Wernecke Mountain Caribou Studies

1980 to 1982

Final Report
by
Richard Farnell,
Yukon Fish & Wildlife Branch
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Yukon
Renewable Resources
Dave Porter - Minister

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ABSTRACT

During 1980-82, 32 caribou (5 bulls, 27 cows) were radio-collared in the Ogilvie-Wernecke Mountains. A total of 18 aerial surveys were flown to delineate distributions, relocate radio-collared caribou, locate specific calving sites, and conduct composition counts. The snow distribution (11 stations) of the Bonnet Plume herd was surveyed during the 1981-82 seasons. Food habits were analysed from fecal samples collected. Physical characteristics of Porcupine and Wernecke Caribou were compared from hunter kill (34) and capture (16) samples.

Relocation and distribution surveys found two distinct woodland caribou herds in the study area. The Hart River herd shared overlapping distributuion with the Porcupine Caribou herd during the winters 1980-81 and 1981-82. The Bonnet Plume herd shared limited overlap with the Porcupine herd during the winter 1981-82. Subsequent radio-collared caribou movements of individuals from each herd found them sorting out and moving to respective calving sites. A strong home range loyalty for the species is suggested. Analysis of weights and measure data indicate that Wernecke Caribou are significantly heavier and larger than Porcupine caribou, and are more typical of woodland caribou type subspecies (Rangifer tarandus caribou).

While the numbers of woodland caribou using a portion of the winter range stayed fairly consistent from year to year the use of particular portions of the winter range by an individual varied greatly. The Bonnet Plume herd winter distribution corresponds almost exactly with a snow shadow region on the north flank of the Wernecke Mountains. Spring, winter and fall movement traditions

are probably dictated by these favorable conditions. Late winter diet was characteristic of caribou wintering in taiga and mountainous regions.

Caribou chose steep confined side valleys and cirque basins for calving. No core calving area was found. The timing of calving from confirmed sightings between May 19 to May 26 indicated that a peak of calving occurred about may 21-22. The peak of calving for the Porcupine herd is around June 6. Of 12 relocations, 6 individuals were relocated in almost exactly the same calving site found the year prior.

A modified aerial photocensusing technique failed to achieve a minimum population count. Estimates based on previous intensive big game surveys put the population size of the Hart River herd at 1,200 caribou in 1978. Overlapping influences of the Porcupine herd during the years of this study precluded unbiased late winter composition counts. Best estimates for the Bonnet Plume herd are approximately 5,000 in 1982. Composition statistics gathered during late winter 1981 and 1982 found very high cow/calf ratios 47.1 and 54.0 ca per 100 respectively. The mean annual estimated harvest for the Hart River herd is 12 caribou, and for the Bonnet Plume herd 18 caribou. Both herds are thought to be stable and the Bonnet Plume herd may be growing in size.

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INTRODUCTION

This report presents the final analysis and conclusions based on a study of mountain caribou in the Wernecke and Ogilvie Mountains conducted from April 1980 to April 1982. The research was initiated to clarify three possibilities concerning the migratory patterns and herd relationships of caribou inhabiting the study area. These were:

1. That barren ground caribou (Rangifer tarandus granti) from the Porcupine herd, which spend the summer in Northern Yukon and eastern Alaska, migrate into the area and winter in the study area during some or most winters.

2. That resident woodland caribou (Rangifer tarandus caribou) which spend all year in the general areas of the Wernecke-Ogilvie Mountains. We believe that woodland caribou are the same subspecies as mountain caribou (Rangifer tarandus Osborni) or (Rangifer tarandus montanus).

3. That both resident woodland caribou and Porcupine caribou inhabit the area on a seasonal basis.

The specific objectives of the study were:

1. To determine the home range use pattern of the resident caribou inhabiting the Ogilvie-Wernecke Mountains.

2. To determine any physical or ecological parameters that properly classify the subspecies to which these resident woodland caribou belong.

3. To examine overlapping distribution between herds and determine whether any significant imigration takes place.

4. To examine some characteristics of winter range and individual use of that range by resident woodland caribou in the study area.

5. To determine the population size and composition of resident woodland caribou populations in the study area.

Previous researchers have defined caribou herds in terms of their affinity for calving grounds (Skoog 1968, Kelsall 1968). However, from limited data available on other ongoing research projects on woodland caribou a distinctive "calving ground" does not exist (Larsen, pers. comm., Russell and Farnell, unpub. observ.) (Hatler 1983, Bergerud 1979). Therefore, to properly define herds of woodland caribou in the study area a comprehensive 2-3 year radio tracking program was required to properly determine home range movements and herd overlaps.

The scope of this study therefore involved the radio-collar deployment outlined below:

April 1980 - animals radio-collared would not have yet migrated and therefore would be known to have wintered in the study area. Initial monitoring during the calving season would be conducted in the study area and on the Porcupine herd calving grounds in the Northern Yukon.

July 1980 - animals radio-collared would be resident in the study area in the summer and thus would not be a part of the Porcupine Herd (summering at that time on Yukon's northern coastal plain).

April 1981 - animals would be collared throughout the study area and subsequent monitoring would help define winter over-lap between resident caribou and Porcupine caribou, if it exists. This was the final collaring activity and sufficient collars would then be active to define calving grounds and range traditions of resident animals.

Various Activities 1980-1981 - animals of the Porcupine Herd were collared as part of other ongoing projects throughout the range of that herd. Missing collars from the Porcupine herd not located on their calving ground were monitored during the summer within the study area.

We would like to gratefully acknowledge Jack Nolan, Alberta Environmental Centre, and Janet McDonald, Yukon Department of Renewable Resources for technical field assistance during this study. Also, we thank the various pilots provided us from Alkan Air, Trans North Turbo Air, Air North, and Quasar Helicopters for safe, reliable and diligent flying. A special thanks goes to Bill Stephen of Aberford Resources for his guidance and assistance in study design and implementation. We would also like to thank Pearl Callaghan and Elaine Irving for the typing and Tom Rodger for drafting. Aberford Resources and the Yukon Department of Renewable Resources provided financial support for the project and the Polar Continental Shelf Program assisted with helicopter support.

STUDY AREA

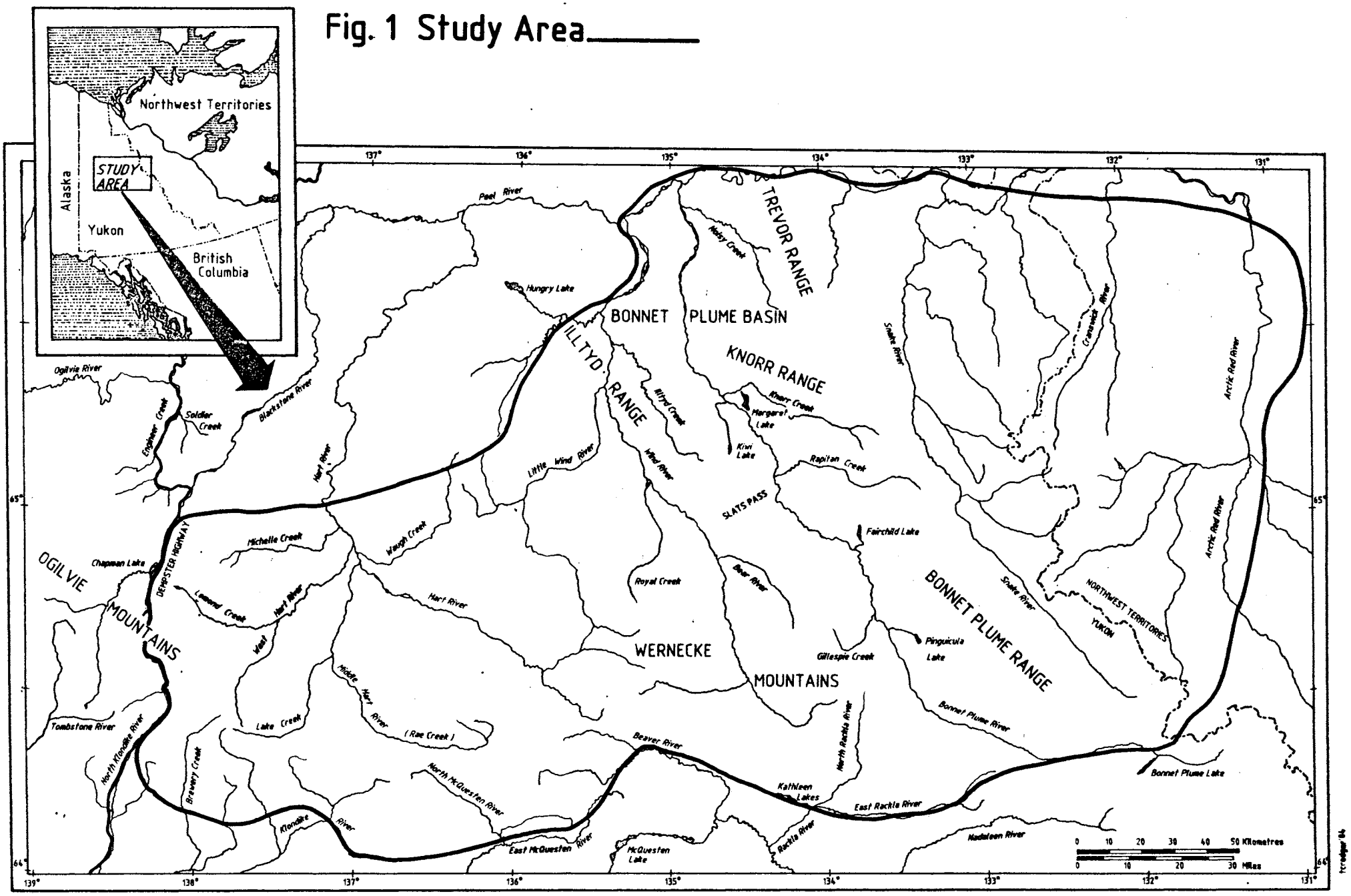
Initially, a large study area (est. 46, 147 sq. km.) (Figure 1) was defined to encompass the area likely to contain all caribou utilizing the Bonnet Plume Basin. This area is bounded on the east by the N.W.T./Yukon border, on the south by the south slope of the Wernecke Mountains, on the west by the Dempster Highway, and on the north by a line extending from the Dempster Highway to the northern Hart River Basin and from there northeast to the Wind River thence following the Wind River to the Peel River and proceeding east to the N.W.T./Yukon border. As more was learned of caribou movements and distributions, the eastern boundary was expanded to include the upper drainage area of the Arctic Red River.

METHODS

Capture and Radio collaring

Two capture techniques were employed for radio-collaring in April 1980 and 1981. Initially, caribou were captured using a dart gun from helicopter with the fast acting tranquilizer drug combination of M-99 (ectorphine) and Rompun (xylazine) with antidote M50-50 (diprenorphine). The resulting drug related mortalities, apparent predisposition to predation and atypical behaviour prompted us to adopt new capture methods and utilize a New Zealand net-gun (Barret and Nolan 1981). More cows were selected than bulls since cows yield a better understanding of calving and calving grounds utilized by resident caribou. As well, cows retain collars better than bulls since neck expansion and contraction during rut often results in shed collars with bulls (Davis et al 1982).

Fig. 1 Study Area



Weights and Measures

To characterize resident caribou and Porcupine caribou body measurements, results of measurements of hunter killed Porcupine caribou obtained in the falls of 1972 and 1973 were compared using a t-test with the data from 16 cows measured during spring collaring operations in the Wernecke Mountains. Standard body measurements were taken (Appendix A).

Aerial and Ground Surveys

Reconnaissance Surveys

Winter range distribution surveys were flown during the month of March 1980, 1981, and 1982. The technique employed was a non-systematic, low level search for caribou and snow-tracking sign throughout the majority of the study area. Spruce forest habitats lying within the major drainage areas were intensively examined. Results of surveys from previous years (1978 and 1979) while surveying Porcupine herd winter ranges were used to contribute to our understanding of the winter range tradition.

One low level fixed wing post-calving survey was flown in the study area during July 1980. Searching for aggregations and possible woodland caribou concentrations on snowfields, this survey was conducted solely in mountainous habitats. The principal objective of this effort was to attempt to photocount post-calving aggregations and determine a minimum population estimate.

Radio-Telemetry Surveys

Four principal life cycle periods were selected for relocation surveys over the years 1980, 1981 and 1982. Surveys were flown during late winter (March), calving period (late May), post-calving distribution (July), and rut and fall

migration period (October). It was felt that relocations at these times would yield a good understanding of movement trends and home range use. The habitat and terrain type selected by collared individuals were recorded at each relocation.

Relocation surveys were flown systematically as east-west transects across the entire study area. Spaced 56 kilometres apart, to insure overlap of reception, altitudes of 3,000 to 4,500 metres A.S.L.) were maintained, unless visual relocations were required (e.g. calving). When relocated, a signal was usually circled at a permissable low altitude and pinpointed within seven square kilometres of its location on 1:250,000 maps. If a signal remained stationary after two or more relocations, a low level attempt at a visual sighting was made. If the animal was not observed at this time, the site was later investigated by helicopter to determine the status of this caribou. Given the remoteness and size of the study area, it was uneconomical to attempt a visual sighting at every relocation. Incidental to these high level searches during fall, winter and spring, caribou snow-tracks were recorded, assisting us in determining an overview of distribution and movements.

A fixed-wing relocation survey was flown over the entire study area during mid May 1980 and 1981 and 1982. Relocated individuals were revisited in 1981 by helicopter at two day intervals until parturition had occurred at which time the calving site and timing of calving were documented. The Porcupine herd calving grounds on the north slope of the Yukon and Alaska were also surveyed. We monitored for previously missing radio-collar frequencies in both the Porcupine herd and within the Study Area.

Snow Distribution

Extensive snow surveys were conducted as part of a separate study throughout the winter range of the Porcupine herd in March 1981 and 1982. Eleven sites were sampled for snow conditions on the wintering range of the Bonnet Plume herd. At each site, depth, density (Mount Rose samples) and hardness (Swiss Rammsonde) were measured at 10 points at 5 meter intervals.

Late Winter Food Habits

Caribou feces pellets were collected in March and April 1981 and March 1982 from five areas in the Bonnet Pume Herd winter range. Each composite sample included one pellet from each of 20 fresh pellet groups, and each composite sample had 100 random fields examined for identifiable plant fragments by the Composition Analysis Laboratory at Colorado State University.

Population Size and Composition

A single attempt to obtain a minimum population estimate on the Hart River herd and Bonnet Plume herd was made during July 1980. A modified aerial photographic censusing technique on post-calving aggregations in alpine habitats similar to methods used by Ritcey (1970), assisted by radio-collar relocations was employed.

The sex and age compositon of the woodland caribou population was determined in April 1981 and 82. It was felt that a spring composition count immediately after the intensive late winter distribution and relocation surveys was logistically the most practical count. This data could yield the overwinter calf survivorship (to 11 months of age) and therefore give us a reasonable

indication of recruitment or relative reproductive success. The large study area and remoteness precluded a full scale count during other life cycle periods.

The search technique employed required a receiver-equipped helicopter searching for previously (late winter) located collared caribou. Counts were conducted on the band associated with these individuals and any other bands found in the area. Likewise, a limited amount of searching occurred in a heavy concentration areas identified during late winter distribution surveys.

Sex and age segregation counts were conducted in two ways:

1. When herds were very large (> 50) or in open terrain, the observer using a spotting scope made counts from the ground paying particular attention to genital characteristics, body size and/or head and antler morphology for aging and sexing animals (Skoog 1968).

2. When herds were small (< 50) and in dense tree habitats, a slow low level overpass was made and presence or absence of a vulva patch on the rump was used in determining sex.

To avoid duplication, counts were made in separate geographic areas during subsequent days and against the observed flow of caribou movement.

RESULTS AND DISCUSSION

Field Effort

Thirty-two caribou (5 bulls, 27 cows) were fitted with radio-collars (Page 11). A total of 83.2 hours of fixed wing and 33.6 hours of helicopter time was utilized on the 18 surveys flown during the study (Pages 12-13).

During these surveys radio-collared individuals were relocated on a total of 204 occasions (x 6.3 per survey, Max 15) including 15 high level fixes and 53 low level visual identification.

Weights and Measures

Adult female characteristics of 34 hunter killed Porcupine caribou and 16 Wernecke Mountain caribou (Appendix B) are statistically significantly heavier and have significantly larger total body length than Porcupine animals (Page 14). Given the small sample sizes involved, we caution against a liberal interpretation of the differences.

Aerial and Ground Surveys

Winter Distribution

Two principal winter ranges for woodland caribou were apparent (Figure 2, Page). The core winter range for the Hart River lies within the Hart River basin including the upper reaches of Rae Creek. The winter range of the Bonnet Plume herd extends across the Wernecke Mountains and includes the densely forested spruce valleys of the Wind, Bonnet Plume, Snake and Arctic Red Rivers, the southern extremity of the Bonnet Plume Basin and northern foothills of the Wernecke Mountains. Traditional core wintering areas with consistently high

TABLE 1. Details of collaring operations on 32 resident caribou in the study area.

DATE	COLLAR	SEX	AGE	LOCATION	HERD	LIFE (WK)	STATUS (as of June 1/82)	NO. OF RELOC.
April 1980	E01	♀	A	Snake River	Bonnet Plume	12	Failure	4
	E02	♂	I	Knorr Range	Bonnet Plume	19	Failure	4
	E57	♀	A	Snake River	Bonnet Plume	100	Active	14
	E59	♀	A	Snake River	Bonnet Plume	100	Active	6
	E65	♀	I	Knorr Range	Bonnet Plume	12	Predation	3
	E66	♀	A	Knorr Range	Bonnet Plume	108	Active	15
	E69	♀	A	Knorr Range	Bonnet Plume	108	Active	14
	F61	♀	A	Rae Creek	Hart River	24	Dead	5
	F63	♀	A	Michelle Creek	Hart River	48	Failure	10
	F94	♀	A	Michelle Creek	Hart River	5	Failure	1
July 1980	G03	♀	A	Knorr Creek	Bonnet Plume	96	Active	15
	G09	♀	A	Knorr Creek	Bonnet Plume	87	Active	8
	G15	♀	A	Wind River	Bonnet Plume	96	Active	11
	G29	♀	A	Royal Creek	Bonnet Plume	35	Mortality	5
	G35	♀	A	Knorr Creek	Bonnet Plume	96	Active	8
	G46	♀	A	Knorr Creek	Bonnet Plume	11	Failure	2
	G62	♂	I	Knorr Creek	Bonnet Plume	0	Failure	0
	G95	♂	A	Knorr Creek	Bonnet Plume	0	Failure	0
	H54	♀	I	Lake Creek	Hart River	96	Active	10
	H58	♀	A	Lake Creek	Hart River	U	Failure	0
	H60	♂	J	Lake Creek	Hart River	87	Active	12
	H96	♀	A	Lake Creek	Hart River	96	Active	13
April 1981	J60	♂	I	Illtyd Creek	Bonnet Plume	58	Active	5
	J61	♀	I	Illtyd Creek	Bonnet Plume	58	Active	8
	J62	♀	A	Illtyd Creek	Bonnet Plume	13	Failure	3
	J63	♀	I	Illtyd Creek	Bonnet Plume	58	Active	7
	J64	♀	A	Illtyd Creek	Bonnet Plume	49	Active	1
	J65	♀	A	W. of Snake River	Bonnet Plume	58	Active	6
	J67	♀	I	W. of Snake River	Bonnet Plume	49	Active	1
	J70	♀	A	Iron Creek	Bonnet Plume	58	Active	6
	J71	♀	A	Illtyd Creek	Bonnet Plume	13	Failure	2
	J76	♀	A	Illtyd Creek	Bonnet Plume	26	Failure	4

TABLE 2. SUMMARY OF ACTIVITIES CONDUCTED
April 1980 - April 1982

	Date	Caribou Season	Objectives
1.	March 13, 1980 April 23-27, 1980	late winter initial spring movements	a. conduct snow surveys in Hart River area. b. determine late winter distribution c. record initial spring movements d. locate and radiocollar Bonnet Plume and Hart River herd caribou.
2.	June 2, 1980	calving	a. relocate radio-collared caribou to help determine calving distribution. b. record habitat selection.
3.	July 14-18, 1980	post-calving and summer range	a. determine summer distribution and centers of habitation b. attempt a census of resident animals c. locate caribou for additional radio collar work.
4.	July 18-21, 1980	summer range	a. capture and radio-collaring of the Hart River and Bonnet Plume area.
5.	September 8-10, 1980	pre-rut	a. determine pre-rut distribution b. determine fall migration movements using radio collared animals. c. conduct composition counts
6.	November 22-30, 1980 January 28, 1981 March 5-8, 1981	winter range	a. relocate radio collared caribou to help determine extent of winter range use and movement trends. b. low-level surveys to document further abundance and late winter distribution. c. conduct extensive snow surveys in the Hart and Bonnet Plume areas. d. collect fecal samples.
7.	March 27 - April 12, 1981	spring migration	a. determine spring migration routes b. relocate radio collared caribou in the Hart and Bonnet Plume areas c. conduct composition counts d. capture and radio-collaring of Bonnet Plume caribou.

Table 2 (CONTD). SUMMARY OF ACTIVITIES CONDUCTED, April 1980 - April 1982.

	Date	Caribou Season	Objectives
8.	May 19 - 26, 1981	calving	a. determine timing of calving b. record initial calf crop c. document calving sites d. relocate radio-collared animals to determine individual fidelity. e. record habitat selection.
9.	July 10 - 11, 1981	post-calving	a. high-level relocations to provide summer movements.
10.	October 12, 1981	rut	a. relocate radio-collared caribou to help determine fall migration movements and rutting areas. b. low-level and ground composition counts.
11.	February 4-5, 1982 March 3-4, 1982 March 23-27, 1982 April 4-5, 1982	winter range	a. determine late-winter distribution and movements. b. conduct snow surveys in the Hart and Bonnet Plume c. conduct a composition count on the Bonnet Plume herd. d. collect fecal samples.
12.	May 23-24, 1982	calving	a. determine if caribou return to same calving sites as determined in 1981.

Table 3. Body characteristics of adult female Porcupine and Wernecke Mountain caribou.

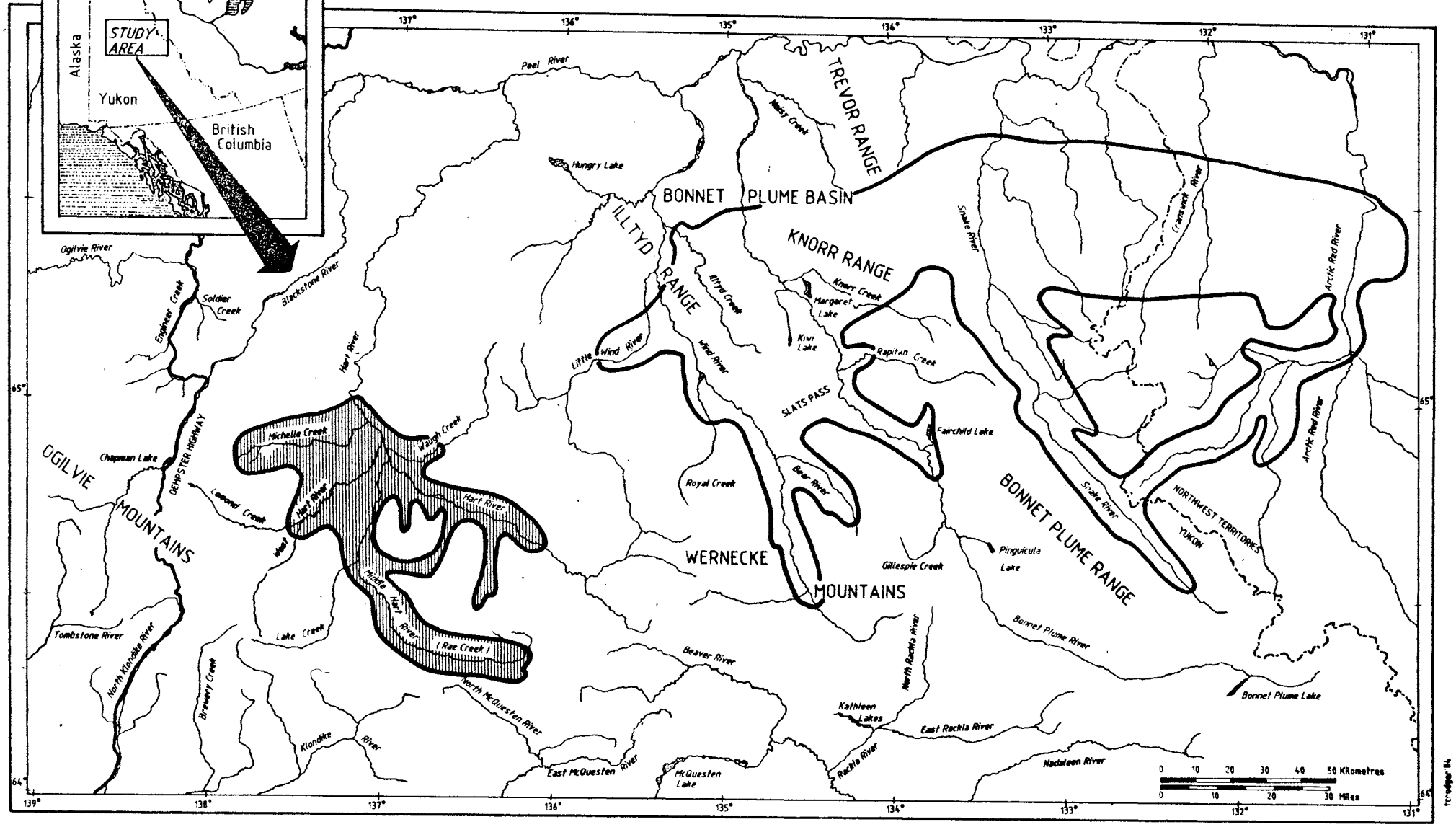
	Mean + SE	N	T Statistic a 95% level
Weight*			
Porcupine	88.9 ± 3.3	10	4.1 p=.0021
Wernecke	112.7 ± 4.7	6	
Heart Girth			
Porcupine	118.8 ± 2.4	9	1.8 p=.09
Wernecke	123.8 ± 1.7	9	
Total Length			
Porcupine	177.0 ± 4.4	9	5.0 p=.0002
Wernecke	203.6 ± 2.5	9	

* Spring weights for Wernecke and fall weights for Porcupine caribou certainly suggests a real difference despite small sample size. Would expect spring animals to be at lowest annual weight.

Fig. 2: Winter Ranges Determined from 1980–1982

Hart River Herd

Bonnet Plume Herd



concentrations of caribou are the Wind River-Bear River confluence, Slats Pass, Illtyd Creek, Snake River, and upper Arctic Red River.

The contrast between early and late winter movements between Porcupine caribou, which may move 150 linear miles from November to March (Russell and Farnell, in prep.), and Wernecke Mountain caribou, which may move 10 to 30 miles in that period, reveals a sedentary nature for this latter herd, quite typical of resident woodland caribou Rangifer tarandus caribou.

Overlaps in distribution between Porcupine herd caribou and Hart River-Bonnet Plume herd caribou were documented for winters 1980-81 and 81-82. These overlaps were evidenced by the proximity of radio-collared individuals from both Porcupine and the Wernecke woodland herds and from observations of large numbers of Porcupine caribou migrating onto and sharing woodland caribou winter range.

1980-81:

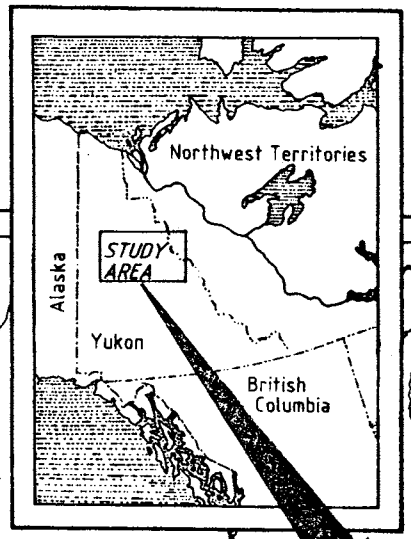
November surveys found 75% of the Porcupine Caribou herd (70-80,000 estimate) to be wintering in the Yukon from the confluence of the North and South Tatonduk Rivers, northeast across the Miner and Whitestone River headwaters, to approximately km 288 on the Dempster Highway, then south up the main fork of the Hart River to Rae Creek and west along the Ogilvie Mountain divide separating North and South flowing streams to the Tatonduk River again (Figure 3).

The abundance of caribou in relation to the Dempster Highway for the November survey period was estimated at approximately 40,000 east of the highway and

Fig. 3: Winter Distribution 1980-1981

Distribution Boundary ———
Assumed Boundary .....

Porcupine Animal ▲
Hart River Animal. ○



30,000 west of the highway. High densities of caribou were observed adjacent to the highway continuously from km 96 to km 240. High densities of caribou were observed east of the Dempster at Rae Creek, Lake Creek, West Hart River, Lomond Creek - Two Beaver Lake area, Engineer Creek, Soldier Creek, and Ogilvie River near km 240 area. West of the highway distribution appeared to be scattered.

A total of seven Porcupine herd radio-collared caribou and four Hart River radio-collared caribou were relocated in November. Large numbers of caribou, exceeding the number estimated for the Hart River herd, were found in the center of the Hart River herd's range. We believe these animals were largely from the Porcupine herd, a belief partially supported by the presence of Porcupine radio-collared invididuals B-40 and C-93, (Figure 3), relocated in association with Hart River caribou. While two radio-collars are not confirmation of "very large numbers" of Porcupine caribou, the extent of tracking sign and observation of numerous caribou suggested that by virtue of numbers along the majority of caribou at this locality at this time, were a portion of the Porcupine herd.

Hart River radio-collared caribou H-54, H-96 and F-63 were sited in bands associatesd with numerous other bands of what we assumed to be Porcupine Caribou. The relocation of F-63 at Engineer Creek is further north than where the Hart River herd was previously thought to range. This individual was in a band of more than 100 mixed caribou.

Spring migration surveys found what we believe to be the vast majority of the Yukon's Porcupine caribou migrating north along the Old Crow route. Subsequent

calving ground surveys accounted for all Porcupine radio-collared caribou on their summer range, and all Hart River collared caribou south onto their respective calving sites in the Ogilvie Mountains (Figure 4, Page).

1981-82:

An estimated 10,000 Porcupine caribou wintered in the study area. They were distributed along the north flank of the Ogilvie-Wernecke Mountains from the Dempster Highway to just east of the lower Bonnet Plume River, (Figure 5, Page 21). The abundance of snow-tracking sign in the Hart River Basin indicated that there were more caribou in that area than could be accounted for by the presence of only the Hart River herd. We suspected that some overlap with the Porcupine herd therefore must have taken place at that locality. However, no Porcupine herd radio-collared individuals were associated with this specific distribution. The Bonnet Plume caribou may have shared very limited overlap in distribution along southern Bonnet Plume Basin area between the Wind and Bonnet Plume Rivers. Once again no radio-collared individuals were associated. Porcupine herd caribou migrated straight north largely along the Richardson route. Calving surveys found no radio-collared Hart River or Bonnet Plume caribou on the Porcupine calving grounds.

Snow Conditions on Winter Range

The winter range of the Bonnet Plume herd is located in the snow shadow on the north flank of the Wernecke Mountains with high snow belt areas to the north (Bonnet Plume Basin) and to the south (headwaters of Stewart, Rackla and Beaver Rivers). Regional snow pattens will be discussed in greater detail in a report on characteristics of Porcupine Caribou herd winter range (Russell and Martell, in prep.).

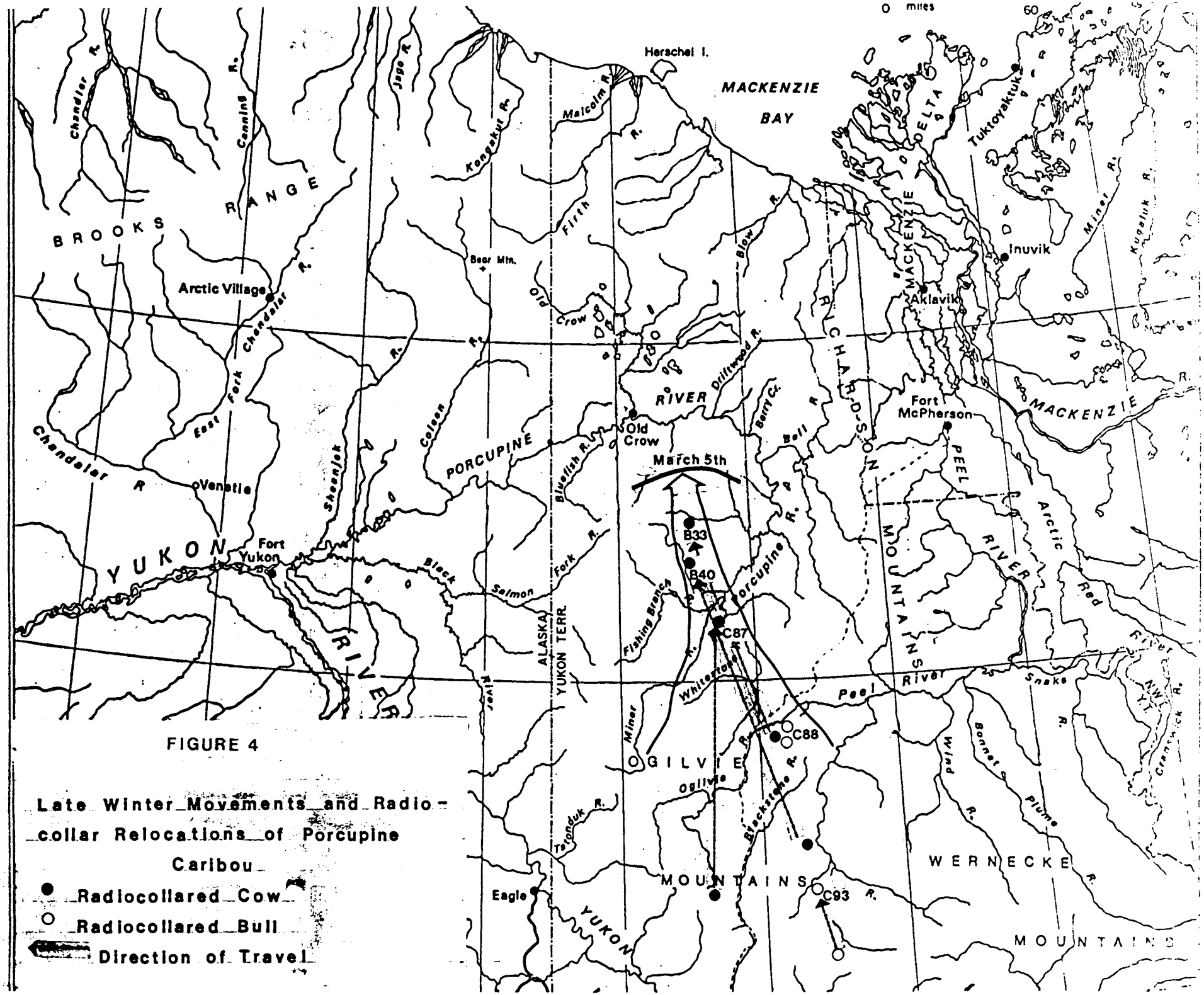
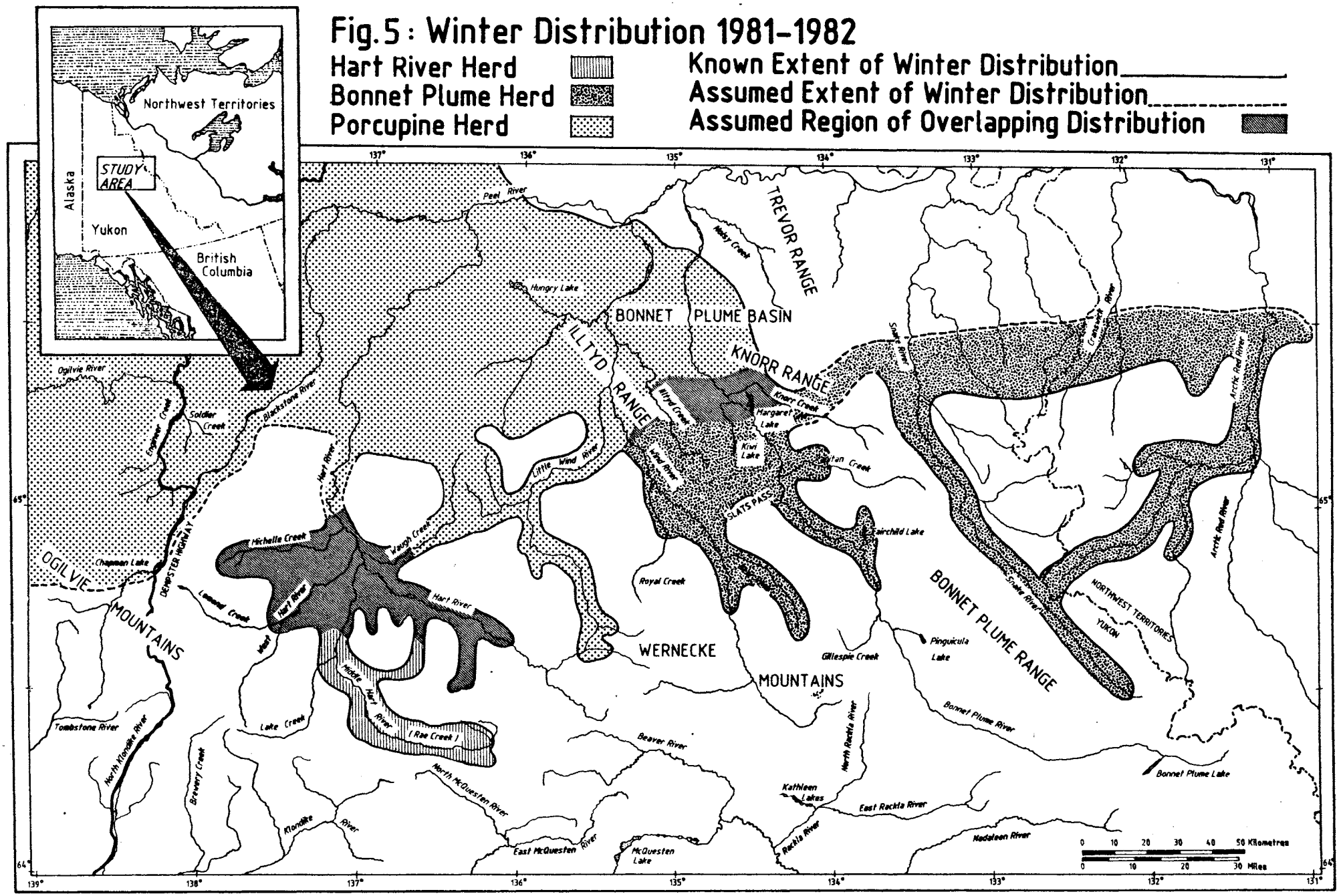


FIGURE 4

Late Winter Movements and Radio-collar Relocations of Porcupine Caribou

- Radiocollared Cow
- Radiocollared Bull
- Direction of Travel

Fig. 5 : Winter Distribution 1981–1982



The winter of 1980-81 was favourable in terms of snow conditions for caribou with mean snow depths varying between 38 cm in forested habitats and 24 cm in tundra and subalpine sites (Page 23). Mean snow densities between .178 and .194 gm/cm^3 in forest and tundra sites, respectively, were recorded while mean snow hardness varyied between 407 and 298 gm/cm^2 on forest and open habitats. Animals did not appear restricted in their movements and habitat selection. The most favourable snow conditions were at sample sites in the Upper Snake River, Upper Illtyd and Knorr Range and at the confluence of the Bear and Wind River. The Snake and Bear River areas have been identified as key winter ranges being consistently utilized over the years that surveys have been conducted.

The winter of 1981-82 was one of deep snowdepth in the region. Large numbers of caribou wintered outside of our snow sampling area in the foothills region of the Arctic Red River area (Figure 6, Page 24). However, during radio-tracking in late winter 1982 it was noted that this region had the lowest snow accumulation within the entire winter range of the Porcupine Caribou herd. Much of the ground was wind blown and virtually snow free. Within our sampling area, mean depths varied between 75.5 and 62.2 cm in forest and tundra while hardness showed the largest discrepancy between forest and tundra with means of 1.74 and 5.28 gm/cm^2, respectively. Caribou sign was restricted to forest sites primarily at the confluence of the Bear and Wind Rivers with snow depths of 59 cm and hardness of 94 gm/cm^2. Animals also utilized the upper Snake River winter range, an area which also had moderate snow hardness values. The reason for the more favourable snow conditions being consistently found in the Snake River area is probably due to the snow shadow effect combined with wind protection.

Table 4. Snow Parameters for March 1981 and 1982 on Bonnet Plume herd winter range.

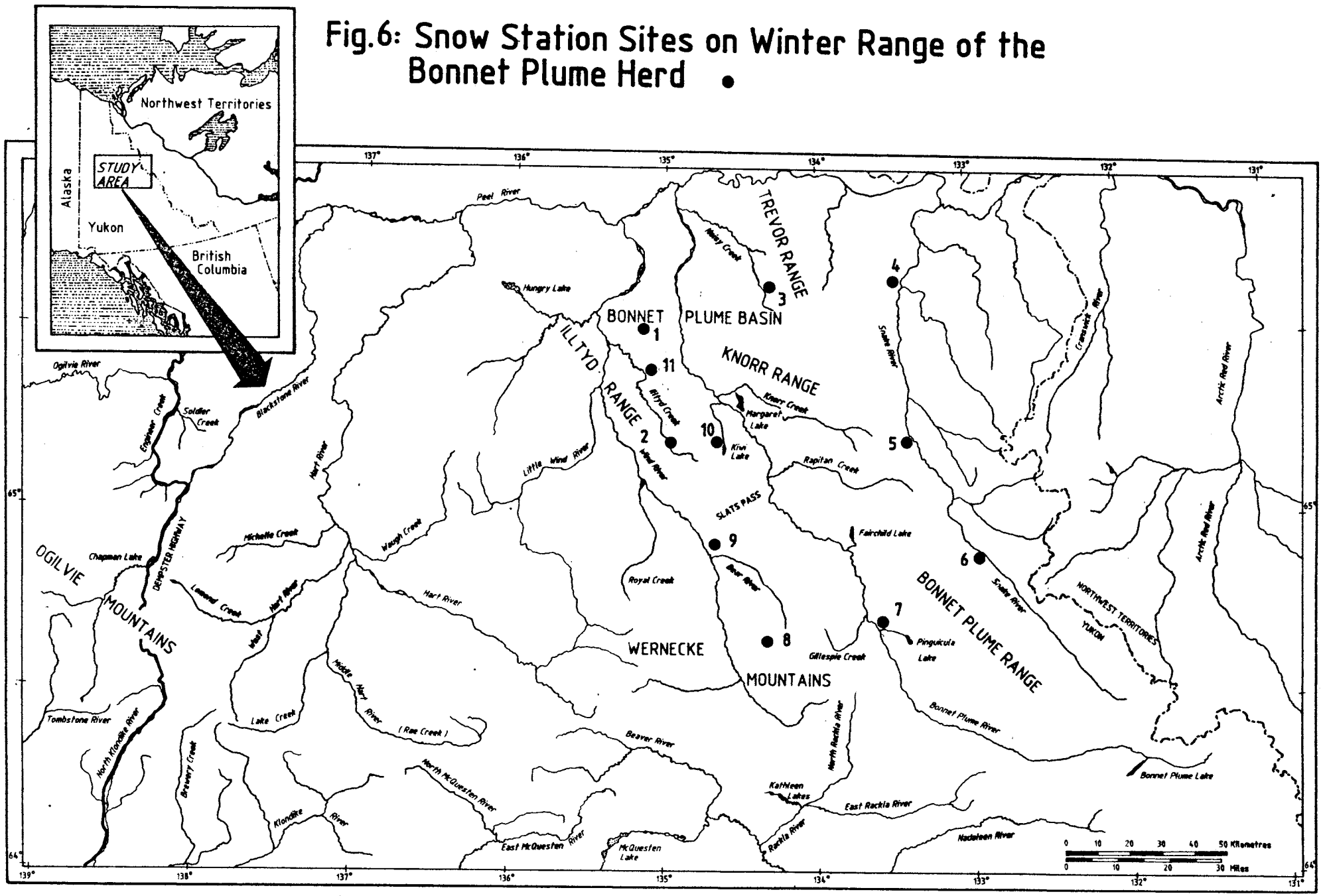
Map Ref. Number	+Area of Sample	1981 Mean Depth	1981 Density	1981 Mean Hardness	1982 Mean Depth	1982 Density	1982 Mean Hardness
1	Bonnet Plume Basin*	61.7	.134	09	95.8	.228	281
2	Upper Illtyd Ck.**	18.8	-	-	87.5	.261	701
3	Knorr Range**	14.7	-	-	42.1	.295	1047
4	Snake R.-lower*	44.8	.203	664	98.5	.225	262
5	Snake R.-mid*	10.8	.111	-	48.1	.175	256
6	Snake R.-upper**	20.2	-	-	55.1	.178	080
7	Bonnet Plume-upper*	56.5	.239	457	66.5	.241	309
8	Wind River-upper*	40.2	.186	266	74.3	.191	109
9	Wind R./Bear R.*	22.2	.180	38	59.3	.196	094
10	Kiwi Lake**	34.1	.194	298	64.0	.222	285
11	Illtyd Ck.lower*	32.3	.195	586	86.3	.211	270

+ See Map __

* Forest Sites

** Tundra Sites

Fig.6: Snow Station Sites on Winter Range of the Bonnet Plume Herd



Late Winter Food Habits

Page 26 presents the food habits for March and April 1981 and March 1982. Lichens constituted 70-88% of the late winter diet, characteristic of caribou wintering in taiga and mountainous regions (Russell and Martell, 1984). The 1981 late winter samples had a 50% composition of Cladina type lichen which suggests snow depths were not limiting in the taiga.

Spring Migration

Surveys conducted during late March and April 1980, 1981 and 1982 found a consistent spring migration tendency for both the Hart River and Bonnet Plume caribou. The Bonnet Plume herd generally tended to shift from previously occupied winter ranges in a southwesterly direction towards subsequent calving sites and summer ranges (Figure 7, Page 27). Caribou wintering in the proximity of the N.W.T. border initially migrated in a westerly direction along the relatively snowfree foothills region of the north flank of the Wernecke Mountains. Caribou inhabiting the Snake River valley migrated north to the Knorr Range foothills before shifting westward, while caribou inhabiting portions of the Knorr Range and Bonnet Plume River valley tended to migrate southwesterly through mountain passes towards the Wind River valley. At this time, many caribou traverse the Aberford properties from Slats Pass north to middle Illtyd Creek. Wind River caribou appear to migrate directly south based on radio-collar movements and penetrate deepest into the summer range.

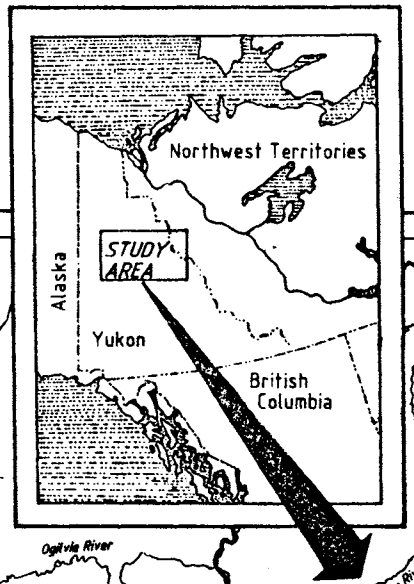
Hart River caribou were found to move directly south from the Hart River Basin and Rae Creek winter ranges to calving sites within the north-south drainages of the Upper Klondike River, (Figure 7).

Table 5. Percent relative frequency of discerned fragments from fecal samples collected.

	Kiwi Lake March 1981	Kiwi Lake April 1981	(alpine) March 1982	Lower Illtyd Creek March 1982	Arctic Red River March 1982
Algae	-	0.76	-	-	-
Moss	10.45	17.43	3.61	1.34	6.71
Lichen	76.21	70.35	81.12	88.52	74.71
Cladonia-type	50.36	50.85	36.32	43.64	42.90
Cetraria-type	10.55	10.52	22.39	10.84	8.87
Stereocaulon	15.3	7.46	8.29	9.29	4.62
Peltigera	-	1.52	14.12	24.75	18.32
Graminoid-like	1.97	4.58	4.33	2.03	5.86
Equisetum	0.66	-	-	-	5.86
Grass-Sedge	1.31	4.58	4.33	2.03	4.58
Herbs	0.66	-	-	0.67	0.64
Lupinus	0.66	-	-	-	-
Saxifraga	-	-	-	0.67	-
Astragalus	-	-	-	-	0.64
Deciduous Shrubs	3.33	3.06	3.65	1.35	8.14
Salix	3.33	3.06	3.65	1.35	8.14
Evergreen Shrubs	7.38	3.82	7.29	6.09	3.94
Picea	0.66	-	-	2.71	-
Dryas	1.31	0.76	-	-	3.94
Ledum	-	0.76	2.17	1.35	-
Cassiope	-	-	0.72	-	-
Vaccinium	5.41	2.30	4.40	2.03	-

Fig. 7: Spring Migration Routes 1980-1982

Hart River Herd
Bonnet Plume Herd



No sign of caribou or radio-collared individuals were noted to move north across the Peel River or Bonnet Plume Basin during this study. During years of winter overlap (1979-80 Hart River, 1980-81 Hart River, 1981-82 Hart River and Bonnet Plume) between the Porcupine herd and the two woodland caribou herds herds. Spring radio-collar movements indicated distinct segregation and subsequent movement towards respective calving areas for individuals from each herd.

During late March and April, Bonnet Plume caribou were found utilizing alpine and windswept tundra habitats to a large degree. Hart River caribou were still found in sparse spruce forest habitats to just prior to calving.

Large concentrations of caribou tend to form during migration. Band sizes of more than 300 caribou, composed of mostly adult females were often observed from the Bonnet Plume herd. In contrast, Hart River herd band sizes rarely exceeded 30 animals.

Calving Grounds

All radio-collared cows located during calving surveys in the study area and on the calving grounds of the Porcupine caribou herd calved in the Western Ogilvie-Wernecke Mountains. As well, for Porcupine caribou transmitters were not located within the study area other than fall, winter or spring.

Survey efforts in the study area during calving, May 1980, were severely limited by poor weather conditions and, few animals were relocated. The 1981 surveys were most successful (Pages 29-30) while in 1982 poor weather limited relocations to 12 individuals.

Table 6. Calving Relocation Data, May 1981.

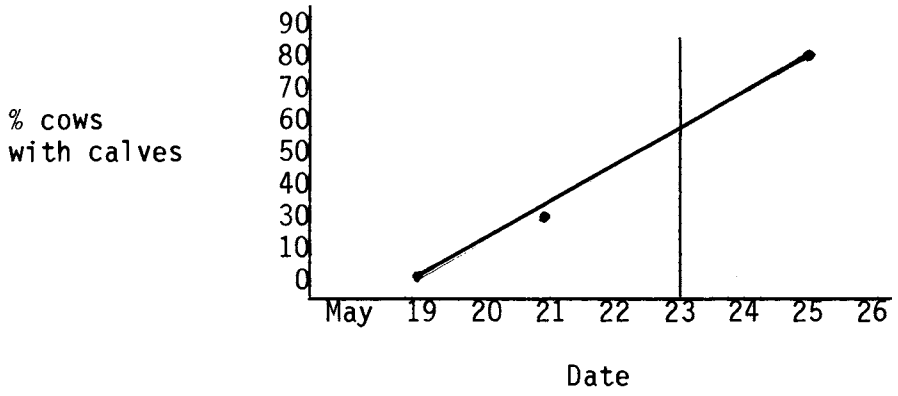
COLLAR	STATUS AT LAST FIX	LATEST CALF DATE	HABITAT SELECTION	REMARKS
E-57	mortality	---	alluvial valley bottom	suspected cast collar or mortality
E-59	unknown	---		general relocation only once; could not relocate on subsequent flights
E-66	calf	May 26	subalpine shrub	very difficult to visually relocate
E-69	no calf	---	alpine basins	relocated 4 times, no calf as of May 26 when 3 cows and 1 calf associated
G-03	calf	May 19	talus alpine	first calf observed
G-09	probable	---	steep alpine	by herself in steep alpine appeared ready to calve
G-15	probable	May 24	alpine cirque	at last fix animal lying down and never got up. Probably in labour.
G-35	no calf	---	alpine basin	located 3 times associated with up to 15 noncalving females and young bulls
H-54	probable	---	subalpine shrub	could not get visual relocation in calving type terrain associated with 2 cow, 1 calf on May 21.
H-60	unknown	---	subalpine	could not locate general fix
H-96	probable	---	subalpine shrub	could not get visual relocation in calving type terrain.
J-60	unknown	N/A	alpine	general relocation with fixed wing and could not relocate.
J-61	calf	May 26	alpine	3 cows associated
J-62	probable	---	steep alpine	could not find on May 26. In cirque valley with 3 cows, 2 calves, 1 yearling, probably calved.

Table 6 contd.

COLLAR	STATUS AT LAST FIX	LATEST CALF DATE	HABITAT SELECTION	REMARKS
J-63	calf	May 26	steep alpine side valley	alone with calf
J-64	calf	May 24	talus alpine	in same side valley as J-76; one collared cow and 1 calf seen.
J-65	calf	May 21	talus alpine	1 cow and 1 calf associated
J-70	calf	May 24	alpine ridge	with 2 cows and 2 calves; 2 grizzlies in vicinity
J-71	calf	May 21	talus alpine	1 cow associated
J-76	probable	---	talus alpine	see comments under J-64

Terrain chosen by calving caribou was extremely rugged and difficult to survey. Normally several passes through a small confined side valley were necessary to spot the collared animals. Invariably if the cow was observed after numerous passes, she was accompanied by a calf. During the 1981 surveys, 19 collared cows were relocated of which 10 were observed with calves, 3 were relocated at high elevation on May 20 and not relocated again, 2 either lost collars or were mortalities, 3 could not be seen after repeated passes in side valleys and were assumed to have calved in that locality, 1 collared cow appeared to be in labour and no attempt was made to return and confirm birth and the remaining collared cow was observed alone in calving type terrain and appeared to be ready to calve (Page 29).

The timing of calving from confirmed sightings between May 19 to May 26 indicated that a peak of calving (that date when 50% of calves are born) occurred about May 23.



During the 1982 surveys, inclement weather precluded visual relocations on 12 radio-collared caribou. The primary objective of the survey was to determine whether individual caribou returned to same calving areas as in 1981.

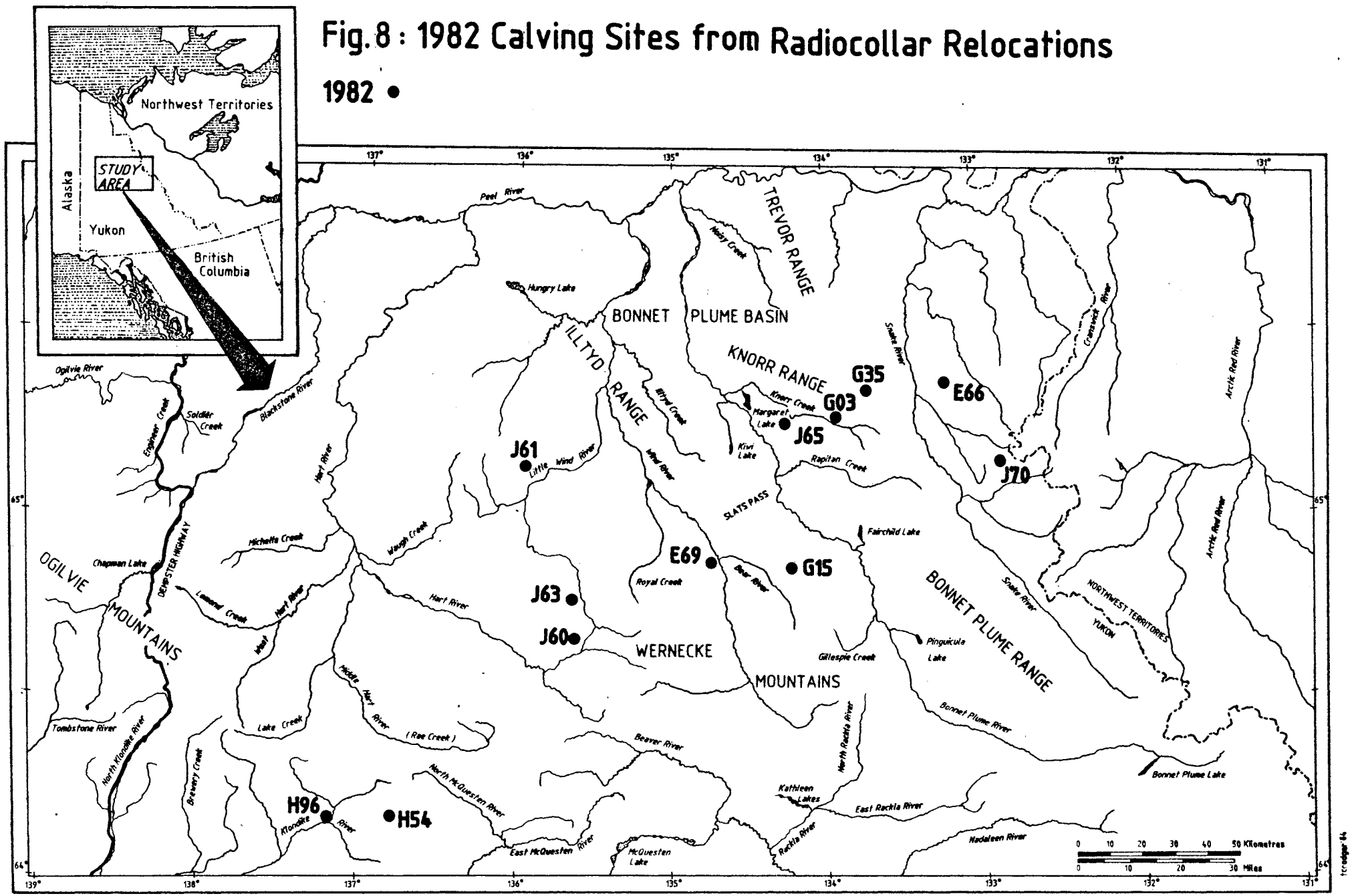
Of the 12 relocations, 6 individuals were relocated in almost exactly the same areas as found in 1981 (Figure 8). Of the remaining 6, 2 were mortalities or shed collars, 2 were in same general areas but exact comparisons were not possible because 1981 locations were not certain or cows did not produce calves in 1981, and 2 were relocated in different locations than 1981 calving sites (1 was 30 miles off and 1 was 72 miles off). These two instances could easily be explained as non-calving cows given a pregnancy rate of between 83-85%, or as cows calving in different sites than in 1981.

Caribou invariably chose very steep confined side valleys and cirque basins for calving. These terrain types were utilized throughout the study area and although local areas of concentration were noted, it does not appear that herds have a well defined calving ground commonly found in barren ground caribou. In fact, 5 of the spring 1981 collared caribou calved in areas outside of known summer range (J63, J61, J64, J60, J76) which necessitated the expansion of subsequent surveys.

Alpine vegetation was present on all but three calving sites (these were subalpine shrub). A stop at one of these sites revealed that plant phenology was very early with Saxifragia oppositifolia, Anemone parviflora and Arctostsphylos alpina flowering. Buds had not even swelled on most of the shrub species.

Fig. 8 : 1982 Calving Sites from Radiocollar Relocations

1982 •



Summer Distribution and Movement Trends

Bonnet Plume herd radio-collar relocations found a distinct southwestern movement trend from calving sites to post-calving summer distribution (Figure 9). Few relocations were made on Hart River caribou and therefore it was not possible to define movement trends. The July 1981 relocations of many radio collars (N=17) defined the outer extent of summer distribution.

An interesting finding from these surveys was the location of J-63, in the extreme headwaters of "Rae Creek", July 1981. This individual was within the periphery of what was previously thought to be the Hart River herd home range and in fairly close proximity to a Hart River radio-collared individual, H-60. 30 km distant. Subsequent relocation of J-63 found her in the "Slats Pass" area during October 1981. Therefore, suggesting that the Hart River and the Bonnet Plume herds may share summer range to limited extent yet maintain their distinct home range loyalty.

The extent of fixed wing surveys flown in July 1980 were not adequate to successfully obtain a minimum population count of either Hart River or Bonnet Plume herds. A core concentration area for the Hart River herd was found in the exact same locality as that found by Larsen (1978) (Figure 10). Eighty percent of the caribou Larsen counted were in the headwaters of Lake Creek and West Hart River. Concentrations of Bonnet Plume caribou occurred in Knorr Creek and Rapitan Creek. During July 81, the occurrence of 3 radio-collared individuals (J-70, G-15, J-71) in upper Gillespie Creek suggests that a summer concentration may have formed there also (Figure 9, Page 35). The July 1980 surveys found no caribou in the Illtyd Range, Upper Illtyd Creek, and Kiwi Lake area.

Fig. 9 : 1981-1982 Summer Movement Trends

Calving 1981 ●
Calving 1982 ▲

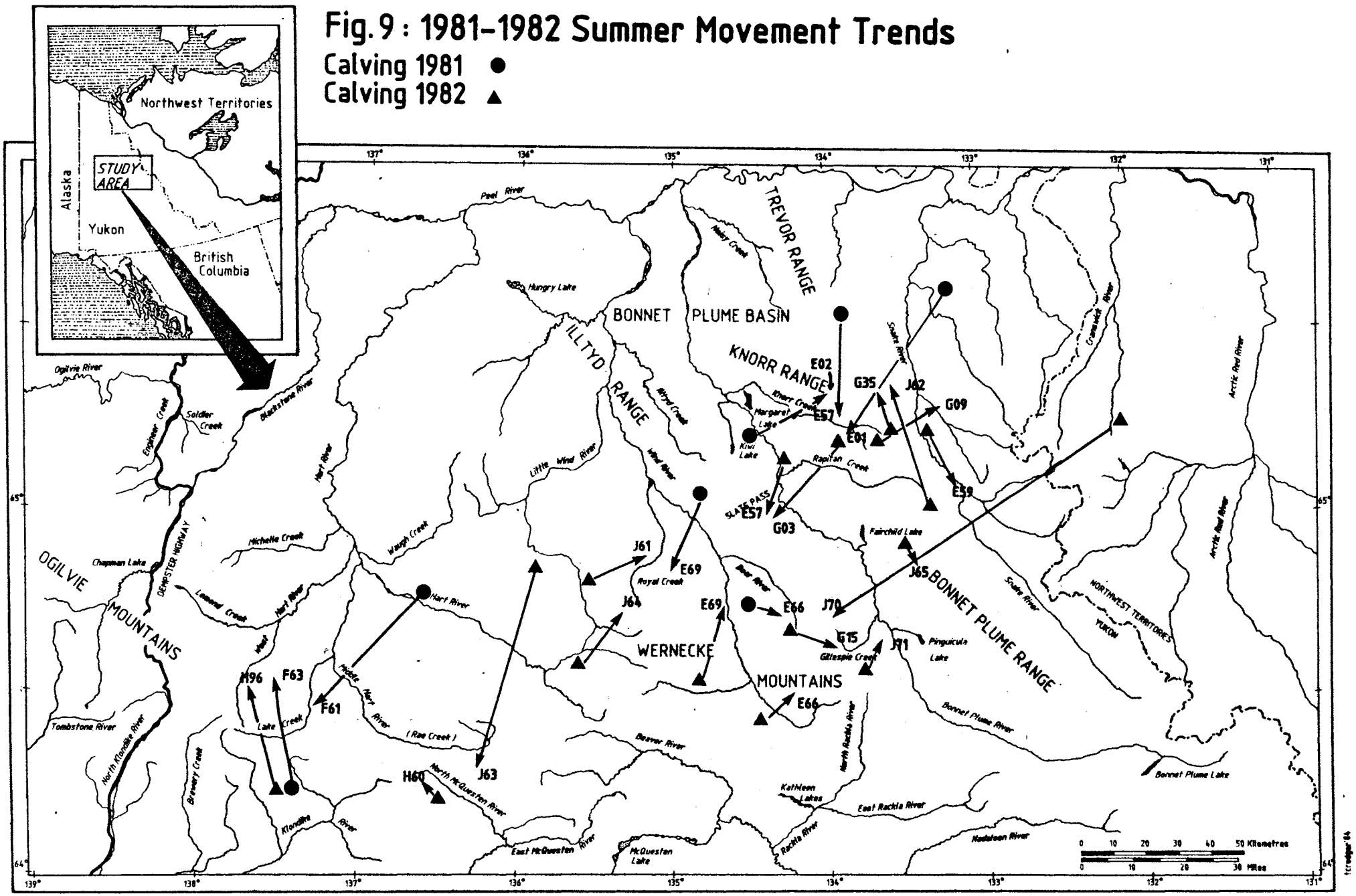
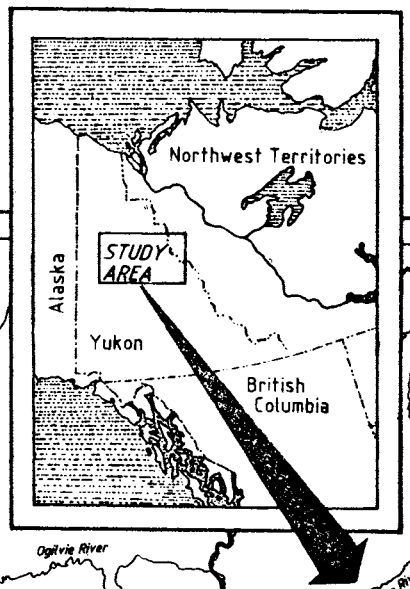


Fig. 10: Results from Fixed Wing Surveys Flown July 14 to 18,1980.

C-Caribou
S- Sheep
M-Moose

G-Grizzly Bear
T-Talus Trails
TS- Snow Trails

*L-Lick
∫- Apparent Centres of Habitation



Fall Migration Movements

Analysis of September 1980 and October 1981 radio-collar relocations (Figure 11, Page 38), and snowtrail alignments observed October 1981 indicate a definite fall migration movement in a northeasterly direction from summer pastures to winter range for the Bonnet Plume herd. Hart River caribou moved straight north out of mountainous habitats to lowland spruce forests in Hart River Basin. The Hart River herd exhibited more localized movements than the Bonnet Plume herd, possibly a product of a lower population size.

Population Size and Composition

We counted 737 caribou in July 1980, 490 from the Hart River herd and 247 from the Bonnet Plume herd. The mean group size for both herds was 36.9, ranging from 2 to 131 caribou, (Page 39) (Figure 10, Page 36).

Hart River Herd

The best estimate available for the population size of the Hart River herd comes from incidental counts made during sheep surveys conducted over most of Hart River herd summer range (Larsen 1978). Then an actual count of 977 caribou yielded a summer population estimate without calculation of 1,200 caribou (pers. comm. D. Larsen). These counts were done in July when it is assumed that no Porcupine herd caribou were inhabiting the home range of the Hart River herd. Unfortunately, sex and age segregations are not adequate in this count for an analysis of productivity or population structure. The key life cycle period for large samples in composition counts selected for this study was late winter. Due to bias created by the overlapping influence of the Porcupine herd with that of the Hart River herd for both winters of the study, no counts were made.

Fig. 11 : 1980–1981 Fall Migration Movements

July 1980 Relocation ●

July 1981 Relocation ▲

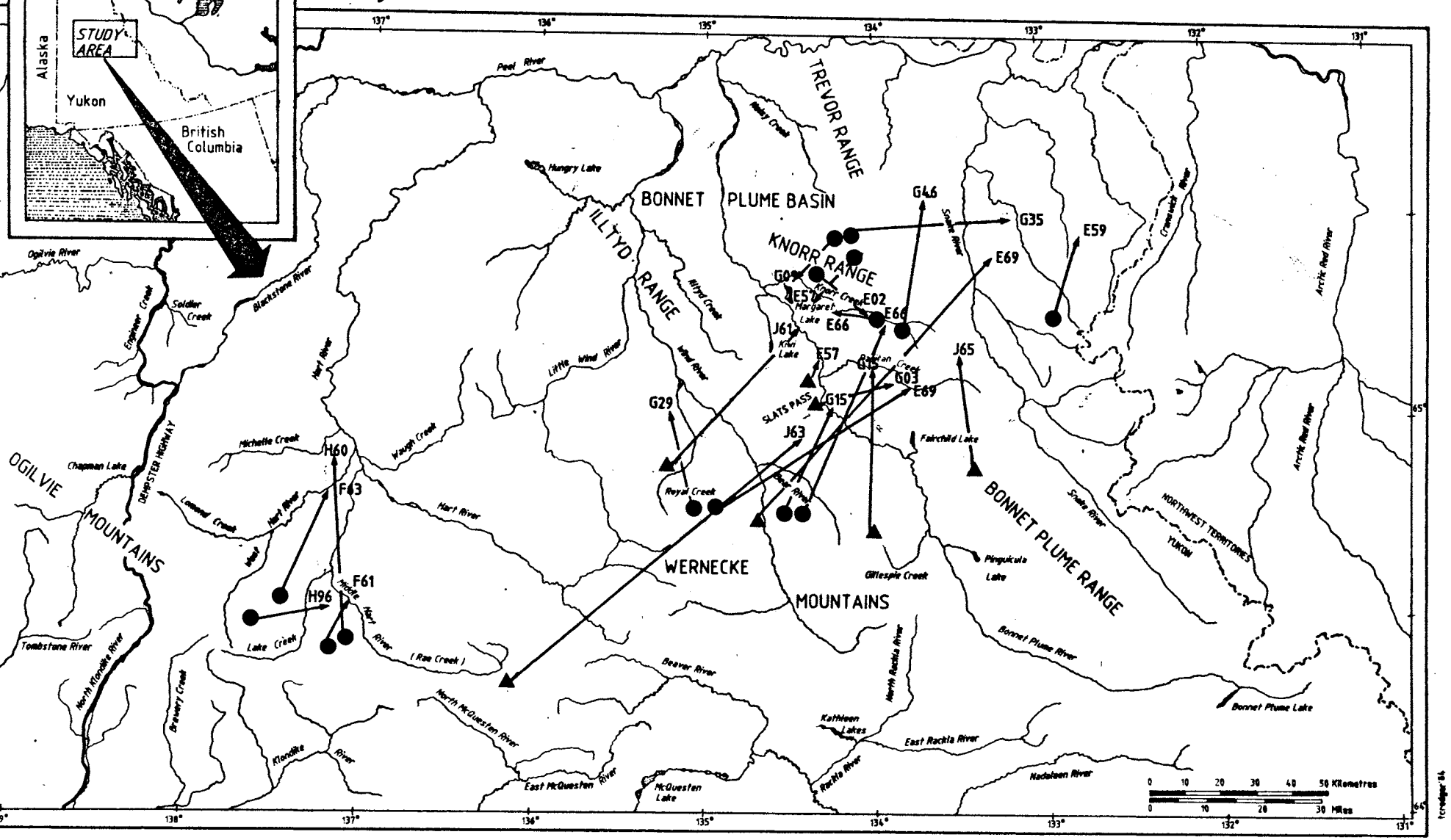


Table 7. Summary of caribou observed during fixed wing flights, July 1980.

Location Point	Location	(from air) Estimated	Actual* Count	Radiocollar Present
Hart River				
1	Brewery Ck.	4	4	--
2	Brewery Ck.	40	41	--
3	W. Hart River	12	12	--
4	W. Hart River	45	95	--
5	W. Hart River	4	4	--
6	W. Hart River	100	131	F-63
7	W. Hart River	35	84	--
8	W. Hart River	45	56	--
9	Klondike River	5	5	--
10	Lake Creek	50	58	F-61
		SUBTOTAL	490	
Bonnet Plume				
11	Royal Ck.	40	77	E-69
12	Wind River	25	48	E-66
13	Knorr Range	4	4	E-57
14	Knorr Range	28	28	E-01
15	Knorr Range	2	2	E-02
16	Knorr Range	50	50	
17	Rapitan Ck.	2	2	
18	Snake River	6	6	
19	Snake River	5	5	
20	Snake River	25	25	E-59
		SUBTOTAL	247	
		TOTAL	737	

Bonnet Plume Herd

During April 1981 and 1982 composition counts on the Bonnet Plume herd yielded large sample sizes taken across the known distribution of the herd, excluding any suspected influence from Porcupine herd caribou, Table 8.

Table 8. Late winter composition of the Bonnet Plume herd, April 1981 and 1982.

	COW	CALF	YEARLING	IM. BULL		MAT. BULL	TOTAL
1981 TOTAL	373	176	86	70		87	792
%	47.2	22.2	10.9	8.8	19.8	11.0	
/100 COWS		47.1	23.1		42.1		
						Unclassified	104
						Total Observed	896
1982 TOTAL	497	269	62	153		93	1074
%	46.3	25.0	5.8	14.2	22.9	8.7	
/100 COWS		54.1	12.5		49.5		
Unclassified	0						
Total Observed	1074						

Our impression of these counts suggest that the yearling cohort was poorly represented due to difficulties in segregating them from adult cows at this time of year. We therefore suspect that many yearlings were counted as adult cows, and interpretation indicates that the cow/calf ratio is conservative. Bulls appear well represented despite their tendency to segregate into isolated uniform bands. The bands are easily missed and typically are poorly represented in late winter counts. One would expect a relatively high bull/cow ratio (60-70 males/100 females)in an undisturbed very lightly exploited

population such as the Bonnet Plume herd (Skoog 1968, Kelsall 1968). The relatively high percent of calves in the population indicates that positive recruitment is likely taking place (Bergerud 1980) and that the Bonnet Plume Herd is most definitely stable and probably increasing.

The relative abundance of Bonnet Plume herd caribou based on the extent of snow tracking sign and the ease with which we could locate bands indicated that we were probably only counting one-fifth of the caribou in this area. Our guesstimate is that the population size of the Bonnet Plume herd may range somewhere in the neighborhood of 5,000 caribou. Future more imperical attempts at determining population size may bear this out. Our impression during this work, however, was that the Bonnet Plume herd is one of the largest woodland caribou population to range wholly or in part of the Yukon.

Harvest

There are five outfitting areas in the confines of the home ranges for the Hart River and Bonnet Plume herds. Based on the location and timing of the kill from annual guide returns beginning in 1960, and assuming that caribou taken prior to mid-October are not Porcupine herd animals, then caribou taken in guide areas 2 and 3 likely from the Hart River herd, and those taken in areas 4,5 and 6 are from the Bonnet Plume herd. A breakdown of the non-resident harvest ascribed to each herd is given in Table 9. Based on a hunter questionnaire sample generated from 1978 through 1981, the mean annual resident harvest for the Hart River herd is 12 caribou, and for the Bonnet Plume herd, one caribou. Native harvest on both herds is extremely light or non-existent. No data is available for Bonnet Plume herd harvest in the N.W.T. Our impression is however that non-resident hunter guiding activity in the area may provide for very light harvest.

Table 9. Non-resident hunter harvest of Hart River and Bonnet Plume Caribou - by outfitting areas

	Hart River			Bonnet Plume			
Year	2	3	Total	5	4	6	Total
1960	-	-	-	21	-	-	21
1961	0	1	1	7	-	12	19
1962	0	3	3	10	-	10	20
1963	2	5	7	5	-	9	14
1964	3	8	11	13	-	3	16
1965	4	0	4	6	-	17	23
1966	10	0	10	6	-	10	16
1967	4	0	4	4	-	12	16
1968	5	0	5	7	-	0	7
1969	3	0	3	10	-	4	14
1970	4	0	4	12	-	12	24
1971	0	6	6	4	4	15	23
1972	0	4	4	10	4	0	14
1973	0	9	9	11	6	0	17
1974	0	11	11	7	3	0	10
1975	2	1	3	0	0	0	0
1976	0	1	1	8	5	0	13
1977	0	1	1	9	4	0	13
1978	5	1	6	9	3	0	12
1979	2	3	5	5	8	17	30
1980	2	2	4	9	6	8	23
1981	1	2	3	7	14	2	23
1982	no data available to date						
Total			105				368

DISCUSSION

Home Range Use

The sum of radio-collar relocations made during this study (Figure 12), depicts two quite distinct "centers of habitation". The consistency with which these areas were exclusively utilized by radio-collared caribou from each population, with what appears to be a slight extent of overlap, indicates that two discrete woodland caribou herds Rangifer tarandus caribou exist in the study area - the larger Bonnet Plume herd to the east (Range 31,000 sq. km, Density .16 per sq. km) and the smaller Hart River herd to the west (Range 13,000 sq. km, Density .09 per sq. km). Range overlap between these two herds likely occurs only in summer, winter ranges being relatively isolated. Winter range overlap, however, did occur for both herds with the much larger Porcupine herd. A number of findings from this study indicate that the Hart River and Bonnet Plume herds are not satellite herds of the Porcupine population.

Previous researchers have surveyed caribou winter distribution in the study area (Pages 45-46) attributing caribou and sign as portions of the Porcupine caribou winter range. The abundance of caribou observed has varied from an estimated 20,000 to a "few". During the winters of 1970-71, 1971-72 and possibly 1973-74, Porcupine caribou apparently did winter in large numbers in the Knorr and Trevor Range. Concentrations were observed migrating north into the Richardson Mountains (Renewable Resources, 1974). However, the observed presence of caribou wintering in the eastern portion of the study area during subsequent years may have been misinterpreted. Although we observed similar concentrations as reported in the literature (with the exception of the 3 years in the early 1970's) we did not document movement north out of the study area from any of the consistently used winter ranges. As reported previously the

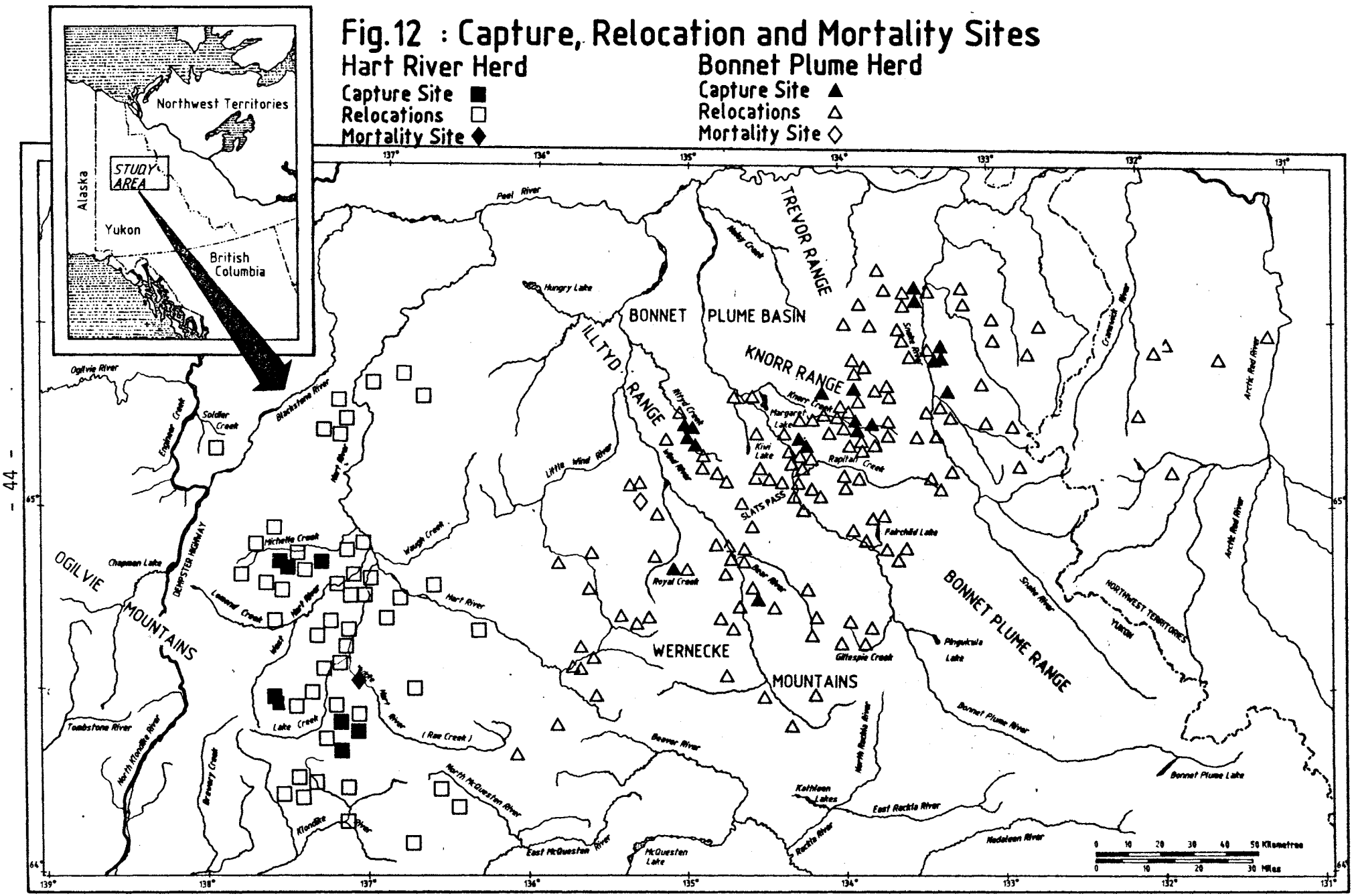


Fig.12 : Capture, Relocation and Mortality Sites
Hart River Herd
Capture Site
Relocations
Mortality Site
Bonnet Plume Herd
Capture Site
Relocations
Mortality Site
Northwest Territories
Alaska
STUDY AREA
Yukon
British Columbia
BONNET PLUME BASIN
TREVOR RANGE
KNORR RANGE
ILLTYD RANGE
WERNECKE MOUNTAINS
OGILVIE MOUNTAINS
BONNET PLUME RANGE
SLATS PASS
DEMPSTER HIGHWAY
Peel River
Hungry Lake
Ogilvie River
Blackstone River
Soldier Creek
Engineer Creek
Chapman Lake
Michelle Creek
Hart River
Lamont Creek
Wind River
Little Wind River
Rapitan Creek
Kiwi Lake
Margaret Lake
Fairchild Lake
Royal Creek
Bear River
Gillespie Creek
Pinguicula Lake
Snake River
Arctic Red River
Crawford River
Blackstone River
Toobstone River
North Klondike River
Brewery Creek
Klondike River
Lake Creek
Raw Creek
North McQuesten River
East McQuesten River
McQuesten Lake
Beaver River
North Rockie River
Kathleen Lakes
East Rockie River
Rockie River
Nadaleen River
Bonnet Plume River
Bonnet Plume Lake
NORTHWEST TERRITORIES
YUKON
0 10 20 30 40 50 Kilometres
0 10 20 30 Miles
137° 136° 135° 134° 133° 132° 131°
139° 138° 137° 136° 135° 134° 133° 132° 131°
65° 64°

TABLE 10. Winter Caribou Use in the Bonnet Plume Basin and Adjacent Areas.

Year	Area	Comments	Source
1970-71	Blackstone-Snake Rivers	15,000	Jackemchuk et al 1974
		many thousands	Calef & Lortie 1971
	Knorr Range	ca. 10,000+	RRCS unpublished notes
		10-20,000	Calef & Lortie 1971
	Trevor Range	10-20,000	Calef & Lortie 1971
1971-72	Knorr Range	"Few"	RRCS unpublished notes
		"Wintering"	Calef & Lortie 1973
	Trevor Range	ca. 3-4,000	McCourt et al 1974
		ca. 10,000	Calef & Lortie 1973
	Noisy Creek	ca. 1,000+	McCourt et al 1974
1972-73	Snake-Bonnet Plume	"Few"	Surrendi & DeBock 1976
	Hungry-Palmer Lake	2,000	Doll et al 1974
1974-75	Hungry Lk-Wind to Snake Rivers	many trails crossing Peel R. into this region by late Nov. 1974	Dennington Person. comm. In Roseneau et al 1974
	Knorr-Trevor	Occasional scattered sign in the Knorr-Trevor Range	Dennington (pers. comm.)
1975-76	Knorr & Trevor Ranges Noisy Ck. & Lower Bonnet Plume Drainage	scattered caribou & sign but no large concentrations.	Dennington (pers. comm.)
	Hungry Lakes-Wind River	Scattered small groups	Dennington & Mossop (pers. comm.)
1976-77	Upper Peel/Hart River east through Snake River drainage & NW flanks of Mackenzie Mtns.	vast majority of herd	B. Horejsi (pers. comm.)
1977-78	Hungry Lk. area	140	J. Russell et al 1978
	Lower Wind River	500-1,000	J. Russell et al 1978
	Lower Snake River	500-1,000	J. Russell et al 1978
	Upper Snake River	100 - 200	J. Russell et al 1978
1978-79	Lower Wind River	moderate sign	R. Farnell winter surveys
1979-80	Bear River-Wind River	heavy sign	present study
	Upper Snake River	heavy sign	present study
	Lower Snake River	heavy sign	present study
	Lower Wind & Bonnet Plume	sparse sign	present study
1980-81	Wind-Bear River	heavy sign	present study
	Snake River	heavy sign	present study
	Bonnet Plume Basin	sparse sign	present study
	Illtyd Creek	heavy sign	present study

(cont'd)

Year	Area	Comments	Source
1980-81	Arctic Red River	heavy sign	present study
	Knorr Range	heavy sign	present study
1981-82	Wind-Bear River	heavy sign	present study
	Bonnet Plume Basin	heavy sign	present study
	Illtyd Creek	sparse sign	present study
	Bonnet Plume River	heavy sign	present study
	Snake River	heavy sign	present study
	Arctic Red River	heavy sign	present study

* Table borrowed from Thompson and Roseneau (1978, and added to.

only Porcupine caribou wintering in the range of the Bonnet Plume herd during our study were those wintering in the Little Wind River and Bonnet Plume Basin area in 1981-82 (Figure 5, Page 21), an area seldom utilized by either the Hart River or Bonnet Plume animals. The Bonnet Plume herd did not occupy the Trevor Range during the 5 winters of aerial surveys by the authors.

Porcupine caribou winter range overlap with the Hart River animals, however, appears to be a more common phenomenon (Table 11). Since 1970-71, Porcupine caribou have occupied Hart River caribou winter range in six of eleven years. During the present study the winter range use by the Hart River herd in 1980-81 appeared greatly influenced by the "swamping effect of the Porcupine caribou herd, resulting in animals wintering much further north then they may normally have done (F-63, Figure 3, Page 17). Some evidence suggests that Hart River animals may even have wintered within the same band as Porcupine caribou. Relocations indicated that Hart River caribou were in bands of 100+ animals in a general locality in which several thousand caribou were wintering, including radio collared Porcupine caribou. Of herds of similar size (1000-2500) elsewhere in the Yukon, Farnell (unpublished observations) recorded a mean band size of 10.8 animals (range 2 to 39) at this time of year. In contrast, mean group sizes during winter for the Porcupine herd are 48.7 ranging from 3 to 400 (Renewable Resources 1972). We consider it unlikely that a herd the size of the Hart River herd (1200) would form such large bands. During spring no evidence was found of interchange of animals between the Hart River herd and the Porcupine herd. Collared animals from both herds occupying the same basin occurred in a sorted disposition during late winter.

Skoog (1968, Pg. 215) noted a similar phenomenon:

> "Mixing between herds at other seasons (primarily winter) occurs from time to time, and has been reported by wildlife biologists in both Alaska and Canada. Such intermingling is not considered contradictory to my definition (of herd), for invariably the herds separate and return in the ancestral calving grounds each spring".

Table 11. Caribou sign in Hart Basin.

Year	Location	Observer
1970-71	Blackstone-Snake, approx. 15,000	Jakimchuk et al 1974
1971-72	Ogilvie-Peel, 40-60,000	McCourt et al 1974
1972-73	---	
1973-74	Hart-Snake, 20,000	Dall et al 1974
1974-75	Blackstone-Hart, light sign	Dennington, pers. comm.
1975-76	Scattered sign but no concentrations	Dennington, pers. comm.
1976-77	Upper Peel-Hart-Snake-majority of herd	B. Horesjei, pers. comm.
1977-78	40-50,000 Porcupine Caribou in area	J. Russell, pers. comm.
1978-79	No Porcupine Caribou in area	This study
1979-80	Very few Porcupine caribou in Hart Basin	This study
1980-81	40,000 Porcupine caribou in Hart Basin	This study
1981-82	Few thousand Porcupine Caribou in Hart Basin	This study

Gauthier et al (1983), while detecting regional movements of radio-collared individuals from the Burwash Caribou herd, could find no evidence of ingress or egress with adjoining herds. From our observations during the deep snow year of 1981-82 the use of winter range is greatly dependent upon distribution of snow within each home range and although traditional areas are consistently utilized by a herd (e.g. the Hart River Basin for the Hart River herd and the Bear River to the upper Snake River for the Bonnet Plume herd).

Radio-collared caribou reloctaions from both herds where data was obtained over two or more winters (N=11), indicate little evidence to suggest individual loyality to a particular winter range. Winter range relocations from two consecutive years on four Hart River animals indicated only one (H-54) at or near the area utilized the previous years. In the Bonnet Plume herd only three of seven collared cows wintered in similar areas between years. The fairly random nature with which radio-collared caribou were found to be inhabiting specific winter ranges from year to year is consistent with 5 years of radio-collaring data collected on the Porcupine Caribou herd (Russell-Farnell in prep.), findings from studies of Alaska's Western Arctic herd, Davis et al (1982), and with the Burwash Caribou herd ranging in Southwest Yukon (Gauthier et al, 1983).

Calving grounds, as conventionally described did not exist for woodland caribou populations in our study. It is an effective strategy against predators for large herds to have highly synchronized calving in a small well defined area (commonly known as "prey swamping"). However, we suggest this is not an effective strategy for smaller woodland caribou herds. Predator avoidance for these herds is likely best accomplished by cryptic behavior and by choosing calving sites in steep rugged terrain. This was the strategy adopted by parturient cows in the study area.

Skoog (1968) and others have taken advantage of the "homing instinct" of cows exhibiting a strong tendency each spring to return to the same calving area. This traditional use of calving area has been used to define herds (Kelsall, 1968) or "subpopulations" (Skoog 1968). Our results also indicate that the

homing instinct is strong in woodland caribou, as evidenced by the consistent use of unique calving sites for individual cows. Other researchers also noted similar behavior in woodland caribou. Shoesmith (1977) reported a cow calving on a small island for 3 consecutive years. However, since calving sites are scattered throughout the entire home range of the herd, they are not particularly useful in defining a population. One must observe the movements of individual animals throughout their life cycles to confidently define a population or herd of woodland caribou.

The data collected indicates the timing of calving is as synchronized as the Porcupine herd (the majority calving within a week), however the peak of calving is earlier than the Porcupine herd by 12-14 days. The timing of calving agrees favourably with the Forty-Mile herd (Davis, Shidleu, Le Resche, 1978), the Squanga herd (Larsen, pers. comm.), the Burwash herd (Gauthier, 1984) and the Redstone herd (Hayes, pers. comm.), which are all woodland caribou populations. This factor would serve to select against woodland caribou migrating with barren ground caribou as calves would be born during migration and survivorship would lilkely be poor.

With few exceptions summer ranges utilized by individual caribou in the Bonnet Plume herd are close to calving sites. In the Hart River herd, however, movements to summer range was usually a distinct northerly movement from calving sites in subalpine shrub terrain in the headwaters of the Klondike drainage to lush alpine ranges in the headwaters of the West Hart River. It is possible that suitable calving habitat does not exist near the best summer ranges. Certainly typical summer habitat is not found near the general calving area of the Hart River animals.

Management Considerations

One of the major givens in caribou management is that management programs can be applied on a herd by herd basis and that the major losses or gains to a herd can be accounted for by births and deaths. The present study offers data to reject two instances that would conflict with this assumption.

a. that population trends in smaller satellite herds could be largely influenced by interchanges with larger migratory herds.

b. that woodland caribou herds are not discrete and actively interchange individuals.

Our data indicates that strong home range loyalties exist for these smaller satellite herds. We have observed unique home range use patterns, a strong loyalty to specific calving sites on a individual basis, and an apparent ability to maintain home range movements and integrity even when "swamped" by tremendous numbers of migratory caribou during winter. These findings serve to define these herds as discrete populations of woodland caribou.

Our data also indicates that, for management purposes, no interchanges between mountain caribou herds need to be considered. The key to this assertion and the reason possible conflicting evidence exists in the literature is in the definition of a herd. Skoog (1968) utilized the concept of "centres of habitation", areas which encompassed much of the best range in each region. He observed that the focal point for a herds movement was a definite calving area "where most of the herd's pregnant cows will drop their calves". In fact Skoog's (1968) definition of a herd is that entity that establishes a calving

area distinct from that of any other herd and uses this area repeatedly over a period of years. Although this definition may be adequate for large migratory herds, where movement patterns are gross and easily generalized and where "prey swamping" on a distinct calving ground is an effective antipredator strategy, the definition is not adequate for smaller herds. From our study the calving area for woodland caribou is not well defined. In fact the focal point upon which movements are determined could be argued to be the winter range. Although not as dramatic in this study, data on the Finlayson herd in central Yukon (Farnell, unpublished observations) indicates that the pattern of movements from winter range to calving sites is similar to the spokes of wheels with the winter range as the hub. Individual, radio-collared animals can be found anywhere across the distribution of the winter range between any given year. Significant winter range overlaps can occur with large migratory caribou herds but not, according to our data with adjacent woodland caribou herds. In Yukon, as in B. C. (Bergerud, 1978), these winter ranges are normally found in rain shadows on the northern flank of major mountain systems. Alpine summer ranges are dictated for the most part, by the location of calving sites and rutting areas are normally (depending on the juxtaposition of adequate terrain) lcoated between summer and winter ranges. Thus even though summer ranges may overlap between adjacent herds, rutting areas although perhaps distinct, remain unqiue for each herd. Just as any an individual can be located in any portion of the winter range between years, any animal can be located in any of the rutting areas. Thus these herds can be considered, for management purposes, reproductively isolated.

We define a woodland caribou herd as that entity utilizing a unique rutting ground and for the most part a unique winter range. British Columbia used

similar herd definition (Bergerud 1978) however, confining their herd designation to the distribution of rutting "groups". This approach fails to recognize that a herd can utiize more than one rutting area. Usng this designation Hatler (1983) was forced to explain an apparent 10% annual immigration from his study area and therefore concluded that woodland caribou herds in northern B. C. do not remain discrete. A 10% annual turnover in gene pool would make it virtually impossible to manage caribou populations in northern B. C. on a herd basis.

The B. C. approach to herd definiton has led to problems already. Elliott et al (1984) based their experimental design for a wolf control program on the fact that the Level Mountain caribou herd was a discrete entity. However, the Level Mountain herd proved less discrete then first thought and during the study marked animals wintered in the suspected winter range of Kawdy-Jennings herd which, according to our definition indicates that the two herds are in fact one herd utilizing at least two rutting grounds.

The situation in Alaska is also confusing. Davis and Valkenburg (1983) indicates that they confirmed the existence of the Yanert Caribou herd since the animals "exhibited all the characteristics required for herd designation". However in the same report they indicate that "during the rut the degree of mixing between the Yanert and Delta herds is unknown". Unique rutting grounds and reproductive isolation do not appear to be a criteria for herd designation. Intensive radio-telemetry studies on Alaska's Western Arctic herd (Davis et al 1982, Davis and Valkenburg 1978) have identified two discrete herds within the greater range of the Western Arctic herd which reside the year

round within a non-migratory range use pattern, (Teshekpak herd, est. 3-4,000, 1980), (Central Arctic herd, est. 9,000, 1981), and two discrete herds, periferal, that do not overlap in distribution, (Andreafsky Herd, and Ray Mountain herd, est. 200). These herds exhibit traits similar to the barren ground caribou in that each population shares its own common calving ground. They are similar to woodland caribou in that they exhibit unique semi-migratory home range use patterns. Further studies of these populations may find them to be ecologically distinct types of caribou.

Delineation of a woodland caribou herd's home range should involve radio telemetry techniques. Initially aerial surveys should be conducted during February or March over a broad area which will ecnompass all of the animals from the projects specific study area. Radio-collars should be applied across these late winter distributions. Experience from this study and subsequent work in the Yukon have shown that in late winter woodland caribou winter ranges are isolated and, particularly in deep snow years, herds are most concentrated. using the New Zealand net-gun, we have found that caribou are easily captured in deep snow, fatalities are rare and the undesireable immediate after effects of drugs are eliminated. Subsequent monitoring, in addition to delineating the herds range, enables the researcher to increase his collared sample at times and in areas of his choosing. Monitoring should continue for two late winter periods following capture to adequately ensure that the distribution during the key life cycle periods are identified. When home range boundaries and movement patterns have been identified, radio-collared caribou may facilitate population estimates and composition counts.

Population Status

The mean annual estimated harvest for the Hart River herd is approximately 12 caribou. Resident hunter harvest constitutes 58% of that harvest and is probably due to the access created by the Dempster Highway and adjoining West Hart River mining road, a four-wheel drive road which bisects the home range of the herd. Our impression during this study was that the caribou abundance and distribution was much the same as that found by Larsen (1978). We feel that given the current level of exploitation by hunters the Hart River herd is probably stable at approximately 1,200 caribou.

The mean annual harvest for the Bonnet Plume herd is approximately 18 caribou. non-resident hunter harvest constitutes 95% of this harvest, and is probably due to the remoteness of the herds range where outfitters have relatively exclusive access by horseback. It should be noted that this harvest trend has a very minimal influence on the herd. Non-resident hunters select for trophy quality bulls. Our best guess at the size of the Bonnet Plume herd is approximately 5,000 caribou. Low harvest combined with high recruitment rates (47.1 and 54.0 short yearlings per 100 cows) suggest that this herd is growing.

Results from this study combined with a documented 8% growth rate in Porcupine herd (Whitten, 1984) prompted us to recommend and obtain a two caribou bag limit for GMZ 1 and 2. Due to easy access and the size of the Hart River herd the GMS encompassing the home range of the Hart River herd was ommitted. The bag limits remains one caribou annually. The possibility exists to direct native harvest from more vulnerable woodland caribou herds in the south to the Bonnet Plume herd. This has been discussed with the Ross River Band during the course of the Finlayson herd Management Project.

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Appendix B. Weights and Measures.

Season	Sex	Age	Heart Girth	Total Length	Ear Length	Tail Length	Hindfoot Length	Shoulder Height	Chest Height	Weight (kg)
Wernecke Herd										
spring	female	mature	118	194	13.0	18.0				
spring	female	mature	124	201	13.5	18.0			54	
spring	female	mature	125	205	14.0	14.0				104
spring	female	mature	116	204	13.0	15.0				97
spring	female	mature	117	193	14.0	13.0				108
spring	female	mature	125	212	13.0	15.0	43			127
spring	female	mature	130	201	12.0	13.0	53			118
spring	female	mature	127	214	12.0	14.0	43			
spring	female	mature	132	208	13.0	14.0	47			122
spring	female	immature	127	191	12.0	11.0	54			
summer	female	calf		181	12.0					
spring	male	immature	118	205	14.0	15.0				
fall	male	immature	139	191	16.5	20.3				
fall	male	mature	142	199	13.9	17.7				
fall	male	mature	178	203	12.7	15.2				
Porcupine Herd										
fall	female	mature	132		14.3	17.8	55.9	107	61	110
fall	female	mature	130	201	12.1	20.3	56.5	109	57	100
fall	female	mature		180	12.7	15.2	52.7			84
fall	female	yearling	112	173	12.1		53.3	58	57	74
fall	female	mature	117	183	11.4	17.8	52.1	107	56	99
fall	female	mature	119	186	13.3	17.8	52.7	109	64	86
fall	female	mature	114	173	12.1	16.5	53.3	106	61	86
fall	female	mature	114	173	12.7	15.9	50.8	91	53	85
fall	female	mature	113	175	12.1	12.1	54.6	104	61	82
fall	female	mature	116	169	12.7	14.0	52.1	99	61	81
fall	female	mature	114	153	12.1	12.7	52.1	99	57	76
fall	female	calf	97	147	10.2	14.0	47.0	91	53	50

Weights and Measures Contd.

Season	Sex	Age	Heart Girth	Total Length	Ear Length	Tail Length	Hindfoot Length	Shoulder Height	Chest Height	Weight (kg)
Porcupine Herd										
fall	male	yearling	125	193	13.1	16.5	61.0	112	66	114
fall	male	yearling	125	173	12.1	12.7	55.9	109	61	91
fall	male	yearling	119	196	12.7	19.1	57.2	112	66	104
fall	male	yearling	117	180	13.1	14.0	57.2	109	64	98
fall	male	yearling		180		15.2	48.9	102	56	95
fall	male	yearling	127	183	11.4	14.0	55.9	118	64	110
fall	male	yearling	132	186	13.3	15.2	58.4	104	64	103
fall	male	yearling	125	186	12.7	16.5	53.3	104	56	99
fall	male	yearling	117	184	13.3	14.0	55.9	104	58	94
fall	male	mature	130	210	12.7	21.6	61.0	117	66	150
fall	male	mature	--	198	13.3	21.0	58.4	119	67	139
fall	male	mature	127	194	14.0	16.5	59.7	114	64	139
fall	male	mature	--	206	14.0	17.1	59.7	--	--	128
fall	male	mature	--	203	13.1	17.8	57.2	107	58	127
fall	male	mature	135	193	13.3	16.5	55.9	114	68	126
fall	male	mature	136	196	12.7	15.2	55.9	114	68	126
fall	male	mature	132	196	12.7	19.1	59.7	114	66	123
fall	male	mature	122	197	11.4	17.8	55.9	--	--	121
fall	male	mature	125	187	12.7	15.2	55.9	109	62	115
fall	male	mature	130	183	13.3	15.2	53.3	107	61	113
fall	male	mature	122	186	12.7	17.8	58.4	118	61	108
fall	male	mature	127	185	14.0	17.8	55.9	104	64	108

WEIGHTS AND MEASURES FORM

Collar Number _____

Date: _____ Personnel: _____
(Biologist, Outfitter, Guide, Hunter, etc.)

Specific Location: _____
(Lake Drainage, Mountain, etc.)

Age: _____ Sex: _____ Blood Collected: Yes No
(Immature, Adult) (M or F)

1. Heart Girth: _____ cm
   Circumference immediately behind the front shoulder, around chest from the withers to brisket following body contour.

2. Total Length: _____ cm
   Following body contour from tip of nose to tip of tail at last vertebrae, not tip of hair.

3. Ear Length: _____ cm
   From node at bottom of V to ear tip.

4. Tail Length: _____ cm
   From base of tail where it flexes to tip of the fleshy tail.

5. Hindfoot Length: _____ cm
   From tip of hoof along the extended leg to the hock, posterior (rear) bone protruding at second joint.

6. Shoulder Height: _____ cm
   From tip of hoof along the extended foreleg to top of shoulder dorsal midline or withers.

7. Chest Height: _____ cm
   From tip of hoof along extended foreleg to sternum between forelegs or brisket.

8. Weight: _____ kg
   When possible.

COLLAR TYPE _____

COLLAR COLOR _____

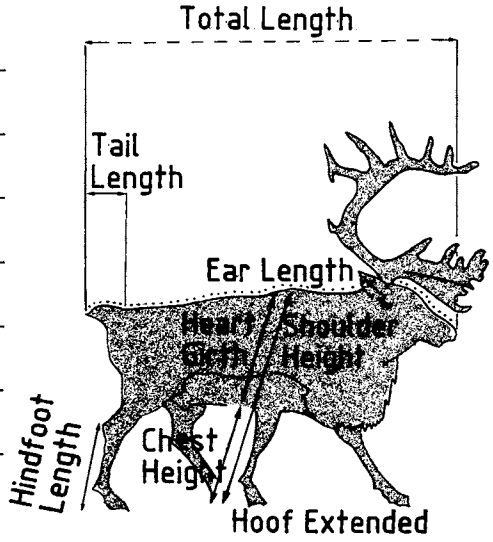
COLLAR NUMBER _____

FREQUENCY _____

PULSE RATE _____

OTHERS MARKED _____

_____



CAPTURE METHOD _____

_____

CAPTURE SITE COORDINATES

_____