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Biophysical Analysis of Vancouver Island Marmot Habitat

by
Dennis A. Demarchi, Lynne Bonner, Larry Lacelle,
Sharon Moss, and Barbara von Sacken

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Ministry of Environment, Lands and Parks
Wildlife Branch
Habitat Inventory Section
Victoria, British Columbia

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INTRODUCTION

The Vancouver Island Marmot (*Marmota vancouverensis*), is a rare, endemic resident in the mountains of southeastern Vancouver Island. There has been considerable concern that their numbers are low, reports vary but it has been estimated that there are currently (1995) only 100-200 animals (Bryant and Janz in press). That number is less than 2/3rds the numbers estimated in the mid 1980s.

Their rarity, coupled with apparent declining or unstable numbers has lead to the Vancouver Island Marmot being placed on the British Columbia Red list and to be designated as Endangered by: a) the Committee on the Status of Endangered Wildlife in Canada COSEWIC; b) the *British Columbia Wildlife Act,*; c) *the United States Endangered Species Act,*; d) the International Union for the Conservation of Nature (IUCN). As a consequence, several studies have been conducted on the social behaviour, habitat use, food habits and the demography of these marmots, with an attempt to understand reasons why they are scarce, possible dangers to their long-term survival, and the possibility to transplant them to vacant habitats (see Heard 1977, Milko 1984, Martell and Milko 1986, Bryant 1990, Bryant and Janz In press).

As part of a recovery and protection effort the Vancouver Island Marmot Recovery Team has encouraged the Habitat Inventory Section of the Wildlife Branch in Victoria to assist them by:

1. conducting base-line biophysical inventories of habitats known to currently support Vancouver Island Marmots;
2. examining similar habitats within the Nanaimo River watershed and adjacent upper Nitinat River watershed in order to determine if suitable habitat exists in sufficient quantity and quality to support marmots if transplanted.

Field work was conducted in August 1993 on meadows known to support marmots at Haley Lake Bowl, upper Bell Creek, Gemini Peak and Green Mountain. In July 1995 similar appearing meadows at Mount McQuillan, Douglas Peak, P Mountain were traversed and sampled; while several meadows on Moriarty, Olson and Spencer mounts, Limestone Mountain, and the northwest ridge of Mount McQuillan were given a preliminary examination from the air (Figure 1). In addition, the marmot habitat at the top of the Mount Washington ski lift was also examined and sampled.

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Permission to study in the Haley Lake Ecological Reserve No 117, was granted by BC Parks, South Coast Region, North Vancouver B.C. Permission to travel in the Jump Creek portion of the Greater Nanaimo Water District Watershed was granted by Peter McKula, Manager, Public Works, City of Nanaimo.

Andrew Bryant assisted us in 1993 and 1995 by locating colonies, guiding us to access routes, and freely providing us with his unpublished materials and personal insights on the Vancouver Island Marmots.

Pilot Jim Vallance of Long Beach Helicopters provided excellent piloting both in 1993 and 1995; he also provided valuable first-hand knowledge about the marmot habitats.

Students, Jamie Duncan and Tony Button provided capable field assistance and logistics arrangements in 1993.

FIELD WORK

In August 1993 the Habitat Inventory Section, Wildlife Branch, Victoria, B.C. undertook a project of biophysical habitat assessment and mapping of several meadows known to harbour Vancouver Island Marmots in the Green Mountain, Gemini Mountain, Haley Lake. The inventory team consisted of a surficial geologist, 2 plant ecologists, 2 wildlife biologists and 3 student assistants.

In July 1995, the Habitat Inventory team consisted of a surficial geologist and an assistant, a plant ecologist and 2 wildlife biologists. They evaluated several potential transplant sites on mountains with known, historical marmot use. For the 1995 field survey, only subalpine meadows that occurred within an arc of about 25 kilometers west-southwest to northwest of Green Mountain were examined.

Ecosystem plots, consisting of surficial geology, soil, vegetation and wildlife descriptions using standards set out in Describing Ecosystems in the Field: second edition (Luttmerding et al. 1990) were completed at Mt. McQuillan, P Mountain, and Douglas Peak. Aerial evaluations from a helicopter were made of Mt. Moriarty, Limestone Mountain, Mt. Spencer, and Mt. Olsen on July 10, 11, 12, 1995. In addition, an examination of the habitats used by marmots near the summit of Mt. Washington was undertaken on July 13 1995.

ECOSYSTEM PARAMETER IDENTIFICATION AND MAPPING CRITERIA

During both the 1993 and the 1995 field work, sampling methods followed Describing Ecosystems in the Field: second edition (Luttmerding et al. 1990). Mapping criteria were initially based on standards outlined in Biophyscial Habitat Mapping Methodology: unpublished (Demarchi et al. 1990) but have subsequently been replaced by, and now follow, Standards for Terrestrial Ecosystem Mapping in British Columbia: review draft (Ecosystems Working Group 1995).

MARMOT HABITAT EVALUATION CRITERIA

High quality habitat for Vancouver Island marmots can be defined as a medium to small meadow with boulders, cliffs and talus that can be used for cover, and with forests surrounding the meadows that limit the overall size of the meadow. Such habitats must supply ample forage. And they must consist of adequate parent material for marmots to dig winter and summer dens.

A meadow, in order to be valuable for supporting Vancouver Island marmots, should have a combination of suitable denning, feeding and loafing sites. Whereas, **a mountain**, in order to be valuable for supporting Vancuver Island marmots, should have more than one meadow and should be in relatively close proximity to other mountains with suitable marmot habitat. While dispersing marmots may travel long distances (Bryant In press), the shorter the distance to suitable habitat, the greater likelihood of survival and establishment of colonies that will persist over time. Therefore, for the purposes of this study, a distance of five kilometers or less between suitable habitats, was considered most desirable.

In determining the value of various habitat units, three life requisites - feeding, denning and loafing sites - were considered to be the most important habitat

LOAFING ROCKS Marmots have an affinity for large boulders as resting or predator/intruder lookout sites. Frequently-used boulders are obvious from the pale brown colouration of patches on top of the boulder worn bare of lichens by marmot use. These "marmot rocks" may also provide an important thermoregulation role by allowing the animals to take advantage of the warmth of the morning sun or to cool off by using the rock to absorb their body heat (Bryant pers. com. 1993). The lack of these loafing rocks may be a limiting factor in marmot colonies being able to persist at any given location. For example, absence of any significant boulders on the meadows of Douglas Peak would appear to be a major limitation of this area for marmot use.

The loafing sites need to be close to an escape burrow. Large bedrock outcrops or rockfaces with ledges or other flat surfaces may provide seemingly adequate surfaces for loafing. However, if there are no crevices large enough to hide a marmot or if soils deep enough for burrowing are not nearby, these outcrops may not be suitable.

Loafing sites were thus rated as high if one or more boulders or suitable outcrops were present and adjacent to sufficient denning material. If boulders were present but denning suitability was questionable, then the sites were rated as moderate for loafing. If suitable loafing sites were not available, then the rating was nil.

ANALYSIS OF MEADOWS ON SELECTED MOUNTAINS

BASE-LINE MEADOWS WITH MARMOT COLONIES -

GREEN MOUNTAIN - GEMINI MOUNTAIN - HALEY LAKE BOWL COMPLEX is a single ridge that lies in a north-northwest south-southeast orientation, with several lower forest ridges that radiate to the northeast. One adjoining mountain, Butler Peak, lies to the southwest. This mountain ridge rises more than 1200 metres above the Nanaimo River valley. There are numerous, open subalpine meadows that occur on the higher slopes of Green and Gemini mountains and the ridge above Haley Lake. Those meadows occur on all aspects with the three largest being on the southwest slopes of Green Mountain, the southern facing slope known as Haley Lake Bowl and the west-facing slopes of the headwaters of Bell Creek.

Haley Lake Bowl is an enclosed basin that extends from 1000 to 1300 metres. While the meadow faces southward it lies within an S-shaped basin that flows south, then east before flowing southward again. Nine sites (plots 93:00601-09) were sampled in 1993.

This meadow is characterized by a diverse variety of shallow colluvial deposits and rock outcrops in its upper half, with only localized blankets (>1m) between rock hummocks. Lower on the slope, the colluvium is deeper and rock outcrops are less common, although outcrop and large block loafing sites still occur. Soil drainage varies from rapid, on rock outcroppings, to imperfect, in channeled areas seasonally occupied by streams.

Haley Lake Bowl has a complex of vegetation communities, with three communities dominating the meadow landscape; Juniper-phlox, lupine-strawberry, and bracken fern. The summit above of Haley Lake Bowl is a parkland of mountain hemlock, with small ponds and a heavy shrub layer of *Vaccinium spp., Phyllodoce empetriformis,* and *Rhododendronalbiflorum.*

1. The juniper - phlox community exists on the very steep, dry, rocky, upper and side slopes of Haley Lake Bowl. This community is dominated by low shrubs (such as, *Juniperus communis, Arctostaphylos uva-ursi)* and *Phlox diffusa.* Patches of bare rock are interspersed with the juniper - phlox community.
2. The midslope of Haley Bowl, with its steep slopes, and deeper richer soils, reflects what can be considered "typical" marmot meadows. This lupine - strawberry community has a varied and heavy cover of forbs (*Fragaria vesca, Veratrum viride, Cirsium edule, Lupinus arcticus,* and *Castilleja miniata*) and grasses/sedges with virtually no shrub cover. These meadows are interspersed with patches of talus and boulders. As well there are drier rockier patches characterized by *Juniperus communis, Phlox diffusa, Achillea millefolium, Selaginella wallacei* , and numerous grasses/sedges.
3. Lower in the moisture receiving sites, bracken fern meadows are the dominate community. In these sites *Pteridium aquilinum,* and grasses/sedges provide a heavy cover. Alder thickets occupy the draws between the bracken meadows on the lower slopes.

Bell Creek is a medium-sized, west-facing meadow that extends from 1120 - 1260 metres in the Bell Creek valley. Three sites (plots 93:00616 & 19-20) were sampled in 1993.

The surficial materials consist of colluvial veneers (<1m) overlying steep hummocks of bedrock and outcroping bedrock hummocks on the steep upper slopes, with deeper colluvium on the lower slopes. Large surface blocks and rock outcrops are common for loafing sites on the upper slopes and less common on the lower slope. Soil drainage varies from rapid on the rock outcrops to moderately well on the lower portions of the deeper colluvium.

The Bell Creek meadow represents an extensive area of very steep, very lush meadows. These meadows move into vaccinium, juniper shrub meadows and mountain hemlock forest with increasing elevation. The meadows themselves are a complex of *Pteridium aquilinum, Senecio triangularis, Veratrum viride, Heracleum lanatum,* and *Cirsium edule* and various other forbs mixed with

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Table 1. Marmot habitat capability ratings for sites sampled or observed from the air.

LOCATION	SURVEY TYPE	MEADOW SIZE	FEEDING	DENNING (WINTER)	LOAFING	OVERALL RATING
GEMINI - HALEY*						
Haley Lake Bowl	Field Sampled	Medium	High	High	High	High
GREEN MOUNTAIN*						
Below Summit	Field Sampled	Large	High	High	High	High
MT. McQUILLAN						
Southeast Meadow	Field Sampled	Small	Low	Low	Moderate	Low
Southwest Meadow	Field Sampled	Small	Moderate	Moderate	Moderate	Low
Northeast Meadow Complex	Field Sampled	Medium	High	High	High	High
West Ridge Medow Complex	Aerial	Medium	High	HIgh	High	High
P MOUNTAIN						
Northwest Meadow	Field Sampled	Small	Moderate	High	Moderate	Low
South Meadow	Field Sampled	Large	High	Moderate	Low	Moderate
LIMESTONE MTN.						
Northeast Basin	Aerial	Small	Low	High	High	Low
East Meadow Complex	Aerial	Medium	Moderate	Moderate	Moderate	Moderate
MT. MORIARTY						
North Basin	Aerial	Small	Moderate	High	High	Low
South Meadow	Aerial	Small	Moderate	High	Moderate	Low
DOUGLAS PEAK						
Southwest Meadow	Field Sampled	Large	High	Nil	Nil	Low
MT. SPENCER						
North Meadow	Aerial	Small	Low	High	High	Low
MT. OLSEN						
Southeast Meadow	Aerial	Small	Low	High	High	Low
MT. WASHINGTON						
West Ski Run	Field Sampled	Small	Low	High	High	Low

* Shaded areas are the benchmark sites, that is, the highest capability against which all other Vancouver Island Marmot habitats were rated.

Table 2. Capability of individual mountains for Vancouver Island marmots based on the size* and number of meadows or meadow complexes, and the proximity to other suitable marmot habitats.

NAME OF MOUNTAIN	SIZE* AND NUMBER OF MEADOWS			PROXIMITY TO OTHER SUITABLE HABITATS** (km)	MARMOT HABITAT CAPABILITY RATING	OVERALL RANKING
	SMALL	MEDIUM	LARGE			
GEMINI-HALEY	2	2	-	Green Mtn. - 3 km Butler Peak - 1.5 km	HIGH	Bench Mark ***
GREEN MOUNTAIN	1	-	2	Gemini-Haley - 3 km Butler Peak - 5 km	HIGH	Bench Mark ***
MOUNT MCQUILLAN	2	3	-	P Mtn. - 5 km Limestone Mtn. - 3 km Douglas Peak - 3 km	HIGH	1
P MOUNTAIN	3	-	1	Mt. Moriarty - 5 km. Mt. McQuillan - 6 km	MODERATE	2
LIMESTONE MOUNTAIN	1	1	-	Mt. McQuillan - 3 km Mt. Spencer - 4 km	MODERATE	3
MOUNT MORIARTY	2		-	P Mtn. - 5 km Green Mtn. - 12 km	LOW	4
DOUGLAS PEAK	1	1	1	Mt. McQuillan - 3 km Limestone Mtn. - 3.5km	LOW	5
MOUNT SPENCER	2	-	-	Limestone Mtn. - 4 km Mt. Olsen - 4.5 km	LOW	6
MOUNT OLSEN	1	-	-	Mt. Spencer - 4.5 km Limestone Mtn. - 8.5 km	LOW	7
MOUNT WASHINGTON	1	1	-	Green Mtn. - >100 km	LOW	8

* Meadow size is relative. Green Mountain (from just below the summit down to the old ski lodge) is considered a large meadow. Haley Lake Bowl and Bell Creek are considered as medium-sized meadows. Any meadow smaller than Haley Lake Bowl is considered to be small.

** Proximity is the distance direct map distance in kilometers to nearby mountains with suitable marmot habitat; it does not take into consideration the nature of the terrain or vegetation between the mountains.

*** Benchmark sites have the highest marmot habitat capability against which all other Vancouver Island Marmot habitats are rated.

APPENDIX. Plant species known to be eaten by Vancouver Island Marmots.
(The following list is alphabetical;
* preferred species after Martell and Milko - 1986)

SCIENTIFIC NAME	COMMON NAME	NOTES AND SOURCES
Alnus sinuata	sitka alder	Bryant (1990); Carson (1978)
Chamaecyparis nootkatensis	Yellow cedar	Bark is infrequently eaten (Heard 1977); Martell & Milko (1986)
Sambucus racemosa	red elderberry	Bark is eaten (Heard 1977); flowers and shoots eaten (Fry et al. 1986)
Tsuga spp.	Hemlock spp.	Martell & Milko (1986)
Achillea millefolium	yarrow	Martell & Milko (1986)
* ***Agrostis diegoensis***	**bentgrass**	**Leaves and new shoots (Heard 1977)**
Aquilegia formosa	red columbine	Leaves and flowers are eaten (Heard 1977)
Arnica latifolia	mountain arnica	Browsed (Fry et al. 1986)
Campanula rotundifolia	common harebell	Flowers eaten (Heard 1977)
* ***Carex macloviana***	**thick-headed sedge**	**Favorite food in late May (Carson 1978)**
* ***Carex mertensii***	**Merten's sedge**	**Favorite food in late May (Carson 1978); leaftips, newshoots used (Heard 1977)**
* ***Carex nigricans***	**black apline sedge**	**Favorite food in late May (Carson 1978); leaftips and newshoots used (Heard 1977)**
* ***Carex spectabilis***	**showy sedge**	**Favorite food in late May (Carson 1978); leaftips and newshoots used (Heard 1977)**
* ***Carex spp.***	**sedge spp.**	**Leaves and new shoots used (Heard 1977); Martell &**

		Milko (1986)
* ***Castilleja miniata***	**Indian paintbrush**	**Favorite food (Carson 1978); new shoots and flowers eaten (Heard 1977); Martell & Milko (1986)**
Castilleja parviflora	Indian paintbrush	New shoots and flowers (Heard 1977)
Cirsium edule	edible thistle	Leaves infrequently eaten (Heard 1977)
Danthonia intermedia	timber oat-grass	Martell & Milko (1986)
Eriophyllum lanatum var. lanatum	wooly eriophyllum	Favorite food in late summer (Carson 1978); leaves infrequently eaten (Heard 1977); browsed (Fry et al. 1986); Martell & Milko (1986)
Erythronium grandiflorum	glacier lily	Leaves, new shoots and flowers eaten (Heard 1977)
Festuca spp.	fescue spp.	Martell & Milko (1986)
Heracleum lanatum	cow-parsnip	Browsed (Fry et al. 1986).
* ***Lathyrus nevadensis***	**purple peavine**	**Martell & Milko (1986)**
Lilium columbianum	tiger lily	Leaves and flowers preferred food (Heard 1977); flowers are a preferred food (Carson 1978); browsed (Fry et al. 1977)
* ***Lupinus arcticus ssp. canadensis (formerly Lupinus latifolius)***	**arctic lupine**	**Favorite food in late May and late summer (Carson 1978); browsed (Fry et al. 1986); Martell & Milko (1986)**
Luzula spp.	woodrush	Browsed (Fry et al. 1986); Martell & Milko (1986)
Penstemon serrulatus	coast penstemon	Browsed (Fry et al. 1977).
* ***Phlox diffusa***	**spreading phlox**	**Martell & Milko (1986)**

Poa spp.	bluegrass	Martell & Milko (1986)
Prunella vulgaris	self heal	Martell & Milko (1986)
Pteridium aquilinum	bracken fern	Fronds are infrequently eaten (Heard 1977); Martell & Milko (1986)
* ***Thalictrum occidentale***	**western meadowrue**	**Leaves, flowers and fruit are eaten (Heard 1977)**
Vaccinium spp.		Martell & Milko (1986)
Valeriana sitchensis	Sitka valerian	Leaves eaten (Heard 1977); browsed (Fry et al. 1986)
Veratrum viride	Indian hellebore	Leaves eaten (Heard 1977); (Fry et al. 1986)