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BROWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA

BY
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Volume I

Project Progress Report
Federal Aid in Wildlife Restoration
Project W-22-1, Job No. 4.17R

(Printed August 1982)

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: John W. Schoen, Jack W. Lentfer, John W. Matthews, Vern Beier

Project No.: W-22-1 Project Title: Big Game Investigations

Job No.: 4.17R Job Title: Brown Bear Habitat Preferences and Brown Bear Logging and Mining Relationships in Southeast Alaska

Period Covered: ~~July 1, 1981~~ September 29, 1981 through June 30, 1982

SUMMARY

Nine brown bears were successfully captured at Hawk Inlet on Northern Admiralty Island. One was captured by snaring along a stream and 8 were captured in the alpine by darting from a helicopter. One mortality occurred associated with immobilization and was attributed to a drug overdose. The sample of instrumented bears was evenly divided between the sexes, however, no large adult males were captured. Ten telemetry flights were flown between mid-September 1981 and early May 1982. Bears began to den in early October and all were denned by early November. All denning of instrumented bears was in high elevation alpine-subalpine habitat.

CONTENTS

BACKGROUND

Historically the brown/grizzly bear (Ursus arctos) was widely distributed in North America from central Mexico to northern Canada and Alaska, and from the Mississippi to the Pacific Coast (Hall and Kelson 1959). The distribution of this species, today, is greatly reduced from its former range with brown/grizzly populations restricted to northwestern Canada, Alaska, and a few scattered wilderness enclaves in Montana, Idaho, and Wyoming. Alaska has the last major population of brown/grizzly bears in the United States. An understanding of their ecology including basic life history, population status, movement and home range patterns, and habitat relationships is essential for knowledgeable management.

Brown bears are indigenous to southeast Alaska where they occur on the mainland and islands north of Frederick Sound. Management concerns include hunting, habitat alteration resulting from clearcut logging and/or mining activities, and effects of disturbance from increased human activities associated with development and recreation.

Hunting mortality of southeast Alaska brown bears has been intensively monitored (Johnson 1980). The relatively little work on basic life history has been directed at litter sizes, spring and summer distribution, and movements (Klein 1958, Klein et al. 1958, Perensovich 1966, Wood 1976, and Johnson 1980). Dufresne and Williams (1932) and Klein (1958) estimated population sizes on Admiralty, Baranof, and Chichagof Islands. Wood (1976) estimated the number of bears in Hood Bay on south Admiralty Island. No work has been done to determine minimum breeding age, breeding interval, age specific survival rates other than as related to hunting, reproductive rates, home range sizes, denning areas, and den site characteristics.

Extensive clearcut logging began in southeast Alaska in the mid-1950's and approximately 142,450 ha of old-growth forest has already been harvested. With passage of the Alaska National Interest Lands Conservation Act in 1980, 4.5 billion board feet per decade was mandated as the timber harvest level. This is equivalent to harvesting approximately 7,000 ha annually. The

current timber rotation cycle in southeast Alaska is approximately 90 to 125 years.

Old-growth forests (see Franklin et al. 1981, Bormann and Likens 1979) are uneven-aged, silviculturally overmature stands which have achieved a dynamic steady state condition of forest succession. Such stands are structurally more heterogeneous and variable than the even-aged regrowth stands which result from clear-cutting (Schoen et al. 1981a). Since it takes from 200 to 300 years for a stand to achieve the characteristics of old growth (Harris and Farr 1974, Alaback 1981, Franklin et al. 1981), old growth is essentially nonrenewable under even-aged silviculture on 100 year rotations.

The effects of removing old-growth forest on brown bear populations in southeast Alaska are unknown. Perensovich (1966) suggested that impacts would probably be minimal, but his data are inconclusive. Wood (1976) reported the results of a prelogging study in Hood Bay on Admiralty Island. This site, however, was never logged because the timber sale was cancelled.

In Montana, Mace (in press) reported grizzlies avoided or moved out of recently logged areas. Craighead (1977) and Jonkel (1977) suggested that human induced mortality associated with logging may be the major constribution to grizzly declines. In British Columbia, Russell (1974) indicated that coastal brown bear populations were incompatible with intensive forestry. Smith (1978) suggested that other factors, in addition to habitat alteration, may be contributing to declines in brown bear populations in this area. Archibald (1981) predicted that development is likely in every major British Columbia coastal watershed within the near future and suggested that development of these coastal mainland forests appears to result in declining brown bear populations.

Although much research has been conducted on northern and interior brown/grizzly bear populations (Pearson 1972, 1975, Craighead et al. 1974, Martinka 1974, Reynolds 1974, 1976, 1978, 1981, Reynolds et al. 1976, Glenn et al. 1976, Russell et al. 1979, Hamer et al. 1979, Miller and McAllister 1982), comparatively less work has been done in forested coastal brown bear habitat. As development, including forestry and mining, increases in the coastal forests of British Columbia and Alaska, more information will be necessary if we are to maintain current brown bear population levels.

The present study proposes capturing, radio-marking, and monitoring movements of bears in 2 study areas. One study area will be near Hawk Inlet on north Admiralty Island. This area is relatively undisturbed now, but will be subjected to major disturbances in the next few years. One of these will be a mining operation in Greens Creek where camp construction is scheduled to start in 1984 and first ore production is scheduled for 1986. The camp will have approximately 250 workers. Another

major disturbance will be a 20 million board foot timber sale on the Mansfield Peninsula immediately north of Hawk Inlet scheduled by the U.S. Forest Service some time in the future. Monitoring bears before mining and logging will yield information on habitat use, home range sizes, movement patterns, denning areas, and behavioral characteristics before disturbance and the opportunity to obtain comparative data by monitoring during and after disturbance. Habitat preferences may be more readily understood by a study in the Hawk Inlet area than elsewhere because of an intensive vegetative study being conducted there as part of an ongoing deer (Odocoileus hemionus sitkensis) investigation (Schoen et al. 1981B). Another study area will be selected on east Chichagof Island which is now being logged. Radio-tracking will give information on bear use of specific drainages before, during, and after logging, and bear-human interactions at logging camps.

OBJECTIVES

To determine weekly and seasonal movement patterns and habitat utilization by brown bears in southeastern Alaska, particularly in respect to activities associated with mining and/or logging, and to locate and describe denning sites and determine reproductive rates and relate these to habitat and harvest levels.

STUDY AREA

The study area is located in the Alexander Archipelago of southeast Alaska. A specific site has been selected on Admiralty Island and an additional site will be selected on Chichagof Island in the northern portion of the Archipelago in summer 1982 (Fig. 1).

Chichagof and Admiralty Islands are the 2nd and 3rd largest Islands in the Archipelago; measuring 3,300 km^2 and 2,734 km^2, respectively. The study area is located between 57° to 58° latitude and 134° to 136° longitude. The topography of the area is rugged with mountains rising from sea level to over 1,400 m. Its shoreline is generally steep and rocky, but is scattered with many sheltered bays and inlets.

The climate of this area is maritime with cool, moist weather predominating. Heavy snow accumulations generally occur during the winter and high elevations are snow-covered for 7 to 9 months of the year. Annual precipitation for this area averages about 254 cm, and monthly temperatures average about 5.6°C.

The vegetation of this area is dominated by 2 major habitat types - temperate rain forest and alpine tundra. Interspersed throughout the forest vegetation are poorly drained muskeg areas. Forests of this region are typically western hemlock - Sitka

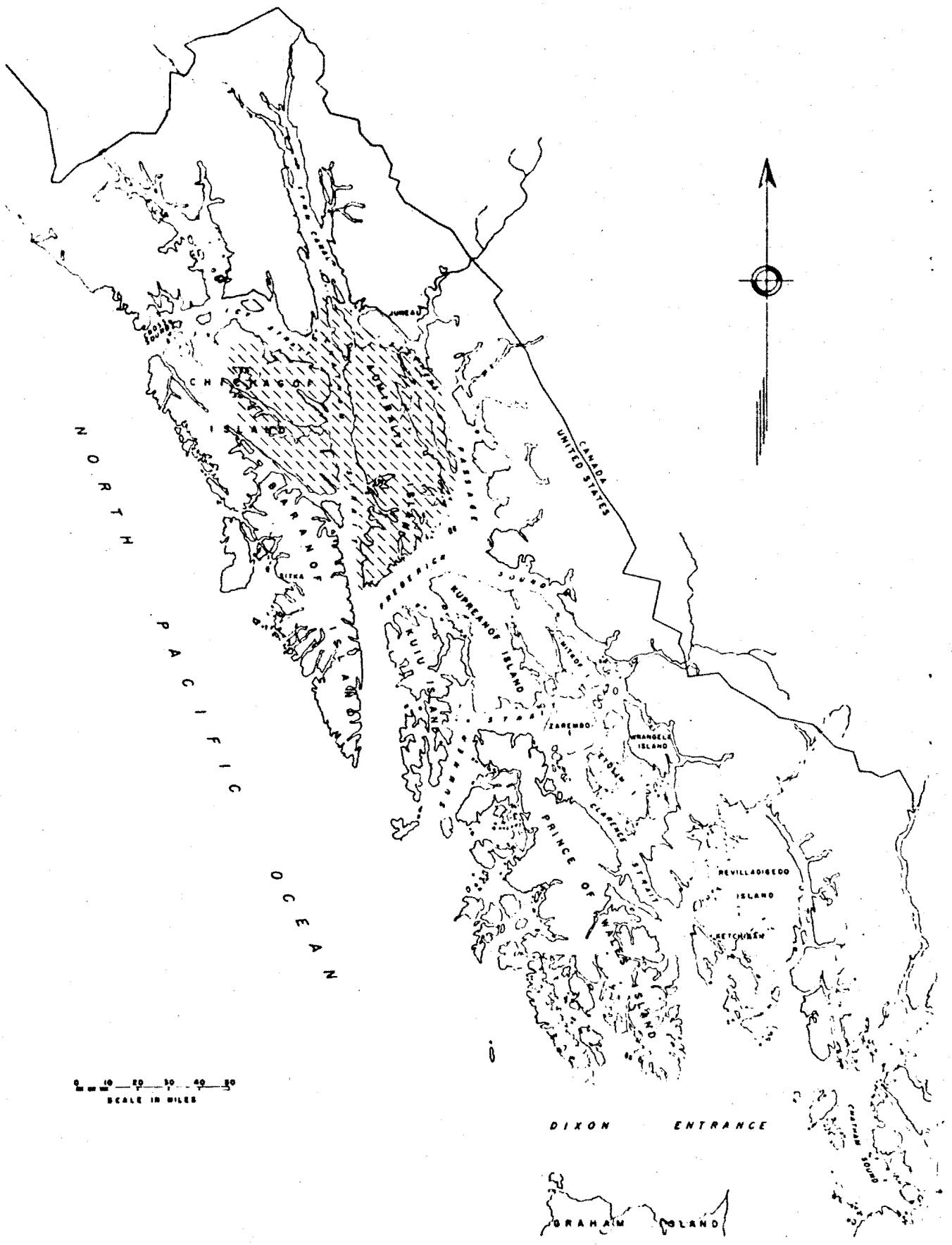

Fig. 1. Brown bear study area (cross hatched) in southeast Alaska.

spruce (Tsuga heterophylla - Picea sitchensis), the primary commercial species. Other tree species found in the region include Alaska-cedar (Chamaecyparis nootkatensis), mountain hemlock (Tsuga mertensiana), lodgepole pine (Pinus contorta), black cottonwood (Populus trichocarpa), and red alder (Alnus rubra). Understory species occurring commonly within the forest include several species of blueberry and huckleberry (Vaccinium sp.), rusty menziesia (Menziesia ferruginea), devils club (Oplopanax horridus), salmonberry (Rubus spectabilis), elderberry (Sambucus racemosa), skunk cabbage (Lysichiton americanum), bunchberry (Cornus canadensis), trailing raspberry (Rubus pedatus), and goldthread (Coptis aspleniifolia).

The Hawk Inlet study site (Fig. 2) contains approximately 380 km^2, and is essentially undisturbed habitat. This site includes the areas to the east and west of Hawk Inlet as well as the southern and western shores of Young Bay. Topography is varied with elevations ranging from sea level to 1,417 m. Timber harvest has been minimal in this area; however, an old cannery site is located on the east side of the Inlet, and the Noranda Corporation is currently involved in mining exploration in the Green's Creek drainage to the southeast. Moderate to high deer hunting pressure occurs in the Hawk Inlet area, primarily by Juneau residents. Approximately 2 bears are harvested from this area annually.

The area is largely forested with western hemlock and Sitka spruce. Muskeg is scattered throughout the site, however, especially on the east side of the Inlet, and alpine and subalpine areas occur above 610 m. There are approximately 70 km of marine shoreline with predominately easterly or westerly exposures and several large tidal flats. Numerous small lakes and an abundance of stream systems also occur within the site.

METHODS

Several capture techniques were attempted including snaring with Aldrich foot snares along salmon streams (Jonkel and Cowan 1971, Wood 1976) and immobilizing bears in the alpine from helicopters by darting with a Cap Chur gun (Reynolds 1974, 1976, Spraker et al. 1981). Immobilizing drugs used were Sernylan (phencyclidine hydrochloride) and M-99 (etorphine) and its antagonist M50-50 (diprenorphine). Once captured the bears were sexed, a premolar tooth extracted for aging, standard body measurements recorded, weight estimated, radio collar fitted and attached, and ear-tagged (a capture data form is attached as Appendix A).

Movements, home range patterns and habitat use were determined by relocating instrumented bears through radio telemetry. Telemetry equipment, purchased from Telonics Company (Mesa, AZ), consisted of a TR-2 telemetry receiver and scanner operating in the 150.0 to 152.0 MHz range and capable of monitoring 200 separate frequencies. Transmitters, also purchased from Telonics,

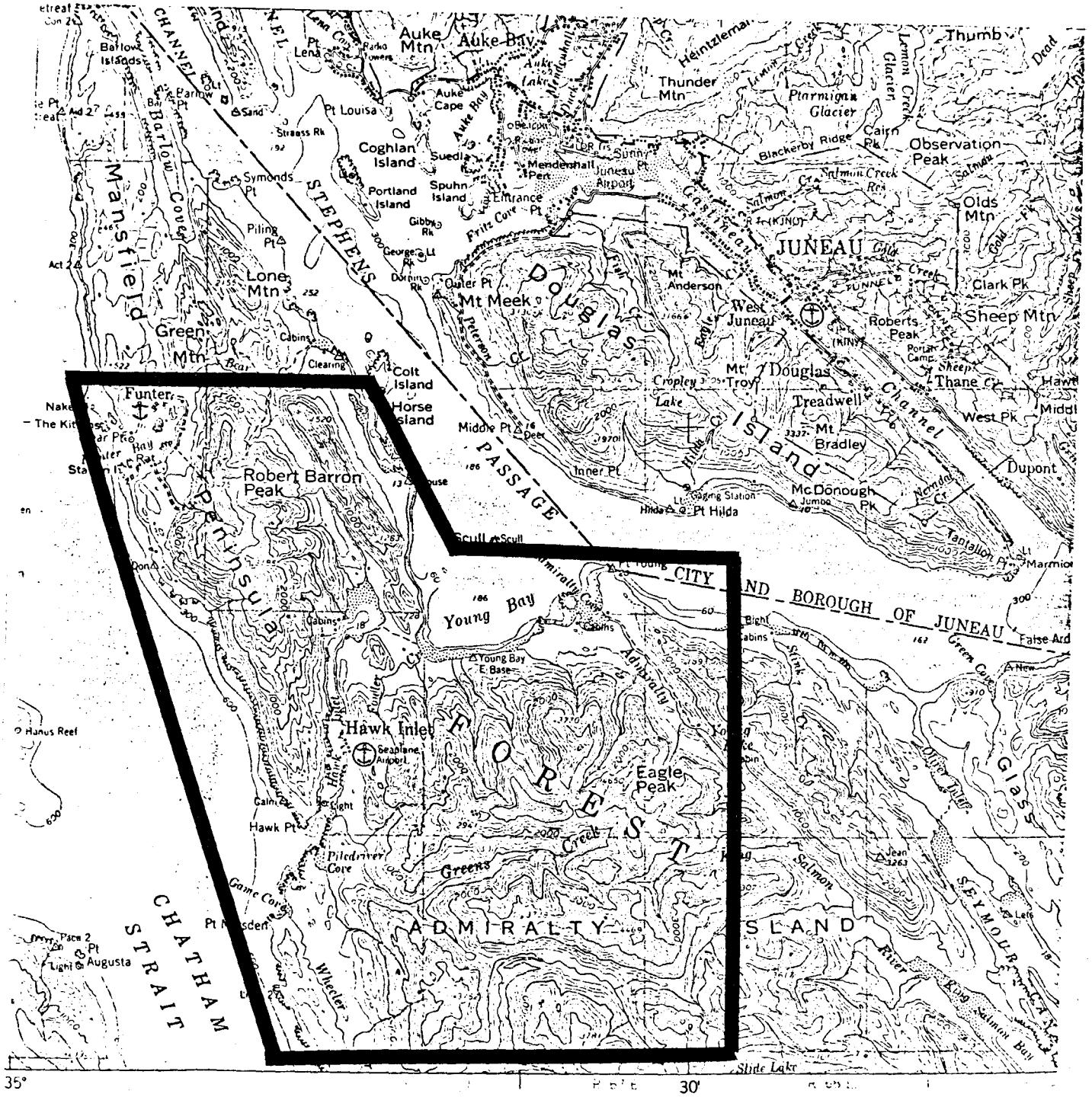

Fig. 2. Brown bear study site at Hawk Inlet on northern Admiralty Island.

operated in the 151.500 to 151.990 MHz range. Fifteen transmitters were initially acquired in anticipation of instrumenting 15 animals in Hawk Inlet. Location and habitat data were obtained using fixed-wing aircraft. Our antenna system consisted of 2 twin-element yagi antennas, 1 mounted on each wing perpendicular to the aircraft fuselage and connected to a right/left switchbox located in the cockpit. Pilot and observer wore boom mike headsets connected to the receiver through a Sigtronic intercom system enabling a free exchange of communication while monitoring the transmitter's signal. Aerial telemetry work was done in a 250-hp Helio Courier on wheels.

Telemetry flights were generally conducted once per week when bears were active, usually between 0800 and 1800 hours depending on light and weather conditions. After reaching the study site the operating frequencies were scanned until 1 was picked up and a pattern was flown to isolate the general direction of the transmitter. Once isolated, diminishing circles were flown over the site until a fix was obtained. During field trials in forested habitat, location accuracy was determined to be generally within a 40 m radius. After an animal was located, its position was plotted on 1:63,360 scale topographic maps, and specific landscape attributes such as elevation, slope, aspect, habitat type, canopy, timber volume, species composition, drainage, and snow cover were recorded. Each location also included the bear number, date, time, weather, and an assessment of the accuracy of that particular fix. Following completion of the flight, location coordinates for each bear were recorded from topographic maps on field data forms (Appendix B).

A map of the study site was overlaid by an X,Y-grid coordinate system. Grid size was 10 ha. This coincided with the accuracy with which the instrumented animals could be located considering both the accuracy of the antenna system and accuracy of determining the location on 1:63,360 scale maps. Thus, for each individual animal we have a record of all locations, by time period (season), that is plotted on a map. Landscape attributes were determined at each location and are described in Appendix C.

Telemetry data were entered into the University of Alaska computer network. Habitat preference data will be analyzed by comparing bear use versus availability of habitat variables (Schoen et al. 1981b). Availability information is currently being collected in the Hawk Inlet area in conjunction with ongoing black-tailed deer telemetry studies (Schoen et al. 1979, 1981B, Schoen and Kirchhoff 1982).

Our approach in monitoring bear response to mining development in the Hawk Inlet study site associated with the Noranda Mine will be to monitor a sample of 15 to 25 instrumented bears before intensive development, during construction, and for 2 years into the operating phase. Movements and home range patterns, activity patterns (determined by an activity recorder), and seasonal

habitat use and preference will be monitored and evaluated relative to changes in local development activity.

RESULTS

Ten brown bears were captured in Hawk Inlet in late summer and early fall 1981 (Table 1). One bear (a yearling boar) was captured in a snare in the Green's Creek drainage and instrumented with an ear radio tag which subsequently ripped out. Nine bears were captured in the alpine by darting from a helicopter. One of these bears died as a result of drug overdose. Of 8 instrumented bears, 4 were adult females, 1 was a sub-adult female, 1 was an adult male (approximately 4 years), and 2 were sub-adult males. Bear no. 60 was an adult sow and no. 59 was her yearling boar cub.

Nine bears were immobilized with M-99, with an average dosage of 7.3 mg per bear (Table 2). One yearling boar was immobilized in a snare with 525 mg (5.25 cc) of Sernylan. Dosages ranged from 4 mg to 9 mg. We attempted to dose at about 1 mg per 22 kg body weight. The average time from injection to immobilization was 23 minutes for 9 animals successfully immobilized. One of these individuals was overdosed and died during handling. Another individual was followed for over 45 minutes and was never immobilized.

Trapping efforts were concentrated in Hawk Inlet during summer 1981 (Table 3). Three hundred and twenty trap sights were recorded, 20 traps were sprung and 1 bear was captured. One bear (a sow with cub) had to be shot when it charged as a capture team was hiking up the creek at Pile Driver Cove. Eight bears were successfully captured by darting from a helicopter (Table 4). Five helicopter flights were made from 17 through 27 September, for a total of 11.5 hours of flight time. Of 16 shots attempted, 88% resulted in hits. Of those animals shot, 90% were immobilized, and 80% were successfully captured. The mortality rate (as a result of drug overdose) was 11%. The capture rate was about 0.8 bears per hour flown.

Ten bear telemetry flights have been flown from 1 September 1981 through 3 May 1982. Bear no. 51 lost his ear tag radio several weeks after capture and bear no. 6 has not been located since 2 October 1981. Of the 7 bears with active radios, 3 had denned by 2 October 1981 and the remaining 4 denned by 2 November 1981 (Table 5). All bears denned between 600 and 1,160 m ($\bar{x}$=890 m) elevation. Most den sites were located in rocky alpine or subalpine habitat. Den sites have been marked by radio transmitters providing an opportunity to locate and describe the actual den locations during the coming summer (Fig 3). On 12 May 1982, 4 instrumented bears had recently left their dens.

Table 1. Brown bears captured in Hawk Inlet study area, fall 1981.

Animal #	General Location	Sex	Capture Age* years	Capture Weight* (Kg)	Capture Date	Radio Frequency Mhz	Capture Technique/ Habitat	Ear Tag Color	Ear Tag #	Ear Tag Ear	Comments
51	Lower Green's Creek	M	1	130	8-28-81	151.733	snare/ riparian	orange orange	51 52	right left	ear radio lost 9-81
60	Upper Green's Creek	F	adult	350+	9-21-81	151.760	helicopter alpine	orange	60	right	w/ #59
59	Upper Green's Creek	M	1	170	9-21-81	151.820	helicopter alpine	yellow	59	left	w/ #60
58	Eagle Peak	M	4	400	9-21-81	151.850	helicopter alpine	yellow	58	left	single
36	Robt. Baron Mt.	F	adult	500	9-26-81	151.860	helicopter alpine	yellow	36	right	w/ 2 cubs
50	Upper Green's Creek	M	2	275	9-26-81	151.830	helicopter alpine	white	50	right	w/ adult
14	Upper Green's Creek	F	3	275	9-26-81	151.800	helicopter alpine	red	14	right	single
43	Upper King Salmon	F	adult	650	9-27-81	151.780	helicopter alpine	orange/ green	43	left	single
6	Upper King Salmon	F	adult	325	9-27-81	151.970	helicopter alpine	blue/ orange	6	right	single
B-14	Upper King Salmon	F	2	230	9-26-81	-------	helicopter alpine	-------	--	-----	capture mortality

* estimate

Table 2. Immobilization results for Hawk Inlet brown bears, fall 1981.

Animal #	Sex	Age[1] (years)	Weight[1] (Kg)	Drug	Dosage (mg)	Time from Injection to Immobilization (min.)	Duration of Paralysis (min.)
51	M	1	60	syrnylan	525[3]	90	315
60	F	adult	160	M-99	5	10	35
59	M	1	80	M-99	4	8	22
58	M	4	180	M-99	9[2]	45	75
36	F	adult	225	M-99	9[2]	15	22
50	M	2	120	M-99	7	25	26
14	F	3	120	M-99	5	16	40
43	F	adult	290	M-99	9[2]	40	40
6	F	adult	150	M-99	7[2]	25	50
----	?	adult	135	M-99	4	not immobilized	---------
B-14	F	2	104	M-99	7	20	mortality

[1] estimate
[2] delivered in 2 injections
[3] delivered in 3 injections

Table 3. Trapping effort and success for brown bears in Hawk Inlet during summer 1981.

Date	Location	Traps Set	Traps Sprung	Estimated Bears In Area	Bears Sighted	Bears Captured	Trend of of Pinks and Chums
8-11-81	Greens Creek						
8-12-81	Pile Driver Cove	4	--	6	♀ w/1 cub of year (sow was shot)		1500 pinks 300 chums
8-13-81	Pile Driver Cove	5	1	3			1200 pinks 150 chums
8-14-81	Pile Driver Cove	5	0	0			1000 pinks 100 chums
8-15-81	Pile Driver Cove	pulled	1	1			1900 pinks 70 chums
8-12-81	2 streams left - Head of Inlet	4	--	3			----------
8-13-81	2 streams left - Head of Inlet	4	0	3			----------
8-14-81	2 streams left - Head of Inlet	4	0	1			----------
8-15-81	2 streams left - Head of Inlet	pulled	0	1			----------
8-24-81	Zinc Creek	15	--	4			6000 pinks
8-25-81	Zinc Creek	15	0	4			6000 pinks

Table 3 (cont'd). Trapping effort and success for brown bears in Hawk Inlet during summer 1981.

Date	Location	Traps Set	Traps Sprung	Estimated Bears in Area	Bears Sighted	Bears Captured	Trend of of Pinks and Chums
8-26-81	Zinc Creek	15	0	2			5200 pinks
8-27-81	Zinc Creek	15	2	0			5000 pinks
8-28-81	Zinc Creek	13	3	1		1 ♂ 130#	4000 pinks
8-29-81	Zinc Creek	14	1	1	1 ♂ yearling captured day before		3400 pinks
8-30-81	Zinc Creek	12	0	0			3000 pinks
8-31-81	Zinc Creek	12	1	1			2300 pinks
9-1-81	Zinc Creek	12	0	1			1250 pinks
9-2-81	Zinc Creek	pulled	0	1			1000 pinks
8-25-81	Green's Creek	6	--	4			26000 pinks
8-26-81	Green's Creek	15	0	1			24000 pinks
8-27-81	Green's Creek	20	1	2	♀ w/ 1 cub of year		22500 pinks
8-28-81	Green's Creek	20	2	0			21000 pinks
8-29-81	Green's Creek	21	1	0			17500 pinks
8-30-81	Green's Creek	23	3	4			16500 pinks

Table 3 (cont'd). Trapping effort and success for brown bears in Hawk Inlet during summer 1981.

Date	Location	Traps Set	Traps Sprung	Estimated Bears in area	Bears Sighted	Bears Captured	Trend of of Pinks and Chums
8-31-81	Green's Creek	23	0	2			12000 pinks
9-1-81	Green's Creek	23	3	1			9000 pinks
9-2-81	Green's Creek	pulled	1	1			6000 pinks
Totals		320	20	17	5	1	

Table 4. Brown bear capture effort and success by darting from a helicopter in Hawk Inlet during fall 1981.

Date	# Bears Observed	# Shots Taken	Hits	Immobilization	Successful Capture	Approximate # of Hours Flown
9-17-81	0	0	0	0	0	1.5
9-21-81	5	6	4[1]	3	3	3.0
9-22-81	4	1	1	0	0	1.5
9-26-81	9	5	5[1]	4	3	3.0
9-27-81	13	4	4[2]	2	2	2.5
Totals	31	16	14	9	8	11.5

[1] 1 bear was darted twice.
[2] 2 bears were darted twice.

Table 5. Den sites of 8 radio-instrumented brown bears in Hawk Inlet, winter 1981-82.

#	Date First Located in Den	General Location	Elevation (m)	Habitat	Comments
60	11-02-81	Upper King Salmon River	915	alpine/rock	denned w/ #59
59	11-02-81	Upper King Salmon River	915	alpine/rock	denned w/ #60
58	10-21-81	West of Eagle Peak	915	rocky outcrop	
36	10-02-81	N.W. Robt. Baron Mt.	640	subalpine/rock	
50	10-02-81	Upper Greens Creek	700	subalpine/rock	
14	11-02-81	Upper King Salmon River	1,160	rocky outcrop	
43	11-02-81	Upper King Salmon River	1,010	alpine/rock	
6	10-02-81	Upper Greens Creek	610	avalanche slide	last location den site, uncertain

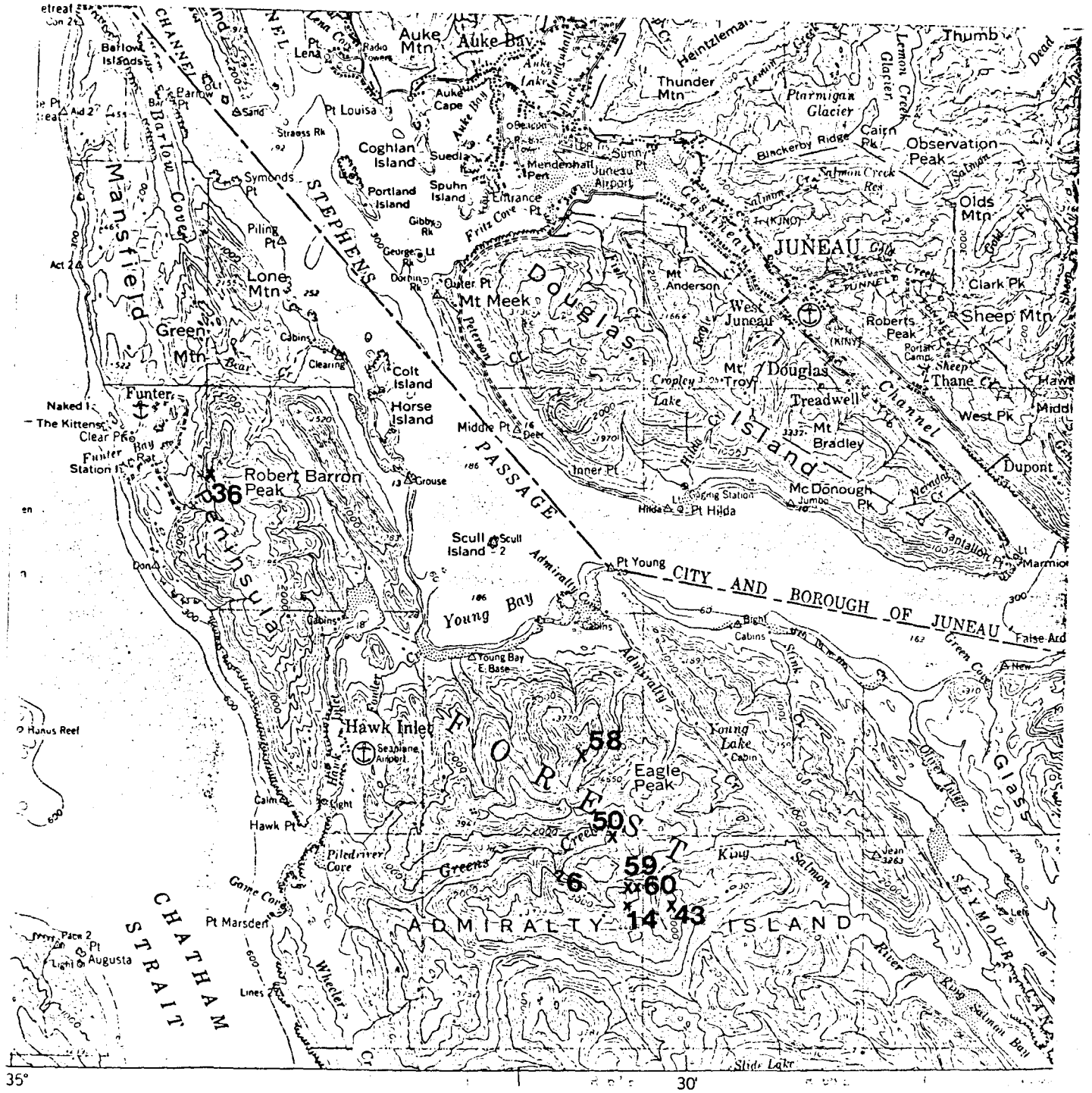

Fig. 3. Brown bear den site locations at the Hawk Inlet study site.

DISCUSSION

Helicopter capture of bears in the alpine was the most successful method. This technique should provide us with a reasonably cost efficient method of capturing bears. Snaring bears on salmon streams was much less efficient. Snaring, however, was initiated late in the season past the peak salmon runs. If conducted earlier in the season, and with a greater density of snares, the success of this technique is expected to increase.

The bear killed by a drug overdose was primarily a result of inexperience with estimating size from the helicopter as well as lack of experience in determining stress and symptoms of overdose in immobilized bears. The 11% mortality rate can be expected to decrease as experience increases.

Following capture, "alpine bears" remained in the alpine until denning in early October to early November but during October through November, bears, or their sign, were observed in forested habitat and on beaches at sea level. This suggests that subpopulations of bears or segregation by sex or age class may occur, with some bears using alpine habitats seasonally, while others may prefer lower elevations. If this is true, then we should carefully consider sample bias resulting from capture in particular habitats. To avoid this potential problem, we will attempt to capture bears in both alpine and low elevation riparian habitats.

As of 1 May, instrumented bears were in their dens from 6 to 7 months. Four bears had just left their dens, but only several sets of tracks in alpine and subalpine areas have been observed. Once the instrumented bears have left their dens, telemetry reconaissance will continue weekly through the summer and fall.

ACKNOWLEDGEMENTS

I would first like to acknowledge the skill and interest of Ron Swanson who flew the helicopter during our alpine capture program. This was dangerous and demanding flying. Jack Lentfer was instrumental in the initial development of the research program. John Matthews, Vern Beier, Matthew Kirchhoff, Nathan Johnson, Lars Holton, Loyal Johnson, Scott Brainerd, Dick Orchard, and Gordon Fisch provided major field support. Don McKnight offered advice and editorial assistance. Dara Miller typed the manuscript and Karen Wiley and Steve Peterson provided editorial comment.

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APPENDIX A. Field data sheet, Hawk Inlet brown bear project.

BEAR NO. _____ SEX _____ EST. AGE _____ EST. WEIGHT _____

RADIO FREQUENCY _____ COLLAR COLOR _____

RADIO MAKE/MODEL/SIZE _____

EAR TAG MAKE/SIZE _____

RIGHT EAR TAG NO. _____ COLOR _____ FLAG COLOR _____

LEFT EAR TAG NO. _____ COLOR _____ FLAG COLOR _____

TATTOO: LOCATION/MARKS _____

_____

SPECIFIC CAPTURE LOCATION _____

_____

DATE OF CAPTURE _____ RESIGHTINGS _____

_____

EXTERNAL MEASUREMENTS: NECK _____ TOTAL LENGTH _____ TOOTH COLL. _____

PRODUCTIVITY: NO. CUBS: 0.5 YR. _____ 1.5 YR. _____ 2.5 YR. _____

MAMMAE LENGTH _____ COLOR _____ LACTATING: YES__ NO__

TAGGING TEAM _____

DRUG NAME(S)/DOSAGE _____

_____

LOCATION OF HIT _____

TIME OF HIT _____ TIME DOWN _____ TIME TO BECOME IMMOBILE _____

RECOVERY TIME _____ TOTAL TIME DOWN _____

GROSS EXTERNAL OBSERVATIONS _____

_____

REMARKS _____

_____

APPENDIX B. Brown bear, mountain goat and black-tailed deer location data

Header Information

Animal	Survey Type	Observer	Date (Yr., Mo., Day)	Julian Date

Weather Data

Air Temp.	Wind Dir. (deg)	Wind Speed (mph)	Clouds (%)	Precipitation
0-				

Observation Data

Number	Elevation (ft)	Habitat	Canopy (%)	Ter-rain	Slope()	Time (hrs)

Cover (%)	Snow Depth (in.)	Grp. Size	#Males	#Females	#Adults	#Juven.

Acc.	Animal Location xloc	yloc	Aspect	%Spruce	Vol	Drainage	Risk	Patchi-ness

APPENDIX B (cont'd). Data codes.

Animal	Survey Type	Observer		Clouds	Preciptiation
1=goat	1=aerial	1=John	5=Charlie	% Cover	1=no rain
2=deer	2=ground	2=Matt	6=Gordon		2=intermittant rain
3=bears		3=Nate	7=Dave		3=steady rain
		4=Jack	9=Lars		4=snow

Wind Direction	Wind Velocity
° Magnetic	MPH
O, Variable=111	

Habitat

01=Beach
02=Beach fringe (old growth forest less than 100 yards from beach)
03=Old growth conifer forest
04=Early successional clearcut (0-15 years)
05=Mid successional clearcut (16-30 years); deciduous dominating
06=Mid successional clearcut (16-30 years); conifers dominating
07=Even aged regrowth (31-200 years); deciduous dominating
08=Even aged regrowth (31-200 years); conifers dominating
09=Deciduous brush (slide or avalanche chute)
10=Muskeg
11=Subalpine
12=Alpine tundra
13=Rocky outcrop; cliff face
14=Permanent ice-snowfield
15=Frozen lake-river
16=Wet meadow
17=Riparian
18=Tidal flats

Canopy	Terrain	Snow Cover (%) and Depth (in)	Snow Type
% cover	1=smooth	(in general vicinity of animal	0=no snow
	2=broken		1=soft
			2=hardpack
			3=crust

Accuracy

1=accurate location within 25 acres-habitat accurate
2=accurate location within 25 acres-habitat uncertain
3=accurate location within 100 acres-habitat uncertain

Animal Location (from map)

First 3 values are the X (EW) coordinate
Last 3 values are the Y (NS) coordinate

APPENDIX B (cont'd). Data codes (cont'd).

Aspect (from map)

01=Flat	04=E	07=SW	10=Ridgetip
02=N	05=SE	08=W	
03=NE	06=S	09=NW	

Slope

degrees-#contour lines/grid

1-15 = 1-2
16-30 = 3-5
31-45 = 6-9
46+ = 10+

Group Size

# of individuals observed in each class within group

% Spruce	Volume	Age	Drainage	Risk	Patchiness
0	1 <8	1 Even	1 Poor	1 Low	1 Low
0	2 8-20	2 Uneven	2 Moderate	2 Moderate	2 Moderate
0	3 20-30		3 Well	3 High	3 High
0	4 30-50				
0	5 50+				
99	0 No Data				

Appendix C

Elevation was recorded to the nearest 30 m using the aircraft altimeter. Slope and aspect were determined from the map. Slope was recorded to the nearest 5° and aspect was recorded as flat, north, northeast, east, southeast, south, southwest, west, northwest, or ridge top.

Fifteen general habitat types were defined. These were beach, beach-fringe forest (old-growth forest less than 100 m from beach), old-growth spruce-hemlock forest (uneven-aged and silviculturally overmature), early successional clear-cut (0-30 years), even-aged second growth with deciduous or conifer species dominating (31-200 years), deciduous brush (e.g., slides and avalanche chutes), muskeg, subalpine, alpine, rocky outcrop-cliff, permanent ice-snowfield, and frozen lake or river.

Overstory species composition was recorded as percent spruce to the nearest 5%. Timber volume was recorded in thousand board feet per ac (mbf/a) by volume class (<8, 8-20, 20-30, 30-50, >50 mbf/a). Stand age was described as even or uneven; soil drainage as poor, moderate, or well drained; risk as high, moderate, low; and patchiness as low, moderate, high.

Overstory canopy coverage was estimated from the air and recorded to the nearest 5%. The character of the terrain was recorded as either smooth or broken. Percent snow cover and depth of snowpack in the general vicinity of the animal were estimated from the air.

Location accuracy was estimated as follows: position accurate to within 10.4 ha (25.6 a) and landscape attributes accurate; position accurate but landscape attributes uncertain; and position accurate only to within 40 ha (100 a) and all landscape attributes uncertain.