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TERRESTRIAL ECOSYSTEM MAPPING OF SALTSPRING ISLAND

for:

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Project management was spearheaded by Jane Thomson, who also provided GIS support. Bioterrain mapping was done by Michelle Trommelen and Wanda Miller, with internal QA provided by Gordon Butt and Pamela Williams, and external QA by Sid Tsang and Deepa Spaeth-Filatow, MoE. Ecosystem mapping and report writing was done by Jodie Krakowski, with external QA and feedback by Jo-Anne Stacey, Ted Lea, Carmen Cadrin, and Corey Erwin. Field crews also included Tania Tripp, Caroline Astley, and Guillermo Pérez. Andrew Neale Digital Mapping provided cascade control. Photos were monorestituted by Chartwell Consultants Ltd. Data entry was supported, in addition to those already named, by Lea Menzies, Ashley Nash, Kyle Resanzoff, Jackie Churchill, and Aleena Nowak. Julie Cowie ran the DC Tool application. Additional discussions with Andy MacKinnon, Helen Reid, Todd Golumbia, and many others provided valuable insight and clarification.

EXECUTIVE SUMMARY

A synthesis of the present distribution and status of the ecosystems and land cover of Saltspring Island was conducted using Terrestrial Ecosystem Mapping to Resource Inventory Standards Committee (RISC) guidelines. Map data and interpretations were conducted to RISC standards, supported by 25% overall polygon field sampling, with a higher intensity (50%) in BC Parks and Ecological Reserves. A total of 519 plots were assessed in the field: 22 full plots, 111 ground inspection plots, and 386 visual inspections. The study area was subdivided into 1761 polygons, with an average area of 10.8 ha.

Saltspring Island is characterized by medium- to coarse-textured soils derived primarily from glaciomarine and till deposits, including some very thick localized deposits. Growing season droughts and moderate, warm temperatures throughout the year result in relatively high productivity sites and highly desirable environmental conditions for resource use and settlement, driving conflicting land use objectives among stakeholders. Since most of the land base is privately held, there is an intricate mosaic of land uses and ecosystem conditions.

This map verified that although much of the island retains a cover of indigenous ecosystems, virtually all of them have been disturbed within the past century, resulting in a landscape dominated by younger forests. Only 7% of the landscape is covered by mature and old forests (1334 ha); 7.24 ha of old-growth forests remain. Much of the land base has been fragmented and alienated due to conversion to other land uses, primarily rural residential and agriculture. A total of 3232 ha, or 17% of the land base was mapped as anthropogenic, reaching 19.9% within the CDFmm portion of the study area. Invasive species are common, but vary in species cover and abundance, generally becoming more frequent with increasing canopy openness, early seral stages, and proximity to agricultural areas.

The CDFmm/CWHxm boundary was adjusted from the default position of 150 m a.s.l. to reflect observed differences in ecosystems. In some locations such as the steep, south-facing aspects of Mount Maxwell and Mount Tuam, the line was adjusted upwards to approximately 500 m a.s.l. On cool aspects such as those at Hope Hill, it was adjusted downwards slightly. Throughout the island, site-specific observations were used to guide delineation of the BGC boundary at the 1:20 000 map scale. The CWHxm1/xm2 boundary was delineated at approximately 650 m a.s.l., consistent with the current zone definition. This only

occurred in two small locations: the tops of Hope Hill and Mount Bruce; ecological differentiation was weak, according to the criteria described in Green (2007).

There was a wide diversity of ecosystem types mapped on Saltspring Island. Most forested ecosystem types classified in the mapped subzones were present, but riparian ecosystems and fluctuating water tables were uncommon, and those typical of floodplains were essentially absent due to the topography and parent material of the study area. Nutrient-rich ecosystems were uncommon, and distributed largely in glaciomarine material and thicker sediment deposits over gentle topography in the CDFmm.

Non-forested native ecosystems (i.e., exclusive of cultivated fields) were far more common in the CDFmm, particularly on shoreline sites and moderately steep to steep south-facing aspects with shallow to very shallow soils. These consisted largely of herbaceous meadows, rocky outcrops with bryophyte and selaginella cover, and graminoid meadows with shrubs and/or Garry oaks.

Throughout the study area, forests had historically been, and still were, being harvested using a variety of silvicultural systems, each leaving differing amounts and components of forest attributes and habitat features. This results in impacts to ecosystem processes and landscape-level factors including fragmentation and changes in connectivity, age class distribution, succession, species representation (particularly where stands are replanted to a preferred species that differs from the natural advance regeneration), potential changes in hydrology due to road construction, and modification of stand structure. These factors combine on the ground to generate ecosystems that often differ substantially from undisturbed stands, presenting challenges for ecosystem classification and site identification. Integrating information from surficial geology, drainage, soils, humus form, mesoslope position, aspect, sediment depth, seral stage, vegetation cover and abundance, and adjacent ecosystems is necessary to correctly classify sites.

The data collected for this project is suitable for generating thematic layers, such as sensitive ecosystem inventory (SEI) updates, broad forest productivity or cover (not to VRI standard), a detailed surficial geology map (to RISC standard), aggregate resource mapping, land use, wildlife habitat ratings (to RISC standard), and generalized slope stability modeling.

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TERRESTRIAL ECOSYSTEM MAPPING OF SALTSPRING ISLAND

1.0 BACKGROUND

This project was initiated by the Integrated Land Management Bureau (ILMB), Ministry of Agriculture and Lands (MAL) as a means to characterize the vegetation resources, landforms, and land use changes affecting the ecosystems of the Coastal Douglas-Fir (CDF) biogeoclimatic zone. The methodology used to achieve this goal was terrestrial ecosystem mapping (TEM), which has been developed and refined over time to adhere to a standardized set of protocols for bioterrain and ecosystem mapping, supported by field data collection and geographic information systems (GIS) mapping and interpretation. Year 1 deliverables focused on Saltspring Island, which also included small areas of the Coastal Western Hemlock (CWH) biogeoclimatic zone (eastern and western variants of the very dry maritime subzone: CWHxm1 and 2, respectively) at higher elevations (Figure 1).

1.1 Project Rationale

Interest in this ecosystem has been driven not only by the fact that the CDFmm is restricted in distribution and includes a densely populated part of the province, but also because the ecology is severely impacted by development pressure and changes in the natural disturbance regime. Historic fairly frequent fires in pre-settlement times were often set by First Nations people in the area to clear out underbrush and stimulate plant growth to provide berries, herbaceous annuals, and attractive forage for ungulate species to facilitate hunting and gathering (Lea 2006).

Fires have been largely eliminated from the landscape over the past century and many of the fire-adapted indigenous plant species and communities are being replaced by aggressive, exotic species that can out-compete them in this modified disturbance regime.

The landbase in the CDFmm has already been heavily influenced by development. There has been such widespread modification that the extent and condition of naturally-occurring ecosystems and wildlife have been impacted by many anthropogenic disturbances such as fragmentation, invasive species, domestic livestock, land alienation, resource extraction, and fire suppression. It is unique in B.C. in that most of the landbase is privately owned and not regulated by the Crown. However, guidance on resource management on public lands can still influence resource management policy and practices on Federal and private lands. Considering the CDFmm as a single, integrated unit, rather than a series of fragmented pieces of land in different administrative areas, will provide essential context for this purpose. Obtaining accurate and comprehensive information on the bioterrain, ecosystem classification, and disturbance history of the CDFmm can aid policymakers in developing and applying land use frameworks.

Covering the entirety of Saltspring Island required mapping of some areas of the CWH biogeoclimatic zone, which occurs at higher elevations immediately above the CDF zone south of Burgoyne Bay, at Mount Erskine, Mount Maxwell, Mount Sullivan, and Hope Hill (Figure 1). The general delineation of the CWH/CDF boundary is at 150 m elevation, but it was necessary to adjust this throughout the study area based on field observations.

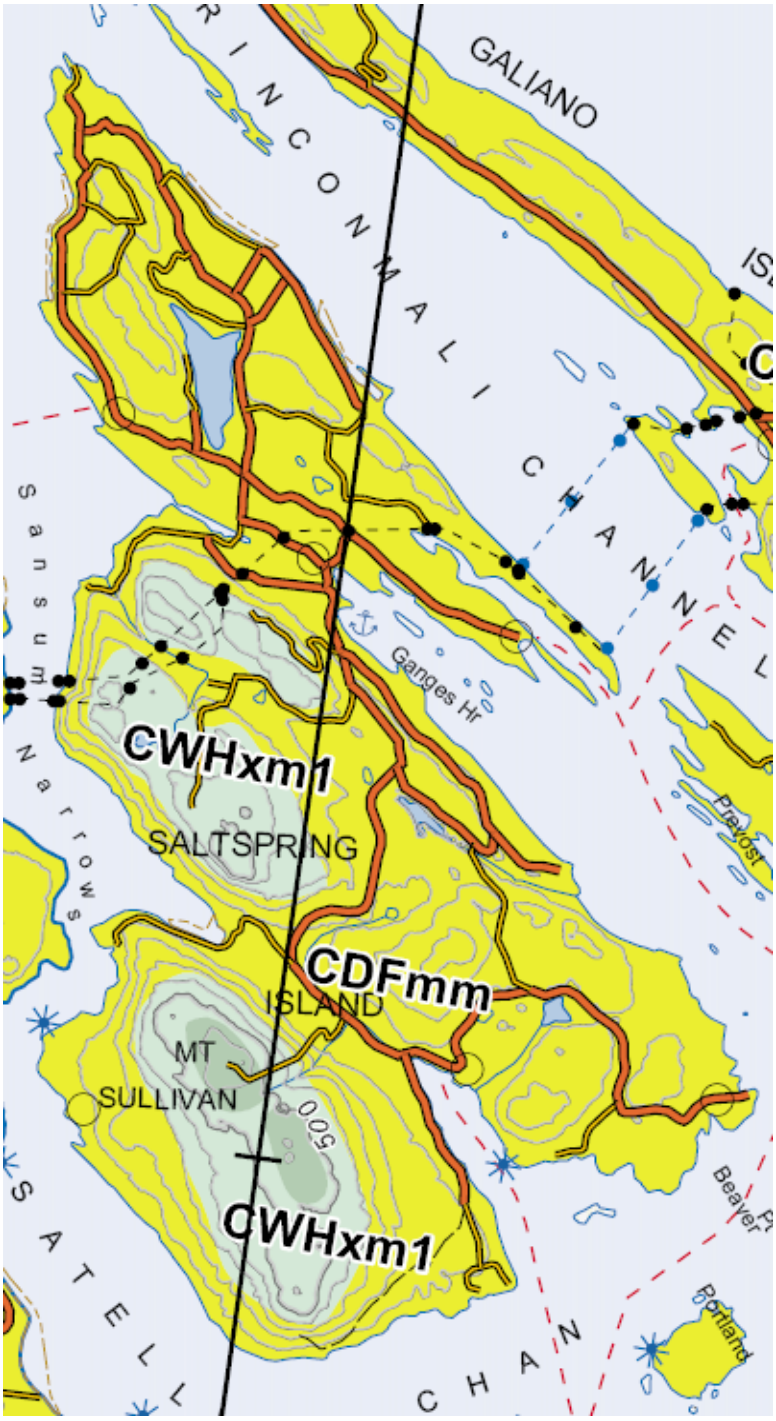


Figure 1. SSI location and biogeoclimatic units: CDFmm yellow, CWHxm1 light green, CWHxm2 dark green[1].

[1] From B.C. Ministry of Forests and Range biogeoclimatic map of the Vancouver Forest Region: ftp://ftp.for.gov.bc.ca/HRE/external/!publish/becmaps/PaperMaps/field/DSI_SouthIsland_Field.pdf

1.2 Climate and Biophysical Setting

Saltspring Island is situated in the Nanaimo Lowland subdivision of the Georgia Depression physiographic region (Holland 1976). The topography is flat to rolling and hilly, with elevations averaging from sea level to 300 m, and upper elevations of 698 m at Bruce Peak, 630 m at Mt Tuam, 595 m at Baynes Peak (Mt. Maxwell) and 441 m at Mt. Erskine (see Figure 1). This topography is roughly controlled by differential erosion of the northwest trending bedrock strata, combined with more resistant bedrock in the south. Several large lakes exist on the island; St. Mary Lake in the north and Cusheon Lake in the east central; formed during glacial scouring. There are no rivers, though a few small streams run along some of the valley bottoms and gullies.

The island is located primarily within the Coastal Douglas-Fir biogeoclimatic zone, moist maritime subzone (CDFmm). This zone extends along the Strait of Georgia from sea level to an approximate elevation of 150 m a.s.l. The CDF zone includes most of the Sunshine Coast, the Lower Mainland, most portions of the Gulf Islands, and the eastern coast of Vancouver Island from Deep Bay to Metchosin. The climate is cool mesothermal with long dry, warm summers and relatively warm, wet winters where temperatures rarely fall below freezing (Table 1). It is in the rainshadow of the Vancouver Island Mountains, and receives less precipitation than adjacent biogeoclimatic units.

The adjacent CWH zone is characterized by a slightly cooler, wetter climate during the growing season; however the subzone that occurs on Saltspring Island (very dry maritime, CWHxm) is dominated by the influence of the Pacific Ocean, resulting in very moderate, mild, warm climates throughout the year (Table 1). Its rainshadow location in the lee of the Vancouver Island Mountains results in a relatively dry climate comparable to the CDFmm, with droughts during the growing season. Exposure and topography of the region result in local variation in climatic conditions and are subdivided into additional biogeoclimatic variants. The eastern and western variants of this subzone (CWHxm1 and CWHxm2, respectively) occur in the study area, with the CWHxm2 slightly wetter and cooler than the CWHxm1, and mapped immediately above it at the highest points on Saltspring Island (Mount Sullivan and Hope Hill), above approximately 600 m.

Table 1. Climate normals (1971-2000) for Environment Canada meteorological stations on Saltspring Island.

Station name / ID / Latitude / Longitude / Elevation		Temperature					Precipitation						
		Daily Mean (°C)	Daily Max (°C)	Daily Min (°C)	Extreme Max (°C)	Extreme Min (°C)	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Extreme Daily Rainfall (mm)	Extreme Daily Snowfall (cm)	Extreme Daily Precipitation (mm)	Extreme Snow Depth (cm)
St. Mary's Lake	**Jan**	3.7	6.0	1.4	13.0	-10.0	136.1	9.6	145.7	71.1	18.0	71.1	0.0
ID 1016995	**Feb**	5.0	7.7	2.2	15.0	-10.5	107.9	4.0	111.9	49.9	11.5	49.9	12.0
48° 53.400' N	**Mar**	6.7	10.1	3.3	19.5	-6.0	85.4	1.4	86.8	52.2	16.0	52.2	0.0
123° 33.000' W	**Apr**	9.4	13.3	5.5	25.5	0.0	55.7	0.0	55.7	51.2	0.0	51.2	0.0
45.70 m	**May**	12.6	16.8	8.5	29.5	2.0	44.1	0.0	44.1	22.6	0.0	22.6	0.0
	Jun	15.4	19.7	11.1	31.5	4.4	38.8	0.0	38.8	29.0	0.0	29.0	0.0
	Jul	17.9	22.4	13.3	33.5	5.0	24.7	0.0	24.7	21.1	0.0	21.1	0.0
	Aug	18.1	22.5	13.6	32.0	8.0	30.0	0.0	30.0	58.8	0.0	58.8	0.0
	Sep	15.2	19.2	11.2	31.5	5.0	36.5	0.0	36.5	58.5	0.0	58.5	0.0
	Oct	10.7	13.8	7.6	25.5	-3.0	85.9	0.5	86.4	43.6	9.0	43.6	0.0
	Nov	6.4	8.7	4.1	16.0	-10.0	159.7	3.6	163.3	62.0	19.0	62.0	0.0
	Dec	4.0	6.1	2.0	17.0	-11.0	138.0	12.3	150.3	55.0	49.0	55.0	0.0
	Year	10.4	13.9	7.0	33.5	-11.0	78.6	2.6	81.2	71.1	49.0	71.1	12.0
Cusheon Lake	**Jan**	2.6	5.5	-0.4	14.0	-14.0	136.4	14.5	150.9	75.6	24.0	75.6	64.0
ID 1016992	**Feb**	3.7	7.3	0.0	16.0	-13.0	116.2	8.9	125.1	55.4	18.0	55.4	32.0
48° 49.200' N	**Mar**	5.8	10.3	1.3	19.5	-10.5	97.4	2.6	99.9	52.8	20.0	52.8	13.0
123° 28.800' W	**Apr**	8.3	13.5	3.1	26.0	-3.0	67.3	0.0	67.3	53.6	0.0	53.6	0.0
107.90 m	**May**	11.4	16.9	5.9	32.0	-1.5	48.9	0.0	48.9	28.8	0.0	28.8	0.0
	Jun	14.0	19.5	8.5	31.5	2.5	37.5	0.0	37.5	38.4	0.0	38.4	0.0
	Jul	16.2	22.1	10.3	31.5	3.5	22.9	0.0	22.9	21.6	0.0	21.6	0.0
	Aug	16.3	22.3	10.3	36.5	3.0	27.6	0.0	27.6	47.4	0.0	47.4	0.0
	Sep	13.2	18.6	7.6	32.0	-0.5	35.0	0.0	35.0	29.6	0.0	29.6	0.0
	Oct	8.7	13.0	4.4	25.5	-5.0	87.6	0.9	88.5	37.6	12.6	37.6	12.0
	Nov	4.7	7.9	1.5	16.5	-16.0	171.2	5.4	176.5	70.0	31.0	70.0	45.0
	Dec	2.6	5.3	-0.2	15.0	-17.5	135.2	12.8	148.0	55.6	35.5	55.6	74.0
	Year	9.0	13.5	4.4	36.5	-17.5	78.6	2.6	81.2	75.6	35.5	75.6	74.0

The CDFmm covers only a very small proportion of the land mass of British Columbia, yet it falls within the most densely populated areas of the province. Its Mediterranean climate makes it extremely attractive for residential and industrial development. Forest soils are often relatively rich supporting productive forest stands and frequently underlie good pastureland. This ecosystem type extends into the Pacific Northwest through Washington and Oregon, with only the northernmost tip in Canada. Saltspring Island is heavily developed for rural and agricultural activities, and – to a lesser extent – logging. Virtually no undisturbed areas remain, and the condition of extant ecosystems often reflects disturbance, frequently including introduced and cultivated species.

1.3 Bedrock and Surficial Geology

Southern Saltspring Island is composed primarily of Middle to Upper Devonian Sicker Group rocks, consisting of the Nitinat Formation calc-alkaline volcanic rocks and the McLaughlin Ridge Formation volcaniclastic rocks (Figure 2; Massey et al. 2005). North of Fulford Harbour and Burgoyne Bay, granodioritic intrusive rocks of the Late Devonian Saltspring Island Plutonic Suite outcrop. These igneous rocks were deposited in an oceanic island-arc environment (Massey et al. 1998). Chert, siliceous argillite and siliciclastic rock of the Mississippian to Pennsylvanian Buttle Lake Group outcrop along the southwestern Mt. Tuam area of Saltspring Island, deposited in a shallow ocean basin during a period of lowered volcanic activity. These rocks were intruded in the Late Triassic by Mount Hall Gabbro gabbroitic and dioritic rocks, as volcanic activity was renewed. Throughout northern Saltspring Island, sedimentary rocks of the Nanaimo Group, Upper Cretaceous age, uncomfortably overlie the igneous rocks. These sandstones, conglomerates and mudstones, sourced from thrusting in the Coast Belt and the north Cascades, were deposited in a marine basin. Eleven formations are recognized, and include alluvial and coastal marine deposits in addition to deep ocean submarine fan deposition. All rocks on Saltspring Island have been subject to various levels of folding and thrusting, which likely occurred during the crustal shortening accompanying formation and emplacement of the Pacific Rim and Crescent terranes outboard of Wrangellia.

Saltspring Island was glaciated by the Cordilleran Ice Sheet during the Vashon Stage of the Fraser Glaciation, between 25 000 and 15 000 years ago (Hickock and Armstrong 1985), resulting in the topography visible today. Thick unconsolidated deposits are present in the lower valley regions, and a mantle of sediment drapes most of the higher elevations. The median depth of surficial sediments is 2.4 m and the greatest thickness recorded in well records is 69 m in a low area northeast of Burgoyne Bay (Hodge 1995).

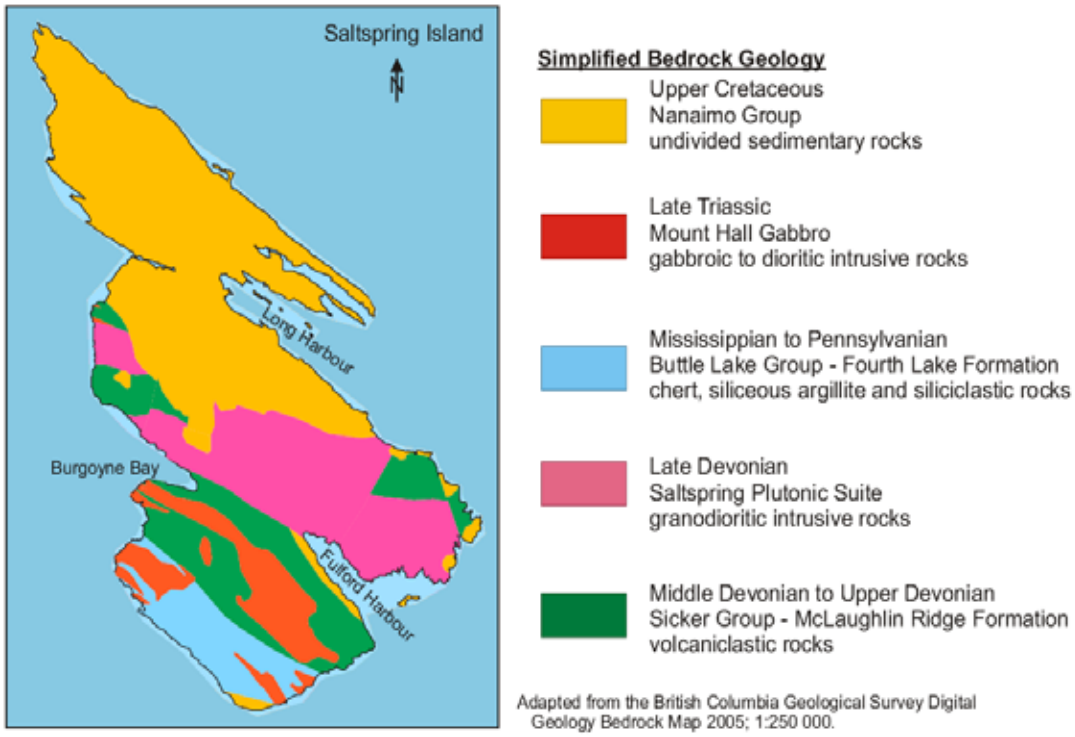


Figure 2. Simplified bedrock geology of Saltspring Island

The quaternary sediments on Saltspring Island consist primarily of till, with glaciomarine deposits located below elevations of 100 m. A mantle of till and colluvium can be found on many of the upper slopes, though bedrock outcrops in many places.

Till on Saltspring Island typically consists of a silty sand matrix with 35-75% coarse fragments. Where found below the maximum relative sea level, the till contains a higher percentage of fines. These fines were likely incorporated from underlying marine/glaciomarine materials as the glaciers overrode the area. Glaciomarine deposition occurred as isostatically depressed areas were inundated by the sea during glaciation and the early deglacial phase (Clague et al. 1982).

This silt and sand, with varying proportions of clay and typically less than 20% coarse fragments, can be found in many of the low-lying areas on Saltspring Island. The deposits generally form flat, moderately well to poorly drained areas, suitable for agriculture. Organic veneers and blankets form on these poorly drained soils in some areas of Saltspring Island though are mostly limited to lake shores. Glaciofluvial sand and gravel deposits are rare, but occur primarily in the valley southeast of Mt. Maxwell, where the Fulford-Ganges road lies. There are several active and inactive gravel pits here, incised into glaciofluvial terraces formed by glacial meltwaters flowing through the valley and into the ocean to the west.

An unusually thick (>30 m) area of sediment is found along the southwestern side of Fulford Harbour, consisting of till, glaciofluvial and glaciomarine sediments. Another thick area of sediment is found along the southwestern side of Mt. Tuam. Here, a bench of till (>40 m thick) has been variably incised by meltwater channels during early deglaciation. The lower slopes have been subject to considerable debris flow events, and should be considered an area of active mass movement processes. These thick sediment areas were likely deposited during a period of increased meltwater and sediment load during the early deglacial phase. As the ice thinned, glacial margins retreated to grounding lines and likely became retreating tidewater glaciers in Cowichan Bay and Sansum Narrows (Huntley et al. 2001).

1.4 Species and Ecosystems at Risk in the CDFmm

Species and ecosystem occurrences were documented using the B.C. Ministry of Environment online database B.C. Species and Ecosystems Explorer. This was preferred over the U.S.-based NatureServe (although methodology for ranking and listing is similar) since the results are more directly applicable to the regional and provincial applications of interest to the project, including specific filtering and searching for the CDFmm. This does not necessarily mean all of the identified species or ecosystems are known to occur on Saltspring Island, but they have been documented or mapped within the local region in the same biogeoclimatic zone.

The B.C. database also features detailed species reports related to provincial, national and international status, which frequently contain detailed information on locations, threats, and other factors affecting the species or ecosytems of interest.

The BC Conservation Data Centre (CDC) lists 160 taxa (species, subspecies/ varieties, and unique populations) whose habitat overlaps or falls completely within the CDFmm, South Island Forest District (B.C. C.D.C. 2007) (Appendix I). Of these, 116 taxa were animals. Animals listed include invertebrates, fish, insectivorous mammals, birds, marine mammals that use terrestrial habitat, amphibians, and reptiles. There were 44 plant taxa listed in the database. Plant species include perennials, annuals, ferns and fern-allies, woody and non-woody shrubs and dwarf shrubs, graminoids, forbs, aquatics, but no non-vascular species.

There are presently 36 ecological communities listed by the CDC on provincial red and blue lists in the CDFmm (B.C. C.D.C. 2007) (Appendix II). Nearly every forested site series, as well as the wetlands, are on these lists, the majority of which are described as "imperiled" (S2) or "critically imperiled" (S1). The ranks and status of species and ecosystems are based on several factors, and screened by committees of experts: rarity/abundance based on inventory data, connectivity based on spatial distribution, changes in abundance or distribution (e.g., fragmentation), areas with protected status, and external factors influencing the species or ecosystem (e.g., exotic pests or diseases, pending land use changes, etc.).

2.0 OBJECTIVES AND DELIVERABLES

The main objective of this project was to conduct bioterrain and terrestrial ecosystem mapping at a 1:20 000 scale for Saltspring Island. Mapping is supported by an overall 25% polygon visitation rate, where ground truthing was conducted according to provincial (RISC) standards.

Supporting deliverables include:

- A seamless digital database to RISC standards containing the polygons and attributes of the study area.
- A digital bioterrain and TEM map of the study area including plot locations.
- Hard copy maps of selected attributes and ratings of Provincial Parks on Saltspring Island.
- A summary report of the findings, supported by monthly progress reporting.

3.0 METHODS

3.1 Background Research

Colour aerial photographs at 1:16 500 (2005) for the entire project area were obtained and sent for cascade control. The project area was delineated. Background materials on the geological history, ecosystems, vegetation, land management, sensitive ecosystem inventory, rare element occurrences, Garry oak communities, aggregate resources, soils, and rare species and ecosystems were researched. A full list of the photos and roll information is in Appendix III.

3.2 Pre-typing Aerial Photographs

The photos were pre-typed for bioterrain (surficial geology material, thickness, expression, processes, modifiers, and drainage) following RIC (1996) standards and Howes and Kenk (1997). Bioterrain mapping was revised based on internal QA. Completed pre-typed photos of representative areas were sent to external quality assurance by S. Tsang, P.Geo., MOE, to ensure accuracy.

After adjustments were made to bioterrain polygons based on the QA, these sections were then pre-typed for terrestrial ecosystem mapping, which consisted of subdividing bioterrain polygons where multiple discrete ecosystem polygons occurred, and adjusting the existing bioterrain polygons to align with the ecosystem polygons (RISC 1998). Pre-typed linework was then sent to J. Stacey, MOE, for QA.

3.3 Field Reconnaisance and Pre-typing Revisions

A draft working legend was compiled to integrate surficial material, thickness, slope position, and drainage, with ecosystem types and modifiers.

Field crews conducted preliminary field work to correlate their observations and data collection methods with each other and with the provincial standards. To clarify the boundaries between biogeoclimatic units, elevational transects were evaluated in accessible areas. Cool and warm aspects were assessed to identify the variability associated with topography in the study area. Pre-typed photos and the draft legend were used as a basis for identifying and adjusting labels and polygons. Pre-typed photos, draft maps, and plot data for areas where data potentially supported localized biogeoclimatic unit (i.e., zone, subzone, or variant) delineation adjustments were sent to the Regional Ecologist for approval of proposed changes.

3.4 Detailed Field Sampling

A stratified sampling strategy was designed to collect field data from as many types of ecosystems as possible throughout Saltspring Island. Full plots (FS882) and ground inspections (FS212) were concentrated on sites likely to support zonal ecosystems, as well as infrequent/uncommon ecosystems, rare species, mature stands, and typical ecosystems representing all site series and positions on the edaphic grid were selected for sampling. Additional plots were included to confirm structural stages, site series, proposed new or non-correlated ecosystem types, and ecosystem types that were difficult to identify from the air photos (e.g., fluctuating water table sites and some disturbed sites). Visual inspections were used to confirm site series, structural stages, identification of some disturbed and anthropogenic areas, and areas not accessible for more detailed plots because they were on private property. Disturbance features and riparian zones were noted, and other features of interest were also recorded. Protocols followed BCMELP (1998).

Field work was conducted in January, March and April of 2007 by staff from Madrone Environmental Services Ltd. 519 plots were assessed in the field: 22 full plots, 111 ground inspection plots, and 386 visual inspections. Sampling included public and private lands, which necessitated obtaining landowner information and consent, supported by A. Todosichuk, Islands Trust.

Most sites were visited by vehicle, walking/hiking, and some by water taxi. Sampling intensity across Saltspring Island aimed to sample 25% of polygons, with 50% polygon visitation rates in BC Parks and lands identified as potential parklands by BC Parks (Figure 3).

3.5 Final Typing and Map Adjustments

Where necessary, adjustments to the draft maps and photos were made to reflect field observations. The entire study area was then typed for ecosystem polygons. Ecosystem typing followed Green and Klinka (1994), and Provincial Government updates[2], including approved TEM codes and species nomenclature. Where necessary, new codes were proposed based on new information (e.g., Erickson and Meidinger 2007) and reviewed by the provincial correlator (Jo-Anne Stacey, MOE) and Regional Ecologist (Andy MacKinnon, MoFR). Once completed, these photos were subject to an internal QC process by an experienced bioterrain and TEM mapper, and then sent to J. Stacey for external

[2] http://www.for.gov.bc.ca/hre/becweb/resources/codes-standards/standards-becdb.html

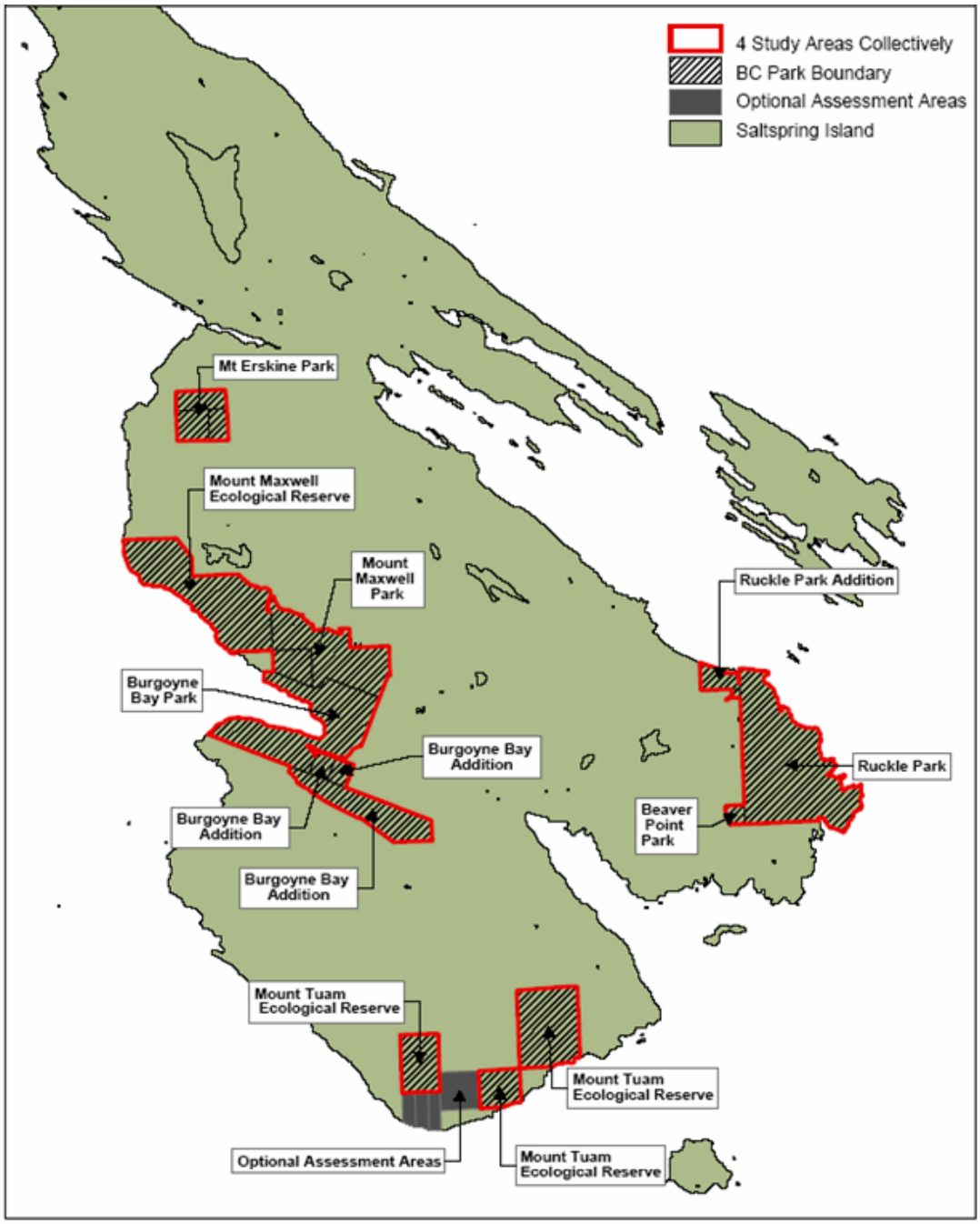


Figure 3. Sampling intensity on Saltspring Island: 25% polygon visitation across the island and 50% within areas highlighted by BC Parks.

QA, accompanied by the draft map and database. After feedback was received, necessary adjustments were made to linework and labels, and hard copy maps containing bioterrain and TEM polygons were generated.

Anthropogenic ecosystems were typed where the site characteristics and species cover were altered to the point where natural ecosystem processes were substantially restricted. For example, although a rurally developed area may still retain some trees and plant gardens, hedgerows, etc., these would not undergo natural succession or provide the same habitat values as indigenous ecosystems. Cultivated fields were mapped as such if they appeared cultivated; fallow fields and grazing lands were mapped as cleared ecosystems where visible. Paved surfaces were typically not pulled out as separate polygons since at the scale of mapping they were too small to distinguish.

Sparsely vegetated ecosystems were defined as those presently supporting no or little natural vegetation due to disturbance (e.g., exposed soil) or the nature of the underlying terrain (e.g., cliffs or rock outcrops).

Water features, including lakes, ponds, and shallow open water were also mapped separately following RISC protocols.

3.6 Database

The standard RISC database was compiled containing the ecosystem and bioterrain map codes for each polygon once pre-typing and labeling was complete. Field plot data was entered into VENUS 5.1 and GRAVITI. The RISC database was linked to the standard TEM GIS database generated from the monorestituted polygons and reviewed for completeness and adherence to RISC standards, usage of correct coding, etc. A one-to-one correspondence between polygon numbers, ecosystem and bioterrain labels was established.

Bioterrain and TEM polygon data were entered into a spatial attribute file component of the ArcInfo database containing digitized polygon data for the project area following RISC (2000, 2004) standards. Once completed, the database including ecosystem and bioterrain labels, pretyped photos, and adjusted polygons, as well as a hard copy map, were sent to MOE for QA. The final database was assessed as error-free by the DC Tool utility, except for non-standard (e.g., wetland) codes, which were substituted for user-defined codes.

3.7 Map Products

A detailed legend was prepared, including all bioterrain and TEM variables, following RISC (2000, 2004) standards. A brief summary report of all legend features and codes was included to aid in the interpretation of the map. A more detailed summary of mapped ecosystems is included here as an expanded legend (Section 4.8).

A more detailed map and report for Saltspring Island was prepared as above to meet deliverables specified in the 2006/07 FY by Islands Trust Fund, and to simultaneously meet deliverables specified by ILMB.

3.8 Data and Map Limitations

Colour air photos at 1:16,000 (2005) were used to create the TEM map products and subsequent interpretations, supported by RISC level 3 to 4 sampling intensity throughout the study area. This scale is appropriate for mapping applications of 1:20,000 or smaller scale.

In localized areas (i.e., parks and other areas shown on Figure 3), higher sampling intensity and use of more detailed inventory and map information yielded a more accurate and detailed map product that would be appropriate for interpretations at 1:5,000 or smaller.

Where sites were mapped using only photo interpretation, recent land use changes may not be reflected. The spatial limitations of mapping and photo interpretation may preclude detailed interpretation of some very steep areas (i.e., information could not be depicted on a 2-dimensional map).

Access to private property was the primary limitation with respect to sampling the complete range of ecosystems throughout the study area. While every effort was made to seek permission from landowners, not all ecosystem types could be directly observed, but were mapped based on supporting information and background research documenting their presence.

The timing of sampling (December, January, March, April) limited the efficacy some ecological sampling, particularly with respect to annual indicator plants and classification of species guilds. In some sites, especially those dominated by herbaceous meadows and Garry oak ecosystems, repeated sampling throughout

the year results in a more comprehensive inventory of species composition since communities represented vary substantially throughout the growing season.

The widespread and moderately intensive nature of disturbance and modification to the ecosystems throughout Saltspring Island was a critical factor affecting ecosystem classification and interpretation, especially for older seral stages. Introduction of exotic species, preferential harvesting and regeneration of forest species that differ from those that would occur under natural succession, and agricultural utilization all had profound impacts on the species and ecosystem dynamics of the study area. To ensure sites were classified appropriately, topography, surficial geology, geomorphological history, soils, drainage, and (where available) local historical information was also evaluated where diagnostic plant communities differed from those expected at a site. There were insufficient sites sampled or present on the landbase for most ecosystem types to generate a complete set of diagnostic, dominant, and associate species for each seral stage.

4.0 RESULTS

4.1 Terrain Characteristics

The predominantly sandstone, intrusive, and conglomerate origins of the bedrock on Saltspring Island, in conjunction with the weathered products and terrain of the area, combine to form a landscape that is dominated by fairly well-drained loamy sands to sandy loams. The perimeter of the island features lower lying, gentler terrain with glaciomarine deposits of variable thickness. Towards the centre of the island, the glaciomarine deposits have been either weathered away or overlain by till veneers (Figure 4). There are no rivers of any considerable size on the island; fluvial deposits are highly localized to immediate active channels. Glaciofluvial materials are found in small deposits throughout, typically in fans and underlying currently active channels, where they are overlain and intermingled with till, colluvium (on steeper sites), and glaciomarine materials (the latter at low elevations, nearer the ocean). Hydrology is dominated by creeks and lakes, with snowmelt a non-significant factor due to the mild climate. There are localized areas of glaciolacustrine deposits in the interior of the island. Marine deposits around the perimeter of the island on flat to gentle terrain are subject to wave action and consequent weathering and deposition (Figure 4).

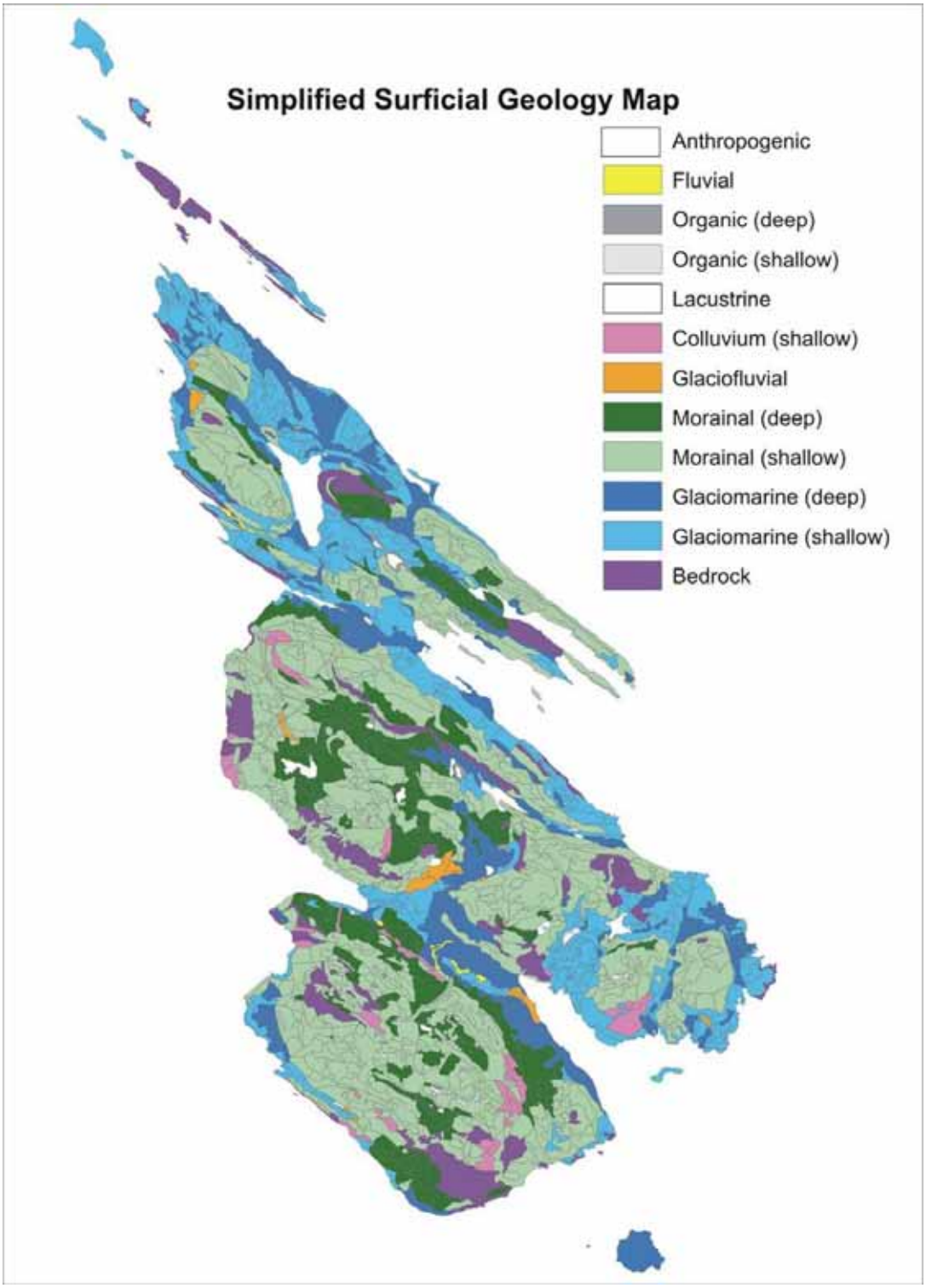


Figure 4. Simplified surficial geology map of Saltspring Island showing dominant material and thickness by polygon (first decile).

Bedrock outcrops, till of varying thickness, and colluvium are the predominant materials covering most of the landbase (Figure 4). Thick glaciomarine deposits form a band from Burgoyne Bay to Fulford Harbour, and are frequently under cultivation or grazing. These fertile sites are generally moderately well to imperfectly drained, and have the potential to support productive forest growth. The remainder of the island consists of undulating to moderately steep hills supporting second-growth forest.

Soils were dominated by medium- to coarse-textured loamy sands and sandy loams. Clay and fines were typically <20%. Gleying was uncommon; mottling more so, but mottles were often weak due to the sandy matrix and underlying parent material. Coarse fragment content varied considerably with parent material: glaciomarine deposits often had virtually no coarse fragments, while tills frequently had 35-50%, and steeper sites with a colluvial component contained upwards of 65%.

4.2 Land Use

Development was extremely widespread throughout the island, and resulted in varying degrees of ecosystem modification. As noted above, glaciomarine materials are heavily used for haying, grazing, and agriculture. Forest harvesting was widespread, but has become less so since the latter half of the twentieth century. Some small-scale orchards and vineyards have been established on gently to moderately sloping well-drained terrain. Shoreline areas are preferred residential sites, and many shoreline habitats have been modified by human disturbance. Opportunities to verify shoreline ecosystems on the ground were extremely limited because of restricted access to private property.

Rural residential use is dispersed throughout virtually the entire island. Some ecosystem modification consists essentially of land conversion or alienation such that natural processes and functions are hampered or modified to the extent that native plant communities are not supported. This does not negate their potential function, should they be restored or set aside for reclamation. Seasonally flooded fields, hedgerows, ditches, and windbreaks also provide habitat for a variety of wildlife species, serving to maintain some degree of landscape habitat connectivity and support forage species, shelter, roosting sites, nest locations, and prey populations. These types of habitats are relatively abundant on Saltspring Island, and may be quantified further by developing a theme layer

based on the TEM data (e.g., for sensitive ecosystem inventory or habitat capability/suitability mapping.

On mesotrophic and richer sites, productive forest growth was noted, while on drier and poorer sites, forest productivity and commercial operability is limited (Courtin et al. 1989). Most upland sites were capable of supporting productive forests of Douglas-fir, either as pure stands or in varying admixtures with western hemlock, western redcedar, grand fir, red alder, and non-commercial species. In some low-lying areas and poorly-drained sites, poor soil trafficability and seasonally anaerobic conditions also hampered forest productivity, although sites supported moderately diverse communities of non-timber species. These sites are typically used for agricultural purposes or fallow at present.

4.3 Soils

Soils were identified and classified following the Canadian System of Soil Classification (Soil Classification Working Group 1998), using methods outlined by BCMOF and BCMELP (1998).

Organic soils (most commonly Fibrisols and Mesisols) were extremely uncommon and localized in depressions, wetlands, and other very poorly drained sites. Only in very few areas were the organic horizons sufficiently deep to meet the criteria for classification. As such, Organic order soils on these sites generally graded to Gleysols and Gleyed and Gleyed Eluviated Dystric Brunisols. Cultivation of the top 20-50 cm often prevented confirmation to the subgroup level in these soil types.

Brunisols were common and widespread throughout Saltspring Island. Orthic Dystric Brunisols were the most common, derived from the sandstone and conglomerate parent material, with few Gleyed and Gleyed Eluviated Dystric Brunisols, as noted above. Brunisols supported a range of ecosystem types, including upland forests, orchards, vineyards, pasture, and rural residential. Eutric Brunisols occurred beneath ecosystems that had long supported Garry oak stands, having developed from the nutrient-rich, high-pH litterfall and associated species in those plant communities.

Podzols were also relatively common in sufficiently deep deposits, supporting upland forest types. Ferro-Humic Podzols were the most prevalent great group, with Orthic Ferro-Humic Podzols predominating. Gleyed Ferro-Humic Podzols

were uncommon. Soil depth was the most limiting factor in development of Podzols around Saltspring Island: many deposits were too thin or too recently disturbed to develop a Podzolic B horizon, limiting them to the Brunisolic order.

Regosols were found in areas with ongoing pedogenic processes, such as beaches and active terrain slumps and slides. They also occurred at the higher elevations and on steeper sites due to the proximity of lithic contact, restricting soil depth. Where sites had insufficient soil development, they were categorized as having Non-soil (CSSC 1998).

4.4 Ecosystems

There were a wide range of ecosystems represented throughout Saltspring Island (Figure 5), but very few in entirely undisturbed states. Forested ecosystems consisted almost entirely of second-growth, and often regenerated stands were stocked with species that differed from those expected under undisturbed conditions to create stands that would support more commercially valuable future forests. This was particularly the case for Douglas-fir, which was extremely widespread where it may be considered off-site, and throughout a range of sites in the CWH zone where mature and advance regeneration of western hemlock had been removed and Douglas-fir planted. The past and current history of livestock grazing has contributed to widespread invasive and weedy species colonizing most habitats, especially more open sites.

The disturbed character of the ecosystems on Saltspring Island presented challenges typical of the south coastal region when identifying and classifying sites in the field. The typical suite of characteristics – including indicator plants, species presence and distribution, and structural attributes – often differed considerably from what was expected in the undisturbed, mature to old seral stands used to develop the classifications (Green and Klinka 1994). This highlighted the importance of assessing soil and bioterrain characteristics, and evaluating site features that did not rely solely on vegetation, particularly mesoslope position, drainage, and disturbance history.

Delineating the boundary between the biogeoclimatic zones to refine the 1:250 000 scale model boundary to the 1:20 000 mapping scale for this project was also challenging for this reason. Based on field observations of species regeneration, cover, presence/absence, aspect, elevation, drainage, and other considerations, it was ascertained that the northern CDFmm/CWHxm1

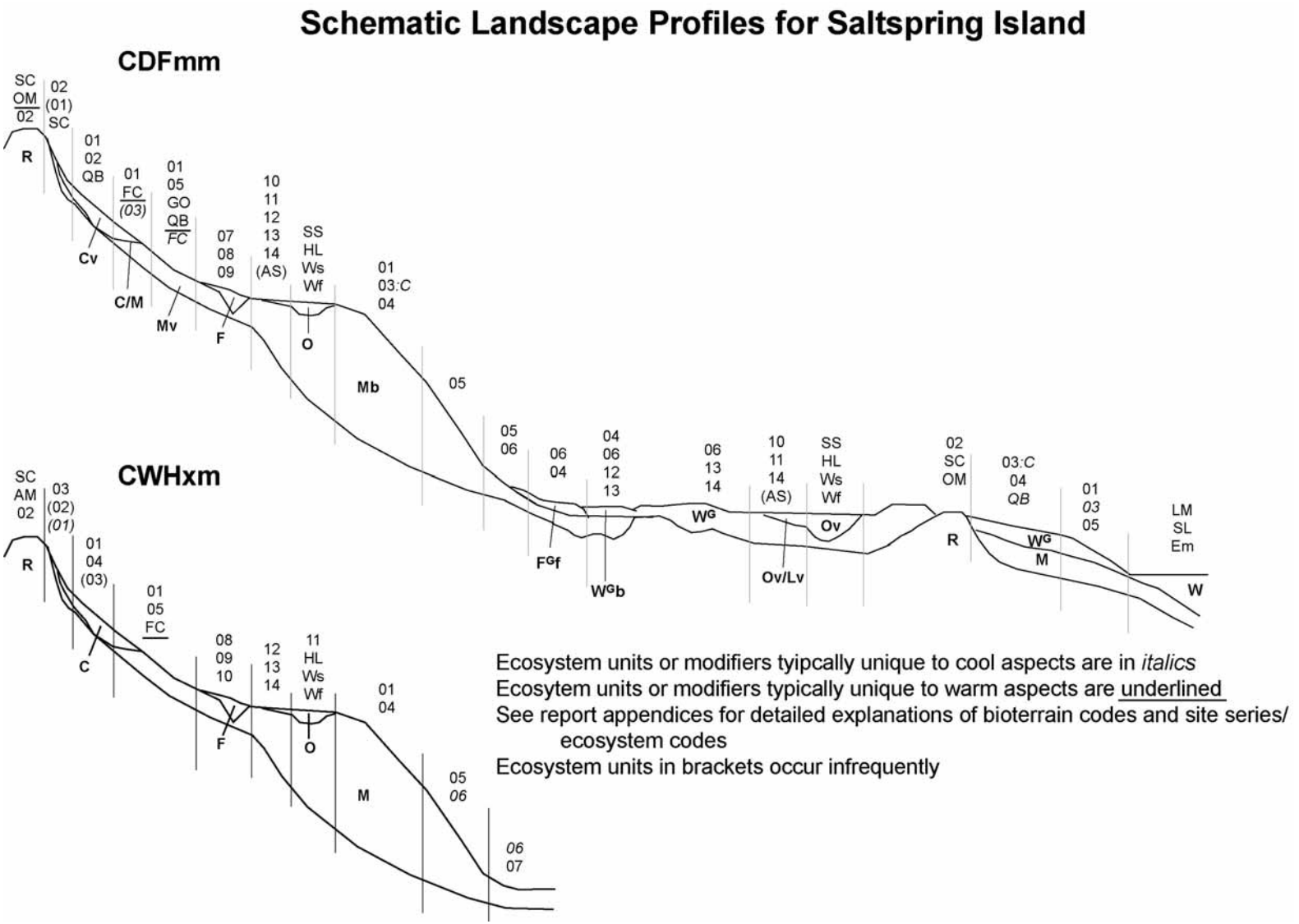


Figure 5. Landscape profiles showing the distribution of typical ecosystem units by topography and surficial material on Saltspring Island.

would be set at approximately 120 m and the southern boundary at approximately 550 m around Mt. Maxwell and Mt. Erskine, and 150 m in more gentle topography. This was also found to be the case for previous mapping in the area (e.g., Madrone 2003).

These data were integrated to develop a working legend prior to beginning field work (following Table 6.1, RISC 1998) and refined following ground truthing and subsequent QA.

4.5 Summary of Mapped Ecosystems

Tables 2 to 5 and Figures 6 to 10 contain detailed information described in this section on the frequency and distribution of ecosystems mapped on Saltspring Island. Altogether, 15 173 ha was mapped within the CDFmm, 3 526 ha within the CWHxm1, and 306 ha within the CWHxm2. A total of 3 232 ha was mapped within all biogeoclimatic units as having anthropogenic cover and 708 ha was mapped as sparsely vegetated (see Table 3 for list of mapped units for each category). Water bodies were mapped covering 297 ha.

Within the CDFmm, 11 283 ha was covered by indigenous forested ecosystems and 601 ha by sparsely vegetated ecosystems. Nearly 20% (3 022 ha) was mapped as anthropogenic. In the CWHxm1, 3 171 ha was forested and 88 ha was sparsely vegetated; 208 ha (5.4%) was anthropogenic. Within the CWHxm2, 284 ha was covered in forested vegetation types, 20 ha was sparsely vegetated, and only 2 ha (0.7%) was anthropogenic.

The study area was subdivided into 1761 polygons, with an average area of 10.8 ha. Polygon sizes ranged from 0.25 to 178.46 ha. Landscape heterogeneity was moderate to high: 611 polygons were comprised of one homogeneous ecosystem type, 958 combined two ecosystems, and 192 contained 3 ecosystem types (including different structural stages of the same ecosystem type).

Virtually no ecosystems were identified that met the criteria for structural stage 7 (old forest): only 7.24 ha were mapped in this category. The history of the area, including moderately intensive land use, repeated logging over the past 150 years, pre-settlement fire history, and land clearing for conversion to other uses has impacted Saltspring Island widely. There are forest stands approaching this structural stage (i.e., currently in structural stage 6, mature forest), but still developing some of the ecological criteria, particularly with respect to structural

diversity, woody debris, representation of species in the various layers, and canopy layer development. Most ecosystems mapped were at developmental stages 4 and 5, reflecting logging over the past 50-80 years. Some ongoing forest harvesting still occurs on Saltspring Island, particularly in the CWHxm. This is reflected by the predominance of structural stages 3 through 5 in the area. Clearcutting with and without reserves, selection systems, seed tree systems, and occasionally strip cuts are clearly visible on air photos, indicating diverse silvicultural approaches in the area.

The most widespread land uses resulting in modification of ecosystems were rural residential and agriculture (Table 4). There was very little land classified as urban on Saltspring Island, centred around Ganges. Agricultural land use varies considerably across the island, from grazing to active cultivation to orchards and vineyards, typically reflecting site productivity and underlying surficial geology. While some of these lands may still be suitable habitat for some species, e.g., seasonally flooded fields, hedgerows, vegetated ditches, fruit trees, etc., they represent areas that are currently alienated from natural ecosystem processes and maintained artificially in early seral stages, often containing high proportions of non-native species.

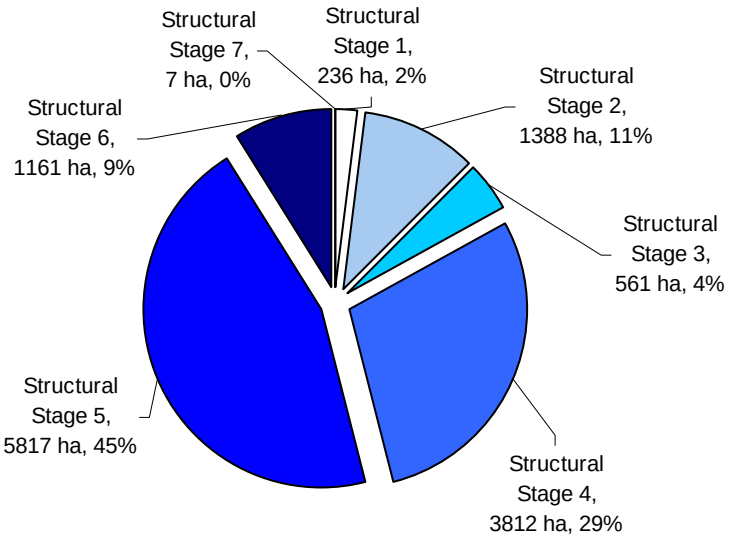


Figure 6. Distribution of structural stages in the CDFmm by area and percentage. See Appendix V for detailed descriptions of criteria.

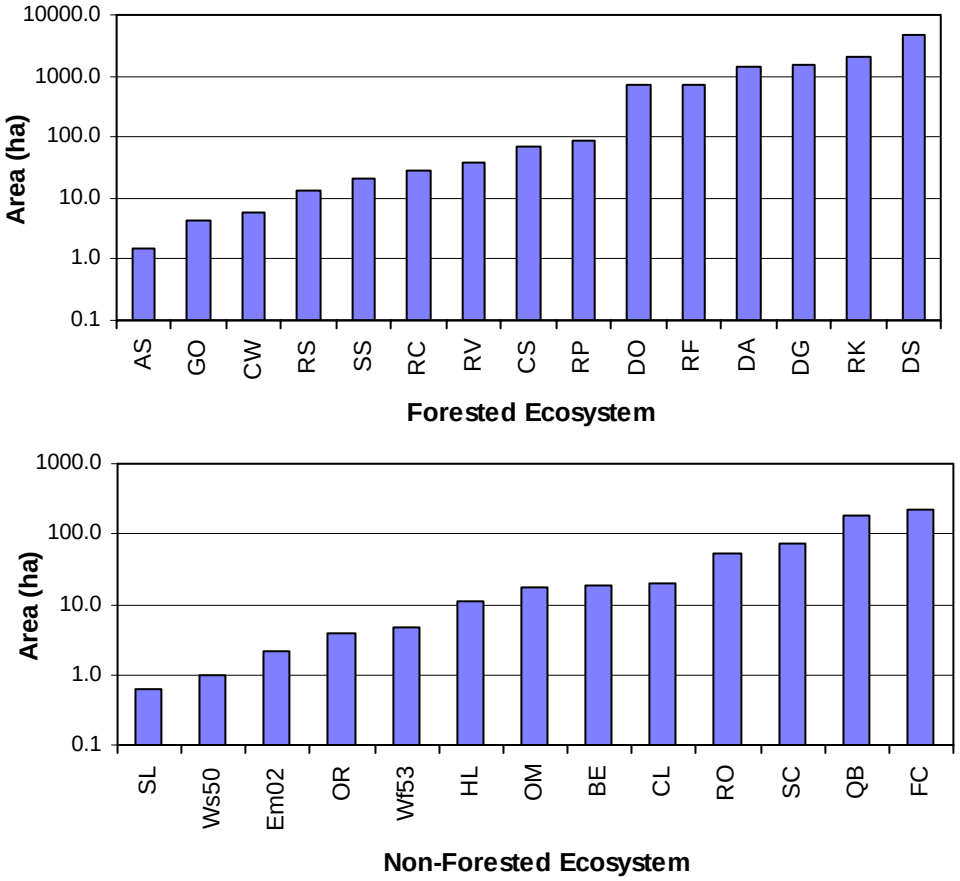


Figure 7. Distribution of vegetated ecosystem units in the CDFmm by area (forested units top, sparsely vegetated units bottom): note log area scale. See Table 2 for detailed ecosystem descriptions.

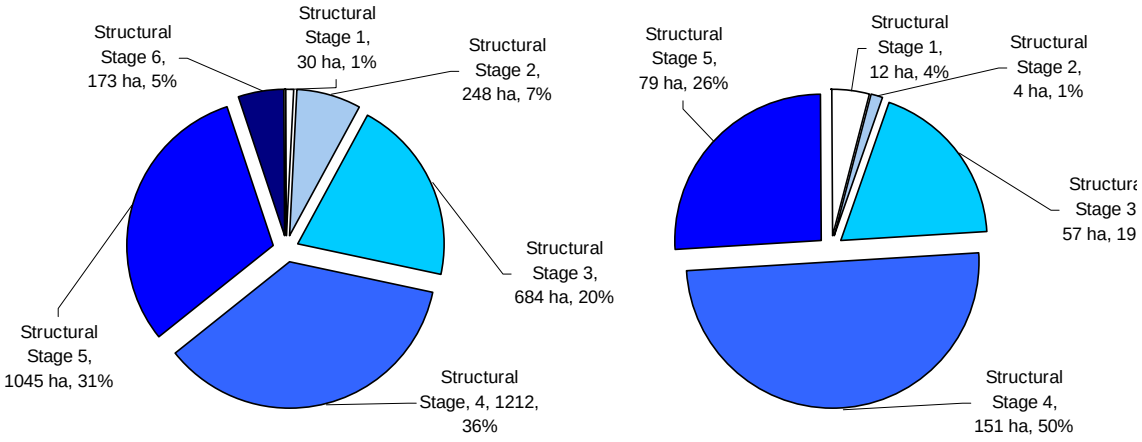


Figure 8. Distribution of structural stages in the CWHxm by area and percentage: CWHxm1 (left) and CWHxm2 (right).

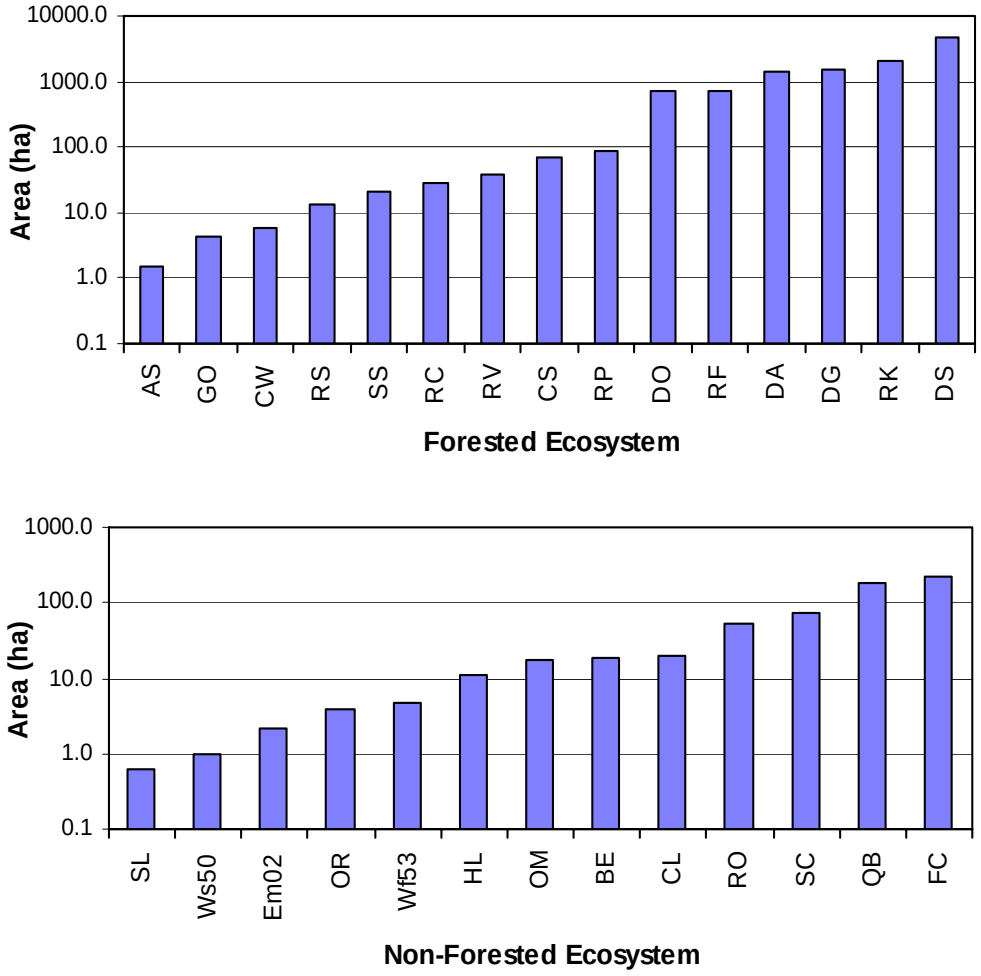


Figure 9. Distribution of ecosystem units in the CWHxm1 by area (forested units top, sparsely vegetated units bottom): note log area scale. See Table 3 for detailed ecosystem descriptions.

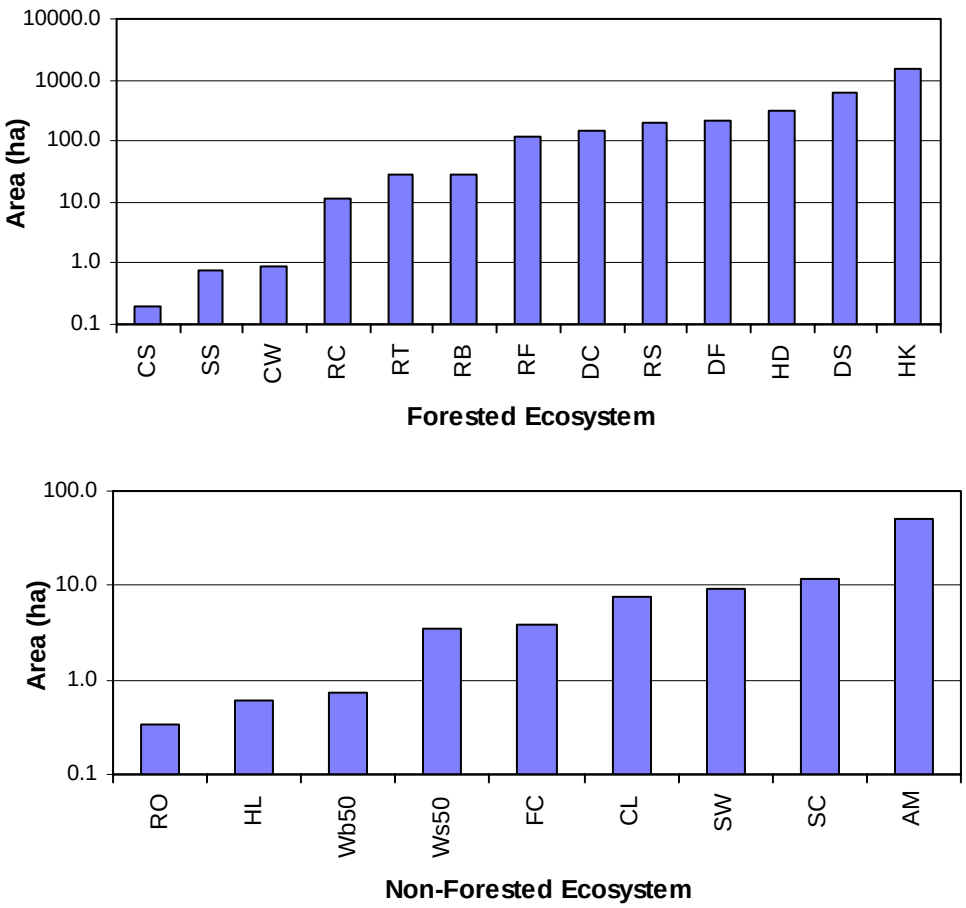


Figure 10. Distribution of ecosystem units in the CWHxm2 by area (forested units top, sparsely vegetated units bottom); note log area scale. See Table 3 for detailed descriptions.

Table 2. CDFmm ecosystems mapped by area (ha), calculated using areas weighted by decile where there are multiple ecosystems within a polygon (e.g., a 10-ha polygon with 50% DS and 50% DA is calculated as 5 ha DS and 5 ha DA; similarly for structural stages).

		Structural Stage							
Code	**Ecosystem Description**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Forested									
AS	Aspen swamp (seral wetland)	0	0	0	1	0	0	0	1
CS	Western redcedar—Slough sedge	0	0	26	35	10	0	0	71
CW	Black cottonwood—willow	0	0	6	0	0	0	0	6
DA	Douglas-fir—Shore pine—Arbutus	2	6	50	658	567	139	0	1421
DG	Douglas-fir—Grand fir—Oregon-grape	9	32	76	348	928	183	7	1582
DO	Western redcedar—Indian-plum	0	4	37	429	230	0	0	700
DS	Douglas-fir—Salal	0	17	144	1569	2527	320	0	4577
GO	Garry oak—Oceanspray	0	0	4	0	0	0	0	4
RC	Western redcedar—Skunk cabbage	0	5	16	5	4	0	0	29
RF	Western redcedar—Grand fir—Foamflower	0	23	11	119	379	177	0	709
RK	Western redcedar—Douglas-fir—Oregon beaked moss	0	47	80	454	1112	334	0	2026
RP	Western redcedar—Indian-plum	0	0	7	48	21	9	0	85
RS	Western redcedar—Snowberry	0	0	0	11	2	0	0	14
RV	Western redcedar—Vanilla-leaf	0	0	0	23	15	0	0	38
Subtotal		11	134	456	3699	5794	1161	7	11262
Sparsely Vegetated									
BE	Beach	18	0	0	0	0	0	0	18
CL	Cliff	19	0	0	0	0	0	0	19
Em02	Glasswort—Sea-milkwort estuary	0	2	0	0	0	0	0	2
FC	Fescue—Camas	1	215	0	0	0	0	0	216
HL	Hardhack—Labrador tea	0	0	11	0	0	0	0	11
OM	Garry oak—moss	0	0	5	13	0	0	0	18
OR	Oceanspray—rose	0	0	4	0	0	0	0	4
QB	Garry oak—Brome (or mixed graminoids)	0	0	59	100	23	0	0	181
RO	Rock outcrop	53	0	0	0	0	0	0	53
SC	Cladina—Wallace's selaginella	72	0	0	0	0	0	0	72
SL	Sedge—Western lilaeopsis	0	1	0	0	0	0	0	1
SS	Spirea—Sedge wetland	0	9	12	0	0	0	0	21
Wf53	Slender sedge—White beak-rush fen	0	5	0	0	0	0	0	5
Ws50	Spirea—Sitka sedge swamp	0	0	1	0	0	0	0	1
Subtotal		163	231	92	113	23	0	0	622
Total		174	365	548	3812	5817	1161	7	11884

Table 3. CWHxm ecosystems mapped by area (ha), calculated using areas weighted by decile where there are multiple ecosystems within a polygon (e.g., a 10-ha polygon with 50% HK and 50% DF is calculated as 5 ha HK and 5 ha DF; similarly for structural stages).

		Structural Stage							
Code	**Ecosystem Description**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
CWHxm1 - Forested									
CS	Western redcedar—Slough sedge	0	0	0	0	0	0	0	0
CW	Black cottonwood—Willow	0	0	0	1	0	0	0	1
DC	Douglas-fir—Western hemlock—Cladina	0	17	38	75	12	0	0	143
DF	Douglas-fir—Sword fern	0	7	40	71	91	3	0	212
DS	Douglas-fir—Western hemlock—Salal	0	27	133	240	176	27	0	603
HD	Western hemlock—Western redcedar—Deer fern	0	10	47	132	108	8	0	305
HK	Western hemlock—Douglas-fir—Oregon beaked	0	77	329	535	515	60	0	1515
RB	Western redcedar—Salmonberry	0	7	18	3	0	0	0	28
RC	Western redcedar—Sitka spruce—Skunk cabbage	0	0	7	0	4	0	0	12
RF	Western redcedar—Foamflower	1	6	13	54	37	7	0	119
RS	Western redcedar—Sword fern	0	14	32	76	77	34	0	233
RT	Western redcedar—Black twinberry	0	0	9	6	13	0	0	28
SS	Sitka spruce—Salmonberry	0	0	0	0	1	0	0	1
Subtotal		1	167	667	1193	1033	138	0	3199
CWHxm1 - Sparsely vegetated									
AM	Arbutus—Hairy manzanita	0	8	13	18	11	0	0	51
CL	Cliff	7	0	0	0	0	0	0	7
FC	Fescue—Camas	0	4	0	0	0	0	0	4
HL	Hardhack—Labrador tea	0	0	1	0	0	0	0	1
RO	Rock outcrop	0	0	0	0	0	0	0	0
SC	Cladina—Wallace's selaginella	12	0	0	0	0	0	0	12
SW	Sedge wetland	6	4	0	0	0	0	0	9
Wb50	Labrador tea—Bog laurel—Peat-moss	0	0	0	1	0	0	0	1
Ws50	Spirea—Sitka sedge swamp	0	0	3	0	0	0	0	3
Subtotal		25	15	17	19	11	0	0	88
CWHxm2 - Forested									
CS	Western redcedar—Slough sedge	0	0	4	0	0	0	0	4
DC	Douglas-fir—Western hemlock—Cladina	0	0	2	23	0	0	0	24
DS	Douglas-fir—Western hemlock—Salal	0	0	15	53	6	0	0	74
HD	Western hemlock—Western redcedar—Deer fern	0	0	3	0	13	0	0	15
HK	Western hemlock—Douglas-fir—Oregon beaked	0	0	27	70	48	0	0	145
RB	Western redcedar—Salmonberry	0	0	0	5	0	0	0	5
RF	Western redcedar—Foamflower	0	0	0	0	0	0	0	0
RS	Western redcedar—Sword fern	0	0	3	0	13	0	0	16
Subtotal		0	0	54	151	79	0	0	284
CWHxm2 - Sparsely vegetated									
AM	Arbutus—Hairy manzanita	0	0	3	0	0	0	0	3
RO	Rock outcrop	11	0	0	0	0	0	0	11
SC	Cladina—Wallace's selaginella	1	0	0	0	0	0	0	1
SW	Sedge wetland	0	4	0	0	0	0	0	4
Subtotal		12	4	3	0	0	0	0	20
Total		39	187	741	1363	1124	138	0	3591

4.6 Summary of Anthropogenic Ecosystems

Many polygons had a substantial proportion of their area (i.e., >10%, sufficiently large to map) modified by anthropogenic land use changes (Table 4, Figure 11). These were distributed throughout the island, but primarily within the CDFmm (Figure 12). Ecosystems converted primarily to rural residential land use covered 1 957 ha of Saltspring Island. Fields, either used for cultivation, grazing, or fallow, covered 1 088 ha, virtually all within the CDFmm. Paved roads accounted for negligible surface area since they were typically too small to be pulled out at the scale of mapping.

With respect to frequency, 471 polygons or polygon components in the CDFmm included an anthropogenic label (as described in Table 4), accounting for 27% of the total number of polygons. In the CWHxm1, of the 695 mapped polygon components (i.e., deciles), only 22 were mapped as anthropogenic, approximately 3%. In the CWHxm2, only one of the 59 mapped polygon components was similarly mapped, or 1.7%.

Table 4. Anthropogenic and mapped water units by area, calculated using weighted averages where there are multiple ecosystems within a polygon as for Tables 2 and 3.

Code	Map Unit Description	Area (ha) CDFmm	CWHxm1	CWHxm2	Total
Anthropogenic					
CF	Cultivated field	1022	65	0	1088
CO	Cultivated orchard	7	0	0	7
ES	Exposed soil	29	0	0	29
GC	Golf course	27	0	0	27
GP	Gravel pit	13	0	0	13
RW	Rural residential	1830	125	2	1957
RZ	Road surface	1	0	0	1
UR	Urban	94	0	0	94
Total			3022	190	2
Water bodies					
LA	lake	236	30	0	267
OW	open water (< 2m deep)	18	1	0	19
PD	pond (> 2m deep)	11	0	0	11
Total		5212	347	5	5563

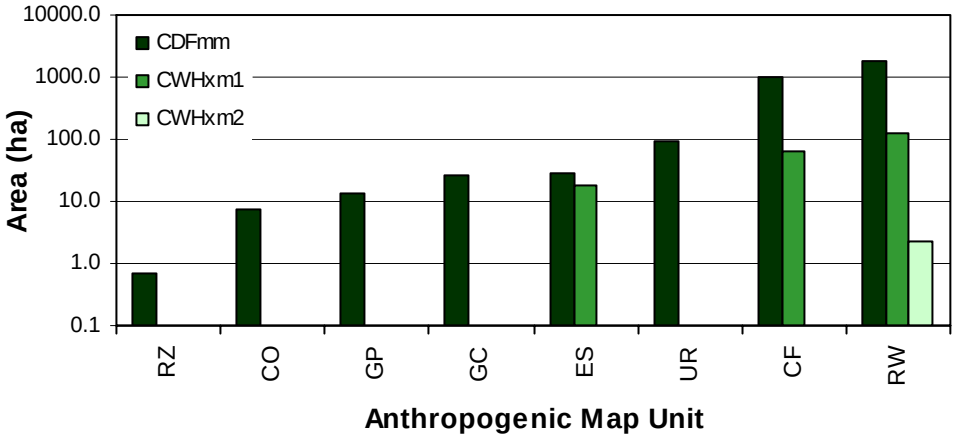


Figure 11. Distribution of anthropogenic map units by area within each biogeoclimatic unit. Note the log area scale.

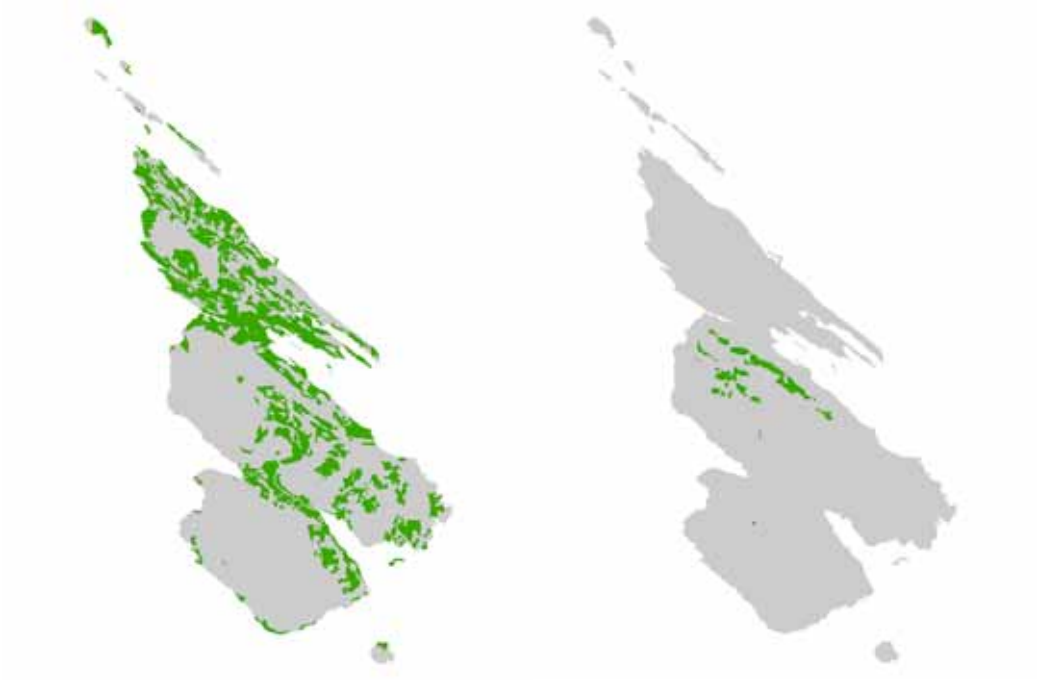


Figure 12. Distribution of anthropogenic and sparsely vegetated units mapped within the study area (left: CDF, right: CWH).

4.7 Summary of Disturbed Ecosystems

In total, 3 478 ha were disturbed by logging and grazing (Table 5). Grazing area is an underestimate since it could only be determined by direct observation. Some historic logging, particularly single-tree selection earlier in the 20th century, also was likely underestimated since it was not always apparent on the photo at 1:16,000.

Table 5. Disturbed ecosystem units mapped by area, calculated using weighted averages where there are multiple ecosystems within a polygon as for Table 2.

Code		Area (ha)				No. of polygons			
	Disturbance	CDFmm	CWHxm1	CWHxm2	Total	CDFmm	CWHxm1	CWHxm2	Total
L	logging / land clearing	1894	1425	124	3442	330	218	21	569
B	biotic (grazing)	35			35	5	0	0	5
Total		1929	1425	124	3478	335	218	21	574

At least 18% of intact ecosystem components within the CDFmm showed evidence of disturbance. In the CWHxm, forest harvesting was the only apparent type of ecosystem disturbance, affecting 43% of native ecosystems in the CWHxm1 and 41% of the CWHxm2 (Figure 12). This distribution also reflects the relative frequency and suitability of land use in the CWHxm relative to the CDFmm: the vast majority of the former is forested and has relatively steep terrain and shallow soils, while the CDF has much gentler topography, more fertile sites, and is amenable to far more diverse land uses in addition to logging.

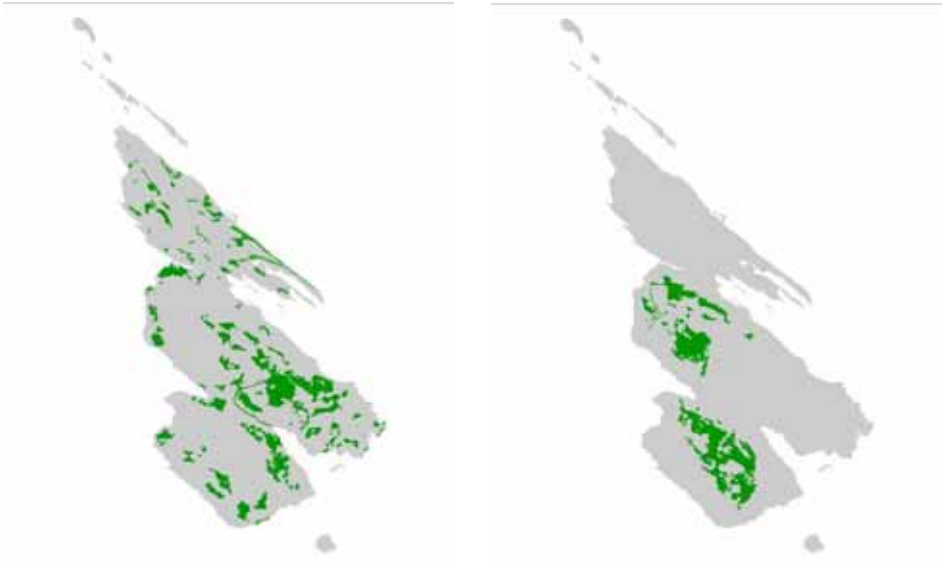


Figure 13. Disturbed ecosystems mapped within the study area (left: CDF, right: CWH).

4.8 Expanded Legend

4.8.1 Forested Site Series of the CDFmm

TEM Code	Site Association	Site Series
CS	**Western redcedar—Slough sedge**	**14**

Site Description

These swamp forests occupy poorly drained flat sites to depressions. Redcedar and swordfern dominate elevated microsites, while sedges, ladyfern, and horsetails occupy hollows with occasional skunk cabbage where there is limited surface flow. Soils are moderately deep to deep (> 0.5m) with medium texture, typically gleyed, with seasonally fluctuating water tables, even where bedrock restricts soil depth. Tree species are limited to shade- and moisture-tolerant trees with relatively shallow roots: western redcedar, grand fir on margins, and black cottonwood with minor amounts of red alder. Shrubs in this site series are diverse, with Indian-plum, snowberry, roses, infrequent currants/gooseberry, and thimbleberry the most frequent associates; ninebark, black twinberry, and red-osier dogwood increased in frequency with increased seasonal flooding. Herbaceous species were variable, with slough sedge commonly dominating the herb layer, and Cooley's hedge nettle in more well-drained and small-flowered rush in more poorly-drained sites also common associates. Moss tended to occupy little of the substrate, and only Oregon beaked moss was a constant associate; large leafy moss and coastal leafy moss were sometimes present, although most often on woody substrates.

Elevation (m): 0-150
Slope (%): 0-35
Aspect (°): variable
Surficial material: O, M, L, W^G
Drainage: m-p
SMR: 6-7
SNR: C-E

Assumed modifiers: d, j, m	Atypical site modifiers: d, s, w

Plots: CA008, CA039, MT036

TEM Code	Site Association	Site Series
CW	**Black cottonwood—Willow**	**09**

Site Description

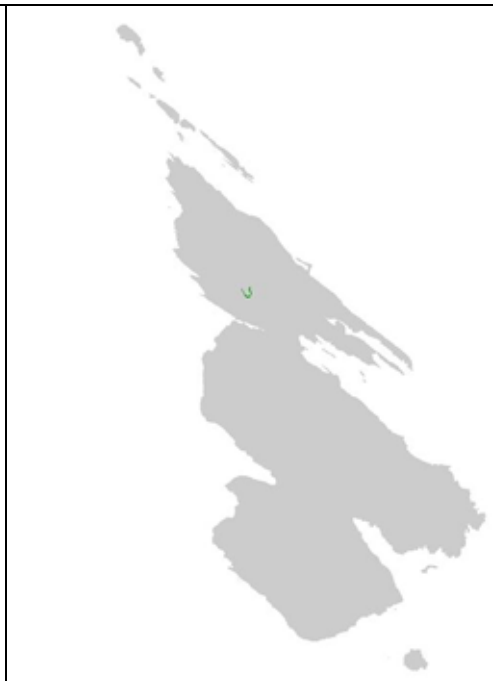
Low fluvial benches and floodplain sites support this site series, featuring deep coarse-textured gravelly sandy soils with relatively high coarse fragment content. This ecosystem type was extremely infrequent on Saltspring Island. Frequent inundation limits the dominant species to red alder, willows (more often in or adjacent to inundation zones) and black cottonwood, with associated flood-tolerant shrubs such as salmonberry. Herbs and mosses are infrequent or absent depending on water table and fluvial characteristics, with blue wildrye most common associate in less frequently flooded sites. Soils are well drained, but the coarse texture limits productivity on sandstone-derived soils, and flooding action often precludes development of an organic soil horizon. Erosion is a typical disturbance agent, leading to a predominance of younger seral stands (structural stages 4-5) in the study area.

Elevation (m): variable
Slope (%): < 15%
Aspect (°): variable
Surficial material: F^{A}
Drainage: m-i
SMR: 5-6
SNR: D

Assumed modifiers: a, c, d, j	Atypical site modifiers: none

Plots: JK136

No photo available



TEM Code	Site Association	Site Series
DA	**Douglas-fir—Shore pine—Arbutus**	**02**

Site Description

Douglas-fir—Shore pine—Arbutus forests are found on drier, poorer sites including crests, upper slopes, dry aspects, and sites with deeper medium-textured (fine sand to silty loam) soils. Some have only a thin veneer of soil derived from glaciomarine or till origin overlying bedrock. Drainage ranges from very rapid to well.

Forested ecosystems are dominated by Douglas-fir and arbutus with shore pine associated on the driest and poorest sites. Garry oak is an infrequent component, typically growing on rock outcrops, more frequently on marine-influenced reefs and islands. Forest canopies are discontinuous with large gaps, and fires were a relatively frequent historic disturbance agent, which have been largely suppressed over the past century, increasing woody debris buildup and soil deposition rates, and likely modifying the understorey composition towards species adapted to less droughty, nutrient-poor conditions. The understorey is relatively diverse, with drought-tolerant dominant shrubs such as hairy honeysuckle, dull Oregon grape, oceanspray, and snowberry orange, with falsebox and baldhip rose common associates. Herbs are relatively sparse in these forest types with oniongrass, sandwort, Pacific sanicle and purple peavine the most common associates. Mosses and lichens cover much of the ground over bedrock and on woody debris (where present) featuring electrified cat's tail moss (dominant), step moss, Oregon beaked moss and *Cladonia* species (associates).

Elevation (m): 0-500
Slope (%): 15-60
Aspect (°): 135-270 (270-135)
Surficial material: M, R
Drainage: w-r
SMR: 0-1
SNR: A-C

Assumed modifiers: d, j, m, r

Atypical site modifiers: h, k, s, v, w, x, z

Plots: BBJK14, CA016, CA028, CA144, CA111, CA112, CA113, CA123, GB022, GB023, GB026, JK010, JK117, JK119, JK120, JK121, JK154, MT057, TTV15, WM066

TEM Code	Site Association	Site Series
DG	**Douglas-fir—Grand fir—Oregon grape**	**04**

Site Description

Richer than zonal sites, these forest types occur mostly on middle to upper sites on gently sloping ground with deep, medium-textured soil, indicated by the absence of arbutus (which may be an incidental on some sites). Bigleaf maple, flowering dogwood and grand fir are common associates, with western redcedar infrequent on wetter sites and more common in the understorey with grand fir; Douglas-fir is the dominant tree species of young to mature forests on Saltspring Island. In the understorey, the shrub layer is also similar in composition to the canopy components, but honeysuckle and snowberry are absent. Sword fern is a relatively frequent dominant and bracken may also occur, most often adjacent to disturbed areas. Palm tree moss is a dominant bryophyte indicative of relatively rich, moist site series (also found in 06). Younger stands have denser canopies due to the varying shade tolerance of the component species and sparse understories until canopy breakup occurs later in structural stage 5.

Elevation (m): < 150
Slope (%): 0-20 (< 35)
Aspect (°): variable
Surficial material: W^G, M
Drainage: w
SMR: 2-4
SNR: D-E

Assumed modifiers: d, j, m	Atypical site modifiers: h, k, r, s, v, w, x

Plots: BB_HR_V12,G13, BBJK10, BBJK12, CA013, CA014, CA015, CA033, CA039, CA042, CA046, CA050, CA084, CA096, CA104, CA106, CA117, WM057, GB005, GB006, GB012, GB033, JK021, GB043, GB045,BB_HR_V4, V5, GB047, GB048, JK001, JK004, JK023, JK101, JK114, JK124, JK132, WM077, JK139, JK140, JK149, JK205, JK221, JK223, JK224, MT009, MT010, MT018, MT033, MT048, MT053, SS003, TTG12, WM068, WM071

TEM Code	Site Association	Site Series
DO	**Douglas-fir—Oniongrass**	**03**

Site Description

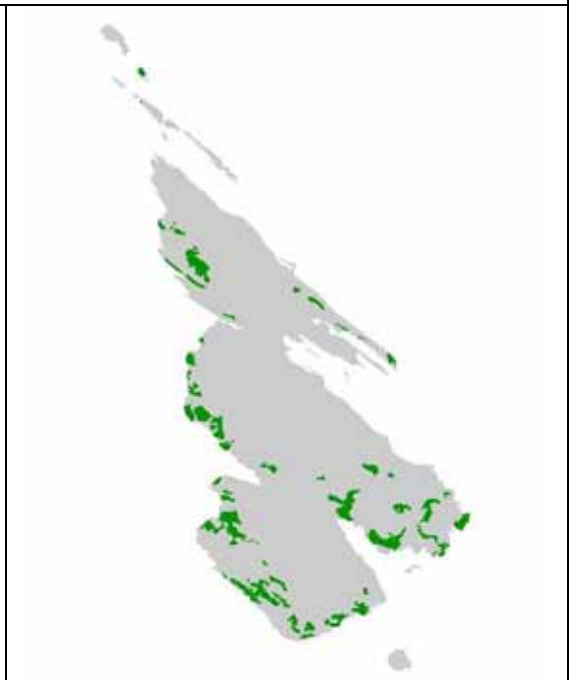
This site series predominates in rich to very rich xeric to subxeric sites (crests to upper slopes) where bedrock is near the surface or forms outcrops, but only infrequently on deeper soils. It often contains or forms mosaics with herbaceous meadows containing Garry oak where soils are deeper, sites that harbour high plant, vertebrate and invertebrate diversity. Often these sites have historically been used for grazing and orchards.

The tree layer characteristically has < 30% canopy closure, dominated by Douglas-fir; Garry oak is a frequent associate on warm aspects with mull humus forms; arbutus is typically the only other tree species and is generally co-dominant. The shrub layer is sparse with small amounts of snowberry and hairy honeysuckle and regeneration of the overstorey species, all constant associates, as was the introduced species Scotch broom. The herb layer is diverse with many annual and perennial species that vary considerably in occurrence and abundance such as Alaska oniongrass, large-leaved sandwort, broad-leaf shootingstar, nodding trisetum and Pacific sanicle being most common associates, with shootingstar species, montane violet, and brodaiea less frequent. Invasive grass species were also common and abundant. The bryophyte layer is dominated by electrified cat's-tail moss with a small associated component of Oregon beaked moss, and *Racomitrium* species on rock outcrops.

Elevation (m): < 500
Slope (%): 15-50
Aspect (°): 100-250
Surficial material: $W^{G}v$, Mv
Drainage: r-w
SMR: 0-1
SNR: D-E

Assumed modifiers: d, m, r	Atypical site modifiers: k, s, v, w, x

Plots: CA010, CA049, CA120, GB004, GB010, JK207, JK208, JK209, JK210, JK217, JK218, MT003, MT041, MT043, WM063



TEM Code	Site Association	Site Series
DS	**Douglas-fir—Salal**	**01**

Site Description

This is the zonal ecosystem that best represents the regional climate on sites with medium (mesic) soil nutrient regimes, but also occurs on lower slopes with drier or poorer characteristics. Zonal sites tend to receive and shed an equivalent amount of moisture, and are found in middle to upper slopes with relatively gentle topography. Soils are most often medium-textured, containing little clay and higher proportions of silt and sand, reflecting their glaciomarine origin, which are generally well-drained. Soils derived from till have more coarse fragments, more clay and overlie bedrock or other soil types in mantles of variable thickness and are moderately well- to well-drained. These sites have been extensively disturbed for forestry on Saltspring Island.

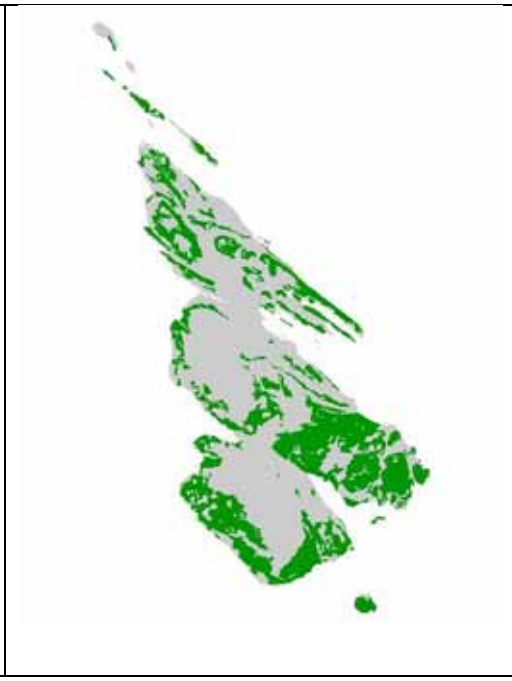
Forests generally have 30-50% canopy closure, although historic gap-driven disturbances have been diminished with the advent of more intensive forestry and fire suppression leading to younger successional forests with denser canopies. Douglas-fir dominates these sites, but is at risk of phellinus root rot and, to a lesser degree, armillaria. Frequent associates (in order of decreasing abundance) include grand fir, arbutus, bigleaf maple, western redcedar, and flowering dogwood. In the understorey, regeneration of the tree species are common, with composition depending on the substrate. Associate species in the shrub layer most often include snowberry, oceanspray, orange honeysuckle, nootka rose, tall Oregon-grape, salal, and invasive species such as Scotch broom and Himalayan blackberry. The herb layer varied considerably in its extent, depending on canopy closure and cover of evergreen shrubs, but was often dominated by introduced grass species. Graminoids were common components but varied significantly from location to location and throughout the growing season. Pacific sanicle and white fawn lily were other fairly frequent associates; the former on more exposed, drier sites and the latter on wetter sites. The moss layer most often supported Oregon beaked moss, with electrified cat's tail moss, pipecleaner moss, knight's plume moss, slender beaked moss, and coastal leafy moss the most common associates, in general order of occurrence from drier to wetter sites.

Elevation (m): < 400 m
Slope (%): variable
Aspect (°): variable
Surficial material: M, W^G, Cv
Drainage: w
SMR: 2-4
SNR: A-C

Assumed modifiers: d, j, m	Atypical site modifiers: g, h, k, q, r, s, v, w, x, y, z

Plots: BB_HR_V21, BBJK02, CA001, CA002, CA003, CA004, CA005, CA007, CA009, CA011, CA022, CA024, CA025, CA027, CA031, CA034, CA035, CA036, CA037, CA038, CA040, CA041, CA043, CA045, CA051, CA057, CA058, CA060, CA061, CA076, CA086, CA087, CA093, JK143, CA102, CA103, CA107, CA108, CA110, CA115, CA118, CA119, WM054, WM055, CA122, CA125, GB001, GB002, GB003, JK200, TT001, GB007, GB008, GB009, GB011, JK211, GB018, GB019, GB020, GB021, GB024, GB025, GB056, B_HR_V22, GB057, GB058, GB059, GB062, JK003, JK006, JK007, JK009, JK011, JK008, JK019, JK106, JK108, JK110, JK111, JK116, JK118, JK122, JK133, JK142, JK146, JK150, JK155, JK201, JK202, JK203, JK204, JK300, JK301,JK302, MT001, MT004, MT016, MT017, MT021, MT022, MT023, MT024, MT040, MT042, MT044, MT045, MT046, MT047, MT049, MT051, MT054, MT055, MT056, MT059, SS001, SS002, BBJK03, SS004, TTV16, TT005, TT006, TT007, TT008, TT009, TT010, TTV17, TTV18, TTV19, TTV20, TTV21, TTV22, WM001, WM002, WM003, WM022, WM026, WM027, WM042, ERSK_GR15, WM043, ERSK_GR13, ERSK_GR14, WM052, WM053, WM064, WM067, WM069, WM070, WM072, WM075, WM076

TEM Code	Site Association	Site Series
DS	**Douglas-fir—Salal**	**01**



TEM Code	Site Association	Site Series
RC	**Western redcedar—Skunk cabbage**	**11**

Site Description

Redcedar—skunk cabbage forests are nutrient-medium to -rich swamps with poor drainage. Soils often include a major component of organic material intermixed with deep, medium textured soils such as silty loam or silty clay loam. These forests inhabit level sites to depressions. Western redcedar and bigleaf maple are the dominant trees. The shrub layer has moderately high cover but low diversity, comprising shade-tolerant indicators of rich sites: Indian-plum, salmonberry and red elderberry are the most common associates, but may or may not be present in the study area. The herb layer is often relatively diverse with many ephemeral species, but the dominant species are lady fern, skunk cabbage, false lily-of-the-valley, and foamflower. The moss layer is dominated by a high cover of Oregon slender moss with less abundant but frequent associate Menzies' tree moss and coastal leafy moss.

Elevation (m): < 150 m
Slope (%): < 20
Aspect (°): variable
Surficial material: Ov, M
Drainage: i-p
SMR: 7
SNR: C-E

Assumed modifiers: d, j, m

Atypical site modifiers: s

Plots: JK127, MT014

TEM Code	Site Association	Site Series
RF	**Western redcedar—Grand fir—Foamflower**	**06**

Site Description

These rich forest ecosystems are found in similar terrain and slope positions to site series 05 (gentle lower slopes and moisture receiving sites), but soils tend to be deeper and richer on average, with a higher proportion of fines (e.g., loamy silt, silty clay loam). These ecosystems can occur on veneers in gentler topography but are more typical of blankets. Tree species composition and abundance is similar to site series 04, dominated by grand fir and western redcedar and red alder in seral stages 5 and younger, with slightly more frequent flowering dogwood and less frequent bigleaf maple. Douglas-fir is an infrequent associate on drier sites; yew is an infrequent associate in wetter, shady sites. The canopy tends to have more complete closure and ingress of western redcedar, with a few shade-tolerant shrubs and herbs persisting in the understorey – typical associates are sword fern, bracken fern and dull Oregon-grape, with very infrequent salal and vanilla-leaf more common on moderate to well-drained microsites. The most common associated mosses in these forest types are electrified cat's tail moss, Oregon beaked moss, step moss and palm tree moss. Herbs and mosses vary with canopy closure and cover of shrubs and woody debris.

Elevation (m): 0-250 m
Slope (%): 0-35
Aspect (°): variable
Surficial material: W^G, M
Drainage: m
SMR: 5-6
SNR: D-E

Assumed modifiers: d, j, m

Atypical site modifiers: h, k, s, w

Plots: BB_HR_G7, BB_HR_V20, GB053, CA026, CA032, CA068, CA124, GB014, GB036, GB039, JK103, JK109, JK123, JK129, JK130, JK147, JK151, WM019, WM020, JK215, JK216, TT011, WM014, WM015, WM018, WM040

TEM Code	Site Association	Site Series
RK	**Western redcedar—Douglas-fir—Oregon beaked moss**	**05**

Site Description

These forested ecosystems have more available moisture than zonal sites (slightly dry to fresh), and are typically situated on lower gentle sloping (moisture receiving) sites. Soils are typically deep and often imperfectly to moderately-well drained. Trees other than Douglas-fir and western redcedar (the constant dominants) are typically absent. The shrub layer is dominated by redcedar regeneration, infrequent grand fir seedlings, salal and dull Oregon grape, with incidental amounts of baldhip rose and ocean spray, most often on raised hummocks. Sword fern and bracken fern are common associates, with vanilla-leaf; the latter more common in stands structural stage 5 and older, while bracken decreased with stand age. Step moss and Oregon beaked moss are the major bryophyte associate species.

Elevation (m): < 350
Slope (%): 0-50
Aspect (°): variable
Surficial material: M, W^G (C)
Drainage: w-m
SMR: 5-6
SNR: A-C

Assumed modifiers: d, j, m

Atypical site modifiers: g, k, h, n, s, v, w, y, z

Plots: BB_HR_G11, BBJK05, BBJK08, BBJK09, BBJK13, CA047, CA048, CA065, CA066, CA077, CA078, CA081, CA091, CA092, CA097, CA109, GB015, GB016, GB017, GB027, GB032, GB041, GB046, GB050, GB051, BBJK06, GB060, GB061, GB063, GB064, JK002, JK126, JK134, JK144, JK152, JK156, SS005, SS006, JK206, JK213, MT006, MT019, MT020, MT025, MT030, MT031, MT032, MT034, MT052, WM047, WM048, WM024, WM046, WM049, WM058, WM059, WM061, WM074

TEM Code	Site Association	Site Series
RP	**Western redcedar—Indian-plum**	**13**

Site Description

These forest types are very similar to site series 12 with respect to soil nutrient status and mesoslope position. They are slightly moister, with less cover of Douglas-fir and more of red alder, which functions as a constant dominant in disturbed sites, along with western redcedar. The increased presence of alder may reflect the gap dynamics of these stand types, as the high water tables limit rooting depth and soil bearing strength, causing individual trees to fall over and expose mineral soil seedbeds for red alder which requires both light and mineral substrate. These forests have more berry-producing shrubs that indicate richer sites (e.g., trailing blackberry, salmonberry dominate) while salal, ocean spray and other indicators of lower pH and nutrient availability are absent. Indian-plum is often present, but more indicative of site moisture status and impacts of the fluctuating water table. The herb layer is relatively sparse as understorey light is limited by the dense forest canopy; shade-tolerant sword fern and foamflower are the most common dominants. Ephemeral herbs may also occur, depending on light and substrate availability. Moss cover is relatively high, dominated by Oregon slender moss with lesser amounts of the mosses found in site series 12.

Elevation (m): < 350
Slope (%): < 35%
Aspect (°): variable
Surficial material: M, W^G
Drainage: i
SMR: 6
SNR: D

Assumed modifiers: d, j, m

Atypical site modifiers: h, k, s, w

Plots: MT012

TEM Code	Site Association	Site Series
RS	**Western redcedar—Snowberry**	**07**

Site Description

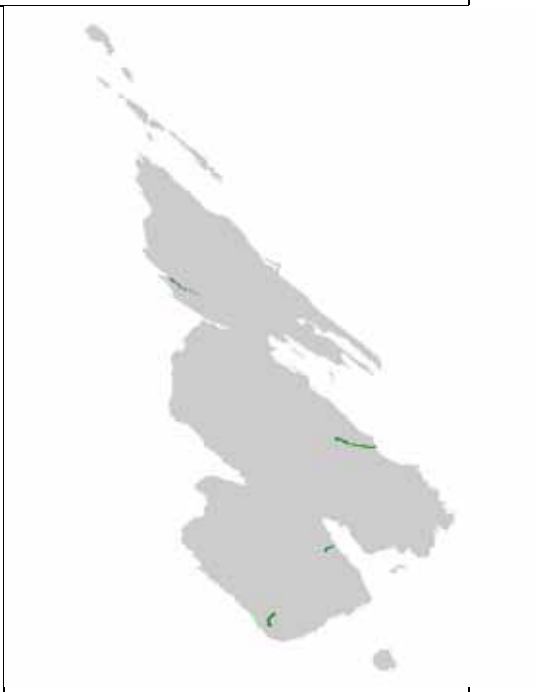
This site series indicates high bench floodplains, very infrequent on Saltspring Island. The moderately well-sorted deep fluvial deposits upon these sites are moderately well to well drained. The fairly coarse soils in this area are frequently veneers over the parent material. Forests are inundated seasonally or even less frequently, and harbour species moderately adapted to periodic flooding or high water tables. Western redcedar is the dominant conifer, red alder and bigleaf maple frequent dominants in younger forests (seral stage 5 and younger), and black cottonwood less frequent in the study area, although in other areas of the CDF with more typical fluvial morphology it is more common. Dominant shrubs in the study area include snowberry, salmonberry, stink currant and red elderberry. Indian-plum is sometimes an associate, as are cascara and flowering dogwood. Typical dominant herb species in the relatively dense layer are false Solomon's seal, false lily-of-the-valley, vanilla-leaf, lady fern and three-leaved foamflower. Other associated herbs vary with canopy closure and seral stage. Mosses are dominated by coastal leafy moss with Menzies' tree moss and small amounts of Oregon slender moss frequent associates.

Elevation (m): 50-150
Slope (%): 0-35
Aspect (°): variable
Surficial material: Fv
Drainage: m
SMR: 5-6
SNR: D-E

Assumed modifiers: a, d, j, m

Atypical site modifiers: g, k, s, w

Plots:



TEM Code	Site Association	Site Series
RV	**Western redcedar—Vanilla-leaf**	**12**

Site Description

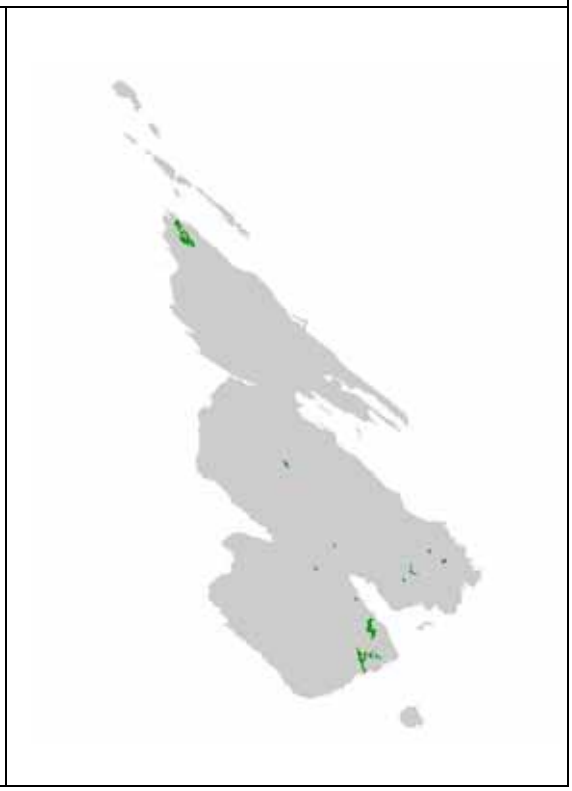
These nutrient-rich, diverse forests are located on lower gentle slopes and have fluctuating water tables. Soils are deep and medium textured, but could have a restricting layer or be adjacent to a seepage or riparian site. The soil texture and seasonally high water table may result in susceptibility to disturbance via soil compaction and windthrow. The tree canopy is dense interspersed with gaps, including dominant components of grand fir, Douglas-fir, bigleaf maple, red alder, and frequent associate flowering dogwood. Shrubs are primarily shade-tolerant (e.g., salal and dull Oregon-grape on hummocks with snowberry dominant) but some less tolerant species also occur such as the infrequent associates ocean spray and red-osier dogwood. Sword fern is frequently co-dominant; vanilla-leaf and foamflower the most common associates. The bryophyte layer typically includes mosses such as Oregon beaked moss, Oregon slender moss, and Menzies' tree moss. Canopy dynamics and microsite disturbance strongly influence species presence and abundance in this ecosystem type.

Elevation (m): 20-200
Slope (%): 0-35
Aspect (°): variable
Surficial material: W^G, M (Fv)
Drainage: m
SMR: 5
SNR: C

Assumed modifiers: d, j, m	Atypical site modifiers: h, k, s

Plots:

No photo available



4.8.2 Non-Forested and Sparsely Vegetated Site Series of the CDFmm

TEM Code	Site Association	Site Series
AS	**Aspen—Slough sedge**	**00**

Site Description

This seral wetland site series was extremely infrequent and no plot data was collected. Trembling aspen, very uncommon in the CDFmm and Saltspring Island, is known to occur in localized treed swamp sites in the study area from the Sensitive Ecosystem Inventory (Ward et al. 1997). It provides a nutrient-rich environment, with contiguous understorey cover of reeds, sedges, and other species tolerant of seasonal flooding and high water table. This may be a successional phase that would, if left undisturbed, develop into a conifer-dominated forest type such as site series 12 or 13.

Elevation (m): 60-200
Slope (%): 0
Aspect (°): n/a
Surficial material: M, L
Drainage: i
SMR: 4-5
SNR: D

Assumed modifiers: j, m

Atypical site modifiers: s

Plots:

No photo available

TEM Code	Site Association	Site Series
Em02	**Glasswort—Sea-milkwort estuary**	**00**

Site Description

These estuarine marshes were extremely rare in the study area, confined to flat, imperfectly drained riparian outlets protected from the open ocean in the intertidal zone on the north part of Saltspring Island. None were empirically sampled. The dominant species are the aquatics glasswort and sea milkwort, with few other species. Ongoing marine deposition and erosion maintain this community at the aquatic herbaceous successional stage, but colonization by cottonwoods is possible, eventually leading to a forested community as the hydrology and substrate stabilize.

Elevation (m): 0
Slope (%): 0
Aspect (°): n/a
Surficial material: W, W^G
Drainage: i
SMR: n/a
SNR: n/a

Assumed modifiers: n/a

Atypical site modifiers: n/a

Plots:

No photo available

TEM Code	Site Association	Site Series
FC	**Fescue—Camas**	**00**

Site Description

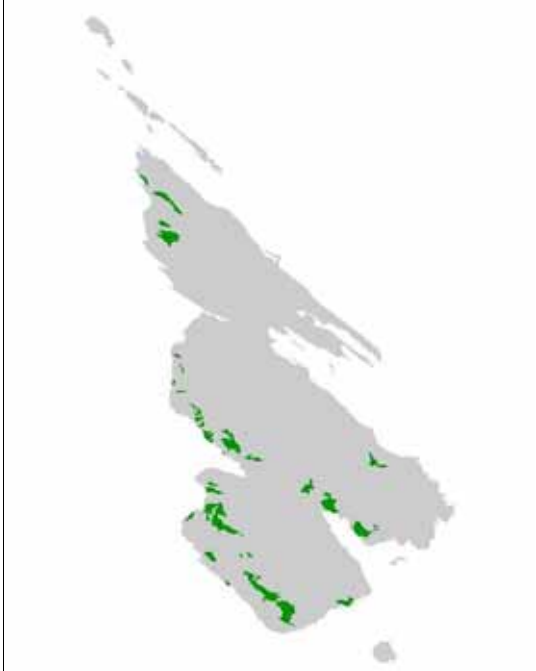
These herbaceous meadows were moderately frequent, typically on gentle to moderately sloping warm aspects with deep but occasionally shallow soils. This site series is the non-forested homologue of site series 03, with many of the same herbaceous species, possibly representing a seral or disturbance-maintained disclimax. Herbaceous and bryophyte cover is nearly total; shrubs were infrequent. Snowberry, Nootka rose, and invasives (e.g., Scotch broom) were the most common shrub associates. Trees were sparse and shrubby in habit, including Garry oak, arbutus, and Douglas-fir as infrequent associates, which may also be present as scattered veterans on site. Herbaceous species were variable depending on season and location. Depending on distance from disturbance, they may be dominated by invasive perennial grasses such as early hairgrass, orchardgrass, Kentucky bluegrass, and many others. Native dominant species included camas species, western and Roemer's fescue, Pacific sanicle, and Alaska oniongrass. Frequent associates included brodaiea, *Lomatium* species, and others which varied by season and presence among sites. Bryophytes and lichens were not abundant; rock moss and Wallace's selaginella occasionally colonized bedrock outcrops.

Elevation (m): 0-550
Slope (%): 15-55
Aspect (°): 135-275
Surficial material: Cv, Mv, $W^{G}v$
Drainage: r-x
SMR: 2
SNR: C-E

Assumed modifiers: j, m, s

Atypical site modifiers: k, w, v

Plots: TT002, TT003, TT004, JK217



TEM Code	Site Association	Site Series
GO	**Garry oak—Oceanspray**	**00**

Site Description

These ecosystems occurred mostly on the southern slopes of Mount Maxwell in steep, south-facing, very rapidly drained thin colluvial material over bedrock. This ecosystem type was defined using a combination of information from Erickson and Meidinger (2007) and Madrone (2003) to determine the site attributes typical for this community. Wetter, cool-aspect sites classified by Erickson and Meidinger (2007) were not mapped on Saltspring Island. Sites dominated by shrubs and Garry oak with a relatively contiguous herbaceous layer were mapped as GO, although species composition varied. Garry oak was a constant dominant, with Douglas-fir the most common (but generally sparse) associate. Canopy closure was typically 5-10%. Oceanspray was the dominant shrub, but nootka and baldhip rose were frequent associates, as was the invasive species Scotch broom. Salal was an infrequent associate, as were hairly honeysuckle and common and trailing snowberry. Herbs were largely graminoid, varying substantially in composition among locations, but often dominated by invasive species such as hedgehog dogtail and early hairgrass. Fescue species were among the native graminoid dominants. Other herbaceous species occurred, varying considerably throughout the growing season. Rock moss species were the most frequent bryophytes.

Elevation (m): 50-500
Slope (%): 40-100
Aspect (°): 135-270
Surficial material: Cv, R
Drainage: x
SMR: 1-2
SNR: B

Assumed modifiers: j, m, r

Atypical site modifiers: s, v, w, z

Plots:

No photo available

TEM Code	Site Association	Site Series
HL	**Hardhack—Labrador tea**	**00**

Site Description

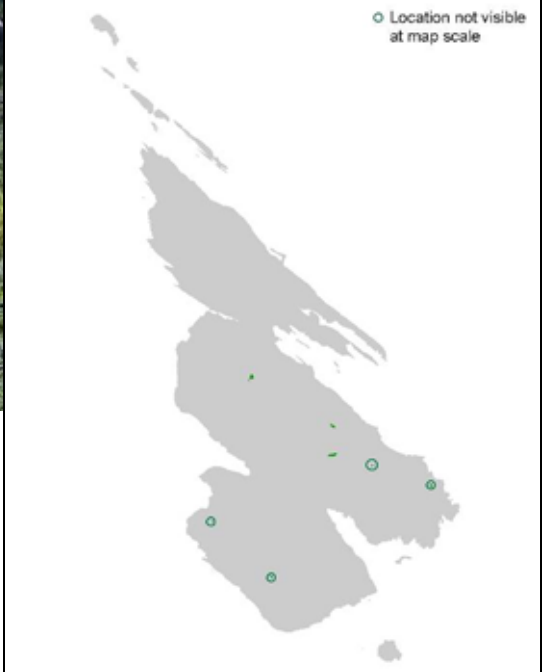
These sites were infrequent in the study area and occupied small areas, most often characterized by organic materials of variable thickness. The shrubby, acidic, nutrient-poor fens were extremely poorly drained. Low shrubs dominated, with taller shrubs (3-4 m) around the margins of the wetlands. Species diversity was low, with hardhack often the most abundant dominant, and lesser amounts of associates red-osier dogwood, willow, and only rarely was Labrador tea present on Saltspring Island. Herbaceous vegetation was sparse to absent due to anoxic conditions and standing water.

Elevation (m): 0-250
Slope (%): 0
Aspect (°): n/a
Surficial material: O
Drainage: p
SMR: 7
SNR: B

Assumed modifiers: d, j, p

Atypical site modifiers: none

Plots: CA008



TEM Code	Site Association	Site Series
OM	**Garry oak—moss**	**00**

Site Description

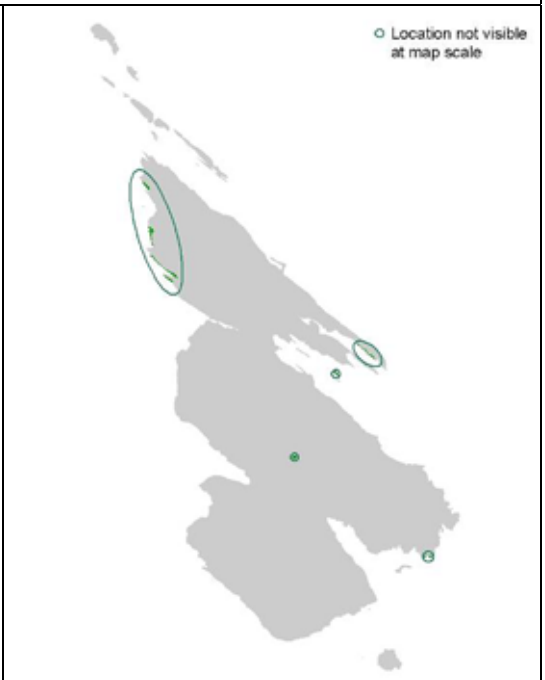
This new ecosystem type reflects the associations classified by Erickson and Meidinger (2007) dominated by Garry oak with the understorey containing a constant dominant or major associate species component of curly heron's bill moss over thin substrate or directly over bedrock, and corresponding with the Garry oak–Racomitrium association as well. A range of crustose and foliose lichens are also typically present. These sites are nutrient-poor and rapidly drained, but litter accumulations likely yield successional transition to more complex and richer ecosystem types, where this would be a seral phase except on very steep terrain. It is infrequent on Saltspring Island, occurring on warm aspects. Other species were uncommon, occasionally including Roemer's fescue or introduced grasses.

Elevation (m): 10-350
Slope (%): 30-65
Aspect (°): 140-225
Surficial material: R
Drainage: x
SMR: 0-1
SNR: A-B

Assumed modifiers: j, v

Atypical site modifiers: w

Plots:



TEM Code	Site Association	Site Series
OR	**Oceanspray—Rose**	**00**

Site Description

This shrub-dominated ecosystem was only mapped as a component of one polygon on Saltspring Island with thick sediment. It is likely more frequent, but occurs within mosaics of other ecosystems and is difficult to distinguish at the 1:20 000 scale. It could also be a seral or disturbance-driven phase of another ecosystem type such as DS. Additional field data would clarify the nature of this ecosystem, previously mapped on small islets including Jedediah Island, where it was found on moisture-receiving microsite depressions between rock outcrops that would be too small to identify at this scale of mapping. Dominant species are oceanspray and baldhip rose, with lesser amounts of snowberry.

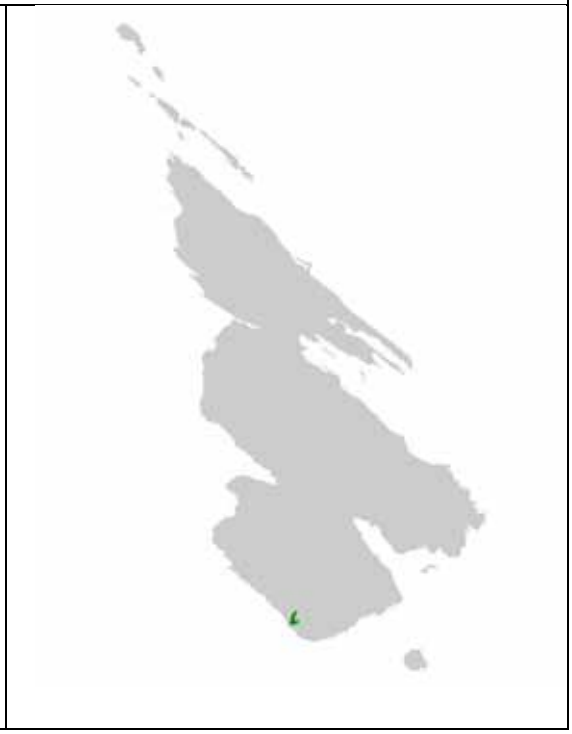
Elevation (m): 100
Slope (%): 35
Aspect (°): 155
Surficial material: Mb
Drainage: w
SMR: 4
SNR: C

Assumed modifiers: m, s

Atypical site modifiers: w

Plots:

No photo available



TEM Code	Site Association	Site Series
QB	**Garry oak—Brome/mixed grasses**	**00**

Site Description

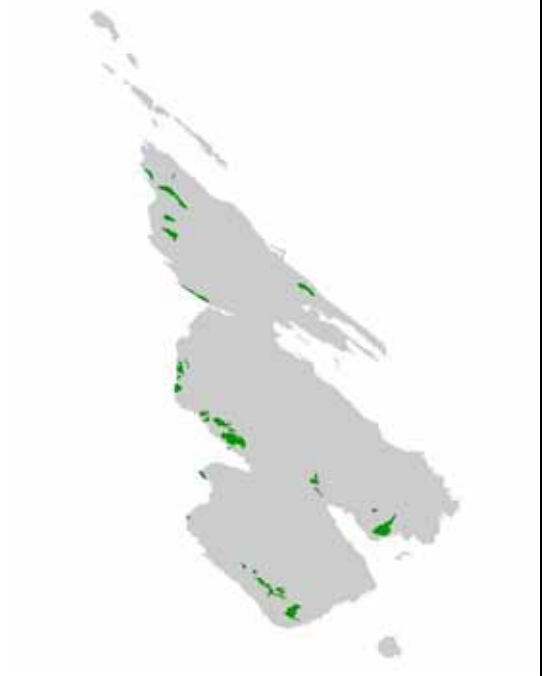
These sites correspond with the associations proposed by Erickson and Meidinger (2007) where the overstorey is sparse and consisting solely of the dominant Garry oak, and the understorey is comprised of a variety of graminoid and forb associates. The composition of the herbaceous layer varied with surficial material and thickness, slope, and drainage: relatively mesotropic sites contain mixtures of graminoids and forbs, while richer sites have fewer graminoids and more ephemeral species found in drier Garry oak meadows including members of the Liliaceae and yellow montane violet. Typical associates included invasive annual and perennial grass species, as well as forbs characteristic of the FC ecosystem type.

Elevation (m): 20-550
Slope (%): 20-50
Aspect (°): 15-260
Surficial material: R, Cv (Mv)
Drainage: r-x
SMR: 1-2
SNR: B

Assumed modifiers: j, m, r

Atypical site modifiers: k, s, v, w

Plots: TT002, TT003, TT004, MT039



TEM Code	Site Association	Site Series
SC	**Cladina—Wallace's selaginella**	**00**

Site Description

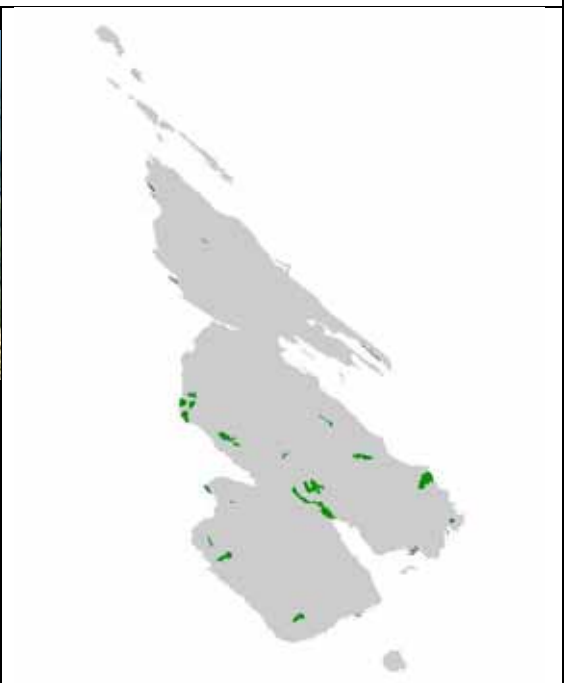
These sites were most often found on very to extremely shallow soils and rocky outcrops. Low water-holding capacity of sites, which occasionally consisted of extremely thin to thin veneers of till or glaciomarine material, supported this plant community which also thrived on bare rock. This association probably can be subdivided into several associations. It supports a range of non-vascular flora, including the constant associates lipstick cladonia, pixie cup, hoary and common rock moss, sidewalk moss, and Wallace's selaginella which often dominated. Curly heron's bill moss is recognized as a seral phase of this community but was not separately mapped at this scale. Field inspection revealed this community varied substantially, frequently including components of diverse vascular species such as stonecrops, and contained low to moderate cover of native and introduced grass species as associates on richer sites. Herbaceous species more typical of richer sites were noted in depressional microsites and crevices, such as brodaiea and, common camas; monkeyflower species were infrequent associates in localized seepage sites.

Elevation (m): 0-550
Slope (%): 0-100
Aspect (°): 135-285 (varies)
Surficial material: R (Mx, $W^{G}x$)
Drainage: x
SMR: 0-1
SNR: A-B

Assumed modifiers: j, m, r, v

Atypical site modifiers: k, s, w, z

Plots: TTV21



TEM Code	Site Association	Site Series
SL	**Sedge—Western lilaeopsis**	**00**

Site Description

This ecosystem type was only mapped in one very infrequent, level estuarine site by the SEI, where thick marine deposits provided conditions suitable for frequent to permanent inundation combining both fresh and salt water, and limited drainage. No plots were sampled within this site series. Species typical of this site series are adapted to brackish water and high but variable water table at and above the ground surface.

Elevation (m): 0
Slope (%): 0
Aspect (°): n/a
Surficial material: W, W^G
Drainage: i-p
SMR: n/a
SNR: n/a

Assumed modifiers: d, j, m

Atypical site modifiers:

Plots:

No photo available

TEM Code	Site Association	Site Series
SS	**Spirea—Sedge wetland**	**00**

Site Description

These shrubby, nutrient poor-to-medium fens occurred in depressional to level microsites. Accumulations of organic material led to gleyed mineral soils and Fibrisols developing in thicker accumulations. These sites generally have some slow water flow and are connected to other riparian sites through surface flow. Dense thickets are comprised of the dominant hardhack and various sedges and rushes. Species diversity is limited, but the vegetation provides some passerine and waterfowl nesting habitat. Occasionally as a result of human disturbance (e.g., draining wetlands or marginal haying of these wet sites) these species can be subsumed by thickets of the dominant weedy indigenous species reed canarygrass, creating a monoculture environment in this habitat type.

Elevation (m): 20-300
Slope (%): 0
Aspect (°): n/a
Surficial material: O (M)
Drainage: p
SMR: 6-7
SNR: C

Assumed modifiers: d, j, p

Atypical site modifiers: s

Plots: CA046

TEM Code	Site Association	Site Series
Wf53	**Slender sedge—White beak-rush fen**	**00**

Site Description

This site series was very infrequent in the study area. Typically developing on deeper organic deposits of Fibrisols to Mesisols over glaciomarine or till blankets with poor drainage, these graminoid-dominated wetlands often feature dense thickets of rhizomatous species and low diversity, interspersed with pockets of shallow open water. Sedge species and white beak-rush or other closely related rushes are the constant dominants. These ecosystems are more common elsewhere in the CDF where parent material and soils contain higher proportions of fine sediment. Often they are seasonally or permanently connected hydrologically to other riparian areas.

Elevation (m): 0-300
Slope (%): 0
Aspect (°): n/a
Surficial material: Ob
Drainage: p
SMR: 7
SNR: A-C

Assumed modifiers: n/a

Atypical site modifiers: n/a

Plots:

no photo available

TEM Code	Site Association	Site Series
Ws50	**Spirea—Sitka sedge swamp**	**00**

Site Description

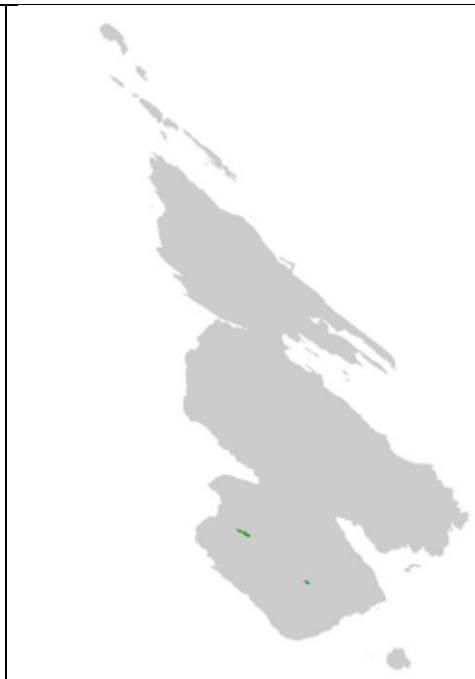
Spirea-dominated swamps were infrequent in the study area, but are relatively widespread along the Georgia Depression. Organic veneers of poorly decomposed plant residue form over gleyed mineral soils. Sitka sedge may not always be present, depending on the density of spirea and amount of open water or bryophyte (often Sphagnum species) cover. Other hydrophytic sedges may be present. These sites may be seral phases of treed swamps.

Elevation (m): 120-550
Slope (%): 0
Aspect (°): n/a
Surficial material: Ov
Drainage: p
SMR: 7
SNR: A-C

Assumed modifiers: n/a

Atypical site modifiers: s

Plots:



4.8.3 Forested Site Series of the CWHxm

TEM Code	Site Association	Site Series
CS	**Western redcedar—Slough sedge**	**15**
Site Description These swamp forests occupy poorly drained flat sites to depressions. Redcedar and swordfern dominate elevated microsites, while sedges, ladyfern, and horsetails occupy hollows with occasional skunk cabbage where there is limited surface flow. Soils are moderately deep to deep (> 0.5m) with medium texture, typically gleyed, with seasonally fluctuating water tables, even where bedrock restricts soil depth. Tree species are limited to shade- and moisture-tolerant trees with relatively shallow roots: western redcedar, grand fir on margins, and black cottonwood with minor amounts of red alder. Shrubs in this site series are diverse, with Indian-plum, snowberry, currants/gooseberry, and thimbleberry the most frequent associates; ninebark, black twinberry, and red-osier dogwood increased in frequency with increased seasonal flooding. Herbaceous species were variable, with slough sedge commonly dominating the herb layer, and Cooley's hedge nettle in more well-drained and small-flowered rush in more poorly-drained sites also common associates. Moss tended to occupy little of the substrate, and only Oregon beaked moss was a constant associate; large leafy moss and coastal leafy moss were occasionally present.		Elevation (m): 150-450 Slope (%): 0-35 Aspect (°): variable Surficial material: Ov, M, L Drainage: m-p SMR: 6-7 SNR: C-E
Assumed modifiers: d, j, m		Atypical site modifiers: s, w
Plots: CA008, CA039, MT036		

TEM Code	Site Association	Site Series
CW	**Black cottonwood—Willow**	**10**

Site Description

Low fluvial benches and floodplain sites support this site series, featuring deep coarse-textured gravelly sandy parent material with relatively high coarse fragment content. Soils vary from Non-soil in recently disturbed locations to gravelly sandy Regosols and Brunisols. This ecosystem type was extremely infrequent on Saltspring Island. Frequent inundation limits the dominant species to red alder, willows (more often in or adjacent to inundation zones) and black cottonwood, with associated flood-tolerant shrubs such as salmonberry. Canopy closure varies with flood regime, terrain, and seral stage. Structural stage 4 supports the densest stands (canopy closure approximately 50%) with fluvial erosion contributing to stand disturbance. This species association is a disturbance-matintained disclimax that would support conifer species in the absence of disturbance. Herbs and mosses are infrequent or absent depending on water table and fluvial characteristics, with blue wildrye most common associate in less frequently flooded sites. Soils are well drained, but the coarse texture limits productivity on sandstone-derived soils, and flooding action often precludes development of an organic soil horizon. Erosion is a typical disturbance agent, leading to a predominance of younger seral stands (structural stages 4-5) in the study area.

Elevation (m): 150-500
Slope (%): < 15%
Aspect (°): variable
Surficial material: F^{A}
Drainage: m-i
SMR: 5-6
SNR: D

Assumed modifiers: a, c, d, j	Atypical site modifiers: none

Plots: JK136

No photo available

TEM Code	Site Association	Site Series
DC	**Douglas-fir—Lodgepole pine—Cladina**	**02**

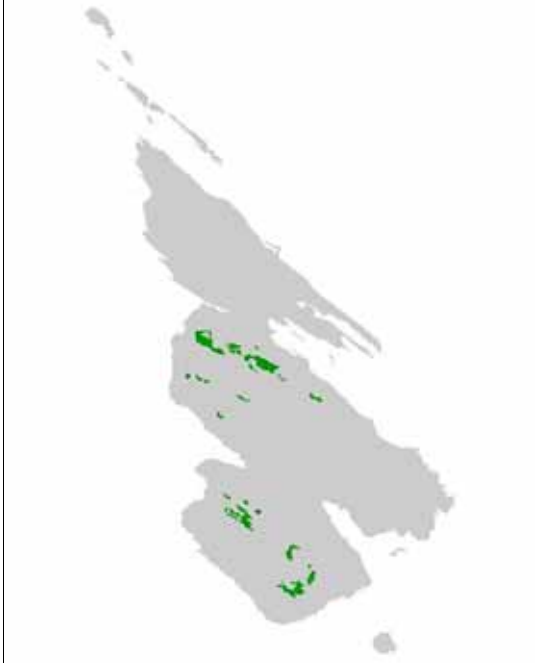
Site Description

This site series was infrequently mapped, generally occurring on water-shedding ridge crests and convex upper slopes with very thin till-derived Brunisols to Non-soils, often with bedrock outcrops and mor humus forms. Douglas-fir and shore pine were dominant in the canopy, with more pine where soils were driest. There were no other trees. Canopy cover was sparse (20-40%), with much of the forest floor exposed. Dominant shrubs included oceanspray, salal, red huckleberry, common snowberry, tall Oregon-grape, and honeysuckle species, which also occupied only 10-30% of sites. Arbutus and regenerating canopy species were frequent associates that occupied the shrub layer. Herb cover was sparse to nil during winter when sites were surveyed. Rocks and substrate were often covered by cladina lichen species and mosses including step moss, Oregon beaked moss, electrified cat's tail moss, and pipecleaner moss.

Elevation (m): 250-650
Slope (%): 5-65
Aspect (°): variable
Surficial material: Mv
Drainage: r
SMR: 0
SNR: A (-B)

Assumed modifiers: d, j, m	Atypical site modifiers: h, k, q, r, s, v, w, z

Plots: WM006, WM007, ERSK_GR02, ERSK_GR03, WM036, JK304,ERSK_GR05,ERS



TEM Code	Site Association	Site Series
DF	**Douglas-fir—Sword fern**	**04**

Site Description

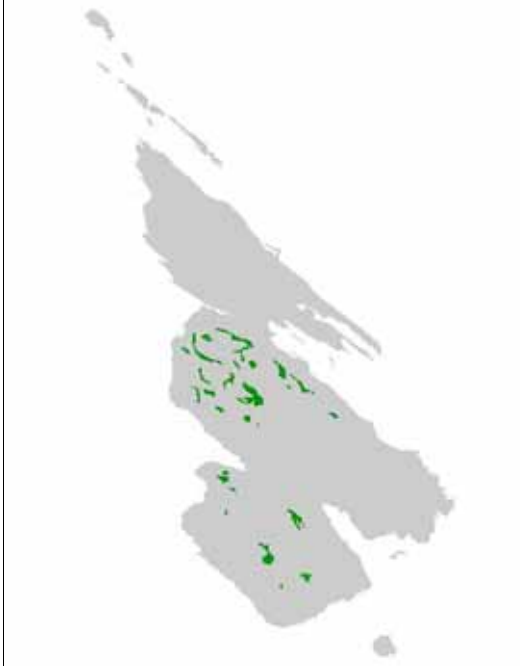
These sites were mapped on well drained upper to mid-slopes with variable thicknesses of till, typically of finer texture than sites supporting site series 03. Humus forms were mulls to moders. Douglas-fir was the most common canopy dominant, but western hemlock was a frequent associate in all canopy layers, although sparser than expected on Saltspring Island. Grand fir was an infrequent associate. Shrubs occupied low to moderate cover (15-30%), with dull Oregon-grape, red huckleberry, common snowberry, and trailing blackberry constant associates. Sword fern dominated the herb layer, with relatively few other species. The bryophyte layer was dominated by Oregon beaked moss.

Elevation (m): 140-575
Slope (%): 35-55
Aspect (°): variable
Surficial material: M
Drainage: w
SMR: 1-2
SNR: C-E

Assumed modifiers: d, j, m

Atypical site modifiers: h, k, q, s, w, z

Plots: GB028, GB031, BBJK11, CA079, WM030, WM031, ERSK_GR07, JK305,K30



TEM Code	Site Association	Site Series
DS	**Douglas-fir—Western hemlock—Salal**	**03**

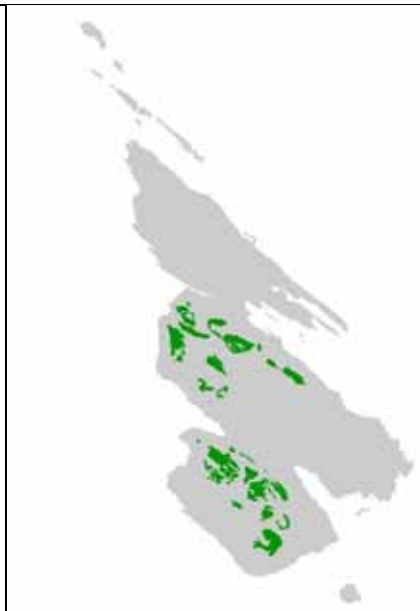
Site Description

These forested sites occurred on well-drained, nutrient very poor to medium upper slopes with mor humus types. Substrate was generally till of various depths, infrequently co-occurring with colluvium. The canopy closure of structural stage 4-5 stands was dense (often greater than 50%), opening up with succession. Regeneration of hemlock tended to be abundant in the understorey, with little Douglas-fir regeneration, reflecting the low shade tolerance of Douglas-fir and its mineral seedbed requirement. Salal formed dense thickets and was a constant dominant in the shrub layer, with little other plant cover except red huckleberry as a frequent associate.

Elevation (m): 130-600
Slope (%): 5-100
Aspect (°): variable
Surficial material: M (C)
Drainage: w-r
SMR: 1-2
SNR: A-C

Assumed modifiers: d, j, m	Atypical site modifiers: h, k, q, r, s, v, w, x, y, z

Plots: CA022, CA057, CA076, JK301, JK302, MT059, WM001, WM002, WM003, WM042, ERSK_GR15, WM043, ERSK_GR13, ERS



TEM Code	Site Association	Site Series
HD	**Western hemlock—Western redcedar—Deer fern**	**06**

Site Description

This site series tended to develop on north-facing mid- to lower slopes with moderately to imperfectly drained Brunisols and Podzols derived from till. Western hemlock was the most abundant tree and constant dominant, with lesser amounts of frequent associates western redcedar and grand fir. Bigleaf maple and red alder were often present in seral stands. Diagnostic species deer fern was infrequent in these stands. The understorey featured salal, salmonberry, and dull Oregon-grape in the shrub layer, with sword fern, bracken dominants in the herb layer. Occasionally spiny wood fern and introduced grass species also occurred. The diagnostic species deer fern was typically absent on Saltspring Island. The moss layer was dominated by Oregon beaked moss with lesser amounts of associated species curly heron's bill moss and knight's plume. Coastal leafy moss was common on decaying wood.

Elevation (m): 250-575
Slope (%): 15-45
Aspect (°): variable
Surficial material: M
Drainage: w-m
SMR: 5-6
SNR: A-C

Assumed modifiers: d, j, m	Atypical site modifiers: h, k, s, v, w

Plots: JK016, JK017, MT058, QAF005, WM037

TEM Code	Site Association	Site Series
HK	**Douglas-fir—Western hemlock—Oregon beaked moss**	**01**

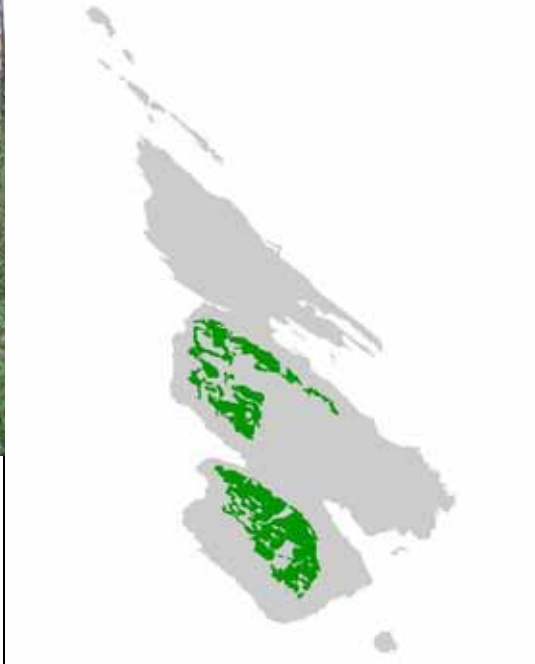
Site Description

This is the zonal ecosystem that best represents the regional climate on sites with medium (mesic) soil nutrient regimes. Soils are generally Humo-Ferric Podzols that originated from till, and infrequently from colluvium, with good drainage. Seral or disturbed sites have high cover of Douglas-fir and red alder; the latter replaced by western hemlock with succession, but disturbed and managed sites tend to have more Douglas-fir than expected under undisturbed conditions. Hemlock regeneration can be extremely dense, with high canopy closure, on moister and more shaded sites. Shrubs are most often dominated by salal, with variable cover of associates salmonberry, dull (infrequently tall) Oregon-grape, red huckleberry, and trailing blackberry most typical. Herbs vary considerably with canopy closure and substrate, often containing sword fern and, less frequently, deer fern. Mosses are overwhelmingly dominated by Oregon beaked moss.

Elevation (m): 120-600
Slope (%): 0-100
Aspect (°): variable
Surficial material: M (C)
Drainage: w
SMR: 3-4
SNR: A-C

Assumed modifiers: d, j, m	Atypical site modifiers: h, k, q, r, s, v, w, x, z

Plots: CA023, CA055, CA082, CA083, GB030, JK012, JK013, JK014, JK303, MT060, MT061, QAF001, QAF002, QAF003, WM004, WM005, WM008, WM009, WM010, WM023, WM032, WM039, WM038



TEM Code	Site Association	Site Series
RB	**Western redcedar—Salmonberry**	**13**

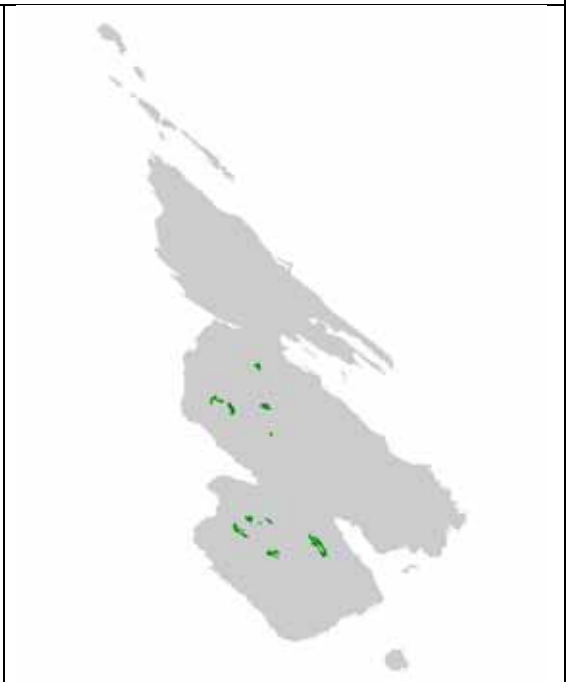
Site Description

These nutrient medium- to-rich, very moist (winter) to fresh (summer) sites were fairly common in hummocky, imperfectly drained, level terrain or moisture receiving toe slopes and in riparian areas. These sites tended to support a mosaic of site series 13 and 07, with the former in hollows and the latter on raised microsites. Soils were often gleyed or weakly mottled Brunisols (typically Gleyed Eluviated Dystric Brunisols, similar to CWHxm/12 but with more pronounced mottling), reflecting the seasonally fluctuating water tables. There were accumulations of fines beneath the organic horizons in depressions. The canopy was open (5-15%), with redcedar the dominant tree species growing on elevated hummocks. Dense thickets of salmonberry were the dominant shrub component, with occasional Douglas maple, thimbleberry, and red elderberry. Herbs were variable, but few were apparent during sampling (largely in winter). Sword fern grew on hummocks and bleeding heart and sweet-cicely were also common associates. Bryophytes were sparse to absent except on decaying wood.

Elevation (m): 120-450
Slope (%): 0-10
Aspect (°): variable
Surficial material: M
Drainage: m-i
SMR: 5
SNR: C-D

Assumed modifiers: d, j, m	Atypical site modifiers: h, s, v

Plots:



TEM Code	Site Association	Site Series
RC	**Western redcedar—Sitka spruce—Skunk cabbage**	**12**

Site Description

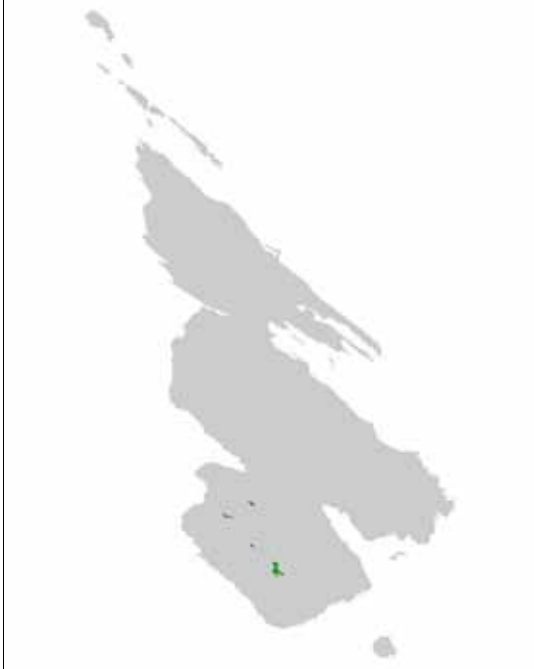
These rich, moist to wet sites occurred in moisture-receiving depressions with fine to medium soils, possibly including a minor component of organics. Although Sitka spruce was not observed on Saltspring Island, western redcedar was a typical dominant with lesser amounts of associated red alder, bigleaf maple, and grand fir on the margins. Alder abundance decreased with stand age. Sites often had abundant moderate to large woody debris. Shrubs observed included salmonberry, thimbleberry, and occasionally salal on hummocks. Species visible in the herb layer were limited by the sampling window, but the most common associate species were vanilla-leaf, lady fern, deer fern, and skunk cabbage. Bryophytes associated with this site series were coastal and large leafy moss and slender beaked moss.

Elevation (m): 120-450
Slope (%): 0-10
Aspect (°): variable
Surficial material: M (O)
Drainage: p
SMR: 7
SNR: C-E

Assumed modifiers: d, j, m

Atypical site modifiers: s

Plots:



TEM Code	Site Association	Site Series
RF	**Western redcedar—Foamflower**	**07**

Site Description

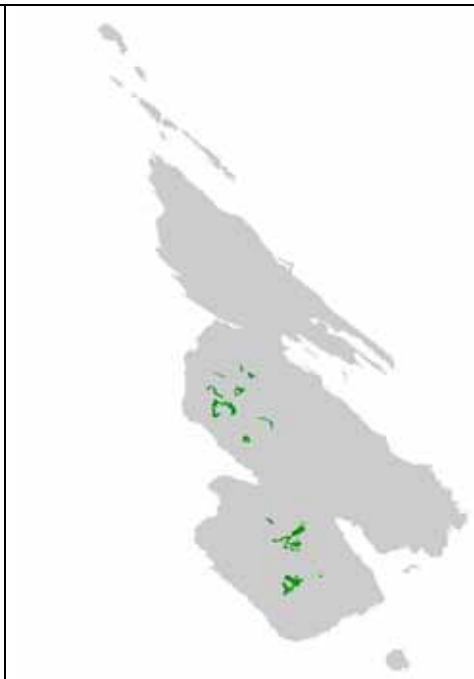
These ecosystems occurred on moisture-receiving toe slopes, some seepage sites, and level sites with thick relatively rich, moderately well to imperfectly drained soils. Common soil types were Humo-Ferric Podzols or occasionally Gleysols on level sites grading to gleyed Brunisols derived from till. Humus forms ranged from moders to mulls. Redcedar was often associated in the semi-open canopy with constant associates grand fir and bigleaf maple; Douglas-fir was infrequent to absent on most sites. Hemlock also was infrequent in the study area on these site types. Trees on these productive sites tended to be larger their cohorts in most other site series. Shrubs included dense cover of the dominant species salmonberry and thimbleberry. Herbs also occupied a high cover proportion, with ladyfern, spiny wood fern, foamflower, vanilla-leaf, oak fern, and small-flowered rush typically present in varying amounts on most sites. Coastal leafy moss was dominant in the bryophyte layer, with lesser amounts of slender beaked moss.

Elevation (m): 120-325
Slope (%): 0-35
Aspect (°): variable
Surficial material: M
Drainage: m
SMR: 5-6
SNR: D-E

Assumed modifiers: d, j, m

Atypical site modifiers: h, k, s, w

Plots: WM040



TEM Code	Site Association	Site Series
RS	**Western redcedar—Sword fern**	**05**

Site Description

This site series was mapped most often on north-facing mid-slopes with well to moderately well-drained soils derived from till and occasionally colluvium. Redcedar was not always dominant in the canopy, likely reflecting the disturbance history of sites in the study area. Western hemlock, grand fir, and Douglas-fir were frequent, represented in all canopy layers. Coarse woody debris was often moderately abundant to abundant on these sites. The understorey was dominated by salal and common snowberry, with variable amounts of salmonberry, and occasionally dull Oregon-grape in the shrub layer. The herb layer featured the dominant species sword fern and bracken, occasionally with spiny wood fern and introduced grass species. Both bracken and graminoids decreased with increasing canopy closure. The moss layer was dominated by Oregon beaked moss with lesser amounts of constant associates curly heron's bill moss, knight's plume, and with coastal leafy moss on decaying wood. Some sites were influenced by seepage, and developed this ecosystem on warm aspects or shallower soils than typical.

Elevation (m): 125-550
Slope (%): 10-100
Aspect (°): 285-135
(135-285)
Surficial material: M, C
Drainage: w-m
SMR: 3-4
SNR: D (E)

Assumed modifiers: d, j, m

Atypical site modifiers: h, k, q, s, v (w)

Plots: GB029, WM013

TEM Code	Site Association	Site Series
RT	**Western redcedar—Black twinberry**	**14**

Site Description

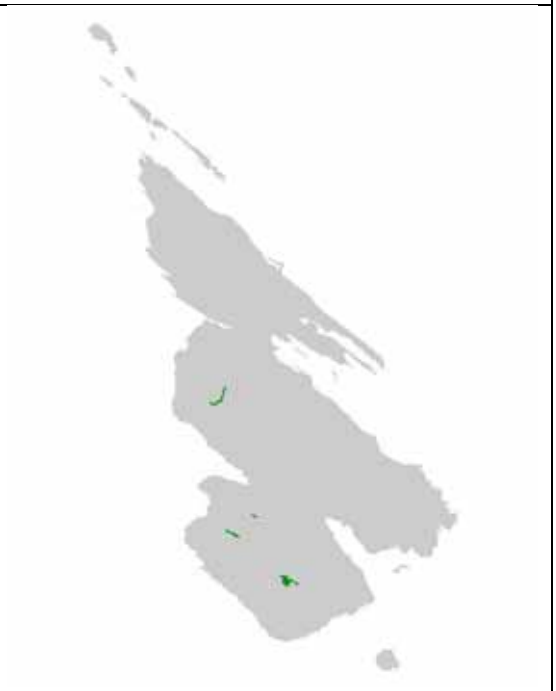
These rich, wet (winter) to moist (summer) sites were infrequent, occurring in hummocky, imperfectly drained, level terrain or moisture receiving toe slopes and in riparian areas. These sites tended to support a mosaic of site series 14 and 07 or 12, with the former in hollows and the latter on raised microsites. The canopy was open to sparse, with redcedar the dominant tree species growing on elevated hummocks. Shrubs had fairly high cover, with salmonberry, twinberry, red elderberry, and willows the most common dominants, and occasional components of ninebark and Pacific crabapple associated with richer sites. Herbs varied among sites; foamflower, lady fern, vanilla-leaf, and sword fern were the most frequent. Bryophytes were sparse to absent except on decaying wood.

Elevation (m): 200-450
Slope (%): 0-15
Aspect (°): variable
Surficial material: M, O
Drainage: i
SMR: 6
SNR: D-E

Assumed modifiers: d, j, m

Atypical site modifiers: s

Plots:



4.8.4 Non-Forested and Sparsely Vegetated Site Series of the CWHxm

TEM Code	Site Association	Site Series
AM	**Arbutus—Hairy manzanita**	**00**

Site Description

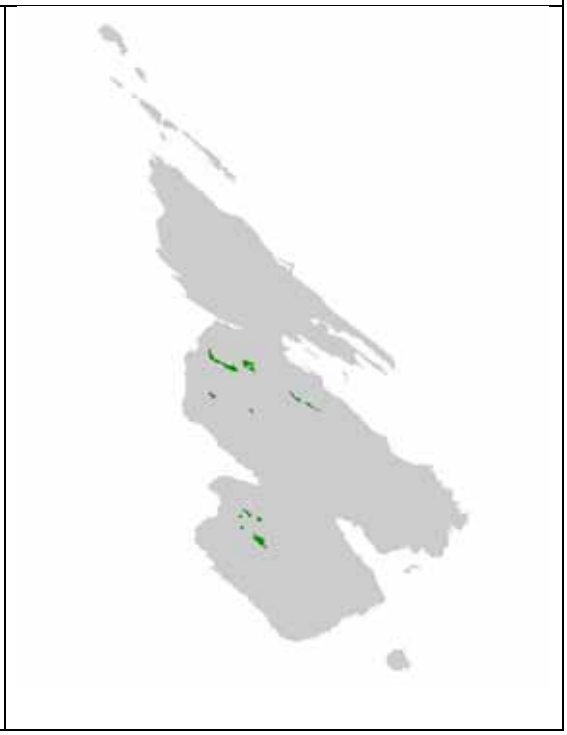
These very xeric sites occurred on ridge crests and water-shedding steep upper slopes directly on bedrock. Canopies were very open (< 5%) with arbutus and occasionally shore pine dominant, rarely reaching past structural stage 4 with respect to structural development criteria. The shrub layer was dominated by hairy manzanita, arbutus regeneration, and occasionally Scotch broom. Herbs were typically sparse, but annuals may be evident in the spring, particularly graminoids, but comprising low (< 20%) cover. The substrate was typically dominated almost completely by curly heron's bill moss and, to a lesser extent, and on rock outcrops, foliose lichens.

Elevation (m):
Slope (%):
Aspect (°): 120-250
Surficial material: R
Drainage: r
SMR: 1
SNR: A

Assumed modifiers: j, r, s

Atypical site modifiers: v, w, z

Plots: ERSK_GR01



TEM Code	Site Association	Site Series
FC	**Fescue—Camas**	**00**

Site Description

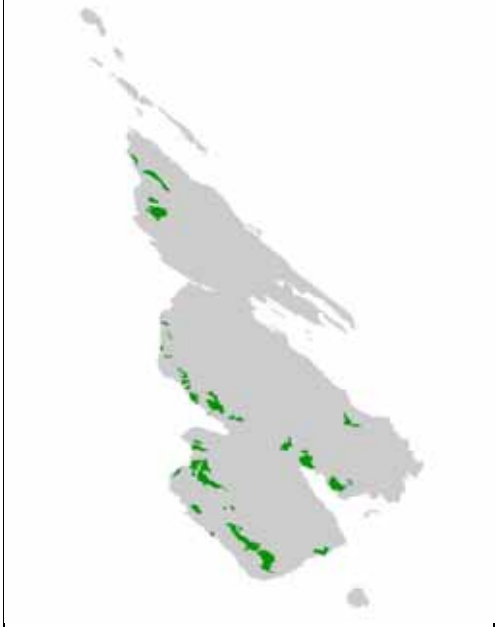
These herbaceous meadows were moderately frequent, typically on gentle to moderately sloping, warm aspects with deep but occasionally shallow soils. This site series is the same community as CDFmm/00 (FC), with many of the same herbaceous species, also possibly representing a seral or disturbance-maintained disclimax. Herbaceous and bryophyte cover is nearly total; shrubs were infrequent. Snowberry and invasives (e.g., Scotch broom) were the most common shrubs. Trees were sparse and shrubby in habit, including Douglas-fir and rarely arbutus. Herbaceous species were dominated on most sites by invasive perennial grasses such as early hairgrass, sweet vernalgrass, Kentucky bluegrass, and many others. Native species included western and Roemer's fescue, Pacific sanicle, and others which varied by season and presence among sites. Bryophytes and lichens were not abundant; rock moss and Wallace's selaginella occasionally colonized bedrock outcrops.

Elevation (m): 150-550
Slope (%): 15-55
Aspect (°): 135-275
Surficial material: C, M
Drainage: r-x
SMR: 2
SNR: C-E

Assumed modifiers: j, m, s

Atypical site modifiers: k, w, v

Plots: TT002, TT003, TT004, JK217



TEM Code	Site Association	Site Series
SC	**Cladina—Wallace's selaginella**	**00**

Site Description

These sites were most often found on very to extremely shallow soils and rocky outcrops. They are the same association documented as CDFmm/00 (SC) and appeared to have the same species composition in general. Low water-holding capacity of sites, which occasionally consisted of extremely thin veneers and thin veneers of till, supported this plant community which also thrived on bare rock. This association probably can be subdivided into several associations. It supported a range of non-vascular flora, including lipstick cladonia, pixie cup, hoary and common rock moss, sidewalk moss, and Wallace's selaginella. Field inspection revealed this community varied to include components of diverse vascular species such as stonecrops, and frequently contained low to moderate cover of introduced grass species on richer sites.

Elevation (m): 150-650
Slope (%): 0-100
Aspect (°): 135-285 (varies)
Surficial material: R, Mx
Drainage: x
SMR: 0-1
SNR: A-B

Assumed modifiers: j, m, r, v

Atypical site modifiers: k, s, w, z

Plots: TTV21

TEM Code	Site Association	Site Series
SS	**Sitka spruce—Salmonberry**	**08**

Site Description

This high bench site series was infrequently mapped in the study area. Fluvial materials and landscape position contribute to highly productive, moderately-well drained sites with relatively open canopies (more open as stands age) Soils were frequently well-developed with moder to mull humus forms. Sitka spruce was not found in the study area; broadleaf species including black cottonwood, red alder and bigleaf maple were dominant, with varying amounts of frequent associate western redcedar. Shrubs were highly variable in cover and diversity, with salmonberry and thimbleberry dominating, and less abundant associates ninebark, red-osier dogwood, cascara, red elderberry, bitter cherry, and Pacific crabapple. Herbs also varied, with relatively low cover compared to shrubs. The common associate species were vanilla-leaf, ladyfern, sweet-cicely, and false lily-of-the-valley. Season of sampling also influenced cover and species recorded. Coastal leafy moss was a common colonizer on woody substrate.

Elevation (m): 150-350
Slope (%): 5-35
Aspect (°): variable
Surficial material: F
Drainage: m
SMR: 5-6
SNR: C-E

Assumed modifiers: d, j, m

Atypical site modifiers: k, s

Plots: WM040

TEM Code	Site Association	Site Series
SW	**Spirea—Sedge wetland**	**00**

Site Description

These nutrient-poor low shrub fens were mapped infrequently and similar to SS in the CDFmm. They are most typically found in slight depressions containing standing water, and hollows in hummocky terrain with poor drainage and a perched water table and/or poor soil nutrient status. Species diversity was low, with the most common associated shrubs including hardhack and willows. Occasionally red-osier dogwood was present. Herbaceous plants typically had relatively high cover of the dominant species bog rush, with small-flowered rush a constant associate on the margins. Few-flowered sedge, long-stoloned sedge, slough sedge were the most common sedge species.

Elevation (m): 120-450
Slope (%): 0
Aspect (°): n/a
Surficial material: Ob
Drainage: p-v
SMR: 7
SNR: A-B

Assumed modifiers: d, j, p

Atypical site modifiers: none

Plots:

TEM Code	Site Association	Site Series
Wb50	**Labrador tea—Bog laurel—Peat-moss**	**00**

Site Description

These nutrient-poor, acidic bogs were mapped very infrequently in the study area due to the paucity of thick organic sediment. Brown sphagnum species comprise the dominant surface cover in microsite depressions which may contain standing water, and herbaceous species are absent to uncommon. Shrubs typical for this association (predominating on the raised microsites) include bog-laurel, Labrador tea, and bog cranberry, which was not observed on Saltspring Island.

Elevation (m): 175-450
Slope (%): 0
Aspect (°): n/a
Surficial material: Ob
Drainage: p
SMR: 7-8
SNR: A-B

Assumed modifiers: n/a

Atypical site modifiers: none

Plots:

No photo available

TEM Code	Site Association	Site Series
Ws50	**Spirea—Sitka sedge swamp**	**00**

Site Description

Spirea-dominated swamps were infrequent in the study area, but relatively widespread along the Georgia Depression. This association is the same as that described for CDFmm/Ws50. Sitka sedge may not always be present, depending on the density of spirea and amount of open water or bryophyte (often Sphagnum) cover. Organic veneers of poorly decomposed plant residue form over gleyed mineral soils, typically Gleysols. These sites may be seral phases of treed swamps.

Elevation (m): 120-550
Slope (%): 0
Aspect (°): n/a
Surficial material: Ov
Drainage: p
SMR: 7
SNR: A-C

Assumed modifiers: n/a

Atypical site modifiers: s

Plots:

5.0 DISCUSSION

5.1 Disturbance and Invasive Species

Saltspring Island contains a diverse range of ecosystems, supported by its complex geomorphological history and present landform aggregation. Disturbance incidence was high, particularly in the north half. Disturbances consisted primarily of rural residential development, followed by logging (largely clearcutting with and without reserves, with minor amounts of single-tree and group selection systems. Fires were infrequent to absent in this populated island, although historically small, moderately frequent fires (particularly fires set in oak and camas meadows by First Nations) had a strong influence on drier ecosystems within the CDFmm. Fire frequency is suspected to have historically fluctuated based on cultural practices (McDougall and Turkington 2004; McCoy et al. 2006).

The characteristic Garry oak dominated ecosystems tend to develop in site series CDFmm/03 (Douglas-fir—Oniongrass). Garry oak meadows represent a disturbance driven, fire-dependent disclimax type and have had widespread declines concurrent with fire suppression (MacDougall and Turkington 2004; MacDougall et al. 2004). The Garry Oak Ecosystems Restoration Team (GOERT) has collected a wide range of contemporary and historical baseline data to provide context regarding the extent, condition, composition, and resilience of these ecosystems, including their responses to restoration treatments.

Displacement of rare indigenous species by exotic and indigenous invasive plants has also contributed substantially to the decline of Garry oak meadows (MacDougall and Turkington 2004). Introduced and feral domestic livestock serve as vectors for many weedy species. Others have been deliberately introduced as ornamentals, or forage crops. Site disturbance that exposes mineral seedbeds hastens colonization by weedy invasives. Scotch broom, many common agronomic grasses, gorse, English hawthorn and oak, holly, and a wide range of other life forms aggressively colonize nearly all sites in the CDFmm. Their adaptations to disturbance, including rapid growth, prolific reproduction, robust seed banks, vegetative spread, and dense monotypic growth habits, tend to render sites unsuitable for many native species, particularly those that require specialized microhabitats.

In wetland ecosystems invasive species also have caused the same types of changes in ecological character and condition. Purple loosestrife, Eurasian milfoil, yellow flag iris, cordgrass species, and many other escaped cultivated plants have altered the hydrological regime, decreased habitat diversity, and displaced native aquatic and estuarine plants. These habitat types are already extremely infrequent throughout Saltspring Island and their sensitivity to ecological disturbance makes them particularly vulnerable to degradation (MacDougall et al. 2006).

Intensive agriculture is not extremely prevalent at present on Saltspring Island, but hobby farms are relatively common and widespread, especially in glaciomarine and glaciolacustrine deposits. These rich, gently undulating to flat sites support productive crop growth and forage. Wetland modification through drainage, excavation, and vegetation change also impacts on ecosystem representation and ecological integrity. Seasonally flooded fields are recognized and mapped as sensitive ecosystems through the Sensitive Ecosystem Inventory (SEI) program (Ward et al. 1998).

5.2 Structural Stage Distribution

There was extremely little old-growth mapped on Saltspring Island (structural stage 7). Occasional scattered and small groups of veteran Douglas-firs were noted within younger forest stands, but a legacy of harvesting and development over the past century has all but eliminated this structural stage from the landscape. Mature forest polygons were mapped throughout Saltspring Island, and forested polygons of younger structural stages have the inherent capacity to develop old-growth attributes over time. Existing forest reserves and parks (including ecological reserves) are the best candidates at present for filling this gap. Except for major storm events or wildfires, a substantial proportion of present mature forest polygons in these areas can be anticipated to develop via succession into old-growth. Technically, for the biogeoclimatic units on Saltspring Island, a polygon is classified as old-growth (structural stage 7) after age 250 (BCMOF and BCMELP 1998).

Forested polygons were predominantly structural stage classes 4 (pole-sapling) and 5 (young forest). Many developed polygons mapped as rural residential had remnants of forest ecosystems that would support ecosystem function and habitat values.

5.3 Polygon Size and Fragmentation

Polygon size varied widely throughout the study area. Size was influenced to a much higher degree by development patterns than by topographic or surficial factors. Disturbance, land conversion, and land alienation were the dominant drivers of polygon size and habitat contiguity. Accessibility was also a major influence on fragmentation: land development facilitated by road networks resulted in more fragmentation and smaller, less intact ecosystems. The high proportion of private land holdings also facilitated fragmentation as land use decisions show a pattern of having been made independently of adjacent properties, and with minimal consideration for landscape-scale ecological context.

Connectivity was typically good in the southern half of the island, but poor in the more developed northern half. There were many fallow fields that were used either for forage or had been cleared and were not in use any longer.

Post-contact human settlement on Saltspring Island has modified the landscape to the extent that the present ecosystem distribution is influenced almost entirely by humans. Replanted forests, reclaimed homestead sites and former agricultural fields are widespread. Ecosystems throughout the Island largely represent various stages of seral succession. Similarly, pre-contact fires set by First Nations people to encourage berry production, ungulate forage, and alter the distribution of herbaceous species are also thought to have modified the landscape, particularly in herbaceous and Garry oak ecosystems.

6.0 CONCLUSION

The map and data produced from this report can support many different applications. It represents data current as of 2005 (air photo coverage), adjusted for sampling sites to 2007.

The Islands Trust is presently the governing agency responsible for land use and permitting on Saltspring Island. Within the context of provincial and regional regulatory frameworks, it is possible to develop and implement land use policies that respect ecological patterns and values. Parks planning, development permitting, riparian area management, and conservation covenants are becoming more widely implemented to facilitate an integrated, large-scale framework for land use planning that preserves and enhances ecological values, and promotes the restoration of degraded ecosystems.

7.0 LITERATURE CITED

AXYS Environmental Consulting Ltd. 2005. Redigitizing of sensitive ecosystems inventory polygons to exclude disturbed areas: summary report. Contract report to Canadian Wildlife Service. Sidney, B.C. 27 pp.

B.C. Conservation Data Centre [B.C. C.D.C.]. 2007. BC Species and Ecosystems Explorer. B.C. Min Environ. Victoria, BC. Available at http://srmapps.gov.bc.ca/ apps/eswp/ [accessed September 18, 2007].

B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks [BCMOF and BCMELP]. 1998. Field manual for describing terrestrial ecosystems. B.C. Min. For. and B.C. Min. Env., Lands and Parks. Victoria, B.C. Land Manage. Handb. 25.

Clague, J.J., Harper, J.R., Hebda, R.J. and Howes, D.E. 1982. Late Quaternary sea-level and crustal movements, coastal British Columbia. Canadian Journal of Earth Sciences 19:597-618.

Courtin, P.J., R.N. Green, and G. Shishkov. 1989. An ecological approach to organizing forests for woodlot management. B.C. Min. For., For. Sci. Sec., Burnaby, B.C. Land Management Report 58. 56 pp.

Erickson, W.R. and D. Meidinger. 2007. Garry oak (*Quercus garryana*) plant communities in British Columbia: a guide to identification. B.C. Min. For. Range, For. Sci. Prog., Victoria, B.C. Tech. Rep. 040. 83 pp.

Green, R.N. 2007. Terrestrial ecosystem mapping of the Southern Gulf Islands. Draft. Contract report by B.A. Blackwell and Assoc. Ltd. to Parks Canada. North Vancouver, B.C. 40 pp.

Green, R.N. and K. Klinka. 1994. A field guide to site identification and interpretation for the Vancouver Forest Region. Land Manage. Handb. 28. B.C. Min. For., Victoria, B.C.

Hicock, S.R., and Armstrong, J.E. 1985. Vashon Drift: definition for the formation in the Georgia Depression, southwest British Columbia. Canadian Journal of Earth Sciences 22:748-757.

Hodge, W.S. 1995. Ground water conditions on Saltspring Island. B.C. Min. Envron., Water Management Div., Victoria, B.C.

Holland, S.S. 1976. Landforms of British Columbia, a physiographic outline. Revised ed. B.C. Dept. of Mines and Petroleum Resources, Victoria, B.C. Bull. 48. 31 pp.

Howes, D.E. and E. Kenk (contributing eds.). 1997. Terrain classification system for British Columbia. V.2. Resource Inventory Branch, Min. Env., Lands and Parks. MOE Manual 10. Victoria, B.C. 99 pp.

Huntley, D.H., Bobrowsky, P.T., and Clague, J.J. 2001. Ocean drilling program leg 169S: surficial geology, stratigraphy and geomorphology of the Saanich Inlet area, southeastern Vancouver Island, British Columbia. Marine Geology 174:27-41.

Lea, T. Historical Garry oak ecosystems of Vancouver Island, British Columbia, pre-European contact to the present. Davidsonia 17(2):34-50.

Madrone Environmental Services Ltd. 2003. Mount Maxwell Terrestrial Ecosystem Mapping and ecological assessment. Unpublished contract report to B.C. Ministry of Water, Land and Air Protection, Environmental Stewardship Division, Vancouver Region. Vancouver, B.C. 124 pp.

Massey, N.W.D., Friday, S.J., Tercier, P.E., and Potter, T.E. 1988. Geology of the Chemainus River and Duncan Area (092C/15, 092B/13). B.C. Min. Energy, Mines and Petroleum Res. Victoria, B.C. Open File 1988-08.

Massey, N.W.D., MacIntyre, D.G., Desjardins, and Cooney, R.T. 2005. Digital geology map of British Columbia, B.C. Min. Energy, Mines and Petroleum Res. Victoria, B.C. Open File 2005-02.

McCoy, M.M. McCoy, M.G. Pellatt, and R.W. Mathewes. 2006. High-resolution fire and vegetation history of Garry oak (*Quercus garryana*) ecosystems in coastal British Columbia. Garry Oak Ecosystems Recovery Team Research Colloquium. Can. For. Serv., Victoria, B.C. pp. 6-7.

MacDougall, A.S.M. and R. Turkington. 2004. Relative importance of suppression-based and tolerance-based competition in an invaded oak savanna. J. Ecol. 92: 422–434.

MacDougall, A.S., B.R. Beckwith, and C.Y. Maslovat. 2004. Defining conservation strategies with historical perspectives: a case study from a degraded oak grassland Ecosystem. Cons. Biol. 18:455–465.

MacDougall, A.S., J. Boucher, R. Turkington, G.E. Bradfield. 2006. Patterns of plant invasion along an environmental stress gradient. J. Vegetation Science 17:47 (Abstract).

Nuszdorfer, F.C., K. Klinka, and D.A. Demarchi. 1990. Coastal Douglas-Fir zone. In Ecosystems of British Columbia. D. Meidinger and J. Pojar (compilers and editors). B.C. Min. For., Victoria, B.C. Special Rep. Ser. 6. pp. 81-93.

Resources Inventory Committee [RIC]. 1996. Guidelines and standards to terrain mapping in British Columbia. Surficial Geology Task Group, Earth Sciences Task Force, B.C. 130 pp.

Resources Inventory Committee [RIC]. 1998. Standard for terrestrial ecosystem mapping in British Columbia. Ecosystems Working Group, Terrestrial Ecosystems Task Force, Resources Inventory Committee. Vancouver, B.C. 100 pp.

Resources Inventory Standards Committee [RISC]. 2000. Standard for Terrestrial Ecosystem Mapping (TEM)—digital data capture in British Columbia. Ecosystem technical standards and database manual. V.3.0. Ecological Data Committee, Ecosystems Working Group/Terrestrial Ecosystems Task Force, Victoria, B.C. 68 pp.

Resource Information Standards Committee [RISC]. 2004. Standards for Terrestrial Ecosystem Mapping (TEM) Digital Data Capture in British Columbia, Version 3.0, Errata No. 1.0. Ministry of Sustainable Resource Management, Resource Information Branch, Victoria, B.C. 9 pp.

Soil Classification Working Group. 1998. The Canadian system of soil classification, 3rd ed. Agriculture and Agri-Food Canada Publication 1646. Ottawa, ON. 187 pp.

van Vliet, L.J.P., A.J. Green, and E.A. Kenney. 1987. Soils of the Gulf Islands of British Columbia. Volume 1: Soils of Saltspring Island. Land Resource Research Centre, Soi1 Survey Unit Contribution No. 84-6. British Columbia Soi1 Survey Report No. 43. (Mapsheets92B/11, 12, 13, and 14) Agriculture Canada, Ottawa, ON. 136 pp.

Ward, P., G. Radcliffe, J. Kirkby, J. Illingworth, and C. Cadrin. 1998. Sensitive Ecosystems Inventory: East Vancouver Island and Gulf Islands. 1993 – 1997. Volume 1: methodology, ecological descriptions and results. Canadian Wildlife Service, Environmental Conservation Branch, Pacific and Yukon Region, Delta, B.C. Tech. Rep. Ser. 320.

APPENDIX I

RED AND BLUE LISTED SPECIES

Appendix I. List of Provincial Red- and Blue-Listed Species Potentially Occurring on Saltspring Island.

Note: potential occurrence and overlapping range in the study area does not necessarily indicate actual presence of these species.

Scientific Name	English Name	RISC Code	Status			
			Global	Provincial	COSEWIC	BC Status
Wildlife - fish						
Oncorhynchus clarkii clarkii	Cutthroat Trout, *clarkii* subspecies	F-ONCL-CL	G4T4	S3S4		Blue
Salvelinus malma	Dolly Varden	F-SAMA	G5	S3S4		Blue
Wildlife - amphibians						
Rana aurora	Red-legged Frog	A-RAAU	G4	S3S4	SC (Nov 2004)	Blue
Rana pipiens	Northern Leopard Frog	A-RAPI	G5	S1	E (May 2000)	Red
Wildlife - reptiles						
Chrysemys picta pop. 1	Western Painted Turtle - Pacific Coast Population		G5TNR	S2	E (Apr 2006)	Red
Contia tenuis	Sharp-tailed Snake	R-COTE	G5	S1	E (May 1999)	Red
Pituophis catenifer catenifer	Gopher Snake, *catenifer* subspecies	R-PICA-CA	G5T5	SX	XT (May 2002)	Red
Wildlife – birds - waterfowl						
Branta canadensis occidentalis	Canada Goose, *occidentalis* subspecies	B-CAGO-OC	G5T2T3	S1N		Blue
Phalacrocorax auritus	Double-crested Cormorant	B-DCCO	G5	S3B	NAR (May 1978)	Blue
Wildlife – birds - herons						
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	B-GBHE-FA	G5T4	S3B,S4N	SC (May 1997)	Blue
Botaurus lentiginosus	American Bittern	B-AMBI	G4	S3B		Blue
Butorides virescens	Green Heron	B-GRHE	G5	S3S4B		Blue
Wildlife – birds - raptors						
Accipiter gentilis laingi	Northern Goshawk, *laingi* subspecies	B-NOGO-LA	G5T2	S2B	T (Nov 2000)	Red
Asio flammeus	Short-eared Owl	B-SEOW	G5	S3B,S2N	SC (May 1994)	Blue
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	B-PEFA-AN	G4T4	S2B	SC (Apr 2007)	Red
Falco peregrinus pealei	Peregrine Falcon, *pealei* subspecies	B-PEFA-PE	G4T3	S3B	SC (Apr 2007)	Blue
Glaucidium gnoma swarthi	Northern Pygmy-Owl, *swarthi* subspecies	B-NPOW-SW	G5T3Q	S3		Blue
Megascops kennicottii kennicottii	Western Screech-Owl, *kennicotii* subspecies	B-WSOW-KE	G5T4	S3	SC (May 2002)	Blue
Tyto alba	Barn Owl	B-BNOW	G5	S3	SC (Nov 2001)	Blue

Wildlife – marine birds						
Phalacrocorax penicillatus	Brandt's Cormorant	B-BRCO	G5	S1B,S4N		Red
Brachyramphus marmoratus	Marbled Murrelet	B-MAMU	G3G4	S2B,S4N	T (Nov 2000)	Red
Wildlife – birds - passerines						
Coccyzus americanus	Yellow-billed cuckoo	B-YBCU	G5	SXB		Red
Eremophila alpestris strigata	Horned Lark, *strigata* subspecies	B-HOLA-ST	G5T2	SX	E (Nov 2003)	Red
Patagioenas fasciata	Band-tailed Pigeon	B-BTPI	G4	S3S4B		Blue
Pooecetes gramineus affinis	Vesper Sparrow, *affinis* subspecies	B-VESP-AF	G5T3	S1B	E (Apr 2006)	Red
Progne subis	Purple Martin	B-PUMA	G5	S2S3B		Blue
Sialia mexicana pop. 1	Western Bluebird (Georgia Depression population)	B-WEBL	G5TNRQ	SHB		Red
Sturnella neglecta pop. 1	Western Meadowlark (Georgia Depression population)	B-WEME	G5TNRQ	SXB		Red
Wildlife – birds - woodpeckers						
Melanerpes lewis pop. 1	Lewis's Woodpecker (Georgia Depression population)	B-LEWO	G5TXQ	SXB		Red
Wildlife - mammals						
Corynorhinus townsendii	Townsend's Big-eared Bat	M-COTO	G4	S3		Blue
Eumetopias jubatus	Steller Sea Lion	M-EUJU	G3	S2S3B,S3N	SC (Nov 2003)	Blue
Mustela erminea anguinae	Ermine, *anguinae* subspecies	M-MUER-AN	G5T3	S3		Blue
Sorex palustris brooksi	American Water Shrew, *brooksi* subspecies	M-SOPA-BR	G5T2	S2		Red
Wildlife - invertebrates						
Callophrys mossii mossii	Moss' Elfin, *mossii* subspecies	IL-CALMOS-MO	G4T4	S2S3		Blue
Coenonympha tullia insulana	Common Ringlet, *insulana* subspecies	IL-COETUL-IN	G5T3T4	S1		Red
Erynnis propertius	Propertius Duskywing	IL-ERYPRO	G5	S2S3		Blue
Euchloe ausonides insulanus	Large Marble, *insulanus* subspecies	IL-EUCAUS-IN	G5T1	SX	XT (May 2000)	Red
Euphydryas editha taylori	Edith's Checkerspot, *taylori* subspecies	IL-EUPEDI-TA	G5T1	S1	E (Nov 2000)	Red
Euphyes vestris	Dun Skipper	IL-EUPVES	G5	S3	T (Nov 2000)	Blue
Fossaria vancouverensis		IM-FOSVAN	GHQ	SH		Red
Hesperia colorado oregonia	Western Branded Skipper, *oregonia* subspecies		G5T3T4	S2S3		Blue
Physella heterostropha	Pewter Physa	IM-PHYHET	G5Q	S1S3		Red
Physella integra	Ashy Physa	IM-PHYINT	G5	S1S3		Red
Plebejus saepiolus insulanus	Greenish Blue, *insulanus* subspecies	IL-PLESAE-IN	G5TH	SH	E (Nov 2000)	Red
Promenetus umbilicatellus	Umbilicate Sprite	IM-PROUMB	G4	S3S4		Blue
Sympetrum vicinum	Autumn Meadowhawk	IO-SYMVIC	G5	S3S4		Blue

Wildlife – gastropods						
Allogona townsendiana	Oregon Forestsnail	IM-ALLTOW	G3G4	S1S2	E (Nov 2002)	Red
Carychium occidentale	Western Thorn	IM-CAROCC	G3G4	S2S3		Blue
Hemphillia dromedarius	Dromedary Jumping-slug	IM-HEMDRO	G3G4	S2	T (May 2003)	Red
Hemphillia glandulosa	Warty Jumping-slug	IM-HEMGLA	G3G4	S2S3	SC (May 2003)	Blue
Monadenia fidelis	Pacific Sideband	IM-MONFID	G4G5	S3S4		Blue
Nearctula sp. 1	Threaded Vertigo	IM-NEASP1	G3G5	S2		Red
Pristiloma johnsoni	Broadwhorl Tightcoil	IM-PRIJOH	G2G3	S2S3		Blue
Prophysaon coeruleum	Blue-grey Taildropper	IM-PROCOE	G3G4	S1	E (Apr 2006)	Red
Prophysaon vanattae	Scarletback Taildropper	IM-PROVAN	G4	S3S4		Blue
Vertigo andrusiana	Pacific Vertigo	IM-VALAND	G2G3	S2		Red
Zonitoides nitidus	Black Gloss	IM-ZONNIT	G5	S3S4		Blue
Plants – ferns and allies						
Botrychium simplex	least moonwort	BOTRSIM	G5	S2S3		Blue
Cheilanthes gracillima	lace fern	CHEIGRA	G4G5	S2S3		Blue
Dryopteris arguta	coastal wood fern	DRYOARG	G5	S2S3	SC (Nov 2001)	Blue
Isoetes nuttallii	Nuttall's quillwort	ISOENUT	G4?	S3		Blue
Ophioglossum pusillum	northern adder's-tongue	OPHIPUS	G5	S2S3		Blue
Woodwardia fimbriata	giant chain fern	WOODFIM	G5	S3		Blue
Plants – dicotyledons						
Abronia latifolia	yellow sand-verbena	ABROLAT	G5	S3		Blue
Anagallis minima	chaffweed	ANAGMIN	G5	S2S3		Blue
Aster curtus	white-top aster	ASTECUR	G3	S2	T (May 2000)	Red
Aster radulinus	rough-leaved aster	ASTERAD	G4G5	S1		Red
Balsamorhiza deltoidea	deltoid balsamroot	BALSDEL	G5	S1	E (May 2000)	Red
Callitriche heterophylla ssp. *heterophylla*	two-edged water-starwort	CALLHET2	G5T5	S2S3		Blue
Cardamine parviflora var. *arenicola*	small-flowered bitter-cress	CARDPAR1	G5T5	S1		Red
Castilleja ambigua ssp. *ambigua*	paintbrush owl-clover	CASTAMB1	G4T3T4	S2		Red
Castilleja levisecta	golden paintbrush	CASTLEV	G1	S1	E (May 2000)	Red
Ceratophyllum echinatum	spring hornwort	CERAECH	G4?	S3		Blue
Chamaesyce serpyllifolia ssp. *serpyllifolia*	thyme-leaved spurge	CHAMSER1	G5T5	S2S3		Blue
Clarkia amoena var. *caurina*	farewell-to-spring	CLARAMO1	G5T5?	S3		Blue
Clarkia amoena var. *lindleyi*	farewell-to-spring	CLARAMO2	G5T5	S3		Blue
Claytonia washingtoniana	Washington springbeauty	CLAYWAS	G2G4	S2		Red
Crassula aquatica	pigmyweed	CRASAQU	G5	S3		Blue
Crassula connata var. *connata*	erect pygmyweed	CRASCON1	G5TNR	S2		Red
Elatine rubella	three-flowered waterwort	ELATRUB	G5	S2S3		Blue
Epilobium ciliatum ssp. *watsonii*	purple-leaved willowherb	EPILCIL3	G5T3T5	S2S3		Blue
Epilobium halleanum	Hall's willowherb	EPILHAL	G5	S2S3		Blue
Epilobium torreyi	brook spike-primrose	EPILTOR	G5	SX	E (Apr 2006)	Red
Fraxinus latifolia	Oregon ash	FRAXLAT	G5	S1		Red
Githopsis specularioides	common bluecup	GITHSPE	G5	S2S3		Blue
Helenium autumnale var. *grandiflorum*	mountain sneezeweed	HELEAUT1	G5T3T5	S2S3		Blue
Heterocodon rariflorum	heterocodon	HETERAR	G5	S3		Blue
Hippuris tetraphylla	four-leaved mare's-tail	HIPPTET	G5	S2S3		Blue

Hutchinsia procumbens	hutchinsia	HUTCPRO	G5	S1		Red
Hydrophyllum tenuipes	Pacific waterleaf	HYDRTEN	G4G5	S2S3		Blue
Hypericum majus	large Canadian St. John's-wort	HYPEMAJ	G5	S2S3		Blue
Idahoa scapigera	scalepod	IDAHSCA	G5	S2		Red
Jaumea carnosa	fleshy jaumea	JAUMCAR	G4G5	S2S3		Blue
Lomatium dissectum var. *dissectum*	fern-leaved desert-parsley	LOMADIS1	G4T4	S1		Red
Lomatium grayi	Gray's desert-parsley	LOMAGRA	G5	S1		Red
Lotus pinnatus	bog birds-foot trefoil	LOTUPIN	G4G5	S1	E (May 2004)	Red
Lotus unifoliolatus var. *unifoliolatus*	Spanish-clover	LOTUUNI1	G5T5	S2S3		Blue
Lupinus densiflorus var. *densiflorus*	dense-flowered lupine	LUPIDEN2	G5T4	S1	E (May 2005)	Red
Lupinus oreganus var. *kincaidii*	Kincaid's lupine	LUPIORE1	G5T2	SX		Red
Marah oreganus	manroot	MARAORE	G5	S1		Red
Meconella oregana	white meconella	MECOORE	G2G3	S1	E (May 2005)	Red
Megalodonta beckii var. *beckii*	water marigold	MEGABEC1	G4G5T4	S3		Blue
Microseris lindleyi	Lindley's microseris	MICRLIN	G5	S1		Red
Minuartia pusilla	dwarf sandwort	MINUPUS	G5	S1	E (May 2004)	Red
Myriophyllum quitense	waterwort water-milfoil	MYRIQUI	G4?	S2S3		Blue
Myriophyllum ussuriense	Ussurian water-milfoil	MYRIUSS	G3	S3		Blue
Navarretia intertexta	needle-leaved navarretia	NAVAINT	G5	S2		Red
Nothochelone nemorosa	woodland penstemon	NOTHNEM	G5	S2S3		Blue
Orobanche pinorum	pine broomrape	OROBPIN	G4	S1		Red
Orthocarpus bracteosus	rosy owl-clover	ORTHBRA	G3?	S1	E (May 2004)	Red
Plagiobothrys tenellus	slender popcornflower	PLAGTEN	G4G5	S2		Red
Polygonum hydropiperoides	water-pepper	POLYHYR	G5	S2S3		Blue
Psilocarphus elatior	tall woolly-heads	PSILELA	G4Q	S1	E (May 2001)	Red
Psilocarphus tenellus var. *tenellus*	slender woolly-heads	PSILTEN1	G4T4	S3	NAR (May 1996)	Blue
Ranunculus alismifolius var. *alismifolius*	water-plantain buttercup	RANUALI1	G5T5	S1	E (May 2000)	Red
Ranunculus californicus	California buttercup	RANUCAL	G5	S1		Red
Ranunculus lobbii	Lobb's water-buttercup	RANULOB	G4	SH		Red
Rubus lasiococcus	dwarf bramble	RUBULAS	G5	S2S3		Blue
Rubus nivalis	snow bramble	RUBUNIV	G4?	S2		Red
Rupertia physodes	California-tea	RUPEPHY	G4	S3		Blue
Sagina decumbens ssp. *occidentalis*	western pearlwort	SAGIDEC1	G5TNR	S3		Blue
Salix lemmonii	Lemmon's willow	SALILEM	G5	S1		Red
Salix sessilifolia	soft-leaved willow	SALISES	G4	S2S3		Blue
Senecio macounii	Macoun's groundsel	SENEMAC	G5	S3		Blue
Sidalcea hendersonii	Henderson's checker-mallow	SIDAHEN	G3	S3		Blue
Silene scouleri ssp. grandis	Scouler's catchfly	SILESCO1	G5TNR	S1	E (May 2003)	Red
Tonella tenella	small-flowered tonella	TONETEN	G5	S1	E (Nov 2003)	Red
Toxicodendron diversilobum	poison oak	TOXIDIV	G5	S2S3		Blue
Trifolium cyathiferum	cup clover	TRIFCYA	G4	S1		Red
Trifolium depauperatum var. *depauperatum*	poverty clover	TRIFDEP1	G5T5?	S3		Blue
Trifolium dichotomum	Macrae's clover	TRIFDIC	G4?	S2S3		Blue
Utricularia ochroleuca	ochroleucous bladderwort	UTRIOCH	G4?	S1		Red
Viola howellii	Howell's violet	VIOLHOW	G4	S2S3		Blue
Viola praemorsa ssp. *praemorsa*	yellow montane violet	VIOLPRA1	G5T3T5	S2	T (May 2000)	Red

Plants – monocotyledons						
Agrostis pallens	dune bentgrass	AGROPAL	G4G5	S3		Blue
Allium amplectens	slimleaf onion	ALLIAMP	G4	S3		Blue
Allium crenulatum	Olympic onion	ALLICRE	G4	S2		Red
Allium geyeri var. *tenerum*	Geyer's onion	ALLIGEY2	G4G5T3T5	S2S3		Blue
Alopecurus carolinianus	Carolina meadow-foxtail	ALOPCAR	G5	S2		Red
Carex feta	green-sheathed sedge	CAREFET	G5	S2		Red
Carex interrupta	green-fruited sedge	CAREINE	G4	S2		Red
Carex scoparia	pointed broom sedge	CARESCO	G5	S2S3		Blue
Cyperus squarrosus	awned cyperus	CYPESQU	G5	S3		Blue
Eleocharis parvula	small spike-rush	ELEOPAR	G5	S2S3		Blue
Eleocharis rostellata	beaked spike-rush	ELEOROS	G5	S2S3		Blue
Glyceria leptostachya	slender-spiked mannagrass	GLYCLEP	G3	S2S3		Blue
Juncus kelloggii	Kellogg's rush	JUNCKEL	G3?	S1	E (May 2003)	Red
Juncus oxymeris	pointed rush	JUNCOXY	G5	S2S3		Blue
Leymus triticoides	creeping wildrye	LEYMTRI	G4G5	S1		Red
Lilaea scilloides	flowering quillwort	LILASCI	G5?	S2S3		Blue
Malaxis brachypoda	white adder's-mouth orchid	MALABRA	G4Q	S2S3		Blue
Melica smithii	Smith's melic	MELISMI	G4	S2S3		Blue
Piperia candida	white-lip rein orchid	PIPECAN	G3G4	S2		Red
Piperia elegans	elegant rein orchid	PIPEELE	G4	S3		Blue
Pleuropogon refractus	nodding semaphoregrass	PLEUREF	G4	S3		Blue
Potamogeton oakesianus	Oakes' pondweed	POTAOAK	G4	S2S3		Blue
Schoenoplectus americanus	Olney's bulrush	SCHOAME	G5	S1		Red
Triglochin concinna	graceful arrow-grass	TRIGCON	G5	S2		Red
Triteleia howellii	Howell's triteleia	TRITHOW	G3G4	S1	E (May 2003)	Red
Wolffia columbiana	Columbian water-meal	WOLFCOL	G5	S1		Red

Search Summary

Time Performed Wed Sep 19 12:38:32 PDT 2007

Results 164 records.

Search Criteria Species Group:Plants & Animals
AND BC Conservation Status:Red List (Extirpated, Endangered, or Threatened) OR Blue List (Special Concern)
AND Forest District:South Island Forest District (DSI) (Restricted to Red, Blue, and Identified Wildlife listed species)
AND Habitat Types:Estuarine,Lacustrine(Lakes),Palustrine(Wetlands),Riverine,Subterranean*,Terrestrial
AND BGC Zone:CDF*
Sort Order:Phylogenetic Ascending

Notes 1. Citation: B.C. Conservation Data Centre. 2007. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, BC. Available: http://srmapps.gov.bc.ca/apps/eswp/ (accessed [enter date accessed]).

2. Forest District tracking lists are restricted to those species that breed in the District; i.e. species will not be placed on Forest District lists for Districts where they occur only as migrants.

APPENDIX II

RED AND BLUE LISTED ECOSYSTEMS

Appendix II. List of Provincial Red- and Blue-Listed Ecosystems Potentially Occurring on Saltspring Island.

Note: potential occurrence and overlapping range in the study area does not necessarily indicate actual presence of these ecosystems. Interpretations with respect to Saltspring Island should focus on mapped ecosystems within the study area (i.e., mapped site series within the CDFmm, CWHxm1 and CWHxm2).

Scientific Name	English Name	Status			BGC
		Global	Provincial	BC Status	
Abies grandis / Mahonia nervosa	grand fir / dull Oregon-grape	GNR	S1	Red	CDFmm/04
Abies grandis / Tiarella trifoliata	grand fir / three-leaved foamflower	GNR	S1	Red	CDFmm/06
Alnus rubra / Carex obnupta [*Populus balsamifera* ssp. *trichocarpa*]	red alder / slough sedge [black cottonwood]	GNR	S1	Red	CDFmm/14
Alnus rubra / Lysichiton americanus	red alder / skunk cabbage	GNR	S2S3	Blue	CDFmm/11
Arbutus menziesii / Arctostaphylos columbiana	arbutus / hairy manzanita	GNR	S2	Red	CDFmm/00 CWHxm1/00
Artemisia campestris / Grindelia integrifolia	northern wormwood / Puget Sound gumweed	GNR	S1	Red	CDFmm/00
Carex lasiocarpa - Rhynchospora alba	slender sedge - white beak-rush	GNR	S2	Red	CDFmm/Wf53 CWHmm1/Wf53 CWHmm2/Wf53 CWHxm1/Wf53 CWHxm2/Wf53
Carex lyngbyei Herbaceous Vegetation	Lyngbye's sedge herbaceous vegetation	GNR	S3	Blue	CDFmm/Em05
Carex macrocephala Herbaceous Vegetation	large-headed sedge Herbaceous Vegetation	GNR	S1S2	Red	CDFmm/00 CWHvh1/00
Deschampsia cespitosa ssp. beringensis - Aster subspicatus	tufted hairgrass - Douglas' aster	GNR	S3	Blue	CDFmm/Ed02 CWH/Ed02
Deschampsia cespitosa ssp. *beringensis - Hordeum brachyantherum*	tufted hairgrass - meadow barley	GNR	S3	Blue	CDFmm/Ed01
Distichlis spicata var. *spicata* Herbaceous Vegetation	seashore saltgrass Herbaceous Vegetation	GNR	S1S2	Red	CDFmm/Em03
Dulichium arundinaceum Herbaceous Vegetation	three-way sedge	GNR	S2	Red	CDFmm/Wm51 CWHmm1/Wm51 CWHxm2/Wm51 ICHwk1/Wm51
Eleocharis palustris Herbaceous Vegetation	common spike-rush	GNR	S3	Blue	BGxw2/Wm04 CDFmm/Wm04 ESSFdv d/Wm04 ESSFdv/Wm04 IDFxm/Wm04 SBSdk/Wm04 SBSmk2/Wm04
Festuca idahoensis ssp. *roemeri - Koeleria macrantha*	Roemer's fescue - junegrass	GNR	S1	Red	CDFmm/00 CWHxm1/00
Juncus arcticus - Plantago macrocarpa	arctic rush - Alaska plantain	GNR	S1	Red	CDFmm/Ed03 CWH/Ed03
Menyanthes trifoliata - Carex lasiocarpa	buckbean - slender sedge	GNR	S3	Blue	CDFmm/Wf06 CWHws1/Wf06 ICHwk1/Wf06 IDFdk2/Wf06 SBSdk/Wf06
Myosurus minimus - Montia spp. *- Limnanthes macounii*	tiny mousetail - montias - Macoun's meadow-foam	GNR	S1	Red	CDFmm/00

Myrica gale / Carex sitchensis	sweet gale / Sitka sedge	GNR	S2	Red	CDFmm/Wf52 CWHmm1/Wf52 CWHmm2/Wf52 CWHvh2/Wf52 CWHwm/Wf52 CWHxm1/Wf52 CWHxm2/Wf52
Pinus contorta / Sphagnum spp. CDFmm	lodgepole pine / peat-mosses CDFmm	GNR	S1	Red	CDFmm/10
Populus tremuloides / Malus fusca / Carex obnupta	trembling aspen / Pacific crab apple / slough sedge	GNR	S1S2	Red	CDFmm/00
Pseudotsuga menziesii - Arbutus menziesii	Douglas-fir - arbutus	GNR	S2	Red	CDFmm/02
Pseudotsuga menziesii / Mahonia nervosa	Douglas-fir / dull Oregon-grape	GNR	S2	Red	CDFmm/01
Pseudotsuga menziesii / Melica subulata	Douglas-fir / Alaska oniongrass	GNR	S1	Red	CDFmm/03
Quercus garryana - Arbutus menziesii	Garry oak - arbutus	GNR	S1	Red	CDFmm/00
Quercus garryana / Bromus carinatus	Garry oak / California brome	GNR	S1	Red	CDFmm/00
Quercus garryana / Holodiscus discolor	Garry oak / oceanspray	GNR	S1	Red	CDFmm/00
Ruppia maritima Herbaceous Vegetation	beaked ditch-grass Herbaceous Vegetation	GNR	S2	Red	CDFmm/Em01 CWH/Em01
Salicornia virginiana - Glaux maritima	American glasswort - sea-milkwort	GNR	S2	Red	CDFmm/Em02 CWH/Em02
Salix sitchensis - Salix lucida ssp. lasiandra / Lysichiton americanus	Sitka willow - Pacific willow / skunk cabbage	GNR	S2	Red	CDFmm/Ws51 CWH/Ws51 ICH/Ws51
Thuja plicata - Pseudotsuga menziesii / Eurhynchium oreganum	western redcedar - Douglas-fir / Oregon beaked-moss	GNR	S1	Red	CDFmm/05
Thuja plicata / Achlys triphylla	western redcedar / vanilla leaf	GNR	S1	Red	CDFmm/12
Thuja plicata / Oemleria cerasiformis	western redcedar / Indian-plum	GNR	S1	Red	CDFmm/13
Thuja plicata / Symphoricarpos albus	western redcedar / common snowberry	GNR	S1	Red	CDFmm/07
Typha latifolia Marsh	common cattail Marsh	GNR	S3	Blue	BGxh1/Wm05 BGxh2/Wm05 BGxw1/Wm05 CDFmm/Wm05 CWHdm/Wm05 CWHxm1/Wm05 CWHxm2/Wm05 IDFdk3/Wm05 IDFdm2/Wm05 PPxh1/Wm05

Search Summary

Time Performed Wed Sep 19 13:01:20 PDT 2007

Results 35 records.

Search Criteria Ecological Communities
AND BC Conservation Status:Red List (Extirpated, Endangered, or Threatened) OR Blue List (Special Concern)
AND Forest District:South Island Forest District (DSI)
AND BGC Zone, Subzone, Variant, Phase:CDFmm*
AND Ecosections:SGI
Sort Order:Scientific Name Ascending

Notes
1. Citation: B.C. Conservation Data Centre. 2007. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, BC. Available: http://srmapps.gov.bc.ca/apps/eswp/ (accessed [enter date accessed]).
2. Results reflect a 2004 review of ecological community Conservation Status Ranks. Additions to the Red and Blue Lists include ecological communities previously considered secure and ecological communities recently described from new inventory data.
3. Biogeoclimatic Site Unit(s): This column indicates the BGC unit(s) on which each ecological community is known to occur (future inventories may indicate range extensions). The two digit number following the slash (01 and up) indicates that the ecological community occurs on a site series that is part of the B.C. Ministry of Forests (MOF) site series classification (see MOF Regional Field Guides to Site Identification and Interpretation for more information). A two digit number of '00' indicates that the ecological community occurs on a site unit that is not part of the MOF site series classification but is recognized from other vegetation and site classifications, and ecosystem mapping projects.

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APPENDIX III

AIR PHOTO DATA

Appendix III. Air Photo Data.

All photos used to map the study area were colour 1:16 500, 2005 air photos flown August 5, 2005 for the Capital Regional District by McElhanney Consulting Services Ltd.

GENERAL AREA	Flight line	Roll	Photos
Saltspring Island	91	RC29	205-206
Saltspring Island	92	RC29	195-198
Saltspring Island	93	RC29	190-194
Saltspring Island	94	RC29	173-178
Saltspring Island	95	RC29	166-172
Saltspring Island	96	RC29	140-147
Saltspring Island	85	RC30	6-14
Saltspring Island	84	RC30	15-24
Saltspring Island	83	RC30	25-33
Saltspring Island	82	RC30	34-44
Saltspring Island	81	RC30	45-56
Saltspring Island	80	RC30	58-67
Saltspring Island	79	RC30	68-74

APPENDIX IV

BIOTERRAIN CODES AND MODIFIERS

Appendix IV. Bioterrain Codes and Modifiers.

All codes and modifiers follow RIC (1996) standards and use the format of Howes and Kenk (1997).

Terrain texture modifiers

Code	Texture	Description
a	blocky	angular fragments > 265 mm
c	clay	particles < 0.002 mm
d	mixed fragments	mixture of angular and rounded fragments > 2 mm
s	sand	particles 0.0625-2 mm
z	silt	particles 0.002-0.0625 mm

Terrain units of Saltspring Island

Code	Surficial Material	Assumed activity[a]	Code	Surficial Material	Assumed activity[a]
A	Anthropogenic	A	N	not mapped	n/a
C	Colluvium	A	O	Organic	A
F	Fluvial	I	R	Bedrock	n/a
F^G	Glaciofluvial	I	W	Marine	I
L	Lacustrine	A	W^G	Glaciomarine	I
M	Morainal (Till)	I			

[a] A = active, I = inactive

Terrain surface expression

Code	Expression	Description
a	moderate slope	slope 27-49%
b	blanket	surface material > 1 m thick
d	depression	hollows below a slope break
f	fan	slope < 26%
h	hummock	rises and hollows with slope > 26%
j	gentle slope	slope 6-26%
k	moderately steep slope	slope 50-70%
p	plain	slope 0-5%
r	ridge	elongated rises with slopes > 26%
s	steep slope	slope > 70%
t	terrace	level area and adjacent downslope scarp
u	undulating	rises and hollows with slope < 26%
v	veneer	surface material < 1 m thick
w	mantle of variable thickness	surface material varies in thickness
x	thin veneer	surface material < 20 cm thick

Terrain geomorphological processes

Group	Code	Process	Activity[a]	Description
Erosional	V	gully erosion	A	surface formation of parallel long narrow ravines
	W	washing	A	modification by waves or running water
Mass movement	R	rapid mass movement	A	rapid downslope falling, rolling, sliding or flowing surficial material or bedrock components
Deglacial	E	channeled by meltwater	I	channel erosion or formation by glacial meltwater
Hydrologic	L	surface seepage	A	abundant surface or seasonal seepage

[a] A = active, I = inactive

Terrain geomorphological process subclasses and subtypes

Group	Code	Process
Mass movement	”	Initiation zone
	d	Debris flow
	u	Surficial material slump

Terrain drainage classes

Code	Description	Code	Description
x	extremely rapid	i	imperfect
r	rapid	p	poor
w	well	v	very poor
m	moderately well		

APPENDIX V

ECOSYSTEM CODES AND MODIFIERS

Appendix V. Ecosystem Codes and Modifiers.

All codes and modifiers follow RISC standards; where warranted, new ecosystem codes were approved by provincial correlators.

Ecosystem codes mapped in the CDFmm

Site series	TEM code	Site Series Name	Assumed Situation	SMR
Non-Forested				
00	AS	Trembling aspen - Slough sedge	Depression to flat, medium-textured, shallow, poorly drained soils, seral woodland	mesic - subhygric
00	FC	Fescue – Camas	Gentle slope, very shallow, medium-textured soils, coastal bluffs and forest openings	subxeric
00	GO	Qg - Ocean spray	gentle slope, upper slope to crest position, medium nutrient regime *Noncorrelated unit, approved by Regional Ecologist	
00	HL	Hardhack - Labrador tea	Shrub fen occurring in depressions, poor to very poorly drained, deep organic soils	subhydric
00	OM	Qg – moss	very thin soils, water-shedding sites, typically warm aspects *Noncorrelated unit, approved by Regional Ecologist	xeric
00	OR	Oceanspray – Rose	Significant slope, shallow, medium-textured soils with seepage present	mesic
00	QB	Qg – Brome	gentle slope, upper slope to crest position, richer nutrient regime *Noncorrelated unit, approved by Regional Ecologist	
00	SC	Cladina - Wallace's selaginella	Typically on ridge crests and upper slopes, very shallow, medium-textured soils on rock outcrops in forest openings	subxeric
00	SL	Sedge - Western lilaeopsis	Level sites, estuarine marsh above high tide, deep, medium-textured soils	hygric
00	SS	Spirea - Sedge wetland	Shrub fen, organic soils	hygric
Em02	Em02	Glasswort—Sea-milkwort estuary		
Wf53	Wf53	Slender sedge - White beak-rush		
Ws50	Ws50	Hardhack - Sitka sedge		
Forested				
01	DS	Fd – Salal	gentle slope, mid to upper slope position, deep, medium - textured soils	subxeric - mesic
02	DA	FdPl – Arbutus	gentle slope, upper slope to crest position, deep medium textured soils	xeric
03	DO	Fd – Oniongrass	upper slope to crest position, deep, medium - textured soil, richer nutrient regime	xeric
04	DG	FdBg - Oregon grape	gentle slope; deep, medium textured soil; middle to upper slope position; richer nutrient regime	subxeric - mesic
05	RK	CwFd - Kindbergia	gentle slope, lower slope receiving position, deep, medium - textured soils	subhygric - hygric
06	RF	CwBg – Foamflower	gentle slope, lower slope receiving position, deep medium - textured soil, richer nutrient regime	subhygric - hygric
07	RS	Cw - Snowberry	high bench floodplain, deep medium - textured soil	subhygric - hygric
09	CW	Act – Willow	active floodplain, low bench, deep coarse - textured soil	subhygric - hygric
11	RC	Cw - Skunk cabbage (equivalent to Ws53)	depression to flat, forested swamp, poorly drained , deep, medium - textured soil	subhydric
12	RV	Cw - Vanilla-leaf	gentle slope, lower slope receiving position, deep, medium - textured soils, richer nutrient regime	subhygric
13	RP	Cw - Indian-plum	gentle slope, lower slope receiving position, deep, medium - textured soils	hygric
14	CS	Cw - Slough sedge	depression to flat, forested swamp, poorly drained , deep, medium - textured soil	subhydric

Ecosystem codes mapped in the CWHxm

Site series	TEM code	Site Series Name	Assumed Situation	SMR
Non-forested				
00	AM	Arbutus-Hairy manzanita	gentle upper slopes, ridge crests; shedding sites on shallow soils; rapidly to well drained	xeric
00	FC	Fescue-Common camas	gentle slopes, ridge crests; shallow soils with small pockets of very shallow soil on rock benches; rapidly to well drained	xeric
00	HL	Hardhack-Labrador tea	Shrub fen occurring in depressions, poor to very poorly drained, deep organic soils	subhydric
00	SC	Selaginella-Cladina	gentle slope, upper slope and crest positions, very shallow soils, very dry and rapidly drained.	very xeric
00	SW	Sedge wetland	level to depressions; poor to very poorly drained, with organic soils.	subhydric
Wb50		Labrador tea-Bog-laurel-Peat-moss		
Ws50		Hardhack-Sitka sedge		
Forested				
01	HK	HwFd-Kindbergia	gentle slope; deep medium - textured soils	submesic-mesic
02	DC	FdPl-Cladina	gentle slope; crest position; medium textured shallow soil	very xeric
03	DS	FdHw-Salal	significant slope, upper slope position; warm aspect, deep medium - textured soils	xeric-subxeric
04	DF	Fd-Sword fern	significant slopes, deep medium - textured soils (use aspect modifiers)	xeric-subxeric
05	RS	Cw-Sword fern	significant slope, deep medium - textured soils; richer nutrient regime (use aspect modifiers)	submesic-mesic
06	HD	HwCw-Deer fern	gentle slope; lower slope position, receiving moisture; deep medium - textured soil	subhygric-hygric
07	RF	Cw-Foamflower	gentle slope; lower slope position, receiving moisture; deep medium - textured soil	subhygric-hygric
08	SS	Ss-Salmonberry		
10	CW	Act-Willow (Fl50-Sitka willow-False lily-of-the-valley)	active floodplain, low bench, deep coarse - textured soil	subhygric-hygric
12	RC	CwSs-Skunk cabbage (Ws53-Cw-Sword fern-Skunk cabbage)	treed swamp, poorly drained , depression to flat, deep medium - textured mineral soil	subhydric
13	RB	Cw-Salmonberry	strongly fluctuating water table, deep medium - textured mineral soil	subhygric
14	RT	Cw-Black twinberry	strongly fluctuating water table, deep medium - textured mineral soil	hygric
15	CS	Cw-Slough sedge	strongly fluctuating water table, deep medium - textured mineral soil	subhydric

Anthropogenic, sparsely vegetated and water map units

Code	Description	Code	Description
Anthropogenic		**Sparsely vegetated**	
CF	cultivated field	CL	cliff
GP	gravel pit	RO	rock outcrop
UR	urban	BE	beach
CO	cultivated orchard		
ES	exposed soil	**Water bodies**	
GC	golf course	LA	lake
RW	rural developed	OW	open water (< 2m deep)
RZ	road surface	PD	pond

Site modifiers for atypical conditions

Code	Criteria
Topography	
a	active floodplain: level or very gently sloping area bordering a river that has been formed by river erosion and deposition, with evidence of active sedimentation and deposition
g	gullying: occurs within a gully, or with gullying throughout the delineated area
h	hummocky terrain: indicated by the terrain surface expression
j	gentle slope: < 35% in the CWH and CDF zones
k	cool aspect: occurs on aspects 285°–135°, on moderately steep slopes (35%–100% in the CWH and CDF)
n	fan: occurs on a fluvial fan or on a colluvial fan or cone
q	very steep cool aspect–very steep slopes (< 100%) with aspects 285°–135°
r	ridge: occurs throughout an area of ridged terrain, or on a ridge crest
w	warm aspect: 135°–285°, on moderately steep slopes (35%–100% slope in the CWH and CDF zones)
z	very steep warm aspect –slopes > 100% on aspects 135°–285°
Moisture	
x	drier than typical
y	moister than typical
Soil	
d	deep soil: > 100 cm to bedrock
m	medium-textured soils: sandy loam, loam and sandy clay loam with > 70% coarse fragment volume; silt loam and silt with > 20% coarse fragment volume; and clay, silty clay, silty clay loam, clay loam, sandy clay, and heavy clay with > 35% coarse fragment volume
p	peaty: on deep organics or a peaty surface (15–60 cm) over mineral materials
s	shallow soils: 20–100 cm to bedrock
v	very shallow soils: < 20 cm to bedrock

Ecosystem structural stages mapped on Saltspring Island

Code	Name	Criteria
1	**Sparse/bryoid**	Bryophytes and lichens dominant, may reflect recent disturbance: little to no tree or shrub cover
1a	**Sparse**	Total < 10% vegetation cover
1b	**Bryoid**	Dominant vegetation lichens and bryophytes
2	**Herb**	Some invading or residual shrubs and trees may be present, may reflect recent disturbance: little to no tree or shrub cover
2a	**Forb-dominated**	Includes non-graminoid herbs and ferns
2b	**Graminoid-dominated**	Grasses, sedges, rushes, reeds
2c	**Aquatic herbs**	Aquatic herbs dominate the site with standing water or submerged vegetation
3	**Shrub/Herb**	Early successional stage or maintained by environmental conditions or disturbance: sparse tree cover
3a	**Low shrub**	Dominated by vegetation < 2 m tall
3b	**Tall shrub**	Dominated by vegetation 2–10 m tall
4	**Pole/Sapling**	Trees > 10 m tall, often densely stocked, no vertical canopy structure, typically < 40 years since disturbance
5	**Young Forest**	Self-thinning and canopy differentiation initiated, typically 40–80 years since disturbance
6	**Mature Forest**	Mature tree canopy with moderate differentiation of vertical structure, typically 80–250 years since disturbance, moderate epiphytic community development; canopy and understorey regeneration of typical species, featuring shade-tolerant species that could differ from dominant canopy species
7	**Old Forest**	Structurally complex stands comprised mainly of shade-tolerant vegetation and intolerant species in gaps; understorey, suppressed, and intermediate canopy layers include regenerating tree species comprising the climax (self-perpetuating) vegetation community; snags and coarse woody debris and patchy understories, typically > 250 years since disturbance.

Stand composition modifiers

Code	Criteria
B	broadleaf (> 75% of stand)
C	conifer (> 75% of stand)
M	mixed (neither comprises > 75% of stand)

Disturbance modifiers

Code[a]	Criteria	Code[a]	Criteria
B	**Biotic disturbances**	**L**	**Forest harvesting**
d	domestic grazing/browsing	a	patch cut system
		wr	with reserves
		c	clearcut system
		wr	with reserves (patch retention)
		d	seed tree system
		un	uniform
		gr	grouped
		e	selection system
		gr	group selection
		si	single tree
		st	strip
		l	land clearing (includes abandoned agriculture)

[a] Hierarchy indicates subclasses of disturbance, where identifiable