VANCOUVER ISLAND WHITE-TAILED PTARMIGAN INVENTORY

Progress Report, May 1997
winter surveys and GIS work

URL: http://www.forestry.ubc.ca/alpine/docs/wtpvi-2.pdf

PERSONNEL

Principal Investigator

Dr. Kathy Martin

Department of Forest Sciences

270-2357 Main Mall

University of British Columbia

Vancouver, BC V6T 1Z4

Phone: (604) 822-9695

Fax: (604) 822-5410

kmartin@interchange.ubc.ca

Post Doctoral Associates

Dr. Christine Hitchcock

Dr. Karen Wiebe

Dr. Jessica Young

Collaborators

Forest Renewal British Columbia (FRBC)

Ministry of Environment, Lands and Parks (MELP)

BC Parks

Conservation Data Centre

Ministry of Forests, Victoria

Environment Canada

Winter survey helicopters: Long Beach Helicopter, Nanaimo, BC

Pilot: Guy Poirier

Report prepared by: Kathy Martin, Christine Hitchcock

GIS and photo scanning by: Christine Hitchcock

Cover photos by: Steve Ogle (ptarmigan), Chris Hitchcock (King's Peak)

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Vancouver Island White-tailed Ptarmigan Winter Surveys

Introduction

Almost all observations of ptarmigan on Vancouver Island have been between July and October (see Table 5 of the previous report). In this report, we summarize the findings of the winter radio telemetry surveys by helicopter and the work that has been done on the geographical information system (GIS) component of this project. These are the first winter data from this project. In 1995, we had only a few birds with radio collars and no money to conduct winter helicopter surveys. This information on winter habitat use is the only detailed work available for the Vancouver Island white-tailed ptarmigan subspecies. We are aware of only 4 winter reports prior to this work: i. December 28, 1962 at Courtney lookout (see figures 1-6); ii. April 21, 1971 on Tsolum Main Road; iii. an observation in the winter of 1995 on Mt. Cokely (Mt. Arrowsmith area); and iv. on Mt. Cain (Woss area). There are likely to be a few additional winter observations by people who have done winter work on wildlife species on Vancouver Island. We would like to make our records of historical sightings as complete as possible, and plan to contact other biologists who have done winter field work on the island.

For mainland ptarmigan populations, winter sites are typically separate from breeding sites and dispersal is a regular part of their life history. Our summer banding locations were made on breeding territories, and the winter helicopter radio telemetry locations were made at wintering sites. We can use these data to compare the movements of the Vancouver Island subspecies to these mainland populations. Given what we know about mainland populations, we had a number of expectations about the winter distribution of ptarmigan. We expected that

(1) we would see movements from summer breeding sites to winter sites;

(2) birds would join up in winter flocks, and females would move further than males;

(3) chicks would remain with females in the early winter, and then make the longest dispersal movements;

(4) birds would move to sites with more deciduous shrubs, such as willow, alder, huckleberry;

(5) the birds in the South Island locations would need to move farther to find suitable winter sites and have associated higher mortality.

Methods

During the summer field season, from July to October, 1996, we put radios on 41 birds (14 males, 20 females and 7 chicks) in 6 major areas: three on the South Island (McQuillan/El Capitan, and 5040 Peak) and three in the region of Strathcona Park, in the Mid Island (Kings Peak, McBride Ridge, and Albert Edward/Jutland). Seven of the radios had batteries to last 6 months; the remainder were 12 month radios. The latter will last until August or September, 1997. From December to the end of April we relocated these radioed birds in a total of 5 radio telemetry helicopter censuses (Dec. 16/17, '96; Feb. 7, '97; Mar. 7, '97; Mar. 27/28, '97; Apr. 21, '97). After determining the precise location of the radio signal (± 50 m), we recorded a GPS location of the bird (signal), the elevation, and the aspect, slope and a general description of the habitat where the bird was located (see Appendix A for these records). In a few cases we saw the birds, and in those cases we also recorded whether birds were alone or were in a flock, and type of activity (in a snow hole, feeding, etc.).

The helicopter surveys were relatively efficient, despite frequent inclement weather during some surveys. The antenna setup comprised a directional antenna mounted on the front, and two long range antennas, one on each side of the helicopter. Initially, we had some technical problems that resulted in low detection distances (1-3 km). These have been resolved, and we can now pick up signals from 10-20 km away. In general, the time required from initial detection of the signal to determination of the location of the bird to a specific valley or a mountainside is 4.5 min (range 1.5-9.5 min). The total time required to pinpoint the specific location of the bird from the point of signal detection is 7.3 min (range 3.5-12 min). Some of these birds are clearly dead. Next year we plan to use radios with mortality switches which will allow us to determine timing of death more quickly, and will also conserve helicopter time.

Summary of Ptarmigan Locations

In 1996-97 winter, we began helicopter surveys, and were successful in locating 33 (80%) of 41 radio-marked birds (Table 1). In total, 81 signals were detected during the five helicopter surveys, and we were able to determine the geographical location for 76 of these signals. On average we obtained 1.85 locations per radio-collared bird. We relocated 15% of the birds four times, 24% three times, 20% twice, 22% once, and 20% were never relocated (Table 1). Of the 8 birds that were not relocated, three were adult males, two were adult females, and the remaining three were chicks, all from one brood (Table 3). Most of the adult birds were relocated, with a slightly higher proportion of females (90%) than males (79%) found. There were no marked differences in our ability to relocate birds based on their geographical location (Table 2). The low detection rate for Albert Edward/Jutland is largely because the 7 chicks were banded there, and our detection rate for chicks was lower than that for adults.

Figures 10-15 illustrate the locations of birds banded at their breeding sites, and in the helicopter censuses, for each of the major geographical clusters. Figure 10 is particularly notable because it depicts the only multi-year dispersal data we have for this subspecies. All three of these birds were banded in 1995, then recaptured and given radios in 1996, and relocated during this past winter. Birds 630 and 631 were banded as chicks (young of the year in 1995) and are sisters. Bird 631 dispersed 34 km to El Capitan, while bird 631 did not move from her natal mountain. Both 631 and 627 were radio-collared on El Capitan in 1996, and are now presumed dead. As we accumulate more of these data, we can move beyond anecdote into a description of the spatial extent of habitat use and the connectivity between suitable regions on the island.

Figures 12 and 13 show the movements of chicks and adults in the Albert Edward/Jutland study area. With the small amount of data we have, we do not find support for our initial hypothesis that chicks would have the longest dispersal movements; this may show up more clearly in the movements between breeding seasons than it does in the seasonal movements.

Using the data from the winter surveys, some preliminary conclusions can be drawn about the winter ecology of white-tailed ptarmigan populations on Vancouver Island. One surprising observation is that we never saw ptarmigan in larger groups than 3, and most of the birds we saw were alone. This contrasts with observations of white-tailed ptarmigan in the mainland populations which form large winter flocks (Braun et al. 1993). Many locations of birds were in inaccessible areas such as cliff faces, exposed alpine, forested areas, three in avalanche chutes and one in a clearcut.

Table 4 summarizes the observations we have on the distance birds moved from their breeding location (see also Figure 16). There was a wide range of distances between the breeding site of a bird and its subsequent wintering location. Some of this is complicated by a few birds that are clearly dead, one of which is over 35 km from her original banding location. Excluding that bird, the average distance between resighting location and banding location was about 2 km. While females (mean = 2.0 km) were found slightly further away than males (mean = 1.3 km) on average, this difference was not significant (two sample t-test with unequal variances, $t = 0.90$; $df = 24$; $p = 0.40$).

The maximum elevations at which we located birds dropped over the winter, then rose again in April (Table 5). However, during all surveys birds were, on average, at about 4400 ft., and there was no overall tendency for elevation to change over the winter. Using the GIS program (Arcview), we tabulated the biogeoclimatic zones associated with each helicopter sighting location (Table 6). Birds were less likely to be found in the alpine tundra during February and March surveys, moving into other biogeoclimatic zones, particularly subalpine mountain hemlock. Observations of birds in cedar-western hemlock (CWH) should be viewed with caution; the bird in CWH xm2 is at an elevation of 1300 ft., under a power cut, and is presumed dead. Over time we hope to associate mortality, breeding success and productivity with the type of overwintering habitat.

At the end of this first winter season of data collection, we now have a few answers to our initial questions. Some Vancouver Island white-tailed ptarmigan do move to winter sites, while some stay in roughly the same place they were found in the summer. We have seen no evidence of the winter flocks that are typical of mainland populations in the winter. Our data on chicks are too preliminary to make general conclusions. We did not

see a movement to areas with deciduous shrubs, on the whole. Two of the three radioed birds on the El Capitan/McQuillan site have died over this winter. This evidence is anecdotal at this point, but tends to support our initial predictions that the fragmented and limited alpine habitat found in the South Island will result in longer dispersal distances and higher mortality. In June 1997, we will confirm mortality when we locate all signals on the ground.

Geographical Information System (GIS) component of the study

The GIS component is a vital part of the inventory and entails 1) establishing what types of digital maps are available; 2) evaluating the suitability of habitat classification; 3) determining total amount of habitat available; 4) looking at dispersal and connectivity aspects, etc.; 5) with a long term goal of predicting population persistence in various patch types (patch size, location and isolation, habitat types, etc.). The spatial scope of this inventory project is both coarse and fine grained; we are interested in distributions across Vancouver Island, but we also have questions about habitat selection at a finer scale. This presents a challenge. For example, our study area crosses 2 UTM (Universal Transverse Mercator) zones (9 and 10), and many NTS (National Topographic System) 1:50 000 sheets. Some of the NTS map sheets that were used in the field are still based on the NAD 27 datum rather than the newer NAD 83 datum. We plan to do the GIS work in the provincial standard projection (Albers), and to convert our data points from the original projection into Albers before working with them.

We have initiated the GIS component of the project this year. We have contacted a number of agencies (BC Environment, Maps BC, Environment Canada, BC Parks) to establish what data are available for Vancouver Island. Through partnerships, we have obtained a number of digital base maps, and have been experimenting with the display of our survey data points on the map. We have re-projected our data from their original projections (sometimes latitude/longitude, sometimes UTM) into the provincial standard projection, with care to make NAD shifts as necessary. We are accumulating a list of bookmarks to useful sites on the world wide web; we have found that the internet is a rich resource for information on GIS. For example, we have compiled a list of mountain peaks

for Vancouver Island from the Natural Resources Canada web site, which has helped in orientation from the helicopter surveys and in labeling some of these features on the map layouts in this report. We are working in Arcview 3.0, and have found it useful simply to visualize the spatial data, as well as to employ the analytical aspects of the program to produce some of the tabular data in this report.

We still have a number of things to work out. We have been using Arc/Info to transform some base maps from UTM Zone 10 into the provincial standard projection, but find that this reprojection sometimes turns filled polygons into polylines. All of the 1996 summer banding locations were taken from NTS 1:50 000 map sheets, and some of these map sheets are still using NAD 27. Our program uses the old algorithm for NAD shifting, rather than the new version 2.0. This is not a serious cause for concern, given the overall precision of our locations, and our tolerance for spatial location. However, next year we will use TRIM paper maps to read our locations, so as to avoid the need for NAD shifting. We will also be using GPS (global positioning system) units on the ground to estimate our locations. Last year we attempted to do this, but our primary unit turned out to be defective. Finally, the database needs to be restructured and made relational. We started with a flat file, and initially, with only a few data points, this was usable. However, we will increasingly want to associate particular locations with study areas and mountains, which themselves have properties, and to be able to generate smaller tables of data for inclusion as event themes in the GIS.

This GIS work has also stimulated us to consider how a spatially-based project differs from a purely bird-based project, and to adjust the data collection and database organization methods for the coming field season. So far, we have established information on the types of digital maps that are available, and have successfully employed GIS to illustrate and analyze our first year's data on dispersal and connectivity. We have made some progress towards evaluating the suitability of habitat classification, although we have yet to systematically compare biogeoclimatic classifications with the baseline thematic mapping, or to integrate these two systems with elevation data. We have recently acquired ESRI's spatial analyst, and will be able to do more detailed analysis and integration of elevation information with habitat classification information. Our future emphasis will be

to build our GPS expertise in the field, to ground truth some of the habitat classifications during our 1997 summer field work, and to use GIS to generate data on the total amount of habitat available in the various study areas, and the distances among the potential ptarmigan habitat. This classification of study areas will allow us to address the questions of habitat suitability, both at an immediate spatial scale and in terms of the fragmentation and extent of suitable habitat, so as to estimate the total habitat available, abundance and population persistence.

References

Braun, C.E., K. Martin and L.A. Robb (1993). White-tailed ptarmigan (*Lagopus leucurus*). In: The birds of North America. No. 68 (A. Poole and F. Gill, Eds.). Philadelphia. The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

K. Martin & L. Elliot (1996) Progress Report (1995-96): Vancouver Island White-tailed Ptarmigan Inventory

Acknowledgments

Many people helped with GIS planning and with pointers to useful sources of maps, including: Dwight McCullough and Kathleen Moore of Environment Canada; Pierre Vernier of the UBC Centre for Applied Conservation Biology; Debbie Narver of the provincial Environment Ministry. We thank BC Parks for letting us examine their maps of habitat mapping of Strathcona Park, and to Doug Janz for sharing his experience with the work on Vancouver Island marmots and mapping in the alpine. We thank Long Beach Helicopters for their assistance during the winter surveys. In particular, Guy Poirier, the pilot, showed a keen interest in increasing the efficiency of our radio detection and a steep learning curve in determining specific locations quickly. Fred C. Zwickel provided photographs and data on the 1962 and 1971 sightings. Finally, we thank Don Doyle (MELP) and Susan Holroyd (FRBC) for their assistance and support in this project. The winter helicopter work would not have been possible without their help.

28 Dec 62 Photo: Fred Zwickel

Figure 1 Courtney Lookout
lat. 49° 40'N long. 125° 11' W

28 Dec 62 Photo: Fred Zwickel

Figure 2 Courtney Lookout

28 Dec 62 Photo: Fred Zwickel

Figure 3 Courtney Lookout

28 Dec 62 Photo: Fred Zwickel

Figure 4 Courtney Lookout

21 April 71 Photo: Fred Zwickel

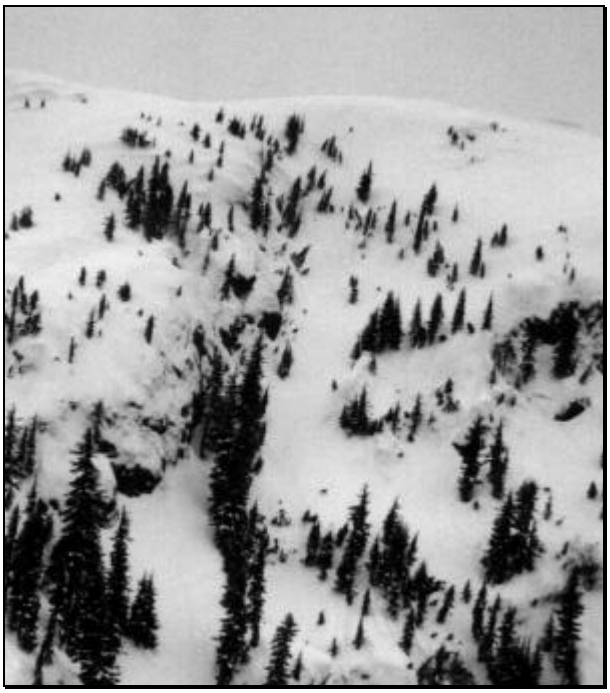
Figure 5 Tsolum Main Road

28 Dec 62 Photo: Fred Zwickel

Figure 6 Courtney Lookout

6 Feb 1997 **photo: C. Hitchcock**

Figure 7 **Bird 676 - Mt. Judy Region**
5900 ft. **lat. 49° 39.3' long. -125° 40.9'**



6 Feb 1997 **photo: C. Hitchcock**

Figure 8 **Bird 732 - NE of Phillips Ridge**
4700 ft. **lat. 49° 37.1' long. -125° 38.8'**

6 Feb 1997 **photo: C. Hitchcock**

Figure 9 **Bird 657 - Bowl of 5040**
4500 ft. **lat. 49° 12.4' long. -125° 16.6'**

Figure 10. Vancouver Island biogeoclimatic zones (BEC) & study areas

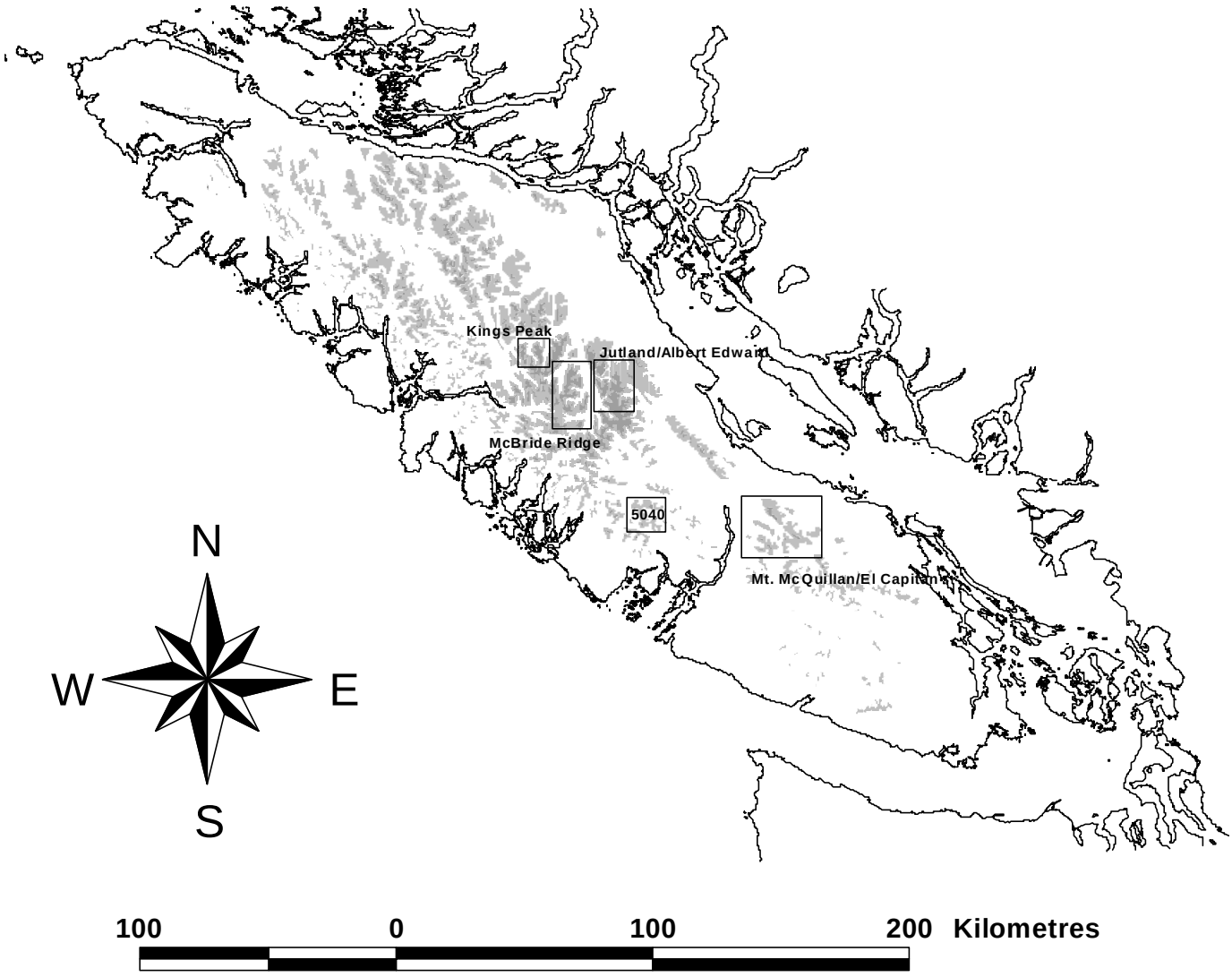
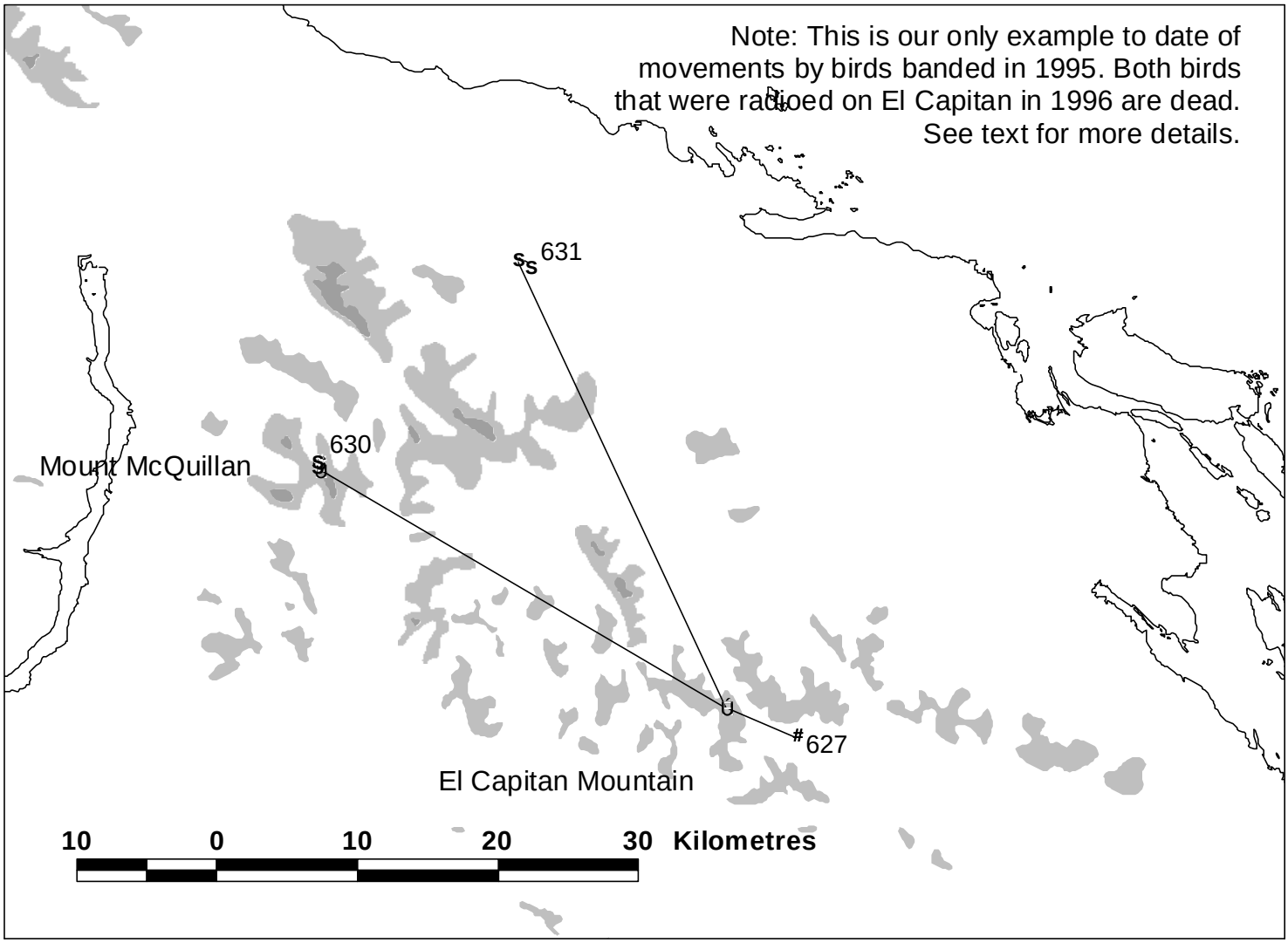


Figure 11. South Island: Mount McQuillan and El Capitan



Radio detection (helicopter)

- s **Adult Female**
- # **Adult Male**

Banding Location

- Ú **Adult female**
- Û **Adult male**

Biogeoclimatic Zones

- **Alpine Tundra**
- **Mountain Hemlock**

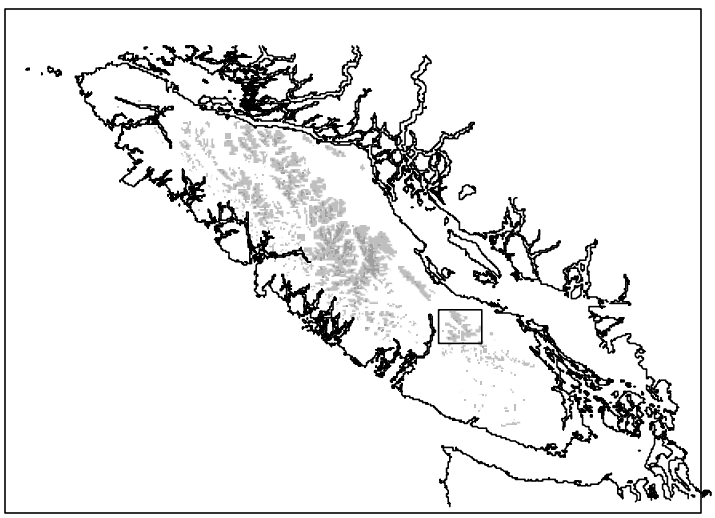
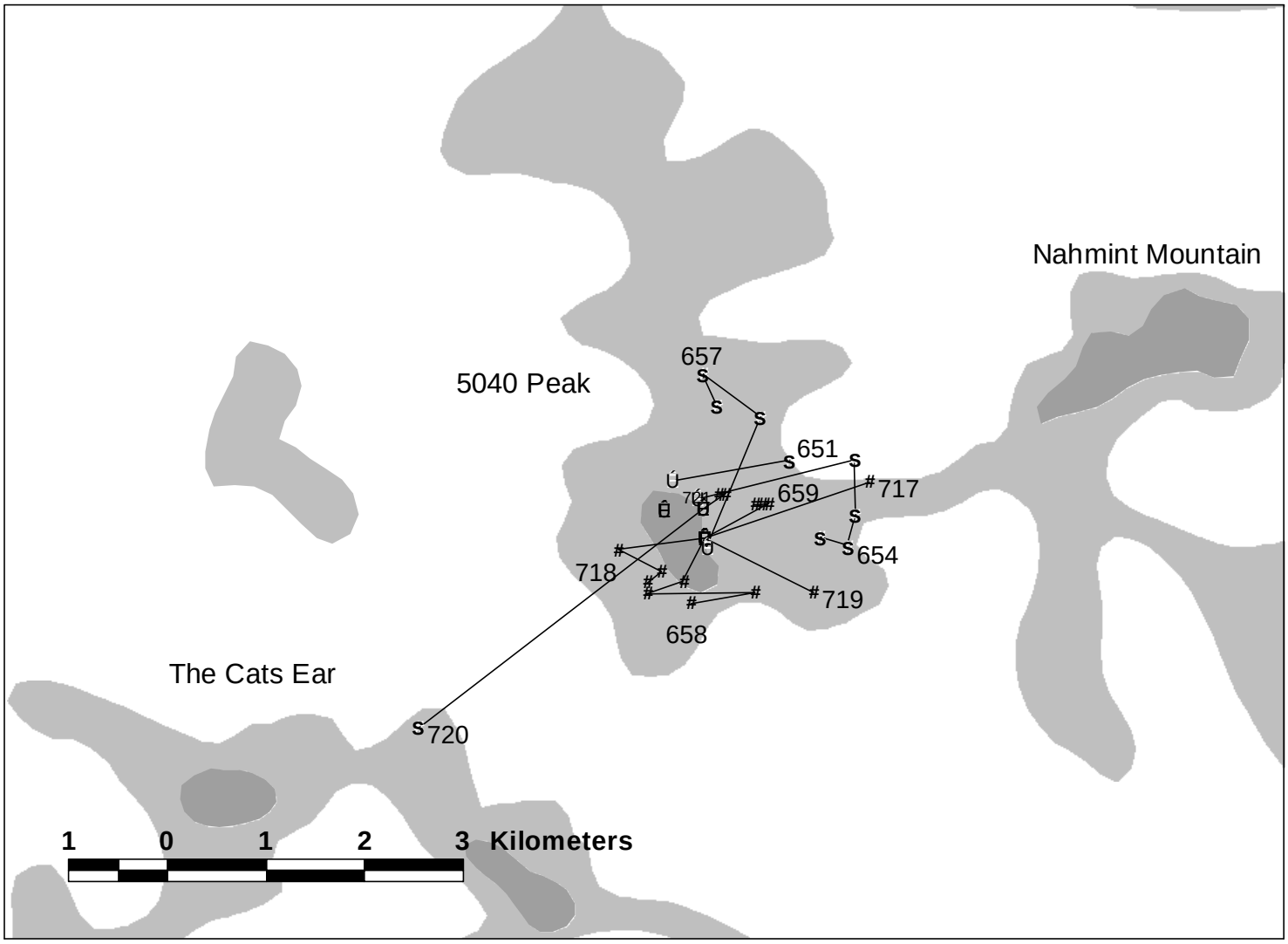


Figure 12. South Island: 5040 Peak



Radio detection (helicopter)

- s **Adult Female**
- # **Adult Male**

Banding Location

- Ú **Adult female**
- Û **Adult male**

Biogeoclimatic Zones

- **Alpine Tundra**
- **Mountain Hemlock**

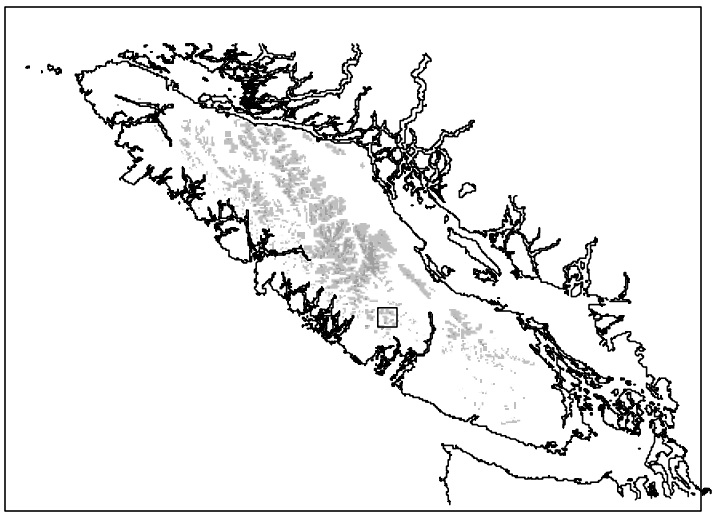
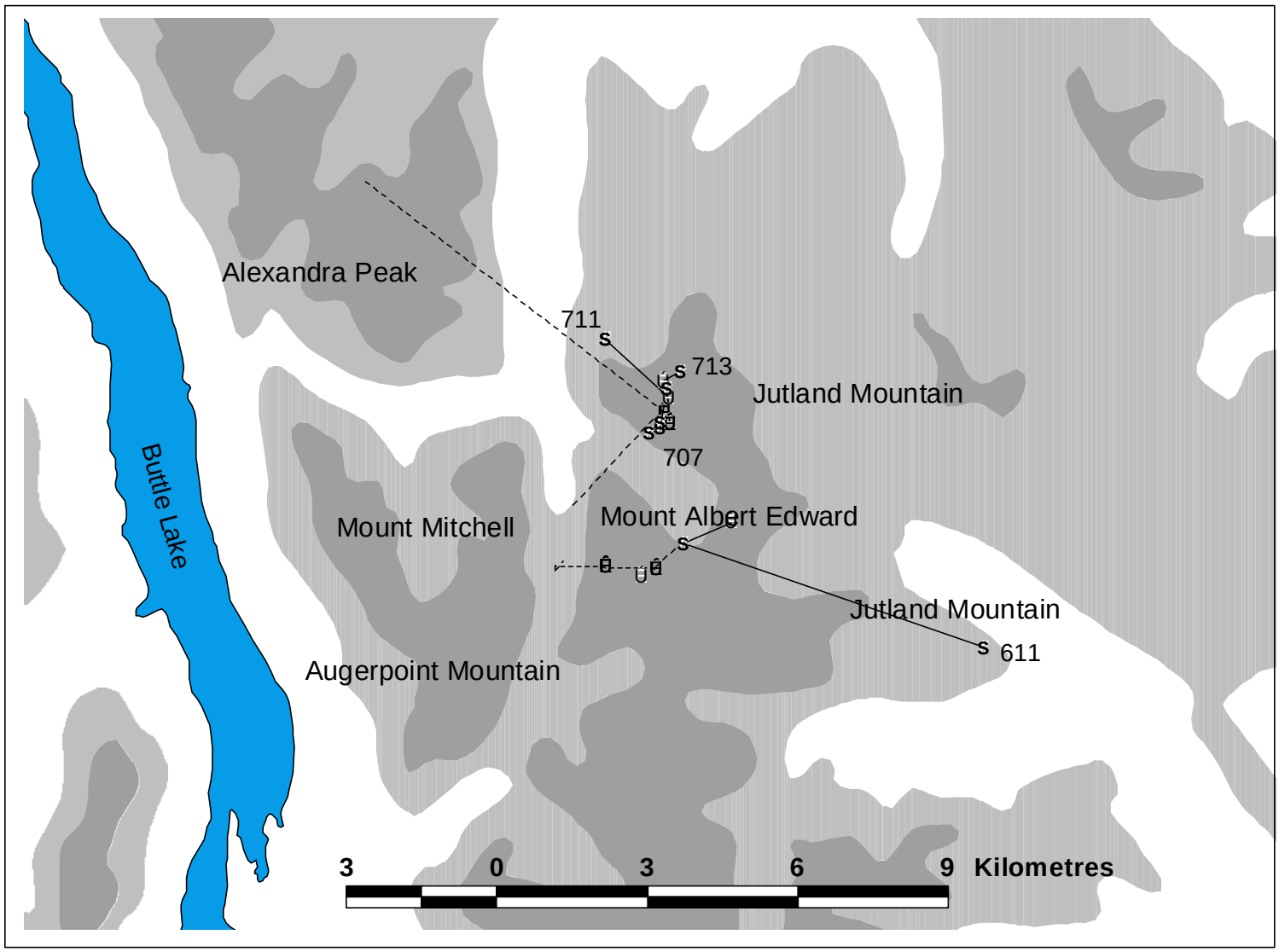


Figure 13. Mid Island: Mt. Albert Edward/Jutland (adults)



Dotted lines indicate movements of chicks (see Figure 14)

Radio detection (helicopter)

- s **Adult Female**
- # **Adult Male**

Banding Location

- Ú **Adult female**
- Û **Adult male**

Biogeoclimatic Zones

- **Alpine Tundra**
- **Mountain Hemlock**

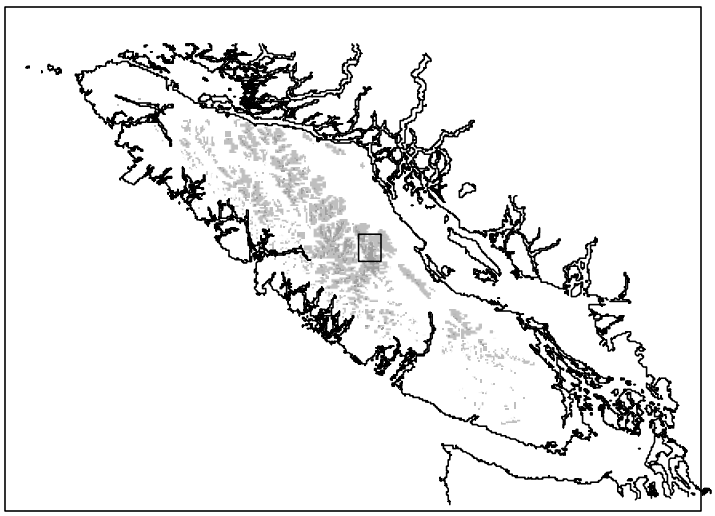
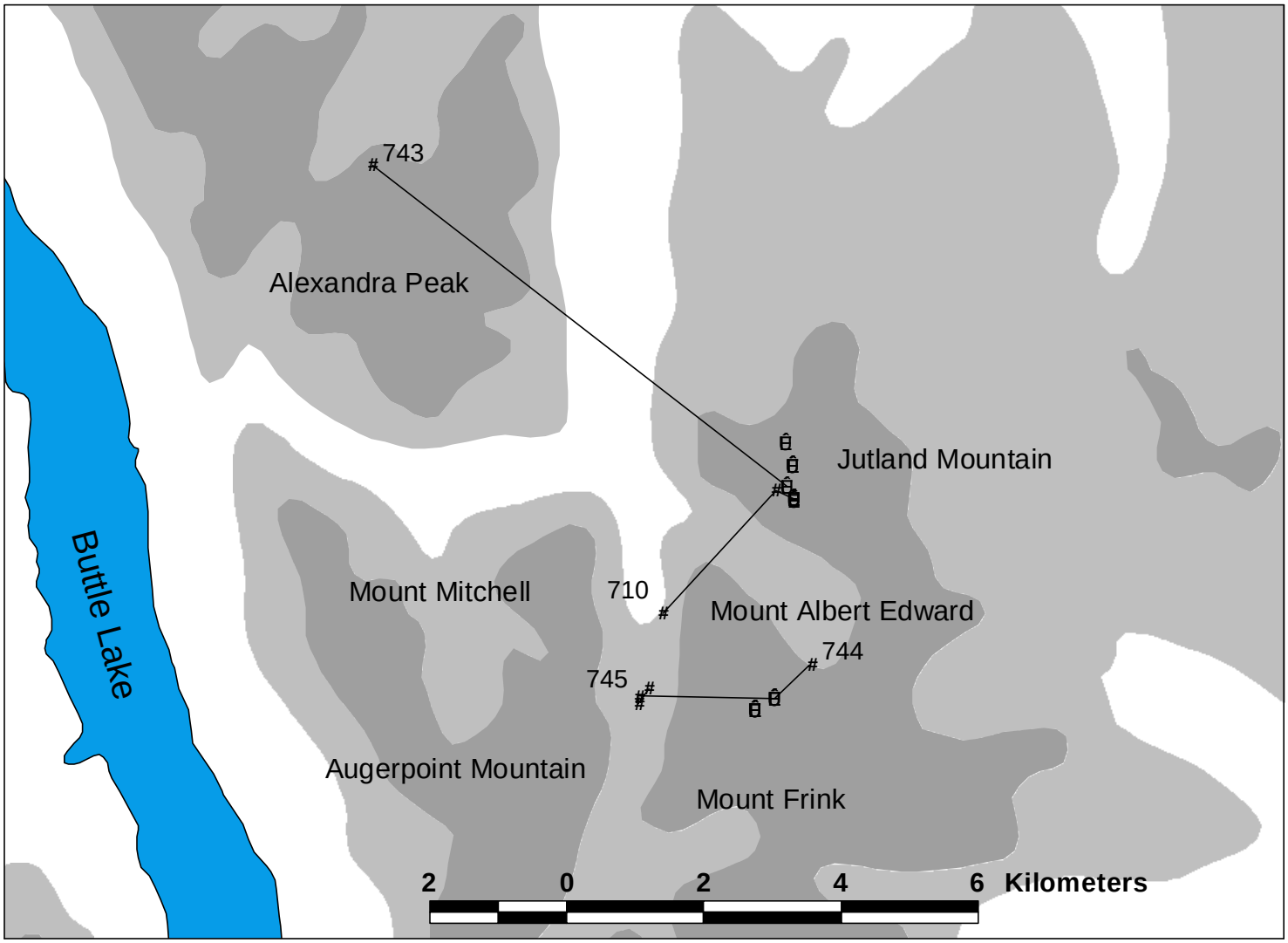
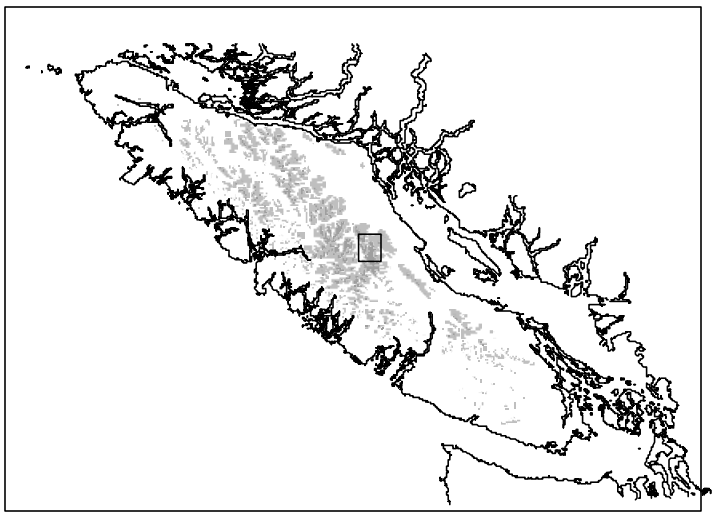


Figure 14. Mid Island: Mt. Albert Edward/Jutland (chicks)





Radio detection (helicopter)

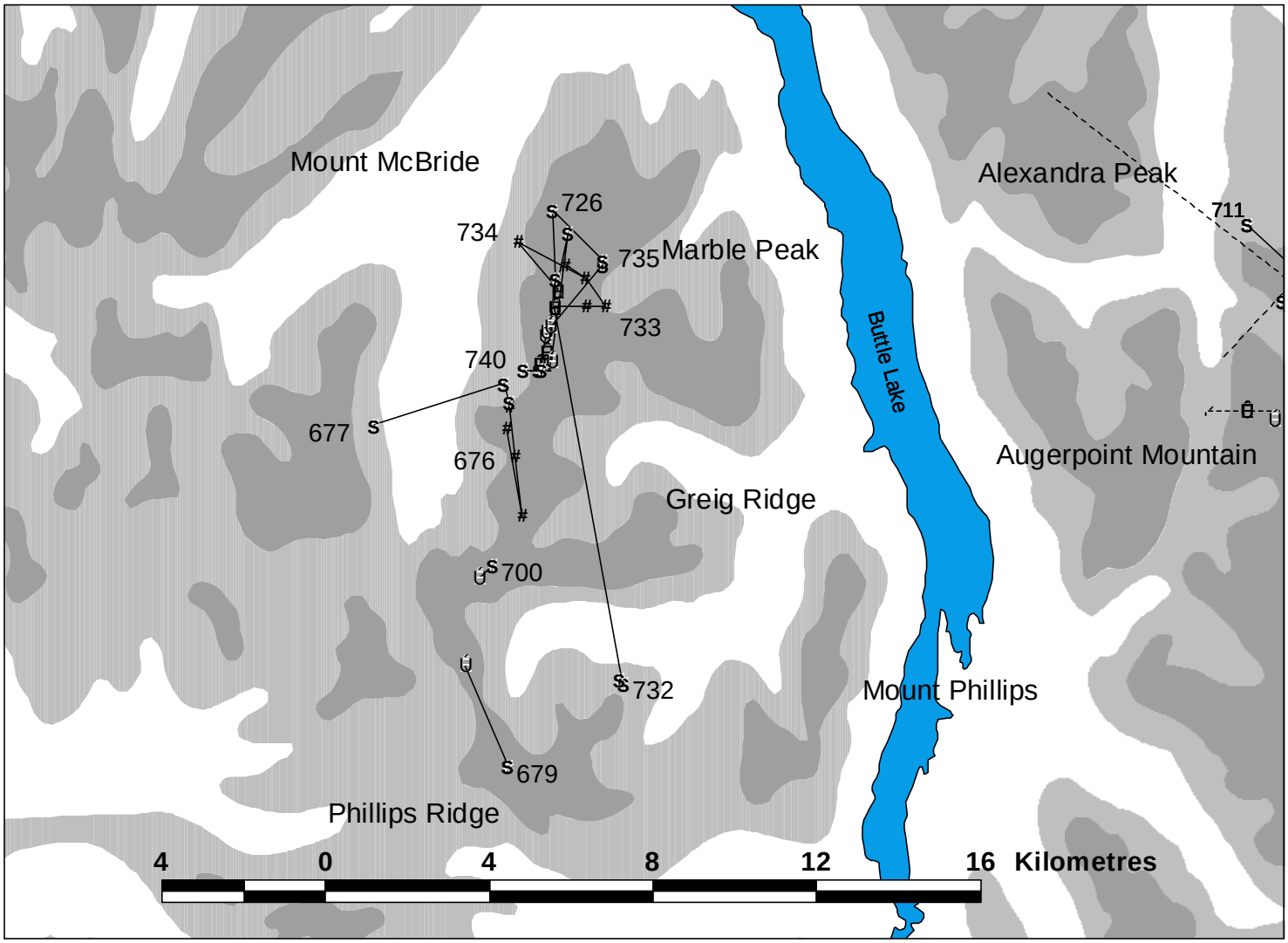
Banding location

Biogeoclimatic Zones

Alpine Tundra

Mountain Hemlock

Figure 15. Mid Island: McBride Ridge (west of Buttle Lake)



Radio detection (helicopter)

- s **Adult Female**
- # **Adult Male**

Banding Location

- Ú **Adult female**
- Û **Adult male**

Biogeoclimatic Zones

- **Alpine Tundra**
- **Mountain Hemlock**

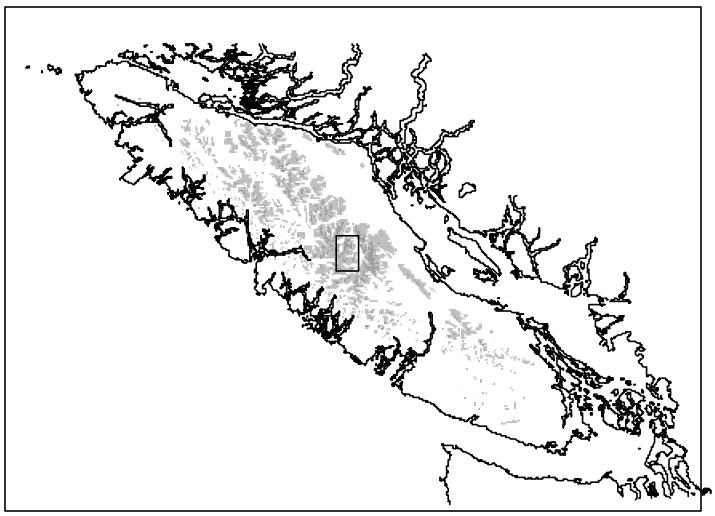
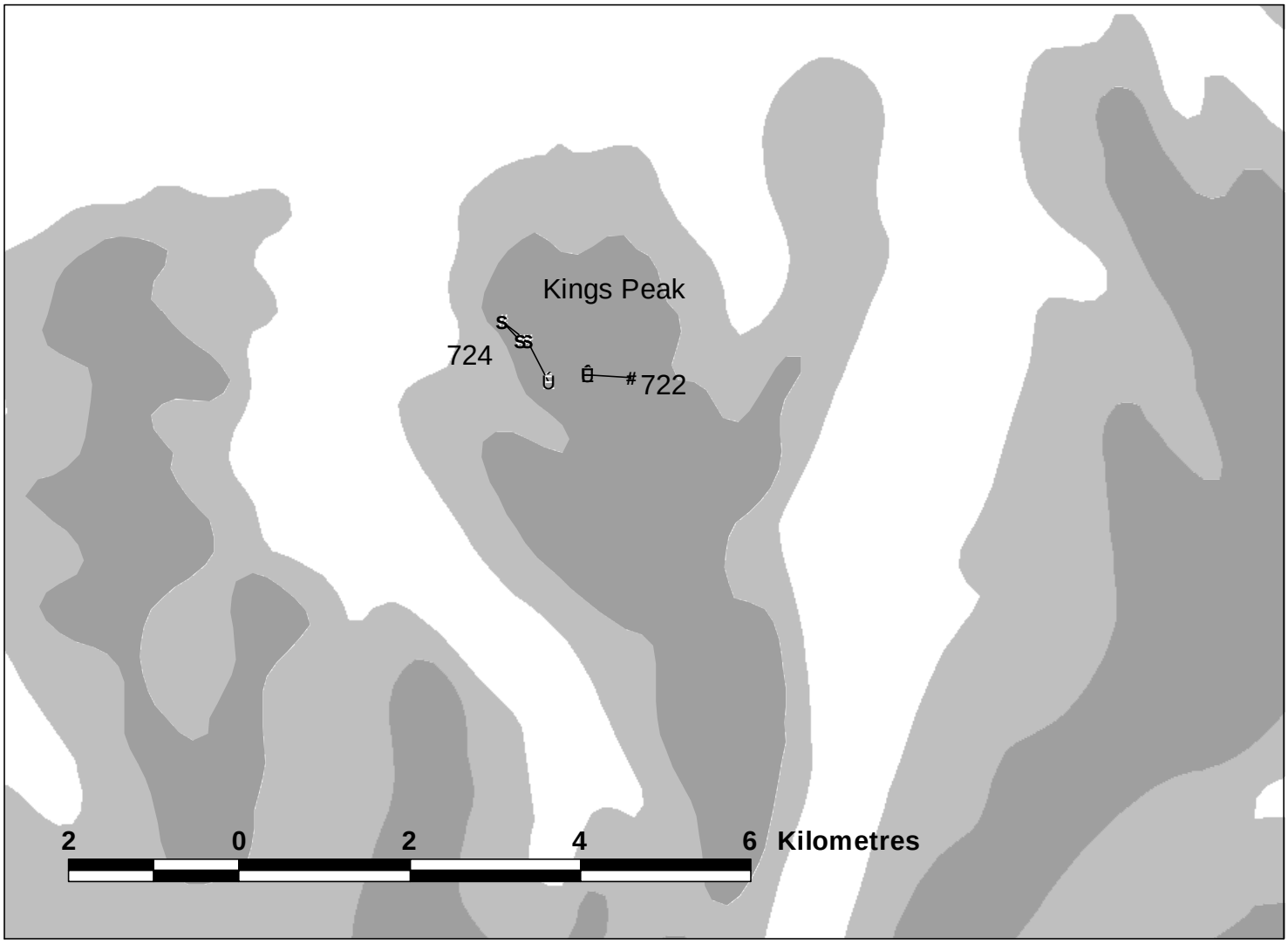


Figure 16. Mid Island: Kings Peak



Radio detection (helicopter)

- s **Adult Female**
- # **Adult Male**

Banding Location

- Ú **Adult female**
- Û **Adult male**

Biogeoclimatic Zones

- **Alpine Tundra**
- **Mountain Hemlock**

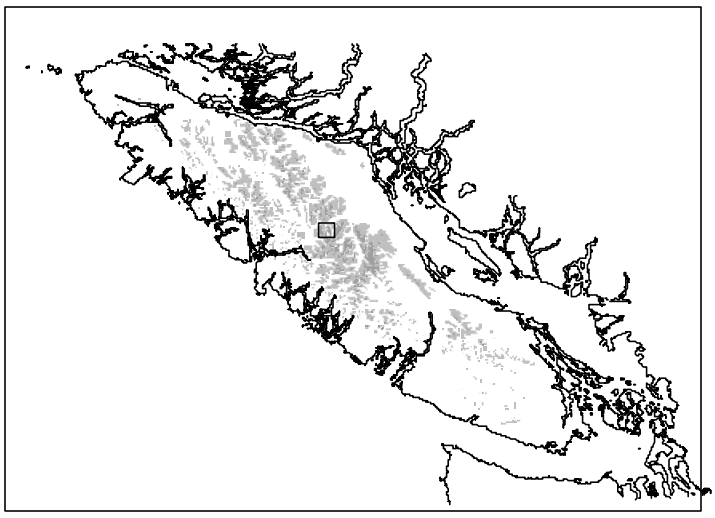


Figure 17. Distance between summer banding locations (breeding areas) and winter survey locations

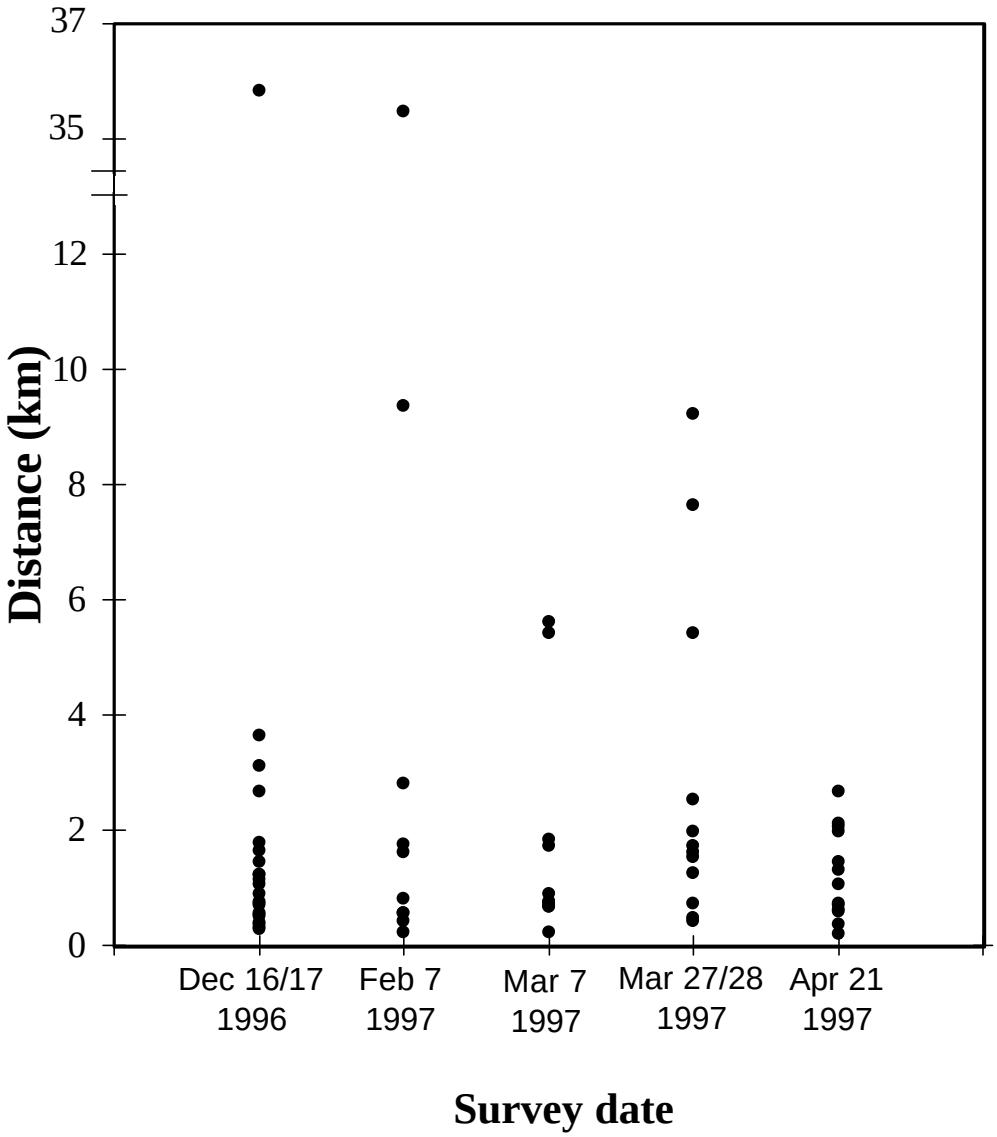


Table 1. Number of detections of radio-collared ptarmigan in the five winter surveys

# of radio detections	# of birds	%
0	8	20%
1	9	22%
2	8	20%
3	10	24%
4	6	15%
total # of radios	41	
# of birds detected at	33	80%

Table 2. Winter radio detection rates, by location of banding for white-tailed ptarmigan on Vancouver Island

Location Banded	# birds relocated	# birds with radios	% detected
South Island			
5040	10	12	83%
McQuillan/El Capitan	3	3	100%
All South Island birds:	*13*	*15*	*87%*
Mid Island (Strathcona Park)			
Albert Edward/Jutland	8	13	62%
Kings Peak	2	2	100%
McBride Ridge	10	11	91%
All Mid Island birds:	*20*	*26*	*77%*
All radio-collared ptarmigan:	33	41	80%

Table 3. Winter radio detection rates, by sex and age of ptarmigan

Sex and age	# birds	# birds with	% detected
Adult Female	18	20	90%
Adult Male	11	14	79%
Chicks	4	7	57%
Total	33	41	80%

Table 4. Distances between original locations on the breeding grounds and radio telemetry relocations in wintering habitat, by general area.

Banding Location	**mean distance (km)**	**Range**	**number of relocations (N)**
South Island			
5040	1.13	(0.21,3.64)	23
McQuillan/El Capitan*	2.48*	(0.36,5.42*)	5
All South Island birds:	*1.37*	*(0.21,5.42)*	*28*
Mid Island (Strathcona Park)			
Albert Edward/Jutland	1.82	(0.2,7.63)	16
Kings Peak	0.63	(0.53,0.89)	4
McBride Ridge	2.35	(0.35,9.36)	18
All Mid Island birds:	*1.95*	*(0.2,9.36)*	*38*
All relocations	1.7	(0.2,9.36)	66
Chicks only Albert Edward/Jutland	2.43	(0.3,7.63)	7

** excludes the data from one bird from El Capitan that is almost certainly dead, at an unusually low elevation, and 35 km away from where it was originally banded.*

Table 5. Elevations of ptarmigan over the winter of 1996-97

Elevation (feet)	Dec 16/17	Feb 7	Mar 7	Mar 27/28	Apr 21	Overall
Average	4413.6	4404.5	4408.3	4418.2	4978.1	4537.5
sd	1210.78	1167.14	827.33	404.52	655.99	949.60
n	22	11	12	12	16	73
Maximum	6200	5900	5800	4900	5850	6200
Minimum	1300*	1500*	3200	3500	3300	1300*

** The lowest elevations come from a single ptarmigan which is probably dead. See note under table 4.*

Table 6. Biogeoclimatic zone (BEC) of the relocations of radio-collared white-tailed ptarmigan during the winter of 1996-97.

BEC	Dec 16/17	Feb 7	Mar 7	Mar 27/28	Apr 21	Total
AT p	10	3	4	3	9	29
MH mm 1	10	7	8	9	6	40
CWH vm 2	2	0	0	0	0	2
CWH xm 2	1	1	1	1	0	4
Grand Total	23	11	13	13	15	75

Legend: *AT - alpine tundra, MH - mountain hemlock, CWH - cedar western hemlock.*

Radio Freq	Band #	BandNo	Sex	Location Banded	Survey Date	RelocatedY/N	Area Relocated	Latitude	Longitude	Aspect	Elev(feet)	Habitat Type Relocated
150.029	**D0710**	**710**	**CK M?**	**Jutland**	16-Dec-96	Y	Jutland - W face	49.705	-125.421		5800	
150.029	D0710	710	CK M?	Jutland	7-Feb-97	N						
150.029	D0710	710	CK M?	Jutland	7-Mar-97	N						
150.029	D0710	710	CK M?	Jutland	27-Mar-97	Y		49.689	-125.444		4600	
150.029	D0710	710	CK M?	Jutland	21-Apr-97	N						
150.220	**D0700**	**700**	**F**	**Mt Judy/Crys.**	16-Dec-96	Y	Mt Judy/Crystal - on W face	49.645	-125.691		5200	In gorge on vertical face, sparse veg, cedar, huckleberry
150.220	D0700	700	F	Mt Judy/Crys.	7-Feb-97	N						
150.220	D0700	700	F	Mt Judy/Crys.	7-Mar-97	N						
150.220	D0700	700	F	Mt Judy/Crys.	28-Mar-97	N						
150.220	D0700	700	F	Mt Judy/Crys.	21-Apr-97	N						
150.244	**D0744**	**744**	**CK F?**	**Albert-Edward**	16-Dec-96	Y - visual	Albert-Edward - below glacier	49.682	-125.414		4800	in 1 m clump of deciduous shrubbery & 1-2 m high cedars. With female 611 (151.879)
150.244	D0744	744	CK F?	Albert-Edward	7-Feb-97	N						
150.244	D0744	744	CK F?	Albert-Edward	7-Mar-97	N						
150.244	D0744	744	CK F?	Albert-Edward	28-Mar-97	N						
150.244	D0744	744	CK F?	Albert-Edward	21-Apr-97	N						
150.262	**D0733**	**733**	**M**	**MM ridge**	16-Dec-96	N						
150.262	D0733	733	M	MM ridge	7-Feb-97	N						
150.262	D0733	733	M	MM ridge	7-Mar-97	Y	S face of McBride; 140o	49.702	-125.659		5600	bare snow with scattered, patchy 3-5m fir; rock face
150.262	D0733	733	M	MM ridge	28-Mar-97	Y		49.536	-125.652		4400	
150.262	D0733	733	M	MM ridge	21-Apr-97	Y	McBride ridge extension top of avalanche (feathers)	49.711	-125.666	235	5300	few 3m fir, above treeline
150.293	**D0737**	**737**	**F**	**MM ridge**	16-Dec-96	N						
150.293	D0737	737	F	MM ridge	7-Feb-97	N						
150.293	D0737	737	F	MM ridge	7-Mar-97	N						
150.293	D0737	737	F	MM ridge	28-Mar-97	N						
150.293	D0737	737	F	MM ridge	21-Apr-97	N						
150.314	**D0734**	**734**	**M**	**MM ridge**	16-Dec-96	Y	MM ridge - closer to Morrison Spire	#VALUE!	#VALUE!			
150.314	D0734	734	M	MM ridge	7-Feb-97	N						
150.314	D0734	734	M	MM ridge	7-Mar-97	N						
150.314	D0734	734	M	MM ridge	28-Mar-97	Y		49.716	-125.682		4200	
150.314	D0734	734	M	MM ridge	21-Apr-97	Y	steep cliff joining McBride, east face of ridge 3 shit piles	49.708	-125.659	80 degrees (east)	5650	exposed rock & snow
150.332	**D0726**	**726**	**F**	**MM ridge**	16-Dec-96	Y - visual	MM ridge - W side	49.708	-125.669		5500	low gorge in cedar clump,deep ravine
150.332	D0726	726	F	MM ridge	7-Feb-97	Y - visual	N face-McBride	49.723	-125.670		5400	open hemlock, 3m, sparse
150.332	D0726	726	F	MM ridge	7-Mar-97	N						
150.332	D0726	726	F	MM ridge	28-Mar-97	N						
150.332	D0726	726	F	MM ridge	21-Apr-97	Y	east face of Mc Bride (flew - ref unclear. is this this bird, or #734?)	49.712	-125.653	140	5200	exposed rock & snow, fir and cedar 2m just a few
150.373	**D0701**	**701**	**F**	**Albert-Edward**	16-Dec-96	N						
150.373	D0701	701	F	Albert-Edward	7-Feb-97	N						
150.373	D0701	701	F	Albert-Edward	7-Mar-97	N						
150.373	D0701	701	F	Albert-Edward	28-Mar-97	N						
150.373	D0701	701	F	Albert-Edward	21-Apr-97	N						
150.389	**D0745**	**745**	**CK M?**	**Albert-Edward**	16-Dec-96	N						
150.389	D0745	745	CK M?	Albert-Edward	7-Feb-97	N						
150.389	D0745	745	CK M?	Albert-Edward	7-Mar-97	Y	NW of Jutland in valley; N-face Alexandria	49.679	-125.447		4300	moderately dense hemlock, cedar; 5-10m
150.389	D0745	745	CK M?	Albert-Edward	28-Mar-97	Y		49.677	-125.449		3500	
150.389	D0745	745	CK M?	Albert-Edward	21-Apr-97	Y - dead?	bottom of valley on back of Albert-Edward, head of Norm Creek	49.678	-125.449		3300	alder-snow chute & rocks
150.412	**D0659**	**659**	**M**	**5040**	16-Dec-96	Y	5040	49.195	-125.268		3800	steep face, dead/live timber
150.412	D0659	659	M	5040	7-Feb-97	N						
150.412	D0659	659	M	5040	7-Mar-97	Y	5040 steep slope	49.195	-125.269		4000	alder, 10m cedar/hemlock. Quite close to 150.861
150.412	D0659	659	M	5040	28-Mar-97	N						
150.412	D0659	659	M	5040	21-Apr-97	Y	Northwest side of 5040, cliff face	49.195	-125.270	east	3850	v. sparce cedar hemlock, alder, 10m
150.493	**D0657**	**657**	**F**	**5040**	16-Dec-96	Y	5040 - at base of peak to W, in draw to NE	49.203	-125.269		4100	in trees
150.493	D0657	657	F	5040	7-Feb-97	Y	5040 in bowl	49.207	-125.277		4500	rock face with 3m firs
150.493	D0657	657	F	5040	7-Mar-97	N						
150.493	D0657	657	F	5040	28-Mar-97	N						
150.493	D0657	657	F	5040	21-Apr-97	Y	West side 5040, alone	49.204	-125.275	east 140 degrees	4500	cedar & hemlock 6m, isolated clumps
150.552	**D0654**	**654**	**F**	**5040**	16-Dec-96	Y	5040	49.199	-125.256		2700	in draws
150.552	D0654	654	F	5040	7-Feb-97	Y - visual	5040 340o facing	49.194	-125.256		3850	1-3m cedar, hemlock, sparse. On cliff face
150.552	D0654	654	F	5040	7-Mar-97	N						
150.552	D0654	654	F	5040	28-Mar-97	Y		49.191	-125.257		<3200	
150.552	D0654	654	F	5040	21-Apr-97	Y	south side 5040 100m. below crest, alone	49.192	-125.261	east 145 degrees	4900	open cedar hemlock, 4-5m, rock cliffs

150.559	**D0717**	**717**	**M**	**5040**	16-Dec-96	Y	5040 - towards Nahmint	49.197	-125.254		2900	open cedar, fir, hemlock
150.559	D0717	717	M	5040	7-Feb-97	N						
150.559	D0717	717	M	5040	7-Mar-97	N						
150.559	D0717	717	M	5040	28-Mar-97	Y	DNL	#VALUE!	#VALUE!			
150.559	D0717	717	M	5040	21-Apr-97	N						
150.620	**D0735**	**735**	**F**	**MM ridge**	16-Dec-96	N						
150.620	D0735	735	F	MM ridge	7-Feb-97	N						
150.620	D0735	735	F	MM ridge	7-Mar-97	N						
150.620	D0735	735	F	MM ridge	28-Mar-97	N						
150.620	D0735	735	F	MM ridge	21-Apr-97	Y	east face of McBride, near 726	49.711	-125.653	140	5000	exposed cliff, few fir
150.730	**D0732**	**732**	**F**	**MM ridge**	16-Dec-96	N						
150.730	D0732	732	F	MM ridge	7-Feb-97	Y		49.619	-125.647		4700	open cedar-hemlock, some huckleberry, scattered conifers (5-8m), alder
150.730	D0732	732	F	MM ridge	7-Mar-97	N						
150.730	D0732	732	F	MM ridge	28-Mar-97	Y		49.620	-125.648		4200	
150.730	D0732	732	F	MM ridge	21-Apr-97	N						
150.751	**D0740**	**740**	**F**	**MM ridge**	16-Dec-96	Y	MM ridge - on McBride, W side of ridge	49.718	-125.665		6200	
150.751	D0740	740	F	MM ridge	7-Feb-97	Y	270o E	49.688	-125.675		5500	scattered 3-8m cedar & fir; exposed rock
150.751	D0740	740	F	MM ridge	7-Mar-97	N						
150.751	D0740	740	F	MM ridge	28-Mar-97	Y		49.688	-125.680		4400	
150.751	D0740	740	F	MM ridge	21-Apr-97	Y	extension to Morrison spire cliff face, 100m from crest	49.688	-125.674	SW 200	5650	few v. sparse 1-2m fir, mostly snow, above treeline
150.770	**D0711**	**711**	**F**	**Jutland**	16-Dec-96	N						
150.770	D0711	711	F	Jutland	7-Feb-97	N						
150.770	D0711	711	F	Jutland	7-Mar-97	Y	W of Jutland, 60o facing bowl area	49.719	-125.435		4600	cedar/hemlock--tall (10-12m) against slope
150.770	D0711	711	F	Jutland	27-Mar-97	Y		49.719	-125.435		4500	
150.770	D0711	711	F	Jutland	21-Apr-97	Y - dead	same as before	#VALUE!	#VALUE!			
150.799	**D0631**	**631**	**F**	**El Capitan**	16-Dec-96	Y	Head of Morrison Creek - N of English Man R. S of French Creek	49.245	-124.410		1300	on powerline in forest
150.799	D0631	631	F	El Capitan	7-Feb-97	Y	El Capitan. Dead?	49.240	-124.397		1500	forest and cutline (same as Dec.16)
150.799	D0631	631	F	El Capitan	7-Mar-97	N	RADIO DEAD					
150.799	D0631	631	F	El Capitan	28-Mar-97	N	RADIO DEAD					
150.799	D0631	631	F	El Capitan	21-Apr-97	N						
150.821	**D0718**	**718**	**M**	**5040**	16-Dec-96	Y	5040 - back side	49.191	-125.289		4500	exposed cliff, shrubby draw
150.821	D0718	718	M	5040	7-Feb-97	Y	5040 220o facing	49.189	-125.283		4700	scattered clumps of hemlock 5 m tall; 100 m from top
150.821	D0718	718	M	5040	7-Mar-97	Y	5040, 180o	49.188	-125.285		4600	treeline hemlock and scattered alder
150.821	D0718	718	M	5040	28-Mar-97	N						
150.821	D0718	718	M	5040	21-Apr-97	N						
150.861	**D0658**	**658**	**M**	**5040**	16-Dec-96	Y	5040 - back side	49.188	-125.280		4500	
150.861	D0658	658	M	5040	7-Feb-97	Y	5040 back; 200m from top	49.187	-125.285		4300	12 m hemlock; sparse
150.861	D0658	658	M	5040	7-Mar-97	Y	40o NE; same place as previously	49.187	-125.270		4300	cedar, hemlock, a little alder
150.861	D0658	658	M	5040	28-Mar-97	N						
150.861	D0658	658	M	5040	21-Apr-97	Y	south facing 150M below ridge, cliff face	49.186	-125.279	120 degrees	4800	cedar 3-5m, few hemlock
150.948	**D0720**	**720**	**F**	**5040**	16-Dec-96	Y	5040 W side to SE	49.175	-125.317		3200	in fir/cedar clump, weak signal
150.948	D0720	720	F	5040	7-Feb-97	N						
150.948	D0720	720	F	5040	7-Mar-97	N						
150.948	D0720	720	F	5040	28-Mar-97	N						
150.948	D0720	720	F	5040	21-Apr-97	N						
150.982	**D0660**	**660**	**M**	**5040**	16-Dec-96	N						
150.982	D0660	660	M	5040	7-Feb-97	N						
150.982	D0660	660	M	5040	7-Mar-97	N						
150.982	D0660	660	M	5040	28-Mar-97	N						
150.982	D0660	660	M	5040	21-Apr-97	N						
150.989	**D0651**	**651**	**F**	**5040**	16-Dec-96	Y	5040	49.199	-125.265		3200	in a lone tree
150.989	D0651	651	F	5040	7-Feb-97	N						
150.989	D0651	651	F	5040	7-Mar-97	N						
150.989	D0651	651	F	5040	28-Mar-97	N						
150.989	D0651	651	F	5040	21-Apr-97	N						
151.002	**D0676**	**676**	**M**	**Limestone Cap**	16-Dec-96	Y - visual	Limestone Cap - low on W side	49.675	-125.686		5700	alone, in snow roost
151.002	D0676	676	M	Limestone Cap	7-Feb-97	Y	S-facing (Mt. Judy?)	49.656	-125.681		5900	open, couple of 2 m firs; 40 m below peak
151.002	D0676	676	M	Limestone Cap	7-Mar-97	Y	Between Mt. Judy and Limestone, NW of limestone, 210o	49.669	-125.683		4800	10 m cedar and spruce; by rock face
151.002	D0676	676	M	Limestone Cap	28-Mar-97	N						
151.002	D0676	676	M	Limestone Cap	21-Apr-97	Y	beneath LC to west	49.680	-125.685	SW	5000	few 5-12 m cedar & fir, exposed rock, alder

151.092	**D0679**	**679**	**F**	**MtJudy/Phillip**	16-Dec-96	Y	MtJudy/Phillip	49.601	-125.686		5600	
151.092	D0679	679	F	MtJudy/Phillip	7-Feb-97	N						
151.092	D0679	679	F	MtJudy/Phillip	7-Mar-97	N						
151.092	D0679	679	F	MtJudy/Phillip	28-Mar-97	N						
151.092	D0679	679	F	MtJudy/Phillip	21-Apr-97	Y	head of Phillip Creek	49.601	-125.686	12 degree facing	5400	100% snow cover
151.108	**D0721**	**721**	**M**	**5040**	16-Dec-96	Y	5040	49.196	-125.274		4200	
151.108	D0721	721	M	5040	7-Feb-97	Y	5040 N-facing, 50 m from top	49.196	-125.275		4100	bare rock (99% snow). Only 2 1m firs
151.108	D0721	721	M	5040	7-Mar-97	N						
151.108	D0721	721	M	5040	28-Mar-97	N						
151.108	D0721	721	M	5040	21-Apr-97	N						
151.162	**D0677**	**677**	**F**	**Limestone Cap**	16-Dec-96	N						
151.162	D0677	677	F	Limestone Cap	7-Feb-97	N						
151.162	D0677	677	F	Limestone Cap	7-Mar-97	Y	N of Limestone across valley. NE facing	49.676	-125.731		3200	dense alder, cedar and hemlock on avalanche chute
151.162	D0677	677	F	Limestone Cap	28-Mar-97	Y		49.685	-125.687		4200	
151.162	D0677	677	F	Limestone Cap	21-Apr-97	Y	close to bird 676 (beneath LC to west)	49.681	-125.685	NW 300 degrees	5000	
151.172	**D0707**	**707**	**F**	**Jutland**	16-Dec-96	Y	Jutland - on slope on E side, above Sunrise Lake	49.710	-125.418		5500	25 ft cedar & hemlock
151.172	D0707	707	F	Jutland	7-Feb-97	N						
151.172	D0707	707	F	Jutland	7-Mar-97	Y	Jutland; SW slope rock face, 220o	49.703	-125.420		5800	extremely sparse fir trees; mostly rock
151.172	D0707	707	F	Jutland	27-Mar-97	Y		49.702	-125.589		4900	
151.172	D0707	707	F	Jutland	21-Apr-97	Y	Jutland 35m near top - rock cliff	49.704	-125.420	south face 200	5850	mostly rock chute - krummholtz spruce
151.181	**D0650**	**650**	**M**	**5040**	16-Dec-96	N						
151.181	D0650	650	M	5040	7-Feb-97	N						
151.181	D0650	650	M	5040	7-Mar-97	N						
151.181	D0650	650	M	5040	28-Mar-97	N						
151.181	D0650	650	M	5040	21-Apr-97	N						
151.192	**D0719**	**719**	**M**	**5040**	16-Dec-96	Y - visual	5040	49.187	-125.262		4100	in deciduous shrubbery
151.192	D0719	719	M	5040	7-Feb-97	N						
151.192	D0719	719	M	5040	7-Mar-97	N						
151.192	D0719	719	M	5040	28-Mar-97	N						
151.192	D0719	719	M	5040	21-Apr-97	N						
151.204	**D0705**	**705**	**M**	**Albert-Edward**	16-Dec-96	N						
151.204	D0705	705	M	Albert-Edward	7-Feb-97	N						
151.204	D0705	705	M	Albert-Edward	7-Mar-97	N						
151.204	D0705	705	M	Albert-Edward	28-Mar-97	N						
151.204	D0705	705	M	Albert-Edward	21-Apr-97	N						
151.214	**D0743**	**743**	**CK M?**	**Jutland**	16-Dec-96	N						
151.214	D0743	743	CK M?	Jutland	7-Feb-97	N						
151.214	D0743	743	CK M?	Jutland	7-Mar-97	N						
151.214	D0743	743	CK M?	Jutland	27-Mar-97	Y		49.748	-125.502		4900	
151.214	D0743	743	CK M?	Jutland	21-Apr-97	N						
151.380	**D0703**	**703**	**CK F?**	**Albert-Edward**	16-Dec-96	N						
151.380	D0703	703	CK F?	Albert-Edward	7-Feb-97	N						
151.380	D0703	703	CK F?	Albert-Edward	7-Mar-97	N						
151.380	D0703	703	CK F?	Albert-Edward	28-Mar-97	N						
151.380	D0703	703	CK F?	Albert-Edward	21-Apr-97	N						
151.462	**D0630**	**630**	**F**	**Mt McQuillan**	16-Dec-96	Y	Mt McQuillan NE side	49.115	-124.610		4200	draws in timber
151.462	D0630	630	F	Mt McQuillan	7-Feb-97	Y	in bowl NW of mt.	49.117	-124.607		4000	15-20 m sparse cedar & hemlock. Rusty rockface
151.462	D0630	630	F	Mt McQuillan	7-Mar-97	Y	NW of McQuillan in water course valley	49.118	-124.610		3500	scattered alder, spruce, hemlock & cedar, 10-15 m clumps beside stream
151.462	D0630	630	F	Mt McQuillan	28-Mar-97	Y	DNL	#VALUE!	#VALUE!			
151.462	D0630	630	F	Mt McQuillan	21-Apr-97	N						
151.483	**D0704**	**704**	**CK F?**	**Albert-Edward**	16-Dec-96	N						
151.483	D0704	704	CK F?	Albert-Edward	7-Feb-97	N						
151.483	D0704	704	CK F?	Albert-Edward	7-Mar-97	N						
151.483	D0704	704	CK F?	Albert-Edward	28-Mar-97	N						
151.483	D0704	704	CK F?	Albert-Edward	21-Apr-97	N						
151.489	**D0702**	**702**	**CK F?**	**Albert-Edward**	16-Dec-96	N						
151.489	D0702	702	CK F?	Albert-Edward	7-Feb-97	N						
151.489	D0702	702	CK F?	Albert-Edward	7-Mar-97	N						
151.489	D0702	702	CK F?	Albert-Edward	28-Mar-97	N						

151.489	D0702	702	CK F?	Albert-Edward	21-Apr-97	N						
151.621	**D0627**	**627**	**M**	**El Capitan**	16-Dec-96	N						
151.621	D0627	627	M	El Capitan	7-Feb-97	N						
151.621	D0627	627	M	El Capitan	7-Mar-97	Y?	SW of Whymper; low in valley BIRD DEAD	48.934	-124.150			v. fast and weird signal. Maybe collar - cougar/elk.
151.621	D0627	627	M	El Capitan	28-Mar-97	Y	BIRD DEAD	48.934	-124.150			
151.621	D0627	627	M	El Capitan	21-Apr-97	N						
151.700	**D0722**	**722**	**M**	**King's Peak**	16-Dec-96	Y	King's Peak - on E face to S	49.809	-125.833			
151.700	D0722	722	M	King's Peak	7-Feb-97	N						
151.700	D0722	722	M	King's Peak	7-Mar-97	?	one signal--MM to Golden Hinde heading W.					
151.700	D0722	722	M	King's Peak	28-Mar-97	N						
151.700	D0722	722	M	King's Peak	21-Apr-97	N						
151.879	**D0611**	**611**	**F**	**Albert-Edward**	16-Dec-96	Y - visual	Albert-Edward - NW below glacier	49.682	-125.414		4800	in 1 m clump of deciduous shrubbery & 1-2 m high cedars. With chick 150.244
151.879	D0611	611	F	Albert-Edward	7-Feb-97	N						
151.879	D0611	611	F	Albert-Edward	7-Mar-97	Y	S. of Castle Craig, W of Moat Lake	49.663	-125.331		3300	clearcut cedar and few fir 3-5m. No other signals nearby.
151.879	D0611	611	F	Albert-Edward	28-Mar-97	N						
151.879	D0611	611	F	Albert-Edward	21-Apr-97	N						
151.892	**D0724**	**724**	**F**	**King's Peak**	16-Dec-96	Y	King's Peak - to W	49.813	-125.850		5300	on exposed vertical rock face, few trees
151.892	D0724	724	F	King's Peak	7-Feb-97	N						
151.892	D0724	724	F	King's Peak	7-Mar-97	Y	King's Peak, W face	49.815	-125.854		4900	some small alder bushes; open area with a few 2-3 m fir
151.892	D0724	724	F	King's Peak	28-Mar-97	N						
151.892	D0724	724	F	King's Peak	21-Apr-97	Y	avalanche chute, King's has repeater (2 birds)	49.813	-125.851	south 230	4950	exposed rock 1-2m spruce & fir, very sparse, dead trees
151.902	**D0713**	**713**	**F**	**Jutland**	16-Dec-96	N						
151.902	D0713	713	F	Jutland	7-Feb-97	N						
151.902	D0713	713	F	Jutland	7-Mar-97	N						
151.902	D0713	713	F	Jutland	27-Mar-97	Y		49.713	-125.414		4800	
151.902	D0713	713	F	Jutland	21-Apr-97	N						
none					21-Apr-97	Y	flying with no radio, near location of 150.314, McBride	49.708	-125.659		5300	