Wildlife Research Annual Progress Report

Habitat Associations and Movement Patterns of Reproductive Female Wolverines (*Gulo gulo luscus*) on the Southeast Alaska Mainland

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Cover photo: A wolverine at a "camera trap" station taken with a Trailwatcher® infra-red camera

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INTRODUCTION

Despite significant gains in our understanding of wolverine ecology and habitat associations in North America over the last 2 decades (Hornocker 1981, Magoun 1985, Gardner 1985, Banci 1987, Copeland 1996, Persson 2003, and others), a major gap exists in our knowledge of wolverines inhabiting coastal ecological zones. For example, in Southeast Alaska (SE AK) the only information available on wolverines is from sealing records of animals taken during the hunting and trapping season. These records only contain information on hunter or trapper identification, month/year of harvest, location and method of harvest, method of transportation, and sex of the animal. During the 10-year period 1994–2003, trappers and hunters harvested an average of 24 wolverines annually in SE AK, with Game Management Unit (GMU) 1B producing an average of 7 (range 1–18) wolverines. Sealing records indicate that GMU 1B typically produces the highest wolverine harvest of any SE AK GMU.

The large expanse of remote, mountainous habitat in SE AK has provided wolverines with expansive refugia from trapping, which along with immigration from Canada has probably helped sustain viable populations in the region. However, recent genetic studies indicate that there may be little interchange between SE AK wolverine populations and those in adjacent Canadian provinces, particularly the female segments of the populations. Further genetic studies are needed to determine the extent of dispersal between these adjacent populations (Tomasik and Cook 2005). Krebs *et al*. (2004) and Magoun and Copeland (1998) emphasized the importance of functional refugia in maintaining source populations to repopulate areas where trapping occurs. Refugia must be large enough and contain enough suitable habitat for reproductive females to successfully den and rear kits without having to make excursions into trapped areas. There is, however, no information currently available on denning habitat, home range size, or the extent or frequency of extra-territorial movements for reproductive female wolverines in SE AK.

A key component of viable wolverine populations is the survival of reproductive females (Persson 2003). Although mature female wolverines have the capacity to produce 2-3 young per year, studies have shown that the actual reproductive rate for wolverines is much lower than expected, primarily due to delayed maturity and frequent failure to recruit young in years following successful reproduction (Persson 2004). Research conducted in other study areas indicates that survival rates for wolverines are substantially higher in untrapped populations than in trapped populations, and estimates of logistic growth rate for trapped populations indicate that wolverine populations would decline in the absence of immigration from untrapped populations (Krebs *et al*. 2004). Population viability analyses of wolverines in Sweden indicate that for populations to remain viable, according to the International Union for Conservation of Nature and Natural Resources (IUCN) classification criteria (IUCN 2000), the number of sexually mature females (≥3 years old) should exceed 46 individuals (Persson 2003). Sealing records for SE AK (including GMUs 1–5) indicate an average annual harvest of 24 wolverines, with approximately 40% females. There are currently no population estimates for wolverines in SE AK and no information is available regarding the age or reproductive status of animals harvested in the region.

Resource development, human settlements, and increased human access in wolverine habitat can have negative impacts on wolverine populations, especially where dispersal potential for wolverines is compromised by disjunct habitats or lack of refugia (Weaver *et al*. 1996). Landscape-scale development activities in wolverine habitat such as those resulting from forest management activities not only modify habitat characteristics but affect wolverine movements (unpublished data from studies in British Columbia and Ontario). Road construction associated with forest management activities and other development can greatly improve trapper access to previously untrapped areas that once functioned as refugia for reproductive segments of a wolverine population (unpublished data from studies in British Columbia and Ontario). Roads also provide travel corridors for wolves, which could increase the potential for mortality of denning females and their kits (Magoun and Copeland 1998).

Until this study there had been no studies of wolverines in SE AK or any other coastal ecosystems, largely due to the expense and inherent difficulties associated with studying the species in these ecosystems. Wolverine populations are notoriously difficult to study because of the remoteness of their habitats, the size of their home ranges, and their low density compared to other mid-size carnivores. Acquiring information on reproductive females is particularly difficult because their home ranges often incorporate some of the most remote areas of occupied wolverine habitat. Past experiences of wolverine researchers suggested that a pilot study should be undertaken to determine the most feasible and cost-effective way to carry out wolverine research in ecosystems that have not yet been studied. For this reason, we conducted a pilot study in 2007 to determine which portions of the GMU 1B Mainland are most likely to support reproductive female wolverines and what methods are suitable for documenting their movements and habitat associations (Magoun et al. 2007). In 2008 we expanded our research effort and here we give preliminary results from the 2008 season.

STUDY AREA

The study area comprises the mainland of SE AK extending from Port Houghton southward to Le Conte Bay (Fig. 1). This area includes portions of GMU 1B and 1C as well as portions of the Juneau, Petersburg, and Wrangell Ranger Districts (U.S. Forest Service). We concentrated our livetrapping efforts in Thomas Bay and our remote camera work from Port Houghton to Le Conte Bay.

GOALS AND OBJECTIVES

The goal of this research is to provide wildlife managers with the information necessary to ensure that wolverine populations are managed sustainably and that functional habitat for reproductive female wolverines is maintained in the face of increasing human development and access to remote areas in SE AK.

The specific objectives for the second year of the project were as follows:

1. Gather information on wolverine movements, home range, and denning habitat in a portion of GMU 1B using ARGOS/VHF collars.

2. Use passive infra-red cameras to gather additional information on the distribution of wolverines.
3. Collect tissue samples from harvested wolverines and hair taken from livetrapped wolverines and wolverines visiting camera sites for use in genetic analysis.
4. Further evaluate and refine camera bait stations and hair snagging techniques as a method for estimating distribution and population size, and for monitoring wolverines over the long term.

METHODS

Livetrapping

We livetrapped wolverines using box traps built with 4x5 rough hewn timbers that were roughly 60 inches long, 30 inches wide, and 20 inches deep (Fig. 2). The heavy timber lid is triggered by the wolverine when it pulls at a piece of bait secured inside the trap at the back near the floor and connected by a cable to a panic snap on the outside of the trap. A cable, extending from the front of the trap lid over a cross member above the trap to the back of the trap, where it is attached to the panic snap, holds the lid up until the wolverine tugs on the bait and releases the panic snap. We lubricated the trigger mechanism with petroleum jelly and covered the trigger with a plastic bag to prevent ice build-up. We removed loose hide from pieces of deer and moose carcasses used as bait to prevent a wolverine from stripping lengths of hide from the bait, which could lengthen the distance between the bait and the back of the trap. This prevented the possibility of a wolverine pulling on the bait and triggering the trap while its head was up or its body is in the trap opening. We attached "chew" logs to the inside front of the traps where wolverines most often try to chew out of the trap. These logs are easily replaced when they become worn. After having wolverines escape by chewing their way out of traps in 2007, all traps were subsequently reinforced with hemlock lumber inside the traps and, in some cases, plywood on the outside of the traps. These reinforcements, combined with checking the trap monitoring devices at least every 8 hours, prevented any wolverines from escaping the traps in 2008. With the amount of snow and rain in the study area during the past 2 winters, trap lids remained heavy enough (>45 kg) that the wolverines could not lift the lids and escape. In addition to the wooden traps, we also tested 2 culvert-style live traps (Fig. 3), which have been used successfully to live-capture wolverines in British Columbia, Canada (L. Goodwin, personal communication).

We checked traps daily at a maximum of every 8 hours, either by visually inspecting them or by monitoring VHF signals emitted by trap-monitoring transmitters (Telonics, Inc.) attached to the traps. Most traps equipped with trap monitors were physically inspected every other day to remove snow and to ensure the trigger mechanisms were functioning properly. During periods of cold weather and heavy snow followed by warm weather and rapid thawing, traps were unset or checked every day to prevent water from building up inside the traps. During periods when sea ice was forming in Thomas Bay, those traps accessible only by boat were closed down. We also set infrared cameras at the traps to determine when wolverines began to visit them. In most cases, we did not set a trap unless we knew it was being visited by a wolverine to reduce the need to visit traps to release marten, the only other species that triggered the traps.

We anesthetized captured wolverines with tiletamine HCl and zolazepam HCl (Telazol®) at a dosage of about 10 mg/kg administered with a 6 cc syringe and 18-gauge needle attached to the jabstick. While one person used a long stick to distract the wolverine, another person would slowly move the jabstick and syringe close to the injection site (shoulder or rump) and then quickly jab the animal injecting the drugs.

Once immobilized, we weighed the animals, measured the head and neck circumferences, took blood samples, pulled hair for DNA and stable isotope analysis, and attached radiocollars. We also photographed the ventral side of the animals because individual wolverines can be identified by unique light-colored markings on the chest, throat, and chin area (Fig. 4). We photographed individual markings while the animal was positioned on its back, both before and after collaring the animal, and then again while the animal was coming out of the anesthesia. This allowed us to record differences in the chest, throat, and chin patterns when the animal was in an upright position, as seen from the front and from the left and right sides. These photographs could then be compared with photographs of wolverines taken at camera sites or harvested wolverines, in the event that the animals were able to remove their collars.

ARGOS/VHF collars

We used 4 ARGOS/VHF satellite collars manufactured by Sirtrack of New Zealand configured with a flexible, flat collar design (Fig. 5). We also had 3 VHF-only collars (with rolled leather collar design) for use in the event we captured more than 4 wolverines or if it became necessary to replace any ARGOS/VHF collars that failed prematurely.

Once activated the ARGOS PTTs emitted signals around the clock (i.e., we did not program a duty cycle to extend the life of the collars). We downloaded locations at regular intervals ($\leq$ 10-days) using the ARGOS internet services and entered the relocations in a GIS database; we also purchased the data CDs as data backup. Using standard VHF aerial tracking techniques we collected VHF relocations from March–July using a PA-18 Supercub. In addition to basic relocation data, we also collected information on habitat characteristics in areas where animals were located.

Hair-snagging

We tested a new design for snagging hair from wolverines. We used a 0.5-m length of plastic, square rod on which we mounted up to 8 alligator clips that were attached to the rod with wire or fishing line (Figure 6). The alligator clips were held open by compressing the tabs and inserting them in a groove along the rod. When an animal pushed against the alligator clip, the clip slipped from the groove and closed on the fur of the animal. In this way, only 1 animal could deposit hair in a single clip, unlike barbed wire that can gather hair from multiple animals on the same barb.

Infrared cameras

Besides the cameras set up to monitor activity at the live traps (Trailwatcher®, Cuddeback®, and Stealthcam®), we also deployed Trailwatcher® digital infrared cameras (triggered by a combination of heat and motion) at baited "camera trap" sites during attempts to photograph the ventral markings on the wolverines' chest, neck, and chin. To photograph ventral patterns, we attached a camera to a tree so that it faced the elevated end of a run pole (Figure 7). We usually positioned bait approximately 40 cm above the run pole and 30 cm in front of the run pole so that a wolverine would look up at the bait as it approached the end of the run pole. We used deer, moose, and beaver meat, beaver castor, and various other baits and lures, either separately or in combination, to entice the wolverines to climb onto the run pole. We tried placing some baits inside a cloth bag to prevent other species from removing all of the bait from the site. We also tried putting baits inside plastic buckets suspended upside down above the run pole to discourage birds and martens.

We deployed and maintained "camera traps" by using boats, snowmachines, or helicopters for access. Some cameras were moved to new locations if more than a month elapsed without being visited by wolverines.

DNA analysis

We cooperated with Dr. Joe Cook from the University of New Mexico (UNM) in a comparative study of wolverine genetics in SE AK and adjacent provinces of Yukon and British Columbia to determine the level of interchange between populations in SE AK and Canada. We purchased skinned wolverine carcasses from trappers in SE AK and collected hair from live-trapped animals and from hair snagging devices set up at some camera sites. All samples were shipped to Dr. Cook for processing in the UNM laboratory.

RESULTS

Livetrapping

We deployed live traps at 12 sites and operated them for a total of 301 trap nights from 18 January–20April 2008; wolverine capture dates ranged from 21 January–20 April.. The least number of trap nights for a given trap site was 3 trap nights with 1 wolverine captured; the longest number of trap nights was 86 with 2 captures (both recaptures from other trap sites). Wolverines were captured on 8 separate occasions, of which 3 were recaptures of previously collared animals. Of the 5 wolverines collared, 2 were adult males, 2 were reproductive females, and 1 was a nonreproductive female (i.e., no teat development indicating past reproduction). One of the females was lactating at the time of her capture on 28 March (Figure 8). One of the males captured in 2008 (Moonshine), had been captured and collared the previous year but was no longer wearing the collar. Photographs from cameras set at trap sites indicated that at least 2 wolverines visited the trap sites during the trapping period but were never captured, either because the traps were not set at the time of the visit or the animal failed to enter or trigger the trap.

ARGOS/VHF and VHF-only collars

Four animals were initially outfitted with ARGOS/VHF collars but 1 of these collars failed after only a couple of weeks so the animal (Beaverdam) was recaptured and collared with a VHF-only rolled leather collar. The nonreproductive female was the last animal captured and was outfitted with a VHF-only collar. Of the remaining 3 wolverines fitted with ARGOS/VHF collars, 2 (an adult male and a reproductive female) retained their collars throughout the study period until the batteries expired. The lactating female apparently shed the collar or died sometime in late May as the VHF signal indicated the collar was no longer moving (mortality mode). No attempt was made to retrieve the collar but a remote video camera captured footage of a wolverine without a collar in the vicinity of her capture site in July that appeared to be this female, indicating she had shed the collar. Before the collar stopped moving, we were able to locate the natal den site and a maternal den site. The subadult female also shed her VHF collar sometime in late May and an attempt to retrieve the collar was unsuccessful; this female was later photographed at a camera site without the collar. Because of the unknown error in ARGOS locations in categories A and B, we only used locations for home range analysis that were in categories 1, 2, and 3. Only relocations determined with VHF signals will be used in habitat analysis because we could locate the animals with known accuracy and describe the habitat that was being used. Home ranges of the animals outfitted with collars were determined using Minimum Convex Polygons (MCP) and are shown in Figures 9-13.

Hair-snagging

We deployed hair-snagging devices at 4 sites; all were locations where we knew wolverines were active. We successfully obtained wolverine hair samples at three of the 4 sites.

Infrared cameras

We established 39 camera trap sites using Trailwatcher® cameras during attempts to photograph the ventral patterns on wolverines. These cameras were deployed for varying lengths of time ranging from 19 January to 26 June. Over 3000 photographs showing at least a portion of a wolverine were taken at the camera traps. Wolverines were photographed at 23 of the 39 camera sites and 21 individuals were identified from photographs (Fig. 14) including all 5 of the collared animals.

The number of photographs taken of an individual wolverine during a “visit” to the camera site ranged from 1 to 218 with an average of 20 photographs per visit. We defined a visit as the period between the first photograph and the last photograph taken of a wolverine before there was more than a 30-minute break between photographs. Some wolverines spent less than a minute at the camera site while one spent as long as 218 minutes. The most visits by a single individual in a day was 4. The same wolverine sometimes visited the same site on as many as 4 consecutive days. The most individuals documented at any one site was 4. It was not uncommon for 2 different wolverines to be photographed at the same site on the same day. Sometimes visits by 2 different wolverines were made within an hour of each other. In one case, 2 wolverines were photographed at a camera during the same “visit”, although they were not photographed together on the run pole. On 2 occasions, wolverines were photographed sites within an hour of our visit to maintain the camera. We were able to identify 3 lactating females using the cameras during March–May (Fig. 15).

Other species that triggered our cameras while on the run poles in 2008 included mice, red squirrel, weasel, mink, marten, flying squirrel, moose, black bear, bald eagle, crow, and Steller's jay.

DNA analysis

In 2008 we purchased 10 wolverine carcasses from trappers, collected hair from 4 of the 5 captured wolverines, and collected hair from 3 others with hair snagging devices. All carcass and hair samples were sent to UNM for DNA analysis.

DISCUSSION

Livetrapping

The only other species captured in the live traps was marten. The culvert-style live trap was not deployed long enough to test the efficacy of the trap for capturing wolverines. Video cameras set up at 1 of the culvert traps documented wolverines going inside the trap and pulling on the bait, but the trap was not set at that time; another wolverine visited a culvert trap that was set but was not caught, probably because the door triggered prematurely. Because of the modifications we made to the wooden live traps and the frequency of trap checks, we experienced no problems with chewing out of the wooden live traps this season. Evidence from our cameras indicated that some wolverines remained very timid around the traps while others readily entered the traps even after they had been caught and radiocollared.

ARGOS/VHF and VHF-only collars

Satellite reception of signals from the ARGOS PTTs varied among collars on different wolverines. Very few signals were obtained from the lactating female wolverine (Sunshine), probably due to steep terrain around her den site and/or poor signal reception from under snow and rocks where she denned. Satellite reception from the other adult female (Mariner) was good and indicated that she was probably not denning, a conclusion supported by VHF relocation data. Satellite reception on the adult male that retained his ARGOS/VHF collar (Moonshine) was relatively poor compared to a similar collar he wore last season. Reasons for the poor reception were unknown. VHF signal reception was good throughout the tracking period and on only a few occasions were we unable to locate collared animals, usually because inclement weather prevented us from searching widely for the signal.

Locations based on ARGOS locations in categories 1 (error <1000 m), 2 (error <350 m), and 3 (error of <150 m) showed no substantial deviations from home ranges derived from VHF relocations, indicating that the MCP home ranges depicted in Figures 9–13 are accurate representations of the core areas used by collared wolverines during the 2008 study period. Only the male wolverine Moonshine was tracked during both years of study. His home range shifted in 2008, indicating an avoidance of the northwestern end of his 2007 home range (Fig. 16). There was no overlap of Moonshine's 2008 home range with that of the 2008 home range of the adult female Mariner to the west (Fig. 17). Photographs indicated the presence of at least 3 other wolverines within Mariner's home range (Fig. 18), and the presence of another adult male may explain the 2008 shift in Moonshine's home range.

Home range size for 4 individuals with at least 20 relocations from March through July falls within the published range sizes of wolverines in other study areas, except for the adult male Beaverdam. His home range was only 163 km^2, even smaller with open water subtracted from the calculation of home range size (Figure 9). This male did not display the typical movements and home range characteristics of a resident adult male. He spent weeks in very small areas, sometimes swimming short distances to offshore islands, and made occasional, rapid movements around the perimeter of Thomas Bay. He was documented only once in the mountainous portion of the study area, when he was phototgraphed at one of the camera sites. This animal had large, recent wounds on his back and face when recaptured on 3 April, indicating that he may have been fighting with another wolverine. All these factors suggest that this male was likely a "floater" living on the margins of other wolverine territories at least during the breeding season. The other adult male (Moonshine) had a home range of 527 km^2 in 2008 and none of this MCP included large bodies of water. The adult female Mariner had a home range of 308 km^2 with no large bodies of water within her MCP. Interestingly, this female was initially captured in Thomas Bay on 27 February. Upon release she moved rapidly westward over 20 km to her core home range (Fig. 19) and was not documented outside of that home range again from March–July. The nonreproductive female Snowstorm had the largest home range at 631 km^2, but the MCP included portions of the ocean. Her home range overlapped those of the other 4 radiocollared wolverines, indicating that she was likely a "floater" as well. As mentioned above, we did not have enough locations to determine home range size or extent for the lactating female Sunshine.

Hair-snagging

We collected wolverine hair samples at 3 of the 4 sites where hair snags were deployed in 2008 (Fig. 6). Video and still cameras set up at the hair snagging sites indicated that wolverines were initially cautious when approaching hair snagging devices but soon ignored the snagging devices during their attempts get baits. The alligator clip hair snags were easier to handle and deploy than the barbed wire set-ups we experimented with the previous season. More testing of the alligator clip snags is required to determine the best way to mount the clips along run poles to obtain a good hair sample during a single visit by a wolverine.

Infrared cameras

Cameras with infrared triggers made it possible to identify 16 wolverines in addition to the 5 animals captured and radiocollared. Because livetrapping wolverines is not feasible in the remote mountainous portions of the study area, documenting wolverines with remote cameras and/or DNA from hair samples is the only way to determine the distribution and number of wolverines using the study area. We plan to expand camera trapping efforts in 2009 to evaluate the feasibility of remote camera traps to determine wolverine distribution and occupancy, estimate population size, determine turnover rate, and document locations of reproductive females.

DNA analysis

Data from wolverine carcasses collected from trappers in SE AK and from livetrapped wolverines have been analyzed and a paper has been submitted for publication. Preliminary results suggest that the glaciated portions of the SE AK Panhandle serve as an effective barrier to dispersal in the female segment of the wolverine population, thereby limiting interchange between SE AK and adjacent Canadian provinces. Additional DNA samples will be collected in 2009 from carcasses collected from trappers and from hair snagging devices at future camera trapping sites. Once again, carcasses and genetic samples will be analyzed by Dr. Joe Cook and his graduate students at the University of New Mexico, Albuquerque.

RECOMMENDATIONS

We propose continuing the camera trapping/hair snagging effort in winter 2009 to both refine techniques and develop guidelines for using remote cameras and DNA to document the distribution and abundance of wolverines SE Alaska; specifically, the objectives of the third year of work are as follows:

1. Use different types, amounts, and positioning of baits to determine the best set-up for targeting wolverines.
2. Apply nonbait lures in various places at the camera sites in order to position the animals so that differences in male and female anatomy can be photographed.
3. Add hair snags to the camera sites to test our ability to accurately identify the sex of the photographed wolverines and to compare the number of animals detected with cameras with the number detected with hair snares.
4. Develop protocols for using cameras as a method for determining distribution and occupancy, estimating population size, documenting the proportion of reproductive females, and estimating turnover rate in harvested and unharvested areas.

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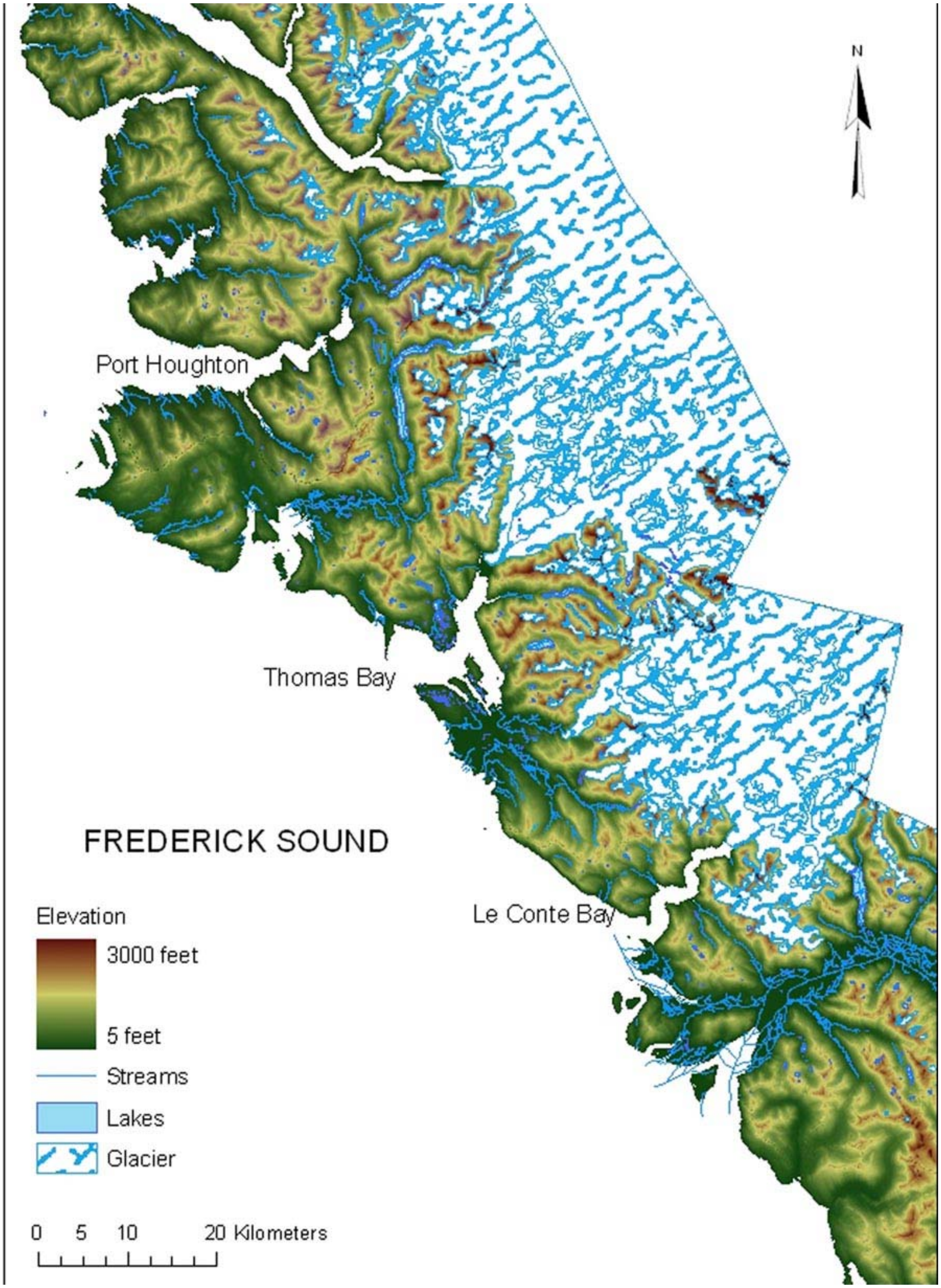

Figure 1. Location of the study area.

Figure 2. Tranquilized wolverine lying on top of a wooden live trap while we prepare to change its collar.

Figure 3. Culvert-style live trap with the door open.

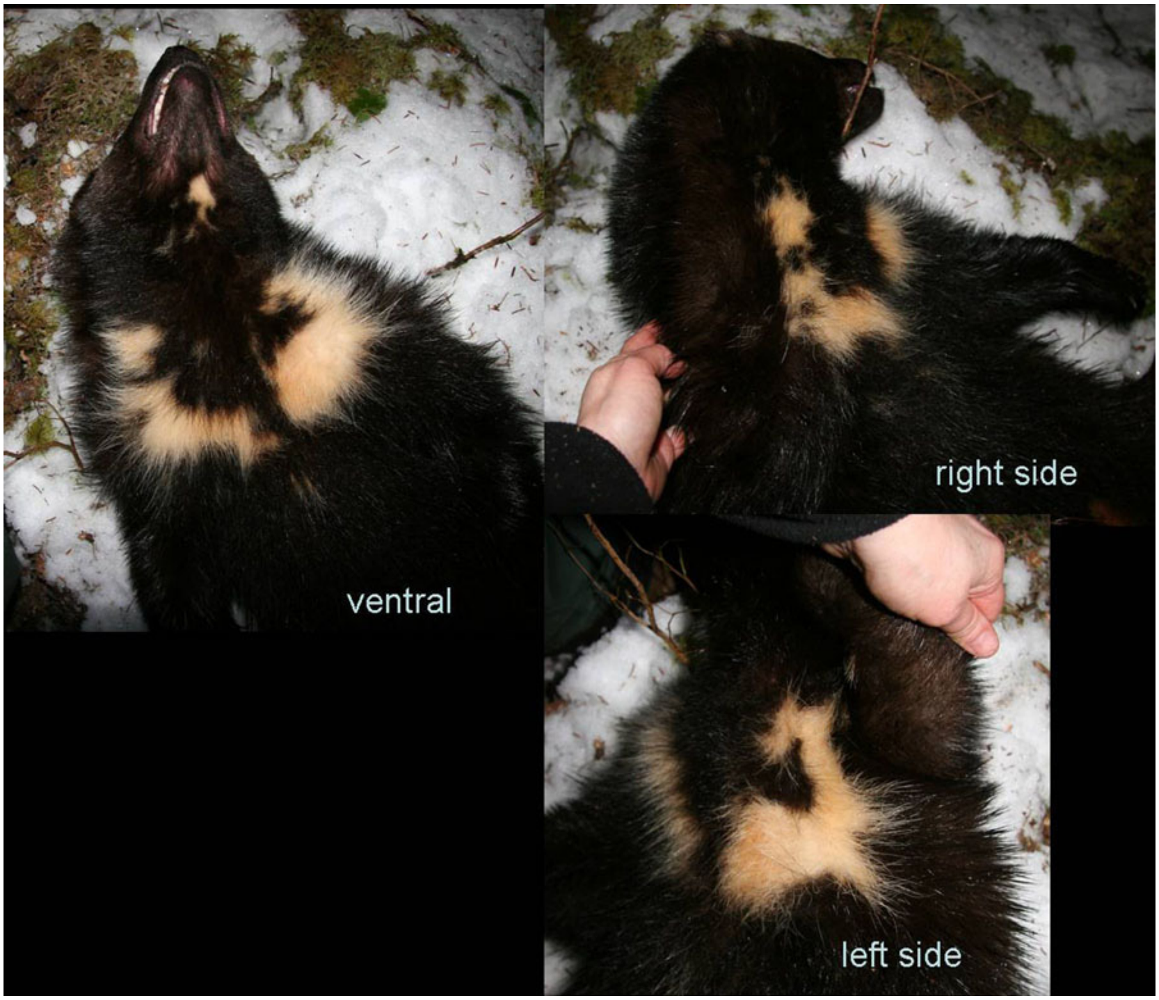

Figure 4. Photographs of the pattern of light coloration on the ventral side of a male wolverine.

Figure 5. Wolverine in Figure 4 now wearing ARGOS/VHF transmitters mounted on a flat vinyl collar.

Figure 6. Device for snagging wolverine hair using alligator clips.

Figure 7. Run pole with hanging bait and a Trailwatcher® camera mounted on a tree about 4 m from the run pole.

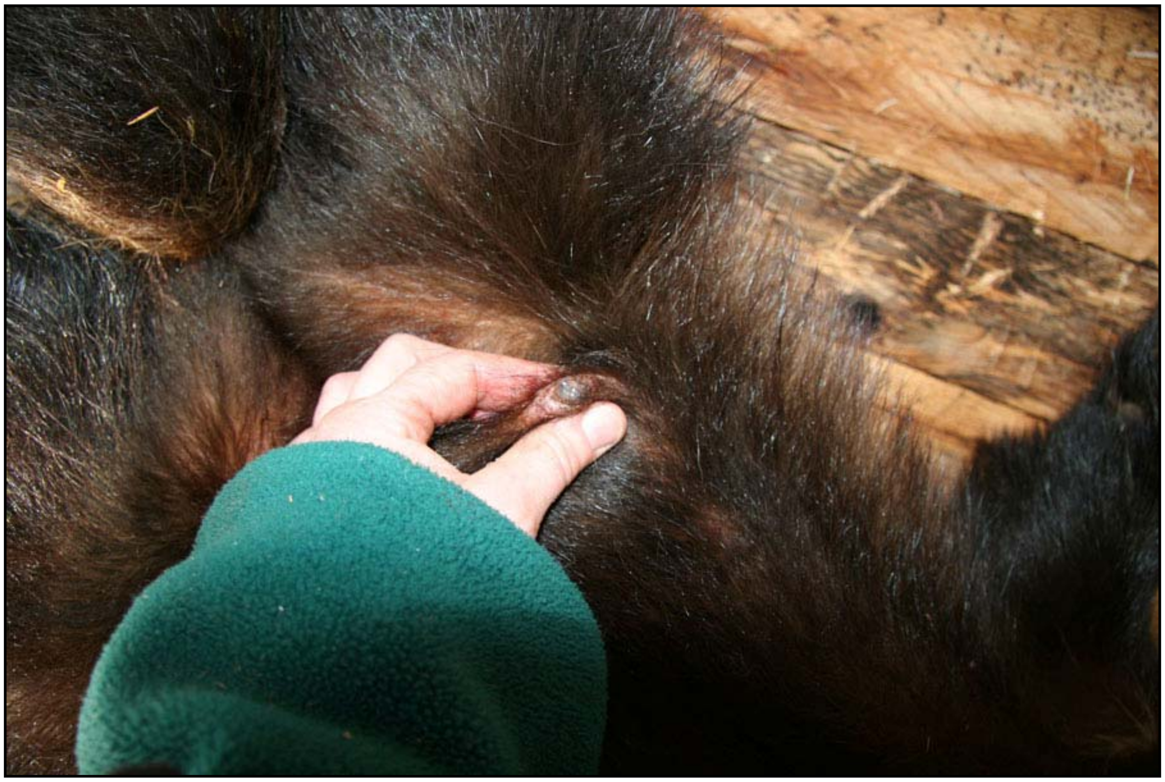

Figure 8. Female wolverine (Sunshine) at the time of her capture on 28 March 2008 showing milk in one of the mammaries.

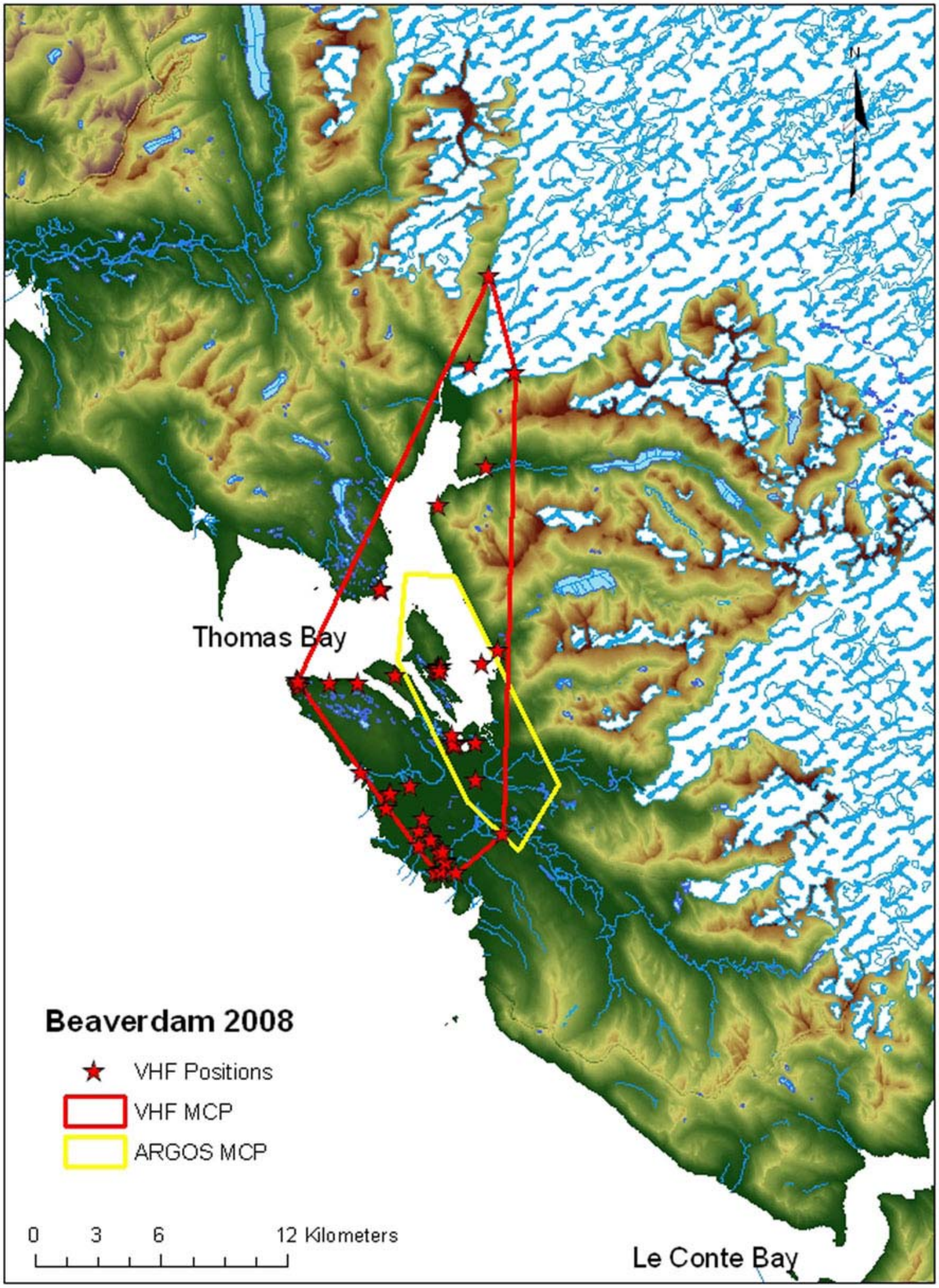

Figure 9. Home range for adult male Beaverdam.

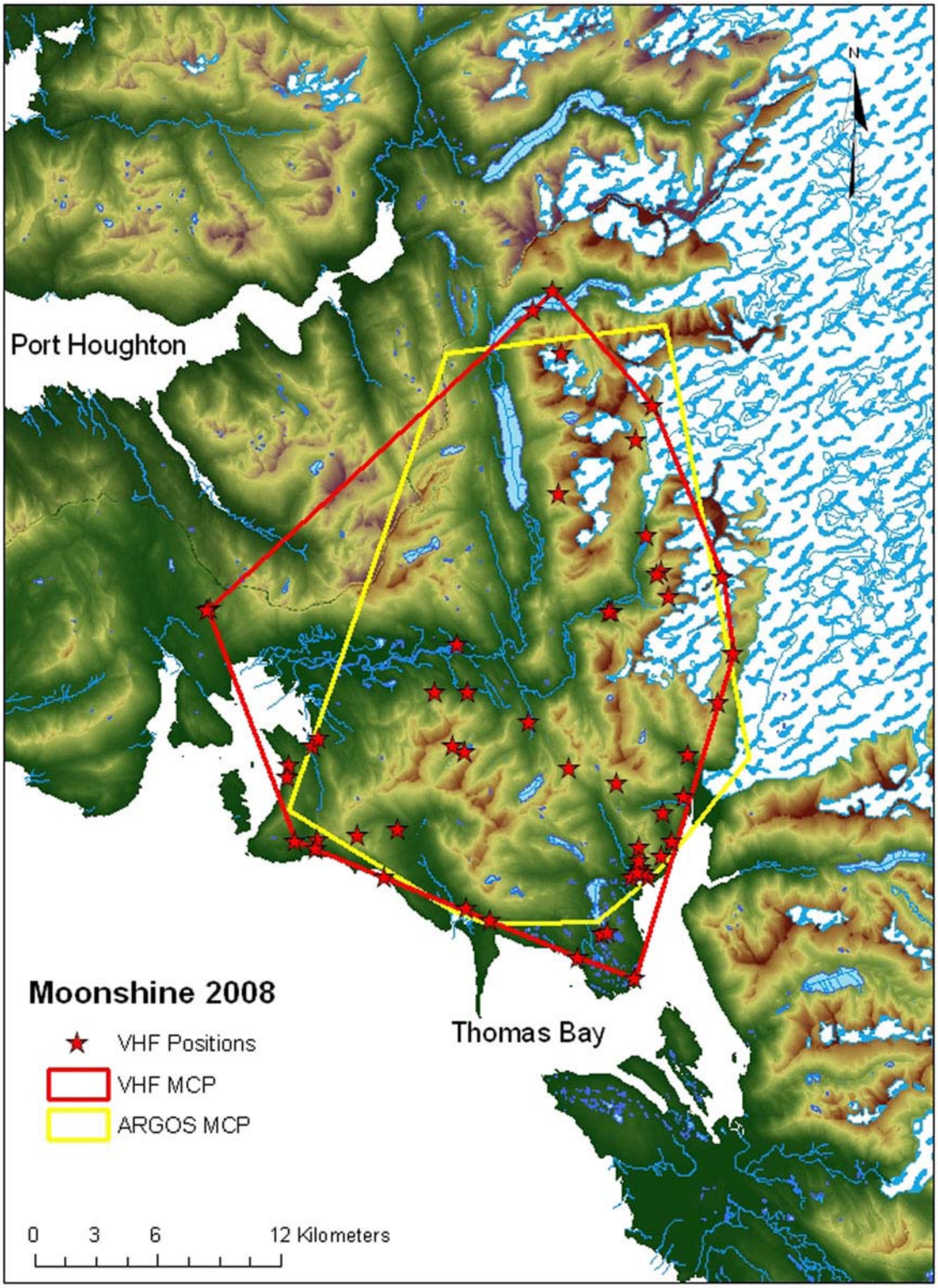

Figure 10. Home range for adult male Moonshine.

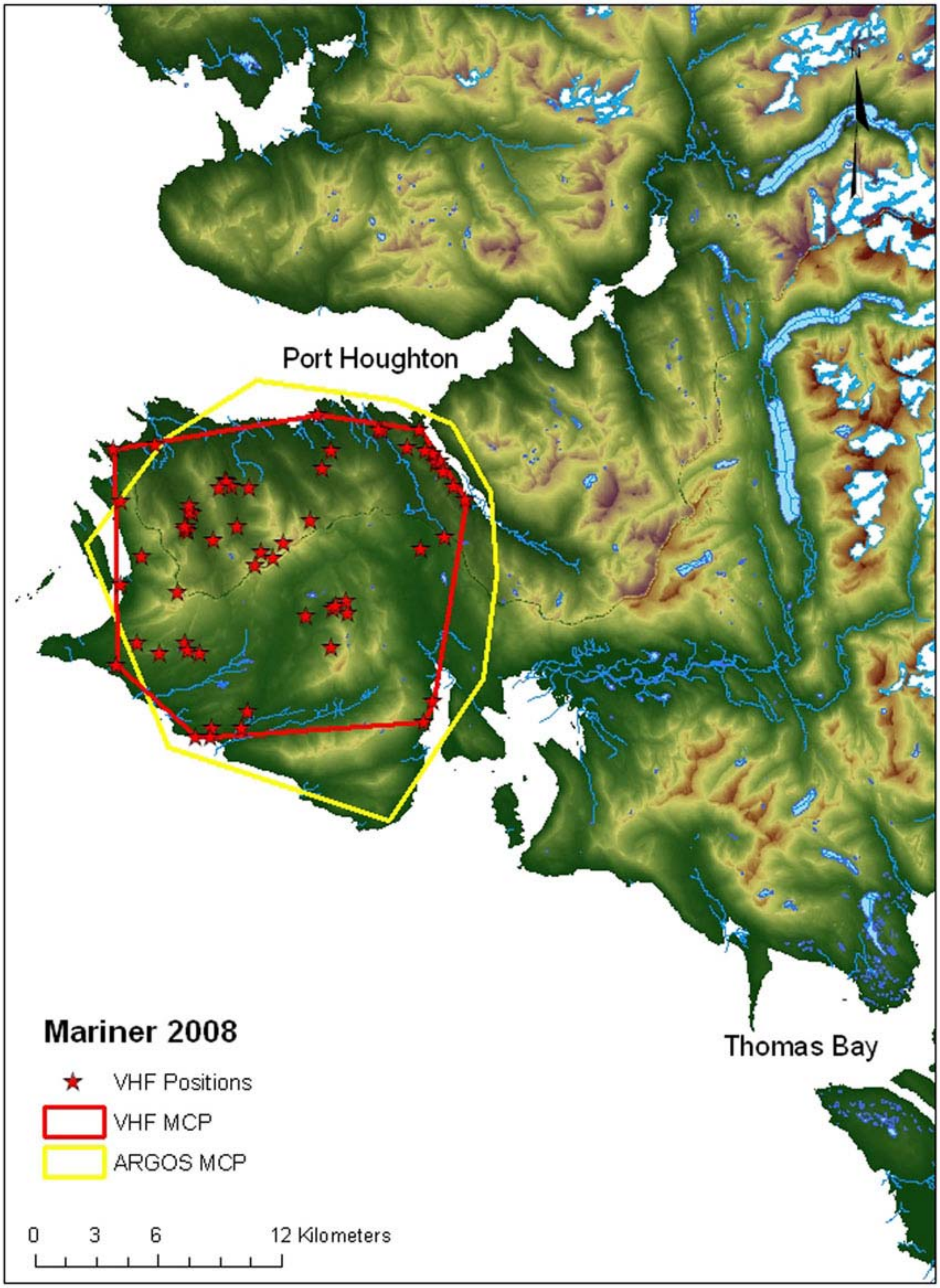

Figure 11. Home range of adult female Mariner.

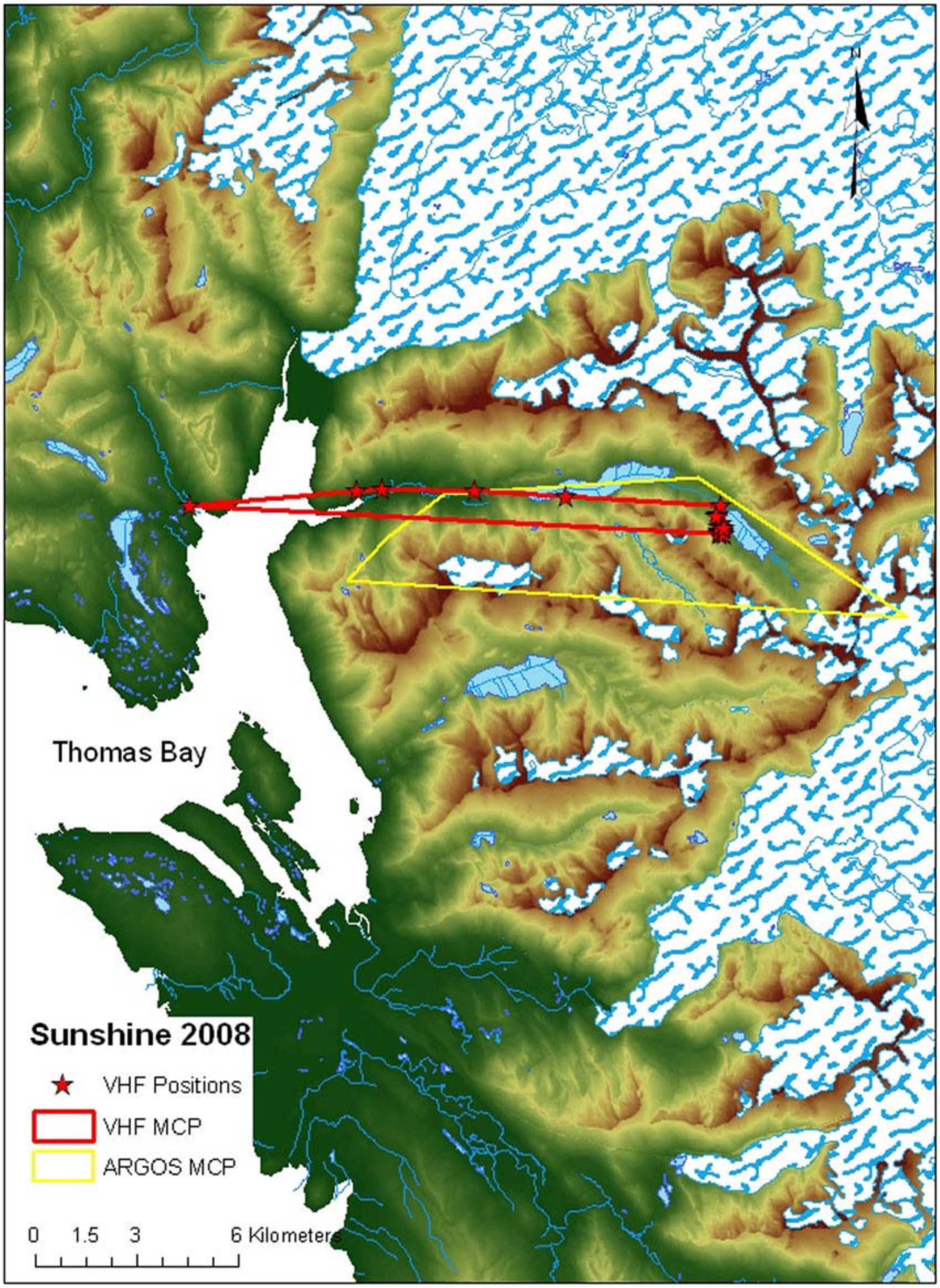

Figure 12. Home range of adult female Sunshine; collar was shed in late May 2008.

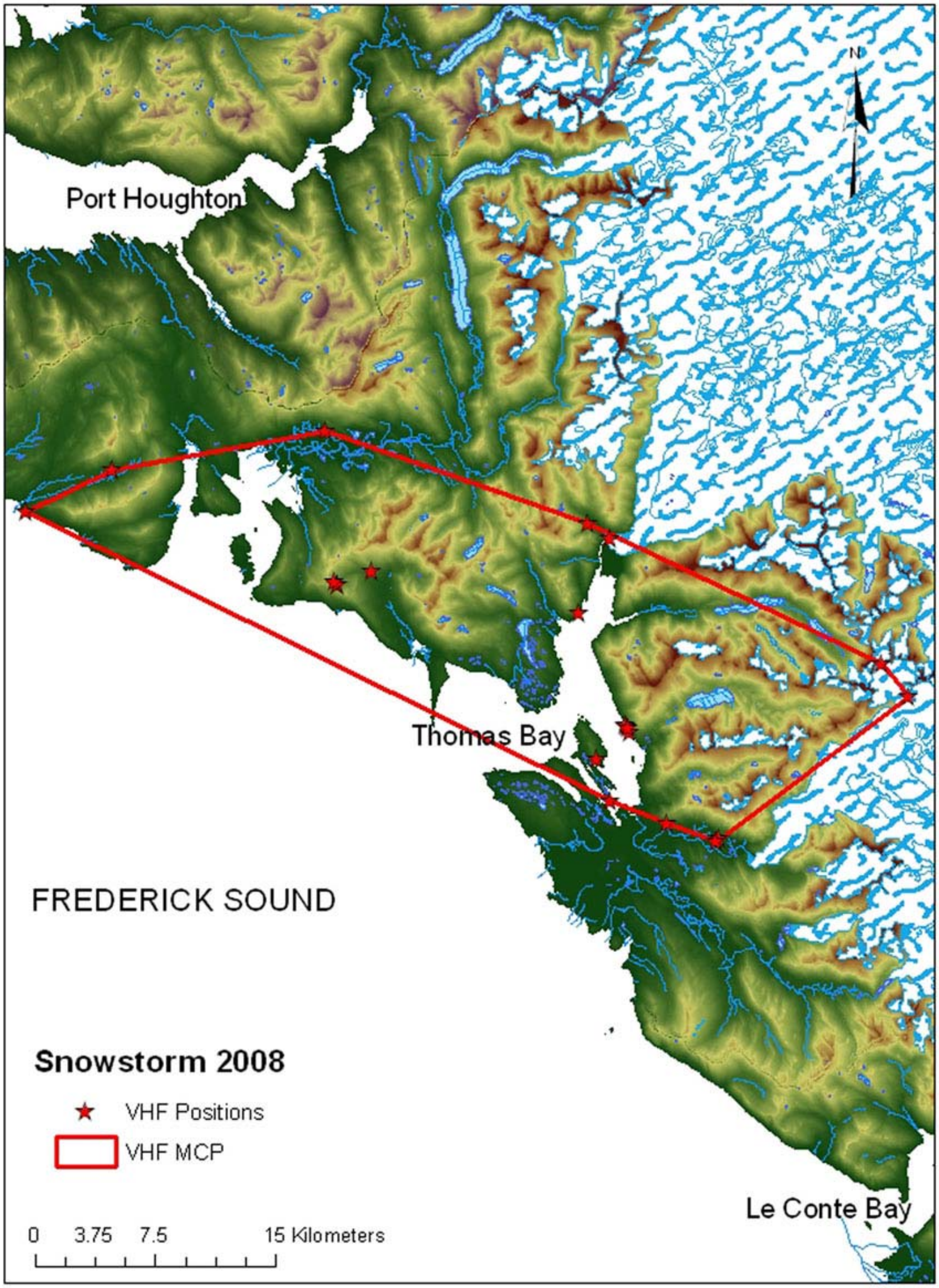

Figure 13. Home range of nonreproductive female Snowstorm; the collar was shed in late May.

Figure 14. Ventral patterns on 10 different wolverines photographed in 2008.

Figure 15. Photo of a lactating female wolverine showing enlarged mammaries.

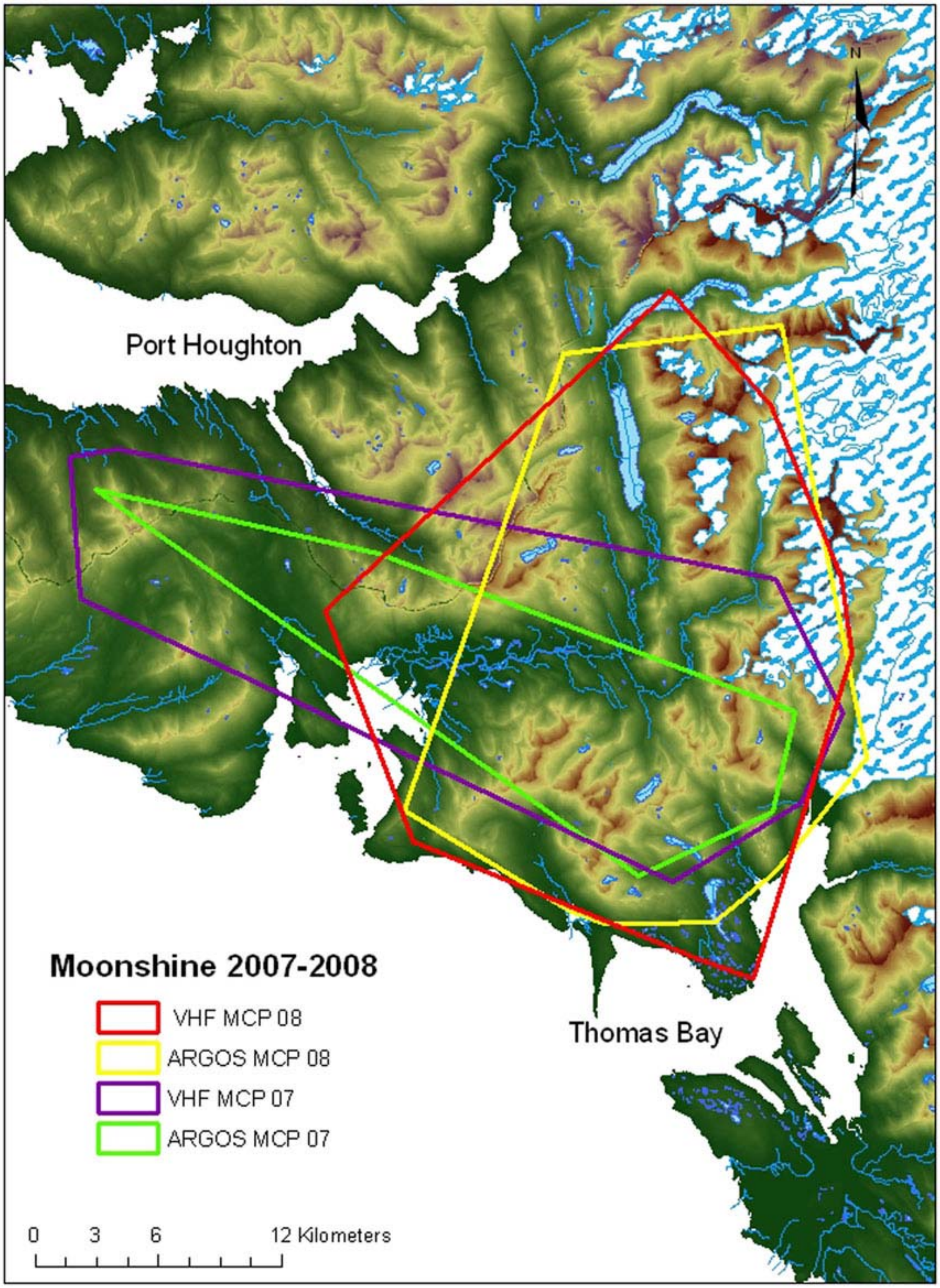

Figure 16. Difference between the location of the 2007 and 2008 home ranges of adult male Moonshine.

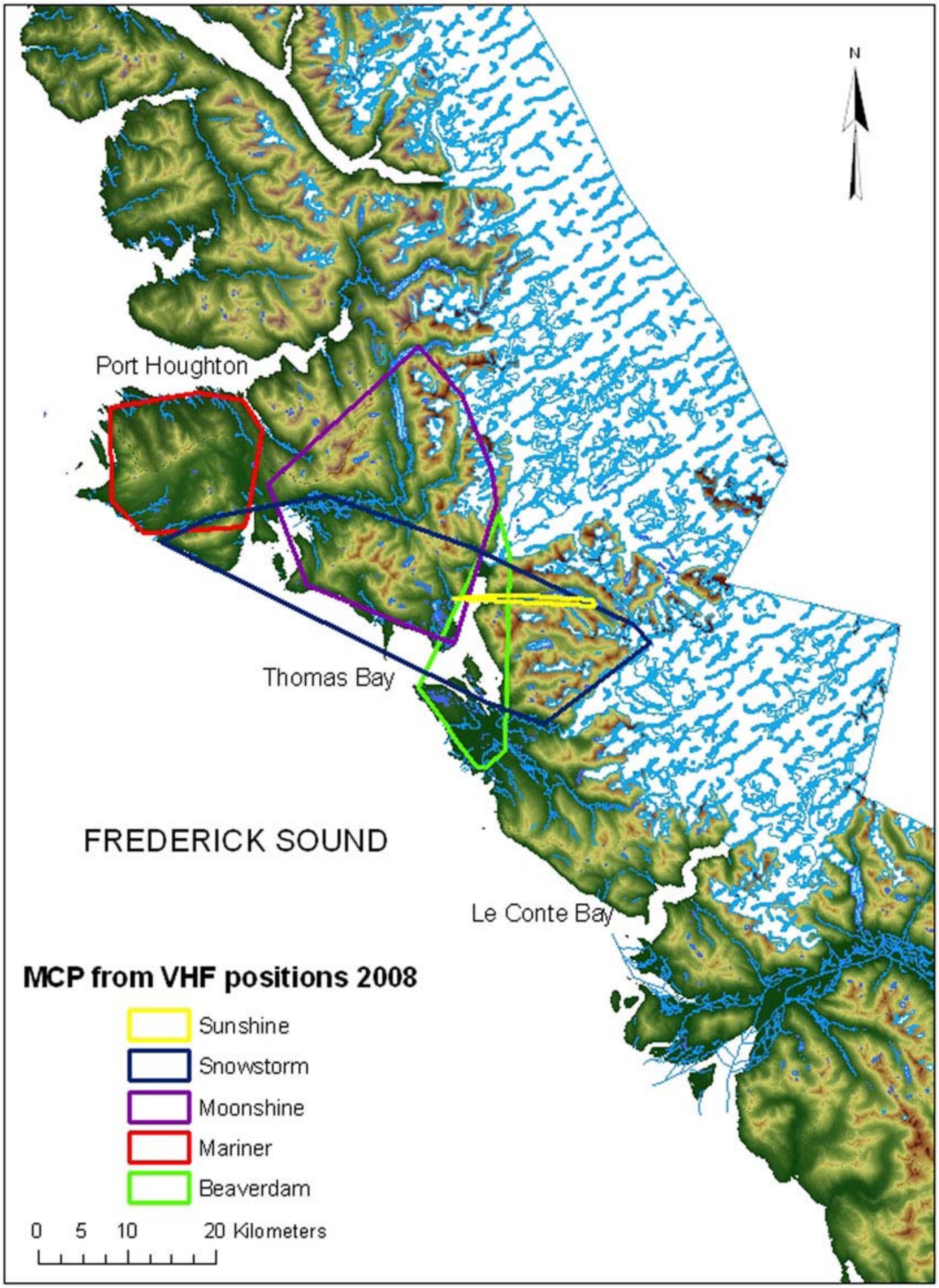

Figure 17. Overlap in 2008 MCP home ranges for wolverines in the study area.

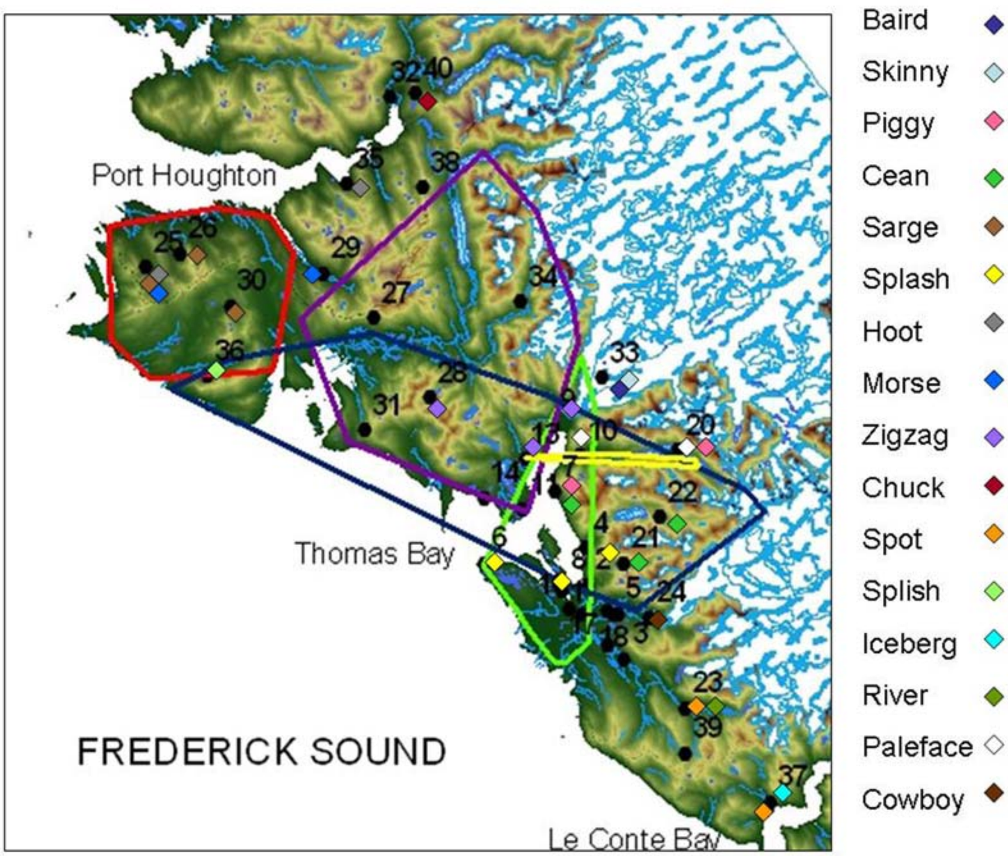

Figure 18. Location of cameras (black hexagon) and uncollared wolverines (colored triangles) in the study area in 2008.

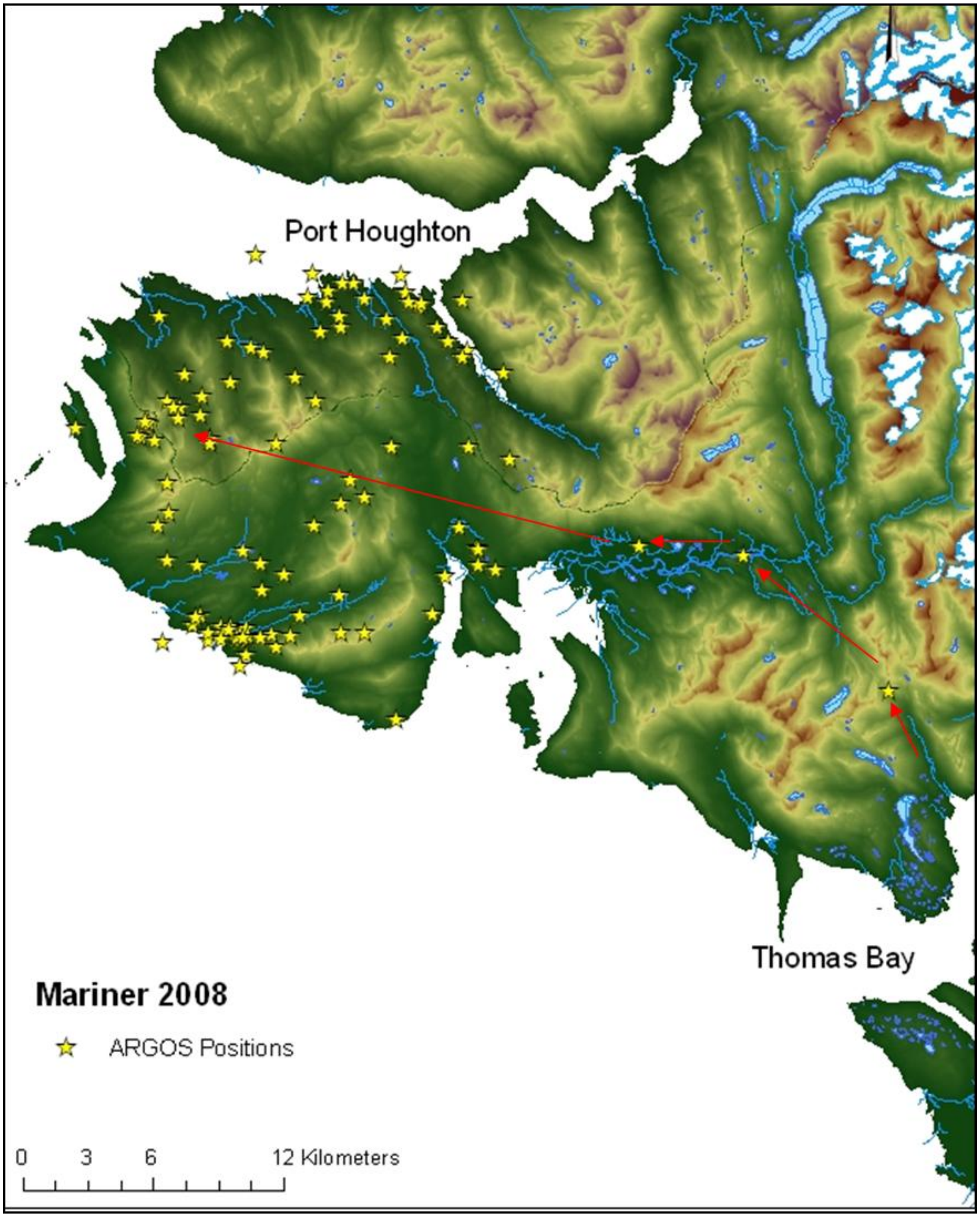

Figure 19. ARGOS satellite locations for adult female Mariner showing her route of travel (red arrows) following her release after capture at Thomas Bay on 27 February to her 2008 home range (March–July) near Port Houghton.