



**Gulf Islands National Park  
Reserve  
Bennett Bay Unit  
Restoration Plan**

**Mayne Island, BC**

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**Mayne Island Conservancy Society  
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## **1. Introduction**

The Bennett Bay unit of the national park reserve was purchased from private owners under the Pacific Marine Heritage Legacy—a federal-provincial agreement initiated in 1995. The lands acquired were administered by the Province of BC until the designation of the national park reserve in May 2003. Portions of the land have been altered to allow for grazing and potential house sites. The purpose of this document is to develop a strategic plan for the restoration of the disturbed sites as well as long term management recommendations for the whole Bennett Bay Unit. Specifically, this report describes treatments and restoration actions for the most disturbed sites within the unit. These would include recommendations on invasive plant removal, regenerating stock protection and replanting of native species with the goal of restoring as close as is possible the seral canopy and other ecosystem components appropriate to each treatment site. Unit wide recommendations to manage and maintain the restoration treatments and prevent incursions of invasive species will also be presented.

## **2. Background**

### **A. General Site Description**

#### **Geology and Soils**

The site is part of the Upper Cretaceous Nanaimo Group, which is made up of primarily sedimentary rocks formed from alternately deltaic and marine sediments. The Bennett Bay Unit is comprised of the Spray Formation that is characterized by inter-bedded shale and siltstone with sandstone bands of marine origin (Geological Survey of Canada. 1983). Topographically this is expressed as a series of exposed and resistant sandstone ridges overlying the more erosion prone shale and siltstone deposits (Foweraker. 1974). For the north side of Campbell Point the sandstone bedding plane slopes are about 24<sup>0</sup>.

The differential erosion of the parent material within the Bennett Bay Unit has given rise to variable patterns surficial deposits. Where the bedrock structure has been eroded away, deposits derived from colluvial, glacial, glacial-marine or marine processes have accumulated. Nowhere are they very deep. The deepest deposits would be those of the 'meadow area', which are wave washed beach material over glacial marine tills. Subsurface textures of clay, silt, sand and gravel and in some areas dense till with boulders are found within this site. Veneers (< 1 m depth) are most common (Geological Survey of Canada. 1983).

The soils of this unit (after Kenney et.al. 1988) have been mapped with four soil types differentiated –

- Saturna and Galiano (orthic dystric brunisol) – moderately coarse to medium textured shallow colluvial and glacial drift materials over bedrock.
- Beddis (orthic dystric brunisol)- Coarse to moderately coarse textured marine materials.
- Neptune (orthic humic regosol) – soils of anthropogenic origin.

The interstitial spaces between the exposed rock ridges of the site are predominated by shallow Saturna soils. The Galiano soils are found downslope from the Saturna soil and are also shallow over bedrock. Beddis soils are confined to the “meadow area” of the site and are deep deposits of marine origin. The Neptune soils are confined to a band along the meadow area shoreline and represent marine and organic deposits including shell middens. These midden deposits extend along the whole beachfront of the unit and at its northern extent overlies Saturna soil veneers over highly fractured shale.

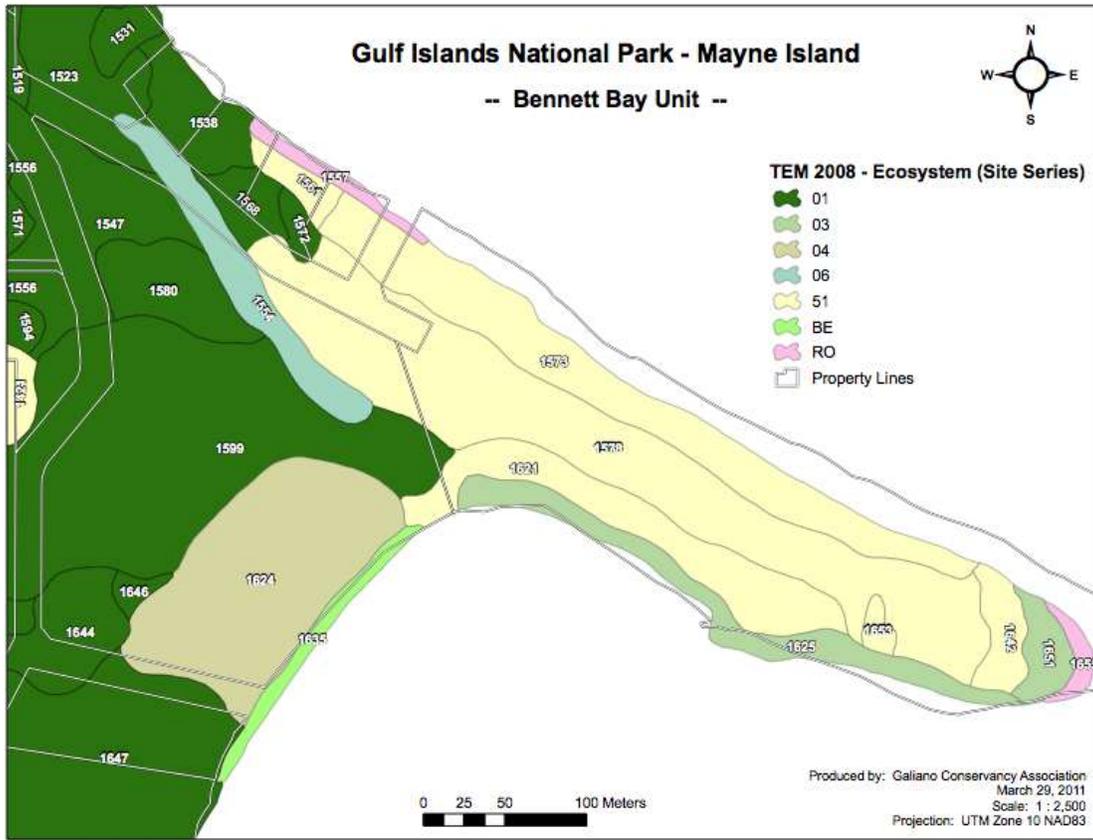
Drainage within these soils is considered rapid to moderately well drained with some becoming wet during winter months but droughty during the summer season.

### **Basic Hydrology**

There are no permanent or ephemeral streams within the Bennett Bay Unit, nor are there any wetland or seasonal ponds. Two drainage sub-basins have been identified for surface water run-off. The northern slopes from the high point of the Campbell Point ridgeline drain toward Campbell Bay, while the remainder of the unit is part of a larger Bennett Bay drainage that flows to the east into the bay (Foweraker. 1974). During the winter wet season, the water table is near or at the surface at the eastern base (above the shoreline riparian zone) of the “meadow area” of this unit. The extreme eastern and southeastern portions of the unit have gentle slopes while the remainder of the unit is comprised of steeper slopes ranging from 16<sup>0</sup> to 35<sup>0</sup>. The highly fractured bedrock underlying most of the unit contributes to the rapid movement of subsurface water through this system and prevents the development of permanent or seasonally wet areas.

### **Terrestrial Ecosystems**

The Terrestrial Ecosystems for the Bennett Bay Unit were mapped in 2006 (Green, 2007) and five vegetated Site Series were identified. The Campbell Point ridge section was classified as a *Douglas fir/Arbutus – Salal/Hairy Honeysuckle* site; the southeastern tip and southern slopes of the point were classified as a *Douglas fir/Oniongrass* site; and, the remaining forested areas excluding the meadow, were classified as a *Douglas fir/Salal* site. The old meadow area was interpreted to support *Douglas fir/Grand fir- Oregon grape* and *Western redcedar/Grand fir-Foamflower* site series. These sites are generally described below (after Green. 2007) :



Distribution of Ecosystem Site Series within the Bennett Bay Unit

### 51 *Fd/Arbutus-Salal-Hairy Honeysuckle*

These are dry, nutrient poor to medium sites on shallow well drained soils; Soil Moisture Regime is classed as very dry to moderately dry, while the Soil Nutrient Regime is rated as poor to medium. This ecosystem is commonly distributed on shallow bedrock controlled ridges, benches, and slopes where trees root in shallow soils and fractured bedrock; forests are moderately dense (around 70% canopy closure) and feature Douglas fir and arbutus with varying amounts of western redcedar; understory vegetation typically features moderate salal and hairy honeysuckle cover with varying Oregon grape, orange honeysuckle, and baldhip rose in the shrub layer; herbs and mosses typically include varying cover of mixed grasses with *Eurynchium oreganum*, *Rhytidiadelphus triquetrus*, and occasional *Hylocomium splendens* in the moss layer.



51 Douglas fir/Arbutus-Salal-Hairy honeysuckle ecosystems. *Blackwell Assoc. Photo*

### *03 Fd-Oniongrass- Douglas Fir-Oniongrass*

These are dry, nutrient rich sites commonly distributed on shallow soils on warm slopes and adjacent ridges; often complexed with rock bluffs on accumulations of shallow colluvium; a key feature is high insolation due to physiography and characteristic open canopies (20 % canopy closures), forests are typically open and feature Douglas fir, arbutus, and varying amounts of Garry oak; the shrub layer includes primarily hairy honeysuckle, with salal rare due to high surface temperatures; mixed grass cover is a characteristic feature, with a variety of herbs such as cleavers, sanicle, woodland tarweed, dovefoot geranium, and hairy cat's-ear; species composition is highly variable due to disturbance history such as grazing, Garry oak has the highest probability of occurring as a seral tree species on these sites although its presence is variable and relatively uncommon. This ecosystem type is minor within the Park and complexed with the above ecosystem. Nonetheless, it represents the Park's most significant ecosystem and the first priority for restoration.

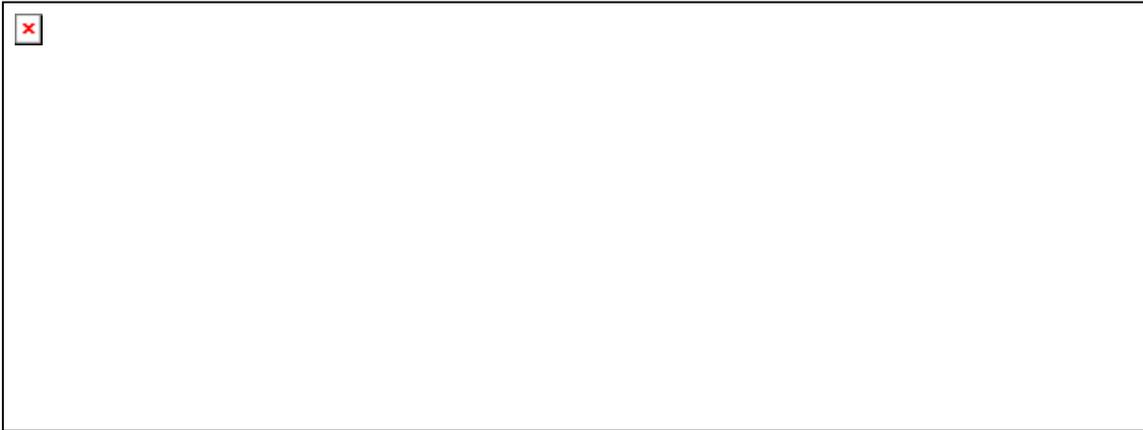


*03 Douglas fir-Oniongrass ecosystems.*

*Blackwell Assoc. Photo*

### *01 Fd/Salal – Douglas fir/Salal*

These sites are well to moderately well drained soils that are of poor to medium nutrient availability. They are widely distributed on a range of parent materials, slopes and aspects. Forests are dominated by Douglas fir with varying amounts of western redcedar, arbutus, and occasionally, grand fir. The understorey typically features salal, Oregon grape, with varying amounts of oceanspray, honeysuckle (hairy and orange), and dominant *Eurynchium oregonum* (Oregon beaked moss) moss cover. This site series dominates the forest around the large old meadow area.

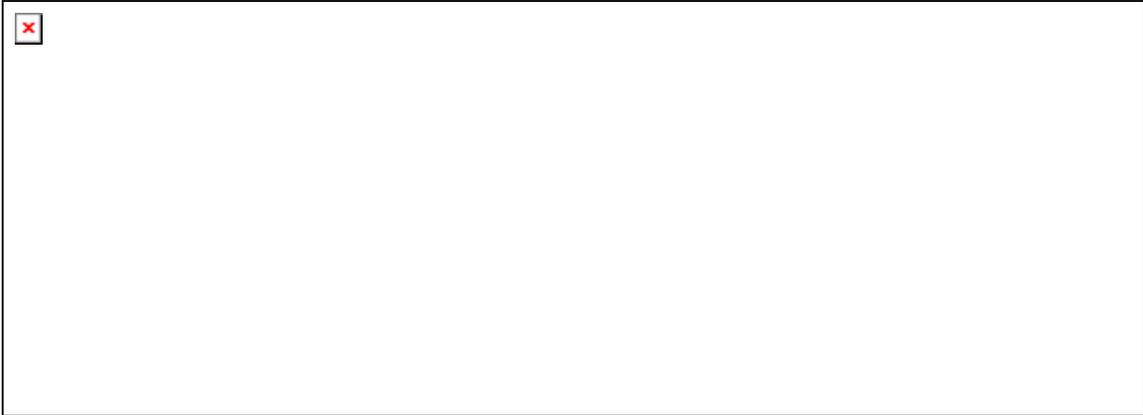


01 Douglas fir/Salal ecosystems

Blackwell Assoc. Photo

### *04 Fd/Bg-Oregon Grape – Douglas fir/Grand fir-Oregon Grape*

These are generally moderately dry, nutrient rich sites commonly distributed on glaciomarine and marine soils in valley bottoms or swale topography at higher elevations. Typically they are found in complexes with moist/rich sites (e.g. site series 06 *Western Redcedar/Grand Fir-Foamflower* within the unit) on marine soils. Forests of this series can be moderately dense (60% canopy closure) and feature Douglas fir, red alder, and western redcedar with varying amounts of bigleaf maple and grand fir. The understorey vegetation is characterized by a well-developed herb layer which can include swordfern as a dominant species and a variety of species such as cleavers, vanilla leaf, wall lettuce, and stinging nettle.



*04 Douglas fir/Grand fir-Oregon Grape Site Series*

*Blackwell Assoc. Photo*

*06 Cw/Bg-Foamflower – Western Redcedar/Grand fir-Foamflower*

These sites are generally fresh to moist and nutrient rich are also commonly distributed on glaciomarine and marine soils in valley bottoms and swale topography at higher elevations. As with the above, this series is typically complexed and can include a dense layer that impedes soil drainage. The forests associated with this series are moderately dense (60% canopy closure) and can include red alder, bigleaf maple, western redcedar, and Douglas fir with varying amounts of grand fir. The understorey vegetation is characterized by a well developed herb layer swordfern in combination with such species as stinging nettle, cleavers, and vanilla leaf. There also can be a variable cover of moss species.



*06 Western Redcedar/Grand Fir –Foamflower Site Series*

*Blackwell Assoc. Photo*

As well as the vegetated series, two non-vegetated series were mapped. Bedrock (RO) and Beach (BE) were mapped within the unit.

Derivative mapping using the TEM database has been done to define Sensitive Ecosystems on Mayne Island (2005). Within the Bennett Bay Unit two sensitive ecosystems and one important ecosystem were described. An extremely small site at the end of Campbell Point was identified as an Herbaceous ecosystem,

while the southern slopes of Campbell Point were classed as a Woodland ecosystem. The remainder of the Campbell Point forested areas were classed as a Mature Forest important ecosystem.

### Native Flora and Fauna

A preliminary list of the vascular plants can be found in the Appendices. The list of vertebrate and invertebrate species observed or suspected follows:

**Table 1: Preliminary Faunal Species List Henderson Park, 2008.**

SPECIES	SPECIES
<b>Mammals</b>	<b>Birds</b>
Columbian Black Tail Deer	Turkey Vulture
Fallow Deer (introduced)	Osprey
Red Squirrel	Bald Eagle
Mink	Sharp-shinned Hawk
River Otter	Red-tailed Hawk
Wandering shrew	Western Screech Owl
Deer mouse	Barred Owl
Townsend's Vole sp.	Common Nighthawk
Raccoon	Rufous Hummingbird
	Downy Woodpecker
<b>Reptiles</b>	Hairy Woodpecker
Western Terrestrial Garter Snake	Northern Flicker
Western Garter Snake	Pileated Woodpecker
Common Garter Snake	Pacific Slope Flycatcher
	Cassin's Vireo
<b>Amphibians</b>	Common Raven
Pacific Tree Frog	Violet-green Swallow (nesting)
	Barn Swallow (nesting)
<b>Invertebrates</b>	Chestnut-backed Chickadee
<b>Slugs and snails</b>	Red-breasted Nuthatch (nesting)
Lancetoothed snail sp.	Brown Creeper
Glass snail sp. (introduced)	Bewick's Wren
Banana Slug	Winter Wren (nesting)
Giant Black Slug (introduced)	Golden-crowned Kinglet
	Swainson's Thrush
<b>Butterflies</b>	Hermit Thrush
Sara Orangetip	Varied Thrush
Lorquin's Admiral	American Robin (nesting)
Woodland Skipper	Spotted Towhee (nesting)
Cedar Hairstreak	Song Sparrow

Western Tiger Swallowtail	Dark-eyed Junco (nesting)
Pale Swallowtail	Red Crossbill (nesting)
Anise Swallowtail	Pine Siskin
Western Spring Azure	
Pine White	
Cabbage White (introduced)	

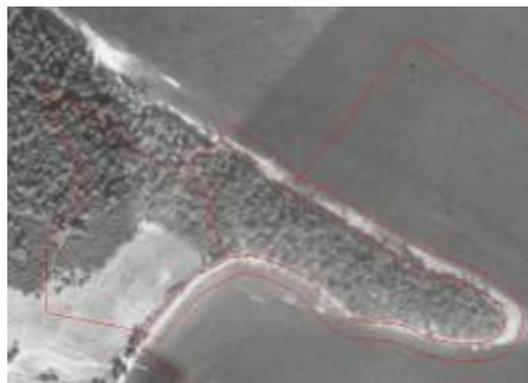
No at risk species have been identified to date within the unit.

### **Cultural Features**

No complete survey has been done for pre-contact cultural features of the Bennett Bay Unit. However, there are extensive midden deposits along the beach shoreline of the Bennett Bay Unit. At the unit's most easterly corner the midden forms a discernible mound (~1.5 m) which has been truncated by the beach access road. These midden deposits (shells and dark organic soils) extend west along the shoreline in front of the meadow area. The deposits continue further to west uphill and sit upon eroding shale deposits about 3.5 m above sea level. Present marine processes are actively eroding the seaward portions of these deposits. Personal communications with John Elliott of the Tsartlip First Nation confirmed that this site was used in summer and fall primarily for shellfish harvesting, salmon reef fishing, and duck netting/hunting.

### **Recent History of the site**

Aerial photographs of the unit taken in 1932 show that the meadow area was already cleared and in cultivation at that time. It was much more extensive, especially to the east, than it is now. The original house site in the south corner of the unit was also present at this time. Past extensive logging and more recent selective harvest are evident at the site. Veteran Douglas fir trees are in the order of 150 + years old while the next generation of large trees are approximately 80 to 100 years. The majority of the forest tree species of the unit are under 80 years. These factors indicate a continuous use of the forest land base from agricultural clearing to cutting for building and other purposes.



1932 Bennett Bay Unit

More recent aerial photographs taken in the 1950's indicate that another house was constructed adjacent to the original building and to the south. This house was occupied until the sale of the unit for park purposes. Farm roads were present at this time mostly in association with the house sites and meadow area. The current farm road network within the unit, including an access road from Isabella Lane (not present in the 1950 air photo), was in place by 1975. The access road associated with Isabella Lane is now described as the upper narrow meadow. The larger meadow area was subdivided by 1975 with the public access road to Bennett Bay forming the southern boundary of the unit.



The meadow area has been used primarily for the production of hay and grazing. Most recently it was used for cattle during the 1990's and sheep until just before the sale of the unit for park purposes. Extensive fencing was put in over this time. In early 2010 the house and outbuildings and all fencing were removed from the unit. The footprint from these buildings was graded and left to revegetate on its own.

Two areas of the most easterly areas of Campbell Point were cleared and leveled for potential building sites. This work was done sometime between 1950 and 1975 for the outer site and sometime between 1975 and 2004 for the inner site. The 2004 air photo also indicates that more clearing was done on the outer site particularly on the northern side. No further work was done on these sites after these dates other than the installation of a dedicated bench at the outer site.

## **B. Processes that Influence or have Influenced the Site**

### **Rock Fall and downslope movement of materials**

The southern side of Campbell Point is the most susceptible area to rock fall and slope failure. There is much unvegetated and exposed material made up of rock fragments, which have no structural integrity. Large blocks of sandstone are present at the base and within the slopes of this area. For most of this area factors contributing to these processes include over steepened slopes, highly fractured shale exposures susceptible to surface water, frost heave and wind erosion and wildlife use. The early air photos of this point indicate that these slopes have been active over the near term into the present. It is anticipated that

these processes will continue along this area until a level of equilibrium is established. No restoration action is recommended for this area because of its active nature.

### **Shoreline Erosion**

Adjacent to the above area and along the shoreline fronting the meadow area, high water levels, storm surge, waves and log debris are rapidly changing the character of this area. All along the beachfront the vegetated midden deposits are being undermined and eroded away by these processes. As a result, tree species have been toppling into the beach and intertidal zone, further exposing this area to erosion. With the anticipated increases to water levels and storm surges attributed to climate change, these active processes are expected to continue and increase in their effects on this area of the unit. The potential loss of the midden deposits is a significant risk over time.

### **Fire History**

Fire is considered one of the stand altering natural disturbance regimes contributing to the ecology of the forests of the Coastal Douglas Fir biogeoclimatic zone. The natural disturbance regime for the CDF zone indicates infrequent stand-initiating fire events, although it is recognized that there is considerable variability within this broad zone (Austin et. al., 2008). Site-specific research by McCoy (McCoy, 2006) finds a mean fire return interval of 27 years for Roe Lake, Pender Island since 1750. Fire suppression and extensive clear cutting within this zone have considerably affected this fire regime.

According to the Disturbance Type and Date Map produced for Mayne Island in April, 2008, the whole of the Campbell Point part of the unit was disturbed by fire estimated to have occurred in 1880. Virtually all of the veteran Douglas fir trees within this part of the unit have fire scars on their trunks. These are the trees estimated to be 150 + years old. This fire was likely due to clearing and slash burning by early settlers to this area.

Fuel load to the forest floor is increasing within areas of the unit, particularly the forested area to the north and west of the meadow area.

### **Blowdown**

Blowdown is another natural disturbance regime of forests that generally operates at a small to medium scale. This process contributes both small and large woody debris to the forest floor in the form of twigs, branches and trees. All of these materials are vital to the development and nutrient stability of the forest soils. Blowdown also provides openings within the canopy that allow for understorey and forest regeneration.

Over the last five years, there have been significant blowdown effects within the unit that are particularly concentrated at the northwesterly corner of the meadow area. Again, with the anticipated increases in severe storms during the winter, blowdown effects would be expected to continue within the unit.

## **Disease**

A third small-scale natural disturbance process within CDF forest ecosystems is disease. The primary form is generally classed as 'root rot' (e.g. Laminated root rot). An examination of trees recently brought down by severe winds indicates that many were affected by root rot and this factor was likely the main determinant of their susceptibility to windthrow.

The extent of root rot within the tree species found within the unit is not known at this time. Based on the observed presence within recently downed trees root rot appears to have centres at the northwest corner of the meadow area and at the ridge area between the upper narrow meadow and the trail from the Isabella Lane parking lot and access trail to the unit.

Veteran arbutus trees within the unit all show signs of disease affecting the stem centres and branches. Some of this is due to a type of blight that had and is still affecting arbutus throughout its range. Based on field observations, older trees seem most affected and as a result also appear to be more susceptible to secondary fungal rots (Dunn, M. Pers. comm. 2011).

## **Climate Change implications**

Climate change can impact forest ecosystems in a number of direct and indirect ways. Temperature-related impacts include changes to mean temperatures, changes to the magnitude and frequency of extreme high or low temperatures, and modifications to the seasonal distributions of temperatures. Examples of direct effects of temperature impacts could be expanded growing seasons or seasonal effects on timing of flowering and seed development (phenology). Precipitation is expected to slightly decrease (based on regional models) for this region, but more significantly, there will be changes to growing-season precipitation and the frequency and magnitude of precipitation events (Spittlehouse. 2008)

Climate change impacts can also affect forest ecosystems indirectly by affecting geomorphic processes, disturbance mechanisms or physical components of ecosystems (e.g., water, soils). Increased summer temperatures can lead to increased drought stress on certain species and increased fire risk. Winter increases in frequency of extreme storm events would lead to increased ecosystem disturbance including landslides caused by wave erosion, flooding and/or windthrow. Climate change can also indirectly affect ecosystems by facilitating outbreaks of pests or pathogens, or favouring the spread of invasive species (Spittlehouse. 2008).

For the CDF climate envelope as whole, modeling has predicted an areal expansion of over 300% from its present extent within the next 80 years. For Mayne Island's complex topography, the response of its ecosystems to these changes is difficult to predict. Nonetheless, it is possible to note that because of the limited size of the island, wide scale species migrations (vegetative primarily) either to or off the island are unlikely. There could be, however, changes to the species compositions and small expansions or contractions of species or ecosystem extents (i.e. more open canopy forest sites, grass dominated understorey or reduction or local extirpation of western redcedar). As the CDF changes, the possibility of 'novel' ecosystem types would also be possible.

Recent work on climate change and the resilience of the dry coastal forest ecosystems has found that site moisture relationships support the current differences in vegetation communities (E. Campbell, 2011). Predicted changes to precipitation will change these relationships though to varying degrees. Other indicators being assessed are soil nutrient relationships and their sensitivity to change. Of particular interest is nitrogen and its compounds. Studies are showing that ammonia peaks at mesic sites, nitrate is highest at high productivity sites and the mass of total nitrogen is positively correlated to the Douglas fir site index. All this is to note that as soil moisture is influenced and in this case moving toward drier conditions, soil processes that cycle nitrogen through the system will also be influenced. The extent of this influence is still not fully understood. At the scale of the Bennett Bay Unit's ecosystems, it is important to be aware of the potential changes and be prepared to adapt to the unforeseen changes.

### **Non-native Plant species**

Non-native and invasive species are found throughout the unit in varying degrees of concentration. There are several centres of concentration:

- The former house and cabin site
- The meadow area
- The back pasture
- The inner and outer clearings on Campbell Point
- The former farm road (now trail) network

The most extensive and pervasive species are introduced pasture grasses, broom, English daisy and the escaped rose species. Secondary species considered invasive but not well established include Himalayan blackberry and laurel spurge (*Daphne*). All other species are considered minor components of the unit and can be managed using spot treatments.

Broom is of special concern because of its habit of forming dense closed canopies, changing soil chemistry balance and its rapid spread. Well-practiced protocols for its removal and disposal are in place. Non-native grasses are more common within the unit and strategies for control and management of these species are limited.

See appendices for the preliminary plant list for the Bennett Bay Unit including invasive and introduced species.

## **Deer Browse and Grazing**

Deer browse and grazing is a major disturbance factor that historically and currently impacts ecosystems on Mayne Island. The Bennett Bay Unit shows evidence of deer browse on shrub and regenerating tree species as well as, increasing signs of deer grazing effects in the natural and created open areas. These are the result of both over-populations of native deer and increasing impacts of the introduced fallow deer. These impacts vary with location. Within the unit there is much evidence of impacts from both species but of particular concern is the increased grazing pressure of fallow deer to the understorey species.

In order to ensure success of any restoration action within the unit, treatment sites will need to be protected from direct deer impacts over the long term.

## **3. Restoration Action**

### **A. Zonal Descriptions and Site Prescriptions**

These zones are based on site characteristics, present state, the feasibility of restoration action and significance of the zone for conservation. For each zone restoration objectives and measurable targets are identified and a plan of action (or no action if it is warranted) will be identified to meet these targets. This plan provides, where needed, an invasive species removal strategy based on several decision criteria:

- Most threatening to native and/or endangered species;
- Most invasive or most advanced in invasion;
- Most likely to provide greatest benefits to native/endangered species when removed; and,
- The likely impacts of removal, positive or negative ie removal of broom increases susceptibility of rare plants to deer browse and ways to mitigate.
-



*Restoration zones map*

### **Identification of target zones**

Four treatment sites have been identified and assessed here in consultation with the Park Ecologist, Todd Golumbia in February 2011.

### **Zone 1 – Meadow Area**

The meadow area is the largest deforested area within the unit, and is made up of two subzones. One of these is a vernal wet zone that borders the shoreline, and the other is the relatively drier remainder of the meadow. The whole zone was previously used as grazing pasture, and had a house standing on its southwestern corner. The meadow slopes gently to the southeast where it meets the shore of Bennett Bay, with a band of trees and shrubs as the interface between the meadow and shore. This zone contains the deepest soils within the unit, which are primarily Beddis, with a band of Neptune soils along the shoreline representing organic and marine deposits, including shell middens. The meadow is part of the Bennett Bay drainage, and has a seepage on its northern edge (Foweraker. 1974). The upper portion of the meadow is considerably drier than the lower portion, although the zone in general has a high level of moisture in comparison with the rest of the unit.

**Subzone 1a** – This subzone constitutes the majority of Zone 1, and is the upper, relatively drier portion of the meadow. It is classified as site series 04, with the exception of the site on which the house stood, which is classified as site series 01. In this subzone Scotch broom and one domesticated rose species have flourished following the removal of livestock grazing and trampling pressure. A second domesticated rose species is present, but not widespread. Daphne is also present, as well as Himalayan blackberry, periwinkle, and other

introduced garden plants. At present, Scotch broom is primarily confined to the upper half of the meadow and has not invaded the lower half, likely due to the wet conditions during the winter. Introduced rose species are present throughout this subzone, and extend to the edge of the wetter subzone 1b. Daphne is sporadic, and Himalayan blackberry is mostly confined to the lower portion of this subzone. Other introduced garden plants, including periwinkle and foxglove, are present around the old house site, likely originating in the garden beds that bordered the house. Introduced grasses densely cover the majority of the meadow.

**Subzone 1b** – This subzone is the lower, wetter portion of the meadow, which borders the shoreline of Bennett Bay and is classified as site series 04. Much of this subzone is composed of Beddis soils, except for a band of Neptune soils along the shoreline. The Neptune soils include a large mound at the southern end of this subzone which represents the main shell midden deposit. The ground of this subzone is densely covered with introduced grasses. Other non-native plants include Daphne and holly, which are primarily around the mound of shell midden on the southern corner, and Himalayan blackberry, which is primarily in the northern portion of this subzone. Native plant species occur in small numbers, primarily near the edges of this subzone. Common rush is present throughout this subzone, and also extends into the lower portion of Subzone 1a. A band of trees and shrubs lines the shoreward edge of this subzone, including grand fir, western redcedar, bitter cherry, nootka rose, snowberry, and Oregon grape.



**Zone 1 Meadow area looking north**

**MICS photo**

## Zone 2 – Campbell Point Clearings

This zone is comprised of two clearings near the tip of Campbell Point. Each is addressed as a separate subzone. They are both extremely dry, well-drained sites. The soils of these sites are relatively shallow in comparison with the other restoration zones in the unit, and bedrock ridges are frequently exposed at the surface. Both clearings are covered with a mix of native and non-native grasses. Grasses are the prevailing non-native species in each, with the exception of a couple strongholds of scotch broom adjacent to the clearing in zone 2b. Both these subzones receive a large amount of foot traffic, as they are en-route to the tip of Campbell Point, a primary destination for visitors to the park.

**Subzone 2a** - This subzone is the second clearing from the tip of Campbell Point, along the main footpath. It is classified as site series 51. Both portions of the loop trail cut through this small clearing, which is mostly flat and covered with a mix of native and introduced grasses. The soil is very shallow and rocky, although the portion of the clearing to the north of the trail contains slightly deeper soils. These soils sit on top of fractured bedrock ridges, angled at approximately 20-30 degrees, and are very well-drained. Deer browse is the main factor preventing the re-establishment of arbutus and other native tree species, although some seedlings of Douglas fir and grand fir are present to the north side of the trail. Introduced plant species, aside from grasses, appear to be limited to an individual willow species.



**Zone 2a House site clearing Campbell Point**

**MICS photo**

**Subzone 2b** - This zone is the clearing at the tip of Campbell Point, and contains portions of three different site series classifications – 51, 03, and RO. It is open to the shore to the north and to the south, with low cliffs on both sides. The majority of the clearing is fairly flat, although it begins to slope towards the

northern and eastern edges. The clearing is covered with a mix of native and introduced grasses, and the soil is quite rocky and shallow with bedrock breaking the surface in places. A few clusters of Daphne are present on the edges of this clearing, and Scotch broom has covered a large area of the slope on the north side of the clearing. Currently visitors appear to be using a large area of this zone for access, with many small trails in use. Deer browse, trampling, and non-native species are the main factors affecting the native plant communities and the regeneration of native tree species. This zone contains a small number of Douglas fir, as well as arbutus, garry oak and rocky mountain juniper along the edges. Arbutus and rocky mountain juniper are largely confined to the southern edges of the clearing, while the garry oak stand is located on the north- and east-facing slope of the point. The most notable stand of broom is amongst and adjacent to this garry oak stand.



**Zone 2b House site clearing Campbell Point** **MICS photo**

### **Zone 3 – Midden Mound and Eroding Bank**

This zone is a very small area bordering the northern edge of the meadow area (Zone 1) on the shoreward side. It is a large mound consisting of Neptune soils, primarily shell midden, and is classified as site series 51. It is exposed to the bay and is heavily affected by erosion from wave action, compounded by the presence of large logs and stumps on the beach below, accelerating the erosion process. In recent years large Arbutus trees from this zone have fallen onto the beach. Non-native plants also have a large impact on this zone, including daphne, Scotch broom, Himalayan blackberry, holly, and some other introduced garden plants. On the edges of this zone there is an understory of Oregon grape and salal, and grand fir seedlings have also been observed on the midden mound. The forest directly inland from this zone is the lower edge of a sloping site series 01 ecosystem, as it intersects with the edge of the meadow area. This

zone receives a significant amount of foot-traffic, and is of high visibility to the public.



**Zone 3 Midden Deposit (upper portion)**

**MICS photo**

#### **Zone 4 – Back Pasture**

This zone is a narrow clearing running northwest to southeast with a very gentle southeasterly aspect. It is classified as site series 06, composed of Galiano soils, and is flanked on its long edges by rocky slopes. An old road cut runs the length of its western edge, and Isabella Lane sits atop the ridge on its east side. It is also part of the Bennett Bay drainage, and is relatively moist in comparison with other areas of the unit (except the lower reaches of the meadow area). Native tree species in this zone include grand fir, Douglas fir, western redcedar, bigleaf maple and red alder. Ground cover and shrub species include Oregon grape, salal, ocean spray, bracken fern, sword fern, salmonberry and stinging nettle.

A footpath runs the length of the clearing and is often used by dog walkers for access to the rest of the park. A small, roofless brick and concrete structure stands along the eastern edge of the clearing, and English ivy is present on and around the structure and has been removed from some of the surrounding trees. Other notable invasive plants in this zone are Himalayan blackberry, a domesticated rose species, and sporadic daphne and Scotch broom.



**Zone 4 Back Pasture looking west**

**MICS photo**

## **Recommended restoration strategies for zones**

### **Zone 1 – Meadow Area**

Introduced grasses densely cover the majority of the meadow and are one of the main factors hindering the regeneration of native tree species. Deer browse also has an impact on the success of regeneration. This zone will be the first priority for restoration in the unit, based on the size of the disturbed area and the dominance of non-native species. Targets for this Zone are the removal of invasive species, primarily Scotch broom and domesticated rose species, and the establishment of a tree canopy with the intention of shading-out introduced grass species. The transition line between the two subzones is roughly fifteen meters in from the shoreline, although it jogs in and out in accordance with moisture levels. Recommended restoration treatments differ for each of the two subzones.

**Subzone 1a** – This zone’s historical reference may be a Douglas Fir-Arbutus-grass ecosystem. It has existed in its present disturbed state for many years, however, and its bordering ecosystems represent slightly different conditions and thus do not represent reference ecosystems. At least two different restoration scenarios present themselves for this subzone. One scenario is to extend plantings of Douglas fir and Arbutus to the edge of the adjacent subzone 1b. An alternate scenario is to extend plantings of these species partway across the meadow, transitioning to plantings of Garry oak in the lower portion, especially at the southern end of the meadow, where sunlight exposure is greatest. Targets for this subzone are the 100% removal of non-native shrub species and the

establishment of a tree canopy, which will eventually shade-out non-native grass species and aid the re-establishment of a native understory.

The two potential scenarios for this subzone are detailed with the following recommendations:

- Complete removal of non-native species, targeting Scotch broom, both domesticated rose species, daphne, blackberry, periwinkle and foxglove.
- Removal of broom plant material to a predetermined site for disposal. The former barn site (adjacent to the main trail) is a possible composting site, as it is well-shaded and will limit re-sprouting. Another composting option is old stone building in zone 4. Burning has been determined not to be an option, from previous experience on the island.
- Assessment of whole zone for evidence of native tree species regeneration. Deer browse protection will be installed wherever seedlings are found.
- Carry out plantings throughout the zone, installing browse protection for each seedling.
  - o Scenario 1: This scenario involves planting Douglas fir and grand fir in the upper and northern portion of the subzone, transitioning to Garry oak in the lower and southern portion. Plantings of Douglas fir and grand fir would be done at a spacing of 3m, and Garry oak can be planted with a wider spacing of 5m.
  - o Scenario 2: An alternate scenario extends the planting of Douglas fir and grand fir to the lower edge of this subzone, including western redcedar in the wetter sections and omitting the planting of Garry Oak.
  - o Scenario 2 contains the additional option of planting an early seral stage in the lower, wetter portion of the zone. This is recommended to include red alder and big leaf maple, at a ratio of Fd5Dr3Mb1Bg1, with the deciduous species in the lower region of subzone. This would be followed 2-4 years later with planting of conifers underneath the deciduous species in the lower section, at a ratio of Bg6Cw2Fd2.
- Selection of photopoint monitoring stations and initial pre-treatment photographs, as set out in monitoring strategy.

Scenario 1 involves establishing Douglas fir and grand fir as the dominant tree species in the upper, northern part of the meadow, transitioning to Garry oak in the lower, southern part. While Garry oak is not present adjacent to the meadow area at this time, there is a stand at the tip of Campbell Point, and Garry oak may have been present historically in this zone. Furthermore, the present conditions here will likely support the establishment of Garry oak. The implementation of this

scenario may also affect the decision of whether or not to install deer browse protection around conifer seedlings in the area intended for Garry oak planting. Deer may control the encroachment of conifer species in this area, although spot removals may still need to take place.

In the case of scenario 2, the additional option of planting an early seral stage of red alder and big leaf maple in the lower portion of the zone would serve the purpose of preparing the soil, and establishing a quick canopy to begin shading out invasive species. Given the duration for which the meadow was maintained as grazing pasture, this option may be especially pertinent in order to prepare these degraded soils. Although neither of these species exist in great numbers on the site, this option may still be preferable for its quick canopy and its restorative effect on the soils of the meadow.

### **Subzone 1b**

This subzone is a vernal wet zone, and experiences higher levels of moisture than anywhere else in the unit. Water drainage is held back just before the shoreline, often resulting in standing water in this zone for much of the wet winter months. It is recommended that this zone be treated as a buffer between the shoreline and the forest ecosystem targeted for zone 1a, focusing on native tree and shrub species characteristic of a marine riparian ecosystem. Targets for this subzone are the 100% removal of non-native species and the establishment of a moderate to high-density (70-100% cover) band of native shrub species.

Recommended strategies for this subzone include:

- Complete removal of non-native species, targeting Himalayan blackberry, daphne, and holly.
- Assessment of zone for evidence of native tree species regeneration. Deer browse protection to be installed where seedlings are found.
- Carry out plantings of marine riparian shrub species, including Nootka rose, snowberry, and possibly ocean spray, which is not currently present in this zone although it is present elsewhere in the unit and is characteristic of marine riparian areas throughout the region. There could also be plantings of western redcedar in northern end of subzone and protection of grand fir natural regeneration along the full length of the zone. Deer browse protection to be installed for all species planted.
- Selection of photopoint monitoring stations and initial pre-treatment photographs, as set out in monitoring strategy.

The area of shell midden running along the length of the shoreline edge of the meadow will be treated as an area of special concern with regards to non-native plant removal, and native tree and shrub plantings. This area is to be left for

Parks Canada staff to address at the agency's discretion, due to the sensitivities regarding such cultural features.

### **Zone 2a – House Site Clearing**

This zone represents a challenge for restoration. Soils are very shallow and rocky, and the zone in general is extremely dry and well-drained. The area to the north of the main trail is characterized by slightly deeper soils, and has a number of seedlings beginning to take hold. Soils are very shallow and rocky in the portion to the south of the main trail, and may support the growth of arbutus and Garry oak. Arbutus seedlings have been observed in this portion of the clearing during initial site surveys, although native tree species regeneration at present is heavily impacted by deer browse. One target for this zone is the establishment of a tree canopy, particularly to the north of the main trail. The soil conditions to the south of the main trail present a challenge, and are unlikely to support the establishment of the canopy necessary to shade out introduced grasses. This portion of the zone presents an opportunity for native grass restoration. This could be undertaken with the installation of a deer enclosure, between the main trail and the unofficial return loop trail, which will also provide the protection needed to encourage natural regeneration of native tree species. This strategy would involve planting bulbs of native wildflowers and plugs of native grasses, keeping to drought-tolerant species suited to the shallow soils of this site. This could include Alaska oniongrass (*Melica subulata*), blue wildrye (*Elymus glaucus*), Idaho fescue (*Festuca idahoensis*), nodding onion (*Allium cernuum*), hooker's onion (*Allium acuminatum*), and possibly great camas (*Camassia leichtlinii*).

The establishment of a native grass and wildflower restoration site, protected by a deer enclosure, would indicate another set of targets for this zone, beyond those indicated for the other zones in the unit. Within the enclosure there would be the added target of establishing the dominance of native grass and forb species, through planting bulbs and plugs. Monitoring of this enclosure should take into consideration these additional targets and incorporate more rigorous methods, such as vegetation plots.

The following strategies are recommended for this zone:

- Assessment of the zone for evidence of native tree species regeneration, and installation of deer browse protection where seedlings are found.
- Carry out plantings of a small number of Douglas fir to the north side of the main trail. This is also the area expected to have the highest occurrence of natural regeneration.
- Installation of a deer enclosure in the area between the two trails that run through this clearing.

- Carry out plantings of native grasses and forbs within the enclosure, such as plugs *Elymus glaucus* and native fescues, as well as Great Camas and other wildflowers according to soil suitability.
- Carry out plantings of arbutus at the eastern and western ends of the enclosure where rocky outcrops begin and bedrock is near the surface, as well as in deeper pockets of soil. Evergreen huckleberry may also be suitable for this shallow soil area.
- Carry out planting of one or two Garry oak trees within the enclosure.
- Selection of photo-point monitoring stations and vegetation plots (or transects) and initial pre-treatment data collection, as determined in monitoring strategy.

### **Zone 2b – House Site Clearing**

This zone represents the very dry tip of Campbell Point. The clearing borders on forests of Douglas fir and arbutus, as well as a dense stand of small and gnarled Garry oak. Rocky mountain juniper is also common on this site. Deer browse and public use are the main disturbances that maintain this zone as an open clearing, and are the main factors to address, in addition to the presence of a stronghold of scotch broom. Scotch broom and public trampling through many unofficial trails have an impact on the sensitive Garry oak and associated ecosystems. Targets for this zone include the establishment of a canopy over parts of the clearing, the 100% removal of scotch broom, non-native blackberry and daphne, and the protection of the Garry oak and associated ecosystems from trampling and deer browse.

This zone is suited to a number of possible restoration actions, both within the clearing and beyond the clearing's edge:

- Installation of a split-cedar fence to guide visitors along designated paths.
- Relocation of the bench from its current location to the viewpoint at the cliff on the southern edge of the clearing.
- Removal of non-native plant species, including scotch broom and Daphne.
- Assessment of zone for evidence of regeneration of native tree species. Deer browse protection to be installed where seedlings are found.
- Carry out plantings of one or two Douglas fir in northern portion of clearing, and planting of 1 or 2 arbutus in southern portion near site of bench relocation. Only a few individual trees, as a full canopy would shade out many important native species. Site potential indicates that a canopy closure of 20-30% would be adequate.
- Carry out plantings of up to 3 Garry oak on slope beyond the northern edge of the clearing.
- Installation of deer browse protection for all tree species planted.

- Installation of a deer enclosure around a portion of the Garry oak and associated ecosystem on Campbell Point's northeastern slope for protection of wildflower species, including fawn lily, chocolate lily, hooker's onion.
- Carry out plantings of *Elymus glaucus* within and outside the potential deer enclosure. This species will compete with introduced grasses, without the establishment of a dense canopy.
- Selection of photopoint monitoring stations and initial pre-treatment photographs, as set out in monitoring strategy.

The installation of a deer enclosure around part of this zone's Garry oak and associated ecosystem would bring the need for a more rigorous monitoring strategy for that portion of the zone. 1x1 meter vegetation plots for monitoring species' percent cover would accomplish this, and could be paired with a reference plot outside the enclosure to observe the differences between treatment and non-treatment.

### **Zone 3 – Midden Mound and Eroding Bank**

Restoration practices in this zone should take into account the large impact of wave erosion on the bank and its affect on any plantings at the edge of the bank. Non-native species are present on the bank, however, and their removal should be complemented with planting of native shrub or tree species to maintain a level of stability in the soil of the bank. Targets for this zone include the 100% removal of non-native species including scotch broom, daphne and holly, as well as the establishment of native ground-cover and a sparse stand of native tree species to help stabilize the bank. The installation of split-cedar rails will help to direct foot traffic away from the eroding bank and thus minimize additional pressure on this portion of the zone.

Recommended strategies for this zone include:

- Removal of non-native plant species, targeting Himalayan blackberry, Scotch broom, daphne and holly.
- Assess zone for evidence of regeneration of native tree species, and installation of deer browse protection where seedlings are found.
- Carry out planting of arbutus, as well as one or two Douglas fir. Ocean spray and evergreen huckleberry are two potential shrub species to plant in this zone as well.
- Install deer browse protection for all trees planted.
- Install split cedar rails to direct foot-traffic at a distance from the eroding cliff edge.

Shell midden composes much, if not all, of the soils of this zone. It will be treated as an area of special concern due to the sensitivities surrounding cultural

features. The planting of native species and removal of non-native ones will be left for Parks Canada staff to address at the agency's discretion.

#### **Zone 4 – Back Pasture**

This zone is relatively moist in comparison with other parts of the unit. English ivy and Himalayan blackberry have blanketed parts of the zone. Deer browse is another significant pressure preventing regeneration of native tree and shrub species. The protection of natural regeneration, along with select plantings, will aid in the advancement of the tree canopy, which will help to shade out introduced grasses that cover much of the ground of the clearing at present, and will aid in the advancement of native groundcover species. Targets for this site are the 100% removal of invasive plant species, and the establishment of a canopy of native tree species.

Recommended strategies for this zone include:

- Removal of non-native species, targeting English ivy, Himalayan blackberry, and daphne, as well as a spot treatment of broom occurrence.
- Complete removal of ivy to a predetermined site for disposal. First priority is to cut it off the trees and then clear it from the ground.
- Assessment of whole zone for evidence of native tree species regeneration. Deer browse protection to be installed where seedlings are found.
- Carry out planting of first seral canopy, with a ratio of Dr7Mb2Cw1
- Protection of natural regeneration of grand fir and Douglas fir as a second seral stage canopy. These seedlings are in high enough numbers not to necessitate plantings of these species.
- Decide on a course of action regarding old concrete and stone structure.
- Selection of photo-point monitoring stations as determined in monitoring strategy.



**Stone building Back Pasture site**

**MICS photo**

Removal of the invasive species present in this zone will open up space for native shrub and groundcover species to move in. Salmonberry and Oregon grape are thick in some patches, and ocean spray seedlings are present throughout parts of the clearing, particularly on the old road cut side. The ocean spray seedlings will require deer browse protection to help ensure their robustness.

### **Unit-wide Recommendations**

In addition to the recommended strategies for the above zones there are certain actions that should be undertaken on a unit-wide basis. Periodic surveys should be undertaken throughout the unit to check for occurrence of non-native plant species. The public trails serve as vectors for the spread of invasive plants, and thus these surveys are particularly relevant along the pathways and adjacent areas. Spot occurrences of Scotch broom and daphne are common, and easily prevented from escalating to larger infestations. Other non-native plants that are likely to occur on a small scale throughout the unit are English daisy, Himalayan blackberry, holly, daffodils and foxglove.

Recommended strategies for whole unit:

- Regular surveys to detect and remove non-native species. Priority invasives are Scotch broom, daphne, and English ivy

- Either in-situ disposal for individual plants, or removal to a composting site for larger numbers of plants. The old stone building, if left in place, could act as a central disposal site for composting invasive species.
- Scotch broom plant material should be composted, as burning has been ruled out from previous experience on the island. The old barn site is a suitable location to deposit broom material for composting, as it is well-shaded and already disturbed.

### **Proposed monitoring of restoration actions**

A monitoring strategy for the restoration zones of this unit should take into consideration the overall goals within each of the zones. With the potential exception of a deer enclosure for native grass and forb restoration in Zone 2a, and in Zone 2b for protection of the Garry Oak and associated habitat, the restoration targets involve the complete removal of priority invasive species, and the establishment of a target canopy and groundcover. These targets can be assessed by optical estimates during yearly monitoring surveys, and through photo-point monitoring. Given the areal extent of Zone 1 a series of 6 1x1m plots for photo-monitoring is suggested in addition to the landscape style photo-monitoring. A yearly survey should also include a mortality count for all seedlings planted. Vegetation plots or transects may be included for added thoroughness, and are recommended especially in the case of deer enclosures in Zone 2a and 2b. A deer enclosure in each of these zones will have the additional target of re-establishing the dominance of native grasses and forb species, or in the case of Zone 2b, alleviating some of the pressures impacting these species. Evaluating these targets will require the added thoroughness of vegetation plots or transects.

Photopoint monitoring stations should be selected and marked, recording the compass direction of the photograph for easy replication. Three to five photopoint stations should be established for each of the restoration zones and subzones. These should be selected so that together they give a clear view of all areas of the zone, particularly any areas that will be receiving different treatments. Selection of stations should also take into account the changes that are projected for the site, as a canopy grows and shrub layers fill in, establishing stations that will maintain a useful perspective as the site changes. Stations can be marked with a short piece of rebar inserted into the ground, with a coloured round marker fitted on top for identification and to prevent injury. A metric scale rod should be placed in the field of view for photos, as a scale reference.

It is recommended that monitoring in Zone 1 be augmented with a series of 6 permanent 1x1m plots throughout the zone. This will help to establish a close-up visual reference for changes in groundcover. For added thoroughness, monitoring of these plots could include recording an estimated percent cover for each species present. These plots should be marked with a rebar rod hammered into the ground, with a round marker fitted to the top.

For those zones that will require vegetation plots it is recommended to use 1x1m gridded quadrats (1m PVC piping frame divided into 100 equal squares). These will be used to provide replicable and repeated estimations of percent cover of species within the quadrat. It is recommended that locations be established and marked for 3 to 5 quadrat samples within each deer enclosure. Each location may be marked with a short length of rebar hammered into the ground and a coloured round marker fitted on top for identification and to prevent injury. A convention should be established for consistency in the placement of the quadrat in relation to the marker. For example, when facing due North the marker is in the lower left-hand corner of the quadrat frame.

Monitoring presents an opportunity for public participation, and may be an effective way to involve the community long-term. The Henderson Park Restoration Program is implementing a monitoring strategy that intends to train community members as citizen scientists to undertake photopoint monitoring in the park, in order to both engage community members as stewards of the island's ecosystems, and to make monitoring and restoration sustainable in the long term. The program at Henderson Park will be entering its first year of training citizen scientists in spring and summer of 2011. Depending upon the level of engagement this program is able to elicit, the knowledge and skills developed within the community may be transferable to the Bennett Bay monitoring program as well. The Henderson Park model involves photo-point monitoring of 1x1 meter plots throughout all zones of the park. Photo stations include ones for landscape images and those for plots that are for vertical images. The main data collected for the plots is percent cover for all plant species present. In general, the monitoring program will be designed to be sustainable in the long term. This is one of the benefits of involving community members as trained monitoring technicians, on a volunteer basis.

### **General Timelines for Implementation**

A general timeline for restoration activities in these zones involves two phases of restoration action followed by a monitoring phase. The first phase includes the removal of non-native plants and the protection of natural regeneration of native tree and shrub species. This phase also includes the installation of deer enclosures and split cedar rails to direct foot traffic, as well as signage for the purposes of public communication and education. The second phase involves all planting activities, and should closely follow the completion of the first phase (or at the same time) so as to minimize the exposure of disturbed and unstable soils. The monitoring phase begins with initial photographs prior to the removal of non-native plants, but primarily is concerned with the time period following the planting phase.

Timing of broom and rose removal should be addressed so as to minimize soil disturbance and to minimize the likelihood of regrowth. It should be cut below

the root collar, with volunteers working in pairs if necessary (one can top the plants while the other follows to remove the trunks). In the case of Zone 1, where Scotch broom and a domesticated rose species have overtaken much of the meadow, broom should be removed first in an initial work party, leaving the roses to be removed at a later date. This will minimize the exposed soil during broom removal, as the roses will need to have their whole root structure removed. Removal of all invasive plant species along the trails and in the meadow area can take place at any time of year. At all other wet locations, as well as shallow soil sites, late summer or fall removal is best in order to avoid causing erosion.

Protection of natural regeneration can take place as soon as possible, and should take place before planting. The numbers and spacing of trees planted will depend on those that are already present on site. It is recommended that protection of natural regeneration happen at the same time as installation of deer exclosures and split-cedar rails, in the initial phase of the project, with all plantings taking place in the second phase. Plantings of all native tree and shrub species should take place during the winter. This will allow the roots to become well-established in the soil in advance of the dry summer months.

The first two phases could take place within one year, with invasive species removal and protection of natural regeneration taking place up until the fall, and planting completed before the early spring. Work parties can be helpful for involving the community on a volunteer basis, and will be necessary in order to complete these first two phases. It is estimated that at least 200 people-hours will be necessary to complete phase 1, and another 200 people-hours for phase 2. These two phases would also require a project coordinator for an estimated total of 175 hours. This estimate for the project coordinator includes sourcing and transporting plant materials, planning and advertising work parties, coordinating and training volunteers on-site, and setting-up the monitoring program.

## **B. Sources of Plant Materials and Seeds**

Plant materials should be acquired from sources that are both as local as possible and that experience similar environmental conditions to the planting site. All of the species intended for planting are available from Fraser's Thimble Farms on Salt Spring Island, with the possible exception of Alaska oniongrass. Some of the Garry Oaks may be grown from acorns collected on Mayne, as Henderson Hill has a few viable Garry oak trees from which to collect. MICS is also in possession of a number of Garry oak seedlings, which may be contributed to restoration plantings in the Bennett Bay Unit. Furthermore, if a deer exclosure is installed around part of the Garry oak and associated ecosystem of Zone 2b it may in future years become a viable source of bulb stock for restoration plantings.

The following species are available from Fraser's Thimble Farms, with plant material sourced from the noted locations:

Douglas fir (*Pseudotsuga menziesii*) Vancouver Island  
Garry oak (*Quercus garryana*) Vancouver Island  
Arbutus (*Arbutus menziesii*) Vancouver Island  
Grand fir (*Abies grandis*) Vancouver Island  
Ocean spray (*Holodiscus discolor*) Vancouver Island  
Snowberry (*Symphoricarpos albus*) Salt Spring Island  
Nookta rose (*Rosa nutkana*) Salt Spring Island  
Great camas (*Camassia leichtlinii*) Gulf Islands  
Hookers onion (*Allium acuminatum*) Gulf Islands  
Blue wildrye (*Elymus glaucus*) San Juan Islands  
Idaho fescue (*Festuca indahoensis*) Vancouver Island

#### **4. Communications and Outreach**

Communications with the public regarding the restoration activities within the park can take place via a number of different methods. An on-site method is the strategic placement of one or two sandwich boards inside the park. There are a number of different locations that would be suitable for this: the trailhead beside the parking lot, Zone 3, Zone 2a, and Zone 2b. The trailhead beside the parking lot is the main entrance point for the park, but it is not the only access point used by the public and thus may not be seen by all visitors. Zone 3, on the shoreline to the north of the meadow area, has a footpath through it and is a highly visible location. Zones 2a and 2b are both along the trail to the tip of Campbell Point, which is the main destination for many visitors to the park. The use of either of these last two locations for public communications and outreach may have the additional advantage of being next to a deer enclosure, if that strategy is followed. A sandwich board in either of these locations would be in the best position for providing information of the purpose of the deer enclosure.

Off-site communications and outreach possibilities include articles written for the Mayneliner and Island Tides newspaper, as well as for the websites of the Gulf Islands National Park Reserve and the Mayne Island Conservancy. MICS will also inform its membership and volunteer base through its regular email communications.

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## Appendix 1

### Bennett Bay Unit, Gulf Islands National Park Reserve Vascular Plants, Mayne Island

Initial list compiled by M. Dunn February 10 and 17, 2011

(with inclusion of small plot list compiled by Emily Gonzales , 2004)

NOTE: List reflects the results of two brief walking tours of the site (not all of the site was observed at this time). For clarification of "locations" represent places the plants were first noted with some comment on whether they are more extensively distributed.

Some scientific names have been up-dated, others will need to be. This is a preliminary list so please feel free to edit, correct, and up-date this list, or change its format if needed.

\* = Introduced plant species.

SCIENTIFIC NAME	COMMON NAME	LOCATION
<b><u>Aceraceae</u></b>		
<i>Acer macrophyllum</i>	bigleaf maple	upper forest, narrow pasture
<b><u>Apiaceae</u></b>		
<i>Daucus pusillus</i>	American wild carrot	House site
<i>Osmorhiza purpurea</i>	Purple sweet-cicely	meadow forest and throughout
<i>Osmorhiza chilensis</i>	Mountain sweet cicely	Campbell Point ridge
<i>Sanicula crassicaulis</i>	Pacific sanicle	Meadow forest and throughout
<b><u>Apocynaceae</u></b>		
<i>Vinca major</i> *	Periwinkle	House site
<b><u>Aquifoliaceae</u></b>		
<i>Ilex aquifolium</i> *	Holly	Narrow field
<b><u>Asteraceae</u></b>		
<i>Achillea millefolium</i>	yarrow	Campbell Point

<i>Adenocaulon bicolor</i>	pathfinder	Centre trail at narrow pasture
<i>Bellis perennis</i> *	English daisy	House site , centre trail and point
<i>Cirsium arvense</i> *	Canada thistle	House site
<i>Hieracium albiflorum</i>	white-flowered hawkweed	Campbell Point
<i>Hypochaeris radicata</i> *	hairy cats-ear	House site and throughout
<i>Lactuca muralis</i> *	wall lettuce	Centre trail
<i>Leucanthemum vulgare</i> *	oxeye daisy	House site
<i>Madia sativa</i>	Chilean tarweed	Campbell Point and throughout
<i>Taraxacum officinale</i> *	Dandelion	Wilkes Road entrance

### **Berberidaceae**

<i>Mahonia nervosa</i>	dull Oregon-grape	Upper meadow forest and throughout
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### **Betulaceae**

<i>Alnus rubra</i>	red alder	Narrow field and lower meadow
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### **Brassicaceae**

<i>Brassica campestris</i> *	field mustard	House site
<i>Barbarea vulgaris</i> *	Bitter Winter Cress	House site

### **Caprifoliaceae**

<i>Lonicera hispidula</i>	hairy/pink honeysuckle	Meadow forest and throughout
<i>Sambucus racemosa</i>	red elderberry	Narrow pasture
<i>Symphoricarpos albus</i>	common snowberry	Campbell Point

### **Caryophyllaceae**

<i>Arenaria macrophylla (Moehringia)</i>	bigleaf sandwort	Campbell Point
<i>Cerastium arvense</i> *	field chickweed	Campbell Point

<i>Cerastium spp.</i> *	chickweed (annual)	House site
<i>Lychnis coronaria</i> *	Rose campion	Wilkes Road entrance, centre trail

### **Crassulaceae**

<i>Sedum spathulifolium</i>	broadleaf stonecrop	Campbell Point
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### **Cupressaceae**

<i>Thuja plicata</i>	western redcedar	Campbell Point
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	Campbell Point

### **Cyperaceae**

<i>Carex opnupta</i>	slough sedge	lower meadow
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### **Equisetaceae**

<i>Equisetum arvense</i>	common horsetail	lower meadow
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### **Ericaceae**

<i>Arbutus menziesii</i>	arbutus, madrone	Meadow forest and throughout
<i>Gaultheria shallon</i>	salal	Upper forest
<i>Vaccinium ovatum</i>	evergreen huckleberry	Campbell Point

### **Fabaceae**

<i>Cytisus scoparius</i> *	scotch broom	Meadow, narrow pasture, south side Campbell Point
<i>Lotus micranthus</i>	small-flowered lotus	Campbell Point
<i>Trifolium tridentata</i>	clover (annual native)	Campbell Point
<i>Trifolium dubium</i> *	Small hop-clover	Wilkes Road entrance
<i>Vicia hirsuta</i> *	tiny hirsuta	Wilkes Road entrance and throughout
<i>Vicia sativa</i> *	spring vetch	Wilkes Road entrance
<i>Vicia spp.</i> *	vetch	tbd

**Fagaceae**

*Quercus garryana* Garry oak Campbell Point

**Geraniaceae**

*Geranium molle*\* dovefoot geranium Lower meadow

**Hypericaceae**

*Hypericum sp.*\* St. John's wort House site

**Juncaceae**

*Juncus effusus* common rush Lower meadow

*Luzula multiflora ssp. multiflora* many-flowered wood-rush Campbell Point

**Labiatae**

*Mentha citrata*\* Lemon balm House site

**Lamiaceae**

*Satureja douglasii* yerba buena Campbell Point and throughout

**Liliaceae**

*Allium acuminatum* Hooker's onion Campbell Point

*Brodiaea coronaria* harvest brodiaea Campbell Point

*Erythronium oregonum* Fawn Lily Campbell Point

*Fritillaria lanceolata* chocolate lily Campbell Point

**Onagraceae**

*Epilobium (ciliatum?)* purple-leaved willowherb Campbell Point

**Orchidaceae**

<i>Corallorhiza mertensiana</i> ( <i>C. maculata</i> spp. <i>mertensiana</i> )	western coral-root	Campbell Point
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<i>Goodyera oblongifolia</i>	rattlesnake-plantain	Upper Forest, Campbell Point
<i>Habenaria unalascensis</i> ( <i>Plantanthera unalascensis</i> )	Rein orchid	Campbell Point

**Pinaceae**

<i>Abies grandis</i>	grand fir	Upper forest
<i>Pseudotsuga menziesii</i> var. <i>menziesii</i>	Douglas-fir	Meadow forest and throughout

**Plantaginaceae**

<i>Plantago lanceolata</i> *	plantain (English)	House Site and others
<i>Plantago major</i>	common plantain	Campbell Point

**Poaceae**

<i>Anthoxanthum odoratum</i> *	Sweet vernal grass	Wilkes Road entrance
<i>Bromus carinatus</i>	California brome	Wilkes Road entrance
<i>Bromus rigidus</i> *	Rip-gut brome	Wilkes Road entrance
<i>Bromus vulgaris</i>	Columbia brome	Wilkes Road entrance
<i>Cynosurus echinatus</i> *	hedgehog dogtail	Campbell Point
<i>Dactylis glomerata</i> *	orchard grass	House Site and throughout
<i>Elymus glaucus</i>	blue wildrye grass	Campbell Point
<i>Festuca rubra</i>	red fescue	Wilkes Road entrance
<i>Melica subulata</i>	Alaska oniongrass	Campbell Point and throughout
<i>Poa compressa</i> *		Wilkes Road entrance
<i>Poa pratensis</i> *	Kentucky bluegrass	Wilkes Road entrance

### **Polygonaceae**

<i>Rumex acetosella</i> *	sheep sorrel	Campbell Point
<i>Rumex crispus</i> *	curled dock	Narrow field

### **Polypodiaceae**

<i>Polystichum munitum</i>	sword fern	Campbell Point
<i>Pteridium aquilinum</i>	bracken	Narrow Field

### **Portulacaceae**

<i>Montia perfoliata</i> ( <i>Claytonia</i> )	miner's lettuce	Centre trail
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### **Primulaceae**

<i>Trientalis latifolia</i>	broad-leaved starflower	Meadow forest and throughout
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### **Ranunculaceae**

<i>Ranunculus repens</i> *	creeping buttercup	Lower meadow
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### **Rosaceae**

<i>Crataegus monogyna</i> *	common hawthorn	Narrow field
<i>Fragaria vesca</i>	woodland strawberry	Wilkes Road entrance and throughout
<i>Holodiscus discolor</i>	ocean-spray	Upper forest and throughout
<i>Prunus emarginata</i>	bitter cherry	lower meadow
<i>Rosa gymnocarpa</i>	baldhip rose	Upper forest and throughout
<i>Rosa nutkana</i>	Nootka Rose	Lower meadow
<i>Rosa eglanteria</i> *?	sweet briar	Meadow
<i>Rubus discolor</i> *	Armenian blackberry (Himalayan)	Lower field, Campbell Point
<i>Rubus spectabilis</i>	salmonberry	Narrow field
<i>Rubus ursinus</i>	trailing wild blackberry	Upper forest and throughout

### **Rubiaceae**

<i>Galium aparine</i>	cleavers	Wilkes Road entrance
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### **Salicaceae**

<i>Salix scouleriana</i>	Scouler's willow	Lower meadow and Campbell Point
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### **Scrophulariaceae**

<i>Collinsia grandiflora</i>	large-flowered blue-eyed Mary	Campbell Point
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<i>Veronica beccabunga</i>	American brooklime	Lower meadow
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<i>Digitalis purpurea</i> *	Foxglove	House site
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### **Taxaceae**

<i>Taxus brevifolia</i>	Pacific Yew	Campbell Point
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### **Thymelaeaceae.**

<i>Daphne laureola</i> *	Daphne	Meadow, upper forest
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### **Umbelliferae**

<i>Hedera helix</i>	English ivy	House site and narrow field
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### **Bryophytes**

<i>Polytrichum sp.</i>	Hair cap moss	Campbell Point
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<i>Kindbergia oregana</i>	Oregon beaked moss	Campbell Point and throughout
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<i>Rhytidiadelphus riquetrus</i>	Electrified cat's tail moss	Campbell Point
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<i>Hylocomium splendens</i>	Step moss	Upper forest and throughout
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<i>Cladonia sp.</i>	Lichen	Campbell Point
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## Appendix 2: Bennett Bay Restoration Zones

