Wildlife Research Annual Progress Report

Wolverine Monitoring for the Juneau Access Improvements Project

Stephen B. Lewis, Rodney W. Flynn, and Neil L. Barten

Alaska Department of Fish and Game
Division of Wildlife Conservation

December 2009

Acknowledgements

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This report contains preliminary data and should not be cited without permission of the authors.

Contents

Introduction

Background

The wolverine (*Gulo gulo*) is one of the rarest and least-known carnivores in North America (Banci 1994, Ruggiero et al. 2007). Wolverines occur at low densities and tend to be found in areas removed from human influence (Banci 1994, Aubry et al. 2007). Because of this, relatively little was known about wolverine ecology until recently (Banci 1994, Squires et al. 2007). Research has shown that wolverines are susceptible to human disturbance (Krebs et al. 2007), suitable denning habitat is a critical habitat component (Magoun and Copeland 1998), and harvest is an additive mortality that can significantly affect population demographics and cause local extirpation of wolverine populations (Hornocker and Hash 1981, Krebs et al. 2004, Squires et al. 2007).

Wolverines are managed as a furbearer in Alaska for which trapping and hunting is allowed. Based on sealing records from southeast Alaska, 19 wolverines (on average) were harvested in Units 1 and 3 over the last 12 years; 42% of these were taken from Units 1C and 1D in northern southeast Alaska. Over that time, 0-4 wolverines were harvested in the Berners Bay area annually. Although sealing provides managers with some useful information on each animal sealed (e.g., sex and general location of harvest) and general trend of harvest, it provides no information about the wolverine ecology or insight about current or future population levels.

In Southeast Alaska, access during the winter trapping season is logistically challenging because of limited road access to wolverine habitats. Near Juneau, the Alaska Department of Transportation and Public Facilities (ADTPF) is planning to construct an all-season highway that will extend the existing highway from Juneau approximately 50 miles northwest (ADTPF 2006). This road will pass through habitats occupied by wolverines and provide significantly increased access to these areas. Increased access to wolverine habitats, provided by this road, will likely increase exploitation rates. In addition, this road could provide snow machine access to habitats used by female wolverines for denning and kit rearing (Magoun and Copeland 1998), potentially resulting in conflicts between female wolverines at their dens and recreational snow machine riders.

Knowledge of wolverine ecology and population dynamics is limited and field studies are needed to fill critical information gaps (Ruggiero et al. 2007). These gaps in knowledge exist in coastal areas like southeast Alaska (Magoun et al. 2007). Information on basic ecology, including home-range size and habitat use, movements and dispersal characteristics, and diet are needed to determine factors affecting wolverine abundance and ultimately to ensure sustainable populations (Krebs et al. 2004, Lofroth and Ott 2007). By learning the role and relative importance of these factors, we will be able to appropriately manage this species in a responsible manner per the Alaska Department of Fish and Game, Division of Wildlife Conservation's mission to "Conserve and enhance Alaska's wildlife and habitats and provide for a wide range of public uses and benefits".

Study Objectives

This research was designed to investigate the ecology of wolverines in the Berners Bay area of northern southeast Alaska. The specific objectives were to: 1) Determine spatial-use patterns (i.e., home range, movements) and habitat selection of wolverines in the Juneau Access study area; and 2) Investigate wolverine food habits in the Juneau Access study area. Initially we wanted to derive a wolverine population estimate for the Juneau Access study area, but were unable to attempt this given logistical constraints. This report provides a summary of project activity from December 2007 – December 2009.

Study Area

We studied wolverine ecology in the watershed complex associated with Berners Bay (58º 46’ N, 134º 56’ W; 60 km north of Juneau, Alaska; Fig. 1), primarily in drainages intercepted by the Juneau Access Project (Alaska Department of Transportation and Public Facilities 2006; Figure 1). Four large rivers (Antler, Berners, Gilkey, and Lace) and several smaller watersheds drain into Berners Bay. Elevation within the study area ranges from sea level to >1900 m. The area has a maritime climate with cool, wet summers and relatively warm, snowy winters. Summers temperatures average 13.9°C while winter temperatures average -3.2°C (Haines, AK; National Weather Service, Juneau, AK; http://www.arh.noaa.gov/clim/climDataSearch.php?stnid=ahna2). Annual precipitation at sea-level averages 140 cm. Higher elevations (800 m) typically receive around 100 cm of snow annually.

Berners Bay is an intensely glaciated landscape. The study area contains rugged topography interrupted in a few areas by river valleys and glacial outwash plains. The mountains have moderate to steep forested slopes, interrupted by raised benches, bare rock cliffs, and steep avalanche chutes. The terrestrial habitat consists mostly of coastal coniferous rainforest dominated by western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), and some scattered mountain hemlock (*T. mertensiana*), Alaska or yellow cedar (*Chamaecyparis nootkatensis*), and red alder (*Alnus rubra*). These forests typically extend from sea level to an elevation of approximately 750 m, with subalpine and alpine habitats at higher elevations. Deciduous forest or mixed deciduous/needleleaf forest communities, dominated by black cottonwood (*Populus balsamifera*), are found in limited areas, primarily in association with floodplains of larger rivers. Interspersed within the forest are open, poorly drained areas, including muskeg and bog communities. The subalpine and alpine areas, with steep slopes and limited soil, support low shrub and dwarf shrub communities, and a variety of grasses, wildflowers, ferns, and mosses; above this, glaciers and snowfields dominate.

Potential wolverine prey in Berners Bay include moose (*Alces alces*), mountain goats (*Oreamnos americanus*), Sitka black-tailed deer (*Odocoileus hemionus sitkensis*), American beaver (*Castor canadensis*), hoary marmot (*Marmota caligata*), North American porcupine (*Erethizon dorsatum*), and various smaller rodents. Many streams in the study area support spawning Pacific salmon (*Oncorhynchus* spp.) during the late summer and fall. Other larger predators include brown bears (*Ursus arctos*), American black bears (*U. americanus*), wolves (*Canis lupus*), and coyotes (*Canis latrans*).

Methods

Wolverine Capture

We captured wolverines using modified box-traps made from red alder or rough-cut western hemlock (Fig. 2; Copeland et al. 1995). All traps were built during the winter 2008 field season. During early winter 2007, we felled red alder trees (15 – 20 cm diameter) and cut them to length (~ 183 cm) on site for transport to our storage location. We used approximately 5 trees per trap and collected enough wood for 4 traps. We obtained scrap sections of rough-cut 15-cm × 20-cm western hemlock for 2 traps and purchased rough-cut, 15-cm × 20-cm hemlock from a local timber mill for 5 traps. We prepared materials for trap construction (e.g., cut sections to length) at our storage location and deployed trap material with the aid of a helicopter to sites for construction. We constructed traps (183 cm long, 102 cm wide, and 86 cm high) on site and felled 1 tree at each site for the lid lever-arm and support (Fig. 2).

We situated traps to intercept travel routes of wolverines, usually along riparian corridors or at the base of valley-side slopes, or to target sites with natural attractants (e.g., winter-killed goat carcasses). We constructed traps beneath the canopy of a large tree to reduce snow accumulation on the trap lid. Later, we covered the trap with a tarp to limit rain and snow. We baited traps with parts from beaver, mountain goat, black-tailed deer, moose, and salmon carcasses. We looped wire around or through the bait and pulled it snug against the back of the trap. We placed a layer of conifer boughs on the trap floor to prevent bait from freezing to the floor and to provide bedding for captured animals. We stapled a 91-cm × 91-cm piece of plastic tarp on the lid at the back of the trap to provide additional shelter from rain or melting snow for animals in the trap.

We captured wolverines during the time when brown and black bears were denning and thus would not molest traps (roughly December – April). During winter 2008, we constructed traps in January – February and operated them throughout the season, ending when bears began to visit traps. Between capture sessions, all traps were left in the field with the bait and triggers removed and lids shut. We re-assembled traps (mounted triggers and trap lids) and pre-baited traps 3-5 days prior to trapping. During winter 2009, we trapped from 14 January 2009 until 22 February 2009 when we deployed our last GPS collar (Table 1). We used a VHF trap-site transmitter (TBT-500, Telonics, Mesa, AZ) on each trap to monitor trap success at least every other day. We visited all traps once every 7 days regardless of whether the trap was tripped to check for excessive snow and ice buildup on the lid and trigger mechanism.

Wolverine Handling

We followed capture and handling guidelines presented by the American Society of Mammalogists (Gannon et al. 2007) and approved by the Alaska Department of Fish and Game's Animal Care and Use Committee (ACUC # 07-20). We visually estimated the weight of captured wolverines by opening the lid and shinning a flashlight on the animal. We immobilized wolverines using as mixture of ketamine (8 mg/kg) and medetomidine (0.3 mg/kg) administered with a jab-stick (Zoolu Arms of Omaha, Omaha, NE). We collected hair, blood, and tissue for genetic identification and stable isotope analysis. We recorded gender, weight, body measurements, and physical condition. We attempted to age animals based on tooth wear and took a set of photographs of each animal's teeth to compare with known-aged specimens. We examined mammary glands of females for evidence of current or previous lactation. We outfitted each animal with a GPS collar (see below) and each animal received a small (5cm x 0.5cm) colored ear tags (Minitag, Dalton ID Systems, Ltd., Oxon, United Kingdom) in each ear.

Once processing was complete and the clinical effectiveness time of the ketamine had expired (approximately 45 min), we returned the animal to the trap and administered atipamezole (0.2 mg/kg) to reverse the medetomidine. We secured the trap door open and allowed the animal to vacate the trap site on their own. Non-target animals were allowed to vacate on their own by securing the door open and leaving the vicinity of the trap.

GPS Collars

We outfitted each animal with a GPS collar (Lotek Wireless, Inc. Newmarket, Ontario). During winter 2008, we used a store-on-board GPS collar (Lotek GPS_3300S). In winter 2009, we used 2 new model GPS collars: a remotely-downloadable version (Lotek GPS_7000 SLU) and a store-on-board GPS collar (Lotek GPS_6000SL). In addition, we used the older model store-on-board GPS collar (Lotek GPS_3300S) once the new collars were all deployed. We deployed collars with a programmable, remote-release mechanism set so the collar came off the animal 24 weeks (2008) and 20 weeks (2009) after capture. Software available with the Lotek collars allowed flexibility in collar programming, enabling us to change the fix rate from 12 fixes / hr (1 fix every 5 min) to 0.2 fixes / hr (1 fix/6 hours). We experimented with different fix schedules and search times in an attempt to maximize the time over which the collar would collect locations while minimizing the length of time between fixes (i.e., the fix rate). All collars except for the remotely-downloadable collars need to be recovered to access data, but could be downloaded in the field with a laptop upon recapture of the wolverine.

Marten

We encountered American marten (*Martes americana*) at almost every trap site and initially had problems with them tripping wolverine traps or eating the bait. To avoid catching marten in wolverine traps, we baited a live trap (Tomahawk model 203; Tomahawk Live Trap Co., Tomahawk, WI) with venison scraps, covered it with a piece of plastic tarp, and then placed it under a log or the base of a tree near the wolverine trap. We removed trapped marten from the vicinity of wolverine traps and released them ~ 10 miles away, so they did not return to the traps.

Wolverine Monitoring

All marked animals were monitored periodically with VHF telemetry to maintain contact with each animal and to check for dropped collars. We used standard aerial radiotelemetry to locate animals monthly. We attempted to retrieve all dropped collars on the ground as conditions permitted.

Spatial Data Analysis

A comprehensive analysis of wolverine habitat use and movement patterns is planned, but will not be completed until all GPS location information is collected. However, a descriptive assessment of home range and movements was conducted based on data opportunistically downloaded from GPS collars on recaptured wolverines or recovered from the field.

Population Estimation

We did not attempt to make a population estimate. We researched different potential techniques to generate a population estimate including hair snagging for a DNA mark-recapture estimate and remote digital cameras to photograph the ventral markings on wolverine chest, throat, and chin (Magoun et al. 2007). However, given the logistical constraints of working in the Berners Bay area, we were unable to capture and collar wolverines and conduct a population estimate for these animals.

Food Habits

We collected hair from live-captured wolverines and from wolverines harvested in the Berners Bay area. After the field season, we sent these samples for an analysis of stable isotope ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) and comparison with known isotopic ratios of a suite of potential prey species (Ben-David et al. 1997). In addition, we sent samples from prey from the Berners Bay area including moose, mountain goat, and deer.

Results and Discussion

Trap Placement and Construction

We constructed traps during late January and February 2008. We used a helicopter to sling trap material and built them on site (Fig. 3). We constructed these 8 traps in late January and February. During 2009, we used the same trap sites and reused most of the existing traps. Any traps not used will either be deconstructed and moved or destroyed on site.

Capture and Handling

2008.—From January to April 2008, we captured 4 individual wolverines (2 males and 2 females) 9 times during 701 trap nights resulting in a capture rate of 1.28 captures/100 trap-nights (Tables 1, 2). We had a capture rate for individual wolverines of 0.57 individual captures/100 trap-nights. All wolverines were captured in log or modified log box traps; no animals were captured in the portable plastic traps. All captures took place away from the beach edge of Berners Bay (Fig. 3). We anesthetized wolverines each time they were caught in our traps, and we collared each wolverine upon initial capture. Upon recapture, we downloaded GPS data from the collars for wolverines that retained them (M1 twice, F1 once) and deployed a new collar on wolverines that had dropped their original collar (F1 and F2; Table 2). Male wolverines weighted 14 – 15 kg and females weighted 8 – 9 kg.

Wolverines escaped from traps 2 times because of a malfunction in the bait attachment. A modified carbineer was used to connect the trigger wire to the wire surrounding the bait. In both cases, the animal was able to free the bait from this carbineer without triggering the trap and escape with the bait. After this occurred, all carabineers were removed and replaced with a locking connector that could not be unlatched by an animal. Non-target species captured included several martens and a domestic dog (*Canis familiaris*) in 2008 (Table 1). In addition, brown and black bears tripped traps, but did not get caught or were able to escape (identified by tracks at site). Two traps were partially destroyed by bears on the last day of trapping.

2009.—From January to February 2009, we captured 7 individual wolverines (5 males and 2 females) 8 times during 237 trap nights resulting in a capture rate of 2.28 captures/100 trap-nights (Tables 1, 3). We had a capture rate for individual wolverines of 2.95 individual captures/100 trap-nights. All wolverines were captured in log or modified log box traps. All captures took place away from the beach edge of Berners Bay (Fig. 3).

We anesthetized and collared each wolverine upon initial capture. One recaptured wolverine was not anesthetized on its second capture because it was only 1 week after the collar was deployed. This animal was released immediately after identifying it. Male wolverines weighted 13 – 14 kg and females weighted 10 – 11 kg. During 2009, non-target species captured included marten and a red fox (*Vulpes vulpes*; Table 1).

Monitoring

2008.—Wolverine M1 was collared originally on 3/21/2008. He was recaptured on 3/29/2008 and retained his collar. We downloaded his collar at that time. He was recaptured a third time on 4/22/2008. He still had his collar, and we downloaded it and replaced the battery. M1's collar did not release on 10/7/2008 as scheduled. We were able to subsequently recapture this animal in 2009 to remove this collar.

Wolverine F1 was captured and collared on 4/15/2008. She was captured again on 4/20/2008 and we downloaded her collar. On 4/29/2008, F1 was captured a third time, but had lost her original collar and was given a new collar. On 4/30/2008, F1 dropped her second collar. On 5/3/2008, we attempted to collect both of F1's dropped collars. We found her second collar in a small cave formed by snow drifting over a large rock on a steep slope (Fig. 4). There were signs of porcupine roosting in the cave. The collar was found wedged between the rock and snow (Figure 4). We located F1's first collar in a band of cliffs but determined that it was in a deep cleft in the cliffs and was unreachable. F1's status at this time is unknown.

Wolverine F2 was first captured and collared on 4/18/2008 (Table 2). She was recaptured on 4/28/08 without that collar and was given a new collar at that time. She was last located on 6/25/2008, but has not been heard since that flight. Her first collar was located on 6/25/2008, but was not recovered before winter snows made it inaccessible. Subsequently this collar stopped transmitting a VHF beacon and therefore, we were unable to recover it. Her second collar was retrieved and downloaded on 9/11/2008. F2's status at this time is unknown.

Wolverine M2 was captured and collared on 4/22/2008 (Table 2). He has not been located since his capture despite several attempts to listen for his collar throughout the bay. At this time, we presume that either this animal dispersed from the study area or that the collar failed.

2009.—We recaptured wolverine M1 on 2/22/2009. We had documented him on 2 occasions near one trap using a remotely triggered camera. He still was wearing his collar from 2008 which we removed. We collared him with a new GPS collar upon recapture. He has been located several times, but his collar did not release. It appears that the collar is no longer transmitting a VHF signal and is lost.

We captured M3 on 1/27/2009 and collared him with a remotely-downloadable collar. We subsequently recaptured him on 2/8/2009, but released him without anesthetizing him. We have remotely downloaded his collar on several occasions and have most of the GPS locations from it. His collar did not release on the scheduled date, and we will need to recapture him to retrieve it.

We captured M4 on 2/11/2009 and collared him with a remotely-downloadable collar. We remotely downloaded his collar twice and have data up to 4/26/2009. Since that time, we have failed to locate his collar causing us to fear he dispersed or that his collar failed.

We captured M5 on 2/18/2009 and collared him with a remotely-downloadable collar. He slipped his collar on 3/22/2009. We recovered it on 9/29/2009 in an avalanche chute in the upper East Fork of Lace River (Fig. 5).

We captured M6 on 2/22/2009 and collared him with a store-on-board GPS collar. He was subsequently located on several occasions from the air, but he has not been located since before his collar was scheduled to release. He has either dispersed from the area or the collar has failed.

We captured wolverine F3 on 2/11/2009 and collared her with a store-on-board GPS collar. She was located from the air on several occasions, but has not been located since before her collar was scheduled to release. She has either dispersed from the area or the collar has failed.

We captured wolverine F4 on 2/14/2009 and collared her with a store-on-board GPS collar. She was located from the air on several occasions, but has not been located since before her collar was scheduled to release. She has either dispersed from the area or the collar has failed.

GPS Location Data

We downloaded collars 3 times from captured animals (M1 and F1; Table 2). We have recovered and downloaded 2 collars that animals dropped prematurely (F1 and F2; Table 2). Four collars remain in the field; 2 still on animals (M1 and M2), 1 yet to be retrieved (F2's first) and 1 that is irretrievable (F1's first).

We experimented with different fix schedules and search times in an attempt to maximize the time over which the collar would collect locations while minimizing the length of time between fixes (i.e., the fix rate). The initial schedule on M1 yielded a 12% fix success (20 fixes over 171 attempts; 70 sec max time) over 8 days (3/21 – 3/29). The second schedule on M1 yielded a 19% fix success (105 fixes over 549 attempts; 120 sec max time) over 24 days (3/29 – 4/22). F1's collar yielded a 36% fix success (39 fixes over 108 attempts; 120 sec max time). F1's collar 2nd fix success was 38% (35 fixes over 93 attempts; 120 sec search time). F2's 2nd collar yielded a 31% fix success (88 fixes over 283 attempts; 120 sec search time). Once we retrieve the remaining collars, we will determine which schedule met our needs and will use that for animals collared this coming field season.

Movements

Based on GPS location data from 1 male and 2 female collars, we calculated a 100% minimum convex polygon for each animal (Fig. 5). During 3/21/2008 – 5/2/2008, M1's home range area was 263 km^2. During this time, he made repeated circuits of his home range, regularly covering the approximately 26 km length of this area in a day or two and crossing the approximately 1500 m ridge that runs the length of this area on several occasions (Fig. 5). Many of his locations were in habitat used by wintering mountain goats (White et al. 2007; K. White, pers. comm.). F1's collars were only worn for 8 days, during which she traveled over an area of 42 km^2 (Fig. 5). During this time, she stayed in the valley bottoms mostly, never climbing higher than 800 m. During 4/28/2008 – 5/10/2008, F2's home range area was 65 km^2. She spent most time on the mountain range between the Berners and Lace Rivers, with 1 foray across the Berners River valley to investigate a mountain goat carcass (collared mountain goat that died over the winter, K. White, pers. comm.). During the 2 weeks she wore her collar, she covered this area 3 times, including crossing the 1100 m ridge on several occasions.

Food Habits

We collected hair and blood sample from 4 wolverine live-captured during this study. In addition, we collected 6 samples from wolverines lethally trapped in the Berners Bay area. We will collect samples from all captured and trapped wolverines from Berners Bay this winter and send those in for stable isotope analysis to examine their diet.

Future Plans

Funding for this project is nearly exhausted. We will use the remaining funds to search for the 6 collars remaining in the field using aerial telemetry and attempt to retrieve them. Collars still in the field are scheduled to release during October 2009. If the collars can be located, we will attempt to determine whether the collars are still on the animals or have dropped. Any dropped collars will be retrieved using a helicopter to get in the vicinity and then honing in on the collar using standard radio telemetry techniques.

Data analysis and report writing will continue through 2010.

Recommendations

Continue live trapping.—Because the traps are in place and we had reasonably good success capturing wolverines, we recommend continuing the live-trapping for another season. Another winter of captures would require an additional $30,000 – $40,000 for helicopter time and replacement collars. By using downloadable GPS collars, we would be able to collect more location data from the animals.

Camera Population Estimation.—The technique of identifying individual wolverines from photographs taken using remote cameras has shown great potential to estimate numbers. The ventral markings on a wolverine's chest, throat, and chin (Magoun et al. 2007; A. Magoun pers. comm.) photographed by remote digital cameras can be used to identify individual wolverines. These photographs can be used to determine the minimum number of wolverines using the study area. In addition, hair for genetic and stable isotope analysis of diet can be collected at camera sites. Any additional camera work would require more funding though.

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Figures

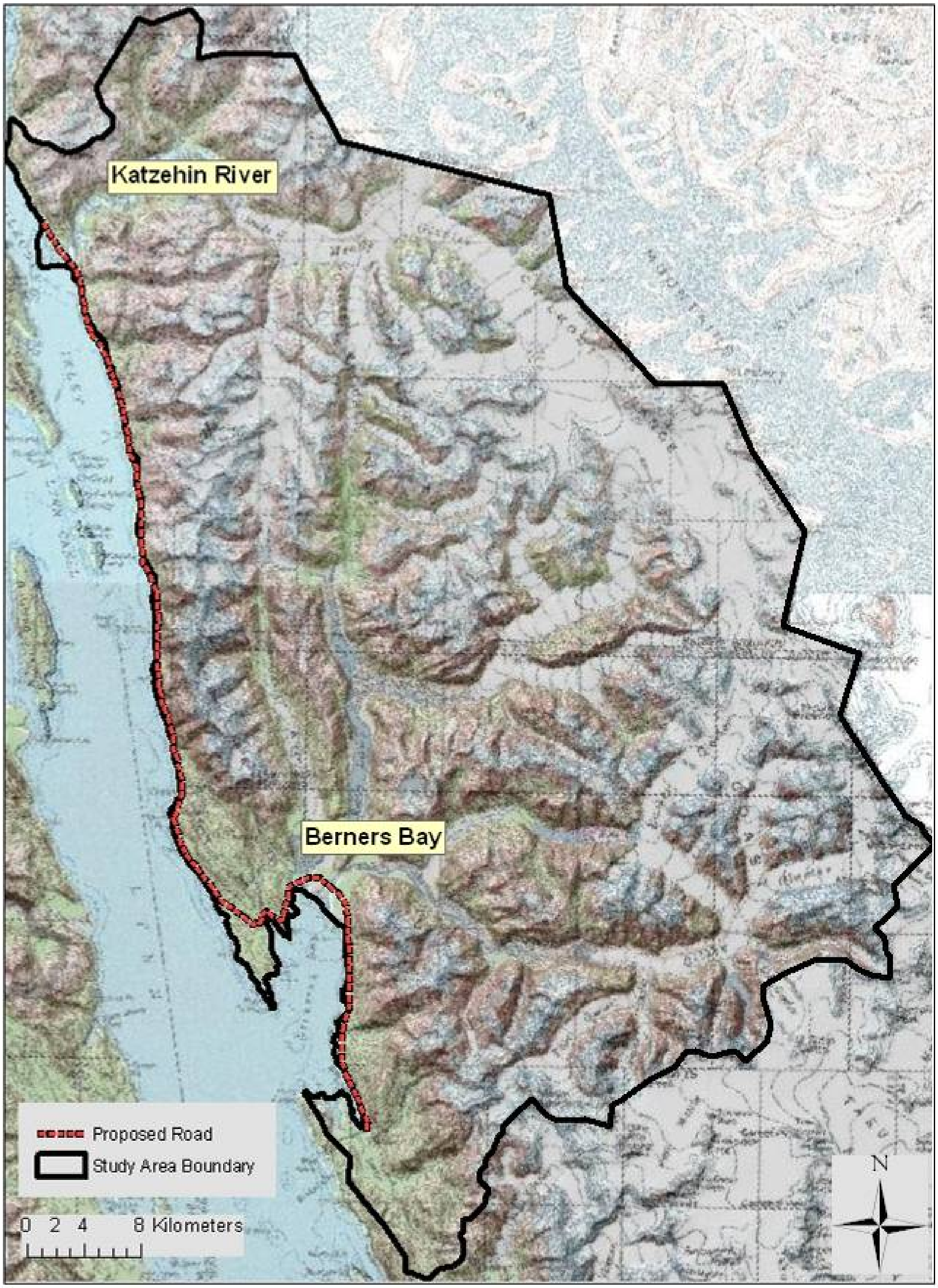

Figure 1. Juneau Access study area in northern Southeast Alaska, showing proposed road route.

Figure 2. Modified log-box traps used to capture wolverines during winters 2008 and 2009 in Berners Bay, Alaska; a) trap made from red alder logs; b) trap made from rough-cut western hemlock; and, c) portable trap made from plastic water tank.

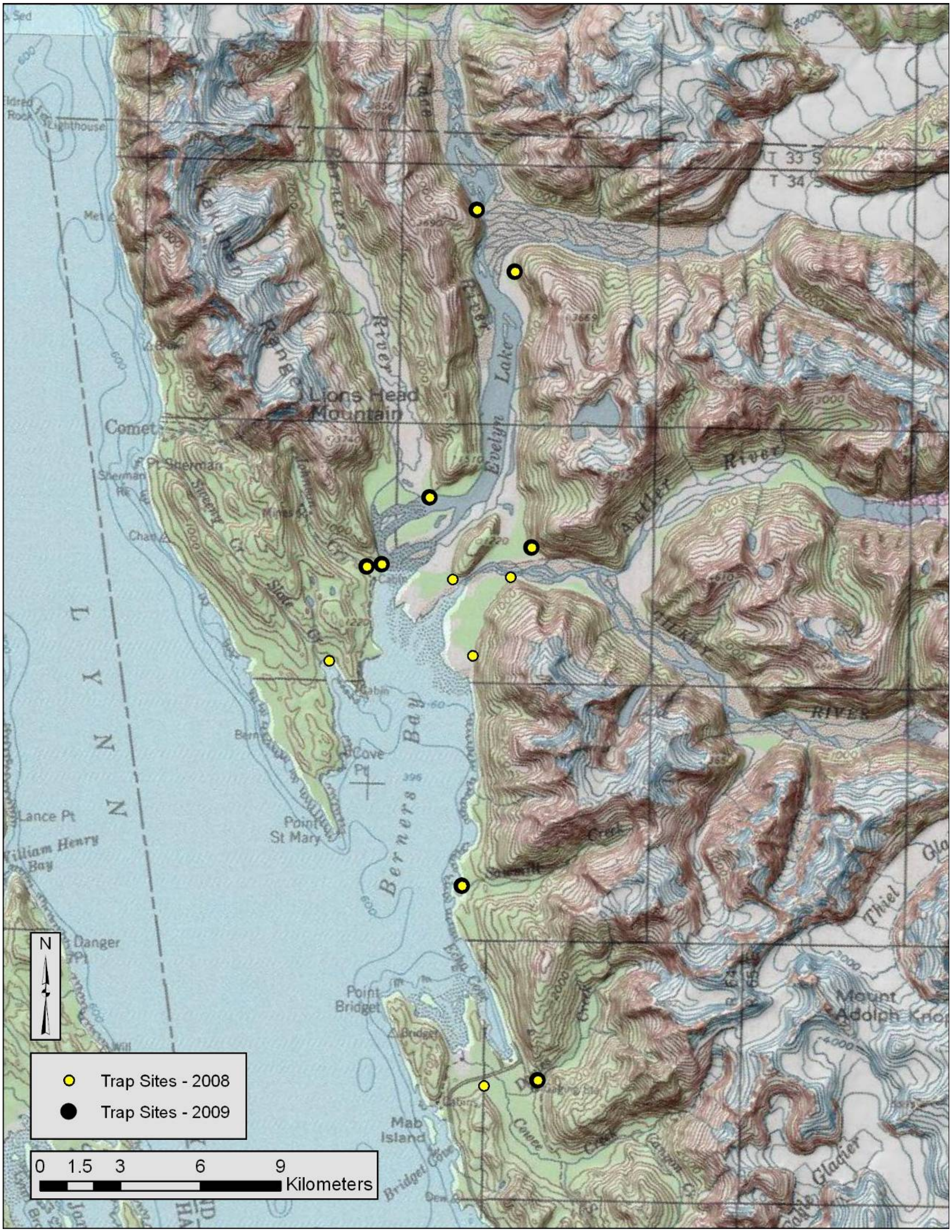

Figure 3. Wolverine trap locations in Berners Bay, Alaska, 2008 and 2009.

a)  b) 

Figure 4. Location of wolverine F1's second dropped GPS collar, Berners Bay; a) shows hole in snow bank in which collar was found; b) collar wedged under rock outcrop and snow.

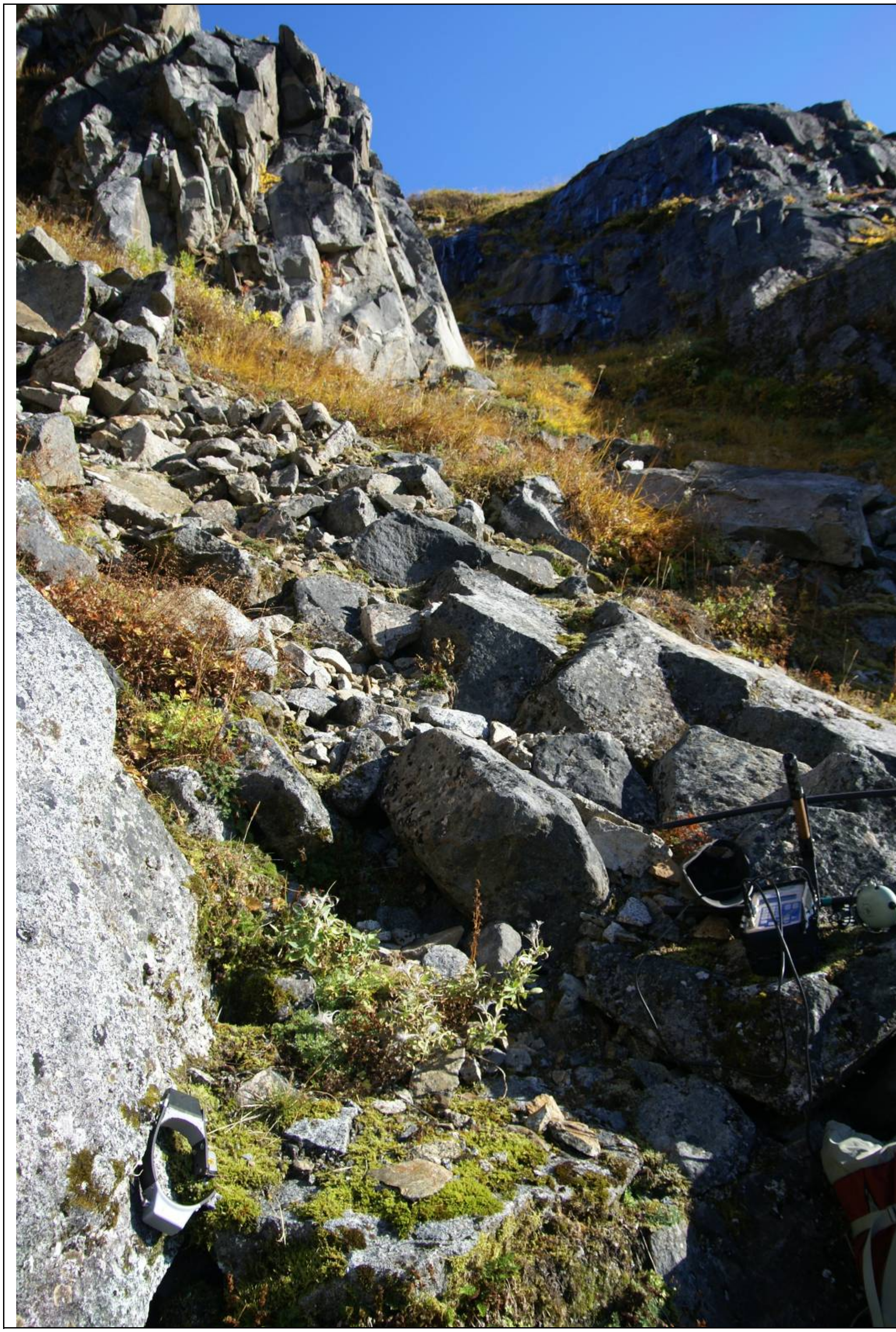

Figure 5. Location of wolverine M5’s dropped GPS collar, Berners Bay.

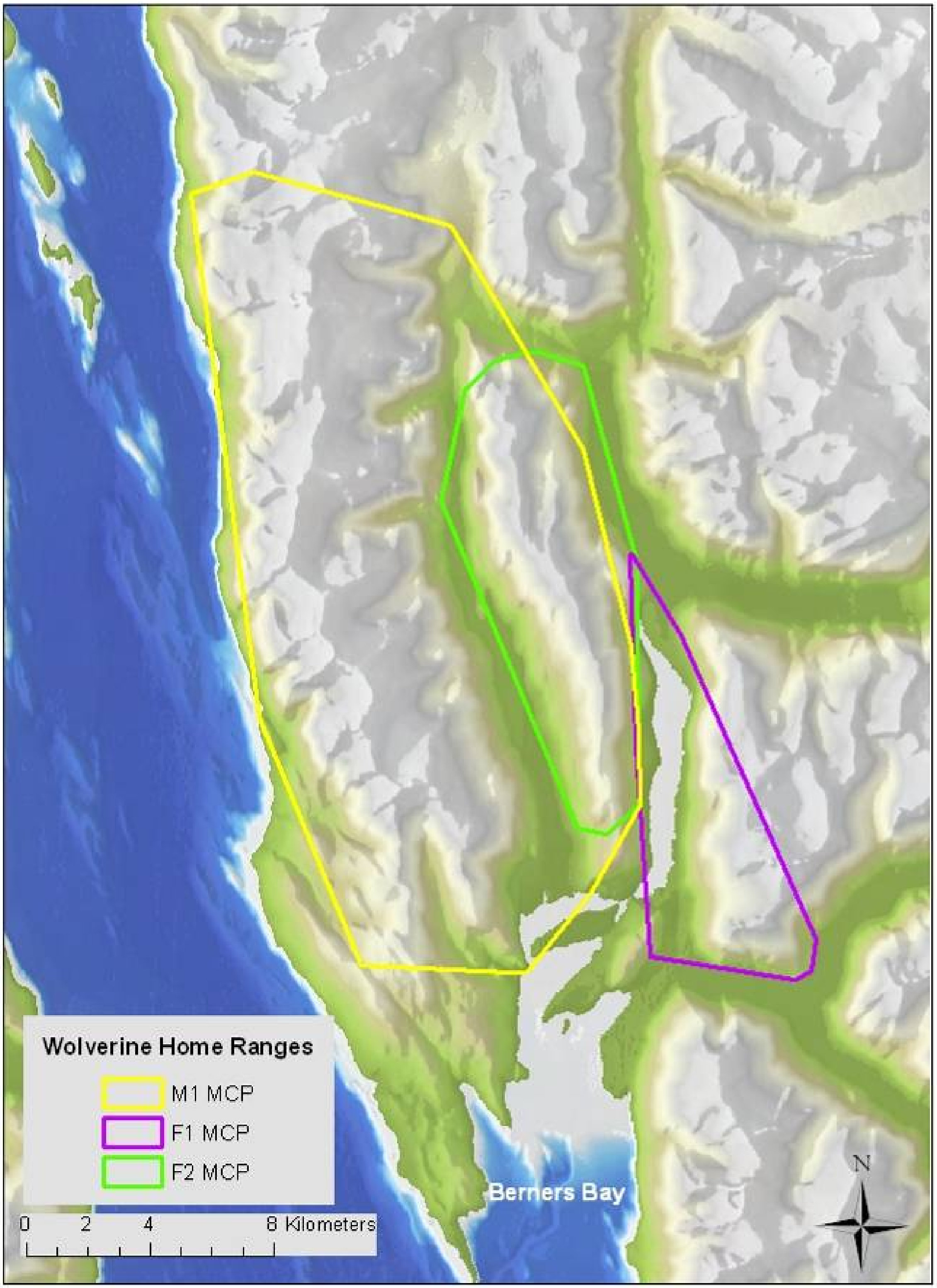

Figure 6. Home range of 3 wolverines in Berners Bay, Alaska; polygons generated from points collected from 3/21/08 to 5/10/08.

Tables

Table 1. Trapping results for 13 and 8 wolverine traps set in Berners Bay during winters 2008 and 2009.

		2008					2009				
Trap name	Trap type	Date set	Trap nights	Wolverines captures[1]	Capture rate	Other captures	Date set	Trap nights	Wolverines captures[1]	Capture rate	Other captures
Back of Bay	Alder	2/21/08	58	2 (1)	3.45		1/19/09	33	2 (2)	6.06	
Berners Cubby	Alder	2/21/08	57	0	0.00		1/19/09	34	0	0.00	Red Fox
Chutes	Hemlock	4/10/08	14	4 (2)	28.57	Marten	1/19/09	33	2 (1)	6.06	Marten
Davies	Hemlock	1/25/08	102	0	0.00		2/02/09	20	0	0.00	
Hump	Alder	2/20/08	65	0	0.00		—	—	—	—	
Johnson Meadow	Hemlock	2/22/08	62	1 (0)	1.61		2/02/09	20	0 (0)	0.00	
Johnson Mouth	Hemlock	2/22/08	60	1 (1)	1.67	Marten	1/19/09	34	2 (2)	5.88	Marten
Kowee	Alder	1/14/08	113	0	0.00	Dog	—	—	—	—	
Pygmy Owl	Hemlock	4/07/08	21	1 (0)	4.76		1/19/09	29	2 (2)	6.90	
Sawmill	Hemlock	2/02/08	83	0	0.00		1/19/09	34	0	0.00	
Slate	Hemlock	2/20/08	66	0	0.00	Marten	—	—	—	—	
Slough	Plastic	3/18/08	42	0	0.00		—	—	—	—	
Lower Gilkey	Plastic	4/10/08	22	0	0.00		—	—	—	—	

[1] Wolverine captures is the total number of wolverines captured at each trap. The number of unique individuals captured is in parentheses. For example, at Chutes trap in 2008, 4 wolverine captures occurred of which 2 were unique animals and 2 were recaptures.

Table 2. Capture results for 4 wolverines caught 9 times in Berners Bay, winter 2008.

Animal ID	Sex	Capture Event	Capture Date	Collar Information
M1	Male	1	3/21/08	Collar attached
		2	3/29/08	Collar downloaded
		3	4/22/08	Collar downloaded and battery replaced; recovered 2009
F1	Female	1	4/15/08	1st collar attached
		2	4/20/08	1st collar downloaded; later dropped by animal and not recovered
		3	4/29/08	2nd collar attached; later recovered and downloaded
F2	Female	1	4/18/08	1st collar attached; later dropped by animal and not recovered
		2	4/28/08	2nd collar attached; later recovered and downloaded
M2	Male	1	4/22/08	Collar attached; collar lost

Table 3. Capture results for 7 wolverines caught 8 times in Berners Bay, winter 2009.

Animal ID	Sex	Capture Event	Capture Date	Collar Information
M1	Male	1	2/22/09	2008 collar removed; new collar deployed; collar lost
M3	Male	1	1/27/09	
		2	2/08/09	Animal released; later collar did not release as scheduled
M4	Male	1	2/11/09	Collar lost.
M5	Male	1	2/18/09	Collar dropped early and recovered
M6	Male	1	2/22/09	Collar lost
F3	Female	1	2/11/09	Collar lost
F4	Female	1	2/14/09	Collar lost