

Photo Alyssa Hollyoake



2024 ANNUAL REPORT



MARMOT
RECOVERY FOUNDATION

ACKNOWLEDGEMENTS

We recognize the unique and enduring relationship that exists between Indigenous People and their traditional territories, and honor with gratitude the people who have stewarded it since time immemorial. Much of the work that we carry out takes place on the traditional territories of the Namgis, Kwakiutl, Wei Wai Kum, We Wai Kai, K'omoks, Mowachaht/Muchalaht, Snaw-Naw-As, Qualicum, Hupacasath, Tseshaht, Snuneymuxw, Stz'uminus, Songhees, Esquimalt First Nations and Cowichan Tribes. We are grateful for the opportunity to learn and work on their traditional lands.

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This report was prepared by Kevin Gourlay, Malcolm McAdie, and Adam Taylor.

EXECUTIVE SUMMARY

The endangered Vancouver Island marmot (*Marmota vancouverensis*, Swarth, 1911) is one of only five endemic land mammals in Canada (Nagorsen, 2004). The Vancouver Island marmot is recognized as a protected species under the B.C. *Wildlife Act* and is on the B.C. Red List of species at risk. Nationally, it is listed under Schedule 1, Endangered, on the Species-at-Risk Act. Internationally, the International Union for Conservation of Nature (IUCN) lists the species as Critically Endangered. A recovery program for the marmot was launched in 1996, and 2024 was the 28th year of intensive recovery efforts.

During 2024, the Foundation conducted core field and conservation breeding activities intended to lead to achieving recovery goals for the species. Field work objectives were intended to (i) increase the number of marmots in the wild and protect the persistence of existing colonies, (ii) support wild reproduction, (iii) restore critical habitat, (iv) relocate marmots found in unsuitable habitat, and (v) monitor the wild population. The Wilder Institute/Calgary Zoo helped the Foundation to monitor marmots at several colonies while also investigating the relationship between supplemental feeding and reproduction in the wild. Data from their team have been incorporated into the results reported here.

Conservation breeding objectives were intended to (i) maintain a safeguard against potential catastrophic or stochastic events in the wild, (ii) act as a long-term genetic reservoir, (iii) refine appropriate management and husbandry techniques for the successful captive maintenance and propagation of Vancouver Island Marmots, (iv) assist directed research, and (v) provide sufficient numbers of individuals for release towards the eventual restoration of the wild population.

This year saw the highest overall wild population counts ever recorded in the Vancouver Island marmot. Approximately 381 marmots were observed in the wild by the end of the season, distributed across 33 colonies in two main regions. Nineteen (19) colonies produced 106 pups over 38 litters, the highest number of pups ever recorded. There were 49 mortalities documented in 2024. Survey effort was similar to the previous 4-year average at most colonies.

In total, 67 conservation-bred marmots and 10 marmots with some level of previous wild-living experience were released or translocated to augment 19 priority colonies. Thirty-six (36) feeders were installed at 23 colonies to improve the early season survival and reproductive potential of ~313 marmots. Forty-three (43) marmots were trapped over the season and subsequently re-released or translocated for various reasons. Since 2003, the conservation breeding program has resulted in the release of 685 captive-bred marmots into the wild. Currently there are 124 marmots in conservation breeding program, including 18 potential breeding pairs for 2025.

This report presents the results from the 2024 field season and trends in recent years.

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1. INTRODUCTION

This report is primarily intended for partners in the Vancouver Island marmot recovery effort to facilitate planning of 2025 recovery actions. Others may find it informative or useful for research. In this report, you will find descriptions of the approach, methodology and results of activities conducted by the Marmot Recovery Foundation during the 2024 field season. These results include data collected by the Foundation's Field and Animal Care teams, as well as observations from the Wilder Institute/Calgary Zoo research team. Collectively, this document refers to all these groups as "field teams". The information shared here is current and accurate to the best of our ability. If you are looking for additional information about recovery planning for the Vancouver Island marmot, please refer to the Provincial Recovery Plan (Vancouver Island Marmot Recovery Team, 2017), Federal Recovery Strategy (Environment and Climate Change Canada, 2020) or visit the Foundation's website. Within this report any mention of the "Recovery Plan" refers to the Provincial document, unless otherwise noted.

2. ABOUT THE VANCOUVER ISLAND MARMOT

The Recovery Plan describes the species as follows:

"The Vancouver Island marmot (*Marmota vancouverensis*) is British Columbia's only endemic mammal species; it lives only in mountainous areas on Vancouver Island. For 7–8 months of the year (approximately early October to May), family groups of Vancouver Island marmots hibernate in underground burrows called hibernacula. During the 4 to 5-month active season in which they breed, raise young, and regain weight, marmots continue to use their underground burrow systems for resting, avoiding summer heat, and protection from predators. They also spend considerable time above ground foraging, resting, sunning, and interacting with other marmots. Marmots typically live in colonies and when above ground, they rely on alarm calls to warn others in the colony that a predator is nearby. The main predators of the Vancouver Island marmot are Golden Eagles, Cougars, and Grey Wolves," (Executive Summary, p.v).

"Because of their reliance on alpine and subalpine habitat, Vancouver Island marmots are not distributed uniformly on the landscape. On a small spatial scale, marmots live in colonies that typically include one to two family groups (Nagorsen, 2005). Multiple colonies can live on a single mountain. Within this document, the term "site" is synonymous with "mountain." Marmots living at the same site can, therefore, disperse or move between colonies without leaving the alpine or subalpine habitat; marmots dispersing between sites must travel through lower-elevation forest habitats. Because alpine and subalpine areas on mountains are separated by areas of unsuitable marmot habitat, it is thought that Vancouver Island marmots have a metapopulation structure (Bryant, 1996); marmot colonies on the same mountain form a subpopulation, and subpopulations are linked by occasional dispersal. The subpopulations that are (or could be) linked by these dispersal events comprise the metapopulation. Dispersal events do not occur between marmot metapopulations because they are isolated by distance. Two metapopulations of Vancouver Island marmots currently exist, one in the Nanaimo Lakes area of south-central Vancouver Island and one further north in the Strathcona region," (Section 3.2, p.3).

3. ABOUT THE RECOVERY EFFORT

The Vancouver Island marmot initially was designated as endangered in 1978 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Additional protections have been provided by Canada's Species at Risk Act, and British Columbia's Wildlife Act, Forest and Range Practices Act, Private Forest Land Management Act, and Oil and Gas Activities Act. Intensive recovery efforts to increase the population size and distribution have been ongoing since 1996. Perhaps the most critical recovery activity was the initiation of a conservation breeding and reintroduction program in 1997 and which continues to date. There are presently three facilities that breed marmots for the recovery program: the Wilder Institute/Calgary Zoo, the Toronto Zoo, and the purpose-built Tony Barrett Mount Washington Marmot Recovery Centre operated by the Marmot Recovery Foundation. Since 2003, the conservation breeding program has released 685 captive-bred marmots, and re-released 12 wild-born marmots that had been brought into the conservation breeding program. During the same period, the number of occupied marmot colonies has grown from 5 to 33.

The Recovery Plan describes as its goal the establishment of two or more persistent, geographically distinct metapopulations of Vancouver Island marmots within the species' historic range. It also specifies seven key objectives:

1. Increase the number of marmots through augmentation and, if possible, by increasing survival rates and reproductive rates in the wild.
2. Maximize opportunities for successful dispersion between colonies.
3. Maintain a large and genetically diverse captive breeding population that can produce adequate numbers of release candidates to support population recovery.
4. Prioritize the maintenance of genetic variability in the global population until recovery goals are met.
5. Reduce knowledge gaps surrounding: (a) natural levels of variability in survival and reproductive rates in the wild; (b) factors that determine key demographic rates; and (c) the best method to monitor population size and key demographic rates long term.
6. Develop and implement a plan for reducing intensive management as metapopulations recover.
7. Develop and implement a sound strategy to ensure sufficient resources are available to support recovery efforts until recovery goals are met.

Objectives 1-5 are the focus for this report of 2024 activities, results, and observations.

4. WILD POPULATION

The known, wild-living population of Vancouver Island marmots is currently distributed in two metapopulations and one isolated colony. The Nanaimo Lakes metapopulation (Figure 1a) includes 15 occupied natural colonies and 40% of wild-living marmots. The Strathcona metapopulation (Figure 1b) includes 16 occupied colonies and 52% of the wild-living marmot population. Clayoquot Plateau Park, in west-central Vancouver Island, contains approximately 8% of the wild-living population.

The Foundation classifies a colony site as “unoccupied” when there was no marmot sign detected on its most recent two surveys. Colonies were classified as “data deficient” when Foundation staff felt there was insufficient data to assess their occupancy. Some data deficient colonies have not been surveyed for several years.

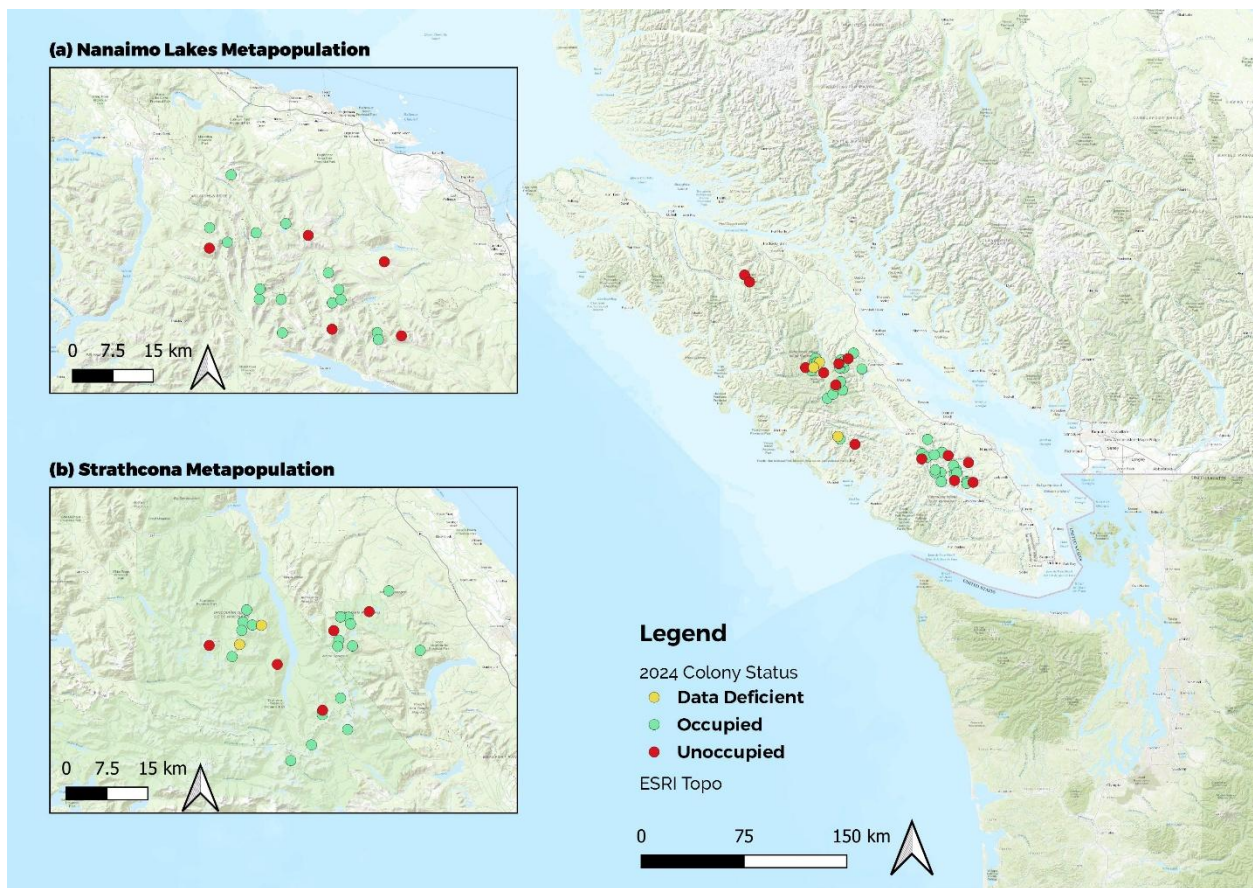


Figure 1. Distribution of the Vancouver Island marmot in the wild (November 2024), including occupied, unoccupied and data deficient colony sites in the (a) Nanaimo Lakes and (b) Strathcona regions.

4.1 Summary of the Wild Population

It has been 21 years since the wild population of Vancouver Island marmots reached its lowest point. In 2003, only 22 individuals were able to be located by the end of the field season. That same year also marked the first release of four captive-bred marmots to the wild. This year, over 380 Vancouver Island marmots were counted, the highest number of marmots ever observed in the wild.

There were improvements in the wild-living population of Vancouver Island marmots in nearly every metric. The 2024 field season saw the largest reproductive output ever recorded in the Vancouver Island marmot, with over 100 pups across 38 litters. Population numbers increased from 2023 in all regions and age classes, and the distribution of marmots increased on the landscape in all regions. The age class which experienced the greatest increase overall compared to last year were pups (184%; n=106 vs. n=60), followed by yearlings (166%, n=89 vs. n=54), and adults (114%, n=176 vs. n=155). The Strathcona metapopulation continued to experience the most significant increase for a second consecutive year and is now the largest meta-population. Compared to the Nanaimo Lakes meta-population it has a larger percent of the wild population (52% vs 40%), a similar number of adults (n=83 vs. n=80), and a greater proportion of the pups (n=66 vs. n=30; see table 1).

Survey effort in 2024 was 109% of the average of the previous five years (650 person-days vs 595 person-days), with the increase in effort concentrated at newly discovered colonies and other infrequently surveyed colonies (see table 11).

The Marmot Recovery Foundation completed a reintroduction attempt of four marmots to the historic colony at Flower Ridge, and two were still confirmed on site hibernating on the last fall check. Following a hiker report from this spring, the Foundation also confirmed marmot occupation near the Drinkwater basin, west of Buttle lake in Strathcona. It is still too early to determine if this is a new colony. Expanded use of habitat was documented at many sites this year, most notably at Shepherds Ridge, and Mt. Jutland. These discoveries suggest that connectivity between larger established colonies within the park may be improving. Field crews also confirmed that the previously discovered colonies in 2021, 2022 and 2023 remain occupied in 2024.

In the Nanaimo Lakes region, most colonies remain relatively small, with slight increases observed at several colonies. In the Clayoquot Plateau region, the Foundation determined the 2023 reintroduction attempt to Lions North was unsuccessful. However, an extended survey of Steamboat mountain resulted in the discovery of nearly 25 wild marmots on-site, compared to the previous average of six marmots annually observed on camera.

Table 1. Mean hill counts of wild marmots by age class.

REGION	Colony	Counts						
		Unk. Age	≥2yo	1yo	0yo	Total		
		Mean	Mean	Mean	Mean	Low	High	Mean
Nanaimo Lakes	Arrowsmith	0	10	4	3	16	17	17
	Big Ugly	0	6	5	0	10	11	11
	Butler	0	5	1	7	13	13	13
	Douglas	0	8	5	3	14	16	15
	El Capitan	0	1	1	3	5	5	5
	Gemini	1	5	4	0	9	10	10
	Green	0	7	3	0	9	10	10
	Haley Lake	0	5	3	4	12	12	12
	Heather	0	1	2	0	2	3	3
	Hooper	1	5	3	0	7	10	9
	Landale	1	4	2	5	12	12	12
	McQuillan	0	13	4	5	19	23	21
	Moriarty	1	5	1	0	6	7	7
	P Mtn	0	3	0	0	2	4	3
	Sadie	1	2	3	0	5	6	6
Cutblock (combined)	0	3	0	0	3	3	3	
Sub Total:	n=15	4	80	40	30	144	162	153
Strathcona	Albert Edward	0	5	5	9	17	19	18
	Becher	0	3	0	0	2	3	3
	Castlecrag	2	9	5	11	25	28	27
	Celeste	0	4	0	3	6	7	7
	Drinkwater	0	2	0	0	1	2	2
	Flower Ridge	0	2	2	0	4	4	4
	Frink	0	1	2	0	3	3	3
	Greig Ridge	0	4	1	3	7	8	8
	Marble Meadows	2	9	4	8	19	24	22
	McBride	2	4	1	3	7	11	9
	Morrison Spire	1	8	3	6	17	18	18
	Red Pillar	0	3	4	4	10	11	11
	Shepherd's Ridge	0	8	2	11	19	21	20
	Sunrise	0	7	3	5	14	15	15
	Washington	0	18	14	4	35	37	36
Wheaton Lake	1	0	0	0	1	1	1	
Sub Total:	n=16	6	83	46	66	187	212	200
Extralimital	Lions North	0	1	0	0	0	1	1
	Steamboat	0	14	4	11	27	29	28
Sub Total:	N=2	0	14	4	11	27	30	29
TOTAL:	33 colonies	10	176	89	106	358	404	381

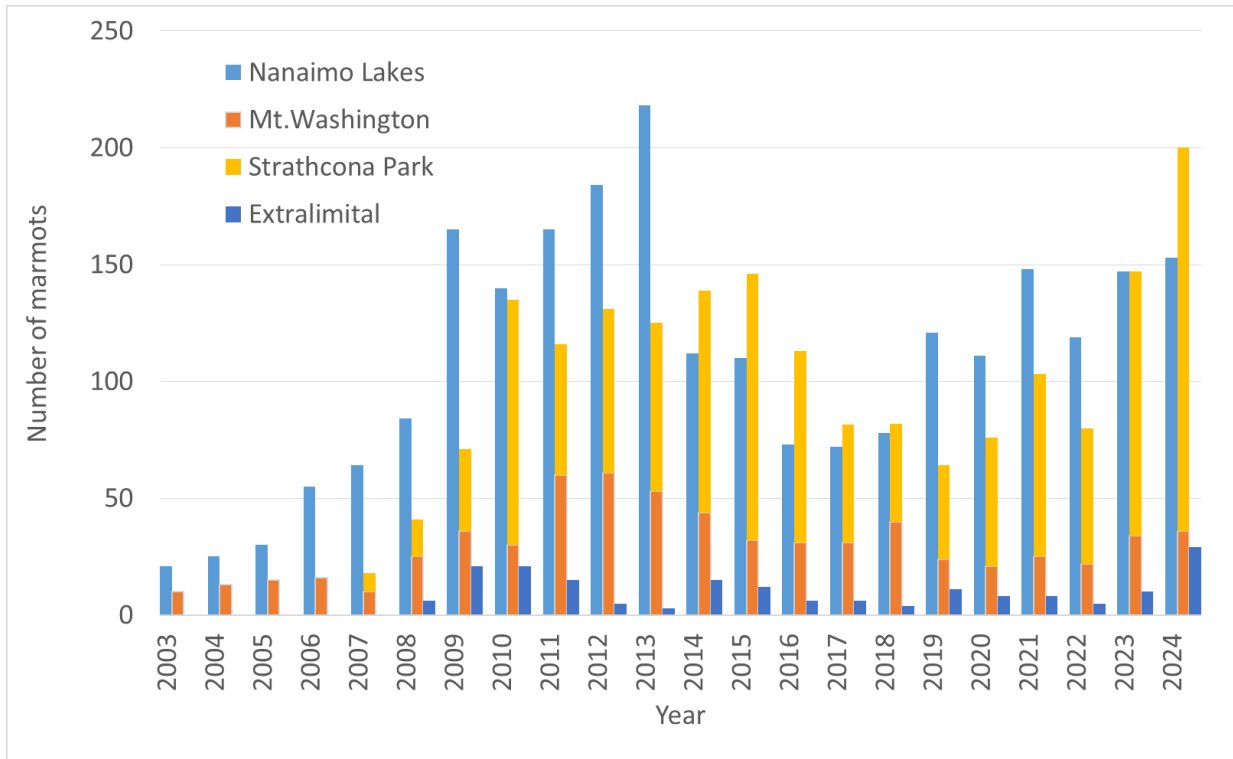


Figure 2. Mean population counts by region (2003-2024).

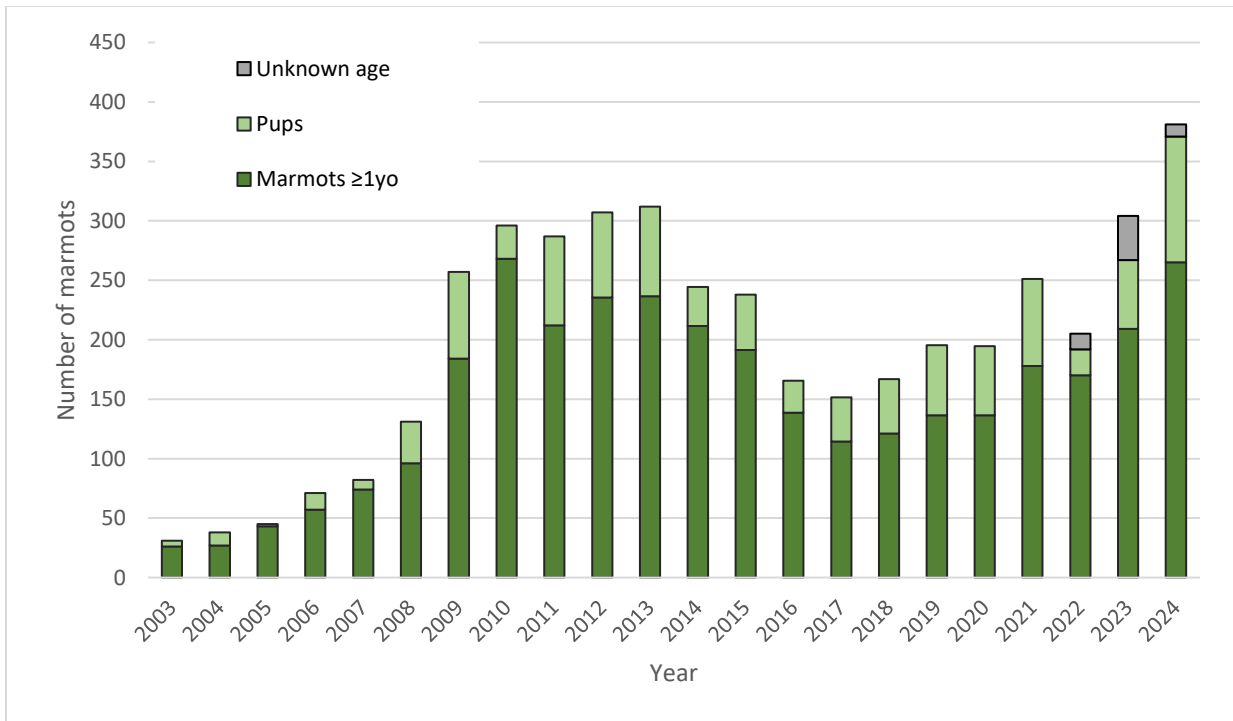


Figure 3. Mean population counts by age class (2003-2024).

4.2 Expanded Habitat Occupation in 2024

Many colonies expanded in geographic area in 2024. Two colonies, Shepherds Ridge and Jutland in Strathcona Provincial Park saw particularly significant expansion. A re-introduction of four marmots was completed at Flower Ridge, and marmots were confirmed successfully hibernating on-site at the last check of the season. Following a report from hikers, the Marmot Recovery Foundation also confirmed 1-2 adult marmots in the Drinkwater basin for the first time since the last re-introduction attempt in the area in 2013. There is not enough evidence to determine if this is a new colony or a single marmots or few marmots temporarily occupying the site during a dispersal.

In Clayoquot Plateau Provincial Park on the west coast, three of four marmots released to Lions North as part of a reintroduction attempt in 2023 were confirmed as having died in hibernation, while the fourth is missing. No other marmots were observed on-site. However, an extensive survey of the colony at Steamboat Mountain resulted in the discovery of multiple new occupied sublocations on different aspects of the mountain.

Table 2. Expanded habitat occupation in 2024.

Region	Colony	# 1+ yo	# Pups	Notes
Strathcona Provincial Park	Drinkwater	1-2	0	Reported to the Foundation by hikers this year. Approximately 1km from historic release site (2013), no marmots seen in area since. Too early to determine if this is a new colony or dispersers.
Strathcona Provincial Park	Shepherds Ridge	10	11	Discovered in 2023 by the Foundation. Historical site of reintroduction. Additional surveys this year discovered marmots in multiple new sublocations along ridge.
Strathcona Provincial Park	Mt. Jutland, Circlet Lake	4	0	Reported to the Foundation by hikers in 2023. Strong connectivity to adjacent colony on Mt. Jutland (previously known as Sunrise) suggests it's a new sublocation.
Strathcona Provincial Park	Flower Ridge	4	0	Successful reintroduction of 4 marmots to this site. Two marmots confirmed hibernating onsite on last fall check. Last known marmot occupation was in 2020.

4.3 Mortalities

The Foundation tracks mortalities using temperature-sensitive radio transmitters, allowing us to determine the body temperature of the individual remotely. Mortalities can only be conclusively detected during the core field season while marmots are active (June 1st -August 31st). Once a mortality has been detected, staff attempt to recover the mortality promptly to determine the cause of death, usually by analyzing the location, timing, and condition of the remains. Please contact the Foundation for a more exhaustive explanation of our process of determining cause of mortality.

The Foundation detected 49 mortalities during the 2024 field season (Table 3), including 36 marmots which are believed to have died this season, and an additional 13 which may have died at an earlier date. Twenty-three (23) mortalities were of marmots released this year, which is consistent with average survival rates of captive-bred marmots in their first year in the wild (IUCN, 2015). Three (3) of 27 recovered

mortalities are believed to be hibernation related, one was found deceased in a water reservoir, there was one confirmed marten predation, two were intact carcasses which had not been predated, ten were cougar predations, and the remainder were of unknown cause. Cougars continue to be the primary predator of marmots.

Table 3. Summary of the mortalities detected in 2024 and their suspected causes.

New mortalities this year					
Region	Colony	Marmot	Age at Death	Suspected cause of mortality	Note
Nanaimo Lakes	Arrowsmith	Murray	4	Unknown	Whole carcass recovered.
		Ginger2	7	Unknown	Whole carcass recovered.
	Big Ugly	Martigold	1	Unknown	Bare transmitter recovered
		Finn2	1	Unknown	Not Recovered
		Ayla	1	Unknown	Not Recovered
		Seymour2	2	Unknown	Not Recovered
	Butler	Moraine	1	Predation	Likely cougar
		Krusty2	1	Predation	Likely cougar
		The Borg	2	Unknown	Not Recovered
	Douglas	Mack	1	Unknown	Not Recovered
		Unknown Pup	0	Marten Predation	Caught on Camera Trap
	Gemini	Owen	1	Unknown	Not Recovered
		Cheekee	1	Unknown	Not Recovered
	Haley Lake	Aubrey	2	Unknown	Not Recovered
		Tank	1	Unknown	Not Recovered
		Gregorie	1	Cougar Predation	Pattern of consumption of remains
	Heather	Kenneth	1	Unknown	Bare transmitter recovered
	Landale	Unknown Pup	0	Predation	Fresh carcass found, unknown predator.
	McQuillan	Liz	1	Unknown	Bare transmitter recovered
		Mitty	7	Cougar Predation	Pattern of consumption of remains
	Moriarty	Poppy2	1	Cougar Predation	Pattern of consumption of remains
	P Mtn	Missy	1	Cougar Predation	Pattern of consumption of remains

		Harvey	1	Unknown	Not Recovered
	Sadie	Marna	1	Unknown	Not Recovered
		Dunmore	2	Unknown	Not Recovered
Strathcona	Elma	Sideshow	1	Unknown	Bare transmitter recovered
	Greig Ridge	Diana	4	Unknown	Not Recovered
	Jutland	Kittle	2	Unknown	Bare transmitter recovered
	Marble Meadows	Elly May	9	Unknown	Not Recovered
	Red Pillar	Becca	1	Unknown	Bare transmitter recovered
	Shepherd's Ridge	Unknown pup	0	Predation	Unknown predator.
	Washington	Kendra	2	Cougar Predation	Pattern of consumption of remains
		Turner	1	Cougar Predation	Pattern of consumption of remains
		Zachery	1	Drown in Reservoir	Remains recovered in water.
		Honey2	2	Cougar Predation	Pattern of consumption of remains
		Ernie2	2	Cougar Predation	Pattern of consumption of remains
Total:		36			
Historic mortalities detected this year					
Clayoquot Plateau	Lions North	Balvenie2	3	Hibernation-related	Transmitter pinned to burrow.
		Crusher	2	Hibernation-related	Transmitter pinned to burrow.
		Everett	3	Hibernation-related	Transmitter pinned to burrow.
Nanaimo Lakes	Arrowsmith	Dee	5	Unknown	Not Recovered
	Big Ugly	Feld	2	Unknown	Not Recovered
	Gemini	Russell2	2	Unknown	Not Recovered
	Heather	Lucky2	2	Unknown	Bare transmitter recovered
	Hooper	Nora	2	Unknown	Not Recovered
		Gabbro	2	Unknown	Not Recovered
	Landale	Worf	2	Unknown	Not Recovered

Strathcona	Greig Ridge	Ace	3	Unknown	Bare transmitter recovered
	Marble Meadows	Ralph	4	Unknown	Not Recovered
	Red Pillar	Septimus	3	Unknown	Not Recovered
Total:		13			
Grand Total:		49			



Photo 1 Adam Taylor. 2024 Releases at Mt Washington

4.4 Reproduction

Marmots typically breed in May after rousing from hibernation. Pups emerge above ground in late June-early July after a one-month gestation and a one-month lactation. Female marmots often exhibit reproductive skipping, typically reproducing every second year to regain sufficient body condition to successfully wean a litter of pups.

This year saw the highest rate of reproductive output ever recorded in the Vancouver Island marmot. Early-season snow melt-off and increased supplemental feeding resulted in increased food availability and better body condition for females, which may have supported the increased reproduction.

Table 4. Weaned pups counted in 2024.

Region	Colony	Litters	Average # of Pup
Clayoquot Plateau	Steamboat	3	11
Nanaimo Lakes	McQuillan	3	5
	Landale	2	5
	El Capitan	1	3
	Douglas	2	3
	Butler	2	7
	Arrowsmith	1	3
	Haley Lake	1	4
Strathcona	Washington	3	4
	Sunrise	1	5
	Shepherd's Ridge	3	11
	Morrison Spire	2	6
	McBride	1	3
	Marble Meadows	3	8
	Greig Ridge	1	3
	Celeste	1	3
	Castlecrag	4	11
	Albert Edward	3	9
Red Pillar	1	4	
Total	19 Colonies	38 Litters	106 pups

4.5 Dispersals

The Foundation tracks marmot movements in point data using manual radio telemetry. This means it is not possible to determine the exact route a marmot takes while dispersing, however we are able to determine if a marmot makes a move from one colony to another, or into ephemeral habitat.

Table 5. Dispersals

Origin	Destination	Marmot	Age	Sex	Approximate Straight-line distance	General Comments
Haley	Gemini	Chloro	2	M	~2km	2023 Haley release, dispersed after 2024 marmots were released
Green	K-block cut block	Sven	2	M	~2.5km	2023 Green release
Washington	Elma	Sideshow	1	M	~3.5km	New release, recovered as mort on Elma

4.6 Overwinter Mortality

Due to monitoring limitations, the Foundation cannot always distinguish between hibernation-related mortalities and shoulder-season mortalities from other causes such as predation or post-emergence emaciation. As such, mortalities from all known or unknown causes are included in the overwinter survival analysis, and these mortalities are not assumed to be associated exclusively with hibernation.

The Foundation defines a marmot as having survived the winter season when it was detected on active telemetry signal, or tracked to a burrow, on or after September 15 of the previous year, and on active signal again in the current year. By this definition, 90% of monitored marmots in the wild survived the 2023/24 winter season (46 of 51).

Table 6. Overwinter survival and mortality in 2024.

	Suspected Overwinter mortalities	Overwinter Survival for monitored Population
Nanaimo Lakes	Russell2, Worf, Rhodes.	86% (18 of 21)
Washington	None.	100% (19 of 19)
Strathcona	None.	100% (9 of 9)
Extralimital Sites	Balvenie2, Crusher	0% (0 of 2) No survivors from the 2023 reintroduction group.
Overall		90% (46 of 51)

4.7 Environment

The Foundation tracks changes in marmot habitat characteristics within each active season, and from year to year. Several environmental variables have been identified that influence key characteristics of marmot habitat which support marmot persistence over time. Winter snowpack has a significant influence on every aspect of marmot life history and the habitat which supports them, from snow energy clearing tree ingress, to melt water supporting vegetation growth and forage availability well into the summer. Within-season weather patterns can also significantly influence marmot persistence. Severe weather events such as heat domes and changing precipitation patterns affect marmot activity patterns, predator detection efficacy, and forage availability.

4.7.1 Snowpack

The 2023-24 winter saw significantly below average snowpack in all regions, and unseasonably early spring melt-off at lower elevation sites. This likely supported the strong reproduction observed this year by increasing availability of early-season forage for females to regain body condition post emergence. In Alpine marmots (*Marmota marmota*) and Yellow-bellied marmots (*Marmota flaviventris*), low snow years have been associated with decreased hibernation success due to less thermal insulation creating greater temperature fluctuation inside the hibernaculum (Rézouki et al, 2016). The Foundation has not observed the same correlation in Vancouver Island marmots, in either this year or previous years of low snowpack. However, the small sample sizes available for the Vancouver Island marmot make it difficult to draw any conclusions about the impact of snowpack on hibernation success in this species.

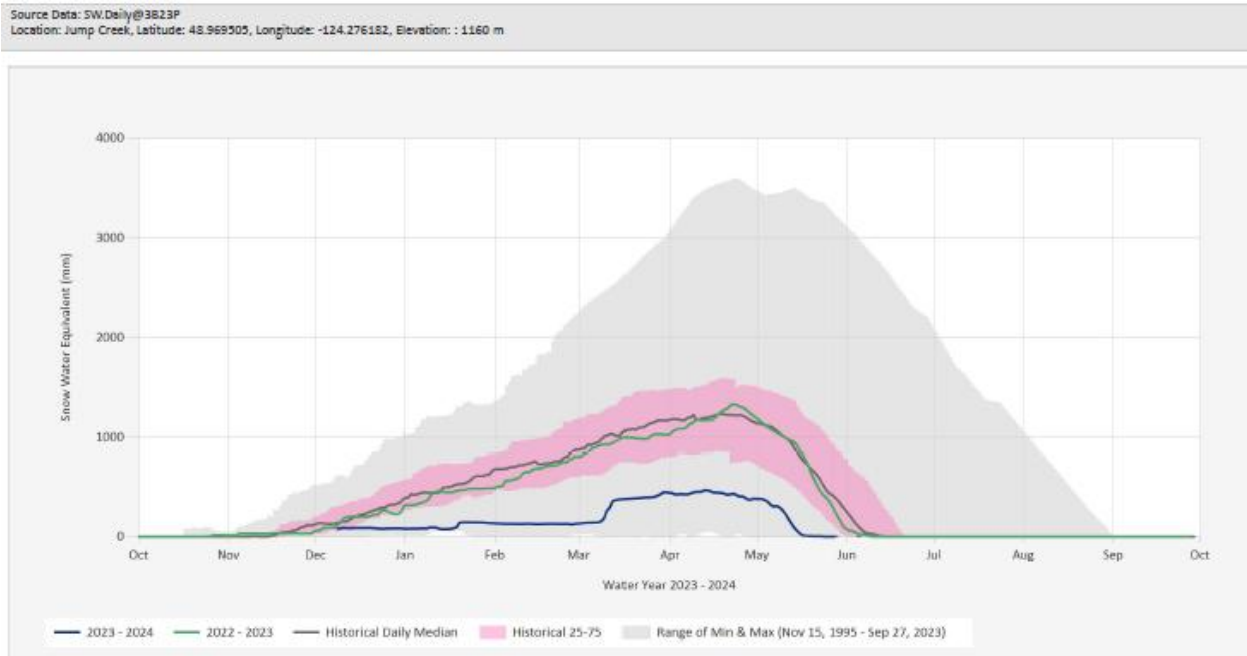


Figure 4 Snow water accumulation at Jump Creek in the Nanaimo Lakes region (2023-24; MOF 2024).

Source Data: SW.Daily@3617P
Location: Wolf River Upper, Latitude: 49.7041389, Longitude: -125.67923, Elevation: : 1490 m

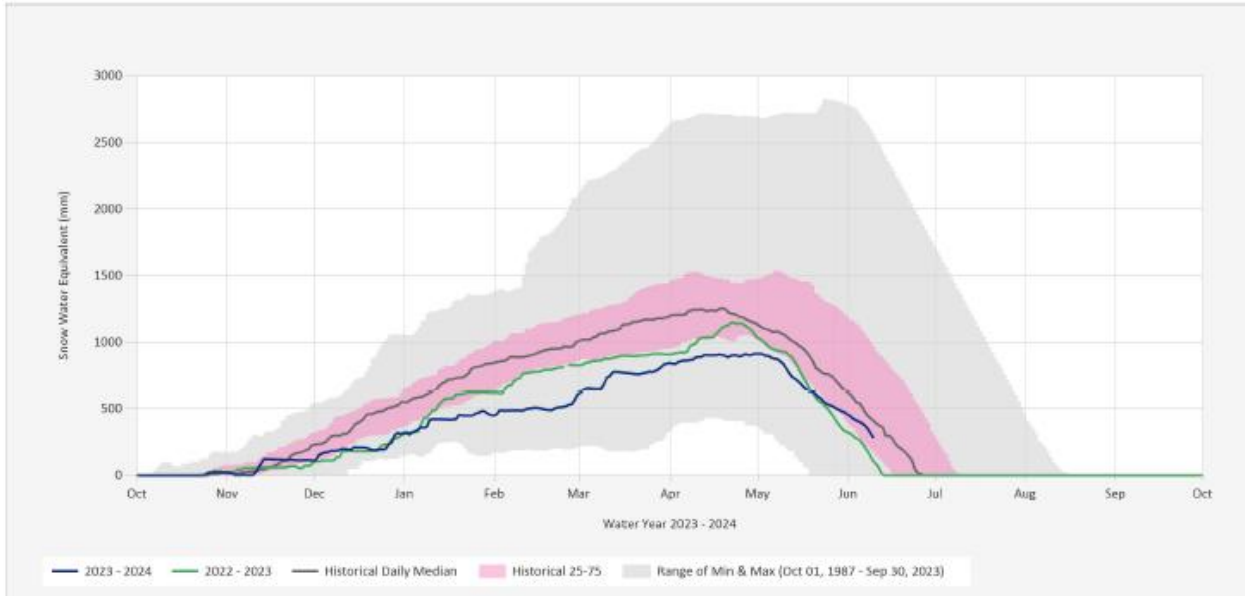


Figure 5. Snow water accumulation at Wolf River in the Strathcona region (2023-24; MOF 2024)

4.7.2 Weather

While much of British Columbia experienced increasing drought conditions throughout the 2024 summer season and it's fourth worst wildfire season in recorded history, the southwest part of the Province experienced cooler and wetter conditions than usual in the month of August, decreasing drought ratings on Vancouver Island. Average air temperature at alpine weather stations in both the Nanaimo Lakes and Strathcona regions were lower on average than the previous year, and raw precipitation volumes were elevated throughout the summer compared to last year for both regions.

In the fall, a developing El Nino system resulted in continued increases in precipitation and decreases in air temperature, resulting in early snowfall in the alpine. In particular, an atmospheric river event in early November resulted in significant precipitation of snow in the alpine. Some marmots were first detected in torpor during the last week of September, which is several weeks earlier than previous years.

4.7.3 Vegetation

Generally, the environmental conditions in the Vancouver Island alpine resulted in consistent forage availability for marmots throughout the 2024 season, particularly in the early spring. Observations of forage vegetation in marmot habitat appeared green and abundant throughout the spring and summer.

Field teams continued to note that tree ingress is a problem at many colonies (Table 7). Tree ingress degrades historic marmot habitat in several ways: (1) immature trees become established and obstruct sightlines from marmot refuges and lookout boulders, and provide stalking cover (2) as trees ingress into formerly open habitat they reduce marmot food plants; and (3) as trees populate meadows, they cover burrow systems that are subsequently abandoned. These issues may improve the hunting success of

predators, especially cougars, and may result in poor survival outcomes for marmots at these locations. This tree ingress is symptomatic of climate change-induced succession of high-elevation habitat from the subalpine and alpine ecosystems on which marmots rely to forest ecosystems.

Tree ingress significantly impacts marmot habitat and eventually replaces it altogether (Laroque et al., 2000). In early stages, young trees facilitate predation as discussed above and make colonies more vulnerable to extirpation. Marmot habitat is already highly constrained, and declining habitat quality or habitat loss will make recovery of the species more difficult and costlier. Ideally, the Foundation or another entity would conduct habitat improvement activities before predation or vegetation succession becomes a significant problem for a colony. Early action also means the clearing work is more efficient because trees are smaller and less numerous.

Table 7. Observations of habitat conditions at marmot colonies

Region	Site	Sublocation	Notes
Strathcona	Castlecrag Mountain	West Shelf, Main Meadow, Talus Bowl	Recommended focal site for future habitat improvement efforts. 2023 field observations continued to see dense forests below well-used hibernacula in all three sublocations. Tree ingress is an ongoing concern within this sublocation and efforts should focus on restoring sightlines from marmot habitat features, with a particular focus on those impacted by dense forests downslope (Figure 6).
	Flower Ridge	Price Pass	Recommended focal site for future habitat improvement efforts. 2022 field observations saw heavy, dense tree cover within the main drainage system once occupied by marmots at this sublocation. Future actions should prioritize addressing tree ingress within this area, particularly upslope where denser forests are (Figure 7).
Nanaimo Lakes	Arrowsmith	South Meadow	Recommended focal site for future habitat improvement efforts. 2022 field observations continued to see heavy tree ingress in the direct vicinity of well-used hibernacula, with some burrows completely enclosed by dense forest.
	Gemini	Main Meadow	2024 and 2021 focal site for habitat improvement – tree ingress report available. Significant tree ingress in the main meadow has been addressed, however additional restoration work could be completed in the saddle sublocation.
	Haley Lake	Bell Creek	2024 focal site for habitat restoration. Considerable tree ingress was removed over 5 days in core marmot habitat, focusing on opening up sightlines from around important marmot habitat features. Efforts focused on removing tree ingress within meadow habitat, and thin

			established patches of forest at it's periphery and towards areas of known marmot travel (e.g. the upper ridgeline).
	Hooper	Main Meadow	Recommended focal site for future habitat improvement efforts. 2024 field observations saw heavy tree ingress within micro-meadows – both the main meadow, as well as in micro meadows adjacent to drainage features at lower elevations. Future restoration efforts should prioritize building upon previous restoration efforts in 2017 by addressing tree ingress at the periphery of the sublocation.
	Moriarty	LDL Meadow	2021 focal site for habitat improvement – tree ingress report available. This site remains a focal priority site for future work due to the extent of the tree ingress remaining. Concerns in this area focused on a stand of trees bordering the south side of three well-used hibernacula. Previous habitat improvement efforts were made here in 2017 and 2021– wherein trees on the north side of the 3 hibernacula were treated.
	McQuillan	West Talus	Recommended focal site for future habitat improvement efforts. 2023 field observations saw considerable tree ingress along the periphery of this sublocation, as well as especially dense forest patches. Future restoration efforts should focus on thinning dense forest in known travel corridors, as well as heavy tree ingress within talus fields.



Photo 2 Photo 3 Tree growth in marmot habitat on Flower Ridge – Price Pass. Photo by Kevin Gourlay



Photo 3 Tree growth in marmot habitat on Castlecrag – Main Meadow. Photo by Kevin Gourlay.

5. RECOVERY EFFORTS

The Foundation’s recovery work is supported by our partners and stakeholders, including the Provincial Government, Mosaic Forest Management, Mount Washington Alpine Resort, the Wilder Institute/Calgary Zoo, the Toronto Zoo, and the Recovery Implementation Group. The Marmot Recovery Foundation’s efforts for the 2024 field season aimed to increase the overall number of marmots in the wild, protect the persistence of existing colonies through augmentation and the promotion of breeding opportunities, habitat restoration to address tree ingress, increase the distribution of marmot colonies on the landscape through re-introduction, and support the growth and future breeding capacity of the wild colony on Mt. Washington.

5.1 Releases from Conservation Breeding Programs

Vancouver Island marmots are bred in a collaboratively managed conservation breeding program with sites at the Wilder Institute/Calgary Zoo, the Toronto Zoo, and the Tony Barrett Mount Washington Marmot Recovery Centre. The young of the year originating from the Zoos are transported to the Marmot Recovery Centre in the fall and spend their first hibernation there before a portion become release candidates for the wild as yearlings. Release decisions are made based on individual animal health, genetic contributions, and the needs of the captive breeding program.

In 2024, there was a significant increase in the number of captive-bred marmots released to the wild. See the captive breeding program update below for a full update on the status of the captive population.

Table 8. Captive-bred releases

Region	Colony	Marmot	Sex	Age	Release Date	Origin	Deceased	
Clayoquot Plateau	Steamboat	Carmanah	Female	2	2024-08-06	WICZ		
		Laura Beth2	Female	2	2024-08-07	TBMWMRC		
		Citrouille	Female	2	2024-08-07	TBMWMRC		
		Quarta	Male	2	2024-08-07	WICZ		
Nanaimo Lakes	Arrowsmith	Quatsino	Male	2	2024-07-09	WICZ		
		Namaka	Female	1	2024-07-09	WICZ	TRUE	
	Landale	Raymond	Male	1	2024-07-03	TBMWMRC		
		Pancake	Female	1	2024-07-03	Toronto Zoo		
	McQuillan	Priddis	Female	1	2024-07-09	WICZ		
		Liz	Male	1	2024-07-09	Toronto Zoo	TRUE	
	Moriarty	Poppy2	Female	1	2024-07-09	Toronto Zoo	TRUE	
		Kevin H	Male	1	2024-07-09	TBMWMRC		
	Butler	Rundle	Male	1	2024-07-03	WICZ		
		Moraine	Female	1	2024-07-03	WICZ	TRUE	
		Douglas	Krusty2	Male	1	2024-07-03	TBMWMRC	TRUE
			Empress	Female	1	2024-07-09	WICZ	
		Ben2	Male	1	2024-07-09	TBMWMRC		

		Mack	Male	1	2024-07-09	TBMWMRC	TRUE
	Gemini	Owen	Male	1	2024-07-09	TBMWMRC	TRUE
		Cheekie	Male	1	2024-07-09	TBMWMRC	TRUE
		Scarface3	Female	1	2024-07-09	TBMWMRC	
	Green	Monica	Female	1	2024-07-09	TBMWMRC	
		Soh	Male	1	2024-07-09	Toronto Zoo	
		Chunk	Male	1	2024-07-09	Toronto Zoo	TRUE
	Heather	Kenneth	Male	1	2024-07-03	TBMWMRC	TRUE
		Roblin	Female	1	2024-07-03	TBMWMRC	
		Kelsey	Female	1	2024-07-03	TBMWMRC	
	Hooper	Chad	Male	1	2024-07-03	TBMWMRC	
		Casie	Female	1	2024-07-03	TBMWMRC	
		Mitchell	Male	1	2024-07-03	TBMWMRC	
	P Mtn	Missy	Female	1	2024-07-09	TBMWMRC	TRUE
		Harvey	Male	1	2024-07-09	TBMWMRC	TRUE
		Diggs	Male	1	2024-07-09	TBMWMRC	TRUE
	Big Ugly	Martigold	Male	1	2024-07-03	TBMWMRC	TRUE
		Faye	Female	1	2024-07-03	TBMWMRC	
		Ayla	Female	1	2024-07-03	TBMWMRC	TRUE
		Finn2	Male	1	2024-07-03	TBMWMRC	TRUE
	Sadie	Jimbo	Male	1	2024-07-03	TBMWMRC	
		Stassi	Female	1	2024-07-03	TBMWMRC	
		Pope	Male	1	2024-07-03	TBMWMRC	
		Marna	Female	1	2024-07-03	TBMWMRC	TRUE
	Haley Lake	Irene	Female	1	2024-07-10	WICZ	
		Odell	Male	1	2024-07-10	TBMWMRC	
		Tank	Male	1	2024-07-10	TBMWMRC	TRUE
		Henrietta	Female	1	2024-07-10	WICZ	
		Gregorie	Male	1	2024-07-10	WICZ	TRUE
		Ultimo	Male	1	2024-07-10	TBMWMRC	
		Ophis	Female	2	2024-08-01	WICZ	
		Aubrey	Female	2	2024-08-01	TBMWMRC	TRUE
Strathcona	Washington	Geordi La Forge	Male	2	2024-06-24	Toronto Zoo	
		Snowball	Female	1	2024-06-24	TBMWMRC	
		Zachery	Male	1	2024-06-24	TBMWMRC	TRUE
		Lamar	Male	1	2024-06-24	TBMWMRC	
		Leena	Female	1	2024-06-24	TBMWMRC	
		Hoodoo	Male	1	2024-06-25	WICZ	
		Turner	Male	1	2024-06-25	WICZ	TRUE

		Kananaskis	Male	1	2024-06-25	WICZ	
		Langdon	Male	1	2024-06-25	WICZ	
		Lyell	Male	1	2024-06-25	WICZ	
		Luna	Female	1	2024-06-26	TBMWMRC	
		Aurora	Female	1	2024-06-26	TBMWMRC	
		Tavia	Female	1	2024-06-26	TBMWMRC	
		Sideshow	Male	1	2024-06-26	Toronto Zoo	TRUE
		Spruce	Male	1	2024-07-18	WICZ	
		Tyrrell	Male	1	2024-07-18	WICZ	
		Ice Cream	Female	1	2024-07-18	Toronto Zoo	
		Timbit	Male	1	2024-07-18	Toronto Zoo	
Total		67				66% within season survival	23

5.1.1 Fates of Released Marmots

Significant research has gone into improving outcomes for released and translocated marmots (Falconer, 2021; Lloyd et al., 2019; Jackson et al., 2016; Jackson, 2012; Aaltonen, 2009; Bryant et al., 2005). However, a wide range of site and temporal variables influence decision making and outcomes. For example, marmots released directly from conservation breeding programs have greater success when released to the Nanaimo Lakes meta-population (Lloyd et al., 2019). What factors create this difference between the two meta-populations has not been researched, but possibly differences in the length of the species' extirpation in the two regions, as well as climate and elevation differences, influence the success of captive-bred marmots post-release.

Since 2017, there have been two significant changes to captive-bred marmot releases and translocations: implementing the results of the stepping stone study and increasing the capacity of the captive breeding population.

Fates of Captive-Bred Marmots released to the Nanaimo Lakes and Mount Washington

Captive-bred marmots are typically released at 1 year of age. For these marmots to contribute to population growth, they must reach breeding age. The average age of first breeding for female marmots is 3.6 years old, with some females breeding as early as 2 years old and others beginning at 4 or later (Bryant, 2005). Between 2019 and 2024, 176 captive-bred marmots were released in the Nanaimo Lakes region or at Mount Washington. Of the 68 marmots release between 2019 and 2022 which could have made it to 3yo by the end of this season, 21% (n=14) reached prime breeding age and are still alive, 9% (n=6) survived to prime breeding age but have since died, and 70% (n=48) died prior to reaching prime breeding age. This result is broadly comparable to wild born marmots, where 25% typically survive to prime breeding age. (Jackson et al, 2015 & Lloyd et al, 2019)

Fates of Released Captive-bred Marmots in Nanaimo Lakes & Mount Washington

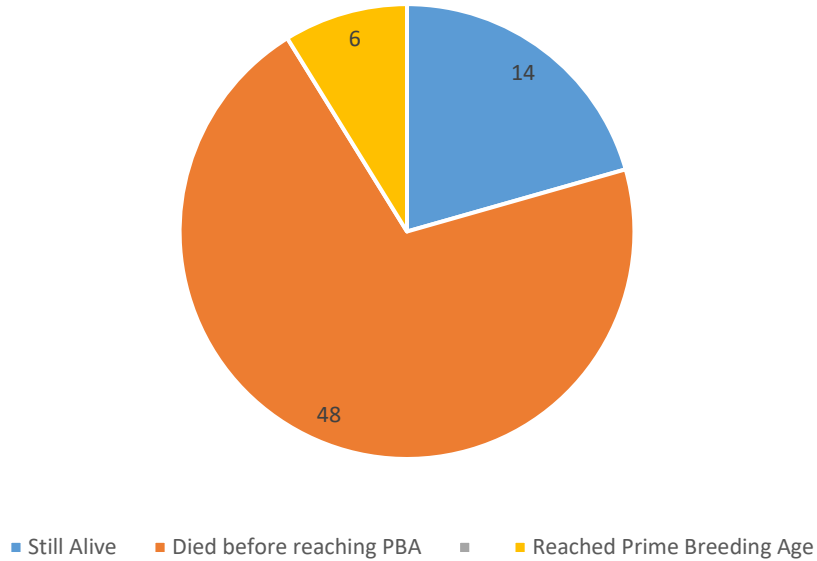


Figure 6 Fates of Captive-bred marmots released to the wild between 2019 and 2022. “PBA” means “Prime Breeding Age.”

5.2 Moving Marmots

Marmots can follow many different life pathways as we manage the population by moving marmots to accomplish various recovery objectives such as augmenting small colonies and maximizing genetic outbreeding. This means it can be difficult to label all possible scenarios that a marmot may take. After their initial captive-release, some captive-bred marmots are recaptured and subsequently re-released to the same colony or translocated to a different colony for various reasons. Wild born marmots are sometimes trapped and brought into captivity for various reasons. They may stay in captivity as part of the breeding program, or only for a short period of time and then may be re-released to the same colony or translocated to a new colony. All marmot movements, excluding captive-bred marmots which are being released to the wild for the first time, are accounted for here.

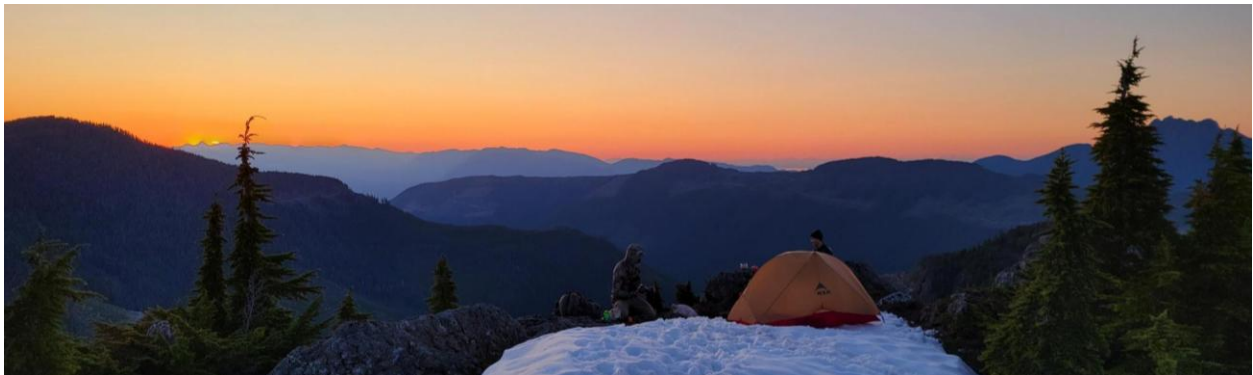


Photo 4 Heather Heim. Camp on multi-day survey

5.2.1 Re-releases and Translocations

There were 10 marmots with some level of previous wild-living experience that were released back into the wild this year. Marmots which were released to the same colony where they were captured after a period in captivity are considered re-releases, whereas if they were moved to a different colony they are considered translocations.

Table 10. Marmots translocated or re-released

Receiving Colony	Marmot	Age	Sex	Release Date	Origin	Deceased
Flower Ridge	Taco	1	F	2024-08-07	wild-born	
	Gilligan	1	M	2024-08-07	wild-born	
	Warden	2	M	2024-08-07	Calgary Zoo	
	Lilibet	2	F	2024-08-07	wild-born	
Red Pillar	PB	2	M	2024-08-07	Toronto Zoo	
	Becca	1	F	2024-08-07	wild-born	TRUE
Sunrise	Kittle	2	M	2024-08-07	wild-born	TRUE
	Aubergine	2	F	2024-08-07	TBMWMRC	
	Olaf	2	M	2024-08-07	TBMWMRC	
Washington	Kendra	2	F	2024-06-24	wild-born	TRUE
Total	10					3

5.2.2 Fates of Translocated and Stepping Stone releases in Strathcona Provincial Park

Preliminary results of the Stepping-stone release methodology (Lloyd et al., 2019) were available to the Foundation in late 2017. Results indicated that taking a stepping-stone approach to releasing captive-bred marmots to the Strathcona meta-population greatly improved outcomes, and that translocated wild-born marmots also had high success rates. By comparison, outcomes for direct released captive-bred marmots in Strathcona Provincial Park were poor. Beginning in 2018, only wild-born or stepping-stone marmots have been translocated into colonies in Strathcona Provincial Park.

While sample sizes are very small, marmots released into Strathcona Provincial Park between 2019 and 2023 have experienced survival rates in line with those found in the study for the wild-born and stepping-stone cohort. During this period, the majority of translocated marmots have been wild-born, located either in inappropriate habitat or from the Mount Washington colony (n=17). Three marmots were born in the captive-breeding program and translocated to Strathcona Provincial Park through the stepping-stone program (n=3). Of all translocated marmots, six have not been re-detected or their fate prior to reaching prime breeding age is unknown (n=6), seven likely died prior to reaching prime-breeding age (n=7), six reached prime-breeding age. (n=6). Of these six, three marmots are likely still alive (n=3). One marmot is alive, but has not yet reached prime-breeding age (n=1).

Fates of Marmots Translocated to Strathcona Provincial Park 2019-2023

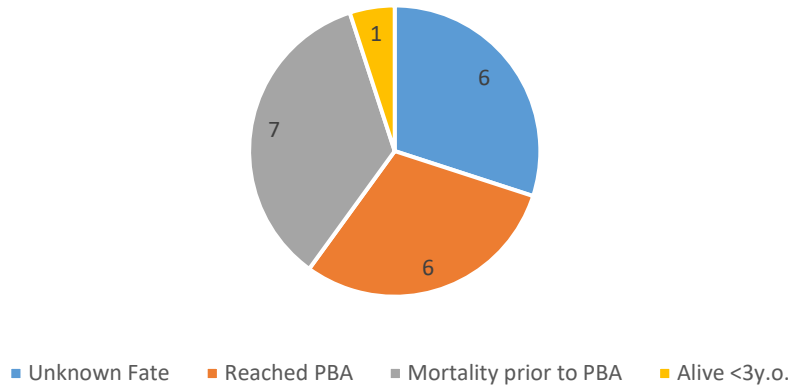


Figure 7 Fates of marmots translocated to Strathcona Park 2019-2023. "PBA" is Prime Breeding Age.

5.2.3 Wild Trapping

Wild marmots are trapped for various reasons including health checkups, weights, transmitter implantation or replacement, translocation, rescues from unsuitable habitat, and contributions to the captive breeding program. Marmots were trapped by both Marmot Recovery Foundation field teams and the Wilder Institute/ Calgary Zoo research field teams, and data from both teams is reported here.

Wild-living marmots frequently show up in areas of ephemeral or unsuitable habitat. The Foundation continues to manage marmots living in unsuitable habitat based on their unique circumstances and projected timeframe for safe occupancy and removal from the site. When possible, these marmots are trapped and receive a thorough health evaluation at the Tony Barrett Mount Washington Marmot Recovery Centre and are translocated into Strathcona Provincial Park to augment existing colonies there.

The capacity of the Foundation to respond to situations of marmots in unsuitable habitat has been greatly improved over the past four years, with year-round operations in place at the Marmot Recovery Centre. In 2024, no marmots were detected in cutblocks that were candidates for translocation, and there were no marmots captured from the wild with the intent to augment the captive breeding program.

Table 6. Wild marmot captures by MRF teams and Wilder Institute/ Calgary Zoo teams.

Colony	Marmot	Team	Date	Purpose
Big Ugly	Bubbers	WICZ	2024-05-22	Trapped for weight.
	Leilani	WICZ	2024-05-22	Trapped for weight.
	Nonnie	WICZ	2024-06-17	Trapped for weight.
	Unknown Adult	WICZ	2024-05-22	Trapped for weight.
	Unknown Yearling	WICZ	2024-05-23	Trapped for weight.
	Unknown Yearling	WICZ	2024-05-22	Trapped for weight.
Castlecrag	Lonnie	MRF/WICZ	2024-08-28	New wild implant

Colony	Marmot	Team	Date	Purpose
	Omati	MRF/WICZ	2024-08-30	Trapped for health check-up
	Salmon	MRF/WICZ	2024-08-28	New wild implant
	Sebastion	MRF/WICZ	2024-08-28	New wild implant
	2x Unknown Pups	MRF/WICZ	2024-08-28	Trapped for health check-up
	Howard	MRF/WICZ	2024-08-28	Re-implant
	Trooper	MRF/WICZ	2024-08-28	Trapped for health check-up
Douglas	Unknown Adult	WICZ	2024-06-06	Trapped for weight.
	Unknown Adult	WICZ	2024-06-06	Trapped for weight.
	Unknown Adult	WICZ	2024-06-06	Trapped for weight.
	Unknown Yearling	WICZ	2024-06-06	Trapped for weight.
	Unknown Yearling	WICZ	2024-06-05	Trapped for weight.
Haley Lake	Chloro	WICZ	2024-05-30	Trapped for weight.
	Gracelyn	WICZ	2024-05-30	Trapped for weight.
	Onslo2	WICZ	2024-05-30	Trapped for weight and ID
	Unknown Adult	WICZ	2024-05-30	Trapped for weight.
	Unknown Yearling	WICZ	2024-05-30	Trapped for weight.
Red Pillar	Kincaid	MRF/ WICZ	2024-08-11	New wild implant
	Miso	MRF/ WICZ	2024-08-11	New wild implant
	Nosers	MRF/ WICZ	2024-08-11	New wild implant
	Unknown Pup	MRF/ WICZ	2024-08-11	Trapped for health check-up
	Unknown Pup	MRF/WICZ	2024-08-11	Trapped for health check-up
Washington	Arwen	MRF	2024-06-27	Trapped for health check-up
	Talamore	MRF	2024-07-15	Trapped for health check-up
	Edgar	MRF	2024-07-16	Trapped for health check-up
	Gord	MRF	2024-07-11	Trapped for health check-up
	Squirrel	MRF	2024-07-11	New wild implant
	Esmeralda	MRF	2024-07-16	Re-implant
	Hoodoo	MRF	2024-07-17	Returned to ski hill after attempting to disperse
	Tavia	MRF	2024-07-11	Returned to ski hill after attempting to disperse
	Aubergine	MRF	2024-07-16	Trapped for translocation

Colony	Marmot	Team	Date	Purpose
	Lilibet	MRF	2024-07-15	Trapped for translocation
	Olaf	MRF	2024-07-16	Trapped for translocation
	PB	MRF	2024-07-16	Trapped for translocation
	Warden	MRF	2024-07-16	Trapped for translocation
	Kittle	MRF	2024-07-04	Trapped for implant and translocation
	Becca	MRF	2024-07-04	Trapped for implant and translocation
	Gilligan	MRF	2024-07-11	Trapped for implant and translocation
	Taco	MRF	2024-07-11	Trapped for implant and translocation
Total		46		

5.3 Wild Transmitter Implants

The Foundation surgically implants radio telemetry transmitters in a subset of the wild-living population to facilitate the monitoring of their survival, hibernation, and location. Transmitter batteries last three to four years, and then can sometimes be replaced. Collecting radio-telemetry data informs a variety of management decisions about the allocation of resources, such as the distribution of supplemental feeders, selection of sites needing augmentation, identification of successful colonies able to provide wild-living marmots for translocation, and the rescue of marmots from unsuitable habitat.

In 2024, all transmitters were implanted by the Foundation’s veterinarian, Dr. Malcolm McAdie. Implanted marmots (Table 7) were aged 1yo or older, and surgeries were conducted in or after June to allow marmots to regain some body condition following their hibernation. All captive-bred and translocated marmots are released with active radio-transmitters.

One marmot, Harold, was recaptured and re-implanted on Castlecrag this year at the age of 11 years old. Harold is a wild-born marmot who was originally trapped and implanted in 2016, and the last known detection of him was in 2018. Recapturing this marmot will give the foundation the unique opportunity to track the movements and survival of this marmot in the later portion of it’s life, a rare opportunity.

Table 7 Transmitter implants of wild-living marmots

Colony	Marmot	Age	Sex	Date	Reasoning
Washington	Squirrel	2	F	2024-07-11	New wild resident implant
	Esmeralda	4	F	2024-07-16	Resident female, transmitter replaced.
	Kittle	1	M	2024-07-11	Translocation
	Becca	1	F	2024-07-11	Translocation
	Gilligan	1	M	2024-07-26	Translocation
	Taco	1	F	2024-07-11	Translocation
Red Pillar	Kincaid	3	M	2024-08-10	New wild resident implant
	Miso	1	F	2024-08-11	New wild resident implant
	Nosers	3	F	2024-08-11	New wild resident implant

Colony	Marmot	Age	Sex	Date	Reasoning
Castlecrag	Salmon	1	M	2024-08-28	New wild resident implant
	Sebastion	1	M	2024-08-28	New wild resident implant
	Lonnie	3+	F	2024-08-29	New wild resident implant
	Harold	11+	M	2024-08-30	Resident male, reimplanted.
Total	13				

5.4 Supplemental Feeding

Anecdotal evidence suggests that supplemental feeding may improve the overwinter survival and reproduction of Vancouver Island marmots. Despite the potential impact on recovery efforts, the Foundation has never had the capacity to properly investigate these relationships. In 2018, the Calgary Zoo’s Centre for Conservation Research (now Wilder Institute/Calgary Zoo) initiated a pilot study to test potential methodology for a study on supplemental feeding and its benefits to marmot reproduction. After a shortened season in 2020, the Wilder Institute/Calgary Zoo research team was able to return for a full field season in 2021 to 2024 with two field teams. This year, the Wilder Institute/Calgary Zoo team did not provision feed but collected a final set of marmot body weights and anticipate providing their findings before next season.

The Foundation provides supplemental food (also Mazuri leaf-eater biscuits) to marmots in the spring, when snow limits the amount of available food for marmots and bears are less likely to discover and empty the feeders. Spring Feeding effort increased slightly this year (36 feeders), compared to last year (32 feeders).

Table 8 Supplemental Feeding in 2024

Region	Colony	# of Feeders	Biscuit Quantity (kg)	Number of marmots potentially benefiting
Clayoquot Plateau (2)	Steamboat	2	22.33	28
Nanaimo Lakes (10)	Butler	1	11.33	13
	El Capitan	1	11.33	5
	Gemini	1	11.33	10
	Green	1	11.33	10
	Heather	1	11.33	3
	Hooper	1	11.33	8.5
	Landale	2	22.66	12
Strathcona (24)	McQuillan	1	11.33	21
	Sadie	1	11.33	6
	Albert Edward	2	22.66	18
	Castlecrag	2	22.66	27
	Celeste	1	11.33	7

	Flower Ridge	1	11.33	4
	Greig Ridge	1	11.33	8
	Marble Meadows	2	22.66	22
	McBride	2	22.66	9
	Morrison Spire	1	11.33	18
	Red Pillar	1	11.33	11
	Shepherd's Ridge	1	11.33	20
	Jutland	1	11.33	15
	Washington	8	54.16	36
	Wheaton Lake	1	11.33	1
Total	23 colonies	36 feeders	365.61 kg	~313 marmots

The Foundation has expanded our feeding effort in recent years. More helicopter time has been allocated to feeding, and feeders have been redesigned to allow more feeders on a helicopter per flight. Not all colonies can be provided with feeders, particularly colonies where avalanche terrain makes safe deployment challenging.

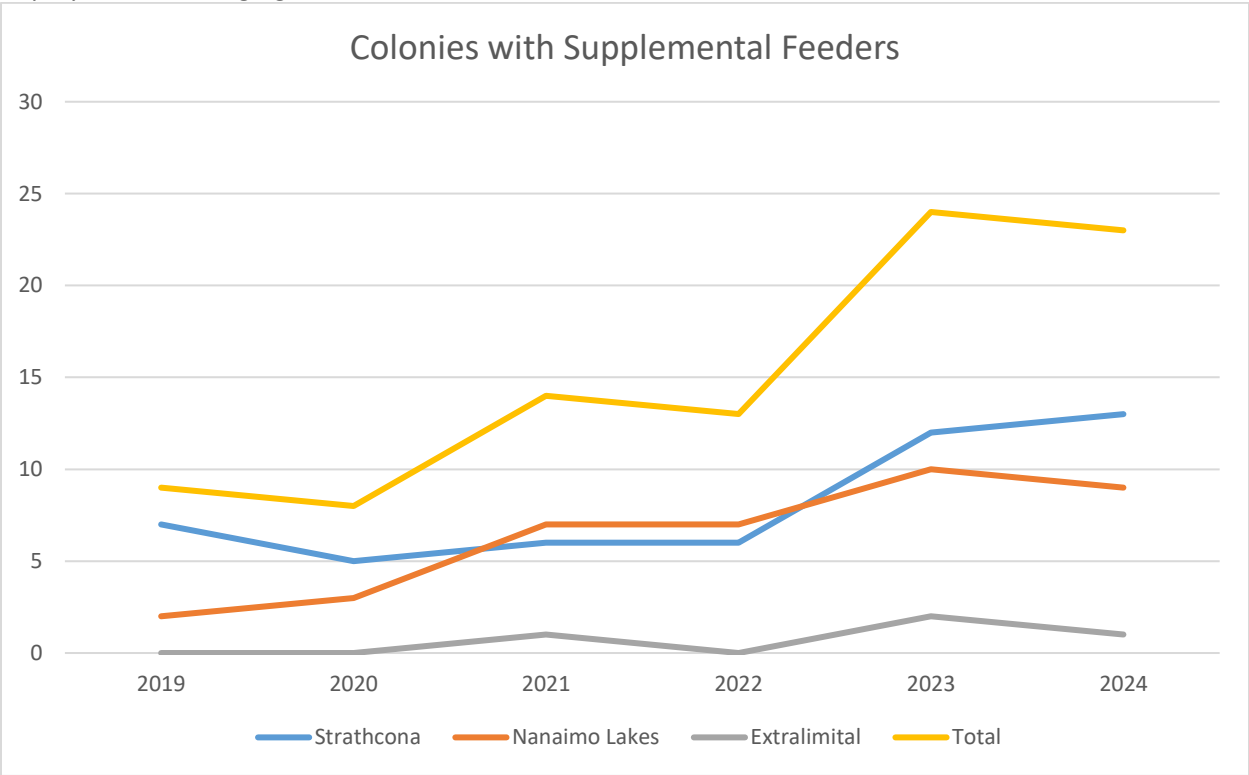


Figure 8 Number of colonies with supplemental feeders by year

5.5 Habitat Improvement

In recent years, the Foundation has conducted habitat improvement activities at colonies with the goal of increasing local survival rates and preserving long-term habitat suitability. Recent habitat improvement has included the removal or partial delimiting of trees in marmot habitat. These trees and low branches provide stalking cover to terrestrial predators and convert marmot’s meadow habitat to

young forest. By regaining long continuous lines of sight, marmots may have a better opportunity to detect and evade predators.

For the fourth year in a row, the Foundation was granted funding for habitat improvement projects during the months of October – November. With the use of chainsaws and large crews, we were able to continue and build on the work that the Foundation has completed in past efforts. All habitat improvement occurred within the Nanaimo Lakes region, following a specific set of best management practices for methodology. This included mitigation efforts to avoid short-term and/or long-term damage to known burrows and/or hibernacula. Further details on methodology, best management practices, and photo analysis results can be found within the Foundation’s “Tree Change in Vancouver Island Marmot Colonies: Best Management Practices, Past Efforts, & Photo Analysis” report.

Table 9 Habitat Improvement

Colony	Hectares improved	Description of Work
Green	1.5	Single day of work with large crew concentrating in core habitat area. Current marmot occupation, documented cougar predation, and significant tree ingress classified this site as high priority for restoration work. This work built on work conducted in 2022.
Gemini	1	Single day of work with large crew concentrating in core habitat area. Current marmot occupation, documented cougar predation, and significant tree ingress classified this site as high priority for restoration work. This work built on work conducted in 2021.
Haley	4	Five days of restoration work completed in core habitat area. Current marmot occupation, documented cougar predation, and significant tree ingress classified this site as high priority for restoration work. Work completed with permit from BC Parks. This work built on work conducted in 2023.

5.6 Invasive Species of Concern

In 2024, at least two Yellow-bellied marmots were located on Vancouver Island. Of these, one was successfully trapped and re-released, and one was not successfully trapped and could not be re-located.

Yellow-bellied marmots (*M. flaviventris*) are a species of colonial marmot found in western mainland Canada and the United States. Although *M. flaviventris* can live in mountains at high elevations, in British Columbia they are often associated with low-elevation habitat in the Thomson Okanagan and Kootenay and Chilcotin regions, though they occupy other areas of the Province as well. They often occupy a range of natural and artificial habitat, including orchards, farmlands, and golf courses where they are frequently viewed as a pest species. As urban centres in these areas have expanded, *M. flaviventris* has also been found to thrive in more developed areas of towns and cities.

Unlike the Vancouver Island marmot, *M. flaviventris* is not native to Vancouver Island, but they have been sighted on the Island with increasing frequency in recent years. This is likely part of a province-wide problem in which marmots have been unintentionally transported from colony locations to non-historic habitat, traveling in bus baggage compartments, vehicle engine bays, and shipments of

equipment and agricultural supplies. Of particular concern to the Foundation is the capacity for *M. flaviventris* to introduce novel diseases and pathogens that could potentially decimate Vancouver Island marmot colonies. Transmission could result from direct contact, or via an intermediate host, such as the soles of hiking boots. The Recovery Plan assesses the risk of Invasive & other problematic species, genes & diseases as medium-to-high impact with slight to serious severity (Vancouver Island Marmot Recovery Team 2017).

On Vancouver Island, *M. flaviventris* have been sighted at various urban and rural locations from Victoria up to Courtenay.

5.7 Monitoring

The Foundation monitors the status of Vancouver Island marmots in the wild in order to make strategic and informed decisions about recovery efforts. Monitoring provides information about colony locations, rates of survival and reproduction, causes of mortality, and the age- and sex- structure and size of colonies. This information directly influences the selection of release sites and release candidates, the installation of spring supplemental feeders, and the identification of habitat needing improvement to facilitate colony growth and persistence. Information about annual mortality and reproduction forms the basis of our understanding of the species' population and conservation status.

5.7.1 Methodologies

Effectively monitoring marmots can be challenging due to the difficulties accessing their sub-alpine habitat, the marmot's semi-fossorial behaviour and activity patterns. For this reason, the Foundation used several approaches to monitoring. Prior to marmots being released or translocated, all marmots were implanted with radio-telemetry transmitters (Holohil A1-2TH) that have a battery life of ~4 years. These transmitters send out a unique radio signal that changes pulse frequency according to body temperature; living marmots are warm, and their transmitters send out a faster pulse than those of deceased or hibernating marmots. This facilitated survival and location monitoring of these marmots which enabled the Foundation to evaluate a marmot's post-release success. The Foundation also implanted a subset of wild marmots, which provided the same survival and location data.

A subset of transmitters were furnished with Weepit or IButton data loggers, which record the body temperature of the marmot for up to 2 years. This data can be retrieved either by recovery of the transmitter after mortality, or wirelessly through the abdominal wall if the individual can be recaptured.

For a typical telemetry survey, 2-4 crew members hiked into marmot habitat and used receivers (Telonics TR-8) and three or five element antennas to scan through a set of frequencies unique to individual marmots. When crew detected a pulse on one such frequency, the number of pulses per minute indicated whether the marmot was alive (≥ 30 ppm), possibly alive (29ppm) or dead/hibernating (≤ 28 ppm). If a dead marmot was accessible for recovery, field teams attempted to track the transmitter to its resting location to collect information about the cause and timing of the mortality and recover the transmitter for refurbishing and data retrieval. Aerial telemetry conducted from helicopters was also an important monitoring tool, particularly for colonies in Strathcona where ground access is more challenging.

Visual surveys of marmot colonies formed a significant component of the responsibilities of annual, seasonal field crew hired by the Foundation. During a visual survey, one or more team members sat at

vantage points near a marmot sublocation and used binoculars and/or a spotting scope to count and age marmots based on their size, pelage, and presence or absence of ear tags. Crew used telemetry to identify the known individuals in the area (whether observed or just detected) and then summarized the number of untelemetered tagged and untagged individuals that were observed.

Field crew typically conducted surveys in the morning (6-10am) or if on overnight trips, during the late afternoon and evening (3-9pm) to match the marmots’ natural activity pattern. On daytrips, most visual surveys lasted for 1-3 hours and at several sublocations depending on the size of the field team. On overnight trips, field crew often surveyed a colony for closer to 8 hours in a single day. It took several surveys over the course of a field season for the Foundation to feel confident in the estimate of a colony’s size and composition; overnight trips with larger teams typically provided the Foundation with a faster and more comprehensive understanding of colony size and composition.

Wildlife cameras were deployed at marmot hibernacula and burrows and at supplemental feeders to capture video and audio footage of marmots. Cameras were also used to confirm that unsuitable habitats have not been recolonized by marmots, and to identify predators in or near marmot habitat, although these scenarios were less common. Cameras proved essential at remote colonies such as those in Strathcona that could not be accessed for regular, on-the-ground surveys. The Foundation used the unique appearance of marmots, particularly their molt pattern, size, and the presence or absence of ear tags, to count pups and identify and age individuals. The Foundation also evaluated marmot behavior in the videos, because this can provide clues about the social structure of the colony. Videos were reviewed quickly during the field season, and in greater depth in the off-season (November and December). The foundation uses the program Timelapse2 to tag and archive videos.

In 2024 the Foundation greatly benefitted from the regular presence of teams from Wilder Institute/Calgary Zoo. The Wilder Institute/Calgary Zoo visited six colonies regularly in the Nanaimo Lakes area, plus numerous exploratory trips into other sites. See Table 11 for more information on how this impacted search effort.

For a greater level of detail about monitoring methodologies, please contact the Marmot Recovery Foundation.

5.7.2 Remote Camera Results

Camera traps contributed significantly to our hill counts and understanding of marmot habitat use by both marmots and other species. Some commonly observed species using marmot habitat features include Black bear, Black-tailed deer, Pine marten, Ermine, Grouse, Elk, and Cougars.

Table 10 Footage captured by select remote cameras in 2024.

Region	Colony	Timeframe	# of Camera Traps	# of unique marmots detected			Notes
				Adult	1yo	Pup	
Nanaimo Lakes	Arrowsmith	May-Oct	2	2	1		Supplemented by WICZ
	Big Ugly						Completed by WICZ
	Butler	May-Oct	3	3		4	
	Cutblock – KBlock	May- July	1	2			

Region	Colony	Timeframe	# of Camera Traps	# of unique marmots detected			Notes
				Adult	1yo	Pup	
	Cutblock-Knight Lake	May-June	1				No marmots detected.
	Cutblock-LDL	May-July	2				No marmots detected.
	Douglas						Completed by WICZ
	El Capitan	May-Oct	1	1	1	3	
	Gemini	May-Oct	2	2			
	Green	May-Oct	4	3	1		
	Haley Lake		2+				Completed by WICZ
	Heather	May-Oct	2				
	Hooper	May-Oct	1	2			
	Landale	May-Oct	3	4		3	
	McQuillan	May-Oct	4	3	1	3	
	Moriarty						Completed by WICZ
	P Mtn						Completed by WICZ
	Sadie	May-Oct	2	2			
Strathcona	Albert Edward	May-Oct	2	2	4	1	
	Becher	May-Oct	3	2			
	Castlecrag	May-Oct	3	6	3	6	
	Celeste	May-Oct	3	2		2	
	Flower Ridge	May-Oct	2	2	2		New releases
	Greig Ridge	May-Oct	2	2	1	3	
	Marble Meadows	May-Oct	4	5	1	6	
	McBride	May-Oct	3	3	1	2	
	Morrison Spire	May-Oct	2	1			
	Red Pillar	May-Oct	2	2	1	4	
	Shepherds Ridge	May-Oct	2	4		2	
	Sunrise	May-Oct	3	4	3	1	
	Washington	May-Nov	Varied.				Used for monitoring post-release behaviour, not inventory.
	Wheaton Lake	May-Oct	1				
Clayoquot Plateau	Steamboat	May-Oct		3		2	
TOTAL	30 colonies		~87				

5.7.3 Summary of monitoring effort by location

In 2024, the foundation continued its expanded field presence with three field teams for most of the season. Along with the continued presence of the WICZ team at seven focal colonies, search effort was comparable this year to the previous three years. The continued additional resources also allowed us to explore new sites and infrequently surveyed sites, particularly in Strathcona Provincial Park and Clayoquot Plateau Provincial Park.

Visual Survey effort is measured in number of total person-hours spent observing marmot habitat at each colony, including ground surveys, drone flights, and helicopter flights. Some historic colonies are not reported in the table below.

Table 11 A comparison of monitoring effort in 2024 to previous years (Including WICZ teams).

Region	Site	Average annual effort (Person Days)	2024 Effort (Person Days)	% of average annual effort	Notes
Nanaimo Lakes	Arrowsmith	57	45	79%	WICZ study site
	Big Ugly	44	44	99%	WICZ study site
	Butler	10	10	98%	
	Douglas Peak	37	45	121%	WICZ study site
	El Capitan	3	4	133%	New colony in 2023
	Gemini	14	6	43%	
	Green	9	14	149%	
	Haley/Bell	50	78	157%	WICZ study site
	Heather	10	21	210%	
	Hooper	4	3	71%	No full survey
	Landale	17	14	82%	New colony in 2021
	McQuillan	14	11	79%	
	Moriarty	30	36	119%	WICZ study site
	P Mtn	31	20	64%	WICZ study site
	Sadie Peak	9	12	140%	
	Cutblocks- all	28	14	51%	
Strathcona	Albert Edwards	4	9	250%	
	Becher	20	11	56%	New colony in 2021
	Castlecrag	10	28	280%	Trapping trip
	Celeste	5	7	156%	New colony in 2023
	Drinkwater	0	15		New colony 2024
	Flower Ridge	4	11	250%	Reintroduction
	Greig Ridge	3	11	324%	
	Jutland	3	15	469%	New areas 2024
	Marble Mdws	11	14	127%	
	McBride	7	5	71%	New colony in 2023
	Morrison Spire	2	9	500%	
Red Pillar	8	15	200%	Trapping trip	
Shepherds Ridge	9	11	122%	New colony 2023	

Region	Site	Average annual effort (Person Days)	2024 Effort (Person Days)	% of average annual effort	Notes
	Tibetan	3	1	36%	Fly-by
	Mt. Washington	157	96	61%	VIU team not present this year
	Wheaton Lake	2	1	43%	No full survey
Extralimital	Lions North	2	2	100%	Overnight Survey
	Steamboat	5	12	231%	Overnight Survey
Total:		595	652	110%	

5.7.4 Community contributions to monitoring

Reports from the community at large, particularly those who work or recreate in or near marmot habitat, make important observations that can improve recovery efforts. Since 2017, the Foundation has made greater outreach efforts to solicit observations and looks forward to building more partnerships with hiking and outdoor recreation organizations in the future. In 2024, the Foundation received 111 marmot reports, including a number of significant observations.

Table 12 Significant reports from the public in 2024.

Region	Location	Nature of Report(s)	Significance
Nanaimo Lakes	Mt Landale	Report, photographs, location	Numerous reports of a marmot near the summit of Mt Landale overlooking the hiking trail.
	Labour Day Lake	Report, photographs, location	Reports of a marmot potentially dispersing on a service road
Strathcona	Red Pillar	Hiker report, photos, location data	Confirmation of continued occupation
	Big Jim and Little Jim Lakes	Hiker reports, photos	At least one marmot reported several times. Staff have been able to confirm one marmot, but more may be present.
	Mt. Washington	Hiker reports, photographs.	Many reports from visitors documenting resident marmots.
Invasive Species	Victoria-area, Nanaimo-area	Reports, photographs	Several reports of Yellow-bellied marmots in the Greater Victoria area and one in the Comox Valley.

6. TONY BARRETT MOUNT WASHINGTON MARMOT RECOVERY CENTRE

6.1 Background

The Tony Barrett Mount Washington Marmot Recovery Centre ("the Centre") received its first marmots on October 15, 2001, and in 2024 the facility completed its 23rd year of operation. From 2001 to 2012 the Centre continuously housed captive marmots and functioned as a quarantine, pre-release, and breeding center. Captive reintroductions and augmentations (which began in 2003) resulted in significant growth of the wild population, and because of this success, the captive program was intentionally downsized in 2012. From 2013 to 2017 the Centre was used as a seasonal quarantine, pre-release (i.e., VIM coming from the other captive facilities in the spring and being prepared for release) and staging facility (temporary holding of VIM prior to translocation, primarily from the wild Mount Washington colony to sites in Strathcona). Inventory conducted in the years following 2012 indicated that the wild population was slowly declining and that its status remained precarious and at risk. In response, the Centre was recommitted to overwintering release marmots during the winter of 2017/18 and returned to being a year-round, multipurpose facility (including hibernation and preparation of release marmots, maintenance of breeding pairs and future breeders) in 2019.

Year-round operation of the Centre significantly increases the program's capacity for captive breeding and releases, and it has given MRF staff greater flexibility in responding to management situations (for example recapturing wayward releases or marmots under predation threat, holding marmots unsuitable or not ready for release or temporary holding of translocation marmots or those originating from unsuitable habitat). The establishment of remote monitoring at the Centre (including internet access CCTV cameras, real-time temperature sensors and a power outage alert system) has allowed us to safeguard its winter operation with a significantly reduced on-site presence, while ensuring the safety of the hibernating marmots. Staff from the Mount Washington Alpine Resort have continued to play an essential role in snow management and Centre support.

6.2 Operations in 2024

In September of 2023, 2 yearling males from the Centre were moved to the Wilder Institute/Calgary Zoo in support of the captive breeding program. A total of 17 pups were received from Calgary and 11 from Toronto (for an overall total of 30 moves). During the 2023/24 hibernation, there were a total of 114 marmots, and all survived hibernation.

The 114 marmots included:

- 22 x breeding pairs (in which both the male and female are 2 years of age or older). This meant that every enclosure (including the Centre's two quarantine spaces) contained a potential breeding pair. In most cases, the breeding adults were housed with yearlings. Based upon previous experiences the yearlings are relatively well tolerated by the older marmots if they are removed before the end of the season.
- 3 x 2-year-olds for release in 2024
- 64 x captive-born yearlings (36 marmots born at the Centre in 2023, 17 from the Wilder Institute/Calgary Zoo and 11 from the Toronto Zoo)
- 1 x wild-born 2-year-old female for re-release
- 1 x female with congenital, bilateral cataracts who was removed from the Studbook and is serving a role as a "mentor" marmot

- 1 x male marmot whose advanced age precluded him from being paired in 2024

With 114 marmots (including 22 breeding pairs) at the Centre, several unprecedented events occurred, including:

- One 2-year-old female marmot was able to get her incisors trapped in the mesh of her outside enclosure. This has happened once previously in the preceding 23 years. While the staff member was engaged in extricating this individual, an adult male was able to move from one enclosure to the adjacent one unbeknownst to the staff member. This resulted in a great deal of contact and physical aggression between the two adult males.
- The cage furniture in the outside enclosures includes boulder piles which have been in place for 23 years. Their stability is checked and re-checked before the marmots are released into their outside enclosures. Unfortunately, despite these safeguards, one of the large boulders shifted and entrapped a yearling female. This resulted in an oblique humeral fracture and an extensive injury to her hind foot. This was an individual scheduled for release and given the extremely poor prognosis for recovery and release; she was euthanized.
- In preparing the marmots for release we implant them with an intrabdominal VHF transmitter. In June we had a yearling female die because of apparent surgical complications. We have been implanting marmots with abdominal transmitters since 1992. The number of implant surgeries in VIM is currently 1,251 including 121 transmitter replacement surgeries. There have been four documented complications including one pelvic impaction, two transmitter reactions and this case of septic peritonitis (0.3% complication rate).
- As mentioned previously, we maintained breeding aged animals in all available enclosures. Except for three enclosures, we also housed yearlings (for retention in the breeding program or release) with these older marmots. In the past this strategy has worked without complications. In 2024, however, it appears that the social aggression resulting from so many individuals in a single enclosure resulted in the loss of three un-weaned litters. Over the course of this project (dating back to 2000), 17 pre-weaned, captive litters have been lost out of 272 total litters or 6.3%). With the possibility of further losses, we removed the yearlings from the enclosures with extant litters and housed them in the outside enclosures (temporarily locking some of the groups inside). This was a suitable, temporary solution although we have had to put up barriers to deal with heat and aggression between the outside enclosures.
- Prior to the onset of hibernation, marmots exhibit a greater level of social tolerance and in September we routinely introduce pups to unrelated adults. Prior experience has indicated that pups exhibit a more efficient, robust hibernation when housed with larger, older marmots. Unfortunately, in 2024 an adult male fatally attacked a large, male pup shortly after introduction.

Most of the complications in 2024 seem to be related to housing a larger number of captive marmots with the purpose of supporting recovery objectives. It appears that the Centre exceeded a numbers and demographic threshold which was not apparent in its previous years of operation. To mitigate the possibility of a similar situation moving forward, the VIM Studbook Keeper identified additional

individuals that could be released in 2024 (without compromising future breeding) to reduce the overall number of breeding pairs and associated space pressure in 2025.

Despite these challenges, the Centre also had significant achievements in 2024 including:

- 6 weaned litters and 22 healthy pups
- 67 captive-born marmots were released to the wild (and one wild-born, temporary captive was returned to the wild).
- 5 captive marmots (released at Mount Washington in 2023) were recaptured and translocated into Strathcona (= stepping stone or pre-conditioned marmots).
- 4 wild born yearlings from Mount Washington were captured and translocated into Strathcona.
- A total of 77 marmots were manipulated in support of ongoing recovery efforts (67 captive releases, 1 wild re-release, 5 stepping-stone and 4 translocations).
- In early December 2024, it was apparent that one of the Centre’s older marmots (“Rascal”) was experiencing excessive hibernation weight loss and was having ongoing and progressive difficulties using his hind legs. His abdomen was also becoming distended with fluid. Given the poor prognosis and the implications for his quality of life, Rascal was peacefully euthanized in late December. Remarkably, he was 16.6 years old. As a yearling he was originally implanted with a transmitter in 2009 at Mount Washington and was taken into captivity in 2019. Because his transmitter had failed, we were not certain about his exact identity until he had passed. He was a friendly, charismatic marmot and will be missed by Centre staff.

6.3 Outlook for 2025

In the September of 2024, prior to the 2024/25 hibernation, 2 young pairs were moved from the Centre to the Wilder Institute/Calgary Zoo and one male was sent to the Toronto Zoo in support of the captive breeding program. A total of 17 pups (and two unpaired, adult females) were received from Calgary, and 13 from Toronto (overall total = 37 moves). Currently there are 90 marmots hibernating at the Centre, including 18 breeding pairs and 40 potential release candidates for 2025.



Photo 5 Adam Taylor. The Tony Barrett Mount Washington Marmot Recovery Centre

6.4 Impact of Resuming Breeding Operations

Between 2013 and 2019, the Tony Barrett Mount Washington Marmot Recovery Centre did not breed marmots. The decision to stop breeding at the Centre was made as the marmot population in the Nanaimo Lakes approached levels that the Recovery Team thought might be sustainable without captive breeding support. Unfortunately, the marmot population in the Nanaimo Lakes area collapsed in 2014 and failed to recover in subsequent years. The decision was made to restart captive breeding at the Marmot Recovery Centre beginning in 2019. Expanding the captive breeding program included retaining young marmots in the program rather than release them and capturing young marmots from wild from unsuitable habitat and genetically underrepresented populations. As with initial establishment of the captive breeding program, marmots with low likelihood of survival were targeted for capture.

Though it took several years for younger marmots to reach breeding age, restarting breeding operations at the Marmot Recovery Centre is now making a sizeable contribution to the number of marmots born in the program and released to the wild annually.



Photo 6 Kevin Gourlay. Marmot Trapping 2024

7. SUMMARY OF CAPTIVE BREEDING PROGRAM

7.1 Project Chronology

Late 1980s and throughout the 1990s – The rare Vancouver Island marmot's (VIM) wild population demonstrates steady and precipitous declines.

1996 – An attempt to translocate 6 wild VIMs from ephemeral, logged habitat to a natural, historical subalpine meadow ends in failure. The 4 marmots that remained at the release site died in a communal burrow during hibernation.

1997 – Six wild marmots are captured and sent to the Toronto Zoo (TZ). This is done pre-emptively to serve as a safeguard against a catastrophic event in the wild and to provide zoo staff with an opportunity to work out the best practices for managing and breeding captive VIM.

1998 – The Calgary Zoo joins the fledgling captive program and receives 4 VIMs. This is done to provide additional space and to manage risk by not having all of the captive VIM in a single facility. Ongoing declines in the wild lead to the conclusion that there were too few wild marmots to support a program of wild translocations or other management activities, and that the wild population would not spontaneously rebound on its own. Rather than just serving as a safeguard measure, captive breeding (with the goal of genetic preservation and reintroduction) is identified as the only reasonable option for minimizing the imminent risk of species extinction and ultimately increasing wild populations within a reasonable period of time.

The Marmot Recovery Foundation is established as a registered charity to “fund, facilitate, promote, and carry out activities necessary to assist and enhance the survival of this species” including intensive captive breeding and reintroduction.

2000 – The captive program celebrates its first breeding success at the CZ.

The Mountain View Conservation and Breeding Society (MVF) joins the program as a third captive facility.

Construction begins on the Tony Barrett Mount Washington Marmot Recovery Centre (MRC)

2001 – The MRC receives its first marmots, just prior to the 2001/02 hibernation. The program now consists of three zoological institutions and a dedicated facility located within the natural range of the marmots.

2002 – TZ and MVF welcome their first litters of pups.

2003 – All four captive facilities have successful reproduction. The captive population is reliably growing due to captive births.

The program conducts its inaugural release of captive marmots into Nanaimo Lakes. The four released marmots do well for 45 days, but then three are killed by a cougar within the course of two days. The remaining survivor is brought back into captivity.

2004 – As the captive population grows, captive releases continue in Nanaimo Lakes and Mount Washington, incorporating the difficult lessons learned in 2003.

A captive male, released in the early spring, successfully breeds with a solitary, wild female. Released marmots successfully survive the summer.

2005 – Captive releases emerge from their first wild hibernation and survive their second summer.

2006 – After emerging from their second successful hibernation, a pair of captive-release marmots produce their first litter in the wild.

2007 – In addition to Nanaimo Lakes and Mount Washington, captive releases are initiated in Strathcona Park and Mount Cain.

2009 – Captive marmots are released in the Clayoquot Plateau.

2012 – After a decade of releases, the wild population has grown significantly from less than 30 marmots at 5 sites in 2003 to an estimated 375 marmots at 25 sites. The size of the captive population and the number of releases was significantly downsized. Releases into Nanaimo Lakes (NL) are curtailed and the focus shifts to augmenting the Strathcona population. The MRC becomes a seasonal, non-breeding facility.

2014 – After 14 years of operation, MVF leaves the captive program.

2016 – Declines in the wild population indicate that the wild population has not yet achieved sufficient resiliency or sustainability and that it is still small and vulnerable to stochastic events like drought, predation, harsh winters, etc. Re-establishing intensive captive breeding and reintroduction is considered to be important in supporting continued growth of the wild population.

Wild marmots are strategically captured to reinvigorate the demographic and genetic integrity of the captive population.

2017 – MRC recommitted to overwintering release marmots during the winter of 2017/18.

Captive releases resume in Nanaimo Lakes.

2019 – MRC returned to serving as a year-round, multipurpose facility, including hibernation and preparation of release marmots, maintenance of breeding pairs and future breeders.

2022 - Breeding success at all three of the participating facilities allows for resumption of operational captive releases in 2023.

2024 – The captive program enters its 27th year with renewed breeding and reintroduction capability to support augmentation of an estimated 34 wild sites.

Captive population numbers (1997 to 2024)

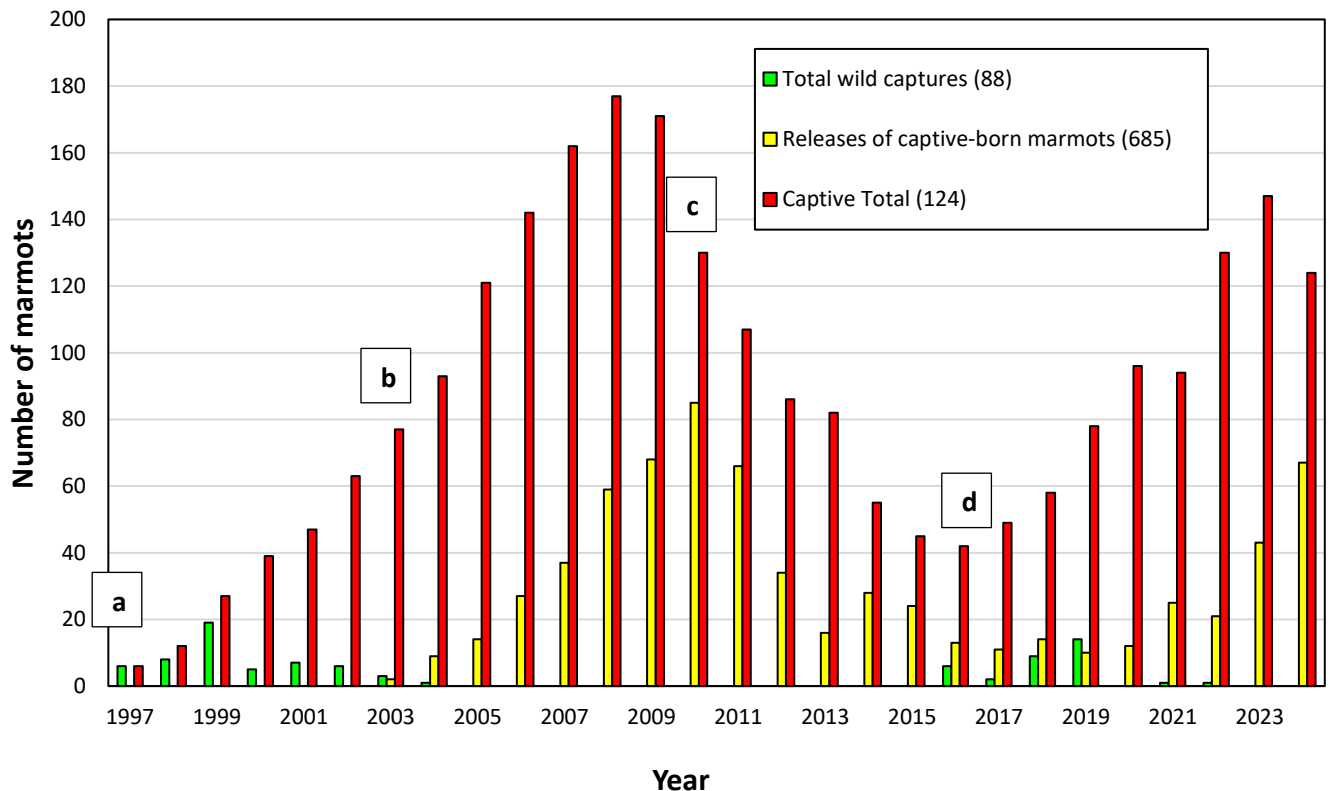


Figure 9 Captive population numbers 1997-2024

- a) 1997 – captive program is initiated with six wild marmots being sent to the Toronto Zoo.
- b) 2003 – wild population reaches nadir with 22 known individuals at 5 sites. Captive reintroduction efforts begin.
- c) 2012 – Captive population and captive releases are curtailed due to apparent success of program.
- d) 2016 – Captive program is genetically and demographically reinvigorated due to declines in the wild population.

7.2 Founders

A total of 55 wild marmots were originally captured from the wild between 1997 and 2004 and these became the foundation of the breeding program. Due to the apparent success of reintroductions and growth of the wild population, the captive program was intentionally downsized in 2012. The wild population subsequently declined and in 2016 the Recovery Team approved the capture of additional wild marmots to reinvigorate the demographic and genetic integrity of the captive population. An additional 31 wild-born individuals were strategically or opportunistically captured between 2016 and 2019. In 2021 a two-year-old, wild-born female was opportunistically captured at Mount Washington due to the late season predation risk. She successfully bred at the MRC in the spring of 2022 and has been retained in the captive program. In 2022 two wild pups were captured from the Labor Day Lake cut

block following the death of their mother and one of these individuals has been retained for breeding. No wild marmots were added in 2023 or 2024. To date, a total of 88 wild marmots have been captured for the captive program.

7.3 Reproduction

2024 represented the 27th potential breeding season and the 25th consecutive year of successful breeding in captivity (2000 – 2024). The program has produced 876 weaned pups (478 males, 392 females and 6 unknown) or 9.95 pups for every wild marmot captured for the breeding program. In the spring of 2024, there were 36 breeding pairs (where the male and female are both 2 years of age or older). The Toronto Zoo produced 4 litters and 13 pups (from 8 pairs), the Wilder Institute/Calgary Zoo produced 5 litters and 17 pups (from 8 pairs) and Tony Barrett Mount Washington Marmot Recovery Centre produced 6 weaned litters and 22 pups (from 20 pairs). Overall, this amounts to a total of 15 litters and 52 weaned pups.

7.4 Hibernation

From the winter of 1997/98 to the winter of 2023/24 there have been a total of 2,357 individual marmot hibernations in captivity with 37 mortalities. Therefore, 2,320 or 98.4% of the captive hibernations have been successful over 27 winters. During these 27 winters there has been 1 pup hibernation mortality and no mortality in yearlings. Over 70% of the hibernation mortalities have been associated with age-related conditions, predominantly cardiovascular disease, and neoplasia. Presumably, older, compromised marmots get to a point where they are unable to cope with the extreme physiological alterations and challenges imposed by hibernation. Typically, they die during hibernation or remain active without properly entering torpor. In some cases, the marmots succumb after hibernation, possibly due to the demands of an increased metabolic rate. Most cellular activity may be senescent during hibernation; however, activity of neoplastic cells may be particularly aggressive once the marmots are once again euthermic and cellular activity is increased.

7.5 Mortalities

There have been 147 captive mortalities since the program began in 1997. The causes include 41 cardiovascular, 34 infectious / inflammation, 26 neoplasia, 16 iatrogenic / management, 9 cardiovascular & neoplasia, 6 congenital / early onset, 4 quarantine-associated, 4 unknown causes, 2 intervertebral disc degeneration, 2 mesenteric torsions, 1 dental malocclusion, and results pending in 2 cases.

Table 13 Captive mortalities by cause

Diagnostic category	No. Cases	%
cardiovascular	41	27.9
infectious / inflammation	34	23.1
neoplasia	26	17.6
iatrogenic / management	16	10.9
cardiovascular & neoplasia	9	6.1
congenital	6	4.1
quarantine	4	2.7
unknown	4	2.7
intervertebral disc degeneration	2	1.4
mesenteric torsion	2	1.4
results pending	2	1.4
malocclusion - emaciation	1	0.7

Causes of mortality in captive Vancouver Island marmots (total = 147)

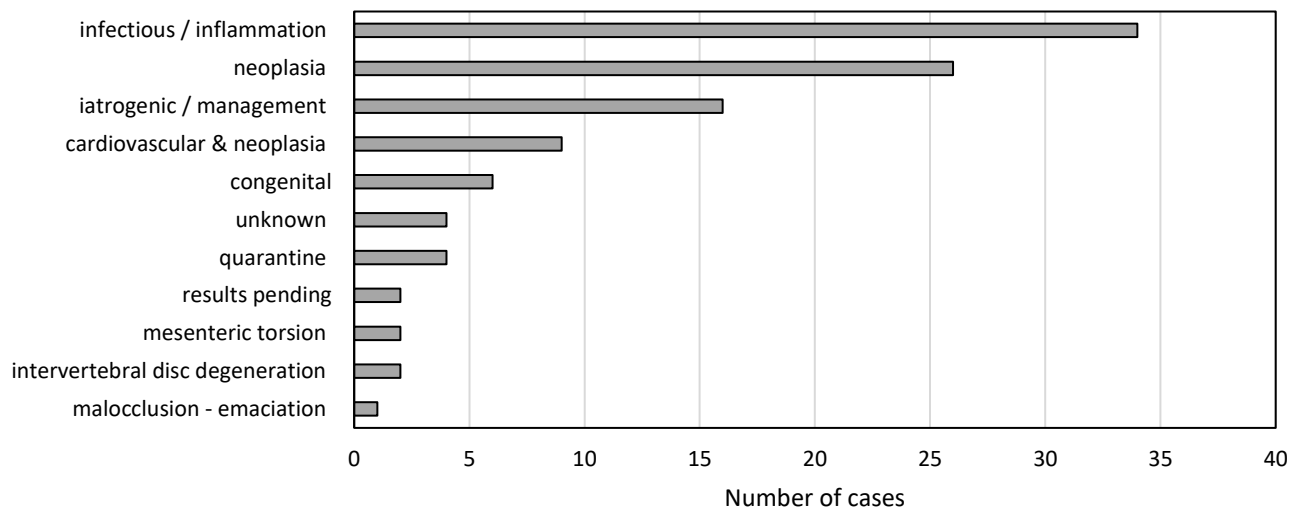


Figure 10 Causes of mortality in captive Vancouver Island marmots

7.6 Releases

Releases began in 2003 and from 2003 to 2024 (21 seasons) a total of 697 captive marmots have been released to the wild (12 wild-born and 685 captive-born marmots). This represents 7.8 captive-born pups for every wild capture. Overall, 78.2% of the captive-born pups have been released to the wild (not including 2024 pups) with an average of 31.1 releases per year (range 4 to 85).

Of the 685 captive-born pups that have been released, 161 were born in Toronto, 187 were born in Calgary, 98 at Mountain View and 239 at MRC

Of the 697 total releases, 294 went to Nanaimo Lakes (42.2%), 167 to Mount Washington (24.0%), 22 to Mount Cain / Mount Schoen (3.2%), 27 to Clayoquot (3.9%) and 187 to Strathcona (26.8%). It should be noted that captive-born marmots are no longer released directly into Strathcona. A more effective strategy has been to release captive marmots into the wild at Mount Washington (where survival is normally high) and then translocated to Strathcona if they survive their first wild hibernation.

Distribution of captive marmot releases 2003 to 2024
(total = 697)

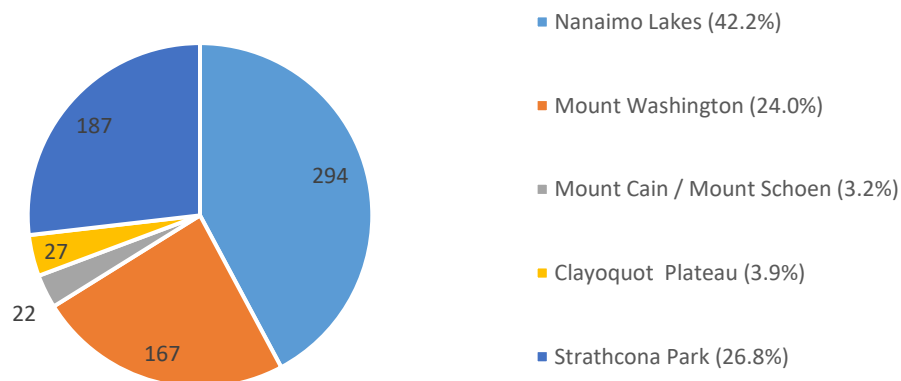


Figure 11 Distribution of Captive marmot releases

7.7 Current numbers

There are currently 124 marmots in captivity including 90 marmots at MRC (including 18 breeding pairs in 2025), 14 marmots at Toronto Zoo (7 pairs) and 20 marmots at the Wilder Institute/Calgary Zoo (10 pairs). Approximately 40 of the marmots currently at the MRC will be release-candidates in the summer of 2025. Exact numbers will depend upon individual marmot health, individual reproductive performance, and overall reproductive performance of the captive population in the spring / early summer of 2025.

OVERALL CAPTIVE POPULATION NUMBERS (1997 to January 2025)

88 wild captures + 876 weaned pups – 697 releases – 147 mortalities + 4 recaptures = 124

It should be noted that the global population of Vancouver Island marmots (wild and captive) now exceeds 500 individuals. It has not approached this level in the past 45 years.

Table 14 Source of marmots brought into the captive program

COLONY SITE	COLONY TYPE	ADULTS	2-YEAR- OLDS	YEARLINGS	PUPS	TOTAL
SHERK LK	LOGGED	4	3	1	4	12
K44	LOGGED	2	0	2	8	12
MT FRANKLIN	LOGGED	2	0	1	1	4
D13	LOGGED	1	0	0	0	1
PAT LK	LOGGED	1	0	0	0	1
MT WASH	SKI HILL	5	1	2	11	18
KNIGHT LAKE	LOGGED	0	0	0	2	2
NW BAY	LOGGED	1	0	0	5	6
LDL TRAILHEAD	LOGGED	0	0	0	1	6
WHISKEY CK	EXTRALIMITAL	0	1	0	0	1
TOTAL – OTHER		16	5	6	32	59
GREEN SUMMIT	NATURAL	0	2	1	2	5
“P” MTN	NATURAL	0	0	0	4	4
BIG UGLY	NATURAL	0	0	1	2	3
MT MORIARTY	NATURAL	1	0	0	2	3
HEATHER MTN	NATURAL	0	0	0	2	2
HOOPER	NATURAL	0	0	1	1	2
SADIE	NATURAL	0	0	0	1	1
McQUILLAN	NATURAL	0	0	0	1	1
HALEY LAKE	NATURAL	0	0	0	2	2
ARROWSMITH	NATURAL	0	0	0	2	2
MARBLE MEADOWS	NATURAL	0	0	0	2	2
CASTLECRAG	NATURAL	0	0	0	2	2
TOTAL – NATURAL		1	2	3	23	29
OVERALL TOTAL		17	6	9	54	88

Table 15 Captive bred marmot releases by year

YEAR	NUMBER OF RELEASES	% OF PREVIOUS YEAR	ADULTS	2-YEAR-OLDS	YEARLINGS	PUPS
2003	4		3	1	0	0
2004	9	225%	2	7	0	0
2005	15	167%	2	6	7	0
2006	31	207%	5	9	17	0
2007	37	119%	3	12	22	0
2008	59	159%	6	17	30	6
2009	68	115%	9	5	48	6
2010	85	125%	16	12	46	11
2011	66	78%	19	6	29	12
2012	34	52%	5	5	24	0
2013	16	47%	0	0	16	0
2014	29	175%	9	3	17	0
2015	24	83%	10	0	14	0
2016	13	54%	0	0	13	0
2017	11	85%	0	0	11	0
2018	14	127%	0	0	14	0
2019	10	71%	0	0	10	0
2020	13	150%	0	0	13	0
2021	27	208%	0	2	25	0
2022	22	81%	0	3	19	0
2023	43	195%	0	2	41	0
2024	67	156%	0	8	59	
TOTAL	697		89	98	475	35

Table 16 Captive bred releases by year and supplemented wild population

Year	Nanaimo Lakes			Mount Wash	Mount Cain / Schoen		Strathcona			Clayoquot		Annual total of captive releases	Annual total of wild-born translocations	Annual total of pre-conditioned
	Captive-release	Wild-born translocation	Pre-conditioned	Captive-release	Captive-release	Pre-conditioned	Captive-release	Wild-born translocation	Pre-conditioned	Captive-release	Wild-born translocation			
2003	4	1	0	0	0	0	0	0	0	0	0	4	1	0
2004	7	1	0	2	0	0	0	0	0	0	0	9	1	0
2005	13	0	0	2	0	0	0	0	0	0	0	15	0	0
2006	29	0	1	3	0	0	0	0	0	0	0	31	0	1
2007	24	0	0	0	4	0	9	0	0	0	0	37	0	0
2008	29	1	0	10	6	0	14	0	0	0	0	59	1	0
2009	27	0	1	0	12	1	22	0	0	6	0	68	0	2
2010	2	0	0	0	0	0	77	0	0	6	0	85	0	0
2011	26	0	0	17	0	0	19	0	0	4	0	66	0	0
2012	0	0	0	17	0	0	17	9	4	0	1	34	10	4
2013	0	1	0	16	0	0	0	16	11	0	0	16	17	11
2014	0	0	0	15	0	0	14	13	8	0	0	29	13	8
2015	0	1	0	13	0	0	11	12	4	0	0	24	13	4
2016	0	0	0	9	0	0	4	10	5	0	0	13	10	5
2017	6	5	3	5	0	0	0	3	0	0	0	11	8	3
2018	9	2	0	5	0	0	0	5	4	0	0	14	7	4
2019	6	8	2	2	0	0	0	5	1	2	0	10	13	3
2020	6	0	0	7	0	0	0	3	0	0	0	15	3	0
2021	17	0	0	8	0	0	0	4	0	2	0	25	4	0
2022	14	1	0	8	0	0	0	3	0	0	0	22	4	0
2023	29	1	0	10	0	0	0	3	2	4	0	43	4	2
2024	45	0	0	18	0	0	0	4	5	4	0	67	4	5
TOTAL	293	22	7	167	22	1	187	90	44	28	1	697	113	52
Number of years	17	10	5	18	4	1	9	13	9	7	1	22	16	12
21	322			167	23		321			29		862		

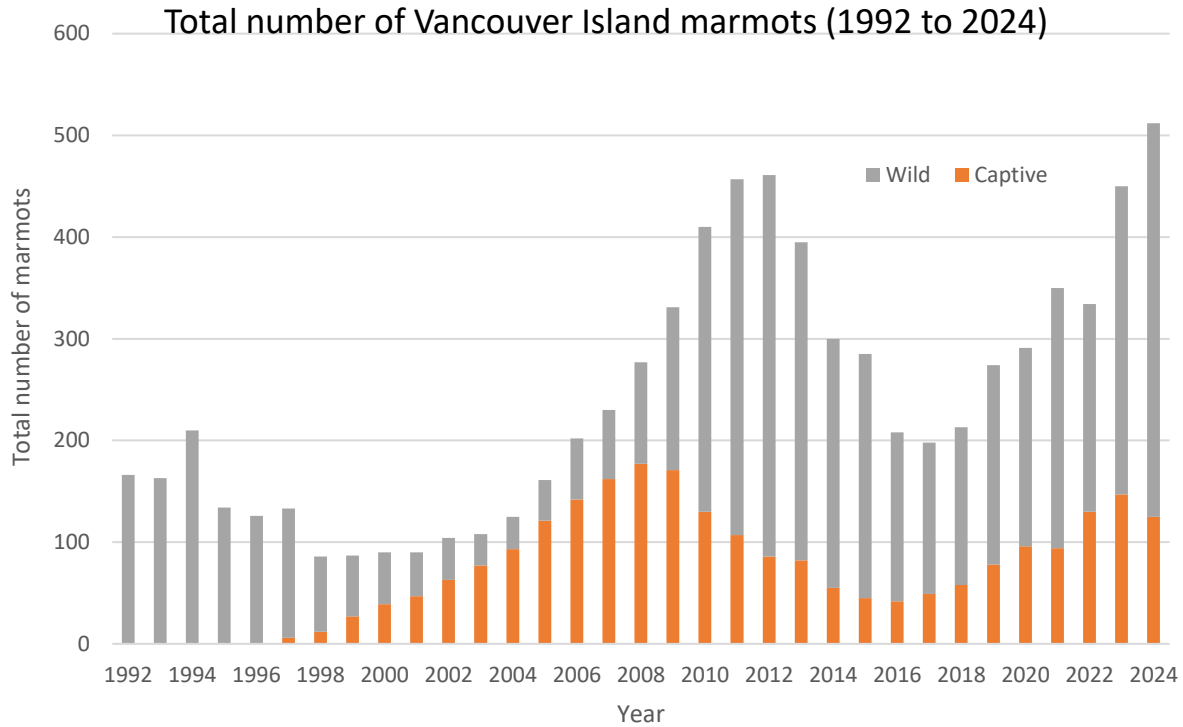


Figure 12 Total number of Vancouver Island marmots (captive + wild)

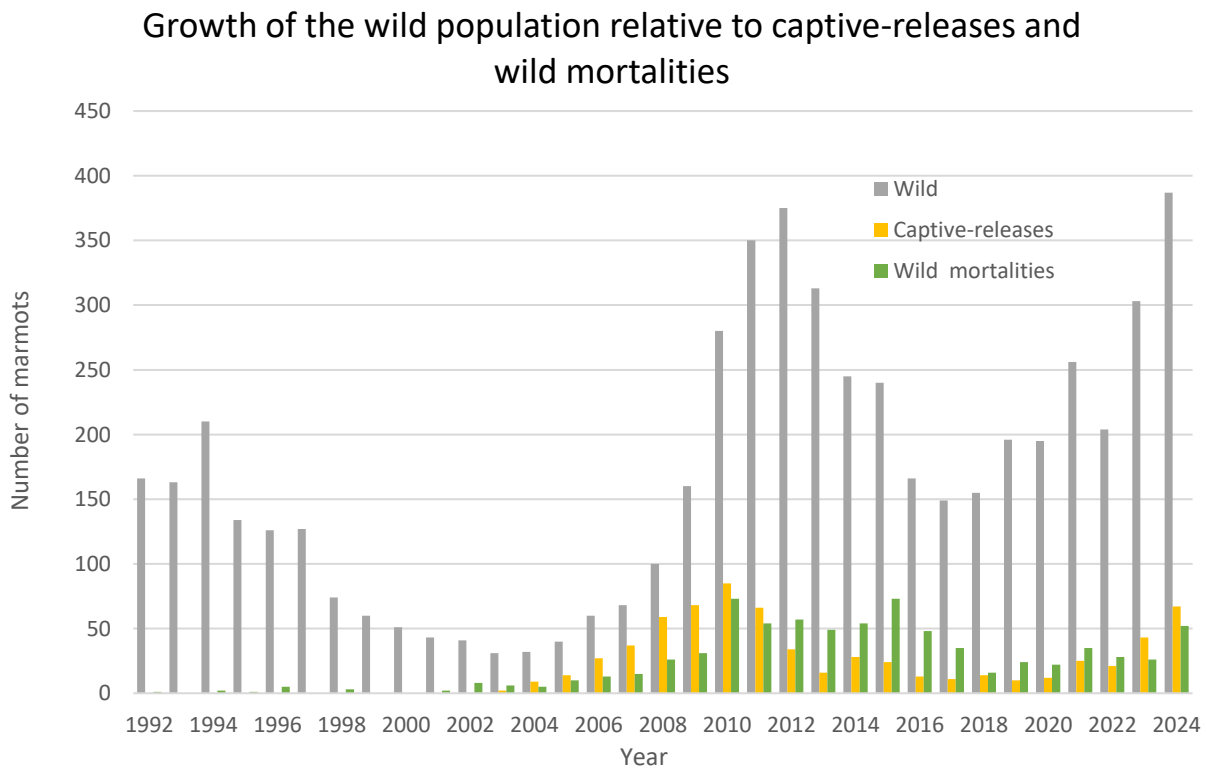


Figure 13 Growth of the wild population relative to captive-releases and wild mortalities

8. RESEARCH PARTNERSHIPS

The Marmot Recovery Foundation relies on science to make sound, evidence supported decisions as we work to recover the wild population of the Vancouver Island marmot. While the Foundation is not a research organization, it collaborates with research partners to answer questions which will advance recovery efforts. In 2024, the Foundation collaborated on the projects noted below.

- Food Supplementation (Wilder Institute/Calgary Zoo)
- Endoparasites of captive and wild marmots (Kevin Gourlay and Jamie Gorrell, Vancouver Island University)
- G.I.T. Microbiome (Pauline Van Leeuwen, Laurentian University)
- Genetic basis of melanism in different marmot species (Kendall Mills and Link Olsen, University of Alaska)
- Diet, lipid metabolism, body composition, and hibernation (Jessica Aymen, University of Guelph)
- Genetic evaluation of degenerative heart conditions (Jaimie Warren and Doug Whiteside, University of Calgary)
- Diet metagenomics (Jasmine Janes, Vancouver Island University)
- Marmot nutrition (Sarrah Gourlie, Beth McGregor, Captive Management Group nutrition advisors at Toronto Zoo)
- Morbidity and mortality (Malcolm McAdie)
- Factors influencing reproduction (Laura Graham)
- Social reproductive suppression (Phoebe Edwards)
- Seasonal changes in vegetation and its impact on habitat suitability and predation risk (Julia Kobetitch/Royal Roads University)

Research published 2024 that involved the Foundation's collaboration include:

- Gourlay, K. P., McAdie, M. L., & Gorrell, J. C. (2024). Population Dynamics of Enteric Parasites in the Endangered Vancouver Island Marmot (*Marmota vancouverensis*). *The Journal of Parasitology*, 110(4), 300-310.
- Graham, L. H., Leishman, E. M., Demers, K., Whiteside, D. P., & McAdie, M. (2024). Factors Associated with Reproductive Success in Captive Vancouver Island Marmots (*Marmota vancouverensis*). *Animals*, 14(3), 387.
- Kobetitch, J. (2024). *The Effect of Seasonal Vegetation Changes on Habitat Suitability and Predation Risk of the Vancouver Island Marmot* (Master's thesis, Royal Roads University (Canada)).
- Mills, K. K. (2024). *Biogeographic History of the World's Marmots and the Genetic Basis of Melanism in an Alaskan Population of Hoary Marmots* (Doctoral dissertation, University of Alaska Fairbanks).
- van Leeuwen, P. M., Mastromonaco, G. F., Mykytczuk, N., & Schulte-Hostedde, A. I. (2024). Captivity conditions matter for the gut microbiota of an endangered obligate hibernator. *Conservation Physiology*, 12(1), coae072.

9. FIELD SAFETY SUMMARY

There were no serious safety incidents in 2024. Field teams continued to take a proactive approach to hazard identification and mitigation and were quick to report new hazards as they emerged. Close calls were discussed as a team and have now been incorporated into the Foundation's job safety documents for next season.

9.1 Minor Incidents

Minor Incidents:

- Ankle sprain: A crew member was exploring a new area of potential marmot habitat on day 2 of a three-day survey in Strathcona Provincial Park. While hiking across a talus field on a moderate slope documenting habitat features, the crew member slipped and twisted their ankle when a rock unexpectedly shifted on them. The individual was able to finish the survey and hike out on the affected ankle. They took modified office duties the following week to allow for recovery before going into the field again and sought minor medical treatment from the walk-in clinic. The talus field where the slip took place can be viewed from above and therefor is noted in the site guide as an area to be avoided during future surveys.
- Pinched leg: On another occasion, a crew member was hiking through a talus field at a backcountry site in Strathcona Provincial Park when a large rock shifted and pinched their leg, resulting in minor bruising. The crew member was able to hike out on their leg, and did not require modified duties for recovery. The site is only visited infrequently, as it is considered one of the more hazardous sites to work at. The area where the incident occurred can be surveyed from a distance, and it has now been noted in the site guide to be avoided during future surveys.

Close Calls:

- Near miss with logging truck from incorrect radio programming: Both the logging truck and the crew were calling their kms according to protocol, however the tone frequency in the crew truck was not programmed correctly and therefor was not heard by the logging truck. A unexpected encounter occurred, however crew were able to get over with sufficient room to let the truck pass. All radio programming was subsequently double checked to confirm proper functioning.

10. RECOMMENDED APPROACH FOR 2025

The Provincial Recovery Plan for the Vancouver Island Marmot (VIM RT 2017) recommends several recovery objectives for the wild population (Table 4, pages 29-31). This section lists several activities that the Foundation believes will contribute to these objectives. These plans are subject to change at the advice of the Vancouver Island Marmot Recovery Implementation Group. In the simplest terms, the Foundation recommends providing support to the wild population when possible and prioritizing long-term recovery actions over short-term gains.

The overall direction for this year should be to continue to build existing colonies and support marmots that are establishing new colonies, while identifying habitats and points that support dispersal. This includes four primary recommendations for 2025:

- Release captive-bred marmots strategically to maximize their recovery impact.
- Translocate marmots to Strathcona Provincial Park to support emerging colonies and dispersal routes.
- Restore marmot habitat to mitigate degradation resulting from climate-change-induced tree creep.
- Continue conservation breeding efforts and manage the Tony Barrett Mount Washington Marmot Recovery Centre to condition 2025 release candidate, produce release candidates for 2026, and assist in managing wild marmots as need arises.

10.1 Proposed Supports for the Wild Population

(i) *Captive breeding releases*

There are 40 marmots currently at the Tony Barrett Mount Washington Marmot Recovery Centre identified as potential release candidates for 2025. The Foundation recommends prioritizing release of captive-bred yearlings onto Mt. Washington and the Nanaimo Lakes region. This strategy reflects best practices to optimize survival of captive-bred marmots and maximize their impact on the wild population. (Lloyd et al, 2019).

(ii) *Translocations*

The Foundation will seek translocation candidates in the wild colony on Mt. Washington, including stepping stone candidates and wild-born marmots, and from marmots occupying unsuitable habitats. At this time, only two marmots are known to occur in unsuitable habitats, such as cut blocks, but there are several potentially occupied sites. These sites will be monitored in the spring once access allows. Sites within Strathcona Provincial Park is the recommended priority for marmots with wild experience.

(iii) *Trapping and implants*

The Foundation will spend at least four weeks trapping in the Nanaimo Lakes and Strathcona regions with the goal of increasing the number of active transmitters and improving their representation across colonies. The Foundation will prioritize trapping at colonies with few functioning transmitters, lots of young marmots that may eventually become dispersers, and colonies that are important to our research partners.

(iv) *Managing marmots in unsuitable habitat*

The Foundation will respond to reports of dispersing marmots that are observed in unsuitable and/or unsafe locations, and if appropriate, will translocate these individuals to active colonies or bring them into the captive program.

(v) *Managing marmots on Mt. Washington Alpine Resort land*

The Foundation will continue to monitor marmots on Mt. Washington and will maintain strong communications with Resort staff and managers about unsuitable locations where marmots are spending time. Unsuitable locations may include features like roads, bike runs, water reservoirs, buildings and structures, and places with past or ongoing development activities. The Foundation will work with Resort staff to educate visitors about marmots, marmot viewing, and how to keep marmots safe during their time at the Resort. The Foundation will also investigate whether technology can be used to increase marmot safety. For instance, the Foundation could trial ultrasonic devices that would produce a warning sound when equipment or vehicles move down a trail when marmots have been sighted nearby.

(vi) *Supplemental feeding*

The Foundation will install supplemental feeders at 18 to 24 colonies, as weather and snow conditions allow. For each feeder that is installed, the Foundation will also install a motion-detecting remote camera that will record feeder use by marmots and the presence of other species.

The amount food provided at each feeder will be reduced in 2025. The goal of reducing food volume is to allow marmots to benefit from supplemental food during spring thaw but also ensure that marmots consume the all the provided food before bears and other wildlife begin to access marmot habitat more regularly.

(vii) *Habitat restoration*

The Foundation will conduct the manual removal of in-growing trees on 6 hectares in order to restore habitat to more historic conditions. Restoring habitat by reducing tree ingress and opening sightline improves habitat conditions by:

- a. reducing stalking cover for predators, making it easier for marmots to detect and evade terrestrial predators;
- b. reducing burrow loss to tree ingress; and
- c. expanding forage opportunities by providing more meadow.

Section 4.7.3 “Vegetation” reports observations of climate-change induced tree ingress at many colonies. Actual restoration sites will be determined in partnership with landowners and managers, by weather conditions, and by marmot activity at the site.

Further information on habitat restoration, including best practices, tree cover ingress analysis, and past efforts can be found in the Foundation’s 2022 report *Tree Change in Vancouver Island Marmot Colonies: Best Management Practices, Past Efforts, & Photo Analysis*.

Priorities for restoration in 2025 are reported in table 17.

Table 17 Priority sites for restoration

Region	Site	Sublocation	Notes
Strathcona	Castlecrag Mountain	West Shelf, Main Meadow, Talus Bowl	Priority site for habitat restoration efforts. 2024 field observations continued to see dense forests below well-used hibernacula in all three sublocations. Tree cover has increased by 25% to 51% between 1977 and 2016 at these sublocations. (Brager et al, 2022).
	Flower Ridge	Price Pass and Cream	Recommended focal site for future habitat improvement efforts. Tree cover has increased by over 58% between 1936 and 2016 at both Price Pass and Cream Lake. (Brager et al, 2022)
Nanaimo Lakes	Arrowsmith	South Meadow	Recommended focal site for future habitat improvement efforts. Tree cover has increased by 68% between 1949 and 2016. (Brager et al, 2022)
	Hooper	Main Meadow	Recommended focal site for future habitat improvement efforts. Tree cover has increased by 20% since 1951, but the site is already one of the more treed areas occupied by marmots. (Brager et al, 2022)
	McQuillan	West Talus	Recommended focal site for future habitat improvement efforts. Tree cover has increased by 32% since 1951. (Brager et al, 2022)
	Moriarty	LDL Meadow	This site remains a focal priority site for future work due to the extent of the tree ingress remaining. Concerns in this area focused on a stand of trees bordering the south side of three well-used hibernacula. Previous habitat improvement efforts were made here in 2017 and 2021– wherein trees on the north side of the 3 hibernacula were treated.

(viii) *Predator deterrence*

In 2025, the Foundation plans to continue testing Foxlights. Foxlights use programmable, irregular flashing lights that may deter predators from spending time near the lights during twilight hours. Research from California has suggested that the effectiveness of Foxlights may decline after a few weeks. Other technologies deployed will include radio-devices that play human voices, and motion sensitive devices that produce sound and light. In hopes of achieving the best results, the Foxlights and other devices will be deployed in mid to late August when the highest rates of predation typically occur.

The Foundation tested Foxlights at Mount Washington in 2024. The lights were deployed in an area where marmots had been predated by cougars in previous years. During

deployment, there were no predations, however, no cougars were detected on camera traps during the period either. While not conclusive, results warrant continued testing. The Foundation will also begin exploring the potential of using biomarkers to reduce the ability of predators to effectively target marmots, following successful predator deterrent research from Australia (Finnerty et al, 2022). We anticipate several years of investigation needed to determine if this approach is appropriate in marmot habitat and financially feasible.

10.2 Proposed Monitoring and Inventory

(i) *Inventory*

The Foundation will conduct visits, repeated where possible, to each of the main colonies in the Nanaimo Lakes and Strathcona regions. This may include emergence flights (both helicopter and drone) in the spring to check for marmot presence at colonies believed to have been extirpated, new locations where colonies recently may have become established, and to locate hibernacula at known colonies lacking spatial data, as well as visits with an emphasis on ground-based inventory in July and August when pups could be seen and counted. Day-trips will be augmented by overnight trips at select sites, especially in periods of warm weather when marmots spend significant periods of the day underground. The Foundation plans to expand the use of wildlife cameras to as many colonies as possible. Priority for camera deployment will be colonies that are difficult to access.

(ii) *Mortality recovery*

The Foundation will attempt to recover transmitters and collect evidence from mortality sites in order to infer cause and timing. The Foundation will install wildlife cameras at Haley Lake and other colonies with a significant predator presence to better monitor predator activity and use of habitat. Staff presence at sites during monitoring may provide a predator deterrent effect, especially during multi-day surveys.

(iii) *Investigation of new monitoring techniques*

The Foundation will continue to investigate using direction-finding software-defined radio to automate collecting data about marmot movements. We will also continue to explore the use of passive RFID readers in the field for detecting tagged marmots at feeders or hibernacula, as was trialled by the VIU team on Mt Washington in 2022. Furthermore, we will continue to investigate the use of acoustic recorders and telemetry base-stations to improve monitoring efficiency and effectiveness. These technologies have been used successfully with other species, but have not been extensively tested on a project with similar goals and terrain. Acoustic recording devices may improve detection of marmots in unsuitable habitats. Base-stations may be able to record telemetered marmot movements both within and between colonies. Both technologies need additional testing before widespread deployment. We will also continue to explore the applications of Unmanned Aerial Vehicles (UAV) for surveying inaccessible sites, particularly during emergence surveys. The Foundation will also continue to test the inclusion of temperature loggers on implanted telemetry transmitters to assist with gathering more detailed biological data.

10.3 Proposed Actions for the Conservation Breeding Program

(i) *Conservation Breeding*

In recent years, increased capacity at the Tony Barrett Mount Washington Marmot Recovery Centre combined with programs at the Toronto Zoo and Wilder Institute/Calgary Zoo have resulted in significantly more releases to the wild. As predicted by the 2015 IUCN Population

Viability Report, larger release numbers have played an important role in recent wild population growth. (Jackson et al, 2016). Continue conservation breeding at the Tony Barrett Mount Washington is a critical component to continued population growth.

(ii) *Translocation management and treatment of wild marmots*

The Tony Barrett Mount Washington Marmot Recovery Centre facilitates the translocation of wild-living marmots to sites in Strathcona Provincial Park which has contributed to large population growth and colony expansion in this meta-population. Continuing this work is an important step to continued success for this meta-population.

A staffed and fully operating Marmot Recovery Centre also gives the Foundation options to treat and care for marmots from the wild as needed, and to manage wild marmots found in inappropriate habitats.

(iii) *Wild captures*

The Foundation consulted with Studbook Keeper John Carnio for the Captive Breeding program to determine whether new additions to the program would be helpful from a genetic or pairings perspective. In 2025, MRF staff may attempt to capture a small number of wild marmots from the few remaining sites (specifically Big Ugly, P Mountain and Steamboat Mtn) that do not have current genetic representation in the captive population. This action is based upon our basic captive management principles and recommendations from the Studbook keeper. This will act to safeguard the genetic legacy of these sites and will further enhance the overall genetic robustness of the captive population. This action has been endorsed by the Recovery Team and is contingent upon inventory results at these colonies (including survivorship and reproduction).

(iv) *Genetic Studbook*

In partnership with Dr. Gorrell, Dr. Janes, and the University of Northern British Columbia, the Foundation will begin to develop and implement a studbook based on individual genetic profiles for marmots in captivity. This is envisioned as a multi-year project that in the long term will provide better tools to conserve genetic variation in the captive and wild populations.

10.4 Biosecurity Measures

DNA analysis indicates that Vancouver Island marmots have low genetic diversity, potentially as a result of population bottlenecks, island isolation, or a combination thereof. This low genetic diversity puts the marmot population at greater risk to novel pathogens. To reduce the risk of accidentally introducing a novel pathogen, the Foundation will continue to take biosecurity measures. In the field this will include:

- Sanitizing footwear and changing clothing between locations.
- Wearing masks and gloves when handling marmots, gear that will come into contact with marmots, or working in close proximity to marmot habitat features, such as active burrows or look out rocks;
- appropriate vaccinations to reduce spillover opportunities.

In the Tony Barrett Mount Washington Marmot Recovery Centre, biosecurity measures will be taken, including:

- Dedicated footwear and overalls inside marmot areas.
- Limiting visitor and non-necessary staff access; and

- Sanitizing footbaths before entering marmot areas.

The Foundation will continuously review and update biosecurity measures in response to emerging threats and best practices.

10.5 Population, Habitat, and Viability Modelling

In partnership with Dr. Gorrell (University of Northern British Columbia), and Dr Gillis (Vancouver Island University), the Foundation will begin a multi-year project to model Vancouver Island marmot habitat, and the populations of the two metapopulations. This builds on a 2015 IUCN Population Viability Model (Jackson et al, 2015) but expands the scope of the modelling to both metapopulations, incorporates another 10 years of data, and provides the resources to more thoroughly investigate key sensitivities that drive marmot population trends.



Photo 7 Adam Taylor. A 2024 wild-born pup

11. DISCUSSION OF RECOVERY RESULTS AND COMPARISONS TO PREVIOUS YEARS

The wild Vancouver Island marmot population in 2024 is the largest ever recorded for species, with the important caveat that comprehensive population surveys began in the 1980s after the species' population had likely been in decline for some time. The previous highest recorded wild population of Vancouver Island marmots was in 2013. Following strong years in the wild from 2011 to 2013, the Recovery Team chose to substantially slow down conservation breeding efforts (particularly at the Tony Barrett Mount Washington Marmot Recovery Centre), cease all releases to the Nanaimo Lakes meta-population, and monitor the population to see if it would sustain itself. It did not, and the wild population declined each year from 2014 to 2017.

For the first time, the population of wild Vancouver Island marmots in 2024 is greater than it was 2013. However, there are substantial differences in distribution and demographics. It remains to be seen if these differences make the population more resilient and able to continue its growth. Recovery efforts and environmental conditions will play a large role in determining outcomes for the wild-living population.

11.1 Limitations

Comparing the current wild Vancouver Island marmot population to previous periods must be done carefully. Monitoring methodology and effort as well as population estimate methodology have changed dramatically from the earliest 1980s surveys. Monitoring results between 2013 and 2024 are more comparable. There was a significant change in the way in which hill counts were tallied in 2014, but this methodology change has been applied retroactively to 2013 data. While the use of camera traps has expanded, the overall approach to counting marmots, including visual surveys and radio-telemetry, remains consistent.

A far more in-depth analysis of population and vital rates trends will be conducted in partnership with Dr. Gorrell, University of Northern British Columbia during the development of Population Viability models. Here we look at two important demographics to understand how the current population compares with previous populations.

11.2 Geographic Distribution

The geographic distribution of wild-living Vancouver Island marmots in 2024 has changed considerably compared to 2013. In 2013, the Nanaimo Lakes meta-population accounted for 65% (n=203) of the wild living population, the Strathcona meta-population was 34% (n=106), and 1% (n=4) of the population occupied colonies outside the meta-populations.

By comparison, in 2024 the Nanaimo Lakes meta-population was just 40% (n=154) of the wild population, Strathcona accounted for 53% (n=204), and 7% (n=29) lived at a single colony outside the meta-populations.

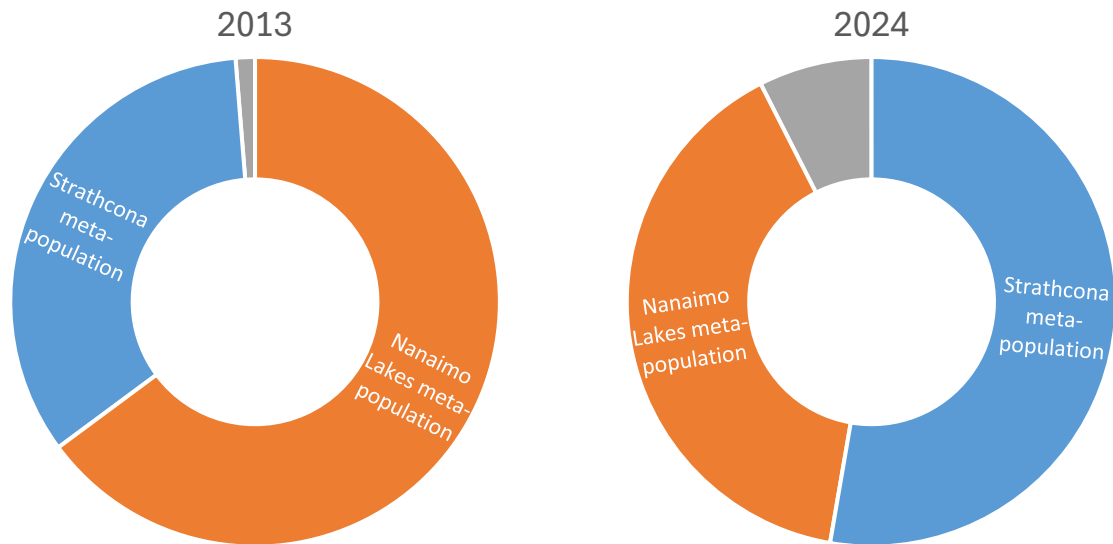


Figure 14 Distribution of wild marmots by meta-population 2013 & 2024

This change in relative distribution is a direct result of recovery actions and allocation of resources.

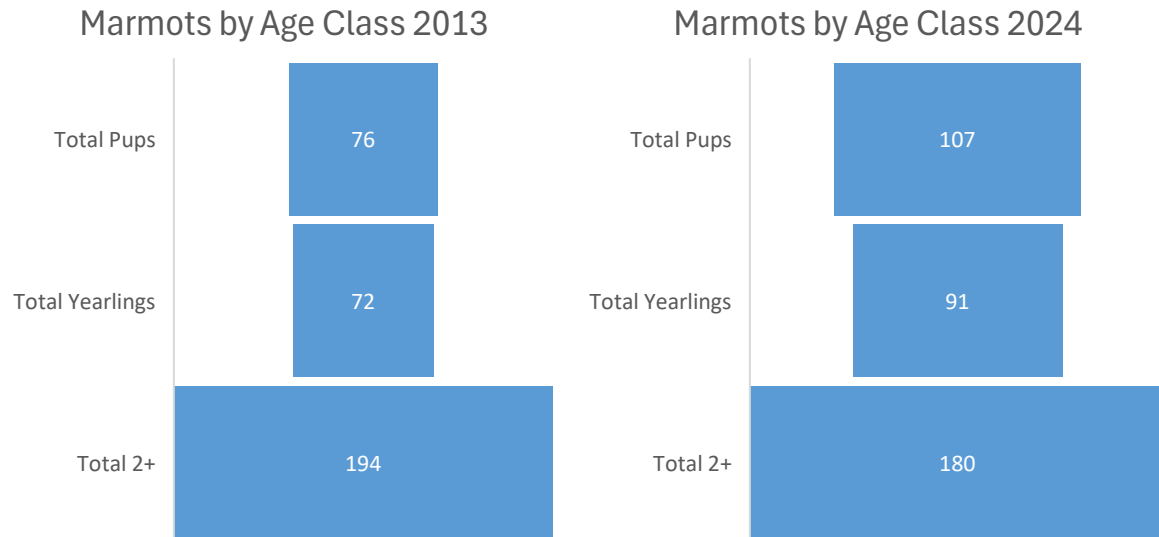
- Recovery efforts in the Strathcona meta-population outside of Mount Washington were quite limited until 2012.
- Outside of Mount Washington, marmots had been extirpated from Strathcona for many years, and their burrow systems had completely vanished from the landscape. Early releases struggled to survive, but changes to release strategies increased multi-year survival dramatically (Lloyd et al, 2019). In 2024, the Foundation observed wild marmots expand habitat use and occupy more of their historic colonies.
- The Nanaimo Lakes meta-population was not supplemented with captive-bred marmots from 2012 to 2016. After stopping releases, the population reached a low of 72 wild-living marmots in 2017. Since releases resumed, the population has grown to 154 wild-living individuals in 2024. In-season mortality, largely as a result of predation, continues to be high, but marmots have expanded occupation to new colonies at El Capitan and Mount Landale.

Smaller, low population density colonies will likely need support from conservation breeding programs to persist until they establish themselves. In the long-term however, the Marmot Recovery Foundation believes that the broader distribution will benefit the species.

- More colonies in a broader range of habitat types over a larger geographic area mitigates risk from predation and weather events. For example, in 2024 accumulated snow levels were low in lower elevation colonies, but in normal ranges in colonies above approximately 1500 meters elevation.
- The distribution of colonies may increase dispersal success, and in turn dispersers may provide rescue effects, though larger colonies should provide more dispersers. (Bryant, 1998)

11.3 Age classes and Reproduction

Both in-season and overwinter survival rates of pups and yearlings tend to be lower than those of marmots with 2 successful hibernations. In 2024, a greater proportion of the wild population (52%) falls into the younger age categories than in 2013 (43%).



With a high proportion of young marmots in 2024, the large number of litters this year, and the general pattern of biennial reproduction, the wild population may decline next year. While it is discouraging if the population does “take a step back,” the fact that large numbers of adult marmots are able to maintain sufficient body condition to support reproduction is encouraging in the long term.



Photo 8 Shayn McAskin. Heather Heim uses telemetry to search for implanted marmots.

12. FUTURE DIRECTIONS

The Foundation acknowledges that some activities that would greatly benefit the recovery effort have not been possible due to funding constraints, the scope of an activity, or the need for external expertise and/or resources. These activities include, but are not limited to:

- Continued exploration of non-lethal predator deterrent methods, including predator-deterrent lights but also additional technologies or methodologies that have not been explored and/or tested in previous years.
- Research into marmot dispersal and habitat needs for marmots when outside core colony areas. The Foundation has begun testing base stations and direction-finding software defined radio, but significant additional opportunity exists to explore marmot dispersal and landscape use.
- Collection and mapping of information about the marmot's extent of historic occupation, especially in the northern and western portions of the marmot's historic range.
- Research into the extent and characteristics of climate change induced habitat change that has occurred in marmot meadows to date.
- Exploration of supplementary or alternative geolocation technologies for re-capture of Vancouver Island marmot location data.

Items that have been identified in the past that are now in the early stages of active development include:

- Further incorporation of advances in our understanding of marmot genetics into the Foundation's management of the captive and wild populations.
- The development of population models that incorporate data collected since 2015 and the Strathcona metapopulation.

The Foundation encourages partnership and collaboration in working to address these challenges.

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