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Mount Maxwell Terrestrial Ecosystem Mapping And Ecological Assessment

for:

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by:

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Bioterrain typing has been the sole responsibility of Gordon Butt. Bob Maxwell correlated this typing. Gordon Butt also completed the ecosystem mapping with Harry Williams providing an internal quality assurance of the ecosystem mapping. Gillian Radcliffe interpreted the ecosystem mapping for wildlife values.

Gordon Butt, Harry Williams, Gillian Radcliffe, Derrick Marven, Adolf Ceska, Oluna Ceska, Pamela Williams and Jeff Bertoia completed the fieldwork. Gill Radcliffe was project manager and conducted overall project review. Shari Willmott entered the field data, built the databases, as well as looked after the overall project coordination for this study.

Ernie Pacholuk of West Coast Geomatics developed the 1:2000 digital map base and Chartwell Consultants Ltd. provided GIS support and completed the spatial files for the terrestrial ecosystem map. Gill and Shari created the interpretive maps for wildlife and Garry oak ecosystems.

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Frontcover: Propertius Duskywings; blue-listed butterfly, photograph by Derrick Marven

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Mount Maxwell Terrestrial Ecosystem Mapping and Ecological Assessment

1.0 EXECUTIVE SUMMARY

The Mount Maxwell Ecological Reserve (ER) and adjacent Nature Trust (NT) Lands, comprising some 345 ha, together support some of the last remaining significant stands of endangered Garry Oak and Associated Ecosystems (GOE's), such as mature Douglas-fir, in British Columbia. This project mapped the terrestrial ecosystems of the study area at 1:2,000, classifying them according to both Terrestrial Ecosystem Mapping (TEM) standards, and to the developing Garry Oak Ecosystem Classification. A brief assessment of ecological values and some preliminary wildlife habitat interpretations were also completed.

Garry oak ecosystems and maturing Douglas-fir forests exist in the ER and adjacent Nature Trust Lands, and include red-listed ecosystem associations. Only about five percent of the Garry Oak Ecosystems that previously occurred on southern Vancouver Island and the Gulf Islands now remain in any semblance of their natural state. Many of the associated ecosystems are also endangered from development and other anthropogenic impacts, including forestry and clearing for agriculture. However, although the ecosystems in the study area have previously been logged, and continue to be grazed by feral sheep, they are in reasonably good condition overall due to their protected locations.

The representation of relatively rare Coastal Douglas-fir zone forests, and of Garry oak and associated ecosystems on Mount Maxwell is substantial, and highly significant at a provincial and even national scale. The Garry oak stands in the study area are exceptional. These are perhaps the largest Garry Oak stands remaining in BC. Perhaps even more importantly, they are surrounded – and thus buffered – by Douglas-fir forests, unlike many other examples of Garry Oak ecosystems which are often directly adjacent to urban developments. The protective shoreline on the west side, and the steep

topography and cliffs of Baynes Peak above, make these areas unusually well protected. Because of this, they probably afford some of our best hopes for future, long-term protection and representation of Garry Oak complexes, including many associated Species-at-Risk, in the province. Their protection from disturbance, including recreational disturbance, should be a top management priority.

The Conservation Data Centre has records of five rare plant species for the area, – four of them on the red list and one on the blue list. However there are undoubtedly more rare plant species that occur in the study area. Several rare or threatened wildlife species are also found in the general area, and likely occur within the study area, but there has been little or no direct inventory.

Preliminary habitat interpretations for two red-listed vertebrate species, the Northern Goshawk and Sharp-tailed Snake, are presented in the report. A future direct inventory for these species, as well as for butterflies, owls, and other wildlife groups, is strongly recommended.

2.0 INTRODUCTION

2.1 Scope

The Protected Areas Section commissioned this Terrestrial Ecosystem Mapping project, with preliminary wildlife interpretations, for the Nature Trust Lands and the existing Mount Maxwell ER. This mapping comprises the first step in gaining detailed knowledge of the ecological values of the properties, and will set the stage for the development of future management plans.

The objective of this project was to classify, map (at a scale of 1:2,000) and describe the natural ecosystems of the Mount Maxwell study area. In addition, we have provided some preliminary interpretations of these ecosystem units for wildlife values and conservation sensitivity. This information should provide a sound basis to support further interpretation, ecological studies, and future ecosystem and wildlife management.

2.2 Study Area

This project describes 345 ha of the protected lands on the southwest slopes of Mount Maxwell, on Saltspring Island. The study area (see Figure 1) encompasses the 65 ha Mount Maxwell Ecological Reserve, and an adjoining 280 ha of Nature Trust Land. The Mount Maxwell Ecological Reserve is adjacent to Mount Maxwell Provincial Park on the north side of Burgoyne Bay, on southwest Salt Spring Island. It was established under the *Ecological Reserve Act* on June 2, 1972 to protect stands of Garry oak and associated vegetation, one of Canada's most threatened ecosystems.

2.3 Management Context

The Nature Trust acquired the adjoining 280 ha of land with funding assistance from the private Forest Biodiversity Program, under Forest Renewal BC. The intent was to lease the property under a long-term agreement to the Province, for inclusion and management with the existing Mount Maxwell Ecological Reserve, as a single unit of land. Thus the Protected Areas Section of the Ministry of Water, Lands and Air Protection (MWLAP) will manage the 280 ha as an extension of the ecological reserve, under a 99-year lease agreement with The Nature Trust of British Columbia. Associated with the

acquisition funding came a sum of money for projects to address priority issues on the property.

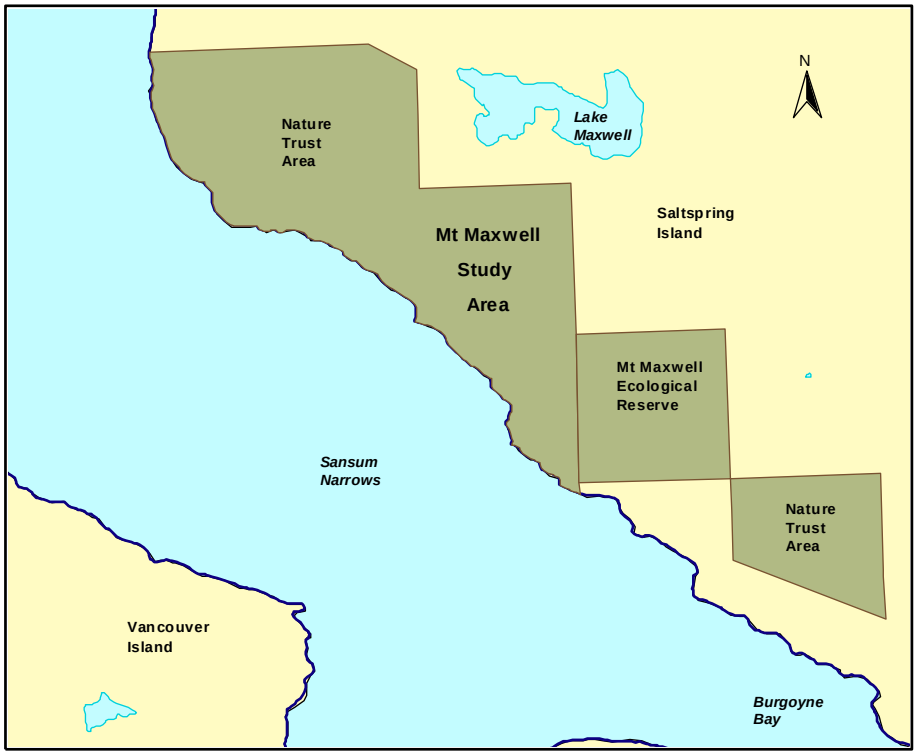

Figure 1. Mount Maxwell Study Area

Two other protected areas abut the Ecological Reserve, the 200 ha Mount Maxwell Provincial Park and the newly acquired (but undesignated) 665 ha Burgoyne Bay Protected Area. Together the three areas present a significant example (1,210 ha) of ecosystem units in the Southern Gulf Islands Ecosection. Management actions for the entire system of Protected Areas on Mount Maxwell and the adjoining Burgoyne Bay should consider the attributes of all sites, and priority should be given to projects that enhance the values of all the Protected Areas.

2.4 Key Management Issues

Some of the principal issues that have been identified as management priorities within Mount Maxwell are:

- feral grazing
- impacts of invasive species;
- the consequences of fire exclusion;
- management of Species at Risk.

Recent field studies within the Ecological Reserve portion of the area determined that the Garry oak ecosystems at this site appear to be most heavily influenced by grazing of feral animals (especially feral sheep), invasive non-native vegetation, Douglas-fir encroachment, and recreational use.

Other management issues include the lack of information on First Nations and cultural heritage values, and the role of First Nations and the local community in the long-term stewardship of the ecological reserve. A relatively recent concern surrounds the implications of the outbreak of defoliating insects, specifically the Western oak looper, and Douglas-fir bark beetle.

3.0 METHODOLOGY

3.1 Data Sources

This mapping project was based on 1:10,000 black and white aerial photography from Geographic Data BC taken in 1985 (Roll. No. 15BC85011: Photo No. 050-052, 062-070). West Coast Geomatics was subcontracted to create a 1:2,000 base map with 5m contour intervals from these air photos, as the TRIM base did not adequately support 1:2,000 mapping.

3.2 Field Work

Field sampling was carried out in six, one-day field trips and consisted of either one or two, two-person crews, sampling between October 2002 and March 2003.

Data collection followed methods in the *Field Manual for Describing Ecosystems* (RIC, 1998a). Full plots (FS882 forms) as well as ground inspection plots and visual checks were completed in the study area to achieve Survey Intensity Level 1 (RIC, 1998b). Relatively few full plots were completed. Rather, a much larger number of ground plots were done, with information collected where possible on exotic and invasive species, history and other pertinent information. Timing of the fieldwork in late fall/winter was, however, a significant limitation in this regard. During fieldwork, most flowering plants and bulbs were finished, and in many grasses the seed heads were spent, making identification of invasive exotics difficult. The chances of finding and identifying rare plants, especially spring ephemerals, was also minimal.

A supplementary field day was conducted in April 2003 (effectively after the end of the project) to further clarify and describe the vegetation and to QA the ecosystem mapping. Some minor polygon edits were made following this field trip, but the data could not be fully incorporated into the report, due to time constraints. The additional vegetation data collected is however provided as Appendix I.

We collected information for a total of 154 plots, consisting of 3 full, 26 ground inspections and 125 visual checks.

3.3 Ecosystem Classification

Classification and presentation of the mapping follow the methodology documented in *Standard for Terrestrial Ecosystem Mapping in British Columbia*, (1998a). Each ecosystem unit (site series) is assigned a two-letter symbol, and identified using *The Field Guide for Site Identification and Interpretation for the Vancouver Forest Region* (Green and Klinka, 1994). Sparsely vegetated, non-vegetated, and anthropogenic units are also assigned two-letter symbols (RIC 1998a). Aspect site modifiers have been applied to steep slopes (>35%), and soil depth modifiers and landform features have been applied to atypical sites using the current Site Series Master Coding List (Appendix A). Structural stages describe the current vegetation stage by the standard seven-level system (RIC 1998a).

3.4 Garry Oak Ecosystem Classification

A variety of classifications for Garry oak and associated ecosystems have been developed ranging from very simple, two class systems, through to highly detailed classifications. For this project, classification of the Garry oak ecosystems followed the *Higher-Level Physiognomic Vegetation Categories for Garry Oak and Surrounding Ecosystems*, (Meidinger et *al.* in progress). This classification is still under development. Each polygon was assigned a mapcode for the Garry oak ecosystem classification, ranging from two to eight letters. Table 2 provides a complete list of mapped Garry oak ecosystems and their corresponding mapcodes. The classification was slightly modified as we added a class to account for broadleaf forest (over 50% cover of broadleaf trees, in this case Garry oak). This class was absent from the original classification.

3.5 Naturalness Assessment

During fieldwork, many polygons were assigned a rating for naturalness, with a qualitative assessment of quality, condition, viability and defensibility, each on a scale of 1-4. This follows on the lines of the rating system used by the CDC and used by government mapping personnel in other projects (e.g. Jedediah Island TEM project). The intention was to develop a naturalness map for the study area from these ratings. In the office, we planned to assign ratings to polygons based on a combination of the field data plus size, distance from roads, fragmentation of landscape, and so on.

In practice, we found that

a) different individuals interpreted these scales differently in the field, due no doubt to insufficient quantitative criteria for making these assessments.
b) As logging is pervasive in the forested units and there is therefore no old-growth, and as introduced grasses are throughout in the non-forested units, the 4-scale system results in almost all polygons being either good (2) or marginal (3). Only the dense broom dominated units would score a poor (4), and these units were separately mapped out as Evergreen Shrubland, Broom (ESBr).
c) Winter fieldwork significantly limited the vegetation information.

As a result, a systematic rating was not applied. However, a brief discussion of the condition of the study area is provided in section 7.2 of this report.

3.6 Digital Mapping and Database Production

Air photos were obtained from Landdata BC, which were then cascade controlled from TRIM photography with additional control points generated through aerial triangulation. Digital images for use in the softcopy environment were generated from diapositives scanned at 12 microns.

Bioterrain polygons were delineated in the softcopy environment using a DiAP Viewer, and where necessary were further subdivided for ecosystem labeling on the basis of aspect or structural stage variation. Polygons were numbered in the softcopy environment and corresponding bioterrain and ecosystem attributes were entered into the data capture (DC) Tool. An additional field was also added to the TEM database for the Garry oak ecosystem classification. Once polygon delineation and attributing was complete, the microstation file was cleaned and converted to a spatial file.

The data was then reviewed using the DC Tool to ensure that the database was error-free. Once the database was clean, ecosystem labels were added to the maps and the final map legend was produced. Draft maps were plotted and reviewed, and final edits made before producing digital maps and attribute files for delivery.

3.7 Data Limitations and Map Reliability

The entire study area was mapped within one biogeoclimatic unit, namely the Coastal Douglas-fir Zone moist maritime subzone (CDFmm). In fact, the

upper limit of elevation was just less than 500 m, well above the conventionally accepted limit for the CDF (which is typically about 150 m). Areas above 150m would normally be mapped in the very dry maritime variant of the Coastal Western Hemlock zone (CWHxm). However, the study area contains a narrow range of ecosystems and aspects (almost everywhere is southwest facing), and therefore we proposed to confine our defined map units to those described under the CDFmm (see section 4.3).

We encountered some difficulty in using established ecosystem units in this mapping exercise. Forested units are based on site series developed by the MOF in their Biogeoclimatic Ecosystem Classification (BEC) system. However, many of the units in the Mount Maxwell study area are non-forested. We used the unit GO (Garry oak – ocean spray) for areas dominated by Garry oak, even though this unit has not been correlated by the Regional Ecologist; see section 5.1.1.5 for further discussion. In reality, the GO unit is a very poor fit for the ecosystems of Mount Maxwell, and some refinement of the classification, and identification of new communities, would be more satisfactory. However, collection of adequate data during the winter field months and within the time frames and scope of this project was not possible. The ecosystems mapped under GO are described further in section 5.1.1.5.

Dry forested units lacking a significant cover of Garry oak were mapped on thinner soils generally as DA (Douglas-fir – Arbutus), reflecting their submesic (slightly dry) moisture regime. Richer areas with deeper soils (less common) were mapped as DG (Douglas-fir – Grand Fir - Oregon Grape Unit). This rather arbitrary division of ecosystem unit is relatively crude in differentiating the range of ecosystems in the study area (most of which are submesic). Some ecologists may view the GO units as a fire (or insect) related seral stages of DA and DG forests. However, for ecosystem management, we feel that separation of these units is appropriate.

The limitations of using a forest-based site series approach on this study area, with such a narrow range of moisture regimes and aspect, was in part alleviated by the use of the physiognomic Garry Oak Ecosystem (GOE) classification, under development through the Garry Oak Ecosystem Recovery Team. The use of both classifications enables us to make reasonable interpretations based on the actual distributions of ecosystem units in the study area.

The fieldwork was conducted in the fall and winter. Accordingly over the course of this fieldwork we were unable to identify many small non-shrubby plants that may be significant in addressing conservation sensitivity. By scheduling an additional botanical survey effectively after the end of this project, in April 2003, with Dr. Adolf Ceska, we attempted to address this limitation to some extent. New information gathered was used to conduct a final QA of the mapping, although data collected could not be fully integrated into the mapping, due to time constraints. Additional botanical information collected is provided in Appendix I. There is however little doubt that we have missed a number of flowering plants in the study area because of the winter fieldwork.

4.0 BIOPHYSICAL DESCRIPTION OF THE STUDY AREA

4.1 Topography and Drainage

Virtually the entire study area faces southwest, with aspects ranging from about 180 to 270 º. Many slopes consisted of bedrock exposures, expressed in the form of bluffs, hummocks, cliffs or steep slopes. Cliffs are notable on the southeast part of the study area, below and adjacent to Mount Maxwell. They are also prominent in the northern part, where they form the western and southern rim of the broad plateau represented by polygon 163. In almost no part of the study area are slopes consistently uniform or planar. On certain talus slopes, where rockfalls and rockslides have resulted in the accumulation of angular rubble and blocks, slopes are relatively planar (eg: polygons 5, 23). At lower elevations below Mount Maxwell, there are moderate, and relatively uniform slopes consisting of deep morainal and colluvial deposits.

Most areas display an irregular surface expression, due to the presence of hummocky bedrock at or near the ground surface. Throughout the study area, there are small, discontinuous areas of gentle slopes, usually on the top of hummocks. Ponds and wetlands are relatively rare; where they do occur they are small and isolated. In all cases, they were too small to type out, even at the large scale of 1:2,000. We observed a few small streams flowing during our winter fieldwork, but the paucity of watercourses was notable. Evidently most of the runoff from these slopes takes the form of groundwater flow. Many of the soils formed on top of bedrock surfaces were wet or saturated during the winter, but the composition of plant species suggests that summer drought is severe on these shallow soils. The combination of winter saturation and summer drought in soils of poor water storage capacity is a common feature in most of Mount Maxwell's ecosystems, and this makes characterization of moisture regimes more complicated.

4.2 Terrain

The terrain is dominated by the irregular bedrock surface. Bedrock outcrops in an estimated 10% of the ground surface, although an observer from the sea may estimate more due to the prevalence of cliffs and bluffs. The bedrock in the northern portion of the study area consists of volcanic rocks of the Nitinat Formation (Sicker Group). In the southern portion the bedrock consists of granodiorites of the late Devonian Saltspring Plutonic Suite (British Columbia

Geological Survey, 2001). These rocks are relatively massive and lack prominent joints and fault sets (although Burgoyne Bay marks the site of the east-west trending Fulford Fault). However, physical weathering has resulted in local accumulations of angular rubble and blocks. These colluvial deposits are widespread, especially at the base of the cliffs described in 4.1, where they form talus slopes. Colluvium is also commonly expressed as veneers and blankets interspersed with morainal mantles and overlying an irregular bedrock surface. Most soils have formed in mixtures of colluvial and morainal mantles. Accordingly, they tend to have a silty sandy texture, with plentiful coarse fragments in the form of rubble or gravel. Most occur on gentle to steep slopes with a southwest aspect and as such tend to be well, rather than imperfectly, drained.

4.3 Biogeoclimatic Zones

There is one biogeoclimatic zone within the Mount Maxwell study area, the Coastal Douglas Fir (CDF) Zone. The CDF is represented by the Moist Maritime subzone (mm) and generally occurs between sea level and 150m. However, due to the steep southwest exposure, we confined our defined map units to those described under the CDF up to the top of the mapping area at 500 m. This decision was supported by Mr. Fred Nuzsdorfer, the Regional Ecologist for the Ministry of Forests (Nanaimo).

4.4 Ecosystems

4.4.1 Terrestrial Ecosystem Mapping (TEM)

A list of TEM units mapped in the study area appears in Table 1. Full descriptions are provided in section 5.1.

The most common ecosystem mapped is Douglas-fir – Lodgepole pine – Arbutus (DA 02). This was the site series applied to the majority of second-growth Douglas-fir stands that cloak much of the area. DA units were mapped on steep or gentle southwest facing slopes that experience a significant summer moisture stress. Slightly moister sites deemed to be 'mesic' in nature were mapped as the Douglas-fir – Salal (DS 01) site series. Relatively few of these were mapped. Also relatively few sites with deeper, richer soils were mapped, as the Douglas fir – Grand Fir - Oregon Grape (DG 04) site series.

Polygons dominated by Garry oak were mapped as Garry oak – Ocean spray (GO 00) units, although the classification is a poor fit and the unit incorporates a number of different Garry Oak types, none of which fit the GO unit well. This unit was mainly mapped as a component in association with non-forested ecosystem units, and less commonly with DA. Most of the open areas visible from Sansum Narrows or Maple Bay are thus complexes of GO and either grassy
knolls; usually Fescue – Camas (FC 00), or mossy rock outcrops of Cladina – Wallace's selaginella (SC 00). Other ecosystem units may well be present, but in
such small areas that we were unable to map them, even as subordinate components.

Table 1. Mapped Ecosystems (TEM) of the Mount Maxwell Study Area

Ecosystem Unit	BEC Site Series	Structural Stages
Forested Site Series		
DS Douglas fir - Salal	01 Fd - Salal	4, 5, 6
DA Douglas fir – Lodgepole pine - Arbutus	02 FdPl - Arbutus	3b, 4, 5, 6
DG Douglas-fir – Grand Fir - Oregon Grape	04 FdBg – Oregon grape	4,5,6
FC Fescue - Camas	00 Fescue - Camas	2b
*GO Garry oak – Ocean spray	00 Qg – Ocean spray	3b, 4, 5
SC Cladina – Wallace's selaginella	00 Cladina – Wallace's selaginella	1
Sparsely Vegetated, Non-Vegetated and Anthropogenic Units		
RO Rock Outcrop	-	1

*probably incorporates several non-correlated units including the Garry oak – *Carex inops* and Garry oak –*Cynosurus echinatus* units of Erikson (1996) (see section 5.1.1.5).

4.4.2 Garry Oak Ecosystem Mapping

In addition to TEM ecosystem units, we also classed each polygon into a physiognomic classification developed by Meidinger et *al.* (in progress). We refer to this as the GOE classification. It recognizes broad structural classes, including forest (greater than 50% cover by trees); woodland (10 to 50% cover

by trees; and savannah (less than 10% cover of trees). Table 2 identifies the

Formation Subclass	Types, by Layer Dominants	Mapcode
Forest: >50% crown cover of trees; >10m trees		
Conifer Forest	Douglas-fir	CFFd
Mixed Conifer / Broadleaf Forest	Douglas-fir – Arbutus – Grand-fir	MCFdArBg
	Douglas-fir - Arbutus	MCFdAr
	Douglas-fir – Broadleaf Maple	MCFdMb
	Douglas-fir Garry oak	MCFdQg
Broadleaf Forest	Garry oak	BFQg
Woodland: <50%, at least 10% crown cover of trees; >10m trees		
Conifer Woodland	Douglas-fir	CWFd
Mixed Woodland	Douglas-fir - Arbutus	MWFdAr
	Douglas-fir – Garry oak	MWFdQg
Broadleaf Woodland	Garry oak	BWQg
Savannah: <10% crown cover of trees; >10 m trees		
Broadleaf Savannah	Garry oak	BSQg
Conifer Savannah	Douglas-fir	CSFd
Low Woodland: single-stemmed species in dominant layer (3 – 10m)		
Broadleaf Low Woodland	Garry oak	LWQg
Shrubland: multi-stemmed species in dominant layer (usually <4m); >20% cover of shrubs; <10% of trees		
Evergreen Shrubland	Broom	ESBr
Herbaceous Formations: >20% cover herbaceous, <20% shrubs		
Grass Communities	-	GC
Moss / Lichen Formations: >50% moss/lichen cover; <20% for each of herbaceous and shrub		
Moss Communities	Rhacomitrium	MRh
Mixed Moss / Lichen Communities	Rhacomitrium/Cladina	MLrc

classes we used in mapping Mount Maxwell.

Table 2. GOE Classification for Garry Oak and Associated Ecosystems.

(This is a classification of Garry oak and associated ecosystems; only six of the above are strictly speaking Garry oak ecosystems, although oak does occur in sporadically in some of the others.)

5.0 ECOSYSTEM DESCRIPTIONS

The terrestrial ecosystems mapped in this project are presented on a stand-alone hard copy map at 1:2,000 scale (see map pocket), and the mapping has also been delivered in digital format.

The following section provides more detailed descriptions of each ecosystem. Tables 3 lists the ecosystems mapped in the Mount Maxwell study area. Structural stages and site modifiers mapped, as well as site attributes typical for the ecosystem, are identified. Details of site modifiers, structural stages, and soil classifications are provided in Appendices A, B, and C of this report.

Table 3. Mount. Maxwell: Coastal Douglas Fir Zone, Moist Maritime Subzone (CDFmm) Mapped Ecosystems

Ecosystem Unit	BEC Site Series	Site Modifiers Used	Structural Stages Present	Slope Position/Gradient	Terrain	Examples of Soil Type	Moisture/ Nutrient Status
DS	01	c, w	4, 5, 6	Mid to lower moderate to moderately steep slopes	Cb, Mv, Mb	O.SB	2-4, B-C
DA	02	c, s, w	2b, 3b, 4, 5, 6	Upper to lower moderate to steep slopes	Cv, Cx, Mv, Mx	O.SB	1-2, A-C
DG	04	w	4, 5, 6	Upper to mid slopes, moderate slopes, deeper pockets of soil	Mw,Mb	O.SB	2-4, D-E
FC	00	w, z	2b, 3	Mid to lower slopes, exposed locations, thin soils over rock	Mx		0-1, C-D
GO	00	w	3b, 4, 5	Upper to lower gentle to moderately steep slopes	Mv, Cv		2-4, D
SC	00	w, z	1	Upper to lower slopes, exposed locations, very shallow soils over rock	Mx, Ro, Ru		0-1, A-B
RO	n/a	w,z	1	n/a	Ro		

5.1 Vegetation Descriptions

The following descriptions are specific to the Mount Maxwell study area. One of the units is a non-vegetated unit (Rock Outcrop). Five of the other six units are recognized site series described for the CDFmm (DS, DA, DG, FC, and SC), while the last unit is project specific (GO). The Garry oak – Brome unit that is listed for Mount Maxwell by the CDC, and is on the provincial red-list, was not mapped. This is discussed further below, under 5.1.1.5.

The descriptions are developed from fieldwork, which was completed between October 2002 and March 2003. Some complementary information is from CRD Parks (2001). Structural stage 3 is used for ecosystems that have been disturbed by logging, or fire and will ultimately return to a forested state. Structural stages 3a and 3b are used for permanent shrub ecosystems caused by excessive moisture or harsh climatic conditions.

5.1.1 Forested Site Series of the CDFmm

5.1.1.1 Douglas fir - Salal

Site Series: CDFmm / 01 Fd-Salal

Ecosystem code: DS

GOERT classification: DS occurs in the Forested subclass (>50% tree cover), which includes the following GOERT units: Conifer forest (**CFFd**) and Mixed Conifer / Broadleaf forest types (**MCFdAr, MCFdMb, MCFdQg**)

Structural Stages: 4, 5, and 6

General Distribution: Uncommon, most frequent in the Ecological Reserve.

Photo 1. Douglas-fir – Salal (DS) unit on Mount Maxwell, Plot GMG25

Description: This unit is most commonly found on mid to lower slope locations where soils are deeper. It is not found on the rocky slopes near the water. Minimum soil depths are generally > 75 cm. Parent materials are morainal (Mv, Mb, Mvb) and stabilized colluvial blankets (Cb, Cbv). DS has medium moisture and nutrient regimes. Douglas-fir regenerates under its own canopy in these forests, but especially in small gaps caused by the death of larger trees. There are scattered Douglas-fir "veterans" but, due to extensive logging in the past, most forests are young to mature. This is a productive ecosystem for Douglas-fir, nevertheless it is still subject to moisture deficiencies in late summer and early fall.

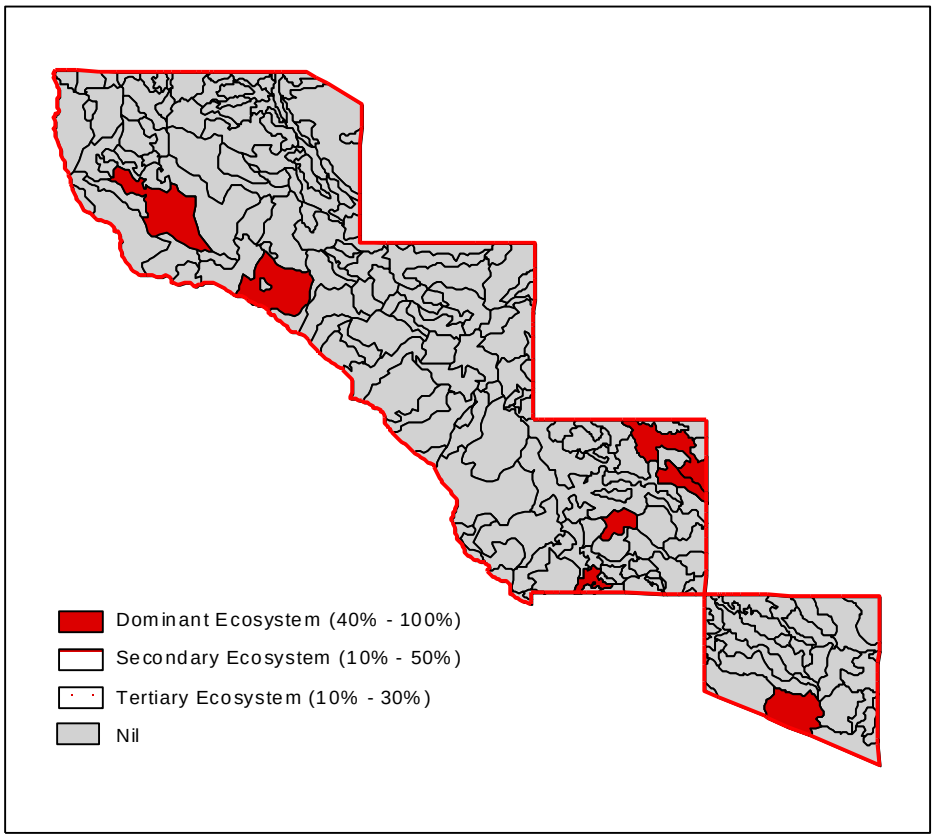

Figure 2. Distribution of the Douglas-fir – Salal (DS) unit in the Study Area.

Vegetation: The dominant tree is Douglas-fir, with scattered deciduous trees such as arbutus, bigleaf maple, Garry oak, and western flowering dogwood. Grand fir has a scattered occurrence. Common shrubs include Oregon grape, ocean spray, baldhip rose, western trumpet honeysuckle, and snowberry. Herbs include vanilla leaf, bracken fern, sword fern, white fawn lily, starflower and various orchids. Moss coverage can be locally high with Oregon beaked moss and electrified cat's tail moss being the most common. Grazing impacts the diversity of the herb layer in this ecosystem type.

5.1.1.2 Douglas Fir – Lodgepole Pine – Arbutus

Site Series: CDFmm / 02 FdPl – Arbutus

Ecosystem code: DA

GOERT classification:

- Forested subclass (>50% tree cover). DA occurs in the following GOERT units: Conifer forest (**CFFd**); Mixed Conifer / Broadleaf forest types (**MCFdAr, MCFdMb, MCFdQg**).
- Woodland subclass (<50% tree cover). DA occurs in the following GOERT units: Conifer woodland (**CWFd**); Mixed woodland types (**MCFdAr, MCFdMb, MCFdQg**).

Structural Stages: 3b, 4, 5, and 6

General Distribution: This is the most common unit in the mapping area, occurring on upper to lower slopes and in all sectors of the mapping area. It often occurs in polygons in a mosaic with the Garry oak – Ocean Spray ecosystem, the Fescue – Camas ecosystem, and rock outcrops.

Photo 2. Douglas-fir – Lodgepole pine – Arbutus (DA) unit on Mount Maxwell, Plot VGR8.

Description: This unit is found wherever there is shallow mineral soil, common throughout the study area from the steep upper slopes down to the rocky headlands near tidewater. Soils are shallow, ranging from 15 cm to perhaps 75 m. Parent materials are thin morainal mantles (Mv, Mx, Mvx, Mvb), colluvium (Cx, Cvx, Cvb), and perhaps weathered bedrock in places. DA has very dry moisture regime and poor to medium nutrient regimes. Douglas-fir regenerates under its own canopy in the DA unit, in fact the semi-shade that these fairly open canopy forests provide are necessary for the survival of seedlings on these dry sites.

Old growth veteran trees are common. This is because open grown Douglas-fir "wolf" trees on DA sites are often very gnarly and full of thick limbs, so therefore were not logged. This unit is very dry in summer and is prone to wildfires, which is in evidence by the occasional fire-scarred fir and arbutus tree. Arbutus typically dominates dry sites after fire events, resprouting vigorously from the trunk bases and exposed roots. Arbutus berries are an important food source for birds such as band-tailed pigeons, cedar waxwings and the American robin. In some polygons, Arbutus is more abundant than Douglas-fir.

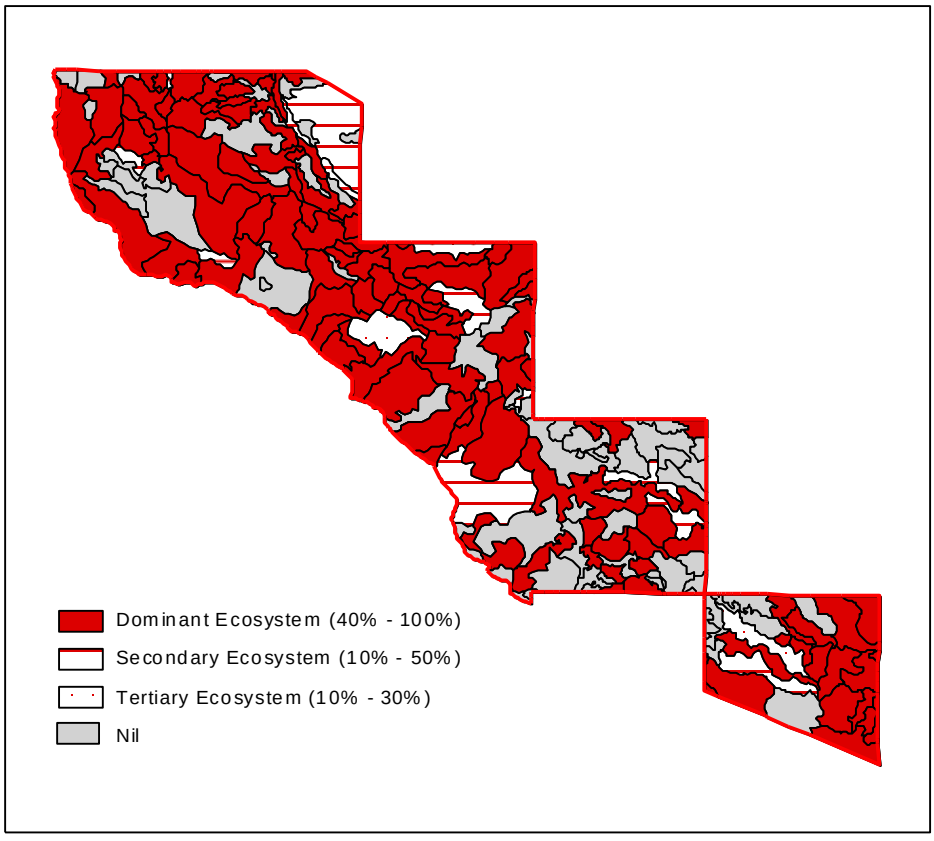

Figure 3. Distribution of the Douglas-fir – Lodgepole pine – Arbutus (DA) unit in the Study Area.

Vegetation: The dominant tree is Douglas-fir, with scattered deciduous trees such as arbutus and Garry oak. Lodgepole pine may also occur, but was uncommon in the study area. Common shrubs include Oregon grape, ocean spray, saskatoon, baldhip rose, hairy honeysuckle, and western trumpet honeysuckle. Herbs include purple peavine, Pacific sanicle, yerba buena, and rattlesnake plantain orchid. Mosses tend to be scattered but include Oregon beaked moss and electrified cat's tail moss. *Cladina* and *Cladonia* lichens are locally common.

5.1.1.3 Douglas-fir – Grand fir – Oregon grape

Site Series: CDFmm / 04 FdBg – Oregon grape

Ecosystem code: DG

GOERT classification: DG occurs in the Forested subclass (>50% tree cover), which includes the following GOERT units: Conifer forest (**CFFd**) and Mixed Conifer / Broadleaf forest types (**MCFdAr, MCFdMb, MCFdQg)**

Structural Stages: 4, 5, 6

General Distribution: DG is locally common, the best examples being on rich soils proximal to the Garry oak woodlands near the ecological reserve.

Photo 3. Douglas-fir – Grand fir – Oregon Grape (DG) unit on Mount Maxwell.

Description: This unit is most commonly found on mid-slope concave locations where soils are slightly deeper and richer. It is not found on the rocky slopes near the water. Parent materials are often stabilized colluvial veneers (Cv) and morainal material (Mv). Soil mixing from historical downslope movement of soil and rock fragments has resulted in a well-

oxygenated soil that contributes to the richer nutrient regime. Some minor subsurface seepage is also possible in these slightly concave areas, but the soil moisture is classified as moderately dry.

Some Douglas-fir regeneration is found in these forests, but seedlings suffer from browsing. There are scattered Douglas-fir "veterans" but most forests are young to mature. Trees on these sites are fast growing and productive, but are nevertheless subject to moisture deficiencies in late summer and early fall. Mature and old-growth DG forests provide thermal and foraging habitat for deer, roosting habitat for bats, and nesting habitat for birds.

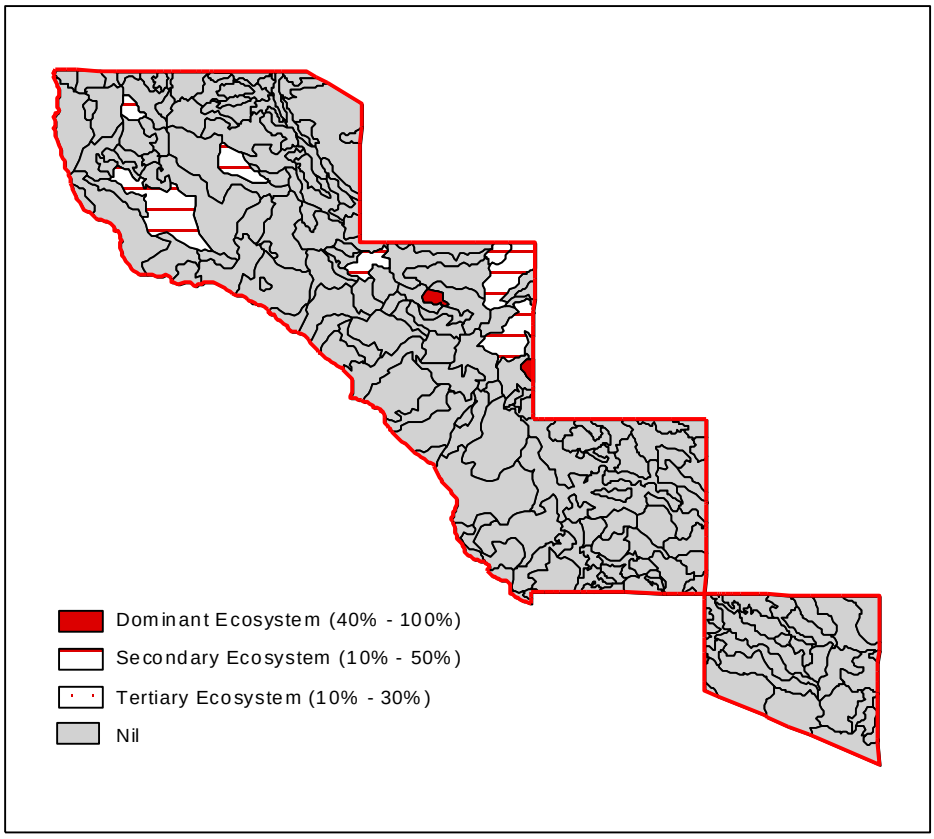

Figure 4. Distribution of the Douglas-fir – Grand fir – Oregon Grape (DG) unit in the Study Area.

Vegetation: The dominant tree is Douglas-fir, with scattered deciduous trees such as arbutus, bigleaf maple, Garry oak, and western flowering dogwood. Grand fir has a scattered occurrence. Much of the oak has been overtopped by the vigorous growth of the Douglas-fir (see photo 3). A greater cover of herbs and shrubs is found in the DG unit than the DS unit due to richer soils. Common shrubs include tall Oregon grape, baldhip rose, and western trumpet

honeysuckle. Herbs found include vanilla leaf, sweet-scented bedstraw, stinging nettle, Pacific sanicle, Columbia brome, few-seeded bittercress, miner's lettuce, cleavers, small-flowered nemophila, mountain sweet-cicely, chickweed, small-flowered geranium, white fawn lily, starflower and various orchids. Moss coverage can be locally high with Oregon beaked moss and electrified cat's tail moss being the most common. Grazing impacts the diversity of the herb layer in this ecosystem type.

5.1.1.4 Fescue - Camas

Site Series: CDFmm / 00 Fescue - Camas

Ecosystem code: FC

GOERT classification: FC occurs in the Herbaceous subclass (>20% herbaceous cover, < 20% shrubs), in the **GC** unit.

Structural Stages: 2b

General Distribution: FC is a common unit throughout the mapping area, but is rarely a major polygon component. It is associated with rock outcrops and the SC unit.

Photo 4. Fescue – Camas (FC) unit on Mount Maxwell, Plot VMG31

Description: This unit is found on extremely shallow mineral soil veneers over gently rolling to moderately steep rock outcrops. Soils are slightly deeper than those on SC sites with depths ranging from 5 – 15 cm. Parent materials are very thin morainal or colluvial materials (Mx or Cvx) with some *in situ* weathering of bedrock. Soils typically exhibit an organically-enriched horizon ("Ah") that has formed from decaying roots of grasses and herbs. The result is a thin, but nutrient rich soil. FC has a very dry moisture regime and a medium to rich nutrient regime. Run-off of rainwater is rapid on these sites, and dry

conditions prevail for most of the growing season. This said, these sites can be moist to wet in the winter and early spring, as water is caught and retained in the cracks, crevices and shallow bowls in the rocks.

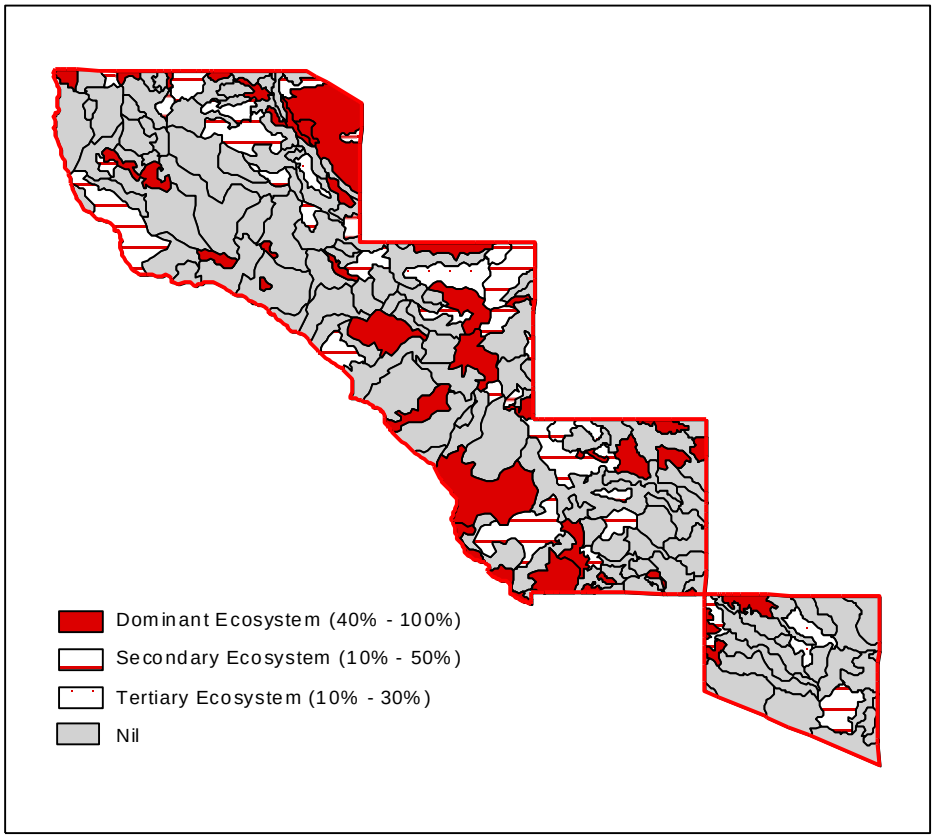

Figure 5. Distribution of the Fescue – Camas (FC) unit in the Study Area.

Vegetation: These are open, non-forested sites dominated by grasses and herbs. Most species mature, flower and go to seed in the spring months before the summer drought. Grasses are common and typically include little hairgrass, western fescue, silver hairgrass and sweet vernal grass. Herbs include Hooker's onion, great camas, early camas, blue-eyed Mary, chocolate lily, dove-foot geranium, spring gold, common monkeyflower, yampah root, seablush, and clover spp.

These sites are very sensitive to trampling, and grazing activity may have a negative impact on the wildflowers on these sites. Grazing, primarily by sheep, was noted in nearly all of the FC ecosystems recorded.

5.1.1.5 Garry Oak – Ocean Spray

Site Series: CDFmm / 00 Qg – Ocean Spray

Ecosystem code: GO

GOERT classification:

- Forested subclass (>50% tree cover). GO occurs in the following GOERT units: Broadleaf forest (**BFQg**)
- Woodland subclass (<50% tree cover). GO occurs in the following GOERT unit: Broadleaf woodland (**BWQg**)
- Savannah subclass (<10% tree cover). GO occurs in the Broadleaf savannah (**BSQg**)

Structural Stages: 3b, 4, and 5

Comments: In reality this unit does not fit most of the Garry oak ecosystems at Mount Maxwell at all well, and further refinement of the classification and mapping needs to be done. Although the Garry oak –brome unit is listed for Mount Maxwell by the CDC, we did not identify this ecosystem during our fieldwork. This is not to say it is not present in small pockets. However on the project aerial photos it is likely to be indistinguishable from the other Garry oak dominated units discussed here.

Appendix I provides plant lists for the Gary oak areas compiled on April 10th, after the mapping had been completed. This work was done to enhance the vegetation descriptions otherwise based on winter data. However, field sampling in the May to July period would be optimal for adequately describing the ecosystems of the area.

Many of the Garry oak areas are park-like, with a dense herbaceous understorey usually dominated by grasses or sedges but with many small herbs such as *Cerastium* arvense and *Trifolium microcephalum*. Shrubs, including oceanspray, are relatively uncommon in most polygons. Small amounts of *Lonicera hispidula* do occur in places although it appears to never be abundant. Erikson (1996) describes a number of oak communities that appear to be represented. However, the understorey is important in distinguishing these units, and as fieldwork was conducted in fall and winter, data is insufficient to classify many of these sites with any real confidence. They

simply do not fit into the existing known and described site series. Nonetheless, it is clear that some areas would likely fall under the Garry oak – *Carex inops* community Erikson describes. These intergrade throughout with areas dominated by dense *Cynosurus*. These sites appear to fall within Eriksons' Oak – *Cynosurus echinatus* community. However, this classification, using invasive species, is problematic. In the pockets where soils are shallower and rocks outcrop at the surface more frequently, then an Oak – *Dicranum scoparium* community (or possibly several variations on this theme) occurs. Other units described by Erikson may also be included within some of the mapped GO polygons, but we do not have sufficient information to classify to this level of detail.

All of the units discussed above intergrade to some degree, and until the classification is better established, and until high resolution, large scale colour photography is available, it is unlikely these areas can be mapped out separately. At present, even if the communities were well defined within a recognized classification system, it would likely be impossible to separate these units on the existing aerial photography.

General Distribution: The Garry oak ecosystem is common throughout the mapping area. It is frequently the major component of polygons, and is found in association with the FC and RO units. It was also mapped commonly as a secondary component with DA sites dominated by Douglas-fir.

Photo 4. Garry oak – Ocean Spray *(Cynosurus echinatus)* community, within the GO unit.

Description: This unit is found on shallow mineral soil, and on moderate to moderately steep slopes. Soil depth ranges between 15 cm and 1 m. Parent materials are thin morainal materials (Mv, Mx, Mvx), colluvium (Cx, Cvx), and perhaps weathered and fractured bedrock in places. Steeper slopes have greater proportions of coarse rock fragments in the soil profile. Organic horizons are thin (<5 cm), consisting of decaying oak leaves as well as grasses and other herbs. GO has very dry to moderately dry moisture regime and poor to medium nutrient regimes. Scattered Douglas-fir trees are found in pockets of slightly deeper soil. However, we noted that numerous Douglas-fir in proximity to/ within Garry oak stands had succumbed or were dying from bark beetles, that infested the trees after defoliation from the western oak looper (*Lambdina fiscellaria somniaria*).

This unit is very dry in summer and can be prone to grassfires, although evidence of fire (in the form of fire-scarred trees) was surprisingly sparse. The open nature of these ecosystems leaves them prone to the establishment of weedy species such as Scotch broom. Only a few areas were infested with broom, but in many units we noted numerous other invasive species including Rose campion (*Lychnis coronaria)*, hedgehog dog-tail (*Cynosurus echinatus*), verbascum (*Thlaspi arvense)* and others.

The diverse structure of oak forests provides important habitat for birds, animals and other species.

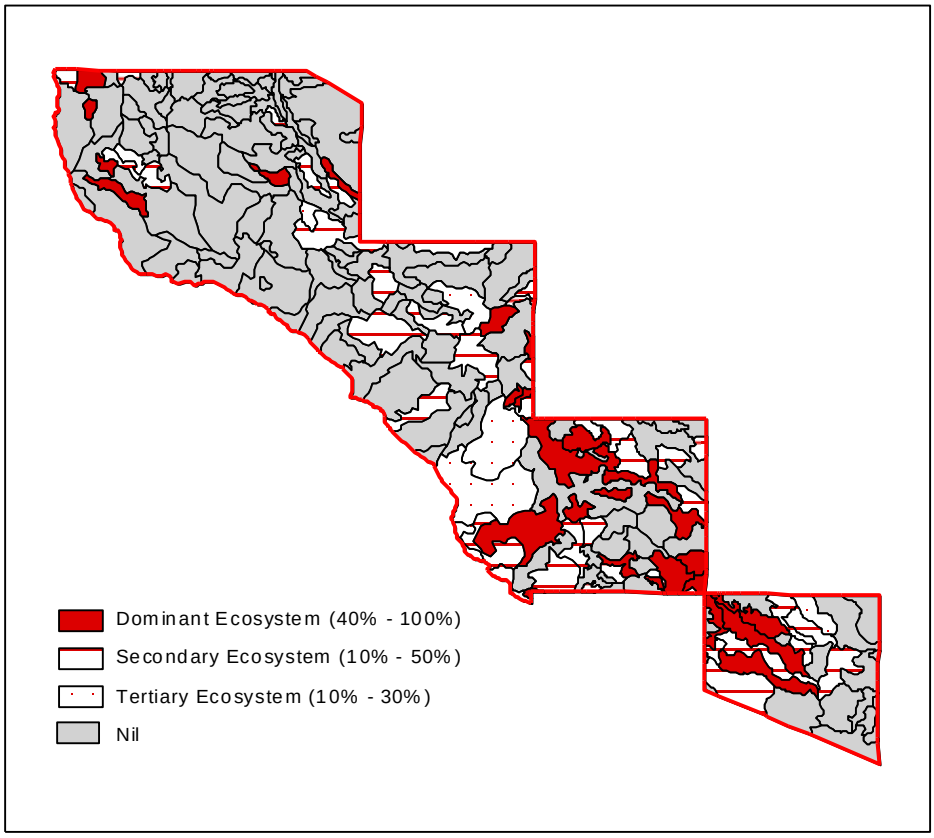

Figure 6. Distribution of the Garry Oak – Ocean Spray (GO) unit in the Study Area

Vegetation: The leading tree species is Garry Oak. Scattered Douglas-fir and arbutus trees do occur. Common shrubs include ocean spray, Douglas-fir, Indian plum, Scotch broom, red-flowering currant, and mock orange. The grass and herb layer is very diverse. Grasses include orchard grass, sweet vernal grass, blue wildrye, little hairgrass, California brome, soft brome, hedgehog dog-tail grass, Kentucky bluegrass, and California oatgrass. Herbs include Hooker's onion, fairy slipper, early and great camas, field chickweed, white fawn lily, spring gold, miner's lettuce, Menzie's larkspur, western buttercup, and red columbine. Arboreal lichens and mosses are very diverse but were not inventoried in this project. Terrestrial mosses are sporadic but consist of scattered electrified cat's tail moss.

5.1.1.6 Garry Oak – Brome (not mapped)

Site Series: Garry Oak – Brome

Ecosystem Code: QB; not mapped.

GOERT classification: QB occurs in the: QG forest, QG woodland (some), QG Savanah

Structural Stages: not mapped

General Distribution: Garry Oak – Brome may be a minor component of polygons; it is recorded for the study area by the CDC. However, we did not specifically identify the unit during fieldwork and it may be generally too small and localized to map. During a field visit to the site with Dr. Adolf Ceska on April 10th 2003, we covered many of the richer oak units in the southern half of the study area. Dr. Ceska was similarly of the opinion these areas did not constitute Garry oak - Brome units. However, as it has been previously recorded for the Ecological Reserve, we have included the description of this unit here for reference.

Description: The typical soils on these sites are thin Brunisols. They are usually shallow (<1 m deep), but deeper and richer than the soil on the Garry-oak – Ocean spray sites. The parent material is typically colluvium or fractured bedrock, but with a fine fraction containing silts, sands, and organic material. Annual accumulations of leaves, herbs and grasses contribute to the richer nutrient regimes of these sites. Some light seepage in winter or early spring is common. Deeper and richer soils allow more biomass for a given area, so the oak trees can be quite large on these sites, with a denser canopy than other oak forest types. Small wildflower and grass meadows thrive in the canopy gaps. Broom and agronomic grasses are present in this unit as well. Scotch broom, a member of the pea family, fixes atmospheric nitrogen in the soil, which creates favourable conditions for non-native agronomic grasses such as orchard grass, sweet vernal grass and hedgehog dog-tail grass.

Vegetation: The dominant tree is Garry oak, usually forming pure stands. The shrub layer is discontinuous and includes baldhip rose, red-flowering currant, Scotch broom, mock orange, western trumpet honeysuckle, and tall Oregon grape. Herbs are bountiful and include common camas, great camas,

Menzie's larkspur, yerba buena, spring gold, white-top aster, and woolly sunflower. Grasses include orchard grass, long-stolon sedge, hedgehog dog-tail, California brome, Roemer's fescue, Lemmon's needlegrass, and California oat-grass.

5.1.1.7 Cladina – Wallace's selaginella

Site Series: CDFmm / 00 Cladina – Wallace's selaginella

Ecosystem code: SC

GOERT classification: SC occurs in the:

- Herbaceous subclass (>20% herbaceous cover, < 20% shrubs); SC occurs within the **GC** unit.
- Moss / Lichen subclass (>50% moss/lichen cover, <20% for each of herbaceous and shrub); SC occurs in the **MLrc** unit.

Structural Stages: 1

General Distribution: Common as a minor component in map polygons throughout the mapping area. Occurs in associations with FC, RO, and GO.

Photo 5. Wallace's selaginella – Cladina (SC) unit on Mount Maxwell, Plot GGR6

Description: This unit is found on extremely shallow mineral soil veneers over gently rolling to steep rock outcrops. Primary soil forming processes – involving the initial and gradual breakdown of rock - occur on these sites. Soil depth ranges from 1 to 5 cm. In places there may be a discontinuous covering of very thin morainal materials (Mx) or, more frequently, *in situ* weathering of

bedrock. A thin layer of organic material forms from decaying moss and herbs. The mosses and lichens often seem to be growing directly on the rock, but usually a very thin soil layer exists. SC has a very dry moisture regime and a very poor to poor nutrient regime. Run-off of rainwater is immediate on these sites, and droughty conditions prevail for most of the year.

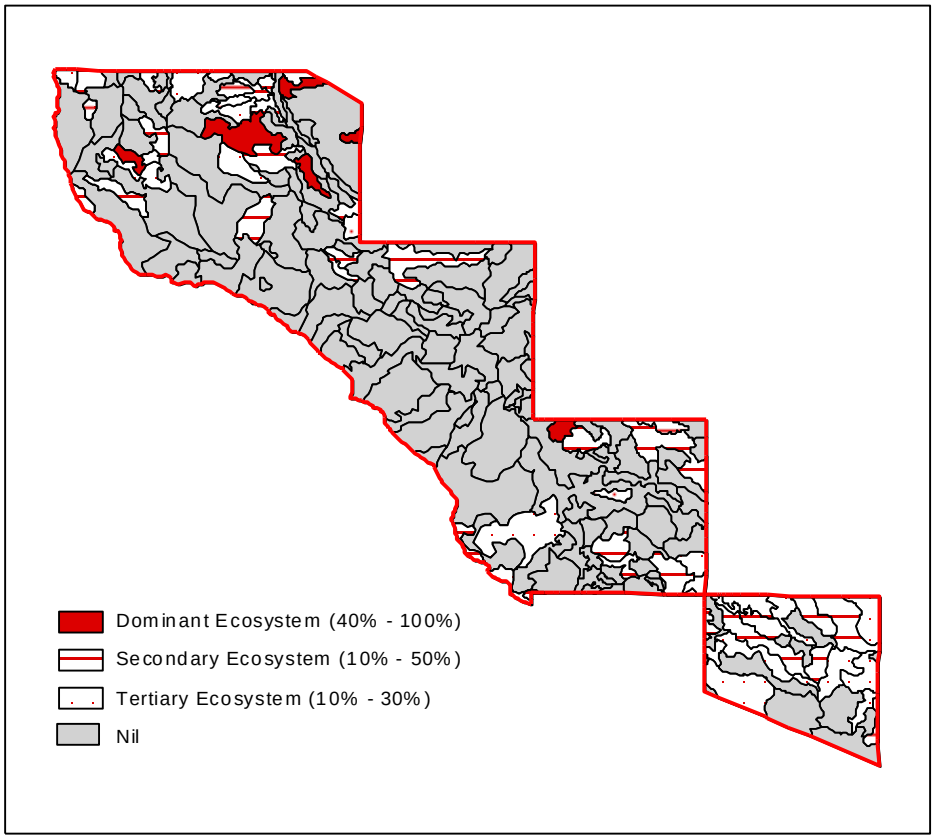

Figure 7. Distribution of the Wallace's selaginella – Cladina (SC) unit in the Study Area.

Vegetation: These are open, non-forested sites dominated by lichens, mosses and herbs. Mosses and lichens that tolerate desiccation are the most common plants. Species include rock moss, *Dicranum* moss, and *Cladina* lichens. Grasses are common and typically include little hairgrass, silver hairgrass and sweet vernal grass. Herbs include Wallace's selaginella, sheep sorrel, woolly sunflower, and blue-eyed Mary. These units are often heavily grazed.

SC is extremely sensitive to trampling – in winter, the moss carpet can easily slough off the rock, and in summer, the dry and brittle mosses and lichens are

readily crushed underfoot. Evidence of browsing was widespread on these units.

5.1.2 Sparsely Vegetated, Non-Vegetated, and Anthropogenic Units of the CDFmm

5.1.2.1 Rock Outcrop

Ecosystem: RO, Rock Outcrop

Structural Stages: 1

General Distribution: Common as a minor component of polygons throughout the mapping area.

Description: Bare rock with fewer than 5% herbs and shrubs, but up to 10% mosses and lichens, often steep. Rock is obviously extremely to very rapidly drained depending on whether it is steep or gently sloping. Run-off of rainwater is immediate on these sites, and droughty conditions prevail all year. Primary soil forming processes occur on these sites (initial and gradual weathering of rock). Very thin veneers (.5 – 3 cm) of soil occur, on which mosses, lichens and scattered herbs occur. Rock is characterized by a very poor nutrient regime due to the lack of soil.

Vegetation: Rock outcrops are dominated by drought tolerant lichens, mosses and herbs. Species include rock moss, *Dicranum* moss, and *Cladina* lichens. Grasses may include little hairgrass, silver hairgrass and sweet vernal grass. Herbs include Wallace's selaginella and stunted sheep sorrel.

6.0 GARRY OAK ECOSYSTEM MAPPING

Table 4 below is an extract from the GOE classification indicating the Garry Oak ecosystems. This is an edited version of Table 2. These types fall into the Garry oak – Ocean spray unit (GO) in the Biogeoclimatic classification system. The 4 units below also represent a range of site conditions, with **BFQg** being on deep soil, moderately dry and quite rich, to the **LWQg**, which has shallow soils, is very dry with a poor nutrient regime. The plant descriptions from the Garry oak – Ocean spray unit (preceding section) generally apply to the 4 units below. However, as forest conditions change from closed to open canopy, the coverage and diversity of the plant community increases, especially with light demanding species such as grasses and lichens. Each one of the units is described in greater detail below.

Table 4. Garry Oak Ecosystem Units in the GOE classification.

Formation Subclass	Types, by Layer Dominants	Mapcode
Forest: >50% crown cover of trees; >10m trees		
Broadleaf Forest	Garry oak	BFQg
Woodland: <50%, at least 10% crown cover of trees; >10m trees		
Broadleaf Woodland	Garry oak	BWQg
Savannah: <10% crown cover of trees; >10 m trees		
Broadleaf Savannah	Garry oak	BSQg
Low Woodland: single-stemmed species in dominant layer (3 – 10m)		
Broadleaf Low Woodland	Garry oak	LWQg

An interpretive map illustrating the results of the mapping according to the GOE classification scheme is presented in Figure 8.

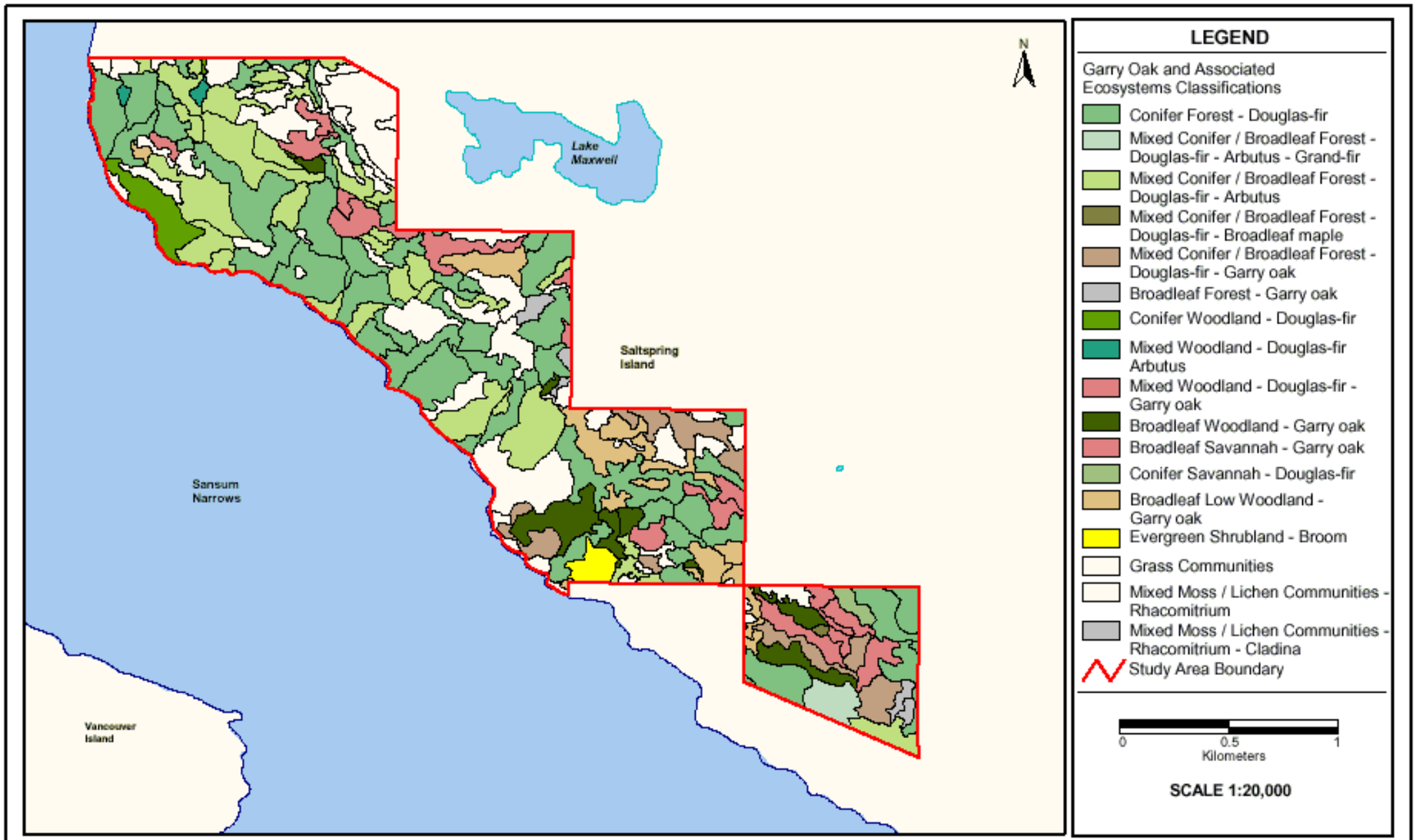

Figure 8. Garry oak and associated ecosystems classifications for the Mount Maxwell Study Area.

6.1 Garry Oak Ecosystem Unit Descriptions

6.1.1 BFQg: Broadleaf Garry Oak Forest

This type has a canopy cover greater than 50%, with trees taller than 10 metres. This is almost a closed forest, although it is a "porous" canopy. Garry oaks, and deciduous trees in general, allow much more light to pass through the canopy than conifer trees. Thus the understory plant layers are still well developed. These sites tend to be on gentle to moderate slopes, with soil depths ranging from 75cm to over 1 metre. Parent materials are morainal (Mvb), or stable colluvium (Cb). Soils have a moderately dry moisture regime, with medium to rich nutrient regimes. Scattered Douglas-fir and arbutus are present. The tallest oak trees in the mapping are in this unit.

6.1.2 BWQg: Broadleaf Garry Oak Woodland

This type has a canopy cover less than 50%, with trees taller than 10 metres. This is fairly open forest with a high diversity of shrubs, herbs, mosses and lichens. These sites tend to be on gentle to moderate slopes, with soil depths ranging from 50 cm to a 1 metre. Parent materials are morainal (Mv), or stable colluvium (Cv). Soils have a moderately dry moisture regime, with medium to rich nutrient regimes. Scattered Douglas-fir and arbutus may be present.

6.1.3 BSQg: Broadleaf Garry Oak Savannah

This type has a canopy cover less than 10%, with trees taller than 10 metres. This is an open forest with a high diversity of shrubs, herbs, mosses and lichens. These sites tend to be on gentle to moderately steep slopes, with shallow soils over rock. Soil depths are generally less than 50 cm. Parent materials are morainal (Mv), stable colluvium (Cv), or fragmented and weathered bedrock. Soils have a dry moisture regime, with poor to medium nutrient regimes. The oak savannah tends to be purely oak with no other tree species present. The open aspect of these stands is due to the lack of moisture in the growing season coupled with shallow soils. These site conditions will not support a dense forest.

6.1.4 LWQg: Broadleaf Low Garry Oak Woodland

This type has a canopy cover less than 50%, with trees between 3 and 10 metres. Single stemmed oaks are in the dominant layer, and can be quite dense in places. This unit represents the most extreme conditions that Garry oak can endure – extreme drought, very thin soils, and exposure. The high

amount of light that passes through the canopy allows a high diversity of plants to occur. This includes the grasses, but especially the mosses and lichens. Terrestrial lichens are common on these exposed oaks. Uncommon lichens grow on oaks, perhaps because of high nutrient levels in the bark. While small, these oaks are nevertheless old; site conditions simply don't allow these trees to develop any stature. These sites tend to be on moderate to steep slopes, with soil depths ranging from 5 to 25 cm. The most usual situation is for the oak to exploit small cracks and crevices in the rock where some soil has accumulated. Oak roots follow fractures surprisingly deep into the rock to obtain moisture. Parent materials are morainal (Mx), colluvium (Cx), or simply fractured bedrock. Soils have a very dry moisture regime, with poor to medium nutrient regimes.

7.0 ECOLOGICAL VALUES OF THE STUDY AREA

The primary purpose of the TEM mapping is to establish the basis for interpreting the natural ecosystems for rare elements of biodiversity, and to assess their naturalness and integrity. In this section, rare ecosystem types and other rare and sensitive elements of biodiversity mapped or potentially present in the study area are briefly discussed and evaluated for their significance. The wildlife is an integral part of the overall biodiversity values, and is discussed specifically in chapter 8.0.

7.1 Ecosystem Representation and Condition

The following sections briefly review the representation of the different units mapped within the study area. In summary however, Garry oak ecosystems and mature Douglas-fir forest exist together on the reserve and Nature Trust Lands, and include a number of red-listed ecosystem associations in the CDFmm biogeoclimatic subzone. Old-growth forests are however generally absent at this time, due to the past history of logging and fire. Almost all of the coniferous forests are in seral stages 4 through 6; no old-growth forests (structural stage 7) were mapped. However, Garry oak stand representation is substantial. Indeed, the Mount Maxwell Ecological Reserve (ER) and adjacent NT lands support some of the last remaining significant stands of endangered Garry Oak and associated ecosystems in BC, together with associated ecosystems such as mature Douglas-fir.

Table 5. Summary of the total areas mapped for the different TEM units and structural stages identified during the mapping process.

Site Series	Structural Stage	Area (ha)
DS	4	7.321
	5	4.939
	6	11.428
DA	3b	0.655
	4	22.779
	5	109.724
	6	67.364
DG	4	1.992
	5	0.911
	6	3.950
FC	2b	48.446
GO	3b	39.919
	4	10.568
SC	1	22.535
RO	1	2.06

7.1.1 Coniferous Ecosystems

7.1.1.1 Douglas-fir – Salal Ecosystem

The CDC does not list the Douglas-fir – Salal (01) unit as a rare element. Indeed, as it is the mesic unit, in most study areas widespread representation of this type can normally be expected (the mesic forests often cover around 50% of the subzone/variant). However, within the Mount Maxwell area mapped, the DS unit covers just under only 24 ha, or only 7% of the study area.

The DS unit everywhere in the CDFmm has been largely logged or developed, so very little remains in relatively natural condition. Although the DS forests at Mount Maxwell have been logged in the past, and grazed, they do maintain some structural elements of older stands in the form of veteran trees. The degree of invasion by non-native species is also limited, and their relatively well-buffered position in the landscape means their potential for recovery to mature/old forest DS stands of good or even excellent condition is high.

7.1.1.2 Douglas-fir – Arbutus ecosystem

This is now on the provincial red list in the CWHxm1. However, we mapped it all as in the CDFmm. The CDC report (see Appendix E) notes, "this community is found on the strongly sloping southwest side of Baynes Peak, facing Sansum Narrows. Site is very dry with rock outcrops, shallow soils over bedrock with some deeper pockets occurs in mosaic with Garry oak community types".

At the present time the vast majority of this type is in structural stages 4 though 6, again a result of past logging and fire history. However, in many of the polygons, older veteran 'wolf' trees of Douglas-fir exist. By supplying some of the structural attributes more typical of old forest, these will enhance the values of the stands for many wildlife species.

The representation of this unit within the study area is relatively extensive (over 200 ha, or 61% of the area mapped), and the condition is generally good, even though stands have previously been logged. Patches of many of the introduced species appear to be fairly localized in extent, although an exhaustive assessment was not done, and there are certainly some areas where grazing and invasive species have degraded ecosystem quality. The stands have not however been so degraded that they cannot recover well, and thus they have the future potential to provide excellent representation of mature/older stands (although fire must be considered part of the normal ecosystem processes and may be included in future management).

7.1.1.3 Douglas – fir – Grand – fir – Oregon Grape Ecosystem

This site is listed on the provincial red list in the CDFmm. About 6 ha of this unit was mapped in the project area. Of this, about 4 ha is in mature forest (structural stage 6), occurring close to the upper, eastern edge of the map area. Forests are productive due to the richer soil and better moisture status than adjacent sites. Trees grow quickly and the herb layer is well developed. Canopies close in quickly with rapid growing trees, allowing only shade tolerant understory plants to thrive. Few invasive plants are found in the understory due to their higher light requirements. The conifers are currently overtopping shorter-lived deciduous trees such as maple and oaks where this unit is present. Old growth characteristics will develop on these stands over the next 50-75 years due to favourable growth. Overall condition of these stands is good.

7.1.2 Garry Oak Ecosystems

The values of Garry oak ecosystems are well documented in a variety of other sources (e.g. Fuchs 2001, GOERT 2002, Burton [Ed.] 2002). In essence, however, Garry oak ecosystems are significant for their rarity, high biodiversity, including genetic diversity, the high proportion of rare and threatened species they support, and for their values to people as a visual, recreational, spiritual and cultural resource. Table 6 summarizes the areas of GOE's mapped in the study area.

Table 6. Total area mapped for each GOE map code.

GOERT Map Code	Number Of Polygons	Area (ha)
CFFd	56	119.79
MCFdArBg	1	3.87
MCFdAr	35	60.24
MCFdMb	1	0.32
MCFdQg	8	16.78
BFQg	4	2.75
CWFd	2	6.80
MWFdAr	2	0.99
MWFdQg	15	23.95
BWQg	8	15.29
BSQg	1	3.29
CSFd	1	1.64
LWQg	14	20.41
ESBr	1	2.97
GC	42	61.29
MRh	4	6.41
MLrc	1	0.95

Garry oak dominated ecosystems cover a little under 42 ha, or 12%, of the study area and nearly 41 more ha support ecosystems which include at least a component of Garry Oak. The representation on Mount Maxwell is therefore substantial, and highly significant at a provincial and even national scale.

7.1.2.1 Garry oak – Oceanspray

Although this is the oak unit we most frequently mapped out in the TEM, as described in 5.1.1.5, in reality we feel that the ecosystems do not fit well here and that in fact several herbaceous oak communities are included within it. The GO unit thus represents a complex of poorly defined oak dominated ecosystems, including at least three different communities identified by Erikson (1996).

7.1.2.2 Garry oak – Brome

In addition to the larger polygons mapped, small inclusions of this unit may have been incorporated under the GO unit, although we did not identify it in the field or on the softcopy images. The CDC report notes it is found on the southwest side of Baynes Peak (see appendix E).

Regardless of classification issues, the Garry oak stands in the study area are exceptional. These are some of the largest GO stands in BC. Indeed, the Mount Maxwell Ecological Reserve was originally established to protect the outstanding Garry Oak stands and associated vegetation. The slopes of the study area support what is probably the largest representation of Garry Oak ecosystems in the province.

Perhaps just as importantly, they are surrounded – and thus buffered – by Douglas-fir forests, and by natural boundaries, unlike many other examples of Garry Oak ecosystems. Elsewhere they are often adjacent to developments (e.g. on Mount. Tzouhalem, and various sites in the Victoria area). The protective ocean on the West side, and the steep slopes and cliffs of Mount Maxwell, make these areas unusually well protected. Because of this, they probably afford some of our best hopes for future, long-term protection and representation of GO complexes in the province. Their protection from disturbance, including recreational disturbance, should be a top management priority.

7.2 Garry Oak Stand Dynamics: fire and grazing

Key management issues that have been identified for Mount Maxwell include Species at Risk, the consequences of Fire exclusion, and Feral Grazing.

Stand dynamics have not been described in any detail for Garry oak systems in Canada (Fuchs, 2001). Prior to European settlement, First Peoples used regular

burning to maintain open vegetation structure favorable to camas (*Camassia quamash* and *C. leichtlinii*), the primary vegetable food (Fuchs 2001). Much of the area of southeast Vancouver Island and the Gulf Islands was subjected to relatively frequent but low intensity fires. Fire suppression following European settlement of the area has altered the natural and human managed fire regime in the area, dramatically altering the vegetation dynamics and successional sequences. This has resulted in changes to the structure and composition of many of the remaining Garry oak ecosystems.

The reduction in fire has permitted many open sites to be invaded by both native and non-native shrubs and trees, leading to overtopping of Garry oaks by conifers. As they are shade intolerant, this leads to eventual death of the oaks. Photograph 5 illustrates this process occurring in polygon 47.

Similarly, succession to dense shrub stands in previously open forb-dominated sites leads to the exclusion of the native wildflower assemblages, and results in dense, often monotypic stands of species such as Scotch broom or snowberry. This was observed in a few areas, usually near the water (e.g. polygon #59 and parts of #101), where dense broom has overtaken what were presumably forb-dominated FC units, or perhaps a mix of FC and GO units. Further upslope, there is relatively little evidence of shrub invasion into herbaceous oak stands. However, introduced grasses, including *Elymus glaucus, Cynosurus echinatus,* and *Anthoxanthum odoratum,* often densely dominate these areas.

Photo 6. Douglas-Fir overtopping Garry Oaks.

It is unclear how much deliberate burning or fire suppression has occurred on Mount Maxwell. The relative inaccessibility of the site may have prevented fire

suppression, thus allowing a more natural fire regime to continue in the area. This would have permitted the Garry Oak woodlands to continue to flourish here. However, within the Garry oak units, evidence of fire (in the form of fire-scarred trees) was sparse. It was more obvious in the DA unit, also very dry in summer and similarly prone to wildfires, evidenced by the occasional fire-scarred fir and arbutus trees.

Similarly, it is unclear what role grazing and browsing by deer and feral sheep plays in the present day successional patterns. Widespread grazing by sheep, now feral, may have also prevented succession to native shrubs and to Douglas-fir in many areas. However, it will also likely prevent establishment of young oak seedlings for future replacement. The study area has also been logged, further clouding the successional sequences that would otherwise occur.

7.3 Ecosystem Condition and Sensitivity

Because units heavily dominated by broom were explicitly mapped as such, the GOE classification to large degree reflects the naturalness also. In terms of condition, none of the area is pristine. Grassland units and the herbaceous understorey of oak units have all been grazed and have a high predominance of introduced species, and can be rated as in moderate to poor condition throughout. However, they may be some of the best representation of Garry oak woodland complexes remaining anywhere, and as such these relatively low ratings are misleading. However, to fine-tune this rating system to sufficiently distinguish between degree of damage/degradation (e.g. %cover different introduced grasses, herbs, shrubs, amount of grazing etc.) would require considerably more field assessment during the spring and summer months, and refinement of the ratings classes and criteria. This was well beyond the scope of the present project.

Garry oak ecosystems are all relatively sensitive to disturbance effects. This said, some are more vulnerable to impacts than others, and sensitivity varies through the year within any one ecosystem. For example, the more closed woodland stands of mixed canopy with a vigorous shrub layer are perhaps rather more resilient to human recreation than more open Garry oak savannahs. Similarly, woodlands with Oregon grape and snowberry scrub are likely less easily impacted than an open Garry oak meadow with abundant native forbs. Open rock bluffs with very shallow soils are highly sensitive,

especially in spring when the thin soil layers are moist. At this time, even walking across the rocks can cause the bryophyte layer to slough off the rock face, leaving bare patches that provide sites for colonization by invasive species. This sensitivity to activity, both between sites, and through the year within sites, needs to be taken in to account when planning management of these ecosystems.

Timing of the fieldwork for this study was far from optimal, limiting our ability to interpret for condition of the herb layer, and for wildflower displays. Within the study area, grazing by feral sheep continues to impact on the vegetation, and it is likely that grazing will restrict/reduce the diversity of the herbs in many areas. Studies using exclosures have been underway for some time and will hopefully reveal insights into the long term effects of ungulate grazing and browsing impacts.

We noted that grazing appears to have impacted the diversity of the herb layer in the DS ecosystem type. Also, grazing, primarily by sheep, was observed in nearly all of the FC ecosystems recorded as well as in the Garry oak areas. However, it has been noted in the past that there are many showy wildflowers despite heavy grazing, particularly on seasonally moist sites and seeps around rock outcrops and Garry oak stands (Ecological Reserves Program 1992).

The open nature of the oak and FC and SC ecosystems leaves them prone to the establishment of weedy species such as Scotch broom. Only a few areas were heavily infested with broom, and these were generally sites very close to the ocean. Oak stands further upslope were generally free of broom. However, in many units we noted numerous other invasive species including Rose campion (*Lychnis coronaria)*, hedgehog dog-tail (*Cynosurus echinatus*), verbascum (*Thlaspi arvense)* and others. Except for the invasive grasses however, which are many and pervasive throughout, invasive plant species were often quite localized in distribution, occurring here and there in small patches.

The SC unit is extremely sensitive to trampling – in winter the moss carpet can easily slough off the rock, and in summer the dry and brittle mosses and lichens are readily crushed underfoot. Evidence of browsing was widespread on these units. Again, grazing activity may have a negative impact on the wildflowers on these sites.

7.4 Rare and Threatened Plants

British Columbia's Garry oak ecosystems harbor at least 60 species of plants considered at risk from loss of habitat through land development and invasions of non-native species. These are species on the provincial red and blue lists. At least 11 of the plants species are endangered nationally. A request to the CDC for element occurrence records within the study area yielded reports of five listed plant species; four of them on the red list and one on the blue list. The CDC rare element report generated is included as Appendix F. The following listed plant species have been identified by the CDC as existing in the Mount Maxwell Ecological Reserve:

- Scalepod (*Idahoa Scapigera)* - red listed plant which occurs on mossy and wet outcrops, from moist seepages to dry rocky slopes; on SW facing rock
- Gray's desert parsley (*Lomatium grayi*) - red listed plant which occurs in at least two patches in the area, with a few plants in each (see Appendix F). One of these is outside the reserve. Generally occurs on dry rocky or open slopes.
- California hedge parsley (*Yabea microcarpa*) – red listed plant on mossy rock outcrops, moist vernal sites and streambanks
- Yellow montane violet (*Viola praemorsa)* – red listed plant of dry grassy slopes and oak woodlands.
- Slimleaf Onion (*Allium amplectans)* – blue listed; is recorded as occurring on south-facing bluffs and ledges.

The notes above are based on the CDC information and Douglas *et al.* 2002. Timing of the project made early spring and summer field checking for rare plants impossible. We did note the presence of *Opuntia fragilis* just outside of our study area boundary, on a rock outcrop adjacent to the ocean. It likely also occurs within the study area. We made a post-mapping field trip to the area on April 10th 2003 in conjunction with Dr. Adolf Ceska and Oluna Ceska, and noted a number of species of interest during that trip. Appendix I provides the botanical information collected on the 10th. Appendix G provides an earlier list of plant species recorded within the Mount Maxwell Ecological Reserve area by Dr. Hans Roemer.

7.5 Recommended Future Work

Mount Maxwell offers some excellent opportunities for studying the dynamics of GOE processes. The relatively protected position limits human visitation. So

far it also affords protection from some of the invasive species. Long-established exclosures to study the effects of grazing have been in place, and work on the vegetation continues. An effort to reconstruct the human and fire history of the area would also be well worthwhile.

Field assessments for locating rare plants and documenting their extent need to be conducted during the appropriate months for likely species – especially May and June, and possibly into July. The ecosystem map will now provide a basis for future field planning and searches for rare species. Any data collected should be referenced to the ecosystem polygon number and build on the existing database.

8.0 WILDLIFE VALUES

8.1 Wildlife Observed

Vertebrate wildlife observed during fieldwork (restricted to late fall and winter) included tree frogs and alligator lizards. Garter snakes are likely to be relatively common but were not seen. Evidence of use by red squirrels and black-tailed deer was noted, as well as sign of use by feral sheep. Noteworthy bird observations included relatively large numbers of band-tailed pigeons feeding on abundant arbutus berries in winter, especially in the northern half of the study area. Mink, otters and raccoons can be expected to utilize the shoreline areas, and a mink was observed along the rocks within the study area. Blue Grouse, Hutton's vireo and Cassin's vireo were heard on a trip to the area on April 10th 2003. At that time birds that were especially conspicuous in the area included varied thrush and northern flicker. Turkey vultures and bald eagles were also observed, but we did not record peregrine falcon, although we had hoped to at least hear them as a pair generally nests in the vicinity.

There are some 14 vertebrates considered at risk that are associated generally with Garry oak ecosystems, including 7 species that are nationally endangered. Unfortunately, of the species specifically dependent on open oak and grassland systems, all are extirpated from this area, or nearly so. Yet it is likely that at one time many of them would have lived and bred within the study area boundaries. The Western Bluebird and Lewis' Woodpecker are two examples that especially spring to mind, and that were recorded in the general vicinity in relatively recent times. Indeed, the last known coastal record for Western bluebird was from Saltspring Island (Mount Tuam vicinity) only a few years ago. There was no sign of either of these species during an April 10th field trip.

The study area is known to have a high diversity of insect fauna, and preliminary surveys in the ER identified some 172 invertebrate species in 98 families (Ecological Reserves Program 1992). At least 10 butterfly species associated with Garry oak areas are considered at risk, as well as an earthworm and seven other insects. Again, many are already extirpated from VI and the Gulf Islands. On April 10th several small moths and one butterfly – a satyr anglewing, were observed. However, the weather had been cold and wet and we considered it too early for most species of interest.

8.2 Wildlife Interpretations

No specific interpretations have been made for the species already extirpated. However, if there are any future plans made for them (e.g. specific reintroduction programs as part of a recovery plan), the TEM and GOE base mapping can serve as a good start to look for potential habitat areas.

Initially it was proposed for this project that capability – suitability (CAPSU) mapping would be conducted and a brief report compiled for a selected set of red-listed wildlife species (3 or 4 species) most likely to occur in the study area. The red-listed wildlife species on the South Island Forest District tracking list were considered at the onset of this project. Through a brief review of these, and discussions with the client, the focus was confined to a limited subset of species most likely to occur in the study area (see Table 8). However, when Parks decided to increase the mapping scale to 1:2,000, there was insufficient budget for full wildlife CAPSU mapping, and the contract was amended to include general wildlife interpretations only. This section therefore reflects that change.

Despite this, we researched a broader range of wildlife species for this project, and for a few species (Northern Goshawk, Peregrine Falcon and Sharp-tailed Snake) we compiled information and species accounts to support mapping. However, mapping to CAPSU standards has been completed only for Northern Goshawk. Mapping for Sharp-tailed Snake is presented, but was not done following CAPSU standards at this stage. Rather, a modified map of potential habitat is provided (see under Sharp-tailed Snake below). Fieldwork identified that Peregrine nesting habitat is located outside of the study area, so no CAPSU mapping has been prepared for this species.

A request to the CDC yielded only two blue-listed element occurrence records (and no red-listed records) for vertebrate or invertebrate wildlife in the study area. One record for Propertius Duskywing, recorded in mixed Garry oak-Douglas fir area, and one for Moss' Elfin on steep rock cliff face (see Appendix F for all the CDC rare element occurrence records for the study area).

Although we did no interpretation for bats, small crevices and caves in the vicinity of the study area could certainly support several species. On April 10th we located the entrance to an old mine (photograph 7) within the area, although we had encountered no records of it prior to fieldwork. We were not armed with equipment to investigate, but it appeared to go back into the mountainside some considerable way. This site would be well worth investigating further for bat colonies.

Photo 7. Old mine entrance on Mount Maxwell.

8.2.1 Summary of Red-listed Wildlife Species

At the start of this project, a total of 29 red-listed wildlife (vertebrate and invertebrate) species were on the full tracking list for the South Island Forest district. However, 16 of these red-listed species were eliminated from further consideration for the project (these are identified in Appendix H). Most of these were marine species, or were species for which the natural range does not include Saltspring Island. A few species for which there was clearly no suitable habitat available in the study area were also eliminated from further research. The following red-listed species of wildlife from the Rare Animal Tracking Lists (Birds, Reptiles, Mammals, Fish, and Invertebrates) remained as ones highlighted for further attention.

Table 7. Red-listed Wildlife Species for the South Island Forest District.

Scientific Name	English Name	Status		
		Global	Sub national	COSEWIC
Contia tenuis	Sharp-tailed Snake	G5	S1	E (1999)
Accipiter gentilis laingi	Northern Goshawk, laingi subspecies	G5T2	S2B,SZN	T (NOV 2000)
Falco peregrinus anatum	Peregrine Falcon, anatum subspecies	G4T3	S2B,SZN	T (MAY 2000)
Brachyramphus marmoratus	Marbled Murrelet	G3G4	S2B,S4N	T (NOV 2000)
Sialia mexicana pop. 1	Western Bluebird (Georgia Depression population)	G5T?Q	SHB,SZN	
Pooecetes gramineus affinis	Vesper Sparrow, affinis subspecies	G5T3	S1B	
Sturnella neglecta pop. 1	Western Meadowlark (Georgia Depression population)	G5T?Q	SXB,SZN	
Myotis keenii	Keen's Long-eared Myotis	G2G3	S1S3	SC (1988)
Euchloe ausonides ssp. 1	Large Marble, undescribed island subspecies	G5T1	SX	XT (May 2000)
Loranthomitoura johnsoni	Johnson's Hairstreak	G2G3	S1S2	
Plebejus saepiolus insulanus	Greenish Blue, insulanus subspecies	G5TH	SH	E (Nov 2000)
Euphydryas editha taylori	Edith's Checkerspot, taylori subspecies	G5T1	SH	E (Nov 2000)
Coenonympha california insulana	Common Ringlet, insulana subspecies	G5T3T4	S2	

For status rankings see Appendix J.

Habitat preferences of these 13 species were then further examined to determine whether there are potential habitats within the areas under study. Table 9 briefly summarizes pertinent information on these red listed species for the study area. Three species were then selected for more detailed review; information for these three key focal species are provided in Section 8.2.3.

Information sources for the following table included species status reports, CDC information, Cannings *et al.* 1999 for the reptiles and mammals, and Fraser *et al*. 1999 for birds. The Wildlife at Risk series, a number of RIC

inventory standards, and the Identified Wildlife Management Strategy (BC Environment 1999) were also used.

Table 8. Red-listed Animal Species at Risk– further information.

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
VERTEBRATES	**Habitats**	**Habits**	**Management**	**Sources and Occurance**
Sharp-tailed snake *Contia tenuis*	Use rock outcrops for basking. Occur in small openings and at edges of Fd/arbutus dominated stands with rotting logs. i..e dry woodlands. Especially on south-facing rocky slopes and talus.	Feed almost exclusively on slugs. Semi fossorial, moving through CWD, under rocks and underground; seldom on the surface. Surface activity peaks in March-April, also late Sept - early Oct. Moves short distances of c. 25metres.	Habitat degradation is a key threat. May also be at risk of predation by cats. Loss of coarse woody debris/cover objects a threat. Protect any known habitat areas.	Range not extensive but can be locally common. Known only from a few localities in the CDF zone, in dry woodlands, including North Pender and Saltspring Islands. Located on Saltspring near Vesuvius ferry terminal. Englestoft and Ovaska 2000. Cannings *et al*. 1999
Gopher snake, *Pituophis catenifer catenifer* subspecies	Use rock outcrops for basking; nest under large logs or rocks or in abandoned mammal burrows; grasslands.	Generally crepuscular, active foragers. Predate rabbits, rodents, lizards in burrows, trees and on ground. Den communally.	Habitat loss to agriculture and urban development. Degradation by Scotch broom, invasive exotic plants. Persecution	No known extant occurrences, probably extirpated. Was historically recorded from Galiano Island. Valley bottoms Cannings *et al*. 1999 Jared Hobbs, MWLAP Victoria, *pers. comm.*
Northern Goshawk *Accipiter gentilis langii* subspecies	Breeds in mature and old coastal coniferous forests. Hunts in forests, along edge of openings, and above canopy.	Preys on medium sized birds and mammals such as red squirrel. On VI red squirrel may be a critical food during spring period. Nesting success depends strongly on prey availability. Nests usually on gentle slopes at bottom third of slope, and generally face east or west on VI.	Is an identified wildlife species under forest practices code. Population believed declining. Logging a key impact.	Fraser *et al.* 1999 Don Doyle, MWLAP Nanaimo, *pers. comm.*
Peregrine Falcon *anatum* subspecies	Steep, rocky cliffs with good visibility of surrounds. Use inaccessible cliff ledges for nesting. Shores and marshes (frequented by shorebirds and waterfowl)	Predate other birds. Not confined to Garry oak ecosystems, but are known to breed on cliffs within Garry oak areas, such as Mount. Tzouhalem and in Mount. Maxwell area.	Avoid any disturbance of nesting habitats during breeding season. i.e no recreational use of cliffs where breeding occurs. Very susceptible to pesticide contamination.	Only about 20 active pairs known in B.C; about 7 pairs nest on Gulf Islands and southeast Vancouver Island. Fraser *et al.* 1999 Godfrey 1966 Don Doyle MWLAP Nanaimo, *pers. comm.*
Marbled Murrelet *Brachyramphus marmoratus*	Nest in coastal mature and old-growth coniferous forests; need large diameter trees limbs with thick moss, needles or lichens.	Forage for small schooling fish in bays, inlets and open ocean.	Substantial documented declines have occurred, thought to be due to loss of breeding habitat from logging. Vulnerable to oil spills.	Fraser *et al.* 1999

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
Lewis' Woodpecker (*Melanerpes lewis*) Georgia depression population	Open forests + woodlands with large standing dead trees and open areas incl. Logged + burnt forests, winter in woodlands, orchards and other open areas. Habitat for breeding comprises open canopy and large dead or decayed limbs, with a brushy understorey to provide abundant insects. (Sousa 1983).	Forage by hawking for insects, also feed on fruit and seeds. Populations can be unstable due to food supply fluctuations (e.g., insect hatches and acorn crops) (Bock 1970).	Dependent on snags Loss of nest trees a key factor in declines, through logging, firewood collection, fire suppression. Competition for nest sites by starlings may be a factor. Loss of oak forests on southern V.I. also may have contributed to decline (DeSante and George 1994 cited in Fraser et al. 1999) Eliminate or minimize pesticide spraying near nesting pairs, which may reduce insect prey base. Prohibit salvage logging of fire-burned trees wherever they occur. Retain standing dead or diseased trees where they occur. If nest cavities are limiting, may manage to provide nest cavity sites.	Formerly bred in southeast V.I. but now extirpated. De Sante and George 1994 Fraser *et al*. 1999 Fuchs 2001 Godfrey 1966 Sousa 1983 Bock 1970
Purple martin *Progne subis*	Areas near water where dead snags with woodpecker holes. Mainly in estuaries and harbors, on wood pilings. Will use artificial nest boxes. Patches of dead trees next to open areas including sheltered harbours, ponds and farmland	Arrive in early April, most in May. Start leaving in August, all gone by late Sept. Forage where flying insects are abundant.	Threatened by lack of nest sites, plus competition form European Starling and House Sparrow. Maintain old, dead and dying trees for cavities. Enhancements possible in right locations as will use nest boxes. Fraser et al. 1997 – plan to expand current range and extend population into protected areas, through a managed nestbox program. Avoid spraying with insecticides anywhere within range (within 12km of breeding sites) Avoid disturbance April – August.	Breeds in about 10 sites on southeastern V.I. Fraser *et al*. 1999 Fraser *et al*. 1997. Fuchs 2001
Western bluebird, Georgia Depression population (*Sialia mexicana*, population 1)	Habitats with interspersed trees + openings including woodlands, sparsely forested slopes, hill summits, burned or logged forest pastures Sparse woodlands, burntland, logged areas with dead trees +stumps, sometimes orchards			Relatively recent records form Saltspring (Mt. Tuam) Fraser *et al*. 1999 Fuchs 2001 Godfrey 1966
Vesper sparrow, *affinis* subspecies (*Pooecetes gramineus affinis*)	Not specific to Garry oaks. Occurs almost exclusively in dry open graslands, grassy clearings, or very open forest. Includes light to moderately grazed pastures with scattered shrubs/trees and grass height <60 cm; also Christmas tree farms, particularly young farms 2-5 years post-planting, if weedy with mixture of grasses, forbs and bare ground.	Ground nesting, in sparsely vegetated spots. Forages on ground for insects, some small seeds. Arrive in April, depart in Sept to Oct.	Habitat patches >8 ha (20 ac) may be sufficient to maintain a small population even if the area is not linked with other vesper sparrow populations. Keep area free of broom. Fire suppression an issue. Mowing or trampling during nesting could be a threat. Invasive exotic plants	Only known extant breeding areas are currently 5 pairs at Nanaimo airport; also at Cobble Hill meadows? Probably 5 to 10 pairs total. Fraser *et al*. 1999 Godfrey 1966

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
Western meadowlark, Georgia Depression population 1 (*Sturnella neglecta,)*	Small areas of suitable habitat (e.g., >8 ha [20 ac]) may provide for a few pairs. Use native and agricultural grass-dominated habitats and grass-dominated fields such as remnant prairies, fallow agriculture fields (e.g., CRP land, abandoned fields), and light to moderately grazed pastures. Areas where shrub/tree cover <10% Hayfields or cultivated grass fields making up <40% of the territory. Marginal habitat: Hayfields and cultivated grass fields (annual or perennial) with the following conditions: • Grass height <90 cm (36 in) tall • Shrub cover <25% • Singing perches as described above present within the territory	Need natural (trees, shrubs) or artificial (fence lines, telephone poles) singing perches within the territory. Habitat must occur within a landscape that includes some optimal habitat	Hayfields and grass-seed fields cut in early summer do not qualify as habitat because they often abort nesting and reduce productivity. Where ecologically appropriate, initiate actions in native prairies, pastures, and fallow fields to maintain or provide: • Shrub-tree cover <10% (fence lines, power lines may provide singing perches if shrubs or trees are absent) • Variable grass heights <76 cm (30 in) tall	Fraser *et al*. 1999 Fuchs 2001 Godfrey 1966
Keen's Long-eared Myotis	Mature coastal forest habitats where tree cavities, rock crevices and small caves thought to be summer roosts.	Appears to be solitary species. Very little known.	Roost sites and maternity roosts vulnerable.	Cannings et al 1999.
INVERTEBRATES	**Habitats**	**Habits**	**Management**	**Sources and Occurance**
Island Large Marble Undescribed subspecies (*Euchloe ausonides insulanus*)	Meadows, all elevations	Fly May and June at low elevations (early August in alpine); single brood. Eggs laid on brassicaceae, including *Arabis* species.	Habitat loss, invasive exotic plant species Overgrazing during early European settlement suspected to have eliminated some larval food plants. Introduced *Pieris rapae* (Cabbage White) may also use the larval food plants.	Possibly extirpated, last recorded Gabriola Island 1908; but found in 1997 on San Juan Island, WA. Probably extirpated from Canada Guppy & Shepard 2001 Fuchs 2001 BC MELP Wildlife At Risk series, 1999
Johnson's Hairstreak *(Loranthomitoura johnsoni)*	Parasitizing western hemlock. (mistletoe); below 625m.	Flies late May to early July. Over-winters in pupal stage. Larva usually feed on mistletoe *Arceuthobium* spp.	Bt spraying and mistletoe eradication in forest industry may impact on this species.	Endangered in BC. Known only from se V.I. and the Lower Fraser Valley. Guppy & Shepard 2001
Island blue (*Plebeius saepiolus insulanus)* or Greenish Blue	Old fields, along dirt roads and other disturbed sites, near host plants including introduced clover *Trifolium pratense*. Open areas including moist meadows, bog edges, prairie streamsides,	Associated with native clovers, Fly late May to July. Several clovers, *Trifolium* spp., are larval food but may also use others. Over-winters as an immature larva; Stays close to larval food plant. Poor dispersal	Invasive exotic species are a problem. Larval food plants are in good supply, but has not been recorded since the 1960's.	Possibly extirpated; known only form historic records, An endemic subspecies. Guppy & Shepard 2001

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
				Fuchs BC MELP Wildlife At Risk series, 1999
Common ringlet, *insulana* subspecies *Coenonympha california insulana*	Meadows, open grassy areas, GOE, but only where damp enough to maintain green grass through summer but that do not flood excessively in winter. Roadsides, woodland edges + clearings, prairies, bogs	Fly May to October (two broods which barely overlap). Lay eggs on grass; green grass and possibly sedges required for larval food	Urbanization, brush incursion, especially Scotch broom. .	Of special concern. Was abundant on VI in early 60's but now uncommon Guppy & Shepard 2001 Fuchs 2001

8.2.2 Summary of Blue-listed Wildlife Species

While focusing on red-listed species, we also compiled some information for a number of additional blue-listed species, to assist future managers in interpreting the wildlife values of the park and the ecosystems. Table 9 identifies blue listed species on the South Island tracking list. Those species not considered further are identified in Appendix H. Table 10 summarizes brief information gathered for remaining blue-listed species.

Table 9. Blue-listed Wildlife Species

Scientific Name	English Name	Status		
		Global	Sub national	COSEWIC
Rana aurora	Red-legged Frog	G4	S3S4	SC (MAY 2002)
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	G5T4	S3B,S4N	SC (1997)
Falco peregrinus pealei	Peregrine Falcon, *pealei* subspecies	G4T3	S3B,SZN	SC (NOV 2001)
Columba fasciata	Band-tailed Pigeon	G4	S3S4B,SZN	
Glaucidium gnoma swarthi	Northern Pygmy-Owl, *swarthi* subspecies	G5T3Q	S3	
Pinicola enucleator carlottae	Pine Grosbeak, *carlottae* subspecies	G5T3	S3B,SZN	
Corynorhinus townsendii	Townsend's Big-eared Bat	G4	S2S3	
Mustela erminea anguinae	Ermine, *anguinae* subspecies	G5T3	S3	
Erynnis propertius	Propertius Duskywing	G5	S3	
Hesperia colorado oregonia	Common Branded Skipper, *oregonia* subspecies	G5T3T4	S3	
Euphyes vestris	Dun Skipper	G5	S3	T (Nov 2000)
Colias occidentalis	Western Sulphur	G3G4	S3S4	
Incisalia mossii mossii	Moss' Elfin, *mossii* subspecies	G4T4	S3	
Icaricia icarioides blackmorei	Boisduval's Blue, *blackmorei* subspecies	G5T3	S3	
Speyeria zerene bremnerii	Zerene Fritillary, *bremnerii* subspecies	G5T3T4	S3	
Cercyonis pegala incana	Common Woodnymph, *incana* subspecies	G5T?	S3	
Aeshna tuberculifera	Black-tipped Darner	G4	S3	
Epitheca canis	Beaverpond Baskettail	G5	S3	
Erythemis collocata	Western Pondhawk	G5	S3	
Pachydiplax longipennis	Blue Dasher	G5	S3	

Scientific Name	English Name	Status		
		Global	Sub national	COSEWIC
Sympetrum vicinum	Yellow-legged Meadowhawk	G5	S3S4	

Table 10. Blue listed Animal Species at Risk– further information

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
VERTEBRATES	**Habitats**	**Habits**	**Management**	**Sources**
Great Blue Heron, *Ardea herodias fannini* subspecies	Nest singly or in colonies in undisturbed mature forests and woodlands near foraging habitats. Nesting colonies usually within 3km of good foraging areas.	Forage in tidal mudflats, estuaries, slow moving rivers and sloughs, and marshy lakes and agricultural fields, kelp forests, shallow beaches.	Sensitive to disturbance at colonies, also to contaminants and pollutants.	Fraser *et al*. 1999
Band-tailed pigeon (*Columba fasciata*)	Oak groves where pigeons will roost and feed Open woodland and edges. Good habitat in the study area, expecially in the northern half. Flocks of perhaps 40 or more observed.	Use arbutus groves.		Godfrey 1966
Barn owl (*Tyto alba*)	Mainly associated with agricultural areas; nests mainly in man made structures, occasionally in natural cavities, cliffs, hawk nests. Thought to be approx. 1000 individuals. meadows, marshes. Roosts and nests in buildings, hollow trees	Prey almost exclusively on Townsend's Vole, which use grassland habitats Known to breed on Saltspring.	Pesticides have been a problem. Severe winters. Highway collisions a key cause of mortality. Have used artificial nestboxes.	Fraser *et al*. 1999 Fuchs 2001 Godfrey 1966
Northern Pygmy-Owl, *swarthi* subspecies	Mixed coniferous woodland, often on steep hillsides, talus slopes or ravines not far from water. May be more common in old growth forest rather than second growth.	Secondary cavity nesters preferring abandoned woodpecker holes and natural tree cavities.	May be impacted by spread of the Barred owl. Also forest harvesting.	Fraser et al 1999
Townsend's Big eared Bat	Cave and cave-like roosts In wide variety of habitats but uses caves or cave-like roosts.	Forage in riparian wetlands and other moist areas	Human disturbance at hibernacula + nursery colonies	Fuchs 2001
Ermine *anguinae* subspecies	Various, especially riparian, thick understorey		Habitat loss and fragmentation, possibly forest practices, limitation of prey base	*Anguinae* subspecies restricted to VI and Saltspring and apparently sparse. There are no recent Saltspring Island records. Cannings et al 1999 Fuchs 2001
INVERTEBRATES	**Habitats**	**Habits**	**Management**	**Sources**
Propertius dusky wing (*Erynnis properties*)	Strongly associated with GOE Hillsides, woodland clearings, open meadows, always near oaks	Lay eggs on Garry oak. Relies on oak as host plant; also meadow plants for nectar Fly late April – early July (1 record late July) Pupate in the leaf litter below Garry oaks. Nectar sources include camas, vetch, and Hooker's onion.	Leave leaf litter at base of trees to protect hibernating larvae	Species of concern in BC; still around in moderate numbers More common to the south in Washington and Oregon. Collected primarily on se tip of V.I. and adjacent Gulf islands, where Garry oak occur. Guppy & Shepard 2001 BC MELP Wildlife At Risk 1999 Fuchs 2001

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
Common Branded Skipper, (Oregon Skipper) *Hesperia colorado oregonia* subspecies	Always in open grassy areas. A distinctive subspecies	Flies early July to early Sept. Larval foods are grasses including *Lolium* and *Bromus*, possibly *Festuca*, and *Carex* species also.	Rare due to land alienation.	Guppy & Shepard 2001
Dun skipper *Euphyes vestris*	Mesic grassy areas Moist areas near deciduous woods incl. Meadows, seeps, swamp edges, streams, roadside ditches, also dry sites with permanent springs or spring floods	Fly late June to mid August; 1 brood Only known food plant (from elsewhere) is *Cyperus esculentus*; possibly other sedges and grasses	Manage for grasses and sedges Threats: habitat loss, invasive exotic plants, hydrological changes	Guppy & Shepard 2001 Fuchs BC MELP Wildlife At Risk 1999 Known from southern V.I. and lower mainland, generally as single individuals. Not found in 1955 survey, and few sightings in recent years.
Western sulphur *Colias occidentalis*	Dry grassy slopes and forest edges; also on VI in sea-level forest openings and edges, up into alpine meadows.	Fly from June to Sept. depending on elevation. Over-winter in fold of shriveled leaf., then larvae start feeding again in April and pupate a month later. Larval foodplants in BC unknown but Lathyrus nevadensis var. nuttallii is likely. Elsewhere eggs found on sweet white clover , lupines, and *Vicia sativa*.		Of special concern in BC. Guppy & Shepard 2001
Moss' elfin, *mossii* subspecies (*Incisalia mossii mossii*)	Likes dry, bluffs and rocky outcroppings or scree slopes, with *Sedum*, the larval foodplant and a nectar source, rocky knolls and cliffs – relatively bare rock faces.	Fly mid April to late May larval food is mainly *Sedum spathulifolium*; may also use *S. lanceolatum.* Pupate on ground among plant debris.	Deer graze larval foodplant heavily (Chris Guppy). Could be threatened by climbers and hikers damaging rock faces, invasive exotic species, habitat loss Number of VI populations greatly reduced by development.	Status uncertain Guppy & Shepard 2001 Fuchs 2001 BC MELP Wildlife At Risk series, 1999
Boisduval's blue, *(Icaricia icariodes blackmorei* subspecies*)*	High sub alpine areas, low elevation habitats with lupins.	Fly mid May for a month at low elevations (to mid-August higher up) Lupins, e.g. *Lupinus latifolius*? are larval foods. Overwinter as pupae and larvae. Extensive myrmecohily (ant attendance) upon larvae.	Broom invasion and fire suppression implicated in loss of low elevation populations (by choking out lupine?-	Of special concern Island populations not observed at low elevations since mid 60's, but flourishing in alpine Guppy & Shepard 2001 BC MELP Wildlife At Risk series, 1999.
Bremner's fritillary, *bremnerii* subspecies (*Speyeria zerene*	Mesic and xeric meadows with permanent springs prairie, sagebrush, woodland clearings,	Early July to late August, depending on elevation. Only occurs where there is no broom invasion. Congregate around *Viola* sp. larval foodplant.	Habitat loss, invasive exotics, especially Scotch broom, woody encroachment Sheep grazing may keep some meadows open.	Subspecies is of special concern. Only know from 3 locations, A thriving population on Saltspring Island, .Mount Tuam, grassland

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
bremnerii) Also Zerene fritillary	subalpine			areas, 2 areas further north, may be found in other areas on Vancouver island, Guppy & Shepard 2001 Fuchs 2001 BC MELP Wildlife At Risk, 1999

Species	Typical Habitats/ habitat elements; range/locations	Habits	Key threats/Issues Special Management (eg elements to manage for, timing)	Likely occurrence in study area; Information sources
Taylor's or Edith's checkerspot *(Euphydryas editha taylori)*	Lowland dry meadows close to ocean, clearings, and where GOE exist –coastal chaparral meadows, fields, foothills, open woods, alpine meadows	Flies from mid April – mid May at low elevations. Ribwort plantain *Plantago lanceolata* and *P. maritima* are larval food. Spring gold *Lomatium utriculatum* is a key nectar source	Adult nectar source, spring gold (*Lomatium utricularium*), nearly eliminated by broom at Beacon Hill Park. Some physical impacts people walking. Encourage or plant spring gold Habitat loss, invasive exotics - broom, woody encroachment, fire suppression, lack of grazing Pesticides, herbicides, land clearing Habitat overrun with Scotch broom	Prior to European settlement Beacon Hill Park; previously found in Heliwell, on Hornby Island., has not been found for several years, (was one health population on Hornby in 1995) Guppy & Shepard 2001 Fuchs, Scudder 1996 BC MELP Wildlife At Risk, 1999
Common Woodnymph *Cercyonis pegala incana* subspecies	Grassy forest openings, clearcuts, roadsides, meadows, stream banks.	Larval foodplants probably grasses in BC. Elsewhere, *Tridens flavus, Avena fatua, Stipa, Andropogon* and *Carex* have been recorded as foodplants. Fly July to September. Adults feed on flowers and on willow and poplar sap.		Of special concern in BC. Guppy & Shepard 2001.
Great Arctic *Oeneis nevadensis*	Forest openings and edges of meadows, from sealevel to above timberline. Males usually on ridgetop clearings but also in forest openings lower down.	Fly in June and July at low elevations; much more abundant in alternate years. Larval foodplants unknown but probably grasses (used in captivity)		Of special concern in BC. Guppy & Shepard 2001.
Black-tipped Darner *Aeshna tuberculifera*	An uncommon dragonfly of peatland pools and peat-margined lakes	Females patrol like the males and often lay eggs in vegetation above waterline. Fly mid-June to early October.		Cannings 2002.
Beaverpond baskettail *Epitheca canis*	Rare inhabitant of marshy lakeshores, boggy ponds and backwaters of slowly flowing streams.	Spring and early summer species that flies from early May to mid-August.		Cannings 2002.
Western Pondhawk *Erythemis collocata*	Lives around ponds and marshy lakes.	Perches flat on ground,. Usually flies mid-May to early October.		Lowlands of BC's south coast. Cannings 2002.
Blue Dasher *Pachidiplax longipennis*	Ponds and lakes with abundant vegetation along shore.	Perch with wings often cocked downward on twigs and stems. Flies from early June to mid-September.		Abundant in North America but restricted in Southern BC, mainly Gulf Islands. Cannings 2002.
Yellow-legged Meadowhawk *Sympetrum vicinum*	Ponds, slow streams and lakes with dense emergent vegetation.	Fly early June to mid-November.		Cannings 2002.

Species accounts for a few of the blue-listed species were located during our reviews, and are included for background information in Appendix E.

8.2.3 Focal Wildlife Species

After compiling brief information on the red-listed species in Table 9, only the following three (Peregrine Falcon, Northern Goshawk and Sharp-tailed Snake) were selected for a more detailed habitat assessments in this project. The results are presented below.

Peregrine Falcon:

We have not produced any interpretive maps for peregrine falcon habitat in the study area. A species account is provided in Appendix E.

Photo 8. Peregrin Falcon (Photo by Derrick Marvin)

A number of cliffs are present and are visible on the TRIM maps and the base mapping for this project. However, from fieldwork it became clear that these cliffs are relatively small, and there are no sufficiently steep cliffs within the study area boundaries to support nesting by this species. Bluffs that occur were generally mapped as SC or RO units; although steep they are not the near vertical cliffs of sufficient size or stature for peregrines to nest. The birds will no doubt hunt over the study area, and a pair regularly nests on the steep cliffs of Mount Baynes, just to the east of the study area boundary. These birds will have an excellent view over Sansum Narrows and likely predate many marine birds. They can also be expected to forage over the habitats within the study area, catching medium sized birds. As they will maintain a substantial territory it is unlikely that another pair would nest within the study area, even if other suitable sites were present.

Northern Gowhawk:

A species account for the goshawk is provided in Appendix E, and Figure 8 illustrates potential habitat (CAPSU ratings applied) within the study area for breeding by Northern Goshawk. This species will almost certainly forage in the area, and may nest in the study area, although there is no inventory information available. The coniferous forests mapped are certainly of sufficient stand size and density, and are reaching sufficient stature in some areas, to possibly support goshawk nesting. However, in southern Oregon, goshawks have been found to be associated with cooler, northerly aspects. Elsewhere on VI there is no such apparent relationship to aspect (Don Doyle, *pers. comm.*), but the very warm, dry conditions prevailing on the slopes of Mount. Maxwell could influence nest site selection. If the upper canopy provides sufficient protection from the sun, and the subcanopy is adequately developed, it is reasonable to expect goshawk could nest in the study area. However habitat values are not high, as there are no extensive areas of mature and old-growth forests. Age classes 5 and 6 in the area are however quite dense in many cases, and have generally been rated as having a moderate potential.

Red squirrel is a major prey base for goshawks on Vancouver Island, and it is possible that there is a link between squirrel densities and goshawk populations (Don Doyle *pers. comm.*). Certainly red squirrels do not appear to be especially abundant in the study area, although this is purely a subjective and qualitative impression only. They are certainly present, and as yet there appear to be no records of the invasive gray squirrel reaching the area and replacing the red squirrels. No gray squirrels were noted during fieldwork.

It should be noted the map of potential goshwak habitat is very preliminary in nature. There is no field inventory or data available for the dry CDF forests, present in our area, with which we can fine-tune the ratings at present.

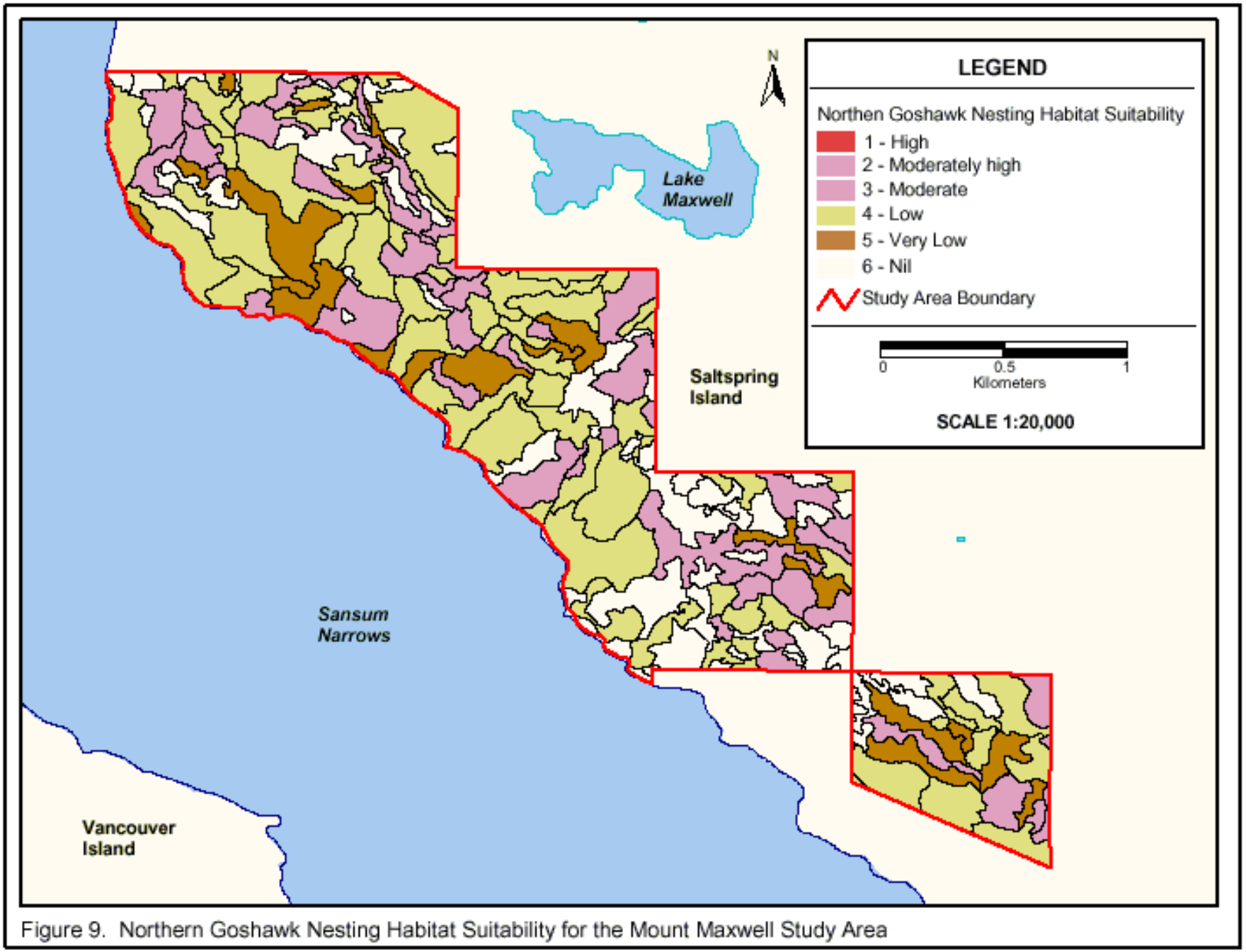

Figure 9. Northern Goshawk Nesting Habitat Suitability for the Mount Maxwell Study Area

Sharp-tailed Snake:

A species account is provided in Appendix E, and potential areas of habitat are illustrated in Figure 9.

There has been no inventory for this species within the study area, and its habits are very poorly known. However, Engelstoft and Ovaska (2000) conducted studies on this species in the Gulf islands over a three-year period (1996-1998). Snake populations were located on Saltspring in the vicinity of Vesuvius ferry landing, but searches were very restricted in distribution. No searching was conducted within this study area. Potential sharp-tailed snake habitat in the study area is based on rather limited knowledge with respect to habitat requirements. However, although seldom on the surface, they are known to use rock outcrops for basking, and occur in small openings and at the edges of fir/arbutus-dominated stands with rotting logs. The relatively extensive south-facing rocky slopes of Mount Maxwell therefore offer some potentially important sharp-tailed snake habitats.

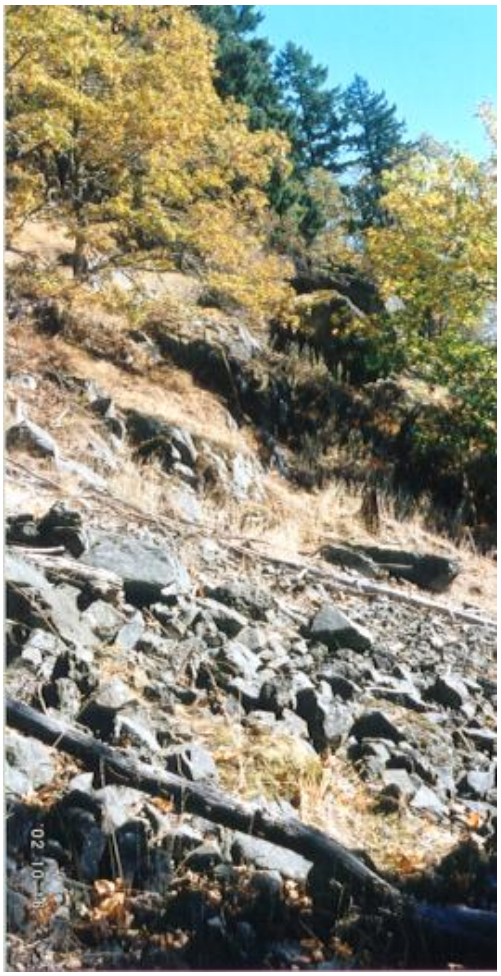

Photo 9. Potential sharp-tailed snake habitat

Based on the above, it seems likely that the best habitats in the study area would be in areas of colluvium supporting forest or woodland cover, with small openings. These sites would provide the snakes with plentiful cover for moving below ground, combined with coarse woody debris from the older forests or deciduous woodlands.

The map of potential habitat therefore illustrates all polygons mapped with colluvium as a component, even if only a small portion in the third decile of the TEM label has colluvium. It is possible some of the adjacent polygons would also have very small pockets of colluvium present, that are generally not visible in air photos, and are too small to map out. Figure 9 is thus intended only to provide a starting point for stratifying surveys to begin searches for this species within the study area. It is not a CAPSU rating map, and it does not provide any rankings of habitat quality. It is only intended as a general indication of where the best areas may be to begin any efforts at inventory. With further inventory information it would be possible to refine this mapping to better define Sharp-tailed snake habitat.

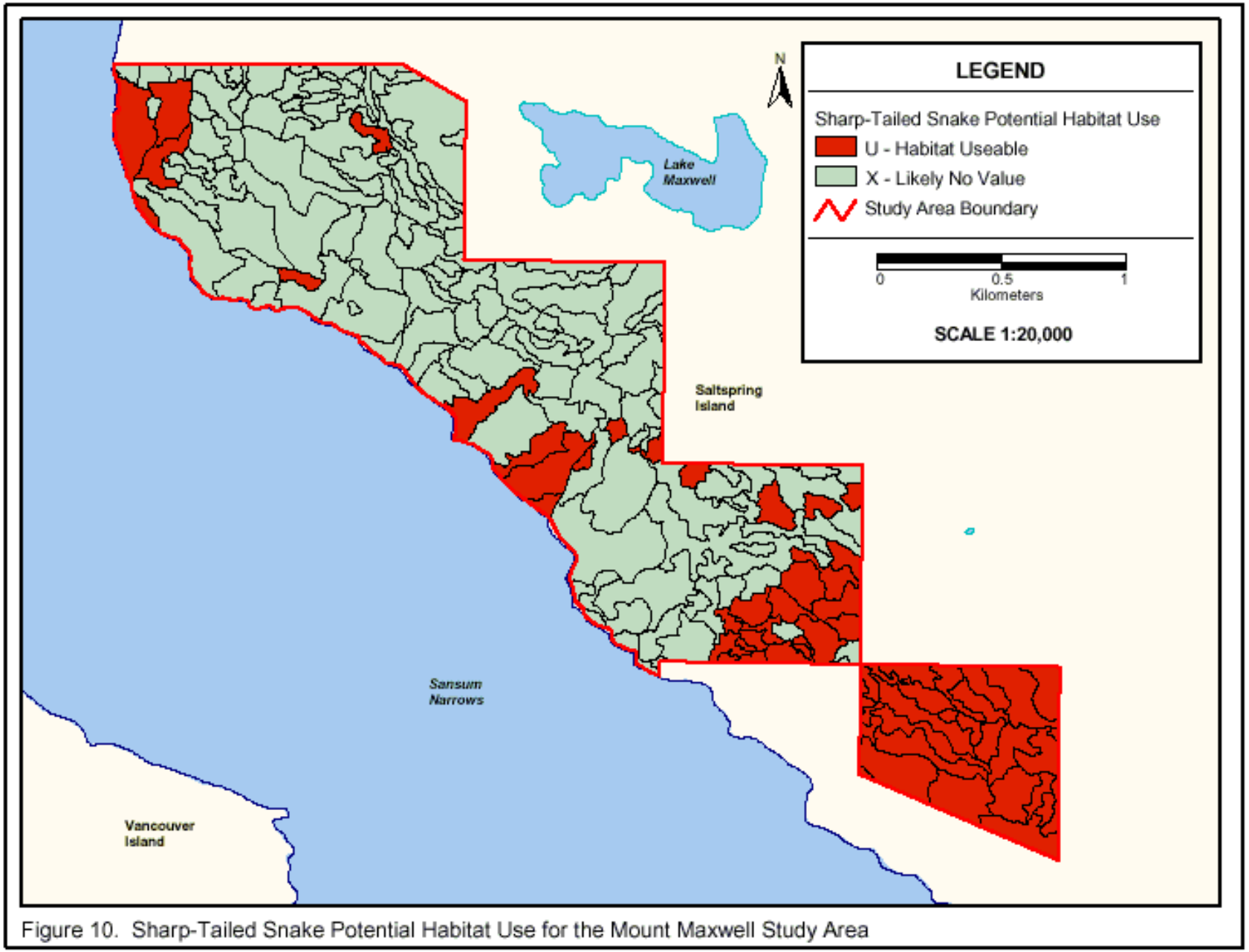

Figure 10. Sharp-Tailed Snake Potential Habitat Use for the Mount Maxwell Study Area

8.3 Future Wildlife Studies

Wildlife interpretations are limited by the paucity of detailed habitat knowledge for many species, combined with a lack of direct inventory within the study area. Future RIC-standard surveys for all wildlife groups, but especially for reptiles (with an emphasis on sharp-tailed snake) and for a number of bird groups, including diurnal raptors and owls, are strongly recommended. Breeding songbird surveys should also be conducted. A series of inventories for invertebrates, including butterflies and dragonflies, is also strongly recommended. Some mark-recapture studies on the small mammal fauna, to get some idea of densities, would assist in developing interpretations for a number of predatory species.

Late spring and early summer field surveys for Western Bluebird and Lewis' Woodpecker should also be conducted. The feasibility of a re-introduction program for Western bluebird in this area (combined with Mount Tuam, Mt Tzouhalem and other possible sites) should also be examined.

The mine located during fieldwork should be investigated for bats (see Photo 7).

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APPENDIX A: SITE MODIFIERS FOR ATYPICAL CONDITIONS

(as per "Table 3.2" from the *Standard for Terrestrial Ecosystem Mapping in British Columbia,* Resources Inventory Committee, 1998.*)*

Code	Criteria
Topography	
a	active floodplain[1] – the site series occurs on an active fluvial floodplain (level or very gently sloping surface bordering a river that has been formed by river erosion and deposition), where evidence of active sedimentation and deposition is present.
g	gullying[1] occurring – the site series occurs within a gully, indicating a certain amount of variation from the typical, or the site series has gullying throughout the area being delineated.
h	hummocky[1] terrain (optional modifier) – the site series occurs on hummocky terrain, suggesting a certain amount of variability. Commonly, hummocky conditions are indicated by the terrain surface expression but occasionally they occur in a situation not described by terrain features.
j	gently slope – the site series occurs on gently sloping topography (less than 25% in the interior, less than 35% in the CWH, CDF, and MH zones).
k	cool aspect – the site series occurs on cool, northerly or easterly aspects (285° – 135°), on moderately steep slopes (25%–100% slope in the interior and 35%–100% slope in the CWH, CDF, and MH zones).
n	fan[1] – the site series occurs on a fluvial fan (most common), or on a colluvial fan or cone.
q	very steep cool aspect – the site series occurs on very steep slops (greater than 100% slope) with cool, northerly or easterly aspects (285°–135°).
r	ridge[1] (optional modifier) – the site series occurs throughout an area of ridged terrain, or it occurs on a ridge crest.
t	terrace[1] – the site series occurs on a fluvial or glaciofluvial terrace, lacustrine terrace, or rock cut terrace.
w	warm aspect – the site series occurs on warm, southerly or westerly aspects (135°–285°), on moderately steep slopes (25%–100% slope in the interior and 35%–100% slope in the CWH, CDF, and MH zones).
z	very steep warm aspect – the site series occurs on very steep slopes (greater than 100%) on warm, southerly or westerly aspects (135°–285°).

Code	Criteria
Moisture	
x	drier than typical (optional modifier) – describes part of the range of conditions for circummesic ecosystems with a wide range of soil moisture regimes or significantly different site conditions. For example, SBSmc2/01 (Sxw–Huckleberry) has three site phases described, and the submesic phase can be labeled with the "drier than average" modifier (e.g., SBx). This code should be applied only after consultation with the Regional Ecologist.
y	moister than typical (optional modifier) – describes part of the range of conditions for circummesic ecosystems with a wide range of soil moisture regimes or significantly different site conditions. For example, SBSmk1/06 (Sb–Huckleberry–Spirea) is "typically" described as submesic to mesic. When this site series is found on subhygric or hygric sites, the "y" modifier is used (e.g., Bhy). This code should be applied only after consultation with the Regional Ecologist.
Soil	
c	coarse-textured soils[2] – the site series occurs on soils with a coarse texture, including sand loamy sand; and also sandy loam, loam, and sandy clay loam with greater than 70% **coarse fragment volume.**
d	deep soil – the site series occurs on soils greater than 100 cm to bedrock.
f	fine-textured soils[2] – the site series occurs on soils with a fine texture including silt and silt loam with less than 20% coarse fragment volume; and clay, silty clay, silty clay loam, clay loam, sandy clay and heavy clay with less than 35% coarse fragment volume.
m	medium-textured soils – the site series occurs on soils with a medium texture, including sandy loam, loam and sandy clay loam with less than 70% coarse fragment volume; silt loam and silt with more than 20% coarse fragment volume; and clay, silty clay, silty clay loam, clay loam, sandy clay and heavy clay with more than 35% coarse fragment volume.
p	peaty material – the site series occurs on deep organics or a peaty surface (15–60 cm)[3] over mineral materials (e.g., on organic materials of sedge, sphagnum, or decomposed wood).
s	shallow soils – the site series occurs where soils are considered to be shallow to bedrock (20–100 cm).
v	very shallow soils – the site series occurs where soils are considered to be very shallow to bedrock (less than 20 cm).

[1] Howes and Kenk, 1997
[2] Soil textures have been grouped specifically for the purposes of ecosystem mapping.
[3] Canada Soils Survey Committee, 1987

APPENDIX B: STRUCTURAL STAGES AND CODES

(as per "Table 3.3" from the *Standard for Terrestrial Ecosystem Mapping in British Columbia,* Resources Inventory Committee, 1998.*)*

Structural Stage	Description
Post-disturbance stages or environmentally induced structural development	
1 Sparse/bryoid[2]	Initial stages of primary and secondary succession; bryophytes and lichens often dominant, can be up to 100%; time since disturbance less than 20 years for normal forest succession, may be prolonged (50–100+ years) where there is little or no soil development (bedrock, boulder fields); total shrub and herb cover less than 20%; total tree layer cover less than 10%.
Substages	
1a Sparse2	Less than 10% vegetation cover;
1b Bryoid2	Bryophyte- and lichen-dominated communities (greater than ½ of total vegetation cover).
Stand initiation stages or environmentally induced structural development	
2 Herb[2]	Early successional stage or herbaceous communities maintained by environmental conditions or disturbance (e.g., snow fields, avalanche tracks, wetlands, grasslands, **flooding**, intensive grazing, intense fire damage); dominated by herbs (forbs, graminoids, ferns); some invading or residual shrubs and tress may be present; tree layer cover less than 10%, shrubby layer cover less than or equal to 20% or less than 1/3 of total cover; time since disturbance less than 20 years for normal forest succession; may herbaceous communities are perpetually maintained in this stage.
Substages	
2a Forb-dominanted[2]	Herbaceous communities dominated (greater than ½ o the total herb cover) by non-graminoid herbs, including ferns.
2b Graminoid-dominated[2]	Herbaceous communities dominated (greater than ½ of the total herb cover) by grasses, sedges, reeds, and rushes.
2c Aquatic[2]	Herbaceous communities dominated (greater than ½ of the total herb cover) by floating or submerged aquatic plants; does not include sedges growing in marshes with standing water (which are classed as 2b).
2d Dwarf shrub[2]	Communities dominated (greater than ½ of the total herb cover) by dwarf woody species such as *Phyllodoce empetriformis, Cassiope mertensiana, Cassiope tetragona, Arctostaphylos arctica, Salix reticulata*, and *Rhododendron lapponicum.* (See list of dwarf shrubs assigned to the herb layer in the *Field Manual for Describing Terrestrial Ecosystems*).
3 Shrub/Herb[3]	Early successional stage or shrub communities maintained by environmental conditions or disturbance (e.g., snow fields, avalanche tracks, wetlands, grasslands, **flooding**, intensive grazing, intense fir damage); dominated by shrubby vegetation; seedlings and advance regeneration may be abundant; tree layer cover less than 10%; shrub layer cover greater than 20% or greater than or

equal to 1/3 of total cover.

Structural Stage	Description
Substages	
3a Low shrub[3]	Communities dominated by shrub layer vegetation less than 2 m tall; may be perpetuated indefinitely to environmental conditions or repeated disturbance; seedlings and advance regeneration may be abundant; time since disturbance less than 20 years for normal forest succession.
3b Tall shrub[3]	Communities dominated by shrub layer vegetation that are 2–10 m tall; may be perpetuated indefinitely by environmental conditions or repeated disturbance; seedlings and advance regeneration may be abundant; time since disturbance less than 40 years for normal forest succession.
Stem exclusion stages	
4 Pole/Sapling[4]	Trees greater than 10m tall, typically dense stocked, have overtopped shrub and herb layers; younger stands are vigorous (usually greater than 10–15 years old); older stagnated stands (up to 100 years old) are also included; self-thinning and vertical structure not yet evident in the canopy – this often occurs by age 30 in vigorous broadleaf stands, which are generally younger than coniferous stand at the same structural stage; time since disturbance ins usually less than 40 years for normal forest succession; u to 100+ years for dense (5,00015,000+ stems per hectare) stagnant stands.
5 Young Forest[4]	Self-thinning has become evident and the forest canopy has begun differentiation into distinct layers (dominant, main canopy, and overtopped); vigorous growth and a more open stand than in the pole/sapling sate; time since disturbance is generally 40–80 years but may begin as early as age 30, depending on tree species and ecological conditions.
Understory reinitiation stage	
6 Mature Forest[4]	Trees established after the last disturbance have matured; a second cycle of shade tolerant trees may have become established; understories become well developed as the canopy opens up; time since disturbance is generally 80–140 years for biogeoclimatic group A[5] and 80–250 years for group B[6].
Old-growth stage	
7 Old Forest[4]	Old, structurally complex stands composed mainly of shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and **coarse woody debris** in all stages of decomposition typical, as are patchy understories; understories may include tree species uncommon in the canopy, due to inherent limitations of these species under the given conditions; time since disturbance generally greater than 140 years for biogeoclimatic group A[5] and greater than 250 years for group B[6].

1 In the assessment of structural state, structural features and age criteria should be considered together. Broadleaf stands will generally be younger than coniferous stands belonging to the same structural stage.

2 Substages 1a, 1b, and 2a-d should be used if photo interpretations is possible, otherwise, stage 1 and 2 should be used.

3 Substages 3a and 3b may, for example, include very old krummholz less than 2m tall and very old, low productivity stands (e.g., gob woodlands) less than 10 m tall, respectively. Stage 3, without additional substages, should be used for regenerating forest communities that are herb or shrub dominated, including shrub layers consisting of only 10%-20% tree species, and undergoing normal succession toward climax forest (e.g., recent cut-over areas or burned areas).

4 Structural stages 4–7 will typically be estimated from a combination of attributes based on forest inventory maps and aerial photography. In addition to structural stage designation, actual age for forested units can be estimated and included as an attribute in the database, if required.

5 Biogeoclimatic Group A includes BWBSdk, BWBSmw, BWBSwk, BWBSvk, ESSFdc, ESSFdk, ESSFdv, ESSFxc, ICHdk, ICHdw, ICHmk1, ICHmk2, ICHmw3, MS (all subzones), SBPS (all subzones), SBSdh, SBSdk, SBSdw, SBSmc, SBSmh, SBSmk, SBSmm, SBSmw, SBSwk1 (on plateau), and SBSwk3.

6 Biogeoclimatic Group B includes all other biogeoclimatic units

APPENDIX C: SOIL CLASSIFICATION

Soil Classification	
Brunisolic Order	
DYB	Dystric Brunisol
E.DYB	***Eluviated Dystric Brunisol***
GL.DYB	Gleyed Dystric Brunisol
GL.SB	Gleyed Sombric Brunisol
O.DYB	Orthic Dystric Brunisol
O.SB	Orthic Sombric Brunisol
SB	Sombric Brunisol
Gleysolic Order	
FE.G	Fera Gleysol
G	Gleysol
O.G	Orthic Gleysol
Organic Order	
FI.M	Fibric Mesisol
FO	Folisol
H.	Humisol
HE.FO	Hemic Folisol
HI.FO	Histic Folisol
HU.FO	Humic Folisol
HU.M	Humic Mesisol
LI.FO	Lignic Folisol
M	Mesisol
TY.H	Typic Humisol
TY.M	Typic Mesisol
Podzolic Order	
FHP	Ferro-Humic Podzol
FR.HFP	Fragic Humo-Ferric Podzol
GL.FHP	Gleyed Ferro-Humic Podzol
GL.HFP	Gleyed Humo-Ferric Podzol
GLSM.FHP	Gleyed Sombric Ferro-Humic Podzol
HFP	Humo-Ferric Podzol
O.FHP	Ortho Ferro-Humic Podzol
O.HFP	Ortho Humo-Ferric Podzol
SM.HFP	Sombric Humo-Ferric Podzol
Regosolic Order	
CU.HR	Cumulic Humic Regosol
CU.R	Cumulic Regosol
GL.HR	Gleyed Humic Regosol
O.HR	Orthic Humic Regosol
O.R	Orthic Regosol
R	Regosol

APPENDIX D: MOUNT MAXWELL LEGEND

TERRESTRIAL ECOSYSTEM MAPPING OF MOUNT MAXWELL ECOLOGICAL RESERVE

Ministry of Water Land and Air Protection
Environmental Stewardship
Vancouver Island Region

Map sheets
092B.083, 092B.073
Scale 1:2 000
March 2003

INTRODUCTION

Terrestrial Ecosystem Mapping of the Mt. Maxwell Ecological Reserve was undertaken in 2002/2003 with the objective to classify, map at a scale of 1:2,000 and describe the natural ecosystems within the study area according to Resource Inventory Committee (RIC) standards of 1998. In addition to mapping using TEM standards, the TEM polygons were also classified by Garry oak ecosystem type, currently under development (Meidenger *et al*. 2001). The Garry Oak Ecosystem Classification is illustrated in additional interpretive maps in the accompanying project report (MESL 2003). The project received funding from the Ministry of Water Land and Air Protection, Environmental Stewardship, Vancouver Island Region. The maps and databases produced in this project are a fundamental first step in the management of sensitive ecosystems on Mt Maxwell and an important tool to support interpretation of these ecosystems for rare elements of biodiversity.

ECOSECTION
SOG: Straight of Georgia

BIOGEOCLIMATIC UNITS
CDFmm Coastal Douglas Fir, Moist Maritime

SITE MODIFIERS

Code	Criteria	Code	Criteria
a	active floodplain	n	fan or cone
c	coarse textured soil	p	peaty material on surface
d	deep soil	q	very steep cool aspect (285°-135°, slope >100%)
f	fine-textured soil	r	ridge
g	gullying occurring	s	shallow soils (20-100cm to bedrock)
h	hummocky terrain	t	terrace
j	gentle slope (slope <35%)	v	very shallow soil (<20cm to bedrock)
k	cool aspect (285°-135°, slope 35 – 100 %)	w	warm aspect (135°-285°, slope 35 – 100 %)
m	medium-textured soil	z	very steep warm aspect (135°-285°, >100% slope)

STRUCTURAL STAGE

Code	Structural Stage
1	Sparse/Bryoid
2	Herb
2a	Forb
2b	Graminoid
2c	Aquatic
2d	Dwarf Shrub
3	Shrub/Herb
3a	Low Shrub
3b	Tall Shrub
4	Pole/Sapling
5	Young Forest (generally 40-80 years but may begin as early as age 30, depending on tree species and ecological conditions)
6	Mature Forest (CWH and MH, 80-250 years)
7	Old Forest (CWH and MH, >250 years)

ECOSYSTEM UNITS

CDFmm Coastal Douglas Fir Moist Maritime

Map Code	Site Series #	Site Series Name	Assumed Modifiers	Typical Conditions	Typical Moisture Regime	Mapped Modifiers
DS	01	Douglas-fir - Salal	d, j, m	mid to upper slope position; medium textured soils.	subxeric - mesic	c, w
DA	02	Douglas-fir – Lodgepole pine - Arbutus	d, j, m, r	upper slope to crest position; medium textured soils.	xeric	c, s, w
DG	04	Douglas-fir – Grand-fir - Oregon grape	d, j, m	deep, medium textured soil; middle to upper slope position; richer nutrient regime	subxeric - mesic	w
FC	00	Fescue – Camas	j, m, s	very shallow, medium-textured soils; coastal bluffs and forest openings.	subxeric	w, z
GO	00	Garry oak – Ocean spray	j, m, r	upper slope to crest position; medium nutrient regime.	xeric - submesic	w
SC	00	Cladina – Wallace's selaginella	j, m, r, v	typically on ridge crests and upper slopes; very shallow, medium textured soils on rock outcrops in forest openings.	subxeric	w, z
RO	-	Rock outcrop	-	-	-	-

DATA SOURCES

This mapping project is based on 1:10,000 black and white aerial photography from Geographic Data BC taken in 1985. Ernie Pacholuk created the base map from these air photos as the TRIM base did not adequately support 1:2,000 mapping. Full plots as well as ground inspection plots and visual checks were completed in the study area to achieve a survey intensity level 1. There was a total of 154 plots, 3 full, 26 ground inspections and 125 visual checks, completed between October 2002 and March 2003. Plot locations are shown on the map. Visual plots begin with V and ground inspection plots begin with G. All other plots are detailed.

CREDITS

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APPENDIX E: SPECIES AND PLANT COMMUNITY ACCOUNTS

LEWIS' WOODPECKER (*Melanerpes lewis*) Provincial Code: B-LEWO

Status

Lewis' woodpecker is BLUE-listed. It is absent from much of its former range in southwestern B.C. Declines have been attributed to loss of riparian habitat, and loss of burned ponderosa pine and Douglas-fir due to fire suppression.

Ecology

The Lewis' woodpecker forages in open woodlands and riparian areas, which provide sufficient visibility and space for effective flycatching. It feeds mainly on flying insects that are caught on the wing or by hawking from exposed perches. It also consumes insects such as ants that are caught on the ground, in low brush, or occasionally gleaned from tree surfaces. Fruits and berries compose the main diet in late summer and fall, while winter food consists mainly of nuts and other seeds. These woodpeckers collect nuts and seeds, often concealing them under bark crevices for winter storage. The Lewis' woodpecker usually nests in cavities excavated by other woodpeckers, but natural cavities are occasionally used and the same cavity is often occupied in consecutive years. In a few places, Lewis' woodpeckers nest in loose aggregations. During the spring breeding season, the Lewis' woodpecker protects only its immediate nest site, but in winter it defends a feeding area of up to six hectares. In winter, they roost in mature deciduous and coniferous trees and snags, similar to those used for nesting. Scanning perches are important year-round.

Distribution

Ecoprovinces: Ecosections

CAM: (NWC, EPR, SPR-former)
GED: (FRL, GEL, NAL-former)
CEI: FRB
SBI: BAU, QUL
SIM: MCR, SCM, SHH, SFH, EKT, (CCM, EPM, NCM-former)
SOI: LPR, PAR, SCR, SOB, SOH, OKR, NOB, NOH, NTU, STU, THB

Biogeoclimatic units

CDF: CDFmm
CWH: CWHxm, CWHdm, CWHmm, CWHds, CWHms
ICH: ICHxw, ICHdk, ICHdw, ICHdk, ICHmw, ICHmm
IDF: IDFxh, IDFxw, IDFxm, IDFdm, IDFdk, IDFmw
PP: PPxh, PPdh
SBS: SBSdh, SBSdw, SBSmh, SBSmw, SBPSmk

Breeding range

Lewis' woodpecker breeds locally throughout lowland areas of B.C.'s southern interior, from the U.S. border north to Williams Lake, Revelstoke and Invermere. It can be found from sea level to 1150 m elevation. Its centre of breeding abundance is in the Okanagan valley.

Nonbreeding range

This species is locally distributed across southern B.C. from Vancouver Island east to the Kootenays, and north to the Chilcotin-Cariboo basin. It is a very rare summer visitant to the south coast including southern Vancouver Island.

Wintering and migration

Lewis' woodpecker winters from southern B.C. to northern Mexico. A few birds are resident in the Okanagan valley with the centre of abundance from Vaseux Lake to Summerland. In B.C., this woodpecker tends to be restricted to residential areas and orchards in winter.

Habitat requirements

Broad ecosystem units

CR, CD, CW, CF, DF, DL, DP, IH, OV, PP, RD, RR

Structural stage

3a: shrub stage for foraging when insects are abundant

6-7: mature - old conifer stands (age class 7-9), mature hardwoods

(age class 5-7) especially in low elevation riparian habitats

Critical habitats and habitat features

The Lewis' woodpecker is a wildlife tree user. Although it can excavate its own nest, it is an inefficient excavator and prefers to use previously excavated holes. It will excavate cavities in large trees, primarily ponderosa pine and black cottonwood, with extensive heartrot (decaying centre). Nest cavities have been found from 1-30 m above ground, but most are between 3.5 and 9 m. Optimal breeding habitats contain large snags (>30 cm dbh), open tree canopy (25% closure), and a shrub understorey (50% crown cover) that harbours abundant insect prey. In riparian areas, the understorey component is not essential. Broken-topped or large limbed trees are used as hawking perches and live or dead trees with heartrot (WT class 2-6) are suitable nesting and roosting trees; however, softer snags (WT class 4-6) are preferred.

Other desirable habitats are partially logged or burned coniferous forest, and deciduous and riparian woodlands. At low elevations, riparian habitat with black cottonwood is preferred. In the Cariboo and East Kootenay Trench, grasslands with large diameter wildlife trees are desirable.

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MARBLED MURRELET (Brachyramphus marmoratus) Provincial Code: B-MAMU

Status

The marbled murrelet is RED-listed and designated as THREATENED in Canada by COSEWIC. The main threat to this species is the loss of old growth nesting habitat. South of Alaska, the marbled murrelet is considered an old growth dependent species. Additional threats are oil spills and possibly gill net fishing.

Ecology

The marbled murrelet is a small seabird found in coastal areas of the eastern Pacific Ocean from Alaska to central California. It spends the majority of its time at sea, where it feeds on small ocean fish such as sand lance and herring. Unlike other members of the family Alcidae, the marbled murrelet nests on branches of old growth trees. The reproductive rate of this species is extremely low as only one egg is laid each year and nest predation by jays, crows and ravens is high.

Distribution

Ecoprovinces: Ecosections

COM: NWC, HEL, KIR, NAB, NAR, APM, BOR, EPR, NPR, OUF, SPR, QCL, SKP, WQC, NWL, NIM, WIM

GED: LIM, NAL, FRL, GEL, SGI, SOG

Biogeoclimatic units

CDF, CWH, MH

Breeding range

Nesting habitat for the marbled murrelet may occur up to 85 km inland from salt water, but is likely more important within 30 km of the ocean.

Nonbreeding range

The marbled murrelet lives at sea outside the breeding season. It is a common resident on salt water throughout coastal B.C., although densities vary widely within and between years.

Habitat requirements

Broad ecosystem units

CB, CD, CG, CH, CP, CS, CW, DA, ES, FR, HB, HL, HS, IM, IS, LL, LS, MF, RB, RD, RR, RS, SR, YB, YM, YS

Structural stage

7: old forest (>250 years - age class 9, but 8 is acceptable if older forest is not present)

Critical habitats and habitat features

Marbled murrelets nest in mature large trees (i.e., 37-55 m in CWH and CDF, and 28-37 m in MH). Large (>50 m) Sitka spruce, Douglas-fir, western hemlock and western redcedar and large (>30 m) yellow-cedar and mountain hemlock are important. Marbled murrelets select large limbs higher than 15 m above the ground with platforms greater than 18 cm across (branch and moss combined). Dwarf mistletoe,

growth deformities that create nesting platforms (e.g., broken tops, multiple leader trees), and moss covered branches are assets.

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NORTHERN GOSHAWK (*Accipiter gentilis)* Provincial Code: B-NOGO

Status: yellow-listed (Identified Wildlife species).

Distribution

Provincial Range

The Northern Goshawk breeds throughout the province.

Elevational Range

Goshawks breed from sea level to alpine habitats (Squires and Reynolds 1997).

Provincial Context

Goshawks are widely distributed throughout the province. The *atricapillus* subspecies is not considered at risk in BC. Population trends are unknown in the province, but given the extent of conversion of old-growth forest to early seral stages, which goshawks tend to avoid, it is reasonable to suggest that populations are probably declining (Cooper and Stevens 1998).

Project Area: Mount Maxwell

Ecoprovince: Georgia Depression
Ecoregions: Georgia-Puget Basin
Ecosections: Straight of Georgia
Biogeoclimatic zones: CDFmm

Project Map Scale: 1:2000

Ecology and Key Habitat Requirements

General

The Northern Goshawk is a relatively large, diurnal, forest-dwelling raptor which is widely distributed in BC and throughout the world. There are 2 subspecies in the province, *laingi* and *atricapillus*. The distribution and ranges of the two subspecies are still unclear at present. The species appears to be dependent on old forests, which makes it a good indicator species for other old-growth dependent wildlife. Goshawk home range is organised hierarchically, composed of nest sites, nest areas (12 ha), a post-fledging area (170 ha) and a foraging area (2400 ha). Goshawks are highly aggressive predators and will take prey as large as a snowshoe hare. Goshawks appear to be food-limited, but little specific information on species requirements within the province is available.

Goshawks return to nesting territories by mid-March (Beebe 1974). Goshawks are partly migratory in the northern portion of the range, and in winters of food shortages, large southward migrations occur (Mueller and Berger 1967). Goshawks in Alaska do not undergo seasonal migrations, but most remain on or close to the breeding territory. In winters of food shortage goshawks may become nomadic (Iverson *et al.* 1996). However, goshawks are present during all seasons even at the

most northerly limits of their range (Beebe 1974). During the winter, goshawks may move to lower elevations (Schaffer *et al.* 1995).

Goshawks are found at low densities in general due to intraspecific aggression. Goshawks are territorial, with nesting territories about 1 km square (Beebe 1974). For the *laingi* subspecies the average internest distance is 7.5 km (T. Ethier, pers. comm.). Egg-laying occurs in April, and young leave the nest in the first week of July and are dependent for another 50-60 days (Beebe 1974).

Home range size may be up to 5200 ha (Kennedy 1990; New Mexico). Few North American studies have produced reliable estimates of abundance, as most are based on searches for active nests and assume all nesting pairs are located. There is no adequate inventory technique for non-breeders, which may make up a large proportion of population (Iverson *et al.* 1996). Pair densities of 7.4/259 square km in recorded in Colorado (Shuster 1976), 17-18/259 square km in Oregon (DeStefano *et al.* 1994), 0.3 to 2.4/259 square km in Alaska (McGowan 1975). Goshawk populations may cycle along with snowshoe hare populations in areas where these are key prey (McGowan 1975).

Goshawks are food- limited (Iverson *et al.* 1996) and the most critical periods are the nestling and fledgling-dependency stages (Jones 1981). Therefore limiting (critical) habitat is reproductive habitat, consisting of old forest with high prey populations and suitable structural attributes for nesting and for effective hunting.

Important habitat features for goshawks are summarized in the table below.

Important habitat features for Northern Goshawks.

Season	Specific Attributes Required
Growing (reproductive)	large old trees
	high coarse woody debris and snags
	cone-producing trees (squirrels)
	high numbers of terrestrial fungi
	patches of SS 3-5 in small openings
	large limbs below canopy
	high-mod productivity (rich site)
	generally sparse shrub layer<30% (open understorey) with patches of dense understorey
	canopy closure>30%, preferably >79%
	average dbh>17cm; at least some trees>50 cm dbh
	mixed stand - presence of aspen
	slope 30-60%
	lower to mid-slope

Habitat Use – Life Requisites

Living Habitat

Spruce and Ruffed Grouse, Willow Ptarmigan, snowshoe hare and red squirrel are the most common prey. Ground squirrels, northern flying squirrels, Northern Flicker, Steller's Jay, crows, American Robin, chipmunks, woodpeckers, Varied Thrush, Mallard, Blue-winged Teal (Bull and Hohmann 1992; Reynolds *et al.* 1992) are also common prey. Goshawks will also prey on conspecifics. Key prey species in the study area are unknown. Areas where many prey species are most abundant (younger forests) may be different from areas where prey is accessible to hunting goshawks (older forests; Schaffer *et al.* 1995).

Hunting typically occurs in structural stage 6-7 forest with high canopy closure and open understorey (Bright-Smith and Mannan 1994; Duncan and Kirk 1994; Crocker-Bedford 1990). The open understorey enhances detection and capture of prey. Prey populations are abundant and sustainable when forests contain large trees and open understories, scattered forest openings are small to medium in size (.3-4 acres), patches of dense mid-aged forests are scattered throughout but most of the forest is mid-aged to old. There is little information on forest types, ages and conditions in which goshawks prefer to hunt (Reynolds *et al.* 1992). There is evidence that foraging goshawks use habitat opportunistically and hunt in many forest types and conditions (Reynolds *et al.* 1992).

The majority of important prey species reside mainly on the ground and in the lower portions of the tree canopy (Reynolds *et al.* 1992). There is a strong pattern for

selection of very high to moderately productive old-growth forest (Iverson *et al.* 1996) and goshawks may use small remnant old-growth patches in the centre of cutblocks (Iverson *et al.* 1996). Goshawks avoid alpine areas (Iverson *et al.* 1996). There is no evidence of preference or avoidance of edges (Iverson *et al.* 1996). There was no elevational preference in Alaska over availability (Iverson *et al.* 1996). Level terrain (usually characterised by poorly drained organic soils with lower forest productivity) was used least (Iverson *et al.* 1996). Primary prey in the growing season are Steller's Jay, grouse, Varied Thrush, red squirrel, hares and woodpeckers (Iverson *et al.* 1996). Structural stages 3-4 may act as a prey "source" although hunting rarely occurs in them (Schaffer *et al*. 1995). If prey is particularly abundant, natural openings, forest edges and clearcuts may be used for hunting (Cooper and Stevens 1998).

During the winter, goshawks often feed in riparian and deciduous forests (Ritcey *et al*. 1988). Habitats used are similar to foraging habitats used in the growing season above (Table 17) but high elevation habits are less productive. Fewer wintering songbirds are available in the winter, so there is a shift in diet to snowshoe hares, ptarmigan, and crows (Iverson *et al.* 1996).

Reproductive Habitat

Goshawks prefer nesting in mixed woodlands over coniferous forest (Apfelbaum and Seebach 1980). Nests are usually in open understories beneath dense overstories; canopy closure of 60-95% (several authors cited in Schaffer *et al.* 1995); slopes usually <30% and always <60%. Most nests are in forested stands with some trees >50 cm dbh in a stand with >60% canopy closure (average 81%), lower to mid-slope (Bull and Hohmann 1992). Schaffer *et al.* (1995) recommended that average canopy cover be >30% for the stand to have any value as nesting habitat. Nests are typically in stands with higher canopy densities and larger trees relative to other forested stands within a locale, and with multiple canopy layers (Iverson *et al.* 1996). Areas of dense saplings are strongly avoided (Beak 1997). Areas of blowdown provide a discontinuous canopy which may act as a landmark or flyway for the adults returning to the nest (Reynolds *et al.* 1992). Adult goshawks imprint on their natal habitat (Schaffer *et al.* 1995).

Nests are built in almost any kind of tree as long as the tree is forked or divided to provide good anchorage for the nest. Nests are often in aspens or mature, relatively level spruce and pine forests with nest trees 120-360 m from a lake or river. The nest is about 1 m across and 1 m deep, made of sticks and bark, placed 10-20 m above ground and always well below the forest crown, close to the trunk on side limbs (Beebe 1974) and in an exposed position. The male maintains a 'plucking station' some distance from the nest tree where prey is prepared and stored if surplus (Beebe 1974). Pairs will have 2-4 alternate nest areas within their home range (Reynolds *et al.* 1992).

Minimum structural attributes for Engelmann spruce-subalpine fir stands for nesting are: 88 trees/ha, 50 cm mean dbh, 150 years old, 70% canopy cover (Reynolds *et al.* 1992). Schaffer *et al.* (1995) recommended that average stand dbh be at least 17 cm for the stand to have any value as nesting habitat. DeStephano *et al.* (1994) recorded higher fledging rates in areas dominated by lodgepole pine than in areas dominated by mixed-conifer forest.

There were few large openings near goshawk nests, which had >25 acres of forest surrounding them (Iverson *et al.*1996). In Alaska, no differences were found between nests and random points in distances to roads, trails and streams (Iverson *et al.* 1996).

The post-fledging family area is an area of about 170 ha with abundant prey (prey habitat intermixed with dense hiding cover for fledglings) (Reynolds *et al.* 1992). The post-fledging area is characterised by large (>45 cm dbh) feeding/nesting trees (cone-producers) for squirrels, snags of same size for nest cavity excavation by woodpeckers, patches of mid-aged forests with high canopy cover (up to 70%) that provide mesic conditions for fungi (important foods for mammalian prey), small openings in the tree canopy to produce herbaceous and shrubby foods for the herbivorous prey, and large downed logs and other woody debris for hiding, feeding, denning and nesting cover for goshawk prey. It has an intermixture of forest conditions intermediate between high foliage volume and canopy cover of nest stands and more open foraging habitats (Reynolds *et al.* 1992). Large limbs below the forest canopy act as perches for hunting.

Seasons of Use

Goshawk life requisites by season are summarised in the table below.

Monthly life requisites for goshawks.

Life Requisites	**Month**	**Season (Southern Interior Ecoprovince)**	**Season (Southern Interior Mtns. Ecoprovince)**
Food, Security, Thermal	January	Winter	Winter
Food, Security, Thermal	February	Winter	Winter
Reproductive, Food, Security, Thermal	March	Winter	Winter
Reproductive, Food, Security, Thermal	April	Spring	Winter
Reproductive, Food, Security, Thermal	May	Spring	Spring
Reproductive, Food, Security, Thermal	June	Summer	Spring
Reproductive, Food, Security, Thermal	July	Summer	Summer

Life Requisites	Month	Season (Southern Interior Ecoprovince)	Season (Southern Interior Mtns. Ecoprovince)
Reproductive, Food, Security, Thermal	August	Summer	Summer
Food, Security, Thermal	September	Fall	Fall
Food, Security, Thermal	October	Fall	Fall
Food, Security, Thermal	November	Winter	Winter
Food, Security, Thermal	December	Winter	Winter

Habitat Use and Ecosystem Attributes

The table below summarises the relationships between goshawk life requisites and TEM-r attributes.

TEM-r attributes and life requisites for goshawks.

Life Requisite	TEM-R ATTRIBUTE
Living	site: structural stage, moisture regime, elevation
	vegetation: % cover by layer, canopy closure
Nesting	site: structural stage, moisture regime, slope, slope position
	vegetation: % cover by layer, canopy closure, species list by layer

Ratings

There is a moderate level of knowledge of goshawk habitat requirements in the province. Therefore, a 4-class rating scheme was used. Reproductive habitat is defined as the critical life requisite for goshawks, so habitats were rated for **RP** (reproduction - nesting habitat) in the growing season.

Provincial Benchmark

Ecosection: unknown
Biogeoclimatic zone : unknown
Broad Ecosystem Unit: unknown
Habitats: mature to old forest with dense canopy closure and sparse understorey.

Ratings Assumptions

1. Habitat use by the *laingi* subspecies is assumed to be similar to that of *atricapillus*.

Ratings Adjustments

Suitable patches of nesting (RP) habitat must be at least 60 ha in area.

Field Ratings (Adams Lake)
The goshawk map was themed for growing season reproduction. No nests were found and no goshawks were heard or seen in the 44 polygons that were visited. Within the ICHmw3 subzone, the only occurrence of high rated goshawk reproduction habitat occurred in the site series 01 and 01-YC. We did a follow up on a reported goshawk sighting, but it turned out to be a juvenile Red-tailed Hawk. The themed polygons visited were for the most part moderately high goshawk habitat. We visited 44 themed polygons and 34 matched our requirements (77%). Originally, structural stage 5 was included in the theme, but after visiting those polygons we excluded structural stage 5 from our themed map as forests of this age did not provide suitable attributes. The IDFxh2 subzone was also added to our themed map. The subzone is located in the southern part of the study area, and structural stages 6 and 7 do provide good goshawk reproductive habitat.

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PEREGRINE FALCON (*Falco peregrinus anatum*) Provincial Code: B-PEFA

STATUS: Red-listed (MELP, 1997); Endangered (COSEWIC, 1998)

DISTRIBUTION:

In North America, peregrine falcons breed from north of the tree-line in Alaska and Canada south to central Canada, and along the Pacific coast and in the western cordillera south to Mexico. They winter from the northern United States, coastal and south western British Columbia and southern Ontario southward (Campbell et al., 1990).

Provincial Range

There are two subspecies that occur within British Columbia: Peale's (Falco peregrinus pealei) and American (Falco peregrine anatum). Peale's peregrine are widespread coastal breeders, essentially residents on the islands and headlands of the Pacific coast. The anatum (American) form is a local breeder in northern areas of BC including the south of Alaska. It is a rare resident in the Okanagan valley and the Chilcotin-Caribou region and very rare elsewhere in the interior. It has been identified as a very rare migrant in the east Kootenay region (Campbell et al., 1990).

Provincial Benchmark

Ecoprovince:
Ecoregion:
Ecosection:
Biogeoclimatic zone:
Broad Ecosystem Units:

Not officially established but likely the Southern Interior Mountains Ecosection (Campbell et al., 1990)

Project Study Area

Ecoregion: Georgia-Puget Basin
Ecosection: Straight of Georgia
Biogeoclimatic zone: CDFmm
Elevational range: Valley bottom to alpine.

ECOLOGY AND HABITAT REQUIREMENTS

Peregrine falcons are sturdy crow-sized falcons that specialise in direct pursuit of small to medium-sized birds. They favour non-forested areas to hunt, particularly along shores, marshes, and river valleys and primarily nest on cliffs. They prefer habitats that support large numbers of shorebirds, waterfowl and other small to medium size birds. In the interior, marshes, lakeshores, river mouths, airports, broad river valleys, and cities (in winter) are utilised. In autumn, migrants have been found in alpine meadows up to 2410m elevation (Campbell et al., 1990).

Peregrines primarily nest on cliffs, but will use abandoned eagle or ravens nests adjacent to rivers or lakes in the interior (Canadian Wildlife Service, 1990; Campbell et al., 1990, Ehrlich et al., 1988). Other nests have been found on grassy benches of rocky bluffs, abandoned nests of Pelagic Cormorants and Bald Eagles (Campbell et al., 1977), eroded banks of watercourses, hills, slopes, dykes, and, where the terrain is quite level, on boulders, hummocks, or on the ground (Palmer, 1988). They will generally nest where there is a good food supply, such as near colonies of white-throated swifts and violet green swallows, bats and waterfowl (Snyder and Snyder, 1991).

The heights of cliffs where nests have been sighted ranged from 12 to 366 meters, with 50% recorded between 23 and 38 meters. Most nesting ledges were sheltered by over hanging grass sods, rocks, tree roots, salal, or mosses. Interior aeries are situated on ledges in rocky bluffs overlooking large lakes and rivers (Campbell et al., 1990). On the coast, 93% of nests are situated on ledges of vertical rocky cliffs. Nest ledges have ranged from 0.3 to 4.6 m deep, and 0.3 to 2.4 m wide. Nesting materials are not usually used, but some aeries are littered with prey remains, bits of leaves, grasses and mosses, and decayed wood. Interior aeries have been situated on ledges in rocky bluffs overlooking large lakes and rivers and cliff face heights have ranged from 6 to 260m.

Peregrine nest site selection is often difficult to predict. In parts of Alaska, they frequently use a low bluff only a few hundred meters from a high cliff; and in the foothills of the Rockies there are hundreds of square kilometres of unoccupied but apparently suitable cliffs, while "poorer" sites are occupied regularly. Ideally aeries that are chosen command a wide view, near water with plentiful prey in its vicinity and seldomly disturbed (Palmer, 1988). Similar sites may be used as plucking areas for prey that overlook an aerie (Palmer, 1988). In the Okanagan a nesting

concentration of three peregrines has been recorded along a half mile of an inaccessible lakeshore cliff (Nelson, in Hickey 1969). Within a breeding territory of several kilometres, a peregrine pair usually has several alternate nest ledges (Canadian Wildlife Service, 1990).

Preference for prey are various types of waterfowl but they will consume a variety of other items including fish, crabs, slugs, hares, lemmings, pikas, voles, rats, chipmunks, and ground squirrels (Palmer, 1988; Synder and Snyder, 1991). They are specialised for capturing aerial prey and are very fast and agile fliers. They prefer to hunt from stationary perches in a high spot such as a prominence or a tall tree (Palmer, 1998). Some hunting is done from the aerie or nearby perches where the male spends time sunning and preening when not hunting or delivering prey (Palmer, 1988). During natal dispersal peregrines prefer open country or water-prairies, lake and river margins, marine shorelines, beaches, dunes, and the sea (Palmer, 1988).

Territorial defence occurs to within 91.4 meters of the aerie and approaching birds that are not prey may be attacked. For example in Alaska, they attack golden eagles when more than 2 km away, but common ravens can approach to within 100 meters and rough-legged hawks within 50 meters (Palmer, 1988). Although the actively defended area is small, the entire hunting range in the breeding season can be as much as 10,000 hectares, and food supply probably determines its size (Palmer, 1988). The territory of some pairs may overlap.

LIFE REQUISITES/SEASONAL USE PATTERNS

Peregrine life requisites include food, security and reproduction (Table 43).

Peregrine falcon seasonal life requisites.

Rank	Life Requisite	Season	Months
1.	Food	Growing	March-September
2.	Security	Growing	March-September
3.	Reproduction	Growing	March-July

Food

The majority of peregrine prey items are found in and around bodies of water such as lakes, ponds, rivers and wetlands.

Security

Security for peregrine falcon refers specifically to nest security. Little is known of interior nesting requirements in BC. Campbell et al. (1990) reports that coastal breeding cliffs on average are 23 to 38 m in height where nest height from the base of the cliffs is 12 to 24 m in height and the nests are generally 3 to 9 m from the top of near vertical cliffs. Nest trees range in height from 12 to 20 m in height.

Reproduction

Suitable reproduction habitat is composed of security (cliffs) in close proximity to food; primarily close to an abundance of birds such as waterfowl.

HABITAT USE AND ECOSYSTEM ATTRIBUTES

The relationship between Peregrine falcon habitat use and TEM ecosystem and terrain attributes are described in Table 44.

Peregrine falcon habitat use related to TEM ecosystem and terrain attributes.

TEM Attribute	Habitat Use
Ecosection	
Biogeoclimatic Zone	
Site Series	Peregrine falcons prefer habitats that support waterfowl, shorebirds and other medium sized birds. which in the interior are found in marshes, lakeshores and large rivers. Therefore, site series with soil moisture regimes mesic, subhydric and hydric provide better food than drier xeric site series.
Structural Stage	Structural stages 01, 1a and 02 wetland sites provide optimal food. All security habitat (cliffs) are structural stage 01.
Slope	Cliffs provide security for reproduction and fledging of young. We assume that in the study area slopes between 80 and 90° and greater than 20 meters in height provide optimal security.

TEM Attribute	Habitat Use
	Slopes between 80 and 90° and less than 20m but greater than 10m in height provide slightly lower security; and slopes less than 80° and/or less than 10m in height provide no security for nesting or fledging.
Aspect	Peregrine falcons prefer south-facing aspects for nest sites (Canadian Wildlife Service, 1990).
Proximity Effects	Suitable reproduction habitat contains security (cliffs) in close proximity to food. We assume that cliffs greater than 5 km from a site that provides food provide poorer reproductive habitat.

Habitat ratings

Rating Scheme/Modelling Theme

A four-class rating scheme is used to rate peregrine falcon habitat. A six-class scheme is used in this draft because the field ratings were completed with this scale; these will be converted to the four-class scheme for the final products. Habitats are rated for food (FD), security (SH) and reproduction (RP) in the growing season (G). Habitat maps will not be produced for this species.

For those peregrines that are non-breeding and for breeders outside of the breeding season, it is assumed that habitat providing food also provides all life requisites necessary for survival but not for reproduction.

Food (FD) ratings are defined in the ratings table. Security (SH) ratings could be applied in one of two ways: using a digital elevation model (DEM) or using the map code CL (cliff). Living and reproduction habitat is found where cliffs (SH) are in close proximity to food (FD). The combinations of FD with SH will be modelled and these ratings will be generated using a GIS algorithm.

Food (FD) Habitat Assumptions

The ratings table assigns a suitability rating for FD to each ecosystem unit. An ecosystem unit is a combination of site series and structural stage. The relationship between peregrine life requisites and the ecosystem attributes are defined by a degrading score relative to the optimal value for the attribute (Table 45). For

example, the optimal structural stage for food (low shrub) has a degrading score of "0"– no degrading effect. However, a sub-optimal structural stage (such as sparse) has a degrading score of -2, which would result in a maximum rating of 3 on a scale of 1 to 6. By summing the degrading scores over all of the ecosystem attributes, a final rating is calculated. See Section 2.5 for a full description of the methodology used to generate the ratings table.

Security (SH) Habitat Assumptions

SH ratings could be generated in one of two ways: using a digital elevation model (DEM) to define cliffs or using the map code CL (cliff). (Table 46).

Peregrine security habitat use assumptions.

Topic	Description
A. Slopes (using a DEM)	Slopes between 80 and 90° and greater than 20 meters in height and rated 1 SH. Slopes between 80 and 90° and less than 20m but greater than 10m in height are rated 3 SH. Slopes between 80 and 90° and less than 10m in height rated 6 SH.
B. Cliffs	Polygons containing the map label CL will be rated 1 SH.

Reproduction (RP) Habitat Assumptions

Suitable reproduction habitat contains security (cliffs) within 5 km of habitat that provides food (Table 47).

Peregrine Falcon reproduction habitat assumptions.

Topic	Description
1. Proximity effects	RP is equal to lower rating between the polygon SH and the best FD rating within 5 km.

2. Aspect	Warm aspects (135-285°) rated up 1 RP. Cool aspects (285-135°) rated down 1 RP.

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TURKEY VULTURE (*Cathartes aura*) Provincial Code: B-TUVU

Status

The turkey vulture is BLUE-listed because interior breeding populations are relatively low, and much of the coastal population gathers in one area of southern Vancouver Island during the autumn migration, which makes it vulnerable to habitat change. Over 1000 turkey vultures stage each autumn near Sooke.

Ecology

The turkey vulture is a large raptor that feeds exclusively on carrion. It searches for carrion by soaring in forested and open habitats, using vision and smell to locate food. Its highly developed sense of smell allows it to find food in dense coastal forest. The turkey vulture nests in caves in cliffs or bluffs, under boulders on rockslides, in large cavities in hollow snags or, occasionally, in dense vegetation on the ground. Its nesting habitat requirements in B.C. are very poorly understood, but in general western populations are thought to use mainly caves for nest sites. In B.C., it nests as isolated pairs. The breeding season extends from early April to late August. The turkey vulture roosts communally at night during migration, and during cold wet weather it may remain in the roost all day.

Distribution

Ecoprovinces: Ecosections

COM: NWC, EPR, OUF, SPR, NWL, NIM, WIM

GED: LIM, NAL, FRL, GEL, JDF, SGI, SOG

CEI: BUB, CAP, QUL

SBI: MCP, NEL

SIM: QUH, MCR, SCM, BRR, SFH, SPK, BBT, EKT

SOI: LPR, PAR, SOB, SOH, HOR, OKR, NOB, NOH, NTU, STU, THB

Biogeoclimatic units

BG, CDF, CWH, ICH, IDF, MS, PP, SBS

Breeding range

The turkey vulture is an uncommon summer visitor and breeder in southern B.C., which represents the northernmost part of its range. They breed regularly on eastern Vancouver Island, the Gulf Islands and the southwestern mainland coast, east through the lower Fraser River valley to near Hope. In the interior, it breeds along lower elevations of the Okanagan valley north to Shuswap Lake. Breeding is documented for the southern Kootenays, and is probable in the Thompson Basin, and on western Vancouver Island. Breeding occurs in lowland areas from near sea level to about 1000 m elevation.

Nonbreeding range

The nonbreeding range is similar to the breeding range, but a few individuals wander north to the Williams Lake and Prince George area.

Wintering and migration

The turkey vulture winters mainly in Central and South America. A few individuals may overwinter in southwestern B.C., but this is exceedingly rare. Spring migrants move in small flocks and arrive in B.C. in late March and April. Turkey vultures are most visible, however, during the autumn migration when flocks build up at staging areas. In September and early October, large numbers congregate on southern Vancouver Island; kettles of several hundred vultures can be seen at Sooke, Beechey Head and Rocky Point. It is possible that the entire coastal population stages there before flying southward across the Strait of Juan de Fuca. Interior movements are much smaller and more subtle.

Habitat requirements

Broad ecosystem units

CB, CD, CG, CH, CR, CW, DA, DF, DP, IH, IS, OA, PP, RD, RO, RR, TA, TC, TR

Structural stage

1: non-vegetated/sparse

6: mature forest

7: old forest

Critical habitats and habitat features

The turkey vulture nests primarily in caves, or crevices in cliffs, bluffs and rockslides, and is very sensitive to disturbance at the nest site. Although most nests found to date have been in cliff or rocky habitat, use of mixed forest, deciduous forest (e.g., mature cottonwoods [>age class 6] in riparian zones), and mature and old-growth coniferous stands (age class 7, 8, 9) has also been documented. Newly fledged young require elevated perches (e.g., broken-topped or large-limbed trees) in the vicinity of the nest site. Large diameter (minimum 50 cm dbh, minimum 10 m height) snags or decaying (decay class 2-4) live trees are required for roosting. Tall conifers on or near staging areas are important roost sites.

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KEEN'S LONG-EARED MYOTIS (*Myotis keenii*) Provincial Code: M-MYKE

Status

The Keen's long-eared myotis is RED-listed due to its limited distribution, apparent rarity and the lack of knowledge about its basic biology. It is designated as VULNERABLE in Canada by COSEWIC.

Ecology

Keen's long-eared myotis occurs only in the Pacific coastal region, where it is associated with low elevation coastal forests. Very little is known about the basic biology of this species. Over-winter behaviour is unknown but it is probable that it hibernates like the other species of long-eared myotis, however it may migrate short distances between its summer and winter ranges. The only known maternity colony (consisting of at least 70 individuals) is located among geothermally heated boulders on Hotspring Island, Queen Charlotte Islands. Tree cavities, loose bark, rock crevices and small caves are likely important as day and maternity roosts. The diet and foraging behaviour of this species is unknown, but based on other long-eared species, the diet probably consists of moths and other insects.

Distribution

The North American distribution of Keen's long-eared myotis is restricted to the Pacific coast, and there are few locality records outside B.C. It occurs on Vancouver Island, the Queen Charlotte Islands and the mainland coast. There is one record of this species from Wrangell Island in south-eastern Alaska and several from western Washington.

Ecoprovinces: Ecosections

COM: KIR, OUF, QCL, SKP, WQC, NWL

GED: LIM, NAL, FRL

Biogeoclimatic units

CDF: CDFmm

CWH: CWHwh, CWHvh, CWHxm, CWHdm, CWHmm, CWHwm

Habitat requirements

Broad ecosystem units

CD, CH, CW, HL, RO

Structural stage

The structural stages used by Keen's long-eared myotis are not known, although use of old growth and mature stands (stage 6-7; age class 5-9) has been indicated.

Critical habitats and habitat features

Crevices in rocks and caves, in addition to tree cavities (decay class 2 and up) and loose bark (decay class 4 and up) are important natural roost sites and may be limiting in some parts of their range. The only known maternity colony is situated

near geothermally heated rocks (associated with hot spring activity). Low elevation coastal forests and riparian areas are important for forage production.

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SHARP-TAILED SNAKE (*Contia tenuis)* Provincial Code: R-COTE

Status: red-listed
Distribution
Provincial Range
Confined to a few locations within dry woodlands in the south Gulf Islands and south Vancouver Island.
Elevational Range
Provincial Context

Project Area: Mount Maxwell

Ecoprovince: Georgia Depression
Ecoregions: Georgia-Puget Basin
Ecosections: Straight of Georgia
Biogeoclimatic zones: CDFmm

Project Map Scale: 1:2000

Ecology and Key Habitat Requirements
General
Sharp-tailed snakes are found in association with rotting logs, and south facing, talus slopes. They're often near the edges of coniferous forests, or areas of open stands of Douglas fir, Garry oak and arbutus. They are often found under objects where they can keep moist (Cannings et al. 1999).
In their southern portion of their range they are most active from late February to November with peaks in March, April and late September to early October (Cannings et al. 1999). Females lay their eggs in late June to early July, and they hatch in the fall. A female will lay 3-5 eggs each or in communal clutches underground (Cannings et al. 1999).
Important habitat features for Sharp-tailed snakes are summarised in the table below.

Ratings
Provincial Benchmark
Ecosection: unknown
Biogeoclimatic zone : unknown
Broad Ecosystem Unit: unknown
Habitats: rotting logs, rocky cover, south facing talus slopes,

DOUGLAS-FIR/GARRY OAK - ONIONGRASS (*Pseudotsuga menziesii/Quercus garryana-Melica subulata*)

Status

This community has a very small range and, historically, occurred infrequently in the natural landscape. It has been fragmented and depleted by urbanization and agricultural conversion. There are only a few occurrences in protected areas, and the level of protection and management in some of these areas is insufficient. Development pressures, including the establishment of new woodlots, seriously threaten remaining occurrences of this community.

Ecology

This forest community has an open canopy of Pseudotsuga menziesii (Douglas-fir) and Quercus garryana (Garry oak). The shrub layer is sparse; Lonicera hispidula (hairy honeysuckle) is usually present. The herb layer is dominated by Melica subulata (Alaska oniongrass), with Carex inops (long-stoloned sedge), Sanicula crassicaulis (Pacific sanicle), Moehringia macrophylla (big-leaved sandwort), Dodecatheon hendersonii (broad-leaved shootingstar), Trisetum cernuum (nodding trisetum), and Galium aparine (cleavers). Rhytidiadelphus triquetrus (electrified cat's-tail moss) is the dominant moss.

This community occurs on dry sites over inactive colluvial and sometimes morainal parent materials. Soils are shallow, mostly sandy loamy, often with moderate coarse fragments, and are classified as Sombric Brunisols. Soil moisture is rated as very dry and the soil nutrient regime is rich to very rich.

Distribution

This community is restricted to low elevations along southeast Vancouver Island from Bowser to Victoria, and may also occur on the southern Gulf Islands. Elevational limits range from near sea level to approximately 150 m. It is now considered to be extirpated from the State of Washington.

Ecoprovince: Ecosections

GED: NAL, SOG, SGI

Biogeoclimatic unit

CDF: CDFmm/03

Broad ecosystem unit

GO (CD)

Structural stages

All stages

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APPENDIX F: RARE PLANT ELEMENTS

BC CONSERVATION DATA CENTRE: RARE ELEMENT OCCURRENCES, MOUNT. MAXWELL ECOLOGICAL RESERVE AND VICINITY

October 23, 2002 **PAGE 113**

MAP #	LOCATION	DIRECTIONS	NOTES	EO RANK	EOTYPE	ECOSECTION - BGC	LAST OBSERVED	SOURCE CODE
* BUTTERFLIES AND SKIPPERS								
*** ERYNNIS PROPERTIUS (PROPERTIUS DUSKYWING) : G5 - S3 - BLUE LIST								
9090	SALTSPRING ISLAND, LAKE MAXWELL	North edge of ecological reserve.	1995: 2 males in Garry oak mixed with Douglas-fir, some CAMAS.Garry oaks mixed with Douglas-fir.			SGI - CWH xm 1	1995-05-08	U95SHE03
*** INCISALIA MOSSII MOSSII (MOSS' ELFIN, MOSSII SUBSPECIES) : G4T4 - S3 - BLUE LIST								
9516	SALTSPRING ISLAND, BAYNES PEAK	In parking lot at summit of Mount Maxwell Provincial Park.	1995: 1 female plus 6 seen at a distance. Most of the habitat was not observable as on a very steep cliff. There were patches of SEDUM SPATHULIFOLIUM.Steep rock cliff with minimum vegetation.			SGI - CWH xm 1	1995-05-08	U95SHE03
* COMMUNITIES								
*** PSEUDOTSUGA MENZIESII - ARBUTUS MENZIESII (DOUGLAS-FIR - ARBUTUS) : - S2 - RED LIST								
9064	SALTSPRING ISLAND, MOUNT MAXWELL	Southwest ridge Baynes Peak, Saltspring Island.	E.R. CDF Table - Cell #6.This community is found on the strongly sloping southwest side of Baynes Peak, facing Sansun Narrows. Site is very dry with rock outcrops, shallow soils over bedrock with some deeper pockets, occurs in mosaic with Garry oak community types.	C/D		SGI - CWH xm 1	1979-PRE	U91ERP01 G89PAR01
*** QUERCUS GARRYANA / BROMUS CARINATUS (GARRY OAK / CALIFORNIA BROME) : - S1 - RED LIST								
9078	SALTSPRING ISLAND, MOUNT MAXWELL	Southwest side of Baynes Peak, Saltspring Island, B.C.	E.R. CDF Table - Cell #1.This community is found on the strongly sloping southwest side of Baynes Peak	BC		SGI - CWH xm 1	1979-PRE	U91ERP01 G89PAR01

facing Sansum Narrows. Site is very dry with rock outcrops, shallow soils over bedrock with some deeper pockets. Occurs in mosaic of Garry oak, ocean spray and mixed Douglas fir-Arbutus stands.

*** QUERCUS GARRYANA / HOLODISCUS DISCOLOR (GARRY OAK / OCEANSPRAY) : - S1 - RED LIST

9084 SALTSPRING ISLAND, Southwest side of Baynes E.R. CDF Table - Cell #2, 3.This BC SGI - CWH xm 1 1979-PRE U91ERP01
MOUNT MAXWELL Peak, Saltspring Island. community is found on the strongly G89PAR01
sloping southwest side of Baynes Peak, facing Sansum Narrows. Site is very dry with rock outcrops, shallow soils over bedrock with some deeper pockets. Occurs in mosaic with Garry oak-broom and mixed Douglas fir-Arbutus stands.

* OTHERS

*** RECORD TREE - ARBUTUS MENZIESII (RECORD TREE - ARBUTUS) : - SU - SPECIAL LIST

B.C. CONSERVATION DATA CENTRE: RARE ELEMENT OCCURRENCES, COWICHAN LAKE STUDY AREA
INDIVIDUAL RECORDS MAPPED AS OF 23 OCT 2002 PAGE 2

MAP #	LOCATION	DIRECTIONS	NOTES	EO RANK	EOTYPE	ECOSECTION - BGC	LAST OBSERVED	SOURCE CODE
9802	SALTSPRING ISLAND, BURGOYNE BAY		2000-01-31: healthy.			SGI - CDF mm	2000-01-31	U01CDC01

*** RECORD TREE - CORNUS NUTTALLII (RECORD TREE - PACIFIC DOGWOOD) : - SU - SPECIAL LIST

9790 SALTSPRING ISLAND, In SEI polygon T0114. 2000-01-23: healthy, trunk forms 3 SGI - CDF mm 2000-01-23 U01CDC01
BURGOYNE BAY stems above 1.37m; main leader broken off; 2 remaining stems are vigorous.

* VASCULAR PLANTS

*** ALLIUM AMPLECTENS (SLIMLEAF ONION) : G4 - S3 - BLUE LIST

SALTSPRING ISLAND, S-facing bluffs and ledges. SGI - CWH xm 1 1981-08-29 O92PMV01
BAYNES PEAK

*** IDAHOA SCAPIGERA (SCALEPOD) : G5 - S2 - RED LIST

9116 SALTSPRING ISLAND, Mossy and wet outcrops, SW-facing SGI - CWH xm 1 1980-04-03 O92PMV01
BAYNES PEAK rock.

*** LOMATIUM GRAYI (GRAY'S DESERT-PARSLEY) : G5 - S1 - RED LIST

9106 O91PMV01	SALTSPRING ISLAND, BAYNES PEAK	Rocky south-facing cliffs.		SGI - CWH xm 1	1981-08-29
9218 P91CES01	SALTSPRING ISLAND, MOUNT MAXWELL	Two patches of a few plants each. On a Douglas-fir/Arbutus dominated slope under a rock overhang. One patch falls outside the ecological reserve.	D	SGI - CWH xm 1	1996-02-25
9220 O92PMV01 P91JAN02 P95PEN01	SALTSPRING ISLAND, MOUNT MAXWELL	Forty plants growing on a small rock cliff on a grassy, fir/oak dominated slope. Aspect north, slope 60%. With BROMUS SITCHENSIS, SELAGINALLA WALLACEI, LATHYRUS NEVADENSIS, SEDUM SPATHULIFOLIUM, CLAYTONIA PERFOLIATA.	B	SGI - CWH xm 1	1996-05-15
9224 O92PMV01 P95PEN01 P91JAN02	SALTSPRING ISLAND, MOUNT MAXWELL	Fifteen plants, on an almost vertical southwest-facing rock face. With BROMUS TECTORUM, POA SECUNDA, ERODIUM CICUTARIA, ROSA SP., GALIUM APARINE, CERASTIUM ARVENSE.	C	SGI - CDF mm	1996-05-15
*** VIOLA PRAEMORSA SSP PRAEMORSA (YELLOW MONTANE VIOLET) : G5T3T5 - S2 - RED LIST					
9150 P91ROE01	SALTSPRING ISLAND, MOUNT MAXWELL	In QUERCUS GARRYANA stand, grazed. Just outside proposed extension to Ecological Reserve.		SGI - CDF mm	1985
*** YABEA MICROCARPA (CALIFORNIA HEDGE-PARSLEY) : G5? - S1 - RED LIST					
10116				CWH xm 1 - SGI	1996-05-15
9210 O91PMV01	SALTSPRING ISLAND, MOUNT MAXWELL	1982: None.Mossy rock outcrop and oak-fir forest, south slope.		SGI - CWH xm 1	1982-05-19

16 Records Processed

Rubus ursinus	trailing blackberry
Rumex acetosella	sheep sorrel
Salix scouleriana	Scouler's willow
Sambucus racemosa	red elderberry
Sanicula crassicaulis v. crassicaulis	Pacific sanicle
Sanicula crassicaulis v. tripartita	three-parted sanicle
Sanicula graveolens	smelly sanicle
Satureja douglasii	yerba buena
Saxifraga integrifolia	entire-leaved saxifrage
Sedum spathulifolium	broad-leaved stonecrop
Selaginella wallacei	Wallace's selaginella
Senecio sylvaticus	wood groundsel
Silene gallica	small-flowered catch-fly
Sonchus asper	prickly sow-thistle
Stellaria crispa	crisp starwort
Stellaria media	chickweed
Stellaria nitens	shining chickweed
Stipa lemmonii	Lemmon's needlegrass
Symphoricarpos albus	snowberry
Taraxacum officinale	dandelion
Tiarella trifoliata	foamflower
Torilis japonica	upright hedge-parsley
Trientalis latifolia	western starflower
Trifolium dubium	small hop-clover
Trifolium microcephalum	woolly clover
Trifolium microdon	thimble clover
Trifolium oliganthum	few-flowered clover
Trifolium tridentatum	tomcat clover
Trifolium variegatum	white-tip clover
Triteleia hyacinthina	fool's onion
Urtica dioica	stinging nettle
Verbascum thapsus	mullein
Veronica arvensis	common speedwell
Vicia hirsuta	hairy vetch
Vicia sativa	common vetch
Viola praemorsa	yellow montane violet
Vulpia bromoides	barren fescue
Vulpia myuros	rat-tail fescue

Terrestrial Mosses:

Antitrichia curtipendula
Bryum miniatum
Bryum sp. (green)
Ceratodon purpureus
Dicranoweisia cirrhata
Dicranum scoparium
Eurhynchium oreganum
Homalothecium megaptilum
Homalothecium pinnatifidum
Hylocomium splendens
Hypnum subimponens
Isothecium spiculiferum
Leucolepis menziesii
Mnium glabrescens
Mnium insigne
Mnium venustum
Polytrichum juniperinum
Polytrichum piliferum
Rhacomitrium canescens
Rhytidiadelphus triquetrus
Tortula ruralis

APPENDIX H: ELIMINATED SPECIES LIST

A number of red-listed species in the Forest District list were eliminated from further consideration early in this project.

Scientific Name	English Name	Status				
		Global	Sub national	COSEWIC	BC Status	Reason
Lampetra macrostoma	Cowichan Lake Lamprey	G1	S1	T (NOV 2000)	RED	1
Oncorhynchus clarki clarki	Cutthroat Trout, *clarki* subspecies	G4T4	S3S4SE		BLUE	1
Gasterosteus sp. 2	Enos Lake Limnetic Stickleback	G1	S1	T (1988)	RED	1
Gasterosteus sp. 3	Enos Lake Benthic Stickleback	G1	S1	T (1988)	RED	1
Dermochelys coriacea	Leatherback	G2	S1S2N	E (May 2001)	RED	3
Chrysemys picta	Painted Turtle	G5	S3S4		BLUE	7
Pituophis catenifer catenifer	Gopher Snake, *catenifer* subspecies	G5T5	SX	XT (MAY 2002)	RED	6
Phalacrocorax auritus	Double-crested Cormorant	G5	S2B,SZN	NAR (1978)	RED	4
Phalacrocorax penicillatus	Brandt's Cormorant	G5	S1B,S4N		RED	4
Botaurus lentiginosus	American Bittern	G4	S3B,SZN		BLUE	7
Butorides virescens	Green Heron	G5	S3S4B,SZN		BLUE	7
Branta canadensis occidentalis	Canada Goose, *occidentalis* subspecies	G5T2T3	S1N		BLUE	
Melanitta perspicillata	Surf Scoter	G5	S3B,S4N		BLUE	4
Lagopus leucurus saxatilis	White-tailed Ptarmigan, *saxatilis* subspecies	G5T3	S3		BLUE	6
Uria aalge	Common Murre	G5	S2B,S4N		RED	4
Ptychoramphus aleuticus	Cassin's Auklet	G4	S2S3B,S4N		BLUE	4
Fratercula cirrhata	Tufted Puffin	G5	S3B,S4N		BLUE	4
Coccyzus americanus	Yellow-billed cuckoo	G5	SXB,SAN		RED	6
Tyto alba	Barn Owl	G5	S3	SC (NOV 2001)	BLUE	7
Asio flammeus	Short-eared Owl	G5	S3B,S2N	SC (1994)	BLUE	7
Melanerpes lewis	Lewis's Woodpecker	G4	S3B,SZN	SC (NOV 2001)	BLUE	6
Melanerpes lewis	Lewis's Woodpecker	G5T?Q	SXB,SZ		RED	6

Scientific Name	English Name	Status				
		Global	Sub national	COSEWIC	BC Status	Reason
pop. 1	(Georgia Depression population)		N			
Progne subis	Purple Martin	G5	S2B		RED	7
Sorex palustris brooksi	Common Water Shrew, *brooksi* subspecies	G5T2	S2		RED	
Marmota vancouverensis	Vancouver Island Marmot	G1	S1	E (May 2000)	RED	6
Orcinus orca pop. 1	Killer Whale (Northeast Pacific resident population)	G4G5 T3Q	S2	E southern population; T northern population (NOV	RED	2
Orcinus orca pop. 2	Killer Whale (Northeast Pacific offshore population)	G4G5 TUQ	S3	SC (NOV 2001)	BLUE	2
Orcinus orca pop. 3	Killer Whale (West Coast transient population)	G4G5 T4Q	S2	T (NOV 2001)	RED	2
Eschrichtius robustus	Grey Whale	G3G4	S2N	NAR (1987) NE PACIFIC POPULATIO N	BLUE	2
Megaptera novaeangliae	Humpback Whale	G3	S1N	T (1985)	BLUE	2
Eumetopias jubatus	Northern Sea Lion	G3	S2B,S3N	NAR (1987)	RED	2
Gulo gulo vancouverensis	Wolverine, *vancouverensis* subspecies	G4T1 Q	SH	SC (1989)	RED	6
Enhydra lutris	Sea Otter	G4	S2	T (MAY 2000)	RED	2
Cervus elaphus roosevelti	Roosevelt Elk	G5T4	S2S3		BLUE	6
Oeneis nevadensis	Great Arctic	G5	S3		BLUE	

1 Freshwater Fish (4)
2 Marine Mammals (7)
3 Marine reptiles (1),
4 Marine birds that do not require ecosystems represented in the study area for nesting (6)
5 Species extremely rarely recorded and/or extirpated
6 Species that do not generally occur on Saltspring Island and that we considered highly unlikely - gopher snake, yellow-billed cuckoo, Lewis' woodpecker – both listings, common water shrew, VI marmot, VI wolverine Roosevelt Elk, (8)
7 Species that may be in range but for which there is effectively no or extremely limited and marginal key habitats (American Bittern, Green Heron, Canada Goose, White-tailed Ptarmigan, purple martin, short-eared owl, barn owl; Great Arctic?- 8)
8 Freshwater aquatic reptiles (1) due to lack of suitable habitat in study boundaries

APPENDIX I: VEGETATION DATA

Vegetation data compiled by Dr. Adolf Ceska April 10, 2003.

VASCULAR PLANTS

Acer macrophyllum
Agoseris grandiflora
Agrostis capillaris
Aira praecox
Allium acuminatum
Allium cernuum
Anthoxanthum odoratum
Anthriscus caucalis
Aphanes microcarpa
Aquilegia formosa
Arbutus menziesii
Arctium minus
Athysanus pusillus
Brodiaea coronaria
Bromus vulgaris
Calandrinia ciliata
Calypso bulbosa
Camassia quamash
Cardamine hirsuta
Cardamine nuttallii
Cardamine occidentalis
Cardamine oligosperma
Cardamine sp.
Carex inops
Cerastium arvense
Clarkia sp.
Claytonia exigua
Claytonia perfoliata
Claytonia rubra ssp. *depressa*
Claytonia sibirica
Clinopodium douglasii
Collinsia grandiflora var. *pusilla*
Cynosurus echinatus
Cynosurus echinatus
Cystopteris fragilis
Cystopteris fragilis
Cytisus scoparius
Dactylis glomerata
Danthonia californica
Digitalis purpurea
Elymus glaucus
Erodium cicutarium
Erythronium oregonum
Festuca roemeri
Festuca rubra
Fritillaria affinis
Galium aparine
Geranium molle
Geranium pusillum
Holodiscus discolor
Hypochaeris radicata
Lactuca muralis
Lathyrus sphaericus
Linanthus bicolor
Lithophragma glabrum
Lithophragma parviflorum
Lomatium utriculatum
Lonicera hispidula
Lotus micranthus
Lychnis coronaria
Mahonia aquifolium
Melica subulata
Mimulus "sookensis"
Mimulus alsinoides
Mimulus guttatus
Moehringia macrophylla
Montia dichotoma
Montia fontana
Montia howellii
Montia parvifolia
Nemophila parviflora
Nemophila pedunculata
Osmorhiza berteroi
Pentagramma triangularis
Perideridia gairdneri
Plectritis congesta
Poa canbyi
Poa pratensis
Polypodium glycyrrhiza
Polystichum munitum
Pseudotsuga menziesii
Quercus garryana
Ranunculus occidentalis
Rosa gymnocarpa
Rumex acetosella
Sanicula crassicaulis
Saxifraga integrifolia
Sedum spathulifolium
Silene gallica
Selaginella wallacei
Stellaria media
Stellaria nitens
Taraxacum officinale
Teesdalia nudicaulis
Trifolium repens
Trifolium variegatum
Trifolium wormskioldii
Urtica dioica
Verbascum thapsus
Vicia lathyroides
Vicia sp.

Bryophytes

Antitrichia curtipendula
Bryum sp.
Dicranum scoparium
Eurhyncium oreganum
Hedwigia stellata
Homalothecium sp.
Mnium sp.
Philonotis fontana
Polytrichum juniperinum
Polytrichum piliferum
Racomitrium elongatum
Rhytidiadelphus triquetrus
Riccia sorocarpa
Tortula sp.

Fungi

Cortinarius subgen. *Telamonia*
Dacryomyces palmatus
Nolanea hirtipes
Psathyrella sp.
Psilocybe inquilina
Psilocybe montana

Transcript of Dr. Adolf Ceska

April 10, 2003

Mt. Maxwell

Waypoint 011 48 48 38.1 123 31 51.7 10-APR-03 17:31

where we entered the area

Aira praecox
Anthoxanthum odoratum
Dicranum scoparium
Festuca roemeri
Galerina sp.
Montia howellii with large flowers? coll
Polytrichum piliferum
Racomitrium elongatum
Rumex acetosella
Selaginella wallacei
Teesdalia nudicaulis

lower down

Montia parvifolia
Plectritis congesta
Psilocybe inquilina

bigger meadow

Acer macrophyllum
Aquilegia formosa
Arbutus menziesii – dying
Cardamine occidentalis
Cardamine sp.
Claytonia sibirica
Cynosurus echinatus
Cystopteris fragilis
Elymus glaucus
Erythronium oregonum
Eurhynchium oreganum
Galium aparine
Hypochaeris radicata
Lithophragma parviflorum
Melica subulata
Mnium sp.
Nemophila parviflora
Osmorhiza berteroi
Pentagramma triangularis
Pseudotsuga douglasii
Quercus garryana
Saxifraga integrifolia
Selaginella wallacei
Stellaria media

Garry oak stand

Antitrichia curtipendula
Cynosurus echinatus
Dactylis glomerata
Dicranum scoparium
Elymus glaucus
Geranium molle
Lomatium utriculatum
Lychnis coronaria
Osmorhiza berteroi
Ranunculus occidentalis
Rhytidiadelphus triquetrus
Sanicula crassicaulis
Stellaria media
Viccia sp.
Vicia lathyroides

in mixed forest

Anthriscus caucalis
Brodiaea coronaria
Calypso bulbosa
Cardamine nuttallii
Cystopteris fragilis
Dactylis glomerata
Hypochaeris radicata
Mimulus guttatus

small creek
Arctium minus
Holodiscus discolor
Pentagramma triangularis
Taraxacum officinale

Creek – photo
Carex inops
Lonicera hispidula
Perideridia gairdneri
Plectritis congesta
Saxifraga integrifolia

Visual plot # 2
Waypoint 012 48 48 28.7 123 31 53.9 10-APR-03 18:33
photo's
Anthriscus caucalis
Cardamine nuttallii
Carex inops
Clinopodium douglasii
Cynosurus echinatus
dead (looper?)
Elymus glaucus
Galium aparine
Holodiscus discolor
Homalothecium sp.
Hypochaeris radicata
Lithophragma parviflorum
Lotus micranthus
Lychnis coronaria
Plectritis congesta
Poa pratensis
Pseudotsuga douglasii
Quercus garryana ca. 25 cm diam.
Rhytidiadelphus triquetrus
Stellaria media
Taraxacum officinale
Vicia sp.
photo *Psilocybe*

Visual #3
Waypoint 013 48 48 26.8 123 31 51.5 10-APR-03 18:57
Cerastium arvense
Elymus glaucus
Festuca roemeri
Hedwigia stellata
Lithophragma parviflorum
Lotus micranthus
Polytrichum juniperinum
Psilocybe inquilina
Racomitrium elongatum
Trifolium oliganthum
or
Trifolium variegatum

shallow soil
Anthriscus caucalis
Athysanus pusillus
Claytonia exigua
Mimulus alsinoides
Mimulus sookensis
Montia dichotoma
Riccia sorocarpa

visual #4
seep over the rock
Agoseris grandiflora
Allium acuminatum
Allium cernuum
Aphanes microcarpa
Athysanus pusillus
Athysanus pusillus
Claytonia rubra ssp. *depressa*
Collinsia pusilla
Cynosurus echinatus
Lithophragma glabrum

Lithophragma glabrum
Lithophragma parviflorum
Lotus micranthus
Mimulus alsinoides
Mimulus sookensis
Montia dichotoma
Montia fontana
Montia fontana
Nemophila pedunculata
Pentagramma triangularis
Poa canbyi
Psilocybe montana
Saxifraga integrifolia
Saxifraga integrifolia
Silene gallica
Tortula sp.
Trifolium oliganthum and/or
Trifolium variegatum
Trifolium wormskioldii

the main grass *Cynosurus echinatus*
Aira praecox
Claytonia sibirica
Collinsia pusilla
Dactylis glomerata
Danthonia californica
Festuca roemeri
Poa canbyi
Polypodium glycyrrhiza
Psilocybe inquilina
Rumex acetosella
Selaginella wallacei
Stellaria nitens

lower slope has more moisture
Cystopteris fragilis
Polypodium glycyrrhiza
Polytrichum juniperinum

back to the ephemeral stream

lots of *Cystopteris fragilis*

in the seep
Lithophragma glabrum
Mimulus guttatus

waterfall
Bryum sp.
Cystopteris fragilis
Mimulus guttatus
Nemophila parviflora

quartz
Athysanus pusillus
Clarkia purpurea ?
Holodiscus discolor
Montia fontana
Ranunculus occidentalis
Taraxacum officinale
Vicia lathyroides
Waypoint 015 48 48 27.6 123 31 56.3 10-APR-03 19:38
Athysanus pusillus
Cardamine sp.
Pentagramma triangularis
Plectritis congesta
Saxifraga integrifolia

on the seepy rock
Elymus glaucus
Galium aparine
Lactuca muralis
Mahonia aquifolium
Mimulus guttatus
Montia fontana
Montia parvifolia
Philonotis fontana

Saxifraga integrifolia
Sedum spathulifolium
Stellaria media

Near the ephemeral creek
Festuca rubra
Inocybe geophila
on the margin of the mixed forest

Clinopodium douglasii
Cynosurus echinatus
Dacrymyces palmatus
Elymus glaucus
Galium aparine
Melica subulata
Pseudotsuga menziesii
Quercus garryana

Seep
Waypoint 016 48 48 23.1 123 31 55.2 10-APR-03 20:02
Aira praecox
Aphanes microcarpa
Geranium pusillum
Montia fontana
Nemophila pedunculata
Ranunculus occidentalis
Saxifraga integrifolia
Stellaria media
Taraxacum officinale
Trifolium repens

depression with *Allium* sp.
Perideridia gairdneri

Where we had lunch on the lookout
Waypoint 017 48 48 22.1 123 31 55.8 10-APR-03 20:24
Cerastium arvense
Claytonia perfoliata
Dactylis glomerata
Elymus glaucus
Festuca roemeri
Galium aparine
Taraxacum officinale
Vicia lathyroides
visual # 5
disturbed
Camassia quamash ?
Carex inops
Cerastium arvense
Collinsia pusilla
Cystopteris fragilis
Melica subulata
Osmorhiza berteroi
Stellaria media

Seep with *Mimulus alsinoides*
Waypoint 018 48 48 21.4 123 31 52.2 10-APR-03 20:38
photo with Oluna &
Athysanus pusillus
Calandrinia ciliata
Cardamine oligosperma
or *Cardamine hirsuta*
Claytonia perfoliata
Collinsia pusilla
dark Cortinarius
Cystopteris fragilis
few grazed *Cytisus scoparius*
Fritillaria affinis
Lithophragma parviflorum
Lychnis coronaria
Pentagramma triangularis
Polystichum munitum

Ranunculus occidentalis
Verbascum thapsus

seep
Nemophila parviflora
big *Quercus garryana*
Waypoint 019 48 48 17.0 123 31 46.7 10-APR-03 21:02
Agrostis capillaris
Festuca roemeri

Psathyrella
Waypoint 020 48 48 17.8 123 31 44.9 10-APR-03 21:11

Next to it is a good stand of *Festuca roemeri*
Anthoxanthum odoratum
Carex inops
Cerastium arvense
Galium aparine
Sanicula crassicaulis
Stellaria media

open spot, with *Clarkia sp.*
Waypoint 021 48 48 16.6 123 31 43.2 10-APR-03 21:14
Clarkia has sessile capsules
about 30 plants
photo with Oluna

another spot with *Clarkia sp.*
022 48 48 15.6 123 31 42.1 10-APR-03 21:22
photo with Oluna sitting elev. 327 m

Athysanus pusillus
Brodiaea coronaria
Linanthus bicolor

on the seep lower down
mostly *Erodium cicutarium*
Montia fontana
Lathyrus sphaericus

old mine shaft
023 48 48 19.9 123 31 48.6 10-APR-03 21:43

Near the grotto
Stellaria nitens

Fuligo septica – photo
Fritillaria affinis

Elymus glaucus
Festuca roemeri

Going in the Pseudotsuga menziesii forest
some *Quercus garryana*
Bromus vulgaris

Rabble
visual # 8
024 48 48 25.1 123 31 54.2 10-APR-03 22:01
Anthriscus caucalis
Bromus vulgaris
Cardamine oligosperma
Claytonia perfoliata
Galium aparine
Geranium pusillum
Nemophila parviflora
Osmorhiza berteroi
Rosa gymnocarpa
Sanicula crassicaulis
Stellaria media
Urtica dioica

In the forest
Nolanea hirtipes

Psathyrella sp.

Back to the waterfall
Cardamine nuttallii
Cystopteris fragilis
Dactylis glomerata
Erythronium oregonum
Holodiscus discolor
Lithophragma parviflorum
Moehringia macrophylla
Perideridia gairdneri
Plectritis congesta
Psathyrella pictures
Saxifraga integrifolia
Stellaria media

Waypoint 25
025 48 48 31.6 123 31 55.2 10-APR-03 22:33
it is a margin of a Garry oak & Douglas-fir forest

Rock outcrop base with
Antitrichia curtipendula
Claytonia perfoliata
Cystopteris fragilis
Dicranum scoparium
Digitalis purpurea
Eurhynchium oreganum
Lithophragma glabrum
Melica subulata
Mimulus alsinoides
Mimulus guttatus
Montia fontana
Nemophila parviflora
Nemophila parviflora
Rhytidiadelphus triquetrus
Stellaria media

Another seep, good, but nothing in it
Waypoint 26
026 48 48 35.6 123 32 04.5 10-APR-03 22:57
Mimulus guttatus

Coming up along the fence
inside the enclosure
Carex inops

small seep with *Athysanus pusillus*
Douglas-fir forest margin
Festuca *occidentalis*

APPENDIX J: STATUS CODES

*Tables from CDC website http://wlapwww.gov.bc.ca/wld/documents/ranking.pdf

Table 1. CDC CONSERVATION STATUS RANKS (S = Provincial, N = National, G = Global)*		
X	Presumed Extirpated or Extinct	Not located despite intensive searches and no expectation that it will be rediscovered.
H	Historical	Not located in the last 50 years, but some expectation that it may be rediscovered.
1	Critically Imperiled	Because of extreme rarity or some factor(s) making it especially susceptible to extirpation or extinction. Typically 5 or fewer existing occurrences 3 or very few remaining individuals, e.g., fewer than 1000 Spotted Owl.
2	Imperiled	Because of rarity or some factor(s) making it very susceptible to extirpation or extinction. Typically 6 to 20 existing occurrences or few remaining individuals, e.g., 1000 to 3000 White Sturgeon.
3	Vulnerable	Because rare and local, found only in a restricted range (even if abundant at some locations), or because of some other factor(s) making it susceptible to extirpation or extinction. Typically 21 to 100 existing occurrences, e.g., Gopher Snake.
4	Apparently Secure	Because uncommon but not rare, and usually widespread in the province. Possible cause for long-term concern. Typically more than 100 existing occurrences, e.g., Olive-sided Flycatcher.
5	Secure	Because common to very common, typically widespread and abundant, and not susceptible to extirpation or extinction under present conditions, e.g., Red-osier Dogwood.
?	Unranked	Rank not yet assessed.
U	Unrankable	Due to current lack of available information.

Table 2. RANK MODIFIERS	
E	Exotic – a species introduced by man to the province.
?	Inexact or uncertain due to limited information; qualifies the immediately preceding rank character.
Q	Taxonomic status is not clear or is in question.
T	Designates a rank associated with a subspecies or variety.
B	Designates a rank associated with breeding occurrences of mobile animals.
N	Designates a rank associated with non-breeding occurrences of mobile animals.

Table 3. SPECIES LISTS		
RED LIST	BLUE LIST	YELLOW LIST
Species with S ranks of 1, 2, 1-2, 1-3, H or X *	Species with S ranks of 2-3, 3, or 3-4 (animals only)	Species with S ranks of 4, 5, 4-5, or 3-4 (plants only)
Examples S1 Nooksack Dace S2 white-top aster S1S2 Preble's Shrew S1S3 Keen's Long-eared Myotis SH shy gilia SX Greater Sage-Grouse	Examples S2S3 Great Basin Pocket Mouse S3 yellow sand-verbena S3S4 Philadelphia Vireo	Examples S4 salt marsh dodder S5 Black Bear S4S5 Northern Alligator Lizard S3S4 yellow lady's-slipper

*Extinct species are excluded from the Red List..