Vancouver Island Marmot Buttle Lake Supplementation Project 2012
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Executive Summary

The Vancouver Island marmot (*Marmota vancouverensis*) is one of the most endangered mammals in North America. The National Recovery Plan for the Vancouver Island Marmot (1994, 2000) recommended captive breeding and reintroduction as the most feasible means of recovering the species. The overall goal of the Recovery Plan is 400-600 marmots in three metapopulations (150-200 each) on Vancouver Island (Janz et al. 2000). Initial releases focused on the southern core area and were then expanded to the northern metapopulation zones (Strathcona Provincial Park/Buttle Lake area and the Mount Washington/Forbidden Plateau) in 2007. Since 2003, the award winning captive program has produced over 400 marmots for release to the wild. The release program has been very successful in recovering the southern Nanaimo Lakes area. Building on this success, there were large scale releases of captive bred marmots to the northern metapopulation zones in 2010 and 2011. Unfortunately the overwinter survival of captive released marmots in 2010 and 2011 was significantly less than the 2004-2009 period (Jackson 2012). In 2011, the Recovery Team approved testing of a new release technique in hopes of significantly improving overwinter survival of released marmots. To facilitate this strategy, 17 marmots were released to the Mount Washington colony in September of 2011. Marmots were supplementally fed at the Mount Washington colony that spring and had a record number of births (17). Seven of these wild born yearlings, as well as a wild born two-year-old, and five of the 2011 releases were translocated. As a control, 17 captive bred marmots were released using the former techniques to evaluate the survival associated with these new techniques. In 2012, a total of 30 marmots (17 captive releases and 13 wild translocations) were moved to the Buttle Lake area: eight to Drinkwater on July 23, eleven to Greig Ridge on July 25, and on July 27, two to Tibetan and nine more to Greig Ridge.

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1. Introduction

The Vancouver Island marmot (*Marmota vancouverensis*) is a house cat-sized mammal endemic to Vancouver Island. In 1979, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Vancouver Island marmot as a nationally endangered species (Munro 1978). In 1980, the provincial *Wildlife Act* listed the marmot as endangered. In 1994, the National Recovery Strategy (Janz et al. 1994) called for increased inventory and research on the species. By 1997, the southern population of Vancouver Island marmots was still in decline and the northern population consisted of one isolated colony on Mount Washington (Bryant 1997). The causes of the population decline were thought to be related to landscape level changes and predation (Janz et al. 2000). The reasons for population decline in Strathcona Park remain unclear; however, the creation of the Buttle Lake reservoir is hypothesized to have impeded immigration and emigration due to a lack of landscape connectivity (Janz et al. 2000). Prior to 2007, the last marmots were sighted in Strathcona Park in 1981 near Sunrise Lake (Gibson pers. comm.).

Due to a continuing population decline, select Vancouver Island marmots were relocated to the Toronto Zoo in 1997, initiating the captive breeding program. By 2003 the captive marmot population was considered to be stable and increasing. Initially the recovery program focused on rebuilding the southern population core area of Vancouver Island to the west of Nanaimo, British Columbia, Canada. The first four captive bred marmots were released on southern Vancouver Island in 2003. Subsequently there have been releases of nine marmots in 2004, 15 in 2005, 30 in 2006, 37 in 2007, 59 in 2008, 68 in 2009, 85 in 2010, 66 in 2011 and 34 in 2012 from northern to southern Vancouver Island. There are now 90 animals in captivity at four institutions in Canada: the Toronto Zoo, Calgary Zoo, Mountain View Breeding and Conservation Center, and the Tony Barrett Mount Washington Marmot Recovery Center (TBMWMRC).

The need to increase the wild population in 2007 necessitated expanding to other historic colony sites on the Island (VIMRT 2008). This expansion meets the mandate set forth by the *Recovery Strategy for the Vancouver Island Marmot (Marmota vancouverensis) in British Columbia* of creating three sustainable metapopulations. Strathcona Provincial Park/Buttle Lake area and the Mount Washington/Forbidden Plateau area are designated as the second and third metapopulation (Janz et al. 2000). Meeting the goal set forth in the Strategy of 400-600 marmots in three metapopulations remains achievable only through the reintroduction of captive bred marmots (Janz et al. 2000). To achieve the strategy the first release into Strathcona Provincial Park occurred in the summer of 2007 at Greig Ridge and consisted of nine captive raised Vancouver Island marmots. In 2008, ten marmots were released and in 2009, 22 marmots were also added to the population. The largest release of Vancouver Island marmots occured in 2010 when 77 individuals were released to eight different locations throughout the park. During the summer of 2011, 19 marmots were released to existing established and known successful sites to supplement the groups and lone marmots in Strathcona Park.

In 2011, the Recovery Team approved testing of a new release technique in hopes of significantly improving overwinter survival of released marmots. To facilitate this strategy, 17 marmots were released to the Mount Washington colony in September of 2011. Marmots were supplementally fed at the Mount Washington colony that spring and had a record number of births (17). Seven of these wild born yearlings, as well as a wild born two-year-old, and five of the 2011 releases were translocated. As a control, 17 captive bred marmots were released using the former techniques to evaluate the survival associated with these new techniques. In 2012, a total of 30 marmots (17 captive releases and 13 wild translocations) were moved to the Buttle Lake area: eight to Drinkwater on July 23, eleven to Greig Ridge on July 25, and on July 27, two to Tibetan and nine more to Greig Ridge.

All measures of success have been met by captive released marmots in the southern and Strathcona metapopulations in terms of site fidelity, successful hibernation and successful reproduction. The total wild population has increased from an estimated 20-30 animals in 2003 to an estimated 300 to 450 animals in 2012. Known tagged and untagged individual observations were 257 to 307 animals in

2012. Strathcona Provincial Park and the Buttle Lake/Forbidden Plateau area have an estimated 60-70 marmots now residing in 8 colonies. Both the successes and trials of 2011/2012 reinforce the need for expansion and supplementation of the metapopulation areas of central (Mount Washington/Strathcona Park) Vancouver Island.

2. Objectives

- Maintain a population of Vancouver Island marmots in Strathcona Park at Greig Ridge, Tibetan Peak and Morrison Spire through supplementation and augmentation.
- Verify reproduction and survival of previously released breeding age females and their offspring.
- Capture and implant pups born in previous year and replace expired transmitters from previous years releases.
- Establish a population of Vancouver Island marmots in Strathcona Park at Morrison Spire, Henshaw/Flower Ridge area, Castlecrag, Sunrise Lake, Mt Allan Brooks, and the upper Drinkwater drainage to establish connectivity between Greig ridge and Mount Washington
- Monitor movements of the release animals. As a part of this monitoring, locate hibernacula to aid in verification of emergence from hibernation in subsequent years.
- Monitor survival and predator activity (aerial and terrestrial) at the release sites within Strathcona Park.

3. Study Area

All of the sites selected (Figure 1) reflect typical Vancouver Island marmot habitat consisting of wet sedge meadows in combination with talus boulder complexes in the alpine tundra (ATc) and subalpine zones (MHmm2) between 900 metres and 1400 metres in elevation (Bryant 1998). They are within the historically occupied range of the Vancouver Island marmot (see Recovery Strategy 1994, 2000, 2008).

Greig Ridge (UTM: 10U 305628 E 5502021 N) is the core site selected within Strathcona Park. It is the largest subalpine complex with high marmot habitat suitability in the Park. Greig Ridge is over six kilometres of alpine/subalpine habitat located approximately 10.5 kilometers west of Buttle Lake. This site was chosen initially because it contained old burrows (c1980) and subsequently to build on the recent reintroduction of marmots from 2007, 2008, 2009, 2010 and 2011. Further refinement of habitat identification methods will use a habitat suitability model (Lewis 2001). These sub-alpine zones lie within the Phillips Creek drainage which flows into the west side of Buttle Lake.

Tibetan (UTM: 10U 306568 E 5503614 N) is the first peak on the connecting ridgeline from Greig Ridge to Marble Meadows and Morrison Spire. Several marmots were seen on site, including pups in 2011. Because the only marmots with working transmitters at this site are female, two males were introduced to this location.

Morrison Spire (UTM: 10U 307683 E 5507015 N) is located near the headwaters of Greig Creek and the Marble Meadows/Limestone Cap area. It was chosen for a release site in 2010 and again in the 2011 because of its close proximity to Tibetan Peak, Greig Ridge and the pristine habitat of the Limestone Cap area itself. This habitat has been one of the first sites to be snow free on all of the spring emergence flights, since the 2005 surveys were conducted. As the location of the surviving marmots on this site was unknown, mo marmots were introduced to them.

The upper Drinkwater drainage (UTM: 10U 316487 E 5483468 N), located at the south end of Buttle Lake and north end of Della Falls, was chosen as it contains ideal marmot slide meadows and boulder complexes. The surrounding area is suitable for dispersing marmots. It was a release site in 2009 and in 2010. It rated high on a 2005 survey of suitable marmot habitat.

Henshaw (UTM: 10U 320795 E 5491691 N) was previously chosen due to its close proximity to Flower Ridge, Drinkwater, and the Forbidden Plateau system for marmot dispersal/connectivity. It is located at the south east end of Buttle Lake near the headwaters of Henshaw creek. Surveys done in 2009 showed large amounts of suitable marmot habitat at this site. A broad band of lush alpine meadows and talus boulder slides spans across the mountain. As no historical record of marmots exists for Henshaw prior to releases, Henshaw was not chosen as a site in 2012.

Sunrise Lake (UTM: 10U 315875 E 5483088 N)) on the Forbidden Plateau was chosen because in 1981 it was one of the last known sites to have marmots in Strathcona Park as well as the close proximity to the Mt. Washington, Henshaw, and Castlecrag Mountain systems. It is an ideal stepping stone for marmot dispersal and connectivity. It is located on the north side of Jutland Mountain near the headwaters of the Oyster River and Piggott Creek. Unfortunately, crew were unable to catch a male marmot to release to the surviving marmots from the 2011 release.

In addition, Castlecrag was not chosen for reintroductions in 2012. Marmots were detected with telemetry on this site; however detections were not consistent. Castlecrag Mountain (UTM: 10U 327898 E 5509715 N) is located on the south end of the forbidden Plateau and has a large expanse of suitable habitat. This includes lush meadows and rock slides on the southern face of the mountain. It is located near the headwaters of the Cruickshank River. It's relatively close proximity to the Sunrise Lake serves as a midpoint link between dispersing marmots over to the Henshaw/Flower/Drinkwater sites.

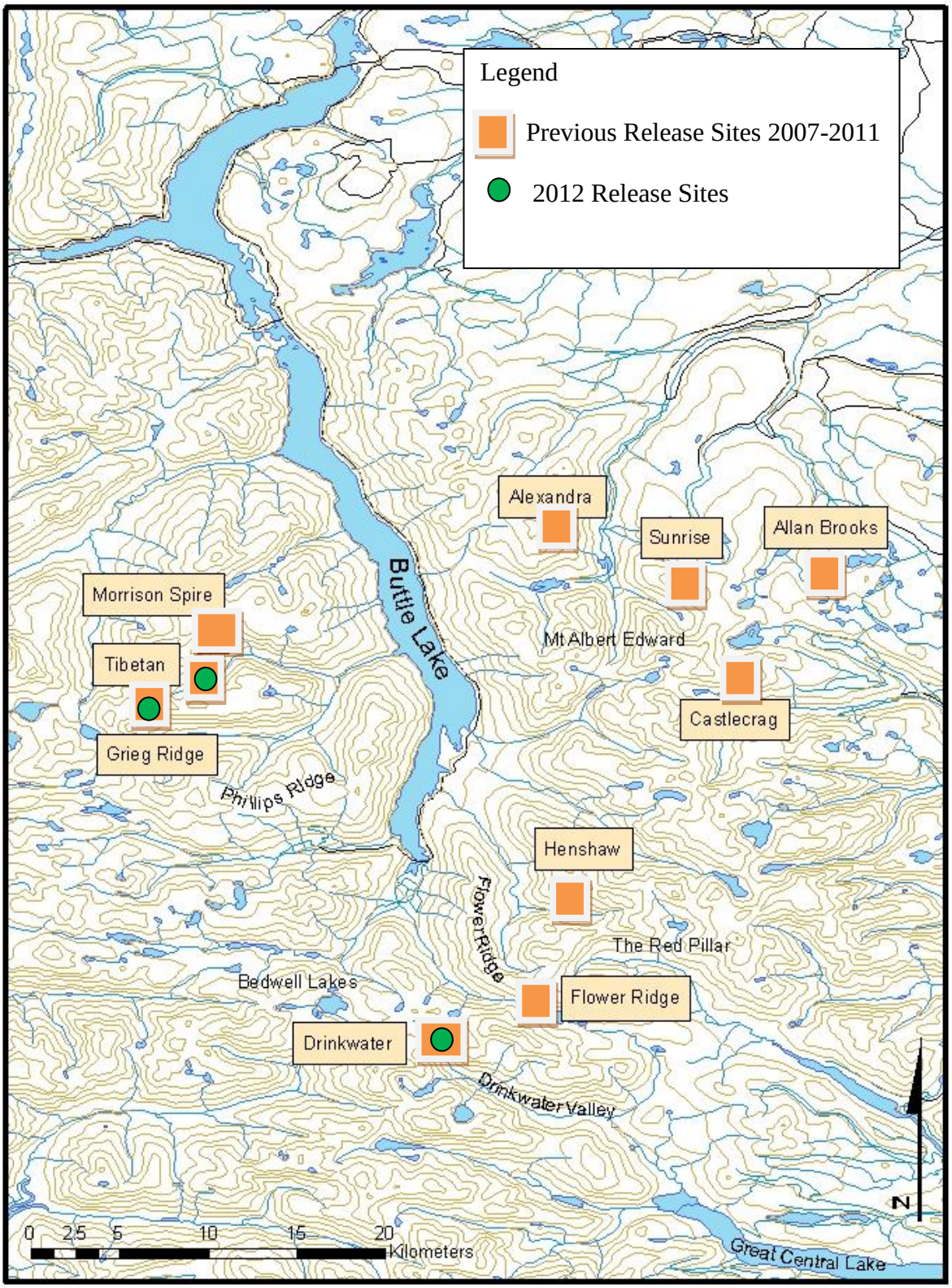

Figure 1. Overview of Study Area and Proximity to Buttle Lake Reservoir

4. Methods

4.1 Assessment of Release Marmots

Thirty Vancouver Island marmots were moved into the Buttle Lake area in 2012. Seventeen of these were captive releases and thirteen were translocations (see table in Appendix V).

Seventeen captive marmots were prepared for release in 2012 to the Buttle Lake area. The groups consisted of marmots from three of the four breeding centres across Canada: the Calgary Zoo (CZ), the Toronto Zoo (TZ) and the Mountain View Breeding and Conservation Center (MVF) in Langley, BC.

As a standard protocol before captive release up to and including this year, all marmots spend a minimum of one hibernation period at the Tony Barrett Mount Washington Marmot Recovery Center (TBMWMRC) on Vancouver Island. This is done in an attempt to acclimatize captive born animals to similar elevation and weather systems they would experience at the release sites. Upon emergence from hibernation in captivity a daily food ration of commercial rabbit pellets, natural vegetation (mainly *Lupinus spp*.), and water is offered. As the summer progressed, the amount of natural vegetation was gradually increased until the date of release.

Between June 11, 2012 and June 18, 2012 all release candidates for Strathcona Park were given physical examinations, implanted with VHF radio transmitters (Telonics Inc. Mesa, AZ. USA, Holohil Systems Ltd. Ontario, Canada, or ATS, Inc. Isanti, Minnesota) and ear tagged (National Band and Tag Co. Newport, KY USA). Marmots were allowed to recover in a quiet dark room in Havahart® traps before being returned to their pens. A minimum of two weeks convalescence was scheduled to allow for adequate healing from the implants before they were released to the wild.

4.2 Assessment of Translocations

Hibernation rhythms in captivity are different than wild rhythms (180 days versus 210 days on average). As stated previously, as a standard protocol, all release candidates spent at least one winter at the Mount Washington marmot facility in hopes of re-establishing more normal hibernation rhythms. Unfortunately this did not happen since the inception of the captive breeding program and the marmots at the Mount Washington facility continued with shorter hibernation cycles. In 2011, the Recovery Team recommended investigating ways of improving survival rates of captive released marmots. Concurrent with this, trials with supplemental feeding produced a record number of pups on the Mount Washington ski hill wild colony. This wild colony, on a very accessible site (Mount Washington ski hill), provided a unique opportunity to test alternative release techniques.

Instead of only releasing captive bred marmots directly to new sites we attempted staged releases:

1. Captive bred marmots were first released to the wild colony on Mount Washington and those that survived their first hibernation were targeted for trapping to take new sites. It is believed that this will increase the survival rates at the new colonies.

2. Given the increased wild reproduction at Mount Washington, we targeted wild marmots as well (assuming they would survive better than captive bred ones).

3. Finally, all marmots trapped were given at least two weeks to recover from surgeries. Field crew recaptured and placed the marmots in the TBMWMRC to be organized into groups for reintroduction by the captive breeding specialist, Dr. McAdie. Captive release marmots (using the old protocols) were part of the groups as a control for the experiment. Groups were in captivity for only a short period of time (3-5 days) and then flown to their respective release sites as soon as possible.

4.3 Release Site Preparation

Reconnaissance helicopter flights in June and July were conducted to verify that release habitat was clear of snow within the Buttle Lake area. On foot, crews located soil burrows in meadows and/or rock chambers in talus slides that would be suitable locations to place plywood nest boxes (pre-existing sites). To smooth the transition from captivity to the wild, these nest boxes were used until the onset of hibernation. These boxes were similar to the nest boxes provided to marmots in captivity however, for transportation purposes were slightly smaller. The nest boxes were positioned flush to the burrow/chamber entrance, so that a rear entrance hole allowed access to the burrow and the front hole faced out into the meadow. These nest boxes were placed at each of the release sites for the duration of the field season and removed in the fall.

4.4 Field Camp Preparation

On Greig Ridge, a reduced base camp was set up in the same location as in previous years. Platforms of cedar and spruce were built for cooking and sleeping tents in 2007. These platforms were raised off of the ground an average of 30 cm to minimize impact to the surrounding vegetation. In addition, an approved BC Parks TAJ holding tank toilet purchased in 2007. Care was taken to minimize the impact from all activities carried out as well as by foot travel along the Ridge, paying particular attention to alpine Heathers (*Calluna spp*).

At Drinkwater and Tibetan field camps were not set up. Due to time restraints and limited crew, releases were delayed and limited due to snow levels and weather conditions at these sites; therefore field camps were not required. In addition, crews can hike from Greig Ridge to Tibetan.

4.5 Release Protocols

All marmots were given a pre-release physical examination before being flown into the park. Marmots were then carried on foot using pack frames in covered Havahart® traps to the release sites. Bedding, peanut butter, commercial rabbit pellets, primate biscuits, and natural vegetation, were placed inside the nest boxes, just prior to release. The marmots were then released into the nest boxes. Covers were placed over the nest box entrances to allow the marmots to become familiar with the new burrow instead of fleeing immediately.

Due to extreme snow conditions and late snow melt, release dates at specific sites was delayed and limited, for this reason release protocol was altered slightly. Stay on site was shortened due to snow/weather. At Drinkwater and Tibetan supplementary marmots were released to known established individuals. These marmots were released directly into the burrows where established marmots were found and nest boxes and bedding was not used. Supplementary feeding and monitoring was still completed when time allowed. These supplementary releases when nest boxes are not used are referred to as a "hard release."

4.6 Spatial Monitoring

Each marmot was tracked with radio telemetry periodically throughout the field season. Telemetry receivers included HR2000 Osprey® (Habit Research Ltd. BC, CA), TR-4® (Telonics Inc. AZ, USA), R1000 (Communications Specialist, Inc. CA, USA) Lotek SRX 400® and SRX 1000® (Lotek Wireless Inc. ONT. CA.). Antennas were the Telonics RA-14® "Rubber Ducky" antennas (Telonics Inc. AZ, USA) and triple Yagis from Wildlife Materials (Wildlife Materials Inc. IL, USA).

Hibernacula and/or locations of deceased marmots were recorded when applicable. Implanted transmitters were programmed to emit different pulse rates dependant on the transmitter temperature and subsequently the body temperature of the marmot. A marmot was determined to be on "active" pulse (above 30 degrees Celsius) if pulse rate averaged 35 beats per minute. A marmot determined to be on "mortality" pulse (below 30 degrees Celsius) had an average pulse rate of 25 beats per minute. A marmot with a slow or mortality pulse rate was determined to be either dead or hibernating depending on the time of year. Conversely a marmot of active pulse was determined to be alive.

4.7 Supplemental Feeding

Large tube feeders full of leaf eater biscuits were placed at Tibetan, Sunrise, Henshaw and Castlecrag. Leaf eater biscuits and peanut butter were provided as supplemental food items during the releases.

4.8 Predator Monitoring

Crews recorded predator activity (aerial and terrestrial) including sightings, scat, and/or tracks of cougars (*Felis concolor*), wolves (*Canis lupus*) and Golden Eagles (*Aquila chrysaetos*). Other wildlife sign and observations (particularly prey species such as ungulates) were noted throughout the day while monitoring the release animals.

5. Results

In the summer of 2012, 30 marmots (17 captive releases and 13 wild translocations) were moved to the Buttle Lake area (see Table 1 and Appendix V). Currently and estimated 60-70 marmots exist in within the Strathcona Park boundaries in eight different colonies.

Table 1: Captive Releases and Wild Translocations to Buttle Lake Area

Date of Introduction	Site	Captive Releases	Wild Translocations	Group Total
23-Jul-12	Drinkwater	4	4	8
25-Jul-12	Greig Ridge # 1	5	6	11
27-Jul-12	Greig Ridge # 2	7	2	9
27-Jul-12	Tibetan	1	1	2

Two three-year-old females from the 2007 releases produced five to six pups into the population during 2009. Only one of these pups was able to be confirmed alive in 2010. It was subsequently captured, and implanted with a Holohil transmitter at the Tibetan Peak site (yearling female Cherry). In 2011 this female was again observed alive and interacting with her mother (adult female, Penny) and three more pups born in 2011. This is the second recorded reproduction at the Tibetan site and third recorded reproduction within Strathcona Park.

In total 100 mortalities have been recorded in Strathcona Park since the first releases in 2007. Twenty-six marmots were confirmed to have died in hibernation and 22 were confirmed to have been killed by predators. Fifty-two mortalities were of unknown causes. It is likely that most of these unknown deaths were attributed to malnutrition and hibernation but crews were not able to confirm them. A breakdown of known mortalities and causes between 2007 and 2012 is recorded below in Table 2.

5.1 Establishing Marmots on Site

The release marmots were observed exhibiting behaviours similar to marmots found in the wild. They were observed digging, using historic burrows, exploring, foraging on natural vegetation, whistling at aerial predators and crew members, nest building, and establishing territories.

Thirty marmots (17 captive releases and 13 wild translocations) were moved to the Buttle Lake area: eight to Drinkwater on July 23, eleven to Greig Ridge on July 25, and on July 27, two to Tibetan and nine more to Greig Ridge. On Greig Ridge, a group was released to the main meadow and another group was released to closer to head of the valley in a large Talus area where marmots have been known to explore and hibernate.

In 2012 at the Tibetan marmot colony, one untagged yearling was observed in the fall. This yearling may be one of the three pups Penny had in 2011. As the only known marmots at this site in the spring were female (Penny and Cherry), a wild born male and a captive born male were released here in 2012. Penny's and the captive born male's, Harry's, transmitters were recovered from the field. Skipper, a three year old marmot from Greig Ridge moved over and joined Cherry.

Margaret, a 2012 release on Greig Ridge, was found in the Morrison Spire vicinity during the October 5th flight. Finding her here suggests that the two marmots from this site that were not able to be located in 2012 may have survived, unlike the remaining marmots at Morrison Spire.

A total of 8 marmots (3 male, 5 female) were released to two separate release boxes in the Drinkwater valley in 2012. In combination with poor survival and transmitter signal strength in that region, locating and tracking them has been problematic. Two mortalities were documented in the Drinkwater Valley in 2012 (Nigel and Spadefoot).

During the spring 2012 aerial inventory, marmots were spotted at known hibernacula in the Henshaw location; a remote feeder was placed at one hibernaculum. Unfortunately, due to the remoteness of the location, crew were not on site until late in the season and recovered three transmitters. Because of this, Eugene's death is unknown. Charlene, a three year old female released in 2010, was suspected to be killed by a Golden Eagle because of nearby whitewash discovered. Andy was also believed to be killed by a predator. Tara may have died during hibernation as her transmitter was unrecoverable and remains in the burrow.

In the summer of 2011, three marmots were released to supplement the surviving Henshaw marmots. The three year old female's (Virgo's) transmitter could not be recovered by field crew. The two males, as well as a male released in 2010, could not be located by the fall of 2012. No marmots were detected alive while crew were on site from September 10th to 13th, 2012.

During flights and ground inventory of Castlecrag Mountain, many transmitters could not be detected. The 2010 releases, Dick and Mia, survived hibernation.

At the Sunrise Lake site, only two marmots were able to be located in the summer. One of the marmots was a self transplanted three year old male from Mount Washington, Erik, who ventured 8km. Unfortunately, Erik was found dead later in the season. The only known marmot at the Sunrise Lake location is a female, Marigold (2010 pup release). Four marmots have gone missing or experienced transmitter failure on this site and three were confirmed to have died.

While monitoring the Allan Brooks site from 2010 to 2012, it was determined all marmots had dispersed off site. Because no marmots could be found onsite it was decided that a supplemental release would not take place in 2012. Instead, it was determined the marmots could be released at other sites where survival had been confirmed and additional individuals are needed. The Allan Brooks site may be reconsidered for future releases as it is an ideal stepping stone from Mount Washington to sites further east in Strathcona Park.

5.2 Monitoring

Due to the large number of marmots released in 2010, along with the supplemental releases in 2011 and 2012, keeping track of all animals proved to be very difficult. In addition, transmitter failures, time restraints, weather and remoteness compounded the problem - making it extremely difficult to extensively monitor all sites.

Crews spent time onsite monitoring both new releases and established individuals. The majority of 2012 releases were successful. It was found that the 2012 release marmots stayed in close proximity to the release site within the summer months. Crews attempted to retrieve marmots that had been heard on slow when possible. Some marmots from Grieg Ridge naturally dispersed; Skipper to Tibetan and Margaret to the more remote Morrison Spire.

5.3 Predator Monitoring and Mortalities

In total, 21 deaths were confirmed in Strathcona Park in 2012. Table 2 shows total mortalities confirmed each year by cause of death from 2007-2012. There were two deaths related to hibernation and two to predation. Seventeen died of unknown causes.

Table 2: Total Known Mortalities by Year of Death and Causes of Death

	2007	2008	2009	2010	2011	2012
Predation	1	2	3	11	3	2
Hibernation	0	0	0	15	9	2
Unknown	0	4	5	6	20	17
Total	1	6	8	32	32	21

Number of mortalities at each location were: Tibetan (2), Sunrise Lake (1), Drinkwater Valley (2), Greig Ridge (10), Henshaw (3), Morrison Spire (3). Due to the large number of marmots and the time restraints of searching for each individual, crews were unable to access all mortality locations; therefore the cause of all deaths could not be determined. Terrain also was a limiting factor.

Many individuals emerged from their hibernacula and were discovered later on slow pulse a short distance away, while others had not been heard prior to 2011-2012 hibernation. Due to the late snow melt and crew restriction, time was spent on releases in areas where ground inventory was both possible and safe.

6. Discussion

6.1 Establishing Marmots on Site

At the onset of the Strathcona Park reintroduction program four phases were proposed to ensure success and establish a healthy population of Vancouver Island marmots in the third metapopulation on the Island. The primary goal of Phase I was to successfully reintroduce Vancouver Island marmots to Strathcona Provincial Park. All measures of success, as outlined in the 2000 Recovery Strategy (Janz et al. 2000), were met by captive released marmots released since 2007 in terms of site fidelity, successful hibernation and successful reproduction.

The primary objective of Phase II was to supplement the previously established group of marmots on Greig Ridge in Strathcona Park. Marmots released during Phase II stayed on site for the summer, interacted with previously established marmots and went into hibernation in the fall. Some aggression was observed and four marmots moved off site in 2008; however, the remaining marmots have integrated into the Greig Ridge colonies. One of the male marmots from the 2008 release successfully sired a litter of pups. All measures of success as outlined in the Recovery Strategy (Janz et al. 2000) for the marmots released in Phase II were again met.

The primary objectives of Phase III included supplementing the previously established group of marmots on Greig Ridge and Tibetan Peak, as well as establishing two more colonies in Strathcona Provincial Park at Flower Ridge and the upper Drinkwater drainage. Twenty-three to thirty of these forty-one survived in four colonies at the end of 2009: one on Flower Ridge, one at the upper Drinkwater drainage and two on Greig Ridge.

The primary objective of Phase IV was the operational phase of the program, in which a larger number of marmots than in previous years would be released to rebuild and re-establish a viable metapopulation around Buttle Lake. The primary focus was to establish colonies on the east side and south end of Buttle Lake and to supplement any past releases on the west and southern end of Buttle Lake. Seventy-seven marmots were reintroduced to form eight colonies including the supplementation of Greig Ridge, Tibetan Mountain, and the upper Drinkwater. First time release groups went to Morrison Spire, Henshaw, Castlecrag, Sunrise Lake, and Mount Brooks area. The majority of goals outlined in the Recovery Strategy (Janz et al. 2000) have been met for Phase IV with the exception of successful breeding activity throughout the established sites.

The primary objective of Phase V included supplementing the established release sites around the east side Buttle Lake of Strathcona Provincial Park. Now that surviving marmots have been established in specific locations the supplementation of these sites is important until they establish sustainable numbers as well as successful first and second generation breeding. Supplementation to priority sites took place in August-September 2011, this included five release sites; Greig Ridge, Morrison Spire, Henshaw, Castlecrag and Sunrise Lake.

In total, 171 marmots have been released to Strathcona Provincial Park. Large scale releases from 2009 to 2011 helped establish sites around Buttle Lake and in 2012 the primary goals were to supplement these sites with additional marmots. This year, 30 marmots were released to increase the population and breeding opportunities. Releases took place at Greig Ridge (20), Tibetan (2) and Drinkwater Valley (8).

6.2 Monitoring

Much like the previous year, time and weather were found to be problematic while monitoring the large number of active sites. Although the number of marmots released in 2012 was similar to 2011 (19 marmots released in 2011, 30 marmots released in 2012), monitoring the previous year's releases is an extensive task. Access to some sites was impossible until mid to late August thus compacting crew's time into a very short and very busy field season. While releasing the new marmots was not the only goal, crews also spent time monitoring for dispersal, retrieving known dead marmots and looking for evidence of pups.

Marmots released to the Greig Ridge area adapted very well to the harsh conditions. One group was released in the main large meadow while the other was released near the head of the valley where marmots from previous releases have been documented to move and hibernate. Each visit back through the rest of the summer, the meadow releases and those released to the valley floor stayed close to the release boxes. Some marmots from Grieg Ridge naturally dispersed; Skipper to Tibetan and Margaret to the more remote Morrison Spire. It is hopeful that with a good winter and fast snow melt these release marmots will survive and help to reinforce the colonies.

While at the Greig Ridge site in 2012, crews also surveyed the Tibetan colony. One untagged yearling was observed interacting with Cherry on the Tibetan slide.

During the spring 2012 aerial inventory, marmots were spotted at known hibernacula in the Henshaw location; a remote feeder was placed at one hibernaculum. Unfortunately, due to the remoteness of the location, crew were not on site until late in the season and recovered three transmitters. Because of this,

Eugene's death is unknown. Charlene, a three year old female released in 2010, was suspected to be killed by a Golden Eagle because of nearby whitewash discovered. Andy was also believed to be killed by a predator. Tara may have died during hibernation as her transmitter was unrecoverable and remains in the burrow. The establishment of this site is critical in creating a link between the Mount Washington/Forbidden Plateau and Buttle Lake colonies.

At Castlecrag, emergence holes were seen during flights in early spring of 2012. A remote camera and supplemental feeder were set up to observe and aid the known marmots in the area respectively. In the 2012 season, Castlecrag was visited six times by field crew. Unfortunately the known marmots in the area had either displaced or there transmitters had failed. After the remote camera was retrieved and the footage viewed, it appeared the marmots dispersed once the snow had significantly melted. At season's end, one marmot with a working transmitter (Mia) was known to be at this location. Personal communication with active outdoor community members in Courtenay, BC, have confirmed the presence of untagged marmots on the Castlecrag site, showing that they have survived but are few in numbers.

Dispersal of release marmots is not unexpected based on experience from previous supplementation releases on southern Vancouver Island (Reid 2009.) This has been observed on the south Island when groups of marmots were released to a colony with similar dynamics, resulting in marmots moving up to 25 kilometres away from a release site (Doyle pers. comm.). Dispersal is a key metapopulation function to prevent inbreeding and help establish new colonies (Bryant 1998).

Although marmots have been seen above ground and active into late November they have still been known to hibernate successfully. Late snow melts and mild temperatures have provided excellent feeding opportunities into October for 2012. This may act to enhance body condition of animals prior to entering hibernation even if the actual length of hibernation is shortened. The result could have beneficial effects for the following spring as body condition at emergence may be more of a driving factor behind successful reproduction (McAdie pers. comm.).

6.3 Predator Monitoring and Predation Related Mortalities

In total, 21 deaths were confirmed in Strathcona Park during 2012 and 100 have been confirmed since 2007 (Table 2). Of the 21 deaths recorded in 2012, two were the result of predation and two died in hibernation. Many individuals emerged from their hibernacula and were discovered later on slow pulse a short distance away, while others had not been heard prior to 2011-2012 hibernation.

Seventeen mortalities were of unknown causes in 2012. Due to time constraints many of these animals were not recovered in time to find fresh sign (like scat or tracks) at the mortality site. Others were not recovered because the mortality site was too dangerous to access. Number of mortalities at each location were: Tibetan (2), Sunrise Lake (1), Drinkwater Valley (2), Greig Ridge (10), Henshaw (3), Morrison Spire (3).

Generally speaking, for any predator kill, the sooner they can be recovered the better for determining the cause of death. Wolves and cougars consume prey differently and sometimes tracks and or scat can be found and identified. For older wolf and cougar kills, transmitters often contain tooth marks indicating terrestrial predation but no other sign remains to indicate precisely what killed the animal. Although a few transmitters were recovered in the summer of 2012, no definitive evidence was found to indicate cougars or wolves had made those kills. Most transmitters appeared in good condition with zero tooth marks, however DNA swabs were taken and an analysis has been undertaken to determine the cause of death more specifically.

Golden Eagles have been frequently observed in Strathcona Park. In total, six mortalities have been confirmed to be caused by Golden Eagles from 2007-2012. The presence of multiple marmots provides

greater protection for all individuals as the more likely they will spot an aerial predator and warn others (Werner 2005).

Typically an animal whose signal is on slow pulse in ideal habitat or timbered habitat during the peak of the summer indicates it has been predated upon. This was believed to be the case for the 2010 Henshaw release (Andy) as he was heard alive in the summer and subsequently heard on slow pulse before hibernation in suspect locations. Andy's transmitter was recovered in 2012.

Field crews and pilots routinely observed significant numbers of black tailed deer (*Odocoileus hemionus*) that appear to reside on Greig Ridge, Morrison Spire, Henshaw, and Castlecrag for the entire summer. Groups of up to fourteen deer have been observed at one time in close proximity to the release sites. In 2007, inventory crew members observed more than 40 deer in a two kilometre stretch between Greig Lake and the head of the Phillips Creek drainage. These deer did not flee from crews or helicopters until approached very closely indicating that they may not be experiencing pressure from terrestrial predators (MacDermott pers. comm.). Each subsequent year (2008-2012) fewer deer were seen on Greig Ridge and those that were observed appeared to be more secretive and skittish. This may indicate that terrestrial predators have started to visit the area, or that these deer have adapted quickly to the human presence.

6.4 Hibernation Related Mortalities

Due to consecutive tough winters, hibernation survival in both the Strathcona Park and the south Island areas has been difficult. Large snow accumulations and extended cold weather into the spring and summer months makes survival difficult for all marmots at all locations (Figure 2). Over the years, many marmots did not emerge and died within their burrows. This poor survival could be the result of poor hibernacula selection regardless of snow depth and spring melt. Others managed to emerge from hibernation but slow spring green-up and limited food availability eventually lead to emaciation and death.

Although 2009 to 2012 saw large amounts of marmots die as a result of hibernation; some benefits of the cold weather and late snow melt could be observed. During hot and dry summers, plants thrive in the early months only to die off in August due heat and drought. Prolonged snow melt and suppressed plant growth provides much better feeding opportunities in later months (September/October). Because feeding can continue until right before hibernation, marmots can go into hibernation in excellent condition. This could result in higher hibernation survival and increased breeding opportunities for the following spring which could be beneficial long term (McAdie pers. comm.). This phenomenon has been observed in southern colonies where excellent pup production was seen despite the large snow pack and cold springs following wet summers.

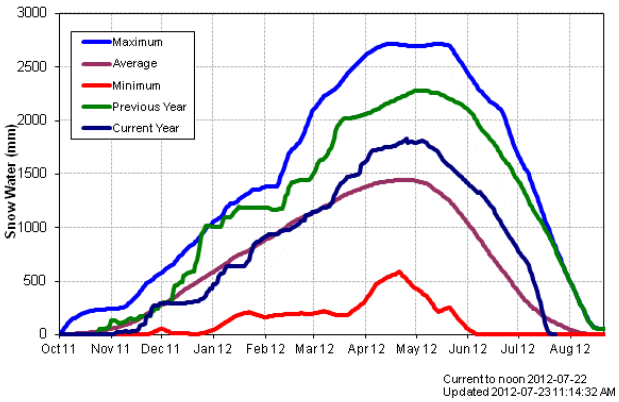

Figure 2. Snow water equivalent data showing above average snow levels and melt time.

7. Recommendations

The proposal for 2013 involves augmenting those sites where marmots have demonstrated survival through hibernation. Unfortunately the 2009, 2010 and 2011 releases suffered high overwinter mortality due to the abnormally long and cold springs experienced in those years - see final reports 10.W.CBR.02, 11.W.CBR.02, and 12.W.CBR.02. The releases from 2006 to 2009 exhibited roughly 50% survival and allowed for rapid expansion of colonies in the southern metapopulation. The winter/springs of 2009 to 2011 only had survival of 10 to 25% and that along with predation has limited the expansion of colonies established in those years. Unfortunately the years with the high overwinter mortality were when the bulk of the releases were done in the Buttle Lake area. Consequently we are not as far along as we had hoped at the end of six years of releases.

The releases in 2013 will supplement sites with surviving marmots from the 2007 to 2012 releases. Experience from the releases in the south have demonstrated that newly established sites with low numbers of marmots are vulnerable to stochastic predation events that hinder population growth. In 2011, the Recovery Team approved testing of a new release technique in hopes of significantly improving overwinter survival of released marmots. The new approach centers around releasing captive bred marmots to the natural colony on Mount Washington and then translocating the survivors (after one winter) to the Buttle Lake area the following summer. (We know survival of released marmots after one year in the wild approaches natural survival rates.) To facilitate this strategy, 17 marmots were released to the Mount Washington colony in September of 2011. We also supplementally fed the marmots at the Mount Washington colony that spring and had a record number of births (17). Seven of these wild born yearlings, as well as a wild born two-year-old, and five of the 2011 releases were translocated. As a control, 17 captive bred marmots were released using the former techniques to evaluate the survival associated with these new techniques. Seventeen more marmots were released to Mount Washington this year (2012) for recapture and translocation to Strathcona Park in 2013. We will augment already established colonies as well as further establishing new colonies (concentrating on both sides of Buttle Lake).

Evaluation of these new release strategies is a key component for 2013 and 2014. Multiple years on multiple sites is required to properly evaluate these alternate release strategies.

The overall plan for releases in 2013 is to augment surviving colonies and establish new ones utilizing the new release strategy of using overwintered captive bred marmots and wild born marmots. There should be 17 to 20 captive bred marmots ready for release and 10 to 20 translocation candidates. The actual locations will depend on survival at the previous years (2007 to 2012) sites. Again, we will focus on establishing colonies along the east side of Buttle Lake and supplementing successful colonies on the west and south ends of Buttle Lake. This will aim to rebuild the metapopulation structure of marmot colonies on both sides of the Lake.

All releases will still require crews to be on site for 3 to 4 days, and will use standard protocols with nest boxes and short term supplemental feeding to promote site fidelity and maximize the chance of overwinter survival. Crews will return to all sites every 10 to 15 days to monitor progress and survival.

We hope to again incorporate a First Nations training component in the release and monitoring phases of the program. First Nations would participate in the releases, and receive training in monitoring marmot populations and use of radio telemetry equipment (both ground and aerial based).

7.1 Site description

a) The specific sites selected will ultimately be decided based on survival through hibernation to 2013 but will most likely include:

a. The upper Drinkwater drainage (south end of Buttle Lake);
b. Mount Albert Edward and Castlecrag south slope areas (east side of Buttle Lake);
c. North east side of Henshaw Creek north of Flower Ridge (east side of Buttle Lake);
d. Morrison Spire (west side of Buttle lake);
e. Greig Ridge (west side of Buttle lake)

All sites are within the historically occupied range of the Vancouver Island marmot (see Recovery Strategy 1994, 2000, 2008).

b) All release sites will be in typical Vancouver Island marmot habitat, which are wet sedge meadows in combination with talus boulder complexes in the alpine tundra (ATc) and subalpine zones (MHmm2) between 900m and 1500m elevation (Janz 2000).

7.2 Relevance to Recovery Plan:

The benefits of this project include re-establishing one of North America's rarest mammals into its historic habitat while assisting in removing the Vancouver Island marmot from the endangered species list. The first version of the National Recovery Plan for the Vancouver Island marmot established a goal of 400 to 600 marmots in three metapopulations: southern Vancouver Island; Strathcona Park and northern Vancouver Island (Janz et al. 1994). The 2000 Plan (Janz et al. 2000) re-affirmed the endangered status and concluded reintroduction of captive bred marmots to historically occupied sites including Strathcona Park as the best approach to recovery. The draft 2008 Recovery Strategy concluded that 15 to 30 marmots would be available annually for reintroduction, and established measures of success for the reintroductions. This was very quickly surpassed. These reintroductions (2003 to 2012) to historic habitat on Vancouver Island have met all these measures of success (strong site fidelity, successful hibernation, normal behaviors and reproduction). The number of captive marmots available for release has increased dramatically from 4 in 2003 to a high of 85 in 2010; totaling 406 captive releases since 2003. This project will continue the reintroductions to Strathcona Park (the largest area of protected marmot habitat on Vancouver Island and two of the three identified recovery zones) and other suitable areas influenced by the footprint of the Campbell Lake/Buttle Lake system.

7.3 Recommendations Summary

The focus for 2013 will be testing the cost efficiency of the new techniques when compared with the traditional methods of releasing captive bred marmots directly to the wild from captivity.

Along with the potential of supplemental feeding, these new techniques may lead to the faster establishment of sustainable colonies in these new metapopulations around Buttle Lake.

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Appendix I

Financial Statement Form **Project # 12.W.CBR.01**

	BUDGET		ACTUAL	
	BCRP	Other	BCRP	Other
INCOME				
Total Income by Source	66,550.00	120,000.00	66,550.00	120,000.00
Grand Total Income (BCRP + other)				
EXPENSES	Note: Expenses must be entered as negative numbers (e.g. –1000, etc.) in order for the formulas to calculate correctly.			
Project Personnel				
Coordinator MRF		-12,250.00		-12,250.00
Field Technicians	-15,000.00	-60,000.00	-15,000.00	-60,000.00
Field Biologists(FLNRO)		-10,500.00		-10,500.00
Field Technician (First Nation Training)	-5,000.00		-5,000.00	-5,000.00
Veterinary Support		-12,000.00		-12,000.00
Materials & Equipment				
Helicopter fuel & rental	-32,000.00	-32,000.00	-32,000.00	-32,000.00
Transmitters	-8,500.00	-8,500.00	-8,500.00	-8,500.00
Food Allowance		-5,500.00		-5,500.00
Camping supplies		-112,000.00		-112,000.00
Vehicle Rental & Fuel		-11,500.00		-11,500.00
Equipment Supplied		-12,200.00		-12,200.00
Administration				
MRF 10% Admin.	-6,050.00		-6,050.00	
Total Expenses	-66,550.00	*-120,000.00*	*-66,550.00*	*-120,000.00*
Grand Total Expenses (BCRP + other)	*-186,550.00*		*-186,550.00*	
BALANCE (Grand Total Income – Grand Total Expenses)			*0.00*	

Appendix II

Performance Measures

Performance Measures – Target Outcomes													
Project Type	**Primary Habitat Benefit Targeted of Project (m^2)**	**Primary Target Species**	**Habitat (m^2)**										
			Estuarine	In-Stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
Impact Mitigation												
Fish passage technologies	Area of habitat made available to target species											
Drawdown zone revegetation/stabilization	Area turned into productive habitat											
Wildlife migration improvement	Area of habitat made available to target species	Marmot									x	
Prevention of drowning of nests, nestlings	Area of wetland habitat created outside expected flood level (1:10 year)											
Habitat Conservation												
Habitat conserved – general	Functional habitat conserved/replaced through acquisition and mgmt											
	Functional habitat conserved											

	by other measures (e.g. riprapping)											
Designated rare/special habitat	Rare/special habitat protected											
Maintain or Restore Habitat forming process												
Artificial gravel recruitment	Area of stream habitat improved by gravel plmt.											
Artificial wood debris recruitment	Area of stream habitat improved by LWD plcmt											
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing	Marmot									158.3 ha	
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved											
Habitat Development												
New Habitat created	Functional area created	Marmot									158.3 ha	

Appendix III

BCRP Recognition

Our research, with recognition of the substantial support from BC Hydro Bridge Coastal Fish and Wildlife Restoration Program, has been presented to the:

- Vancouver Island Marmot Recovery Team at the biannual full day meetings at the Ministry of Environment office in Nanaimo (2080 Labieux Road)
- Vancouver Island Marmot Captive Management Group multiday meetings
- Habitat Recovery Implementation Group Chair at the Habitat Action Plan Subcommittee meeting at TimberWest Forest Corp., Nanaimo
- Arrowsmith Naturalists, who are affiliated with B.C. Nature and Nature Canada

Weekly reports were electronically mailed to the Vancouver Island Marmot Recovery Board during the field season. The public is made aware through news (BCRP was thanked in the Cowichan Valley Citizen), television programs (*Animal Rescue Squad*, etc.) and newsletters: the Mount Washington Marmot Newsletter Fall/Winter edition and the Marmot Recovery Foundation's Newsletter – the Marmoteer. Also, BCRP was thanked in NatureWILD Magazine (Volume 10, Issue 2).

Appendix IV

Photographs

Photo: Rick Merriman

Greig Ridge main meadow site, release 2007-2012.

Photo: Jesse Percival

Rick Merriman, Crystal Reid, Shawn Lukas and Cheyney Jackson taking Avalanche Skills Training.

Photo: Rick Merriman

Shawn Lukas releases marmots at Mount Washington for their first outdoor hibernation, later to be trapped and taken to Strathcona Park.

Photo: Shawn Lukas

Sharon Hadway, Regional Executive Director, Ministry of Forests, Lands, and Natural Resource Operations, West Coast Operation and Jesse Percival, Ski Patrol Director of Mount Washington Alpine Resort help the marmot team.

Photo: Shawn Lukas

Bedding inside nest box.

Photo: Shawn Lukas

Leaf eater biscuits are provided as supplemental food to marmots in nest boxes and feeding tube stations.

Photo: Shawn Lukas

Marmot eating peanut butter on a leaf eater biscuit.

Photo: Shawn Lukas

Drinkwater release site on July 19th , 2012.

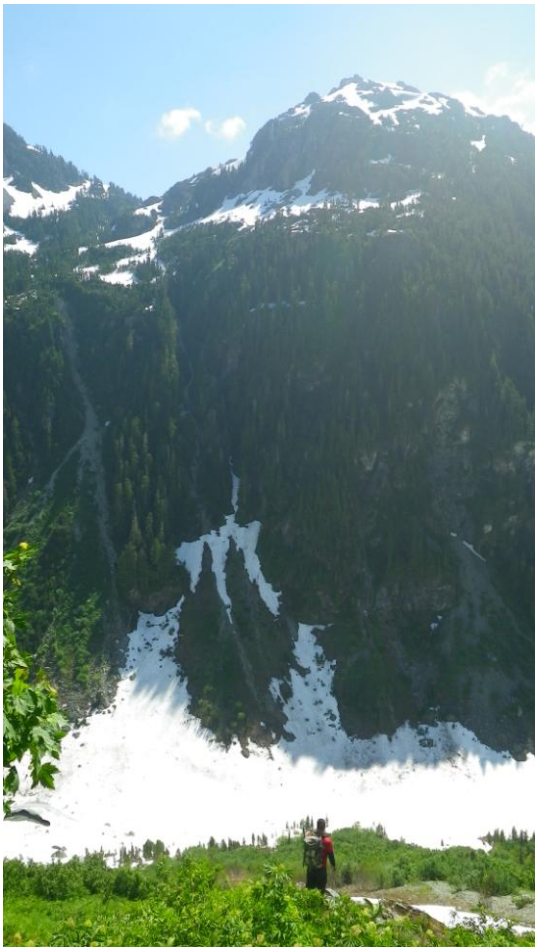

Photo: Shawn Lukas

Rick Merriman preparing Drinkwater release site on July 19th , 2012.

Photo: Shawn Lukas

Lupines make up a large portion of the marmots' diet.

Photo: Chris White

Rick Merriman glassing for marmots along Greig Ridge.

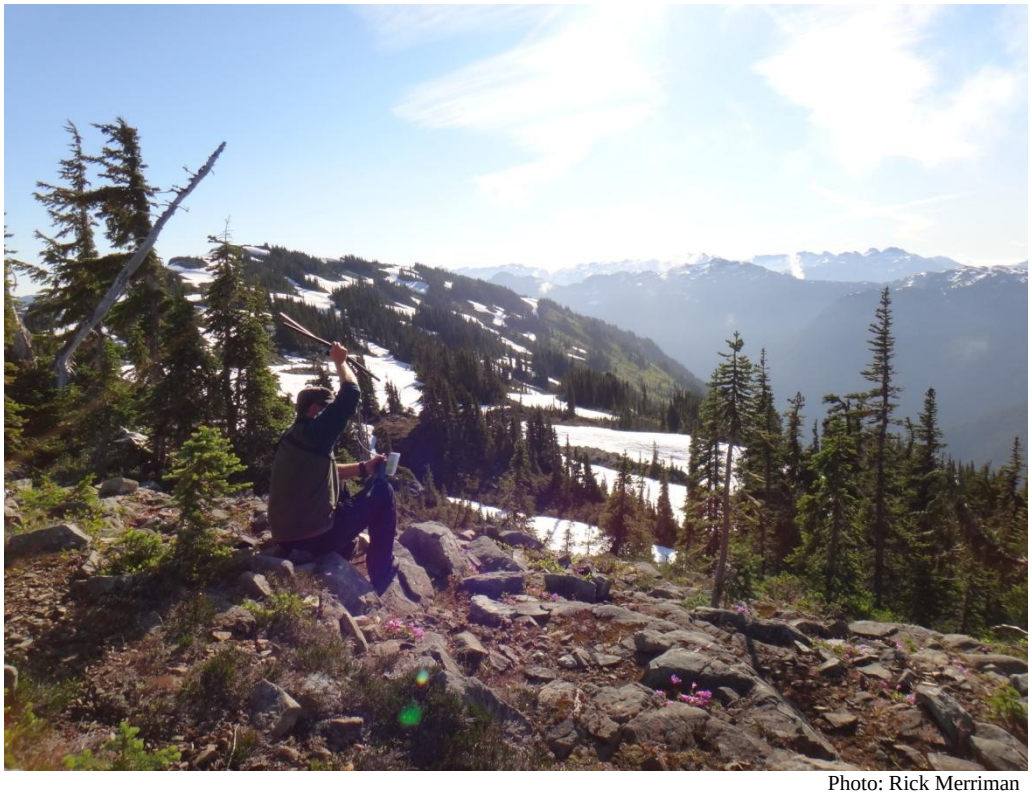

Photo: Rick Merriman

Chris White doing telemetry along Greig Ridge.

Photo: Rick Merriman

Tibetan Mountain and meadows from Greig Ridge.

Photo: Chris White

Morrison Spire meadow, Limestone Cap and Marble Mountain.

Photo: Shawn Lukas

Rick Merriman listening for marmots underground with telemetry.

Photo: Cheyney Jackson

Chris White carrying feeder to emergence hole.

Photo: Shawn Lukas

Feeding tube at emergence hole.

Photo: Rick Merriman

Castlecrag hibernacula in main bowl.

Appendix V

Releases and Translocations

Name	Stud book #	Release site	Date of implant	Date of recapture	Date of release	Year of birth	Location of birth	Sex	Transmitter type	Battery life of transmitter
Horizon	1505	Drinkwater	16-Aug-11	20-Jul-12	23-Jul-12	2010	MVF	Female	ATS 1240T	50 months @ 35 ppm
Carol	NA	Drinkwater	20-Jun-12	19-Jul-12	23-Jul-12	2011	Mt Wash	Female	HOLOHIL A1-2TH	60 months @ 40°C
Elise	NA	Drinkwater	20-Jun-12	19-Jul-12	23-Jul-12	2011	Mt Wash	Female	HOLOHIL A1-2TH	60 months @ 40°C
Corey	1511	Drinkwater	15-Jun-12	NA	23-Jul-12	2011	TZ	Male	HOLOHIL A1-2TH	60 months @ 40°C
Nigel	1509	Drinkwater	15-Jun-12	NA	23-Jul-12	2011	TZ	Male	HOLOHIL A1-2TH	60 months @ 40°C
Velvet	1512	Drinkwater	15-Jun-12	NA	23-Jul-12	2011	TZ	Female	HOLOHIL A1-2TH	60 months @ 40°C
Tobe	1325	Greig Ridge # 1	17-Aug-11	24-Jul-13	25-Jul-12	2008	MVF	Male	HOLOHIL A1-2TH	60 months @ 40°C
Roberta	1453	Greig Ridge # 1	17-Aug-11	19-Jul-12	25-Jul-12	2009	CZ	Female	HOLOHIL A1-2TH	60 months @ 40°C
Finn	NA	Greig Ridge # 1	20-Jun-12	23-Jul-12	25-Jul-12	2011	Mt Wash	Male	HOLOHIL A1-2TH	60 months @ 40°C
Nic	1467	Greig Ridge # 1	14-Aug-11	20-Jul-12	25-Jul-12	2010	TZ	Male	HOLOHIL A1-2TH	60 months @ 40°C
Kelly	NA	Greig Ridge # 1	19-Jun-12	21-Jul-12	25-Jul-12	2011	Mt Wash	Female	HOLOHIL A1-2TH	60 months @ 40°C
Cricket 2	NA	Greig Ridge # 1	19-Jun-12	21-Jul-12	25-Jul-12	2011	Mt Wash	Female	HOLOHIL A1-2TH	60 months @ 40°C
Kasia	1468	Greig Ridge # 2	13-Jun-12	NA	27-Jul-12	2010	TZ	Female	HOLOHIL A1-2TH	60 months @ 40°C
James	1520	Greig Ridge # 2	13-Jun-12	NA	27-Jul-12	2011	TZ	Male	HOLOHIL A1-2TH	60 months @ 40°C
JT	1521	Greig Ridge # 2	13-Jun-12	NA	27-Jul-12	2011	TZ	Male	HOLOHIL A1-2TH	60 months @ 40°C
Lanigan	1502	Greig Ridge # 2	13-Jun-12	NA	27-Jul-12	2010	MVF	Male	HOLOHIL A1-2TH	60 months @ 40°C
Ota	1522	Greig Ridge # 2	13-Jun-12	NA	27-Jul-12	2011	TZ	Female	HOLOHIL A1-2TH	60 months @ 40°C
Francesca	1523	Greig Ridge # 2	13-Jun-12	NA	27-Jul-12	2011	TZ	Female	HOLOHIL A1-2TH	60 months @ 40°C
Isis	NA	Greig Ridge # 2	19-Jun-12	21-Jul-12	27-Jul-12	2011	Mt Wash	Female	HOLOHIL A1-2TH	60 months @ 40°C
Erica	NA	Greig Ridge # 2	20-Jun-12	20-Jul-12	27-Jul-12	2011	Mt Wash	Female	HOLOHIL A1-2TH	60 months @ 40°C
Margaret	1513	Greig Ridge # 2	15-Jun-12	NA	27-Jul-12	2011	TZ	Female	HOLOHIL A1-2TH	60 months @ 40°C
Ringo	1510	Tibetan	15-Jun-12	NA	27-Jul-12	2011	TZ	Male	HOLOHIL A1-2TH	60 months @ 40°C
Harry 2	1287	Tibetan	19-Jun-12	20-Jul-12	27-Jul-12	2007	MVF	Male	HOLOHIL A1-2TH	60 months @ 40°C