Arctic Gas

BIOLOGICAL REPORT SERIES
VOLUME FOUR

THE PORCUPINE CARIBOU HERD — CANADA

Edited by
R. D. JAKIMCHUK

Prepared by
RENEWABLE RESOURCES CONSULTING SERVICES LTD.

FEBRUARY, 1974

Arctic Gas

BIOLOGICAL REPORT SERIES
VOLUME FOUR

THE PORCUPINE CARIBOU HERD — CANADA

Edited by
R. D. JAKIMCHUK

Prepared by
RENEWABLE RESOURCES CONSULTING SERVICES LTD.

FEBRUARY, 1974

CANADIAN ARCTIC GAS STUDY LIMITED

ALASKAN ARCTIC GAS STUDY COMPANY

S E C O N D E D I T I O N

THE TEXT OF THIS VOLUME CONTAINS MINOR DIFFERENCES FROM COPIES OF THIS VOLUME PRINTED EARLIER WHICH DO NOT CONTAIN THIS PAGE.

CHANGES WERE MADE ONLY TO CORRECT ERRORS AND NOT TO CHANGE THE SUBSTANCE OF ANY STATEMENT MADE IN THE REPORT.

CHAPTER I

A STUDY OF THE PORCUPINE CARIBOU HERD, 1971

R. D. JAKIMCHUK
E. A. DeBOCK
H. J. RUSSELL
G. P. SEMENCHUK

TABLE OF CONTENTS

TABLES

LIST OF FIGURES

TABLE OF APPENDICES

SUMMARY

1. Wintering grounds of three sub-groups of the Porcupine Caribou herd were delineated.

2. The Central group of approximately 30,000 animals wintered between the Blackstone River and Fishing Branch River.

3. The Trevor Range-Bonnet Plume group of approximately 17,500 occupied a winter range within the Peel River drainage from the Hart River east.

4. The Ogilvie group of an estimated 12,000 wintered to the south and west of the headwaters of the Ogilvie River.

5. In their spring migration north, the above groups used two separate routes: the Old Crow Route and the Richardson Route.

6. Spring migration started on 10 May and was essentially completed by 10 June.

7. Caribou encountering seismic lines in northward migration tended to follow such lines to their northern or western ends.

8. There were caribou crossing the interior alternative pipeline route along its entire length in the northern Yukon between 15 May and 10 June.

9. Animals from both of the routes converged in the British Mountains and crossed into Alaska toward their calving ground on the north slope by 10 June.

10. Between 1 July and 15 July approximately 85,000 animals re-entered the Yukon Territory.

11. Between 1 July and 6 July 60,000 animals moved parallel to the proposed coastal pipeline route for 70 miles.

12. The general summer movement was first southeast across the northern Yukon Territory and then rapidly west.

13. Between 27 July and 2 August the majority of the animals re-entered Alaska. Approximately 10,000 remained in the Yukon through August.

14. Fall migrations were initiated in the first week of September during the first major snowfall.

15. Fall migrations southward followed the same two routes utilized in the spring migration.

16. Approximately 30,000 caribou using the Old Crow Route crossed the interior alternative pipeline route between 5 September and 9 September.

17. An estimated 15,000 animals moved along the Richardson Mountains crossing the southern pipeline route between 1 September and 10 September.

18. By mid-October most caribou were in the Peel River drainage where rutting took place.

19. When aerial surveys were terminated approximately 45,000 caribou were in the northern Yukon Territory.

20. Several aspects of caribou behaviour were noted. These include reactions to natural and unnatural obstacles, timing of migrations, and reactions to predators.

21. Three disturbed sites, all of which had been extensively used by caribou, were examined for attributes enhancing their attractiveness to caribou.

22. Data on wolves and their predation on caribou were gathered.

23. Ninety-three grizzly bears were sighted and 11 dens were located.

24. Four sheep populations were found near proposed pipeline routes. These were located on the Hula Hula River, the Sheenjek and Firth rivers, and in the Richardson Mountains.

25. Summer and winter areas of moose ranges were delineated.

I. Introduction

During the past fifteen years increasing efforts have been made to locate and extract the non-renewable natural resources of the Canadian north. In the last three years, large reserves of petroleum and natural gas have been located in Alaska. Indications of reserves in Canada have resulted in accelerated exploration activities. During this period of increased industrial interest in the Arctic, public and governmental concerns regarding the ecological impacts of future development have grown, particularly in relation to wildlife resources.

The Northwest Project Study Group was formed to assess the feasibility of a large diameter gas pipeline from Prudhoe Bay to Emerson, Manitoba. In addition to engineering studies, several ecological studies were initiated in 1971. One important consideration was to establish a sound basis for the assessment of impact on caribou resulting from the construction and operation of a large diameter pipeline.

A comprehensive study of the Porcupine herd was initiated in March 1971. The study was sponsored by the Northwest Project Study Group and coordinated by Williams Brothers Canada Ltd. This report presents the first year's findings from a comprehensive study of caribou and other species occurring within the area of proposed pipeline route alternatives.

The Porcupine Caribou herd, a population of migratory barren ground caribou (Rangifer tarandus granti) of the northern Yukon Territory, Northwest Territories and Alaska, has been the subject of intensive study. This herd crosses proposed pipeline routes at least twice annually in major migrations, as well as during summer movements in the northern portion of their range.

Barren ground caribou have been a vital food resource and an integral part of the culture of native peoples of Aklavik, Fort McPherson, Old Crow and several villages in northern Alaska for thousands of years. The heavy dependency on caribou in the economy of this region declined somewhat in recent years. However, the resource is still of considerable importance.

The caribou of the northern Yukon have been investigated only sporadically since the early 50's. Prior to 1971 no systematic studies had been carried out and previous data are largely fragmentary.

II. Objectives

The primary objective of the caribou study is to determine the impact which construction and operation of an underground gas pipeline would have on Yukon caribou populations. Implicit in the objectives is the need to identify potential conflicts and to recommend means to avoid endangering the caribou populations. The specific objectives which follow are biological in orientation and are designed to provide baseline information during the first phase of study. This information provides a basis for experimental and corroborative studies in 1972. The objectives of the 1971 study were:

(1) To determine the population size and dynamics of the migratory caribou population of the northern Yukon.

(2) To delineate winter ranges of the Porcupine caribou population of the northern Yukon.

(3) To determine migratory routes used by the above caribou, the timing of migration and approximate numbers of animals using various migratory routes.

(4) To investigate factors influencing migration, including ecological factors, human activities, and alterations of the landscape.

(5) To determine calving areas used by the Porcupine caribou herd.

(6) To obtain data on other major species within the study area which may be affected by a pipeline. These include moose (Alces alces), Dall Sheep (Ovis dalli dalli), grizzly bears (Ursus arctos), wolves (canis lupus), and other predators.

The foregoing objectives are oriented towards the acquisition of baseline information and its relation to proposed pipeline routes and facilities. Objectives (3) through (6) are particularly related to proposed pipeline route alternatives.

III. Methods

A ski wheel-equipped Cessna 185 aircraft was used for most fall and winter survey flights. A float-equipped Cessna 185 was used during the summer season. A Piper Aztec C was used occasionally when the Cessna 185 became unserviceable; however, the Piper Aztec C was found to be generally unsatisfactory due to its high speed, low maneuverability, and poor observational qualities. The Cessna 185 provided excellent maneuverability, range, and visibility. Both Allouette II and 206 Bell Ranger jet helicopters were used in establishing and servicing ground camps. The Bell Ranger was found to have excellent range and capacity for the required purpose.

The village of Old Crow, Yukon Territory was used as a base for all survey operations. A total of 583 hours in fixed-wing aircraft and 41 hours in helicopters was flown in the surveys covered by this report. Of the total hours flown, 486 were spent in actual survey and 96 in logistic support of the survey. A breakdown of hours flown per month in survey and logistic support is shown in Table 1.

Survey flights were carried out with a crew of three men plus the pilot. One crew member served as navigator and two crewmen served as observers. One of the observers recorded data while the navigator plotted checkpoints on the flight map. Flight maps used were 1:250,000 scale topographic maps.

In-flight data were recorded on portable tape recorders. Each time animals or animal sign were encountered, the location was recorded as a checkpoint (e.g. Checkpoint I, etc.) and the checkpoint number was located and marked on the appropriate 1:250,000 scale topographic map. Data were later transcribed from tape records to data forms. Daily flight paths were recorded on 1:1,000,000 scale topographic maps. Observations on predators and ungulates other than caribou were recorded on standard 5" x 8" Key sort analysis cards. Map coordinates of all observations were recorded daily.

TABLE I

Flight Time 1971 Field Season

Fixed-Wing Time

Month	Survey Flight Time in Hours	Logistic Support Time in Hours	Total Time
April	80.7	16.4	97.1
May	124.6	15.9	140.5
June	11.6	7.5	19.1
July	104.0	19.7	123.7
August	75.4	8.1	83.5
September	72.7	16.3	89.0
October	17.5	12.4	29.9
TOTAL	486.5	96.3	582.8

Helicopter Time

Month	Survey Time	Ferry Time	Total
May	2.9	1.3	4.2
July	10.0	26.9	36.9
TOTAL	12.9	28.2	41.1

Caribou concentrations were first located by flying the drainages of major tributaries of the Peel and Porcupine Rivers, as well as major rivers of the north slope of the Yukon Territory. The extent of wintering areas was determined by flying the perimeters of areas showing caribou sign. Tracks and feeding craters as well as the presence of caribou provided evidence of caribou winter utilization. Perimeters of wintering areas were plotted on 1:250,000 scale topographic maps.

Migratory routes used by caribou were determined by aerial surveillance or transect survey flights. In aerial surveillance, flights were made one to three days apart to determine the locations, numbers and behaviour of caribou. The frequency of flights depended on weather and distance to caribou; close surveillance was maintained over moving caribou whenever possible. If inclement weather or lack of time reduced the frequency of flights, transect flights were carried out to note evidence of caribou passage by trails which were usually visible from survey elevations (Figs. 1 and 2).

Two types of transects were flown across suspected migration paths. The first type consisted of a zig-zag flight path with angles between straight line transects maintained at approximately 30^{o}. The second type consisted of parallel flight lines two to five miles apart. Examples are shown in Figure 3. Locations of all evidence of caribou passage were recorded and plotted on 1:250,000 scale topographic maps. All transect flights were flown at less than 1,000 feet above the ground surface and at approximately 130 miles per hour.

Conditions in the study area were not conducive to application of random counts techniques used by researchers in other areas. A discussion of this is presented in another section of this report. Population estimates were arrived at by two separate methods. Small groups or long lines of caribou were counted individually while larger groups were counted by units or estimated. When counting individuals it was possible to slow the survey aircraft down to approximately 110 miles per hour. With practice reasonably accurate estimations could be

made. Photographs were taken of concentrations of caribou and were filed according to location and date. Subsequently, visual estimates were cross-checked with systematic counts from photographs. For example, in Figures 4a - d the numbers of caribou were estimated separately by the survey crew as:

	Estimated Number			
	1	2	3	Counted number (from photos)
Figure 4a	350	400	400	648
Figure 4b	3,000	4,000	1,500	2,570
Figure 4c	5,400	5,000	6,000	5,176
Figure 5d	3,500	3,500	2,000	3,700
TOTALS	12,250	12,900	9,900	12,094

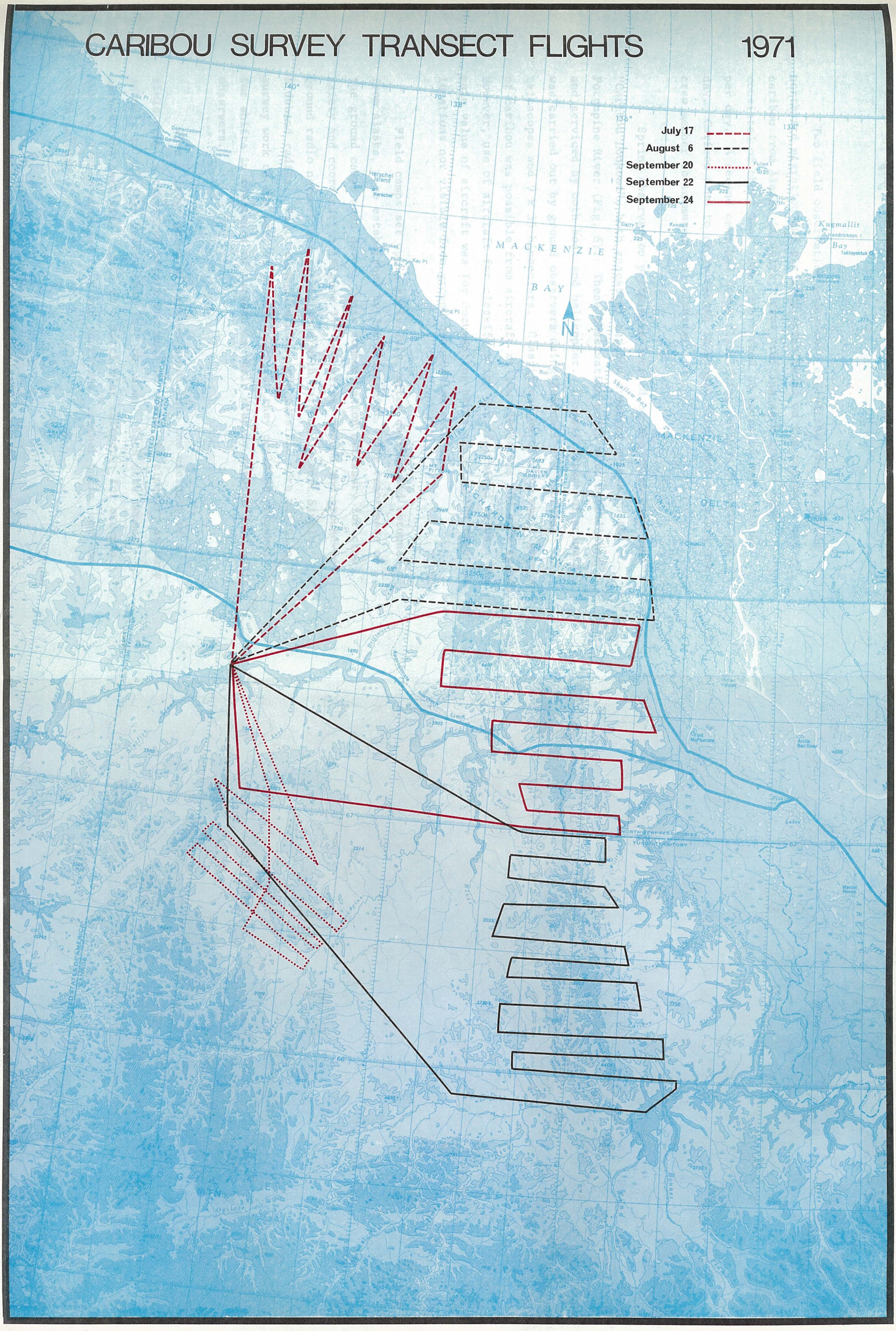
The foregoing estimates ranged from 8 percent above to 18 percent below the actual count.

Aerial photographs were taken with either Nikon F, Pentax SV, or Konica cameras. Films used were Plus X Pan, Kodachrome X or Kodachrome II. Wide angle and normal lenses were used for high - oblique photography.

Classification of caribou as to sex and age categories was carried out primarily from field observation posts. Depending on the season, four or five of the following classes were used: calves, yearlings, cows, bulls, unclassified (Figure 5). Classification criteria used were as follows: a caribou under 11 months old was designated as a calf; a caribou over 11 months old (birth date taken as 10 June) was designated as a yearling; males over two years of age and females over two years of age were classified as bulls and cows respectively. Unclassified caribou were those which had not been assigned to one of the previous sex or age classes for any of several reasons.

FIGURE 3

CARIBOU SURVEY TRANSECT FLIGHTS 1971



Two field observation posts were established during spring northward migration and six were established on the return of the caribou from Alaska in July. Crews staffing each ground camp consisted of three men. One camp worked 16 hours of surveillance per day. A second camp had crews classifying caribou 24 hours per day. Caribou tend to cross rivers in single file, thus enabling one crew member to enumerate all classes.

Spring observation posts were located at the "Fish Camp" and "Caribou Lookout", both ancestral caribou crossing points on the Porcupine River (Fig. 6). These observation posts were established and serviced by both boat and helicopter. Classification of animals was carried out by ground observers using Bushnell 20X spotting telescopes and 9 x 35 binoculars. Classification of very small groups of caribou was possible from aircraft at low elevations and slow speeds. However, use of aircraft for classification was of limited value. The main value of aircraft was for documenting herds crossing the river at locations not visible from ground observation points.

Field camps set up in early July, after caribou had returned from Alaska, were established by jet helicopter. The remoteness of the ground camps made direct radio communication necessary for crew safety and coordination (Figure 7). An air-to-ground and ground-to-ground radio network was established with Marconi 10-watt Single Sideband radios. Radio communications made possible more efficient survey work on the part of ground crews, as they could be prepared for shifts in movements of caribou in their area by reports from aerial observers.

When a large group of caribou moved into the vicinity of a field camp, a concerted effort was made to count and classify as many animals as possible before they left the area. Each crew member counted the herd with regard to a particular category; for example, one crew member censused cows and yearlings, another bulls, and the third calves.

Observations of caribou mortality were made from the air and also by ground observers. All suspected wolf and bear kills were recorded and plotted on 1:250,000 scale topographic maps. Kill data were recorded on key sort cards. Ground observers recorded sex and age data and other pertinent information at each kill site. Hunter-taken caribou were counted by ground observers except in the case of hunter-taken caribou in the eastern Richardson Mountains, where data were obtained from Northwest Territories Conservation Officers Mr. D. Lepp and Mr. C. Cook.

In this report seasons have been arbitrarily divided as follows: Spring is the period from 1 March to 31 May; Summer, 1 June to 31 August; and Fall, 1 September to 1 November.

IV. Description of Study Area

The area surveyed in this study extends from 63^{o}N to 70^{o}N latitude and from approximately 134^{o}W to 143^{o}W longitude. Physiography of the area has been partially adapted from the descriptions and classifications given by Bostock (1948). Vegetative descriptions of the area have been determined by field observations.

Three major mountain systems are found in the study area (Figure 6): The Ogilvie Mountains to the south; the Richardson Mountains to the east; and the British Mountains to the north. The British Mountains, an easterly projection of the Brooks Range in Alaska, run parallel to the Arctic Coast approximately 35 miles inland. They are bordered by foothills to the north and south. A wet tundra plain separates the British Mountains from the Beaufort Sea (Figure 8). The coastal plain and Arctic Plateau, as defined by Bostock (1948), widen in the vicinity of the Blow River, thus separating the British and Richardson Mountains (Fig. 6). Tree line is generally south of the British Mountains except in certain tributaries of the Firth River. There, good stands of spruce (Picea mariana)occur (Fig 9). Some

FIGURE 6

GEOGRAPHICAL FEATURES

BEAUFORT SEA

MACKENZIE BAY

MACKENZIE DELTA

OLD CROW FLATS

OLD CROW RANGE

KEELE RANGE

RAT PASS

CADZOW LAKE

SALMON CACHE

LONE MTN

JOHNSON CREEK

BARRIER RIVER

CODY CREEK

FISHING BRANCH

TREVOR RANGE

KNORR RANGE

BRITISH MOUNTAINS

RICHARDSON MOUNTAINS

Herschel Island

Kugmallit Bay

Tuktoyaktuk

Inuvik

Fort McPherson

Griffin Pt

Siku Pt

Demarcation Point

Stokes Pt

King Pt

Shallow Bay

Mt Pitton

Mt Davies Gilbert

UNITED STATES OF AMERICA CANADA

NORTHWEST TERRITORIES

YUKON TERRITORY

low willows (Salix spp.) occur along the upper reaches of the Babbage and Firth rivers.

The Richardson Mountains run in a north-south direction from the Peel River to a point approximately 20 miles from the Arctic Coast. These mountains are skirted to the east and west by rolling foothills which are often timbered (Fig. 10). Only major stream valleys, such as the Bell River valley, are timbered (Fig. 11). The Richardson Mountains are generally low, glaciated, and eratically cut by streams. The only extremely precipitous section of the Richardson Mountains lies north of McDougall Pass (Fig. 6).

The Ogilvie Mountains form the headwaters of the Porcupine, Blackstone, Hart, Snake and Wind rivers. This range is extremely rugged and poorly mapped (Fig 6). Most valleys of the Ogilvie Mountains are timbered with black spruce. Better drained areas support limited stands of white spruce (Picea glauca). Most of the rivers in the study area have limited stands of balsam poplar (Populus balsamifera) and birch (Betula spp.) along their margins (Fig. 12). Several old burns in the Ogilvie Mountains are covered with birch and poplar.

Three minor mountain ranges of particular importance to caribou occur in the study area. These systems are the Barn Range, an eastern extension of the British Mountains; the Old Crow Range, an essentially isolated range immediately north of the village of Old Crow; and the Keele Range, which lies south of the Porcupine River (Fig. 6).

The Ogilvie, Richardson, and British mountain ranges, form a ring around a rolling plateau and lowland drained by the Porcupine River, the major river in the northern Yukon. The Porcupine River flows northeast from the Ogilvie Mountains to its confluence with the Bell River, then northwest to the Driftwood River and westward to the Alaskan border. It enters the Yukon River near Fort Yukon, Alaska. The course of the Porcupine River describes a large U-shape with the

longer reaches running northeast and southwest.

Porcupine Plateau

The wide highland area joining the British and Ogilvie mountains is termed the Porcupine Plateau (Bostock 1948). The plateau, which lies at right angles to the Porcupine River, effectively separates the Yukon Flats of Alaska from the Porcupine Lowlands of the Yukon. Numerous streams are tributary to the Porcupine River. These include the Bluefish, Fishing Branch, Whitestone, Miner, Driftwood, Orange, Black, and Old Crow rivers as well as Johnson, Cody, Lord, Berry, and Caribou Bar creeks which drain the Porcupine Plateau (Fig. 6). The Old Crow Range and the Keele Range represent the highest elevations on the plateau.

The lower elevations of the Porcupine Plateau are generally covered with forests of black spruce (Fig. 13). The better drained regions occasionally support a cover of white spruce. Several very large forest fires have occurred in recent times on the Porcupine Plateau. Notable examples are found in the Eagle Plains area between the Eagle and Porcupine river systems and in the Rapid River area of Alaska. These large burnt-over areas are variably covered with balsam poplar, birch, and willow (Fig. 14). The most recent fires on the Plateau occurred during the summer of 1971 along the Fishing Branch River.

Porcupine Lowlands

The lowlands occur along the southern base of the British Mountains and western edges of the Richardson Mountains. The basins of the Old Crow, Driftwood, and Eagle Rivers, all tributaries of the Porcupine River, drain the region. The Old Crow and Bell Flats are the lowest areas in the Porcupine Lowlands and contain numerous lakes and ponds (Figs. 6 and 15). The Bell Flats are vegetated with black spruce while the Old Crow Flats are generally treeless except along water

courses (Fig. 16).

Several rivers drain the northern portions of the study area. Four large rivers, the Blow, Babbage, Firth, and Malcolm rivers, all originate in the British Mountains and flow into the Beaufort Sea. The Firth is the largest of the north slope rivers. Six minor rivers, the Rat, Barrier, Road, Trail, Vittrekwa, and Caribou rivers, flow from the east slope of the Richardson Mountains into the Peel River (Fig. 6).

The Peel River drainage, which is well forested with black spruce, is frequently used by caribou as winter range. This region is separated from the Porcupine Plateau and Lowlands by ranges of low hills and an east-west extension of the Richardson Mountains. Tributaries of the Peel originate mainly in the extremely rugged Wernecke and Selwyn mountains to the south. Extensive lowlands are also found along the southern edge of the Peel Valley in the vicinity of Hungry Lake between the Wind and Hart rivers. Nearly all streams are braided (Fig. 17) and flow through very flat valleys with steep sides (Fig. 18). Several major tributaries coalesce to form the Peel River. These are the Ogilvie, Blackstone, Hart, Wind, Bonnet Plume and Snake rivers.

Several large forest fires have occurred in the Peel drainage, eliminating large tracts of caribou winter habitat. The most recent fire (summer of 1971) destroyed approximately 100 square miles of black spruce - lichen forest.

All rivers in the study area possess at least one of three basic characteristics. They are either meandering streams, braided streams in wide flat steep-walled valleys, or flow in steep-walled canyons. The Old Crow River is a typical example of a meandering stream (Fig. 16). All tributaries of the Peel River are braided streams (Fig. 17). The Chandler River of eastern Alaska is a typical braided river in a flat valley with steep sides (Fig. 18). The Firth River is an example of a mountain river which has cut a steep-walled canyon in its lower reaches (Fig. 19).

V. Results

A. Distribution and Movement

1. Description of Wintering Areas

The Porcupine herd utilized two general habitat types as winter range in the early spring of 1971. These were mature spruce-lichen forest and slopes above timber line(Fig 20 and 21). Areas of rolling hills and benches covered with stands of spruce-lichen forest were preferred. Wintering areas in lowlands were frequently interspersed with small lakes and streams surrounded with sedges. Caribou wintering in mountain areas frequently moved into extremely rough terrain, using steep, lichen-covered slopes in early spring (Fig. 21). Animals tended to avoid burned-over areas and did not utilize areas of deciduous forest; they merely passed through these areas en route to preferred range.

Ground cover on winter ranges of black spruce forest is composed primarily of caribou lichen (Cladonia spp.; Figure 22), except in areas surrounding ponds, lakes or streams, where sedges and grasses predominate. Several other species of lichen are also associated with the black spruce taiga habitats. In general, winter habitat in the Yukon consists of areas which have not been subjected to any recent radical change such as fire or mechanical disturbance.

In past years, caribou are reported to have wintered on the North Slope and on the Old Crow Flats. The 1970/71 winter range included the area from approximately 100-200 miles south of Old Crow. Residents of Old Crow reported a considerable amount of north-south movement until snow depths finally curtailed movements during the winter of 1970/71. The 1970/71 winter range is considered to be a more suitable winter habitat from the stand-point of food and shelter than the treeless Old Crow Flats. When wintering on the Old Crow Flats, caribou reportedly feed on sedges and muskrat push-ups (Peter Lord

and Charlie Peter Charlie, pers. comm.).

At the time of the last survey (28 October 1971), a large segment of the Porcupine herd was located south of the Ogilvie River in the vicinity of Chapman Lake (Figure 6). These animals were utilizing very large, open flat areas interspersed with numerous lakes and streams (Figure 23). Sedges appeared to be the dominant plant species associated with the lakes and water courses. In addition, many of the open ridges showed evidence of grasses and sedges through the snow. Caribou were found in all valley bottoms of the Ogilvie, Hart, Wind and Blackstone rivers, and there was some evidence of movements high onto open mountain slopes. Snow depth around the caribou was 10 - 16 inches. The snow conditions did not appear to be hindering caribou movement.

2. Distribution of Population Subgroups, Winter 1971

Based on intensive aerial surveys of wintering herds, three basic divisions of the total population inhabiting the study area were identified. The distribution of these groups and their populations are described below.

a. Central Group

Almost all caribou which wintered between the Blackstone River and Miner River moved northwest to the Fishing Branch River on migration. This population segment is referred to as the Central Group (Figure 24). It comprised the largest single segment of the Porcupine Caribou herd. Aerial and ground observers along the Porcupine River during the spring northward counted over 23,000 caribou in the Central Group; however, the actual size of the group is probably in excess of 30,000 animals, since uncounted groups crossed at numerous locations on the Porcupine River.

b. Trevor Range - Bonnet Plume Group

The caribou comprising the Trevor Range - Bonnet Plume Group wintered between the Snake and the Blackstone rivers (Figure 24). This group was the second largest segment of the Porcupine herd; surveys and reports indicate that this segment contained 17,500 caribou. This figure compares favorably with figures derived by Canadian Wildlife Service personnel (A. Pearson, pers. comm.). Approximately 2,500 animals from this group wintered along the Vittrekwa River in 1970/71 (D. Lepp, pers. comm.).

c. Ogilvie Group

The Ogilvie Group wintered south and west of the headwaters of the Ogilvie River. Aerial census and ground counts indicated a population in excess of 12,000 animals. The largest segment, consisting of 10,000 caribou, crossed the Porcupine River at Fish Camp (Figure 24). An estimated 2,500 animals crossed at Crow Point.

FIGURE 24

WINTERING AREAS AND SPRING MIGRATION ROUTES OF THE PORCUPINE CARIBOU HERD 1971

GROUND OBSERVATION POSTS I

PROPOSED PIPELINE ROUTES

MAJOR RIVER CROSSINGS

CONCENTRATION AREAS

MIGRATION ROUTES

GRIZZLY DEN SITES

WINTERING AREAS

Scale: 1 inch = 24 miles approx.

II I

CENTRAL GROUP 30,000+

TREVOR RANGE - BONNET PLUME GROUP 15,000+

OGILVIE GROUP 12,000+

In total, the spring population of the Porcupine herd, comprised of the above subgroups, was estimated at approximately 60,000 animals.

3. Spring Migration

a. Timing of Spring Migration

Factors related to the timing of the caribou migration are of considerable importance, particularly as they relate to construction of a pipeline. The mechanism or series of related factors which trigger movement are largely unknown but are suspected of being related to snow conditions. During the spring surveys, migratory movement appeared to take place under two general conditions: when snow had crusted sufficiently to allow travel over snow, and when snow depths had decreased. In the latter case, movement was concerted and direct. The winter of 1970/71 was one of unusually deep snow in the northern Yukon. The snow remained deep until late in the spring, possibly delaying migration. The time of onset of spring migratory movement varied among the different groups of the Porcupine Caribou herd.

The Central Group had moved into the Fishing Branch River valley by 22 April, and was concentrated on ridge tops between Cody Creek and the Fishing Branch River (Figure 25). 11 May 1971 marked the beginning of a direct movement northward to Lone Mountain and the Porcupine River. The caribou concentrated around Lone Mountain for three days, then proceeded northward and began crossing the Porcupine River on 21 May. By 23 May large groups were halfway across the Old Crow Flats. At this time evidence was found of small groups of caribou which had already penetrated the British Mountains.

The Trevor Range - Bonnet Plume Group did not begin moving north in large numbers until the period of 13 - 16 May. A herd of 2,000 animals had commenced movement north from the southern Richardson Mountains by 10 May. Caribou entering the eastern end of the Barn Range were

discovered on 23 May 1971. Caribou from south of the Peel River had apparently moved over 200 miles through difficult terrain in 10 days.

The Ogilvie Group was initially located on 17 May 1971 resting on two ridge tops at the headwaters of the Ogilvie River. This herd had moved approximately 20 miles from their wintering area by 17 May and reached the Porcupine River by 25 May (Figure 24), covering 160 miles in 8 days. Crossing of the Porcupine River began on 21 May 1971 and was completed by 10 June except for stragglers which were still crossing on 23 June (Peter Lord, pers. comm.).

b. Spring Migration Routes

In the spring migration the Porcupine herd moved northward along two basic routes which, on the basis of current surveys and indirect evidence, appear to have been relatively constant for hundreds of years. The northward migration routes have been termed the Old Crow Route and the Richardson Route.

i. Old Crow Route. The majority of the Porcupine herd, the Ogilvie and Central groups, travelled up the Fishing Branch River, Cody Creek and north through the Keele Range to Lone Mountain (Figure 24).

The Ogilvie Group moved north through the Ogilvie Mountains in a slight variation of the Old Crow Route. One segment moved westward just across the Alaskan border, then swung northeast straight to Lone Mountain (Figure 24). Most of the Ogilvie Group moved north to Bear Cave Mountain, then westward to the Bluefish River before returning to Lone Mountain. Prior to reaching Lone Mountain, animals moved in a narrow front. However, upon moving north from Lone Mountain, herds dispersed into a wide front which extended from the mouth of the Bell River to Rampart House on the Porcupine River, a distance of about 100 miles. The Ogilvie Group followed the Central Group as they left the Lone Mountain area and were the last to cross the Porcupine River. All parts of the river were crossed, although the

majority of animals converged on certain traditionally used crossing sites. Once north of the Porcupine River, both groups crossed the Old Crow Flats and proceeded into the British Mountains.

Migrating caribou were widely dispersed when crossing the interior alternative pipeline route. There tended to be a slight westward shift while crossing the Old Crow Flats. Movement across the Flats was in a wide front, and no particular migration paths were favored. Upon reaching the British Mountains, migrating caribou moved in a northwesterly direction and proceeded to the Firth River. Caribou moved westward on a broad front that spanned the Firth River from the Firth Glacier to the Arctic Coast (Figure 24).

ii. Richardson Route. The second major migration path used by the Porcupine herd was northward up the long axis of the Richardson Mountains (Figure 24). This route was used by an estimated 17,500 animals of the Trevor Range - Bonnet Plume Group. Movements from winter range proceeded up the east slope of the Richardson Mountains to the latitude of the Road River. From the Road River most caribou moved west across the mountains to the west slope and a point immediately south of Rat Pass. At this point one segment of the group moved around the east end of Rat Pass and proceeded northward. Caribou crossed McDougall Pass along its full length, then moved north by various paths until reaching the latitude of the southern end of the Barn Range. There they turned westward, moving through the Barn Range into the British Mountains on a front that spanned the Barn Range. On reaching the western extent of the Barn Range, the caribou from the Richardson Route joined those moving north across the Old Crow Flats.

4. Calving Period

Survey operations ceased between 4 June and 1 July, and preparation of an interim report was undertaken. Thus specific data on

the calving area and calving period were not obtained. George Calif, Templeton Engineering, saw many thousands of cows, calves and yearlings on the coastal plain between Spring River and Kongakut River moving rapidly west on 17, 18 and 19 June. He estimated that 20,000 caribou were in the area at that time. This suggests that a considerable portion of the herd calved in the Yukon in 1971. However, it is believed that at least half of the population calved in Alaska.

5. Summer Movements

The following is a detailed description of caribou movements observed during July and August (Figure 26).

On 1 July approximately 60,000 animals were located crossing the Yukon-Alaska border from the Clarence River drainage in the northern foothills of the British Mountains. The density of the herd is illustrated in Figure 4a, b and c. They continued as one group moving east and then southeast until 7 July when they began wandering and breaking into several groups in the Crow and Trail River drainages. There they were joined by a group of 10,000 animals which had entered the Yukon on approximately 6 July further south in the central British Mountains. Figure 27a - d shows a herd of at least 20,500 animals moving from the Crow to the Trail River drainage.

The resulting herd of 70,000 stayed in the same general region until approximately 14 July when the caribou began moving southeast. On 17 July they crossed the Blow River and entered the northern Richardson Mountains. For approximately one week this herd dispersed somewhat and wandered throughout the headwaters of the Bell and Big Fish rivers.

On 15 July another herd of 15,000 animals entered the Yukon in the Firth River area. On 21 July this herd was reported south of Trout Lake on the southern edge of the Barn Range (George Calif, pers. comm.).

FIGURE 26

SUMMER MOVEMENTS — PORCUPINE CARIBOU HERD 1971

GROUND OBSERVATION POSTS

NON-DIRECTIONAL MOVEMENT

DIRECTIONAL MOVEMENT

July 1
60,000

July 8–18
10,000

July 7–20
70,000

Mid-July
to Aug. 2
15,000

Aug. 1–14
2,000

July 17–25
70,000

Aug. 3–10
5,000

July 21–
Aug. 11
65,000

Aug. 2
60,000

July 27–31

July 28

Aug. 10
1,000

Aug. 16
1,000

Aug. 1–31
1,000

MACKENZIE BAY

MACKENZIE DELTA

Kugmallit Bay

Herschel Island

Fort McPherson

NORTHWEST TERRITORIES

YUKON TERRITORY

UNITED STATES OF AMERICA

These animals were located on 23 July immediately southwest of the headwaters of the Blow River. On 24 July they had moved several miles west. They doubled back along their previous route of entry and returned to Alaska before the end of July.

Thus, between 1 - 15 July a total of 85,000 animals had entered the Yukon in three separate herds.

On 21 July approximately 65,000 animals from the northern Richardson Mountains began to move southeast, then directly south between the Driftwood River and Johnson Creek. Five thousand remained at Canoe Lake in the northeastern Richardson Mountains.

On 28 July approximately 60,000 animals left the Driftwood - Johnson Creek area and moved rapidly westward towards Alaska via Schaeffer Mountain and King Edward Mountain. Both mountains are north of the village of Old Crow on the southern edge of the Old Crow Flats. Some 5,000 animals remained scattered between Bonnet Lake and the Porcupine River.

By 2 August all but 10,000 of the animals had re-entered Alaska and apparently spent most of August on the north coast and in the area west of the Sheenjek River.

During August the 5,000 animals at Canoe Lake split up. Approximately 2,000 moved north to the Coal Mile Lake area and the mouth of the Blow River. These animals gradually trickled south down the Richardson Mountains. A herd of 1,000 animals moved south from Canoe Lake toward Rat Pass. They were observed just north of Rat Pass on 16 August. The remaining 2,000 dispersed throughout the northern Richardson Mountains.

The 5,000 caribou in the Driftwood River - Johnson Creek area remained in that region throughout August. Old Crow hunters observed

a few of these animals crossing and recrossing the Porcupine River between the Driftwood River and Lord Creek and harvested approximately 50 animals during this period.

6. Fall Migration

a. Timing of Fall Migration

The initiation of the southward fall migration was abrupt and movements were rapid. As in spring migration, movement appeared to be largely related to snow and other weather conditions.

The first stage of the fall migration began in early September immediately following the first snow storm of the season. Animals from northern Alaska moved south through the Brooks Range ahead of a north wind. No more than 8 inches of snow had fallen. The first movement in September brought caribou to the Porcupine River at Caribou Bar Creek on 6 September. After crossing the Porcupine River, this movement stopped at the Fishing Branch River on 16 September. On 20 September the weather turned warm and winds were strong from the west. Herds drifted slowly northward from 20 - 29 September, when they stopped along the south shore of the Porcupine River.

The third stage of the fall migration again followed a severe storm, which began on 30 September and lasted for at least five days, leaving approximately 1.5 feet of snow on the ground. Animals travelled southward through heavy snow and difficult terrain to the Ogilvie River, which they crossed by 11 October (Fig. 6). This movement was primarily single file with lines of caribou extending over several miles in length. There was a steady high wind from the north during and after the storm. Following the storm the southward movement appeared to lose momentum, particularly after the caribou crossed the Ogilvie River. At this point the herd split up into small rutting bands which drifted up the valleys of the major tributaries of the Peel River (Fig. 6).

b. Migration Routes Used

During the fall migration intensive aerial surveillance was made impossible by several periods of inclement weather which lasted as long as six days. Therefore, extrapolations pertaining to numbers and dates are greater than was the case for either the spring or summer movements.

Caribou moving south during September and October followed the same two basic routes used in the northward spring migration. Fall migration routes are shown in Figure 29.

i. Old Crow Route

The first concerted southward movement was observed on 7 September 1971. Caribou were located crossing the Porcupine River from Salmon Cache to the Alaska border. An estimated 3,000 caribou were strung out single file in a broken line that extended for 25 miles, crossing the Porcupine near Caribou Bar Creek, 20 air miles west of Old Crow. The movement across the river lasted from 6 - 8 September inclusive. Since there were 6 - 8 inches of snow on the ground in the region, it was possible to retrace the movement to the Brooks Range where several heavily used trails were observed in the Mancha and Boulevard Creek valleys. These trails indicated a southward movement from the Kongakut River into the Firth River area. It was estimated that 35,000 animals had passed over and around Ammerman Mountain as they moved out of the Firth River drainage. Of this group, 5,000 moved around the eastern side of the Old Crow Flats, and 30,000 moved southward across the western half of the Flats to King Edward Mountain, Schaeffer Mountain and the ridges south of Bilwaddy Creek. Only a few hundred animals moved to King Edward Mountain where they continued south. Approximately 25,000 moved to the ridges south of Bilwaddy Creek, following the ridges south, then southwest to the head of Caribou Bar Creek.

At this point they diverged and approximately 20,000 animals moved down Caribou Bar Creek, crossing the Porcupine River at its junction with the creek. The remaining 5,000 travelled east to Old Crow Mountain, some continuing further eastward to Schaeffer Mountain. Some of this group crossed the Porcupine River at numerous locations between Caribou Bar Creek and Crow Point.

A group of 5,000 caribou that had moved south across the Old Crow Flats to Schaeffer Mountain crossed the Porcupine River between Caribou Lookout and Dave Lord Creek.

Of the group of 5,000 animals that remained scattered between Bonnet Lake and the Porcupine River in August, an estimated 4,000 moved east and then south along the Richardson Route on 1 September. The remaining animals crossed the Porcupine River between Driftwood River and Salmon Cache and moved into the eastern part of the Keele Range. The same movements as above can be described for the estimated 5,000 animals which had re-entered the Yukon in the Firth River area and circumvented the northeastern edge of the Old Crow Flats.

By 9 September the movement across the Porcupine River was nearly complete, with only a few stragglers to be found north of the river.

Animals which had crossed the river between Caribou Bar Creek and Salmon Cache (approximately 30,000) moved south over the Keele Range where they dispersed. Survey flights on 13 and 16 September revealed caribou dispersed over much of Porcupine Plateau. A slight southward drift was noted, since on 16 September animals were found at the same latitude as Bear Cave Mountain ($66^{o}30'$ North), 15 miles further south than observed on 13 September.

On 20 September caribou south of the Keele Range had reversed direction and begun moving northward. On 21 September 10,000 caribou were moving north through the Keele Range toward Lone Mountain. These animals moved in much the same pattern as was used during spring migration in the region. On 29 September 9,000 caribou were concentrated

FIGURE 29

SUMMER MOVEMENTS — PORCUPINE CARIBOU HERD 1971

GROUND OBSERVATION POSTS

NON-DIRECTIONAL MOVEMENT

DIRECTIONAL MOVEMENT

July 1
60,000

July 8–18
10,000

July 7–20
70,000

Mid-July
to Aug. 2
15,000

Aug. 1–14
2,000

July 17–25
70,000

Aug. 3–10
5,000

July 21–
Aug. 11
65,000

Aug. 2
60,000

July 27–31

July 28

Aug. 10
1,000

Aug. 16
1,000

Aug. 1–31
1,000

MACKENZIE BAY

MACKENZIE DELTA

Kugmallit Bay

Herschel Island

Fort McPherson

NORTHWEST TERRITORIES

YUKON TERRITORY

UNITED STATES OF AMERICA

FIGURE 29

FALL MIGRATION – PORCUPINE CARIBOU HERD 1971

just south of the Porcupine River, about 10 miles west of Old Crow, having travelled north from Lone Mountain. An additional 10,000 animals were 10-12 miles southeast of Lone Mountain on 28 and 29 September. This herd had moved northwest out of the Pine Creek-Burnthill Creek area.

On 2 October when surveys resumed after a storm on 30 September, only a few stragglers were left north of the Keele Range. Low clouds prevented a survey south of the range at this time. During a flight on 11 October, tracks were followed south from Bear Cave Mountain up the head of the Whitestone River and over the headland into the Ogilvie River valley, where 2,000 caribou were observed. The last survey flight of 1971 was carried out on 26 October. Limitations of daylight and fuel precluded the location of many caribou; however, from evidence of tracks it appeared that the majority of the Porcupine herd occupied the valleys of the Ogilvie, Blackstone and Hart rivers. Trails also revealed that some animals had also moved into this area by travelling southwest from Hungry Lake and the Richardson Route.

ii. Richardson Route

During September, adverse weather limited surveillance of the Richardson Mountains to two survey flights. Although only 6,000 animals can be documented on the basis of direct observation, large numbers of caribou moved over the Richardson Route unobserved.

On 1 September, more than 1,000 caribou were found just north of the Bell River in the western Richardson Mountains, moving in groups that ranged in size from a few animals to 200. They moved south through the forested western foothills and crossed the Bell River just east of its junction with the Eagle River. Simultaneously other similar sized groups were crossing McDougall Pass throughout its length.

On 10 September, 1,600 animals were located on the west side of the Richardson Mountains in the Rock River area 45 miles south of McDougall Pass.

Transects flown 22, 23, and 24 September revealed 2,000 caribou in the region of Doll Creek which flows south into the Peel River.

Later reports by R. Ruttan (pers. comm.) indicated that approximately 2,000 animals remained in the headwaters of the Rat, Barrier, Stony and Vittrekwa rivers on the east slopes of the Richardson Mountains during October and November. Approximately 320 animals were harvested by Aklavik and Fort McPherson hunters during that time (D. Lepp and C. Cook, pers. comm.).

An unknown number of caribou crossed the Peel River into the Bonnet Plume River, Wind River and Hungry Lake regions, where tracks and animals were observed on 26 October. In addition, some of these animals had moved southwest into the Blackstone River drainage, joining herds which had moved into the area via the Old Crow Route.

B. POPULATION DYNAMICS

1. Age and Sex Structure of the Porcupine Herd

A knowledge of the age and sex structure of a wildlife population is necessary for determining whether its numbers are growing, decreasing or static. The population structure is also an important consideration in determining the potential effects of disturbance to the population. For example, the implications of disturbing pregnant cows during migrations may have more immediate effects than disturbance of other members of the population.

a. Spring 1971

Two ground observation posts located at the Fish Camp and Caribou Lookout were used to classify caribou as they crossed the Porcupine River (Figure 24). These posts plus an aerial survey classified 29,222 caribou. Observers counted 11,694 caribou at Post I and 16,024 at Post II. The aerial survey classified 1,504 animals. The system of classification was based on four categories: cows, bulls, yearlings and unclassified. The method of identifying the different classes during this period was as follows: adult-sized animals carrying well-developed, hard antlers were recorded as females. In rare instances adults that looked like cows but did not have hard antlers were also recorded as females. Small animals with or without properly developed antlers were listed as yearlings. Adult-sized animals with velvet antlers which varied in size from buttons to approximately 15 inches in length were recorded as males. Animals which could not be placed readily into the foregoing categories or were too far away to identify were entered as unclassified.

Table II presents the results of this classification.

One would expect a sample of the size given to reflect the structure of the entire population. However, the low representation of males

suggests this is not the case. The separation of sexes on spring migration has been previously discussed. Also the yearling segment of the sample is higher than would be expected. Aerial surveys showed that herds comprised largely of bulls with some yearlings and cows, crossed the river further east than either of the observation posts. It therefore can be safely assumed that the percentage of 28.7 for yearlings found in the sample is higher than that for the entire Porcupine herd. When calculated in terms of yearlings per 100 cows this yields a figure of 53.2. This indicates an unusually high recruitment from the 1970 calf crop, assuming that the method used for classifying yearlings is valid.

Only animals of the Central and Ogilvie groups were counted and classified from ground observation posts. Limitations of manpower precluded the classification of caribou moving north through the Richardson Mountains. It is assumed that the ratios of cows and yearlings compiled for the Central and Ogilvie groups are representative of the Trevor Range - Bonnet Plume Group and that the male segment is larger than given, for both groups.

b. Summer 1971

Six ground observation posts were established to count and classify caribou as they returned from Alaska. Positions of each camp are shown in Figure 26 and coordinates are given in Appendix A. A total of 53,180 caribou were counted at these posts.

Observers in Observation Posts II, IV, and VI classified herds according to five categories: cows, calves, yearlings, males and unclassified. Observers in Posts I, III and V used three categories consisting of calves, males and unclassifed. Unclassified animals include cows, yearlings and subadults.

The method of identifying classes at Posts II, IV, and VI were

as follows. Adult-sized animals, antlerless or with velvet antlers up to about 15 inches and in rare cases with hard antlers, were classed as cows. Calves were easily identified by their small size and light, short tawny hair. Intermediate-sized animals with thin velvet spikes up to approximately 8 inches were recorded as yearlings. Mature males were easily identified by the large velvet antlers from about 15 - 40 inches long. In the case of most immature males the penis sheath had to be observed before classification was possible (classifying large herds makes this procedure difficult). This method had its drawbacks because of the possibility that immature bulls might be classed as cows.

The methods used at Posts I, III and V for identifying classes differed only in that all animals other than calves and bulls were recorded as unclassified.

Table III gives the composition counts acquired in July. Table IV summarizes Table III in terms of percentages and ratios. An examination of Table IV reveals that between Post II, IV and VI the representation of cows in the samples was quite constant as was the yearling segment. However, both calves and bulls varied considerably among all six posts. This variability points to the need for extremely large sample sizes when classifying a migratory caribou population.

The greatest degree of variation in representation between posts occurs for males. The highest percentage, counted at Post IV is more than $3\frac{1}{2}$ times that obtained at Post III. This probably reflects an incomplete mixing of the sexes since their separation during spring migration and calving.

Post II and IV show a cow:bull ratio of almost 1:1 and Post VI shows a ratio of about 3:2. However, the lower proportion of bulls seen at Post I and III suggests that the ratio for these posts would be closer to 2:1. Since the number of animals classified as bulls is considered to be minimum (see section on Recruitment of Yearlings), it

can be assumed that the cow:bull ratio approached 3:2.

c. Recruitment of Yearlings

Since there is not a full representation of bulls in the spring count, the percentage given for yearlings (28.7) and cows (54.0) is not representative of the entire population. To attain a more realistic figure the percentage of bulls in the summer counts must be used. In the summer 11,713 bulls were counted from a total sample of 43,103 cows, bulls and yearlings. This figure excludes calves, since they were not present in the spring population. Thus, bulls constituted 27.2 percent of the summer population excluding new calves. This is a minimum figure because cows and yearlings would not be misclassified as males, whereas young bulls might often be misclassified as cows.

Assuming a percentage of 27.2 for the bulls in the entire population and a spring yearling:cow ratio of 53.2:100, the proportions for the three classes can be calculated as follows:

If x = percentage of yearlings

then $\frac{100x}{53.2}$ or 1.88x = percentage of females

$$x + 1.88 + 27.2 = 100$$

$$2.88x = 72.8$$

$$x = 25.3$$

The resulting percentage for the various age and sex classes during spring migration are: yearlings 25.3, cows 47.6, and bulls 27.2. Because the proportion of bulls is minimum the percentages calculated for yearlings and females are maximum.

The above percentage of yearlings is very high. This indicates that the population increased considerably in 1971 and is probably undergoing a general increase over a period of years.

TABLE II

Classification of Caribou According to Age and Sex, Spring 1971: Observations were made at crossings on the Porcupine River from 21 May to 3 June 1971. (See Figure 24 for exact locations).

	Cows	Yearlings	Bulls	Unclassified	Total
Post I Caribou Lookout	5,490	3,698	1,781	725	11,694
Post II Fish Camp	9,660	4,482	1,882	-	16,024
Aerial Survey	643	223	575	63	1,504
TOTAL	15,793	8,403	4,238	788	29,222
Percentage of Total	54.0	28.7	14.5	2.7	100.0

TABLE III

Classification of Caribou According to Age and Sex, Summer 1971. Observations were made at 6 locations in the summer range from 9 July to 25 July 1971. (See Figure 26 for exact locations.)

Post	Cows	Calves	Yearlings	Bulls	Unclassified	Total
I		2,920		2,028	7,637	12,58
II	2,279	922	1,645	2,387	1,872	9,10
III		1,063		358	2,684	4,105
IV	2,748	1,283	2,233	2,836		9,10
V		3,149		3,413	8,536	15,09
VI	951	740	805	691		3,187
TOTAL	5,978	10,077	4,683	11,713	20,729	53,180

TABLE IV

Population Structure According to Age and Sex in a Sample of the Porcupine Herd. These percentages are derived from data in Table III.

Post	Females	Calves	Yearlings	Males	Calves/100 Females	Yearlings/100 Females	Males/100 Females	Calves/100 Females, Yearlings and unclass.
I		23.2		16.1				38.2
II	25.0	10.1	18.0	26.2	40.5	72.2	104.7	15.9
III		25.9		8.7				39.6
IV	30.2	14.1	24.5	31.2	46.7	81.3	103.2	29.8
V		20.9		22.6				36.9
VI	29.8	23.2	25.3	21.7	77.8	84.6	72.7	42.1
Percentage of Totals	27.9	18.9	21.9	22.0	49.3	78.3	98.9	22.7

d. Calf Productivity

The percentage of calves in the total population was calculated for all field camps, while calves/100 cows was computed for Posts II, IV, and VI (Table IV). Considerable variability between Posts II and IV and other posts is evident. The mean ratio of calves: cows was 49.3:100 while the percentage of calves in the total sample was 18.9. The cow:calf ratio in July is already almost identical with the yearling:cow ratio of the previous year and has not yet been subject to additional mortality factors which are to be expected. As a result, recrutiment of yearlings in 1972 is expected to be lower than that in 1971.

2. Separation of Sexes

A factor affecting data on the composition of the spring population is that generally not all adult male caribou accompany migrating female and yearling groups. Most males accompanying female-young groups appear to be young animals. There was a slight time lag between the appearance of the females at the crossing points on the Porcupine River and the appearance of yearlings and males. Figures 30 and 31 demonstrate the temporal separation of sexes and ages found at each of the crossing points where ground camps had been established. These data were derived from large samples at each observation post (11,694 at Caribou Lookout and 16,024 at Fish Camp). Figure 30 shows a steady decrease in the percentage of cows crossing at Caribou Lookout, concurrent with a steady increase in the percentage of yearlings and bulls until there are more yearlings and bulls than cows crossing per day. Two different population groups are represented in Figure 31. The point of inflection occurring on 27 May indicates the arrival of the Ogilvie Group. The change in sex and age composition after their arrival closely resembles that prior to their arrival.

Figure 31 indicates that from day to day the percentage of females varied inversely to the percentages of both yearlings and males. At the same time there was a direct relationship between the percentages of yearlings and males.

Figure 30 shows a similar relationship. The males and yearlings are not as directly related as in Figure 31 but they still show such a relationship to some extent.

In addition to the temporal separation of migrating male and female caribou, adult male caribou were found crossing the Porcupine River at different locations than those used by the female-young groups. These sites were between Cadzow Lake and Salmon Cache (Figure 24).

Structure of the individual herds of caribou encountered by ground observers during the summer of 1971 varied considerably (Table V).

One large herd seen from the air in late July was composed of a large number of bulls and a few cows with calves. This suggests that there is still a degree of separation of sexes during this summer. It also supports the inference that the representation of males in the classified herds (Table III) is a minimum for the entire population.

No absolute division of sexes or ages was evident but their relative positions within a herd which had been moving for a few miles was fairly consistent in those groups classified. The leaders of each herd were made up primarily of nonlactating cows and immature animals while the central portion generally consisted of lactating females and calves. Yearlings often occupied the periphery of herds and trailing portions of the herds contained a large proportion of adult males. However, the herd structure described was not entirely rigid since adult males occasionally occurred throughout a moving herd. In addition, small numbers of separated cows and calves were observed in the trailing portion of moving herds.

There was no apparent separation of sexes during the fall, possibly due to the approaching rutting period in October. During survey flights in October, numerous small herds of caribou were located. Each had at least one adult male present or in the near vicinity. Lone males

were frequently observed travelling from band to band.

There may have been some separation of age classes among rutting caribou, but available data are insufficient to clarify this point.

Figure 30

Porcupine Caribou Herd Structure Shown as Percentage Increments Passing Caribou Lookout.

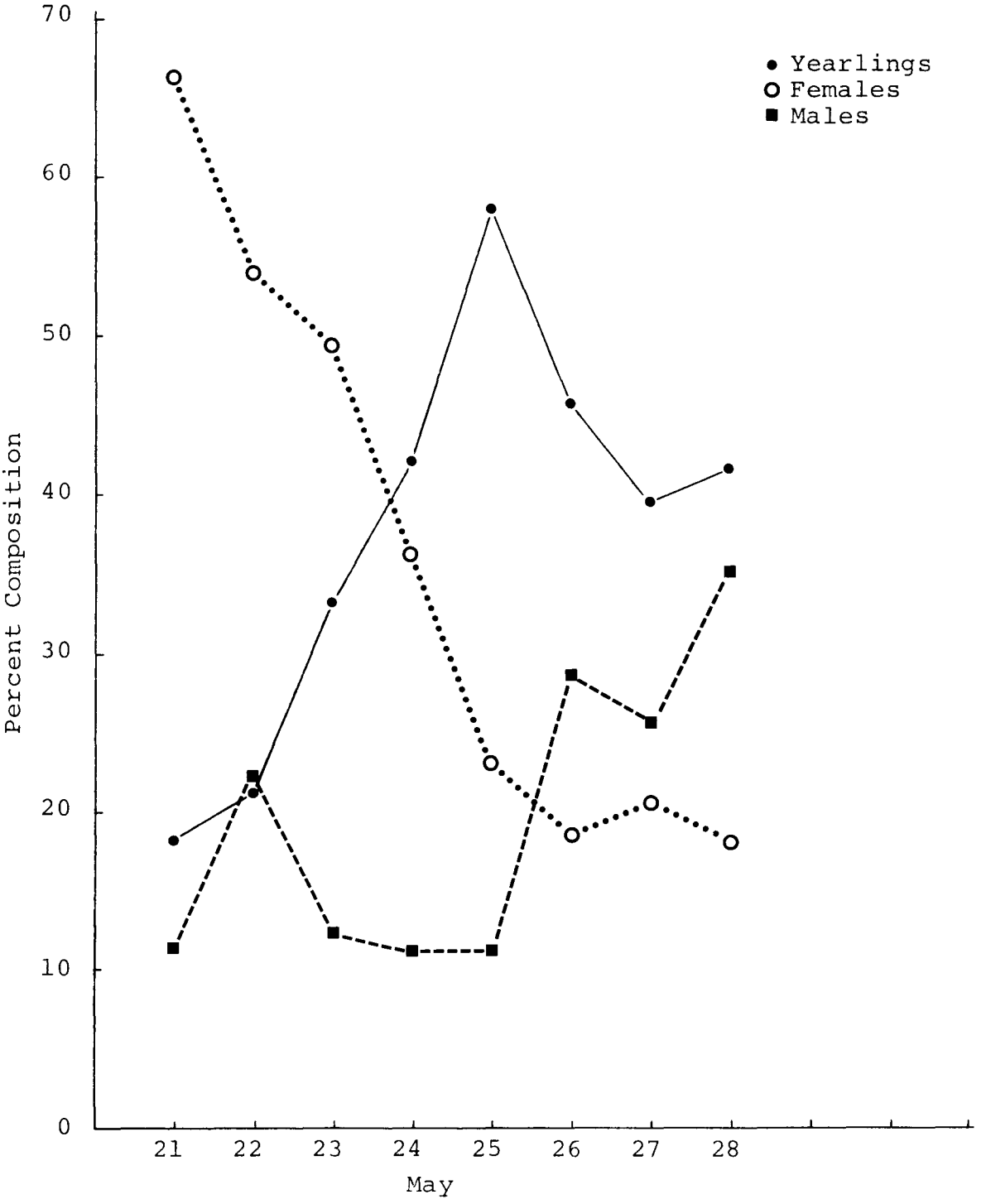


Figure 31

Porcupine Caribou Herd Structure Shown as Percentage Increments Passing Fish Camp.

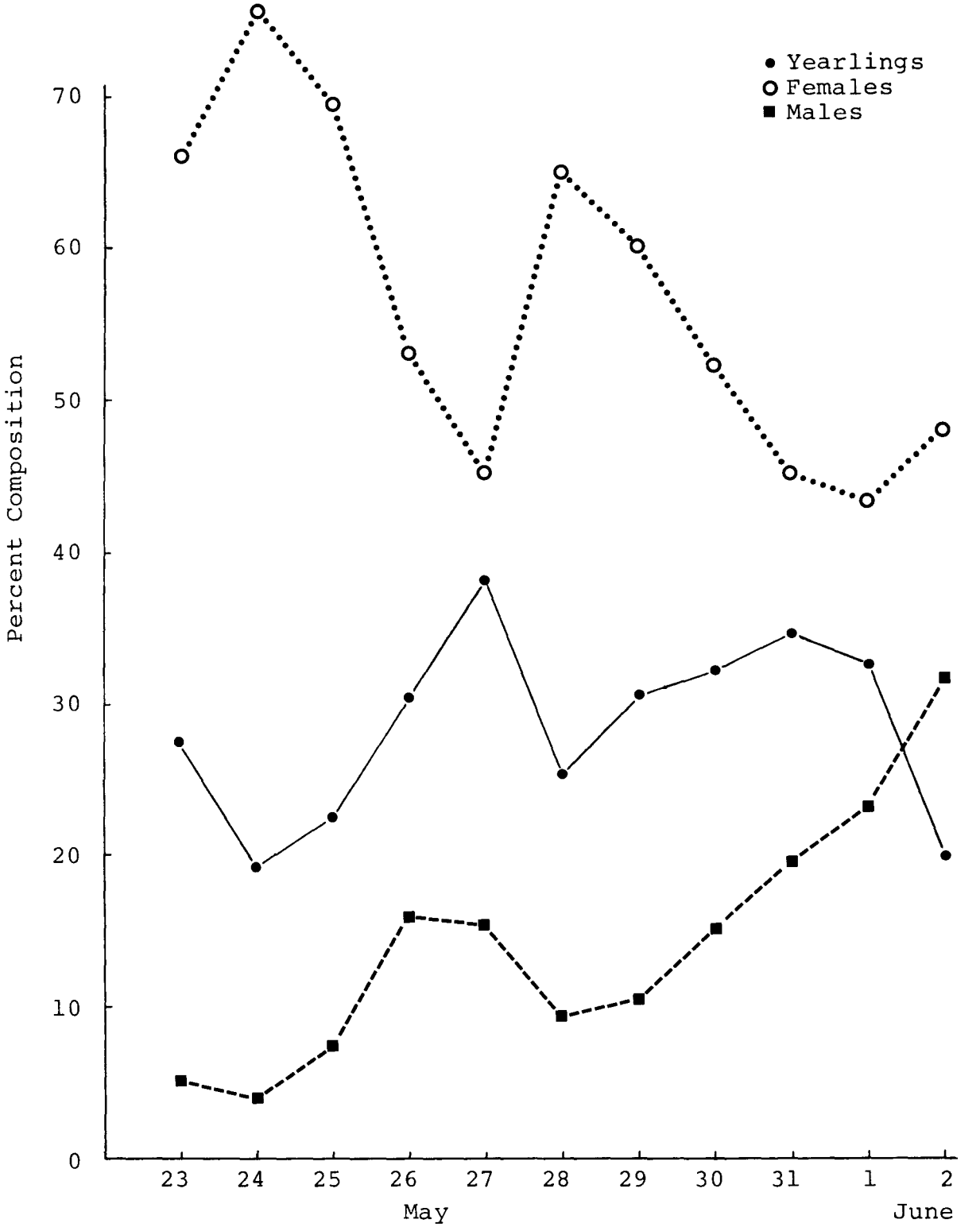


TABLE V

General Physiographic Descriptions of Areas of Suspected Wolf Kills in the Northern Yukon (1971)

Month	Kills on river ice	Kills on river bars	Kills on lake ice	Kills on ridge tops or open slopes	Kills in timber	Kills in open tundra	No. of Kills
April	7	0	0	9	17	0	33
May	3	0	0	23	45	0	71
June	0	0	0	0	0	0	0
July	0	2	0	3	1	11	17
August	0	0	0	0	0	1	1
September	0	0	0	3	1	0	4
October	0	1	4	0	0	0	5
TOTAL	10	3	4	38	64	12	131

3. Mortality Rates

A knowledge of natality and mortality rates is necessary to determine the population dynamics of a wild animal population. Aerial and ground surveys have documented many of the mortality factors which affect the population.

a. Predation

Wolves are the most significant predator of the Porcupine Caribou herd. In the period of 1 April to 28 October 1971, a total of 131 caribou carcasses were located. Based on observational evidence these were all considered to be wolf kills, although death may have been a result of other factors in some cases. Table V shows the general localities at which wolf kills were found and the frequency for each locality. These included:

(1) open tundra during the summer
(2) river bars or long stream banks
(3) river or lake ice
(4) spruce forest from creek edges to timber edge
(5) open ridges

As can be seen in the Table, most caribou carcasses were found in timber. Ridge tops were second in frequency. A common denominator in all of the above situations is that all kills were made on or close to trails used by caribou. Trails wandering through timber, whether man-made or created by the caribou themselves, provide numerous ambush points for wolves. Wolves were adept at ambushing caribou travelling in long lines through deep snow. They appeared to wait for passing caribou, singling out an animal and driving it into deep snow, where it was at a disadvantage. Caribou appeared to lose much of their alertness when migrating and were quite susceptible to wolf predation during such times.

In summer, wolves were able to take caribou readily from large

TABLE VI

Percent Utilization of Caribou Carcasses

Month	Categories 0%	1-24%	25-49%	50-74%	75%+	Not Given
April	1	-	1	5	1	25
May	-	-	4	20	32	15
June	-	-	-	-	-	-
July	3	4	-	1	1	5
August	-	1	-	-	-	-
September	-	1	-	1	1	1
October	-	-	-	-	2	3
TOTAL	4	6	5	27	37	49

herds. During the summer a large proportion of the caribou taken by wolves were calves. From a total of 17 kills located near field camps in July 7 41 percent were calves. Direct observations by field personnel also suggest that calves are more vulnerable than adult caribou; 5 out of 12 attacks on calves were successful. No direct evidence of predation on calves by grizzly bears and golden eagles was seen.

i. Kill Utilization

Consumption of caribou killed by wolves was estimated subjectively. The degree of consumption of carcasses varied from 98 percent to nil. One of five utilization categories was applied to each wolf kill located. The categories used were as follows:

0	-	no consumption
0-24%	-	not more than 25% consumed
25-49%	-	not more than 50% consumed
50-74%	-	not more than 75% consumed
75%+	-	more than 75% consumed

Figures 32, 33, and 34 illustrate the various degrees of consumption of wolf kills. Table VI gives the times and frequency of kill utilization.

Table VI suggests that during early spring the degree of utilization of carcasses is considerably higher than in other months. Based on the number of sightings of wolves and caribou kills, it is estimated that wolf predation probably accounts for several thousand animals of the Porcupine herd. Wolves are believed to account for the annual loss of 4.8 percent of the caribou one year old or more from the Kominuriak Herd (Macpherson, 1971).

Many of the lesser carnivores are known to scavenge remnants

of wolf-killed caribou. The raven (Corvus corax), golden eagles, red foxes (Vulpes fulva) gray jays (Perisoreus canadensis), and grizzly bears have all been observed scavenging wolf kills. It is suspected that wolverines, bald eagles (Haliaeetus leucocephalus), and marten (Martes americana), also utilize wolf kills. Six golden eagles were observed feeding on wolf kills, while many others were near carcasses. In 31 of 131 kills, ravens were present, and in 7 cases golden eagles were present at the same time. Grizzly bears were found to have scavenged at least eight wolf kills.

b. Hunters as a Mortality Factor

Native and non-native hunting is also an important source of mortality affecting the Porcupine Caribou herd. The herd is subjected to hunting pressure on spring and fall migrations in Canada and Alaska. Caribou are also taken during the summer in Alaska by residents of Arctic Village and possibly other small native camps. Hunters from Old Crow, Aklavik, Fort McPherson, Tuktoyaktuk, Inuvik, Arctic Red River and communities in the southern Yukon take caribou during spring and fall migrations as well as during the winter (Figures 35 and 36). The construction of the Dempster Highway has now provided the means of non-native sport hunters to increase the harvest of caribou from the Porcupine herd.

The actual total yearly caribou harvest is difficult to document since hunting takes place in the Northwest Territories, the Yukon Territory and Alaska. Rough figures are available for most native hunting in the Northwest Territories and the Yukon. From reports of the resident Conservation Officer, Cliff Cook, hunters from Aklavik harvested 465 caribou in 1969, 383 caribou in 1970 and 441 in 1971. He estimated that these reported figures represented about 80 percent of the actual harvest. Conservation Officer D. Lepp of Fort McPherson reports a harvest of 676 caribou in the 1970-71 season plus 250 caribou during the fall of 1971. The caribou are also hunted by residents of Inuvik, Tuktoyaktuk, and Arctic Red River.

Hunters of Old Crow took approximately 250 caribou during 10 days of the spring migration and approximately 150 caribou during July, August and September. There are no figures presently available for harvest of the Porcupine Caribou herd in Alaska.

The most informed estimate of caribou harvest from the area of the Dempster Highway, is approximately 250 animals (A. Pearson pers. comm.). Since the Dempster Highway provides easy access to the rutting area of the Porcupine Caribou herd, this hunting will undoubtedly increase in the near future.

In summary, the total mortality from hunting in Canada probably exceeds 2,000 animals and, when one considers the number of animals wounded which later die, perhaps 3,000 animals is not an unrealistic figure. When the harvest in Alaska is added to this, total mortality resulting from hunting may approach the rate for the Kaminuriak Herd, approximately 5 percent of the population (Macpherson 1971).

c. Other Mortality Factors

Natural hazards may occasionally cause significant mortality. For example, dangerous river crossings have on occasion caused the deaths of large numbers of migrating caribou. In the 1971 spring migration at least 28 caribou were killed attempting to cross the

Porcupine River. Caribou persistently tried to cross the river while it carried moving ice. When trapped, animals tried to climb onto ice pans (Figure 37), which sometimes became too heavily burdened with animals and overturned, causing death by crushing and drowning. Heavy losses from this cause in past years have been described by Old Crow hunters.

A second natural mortality factor which can significantly affect a caribou population is inclement weather during the calving season. Cold wet weather may cause a high mortality in calves from exposure, since calves have poor thermoregulation for some time following birth (Lent, 1964, Hart et. al. 1961). Much of the 1971 calving season was relatively cold and wet. Data relating to the calf mortality caused by weather were not obtained.

The total annual mortality of caribou, one year or more old, in the Porcupine herd is estimated to approach 10,000 animals or 10 percent of the population. This includes losses through natural predators, hunters and natural catastrophes. It is within the capacity of the herd to replace this amount of loss by the annual production of calves.

C. Behaviour

An important aspect of the study entailed observations of caribou behaviour. Of particular interest were reactions of caribou to natural and unnatural terrain features, the timing of migration, reactions to crossing points, and funnelling at particular barriers. Modes of movement, whether in broad or narrow fronts, were also documented. Also of interest were factors influencing the speed and direction of movements.

1. Grouping Behaviour

In nearly all observed cases of spring migratory movement in 1971, a period of aggregation preceded the movement. Herd concentrations normally occurred on ridges or benches above timber-line (Figure 25). Caribou remained concentrated for periods ranging from a day to two months. The longer period was observed in the Trevor Range - Bonnet Plume Group prior to spring migration. Figure 24 shows locations where large aggregations of caribou occurred.

Spring behaviour associated with movements has several ecological implications. For example, caribou concentrations on ridge tops prior to or during spring movements may be a result of unfavorable snow conditions in the path of a moving herd. This appeared to be the case with the Trevor Range - Bonnet Plume Group, which was surrounded by low lying areas with snow depths of up to 36 inches. This group attempted twice to move north to the Richardson Mountains before they succeeded in penetrating the diminishing snow barrier.

Aggregations may also act as a behavioral stimulus to cause movement when a "threshold level" is reached. Movement may also be initiated as a result of large aggregations of caribou utilizing most of the available food resources. Grouping of caribou following initial movements may represent rest periods. "Concentration-movement-reconcentration" was observed numerous times within groups of caribou moving north on the Old Crow migratory route.

Periods of aggregation during the spring were characteristically followed by concerted movements. For example, the Trevor Range - Bonnet Plume Group moved north through the Richardson Mountains to the Barn Range essentially non-stop after leaving concentration areas. Although herds move out of spring concentration areas in narrow fronts, they may then disperse and move northward in a wide front. At the onset, movement often appeared erratic and many instances of unexplainable migratory behaviour were observed. For example, caribou would often move through or over the roughest terrain when other apparently easier routes were available. Animals would also occasionally move off at right angles to the direction of movement, then return to the original line of movement and continue northward.

The major differences seen between spring and summer groupings were in the density of the aggregations and the duration of their existence. Summer aggregations were extremely closely-packed and contained several thousand animals (Figures 38 and 39). As illustrated in Figure 38, the grouping often occurred on a rise or ridge top. Grouping occurred with much greater frequency in summer than in spring. The length of time an aggregation may remain together was much shorter in summer, usually lasting only a period of hours, than in spring, when it might last for several weeks.

Summer groupings of caribou herds on heights of land have been observed by others. The primary explanation for this behaviour is the animals' attempt to escape insect harassment. A high, cool, windy area discourages insect concentrations and activities. In addition, grouping of animals tends to reduce the intensity of insect harassment on individual animals.

Grouping behaviour did not appear to be as intense in the fall as in the spring and summer. No dense aggregations were located on ridge tops and no very large groups were located after September 1. The probable reason for the decreased degree of social aggregation of the animals was the approaching rutting season.

2. Movement Behaviour

Migratory movements are variable and often made in spurts. During spring, herds may move 20 to 40 miles per day, then rest for a day; or continue for several days before pausing. When migrating through areas with heavy snow cover, caribou regularly travelled single file in long lines (Figure 40). Such funnelled movements often resulted in the creation of muddy trails in warm weather and damage to the underlying vegetation. Where there is little snow to impede movement, caribou spread out over wider areas in small groups (Figure 41). Movement in wide fronts appears to have little effect on vegetation.

Summer movements were generally more leisurely than those in the spring. The mean mileage covered by herd movement from 1 - 6 July was 8.1 miles per day. Summer movements were not restricted to single file travel although caribou did generally move in a linear fashion (Figure 42). In mountain passes single file movement prevailed and damage to the ground cover was evident (Figure 2).

Air temperature, wind direction and velocity appear to have a marked effect on direction and speed of caribou movement during the summer. Several knowledgeable hunters from Old Crow state that caribou prefer to move into the wind during the summer to reduce insect harassment (Peter Lord, Charlie Peter Charlie, pers. comm.). This effect of wind on caribou movements has also been reported by R. Ruttan (pers. comm.). The prevailing winds in the northern Yukon were from the east from 30 June to 19 July. Herds moved toward the east from 1 July (when the first animals were observed crossing the Alaskan boundary) to 18 July (when they began to disperse and wander throughout the northern Richardson Mountains). This behaviour appears to support such a hypothesis.

During fall herd movement, animals moved single file through snow cover, as in spring. When snow was absent caribou still tended to move in long lines, although they did not maintain a single file formation.

In the fall, herd movements were often direct and concerted, covering long distances in a short time. The first such movement was from the Brooks Range to the Fishing Branch River, an essentially non-stop movement covering about 200 miles in approximately two weeks.

3. River Crossings

Natural barriers in the path of migrating caribou occasionally appeared to create a funnelling effect. In the spring and fall the Peel and Porcupine rivers are possibly the greatest natural physical obstacle encountered and overcome. Caribou crossed the Porcupine River 175 miles miles along its length, from north of the Bell River to within 50 miles of Fort Yukon, Alaska. The majority of migrating caribou used traditional crossing points. Animals were observed funnelling into these points from several miles away. Six of the major crossing points are shown in Figure 24. Large numbers of animals crossing at specific sites made ground observations of numbers and herd composition extremely effective.

Observers at "Fish Camp" during spring migrations noted that under a 24-hour daylight regime caribou crossed the river throughout the 24-hour day. A decrease in crossing activity appeared to occur after midnight and again after about 0500. Since many large mammals feed in a definite cycle, it is thought that pauses in crossing activity coincide with feeding periods.

Caribou show little hesitation when crossing rivers. They are strong, buoyant swimmers, able to swim high out of water (Figure 43). In spring they can swim the Peel and Firth rivers, both of which are fast flowing and dangerous at that time. They appear able to swim at rates of 4-7 miles per hour. Undisturbed caribou swim rivers in single file, often with their tails erect. They will readily enter water when pursued by predators. Five observations of wolves pursuing caribou, and several native hunters pursuing animals by boat, have confirmed this point.

Rivers presented no obstacle to summer movements of caribou. The only rivers of sufficient depth to force caribou to swim were the Firth River and Porcupine River. The other rivers they encountered were low enough to be waded, even by calves. There did not appear to be any funnelling effect at any of the summer river crossings.

River crossings were easily made by caribou on their fall southward migration. The major crossing point was near Caribou Bar Creek (Figure 29) on the Porcupine River. Water levels were low in all rivers encountered and crossing behaviour did not vary from that previously described.

4. Reactions to Predators

Both ground and aerial surveys frequently provided opportunities for observation of caribou reactions to predators, primarily wolves and grizzly bears. The mere presence of either wolves or grizzly bears did not appear to cause any significant alarm in caribou. The pursuing action of the predators was the mechanism which triggered alarm, flight or occasionally attack on the part of the caribou.

Wolves were very active during the spring and were frequently sighted in close association with caribou. Of 133 wolves observed during April and May, 83 were found closely associated with large numbers of caribou. Forty wolves were on or near a kill. Numbers of wolves per observation associated with caribou varied between one and eight. A total of 24 wolf kills were observed within 200 yards of large numbers of caribou. In 10 cases wolves were still on the kills. Adjacent caribou showed no observable reactions.

During the spring, 9 attacks on caribou by wolves were observed. The number of wolves attacking ranged from 1 to 3. Of the 9 attacks, 5 were on bands of caribou and 4 were on single animals. In 5 cases the caribou escaped by fleeing into the Porcupine River; in 2 cases, they turned and fought the pursuing wolf, which eventually killed the prey;

and in the 3 remaining cases, the caribou fled over open terrain.

In a few instances, grizzly bears were observed feeding on caribou carcasses. Caribou as close as 200 yards away did not appear to be disturbed by the bears' presence. Grizzly bears were not observed attacking caribou in the spring.

During July and August, 12 wolf attacks were observed on individual caribou or animals in herds, of which 8 were successful. The presence of an attacking wolf generally caused the herd to open an avenue around the wolf and stampede away. When wolves chased animals which were members of a small herd, all herd members fled. In 2 of the 12 attacks, the prey animals (or the cow in the case of an attack on a calf) turned and attacked the pursuing wolf. In one instance an old cow, closely pursued by a single wolf, turned and attacked the wolf with her forefeet. The cow struck the wolf with both forefeet; but the wolf seized her by the throat and killed her. Calves were killed by crushing the skull, while adults were killed by grasping the throat and strangling or breaking the neck.

Of 40 grizzly sightings near caribou in July and August, only one grizzly was observed to attack. When a single cow encountered a sow grizzly with her cub at a distance of about 200 yards, the sow gave chase for approximately 250 yards. The caribou outdistanced the bear rapidly. The bear slowed to a walk and followed the caribou for one-half mile before turning and leaving the trail. The cub stayed at the sow's heels throughout the encounter. No other potential predators, including the wolverine (Gulo luscus) and golden eagle (Aquila chrysaetos), were observed to influence caribou behavior.

Fall observations of caribou reactions to predators are very limited. Five suspected wolf kills were located, all in close proximity to caribou herds. As in the previous sightings, caribou did not show any visible reaction to the presence of wolf kills. No wolves

or grizzly bears were observed near caribou during September or October.

5. Reactions to Humans and Man-Made Features

a. Reaction to Humans:

In the spring, migrating caribou appeared to be largely indifferent to the presence of man or human activities, even when men were at the ancestral crossing points on the Porcupine River. Caribou were repeatedly observed crossing the Porcupine River directly in front of Old Crow. In addition, they regularly landed in front of observation posts, then walked through field camps. Caribou continued swimming the Porcupine River at various locations despite the activities of native hunters and their motor boats. Animals showed no escape or alarm behavior until approached closely by a boat, in which case they swam frantically away from it. Large groups of caribou appeared to show a greater degree of indifference to the presence or activities of man than did small groups.

Response of caribou to the presence of humans was similar during the summer. Herds numbering up to 30,000 animals passed around field camps within 100 yards of tents and personnel. The herd in Figure 7 moved directly toward the observers and then veered around them. The caribou initially showed alarm, and then curiosity, prior to continuing past the crew. No noise, other than verbal communication between party members, emanated from the camps. Larger groups of caribou showed less response to the presence and activities of men than did smaller groups of twenty or less, as in the spring migrations.

In their fall migration, caribou encountered few humans until reaching the area of the Dempster Highway. Animals did not appear to be unduly disturbed by human activity, hunting or construction along the Dempster Highway. On 26 October caribou were observed in numerous instances lying on or beside the Dempster Highway, watching vehicles pass by (Figure 44).

Caribou reacted in varying degrees to aircraft. Animals react strongly to the noise of helicopters by scattering and running for some distance. They respond secondarily to the movement of aircraft, particularly when aircraft are flying at low elevations.

Observations of caribou reaction to the presence of a helicopter were revealing. On 29 April a Bell 206 jet helicopter was observed flying low over an estimated 30,000 caribou concentrated on a ridge top. The caribou reacted by fleeing frantically in all directions. On 18 May the response of caribou preparing to cross the Porcupine River to a Bell 206 jet helicopter were observed at close range. The helicopter was flown about the animals in elevations varying from 500 to 1500 feet. Invariably the reaction was panic and flight. Further observations were made on caribou reactions to helicopters in July. When commuting to field camps on 9 and 11 July an attempt was made to approach caribou upwind from behind hills or ridges. It was often possible to approach and return from the camps by helicopter with little visible alarm on the part of the animals. The above observations were repeated on 21 July. An upwind approach from behind a barrier muffled the sound of helicopters to a large extent. A helicopter pilot reported that the above approach was generally very successful in avoiding disturbance to big game with a jet helicopter.

Repeated observations indicate that caribou are much more tolerant of fixed-wing aircraft. As can be seen in Figure 20, taken from 250-300 feet above the herd, caribou show little fear of light aircraft flying at this height. Caribou do react to fixed-wing aircraft when approached more closely.

There appeared to be seasonal variation in reaction to fixed-wing aircraft. When environmental conditions such as snow depth and wind intensity were restrictive to movement, the animals reacted less than in the summer when there were no restrictions to movement.

Herd size also appeared to govern the reaction of animals to fixed-wing aircraft in that large herds showed less disturbance than did small bands.

Effects of Man-Made Features on Migrating Caribou

In the course of their yearly migrations, caribou of the Porcupine herd encounter many natural obstacles in their path which might affect the speed or direction of their movement. In recent years human activities have altered portions of their range. Following are observations made on the reaction of caribou to various human structures and activities.

i. Oil Exploration Activity

For the past fifteen years sporadic exploration activities have been carried out in the northern Yukon. Mineral exploration has led to the construction of numerous winter roads, airstrips, seismic lines and well sites (Figure 45) in areas utilized by caribou.

During aerial surveys caribou were observed making extensive use of many man-made features (Figure 46 and 47).

Roads and seismic lines lying in an east-west and north-south direction were preferred travel routes during the spring migration northward. In areas of heavy caribou winter utilization, virtually every road or trail was travelled upon, often by large numbers of animals (Figure 47). One survey flight over areas of light to very heavy winter use in the Whitestone-Miner River area revealed that 36 of 52 seismic lines, trails, roads and airstrips had been used by caribou. Those seismic lines, roads and airstrips between the Miner and Whitestone rivers were generally followed to their western or northern ends. From this point, migrating caribou travelled northwest to the area of the Fishing Branch River and Cody Hill. It appeared that if roads and seismic lines in this region had extended further westward caribou would have continued following them in that direction until travel routes terminated. Caribou are reluctant to leave roads or trails in deep snow situations.

ii. Summer Ground Survey of Winter Roads and Seismic Lines Used by Caribou

In an attempt to determine why caribou found winter roads and seismic lines attractive for travel, several areas were visited by ground parties in July 1971. Three particular areas are described here: an area north of the Old Crow Flats; a winter road immediately west of the Whitestone River; and a seismic line immediately north of the Whitestone River. All areas had been used extensively by migrating caribou (locations given in Appendix D).

The first disturbed area examined was north of the Old Crow Flats on open-rolling tundra (Figure 48). A heavy multi-wheeled, all-terrain vehicle had moved through the area twice in 1958 during the winter. This disturbance was sufficient to change the vegetation pattern along its route. In 1971, cotton grass (Eriophorum sp.) comprised approximately 98 percent of the cover on this roadway (Figure 49), while on either side the area was comprised of hummocks with a cover of low willows and white birch, sedges and cotton grass. No hummocks remained on the road. Its surface, consisting of thick clay, was very wet with standing and running water. The roadway stands out as a bright green strip against a dull green background. It was used in mid-July 1971 by thousands of caribou moving to the southeast into the Richardson Mountains, in preference to the adjacent hummocky terrain. The animals entered the road directly east of Mount Fitton and followed it for approximately five miles before moving into the Richardson Mountains. Trails made by the passage of the animals were deeply rutted and muddied (Figure 49). Damage to the underlying vegetation was severe in the ruts where animals travelled single file.

Two further areas, both in the Whitestone-Miner River region, were investigated. The sites included an old winter road and a seismic line constructed during the winter of 1970/71. The winter road

(Figure 47) was heavily travelled by caribou during the spring of 1971. Dominant vegetation adjacent to it included: black spruce with an understory of cranberry (Vaccinium vitis-idaea), blueberry (Vaccinium spp.), Labrador tea (Ledum decumbens), shrub birch and willow. Ground cover in the area consisted of cotton grass, sedges (Carex spp.), mosses and lichen (Cladonia spp; Figure 50). Vegetation on the roadway consisted of a robust growth of grass (Calamagrostis spp.; Figure 51). The roadway was wet, with standing and running water cutting erosion channels. The road surface had been graded to mineral soil by bulldozer. The permafrost in the spruce forest 20 feet from the road was less than 12 inches from the surface, while on the road it was at least 16-18 inches below the surface at the time of investigation. The road was covered with tracks of wolves, moose, grizzly bears and caribou. It appeared that all of these species had made extensive use of the road.

The seismic line examined had been bulldozed through a spruce forest on a ridge top. The surrounding vegetation consisted of an overstory of open black spruce, an understory of wild rose (Rosa spp.), alder (Alnus spp.), Labrador tea and a ground cover of mosses and Cladonia, the dominant ground cover (Fig. 52). The seismic line lay in a straight north-south direction and extended over several timbered ridges and through several stream valleys (Fig. 53). The ground surface was dry, permitting good footing and easy travel. Evidence of caribou use was observed.

iii. The Dempster Highway

In a previous section of this report it was stated that increasing access to regions frequented by the Porcupine Caribou herd would result in increased harvest by non-native hunters. The Dempster Highway, running from Dawson City up to and along the Ogilvie River, has recently provided easy access to the southern edge of the Porcupine Caribou range (Fig. 54).

On 26 October 1971 caribou were followed from Old Crow to the southern end of the Blackstone River. Animals were observed on and adjacent to the Dempster Highway for 70 miles. Evidence of caribou killed on the road by hunters (Fig. 55) was seen. Caribou were observed crossing the road, bedding on the highway and side roads (Fig. 44), and moving to and from the highway from both sides. No accurate estimate of caribou numbers was possible, although several thousand were likely in the area mentioned.

D. Forest Fires in the Range of the Porcupine Herd

In former times much of the northern Yukon was burned over by unchecked forest fires. However, habitat losses from forest fires were not critical to caribou since winter range was extensive.

During the last fifteen years losses of available winter range have been occurring at an increasing rate. Unchecked forest fires and habitat destruction by man are the primary sources of loss to existing winter ranges.

Several severe forest fires occurred in the northern Yukon and adjacent Northwest Territories during the summer of 1971 (Fig. 56). Several of the areas burned had been occupied by large numbers of caribou during the previous winter. The most severe fire occurred near Margaret Lake and the Bonnet Plume River (Figs. 57 and 58). The Margaret Lake fire alone burned over 100 square miles of winter range. The Margaret Lake-Knorr area had supported about half of the Trevor Range-Bonnet Plume caribou group from early March through early May.

A second severe fire during the summer of 1971 burned an area of approximately 25 square miles in the Fishing Branch-Cody Creek area (Fig. 59). This area had been used extensively by migrating caribou during the spring of 1971. The burned area was particularly important as a staging or concentration area for caribou prior to commencement of both the northward and southward migrations. When the burn was photographed and mapped on 20 September, caribou were observed moving through the burn.

A third extremely large forest fire burned an area from the vicinity of Caribou Lake to Arctic Red River, an area formerly used by the Porcupine herd. The actual size of the burn is unknown.

A fourth forest fire took place in the vicinity of Hungry Lake. This was a series of relatively small individual fires which in combination burned over a relatively large area. Caribou had wintered in this area in 1970/71.

The major effect of forest fires on a caribou population is elimination of winter range. Caribou rarely make use of a burned area for feeding or passage. On 26 October, caribou were followed from the Richardson Mountains to the northern edge of the Margaret Lake fire. Tracks indicated that migrating animals deliberately skirted burned areas on their way southward. Caribou were also observed moving along the edges of the Fishing Branch - Cody Hill fire.

FIGURE 56

1971 FOREST FIRES
IN RELATION TO CARIBOU WINTER RANGE

CARIBOU WINTER RANGE

FOREST FIRES

VI. DISCUSSION

A. Population Subgroups

The Porcupine herd consists of a variable number of groups which vary in size and cohesiveness during the course of the year. All three wintering groups observed in 1971 (the Central Group, the Ogilvie Group, and the Bonnet-Plume Group) maintained their cohesiveness until late May. At that time they intermingled on the Old Crow Flats and British Mountains while on migration to the calving grounds.

The greatest degree of discreteness between groups occurs during the winter, particularly when snow conditions restrict movements. Bergerud (1967, 1971) also found this to be the case with Woodland caribou (Rangifer tarandus caribou) in Newfoundland and Barren-ground caribou (Rangifer tarandus groenlandicus) in Labrador.

Herds of caribou are sometimes segregated according to sex (Lent, 1966) (Hemming, pers. comm.). The present study detected this segregation during spring migration. Lent (1966) describes calving herds as being comprised of less than one percent bulls. The majority of bulls remain on the periphery of the calving herd and dispersed towards the winter range.

The characteristic regrouping on calving areas of previously separated subgroups has been documented in the past (Lent, 1966). Kelsall (1968) reported that several herds wintering in widespread areas reunited on the calving grounds around Beverly Lake in the central Arctic. The Central, Bonnet-Plume and Ogilvie groups of the Porcupine herd were also united prior to reaching a common calving ground.

Whether or not the three wintering groups identified in the spring of 1971 are consistent, or whether group formation is random, is at present unknown. Evidence of widespread mixing during the breeding

period in late October indicates a random distribution, at least in early winter.

The period during which large, closely-knit groups existed during the summer was much shorter than in the winter.

Kelsall (1968) and Lent (1966) described a tendency to form large aggregations in post-calving movements. Post-calving movements in 1971 were rapid and groups were widespread. This behavior continued until the reduction of insect harassment, after which a general dispersion of animals occurred.

The largest aggregations of the Porcupine herd occurred in early July, immediately following the calving period. By late July, group sizes decreased and the numbers of small groups and individually dispersed animals increased. Movement in several directions accompanied the dispersal and was most pronounced during cold, windy weather in mountainous regions.

During the fall, groups were generally loose aggregations with little cohesiveness. In 1971 herds on migration were discrete along the two main routes southward until re-uniting in the vicinity of Chapman Lake. During the breeding period (rut), groups occupied widespread areas and were loosely-knit. It is unknown if the breeding area used in 1971 is consistent with other years.

All subgroups merge at various times of the year, interacting as a single population. The entire range of this population includes northeastern Alaska, the northern Yukon Territory and a very small segment of the Northwest Territories along the Richardson Mountains.

B. Wintering Areas

In his study "Snow as a Factor in the Ecology of Caribou", Pruitt (1959) described ideal conditions for a caribou winter range as

consisting of: (1) soft forest snow (2) light, low-density forest snow (3) snow depth not over 50-60 centimeters (20-24 inches) and (4) continuous low temperatures during the snow season. These conditions were based on studies of barren-ground caribou wintering in the taiga east of the Mackenzie River.

When the above snow conditions do not occur, caribou tend to move to areas where an acceptable snow regime is present. Thus winter range use by a specified number of animals on any one range unit is not static but varies considerably over broad areas according to the seasonal climatic conditions.

In the late winter of 1970-71 the Porcupine herd utilized both spruce-lichen forest and mountain slopes where suitable snow conditions prevailed. Forest winter range used by the Porcupine herd is similar to that described by Pruitt (1959) and Kelsall (1968) for eastern Arctic caribou. Pruitt (1960) has suggested that the use of alpine areas is an altitudinal shift stimulated by unfavorable snow conditions in forested areas.

On mountain slopes used by caribou during the 1970/71 winter, snow depths were less than in forested lowlands. High winds probably caused the significant reduction in snow depth on exposed slopes. In early April, large herds of caribou were found on ridge tops of varying exposures. The use of mountains as winter range has also been described for barren-ground caribou in Labrador (Bergerud 1967).

Kelsall (1968) remarked on the variability of winter range in the eastern Arctic. Reports of winter range use by the Porcupine herd have varied in recent times. Munro (1954) reports that the "Chandalar herd", now believed to be a segment of the Porcupine herd, wintered in the east fork of the Chandalar River in Alaska in 1948/49.

Fuller (1957) reported that caribou, presumably a segment of the Porcupine herd, frequently wintered in the Ogilvie Mountains. Unknown numbers of animals were also reported to have wintered on Arctic coastal areas (McEwan 1952, Radvanyi 1959); however this information is based on few observations. Murie (1935) reports the primary wintering area of the Porcupine herd as the drainage of the Porcupine River.

Hemming (1970) reports that during the winter of 1969/70 four separate groups of the Porcupine herd wintered in the following areas:

(1) In Alaska south of Arctic Village and north of Venetie; also between Big Lake and Koness Creek in an east-west direction.

(2) Between Chalkyitsik and the headwaters of the Black River; and from Old Rampart in the north to the headwaters of the Kandik River to the south.

(3) In the Porcupine River valley from the Bell River south, throughout its upper drainages.

(4) On the east side of the Richardson Mountains (Caribou River-Caribou Mountain areas) in the Northwest Territories.

There is no question that use of winter range varies in response to snow and forage conditions. While the present study has closely delineated winter ranges utilized in 1971, specific areas of utilization within the general winter range may change annually.

The above-mentioned reports of caribou wintering on the Old Crow Flats and Arctic coast are difficult to reconcile with the climatic requirements previously discussed. Furthermore, both the treeless Old Crow Flats and tundra areas lack extensive lichen range and are subject to crusted or hard-packed snow conditions. In contrast, the winter range delineated by this study in 1970-71 satisfies habitat requirements described by Pruitt (1959) and others. Alpine areas north of the Rock

River are largely devoid of lichen, while to the south, alpine slopes contain extensive lichen cover. This indicates more favorable winter forage conditions in the southern portions of the range defined in 1971.

With the exception of Peary caribou (Rangifer tarandus pearyi) on the Arctic Islands, most barren-ground caribou exhibit a marked annual cycle of migration consisting of a migration to tundra in the spring and return to winter range in taiga areas during the fall. It is highly significant that according to archaeological evidence, traditional migratory routes across the Porcupine River have been used for hundreds, perhaps thousands, of years. The routes used suggest that any wintering north of the river is an aberrant situation rather than a regular occurrence.

Mention of caribou wintering on tundra areas has been made in the literature (Lent,1966), and small groups have been frequently observed wintering on the north slope of Alaska (Angus Gavin, pers. comm.). Numbers of caribou reported wintering in the Old Crow Flats have not been substantiated. Nevertheless, it is difficult to entirely reject the reports of such an occurrence and the possibility of such occurrences in future.

Although caribou have been reported wintering north of the Porcupine River, it is unlikely that observations made represent the entire population; or that this area is an important winter range. Previous observations are sketchy and may represent only a small segment of the total Porcupine herd. However, evidence compels us to believe that the most suitable forest and mountain winter ranges are south of the Porcupine River, and that historically the bulk of the population has utilized this area.

It is concluded, therefore, that the primary and most important winter range for the Porcupine herd in the Yukon is generally south of the Porcupine River.

C. Population Estimates

A reliable population estimate is one of the most important but difficult statistics to obtain for a large ungulate population. Large numbers, mobility and varying and difficult terrain all pose particular problems in caribou censusing. The limitations and advantages of various census methods have been described in detail by Siniff and Skoog (1964) and Thomas (1969).

Any population estimate must be viewed according to survey constraints and inherent natural fluctuations in population size. Time of year is thus an important factor. Estimates in April may be 30-40 percent lower than for later June or early July, following the addition of a new calf crop.

In the current study, the number of animals occupying a specific area or utilizing migration routes are an important consideration. Population estimates were made throughout the study period, and were done in replicate whenever possible. Two major census efforts were made in the annual cycle: during spring migration prior to calving and in early July immediately following the calving period.

During the spring period, systematic census transects were unsuitable, primarily because of the clumped distribution of animals. Aggregations preclude the effectiveness of a true random sample of the area. Since topographic conditions and poor visibility in forested areas precluded a total aerial count, a series of estimates were made based on repeated survey flights supplemented with photographs. Estimates were made by counting the largest manageable groups (10's, 100's, 500's). Repeated surveys provided a basis for establishing consistency and corroboration of estimates at various locations. Subsequent counts from photographs were used to establish accuracy levels. Ground surveys provided the most accurate basis for confirming aerial counts. With this method, we feel that as accurate a representation of

the population as possible was obtained. In most cases, the population figures contained in this report have an accuracy of ± 15 percent.

Field camp classifications during the summer indicated that 18.9 percent of the population consisted of calves. Based on spring estimates of 60,000 animals total, the summer population would be 70,950 animals of which 10,950 represent the addition of calves to the population. However, the total summer population in the northern Yukon was estimated at 85,000 animals. This discrepancy may represent additional animals from Alaskan segments of the Porcupine herd which joined post-calving aggregations returning to the Yukon in July. Alternatively it may be a result of estimation error. As the Porcupine herd moved eastward from the calving ground it is likely that small groups of Alaskan caribou joined the larger herd along the way.

The relationship between the Alaskan and Canadian segments of the Porcupine herd is at present unclear. Traditionally, the Porcupine herd has been referred to as those animals wintering in Canada and migrating north to calve either on the Yukon North Slope or in Alaska. However, the herd calving in Alaska has been called both the Porcupine and the "International Herd" because of its movements across the international boundary. In some cases, the Canadian Porcupine herd has wintered in contiguous areas of Alaska; observations during 1971 indicate that a substantial segment of the population remained in Alaska at the time surveys ceased for the winter. Whether the 1971 distribution is typical is not yet known. Hemming (1970) believes that separate Alaskan segments may winter in Alaska and migrate to a calving ground common with the Canadian component, then remain in Alaska during summer and fall movements. Skoog's 1962 estimate of 140,000 for the Porcupine herd supports this theory. In any case, the known return to Alaska by most of the Canadian herd during the summer as well as the indication that some remained in Alaska in the winter makes an interchange between Yukon and Alaskan herds appear probable. Until additional surveys are carried out in Alaska, the delineation and population size of what is termed "the Porcupine herd" will remain uncertain.

D. Age and Sex Structure and Productivity

Prior to the 1971 field season there were no baseline data available to assess the status and productivity of the Porcupine herd. In this study, considerable emphasis was placed on gathering valid population estimates and determining age and sex structure of this population. The resulting data provide necessary understanding of the current structure of the population and its potential responses to disturbance and also serve as a baseline with which to compare future structure and productivity of the herd.

In the absence of a prior baseline, comparisons have been made between the Porcupine herd and other caribou populations in Alaska and the central Canadian Arctic. Table VII summarizes pertinent data from surveys carried out by members of the Alaskan Department of Fish and Game and comparable data from the present study. In terms of calves as a percentage of total sample counted there is a very obvious difference between Skoog's figures for the Steese-Forty mile herd and the Porcupine herd. There are probably two main reasons for this: (1) As calving continues to mid-June in both herds and Skoog did his counts one month earlier than the present study the calves have not suffered as much mortality as would have occurred by July in the Porcupine herd. (2) Skoog has suggested that his values are inordinately high since large numbers of males, yearlings and non-lactating females were not included in his sample. The ratio of calves:cows is a better comparison. Again, however, Skoog's data are from June rather than July. The general concensus among researchers is that during the first month after calving a mortality of 40-50 percent of the calves occurs.

Other figures from Alaska for calf:cow ratios compare favorably with those obtained in our study with the exception of Hemming's data for 1967 and Lent's 1961 and 1962 data. It appears that those data reflect unusual occurrences in the population cited. For instance, Hemming's late June census of the Nelchina herd showed a calf:cow

ratio of 58:100. A loss of one percent of the calves from June to October is unusually low. The ratio of 49.3:100 calves to cows in July represents a good production of calves for 1971.

Tables VII and VIII show that the percentage of yearlings obtained for the Porcupine herd is considerably above normal. In all years and herds for which there is information Kelsall's figure for 1952-53 is the only one that is higher. Assuming 10 percent annual mortality rate of caribou one year old or older, yearling recruitment in 1971 was much higher than necessary to maintain the population. It therefore appears that recruitment from the 1970 calf crop resulted in an overall increase in the total number of animals in the population. While the recruitment from the 1971 calf crop cannot be as high there is no reason to expect a decrease in total numbers in 1972.

In summary, data indicate that the Porcupine herd is a healthy and productive population. Production rates, recruitment and survival all indicate a capacity of the herd to maintain its numbers despite the many mortality factors operating on all age classes, including current levels of human utilization. From productivity and population data it may also be inferred that recent human activities have not had an adverse impact on the population as a whole.

TABLE VII

Comparison of Productivity of Alaskan and Yukon Caribou Herds

Author	Herd	Yearlings as % of total population counted	Calves as % of total population counted	Yearlings per 100 females	Calves/100 females plus unclassified
Skoog (1956)	Steese-Forty Mile	-	25.3 (June 1952)	-	-
	Steese-Forty Mile	12.4 (May 1953)	37.2 (June 1953)	-	72.9 (June 1953)
	Steese-Forty Mile	18.2 (May 1954)	37.2 (June 1954)	21.4 (May 1954)	72.5 (June 1954)
	Steese-Forty Mile	10.5 (May 1955)	-	11.8 (May 1955)	-
Hemming (1968)	Nelchina	-	-	-	57 (October 1967)
	Adak	-	32.8 (June 1967)	-	54 (June 1967)
Hemming (1969)	Alaska Peninsula	-	-	39 (Spring 1968)	50(Fall 1968)
	Arctic	-	-	-	41 (July 1968)
Lent (1964)	Arctic	-	-	-	73 (June 1960)
	Arctic	-	-	-	42 (June 1961)
	Arctic	-	-	-	53 (June 1962)
Hemming (1969)	Nelchina	-	-	-	61 (June 1968)
Renewable Resources (1971)	Porcupine	25.3 (May 1971)	18.9 (July 1971)	78.3 (July 1971)	49.3 (July 1971)

TABLE VIII

Caribou Calf Production in the Central Canadian Arctic, from Kelsall (1968) and Thomas (1969)

Calf Year	Calves as percent of total animals	Sample as percent of total animals
Kelsall, (Late Winter)		
1947-48	14.8	2.9
1948-49	24.3	1.0
1949-50	16.4	1.0
1950-51	7.6	1.0
1951-52	11.0	2.3
1952-53	26.6	5.6
1953-54	15.4	4.9
1954-55	12.2	3.8
1955-56	6.9	8.0
1956-57	8.0	1.6
1957-58	11.3	6.5
1958-59	20.0	5.2
1959-60	25.0	7.8
1960-61	21.5	Unknown
Mean	15.9	4.0
Thomas, 1967 (March to May)		
Bluenose	14.1	
Bathurst	9.3	
Beverly	12.0	

E. Migration Routes

Pruitt (1959) has suggested that migration routes are governed by the combined factors of snow and topography. In the case of the Porcupine herd, topography appears to have a very significant bearing on routes utilized.

Kelsall (1968) refers to "migration shifts" in central Arctic herds; however, data on the extent of such shifts and causative factors are sparse. For example, Kelsall presents data that indicate substantial shifts around the Slave River; caribou reportedly crossed the Slave River in 1901, 1917, 1934-37, 1947, 1949/50 and 1950/51. Herds have not crossed the river since 1951 although large numbers pass east of the river.

Evidence indicates that spring migration routes of the Porcupine herd have been relatively constant over a long period of time. The geographic position of caribou fences and old hunting camps at traditional crossing points on the Porcupine River are indicative of the constancy of migration routes. Hunting camps at Crow Point and Caribou Lookout have been used for centuries and are still used by residents of Old Crow. Similarly, caribou fences north of the Porcupine River coincide with existing summer travel routes used by caribou.

While fall migrations do not appear to be as deliberate as spring migrations, the same routes southward were utilized as during the northward migration. The majority of animals moved south slightly west of the Old Crow route while those travelling the Richardson Route retraced their spring paths.

The starting points of the fall migration have been reported from the area between the Blow River and the Firth River (McEwan 1955) to within 50 miles northwest of Aklavik (Bryant 1957). In 1971 migration is believed to have originated at the northern edge of the

Brooks Range, north of the headwaters of the East Chandalar River in Alaska. The starting point of a smaller group was in the northern Richardson Mountains. In all documented cases, aggregations prior to the onset of fall movements occurred south of the coastal plain and west of the eastern slope of the Richardson Mountains.

The constancy of route utilization provides a degree of predictability of major movements across pipeline routes. The significance of variability in the timing of migration will be discussed further in the report.

F. Migration Behavior

From data obtained, spring concentrations and "funneling" are most significant in movements over the Richardson Mountains. A dispersion occurred at the same latitude in animals crossing the Old Crow Flats in 1971.

Aggregation size varies from season to season. The largest groups occur in early summer, and their movements are least predictable. It appears that in order to reduce insect harassment, caribou move into the wind. This behavior suggests that movements will occur into prevailing winds when caribou are in areas of low topographical relief, such as the Arctic Plateau.

Some movements occur during midwinter, but since aerial surveys cannot be carried out during this time, few data are available. Lent (1966) observed only local movements during December, January and February. He states that "caribou were constantly making short local movements, feeding and moving across the same clearings several times". Lent also noted that the Arctic herd in Alaska attained its maximum dispersal on the winter range during the first part of February. Since the habitat of the Porcupine herd is quite similar to that of the Arctic herd, the above description should be applicable to the Porcupine herd.

A tendency to follow paths such as seismic lines and winter roads has been observed in summer and winter during this study. The reason for the use of such paths appears to be related to greater ease of travel through timbered areas and hummocky terrain; it might also represent a response to the visual stimulus provided by a path.

Evidence that caribou are not adversely affected by river crossing, nor disturbed by the presence of humans or predators, indicates a high threshold of tolerance to both physical barriers and external disturbance during migration. However, their strong fright reactions to low-flying aircraft, and particularly to helicopters, underlines the need to avoid this type of disturbance, particularly to pregnant cow herds on migration and during the calving and early post-calving periods.

The separation in space and time of northward migrating male and female herds has significant implications. The most important factors which may affect the status of the population relate to pregnant cow herds and their need to reach specific calving areas. The male segment of the population would likely be less susceptible to adverse consequences of deflection in the spring. By autumn, both sexes travel in common herds. Thus, relatively undisturbed conditions prior to and during the breeding season become important considerations in reproductive success.

G. Timing of Migration

The data presented in Table IX illustrate the variability in times of spring northward migration of the Porcupine herd as reported by various sources. If Pruitt's theory of snow conditions initiating and controlling migratory movements is correct, variations in spring snow conditions could account for variations in the timing of spring migration. While it is difficult to generalize from the data in Table IX, it can be estimated that commencement of spring

TABLE IX

Dates of Spring Migration of Porcupine Caribou Herd

Adapted from Kevan (1970)

Date	Localities	No. of Animals	Reference
May 1950	Headwaters of Firth and Colleen Rivers	20,000	Chatelain
March 1951	South of Lapierre House	-	Bonnetplume
February-March 1952	Opposite Herschel Island	Unusual	Kayaktok
25 March 1952	Yukon Coast	20,000	McEwan
23 March 1953	40 miles north of Porcupine River and along west slope of Richardson Mountains.	5,763	Munro
23 March 1953	S and W of Salmon Cache	2,501	Munro
22 April 1954	Porcupine River E of Driftwood River	Thousands	Rice
2 May 1956	20 miles W of Porcupine River	Many	Olson
21 May 1971	Porcupine River Old Crow	30,000	Renewable Resources (June, 1971)

TABLE X

Timing of Fall Southward Migration for the Porcupine Caribou He

Adapted from Kevan (1970)

Date	Localities	Numbers of Animals	Reference
15 August 1949	Mount Fitton	Many	Hoydahl
October 1949	Near Peel	Many	Stevens
September 1950	Driftwood River Salmon Cache Old Crow	15,000	Webster
15-21 October 1951	Cache Creek	Many	MacLeod
30 August 1953	Old Crow Mountain	5,000	Moore
15 September 1954	Old Crow Mountain	Many	McEwen
16 August 1956	Just North of Old Crow	30-40,000	Wien Airline
1-6 September 1971	Porcupine River and Rat Pass	30-45,000	Renewable Resources

migration ranges from mid-March to mid-May. Hemming (1971) reports that, in general, migration of the Alaskan Arctic herd commences in mid-March. From data gathered from other caribou populations (Kelsall, 1968) it appears that April and May represent the months of peak caribou movement.

Timing of fall migration has not been thoroughly investigated. Kelsall (1968) suggests that "the first substantial snowfall" of the fall "may release true migratory behavior". In 1971 the first portion of the fall migration of the Porcupine herd was coincident with the first snowfall of the season, an accumulation of approximately 4-6 inches. Lent (1966) also reports the onset of movement being stimulated by the first widespread snow flurries of the autumn.

Kelsall also suggests that the timing of fall migration is much more variable than spring migration. Initially, this appears to be the case when Tables IX and X are compared. However, when locations of fall migration observations in Table X are related to time, a consistency is evident, in that during the latter part of August and early September the southward migrating herds are in the vicinity of the Porcupine River.

When weather records from Old Crow are examined, it is obvious there is little correlation between migration dates and snow depths per se (Table XI). Kelsall (1968) suggests that the speed and direction of fall migration are commonly influenced by the progress of freeze-up of major lakes and rivers. This does not always appear to be the case for the Porcupine Caribou herd, since the average August and September temperatures at Old Crow are not low enough for freeze-up conditions.

Therefore, it is suggested that initial fall migration begins as an erratic movement which may be greatly influenced by weather conditions, primarily winds and storms. In the fall of 1971 it was obvious that stormy weather influenced both the speed and direction of migration to winter range.

TABLE XI

Fall Weather Data from Old Crow, Yukon Territory

Date		Temperatures			Snowfall
		Mean Maximum	Mean Minimum	Mean Monthly Temperature	Depth of Snow (inches)
August	1952	57.5	37.9	47.7	-
	1953	60.9	39.6	50.2	-
	1954	66.0	44.4	55.2	-
	1955	-	-	-	-
	1970	59	41.9	50.5	-
	1971	57.5	37.4	47.5	-
September	1952	39.6	25	32.3	-
	1953	46.5	29.2	37.8	0.2
	1954	44.7	23.8	34.2	-
	1955	45.1	29.9	37.5	-
	1970	37.9	22.2	30.1	-
	1971	42.2	29.3	35.8	6.0
October	1952	27.8	13.2	20.5	7.0
	1953	24.2	8.9	16.6	8.0
	1954	28.0	12.8	20.4	10.0
	1955	24.8	9.3	17.0	-
	1970	16.9	1.2	9.1	-
	1971	-	-	-	15.5

VII. CONCLUSIONS

1. Several subgroups of the Porcupine herd existed during the winter of 1970/71. These interacted as one population after spring migration.

2. The general winter range lies between longitudes 133°W in the Yukon Territory to 149°W in Alaska and from the Porcupine River south to the Ogilvie Mountains.

3. Although large groups of caribou have been reported to winter in the Old Crow Flats and on the North Slope in the past, this is considered to be an aberrant situation.

4. The specific wintering areas which caribou utilize vary from year to year within the general winter range.

5. The Porcupine herd in the Yukon consists of approximately 85,000 animals.

6. The age and sex composition of the herd indicate that it is a healthy, productive population.

7. Spring migration routes are influenced by topography and snow depth and are largely traditional. However, some annual variations in routes used are to be expected.

8. Historical evidence indicates that commencement of spring migration is variable and occurs between mid-March and mid-May.

9. During spring migration concentrated herds of caribou cross the Richardson Mountains and dispersed groups cross the Old Crow Flats. Funnelling may occur in both areas during fall migration.

10. Some separation of sexes exists during spring migration, calving and post-calving movements. Reunion of the sexes takes place between early July and the breeding season in October.

11. Summer movements are variable and unpredictable.

12. During summer the caribou display characteristic reactions to insect harassment and wind.

13. Fall migration is initiated by the first severe storm of the fall and usually occurs between mid-August and mid-September.

VIII. OBSERVATIONS OF OTHER SPECIES

A. Possible Predators

Throughout the seven months of the caribou study, data were compiled on a variety of predators intimately or incidently involved with caribou. All sightings of predators or predator activity were recorded.

1. Wolves

In 499 hours of survey flying, 159 wolves were observed in 69 sightings (Figure 60). Table XII shows the number of wolves sighted and mean number per observation by month. The largest pack observed was on the Old Crow Flats and contained 14 wolves. Table XII demonstrates a marked decrease in wolves sighted from April through September, when the number of sightings began to increase again.

It is unknown what portion of the total wolf population of the study area was observed in the course of caribou survey flights. In this highly mobile species, characterized by secretive behavior and clumped distribution, a valid population estimate is difficult to derive. Various researchers have made attempts to estimate wolf densities around caribou or reindeer populations. Kelsall (1968) estimated 1 wolf per 60 square miles in the mainland central Arctic while Makridin (1959) estimated 1 wolf per 270 - 309 square miles in the Russian Arctic. The validity of methods used to obtain these population estimates is questionable, as a result of the factors mentioned above. A subjective estimate of northern Yukon wolf populations based on frequency of sightings would be 300 - 400 wolves in the area between the Peel River drainage route and the Beaufort Sea.

TABLE XII

Wolf Sightings in the Northern Yukon.

Month	No. of Wolves sighted	No. of Observations	Average No. per Observation
April	79	19	4.2
May	40	19	2.1
June	1	1	1.0
July	25	21	1.2
August	5	4	1.3
September	3	3	1
October	6	2	3
TOTAL	159	69	2.3

FIGURE 60

WOLF SIGHTINGS 1971

APRIL MAY JULY AUG. SEPT. OCT.

WOLF SIGHTING

GENERALIZED CARIBOU MOVEMENT

MACKENZIE BAY

MACKENZIE DELTA

N

The status of the wolf population in the northern Yukon is unknown. There have been no known poisoning programs in the northern Yukon for the past decade, nor have there been any reported outbreaks of contagious diseases such as mange, distemper or rabies. It is assumed that in absence of any known depressing factors the wolf population of the northern Yukon is either stable or increasing.

Wolves were sighted in a wide variety of situations. Four categories of wolf-caribou associations are presented in Table XIII: feeding on caribou carcasses, attacking caribou, in the general vicinity of caribou (within one mile), and not associated with caribou. It is evident that in a large percentage of the total sightings, wolves were in close association with the caribou.

Of 133 wolf-killed carcasses found, 131 were caribou and 2 were moose. Wolves were found to take caribou consistently throughout the field season, with certain peaks occurring in predation. Observations suggest that wolves not concerned with denning activities followed caribou. Wolves were actively taking caribou long after denning had begun.

Little information is available on denning in the study area. However, several den sites are thought to be located along the north and south banks of the Porcupine River west of Old Crow. In addition, it is thought that several dens are situated in the vicinity of Cody Creek and the Fishing Branch River, since there were large numbers of wolves associated with caribou in this area until mid-May, some time after the onset of denning.

Four color variations were recognized among wolves sighted although three color phases predominated. These are shown in Table XIV. Silver-grey was the most common color phase observed.

TABLE XIII

Wolf - Caribou Relationships

Month	Wolves on kill	Wolves attacking caribou	Wolves associated with caribou	Wolves not associated with caribou
April	30	-	28	31
May	10	9	6	19
June	-	-	-	1
July	7	10	7	8
August	-	2	2	3
September	1	-	1	1
October	-	-	-	6
TOTAL	48	21	44	69

TABLE XIV

Wolf Color Phases in the Northern Yukon 1971

Month	No. Observed	Black	Silver Grey	White	Yellow	Other
April	79	28 35.4%	39 49.4%	2 2.5%	3 3.8%	7 8.9
May	40	13 32.5%	25 62.5%	1 2.5%	1 2.5%	
June	1		1 100.0%			
July	25	8 32%	12 48%	2 8%	1 4%	2 8%
August	5	5 100%				
September	3	1 33.3%	1 33.3%	1 33.3%		
October	6	2 33.3%	1 16.7%		3 50%	
TOTAL	159	57 35.8%	79 49.7%	6 3.8%	8 5.0%	9 5.7%

2. Grizzly Bears

The significance of grizzly bears as predators on the Porcupine Caribou herd is uncertain. Grizzlies are capable of killing adult caribou, but this is probably a rare occurrence.

Grizzly bears were regularly observed from 6 May 1971 when they began to emerge from dens and were active, until the cessation of field work on 26 October. Old Crow hunters report that grizzly bears do not enter dens until about mid-November (Peter Lord and Charlie Peter Charlie, pers. comm.). From 6 May to 26 October a total of 93 grizzly bears were observed. Table XV shows the numbers sighted per month and includes a partial age and sex classification. Since sex is impossible to determine with certainty unless a female is observed with cubs, and age classes can only be ascertained when young of various ages are observed with an adult, this classification is incomplete. Coloration in grizzly bears varied considerably among individuals and according to geographic areas. Table XVI shows the variation in color phases as well as size categories. Color phases were generally as follows: dark brown body, grey head, neck and shoulders; light brown body; very light brown or nearly white body with dark brown head and feet (toklat phase). Grizzly bears south of the Porcupine River were generally dark, although occasionally a light brown bear was observed. Those of the northwestern Yukon or British Mountains (Figure 6) were normally very light brown to pure toklat phase. In some cases bears were nearly pure white. Grizzlies of the northeastern Yukon were variable but no toklat phase bears were observed.

In addition to the grizzly bears sighted, 11 dens were also located. These are plotted in Figure 61 and locations given in Appendix B. Four of these were located by backtracking on a survey flight and the balance were located in the course of survey flights. Old Crow hunters report an additional three dens which were not located. One of these has reportedly been in use for 75 years or more. (Charlie Peter Charlie, pers. comm.).

TABLE XV

A Partial Classification of Grizzly Bears Observed in the Northern Yukon

Month	No. Sighted	Single Adult	Female	New Cub(s)	Yearling Cub(s)	2-yr-old Cub(s)
May	11	8	1			2
June						
July	49	26	9		10	4
August	15	11	2	1	1	
September	18	11	3	3		1
October	—	—	—	—	—	—
TOTAL	93	56	15	4	11	7

TABLE XVI

Color Classification of Grizzly Bears

Month	No. Sighted	Dark Brown	Light Brown	Toklat Phase	200-249 lb. Class	250-349 lb. Class	350+ Class	Less than 200 lb.	No Estimate
May	11	9	2		3	1	6		
June									
July	49	18	20	10*	13	12	4	8	12
August	15	3	5	7	3	8	2	2	
September	18	10**	2	4	3	4	5	2	4
October	—	—	—	—	—	—	—	—	—
TOTAL	93	40	29***	21	22	25	17	12	16

* 1 not described
** 2 not described
*** 3 not described

The den sites were situated in a wide variety of terrain types. Two were on southwest slopes, one near the crest of a mountain, and one on a stream bank at the base of a spruce tree. Two dens were located on north and northeast slopes at the upper level of vegetation. Two others were located on east slopes. All were places of dry, porous soil conditions and in places where the den mouth would remain covered with snow after most of the surrounding snow pack had melted. Den sites are extemely important to grizzly bear populations. Lack of suitable den sites may in fact limit northern Yukon populations of this species.

Over half the grizzly bears observed were near caribou, either in the vicinity of herds or feeding on carrion (Table XVII). The frequency of sightings of grizzly bears in conjunction with caribou suggests that they actively follow the herds (See Figure 62). However, they are insignificant predators of caribou. Only one pursuit was observed in this study, and Lent (1964) saw few pursuits and only two cases where calves were taken. It appears that the bears will kill caribou when the opportunity arises. However, they generally feed on small mammals, vegetation and carrion. Murie (1944) found that the summer diet of grizzly bears in McKinley National Park was almost exclusively vegetation. Observations made in May 1971 suggest that grizzly bears emerging from dens rely to a large degree on caribou carrion, since many carcasses were located by following grizzly trails.

During most of the period in which grizzly bears were active the caribou were north of the Porcupine River, hence few flights were made in the area between the Peel, Ogilvie and Porcupine rivers. Based on the total of 93 grizzly bears observed in the course of the survey flights north of the Porcupine River, a purely subjective estimate of the number of grizzly bears between the Peel, Ogilvie and Porcupine rivers would be 200 animals.

TABLE XVII

Situations in Which Grizzly Bears Were Found

Month	Grizzly Bears On Kills	Grizzly Bears Near Caribou	Grizzly Bears Other Situatio
May	4		7
June			
July	8	28	13
August		6	9
September		6	12
October			
	—	—	—
TOTAL	12	40	41

FIGURE 61

IMPORTANT AND CRITICAL AREAS 1971

TABLE XVIII

Lesser Predators Observed in the Northern Yukon

Month	Red Fox	Black Fox	Black Bear	Lynx	Wolverine	Golden Eagle	Bald Eagle	Peregrine Falcon	Gyr-Falcon
April	1	-	-	-	1	10	5	-	-
May	3	-	-	-	-	17	6	1	2
June	-	-	1	-	-	2	3	-	-
July	1	-	5	-	2	12	3	3	2
August	-	-	1	1	-	19	7	1	4
September	-	-	3	-	2	3	-	-	-
October	4	3	-	-	1	2	-	-	-
Total	9	3	10	1	6	65	24	5	8

The status of the grizzly bear in the northern Yukon is unknown since no previous data are available for comparison. There are no known selective pressures acting on the grizzly bear population north of the Peel River. Bears are taken throughout the Ogilvie Mountains south of the Ogilvie and Peel rivers by sport hunters. Old Crow hunters take from one to four grizzly bears annually and several are taken annually by Aklavik hunters. (C. Cook, pers. comm.). Crews of oil exploration camps are not allowed to possess firearms.

3. Black Bears

The black bear (Ursus americanus) is the least common of the large carnivores in the northern Yukon. In 499 hours of survey flying only 10 black bears were sighted. Of these, two were cubs of the year. In one case a large black bear was observed feeding on a newly born caribou calf.

4. Other Predators

Although not directly relevant to the survey work, observations on the presence and numbers of many of the lesser predators of the study area were documented during surveys. Most lesser predators are dependent in varying degrees upon caribou as carrion. Table XVIII lists the various species observed and the frequency with which they were encountered.

The most numerous lesser predator in the study area is the golden eagle, of which 65 were observed. Numerous observations of golden eagles at wolf kills or near herds of caribou suggest that golden eagles may depend largely on caribou carcasses for survival in early spring. Golden eagles were first observed in low numbers, increasing from 10 in April to 17 in May. The golden eagle is reportedly migratory in this region. Our observations indicate that

if this species does migrate, it returns to the northern Yukon extremely early in the spring. Two golden eagle nests were located, one at Old Crow and one on the Rapid River (locations are given in Appendix C).

Five bald eagles were observed in late April and 6 in May. Nests of bald eagles were found at several locations (Appendix C). The bald eagle appears to return to the northern Yukon slightly later than the golden eagle. Bald eagles were frequently observed near caribou and in areas where there were known kills, although they were never observed feeding on a caribou carcass.

The two rarest avian predators observed were the gyrfalcon (Falco rusticolus) and the peregrine falcon (Falco peregrinus). Both species were late arrivals to the study area, being first observed in mid-May. Gyrfalcons were observed on 8 occasions and peregrines on 5 occasions.

B. Other Ungulate Species

Throughout the survey caribou were the species of primary emphasis. However, the presence and status of other ungulate species was documented whenever possible. Particular attention was given to ungulate populations which occurred on or near potential pipeline routes.

1. Dall Sheep (Ovis dalli dalli)

Dall sheep occur as discrete populations within the study area. The locations of the sheep populations identified by the present study are given below and described in Appendix F:

(1) Firth River Population
(2) Knorr Range Population
(3) Kongakut River Population
(4) Sheenjek River Population
(5) Miner River Population
(6) Fairchild Lake Population
(7) Richardson (North of Rock River) Population
(8) Carpenter Lake Population
(9) Hula Hula River Population
(10) Doll Creek Population

These populations are considered to be separate since they are separated geographically by river systems, forests, and mountain ranges.

The total number of sheep observed, including those in the Northwest Territories, northern Yukon, and Alaska, was 767 individuals. The largest sheep population found within the study area was the Richardson population north of Rock River. The number of sheep in this population was counted at 337 and is estimated to be about 450. Figure 61 shows the sporadic distribution of the sheep in the Richardson Mountains. They are located primarily between the Bell River and Mount Goodenough.

The second largest known population in the study area is the Carpenter Lake population. There were 253 sheep counted in this population and the probable total for the population is estimated at 400. The Knorr Range group, the third largest population, had 69 individuals when counted and probably contains over 100.

The winter range of the Mount Goodenough population includes the spruce forest forming a narrow fringe around the eastern base of Mount Goodenough. The southern limit of this population extends to within ten miles of Chute Pass in the Richardson Mountains. Three rams were observed in this vicinity during the summer of 1971.

The Firth River population is about 15 miles from the coastal pipeline route.

Very little is known about Alaska sheep populations at this time. Sheep have been observed approximately 7 miles up the Hula Hula River valley from the coastal route in Alaska. The Kongakut and Sheenjek populations are well removed from both pipeline route alternatives. However, Leffingwell (1919) reported numerous Dall sheep in the Canning River valley.

The sheep ranges delineated in this study had the following characteristics:

(1) steep south, southeast or southwest slopes with escape terrain nearby and bushy slopes for browse, or
(2) high, wind-blown slopes and plateaus, covered with sedge or grass, with escape terrain nearby which is commonly below the grazing area.

The Mount Goodenough sheep range north of McDougall Pass possesses all of these attributes. The Joe Creek and Aspen Creek area of the Firth River also possess the above attributes to a lesser degree.

A partial age and sex classification for the various populations observed is presented in Table XIX. All populations appeared to have good numbers of lambs, but low numbers of yearlings. The low number of yearlings observed could be due to one of two factors. First, because they are not as obvious as lambs, some yearlings may be included in the unclassified category; and secondly, they may be low in number due to poor survival over the first winter.

Several of the Dall sheep populations are exploited by native hunters or non-native sport hunters. The heaviest exploitation takes place on the Richardson population, which is open to native hunting only. Hunters from Aklavik regularly hunt sheep on and around the Mount Goodenough winter range. Kill records kept by Cliff Cook, Conservation Officer for Aklavik, indicate the following kill of the Richardson population over 1969-71: 1969, 41 sheep; 1970, 22 sheep; and 1971, 33 sheep. This represents about 10 percent of the known population. The recruitment of yearlings appears to be falling short of the number of animals killed each year, with the result that this population is slowly declining.

Two of the other sheep populations are exploited to a limited extent by sport hunters. The Fairchild and Carpenter lake populations are hunted periodically. Personal interviews indicate that only four legal rams were taken from the Fairchild Lake area and one from the Carpenter Lake population.

The reactions of sheep to aircraft disturbance are much more pronounced than those of caribou. Even fixed-wing aircraft at relatively high altitudes elicit immediate flight responses. Helicopters are extremely disturbing to sheep causing instant flight responses even at long distances.

FIGURE 62

BARREN GROUND GRIZZLY BEAR SIGHTINGS 1971

TABLE XIX

A Partial Sex and Age Classification of Dall Mountain Sheep in the Northwest Territories, Northern Yukon and Northern Alaska Populations

Class	Richardson Mts. North of Rock R.	Firth River	Knorr Range	Konga-kut River	Sheen-jek River	Hula Hula River	Miner River	Fair-child Lake	Carp-enter Lake	Doll Creek	Total
Rams	43	4	4	-	1	-	-	2	19	-	73
Ewes	94	7	6	3	-	4	-	-	58	5	177
Lambs	82	4	6	2	-	4	-	-	29	3	130
Yearlings	12	2	-	-	-	-	-	-	7	-	21
No. Classi-fied	231	17	16	5	1	8	-	2	113	8	401
Unclassi-fied	106	27	53	3	2	11	3	16	140	5	366
Total	337	44	69	8	3	19	3	18	253	13	767

Disturbance of mountain sheep resulting in flight, particularly when animals are on winter range, can result in unnecessary energy drains deleterious to sheep. The total effect of energy losses varies with age, sex and is most significant in late winter. A flight reaction in March could be much more damaging than one in November and an energy loss to pregnant ewes much more damaging to the population than the same loss to rams.

2. Moose

In the northern Yukon, moose rank second to caribou in economic importance to the native people. Moose populations within the area of study are relatively low and are sporadically dispersed because of the scarcity of suitable habitat. The most apparent limiting factor on the moose population there is the quantity and quality of winter habitat. Preferred winter ranges have abundant willow, birch and popular browse, as well as nearby timber for cover and escape.

Several winter moose concentrations were located during early spring (Fig. 61). These included the Fishing Branch, Miner, Bell and Firth rivers. On 8 April, 34 moose were sighted in a small area on the Miner River. In the Bell River drainage, 6 moose were first observed yarded up on 2 April and again on 26 April. Concentrations of moose were observed when flying the Fishing Branch River drainage during caribou surveys. On 18 April, 23 moose were sighted in the only available winter range in the Firth River area, high on the south-facing timbered slopes. Some moose were seen on the Babbage River, with no forest cover nearby; this is an extemely marginal winter range.

During the summer, moose were dispersed over a much wider area than during the winter. An exception was the western portion

TABLE XX

Partial Classification of Moose in the Northern Yukon

June - October 1971

Month	Bull	Cow	Calf	Yearling	Un-Classified	No. Class.
April					77	77
May					24	24
June						-
July	10	12	5	1		28
August	10	13	4	1		28
September	36	14	2	1		53
October	3	6	1	1		11
TOTAL	59	45	12	4	101	221

of Old Crow Flats, which had higher concentrations in summer than in winter (6 sighted on 3 July, 11 on 29 July, and 10 on 3 August). On 12 August 2 moose were found on the north slope within 5 miles of the Beaufort Sea.

In the early fall, bull moose were more easily observed from the air because of their light-colored antlers. Since the rutting season was approaching, moose were found in closer proxmity to each other. On 22 August, 5 moose were found on the Salmon Fork, and 11 were found on the Salmon Fork and Fishing Branch rivers on 16 September. On 17 September, 13 moose were observed on the Kongakut River, all within 200 yards of each other.

A total of 221 moose were observed during 1971 surveys.

Both the productivity and harvest of moose are fairly low in the northern Yukon. Based on data from Table XX, productivity has been calculated at approximately 27 calves per 100 cows in 1971. Survival of calves to the yearling stage is also very low, with approximately 9 yearlings per 100 cows.

The annual harvest by Old Crow hunters is between 30 and 40 moose. This exceeds the number of calves and yearlings observed in the 1971 field season. There is no selection for a particular sex or age class. Nearly all moose are taken along the banks of the Porcupine River and moose numbers appear to be reduced along the Porcupine River for approximately 75 miles on either side of Old Crow.

Moose do not usually react strongly to the presence of aircraft. Cows accompanied by new calves will flee if approached directly or too closely. Moose appear to be disturbed more readily by aircraft during late winter and in deep snow conditions.

APPENDIX A

Locations of Field Camps

July 1971

Post I	68° 49'N 139° 15'W	9-11 July
Post II	68° 48'N 139° 53'W	9-11 July
Post III	68° 35'N 137° 40'W	18-21 July
Post IV	68° 15'N 137° 18'W	18-21 July
Post V	68° 08'N 136° 58'W	21-25 July
Post VI	68° 10'N 137° 40'W	21-25 July

APPENDIX B

Grizzly Bear Den Locations

1.)	66° 54'N 139° 50'W	7.)	68° 11'N 136° 29'W
2.)	66° 54'N 139° 49'W	8.)	68° 15'N 137° 20'W
3.)	67° 45'N 139° 42'W	9.)	68° 08'N 137° 00'W
4.)	67° 52'N 140° 26'W	10.)	67° 56'N 137° 58'W
5.)	67° 51'N 140° 25'W	11.)	67° 37'N 136° 18'W
6.)	67° 50'N 140° 26'W		

APPENDIX C

Location of Eagle Nests

A. Golden Eagle Nests

1.) Occupied
69° 25'N
139° 59'W

2.) 66° 58'N
144° 57'W

B. Bald Eagle Nests

1.) Occupied
67° 06'N
139° 05'W

2.) 69° 25'N
140° 58'W

Suspected nests - unoccupied

1.) 60° 38'N
142° 50'W

2.) 60° 30'N
139° 42'W

APPENDIX D

Location of Ground Survey Points of Winter Roads and Seismic Lines

Point	Coordinates
1	68° 18'N 138° 03'W
2	66° 10'N 138° 20'W
3	66° 03'N 138° 22'W

APPENDIX E

Caribou Fences

The existence of the Loucheux people has for untold years been inseparably connected to the presence of their major food source, the caribou. Until recent times, methods of taking caribou were primitive: spearing at major river crossings; stalking with bows and arrows; snaring or entrapment of caribou in fences, where all three methods of dispatch were employed.

Throughout the numerous flights made over the study area, several caribou fences formerly used for taking caribou have been located. Since much of the life of the Loucheux hunters and some Eskimos revolved around the harvesting of caribou at caribou fences, these areas are of archeological and anthropological interest.

To date, four caribou fences have been located. All were in or near the margins of the Old Crow Flats. The fences appeared to be of varying ages. This opinion is based on the relative condition of each fence. All fences were placed in the vicinity of migratory paths still used by caribou. This fact illustrates the constancy of caribou movements over a long period of time. In addition to the caribou fences, two apparent villages or campsites have been located. The camp or village sites were composed of several circles of stones approximately 12 feet in diameter. The sites are all named after the locale in which they were found. It is unknown whether these sites were of Indian or Eskimo origin. The first site was located immediately east of the Driftwood Caribou Fence on a ridge top above the Driftwood River. The river runs immediately to the east of the site. The second camp site was on the west bank of the Trail River at approximately 68^{o} 51'N, 139^{o} 05'W. The third site was on the Trail River within a few miles of the Arctic Coast and may be of Eskimo origin.

All caribou fences were constructed of spruce poles and bush located in the area. The wings of the fences appeared to be approximately three feet off the ground. Each fence had a central fence extending beyond the wings, possibly to facilitate capturing animals moving from both directions, perpendicular to the long axis of the fence proper. With the exception of the Bilwaddy fence in Alaska, all caribou fences were constructed in spruce forests. The description and location of each of the four caribou fences is as follows:

1. Thomas Creek Caribou Fence

This site is located at 68° 31'N, 140° 41'W. The fence is the second largest of its kind located. This is the only site which had been located and examined previously. This fence runs in a northeasterly direction below the tree line. The site is easily detected as one flies up the course of Thomas Creek. Several caches are located near the terminal corral.

2. Black Fox Caribou Fence

This site is located at the coordinates, 68° 19'N, 139° 06'W. It appears to be the most recently constructed fence of those located and is the longest known in the study area. The central fence is nearly four miles long and runs in a north-south direction; the terminal portion turns to a northeast direction (Fig. 63). There are several teepee-shaped caches near the terminal corral.

3. Driftwood Caribou Fence

This site is located at the coordinates 67° 54'N, 138° 22'W. The Driftwood fence appears to be in a relatively good state of repair. It is perhaps the smallest caribou fence located this past season. The long axis lies in an east-west direction. Remains of several old caches are visible near the terminal corral. The open end of this fence is on the banks of a small wooded stream.

4. Bilwaddy Caribou Fence

This site is located at the coordinates 68° 113'N, 141° 39'W. The Bilwaddy Caribou fence appears to be the oldest fence located. The entire fence is lying flat on the ground and is extremely difficult to see unless approached from a specific angle (Fig. 64). The long axis of this fence runs in a northwest-southeast direction. No buildings or caches were visible in the vicinity of the fence. Most of the Bilwaddy Fence lies on an open-ridge top.

APPENDIX F

Locations of Dall Mountain Sheep Populations

Richardson Populations north of Rock River -	
Mount Goodenough areas	67° 57'N 135° 31'W
Firth River Population	69° 07'N 140° 25'W
Knorr Range Population	65° 26'N 134° 27'W
Kongakut River Population -	
Headwaters of Kongakut River	
Sheenjek River Population	68° 47'N 143° 30'W
Hula Hula River Population	69° 26'N 144° 29'W
Miner River Population	65° 59'N 139° 14'W
Carpenter Lake Population -	
Areas west and south of Carpenter Lake	64° 30.5'N 135° 06'W
Fairchild Lake Population -	
Areas east and west of the lake	64° 58'N 133° 46'W
Doll Creek Population	66° 10'N 136° 07'W

APPENDIX G

P H O T O S

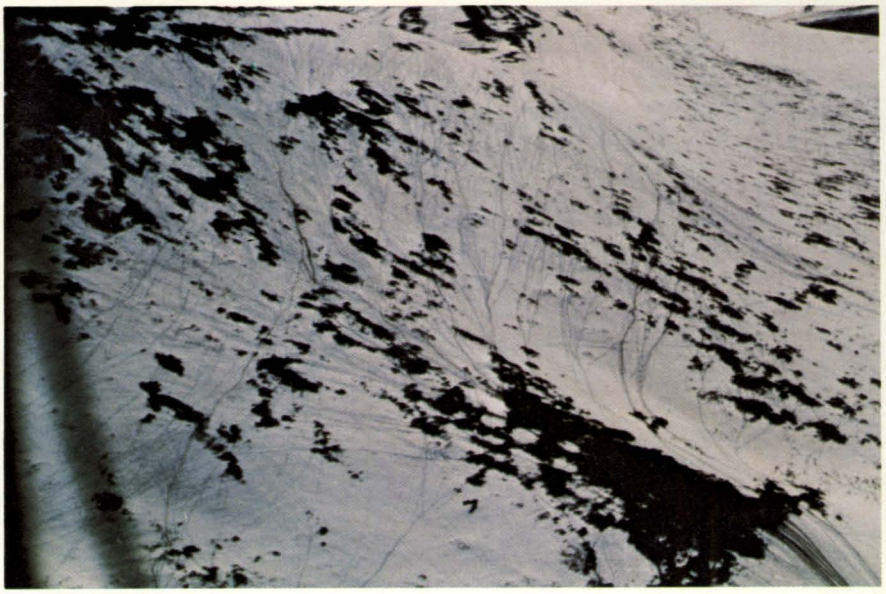


FIG. 1: Winter caribou trails contouring ridge in the Keele Range (May 1971).

FIG. 2: Summer caribou trails through a pass in the northern Richardson Mountains. Funneling has damaged vegetative cover (July 1971).

FIG. 4A: Figures A, B, and C illustrate density of herd of 60,000 between the Malcolm and Firth rivers (3 July, 1971).

FIG. 4B.

FIG. 4C.

FIG. 4D: Census photo showing 5,100 caribou near the Crow River (6 July, 1971). Note arctic plain in background.

FIG. 5: An example of the four classes used when ground crews classified animals in the field. From top to bottom are a calf, cow, bull and yearling.

FIG. 7: A field camp for classifying caribou on summer range in the northern Richardson Mountains (July 1971). Note the proximity of caribou to the camp.

FIG. 8: Wet tundra on Arctic coastal plain with Beaufort Sea on right.

FIG. 9: Spruce stands on northwest side of the Firth River valley. Firth Glacier in foreground.

FIG. 10: Rolling western foothills of Richardson Mountains in early fall. Note diversity of forest cover, including spruce, poplar and birch.

FIG. 11: A timbered river valley on the western side of the Richardson Mountains.

FIG. 12: Dave Lord Creek, looking southwest. Note how poplar (yellow) are limited to the well drained stream banks of the valley.

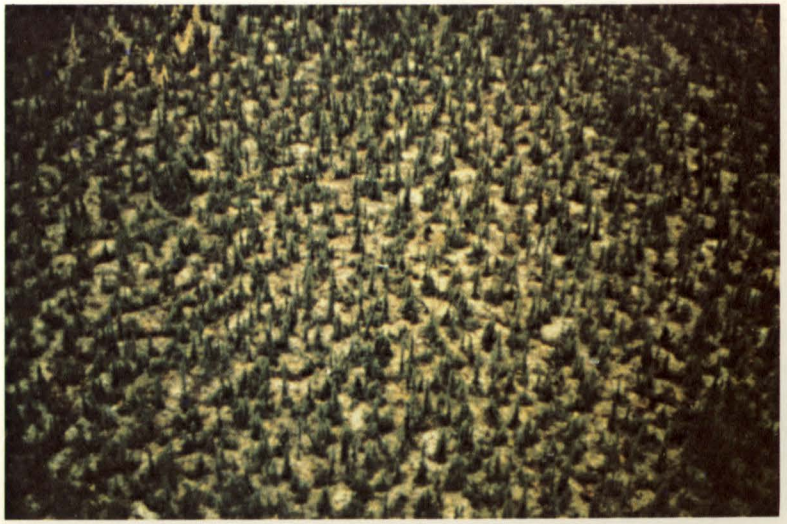


FIG. 13: A black spruce forest on the Porcupine Plateau with lichen ground cover.

FIG. 14: An old burn in the Keele Range near Salmon Cache. New forest cover is primarily birch.

FIG. 15: Old Crow Flats. King Edward Mountain in the background. This region was used by caribou during the summer of 1971.

FIG. 16: The Old Crow River meandering through Old Crow Flats. Note the stands of spruce in the better drained loops of its course.

FIG. 17: The Wind River is one of the many tributaries of the Peel River which have a braided flood plain.

FIG. 18: A flat valley bottom with steep walls. Caribou use these valleys in their movement through the Brooks Range.

FIG. 19: The Firth River runs for thirty miles through a rock-walled canyon before entering the coastal plain. Caribou were observed crossing the canyon at several locations.

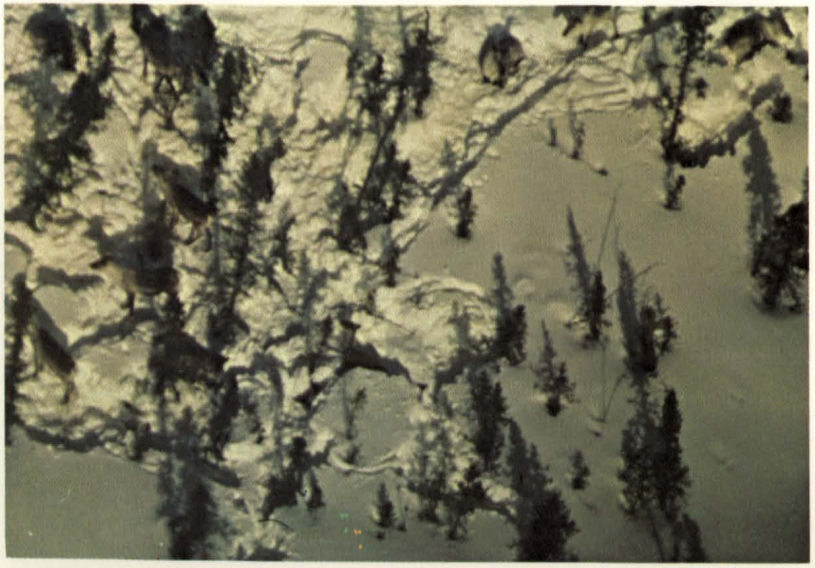


FIG. 20: Caribou feeding and bedding in deep snow in black spruce forest winter range.

FIG. 21: Wintering caribou on a wind-swept slope near timberline in Cody Creek area.

FIG. 22: Heavy lichen ground cover, an important component of caribou winter range.

FIG. 25: A group of 1,210 caribou concentrated on a ridge near Cody Creek. This is one of the densest aggregations encountered during spring migrations.

FIG. 23: A wide section of the Blackstone River Valley near Chapman Lake. Caribou rutted in this area in the fall of 1971.

FIG. 27A: Figures 26A—D illustrate the largest concentration of caribou photographed during the study. Of an estimated 30,000 caribou, 20,535 were counted in the photos.

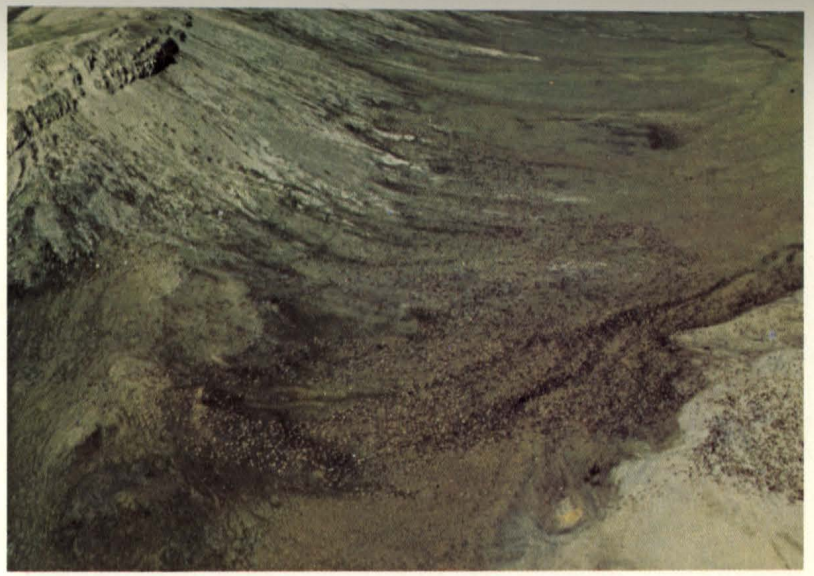


FIG. 27B.

FIG. 27C.

FIG. 27D.

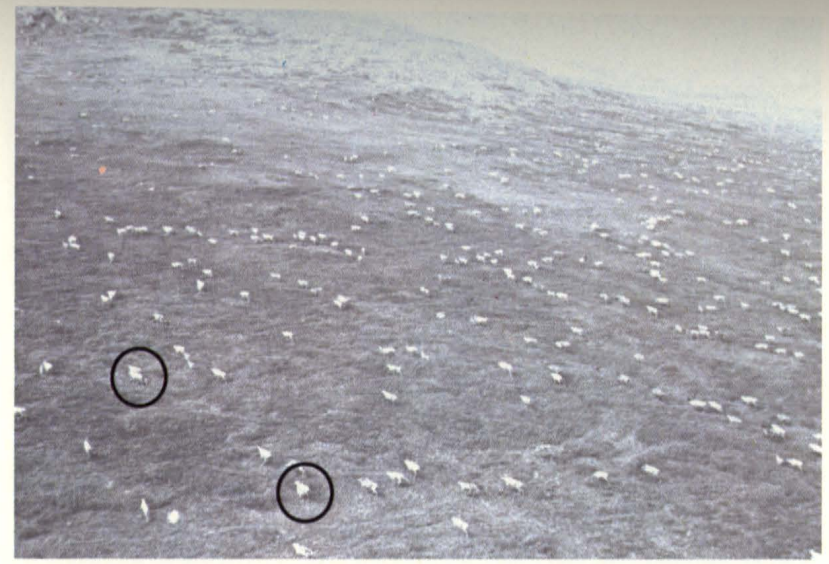


FIG. 28: One of the problems in censusing large aggregations from photographs is that calves are often eclipsed by cows, since they move close to the side of the cow in the presence of an aircraft.

FIG. 32: Wolf-killed cow caribou showing 0% consumption.

FIG. 33: Wolf-killed calf caribou showing 1—24% consumption.

FIG. 34: Wolf-killed caribou showing 75% + consumption.

FIG. 35: A successful hunter from Old Crow returning with six adult bull caribou.

FIG. 36: Hunter-killed caribou unloaded at spring camp where the meat was cut and dried.

FIG. 37: Caribou trapped on a pan amid flowing ice on the Porcupine River. This group later perished among crushing ice pans.

FIG. 38: Summer concentration on a rise of ground in the Trail River drainage. A total of 9,134 caribou were counted in this photo.

FIG. 39: An extremely dense aggregation observed on the Blow River, 17 July 1971.

FIG. 40: Part of a large herd moving single file through deep snow. The herd numbered approximately 3,000 animals. Cody Creek valley.

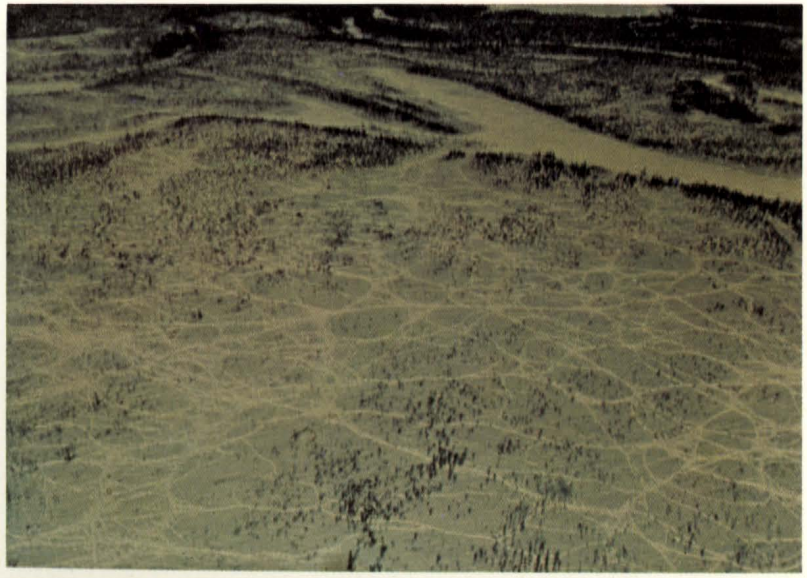


FIG. 41: Valley of the Fishing Branch River after many groups of caribou had moved through in migration.

FIG. 42: Summer movement in linear fashion on western edge of the Firth River valley.

FIG. 43: Caribou swimming single file through ice pans.

FIG. 44: Caribou bedded along access road near the Dempster Highway.

FIG. 45: Storage tanks near a well site. Note the extensive use of the area by feeding caribou.

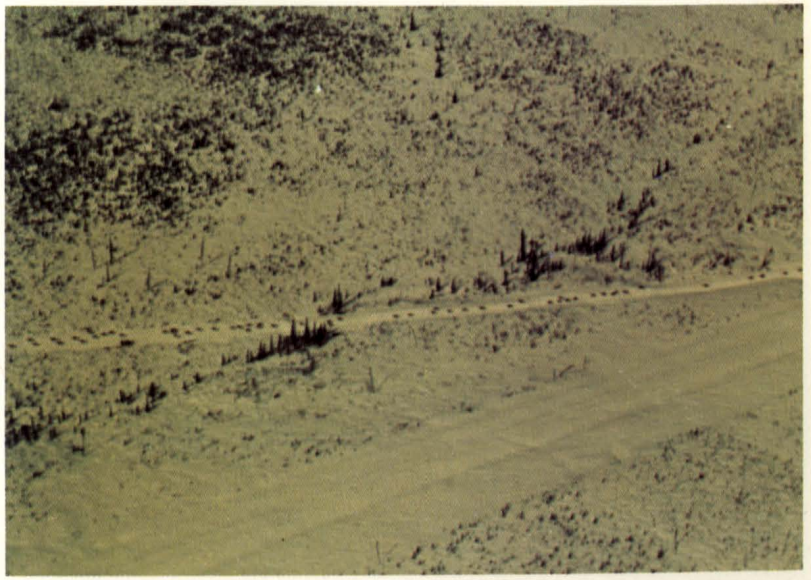


FIG. 46: A portion of a herd of approximately 200 caribou moving west from the Eagle Plain area on a seismic line.

FIG. 47: A winter road heavily used by caribou. Note the large number of tracks on road.

FIG. 48: A winter road north of the Old Crow Flats. This was created and used only twice by an extremely large all-terrain vehicle in 1958.

FIG. 49: Cotton grass colonized the road shown in Fig. 48 and is the dominant species. Note many fresh caribou trails passing down the road.

FIG. 50: Black spruce along a winter road in the Whitestone River valley.

FIG. 51: The road in Fig. 50 has naturally revegetated with a tall dense stand of reed grass *(Calamagrostis spp.).*

FIG. 52: A diverse understory in a dry black spruce forest.

FIG. 53: A seismic line cut in the winter of 1970/71.

FIG. 54: Hunter vehicles on Dempster Highway. Note caribou tracks.

FIG. 55: Trails and kill site of hunter-killed caribou on the Dempster Highway.

FIG. 57: Margaret Lake fire burned in the summer of 1971. This area was used by caribou in the winter prior to 1970/71. Fires cause extensive loss of caribou winter range.

FIG. 58: Margaret Lake fire of the summer of 1971. The fire burned upslope into Dall sheep habitat in the Knorr Range.

FIG. 59: Fishing Branch River fire. This area had been heavily used by caribou in April and May of 1971.

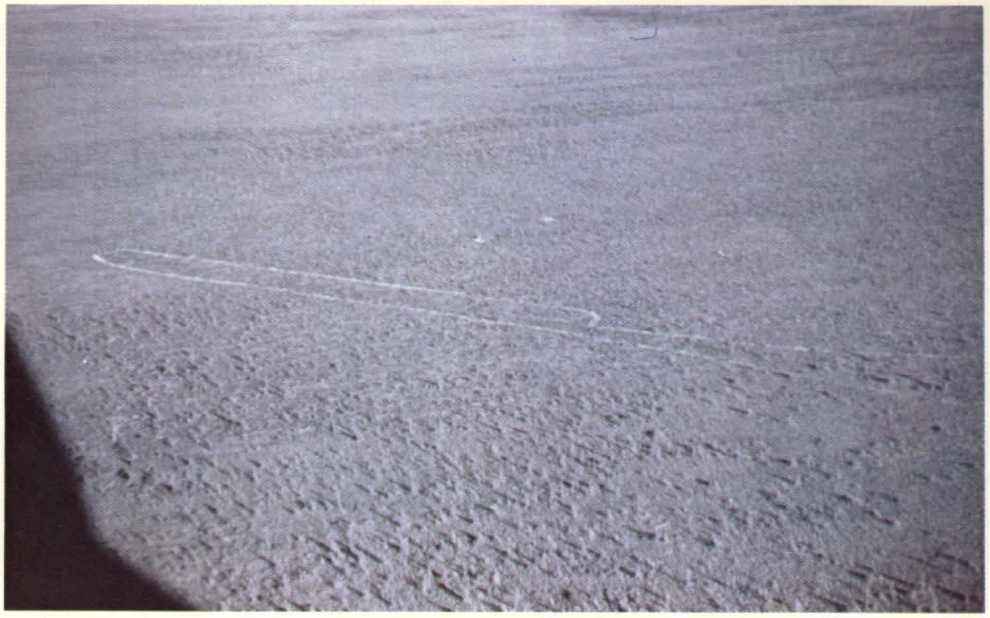


FIG. 63: The corral, approximately 300 yards long, at the terminus of the Black Fox caribou fence. The fence extended four miles to the right. Note the two meat caches beyond the corral.

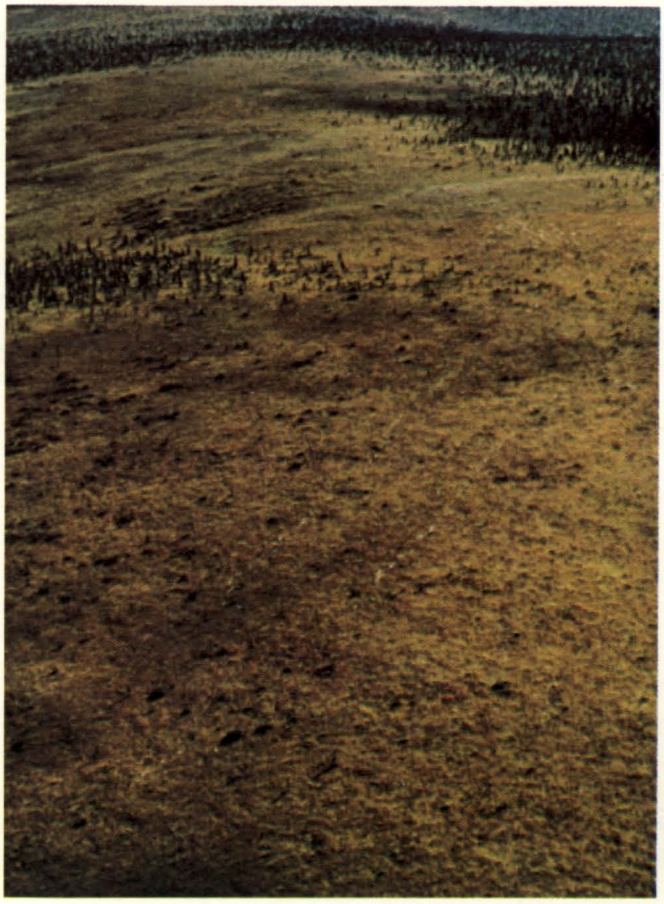


FIG. 64: There are remains of an old caribou fence located at the head of Bilwaddy Creek and on the edge of the Alaskan Arctic National Wildlife Range.

LITERATURE CITED

Banfield, A.W.F., 1954
Preliminary Investigations of the Barren-Ground Caribou. Canadian Wildlife Service, Wildlife Management Bulletin, Ser. 1, Nos. 10A and 10B.

Bergerud, A.T., 1967
Management of Labrador Caribou. Journal of Wildlife Management, 31: 621-682.

Bergerud, A.T., 1971
The Role of the Environment in the Aggregation, Movement and Disturbance Behavior of Caribou. Paper delivered at Ungulate Conference, Calgary, Alberta. November, 1971.

Bostock, H.S., 1948
Physiography of the Canadian Cordillera, with Special Reference to the Area North of the Fifty-fifth Parallel. Can. Geol. Surv. Mem. 247. Ottawa, 1948.

Bryant, J.E., 1957
Memorandum of December (sic) 10, 1957. Aklavik, N.W.T. for Chief (CWS) WLU 226-8 in Kevan, P.G., 1970. The Caribou of the Northern Yukon Territory. A history of man's interest in them with a special reference to wildlife biology. Canadian Wildlife Service. Unpublished Report.

Childs, Kenneth N., 1971
A Study of the Reaction of Caribou to Various Types of Simulated Pipeline at Prudhoe Bay, Alaska. Alaska Cooperative Wildlife Research Unit, University of Alaska. College, Alaska.

Fuller, W.A., 1957
Observations on Yukon Caribou 1956-1957. Mss. 8 pp. in Kevan, P.G., 1970. The Caribou of the Northern Yukon Territory. A history of man's interest in them with a special reference to wildlife biology. Canadian Wildlife Service, Unpublished Report.

Geist, V., 1971
Is Harassment Harmful. Oil Week, 22(14): 12-13.

Hart, J.S., Heroux, O., Cottle, W.H., and Mills, C.A., 1961.
The Influence of Climate on Metabolic and Thermal Responses of Infant Caribou. Canadian Jour. Zool., 39(6): 845-856. Illus. 1961.

Hemming, J.E., and Glenn, L.P., 1968
Caribou Report. Alaska Dept. of Fish and Game, Vol. IX, Annual Project Segment Report. Federal Aid in Wildlife Restoration. Project W - 15 - R - 2 and 3, Work Plan L.

Hemming, James E. and Glenn, Leland P., 1969
Caribou Report. Department of Fish and Game. Division of Game, Alaska.

Hemming, James E. and Pegau, Robert E., 1970
Caribou Report. Department of Fish and Game, Game Division

Hemming, James E., 1971
The Distribution and Movement Patterns of Caribou in Alaska. Alaska Department of Fish and Game, Game Division, Technical Bulletin No. 1.

Kelsall, J.P., 1968
The Migratory Barren-Ground Caribou of Canada. Dept. of Indian Affairs and Northern Development. Canadian Wildlife Service.

Kevan, P.G., 1970
The Caribou of the Northern Yukon Territory. A History of Man's Interest in Them with a Special Reference to Wildlife Biology. Canadian Wildlife Service. Unpublished Report.

Klein, D.R., 1971
Reaction of Reindeer to Obstructions and Disturbances. Science (73): 393-398.

Leffingwell, E. deK., 1919
The Canning River Region Northern Alaska. United States Geological Survey Profess. Papers No. 109.

Lent, P.C., 1964
Calving and Related Social Behavior in the Barren-Ground Caribou. Unpublished Doctoral Thesis. Univ. of Alberta.

Lent, P.C., 1966
The Caribou of Northwestern Alaska Environment of the Cape Thompson Region, Alaska. Ed. N.J. Wilimovsky. U.S. Atomic Energy Commission. Division of Technical Information.

Leopold, A.S. and Darling, F.F., 1953
Wildlife in Alaska. P. 129. Ronald Press Co. N.Y.

Makridin, V.P., 1959
The Biology of the Tundra Wolf in Kelsall, J.P., 1968
The Migratory Barren-Ground Caribou of Canada. Canadian Wildlife Service.

McEwen, E.H., 1952
Barren-Ground Caribou Survey from Aklavik to Herschel Island. March 25, 1952, Mss. in Kevan, P.G., 1970. The Caribou of the Northern Yukon Territory. A History of Man's Interest in Them with a Special Reference to Wildlife Biology. Canadian Wildlife Service. Unpublished Report.

McEwen, E.H., 1956
Yukon Caribou Investigation. Memorandum of Jan. 27, 1955. Aklavik, N.W.T. to Chief, CWS. DNANR, Ottawa in Kevan, P.G., 1970. The caribou of the northern Yukon Territory. A history of man's interest in them with a special reference to wildlife biology. Canadian Wildlife Service. Unpublished Report.

Macpherson, A.H., 1971
Barren-ground caribou management in Canada: a question of inventory, supply and demand. American Society of Mammalogists. 20 June, 1971, Vancouver.

Munro, D.A., 1954
A Preliminary Report on the Caribou of the Northern Yukon Territory. Can. Wildlife Service.

Murie, A., 1944
The Wolves of Mount McKinley. Fauna of the National Parks of the U.S. Fauna Series No. 5, 1944.

Murie, O.J., 1935
Alaska - Yukon Caribou. North American Fauna. No. 54 pp. 1-93. U.S. Department of Agriculture, Washington, D.C.

Pruitt, W.O. Jr., 1959
Snow as a Factor in the Winter Ecology of the Barren-Ground Caribou (Rangifer arcticus) Arctic 12(3).

Radvanyi, A., 1959
Yukon Caribou Survey Flight (January 24, 1959) Mss. p.3 and map in Kevan, P.G., 197-. The caribou of the northern Yukon Territory. A history of man's interest in them with a special reference to wildlife biology. Canadian Wildlife Service. Unpublished Report.

Scotter, G.W., 1970
Wildfires in Relation to the Habitat of Barren-Ground Caribou in the Taiga of Northern Canada. Reprinted from Proceedings Annual Tall Timbers Fire Ecology Conference. Aug. 20-21, 1970.

Scotter, G.W., 1971
Fire, Vegetation, Soil and Barren-Ground Caribou Relations in Northern Canada. Pp. 209-230. Proceedings - Fire in the northern Environment - A Symposium College (Fairbanks) Alaska.

Siniff, D.B. and Skoog, R.O., 1964
Aerial Censusing of Caribou Using Stratified Random Sampling. Jour. Wildlife Management. 28(2): 391-401. Illus. Map 391-401. 1964.

Skoog, R.O., 1954
Steese-Fortymile Herd in Wildlife Investigations Report. Quarterly Progress Report. Cooperative Wildlife Research Unit, Univ. of Alaska.

Skoog, R.O., 1962
A Method for Estimating Current Size and Status of Caribou Herds. 13th Alaska Science Conference. The American Association for the Advancement of Science, Alaska Division, Washington.

Skoog, R.O., 1968
Ecology of the Caribou (Rangifer tarandus granti) in Alaska. Unpub. PhD. Thesis. Univ. of California, Berkeley.

Thomas, D.C., 1969
Population estimates and distribution of Barren-Ground Caribou in Mackenzie District, N.W.T., Sask. and Alta. March to May, 1967. Can. Wildlife Service Report Series No. 9, Ottawa, 1969.

CHAPTER II

DISTRIBUTION AND MOVEMENTS OF THE PORCUPINE CARIBOU HERD IN THE YUKON, 1972

K. H. McCOURT
J. J. RUSSELL
D. DOLL
J. D. FEIST
W. McCRORY

TABLE OF CONTENTS

TABLES

TABLE OF FIGURES

APPENDICES

I. GENERAL INTRODUCTION

A comprehensive study of distribution and movements of the Porcupine Caribou Herd was initiated in March 1971. These studies provided baseline information concerning winter distribution, migration routes and calving areas of the herd, as well as an updated estimate of the size of the migratory population. Data were obtained on behavior of caribou during all stages of their annual cycle. The first field season was concluded in October 1971 and the results reported in "A Study of the Porcupine Caribou Herd, 1971" (Chapter I of this volume).

The second phase of field studies to further the initial objectives was initiated in March 1972. This phase produced data concerning distribution and movements of the herd that could be compared to the previous year's information, and also facilitated experimental studies discussed in "Disturbance Studies of Caribou and Other Mammals in the Yukon and Alaska, 1972 " (McCourt et. al., 1974).

This volume presents the findings of the second year's study of distribution, movements and associated behavior of the Porcupine Herd, and compares results with those of 1971. Maps referred to in this volume are included in "Map Folio to Accompany Distribution and Movements of the Porcupine Caribou Herd in the Yukon, 1972."

II. METHODS:

Distribution and movements of the caribou herd were determined through aerial surveys from a base at Old Crow, Yukon Territory. A ski-wheel equipped Cessna 185 was used during winter, spring and fall surveys. The airplane was converted to floats for the summer season, resulting in the suspension of surveys during the third week in June and the use of a Bell 206 helicopter in September. Flights in the Bell 206 helicopter associated with experimental studies served as well for collection of data for the survey program. A De Havilland Beaver aircraft was used for a brief period during October when the Cessna 185 became unserviceable. A total of 524 hours of survey time was logged in fixed-wing aircraft.

The Cessna 185 was found to be the most suitable survey aircraft tried, because of its combination of window surface, speed, maneuverability, and range.

Surveys in the Cessna 185 were usually flown at an airspeed of approximately 140 miles per hour with detailed observations at approximately 100 miles per hour. The altitude of the aircraft was adjusted to accommodate variations in visibility caused by differing light conditions or forest densities.

Surveys were generally conducted in two stages. The initial stage consisted of general flights over areas deemed likely to be inhabited by caribou. The second stage involved more detailed flights over inhabited areas to determine range boundaries, movements, abundance and distribution of caribou, and sign of caribou activity.

The survey team usually consisted of two observers and a pilot. One observer navigated and recorded locations of checkpoints and trails

on a 1:250,000 scale map. The other observer recorded information on a Sony TC-40 tape recorder. At times when only one crew member was available for survey flights he assumed both duties. This sometimes limited the amount of detail that could be gathered.

Locations of animals or of signs of animals were recorded as a checkpoint. At each checkpoint where animal signs were sighted, information concerning the characteristics and extent of the sign and the habitat was recorded as follows:

Checkpoint No.

Characteristics of Sign

A. Species (e.g. caribou)

B. Tracks (whether present)

C. Feeding craters (whether present)

D. Utilization (e.g. heavy, moderate, or light utilization of area)

E. Age (e.g. whether sign is fresh or old)

F. Comments (any additional characteristics of the sign)

Characteristics of Habitat

G. Vegetation (species and density)

H. Terrain (mountainous, rolling, gently rolling, flat)

I. Slope aspect (south facing, west facing, etc.)

J. Snow conditions (ground cover, drift conditions)

K. Comments (any other information on habitat)

L. Time

M. Extent (number of miles in which sign was continuously observed).

At a location where animals were observed, the following information was recorded:

Checkpoint No.

Characteristics of Animal (s)

1. Species (e.g. caribou, moose, wolf)

2. Group size (number of animals per group)

3. Group formation (e.g. closely-knit, scattered, linear)

4. Activity (feeding, lying down, travelling)

5. Comments (other information).

Characteristics of Habitat

6. Vegetation

7. Terrain

8. Slope Aspect

9. Snow conditions

10. Comments

Behavior in Response to Aircraft

11. Elevation of aircraft

12. Degree of response of animals

13. Comments (additional notes on behavioral response)

Where it was considered helpful and where time was available, characteristics of the sign were also recorded at checkpoints where animals were observed.

Groups were defined as aggregations of animals separated by some distance from other aggregations and having some coordination of activities (Lent 1965).

Groups of less than 50 animals were counted by individuals, while groups numbering in the hundreds were counted by tens and groups numbering in the thousands were counted by hundreds.

The spatial distribution of each group, or group formation, was recorded as closely-knit, scattered or linear.

Group activity was observed and recorded. Four major activities were noted: feeding, travelling, bedding and standing. When more than one activity was apparent in a group, the predominant activity was recorded.

Forest densities were derived from a rough estimate of canopy cover. Terrain types were characterized relative to the steepness and ruggedness of slopes. Snow conditions that were obvious from the aircraft were recorded (e.g. heavily drifted).

Following termination of field studies these data were compiled and analyzed. Checkpoints, trails, etc. were placed on composite 1:250,000 scale maps according to seasons or seasonal activities.

III. DESCRIPTION OF STUDY AREA

The area surveyed in 1972 was the same as that described for the 1971 study, "A Study of the Porcupine Caribou Herd, 1971" (Chapter I of this volume), in which detailed descriptions of the watersheds, terrain and vegetation over the entire study area are provided.

The study area included the entire Yukon Territory north of the 64th parallel and the Richardson Mountains and their eastern foothills in the Northwest Territories. A portion of Alaska near the international border was surveyed as well. The study area in the territories includes approximately 63,000 square miles.

Further detail concerning characteristics of particular portions of the study area as they are related to the seasonal distribution of caribou will be discussed in the following sections.

IV. RESULTS AND DISCUSSION:

A. Winter Distribution:

Survey flights during the 1971 program were concluded on 26 October. At this time a large segment of the herd was already south of the Ogilvie River in the vicinity of Chapman Lake. Caribou were also found in valley bottoms of the Ogilvie, Hart, Wind, and Blackstone rivers, and there was evidence of movements into higher mountain slopes.

The four-month period from November through February represents a gap in our knowledge of the winter distribution and movements of the herd. Aerial surveys begun in March 1972, however, often revealed where caribou had previously ranged during the winter, especially in low-lying, sheltered areas where wind did not obliterate sign. In a few instances old sign was found in tundra areas. Wind sweeping mountain slopes quickly obliterated sign of caribou activity.

Due to the remoteness of the southern extent of the winter range from the base at Old Crow and from the proposed pipeline routes, our surveys of the winter range were usually restricted to the area north of the 65th parallel. Therefore, of approximately 15,500 square miles of the range in the Ogilvie-Peel area, only 10,000 came under surveillance.

The following discussion of the winter range deals with the distribution of caribou from 7 March to 15 March 1972 in the Richardson Mountains and from 7 March to 6 May 1972 in the Porcupine and Peel drainages.

1. Geographic Description of the 1972 Winter Range:

The 1972 winter range of the Porcupine Herd was centred around the southern extent of the Peel River drainage. Map No. 1 illustrates the extent of this range.

For convenience of description, the range has been divided into three general areas. These areas are not independent, and interchange of animals between them probably occurs. They are as follows:

a. The Richardson Area:

This area includes the Richardson Mountains south of Rat Pass and the adjacent, eastern piedmont extending to the Peel River. The total area encompasses at least 3,500 square miles. More than half of this area is mountainous with easily accessible slopes. This section is for the most part above 2,000 ft. in elevation. It contains may small lakes and gently rolling hills.

b. The Eagle-Whitestone Area:

The Eagle-Whitestone area includes the southern reaches of the Eagle and Whitestone River drainages, a small segment of the Miner River drainage, and the small drainages flowing south into the Peel River. Less than 10 percent of the region is mountainous; the remainder is below 2,500 ft. in elevation, with gently rolling terrain. The area covers approximately 2,500 square miles.

c. The Ogilvie-Peel Area:

This area encompasses approximately 15,500 square miles. It includes the Tatonduk drainage and the area drained by the eastern flowing Peel River including the Ogilvie, Blackstone, Hart, Wind, Bonnet Plume and Snake river drainages as far south as latitude $64^{o}30'$.

Approximately 15 percent of this area is relatively flat terrain, below 2,000 ft. in elevation. The Ogilvie and Blackstone rivers drain two plateaus, one between 2,000 and 3,000 feet in elevation and the other between 3,000 and 4,000 ft. These are relatively flat and tundra-covered and are often referred to by bush pilots as the "prairies". They comprise about 10 percent of the Ogilvie-Peel area. The remaining area includes mountains, foothills and valleys of the Ogilvie and Wernecki mountain ranges which range in elevation up to approximately 8,000 ft. and in many cases are extremely rugged.

2. Distribution of Caribou on the Winter Range:

a. Population Estimates on the Winter Range:

Accurate estimates of caribou populations on the winter range are difficult to make, especially in forested areas or where winds obliterate caribou trails and feeding craters. Estimates made are based on numbers of animals sighted, amount and freshness of caribou activity sign, and numbers of caribou seen migrating out of these areas.

Approximately 20,000 caribou wintered in the Richardson area. During March and April an estimated 2,000 caribou wintered in the Eagle-Whitestone area. It is believed that at least 5,000 animals had moved south of this area in January and February, judging from the preponderance of old sign in relation to the number of animals observed. The Ogilvie-Peel area was used as winter range by the remainder of the herd, which totalled 40,000 to 60,000 animals.

In the Richardson area sign of heavy utilization existed on some slopes east of Palmer Lakes, Doll Creek and an unnamed creek north of its headwaters, Mountain Creek, Caribou River, Trail River, Road River, and Vittrekwa Rivers. A few caribou were observed lingering in these areas but only in the Caribou River area were substantial numbers

observed below timberline. The majority of the animals had moved to the higher wind-swept slopes of the Richardson Mountains where sign lasted only a short time. Between 9 and 25 March at least 9,500 animals were observed utilizing the latter habitat. Only 300 animals were observed below timberline, half of those on 25 February.

The Eagle-Whitestone area showed signs of heavy utilization. Ridges between Whitestone and Miner rivers and those west of Palmer Lakes were heavily used as were some ridges just north of the Ogilvie and Peel rivers. Much of this utilization must have taken place in early winter, the majority of animals having moved south into the Ogilvie-Peel area prior to March.

The Ogilvie-Peel area had abundant sign on the treed portion of slopes between the Ogilvie Mountains and the Peel River west of Hungry Lake. One of the areas of heaviest utilization was in the immediate vicinity of Hungry Lake and in the foothills to the south and southeast. Most of the animals that had utilized these two regions must also have moved further south earlier in the winter. Feeding craters and many animals were observed as well in the Wind-Bonnet Plume lowlands. The Noisy Creek drainage was heavily utilized and at least 1,000 animals remained in this area during March. Between 3,000 and 4,000 animals were observed throughout March and April on tops of the wind-scoured ridges of the Trevor range (Photo 1). Caribou sign was also observed in the major river valleys as far south as $64^{o}30'$ (Clint Jorgensen, Elmer DeBock, pers. comm.)

A total of 11,440 caribou sightings were made in March and April in the portion of the Ogilvie-Peel area surveyed, some of which were resightings. A rough extrapolation suggests a total population of approximately 20,000 for the area surveyed. If this number is reliable, it must be assumed that 30,000 to 40,000 animals wintered south of the 65th parallel. There is no doubt that many animals were in this area as large numbers of trails were found leading from it during the spring migration (Elmer DeBock, pers. comm.).

b. Factors Influencing Winter Distribution and Movements:

A comprehensive explanation of the winter distribution of caribou has not yet been made. The following are considered important factors:

i. Vegetation:

The winter range of the Porcupine Herd during 1971-1972 extended over a large variety of terrain types and their associated vegetation communities. Aerial surveys allowed only the distinction of forested and non-forested areas and the type and density of the former. Unforested areas were either barren (rock and rubble), alpine tundra (mountain slopes and ridge tops), or low tundra (usually valley bottoms).

Caribou in the Richardson Mountains area were primarily located in the alpine tundra community. Lichen growths and minimal snow depths made this area attractive winter range (Photos 2 and 3). Caribou activity sign was also evident in some of the forested river valleys in the mountains and along the eastern piedmont.

The Eagle-Whitestone area is dominated by open canopy black spruce (Picea mariana) forest. There are, however, large areas of deciduous forest, predominately birch (Betula papyrifera), on the central and western Eagle plains. The hills between the Miner and Whitestone rivers are covered with moderately dense, black spruce, with occasional open ridges, especially in the southwest. The preponderance of caribou activity in this area was in black spruce forest of medium density.

The Ogilvie-Peel area incorporates a full range of vegetation types. Alpine tundra of the Trevor, Illtyd and Knorr ranges and the Ogilvie and Wernecki mountains received utilization by caribou. Sparsely vegetated valleys of the Hart and Ogilvie rivers were used, as were more densely forested valleys of the Blackstone, Bonnet, Plume, Wind and Snake rivers.

In the course of aerial surveys over Eagle-Whitestone and Ogilvie-Peel winter ranges, type and density of vegetation and extent of utilization by caribou was recorded at one-minute intervals for the area immediately below the aircraft. The results are presented in Table 1.

Black spruce forest was the most common type of vegetation, comprising 81% of the total sample. The remainder of the sample was composed of burned black spruce forest, mixed-wood forest, and non-forested areas, forming 4%, 7% and 9% of the sample respectively.

Instances of utilization of all forest types and non-forested areas were recorded. Three density classes of black spruce forests - sparse, medium and dense - were recorded, based on a rough approximation of canopy cover. The sample of observations from dense black spruce forest is too small to allow conclusions concerning extent of its use.

An interesting difference was found in extent of utilization of sparse vs. medium density black spruce forest: sparse spruce forest was not used as frequently or as heavily as medium density forest (Photos 4 and 5). Of 284 samplings of medium density black spruce,

70% showed utilization by caribou, with 48% of these showing moderate or heavy utilization. Sparse black spruce on the other hand, was utilized in only 30% of the samplings (51 of 170 observations), and in only 15% of these cases was the use moderate or heavy.

In samples of burned areas and mixed-wood forests only light use was observed (21% and 11%, respectively). Treeless areas showed 14% utilization, but moderate and heavy use was occasionally observed in these cases.

The relationship between growth and availability of food items used by caribou and the type and density of forests has not yet been investigated. Knowledge gained in current studies of caribou food habits, combined with a knowledge of the associations of plant species, could provide the basis for an explanation of the winter distribution of caribou.

ii. Terrain:

Caribou are capable of traversing all but the most rugged landforms. The type of terrain influences the type of vegetation, snow conditions and weather of a particular area.

Caribou using the Richardson Mountains take advantage of lichen growths on windblown slopes and ridge tops. It is possible that animals in the mountains move to take advantage of thermal inversions.

Table 1: Extent of utilization by caribou of various forest types and densities during the winter, 1971 - 1972.

VEGETATION TYPE	DENSITY	APPROXIMATED RANGE OF CANOPY COVER	EXTENT OF UTILIZATION				
			NIL	LIGHT	MODERATE	HEAVY	TOTAL
Black spruce forest	Sparse	<15%	119	25	19	7	170
Black spruce forest	Medium	15%-75%	86	61	81	56	284
Black spruce forest	Dense	>75%	2	0	5	1	8
Burned black spruce	All		19	5	0	0	24
Mixed (deciduous and coniferous)	All		34	4	0	0	38
No visible vegetation		0	42	2	3	2	49

Caribou in the Eagle-Whitestone and Ogilvie-Peel areas were found in virtually every available type of terrain. Table 2 shows the number of groups and individuals found in four general types of terrain in these areas.

Most caribou were observed in gently rolling and rolling terrain, which comprises most of the area described. As a rule, these types of terrain support a medium-density black spruce-lichen community, generally favored by caribou for feeding.

Utilization of flat areas was often observed around lakes, where growth of sedges may compensate for lack of lichen. Caribou were also observed in mountainous terrain of the Ogilvie and Wernecki ranges, although the heaviest utilization was centered around river valleys.

iii. Snow Conditions:

Measurements of snow depth and caribou track depth were made on winter range in conjunction with the "cutline deflection" studies. For comparison, measurements of snow depth were made north of the area used as winter range, including a number of sites along the interior pipeline route alternative. Location of sampling areas is shown on Map 2.

Winter Range

Snow depth and track depth measurements for areas within winter range are presented in Table 3.

Considerable variation within sampling areas is apparent in the data. This variation is related in part to the amount of wind action at sampling sites. Snow depths on lake ice or on windblown ridges were less than depths in forested areas.

Table 2: Numbers of caribou and caribou groups observed in four general terrain types in the Eagle-Whitestone and Ogilvie-Peel portions of winter range; March and April, 1972.

TERRAIN TYPE	NUMBER OF GROUPS OBSERVED	NUMBER OF ANIMALS OBSERVED	NUMBER OF ANIMALS/GROUP
Flat	23	285	12.4
Gently rolling	74	2752	37.2
Rolling	85	5121	60.3
Mountainous	17	1421	83.6

Table 3: Snow depth and track depth measurements in various localities on the 1972 winter range of the Porcupine Caribou Herd. (March, 1972).

VEGETATION	DENSITY	SNOW DEPTH (INCHES) MEAN	SNOW DEPTH (INCHES) RANGE	CARIBOU TRACK DEPTHS (INS.) MEAN	CARIBOU TRACK DEPTHS (INS.) RANGE
		CARIBOU RIVER			
Black spruce	Sparse	25.6	22-32	13.6	10-19
Black spruce	Sparse	26.0	24-29	-	-
Black spruce	Sparse to Medium	25.2	22-28	-	-
Black spruce	Sparse to Medium	25.6	22-28	16.0	15-17
Black spruce	Sparse to Medium	32.4	26-44	16.8	15-21
Black spruce	Sparse to Medium	32.0	30-34	18.0	16-20
		RICHARDSON MOUNTAINS			
Alpine tundra		22.0	15-25	5.6	0-15
Alpine tundra		19.8	17-23	14.8	11-21
Alpine tundra		19.8	17-25	5.8	3-10
Alpine tundra		30.2	13-46	7.4	4-10
Alpine tundra		12.0	8-25	2.9	2-4
Alpine tundra		10.4	7-16	3.4	2-7
Alpine tundra		16.2	13-19	1.9	0-3
Alpine tundra		9.6	5-13	1.0	0-3
Alpine tundra		11.6	7-19	8.1	6-9.5
Alpine tundra		11.8	6-17	4.0	2-5
Alpine tundra		2.3	1-5	1.1	.5-1.5
Alpine tundra		6.7	2.5-10	2.3	1-2.5
Alpine tundra		8.6	5.5-10	4.8	2-5
Alpine tundra		8.0	7-14	4.0	3-5

Table 3: continued.

VEGETATION	DENSITY	SNOW DEPTH (INCHES) MEAN	SNOW DEPTH (INCHES) RANGE	CARIBOU TRACK DEPTHS (INS.) MEAN	CARIBOU TRACK DEPTHS (INS.) RANGE
	SNAKE, WIND AND BONNET PLUME RIVERS				
Lake ice		21.2	21-22	12.0	11-13
Lake ice		23.8	22-26	12.4	8-16
Lake ice		25.6	24-27	14.8	14-17
Black spruce	Sparse to Medium	29.0	26-34	17.2	15-19
Black spruce	Sparse to Medium	15.2	9-19	7.4	5-13
Black spruce	Medium	29.6	25-32	17.6	15-22
Black spruce	Medium	29.2	26-32	18.4	16-21
Black spruce	Medium to Dense	27.6	25-31	16.2	13-18
	PEEL RIVER				
Lake ice		17.4	17-18	11.8	10-14
Lake ice		17.6	17-19	11.0	10-12
Black spruce	Sparse	31.6	29-34	24.0	21-28
Black spruce	Sparse to Medium	27.4	22-31	18.4	17-23
Black spruce	Sparse to Medium	27.2	23-30	15.0	12-19
Black spruce	Medium	31.8	30-33	19.2	17-22
Black spruce	Medium	26.6	25-28	17.6	17-18
Black spruce	Medium	26.0	24-28	18.4	17-20
Black spruce	Medium	29.4	26-33	19.2	18-21
Black spruce & Birch	Medium	29.6	28-30	20.2	14-23
Black spruce & Birch	Medium	30.0	28-33	21.4	19-26

As a result, snow depths in the Richardson Mountains were generally less than at the other sampling areas. Mean depths at sites in this area varied between 2.3 in. (ridge top) and 30.2 in. (valley bottom).

A comparison of sites in the remaining sample areas reveals little difference in snow depths under similar shelter conditions. Mean snow depth in forested areas was about 28 in. The mean depths in forested areas samples were: 27.8 in. in the Caribou River area, 26.1 in. in the Snake, Wind, Bonnet Plume area and 28.8 in. in both the Peel and Miner-Whitestone areas.

Track depths were least in the Richardson Mountains sampling area, a function of both shallow snow and wind-packing. Mean track depths in this area varied between 1.0 in. (ridge top) and 14.8 in. The overall mean track depth from all sites in this area was 4.8 in.

Track depths in forested areas were generally around 17 in. The mean track depths in the sampling areas were: 16.1 in. in the Caribou River area, 15.4 in. in the Snake, Wind and Bonnet Plume area, 19.3 in. in the Peel River area and 18.1 in. in the Whitestone River area.

Outside Winter Range:

Snow depths measured in areas outside the winter range are presented in Table 4.

Mean snow depths measured at four sample sites in the Bell River area ranged from 24.4 to 29.6 in. The overall mean depth was 28.1 in.

Table 4: Snow depths, measured at various localities outside of the 1972 winter range of the Porcupine Caribou Herd. (March, 1972).

VEGETATION	DENSITY	SNOW DEPTH (INCHES) MEAN	RANGE
	BELL RIVER		
Black spruce	Sparse	29.2	26-34
Black spruce	Sparse to Medium	29.6	25-30
Black spruce	Medium	24.4	24-28
Black spruce	Medium	28.4	26-30
	WITHIN TWENTY MILES OF OLD CROW VILLAGE		
Black spruce	Sparse	25.8	15-33
Black spruce	Sparse to Medium	29.2	26-32
Black spruce	Medium	27.8	25-30
Black spruce	Medium	31.0	29-33
Black spruce	Medium	28.6	21-30
	OLD CROW FLATS		
Lake ice		10.0	7-13
Barren		24.8	18-34
Barren		12.0	11-13
Barren		9.6	7-13
Black spruce	Sparse	25.8	20-30
Black spruce	Sparse	22.2	21-23
Black spruce	Sparse	19.2	11-28
Black spruce	Sparse to Medium	28.6	22-33
Black spruce	Sparse to Medium	27.4	26-30
Black spruce	Medium to Dense	25.8	23-30
Black spruce	Medium to Dense	27.4	25-29
Black spruce	Medium to Dense	27.2	26-29

Snow depths measured in the Old Crow area were slightly greater, with means from 5 sample sites ranging from 25.8 to 31.0 in. The overall mean depth in this area was 28.2 in.

Due to increased exposure to winds, the Old Crow Flats had snow depths somewhat less than surrounding areas. Mean depths from 12 sites ranged from 9.6 in. to 28.6 in. The overall mean depth in this area was 21.8 in. A small group of caribou was found wintering on the Old Crow Flats. These caribou were chipping through hard-drifted snow along a lake shore and feeding largely on sedges.

In terms of snow depths, the Richardson Mountains had the most attractive snow conditions for wintering caribou. The depths measured were approximately half those measured in other areas, as were track depths. Due to these conditions, movement would be much easier, and this might explain the earlier migration into the mountains. Apparent winter shifts from low-lying areas to more mountainous terrain may be attributed in part to more favourable snow conditions.

On ridges that are windswept, drifts of varying depths developed at timberline. In late winter these drifts form a fairly narrow band on the side of ridges which is deep enough to prevent feeding. Feeding can take place above and below this band; thus the drifts create a kind of enclosure, the effects of which were particularly obvious during summer in the southern Richardson Mountains. Since Cladonia lichens have been observed in the region of the timberline, it is likely that during early winter these enclosed areas are popular for feeding.

A comparison of snow depths within and outside of the winter range does not yield differences sufficient to explain winter distribution.

iv. Meteorological Conditions:

Data concerning meteorological conditions were obtained from the Meteorological Branch, Department of Transport, Canada, for two climatological stations, Parkin ($66^{o}14'N$, $137^{o}17'W$) and Old Crow.

Comparisons of temperature and wind conditions were made between Parkin and Old Crow. The former location was considered within winter range, and the latter outside of it.

Temperature:

Mean maximum, mean minimum and mean monthly temperatures for both locations for the months of November through May are presented in Table 5. Graphical representation of daily temperature variations are found in Figure 1.

The following points are raised in the comparison of temperature:

a. Warm and cold periods at Parkin and Old Crow are generally synchronous. The first extremely cold period of the winter occurred from 8 to 15 December. Practically the entire month of January (8 - 26) was cold. Cold spells of lesser duration occurred on 16 to 21 February and 7 to 12 March. Minimum daily temperatures during these periods approached -50^{o} F, especially at Old Crow. Warm periods occurred from 17 to 19 December, 25 December to 1 January, 27 January to 2 February, and 24, 25 February. Temperatures during these warm periods reached highs of around 20^{o} F at Parkin and slightly lower at Old Crow. At no time between the end of October and the end of March were thawing temperatures recorded.

Table 5: Mean maximum, mean minimum and mean monthly temperatures (°F) from Old Crow and Parkin base: November, 1971 through May, 1972.

	PARKIN			OLD CROW		
	MEAN MAX.	MEAN MIN.	MEAN	MEAN MAX.	MEAN MIN.	MEAN
November	-2.2	-13.1	-7.7	-3.3	-19.3	-11.3
December	-6.4	-22.8	-14.6	-11.7	-28.2	-20.0
January	-10.2	-26.3	-18.3	-20.4	-40.0	-30.2
February	-14.8	-27.8	-21.3	-20.3	-31.3	-25.8
March	3.7	-14.3	-11.5	-4.2	-28.3	-16.3
April	21.2	1.4	11.3	16.4	-10.6	3.2

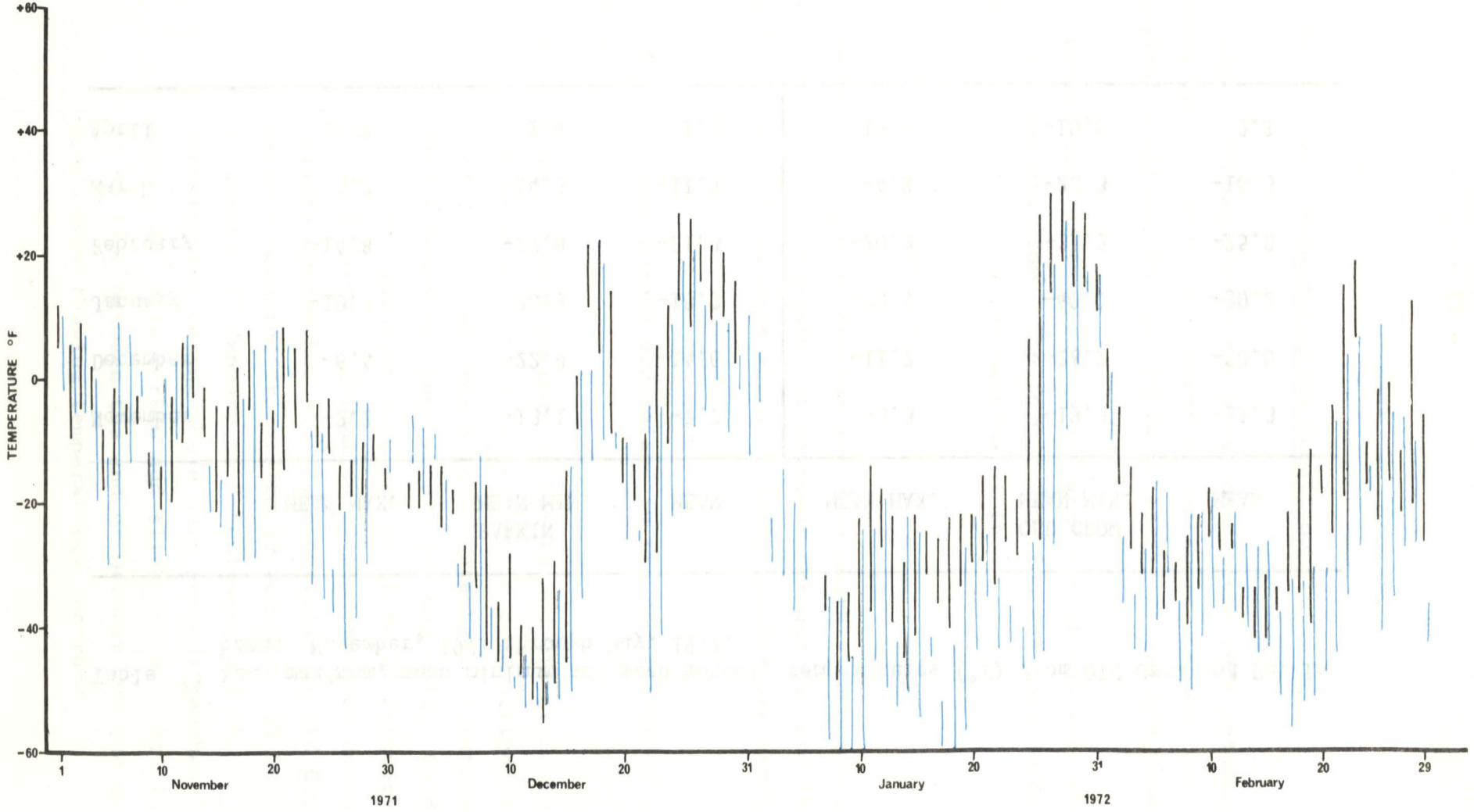


Figure 1A

PARKIN and OLD CROW Maximum-Minimum Temperatures

Parkin | Old Crow

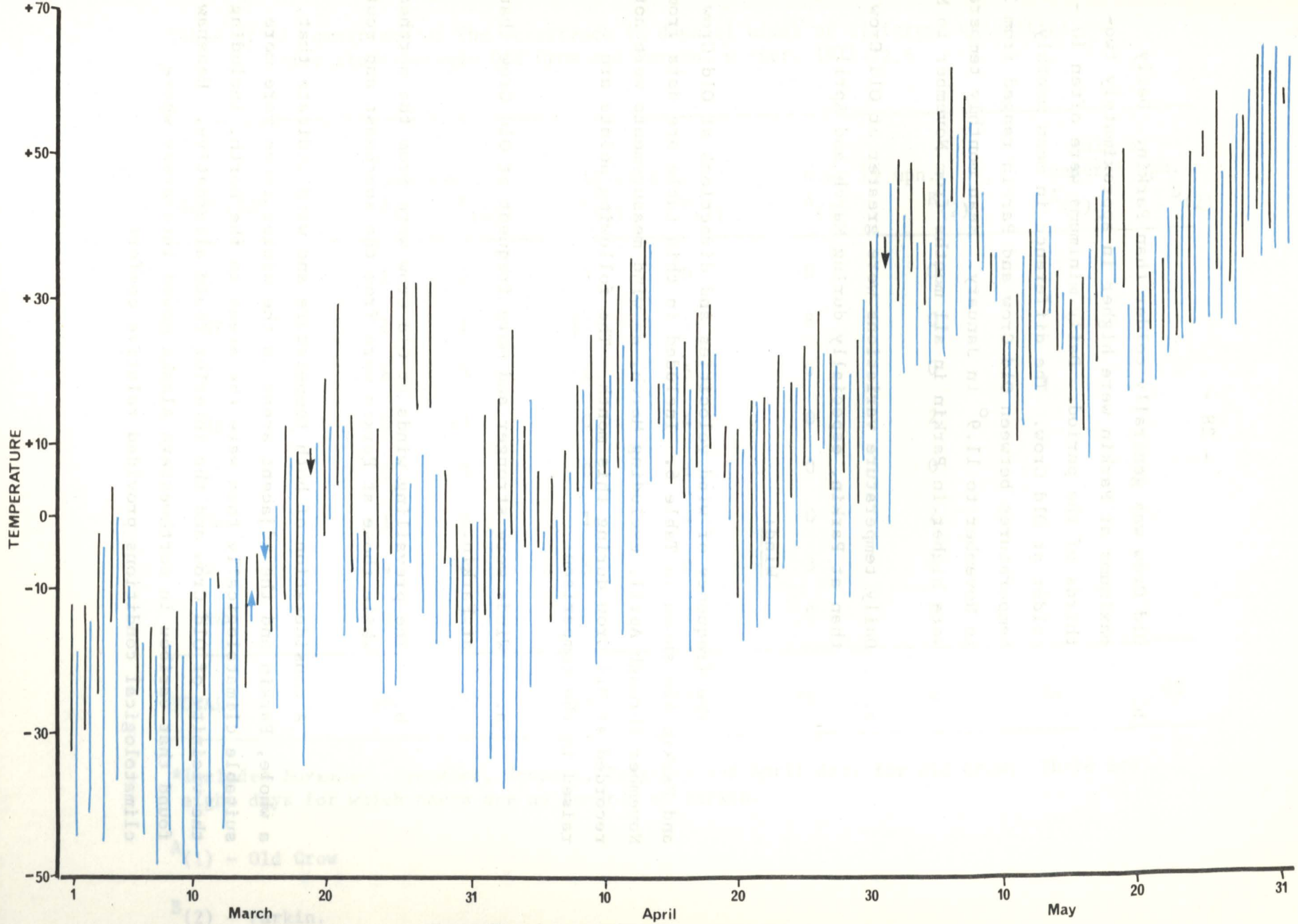


Figure 1B
PARKIN and OLD CROW Maximum - Minimum Temperatures, 1972

b. Old Crow was generally colder than Parkin. Daily maximums at Parkin were higher in approximately two-thirds of the period. Daily minimums were often 10 - 15° colder at Old Crow. The difference in mean monthly temperatures between Old Crow and Parkin ranged from 3.6° F in November to 11.9° in January. Mean monthly temperatures were higher in Parkin in all months from November to May.

c. Daily temperature variations were greater at Old Crow than at Parkin, especially during March and April.

Wind:

The frequency of wind velocities and directions at Old Crow and Parkin are shown in Table 6. Included in this table are data from November through April, excluding March, as wind measurements were not recorded at Old Crow during this month. The following points are raised in the comparison:

a. Winds were stronger and more frequent at Old Crow than at Parkin.

b. The prevailing winds at Old Crow were from the northeast, while those at Parkin were from the southeast and southwest.

A consideration of both temperature and wind indicate that, as a whole, Parkin and the adjacent areas in the winter range were more suitable climatologically than were the areas to the north, including the vicinity of Old Crow and the interior route alternative. Henshaw (1968) found that caribou in northwestern Alaska moved into areas where climatological conditions provided relative comfort.

Table 6: A comparison of the occurrence in days of winds of different velocities and directions between Old Crow and Parkin, winter, 1971-72.*

DIRECTION	5-9 mph.		10-49 mph.		over 19 mph.		calm or under 5 mph.	
	$A_{(1)}$	$B_{(2)}$	$A_{(1)}$	$B_{(2)}$	$A_{(1)}$	$B_{(2)}$	$A_{(1)}$	$B_{(2)}$
N	1	0	3	0	0	0		
NE	11	1	13	1	8	0		
E	6	3	1	5	0	0		
SE	0	13	0	4	0	2		
S	0	0	0	1	0	0		
SW	1	9	1	4	0	2		
W	9	0	5	0	3	0		
NW	0	1	1	2	0	0		
TOTALS	28	27	24	17	11	4	88	95

*Includes November, December, January, February and April data for Old Crow. There are eight days for which there are no records at Parkin.

$A_{(1)}$ - Old Crow

$B_{(2)}$ - Parkin.

Warmer temperatures at Parkin are probably due in part to an inversion effect. Parkin, as well as much of the surrounding area, is approximately 1,000 ft. higher than Old Crow. The flat land south of Old Crow and the basin to the north containing the Old Crow Flats are similar in elevation to Old Crow. Thus much of the area near Old Crow probably has a similar temperature regime.

Most of the area inside the major bend of the Porcupine River offers the advantages of temperature inversion and forest for protection from wind. This area includes the Keele Range, where caribou are known to winter. This winter distribution has been reported by Old Crow hunters and by Munro (1953) during his surveys of March, 1953.

Surveys of the wintering areas during the past two years found the majority of caribou at elevations above 1,500 ft.

In addition, winds probably affect caribou distribution, by altering snow conditions and influencing temperature. Winds with a northerly component involve air masses from the Arctic Ocean and are invariably colder than south winds. Strong west winds bring the warmest temperatures at Old Crow as do southwest winds to Parkin.

Old Crow commonly receives strong northeasterly winds, often accompanied by extremely cold temperatures, whereas when low temperatures are recorded at Parkin wind velocity is usually below 5 m.p.h. Thus wind-chill is more extreme in the Old Crow area than the Parkin area.

In summary, temperature and wind affect winter dispersion and behavior of caribou at least in their local movements within the winter range. It seems reasonable to assume that the more favorable climate of the winter range areas is a factor in their selection of the Parkin area over the Old Crow area for winter range purposes.

3. Group Size:

Data concerning caribou group sizes have been collected during two late winter periods, from 2 April to 13 May 1971 and 7 March to 6 May 1972. As animals in the Richardson Mountains area began migrating as early as 15 March, data on group sizes after this time were included with spring migration data and excluded from this section. Only a few animals were found in the Richardson Mountains in 1971 prior to the spring migration.

Caribou observed in the Richardson Mountains prior to 15 March were in comparatively small groups ranging from 3 to 400 animals and averaging 49 animals per group. Groups in the Eagle-Whitestone and Ogilvie-Peel area were found to range in size from single animals to thousands of animals during both 1971 and 1972.

Figure 2 illustrates relative abundance of groups of various sizes during these years. A similar distribution of group size was observed in both 1971 and 1972. Groups of 10 to 49 animals were the most frequent of all group sizes, comprising 35% of the sample in 1971 and 39% in 1972.

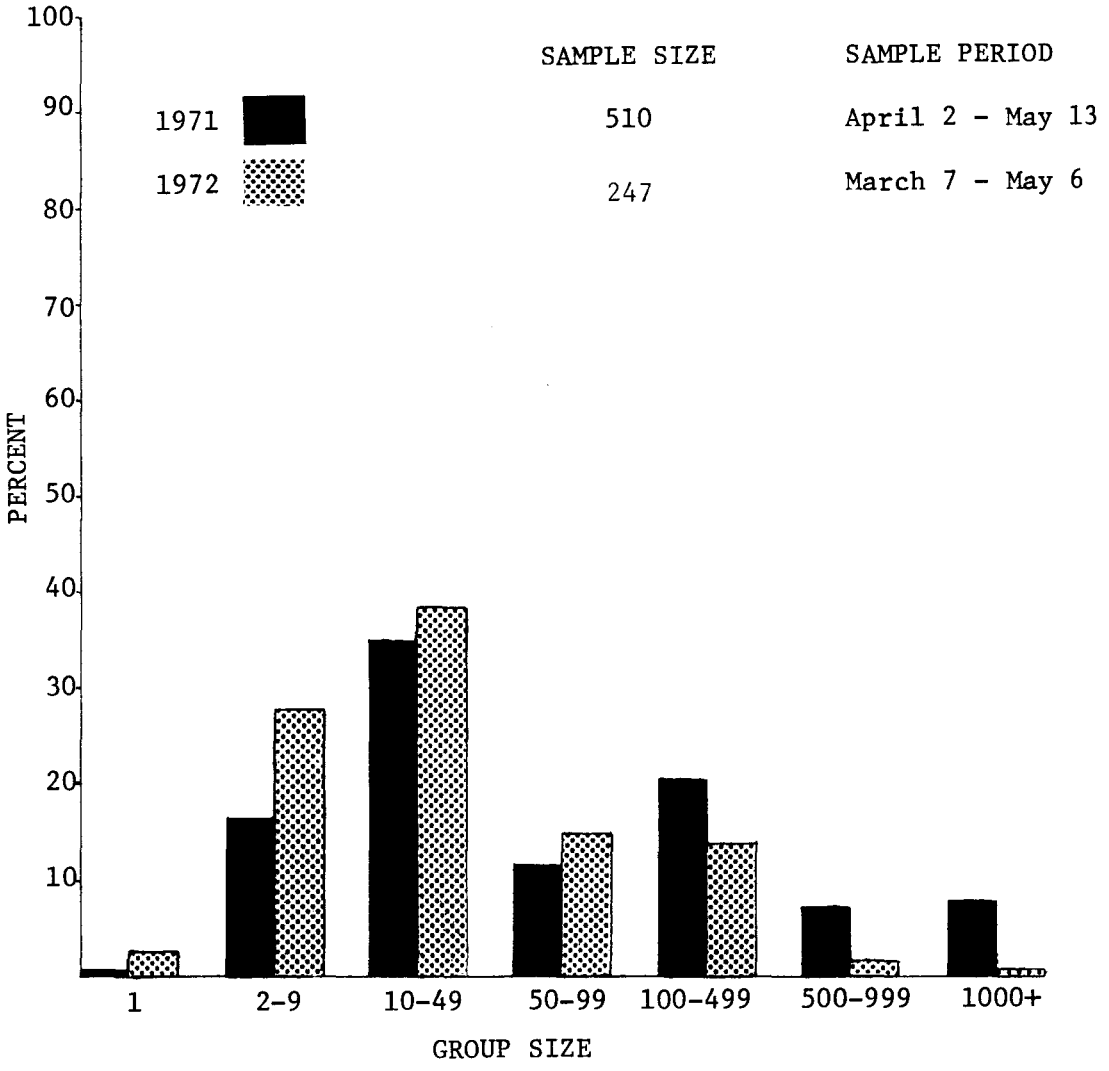


Figure 2: Frequency of observation of groups in various size ranges; winters, 1971 and 1972.

The most striking difference between the two years is a general trend toward larger group sizes in the late winter of 1971.

Groups in the smaller size ranges (1-100 animals) were more frequently observed in 1972 than in 1971. Groups in the larger size ranges (100-1000+) were more frequently observed in 1971. An explanation of this difference is difficult. It is possible that flights conducted in 1972 were concentrated over the northern periphery of the range, where only the smaller groups were found, whereas in 1971 the area surveyed was more heavily populated and hence groups observed tended to be larger. On the other hand, it may be that aggregations became larger prior to spring migration in 1971 (discussed in Spring Migration section) but not in 1972.

A correlation between group size and habitat type was noted. More open or more mountainous habitat was generally occupied by larger groups than those found in forested areas. Table 2 shows that groups in flat areas had a mean size of 12 animals per group; in gently rolling areas, 37; in rolling areas, 60; and in mountainous areas, 84 animals per group. It is possible that group size was underestimated in forested areas where visibility was poor. Nevertheless the data concur with the general impressions of observers in the field.

4. Comparison and Contrast of Winter Ranges, 1970-71 and 1971-72:

The winter ranges of the Porcupine Herd during the past two winters are included in Maps 1 and 3.

a. Similarities Between Years Include:

1. The majority of the Porcupine Herd wintered in the Yukon.

2. Very few animals utilized any of the range north of 66°30'N in the Yukon.

3. The use of the open ridgetops of the Trevor Range appeared very heavy.

4. The entire Peel Plateau was utilized.

5. Major river valleys of the southern Ogilvie Mountains were used.

b. Differences Between Years Include:

1. In 1971-72 the ridges between the Miner and Whitestone rivers were only utilized early in the season (prior to 1 February), whereas in 1970-71 they were used until the spring migration.

2. In 1971-72 approximately 20,000 caribou wintered in the Richardson Mountains, whereas in 1970-71 only about 2,500 caribou wintered there.

3. The Knorr Range contained 10,000-15,000 caribou in April 1971, whereas in April 1972 very few were observed there.

4. In April 1971 several large, relatively stationary, aggregations were observed throughout the winter range, however in April 1972, with the exception of groups in the Richardson Mountains and Trevor Range, the herd remained in smaller, more dispersed groups. In April 1971, 19 sightings of groups exceeding 1,000 caribou were made, compared to 3 in April 1972.

5. In April 1972, the majority of the Porcupine Herd was south of the 65th parallel, whereas in 1971 the majority was north of latitude 65°30'N. This area, however, was used heavily earlier in the winter of 1971-72.

6. Only a few thousand animals wintered in the Tatonduk River and south in 1972, compared to 10,000-12,000 in 1971.

c. Comparison of Winter Distribution Observed to that Prior to 1971:

Munro (1953) described the winter range for 1952-53 as being within the main bend of the Porcupine River from its headwaters to the highest ridges of the Keele Range and across the international boundary at least as far west as Black River. He also found tracks in headwaters of Ogilvie River, but considered this to be separate range. Evidently Munro concluded that animals inhabiting the latter area were part of the Steese-Fortymile Herd as he mentions them only once. Skoog (1956) considered the headwaters of the Ogilvie and Tatonduk Rivers to be both summer and winter range of the Steese-Fortymile Herd.

Animals from the Tatonduk area moved north, past Old Crow, during spring migrations of both 1971 and 1972. Two explanations can be postulated for this phenomenon. One explanation is a population shift of animals from the Steese-Fortymile Herd to the Porcupine Herd. The second possible explanation is that no shift of animals from one herd to the other occurred, but the Steese-Fortymile Herd's home range retracted from the Ogilvie-Tatonduk area and the range of the Porcupine Herd expanded into this area.

The first explanation is more likely, considering the frequency of population shifts of the various Alaskan herds over the last hundred years (described by Skoog, 1968). Skoog stated that the Porcupine Herd experienced an immigration of animals from the Steese-Fortymile Herd some time between 1957 and 1964.

B. Spring Migration:

Aerial surveys were conducted throughout spring migration of the herd. The major emphasis of the program was to delineate migration routes, study timing and progress of the migration, and make comparisons of routes used with those used in 1971. Secondary emphasis was placed on the responses of the caribou to variations in the habitat (i.e. changing snow conditions, terrain, etc.). Records of the sizes of aggregations are presented here.

The spring migration of 1972 included two waves of movement up the Richardson Mountains and a central movement along the Old Crow Route. These routes are illustrated in Map 1.

1. Initiation of the Migration:

The stimuli that lead to initiation of spring migration are very poorly understood. The problem may be complicated by the interdependence of a number of stimuli or the specificity of stimuli to different years, localities, or populations. Hopefully, further research in this area will be able to provide a fairly accurate method for predicting the time of initiation of migration.

Our observations suggest that the migration is probably triggered by snow conditions allowing movement. Animals wintering in the Richardson Mountains began migrating as early as 15 March. Snow conditions in the mountains at this time, with the possible exception of narrow strips of deep soft snow in valley bottoms, were not prohibitive to movement.

Animals migrating along the Old Crow Route did not begin the migration until snow depths had diminished to almost half their original

depth (the first week in May). Figure 1 shows the sharp rise in temperature causing this change in snow conditions.

Pruitt (1959) interprets initiation of the migration as a response to supposedly unfavorable snow conditions such as increased hardness and density of snow caused by increased solar radiation on the winter range. Caribou were thought to move toward lighter and softer snow.

2. Migration Routes:

Spring migration in 1972 as in 1971 occurred along two general migration routes: the Richardson Mountains Route and the central Yukon or Old Crow Route. Movements occurred through the Richardson Mountains in two waves, six weeks apart. Map 1 is a map of the migration routes.

a. Richardson Mountains Route - First Wave:

The first wave of migration along the Richardson Mountains route, initiated 15 March, was comprised of 20,000 animals that had wintered north of the Peel River. Prior to 15 March the majority of caribou which had wintered in the Richardson area ranged at intermediate elevations in the southern extent of these mountains. As they moved into higher elevations, larger aggregations began to form. On 21 March an aggregation of 8,400 was observed near the southernmost headwaters of Rock River.

The most frequently used course of migration was the height of land which forms the central north-south axis of the narrow 120-mile

southward extension of Richardson Mountains. During March and early April the majority of animals stayed very close to this axis (Photo 6 illustrates part of this route). As the days grew warmer snow on the western slopes melted and the migration route shifted slightly to the west, probably in response to more attractive feeding conditions.

Upon crossing the westward flowing Rat River the caribou turned northeast, avoiding the highest, most rugged terrain. They approached McDougall Pass in the region of Symmetry Mountain, where they were held up probably by the deep, loose snow in the bottom of the pass. They then turned eastward and aggregated on a mountain slope directly south of a large unnamed crescent-shaped lake at longitude 136°04'W. From this point, groups sporadically crossed the pass, many crossing the ice of the lake. From the lake they moved northwesterly into Bear Creek and continued north into Cache Creek and Fish River valleys. Upon reaching the northern Richardson Mountains, large groups dispersed and stalled to graze in the Cache Creek, Fish and Rapid River drainages throughout April.

By 2 May temperatures had risen considerably and the snow had settled, once again allowing greater freedom of movement. Thereafter, animals encountering the Rat Pass crossed it throughout its length. At the same time the vanguard movement crossing the Blow River passed into the northern slopes of the Barn Range. As the season progressed a snow-free corridor developed on the Arctic Plateau (the transitional elevations between the Arctic Coastal Plain and the Barn and British Mountains). By mid-May more than 1,000 caribou were scattered between the Trail and Firth rivers on the north slope.

The progress of the vanguard of the first wave of migration can be summarized as follows:

March 24 -- divide between Stony Creek and western Rat River (Chute Pass).

March 31 -- Barrier River.

April 15 -- Head of Cache Creek (N. Richardson Mountains).

May 2 -- Blow River.

May 11 -- Trout Lake.

May 16 -- Firth River.

May 26 -- Alaska border (very few).

b. Richardson Mountains Route - Second Wave:

After the arrival of thawing temperatures on 30 April, the snow began to melt rapidly and settle, and animals which had been stalled south of the Peel River began moving. Those that were stalled in the Trevor Range, Wind and Bonnet Plume rivers and the hills just south of the Peel River and west of the Wind River began moving north. They either entered the southern Richardsons or stayed on their western slopes, depending on their initial position. The animals that travelled up the west side of Doll Creek crossed to the western slopes of the Richardsons at a gorge just north of the headwaters of Doll Creek. They then continued north on the western slopes. Caribou which had travelled through the mountains east of Doll Creek crossed to the western slopes at the first topographically favorable location between latitudes $66^{o}28'$ and $66^{o}30'$. Thus in the second migratory wave along the Richardson Route very few animals actually travelled in the mountains. Instead they utilized the lower western slopes and piedmont of the southern Richardsons.

A major portion of these animals stayed on the immediate slopes while another portion took a northwesterly course across the Eagle River through the complex of lakes in the Whitefish Lake area on the northern Eagle Plains. From here they went due north, crossing

the Bell River on a wide front, and across the western extent of the Richardson Mountains into the eastern Berry Creek and Driftwood River drainages.

Animals which had stayed on the western slopes followed the western Rat River to Lapierre House, crossing the Bell River in this vicinity and continuing north up the Waters River valley to cross into Driftwood Valley. From the Driftwood area they moved northwest to the vicinity of Bonnet Lake and on to the Barn Range, the cows continuing to the calving area and the non-breeders apparently drifting very slowly northwest through the mountains south of the calving area.

An accurate estimate of the total number of animals involved in the second wave of migration was difficult to make because of the degree of dispersal. It is estimated that this movement included 15,000 animals.

The progress of the vanguard of the second wave of migration can be summarized as follows:

May 4 -- Trevor Range and Deception Lake.

May 7 -- Western Slope of Richardson Mountains ($66^{o}45'$N latitude).

May 17 -- Bell River - Lapierre House, etc.

May 21 -- Headwaters of the Driftwood River.

May 27 -- Crow River on the North Slope.

Stragglers (mostly mature bulls) from the second wave of movement were seen in the vicinity of Lapierre House as late as 5 June. This reflects the amount of dispersal of the migrating herd as well as the length of time of the migration period.

The first intersection of the Richardson and Old Crow routes was observed in the Driftwood River area, where animals using the Richardson Route were joined by a few animals from the Old Crow Route which had crossed the Porcupine River near its junction with Berry Creek.

c. Old Crow Route:

Approximately 50,000 caribou used the Old Crow Route. About 90 percent of the caribou that used this route during the 1972 spring migration had spent the late winter between Hungry Lake and Tatonduk River and up to 80 miles south of a line drawn between these. Because of a late thaw there were few animals observed moving north until the first week of May, when the first major movement occurred along the Whitestone River (Photo 7).

Migration along the Old Crow Route was not restricted to as narrow a route as that of 1971. There was no large area between the Richardson Route and the Alaska border that was not traversed in the northward migration from the winter range; however, one narrow course was the most popular. This included both banks of the Whitestone River, the lower Cody Creek area, the ridges between Cody, Burnthill, and Pine Creeks, Whitesnow Mountain and the next ridge west of it, into the lowlands including most ridges extending north between the headwaters of Johnson Creek and Lone Mountain.

Caribou continued northward across the lowlands and forded the river at various points: Cadzow Lake, Dave Lord Creek and four miles below it (Goose Camp), Caribou Lookout, Crow Point (1 mile east of Old Crow), "first bend" (west of Old Crow), "10 mile bluff" (west of Old Crow) and Fish Camp. From 5 - 10 percent of the animals crossed the river at various places between the above points. A ground crew counted 14,000 caribou crossing the river at Caribou Lookout.

Caribou that did not use the route described travelled on either side of it, crossing the Porcupine River at different points. Animals migrating from Johnson Creek to Porcupine River crossed the river near Berry Creek; animals moving north through the western Ogilvie Mountains from the Ogilvie and Tatonduk river areas crossed Porcupine River from Fish Camp to as far west as Old Ramparts.

Once north of the Porcupine River, animals crossed the Old Crow Flats in a wide front. Those nearest the Driftwood Mountains tended eastward, apparently to take advantage of drier, firmer ground. Many caribou which had crossed the Porcupine River at "Caribou Lookout" travelled along the ridgetop of Schaeffer Mountain (Photo 8) and crossed the central portion of the Flats. Others, perhaps 15,000, used the Old Crow Range and travelled west and then northwest to avoid the Old Crow Flats entirely, entering Alaska in the same region as the interior alternative pipeline route.

Upon reaching the British Mountains the cows from the Old Crow Route continued on to the coastal plain, moving onto it anywhere from Firth River west into Alaska. Males and some barren females wandered throughout the British Mountains without immediately entering the coastal plain. These animals slowly worked their way west into Alaska during calving period.

Progress of the vanguard movement over the Old Crow Route was as follows:

May 4 -- Whitestone River near 65^{o} latitude.
May 7 -- Chance Creek.
May 10 -- Whitesnow Mountain.
May 12 -- Junction of Lord Creek and Porcupine River.
May 19 -- Leaving the north end of Schaeffer Mountain.
May 25 -- North side of Old Crow Flats.
May 28 -- Head of Malcolm River near Alaska border.

3. Dye Marking Program (C.W.S.):

The Canadian Wildlife Service conducted a dye marking program on animals from different parts of the 1972 winter range. Data obtained from this program corroborate previous conclusions concerning the movement of animals from different areas on the winter range along different migration routes.

Thirty-two caribou were dyed black in the headwaters of the Blackstone and Ogilvie rivers. One of the caribou was observed on Old Crow Mountain.

Thirty-five caribou were dyed green in the head of the Hart River. Caribou dyed this color were observed west of Old Crow at "Fish Camp" and two miles west from the townsite. A subsequent observation was made of green dyed caribou at the mouth of the Firth River.

Twenty-four animals wintering on Trevor Range were dyed red. One of these animals was observed near Trout Lake.

Caribou dyed yellow in the southern Richardsons near Trail River were observed in the headwaters of the Trail River (Buckland Mountains) and at the mouth of the Firth River.

4. Group Size:

The formation of larger aggregations prior to spring migration was described in the 1971 report. Similarily, animals in the Richardson Mountains in 1972 were found to form large aggregations, often numbering in the thousands, just prior to migration. This aggregation behavior was not as pronounced prior to migration along the Old Crow Route during 1972. A large aggregation was seen, however, along the west bank of Whitestone River.

The large aggregations which had formed in the southern Richardson Mountains dispersed when the animals reached the northern Richardson Mountains.

Figure 3 illustrates the frequency of observation of groups in various size ranges from both 1972 and 1971. A similar distribution was noted in both years. Groups in the size ranges 2 - 9 animals and 10 - 49 animals were most frequently observed.

A slight shift towards larger aggregations during 1972 is apparent from the graph. This is probably a reflection of the intensity and duration of surveys in the Richardson Mountains, where groups were somewhat larger.

Two environmental factors almost surely influence the size of aggregations during migrations. The first is snow conditions. Animals reaching a barrier imposed by particularly unfavorable snow conditions will become stalled until the conditions improve. While stalled, they are joined by other groups, and larger aggregations tend to form. Secondly, the preference of caribou for moving along particular terrain types (lakes, open ridges, rivers, etc.) creates a funnelling effect which inevitably results in the amalgamation of groups or formation of larger aggregations.

5. Comparison of Spring Migrations of 1971 and 1972 to Earlier Migrations:

Spring migrations during the past two years were similar with regard to the routes used. In both years, two waves of movement occurred up the Richardson Mountains and one up the central Yukon along the Old Crow Route. Considerable variation occurred with regard to timing of movements and detail of movement within these general migration routes. Maps 1 and 3 include spring migration routes for 1971 and 1972.

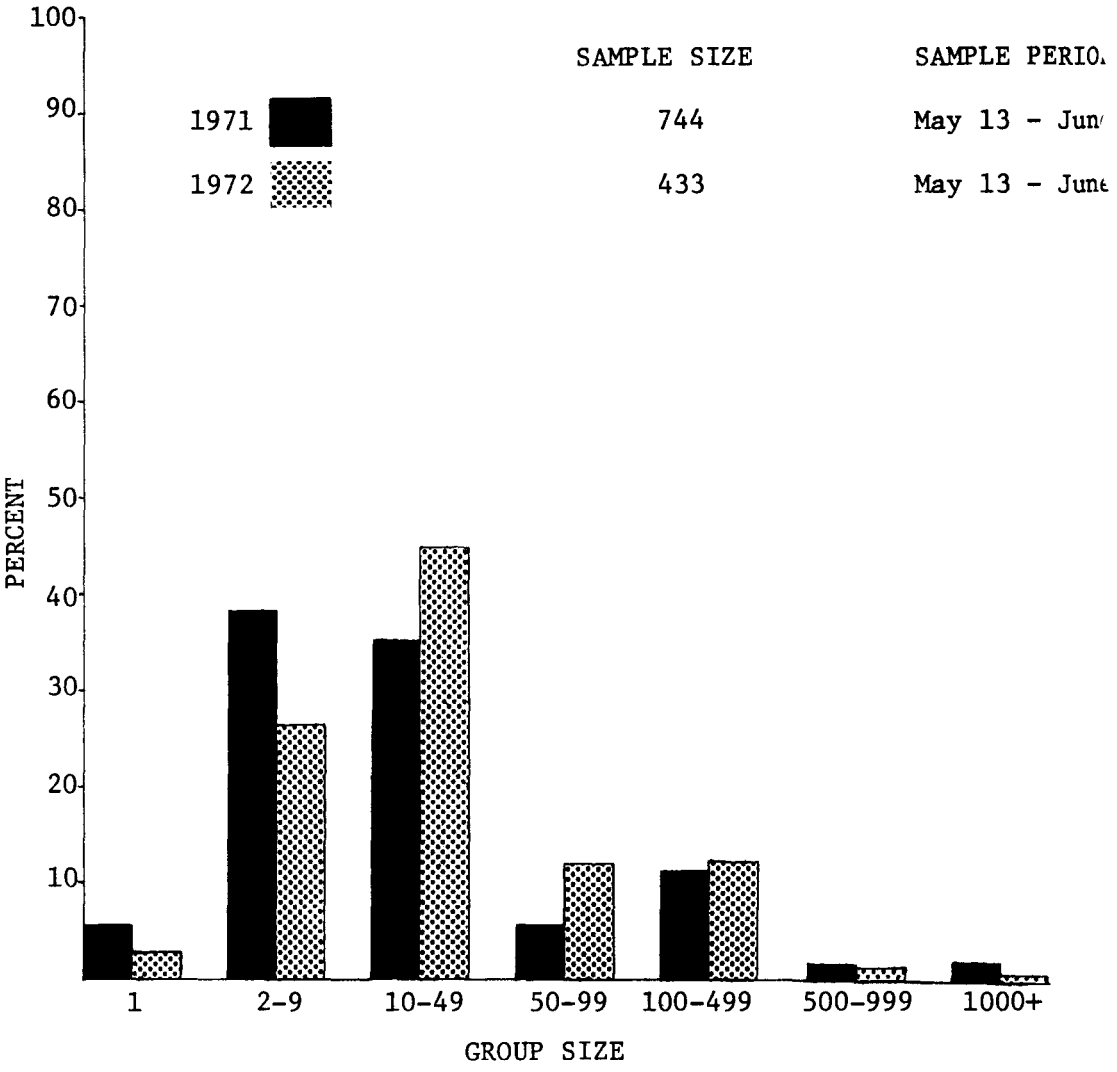


Figure 3: Frequency of observation of groups in various size ranges during Spring Migrations 1971 and 1972.

a. Comparison of Timing and Progress of Vanguard Movements:

Table 7 relates the progress of vanguard movements through the Richardson Mountains during spring migrations of 1971 and 1972.

The first wave of movement through the Richardson Mountains in 1972 was initiated at least a month earlier than in 1971. The animals involved in the 1972 movement spent most of April in the northern Richardsons, while in 1971 the animals remained in the Caribou River area during this period.

The second wave of movement up the Richardson Mountains was initiated about nine days earlier in 1972 than in 1971. By 21 May of both years the migrations had progressed along the Richardson Mountains the same distance. Subsequent progress was also similar.

Table 8 is a summary of the progress of animals along the Old Crow Route. In 1971 caribou were already north of the Fishing Branch River by 5 April, while in 1972 very few animals were north of the Peel River. In 1972 animals were in the area transected by the interior alternative pipeline route by 13 May. The vanguard movement in 1971 became stalled in the northern Keele Range due to excessively deep snow in the Porcupine River Valley. By 30 May in both years the caribou were on the coastal plain.

Peter Benjamin, a special constable with the R.C.M.P. in Old Crow, reported that thousands of caribou went by Old Crow within a few miles of the village starting about 15 April 1970, before the ice went out of the river. By 1 May the last of the caribou had crossed the river.

Table 7: A summary of the progress of the vanguard movement of spring migrations through the Richardson Mountains; 1971 and 1972.

DATE	LOCATION 1971	LOCATION 1972
	RICHARDSON ROUTE FIRST WAVE	
April 16	Caribou River (S. Richardson)	Cache Creek (N. Richardson)
April 27	67°00'N	68°20'N
May 5	Head of Bell River	Barn Mountains
	RICHARDSON ROUTE SECOND WAVE	
May 13	First rapid surge from the Trevor Range crossed Peel River.	Near Rock River.
May 21	Latitude 68° N	Latitude 68° N
May 23	Blow River	A few miles west of Blow River.
May 25	Babbage River	Babbage River

Table 8: A summary and comparison of the progress of the vanguard movement during sping migration along the Old Crow Route; 1971 and 1972.

DATE	LOCATION 1971	LOCATION 1972
April 5	Bear Cave Mountain. Little northward movement.	Small percentage north of Peel River. Little northward movement.
April 20	South end of Cody Hill.	As above.
May 11	First rapid surge started from north end of Cody Hill.	North side of Keele starting for Porcupine River.
May 13	Headwaters of Dave Lord Creek.	A few miles north of the Porcupine River.
May 16	Lone Mountain.	Still largely stalled at Porcupine River due to slow break-up.
May 21	Crossing Porcupine River.	Latitude 68° on Old Crow Flats and Coleen Rivers.
May 30	Coastal plain near Alaska border and west of it.	Coastal plain near Alaska border and west of it.

Benjamin also reported that in 1969 caribou crossed the Porcupine River near Cadzow Lake beginning about 25 March. No animals crossed between there and Old Crow during the entire migration. Benjamin also observed them crossing the river at Salmon Cache on about 20 March of the same year.

The only other spring migration monitored by aerial surveillance was during 1953 (Munro, 1953). In that year spring migration began on about 15 March along both the Richardson Mountains and the Old Crow routes. From the description given by Munro, it can be assumed that only a few animals wintered in the southern Richardson Mountains and used that route; most of the animals he observed crossed the Porcupine River near Salmon Cache and moved northeast across from the Keele Range onto the western slopes of the northern Richardson Mountains.

In spite of the early commencement of northward movements observed in 1953, it was not until 15 May that Munro noted animals traversing the Barn Range into the calving area. The same was observed from the first wave of caribou that proceeded along the Richardson route in 1972. Hence it appears that no matter when the lead animals commence their northward movement, the calving ground is not entered until mid-May. Skoog (1968) also made this observation.

Stalling and grouping of caribou on the Old Crow Route was not seen nearly as frequently in 1972 as in 1971 since in 1972 the initial surge was two weeks later than in 1971 and began approximately 40 miles further south.

b. Comparison of Routes Used:

i. Richardson Mountains Route:

The first wave of movement up the Richardson Mountains in 1972 followed a similar route to that observed the previous year. One possible

exception was a slight westward shift in 1972; hence the 1971 movements took place in higher country. The shift of vanguard movement to the eastern side of Rat Pass was observed in both years. When snow conditions improved, the pass was crossed along its entire length.

The second wave of movement in 1972 differed from that of 1971 in that animals moved to the western piedmont of the Richardson Mountains as quickly as possible in 1972. Part of this movement extended into the Eagle Plains, and the Bell River was crossed throughout its length. In 1971 the second wave remained in the higher elevations of the Richardson Mountains, crossing the Bell no further west than 10 miles from Summit Lake.

In 1971 caribou encountered the proposed interior pipeline route only east of LaPierre House to Barrier River whereas in 1972 they crossed it from Berry Creek east.

ii. Old Crow Route:

In both years, most movement along this route was through the Whitestone River area, over Keele Range and across Porcupine River near Old Crow. From here, the migrations moved across Old Crow Flats to British Mountains, arriving on the coastal plain in late May. Animals along this route were joined in both years by a movement up the western Ogilvies from the Tatonduk River area.

In both years, the proposed interior pipeline route was encountered along its length from Berry Creek to Coleen River.

Some variation between the 1971 and 1972 routes did occur. In 1972 thousands of animals moved north to the east of Cody Creek and then north to Sharp Mountain via Whitesnow Mountain. In 1971 only a

few dozen used this route, with the bulk travelling up the west side of Cody Creek, a route also used in 1972. In general the 1972 route was much wider south of Old Crow than in 1971.

Only two or three thousand animals moved north through the western Ogilvies in 1972, as opposed to more than 10,000 in 1971.

In 1972 most animals crossed the Porcupine River east of Old Crow, whereas in 1971 at least half crossed west of Old Crow.

In 1971 a large movement crossed Firth River near Wolf and Sheep creeks, whereas in 1972 most of animals crossed near Muskeg and Joe creeks.

C. Calving:

Objectives of the surveys flown during calving period were primarily to delineate calving grounds. Aerial calf counts on the calving herds result in harassment, in that it is necessary to fly low or even hover over the herds in order to rouse bedding calves so that they may be counted.

1. Location of Calving Areas:

The calving ground in the Yukon included the Arctic Coastal Plain and the foothills between the Babbage River and the Alaska border. It extended from the coast inland to a line from the headwaters of Babbage and Spring rivers, mid-way up Trail, Crow and Malcolm rivers and along the lower Firth River. The highest density of the herd was located from the Spring River west, from the coast to the lower foothills. Map 1 includes a delineation of the calving grounds.

The calving ground extended into Alaska as far west as the Hula Hula River, although relatively few calves were born west of the Jago River (Photo 9). The majority of the calving herd occupied the northern foothills of the Brooks Range, ranging in elevation between 1,000 and 2,400 ft. (Photo 10). A few cows and calves were observed as far north as the 500 ft. contours. The calving ground did not extend all the way to the coast as it did in the Yukon.

The Alaskan portion of the calving area received a continuous slow influx of cows and calves throughout the calving period. This was evidenced by nursing herds moving west from the Yukon and trails becoming more numerous throughout the period. A more detailed description of the calving ground and calving period is included in "Distribution and Movements of the Porcupine Caribou Herd in Northeastern Alaska, 1972".

In addition, data collected on the behavior of caribou during calving are discussed in "Disturbance Studies of Caribou and Other Mammals in the Yukon and Alaska, 1972" in the section on the Jago River Experiment.

Two small, isolated calving areas were located in the northern Yukon. The location of these is included in Map 1. Only a few dozen cows calved in these areas. One area was located between Joe Creek and the Firth River; the other, northwest of Black Fox Creek. The survey crew was directed to the latter area by a 50-year-old resident of Old Crow who claimed that people older than himself had told him of its existence. Thus the area appears to be a traditional calving site even though only a small number of caribou used it during 1972.

During the first two weeks of June the calving area was populated almost entirely by adult females, calves and yearlings. Bulls were rarely seen in the area, except near the periphery. Males, immature caribou and dry females were observed throughout the British and Barn mountains; a few were also observed in the northern Richardsons. In Alaska this segment of the herd occupied the Brooks Range south of the calving grounds. A few migrating animals were noted at latitudes as far south as Old Crow. On 5 June, 96 caribou were observed along the proposed interior pipeline route between the Alaska border and LaPierre House.

During the height of the calving period the herd is quite sedentary; however travelling groups were occasionally observed, most commonly moving west. The westerly shift of the overall population was however, very slow.

2. Timing and Progression of Calving:

The first calf was observed in the Yukon on 28 May by a C.W.S. crew (Dennis Surrendi, pers. comm.). On 1 June, 20 calves and

1,047 adults and yearlings were observed. On 7 June the progress of calving was far advanced with some nursery bands apparently containing as many or almost as many calves as cows. The peak of calving occurred about 5-7 June. Many newly-born calves were observed on these dates. By 13 June it appeared that calving was almost completed and almost all the calves were mobile and easily able to keep pace with their mothers.

3. Group Size:

During calving the caribou herd is widely dispersed, and any aggregations are generally quite small (Photo 10). Figure 4 illustrates the frequency of observation of groups in various size ranges from 3 June to 17 June 1972. The most frequently observed size class contained 2 - 9 animals, comprising 59% of the total observations. Single animals or animals not associated with a group comprised 10% of the total, a greater percentage than at other periods of the year. Groups in the range of 10 - 49 animals were quite common (26%), especially toward the end of the period. Few groups of over 500 animals were observed.

Observations made near the Jago River in Alaska indicate that a general increase in herd size occurs after the peak of calving. This increase in size of the nursery bands is facilitated somewhat by the restrictions on movement imposed by swollen, fast flowing coastal rivers. The Jago River acted as a partial barrier to the general westward drift of the calving herd due to apparent inability of young calves to ford it; consequently animals became concentrated along the east bank (Photo 11). At first, very little synchrony of activity was apparent, but as time progressed aggregations began to act in coordinated fashion and thus could be identified as groups. This phenomenon could be considered the first phase in the evolution of the large post-calving aggregations.

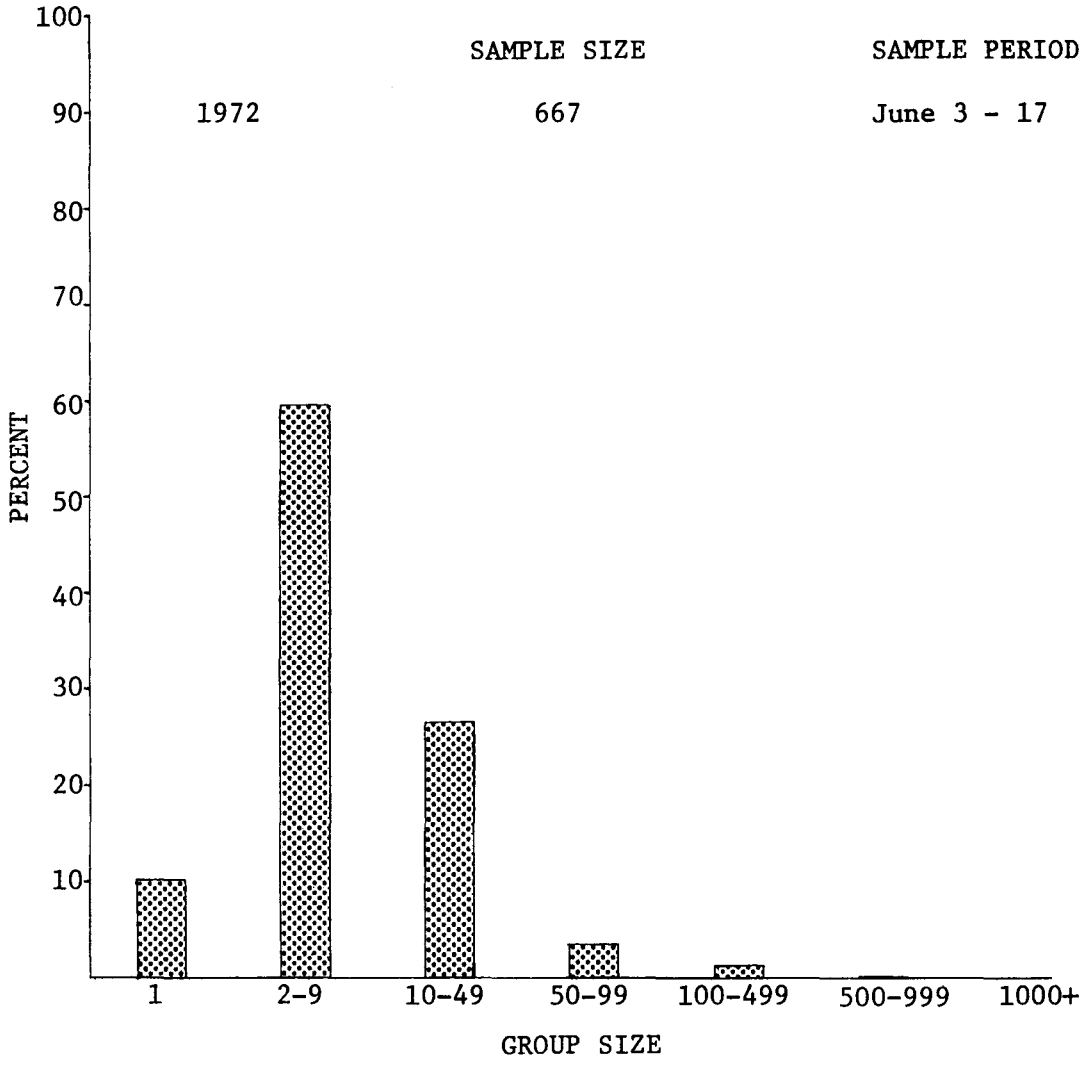


Figure 4: Frequency of observation of groups in various size ranges during the calving period, 1972.

D. Post-Calving Aggregations and Movements:

1. Movements:

Toward the end of the calving period and thereafter, a continual shift of animals took place west from the Yukon into Alaska, where post-calving aggregations began to form. By 2 July very few animals remained in the Yukon.

In the Yukon between 2 - 9 July, a few caribou were found scattered along the coast from Coal Mine Lake to the border, and in the lower reaches of Firth River. On 2 July 200 to 300 caribou, mostly bulls, were located along the lower Firth, but these animals moved out before 5 July. On 3 July several small groups totalling about 100 caribou were located moving northeast towards the coast in the vicinity of the Clarence River. On the latter date probably less than 1,000 caribou remained in the Yukon.

Large numbers of caribou moved from Alaska into the British Mountains of the Yukon on 10 July. Movements subsequent to this date are included in Map 4. On this date about 15,000 caribou were scattered in the headwaters of the Clarence River and another estimated 30,000 to 40,000 were in a small valley between the Clarence and Malcolm rivers. These were post-calving herds containing a mixture of cows, calves, sub-adults and mature bulls.

Aerial reconnaissance on 14 July determined the route taken from the Jago River area into the Yukon. The bulk of the herd appeared to have moved easterly across the lower foothills and divided on Kongakut River, with a larger group (the 30,000 to 40,000 located on 10 July) moving almost due east and a smaller group of 15,000 moving up the Kongakut and Pagilak rivers across high mountain passes into the headwaters of Clarence River.

By 15 July nearly all of the post-calving herds that had moved into the Yukon on 10 July had moved east of the Firth River. Movement continued steadily southeast at an average rate of approximately 10 miles per day. Most movement occurred through the lushly vegetated valleys during evening (Photo 12), while mid-day was often spent in dense aggregations on barren tops of mountains (Photo 13). Most caribou moved through the headwaters of the Trail and Babbage rivers, but 10,000 - 12,000 animals moved through the Buckland Hills as far as Crow River before moving inland to the head of the Babbage River. On 19 July an estimated 44,200 caribou were located at the head of the Babbage River and Black Fox Creek and in the north end of the Barn Range near Mount Fitton. The majority of these animals were in three large groups.

Most of these caribou continued eastward through the north end of the Barn Range and across the head of the Blow River. Thus on 21 July, approximately 44,300 animals in nine herds were located in the head of the Blow River, most of these moving east and southeast. From the Blow River, the caribou crossed into the headwaters of the Bell and Driftwood Rivers.

There appeared to be a westward movement of some caribou from the head of Babbage River and Black Fox Creek into Alaska beginning about 19 July. On 19 July 2,500 caribou were located about 5 miles west of the main travel route, at the head of Black Fox Creek. These may have been part or all of the animals that moved west. Later, near the end of July, fresh trails were located, along with some stragglers, near the "fishhole" on the Firth River, Bear Mountain and west of the Coleen River. (Later, in August, many of the caribou remained in the broad, lush slopes and valleys at the head of the Bell and Driftwood rivers in the Richardson Mountains. During this period the caribou remained in large, sometimes loosely-scattered herds.)

This area appeared to be the limit of the western movement. The areas to the east (Canoe Lake) and to the south toward the Rat Pass were thoroughly checked but no caribou appeared to move in those directions. Some fresh trails were noted south of Berry Creek, indicating some southward movement.

2. Population Estimates:

The Alaska Department of Fish and Game in cooperation with the U.S. Bureau of Land Management took a series of aerial photos of the aggregations on the Alaskan Coastal Plain on 3 July. There were 82,680 animals counted from the photos and an estimated 3,580 in areas other than that covered by the photo survey, giving a total of approximately 86,000 animals. A small portion of the herd was scattered in small bands throughout the Brooks Range, British and Barn mountains. LeResche (1972) estimates that if unphotographed areas are considered, the Porcupine Herd contains approximately 110,000 - 120,000 animals.

During the week in which animals were summering in the Richardsons, two attempts were made to estimate their total number. On 24 July, 10 herds totalled 52,600 caribou and on 30 July, 7 herds totalled 48,950 caribou (similar to the 51,250 count of 2 August).

3. Group Size:

Upon their return from Alaska to the Yukon, the herd had already formed characteristically large post-calving aggregations. These aggregations remained essentially intact during the move west into the northern Richardsons.

Figure 5 illustrates the frequency of observation of groups of different sizes. A certain amount of bias is probably present, as single animals and small groups were not always recorded, in order that

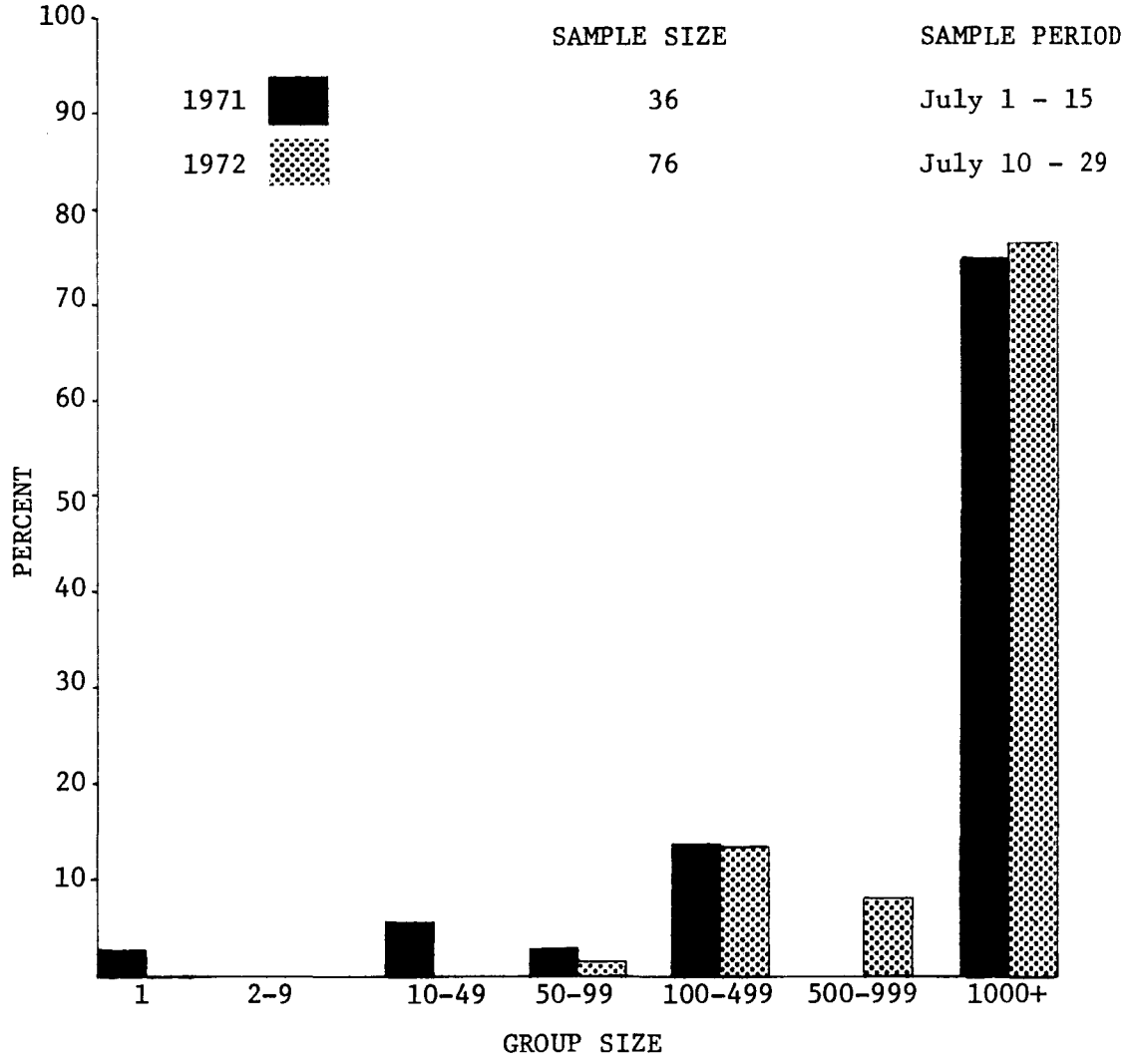


Figure 5. Frequency of observation of groups in various size ranges during the Post-calving and early summer periods, 1971 - 1972.

the larger groups could be followed and counted. The graph, however, gives a close representation of the distribution of the animals in various group sizes. Over 70 percent of the groups observed contained more than 1,000 animals, and of these the majority contained over 5,000.

A comparison of the frequency of observations of various size classes in 1971 and 1972 reveals a similar pattern. Apparent differences are probably a reflection of sampling error.

A number of stragglers, usually single animals or cow-calf pairs, were often observed in the wake of large movements. The reason for separation of individuals from the aggregations was not always apparent, but often the animals appeared injured. High incidence of predation upon these animals by grizzly bears was suspected.

4. Comparison of Post-Calving Aggregations and Movements During 1971 and 1972:

Post-calving aggregation was not observed in 1971; however, it is suspected that this phenomenon is similar each year and usually occurs in Alaska.

The July movements differed in 1971 and 1972 in that caribou entered the Yukon on 1 July 1971 and 10 July 1972. The region of entry was the same and the general southeasterly movement through the British and Barn mountains was similar. The progress of movements during this period is illustrated in Maps 4 (1972) and 5 (1971).

Specific differences in these movements were:

a. In 1971 no animals were observed travelling from the head of the Clarence River to cross the Firth between Joe and Sheep creeks, whereas in 1972 at

least 10,000 did so. However, in 1971 a move of 10,000 was suspected to have occurred between the Kongakut headwaters and the Firth.

b. In 1971 the majority of the animals travelled through the northern half of the Barn Mountains whereas in 1972 almost all of the caribou utilized the southern half of the Barn Mountains in their southeastward movement.

c. In 1971 the caribou travelled from the international boundary to the Blow River in 18 days, whereas in 1972 they took 11 days. Higher temperatures during 1972 may have indirectly resulted in faster movements on account of insect harassment.

The overall similarity between the 1971 and 1972 post-calving movements suggests that the route described above is a traditional route. Further evidence is seen in reports of previous years.

a. Movements in Years Prior to 1971:

In summarizing observations of caribou on the north slope, Kevan (1970) reported that Hoydahl saw few caribou on 10 July 1948; Soper saw none in July 1949; and McEwan saw 27,000 crossing the Firth on 8 July 1953, travelling in an east-southeast direction between Joe and Sheep creeks. Thus it appears that post-calving aggregations larger than those observed during 1971 and 1972 sometimes travel southeast through the center of the British Mountains, rather than along their northern fringe. However, may old trails were observed in passes and along ridges, the majority of these having a southeasterly orientation, and from these it appears that caribou entering the Yukon during post-calving movements usually used the same route as was observed during 1971 and 1972.

E. Summer Movements and Dispersal:

The period between 30 July and 15 September entailed first, a shift in direction of movement to the west, along the treeline; second, a slow dispersal of the large summer aggregations, until few herds of over 1,000 animals were observed; and third, a general drift back to the Yukon to the headwaters of Timber, Thomas and Muskeg creeks.

1. Movements:

The movements of animals during this period are illustrated in Maps 4, 6 and 7.

On the evening of 30 July caribou began moving westward out of the Richardsons. Four herds totalling 42,500 animals moving west across the upper Driftwood drainage were counted.

Several small herds and a large scattered herd remained in the mountains at this time and on 3 August a total of 8,000 caribou were estimated in the Richardsons near the head of Berry Creek. Due to poor weather in the mountains these animals could not be closely followed, but some of them appeared to move westward, following the same path as the initial surge, while others dispersed and gradually shifted southward. On 11 August small scattered groups were located in the vicinity of the head of the Waters River and south to about 20 miles north of LaPierre House.

The majority of caribou moving westward out of the Richardson Mountains on 30 July moved into hills west of the Driftwood River, where subsequent movement fanned out on a broad front along five routes. On 2 August the following movements were taking place:

(1) Seven groups of caribou totalling 5,600 animals were

moving rapidly northward between Bonnet Lake and the head of Blow River. (It appeared that most of these caribou moved down the Blow and then westward near Mount Fitton).

(2) Ten groups of caribou totalling 17,650 animals were between Johnson Creek and headwaters of Black Fox Creek, moving northwest across the northeast corner of Old Crow Fla

(3) Five herds totalling 18,000 caribou were moving northwest across the Old Crow Flats between Johnson Creek and Black Fox Creek.

(4) One herd of about 10,000 caribou was located moving west about 10 miles south of the Old Crow Flats on the flats at Black Fox Creek.

(5) A small number of caribou were moving down the Driftwood River and across the Porcupine and south end of the flats towards Schaeffer Mountain.

The general westward movement of caribou continued on a very broad front.

From Black Fox Creek, scattered herds continued across the flats and then appeared to move up Bilwaddy Creek, Surprise Creek and Ammerman Mountain. About 2,000 or more caribou followed the course of Black Fox Creek and the Old Crow River downstream 20 miles, crossed the flats southwest to the head of Schaeffer Creek, and then turned west, crossing the border near Spike Mountain and the head of Strangle Woman Creek. Some appeared to have crossed the Coleen River (trails noted on 15 August).

The majority of the caribou (probably about 35,000) moved westward along the slopes at the north end of the Old Crow Flats. About 10,000 of these moved in dispersed groups northwest from the head of Timber Creek, while the remainder continued west across the headwaters

of Thomas Creek and the Firth River to the Coleen River and beyond and southwest to Bear Mountain. On 10 August, deeply rutted trails and 10 small bands of caribou were located east of the Coleen River about 10 miles north of Bear Mountain. On 15 August, scattered groups were located moving west on the south side of Bear Mountain and throughout the hills west of the Coleen River as far south as Strangle Woman Creek.

General dispersal into very small bands occurred once the herds reached Alaska. This dispersal is possibly related to the cooling temperatures and reduced insect harassment.

It is of interest that the movement eastward to the summering area from the post-calving area of aggregation was more direct and took place in larger groups than the later westward movement. The latter took place on a much broader front. The eastward shift was well north of treeline, whereas the westward movement proceeded along treeline.

From 15 August to 7 September the majority of the Porcupine Caribou Herd was in Alaska. Small scattered bands of caribou remained in the northern Yukon in 4 distinguishable areas.

(1) An estimated 500 - 700 remained scattered in small groups between Bonnet Lake and Sam Lake along the south end of the Barn Range. By 28 August most of these caribou had moved east to the Fish River area near Mount Davies Gilbert and 550 were estimated there on that date.

(2) Small bands remained scattered in the Richardsons in the Bell River and Waters River areas, probably totalling not more than 2,000 animals. Only a few animals were noted in the Chute Pass area to the south. In general, these bands remained in this area and had not begun moving

south on 9 September, despite fresh snow on the peaks and cold winds.

(3) Scattered bands totalling approximately 500 caribou were in the southern British Mountains from Black Fox Creek west to the Firth River. These animals remained in the area at least until fall migration began.

(4) 50 - 100 caribou remained in the northern foothills and coastal plain between the Firth River and the Alaska border

In Alaska, scattered bunches totalling 2,000 to 2,500 animals remained in the hills west of Old Crow, including the Strangle Woman Creek area. An estimated 50,000 - 60,000 animals were scattered between the Coleen River and the Chandalar River on the south side of the Brooks Range. An estimated 20,000 - 30,000 animals were north of the Continental Divide.

On 6 September, caribou began aggregating in the hills west of the Old Crow Flats, commencing the drift back to the Yukon from Alaska. Some of these animals were moving northeast towards Ammerman Mountain and it appeared that most had moved along the north edge of Old Crow Flats and then southeast towards the Driftwood River. On 9 September several small bands totalling 2,000 - 2,500 animals, were noted moving southeast between Black Fox Creek and Johnson Creek. These caribou were probably the same animals that had moved south across the Old Crow Flats in early August and into the hills west of the Flats. This movement preceded a much larger movement of 20,000 - 25,000 animals about 9 days later.

On 2 September, the first groups of caribou were observed moving south from the Alaska north slope toward the Yukon via the Kongakut River. On 5 and 6 September caribou were also observed moving southward down Boulevard Creek. On 6 September one herd of caribou was observed moving rapidly southward over a pass from the Kongakut River toward the

head of Joe Creek.

In general, there appeared to be three major thrusts of caribou movement towards the Yukon. The routes travelled were similar to those taken in the opposite direction a month earlier. These routes are described below:

(a) A movement took place eastward from areas west of Coleen River (probably Sheenjek River and Brooks Range) through the area south and west of Bear Mountain to Ammerman Mountain. On 7 September, approximately 2,300 caribou were observed moving east. These animals were scattered from west of the Coleen River to the headwaters of the Old Crow River.

(b) A second movement occurred eastward across the Coleen River into the Firth River area to the headwaters of Thomas Creek north of Bear Mountain. On 7 September about 5,400 caribou were located between the Coleen and Firth rivers, most moving almost due east. These caribou may have moved in from the Brooks Range and from the coast.

(c) A movement occurred south and southeast from the Kongakut River down Boulevard Creek to the headwaters of the Firth River. This movement joined the second movement (b) near the large aufeis on the Firth River. On 10 September approximately 2,900 caribou were located moving downstream from the head of the Firth to the aufeis.

These three general movements appeared to merge at the head of Thomas Creek where, on 11 September, approximately 6,500 - 7,500 caribou were observed. On 14 September, the numbers observed in this area had increased to approximately 40,000 - 50,000. The herd in this area subsequently split during fall migration.

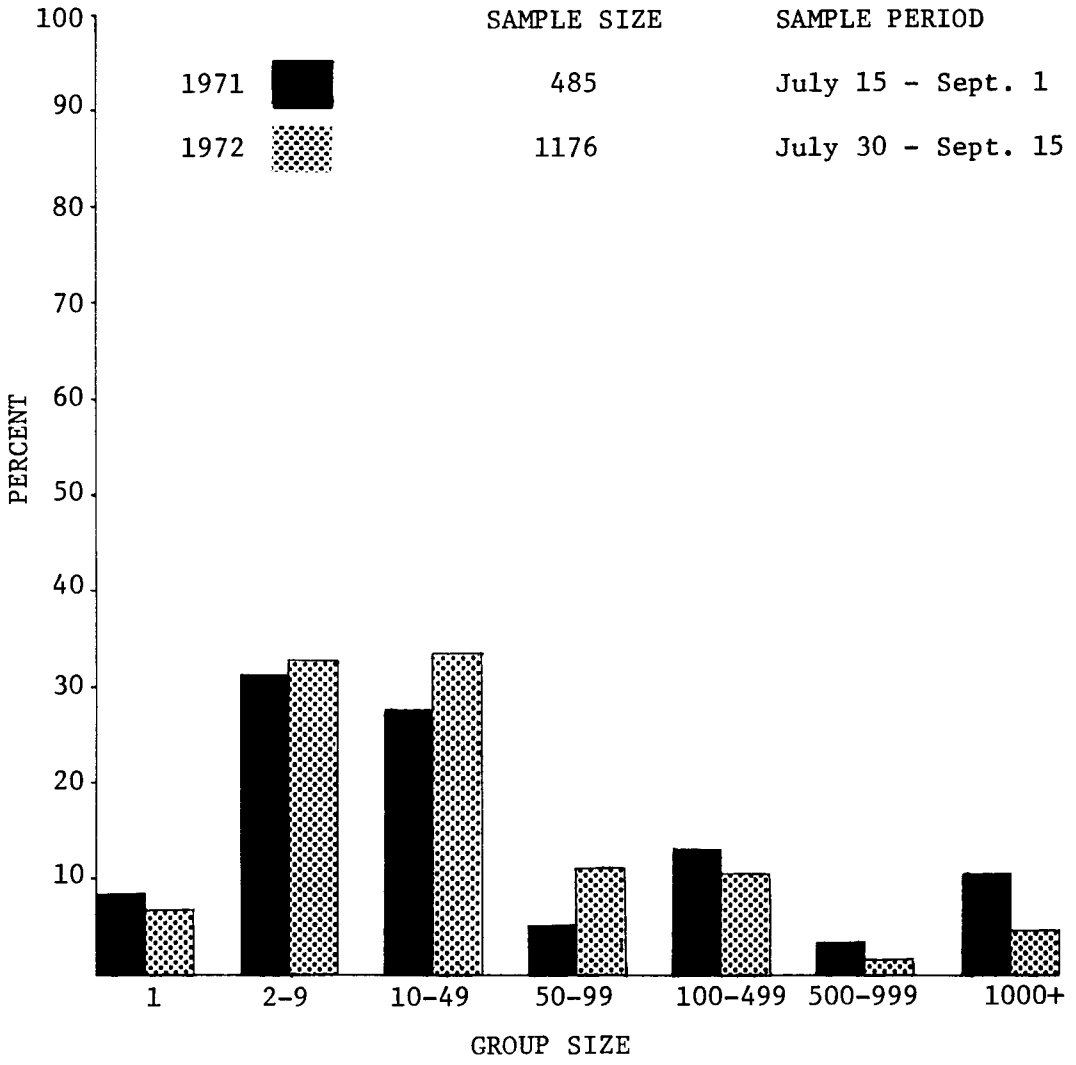


Figure 6: Frequency of observation of groups in various size ranges during the late summer (dispersal) period; 1971 and 1972.

2. Group Sizes:

The slow breakdown of the large post-calving aggregations characterizes this period of the year. Figure 6 illustrates the frequency of observation of groups in various size classes.

The most commonly observed group sizes were the 2 - 9 and 10 - 49 size ranges.

Breakdown of the large aggregations proceeded as the westward movement of the herds progressed. The majority of the animals in the northern Richardson Mountains were in groups of over 1,000, but upon reaching the Alaska border, the herd dispersed into groups seldom exceeding 50 animals and usually less than 10.

Data from the early fall dispersal period 1972 are compared to results obtained during the similar period in 1971. Except for a tendency toward larger group sizes in 1972, data from these years are similar.

3. Comparison of Summer Movement and Dispersal, 1971 and 1972 with Reference to Previous Years:

Movements referred to during this period are included in Maps 4, 5 and 6.

In 1971 the early fall dispersal began about 10 July and continued until 1 September. Weather conditions did not allow aerial surveillance between 10 July and 15 July, and it was not until 16 July that dispersal into smaller groups was observed. It is likely that the stormy weather initiated dispersal. By 15 July the caribou were travelling southeastward through the British and Barn mountains, with the greatest number just east of Babbage River. The herd continued to

the head of Bell River in the Richardsons before turning west to re-enter Alaska. The westward movement took place in the region of Old Crow Flats and the southern Barn and British mountains. The animals travelled rapidly, reaching Alaska 10 days after turning west.

In 1972 the route followed west from Bell River was similar to that in 1971. The timing of the western movement differed, occurring from 24 July to 2 August in 1971 and from 20 July to 8 August in 1972. In 1972 the dispersal coincided with the beginning of the westward movement, whereas in 1971 it had already been in progress for about 10 days.

In both years all but the first few days of August were spent in Alaska by most of the herd. The few surveys made in Alaska in 1971 gave the general impression that caribou distribution immediately west of the international boundary was similar in both years.

Fall migration to the Yukon in 1971 was well underway by 6 September and by 15 September caribou were seen at Fishing Branch River, 150 miles south of Thomas Creek. About 8 inches of snow had accumulated on the hills west of Old Crow Flats by 7 September. It is possible that this snowfall influenced the initiation of migration. In 1972 such snow conditions did not exist until 26 September, and the early fall dispersal continued until about 15 September, at which time caribou were seen in the Thomas Creek area.

Kevan (1970) summarized sightings reported by various observers during this time of year. He reports that Hoydahl in 1949 observed caribou passing Mount Fitton. Although the direction of movement is not indicated it must have been southerly, since the movement is interpreted as the beginning of fall migration. On the basis of our observations, this would be interpreted as part of the movement toward the Richardsons

after the early fall dispersal had begun. If this interpretation is correct, Hoydahl's observation suggests that in some years post-calving herds reach the vicinity of the Blow River up to 25 days later than during the summers of 1971 and 1972.

Residents of Old Crow state that caribou frequently move south across the Porcupine River in the region of the Driftwood River during the first few weeks of August. They say that the caribou usually recross the river going north near Old Crow or some distance west sometime in early September. Such a movement has not been observed in the past two summers but reportedly occurred in 1969 and 1970. The proportion of the Porcupine Herd involved and the reasons for this movement are unknown. Unless this movement is part of a recent change in movement pattern, it is unlikely that the majority of the herd is involved. Caribou fences, constructed prior to 1900 at the bases of the mountains east and north of Old Crow Flats to impound animals particularly during the late summer movements, attest to the fact that a large number of caribou must have travelled along that route in a fairly predictable fashion during early fall.

Location of early fall movements and the dates of spring migrations across the Porcupine River seem to be correlated. The dates when caribou encounter the Porcupine River during the spring and during August over the past four years, follow:

	SPRING MIGRATIONS	AUGUST DISPERSAL
1969	March 25 - 31	Many went south across Porcupine River.
1970	April 15	Many went south across Porcupine River.
1971	May 21	Very few went south across Porcupine River.
1972	May 12	Very few went south across Porcupine River.

These observations suggest that crossing of the Porcupine during August might occur only in years when there is an early crossing of the river during spring migration. Further information is necessary to further this theory.

F. Fall Migration:

1. Distribution Prior to Migration:

Prior to the beginning of fall migration most of the Porcupine Herd occupied three areas in the Yukon. This distribution of caribou from 1 to 15 September is included in Map 7.

The area about 6 miles west of Shingle Point was occupied by approximately 2,000 caribou.

The Richardson Mountains in the vicinity of Rat Pass was occupied by an estimated 2,000 caribou. Most of these animals were on the north side of the pass.

The area in the vicinity of Thomas, Muskeg and Timber creeks contained the largest concentration. Knowledge of the numbers of caribou spread over the remainder of the range suggests that approximately 70,000 animals occupied this area.

In Alaska there were two areas occupied at this time. The northern foothills of the Brooks Range in the region of the Canning River contained approximately 5,000 caribou. The south side of the Brooks Range in the region of the head of the Coleen and Sheenjek rivers was occupied by at least 2,000 to 3,000 caribou.

There were a few stragglers at the head of the Firth River and Ammerman and Bilwaddy creeks, but most caribou appeared to have moved east through this area into the Thomas Creek area. The total number of caribou in all but the Thomas Creek area was approximately 20,000. If the total Porcupine Herd size is 90,000, a total of about 70,000 animals for the Thomas Creek area is suggested.

2. Movements:

Movements associated with the fall migration are given in Map 8.

Fall migration was underway by 17 September. On this day caribou in the Shingle Point area appeared to have divided in two groups. One group of about 500 were moving up Blow River into the Driftwood River region while the second group remained until the following day, when they were observed travelling rapidly west near Babbage River as a storm front moved in from the Arctic Ocean. Contact with these animals was lost after this date, but it is probable that they either continued west along the coastal plain into Alaska or turned southwest into the Thomas Creek area.

Very few observations of the animals in Rat Pass were made. They moved slowly south along the west side of the Richardson at least as far as the Doll Creek area. Elmer DeBock (pers. comm.) observed a few trails near Hart River on 20 October which could have been made by this group.

Two major movements emerged from the Thomas Creek area. In the first movement, an estimated 35,000 caribou headed southeast, and on September 18 many thousands were seen in the southern hills of the Driftwood River, Rat, Indian, and Berry creeks, where they hesitated for about two days before crossing Porcupine River. As they crossed, hunters from Old Crow harvested about 200 animals.

A tagging program organized by the Canadian Wildlife Service tagged 36 caribou as they swam the river four miles below the Berry Creek junction. On 23 September the river began to freeze, which discouraged about 2,000 animals from crossing. Instead, they moved gradually west to the ridge north of the Porcupine and west of the Driftwood Rivers. One animal with a C.W.S. collar was observed in this region on 27 September.

Animals which had crossed Porcupine River near Driftwood River and Berry Creek moved through the Keele Range to headwaters of Pine and Cody creeks and then to the head of Fishing Branch River, where they were observed on 28 September (Photo 14). An unknown number of these animals travelled west to join a movement toward Arctic Village. Approximately 10,000 caribou observed near Fishing Branch River on 28 September moved south-southeast from this region, passing west of Bear Cave Mountain and later just west of Mountain Dewedney (Elmer DeBock, pers. comm.). They crossed the head of the Whitestone River and proceeded due south to the Ogilvie River about 20 miles above the Dempster Highway bridge. At this point they turned due west and proceeded up the Ogilvie River and over the ridges into the Tatonduk River drainage (Grant Lortie, pers. comm.).

The second major movement from the Thomas Creek area consisted of about 20,000 animals which entered Old Crow Flats and progressed slowly south on the east side of the Old Crow River between 17 - 25 September. During this time lakes on the flats had frozen over with ice up to four inches. Numerous observations were made of trails across lakes and places where caribou had chopped through the ice. This movement proceeded south toward Schaeffer Mountain and then split in two. One group proceeded east of the mountain to the "Little Flats", while the other turned

west, crossed the Old Crow River and entered the Old Crow Mountain region to join several thousand animals which had moved south out of Alaska around the western rim of the flats. The latter animals reached Old Crow Mountain on September 20. Old Crow hunters harvested about 100 animals on the mountain.

Between 20 - 25 September approximately 25,000 animals had moved into the Old Crow Range between the Alaska border and the Little Flats. Between 25 September and 1 October there was a certain amount of milling, producing minor movements too complicated to describe here. In general, there was a southward shift of animals across the Porcupine River to the Dave Lord Creek and Bluefish River regions of the Keele Range. They crossed the ice-choked Porcupine River between Cadzow Lake and the Alaska border. Main crossings of the Porcupine River, in order of most used to least used occurred at longitudes: $140^{o}27'$ (top of Ramparts), $140^{o}40'$ (three miles below Caribou Bar Creek), $139^{o}22'$ (Goose Camp), $138^{o}54'$ (Cadzow Lake) and $139^{o}32'$ (Caribou Lookout). All of these animals converged on Keele Range in Salmon Fork valley or west of it between 28 September and 8 October. Elmer DeBock (pers. comm.) observed 13,000 animals in Salmon Fork valley on 1 October.

Tracks of another movement of approximately 5,000 animals which had moved southeast to the New Rampart House from Alaska were found on 3 October. These animals had crossed the river near New Rampart, and although they were not observed due to fog, it is suspected they moved south to join the animals in the western Keele Range.

All of the animals that had moved into the western Keele Range were discovered travelling rapidly in a northwesterly direction

toward Coleen River on 8 October. They formed a front about 10 - 15 miles wide immediately west of Salmon Trout River which was estimated to consist of approximately 30,000 animals, 10,000 of which were already north of the Porcupine River (E. DeBock, pers. comm.). This is probably a highly conservative estimate. By 10 October the northern vanguard of the movement had reached the Sheenjek River (Grant Lortie, pers. comm.). This portion of the herd was joined from the east by approximately 10,000 animals which had accumulated in the southern Brooks Range. It was suspected that these animals had moved back west from the Thomas Creek area.

The latter animals proceeded west along the southern Brooks Range to join the caribou from the Keele Range between 10 to 25 October in the region just north of Arctic Village, where they remained through the winter.

Approximately 5,000 caribou remained on the Little Flats instead of moving south to cross the Porcupine River. They were observed in this area on 1 October. On 4 October their trails were followed east to the head of Waters Rivers. At this point about 1,000 turned south and crossed the Bell River while the remainder continued east through Rat Pass. The group which had crossed the Bell River stalled for about three days, then dispersed. The majority headed south toward Whitefish Lake while some headed southeast toward the Richardsons, and still others went west to Johnson Creek, where they turned south. Those which had proceeded to Whitefish Lake veered southwest toward the low foothills of the Richardson Mountains, where they were still moving south when surveys terminated on 27 October.

The 4,000 caribou that went east through the Rat Pass were seen at Summit Lake on 17 October and Barrier River on 28 October. Hunters from Aklavik harvested some of these in the Rat Pass. The McPherson hunters also harvested there throughout the winter. Apparently hunters from Tuktoyaktuk flew in to hunt these caribou west of Aklavik. Surveys flown on 28 and 29 November revealed that these caribou had scattered north to within two miles of the MacKenzie Delta near the mouth of Fish River. They were also as far south as the Vittrekwa River on the east side of the Richardson Mountains (Bruce Pendergast, pers. comm.).

3. Group Sizes:

The frequency of observation of groups in various size ranges during the fall migration period is illustrated in Figure 7.

The majority of sightings were of small groups (2 - 49 animals), with the next most frequent size group ranging from 100 - 499 animals.

A comparison of group sizes observed during 1972 with those of 1971 reveals a fairly similar situation. The only major difference is the frequency of observation of groups in the size ranges 2 - 9 and 10 - 49: the tendency was toward groups in the former range during 1971 and the latter range during 1972.

4. Comparison of Fall Migrations, 1971 and 1972:

The most drastic change in the pattern of movement established during 1971 occurred during the late fall migration period. Map 8 and 9 illustrate the movements in 1972 and 1971 respectively.

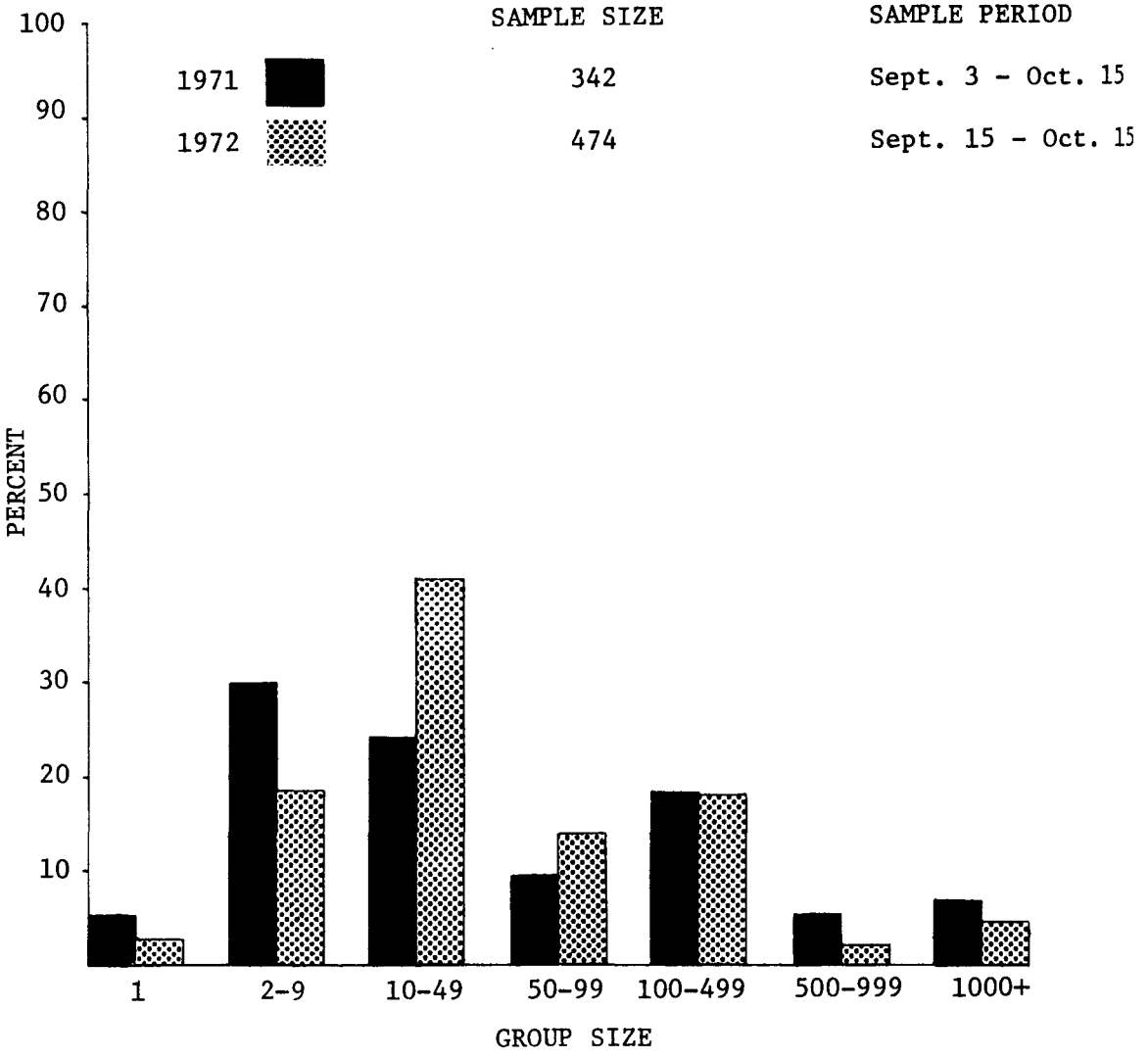


Figure 7: Frequency of observation of groups in various size ranges during fall migrations, 1971 and 1972.

Events leading up to initiation of the migration in the Yukon were similar in both years. Most of the herd was in Alaska prior to migration. An influx of most of the herd into the Ammerman Mountain and Thomas Creek areas occurred in both years. Animals from this area travelled along the following routes during the beginning of migration in both years: across the Old Crow Flats, southeast around the flats, and along the western edge of the flats into the Old Crow Range. After this point, differences occurred in the routes travelled. Instead of continuing into the Richardson Mountains after going around the northeastern flats as in 1971, most of the caribou during 1972 changed direction and headed southwest into the Keele Range. As a result, migration down the Richardson Mountains was very small during 1972.

The routes across the flats and along the western periphery of the flats were similar in 1971 and 1972, with the exception of the diversion into the Little Flats area. Concentrated river crossings were made in similar areas. During 1971, caribou moved into the Keele Range, reversed direction and moved back towards Old Crow, then reversed direction again and moved down the western edge of the Ogilvie Mountains into the Ogilvie River area. In 1972 most animals in the Keele Range moved to the northwest, ultimately moving into the Arctic Village area. The remainder of the animals followed a route south to the Ogilvie River area, in 1971. The reason for this major change in fall migration and the resulting shift in winter ranges is not known. This shift, however, provides an opportunity to study and compare winter ranges as well as new migration routes and migratory behavior.

The 1971 migration was somewhat earlier. Animals crossed the river at Caribou Bar Creek as early as 6 September, while in 1972 major crossings were not made until 25 September. Comparison on dates after this time is meaningless because of the vastly different routes used.

V. SUMMARY:

A. Winter Distribution:

1. The majority of the Porcupine Herd wintered in the Yukon, as they had in the previous years.

2. Population estimates for different areas of the winter range in 1971-72 were:

Richardson Mountains area	--	20,000
Eagle-Whitestone area	--	2,000
Ogilvie-Peel area	--	40,000 - 60,000

3. Heaviest utilization was made of medium density black spruce forest.

4. Caribou were most often sighted in rolling terrain.

5. Snow depths measured at various locations in the winter range approximated 28 inches in low-lying forested areas and 14 inches in the Richardson Mountains. Snow conditions were not greatly different in areas examined outside the winter range.

6. A comparison of meteorological conditions between Old Crow and Parkin revealed that Old Crow is both colder and windier than Parkin from November to May.

7. The winter range used in 1971-1972 was quite similar to the 1970-1971 winter range. Major differences included:

   a. a general southward shift of the range in 1971-1972.

   b. far more animals wintering in the Richardson Mountains during 1971-1972, and

c. fewer animals wintering in the Tatonduk River area during 1972.

B. Spring Migration:

1. Spring migration occurred along two routes during both 1971 and 1972.

2. Two waves of movement occurred up the Richardson Mountains. The earlier wave consisted of the 20,000 animals that had wintered in the mountains and began on 15 March. The second wave was initiated on 4 May and consisted of animals which had wintered south of the Peel River (Trevor Range, etc.). The movement was thought to include 15,000 animals. The major difference in the route from 1971 was a general westward shift to the lower slopes.

3. Movement of the Old Crow Route was initiated during the first week of May. The animals had reached the Porcupine River by 12 May. The major difference in the 1971 and 1972 spring migration along the Old Crow Route was the much wider route used in 1972. The caribou had reached the calving ground by the last week in May.

C. Calving:

The calving ground in the Yukon included the Arctic coastal plain and the foothills from the Babbage River to the Alaska border. Calving activity was noted on 28 May, peaked about 5 - 7 June and by 13 June was essentially completed. The calving area was populated almost entirely by cows, yearlings and calves. Bulls were seen only rarely on the grounds during the calving season. Throughout the late calving period a slow westward drift of the herd occurred.

D. Post-Calving Aggregations and Movement:

Following calving, the entire herd, with the exception of possibly 1,000 animals, moved into Alaska, where the large post-calving aggregations formed. These large herds moved back into the Yukon on 10 July and moved through the Barn Range to the headwaters of the Bell and Driftwood rivers.

E. Summer Movements and Dispersal:

The caribou moved west along the tree line from the headwaters of the Bell and Driftwood rivers on 30 July. Numerous routes were taken, but the majority of animals moved across the north side of the Old Crow Flats. Almost the entire population was in Alaska between 15 August and 7 September. The large summer aggregations had dispersed by this time. Caribou started moving back to the Yukon by 10 September.

F. Fall Migration:

Fall migration was underway from the north end of the Old Crow Flats by 17 September. Animals skirted the east side of the flats or followed the Old Crow River across the flats and moved around the western edge into the Old Crow Range. The majority of the herd had moved into the Keele Range by the end of September. About 10,000 of these animals proceeded south to the Tatonduk River while the rest moved northwest into Alaska, where they spent the winter.

A summary of the frequency of observation of groups of different sizes during weekly periods from April to October in 1971 and March to November of 1972 is presented in Figures 8 and 9. These data were collected primarily in the Yukon Territory and hence do not necessarily present a total picture for the Porcupine Herd during all times of the year. The following points are illustrated by the graph:

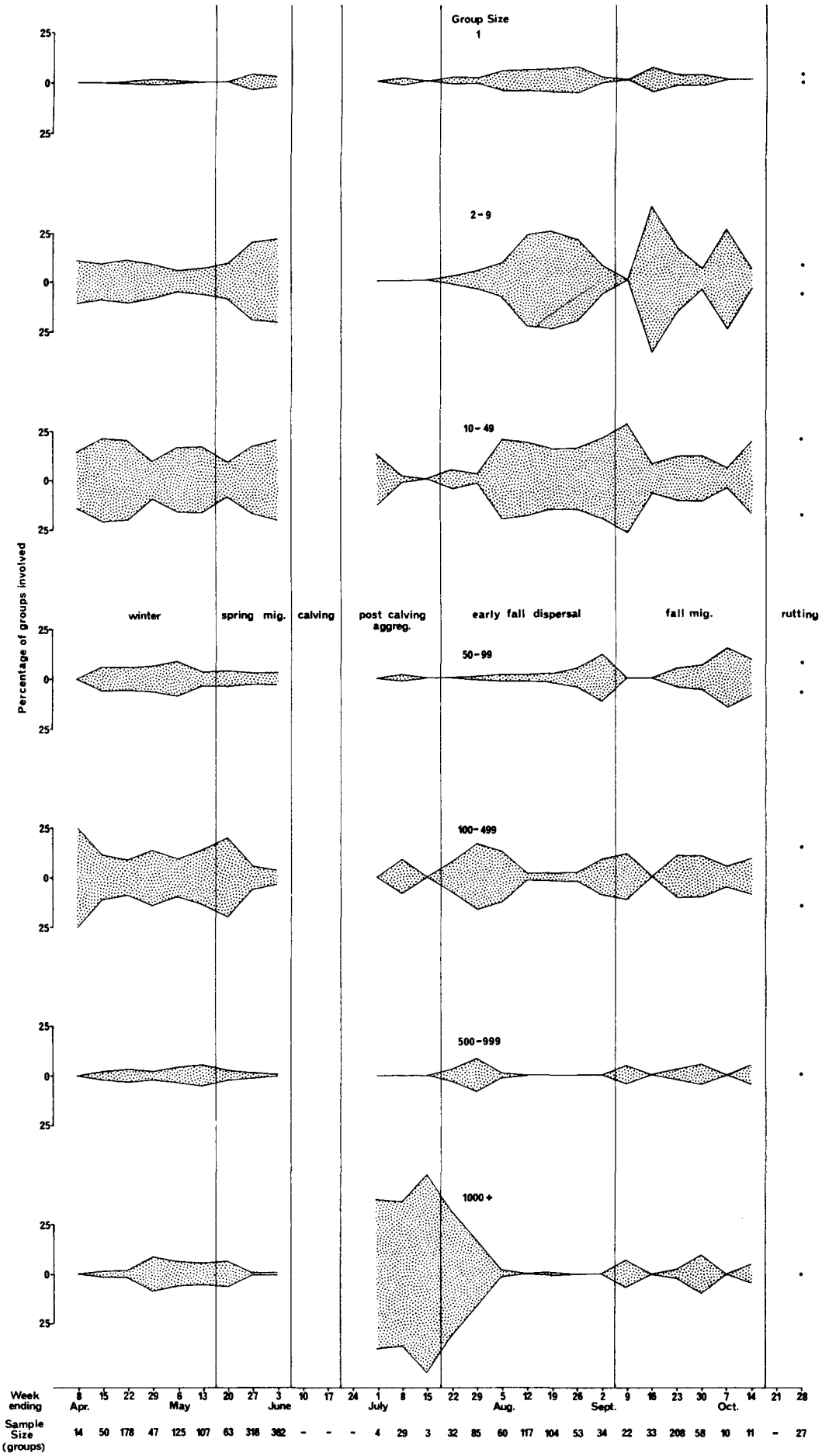


FIGURE 8: Frequency of group sizes of caribou from April to October 1971 in the Yukon

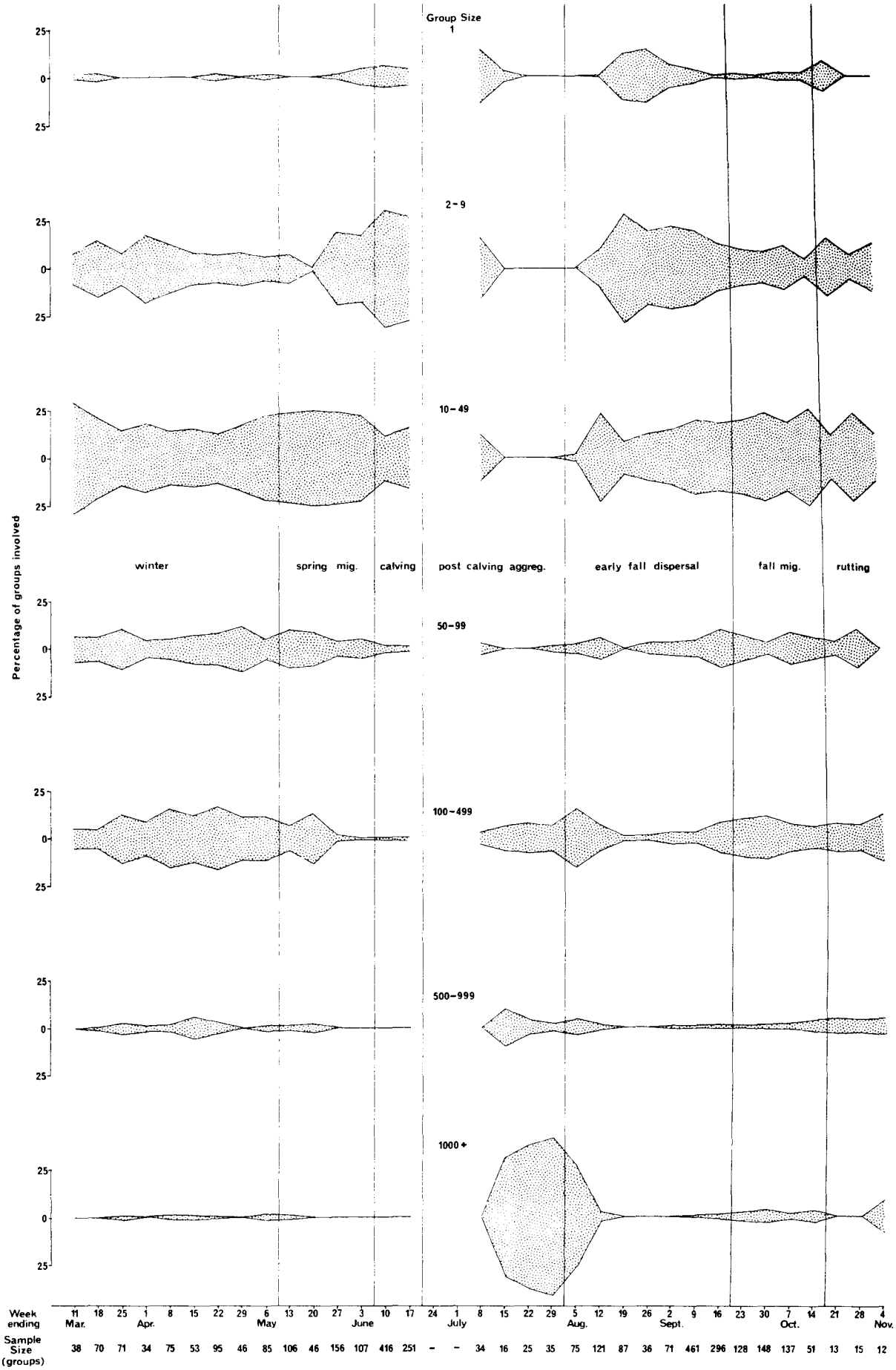


FIGURE 9: Frequency of group sizes of caribou from March to November 1972 in the Yukon

(1) There was no overt aggregation behavior prior to spring migrations during 1972.

(2) Groups generally decreased in size as the spring migration progressed.

(3) The herd was most dispersed during the calving period.

(4) The formation and breakdown of the large summer aggregations is apparent.

(5) Fall migration closely resembles spring migration in terms of group sizes, except for the slightly higher frequency of large groups in the fall.

LITERATURE CITED

Canadian Arctic Gas Study Limited. 1974.
Map Folio to Accompany Biological Report Series, Vol. IV, VI, and VII.

Henshaw, J.P. 1968.
An environmental study of wintering caribou in northwestern Alaska. Master's thesis, Institute of Biology, London, England.

Kevan, P.G. 1970.
The caribou of the Northern Yukon Territory. A history of man's interest in the northern Yukon with special reference to wildlife biology. Unpubl. Report, Canada Wildlife Service.

Lent, P.C. 1964.
Calving and related social behavior in the barren ground caribou. Unpubl. Ph.D. thesis. University of Alberta, Edmonton.

Lent, P.C. 1965.
Rutting behavior in a barren ground caribou population. Animal Behavior. 13:259-264.

LeResche, R. 1972.
A summary of significant observations of Porcupine and Arctic caribou herds in Alaska, 1972. Alaska Dept. of Fish and Game Report.

McCourt, K.H., J.D. Feist, D. Doll and J.J. Russell. 1974.
Disturbance Studies of Caribou and Other Mammals in the Yukon and Alaska, 1972. CAGSL Biological Report Series, Vol. V.

Munro, D.A. 1953.
A preliminary report on the caribou of the Northern Yukon Territory. Canadian Wildlife Service Report.

Pruitt, W.O. Jr. 1959.
Snow as a factor in the winter ecology of the barren ground caribou. Arctic 12(3):158-179.

Roseneau, D.G. and P.M. Stern. 1974.
Distribution and Movements of the Porcupine Caribou Herd in Northeastern Alaska, 1972. CAGSL Biological Report Series, Vol. VII.

Skoog, R.O. 1956.
Range, movements, population, and food habits of the Steese-Fortymile Caribou Herd. M.S. Thesis, University of Alaska, College, 145 pp.

Skoog, R.O. 1968.
Ecology of the caribou (Rangifer tarandus granti) in Alaska. Ph.D. Thesis. Univ. California, Berkeley, 699 pp.

Appendix A: Photographs illustrating aspects of the distribution and movements of the Porcupine Caribou Herd in 1972.

PHOTO 1: The Trevor Range. Thousands of caribou spent the late winter of 1971 and 1972 on the treeless ridge tops digging through the shallow snow cover to feed on lichen.

PHOTO 2: A densely cratered area on an alpine ridge.

PHOTO 3: A close-up view of a caribou feeding crater on an alpine ridge showing the shallow but hard snow cover.

PHOTO 4: A view of a typical forested portion of the winter range showing heavier utilization in forest of medium density than in sparsely forested areas.

PHOTO 5: A close-up view of a feeding crater in deep snow in a forested area. The lower branches of the tree result in conditions favorable for cratering.

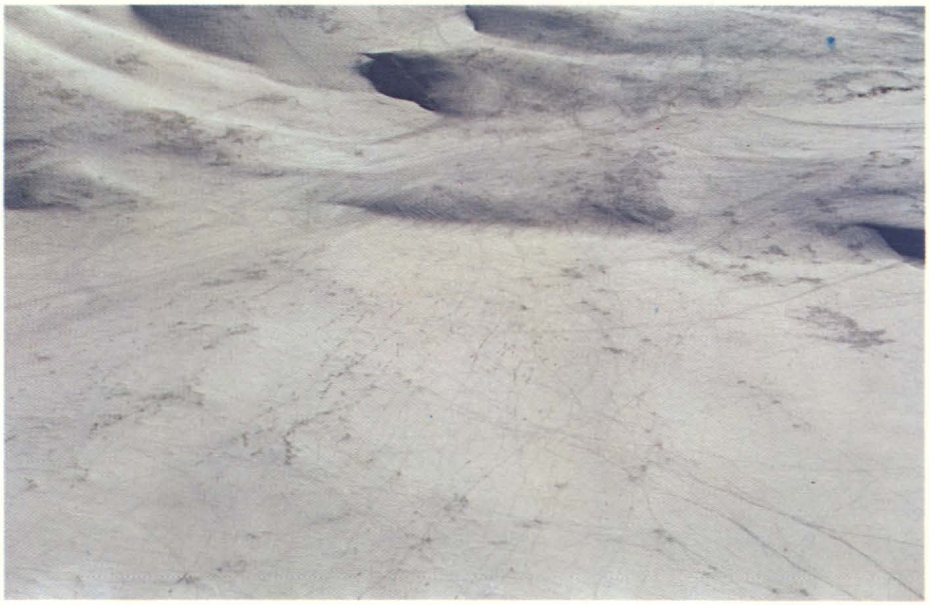


PHOTO 6: Trails used by thousands of caribou migrating north along the Richardson Mountains.

PHOTO 7: Caribou of the initial migratory movement near the Whitestone River. The linear formation facilitates travel through relatively deep snow.

PHOTO 8: Spring migration trails on Schaeffer Mountain illustrate the frequent use of ridges probably because of more favorable travelling conditions.

PHOTO 9: One of the few calves born west of the Jago River in Alaska in 1972.

PHOTO 10: The typical scattered distribution of caribou in the foothills of the Brooks Range during the calving period.

PHOTO 11: An aggregation of caribou along the east bank of the Jago River.

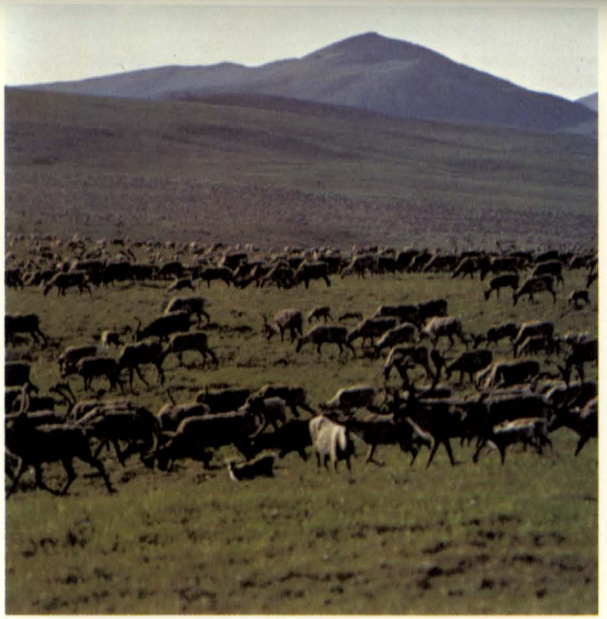


PHOTO 12: Movement of a large mixed herd through lushly vegetated lowlands during late afternoon.

PHOTO 13: A dense aggregation of caribou located on a barren mountain top during mid-day.

PHOTO 14: Caribou migrating in the snow covered hills near the Fishing Branch River in the fall of 1972. The linear formation is characteristic of both spring and fall migrations.