REPORT ON GRIZZLY BEAR

SURVEY AND INVENTORY

J. Lynn Crook, Investigator

This report is not final and is subject
to revision - December 31, 1971

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JOB COMPLETION REPORT

State: Alaska

Cooperator: J. Lynn Crook

Project No: W-17-3 Project Title: Grizzly Bear Survey and Inventory

Job No: 4

Period Covered: January 1, 1970 - December 31, 1971

BACKGROUND AND OBJECTIVES

This project was begun at a time when the exploitation of the Arctic mineral resources threatened to change the habitat and utilization of the brown bear found in the region. The study area was defined as Game Management Unit 26 (GMU 26) - that area of Alaska north of the watershed-dividing line of the Brooks Range (Figure 1).

The objectives listed in the project proposal were:

1. Estimation of current abundance (or a reliable index of abundance), areal densities and distribution of bears in Game Management Unit 26.
2. Analysis of changes, of any, in the distribution and recorded abundance of bears during the recent past.
3. Definition of seasonal movements of bears in an attempt to determine denning areas.
4. Definition of seasonal habitat preferences of the bears in Game Management Unit 26.
5. Estimation of productivity based on age and sex composition of bears observed.

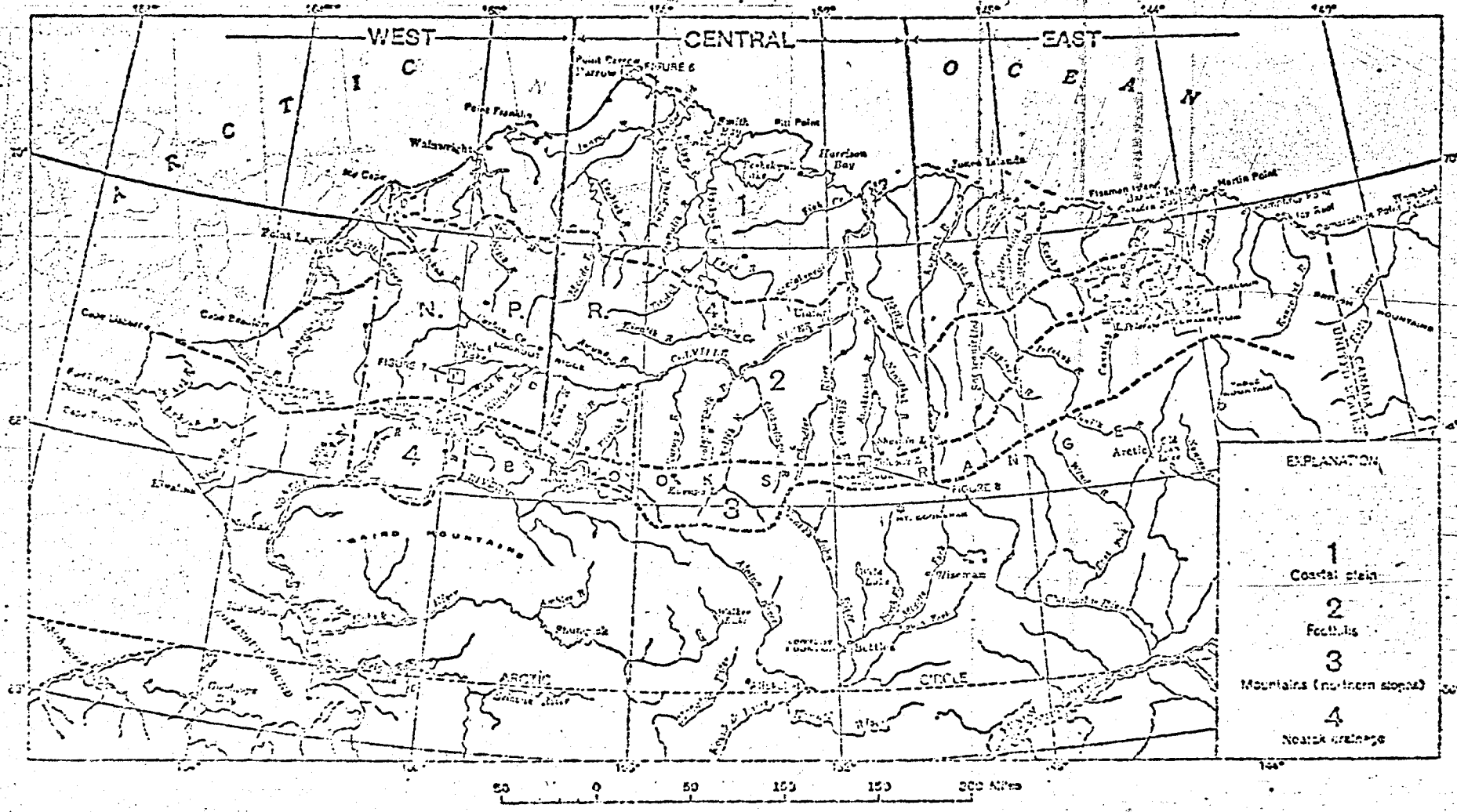

Figure 1. Northern Alaska with the study area and its subdivisions outlined, taken from Spetzman, 1953.

It was further agreed that a M. S. thesis would constitute the project completion report. However, a M. S. thesis was completed during the winter of 1970-71 and did not, of course, include the results of the 1971 field season. Therefore, this report and the completed thesis together constitute the required completion report.

This report is intended as a summary of data pertinent to the management recommedations which conclude it.

I. POPULATION PARAMETERS

Composition

During 1970 and 1971, 689 bear sightings were recorded from all sources. This includes sighting reports solicited by means of the Sighting Report Card distributed to cooperators traveling in the region. Table 1 gives the year, source and observable sex-age of these sightings.

A word of caution is necessary regarding the assumptions implicit in using data collected in this manner as a souce of statistics. First, since it is impossible to judge the number of the sightings which are of bears already reported, no effort was made to cull duplicate sightings and, therefore, the absolute numbers are not a reliable index of bear abundance. I assumed that all adult bears had an equal probability of being sighted, and that having been once sighted, no bear was more or less likely to sighted again. Second, there was a source of possible bias if the distribution of the two classes, i.e. solitary adults and females with young, is not random. Evidence presented elsewhere in this report (see Distribution) suggests that the summer distribution is not random but distribution patterns are not yet clear enough to allow correction of this data.

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Table 1. Sex-age composition of brown bears reported from Game Management Unit 26, 1970 and 1971.

	Biologist[a]		Non-Biologist		Total	
1970	N	%	N	%	N	%
Females w/young	31	(14.2)	50	(16.4)	81	(15.5)
Cubs & yearlings	59	(27.1)	85	(28.0)	144	(27.6)
Solitary adults	128	(58.7)	169	(55.6)	297	(56.9)
Total	218	(100)	304	(100)	522	(100)
1971	N	%	N	%	N	%
Females w/young	3	(5)	12	(11)	15	(9)
Cubs & yearlings	8	(14)	23	(21)	31	(19)
Solitary adults	45	(81)	76	(68)	121	(72)
Total	56	(100)	111	(100)	167	(100)

[a] Includes personal data and reported sightings of other biologists.

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The composite results of the total 689 sightings reported are: Solitary - 61 percent, females with young - 14 percent, cubs and yearlings - 25 percent.

Table 2 gives the sex-age composition of the bears tagged during 1971. This is a subsample of the 1971 data in Table 1 and the results are generally similar: Females with young - 9.7 percent, young - 25.8 percent and solitary adults 64.5 percent.

The 1971 composition is significantly different from the 1970 composition ($X^2 = 14.069$ with 2 df, significant at 1%). This difference cannot be acounted for and, in fact, is opposite the expected change. Apparent changes in composition of this magnitude are not found in the literature or data from brown bear investigations elsewhere in the state (Table 3).

I feel these results generally represent the population composition for the whole of GMU 26. Table 3, taken from the 1969 Brown Bear Segment Report (Glenn and Miller, 1970), is included to show both the range of variability encountered with such statistics and as a contrast to the composition reported from GMU 26. It is clearly evident by contrasting the percentages given in the Tables 1, 2, and 3 that composition counts in GMU 26 show a larger proportion of solitary animals and therefore smaller proportion of females with young.

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Table 2. Sex-age composition of brown bears captured, tagged, and released in Game Management Unit 26, May - October 1971.

	N	%
Females w/young	3	9.7
Young[a]	8	25.8
Young of year	5	
Yearlings	3	
Solitary	20	64.5
Adult males	12	
Adult females	8	

[a] Young not tagged, although they were accompanying females which were tagged.

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Table 3. Aerial survey brown bear composition data, Alaska Peninsula trend count areas.[1] (From: Glenn and Miller, 1970).

Study Area and Year	PERCENT OF POPULATION					Total Sample Size	Number of Replicate Counts
	F W/Young	Cubs	Yearlings	Cubs and Yearlings	Single Bears		
Ugashik Lakes							
1965	22	22	28	49	29	65	1
1966	22	24	27	51	27	55	1
1967	21	29	19	48	31	58	1
1969	24	21	36	56	20	117	2
Black-Chignik Lakes							
1962	26	30	22	52	23	1718	27
1965	28	32	25	57	15	236	2
1966	22	34	13	47	31	108	1
1967	27	45	10	55	17	157	2
1968	23	43	14	57	19	129	3
1969	22	30	22	51	26	663	6
Sandy Lake							
1965	26	31	19	50	24	42	1
1966	22	51	8	59	19	37	1
1967	25	39	21	61	14	28	1
Moffet Bay							
1966	23	33	12	45	32	60	1
1967	22	31	13	44	35	55	1
1968	25	30	21	51	24	128	2
1969	16	19	14	33	51	92	1
Canoe Bay							
1966	21	16	32	47	32	19	1
1967	24	27	24	51	24	37	1
1968	22	32	14	46	32	63	2

[1] Figures based upon cumulative total of all replicate counts.

The sex ratio of the solitary adult segment of the population can be inferred from the tagging results. When aircraft availability and weather would allow, each bear encountered was tagged, and no intentional effort was made to bias the sample. Table 2 shows that 12 adult males and 11 adult females (three of which were accompanied by a total of 8 young) were tagged. In this sample, 52 percent of the adults were male and 48 percent were female. Mundy (1963) reports that the sex ratio in 81 liver-trapped young of the year and yearling bears was essentially even: 41 females and 40 males.

Reproduction

The data presented in Tables 1 and 2 indicate that the component of the observed population which were females accompanied by young was about 15 percent in 1970 and about 9 percent in 1971. Regardless of the causes or significance of this variation, it seems reasonable that a range of values from 5 percent to 17 percent (minimum and maximum observed) would include the actual value for the population.

Since the young accompanying females are separable into two year classes, and no evidence to the contrary is available, it is assumed that the maximum rate of reproduction for GMU 26 female bears is one litter every three years (Hensal, et al., 1969).

Table 4 is a summary of litter sizes observed in various areas in the State. The litter sizes reported from GMU 26 are not appreciably lower than those observed elsewhere in the State. For the sake of clarity, the recruitment of young into the adult population is assumed to occur in June of the third year, or at the age of approximately two years, four months. Further note that the females which reared these young will be solitary for the remainder of the summer and fall. These

pregnant but unaccompanied females must be included as a part of the breeding female component of the population. In computing productivity, the percentage of females accompanied by young observed is used as 2/3 of the breeding female component.

Combining the above relationships, estimates of the potential annual increment of population growth can be computed. Using the range of observed values for percent breeding females and yearling litter size, estimates of recruitment per year range from 3 percent to 17 percent. Basing estimates of recruitment on the percent of the population which is young with female, and assuming that the percent observed represents two year classes, then recruitment estimates would be 14 percent (1970 data), 10 percent (1971 data), and 13 percent (total data).

This percent recruitment into the adult population, i.e. young reaching the age of independence, is probably a relatively stable statistic of the reproductive biology of the GMU 26 bears.

I have found no evidence to suggest that the reproductive rate is density-dependent in brown bears. Cub survival also is probably not density-dependent in a population like that in GMU 26 where density is very low. The recruitment rate then would be dependent only on numbers of adult females breeding.

Mortality

Natural mortality in bears is poorly understood. As a species, the bear appears to be resistent to dibilitating diseases or parasites, and is not regularly killed by other species. Although records exist of bears being killed by wolves, moose, and other bears, these losses probably have little effect on overall population numbers. The proximate causes of death of "old" bears have not been identified but it is assumed that such

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Table 4. Litter size as observed in brown bear in three regions of Alaska.

	Kodiak[a]	1969 Southcentral[b]	1970 GMU 26	1971 GMU 26
Sample Size (females w/young)	201	148	79	15
Mean Litter Size	2.1	2.3	1.8	2.1
Mean Litter Size (young of year)	2.2	NA	2.0[c]	2.0[d]
Mean Litter Size	2.0	NA	1.5[c]	2.0[d]

[a] Hensel, et al. 1969.

[b] Black-Chignik Lake (159°W, 56°20'N) surveys July-August 1969 (Glenn, 1970). Observations made along salmon streams from Supercub.

[c] Sample size = 52.

Sample size = 14.

deaths usually occur while in the den (Erickson, 1965).

Human-caused bear mortality is the combination of legal sport harvest, legal defense kills and unreported poaching. Table 5 is a summary of the sport harvest in GMU 26 since the inception of the hide sealing program. The change in numbers harvested from 1961 to 1969 reflects a similar change in license sales and therefore, is probably unrelated to the number of bears available for harvest. The mean age of harvested bears (based on cementum examination) shown in Table 5 suggests that the sport harvest is not restricted to old bears. Interviews with hunters and guides hunting in GMU 26 confirm the impression that little hunter selectivity is exercised. With few exceptions, the first bear encountered is hunted. Further support for this conclusion can be found in Table 6. The sex ratio of the kill followed closely the hypothetical sex ratio of the solitary adult, or huntable, population. The greatest non-random factor of the sport harvest is probably the later den emergence and earlier den re-entry of females, causing males to constitute an even greater portion of the huntable population during part of the hunting season.

Native utilization of brown bear is supposedly included in the sealing program but this is probably true for only the last couple of years. Little doubt exists that some bears harvested by natives since 1961 have yet to be sealed. The native harvest near Anaktuvuk Village is reported by R. L. Rausch (pers. comm.) but similar information from other villages is lacking.

The number of legal defense of life or property kills in GMU 26 is small, averaging less than one per year including those troublesome bears moved. An influx of people into the region who are unfamiliar with bears, will probably result in an increase in the number of incidents.

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Table 5. Sport harvest comparison 1961-1970, Game Management Unit 26.

Year	Total Reported Kill	% Males	Mean Hide[a] Size	Mean Cem. Age Male[b]
1961	1	100	10.2	-
1962	2	50	15.0	-
1963	13	73	12.8	-
1964	16	80	13.9	-
1965	5	60	13.4	-
1967	4	67	10.4	-
1968	14	93	12.0	5.7(7)
1969	16	79	12.8	7.4(7)
1970	14	71	12.9	-
1971	22	57	12.5	-
Mean % of Males		73		

[a] Length plus width - given in feet.

[b] Tooth sample size in parenthesis.

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Table 6. Comparison of hypothetical sex ratio of the adult population with sport harvest sex ratio, for 1970 and 1971.

	1970	1971
Adults observed	378	136
Solitary females w/young	297/81	121/15
Hypothetical adult sex distribution[2]	197 M/181 F	71 M/65 F
Hypothetical solitary adult sex distribution	197 M/100 F	71 M/50 F
Hypothetical solitary adult sex ratio	66% M/34% F	59% M/41% F
Sealed harvest sex distribution	10 M/4 F	13 M/9 F
Sealed harvest sex ratio	71% M/29% F	57% M/43% F

[2] Hypothetical adult sex ratio 52% M/48% F (See Composition).

Table 6. Comparison of hypothetical sex ratio of the adult population with sport harvest sex ratio, for 1970 and 1971.

Poaching and wanton killing of bears occur, but the extent is not known. In GMU 26 two circumstances exist which provide opportunity for poaching. One is that part or all of the unit is closed during the traditional bear hunting season when the neighboring units are open, and the other is the presence of numerous people traveling in the region who have the opportunity to poach bears and successfully smuggle the hides out of the area. If illegal hunting cannot be completely controlled, its effects must at least be considered as a part of the overall mortality in the bear population.

Figure 2 is a map of the known sport harvest and known unsealed harvest in GMU 26 since 1960. The aggregation of kills near Anaktuvuk Pass are the above mentioned reports from Rausch. It is evident by examining Figure 2 that the harvest in recent years is concentrated in the central Arctic area. A discussion of the importance of this trend is found in the Management Section of this report.

Delimitation of Populations

Heretofore in this report the term population has been used in reference to the total of GMU 26. It remains to demonstrate geographic boundaries of any breeding population(s) which may exist in the region.

Since breeding occurs in June and early July, and at least some hunting occurs in fall, seasonal migration patterns enter the question. Also, the term breeding population is subject to some interpretation. The basic question to be considered in GMU 26 is whether or not the population parameters discussed in this section can properly be applied to the unit as a whole. No data contained in this report thoroughly supports this assumption, and a proper consideration of this question can only come after more data has been amassed.

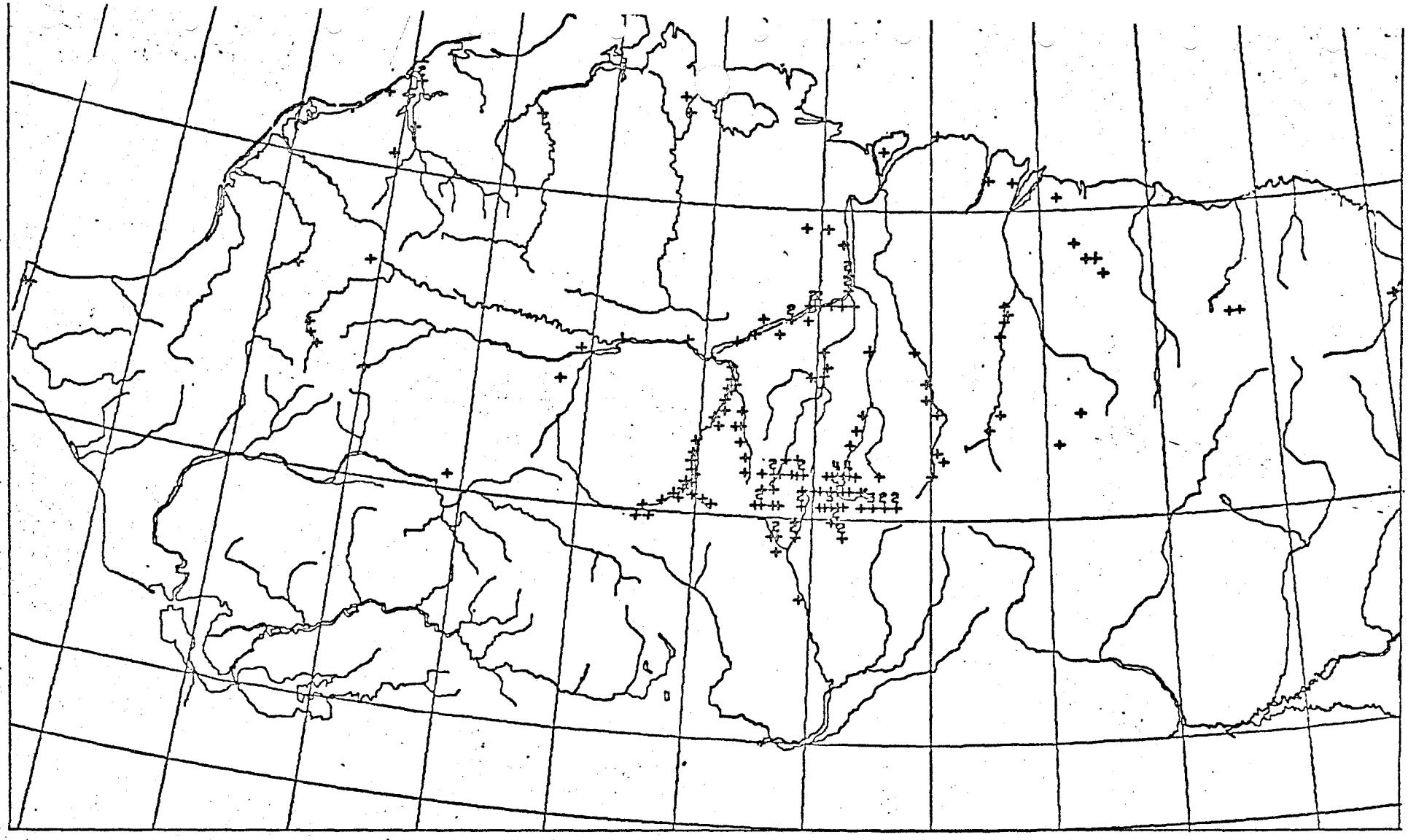


Figure 2. Sealed sport harvest and unsealed native harvest since 1961 in GMU 26.

DISTRIBUTION

Observed Distribution

Brown bears are found in all parts of GMU 26. Brown bears are not, however, sedentary animals, and probably do not move at random in an environment like the Arctic Slope where seasonal habitat change is both rapid and drastic. Hence, distribution is probably related to seasonally preferred habitat.

In an earlier report (Crook, 1971), the locations reported on the Sighting Report Cards from 1970 were plotted on maps. These maps demonstrate that bears during all seasons are more commonly found in the mountains and foothills than in the coastal plain. The observations do not support the hypothesis that most of the GMU 26 bears migrate north out of the mountains in spring and return in the fall.

Figure 3 is the total of sightings from 1970. One of the problems of this method of collecting data is, that it is impossible to distinguish the effects of the density of bears from the effects of the density of observers. The absence of sightings in the central coastal plain, however, may indicate fewer bears there since some of the contributors did travel in that area.

Movement Records

The results of radio-tracking of three bears and the recovery or resightings of some of the tagged bears are presented in Figure 4, and at least two different seasonal patterns are evident. Three individuals' (3000, 2001, 3019) travels illustrate the mountains in spring, foothills in summer, mountains in fall pattern ranging from 34 to 83 miles line of sight. This pattern of seasonal migration is reported as common by natives of Anaktuvuk Village and tracks of bears in the snow of late

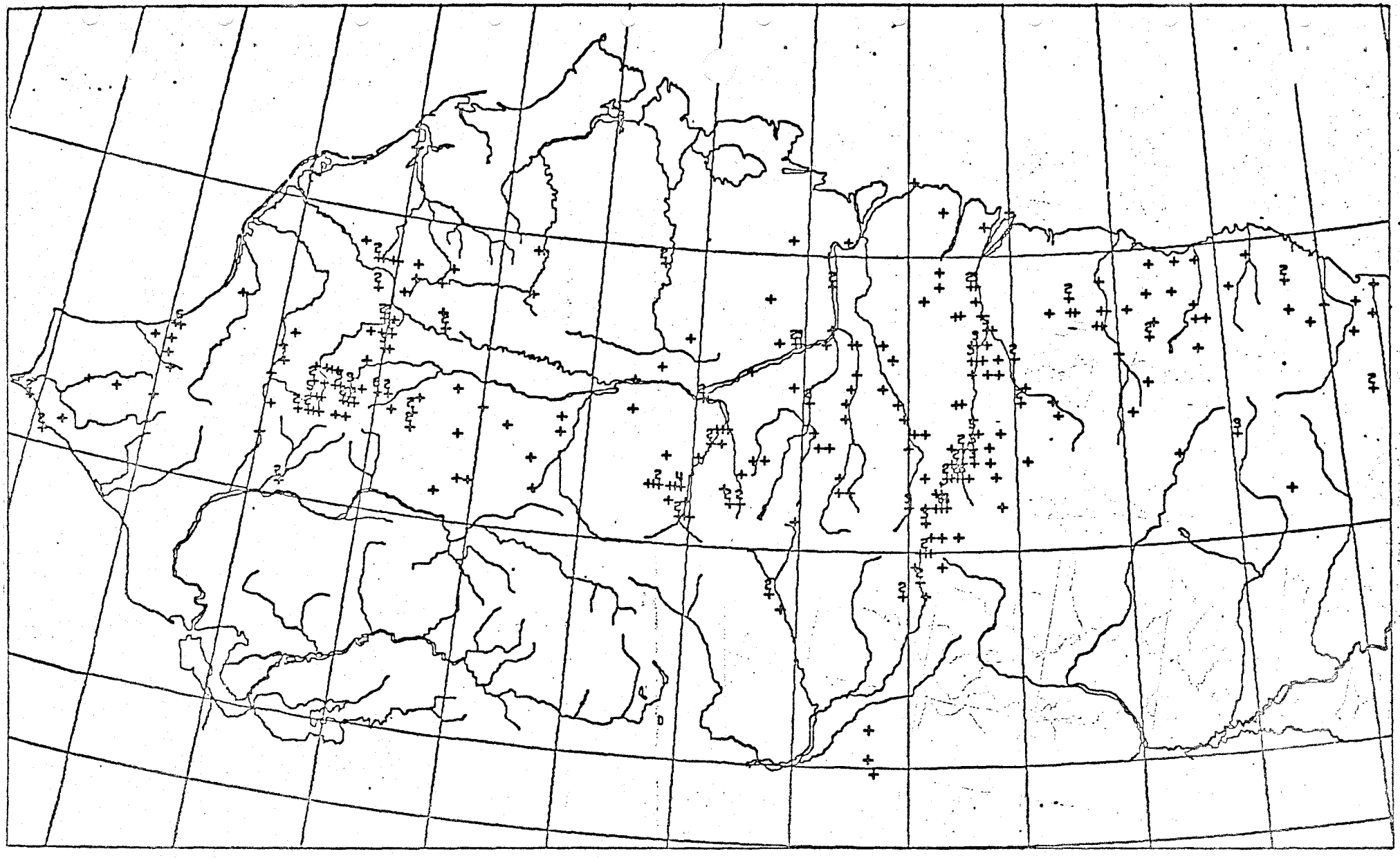
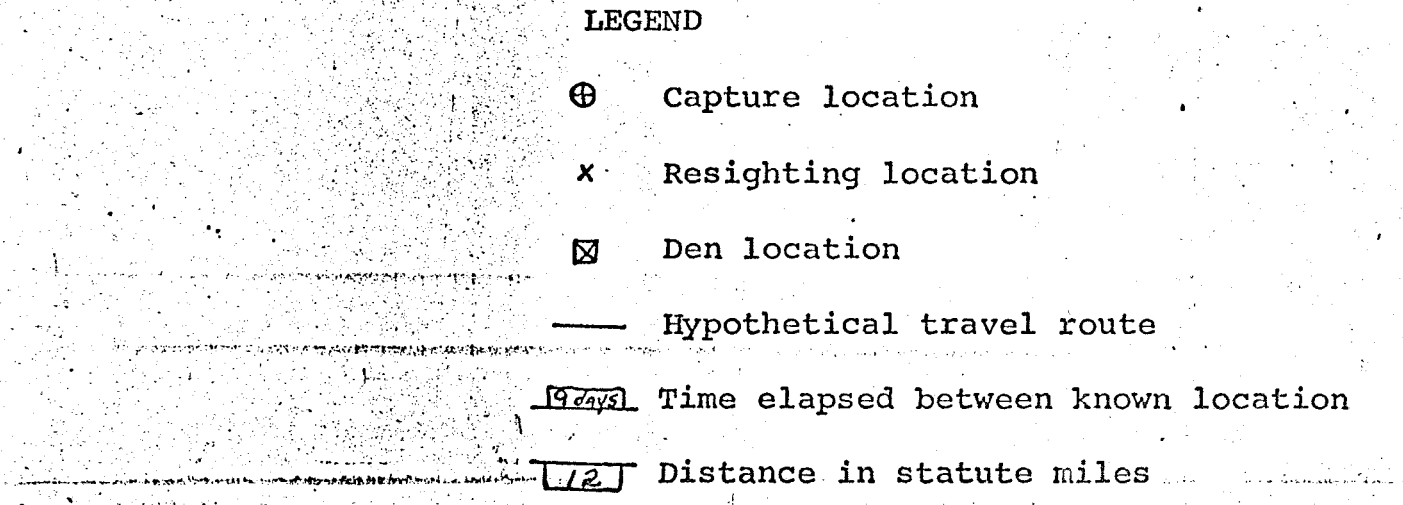
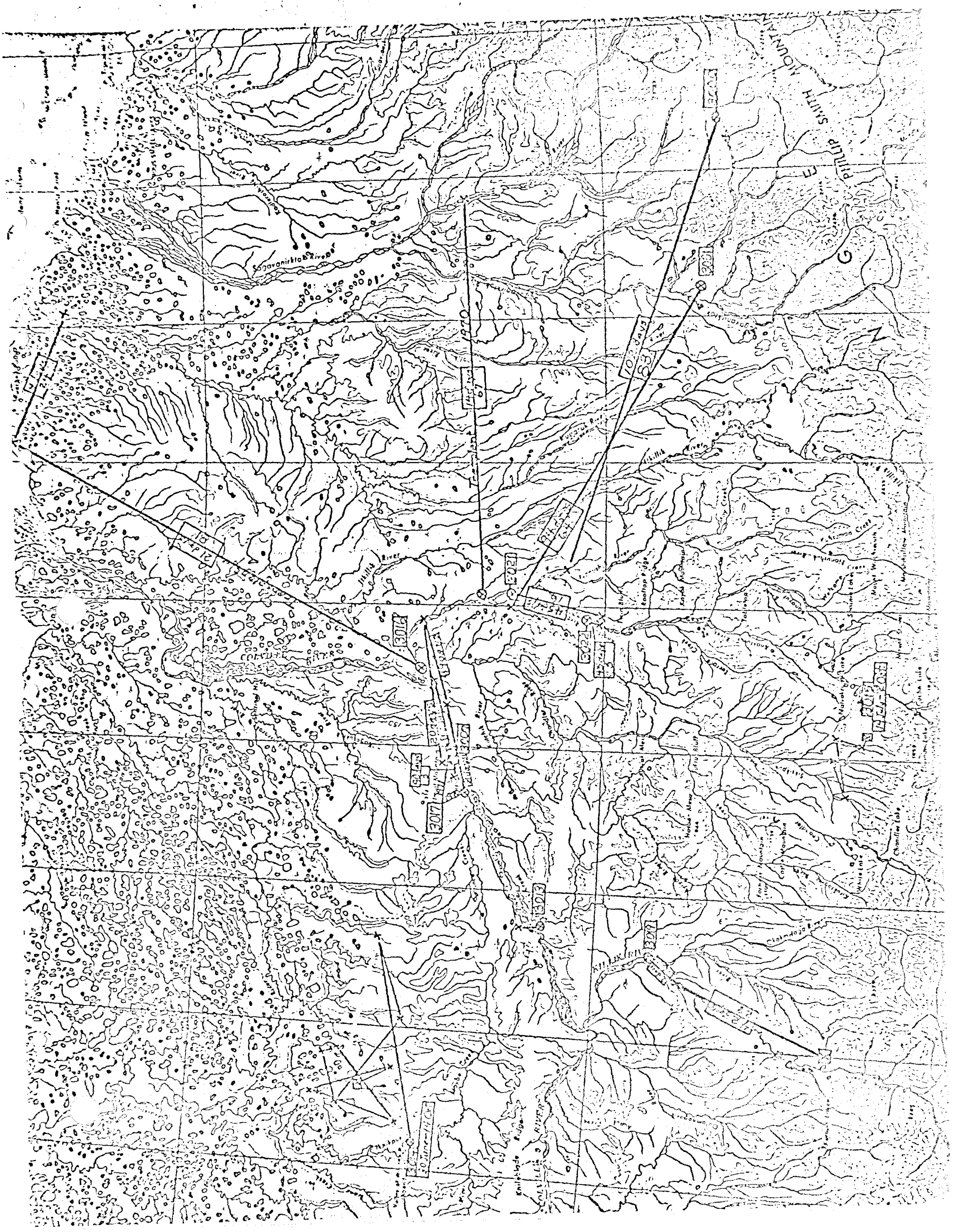


Figure 3. Brown bear sightings reported during 1970 in GMU 26. Number of data point is number of separate sightings at that location.

FIGURE 4

Known movements of bear tagged during 1971 with hypothetical routes of travel.





PHILLIP SMITH MOUNTAINS
Sagavanirktok River

spring and early winter further support this conclusion.

The records of bears 3014, 3015 and 3017 illustrate a pattern of movements restricted to a localized area with 6 to 15 mile radius of activity. Bears 3014 and 3015 denned in their respective areas of activity.

Also, on Figure 4 are the hypothetical routes of return of two bears moved from garbage dumps. These bears traveled 67 miles and 105 miles respectively, and clearly were able to navigate successfully over these distances. This ability would suggest that the other movements documented are not the result of random wanderings. The fact that these bears returned to the site from which they were moved means that transplanting is not a solution to problem bear complaints. In one case however, after the bear returned he caused no further problem and apparently lived through the experience.

While these records of movements do not reveal any startling region-wide scheme, they do document the variety of patterns which exist. They suggest that there is considerable flux between the three physiographic provinces of GMU 26, or that there are both resident and migratory populations of bears.

Dens

Although available data does not allow the general characterization of the bears' denning requirements, apparently those requirements are met in many sections of GMU 26. Bears reportedly den near Barrow along the Mead River, Chipp River, Ikpikpuk River and others. Bear dens have been observed along the Colville River bluffs and other similar topography in the foothills and bears are known to den in the mountains.

The locations of the dens of the radio-tracked bears are in Figure 4.

Bear #3014 denned along a small creek in a sandy cutbank. The den opening was about six feet from the top of the 40-foot bank and its opening faced west northwest. Bear #3015 denned at the mountain front in rugged terrain and bear #3019 denned in a small intermontane valley which branched from the Killik River. The actual dens of #3015 and #3019 were not observed due to sharp relief of the surroundings and the high winds typical of the mountains.

Food Habits

Animal material as food for bears includes moose, caribou, ground squirrel (Spermophilus undulatus), voles (Microtus spp.), and lemmings (Lemmus spp.) In the early spring, animal material, both carrion and prey, appears to be an important item in the diet of bears. Wolf-killed animals and gut piles left by hunters are claimed by bears when available and bears are occasionally successful at killing moose and caribou.

Personal observations and the data in Table 6 generally support the view of Murie (1944) and Rausch (1951) that bears are primarily vegetarian throughout the summer. The roots of Hedysarum spp. and Petasites spp., the succulent stems of various herbs, Equisetum spp., and the variety of available berries, all are eaten when available.

Habitat

Habitat requirements and preferred terrain play an important role in the distribution pattern of any species, but in GMU 26 the superficial homogeneity of the region and the life style of the bear make objective distinctions difficult.

A series of aerial surveys was conducted during the summer of 1970 (Crook, 1971). The intention was the accumulation of data concerning distribution which would allow the quantification of terrain preferences

Table 6. Contents of bear scats collected while tagging during 1971 in GMU 26.

Date	Bear #	Location	Contents - % Dry Weight
9 June	3011	Kuna R. 68°56', 157°35'	55% caribou hair and bone, 45% Equisetum spp., Carex spp., Eriophorum vaginatum.
15 July	3016	Kuparuk R. 70°22', 149°02'	100% Equisetum spp., Carex spp., Eriophorum vaginatum.
23 August	3018	Killik R. 68°56', 153°30'	100% Vaccinium uliginosum (blueberry).
23 August	3019	Killik R. 68°51', 153°25'	100% Vaccinium uliginosum (blueberry).
24 August	3000	Nanushak R. 69°09', 150°48'	75% root material, 15% Arctostaphylus uva-ursi (bearberry), 10% misc. Ericaceae.
24 August	3021	Anaktuvuk R. 69°09', 150°53'	5% calf moose hair, 95% Vaccinium uliginosum (blueberry).
24 August	3022	Anaktuvuk R. 69°03', 151°05'	95% Arctostaphylus uva-ursi (leaves & berries), 5% Equisetum spp.
1 Sept.	3007	Colville R. 69°22', 159°06'	100% Assorted berries and leaves, mostly Arctostaphylus uva-ursi and Empetrum nigrum (crowberry).
5 October	3023	Sagavanirktok R. 70°15', 148°24'	5% Vaccinium uliginosum, 95% garbage.

and from which habitat requirements could be inferred. This technique failed to accomplish this goal because so few bears were observed that statistical analyses of the data were meaningless. The following discussion of terrain preference is a summary of notes accumulated on the subject during two field seasons.

Descriptions of physiography, climate and vegetation types are contained in the earlier report (Crook, 1971). The seasonal changes described are important to the following discussion.

In April and May, when GMU 26 bears emerge from their dens, available food is limited. At this time, the large river valleys appear to be strongly preferred habitat, possibly because moose and migrating caribou are more likely to be killed by bears among the willows and braided river channels than in the open snow covered foothills. Winter-killed moose carcasses are often utilized for food by bears during this period, and caches of meat near wolf dens are reported to attract bears. Bears travel along the river valleys commonly during this period. The diet shifts to vegetation with the thaw (Murie, 1944; Rausch, 1951; Porsild, 1945) and as breakup progresses, food becomes more available.

Breeding activity is more commonly observed in the southern foothills, than in other areas of the central Arctic. At this time (June and early July) the foothills are green and bears are seen out of the valleys in the large expanses of rolling hills covered with dry tussock tundra.

Immediately following breeding time the large male bears seem to "disappear." In direct efforts to radio collar a large bear in July and early August, I was unable to find such a bear, despite the fact that areas representative of all the habitat types were searched. This segment of the population "reappeared" in the river valleys in late August.

During August and early September berries appear to be the major food item for most bears (Table 6). Berries are far more abundant in river valleys and tributary streams than elsewhere and bears again are drawn into this terrain type. Neither bear being radio-tracked during this period (3014 and 3015) was in a major river valley, but both were invariably found along a creek.

Concomitant with the advent of fall, bears' pelage color changes due to hair replacement, and it becomes difficult to identify individuals. Certainly during this time, some bears are moving and, again, using the river valleys as routes of travel. Food does not seem to limit movements during this period. In two cases, bears remained in the smaller creeks and the surrounding snow-covered hills after freezeup. These individuals scratched through the snow on the sidehills and grazed, dug for roots and generally caused the area to resemble a winter caribou feeding area.

ABUNDANCE

The survey technique described earlier (Crook, 1971) was employed in order to provide information for statistical estimates of abundance; however, too few sightings were made to allow valid statistical treatment.

Considering movement pattern of some individuals (3000,3001, 3014), i.e. migrating from the mountains to the northern foothills, care must be exercised in the establishement of geographic units for comparison. The area within which most of our flying has been done is used as a subunit and abundance estimates made for this area from 150°30'W longitude to 154°30'W longitude, or approximately from the Nanushak River to the Oolamnagavik River, and extending from the crest of the Range to the

southern edge of the coastal plain. This "intensive study area" has an approximate area of 11,000 square miles.

During 1971, from 10 May to 15 October, I flew approximately 300 hours of low-altitude observation in this limited area and have recorded a total of 51 different bear sightings. From 15 July to 15 August, a period during which 8 tagged bears were probably in this area, one of three bears observed was tagged. From 1 September to 15 October, a period during which 15 bears were probably in this area, one of five bears observed was tagged and four of 19 bears harvested in this area were tagged. Assuming tagged bears are resighted or harvested in the same proportion as they exist in the population, the small samples suggest, that the number of bears in that area was 24, 75 and 71 respectively.

Based on the above data, I believe that during 1971 there could not have been more than 200 bears in this limited area - a density of one bear per 55 square miles - and probably only 100 bears - a density of one bear per 110 square miles.

Although this area is more heavily hunted, neither the sightings reports (Figure 3) nor personal reconnaissance suggest that the other portions of GMU 26 are appreciably different.

With regard to abundance in the recent past, no sources of precise data or adequate number of reliable sightings have been unearthed. However, the concensus of the dozen or more people interviewed, whose opinions are based on many years of experience of traveling in the region, was almost unanimous that there are appreciably fewer bears to be found in GMU 26 than a few years ago.

GENERAL NOTES ON THE BEAR OF GMU 26

Size

It is a commonly held opinion that the bears of GMU 26 are smaller than interior bears and much smaller than coastal bears. The list of weights and physical dimensions in Table 7 generally supports this view. Also, one would anticipate a weight gain during the summer to a peak weight immediately preceding denning. In the case of bear #3000, on 14 May (a male) weighed 425 lbs., and on 24 August he weighed 540 lbs. This is a 27 percent weight gain. Most bears tagged in May and June were lean and lacked apparent subcutaneous fat deposits but those captured in August and later were markedly fatter.

Table 7 shows the mean weight of 23 individuals was 398 lbs. (std. dev. = 132). The mean weight of 12 males is 479 lbs. (std. dev. = 135) and for 11 females was 325 lbs. (std. dev. = 76). The difference in weights for males and females is significant at the 95 percent confidence level (t = 3.288), again, in agreement with expected results.

Pelage

Pelage color is generally lighter in the arctic bears than in bears from other areas of the State. More than 50 percent of the adults seen during 1970 and 1971 were blonde or predominately light brown. Males are generally darker in color than females, although exceptional animals of both sexes can be found. Individual animals can vary remarkably during the course of one year due to bleaching and hair replacement.

Shedding begins in June, but bears handled in early July had full coats with 10"to 12" hairs on their flanks and bellies. No rubbed pelts were observed. Hair replacement is complete by early September at which time the new hair is about 4" long. The new hair is generally medium to

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Table 7. Data obtained from brown bears tagged in GMU 26, 1971.

#	Date	Sex	Wgt	Color	Est'd Age	P M Cementum Age	("s) Length	("s) RF (LxW)	Max HD Circum	Location
3000	14 May	M	425	medium-dark	12	18	69-1/4	5-1/2 x 5-3/4	32"	68°40', 147°40'
3001	15 May	M	610	dark	12	12	75-1/4	6-1/2 x 4-1/4	40	68°43'. 148°49'
3002	15 May	M	340	medium-dark	7	7	68	5-1/5 x 5-1/2	30	68°58', 148°50'
3004	2 June	M	505	blonde	8	12	75	6-1/4 x 6-1/4	38	68°53', 151°53'
3005	3 June	M	575	medium-dark	10	12	75	5-1/2 x 6	36	68°47', 152°15'
3006	3 June	F	270	blonde	10	-	65	5-1/4 x 5-1/4	26-1/2	69°08', 151°43'
3007	3 June	M	345	blonde	6	6	69	5-1/2 x 5-1/2	29	69°22'30", 152°06'
3008	4 June	F	400	blonde	20	18	63	6-1/4 x 5-3/4	29-1/2	68°42', 158°33'
3009	7 June	F	310	medium-dark	8	-	71	5-1/2 x 5	29	68°58', 158°15'
3010	7 June	F	400	medium	14	15	71	5-1/2 x 5-1/4	30	69°00', 158°45'
3011	9 June	M	550	blonde	12	11	79	6-1/2 x 5-1/2	35	68°56', 157°35'
3012	9 June	F	305	medium	10	13	69-1/2	5 x 4-1/4	28	68°56', 157°35'
3013	12 June	F	205	blonde	4	2	64-1/2	4-1/2 x 4.	24-1/2	69°11', 153°05'
3014	30 June	F	295	medium-blonde	7	11	63-1/2	4-1/2 x 5-1/2	26	69°29', 154°52'
3015	14 July	F	305	medium	10	10	62	5-1/2 x 5-1/2	27-1/2	68°22', 152°01'
3016	19 July	M	240	medium	4	3	63	5 x 5	26	69°27', 151°28'
3017	20 July	F	240	medium-light	10	-	69	5 x 5	27-1/2	69°22', 152°04'

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Table 7 (Continued).

#	Date	Sex	Wgt	Color	Est'd Age	P M Cementum Age	("s) Length	("s) RF (LxW)	Max HD Circum	Location
3018	23 Aug.	F	300	blonde	15	11	66	5 x 5	26-1/2	68°56', 153°30'
3019	23 Aug.	F	460	blonde	10	9	68	5-3/4 x 5-1/2	29-1/2	68°51', 153°25'
3020	23 Aug.	F	405	medium	12	8	69	6 x 5-1/2	28-1/2	68°53', 153°25'
3021	24 Aug.	M	560	medium-dark	20	13	77	6 x 6-1/4	33-3/4	69°09', 150°53'
3022	24 Aug.	M	430	medium	15	8	73	5-3/4 x 5-1/2	30-1/2	69°03', 151°05'
3023	5 Oct.	M	690	dark	25	20+	83	6-1/4 x 6	32	69°25', 151°28'

dark brown and most bears observed after mid-September are dark.

These notes generally agree with Erickson (1965) except with regard to rubbed pelts and the time of the beginning of shedding.

Feet

Two points of interest were noted while examining the feet of tagged bears. In addition to buff and white streaked claws, three bears had foot pads which were not fully pigmented. In these cases the pad was black with pink blotches. One of the bears exhibiting this condition was a large dark brown male.

Three of 10 bears tagged in June 1971 appeared to be shedding the rear pad surface. On one of these, fragments of the shed pad, 1/4" to 5/16" thick, were still attached. The new surface of these pads was not noticeably different from other pads examined. None of the natives of Anaktuvuk Village interviewed recalled having seen this condition.

Wounds

Of the 23 bears tagged only two males had evident wounds or scars. One of these had been thoroughly mauled and had two festering wounds on the side of the head, torn nose and scars on hips and back. Another male examined was missing the external pinna of the right ear and the front part of the lower lip. Several of the older bears examined had broken teeth and appreciable tooth wear. Incisors were often broken in older bears.

Bear Predation on Moose

On June 14, 1971 on the Nanushak River at 69°09'N latitude, 150°50'W longtitude, Rudd Thabes and I observed a bear in the process of killing a moose. The bear was a large adult and the moose appeared to be a yearling cow. They were in a depression of a gravel channel 50 yards from the

nearest willows. When we arrived on the scene, the bear was straddling the moose's head raking the shoulders with its forepaws. Blood was visible from these wounds but the moose was still on its feet. The noise of the aircraft caused the bear to pause and look up, but it made no move to leave the moose. Within four minutes from initial sighting the moose was on its back and the bear promptly opened the abdominal and/or thoraxic cavity. When we left the scene, eight minutes after initial sighting, the bear was feeding on the viscera of the moose.

There were other moose within 500 yards of the scene, but only one bear was observed.

SUMMARY CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

1. The central Arctic section of GMU 26A is currently being over-harvested.

2. From 1961 until 1970 the hunting season included a month to six weeks in spring and three to five months in fall. In 1970 the spring season was closed by emergency field order. The harvest during 1970, however, was not reduced (Table 5). There was no spring hunting season in 1971 by regulation and the area available for hunting in fall was reduced by about one-third; but even so, the sport harvest was the highest yet recorded (Table 5). Therefore, hunting pressure can be expected to increase and further restrictions will be necessary to stabilize or reduce the harvest.

3. The range of seasonal movements of some segments of the population precludes management of small subunits within GMU 26.

4. Bears den in widely scattered areas of GMU 26 and there is a component of the population which are resident in the foothill and coastal plain provinces.

5. The river valleys are preferred habitat during the hunting season and are the most readily available areas for hunting. The bear abundance could be markedly reduced before hunter success reaches the point of diminishing returns.

6. The transplanting of bears habituated to feeding at garbage dumps is ineffective and preventative measures alone will be successful at reducing this problem.

7. The change in the percent of the observed bears which were females with young between 1970 and 1971 in Table 1, may portend a greater problem. Most bear hunting in GMU 26 is by aircraft. Further, helicopter traffic will continue to exert a harassing effect even when no overt chasing is done by the pilot. I pose the question: could harassement of female bears reduce their fecundity or cause greater fetus mortality?

The management of every renewable resource should be based on a philosophic framework of judgements of what, in fact, is "wise use" of the resource. Management, per se, can only proceed in a straightforward manner when the ultimate goals are borne in mind. What then, are the goals toward which management of the brown bear resource of GMU 26 shall be directed?

If the maintenance of pristine wilderness is to be the goal, then all harvest should stop. Unfortunately, we are a few years too late to realize that goal, but if that is the desired goal, then the necessary course of action is obvious.

If sustained sport harvest is the goal, and if the population is to be maintained near its present level, then the current level of harvest in GMU 26A is too high. There is no biological reason why GMU 26B and 26C cannot be hunted. The choice of spring or fall hunting seasons should

be more carefully considered in view of the probable reduction of harvest resulting from spring only hunting.

LITERATURE CITED

Crook, J. L. 1971. Distribution and abundance of brown bear (Ursus arctos) north of the Brooks Range, Alaska. M. S. Thesis, Univ. of Alaska. 78 pp.

Erickson, A. W. 1965. The brown-grizzly bear in Alaska. Fed. Aid W. R. Vol. V, Project W-6-R-5.

Glenn, L. P. and L. H. Miller. 1970. Brown bear studies. Unpubl. Alaska Dept. Fish and Game P-R Project Rep., Project No. N-17-2, Alaska. 63 pp.

Hensel, R. J., W. A. Troyer and A. W. Erickson. 1969. Reproduction in the female brown bear. J. Wildl. Mgmt. 33(2):357-365.

Mundy, K. R. D. 1963. Ecology of the grizzly bear (Ursus arctos) in Glacier National Park, British Columbia. M. S. Thesis., Univ. Alberta, Edmonton. ix + 103 pp.

Murie, A. 1944. The wolves of Mount McKinley. Natl. Park Serv., Fauna Ser. No. 5, 238 pp.

Porsild, A. E. 1945. Mammals of the MacKenzie Delta. Can. Field-Nat. 59:4-22.

Rausch, R. L. 1951. Notes on the Nunamuit Eskimo and mammals of the Anaktuvuk Pass region, Brooks Range, Alaska. Arctic 4(3):147-195.

Spetzman, L. A. 1953. Vegetation of the Arctic slope of Alaska. U. S. Geol. Sur. Prof. Paper 302-13, p. 19-42.

Appendix I

Techniques of Interest to Other Investigators

A. Capture Technique

Most of the bears captured were darted from a helicopter. Of all those used, the Hiller 12-E or Bell G-4 are personally preferred. They allow the "gunner" good visibility while searching and a convenient position from which to shoot when a bear is found. Ships less powerful than these, e.g. Bell G-2, should be avoided.

The Supercub was used as a search vehicle, although occasionally the absence of an observer in the backseat limited its effectiveness. Radio contact was maintained with the aircraft VHF sets on 122.9 mhz (assigned air-to-air frequency).

If the Supercub located a bear, it would orbit the animal and direct the helicopter to its position. Because of the short range of some of the helicopters employed, the Supercub was also used to ferry fuel to a suitable landing site within the area of interest.

Immobilization of the bears was accomplished with Palmer Cap-Chur brand equipment (Douglasville, Ga.). Their long-range dart rifle, dart assemblies, and charges functioned well except where moisture contamination caused misfires of both primary and secondary charges. The 5 cc dart was fitted with 1 inch barbed needles. The bears' accumulation of fat during the fall season

required a change to 1¼ inch needles for reliable drug administration. The "Low" propellant charge proved most effective.

Sernylan 100 mg/cc (Phencyclidine hydrochloride, Bio-Ceutic Lab., Inc., St. Joseph, Mo.) was the immobilizing drug employed. The desired dosage was .75 mg/lb and the drug performed as expected except that it proved unstable under field conditions. One batch of 10 vials was used within three weeks, but during that period the effective strength of the drug changed so much that dosages of 2.0 mg/lb. were not sufficient to immobilize a bear.

Haglodose (Hyaluronidase, Hauer-Lockhart Lab., Shawnee, Kan.) was used but the results did not markedly change and its use was discontinued.

Sparine 50 mg/cc (Promazine hydrochloride, Wyeth Lab., Inc., Philadelphia, Pa.) was a valuable adjunct to Sernylan for both reducing the occurrance of convulsions and as a means of relieving some of the stress of the tagging procedure. As a rule, Sparine was used to fill the 5 cc dart after the appropriate amount of Sernylan had been put in. Both Sernylan and Sparine were occasionally administered by hand syringe to a bear which was not sufficiently immobilized.

The unreliable charges and unstable Sernylan created an additional problem. When a bear was properly hit with a dart but failed to respond in the normal five to eight minute time period, the decision to deliver another dart was a difficult one. On the one hand, continued chasing of the animal with no results could cause exhaustion, but on the other hand, a double dose of drugs could be dangerous. In the case of one bear, the undesirable factors accumu-

lated to cause a 45 minute chase before the animal became immobile. his animal's respiration was forced ~~[illegible]~~ for 25 minutes after immobilization but it returned to normal, and he appeared to be resting comfortably and unharmed by the experience by the time we departed.

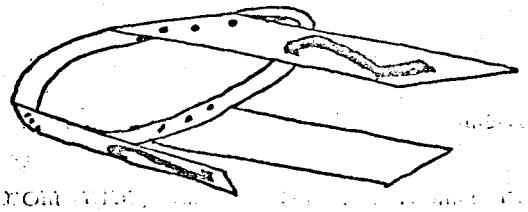
Another problem encountered was the propensity of some bears to attempt to hide in small creeks. On three occasions, quick action by the tagging crew was necessary to avoid the bears' drowning.

No bears were killed while being tagged and tagged bears observed as much as one year later showed no ill effects.

B. Collaring and Tagging of Bears

Two types of tagging were desirable for the captured bears. The first was a permanent ear tag which could be recovered upon sealing the bear when harvested. A yellow nylon ear tag (from Salt Lake Co, Salt Lake City, Utah ~~[illegible]~~) answered this need. It proved convenient to install, and the necessary slit in the ear healed quickly and completely in the case of four tagged bears reexamined. It was visible from air or ground at a maximum range of approximately 50 yards. Two ~~One~~ of the harvested bears were ~~was~~ recovered with only the male unnumbered portion of the tag. The female part may have been removed by the bear or by an unscrupulous hunter wishing to conceal the fact that he had taken the bear in a closed area. The possibility that a tag may fail clearly emphasizes the need for lip tattoes.

The other type of marking desired was a means of identifying an individual animal from the air. Since some tagging was to be conducted in an area open to sport hunting, hair dye was unacceptable. The next most reasonable alternative proved to be a neck collar. After much trial and error, a functional method was devised. It consists of a 2 inch wide band of a durable material, e.g. nylon webbing, around the neck. Attached to this are three equally spaced flaps 5 inches wide and 8 inches long. On the flaps are contrastingly colored numbers or symbols for that specific animal. (See sketch). Aluminum pop-rivets are used to assemble the collar. Regardless of their position on the bear's neck, at least one of the flaps is readily visible.



It is known that early model collars have come off, but collars similar to that described here have remained on for three months at least.

C. Radio-Tracking

The equipment used for the radio-tracking was supplied by Davidson Electronics (Minneapolis, Minn). The transmitters were mounted as neck collars. Each transmitter was on a different

frequency (150.815 mhz, 150.830 mhz, 150.845 mhz) and broadcasted a pulsed signal. The receiver was crystal controlled with provision for 12 frequencies. The antenna was a three element yagi-type mounted on the left wing struts of the aircraft outboard of the propellor wash and forward of the struts. The elements of the antenna were mounted 15° away from vertical. (In this configuration, maximum antenna gain occurred in a 15° right bank). Interference electrically induced by the aircraft was reduced by the standard ignition shielding and additional suppressors on the generator and magnetoes.

The search technique was to fly to the last known position of the transmitter-equipped bear at the maximum practical altitude. The area around this position was then scanned with a 15° right-banked 360° turn. In the event that failed to locate the signal, the 360° turns were continued at increasing distances from the last known positin. Elaborate search patterns were not necessary because the signal was usually picked up during the initial approach to the area.

The effective range of the transmitters is primarily a function of the altitude of the antenna. With the antenna 10 feet from the ground the line-of-sight range was one mile or less. With the antenna 8000' above the transmitter the maximum range was 38 miles. The directionality of the antenna resulting in a signal strength peak over the transmitter allowed location to within one mile while at 8000' AGL. Location to within 50

yards was possible from 500' AGL.

Because this frequency range is reliably received only in a line-of-sight situation, the topography near the transmitter essentially creates a minimum search altitude below which there are "blind spots" in the scanning coverage. In the foothills of GMU 26 this minimum altitude appears to be about 2000' AGL. The signal scattering effects of rock outcrops, scale slopes, and other similarly reflective surfaces, caused some confusion but did not prevent the ultimate location of the bear and transmitter.

One of the three transmitter collars was mounted by flexible nylon webbing (3019). This is a significant improvement over the earlier rigid collar in ease of fitting and probably comfort of the animal. All subsequent collars should be similarly made, i.e. electronics and flexible mounting strap potted as a unit. The factor which appears to limit range and convenience in the radio-tracking procedure now is receiver gain or sensitivity. Higher gain antennas or receiver preamplifiers may be possible alternatives to a more sophisticated receiver.

Appendix 2

Specimen Analysis in Progress

The following specimens are currently in the process of analysis. The results of these analyses should be forthcoming:

1. A blood sera sample collected from each tagged bear delivered to Kenneth Neiland, Alaska Department of Fish & Game, Fairbanks, for virological analysis.

2. A blood sera sample collected from each tagged bear delivered to Peter Shaughnessy, Institute of Arctic Biology, University of Alaska, for examination using his electrophoretic techniques.

3. A whole blood sample collected from each tagged bear delivered to Dr. Charles Genaux, Department of Chemistry; University of Alaska, for examination of primary protein structure as it may relate to sex, age, or discreetness of breeding population.

4. A taenioid proglotid delivered to R. L. Rausch, Arctic Health Research Center, University of Alaska, for identification (to be returned).