

Seasonal Distributions of Rocky Mountain Bighorn Sheep in Canadian National Parks, 1966-1972

by John G. Stelfox



Prepared for Parks Canada

By the Canadian Wildlife Service, Edmonton, 1978

PRECIS

AUTHOR AND TITLE

Stelfox, John G., 1978. Seasonal distribution of Rocky Mountain Bighorn Sheep in Canadian National Parks, 1966-1972.

CONTRACT

This study was part of the CWS Park Research function, jointly funded by Parks Canada and the Canadian Wildlife Service.

PURPOSE AND OBJECTIVES

The report examines seasonal and year long distributions in relation to the species range requirements, weather and human activities in Jasper, Banff, Kootenay and Waterton Lakes National Parks. The information in this report is based primarily on observations made by the author and Warden Service staff during the period 1966-1972.

RESULTS

Sheep distributions have been divided into relatively discrete units (discussed fully in the text) with highest summer and winter counts and the locations of natural licks plus migration routes indicated. Distributions are discussed in the report in relation to the species range requirements, weather and human activities.

A detailed summary of the study is contained on pages 120-129.

RECOMMENDATIONS

The author makes three recommendations on page 130.

1. Small, isolated grasslands on south and west facing exposures at both 2,200 - 2,400 m. and $<1,500$ m. elevations need to be protected for winter habitat.
2. Natural licks are apparently essential to the well-being of the species, and these licks should be located, mapped and the animals given unrestricted use of them.
3. Park planning should attempt to minimize interference with the migration routes of the sheep between their seasonal ranges and natural licks.

David Reynolds
Assistant Resource Studies Manager
May 3, 1978

SEASONAL DISTRIBUTIONS OF ROCKY MOUNTAIN
BIGHORN SHEEP IN CANADIAN NATIONAL PARKS:
1966-1972

by
John G. Stelfox

1978

Canadian Wildlife Service
Edmonton, Alberta



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WLU 200-Sheep

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Canadian Wildlife Service Service canadien de la faune

February 28, 1978

Mr. W.C. Turnbull
Director, Western Region
Parks Canada
Calgary, Alberta

Dear Sir:

Enclosed herewith, please find a report "Seasonal Distributions of Rocky Mountain Bighorn Sheep in Canadian National Parks 1966-1972" by John G. Stelfox. This study was part of the CWS Parks Research function, jointly funded by Parks Canada and the Canadian Wildlife Service.

The report outlines seasonal sheep distributions in Jasper, Banff, Waterton Lakes and Kootenay national parks based primarily on observations made by the author and Warden Service staff during the period 1966-1972.

Maps for each park showing seasonal distributions, migration routes, largest numbers observed and the locations of natural licks are included. Sheep distributions throughout each park are divided into relatively discrete population units with seasonal counts for each unit provided in tabular form.

The report examines seasonal and yearlong distributions in relation to the species range requirements, weather and human activities. Major summer and winter ranges are delineated and comments provided on the impact of various park activities on the future welfare of various herds.

Warden Service personnel played a major role in providing information for this report and their cooperation is gratefully acknowledged. They reviewed the first draft of the report and their comments were included in this final draft.

Yours sincerely,

M.R. Robertson
Regional Director

Encl.

ABSTRACT

Seasonal and yearlong distributions of Rocky Mountain bighorn sheep (*Ovis c. canadensis* Shaw) are presented for the period 1966-1972 for Jasper, Banff, Waterton Lakes and Kootenay national parks. Sheep distributions are divided into relatively discrete units with highest summer and winter counts and the locations of natural licks plus migration routes also recorded. Distributions are discussed in relation to the species range requirements, weather and human activities. The future welfare of the sheep is discussed in relation to prime summer and winter ranges and various park activities on or near these ranges.

In summer, most sheep ranged on alpine grasslands above 2100 m, using south and east exposures early in summer with progressively more use of west and north exposures during late summer and fall. Fall snow storms caused about two-thirds of the population to descend below 2300 m. Most wintered on southwest, south, west and southeast exposures in that order of preference. There were two critical and widely separated winter ranges, namely: the subalpine and alpine grasslands above 1800 m, where about two-thirds of the sheep wintered and the transitional-prairie grasslands below 1375 m where about one-seventh of the animals wintered. The remainder wintered on small, isolated grasslands within the coniferous zone above 1375 m. Winter distributions were greatly influenced by snow depth, with sheep avoiding snow depths in excess of 30 cm.

New plant growth began first on low-elevation south-facing slopes and valley bottoms in April, at which time there was a further descent to this new forage. Sheep concentrated on these low spring ranges during April and May with ewes moving upwards to rugged, cliff

escarpment on south and east exposures in late May and June to have their young. There was then a gradual migration upward along south slopes towards high-elevation summer ranges, in response to the receding snowline.

The lambing and shedding period of June and July were accompanied by a craving for minerals, in particular copper, calcium and phosphorous. Frequent trips were made to natural dry and wet licks usually located at cutbanks near the mouth of streams. Man-made minerals and chemicals along roads, railways and within campgrounds were sought where available.

In 1966, there were about 4425 sheep in the parks, of which 2600 were in Jasper, 1300 in Banff, 350 in Waterton Lakes and 175 in Kootenay National Parks. During winter, all suitable grasslands were utilized, indicating a maximum distribution throughout the parks.

ACKNOWLEDGEMENTS

Park staff, in particular the Warden Service, recorded observations of bighorn sheep in the mountain national parks since these parks were established. Their observations and those obtained jointly with the author during ground and aerial surveys form the basis of this report. The major contribution they made to this report is gratefully acknowledged.

Much of the information for Kootenay National Park was obtained by Chief Naturalist Ian Jack to whom special acknowledgement is extended.

Several guides and outfitters and fire towermen contributed important information and their contributions are cited throughout the report.

Although the persons contributing information to this report are too numerous to mention, all contributions are hereby acknowledged. It is hoped that this compilation will serve as a useful reference and somewhat repay their efforts.

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1.0 INTRODUCTION AND LITERATURE REVIEW

The range of Rocky Mountain bighorn sheep (*Ovis c. canadensis* Shaw) in the Canadian Rockies occupies a strip about 50 x 700 km or 35 000 km², mainly east of the Continental Divide and between latitudes 51 and 55°N. Along this East Slope the pervious shale, sandstone and limestone mountains with gentle westerly slopes have developed productive grasslands that are optimally exposed to the prevailing westerly winds and to solar warmth, making the grasslands suitable for the winter survival of wild sheep. These pervious mountains extend into the East Kootenay region of southeastern British Columbia (B.C.) where bighorns have traditionally been plentiful (Bandy 1966, Demarchi 1967). West of the Continental Divide, the rugged, resistant, quartzite and limestone mountains contain only small grasslands and rocky alpine ranges which drop rapidly into coniferous forests. Bighorns were absent except for the area south of latitude 51° where the less resistant geological formations extend west of the divide and where winter conditions were less severe (Mackay 1952). The historical distribution of these bighorns is therefore closely correlated to the limestone-dolomitic mountain ranges in the Rockies.

Historically, bighorns were abundant along the North Saskatchewan Valley as far west as Mt. Wilson near the junction of the Howse and North Saskatchewan rivers. Local Indians reported this to be the western limit of this species (Tyrrell 1916). In 1811, the North Saskatchewan Valley from Gap Pass on the east to the south end of the upper Kootenay Plains supported large numbers of sheep with some bands containing more than 100 animals (Coues 1897). In 1859, the Palliser Expedition found bighorns in this valley with one band estimated at several hundred (Spry 1963). To the south they were common along the upper Kootenay River in 1811, the

upper Simpson River, and Cascade Mountain along the Bow River in 1841, and along Pipestone Creek north of the Bow Valley in the 1850's (Southesk 1875, Coues 1897, Simpson 1931, Spry 1963).

In what is now Jasper National Park, bighorns were plentiful on the eastern two ranges of mountains in the 1820's but were not present on the Continental Divide or west of it (Hollister 1912, Douglas 1914). Between 1855 and 1861 they were plentiful from the Brazeau River northward to the mountains along the Big Smoky River (Moberly and Cameron 1929).

Populations declined by 65-80% between 1850 and 1915 from over-hunting which was then made possible by modern firearms and the demand for meat by miners, railway workers, fur traders and lumbermen. Trophy hunting became a major industry with trophy hunters either shooting rams or purchasing them for \$25 to \$50 from Stoney Indians (Moberly 1884, Millar 1915, Hornaday 1923, Simpson 1931). Stoney Indians were annually shooting 650 to 1000 bighorns between 1913 and 1915 (Millar 1915). In severe winters such as 1886-87, 1887-88 and 1906-07, forage competition from livestock and possibly extensive fires also contributed to this decline (Jameson 1955, Soper 1962, Stelfox 1971). The decline was more noticeable between the Bow and Smoky valleys, where only 375 - 900 sheep remained by 1915. Along the Bow Valley and south to the international boundary, 1400 - 2500 bighorns remained in an area less than one-half the size of the northern area (Millar 1915). By 1915 only 75 - 250 sheep remained throughout the entire Athabasca drainage area (Millar 1915). Further south in Waterton Lakes National Park, bighorns were trying to survive the onslaught of large numbers of livestock on their grassland winter ranges. During the winter of 1910-11 an estimated

15,000 cattle and 100 horses wintered within this 530 km² park (1911 Annual Report by Superintendent of Waterton Lakes National Park).

The establishment of Jasper, Banff, Waterton Lakes and Kootenay national parks (hereafter referred to as Jasper, Banff, Waterton and Kootenay), in the late 1800's and early 1900's, brought relief from hunting and grazing, and new forage was produced on recent burns in the mountains. Bighorns increased rapidly in numbers and gradually filled their former ranges. The period 1915-1936 was a time when depleted populations, enjoying protection from hunters and low interspecific competition, tripled in size in the parks. The total 1936 population was estimated at 1300 in Jasper, 2000 in Banff, 1000 in Waterton and 125 in Kootenay (Stelfox 1971).

The period 1937-50 produced one of the highest recorded populations of sheep and this period was followed by rapid declines. In Banff and Waterton, numbers dropped below those estimated for the low population period of 1913-15. The Jasper die-off began during the winter and spring of 1947-48. Although populations did not decline concurrently, those in each of the four parks decreased by at least 75%. The die-offs were due to a verminous pneumonia or pneumonia-lungworm disease, precipitated by overstocked winter ranges and severe winter-spring weather (Stelfox 1971). By 1950, the national parks contained only about 1000 bighorns, approximately 400 in Jasper, 350 in Banff, 150 in Waterton and 75 in Kootenay.

From 1950 to 1966, sheep numbers rose slowly until 1955, then increased rapidly during the next decade. Counts by park wardens and Banfield (1953) indicated about 600 sheep in Banff, slightly fewer in Jasper, 150 in Waterton and 75 in Kootenay in 1953. By 1962 their numbers had increased to 1000 in Jasper, 900 in Banff, 235 in Waterton

and 125 in Kootenay (Tener 1953, Ward 1956). Corresponding populations in 1966 were estimated at 2600 in Jasper, 1300 in Banff, 350 in Waterton and 175 in Kootenay (Stelfox 1971).

Of interest is the fact that historical records indicate that the distribution of bighorns throughout the parks remained similar over the past 150 years. Whether numbers were high or low, their distribution over summer and winter ranges remained quite constant with differences mainly confined to changes in numbers. In addition to the sheep in Kootenay, a few ranged north, with one small herd found north of Golden at the head of Sheep Creek near the B.C.-Alberta boundary (Cowan and Guiget 1956).

A pneumonia-lungworm disease die-off in southeastern B.C. and in Kootenay in 1965 and 1966 prompted a study of the abundance and distribution of bighorns in these four national parks plus information on occasional sightings in Yoho National Park. Distributions are compared to those obtained in the 1940's and 1950's. This information should be useful for park planning, wildlife management and interpretive purposes.

2.0 THE STUDY AREA

Seasonal distributions of bighorns are presented for Jasper, Banff, Waterton and Kootenay parks. Although wild sheep do not normally frequent Yoho National Park, I have summarized records of occasional sightings. The locations of these parks are shown in Figure 1.

The study area encompassed 19 528 km² of which 10 920 km² are in Jasper, 6666 km² in Banff, 530 km² in Waterton and 1412 km² in Kootenay. Distributions are also shown for areas adjacent to Kootenay and Yoho parks on provincial lands.

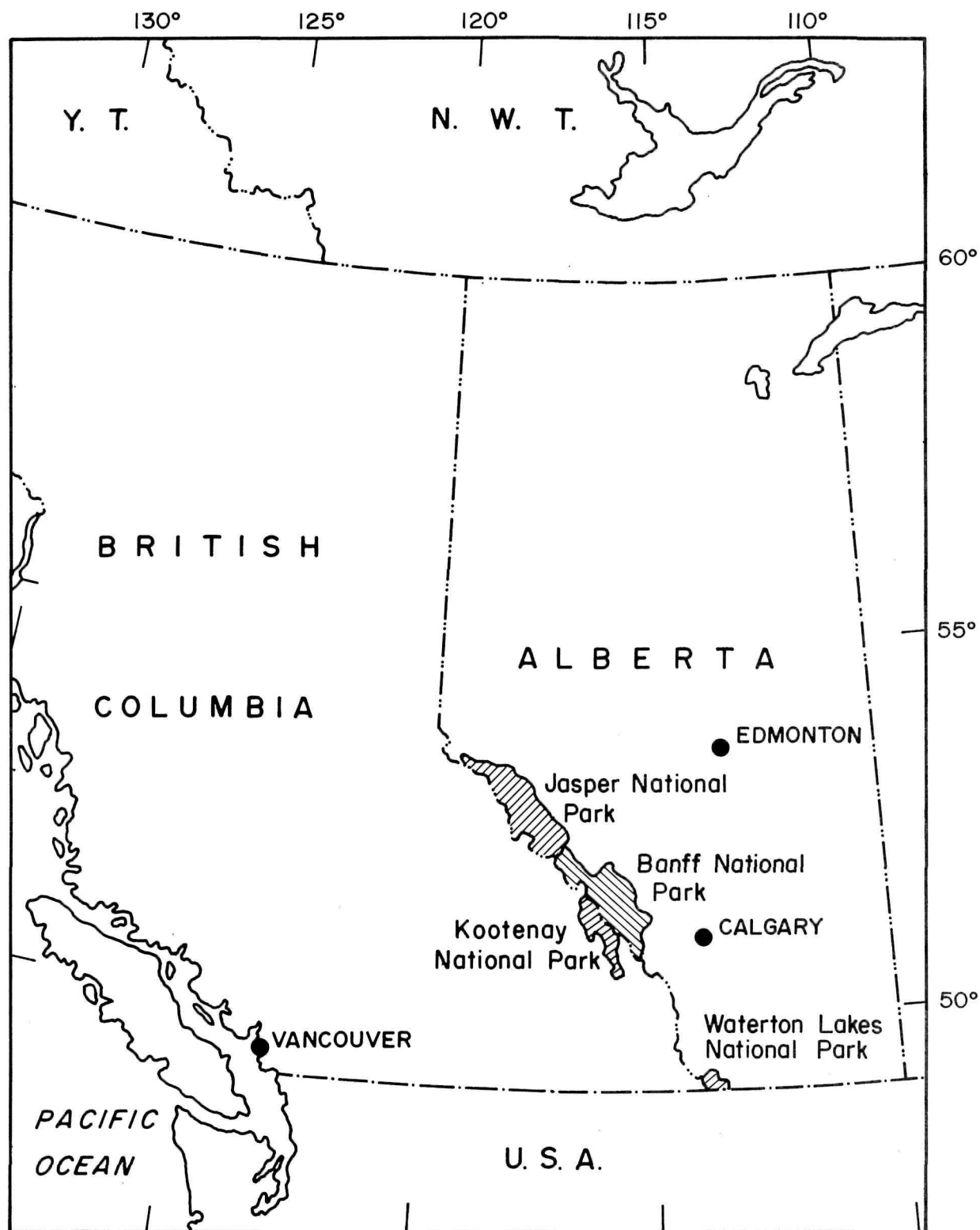


Figure 1. Locations of Jasper, Banff, Kootenay, and Waterton Lakes National Parks within the northern Rocky Mountains.

Geologically, the mountains supporting bighorns in Jasper and Banff lie within the front ranges of the Rocky Mountains. They are complex, folded and faulted sheets of grey paleozoic carbonates and shales, often with exposed Mesozoic shales, sandstones and carbonates. Characteristically they have steep eastern escarpments and gentle westerly slopes on which extensive alpine and subalpine grasslands have developed, that are essential for the survival of bighorn sheep. Mountains in Waterton and Kootenay lie within the main range of the Rocky Mountains and are composed of older and harder strata, mostly red, green and grey precambrian and cambrian sandstones, quartzites, shales and limestones.

The ranges run in a northwest to southeast direction, thus optimally exposing the gentle southwest slopes in winter to the beneficial effects of solar heat and the westerly winds which bare these grasslands of snow for most of the winter.

The drier and warmer slopes facing south and west support more herbaceous and shrubby vegetation, while the moister and cooler slopes facing east and north support more coniferous trees. Variations in topography, altitude, geological formation and climate provide the alternation between pasture and cover, and the opportunity for escape, which is so important to all ungulate species.

3.0 METHODS

Aerial surveys of the parks during the period December 1966 to December 1971 form the basis of the results presented here. These surveys were conducted from helicopters, principally the G3B-1 model, in cooperation with park warden service officers. Surveys covered all known ranges of bighorns, with sightings of sheep correlated to elevation and exposure.

Supplementary information obtained from ground studies was also incorporated with aerial survey information.

Fall counts of ungulates by wardens for various warden districts were also most useful in providing information on the abundance and distribution of bighorns during the fall period. Wildlife observation cards also provided some useful information, especially concerning unusual sightings such as those west of the Athabasca and Sunwapta rivers in Jasper, and summer distributions in Kootenay.

4.0 RESULTS

4.1 General Seasonal Migration Patterns

Sheep generally summered above 2100 m. They passed through winter ranges on their way to low-elevation natural licks, on their way to water or when crossing valleys to reach other ranges. As the September and October snows and low temperatures froze and partially covered the alpine forage, about two-thirds of the sheep drifted downward onto winter grasslands below 2300 m (Figure 2). Of these, about 50% wintered in the subalpine-alpine zone (1800-2300 m), 29% on small grasslands within the Canadian coniferous zone (1350-1800 m), and 21% within the Transition (Prairie) zone of 1050-1350 m (Stelfox and Taber 1969).

Throughout the year, sheep remained almost exclusively on grasslands and rocky escarpments where they foraged on a variety of grasses, forbs, and low shrubs. Climatic factors affecting the distribution of sheep, especially during winter, were snow depth and snow resistance, wind velocity, temperature and barometric pressure. The mobility of bighorns was noticeably impaired when snow depths reached two-thirds of their chest height or 29.3, 31.8, 32.4 and 35.9 cm for lambs, yearlings, ewes

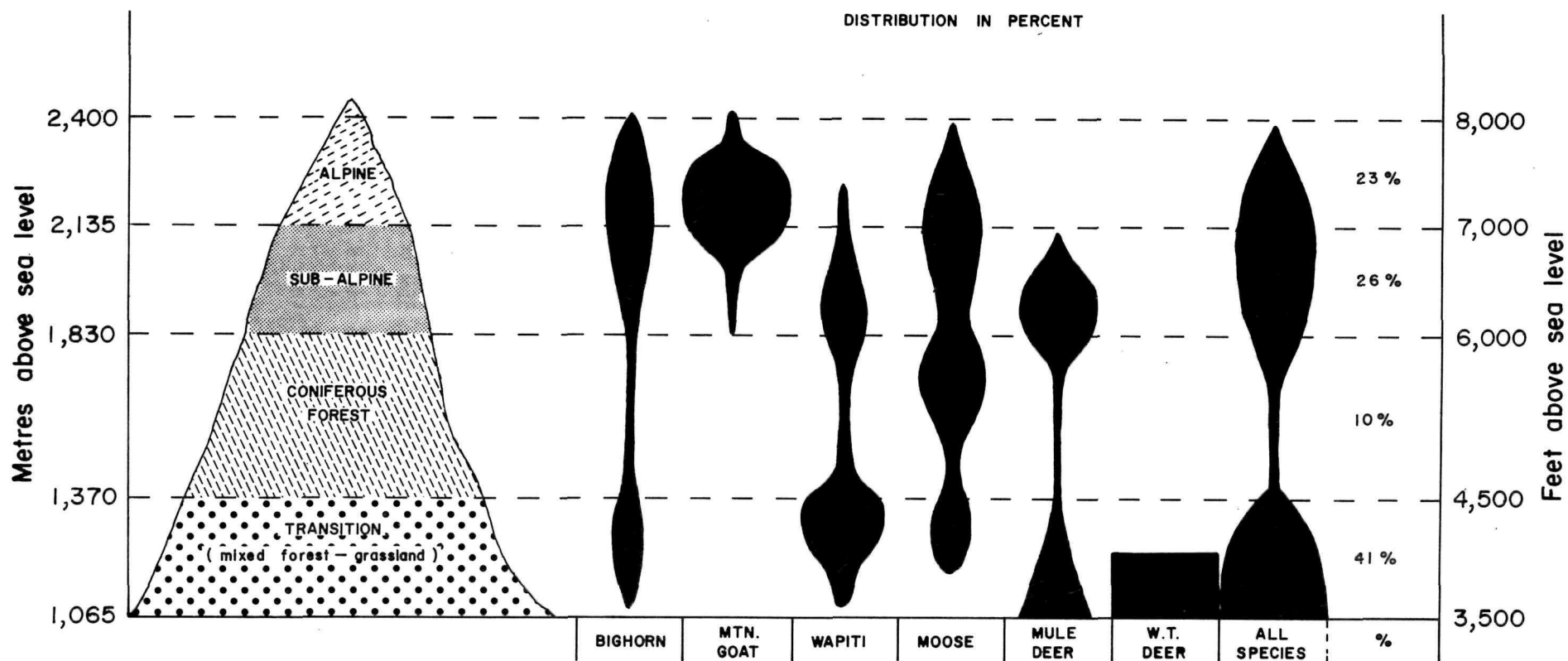


Figure 2. Midwinter distribution of ungulates by elevation in the Canadian Rocky Mountain national parks.

and rams respectively (Stelfox 1976). In general, sheep avoided snow depths in excess of 30 cm, so their winter distribution was restricted to grasslands near to rocky escarpments where snow depths were less than 30 cm. Thus the winter distribution of sheep may vary considerably from year to year because some winters impose a snow severity 10 times greater than other winters. Movements of bighorns were generally most restricted during the period January-March when the greatest snow resistance (depth x hardness) occurred.

Bighorns maximized nutrient intake by pursuing areas of "green-up" which occur on various exposures and elevations throughout the six-month growing season (April-September). They generally migrated upward along slopes facing south and east which green up first in May and June, until they reached the subalpine and alpine grasslands. In July and August they foraged on south and west slopes at the highest vegetation elevations and along alpine valley bottoms as snow fields receded. By late August and early September they shifted towards north-facing grasslands and semi-open forests where the snow melted late and the herbaceous forage remained succulent and nutritious late into the fall. During winter they ranged on grasslands facing south and west at either high or low elevations depending on snowpack conditions (Figure 3).

4.2 Winter Distributions Related to Exposure and Elevation

The distribution of bighorns, elk, deer and mountain goats according to the eight exposure aspects are presented in Table 1 and Figure 3 for the winter of 1966-67. This table shows that for all parks 89.1% of the bighorns were found on southwest, south, west and southeast exposures (26.7, 24.1, 21.1 and 17.2%, respectively). On these same exposures were

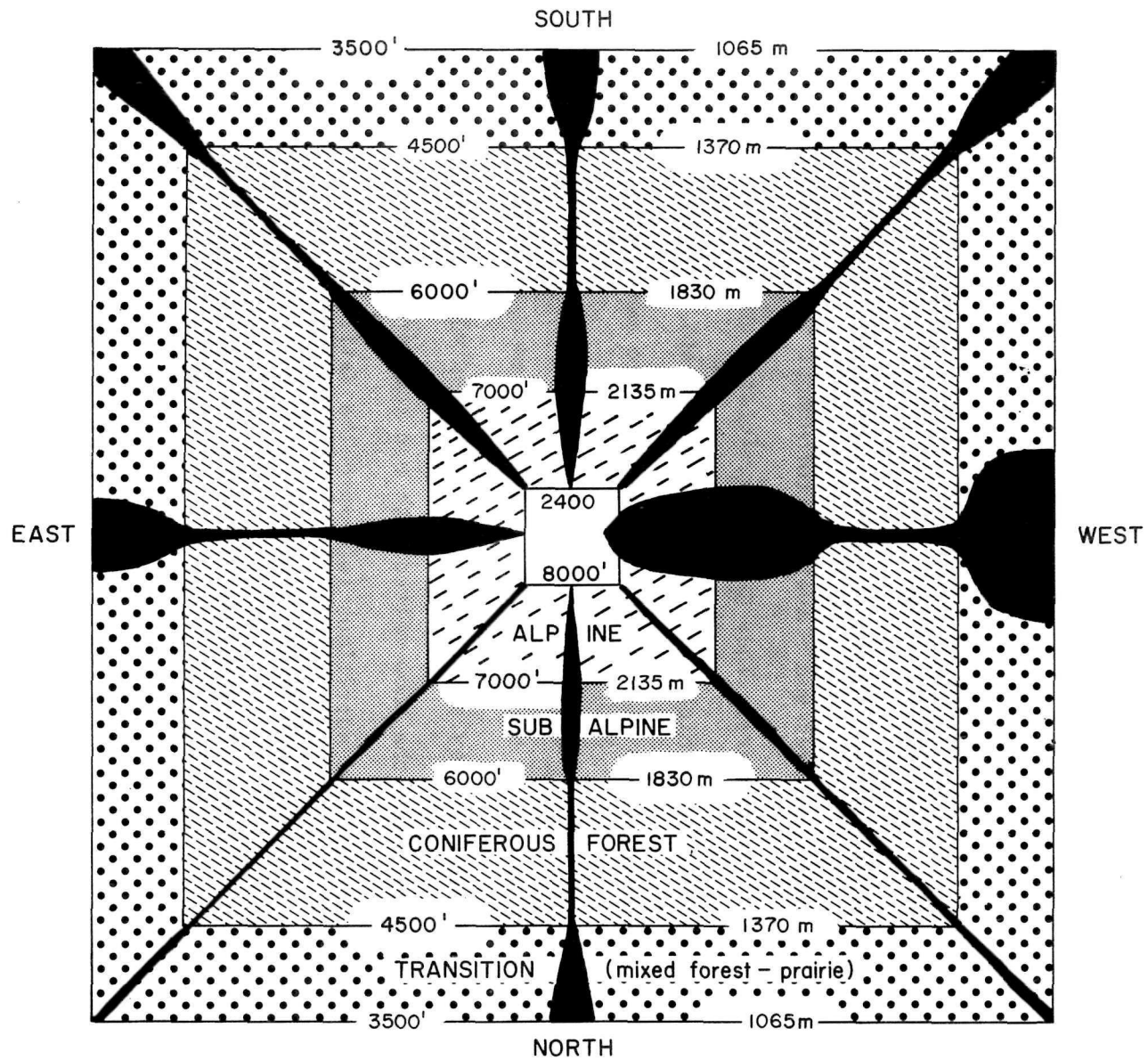


Figure 3. Midwinter distribution of ungulates by elevation and exposure in the Canadian Rocky Mountain national parks.

Table 1. Winter distribution of wild ungulates in relation to various exposures (aspects) on open and semi-open winter ranges, December 1966 to February 1967.

Species	Total No.	Directional Slopes								
		W	SW	E	SE	N	NW	NE	S	Flats*
JASPER										
Bighorn	1407	15.9	36.6	0.4	21.3	1.0	1.4	-	23.4	-
Moose	20	10.0	5.0	-	-	-	-	-	10.0	75.0
Elk	119	12.6	13.4	-	-	-	5.0	-	21.8	47.2
Goat	31	45.2	6.5	-	-	3.1	-	-	-	45.2
Mule deer	21	4.8	71.4	-	23.8	-	-	-	-	-
BANFF										
Bighorn	585	27.7	16.6	-	10.4	-	5.5	-	39.8	-
Moose	1	100.0	-	-	-	-	-	-	-	-
Elk	61	11.5	-	-	9.8	-	-	-	78.7	-
Goat	35	91.4	-	-	-	-	2.9	-	5.7	-
Mule deer	0	-	-	-	-	-	-	-	-	-
WATERTON LAKES										
Bighorn	271	11.8	5.2	8.1	15.1	42.2	17.0	0.6	-	-
Elk	244	1.6	-	77.9	-	20.5	-	-	-	-
Goat	14	-	57.1	-	42.9	-	-	-	-	-
Mule deer	150	-	34.7	32.7	4.0	20.0	1.3	7.3	-	-
KOOTENAY										
Bighorn	79	97.5	-	-	-	-	-	-	2.5	-
Elk	5	100.0	-	-	-	-	-	-	-	-
Mule deer	80	71.2	-	-	-	-	-	-	28.8	-
White-tailed deer	8	100.0	-	-	-	-	-	-	-	-
TOTALS & AVERAGES (ALL PARKS)										
Bighorn	2342	21.1	26.7	1.1	17.2	5.5	4.2	.01	24.1	-
Moose	21	4.8	9.6	-	4.8	-	-	-	9.6	71.2
Elk	429	7.2	3.7	44.3	1.4	11.7	1.4	-	17.2	13.1
Goat	80	57.5	12.4	7.4	-	1.3	1.3	-	2.6	17.5
Mule deer	251	23.1	26.7	19.5	4.3	12.0	0.8	4.4	9.2	-
White-tailed deer	8	100.0	-	-	-	-	-	-	-	-

*Refers to high elevation table-land, semi-open passes or sedge and willow bogs

found 38.1% of the mule deer, 29.5% of the elk, 72.5% of the goats and 28.8% of the moose. Table 2 shows that these concentrations of wild ungulates occurred on the alpine, subalpine and transition (Prairie) grasslands biomes.

Southwest slopes received first preference by bighorns and mule deer, whereas elk favored east slopes. The sample size was 2088 sheep, 159 mule deer and 127 elk using the same ranges on the southwest, west, south and southeast slopes. Preferred wintering slopes were not the same in all parks. For example, in Kootenay on the west slope of the Rockies, all the elk and white-tailed deer, plus 97.5% of the sheep and 71.2% of the mule deer were on south-facing slopes. In Banff and Jasper, most sheep, elk and mule deer were on south, southwest, west and southeast slopes, whereas goats and moose were most common west, southwest or alpine topline exposures. In Waterton, all ungulates were scattered over almost all exposures with 59.2% of the sheep on the north and northwest slopes. Southeast, east and southwest slopes were the next most preferred slopes by the majority of ungulates. A warm "chinook" wind bared most mountain slopes of snow up to the 2250 m elevation in Waterton the day prior to the February aerial survey. The disappearance of snow in mid-winter probably permitted this dispersion of ungulates throughout various exposures and upwards onto high-elevation grasslands.

Concerning the winter distribution of ungulates at various elevations, 62.8% of the sheep, 25.0% of the moose, 36.0% of the elk, 100% of the goats and 63.6% of the mule deer were observed wintering above the 1825 m elevation during the period December 5 to February 23 (Table 2 and Figure 2); 32.1% of the bighorns were even wintering above 2250 m. Only 11.4% of the sheep wintered on small grasslands within the Canadian

Table 2. Elevations utilized by wild ungulates on open or semi-open mountain slope winter ranges, December 1966 to February 1967.

Species	Total No.	Percent Occurrence of Bighorns at Various Elevations (metres)								
		1050 1225	1250 1375	1400 1525	1550 1675	1700 1800	1825 2000	2010 2135	2150 2250	2300 2450
JASPER										
Bighorn	1407	14.6	22.7	4.6	4.5	6.4	3.4	14.1	12.4	17.3
Moose	18	-	22.1	-	-	50.0	-	16.7	5.6	5.6
Elk	120	37.5	15.8	6.7	-	0.8	29.2	10.0	-	-
Goat	65	-	-	-	-	-	-	3.1	75.4	21.5
Mule deer	25	24.0	28.0	-	-	-	16.0	32.0	-	-
BANFF										
Bighorn	585	-	-	4.6	-	-	7.6	34.0	50.6	3.3
Moose	2	-	-	-	-	-	-	-	-	100.0
Elk	46	-	-	-	-	-	80.4	2.2	17.4	-
Goat	35	-	-	-	-	-	5.7	28.5	65.7	-
Mule deer	0	-	-	-	-	-	-	-	-	-
WATERTON LAKES										
Bighorn	271	-	-	6.3	-	1.1	56.1	29.1	7.4	-
Elk	244	-	77.9	-	-	-	22.1	-	-	-
Goat	14	-	-	-	-	-	-	100.0	-	-
Mule deer	150	-	-	-	-	-	100.0	-	-	-
KOOTENAY										
Bighorn	79	100.0	-	-	-	-	-	-	-	-
Elk	5	100.0	-	-	-	-	-	-	-	-
Mule deer	80	100.0	-	-	-	-	-	-	-	-
White-tailed deer	8	100.0	-	-	-	-	-	-	-	-
TOTALS & AVERAGES (ALL PARKS)										
Bighorn	2342	-	23.6	4.7	2.7	4.0	10.4	20.3	20.9	11.2
Moose	20	-	20.0	-	-	45.0	-	15.0	5.0	15.0
Elk	410	11.0	51.0	2.0	-	0.02	30.7	3.2	2.1	-
Goat	100	-	-	-	-	-	2.0	12.0	72.0	14.0
Mule deer	255	33.7	2.7	-	-	-	60.4	3.2	-	-
White-tailed deer	8	100.0	-	-	-	-	-	-	-	-

coniferous zone between 1400 and 1800 m, although 13.6% were found below 1400 m on the transition grasslands. This break in altitudinal distribution means that sheep, and to a lesser extent elk and mule deer, preferred the alpine and subalpine (Hudsonian) zones whenever grassland forage was available due to mild winter conditions. When deep snows forced a downward migration, they generally moved down through the 400 m Canadian (Montane) zone to the lower semi-open portions of this zone and onto the grass-shrublands of the transition (Prairie) zone near the valley floor.

One point that becomes apparent when examining Table 2 and Figure 2 is that the altitudinal winter distribution of sheep and other ungulates is quite different among the various parks. This will be discussed in detail later but in Kootenay, sheep, elk, mule and white-tailed deer generally wintered at the 1050 - 1225 m elevation. In Jasper, sheep, elk and mule deer wintered both at this low elevation and on high, wind-swept slopes at the 1850 - 2150 m zone. Banff and Waterton had similar wintering patterns, with most sheep and mule deer at the 1850 - 2250 m zone.

The following conclusions can be drawn concerning sheep and other ungulate winter distributions in the four parks:

1. Most sheep and goats wintered on the southwest, south, west and southeast exposures in that order of preference.
2. Southwest slopes received first preference by sheep and mule deer whereas elk favored east exposures.
3. Preferred wintering slopes and elevations for ungulates were not consistent among the parks.
4. There were basically two critical and widely separated

altitudinal zones on which sheep and other grazing ungulates wintered. About two-thirds of the sheep and mule deer, virtually all the goats and one-third of the elk wintered above 1800 m with one-third of the sheep and most goats above 2135 m. The second important winter zone lies below 1375 m where one-seventh of the sheep, one-third of the mule deer, two-thirds of the elk and all of the whitetails occurred.

4.3 Jasper National Park

4.3.1 Historical

Jasper contains extensive summer ranges (Figure 4) but due to severe winter conditions the winter ranges are confined to low-elevation Athabasca grasslands, to small isolated grasslands in the montane and sub-alpine forests and to some alpine-tundra grasslands throughout the eastern half of the park where the effects of wind and sun maintain shallow snow depth (Stelfox 1975). There are also vital winter ranges east of the park onto which several hundred sheep annually migrated in late fall.

The fall-early winter distributions of sheep on 24 ranges during the period 1941-66 are presented in Table 3 while Figure 5 shows the 1944 and 1946 distributions as determined by Cowan (1944) and Banfield (1953). Both these observers noted that some populations may have been missed.

Distributions in the late 1960's were similar but more extensive than those reported in either the 1800's (Tyrell 1916, Spry 1963, Stelfox 1971) or in the 1930's and 1940's (Cowan 1944, Banfield 1953). Hollister (1912) reported that in 1911 bighorns had been formerly abundant but were not confined to a few limited ranges. In 1924 J. Harold



Figure 4. A major yearlong sheep range along the east side of Mt. Stornoway, Jasper, July 1967.

Table 3. Abundance of bighorn sheep in Jasper National Park, 1941 to January 1967.

Area	1941-43	1944	1948	1952	1955	1959	1961-65*	1965	Aerial survey 1966	Best counts 1965- 66	1966 Est. pop.	
	Cowan				Warden Counts						summer	winter
Wilcox - Tangle		28	None seen during 18 day survey of Brazeau, Rocky and Mailgne districts, summer 1948, nor since June 1947.	-	50	17	-	63	49	110	110**	65
Signal - Kerkeslin	9	101		-	-	1	36	9	22	30	50	50
Leah - Opal Mtns.	-	-		-	1	-	-	-	1	6	5-10	5-10
Portal Creek	5	0		-	4	-	-	-	-	1	0-5	0-5
Lodge Turnoff	22	66		72	100	-	131	95	87	95	100	110
Colin - Jacques Rges	229	160		9	65	296	-	220	190	206	225	225
Jacques Lake	-	-		-	4	-	-	53	20	20	25	25
Head of Rocky	-	19		-	-	-	-	93	93	93	225**	125
Miette Rge - Makwa	46	100		27	22	-	62	83	101	101	110	110
East Gate - Hot Springs												
- Mystery Lake	47	73		51	23	46	23	189	80	187	190	190
Upper Fiddle**	-	-		-	-	-	-	39	83	83	200**	100
Moosehorn Tunnel	450***	199		64	65	-	-	79	140	140	250**	125
Devona (Snake Ind.)	223	263		99	50	105	-	319	63	81	85	85
Windy Point	-	-		50	84	87	-	110	166	166	175	175
Ram Pass (Stornoway)	150***	-		3	-	-	93	178	178	178	250	250
Daybreak Ridge	-	-		-	-	-	25	153	55	60	75	75
Mowitch Creek	-	-		-	14	0	12	19	27	27	75**	25
Natural Arch	-	32		6	7	35	17	12	3	17	25	25
Cairn - Southesk	247	250		9	80	85	-	245	116	245	250**	200
Brazeau & Isaac	22	15		26	44	-	-	103			175**	150
Totals	1450	1306	counted	416	613	672	399	1258	1390	1846	2600	2115
		2259	estimated									

*Warden N. Woody's count 1961-65

**Part of these herds winter outside the park

***Count by F. Burstrom

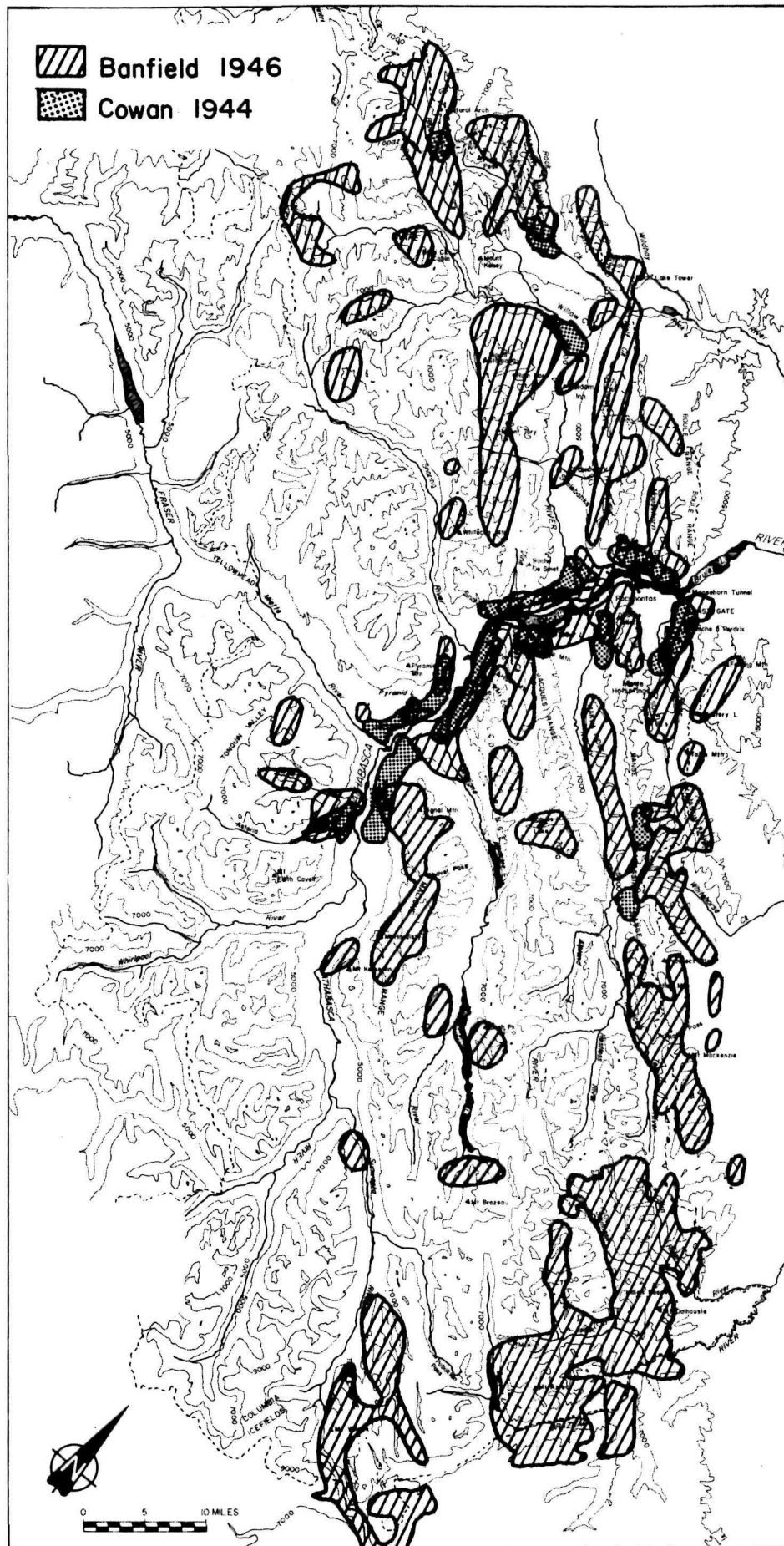


Figure 5. Distributions of bighorn sheep in Jasper National Park, 1944-46 as reported by Drs. I. McT. Cowan and A.W.F. Banfield.

McLaughlin (Canada Geological Survey) reported (pers. comm.) sheep to be very plentiful along the Rocky River with 300-400 seen in 3 months in bands of 50-60. In 1941, bighorns were abundant and seen on both sides of the Athabasca Valley from Jasper townsite down; all the way up the Snake Indian to the head of Blue Creek; at Rocky Forks; Rocky Pass; Cairns Pass, Brazeau River and Lake with an estimated total of 841 head in the park (Clarke 1942).

However, the distribution of sheep along the Miette and Astoria watersheds was more extensive in the 1930's and 1940's. George Camp (retired park warden) reported (pers. comm.) that during the winters between 1930 and 1940 he often saw up to 30 sheep in the Portal Creek area along the Cavell Road near the Mile 11 hoodoos, an area where no sheep were seen in the 1960's. He believed they summered west toward Lectern Park and the headwaters of Portal Creek. Cowan (1943) reported a small band wintering on the lower part of the Astoria and saw part of this flock on 21 April 1943. Park Warden Larry McGuire reported that during the 1930's, outfitter Roy Hargreaves hunted bighorns along the headwaters of the Miette River and that in the summer and fall they were found at the headwaters of the Snaring River. However, none were found in Mt. Robson Provincial Park to the west, and Superintendent D.E. (Herb) Greene of that park stated (pers. comm.) that bighorns had not been seen there, at least since 1921. He thought that a few may be found in the Tonquin basin near the head of the Fraser River.

In 1943, 247 sheep were reported on Mt. Southesk (Cowan 1943) while Warden Frank Burstrom estimated 450 sheep between the Moosehorn River and Brule Lake. Warden Norm Woody reported (pers. comm.) that in 1944-45 he counted over 500-600 sheep in the Isaac-Cairn-Rocky area with deer, moose

and elk also plentiful and feeding in close association with sheep in the Cairn area. In 1949 he found only one 2-year-old ram in the Cairn area, with the big die-off occurring during the winter of 1947-48.

In 1948, an 18-day reconnaissance of the Rocky River area by wardens Fisher and Camp resulted in no sheep seen and it was presumed a die-off had occurred outside the park on Ruby and Thistle creeks (Fisher 1948). Careful scrutiny of Cairn Pass and Deception Creek by Warden Frank Camp revealed 3 weak ewes at Cairn Pass in June 1947. Wardens believed the die-off occurred during the winters of 1944-45, 1945-46 or 1947-48. In 1953, bighorns were still scarce and an aerial survey revealed 30 at Isaac Creek, 25 north of the Brazeau cabin and 10 on the Southesk drainage area (Banfield 1953). Banfield concluded the die-off occurred during the severe winter of 1947-48 and that the maximum park population in 1953 was 600 sheep.

Two other areas where bighorns were more plentiful prior to the 1946-49 die-off than in the 1960's were Mt. Kerkeslin, where George Camp reported seeing 17 - 20 from the mid 1920's until the above die-off, where Cowan reported 16 in 1944 and the wardens 2 in 1953, and also the Beatty Creek headwaters across the Rocky River from Deception Mountain.

The western limit of sheep in 1941 was described by Clarke (1942) as Nigel Pass and Sunwapta River around Wilcox Peak, east to Jonas and Poboktan passes, north along the Brazeau Range, Maligne Pass and Divide to about Antler Mountain, west to the Athabasca River, down the Athabasca to Jasper town, around the slopes behind Jasper to the Snaring River, northwest to Blue Creek, then up Blue Creek to Rockslide Creek and the Smoky River. However, in 1944 and 1946 sheep were reported as far west of the Athabasca River as the Tonquin Valley and also west of Blue Creek

(Figure 5). Again in 1955 or 1956, Warden Larry Tremblay reported seeing large numbers of sheep summering between the south and north forks of the Snake Indian River and toward the head of the Snaring River. This was not a stable population as Woody reported seeing no sheep west of Blue Creek during the 1962-65 period.

4.3.2 1966-71 Populations and distributions

From examinations of both aerial and ground counts plus movement observations from 1966 to 1971 there appeared to be 12 relatively discrete sheep populations in Jasper. Some intermingling among populations occurred and these will be discussed later.

Figure 6 presents the known summer and winter distributions and rutting ranges while Figure 7 delineates the 12 population units and shows the highest counts for each band for the 1966-71 period.

Seasonal counts and a population estimate for each unit are presented in Table 4. It is important to realize that both the summer and winter distributions were strongly influenced by the duration and severity of winter weather. Mild, light-snow winters permitted sheep to survive in vigorous condition and to head for summer ranges earlier, thus covering extensive areas in summer. The converse was true during and after severe, long winters.

A description of the location, seasonal movements and a population estimate of each unit follows. For information on numbers of sheep counted in each locale during a thorough population survey during the winter of 1966-67 the reader is referred to Appendix I.

Descriptions of these 12 geographic sheep units, and the winter and summer populations within each, are as follows:

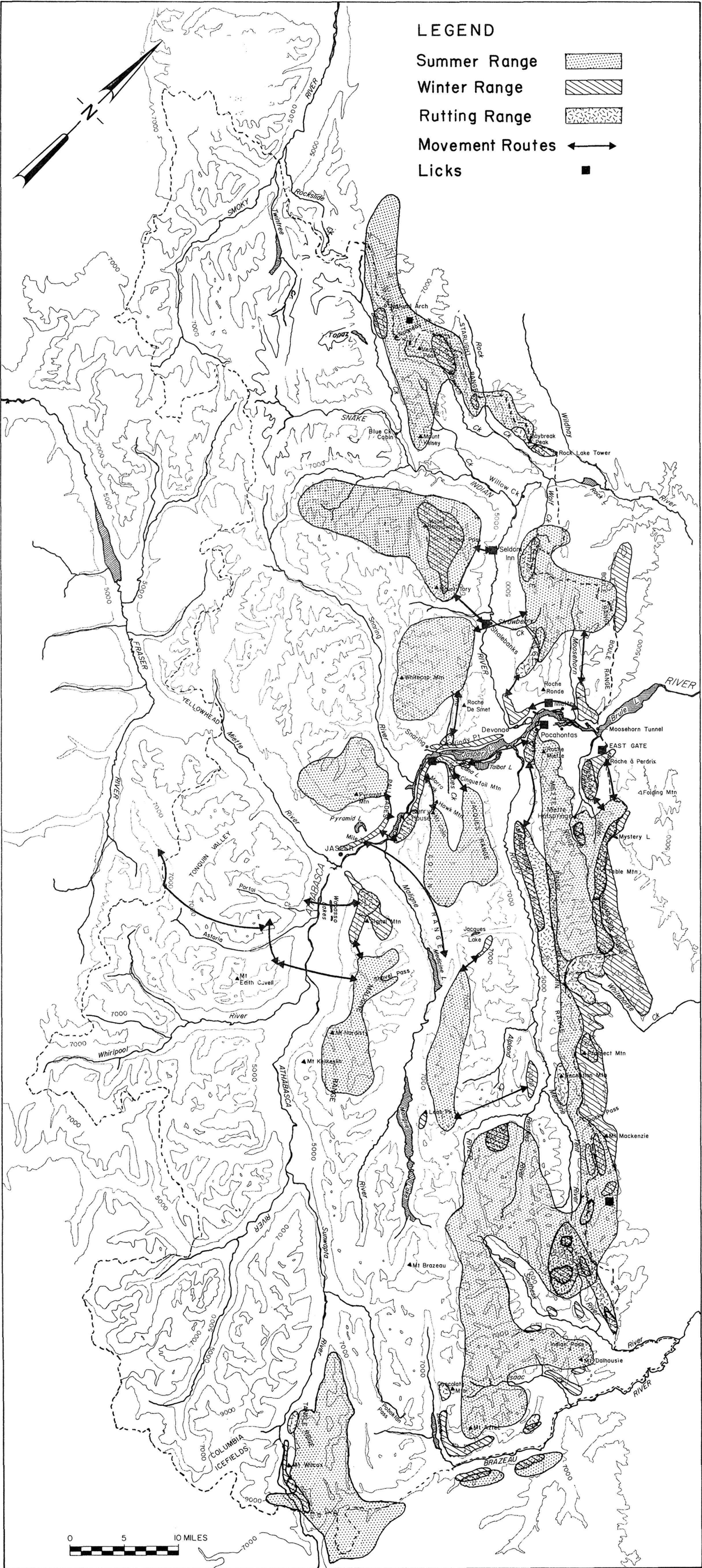


Figure 6. Seasonal sheep distributions in Jasper National Park, 1965-1972 .

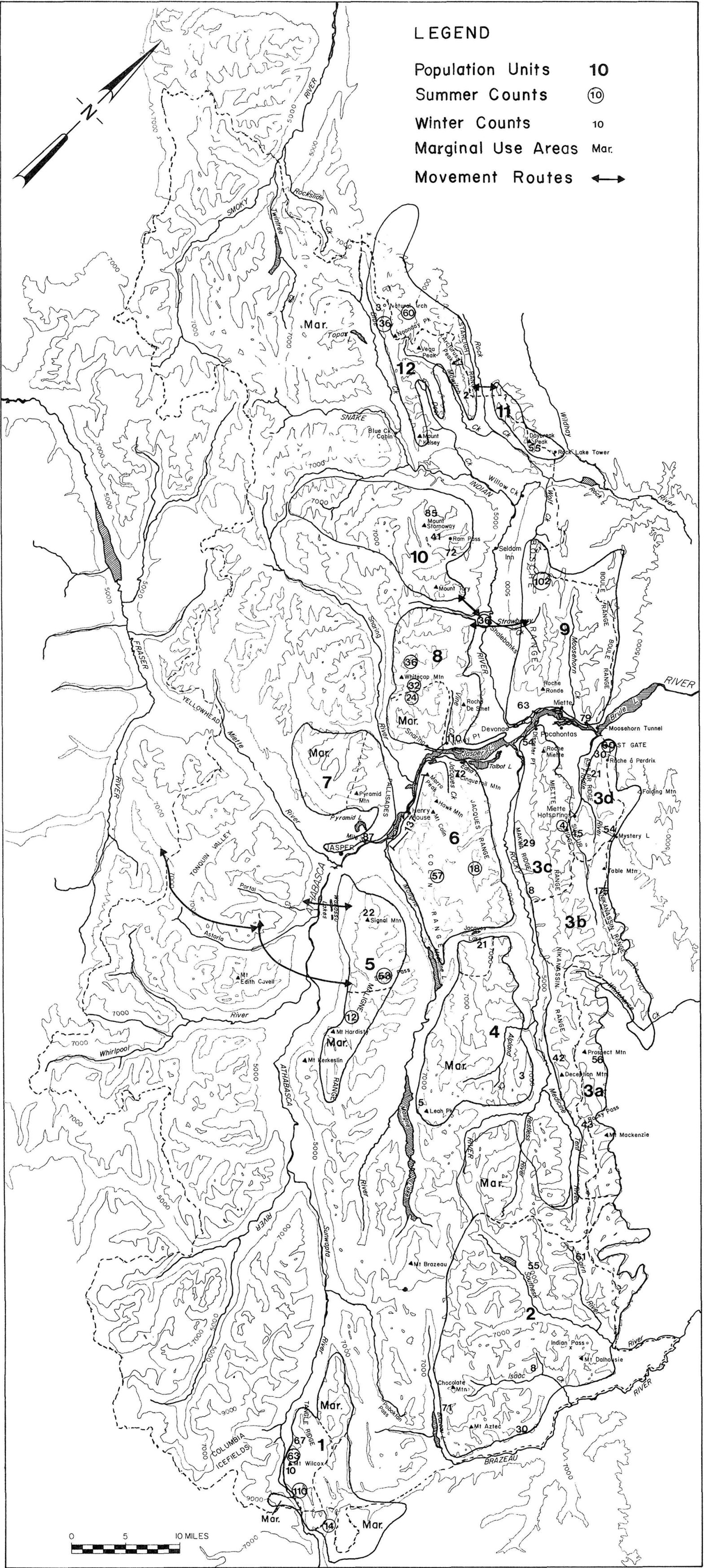


Figure 7. Bighorn sheep population units, maximum numbers counted in winter and summer counts, 1966-1970.

Table 4. Bighorn sheep populations within 12 units in Jasper National Park, 1965-71 and the highest unduplicated counts by season.

Brand Name and Number	BEST UNDUPLICATED COUNTS BY SEASON, 1965-71				Est. Pop.
	Oct.-Dec.	Jan.-March	Apr.-June	July-Sept.	
1 Tangle Ridge	102	63	28	110	110
2 Brazeau-Cairn	245	225	90(Cairn)	106	300-350
3 Rocky-Fiddle	215(346*)	320	220	-	575-650
4 Queen Elizabeth	26	29	-	-	30-50
5 Maligne Mtns.	36	23	48(Fort Pt.)	53	55-75
6 Jacques-Colin	201	190	-	-	200-225
7 Pyramid-Graveyard	95	87	108	-	100-110
8 Snaring-Windy	106	110	73	-	110-125
9 Bosche-Boule	201	142	-	104	175-200
10 Stornoway	178	198	-	133	200-250
11 Daybreak	42	55	60	-	60-75
12 Starlight	18	22	-	40	40-50
TOTALS	1465	1464	-	-	1955-2270

*Dec/63 helicopter census of sheep along east boundary and on adjacent Alberta ranges.

Unit 1 (Tangle Ridge)

This population which numbered about 110 animals in summer and 65-100 in winter, utilized the southern portion of Jasper in the vicinity of the Columbia Icefield and the northern portion of Banff in the Nigel Creek, Cline River area. Rams wintered along the west side of Wilcox Peak and the south end of Tangle Ridge at 1800-2000 m, adjacent to Highway 93, where 16 mature rams were counted in February 1968. Ewes and immatures wintered mainly along the south end of Wilcox Peak at 2200-2500 m. The main rutting area was on the south end of Wilcox Peak. In October and November 1965, wardens counted 63 sheep on this rutting range and in December 1966 they counted 43 sheep on the Wilcox and Tangle slopes. Some of this band appeared to winter to the southeast along the Cline River, as the population was always higher in summer than in winter, and because some were seen south of Nigel Peak in the fall. In September and October 1971, 14 sheep (4 full curl rams and 10 ewes and lambs) were seen on the south side of Nigel Pass. In September 1966 a full curl ram with numerous porcupine quills in its face was observed along Highway 93 below Cirrus Mountain, presumably part of this herd.

In summer this band dispersed east towards Jonas and Nigel passes where their number was probably increased by animals migrating northeast from the Cline River, Pinto Lake area. Warden Max Winkler counted 110 sheep (including 35 rams) on Tangle Ridge and Wilcox Peak in the summer of 1965. Some of these animals moved west of Highway 93 onto Mount Athabasca in the summer for a short period. Summer dispersal began in late April-early May. On 17 May 1972 some were at the Sunwapta Viewpoint, some high on Tangle Ridge (2400 m) and some on the south slope of Wilcox Peak. By late May-early June they made frequent trips to obtain salt at

the Icefields Chalet. Here 38 rams and ewes were seen on 2 June 1969. At this time they were using the south, west and northwest slopes of Wilcox Peak.

Unit 2 (Brazeau-Cairn)

The distribution of this population ran from the Brazeau River on the south and east to the Rocky River on the north and the headwaters of the Thistle and Ruby creeks on the east. There were about 350 sheep inside the park in summer and fall and about 300 in winter and spring. In the fall of 1965, wardens counted 245 bighorns on the Southesk, Cairn, Isaac and Brazeau slopes while 215 sheep were counted in this unit during the December 1966 helicopter survey. Winkler estimated a population of 300-350 in this unit in the fall of 1965.

The major rutting ranges were on the south slopes of Chocolate and Aztec mountains where Warden Bob Barker counted 90 sheep (32 rams) on 7 November 1971 and the upper Cairn River where Barker counted 78 sheep (33 rams) on 3 November 1968.

The six main winter ranges were on the south and west slopes of:

1. Chocolate and Aztec mountains (50-75 sheep).
2. Arete-Valleyhead mountains (15-30).
3. Isaac-Dalhousie mountains (10-20).
4. Mount Southesk (50-55).
5. Upper Cairn Valley (60-70).
6. Thistle-Ruby mountains east of Jasper (50-75).

CWS biologist Jack Nolan observed a small band of 15-20 sheep (ewes and rams) wintering on a ridge between the Restless and upper Rocky rivers during two recent winters and noticed them using this ridge as a rutting

range in early winter.

In June, large numbers still occurred in the Cairn Pass area and here 90 were seen in June 1965 by wardens. In July and August they were spread throughout the unit on the alpine ranges, especially at the head of Isaac Creek where 28 rams were seen on 22 July 1971 by Barker. A helicopter survey on 14 July 1968 showed 84 sheep at Cairn Pass, 10 at Indian Pass between the Southesk and Isaac and 7 on the south slope of Isaac Creek.

Portions of this population moving north from Cairn Pass along the east side of the Medicine Tent undoubtedly extended into Unit 3 while the converse was true for sheep moving south from Toma-Lagrace mountains. This interchange was not believed to be extensive enough to warrant putting all of the Medicine Tent watershed into Unit 2. Certainly some of the Cairn Pass band moved over to Thistle and Ruby mountains, presumably to use winter ranges there and to use the natural lick on the northeast side of Ruby Mountain.

Some movement was also believed to take place across the upper Rocky River between the small bands that winter west of the Restless River and east of Alpland Creek. It is likely that the rams that wintered on the Leah-Opal slopes overlooking Maligne Lake came from one or both of these ranges.

Unit 3 (Rocky-Fiddle)

This population ranged from the upper Medicine Tent River northwesterly to the Athabasca Valley and the mountain range extending east of the park, a distance of 10 - 25 km. Although there was an interchange of animals throughout the area there were four relatively discrete

subpopulations as follows:

- 3a - Upper Rocky and Medicine Tent area south of the Miette Range and the head of the Fiddle River. This area supported about 150-225 sheep in winter comprising 50-75 between Ruby Mountain and Rocky Pass, 75-100 from Rocky Pass to Whitehorse Creek east of the park, and 40-50 along the Nikanassin Range south of the mouth of Jacques Creek. This area has long been a productive sheep area, as Warden George Camp reported seeing 125 big-horns on Mount Lindsay and Mount Balcarres in February 1941.
- 3b - Nikanassin Range and upper Fiddle River. About 175-225 sheep wintered here with 150-175 along Table Mountain and Whitehorse-Berry creeks, together with another 25-50 along the Nikanassin Range east of the Rocky River.
- 3c - Miette Range and Makwa Ridge. This sub-unit supported 90-100 sheep on a year-long basis.
- 3d - Sulphur and Ashlar ridges and Roche a Perdix. This area contains about 100 sheep which spent most of the year within the park.

A reasonable estimate of numbers in this unit which included adjacent Alberta range was at least 580 sheep. A helicopter count by the author on 10 December 1963 from Mystery Lake south to Mount McBeath and on adjacent Alberta ranges yielded 346 sheep (178 ewes and immatures, 51 lambs, 39 rams of 3/4 curl or larger, and 78 unclassified). The distribution of sheep during this census was:

Upper Whitehorse - head of Fiddle	= 15
Luscar and Gregg mountains	= 68
Table Mountain	= 83

Red Cap and Cadomin mountains	= 54
McKenzie and Russell mountains	= 51
Mystery Lake - Folding Mountain	= 21
Prospect and Cheviot mountains	= 48
Ruby Mountain	= 6

An estimate of the total sheep production for the above area in December 1963 was 460-520. Of these, 65-75% (including most of the rams) spent the summer-early fall (June 15-October 15) in Jasper along the Fiddle and Rocky drainages and the other eight months along the east boundary and on Alberta range.

In addition to this population there were at least 93 sheep that remained in the Disaster Point-Makwa Ridge area, another 40-50 along the west side of the Nikanassin Range adjacent to the Rocky River and 100 between Sulphur Mountain and the East Gate.

Major winter ranges in sub-units 3b, 3c and 3d were:

1. Disaster Point on the west side of Roche Miette. This and the Makwa Ridge bands interchanged. There were usually 40-50 on Disaster Point and 35-40 on Makwa Ridge from late October until late May. On 2 November 1969 there were 67 sheep on Disaster Point while in May 1971, Warden Abe Loewen counted 78 sheep at that location.
2. Makwa Ridge overlooking the Rocky River. The highest count for Disaster Point plus Makwa Ridge was 91 in November 1967.
3. Ashlar Ridge-East Gate. This cohort usually numbered 30-50.
4. Sulphur Ridge-Mystery Lake. Usually 50-75 sheep wintered in this area. Large numbers were located at Miette Hot Springs and Sulphur Ridge in summer.

5. South of Mystery Lake-Head of Fiddle River and adjacent provincial lands. In November 1967 Barker counted 175 sheep (145 ewes and immatures and 30 adult rams) between Mystery Lake and the head of the Fiddle River while 83 were counted on Table Mountain in December 1965.

Helicopter surveys of these 5 winter ranges during the winters of 1967-68 and 1968-69 produced counts of 210 and 222 sheep respectively. During the same periods 100-200 sheep on the same population were wintering outside the park north of Whitehorse Creek.

An interesting example of the early winter migrations of sheep from Miette Hot Springs to the Berry Creek area outside the park occurred in late October 1977. Hunters George and Joan Mitchell of Edmonton were glassing a band of 10-15 ewes and immatures when suddenly one ewe spotted them, started licking her lips and began running to the hunters. They came right up to the hunters and licked their hands looking for a salt hand-out. They must have come from the salt licks at Miette Hot Springs or the East Gate (17 and 26 km airline distance respectively).

Many sheep were eartagged and neck-collared on the Red Cap Range east of Cadomin by the Alberta Fish and Wildlife Division in the 1970's to determine seasonal movements of that band of sheep. Apparently the Red Cap sheep are part of the Rocky-Fiddle population as previously suggested (Stelfox 1964). Warden John Turnbull and a provincial biologist saw one of these collared rams at Miette Hot Springs in the summer of 1973. In the fall of 1974, wardens saw one of these marked rams in Whitehorse Pass while in the fall of 1977 they also saw 10 rams and 4 or 5 ewes that were marked in the Whitehorse Pass area. In the summers of 1975, 1976 and 1977, Warden Marv Miller saw many marked sheep from Red

Cap at Miette Hot Springs and most were ewes and immatures. There were generally 40 - 50 sheep around these springs of which 6 or 7 were animals marked at Red Cap.

Major wintering slopes in 3a of the upper Rocky and Medicine Tent area were:

1. Rocky Pass - Cardinal River where 50-75 head were usually seen. A band of 80 were seen in Rocky Pass by wardens in the early winter of 1966 while 55 were seen there on 14 July 1968.
2. Blackface Mountain. This year-long favorite haunt for sheep supported 40-50 sheep.
3. Prospect Mountain - Whitehorse Creek, where 50-75 sheep wintered. There was a fairly continuous movement of sheep from Rocky Pass to the upper Cardinal River then northeast onto Prospect and Cheviot mountains during fall and early winter.

Interchange between 3c and 3d was shown from an observation by Loewen on 24 October 1969 when he saw 13 sheep crossing the valley of Sulphur Creek from Utopia Mountain to Sulphur Ridge. In June and July 1969 there were 42 ewes and immatures on the southwest slope of Sulphur Ridge while another four ewes and lambs were present across the valley on the east side of Utopia Mountain.

In Unit 3a, 26 sheep were seen on a north slope above Deception Creek on 25 January 1971. Also 23 ewes (1 ram) were in Rocky Pass and 20 on the east slope of the upper Medicine Tent west of Ruby Lake on 21 June 1971. On 5 September 1971, 22 ewes and immatures were seen in a basin west of Rocky Forks. In Unit 3c, 53 and 78 sheep were counted at Disaster Point in April and May 1971, respectively. Some interchange among Disaster Point, Talbot - Edna and Cinquefoil Mountain bands was

suspected. On 26 October 1969, Loewen counted 118 sheep at Talbot-Edna, 19 on Cinquefoil and 59 on Disaster Point for a total of 196 sheep.

There was some interchange between Unit 3c and Unit 8 across the Athabasca River. Ewes that had been tagged at Vine Creek (Windy Point) showed up at Disaster Point and the nearby Lime Kiln in April, October and December 1971.

Unit 4 (Queen Elizabeth Range)

Sheep have been seen wintering at three locations:

1. SE of Jacques Lake at 1700 m. This was a band of 20-25 animals.
2. Opal Hills (Leah Peak) at 2300 m. Five rams wintered on this southwest slope during the two winters of 1966-68. In the winter of 1970-71, there were 3 rams on Opal Mountain in January and February and 7 rams from March to May 12.
3. Beatty Creek facing the Rocky River at 2300 m. This small grassland is near the junction of the Restless and Medicine Tent rivers. Between 1975 and 1977, Nolan saw a small band (never more than 12 ewes and rams) wintering between Alpland Creek and the Rocky River above Medicine Tent River.

There were at least 29 sheep in this unit and the main rutting range appeared to be southeast of Jacques Lake. Part of this population moved onto an old burn above Medicine Lake where a full curl ram was seen by the author on the southeast end of Sirdar Mountain 400 m above the lake. Some may have moved west across the Maligne Valley towards Evelyn Creek as 2 rams were seen at the Maligne road five miles below Maligne Lake in October 1971.

Unit 5 (Maligne Mountains)

This population ranging between the Maligne and Athabasca rivers numbered 55-75 animals. The main winter area was from Signal Mountain to Excelsior Mountain at 2000 m with most rutting activity occurring on the west and north sides of Signal Mountain. Many winter observations occurred between Wabasso Lakes and Signal Mountain. Some sheep also moved lower to Old Fort Point where 9 sheep (ewes and rams) were seen in October and November 1965. Occasionally, part of this population moved west across the Athabasca Valley towards Mount Edith Cavell and Lectern Peak. In October 1965, one ram was seen near Portal Creek by wardens. On 21 August 1964 Warden Gordon McLain saw five sheep at Wabasso Lake and reported this to be the first time he had seen them in that area. One ewe walked through the yard at Athabasca Falls Warden Station on 11 July 1967. Two ewes crossed Highway 93 at Mile 8 south of Jasper on 9 June 1964 and were reported by wardens to be migrating to the west side of the Athabasca River. The approximate movement routes across the Athabasca Valley are shown in Figures 6 and 7. George Camp had often seen several sheep around Astoria viewpoint in the early 1940's although none were seen there in the 1960's. However, in August 1964 or 1965 Warden Toni Klettli saw 2 full curl rams on the south slope of Mount Clitheroe east of Amethyst Lake. They moved quickly west downhill to the lake, then past the chalet, across the narrows and northwest towards Moat Lake. That afternoon they went through Tonquin Pass and headed west (Figure 7). Fred Brewster and Loui Joachim had not seen sheep in that area before that sighting.

In spring, many animals moved to the lower grasslands by Old Fort Point where new growth was beginning. On 20 April 1964, McLain counted 36 sheep including 6 rams at this location. On 4 May 1973, 48 sheep were

seen at Old Fort Point at 1420 m in semi-open pine. Ewes then moved up towards rugged escarpment along Excelsior and Tekarra mountains for lambing. A ewe and newborn lamb and four rams were sighted on the south slope of Mount Tekarra at 2300 m elevation on 17 May 1972.

In summer, most sheep were seen in the Shovel Pass area, where 22 were seen in the summer of 1966 by Warden Mac Elder. At Big Shovel Pass at the head of Watchtower Creek, 53 sheep (26 ewes and immatures) and 27 rams (13 full curls) were counted on 27 August 1971. During the same month 2 rams were seen at a lake on the north side of Curator Mountain and 4 ewes and lambs were seen between Amber and Tekarra mountains.

Unit 6 (Jacques-Colin)

This population which frequents the Jacques and Colin range numbers 200-225 head (Table 4). There were three major rutting and winter ranges, namely:

1. Morro Peak-Roche Bonhomme, especially at the north end of Morro Peak and at Garonne Creek at the 1500 m elevation. Some 125-150 sheep wintered on this range.
2. Cinquefoil Mountain (Jacques Creek) at the 1700 m level. This band usually numbered 50-75 although 97 were counted there on 4 October 1964 by McLain.
3. Talbot-Edna Knoll at 1300 m elevation, where 25-50 sheep wintered; Lowen counted 118 sheep here on 25 October 1969.

The author counted 176 sheep on these winter ranges from Highway 16 on 25 October 1971. There were 54 on the Knoll, 42 on Cinquefoil, and 80 between Garonne Creek and Maligne Canyon. In October 1969 wildlife photographer Tom Tomkins counted 201 sheep between Cinquefoil Mountain

and the Knoll. A census by helicopter in January 1967 showed 190 sheep on Ranges 1 and 2.

As mentioned earlier, some interchange of animals occurred between this and the Unit 3 population via Highway 16 between Disaster Point and the Knoll, especially by rams during the rutting period and by mixed bands foraging on new spring forage adjacent to this highway. Some movement occurred across both the Athabasca and Maligne rivers. Two rams were observed leaving the Cold Sulphur Spring (Morro Point) heading across the Athabasca River towards Mount Chetamon on 11 November 1957. Five days later, 2 rams (perhaps the same ones) were seen heading from Moberly Flats towards the Snaring River. Earlier in August 1955, Warden Norman Young saw 11 sheep crossing the Athabasca Valley in the vicinity of Mile 13 near the Cold Sulphur Spring. Movements across the valley were probably for the purposes of using the Sulphur Springs and also for rams working ewe bands on both sides of the Athabasca Valley.

McGuire saw a band of 29 sheep cross the Athabasca bridge at the Lodge Turnoff (Mile 3) and show up at Maligne Canyon later that day. A couple of days later they showed up at the south end of Medicine Lake. Ten sheep (6 rams) were seen at the north end of Medicine Lake on 1 June 1971. Three rams were reported on the Medicine Lake burn on 18 May 1957 and wardens reported seeing more sheep than usual at the south end of Medicine Lake in late May 1957. It was therefore possible that those sheep that occasionally migrated in the spring from the Athabasca Valley southward along the east side of the Maligne River to the south end of Medicine Lake were also the same animals seen between the Medicine and Maligne lakes. They may then have headed west across the Maligne Valley

into the mountains of the Jeffrey and Oven creek watersheds then onto the Big Shovel Pass area for the summer. In fall they may have then migrated northwest along the Maligne mountains onto the rutting ranges of Signal Mountain and Mile 3.

Unit 7 (Pyramid - Mile 3)

This population ranged along the southeast end of the Victoria Cross Range, west of the Athabasca River and between the Miette and Snaring rivers. The population numbered 95-110 during the period 1959 to 1966, but declined to 35-40 by 1974 (Sullivan and Stelfox 1974). The major yearlong range was the Palisades, with the rutting and winter range located along the semi-open grasslands in the vicinity of the Lodge Turnoff at Mile 3 north of Jasper townsite. They wintered all the way from the west end of the townsite (Cabin Creek) to the airstrip by Henry House. George Camp saw sheep as far as 14 km west of Jasper, about 3 or 4 km west of Wynne on 11 February 1952. They were seldom seen that far west.

During the rutting period, counts by the wardens and the author included 97 on 4 October 1964, 95 in December 1966 and 87 in January 1967. Earlier Burstrom had counted 204 separate sheep between Jasper and Mile 5 in November 1959. Then in November 1959 Burstrom counted 112 between Mile 1 and Rock Quarry, in addition to 10 that were killed by the train.

Seasonal distributions of this band are shown in Figures 6 and 7, although greater detail is presented in Figure 11 of the report by Sullivan and Stelfox (1974).

Although these sheep wintered on the grassy flats and terrace slopes at the 1130-1500 m elevation zone, they concentrated on the Athabasca

Valley bottom even more in April and early May to obtain the earliest plant growth. In April 1964, McLain counted 108 bighorns at Mile 3. In May or early June, depending on spring weather, the band migrated upwards along the Palisades towards the Pyramid Mountain summer range above the 2000 m elevation.

In summer, they pastured mainly on the upper portions of the Palisades and the northeastern and eastern slopes of Pyramid and Zengel mountains. Ewes and immatures frequented the alpine grasslands near the Palisades Firetower at 2330 m in summer.

Some interchange occurred between this band and the ones across the Athabasca River on Signal Mountain and Roche Bonhomme especially during the rutting period of November and December. One ram travelled at least 21 km along Highway 16 in less than one day from Mile 3 to Cinquefoil Mountain (Sullivan and Stelfox 1974). A lamb tagged at the Vine Creek trap (Windy Point) in Unit 8 was later observed at Mile 3. A young ram from Windy Point with ear tag #904 was observed at the Palisades Firetower on 21 September 1967 by N. Young, and this ram must have crossed the Snaring River. Woody observed sheep with red-painted horns, of the Vine Creek band, at the headwaters of Laura Creek (south fork of the Wildhay River) during 1964-65.

Unit 8 (Snaring-Windy)

Sheep in this unit ranged between the Snaring and Snake Indian rivers mainly along the De Smet Range. The population numbered 110 - 125 during the study period. Most of this population wintered between the Snaring and the Devona stations at the 1200-1300 m elevation (Figure 8). The three main wintering areas were:



Figure 8. Winter range of Snaring-Windy band between Windy Point and the Gravel Notch.



Figure 9. Devona sheep lick across the Snake Indian River from Devona cabin, May 1968.

1. Vine Creek (Windy Point)
2. Gravel Notch (across from Talbot-Edna Knoll)
3. Little Windy Point near Devona

The major rutting area was on the southeast slope of Mount Greenock at Vine Creek. In January 1967, 110 sheep were counted there compared to 106 in late October 1964.

There was a small band of 5 - 10 rams that usually wintered at Whitecap and Cliff mountains at the 2000-2300 m elevation.

In March some of the Vine Creek band had moved to the head of Vine Creek. On 2 April 1968, 3 rams were observed on the licks between Shale Banks and Seldom Inn on the southwest side of the Snake Indian River. However, most of this band was still on the low-elevation terrace grasslands above Jasper Lake in May and June. There were 73 ranging between Windy Point and the Gravel Notch on 16 May 1972 and 36 were at the Vine Creek trap on 7 June 1964 (Figure 8).

In summer this band was spread out between the Snaring and Snake Indian rivers as far north as Mount Haultain, Mount Bistre and the Shale Banks across from Seldom Inn. Here they met the northern Mount Stornoway-Mount Tory herd. There were 36 ewes and immatures on the Shale Banks on 19 June 1971. A helicopter survey on 21 August 1970 revealed 24 rams on the east side of Cliff Mountain and a ewe band numbering 36 on the southeast side of Mount Thornton. Some of the animals which moved north along the De Smet Range towards Mount Bistre and Shale Banks apparently crossed the Snake Indian River onto the Strawberry Creek watershed. A 5-year-old ram ear-tagged at Vine Creek in November 1968 was later shot in September 1970 by a hunter near Moosehorn lakes at the north end of the Bosche Range. This was a straight line distance of 38 km. In the

summer of 1966, biologist Wayne McCrory saw some of the ear-marked and horn-painted sheep from Vine Creek along the Bosche Range near Strawberry Creek.

A small interchange apparently occurred with the Stornoway population to the north in the summer. As no well-defined sheep trails were observed between Bistre and Tory mountains the interchange must have been slight, with most exchanges probably occurring near Shale Banks and also at the north end of Mount Rowland. One ram from Vine Creek with painted (red) horns was observed on the Mount Stornoway range about a mile south of Snake Indian Falls in late summer by Young. Woody reported the sheep crossed above Shale Banks at the old goat trap and then headed to the headwaters of Strawberry Creek.

The lick at Shale Banks issued from April until at least late August.

Unit 9 (Bosche-Boule)

This population, which ranged throughout the Bosche and Boule ranges, as well as Bedson Range, numbered 175-200 animals during the period 1966-71.

Although this population wintered from the Brule Tunnel east of Moosehorn Creek to the Snake Indian River at the 1200-1500 m elevations, the two main winter ranges were:

1. Bedson Ridge, east of Moosehorn Creek (60-100 sheep)
2. Beaver Bluffs, north of Celestine Lake (50-75)

The fall migration southward to the low-elevation grasslands above the Athabasca River occurred in October. A band of 78 sheep were observed moving along the railway to their winter range at the south end of the

Bosche Range on 10 October 1966 by Loewen.

On these two ranges 142 sheep were counted in January 1967, while in October 1966 Loewen counted 140 on the east and south end of Moosehorn Creek. In November 1965 the distribution of 153 sheep on this winter range was 72 at the mouth of Moosehorn Creek, 34 at the south end of Roche Ronde and 47 on the Beaver Bluffs. In addition to these bands there were 25 to 50 sheep that wintered just east of the park along the Boule Range especially along the headwaters of West Solomon Creek.

There were two natural licks which were utilized heavily both in fall and spring. The lick at the south end of Roche Ronde was being used by 64 sheep out of a band of 95 on 18 December 1957. The other lick on the upper banks of the Snake Indian across from Devona station was used by 36 bighorns in November 1967 and was heavily used in April and May (Figure 9).

The major summer range lay along the north end of the Bosche Range between Wolf Pass and the head of Strawberry Creek. McCrory counted 104 sheep at the head of Strawberry Creek on 25 June 1965, and 65 were seen in this area on 17 September 1966. McCrory counted 102 sheep on the same range in July and August 1967.

Unit 10 (Stornoway)

This population which probably numbered 225 to 250 animals between 1966 and 1971, consisted of one large band that extended from the north slopes of Mount Stornoway to Mount Tory. The major yearlong range was located in the Ram Pass area west of Snake Indian Falls at the 2000 to 2500 m zone. Aerial counts from helicopters revealed 198 in March 1969 and 178 in January 1967.

Although most of this population wintered on wind-swept alpine and sub-alpine grasslands on the northeast side of Mount Stornoway, it spent the summer on range extending east from Mt. Simla and Maynard Pass west of the south fork of the Snake Indian River to Mt. Stornoway and south to the creek near Shale Banks. This extensive alpine grassland range (Figure 4) was one of the most productive sheep ranges in Jasper.

Concerning distributions at the west end of this unit, Warden Al Stendie saw about 20 sheep on a slidepath along the south side of Mt. Simla about 5 km up the south fork of the Snake Indian in the fall of 1973. Warden Brian Wallace observed small groups of rams 12-14 km up this south fork in June 1976 and the fall of 1977 and thought they might extend west into Maynard Pass. Both wardens believed these were part of the Stornoway population.

In 1955 or 1956 Tremblay saw large numbers of sheep summering between the south and north forks of the Snake Indian and toward the head of the Snaring River.

Unit 11 (Daybreak)

This population ranged north of Rock Creek and west from the Rock Lake Tower to Eaglesnest Pass. Generally, in late fall and winter this band which numbered 60-75 animals during this study was located between the tower and the mouth of Mowitch Creek at the 1800 - 2200 m zone. There were 55 counted from the air in January 1967 and it was believed that another small band was wintering near Eaglesnest Pass. On 6 May 1966 wardens counted 60 bighorns around the tower and to the west.

In summer these sheep ranged at higher elevations extending their range throughout all alpine grasslands between the tower and Eaglesnest

Pass. At times they moved west of the pass and even across Rock Creek near Mile 51 onto the Starlight Range. This interchange with the Starlight population concerned mainly the ram segment, especially in the fall, before snow depths prevent movements across valley floors.

Unit 12 (Starlight)

This population in 1966-71 consisted of a fragmented band numbering 40 to 50 animals that utilized small grasslands along the Starlight Range, Arcturus Peak and the Ancient Wall. The two winter ranges were located north of Mowitch Creek and along the Ancient Wall by the Natural Arch.

Only 22 sheep were counted in this unit during the January 1967 helicopter survey, although on 20 October 1971 wardens counted 36 in the Natural Arch area between Noonday Peak and Mont Perce. In October 1965 they counted 14 sheep at Arcturus Peak, 12 above Blue Creek and 4 at Quoin Peak.

This population seemed to remain quite stable, as there were 35 sheep counted along Blue Creek in November 1959 by Klett1 and 40 sheep in the summer of 1965 at Vega Peak.

The total number of sheep in this unit, which includes the headwaters of the South Sulphur River and Rockslide Creek outside the park, may have been greater than 50, as one band of 12 rams were seen in Glacier Pass in October and November 1966. Big game guide Charles Lacy reported (pers. comm.) that in late August 1973 he counted 60 ewes and lambs along the west side of the South Sulphur and six rams to the east of that river and closer to the park. He observed 6 ewes using a lick on the west side of the South Sulphur in August 1975 (Figure 6) and 14 rams

ranging in and out of the park at the head of this river in August 1975. Lacy observed that the area west of the South Sulphur was primarily a summer ewe range though he saw 3 "sickle horn" rams there on 24 August 1973 and Dennis Weisser and Jim Simpson saw rams there in late August and early September. Lacy stated that whenever the ewes and rams became alarmed they ran back into the park. His observations suggested there were about 75 sheep (60 ewes and immatures plus 14 rams) using the Starlight Unit both within and adjacent to the park during the early 1970's.

In summer the sheep ranged higher, on alpine grasslands and scree slopes above 2250 m at the head of Mowitch, Deer and Blue creeks along the north boundary of the park. Warden Art Cochrane saw 20 to 30 sheep in the McClairn's Pass area of Mt. Kelsey in the summer of 1970 and these were probably part of the Starlight population.

4.3.3 Seasonal distributions related to elevation and aspect

The locations of 2222 sheep in relation to elevation and aspect are presented in Table 5. On a yearlong basis, 78% of the sheep were on the south (15.4%), southwest (40.8%) and west (21.7%) exposures. These are therefore the critical aspects in Jasper. Only 13.1% were observed on NE (9.3%), N (2.8%) and NW (1.0%) aspects. The relatively high use of the NE exposure compared to other northern aspects was probably an escape response from the bitter SW prevailing winds during the period October-March. No use of the NE aspect was observed during the spring and summer seasons.

The animals concentrated on four exposures during October-December with 82.0% on the W and SW aspects. During the spring season they also

concentrated on 4 exposures, with 86.4% on S, SW and W aspects. During this season the greatest number concentrated on the S (38.3%) exposure at low elevations (1050-1225 m) where new plant growth began first. They also moved onto flatlands to a small extent (4.3%).

During winter (January-March) the animals used virtually all aspects on the small shallow-snow winter ranges which provided either forage or shelter from blizzards. Although 77.8% of the winter use was on SW (50.3%), S (13.9%) and W (13.6%) exposures, where the strong westerly winds and solar activity maintained shallow-snow depths, there was a significant use of NE (9.7%) and SE (5.1%) aspects. These eastern aspects were important in providing shelter in the lee of blizzards blowing in from the west.

In summer (July-September) the sheep used all aspects as well as the relatively flat subalpine and alpine basins, as they followed the changing floral phenology in order to obtain lush green forage all summer long. In late summer as the grasslands dried on the S and W exposures the sheep moved to the northern aspects where the peak of forage production was beginning and the vegetation was succulent. The highest use of northern aspects occurred during summer when 28.5% of the use was on N (20.2%) and NW (8.3%) exposures.

The results presented in Table 5 show that although the S, SW and W exposures were the critical aspects on a yearlong basis, virtually all aspects were important during at least one season. The importance of the N and NE exposures were twofold:

1. to provide an abundance of nutritious and succulent forage in late summer and until freeze-up in fall;
2. to provide shelter from winter blizzards blowing in from the

Table 5. Seasonal distributions of sheep in Jasper National Park in relation to elevation (m) and aspect, showing numbers seen and the percentage () in each column.

Period	n	1050- 1225	1250- 1375	1400- 1525	1550- 1675	1700- 1800	1825- 2000	2010- 2135	2150- 2250	2300- 2450+	Totals + %	Aspect
WINTER (January-March)												
March 4-12/69	687						11(0.8)		117(8.9)		128(9.7)	NE
March 24/70	190							6(0.5)	4(0.3)		10(0.8)	NW
Jan. 7-12/67	366	24(1.8)		53(4.0)		6(0.5)	4(0.3)	23(1.7)	74(5.6)		184(13.9)	S
Jan. 17/72	37						6(0.5)		61(4.6)		67(5.1)	SE
Feb. 4-5/69	39	97(7.3)	58(4.4)	43(3.3)	5(0.4)	8(0.6)	84(6.4)	248(18.8)	71(5.4)	49(3.7)	663(50.3)	SW
								4(0.3)		5(0.4)	9(0.7)	E
		28(2.1)					18(1.4)	29(2.2)	100(7.6)	5(0.4)	180(13.6)	W
								50(3.8)	18(1.4)	10(0.8)	78(5.9)	Flat
Totals + %	1319	149(11.3)	58(4.4)	96(7.3)	5(0.4)	14(1.1)	123(9.3)	360(27.3)	445(33.7)	69(5.2)	-	
SPRING (April-June)												
May 17-19/72	119						2(0.7)	24(8.5)			26(9.3)	N
May 4/72	163							108(38.3)			108(38.3)	S
		52(18.4)						25(8.9)			77(27.4)	SW
		54(19.2)						4(1.4)			58(20.7)	W
							10(3.6)		2(0.7)		12(4.3)	Flat
Totals + %	282	106(37.6)					13(4.6)	161(57.1)	2(0.7)		-	
SUMMER (July-September)												
Aug. 22/70	173								32(20.2)		32(20.2)	N
Sept. 2/70	80								13(8.3)		13(8.3)	NW
									49(31.0)		49(31.0)	S
							23(14.6)				23(14.6)	SE
					4(2.5)		16(10.1)				20(12.6)	SW
									12(7.6)		12(7.6)	W
							22(13.9)	75(47.5)	6(3.8)		103(65.2)	Flat
Totals + %	253					4(2.5)	45(28.5)	91(57.6)	18(11.4)		-	
FALL (October-December)												
Dec. 14-17/66	463								5(1.1)		5(1.1)	N
								5(1.1)	73(15.8)		78(16.9)	NE
			93(20.1)	54(11.7)							147(31.7)	SW
			170(36.7)	63(13.6)							233(50.3)	W
Totals + %	463		263(56.8)	117(25.3)				5(1.1)	78(16.8)		-	
YEARLONG												
	2222	255(11.5)	321(14.4)	213(9.6)	5(0.2)	18(0.8)	181(8.1)	617(27.8)	543(24.4)	69(3.1)	-	
For Aspects =		S (15.4),	SW (40.8),	W (21.7),	SE (4.0),	NW (1.0),	NE (9.3),					
		N (2.8),	E (0.4),	Flat (8.7)								

SW and W directions.

Concerning the seasonal use of various elevations, the two zones which were used the heaviest on a yearlong basis were the high subalpine and alpine grasslands at 2010-2250 m (52.2%) and the low transitional (Prairie) grasslands at 1050-1375 m (25.9%). Only 3.1% of the range use in Jasper was on the relatively barren arctic-alpine range above 2250 m. Correspondingly, only 10.6% of the use was in the coniferous (Canadian) forest zone from 1400-1800 m, with most of this use confined to the semi-open savannah type coniferous forests at the 1400-1525 m elevation on S and W exposures in late fall and winter.

In spring, the sheep concentrated at two widely separated elevations. Those that wintered on low-elevation grasslands moved down even lower to the 1050-1225 m zone (37.6%) to make use of the first new plant growth. Those that wintered on subalpine and alpine grasslands concentrated on the 2010-2135 m zone (57.1%) on the S and SW slopes, where the warmth of the spring sun bared the grasslands and provided the best climatic conditions for lambing.

In summer, almost all the sheep were observed on high-elevation ranges at the 1825-2250 m zone (97.5%). During fall, the bands split onto two elevational ranges for the rutting period with 82.1% moving onto low-elevation grasslands at the 1250-1525 m zone, while 16.8% concentrated on the alpine grasslands at the 2150-2250 m zone.

In winter, 70.3% of the animals were observed on the subalpine and alpine zones (1825-2250 m) while another 14.7% were found on the transitional-prairie grasslands at the 1050-1375 m zone. Another 7.3% wintered on the semi-open savannah portion of the Canadian forest zone at 1400-1525 m.

After examination of the way both elevations and aspects combine to influence seasonal sheep distributions, the following generalities can be made for Jasper.

1. In spring, sheep concentrated on south and southwest aspects at the 1050-1225 m and 2010-2135 m elevations where the warmth from the sun produces the first new forage and where conditions were most favorable for lambing in late May and June.
2. In summer, the animals concentrated above 1800 m, moving progressively from SE to S, SW, S, NW and N aspects in order to obtain the most nutritious and succulent forage throughout summer. At this time considerable use was made of alpine valley bottoms where favorable soil and moisture conditions combined to produce the greatest biomass of summer forage.
3. In fall, they concentrated on W and SW slopes at both the 2150-2250 m and the 1250-1525 m elevations for the rutting period. In early fall they continued to make considerable use of NE and N aspects on the alpine ranges, where succulent forage remained until snow depths became excessive in late fall.
4. In winter, over 75% of the sheep use occurred on S, SW and W aspects with 70% at the 1825-2250 m elevation and 23% at the 1050-1525 m elevation. Use of the dense coniferous forest zone from 1550 to 1800 m was almost nil (1.5%) and restricted to grasslands perpetuated by avalanches, highway or powerline right-of-ways.

4.4 Banff National Park

4.4.1 Historical

Sheep distributions during the 1966-71 period were evidently similar to those observed by explorers in the 1800's. These explorers included Duncan McGillivray and David Thompson in 1800, Alexander Henry in 1811, George Simpson in 1841-42, the Palliser Expedition in 1858-59 and the Earl of Southesk in 1859. Their observations are summarized in Banfield (1958) and Stelfox (1971). In general, they commonly found sheep in their travels between the Bow and North Saskatchewan valleys. The western limit was Mt. Wilson near the junction of the North Saskatchewan and Mistaya rivers and Pipestone Creek north of Lake Louise. These locations are also the western limits today.

The first inventory of sheep was the one conducted during the period 1913-15 on the big game of the Canadian Rockies by Millar (1916). He estimated the sheep population within the 536 km² area of the Bow Valley drainage, known as Rocky Mountain National Park, at 500 to 700, with another 200 to 450 between the park and the head of the Athabasca River of which some lies within the present boundaries of Banff National Park. Sheep numbers were considered to be low outside the park in 1915 with the decline attributed to excessive yearlong hunting with firearms by Indians, explorers, miners and railway workers. The Park Superintendent's report for 1914 gave a count of 100 sheep south and 550 north of the Bow River.

From 1919 to 1930, sheep numbers were probably higher than during any period from 1935 to 1971. The Sawback Range supported 300 to 400 and the Palliser Range 600 to 700 sheep (Banfield 1958). The mortality rate was heavy in 1931, 1935, 1936 and 1941 (Cowan 1943).

From 1938 to 1949, H.U. Green of the National Parks Service studied bighorn sheep in Banff and reported there were no sheep west of the Bow, Mistaya and North Saskatchewan rivers (Green 1949). He reported them to be confined to 11 localities as follows:

- | | | |
|-------------------|-----------------|------------------|
| 1. Eisenhower | 5. Aylmer | 9. Bare Mountain |
| 2. Johnston Creek | 6. Carrot Creek | 10. Red Deer |
| 3. Sawback | 7. Palliser | 11. Mount Wilson |
| 4. Vermilion | 8. Dormer | |

For these areas, the Palliser included the upper Cascade River valley to Flints Park; Bare Mtn. included the Panther River and Snow Creek; and Red Deer included Tyrell, McConnell and Divide creeks.

The highest annual census counts for the period 1942-48 as reported by Green (*op. cit.*) are presented in Table 6.

In the early 1950's, A.W.F. Banfield collated information on the distribution, population and migrations of sheep from aerial surveys, ground patrols and warden observations (Banfield 1958). He estimated the 1953 population at 625 sheep, distributed as follows:

Citadel Pass	= 2	Dormer R.	= 90
Sulphur Mtn.	= 25	Panther R.	= 50
Mt. Bourgeau	= 5	Bare Mtn.	= 40
Carrot Cr.	= 15	Tyrell Cr.	= 40
Lake Minnewanka	= 90	Ya-Ha-Tinda	= 35
Sawback Rge.	= 30	Clearwater R.	= 25
Mt. Eisenhower	= 15	Indian Head Cr.	= 30
Baker Cr.	= 10	Mt. Wilson	= 10
Cascade R.	= 100	Three Sisters	= 3

Banfield reported that sheep numbers had declined south of the Bow Valley with the last sheep report on the Goat Range being in 1943. The general decline in sheep numbers during the 1940's and early 1950's was blamed on competition from elk, on wolf predation, and on shrinking ranges resulting from forest regeneration on temporary grassy slopes (Banfield 1958).

Table 6. Highest annual sheep counts on ten ranges in Banff National Park, 1942-48 (after Green 1949).

Range	Highest Sheep Count by Year						
	1942	1943	1944	1945	1946	1947	1948
Eisenhower (Castle)	-	13	15	-	18	10	25
Sawback-Vermilion	147	105	74	87	85	61	78
Johnston Cr.	-	-	-	10	13	23	28
Aylmer	-	21	15	25	37	17	47
Carrot Cr.	-	60	-	-	-	-	11
Palliser	-	-	32	40	17	37	43
Dormer	-	-	-	41	18	13	32
Bare Mtn.	-	-	-	25	10	12	47
Red Deer	-	-	-	-	-	38	34
Mt. Wilson	-	-	38	36	-	-	15
Totals	147	199	174	264	198	211	360

4.4.2 1966-71 Populations and distributions

There appeared to be 11 relatively discrete sheep populations in Banff during the 1966-71 period (Figure 10). The largest summer and winter counts in each unit and some of the movement routes are shown in Figure 10.

Summer and winter distributions are compared in Figure 11. Rutting ranges, movement routes between some units and the locations of natural licks are also shown in Figure 11.

A comparison of numbers of sheep counted during an inadequate helicopter census (because of an inferior J2 helicopter and an inexperienced pilot) plus estimates of numbers in 1966 with ground counts by the Warden Service from 1948 to 1965 is presented in Table 7.

An examination of counts by wardens in 1963 and 1965, counts from the helicopter in 1966, together with information received from biologist Bill Wishart (Alberta Fish & Wildlife Division) on aerial survey counts of boundary herds, indicated a summer population of 1345 and a



Figure 10. Bighorn sheep population units, maximum numbers counted during winter and summer counts, 1966-1970, Banff National Park.

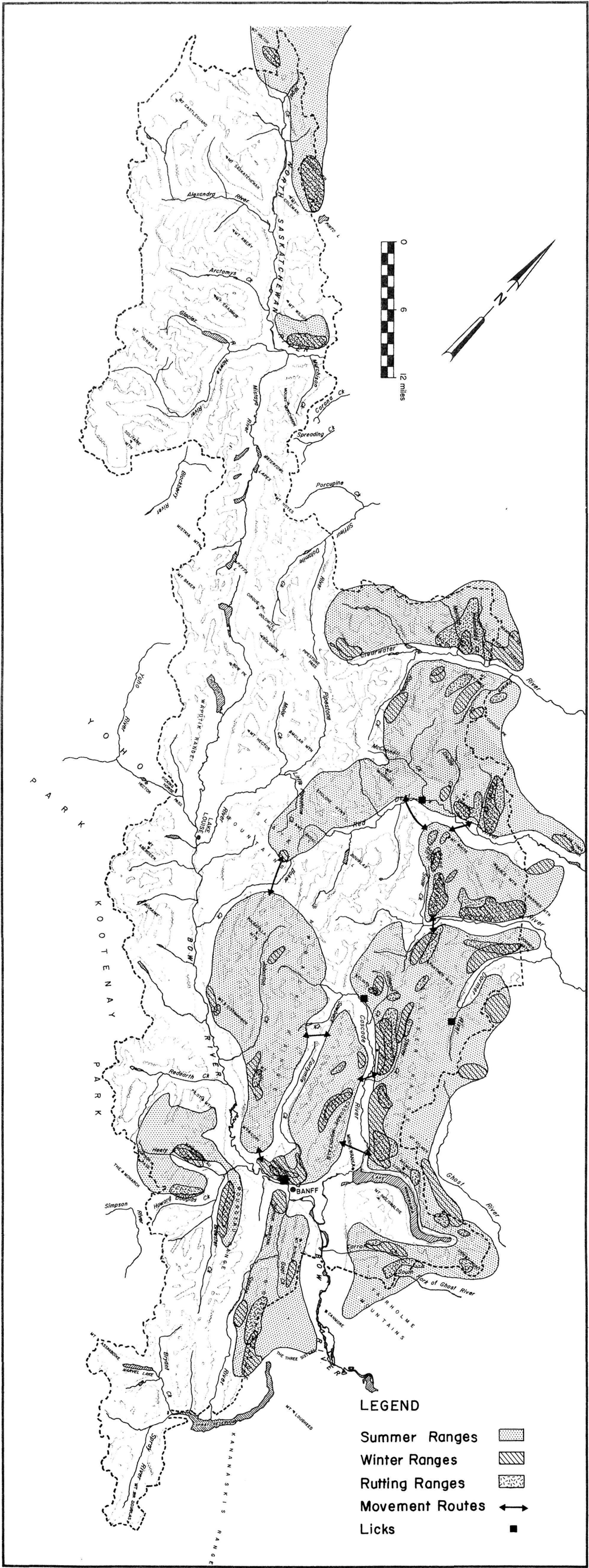


Figure II. Seasonal sheep distributions in Banff National Park, 1965-1972.

Table 7. Abundance of bighorn sheep in Banff National Park, 1943 to December 1966.

Area	1943 Cowan est.	1948 Warden counts	1952 Warden counts	1953 Banfield	1956 - -Warden	1960 counts-	1963 -	1965 -	1966 Helicopter December	1966 estimate summer	1966 estimate winter
Mt. Bourgeau	40	-	8	7	1	-	-	-	65	75	75
Sulfur Mtn. & Goat Rge.	-	-	30	28	35	49	33	42	49	60	60
Cascade Mtn. & Vermilion Lakes	150	78	80	130	64	64	76	69	59	90	90
Mt. Eisenhower	-	25	35	15	-	80**	5	4	5	25	25
Johnston & Hildale Crs.	-	28	-	-	-	-	-	-	68	70	70
Aylmer Creek	-	47	75	90	86	120	134	91	37	-	-
Carrot Cr. - Phantom Crag	60	11	20	15	-	-	-	-	0	40	30
Palliser Range	100	43	-	-	-	143	503	361	113	375*	225
Dormer River	-	32	90	90	70	-	-	-	14	-	-
Panther Mtn. to Red Deer R.	150	47	50	90	135	46	105	107	98	200*	160
Tyrell & McConnell Crs.	-	34	10	40	15	-	-	-	19	125*	75
S. of Clearwater R.	-	-	-	-	-	41	30	136	35	75*	40
N. of Clearwater R.	25	-	25	55	-	-	-	-	8	100*	15
Baker & Pipestone Crs.	-	-	-	20	4	-	-	8	not flown	10	0
Mt. Wilson & Cirrus Mtn.	-	15	25	10	12	-	24	31	16	35	25
Ya-Ha-Tinda Ranch	-	-	70	35	30	-	-	-	not flown	30*	75
Totals	525	360	518	625	452	543	910	849	586	1310	965

* Transient herds ranging on both federal and provincial lands

** Figures presented mid-way between two lines refer to combined counts from two areas

- Means no data available

0 Means no animals observed

winter population of 1105 in 1966 in Banff. Counting transient boundary populations on adjacent provincial ranges, the total population for the 10 units shown in Figure 10 was believed to be approximately 1850 in 1966. Seasonal counts and a population estimate for each unit are presented in Table 8.

Sheep were occupying all ranges that were suitable for wintering bighorns during 1966-71. Suitable winter ranges were those facing south or west, well-grassed with a light snow cover in winter and containing rugged escarpment in close proximity to the grassland forage. In summer and fall, sheep dispersed over a much greater area, with the extent of dispersal dependent upon how early the snowpack melted, the condition of sheep in spring and the severity of summer and fall weather.

The distribution of sheep in early winter (December) and summer (August) as observed during aerial (helicopter) surveys from 1966 to 1970 is presented in Appendix II.

Descriptions of the 11 geographic sheep units and the winter and summer populations within each are as follows:

Table 8. Bighorn sheep populations within 11 units in and adjacent to Banff National Park, 1965-71 and highest unduplicated counts by season.

Population Unit Name and Number	Best Unduplicated Counts by Season				Est. Park Pop.	
	Oct- Dec	Jan- Mar	Apr- Jun	July- Sept	Summer	Winter
1. Goat-Spray	54	-	40	-	60	60
2. Bourgeau	65	24	54*	66*	75	75
3. Sawback	83	73	63	-	95	95
4. Cascade-Vermilion	88	45	63	-	90	90
5. Carrot Creek	28	-	-	-	50	30
6. Palliser-Dormer	265	-	200**	147***	385	300
7. Panther-Bare Mtn.	131	104	-	90	200	160
8. Red Deer-Clearwater	97^	15	-	-	150-200	115
9. Malloch-Indianhead	8	-	-	29	50-100^^	15
10. Mt. Wilson	20	20	33	-	35	25
11. Nigel-Cirrus	14	-	-	14	10-20~	0
Totals	853	281	390	346	1200-1310	965

* Counts on Mt. Bourgeau only

** Refers only to the west side of the Palliser Range from Stoney Cr. to Cabin Mtn.

*** Count at Aylmer Lookout only

^ Does not include the Ya-Ha-Tinda Ranch area

^^ Primarily a summer population, perhaps 10-15 wintering within the park

~ Summer population only; sheep winter east of the park

Unit 1 (Goat-Spray)

This population ranged mainly east of the Spray River along the Goat Range and Mt. Rundle. A small amount of use was made of Sulphur Mtn. especially during winter (Figures 10 and 11). During the rutting period in December, most of these sheep were found along the west side of the Goat Range at the 2000 to 2500 m elevations, especially above Mile 16 cabin along the Spray River. An aerial survey on 5 December 1966 revealed a ewe and lamb at the northwest end of Sulphur Mtn. and 47 assorted sheep on southwest slopes just above timberline along the Goat

Range within 5 km of Mile 16 cabin. None were seen on Mt. Rundle although wardens had previously sighted small numbers on the west side of Mt. Rundle east of the confluence of Goat Creek and Spray River. They had also observed these sheep moving across Goat Creek onto the Goat Range. On 8 October 1971 Warden Billy Vroom counted 54 sheep on the Goat Range. During fall and winter, sheep were observed at four locations:

1. The west side of the Goat Range above Mile 16 cabin
2. The southwest end of Mt. Rundle, east of Goat Creek
3. The southwest end of Sulphur Mtn.
4. The northwest end of Sulphur Mtn.

In spring, most of this population moved to the east side of the Goat Range onto the lowest grassland on south and southeast exposures. In May 1969 wardens Keith Brady and Bryan Macdonald observed at least 40 ewes and immatures on a low elevation grassland at the head of Goat Creek.

The summer range extended throughout the Goat Range and parts of Mt. Rundle and Sulphur Mtn. above 2500 m. In 1966 wardens reported that in May, and again in fall, sheep had been known to travel about 28 km (17 miles) up the Spray River. These were believed to be sheep from the south end of Sulphur Mtn. Warden Perry Jacobson later observed a group of 8 rams at the extreme south end of the Goat Range on the west side of Mt. Nestor in the falls of 1976 and 1977.

The population estimate for Unit 1 was 60, because in addition to the 49 seen on the Goat Range and the northwest end of Sulphur Mtn., Warden Fred Bamber believed a few sheep present on Mt. Rundle and Sulphur Mtn. had been missed. In October and November 1963, wardens had

observed a band of 13 sheep on Sulphur Mtn.

Unit 2 (Bourgeau)

This population was centred at Mt. Bourgeau and extended from Massive Mtn. throughout the headwaters of Healy Creek and across Healy Creek, near its junction with Brewster Creek, onto the western portion of the Sundance (Bourgeau) Range.

During the rutting period in December, most sheep were located on the southeast portion of Mt. Bourgeau, where they frequented south-facing grasslands 200 to 400 m below timberline. They were also found at this time on small grasslands about 200 m below timberline on the northwest portion of the Sundance Range. The aerial survey on 5 December 1966 recorded 48 sheep on Mt. Bourgeau and another 17 on the Sundance Range. Another aerial survey on 17 December 1968 showed the sheep to be at the same two locations although only 26 and 3 were seen at that time.

During winter, from 25 to 55 sheep could be seen on the small grasslands at the base of cliffs on south-facing slopes at the 2000 - 2300 m elevation above the Sunshine road. They also foraged along the edges of three avalanche slopes from the Sunshine road up to the cliffs. After an avalanche they would move onto the bared slide area to forage on herbaceous vegetation and branches of subalpine fir.

In late April and early May they concentrated along the base of the south-facing cliffs and close to the road where new plant growth came first. With the snow melt in May and June they followed the south slopes upward along the eastern portion of Mt. Bourgeau. Adult ewes sought the cliff faces to produce their lambs in late May and early June. On 14 May 1969 there were 54 sheep (including a newborn lamb and 14 rams)

observed by Warden John Wackerle on the Sunshine road by the second avalanche slope. In July 1967, 49 ewes and newborn lambs were observed on a higher south-facing subalpine cirque basin. In addition to this ewe band there were three groups of 7, 4 and 5 rams plus 1 ewe on Mt. Bourgeau for a total of 66 observed on 9 July 1967. Another 6 to 12 sheep were expected to be along the Sundance Range and other parts of the Healy Creek drainage to make a total of at least 75 sheep for this unit. Some of these rams were observed on Lookout Point east of Sunshine Lodge in July 1970 by biologist George Scotter while in the summer of 1967 and in February 1968 rams were seen above the 2600 m elevation between Healy and Howard Douglas creeks and also at the south end of Massive Mtn. The rams evidently frequented the headwaters of Howard Douglas, Healy and Redearth creeks in summer in the vicinity of the Alberta-B.C. boundary. Jacobson saw a mixed band of 21 sheep on the Fatigue and Citadel Pass summits in January 1978. Ewe bands generally remained on Mt. Bourgeau throughout the summer and fall utilizing all exposures and elevations in response to changing floral phenology, consequently maximizing the period of foraging on succulent herbaceous vegetation.

The Bourgeau population was estimated to be 75 during the 1966-71 period. The future welfare of this population depends on their continued use of the Mt. Bourgeau range on a yearlong basis plus the headwaters of Howard Douglas, Healy and Redearth creeks in summer. Heavy human use of these subalpine and alpine grasslands in summer would undoubtedly endanger the existence of this band.

Unit 3 (Sawback)

The Sawback population centred upon Mt. Ishbel and Castle Mtn. (Mt. Eisenhower), but ranged all the way west from Fortymile Creek to Baker Creek, and north from the Bow River at Sawback to Pulsatilla Pass at the head of Johnston Creek. Banfield (1953) observed 10 bighorns near the Mt. Temple Chalet above Baker Creek but none were reported there during 1966-71.

The two critical ranges for this population, which numbered 85 to 95 animals during 1966-71, were the grasslands along the south and west slopes of Mt. Ishbel (Figure 12) and Castle Mtn. (Figure 13). During the December 1967 rutting period 68 bighorns were counted on the Ishbel grasslands between 2000 and 2200 m while another 15 were on the Castle Mtn. grassland at the same elevation. The Ishbel grasslands were shared with mountain goats and in November 1967 Warden Keith Brady counted 44 sheep and 19 goats on these grasslands.

After wintering on the above two grasslands and occasionally on a small grassland further up Johnston Creek (Figure 10), some of the sheep migrated to the south end of Mt. Cory near the junction of Hwys. 1 and 1A near Hole-in-the-Wall. From late April to early June they were observed foraging on the new growth of *Agropyron cristatum*, *Festuca rubra*, *Poa* spp., *Agrostis alba* and *Artemisia frigida* adjacent to Hwy. 1. They foraged east along this highway towards Vermilion Lakes and appeared to mix to some extent with the Cascade-Vermilion band at that time. They appeared very hungry for minerals and were observed licking the rock cut at Mile 5, calcium and sodium chloride from the surface of Hwy. 1 and chemicals along the railway by Mile 5.

Ewes appeared to lamb along the east and south cliffs of Cory and



Figure 12. Rutting and winter range on the west slope of Mt. Ishbel which supported 65 - 70 bighorns and 15 - 20 goats during 1966-71.

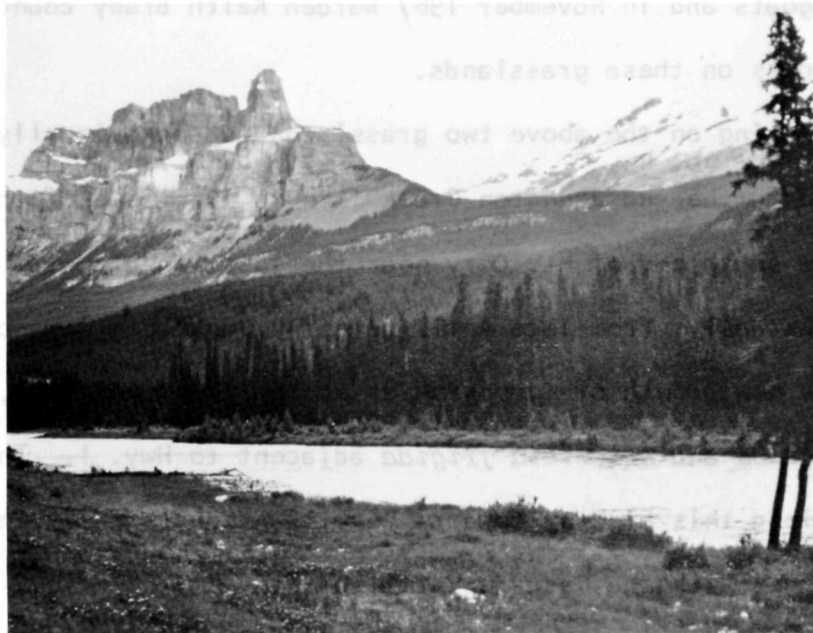


Figure 13. A small subalpine grassland on the south slope of Castle (Eisenhower) Mtn. which supported 15 - 25 bighorns during 1966-71.

Edith mountains in late May and June. Some lambs were undoubtedly born on Castle and Ishbel mountains. By July the rams and many ewes and immatures had reached the headwaters of Johnston and Ishbel creeks, although some continued to make brief journeys back to the lush forage along the Trans Canada Hwy. Well-travelled sheep trails along the south and west sides of Mt. Edith indicated that the journey from Mt. Ishbel to Mile 5 was via the north end of Mt. Cory and the west side of Mt. Edith (Wardens Ed Carlton and Jim Robertson, pers. comm.).

The Castle Mtn. ewe band summered around Rockbound Lake and Lookout Point at the 2300-2500 m elevation, while the Ishbel band summered towards the head of Johnston Creek. Ewe bands were observed crossing Johnston Creek about six km north of Hwy. 1A on their way between the Sawback Range and Castle Mtn.

Rams spent their summer and fall at the head of Johnston and Baker creeks. In late July 1969, Warden Jimmy Robertson observed 8 rams in Badger Pass east of Pulsatilla Mtn. and Jacobson saw 15 rams there in August 1976. Ram sign was also seen on the east side of Mt. Avens. Rams that were occasionally seen in summer near the Mt. Skoki Ski Lodge came from either Johnston Creek to the south or from the Red Deer River from the northeast. Wardens reported rams above Baker Lake on the southwest side of Fossil Mtn. in ~~August~~ 1964.

There was undoubtedly some interchange of sheep from the Sawback, the Red Deer-Clearwater, and the Palliser-Dormer bands at the headwaters of Johnston, Baker and Pipestone creeks and the Cascade and Red Deer rivers. This interchange occurred during July to September and was mainly among rams. Jacobson observed that Baker Creek supported 15-20 mixed sheep annually for the period 1973 to 1977. He also saw 14 mixed sheep

on Cyclone Mtn. in December 1976.

The Sawback population was estimated at 95, of which 65 - 75 used the Ishbel slopes along Johnston Creek, 15 - 25 the Castle Mtn. slopes and a few animals that wintered along the upper Baker and Johnson creek slopes. Jacobson reported that 16-20 sheep regularly wintered along Baker Creek during 1973-77.

The two critical ranges were the west and south slopes of Ishbel and Castle mountains (Figures 12 and 13). Any significant human use of these two grasslands, or harassment from adjacent forest edges, especially during winter, would result in a significant reduction in this band of 95 sheep and 15 - 25 goats.

Unit 4 (Cascade-Vermilion)

This population ranged between Forty Mile Creek and the Cascade River and also covered the Stoney Squaw and Norquay mountains as far south as Vermilion Lakes. An estimated 90 sheep formed this band. The highest count was 83 located at the north end of the Cascade Mtn. in December 1968. An adequate aerial survey was impossible in the Vermilion Lakes area because of forested and rugged terrain conditions, although it was believed there were at least 6 - 12 there. In December 1966 there were 56 near Vermilion Lakes and 32 at the north end of Cascade Mtn., for a total of 88 sheep.

The major rutting area lay at the north end of Cascade Mtn. southwest of the Stoney Creek Warden Station, on a southeast slope at the 2300 - 2400 m elevation. One mixed band of 75 was observed on this slope on 17 December 1968, while 3 singles and a group of 5 were seen nearby. Following the rut, most ewes and immatures migrated southward along the

west side of Cascade Mtn. to winter on the narrow grasslands adjacent to the Trans Canada Hwy. 1. About a dozen rams could usually be observed throughout the winter on the rutting ranges, while another 12 - 18 rams wintered with the ewes at the 1500 - 1800 m elevation at the of Mt. Norquay and Stoney Squaw Mtn. near Vermilion Lakes.

During winter, animals on this semi-open Douglas fir range near Vermilion Lakes fed primarily on the seeded grasslands along Hwy. 1 from the Mt. Norquay turnoff west as far as Mile 4.

This low-elevation range was mainly covered with a spruce-fir-aspen forest during this study except for small grasslands on the driest south-facing slopes. The carrying capacity of the native winter range declined significantly after 1921. Hewitt (1921) reported the recently burnt area to be an open grassland with few firs supporting 375 sheep. Between 1942 and 1948 the highest count on this range was 147 (Green 1949) while in 1953 only about 30 sheep remained and the area was thickly covered with a young forest of Douglas fir (Banfield 1953). Wardens reported that the new highway grade, established in 1955 above the old highway grade near Vermilion Lakes, removed most of the firs observed by Banfield and also made significant rock cuts along Stoney Squaw and Norquay mountains. The broad highway right-of-way was seeded to a grass mixture of *Poa*, *Festuca* and *Agrostis* species which noticeably increased the range carrying capacity of that area.

The population might have remained low except for a major road-widening and back-sloping of the Trans-Canada Hwy. and grass seeding of the broad right-of-way in the 1950's (Figure 14).

In spring, this band concentrated along Hwy. 1 between the Norquay turnoff and Mile 4, foraging on the new vegetation on the south-facing



Figure 14. Seeded highway slopes along Hwy. 1 near Vermillion Lakes which greatly increased the winter carrying capacity of Mt. Norquay Range.



Figure 15. Famous Palliser winter range between Stoney and Cuthead creeks.

highway slope. Robertson counted 63 sheep feeding along the highway between the Timberline Hotel and Mile 4 in April 1969. The spring and early summer period was a hazardous time for this band with many killed by automobiles while crossing the highway or merely standing on the highway soliciting handouts from tourists (Stelfox 1969).

Rams migrated north and northeastwards along Forty mile Creek and the west side of Cascade Mtn. in early May followed by pregnant ewes which probably lambled along the cliffs of Mt. Norquay, Stoney Squaw and Cascade mountains. In summer, this band roamed the extent of Cascade Mtn. from the northern alpine grasslands south to Vermilion Lakes. Some of this band probably crossed the Cascade Valley near the bridge about 4 km north of the Minnewanka station, as small numbers of sheep were seen twice by the author licking soil at the north end of this bridge in summer.

There was an interchange between the Palliser-Dormer population and the Cascade-Vermilion band both in summer near this bridge and in fall near the mouth of Stoney Creek (Figure 11). Green (1949) reported that of 11 sheep tagged at the Aylmer Creek lookout, seven were later observed on the Vermilion and Sawback ranges. Warden Jim Rimmer reported often seeing sign of sheep travelling from the Palliser Range across the Cascade Valley near the mouth of Stoney Creek and west onto the rutting range at the north end of Cascade Mtn. On 9 May 1968 there were 2 adult ewes that had been tagged at Lake Minnewanka in a group of 59 at Vermilion Lakes.

Unit 5 (Carrot Creek)

A band of 18 - 28 sheep was commonly seen along the upper slopes of Carrot Creek and the headwaters of the South Fork of Ghost River on Saddle Pk. and Orient Point. These were seen in December of both 1967 and 1968. About 12 of these sheep wintered on a grassy slope of Mt. Peechee on the north side of Carrot Creek. The remainder wintered on both sides of the park boundary at the headwaters of Carrot Creek and the Ghost River.

This band, which may have numbered as high as 30 - 40 (28 was the highest count) during the study, probably crossed Devils Gap occasionally during the rutting period and also in summer to obtain salt from the Aylmer Lookout or at the Lake Minnewanka picnic shelter.

In summer they ranged along the alpine slopes of Peechee, Girourd and Inglismaldie mountains. They were never observed below 2300 m and seemed to survive on alpine and upper subalpine grasslands. They competed with elk for forage on the alpine grasslands at the head of Carrot and the Ghost River. In the fall of 1977, Jacobson observed 35 rams near the pass at the head of Carrot Creek.

Unit 6 (Palliser-Dormer)

This population ranged throughout the Palliser Range, from Lake Minnewanka north to the Panther River and east of the

Cascade River, to include the winter range west of the Ghost and Burnt Timber rivers east of the park. It excluded the north end of Panther Mountain which was used by the Windy band from Bare Mountain.

There were three relatively discrete sub-units based on the separation of ewe bands in winter, namely:

6a (Aylmer) - north from Devils Gap along the Palliser Range to Stoney Creek and east of the Cascade River to the head of the Ghost River. There were 85 - 100 ewes and immatures using this range, not including those from north of Stoney Creek which made excursions to Aylmer Mountain in summer.

6b (Palliser) - north from the south end of Stoney Creek to the headwaters of the Cascade River and Cuthead Creek, then east to include the headwaters of the Dormer River, the Stoney and Burnt Timber creeks. There were 100 - 110 ewes and immatures on this range.

6c (Dormer Mtn.) - the mountains between the Dormer and Panther rivers extending from outside the park west to the north fork of the Dormer. There were 40 - 50 ewes and immatures on this range.

In addition to the 210 - 275 ewes and immatures there were 110-115 rams (half-full curl) on Unit 6. A helicopter survey on 17 December 1968 showed 78 rams on these three areas with 23 in 6a, 50 in 6b and 5 in 6c. Geist (1967) reported that the largest number of rams (during the period 1964-66) was observed in May on the Palliser Range (north of Stoney Creek to third

ridge north of the elk trap) when they reached a total of about 85.

The estimated population of 325 - 375 sheep was considered to be realistic. The December 1968 survey gave a count of 265 sheep and no survey was made of the winter range adjacent to the park along the Ghost and Burnt Timber. A comparison of sheep counts from a helicopter with known numbers present from ground counts (Stelfox 1964) showed the helicopter count to be about 75% of the actual number present. Thus a count of 265 would indicate a population of 350-355 animals.

In July 1969 a band of 147 sheep was counted by Towerman Toby Burks at Aylmer Lookout. However, the artificial salting in the 1950's and 1960's was believed responsible for luring abnormally high numbers of sheep to the tower from several mountain ranges during summer. Both the tower and artificial salting were discontinued in 1971, following which the use by sheep declined noticeably according to Warden surveys.

Many of these sheep wintered along the Ghost drainage and were not counted during the December helicopter surveys. For the Stoney Creek area, Warden Jim Rimmer estimated 300 sheep for the period 1966-69. On 4 April 1970 wardens Keith Brady and John Wackerle counted 200 sheep between Stoney Creek and Cabin Mtn. (near Cuthead Creek).

The seasonal abundance and distribution of sheep in each

sub-unit during 1966-71 was as follows:

6a (Aylmer)

The focus of this band was Aylmer Creek where large numbers have concentrated each summer since the late 1940's to feed on artificial salt. Sheep came from as far as the head of the Cascade Valley (Flints Park) and the Vermilion Lakes. Green (1949) believed that some sheep from as far east as Exshaw (20 km east of the park) utilized the Carrot Creek and Aylmer Range. From 20 - 147 sheep frequented the Aylmer Lookout area in summer with the largest numbers present during July to early September. Unduplicated counts by Burks in July 1968 and July 1969 at the lookout were 110-150 and 147, respectively. Many of these sheep were tagged by Warden Ernie Stenton in the 1950's and early 1960's to obtain information on seasonal movements of this band. Many tagged rams were observed to winter about 15-20 km northwest on the southwest slopes of the Palliser Range above the elk trap (Figure 15). In the spring and summer some of these tagged rams and ewes migrated further northwest along the Cascade Valley to Flints Peak where they obtained minerals from both a natural lick as well as salt from the goat trap. At that point they would have been about 30 km from Aylmer Lookout. As mentioned previously, some crossed the Cascade Valley by the Mile 4 bridge near the Cadet Camp. Three separate groups of sheep (7, 2 and 15), of which some were tagged, were seen in July of 1970, 1971 and 1972 at this bridge. They were obtaining salt or other minerals from the

north approach to the bridge. Sheep often crossed at this location and moved west onto Cascade Mtn. where they proceeded southwest to Vermilion Lakes. The 2 half-curl rams seen by the author on 1 July 1970 were kneeling down licking and chewing the wooden bridge decking. On 30 July 1971 there were 7 ewes and lambs near the bridge and on 21 July 1972 there were 15 rams (10 mature) of which one had green tag 870L in the left ear (W. Etherington pers. comm.).

In June and July several Aylmer sheep were observed at the Minnewanks picnic site searching for handouts and salt.

After the hunting season east of the park, many of these sheep moved onto the grassy slopes of the Ghost River drainage while some remained on the south-facing slopes above Lake Minnewanka and along the west side of Mt. Aylmer. Others migrated to their winter range north of Stoney Creek.

This band numbered as high as 147 in summer but in winter only 40 - 65 were observed inside the park.

6b (Palliser)

Of those sheep wintering north of Stoney Creek, many made excursions to the Aylmer Lookout in summer. However the main summer range occurred around Panther Mtn. and the headwaters of Stoney and Cuthead creeks and the Dormer River. One band ranging in size from 32 - 36 were observed along the south side of Flints Pk. near the goat trap during the period May-July in

1968, 1969 and 1970. Rimmer believed they spent most of the summer in that vicinity. In August 1970 wardens observed a group of 35 sheep (30 rams and 5 ewes) at the western headwaters of Wigmore Creek, just north of the headwaters of Cuthead Creek. This appeared to be another favorite summer range for rams from the Palliser and Bare Mountain areas. The main band summered within a few kilometres of Dormer Pass and spent considerable time at the black shale lick just north of the Pass. It shared this lick with large numbers of mountain goats and elk from April through July. Twelve elk and a band of 41 sheep were observed near this lick on April 12 by biologist W. Etherington. Another band of 11 rams was using this lick on 19 June 1970. The rams concentrated around the headwaters of Stoney Creek and Dormer Pass while the ewes concentrated around Bighorn Valley and Wigmore Lake along the west side of Panther Mtn. The ewe band and 50-100 elk foraged on these grassy slopes from the 2200 - 2400 m elevation.

In late September the ewe and ram bands began moving onto the main winter range along the west side of the Palliser Range from Stoney Creek north to Bighorn Lake at the 2000-2300 m elevation. During the rutting period, groups of sheep were found from Flints Pk. to Lake Minnewanka. Rams also moved freely across the Cascade River near the mouth of Stoney Creek (Figure 10) to service ewes on Cascade Mtn. and also across the Panther

River to the ewes on Bare Mountain. Geist (1967) found that the Palliser Range from Stoney Creek to the third ridge north of the elk trap served as a ram concentration area during the pre-rut from late September to the first week in November.

The best sheep counts were possible during the fall and spring periods when both ewes and rams were concentrated on the open alpine winter ranges.

On 2 September 1970 a band of 39 rams had just moved onto the winter range above the elk trap. On 15 September 1970, Biologist Don Hutton counted 135 sheep from the elk trap. In the fall of 1968, Rimmer counted 135 sheep from the elk trap; Rimmer also counted 160 sheep in the Stoney Creek district and estimated the population at 300.

After the pre-rut the majority of rams from the main Palliser range split into two groups with one going north towards the Panther River and the other going south towards Lake Minnewanka and also up Stoney Creek (Geist 1967). He reported that seven Palliser rams visited ewe bands on Snow Creek summit during the November-December rutting period.

At the end of the rut, part of this band (about 40 head) moved to the upper Dormer Valley between the junction of the two forks and the headwaters of the north fork. An aerial survey on 11 March 1969 revealed four groups of 5, 8, 9 and 18 for a total of 40 sheep (11 rams) on south-facing grasslands at the 2000-2300 m elevation along the north side of the Dormer Valley.

They were sharing these grasslands with 80 elk which utilized the 1830 - 2250 m elevation zone. At that time there were another 21 sheep on Panther Mtn. and 8 near Bighorn Lake.

The number of sheep remained high from September to June on the range between Stoney Creek and Cabin Mtn. east of the Cut-head Cabin. On 2 February 1968 there were 91 sheep (40 rams) and 47 elk on this range, while on 22 April 1970 Warden Tom Thordarson counted 94 sheep between Stoney Creek and the elk trap.

When the warm March and April sun began to melt south-facing slopes, the Palliser band spent more time on the south slope of Grassy Mtn. On 22 April 1970, Brady counted 72 sheep on this slope and 63 on the same slope the next day. During this spring period, large numbers of sheep were present throughout the west side of the Palliser Range from Stoney Creek to Cabin Mtn. On 4 April 1970 wardens Brady and Wackerle counted 200 sheep on this range and on 28 April 1971 there were 46 adult rams on this range.

These subalpine and alpine grasslands were shared with some 150 - 200 elk during 1966-71.

6c (Dormer-Panther Mtn.)

There were two small wintering groups of sheep located on Dormer Mtn. on the east boundary of the park and on Panther Mtn. east of Wigmore Creek. The band of 14 - 20 sheep wintering on the west side of Dormer Mtn. was observed about 100 m below

timberline at the 1830 m elevation. The Panther Mtn. group ranged in number between 16 and 46 and was found on NW and SW slopes between 1980 and 2400 m. During mild winters and during summer there was probably some interchange between these bands. The Panther Mtn. sheep interchanged freely with sheep from Bare Mountain, and were considered to be part of that band so are not counted as part of the Palliser sheep.

The secret to the high carrying capacity of the Palliser-Dormer unit was a combination of 2 main factors:

1. the productive and extensive southwest facing grasslands along the west side of the Palliser Range, especially between Stoney Creek and Wigmore Summit;
2. the unrestricted use of a vast wilderness area extending from the Panther River to Carrot Creek which permitted them to obtain necessary minerals from natural licks along the Dormer and Panther rivers, Flints Park and Lake Minnewanka; it also provided a diversity of grassland-shrubland ranges on all aspects and elevations from 1830-2300 m to meet all seasonal dietary requirements.

All of the above range components are vital to the future welfare of this large sheep population. Park planning should be designed to permit the sheep unrestricted use of all these range components.

Unit 7 (Panther-Bare Mtn.)

The heart of this population was Bare Mtn. and Mt. White between the Panther station and Scotch Camp. In addition to the sheep on these mountains, another group was found on Gable and Barrier mtns. near the east boundary of the park. During the rut and again in the spring, sheep were found on grasslands all along the north side of the Panther Valley from the Panther station to Barrier Mtn. The Windy band from Bare Mtn. also moved freely across the Panther River as far south as Bighorn basin near Wigmore Lake.

There were approximately 150 sheep in this unit during 1966-71. The highest aerial count was 114 in December 1968 (Appendix 2) and the warden count in the fall of 1968 was 124. The distribution of sheep from the aerial count was 16 on Mt. White, 18 at the north end of Bare Mtn., 1 at Sulphur Spring and 79 on Barrier and Gable mtns. near the Shortcut Trail. In December 1967 an aerial survey showed 104 sheep located at Gable Mtn. (40), Sulphur Spring (28), Bare Mtn. (25) and Mt. White (11). Biologist V. Geist counted 131 sheep in the Panther River area, including 38 rams in the fall of 1966, and estimated 400 in summer and 200 in winter (Geist 1967). The band of 79 observed on Barrier and Gable mtns. may be the same band often seen on the grassy slope SW of the Ya-Ha-Tinda Ranch. This grassy slope is a northern extension of Barrier Mtn. and 69 sheep were counted on this grassy slope in December 1966.

The Windy area (Bare Mtn., Panther slope and slopes adjacent to Rimrock basin near the head of Snow Creek) supported 58 ewes and immatures during November-December 1966, according to Geist (1967). Warden Andy Anderson reported that in August 1966 he and Phil Temple counted 122 rams between Scotch Camp and the Panther (Windy) station along Bare Mtn. and Mt. White. All these rams were above the east side of the road and there were also about 40 ewes and immatures on the same range. One band of 9 large rams that spent July and August on Mt. White near Fagin Pass and then disappeared was believed to be the same one seen later in September at the headwaters of Ranger Creek north of the Clearwater River.

The alpine and subalpine grasslands used by these 160 - 200 sheep were also shared by 350 - 500 elk. During the December 1967 aerial survey, 358 elk were counted on these grasslands. Most wintered in the basins north of Sulphur Spring and the west side of Barrier and Gable mtns. near the Shortcut Trail between the Panther and Red Deer rivers.

Sheep wintered at the 2400 m elevation on W and SW slopes on Mt. White and Snow Creek summit; at the 2100 - 2400 m elevation on W, SW, W and tableland aspects along Bare Mtn.; at the 2300 m elevation on a S aspect near Sulphur Spring and at the 2200 m elevation and a SW exposure on Barrier and Gable mtns.

Bare Mtn. served as a ewe concentration area in spring (Geist *op. cit.*).

During the summer, there was a western movement from Barrier and Gable mtns. towards the north end of Bare Mtn. near Snow Creek summit and also west of the road onto Mt. Prow. Some sheep probably moved northwest to the natural lick on the north side of the Red Deer River near the mouth of McConnell Creek (Figure 11). Large numbers of ewes and lambs were seen by warden Bill Waslenchuk near Rimrock Basin (Summit Lake) from June to August. In June 1968 he saw 40 ewes and 25 lambs at that location.

By August the rams had concentrated at the north end of Bare Mtn. and Mt. White and also ranged west of the road and north onto the Mt. McConnell range. A band of 25 rams was observed on Bare Mtn. by Biologist E.B. Cunningham on 27 August 1968 and 15 rams were seen on Mt. White on 21 August 1968 by Waslenchuk. On 13 August 1968, 5 ewes were seen on Mile 32 on Mt. Prow although little use was made of the range west of the Snow Creek road.

During the period 22 June to 2 September 1968, warden counts indicated there was a minimum population of 95 sheep on Bare and White mtns. and the Panther slope 1.5 km SE of Panther station. This population consisted of 49 ewes, 26 lambs and 25 mature rams.

During the rutting period the rams covered all ewe bands within this unit plus those north of the Red Deer River on Mt. Tyrell and probably some ewe bands south of the Panther River. On 4 November 1968 the author saw some fresh tracks of 5 or 6 rams that had moved east from Mt. Prow to the ewe band on Mt. White. Two days later there were tracks of 10-15 rams walking

along the road from Mt. White at Mile 33 down to Scotch Camp and across the Red Deer River to the Mt. Tyrell ewe band. Most rutting activity occurred at the south end of Mt. White, the south end of Bare Mtn., the south side of Gable Mtn. and the west side of Barrier Mtn.

Geist (*op cit.*) believed that Palliser rams worked all ewe bands between the Bow and Red Deer rivers during the rutting period.

The natural lick at Sulphur Spring probably provided most of the lick requirements of sheep in this unit although large numbers of sheep used the salt blocks in the horse corral at the Panther station. Some use of the McConnell Creek lick was also suspected.

Unit 8 (Red Deer-Clearwater)

Sheep in this unit ranged between the Ya-Ha-Tinda Ranch east of the park to McConnell Creek and occasionally as far west as Little Pipestone Creek at the headwaters of the Red Deer River. Jacobson saw a few individual sheep near Pipestone Pass in 1974 and 1975. On the north side of this unit towards the Clearwater River they ranged as far west as Roaring Creek (Figures 10 and 11).

There were 100 - 120 sheep in this unit inside the park plus another 40 - 80 sheep on the Scalp Creek drainage near the Ya-Ha-Tinda Ranch.

The two rutting ranges were along the east side of Tyrell Creek, where 62 sheep were counted in December 1968, and on Mt. Peters between Peters and Roaring creeks, where 35 sheep were counted during the rutting period (Appendix II). There were thus at least 97 sheep at these two locations. In addition there was a band of 40 - 80 sheep in the Scalp Creek area at the Ya-Ha-Tinda Ranch (W. Wishart, pers. comm.). Some of the rams from this band were probably the same ones that worked the Tyrell Creek band during the rutting period.

The rutting range on Mt. Tyrell was located mainly along the east side of the creek at the 2300 - 2400 m elevation on a SW exposure. On Mt. Peters the two small rutting ranges were along the east fork on a W exposure at 2350 m and along the west fork on a SW exposure at 2250 m.

After the rutting season, many of these sheep moved east outside the park onto winter ranges along Forbidden and Scalp creeks.

In summer the band at the Ya-Ha-Tinda Ranch used a lick along Scalp Creek while the Tyrell Creek band used the lick near the mouth of the McConnell Creek. On 1 August 1969, there were 12 ewes and lambs at this latter lick and another group of 9 ewes and lambs was at the lick in August 1970. On 19 August 1969 and 29 July 1971 there were ewes and lambs at the Scalp Creek lick.

A favorite summer range for rams was the headwaters of

Roaring Creek where wardens reported seeing up to 30 rams. Ewes and immatures summered along McConnell Creek and along the headwaters of the Clearwater River above Roaring Creek. Some rams summered on the southwest side of Mt. McConnell and west onto Cyclone Mtn. Some probably reached Mt. Skoki where small numbers of sheep have occasionally been reported. Rimmer reported small numbers of transient sheep showing up during some summers on the high ground in the vicinity of Red Deer Lakes between Cyclone Mtn. and Mt. Skoki and believed they were from the McConnell Creek band. Wardens also saw rams at Shale Pass between Divide and Peters creeks in the summer. This location is also the headwaters of Forbidden Creek and these rams would also service the ewe band east of Condor Pk. north of Forbidden Creek. A band of 54 sheep was counted at this location in the fall of 1966.

Ewes and immatures were seen between Tyrell Creek and Wapiti Mtn. yearlong and it is probably that some ewes from the Ya-Ha-Tinda Ranch had their lambs in this area. Ewes and newborn lambs were seen on the SW slope of Wapiti Mtn. in June 1968.

Large numbers of elk also used the Tyrell Creek and Divide Creek ranges in summer and fall. There were 384 elk counted near Tyrell Creek on 7 December 1967. In August 1968 there were 150 elk at 2350 m along Tyrell Creek.

Unit 9 (Malloch-Indianhead)

This small summer population was located in the northeast corner of the park along the Indianhead and Malloch creek drainages. They also ranged onto the headwaters of Ranger, White-rabbit and Siffleur creeks and Escarpment River outside the park. The main winter ranges lay outside the park on the above watersheds.

During the rutting period most sheep within the park were located on a SW exposure at the 2450 - 2500 m elevation, east of Malloch Creek (Figure 10). There were 8 ewes and rams at that location in December 1966 while only 2 rams were sighted there in December 1968.

In summer, the number of sheep within the park increased greatly as sheep moved in from Ranger, Whiterabbit and Siffleur creeks and Escarpment River. They ranged between Indianhead and Malloch creeks and also moved west of Malloch Creek overlooking the Clearwater River. Sheep were also reported as far west as Clearwater Lake near the headwaters of the Siffleur and Clearwater rivers. As there was a good winter range along the Siffleur River north of the park it was likely that sheep seen by Clearwater Lake in summer came from the Siffleur rather than from Malloch Creek.

Wardens reported seeing a band of 29 sheep (14 rams and 15 ewes & lambs) at the head of Indianhead Creek on 2 September 1970).

A major summer range for rams lay along the west side of

Mt. Malloch where wardens report up to 50 sheep, including large numbers of rams using the area east of Martin Creek. These sheep wintered along the Escarpment River watershed north of the park. A small band of 6 or fewer ewes summered on Mt. Kentigern along the north boundary of the park and wintered on the Escarpment drainage.

The summer population probably numbered between 50 and 100 within the park and they ranged all the way from the Siffleur River east to Wampum Park. In winter these sheep moved north of the park with only 10 - 15 remaining in the park.

Unit 10 (Mt. Wilson)

This isolated band of 15 - 30 sheep frequented the south slope of Mt. Wilson overlooking Saskatchewan Crossing. Their winter range lay west of Owen Creek at the 2250-2350 m elevation on a small isolated grassland.

Rimmer (1974 wildlife report to Warden Service hdqs.) reported that this band numbered 12 - 30 with the highest count on any one day being 20. He reported that occasionally sheep were observed on Mt. Coleman and Cirrus and that they could be part of the Wilson band. Wardens Jacobson and Carlton believe this is not correct and that these sheep come in from the Pinto Lake area east of the park.

The Wilson band was the furthest west band of sheep in Banff as it was in the 1850's (Spry 1963). The number of sheep had remained low because the winter range on the south end of Mt.

Wilson was small and shared by mountain goats. In 1953 wardens counted 11 sheep on Mt. Wilson compared to 31 in 1965. Rimmer counted 33 sheep on one day in the spring of 1970 with the highest count for the rest of the year being 24. He observed that inter-specific competition between sheep and goats on the south grassy slopes of Mt. Wilson occurred only in late fall when both used the same grasses and range. He observed heavy range use and some ground sloughing on this steep grassland range (1970 Game Census Report, Area #2).

Rimmer believed that sheep which were occasionally observed in the fall on Cirrus Mtn. and Mt. Coleman could come from Mt. Wilson. I concur with this possibility, but believe they were basically outriders of the Onion Lake band east of the park which extended westward in summer to Cirrus and Coleman mountains and the Nigel Pass area.

Unit 11 (Nigel-Cirrus)

This unit, which extended from Sunset Pass north to Jasper Park, contained occasional migrant sheep from east of Banff along the upper Coine River, Cataract Creek and Onion Lake area. Some of these sheep have also ranged south from Mt. Wilcox and Nigel Pass at the Banff-Jasper border.

Rimmer reported that the 7 sheep observed in 1970 on the high slide area south of Nigel Pass were part of the Brazeau River band. In the earlier discussion of sheep in Unit 1 (Tangle

Ridge) of Jasper it was mentioned that in September and October 1971, 14 sheep were seen on the south side of Nigel Pass. I believe some of the Tangle Ridge band wintered to the southeast along the Coine River and near Pinto Lake. It therefore seems reasonable that in summer and fall sheep from the Pinto Lake area would have migrated west onto Mt. Coleman especially through Sunset Pass. They would probably also have migrated northwest along Cataract Creek towards Coine Pass and Nigel Pass with some moving west onto Cirrus Mtn. It is just as probable that some would have migrated southeast to Mt. Wilson and would have mingled with sheep moving north from the Mt. Wilson sheep range.

In September 1966 a ram was seen along Hwy. 93 on the west side of Cirrus Mtn. and this ram probably came from the Pinto Lake area.

There did not appear to be any winter range in this unit, and therefore the population was estimated at 6 - 15 in summer and 0 in winter.

There have been tracks observed in summer west of Hwy. 93 and the North Saskatchewan River and Nigel Creek that were believed to be either sheep or goats, but no sheep have been seen west of Hwy. 93 to date.

4.43 Seasonal distributions related to elevation and aspect

The distribution of sheep in relation to elevation and aspect during the four seasons as recorded during aerial (helicopter) surveys from 1966 to 1970 is presented in Table 9. Only for the summer (July-September) and the fall (October-December) seasons were the samples large enough to provide accurate results, however, general conclusions can be reached for all seasons.

Concerning aspect (exposure) in both winter (January-March) and spring (April-June), sheep were only observed on the south (S), west (W) and southwest (SW) exposures with most (88.1%) on the south and southwest exposures. During summer, sheep were widely distributed on all aspects in the following decreasing order of abundance: SW (26.9%), SE (21.5%), W (13.0%), NE (11.0%) E (8.8%), S (6.7%), Flat (6.8%), NW (2.7%) and N (2.6%). In fall, they were found on three fewer aspects in decreasing order of importance: SW (39.9%), S (26.0%), W (25.3%), NW (6.4%), SE (1.8%) and Flat (0.6%).

On a yearlong basis, 35.4% were on the SW exposure, 23.5% on the S, 18.8% on the W, 8.1% on the SE, 4.0% on the NW, 3.7% on the NE, 3.0% on the E, 2.6% on flatland and 0.9% on the N exposure. These values showed that approximately 77.7% of the yearlong sheep use occurred on the SW, S and W aspects or exposures while only 8.6% occurred on the NW, NE and N aspects. These results were significant for sheep management purposes because the survival of

Table 9. Seasonal distributions of sheep in Banff National Park (1966-72) in relation to elevation (metres) and aspect showing numbers seen and the percentage () in each column.

Period	n	1675- 1825	1825- 1980	1980- 2135	2135- 2285	2285- 2440+	Totals + %	Aspect
WINTER (January-March)								
March 11/69	300		13(4.1)	14(4.5)	62(19.7)	49(15.6)	138(43.9)	S
Jan. 26/71	14			17(5.4)	63(20.1)	67(21.3)	147(46.8)	SW
Totals + %	314		13(4.1)	31(9.9)	125(39.8)	145(46.2)	-	W
SPRING (April-June)								
May/68	13			90()	9()		99(55.9)	S
April, May, June/69	164		30()	2()	14()		46(26.0)	SW
			5()	27()			32(18.1)	W
Totals + %	177		35(19.8)	119(67.2)	23(13.0)		-	-
SUMMER (July-September)								
July, August/68	401		4(0.4)	1(0.1)	57(6.2)		62(6.7)	S
Aug./69	407		25(2.7)	142(15.4)	19(2.1)	13(1.4)	199(21.5)	SE
Aug., Sept./70	116			223(24.1)	18(1.9)	8(0.9)	249(26.9)	SW
			22(2.4)		9(1.0)	50(5.4)	81(8.8)	E
				8(0.9)	15(1.6)	97(10.5)	120(13.0)	W
					24(2.6)		24(2.6)	N
			18(1.9)	81(8.8)	3(0.3)		102(11.0)	NE
				3(0.3)	15(1.6)	7(0.8)	25(2.7)	NW
				56(6.1)	6(0.6)		62(6.8)	Flat
Totals + %	924		69(7.5)	514(55.7)	166(18.0)	175(19.0)	924	
FALL (October-December)								
		6(0.4)	47(3.6)	205(15.5)	85(6.4)	1(0.1)	344(26.0)	S
			6(0.4)		18(1.4)		24(1.8)	SE
	12(0.9)	47(3.6)	200(15.1)	242(18.3)	27(2.0)		528(39.9)	SW
		47(3.6)	165(12.5)	88(6.7)	34(2.6)		334(25.3)	W
	2(0.1)	25(1.9)	17(1.3)	30(2.3)	10(0.8)		84(6.4)	NW
				8(0.6)			8(0.6)	Flat
Totals + %	1322	20(1.5)	172(13.0)	587(44.4)	471(35.6)	72(5.5)	1322	
YEARLONG								
	2737	20(0.7)	289(10.6)	1251(45.7)	785(28.7)	392(14.3)	2737	
For Aspects = S (23.5), SW (35.4), W (18.8), SE (8.1), NW (4.0), NE (3.7), N (0.9), E (3.0), Flat (2.6).								

sheep in Banff depends on them being able to have continued access to grassland ranges with light snow depths on SW, S and W aspects. All factors that significantly reduce winter sheep use of these critical slopes will markedly reduce the park's carrying capacity for sheep. Forcing them off these slopes or increasing forage competition from other ungulates will greatly reduce sheep numbers.

Concerning various elevational zones used by sheep, 74.4% occurred at the 2000 - 2285 m elevations while 14.3% were above 2315 m and only 11.3% below 1980 m on a yearlong basis. During the fall rutting period sheep concentrated at the 2000-2285 elevations on the W, SW and NW aspects. More information is required on seasonal distributions by elevation and aspect for the winter and spring period, before any definite conclusions can be drawn. The small amount of data for these two seasons presented in Table 9 indicates a shift towards lower elevations and south slopes in spring compared to winter. Such a trend would be expected as the animals move onto the first area to "green up" in spring which should be the low-elevation, south-facing slopes.

4.5 Waterton Lakes National Park

4.5.1 Historical

In 1915, there were an estimated 500-1000 sheep in southwest

Alberta from the International Boundary to Crowsnest Pass (Millar 1916). By this time in Waterton, bighorns were already facing heavy competition for the forage on low-elevation grasslands. During the winter of 1910-11, an estimated 1,500 cattle and 100 horses wintered within the 530 km² (204 mi²) park (Stelfox 1971). In 1925, Warden J.C. Holroyd estimated 375 sheep in the park as follows: Pass Creek 95, Cameron Creek 70, Boundary Creek 70, Twin Lakes 60, S.K. Pass 50, and Sage Creek 30.

After that time their numbers continued to increase until 1936 (Waterton files 1925-36). Their numbers may have reached or exceeded 1000 animals by 1936.

In the spring of 1937 about 50% of the sheep died, according to the 1937 Superintendent's annual report. However, 10 years later, after a build-up in numbers, the population was only 125; the die-off may have exceeded 75% (Banfield 1947). This die-off was due to verminous pneumonia (Cowan 1943). A similar die-off in Glacier Park, Montana, was diagnosed as verminous pneumonia (Marsh 1938).

Populations began to increase again after the 1937 die-off, because livestock competition was decreased. In 1947, Banfield (1947) estimated 125 sheep in the park at the following locations: Carthew 45, Vimy 20, Rowe 17, Bellevue 40 and Lakeview 3. He reported the bighorns to be in excellent condition and increasing in number. In 1952, the sheep population was estimated at 150 (Banfield 1953). Over the next decade a marked increase occurred,

with numbers in 1962 estimated at 235 (Stelfox 1971).

4.5.2 1966-71 Populations and distributions

Seasonal distributions are presented in Figure 16. The distribution map indicates there are two relatively discrete populations in Waterton, as follows:

Unit 1 (West Waterton) - West of Waterton Lakes and containing about 250 sheep during 1966-71.

Unit 2 (East Waterton) - East of Waterton Lakes and containing about 100 sheep during 1966-71.

Although studies of seasonal movements of sheep within and adjacent to the park using ear-tagged and point-marked animals commenced in 1957 and wardens had recorded sightings of sheep for many years, it was not until February 1967 that a detailed helicopter census and co-ordinated ground count by the author and the Warden Service produced a fairly clear picture of how many sheep were in the park. A helicopter count of 251 sheep plus an estimate of those sheep missed, but counted on the ground, indicated the 1967 population was about 350 sheep. This compared to the 1962-65 estimate of 236 (Blood 1966).

The February 1967 census indicated there were 350 sheep, 264 elk, 235 mule deer and 14 mountain goats wintering on 60 km^2 (23 mi^2) of semi-open and open grasslands. This amounted to a

density of 14.4 ungulates/km² (37.5/mi²). The condition of winter sheep ranges was classed as good to excellent (Stelfox 1975) indicating that ungulate numbers on sheep ranges had not reached or exceeded range carrying capacities.

Several reports were written on the abundance and distribution of bighorn sheep in Waterton between 1957 and 1971 and the reader is referred to them for greater details than those presented in this report. They include Holsworth (1957), Blood (1966), Sturko (1969), Christiansen (1971), Courtney (1971), Stelfox (1971), Nielsen (1973).

A collation of aerial and ground survey results for the period 1967-72 indicated that the estimate of 350 sheep in the park (Stelfox 1971) was reasonable. Table 10 presents aerial survey results for three areas of the park for this period and the highest count for each area. Assuming that interchange between sheep east and west of Waterton Lakes was insignificant, which appeared to be the case, then the minimum number of sheep in the park was 299. This minimum population consisted of 204 in West Waterton (152 north of Redrock Rd. and 52 south of Redrock Rd. during winter period) and 95 in East Waterton.

The population appeared stable or slightly on the increase, as late winter aerial counts by the Warden Service throughout the park were 89 in 1968, 144 in 1971 and 194 in 1972.

A description of the seasonal abundance and distribution in the two population units is as follows:

Table 10. Bighorn sheep population counts from helicopter surveys, Waterton Lakes National Park, 1967-72.

Area	Bighorn Sheep Count				Best Count	Est. Pop.
	1967	1968	1971	1972		
East of Waterton L.	71	17	95	44	95	100
North of Redrock Rd.	152	45	49	140	152	185
South of Redrock Rd.	52	27	0	10	52	65
Total Park	275	89	144	194	299	350

Unit 1 (West Waterton)

Sheep ranged in summer throughout the alpine and subalpine grasslands of the park, west of Waterton Lakes. They also ranged into British Columbia from the headwaters of Blakiston Brook and Rowe Brook. They extended their range northward towards Crowsnest Pass via the headwaters of Bauerman Brook, Spionkop Ridge and the Castle River, keeping to the east of the Flathead River. Most frequent observations were made along the north side of Blakiston Valley from Red Rock station east to the Eskerine Complex, Horseshoe Basin, Ruby Ridge, Akamina Hwy. and Carthew Lakes.

On at least three occasions between 1966 and 1969, several bighorn sheep that had been tagged and their horns painted on Mt. Galwey in the park were observed near Crowsnest Lake in Crowsnest Pass west of Coleman, Alberta. These sheep travelled a minimum distance of 75 km (47 miles).

In October 1972 a ram (10 years old) was shot west of Waterton on the Kishinena Creek watershed in British Columbia. It was

at least 16 km from where it had been tagged eight years earlier.

Waterton contained adequate, productive rough fescue grasslands to winter the 1966-71 population of sheep but was somewhat lacking in summer alpine grasslands (Stelfox 1975). The sheep relied heavily on available summer range adjacent to the west and north boundary of the park to meet their summer range needs. One band of sheep traditionally wintered at the headwaters of Yarrow Creek north of the park and was thus vulnerable both to hunting during the fall hunting season and to indiscriminate year-long hunting by Indians. Population trends were thus largely influenced by the availability of alpine and subalpine range adjacent to the park in B.C. and Alberta and by the annual harvest from white and Indian hunters. The other major limiting factors were winter and spring weather plus forage competition from elk and mule deer.

Unit 1 contained three winter ranges, namely:

1. Blakiston Brook - Mt. Dungarvan - Lakeview Ridge (1500-2300 m);
2. Ruby Ridge - southeast side from 2000 - 2400 m elevation;
3. Mt. Richards - southeast side from 1500-1800 m elevation.

Depending on snowpack conditions, sheep either concentrated on the south and east side of Mt. Galwey, Mt. Dungarven and Lakeview Ridge at the 1500-2000 m elevation, or else ranged throughout the area north of Blakiston Brook and Ruby Ridge to the south, using all grasslands above 1500 m. The major wintering

areas were Blakiston Valley (Mt. Galwey and Bellevue Ridge), Horseshoe Basin, Ruby Ridge (south and east side) plus Yarrow Creek north of the Park. The distribution of sheep in relation to elevation and aspect is presented in the next section, but briefly it was as follows. During deep snow periods following storms, and before strong winds bared alpine ranges, sheep concentrated on south and east exposures at the 1500-2000 m elevation. Following strong winds and/or mild chinook conditions, sheep migrated upwards onto the bared or shallow snow alpine ranges, using all aspects where forage was exposed.

The extensive and productive winter range along the Blakiston Valley is depicted in Figure 17. Only small numbers of sheep (6 or fewer) wintered on Mt. Richards and during some winters none were observed.

As soon as new grass and forb growth began along low-elevation south and east slopes in late April and early May, sheep moved to the lowest grasslands along the north side of the Blakiston Valley, along the Eskerine Complex at the mouth of this valley and the east side of Bellevue Hill onto the Badlands (Figure 18). They also foraged heavily on new grass growth on lawns within the townsite.

Blood (1966) reported that a common spring migration route from winter ranges along the lower slopes of Mt. Galwey was south across Blakiston Brook, over Ruby Ridge and across Cameron Creek and the Akamina Hwy. to the Carthew Lakes area. He



Figure 17. The Blakiston Valley winter range showing Mt. Galwey and a band of bighorns along the lower south-facing slopes, 6 May 1969.

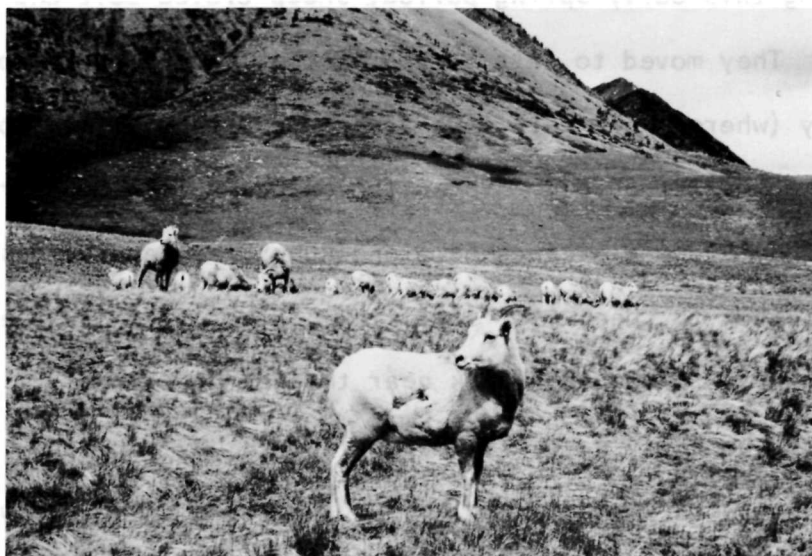


Figure 18. Sheep moving onto the Eskerine Complex at the southeast end of Bellevue Hill to forage on new spring plant growth, May 1970.

reported that a bighorn with red-painted horns from Mt. Galwey had shown up in Glacier National Park, Montana.

Before the ewes left the lambing ranges in June they were located in the following areas:

1. Ruby Ridge: the west slope of Ruby Ridge and the east slope of Mt. Blakiston;
2. Mt. Anderson;
3. Mt. Glendowan (S side) and Redrock Creek (W side);
4. Mt. Galwey (Deadhorse and Coppermine creeks);
5. Bellevue Hill (E side);
6. Galwey Creek Valley (E side of Mt. Galwey);
7. Dungarven Creek Valley (NW side of Mt. Dungarven);
8. Mt. Crandell (E side above Govt. Compound).

During this early spring period, sheep craved salt and minerals. They moved to salt blocks at the lower south slope of Mt. Galwey (where sheep were live-trapped and tagged) and to salt by the Tourist Bureau. Sheep followed a well-beaten trail from the Ruby Ridge Winter range along Ruby Creek and across Blakiston Brook to the Galwey salt lick. Others from further west moved down to the salt lick near the Redrock cabin.

During the early part of lambing in late May and early June, bands of ewes were common along the south slopes of Mt. Galwey and Bellevue Hill. Some lambing occurred at the head of Coppermine Creek and along the cliffs on the east side of Mt. Crandell above the Govt. Compound. Ewes left these area in early June, although

some rams, yearlings and two-year olds were still there throughout June. During the last half of June, ewes and newborn lambs were seen along the headwaters of Dungarven Creek (Holsworth 1957 and Warden Service reports). At that time the ewes shared Dungarven Valley with a small group of mountain goats with both species often in close association.

Some lambs were also born along the south side of Mt. Crandell above the Cameron Lake road.

An April aerial survey by the Warden Service showed that many rams were concentrated in the Horseshoe Basin and Ruby Ridge areas.

In June, sheep migrated along the south side of Mt. Galwey and Bellevue Hill above the 2300 m elevation.

Some sheep moved along Cloudy Ridge and Avion Ridge and north of the park along the headwaters of Yarrow Creek and the Castle River. Rams summered on high alpine ranges especially along the northern and western limits of the park along the Continental Divide in areas such as Lone Brook and Mt. Hawkins. The ewes, lambs and immatures generally summered on lower alpine grasslands, especially along Dungarvan, Red Rock, Carthew and Bertha creeks and Mt. Blakiston and the Goat Lake areas.

The highest number of sheep on Mt. Richards was observed during the rutting period, indicating that the southeast slope of this mountain is a rutting range. Wardens counted 19 sheep on this

range in early December and observed that the animals were rutting there. Wardens noted that much of the rutting activity throughout the park occurred on coniferous savannah slopes.

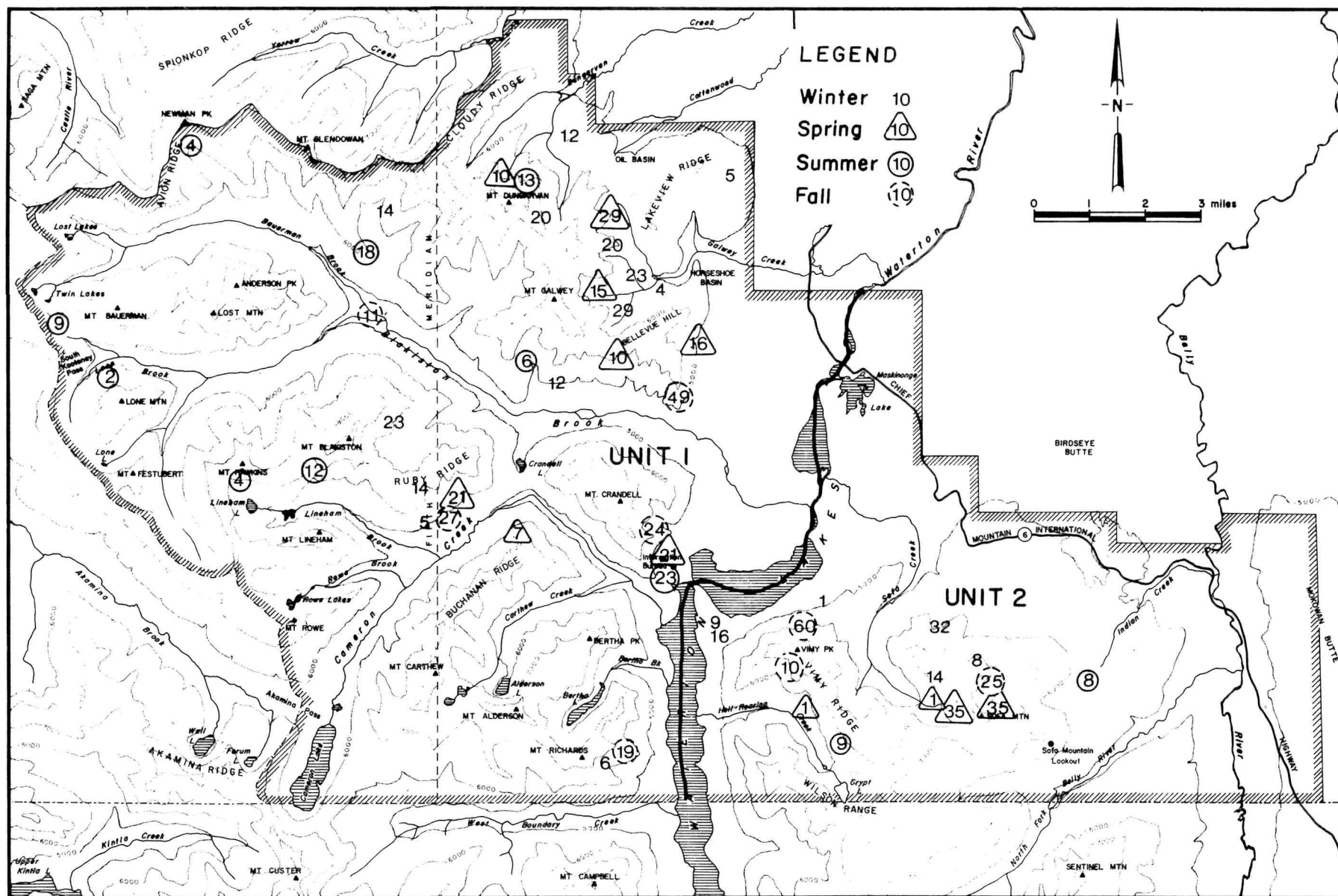
Numbers of sheep observed seasonally at various locations throughout the park are shown in Figure 19.

Unit 2 (East Waterton)

Sheep in this unit ranged from Waterton Lakes at Bosporus Point to the headwaters of Indian Creek and the Belly River. The main winter range was along the north slope of Sofa Mountain and the west slope of Vimy Peak. The summer range lay further south along Vimy Ridge, Sofa Mountain Lookout, the head of Indian Creek and Hell-Roaring Creek. The highest count of sheep in this unit from helicopter surveys by the Warden Service was 84. The author estimated a total of 100 sheep in this unit.

Occasionally, sheep crossed the narrows of Waterton Lakes at Bosporus Point providing interchange between Units 1 and 2. This interchange occurred on the ice in winter and in mid-summer. Although no sheep were seen swimming across the narrows, on two occasions wardens observed wet sheep feeding on grasslands by the Prince of Wales Hotel indicating they swam across from Bosporus Point. As no tagged sheep from west of Waterton Lakes have been sighted in Unit 2 it is safe to assume that interchange between these two units is negligible.

Seasonal distributions in Unit 2 were approximately as



follows:

During winter after the rutting period the sheep concentrated between Sofa and Crooked creeks on windswept slopes of the Vimy Peak towards Bosporus Point. Wardens counted 71 sheep on 2.4 km^2 (1 mi^2) along the north side of Sofa Mountain on 23 March 1973. Most sheep wintered at the 1500 - 2200 m elevation. Above Bosporus Point the sheep wintered among sparsely distributed scrub pine and spruce at the 1500 - 1700 m elevation on west and north slopes. Where most sheep wintered at the head of Crooked Creek they were found at the 1900 - 2200 m elevation on all aspects but primarily on north slopes. Here they were found on alpine and subalpine grasslands, rock, talus, ice and snow. A few were found in Vimy Ridge and Vimy Mountain at higher elevations (2000-2300 m) on north, south and west aspects (Table 11).

In spring the Sofa-Vimy bands remained on their winter ranges but there was a shift towards lower elevations (1300-1900 m) and south and east aspects where new plant growth came first. Some were found at the lowest portions of Bosporus Point. Lambing probably occurred on south and east facing cliff areas of Sofa Mountain, Vimy Peak and Vimy Ridge.

During summer, more sheep were observed south and west of the winter ranges and were more widely distributed throughout the subalpine and alpine ranges. Large numbers were still observed on the north side of Sofa Mountain (Figure 19) while many were on Vimy Ridge and some around the Lookout above the Belly River.

Table 11. Seasonal distribution of sheep on various watersheds and mountains in Waterton Lakes National Park, 1967-72.

Area	WINTER		SPRING		SUMMER		FALL	
	Sheep	Elevations & Aspects	Sheep	Elevations & Aspects	Sheep	Elevations & Aspects	Sheep	Elevations & Aspects
UNIT 1a NORTH OF BLAKISTON BROOK								
Galwey Cr. (Lakeview Ridge Horseshoe Basin)	76	2000 SE, N S, F					17	1900 E
Bellevue Hill	22	1900 S, SW	10	2100 E			31	1500-1700 S,E
Mt. Dungarven	32	2200 W	10	1900-2300 SW, S	13	2200-2400 E, NE		
Mt. Galwey	12	1900 S	44	1900-2300 SW, S	9	2300-2400 N, SW	13	1600-1700 S
Redrock Cr.	14	2000 S, SW			19	2000 NE	8	1800 E
Yarrow Cr.							15	1800 SE
Avion Ridge and Goat Lake					4	2300 S		
UNIT 1b BLAKISTON BROOK TO CAMERON CREEK								
Ruby Ridge	42	1900-2200 NW, S, SE	21	1900 SE			19	1600 S, SE
Mt. Rowe	4	1900-2200 E			18	2300 NW		
Crandell Mt. & Information			21	1300 E	11	2000-2300 Top & N		
Lone Mt. & Brook					4	2300 S		
Mt. Hawkins					12	2400 S		
Mt. Blakiston								
UNIT 1c CAMERON CREEK TO WATERTON LAKE								
Mt. Richards	6	1500-2000 SW					19	1800 SE
Buchanan Ridge			7	1900 NW				
UNIT 2 SOFA MOUNTAIN & VIMY RIDGE								
Sofa Mtn.	95	1800-2100 N, NW, E	71	1900 NE, NW	17	2100-2300 E	74	1900-2200 N, NE, NW
Vimy Ridge	24	2000-2300 N, S, E, W					10	1400-1800 NW
Bosporus Pt.	16	1400 NW	9	1300 NW				

In fall during pre-rut and the rutting period (November-December) most sheep were found on Sofa Mountain on northern slopes at the 2000-2300 m elevation. Some were found at lower elevations (1300-1700 m) on a NW slope and at higher elevations (2000-2300 m) on Vimy Mountain (Table 11 and Figure 19).

During recent years, the park staff noted sheep favoring the Sofa Fan area and believe this may indicate a range extension due to a change in population dynamics.

4.5.3 Seasonal distributions related to elevation and aspect

The distribution of sheep throughout the park on a seasonal basis for various elevations and aspects is presented in Table 12.

Concerning the various aspects used, there was a significant difference in preferred slopes in Waterton from those in Banff and Jasper. Whereas southwest and west aspects were the important wintering slopes in Banff and Jasper, in Waterton most sheep wintered on north and northwest slopes (58.0%). Another 28.4% were on south and southeast aspects, 11.8% on a west exposure and 1.8% on flat ridge tops. During spring, 37.9% were still on north facing slopes, but there were 30.1% on east and southeast aspects compared to only 19.9% in winter. In summer, there was a preference (44.8%) for the north aspect; however, there were 24.3% on the east aspect, 22.4% on south slopes and 8.4% on ridge tops. During the fall rutting period there was a

Table 12. Seasonal distributions of bighorn sheep in Waterton Lakes National Park by elevation and exposure.

Numbers at each elevation zone (Metres)							Totals	%	Aspect
<1600	16-1800	18-2000	20-2200	22-2400	24-2600	2600+			
WINTER									
			23(8.5) *				23	8.5	S
		3(1.1)	45(16.6)	6(2.2)			54	19.9	SE
			2(0.7)	3(1.1)			5	1.8	Flat
				32(11.8)			32	11.8	W
	16(5.9)			30(11.1)			46	17.0	NW
		1(0.4)	2(0.7)	68(25.1)	40(14.8)		111	41.0	N
Totals	16(5.9)	1(0.4)	5(1.8)	138(50.9)	111(41.0)		271		
SPRING									
		11(3.3)	9(2.7)		6(1.8)		26	7.8	S
			21(6.3)				21	6.3	SE
			25(7.5)		29(8.7)		54	16.3	SW
	9(2.7)		8(2.4)				17	5.1	NW
			29(8.7)				29	8.7	N
			70(21.1)	10(3.0)			80	24.1	NE
	29(8.7)	28(8.4)			22(6.6)		79	23.8	E
	26(7.8)						26	7.8	W
Totals	64(19.3)	39(11.7)	162(48.8)	10(3.0)	57(17.2)		332		
SUMMER									
				4(3.7)	16(15.0)		20	18.7	S
				4(3.7)			4	3.7	SW
				18(16.8)			18	16.8	NW
			2(1.9)	5(4.7)			7	6.5	N
			19(17.8)	4(3.7)			23	21.5	NE
			8(7.5)	18(16.8)			26	24.3	E
				9(8.4)			9	8.4	Flat
Totals			29(27.1)	62(57.9)	16(15.0)		107		
FALL									
		49(21.7)					49	21.7	S
			39(17.3)	1(0.4)			40	17.7	SE
	8(3.5)	2(0.9)		3(1.3)	4(1.8)		17	7.5	NW
				35(15.5)	16(7.1)		51	22.6	N
				16(7.1)			16	7.1	NE
	28(12.4)		8(3.5)	17(7.5)			53	23.4	E
Totals	36(15.9)	51(22.6)	47(20.8)	72(31.9)	20(8.8)		226		
Yearlong	116(12.4)	91(9.7)	214(22.9)	249(36.6)	250(26.7)	16(1.7)	936		
Totals									

*Values in brackets () refer to percentages.

preference for south and southeast aspects (39.4%), followed next by east and northeast aspects (30.5%) and by north and northwest aspects (30.1%).

The yearling distribution of sheep according to elevation was greatest for the 1800-2400 m zone (76.2%) of subalpine and alpine grasslands, krummholz, talus and cliffs. A considerable percentage (12.4) of yearlong use occurred at low elevations below 1600 m, especially on east and northwest exposures. In winter, 91.9% were located between the 2000 and 2400 m elevations with another 5.9% below 1600 m. During spring, a higher percentage of the sheep (19.3) migrated down to low-elevation grasslands that were greening up below 1600 m. There was also a marked increase in the use of the 1800-2000 m zone (48.8%) compared to only 1.8% during winter. In summer, 72.9% of the animals were above 2200 m of which 15.0% were above 2400 m. During the fall period, most (75.3%) ranged between 1600 and 2200 m, although significant numbers (15.9%) were below 1600 m.

4.6 Kootenay National Park

4.6.1 Historical

A major die-off occurred about 1922 in the Radium band according to big game guide Roy Lake of Invermere. Forest fires in the 1920's extended the grasslands by opening up the coniferous forests thus providing suitable range conditions from the late 1920's to the late 1930's (Cowan 1943). Bighorn sheep were

reported to have been very plentiful from 1936 to 1940 according to farmer K. Hansen, north of Shuswap Creek.

Cowan estimated 140 sheep in the Radium area in 1938. In November 1940, the Warden Service became aware that a die-off was taking place near Radium. During a short period of time, 106 dead sheep were found and a total of 120 were believed to have perished (Cowan 1943). Warden J. Meredith estimated that the remaining 20 or fewer animals had increased to 30 or 31 by the winter of 1942-43. By 1946 their numbers had increased to about 60 (Cowan 1946).

Counts of sheep on the Radium winter range (Sinclair Creek to Shuswap Creek) by park wardens were 74 in 1963 and 78 in 1965. Warden Max Winkler counted 86 ewes and lambs on the Kindersley summer range in 1966 at a time when another 12-15 sheep were present near the Hot Springs. Winkler and a big game outfitter estimated the summer 1966 population throughout the park to be 150-200.

B.C. biologist Don Eastman reported there were 79 ewes, 21 lambs and 12 rams in the Stoddart Creek-Radium area during the winter of 1965-66. In April 1966, wardens counted 103 sheep at Stoddart Creek and 30 along Sinclair Canyon. They estimated up to 15 more sheep present in the Edgewater-Brisco area at that time.

4.6.2 1966-71 Populations and distributions

The 1966 midsummer sheep population was estimated to be 175,

based on counts by the Warden Service together with those by the British Columbia Fish and Wildlife Branch when the sheep were on the Stoddart Creek winter range (Stelfox 1966b). A major die-off began in September 1966 when emaciated animals with symptoms of pneumonia-lungworm disease began dying, although weather and forage conditions were favorable. The disease die-off was initiated by deteriorated winter range conditions and inclement weather during the winter of 1964-65. Sheep numbers declined from 175 in 1966 to 50-55 by the spring of 1967 and to 40-45 by December 1967 (Stelfox 1971). A continuous encroachment of coniferous forest onto the winter range plus increased competition from livestock and deer, were other causative factors.

After three subnormal reproductive years in 1966, 1967 and 1968, productivity returned to normal in 1969 when 23.4% of the band was lambs during the winter of 1969-70. The Radium band increased to 50-60 animals by the fall of 1969 and to 80-85 by the fall of 1970 on the basis of aerial and ground counts by the author and Park personnel.

There were two populations of bighorns in Kootenay during 1966-71. Most were contained in Unit 1 (Radium) west of the Kootenay River while Unit 2 (Simpson River) provided summer range for up to 40 sheep which wintered along the upper Simpson and Mitchell rivers.

Seasonal distributions of bighorns throughout Kootenay for

the period 1966-71 are presented in Figure 20, while numbers observed seasonally are presented in Figure 21.

The seasonal abundance and distribution of sheep in each unit for the period 1966-71 were as follows:

Unit 1 (Radium)

Sheep in this unit ranged from Stoddard and Shuswap creeks, south of the park (Figures 20 and 21), north to the Kindersley Creek headwaters. Occasionally, they moved as far north as Kicking Horse Canyon east of Golden. During the summer of 1972 a 2-year-old ram was observed at that location and it had silver-colored ear tags. This sighting was confirmed by B.C. Conservation Officer Billy Blower. As no other tagged 2-year-old rams were available from other free-ranging B.C. herds or from neighboring Glacier, Yoho and Banff national park this ram must have been the one tagged at Radium in March 1972 by the author, Park Naturalist Ian Jack and biologist David Shackleton. It had travelled a minimum distance of 90 km (56 miles). CPR railway officials reported seeing as many as four bighorns along Kicking Horse Canyon during the summer and early fall of 1972, but had not been close enough to tell if any had ear tags. It is probable that they were also from the Radium band.

Jack reported that in the summer of 1972 a herd of 21 bighorns were seen adjacent to the Trans Canada Hwy. east of Golden

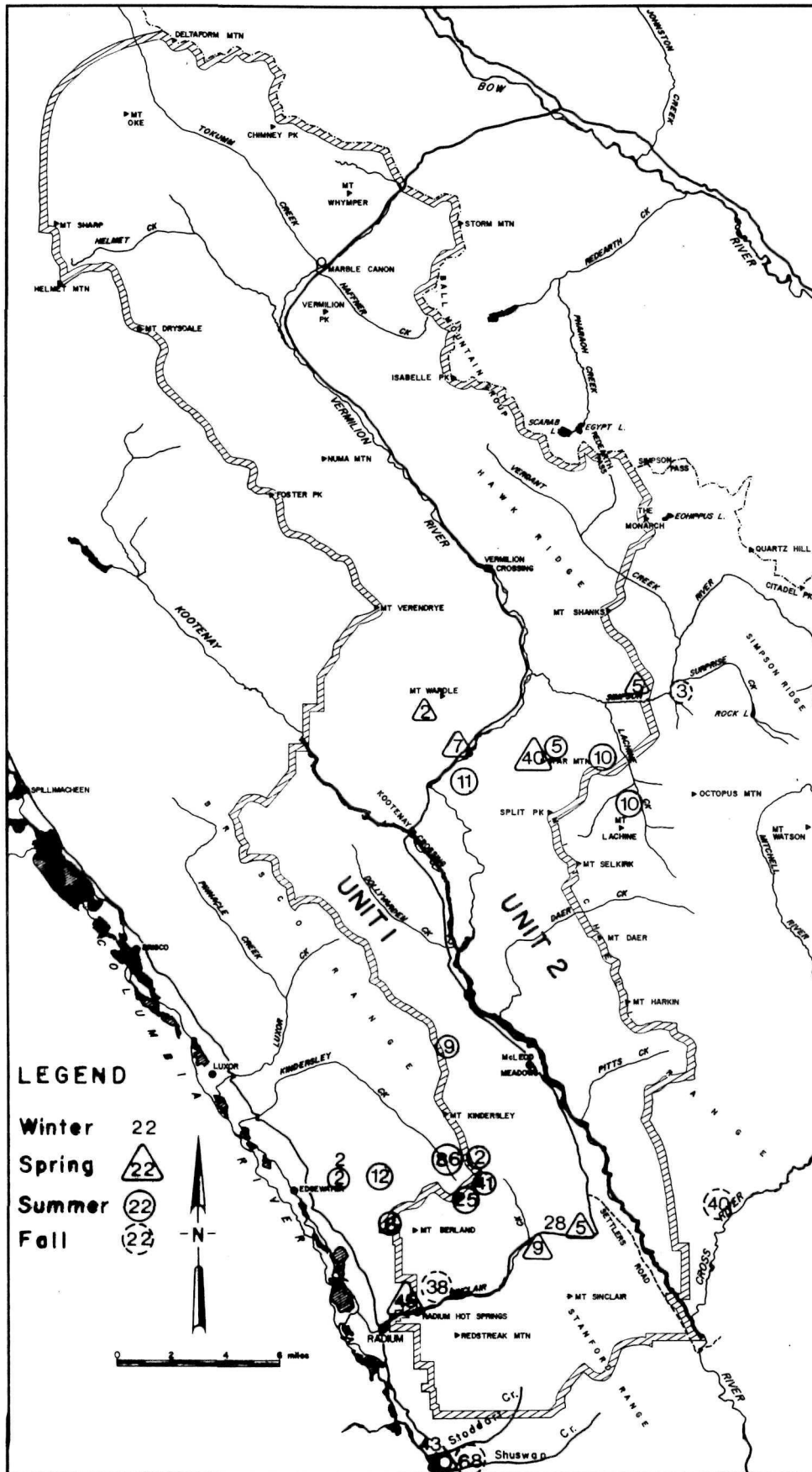


Figure 21. Numbers of sheep observed within and adjacent to Kootenay National Park, 1966-71.



Figure 22. Low-elevation winter range in Dry Creek-Stoddart Creek area south of Radium, B.C., October 1966.



Figure 23. Bighorn sheep and deer winter range along Sinclair Creek near Radium, B.C., 15 October 1966.

Golden and that at least one had a Radium ear tag. On 25 March 1974, CPR official George Burchinshaw saw 7 bighorn sheep 1.5 km east of Golden on a grassy slope above the railway track. It appeared that a nucleus of a new band of sheep had become established east of Golden and this band originated from the Radium band. No reports of sheep in the area east of Golden was received by the author prior to 1973.

More than 75% of the sheep in Unit 1 spent the period October-April between Dry Gulch and Shuswap creeks, south of Radium. Most were observed near Stoddart and Shuswap creeks on provincial crown land south of the park. This major winter range lay at the 1300-1600 m elevation on a W exposure (Figures 22 and 23) with major grassland species consisting of bluebunch wheatgrass (*Agropyron spicatum*), bearded wheatgrass (*A. subsecundum*), june-grass (*Koeleria cristata*) and Indian ricegrass (*Oryzopsis hymenoides*). Details of this winter range are provided in Stelfox (1966b).

An aerial survey along the east side of the Columbia Valley from Shuswap Creek north to Briscoe in December 1966 showed 68 sheep between Radium and Shuswap Creek, 10 or 11 along Sinclair Canyon below the Hot Springs, and 2 near Edgewater. The previous winter an aerial survey by B.C. biologists showed 98 sheep between Sinclair and Stoddard creeks.

After the November-December rutting period, many of the rams were reported to winter further north towards Edgewater and

Brisco. There were 14 rams (half to full curl) between Shuswap and Sinclair creeks on 9 December 1966 plus one full-curl ram east and 6 km north of Edgewater. In late January only 5 rams were on this range; the rest wintered elsewhere. Some ewes and immatures also moved north after the rut towards Brisco. On 22 December 1968 a ram lamb was observed feeding with a herd of cattle on the Goodwin farm near Edgewater where it remained until killed by dogs on 29 April 1969 (Park files). In February 1967, Jack observed 27 sheep (6 rams) near Stoddart Creek, 11 (2 rams) near Dry Gulch Creek and 4 (2 rams) along the north side of Sinclair Canyon. A mixed group of 28 ewes and rams was observed at Sinclair Pass above Hwy. 93 in January 1970.

New grass growth begins first in spring along the north side of Sinclair Canyon from Radium east to the Government Compound. At this time private lawns at motels and homes as well as the seeded highway slopes along the north side of this canyon have also started to green up. The sheep migrated from Stoddart Creek to this lush new growth and most remained there until just prior to lambing in late May and June. Rams also migrated onto this early spring range in April and May before migrating to higher summer ranges. On 5 April 1971, Jack saw a herd of 14 rams feeding near the Hot Springs. On 28 April 1967 Jack reported 25 sheep along Sinclair Canyon near the Hot Springs and about a dozen on the Stoddart Creek range. The author observed rams and ewes feeding

extensively on red-osier dogwood (*Cornus stolonifera*) in early April 1967. They were also grazing on both new and old grass growth at that time. By late April, sheep were distributed along Sinclair Canyon from Radium up to the Park Compound. On 28 April 1969, Jack counted 40 sheep along this canyon including 28 ewes, 5 lambs of last year, and 7 rams. Some sheep still remained on the Edgewater area at that time as evidenced by the ram lamb which had wintered with cattle on the Goodwin Ranch and was killed by dogs on 29 April 1969.

In early May the sheep were still using both the Stoddart Creek and the Sinclair Canyon ranges. On 6 May 1971, Warden Paul Galbraith counted 45 sheep (11 rams) near the Hot Springs and 9 ewes and immatures at Stoddart Creek. During the later half of May, ewes began migrating NE to the rugged higher ranges of John McKay Creek to lamb. Galbraith reported the 2 lambing areas were the SW slopes just east of Stoddart Creek and the SW slopes along John McKay Creek, within 200 m of the peaks. He reported that after parturition the McKay group moved about 5 km north towards the Kindersley Creek summer range.

The main summer ewe range was the upper Kinderlsey Creek area where Winkler counted 86 ewes and lambs in July 1966. Some ewes may have summered along the Stanford Range near the headwaters of Stoddart and Shuswap creeks. The largest area of summer distribution extended between Mt. Kindersley and Mt. Berland in the

Baptiste, John McKay and Nixon Creek watersheds. The Kimpton Creek watershed and several isolated areas north of it were also utilized by sheep during summer. There was also a summer distribution area in the Dollyvarden, Luxor and Kindersley creek watersheds, on the western edge of the park near Luxor Pass.

Summer ram ranges were not well known, although some animals were believed to summer north of the Kindersley ewe range towards Luxor Pass, east of Brisco. Winkler believed that some rams summered along the Stanford Range above the Kootenay River. On 6 August 1971, Logan Atwood reported to Jack that he saw 6 young rams on the west side of Mt. Berland, south of Baptiste Lake. They believed these were the younger members of the ram group that frequented the Hot Springs area in spring. Chief Warden Bill Hollingsworth reported that during a helicopter survey on 22 August 1968 he observed a band of 9 rams along the west boundary of the park at the headwaters of the north fork of Kindersley Creek east of Luxor. A few sketchy reports were also received of up to 12 sheep summering west of Kindersley Creek outside the park. Guide Dalton Price reported to Jack that he saw 7 rams at the head of Pinnacle Creek northeast of Brisco on 6 August 1967. These rams were located in the timber.

Groups of sheep continued to return to the Hot Springs area throughout the summer, primarily to feed on soil along road cuts across the highway from the Hot Springs. Jack reported seeing

rams and ewes taking soil from this area during July 14-21 and August 12-17, 1968. He also reported 4 rams feeding on shrubs and trees on the 1967 burn area above and south of the Hot Springs during 5 and 6 August 1968.

Unit 2 (Simpson River)

This population wintered along the upper portion of the Simpson and Mitchell rivers east of the park. Their summer range extended into the park along Verdant, Lachine and Daer creeks and the Simpson River. Often they were seen on Split Peak and Spar Mountain. Occasionally they crossed the Vermilion River onto Mt. Wardle, mainly to obtain minerals at the goat lick above Hwy. 93. One ewe and lamb were seen on Mt. Wardle (2000-2200 m) in May 1970 while six ewes and a lamb were seen at the goat lick in June 1967 by Biologist Elmer DeBock.

In both April and May 1968, DeBock counted 40 sheep on the north end of Split Peak across the Vermilion Valley from Mt. Wardle. These were mostly ewes and immatures and he also saw 3 half-curl rams on the south side of Mt. Wardle (2100 m) in June 1968. They were observed to swim across the Vermilion River and moved onto Split Peak. During his two-year study of goats, he saw no sheep on Mt. Wardle in winter. About 1 May 1968 a ewe and lamb were seen just across the river from Mt. Wardle and about the middle of May they showed up on Wardle.

In late August and early September, DeBock saw 10 bighorns (5 ewes, 4 lambs and 1 adult ram) along the center fork of the Lachine River. This band moved in and out of the park from the Lachine. In August 1967 he saw 5 sheep on the east side of Spar Mountain across Hwy. 93 from Mt. Wardle, while in mid-May 1968 he and Jack saw 8 ewes and 3 rams on the northwest slope of Split Peak.

North of the Simpson River, small numbers of sheep summered in the Simpson Pass-Eohippus Lake area, presumably having come from the Bourgeau band in Banff. Five rams were spotted on the north side of the Simpson at the south end of Hawk Ridge in June 1967. They were probably after new grass growth on this lower south slope or else were down at a mineral lick.

South of the Simpson, sheep were observed to summer on Octopus and Lachine mountains and to roam the headwaters of Lachine and Daer creeks during the fall hunting season, according to big game guides Albert Cooper and Elwood Goodwin. They reported seeing fewer sheep along the Mitchell and Simpson rivers in the fall of 1967 following the die-off at Radium. However, Cooper's hunters shot 3 rams near the junction of Surprise Creek and the Simpson River just east of the park in the fall of 1967.

Further south, the Mitchell Range along the east boundary of the park summered small numbers of sheep. Split Peak and Spar Mountain lie at the north end of this range inside the park. At

the south end of that range and north of the Cross River, outfitters counted 40 unclassified sheep in the fall of 1963. It was very likely that some sheep wintered at the south end of the Mitchell Range just east of the park and that rams from this band moved to Stoddart Creek during the rutting period. There may have been considerable interchange between Units 1 and 2 at the junction of Swede Creek and the Kootenay River with sheep moving from Sinclair Pass to the north side of the Cross River and vice versa. This theory was strengthened by the appearance of the 28 sheep at Sinclair Pass in January 1970. It is only about 6 km from there to the Cross River.

There is still much to be learned about the seasonal abundance and distribution of sheep within Unit 2 and neighboring provincial ranges to the east and north. During a helicopter survey of the area from Simpson Pass to Citadel Peak and along the north side of the Simpson River to its junction with the park boundary in December 1966, I found the area composed of Canadian (Hudsonian) and Alpine-Tundra zones. The forest flora consisted of fairly-closed mature stands of coniferous trees of spruce, fir, pine and larch. The alpine regions received a heavy winter snowfall and there appeared to be few or no winter ranges for bighorn sheep. In general, it appeared to provide a small summer capacity for sheep.

4.6.3 Seasonal distributions related to elevation and aspect

On the Radium winter range, 97.5% of the sheep preferred the west aspect at the 1150-1300 m elevation. The remainder were on a south exposure at the same elevation.

During April, May and June they concentrated on low-elevation (1200-1300 m) south aspects to obtain the earliest green forage. Pregnant ewes moved upwards onto south and east exposures onto cliff escarpment along the north side of Sinclair Canyon and John McKay Creek in late May and June to give birth to lambs.

By mid-July ewe bands had reached the 2200-2400 m elevations near Kindersley Pass as well as Split Peak and Spar Mountain to the east. Here they were using all aspects but mainly the west and northwest exposures. During July and August both ewes and rams occasionally returned to the natural soil licks near the Hot Springs. They had a particular hunger for salt and various minerals when shedding their winter coat and growing the new summer coat. Sheep reached their highest elevations by August, at which time they were found all the way from the valley bottom along Sinclair Canyon to the mountain peaks at Mt. Kindersley, Spar Mountain and Split Peak from 1200 - 2600 m. At this time they utilized all aspects but spent more time on north-facing alpine grasslands where the forage remained succulent. They began their downward migration onto rutting and winter ranges in September, and reached these ranges by October.

5.0 SUMMARY AND CONCLUSIONS

Seasonal distributions of Rocky Mountain bighorn sheep (*Ovis c. canadensis* Shaw) for the western Canadian national parks were determined for the period 1966-71. The author in cooperation with the Warden and Interpretive Services of Jasper, Banff, Waterton Lakes and Kootenay national parks collated observation information obtained from both aerial and ground surveys plus historical sightings by old-timers of each region.

Members of this species ranged along the Front Ranges of the Rockies in Alberta and the southeast portion of British Columbia over an area about 50 x 700 km (35 000 km²). They occupied mountains composed mainly of pervious shale, sandstone and limestone whereas the resistant and more rugged quartzite and limestone mountains to the west were generally devoid of sheep.

Historically, bighorns were abundant throughout southwestern Alberta and southeastern B.C. in the 1800's until about 1870 after which large numbers were killed with modern firearms both for their meat and trophy heads by Indians, miners, loggers, railway men and sportsmen. Historic distributions were virtually identical with those of the 1960's. In Alberta they were located as far west as the Miette, Sunwapta, Mistaya and Pipestone rivers in Jasper and Banff as well as all the mountains in Waterton. They were also common throughout the Kootenay and Bull river region of southeastern B.C. Populations declined by 65-80% between 1850 and 1915 from overhunting, severe winters and forage

competition from livestock. By 1915 only 75 to 250 sheep remained throughout the entire Athabasca drainage while further south in Waterton sheep were trying to survive the onslaught of livestock onto their winter ranges. The establishment of the above four parks in the early 1900's and protection from hunting plus newly created grasslands from extensive forest fires permitted a rapid increase in sheep numbers. By 1936 there were about 1300 sheep in Jasper, 2000 in Banff, 1000 in Waterton and 125 in Kootenay. A series of die-offs in these parks from 1937 to 1949 caused populations to decline so that by 1950 there were an estimated 400 in Jasper, 350 in Banff, 150 in Waterton and 75 in Kootenay. Reductions in the numbers of elk and livestock in the parks after 1950 helped sheep numbers to increase between 1950 and 1966 to approximately 2600 in Jasper, 1300 in Banff, 350 in Waterton and 175 in Kootenay in 1966. From 1966 to 1972, numbers remained fairly constant except in Kootenay where a die-off in the fall, winter and spring of 1966-67 reduced sheep numbers to 40-45 by December 1967. By the fall of 1970 their numbers had increased to 80-85.

The general seasonal migration patterns throughout the parks followed a set pattern. In summer, most sheep ranged on alpine grasslands above 2100 m using south and east exposures early in summer with considerable use of northern exposures in late summer where herbaceous forage remained succulent and palatable later

than on the warmer and drier southern slopes. Fall snow storms in September and October caused about two-thirds of the sheep to drift downwards onto winter grasslands below 2300 m.

Most sheep and mtn. goats wintered on the southwest, south, west and southeast exposures in that order of preference. Southwest slopes received first preference by sheep and mule deer whereas elk favored east exposures. There were two critical and widely separated ungulate winter ranges (not counting the low-elevation valley bottoms). About two-thirds of the sheep and mule deer, virtually all the goats and one-third of the elk wintered above 1800 m. The second critical range lay below 1375 m where one-seventh of the sheep, one-third of the mule deer, two-thirds of the elk and all of the whitetails wintered. Winter distributions were greatly influenced by snow depths with sheep avoiding snow depths in excess of 30 cm. Their mobility was noticeably impaired by snow depths that were two-thirds of chest height which was 29.3 cm for lambs, 31.8 cm for yearlings, 32.4 cm for ewes and 35.9 cm for rams.

When new grass growth began on low-elevation, south-facing slopes in April there was a migration down to these low spring ranges. Bighorns concentrated on this nutritious spring range during April and May with the ewes moving upwards onto rugged, cliff escarpment along south and east exposures in late May and throughout June to have their young. Once the major spring

storms were over, the sheep followed the receding snowpack upwards to the high-elevation summer ranges. About this time (June-July) they had started shedding their winter pelage and craved minerals. They made numerous journeys to natural licks that were often present along cutbanks near the mouth of streams. When available they sought out man-made minerals and chemicals such as salt blocks, highway salt and calcium chloride, chemicals spilled from trains, etc. The upward migration in May and June generally followed the south and east slopes which green-up first. During July and August they foraged on south and west slopes and alpine valley bottoms above timberline. By late August and early September they shifted towards north-facing grasslands and semi-open forests.

In Jasper, sheep distributions in the 1960's were similar but more extensive than those reported in either the 1800's, 1930's and 1940's. This may be largely due to the long-term warming trend throughout the Rockies converting the inhospitable Arctic-Tundra biome to the more favorable Alpine biome. The exception was the Miette and Astoria watersheds where the distribution and abundance of sheep was more extensive in the 1930's and 1940's. Sheep, elk, moose and mule deer were plentiful in the early 1940's and an elk reduction program was developed to control their numbers. A major die-off occurred during the winter and spring of 1947-48 which caused sheep numbers to decline about 85%. Prior to that die-off sheep were often seen along the lower reaches of

the Astoria watershed and west of Blue Creek. During the period 1967-71 there were 12 relatively discrete population units with a small amount of interchange, especially during summer and fall by rams. The unit names and an estimate of the number of sheep are: Tangle Ridge (110), Brazeau-Cairn (300-350), Rocky-Fiddle (575-650), Queen Elizabeth (30-50), Maligne Mtns. (55-75), Jacques-Colin (200-225), Pyramid-Graveyard (100-110), Snaring-Windy (110-125), Bosche-Boule (175-200), Stornoway (200-250), Day-break (60-75), Starlight (40-50); for a total estimated population of 1955-2270 sheep.

For all sheep populations in Jasper, on a yearlong basis, 78% were observed on southwest, west and south exposures in that order of importance. Only 13% were on northeast, north and northwest exposures. They favored southwest exposures in winter, compared to south in spring and all aspects in summer.

Concerning the yearlong distribution by elevation, the 2 most important areas were:

1. the subalpine and alpine grasslands between 2000 and 2250 m and,
2. the low transitional grasslands below 1375 m.

Only 3.1% of the range use was on relatively barren arctic-alpine range above 2250 m, while only 10.6% was in the coniferous zone between 1400 and 1800 m. In summer, most sheep (97.5%) were found above 1825 m while during the fall rutting period 82.1%

had moved onto low-elevation grasslands (1250-1525 m) and 16.8% were on alpine grasslands at 2150-2250 m. In winter, 70.3% were on subalpine and alpine ranges above 1825 m, 14.7% below 1375 m and only 7.3% on the semi-open savannah portion of the coniferous forest zone (1400-1525 m).

In Banff, sheep distributions during 1966-71 were similar to those observed in the 1800's. The western limit was Mt. Wilson at the junction of Mistaya and North Saskatchewan rivers and Pipestone Creek north of Lake Louise. There were 11 relatively discrete population units with estimated populations as follows:

	<u>Summer Population</u>	<u>Winter Population</u>
1. Goat-Spray	60	60
2. Bourgeau	75	75
3. Sawback	95	95
4. Cascade-Vermilion	90	90
5. Carrot Creek	50	30
6. Palliser-Dormer	385	300
7. Panther-Bare Mtn.	200	160
8. Red Deer-Clearwater	150-200	115
9. Malloch-Indianhead	50-100	15
10. Mt. Wilson	35	25
11. Nigel-Cirrus	10- 20	0
Totals	1200-1310	965

During winter and spring, sheep in Banff were observed only on south, west and southwest exposures. During summer they were widely distributed on all aspects in the following decreasing order of abundance: SW (26.9%), SE (21.5%), W (13.0%), NE (11.0%), E (8.8%), S (6.7%), Flat (6.8%), NW (2.7%) and N (2.6%). During the fall (October-December) 91.2% were on SW, S and W exposures in that order of preference. On a yearlong basis preferences for various exposures were in this decreasing order: SW (35.4%), S (23.5%), W (18.8%), SE (8.1%), NW (4.0%), NE (3.7%), E (3.0%), Flat (2.6%) and N (0.9%).

Concerning elevation zones used by sheep on a yearlong basis, 74.4% of the use was at the 2100-2400 m elevation with only 11.3% of the use below 2100 m.

In Waterton, sheep were observed on all mountains during summer while in winter they were mainly concentrated along the north side of Blakiston Valley, Ruby Ridge, Horseshoe Basin, the north slope of Sofa Mtn. and the west slope of Vimy Peak. An estimated 350 sheep were in the park during 1967-1972 in the following distribution: East of Waterton Lakes (100), North of Redrock Road (185), south of Redrock Road (65). In summer many sheep from north of Redrock Road moved north along Cloudy Ridge and Avion Ridge outside the park as far as Crowsnest Pass and west onto Kishinena Creek.

When new forage growth began on low-elevation south and east slopes in late April and early May, sheep moved to the

lower slopes of Mt. Galwey and Bellevue Hill and onto the Eskerine Complex. They also moved onto lawns within the townsite. In spring and early summer they utilized licks at the Galwey sheep trap, at Redrock station and at the Information Bureau. In late May and June ewes moved onto cliff escarpments along the east and south sides of Mt. Crandell, Mt. Galwey and Mt. Glendowan, Mt. Dungarven, Sofa and Vimy mountains. Occasionally, sheep crossed the narrows of Waterton Lakes at Bosphorus Point.

There was a significant difference in the aspects preferred in Waterton from those in Banff and Jasper. Most sheep wintered on north and northwest slopes (58%) in Waterton with another 28% on south and southeast slopes. In spring there were still 38% on north slopes although more had moved to east and southeast aspects. In summer there was a preference for the north aspect (45%), the east (24%) and south slopes (22%). During the rutting period, they preferred south and southeast aspects. Concerning yearlong distribution, 76% of the use was within the 1800-2400 m elevation zone. The 1800-2000 m zone received the heaviest spring use while in summer 73% of the use was above 2000 m. During fall 75% of the use was between 1600 and 2200 m.

In Kootenay, a die-off from pneumonia-lungworm disease during 1966 and 1967 reduced the population from 175 to 40-45. The Radium band increased to 80-85 by the fall of 1970. The two population units were in Unit 1 (Radium) west of the Kootenay

River and Unit 2 (Simpson River) east of the Kootenay River. The rutting and winter range in Unit 1 extended south from Sinclair Canyon to Shuswap Creek with most use near Stoddart Creek. A few animals wintered as far south as Briscoe. In April and May, sheep concentrated on new forage along the north side of Sinclair canyon. Ewes moved onto rugged escarpment along John Mackay Creek to lamb. After parturition ewes and immatures moved north to the main summer range of the upper Kindersley Creek area. Rams summered further north towards Luxor Pass on Mt. Berland and the Stanford Range.

Throughout the summer, especially during July and August, sheep made extensive use of natural licks along road cuts near Radium Hot Springs.

A small band of sheep became established on small grasslands in Kicking Horse Pass east of Golden in the 1970's from animals that had migrated north from the Radium band.

In Unit 2, sheep that wintered outside the park along the upper portion of the Simpson, the Mitchell and Cross rivers moved north onto summer ranges on Split Peak, Spar Mountain, Lachine Mtns., the Mitchell Range and the lower portions of the Simpson River within the park. Occasionally they crossed the Vermilion River onto Mt. Wardle, mainly to obtain minerals. Small numbers of sheep summered in the Simpson Pass-Eohippus Lake area presumably from the Bourgeau band in Banff.

On the winter ranges in Unit 1, 97% of the sheep preferred the west aspect at the 1150-1300 m elevation. During April, May and June they concentrated on the south exposure along Sinclair Canyon to obtain the earliest forage. Pregnant ewes moved onto south and east exposures to have their lambs. By mid-July ewe bands were settled on summer ranges at the 2200-2400 m elevation.

RECOMMENDATIONS

1. Small, isolated grasslands on south and west exposures at both the 2200-2400 m and <1500 m elevations are essential for the winter survival of sheep in the national parks discussed. These grasslands are identified for each park and park planning should be designed to protect them for use by sheep, goats, elk and deer.
2. Natural licks are apparently essential for providing vital minerals such as calcium, phosphorus and copper required to promote adequate bone and hair growth. Some probably serve to reduce endo-parasite loads. All of these licks should be located, mapped out and wild ungulates given unrestricted use of them, especially during the period June-August.
3. Sheep must cover extensive areas to reach their separated seasonal ranges and natural licks. Park planning should be designed to minimize interference with these traditional migrations.

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APPENDIX I

Locations and Numbers of Bighorn Sheep
in Jasper National Park
from Helicopter Surveys,
December 1966 and January 1967

Table 1. Numbers of bighorn sheep counted during an aerial survey by helicopter in Jasper, December 1966 and January 1967.

Locality	Total Sheep	Lambs	Rams		Ewes and Yearlings	Unclass.
			Total	Full Curl		
UNIT 1 (Tangle Ridge)						
Wilcox Peak	10	1	5	3	4	
Tangle Ridge	39	6	11	10	22	
Totals	49	7	16	13	26	
UNIT 2 (Brazeau-Cairn)						
Lower Brazeau	101	18	31	15	52	
Isaac Creek	8	1	6	3	1	
Southesk River	55	9	13	4	33	
Cairn River	73	13	22	13	38	
Totals	237	41	72	35	124	
UNIT 3 (Rocky-Fiddle)						
Upper Rocky	93	26	21	9	46	
Makwa Ridge	29	7	8	1	14	
Roche Miette	80	10	7	2	31	32
East Gate	16	4	1	0	11	
Ashlar Ridge	9	2	3	2	4	
Sulphur Ridge	29	7	5	0	17	
Mystery Lake	26	5	2	0	19	
Upper Fiddle	39	10	5	2	24	
Totals	321	71	52	16	166	32
UNIT 4 (Queen Elizabeth)						
Osborne Creek	20					20
Opal Mountain	1		1	1		
Totals	21		1	1		20
UNIT 5 (Maligne Mtns.)						
Signal Mountain	21	1	2	0	3	15
UNIT 6 (Jacques-Colin)						
Roche Bonhomme-Hawk Mtn.-						
Morro Point	137	34	15	5	79	9
Cinquefoil Mountain	53	13	9	3	31	
Talbot-Edna	5	1	0	0	4	
Totals	195	48	24	8	114	9

Table 1. Continued.

Locality	Total Sheep	Lambs	Rams		Ewes and Yearlings	Unclass.
			Total	Full Curls		
UNIT 7 (Pyramid-Mile 3)						
Mile 3 (Lodge Turnoff)	83	18	17	3	48	
UNIT 8 (Snaring-Windy)						
Windy Point	110	20	35	15	55	
UNIT 9 (Bosche-Boule)						
Beaver Bluffs-Roche Ronde	63					63
Moosehorn-Tunnel	79	16	10	2	27	26
Totals	142	16	10	2	27	89
UNIT 10 (Stornoway)						
Stornoway-Tory Mountains	178	33	57	30	86	2
UNIT 11 (Daybreak)						
Daybreak Ridge	55	8	8	0	39	
UNIT 12 (Starlight)						
Mowitch Creek	18	3	9	0	6	
Arcturus Pk.	1		1	1		
Blue Cr. (Natural Arch)	3	1			2	
Totals	22	4	10	1	8	
Grand Total	1434	267	304	124	696	167

Table 4. Late winter distribution of bighorn sheep in Banff National Park from a helicopter survey, 11 March 1969.

Location	Altitude & Aspect (m)	Numbers of Sheep					Other Wildlife
		Total	Lambs	Rams	Ewes*	Unclass.	
RED DEER-PANTHER R.							
Mt. White	2440(S)	17	3	3	8	3	
" "	2315(W)	9	3		6		
Bare Mtns.	2530(W)	16		15	1		5 elk
" "	2440(F)	1		1			1 coyote
" "	2105(S)	26	7	4	15		
PALLISER RGE..							
Panther Mtn.	2285(SW)	21	6	6	9		
Bighorn Lake	2075(S)	2				2	1 ♂ elk
Cuthead Cr.	2135(SW)	6		6			2 ♂ elk
Grassy Mtn.	2375(SW)	31	7	1	23		ewe with yellow ear streamer
" "	2375(S)	18	1	5	12		
N. of Stoney Cr.	2255(SW)	3		3			
" " " "	2195(SW)	17		5		12	
" " " "	2225(S)	31	6	2	23		
CASCADE MTN.	2500(W)	2		2			2 ♂ elk, 2 w.t. ptarmigan
N. end	2195 (S)	13	3	1	9		
" "	2225 (SW)	16		16			
DORMER CR.							
N. Fork	2285(s)	27	4	11	12		32 elk
Near Cabin	1980(S)	13	2		6	5	11 ♂ elk (7300'W)
Dormer Mtn.	1825						37 elk
Barrier Mtn.	2135(SW)	11		1		10	3 elk
RED DEER-CLEARWATER							
Tyrell Cr.	2255(SW)	7				7	
" "	2440(SW)	7	1	2	2	2	
Mt. Peters	2500(SW)	1		1			9 goat
Malloch Cr.	2500(W)	2		2			
SURVEY TOTALS		297	43	87	126	41	93 elk, 9 goat, 1 coyote, 2 ptarmigan

*Ewes include yearlings

Table 3. Early winter abundance and distribution of bighorn sheep in Banff National Park from a helicopter survey 17 December 1968.

Location	Altitude & Aspect (m)	Numbers of Sheep				Other Wildlife
		Total	Lambs	Rams	Ewes*	Unclass.
CARROT CR.						
Orient Pt.	1980(SE)	3		1	2	
Saddle Pk-Lookout	2285(SE)	5	2	1	2	
Carrot Cr.	2440(W)	8	1	2	5	6-12 bull elk (2134 SE)
" "	2135(S)	12	3	2	7	
PALLISER RGE.						
2nd basin N. of Minn.	2075(S)	1		1		1 goat (2134SE)
" " " "	2440(W)	5		3	2	
3rd " " "	2135(S)	7		1		6
" " " "	2285(S)	23	4	3	16	2 w.t. ptarmigan 2 " "
5th " " "	2135(SW)	17	4	9	4	2 σ elk (2037 SW)
Stoney Cr.	1980(NW)	4	1	1	2	
" "	1980(S)	8	1	4	3	
Stoney to Trap	2135(SW)	47	7	13	27	
Elk Trap	2075(SW)	13				13
3km N of Elk Trap	2285(SW)	4		3	1	
Bighorn Lake	2165(SW)	16	4	4	8	
" "	2440(W)	5	2	1	2	
Grassy Mtn.	1980(SW)	5		5		8 σ elk (1981 SE)
" "	2135(SW)	45	3	7	7	28
Flints Park	2075(S)	1		1		58 elk (2073 S) 1 moose
PALLISER TOTALS		201	26	56	72	47
CASCADE MTN.	2285(SW)	6		6		
N end	2135(S)	75	12	15	48	
Head of FortyMile	2315(NW)	2		2		100-125 elk (2073)
PANTHER MTN.	2440(SW)	6	1	3	2	3 σ elk (2377 SW)
" "	2240(NW)	30	10	1	19	2 w.t. ptarmigan
" "	1980(NW)	10	4	2	4	
PANTHER-RED DEER						
Snow Cr.	2440(SW)	18	4	7	7	
Mt. White	2440(W)	8	1	2	5	
" "	2315(NW)	8	2	4	2	
Gable Mtn.	1980(SW)	42	8	8	26	90 elk, 2 moose
" "	1980(SW)	37	10	8	19	
Sulphur Spring	2315(S)	1		1		82 elk + 7 mule deer (2195S)
DORMER MTN.	1825(SW)	18	5	5	8	25 elk
RED DEER-CLEARWATER						
Tyrell Cr.	2285(SW)	47	11	11	25	
" "	2285(SW)	4	2		2	
" "	2440(SW)	11	2	1	8	
Mt. Bourgeau	2195(S)	10	2	3	5	
" "	2105(SW)	16	4	4	8	
Brewster Cr.	2075(W)	1		1		
" "	2135(S)	2		1	1	
TOTAL SURVEY		584	111	148**	278	47
						370-405 elk, 7 mule deer, 18 ptarmigan, 1 goat, 3 moose

*Ewes include yearlings **73 of the rams were full curls

Table 5. Summer distribution of bighorn sheep in Banff National Park, from a helicopter survey, 21 August 1968.

Location	Altitude (m)	Aspect	Sheep observed						Other Wildlife
			Total	Ewes	Lambs	1/2	3/4	Full	
Palliser Rge.									
1.5 km N of elk trap	2440	W	8			2	2	4	2 mule deer at elk trap
1.5 km S of Wigmore L.	2135	W	19	16	3				45 elk
1.5 km S of Panther St.	2255	NW	2	2					
0.5 km N of Stoney Cr.	1980	SW							40-50 elk
Bare Mtn.	2225	W	3					3	
" "	2405	W	32	20	12				
White Mtn.	2500	NW	2					2	
" "	2375	SE	13			3	6	4	6 goats (2 kids)
Tyrell Cr.	2285	E							2 ad. goats & 150 elk
Panther Mtn.	2440	SW	3			2	1		27 elk on Divide Cr.
Dormer Summit	2325	NW	5			5	uncl. rams		
Stoney Cr.	2285	S	4			2	2		8 adult goats
" "	2165	S	1						
Mt. Bourgeau (E side)	2285	S	5	3	2				
" " (SW side)	2195	SW							3 bull elk
Totals			97	41	17	9	11	14	265-275 elk, 16 goat, 2 mule deer

Table 6. Summer distribution of bighorn sheep in Banff National Park, north of Bow Valley, from a helicopter survey, 11 August 1969.

Location	Altitude & Aspect (m)	Numbers of Sheep				Other Wildlife
		Total	Lambs	Rams	Ewes* Unclass.	
PALLISER RGE.						
Aylmer Cr.	2315 (E)	62	7		55	
NE of trap	2440 (W)	3		3		
Grassy Mtn.	2135 (E)					20 elk
Bighorn Lake	2135 (W)					21 cow & calf elk
SE Wigmore Lake	2285 (W)					9 cow & calf elk
BARE MTNS.	2285 (SW)	33	8		25	34 cow & calf elk
RED DEER-CLEARWATER						
Tyrell Cr.	2285 (SE)	2	1		1	2 cow & calf elk
Roaring Cr.						6 goat
McConnell Cr.						1 goat
Trident Cr.						3 moose
TOTALS		100	16	3	81	86 elk, 7 goat, 3 moose

*Ewes include yearlings

APPENDIX II

Seasonal Abundance and Distribution of Bighorn Sheep
in Banff National Park from
Helicopter Surveys, 1966 to 1970

Table 1. Late fall abundance and distribution of bighorn sheep in Banff National Park from a helicopter survey, 6 December 1966.

Location	Number of Sheep					Elevation & Terrain
	Total	Lambs	Rams	Ewes*	Unclass.	
Mt. Bourgeau	48	4	6	6	32	Slope, 200-300 m below timberline for 42, 100 m above T.L. ** for 6
Bourgeau Rge.	17	2	2	2	11	NW and W slopes, 200 m below T.L.
Sulphur Mtn.	2	1		1		NW corner, 300 m below T.L.
Goat Rge.	47	10	6	29	2	S&W slopes, at T.L.
Cascade Mtn.	34	4	11	15	4	W slope, N end of mtn. From 100 m below to 200 m above T.L.
Mt. Norquay	1		1			200 m above T.L., W slope
Vermilion Lakes	55		13		42	S slope, near Hwy. 1
Aylmer Cr.	37	2	10	6	19	S slope, 200 ⁰ -2300 m
Palliser Rge.	113	9	29	29	46	SW slope, 0 to 200 m above T.L.
Bare Mtn.	34	2	10	7	15	W slope, 100 m above T.L.
Panther Mtn.	16				16	
Panther R.	48	8	13	18	9	S&W slopes, 0 to 100 m below T.L.
Dormer R.	14	2	1	4	7	100 m below T.L.
Mt. Tyrell	19	4	4	6	5	50 m above T.L., W slope
Peters Cr. (E)	15	4	4	7		W slope, 25 m above T.L.
" " (W)	20				20	SW slope, 25 m below T.L.
Malloch Cr.	8	2	1	2	3	75 m above T.L.
Cirrus Mtn.	2		2			W slope, 1800 m by Hwy. 93
Mt. Wilson	13				13	S slope, 2300 m
Castle Mtn.	5	1	2	2		S slope, 0 to 25 m above T.L.
Johnston Cr.	68	8	11	16	33	W slope, 0 to 200 m above T.L.
Totals	616	63	126	150	277	

*Ewes include yearlings

**T.L. = timberline

Table 2. Late fall abundance and distribution of bighorn sheep in Banff National Park from a helicopter survey, 7 December 1967.

Location	Numbers of Sheep					Other Wildlife
	Total	Lambs	Rams	Ewes*	Unclass.	
Mt. Costigan	38	6	10	22		1 w.t. ptarmigan
Orient Point	18	5	2	11		1 elk, 4 mule deer
Minnewanka to Stoney Cr.	51	1	9	12	29	2 elk
Stoney Cr. to Wigmore Lake	51	2	19	22	8	50-90 elk, 8 goat
Wigmore to Panther R.	46	11	11	21	3	
Dormer R.	10				10	4 goat
Panther to Red Deer R.	114	9	14	13	78	358 elk, 1 goat
Tyrell Cr.	48	7	13	28		384 elk
Cascade Mtn.	46	5	9	12	20	21 elk
Johnston Cr.	34	1	6	19	8	11 goat, 4 moose
Mt. Bourgeau	36	8	5	16	7	34 goat, 1 mule deer, 1 ptarmigan

*Ewes include yearlings

APPENDIX III

Seasonal Abundance and Distribution of Bighorn Sheep
in Waterton Lakes National Park from
Helicopter Surveys, 1967 to 1970

Table 1. Seasonal abundance and distribution of bighorn sheep in Waterton Lakes National Park from helicopter surveys, 1967 to 1970.

Location	Altitude	Slope	Total bighorns	No. Unclass.	Ewes & Imm.	Lambs	%* Lambs	Rams
February 23, 1967								
Akamina			48	0	27	8	16.7	13 (9)**
Belly River			71	0	30	21	29.6	20(10)
Red Rock & Waterton Lakes			132	0	63	29	21.9	40(20)
Totals			251	0	120	58	23.1	73(39)
August 10, 1968								
Belly River District								
Sofa Creek			9	0	6	3	33.3	
E.end Sofa Mtn.			8	0	4	2	25.0	2
Blakiston Valley District								
Mt. Galway		S	4	0	3	1	25.0	
Mt. Glendowan		S	5	0	3	2	40.0	
Dungarvan Cr.		S	4	0	2	2	50.0	
Dungarvan Cr.			9	0	3	3	33.3	3
Akamina District								
Mt. Blakiston		S	12	0	9	3	25.0	
Mt. Hawkins			3					3(1)
Mt. Hawkins			1		1			
Lone Mtn.			2					2
Lone Brook N. Fork			9					9(2)
Goat Lake			4		2	2	50.0	
Red Rock Creek			19		13	5	26.3	1
Totals			89	0	46	23	25.8	20(3)

*No. Lambs x 100

Total Bighorns

**Figures in brackets refer to full curl rams.

APPENDIX IV

Seasonal Distributions of Bighorn Sheep in
Kootenay National Park from
Helicopter Surveys, 1966 to 1969

Table 1. Seasonal distributions of bighorn sheep in Kootenay National Park from helicopter surveys, 1966 to 1969.

Location	Altitude (m)	Slope	Total bighorns	No. Unclass.	Ewes & Imm.	Lambs	%* Lambs	Rams
December 9-11, 1966								
Stoddart Cr.			68	0	45	12	17.6	11(1)**
Trap & Sinclair Canyon			11	0	7	1	9.1	3(2)
Edgewater			2	0	1			1(1)
Total			81	0	53	13	16.0	15(4)
August 20, 1968								
Mt. Kindersley	2286	E	1		1			
Mt. Kindersley	2225	E	1		1			
Split Peak	2347	SW	8		5	3	37.5	
Total			10		7	3	30.0	

*No. Lambs X 100
Total bighorns

**Figures in brackets refer to full curl rams

