STATUS AND MANAGEMENT OF THE VANCOUVER ISLAND MARMOT

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SUMMARY

The Vancouver Island marmot is the rarest of all the North American species of marmot, and it exists solely on Vancouver Island. In March 1980 it was officially designated an endangered species by Order-In-Council. Active management of the Vancouver Island marmot has been relatively recent. Information on distribution, population trends, biology and habitat requirements initiated in the 1970's is receiving greater attention in the 1980's. Surveys in recent years and observations of some of the more well known colonies indicate that the Vancouver Island marmot population has increased in both numbers and distribution since the early 1970's.

The ultimate goal of the Vancouver Island marmot management plan is to establish and maintain the population of Vancouver Island marmots at a level and distribution that provides a reasonable likelihood of long-term survival of the species.

Specific objectives of the management plan include:

(1) to ensure that six distinct reproducing populations are in existence by 1985 and ten by 1990,

(2) to secure habitat for key marmot colonies and prevent alienation and alteration of known marmot habitat,

(3) to maintain one small captive breeding colony,

(4) to encourage and support approved scientific research, and

(5) to encourage public participation in various aspects of the program and to keep the public informed of progress.

Implementation of the activities associated with each objective are detailed in the plan.

Modifications to the plan may periodicaly be required in response to increasing knowledge, implementation progress, availability of funding, and management priorities.

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1.0 INTRODUCTION

The Vancouver Island marmot (Marmota vancouverensis) is one of 14 living species of marmots in the world (Barash, 1974b). Six of the species live in North America and four in British Columbia (Cowan and Guiguet 1965, Frase and Hoffman 1980). The Vancouver Island marmot is the rarest of all the North American species and exists solely on Vancouver Island.

In 1973 the Vancouver Island marmot was given legal protection under the Wildlife Act. In 1979 it was given the status of endangered by the Committee on the Status of Endangered Wildlife in Canada, and following the publication of "The Preliminary Plan for the Designation of Threatened and Endangered Species in British Columbia" (Munro and Low 1979) it was officially designated an endangered species by Order-in-Council in March 1980.

The purpose of this document is to collate information specific to the Vancouver Island marmot and other closely related species, and to formulate a plan for future management of the Vancouver Island marmot.

1.1 Description and Taxonomy

The species was discovered in 1910 and described by Swarth (1911) from 11 adult specimens taken in the King Solomon Basin, Golden Eagle Basin and Mt. Douglas south of Port Alberni.

Freshly molted animals are very dark brown with patches of white on the muzzle, forehead and breast. The dark colour gradually fades until the fur is replaced at the next molt (Heard 1977). Adults generally weigh between three and six kilograms with a doubling of weight between emergence in the spring and the onset of hibernation in the fall (Heard 1977).

Four of the six marmot species in North America occupy subalpine to alpine habitat and are considered to be closely related. Marmota broweri is considered to be most closely linked with the black-capped marmot (Marmota camtschatica) of Siberia whereas the other three may be considered in one superspecies (Hoffman et al. 1979). It is from studies of two of these three - hoary marmot (M. caligata) and Olympic marmot (M. olympus) -that we can obtain greater insight into the third -the Vancouver Island marmot (M. vancouverensis).

1.2 Biology

Although intensive studies have been made of the yellow-bellied marmot (Marmota flaviventris) in western North America (see Armitage 1973, 1977; Armitage and Downhower 1974; Nowichi and Armitage 1979), fewer studies have been made of the Olympic and hoary marmots and fewer still of the Vancouver Island marmot.

1.2.1 Hibernation

Marmots hibernate during the winter, the duration depending upon the altitude and latitude. Olympic marmots usually begin hibernation between mid-September and mid-October and emerge in mid-May (Barash 1973). Barash (1976) also reported adult males and non-maternal adult females were the first to hibernate, followed by the yearlings and finally maternal adult females and their infants. Holmes (1979) reported emergence during the first week of May for hoary marmots in Alaska. Heard (1977) considered emergence to be early May and hibernation of most individuals by mid-September in the Vancouver Island marmot. However, there are many marmot sightings on file in the Region 1 Fish and Wildlife records that occurred in late September into October. Copulation apparently takes place after emergence in the spring. Young Olympic marmots are born in late June

and first appear above ground in late July (Barash 1973). Heard (1977) reported two litters of Vancouver Island marmots emerging for the first time on July 11. Swarth (1912) reported that several of the six adult females collected in the Mt. Douglas area were lactating, but no infants were seen by the third week of July. The Fish and Wildlife survey crew observed two infant marmots on 1982 June 29. Our own observations suggest emergence of adults may occur as early as mid-April and some animals are known to be above ground until mid-October. Captive Vancouver Island marmots held at the Okanagan Game Farm near Penticton emerge in mid-April and are underground by late September (pers. comm. Lacey and Dyer).

1.2.2 Population dynamics

Both hoary and Olympic marmots first breed as three year olds and may disperse as two year olds (Barash 1973, 1974a, Holmes 1979). Heard (1977) believed the same was true for Vancouver Island marmots. Dispersal, "the movement of an individual from its place of birth to its place of reproduction" (Shirer and Downhower 1969), begins in the Olympic marmot about 25 days after emergence of the two year olds and seems inversely related to winter mortality (Barash 1973). The same author also suggested the greater number of animals in the colony, the greater the chance of dispersal. The higher the winter mortality in the colony, the less likely are two year olds to disperse. Holmes (1979) found two year old hoary marmots in the harsh climate of Alaska dispersed only if their dam had another litter. Dispersing marmots of both sexes can cover long distances through a variety of habitats and elevation, over 13 km and almost down to sea level in the case of Olympic marmots (Barash 1973). Sightings of isolated Vancouver Island marmots in unusual locations are undoubtedly a result of such dispersion (Smith

1982). Movement otherwise is generally limited to less than 500 m in hoary marmots (Holmes 1979).

There are several natural predators of marmots. The following species, which occur on Vancouver Island, have been known to prey on marmots: cougar (Barash 1973, Heard 1977), wolverine, golden eagle (Holmes 1979, Noyes and Holmes, 1979), and probably red-tailed hawk, goshawk, wolf, and possibly black bear and bald eagle. Such predation has not been shown to be a significant factor elsewhere. The accidental introduction of cottontail rabbits near Victoria some years ago, and their subsequent spread north to Nanaimo, may attract more aerial predators, especially golden eagles, which may have an effect on small colonies (Merilees 1980).

The major source of mortality appears to occur over winter, especially in the young and older animals. Holmes (1979) reported 37.5% winter mortality in young hoary marmots and Barash (1973) about 50% in young Olympic marmots. Whereas Barash (1973) suggested winter mortality in Olympic marmots was inversely correlated with snow depth because of the insulating qualities of snow, Wood (1973) suggested precipitation (both snow and rain) was the greatest factor affecting population size in Olympic marmots because it affected the plant communities and thus the condition in which marmots entered hibernation. Barash (1973) was able to correlate increased mortality with low snowfalls.

1.2.3 Social organization

All three species live in colonies which may vary from 2 to 16 animals before the young emerge, but the average size before young emerge is 6.8 (n=12) in the Olympic marmot (Wood 1973), 8.3 (n=2) in the Vancouver Island marmot (Heard 1977), and 4.4 (n=16) in the hoary marmot (Holmes 1979). Average litter size is similar, averaging close to 4 (3.8, n = 38)

in the Olympic marmot (Barash 1973, Wood 1973), 3.4 (n = 8) in the hoary marmot (Holmes 1979) and 3.0 (n = 5) in the Vancouver Island marmot (Heard 1977). From the same authors, it appears that colonies are usually composed of one adult male, one or two adult females, some one or two year olds and some infants. Barash (1973) found that female Olympic marmots were usually producing a litter in alternate years and the most common colony make-up was one litter of infants, one litter of one year olds, one adult male and two adult females. A similar situation probably occurs on Vancouver Island.

The geographic area occupied by a colony is not large. Heard (1977) reported colonies of Vancouver Island marmots of 3 ha and 4.5 ha. Barash (1973) determined the average area to be about 2.2 ha in the Olympic marmot whereas Holmes (1979) found the average range to be about 13.8 ha in the hoary marmot. In the latter two studies, the authors found only one hibernaculum per colony. The mean distance between hibernacula in Olympic marmots was 250 m (n=6) and 449 m (190-520; n=6) in the hoary marmot.

Kilgore and Armitage (1978) defined a yellow-bellied marmot colony as "... a social grouping of marmots consisting of one or more polygamous units and some nonreproductive individuals (yearlings and young) occupying a circumscribed habitat." Holmes (1979) found hoary marmots in his study area in Alaska to be monogamous. Both the hoary and Olympic marmots also had nonreproductive two year olds associated with colonies. Holmes (1979) reported 10 of 11 colonies bounded on one or two sides by other colonies resulting in a nearly continuous distribution. Each colony was defended when its circumscribed area was violated by a member of a neighbouring colony. Such violations were infrequent. Wood (1973) found the number of burrows per colony of Olympic

marmots to average 53 (13-79, n=11) or an average of 5.5 burrows per marmot (adult and juvenile only). Burrows for both species contained one hibernaculum, sleeping burrows and short refuge burrows. A review of the data for the Vancouver Island presented in Heinsalu and Smith (1982) gives a comparable figure of 3.1 burrows per marmot although their inventory did not concentrate on sightings of animals. Considering that colonies may contain only one breeding female and alternate year breeding is likely, we will define a colony as a circumscribed habitat containing two or more marmots with evidence of reproduction. Verification of present use of historic colonies implies population recruitment, as does direct observation of infants or yearlings at least once every 3 years. In addition, based on the review of average colony size (p. 4), direct observation of 5+ individuals within a 3 year period will be interpreted as a viable colony.

As reported above, the geographic area occupied by colonies is small, and non-dispersing marmots are not known to wander more than 500 m from their colony. Thus, colonies separated by distances greater than that may be considered to be isolated and distinct. Therefore, we will define a colony complex as a grouping of two or more colonies, none of which are separated from their nearest neighbour by more than 500 m. Genetic interchange among colonies within a complex is probably not uncommon. Colonies or colony complexes separated by more than 500 m likely obtain genetic interchange only infrequently through dispersing 2 year olds, the frequency depending on the distance and terrain between the complexes. In cases where the separation between colonies or complexes is less than 1 km horizontally, and less than 500 m vertically, the interchange is likely more frequent and the complexes may be considered to be part of a single population. Further separation probably results in

much less interchange and the populations can be considered distinct. We will use distinct population to mean a grouping of two or more colonies or colony complexes separated from their nearest neighbour by more than 1 km horizontal distance or 500 m vertical distance. Situations exist where only one colony is documented, but could be considered a distinct population due to either long-term existence or isolation from other known colonies (e.g. Buttle, Heather). At present, however, we will not classify these as distinct populations until further investigation is conducted.

1.2.4 Habitat requirements

Food preferences for Olympic marmots have been described by Barash (1973) and Wood (1973) and for hoary marmots by Holmes (1979). Forbs and grasses, especially the flower parts, are preferred. Heard (1977) reported similar findings for the Vancouver Island marmot. Steep slopes appear necessary to provide food in the early spring when marmots first emerge from hibernation, as the majority of the area is often snow covered and food is restricted to areas free of snow (Barash 1973, Heard 1977, Holmes 1979). Robert Milko, a candidate for a Masters degree at the University of Victoria, is currently in the last year of a three year study of habitat use of the Vancouver Island marmot. In conjunction with the Canadian Wildlife Service, seasonal food habits will be determined by fecal fragment analyses to complement visual observations.

Vancouver Island marmots have traditionally been reported inhabiting a specialized sub-alpine habitat characterized by talus debris, steep slopes, and lush open areas. These areas generally occur within 975 m (3,200 ft) and 1,430 m (4,700 ft) elevation and usually exhibit a southern exposure (a few northern exposures exist) (Swarth 1911, Carl 1944, Hardy 1954, Heard 1977). The plant communities are typical of the Parkland subzone of the

Mountain Hemlock Biogeoclimatic Zone (Brooke et al. 1970). The slope (35-95%) and rock bluffs encourage snow creep and snow slide, thereby inhibiting the establishment of trees within the meadow areas. Adjacent tree growth consists of mountain hemlock (Tsuga mertensiana), yellow cedar (Chamaecyparis nootkatensis), alpine fir (Abies lasiocarpa) and slide alder (Alnus sitchensis). The predominant feature of this specialized habitat is the diversity of forbs and grasses, providing a good food source for the Vancouver Island marmot.

Within recent years, however, we have found Vancouver Island marmots inhabiting areas other than traditional sub-alpine habitat. One such area is openings created by logging. Within the cutovers, marmots have utilized the logging debris for cover, shelter and look-out spots. These newly opened areas, devoid of trees, have encouraged diverse plant communities to develop, supplying herbaceous food species. Although clearcuts in young primary stages provides a seemingly adequate habitat, they are subject to rapid seral succession. It is unknown how logging openings will feature in long term marmot utilization.

Vancouver Island marmots appear to have successfully utilized the ski runs occurring within operating ski resorts. These ski runs act as artificially created sub-alpine habitat providing the marmot requirements of food and shelter. This habitat is more stable than logging cutovers in that the ski resorts periodically brush their runs to remove trees and excessive shrub growth. The removal of this growth retards the seral succession trend, encouraging the ground-layer plant forms to flourish. These lower plant forms in turn encourage marmot utilization. The Green Mountain marmot colony is a prime example of the Vancouver Island marmot's ability to live within a ski area successfully and productively. Between 1973 and 1983, the Vancouver Island

marmot has expanded its distribution and abundance over much of the mountain, while over the same period ski operations have been maintained and expanded.

In addition to cutovers and ski runs, used burrows and active Vancouver Island marmot sign has been found within timber stands and alder slides that are close to sub-alpine meadows. The increase in reported sightings of marmots outside of traditional habitat may be a function of expanding population or improved inventory technique. Presently, it appears sub-alpine habitat will continue to support the major concentrations of the Vancouver Island marmot. The population of Vancouver Island marmots within the newly reported habitat types will most likely fluctuate in response to the relatively rapidly changing habitat and winter weather conditions.

2.0 DISTRIBUTION AND ABUNDANCE

2.1 Historical

The Vancouver Island marmot was not known to be widely distributed nor abundant in historical times. Swarth (1912) did not find any on Mt. Arrowsmith or on the mountains northwest of Great Central Lake. In 1931, Kenneth Racey and Ian McTaggart Cowan collected six marmots (three juveniles) from the Haley Lake colony. They were also told of marmots on Mt. Buttle, but were unable to verify the report (pers. comm. Cowan to G. Smith, January 1982). Munro (1933) makes reference to a "Marmot Mountain" near Shaw Creek but does not specifically mention marmots. Dr. Cowan reported seeing and hearing marmots on Mt. Arrowsmith, in addition to locating occupied burrows on the Northeast face in 1938 (per. comm. Cowan to G. Smith, January 1982). Carl (1944) reported animals from Mt. Washington, Forbidden Plateau, Jordan Meadows and the head of Shaw Creek. A small colony on Mt.

Washington, and one active burrow and one animal on Mt. Strata in 1942, was reported by Hardy (1954). Finkelstein and Darling (1973) found marmots only at Heather Mountain. In 1973 and 1974, Heard (1977) observed two colonies near Haley Lake, two on Green Mountain, and one each on Mt. Washington, Butler Peak, Heather Mountain, and Gemini Peak.

Working from old reports, conversations with individuals and museum records, Carson (1978) suggested 25 colonies existed historically, while Munro (1978) suggested colonies existed historically on 12 separate mountains. Recent experience leads us to believe some of the historical records referred to dispersing marmots, not breeding colonies. Several other unpublished records, prior to 1978, are held at the Nanaimo office of the Fish and Wildlife Branch, including a number of sightings by staff. Based on the above information through 1977, Munro (1978, 1979) estimated a population of between 50 and 100 animals distributed in five colonies on four separate mountains.

2.2 Current

In the summer of 1979, three students were hired by the Vancouver Island Marmot Preservation Committee (a committee formed by the Federation of B. C. Naturalists) funded by a Canada Works Grant, with additional support from the Fish and Wildlife Branch and the Public Conservation Assistance Fund. The objective was to survey sites for Vancouver Island marmots. Work was carried out under the auspices of that group and/or its successors for three summers. Routledge and Merilees (1980) reported 45 marmots and 166 burrows seen during inventories in 1979. Routledge (1981) reported 94 marmots and 225 burrows in field studies in 1980. In the 1981 field season, he reported 87 marmots and 222 burrows (Routledge 1982).

Fry (1981) reported marmots on three of six sites investigated for the Canadian Wildlife Service. A summary of status of the marmot up to 1981 was reported by Smith (1982).

The most detailed and systematic survey to locate areas occupied by marmots was conducted in 1982 by Heinsalu and Smith (1982). The inventory concentrated on active burrows with sightings of marmots used as supplementary information. Twenty-two areas were thoroughly searched. A total of 409 active burrows was found and 148 marmots observed, including 16 infants. Using the same survey techniques in 1983, the same observers searched 17 areas and recorded 165 marmots including 23 young (Heinsalu and Smith in prep.).

Using the definitions outlined earlier, the status of the Vancouver Island marmot in 1983, based on Fish and Wildlife Branch surveys, is summarized in Tables 1 and 2. Three distinct populations exist, consisting of 13 colonies, with another 6 individual colonies documented (Table 1). In addition, 21 areas with active marmot use were recorded, but at present do not meet the criteria of viable colonies (Table 2). These potential colonies and colony complexes will receive emphasis in future surveys.

It must be emphasized that the major aim of the 1982 and 1983 surveys was to determine areas occupied by marmots, not to specifically determine population figures for each colony. Thus, the numbers of marmots seen at any location are the absolute minimum. Further, many colonies were visited only prior to the emergence of young in mid-July. The production of young was undoubtedly higher than indicated in Table 1.

TABLE 1. Vancouver Island Marmot Status - 1983

Distinct Population (adults & young)	Colony Complexes	Colonies (adults & young)
Haley-Gemini (46+11)	Haley-Bell	Haley Lake Basin Bell Creek
	Westerholm-Gemini	Westerholm Basin Westerholm Meadow #1 Bell Creek N. Gemini South Slope
Green (34+5)	Green Proper	West Green N.W. Arm Top Green K44 Area South Green
Butler (14)	Butler Proper	West Slope K43 area
---	---	Buttle Mtn (3 + 1)
---	---	Heather Mtn (2 + 1)
---	---	Hooper Basin (4)
---	---	Hooper North (0)
---	---	'P' Mtn Basin (5)
---	---	Mt. Whymper (3 + 2)

TABLE 2. Vancouver Island Marmot Status - 1983

Existing Distinct Population	Existing Colony Complexes	Potential Colonies (adults)
Haley-Gemini	Haley-Bell	Haley Lake slash (1) Haley Lake parking lot N (1) Haley Lake rim S (1) * Haley Lake Basin
	Westerholm-Gemini	Westerholm slash (1) Westerholm meadow #2 (2) Gemini lower saddle (4) Gemini side saddle (2)* Gemini bluffs (4) Gemini 1st opening (1) Gemini 2nd opening (1) * Westerholm Basin * Westerholm Meadow #1 * Bell Creek N * Gemini South Slope
Green	Green Proper	Elk meadow (1) West face ridge (1) * West Green * N.W. Arm * Top Green * K44 Area * South Green
Butler	Butler Proper	Meadow below cliff (1) snow slide (3) K43E1 (2) * W slope * K43E
---	---	MB side (1) NW colony (2) CWS area (11 burrows) * 'P' Basin
---	---	Mt. Washington (0)
---	---	Whymper bluff (1) Whymper west (3) * Whymper stump
---	---	MBD16 (1)

* existing colonies

Surveys in recent years and observations of some of the more well known colonies indicate that the marmot population has increased in both numbers and distribution since the early 1970's. One area in which they have not recovered is the type locality in the vicinity of Mt. Douglas. Few marmots have been recorded in that area since Swarths' collecting expedition in 1910. This expedition collected five adult males and six adult females, several of which were lactating, and was combined with unknown numbers which were shot but managed to retreat down burrows (Swarth 1912). Other marmots were collected in this area in the 1920's (pers. comm. Frost to Smith, February 1978).

3.0 TOPICS OF CONCERN

Many concerns regarding Vancouver Island marmots have been expressed by a variety of individuals. The major concerns are highlighted here along with our thoughts on each.

3.1 Extinction

Our understanding about the process of extinction is very limited, primarily due to the time scale. Direct observation is generally not feasible and fossil records are incomplete (Ricklefs 1979). Vulnerability of a species to extinction is speculated to be associated with numerous factors, although many opposing views are presented. For example, it has been postulated that the probability of extinction increases with increasing degree of environmental fluctuation, although it can be argued that relatively

constant environmental conditions result in reduced genetic variability and therefore decreased evolutionary potential. Specialized species, often associated with higher trophic levels, are thought to be more vulnerable than generalists. Large-bodied species are generally more vulnerable due to large home ranges and less dense populations, less genetic diversity, and greater conflict with human activity as compared to species of small body size. Isolated endemic species are vulnerable due to low rates of gene flow and subsequent loss of heterozygosity and ability to respond to competition and environmental change.

The population size required to ensure long-term preservation and viability of the Vancouver Island marmot is unknown. One major concern is the maintenance of genetic variability within the population to allow response to environmental change. The importance of genetic variance, however, is poorly understood, and criteria for determining desirable levels of genetic diversity are not developed. In addition, little information is available from wild populations, although electrophoretic surveys are becoming more common. Denniston (1977) suggests a constant population of 50 animals over 10 generations will retain 0.90 of its genetic variance. The percentage increases with population size; 100 animals retaining 0.95 and 1,000 retaining 0.99. Small populations that have been isolated for many generations should theoretically be devoid of recessive lethal genes (Cowan and Hollonay 1974). Immigration and exchange of males, however, is essential to maintain gene flow within small populations. According to Bunnell (1970), exchange can be effective at intervals of 10 generations or less. Frankel (1970) suggests a minimum viable population should consist of 200 - 300 individuals and, as a general

rule, 50 breeding-age females should be maintained (Frankel and Soule 1981).

Another important factor influencing small populations is the probability of extinction owing to random events (i.e., natural catastrophe). Probability of extinction will decrease as the ratio of death rate (d) to birth rate (b) decreases and as population size increases (Ricklefs 1979). For a stable population in which b = d = 0.5 (annual probability of death of an individual equals one-half), the relationship of extinction probability to population size over time is shown in Table 2.

Table 2. Probability of extinction when birth rate = death rate = 0.5 per year, for populations of initial size N within period t (from Ricklefs 1979: Table 35 - 1).

Population Size (N)	Time (t)			
	1	10	100	1000
1	0.33	0.83	0.98	0.998
10	$< 10^{-4}$	0.16	0.82	0.980
100	$< 10^{-48}$	$< 10^{-7}$	0.14	0.819
1000	$< 10^{-99}$	$< 10^{-79}$	$< 10^{-8}$	0.135

Extinction probability will decrease with lower population turnover rates. If b = d = 0.25, for example, probability of extinction for N = 100 at 100 years will be 0.02; an initial population size of 200 will have a probability of less than 10^{-3} at 100 years.

If it is assumed that the extinction probability of each distinct population is equal only to the number of animals, then the best strategy is numerous small viable populations rather than a few large ones (McCullough 1969). For example, three distinct populations of 25 marmots each would have a probability of extinction of 1 in 15,625 (1/25 X 1/25 X 1/25) while 1 population of 25 and 1 of 50 animals would have a probability of 1 in 1,250 (1/25 X 1/50) and a single population of 75 animals would have a probability of 1 in 75.

Based on the above theoretical considerations and present knowledge of the distribution of suitable habitat and marmot colonies, it is our view that a population of approximately 200 animals, distributed within 10 distinct populations (by definition, each containing at least 2 colonies) will be sufficient to ensure long-term survival of the species and removal from endangered or threatened status. Although somewhat arbitrary, these criteria can be modified as our knowledge and experience increases.

3.2 Adaptability

The historical evidence presented earlier suggests there never were large numbers of Vancouver Island marmots. Certainly, we can demonstrate increases in numbers since the early 1970's. As discussed in the previous section, the viability of the species likely de-pends more on distribution of colonies rather than the total number of animals. It is unlikely that we can expect to have more than a few hundred marmots living in natural habitats.

Concerns related to adaptability of the species to human activities include the effects and influence of ski operations and logging. Potential adverse impacts of ski resorts include elimination of habitat by the construction of ski runs, lifts and access roads. Winter use of these areas contributes to snow compaction, which may detrimentally affect spring emergence.

From observations in 1982 at the Green Mountain ski area and Mt. Washington Ski Resort, it appears that ski areas and Vancouver Island Marmots are compatible. This should not be surprising as the hoary marmot, a close cousin of the Vancouver Island marmot, is productive and successful in ski areas in B. C. and Washington. The Vancouver Island ski areas, in fact, seem to be creating new habitat for the marmots by removing existing tree growth and maintaining a somewhat alpine meadow situation to form ski runs. Mt. Washington, prior to the ski resort, was not characterized by open meadow. Instead, Vancouver Island marmots had to contend with shrub vegetation and alpine fir tree growth (Heard 1977). The creation of ski areas by the resort opened the mountain up, encouraging meadows to develop. In 1982, the ski resort commenced a project of seeding clover/lupine mixtures on the ski slopes to aid slope stability. This development has created suitable new habitat where before it was marginal. It is interesting to note that in 1983, however, the Green Mtn ski area continued to support healthy populations of Vancouver Island marmots, whereas the original colony area at Mt. Washington no longer contained marmots. Until more of Mt. Washington is searched, it would be premature to state that the Mt. Washington Ski Resort colony is no longer in existence.

Vancouver Island marmots in the Green Mountain ski area have shown an increase of distribution over much of the mountain. Between 1930 and the 1970's, only a few marmot burrows had been reported on Green Mountain. Since 1972, naturalists, hunters, and Fish and Wildlife staff have all reported a major expansion of marmots.

It is not known if or how logging or logged-over areas affect the Vancouver Island marmot. It has been speculated that slash, steep cut banks and noise may adversely effect dispersal of marmots. Lack of cover in the cutovers has been suggested as promoting predation of dispersing individuals.

From observations and sighting reports, it has been found that Vancouver Island marmots are occupying young cutovers successfully. We have observed at least 25 marmots in 6 areas living undisturbed in various stages of recent logging. A newly cut slash area is quickly invaded by forbs and grasses providing adequate cover and food plants for small sized animals such as marmots. On the topic of logging, Dr. Ian McTaggart Cowan and Douglas Heard stated that the removal of forest cover for a few years could permit displaced animals to move to adjacent mountain areas which now appear to lack colonies (pers. comm. Cowan to Hebert, August 1974).

Concerns about logging may be justified as succession advances to stages of conifer regeneration. Although restocked cutovers will likely not provide long-term habitat, dispersers from these areas can serve both as a source of genetic variability to the stable alpine colonies and as a source of animals for captive breeding and transplants (pers. comm. Armitage to Janz, Rausch to Janz, May 1983).

3.3 Harrassment

Access associated with ski operations and logging and growth of the recreating public has caused concern of animal harrassment and disruption of daily activity patterns. In addition, the use of dogs for inventory purposes has caused some public concern. Our own observations on Vancouver Island marmots (reported above), coupled with information on other marmot species (pers. comm. Armitage to Janz, May 1983) indicate marmots readily acclimatize to human noise and activity. In addition, human daily activity tends to occur after the early morning active period of marmots. The use of dogs is considered an effective technique for inventory of potential marmot habitat to determine presence/absence. Dogs are not used when the objective is to census colonies to determine reproductive status.

Incidents of shootings (2 verified reports, 1979 and 1981) and other vandalistic acts can be minimized by various options of access control, local closures, and enforcement. Increased public awareness generated by field signs and various public education activities will hopefully result in maintaining public recreation in these areas without restrictive actions. Reports of marmot observations by hunters and naturalists has greatly aided our inventory program.

3.4 Captive colony

Prior to 1980, some thought had been given to establishing a captive breeding colony of marmots with the objective of eventually releasing young captive reared animals into the wild. The plan was to first experiment with hoary marmots and then apply the techniques to Vancouver Island marmots. In 1980 July, however, the Fish and Wildlife Branch received a complaint about a marmot that was eating a

vegetable garden near a highway in Coombs. Upon investigation, it turned out to be a Vancouver Island marmot that had lived there for a year. The animal was taken to the Okanagan Game Farm as the start of a captive colony of Vancouver Island marmots. Initial determination of sex indicated it was a female. Marmots were subsequently trapped at a Green Mountain colony and one male was sent to join the supposed female later that same year. In 1981, another animal was trapped close to a road in the Nanaimo River valley and sent to join the other two. Closer examination of the three captive marmots suggested they were all males. Two young marmots, captured in the late summer of 1981 and examined by a number of individuals, including two veterinarians, who sexed the animals as females, were shipped to join the captive colony. One of the young did not emerge from hibernation in 1982. There are now four marmots in captivity, three are believed to be adult males and one to be a female, born in 1981. We do not expect her to be ready to breed until 1984, when she is 3 years old. The animals were ear tagged in 1982 and notes made on their behaviour (Dyer 1982). No serious antagonism has been noted. In 1983, however, examination revealed the ear tags were missing, indicating that this is not a feasible marking technique.

Although some public groups are critical of the concept and progress of the captive colony, we believe it is an important component of a recovery program.

4.0 MANAGEMENT PLAN

This section will first outline the Fish & Wildlife goal and objectives for the Vancouver Island marmot with activities necessary for their achievement. Secondly, it will provide details on why those activities are considered necessary and how they will be carried out. Thirdly, it will provide information on funding.

4.1 Goal, Objectives and Activities

Goal

To establish and maintain the population of Vancouver Island marmots at a level and distribution that provides a reasonable liklihood of long-term survival.

Objectives

1. To ensure that six distinct reproducing populations are in existence by the summer of 1985 and ten by the summer of 1990.

   Activities:

   (a) Inventory potential habitat for presence/absence of marmots - May-June, annually.

   (b) Monitor potential and known colonies with emphasis on whether they are reproducing - July - September, annually.

   (c) Transplant marmots (if and when necessary).

   (d) Enhance marmot habitat (if and when necessary).

2. To secure habitat for key marmot colonies and prevent alienation and alteration of known marmot habitat.

   Activities:

   (a) Protect the habitat of all known colonies.

   (b) Support establishment of an Ecological Reserve around Haley Lake by the end of 1984.

   (c) Establish a Critical Wildlife Management Area on Green Mountain (Block 1392) by the end of 1984.

   (d) Establish Wildlife Management areas on Butler Peak and "P" Mountain by the end of 1984 provided donations are finalized.

(e) Arrange with the appropriate forest companies to establish "company marmot reserves" for colonies on their private lands.

(f) Work with the Mt. Washington Ski Resort Ltd. to enhance habitat for marmots on Mt. Washington.

3. To maintain one small captive breeding colony of marmots.

Activities:

(a) Separate or return one or more of the captive males to the wild in early 1984 if excessive antagonism is observed.

(b) Obtain a second female (infant or 2 yr. old) for the captive colony - 1984 if necessary.

4. To encourage and support approved scientific research on the marmots and marmot habitat.

Activities:

(a) Identify research needs and implement a research plan - 1984/85.

(b) Encourage universities to undertake studies on the species by writing to the appropriate professors outlining research needs - 1984.

(c) Provide logistical and monetary support for such studies, annually where possible.

(c) Provide written support for such studies in support of applications for outside funding where required.

5. To encourage public participation in some aspects of the program and to keep the public aware of what is taking place.

Activities:

(a) Provide marmot observation forms to be filled in and returned by the public.

(b) Interested members of the public and press will be guided to some areas where marmots can be seen - as public interest dictates.

(c) Produce a "fact sheet" on marmots which will provide the public and press with accurate information on the current status of marmots - 1983 and updated as required.

(d) Maintain a close working relationship with various public interest groups.

(e) Cooperate in production of educational films.

4.2 Implementation

Objective 1

The objective of six distinct populations by 1985 was chosen because it was close enough to ensure continued effort and at the same time being realistic in terms of further inventories and possible transplants. When this requirement is satisfied, the official status will be reviewed by COSEWIC. The establishment of 10 discreet populations by 1990 was set as tentative criteria for ensuring long-term survival of the species. The date for achieving this objective is thought to be realistic, although modifications are possible as our information and experience progresses.

Activity 1(a)

Inventory will be continued by staff from our Nanaimo office. The first priority for areas to be searched will be sites where we have recent reliable observations of marmots. Subsequent searches will follow-up on other less reliable sightings, remaining historical sites, and areas of potential habitat.

Activity 1(b)

Monitoring of potential and known colonies will be done by staff from our Nanaimo office. Recruitment and

population trends will be documented. In future years, we will consider a more widespread public input into monitoring if interest and reliability is evident.

Activity 1(c)

Transplanting of wild and captive reared marmots will likely be required to meet the longer term objective of 10 discreet poulations.

If such transplants are to be undertaken, the details will be the subject of a separate project report.

Objective 2

Animals cannot live without appropriate habitat. We believe the habitat required for the population levels outlined in Objective 1 should have some form of long term security. This security can, and probably should, take several different forms. One form was suggested recently by the Sierra Club (1982). We have reviewed their suggestions and those of other groups and individuals and recommend the following activities.

Activity 2(a)

Development proposals which are considered to be adversely impacting the habitat of existing colonies will, wherever feasible, be restricted. Continued liaison with private companies will be emphasized.

Activity 2(b)

The Haley Lake Bowl contains the colony with the longest recorded history. Two major research studies have been conducted on it. It has been the centre of numerous proposals for an Ecological Reserve. If made an Ecological Reserve, it will provide a benchmark against which to measure management efforts in other areas, and ensure opportunities for continued research.

Activity 2(c)

Block 1392 on Green Mountain recently came under

Crown ownership. It contains a number of marmot colonies, a ski development, and is the most easily accessible area for people to view marmots in the wild. A Critical Wildlife Area (CWA) designation would permit us to prohibit those activities which are directly destructive to marmots or their habitat, while allowing non-destructive activies to continue. It would allow us to experiment both with the animals in the case of transplants or with the habitat in the case of enhancement. It could also serve as the major public viewing area for marmots. If the area becomes designated as a CWA, a management plan would be prepared.

Activity 2(d)

Portions of Butler Peak and "P" Mountain are promised to come under Crown ownership by donation from MacMillan Bloedel. We believe the suggested designation of a Wildlife Management area will provide protection for the habitat while allowing opportunity for any active management that may be required.

Activity 2(e)

The two major forest companies owning most of the land occupied by marmots (Crown Zellerbach and MacMillan Bloedel) have been very cooperative in the past in protecting identified areas. We believe that by negotiating with the companies, key marmot colonies will be officially designated as "marmot reserves" and the habitat left undisturbed.

Activity 2(f)

As meadow habitat is greatly restricted on Mt. Washington, ski run development and maintenance will likely provide food resources that would otherwise be unavailable to the marmots. We will keep in touch with

the company and monitor marmot use of seeded areas. Fertilization, as tried successfully by Holmes (1979) for hoary marmots, may be a useful technique. Other enhancement techniques may be clearing and seeding small areas adjacent to the ski runs to provide areas where the snow will not be compacted and thus may melt earlier in the spring.

Objective 3

The maintenance of a captive breeding colony is an additional hedge against disaster, whether from disease or any other source. The facilities at the Okanagan Game Farm are good and the arrangement has worked well to date in terms of keeping the marmots alive and healthy. Mortality of young marmots in the wild, as mentioned earlier, often reaches 50% during their first winter, so we see no serious cause for alarm in the fact that one of the captive young died during its first winter.

Activity 3(a)

Three adult males may be too many for a small facility when the female reaches breeding age. No exceptional antagonism has been shown to date but that may change with a female in estrous. If such antagonism is observed, one or more males will be segregated and possibly returned to the wild. In the latter case, they would preferably be accompanied by wild two year olds. In addition, the release site would be in suitable habitat in an area far removed from any known colony to lessen the chance of any disease being spread to the wild population.

Activity 3(b)

The young, presumably female, animal will be three years old in the spring of 1984 when we expect her to breed. We believe it desirable and the most efficient

use of the facility to have a second female that will probably breed in alternate years to the present female. Plans to obtain another female of a specific age-class will depend on confirmation of reproductive success of the existing female.

Objective 4

Management effectiveness will increase with greater scientific knowledge. Scientific studies with direct management implications should have top priority.

Activity 4(a)

Following field studies in 1983, and the completion of Bob Milko's thesis, a priority listing of research topics should be addressed. The Ministry of Environment research section may be able to conduct a problem analysis to identify and priorize research needs.

Activity 4(b)

We will send letters to professors of wildlife management at universities in B. C. in 1984 requesting they and their students consider studies on the Vancouver Island marmot for thesis.

Activity 4(c)

We will provide logistical and financial support for approved studies within our capabilities. The former is likely to be much more possible than the latter in the near future.

Activity 4(d)

We will provide written support when requested (as in the past) for approved studies where funding from outside agencies is sought.

Objective 5

Public support for wildlife programs is achieved largely through public information and participation. Wide dissemination of accurate information and directed

participation with specific aims are the two basic elements of such a program.

Activity 5(a)

The observation form to be used is in Appendix A of this document. Copies will be distributed in 1983 to all the outdoor oriented clubs for which we have addresses on Vancouver Island. A covering letter will explain why we want the forms filled out. More specific projects are discussed under Activity 1(b).

Activity 5(b)

Fish & Wildlife staff will arrange field trips for interested members of the public when deemed appropriate.

Activity 5(c)

We have written and published a fact sheet on the Vancouver Island marmot which provides accurate information on the status of the animal. It will be widely circulated and will be updated when necessary.

Activity 5(d)

Although there are very divergent opinions among the representatives of the groups on the public liaison committee, we believe it is a useful arena in which to exchange views, test ideas and solve problems. We will continue to host biennial meetings of the committee as long as it serves a useful function.

Activity 5(e)

We will cooperate with bona fide film producers in the production of approved projects for educational purposes.

4.3 Schedule and Cost Summary

Responsibility, target dates, and estimated costs of manpower and operations by activity is summarized in Table 3. Detailed budgets will be required on an annual basis to

account for implementation progress, availability of funding, research proposals, and possible changes in activity priorities.

Table 3. Activity schedule and cost summary.

Activity	Participant	Target date	Estimated annua costs (1983$)
Inventory			
- colonies/habitat	MOE-Region	Ongoing	6 MM (MOE) - $12,000
- population trends	MOE-Region, Public	Ongoing	
Habitat			
- protection	MOE-Region	Ongoing	Within wildlife program
- company reserves			
- Haley Lk. ER	MOE-Region, HQ		
- Green Mt. CWMA	MLPH-HQ	1984	3 MM - $6,000
	MOF-HQ		Operations $30,000(?)
- enhancement	MOE-Region	Ongoing (as req'd)	?
Transplants	MOE-Region, HQ (CWS ?)	1984 (if req'd) 1985-90(as req'd)	3 MM - $6,000 Operations - $5,000
Captive Colony	MOE-HQ, Region	Ongoing	1 MM - $2,000 Operations - $1,000
Research	MOE-HQ, Region Universities	1984 Ongoing	3 MM - $6,000 ?
Public relations	MOE-Region, HQ Others (i.e. films)	Ongoing Ongoing	1 MM - $2,000 ?

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APPENDIX 1

MARMOT REPORT FORM

OBSERVER NAME, ADDRESS AND TELEPHONE NUMBER: _____

_____

LOCATION: _____

Map number: _____ Aerial photo number: _____

DATE: _____ Time: _____

WEATHER: _____

% cloud: _____ Precipitation _____

temperature _____ sun:

snow conditions _____ wind:

TOPOGRAPHY: _____

slope: _____ Aspect _____

soil depth: (transplant sites only) _____ Suitable for burrows _____

MARMOTS: _____

	number seen	(whistles animals not seen)	behaviour
adults			
subadults			
young			
unknown			
total			

SCATS: fresh: _____ old: _____ nil: _____

BURROWS: _____

active: # _____ inactive: # _____

LOOKOUT AND SUNNING SPOTS: _____

used rocks: _____ logs: _____ stumps: _____

FOOD SPECIES (if present
indicate if browsed)

Cow Parsnip (Heracleum lan.) _____

Grasses and Sedges _____

Hellebore (Veratrum vinide) _____

Indian Paintbrush (Castilleja sp.) _____

Lupine (Lupinus latifolius) _____

Meadow Rue (Thalictrum occid.) _____

Mtn. Valerian (Valeriana sitch) _____

Orange Tiger Lily (Lilium columb) _____

Purple Pea (Lathyrus nevad.) _____

Spreading Phlox (Phlox diffusa) _____

Additional observations and comments
(e.g. red tailed hawk, black bear)