (Appendix F) Six exotic species were the predominant plants (i.e. frequency of occurrence and density) found in the seed banks. *Rumex acetosella* occurred in 55% (565 seedlings) of our samples and when the samples were grouped by vegetation community, it was documented in 66% of the communities. *Holcus lanatus* grew in 51% of our samples (718 seedlings) and in 92% of the vegetation communities. *Myosotis discolor* grew in 36% of our samples (323 seedlings) and 75% of the vegetation communities. *Aira caryophylla*, *A. praecox*, and *Aira* spp. were grouped together and documented in 43% of all samples (570 seedlings) and 83% of the vegetation communities. *Bromus rigidus* was documented in 8% of the samples (86 seedlings) and 43% of all communities sampled. *Bromus* spp. were documented in 31% of the samples (250 seeds) and 66% of the communities, but seedlings were not grown long enough to determine if they were exotic or native species. *Festuca romerii* was the most frequently documented native species. It occurred in 15% of the seed bank samples (63 seedlings) and 50% of the vegetation communities. Two communities only had three species emerge from the seed banks: the *Agrostis capillaris* community only included *Poa compressa*, *Bromus* sp., and *Cirsium arvense*. Only *Aira caryophylla*, *Holcus lanatus*, and *Sonchus asper* emerged from samples collected in the *Agrostis stolonifera* community. Samples from both of these communities were collected in the area which had been heavily grazed by European rabbit (*Oryctolagus cuniculus*).

Discussion

Vascular plant inventories conducted within San Juan Island National Historical Park between 2001 and 2005 supplemented previous vegetation studies (Agee 1984, 1987, Rolph and Agee, 1993, Holmes 1998, Peterson 2002) by verifying species occurrences with herbarium specimens, describing the American Camp prairie communities, and refining the potential species lists through systematic field surveys. In this inventory, we documented 400 species and were able to verify 84% with herbarium specimens. Although 33% of the species were exotic, most exotic species were found in the prairies or in developed zones adjacent to current or historic building locations. Fewer exotic species were found within the forests and those that were found growing in the forest were generally close to roads or trails or in areas that were being thinned for forest fuel reduction (specifically near the slash burn piles).

Perhaps one of the most surprising “discoveries” of the inventory was the documentation of native prairie communities (Figures 7 and 13). Previous studies had documented the dominance of exotic grasses within the American Camp prairie and recommended that the most successful restoration strategy might be to focus on replacement of annual exotic grasses with exotic perennials and the addition of a few native grasses (Romo 1985a, 1985b, Rolph and Agee 1993,). We described six native plant communities and mapped 87 native prairie plant polygons that ranged in size from 25 m² to 1.8 ha, totaling 34.2 ha or 12% of the total prairie area (McCoy and Dalby 2009). The occurrence of these communities will aid in the park’s prairie restoration program by providing reference communities for development of desired future conditions, sources of native seeds, and islands of native diversity from which restoration can expand.

The *Festuca roemerii*, *Bromus sitchensis*, and *Leymus mollis* communities will probably be the most useful for upland prairie restoration. The *Festuca roemerii* community was the most diverse community that we observed ($S=18.8/\text{m}^2$) and we may have missed a few species such as *Brodiaea coronaria* and *Ranunculus occidentalis* var. *occidentalis* due to the timing of our inventories. In the case of *Brodiaea coronaria*, we did not see it flowering until 2006 after the restoration area had been burned, so we were not certain what it was. Although we may have missed a few species in this community, it is apparent that the Roemer’s fescue association on San Juan is slightly different from the Roemer’s fescue communities in the South Puget Sound or on Yellow Island. Unlike Yellow Island (Dunwiddie 2002) or the *Festuca roemerii*- *Camassia leichtlinii* association (Chappell 2006), the San Juan *Festuca roemerii* community did not have any *Castilleja hispida* (harsh paintbrush), *Camassia leichtlinii* (great Camas), or *Erythronium oregonum* (white fawn-lily) present. Although we did find *Camassia leichtlinii* in the American prairies, it was generally close to the coastal bluffs and associated with *Festuca rubra* var. *littoralis*. *Erythronium oregonum* grows in English Camp on Young Hill between the Garry Oak community and the coniferous forest. *Camassia quamash* was an important component of this type and while it was a component of Chappell’s *Festuca roemerii*- *Sericocarpus rigidus* (2006) association, *Sericocarpus rigidus* did not occur in SAJH. Although *Lomatium nudicaule* and *L. utriculatum* both occurred at American Camp, they were patchily distributed and generally occurred in low densities.

The *Bromus sitchensis* community is probably more widespread than we had initially thought since we have now documented it in many of the forest openings north of the park road where it occurs with *Elymus glaucus*. In our current classification, *Elymus glaucus* is primarily in the

Holcus lanatus type. In our plots, *Elymus glaucus* cover ranged from 0 to 77% within the *Holcus lanatus* type. In more recent field surveys, we have noticed more sites where *Elymus* dominates and often, it is growing either with *Bromus sitchensis* or adjacent to it. Our sampling strategy did not include many of the forest openings or sites close to the forest edge where the two species seem to occur. It now appears that the *Elymus glaucus* and *Bromus sitchensis* communities need better description and that *Holcus lanatus* is invading these communities in some situations. Another species that we missed was *Schedonorus arundinaceum* (*Festuca arundinacea* at the time of our study). This species is prevalent in the northern prairie areas labeled as mesic grasslands with tree regeneration (Peterson 2002, Figure 4). We did not have any sample points in those polygons and based on our subsequent surveys, we feel that we missed an additional vegetation type, not just one species.

The *Abronia latifolia* and *Lupinus littoralis*-*Bromus rigidus* communities were found primarily within the sand dune and sandflat vegetation types described by Peterson (2002). When we began our study, there were very few exotics within the *Abronia latifolia* community, but during the course of our study, *Cirsium arvense* increased in abundance in this community and in the *Festuca roemerii* communities near the Redoubt. *Holcus lanatus* was another species that increased in abundance in the sand dunes but also in the extant *Festuca roemerii* communities and in the areas that were being restored to *Festuca roemerii* (below the Redoubt) or *Elymus glaucus* and *Bromus sitchensis*. Based on our seed bank survey, *Holcus lanatus* and *Rumex acetosella* were the most abundant and the most widespread species in the seed bank. While *Holcus* seeds can last several years in the soil, it is also a prolific producer of seeds and one plant can produce between 177 to 240,000 seeds (Organic Weed Management 2009). The results of our seed bank survey indicate that most stored seeds are exotic and the seed bank composition does not reflect the dominant above ground species. Our findings reinforce the current park restoration strategy that site preparation is extremely important, but in order for the restoration program to be successful over time, continued site maintenance (exotic plant control) will be critical in the initial stages of restoration to prevent establishment of exotic species either from the seed bank or adjacent exotic plant populations.

In conclusion, San Juan Island National Historical Park protects a surprisingly diverse array of vegetation communities including coniferous forests, rocky balds, prairies, and coastal and inland wetlands. This study provides a foundation for other studies to look at the environmental parameters and historical uses that have influenced the development and status of these communities. The prairies, wetlands, and sand flat communities of SAJH generate many interesting questions with regards to restoration, responses to climate change, and relationships to pollinators and herbivores (rabbits, deer, and voles). During the course of this study, we collected environmental parameters (slope, aspect, elevation, microtopography) and hope to investigate the distribution of plant communities with respect to these attributes and soil type. However, past site history might play an important role, so activities such as agriculture and use by livestock will be investigated at a later time when we have completed digitizing of data from the historic period.



Figure 13. Photographs of selected prairie vegetation communities at American Camp. a) rabbit warren area dominated by *Agrostis capillaris* community, pink flowers are *Erodium cicutarium*, b) landscape view of *Agrostis capillaris* community with *Holcus lanatus* in the foreground, c) *Camassia quamamash* in the *Festuca roemerii* community, d) *Festuca roemerii* community with *Ranunculus californicus*, *R. occidentalis*, and *Fritillaria affinis*, e) *Abronia latifolia* community, f) area along beach referred to as sand flat by Peterson (2002) and frequently dominated by the *Cakile maritima* community



Figure 13 (continued). Photographs of selected prairie vegetation communities at American Camp g) view toward Douglas fir forest across the *Elymus repens* community, h) landscape view of sand flat community dominated by *Cakile maritima*, i) *Holcus lanatus* community, j) close up view of *Abronia* community with *Bromus rigidus*, k) *Bromus sitchensis* community, and l) view along coast near Grandma's Cove showing shrubs (willows) and prairies

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Appendix A. Forbs of San Juan Island National Historical Park.

Family	Scientific Name	Common Name	Origin
Apiaceae	<i>Cicuta douglasii</i>	Western Water Hemlock	N
Apiaceae	<i>Daucus carota</i>	Queen Anne's Lace	E
Apiaceae	<i>Heracleum maximum</i>	Common Cowparsnip	N
Apiaceae	<i>Lomatium nudicaule</i>	Barestem Biscuitroot	N
Apiaceae	<i>Lomatium utriculatum</i>	Common Lomatium	N
Apiaceae	<i>Oenanthe sarmentosa</i>	Water Parsely	N
Apiaceae	<i>Osmorhiza berteroi</i>	Sweet cicely	N
Apiaceae	<i>Osmorhiza purpurea</i>	Purple Sweetroot	N
Apiaceae	<i>Sanicula crassicaulis</i> var. <i>crassicaulis</i>	Pacific Black snakeroot	N
Apiaceae	<i>Sanicula crassicaulis</i> var. <i>tripartita</i>	Pacific Black snakeroot	N
Apocynaceae	<i>Vinca major</i>	Bigleaf Periwinkle	E
Araceae	<i>Lysichiton americanus</i>	American Skunkcabbage	N
Araliaceae	<i>Hedera helix</i>	English Ivy	E
Aspleniaceae	<i>Asplenium trichomanes-ramosum</i>	Brightgreen Spleenwort	N
Asteraceae	<i>Achillea millefolium</i> var. <i>occidentalis</i>	Western Yarrow	N
Asteraceae	<i>Adenocaulon bicolor</i>	American Trailplant	N
Asteraceae	<i>Ambrosia chamissonis</i>	Silver Bur Ragweed	N
Asteraceae	<i>Anaphalis margaritacea</i>	Western Pearly Everlasting	N
Asteraceae	<i>Arctium minus</i>	Lesser Burdock	E
Asteraceae	<i>Bellis perennis</i>	Lawndaisy	E
Asteraceae	<i>Cichorium intybus</i>	Chicory	E
Asteraceae	<i>Cirsium arvense</i>	Canada Thistle	E
Asteraceae	<i>Cirsium vulgare</i>	Bull Thistle	E
Asteraceae	<i>Crepis capillaris</i>	Smooth Hawksbeard	E
Asteraceae	<i>Gnaphalium purpureum</i>	Spoonleaf Purple Everlasting	N
Asteraceae	<i>Grindelia stricta</i> var. <i>stricta</i>	Oregon Gumweed	N
Asteraceae	<i>Heliopsis helianthoides</i>	Smooth Oxeye	N
Asteraceae	<i>Hieracium albiflorum</i>	White Hawkweed	N
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Cat's Ear	E
Asteraceae	<i>Hypochaeris radicata</i>	Hairy Cat's Ear	E
Asteraceae	<i>Jaumea carnosa</i>	Marsh Jaumea	N
Asteraceae	<i>Lapsana communis</i>	Common Nipplewort	E
Asteraceae	<i>Leontodon autumnalis</i>	Fall Dandelion	E
Asteraceae	<i>Leontodon hirtus</i>	Rough Hawkbit	E
Asteraceae	<i>Leucanthemum vulgare</i>	Oxeye Daisy	E
Asteraceae	<i>Logfia arvensis</i>	Field Cottonrose	E
Asteraceae	<i>Madia madioides</i>	Woodland Madia	N
Asteraceae	<i>Madia sativa</i>	coast tarweed	N
Asteraceae	<i>Matricaria discoidea</i>	Disc Mayweed	E
Asteraceae	<i>Mycelis muralis</i>	Wall-Lettuce	E

Appendix A. Forbs of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Asteraceae	<i>Senecio jacobaea</i>	Stinking Willie	E
Asteraceae	<i>Solidago canadensis</i> var. <i>salebrosa</i>	Rough Canada Goldenrod	N
Asteraceae	<i>Sonchus asper</i>	Spiny Sowthistle	E
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	E
Asteraceae	<i>Symphyotrichum eatonii</i>	Eaton's Aster	N
Asteraceae	<i>Symphyotrichum hallii</i>	Hall's Aster	N
Asteraceae	<i>Taraxacum laevigatum</i>	Rock Dandelion	E
Asteraceae	<i>Taraxacum officinale</i>	Common Dandelion	E
Asteraceae	<i>Tragopogon dubius</i>	Yellow Salsify	E
Boraginaceae	<i>Amsinckia menziesii</i>	Menzies' Fiddleneck	N
Boraginaceae	<i>Amsinckia menziesii</i> var. <i>intermedia</i>	Common Fiddleneck	N
Boraginaceae	<i>Cryptantha intermedia</i>	Clearwater Cryptantha	E
Boraginaceae	<i>Myosotis discolor</i>	Changing Forget-Me-Not	E
Boraginaceae	<i>Myosotis laxa</i>	Bay Forget-Me-Not	N
Brassicaceae	<i>Arabidopsis thaliana</i>	Mouse-ear Cress	E
Brassicaceae	<i>Barbarea orthoceras</i>	American Yellowrocket	N
Brassicaceae	<i>Brassica rapa</i> ssp. <i>campestris</i>	Common Mustard	E
Brassicaceae	<i>Cakile maritima</i>	European Searocket	E
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's Purse	E
Brassicaceae	<i>Cardamine hirsuta</i>	Hairy Bittercress	E
Brassicaceae	<i>Cardamine oligosperma</i> var. <i>oligosperma</i>	Little Western Bittercress	N
Brassicaceae	<i>Cardamine pennsylvanica</i>	Pennsylvania Bittercress	N
Brassicaceae	<i>Draba verna</i>	Spring Whitlow Grass	E
Brassicaceae	<i>Lepidium densiflorum</i> var. <i>densiflorum</i>	Common Pepperweed	N
Brassicaceae	<i>Lepidium virginicum</i> var. <i>menziesii</i>	Menzies' Pepperweed	N
Brassicaceae	<i>Rorippa nasturtium-aquaticum</i>	Watercress	N
Brassicaceae	<i>Sisymbrium altissimum</i>	Tall Tumblemustard	E
Brassicaceae	<i>Teesdalia nudicaulis</i>	Barestem Teesdalia	E
Callitrichaceae	<i>Callitriche heterophylla</i> ssp. <i>bolanderi</i>	Bolander's Water-Starwort	N
Campanulaceae	<i>Campanula scouleri</i>	Pale Bellflower	N
Caprifoliaceae	<i>Linnaea borealis</i> ssp. <i>longiflora</i>	Longtube Twinflower	N
Caprifoliaceae	<i>Lonicera ciliosa</i>	Orange Honeysuckle	N
Caprifoliaceae	<i>Lonicera hispidula</i>	Pink Honeysuckle	N
Caryophyllaceae	<i>Cerastium arvense</i>	Field Chickweed Common Mouse-Ear	N
Caryophyllaceae	<i>Cerastium fontanum</i>	Chickweed	E
Caryophyllaceae	<i>Cerastium glomeratum</i>	Sticky Chickweed	E
Caryophyllaceae	<i>Dianthus armeria</i>	Deptford Pink	E
Caryophyllaceae	<i>Honckenya peploides</i>	Seaside Sandplant	N
Caryophyllaceae	<i>Lychnis coronaria</i>	Rose Campion	E
Caryophyllaceae	<i>Moehringia macrophylla</i>	Largeleaf Sandwort	N
Caryophyllaceae	<i>Sagina maxima</i> ssp. <i>crassicaulis</i>	Stickystem Pearlwort	N
Caryophyllaceae	<i>Sagina procumbens</i>	Birdeye Pearlwort	E
Caryophyllaceae	<i>Scleranthus annuus</i>	German knotgrass	E

Appendix A. Forbs of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Caryophyllaceae	<i>Spergularia canadensis</i>	Canadian Sandspurry	N
Caryophyllaceae	<i>Spergularia macrotheca</i>	Sticky Sandspurry	N
Caryophyllaceae	<i>Spergularia rubra</i>	Red Sandspurry	E
Caryophyllaceae	<i>Stellaria crispa</i>	Curled Starwort	N
Caryophyllaceae	<i>Stellaria media</i>	Common Chickweed	E
Caryophyllaceae	<i>Stellaria nitens</i>	shiny chickweed	N
Chenopodiaceae	<i>Atriplex gmelinii</i>	Gmelin's Saltbrush	N
Chenopodiaceae	<i>Atriplex patula</i>	Spear Saltbrush	N
Chenopodiaceae	<i>Atriplex patula</i> ssp. <i>patula</i>	Spear Saltbrush	N
Chenopodiaceae	<i>Atriplex prostrata</i>	Triangle Orache	N
Chenopodiaceae	<i>Chenopodium album</i>	Lambsquarters	E
Chenopodiaceae	<i>Chenopodium leptophyllum</i>	Narrowleaf Goosefoot	N
Chenopodiaceae	<i>Salicornia virginica</i>	Virginia Glasswort	N
Clusiaceae	<i>Hypericum scouleri</i> ssp. <i>scouleri</i>	Scouler's St. Johnswort	N
Convolvulaceae	<i>Calystegia soldanella</i>	Seashore False Bindweed	N
Cornaceae	<i>Cornus canadensis</i>	Bunchberry Dogwood	N
Crassulaceae	<i>Crassula connata</i>	Sand Pygmyweed	N
Crassulaceae	<i>Sedum lanceolatum</i> ssp. <i>nesioticum</i>	Spearleaf Stonecrop	N
Crassulaceae	<i>Sedum oreganum</i>	Oregon Stonecrop	N
Crassulaceae	<i>Sedum spathulifolium</i>	Broadleaf Stonecrop	N
Cucurbitaceae	<i>Marah oreganus</i>	Coastal Manroot	N
Cuscutaceae	<i>Cuscuta salina</i>	Saltmarsh Dodder	N
Dennstaedtiaceae	<i>Pteridium aquilinum</i> var. <i>pubescens</i>	Hairy Brackenfern	N
Dipsacaceae	<i>Dipsacus fullonum</i> ssp. <i>sylvestris</i>	Fuller's Teasel	E
Dryopteridaceae	<i>Athyrium filix-femina</i>	Common Ladyfern	N
Dryopteridaceae	<i>Dryopteris expansa</i>	Spreading Woodfern	N
Dryopteridaceae	<i>Polystichum munitum</i>	Western Swordfern	N
Equisetaceae	<i>Equisetum arvense</i>	Field Horsetail	N
Equisetaceae	<i>Equisetum hyemale</i>	Scouringrush Horsetail	N
Equisetaceae	<i>Equisetum telmateia</i> var. <i>braunii</i>	Giant Horsetail	N
Fabaceae	<i>Lathyrus japonicus</i>	Beach Pea	N
Fabaceae	<i>Lathyrus nevadensis</i> var. <i>nuttallii</i>	Sierra Pea	N
Fabaceae	<i>Lathyrus nevadensis</i> var. <i>pilosellus</i>	Sierra Pea	N
Fabaceae	<i>Lotus micranthus</i>	Desert Deervetch	N
Fabaceae	<i>Lupinus bicolor</i> ssp. <i>bicolor</i>	Miniature Lupine	N
Fabaceae	<i>Lupinus densiflorus</i> var. <i>densiflorus</i>	Whitewhorl Lupine	N
Fabaceae	<i>Lupinus latifolius</i>	Broadleaf Lupine	N
Fabaceae	<i>Lupinus littoralis</i>	Seashore Lupine	N
Fabaceae	<i>Lupinus polycarpus</i>	Smallflower Lupine	N
Fabaceae	<i>Medicago lupulina</i>	Black Medick	E
Fabaceae	<i>Medicago sativa</i>	Alfalfa	E
Fabaceae	<i>Melilotus alba</i>	Yellow Sweetclover	E
Fabaceae	<i>Trifolium dubium</i>	Suckling Clover	E

Appendix A. Forbs of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Fabaceae	<i>Trifolium microcephalum</i>	Smallhead Clover	N
Fabaceae	<i>Trifolium microdon</i>	Thimble Clover	N
Fabaceae	<i>Trifolium oliganthum</i>	Few-Flowered Clover	N
Fabaceae	<i>Trifolium pratense</i>	Red Clover	E
Fabaceae	<i>Trifolium repens</i>	White Clover	E
Fabaceae	<i>Trifolium subterraneum</i>	Subterranean Clover	E
Fabaceae	<i>Trifolium willdenowii</i>	Tomcat Clover	N
Fabaceae	<i>Vicia americana</i> ssp. <i>americana</i>	American Vetch	N
Fabaceae	<i>Vicia cracca</i>	Bird Vetch	E
Fabaceae	<i>Vicia hirsuta</i>	Tiny Vetch	E
Fabaceae	<i>Vicia nigricans</i> ssp. <i>gigantea</i>	Giant Vetch	N
Fabaceae	<i>Vicia sativa</i> ssp. <i>sativa</i>	Garden Vetch	E
Fabaceae	<i>Vicia tetrasperma</i>	Lentil Vetch	E
Fabaceae	<i>Vicia villosa</i>	Winter Vetch	E
Gentianaceae	<i>Centaurium erythraea</i>	European Centaury	E
Geraniaceae	<i>Erodium cicutarium</i>	Redstem Stork's Bill	E
Geraniaceae	<i>Geranium dissectum</i>	Cutleaf Geranium	E
Geraniaceae	<i>Geranium molle</i>	Dovefoot Geranium	E
Geraniaceae	<i>Geranium robertianum</i>	Robert Geranium	E
Hippuridaceae	<i>Hippuris vulgaris</i>	Common Mares-tail	N
Hydrophyllaceae	<i>Nemophila parviflora</i> var. <i>parviflora</i>	Smallflower Nemophila	N
Iridaceae	<i>Olsynium douglasii</i>	Grass widows	N
Iridaceae	<i>Sisyrinchium idahoense</i>	Idaho Blue-Eyed Grass	N
Lamiaceae	<i>Clinopodium douglasii</i>	Yerba Buena	N
Lamiaceae	<i>Lamium purpureum</i>	Red Dead-nettle	E
Lamiaceae	<i>Mentha arvensis</i>	Wild Mint	N
Lamiaceae	<i>Prunella vulgaris</i> ssp. <i>lanceolata</i>	Lance Selfheal	E
Lamiaceae	<i>Stachys chamissonis</i> var. <i>cooleyae</i>	Coastal Hedgenettle	N
Lemnaceae	<i>Lemna minor</i>	Common Duckweed	N
Liliaceae	<i>Allium acuminatum</i>	Tapertip Onion	N
Liliaceae	<i>Allium cernuum</i>	Nodding Onion	N
Liliaceae	<i>Brodiaea coronaria</i>	Crown Brodiaea	N
Liliaceae	<i>Camassia leichtlinii</i> ssp. <i>suksdorfii</i>	Suksdorf's Large Camas	N
Liliaceae	<i>Camassia quamash</i>	Common Camas	N
Liliaceae	<i>Clintonia uniflora</i>	Bride's Bonnet	N
Liliaceae	<i>Erythronium oregonum</i>	Giant White Fawnlily	N
Liliaceae	<i>Fritillaria affinis</i> var. <i>affinis</i>	Checker Lily	N
Liliaceae	<i>Hyacinthoides hispanica</i>	Scilla	E
Liliaceae	<i>Maianthemum dilatatum</i>	False Lily Of The Valley Starry False Lily Of The Valley	N
Liliaceae	<i>Maianthemum stellatum</i>	Valley	N
Liliaceae	<i>Triteleia grandiflora</i> var. <i>howellii</i>	Howell's Triteliea	N
Liliaceae	<i>Triteleia hyacinthina</i>	White Brodiaea	N
Liliaceae	<i>Zigadenus venenosus</i> var. <i>venenosus</i>	Meadow Death camas	N

Appendix A. Forbs of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Monotropaceae	<i>Monotropa uniflora</i>	Indian Pipe	N
Monotropaceae	<i>Pterospora andromedea</i>	Woodland Pinedrops	N
Nyctaginaceae	<i>Abronia latifolia</i>	Coastal Sand Verbena	N
Onagraceae	<i>Camissonia contorta</i>	Plains Evening Primrose	N
Onagraceae	<i>Chamerion angustifolium</i>	Fireweed	N
Onagraceae	<i>Circaea alpina</i>	Small Enchanter's Nightshade	N
Onagraceae	<i>Epilobium ciliatum</i> ssp. <i>ciliatum</i>	Fringed Willowherb	N
Onagraceae	<i>Epilobium ciliatum</i> ssp. <i>watsonii</i>	Fringed Willowherb	N
Onagraceae	<i>Epilobium minutum</i>	Chaparral Willowherb	N
Orchidaceae	<i>Calypso bulbosa</i>	Fairy Slipper	N
Orchidaceae	<i>Corallorrhiza maculata</i>	Summer Coralroot	N
Orchidaceae	<i>Corallorrhiza mertensiana</i>	Pacific Coralroot	N
Orchidaceae	<i>Corallorrhiza striata</i>	Hooded Coralroot	N
Orchidaceae	<i>Goodyera oblongifolia</i>	Western Rattlesnake Plantain	N
Orchidaceae	<i>Listera cordata</i>	Heartleaf Twayblade	N
Orchidaceae	<i>Piperia elegans</i> ssp. <i>elegans</i>	Elegant Piperia	N
Orchidaceae	<i>Piperia unalascensis</i>	Slender-Spire Orchid	N
Orchidaceae	<i>Spiranthes romanoffiana</i>	Hooded Lady's Tresses	N
Papaveraceae	<i>Eschscholzia californica</i>	California Poppy	E
Papaveraceae	<i>Papaver somniferum</i>	Opium Poppy	E
Plantaginaceae	<i>Plantago lanceolata</i>	Narrowleaf Plantain	E
Plantaginaceae	<i>Plantago major</i>	Common Plantain	N
Plantaginaceae	<i>Plantago major</i> var. <i>major</i>	Common Plantain	E
Plantaginaceae	<i>Plantago maritima</i> var. <i>juncoides</i>	Goose Tongue	N
Plumbaginaceae	<i>Armeria maritima</i> ssp. <i>sibirica</i>	Siberian Sea Thrift	N
Polemoniaceae	<i>Linanthus bicolor</i> ssp. <i>minimus</i>	True Babystars	N
Polygonaceae	<i>Polygonum aviculare</i>	Prostrate Knotweed	E
Polygonaceae	<i>Polygonum douglasii</i> ssp. <i>spargulariiforme</i>	Scatter Knotweed	N
Polygonaceae	<i>Rumex acetosella</i>	Common Sheep Sorrel	E
Polygonaceae	<i>Rumex crispus</i>	Curly Dock	E
Polygonaceae	<i>Rumex maritimus</i>	Golden Dock	N
Polypodiaceae	<i>Polypodium amorphum</i>	Irregular Polypody	N
Polypodiaceae	<i>Polypodium glycyrrhiza</i>	Licorice Fern	N
Portulacaceae	<i>Claytonia perfoliata</i> ssp. <i>perfoliata</i>	Miner's Lettuce	N
Portulacaceae	<i>Claytonia rubra</i> ssp. <i>rubra</i>	Redstem Springbeauty	N
Portulacaceae	<i>Claytonia sibirica</i> var. <i>sibirica</i>	Siberian Springbeauty	N
Portulacaceae	<i>Montia parvifolia</i>	Littleleaf Minerslettuce	N
Portulacaceae	<i>Montia parvifolia</i> ssp. <i>flagellaris</i>	Littleleaf Minerslettuce	N
Primulaceae	<i>Anagallis arvensis</i>	Scarlet Pimpernel	E
Primulaceae	<i>Dodecatheon hendersonii</i>	Mosquito Bills	N
Primulaceae	<i>Trientalis borealis</i> ssp. <i>latifolia</i>	Broadleaf Starflower	N
Pteridaceae	<i>Pentagramma triangularis</i> ssp. <i>triangularis</i>	Goldback Fern	N

Appendix A. Forbs of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Ranunculaceae	<i>Aquilegia formosa</i>	Western Columbine	N
Ranunculaceae	<i>Delphinium menziesii</i> ssp. <i>menziesii</i>	Menzies' Larkspur	N
Ranunculaceae	<i>Ranunculus acris</i>	Tall Buttercup	E
Ranunculaceae	<i>Ranunculus californicus</i>	California Buttercup	N
Ranunculaceae	<i>Ranunculus flammula</i>	Greater Creeping Spearwort	N
Ranunculaceae	<i>Ranunculus occidentalis</i> var. <i>occidentalis</i>	Western Buttercup	N
Ranunculaceae	<i>Ranunculus repens</i> var. <i>repens</i>	Creeping Buttercup	E
Ranunculaceae	<i>Ranunculus uncinatus</i> var. <i>parviflorus</i>	Idaho Buttercup	N
Rosaceae	<i>Argentina egedii</i> ssp. <i>egedii</i>	Pacific Silverweed	N
Rosaceae	<i>Fragaria chiloensis</i>	Beach Strawberry	N
Rosaceae	<i>Fragaria vesca</i> ssp. <i>bracteata</i>	Woodland Strawberry	N
Rosaceae	<i>Fragaria virginiana</i>	Virginia Strawberry	N
Rosaceae	<i>Geum macrophyllum</i> var. <i>macrophyllum</i>	Largeleaf Avens	N
Rubiaceae	<i>Galium aparine</i>	Stickywilly	N
Rubiaceae	<i>Galium tricornutum</i>	Roughfruit Corn Bedstraw	E
Rubiaceae	<i>Galium trifidum</i> ssp. <i>columbianum</i>	Threepetal Bedstraw	N
Rubiaceae	<i>Galium triflorum</i>	Fragrant Bedstraw	N
Rubiaceae	<i>Sherardia arvensis</i>	Blue Fieldmadder	E
Ruppiaceae	<i>Ruppia maritima</i>	Widgeongrass	N
Saxifragaceae	<i>Heuchera micrantha</i> var. <i>diversifolia</i>	Crevice Alumroot	N
Saxifragaceae	<i>Lithophragma parviflorum</i>	Smallflower Woodland-Star	N
Saxifragaceae	<i>Tellima grandiflora</i>	Bigflower Tellima	N
Saxifragaceae	<i>Tiarella trifoliata</i> var. <i>trifoliata</i>	Threeleaf Foamflower	N
Saxifragaceae	<i>Tolmiea menziesii</i>	Youth On Age	N
Scrophulariaceae	<i>Castilleja attenuata</i>	Attenuate Indian Paintbrush	N
Scrophulariaceae	<i>Castilleja hispida</i> ssp. <i>hispida</i>	Harsh Indian Paintbrush	N
Scrophulariaceae	<i>Collinsia parviflora</i> var. <i>parviflora</i>	Smallflower Blue Eyed Mary	N
Scrophulariaceae	<i>Cymbalaria muralis</i>	Kenilworth Ivy	E
Scrophulariaceae	<i>Digitalis purpurea</i> var. <i>purpurea</i>	Purple Foxglove	E
Scrophulariaceae	<i>Mimulus guttatus</i>	Seep Monkeyflower	N
Scrophulariaceae	<i>Parentucellia viscosa</i>	Yellow Glandweed	E
Scrophulariaceae	<i>Triphysaria pusilla</i>	Dwarf Owl's-Clover	N
Scrophulariaceae	<i>Verbascum thapsus</i>	Common Mullein	E
Scrophulariaceae	<i>Veronica americana</i>	American Speedwell	N
Scrophulariaceae	<i>Veronica anagallis-aquatica</i>	Water Speedwell	N
Scrophulariaceae	<i>Veronica arvensis</i>	Corn Speedwell	E
Scrophulariaceae	<i>Veronica officinalis</i>	Common Gypsyweed	E
Scrophulariaceae	<i>Veronica scutellata</i>	Skullcap Speedwell	N
Scrophulariaceae	<i>Veronica serpyllifolia</i> ssp. <i>humifusa</i>	Brightblue Speedwell	N
Selaginellaceae	<i>Selaginella wallacei</i>	Wallace's Spikemoss	N
Solanaceae	<i>Solanum physalifolium</i>	Hoe Nightshade	E
Solanaceae	<i>Solanum triflorum</i>	Cutleaf Nightshade	E
Urticaceae	<i>Urtica dioica</i> ssp. <i>gracilis</i>	California Nettle	N

Appendix A. Forbs of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Valerianaceae	<i>Plectritis congesta</i>	Shortspur Seablush	N
Violaceae	<i>Viola adunca</i> var. <i>adunca</i>	Hookedspur Violet	N
Zosteraceae	<i>Zostera marina</i>	Seawrack	N

Appendix B. Grasses, sedges, and rushes of San Juan Island National Historical Park

Family	Scientific Name	Common Name	Origin
Cyperaceae	<i>Carex athrostachya</i>	slender beaked sedge	N
Cyperaceae	<i>Carex aurea</i>	Golden Sedge	N
Cyperaceae	<i>Carex brevicaulis</i>	Shortstem Sedge	N
Cyperaceae	<i>Carex deweyana</i>	Dewey Sedge	N
Cyperaceae	<i>Carex inops</i> ssp. <i>inops</i>	Long-Stolon Sedge	N
Cyperaceae	<i>Carex macrocephala</i>	Largehead Sedge	N
Cyperaceae	<i>Carex obnupta</i>	Slough Sedge	N
Cyperaceae	<i>Carex pachystachya</i>	Chamisso Sedge	N
Cyperaceae	<i>Carex praticola</i>	meadow sedge	N
Cyperaceae	<i>Carex rossii</i>	Ross' Sedge	N
Cyperaceae	<i>Carex tumulicola</i>	Splitawn Sedge	N
Cyperaceae	<i>Eleocharis palustris</i>	Common Spikerush	N
Cyperaceae	<i>Schoenoplectus acutus</i> var. <i>acutus</i>	Hardstem Bullrush	N
Cyperaceae	<i>Schoenoplectus americanus</i>	Chairmaker's Bulrush	N
Juncaceae	<i>Juncus acuminatus</i>	Tapertip Rush	N
Juncaceae	<i>Juncus balticus</i> var. <i>balticus</i>	Mountain Rush	N
Juncaceae	<i>Juncus bufonius</i>	Toad Rush	N
Juncaceae	<i>Juncus effusus</i> var. <i>gracilis</i>	Lamp Rush	N
Juncaceae	<i>Juncus ensifolius</i>	Swordleaf Rush	N
Juncaceae	<i>Juncus tenuis</i>	slender rush	N
Juncaceae	<i>Luzula campestris</i>	Field Woodrush	N
Juncaceae	<i>Luzula multiflora</i> var. <i>multiflora</i>	Common Woodrush	N
Juncaginaceae	<i>Triglochin maritimum</i>	Seaside Arrowgrass	N
Poaceae	<i>Achnatherum lemmonii</i> var. <i>lemmonii</i>	Lemmon's Needlegrass	N
Poaceae	<i>Agrostis capillaris</i>	Colonial Bentgrass	E
Poaceae	<i>Agrostis exarata</i> var. <i>exarata</i>	Spike Bentgrass	N
Poaceae	<i>Agrostis stolonifera</i>	Creeping Bentgrass	E
Poaceae	<i>Aira caryophyllea</i>	Silver Hairgrass	E
Poaceae	<i>Aira praecox</i>	Yellow Hairgrass	E
Poaceae	<i>Alopecurus aequalis</i>	Shortawn Foxtail	N
Poaceae	<i>Alopecurus pratensis</i>	Meadow Foxtail	E
Poaceae	<i>Anthoxanthum aristatum</i>	Annual Vernalgrass	E
Poaceae	<i>Anthoxanthum odoratum</i>	Sweet Vernalgrass	E
Poaceae	<i>Arrhenatherum elatius</i>	Tall Oatgrass	E
Poaceae	<i>Bromus carinatus</i>	California brome	N
Poaceae	<i>Bromus commutatus</i>	hairy brome	E
Poaceae	<i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>	Soft Brome	E

Appendix B. Grasses, sedges and rushes of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Poaceae	<i>Bromus inermis</i> ssp. <i>inermis</i>	Smooth Brome	E
Poaceae	<i>Bromus pacificus</i>	Pacific Brome	N
Poaceae	<i>Bromus rigidus</i>	Ripgut Brome	E
Poaceae	<i>Bromus sitchensis</i> var. <i>sitchensis</i>	Sitka Brome	N
Poaceae	<i>Bromus sterilis</i>	Poverty Brome	E
Poaceae	<i>Bromus vulgaris</i>	Columbia Brome	N
Poaceae	<i>Cynosurus cristatus</i>	Crested Dogstail Grass	E
Poaceae	<i>Cynosurus echinatus</i>	Bristly Dogstail Grass	E
Poaceae	<i>Dactylis glomerata</i>	Orchardgrass	E
Poaceae	<i>Danthonia californica</i>	California Oatgrass	N
Poaceae	<i>Deschampsia caespitosa</i>	Tufted Hairgrass	N
Poaceae	<i>Deschampsia elongata</i>	Slender Hairgrass	N
Poaceae	<i>Distichlis spicata</i>	Saltgrass	N
Poaceae	<i>Elymus glaucus</i> ssp. <i>jepsonii</i>	Jepson's Blue Wildrye	N
Poaceae	<i>Elymus repens</i>	Quackgrass	E
Poaceae	<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	Slender Wheatgrass	N
Poaceae	<i>Festuca occidentalis</i>	Western Fescue	N
Poaceae	<i>Festuca roemerii</i>	Roemer's Fescue	N
Poaceae	<i>Festuca rubra</i> ssp. <i>rubra</i>	Red Fescue	N
Poaceae	<i>Festuca rubra</i> var. <i>littoralis</i>	Coastal Red Fescue	N
Poaceae	<i>Festuca subuliflora</i>	Crinkleawn Fescue	N
Poaceae	<i>Glyceria borealis</i>	Small Floating Mannagrass	N
Poaceae	<i>Holcus lanatus</i>	Common Velvetgrass	E
Poaceae	<i>Hordeum brachyantherum</i>	Meadow Barley	N
Poaceae	<i>Hordeum jubatum</i>	Foxtail Barley	N
Poaceae	<i>Hordeum murinum</i>	Mouse Barley	E
Poaceae	<i>Hordeum murinum</i> ssp. <i>leporinum</i>	Hare Barley	E
Poaceae	<i>Koeleria macrantha</i>	Prairie June Grass	N
Poaceae	<i>Leymus mollis</i> ssp. <i>mollis</i>	American Dunegrass	N
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass	E
Poaceae	<i>Lolium perenne</i> ssp. <i>multiflorum</i>	Italian Ryegrass	E
Poaceae	<i>Melica smithii</i>	Smith's melic grass	N
Poaceae	<i>Melica subulata</i> var. <i>subulata</i>	Alaska Oniongrass	N
Poaceae	<i>Phalaris arundinacea</i>	Reed Canarygrass	E
Poaceae	<i>Phleum pratense</i>	Timothy	E
Poaceae	<i>Poa annua</i>	Annual Bluegrass	E
Poaceae	<i>Poa bulbosa</i>	Bulbous Bluegrass	E
Poaceae	<i>Poa compressa</i>	Canada Bluegrass	E
Poaceae	<i>Poa confinis</i>	Coastline Bluegrass	N
Poaceae	<i>Poa pratensis</i>	Kentucky Bluegrass	E
Poaceae	<i>Poa trivialis</i>	Rough Bluegrass	E
Poaceae	<i>Polypogon monspeliensis</i>	Annual Rabbitsfoot Grass	E

Appendix B. Grasses, sedges and rushes of San Juan Island National Historical Park (continued).

Family	Scientific Name	Common Name	Origin
Poaceae	<i>Puccinellia nuttalliana</i>	Nuttall's Alkaligrass	N
Poaceae	<i>Schedonorus arundinaceum</i>	Tall Fescue	E
Poaceae	<i>Schedonorus pratensis</i>	Meadow ryegrass	E
Poaceae	<i>Vulpia bromoides</i>	Brome Fescue	E
Poaceae	<i>Vulpia myuros</i>	Rat-Tail Fescue	E

Appendix C. Shrubs and vines of San Juan Island National Historical Park

Family	Scientific Name	Common Name	Origin
Berberidaceae	<i>Mahonia aquifolium</i>	Hollyleaved Barberry	N
Berberidaceae	<i>Mahonia nervosa</i>	Cascade Barberry	N
Caprifoliaceae	<i>Lonicera involucrata</i> var. <i>involucrata</i>	Twinberry Honeysuckle	N
Caprifoliaceae	<i>Sambucus racemosa</i>	Red Elderberry	N
Caprifoliaceae	<i>Symphoricarpos albus</i> var. <i>laevigatus</i>	Common Snowberry	N
Elaeagnaceae	<i>Shepherdia canadensis</i>	Russet Buffaloberry	N
Ericaceae	<i>Gaultheria shallon</i>	Salal	N
Ericaceae	<i>Vaccinium ovatum</i>	California Huckleberry	N
Grossulariaceae	<i>Ribes divaricatum</i>	Spreading Gooseberry	N
Grossulariaceae	<i>Ribes lacustre</i>	Prickly Currant	N
Grossulariaceae	<i>Ribes sanguineum</i>	Redflower Currant	N
Hydrangeaceae	<i>Philadelphus lewisii</i>	Lewis' Mock Orange	N
Lamiaceae	<i>Marrubium vulgare</i>	Horehound	E
Rosaceae	<i>Amelanchier alnifolia</i> var. <i>alnifolia</i>	Saskatoon Serviceberry	N
Rosaceae	<i>Cotoneaster horizontalis</i>	Rockspray Cotoneaster	E
Rosaceae	<i>Holodiscus discolor</i>	Oceanspray	N
Rosaceae	<i>Rosa gymnocarpa</i>	Dwarf Rose	N
Rosaceae	<i>Rosa nutkana</i> var. <i>nutkana</i>	Nootka Rose	N
Rosaceae	<i>Rubus discolor</i>	Himalayan Blackberry	E
Rosaceae	<i>Rubus laciniatus</i>	Cutleaf Blackberry	E
Rosaceae	<i>Rubus leucodermis</i>	Whitebark Raspberry	N
Rosaceae	<i>Rubus parviflorus</i>	Thimbleberry	N
Rosaceae	<i>Rubus spectabilis</i>	Salmonberry	N
Rosaceae	<i>Rubus ursinus</i> ssp. <i>macropetalus</i>	California Blackberry	N
Rosaceae	<i>Spiraea douglasii</i>	Rose Spirea	N
Salicaceae	<i>Salix hookeriana</i> ¹	Dune Willow	N
Salicaceae	<i>Salix lucida</i> ssp. <i>lasiandra</i>	Pacific Willow	N
Salicaceae	<i>Salix scouleriana</i>	Scouler's Willow	N

¹ all willows are listed as shrubs

Appendix D. Trees of San Juan Island National Historical Park

Family	Scientific Name	Common Name	Origin
Aceraceae	<i>Acer glabrum</i> var. <i>douglasii</i>	Douglas Maple	N
Aceraceae	<i>Acer macrophyllum</i>	Bigleaf Maple	N
Aquifoliaceae	<i>Ilex aquifolium</i>	English Holly	E
Aquifoliaceae	<i>Ilex opaca</i>	American Holly	E
Betulaceae	<i>Alnus rubra</i>	Red Alder	N
Cornaceae	<i>Cornus sericea</i> ssp. <i>occidentalis</i>	Western Dogwood	N
Cupressaceae	<i>Juniperus scopulorum</i>	Rocky Mountain Juniper	N
Cupressaceae	<i>Thuja plicata</i>	Western Redcedar	N
Ericaceae	<i>Arbutus menziesii</i>	Pacific Madrone	N
Fabaceae	<i>Laburnum anagyroides</i>	Golden Chain Tree	E
Fagaceae	<i>Quercus garryana</i>	Oregon White Oak	N
Pinaceae	<i>Abies grandis</i>	Grand Fir	N
Pinaceae	<i>Picea sitchensis</i>	Sitka Spruce	N
Pinaceae	<i>Pinus contorta</i> var. <i>latifolia</i>	Lodgepole Pine	N
Pinaceae	<i>Pseudotsuga menziesii</i> var. <i>menziesii</i>	Douglas-Fir	N
Pinaceae	<i>Tsuga heterophylla</i>	Western Hemlock	N
Rhamnaceae	<i>Frangula purshiana</i>	Cascara Buckthorn	N
Rosaceae	<i>Crataegus douglasii</i>	Black Hawthorn	N
Rosaceae	<i>Crataegus monogyna</i>	Oneseed Hawthorn	E
Rosaceae	<i>Crataegus suksdorfii</i>	Suksdorf's Hawthorn	N
Rosaceae	<i>Malus fusca</i>	Oregon Crab Apple	N
Rosaceae	<i>Malus sylvestris</i>	European Crab Apple	E
Rosaceae	<i>Oemleria cerasiformis</i>	Indian Plum	N
Rosaceae	<i>Prunus avium</i>	Sweet Cherry	E
Rosaceae	<i>Prunus emarginata</i>	Bitter Cherry	N
Rosaceae	<i>Pyrus communis</i>	Common Pear	E
Rosaceae	<i>Sorbus aucuparia</i>	European Mountain Ash	E
Salicaceae	<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Black Cottonwood	N
Salicaceae	<i>Populus tremuloides</i>	Quaking Aspen	N
Taxaceae	<i>Taxus brevifolia</i>	Pacific Yew	N
Ulmaceae	<i>Ulmus alata</i>	Winged Elm	E

Appendix E. Average percent cover of plant species within each vegetation community (continued).

	Species	Vegetation Community ¹											
		1	2	3	4	5	6	7	8	9	10	11	12
	<i>Carex tumulicola</i>	3.15	1.00	0.00	2.63	0.00	0.00	0.00	0.00	2.45	0.00	0.00	0.0
	<i>Cerastium arvense</i>	0.81	0.13	0.00	0.00	0.13	0.13	0.16	0.19	0.00	0.00	0.00	0.00
	<i>Cerastium viscosum</i>	0.06	0.00	0.00	0.00	0.06	0.17	0.00	0.06	0.16	0.00	0.00	0.00
	<i>Cichorium intybus</i>	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>Cirsium arvense</i>	3.99	5.63	5.38	5.88	1.42	1.21	5.66	4.44	4.09	2.15	0.00	0.00
	<i>Cirsium vulgare</i>	2.56	0.13	1.61	1.25	0.11	0.75	3.44	0.44	0.10	0.00	0.00	0.00
	<i>Crataegus monogyna</i>	0.03	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00
	<i>Crepis capillaris</i>	1.61	0.00	0.38	0.00	0.11	1.29	0.94	0.81	1.09	0.00	0.00	0.00
	<i>Dactylis glomerata</i>	0.00	0.00	0.00	0.00	0.00	0.04	0.16	0.00	0.00	0.00	0.00	0.00
	<i>Danthonia californica</i>	2.05	0.00	0.00	0.00	0.23	2.83	0.78	0.00	1.46	0.00	0.00	0.00
	<i>Daucus carota</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
	<i>Elymus glaucus</i>	9.78	0.00	0.00	0.00	0.00	1.04	0.00	0.00	1.35	0.00	0.00	0.00
	<i>Equisetum arvense</i>	0.69	0.88	0.18	0.00	0.00	0.00	0.00	0.38	0.05	0.00	0.00	0.00
	<i>Equisetum hyemale</i>	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	<i>Erodium cicutarium</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.08	0.00	0.00	0.00
	<i>Festuca roemerii</i>	3.07	0.00	0.00	0.00	0.00	57.50	0.00	3.56	0.00	0.00	0.00	0.00
	<i>Festuca rubra</i> ssp. <i>rubra</i>	0.18	0.75	8.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>Fragaria crinita</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.21
	<i>Fragaria vesca</i> ssp. <i>bracteata</i>	0.03	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
	<i>Fragaria virginiana</i>	0.00	0.25	3.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>Fritillaria affinis</i> var. <i>affinis</i>	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.16	0.00	0.00	0.00
	<i>Galium aparine</i>	0.24	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.10	0.00	0.00	0.00
	<i>Galium tricornutum</i>	0.24	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00
	<i>Galium trifidum</i>	0.00	0.25	0.09	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>Geranium dissectum</i>	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00
	<i>Geraium molle</i>	0.06	0.00	0.09	0.00	0.00	0.00	0.00	0.00	2.81	0.00	0.00	0.00
	<i>Holcus lanatus</i>	40.98	4.63	22.64	12.75	4.89	13.93	5.31	1.88	5.99	0.00	0.00	0.00
	<i>Hypericum formosum</i>	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>Hypochaeris glabra</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.00	0.00
	<i>Hypochaeris radicata</i>	5.00	0.00	3.30	0.00	3.86	2.67	0.16	3.81	3.59	2.22	0.00	0.63

Appendix E. Average percent cover of plant species within each vegetation community (continued).

Species	Vegetation Community ¹											
	1	2	3	4	5	6	7	8	9	10	11	12
<i>Juncus balticus</i> var. <i>balticus</i>	0.98	24.23	0.00	0.00	0.00	0.00	0.00	2.31	0.00	0.00	0.00	0.00
<i>Koeleria cristata</i>	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lathyrus japonicus</i>	0.00	0.00	3.66	0.00	0.00	0.00	0.00	1.88	0.00	0.00	0.16	0.00
<i>Leontodon autumnalis</i>	0.00	0.00	0.71	0.00	0.23	0.13	0.00	0.13	0.00	0.00	0.00	0.63
<i>Leontodon nudicaulis</i>	0.09	0.00	0.00	0.00	0.28	0.08	0.00	0.06	0.00	0.00	0.00	0.00
<i>Lepidium virginicum</i>	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.05	0.69	0.00	0.00
<i>Leymus mollis</i> ssp. <i>mollis</i>	0.00	0.00	32.82	1.50	0.06	0.00	10.94	4.50	0.00	6.39	0.16	0.00
<i>Lomatium nudicaule</i>	0.00	0.00	0.00	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lupinus latifolius</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00
<i>Lupinus littoralis</i>	2.44	0.00	0.18	0.00	0.11	0.92	0.00	35.05	0.00	3.06	0.00	0.00
<i>Luzula multiflora</i> var. <i>multiflora</i>	0.27	0.00	0.00	0.00	0.97	1.50	0.00	0.06	0.10	0.00	0.00	0.00
<i>Myosotis discolor</i>	0.09	0.00	0.18	0.50	0.40	0.00	0.31	0.06	0.21	0.00	0.00	0.00
<i>Oenanthe sarmentosa</i>	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Orthocarpus pusillus</i>	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00
<i>Plantago lanceolata</i>	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00
<i>Poa compressa</i>	2.56	0.00	1.61	0.00	0.00	0.13	0.00	0.75	0.73	0.00	0.00	0.00
<i>Poa confinis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.69	0.00	3.40	0.00	0.00
<i>Poa pratensis</i>	14.89	0.63	4.32	21.00	1.19	4.17	78.44	0.81	24.90	0.00	0.00	0.00
<i>Potentilla pacifica</i>	0.00	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00
<i>Pteridium aquilinum</i>	7.26	2.88	10.80	0.00	2.84	4.88	10.06	6.44	2.97	0.00	0.00	0.00
<i>Ranunculus californicus</i>	0.00	0.00	0.00	0.00	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00
<i>Rosa nutkana</i> var. <i>nutkana</i>	0.27	0.13	0.00	0.00	0.00	0.00	1.09	0.00	0.00	0.00	0.00	0.00
<i>Rubus discolor</i>	0.57	5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00
<i>Rubus laciniatus</i>	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Rubus ursinus</i>	0.71	0.00	12.05	0.75	0.00	0.38	2.34	0.00	0.99	0.00	0.00	0.00
<i>Rumex acetosella</i>	4.44	0.00	0.84	1.00	10.51	4.63	2.50	6.31	5.26	3.33	0.00	4.17
<i>Sanicula crassicaulis</i>	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00
<i>Schedonorus pratensis</i>	0.07	19.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Silene species</i>	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix E. Average percent cover of plant species within each vegetation community (continued).

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Species	Vegetation Community ¹											
	1	2	3	4	5	6	7	8	9	10	11	12
<i>Sisymbrium altissimum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.21	0.00	0.21	0.00	0.00
<i>Sisyrinchium idahoense</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
<i>Sonchus oleraceus</i>	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
<i>Stipa lemonii</i>	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.05	0.00	0.00	0.00
<i>Symphoricarpos albus</i>	0.03	0.00	0.80	0.00	3.41	0.13	2.34	0.00	0.42	0.00	0.00	0.00
<i>Taraxacum officinale</i>	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00
<i>Teesdalia nudicaulis</i>	0.00	0.00	0.00	0.00	1.36	0.88	0.00	0.06	0.00	0.00	0.00	3.54
<i>Tragopogon dubius</i>	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00
<i>Triteleia grandiflora</i>	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
<i>Triteleia hyacinthina</i>	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.10	0.00	0.00	0.00
<i>Trifolium microdon</i>	0.09	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trifolium oliganthum</i>	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Veronica arvensis</i>	0.27	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.47	0.00	0.00	0.00
<i>Vicia americana</i> ssp. <i>americana</i>	0.66	0.00	0.18	0.00	0.00	0.17	0.00	0.00	0.10	0.00	0.00	0.00
<i>Vicia hirsuta</i>	3.96	0.00	2.46	16.50	3.13	2.21	0.94	1.50	2.87	0.00	0.00	0.00
<i>Vicia sativa</i> ssp. <i>sativa</i>	3.78	2.75	1.23	4.75	4.66	5.58	2.81	0.31	10.42	0.00	0.00	0.00
<i>Viola adunca</i> var. <i>adunca</i>	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Vulpia bromoides</i>	0.92	0.00	1.16	0.00	1.53	0.58	0.00	0.25	5.37	0.00	0.00	0.00
<i>Vulpia myuros</i>	0.03	0.00	3.13	0.00	0.06	0.00	0.00	2.31	0.00	0.69	0.00	0.00
<i>Zigadenus venenosus</i>	0.00	0.00	0.00	0.00	0.23	0.33	0.00	0.00	0.05	0.00	0.00	0.00

¹ See Table 4. Quantitative description of American Camp prairie vegetation communities.

Appendix F. Average density (no. of seeds/sq.m.) and frequency of species (percent of samples/community) that emerged from seed bank samples within each vegetation community.

# Samples ²	Community ¹											
	1 (12)	2 (2)	3 (4)	4 (5)	5 (10)	6 (2)	7 (3)	8 (4)	9 (3)	10 (8)	11 (4)	12 (1)
Species												
<i>Achillea millefolium</i>												
Density	0	0	0	0	0	0	0	20	0	0	0	0
Frequency	0	0	0	0	0	0	0	25	0	0	0	0
<i>Agrostis spp</i>												
Density	13	14	338	39	0	65	0	0	0	0	0	0
Frequency	20	33	40	25	0	100	0	0	0	0	0	0
<i>Aira spp</i>												
Density	0	0	1,391	0	0	65	0	0	0	130	0	0
Frequency	0	0	30	0	0	100	0	0	0	50	0	0
<i>Aira caryophyllea</i>												
Density	0	110	26	59	0	0	0	1,495	195	0	52	20
Frequency	0	67	20	17	0	0	0	50	50	0	13	25
<i>Aira praecox</i>												
Density	0	0	136	188	0	0	65	455	1,300	84	104	0
Frequency	0	0	10	30	0	0	33	75	50	50	25	0
<i>Allium spp</i>												
Density	0	0	0	0	0	0	0	0	33	0	0	0
Frequency	0	0	0	0	0	0	0	0	50	0	0	0
<i>Amsinckia menziesii</i>												
Density	0	0	0	0	0	65	46	0	0	0	0	0
Frequency	0	0	0	0	0	100	33	0	0	0	0	0
<i>Anaphalis margaritacea</i>												
Density	0	0	6	0	0	0	0	0	0	0	0	0
Frequency	0	0	10	0	0	0	0	0	0	0	0	0
<i>Arenaria spp</i>												
Density	0	0	0	13	0	0	0	0	0	0	0	0
Frequency	0	0	0	8	0	0	0	0	0	0	0	0
<i>Aster spp</i>												
Density	0	0	0	0	0	0	0	0	0	234	0	0
Frequency	0	0	0	0	0	0	0	0	0	25	0	0
<i>Bromus spp</i>												
Density	134	20	13	410	163	0	0	377	0	312	98	0

Appendix F. Average density (no. of seeds/sq.m.) and frequency of species (percent of samples/community) that emerged from seed bank samples within each vegetation community (continued).

# Samples ²	Community ¹											
	1 (12)	2 (2)	3 (4)	4 (5)	5 (10)	6 (2)	7 (3)	8 (4)	9 (3)	10 (8)	11 (4)	12 (1)
Species												
Frequency	40	33	10	25	50	0	0	25	0	25	13	0
<i>Bromus rigidus</i>												
Density	0	520	0	0	0	0	240	117	33	702	0	0
Frequency	0	33	0	0	0	0	33	25	50	25	0	0
<i>Camissonia contorta</i>												
Density	26	0	0	104	0	0	0	0	0	0	0	0
Frequency	020	0	0	8	0	0	0	0	0	0	0	0
<i>Cardamine oligosperma</i>												
Density	169	110	117	6	0	0	0	0	0	0	0	0
Frequency	80	33	20	8.3	0	0	0	0	0	0	0	0
<i>Cirsium arvense</i>												
Density	6	0	13	6	33	0	195	33	0	0	0	0
Frequency	60	0	20	25	50	0	33	25	0	0	0	0
<i>Erodium cicutarium</i>												
Density	26	20	0	6	0	0	46	0	0	6	0	0
Frequency	20	33	0	8	0	0	67	0	0	25	0	0
<i>Festuca roemerii</i>												
Density	0	20	0	149	0	0	370	20	520	20	0	0
Frequency	0	33	0	17	0	0	67	25	100	25	0	0
<i>Galium aparine</i>												
Density	0	0	52	13	0	0	0	0	0	0	0	0
Frequency	0	0	20	17	0	0	0	0	0	0	0	0
<i>Geranium molle</i>												
Density	0	0	0	13	0	0	130	0	0	0	26	0
Frequency	0	0	0	8	0	0	67	0	0	0	13	0
<i>Holcus lanatus</i>												
Density	546	306	462	1,826	0	195	1,560	345	1,462	1,398	195	52
Frequency	40	33	60	67	0	100	667	50	100	75	25	25
<i>Hypochaeris radicata</i>												
Density	13	0	58	52	0	0	65	163	0	292	0	0
Frequency	20	0	50	25	0	0	33	50	0	75	0	0
<i>Leontodon autumnalis</i>												
Density	0	0	0	0	0	0	0	65	65	0	0	0
Frequency	0	0	0	0	0	0	0	50	50	0	0	0
<i>Leymus mollis</i>												
Density	143	0	0	20	0	0	0	0	0	0	0	0
Frequency	20	0	0	8	0	0	0	0	0	0	0	0

Appendix F. Average density (no. of seeds/sq.m.) and frequency of species (percent of samples/community) that emerged from seed bank samples within each vegetation community (continued).

	Community ¹											
	1	2	3	4	5	6	7	8	9	10	11	12
# Samples ²	(12)	(2)	(4)	(5)	(10)	(2)	(3)	(4)	(3)	(8)	(4)	(1)
Species												
<i>Myosotis</i>												
<i>discolor</i>												
Density	585	240	403	696	0	195	0	162	162	812	97	0
Frequency	100	100	40	33	0	100	0	25	50	25	12	0
<i>Poa compressa</i>												
Density	832	540	325	143	260	1,040	65	0	228	0	0	0
Frequency	80	67	20	33	50	100	33	0	50	0	0	0
<i>Poa confinis</i>												
Density	0	0	0	20	0	0	0	475	0.0	20	32	0
Frequency	0	0	0	8	0	0	0	25	0	25	13	0
<i>Poa pratensis</i>												
Density	0	0	0	26	0	0	0	0	0	0	0	0
Frequency	0	0	0	8	0	0	0	0	0	0	0	0
<i>Poa spp</i>												
Density	0	0	202	65	0	0	214	0	0	117	0	0
Frequency	0	0	30	17	0	0	33	0	0	25	0	0
<i>Rumex</i>												
<i>acetosella</i>												
Density	130	1,625	1,930	416	0	0	195	0	455	1,027	1,625	0
Frequency	40	100	90	75	0	0	67	0	100	100	13	0
<i>Sonchus asper</i>												
Density	26	46	0	0	0	0	0	0	0	0	0	52
Frequency	20	33	0	0	0	0	0	0	0	0	0	25
<i>Stellari spp</i>												
Density	0	0	0	0	0	65	0	0	0	0	0	0
Frequency	0	0	0	0	0	100	0	0	0	0	0	0
<i>Taraxacum</i>												
<i>laevigatum</i>												
Density	0	0	0	0	0	0	0	0	33	0	0	0
Frequency	0	0	0	0	0	0	0	0	50	0	0	0
<i>Veronica spp</i>												
Density	26	0	0	65	0	0	0	0	0	0	0	0
Frequency	20	0	0	17	0	0	0	0	0	0	0	0
<i>Vicia hirsuta</i>												
Density	0	0	0	6	0	0	0	0	0	0	0	0
Frequency	0	0	0	8	0	0	0	0	0	0	0	0
<i>Vicia spp</i>												
Density	351	46	162	72	0	195	195	0	0	0	6	0
Frequency	100	33	40	17	0	100	67	0	0	0	13	0

¹ See Table 4. Quantitative description of American Camp prairie vegetation communities.

² number of seedbank samples per community

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.

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