Wolf Population Research and Management Studies in the Yukon Territory

1984 Progress Report

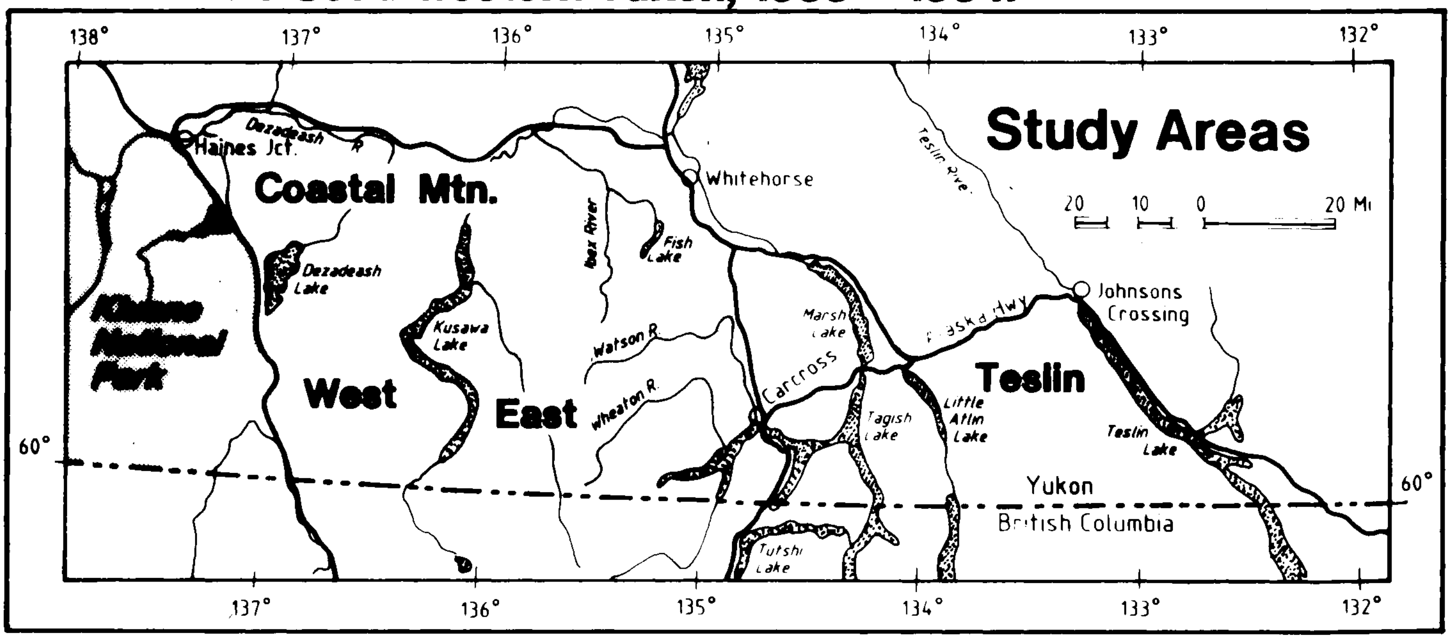
Yukon
Renewable Resources
David Porter - Minister

and document wolf age and sex composition, morphology, physical condition, and radio-cesium levels of removed wolves.

STUDY AREAS

Wolf studies were conducted in two areas of the south-western Yukon; the 11 200 sq km Coastal Mountain (CM) study area and the 2580 sq km Teslin Burn study area (Figure 1).

Fig. 1 : The Coastal Mountain and Teslin Burn Wolf Study Areas in the Southwestern Yukon, 1983 – 1984.



1. COASTAL MOUNTAIN (CM) WOLF STUDY AREA

In 1982-83, wolf studies were initiated in a 7650 sq km area of the southwestern Yukon (Hayes et al. 1985). In 1983-84, the Coastal Mountain (CM) study area was expanded to include all of Game Management Zone 7 (GMZ) (Figure 1). A 1620 sq km area studied in 1982-83 (Game Management Sub-zones 9-01 to 9-05) was deleted from the 1983-84 wolf study area for logistical reasons. The 4890 sq km area of GMZ 7 (CM West) added to the wolf study area is a portion of the Yukon Coastal Mountain ecoregion (Oswald and Senyk 1977). The physiography, vegetation and climate are similar to the CM East study area described by Hayes et al. (1985). The Haines Road forms the western boundary of the study area,

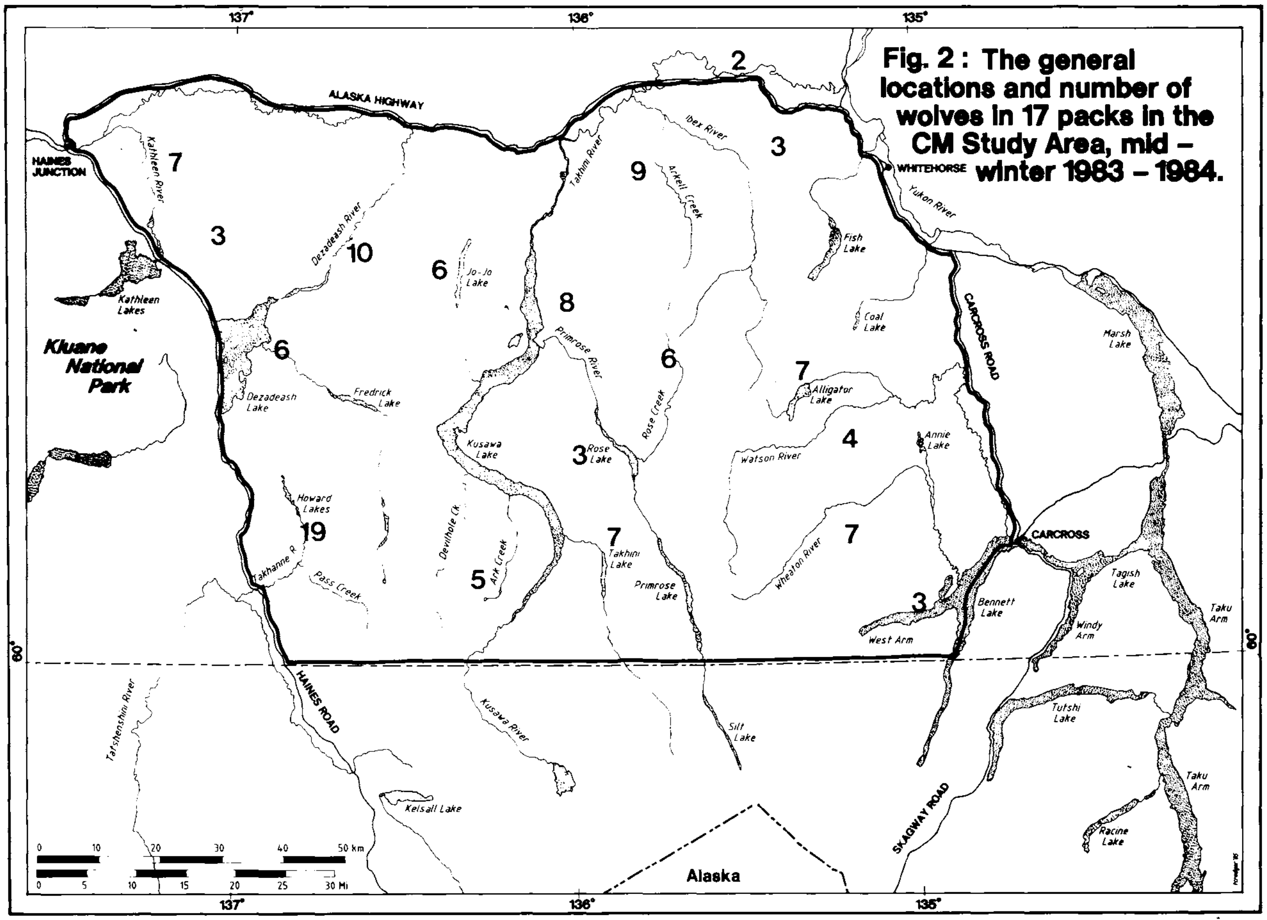


Fig. 2 : The general locations and number of wolves in 17 packs in the CM Study Area, mid – winter 1983 – 1984.

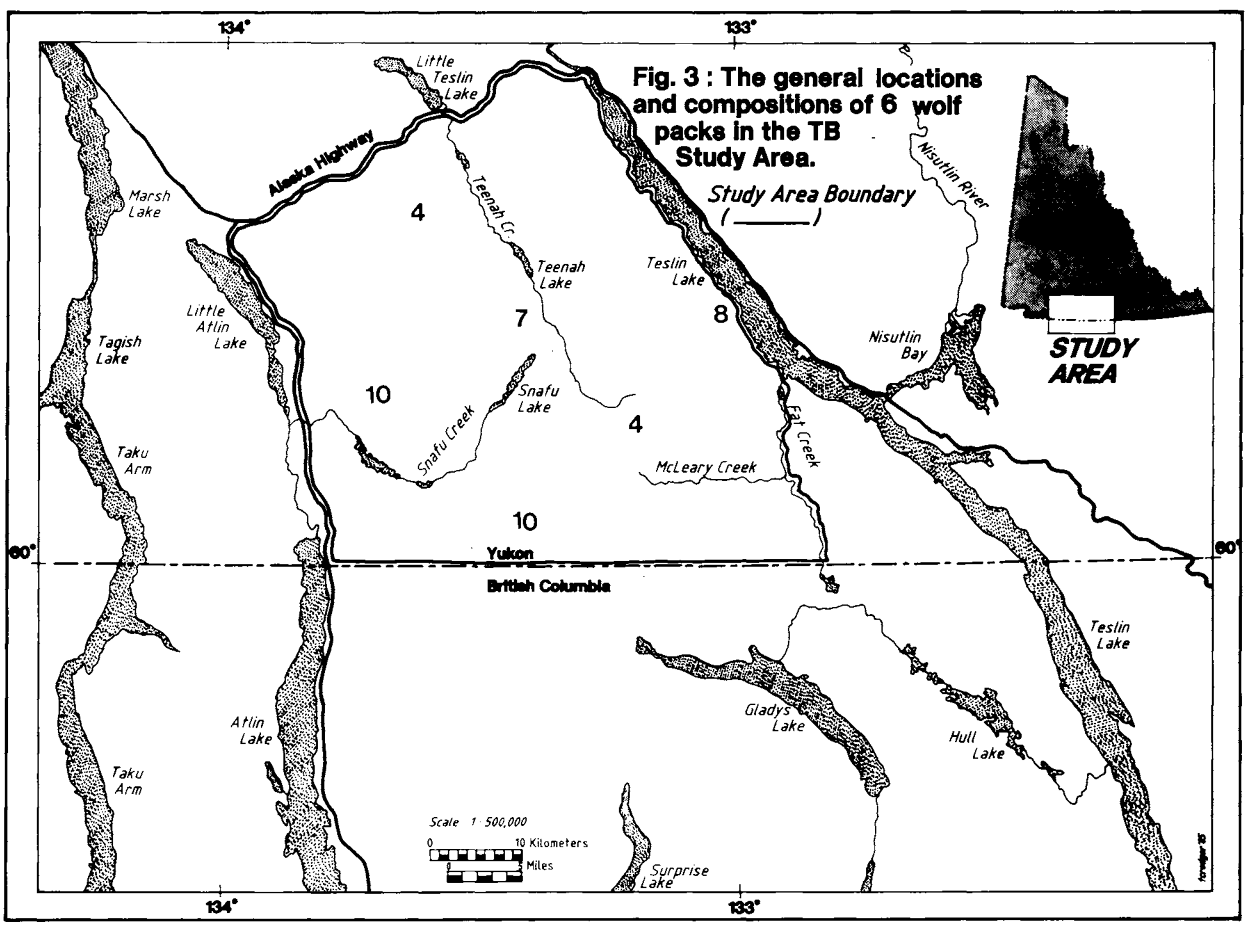


Fig. 3 : The general locations and compositions of 6 wolf packs in the TB Study Area.

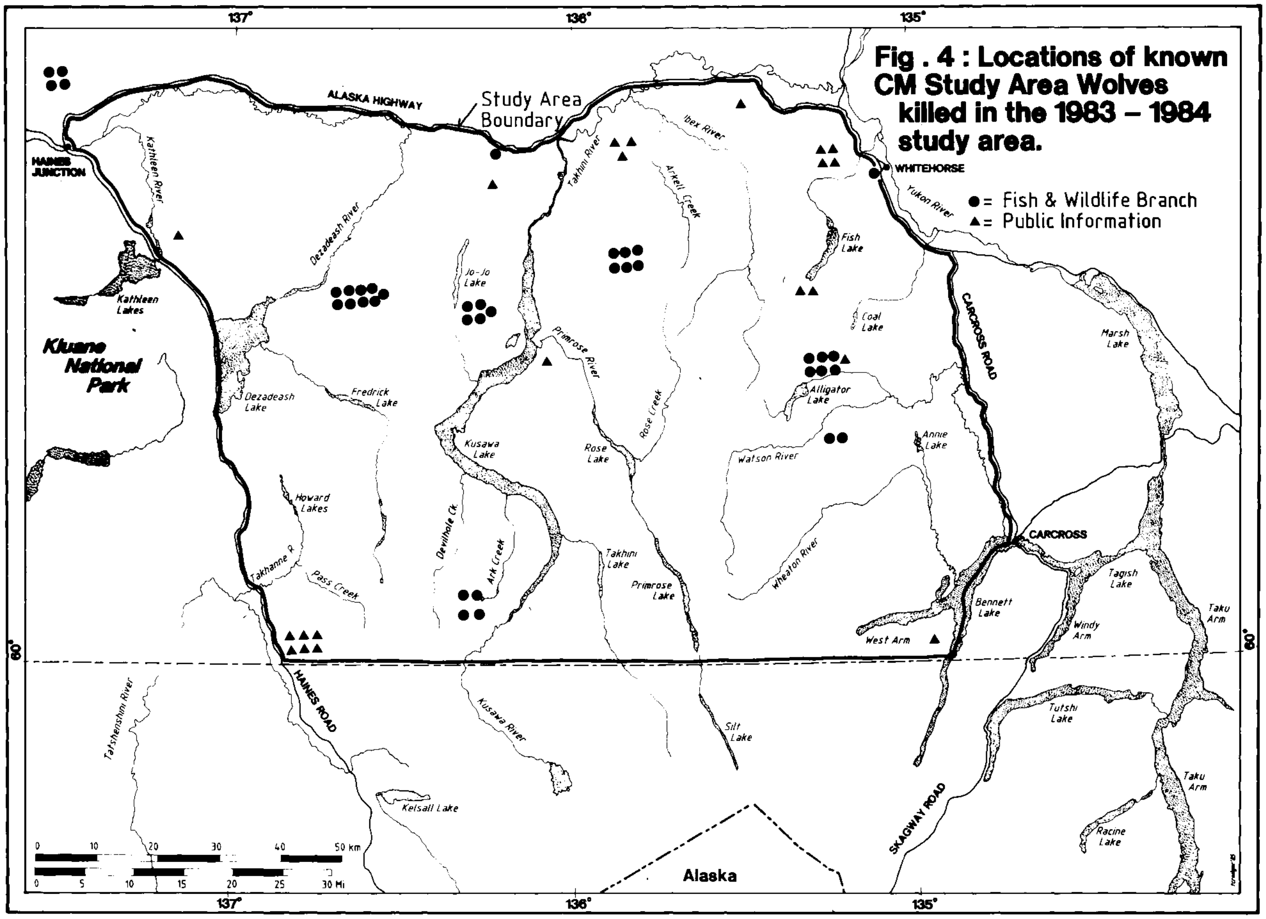


Fig. 4: Locations of known CM Study Area Wolves killed in the 1983 – 1984 study area.

Keith's (1983) analysis of rates of increase observed in 6 wolf populations showed mean finite rates of increase ranging from 1.15 to 1.46. Our observed rate was higher but may be related to the small area where wolf reduction was carried out in 1982-83. Given that the surrounding wolf population was naturally regulated and egress of subadults from these areas was normal, the vacant wolf habitat in the CM study area should be repopulated more rapidly than larger removal areas.

Because no systematic wolf survey was conducted in CM West in 1982-83, we can only speculate on the population effects of the harvest that year by knowing the reported minimum harvest and measuring density in 1983-84. Eighteen wolves were reported taken in 1982-83. Given that the 1982 early winter wolf density in CM West was similar to density in CM East (84 sq km/wolf, Hayes et al. 1985), we expect about 31% of the wolves were removed from CM West in 1982-83. Keith (1983) predicted a minimum annual reduction of 38% was necessary to cause a wolf population to decline. The estimated 31% reduction in CM West was apparently not sufficient to lower wolf numbers in early winter 1983-84, when a density of 79 sq km/wolf was observed.

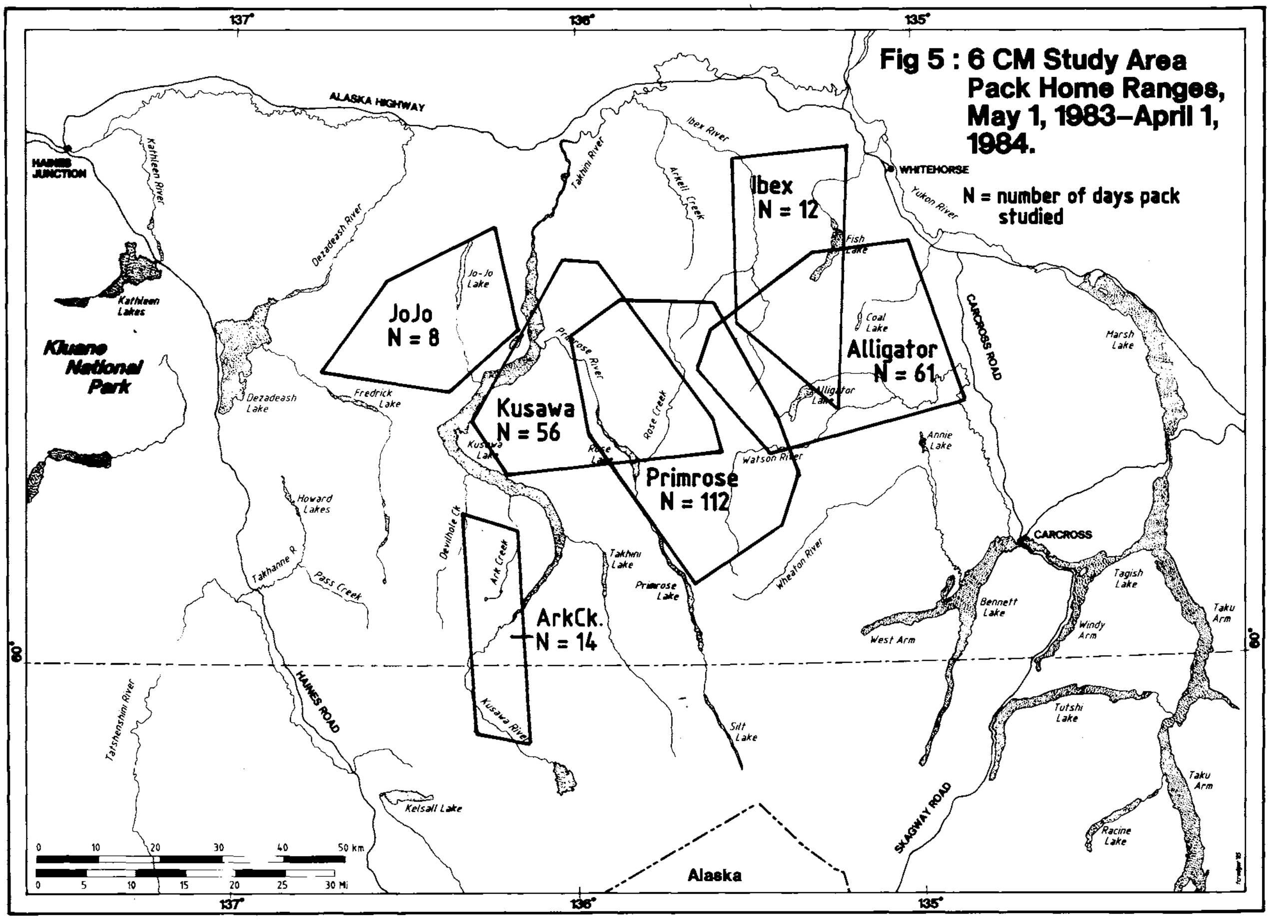


Fig 5 : 6 CM Study Area Pack Home Ranges, May 1, 1983–April 1, 1984.
N = number of days pack studied
JoJo N = 8
Kusawa N = 56
Primrose N = 112
Ibex N = 12
Alligator N = 61
ArkCk. N = 14
ALASKA HIGHWAY
HAINES JUNCTION
WHITEHORSE
CARCROSS
Kluane National Park
Alaska
CARCROSS ROAD
HAINES ROAD
SKAGWAY ROAD
137°
136°
135°
60°

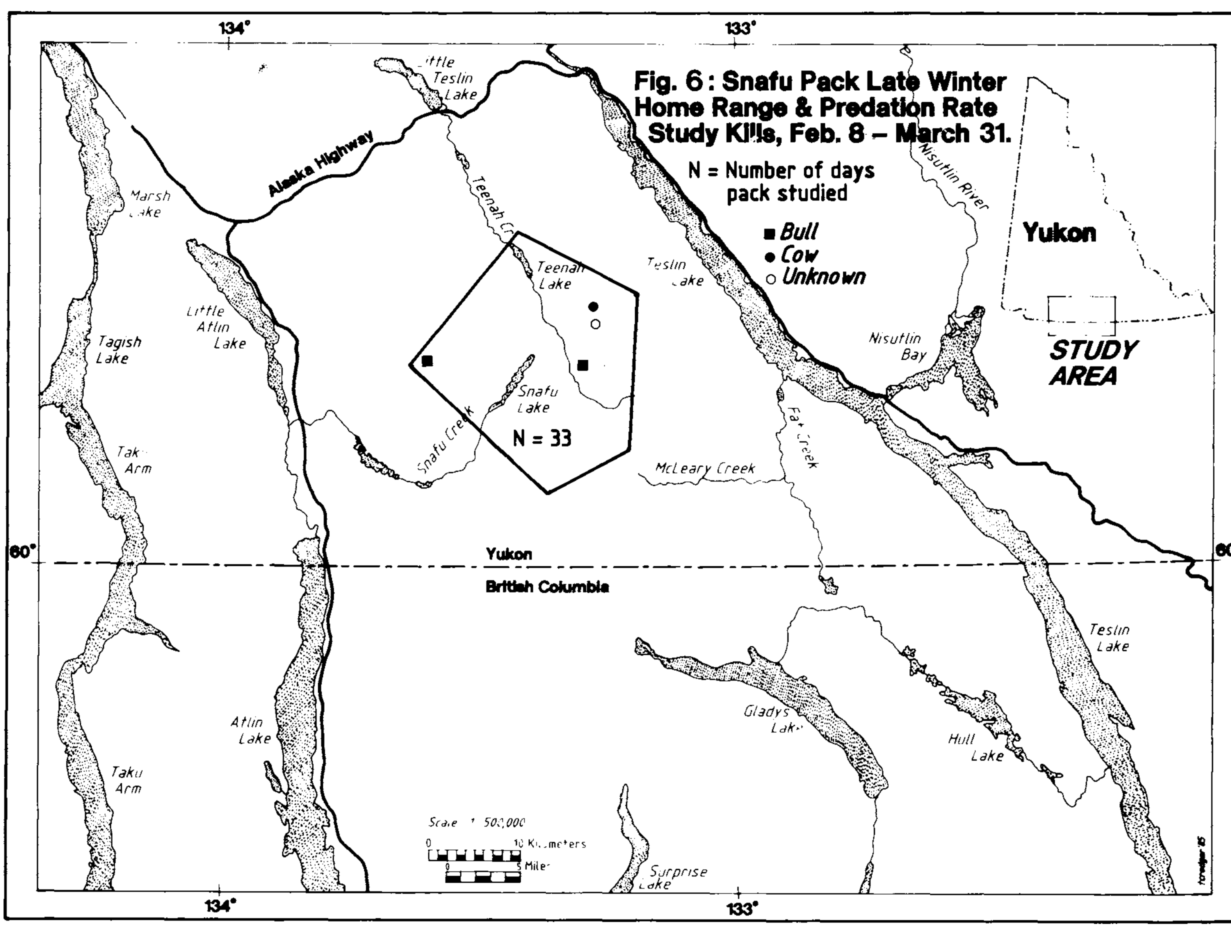


Fig. 6 : Snafu Pack Late Winter Home Range & Predation Rate Study Kills, Feb. 8 – March 31.
N = Number of days pack studied
Bull
Cow
Unknown
N = 33
Yukon
STUDY AREA
Alaska Highway
Yukon
British Columbia
Teenah Lake
Snafu Lake
Teslin Lake
134°
133°
60°

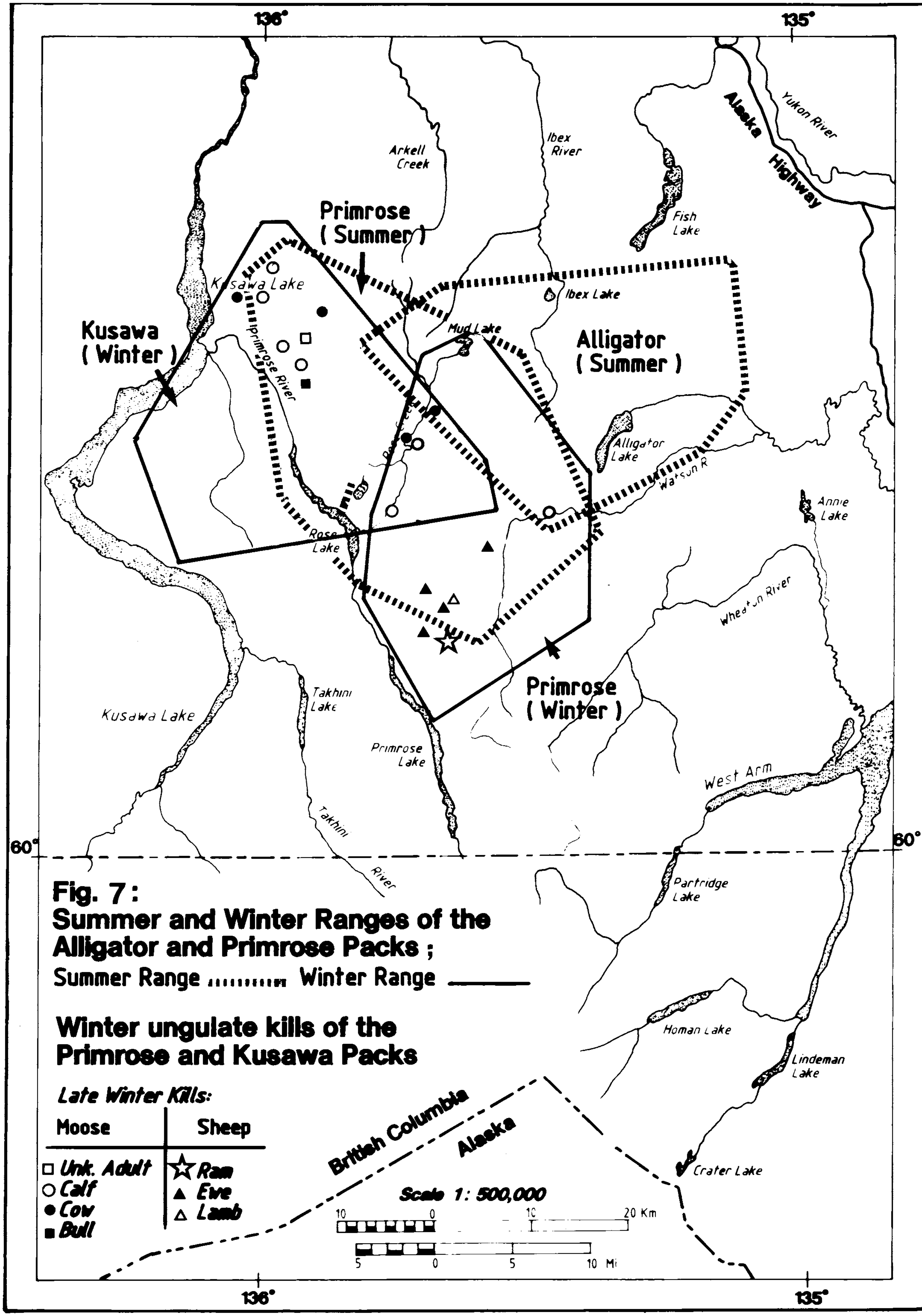


Fig. 7:
Summer and Winter Ranges of the Alligator and Primrose Packs ;

Winter ungulate kills of the Primrose and Kusawa Packs

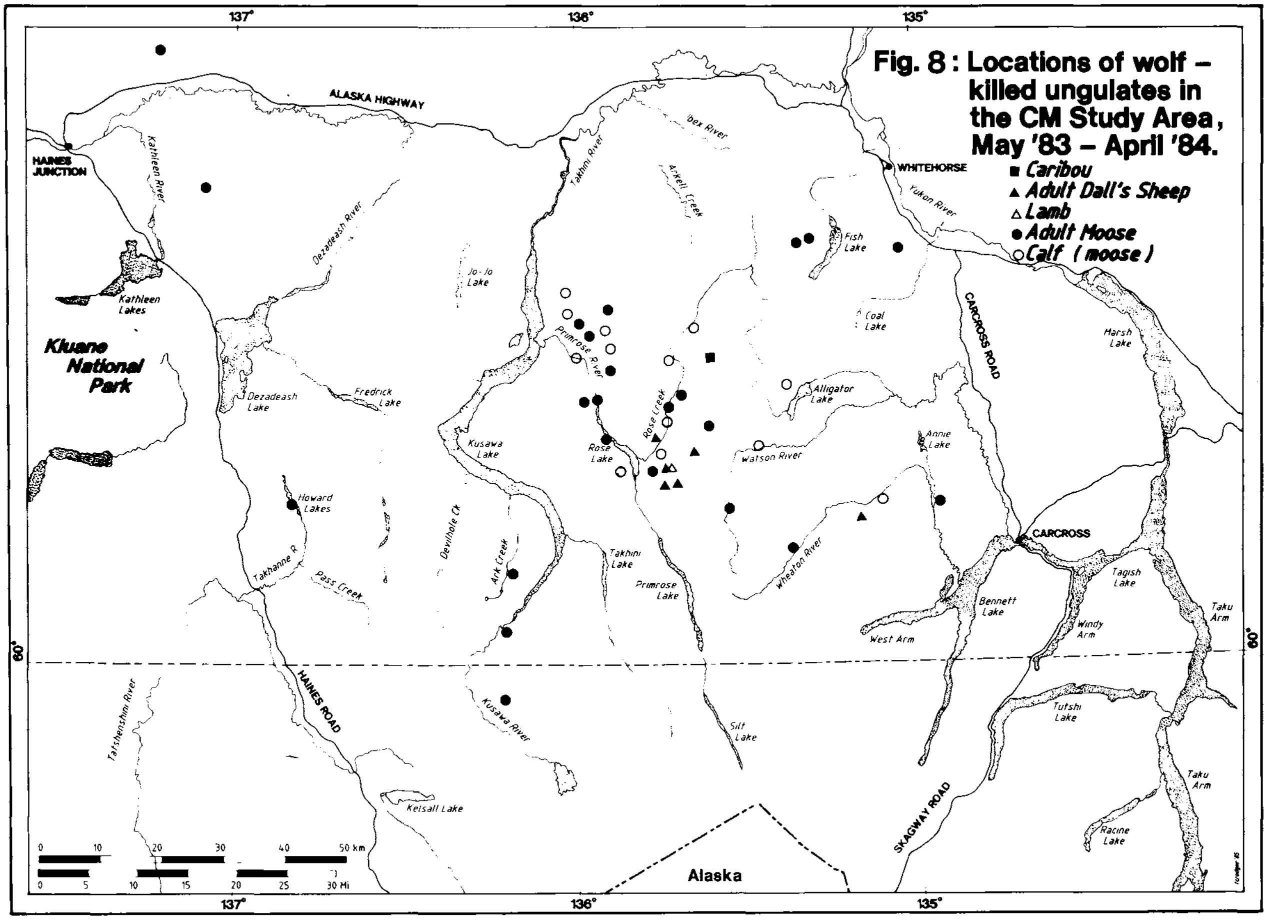
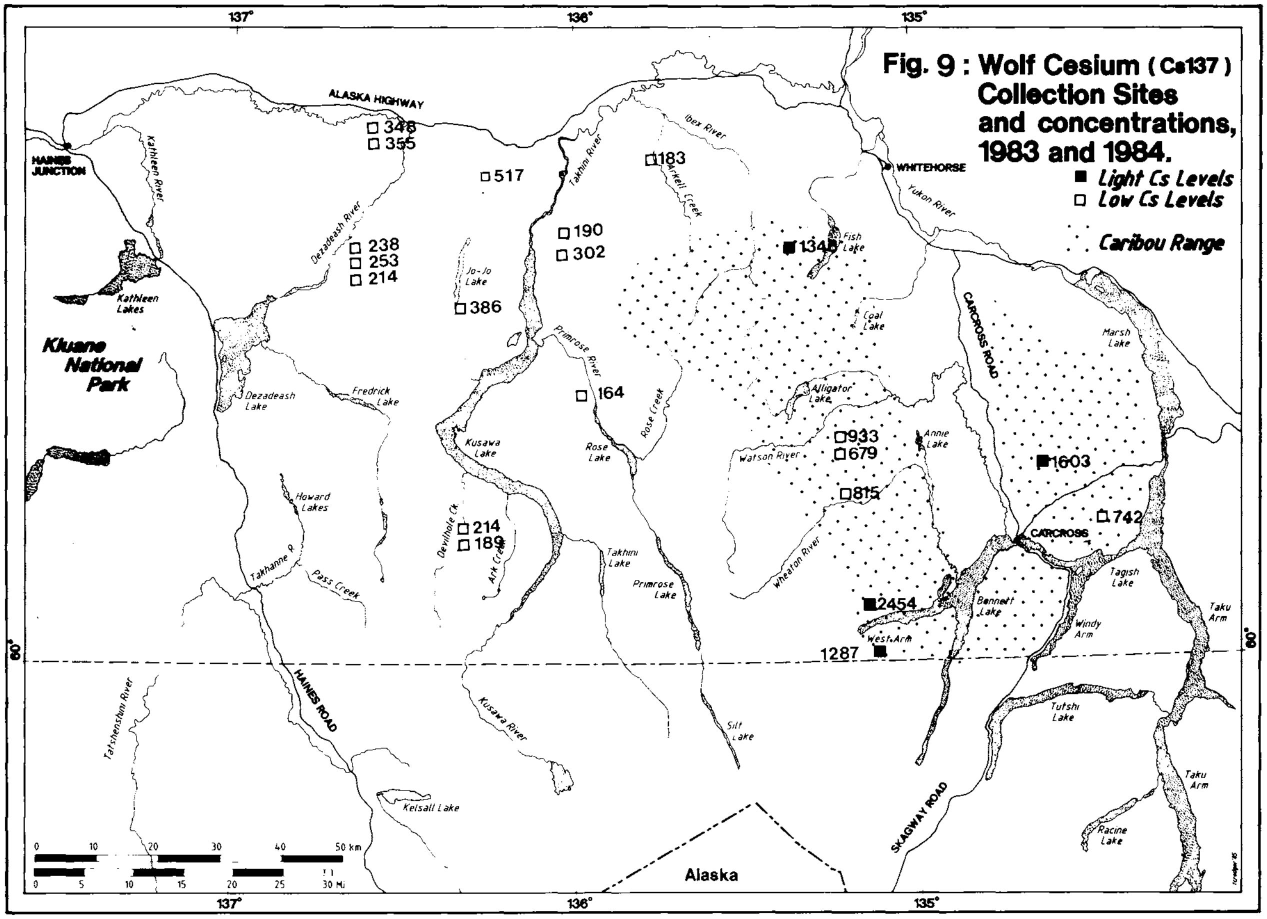


Fig. 8: Locations of wolf-killed ungulates in the CM Study Area, May '83 – April '84.

yearlings (6.5%), and 18 adults (58%). Adults ranged from 6 to 17 years old (Table 8), averaging 10.58 years (n=12, SD=3.32). Adult males averaged 9.8 years (n=5, SD=3.35) and females averaged 11.8 years (n=6, SD=3.19). The mean age of adult (> yearling) female moose killed by wolves in the study area in 1982-83 and 1983-84 was 10.8 years (n=10 SD=2.8), significantly different ($p<0.05$) than the average age of 68 radio-collared females aged in 1983 and 1984 (mean=8.1, SD=3.6, Markel pers. comm.). The proportion of calves in the fall moose population in various regions of the CM and TB study areas ranged from 7.8% to 15.5% in 1982 (Johnston and McLeod 1983), and 4.9% to 19.1% in 1983 (Markel and Larsen 1984). The 35% calf proportion in the wolf kill sample shows wolves selected calves in a greater proportion than their representation in the population ($P<0.05$). Wolf selection for middle and older age moose has been shown in other northern studies (Fuller and Keith 1980, Peterson et al. 1984) and high predation on calves is characteristic in many wolf studies during winter (McIlroy 1976, Fuller and Keith 1980, Peterson et al. 1984), especially during winters of deep snow (Stephenson and Johnson 1983, Peterson 1983, Peterson et al. 1984). In most studies, researchers concluded that the selection for young and old



7. SUMMER PREDATION STUDIES

Scat Analysis

Traditionally, wolf scat analysis has been used to estimate the relative importance of wolf prey during the summer season (Mech 1970, Peterson 1977, Stephenson 1978, Ballard et al. 1981, Peterson et al. 1984, Messier 1984).

Ballard et al. (1981) studied 3624 scats from Nelchina Basin wolf dens in interior Alaska, concluding that calf moose (44%), snowshoe hare (14%) and beaver (13%) were the three most important prey. Peterson et al. (1984) studied 592 Kenai peninsula wolf scats and found moose (adult and calf) in 75% of scats, snowshoe hare in 14% and beaver in 5%. Peterson et al. observed radio-instrumented wolves frequenting old moose kills of little or no nutritional value, and this led to a high proportion of adult moose hair in scats. They found that only 16% of wolf-kills visited in summer were fresh, compared to 80% in the winter (Peterson et al. 1984). A wide range of small and large mammal spe-

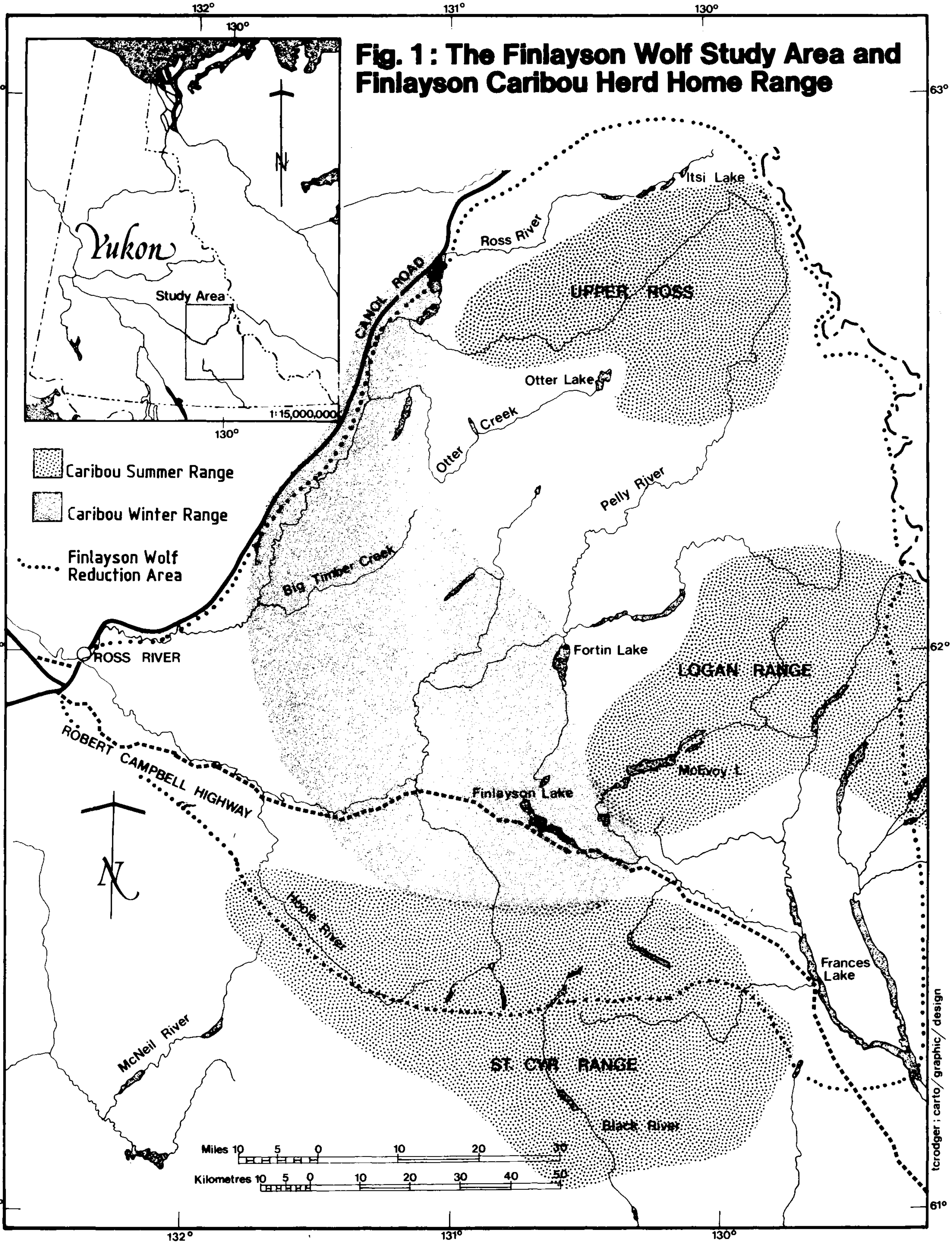


Fig. 1: The Finlayson Wolf Study Area and Finlayson Caribou Herd Home Range
Yukon
Study Area
1: 15,000,000
Caribou Summer Range
Caribou Winter Range
Finlayson Wolf Reduction Area
Itsi Lake
Ross River
UPPER ROSS
CANOL ROAD
Otter Lake
Otter Creek
Pelly River
Big Timber Creek
Fortin Lake
LOGAN RANGE
ROSS RIVER
ROBERT CAMPBELL HIGHWAY
McEvoy L.
Finlayson Lake
Hoole River
Frances Lake
McNeil River
ST. CYR RANGE
Black River
Miles
Kilometres
132°
131°
130°
63°
62°
61°
tcrodger: carto/graphic/design

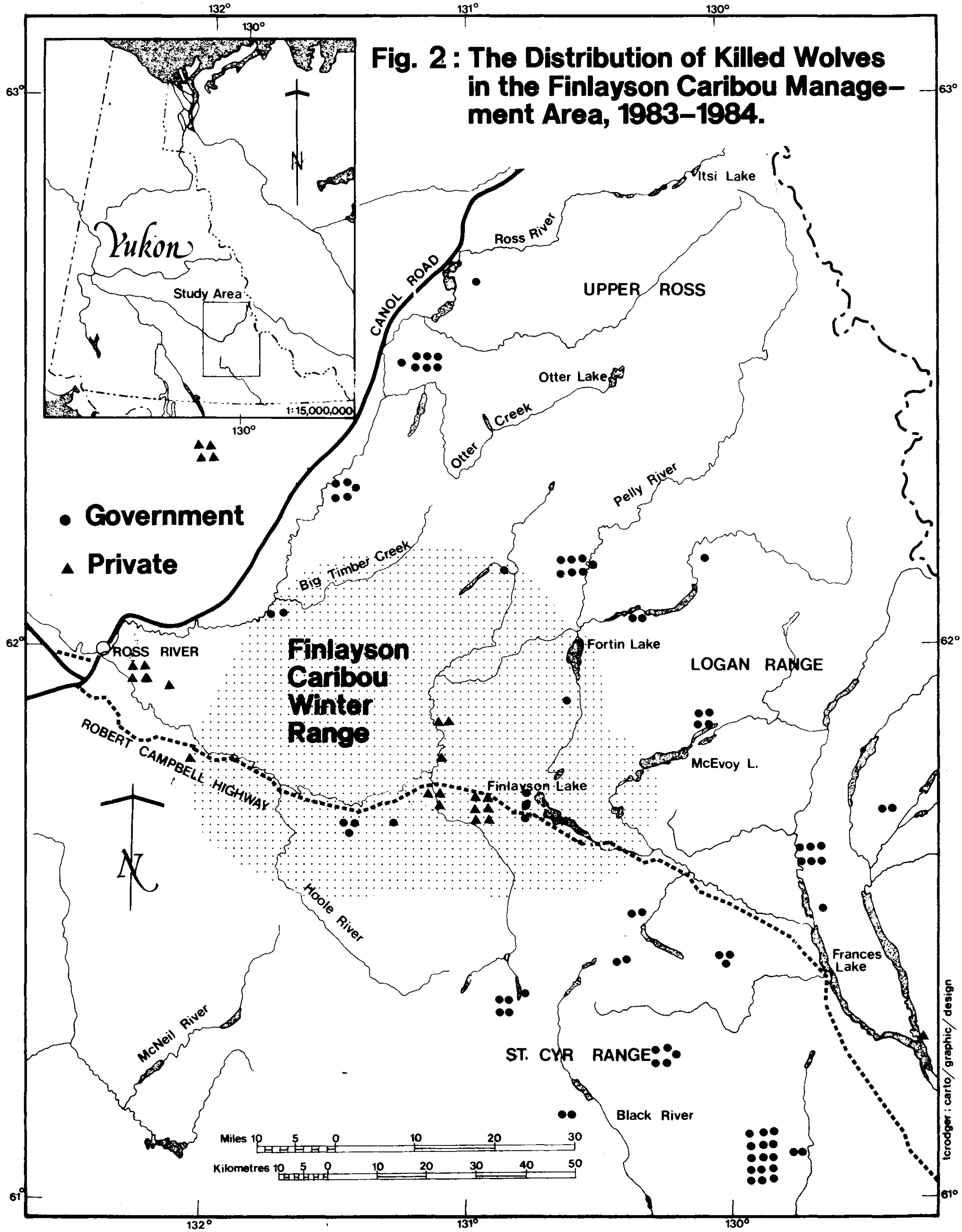


Fig. 2: The Distribution of Killed Wolves in the Finlayson Caribou Management Area, 1983–1984.

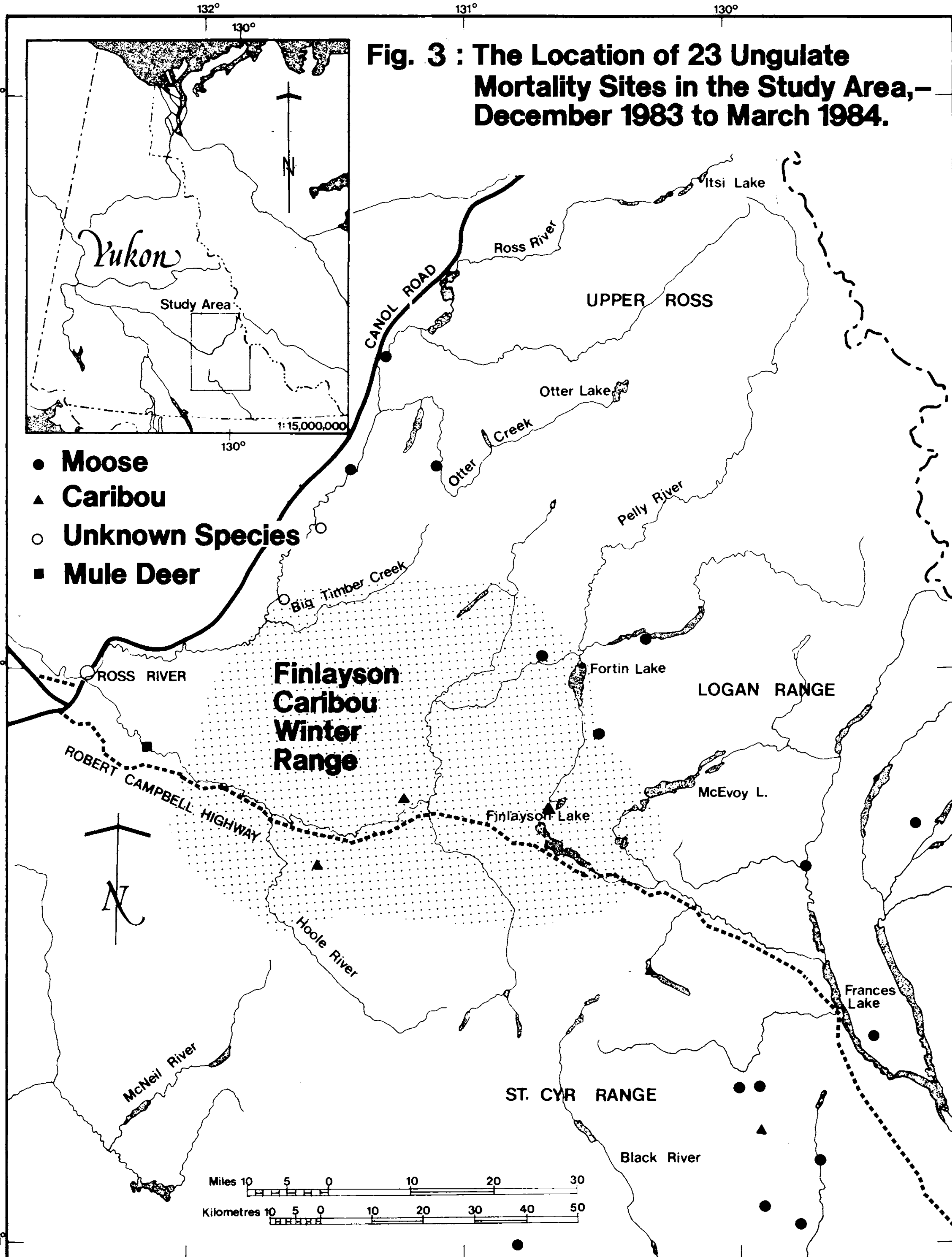
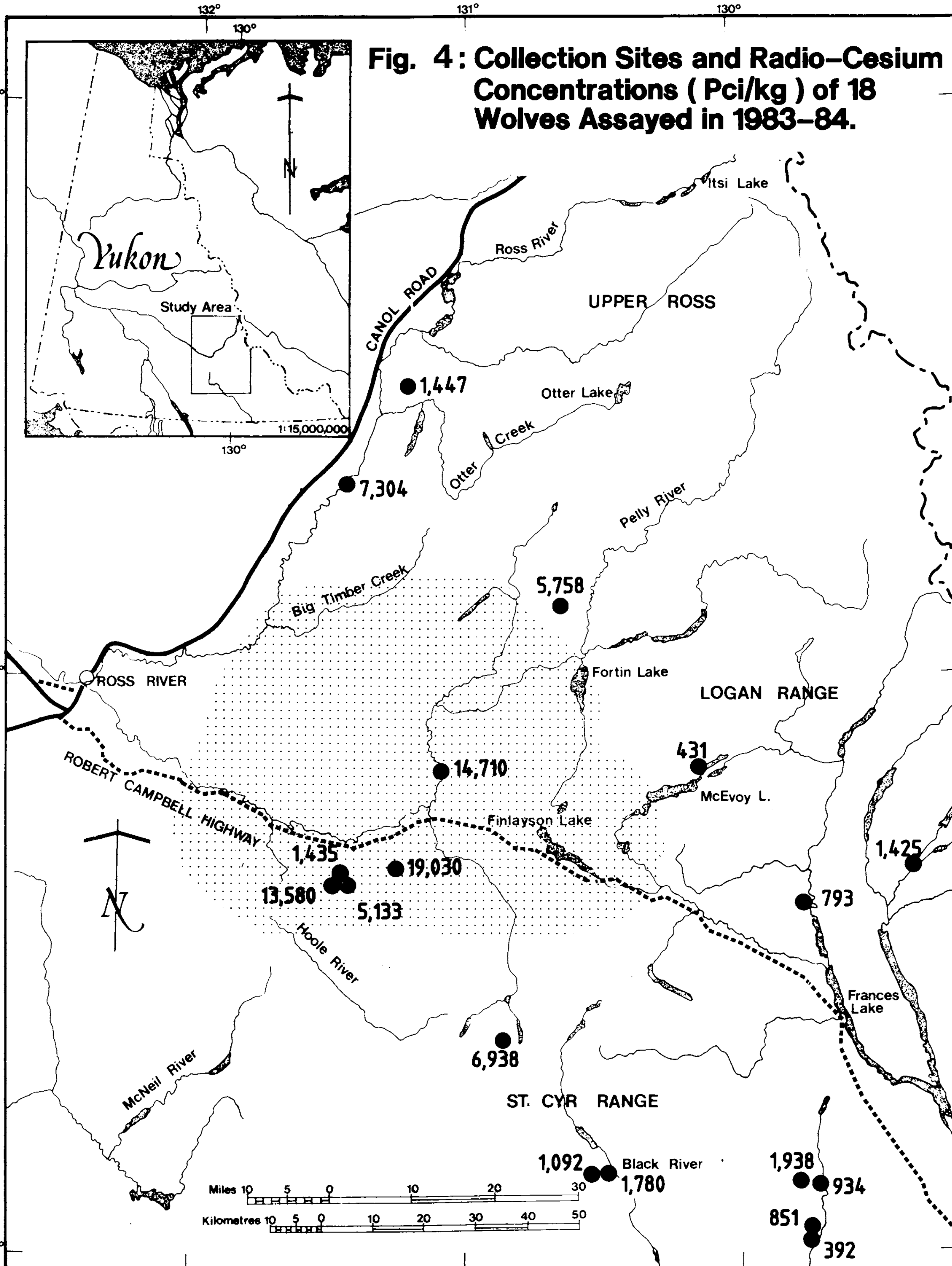


Fig. 3 : The Location of 23 Ungulate Mortality Sites in the Study Area,– December 1983 to March 1984.
Yukon
Study Area
1:15,000,000
Moose
Caribou
Unknown Species
Mule Deer
CANOL ROAD
Itsi Lake
Ross River
UPPER ROSS
Otter Lake
Otter Creek
Pelly River
Big Timber Creek
ROSS RIVER
Finlayson Caribou Winter Range
Fortin Lake
LOGAN RANGE
ROBERT CAMPBELL HIGHWAY
McEvoy L.
Finlayson Lake
Hoole River
Frances Lake
McNeil River
ST. CYR RANGE
Black River
Miles 10 5 0 10 20 30
Kilometres 10 5 0 10 20 30 40 50
132°
131°
130°
63°
62°
61°
tcrodger ; carto/graphic/design

Fig. 4: Collection Sites and Radio-Cesium Concentrations (Pci/kg) of 18 Wolves Assayed in 1983-84.



We also indirectly assessed prey selection by collecting 1 kilogram of muscle tissue from one or more members of most removed packs. Using radio-cesium (Cesium 137) techniques (Holleman and Stephenson 1981), D. Holleman of the Institute of Arctic Biology, Fairbanks, analyzed tissue samples to determine the levels of Pci/kg.

RESULTS AND DISCUSSION

1. WOLF INVENTORY

a. Coastal Mountains Study Area.

The minimum CM study area population was 125 wolves in mid-winter, including 113 in packs and 12 lone, or unaffiliated wolves (Table 1). Lone wolves were not directly counted; we assumed unaffiliated wolves, including dispersing subadults and adults not in packs, represented 10% of the pack population, based on other studies (Stephenson 1978, Gasaway et al. 1983).

Table 1. Wolf population inventory data in mid and late winter, 1983-84.

	AREA		
	CM WEST	CM EAST	TOTAL
number of packs	7	10	17
wolves in packs	56	57	113
lone wolves	6	6	12
total in area	62	63	125
number killed	27	28	55
number alive	35	35	70
1983 % killed	31.0	44.0	37.5
1984 % killed	43.5	44.4	44.0
Wolf Density (sq km/wolf)			
mid winter	79	100	90
late winter	140	186	162

A total of 17 packs resided in the study area (Figure 2, Table 2). Pack sizes ranged from 3 to 19 wolves, and the average pack sizes were 5.7 (SD=2.1) wolves in CM East and 8.0 (SD=5.3) in CM West; not significantly different between areas ($p>.05$). However, the mean pack size in CM East was significantly smaller ($p<.05$) than the 1982-83 average of 8.6 (SD=3.5) wolves per pack. This portion of the study area received a 44% wolf reduction in 1982-83 and the smaller packs observed this year was undoubtedly related to human exploitation.

Table 2. The membership of 17 known wolf packs in the CM study area, mid-winter 1983-84.

AREA	PACKNAME	NO. OF WOLVES	SOURCE*
CM EAST			
	Arkell	9	Tr
	Ibex	3	Rc
	Kusawa	8	Rc
	Alligator	7	Rc
	Rose Lake	3	Tr,Tp
	Primrose	6	Rc
	Hodnett L.	4	Tr
	Takhini L.	7	Tr
	Wheaton R.	7	Tr
	Black L.	3	Tr,Tp
	Subtotal	57	
CM WEST	Haines Jct.	7	Tr
	Granite L.	3	Vs,Tr,Tp
	Mt. Kelvin	10	Vs,Tr
	Jo Jo L.	6	Rc
	Dezadeash	6	Tr
	Takhanne	19	Tr,Tp
	Ark Mt.	5	Rc
	Subtotal	56	

* Tr indicates pack was enumerated by trail counts.
Rc indicates pack contained a radio-instrumented wolf.
Tp represents trapper observation of pack.
Vs represents a visual sighting of pack by survey crew.

Mid-winter wolf density was 79 sq km/wolf in CM West and 100 sq km/ wolf in CM East.

Pack size was determined by various techniques (Table 2). Six packs were radio-instrumented and pack size observed on various occasions. Two packs were seen only once and 9 packs were not seen, but pack size was estimated from at least 3 separate observations of trails.

b. Teslin Burn Study Area

The minimum wolf population in the TB study area was 47 animals in mid-winter, representing a density of 55 sq km/wolf. A total of 6 wolf packs occupied the area (Figure 3, Table 3), ranging from 4-10 wolves per pack. Average pack size was 7.1 (SD=2.7) wolves. Of the 6 packs, the Snafu pack was radio-instrumented and counted on numerous occasions, the McLeary Creek pack was seen once and the pack's trails observed on 3 survey flights. The Dalayee, Border, and Teslin Lake packs were estimated from 3 separate trail observations each, and the Tarfu pack was estimated from a single 25 km trail.

Table 3. A summary of wolf population inventory in Teslin Burn wolf study area, 1983-84.

PACKNAME	NO. OF WOLVES*	
Dalayee	4	
Snafu	7**	
Bryde Mt.	10	
Tarfu	10	
McCleary Ck.	4	
Teslin	8	
Total pack wolves	43	+ 4 lone wolves
Minimum total		47 wolves

* The number of wolves in each pack is a minimum value.
** Denotes a radio-marked individual in pack.

2. WOLF REDUCTION

In CM West, 27 of 62 (43.5%) known wolves were removed between January and April, 1984. Twenty-eight of 63 (44%) wolves were also killed in CM East, bringing the total CM reduction to 55 wolves; or 44% of the 1983-84 mid-winter population (Table 1). Trappers and hunters reported a harvest of 21 wolves and government aerial hunters took 34 (Figure 4) from 7 discrete packs.

A reduction of 70% of the original 1982 wolf population was the upper limit removal target. Based on an original density estimate of 82 sq km/wolf*, we estimated that about 134 wolves were present in the CM study area before the 1982-83 reduction (Hayes et al. 1985). In early winter 1983-84, 125 wolves were present; by late winter 70 survived (Table 1). This represents an 48% reduction from the original study population.

Wolf density fell from 79 sq km/wolf in early winter to 140 sq km/wolf in late March in CM West; in CM East density fell from 100 to 186 sq km/wolf. Over the entire study area, density fell from 90 to 162 sq km/wolf by late winter (Table 1).

The 44% wolf reduction documented in CM East in 1982-83 (Hayes et al. 1985) was apparently sufficient to reduce wolf numbers in early winter 1983-84. The pre-reduction population estimate for the area was 73 wolves in 1982-83, reduced to 41 by late winter. By early winter 1983-84, wolf numbers had increased to 63; a rate of increase of 1.54.

* this figure was derived by taking the mid-point between the 1982-83 density estimate of 84 sq km/wolf in CM East and the 78 sq km/wolf in CM West in 1983-84.

Age and Sex Composition

The age composition of pack wolves in Table 4 includes wolf specimens aged by tooth cementum techniques and radio-instrumented wolves of known age classes.** In total, we were able to assign age classes to 39 pack wolves, including 32 dead wolves, 6 live radio-collared wolves, and 1 additional wolf. The largest age class was juvenile (pups), representing 42.5%, followed by yearling at 17.5% and 2-year-old at 10%. Adult wolves 2 years and older accounted for 38% of the sample. The oldest wolf was a 12 year old.

Table 4. Wolf harvest statistics from known pack wolves killed in the study area in winter 1983-84.

		No. of Wolves		Age Composition								
Pack Name	In Pack	Killed	Retrieved	Pup	Yrling	2 yr.	3 yr.	4 yr.	6 yr.	7 yr.	12 yr.	Adult*
Alligator	7	7	2	4		1				1"	1"	
Ark Creek	5	4	4	2	1		1					1"
Jo Jo	6	5	5	3	1				1			1"
Kelvin	10	9	8	5	3							2*/*
Kusawa	7	5	5	3"		2		1				1
Ibex	3	2	2		1	1						1"
Granite	3	1	1		1"							
Pack totals	42	34	27	17	7	4	1	1	1	1	1	6
Percentages		81%	64%	42.5%	17.5%	10%	2.5	2.5%	2.5%	2.5%	2.5%	17.5%

* 3 unknown age adult male wolves were radio-instrumented but not killed; all 3 were alpha males. Another adult male from the Kusawa pack was not collared, but survived with a radio-instrumented male pup.

" denotes a radio-collared wolf.

/ Eight of the 10 wolves in the Kelvin pack were collected and aged. Of the remaining 2 wolves, 1 was shot but not retreived and another escaped. It is presumed that these 2 were the adult alpha male and female of the pack. They are classified as unknown age adults.

Table 5 compares data from wolves of known sex and age in 1982-83 (Hayes et al. 1985) and 1983-84. There was no significant difference ($p>.05$) in the sex and age class ratios between years, although females declined from 63% to 49% and males increased from 37% to 51%. Juvenile wolves represented the largest age class in both years; 34% of the 1983 collection and 39% in 1984. The proportion of adults greater than 24 months old increased only slightly from 38% to 44% in 1984.

Reproductive History

Five of 19 female wolves (26%) showed historical reproductive activity. Reproductive females ranged from 2 to 6 years old and only one female greater than 2 years old showed no historic or recent reproductive activity. Three females showed recent placental scars from the 1983 breeding

** Tooth samples were not collected from radio-instrumented wolves but ages were estimated by carnassial tooth wear, canine eruption, tooth coloration and breakage.

Table 5. Age and sex of wolves studied in 1983 and 1984 in the CM study area.

YEAR	1982-83	1983-84	PERCENTAGE CHANGE (1984)
Number of wolves sexed	38	39	
Number and (%) of males	14 (37%)	20 (51%)	14%
Number and (%) of females	24 (63%)	19 (49%)	-14%
Number of wolves aged	38	43	
Number and (%) of juveniles (<12 months old)	13 (34%)	17 (39%)	5%
Number and (%) of yearlings (>12 and <24 months)	11 (28%)	8 (19%)	-9%
	Adults		
Number and (%) of 2 yr. old (>24 and <36 months)	9 (24%)	5 (12%)	-12%
Number and (%) of 3 yr. old (>36 and <48 months)	4 (11%)	2 (5%)	-6%
Number and (%) of 4 yr. old (>48 and <60 months)	1 (3%)	2 (5%)	2%
Number and (%) of 5 yr. old (>60 and <72 months)	0	0	
Number and (%) of 6 yr. old (>72 and <84 months)	0	1 (2%)	2%
Number and (%) of 7 yr. old (>72 and <84 months)	0	1 (2%)	2%
Number and (%) of 12 yr. old (>84 and <96 months)	0	1 (2%)	2%
Number and (%) of unk. age ad. (>24 months ?)	0	7 (14%)	14%
Total Adults	14 (38%)	17 (44%)	

season and 2 females shot in April had developing fetuses. From scar and fetus counts, we calculated an average litter size of 5.2 (SD=2.7) pups. Two Kusawa pack females, a 4-year-old and a 2-year-old, showed recent breeding activity. The 4-year-old had 4 developing fetuses, but it could not be determined whether older placental scars were present. The 2-year-old had 10 recent placental scars indicating she reproduced as a yearling in 1982-83. The remaining reproductive females were from the Jo Jo, Ark Creek, and Alligator packs.

4. RADIO-TELEMETRY

Between 23 May 1983 and 21 March 1984, 9 wolves in the CM study area and 1 in the TB study area were radio-instrumented. Two were members of packs that had individuals instrumented in 1982-83 (Hayes et al. 1985). Table 6 summarizes biological and radio-frequency data of each instrumented wolf.

In total 7 males and 3 females were collared. Males included 5 adults and 2 juveniles and females included 1 adult, a juvenile and a yearling. Seven wolves were immobilized from helicopters, 2 were snared and 1 was captured in a leghold trap. Attempts were made to aerially

Table 6. Biological and radio-frequency information for radio-equipped wolves in the study area.

PACK NAME	NO.	STATUS**	SEX	AGE*	WT.(kg)	DATE	FREQUENCY
CM STUDY AREA							
Primrose	6	alpha	M	A	45	Feb /83 +	150.192
		subord	F	J	34	Feb /83 +	150.170
		subord	M	J	--	Mar /83 +	151.100
		?	M	A	--	May 26/83	151.830
Alligator	12	subord	M	Y	51	Feb /83 +	151.040
		subord	F	Y	43	Feb /83 +	151.000
		alpha	F	5	46	Mar /83 +	151.150
		alpha	M	4	50	May 23/83	151.121
Takhini	1	alpha	M	A	49	Mar /83 +	151.090
Sandpiper		subord	M	A	45	Mar /83 +	151.070
John's Wolf	1	?	F	A	25	Mar /83 +	151.050
Granite L.	3	subord	M	J	--	Nov 27/83	151.112
Jo Jo L.	6	alpha	M	5	55	Nov 27/83	151.221
Ibex Mnt.	3	alpha	M	4	48	Jan 5/84	151.180
Wheaton R.	7	subord	F	J	34	Jan 15/84	151.081
Kusawa	7	subord	M	J	45	Jan 23/84	151.821
Ark Creek	5	alpha	M	A	45	Feb 29/84	151.810
Trout L.		?	F	Y	39	Mar 21/84	151.191
TB STUDY AREA							
Snafu Lake	4-7 $	?	F	A	--	Feb 8/84	151.851

** alpha represents dominant status, subord is subordinate. Unknown status of individual is "?".

* J represents juvenile, Y is yearling and A is adult. Numeric designation is age in years.

+ represents wolves captured prior to this report period.

$ This pack numbered 7 at the time of capture but fell to 4 after the first several relocations.

dart the largest and most elusive pack members, presuming these were likely to be the breeding or dominant males in the packs (Hayes et al. 1985). Adult males were captured

Basin of Alaska, Ballard et al. (1981) found core areas of individual packs remained constant while total home ranges fluctuated in response to human exploitation of wolves. In our studies between 1983 and 1984, the Alligator pack territory changed following a decline from 12 to 7 members and the loss of the alpha male (see pack history, this report). The centre of pack activity changed also, from the more isolated upper drainages of the Watson River toward the more developed Carcross valley area. Second, after systematic reduction is terminated, we expect the pack density to increase, pack sizes to be initially small (Peterson et al. 1984), and territories to be characteristically unstable until optimal wolf density occurs.

Table 7. Radio telemetry data from instrumented wolves observed from May 1,1983 to April 1,1984 in the southwestern Yukon.

pack name	collars per pack	pack days *	radio wolf days **	locations Vis/Gen ***	annual home range (sq km)	late winter range (sq km)	summer range (sq km)
CM STUDY AREA							
Alligator	4	61	69	38 / 31	1141	671	622
Ark Creek	1	14	14	14 / 0	_*	_*	_*
Granite	1	1	1	1 / 0	_*	_*	_*
Ibex Mnt.	1	12	12	11 / 1	_*	_*	_*
Jo Jo L.	1	8	8	7 / 1	_*	_*	_*
Kusawa	1	56	57	53 / 4	_*	422	_*
Primrose	4	112	165	105 / 60	1262	452	932
Lone wolves							
John's	1	5	5	1 / 4	_*	_*	_*
Takhini	1	9	9	2 / 7	_*	_*	_*
Trout L.	1	4	4	2 / 2	_*	_*	_*
Wheaton	1	7	7	2 / 5	_*	_*	_*
TB STUDY AREA							
Snafu	1	33	33	25 / 8	_*	504	_*

* represents the number of days on which the pack was located during telemetry flights.
** represents the number of radiocollars located on any given packday.
*** Vis/Gen represents number of times wolves were seen/not seen when radio collars were located (radiowolf days = visual + general).
_* insufficient number of locations to plot home range.

Seasonal wolf territorial relationships have not been well documented, largely because summer activities are monitored infrequently (Ballard et al. 1981). Also, wolf obsermoose was a function of higher vulnerability of these age classes compared to middle age cohorts. In our study, if we assume the age structure of radio-instrumented female adults represents the overall adult population age structure, then the absence of young, prime age moose in the wolf-kill sample may be a function of their low availability in addition to better fitness, compared to older age moose. In our study, high wolf predation on calves in winter was further additive mortality on already high calf mortality rates in the moose population. High calf mortality through to fall was mainly caused by grizzly bear predation (Larsen and Gauthier, in prep.). The continued wolf predation on calves throughout the winter was partially responsible for the recent low yearling

Table 8. The age distribution of wolf-killed ungulates in the CM and TB study areas, May 1983 to April 1984 *.

SPECIES Frequency Row Percent	AGE IN YEARS												
	COY**	YRLNG**	6 YR	7 Yr	8 YR	9 YR	10 YR	11 YR	12 YR	14 YR	17 YR	ADULT	UNKNOWN	TOTAL
Moose	15 34.88	2 4.65	1 2.33	3 7.00	0 0	0 0	1 2.33	1 2.33	4 9.30	1 2.33	1 2.33	8 18.60	6 13.95	43 100.00
Dall's sheep	1 14.29	0 0	0 0	0 0	1 14.29	1 42.83	2 14.29	0 0	1 14.29	0 0	0 0	0 0	0 0	6 100.00

* The age distribution is not broken down by study period.
** COY represents moose calf of year and Dall's sheep lamb of year. Yrlng represents yearling.

recruitment rates in the southern Yukon, ranging from 1.0 to 6.0% in various areas (Markel and Larsen 1984). Calf recruitment has been low in the study area since 1981 (Markel and Larsen 1984), and the small proportion of young to middle age adults (2-6 years) in the collared cow sample (36%, n=25, Markel pers. comm.) verifies that survival of young moose has been low for a number of years. It appears that continued high calf and middle-old age adult mortality rates will likely cause a dramatic decline in moose numbers in the area, for few moose have achieved prime age in recent years to replace other adult losses.

Female (yearling and older) moose kills (11) were found at nearly twice the rate of male moose kills (6), however, there was no significant difference (p>0.05) between sex proportions in the kill sample and fall population (Markel and Larsen 1984). Peterson et al. (1984) found a low frequency of bulls among wolf-killed adults, and suggested a scarcity of males in the study area resulted from intensive bull harvest. Bull harvest management strategies in our study area are probably increasing the rate of wolf predation on cows by skewing the moose population towards females (37 bulls/ 100 cows, Markel and Larsen 1984, our calculations). The relationship between female moose avail-

Table 9. Cesium (Cs-137) concentrations from 21 wolves collected from the CM study area, winters 1983 and 1984.

1983

ID	AREA	AVERAGE pCi/kg	S.DEV.
0113	Whitehorse	1346	48
0114	Champagne	355	35
0116	Jo Jo Creek	517	37
0122	Wheaton	815	44
0127	Tagish Creek	742	47
0130	Arkell Mountain	183	39
0135	Bennett Lake	1247	50
0100	Sandpiper Creek	164	30
0111	Jo Jo Lake	386	33

Average Pci/kg = 639
Standard Deviation = 433
Range = 164-1346 pCi/kg

1984

ID	AREA	AVERAGE pCi/kg	S. DEV.
315	Mount Kelvin	238	36
330	Mount Kelvin	253	30
316	Mount Kelvin	214	31
326	Watson River	933	46
327	Watson River	679	40
331	Moose Hollow	190	30
332	Moose Hollow	302	37
323	Ark Creek	214	31
324	Ark Creek	189	35
332	Lorne Mountain	1603	68
400	Bennett Lake	2459	67
321	Champagne	348	46

Average Pci/kg = 633
Standard Deviation = 713
Range = 189-2459 pCi/kg

limiting the growth of already depressed woodland caribou herds. Bergerud (1978) suggested that caribou herds that enter a low equilibrium population phase can be limited by wolf predation. In order for the small (<100 animals) herds to increase, adult recruitment must exceed adult mortality. Light predation by wolves, coupled with native harvest, poaching losses, permit sport harvest, and natural mortality factors are likely maintaining the low caribou population density in the CM study area. The Ibex herd is being annually monitored to document any demographic changes that may occur in response to wolf population reduction (Farnell 1982).

cies were identified in the 66 scats collected from the Alligator den site (Table 10). Beaver was the most

Table 10. Food items and their relative frequencies in 66 wolf scats collected from the Alligator pack natal den, 2 August 1983.

Food item	No.	% occurence
Large mammal		
Moose calf	8	10.7
Caribou calf	3	4.0
Dall's sheep	1	1.3
Small mammal		
Beaver kit	12	16.0
Beaver adult	10	13.3
Muskrat	6	10.0
Red fox	2	2.7
Squirrel (sp.?)	7	9.3
Snowshoe hare	3	4.0
Marmot	3	4.0
Microtines	12	16.0
Spruce grouse	3	4.0
Passeriformes	3	4.0
Grayling (fish)	2	2.7
Total	75	100.0

frequently recorded prey species. In total, young and adult beaver were found in 29.3% of all scats. Together, aquatic furbearers (beaver and muskrat) represented 39.3%. The den was located in the centre of a subalpine wetland and the high proportion of both species was undoubtedly related to their availability around the den. Large mammal young occurred in 16% of scats. Moose calf was the most frequent (10%), followed by caribou calf (4%) and Dall's sheep lamb (1%). The presence of caribou calf remains is noteworthy for it is the first evidence the Alligator pack preyed on the Ibex caribou herd, although the pack's territory was encompassed by most of the summer and winter range of the herd. While a small sample collection of scats from one den has limited value as a regional indicator of prey selection of denning wolves, it does provide an initial view.

Summer Predation Rates

Two large mammal kills were made by the Primrose pack between May 15 and July 16; both were adult cow moose. It is possible that other ungulate kills were made, especially Dall's sheep, but were not detected by study techniques.

Of 39 radio-instrumented moose calves that occupied the Primrose pack territory during the summer study period, 4 (10%) were killed by Primrose pack members. For the same

The daily prey consumption rates of our 3 study packs ranged from 0.14 to 0.20 kg/kg wolf/day (Table 12). These rates are considered moderate based on rates of 0.09 to 0.19 kg/kg wolf/day found for wolves eating moose in northern Alberta (Fuller and Keith 1980, cited in Peterson et al. 1984), the Kenai Peninsula (Peterson et al. 1984), and Quebec (Messier and Crete 1985).

Table 11. Live weights of moose and sheep prey consumed by the Primrose, Kusawa and Snafu wolf packs; late winter 1984.

MOOSE	Mean Weight (kg)	Source	Number Killed by Packs Primrose	Kusawa	Snafu	% of Kills By Species
Adult bull	454	Franzemann et al. (1978)	0	1	2	18
Adult cow	400	Franzemann et al. (1978)	2	2	1	29
Calf	150	Franzemann et al. (1978)	3	4	0	41
unknown adult	430	our estimation	0	1	0	6
unknown age/sex	454-150	our estimation	0	0	1	6
DALL'S SHEEP						
Ram	74.6	Bunnell and Olsen (1976)	1	0	0	16.66
Ewe	48.8	Bunnell and Olsen (1976)	4	0	0	66.66
Lamb	40	Nichols (1978)	1	0	0	16.66

Table 12. Predation rates for wolf packs in the CM and TB study areas during late winter 1984.

Pack	Dates	Pack days studied	Wolves per pack	N ungulate Kills located	Pack Kill Rate	Wolf Consumption Rates ** (kg/wolf/day)	(kg/kg wolf/day)
Coastal Mountains							
Primrose	Feb 6 - March 29	53	5	5 moose, 6 sheep	1 ung/4.8 days	4.77	0.14
Kusawa	Feb 5 - April 1	56	7	8 moose	1 moose/6.8 days	4.76	0.14
Teslin Burn							
Snafu	Feb 8 - March 31	51	4-7*	4 moose	1 moose/14.3 days	5.4-6.7	0.16-0.20

* The Snafu pack made 1 kill as a 7 member pack. After Feb 14 the pack split and the radio-instrumented female wolf was associated with 2-3 other wolves for the duration of the study period.

** The range of daily wolf consumption rates varies depending on the age and sex of the unknown age moose kill. If an adult male was killed, the highest value applies; if a calf was killed, the lower value is accurate.

Similar to the overall kill composition of all known wolf-killed prey in the entire study areas, calves were numerically the most important moose age class, representing 41% of kills. Peterson et al. (1984) cautioned the frequency of calves among kills does not reflect the relative importance of this age class to wolves, for the biomass of adult moose is considerably greater than calves. In our sample, adult cows were the most important group, providing 50% of prey biomass, followed by calves (21%). Peterson et al. (1984) also found cow moose provided the majority of prey biomass for Kenai wolves.

Dall's sheep prey were only important to the Primrose study pack, although the Kusawa pack was observed unsuccessfully hunting sheep on 1 occasion. From the small sample of 6 sheep kills, adult ewes were the most frequently selected (66%). Barichello and Hayes (Yukon Wildlife Branch file re-

WOLF MANAGEMENT ANNUAL REPORT

Wolf Population Research and Management Studies in the Yukon Territory

Progress Report 1984

Approved: ____________________

Senior Small Game Biologist

Date: 86.06.16

The wildlife projects reported here are continuing and conclusions are tentative. Persons are free to use this material for education or informational purposes. Persons intending to use the information in scientific publications should receive prior permission from the Fish and Wildlife Branch, Government of Yukon, identifying in quotation the tentative nature of conclusions.

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WOLF POPULATION RESEARCH AND MANAGEMENT STUDIES IN THE YUKON TERRITORY

Part 1. Southwestern Yukon

1984 Annual Report. May 1986

R. Hayes, Wildlife Biologist II
A. Baer, Wildlife Technician II

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ABSTRACT

Between May 1983 and April 1984, wolf studies were conducted in the 11 200 sq km Coastal Mountain (CM) and the 2580 sq km Teslin Burn (TB) study areas in the southwest Yukon. Wolf inventory, population reduction, and summer and winter predation rate studies were completed in the CM study area. Wolf inventory and winter predation rate studies were completed in the TB study area.

The minimum mid-winter population in the CM study area was 125 wolves, with a density of 88 sq km/wolf. In the TB study area the minimum mid-winter population was 47 wolves, with a density of 55 sq km/wolf.

In 1983-84, 44% of the wolves were removed from the CM study area. Overall density fell from 1 wolf/88 sq km in mid-winter to 1 wolf/158 sq km by late winter.

Age structure showed a population comprised of 41% pups, 17% yearlings and 42% adults. From placental scar and fetus counts, the average minimum litter size was 5.2 pups.

Late winter home ranges from 4 study packs ranged between 422 and 671 sq km and summer ranges for 2 packs were 622 sq km and 932 sq km.

Two wolf packs, one of which was a denning pack, were monitored over a two month summer period in 1983 to document predation activities. In addition to telemetry techniques, 66 scats were collected from the denning wolves's natal den site. Analysis showed small mammals were, numerically, the most important summer prey. Beaver and muskrat were the most important prey species, represented in 39% of scats. Calf moose, caribou, and Dall's sheep lamb hairs were found in a relatively small proportion of scats.

The non-denning wolf pack's activities were monitored in conjunction with a moose calf mortality study in summer 1983. During a two-month study period, 2 adult cow moose were killed and 4 of 39 (10%) radio-instrumented calf moose occupying the pack's summer range were killed by pack members. The combined kill rate of adults and radio-instrumented calves was 1/10.5 days.

Winter predation studies showed pack kill rates ranged from 4.8-14.3 days per ungulate kill. Moose were the primary prey biomass but Dall's sheep were important prey to at least one pack. Large mammal prey consumption ranged from 0.14-0.20 kg of prey/kg wolf/day, within the range of consumption rates documented elsewhere. Numerically, calves

were the most important moose age class selected, representing 41% of kills, but yearlings and adult cows provided 50% of the total large ungulate biomass consumed by packs. Of the Dall's sheep taken, ewes were the most important age/sex class.

Evaluation of 12 wolf tissue samples analysed for radio cesium, from various regions of the study area, showed some wolves taken from the range of the Ibex Mountain and Caribou Mountain woodland caribou herds predated lightly on caribou. Light predation by wolves, coupled with other mortality factors, may be limiting the growth of the herd. With continued wolf reduction, the herd is expected to increase.

Although wolves were secondary predators of summer moose calves, wolf telemetry data shows wolves are important predators of moose calves during winter, and appear to be removing a significant number of the calves that survive the summer bear predation period.

INTRODUCTION

Wolf (*Canis lupus*) ecology studies in the southwestern Yukon were initiated in 1983 (Hayes et al. 1985) in response to increased predation on domestic livestock, low moose (*Alces alces*) calf survivorship (Larsen 1982, Markel and Larsen 1983), and a regional moose population decline (Johnston and McLeod 1983). Wolf predation on domestic livestock and pets in the Whitehorse area increased sharply in 1982 (Hayes et al. 1985). In response, the Yukon Government initiated various programs to reduce wolf numbers near Whitehorse and throughout the southwestern Territory. Removal techniques included snaring, trapping, poisoning, and government and private aerial hunting. Government poisoning and aerial hunting were restricted to local areas surrounding the City of Whitehorse. Beginning in January 1983, wolf population data were collected in order to census the resident wolf population in the area, document basic wolf ecology, and predict the potential effects of wolf predation on wild ungulate populations.

Results from the first year of studies (Hayes et al. 1985) showed a wolf density of 84 sq km/wolf, similar to densities of naturally-regulated wolf populations in interior Alaska (Haber 1977, Gasaway et al. 1983). Incidental collection of wolf prey remains, and initial wolf telemetry studies suggested moose were a primary prey species. A ratio of 8-12 moose/wolf was found, suggesting wolves were likely causing moose numbers to decline in the area, based on moose/wolf ratio criteria developed by Gasaway et al. (1983).

In 1982-83, 44% (n=42) of the wolves were removed from a 7650 sq km study area; a substantial number (n=35) were also killed on the study area perimeter near Whitehorse. Most killed wolves (86%) were young, including juveniles (pup), yearlings and 2-year-olds. The majority of the wolves killed were taken by trappers and hunters. Government aerial hunters took mostly wolves near Whitehorse in response to public complaints (Hayes et al. 1985).

Between 20 May 1983 and 30 May 1984, Larsen and Gauthier (in prep.) conducted moose calf mortality studies in 2 areas of the southern Yukon, including the Coastal Mountains and the Teslin Burn. The annual mortality rate of collared and uncollared calves was 91% in the Coastal Mountains (Larsen and Gauthier in prep.) and 76% in the Teslin Burn (Larsen pers. comm.). Predators were the most important mortality agent in both areas, being responsible for 95% of the 54 collared calf mortalities in the Coastal mountains, and 100% of the 10 deaths in the Teslin Burn. Grizzly bears (*Ursus* arctos) killed the greatest proportion of instrumented calves in the Coastal Mountains (63%) and Teslin Burn (50%). Wolves were less important, killing 26% in the Coastal Mountains and 40% in the Teslin burn. Black bears (U. americanus) and unknown predators (wolf or bear) accounted for most of the remaining mortalities (Larsen and Gauthier, in prep.).

In response to the moose population decline and the problem of limited calf recruitment, Larsen and Gauthier (1985) proposed an experimental moose recovery program. Using a spatial design, they proposed 4 prescription areas: a 70% wolf-only reduction area (Haines Junction), a 70% wolf and 50% grizzly bear reduction area (Whitehorse/Carcross), a 50% grizzly bear-only reduction area (Teslin), and a control area (Kluane) (Larsen and Gauthier in prep.).

A 3 year, 70% reduction in the wolf population was proposed to commence in winter 1983-84 in a 11 200 sq km area, including the Haines Junction and Whitehorse blocks. As part of this predator reduction experiment, The long-term goals of wolf studies are:
1) to measure wolf predation rates on large ungulates before, during and following 70% wolf reduction,
2) in conjunction with moose, Dall's sheep (Ovis dalli), and woodland caribou (Rangifer tarandus caribou) studies, measure the impacts of reduced wolf numbers on resident ungulate populations and,
3) to document changes in wolf demography, breeding ecology, and territorial spacing during the study period.

This paper reports and discusses wolf reduction, population dynamics, and wolf predation studies conducted between 1 May 1983 and 1 April 1984. Results from 1982-83 wolf studies are found in Hayes et al. (1985).

OBJECTIVES

The objectives of wolf studies in 1983-84 were:

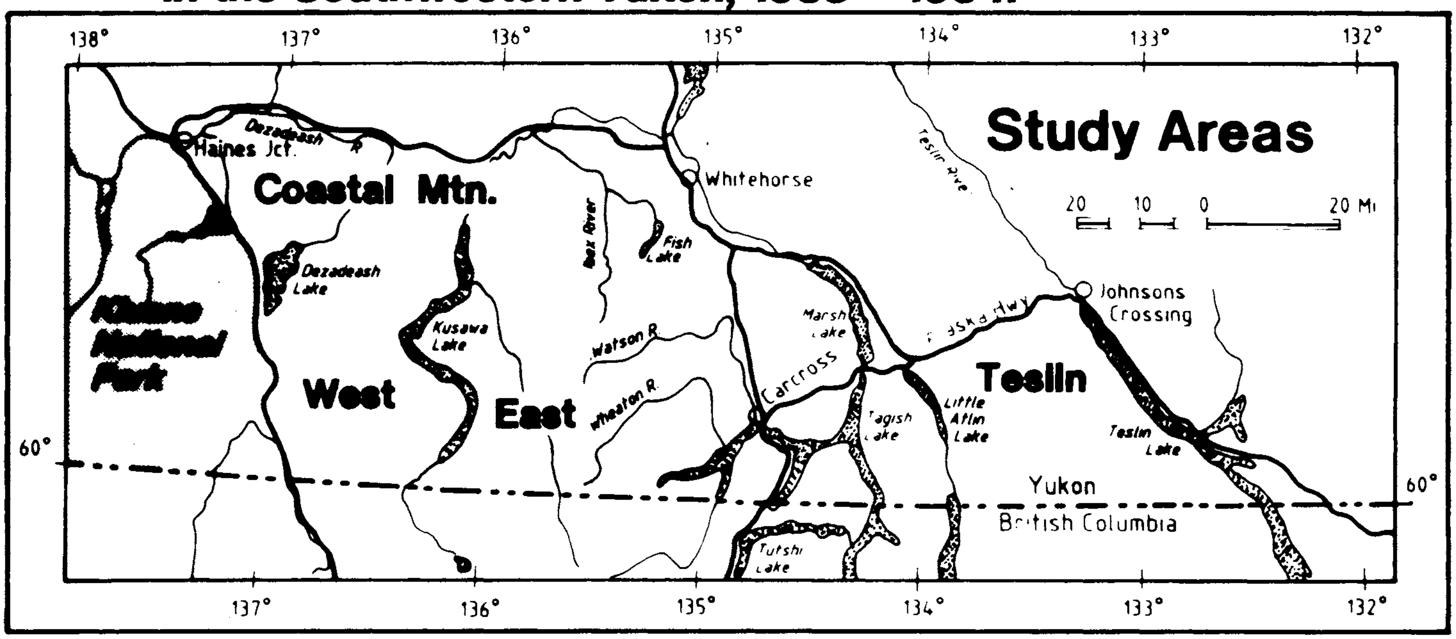
1. to aerially census the mid-winter wolf populations in the Coastal Mountain and Teslin Burn wolf study areas and determine the ratio of wolf/moose in both areas.
2. to radio-instrument 1 adult male wolf from each pack observed in the CM study area.
3. to determine the territorial spacing and predation rates of radio-equipped wolf packs in summer and late winter.
4. to determine species, age, and sex composition of all wolf-killed ungulates during the study period.
5. to reduce wolf numbers to 30% of the original pre-reduction level in the Coastal Mountain study area

and document wolf age and sex composition, morphology, physical condition, and radio-cesium levels of removed wolves.

STUDY AREAS

Wolf studies were conducted in two areas of the south-western Yukon; the 11 200 sq km Coastal Mountain (CM) study area and the 2580 sq km Teslin Burn study area (Figure 1).

Fig. 1 : The Coastal Mountain and Teslin Burn Wolf Study Areas in the Southwestern Yukon, 1983 – 1984.



1. COASTAL MOUNTAIN (CM) WOLF STUDY AREA

In 1982-83, wolf studies were initiated in a 7650 sq km area of the southwestern Yukon (Hayes et al. 1985). In 1983-84, the Coastal Mountain (CM) study area was expanded to include all of Game Management Zone 7 (GMZ) (Figure 1). A 1620 sq km area studied in 1982-83 (Game Management Sub-zones 9-01 to 9-05) was deleted from the 1983-84 wolf study area for logistical reasons. The 4890 sq km area of GMZ 7 (CM West) added to the wolf study area is a portion of the Yukon Coastal Mountain ecoregion (Oswald and Senyk 1977). The physiography, vegetation and climate are similar to the CM East study area described by Hayes et al. (1985). The Haines Road forms the western boundary of the study area, and the B.C-Yukon border the southern boundary; the northern border follows the Alaska Highway between Haines Junction and the Carcross Road, and the eastern boundary follows the Carcross Road to the western shore of Bennett Lake.

Kusawa Lake divides the CM East and West study areas. Dezadeash Lake and its drainages form the major watershed of CM West. Similar to CM East, the majority of the CM West terrain is above timberline (1050-1500 m) except for the western edge, where extensive lodgepole pine (*Pinus contorta*) and white spruce (*Picea glauca*) forests dominate the Dezadeash Lake lowlands and the Shakwak Valley.

The study area climate is semi-arid, influenced by the orographic rainshadow effects of the Coastal Mountain Range. Precipitation generally decreases from south to north in the study area. Snow accumulations average 431 cm (172 inches) at the Mule Creek station in the southwestern corner of the study area, 136 cm (54 inches) at Haines Junction, and 127 cm (51 inches) at Whitehorse (Department of the Environment, Atmospheric Environmental Services). Snowfall in 1983-84 was exceptionally low throughout the study area. In Whitehorse, a record low snowfall of 9.2 cm was recorded during the month of December. In total, 96 cm of snow fell between November 1,1983 and 1 April 1984; 25% less than the normal accumulation. At Mule Creek the winter snowfall was 47% below normal.

1A. UNGULATE POPULATIONS

Hayes et al. (1985) described prey populations in CM East. The composition of ungulate species in CM West is similar, with the exception that woodland caribou are not present. Johnston and McLeod (1983) documented a 19% decline in moose numbers between fall 1981 (Larsen 1982) and 1982 in CM West. They estimated between 527-757 (90% C.I.) moose in CM West and 1256-1658 (90% C.I) moose in the entire CM study area in 1982, using the ratio estimator technique (Gasaway et al. 1981). Dall's sheep numbered about 1200 in CM West, and 4000 over the entire CM study area (Barichello, pers. comm.). An estimated 200 mountain goats (*Oreamnos americanus*) are scattered in small groups throughout the southern portion of the study area from Bennett Lake to the Haines Road, concentrated mainly along the B.C.-Yukon border (Barichello, pers. comm.).

2. THE TESLIN BURN (TB) WOLF STUDY AREA

The 2580 sq km Teslin Burn wolf study area (Figure 1) is a part of the Lake Laberge Ecoregion (Oswald and Senyk 1977), characterized by dissected plateaus and low mountains. Most major valleys are poorly drained, and small lakes are common throughout. Mountains are lower (1200 m) and more rounded than in the Coastal Mountain study area. Most of the TB study area was burned in 1958 and the present seral community is mainly comprised of willow (*Salix sp*) shrub communities, lodgepole pine in early successional stages, and unburned tracts of white spruce scattered throughout. In many valleys, fire-killed deadfalls are thick along the mountain shoulders and valley bottoms, providing good cover for moose. Teslin Lake and the Alaska Highway form the northern boundary, the Atlin Road the western boundary and the Yukon-B.C.border the southern boundary. The eastern edge of the study area follows the Fat Creek drainage to Teslin Lake.

The long-term average winter temperature at Teslin is -14.0 C, similar to Whitehorse (-13.6 C). Snowfall is normally about 64.7 cm.

2A. UNGULATE POPULATIONS

Markel and Larsen (1984) calculated a density of 0.43 moose/sq km of habitable moose range in the Teslin Burn. The estimated moose population was about 1000 animals and has remained stable since stratified moose surveys were initiated in the area in 1980 (Larsen, pers. comm.). The successional willow shrub storey provides excellent browse for moose, and the Teslin Burn moose population represents the densest population recorded in the Yukon (Larsen, pers. comm.).

A small woodland caribou herd occupies the southern portion of the study area (Larsen 1979). The herd calves in alpine areas along the Yukon-B.C. boundary, moving to a traditional riparian wintering area near Gladys Lake, B.C. No sheep are present, but mountain goats have been reintroduced in the northwestern corner of the study area in 1983 and 1984 (Barichello and Carey, in prep.).

METHODS

1. WOLF INVENTORY

Aerial wolf census procedures were previously described by Stephenson (1978) and Hayes et al. (1985). A minimum of 5-10 cm of fresh snow, followed by high contrasting sunlight, is critical to the success of wolf track surveys. Ideally, aerial wolf surveys should be conducted over a short period using multiple aircraft to ensure pack duplication does not occur (Stephenson 1978). In 1982-83, our experience with Cessna 185 aircraft showed this aircraft type was unsuitable for wolf track surveys due to its limited low speed capabilities (Hayes et al. 1985). In 1983-84, a more suitable Supercub (PA 18) was used for wolf surveys, resulting in more successful tracking flights. Only a single Supercub aircraft was commercially available, limiting our ability to intensively fly large survey blocks in a short period. Also, the tendency of wolves to travel in the alpine zone made it difficult to cover large areas during periods of ideal tracking conditions, for alpine trails became windblown shortly after snowfalls. Consequently, the CM study area was surveyed between 21 December and 1 April, using a single aircraft in comparatively small survey blocks. The size of the area covered depended upon the duration of suitable snow and weather conditions for tracking. Most of the study area was flown on a minimum of 3 occasions, and certain regions, where tracking conditions were particularly difficult, were flown more often. Surveying was most difficult in the northern half of the study area where snow accumulation was lowest.

The Teslin Burn study area was aerially censused during 2 periods: 4 to 9 December, and 8 to 12 February. Surveys were conducted in a Maule Lunar Rocket 5 fixed wing aircraft. Both authors, experienced in wolf census techniques in 1983, conducted all CM and TB study area surveys.

Pack size was estimated by various methods. Some packs were radio instrumented and group size recorded on multiple occasions, some non-instrumented packs were observed only once, and others were estimated from multiple observations of trails. The mid-winter inventory represents a minimum population count.

2. WOLF REDUCTION

Wolf reduction was carried out by government aerial hunters, trappers, and resident hunters. In an effort to increase trapper harvest of wolves, a 200 dollar incentive was offered to trappers in 1983 for each wolf taken; the incentive was continued into 1984 (Jessup, in prep.). Aerial wolf reductions began in CM West in January 1984, but were postponed in CM East until 15 March to allow for uninterrupted wolf predation rate studies (this report), and radio-collared cow moose and calf mortality studies (Larsen and Gauthier, in prep.). Wolves were shot by a helicopter crew using 12 gauge shotguns, then retrieved, skinned, dressed, and marketed. In most cases, aerially shot wolf packs were previously radio-marked. Once their general home ranges were established, all members were removed except the radio-instrumented wolf. The total wolf harvest was determined by adding the number of wolves aerially shot and the number of reported wolves taken by trappers and hunters during the winter period.

Carcasses were necropsied following procedures outlined by Stephenson (pers. comm.), Nielsen (1977) and Hayes et al. (1985). Teeth were sectioned and cementum annuli counted (Stephenson and Sexton 1974, Hayes et al. 1985), and female reproductive tracts were examined for placental scars, corpora lutea and corpora albacantia (Hayes et al. 1985).

3. WOLF CAPTURE AND TELEMETRY

Wolf capture and telemetry procedures were described by Hayes et al. (1985). In addition to helicopter collaring techniques, wolves were live-captured with No. 4 1/2 Newhouse leghold traps (Woodstream Corp. Niagara Falls, Ontario) modified with padded, offset jaws. Traps were set following techniques by E. Kowal (Saskatchewan Department of Renewable Resources, pers. comm.). Wolves were also live-captured with Thompson (Raymond Thompson Co., Lynwood, Washington) wolf snares, modified to stop the loop closure at 350 mm (14 inches). Snare setting followed procedures by D. Grangaard (Alaska Dept. of Fish and Game, pers. comm.). All wolves were instrumented with fibreglass- reinforced Telonics (Mesa, Arizona) radio collars.

In winter, the locations and activities of radio-instrumented wolves were monitored from a PA-18 supercub in the CM study area, and a Maule Lunar Rocket 5 in the TB study area, using a receiving system comprised of a Telonics TR-2 receiver, TS-1 scanner and wing-mounted H-antennae. In summer, wolf relocations were made from a Hughes 500D helicopter equipped with a receiver-scanner, attached to Yagi antennae.

The analysis of home range was carried out using Mohr's (1947) minimum polygon method.

4. PREY SELECTION

To provide an initial assessment of prey selection by denning wolves in the study area, 66 scats were collected from the Alligator pack densite on 2 August.

We followed the movements and monitored ungulate prey selection of the non-denning Primrose pack from 15 May to 16 July. Wolf observations were made in conjunction with a summer moose calf mortality study (Larsen and Gauthier, in prep.). We initially attempted to maintain daily visual contact with the pack, however, wolves invariably ran as the helicopter approached making it difficult to determine their pre-contact activities. As a result, wolf sightings were not intentionally made unless radio-locations suggested the pack had remained in a local area for more than 2 days. If this occurred, a systematic aerial search was made to locate any large mammal kills. The detection of wolf-killed calf moose would, under normal circumstances, be almost impossible to detect with aerial monitoring methods, for moose calves killed by large predators are often completely consumed in a few hours (Ballard et al. 1981, Peterson et al. 1984). From documenting the Primrose pack's territorial movements during summer, and the distribution of radio-instrumented calves, we were able to identify a minimum of 39 radio-instrumented calves which were potential prey for this pack (Larsen and Gauthier in prep.). Calf kill rates during summer are based on the presence of the pack at, or near, instrumented calf mortality sites. The cause of calf mortality was determined by following techniques described in Larsen and Gauthier (in prep.).

Winter predation rate studies of 2 radio-instrumented packs were conducted between 5 February and 1 April in the CM East study area, and a single pack in the TB study area was monitored between 8 February and 31 March (see telemetry procedures). Predation rate studies have employed various radio telemetry techniques to determine wolf kill and consumption rates. Mech (1977) and Stephenson (1978) calculated kill rates by assuming the average number of kills observed per relocation flight represented the mean daily kill rate. Fuller and Keith (1980) followed 1 wolf pack daily and used that kill rate to calculate rates for other packs studied at average intervals from 2 to 6 days. Other researchers (Oosenbrug and Carbyn 1982, Carbyn 1983, Peterson et al. 1984, Messier 1984) calculated predation rates by intensive aerial monitoring. We determined rates by regular, intensive monitoring over a two month, late-winter period. Two bordering packs in the CM study area, the Kusawa and Primrose packs, and the Snafu pack in the Teslin Burn study area were monitored. The activities and movements of the 5-6 member Primrose pack were aerially monitored during the period 6 February to 29 March. Intensive ground surveillance was conducted on 1 CM pack (Primrose) in conjunction with aerial observations, using techniques modified from Oosenburg and Carbyn (1982) and Carbyn (1983). The Kusawa pack was observed daily from aircraft between 5 February and 1 April. Observations were made on all days but 3, and we are confident all kills made by both packs were detected during the study periods. We chose to monitor the 2 CM study packs at daily intervals because we anticipated that Dall's sheep kills, being small in size, could be consumed in 1 day. In the TB study area, the 4-7 member Snafu pack was observed on 33 days between 8 February and 29 March, for an average of 1.6 days between relocations. Given moose was the most common prey species, and other studies (Fuller and Keith 1980, Peterson et al. 1984) showed the average interval between winter moose kills for packs >2 wolves was 4.7 days, we expected all kills made by this pack were observed.

Wolf pack kill rates were calculated by following packs until they made their first kill. From that day until the last kill date, the mean interval between kills was calculated. To estimate the period the last kill supported each pack, the mean interval between kills was added to the period between first and last kills, and daily wolf consumption rates were derived from this total period. Had we not incorporated this additional, projected consumption period for the last kill, we would over-estimate kill and consumption rates.

Calculation of consumption rates, expressed as kg/kg of wolf/day, were made by averaging known late winter body weights of 68 southwestern Yukon wolves. The percentages of biomass weights available for wolf consumption were 75% for moose (Peterson 1977, Fuller and Keith 1981, Peterson et al. 1984), 85% for Dall's sheep rams, and 95% for ewes. The difference between rams and ewes was based on horn weights. Schaller (1977) estimated horns account for 10-11% of male North American wild sheep weight; we assumed no measurable weight for female horns.

After a kill was located by air, or wolf activities suggested a kill had been made, the site was visited by a ground crew. The investigation occurred only after the pack moved away from the area to ensure ground activities did not influence prey utilization or abandonment. We were confident no pack displacement occured as a result of our activities.

In addition to kills made by radio-instrumented wolf packs, other moose kills were incidentally found during wolf surveys. Criteria used to determine whether a kill was made by wolves and not scavenged were: 1) the presence of tracks and blood spoor suggesting wolves attacked the prey, 2) the presence of significant amounts of blood near the site showing wolves fed on the animal at, or near the time of death, and 3) the orientation of the carcass and articulation of its legs. If a carcass being fed upon by wolves was in a recumbent, kneeling position, we assumed the cause of death was not wolf predation. If the carcass was in a laying position with legs splayed, and other sign suggested wolf predation, we assumed it was killed by wolves.

At each ungulate kill site, the kill sequence was interpretated by track and blood spoor. The percentage of carcass consumed was estimated, and habitat information recorded. Sex was determined by antler pedicel presence on moose kills, and by horn size for Dall's sheep. Whenever possible, an incisor bar was collected to determine age (Sargent and Pimlott 1959), and a long bone was collected to assess marrow fat content (Neiland 1970).

We also indirectly assessed prey selection by collecting 1 kilogram of muscle tissue from one or more members of most removed packs. Using radio-cesium (Cesium 137) techniques (Holleman and Stephenson 1981), D. Holleman of the Institute of Arctic Biology, Fairbanks, analyzed tissue samples to determine the levels of Pci/kg.

RESULTS AND DISCUSSION

1. WOLF INVENTORY

a. Coastal Mountains Study Area.

The minimum CM study area population was 125 wolves in mid-winter, including 113 in packs and 12 lone, or unaffiliated wolves (Table 1). Lone wolves were not directly counted; we assumed unaffiliated wolves, including dispersing subadults and adults not in packs, represented 10% of the pack population, based on other studies (Stephenson 1978, Gasaway et al. 1983).

Table 1. Wolf population inventory data in mid and late winter, 1983-84.

	AREA		
	CM WEST	CM EAST	TOTAL
number of packs	7	10	17
wolves in packs	56	57	113
lone wolves	6	6	12
total in area	62	63	125
number killed	27	28	55
number alive	35	35	70
1983 % killed	31.0	44.0	37.5
1984 % killed	43.5	44.4	44.0
Wolf Density (sq km/wolf)			
mid winter	79	100	90
late winter	140	186	162

A total of 17 packs resided in the study area (Figure 2, Table 2). Pack sizes ranged from 3 to 19 wolves, and the average pack sizes were 5.7 (SD=2.1) wolves in CM East and 8.0 (SD=5.3) in CM West; not significantly different between areas ($p > .05$). However, the mean pack size in CM East was significantly smaller ($p < .05$) than the 1982-83 average of 8.6 (SD=3.5) wolves per pack. This portion of the study area received a 44% wolf reduction in 1982-83 and the smaller packs observed this year was undoubtedly related to human exploitation.

Table 2. The membership of 17 known wolf packs in the CM study area, mid-winter 1983-84.

AREA	PACKNAME	NO. OF WOLVES	SOURCE*
CM EAST			
	Arkell	9	Tr
	Ibex	3	Rc
	Kusawa	8	Rc
	Alligator	7	Rc
	Rose Lake	3	Tr,Tp
	Primrose	6	Rc
	Hodnett L.	4	Tr
	Takhini L.	7	Tr
	Wheaton R.	7	Tr
	Black L.	3	Tr,Tp
	Subtotal	57	
CM WEST	Haines Jct.	7	Tr
	Granite L.	3	Vs,Tr,Tp
	Mt. Kelvin	10	Vs,Tr
	Jo Jo L.	6	Rc
	Dezadeash	6	Tr
	Takhanne	19	Tr,Tp
	Ark Mt.	5	Rc
	Subtotal	56	

* Tr indicates pack was enumerated by trail counts.
Rc indicates pack contained a radio-instrumented wolf.
Tp represents trapper observation of pack.
Vs represents a visual sighting of pack by survey crew.

Mid-winter wolf density was 79 sq km/wolf in CM West and 100 sq km/ wolf in CM East.

Pack size was determined by various techniques (Table 2). Six packs were radio-instrumented and pack size observed on various occasions. Two packs were seen only once and 9 packs were not seen, but pack size was estimated from at least 3 separate observations of trails.

b. Teslin Burn Study Area

The minimum wolf population in the TB study area was 47 animals in mid-winter, representing a density of 55 sq km/wolf. A total of 6 wolf packs occupied the area (Figure 3, Table 3), ranging from 4-10 wolves per pack. Average pack size was 7.1 (SD=2.7) wolves. Of the 6 packs, the Snafu pack was radio-instrumented and counted on numerous occasions, the McLeary Creek pack was seen once and the pack's trails observed on 3 survey flights. The Dalayee, Border, and Teslin Lake packs were estimated from 3 separate trail

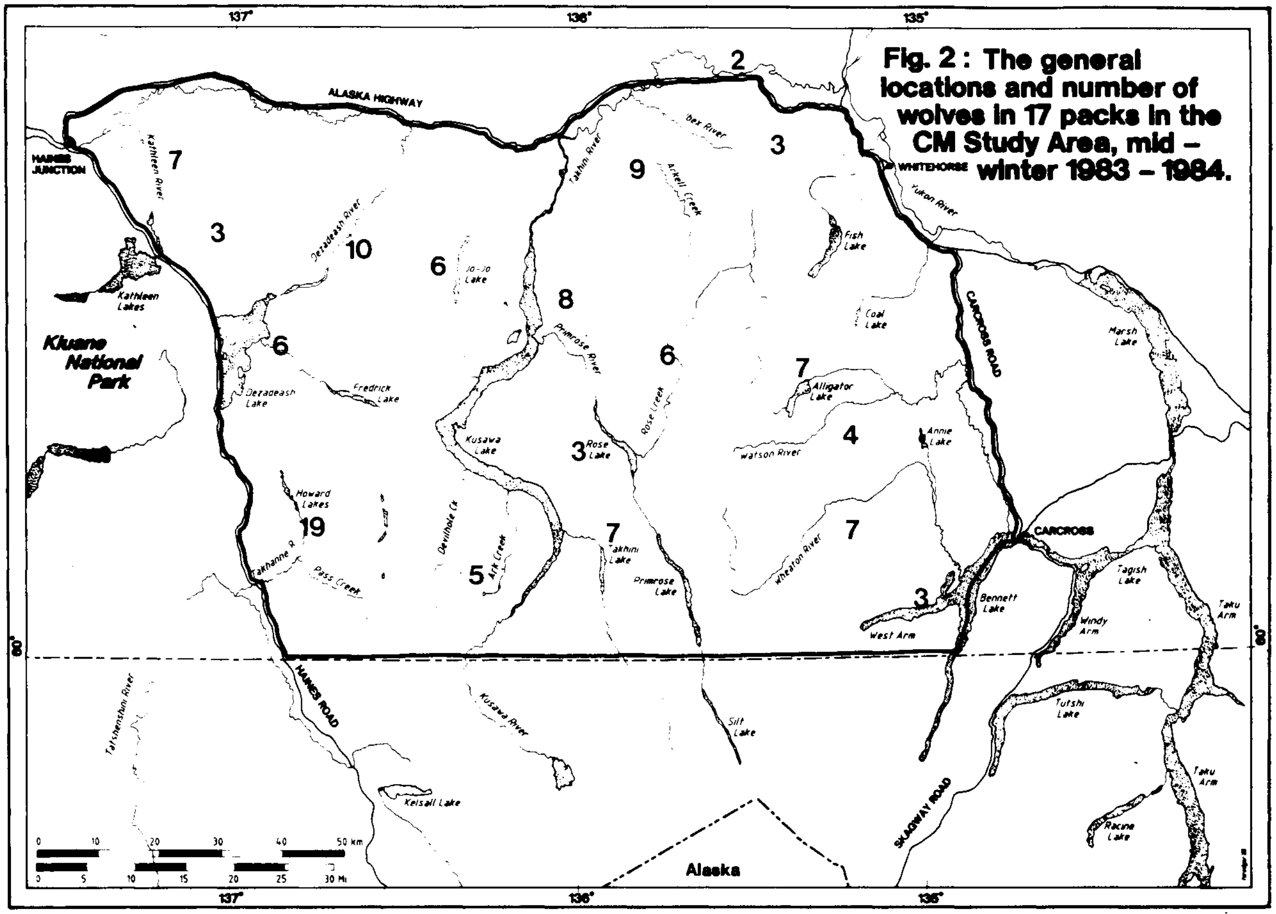


Fig. 2 : The general locations and number of wolves in 17 packs in the CM Study Area, mid – winter 1983 – 1984.

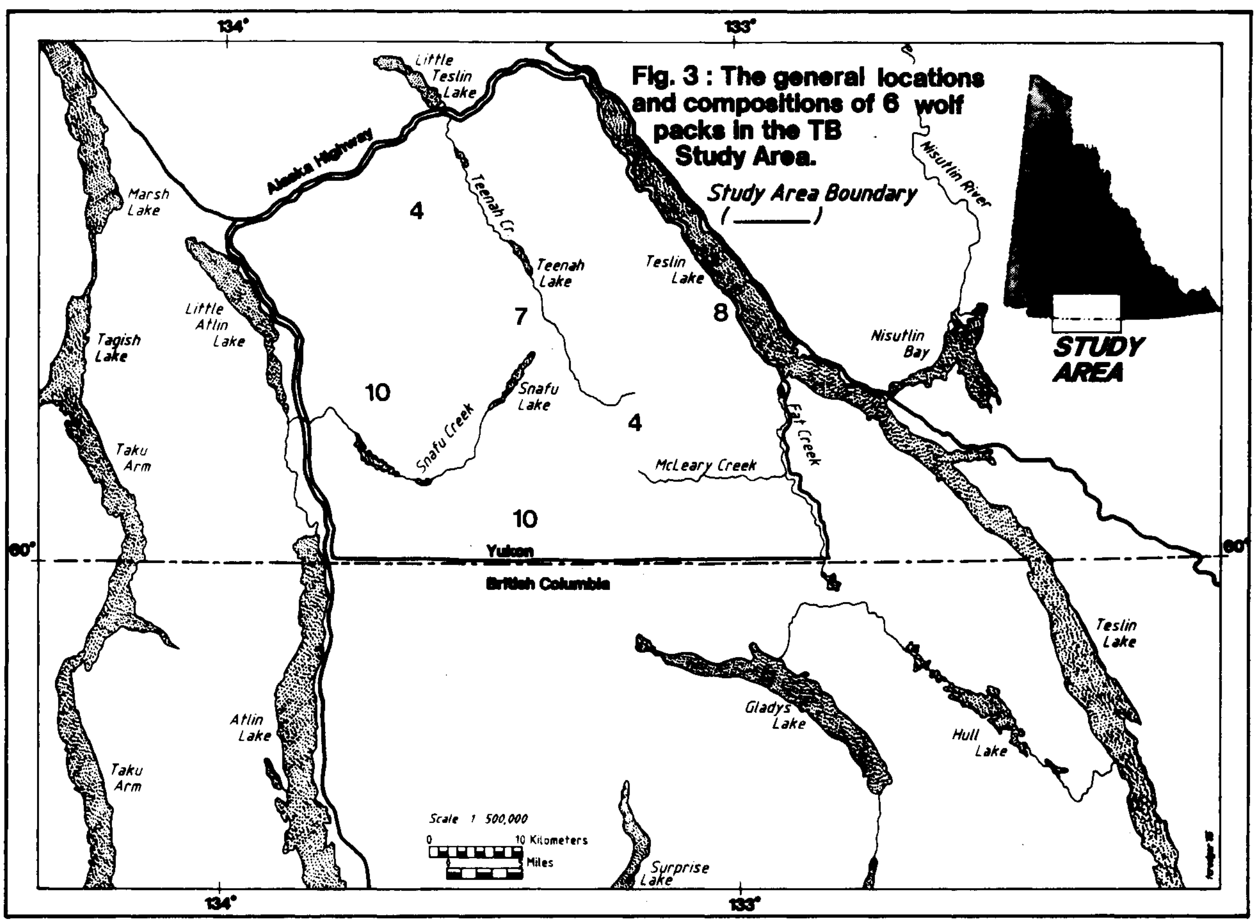


Fig. 3 : The general locations and compositions of 6 wolf packs in the TB Study Area.

observations each, and the Tarfu pack was estimated from a single 25 km trail.

Table 3. A summary of wolf population inventory in Teslin Burn wolf study area, 1983-84.

PACKNAME	NO. OF WOLVES*
Dalayee	4
Snafu	7**
Bryde Mt.	10
Tarfu	10
McCleary Ck.	4
Teslin	8
Total pack wolves	43 + 4 lone wolves
Minimum total	47 wolves

* The number of wolves in each pack is a minimum value.
** Denotes a radio-marked individual in pack.

2. WOLF REDUCTION

In CM West, 27 of 62 (43.5%) known wolves were removed between January and April, 1984. Twenty-eight of 63 (44%) wolves were also killed in CM East, bringing the total CM reduction to 55 wolves; or 44% of the 1983-84 mid-winter population (Table 1). Trappers and hunters reported a harvest of 21 wolves and government aerial hunters took 34 (Figure 4) from 7 discrete packs.

A reduction of 70% of the original 1982 wolf population was the upper limit removal target. Based on an original density estimate of 82 sq km/wolf*, we estimated that about 134 wolves were present in the CM study area before the 1982-83 reduction (Hayes et al. 1985). In early winter 1983-84, 125 wolves were present; by late winter 70 survived (Table 1). This represents an 48% reduction from the original study population.

Wolf density fell from 79 sq km/wolf in early winter to 140 sq km/wolf in late March in CM West; in CM East density fell from 100 to 186 sq km/wolf. Over the entire study area, density fell from 90 to 162 sq km/wolf by late winter (Table 1).

The 44% wolf reduction documented in CM East in 1982-83 (Hayes et al. 1985) was apparently sufficient to reduce wolf numbers in early winter 1983-84. The pre-reduction population estimate for the area was 73 wolves in 1982-83, reduced to 41 by late winter. By early winter 1983-84, wolf numbers had increased to 63; a rate of increase of 1.54.

* this figure was derived by taking the mid-point between the 1982-83 density estimate of 84 sq km/wolf in CM East and the 78 sq km/wolf in CM West in 1983-84.

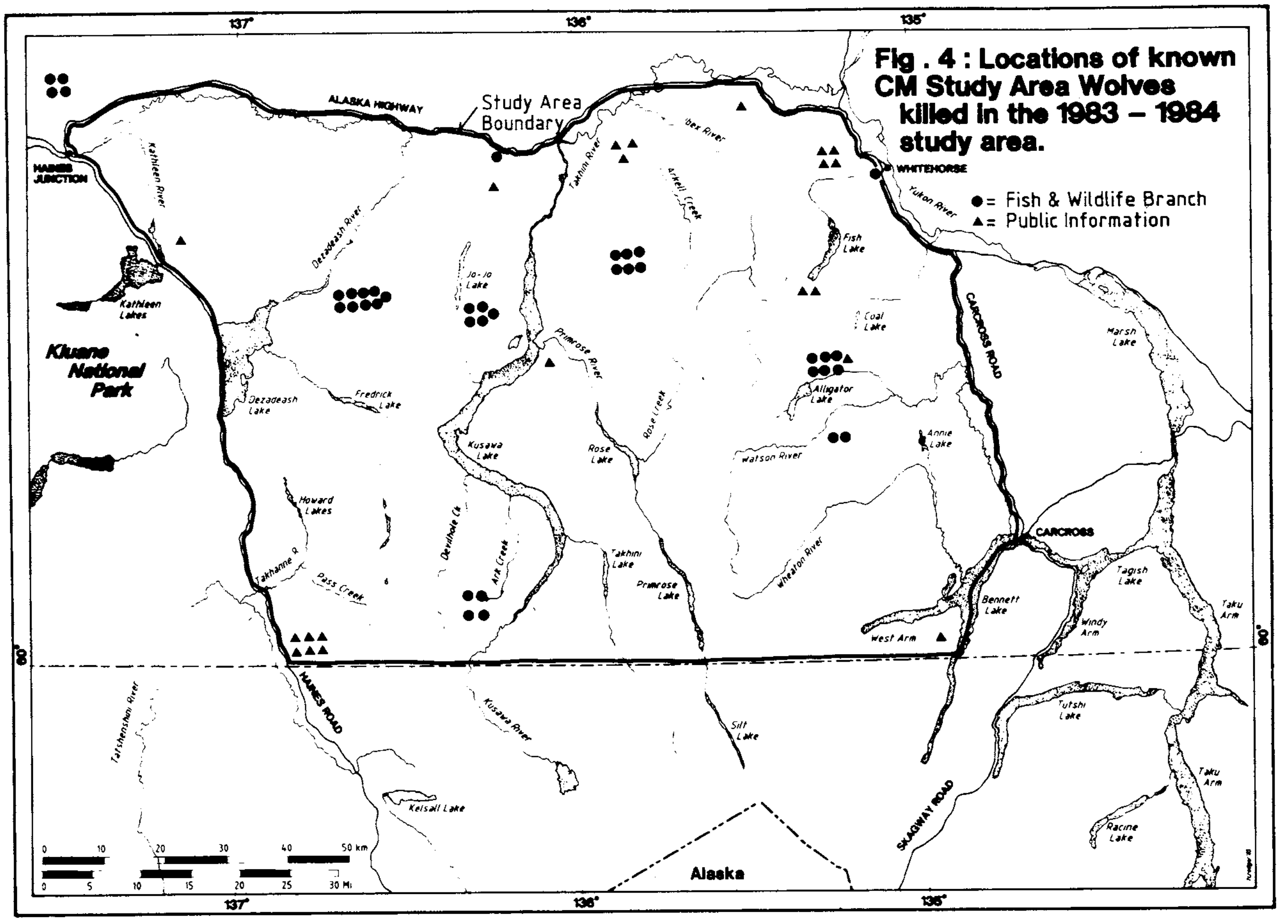


Fig. 4 : Locations of known CM Study Area Wolves killed in the 1983 – 1984 study area.

Keith's (1983) analysis of rates of increase observed in 6 wolf populations showed mean finite rates of increase ranging from 1.15 to 1.46. Our observed rate was higher but may be related to the small area where wolf reduction was carried out in 1982-83. Given that the surrounding wolf population was naturally regulated and egress of subadults from these areas was normal, the vacant wolf habitat in the CM study area should be repopulated more rapidly than larger removal areas.

Because no systematic wolf survey was conducted in CM West in 1982-83, we can only speculate on the population effects of the harvest that year by knowing the reported minimum harvest and measuring density in 1983-84. Eighteen wolves were reported taken in 1982-83. Given that the 1982 early winter wolf density in CM West was similar to density in CM East (84 sq km/wolf, Hayes et al. 1985), we expect about 31% of the wolves were removed from CM West in 1982-83. Keith (1983) predicted a minimum annual reduction of 38% was necessary to cause a wolf population to decline. The estimated 31% reduction in CM West was apparently not sufficient to lower wolf numbers in early winter 1983-84, when a density of 79 sq km/wolf was observed.

Moose/Wolf Ratios

In Alaska, where moose were the primary prey of wolves, Gasaway et al. (1983) predicted that moose populations declined due to wolf predation when moose/wolf ratios were less than 20 moose/wolf. Based on ranges of moose population estimates for the study area (Markel and Larsen 1984), we predicted a ratio of between 13-20 moose/wolf in CM East and 7-12 moose/wolf in CM West, in mid winter 1983-84. In 1982-83, the ratio was 8-12 moose/wolf in CM East (Hayes et al. 1985). The increased ratio in 1983-84 was due to a reduced wolf population in CM East (see wolf inventory results), for Markel and Larsen (1984) did not observe an increase in moose numbers in the area between 1983 and 1984. These ratios suggest mid-winter CM wolf numbers were large enough to cause moose population declines in both areas. In CM West, where the ratio was lowest, moose declined by about 20% from 1982 (Markel, pers. comm.). However, in CM East, there has been no detectable decrease in moose numbers since 1981 (Markel, pers. comm.). While moose census data suggests stability, the variance confidence limits are wide, such that small annual declines in numbers cannot be detected.

Following wolf reduction in late winter, the moose/wolf ratio* increased to 12-21 moose/wolf in CM West and 25-39 moose/wolf in CM East. From these values we predict the moose population in CM East is not declining, and, in CM West, moose may be stabilized or continuing to decline due to wolf predation.

In the TB study area, moose numbers have remained stable since the 1982 census (Markel, pers. comm.) From moose survey results in fall 1983 (Markel and Larsen 1984), we determined a late winter ratio between 16-28 moose/wolf. From this range, we predict the moose population was probably stable, but perhaps declining due to wolf predation and other mortality factors.

3. CHARACTERISTICS OF KILLED WOLVES

Of 34 aerially-shot pack wolves, 27 were retrieved and necropsied. Four of 21 wolves reported killed by trappers and hunters were collected. Their pack affiliations were unknown.

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* We assumed that moose numbers did not decline substantially from the December 1983 survey period to March 1984.

Age and Sex Composition

The age composition of pack wolves in Table 4 includes wolf specimens aged by tooth cementum techniques and radio-instrumented wolves of known age classes.** In total, we were able to assign age classes to 39 pack wolves, including 32 dead wolves, 6 live radio-collared wolves, and 1 additional wolf. The largest age class was juvenile (pups), representing 42.5%, followed by yearling at 17.5% and 2-year-old at 10%. Adult wolves 2 years and older accounted for 38% of the sample. The oldest wolf was a 12 year old.

Table 4. Wolf harvest statistics from known pack wolves killed in the study area in winter 1983-84.

	No. of Wolves			Age Composition								
Pack Name	In Pack	Killed	Retrieved	Pup	Yrling	2 yr.	3 yr.	4 yr.	6 yr.	7 yr.	12 yr.	Adult*
Alligator	7	7	2	4		1				1"	1"	
Ark Creek	5	4	4	2	1		1					1"
Jo Jo	6	5	5	3	1				1			1"
Kelvin	10	9	8	5	3							2*/*
Kusawa	7	5	5	3"		2		1				1
Ibex	3	2	2		1	1						1"
Granite	3	1	1		1"							
Pack totals	42	34	27	17	7	4	1	1	1	1	1	6
Percentages		81%	64%	42.5%	17.5%	10%	2.5	2.5%	2.5%	2.5%	2.5%	17.5%

* 3 unknown age adult male wolves were radio-instrumented but not killed; all 3 were alpha males. Another adult male from the Kusawa pack was not collared, but survived with a radio-instrumented male pup.

" denotes a radio-collared wolf.

/ Eight of the 10 wolves in the Kelvin pack were collected and aged. Of the remaining 2 wolves, 1 was shot but not retreived and another escaped. It is presumed that these 2 were the adult alpha male and female of the pack. They are classified as unknown age adults.

Table 5 compares data from wolves of known sex and age in 1982-83 (Hayes et al. 1985) and 1983-84. There was no significant difference (p>.05) in the sex and age class ratios between years, although females declined from 63% to 49% and males increased from 37% to 51%. Juvenile wolves represented the largest age class in both years; 34% of the 1983 collection and 39% in 1984. The proportion of adults greater than 24 months old increased only slightly from 38% to 44% in 1984.

Reproductive History

Five of 19 female wolves (26%) showed historical reproductive activity. Reproductive females ranged from 2 to 6 years old and only one female greater than 2 years old showed no historic or recent reproductive activity. Three females showed recent placental scars from the 1983 breeding

** Tooth samples were not collected from radio-instrumented wolves but ages were estimated by carnassial tooth wear, canine eruption, tooth coloration and breakage.

Table 5. Age and sex of wolves studied in 1983 and 1984 in the CM study area.

YEAR	1982-83	1983-84	PERCENTAGE CHANGE (1984)
Number of wolves sexed	38	39	
Number and (%) of males	14 (37%)	20 (51%)	14%
Number and (%) of females	24 (63%)	19 (49%)	-14%
Number of wolves aged	38	43	
Number and (%) of juveniles (<12 months old)	13 (34%)	17 (39%)	5%
Number and (%) of yearlings (>12 and <24 months)	11 (28%)	8 (19%)	-9%
	Adults		
Number and (%) of 2 yr. old (>24 and <36 months)	9 (24%)	5 (12%)	-12%
Number and (%) of 3 yr. old (>36 and <48 months)	4 (11%)	2 (5%)	-6%
Number and (%) of 4 yr. old (>48 and <60 months)	1 (3%)	2 (5%)	2%
Number and (%) of 5 yr. old (>60 and <72 months)	0	0	
Number and (%) of 6 yr. old (>72 and <84 months)	0	1 (2%)	2%
Number and (%) of 7 yr. old (>72 and <84 months)	0	1 (2%)	2%
Number and (%) of 12 yr. old (>84 and <96 months)	0	1 (2%)	2%
Number and (%) of unk. age ad. (>24 months ?)	0	7 (14%)	14%
Total Adults	14 (38%)	17 (44%)	

season and 2 females shot in April had developing fetuses. From scar and fetus counts, we calculated an average litter size of 5.2 (SD=2.7) pups. Two Kusawa pack females, a 4-year-old and a 2-year-old, showed recent breeding activity. The 4-year-old had 4 developing fetuses, but it could not be determined whether older placental scars were present. The 2-year-old had 10 recent placental scars indicating she reproduced as a yearling in 1982-83. The remaining reproductive females were from the Jo Jo, Ark Creek, and Alligator packs.

4. RADIO-TELEMETRY

Between 23 May 1983 and 21 March 1984, 9 wolves in the CM study area and 1 in the TB study area were radio-instrumented. Two were members of packs that had individuals instrumented in 1982-83 (Hayes et al. 1985). Table 6 summarizes biological and radio-frequency data of each instrumented wolf.

In total 7 males and 3 females were collared. Males included 5 adults and 2 juveniles and females included 1 adult, a juvenile and a yearling. Seven wolves were immobilized from helicopters, 2 were snared and 1 was captured in a leghold trap. Attempts were made to aerially

Table 6. Biological and radio-frequency information for radio-equipped wolves in the study area.

PACK NAME	NO.	STATUS**	SEX	AGE*	WT.(kg)	DATE	FREQUENCY
CM STUDY AREA							
Primrose	6	alpha	M	A	45	Feb /83 +	150.192
		subord	F	J	34	Feb /83 +	150.170
		subord	M	J	--	Mar /83 +	151.100
		?	M	A	--	May 26/83	151.830
Alligator	12	subord	M	Y	51	Feb /83 +	151.040
		subord	F	Y	43	Feb /83 +	151.000
		alpha	F	5	46	Mar /83 +	151.150
		alpha	M	4	50	May 23/83	151.121
Takhini	1	alpha	M	A	49	Mar /83 +	151.090
Sandpiper		subord	M	A	45	Mar /83 +	151.070
John's Wolf	1	?	F	A	25	Mar /83 +	151.050
Granite L.	3	subord	M	J	--	Nov 27/83	151.112
Jo Jo L.	6	alpha	M	5	55	Nov 27/83	151.221
Ibex Mnt.	3	alpha	M	4	48	Jan 5/84	151.180
Wheaton R.	7	subord	F	J	34	Jan 15/84	151.081
Kusawa	7	subord	M	J	45	Jan 23/84	151.821
Ark Creek	5	alpha	M	A	45	Feb 29/84	151.810
Trout L.		?	F	Y	39	Mar 21/84	151.191
TB STUDY AREA							
Snafu Lake	4-7 $	?	F	A	--	Feb 8/84	151.851

** alpha represents dominant status, subord is subordinate. Unknown status of individual is "?".

* J represents juvenile, Y is yearling and A is adult. Numeric designation is age in years.

+ represents wolves captured prior to this report period.

$ This pack numbered 7 at the time of capture but fell to 4 after the first several relocations.

dart the largest and most elusive pack members, presuming these were likely to be the breeding or dominant males in the packs (Hayes et al. 1985). Adult males were captured and collared in the Alligator, Ark Creek, Jo-Jo, Primrose, and Ibex Mountain packs. Based on criteria described in Hayes et al. (1985), we believe these were all alpha males.

One of the 10 radio instrumented wolves, a yearling male of the Granite Lake pack, sustained intestinal injuries from the dart penetration and died.

Of the previous 12 wolves collared in the winter of 82-83 (Hayes et al. 1985), 3 either dispersed or their collars became inactive and 5 died. Three of the deaths and 1 dispersal occurred prior to April 1983 (Hayes et al. 1985). Two wolves, the Takhini male (1090) and the John's female (1050), died during this report period (April 1 1983 to April 1 1984), and two Alligator pack members dispersed from the study area. Wolf 1000, a yearling female, left in early spring 1983 and a 2-year-old male (1040) dispersed in early January 1984. Both wolves were found alone on various occasions prior to leaving the pack.

Annotated histories of radio-instrumented wolves and associated pack members are presented in Appendix 1.

5. WOLF TERRITORIES

Seven radio-instrumented packs and 4 lone wolves were relocated during the study period (Table 7). We calculated annual home range sizes for 2 packs, the Alligator and Primrose, which were studied during summer and winter. Late winter home ranges were also documented for the Kusawa and the Snafu packs. All minimum home ranges of 6 CM study area packs are shown in Figure 5, and the 1 TB area pack in figure 6.

A limitation of plotting outermost observations to describe total home range of marked packs is the technique includes movements that are "outside" the core activity area. While the bordering areas may be socially important in maintaining contact with neighbouring packs, the inclusion of the areas inflate the size of territories. A better method is to estimate the relative importance of areas within a territory using percent use (Harestead 1977) to determine the most frequently occupied portions. This method is being developed for our wolf data, but is not presently available.

Two preliminary observations can be made regarding wolf territorial relationships. First, based on observations of other exploited wolf populations (Ballard et al. 1981, Peterson et al. 1984), we expect wolf territories will become unstable as the population is reduced. The generally static wolf home ranges Haber (1977) annually observed in Denali National Park wolf packs are likely rarely found in moderately exploited wolf populations. In the Nelchina

Basin of Alaska, Ballard et al. (1981) found core areas of individual packs remained constant while total home ranges fluctuated in response to human exploitation of wolves. In our studies between 1983 and 1984, the Alligator pack territory changed following a decline from 12 to 7 members and the loss of the alpha male (see pack history, this report). The centre of pack activity changed also, from the more isolated upper drainages of the Watson River toward the more developed Carcross valley area. Second, after systematic reduction is terminated, we expect the pack density to increase, pack sizes to be initially small (Peterson et al. 1984), and territories to be characteristically unstable until optimal wolf density occurs.

Table 7. Radio telemetry data from instrumented wolves observed from May 1,1983 to April 1,1984 in the southwestern Yukon.

pack name	collars per pack	pack days *	radio wolf days **	locations Vis/Gen ***	annual home range (sq km)	late winter range (sq km)	summer range (sq km)
CM STUDY AREA							
Alligator	4	61	69	38 / 31	1141	671	622
Ark Creek	1	14	14	14 / 0	_*	_*	_*
Granite	1	1	1	1 / 0	_*	_*	_*
Ibex Mnt.	1	12	12	11 / 1	_*	_*	_*
Jo Jo L.	1	8	8	7 / 1	_*	_*	_*
Kusawa	1	56	57	53 / 4	-*	422	_*
Primrose	4	112	165	105 / 60	1262	452	932
Lone wolves							
John's	1	5	5	1 / 4	_*	_*	_*
Takhini	1	9	9	2 / 7	_*	_*	_*
Trout L.	1	4	4	2 / 2	_*	_*	_*
Wheaton	1	7	7	2 / 5	_*	_*	_*
							TB
STUDY AREA							
Snafu	1	33	33	25 / 8	_*	504	_*

* represents the number of days on which the pack was located during telemetry flights.

** represents the number of radiocollars located on any given packday.

*** Vis/Gen represents number of times wolves were seen/not seen when radio collars were located (radiowolf days = visual + general).

_* insufficient number of locations to plot home range.

Seasonal wolf territorial relationships have not been well documented, largely because summer activities are monitored infrequently (Ballard et al. 1981). Also, wolf obser-

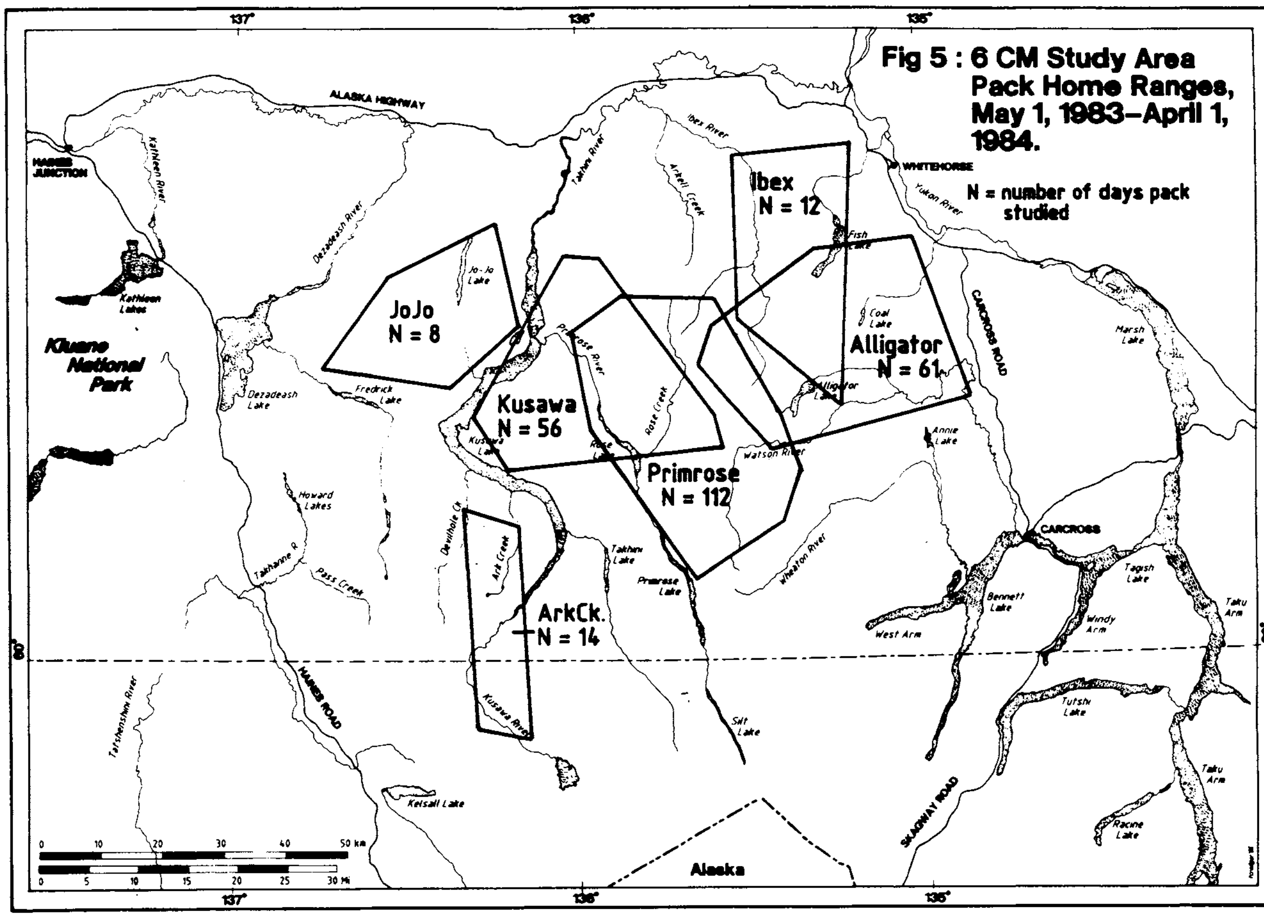

Fig 5 : 6 CM Study Area Pack Home Ranges, May 1, 1983–April 1, 1984.

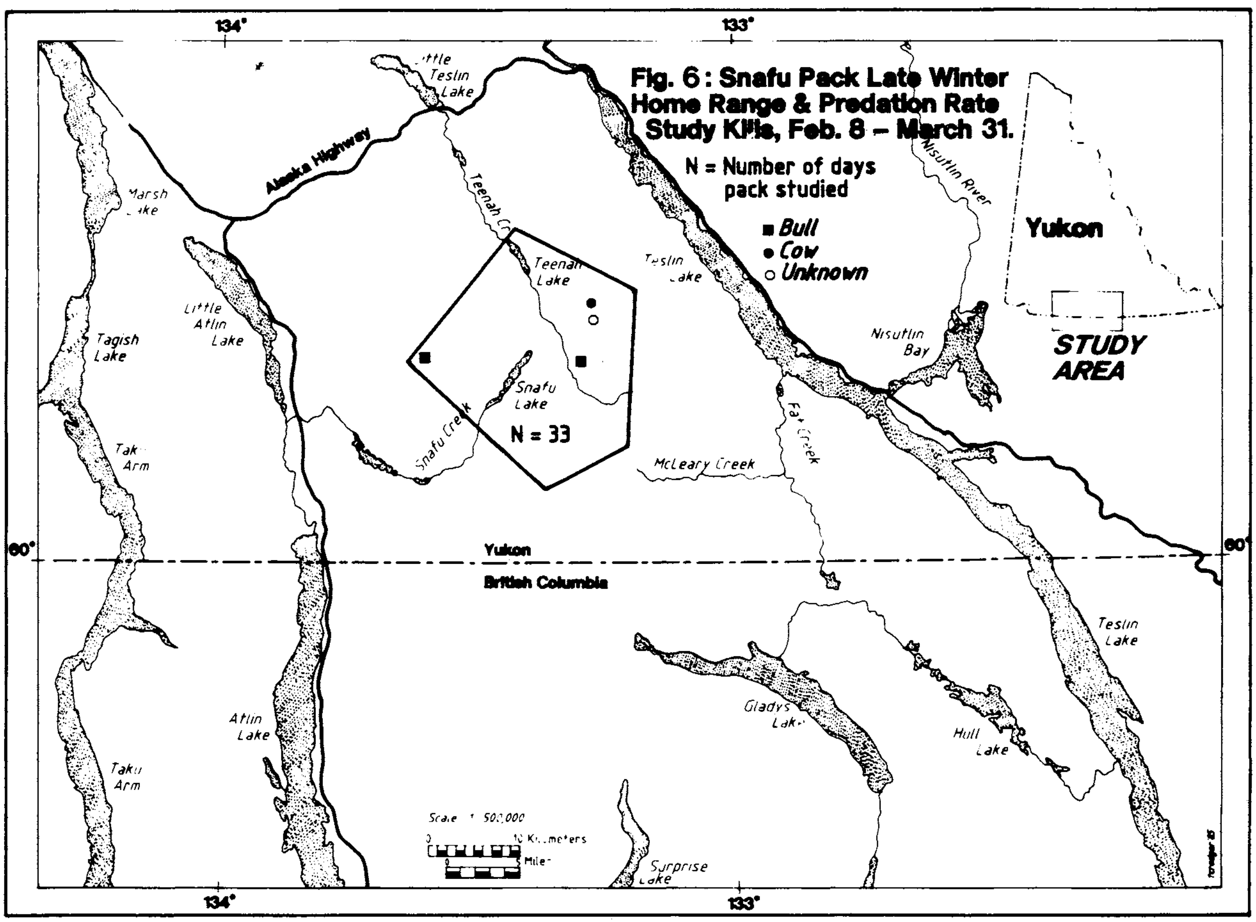

Fig. 6 : Snafu Pack Late Winter Home Range & Predation Rate Study Kills, Feb. 8 – March 31.

vations are more difficult to interpret without trails and sign to aid in observations. We had opportunity to study two packs during summer and winter, and were able to document continuous activities over two month intervals in each season (see summer and winter predation studies, this report). On average, The Primrose pack was relocated every 1.43 days in summer, and the Alligator pack every 2.6 days. The Primrose and Kusawa packs were both relocated every 1.04 days in the winter study period. Territorial use varied between packs and study periods (Figure 7 and Table 7). In the non-denning Primrose pack, the summer home range (932 sq km) was considerably larger than the denning Alligator pack's (622 sq km). Stephenson (1978) and Peterson et al. (1984) found that denning pack home ranges declined in area during the summer when pups required adult care. While this may be true for denning wolves, the non-denning Primrose pack was not restricted to a den and often made large territorial movements. Peterson et al. (1984) also found that wolf range use peaked in March, when frequent extraterritorial movements and dispersal occurred. A comparison of seasonal territorial use by the Primrose pack shows the reverse condition. Home range use was considerably larger in June 1983 (864 sq km), than in the late winter period of 1982-83 (413 sq km) and 1983-84 (452 sq km). In late winter 1982-83, the Alligator pack's territory was 636 sq km (n=34 wolf days) similar to their summer territory of 622 sq km (n=42 wolf days).

The average annual territory size was 1201 sq km (n=2 packs, SD=85) similar to average territory size of 1171 sq km in the Nelchina Basin (n=10 packs, Stephenson 1978).

6. AGE AND SEX OF WOLF-KILLED UNGULATES

Between 10 May 1983 and 1 April 1984, a total of 43 wolf-killed moose, 7 Dall's sheep, and 1 woodland caribou were found in the CM and TB study areas (Figures 6 and 8, Appendix 2). Thirty-six moose kill sites were examined on the ground and the other 7 were observed from fixed-wing aircraft. All 7 Dall's sheep kill sites and the single woodland caribou kill site were ground-examined.

The age distribution of kills is presented in Table 8. Fourteen of 43 (32.6%) moose kills were not aged into specific year classes*. Four radio-instrumented calves of the year (COY) were killed between May and July 1983 (See Larsen and Gauthier, in prep.) Two adult cow moose were killed by a radio-instrumented wolf pack during the same period. Between August 1983 and March 1984, the age class breakdown of 31 aged moose mortalities was as follows: 11 calves (35%), 2

* Eight of these moose could not be aged into year classes but were verified to be adults.

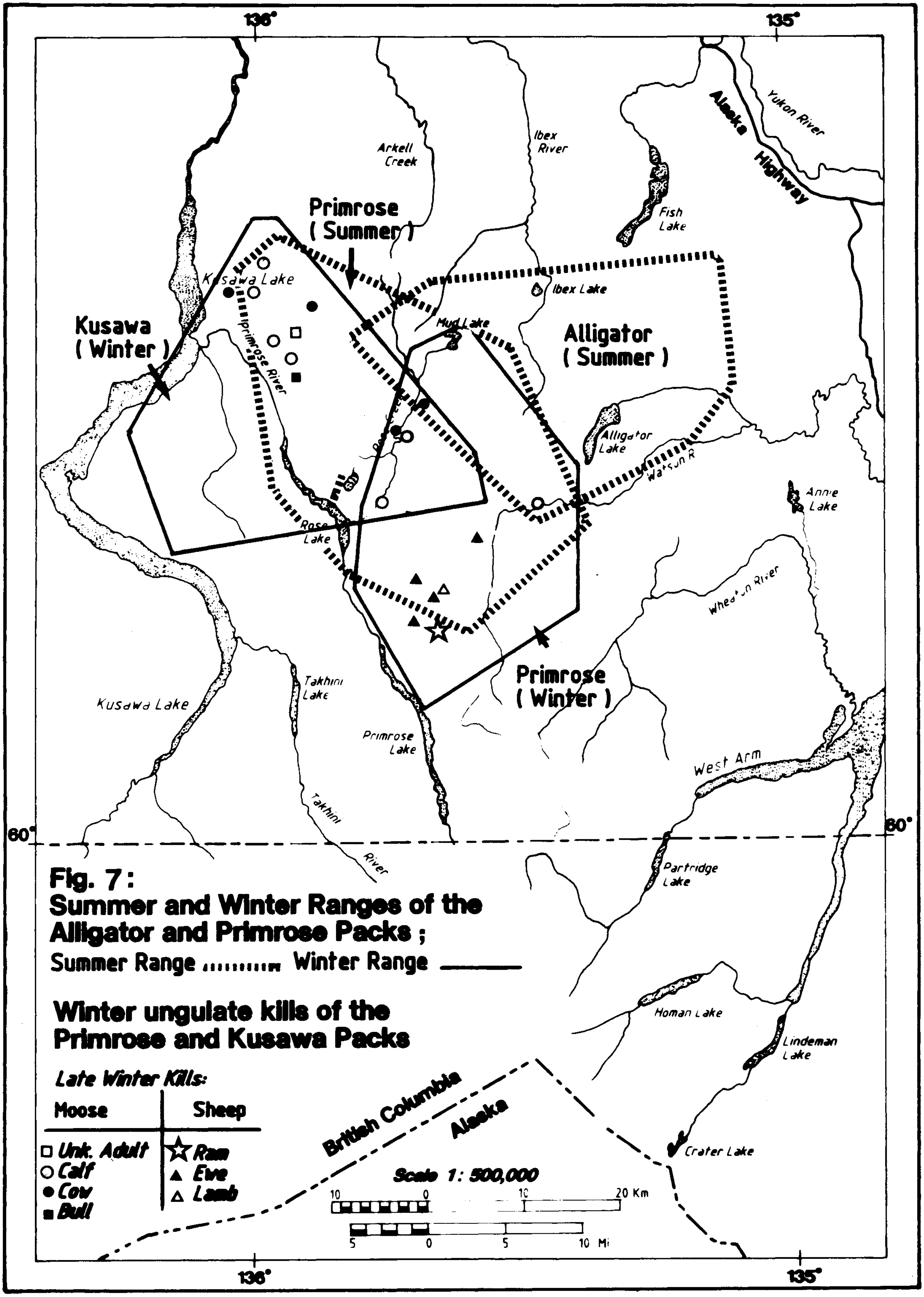

Fig. 7: Summer and Winter Ranges of the Alligator and Primrose Packs; Summer Range .... Winter Range ——

Winter ungulate kills of the Primrose and Kusawa Packs

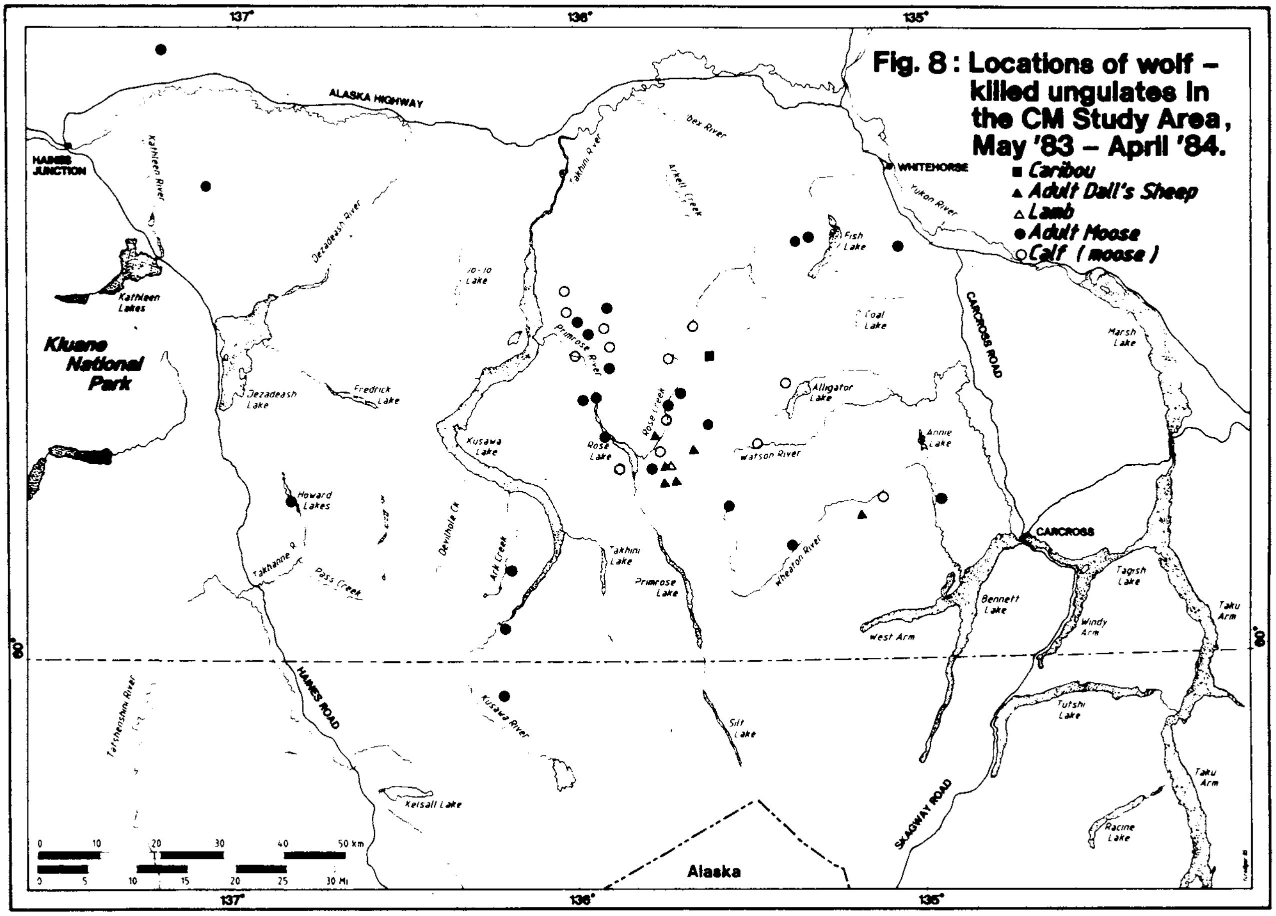

Fig. 8 : Locations of wolf - killed ungulates in the CM Study Area, May '83 – April '84.
■ Caribou
▲ Adult Dall's Sheep
△ Lamb
● Adult Moose
○ Calf (moose)

yearlings (6.5%), and 18 adults (58%). Adults ranged from 6 to 17 years old (Table 8), averaging 10.58 years (n=12, SD=3.32). Adult males averaged 9.8 years (n=5, SD=3.35) and females averaged 11.8 years (n=6, SD=3.19). The mean age of adult (> yearling) female moose killed by wolves in the study area in 1982-83 and 1983-84 was 10.8 years (n=10 SD=2.8), significantly different (p<0.05) than the average age of 68 radio-collared females aged in 1983 and 1984 (mean=8.1, SD=3.6, Markel pers. comm.). The proportion of calves in the fall moose population in various regions of the CM and TB study areas ranged from 7.8% to 15.5% in 1982 (Johnston and McLeod 1983), and 4.9% to 19.1% in 1983 (Markel and Larsen 1984). The 35% calf proportion in the wolf kill sample shows wolves selected calves in a greater proportion than their representation in the population (P<0.05). Wolf selection for middle and older age moose has been shown in other northern studies (Fuller and Keith 1980, Peterson et al. 1984) and high predation on calves is characteristic in many wolf studies during winter (McIlroy 1976, Fuller and Keith 1980, Peterson et al. 1984), especially during winters of deep snow (Stephenson and Johnson 1983, Peterson 1983, Peterson et al. 1984). In most studies, researchers concluded that the selection for young and old moose was a function of higher vulnerability of these age classes compared to middle age cohorts. In our study, if we assume the age structure of radio-instrumented female adults represents the overall adult population age structure, then the absence of young, prime age moose in the wolf-kill sample may be a function of their low availability in addition to better fitness, compared to older age moose. In our study, high wolf predation on calves in winter was further additive mortality on already high calf mortality rates in the moose population. High calf mortality through to fall was mainly caused by grizzly bear predation (Larsen and Gauthier, in prep.). The continued wolf predation on calves throughout the winter was partially responsible for the recent low yearling

Table 8. The age distribution of wolf-killed ungulates in the CM and TB study areas, May 1983 to April 1984 *.

SPECIES Frequency Row Percent	AGE IN YEARS												
	COY**	YRLNG**	6 YR	7 Yr	8 YR	9 YR	10 YR	11 YR	12 YR	14 YR	17 YR	ADULT	UNKNOWN	TOTAL
Moose	15 34.88	2 4.65	1 2.33	3 7.00	0 0	0 0	1 2.33	1 2.33	4 9.30	1 2.33	1 2.33	8 18.60	6 13.95	43 100.00
Dall's sheep	1 14.29	0 0	0 0	0 0	1 14.29	1 42.83	2 14.29	0 0	1 14.29	0 0	0 0	0 0	0 0	6 100.00

* The age distribution is not broken down by study period.
** COY represents moose calf of year and Dall's sheep lamb of year. Yrlng represents yearling.

recruitment rates in the southern Yukon, ranging from 1.0 to 6.0% in various areas (Markel and Larsen 1984). Calf recruitment has been low in the study area since 1981 (Markel and Larsen 1984), and the small proportion of young to middle age adults (2-6 years) in the collared cow sample (36%, n=25, Markel pers. comm.) verifies that survival of young moose has been low for a number of years. It appears that continued high calf and middle-old age adult mortality rates will likely cause a dramatic decline in moose numbers in the area, for few moose have achieved prime age in recent years to replace other adult losses.

Female (yearling and older) moose kills (11) were found at nearly twice the rate of male moose kills (6), however, there was no significant difference ($p>0.05$) between sex proportions in the kill sample and fall population (Markel and Larsen 1984). Peterson et al. (1984) found a low frequency of bulls among wolf-killed adults, and suggested a scarcity of males in the study area resulted from intensive bull harvest. Bull harvest management strategies in our study area are probably increasing the rate of wolf predation on cows by skewing the moose population towards females (37 bulls/ 100 cows, Markel and Larsen 1984, our calculations). The relationship between female moose availability and wolf predation will be made more clear with further collection of wolf-killed moose.

Marrow fat levels measured in 11 adult moose longbones showed an average of 72.72% marrow fat (wet weight method) (SE=4.79), ranging from 36% to 90% (Appendix 2). Three sampled calves averaged 62% (SE=4.04), ranging between 55% and 69%. In winter, moose calves generally have lower fat reserves than adults due to growth requirements (Peterson et al. 1984). A comparison of mean marrow fat levels from samples of 6 calves and 17 adults collected in 1983 (Hayes et al. 1985) and 1984 showed no significant difference ($P>0.05$) between calves and adults. No adult or calf marrow fat samples were within the 0-20% range found for starved moose in Alaska (Franzmann and Arneson 1976, Peterson et al. 1984). These data show that, despite the old average age of wolf-killed moose, there is no evidence that wolves are selecting severely malnourished or low condition moose prey in the southwestern Yukon.

Wolf-related Dall's sheep mortalities were less commonly observed than moose kills (Appendix 2), representing 16% of observed kills in the CM study area. Six of the 7 sheep kills were found during radio-telemetry observations of the Primrose pack (see following predation rate studies section), and the other kill was located by the public. In our previous report (Hayes et al. 1985), we cautioned that moose kills, by their larger size and contrasting colour on snow, would more likely be observed than smaller Dall's sheep kills. The location of sheep kills in wind-blown alpine areas would also make detection more difficult than for moose. The detection of wolf-killed sheep was almost wholly dependent upon the location of radio-instrumented wolves at the kill site. Without the aid of telemetry, it is unlikely any kills would have been seen from the air. This adds further caution to the use of incidental observation of wolf-kill sites as a method of quantitative and qualitative wolf-prey analysis, especially in mountainous areas where sheep or goats are present. Furthermore, the collection of wolf scats as a qualitative assessment of food habits would be inadequate in our study area. Most scats with Dall's sheep remains would likely go undetected because they would be cast in the vicinity of the kill. The collection of scats would be biased to lowland areas where moose kills were more common and where wolf tracking was more successful.

Six of the 7 sheep kills were adults older than 8 years old and 1 was a lamb (Table 8). Four ewe kills were located compared to 2 ram kills. The dynamics of wolf predation on mountain sheep populations has had only limited study. Murie (1944) studied the demographic effects of wolf predation on Denali Park, Alaska, Dall's sheep, concluding that during a period of low caribou numbers, wolves limited the growth of the sheep herd by selecting yearling sheep. In interior

Alaska, Heimer and Stephenson (1982) suggested that wolves may have been responsible for Dall's sheep population declines observed in the 1970's. Incidental observations of wolf-killed sheep have been previously documented, but no studies have directly measured the importance of Dall's sheep in the annual diet of wolves. From our limited data, it appears that mountain sheep are a secondary prey species for wolves, but in certain packs they may be numerically as important as moose during the winter period. Further collection of wolf kills will allow us to determine whether certain sheep age or sex classes are more vulnerable to wolf predation than others. The demographic effects of wolf predation on Dall's sheep is presently under study. This will be accomplished by comparing sheep productivity and mortality rates in the CM wolf reduction area with an experimental control area where wolf numbers were not manipulated (Barichello, in prep.).

Radio-cesium Analysis

Muscle tissue from 9 CM East wolves taken in 1983 and 12 CM study area wolves taken in 1984, were sampled for cesium 137 concentrations by D. Holleman (Holleman and Stephenson 1981). The main purpose of the analysis was to determine the importance of the Ibex woodland caribou herd in the winter diet of wolves. A detailed discussion of the radio-cesium technique is given in Holleman and Stephenson (1981).

In both years, the average cesium concentration was similar; 639 pCi/kg in 1983 and 633 pCi/kg in 1984. Levels ranged from 164 to 2459 pCi/kg (Table 9). Holleman (pers. comm.) suggested wolf cesium levels below 1000 indicated low or negligible predation on caribou, 1000-3000 indicated light use, 3000-7000 showed moderate predation, and higher levels indicated heavy predation. A comparison of the plotted range of the Ibex herd (Farnell, pers. comm.) and the wolf cesium collection sites (Figure 9), shows a close relationship between light wolf cesium levels and the Ibex herd winter distribution. The four samples within the light caribou consumption range were all collected from the herd's winter activity areas. Additionally, 1 wolf in 1983 (815 pCi/kg) and another in 1984 (933 pCi/kg) were just below the light caribou use levels. Both were also collected from the herd winter range. The cesium data supports preliminary results from radio-telemetry and incidental observations of ungulate kills, which suggest caribou are a tertiary prey species, well behind moose and Dall's sheep in importance. Based on collections to date, wolves present on the ranges of the Ibex and Caribou Mountain caribou herds do not predate heavily on the herds during winter. However, even relatively light use of caribou by wolves could have a limiting effect on the herds. Gasaway et al. (1983) in Alaska, and Gauthier (1984) in southwestern Yukon, found wolf predation

Table 9. Cesium (Cs-137) concentrations from 21 wolves collected from the CM study area, winters 1983 and 1984.

1983

ID	AREA	AVERAGE pCi/kg	S.DEV.
0113	Whitehorse	1346	48
0114	Champagne	355	35
0116	Jo Jo Creek	517	37
0122	Wheaton	815	44
0127	Tagish Creek	742	47
0130	Arkell Mountain	183	39
0135	Bennett Lake	1247	50
0100	Sandpiper Creek	164	30
0111	Jo Jo Lake	386	33

Average Pci/kg = 639
Standard Deviation = 433
Range = 164-1346 pCi/kg

1984

ID	AREA	AVERAGE pCi/kg	S. DEV.
315	Mount Kelvin	238	36
330	Mount Kelvin	253	30
316	Mount Kelvin	214	31
326	Watson River	933	46
327	Watson River	679	40
331	Moose Hollow	190	30
332	Moose Hollow	302	37
323	Ark Creek	214	31
324	Ark Creek	189	35
332	Lorne Mountain	1603	68
400	Bennett Lake	2459	67
321	Champagne	348	46

Average Pci/kg = 633
Standard Deviation = 713
Range = 189-2459 pCi/kg

limiting the growth of already depressed woodland caribou herds. Bergerud (1978) suggested that caribou herds that enter a low equilibrium population phase can be limited by wolf predation. In order for the small (<100 animals) herds to increase, adult recruitment must exceed adult mortality. Light predation by wolves, coupled with native harvest, poaching losses, permit sport harvest, and natural mortality factors are likely maintaining the low caribou population density in the CM study area. The Ibex herd is being annually monitored to document any demographic changes that may occur in response to wolf population reduction (Farnell 1982).

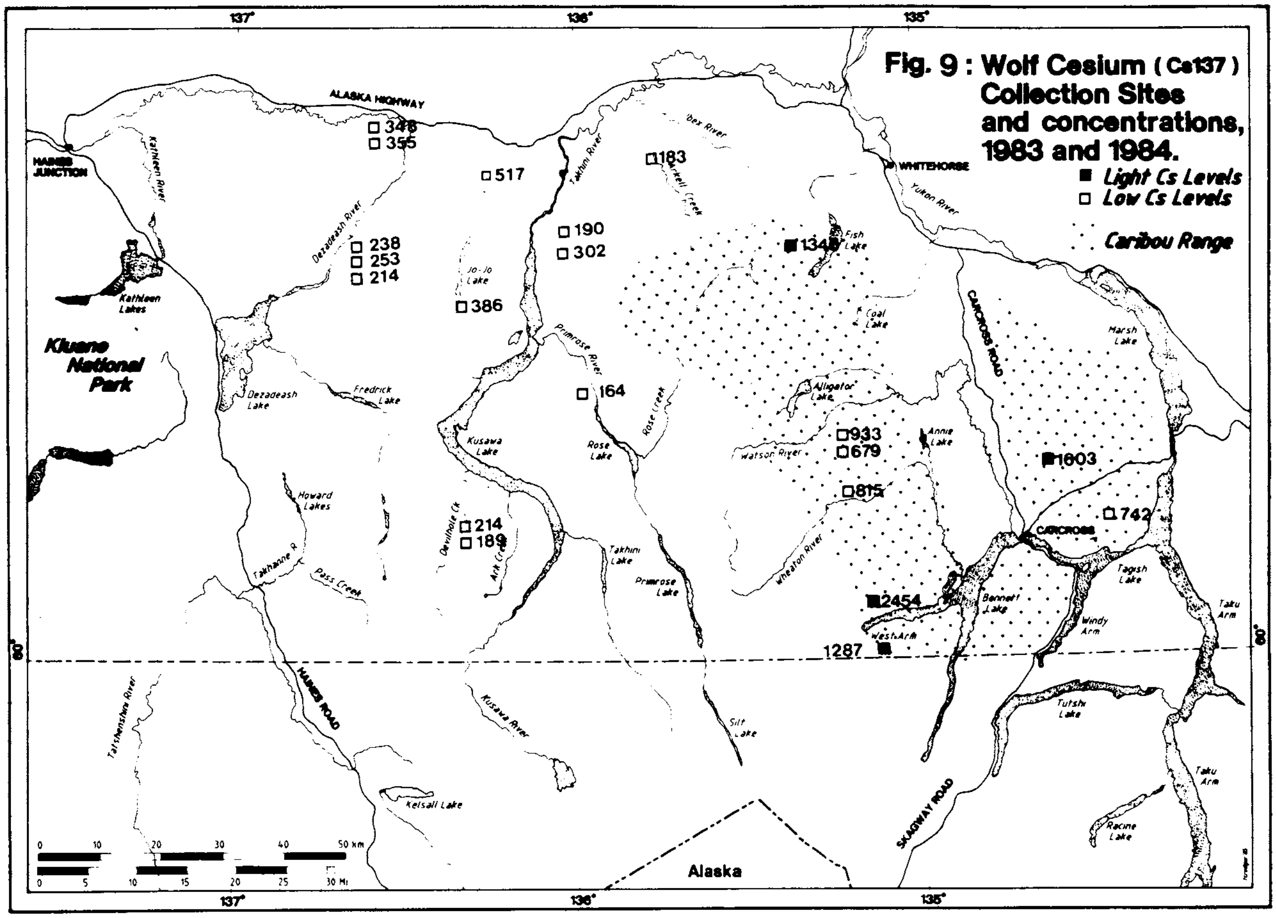

Fig. 9 : Wolf Cesium (Cs137) Collection Sites and concentrations, 1983 and 1984.

7. SUMMER PREDATION STUDIES

Scat Analysis

Traditionally, wolf scat analysis has been used to estimate the relative importance of wolf prey during the summer season (Mech 1970, Peterson 1977, Stephenson 1978, Ballard et al. 1981, Peterson et al. 1984, Messier 1984).

Ballard et al. (1981) studied 3624 scats from Nelchina Basin wolf dens in interior Alaska, concluding that calf moose (44%), snowshoe hare (14%) and beaver (13%) were the three most important prey. Peterson et al. (1984) studied 592 Kenai peninsula wolf scats and found moose (adult and calf) in 75% of scats, snowshoe hare in 14% and beaver in 5%. Peterson et al. observed radio-instrumented wolves frequenting old moose kills of little or no nutritional value, and this led to a high proportion of adult moose hair in scats. They found that only 16% of wolf-kills visited in summer were fresh, compared to 80% in the winter (Peterson et al. 1984). A wide range of small and large mammal species were identified in the 66 scats collected from the Alligator den site (Table 10). Beaver was the most

Table 10. Food items and their relative frequencies in 66 wolf scats collected from the Alligator pack natal den, 2 August 1983.

Food item	No.	% occurence
Large mammal		
Moose calf	8	10.7
Caribou calf	3	4.0
Dall's sheep	1	1.3
Small mammal		
Beaver kit	12	16.0
Beaver adult	10	13.3
Muskrat	6	10.0
Red fox	2	2.7
Squirrel (sp.?)	7	9.3
Snowshoe hare	3	4.0
Marmot	3	4.0
Microtines	12	16.0
Spruce grouse	3	4.0
Passeriformes	3	4.0
Grayling (fish)	2	2.7
Total	75	100.0

frequently recorded prey species. In total, young and adult beaver were found in 29.3% of all scats. Together, aquatic furbearers (beaver and muskrat) represented 39.3%. The den was located in the centre of a subalpine wetland and the high proportion of both species was undoubtedly related to their availability around the den. Large mammal young occurred in 16% of scats. Moose calf was the most frequent (10%), followed by caribou calf (4%) and Dall's sheep lamb (1%). The presence of caribou calf remains is noteworthy for it is the first evidence the Alligator pack preyed on the Ibex caribou herd, although the pack's territory was encompassed by most of the summer and winter range of the herd. While a small sample collection of scats from one den has limited value as a regional indicator of prey selection of denning wolves, it does provide an initial view.

Summer Predation Rates

Two large mammal kills were made by the Primrose pack between May 15 and July 16; both were adult cow moose. It is possible that other ungulate kills were made, especially Dall's sheep, but were not detected by study techniques.

Of 39 radio-instrumented moose calves that occupied the Primrose pack territory during the summer study period, 4 (10%) were killed by Primrose pack members. For the same period in the moose calf mortality study area (CM East), Larsen and Gauthier (in prep.) determined 9 of 60 (15%) radio-collared calves died from wolf predation, comparing closely with the Primrose pack's rate of predation.

Stephenson (1978) suggested ungulate kill rates were likely higher in summer than in winter, owing to the small biomass of neonatal ungulates and their potential vulnerability to predators. We tested this assumption by comparing projected moose kill rates in summer with the pack's predation rate documented during late winter (Table 11). To establish the total number of calves available to the Primrose pack during summer we first estimated cow moose density at 7 sq km/cow, based on fall survey data (Markel and Larsen 1984) and then estimated calf density at 5.4 sq km/calf by projecting the birth rate of 1.3 calves/cow documented from palpitation of radio-instrumented cows (Larsen and Markel 1986). By extrapolating calf density to the 932 sq km summer territory, we estimated 172 calves were available to the pack. Using the pack predation rate on radio-instrumented calves (10%), we estimated a minimum of 17 calves were taken by the pack in addition to the 2 adults killed. Over the 63 day study period, this represents a minimum pack kill rate of 3.3 days/moose kill compared to the pack's winter kill rate of 10 days/moose and the Kusawa pack's rate of 6.8 days/moose kill. This suggests summer wolf kill rates on moose are 2-3 times greater than during winter, supporting Stephenson's (1978) prediction.

8. WINTER PREDATION AND CONSUMPTION RATES

The live weights of moose and sheep prey and the number of each age and sex class killed during predation rate studies by the 2 CM packs and the 1 TB study pack are presented in Table 11.

Winter wolf pack kill rates varied between 4.8 and 14.3 days per ungulate kill (Table 12). The Primrose pack utilized Dall's sheep and moose prey and had the highest ungulate kill rate. The Snafu pack, the smallest study pack, had the lowest kill rate. The Kusawa pack was about twice as large as the Snafu pack and killed moose at about twice the rate. This contradicts other studies (Stephenson 1978, Peterson et al. 1977) that found the frequency of predation during winter was not proportional to pack size. Moose kill rates for large (12-15) to medium size (7-8) packs in other studies (Mech 1966, Peterson 1977, Peterson et al. 1984) ranged from 3 to 7.1 days/kill. The Kusawa pack rate was also within the range of 3.4 to 7.1 days/wolf-killed moose found by Peterson et al. (1984) on the Kenai peninsula.

The daily prey consumption rates of our 3 study packs ranged from 0.14 to 0.20 kg/kg wolf/day (Table 12). These rates are considered moderate based on rates of 0.09 to 0.19 kg/kg wolf/day found for wolves eating moose in northern Alberta (Fuller and Keith 1980, cited in Peterson et al. 1984), the Kenai Peninsula (Peterson et al. 1984), and Quebec (Messier and Crete 1985).

Table 11. Live weights of moose and sheep prey consumed by the Primrose, Kusawa and Snafu wolf packs; late winter 1984.

MOOSE	Mean Weight (kg)	Source	Number Killed by Packs Primrose	Kusawa	Snafu	% of Kills By Species
Adult bull	454	Franzemann et al. (1978)	0	1	2	18
Adult cow	400	Franzemann et al. (1978)	2	2	1	29
Calf	150	Franzemann et al. (1978)	3	4	0	41
unknown adult	430	our estimation	0	1	0	6
unknown age/sex	454-150	our estimation	0	0	1	6
DALL'S SHEEP						
Ram	74.6	Bunnell and Olsen (1976)	1	0	0	16.66
Ewe	48.8	Bunnell and Olsen (1976)	4	0	0	66.66
Lamb	40	Nichols (1978)	1	0	0	16.66

Table 12. Predation rates for wolf packs in the CM and TB study areas during late winter 1984.

Pack	Dates	Pack days studied	Wolves per pack	N ungulate Kills located	Pack Kill Rate	Wolf Consumption Rates ** (kg/wolf/day)	(kg/kg wolf/day)
Coastal Mountains							
Primrose	Feb 6 - March 29	53	5	5 moose, 6 sheep	1 ung/4.8 days	4.77	0.14
Kusawa	Feb 5 - April 1	56	7	8 moose	1 moose/6.8 days	4.76	0.14
Teslin Burn							
Snafu	Feb 8 - March 31	51	4-7*	4 moose	1 moose/14.3 days	5.4-6.7	0.16-0.20

* The Snafu pack made 1 kill as a 7 member pack. After Feb 14 the pack split and the radio-instrumented female wolf was associated with 2-3 other wolves for the duration of the study period.

** The range of daily wolf consumption rates varies depending on the age and sex of the unknown age moose kill. If an adult male was killed, the highest value applies; if a calf was killed, the lower value is accurate.

Similar to the overall kill composition of all known wolf-killed prey in the entire study areas, calves were numerically the most important moose age class, representing 41% of kills. Peterson et al. (1984) cautioned the frequency of calves among kills does not reflect the relative importance of this age class to wolves, for the biomass of adult moose is considerably greater than calves. In our sample, adult cows were the most important group, providing 50% of prey biomass, followed by calves (21%). Peterson et al. (1984) also found cow moose provided the majority of prey biomass for Kenai wolves.

Dall's sheep prey were only important to the Primrose study pack, although the Kusawa pack was observed unsuccessfully hunting sheep on 1 occasion. From the small sample of 6 sheep kills, adult ewes were the most frequently selected (66%). Barichello and Hayes (Yukon Wildlife Branch file report) predicted Dall's sheep rams were more vulnerable than ewes to winter wolf predation because their greater mobility, compared to ewes with offspring, would allow them to forage further from escape terrain. Our initial observations did not support this prediction. In fact, ewes were apparently more vulnerable to predation than rams at, or nearer escape terrain. All killed ewes were found at the base of winter range cliffs, often less than 3-4 meters from cliff walls. Three of 4 ewes and the single lamb were killed on canyon creek ice below cliffs, suggesting the Primrose wolves were especially successful at driving sheep from rocks, or suprising sheep below cliffs onto ice where the hard-hoofed animals may have been more vulnerable to capture. The 11 year old ram was killed in a boulder field at least 2 km from any cliff.

9. POTENTIAL EFFECTS OF REMOVAL ON WOLF DEMOGRAPHY AND PREDATION

While the responses of ungulate populations to reduced wolf populations have been studied (Mech and Karns 1977, Ballard et al. 1981, Gasaway et al. 1983, Boertje et al. 1985), there is little documentation of the effects of major (>50%) wolf removals on wolf demography and predation ecology. The mechanisms and rate of population recovery from severely depressed levels have not been previously studied. In interior Alaska, Gasaway et al. (1983) reported changes in wolf population characteristics through examination of a large sample of wolf carcasses collected during a wolf control program that annually removed 38-61% of the wolves. Wolf predation was not directly measured, and changes in wolf-prey relationships were speculated from observed shifts in mortality rates of moose in their study area. Wolf studies were terminated after the reduction phase was completed. On the Kenai peninsula, Peterson et al. (1984) made a comprehensive study of the effects of excessive wolf harvest on wolf demography and wolf-prey relationships. However, harvest rates were only marginally excessive (>40%) and pack removals were not systematic or complete.

We recognize wolf repopulation mechanisms and recovery rates are important parameters to document in order to better understand the role of wolf reduction as an ungulate management tool. The long-term objective of our studies is to document the effects of 70% annual reduction on wolf demography, including:

1. the dynamics and rates of wolf territory re-occupancy,
2. the origin, sex and age of re-establishing wolves,
3. new pack composition, productivity and pup survival rates,
4. the wolf population rate of recovery.

Peterson et al. (1984) showed the principal impact of wolf harvest was a reduction of pack size, which allowed for an increase in the number of adult breeding units and proportion of pups. Given ingressing wolves are critical to pack re-establishment where resident packs have been removed, and dispersing wolves are characteristically young adults, we expect the mean adult age of packs and the average age of breeding females to decrease.

As pack sizes decrease, we also expect numerical and functional changes in wolf predation. Carbyn (1983) speculated that as pack sizes are reduced, shifts in principal prey species or age-class selection may occur. If we assume small packs (2-4 wolves) are less efficent at killing moose than normal size packs (7-8 wolves), our study population provides an ideal opportunity to test the hypothesis that smaller packs prey less on adult moose, shifting predation strategies to select Dall's sheep prey. We also predict small packs will prey on moose calves at a higher rate than normal size packs did during this study period.

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APPENDIX 1

Alligator Pack

The Alligator Pack was the only collared pack to produce pups during the 1983 denning season. Wolf 1150 was confirmed to be the alpha female and the dam of the litter from den observations made 17 to 19 June. A minimum of 5 pups were seen at the den site during this observation period.

An adult light-cream male (wolf 1121), was captured and radio-collared on 23 May, 5 kilometers north of Mud lake while feeding on a recently-killed, radio-instrumented cow moose (see summer predation studies). This 12-year-old male wolf bred with 1150 during the March 1983 breeding period (Hayes et al. 1985) and attended the natal den during mid May. After being collared, the wolf was observed at the den on 8 occasions. Wolf 1040, collared in February 1983, was seen at the den on several occasions. In addition to the 3 collared wolves, 2 other grey-tan wolves were seen at the densite. Wolf 1000, a yearling female, was not located during the report period. Her lone movements during March 1983, indicated she dispersed from the territory sometime during the spring.

Wolf 1121 was illegally shot by unknown persons on 27 June, 4 kms from the densite. Wolf 1150 left the den site on 29 June, but wolf 1040 was located there on 29 and 30 of June. Wolf 1150 was next located near Mud Lake on 9 July, and although she was located within 5 kilometers of the den site on the next 2 relocations, she was not seen again at the den until 29 July.

Six relocations were made of the Alligator pack during August and September. On 20 October, 1150 and 1040 were seen with 4 other wolves at Bonneville Lake on 2 freshly-killed yearling moose. On 20 December, wolf 1150 and 1040 were seen with 6 other wolves on a moose kill at Golden Horn Mountain. On 23 January, 6 wolves were again seen, but 1040 was not present. The last sighting of wolf 1040 was on 10 January near the Watson River, south of Alligator Lake. It is believed wolf 1040 dispersed sometime after this date.

Sometime between 8 and 21 of February most pack members were lost. On 8 February, wolf 1150 and 5 other grey-tan wolves were seen on the west side of Lewes Lake near the Carcross Road. On 21 February, wolf 1150 was seen alone near the Whitehorse Copper mine site. On 1 March, she was seen with 2 grey-tans and a new black-grey male at the summer den site. She was again seen with the black-grey and 3 grey-tans on 11 March at Alligator Lake. Between 12 March and 19 March, wolf 1150 was seen with the black-grey on 3 occasions, with no other wolves present. The black-grey wolf was killed by government aerial hunters on 19 March, about 4 kilometers from an early winter moose kill he and 1150 had visited on 14 and 15 of March. On the same day, 2 grey-tan females with the Ibex pack were shot while at this same kill (see pack histories, this report). We suspect the black-grey male was a member of the Ibex pack in mid-winter and dispersed into the bordering Alligator pack in an attempt to pair and mate with 1150.

The loss of the 1983 alpha male (1121) produced a great deal of social unrest in the pack. During the winter study period, the pack composition continually changed. The activity centre of the pack moved from the wild upper drainages of the Watson River to the lower, more populated areas in the Carcross valley. We suspect this was due to the loss of the old alpha male (1121) which probably lessened the territorial imperative and hunting efficiency of the pack.

Following the removal of the newly-attached black-grey male, 1150 spent about a week with the Ibex male (1181), travelling in the boundary area of their respective territories. The two wolves parted company in late March and 1150 was subsequently shot on 24 April, while feeding on a disposed horse carcass above Coal Lake. No other wolves were present at that time. We concluded the pack disintegrated during the study period and most of the members were killed by unknown causes.

Ark Creek Pack

The Ark Creek pack was instrumented on 29 February 1984, when the alpha male (wolf 1810, black-grey) was captured at a moose kill on Ark creek. The pack consisted of wolf 1810, a grey adult female, and 3 black-grey pups.

This pack was monitored on 11 relocation flights between 1 March and 14 March. During the 2 week period, the pack killed 3 moose: a 14 year old bull moose, an unknown age adult bull and a moose of unknown age and sex. The territory of this pack was 217 sq km during the 15 day observation period. Their activity areas included Ark and Devilhole Creeks, and the Hendon and Kusawa Rivers (Figure 5). All members of the pack, except 1810, were shot on 15 March. Wolf 1810 was subsequently relocated alone on 27 March.

Cousins Wolf

This wolf (1141) was snared and radio-instrumented 15 December at Cousins Airstrip, 8 km north of Whitehorse. Another adult female wolf was killed in the same snare set 3 days earlier. We estimated 1141 to be a 3-4 year-old-female, associated with a 4 member pack on her capture date. She was relocated 4 times over the report period and was not seen with another wolf. We suspect she was peripherally associated with the Cousins pack, but not a consistent member. All locations of this wolf occurred on the north and west edges of the city of Whitehorse, from the dump site to the sewage lagoon.

Granite Lake Pack

This pack was located in the upper Granite Creek drainage on 27 November 1983, during aerial moose surveys. The pack was composed of 2 black-grey wolves and a grey-tan, and was feeding on a freshly killed moose. On 28 November, a single black-grey was present and was immobilized from a helicopter. This yearling male (1112) was hit low on the left side, puncturing the intestinal tract. The injury was not noticed during handling and the wolf was collared. He was found dead at the collaring site the next day. We concluded the animal died of internal injuries caused by the dart. This was the first wolf to die from capture-related causes since the study was initiated in January 1983.

Ibex Mountain Pack

The Ibex Mountain pack was instrumented on 5 January, 1984. Wolf 1181 (adult grey-tan male) was captured in a leg hold trap at the Whitehorse city dumpsite. The wolf was monitored daily from 5 to 8 February in the company of 2 wolves, a black-grey and a grey-tan. They were next located on 22 February, when they were found 4 kilometers west of Ibex Lake. During this period, the pack ranged in the Ibex Lake and Ibex River drainage, travelling as far east as Bonneville and Fish Lakes. The area this pack travelled in had also been used by the Alligator pack during the winter of 1982-83 (Hayes et al. 1985). The next relocation of the pack was on 19 March when wolf 1181 and 2 grey-tan females (a yearling and a 2-year-old) were seen at a moose kill on the Watson River. The 2 grey tans were killed on this occasion and, as well, an adult black-grey male was killed 4 kilometers north of this site while with the alpha female of the Alligator pack (see Alligator pack history, this report).

The next day, the Ibex male and Alligator female were found together and remained in a small area near Coal Lake on their old pack boundaries. The 2 wolves separated on 22 March, and the Ibex male moved back to the Whitehorse City dump. He was not seen in the company of other wolves at the end of the report period.

Jo-Jo Lake Pack

This pack was first contacted on 27 November 1983 on a ridge north of Jo-Jo Lake when wolf 1221 (alpha grey-tan male) was radio-collared. The Jo-Jo pack consisted of 6 wolves: an adult grey-tan male (wolf 1221), a 6-year-old cream-colored female, a yearling grey-tan female, a juvenile grey-tan male, and 2 juvenile grey-tan females.

The pack was not monitored again until 20 December when they were seen hunting sheep on the northeast flank of Jo-Jo Mountain. They remained in the general area until at least 23 December. It was likely that they made a sheep kill in the area but this could not be verified by aerial searching.

On 19 January 1984, 3 members of the pack were shot. An effort was made to remove all pack members excluding the collared male, but this effort was not successful. The 3 shot wolves were juveniles; 1 male and 2 females. On 15 February, the remaining 6-year-old alpha female and a yearling female were shot, but 1221 was not killed. While no kills by this pack were observed, the wolves were seen hunting sheep on 2 location flights and it is likely they spent most of their time hunting Dall's sheep, based on their frequent presence in sheep winter ranges.

Kloo Lake Pack

The Kloo Lake pack was first encountered on 20 July 1983, when an 5-year-old black-grey male (1190) was caught in a snare set at the Haines Junction dump site. The wolf was not monitored until 20 December when it was found with 7 other wolves on a freshly-killed moose, 12 km northeast of Haines Junction. The pack was only observed on 3 dates, 22 and 23 December, and 20 January. The pack killed an adult moose near Marl Creek on or about 22 December. On 20 January, 1190 and two juvenile black-grey females were aerially shot. Wolf 1190 weighed 52 kg, and was believed to be the alpha male.

Kusawa Lake Pack

The Kusawa Lake pack was known from winter wolf surveys during the winter of 1982-83. On 5 March 1983, 5 of 9 wolves of the then-called Arkell pack (Hayes et al. 1985) were shot near moose hollow, in the central activity area the Kusawa pack used in 1983-84. All shot wolves were females; 2 were 2-year-olds, 2 were juveniles or yearlings, and 1 was of unknown age.

During November and December 1983, snare sets were established in several important wolf travel corridors in the area in an effort to instrument the pack. One wolf was snared but immediately killed and eaten by wolves. On 23 January 1984, a juvenile black-grey male (wolf 1821) was aerially captured and instrumented on the upper west fork of Sandpiper Creek. The wolf was accompanied by another at the time of capture. Subsequent relocations confirmed the pack consisted of 7 wolves; wolf 1821 and 2 other pups, 2 2-year-olds, a 4-year-old light-cream female, and an adult black-grey male.

This pack was monitored on 56 relocation flights from 23 January to 1 April 1984. During this time the pack was seldom seen apart and all members seemed well-established. The black-grey adult was seen copulating with the light-cream female on 5 March. This observation, along with other displays of social dominance, verified they were the alpha unit.

The pack preyed exclusively on moose during the study period (see winter predation rate studies, this report). The pack made 2 significant short distance excursions, both into the neighbouring Primrose pack territory. One visit occurred on 22, 23 and 24 February and another on 28 and 29 February, when the pack visited a moose kill made earlier by the Primrose pack on Rose Creek. On the second visit, the Kusawa pack and Primrose pack were within a few kilometers of each other but were not observed to make contact. From movement patterns of both, it appeared the Primrose pack actively avoided an encounter with the Kusawa pack.

Five members of the pack were shot on 1 April 1984, with only the alpha male and wolf 1821 surviving. Wolf 1821 was left alive in the hope of instrumenting the alpha male at a future, more favourable, location.

John's Wolf

This wolf (1050), captured at Johns Lake on 2 March 1983 (Hayes et al. 1985), was relocated on 4 May about 5 miles northeast of Rose Lake. This was the only observation we had of this wolf during the period May-September 1983. However, she was incidentally located by Federal Dept. of Fisheries personnel on several occasions in the general area of Lake Laberge during June and July. She was relocated by us on 27 September and 12 October, both locations being within the Whitehorse city limits. She was found dead on 22 December, apparently killed as a result of internal injuries sustained from being struck by a vehicle. She was in an emaciated condition, her tail was missing, and she had a severe hemmorage on her right side.

Primrose Mountain Pack

The Primrose Mountain pack represents our most studied wolf pack to date (see summer and winter predation studies, this report and Hayes et al. 1985). By early June, 4 wolves were radio instrumented in the 6 member pack, including 2 adult grey-tan males (1830 and 0192), a yearling grey-tan male (1100), and a yearling grey-tan female. The yearling female (1700) was collared as a juvenile in 1983 (Hayes et al. 1985) but was not on an effective frequency. The other 2 pack members were a 5 year old black-grey alpha female and a smaller, unknown age, black-grey female.

During the summer of 1983, the pack was studied to determine wolf predation rates on large mammals in the area (see Summer predation rate studies, this report). From May to July, the pack was loosely affiliated, and members spent much time travelling alone or in groups of 2 or 3. Their pack territory was in the centre of the 1983 moose calf mortality study area (Larsen and Gauthier, in prep). During this period the pack killed at least two adult cow moose and a number of radio-instrumented calves. The pack was monitored on 12 days between August and December 1983. On 27 September, they were found on a freshly killed calf moose; they killed another calf on 20 December.

During February and March 1984, another study was carried out to document winter predation rates of the pack (this report, page 31). The Primrose pack was monitored daily from 5 February to 29 March. The pack was initially a single group, until 11 February when the unknown aged black-grey female left the pack. She eventually returned to the pack on 16 March. On 20 February, wolf 1100 was located 7 kilometers north of the pack;

0192 left the pack on 21 February and did not return until 4 March. He was observed on several days during this period. A black-grey wolf, presumably the female that left on 11 February, was seen with 0192 in late February.

After 20 February wolf 1100 appeared ostrasized from the remaining pack members, usually travelling at a distance behind them. On 3 March, the pack killed a Dall's sheep ewe near big bend on the Watson River. Wolf 1100 remained at the killsite for almost a week after breaking his right hind leg. It is likely 1100 was injured by a fall during the chase, as the killsite was at the base of a high cliff wall. He eventually relocated the pack, but was never seen in close association, remaining detached and scavenging the pack's kills. Following the return of 0192, the pack appeared stable for the rest of the study period. The second black-grey joined up again on 16 March and remained. No wolves were removed from this pack during 1983-84.

The pack did not breed in 1983 or 1984 (Hayes and Baer, in prep.). It was suspected the alpha male (0192) and the 5 year-old black-grey female (wolf 1062, radio-collared 24 April, 1984) were not a compatible pair. Wolf 0192 appeared to lose his alpha status during the 1984 breeding season when wolf 1830 challenged for the attention of 1062. Wolf 1062, the alpha female, may have been bred prior to her capture as she showed distended nipples and appeared pregnant. It is possible the extended (30 minutes) aerial pursuit resulted in the pups being aborted.

Sandpiper Wolf

This wolf (1070) had not returned to the study area within this report period and was subsequently located in August 1984, near the Tatshenshini River, about 25 kilometers upstream from the confluence with the Alsek River. The area was intensively searched from a PA-18 supercub and it was evident the animal was not there, for the signal came from an open, easily visible area. It was not determined whether the wolf had died or the collar was cast.

Snafu Pack

This pack was first seen on 3 December 1983 when it numbered 7 black-greys and 1 grey-tan. A helicopter was used in an attempt to immobilize and collar an individual but the effort was unsuccessful. The pack was seen and pursued by helicopter again the following day, but this also proved unsuccessful. The area in which the pack was found was typified by low rolling hills, which were covered by fire killed spruce, making aerial capture difficult. Snares were set for the pack and a member was subsequently snared on 7 December, although this animal died as a result of twisting the snare in a manner that rendered the stop nut on the snare ineffective.

An adult black-grey female (1851) was immobilized and collared using a helicopter on 8 February, 1984. At that time there were 6 black-greys and a grey- tan. The pack was monitored on an average of every 1.6 days between the capture date and 31 March (see winter predation rate studies, this report). After 11 February the pack lost several members. The grey-tan and 2 black-greys either separated from the pack or were killed by unknown causes. For the remainder of the observation period the pack consisted of 1851 and 3 other black-greys.

Takhini Pack

The only known remaining member of this pack (1090) (Hayes et al. 1985) was relocated on 9 occasions between 13 May and 22 December 1983. All of these locations were within a 40 sq km area around the Mendenhall River near the confluence of Pond Creek. This area is open meadowland and a substantial number of horses are wintered there each year.

The wolf apparently died between 27 September and 22 December. The radiocollar was not picked up until the spring of 1984 and no bones or skull were located. There were teeth marks and blood on the collar, indicating the wolf died and the collar had not been cast. It is likely this wolf was either injured by horses or by their owners sometime during the summer of 1983 and that it eventually died during the winter.

Trout Lake Female

Wolf 1190 was radio-collared on 21 March 1984, after being caught at a baited snare set on the upper Ibex River, west of Ibex Mountain. This yearling black-grey female was travelling with at least one other wolf at the time she was caught, although she was not seen with any other wolves on subsequent relocations. She was located on 3 other occasions between 22 March and 12 April. She was not relocated again during the study period. On 7 November 1984, we located her signal at Dullmitt Lake near Aishihik Lake. A light snow covered the area and there was no sign the wolf was present. It is unknown whether the wolf died, or the collar was cast.

Wheaton River Female

This wolf (1081) was a juvenile grey-tan female pup. She was captured in a snare set on 15 January at a freshly killed moose carcass in the upper Wheaton River valley. The kill was made by the Wheaton River pack estimated at 7 or 8 members, based on track counts. She was likely associated with the pack at the time of capture but was not seen with other wolves on 6 subsequent relocations. She had moved out of the Wheaton River valley by 8 February 1984 when the third location found her about 8 kilometers north of Annie Lake. All subsequent relocations were within 6 kilometers of the Wheaton River bridge on the Annie Lake Road. During this period she was seen in close proximity to rural dwellings along the road. She was located at an old moose kill near the Watson River bridge on one occasion.

Her signal was not heard after March 1984, indicating she dispersed from the study area or the transmitter failed.

APPENDIX 2.

A Summary Of Wolf-killed Ungulates Collected Between 1 May, 1983 and 1 April, 1984.

COASTAL MOUNTAIN WOLF STUDY AREA

ID NO.	LOCATION	SPECIES	AGE*	SEX	MARROW FAT**	KILL DATE
138	Alligator Lake	Moose	coy	unk		25 May/83
144	Upper Watson R.	Moose	12	F		25 May/83
142	Upper Rose Ck.	Moose	coy	unk		3 Jun/83
139	Lower Rose Ck.	Moose	ad.	F		7 Jun/83
141	Rose Lake	Moose	coy	unk		7 Jun/83
147	Ibex Lake	Moose	coy	unk		1 Jul/83
131	Upper Rose Ck.	Moose	coy	unk		16 Aug/83
129	Rose Creek Lakes	Moose	coy	unk		27 Sep/83
151	Bonneville Lakes	Moose	yrl	F		19 Oct/83
152	Bonneville Lakes	Moose	yrl	F		19 Oct/83
134	Granite Lake	Moose	17	F	89	25 Nov/83
135	Howard Lakes	Moose	6	M	66	1 Dec/83
132	Golden Horn Mnt.	Moose	ad.	unk		19 Dec/83
133	Marl Creek	Moose	unk	unk		19 Dec/83
136	Rose Creek	Moose	coy	unk		20 Dec/83
128	Rose Lake	Moose	unk	unk		1 Jan/84
122	Wheaton River	Moose	7	M	36	4 Jan/84
105	Primrose River	Moose	unk	unk		7 Jan/84
125	Primrose River	Moose	ad.	unk		27 Jan/84
108	Annie Lake	Moose	unk	unk		1 Feb/84
100	Saddleback Mnt.	Moose	coy	unk	62	11 Feb/84
127	Rose Creek	Moose	12	F	70	11 Feb/84
101	Mnt. Coudert	Moose	12	F	90	15 Feb/84
106	Ark Creek	Moose	14	M	57	26 Feb/84
109	Primrose River	Moose	coy	unk		2 Mar/84
107	Kusawa River	Moose	unk	unk		5 Mar/84
111	Primrose River	Moose	ad.	M		8 Mar/84
112	Primrose River	Moose	coy	unk	55	10 Mar/84
119	Watson River	Moose	ad.	M		13 Mar/84
113	Big Bend Pass	Moose	coy	unk		14 Mar/84
115	Big Bend Pass	Moose	ad.	F		14 Mar/84
117	Kusawa River	Moose	ad.	M		14 Mar/84
120	Rose Creek	Moose	coy	unk		17 Mar/84
121	Mnt. Coudert	Moose	7	unk	87	19 Mar/84
150	Big Bend	Moose	coy	unk	69	26 Mar/84
124	Mnt. Coudert	Moose	coy	unk		27 Mar/84
145	Moose Hollow	Moose	11	F	77	29 Mar/84
140	Mud Lake	Caribou	ad.	F		10 May/83
156	Sheep Bowl	Sheep	9	F		6 Feb/84

ID NO.	LOCATION	SPECIES	AGE*	SEX	MARROW FAT**	KILL DATE
126	Sheep Bowl	Sheep	9	F		7 Feb/84
110	Sheep Bowl	Sheep	loy	unk		8 Feb/84
104	Sheep Bowl	Sheep	12	M		27 Feb/84
130	Watson River	Sheep	10	F		2 Mar/84
116	Primrose Mnt.	Sheep	9	F	97	10 Mar/84
153	Becker Creek	Sheep	8	M		1 Apr/84
TESLIN BURN WOLF STUDY AREA						
123	Seaforth Creek	Moose	ad.	F		6 Dec/83
146	Teslin Lake	Moose	coy	unk		5 Feb/84
114	Needle Lake	Moose	10	M	70	9 Feb/84
102	Grayling Lake	Moose	7	F	77	16 Feb/84
103	Teenah lake	Moose	12	M	81	3 Mar/84
148	Grayling Lake	Moose	unk	unk		26 Mar/84

* coy represents calf of the year, loy represents lamb of the year, yrl is yearling and ad. is adult (age unknown). Numbers represent ages based on tooth cementum analysis for moose and horn annuli for Dall's sheep.

** marrow fat content is expressed in wet weight.

WOLF POPULATION RESEARCH AND MANAGEMENT STUDIES IN THE YUKON TERRITORY

Part 2. Finlayson Caribou Herd Management Area.

1984 Annual Report. December 1985

R. Hayes, Wildlife Biologist II
R. Farnell, Wildlife Biologist II

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Conservation officers K. Gustafson and B. Tokarek provided invaluable field assistance during all phases of the project. Wildlife technicians G. Lortie and J. McDonald assisted during caribou and wolf surveys, wolf snaring, and wolf necropsies. E. Kotyluk entered data to computer programs and A. Baer assisted with data analyses.

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INTRODUCTION

The population status of the Finlayson caribou herd (FCH) in the east central Yukon has been studied annually since 1981 (Farnell 1981, 1982, 1983, 1984). In 1982, low fall recruitment rates (9.8% calves), high adult natural mortality (27.7% of radio instrumented adults), and high annual harvest rates (+10%) suggested the woodland caribou (Rangifer tarandus caribou) herd was declining. In an attempt to increase the FCH from an estimated 2000 animals to a target of 5000, Farnell (1982) proposed a 5 year recovery program for the herd. To minimize adult mortality, a "bulls only" sport hunting season was implemented and a cooperative program was initiated to reduce native harvest on the herd. To minimize wolf (Canis lupus) related calf and adult mortality, a 3-5 year, 70 percent wolf reduction was recommended throughout the winter and summer ranges of the caribou herd.

In the winter of 1982-83, 105 wolves were removed from an estimated +200 resident population (49%) (Hayes and Farnell 1985). Examination of 88 necropsied carcasses taken in the area revealed that most removed wolves were subadults (66%) in good physical condition. Incidental observation of ungulate winter mortalities, and cesium 137 and stomach content analyses showed that moose (Alces alces) were the most important prey species for wolves. However, aerial survey and reduction efforts were much less intensive in the core winter range of the FCH compared to other areas, and likely biased our evaluation of prey selection (Hayes and Farnell 1985). Poor observability and difficult wolf tracking conditions in the caribou winter range were the most important factors limiting wolf removal there.

This report discusses the wolf population status in the FCH study area and discusses the results of the second year of a 3-5 year wolf reduction program. Changes in fall calf survivorship between 1982 and 1983 are briefly discussed in relation to the 49% wolf reduction of March 1983. Detailed caribou population data for 1984 are presented in Farnell (1984).

OBJECTIVES

The objectives of 1983-84 wolf studies were:

1. to census the wolf population, evaluate wolf density in the study area and compare these data to 1982-83 results.

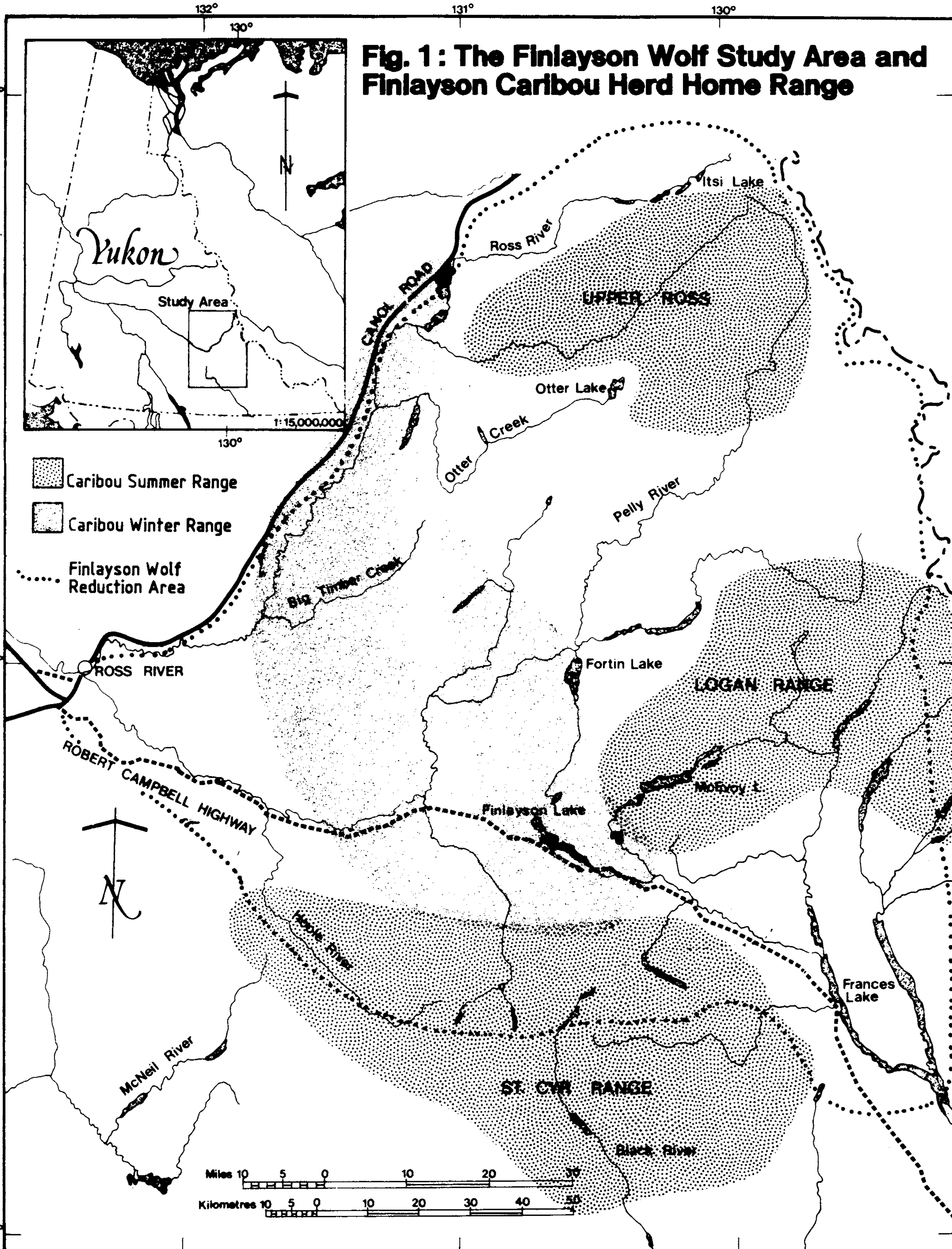
Fig. 1 : The Finlayson Wolf Study Area and Finlayson Caribou Herd Home Range
Yukon
Study Area
1:15,000,000
Caribou Summer Range
Caribou Winter Range
Finlayson Wolf Reduction Area
Itsi Lake
Ross River
UPPER ROSS
CANOL ROAD
Otter Lake
Otter Creek
Pelly River
Big Timber Creek
Fortin Lake
LOGAN RANGE
ROSS RIVER
ROBERT CAMPBELL HIGHWAY
Finlayson Lake
McEvoy L.
Hoole River
Frances Lake
McNeil River
ST. CYR RANGE
Black River
Miles
Kilometres
tcrodger ; carto/ graphic/ design

2. to document wolf predation on caribou, moose and other ungulates during the winter months.

3. to reduce 1984 wolf numbers to 30% of the original pre-reduction level.

4. to monitor the physical condition, age classes, sex ratios, productivity and prey selection of the removed portion of the wolf population.

5. to live capture and radio-instrument 5-7 wolves in the traditional caribou winter range to assist in the location of packs for removal purposes.

STUDY AREA

The physiography, climate, vegetation, and resident ungulate populations were previously described by Farnell (1982) and Hayes and Farnell (1985). Recent data from radio-instrumented caribou cows (Farnell in prep.) show Finlayson caribou disperse from the lowland winter range in the Tintina Trench-Pelly Plateau area to 3 relatively discrete and traditional mountain calving areas (Figure 1). Seasonal movements of wolves from mountain areas to the drier, more ungulate-rich, lowland wintering areas were documented during caribou and wolf surveys (Farnell in prep.). In addition to areas surveyed for wolves in 1983, aerial coverage was increased in the central and southeastern portion of the management area, especially in the St. Cyr range of the Pelly Mountains (Figure 1).

PROCEDURES

Aerial wolf inventory was carried out using Cessna 185 fixed-wing aircraft and a Bell 206B helicopter during the period March 1 to March 22. Surveys were flown over 90% of the management area following procedures outlined in Hayes and Farnell (1985). In addition to surveying lowland riparian areas where wolf activity was concentrated in 1983, subalpine and alpine areas were also checked. Wolf survey experience in 1983 showed that the core caribou winter range was difficult to locate and census wolves in, due to heavy caribou tracking and the extensive spruce (*Picea sp.*) and lodgepole pine (*Pinus contorta*) forest that dominates the Tintina Trench and Pelly Plateau. To increase our knowledge of wolf activity in this wintering area, wildlife technicians documented wolf activity from January 5 to March 10. Observations of wolf abundance and movements, wolf-kills, and general caribou distribution and activities were recorded. Wolf observations were especially important for determining the density of wolves in the caribou winter range. Wildlife technicians also maintained and monitored a wolf live snare line on various snowmobile trails off the Robert Campbell Highway, in an attempt to radio-instrument wolves. Live snare design was described in Hayes and Baer (1985).

Wolf reduction was mainly carried out by government aerial hunters using techniques described in Farnell (1983, 1984) and Hayes and Farnell (1985). Registered trappers, resident hunters and licenced aerial hunters also participated in the reduction program.

Whenever possible, wolf carcasses were collected and necropsied at the Finlayson Lake base camp following procedures described in Hayes et al. (1985). The locations of all dead ungulates were recorded during surveys. Lower incisor bars of moose and caribou were collected to determine age by cementun annuli (Sargent and Pimlott 1959). Long bone marrow fat content was analysed (Neiland 1970) to determine physical condition.

RESULTS AND DISCUSSION

1. WOLF POPULATION INVENTORY AND REDUCTION

Hayes and Farnell (1985) described wolf inventory and reduction results from the study area in the winter of 1982-83. In summary, 200-215 wolves occupied the area in late winter; a density of about 84 sq km/wolf. A minimum of 49% of the late winter wolf population (105 wolves) was removed by March 1983, leaving 110 wolves. The majority of surviving wolves were located in the southern portion of the study area.

By mid-winter 1983-84, the population had recovered to about 140 wolves. This estimate was derived from observation of wolf tracking sign and pack observations before and during removal efforts. This represents a finite rate of increase of 1.27, falling within the range of rates of increase (1.15 to 1.46) calculated by Keith (1983) from 6 previous wolf population studies in North America. The biological mechanisms by which wolves repopulate are not well-understood. Ingress, increased survival rates of pups (Keith 1983), and increased density of breeding pairs (Peterson et al. 1984), are likely contributing factors that would allow for high rates of increase.

In March 1984, the population was reduced from 140 wolves to 34 wolves following the government aerial hunting program. This represents an 84% decline from the original popu-

Table 1. Wolf population status, density, and removal data from March 1983 and 1984.

Date	No. Wolves Alive	Dead	% of wolves killed	Density Sq km/wolf
1983				
March 1	215	---	---	84
March 15	110	105	49*	163
1984				
March 1	140	---	---	128
March 22	34	106	84*	529

* The percentages of wolves removed are measured against the original wolf population estimate of 215, March 1983.

lation level of 1982-83. Wolf density fell to 529 sq km/wolf. Wolf population levels, removal proportions, and density estimations during mid and late winter 1983 and 1984 are summarized in table 1.

Of the 106 wolves reported killed, 80 were taken by government aerial hunters (GAH), 19 were caught or shot by trappers, 3 were snared by wildlife technicians and 4 were shot by private aerial hunters. Aerial hunters shot 79 of 89 pack wolves (89%) encountered, and retrieved 69 carcasses (87%). In addition, 27 lone wolves were killed by various methods (table 2). Twelve were retrieved, bringing the total sample of necropsied wolves to 81. Some lone wolves were probably affiliated with certain packs, but the proportion was not known.

Average pack size was 5.4 wolves (SE=1.8) before March 1984, down from the pre-reduction mean pack size of 9.6 wolves per pack (SE=1.3) in 1982-83.

Of 17 packs encountered during wolf reduction flights, 13 were completely removed by GAH. Private aerial hunters completely removed another pack. From 9 of these packs, all wolf carcasses were retrieved and necropsied (table 2). In 3 other completely removed packs (Tuchitua, Traffic Mt. and Big Timber), one wolf from each pack was not retrieved. None of the 3 members shot in the Money Creek pack were retrieved.

Figure 2 shows the distribution of wolves killed in the study area in winter 1983-84 (Hayes and Farnell 1985). Gen-

Table 2. Wolf harvest statistics from the Finlayson Mananagement Area, July 15,1983 to March 27,1984.

Date	Pack Name	No. of Wolves In Pack	No. of Wolves Killed	Method*	Wolves not Retrieved	Age Composition Pup	Yrlng	2 yr.	3 yr.	4 yr.	5 yr.	6 yr.	? Ad
83 07 15	North Lakes	2	2	GAH	0					1	1		
84 01 11	Woodside River	8	3	GAH	0			1	1	1			
84 02 05	Fortin Lake	3	1	GAH	1								
84 03 01	Grass Lake	4	4	GAH	0		1	2	1				
84 03 01	Wolverine Lk.	7	7	GAH	0	4	2						1
84 03 02	Ross River	8	5	GAH	0	1	1	1	1			1	
84 03 03	Traffic Mt.	8	8	GAH	1		1	4		1			1
84 03 05	Big Timber	2	2	GAH	1					1			
84 03 05	Otter Creek	7	7	GAH	3	2	1		1				
84 03 06	Black River	2	2	GAH	0			1	1				
84 03 06	Yusezyu R.	7	7	GAH	0	1	3		1		1		1
84 03 06	McEvoy L.	4	4	GAH	0	2				2			
84 03 08	Thomas Cr.	2	2	GAH	0			1			1		
84 03 08	Money Ck.	3	3	GAH	3								
84 03 20	Mink Creek	3	3	GAH	0		2		1				
84 03 21	Tuchitua R.	15	15	GAH	1	11		2			1		
84 03 27	Connelly	4	4	PAH	0			1					3
Pack wolves subtotal		89	79		10	21	11	13	7	6	4	1	6
Lone wolves subtotal		NA	27	VARIOUS**	15	2	2	2	4	0	1	1	
Total no. wolves			106		25	23	13	15	11	6	5	2	6
			Percentages of each age class			28%	16%	19%	13%	8%	6%	3%	7%

*GAH represents government aerial hunters and PAH represents private aerial hunters.
** Nineteen lone wolves were caught or shot by private trappers, 5 were shot by GAH and 3 were snared by government trappers. Some were probably pack members, but this could not be verified.

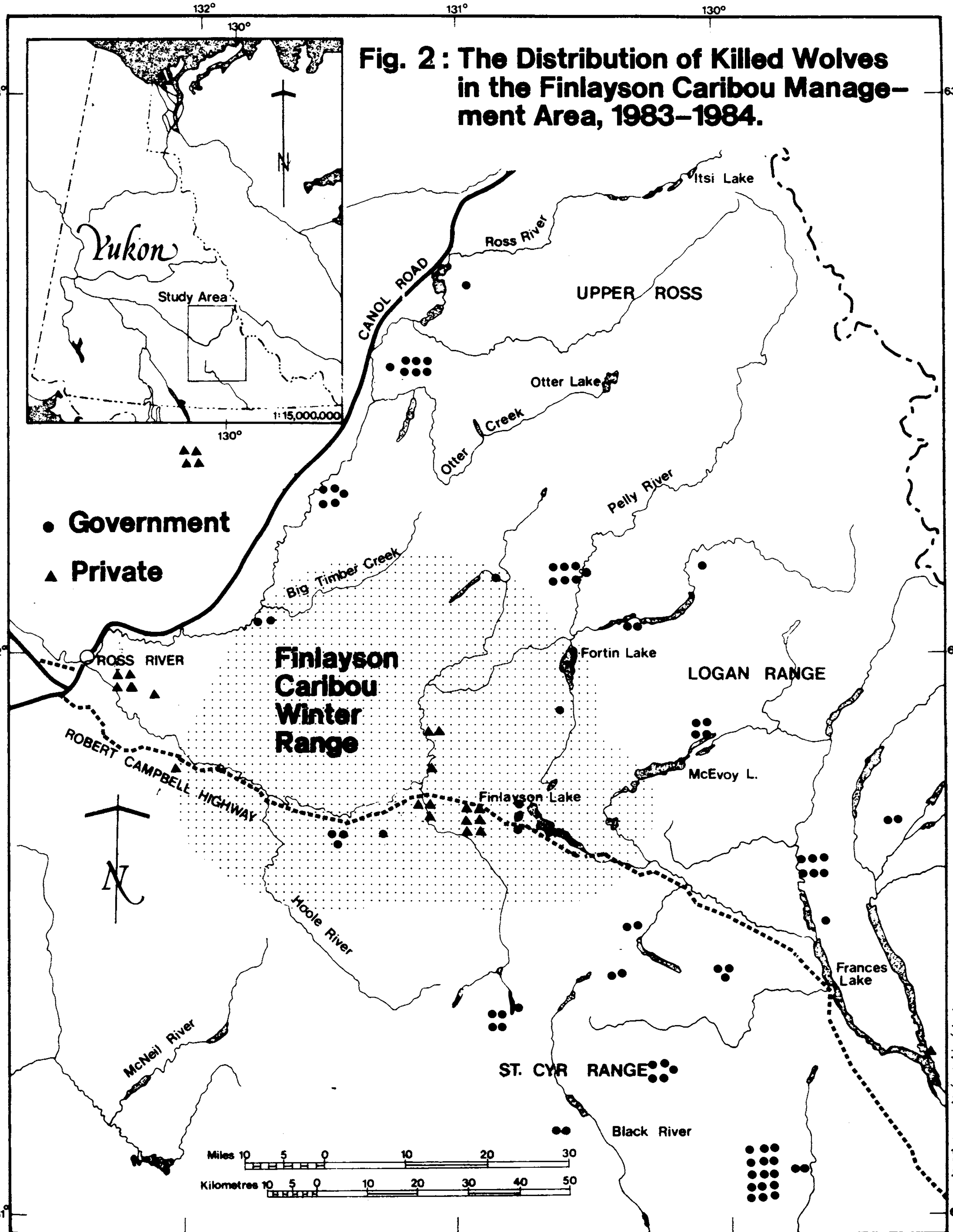
Fig. 2 : The Distribution of Killed Wolves in the Finlayson Caribou Management Area, 1983–1984.
Yukon
Study Area
1:15,000,000
Government
Private
Itsi Lake
Ross River
CANOL ROAD
UPPER ROSS
Otter Lake
Otter Creek
Pelly River
Big Timber Creek
ROSS RIVER
Finlayson Caribou Winter Range
Fortin Lake
LOGAN RANGE
McEvoy L.
Finlayson Lake
ROBERT CAMPBELL HIGHWAY
Hoole River
Frances Lake
McNeil River
ST. CYR RANGE
Black River
Miles
Kilometres
tcrodger ; carto/ graphic/ design

erally, the 1984 reduction was more efficient in 2 areas of the Finlayson caribou range: 1) the core winter range along the Robert Campbell Highway and Pelly River basin and 2) the St. Cyr Mountains calving and summer range in the southeastern portion of the study area. In the core winter range, 18 wolves were removed in 1983 compared to 24 in 1984. Increased aerial coverage of the St. Cyr mountains in 1984 resulted in 45 wolves removed, compared to 18 wolves in 1983. In the northern portion of the study area, the reduction effort was most successful in 1983 when 52 wolves were killed. In 1984, 22 wolves were removed from the same area. Survey coverage in both years was about the same, showing northern wolves were the most severely depressed group, following the first year of wolf control.

2. WOLF SNARING RESULTS

Six live-capture snare sets were distributed throughout the caribou winter range in an effort to collar wolves from 4 known packs. Five wolves were eventually caught; 2 escaped after a brief struggle and 3 were accidentally killed by strangulation. No wolves were radio-instrumented during the snaring project.

3. NECROPSY RESULTS

a. Wolf Sex and Age Composition

Of 81 necropsied wolf carcasses, 47 (58%) were females and 34 (42%) were males. Table 2 shows wolf age distribution for packs and lone wolves. Juvenile wolves (< 12 months old), representing 28% of the sample, were the largest age class, followed by two-year old wolves (>24 months and <36 months) at 19%. Table 3 compares wolf sex and age distributions between 1983 and 1984.

With the large number of wolves removed in 1983, proportional changes in age classes were expected in the 1984 sample. The proportion of juveniles fell from 36% in 1983 to 28% in 1984 and yearling wolves (>12 months and <24 months) fell from 27% to 16%. Adult wolves (>24 months) represented only 35% of the 1983 sample, but accounted for 56% of the 1984 wolves. While proportional changes were noted in all age classes (table 3), the adult age class was the only one that was significantly ($p>0.05$) different from 1983. The increase in the proportion of adults in this year's sample was expected. With the increased experience of aerial hunters and the smaller pack sizes, adults were more vulnerable

Table 3. A comparison of age and sex distribution between 1983 and 1984 wolf carcasses.

	1983	1984	PERCENTAGE CHANGE (1984)
Number of carcasses studied	88	81	
Number and (%) of males	45 (51%)	34 (42%)	-9%
Number and (%) of females	43 (49%)	47 (58%)	9%
Number of wolves aged	79	81	
Number and (%) of juveniles (<12 months old)	28 (36%)	23 (28%)	-8%
Number and (%) of yearlings (>12 and <24 months)	21 (27%)	13 (16%)	-11%
	Adults		
Number and (%) of 2 yr. old (>24 and <36 months)	16 (20%)	15 (19%)	-1%
Number and (%) of 3 yr. old (>36 and <48 months)	4 (5%)	11 (13%)	7%
Number and (%) of 4 yr. old (>48 and <60 months)	3 (4%)	6 (8%)	5%
Number and (%) of 5 yr. old (>60 and <72 months)	0	5 (6%)	6%
Number and (%) of 6 yr. old (>72 and <84 months)	3 (4%)	2 (3%)	-1%
Number and (%) of 8 yr. old (>84 and <96 months)	1 (1%)	0	-1%
Number and (%) of unk. age ad. (>24 months)	0	6*(7%)	7%
Number and (%) of all adults	27 (35%)	45 (56%)	21%
Number and (%) of unk. subad. (<24 months)	3*(4%)	0	

* The 3 unknown aged subadults in 1983 and the 6 unknown aged adults in 1984 were classified by tooth development, breakage, colouration and carnassial and canine wear characteristics.

to aerial hunting than in 1983. Only 3 of 10 packs (30%) were completely removed in 1983, compared to 14 of 17 (82%) packs this year. In both years, wolf reduction efforts were concentrated during the March breeding period. Juvenile production would be negatively affected by the removal of wolves during this period because reproductively active females would be removed along with any in utero embryos. The proportion of pups decreased only 8% between 1983 and 1984, suggesting that, in spite of the 49% decline in wolf numbers during the 1983 breeding season, the reproduction rate was not noticeably reduced. We feel the high proportion of pups (28%) in the sample was mainly influenced by the uneven distribution of wolves removed in 1983. Most southern wolf packs were not disturbed by aerial hunting and bred freely in 1983. Also, we know that certain impregnated females in the northern portion of the study area must have survived the March 1983 reduction, for aerial hunters removed reproductive (and likely alpha status) females from 5 of the 10 packs encountered (Hayes and Farnell 1985). The breeding females that escaped, as well as new females that may have been bred following the aerial hunting in March 1983, contributed to the 28% juvenile proportion taken in the March 1984 reduction. This total production resulted in a 16% increase in wolf numbers from post reduction levels in 1983, but was insufficient to cause a complete recovery in numbers. The pre-reduction wolf population in 1984 was 35% smaller than the original 1983 population estimate of 215.

The "yearling" age class was most affected by the 1984 reduction. A decline of 11% was observed in the 1984 yearling sample compared to 1983. Hayes and Farnell (1985) predicted that juvenile wolves were more vulnerable to aerial hunting because of their inexperience, curiousity and slower speed compared to adults. We expect that the decline in the number of yearlings was due to the high proportion of juveniles (pups) that were taken in 1983.

b. Morphological Data

Weights and external morphological measurements were again collected on all wolf carcasses. Similar to other wolf morphological studies (Rausch 1958, Neilsen 1977, Hayes and Farnell 1985), males were, on average, heavier and larger than females in all age classes. In the 1984 sample, (Table 4), adult male wolves averaged 43.7 kg compared to 34 kg for adult females. Contour length, and chest and neck circumferences were larger for adult males, similar to 1983 morphological data (Hayes and Farnell 1985). More detailed analysis of wolf weight and morphology will be conducted following the termination of wolf collections.

Table 4. Average weights and measurements of adult male and female wolves.

VARIABLE	N	AVERAGE	SD	MINIMUM	MAXIMUM
Females					
whole weight(kg)	14	34.9	5.2	24	43
contour len (mm)	16	1260	42.5	1176	1354
chest circum(mm)	16	743	37.2	660	810
neck circum(mm)	16	477	45.1	380	558
Males					
whole weight(kg)	12	43.8	6.1	35	52
contour len (mm)	14	1309	55.7	1224	1454
chest circum(mm)	15	782	56.8	690	886
neck circum(mm)	15	506	54.2	410	575

c. Stomach Content Analysis

The distribution of prey items from stomach content analysis was similar to 1983 results, despite more intensive wolf reduction in the caribou core winter range. Moose was represented in 91% of stomachs containing prey (10 of 11) compared to 83% in 1983. Caribou were represented in 9% of stomachs in 1983 and remained at 9% (1 of 11) in 1984.

d. Wolf Productivity

A total of 47 female wolves were examined for the presence of placental scars, corpora lutea and corpora albacantia. Thirty-nine, or 87%, showed no sign of reproductive activity. Of the 8 historically-reproductive females, 6 showed recent placental scars indicating they bred and produced pups in May 1983. Two wolves (3 and 6 years old) exhibited historic placental scars but no sign of recent scarring. The interpretation of historical scars as an indicator of past years pup production is not a reliable method. Embryos from the last breeding season may have been resorbed, producing scar tissue that appears similar to placental implants from other years. The limited application of degenerated scars in assessing lifetime pup production is displayed in the 2 two-year old wolves that showed both recent and degenerative scars. If we assume the scars represent breeding activity from 2 years, then we must conclude that the females bred as 10 month old pups. While there is evidence showing that females are capable of sexual maturation at 10 months (Medjo and Mech 1975, Zimen 1975), Rausch (1967) found no sign of reproductive activity in 256 wolf pup uteri, concluding that ovulation was extremely rare in pups. It seems extremely unlikely that the abovementioned wolves bred as pups, and the degenerated scars were likely produced during the yearling breeding period.

The ages of previously bred females ranged from 2-6 years, the same breeding age range found in 1983 (Hayes and Farnell 1985). Table 5 summarizes the frequency and percentage of previously bred females collected in 1984.

Previously bred females were present in 4 of 9 packs that were completely removed with all members retrieved (table 6). In the remaining 5 packs that did not include a reproductive female, 3 were pairs composed of an adult male and female (North Lakes, Black River, Thomas Ck.), and the 4 member Connelly pack was composed of 3 adult males and one adult female. The 7 member Wolverine Lake pack was reduced on several different occasions. It appears that the breeding female escaped the removals as the pack was composed of an unknown age male, 2 yearlings, and 4 pups. In the 4 other packs that were completely removed, some wolves were not retrieved (Traffic Mt., Big Timber, Otter Creek, Tuchitua River). Reproductive females were collected from 2 of these (table 6), and it is possible that previously bred females were present in the other 2 incompletely retrieved packs. Its likely that two reproductively active females were removed from the Ross River pack, as one reproductive 3 year old was killed with the pack and another (6-year-old) reproductive female was collected the next day on the same moose kill.

Wolf reductions carried out mainly during the March breeding season may operate to limit our interpretation of pack composition. It is thought that breeding pairs may split from other pack members during courtship (Mech 1970, Hayes et al. 1985). It follows that certain alpha pairs were possibly absent, making our interpretation of complete pack removals inaccurate. Nevertheless, 8 previously bred females were removed in 1984. Only one was with a single male, suggesting either a breeding pair temporarily separated from other pack members, or they were a newly formed pair. Four packs, consisting of adult male and female wolves, contained no breeding females and likely were recently formed, following the 1983 reduction. While the origin of these adult packs is unknown, it is obvious that they either ingressed into vacant territories or were resident survivors of the 1983 reduction. The low rate of complete pack removal in 1983 (Hayes and Farnell 1985) suggests that the packs were probably composed of resident survivors. Further analysis of the distribution of annual pack removal and subsequent wolf composition in those areas may provide more complete understanding of wolf repopulation mechanisms.

As a wolf population is annually reduced, the mean age of reproductive females should decrease. As the older established females are removed, the vacant territories would likely be occupied by younger subadult or adult females that will eventually breed. To date, our data does not indicate

Table 5. Placental scar frequencies and breeding ages of reproductive female wolves collected in 1984.

Age Class	Number of wolves with Past year scars	Number of wolves with recent scars	% of age class reproductive
juvenile	0/16 *	0/16	0**
yearling	0/6	0/6	0
two years	0/11	2/11	27
three years	0/3	0/3	0
four years	1/2	1/2	40
five years	2/5	2/5	0
six years	1/2	0/2	50
unknown adult	1/2	1/2	50

* the first value represents the number of females that showed historical scar tissue in uteri. The second value represents the number of females in the age class.
** The percentage value represents the proportion of females in age class that showed recent or historical placental scars.

Table 6. Pack removal and reproduction data.

Pack Name	No. of Wolves In Pack	No. of Wolves Killed	No. of Wolves Retrieved	bred females
North Lakes	2	2	2 *	0
Woodside River	8	4	3	0
Fortin Lake	3	2	1	0
Grass Lake	4	4	4 *	1
Wolverine Lk.	7	7	7 *	0
Ross River	8	5	5	2
Traffic Mt.	8	8	7	0
Big Timber	2	2	1	1
Otter Creek	7	7	4	0
Black River	2	2	2 *	0
Yusezyu R.	7	7	7 *	1
McEvoy L.	4	4	4 *	1
Thomas Cr.	2	2	2 *	0
Money Ck.	3	3	0	0
Mink Creek	3	3	3 *	1
Tuchitua R.	15	15	14	1
Connelly	4	4	4 *	0

* denotes packs where all members were removed and retrieved.

any trend that supports this prediction. However, if Hayes and Farnell's (1985) assumption that aerial reduction programs select for younger animals is accurate, it follows that we would expect to remove proportionally more younger age females in the initial year and more older age females as the program progresses, for the chance of eventual removal of an individual increases over time. This was supported by the higher proportion of adult wolves in this years' sample compared to 1983. Until the majority of older alpha females of longstanding breeding status are removed, their inclusion in small annual samples of breeding females will effect the analysis. The 84% reduction, and high proportion of complete packs removed this year, likely has resulted in the removal of most longstanding female breeders from the population.

e. Characteristics of Ungulate Carcasses

A total of 23 ungulate carcasses including 15 moose, 5 caribou, 1 mule deer (*Odocoileus hemionus hemionus*), and 2 unknown species (figure 3, table 7), were located during the period November to April. The distribution of suspected wolf killed ungulates was similar to 1983 (Hayes and Farnell 1985) with the majority of caribou mortalities located within the core winter range of the FCH and with most moose mortalities distributed throughout the northern and southeastern portions of the study area.

Of the 15 moose mortality sites studied, age and sex data were collected at 8 sites, and marrow fat content was collected from 10. The frequency of age/sex classes were as follows; 3 adult cows, 3 adult males, and 2 calves. The average wet weight marrow fat content for adults was 88.25% (SD=5.8). None were within the 10-20% range determined for starved moose in Alaska (Franzmann and Arneson 1976). The 2 calves showed 56% and 43% marrow fat values, well above the 10% or less for Alaskan calves (Peterson et al. 1984). The only specimen that showed low marrow fat content was an adult caribou with a 26% value. Hayes and Farnell (1985) found no indication of poor physical condition in 5 wolf-killed moose carcasses collected from same study area in 1983.

f. Radio-cesium Analyses

The application of radio-cesium (Cs-137) analyses, as a method to estimate winter wolf prey selection and consumption, has been shown by Holleman and Stephenson (1981). Generally, wolves feeding exclusively on moose in the winter

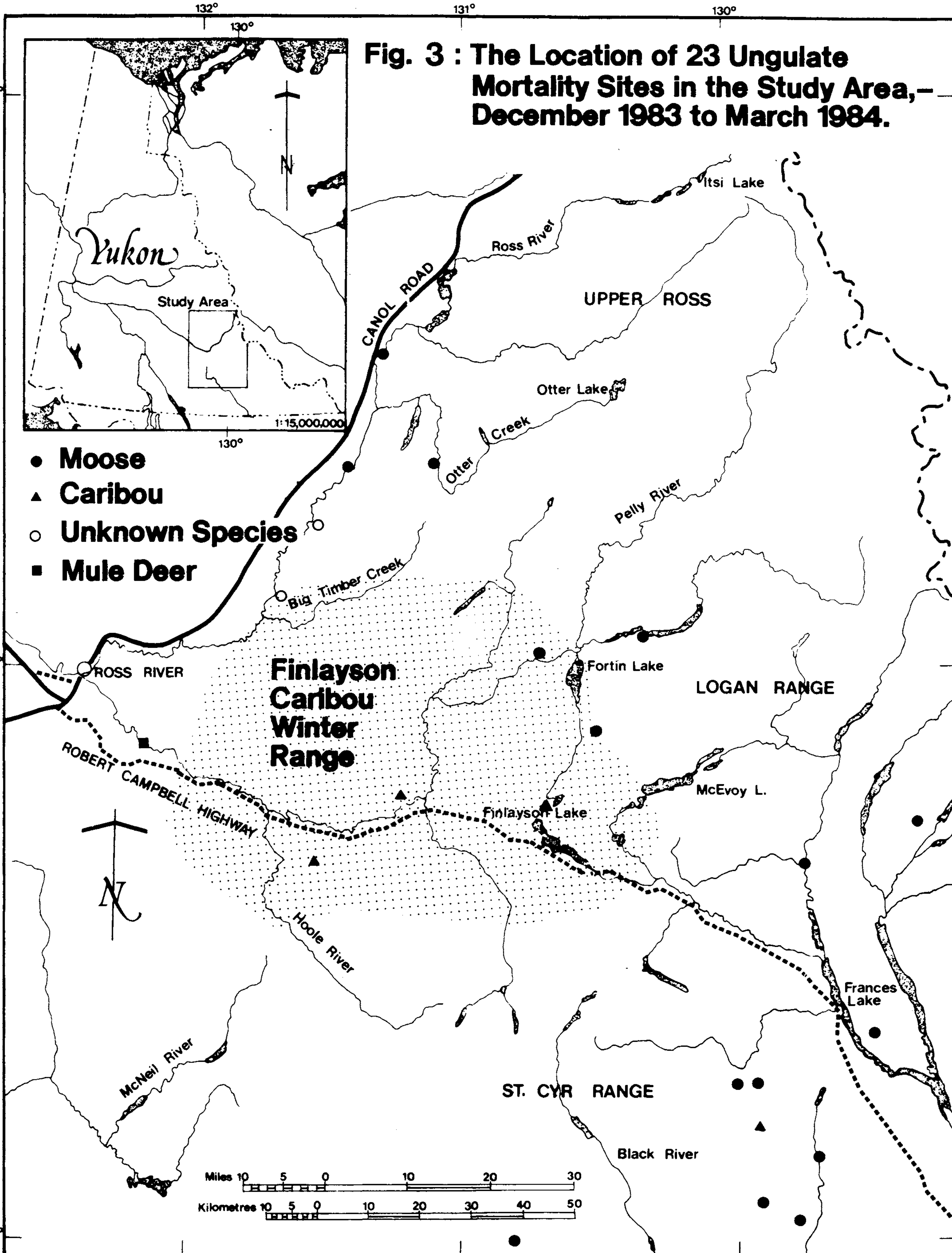
Fig. 3 : The Location of 23 Ungulate Mortality Sites in the Study Area,– December 1983 to March 1984.
Yukon
Study Area
1:15,000,000
Moose
Caribou
Unknown Species
Mule Deer
Itsi Lake
Ross River
CANOL ROAD
UPPER ROSS
Otter Lake
Otter Creek
Pelly River
Big Timber Creek
ROSS RIVER
Finlayson Caribou Winter Range
Fortin Lake
LOGAN RANGE
ROBERT CAMPBELL HIGHWAY
McEvoy L.
Finlayson Lake
Hoole River
Frances Lake
McNeil River
ST. CYR RANGE
Black River
Miles 10 5 0 10 20 30
Kilometres 10 5 0 10 20 30 40 50
tcrodger : carto/ graphic/ design

Table 7. Timing and characteristics of ungulate mortalities in the study area, November 28 to March 20, 1984.

Kill Date	Species	Sex	Age	% Marrow fat
831128	Mule deer	M	Ad	94
831127	Caribou	Unk	Ad	26
831128	Caribou	F	Yr	___
8311??	Caribou	F	Ad	80
8311??	Moose	M	Ad	___
8311??	Moose	Unk	Unk	95
8312??	Moose	Unk	Unk	91
8312??	Moose	Unk	Unk	___
840221	Moose	M	Ad	87
840221	Caribou	Unk	Unk	___
840225	Moose	Unk	Unk	91
840227	Moose	F	Ad	86
840301	Moose	Unk	Unk	76
840301	Moose	M	Ad	87
840302	Moose	F	Ad	92
840302	Moose	Unk	Ca	43
840320	Moose	M	Ca	56
Unknown	Unknown	unk	unk	___
Unknown	Moose	unk	unk	___
Unknown	Unknown	unk	unk	___
Unknown	Caribou	unk	unk	___
Unknown	Moose	unk	unk	___
Unknown	Moose	unk	unk	___

have low cesium 137 levels and wolves preying on caribou have much higher levels. *

In 1983, 39 muscle samples were collected from study area wolves and assayed for cesium 137 levels (Hayes and Farnell 1985). Low to light cesium levels were recorded in 82% of the samples, indicating that most wolves were not preying heavily on caribou during the winter. Most of the wolves removed in 1983 were taken from the northern portion of the study area, outside the traditional winter range of the caribou herd. Hayes and Farnell (1985) predicted that more intensive wolf reductions in the caribou winter range would provide a more complete analysis of prey selection using cesium 137 techniques.

* Moose-eating wolves generally carry concentrations less than 1000 Pci/kg; 1000-300 Pci/kg indicates light consumption of caribou; 3000-7000 Pci/kg suggests moderate use of caribou and 7000-10000 Pci/kg indicates extensive caribou consumption (Holleman pers. comm).

Table 8. A summary of cesium 137 levels from wolves assayed in 1984.

Packname	mean Pci/kg	Standard Deviation
Grass Lake	6938	119
Wolverine Lk.	1092	48
Ross	7307	124
Tuchitua loner	934	40
Pelly River	14710	181
Traffic Mountain	5789	104
Black Lake	1780	56
McEvoy	431	34
Otter Lake	1447	52
Yusezyu	793	39
Tuchitua loner	1938	58
Tuchitua River	851	44
Tuchitua River	392	33
Mink Lake	1435	52
Mink Lake	1535	97
Mink Lake loner	13580	191
Mink Creek loner	19030	262
Thomas Creek	1425	52

Table 9. The distribution of cesium 137 levels from 18 wolves assayed in 1984.

PCi/kg (wet)	Level	Frequency	Percentage
0-1000	low	5	27.7
1001-3000	light	6	33.3
3001-7000	moderate	4	22.2
>7001	high	3	16.6

In 1984, 18 muscle tissue samples were collected (figure 4). Thirteen separate packs and 3 solitary wolves were represented in the assay (table 8). Compared to 1983 collections, the 1984 samples were taken from a more complete cross-section of the study area. Of the 5 assayed wolves taken from the core winter range, 4 showed moderate to high levels and one was light. Three wolves collected on the boundary of the winter range showed moderate cesium levels, suggesting these packs also preyed on caribou during late winter. The low to light cesium levels recorded from the remaining wolves suggest that wolves in those areas likely have only occassional opportunity to prey upon caribou during the winter. In these areas, moose are likely the primary

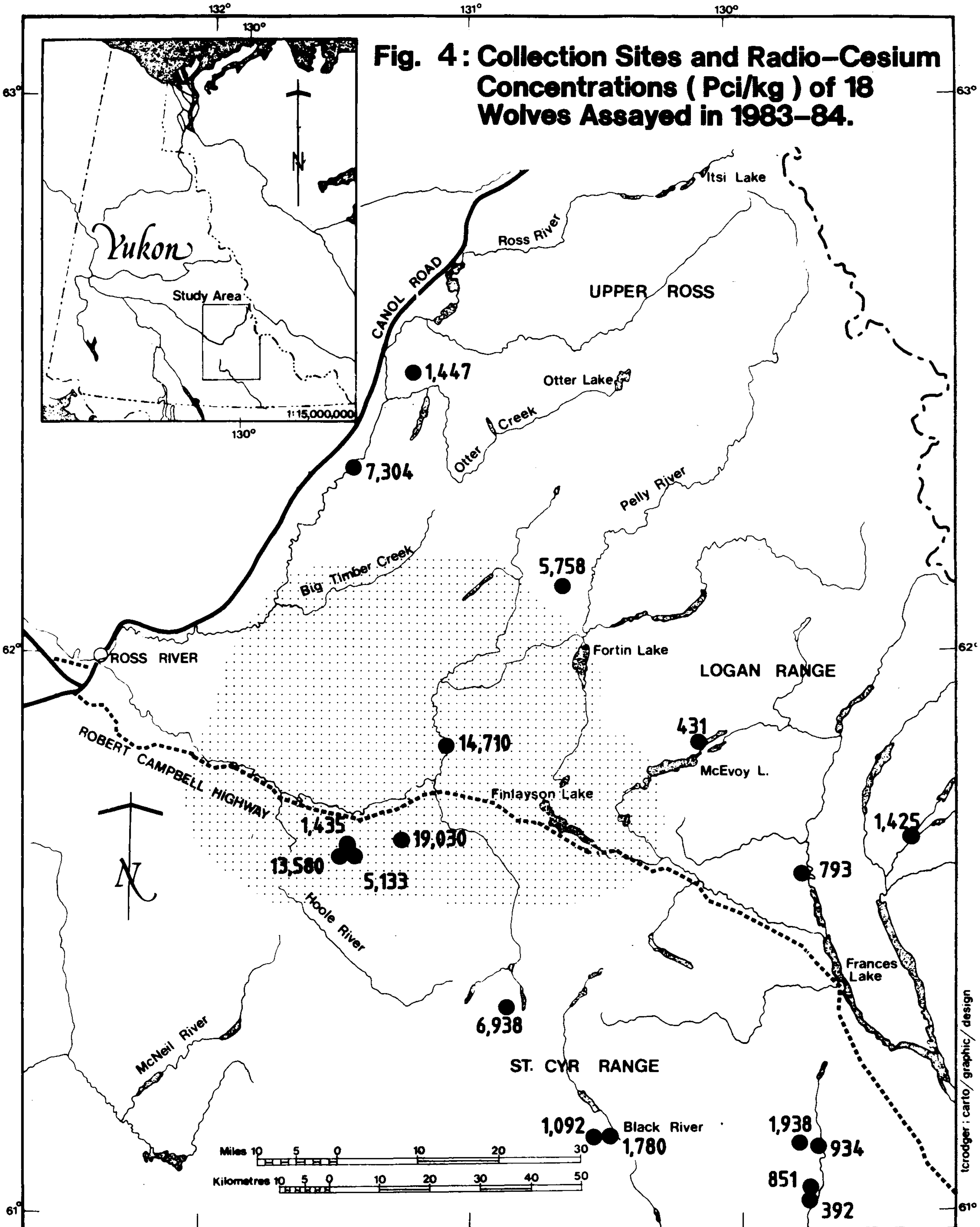
Fig. 4: Collection Sites and Radio-Cesium Concentrations (Pci/kg) of 18 Wolves Assayed in 1983-84.
Yukon
Study Area
1:15,000,000
Itsi Lake
Ross River
CANOL ROAD
UPPER ROSS
1,447
Otter Lake
Otter Creek
7,304
Pelly River
Big Timber Creek
5,758
Fortin Lake
ROSS RIVER
LOGAN RANGE
431
McEvoy L.
14,710
ROBERT CAMPBELL HIGHWAY
Finlayson Lake
1,435
19,030
13,580
5,133
1,425
793
Hoole River
Frances Lake
6,938
McNeil River
ST. CYR RANGE
1,092
Black River
1,780
1,938
934
851
392
Miles 10 5 0 10 20 30
Kilometres 10 5 0 10 20 30 40 50
132°
131°
130°
63°
62°
61°
tcrodger : carto / graphic / design

prey species, based on the low cesium levels recorded and the frequency of wolf-killed moose carcasses located.

Wolf cesium analysis techniques have a useful potential in the study of wolf-woodland caribou relationships. Caribou kills are more likely to be missed during aerial searches in the Finlayson study area compared to moose, due to their smaller size and their tendency to occupy more densely forested areas during the winter. Furthermore, our success in tracking wolves through caribou winter range was considerably lower than in moose wintering areas, due to a profusion of heavy localized caribou trails that generally obscured the wolf trails being followed. In both years, moose mortality sites were more frequently observed than caribou sites and analysis of wolf stomach contents showed that most full stomachs contained moose. In light of the abovementioned restrictions in determining wolf activity on caribou range, Hayes and Farnell (1985) predicted that prey selection and consumption indices, including kill observations, stomach contents, and cesium analyses, were biased toward moose. In 1984, the more extensive wolf reduction efforts in the caribou winter range resulted in the collection of wolves with high and moderate cesium levels, showing an important dependence on caribou that was not reflected in stomach contents and killsite observations. More elaborate analysis of wolf cesium data is planned for the future to predict caribou consumption rates using a formula developed by Holleman and Stephenson (1981).

4. CARIBOU POPULATION STATUS

Farnell (1983) compared fall caribou calf survivorship in November 1982 (pre-reduction period) and November 1983, 6 months after the initial 50% wolf reduction. The percentage of calves in the FCH went from 9.8% to 14.3%, and he felt that this increase may have been greater if a wolf reduction had been applied over a greater range of caribou calving areas. July calf/cow ratios showed a regional variation that appeared to be related to wolf removal. The highest ratios (36-47 calves/100 females) were recorded in the Logan Mountains and the Upper Ross River areas, where wolf numbers were most depressed in 1983. The lowest ratio (17/100) was observed in the St. Cyr Mountains where wolves had remained largely undisturbed. While there is presently insufficient data to correlate survivorship trends with wolf reduction, there is encouraging first evidence of a recovery in potential caribou calf recruitment.

SUMMARY AND CONCLUSIONS

After the March 1983 removal of 105 (49%) wolves from the estimated population of 215, the Finlayson wolf population recovered to a mid-winter 1984 level of 140 individuals, representing a finite rate of increase of 1.27. This was not sufficient to compensate for the 105 wolves killed in 1983 and the natural mortality in winter 1983-84. The net effect was a 35% decrease in wolf numbers. We conclude that the 49% reduction in 1983 achieved the desired declining effect on annual wolf numbers in the study area.

Following the removal of another 106 wolves in March 1984, the population was further reduced to around 34 wolves; 84% below the original pre-reduction population. The aerial reduction program was more efficient in 1984; 76% of the mid-winter population was removed compared to 49% in 1983. Of 17 packs encountered by aerial hunters, 14 were completely removed (76%), compared to 3 of 10 packs (30%) in 1983 (Hayes and Farnell 1985). In total, aerial hunters shot 89% of the pack wolves encountered. Compared to 1983, wolves were more completely removed over the entire study area, especially in the Finlayson herd winter range along the Tintina Trench and in the St. Cyr Mountains.

Adult wolves (2 years and older) were the only age class that had a significantly ($p>0.05$) different proportion (37%) compared to 1983 (9%), although changes were observed in all ages. More adults were expected in the 1984 sample, given the prediction that the chance of encountering and removing an adult wolf increases with time. The largest cohort decline was observed in yearling wolves; a difference of -11% compared to 1983. We conclude that the decline in survival of yearlings in 1984 was a result of the high proportion of juveniles (pups) (36%) taken in 1983.

A minimum of 8 historically reproductive females were removed from the Finlayson wolf population in 1984. Since 1983, 13 previously bred females have been collected, and we predict that the majority of longstanding female breeders were removed by March 1984. It is interesting to note that only 1 of the 8 females taken in 1984 had no recent placental scars, indicating that, despite significant pack disturbance during the 1983 March reduction, some females still bred. However, it is unknown whether these females were in undisturbed packs or not. Four packs, consisting of adult males and females, contained no previously bred females. These packs probably represent resident survivors, or newly ingressed individuals that have established in vacant territories.

The frequency and distribution of ungulate winter mortalities was similar to 1983. Most dead caribou were located within the core caribou wintering area while moose mortality sites were located throughout the the northern and southeastern study area. Similar to 1983 findings, the analysis of physical condition paramaters show that most individuals were not in a starved condition at the time of death.

Radio-cesium analyses of 18 wolves collected from a wide area showed a strong dependence on caribou prey for wolves removed from the Finlayson winter range, moderate caribou consumption for wolves collected on the periphery, and only light or low use for wolves removed from general moose wintering areas. Without radio-cesium techniques, the analysis of stomach contents and incidental observation of ungulate mortalities would indicate only a light use of caribou in winter. Therefore, the inclusion of radio-cesium assay studies was beneficial in more accurately assessing wolf consumption in caribou and non-caribou areas.

While there is insufficient data to correlate the increase in fall caribou calf/cow ratios, there is encouraging first evidence of an increasing calf survivorship trend. With the 84% wolf reduction in 1984, we predict the ratio will further increase.

FUTURE STUDIES

The deductive study design of this caribou-wolf population management program is testing the hypothesis that the Finlayson wolf population, in combination with excessive hunter harvest, is exerting a regulatory effect on the Finlayson caribou herd.The study design pursues a temporal strategy, comparing trends in Finlayson wolf-caribou demography before, during, and following wolf reduction. A more desireable technique would be to concurrently study a similar wolf-caribou system that can act as an experimental control to the Finlayson study area. The Wolf Lake caribou herd, occupying the southern flank of the Pelly Mountains immediately south of the Finlayson study area, could possibly provide the necessary control criteria. Physiography and weather is similar in both areas (Oswald and Senyk 1977). Moose and woodland caribou are the important large mammal species. The traditional hunter harvest on the Wolf Lake herd is low (2-4%, Fish and Wildl. Br. files) by comparison to the Finlayson herd, mainly due to the absence of road access into the Wolf Lake area. The wolf population in the Wolf Lake area is naturally-regulated with insignificant trapper or hunter harvest of wolves (Jessup pers. comm), similar to the situation in the Finlayson area prior to wolf reduction (Hayes and Farnell 1985). It is our intention in 1984-85 to determine wolf distribution and density in the

Wolf Lake area and to continue collecting the same data in the Finlayson area. Concurrently, a number of woodland caribou will be marked in the Wolf Lake area to aid observers in the classification of fall herd composition and in development of calf/100 female ratios for comparative purposes with Finalyson calf survivorship trend data.

In 1984-85, efforts will be made to continue the collection of necropsy data to document trends in age, sex, pack composition, and food habits of the remnant Finlayson wolf population. Attempts will be made to maintain the wolf population at 30% of the pre-reduction level. Based on reported rates of increase from other wolf studies, we expect the wolf population to recover to about 60 wolves by early winter 1984-85.

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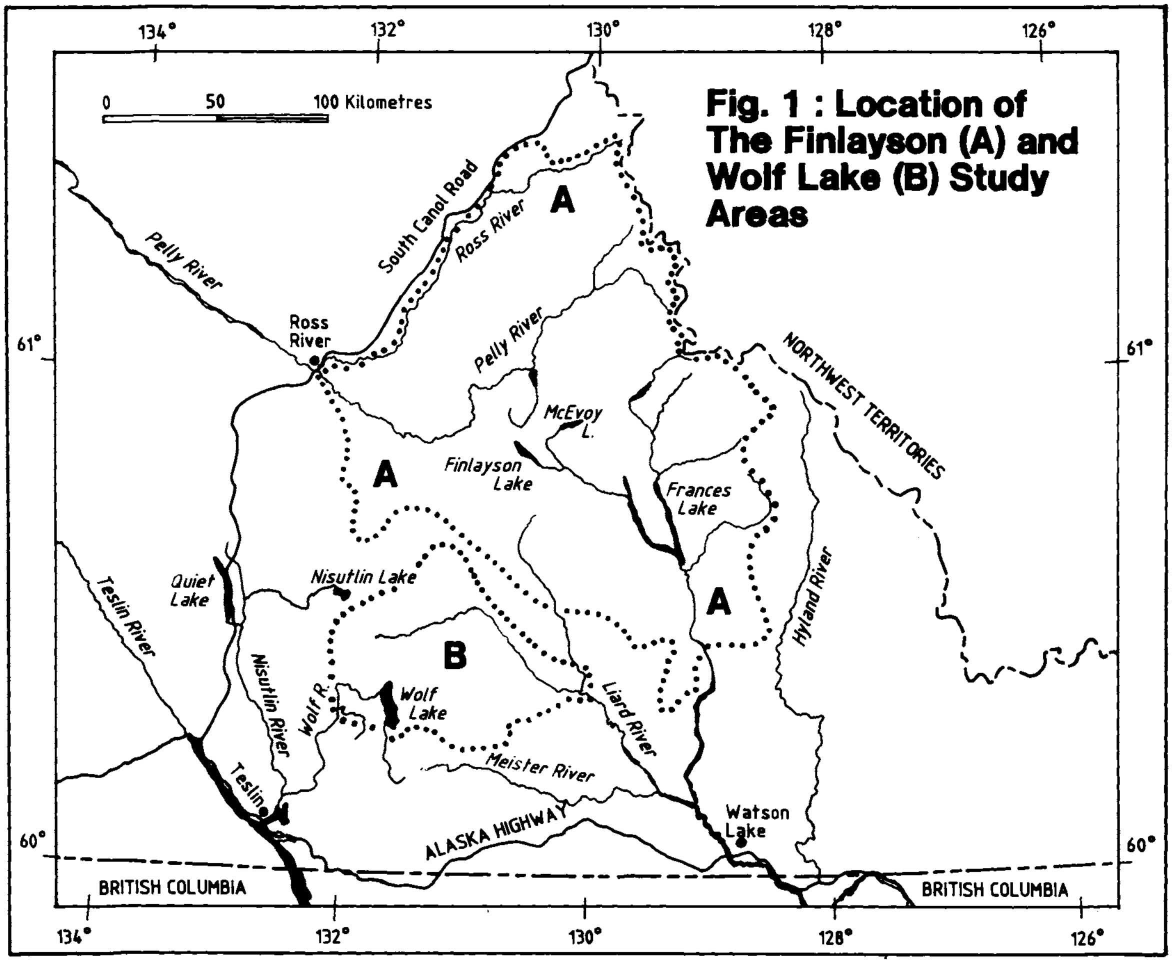

Fig. 1 : Location of The Finlayson (A) and Wolf Lake (B) Study Areas

OBJECTIVES

The objectives of 1985 wolf study were to document wolf numbers, distribution and density in the WLSA, and compare these parameters to the adjacent Finlayson wolf population, which has been severely reduced since 1983. From these data, we can: 1) assess the suitability of the WLSA wolf population as a control for the Finlayson experiment, and 2) measure and monitor the effects of wolf control on an adjacent, relatively undisturbed wolf population.

STUDY AREA

PHYSIOGRAPHY, CLIMATE AND VEGETATION

The 6100 sq km Wolf Lake Study Area (Figure 2) included most of the Nisutlin Plateau, the northern portion of the Cassiar Mountains and the southern flanks of the Pelly Mountain Range. Irvine Creek, Cabin Creek and Wolf Lake formed the southern study area boundary; the Liard River drainages

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