

DISTRIBUTION, ABUNDANCE AND MANAGEMENT OF
WILD SHEEP IN YUKON

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ABSTRACT

Inventories carried out for the past decade have covered about 80% of the Yukon's known sheep ranges. It is estimated that the present population size is about 22,000, of which 19,000 are white Dall sheep and about 3,000 are coloured Stone sheep. About 5,400 sheep are under full protection in Kluane National Park and various preserves. Non-resident sheep hunters contribute on the average 72% to the annual harvest of about 280 rams; resident hunters and trappers account for the remaining 28%. Based on trophy quality and hunter success, it is assumed that the present management regime is sustainable. Trophy quality has improved over the past decade, both in respect to horn lengths of rams taken ($r=0.793$) as well as in age of rams ($r=0.668$). Presently (1983) the mean horn length is 35.4 inches and the mean age is 9.8 years.

While harvest can be regulated, the existing arrangement of Yukon Government having responsibility over wildlife, while the Federal Government has jurisdiction over lands, causes problems with habitat protection and with the imposition of regulations that would address disturbance of sheep.

INTRODUCTION

The Yukon has the largest wild sheep population of any jurisdiction in Canada. Both subspecies of Thinhorn sheep inhabit this Territory, and this fact has attracted trophy hunters, naturalists and wildlife biologists for almost a century.

The first surveys of Yukon sheep populations were conducted in 1904 and 1905 by an expedition primarily interested in documenting the distribution of various colour phases of this species (Sheldon, 1911). This expedition concentrated its efforts in the Ogilvie Range north of Dawson and in the Pelly Mountains. However, available information from other Yukon mountain ranges was incorporated into the resulting book which includes a preliminary map of sheep distribution in the Yukon and the colour phases of sheep inhabiting various regions. Early this century, few roads had been built in the Yukon, and



Dall ewe and lamb in Kluane National Park
Photo: M. Hoefs



Dall rams in Kluane National Park
Photo: M. Hoefs



Sheep Mountain, Kluane National Park,
well-known Dall sheep winter range
Photo: M. Hoefs

aircraft were not yet available. Considering the logistic difficulties these early explorers were confronted with, their tasks were remarkable indeed. Sheldon's (1911) book, "The Wilderness of the Upper Yukon", has become a classic, and while in specific regions, much more detailed surveys have been carried out recently, his effort on a Yukon-wide scale has never been duplicated.

The Yukon has been of great interest to trophy hunters since the turn of the century, and sheep along with grizzly have always been the most desired quarry. Some of these hunters have published their experience, and from these accounts, additional information on sheep distribution and abundance can be gleaned (Auer, 1917; Bond, 1948; Martindale, 1913; McGuire, 1921; Young, 1947). In 1958, the present registered outfitting areas were formalized in law. Sheep distribution played a major part in boundary delineation. The quality of information available, therefore, was sufficient to be used in such an important legislative matter.

In the years 1961 to 1965, the National Museum of Canada conducted Yukon-wide collections of mammals. Based on these collections and supplementary information published by other investigators, Youngman (1975) published his "Mammals of the Yukon", which includes distribution maps of the 64 species of recent mammals presently inhabiting the Territory. He is the presently accepted authority on the division of Yukon's sheep into white "Dall sheep" and coloured "Stone sheep", and the delineation of their respective ranges. At one time, the Yukon's coloured sheep were referred to as "Fannin sheep", and were given subspecific status. Youngman (1975) classifies Yukon's sheep as Ovis nivicola dalli and Ovis dalli stonei, thereby lumping the white Dall sheep with the Siberian Snow sheep. Most experts continue to use the taxonomic description of Ovis dalli dalli and Ovis dalli stonei for Yukon's sheep.

With the initiation of wildlife management in Yukon in the early 1970's, the documentation of distribution and abundance of this Territory's big game species was considered a priority objective. This report presents the inventory data collected for wild sheep over the past decade.

METHODS

AERIAL SURVEYS

When conducting sheep inventories and monitoring individual populations, an attempt is being made to obtain a total count. Helicopters are used exclusively and the survey method used has been referred to as "drainage-pattern flight technique" (Nowlan et al, 1977, Hoefs, 1978). The survey area is divided into physiographic subdivisions with distinct boundaries. These subdivisions have a size that can be covered in a 2 to 3 hour flight. The most commonly employed aircraft is a Bell 206 helicopter, which can carry 3 passengers in addition to the pilot. The navigator, who is principal observer is seated to the left of the pilot. The other observer is located in the left backseat, the right one being occupied by the recorder. An intercom system allows continuous contact between the survey crew members. Each survey unit is covered by flying around it in a counter-clockwise direction at an elevation appropriate to the prevailing relief. This means

that the elevation of the aircraft chosen and the distance of it from the mountains are such that the observers can keep surveillance over the slopes as well as over the ridge tops and plateaus. Wherever this is not possible with a single pass, several are made at different altitudes. The route flown and the exact locations where sheep are observed are marked on a map. All sightings are verified between the observers. If there is disagreement, another overflight is made.

The observations made are recorded on prescribed forms, which list size and composition of sheep bands, location, time of day, and other relevant information. Surveys are made in July when sheep are on alpine summer ranges. At that time, most of the snow has melted and the light colour of these animals is very conspicuous against the dark background of rocks and alpine meadows. Sheep surveys are relatively easy to conduct since these animals are very nervous and always run when approached by aircraft. By comparison, Mountain goats often hide, and counts obtained are therefore less reliable. It is known from repeated surveys made in Kluane National Park, from comparisons of ground and aerial surveys, and by using 80 marked sheep (Hoefs and Cowan 1977), that this survey technique is fairly reliable in that over 90% of the sheep can be accounted for; underestimates being influenced by terrain type and weather conditions.

While considerable variation can be expected due to terrain type, sheep density and aircraft ferry time, on the average this survey technique translates into about 100 sheep located per helicopter hour or about 120 km² of sheep habitat searched per helicopter hour.

TROPHY EVALUATION

Beginning in 1974, all skulls of rams taken by hunters were inspected by wildlife branch staff. Assessment of these trophies include age determination using the horn annulus technique (Geist, 1966; Hemming, 1969), and evaluations of various horn growth parameters (Shackleton, 1973). All skulls were clamped into a specially designed measuring device for these assessments and photographs were taken for permanent records (Merchant et al, 1982).

RESULTS AND DISCUSSION

DISTRIBUTION AND ABUNDANCE

The Yukon Government began a systematic survey of its wildlife in 1973, when the first technical staff members were hired. An assessment of sheep distribution and abundance, along with an evaluation of the impact of hunting, were a top priority in these wildlife inventories. About 72% of the sheep harvest was brought about by non-resident hunters, and the distribution of outfitting areas assured that most of Yukon's sheep populations were subjected to hunting. In 1973, no game management zones existed in Yukon. The only subdivision of the Territory into smaller units was the existence of twenty-two outfitting areas. These outfitting areas covered the southern two-thirds of the Yukon and took in all sheep ranges except those under protection in the Kluane and MacArthur game sanctuaries and in the northern Yukon. Wildlife inventories were therefore carried out on the basis of outfitting areas. From 1973 to 1982, fifteen outfitting areas were surveyed, and two additional ones

TABLE 1 POPULATION ESTIMATES OF YUKON WILD SHEEP

Outfitting Area Geographical Region	G.M.Z.	Numbers of sheep observed						Total number estimated	Survey Date	Info. Source
		♂	♀	♂y	Nurs	lbs	Σ			
1	2	281	76	205	743	323	1347	1500 ¹	1980	Hoefs & Nette, 1980
2	2	96	52	44	263	89	448	551	1978	Larsen, 1978
3	2	85	52	33	360	69	514	616	1978	Larsen, 1978
4	?							800		Estimate
5	?							800 ²		Estimate
6	2							400 ²		Estimate
7	4							480 ²		Estimate
8	4	62	62	13	49	132	25	275	1981	Nette & Merchand 1981
9	4							540		Estimate
10	5	236	100	136	537	172	945	1121 ²	1974	Hoefs, 1975
11	5	152	65	87	364	106	622	860	1974/82	Hoefs, 1975/82
12	5	203	77	126	430	144	777	870	1974/82	Hoefs, 1975/82
13	5	454	196	248	867	213	1534	1784	1974	Hoefs, 1975
14	4							540		Estimate
15	8	94	27	67	107	41	242	332	1976/77	Lortie et al 1978
	10	156	51	105	191	61	408	784	1976/77	Lortie et al 1978
16	7	142	60	82	455	151	748	1248	1973	Hoefs, 1974
17	8	8	2	6	29	11	48	60	1976	Lortie et al 1977
	7	137	43	94	277	118	532	920	1973	Hoefs, 1974
18	7	305			728	169	1202	1300	1980	Nette, 1980
19	8610	25	10	15	56	21	102	125	1976/77	Lortie et al 1978
20	10611	35	14	21	71	31	137	160	1976/77	Lortie et al 1978
22	11						177	322 ²	1976	Hoefs & Lortie 1976
Miners Range	5-50	39	5	34	88	34	161	170	1982	Hoefs, 1982/83
Knorr Range	2-67 2-71							150		Estimate
Richardson Mountains	1-64 1-53, 54, 58 1-14, 25	4 22			10 59	5 26	19 107	25 120 100	1977 1980 1977	Hoefs, 1978 Hoefs, 1980 Hoefs, 1978
British Mountains	1-06 1-07						80	100	1974	Hoefs, 1974
Kluane Park/ Kluane Sant.	6						4500	5000	1972	Hoefs, 1973
White Mtns.	3-16	14			16	9	39	40	1980	Hoefs, 1980
MacArthur Sanctuary	4-03	14			38	15	67	70	1978	Hoefs, 1978
TOTALS							14975	22163		

Explanations for Table 1.

- σ^r = Sum of all rams (separated from nursery bands)
- σ_e^r = Legal rams in such ram bands
- σ_y^r = Younger rams in such ram bands
- Nurs = Nursery sheep includes ewes, yearlings and young rams that are still associated with nursery bands, and are usually less than 3 years old.
- lbs = lambs (young of the year)
- Σ = sum of all sheep observed

The estimated numbers of sheep in general is about 20% higher than the number actually counted. It is a reflection of a correction factor applied, which considers weather conditions during flying, nature of terrain, time of day, number of observers, etc.

For areas not surveyed as yet, the estimated population size is calculated from the age and numbers of rams killed over the past 10 years and the intensity of hunting pressure, as explained in Table 2.

- (1) Some sheep in these populations move across the Yukon/Alaska boundary
- (2) Some sheep in these populations move across the Yukon/NWT boundary

were partially covered by inventories. Kluane National Park and the Kluane Game Sanctuary were completed already in 1972. The British Mountains in the northern Yukon were surveyed in 1974 and the Richardson Mountains in 1978. Only four outfitting areas have so far not been assessed, and in two additional ones, surveys are as yet incomplete. Therefore, about 85% of Yukon's known sheep ranges have been evaluated. Fig. 1 shows the distribution of sheep in Yukon and Fig. 2 reveals the completion of inventories in relation to outfitting areas. In Table 1, the survey results are summarized. Where appropriate, the numbers of sheep actually observed, are listed and identified as legal and sub-legal rams, adult members in nursery bands and lambs. Also listed is an estimate of the total number. These estimates are, in general, 10% to 20% higher than the numbers observed. The numbers of sheep in outfitting areas not surveyed or only partially surveyed, are estimated on the basis of 10-year harvest statistics and the ages of the rams shot, as explained in Table 2. The total number of sheep estimated to inhabit the Yukon at present is around 22,000 (Table 1). Based on 10,165 classified sheep, the composition of this population is as follows: 25.2% mature rams, 56.9% adult sheep in nursery bands, and 17.9% lambs. Mature rams are those found in separate ram bands during summer; adult nursery sheep includes ewes, yearlings, and those young rams still in nursery bands; lambs are young of the year. All these population statistics refer to July counts, when inventories are generally carried out.




Table. 2. Estimation of numbers of sheep in outfitting areas which have not been surveyed or have only been partially surveyed.

<u>Outfitting Area</u>	<u>Average Harvest (n = < 10 years)</u>	<u>Factor*</u>	<u>Sheep Population Estimate</u>
4	10	80	800
5	10	80	800**
6	5	80	400**
7	6	80	480**
9	9	60	540
14	9	60	540

*This factor, by which the annual harvest is to be multiplied to arrive at the total population estimate, is based on the known percentage of annually recruited legal rams (≥ 9 years old) of the total population (2.5%). It also takes into consideration known hunting pressure. It is assumed that in areas where no competition for sheep by resident hunters occurs, 50% of the annual recruitment of legal rams are removed by outfitter-guided hunting. In such remote areas, a multiplication factor of 80 was applied. In areas where non-residents as well as residents hunt sheep, the hunting pressure is greater. If all legal rams are removed annually, which translates into 2.5% of the total population, a multiplication factor of 40 is appropriate. None of the areas listed here are hunted that intensely, but outfitting areas #9 and 14 receive some pressure by resident hunters.

**These areas border on the N.W.T. boundary, and some of the sheep may occasionally be out of the Yukon.

Fig. 1 - Distribution of Wild Sheep in Yukon (1983)

-  DALL SHEEP
-  STONE SHEEP
-  ZONES OF OVERLAP

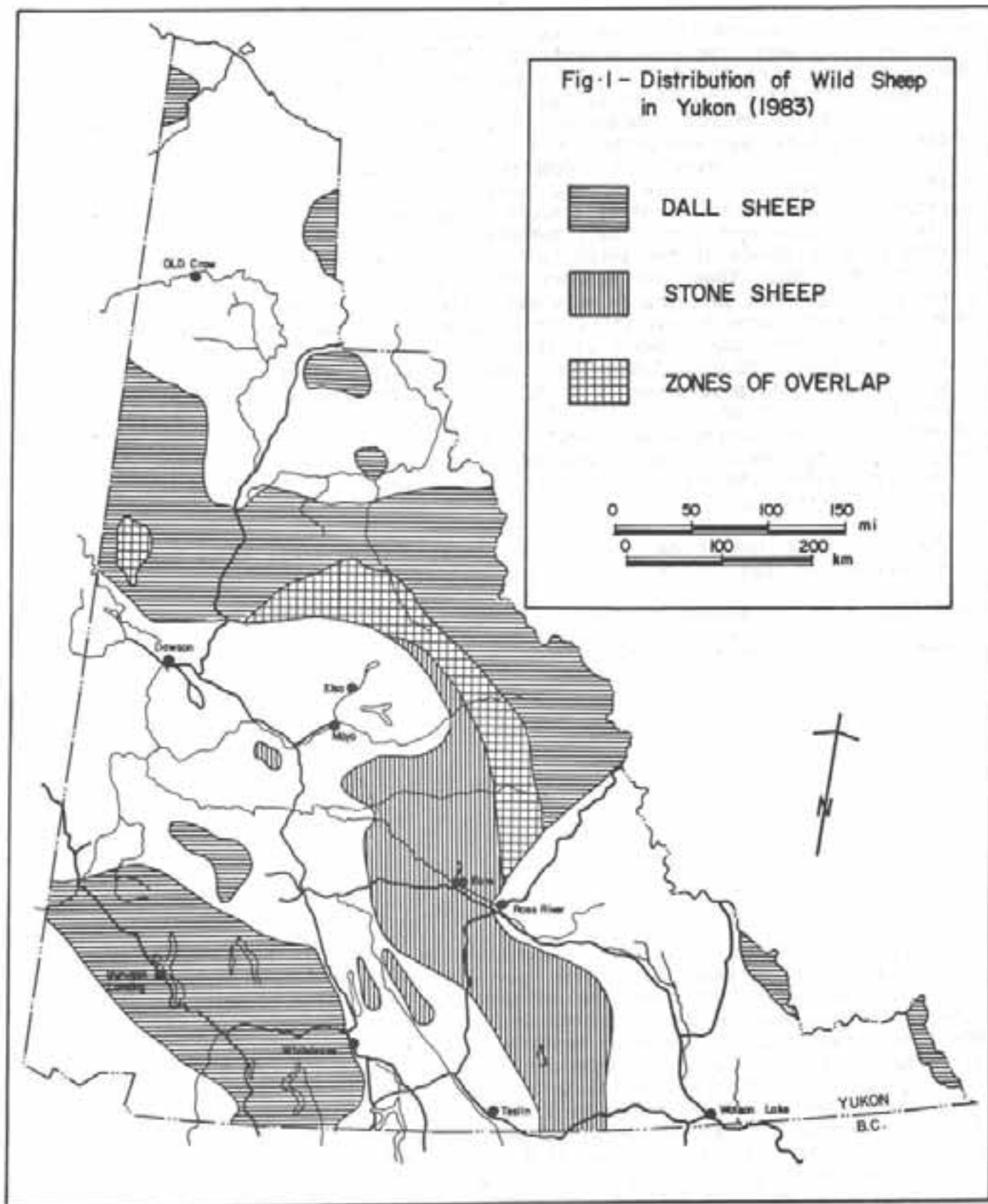
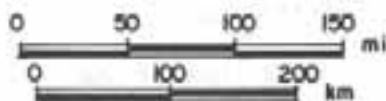


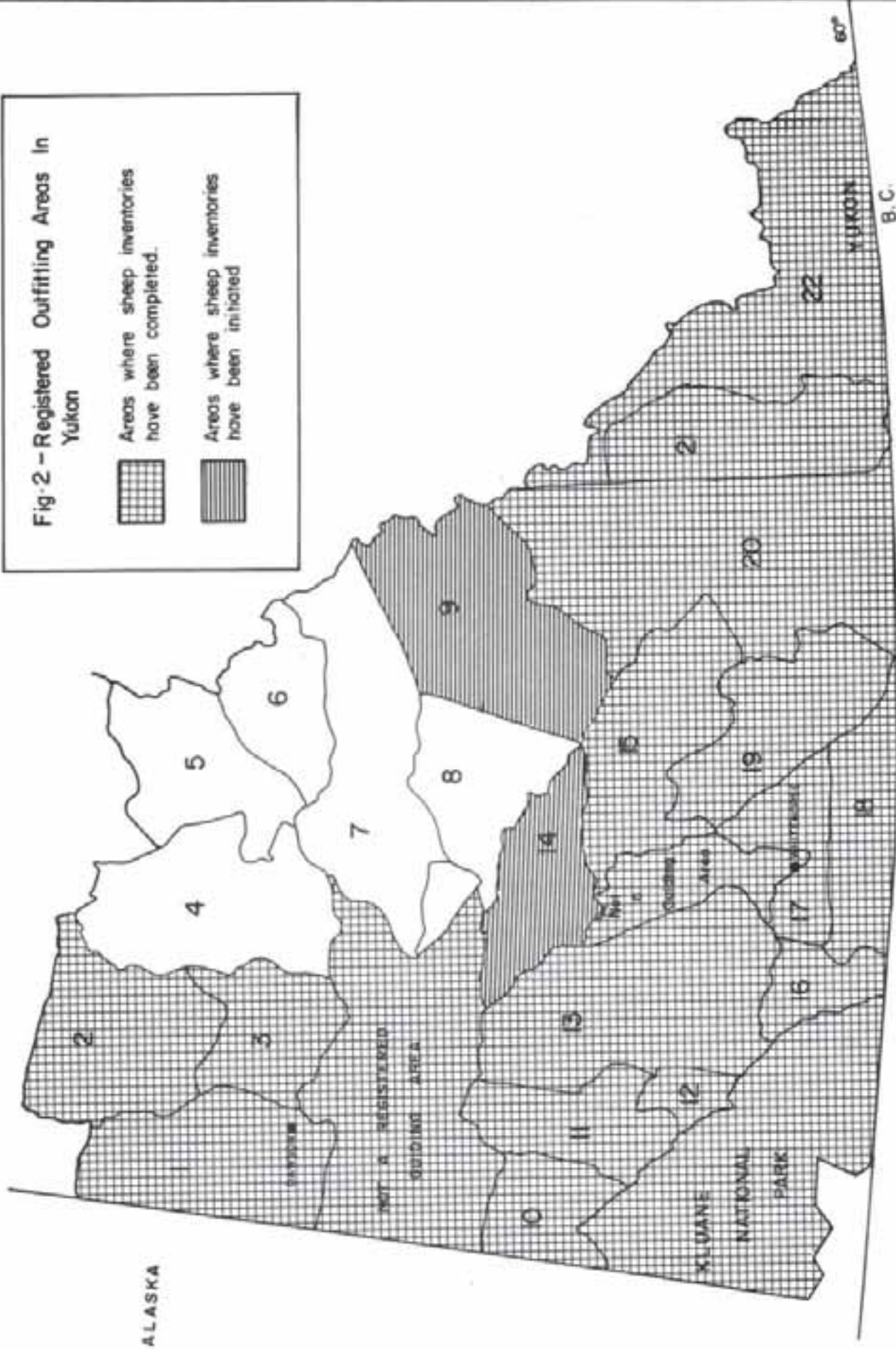


Fig. 2 - Registered Outfitting Areas In Yukon

-  Areas where sheep inventories have been completed.
-  Areas where sheep inventories have been initiated.



Of some 22,000 sheep in Yukon, about 3,000 are coloured sheep, now classified as "Stone sheep", but formerly known as "Fannin sheep". Sheep in the Cassiar and Pelly mountains, in the MacArthur Ranges, and on the White Mountains, are all of the coloured variety, while those in the Wernecke, Hess and Ogilvie ranges include a certain percentage of dark sheep. In Table 3, an attempt was made to estimate their frequencies in the relevant outfitting areas, and on Fig. 1, the Yukon-wide distribution of these two subspecies of Thinhorn sheep is shown.

Table 3. Estimated number of Stone sheep (fannin) in Yukon.

<u>Outfitting Area</u>	<u>Estimated Sheep Population Size</u>	<u>Estimated Percentage of Fannin Sheep</u>	<u>Number of Fannin Sheep</u>
8	275	100%	275
14	540	100%	540
15	1116	100%	1116
19	125	100%	125
20	160	100%	160
1	1500	10%	150
4	800	20%	160
2	551	10%	55
3	616	10%	62
7	480	10%	48
9	540	30%	160
17	980	6%	59
MacArthur Rg.	70	100%	70
White Mountains	40	100%	40
		Total	3020

About 5,300 white sheep are under full protection in Kluane National Park, Kluane Game Sanctuary, and the Richardson and British Mountains in Northern Yukon, and so are about 100 coloured sheep in the MacArthur Game Sanctuary and in the White Mountains.

It is assumed that sheep still occupy about 90% of their historic range in Yukon. Therefore, reintroductions to areas where sheep have disappeared may bring the Yukon total population size to about 25,000.

In 1974, Yukon's sheep population was estimated at 22,400 (Hoefs, 1975b), very similar to our present estimate of 22,163. In 1973, only 10% of the sheep ranges had been surveyed, and the information on which estimates were based consisted of harvest statistics and reports from outfitters and hunters. The method used to compute the Yukon's total sheep population was similar to the one applied in this paper for the outfitting areas not yet subjected to sheep inventories.

From repeated surveys of certain herds, it appears that the Yukon sheep population is relatively stable, even though annual fluctuations of up to +20%

around some mean value can be expected because of varying winter mortalities and lamb productions.

POPULATION DYNAMICS

Ratios between population components are of interest in the study of population dynamics, since they may reflect the degree of hunting pressure a given herd is exposed to, or they may also be a reflection of different productivity or of disturbance through land use activities. Several ratios are given in Table 4. For comparative purposes, the Yukon-wide hunted sheep populations are listed in reference to four unhunted herds. The ratio between rams and nursery sheep averaged 44.1% Yukon-wide, which is a lower ratio than observed on Sheep Mountain (Kluane National Park), White Mountain (GMZ 3), and Grey Ridge (GMZ 9). This difference in ratio is expected since hunting will remove 5 to 10% of the rams annually. It is not known why the Mt. Cronin population in the Richardson Mountains (GMZ 1-53, 1-54, 1-58) has such a low ram/nursery sheep ratio, but the possibility of unrecorded native hunting or migration of young rams can not be ruled out.

Table 4. Ratios between population segments

	Hunted Populations		Unhunted Populations		
	Yukon-wide	Sheep Mt. 1969-81	White Mt. 1980	Grey Ridge 1978-81	Mt. Cronin 1979-81
<u>Rams*</u>	2510 = 44.1%	50.0%	87.5%	79.5%	37.3%
<u>Nursery** sheep</u>	5698				
<u>Lambs</u>	1778 = 31.7%	24.0%	62.0%	37.3%	36.5%
<u>Nursery sheep</u>	5698				

*Rams are those mature animals, which are separated from nursery bands in summer; they are usually in their third year and older.

** Nursery sheep includes ewes, yearlings and those young rams still in nursery bands. These rams are usually less than three years old.

Densities of Yukon sheep populations vary widely. They are highest in Kluane National Park, on the neighboring Ruby Ranges (Outfitting Areas #10, 11, 12, 13) and in the Coastal Mountains (Outfitting Areas #16, 17, 18). Here, year-round densities of up to 1.8 sheep/km² have been reported (Hoefs and Cowan, 1979). In general, more northern populations are more widely dispersed. The Mt. Cronin population in the northern Richardson Mountains (GMZ 1-53, 1-54, 1-58 at a latitude of 67°N) for instance, has a density of only 0.6 sheep/km² (Hoefs, 1978a).

MANAGEMENT

To many hunters, wild sheep are probably the most prized trophy animal in North America. Others value their meat, and the non-consumptive use of sheep for recreational and educational purposes is steadily rising.

In the Yukon, sheep are the main drawing card that attracts non-resident hunters, and the income to outfitters from sheep hunting exceeds that of any other wildlife species and is estimated at more than 1 million dollars annually. Of some 400 non-resident hunters per year, about 300 engage in sheep hunting, and have, over the past decade, accounted for about 72% of the Yukon sheep harvest. Sheep hunting provided some 1,930 recreation days for local hunters in 1978 and about 1,600 recreation days for non-resident hunters.

At present, the primary goal of sheep management in Yukon is the provision of large, old rams for trophy hunting. To achieve this goal, a number of sheep hunting regulations have been implemented over the years mainly for non-resident hunters. While these led to a slight reduction in harvest (Table 5), they have at the same time improved the trophy quality of the rams taken. Relevant regulations can be summarized as follows: Since 1908, the hunting of female sheep has been prohibited; since 1972, only rams can be taken whose horns have reached 3/4 curl or better. A compulsory submission of trophies to the Wildlife Branch, for assessment of age and horn growth parameters, was initiated in 1974. Since 1975, non-resident hunters can only take rams whose horns have reached full curl, and this requirement was extended to resident hunters in 1981. One of the existing 21 outfitting concessions, (#18), was revoked in 1980 and this area is now managed for resident trophy sheep hunting through a limited entry provision.

The Wildlife Branch recognizes the need to accommodate non-consumptive uses of sheep to a greater degree than presently granted, as well as the desires of some resident hunters that would like to take sheep for meat rather than trophies, and these issues will be addressed in a sheep management plan, which is presently being prepared.

In Fig. 3, the Yukon sheep harvest for the past 14 years is graphically displayed. The total take is divided into contributions by non-resident hunters as well as resident hunters and trappers. On the average, 278 rams were taken per year; non-resident hunters, guided by registered outfitters, accounted for 72% of the harvest; resident hunters and trappers took 28%. The harvest by residents has remained fairly stable, while there was a slight reduction in non-resident sheep harvest, particularly in 1980 when one of the 21 outfitting areas (#18) was closed.

The Yukon Wildlife Branch feels that the present harvest is sustainable and that there are no indications of "overuse" of this resource. These claims are supported by the information in Fig. 4., which lists parameters of trophy quality of the rams taken by non-resident hunters. The average age of the rams taken ($r=0.668$) as well as the average horn lengths ($r=0.793$) have remained fairly stable in recent years after improving during the period of 1974 to 1980. With a mean horn length of 35 inches and a mean age of close to 10 years, management for trophy rams may have reached the optimum achievable. Any improvement in average trophy quality can only be brought about at the expense of numbers of available rams. It is known that in older rams the natural mortality rate increases greatly; for the 10 to 11 year cohort, it may amount already to >50% (Hoefs and Bayer, 1983). It is also known that in rams 10 years old and older, the wear rate of the horn tips may exceed the new growth put on at the horn base (Hoefs and Nette, 1982).

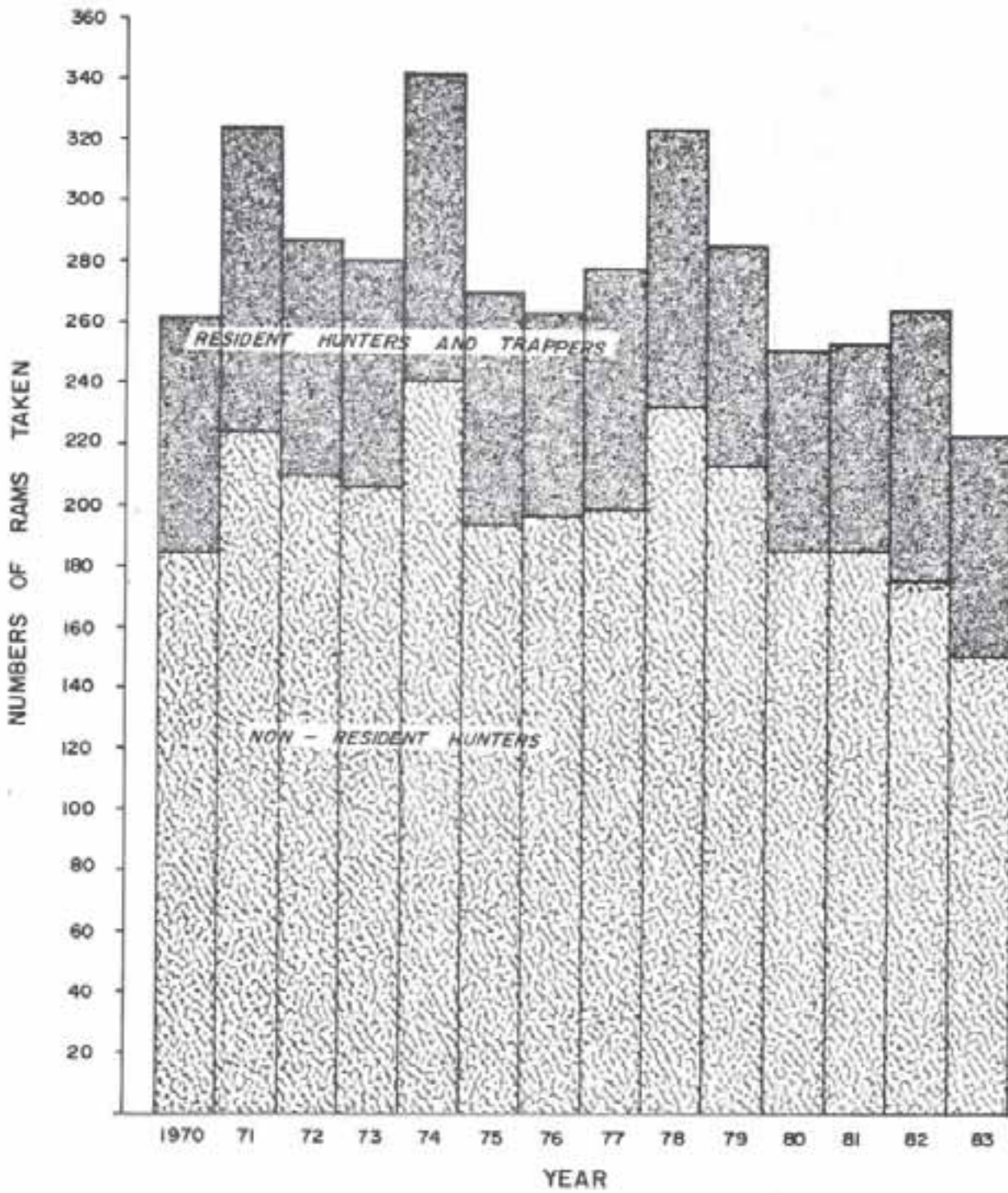
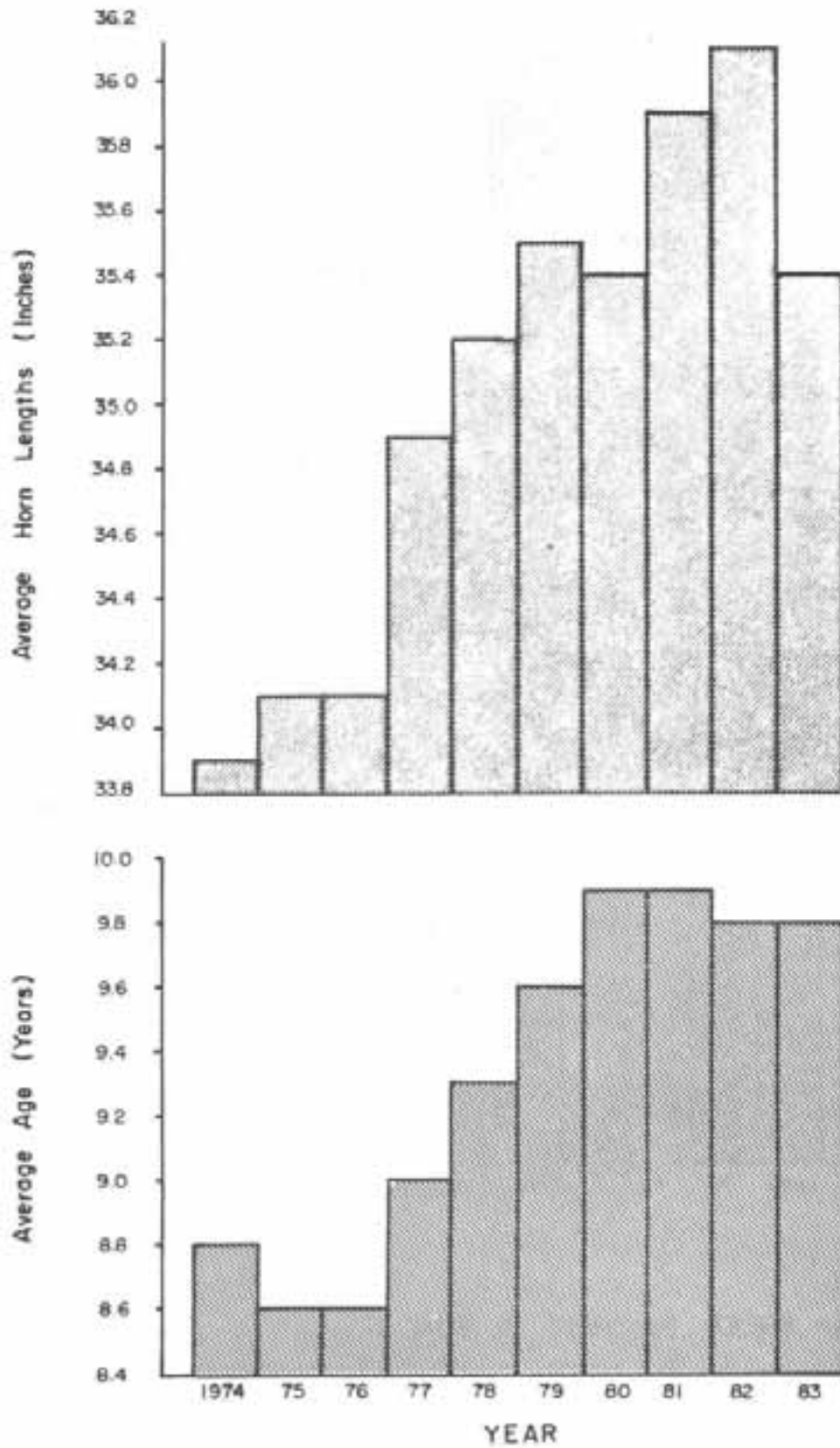


Fig. 3 - SHEEP HARVEST IN YUKON

Fig. 4 - TROPHY QUALITY OF RAMS TAKEN IN YUKON DURING PAST DECADE BY NON-RESIDENT HUNTERS.



The apparent stability in the Yukon sheep harvest is also obvious from the estimated hunter success (Table 5). For the purpose of this assessment, we have computed hunter success by dividing the numbers of rams taken by the number of hunters that have purchased sheep hunting tags, and thereby revealed their intentions to hunt. While this method may not be adequate to quantify success in absolute terms, it may be sufficient for comparative purposes and to establish trends. An inspection of Table 5 will reveal that both non-resident and resident hunters success have remained relatively stable. At this time, we therefore conclude that hunting at the present level is sustainable; no evidence of population declines because of hunting is apparent.

Table 5. Estimated success of sheep hunters.

<u>Year</u>	<u>Tags Purchased by Residents</u>	<u>Harvest by Residents</u>	<u>% success Residents</u>	<u>Tags Purchased By Non-Res.</u>	<u>Harvest by Non-Res.</u>	<u>% Success Non-Res.</u>	<u>Total Harvest</u>
1982	772	88	11.4%	306	177	57.8%	265
1981	853	68	8.0%	283	186	65.8%	254
1980	705	66	9.4%	348	186	53.5%	252
1979	801	73	9.1%	370	213	57.6%	286
1978	891	91	10.2%	393	233	59.3%	324
1977	927	76	8.2%	339	199	58.7%	275
1976	816	50	6.1%	275	197	71.6%	247
1975	743	53	7.1%	N/A	192	N/A	245

We do have concerns, though, with potential impacts other than hunting. While the Yukon Government has jurisdiction over wildlife management, responsibility over land and land-use matters are retained by the Federal Government in Ottawa. This bipartite jurisdictional arrangement poses considerable problems in respect to habitat conservation as well as habitat enhancement work. It also limits the possibilities of mitigating disturbance of sheep through various land-use activities by regulations or conditions on land-use permits. Mining, both hard rock and placer, and mineral exploration have always been very important in Yukon. Judging by the number of claims staked during the past decade, we are presently experiencing a second gold rush. Exploration in the "Hinterland" usually requires helicopter support; promising mineral sites as well as new placer claims are usually made accessible by new roads and trails.

Potential negative impact on sheep is possible through these activities. Improper routing of roads and trails may destroy critical areas such as winter ranges, migration corridors, lambing areas or sites of mineral licks. Trails

ascending mountain ranges provide easy access to hunters and tourists, and may lead to abandonment of such areas if disturbance becomes intolerable to sheep. Low-flying helicopters may cause considerable disturbance.

There appears to be general agreement that sheep are more sensitive to disturbance than other large mammals (Anonymous 1976; Anonymous 1977; Lenarz 1974; Price 1972; Reynolds 1974). Aircraft disturbance of wildlife is generally recognized as a major concern accompanying development activities in remote areas (Anonymous 1976; Geist 1971, Klein 1973; Lenarz 1974). This problem is particularly severe with social animals such as sheep and caribou. Helicopters frighten animals more than fixed-wing aircraft (Klein 1973).

The various negative effects of disturbance have been described in detail by Geist (1971) and only a brief resume is necessary here. The direct consequence of disturbance is usually flight by the animal, with a resultant excessive expenditure of energy, possible injury or even accidental death, fragmentation of social structure (including separation of mother and offspring), withdrawal from critical habitats, and decreased reproductive performance. Disturbance on winter range, when ungulates experience a negative energy balance, is particularly harmful. Because the nutritional status of pregnant ewes influences resorption and abortion rates and the conditions of lambs at birth and their survival, harassment and displacement from winter ranges can severely depress birth rates and increase mortality. Displacement from traditional lambing grounds to unfamiliar terrain will influence early mortality of lambs (Calef and Lortie 1973; Anonymous 1976; Geist 1971, 1975; Anonymous 1977; Klein 1973; Lenarz 1974; Price 1972; Reynolds 1974).

It is these problem areas that must be more thoroughly addressed in Yukon, if wild sheep are to continue to inhabit their pristine ranges in present numbers.

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