

Haley Lake Ecological Reserve

MANAGEMENT PLAN

Appendix 1



HALEY LAKE ECOLOGICAL RESERVE

BACKGROUND REPORT

October 1994



South Vancouver Island District

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Introduction

The preservation of representative and special natural ecosystems, plant and animal species, features and phenomena is the objective of the ecological reserve program in British Columbia. Scientific and educational activities are the principal uses of ecological reserves. Ecological reserves contribute to the maintenance of biological diversity and the protection of genetic materials. Most ecological reserves are open to the public for non-destructive uses such as nature appreciation, wildlife viewing, bird watching and photography. However, they are not intended for outdoor recreation and consumptive uses are not permitted.

The Haley Lake Ecological Reserve was created to protect a population of the endangered Vancouver Island marmot (*Marmota vancouverensis*) and to protect its habitat. The Vancouver Island marmot is Canada's only endemic endangered mammal species and is the rarest marmot in North America.

Located on Vancouver Island, approximately 32 kilometres southwest of Nanaimo, the ecological reserve covers an area of 120 hectares (Figure 1). It was established in 1987 as a result of a 93-hectare donation, and in 1991, a 27-hectare parcel was donated to the Crown and added on the western side of the ecological reserve.

The purpose of this background report is to provide information on the natural and cultural resources of Haley Lake Ecological Reserve; on surrounding land uses; and management considerations that will be addressed in the management plan for the ecological reserve.

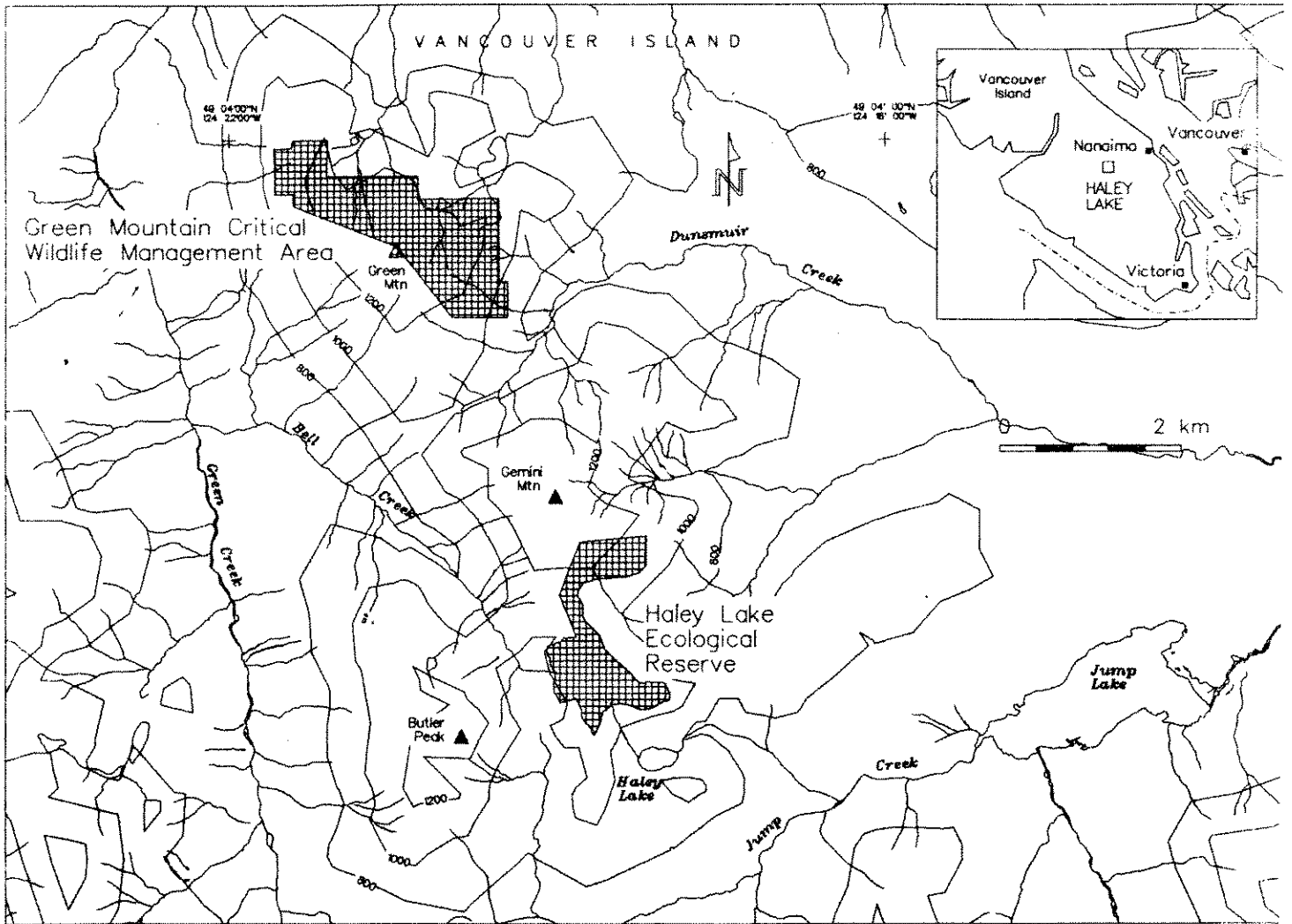


Figure 1. Location of Haley Lake Ecological Reserve

Ecological Reserve Description

Location and Access

Haley Lake Ecological Reserve is located on Vancouver Island, approximately 32 kilometres southwest of Nanaimo (Figure 2). The elevation of the ecological reserve is between 1140 and 1518 metres and it is located at a latitude 49°01'N and longitude 124°18'W.

Access to the ecological reserve is restricted and controlled since the surrounding land is privately-owned by MacMillan Bloedel. It is also part of the Greater Nanaimo Water District and under section 94 of the *Greater Nanaimo Water Act* there is no entry into the area. In order to gain access to the ecological reserve, permission is required from both the Greater Nanaimo Water District and MacMillan Bloedel Ltd., Cowichan Woodlands Division. Before each visit to the ecological reserve, permission to travel through MacMillan Bloedel land and a key must be obtained.

The ecological reserve is inaccessible to vehicles and access is gained only by four-wheel drive vehicles along logging roads and then on foot. The major access to the ecological reserve is from MacMillan Bloedel's Nanaimo River camp along a new (1994) logging road which connects to Vaughan Road above 1000 metres. This road is gated but for those with keys it is a 15-minute hike to the ecological reserve. Another access is by driving to the end of another logging road (approximately a one hour drive) and hiking approximately one hour along a bedded road.

Size and Boundaries

The current area of the ecological reserve is 120 hectares. A 93-hectare parcel was donated in 1986, and in April 1991, an addition of 27 hectares on the western boundary was donated. The current boundaries follow legal lot lines and an elevation contour line at approximately 1200 metres.

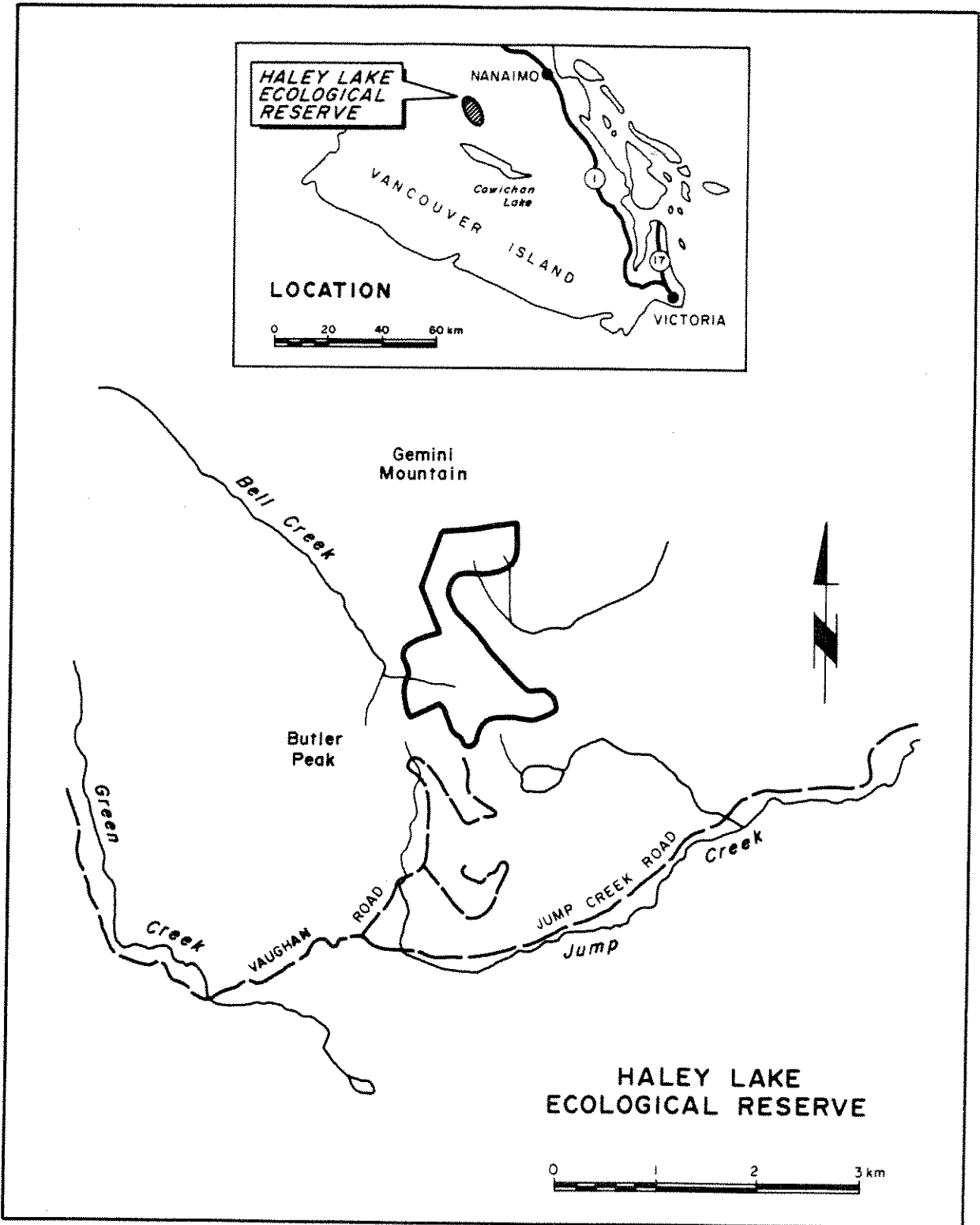


Figure 2. Haley Lake Ecological Reserve

History of Ecological Reserve Establishment

Vancouver Island marmots were an issue in this area long before the ecological reserve was created. Several groups were very active in advocating for the protection of the Vancouver Island marmot through the establishment of reserves, including one at Haley Lake.

In 1968, members of the Nanaimo Fish and Game Protective Association expressed concern that the "re-discovered Vancouver Island marmot colony at Haley Lake was possibly the only viable colony left on Vancouver Island and steps should be taken to permanently protect it" (Sierra Club of Western Canada 1982). In 1973, the Haley Lake basin (109 hectares) was placed under moratorium by MacMillan Bloedel, removed from its logging plans and designated as a company reserve. In addition, the headwaters of Bell Creek (41 hectares) was removed from Crown Zellerbach's logging plans in 1973 and designated as a company reserve.

In 1975, Ecological Reserve Proposal 237 was submitted by Douglas Heard, J.B. Foster and Jim Pojar for the protection of the Vancouver Island marmot. The proposal encompassed an area of 526 hectares and included Haley Lake and Butler Peak. The next year, the Vancouver Island clubs of the Federation of British Columbia Naturalists requested MacMillan Bloedel and Crown Zellerbach to set aside an area to be given full protection and made into a permanent reserve as soon as possible. In 1977, the Nanaimo Fish and Game Protective Association requested that an area above Haley Lake be secured to give permanent protection for a colony of Vancouver Island marmots. The Federation of British Columbia Naturalists, in the same year, presented resolutions to the Ministry of Environment, Wildlife Branch requesting that the Haley Lake basin and the adjoining ridges be declared a non-shooting area and that Vancouver Island marmots be given the utmost protection. The next year the Federation of British Columbia Naturalists requested that Crown Zellerbach and MacMillan Bloedel donate their land at Haley Lake for permanent reserves. In 1980, MacMillan Bloedel agreed to donate lands at Butler Peak, Pea Mountain and Haley Lake for protection of the Vancouver Island marmot.

In 1981, a proposal was submitted by the Vancouver Island Marmot Preservation Committee to government for permanent protection of Vancouver Island marmot habitat. The Sierra Club of Western Canada in 1982, made a submission to the Premier for the establishment of a permanent Vancouver Island Marmot habitat reserve that encompassed Green Mountain, Gemini Mountain, Haley Lake and Butler Peak to protect approximately 75% of all known Vancouver Island marmots.

In BC Environment's 1985 management plan for the Vancouver Island marmot, one of the activities for securing habitat for the marmot was to support the establishment of an ecological reserve around Haley Lake (Munro et al 1985).

In 1986, MacMillan Bloedel donated land to the Crown to be established as an ecological reserve. The 93-hectare ecological reserve was established in February 18, 1987 by Order in Council 293 on the land donated by MacMillan Bloedel (Lot 1, Block 1300, Dunsmuir District, Plan 44043). Fletcher Challenge donated a 27-hectare site (Lot 1, Blocks 1049 and 1301) that resulted in a boundary expansion on the western side of the ecological reserve in April 18, 1991, by Order in Council 522.

Features and Resources

Climate

The climate in the area is characterized by cool short summers and mild wet winters with considerable precipitation falling as snow. Minimum air temperatures are often well above freezing while snow persists on the site due to great accumulations during the winter. The winters are long, but not particularly cold, with snow depths of 1 to 3 metres and snow patches persist until early July.

As part of the background information for research by Heard (1977) and Milko (1984), climatic data was provided for the area (Table 1).

Table 1. Climate data for the area that includes Haley Lake (from Heard 1977 and Milko 1984)

mean annual precipitation	3358 ± 1434mm
mean precipitation of the wettest month	532 ± 200mm
mean precipitation of the driest month	76 ± 46mm
rainfall from June through September	25 cm
mean temperature July through September	13°C (1973) 15.5°C (1974)
date of last frost in spring	13-20 June 1973 3 June 1974
number of frost-free days	115 (1973) 135 (1974)
maximum snow accumulation	370 cm
last accumulation of snow in the spring	early June 1973 late June 1974

Physical Features

Landform

The ecological reserve lies in the western system of the Canadian Cordillera and is included within the Vancouver Island Ranges of the Insular Mountains (Holland 1976). The Vancouver Island Ranges are composed of a heterogeneous group of pre-Cretaceous sedimentary and volcanic rocks folded about northwesterly trending axes and intruded by numerous granitic batholiths (Jungen 1985). The mountains are a result of the mature dissection of a Tertiary erosion surface of low relief.

The ecological reserve consists of steep rocky, south-, east-, west- and northeast-facing slopes of a subalpine ridge and the upper parts of associated colluvial slopes. The majority of the ecological reserve consists of slightly bowl-shaped, continuously steep southeast-facing slopes with elevation ranges from 1000-1500 metres. Vegetated cliffs at the top of the site are subtended by a well-stabilized talus and boulder field. Numerous boulders, bedrock outcroppings, scattered krummholz and shallow gulleys are found throughout the ecological reserve.

Geology

Three volcanic cycles largely account for the geological history of Vancouver Island. The mountains of Vancouver Island, including the area of the Haley Lake Ecological Reserve, comprise a mid-Palaeozoic and Jurassic volcanic-plutonic complex called the Sicker Group which was part of the cycle (Milko 1984). The long history of the Sicker Group has resulted in the rocks being subjected to various geological processes. This has resulted in this group having some of the most deformed and metamorphosed rocks on Vancouver Island (Northcote 1973). Various degrees of metamorphism has affected its mainly basic and silic and less abundant, clastic and carbonate rocks (Milko 1984). The ecological reserve occurs in the Myra formation, ranging from basalt to rhyodacitic banded tuff to sediments and conglomerates, often associated with sulfides (Milko 1984).

Glaciation and Surficial Deposits

Vancouver Island presents a mountainous landscape constructed of landforms that have been considerably modified by glaciation, primarily from the most recent glaciation (Fraser glaciation) which covered the entire island and ended 10 to 12,000 years ago (Keser and St. Pierre 1973; Jungen 1985). During this period, a Cordilleran ice sheet covered most of Vancouver Island. At the maximum

glaciation, the thickness of the ice sheet reached a little over 1800 metres at Buttle Lake (Keser and St. Pierre 1973). Therefore the area of the ecological reserve was probably under ice at this time. Currently, in the ecological reserve, glacial overburden varies from completely absent on rock outcrops to deeper than one meter elsewhere.

Surficial deposits have also been affected by glaciation and most deposits on the island have resulted from glacial-related processes (Keser and St. Pierre 1973). Glacial till is generally thin on mountainous areas such as the ecological reserve.

Soils

On Vancouver Island, the soils are generally mainly of glacial origin or have been subsequently modified by natural processes of colluviation, fluvial activity and marine inundation (Jungen 1985). The soils have developed in a relatively short period of time but they generally have strong characteristics (Klinka et al 1979). As a result of the low temperatures and high moisture content in most of the soils, litter decomposition is slow and therefore the soils often have a high content of organic matter (Klinka et al 1979).

A recent biophysical study (Duncan 1993) determined that there are three main soil types in the area: Ortho Ferro-Humic Podzols, Sombric Ferro-Humic Podzols and Orthic Humic Regosols.

Podzolic soils are very widespread in southern Vancouver Island and have been formed as a result of the maritime climate. The perhumid to humid soil moisture regimes act on the soil parent material to form bright reddish-coloured, deeply weathered soils which are strongly leached, have low base saturations and are very acid (Jungen 1985). Ferro-Humic Podzols have a dark-coloured podzolic B horizon due to a high content of organic carbon and an appreciable amount of extractable iron and aluminum (Duncan 1993). They occur in the more humid part of the region of podzolic soils under forest vegetation, or forest with heath or moss undercover. Sombric Ferro-Humic Podzols are located in the established meadows of the subalpine zone.

At high elevations Regosolic soils occur mainly on steep, unstable colluvium (Jungen 1985). Regosolic soils are weakly developed, with little vegetation growing on them and frost action continuously disrupting the surface materials (Valentine et al 1978). These soils have a significant accumulation of organic matter. Orthic Humic Regosols are identified by several characteristics, including that the control section contains a small amount of organic matter and the horizons are well-drained and lack evidence of gleying within the upper 50 cm.

The characteristic soil processes in the area include an accumulation of acid decomposition products on the forest floor compacted by the snow, a moist to saturated state throughout the year, leaching, eluviation and illuviation (Klinka et al 1979).

Hydrology

There are no major hydrological features located in Haley Lake Ecological Reserve. Several small streams exist in the ecological reserve, including one that drains into Haley Lake (located outside the ecological reserve) and another into the Dunsmuir Creek system.

Biotic Features

Vegetation

The higher portions of the ecological reserve are located in the Subalpine Mountain Hemlock Biogeoclimatic Zone with some Coastal Western Hemlock transitions at lower elevations. The Haley Lake Ecological Reserve is located within the Windward Moist Maritime Mountain Hemlock Variant surrounded by Mountain Moist Maritime Coastal Western Hemlock Variant (Nuszdorfer and Boettzer 1994). Development of the vegetation in this zone is influenced to a large degree by the cold climate. The deep winter snow is slow to disappear, resulting in a short growing season. The differences in vegetation and productivity are related to local or altitudinal differences in snow depth and cover (Klinka et al 1979).

Thickets of Sitka alder dominate the lower regions of the area above Haley Lake as well as the slopes facing Dunsmuir and Bell creeks. The sides of the Haley Lake bowl are dominated by coniferous forests. Lush forb subalpine meadows are characteristic of the ecological reserve (Milko 1984). These meadows show little sign of succession except for the seral *Pteridium aquilinum* (bracken) (Milko 1984). The meadows are kept free of trees by snow-creep and avalanches.

A variety of forbs and grasses are found within the ecological reserve, including common species such as *Phlox diffusa* (spreading phlox), *Castilleja* spp. (paintbrush), *Erythronium grandiflorum* (glacier lily), *Saxifraga ferruginea* (Alaska saxifrage), *S. rufidula* (rusty-haired saxifrage), *Anaphalis margaritacea* (pearly everlasting), *Aster foliaceus* (leafy aster) and *Lupinus latifolius* (lupine) (Bryant 1990a). *Pteridium* ferns and dwarf *Vaccinium* spp. are occasionally dominant in the area (Bryant 1990a). Rare plants occurring in the ecological reserve are the

Olympic onion (*Allium crenulatum*) and the coastal shield-fern (*Dryopteris arguta*). A comprehensive list of the plant species for the ecological reserve is found in Appendix 1.

Major plant community types are stunted mountain hemlock and mountain heathers along the ledges and crest of the ridge, sparse moss, lichen and other herbaceous plant cover on rocky knolls and faces and meadow vegetation on talus and other colluvium. Several different meadow communities occur with dominants such as pearly everlasting, bracken fern, cow-parasit, showy sedge and Indian hellebore, depending on the drainage and soil texture.

As part of the vegetation research conducted by Milko (1984), plant community types for Haley Lake Ecological Reserve were classified based on species dominance. He described community types representing the subalpine meadows in which the marmots were located. The following description of community types is based on his research.

1. *Phlox-moss*

This type is restricted to cliffs and areas of bedrock outcroppings with shallow undeveloped soils. These xeric sites are often windswept in winter and the first areas to be snow-free in the spring. It is dominated by spreading phlox and is associated with a high abundance of mosses and Wallace's selaginella (*Selaginella wallacei*). Conspicuous, early flowering plants are the Alaska saxifrage and western saxifrage.

2. *Ribes-Heuchera*

This relatively rare community type occurs among moderate to large boulders in stabilized talus deposits. Low shrubs of black gooseberry (*Ribes lacustre*) dominate and are commonly associated with moderately abundant small-flowered alumroot (*Heuchera micrantha*) and abundant mosses.

3. *Anaphalis-Aster*

This mesic community contains pearly everlasting and leafy aster as co-dominants. Lupine also assists in distinguishing this community. Well-drained, fine soils are deep and developed in this community type.

4. *Pteridium aquilinum*

This community type becomes obvious after mid-July when the bracken fern fronds expand to a cover greater than 70%. Clones of bracken generally have a discontinuous distribution except at lower elevations.

5. *Senecio-Veratrum*

Arrow-leaved groundsel (*Senecio triangularis*) and Indian hellebore (*Veratrum viride*) are co-dominants in this type. It occurs on moist areas, often in shallow gullies and is associated with a two-week delay of snow melt in the spring. The soils are fine-grained and moist with a moderate humus layer development.

Seepage area

A seepage area was observed at Haley Lake. Red columbine (*Aquilegia formosa*) and maidenhair fern (*Adiantum pedatum*) differentiate this area.

Milko (1984) also described three vegetation types based on species dominance as seen in the spring. All three types have a low total percentage cover.

1. *Juniperus communis*

This type is found in areas that are snow-free early in spring and is dominated by juniper with less abundant kinnikinnick (*Arctostaphylos uva-ursi*) and *Vaccinium* spp.

2. Grasses

These stands are dominated by graminoids and the only other species of high abundance is wood strawberry (*Fragaria vesca*). The areas of this vegetation type appear snow free due to avalanches and convex mesotopographic positions.

3. *Phlox*-moss

This vegetation type is the spring stage of the summer *Phlox*-moss community type.

Wildlife

Using the ecoregion classification system (a system that is used as an overview of the habitats of the province), the ecological reserve is located in the Leeward Island Mountains Ecoregion of the Eastern Vancouver Island Ecoregion.

Vancouver Island Marmot

The ecological reserve was established to provide protection for the Vancouver Island marmot. It is Canada's only endemic mammal that has been listed as an endangered species. The Vancouver Island marmot is also endemic to Vancouver Island and is the only marmot that occurs on the island.

The Vancouver Island marmot was first identified in 1910 on Douglas Peak near Port Alberni (Swarth 1911). It is unknown when the marmot first colonized the island. There is speculation that the Vancouver Island marmot survived the last glacial refugia on Vancouver Island but there is no fossil evidence to confirm the presence of the Vancouver Island marmot on the island during the Pleistocene (Nagorsen 1987).

Recent finds of marmot bones in high-elevation caves on west-central Vancouver Island, where marmot colonies are not known to presently occur, suggest the species may have been more widespread in prehistoric times than what is currently the case (B.C. Ministry of Environment, Lands and Parks 1993). It is generally accepted that in 1977 the total known population was 50-100 animals located in five colonies. However, this figure may be partly due to poor knowledge of distribution and incomplete counts.

It is apparent that the marmot no longer inhabits portions of its historic range. There have only been sporadic sightings of the marmot until the early 1970s. Today the Vancouver Island marmot is found only in mountainous regions of Vancouver Island, mostly confined to a small area west of Nanaimo that includes the ecological reserve. The entire population inhabits a very restricted geographic area. This specialized and limited habitat of the Vancouver Island marmot is a contributing and limiting factor to the current status of the population. The Haley Lake Ecological Reserve is essentially in the centre of the geographic range (south-central Vancouver Island) of the Vancouver Island marmot and contains a large proportion of the total population of the species (Bryant 1993).

The total population is currently less than 500 individuals (B.C. Ministry of Environment, Lands and Parks 1993) and recent surveys indicate a population of 200 to 300 individuals concentrated in the Nanaimo-Cowichan Lake area (Vancouver Island Marmot Recovery Team 1993). Intensive surveys of known and potential colony sites on southern Vancouver Island from 1982 through 1986 resulted in counts of 170 to 191 marmots (Bryant, pers. comm.). However, it is unknown if the population is increasing or decreasing.

There is good inventory data in Haley Lake Ecological Reserve since 1972 (Bryant, pers. comm.). The colony in the Haley Lake bowl has been observed for the longest period (Munro et al 1985). It was first discovered in 1932 and has been (presumably) in existence continually since then (Heard 1977). Based on 1992 data, the actual ecological reserve contained 12 marmots in the "Bell Creek" colony and perhaps 3-5 marmots in the bowl site portion of the ecological reserve (Bryant 1993). The population appears to be fairly stable in the Haley Lake area and there are currently three colonies in the Haley Lake area (Bryant 1990b). Inventory data for the Haley Lake area is tabulated in Appendix 3.

The habitat for the marmot is alpine and subalpine areas characterized by steep slopes, talus debris and open meadows (Heard 1977). The marmots generally prefer the edges of open subalpine areas with pockets of deep soil suitable for hibernacula and burrows; contain scattered boulders or rock ledges used for thermoregulation and lookouts; and are situated below steep rock bluffs that shed snow and offer protection from digging by bears. It appears that the location of hibernacula are chosen where snow can accumulate and where snow cover persists the longest, i.e., in "snow-bowls" below steep slopes (Bryant 1990a). However, it is unclear what constitutes critical habitat for this species (Vancouver Island Marmot Recovery Team 1993).

The steep meadow slopes of Vancouver Island marmot habitat are maintained because of their susceptibility to snow avalanches and snow creep (Heard 1977). Avalanches provide suitable habitat by maintaining herbaceous communities through the inhibition of tree growth, and by reducing the accumulation of snow. This in turn results in the meadow becoming snow-free earlier in the spring, thus increasing the effective growing season (Heard 1977). Steep slopes appear to be necessary to provide food in early spring when marmots first emerge from hibernation since food sources are restricted to these snow-free areas due to the elevation of the area (Heard 1977).

The location of all known Vancouver Island marmot colonies are between 730-1450 metres with most of the colonies being located between 1000-1400 metres (Bryant 1993). The marmots at Haley Lake are almost invariably found in the lower and eastern portions of the 5-hectare bowl (Bryant 1993) (Figure 3).

There has been variable reproductive success in recent years at Haley Lake (Bryant 1990a). In 1990, the reproductive success was limited to a single litter of three; while in 1991, there were three litters that produced 9 infants; in 1992, there were no litters; in 1993 there were 3 litters with 12 infants; and in 1994 there were 2 litters with 10 infants (Bryant, pers. comm.).

Research by Bryant has found that the Vancouver Island marmot seems to have a metapopulation¹ lifestyle in which a patchwork of colonies experience periodic extinctions and recolonizations (Bryant 1990a). Dispersal is a key ingredient of this metapopulation model and long-term survival of the Vancouver Island marmot requires that additional metapopulations be found or established and that adequate gene flow between individual colonies is maintained.

¹ A network of small colonies that typically inhabit patches of suitable habitat surrounded by areas of unsuitable habitat.

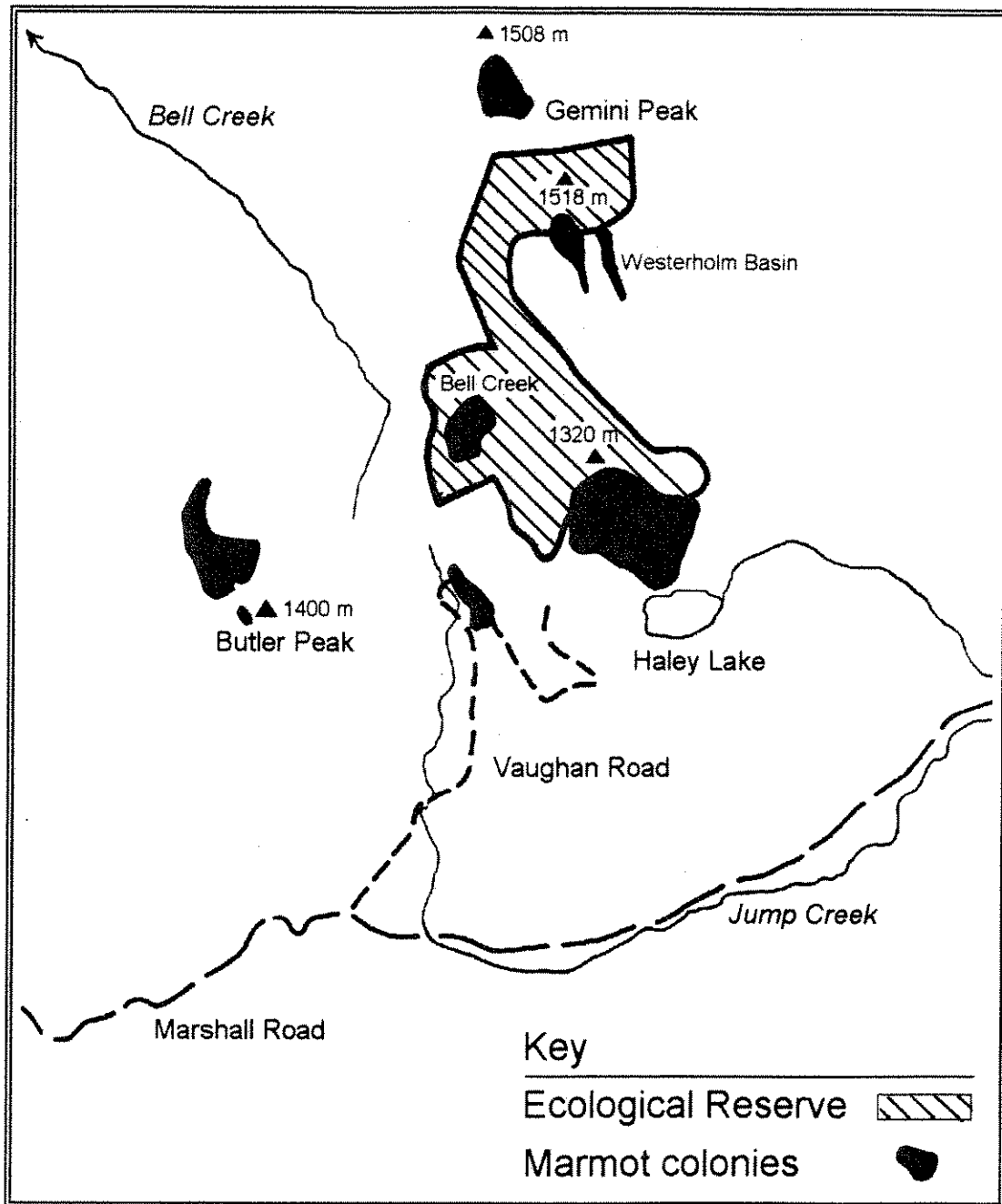


Figure 3. Marmot colony location (from Bryant 1993, not to scale)

The Vancouver Island marmot has been found in areas other than the traditional subalpine habitats in a variety of disturbed habitats such as logged-over habitat and openings created by ski-run developments. However, the effect of logging on the marmot population is unclear at this time (B.C. Ministry of Environment, Lands and Parks 1993). Although the marmots are currently utilizing the logged-over habitat in the Haley Lake area, it is unknown how long these openings can be used by the marmots before the trees grow back (Munro et al 1985). There are concerns that the use of these areas may decrease dispersal to more distant natural habitats and that hibernation in logged areas may be less successful.

Marmots also utilize habitat created for ski runs at Green Mountain and Mount Washington. These areas act as artificially created subalpine habitat. In April 1991, a portion of the Green Mountain area was designated as a 300 hectare Critical Wildlife Management Area to provide protection for the Vancouver Island marmot.

Status of the Vancouver Island Marmot

The need for protecting the Vancouver Island marmot has been recognized for quite some time. In 1973, the Vancouver Island marmot was given legal protection under the provincial *Wildlife Act* and in 1979, the marmot was classified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as one of Canada's endangered species (any indigenous species of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its Canadian range).

In 1980, the Vancouver Island marmot was legally designated as an endangered species under the provincial *Wildlife Act* and was the first land mammal in British Columbia to be so designated. This designation was related to concerns about the late 1970s population estimate of 50 - 100 animals, minimal data on historical abundance and distribution and the unknown influence of human activities on marmot colonies (Vancouver Island Marmot Recovery Team 1993). Currently the marmot is protected under the B.C. Reg 168/90 *Wildlife Act* - Designation and Exemption Reg. s.13. It has also been designated as a red-listed species by the Wildlife Branch of BC Environment and an endangered species under the U.S. *Endangered Species Act* and the International Union for the Conservation of Nature (IUCN).

The Vancouver Island Marmot Preservation Committee was established in 1979 as part of the Federation of British Columbia Naturalists to address the protection of the Vancouver Island marmot. This committee became the Vancouver Island Marmot Sub-Committee in 1981. This committee actively pursued the protection of the Vancouver island marmot and also conducted extensive inventories in 1979, 1980 and 1981 of the Vancouver Island marmot and produced several reports

documenting the results. In 1982, the Vancouver Island Marmot Public Liaison Committee was formed to provide an information exchange and public input into management activities directed at the Vancouver Island marmot. Various public interest groups are represented on the committee and it is chaired by the Wildlife Branch of BC Environment.

A management plan for the Vancouver Island marmot was prepared by the Wildlife Branch in 1985 (Munro et al 1985). The plan discusses the status of the Vancouver Island marmot and presents a Vancouver Island marmot management plan with the goal of establishing and maintaining the population at a level and distribution that provides a reasonable likelihood of long-term survival of the species.

As part of the national Committee on the Recovery of Nationally Endangered Wildlife (RENEW), the Vancouver Island Marmot Recovery Team was established by the British Columbia government in 1988 to prepare an action plan. The lead agency responsible for implementing the plan is the Wildlife Branch, Ministry of Environment, Lands and Parks. Other agencies and organizations that will also participate in recovery efforts include BC Parks, Royal B.C. Museum, Canadian Wildlife Services and various non-government organization (private industry, outdoor groups and universities). The team and plan are integral components for the RENEW initiative. Members on the team represent federal/provincial wildlife agencies, the Royal B.C. Museum, forest companies and conservation groups.

The goal of the plan is to effect population increases and distribution sufficient to justify removal of the species from the endangered species list. The population objectives are based on the need to prevent inbreeding, maintain long-term genetic variability and reduce the vulnerability of marmot colonies to extinction through random environmental events (Vancouver Island Marmot Recovery Team 1993). The plan will be reviewed every five years.

In the draft plan, the team recommends a population objective of 400 to 600 marmots dispersed in three metapopulations on Vancouver Island. Further, the metapopulations should consist of approximately 100-200 marmots each, and each metapopulation should consist of at least six sub-populations or colonies, among which natural dispersal and re-colonization will occur.

A Vancouver Island Marmot Recovery Fund has been established through the Nature Trust of British Columbia to assist with the recovery project. Donations are acknowledged with tax receipts and the money collected will go directly to work on the marmot. All administration costs will be paid by the Nature Trust as its contribution to the recovery of the species. Disbursements from this fund and all work done as a result will be under the direction of the Vancouver Island Marmot Recovery Team.

Previous project supporters have included the Habitat Conservation Fund, BC Environment, BC Parks, Canadian Wildlife Service, World Wildlife Fund (Canada), Cowichan Valley Naturalist's Society, Friends of B.C. Ecological Reserves, Nanaimo Field Naturalists, University of Calgary and a variety of individual donors.

Other Wildlife

Other wildlife such as the Roosevelt elk (*Cervus elaphus roosevelti*), black bear (*Ursus americanus*), black-tailed deer (*Odocoileus hemionus columbianus*), cougar (*Felis concolor*), marten (*Martes americana*), golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), and gray jay (*Perisoreus canadensis*) may be seen in the area.

Historical/Cultural Features

There is little documentation on the historical and cultural use of the Haley Lake area. There is an indication that First Nations people may have utilized the Vancouver Island marmots for food and skins in the past, concluding from the presence of tool markings on the recent finds of marmot bones in archaeological sites located in caves in the Clayoquot Plateau, Vancouver Island (Nagorsen 1989). It is not known if this occurred in the area of the ecological reserve but similar caves are not found in the ecological reserve. Reports of early explorers on Vancouver Island also make reference to the use of marmot skins by First Nations people (Vancouver Island Marmot Recovery Team 1993).

There are no recorded archaeological sites in the ecological reserve.

Land Tenure, Occupancy Rights and Jurisdictions

Leases, Rights-of-Way and Reserves

Haley Lake Ecological Reserve is located within the Greater Nanaimo Water District (Figure 4). Under section 94 of the *Greater Nanaimo Water Act* there is no entry into the area surrounding the ecological reserve without permission from the Greater Nanaimo Water District. In addition, a Mineral and Placer Reserve (OIC 1701) exists over the same area which prevents any staking in this reserve. The western boundary of this No Staking Reserve lies along the western boundary of the ecological reserve. Another Mineral and Placer Reserve (OIC 1705/82) follows the 900-metre contour in the area completely surrounding the ecological reserve and includes all of Haley Lake, Gemini Peak and Green Mountain. There is an area where the 900-metre contour lies directly along the boundary of the ecological reserve. Therefore, there is area adjacent to the ecological reserve that is not covered by a No Staking Reserve. Within this area there is a two-post mineral claim, Laura 2.

Guide Territories and Traplines

A registered guide outfitter territory exists in the area that encompasses the Nanaimo Lakes and Nanaimo River watersheds. There are also two registered trappers in the same watershed area.

Resource Use Adjacent to the Ecological Reserve

The entire area surrounding the ecological reserve is owned by private logging companies as a result of the E&N Railway Land Grant (Figure 5). The following blocks are those that surround the ecological reserve:

Block 1028 - MacMillan Bloedel
Block 1049 - Timberwest Forest Limited
Block 1300 - MacMillan Bloedel
Block 1301 - Timberwest Forest Limited
Block 1302 - Timberwest Forest Limited

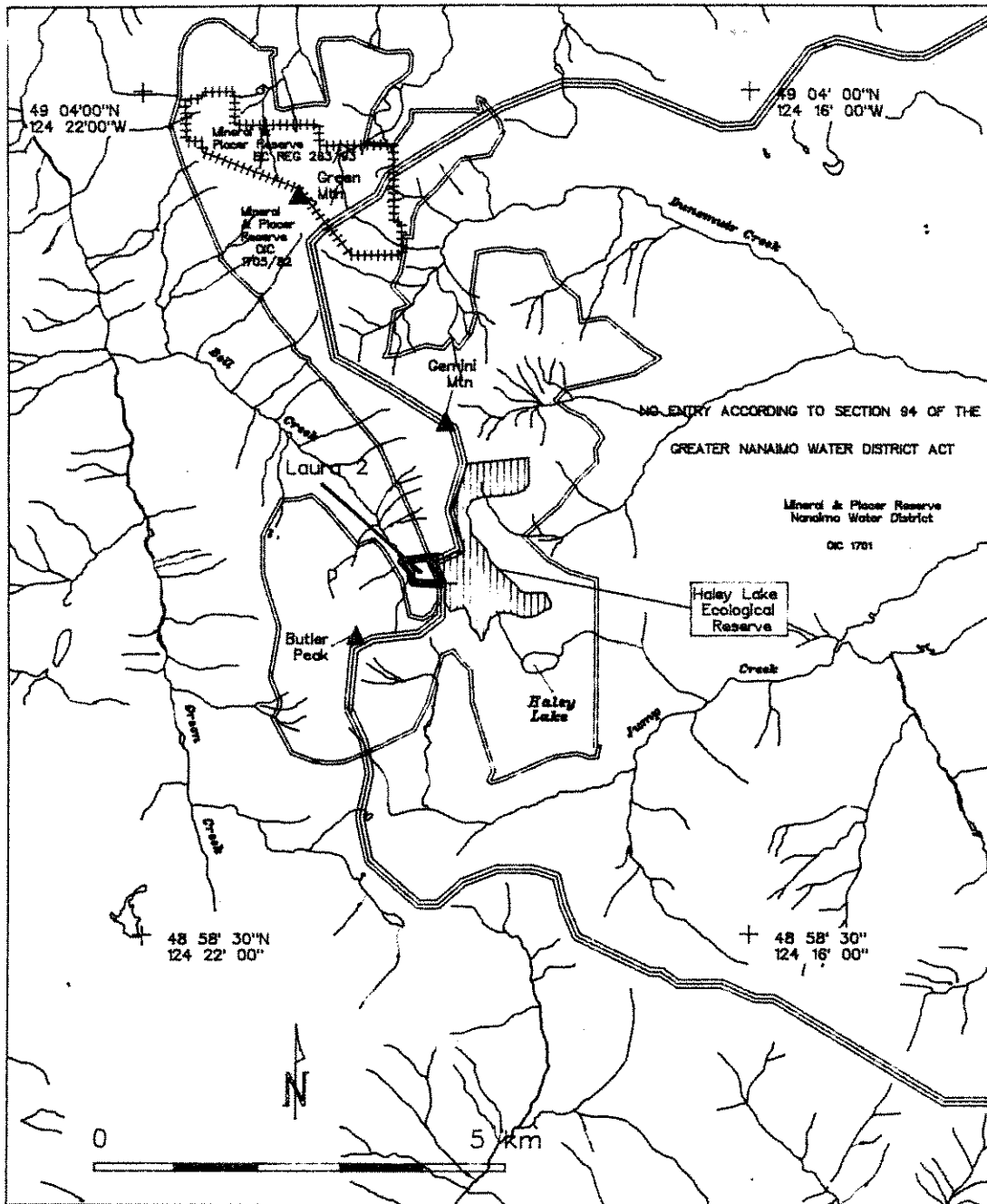


Figure 4. Reserves in the Haley Lake area

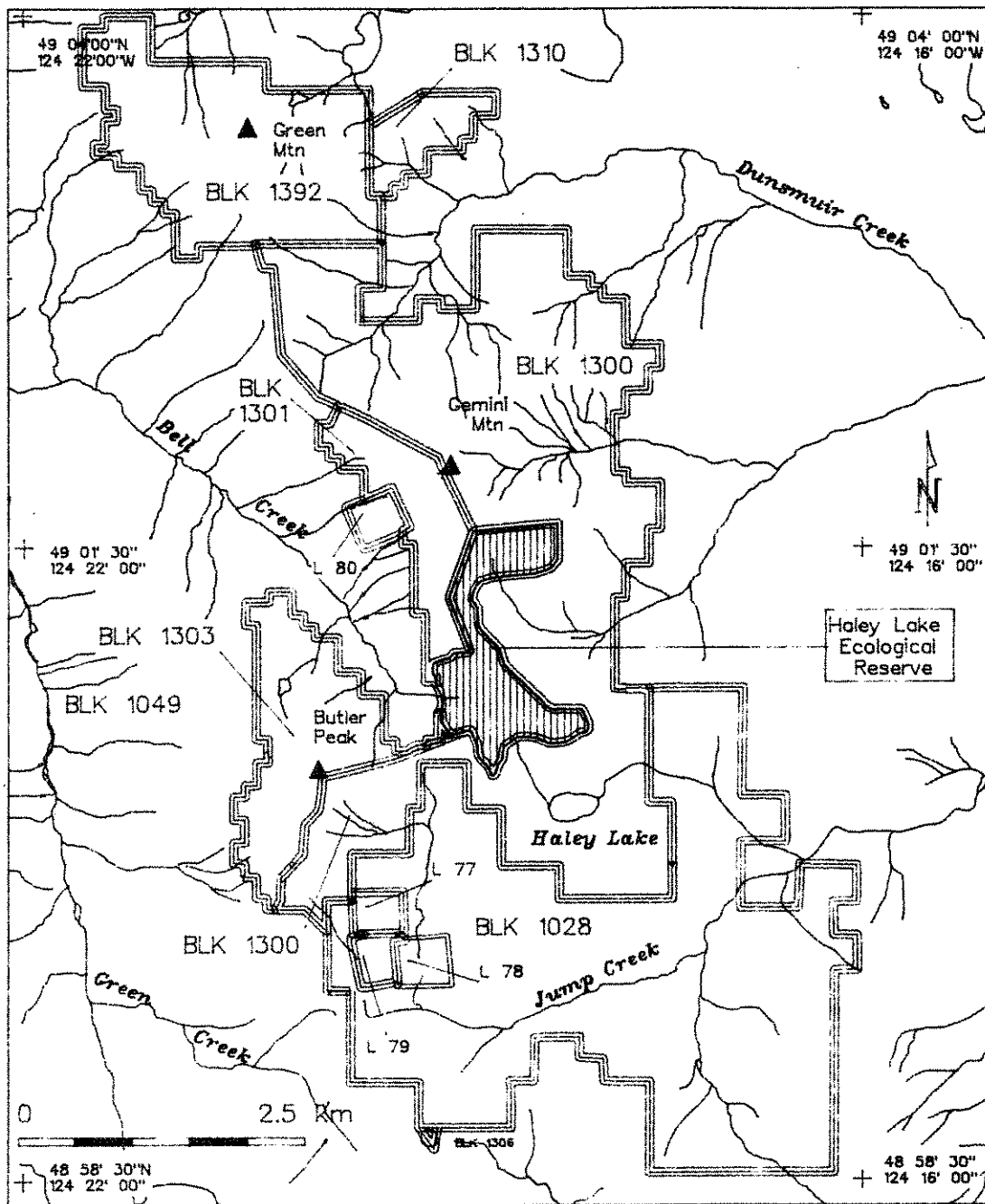


Figure 5. Tenure in the Haley Lake area

There are future logging plans for the north-facing slope just south of Haley Lake (Bryant 1993). However, according to the draft recovery plan, MacMillan Bloedel will not be logging near the existing ecological reserve for at least one year (Vancouver Island Marmot Recovery Team 1993). MacMillan Bloedel is currently building roads in the area in preparation for harvesting that will probably occur in 1995. The new road that approaches the southern end of the ecological reserve is gated.

Use

Research

Haley Lake Ecological Reserve has been the subject of several in-depth research studies related to the Vancouver Island marmot on topics such as behaviour, foraging ecology and genetic variability. All these studies provide valuable information for the management of the ecological reserve and the Vancouver Island marmot.

The first major field study on the Vancouver Island marmot was conducted between 1973 and 1974 by Douglas Heard as part of a Masters thesis at the University of British Columbia. He studied the social behaviour of the marmot and its social interactions and used the Haley Lake area as one of the major study areas. The ecological and population data that was compiled established the basis for all later investigations.

From 1981 to 1982, Robert Milko conducted a vegetation characteristics and habitat comparison study as part of a Masters thesis at the University of Victoria. Foraging ecology was studied to determine the degree of patch-type selection and diet breadth of the Vancouver Island marmot. The Haley Lake area was the major study site and was chosen because it was the only site known to have supported a population of marmots for the last 50 years (Milko 1984). Vegetation was intensively studied at the Haley Lake site as part of the research and resulted in descriptions of the plant community types in the ecological reserve.

In 1982, the Ministry of Environment initiated a systematic inventory of marmot colonies, including those in the ecological reserve. Population surveys and habitat selection by the Vancouver Island marmot were conducted by the Vancouver Island Marmot Liaison Committee in 1985 and by Ministry of Environment, Wildlife Branch in 1986 and 1988.

The majority of the recent research in Haley Lake Ecological Reserve has been conducted by Andrew Bryant. His research has made major contributions to the knowledge of the Vancouver Island marmot. From 1987 through 1989, four colonies of Vancouver Island marmots were studied by Bryant to assess genetic variability and population viability as a Masters degree project for the University of Calgary. The marmot colonies in Haley Lake Ecological Reserve were part of the study. Research on the demography of the Vancouver Island marmot was a continuation of research that was initiated for his thesis project. In 1990, the work on the project was done on behalf of the Vancouver Island Marmot Recovery Team and in 1991, on behalf of BC Parks.

There are ongoing studies being conducted monitoring the marmot's reproductive success, survivorship and burrow use at the ecological reserve and other study colonies as part of a program supported by BC Parks and BC Environment.

Another aspect of the research conducted by Bryant is the dispersal and metapopulation ecology of the Vancouver Island marmot. It is a planned 4-year field project which was initiated in 1992. The objectives of the project include marmot dispersal, demography and thermoregulation. The project will provide data, techniques and guidelines necessary for the enhancement of Vancouver Island marmot populations.

In 1993, a study was initiated by BC Environment on the identification and classification of habitats used by Vancouver Island marmots. The biophysical habitat inventory project on the marmot was requested by the Vancouver Island Marmot Recovery Team and the BC Environment Wildlife Branch in Nanaimo. The inventory consists of bioterrain mapping, ecosystem mapping and data collection for vegetation, soils and wildlife analysis (Duncan 1993). It will provide information that will help develop a model to assist in the location of new areas suitable for the Vancouver Island marmot.

Education

Educational use of the ecological reserve is probably limited to field trips that are organized by such groups as the Friends of Ecological Reserves and local naturalist groups like the Sierra Club and the Nanaimo Fish and Game Protective Association. There is no formal education program that is directly related to the ecological reserve.

There are several initiatives that are providing education about the Vancouver Island marmot. For example, a brochure and educational program was developed by the Northwest Wildlife Preservation Society to provide information on the marmot to children in primary schools. A slide program is presented by a representative of the society and teachers' resources are also provided.

The Vancouver Island Marmot Public Liaison Committee was formed in 1982 to provide an information exchange and public input into management activities directed at the Vancouver Island marmot. The committee meets regularly to discuss initiatives for the protection of the marmot and recently established a small working group to develop a communication strategy that includes fund-raising activities.

In 1993, BC Environment produced a brochure on the Vancouver Island marmot as part of its Wildlife in British Columbia at Risk series. In addition, signs and posters have been posted by BC Environment encouraging people to report Vancouver Island marmot sightings on the access roads to Nanaimo Lakes and River watersheds (Vancouver Island Marmot Recovery Team 1993). Additional signs have been placed near Forbidden Plateau in Strathcona Provincial Park. Posters requesting marmot information will be placed in government offices on Vancouver Island.

Due to the international appeal of the Vancouver Island marmot, Haley Lake Ecological Reserve has been the location for several documentaries and a great deal of photographic use. The Nature of Things has filmed an episode in the ecological reserve on the marmot.

A brochure on the Vancouver Island Marmot Recovery Project has been produced with the assistance of the Friends of the Environment Foundation. This brochure is an invitation to participate in the recovery of the marmot by providing financial assistance.

Other Activities

The degree of human visitation is presently low in the Haley Lake area except during the hunting season, when it is moderate (Bryant 1993). Human recreational activity in accessible marmot colonies could be a future threat but access control and public education will help to keep human impacts at a minimum (B.C. Ministry of Environment, Lands and Parks 1993). Observations by researchers and others also suggest that the Vancouver Island marmot may be tolerant of human presence.

Hunting is popular in the area and there are some instances of trespass by hunters into the ecological reserve. During hunting season, the gate on one of the logging roads that provides access to the ecological reserve is unlocked by MacMillan Bloedel. The gate is operated by the local Fish and Game Club with a check-in/check-out procedure. The gate on the other logging road is kept locked at all times.

In order to assist in preventing trespass, the Ecological Reserves Program developed a Notice to Hunters brochure in 1987 to inform hunters of the ecological reserve and that hunting is not allowed in the ecological reserve. The information on Haley Lake Ecological Reserve from the *Guide to Ecological Reserves in British Columbia* was included as part of the hand-out. This brochure is no longer in circulation.

Management Considerations

The primary goal of Haley Lake Ecological Reserve is to protect and preserve an existing population of Vancouver island marmots by providing a sanctuary for the species. A secondary goal is to permit research that will increase the knowledge with which to provide management and protection of the Vancouver Island marmot.

A management statement was prepared for the ecological reserve in 1990 by BC Parks. This statement is a brief summary of the management issues and actions required for the protection and management of the ecological reserve (a copy of the management statement is provided in Appendix 4). It was recognized that this statement was no longer adequate for the protection of the ecological reserve and that a more in-depth management plan should be developed to address the current issues.

There are several important issues that will be considered in the management plan for Haley Lake Ecological Reserve and these are discussed below. In addition, the management of the ecological reserve will work in conjunction with the recovery plan for the Vancouver Island marmot. The draft recovery plan recommends several actions that need to be considered when developing the management plan for the ecological reserve:

1. a population objective of 400 to 600 marmots dispersed in three metapopulations on Vancouver Island, each large enough to avoid inbreeding, depression or extinction through random demographic events, is judged to be a reasonable way of maintaining long-term viability;
2. every effort must be made to ensure that colonies within a metapopulation are connected through natural dispersal or transplants;
3. the objective must be to manage larger populations that are resilient to random effects, not to protect every small colony of marmots;
4. existing animal inventory databases will be maintained and expanded as a high priority task;
5. a biophysical habitat mapping program to determine existing and potential marmot habitat and biophysical characteristics of all known hibernacula; and
6. the highest priority is protection of marmot habitat through long-term land-owner agreements.

The goals and objectives of the recovery plan and the strategies to achieve them, are described in Appendix 5.

Habitat

A focal point for the protection of the Vancouver Island marmot is the preservation of the habitat of the marmot colonies. Other than Haley Lake Ecological Reserve and the Green Mountain Critical Wildlife Management Area, most of the marmot habitat is either owned by, or licensed to, private forest companies. In addition, from an ecological perspective, the boundaries of Haley Lake Ecological Reserve are less than ideal. Most of the actual marmot colonies are located outside of the ecological reserve with only one colony (Bell Creek) fully contained within the current boundary. The important bowl area to the south is largely outside the ecological reserve as are two other colonies. At least two known hibernacula in the bowl are located outside the ecological reserve. Clearly, changes to the current boundaries and investigation of stewardship initiatives needs to occur so that the ecological reserve represents a viable area, that includes more than one colony in its entirety, for the Vancouver Island marmot.

The metapopulation structure of the Vancouver Island marmot suggests that rather than focusing on attempts to protect individual marmot colonies from extinction, provisions for a mosaic of occupied habitats, close enough together to facilitate re-colonization, if and when local extinctions occur, should be made (Bryant 1990a). Therefore, we need to identify and protect clusters of habitat patches, whether currently occupied by marmots or not, and to assign boundaries which would encompass these in a practical fashion.

Research has shown that all the large marmot colonies are located on, or very close, to the Haley-Gemini-Green-Butler Peak ridge system, a geographic range of some 20 square kilometres (Bryant 1993). Large colony-complexes such as the Haley-Gemini-Green-Butler ridge system fulfil an important role in facilitating the re-colonization of smaller colonies (Bryant 1990a). This area is functionally the central area of marmot activity and needs to be protected. In order to provide adequate habitat protection an enlargement of the ecological reserve needs to be assessed so that the integrity of the colony-complex is ensured.

Viability of the Species

A population viability analysis indicates that the current populations are not viable (Bryant 1990a). However, the population size required to ensure long-term preservation and viability of the species is unknown. Random demographic and environmental events (bad winters, predation, disease, natural catastrophes, poor reproduction, and/or survivorship in consecutive years, etc.) currently pose the largest threat of extinction to the Vancouver Island marmot (Bryant 1990a). It can

reasonably be expected that local extinctions and re-colonizations will occur on a random basis (Bryant 1993). It is, therefore, important to maintain the genetic variability within the population in order to allow a viable response to environmental events. The objective must not be to protect every small colony from random effects, but to manage larger populations that are resilient to such processes (Vancouver Island Marmot Recovery Team 1993).

Control of Access

Activities associated with human visitation and harassment could create problems, mostly by providing easy access to the marmot colonies. Possible deleterious effects include trampling of vegetation, snow compaction, disturbance by wildlife photographers and others, shooting, habitat destruction by all-terrain vehicles and vandalism. However, in general, most colonies are protected by their inaccessibility and through the lack of common knowledge of their specific location. In the case of Haley Lake Ecological Reserve, however, the location is quite well-known to naturalist groups and others interested in the species. The ecological reserve is protected from access to a large degree due to it being surrounded by private land and the presence of locked gates on the road accesses. However, during hunting season one of the gates is unlocked allowing easier access.

In order to monitor the amount of human visitation to the ecological reserve, the management plan should consider the issue of controlling access.

Wardenship

Jan and Warrick Whitehead, of the Sierra Club, Cowichan Group and David and Adele Routledge, of the Vancouver Island Marmot Preservation Society have been the volunteer wardens since the establishment of the ecological reserve.

The role of the BC Parks Volunteer Program, including the ecological reserve warden program, is currently being reviewed by BC Parks. The wardenship of Haley Lake Ecological Reserve will be addressed when this is completed.

Research

There are several areas of research that have been recommended by Andrew Bryant and the recovery plan to assist in the protection of the Vancouver Island marmot that involve Haley Lake Ecological Reserve. In his work plan for the Vancouver Island marmot from 1992-1996, Bryant stated that updated information on population status of known colonies within the "core" area (Nanaimo River-Nanaimo lakes watersheds east of Nitinat River) is required. The recovery plan (Vancouver Island Marmot Recovery Team 1993) states several priorities for research:

1. dispersal characteristics: data is required on the rates and magnitudes of dispersal and the effects of dispersal upon colony establishment, maintenance and disappearance;
2. hibernacula requirements: research is needed to determine what constitutes suitable hibernacula for the species and the importance of hibernacula for over-winter survival in different habitats; and
3. research on translocation techniques: it is important that appropriate methods exist for transplanting marmots.

A further recommendation from the recovery plan is that in order to maintain the population of the Vancouver Island marmot, survivorship and reproductive status must be monitored.

When formulating a research program for the ecological reserve, these recommendations and objectives should be considered. However, research activities that could cause significant population declines should be prohibited.

Education

Viewing opportunities for the Vancouver Island marmot have been discussed in the draft of Vancouver Island Regional Wildlife Viewing Plan which states that there will be "careful development of viewing opportunities in Green Mountain area" for Vancouver Island marmots (Mol 1992). The plan states that only marmot colonies where viewing opportunities can be carefully developed with minimal impact should be developed.

Surrounding Land Uses

The dominant surrounding land use is logging. Although it is believed that there are no plans for immediate (within one year) logging of the areas surrounding the ecological reserve, there are probably future logging plans that will approach the boundary of the ecological reserve. In the past, the companies have been very cooperative with such actions as company reserves that have removed areas from logging plans. The management plan will provide recommendations on how to protect the integrity of the ecological reserve.

Summary

The long-term survival of the Vancouver Island marmot will require the establishment of additional metapopulations, a larger overall population size and maintenance of reasonable levels of gene flow between the marmot colonies (Bryant 1993). If the ecological reserve is to provide a valuable contribution to the preservation of the Vancouver Island marmot, there are several major issues that the management plan will need to address:

1. changes to the current boundaries of the ecological reserve and investigation of stewardship initiatives to ensure that a viable number of colonies, i.e., a metapopulation, are protected;
2. the monitoring of the amount of human visitation to the ecological reserve and control the access to the ecological reserve;
3. the formulation of a research and monitoring program for the ecological reserve; and
4. the actions for ensuring the integrity of the ecological reserve with regard to surrounding land uses.

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Personal Communications

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Appendix 1. Plants of Haley Lake Ecological Reserve (from Roemer 1987)

Trees

<i>Abies amabilis</i>	amabilis fir
<i>Abies lasiocarpa</i>	subalpine fir
<i>Chamaecyparis nootkatensis</i>	yellow-cedar
<i>Pinus monticola</i>	western white pine (uncommon)
<i>Pseudotsuga menziesii</i>	Douglas-fir (uncommon)
<i>Tsuga heterophylla</i>	western hemlock
<i>Tsuga mertensiana</i>	mountain hemlock

Shrubs

<i>Alnus viridis</i> ssp. <i>sinuata</i>	Sitka alder
<i>Arctostaphylos uva-ursi</i>	kinnikinnick
<i>Cassiope mertensiana</i>	white mountain-heather
<i>Cladothamnus pyroliflorus</i>	copperbush
<i>Juniperus communis</i>	common juniper
<i>Lonicera utahensis</i>	Utah honeysuckle ¹
<i>Mahonia nervosa</i>	dull Oregon-grape
<i>Oplopanax horridus</i>	devil's club
<i>Paxistima myrsinites</i>	false box
<i>Phyllodoce empetriformis</i>	pink mountain-heather
<i>Rhododendron albiflorum</i>	white-flowered rhododendron
<i>Ribes lacustre</i>	black gooseberry
<i>Rubus parviflorus</i>	thimbleberry
<i>Rubus spectabilis</i>	salmonberry
<i>Vaccinium alaskaense</i>	Alaskan blueberry
<i>Vaccinium caespitosum</i>	dwarf blueberry
<i>Vaccinium deliciosum</i>	blue-leaf huckleberry
<i>Vaccinium membranaceum</i>	black huckleberry
<i>Vaccinium ovalifolium</i>	oval-leaved blueberry
<i>Vaccinium parvifolium</i>	red huckleberry

¹ Rare on Vancouver Island.

Herbaceous Vegetation

<i>Achillea millefolium</i>	yarrow
<i>Achlys triphylla</i>	vanilla-leaf
<i>Actaea rubra</i>	baneberry
<i>Adenocaulon bicolor</i>	pathfinder
<i>Adiantum pedatum</i>	maidenhair fern
<i>Agoseris aurantiaca</i>	orange agoseris
<i>Allium crenulatum</i>	Olympic onion ¹
<i>Anaphalis margaritacea</i>	pearly everlasting
<i>Aquilegia formosa</i>	red columbine
<i>Arabis glabra</i>	tower mustard
<i>Arenaria macrophylla</i>	sandwort
<i>Arnica latifolia</i>	mountain arnica
<i>Asarum caudatum</i>	wild ginger
<i>Aster subspicatus</i>	Douglas' aster
<i>Athyrium filix-femina</i>	lady fern
<i>Boykinia elata</i>	coast boykinia
<i>Bromus marginatus</i>	brome
<i>Campanula rotundifolia</i>	common harebell
<i>Carex macloviana</i>	sedge
<i>Carex mertensii</i>	Mertens' sedge
<i>Carex nigricans</i>	black alpine sedge
<i>Carex spectabilis</i>	showy sedge
<i>Castilleja miniata</i>	common red paintbrush
<i>Cerastium arvense</i>	field chickweed
<i>Chimpaphila menziesii</i>	Menzies' pipsissewa
<i>Chimpaphila umbellata</i>	prince's pine
<i>Cirsium edule</i>	edible thistle
<i>Clintonia uniflora</i>	queen's cup
<i>Cryptogramma crispera</i>	parsley fern
<i>Danthonia intermedia</i>	timber oatgrass
<i>Deschampsia atropurpurea</i>	mountain hairgrass
<i>Dicentra formosa</i>	bleeding heart
<i>Dryopteris arguta</i>	coastal shield-fern ¹
<i>Elymus glaucus</i>	blue wildrye
<i>Epilobium alpinum</i>	alpine fireweed
<i>Erigeron peregrinus</i>	subalpine daisy
<i>Eriophyllum lanatum</i>	woolly eriophyllum
<i>Erythronium grandiflorum</i>	glacier lily
<i>Fragaria virginiana</i>	wild strawberry
<i>Galium triflorum</i>	sweet-scented bedstraw
<i>Goodyera oblongifolia</i>	rattlesnake plantain
<i>Gymnocarpium dryopteris</i>	oak fern

<i>Habenaria elegans</i>	slender rein orchid
<i>Heracleum lanatum</i>	cow-parsnip
<i>Heuchera micrantha</i>	small-flowered alum-root
<i>Juncus drummondii</i>	Drummond's rush
<i>Lactuca muralis</i>	wall lettuce
<i>Lathyrus nevadensis</i>	purple peavine
<i>Lilium columbianum</i>	tiger lily
<i>Lomatium martindalei</i>	Martindale's lomatium
<i>Luetkea pectinata</i>	partridgefoot
<i>Lupinus arcticus</i>	arctic lupine
<i>Luzula campestris</i>	field woodrush
<i>Luzula parviflora</i>	small-flowered woodrush
<i>Lycopodium annotinum</i>	stiff clubmoss
<i>Melica subulata</i>	Alaska oniongrass
<i>Mimulus guttatus</i>	yellow monkey-flower
<i>Mitella trifida</i>	three-toothed mitrewort
<i>Montia parvifolia</i>	small-leaved montia
<i>Montia sibirica</i>	western spring beauty
<i>Osmorhiza chilensis</i>	sweet-cicely
<i>Penstemon davidsonii</i>	Davidson's penstemon
<i>Penstemon serrulatus</i>	coast penstemon
<i>Phleum alpinum</i>	mountain timothy
<i>Phlox diffusa</i>	alpine timothy
<i>Poa gracillima</i>	Pacific bluegrass
<i>Poa scabrella</i>	bluegrass
<i>Polygonum douglasii</i>	Douglas' knotweed
<i>Polygonum minimum</i>	leafy dwarf knotweed
<i>Polystichum lonchitis</i>	mountain holly fern
<i>Polystichum munitum</i>	sword fern
<i>Potentilla diversifolia</i> var. <i>diversifolia</i>	cinquefoil
<i>Pteridium aquilinum</i>	bracken
<i>Pyrola secunda</i>	one-sided wintergreen
<i>Ranunculus eschscholtzii</i>	subalpine buttercup
<i>Rubus pedatus</i>	five-leaved bramble
<i>Saxifraga bronchialis</i>	spotted saxifrage
<i>Saxifraga ferruginea</i>	Alaska saxifrage
<i>Saxifraga rufidula</i>	rusty-haired saxifrage
<i>Sedum divergens</i>	spreading stonecrop
<i>Sedum oreganum</i>	Oregon stonecrop
<i>Selaginella wallacei</i>	Wallace's selaginella
<i>Senecio triangularis</i>	arrow-leaved groundsel
<i>Sibbaldia procumbens</i>	sibbaldia
<i>Silene parryi</i>	Parry's campion

<i>Sorbus sitchensis</i>	Sitka mountain-ash
<i>Stenanthium occidentale</i>	mountainbells
<i>Streptopus amplexifolius</i>	clasping twistedstalk
<i>Streptopus roseus</i>	rosy twistedstalk
<i>Streptopus streptopoides</i>	small twistedstalk
<i>Tellima grandiflora</i>	tall fringecup
<i>Thalictrum occidentale</i>	western meadowrue
<i>Tiarella laciniata</i>	cut-leaved foamflower
<i>Tiarella trifoliata</i>	three-leaved foamflower
<i>Tiarella unifoliata</i>	one-leaved foamflower
<i>Trillium ovatum</i>	western trillium
<i>Trisetum spicatum</i>	spike trisetum
<i>Valeriana sitchensis</i>	Sitka valerian
<i>Veratrum viride</i>	Indian hellebore
<i>Veronica wormskjoldii</i>	alpine speedwell
<i>Viola adunca</i>	early blue violet
<i>Viola glabella</i>	stream violet
<i>Viola sempervirens</i>	trailing yellow violet

Some Prominent Bryophytes and Lichens

Andraea rupestris
Caldonia spp.
Dicranum fuscescens
Mnium spinulosum
Orthocaulis floerkii
Rhacomitrium canescens
Rhytidiadelphus loreus
Rhytidiopsis robusta
Stereocaulon tomentosum
Thamnolia spp.

Appendix 2. The Vancouver Island Marmot

The Vancouver Island marmot is closely related to the hoary marmot of the mainland but this island form has evolved in isolation for thousands of years, resulting in very distinctive characteristics. The most obvious is the unique dark brown pelage with white patches around muzzle and forehead and irregular white streaks on its chest and abdomen. The mainland marmots range in colour from light brown to almost silvery. The colour of the fresh pelage gradually fades over the summer and following spring to a cinnamon brown. The Vancouver Island marmot moults once per year starting around mid-July (Heard 1977). The Vancouver Island marmot also has different skull characteristics, karyotype and behavioural traits. Its weight ranges from approximately 2.5 kg to 6 kg (mainly due to seasonal variation). An adult marmot is 65 to 70 cm from nose to end of tail, with the tail comprising about 40% of the total body length (Nagorsen 1987). The main vocalization of the Vancouver Island marmot is a loud shrill whistle which serves as a warning signal.

The Vancouver Island marmot, like other marmots, is colonial and a gregarious animal, with frequent social interaction. It lives in small colonies or family groups. Most colonies are small and usually consist of one or two family groups and usually contain an adult male and female and a variable number of two-year olds, yearlings and infants. These small colonies, however, are vulnerable to extinction through random demographic and environmental events. Heard (1977) reported that the size of the colonies of Vancouver Island marmots generally range from 0.5 to 4.0 hectares.

The Vancouver Island marmot is active for 4-5 months of the year (May to September) and hibernates for 7-8 months (early October to early May). On a daily basis, it is a relatively sedentary animal and movements during the day are not likely to exceed 1 kilometre (Bryant 1990a). The marmot is most active in the mornings and evenings, and least active during the heat of day and generally rest in burrows at this time (Heard 1977). The burrows are generally dug under protective boulders. The majority of the time spent outside of the burrow includes two activities, resting and feeding.

These marmots are specialized feeders and their diets vary little between colonies. Foraging occurs mainly during two periods, early morning and early evening (Milko 1984). Their food habits include a diet of grasses and grass-like plants in the spring such as oatgrass, sedges and herbs such as lupines. During the summer forbs such as lupines, Indian paintbrush, cow parsnip are preferred.

They are highly dependent upon the *Anaphalis*-Aster wildflower community which provides a diversity of food sources and soil conditions suitable for burrows (Vancouver Island Marmot Recovery Team 1993). They also eat berries of kinnikinnick and blueberry, and flowers of the tiger lily.

Not much is known about the reproductive behaviour of the Vancouver Island marmot but mating probably occurs above ground during the first three weeks after emergence from hibernation and the gestation period is probably around one month. The species seems to be monogamous within any given reproductive season but there is no persistence of pair-bonds from year-to-year (Bryant 1990a, 1992b). Females may produce young at three years, but most females produce at four years of age. A litter of three is typically produced with the young emerging from their burrows from late June to early July.

The major source of mortality for the Vancouver Island marmot appears to occur over winter, especially for young and old animals (Munro et al 1985). Mortality is highest for young marmots during their first winter of hibernation and for dispersing subadults. (In 1981, an adult female was found dead from shotgun wounds at Haley Lake and was given to the Royal B.C. Museum for detailed scientific examination (The Sierra Club of Western Canada 1982)). Natural predators may include the cougar (*Felis concolor*), wolverine (*Gulo gulo*), golden eagle (*Aquila chrysaetos*) and probably the red-tailed hawk (*Buteo jamaicensis*), wolf (*Canis lupus*), black bear (*Ursus americanus*) and possibly bald eagle (*Haliaeetus leucocephalus*).

Interesting data is currently being collected by Bryant regarding thermoregulation of the Vancouver Island marmot. Recent research indicates that the Vancouver Island marmot can have body temperature changes of $>4^{\circ}\text{C}$ within an hour during the summer (Bryant and Janz 1993). In addition, research (Bryant and Janz 1993) suggests that the marmots use rocks or stumps to conduct heat away from their bodies.

There have been recent discoveries of skulls and bones of the Vancouver Island marmot in locations other than its present distribution. Skulls and bones found on Mariner Mountain in Strathcona Provincial Park have been estimated to be 900 years B.P. (Keddie and Nagorsen 1993). This find is significant because it contains the largest assemblage of Vancouver Island marmot bones ever discovered. Marmot bones have also been located in a small cave in Clayoquot Plateau and are estimated to be about 2500 years B.P. (Nagorsen 1989).

A recent report (Keddie and Nagorsen 1993) indicates that there may have been traditional hunting of the marmot in Bedwell River area. First Nations people may have utilized the Vancouver Island marmot for food and/or skins in the past but it is not known if this occurred in the area of the ecological reserve. These discoveries also indicate that the habitat of the marmot may have been more widespread in the past (Figure 6).

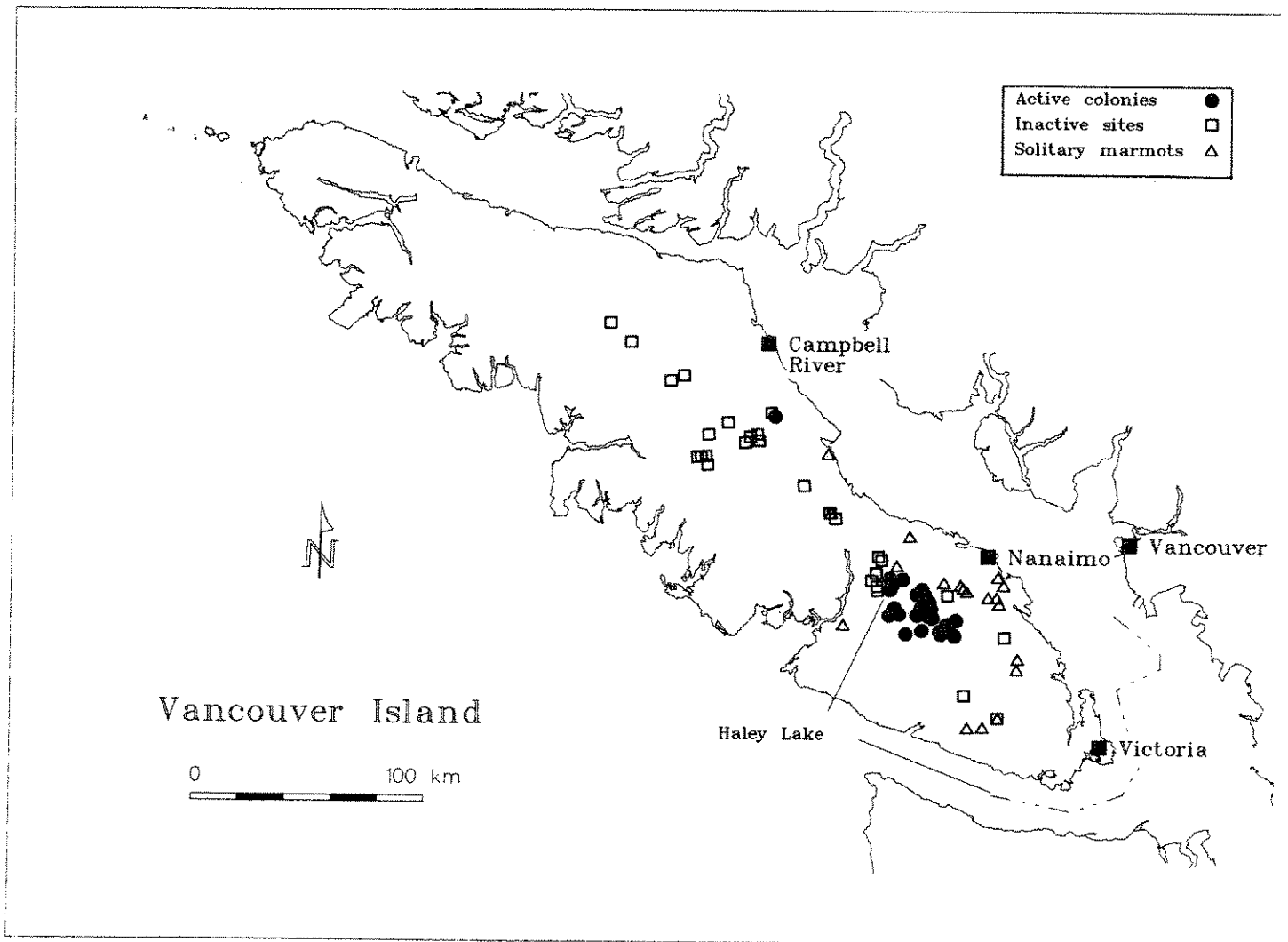


Figure 6. Past and present distribution of the Vancouver Island marmot (Bryant, pers. comm.)

Appendix 3. Inventories of the Vancouver Island marmot in the Haley Lake Ecological Reserve area, 1972-1994 (Bryant, pers. comm.)

Adult Counts (all counts)	Bowl¹	Bell Creek²	Vaughan Road³
Years counted	23	20	12
<i>n</i> of counts	120	52	85
\bar{x} <i>n</i> of adults	12.83	7.00	5.00
SD	3.97	3.21	3.13
Range	1-12	1-11	1-9
Infant Counts (after July 1)			
Years counted	22	15	11
<i>n</i> of counts	75	25	44
\bar{x} <i>n</i> of infants	5.23	1.60	1.91
SD	4.62	1.64	2.34
Range	0-14	0-4	0-6

¹ Partially located in the ecological reserve.

² Located entirely inside the ecological reserve.

³ Located outside the ecological reserve, clearcut site.

Appendix 4. Haley Lake Ecological Reserve Management Statement

File: 6-6-2-537-50

Date: 90-02-22

HALEY LAKE ECOLOGICAL RESERVE #117 MANAGEMENT STATEMENT

(This statement is intended for use in conjunction with the descriptive text and map pages supplied in the "Guide to Ecological Reserves in British Columbia".)

Features Requiring Special Management Consideration:

The Vancouver Island marmot (Marmota vancouverensis), is endemic to the island and there are only approximately 250 in the world population.

Management Issues:

1. Land additions required to provide more habitat for the population as marmots utilize area beyond ER.
2. Enclosed on either side by privately owned forest land. MacMillan Bloedel and Fletcher Challenge allow access to hunters each year. A key must be obtained for each visit by staff and wardens from MacMillan Bloedel (Chemainus office).
3. Cable gate and posts installed by MacMillan Bloedel in 1981 have fallen down, but road washouts prevent vehicle access. Hunting suspected to trespass on reserve.
4. Fletcher Challenge will donate additional land west of present reserve. Efforts to acquire more land from MacMillan Bloedel to the south and east continue.
5. Guiding/outfitting coincides with reserve.

Management actions required and their Priority:

1. Continue to support research on Vancouver Island Marmot to obtain guidance on management measures.
2. Continue efforts to enlarge reserve; expedite land transfer from Fletcher Challenge.
3. Ensure frequent presence of volunteer wardens, including during hunting season.
4. Attempt improving the availability of keys from MacMillan Bloedel.
5. Monitor visiting naturalist groups and ensure that they

will not become a disturbance to the marmot colony.

6. Participate in Vancouver Island Marmot Liaison Committee.

Fire, Insect and Disease Contingency:

1. Avoid fires; if firefighting becomes necessary, avoid using chemicals and bulldozers in the reserve.
2. No insect and disease control desired.

Warden Name/Address:

David and Adele Routledge
V.I. Marmot Preservation Society,
Box 900,
Cumberland, B.C.,
VOR 1S0
(336-2130)

Warrick & Jan Whitehead
Sierra Club,
Box 754,
Duncan, B.C.,
V9L 3Y1
(748-1374) or (746-5751)

Zone Manager: MALAHAT - NORTH ZONE
DERRICK AURINGER

Approval:

Date

District Manager

RT ROUTLEDGE
Robin Soule

9-09-24

LJN/MGMT.117/90-02-21

Appendix 5. Recovery Plan Goals, Objectives and Strategies (excerpts from Vancouver Island Marmot Recovery Team 1993)

1. Recovery goal and objectives

The goal of the Recovery Plan is to remove the Vancouver Island marmot from the Endangered Species list. Population objectives are designed to ensure the long-term survival of the species despite natural catastrophes, inbreeding, or habitat changes. The team and appropriate jurisdictional authorities (primarily B.C. Ministry of Environment, Lands and Parks) are responsible for implementing the plan. The Recovery Team and the Recovery Plan are integral components of the Recovery of Nationally Endangered Wildlife in Canada (RENEW) initiative.

Objective #1: Maintain the existing Nanaimo - Cowichan Lake metapopulation at not fewer than 200 animals within the currently known distribution of the species. Species status remains Endangered.

Objective #2: Down-list the Vancouver Island Marmot from Endangered to Threatened when a second stable or increasing metapopulation of between 100 and 200 animals is discovered or established by translocation. Total population of marmots would be 300 to 400.

Objective #3: Down-list the Vancouver Island Marmot from Threatened to Vulnerable when a third stable or increasing metapopulation of between 100 and 200 animals is discovered or established by translocation. Total population of marmots would be 400 to 600.

2. Strategies

Seven integrated strategies have been designed to meet the recovery goal:

- A. Monitor known populations (to provide early warning if population trends turn downwards).
- B. Determine habitat requirements and map habitat (to determine how much marmot habitat exists on Vancouver Island and what complete recovery would mean in a geographic and population sense).
- C. Inventory for undiscovered colonies and habitats (to verify that marmots have, or have not, disappeared from parts of their historic range).

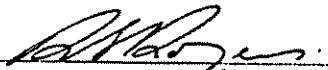
- D. Investigate dispersal characteristics (to understand how frequently marmots move from one colony to another and whether such movements are influenced by human activity).
- E. Protect and manage important subalpine and logged habitats (to ensure protection of keystone colonies).
- F. Conduct marmot transplants if warranted (to rebuild colonies in historic habitats or to encourage gene flow among existing colonies).
- G. Develop public support through education, participation and fund-raising activities (to facilitate implementation of the recovery plan).

Appendix 6. Order in Councils



293

APPROVED AND ORDERED FEB. 19. 1987


Lieutenant-Governor

EXECUTIVE COUNCIL CHAMBERS, VICTORIA FEB. 18. 1987

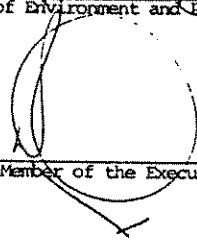
On the recommendation of the undersigned, the Lieutenant-Governor, by and with the advice and consent of the Executive Council, orders that on publication in the Gazette of a notice signed by the Minister of Environment and Parks, the land described in the Schedule is established as an ecological reserve, to be known as the Haley Lake Ecological Reserve.

SCHEDULE

DESCRIPTION OF LAND

Lot 1, Block 1300, Dunsmuir District, Plan 44043, containing 93 hectares, more or less.


Minister of Environment and Parks


Presiding Member of the Executive Council

4-6-2-537

(This part is for administrative purposes and is not part of the Order.)

Authority under which Order is made:

Act and section Ecological Reserve Act - Section 3

Other (specify) _____

Statutory authority checked by: Colame Kelly

(Signature and type or printed name of Legal Officer)

PROVINCE OF BRITISH COLUMBIA
ORDER OF THE LIEUTENANT GOVERNOR IN COUNCIL

Order in Council No. 522 . Approved and Ordered APR 18, 1991



Lieutenant Governor

Executive Council Chambers, Victoria APR 17, 1991

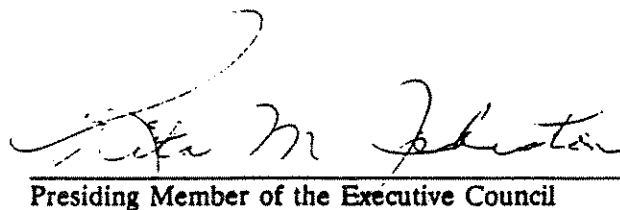
On the recommendation of the undersigned, the Lieutenant Governor, by and with the advice and consent of the Executive Council, orders that on publication in the Gazette of a notice signed by the Minister of Parks, the land described in the Schedule is added to Haley Lake Ecological Reserve.

SCHEDULE

All those Crown parcels or tracts of land, together with all that foreshore or land covered by water, situated in Dunsmuir Land District, and lying within the following described boundaries:

Lot 1, Blocks 1049 and 1301, Plan VIP51887.

The whole containing 27.17 hectares, more or less.


Minister of Parks
Presiding Member of the Executive Council

(This part is for administrative purposes only and is not part of the Order)

Authority under which Order is made:

Act and section: Ecological Reserve Act Section 4

Other (specify): O/C 293/87

