



Restoring British Columbia's  
**Garry Oak**  
**Ecosystems**  
 PRINCIPLES AND PRACTICES

**Chapter 2**  
**Distribution and Description**

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## Chapter 2

### Garry Oak and Associated Ecosystems: Distribution and Description

by Ted Lea



Figure 2.1 Looking west toward Fort Victoria in the late 1840s. Plants shown include camas (*Camassia* spp.), Woolly Sunflower (*Eriophyllum lanatum*), Barestem Desert-parsley (*Lomatium nudicaule*), and Spring Gold (*Lomatium utriculatum*). Painting by Michael Kluckner (Kluckner 1986; used with permission).

#### 2.1 Introduction

When Europeans first arrived in Victoria in the early 1840s they found a landscape and vegetation that was quite different than it is today (Figure 2.1). James Douglas noted that more than two-thirds of the land between the Inner Harbour and Gonzales Point was “Prairie Land” (Kluckner 1986). For centuries, First Nations people had set fires throughout the range of Garry Oak (*Quercus garryana*) ecosystems to burn off trees and shrubs and promote the growth of edible root crops, such as camas (*Camassia* spp.) and Bracken Fern (*Pteridium aquilinum*), and to create openings for hunting ungulates, such as deer and Roosevelt Elk (*Cervus canadensis roosevelti*) (Turner 1999). This created the areas of prairie land noted by







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Douglas. The oldest detailed map of the Victoria region was drawn in 1842 by Adolphus Lee Lewis, who accompanied James Douglas (Figure 2.2). It shows the extent of cleared areas, forests, Garry Oak trees, and riparian areas. European settlers eventually halted the burning by the Aboriginal people. Shrub-sized Garry Oaks, then larger oak trees, rapidly became established (B. Beckwith, pers. comm. 2010). Photographs and maps made 20 to 40 years after Lewis's map showed a far more extensive distribution of Garry Oak trees. Further succession resulted in Douglas-fir-dominated communities on many sites (see Chapter 3).



Figure 2.2 Ground plan of the portion of Vancouver Island selected for new establishment by James Douglas Esqr. 1842. Hudson's Bay Company Archives, Archives of Manitoba; used with permission.

### LEGEND

-  dark areas: woods and forests
-  lighter areas: 'plains' or open parkland
-  dots within light areas: Garry Oak trees
-  enclosed darkest areas: riparian areas such as Bowker Creek

This chapter describes where Garry Oak and associated ecosystems currently exist, where they occurred in the past and where they could exist based on current climatic conditions. Chapter 3 (Natural Processes and Disturbance) describes where these ecosystems could occur in the future with global climate change.

This chapter also provides a general introduction to the classification of plant communities within Garry Oak and associated ecosystems, and it presents a classification system of **Restoration Ecosystem Units** that is used throughout this guide to help restoration practitioners determine what plant communities can be returned to which sites (see Section 2.5.7).

### 2.1.1 The Setting

The Garry Oak landscape lies within a rain shadow zone in the lee of the Olympic and Vancouver Island Mountains, and has a mild, winter-wet, summer-dry modified Mediterranean climate. This area is comprised of inner coast and islands with elevations ranging from sea level to 550 m on ridge tops and mountains. Geologically, this region is complex. It is composed of a folded and faulted sedimentary basin, metamorphic contact zones with exotic terranes, granitic intrusions, and both glacial and colluvial



surface overlays. Soils have been organically enriched with Ah horizons and are often shallowly underlain by bedrock. Persistent exposure to insolation, wind, or sea spray is common. Periodic fire is thought to have typified the natural disturbance regime, as in other oak woodlands of the Pacific Northwest. At a landscape scale, plant communities are most strongly influenced by site-level moisture regime, elevation, and amount of surface bedrock (exposed or with shallow humus). At the plant community scale, the most important distinguishing variables are site mineral soil exposure, soil coarse fragments, and geographic area, followed by topographic drainage, soil texture, depth to bedrock, percent downed wood, and elevation (Erickson and Meidinger 2007).

## 2.2 Current Distribution

The distribution of Garry Oak (Oregon White Oak) is restricted to the western portion of North America, mainly close to the Pacific Ocean. In British Columbia, Garry Oak and associated ecosystems occur primarily on southeastern Vancouver Island, the adjacent Gulf Islands, and a couple of locations on the mainland, namely Sumas Mountain and Yale (Figure 2.3). The locations on the mainland are related to the distribution of Garry Oak in Washington State, which approaches the British Columbia border. The North American distribution of Garry Oak extends through Washington and Oregon State into northern California (Figure 2.4). Unlike in British Columbia, a fair amount of Garry Oak occurs in the interior portions of these states.

The current distribution of Garry Oak ecosystems in Canada is centered mainly around Victoria, Duncan, Nanaimo, and Comox (Lea 2006; Appendix 2.1). These ecosystems also occur on most of the southern Gulf Islands, although only their distribution on Salt Spring, Denman, and Hornby Islands has been mapped. On most other surrounding Gulf Islands, Garry Oak occurs on warm, steeper, south-facing slopes or on rock outcrops. For example, significant areas of Garry Oak occur along the coastlines of Gabriola and Pender Islands.

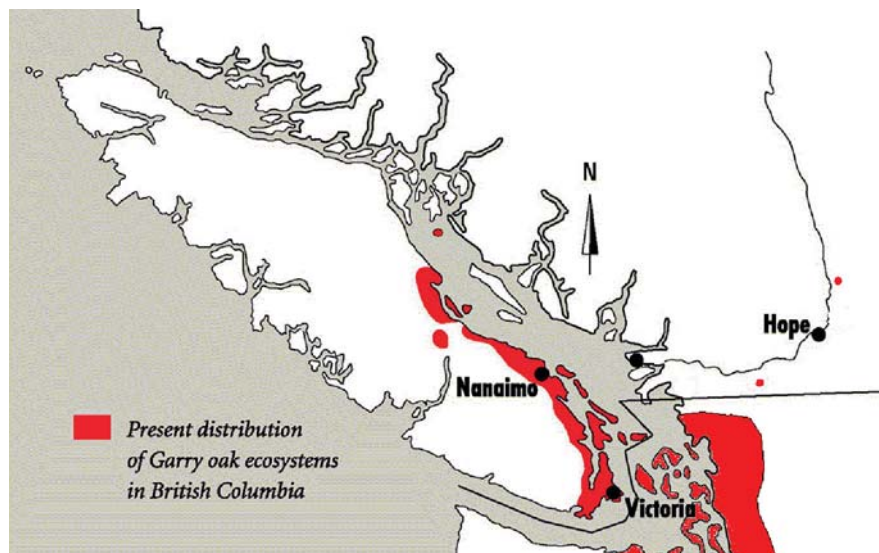


Figure 2.3 Current distribution of Garry Oak ecosystems in British Columbia. Map © Province of British Columbia





Figure 2.4 Current global distribution of Garry Oak ecosystems. Map © Province of British Columbia

### 2.3 Historical and Present Day Distribution

Pollen in soil cores sampled on southern Vancouver Island and the adjacent mainland suggests that the range of Garry Oak woodlands in Canada was more extensive several thousand years ago than it is today (R. Hebda, pers. comm. 2010; Brown and Hebda 2002; Pellat et al. 2001; Walker and Pellatt 2001). According to pollen analysis, Garry Oak first occurred in British Columbia around 9500 ybp<sup>1</sup> and was most common from about 8000 ybp to 6000 ybp. After that, the distribution of Garry Oak was similar to present day (Pellatt et al. 2001).

The distribution of Garry Oak ecosystems, including prairies, prior to European settlement and for the present day has been mapped (Lea 2006; Appendix 2.1). The maps cover most of the distribution of Garry Oak ecosystems on Vancouver Island, and include minor occurrences on many of the Gulf Islands (see Section 2.2). Significant losses of deep soil ecosystems have occurred within these areas due to agricultural and urban development, as is reflected in the present day distribution. Shallow soil ecosystems have been less impacted by development.

### 2.4 Current Suitability of Climate for Garry Oak Ecosystems

Figure 2. 5 shows where planting of Garry Oak could be successful based on current climatic conditions, if appropriate sites are chosen. These sites include areas with deep soils on average to

<sup>1</sup> ybp - years before present

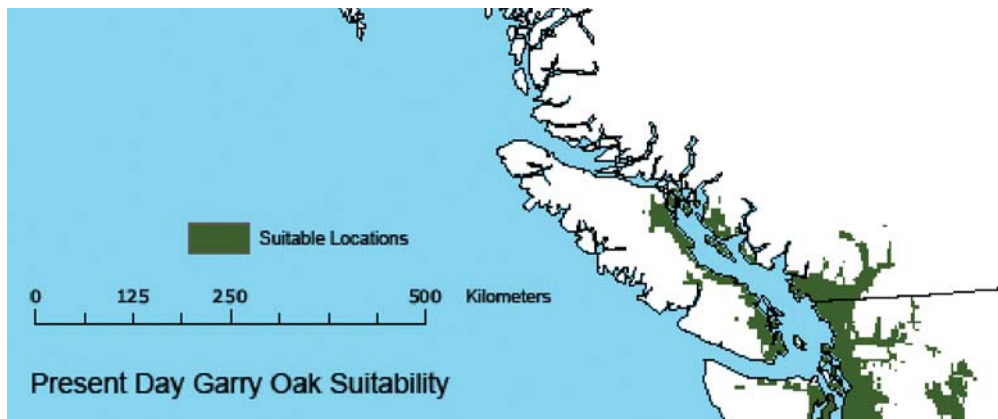


Figure 2.5 Areas that currently have suitable climate for supporting Garry Oak ecosystems. Royal BC Museum n.d.

drier sites with gentle slopes or warm aspects, and shallow soils. This indicates that Garry Oak and associated ecosystems could be established beyond their current range, in areas such as the Sunshine Coast and the lower Fraser Valley, which are believed to have supported Garry Oak in the past (R. Hebda, pers. comm. 2010).

Terrestrial Ecosystem Mapping (TEM) has been done for the entire Coastal Douglas-fir biogeoclimatic zone (CDFmm) (Madrone 2008), which corresponds with much of the area where current climatic conditions could support Garry Oak. This mapping will allow restoration practitioners to determine where connectivity between existing Garry Oak communities could be developed so that these communities can expand as climate warming occurs. Many areas, such as the Sunshine Coast, already support many of the species that occur in Garry Oak and its associated ecosystems.

The results of this Terrestrial Ecosystem Mapping for the Coastal Douglas-fir biogeoclimatic zone (CDFmm) and the Coastal Western Hemlock portion that is surrounded by CDFmm (CWHxm) indicate that the following mapped ecosystem units have the potential to support Garry Oak and its associated species or could be maintained as associated ecosystems (Table 2.1).

The Terrestrial Ecosystem Mapping for these zones is available on the provincial government EcoCat website ([www.env.gov.bc.ca/ecocat](http://www.env.gov.bc.ca/ecocat)).

Garry Oak and associated ecosystems could be established beyond their current range, in areas such as the Sunshine Coast and the lower Fraser Valley, which are believed to have supported Garry Oak in the past.



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Table 2.1 Ecosystem map units that could support Garry Oak and associated ecosystems (from Madrone 2008).

TEM Map Code	Site Series Number	Name
CDFmm <sup>1</sup>	00	Fescue – Camas
FC	00	Oceanspray – Rose
OR	00	Cladina – Wallace’s Selaginella
SC	00	Garry Oak – Oceanspray
GO	00	Garry Oak – Moss
OM	00	Garry Oak – Brome/mixed grasses
QB	01	Douglas-fir – Salal (officially known as Douglas fir/Dull Oregon-grape; gentle slopes and warm aspects only, not cool aspects)
DA	02	Douglas-fir – Shore Pine – Arbutus
DO	03	Douglas-fir – Oniongrass
CWHxm <sup>2</sup>		
AM	00	Arbutus – Hairy Manzanita
FC	00	Fescue – Camas
QB	00	Garry Oak – Brome/mixed grasses
SC	00	Cladina – Wallace’s Selaginella

<sup>1</sup> Coastal Douglas-fir moist maritime biogeoclimatic subzone  
<sup>2</sup> Coastal Western Hemlock very dry maritime subzone

## 2.5 Ecosystem Classification and Uses in Restoration

This section briefly describes the plant communities that are found in Garry Oak and associated ecosystems. It is intended to provide enough information for restoration practitioners to determine which plant communities could be developed on sites that are being restored. These communities are described in detail in Erickson and Meidinger (2007), Erickson (1995), and Parks Canada Agency (2006a, b, c; 2008). The information provided in this section is particularly relevant to creating new plant communities on sites that no longer have significant cover of native flora. The more detailed descriptions provided in Erickson and Meidinger (2007) can be used when working on relatively natural sites with Garry Oak woodlands. There is no similar plant community classification for associated ecosystems, such as maritime meadows or vernal pools; therefore, it is recommended that a knowledgeable local botanist be involved in determining appropriate activities when creating or restoring fairly natural areas, especially if species at risk could be present. Refer to Chapter 4: Species and Ecosystems at Risk, for further information about special considerations at a site that may contain at-risk species.

Communities often occur in mosaics across the landscape, and site conditions can change over very short distances and time periods. Site conditions will determine what plant communities can be supported on a piece of land, so they are the first attributes that should be determined before restoration begins. The key below provides a means to determine which plant communities may be appropriate for a particular property based on site conditions.





### KEY TO RESTORATION ECOSYSTEM UNITS

- 1a. Forests dominated by coniferous species, such as Douglas-fir. **Restoration Ecosystem Unit #8: Douglas-fir Communities.**
- 1b. Not forests dominated by coniferous species. Go to step 2.
- 2a. Steep slopes (greater than 30% slope) along the coastline dominated by small trees, shrubs, and herbs. **Restoration Ecosystem Unit # 7: Coastal Bluff Communities.**
- 2b. Gentle slopes or steeper slopes dominated by open stands of Garry Oak. Go to step 3.
- 3a. Depressional areas where water accumulates in the winter and early spring; variety of soils conditions, which prevent percolation of water. **Restoration Ecosystem #6: Vernal Pool Communities.**
- 3b. Generally well-drained soils, either on deep or shallow soils. Go to step 4.
- 4a. Low-elevation, treeless areas along the coastline; soils are often shallow, frequently 10–20 cm deep, but usually less than 50 cm of soil over bedrock; parent material may consist of till or glaciomarine clay, silt, or loam. **Restoration Unit #5: Maritime Meadow Communities.**
- 4b. Other conditions. Go to step 5.
- 5a. Areas of shallow soil over bedrock. Go to step 6.
- 5b. Areas with deeper soil. Go to step 8.
- 6a. Sites (often microsites) with significant seepage throughout the growing season. **Restoration Unit #4: Shallow Soil Seepage Communities.**
- 6b. Well to rapidly drained soils with limited seepage during the growing season. Go to step 7.
7. **Restoration Unit #3: Shallow Soil Garry Oak Communities.** Steps for 7a, 7b, and 7c are taken directly from Erickson and Meidinger (2007) for bedrock or other rocky, xeric landscapes, usually dominated by bryophytes or sparse, deep-rooted shrubs.
  - 7a. Primarily uniform bedrock, usually dominated by bryophytes. Warm aspects, exposed sites on rapidly drained topography, high site mineral soil exposure, trees if present may include Douglas-fir and Arbutus at relatively high cover. **Garry Oak – *Racomitrium elongatum* – Wallace’s Selaginella plant association.**
  - 7b. Cool aspects, topographically protected sites but with high mineral soil exposure and high percent soil coarse fragments. **Garry Oak – *Dicranum scoparium* plant association.**
  - 7c. Dry colluvial sites primarily underlain by fractured rock talus; if bedrock present, then cracked and fissured, not uniform; usually dominated by sparse, deep-rooted shrubs. **Garry Oak – Hairy Honeysuckle plant association.**



- 8a. Deep soil; average moisture conditions; gentle to steep slope. Go to step 9.
- 8b. Deep soil; wetter than average moisture conditions; receiving moisture from upslope. Often subhygric sites. Go to step 11.
- 9. **Restoration Unit #1: Deep Soil, Average Moisture Garry Oak Communities.** Steps 9a, 10a, and 10b are taken directly from Erickson and Meidinger (2007) for less xeric landscapes with a surface soil mantle.
  - 9a. Usually dominated by grassy herbaceous species; high percentage of soil coarse fragments. **Garry Oak – Roemer’s Fescue plant association.**
  - 9b. Gentle to steep slopes with soil mantle, usually dominated by native herbaceous vegetation. Go to step 10.
- 10a. Less xeric, often submesic gentle to moderate mid-slopes, sometimes with high mineral soil exposure cover; light to moderate native shrub understorey, usually dominated in early season by herbaceous forb species or later by herbaceous grasses. **Garry Oak – Common Camas – Blue Wildrye plant association.**
- 10b. Mesic to submesic gentle lower slopes, sometimes cool, protected, or wetter topographic sites including basins and gentle topography; soils relatively deep, medium-textured with low or moderate percent coarse fragments; light to moderate native shrub understorey; usually dominated in early season by herbaceous forb species or later by herbaceous grasses. **Garry Oak – Great Camas – Blue Wildrye plant association.**
- 11. **Restoration Unit #2: Deep Soil, Wetter Garry Oak Communities.** Step 11 is taken directly from Erickson and Meidinger (2007) for wetter topographic sites; cool sites receiving moisture additions off bedrock, and wet, mesic to subhygric, deep-soil sites usually dominated by dense cover of native shrubs, including dense, multi-layered native shrub thickets. **Garry Oak – Oceanspray – Common Snowberry plant association.**

### 2.5.1 Garry Oak Woodlands

Garry Oak ecosystems have been described in general by Parks Canada Agency (2006a), and in detail by Roemer (1972), Erickson (1995), and Erickson and Meidinger (2007). Originally, two major types were recognized within the Garry Oak ecosystem: *parkland* and *scrub oak*.

The parkland community type, which occurs on deep soils (Pojar 1980a, 1980b), supported common understorey plants, including Common Snowberry (*Symphoricarpos albus*), Common Camas (*Camassia quamash*), Great Camas (*Camassia leichtlinii*), Fawn Lily (*Erythronium oregonum*), various graminoid species (grasses, sedges, and rushes), and Bracken Fern (*Pteridium aquilinum*). Almost all of this community type has disappeared because it occupied areas that were most suitable for growing crops. Those areas started being cleared for agriculture and urban development in the 1840s. While many large Garry Oak trees remain, the original plant communities beneath them have been replaced by lawns, roads, agricultural fields, or concrete. A few examples of this community type remain in the Nature Conservancy of Canada’s Cowichan



Garry Oak Preserve, in a stand in Beacon Hill Park in Victoria, and in the Department of National Defence lands at Rocky Point in the District of Metchosin.

The scrub oak community type occurs on shallow soils and rock outcrops. The oak trees are often of lower stature than those growing on deep soils. The understories of these rock outcrop communities were originally dominated by many spring-flowering perennial forbs, grasses, and mosses, but now they often contain extensive cover of invasive alien species such as Scotch Broom (*Cytisus scoparius*), agronomic grasses, and other weeds. More of this community type remains, probably because many of the rocky habitats that support it were difficult to develop. Many scrub oak sites are now in protected areas such as Mount Tzuhalem Ecological Reserve, Mount Tolmie Park, and Mount Douglas Park.

These deep soil and shallow soil Garry Oak woodlands occur as patches within the Coastal Douglas-fir biogeoclimatic zone as a result of climatic, edaphic, and cultural factors (see Fuchs 2001). Recent classification of these two community types is described in detail in Erickson and Meidinger (2007). The authors defined seven Garry Oak plant associations, which are subdivided into 16 plant community types and six sub-communities. These plant communities are combined in Section 2.5.7.

### 2.5.2 Maritime Meadows

Maritime meadow plant communities in British Columbia have not been formally recognized or described. They are typically low-elevation, herb-dominated communities that occur within 3 km of the coastline (Parks Canada Agency 2006b). Much of the original area occupied by these ecosystems has been developed for housing, and it is believed that less than 200 ha remain (Parks Canada Agency 2006b). Environmental conditions of these ecosystems have been well described in the recovery strategy for maritime meadow species at risk (Parks Canada Agency 2006b, 2008).

Tree species are mostly or completely absent. The shrub layer is typically sparse and composed of combinations of Tall Oregon-grape (*Mahonia aquifolium*), Nootka Rose (*Rosa nutkana*), Common Snowberry, and Trailing Blackberry (*Rubus ursinus*), and may include sparse trees such as Garry Oak or Douglas-fir (*Pseudotsuga menziesii*). Under natural conditions, the well-developed herb layer tends to be dominated by a mix of forbs and graminoids. Forbs that may dominate the community include Common Camas, Great Camas, Wild Strawberry (*Fragaria virginiana*), Field Chickweed (*Cerastium arvense*), Pacific Sanicle (*Sanicula crassicaulis*), Barestem Desert-parsley (*Lomatium nudicaule*), Woolly Sunflower (*Eriophyllum lanatum*), Puget Sound Gumweed (*Grindelia stricta*), and Bracken Fern. Other less common forbs include Common Yarrow (*Achillea millefolium*), Hooker's Onion (*Allium acuminatum*), Slimleaf Onion (*Allium amplexans*), Chocolate Lily (*Fritillaria affinis*), Fool's Onion (*Triteleia hyacinthina*, White *Triteleia*), Spring Gold (*Lomatium utriculatum*), Cleavers (*Galium aparine*), Thrift (*Armeria maritima*), and Western Buttercup (*Ranunculus occidentalis*). The most commonly occurring native graminoids are California Oatgrass (*Danthonia californica*), Tufted Hairgrass (*Deschampsia cespitosa*), Red Fescue<sup>2</sup> (*Festuca rubra*), Blue Wildrye (*Elymus glaucus*), and Pacific Woodrush (*Luzula comosa*).

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<sup>2</sup> Red Fescue is a species complex with both native and non-native elements, sometimes described as sub-species, and with confused taxonomy.



Cover of the moss layer is often quite limited. Many invasive alien plant species dominate these sites (Parks Canada Agency 2008). These species are discussed in Chapter 9 (Alien Invasive Species).

Soil depth, parent material, and the percent of coarse fragments vary considerably among sites. Soils are often shallow, from 10–20 cm deep, but occasionally there is 30 cm or more of soil over bedrock. The parent material may consist of till or glaciomarine clay, silt, or loam. Coarse fragments are often abundant in the soil but may be almost absent. The soil tends to be well to rapidly drained. In the early growing season (October to March), the soil tends to remain moist. Soil moisture levels diminish as the growing season progresses, and by mid-summer significant water deficits occur for prolonged periods. Sites usually occur between 1 and 15 m above sea level (Parks Canada Agency 2008).

Maritime meadow ecosystems with more than 5% cover of California Oatgrass, Roemer's Fescue (*Festuca roemeri*), and/or native elements of Red Fescue have been described for the Puget Trough in Washington State, but other maritime meadow ecosystems in this area have not been classified (Chappell 2006).

Vernal pools are spatially discrete, seasonally flooded depressions that form on top of impermeable layers such as hardpan, claypan, or bedrock.

### 2.5.3 Vernal Pools

Vernal pool plant communities in British Columbia have not been formally recognized or described. Vernal pools are spatially discrete, seasonally flooded depressions that form on top of impermeable layers such as hardpan, claypan, or bedrock (Parks Canada Agency 2006c). The pools on Vancouver Island tend to be of two types: those formed by rock depressions and those forming on clay soils (Parks Canada Agency 2006c). They occur under Mediterranean-type climatic conditions that include relatively high levels of precipitation in winter and early spring, followed by complete or partial drying in summer. Environmental conditions have been well described in the recovery strategy for maritime meadow species at risk (Parks Canada Agency 2006c) and by the Parks Canada Agency (2008). Today, most of the remaining vernal pool/vernal seep habitat on Vancouver Island is confined to isolated coastal bluffs on the southeast side of the island, and to small undeveloped islands adjacent to the coast (Parks Canada Agency 2006c). Vernal pools, swales, and seeps are scattered throughout the Gulf Islands and along the Vancouver Island coast as far north as Campbell River and Mitlenatch Island. Harewood Plains, near the City of Nanaimo, is an important vernal pool and seepage area (Parks Canada Agency 2006c).

Trees and shrubs are absent. The herb layer is dominated by forbs with a lesser component of graminoids. Vernal pools have a variety of dominant plants, with annual plants being the most common. Some of the plants species found on Vancouver Island and the Gulf Islands include Scouler's Popcornflower (*Plagiobothrys scouleri*), Blinks (*Montia fontana*), Water-starwort (*Callitriche* spp.), Nuttall's Quillwort (*Isoetes nuttallii*), Macoun's Meadowfoam (*Limnanthes macounii*), Puget Sound Gumweed, Lowland Cudweed (*Gnaphalium palustre*), Tiny Mousetail (*Myosurus minimus*), Dwarf Owl-clover (*Triphysaria pusilla*), Erect Pygmyweed (*Crassula connata* var. *connata*), Yellow Monkey-flower (*Mimulus guttatus*), Toad Rush (*Juncus bufonius*), White-tipped Clover (*Trifolium variegatum*), and Long-spurred Plectritis (*Plectritis macrocera*). Perennial native forbs are not common but can include Thrift and Hooded Ladies' Tresses



(*Spiranthes romanzoffiana*). The moss layer may be present and common on some sites. Many alien invasive plant species dominate these sites (Parks Canada Agency 2006c, 2008).

Soils are imperfectly drained. In the early growing season (December to February), the water table is at or near the soil surface. Seepage diminishes as the growing season progresses. Winter seepage waterlogs the soil, creating conditions that are unsuitable for most woody or tall herbaceous species. Summer drought creates conditions that are unsuitable for those woody and tall herbaceous species that tolerate winter flooding. Parent material usually consists of glacio-marine clay-loam. The soils commonly consist of thin (1–20 cm deep) deposits over level bedrock. Coarse fragments are scarce in the soil and absent at the surface (Parks Canada Agency 2008).

### 2.5.4 Vernal Seeps

Vernal seep plant communities in British Columbia have not been formally recognized or described. Vernal seeps have shallow groundwater flow that emerges on sloping terrain, usually on the lower slopes of shallow soil and rock dominated hillsides (Parks Canada Agency 2006c). Seeps differ from vernal pools in that they are not usually associated with prolonged inundation; however, like vernal pools, they tend to dry up by late spring or early summer and thus present plants with similar challenges (Parks Canada Agency 2006c).

The ground cover is dominated by bryophytes and low annual herbs. The most abundant native species are bryophytes, particularly the Grey Rock-moss (*Racomitrium elongatum*) and *Bryum miniatum*. A number of native annual herbs may be present, most notably Yellow Monkey-flower, Fool's Onion, Small-leaved Montia (*Montia parvifolia*), Sea Blush (*Plectritis congesta*), Large-flowered Blue-eyed Mary (*Collinsia grandiflora*), Cup Clover (*Trifolium cyathiferum*), Smooth Fringecup (*Lithophragma glabrum*), Blinks, Narrow-leaved Montia (*Montia linearis*), Grassland Saxifrage (*Saxifraga integrifolia*), and Tomcat Clover (*Trifolium willdenowii*). Three bulb-forming species—Common Camas, Fool's Onion, and Harvest Brodiaea (*Brodiaea coronaria*)—are often present, as is Wallace's Selaginella (*Selaginella wallacei*), which may be abundant. Native graminoids are uncommon or absent. Most of the native plant species found in vernal seeps are habitat specialists and are not generally found in drier habitats (Parks Canada Agency 2006c, 2008).

The slope of vernal seep sites is usually greater than 35%; however, plants tend to occur on small, nearly level to moderately sloping benches. Soils tend to be very shallow, from 0.5 to 10 cm thick. Parent material tends to consist of weathered bedrock and slope-wash, and is generally rich in organic matter and often has a significant component of sand and/or fine gravel. Rock outcrops are generally present within or immediately adjacent to vernal seeps. The soil tends to be well- to rapidly-drained. In the early growing season (January to March), the soil tends to remain moist or wet as a result of near constant seepage. The soil moisture level diminishes as the growing season progresses, and by late spring, the soil experiences significant water deficits for prolonged periods. The soil surface is characterized by relatively small amounts of exposed mineral soil and fine litter (Parks Canada Agency 2008).

### 2.5.5 Coastal Bluffs

Coastal bluff plant communities in British Columbia have not been formally recognized or described. Two categories of the coastal bluff ecosystem have been identified: vegetated rocky



islets and shorelines, and vegetated coastal cliffs and bluffs (Ward et al. 1998). These areas are subjected to harsh environmental conditions such as crashing waves, winds, heat, storms, and salt spray. Coastal bluff ecosystems are often intermixed with other ecosystems such as Garry Oak woodlands, maritime meadows, and vernal pools.

Trees, when present, are sparse and may be stunted or windblown. Species include Arbutus (*Arbutus menziesii*), Garry Oak, Douglas-fir, and occasionally Seaside Juniper (*Juniperus maritima*). Shrub cover is usually limited but may include Tall Oregon-grape, Saskatoon (*Amelanchier alnifolia*), Oceanspray (*Holodiscus discolor*), and Common Snowberry. The herb layer consists mainly of graminoids, including Roemer's Fescue, Alaska Brome (*Bromus sitchensis*), Long-Stoloned Sedge (*Carex inops*), and Red Fescue, with a few herb species such as Stonecrops (*Sedum* spp.), Small-flowered Alumroot (*Heuchera micrantha*), strawberries (*Fragaria* spp.), Nodding Onion (*Allium cernuum*), Death-camas (*Zigadenus venenosus*), Sea Blush, Wallace's Selaginella, and Puget Sound Gumweed. Harvest Brodiaea and Menzies' Larkspur (*Delphinium menziesii*) occur less often. The moss and lichen layer is diverse and typically includes *Racomitrium elongatum*, *Syntrichia ruralis*, and on exposed rock, *Polytrichum piliferum* (Ward et al. 1998).

Coastal bluffs are usually rock-dominated and lack soils or have a shallow veneer of soil in rock crevices and depressions that allows vegetation to grow. Soils are usually very dry and nutrient poor and may have high salinity due to salt spray. Due to the surrounding harsh environment, it takes many years for organic matter to accumulate and distinct soil horizons to develop. Soils are usually sand to sandy-loams. Steep slopes limit the accumulation of organic matter to bedrock fissures on cliffs and bluffs (Ward et al. 1998).

Restoration Ecosystem Units, developed for this publication, provide restoration practitioners of Garry Oak and associated ecosystems with information that can be used at a broad scale.

### 2.5.6 Douglas-fir Plant Communities

Many of the deep soil sites that currently support Garry Oak can also support Douglas-fir communities. Within the Coastal Douglas-fir biogeoclimatic zone, many of the Douglas-fir communities are red- or blue-listed by the BC Conservation Data Center (see Chapter 4: Species and Ecosystems at Risk). The Douglas-fir communities are considered the end point in succession for these sites (see Section 2.6), and ecologically are acceptable to restore to on these sites. Douglas-fir communities have been described by Roemer (1972), McMinn et al. (1976), Green and Klinka (1994), and Madrone (2008). Tree species commonly found on these sites include Douglas-fir, Western Redcedar (*Thuja plicata*), and Grand Fir (*Abies grandis*). Common shrubs are Salal (*Gaultheria shallon*), Red Huckleberry (*Vaccinium parvifolium*), and Dull Oregon-grape (*Mahonia nervosa*). Sword Fern (*Polystichum munitum*) and Bracken Fern occur in the herb layer. Mosses are common and include *Hylocomium splendens*, *Kindbergia oregana*, *Plagiothecium undulatum*, and *Rhytidiadelphus loreus*. The plant communities where restoration of

Garry Oak and associated species would be successful include Douglas-fir/Dull Oregon-grape (CDFmm/o1), but only on gentle slopes and steeper warm aspects, not cool aspects; Douglas-fir/Arbutus (CDFmm/o2); and Douglas-fir/Alaska Oniongrass (CDFmm/o3).



## 2.5.7 Restoration Ecosystem Units

To aid the restoration of Garry Oak and associated ecosystems, the authors of this publication have developed broad ecological units called Restoration Ecosystem Units (REUs). These units are used throughout this publication to provide restoration practitioners with information that can be used at a broad scale. If practitioners require vegetation classification information for a site, they can refer to Erickson and Meidinger (2007).

Table 2.2 Restoration ecosystem units and their plant associations.

Restoration Ecosystems Unit No. and Name	Restoration Ecosystem Unit Description	Common Native Plant Species	Plant Associations <sup>1</sup>
<b>REU #1: Deep Soil, Average Moisture Garry Oak Communities</b>	Deep soil; variety of soil conditions; average or mesic moisture; low elevations; gentle slopes to moderate and steep south-facing slopes; usually over deeper bedrock	<p>Tree layer Garry Oak, Douglas-fir</p> <p>Shrub layer Common Snowberry, Tall Oregon-grape</p> <p>Herb layer Common Camas, Great Camas, White Fawn Lily, Western Buttercup, Broad-leaved Shootingstar (<i>Dodecatheon hendersonii</i>), Sea Blush, Pacific Sanicle, Cleavers, Harvest Brodiaea, Spring Gold, Miner's-lettuce (<i>Claytonia</i> spp.), Blue Wildrye, California Brome (<i>Bromus carinatus</i>), Alaska Oniongrass (<i>Melica subulata</i>), Long-Stoloned Sedge</p> <p>Moss layer <i>Racomitrium elongatum</i></p>	<p>Garry Oak – Common Camas – Blue Wildrye</p> <p>Garry Oak – Great Camas – Blue Wildrye</p>
<b>REU #2: Deep Soil, Wetter Garry Oak Communities</b>	Deep soil; wetter than average moisture; lower slopes that receive moisture from above; wetter subhygric	<p>Tree layer Garry Oak, Oregon Ash (<i>Fraxinus latifolia</i>), Douglas-fir</p> <p>Shrub layer Common Snowberry, Oceanspray, Nootka Rose, Indian-plum (<i>Oemleria cerasiformis</i>), Western Trumpet (<i>Lonicera ciliosa</i>), Tall Oregon-grape</p> <p>Herb layer Cleavers, Great Camas, White Fawn Lily, Chocolate Lily, American Vetch (<i>Vicia americana</i>), Blue Wildrye, California Brome, Long-stoloned Sedge</p> <p>Moss layer <i>Rhytidiadelphus triquetrus</i></p>	Garry Oak – Oceanspray – Common Snowberry

<sup>1</sup> From Erickson and Meidinger (2007) and Green and Klinka (1994)



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Restoration Ecosystems Unit No. and Name	Restoration Ecosystem Unit Description	Common Native Plant Species	Plant Associations <sup>1</sup>
<b>REU #3: Shallow Soil Garry Oak Communities</b>	Primarily underlain by bedrock or fractured rock; if bedrock, then cracked and fissured, not uniform; also found on talus or coarse colluvial material and at the margins of bedrock or other rocky xeric landscapes; occupies a variety of slope positions—usually moisture-shedding, gentle upper slope positions or steeper south-facing slopes	<p>Tree layer Garry Oak, Arbutus, Douglas-fir</p> <p>Shrub layer Common Snowberry, Oceanspray</p> <p>Herb layer Common Camas, Hairy Honeysuckle (<i>Lonicera hispidula</i>), Common Yarrow, Small-flowered Birds-foot trefoil (<i>Lotus micranthus</i>), Small-flowered Blue-eyed Mary (<i>Collinsia parviflora</i>), Woolly Sunflower, Broad-leaved Stonecrop (<i>Sedum spathulifolium</i>), Cleavers, Pacific Sanicle, Sea Blush, Satinflower (<i>Olsynium douglasii</i>), Wallace's Selaginella, California Brome, Blue Wildrye, Licorice Fern (<i>Polypodium glycyrrhiza</i>), Roemer's Fescue</p> <p>Moss layer Abundant with <i>Racomitrium elongatum</i>, <i>Dicranum scoparium</i>, <i>Polytrichum juniperinum</i></p>	<p>Garry Oak – Roemer's Fescue</p> <p>Garry Oak – Hairy Honeysuckle</p> <p>Garry oak – Grey Rock-moss – Wallace's Selaginella Garry Oak – Broom-moss Garry Oak – Hairy Honeysuckle</p>
<b>REU #4: Shallow Soil Seepage Communities</b>	Shallow soil seepage areas where water slowly flows in the winter and early spring; very dry in summer	<p>Tree layer: absent</p> <p>Shrub layer: absent</p> <p>Herb layer Blue-eyed Mary (<i>Collinsia</i> sp.), Smooth Fringecup, Blinks, Narrow-leaved Montia, Grassland Saxifrage, Tomcat Clover, Common Camas, Fool's Onion, Harvest Brodiaea, Wallace's Selaginella</p> <p>Moss layer Usually abundant with <i>Racomitrium elongatum</i> and <i>Bryum miniatum</i>, and significant lichen growth, mainly on rock outcrops or very shallow soil</p>	None defined

<sup>1</sup> From Erickson and Meidinger (2007) and Green and Klinka (1994)





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Restoration Ecosystems Unit No. and Name	Restoration Ecosystem Unit Description	Common Native Plant Species	Plant Associations <sup>1</sup>
<b>REU #5: Maritime Meadow Communities</b>	Low-elevation, treeless areas along the coastline; soils are less than 50 cm deep and are over bedrock; parent material may consist of till or glaciomarine clay, silt, or loam	<p>Tree layer Sparse, usually Garry Oak or Douglas-fir</p> <p>Shrub layer Sparse and composed of Tall Oregon-grape, Nootka Rose, Common Snowberry, and Trailing Blackberry</p> <p>Herb layer Common Camas, Great Camas, Wild Strawberry, Field Chickweed, Pacific Sanicle, Barestem Desert-parsley, Woolly Sunflower, Puget Sound Gumweed, Bracken Fern, Common Yarrow, Hooker's Onion, Slimleaf Onion, Chocolate Lily, Fool's Onion, Spring Gold, Cleavers, Thrift, Western Buttercup, California Oatgrass, Tufted Hairgrass, Red Fescue, Blue Wildrye, Pacific Woodrush</p> <p>Moss layer: typically sparse</p>	Non-defined
<b>REU #6: Vernal Pool Communities</b>	Depressional areas where standing water accumulates in the winter and early spring; soil conditions prevent percolation of water; dry in summer	<p>Tree layer: absent</p> <p>Shrub layer: absent</p> <p>Herb layer Variety of species including Scouler's Popcornflower, Water Chickweed (<i>Myosoton aquaticum</i>), Water-starwort, Nuttall's Quillwort, Macoun's Meadowfoam, Puget Sound Gumweed, Lowland Cudweed, Tiny Mousetail, Dwarf Owl-clover, Erect Pygmyweed, Yellow Monkey-flower, Toad Rush, White-tipped Clover, Long-spurred Plectritis, Blinks, Thrift, Hooded Ladies' Tresses</p> <p>Moss layer May be present and common on some sites</p>	Non-defined

<sup>1</sup> From Erickson and Meidinger (2007) and Green and Klinka (1994)



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Restoration Ecosystems Unit No. and Name	Restoration Ecosystem Unit Description	Common Native Plant Species	Plant Associations <sup>1</sup>
<b>REU #7: Coastal Bluff Communities</b>	Steep slopes (over 30% slope) along the ocean; dominated by shrubs and herbs	<p>Tree layer Arbutus, Garry Oak, Douglas-fir, Seaside Juniper</p> <p>Shrub layer Tall Oregon-grape, Saskatoon, Oceanspray, and Common Snowberry</p> <p>Herb layer Roemer's Fescue, Alaska Brome, Long-stoloned Sedge, Red Fescue, stonecrops, Small-flowered Alumroot, strawberries, Nodding Onion, Death-camas, Sea Blush, Wallace's Selaginella, Puget Sound Gumweed</p> <p>Moss layer: sparse</p>	Non-defined
<b>REU #8: Douglas-fir communities</b>	Variety of site conditions, but mostly deep, moist soils, gently sloping over bedrock	<p>Tree layer Douglas-fir, Western Redcedar, Grand Fir</p> <p>Shrub layer Salal, Red Huckleberry, Dull Oregon-grape</p> <p>Herb layer Sword Fern, Bracken Fern, Alaska Oniongrass</p> <p>Moss layer <i>Hylocomium splendens</i>, <i>Kindbergia oregana</i>, <i>Plagiothecium undulatum</i>, and <i>Rhytidiadelphus loreus</i></p>	<p>Douglas-fir / Dull Oregon-grape (also known as Douglas-fir – Salal)</p> <p>Douglas-fir – Shore Pine – Arbutus</p> <p>Douglas-fir – Oniongrass</p>

<sup>1</sup> From Erickson and Meidinger (2007) and Green and Klinka (1994)



### 2.6 Successional Perspective and Implications for Restoration

As the beginning of this chapter indicates, changes to Garry Oak ecosystems can occur quite quickly. Areas that originally supported prairie quickly succeeded to stands of Garry Oak when burning ceased. Over time, stands dominated by coniferous trees, such as Douglas-fir, developed mainly on sites with deep soil. On sites with shallow soil, Garry Oak communities may never be replaced by Douglas-fir.

Restoration workers often seem to select a particular successional community and try to manage their area to that “ideal state.” In the case of Garry Oak stands, this is often an oak savannah or oak woodland with a meadow-like understorey of camas, Fawn Lily, and other attractive flowers, but many other stages could also be appropriate (see Peter and Harrington 2004). Restoration practitioners can use successional information to determine which vegetation communities or stages could occur on the site they wish to restore, and what may happen to a particular community over time if it is not actively managed. For example, many deep soil areas that support Garry Oak communities can also support dense shrubby communities or coniferous forest (Roemer 1972). Therefore, shrubby species, such as snowberry or Indian-plum, or coniferous species, such as Douglas-fir, may establish on sites where restoration practitioners are attempting to maintain a Garry Oak woodland with a forb/graminoid understorey.

A variety of successional pathways can occur in deep soil sites in the Puget Sound area (Figure 2.6; Peter and Harrington 2004). These sites can support open prairie dominated by forbs and graminoids; parkland or woodland Garry Oak communities; dense shrub-dominated communities; or Douglas-fir communities all on the same site depending on disturbance history and intensity. Successional stages often existed in mosaics across the landscape depending on disturbance history (Lea 2006). Much of the area that historically supported Garry Oak ecosystems included sites where a Douglas-fir/Salal/Dull Oregon-grape community would be the climax plant community (McMinn et al. 1976).

In the past, the First Nations people regularly burned much of southeastern Vancouver Island to maintain important wildlife habitat and plant resources such as camas, and other root crops such as Bracken Fern (Roemer 1972; Turner 1999). Paleoecological evidence indicates that this burning allowed Garry Oak woodlands to persist over the last several thousand years by preventing succession to coniferous forest (Pellatt et al. 2001). Historical records indicate that the resulting landscape was a matrix of open prairies, rich meadows, and shrub thickets (MacDougall et al. 2004). Many Garry Oak woodland ecosystems (particularly the more mesic, deeper soil sites) depend on fire to maintain an open canopy and understorey, and remove thatch accumulation. Fire suppression also changes hydrological and nutrient regimes, which could negatively affect the species within these ecosystems. The expansion of shrubs is evident in portions of the Garry Oak woodlands at the Cowichan Garry Oak Preserve and at Somenos Lake, where Common Snowberry dominates the understorey vegetation. Snowberry appears to effectively shade out and eliminate most herbaceous species (Parks Canada Agency 2006a). Detailed successional relationships are also defined within each plant community described by Erickson and Meidinger (2007) and

Restoration practitioners can use successional information to determine which vegetation communities or stages could occur on the site they wish to restore, and what may happen to a particular community over time if it is not actively managed.



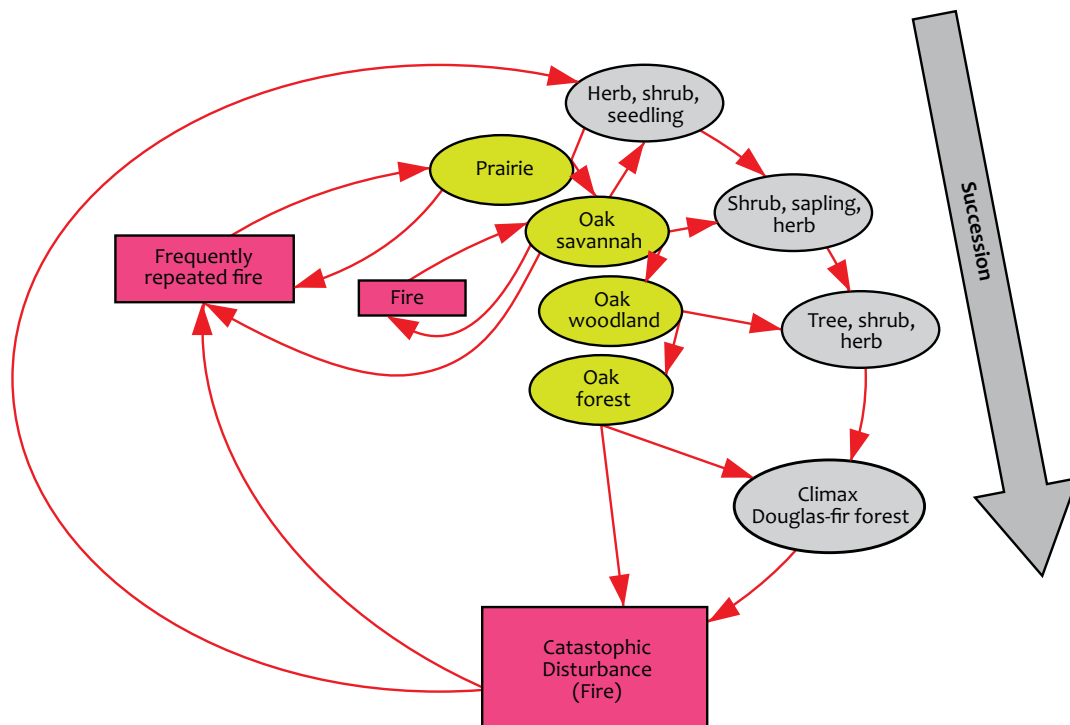


Figure 2.6 Successional pathways in deep soil sites in the Puget Sound area (modified from Peter and Harrington 2004).

Erickson (1995). These considerations of succession shed much light on the restoration process, since restoration must take into consideration the dynamic nature of Garry Oak communities. Chapter 3 (Natural Processes and Disturbance) provides a more in-depth look at fire and succession in relation to restoration.

### 2.7 Acknowledgements

Thanks to Brenda Costanzo, Carmen Cadrin, and Matt Fairbarns for information on maritime meadows and vernal pools; to Mike Miller for information on vernal pools and seeps; and to Lora Lea for review of the chapter.



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## Appendix 2.1

### Historical (pre-European settlement) and Present Day Distribution of Garry Oak Ecosystems

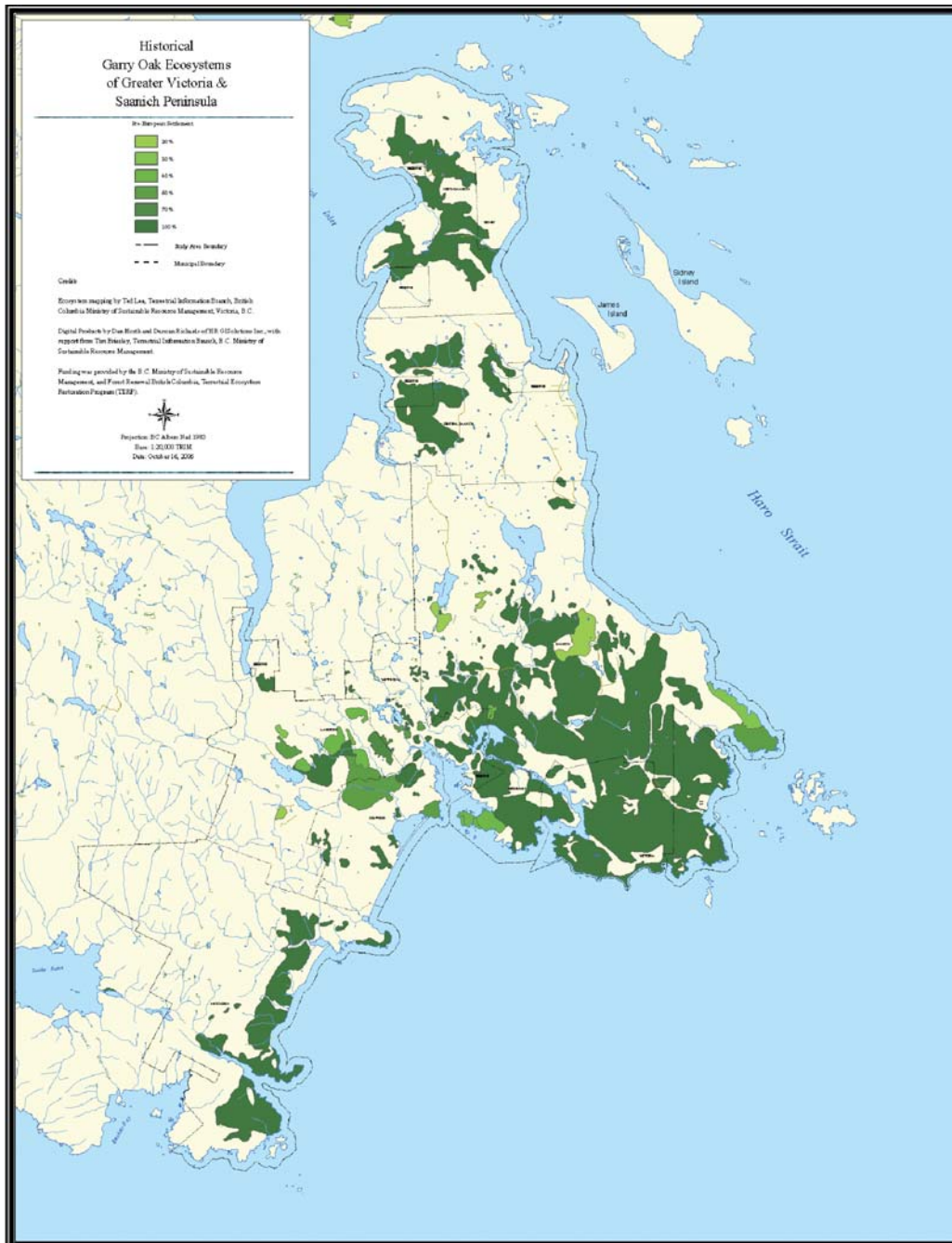


Figure A2.1 Historical Garry Oak Ecosystems of Greater Victoria and Saanich Peninsula (pre-European settlement).





Figure A2.2 Present day (1997) Garry Oak Ecosystems of Greater Victoria and Saanich Peninsula.



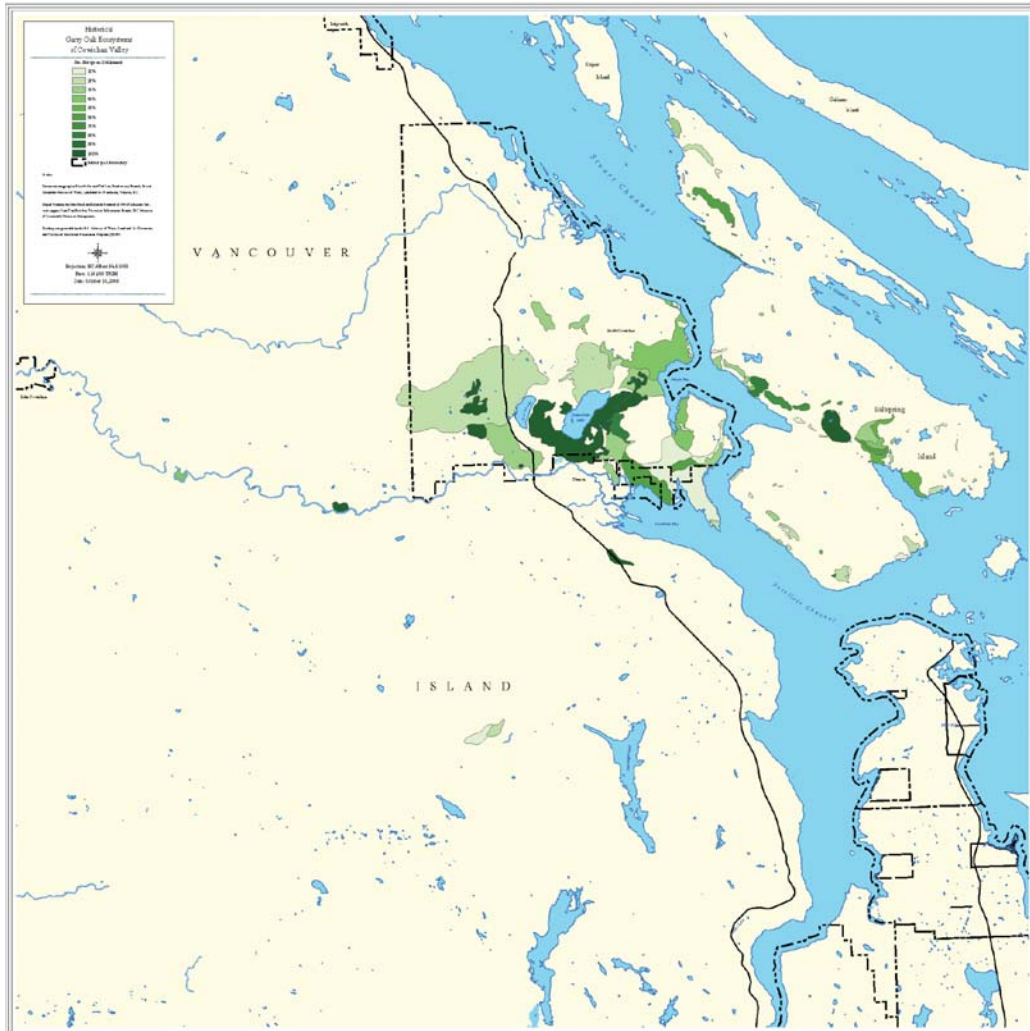


Figure A2.3 Historical Garry Oak Ecosystems of Cowichan Valley (pre-European settlement).

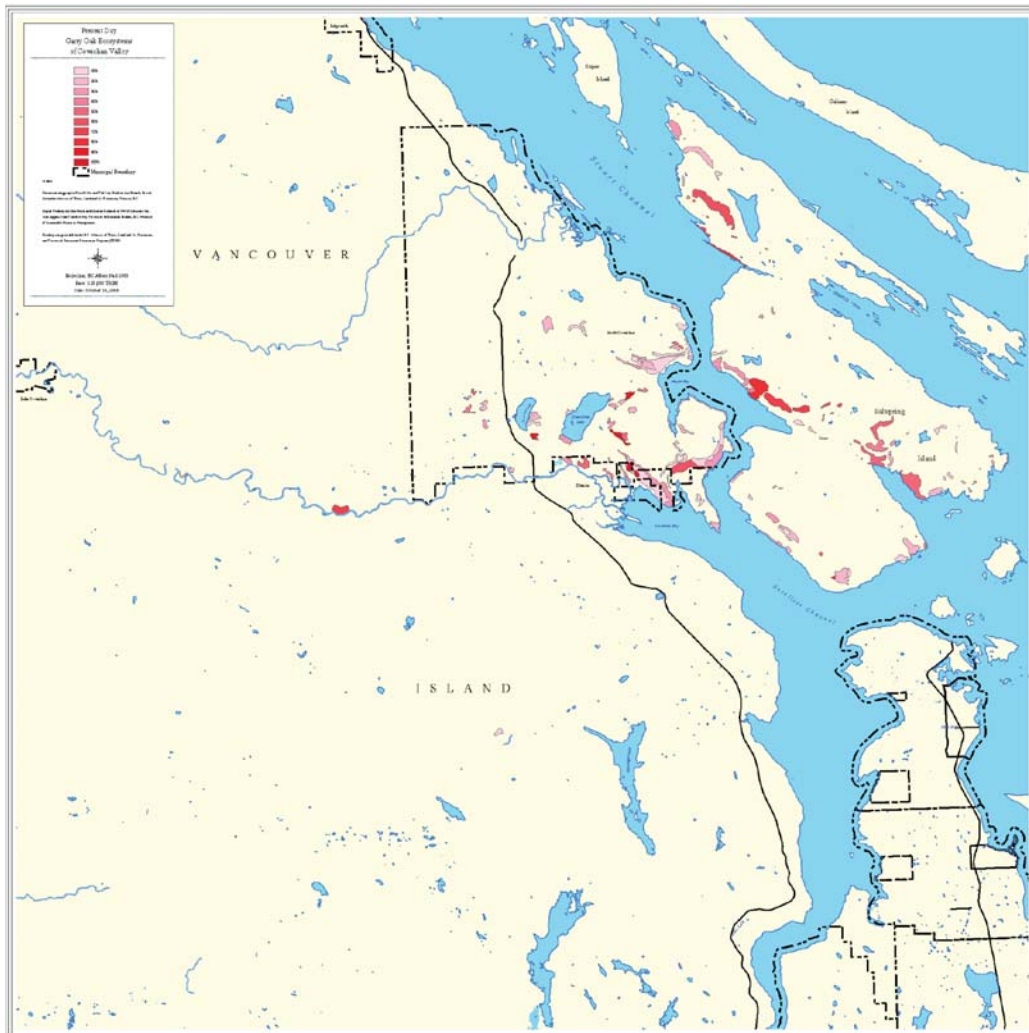


Figure A2.4 Present day (2006) Garry Oak Ecosystems of Cowichan Valley.





Figure A2.5 Historical Garry Oak Ecosystems of Nanaimo (pre-European settlement).

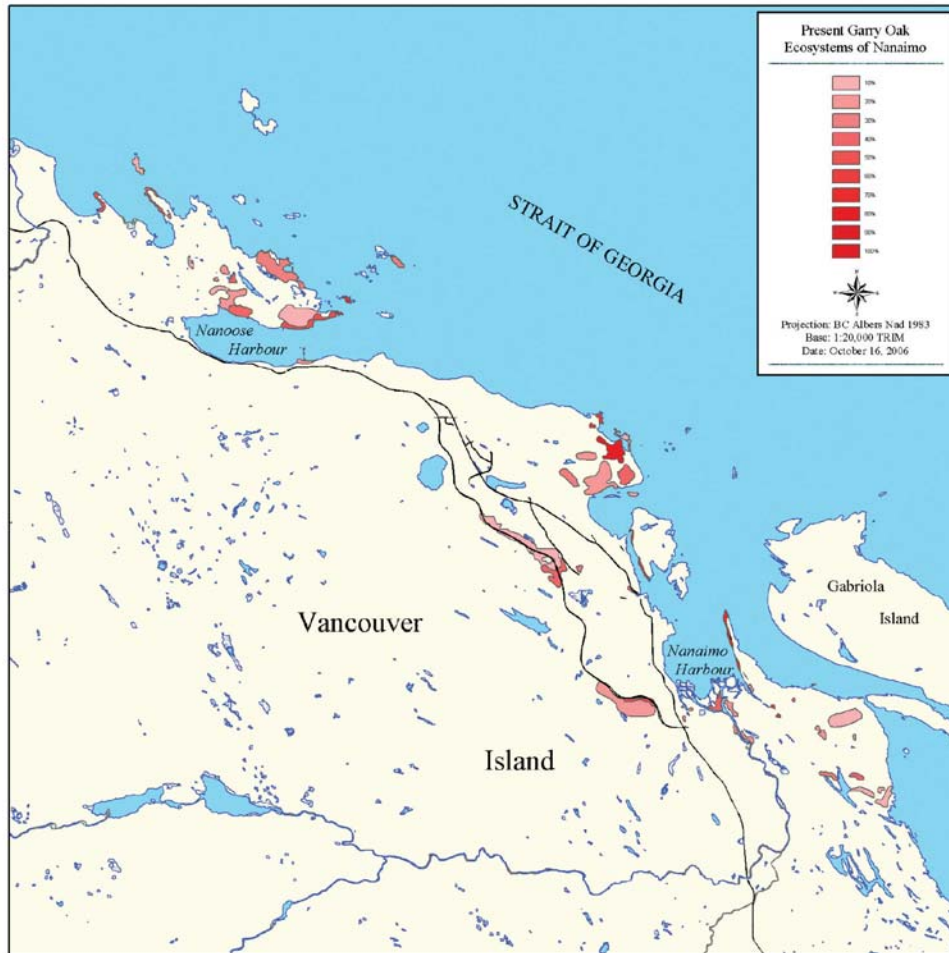


Figure A2.6 Present day (2006) Garry Oak Ecosystems of Nanaimo.



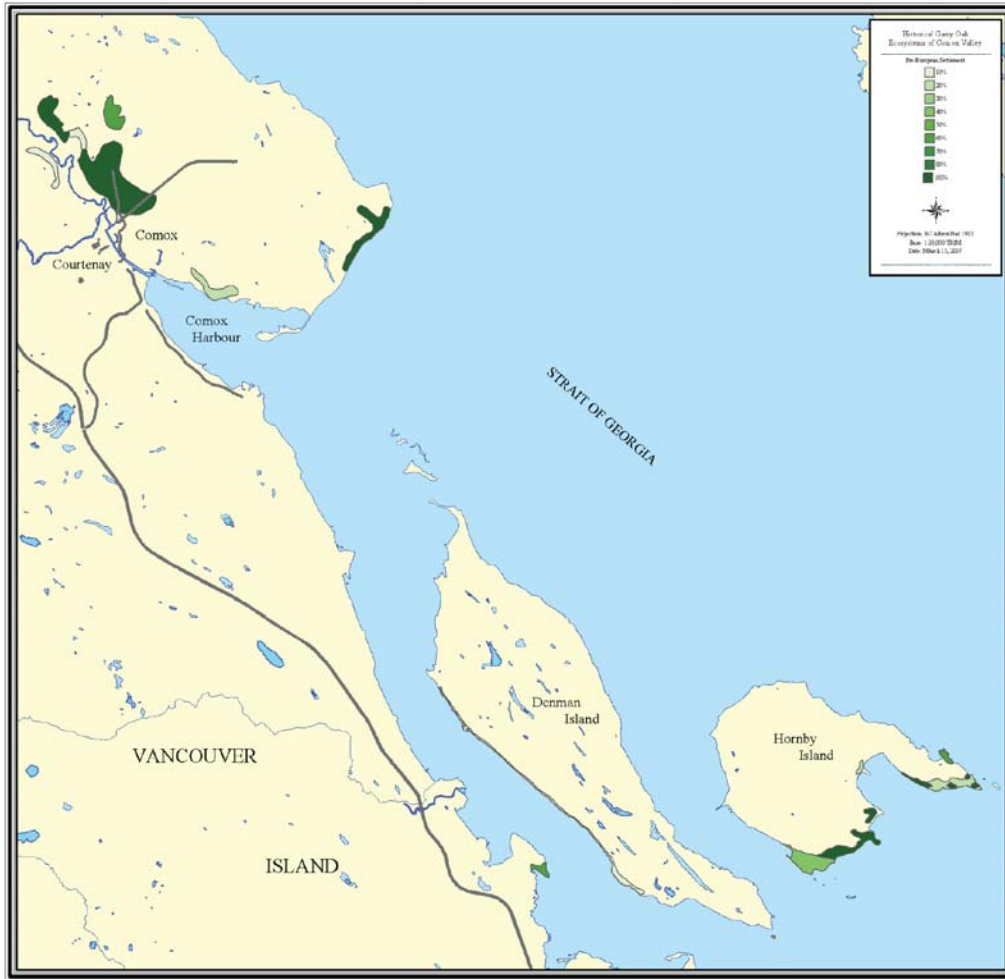


Figure A2.7 Historical Garry Oak Ecosystems of Comox Valley (pre-European settlement).

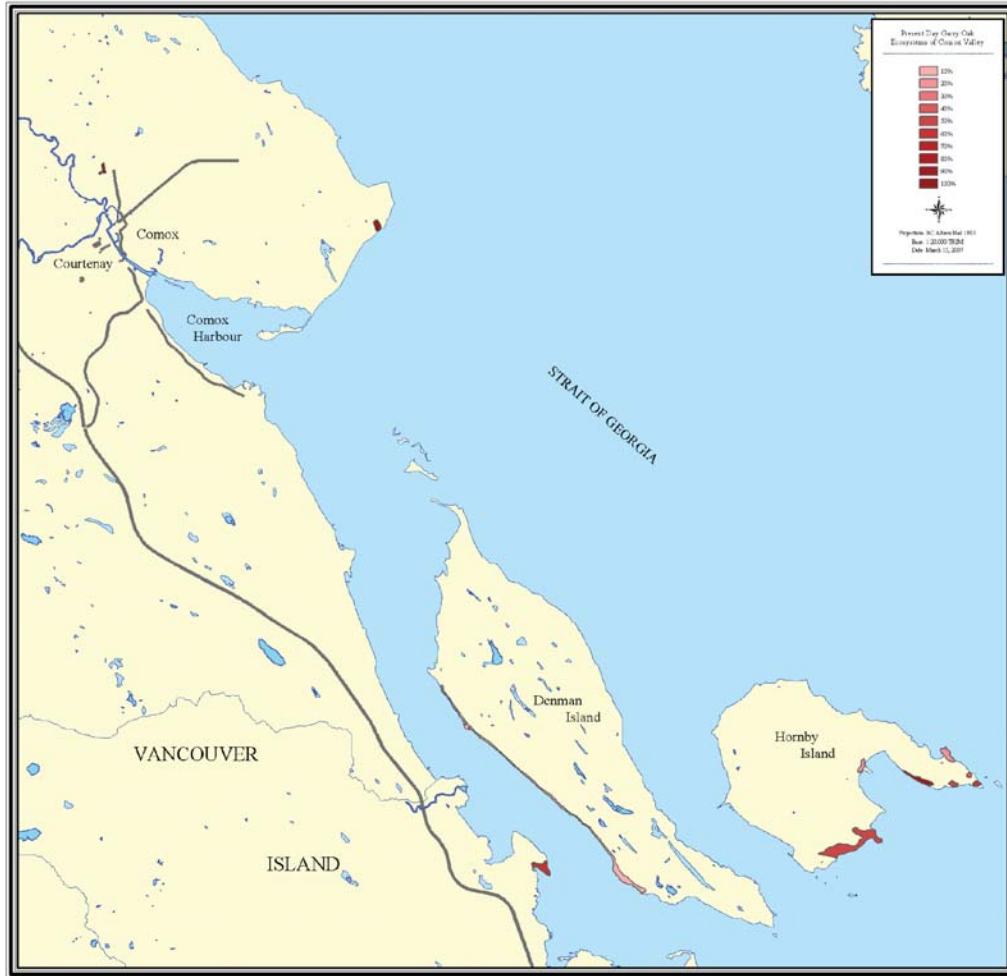


Figure A2.8 Present day Garry Oak Ecosystems of Comox Valley.



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