East Kootenay Badger Project: 1997/98 Year-End Summary Report

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Abstract

This report summarizes activities undertaken in Year 3 of the East Kootenay Badger Project. In 1997/98, 37 badger sightings from throughout the East Kootenay were catalogued, in addition to the 357 sightings recorded in 1995/96 and 1996/97. An updated distribution map was also prepared. Badger sightings were recorded regularly throughout the Rocky Mountain Trench from Parson south, and in major tributaries such as the Flathead, Elk, Moyie and upper Kootenay drainages. Outliers occurred at a scattering of high-elevation sites and as far north as the Blaeberry River. Sightings occurred in all biogeoclimatic zones, with the majority concentrated in the Interior Douglas-Fir zone.

Within the intensive study area, from Brisco to Wasa, five additional badgers were captured and fitted with radiotransmitters, bringing the total number of study animals to nine. Of these nine, one was a juvenile, and the adults ranged from three to 10 years. One adult was killed by a vehicle on Highway 93/95, one adult appeared to have been killed and eaten by a cougar, the juvenile was killed from undetermined causes, likely cougar predation. The juvenile had dispersed 21 km south-southeast from her natal area.

Home ranges were significantly larger than had been found in other studies from Idaho, Wyoming and Illinois. Using the 100% MCP method, home ranges for females in this study ranged from 2 to 82 km^2 while males ranged from 293 to 513 km^2. The largest home ranges in other studies was from Illinois, where females averaged 13 km^2 and males averaged 44 km^2.

Indications from the first two years of trapping and radiotelemetry suggest that the badger population in the study areas is very low, particularly north of Canal Flats. This statement is based on low trap success, large home range sizes, predominantly adult captures and no known offspring.

Most of the time (60%) radiolocated badgers were in burrows that had been previously dug, and most burrows were in areas also having Columbian ground squirrels within 50 m (at least 76%). Most of these burrows (74%) were within 50 m of a road, including 19% that were within 50 m of a highway.

Most sightings and radiolocations were from non-forested habitats, mainly sites classified as open range or cultivated, but also including urban and cutblocks. Of the forested habitats, most radiolocations were in stands composed of Douglas-fir, ponderosa pine, or a mix of the two and having 6-35% crown closure. Soil types for most sightings and radiolocations were moderately coarse to medium textured sandy loam or silt loam.

Public education included school programs, radio interviews, public service announcements and newspaper articles.

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1. Introduction

1.1 Background and Objectives

Badgers (*Taxidea taxus*) are "blue listed" in British Columbia, largely because the low-elevation grasslands and open forests in which they usually live are rapidly being altered or lost through forest ingrowth, subdivisions, roads, and other developments. Badger populations are also impacted through shooting, trapping, poisoning and roadkills. Badgers are limited to south-central and southeastern British Columbia, including the Cariboo, Thompson-Nicola, Okanagan, extreme southern West Kootenay/Boundary, and the southern East Kootenay, including the upper Columbia valley (Rahme et al. 1995). Informal discussions with long-time residents suggest that there are significantly fewer badgers in the upper Columbia than in the past. Despite their vulnerable status, there had been no radiotelemetry-based research on badgers in BC until now. The Forest Practices Code requires that all blue-listed species be included in forest and range management plans, but the lack of basic information on habitat requirements, home range size and distribution makes planning and management very difficult.

In order to provide the information that is currently lacking, the East Kootenay Badger Project was initiated in 1995/96 by Kootenay National Park and the Columbia Basin Fish and Wildlife Compensation Program. In 1996/97 Forest Renewal British Columbia, through BC Environment, became a major contributing partner. The project takes a three-pronged approach to provide information that is currently lacking. Project components include inventory, telemetry-based habitat research, and public education.

The overall goal is to provide information to resource managers so the needs of badgers can be incorporated into land management planning. Specifically, the objectives are to:

- determine the distribution of badgers in the East Kootenay, based on sighting records;
- determine home range size, dispersal patterns and habitat use patterns based on radiotelemetry data;
- develop a habitat suitability algorithm based on soil types, forest cover, and distance and proximity to roads and houses;
- facilitate the use of this information by resource managers and provide input directly into forest harvesting plans and construction development plans; and
- provide public education to improve the understanding of badger ecology and to decrease the likelihood of them being intentionally killed.

This report summarizes the activities of year three of this project (1997/98). The objectives of this year were to:

- continue soliciting and recording sightings from throughout the East Kootenay;
- continue trapping and radiotagging badgers from Brisco to Wasa;
- monitor study animals to record locations and corresponding habitat attributes; and
- continue providing public education and input into development planning processes.

1.2 Study Areas

The inventory study area is BC Environment's East Kootenay subregion. The radiotelemetry portion of the study was originally designated as Canal Flats to Edgewater. In 1996/97, trapping and monitoring efforts were extended north to Spillimacheen and south to the Findlay Creek drainage and the Whiteswan Forest Service Road (Newhouse 1997). In 1997/98, trapping efforts were expanded further north to Brisco and south to Wasa (Figure 1). This expansion was required because of the low density and large home ranges of the badgers fitted with radiotransmitters. Monitoring extended beyond even the expanded boundaries to follow badger movements.

The trapping area includes the low-elevation grasslands and open forests of the Interior Douglas-fir and Ponderosa Pine biogeoclimatic zones (IDFun, IDFdm2 and PPdh2 variants) from Brisco to Wasa. Most of the study area falls within the East Kootenay Trench ecosection of the Southern Rocky Mountain Trench ecoregion, which is part of the Southern Interior Mountains ecoprovince.

1.3 Review of Existing Information on Distribution, Abundance and Habitat Requirements of Badgers

1.3.1 Distribution and Abundance

Badgers occur in the south-central and southeastern portions of the province. Distribution of badgers correlates with the distribution of their major prey species (Columbian ground squirrels, *Spermophilus columbianus*; northern pocket gophers, *Thomomys talpoides*; and yellow-bellied marmots, *Marmota flaviventris*) in the Interior Douglas-fir (IDF), Ponderosa Pine (PP) and Bunchgrass (BG) biogeoclimatic zones, with occasional use of the Interior Cedar-Hemlock (ICH), Montane Spruce (MS), Engelmann Spruce-Subalpine Fir (ESSF) and Alpine Tundra (AT) zones. Prior to this study, there was very little information available on the distribution and abundance of badgers in British Columbia. The report "Status of Badgers in British Columbia" estimated that there were 100-500 badgers in the East Kootenay in 1990 based on the "best guesses" of regional biologists (Rahme et al, 1995). Information from the current study suggests that the population is at the lower end of this estimate.

1.3.2 Habitat Use

There has been little research done to define badger habitat requirements. In a study of badgers in south-central Idaho, Todd (1980) found that the distribution and abundance of badgers were related to concentrations of Belding's ground squirrels (*Spermophilus beldingi*). He found that areas with intensive irrigated agriculture and interspersions of annual vegetation supported greater numbers of both ground squirrels and badgers than did areas of native vegetation and crested wheatgrass (*Agropyron cristatum*). In the West Kootenay of BC, Ketcheson and Bauer (1995) also found that northern pocket gophers and Columbian ground squirrels occurred more frequently on sites where the surface had previously been disturbed by humans. Ritcey et al. (1988) rated the value of various habitat types to badgers in BC according to relative use. Their only "high" rating was for bunchgrass (*Agropyron* spp.) grassland, while the grass/forb stage of big sage (*Artemesia tridentata*) grassland, ponderosa pine (*Pinus ponderosa*), and Douglas-fir (*Pseudotsuga menziesii*)/ponderosa pine habitats were rated as "medium". Preferred habitat types may not be abundant in the East Kootenay because bunchgrass grassland is restricted mainly to warm aspects on steep slopes in the PPdh, there are no extensive patches of true big sage grassland, and the grass-forb stage of ponderosa pine and Douglas-fir/ponderosa pine habitats is being reduced rapidly by conifer encroachment. Ketcheson and Bauer (1995) found in the West Kootenay that badgers tended to occur in areas of shrubby vegetation. Minta (1993) found that badgers primarily occupied the bottoms and gentler slopes of hollows (deep silt soils), and to a lesser extent the breaks and plateaus of higher elevations (gravelly soils). Based on the literature, Ketcheson (1994) hypothesized that the habitat attributes that are important to badgers in the West Kootenay include:

- established populations of prey species;
- fluvial, glaciofluvial, lacustrine, glaciolacustrine or morainal terrain with less than 20% coarse fragments and a cohesive, yet friable, fine fraction; and
- grassland, shrub or open forest structural stage.

Warner and Ver Steeg (1995) found that burrows were significantly closer to corridors (fencelines, field borders, roadsides, ditch banks) than were random locations, and suggest that these habitats were used as travel lanes and possibly for hunting.

1.4 Acknowledgments

Funding and technical and administrative support for Year 3 of this project were provided by FRBC (through BC Environment), the Columbia Basin Fish and Wildlife Compensation Program, Kootenay National Park, the East Kootenay Environmental Society, and the Invermere Veterinary Hospital. Contract monitors Sue Crowley of BCE, Larry Ingham of CBFWCP and Alan Dibb of KNP all provided enthusiastic and knowledgeable guidance. Ian Parfitt, of the CBFWCP, prepared all the maps for the report. Summer CBFWCP technicians, Renee Franken, Hillary Page, Rich Klafki and Christi Wright undertook all aspects of trapping, successfully adding five additional badgers to the study. KNP's summer student, Ramona De Graaf, developed and presented an excellent school program and assisted with trapping. Trevor Kinley provided advice on all aspects of the project and became our expert skunk releaser. Last, but by no means least, Tim McAllister was responsible for radiotelemetry, trapping, photography and maintaining good humor in the working team.

Figure 1. East Kootenay Badger Project study areas.

2. Materials and Methods

2.1 East Kootenay Inventory

In 1997/98, sightings were obtained by contacting knowledgeable people (government officials, forest company employees and contractors, wildlife researchers, ranchers and naturalists), by distributing a poster requesting sighting information, and through newspaper articles, radio interviews and public presentations.

Inventory data was recorded in an *Excel* database. For each sighting, the date, observer's name and phone number, Universal Transverse Mercator (UTM) coordinates, map sheet, mapping datum system, level of accuracy, soil type, biogeoclimatic subzone, type of sign seen, air photo number, forest cover type, and notes describing the sighting were recorded. Forest cover type was taken from forest inventory planning (FIP) maps produced by the Ministry of Forests, and soil information was drawn from maps accompanying Lacelle (1990) and Wittneben (1980).

2.2 Trapping and Radiotransmitter Implants

Potential trap sites were located by reviewing the sightings database then field-checking these areas, or by field-checking areas with known Columbian ground squirrel colonies or known use by a radiotagged badger. A significant portion of badger habitat is on private land. Landowners were contacted either in person or by telephone to request permission to access their land to check for badger holes and, if holes were found, to set traps. Landowner cooperation was excellent. Cooperating land holders included the Columbia Lake and Shuswap Indian bands, Kirk's and Hofert's Christmas tree lands, Canadian Maple Leaf Corporation Holdings, The Springs and Windermere Valley golf courses, and at least 20 individual landowners.

Badgers were trapped at burrow entrances using #1½ soft-catch leghold traps baited with meat (ground squirrels or rabbits) and scented with *Carmen's Canine Call* (Russ Carmen, New Milford, PA). Traps were checked at least once daily. Trapped badgers were noosed and hand-injected with 10 mg/kg of *Telazol* mixed at 100 mg/ml. The animals were then transported to the Invermere Veterinary Hospital where an intraperitoneal transmitter was implanted. Blood, fecal, upper premolar tooth and hair samples were taken. Once the badger was alert, it was released either at the original trap site if the hole was still intact, or at a nearby burrow. Teeth were sent to *Matson's Lab* in Milltown, Montana for aging.

2.3 Monitoring and Data Entry

Badgers were usually located weekly from April to September and once every two weeks from October to March. A fixed-wing aircraft (Cessna 172) was used to radiolocate animals. After the animals were located from the air, a hand-held antenna was used by a ground-based observer to locate the actual burrows. The UTM coordinates, forest cover type and soil type were identified from FIP maps and Lacelle (1990) or Wittneben (1980). In addition, a site assessment was conducted which described burrow type and size, cover type, distance to nearest change in cover type, presence and characteristics of trees or stumps within 2 m of burrow, proximity and type of three nearest roads, proximity and type of two nearest buildings, slope angle and aspect, distance to nearest change in slope, and number of ground squirrel and badger holes with 1 m of either side of four 50-m perpendicular transects originating at the burrow. This data was recorded in an *Excel* database. Data reported in this document covers the period from the summer of 1996 to September, 1997.

In addition to daytime locations, one 24-hour monitoring session was conducted to explore activity patterns and habitat use. Female #3 was followed for 24 hours beginning at 09:00 MST on May 13, 1997. This was compared to a parallel session conducted on August 28, 1996.

2.4 Home Range Calculations

Home ranges were calculated using the program CALHOME (Kie et al. 1994). Both the Adaptive Kernel (ADK) and the Minimum Convex Polygon (MCP) methods were used. Only the locations where badgers were known to have moved from the previous locations were used in home range calculations. Thus, locations from a winter burrow which was occupied continuously for 98 days counted as only one location. Home range was not calculated for animal #8 as she was a dispersing juvenile.

2.5 Public Education

Public presentations were given to students from Radium, Invermere and Canal Flats. Six schools and approximately 226 students were visited from grades 2-11. Radio interviews were given on Cranbrook (CKEK), and Invermere/Golden (CKIR/CKGR) radio stations. Public service announcements were also aired on these stations requesting sighting information. In addition, several newspaper articles were written (Appendix 1).

3. Results

3.1 East Kootenay Distribution

In 1997/98 an additional 37 sightings were catalogued from throughout the East Kootenay, bringing the total number of sightings recorded to 394. Badger sightings were concentrated in the Rocky Mountain Trench from Parson to the U.S.A. border and in major low-elevation tributaries, such as the Elk, Flathead and St. Mary rivers. Sightings were also recorded at a scattering of higher elevation sites and as far north as the Blaeberry River (Appendix 2). The majority of sightings were from the IDF (60%). However, sightings occurred in all biogeoclimatic zones of the East (Figure 2).

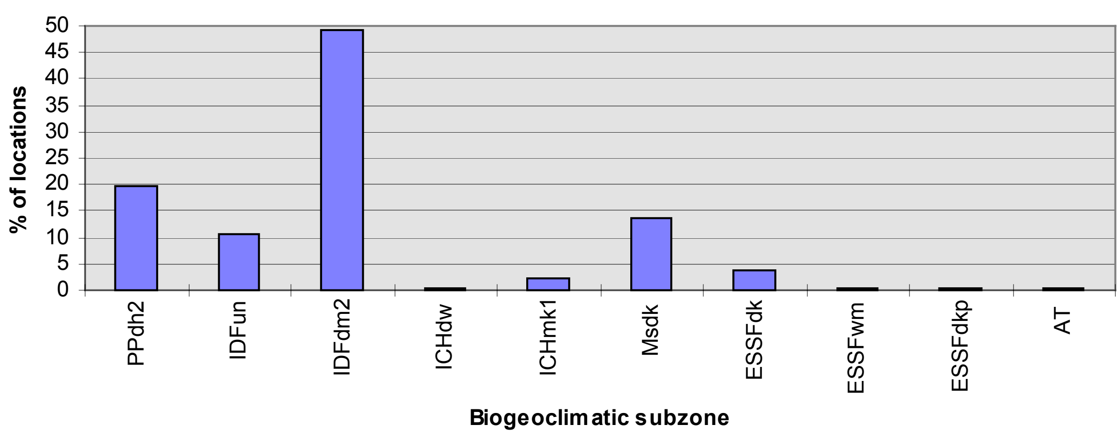

Figure 2. Percentage of sightings by biogeoclimatic subzone (n=393).

3.2 Badger Capture, Age and Status

Four adult females, four adult males and one juvenile female have been radiotagged in 1996/97 and 1997/98 (Table 1).

Table 1. Badger capture summary.

Date of Capture	Nearest Community	ID #	Sex	Weight (kg)	Age at Capture	Status as of March, 1998
June 20, 1996	Windermere	1	F	6.1	6	alive
July 26, 1996	Invermere	2	M	10.5	10	roadkilled 97/06/30
August 3, 1996	Radium Hot Springs	3	F	8.6	3	alive
Feb. 12, 1997	Canal Flats	4	M	10.9	3	alive
June 28, 1997	Canal Flats	5	F	6.4	3	cougar-killed 98/02/17
July 5, 1997	Skookumchuck	6	M	7.7	9	alive
July 24, 1997	Wasa	7	F	5.9	3	alive
July 24, 1997	Wasa	8	F	3.6	<1	predator-killed 97/11/13
March 9, 1998	Ta Ta Creek	9	M	10.5	?	alive

3.3 Home Ranges and Dispersal

Home range calculations to September 29, 1997 are shown in Table 2 and mapped in Appendix 3. Males had considerably larger home ranges than females (t=6.3, df=5, P=0.001). The mean 100% MCP home range for females was 41.9 km^2 (SD=33.4) and for males was 399.4 km^2 (SD=110.2). We documented the home range shift of female #1 into the central part of male #2's home range after his death. The female had been monitored for over a year and appeared to have a well-defined range when the male died on June 30, 1997. On August 18, the female was in an area with a high concentration of ground squirrels that had formerly been used by the male, and which was 3.3 km further south than the female had ever been found previously. Since that time (from August to March), we have not documented the female using her original home range to the north. Only one juvenile was radiotagged. She was captured with her mother on July 24, 1997 and dispersed sometime between August 4 and 12. Her furthest point from the natal den was 21 km south-southeast. She died of apparent cougar predation in November.

Table 2. Home ranges of radiotagged badgers.

I.D.#	Sex	n	100% MCP (km^2)	95% ADK (km^2)	75% ADK (km^2)
7	F	9	2.2	5.3	5.2
1	F	95	33.2	94.6	27.9
5	F	16	49.7	88.4	51.5
3	F	83	82.4	268.8	77.4
6	M	11	292.9	381.2	209.3
4	M	35	392.3	539.1	247.3
2	M	53	513.0	768.6	167.5

3.4 Activity Patterns (24-hour Monitor)

Only one 24-hour monitor was conducted during each of the last two field seasons on the same individual, so the results must be interpreted with caution. Most hunting occurred at night, with the longest active period from 20:30 to 07:45 in August of 1996 and from 20:40 to 5:40 in May of 1997 (Table 3). The badger was also active in late morning from 10:00 to 11:25 in August of 1996 and active in late afternoon from 15:55 to 17:10 in May of 1997. Data was recorded in one minute segments then summarized in half hour units. Thus, if the badger was active for less than a half hour within a block of inactivity, this was not recorded in the summary table below.

Table 3. 24-hour activity pattern for female badger #3. Times reported as MST.

Behavior	Time - August/96	Time - May/97
Inactive (grooming, resting in burrow and on mound)	------	09:00-15:55
Active (possibly hunting)	09:00-10:25	15:55-17:10
Inactive (grooming, resting in burrow and on mound)	10:25-20:35	17:10-20:40
Active (possibly hunting)	20:30-07:45	20:40-05:40
Inactive (in burrow)	07:45-09:00	05:40-09:00

3.5 Habitat Use

When it was obvious whether burrows had been freshly dug or previously dug, they were classified as "new" or "old". Badgers tended to use old burrows (60%) more often than they dug new ones (binomial test, p=0.067; Figure 3). Many burrows appear to be used year after year and on two occasions two badgers used the same burrow at different times.

Figure 3. Use of existing versus new burrows (n=118).

Most badger burrows were found in association with Columbian ground squirrel holes (binomial, p<0.001). For 76% of badger burrows, Columbian ground squirrel holes were recorded at least once on four 50-m transects originating from the burrow (Figure 4).

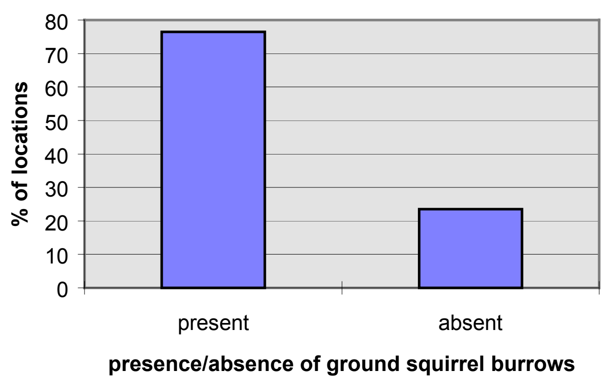

Figure 4. Presence of Columbian ground squirrel burrows on at least one of four 50-m transects originating at badger burrows (n=170).

More than half of the radiolocations (74%) were within 50 m of a road (χ^2=64.155, df=1, p<.001; Figure 5). A road was defined as any surface (dirt, gravel or paved) that was used for vehicular traffic. This included 19% that were within 50 m of a highway. This data was not biased by the ease of locating animals from the road because animals were first located from a fixed-wing aircraft and then tracked to the burrow on the ground.

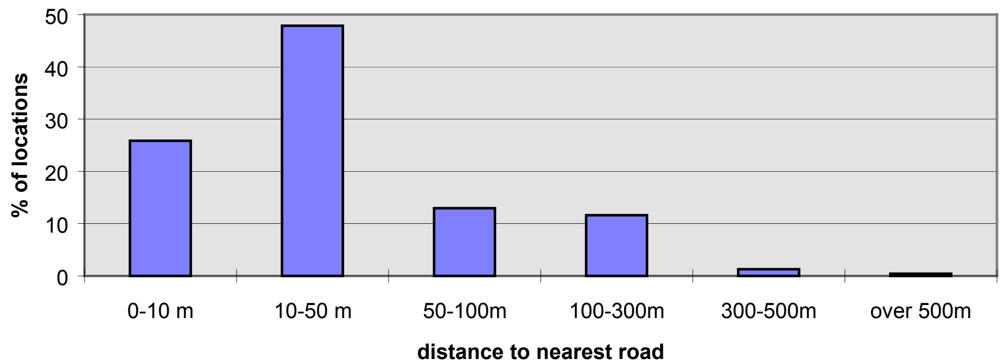

Figure 5. Distance of radiolocation sites to nearest roads (n=232).

Records of badgers in forest was higher for radiotagged badgers (38%) than for sightings (25%; χ^2=3.9, df=1, p=0.048). Based on forest cover mapping, tagged badgers used more non-forested (62%) than forested habitats (25%; binomial, p>0.001; Figure 6). For non-forested habitat types, the most common forest cover map classification of radiolocations was open range, followed by cultivated, urban and "not satisfactorily restocked" (NSR), and for sightings it was cultivated, followed by open range, urban and NSR (Figure 7).

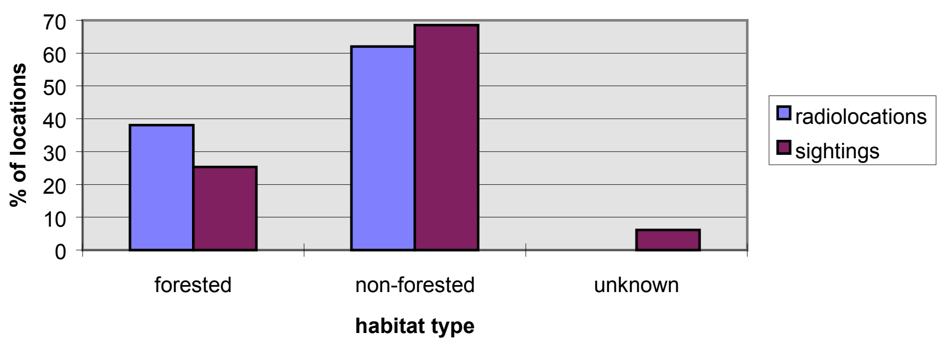

Figure 6. Classification of sightings (n=391) and radiolocations (n=313) as forest or non-forest.

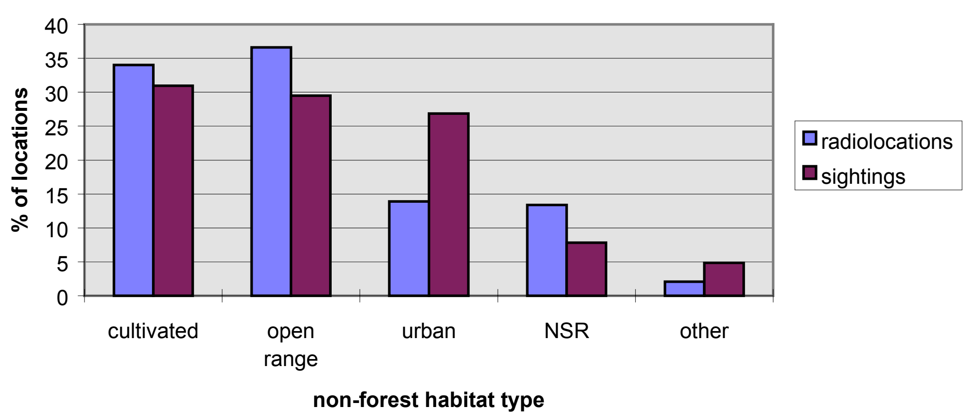

Figure 7. Classification of non-forest sightings (n=268) and radiolocations (n=194) by cover type.

Most of the radiolocations in forested habitats (72%) were in stands composed of Douglas-fir, ponderosa pine or a mix of the two (Figure 8). A further 16% of radiolocations in forested habitats were in stands dominated by lodgepole pine (*Pinus contorta*) or by mixes of hybrid white spruce (*Picea glauca* x *engelmannii*) and/or lodgepole pine and/or Douglas-fir and/or western larch (*Larix occidentalis*). The other 12% were in trembling aspen (*Populus tremuloides*) or mixed aspen/conifer stands.

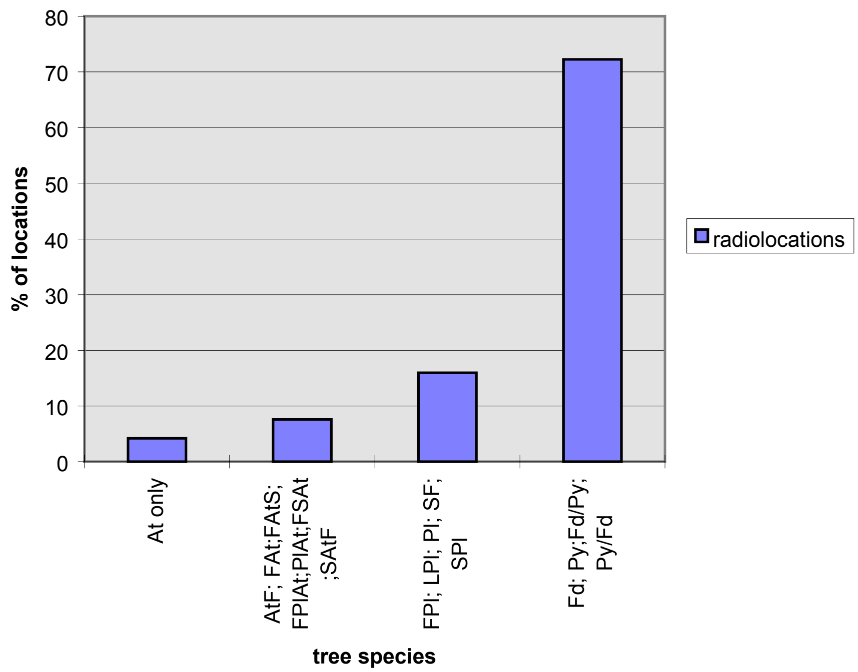

Figure 8. Tree species in forested radiolocation sites (n=119).
At=trembling aspen; F or Fd=Douglas-fir; L=western larch; Pl=lodgepole pine; Py=ponderosa pine; S=hybrid white spruce

Most of the radiolocations from forested sites (89%) were in polygons having 6-35% crown closure (Figure 9). There was some use (11%) in forests having 36-65% crown closure, but none were in very dense forest (66-100% crown closure). Badgers used almost all age classes (Figure 10), ranging from stands with trees in the dominant canopy layer being 1-20 years old (6%) to 141-250 years (2.5%). Most radiolocations were in stands between 21 and 120 years old (92%).

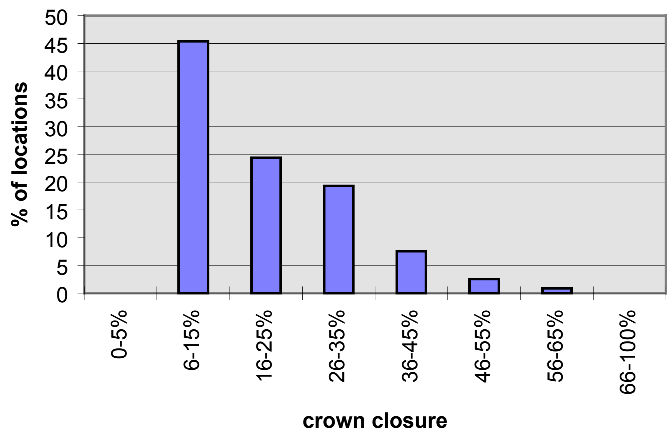

Figure 9. Crown closure of forested radiolocation sites (n=119).

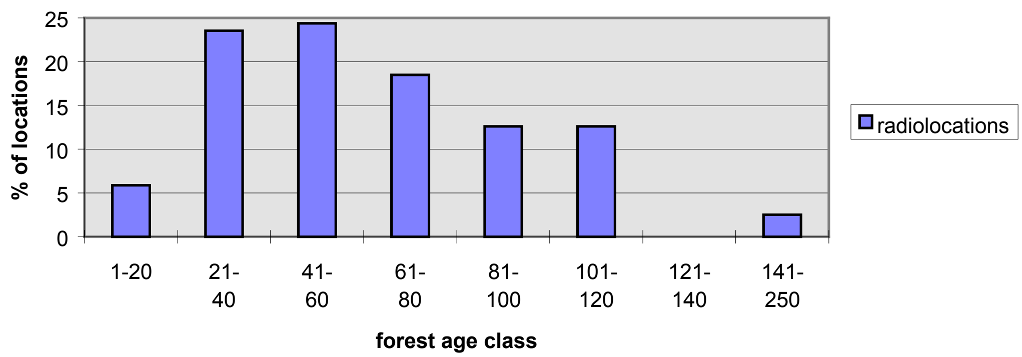

Figure 10. Forest age class of forested radiolocation sites (n=119).

Soil maps of Lacelle (1990) and Witteneben (1980) identify the decile of each of up to three soil associations present in each polygon. When two strongly contrasting textures are within 1 m of the surface, the subsurface texture is classified separately from the surface texture. For this analysis, only the dominant association was considered for each of the surface and subsurface layers. Lacelle (1990) groups soil textures into 5 classes:
Coarse textured - sand, loamy sand
Moderately coarse textured - sandy loam, fine sandy loam
Medium textured - very fine sandy loam, loam, silt loam, sandy clay loam
Moderately fine textured - clay loam, silty clay loam, sandy clay loam
Fine textured - sandy clay, silty clay, clay, heavy clay
The highest percentage of radiolocations (52%) and sightings (430%) were in surface soils of silt loam and gravely silt loam, which is medium textured. Most of the other

locations were in moderately coarse textured soils of sandy loam, fine sandy loam and gravely sandy loam (Figure 11).

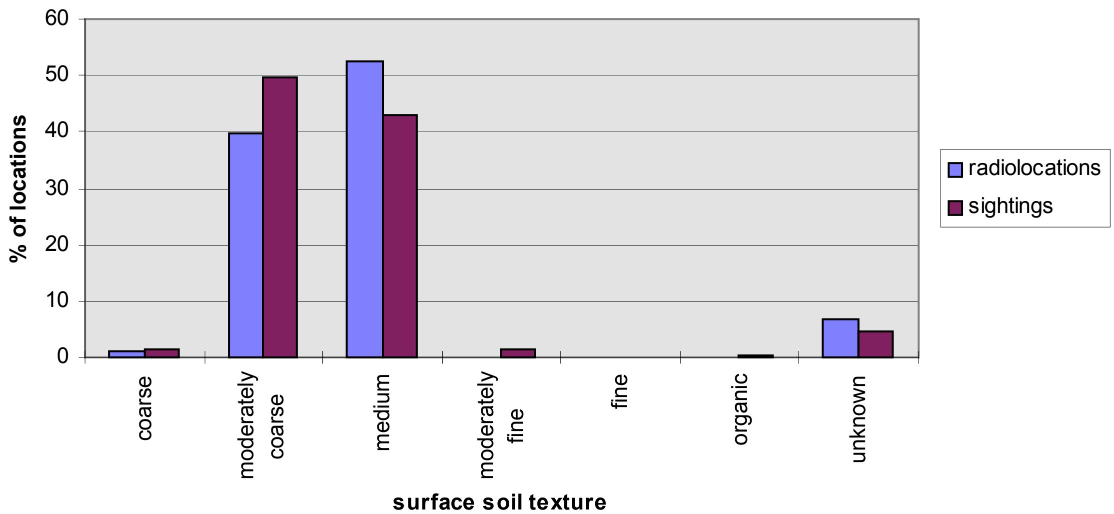

Figure 11. Surface soil texture for radiolocations (n=313) and sightings (n=391).

Subsurface soil textures for radiolocations and sightings also were mostly medium (51% of radiolocations; 41% of sightings) and moderately coarse (41% of radiolocations; 52% of sightings) textured (Figure 12).

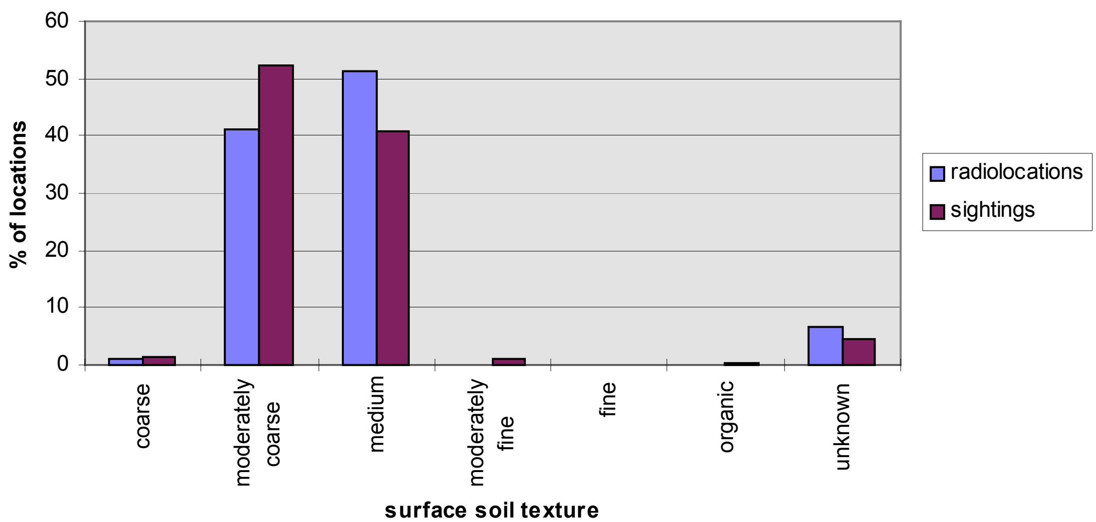

Figure 12. Subsurface soil texture for radiolocations (n=313) and sightings (n=391).

4. Discussion

The data presented in this report are preliminary. They are based on two years of research and only eight radiotagged animals. Therefore, the results must be interpreted with caution. Furthermore, the data summarized here only represents habitat use. Habitat selection cannot be determined yet as availability of the habitat attributes surveyed has not been compared with use. In the final year of the project, a habitat suitability algorithm will be produced.

4.1 Home Range and Dispersal

Home range sizes documented in this study are significantly larger than any reported in the literature, as summarized in Table 4. A dispersed prey base in probably a significant contributor to these large home ranges. This, coupled with low density because of mortality and low reproductive output also likely contributes to large home range size. As Apps (1996) noted for bobcats (*Lynx rufus*) in the East Kootenay, being limited by increased mortality and decreased fecundity, populations may simply spread into a greater available space, and resulting large home ranges may not necessarily reflect total resources required by individuals. The percentage difference between the mean size of female and male home ranges also appears to be higher here than elsewhere. It may be that there is so little home range overlap between females here compared to elsewhere (in fact there are probably gaps of vacant habitat) that males may have to travel proportionately farther to have a home range encompassing a given number of females. Interestingly, one female had a home range of only 2.2 km^2 from July 23 to September 29. While this calculation was based on only nine locations over 68 days, it did cover periods when her kit was either old enough to travel long distances with her or had dispersed. Thus, this calculation is likely reasonably representative of her true home range. This small home range could be the result of the availability of a second prey species, northern pocket gophers, that do not occur in any of the other adult badgers' home ranges.

Table 4. Comparison of mean home ranges, based on 100% MCP method.

Study Location	Females (km^2)	Males (km^2)
Idaho (Messick and Hornocker, 1981)	1.6	2.4
Wyoming (Minta, 1990)	2.8	8.3
Illinois (Warner and Ver Steeg, 1995)	13.0	44.0
East Kootenay (this study)	41.9	399.4

The home range shift documented for an adult female who moved south into an area of high ground squirrel density two months after the death of the adult male previously frequenting this area suggests that there may be intersexual competition for habitat elements even with large home ranges.

Only one juvenile was captured this year, and she dispersed in early August. Messick et al. (1981) found in one Idaho study area (Birds of Prey) that nearly all young-of-the-year left their natal area in June. In contrast, they found in another Idaho study area (Twin Falls) that dispersal began in June and continued into August. They note that dispersal in their study area coincided with estivation of Townsend and Belding's ground squirrels, with later dispersal in the area with later estivation of prey. This could also explain the late dispersal witnessed here, as Columbian ground squirrels generally begin hibernation in mid-August. Once ground squirrels hibernate, badgers in Idaho concentrated more on other foods such as smaller rodents and insects. It would require significant energy for a mother to provide enough of these smaller foods for her young, so when ground squirrels become less available, there is probably increased pressure for the young to disperse. The fact that there was only one kit in the litter we observed may also have contributed to late dispersal, as the mother's energetic cost of raising a family would be lower than with a larger litter.

4.2 Indications of Population Density

Indications from the first two years of trapping and radiotelemetry suggest that the badger population in the study area is very low, particularly in the northern portion, from Canal Flats to Brisco. This statement is based on the following observations:

- Of eight badgers trapped, only one was a juvenile. Juveniles should be more susceptible to trapping as they are less trap-wary and can travel great distances when dispersing from natal ranges, so their near-absence in the trapped sample may be indicative of low kit production.
- Neither of the females captured in 1996 appeared to have had young that year and did not in 1997. Only one of the two adult females captured in 1997 showed evidence of having reared young. Furthermore, the productive female only had one kit with her, despite litter sizes in other studies being up to five (Lindzey 1982). Messick and Hornocker (1981) found that fecundity rose with age and the proportion of productive females of all ages in a given year averaged 57%. The females trapped in this survey were all between the ages of three and six, so higher fecundity would be expected. Messick and Hornocker (1981) speculate that if badgers are induced ovulators, as suggested for other mustelids, then frequent copulation over an extended period might ensure a high conception rate. The low population density in the East Kootenay may result in reduced frequency of copulation and hence low productivity.
- Despite extensive trapping efforts in 1997, no additional badgers were captured north of Canal Flats.
- Home ranges were much larger than in other studies, indicating that there was probably a proportionately lower density.

There is possibly a higher population south of Canal Flats. The only productive female was captured near Wasa and she had a much smaller home range than the other study animals (2.2 km^2 over a short term, compared with an average of 55.1 km^2 for other three adult females). Furthermore, another unmarked badger was observed in the same field that this female frequents. An unmarked badger was also sighted north of Skookumchuck, and an untagged badger set off traps in the Premier Lake area. If badger populations are more dense farther south, it could be related to the availability of northern pocket gophers, which only appear to occur from about Wasa south. Finally, the proportion of treeless habitats and the width of the Rocky Mountain Trench increase farther south. More radiotagged animals would be required to adequately assess relative population densities.

4.3 Activity Patterns

The activity pattern found in 1996 and 1997 supports the notion that badgers are primarily nocturnal with female #3's most active period beginning at approximately 21:30 and continuing to early morning during both 24-hour monitors. However, during both monitoring sessions, there was also a short period of daytime activity. Superficially, there did not appear to be significant differences in habitat type used between day and night.

4.4 Habitat Use

The high degree of re-use of burrows by badgers may be part of a predation strategy, because we also noted frequent use of badger burrows by Columbian ground squirrels. Alternately, re-using burrows might reflect badgers repeatedly occupying certain locales and simply conserving energy by not digging new holes. Whatever the reason, this pattern of use suggests that significant conservation value could be gained by protecting known burrows during forest harvesting or other developments.

The high percentage of burrows near Columbian ground squirrels supports the notion that ground squirrels are a primary food source. Burrows that were not found in association with ground squirrels could be a result of badgers resting in non-foraging areas en route to foraging areas, or simply using a different food source. We documented feeding on beetles, immature microtines and immature birds. Alternately, the random transects may have missed squirrel holes even in areas with a ground squirrel population.

The fact that the majority of locations were within 50 m of a road suggests that badgers are not avoiding roads. There may actually be an attraction to roads, as disturbed soil appears to support higher ground squirrel populations (Ketcheson and Bauer 1995), and Warner and Ver Steeg (1995) reported a high use of edges, possibly for travel lanes. Badgers will also eat road kills, so the 19% of locations falling within 50 m of a highway might be partially a result of an attraction to carrion. If so, this could result in high roadkill mortality among badgers. To date, one radiotagged male badger has been killed on Highway 93/95.

One of the striking features of the data relating to cover type is that badgers were found in almost every category. This points to this species' inherent flexibility and is, to some extent, expected of a carnivore that must rely on a variety of food sources to survive, especially at the northern extent of its range. However, certain habitat types were used much more consistently than others. The much higher use of non-forested than forested habitats from both sightings and radiolocations probably relates to a higher prey density in non-forested areas. Data from next year's ground squirrel survey should help to quantify this assumption. Forest cover polygons labeled as cultivated or open range were used extensively, based on both radiolocation and telemetry data. The moderately high use of the urban category was primarily related to badgers apparent selection of habitat adjacent to roads, because much of the area labeled "urban" on forest cover maps is simply road rights-of-way through rural areas.

Within the forested sites, the preponderance of radiolocations in stands dominated by Douglas-fir, ponderosa pine or a mix of the two would be expected, given that these stands tend to occur mostly in open, dry sites. By contrast, lodgepole pine, trembling aspen and hybrid white spruce tend to occur in sites with greater soil moisture, which ground squirrels would be less likely to inhabit and which would be less suitable for badgers to burrow in. Likewise, the use by badgers of relatively open stands probably also relates to prey abundance. The use of almost all forest age classes suggests that this attribute does not strongly affect badger habitat use.

Almost all of the radiolocations and sightings were in moderately coarse-textured and medium-textured surface or subsurface soils. Likewise, most of the subsurface soils used were also sandy or silt loams. These soils are friable and relatively well-drained, which makes them ideal both for badgers and their fossorial prey. The finer textured soils would probably be prone to flooding and collapse because of poor drainage, while coarse textured soils might not have sufficient cohesion to prevent collapse.

5. Further Research

Research over the remainder of the project will clarify badger habitat preferences and population status in the study area. Sightings will continue to be collected, and up to nine more badgers will be radio-implanted and monitored for the remaining two years, which will provide accurate data on habitat use. A survey of ground squirrels within the IDF will determine the availability of this species and will aid in determining ground squirrel habitat requirements. A GIS-assisted availability-versus-use assessment will then be completed to determine badgers' selection and avoidance of classes within a number of habitat variables.

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Appendix 1:
Publicity for the East Kootenay Badger Project

Appendix 2:
Badger Sightings Recorded Throughout the East Kootenay

Appendix 3:
Badger Telemetry Locations and Home Ranges