Black Bear, *Ursus americanus*, Ecology on the Northeast Coast of Labrador

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Twenty-three Black Bears (*Ursus americanus*) were captured, 20 were measured, marked and/or radio collared, in northeastern Labrador, between 1996 and 1997. Bears used sea ice for travel, coastal islands for denning, hunted adult Caribou (*Rangifer tarandus*), and were the possible cause of Moose (*Alces alces*) calf mortality. Body sizes were small, median weight of adult females was 48 kg, and the sex ratio for captured subjects was 1:1. Four of six radio-collared females gave birth during the winter of 1997, female reproductive histories suggest delayed sexual maturity. Den entry occurred between October and December 1996; spring emergence occurred between April and May 1997, with estimated denning period ranging from 148-222 days. Visual observations of habitat use by radio collared subjects (n = 10) were not tested statistically but suggest that barren areas are used nearly as much as forest. Location data from three GPS collars deployed on three adult females were analysed using Chi-square goodness-of-fit test with Bonferroni correction; two females appeared to prefer forest habitats ($p < 0.05$).

Key Words: Black Bear, *Ursus americanus*, Labrador, telemetry, home range, morphology, denning, habitat, translocation, activity.

Although the Black Bear (*Ursus americanus*) has been studied throughout most of its range, it had been virtually ignored in Labrador. This changed in 1989, when a five-year research program was initiated to document Black Bear ecology near Hebron Fiord in northern Labrador (Veitch 1992; Veitch 1994; Veitch and Harrington 1996). The Hebron bears demonstrated atypical characteristics such as heavy reliance on animal protein, home ranges orders of magnitude larger than bears to the south, and year-round activity on barren habitats, earning them the name "barren-ground Black Bear" (Veitch 1992). However, it remained unclear if bears in more southerly regions of Labrador shared these barren-ground characteristics, if they displayed characteristics more closely associated with forest dwelling bears or were intermediary between the two.

Shortly after the completion of the Hebron study in 1993, a large nickel deposit was discovered approximately 200 km to the south, near Voisey's Bay, Labrador. The anticipated development of that deposit, and the associated environmental impact assessment prompted the present study on the ecology of Black Bears in the Voisey's Bay area. This article describes observations made during 1996 and 1997 regarding Black Bear habitat use, den site characteristics, denning period, food habits, daily activity, morphology, productivity, and demographics.

Study Area

The study area (Figure 1), approximately 1600 km^2, located south of Nain, Labrador, is rugged with elevations ranging from 0 to 650 m above sea level (asl). The western section is relatively flat, with the main habitat types being heath and rock barrens. The central region is comprised of rounded topography, valleys, and depressions and the main habitat types include heath and rock barrens. The eastern portion is characterized by low-lying coastline, sheltered river valleys, and rolling hills (JWEL 1997*). The habitat mapping component of this study was defined by a 1:20 000 ecological land classification (JWEL 1997*) and comprised approximately 364 km^2 of the larger study area (Figure 1).

Weather and climate information collected by Environment Canada at Nain from 1951 to 1989 show that the mean monthly temperature varies from -19°C in January to 10°C in July, with a mean annual temperature of -3°C. Mean annual precipitation is 740 mm, with the highest monthly rainfall recorded during July (79 mm) and maximum monthly snowfall occurring in January (87 mm). Snow and ice can persist until July (Environment Canada 1989).

Methods

Human activity related to mineral exploration in the study area at the time of this study, although recent, was at an all time high, and bear-human conflicts were common. To reduce the number of bears killed, camp personnel initiated a Black Bear translocation program. In addition the study team used leg snares, and darting from a helicopter to capture Black Bears. All bears captured in culvert traps were moved away from project activities by helicopter: translocation distances

varied. For most translocations, a second helicopter was used to transport the study team to the release location. All marked Black Bears were initially tranquilized with 4-7 mg/kg of Telazol (White et al. 1996). All subjects were monitored during recovery from anesthetic and were revisited 24-30 hours after being tranquilized.

Most bears were aged, weighed, and sexed and signs of estrus (Coy and Garshelis 1992) were recorded. The senior author supervised all measurements in order to reduce researcher variation (Eason et al. 1996). Bears were marked with Flex-Lok plastic ear tags (Ketchum Manufacturing, Ottawa, Ontario). A premolar was extracted from each bear and sent to Matson's Laboratory (Montana) for cementum annuli analysis (Dimmick and Pelton 1996), which was used to determine age. For purposes of analysis and discussion, bears were classed as adults if they were 5 years and older, and sub-adults if 3-4 years of age; cubs (ages 1-2 years) were not captured or marked. The alpha-numeric code used to identify each bear was formatted as follows: age class (i.e., A,S,U), sex (i.e., M,F,U), capture sequence number (i.e., AMB01 = adult male bear number 01; SFB16 = sub-adult female bear number 16; UUB22 = Unknown sex and age bear number 22).

Seven VHF collars (Holohil Inc., Carp, Ontario) and three Global Positioning System (GPS) collars (Lotek Engineering Inc., Newmarket, Ontario), were fitted on Black Bears during June and July 1996. GPS collars weighed 1.36 kg and recorded geodetic coordinates (latitude and longitude, WGS 84), temperature, time, date, fix status, horizontal dilution of precision (HDOP), convergence (distribution of satellites above the horizon), and activity every three hours during a total of eight fix attempts/day.

Activity was measured by means of mercury switch activations; these were summed every ten minutes and averaged every three hours to provide a single activity count at the time of data logging. Activity data were summarized and expressed as a function of an average day relative to sunrise and sunset. After failure, GPS collars were retrieved and replaced with VHF collars. Two-dimensional locations were assumed to have an error radius of 50 m (Lotek Engineering Inc., 1996*); differentially corrected GPS data were assumed to have an error radius of 10 m (Moen et al. 1996); only three-dimensional (3-D) fixes were differentially corrected.

Telemetry flights were conducted between 24 June and 15 October 1996 using a Bell 206B helicopter. Once a radio signal was localized to a small area (100 m radius), an effort was made to acquire a visual fix. When a visual fix was not possible, the subject's location was estimated. The helicopter's GPS was used to record the location of all observations. Ground telemetry was conducted during the same period when aerial telemetry or animal handling were not in progress. GPS locations obtained from the helicopter and handheld GPS units were not differentially corrected and were assumed to have an accuracy of +/-100 m (Moen et al. 1996); geodetic data were recorded in World Geographic System (WGS) 84 latitude and longitude, and were converted to latitude and longitude, North American Datum 83 using MAPINFO.

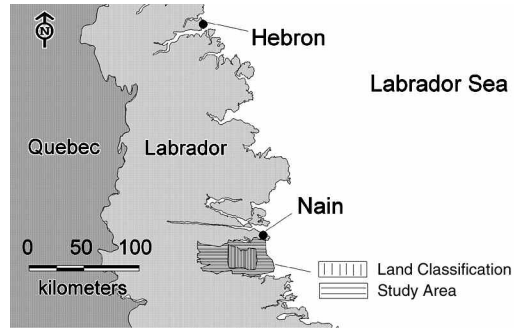

FIGURE 1. Black Bear Study Area Voisey's Bay Labrador 1996 and 1997.

We searched for den sites in October and November 1996, while conducting ground and aerial telemetry. Frequency of monitoring flights was reduced after October. Monitoring flights were conducted on 3, 4 and 29 November 1996. Known Black Bear dens were monitored for activity on a monthly basis from January to March 1997. In the spring of 1997 four aerial monitoring sessions were conducted to determine the timing of den emergence (10 April, 26 and 27 April, 25 May, and 12 June). Due to gaps in monitoring we were not able to determine exact dates for either den entry or emergence. For example, the maximum date of den entry was the date the study team was able to confirm if a bear had entered its den. The minimum date of den entry is the date of the prior survey when the bear was still active. The converse was done for den emergence. We assumed each bear entered/exited its den halfway between the minimum and maximum dates of den entry/emergence. However, for ease of calculation the estimated den occupancy as the difference (in days) between maximum date of den entry in 1996 and the maximum date of den emergence in 1997.

Den sites were assigned to three habitat types: forest, barren, and other based on visual inspection of the surrounding landscape. Forest habitat was any area with canopy height exceeding 1 m, barren habitat was any non-wetland area with less than 5% canopy cover. Visual observations of radio collared Black Bear habitat use was recorded in the field, and habitats were classed using the same criteria as den site habitat classification. Visual observations reported in this study were not tested for selection because many of the observations occurred outside the area described by the 1:20 000 digital vegetation maps, and therefore habitat availability could not be calculated.

As part of the environmental baseline research for the Voisey's Bay Environmental Impact Statement (EIS), digital habitat maps (1:20 000) were developed based on interpretation of aerial photography and ground surveys (JWEL 1997*); 21 habitat classes were differentiated. However, given the limited number of locations per subject in each habitat type, we grouped these 21 habitat classes into three broad categories: barren, forest or other.

For the three GPS collared bears, Minimum Convex Polygons (MCP) and habitat maps were used to estimate habitat availability. Observed versus expected habitat use was tested for evidence of habitat selection using Chi-square goodness of fit (Neu et al. 1974). If the test was significant at $p < 0.05$, availability was compared to the 95% confidence interval (CI) for that habitat. The 95% CI was based on the normal approximation to the binomial distribution, with a Bonferroni correction for multiple testing (Neu et al. 1974). Throughout the text ± is used to represent standard deviation, whereas in the tables it is denoted by SD.

Results

There were 44 capture events (23 bears, 20 of these were marked, and 11 were captured on more than one occasion) between June and November 1996 (Table 1). Sex and age were not determined for three subjects, as camp officials captured and released these bear without participation by the study team. Twenty Black Bears were marked with ear tags and/or radio-collars, but no more than 10 Black Bears were fitted with radio-collars at any given time. Culvert traps and leg snares accounted for 27 and 9 captures respectively, one bear was darted from helicopter (Table 1).

Of the 20 marked bears, 10 were male and 10 were female. Of the 22 bears that were assigned to an age class, 10 were sub-adult and 12 were adult; cementum analysis revealed ages from 2 to 23 years (Table 1). The mean cementum age of adult males was 12.5 ± 7.0 years (n = 4), the mean cementum age of adult females was 9.1 ± 3.6 years (n = 8). The mean age of sub-adults was 2.8 ± 0.8 year (n = 5). The mean age of all males was 8.1 ± 7.4 years (n = 10), and the mean age for all females was 8.0 ± 3.0 years (n = 10). Thirty percent of bears were 10 years or older, and 67% were older than 6 years (n = 17). AMB18 was radio tracked and observed in spring of 1997, making it 24-years-old at time of last contact (Table 1).

Two of 10 females were in estrus at the time of capture (AFB02 and AFB04). Two opposite-sex pairs of Black Bears were observed together for extended periods during July 1996. Only one collared bear (AFB07) was actively caring for cubs during 1996; this family group was still intact at the time of den emergence in 1997. According to reproductive histories based on cementum analysis, only AFB06 had given birth prior to 1996, at ages 6, 9, and 11 years; AFB06 also produced cubs for the fourth time at the age of 14 during the winter of 1997. Radio tracking during the spring of 1997 showed that four of the five collared females gave birth during the winter of 1997; the mean age at first reproduction was 8 ± 1.6 years (range = 6 – 10 years). (Table 2).

Based on analysis of cementum annuli two females, AFB03 and AFB04, had not reproduced at the time of capture (age 7 and 6, respectively). Five of seven females (71%) produced cubs over a two-year period. From 1996 to 1997, 11 cubs of the year (COY) were produced, mean = 1.8 ± 1.0 cubs/adult female, n = 6 (Table 2), the mean annual rate of reproduction = 0.8 ± 0.6 cubs/female/year (range 0-1.5, n = 7).

Fifteen bears were translocated a total of 25 times (Table 3). Estimated return periods from translocation point to capture site for 11 bears ranged from 1-55 days (mean = 18.3 ± 19.0 days); estimated rate of return ranged from 0.5 km/day to 6.5 km/day with mean rate of return of 2.6 ± 2.2 km/day (Table 3). Four bears in the study area were shot by mining camp and provincial wildlife officials in 1996: two were collared (AMB01 and SMB11), one was tagged (AMB19), and one was unmarked (UMB17). Three bears died during 1997: SFB16 (natural causes), SMB13 (shot by hunter), and SMB10 (shot by camp personnel) (Table 1). Six of seven known mortalities were males (three adults, two sub-adults, one age unknown). A post-mortem examination of AMB19 at the Atlantic Veterinary College (University of Prince Edward Island, Charlottetown) showed that this bear had previously been shot and had been suffering from lead poisoning for approximately six weeks prior to its death. No Black Bears died as a result of capture or handling by the study team.

Between June and October 1996, weights and physical measurements were recorded for 20 adult and sub-adult bears. Weights for all subjects ranged from 27 to 130 kg (n = 20); adult males (120 ± 19 kg, n = 4) were about twice as heavy as females (48 ± 13 kg, n = 8). The heaviest male and female were 8 and 7 years old, respectively. Chest measurements for all subjects ranged from 64 to 112 cm (n = 18) with adult males averaging 103 ± 13 cm (n = 4) and adult females 87 ± 8 cm (n = 7).

Activity counts from the GPS collars were averaged and graphed to represent mean daily activity. Minimum daily activity occurred 2-3 hours after sunset (23:00). Peak activity occurred 3-4 hours before sunset (17:00). Activity was relatively constant across other time intervals (Figure 2).

Eighteen den sites were located during 1996: 7 in forest, 6 in barren and 5 in shrub thicket (Table 4). The entrance to all dens faced south or southwest. Eight dens were unoccupied and were located prior to the start of fall denning; 10 dens were located after denning. One bear left the mainland in late summer 1996 and took up residence on a large coastal island where it excavated a den in a sandy spot underneath a shrub

TABLE 1. Capture Information for Black Bears in the Voisey's Bay, Labrador study area, 1996-1997.

ID	Mark*	Field Age	CA Age	Diff **	Sex	Captures	Culvert	Snare	Air	Deaths 1996	Deaths 1997	Comments
SMB00	E	3			M	3	3					First bear ear tagged
AMB01	E/V	12	10	-2	M	3	1	1		1		Destroyed by camp officials
AFB02	E/G/V	6	7	1	F	3	1	1	1			GPS collar replaced August (96)
AFB03	E/G	6	7	1	F	1		1				GPS collar recovered after 3 days
AFB04	E/G/V	6	6	0	F	2		2				GPS collar replaced August (96)
AMB05	E/V	8	8	0	M	1	1					Lost contact June (96)
AFB06	E/V	8	13	5	F	1	1					
AFB07	E/V	6	10	4	F	1		1				
AFB08	E/G/V	3	6	3	F	3	2	1				GPS collar replaced August (96)
AFB09	E/V	3	8	5	F	2	2					
SMB10	E/V	3	2	-1	M	3	2				1	Destroyed by camp officials
SMB11	E/V	3			M	2	1			1		Destroyed by camp officials
AFB12	E	5	16	11	F	4	4					
SMB13	E	3	2	-1	M	2	1				1	Killed by local hunters
SFB14	E	3	3	0	F	1		1				
SMB15	E	3	3	0	M	1		1				
SFB16	E/V	4	4	0	F	3	2				1	Died of natural causes
SMB17		3		-3	M	1				1		Destroyed by government officials
AMB18	E/V		23	23	M	1	1					Last bear collared, oldest bear
AMB19	E	5	9	4	M	3	2			1		Destroyed government officials
UUB20						1	1					First bear captured, not marked
UUB21						1	1					Captured/released camp officials
UUB22						1	1					Captured/released camp officials
Count		19	17	18		23	17	8	1	4	3	
Mean		5	8	3		2	2					
Median		4	7	0		2	1					
SD		2.4	5.4	6.0								

E = ear tagged, V = VHF collar, and G = GPS collar ** Difference between Field Age and CA (cementum annuli) age.

TABLE 2. Summary of Cubs of the Year (COY), Reproductive History and Age at first Birth for marked adult female Black Bears in Voisey's Bay, Labrador study area during 1996 and 1997. Age at first Birth, and Reproductive History were discerned through analysis of cementum annuli (Coy and Garshelis 1992).

ID	Age (96)	(COY) 1996	1997	Total COY	Annual Rate (COY)	Age at first birth	Reproductive History
AFB02	7	0	2	2	1	8	In estrus June (1996)
AFB03	7	0		0	0		Lost contact with this bear in June 1996
AFB04	6	0	0	0	0		In estrus June (1996); non-productive (1996 & 1997)
AFB06	13	0	2	2	1	6	Cubs at age 6, 9, 11, & 14 (1997)
AFB07	10	2	0	2	1	10	Two cubs at time of capture in June (1996)
AFB08	6	0	3	3	1.5	7	
AFB09	8	0	2	2	1	9	
Count	7	7	6	7	7	5	
Sum		2	9	11	5.5	40	
Mean	8.0	0.3	1.5	1.6	0.8	8.0	
Median	7.0	0.0	2.0	2.0	1.0	8.0	
SD	2.5	0.8	1.2	1.1	0.6	1.6	

thicket (Table 4). Three radio collared females entered dens by mid-October 1996. A mother with two cubs (AFB07), left her den in late October and moved to a second den by early November. Six other bears (5 females and 1 male) entered their dens by late November, while one bear, AMB18 was still active on 29 November 1996 (Table 4). In 1996, Black Bears were first sighted in March. Monitoring flights conducted in 1997 found that 10 of 11 radio-collared bears had emerged from their dens between 27 April and 27 May, 1997. The mean length of the estimated den period was 190 days ± 28.2 days (n = 9).

A total of 185 visual observations were made of Black Bear habitat use based on aerial tracking of VHF collared subjects: subjects were observed in forest on average 54% ± 21.5, barrens = 40% ± 25.7, and other = 6% ± 7 (Table 5). Individual bears varied in their relative use of barren and forest habitats. For example, 86% of AFB02's locations (n = 28) were on barrens, whereas only 10% of AFB08's locations (n = 20) occurred in similar habitat (Table 5).

Three adult female Black Bears were tracked using GPS collars during July and August, 1996 (n = 24, 45 and 56 locations, respectively). Bear locations most commonly occurred in forest habitats: Spruce/Fir/Dwarf-Shrub, Birch Thicket, Black Spruce Lichen, and Tuckamore. Chi-square analysis of gross habitat indicated that two bears (AFB04 and AFB08) occupied habitats differently from availability ($p < 0.02$); they appeared to prefer forest more than the other two primary habitat types. The other subject (AFB02) appeared to use all three habitats in accordance with availability (Table 6); forest habitat comprised 65% of her home range. During May and June the study team observed three incidences of Black Bears walking on sea ice up to 2 km from shore.

Two incidences of ungulate predation/scavenging by Black Bears were observed during 1996. The first incident occurred in April and involved an unmarked adult male Black Bear attacking an adult female Caribou (*Rangifer tarandus*), which later died from its wounds and was partially eaten by the bear. The second incident occurred during an unsuccessful attempt to dart a Black Bear from helicopter in June 1996. The Black Bear was observed walking along an esker near a river. As we circled to dart the bear, it ran to the river and retrieved a dead Moose (*Alces alces*) calf and proceeded to run with the carcass in its mouth for approximately 50 m. The bear then dropped the carcass and ran into the forest. An adult female Moose was seen within 200 m of the carcass.

Discussion

After the Muskox (*Ovibos moschatus*), Black Bears have the lowest reproductive rate of any land mammal in North America (Jonkel and Cowan 1971). Elowe and Dodge (1989) reported ages at first reproduction for a hunted population of Black Bears in Massachusetts; mean age at first reproduction was 3.7 ± 0.7 years

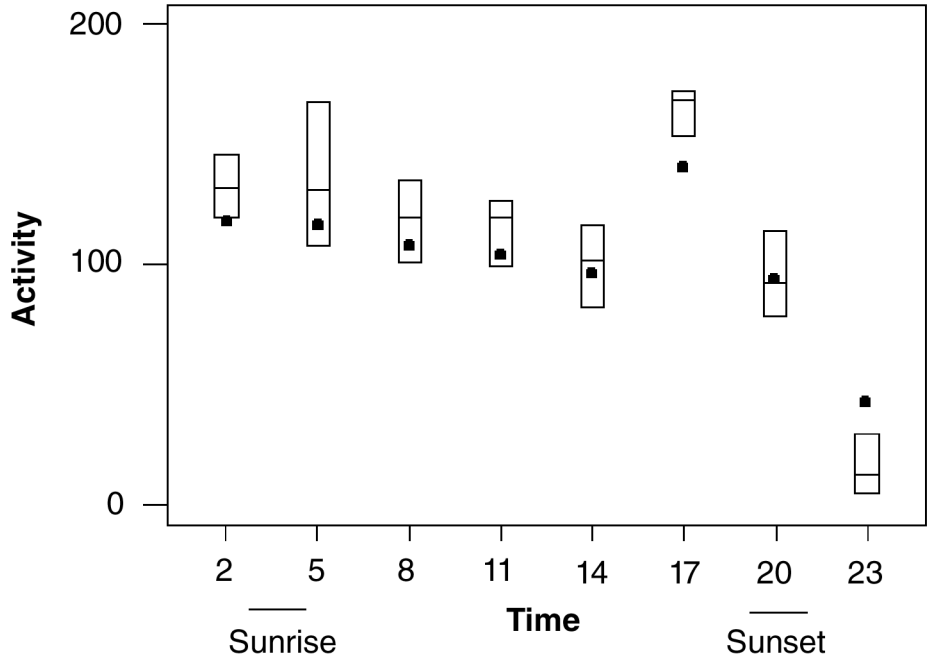

FIGURE 2. Mercury Switch Activations (Activity) averaged over 8, three-hour time periods for three adult female Black Bears near Voisey's Bay, Labrador. Observations were downloaded from data loggers housed in the GPS collars and occurred over 50-day period from 25 June to 13 August 1996 (n = 1080). The range of times for sunrise and sunset during this period are shown on the x-axis. On 25 June sunrise occurred at approximately 03:19 and set at 21:03 Atlantic Daylight Savings Time (ADST); on 13 August sunrise occurred at 04:32 and set 19:53 (ADST), times for sunrise and sunset are based on an elevation of 400 m for the community of Nain, Labrador (Environment Canada 1998). Dark squares indicate mean activity. Horizontal lines indicate the 95% Confidence Interval for the median.

(range 3 – 5). Rogers (1993*) reported that the age at first reproduction for wild bears in eastern Minnesota was 6.3 years (n = 17). The mean age at first reproduction for females in our study area was 8 years, 30% older than wild bears in Minnesota (Rogers 1993*) and 54% older than bears in Massachusetts (Elowe and Dodge 1989).

Black Bear productivity in the Voisey's Bay area was much higher than reported by Veitch and Harrington (1996) in northern Labrador. They tracked eight adult females for 22 bear years and during this time cubs accompanied females in 3 years (14%). In our study seven females were tracked for an equivalent of 13 bear years, and during this time cubs accompanied females in 5 years (38%).

Due to logistical constraints we were not able to determine litter size at birth, so direct comparison with litter sizes in other areas of North America are difficult. We were able to document the number of cubs with each marked female during 1996 and spring of 1997. During this period 7 females produced 11 cubs (1.6 ± 1.1 cubs/female, n = 7); however, if we exclude females that did not produce cubs the average number of cubs/female increases to 2.2 ± 0.4 (n = 5). This compares to an average litter size = 2.4 cubs/female in Massachusetts (Elowe and Dodge 1989) and average litter sizes ranging from 2.1 to 3.4 cubs/female in Minnesota, where litter size varied with foraging behaviour and reproductive history (Rogers 1993*).

We did not include observations of cubs associated with marked females in our capture statistics. In our study we found that sub-adults comprised 48% and adults 52%. Young and Ruff (1982) conducted a removal experiment on a population of Black Bears in central Alberta. For comparison purposes, we excluded cubs from their pre-removal capture data (1968-1971) and recalculated age structure statistics; sub-adults comprised 28% and adults 72% (n = 302). Kohn and Rolley (2000*) tabulated age structure data for bears harvested during 1998-1999 in Wisconsin. We re-calculated their age structure statistics with cubs excluded; sub-adults comprised 54% and adults 46% (n = 1664). Based on these comparisons the age structure of our study set was older than that reported in Wisconsin (Kohn and Rolley 2000*) and younger than that reported in Alberta (Young and Ruff 1982), albeit our sample sizes were very small in comparison.

Six of 21 bears died during our study period translating into a 28.6% mortality rate; all were male and five were sub-adult. No bears died as a result of handl-

TABLE 3. Summary of Black Bear translocation and homing near Voisey's Bay, Labrador during 1996.

ID	Captures	Translocations	Date	Distance (Km)	Return Period (days)[1]	Rate of Return km/day
SMB00	3	3	06/19/96	1	1	1.0
			08/19/96	30		
			10/08/96	26		
AMB01[2]	3	1	08/02/96	13	2	6.5
AFB02[2]	3	1	07/29/96	31	6	5.2
AFB03	1					
AFB04[2]	2					
AMB05	1	1	06/23/96	25		
AFB06[2]	1	1	06/23/96	12	22	0.5
AFB07[2]	1					
AFB08[2]	3	2	07/10/96	12	5	2.4
			08/22/96	23	8	2.9
AFB09[2]	2	2	07/31/96	16	10	1.6
			08/11/96	56		
SMB10[2]	2	2	07/31/96	13	4	3.2
			08/31/96	52		
SMB11[2]	2	1	08/01/96	20	55	0.4
AFB12	4	4	08/01/96	27	7	3.9
			08/08/96	56	9	6.2
			08/18/96	32	33	1.0
			09/20/96	42		
SMB13	1	1	08/02/96	26		
SFB14	1					
SMB15	1					
SFB16[2]	2	2	08/26/96	26		
			10/05/96	18		
SMB17	1					
AMB18	1	1	10/21/96	13		
AMB19	3	2	08/27/96	35	48	0.7
			10/18/96	23	46	0.5
UUB20	1	1	06/19/96	18		
Count	21	15	25	25	14	14
Mean	1.9	1.7	08/13/96	25.8	18.3	2.6
Median	2	1	08/08/96	25	8.5	2
SD	1.0	0.9	35.9	14.0	19.0	2.2
Range	3	3	124	55	54	6.1

[1] Based on estimated return date to capture site; some subjects may have returned sooner than indicated.
[2] Radio collared subjects

ing. If we only include bears that died of natural causes the mortality rate of marked bears drops to 4.5%. The impact of these losses on the local Black Bear population remains unknown. In Labrador, for much of the 1980s and 1990s a single Black Bear license provided a quota of five bears per year; this has since been reduced to two bears per year (D. Blake personal communication). It is unclear how many Black Bears were harvested annually in the study area when the Black Bear quota was at its highest, but given the weak fur market and lack of a sport hunt, the harvest was probably low compared to elsewhere in Labrador.

Estimates by provincial wildlife officials suggest that bear mortalities in the study area averaged about one per year from 1998-2003 (F. Phillips, D. Blake personal communication). In 2003, mining camp officials recorded over 300 bear sightings. In total four Black Bears were captured, of these two were translocated and two were destroyed (D. Lampe personal communication). While not rigorous, this information seems to suggest that in 2003 Black Bears were still relatively abundant in the study area.

Although not an initial goal of the study, we also tracked the effectiveness of bear translocation and homing. Our results were consistent with observations of bear homing in other areas (Rogers 1986); most translocated bears (75%) eventually returned to the capture area, generally within 1-2 weeks.

Mahoney et al. (2001) analysed body mass for Black Bears from various regions of North America. The lowest average weight for adult females were from Quebec at 54 kg, and the highest from insular Newfoundland at 101 kg; the lowest average weight for adult males was reported in Maine at 116 kg, and the highest from insular Newfoundland at 178 kg. The median weight of adult females from our study (48 kg)

TABLE 4. Approximate Den Entry and Emergence Information and estimated denning period for Black Bears in the Voisey's Bay, Labrador study area, 1996-1997. The estimated den period is based on the difference between maximum den entry date and maximum den emergence date.

ID	Habitat	Maximum Den Entry Date	Minimum Den Entry Date	Minimum Den Emergence Date	Maximum Den Emergence Date	Estimated Den Period (Days)	Comments
AFB02	Forest	11/04/96	11/29/96	04/26/97	05/27/97	179	
AFB04	Barren	10/10/96	10/18/96	04/26/97	05/27/97	221	
AFB06	Barren	10/10/96	10/17/96	04/26/97	05/27/97	222	
AFB07	Barren	10/10/96	11/04/96	04/26/97	05/27/97	204	1st den 10/18, moved to 2nd den by 11/04
AFB08	Barren	11/04/96	11/29/96	04/10/97	04/26/97	148	First bear to emerge in '97
AFB09	Forest	10/18/96	11/03/96	04/26/97	05/27/97	205	Moved to 2nd den during the winter
SFB16	Barren	10/18/96	11/04/96	04/26/97	05/27/97	204	Died shortly after emergence
SMB10	Other	11/04/96	11/29/96	04/26/97	05/27/97	179	Denned on Kikkertavak Island
AMB18	Other	11/29/96	01/15/97	05/27/97	06/12/97	148	Still active on 11/29/96
Unoccupied Den	Forest						Found by camp personnel
Unoccupied Den	Forest						The next two dens were within 3 m^2
Unoccupied Den	Forest						Adjacent to above
Unoccupied Den	Forest						Adjacent to above
Unoccupied Den	Forest						
Unoccupied Den	Other						
Unoccupied Den	Other						
Unoccupied Den	Other						
Count	18	9	9	9	9	9	
Min		10/10/96	10/17/96	04/10/97	04/26/97	148	
Max		11/29/96	01/15/96	05/27/97	06/12/97	222	
Range		50	90	47	47	74	
Median		10/18/96	11/04/96	04/26/97	05/27/97	204	
Mean		10/25/96	11/14/96	04/27/97	05/25/97	190	
SD		16.9	29.5	12.2	12.2	28.2	

TABLE 5. Visual observations (n=185) of Gross Habitat use as percent use by radio collared black bears (n=10) near Voisey's Bay Labrador, from June to November, 1996. Habitats were visually classed as either barren, forest, or other at time of data collection.

Bear ID	N	Barren (%)	Forest (%)	Other (%)
AMB01	11	27.3	63.6	9.1
AFB02	27	40.7	51.9	7.4
AFB04	28	85.7	14.3	0.0
AFB06	19	26.3	73.7	0.0
AFB07[1]	22	68.2	31.8	0.0
AFB08	20	10.0	80.0	10.0
AFB09	17	11.8	70.6	17.6
SMB10	14	28.6	57.1	14.3
SMB11	14	35.7	64.3	0.0
SFB16	13	69.2	30.8	0.0
Count	185	80	95	10
Mean	18.5	40.4	53.8	5.8
Median	18	32.2	60.4	3.7
SD	5.8	25.7	21.5	6.8

[1] AFB07 was caring for two cubs in 1996.

TABLE 6. Summary of Chi-square goodness of fit test for evidence of selection. The 95% CI were based on the normal approximation to the binomial distribution, with a Bonferroni correction for multiple testing. MCP home range was used to delineate habitat availability.

Bear ID	Habitat	Area (Km^2)	Observed	Expected	(obs-exp)^2/exp	Proportion Available	95% CI Lower	95% CI Upper
AFB02								
	Barren	10.07	5	8.23	1.27	0.18	-0.00	0.22
	Forest	35.97	32	29.38	0.23	0.65	0.55	0.87
	Other	9.05	8	7.39	0.23	0.16	0.04	0.31
	Total	55.09	45	45				
	χ^2				1.73			
	df				2			
	P-value				0.46			
AFB04								
	Barren	8.91	6	10.42	1.87	0.43	0.05	0.53
	Forest	8.61	17	10.07	4.78	0.42	0.63	1.03
	Other	3.01	1	3.52	1.80	0.15	-0.06	0.16
	Total	20.53	24	24				
	χ^2				8.45			
	df				2			
	P-value				0.01			
AFB08								
	Barren	13.37	7	17.23	6.08	0.31	0.02	0.23
	Forest	27.65	48	35.63	4.29	0.64	0.75	0.97
	Other	2.43	1	3.14	1.68	0.06	-0.02	0.06
	Total	43.45	56	56				
	χ^2				12.05			
	df				2			
	P-value				0.00			

were slightly lower than those reported from Quebec by Mahoney et al. (2001). The median weight of adult males in our study (120) was slightly higher than males from Maine. In general the median weight for our subjects was comparable to the lowest average weights reported by Mahoney et al (2001) and to weights reported for Black Bears in northern Labrador by Veitch and Harrington (1996).

Daily activity patterns arise in response to seasonal and diurnal variation in the environment (Nielsen 1983). Black Bears are generally considered diurnal, a view substantiated by Amstrup and Beecham (1976),

Lindzey and Meslow (1977), and Lariviere et al. (1994). Lariviere et al. (1994) found that Black Bears in Gaspesie National Park commenced daily activity approximately 0.5 hours after sunrise, and ceased activity approximately 2.5 hours after sunset. These results are similar to those observed in our study. The activity sensors revealed greatest activity in late afternoon several hours before sunset, and minimal activity about 2-3 hours after sunset. However, our bears appeared to resume activity later in the night, several hours before dawn. Unfortunately the batteries in the GPS collars failed in mid-August and the short life span of the GPS collars prevented analysis across seasons.

In Maine, Schooley et al. (1994) reported denning periods ranging from 134 to 197 days, with entry occurring in October and November and emergence occurring in April. In Alberta, Tietje and Ruff (1980) reported numbers that translate into a median denning period of 171 days, with average den entry occurring in October and emergence in April. In northern Labrador, Veitch (1994) reported denning periods ranging from 180-220 days. The estimated denning period for bears in our study area ranged from 148 to 222 days (median = 204 days), with the median emergence occurring in May. Our data for both entry and emergence are limited due to the frequency of monitoring during the fall and spring periods. As reported our data are similar to those for barren-ground Black Bears, but in reality they may be intermediary between bears in northern Labrador and elsewhere.

In northern areas where large hollow trees are uncommon, bears tend to use excavated dens lined with plant material (Fuller and Keith 1980; Tietje and Ruff 1980; Klenner and Kroeker 1990). All known dens in our study were excavated, den roofs were supported by the root systems of the adjacent vegetation, and all entrances faced south or southwest, possibly to minimize exposure to north winds and to increase exposure to sunlight.

MCP home ranges based on 1.5 months of GPS location data were used to determine the habitat availability boundary of each subject. At least two adult females occupied forested habitat disproportional to their availability during the period July-August. The most commonly used habitat classes appeared to be Spruce/Fir/Dwarf Shrub, Birch Thicket, Black Spruce/Lichen, and Tuckamore. However, subject sample size (n = 3), location sample size (n = 24-56), time frame (1.5 months), and geographical extent of base mapping place restrictions on generalizing habitat selection behaviors to other individuals. If Black Bears in the study area prefer forest to barren habitats it did not seem to be supported by visual observations of the VHF radio collared bears, where 3 of 10 were found more often on barrens than in forests. However, the visual observations occurred over a large region and habitat availability could not be determined, so statistical analysis of habitat use relative to availability could not be conducted.

Schwartz and Franzmann (1989) found that Black Bears in Alaska accounted for 80% of Moose predation and 70% of Moose mortality; however, even there Moose predation provided only a small proportion of the overall Black Bear diet. We observed two incidences of ungulate predation/scavenging in our study during 1996; these corroborate findings elsewhere (Schwartz and Franzmann 1989; Veitch and Krizan 1996).

At the outset of the study we were curious which characteristics, if any, were similar: to the barren ground Black Bears in northern Labrador, to bears elsewhere, or were intermediary between the two. We found that habitat use was likely to be intermediary between bears in northern Labrador and bears from other regions of North America. Cub production, homing, daily activity patterns, and den site construction, were similar to that reported from other regions of North America. However, the small body size was most similar to barren ground Black Bears from more northerly regions of Labrador.

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