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JUNEAU, ALASKA

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DISEASE, PARASITE & DATA COLLECTIONS

by

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Volume VII
Annual Project Segment Report
Federal Aid in Wildlife Restoration
Projects W-6-R-5, Work Plans C,D,E; W-6-R-6, Work Plans D,M;
W-15-R-1, Work Plan P

(Printed July 1966)

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECTS:	W-6-R-5 and 6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	C (6-R-5)	TITLE:	Caribou Studies
AND:	M (6-R-6)	TITLE:	Disease and Parasite Studies
	P (15-R-1)	TITLE:	Disease, Parasite & Data Collections
JOBS:	7 (6-R-6)		
AND:	1 (6-R-6)		
	1 (15-R-1)	TITLE:	Caribou and Reindeer

PERIOD COVERED: July 1, 1963 to December 31, 1965

ABSTRACT

Four species of worm parasites previously unknown in Alaskan Caribou are reported. *Avitellina arctica*, a Siberian reindeer cestode only recently found in Canadian reindeer, has thus far been observed in Alaska only in the Alaska Peninsula caribou herd. Similarly this herd has been found to harbor two nematode species, *Teladorsagia davtiani* and *Nematodirus* sp (?). The moose rumen fluke *Paramphistomum* sp (?) is also abundant in this same herd.

Brucellosis reactors continue to be common (10-20%) in the Arctic herd, rare (1%) in the Nelchina herd, and evidently not present in the Alaska Peninsula herd.

Penned reindeer brucellosis experiments have revealed:

1) Comparatively low titres (1:40) can be associated with fatal infections acquired through simple exposure experienced during association of experimental and "control" animals in a common pen.

2) Does who aborted at the first pregnancy following experimental infection produced normal births at the termination of the second pregnancy.

3) Dall sheep appear very susceptible to experimental infection, while moose appear refractory and cattle resistant.

RECOMMENDATIONS

No recommendations relating to management can be made at this time.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECTS:	W-6-R-5 and 6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	C (6-R-5)	TITLE:	Caribou Studies
AND:	M (6-R-6)	TITLE:	Disease and Parasite Studies
	P (15-R-1)	TITLE:	Disease, Parasite & Data Collections

PERIOD COVERED: July 1, 1963 to December 31, 1965

OBJECTIVES

To determine the pathogenic organisms present in caribou and reindeer, their prevalence and virulence, the extent or magnitude of the infections, and the effect of such upon selected populations.

To evaluate the significance of brucellosis in the caribou and reindeer herds of Alaska, as related to individual animals, herd productivity, population fluctuations, and other game species.

To investigate the occurrence of foot rot and other diseases in the Arctic caribou herd.

TECHNIQUES

A cooperative study initiated last year with the Arctic Health Research Center to study diseases in the Arctic herd, and the work already in progress by ADF&G on the Nelchina herd will be continued, with further expansion to the Steese-Fortymile and Alaska Peninsula herds. Productivity studies will be emphasized to complement the brucellosis work. Insofar as possible, all animals examined will be weighed and measured and samples collected for aging, racial studies, and radioactivity work.

1. The prevalence of foot rot will be investigated in the Arctic herd with quantitative data being obtained in conjunction with other studies.

2. Brucellosis studies will involve the taking of blood samples for serological tests from hunters' kills from the Steese-Fortymile and Nelchina herds: each hunter will be given a vial and asked to bring back a sample of blood from the kill. Cooperative efforts will continue with regard to the penned reindeer experiment, and the ADF&G will supply half the feed required. Carcasses from the Arctic will be examined to obtain data on pre- and postnatal mortality. Ground counts of short-yearlings during this same period will serve to measure calf mortality since the pervious June.

3. General pathology studies will be continued on the Nelchina herd and expanded to include the Alaska Peninsula herd. Most of the Nelchina data will be obtained from hunter kills. That obtained from the Alaska Peninsula probably will be limited to the collections of obviously diseased animals observed during radiological studies proposed for 1965.

FINDINGS

Parasites of Caribou

Some of the forms included in Table 1 are well known parasites of caribou in Alaska. These have been covered in detail in previous segment reports and will not be further considered at this time. However, during the time period of this report, some helminth species previously unknown in Alaskan caribou were discovered. These are dealt with in greater detail below.

Tapeworms

In addition to being the intermediate host to the larvae of two species of tacniid tapeworms which mature in wolves (ie. *Taeniid hydatigena* and *T. krabbei*), caribou are also the final host for two species of anoplocephaline tapeworms transmitted by free-living oribatid mites. We have previously reported an undetermined species of *Moniezia* which occurs in calves, rarely older animals. While we have no data suggesting that this worm is significantly pathogonic in Alaskan caribou, Russian workers have reported that three species of *Moniezia* are responsible for unthriftiness and high mortality in reindeer calves in Siberia. Eventually we should make detailed studies of parasitism in caribou calves late in the summer. Thus far we have examined only very few calves and most of these were recently dropped, too soon to be expected to be infected. Another species of tapeworm was found on several occasions in animals from the Alaska Peninsula. *Avitellina arctica* has not been previously reported in Alaskan caribou and was only recently reported for the first time in Canada. This species, in contrast to the *Moniezia* apparently restricted to calves, has been found only in older animals. The infections thus far observed were comprised only of a few worms and likely not of any pathological significance.

Roundworms

Nematodes have not been previously recorded in Alaskan caribou. Two species of trichostrongylid, roundworms have been observed. Teladorsagia davtiani has been reported in Alaskan reindeer, but Nematodirus (probably N. skrjabini previously known only in Eurasia) is evidently unknown in North America. The infections observed involved only low numbers of worms and likely were of little effect on the well-being of the infected individuals. However, because of the wealth of data implicating trichostrongylids in unthriftiness, etc. in domestic and occasionally wild species, it is reasonable to conclude that these Alaskan species have the potential for being significant parasites of caribou when epideo miological factors favor heavy infestations.

Rumen fluke

Although known in Russian reindeer and Alaskan moose and elsewhere in North America for some time, it is only recently that we have found rumen flukes (probably Paramphistomum cervi) in Alaskan caribou. Thusfar this worm has been found only once in a caribou herd other than that on the Alaska Peninsula in which it is a common parasite (see Table 1). It is very likely that the caribou form is the same as that found in moose. In this respect the commoness in caribou of this worm at this time only on the Alaska Peninsula may be at least partly the result moose population expanding into an area in which climate, terrain and various biological factors seem particularly favorable to transmission of this parasite probably common to both host species. Unfortunately, I have had no opportunity to examine moose in this area, but it would be unexpected indeed to find few or no rumen fluke infections in moose when infestations in caribou occur in more than 50% of the adult animals examined.

While none of the infestations in moose or caribou observed to date appeared pathogenic, there is abundant documentation in the world literature implicating Paramphistomum cervi as a serious pathogen of domestic and various wild ungulate species in Eurasia and Africa. More detailed studies of this parasite are planned for the future.

Serological Investigations

The serological observations on diseases of caribou are summarized in Table 2. The data on leptospirosis (all negative) and anaplasmosis (positives questionable) do not warrant further discussion. However, the data on brucellosis are of particular interest and will be further considered at this time.

Because of the size of the herds, the large areas involved and the relatively small samples in some instances the incidence data provided in Table 2 should be interpreted with caution. Probably it is safest, and also adequate for our purposes, to view the data as indicating only the order of magnitude of the incidence of the disease in the respective herds each year. In this respect the low incidences seen in the Nelchina herd since 1962 probably represent "maintenance levels" of the disease in nature. At the highest point, incidence rates of 20 - 30% were observed in the Arctic herd. The frequency of serological reactors now appears to be dropping. The order of magnitude change in the Arctic incidence rate for 1965 resulted from the absence of reactors among about sixty animals examined during October. Whether this may be a sampling error rather than a real change in incidence in the herd remains to be seen. We intend to adequately sample the entire migration through Anaktuvuk Pass this spring to varify the apparent change. In any event the incidence rates observed in the Arctic herd since 1962 suggest that the disease has been occuring in what may be termed epidemic proportions. The periodic occurence of this disease elsewhere in semi-wild range cattle suggests that we may witness cyclic eruptions of the disease in caribou resulting possibly from periodic changes in pathogenicity of the organism and susceptibility of the host. Only continued serological surveys will reveal whether brucellosis is cyclic in our caribou herds. Too few observations on other herds are as yet available to establish the actual distribution in Alaskan game herds.

Experimental Investigations

The recent experimental accomplishments of the Arctic Health Research Center supported in part by department Federal-Aid funds fall into four general categories.

Significance of serological titres

On repeated occasions the Center has been able to recover the causative organism from animals in which titres of only 2+1:20 were recorded. In normal, routine serology, reactions observed at less than 1:50 dilution are classed as non-reactors and the animals as uninfected. Of particular significance in this regard is Reindeer #2132 listed in Table 3. The animal was a bull kept for breeding purposes and naturally exposed to the disease in its close association with the experimental animals. About 13 months after it was introduced into the experimental pen, the animal registered what would be normally considered a low titre of 2+1:40. About one month later the animal died. Necropsy revealed numerous liver abscesses which yielded pure cultures of Brucella. One cannot help but wonder if the stress of rutting activities interfered with normal body defense mechanisms which previously had held the infection under control. In this regard it would be desireable to investigate on a more intensive scale than we have, the incidence in breeding bulls of reactors immediately before and soon after their rut. A thorough investigation of the effects of host nutrition on titre levels in conjunction with antigenic and pathogenic studies of the associated strains of Brucella may provide a means along with other observations of evaluating in general terms the nutritional history of infected herds from year to year.

Long-term effects of brucellosis on calving

During the first year of the study it was shown that severe experimental infections resulted in abortion of the fetuses. Some of these animals were held over, and bred the following fall. These gave birth to live calves, some of which died within a few weeks after birth from undetermined causes. Only one of the dead and none of the surviving calves had titres at or near the time of birth even though they all were carried by ones infected at one time or another. A great deal more experimental work is required before the effects of brucellosis on calving are adequately understood.

Susceptibility of other species

The available data on moose, wild sheep and domestic cattle are summarized in Table 3. Obviously much additional experimentation is required. The resistance of the "large" (ie. older) moose to infection by "natural" exposure (or the development of an antigenic response?) is consonant with our failure to find reactors in moose even in areas where infected caribou occur. The apparently high susceptibility of sheep suggests that it would be rewarding to survey this species in the Brooks Range where caribou are frequently infected and commonly are found on sheep range. The cattle were removed too soon to evaluate their complete response to the infection when their further upkeep was judged prohibitive in terms of their experimental value. A detailed knowledge of the susceptibility of all our wild ungulates and other resident mammals (ep. rodents) will be required for an adequate understanding of the natural history of this disease.

Modes of transmission

"Natural" transmission via contact with contamination has been amply demonstrated (see Table 3). The organism has been isolated from surface soil samples taken from within the experimental pen. However, until all animals are removed, it will not be possible to determine the independent survival of the organism in the soil under natural conditions.

Table 1. The incidence of some parasites in caribou, 1964 - 65.

		Incidence							
Herd	Date	Nose Bots	Warbles	Lungworms	Hydatid Cysts	Taenia[1] Cysts	Tape-[2] Worms	Round[3] Worms	Rumen[4] Flukes
Arctic	1964	24/68	63/68	9/68	5/68	14/68	0/68	3/68	0/68
"	1965	____	____	5/132	6/132	27/132	3/132	0/132	0/132
Nelchina	1964	____	____	0/18	2/18	2/18	0/18	0/18	1/18
"	1965	____	____	0/11	0/11	5/18	0/11	0/11	0/11
Alaska Peninsula	1964	____	____	2/41	4/41	10/41	7/41	4/41	19/41
" "	1965	____	____	0/4	0/4	0/4	0/4	0/4	2/4

[1]Includes two species, _Taenia hydatigena_ and _T. krabbei_.

[2]Includes two species, _Avitellina arctica_ and _Moniezia_.

[3]Includes two species, _Teladorsagia davtiani_ and _Nematodirus_.

[4]Probably _Paramphistomum cervi_.

Table 2. The serological incidence of some diseases of caribou, 1964 - 65.

Area	Date	Brucellosis Sample Size	Brucellosis Frequency	Leptospirosis Sample Size	Leptospirosis Frequency	Anaplasmosis Sample Size	Anaplasmosis Frequency
Arctic	1964	84	20.2%	24	0.0	18	0.0
"	1965	203	8.4%	122	0.0	56	0.0
Nelchina	1964	208	0.5%	197	0.0	137	0.0
"	1965	92	1,0%	74	0.0	52	5.9[1]
Alaska Peninsula	1964	40	0.0	40	0.0	40	0.0
" "	1965	6	0.0	6	0.0	1	0.0

[1] These results must be viewed with caution because the bovine test system employed may yield anomalous results when applied to cervids.

Table 3. Summary of cooperative experimental brucellosis studies reported by Arctic Health Research Center, 1964 - 65.

Species	No.	Date infected or exposed	Highest Titre[1]	Latest Titre	Remarks
Reindeer	15	Exposed, 9/64	2+1:20 5/65	N.R.[2]	
Reindeer	17	Exposed, 9/64	2+1:40 4/65	<1:20	
Reindeer	2132	Exposed, 9/64	2+1:40 10/65	N.R.[2]	Died 11/65, massive brucellar abscess of liver
Reindeer	2133	Exposed, 9/64	2+1:20 4/65	<1:20	
Reindeer	2144	Exposed, 9/64	2+1:40 5/65	<1:20	
Reindeer	2128	Infected, 1/65	2+1:40 5/65	<1:20	
Reindeer	2124	Infected, 1/65	2+1:320 2,5/65	<1:20	
Reindeer	2149	Infected, 1/65	2+1:160 2,5/65	<1:20	
Moose	"Large"	Exposed, 10/64	<1:20	<1:20	Died 12/65, cause undetermined.
Moose	"Small"	Infected, 1/65	3+1:640 3/65	<1:20	Died 12/65, cause undetermined.
Mtn. Sheep	--	Infected, 1/65	2+1:1280 3/65	<1:20	
Cattle	Red	Infected, 1/65	2+1:40 4/65	2+1:20 5/65	Killed, 6/65.
Cattle	Black	Infected, 1/65	2+1:20 4/65	2+1:20 5/65	Killed, 6/65.

Table 3. (Continued)

Species	No.	Date infected or exposed	Highest Titre[1]	Latest Titre	Remarks
Reindeer Calves	--	Born, 5/65	--	--	Four calves, died from undetermined causes few weeks after birth. One had titre of 2+1:20 two were neg. and one was not checked.
Reindeer Calf	68	Born, 5/65	1:20	1:20	
Reindeer Calf	57	Born, 5/65	1:20	1:40 10/65	

[1]Month (s) and year included (eg. 2,5/65 or Feb. and May, 1965)

[2]Not recorded.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT NO.:	W-6-R-5 and 6	TITLE:	Alaska Wildlife Investigations
and	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	E (6-R-5)	TITLE:	Dall Sheep Studies
	M (6-R-6)	TITLE:	Disease and Parasite Studies
	P (15-R-1)	TITLE:	Disease, Parasite & Data Collections
JOB NO.:	3 (6-R-5), 2 (6-R-6)		
and	2 (15-R-1)	TITLE:	Sheep

PERIOD COVERED: July 1, 1963 to December 31, 1965

ABSTRACT

The eggs or larvae of four species of roundworm parasites are more or less commonly found in the fecal pellets of sheep in Wrangell Mountains and Kenai Peninsula herds. The oocysts of several species of coccidia are also occasionally present. Lump jaw can lead to severe losses of teeth and erosion of the mandible in both areas, but the data are as yet too meager to make any accurate estimate of the extent of the problem.

RECOMMENDATIONS

No recommendations relating to management can be made at this time.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESORATION

STATE:	Alaska		
PROJECT NO.:	W-6-R-5 and 6	TITLE:	Alaska Wildlife Investigations
and	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	E (6-R-5)	TITLE:	Dall Sheep Studies
	M (6-R-6)	TITLE:	Disease and Parasite Studies
	P (15-R-1)	TITLE:	Disease, Parasite & Data Collections
JOB NO.	3 (6-R-5), 2 (6-R-6)		
and	2 (15-R-1)	TITLE:	Sheep

PERIOD COVERED: July 1, 1963 to December 31, 1965

OBJECTIVES

To obtain information on occurence and incidence of diseases and parasites, and influences on sheep populations.

PROCEDURES

1. Hunter Killed Animals: Prior to the 1965 hunting season the general hunting public, guides and all other interested parties will be contacted via news releases, posters in sporting goods establishments, and each field office. All sheep hunters will be requested to take a sample of pellets and the jaws from their kill and forward these to their nearest game office.

2. Independent Field Work: Over the next few years an attempt will be made to collect fresh pellet samples at random or from known animals over a few representative sheep ranges in Alaska. These efforts will complement the contribution of specimens by hunters.

3. Laboratory Analysis: Standardized procedures will be used for the isolation of coccidia and lungworm larvae from fecal pellets. A review of the theory and interpretation of pellet sample data will be made.

FINDINGS

Although samples of pellets from the Wrangell Mountains (1963), Kenai Peninsula (1964, 1965) and Brooks Range (1965) have been collected only the 1963 sample from the Wrangells and the 1964 sample from the Kenai have been analyzed to date. The results are tabulated in Table 1. The collection of jaws has not been at all succesful because with few exceptions hunters (even game biologists) refuse to burden (?) themselves with the extra weight to pack out. Accordingly too few jaws have come in to allow a more meaningful description of the lump-jaw-situation than to simply say that, Alaskan sheep are infected, sometimes severely.

TABLE 1

THE INCIDENCE OF SOME PARASITES OF DALL SHEEP, AS DETERMINED BY RANDOM FECAL PELLET ANALYSIS.

Condition Observed	AREA, DATE [1] Wrangell Mtns., 1963		Kenai Peninsula, 1964	
	Number Infections Observed	Frequency (%)	Number Infections Observed	Frequency (%)
Negative	1	1.2	60	55.5
Lungworm[2]	50	59.5	34	31.5
Trichostrongylids[3]	74	88.1	10	9.2
Trichuris sp.[4]	16	19.1	2	1.9
Coccidia	4	4.8	2	1.9
Total Number of Samples:	84		108	

[1] Pellet samples collected during July in both instances
[2] Probably *Protostrongylus stilesi*
[3] At least two species are involved
[4] Probably *Trichuris ovis*

The data in Table 1 suggest that parasite infections were considerably more common in the Wrangell Mountains than the Kenai sheep population sampled during the summer of 1963. However, because there may be significant variation in the number of worm eggs or larvae in fecal pellets produced by individual animals at different times of the day, the differences between the two populations may not be as great as they appear, or of course, they may be greater. Actually, it is likely that the influence of daily variations was successfully minimized by collecting all of the pellet samples in relatively small areas in which the presence of large numbers of individual pellet groups suggested that bands of sheep had lingered for some time. Thus, pellets formed during low parasite production periods of the day would be offset by those produced at other times. Of course, it is also possible that this sampling procedure will yield satisfactory data only for small bands of sheep within a given area. Probably the best procedure would be to use some formally randomized method of sampling a number of "dense pellet beds" within a given range. At present, because of the great amount of time required to analyze pellets, it is not possible to handle very large series of samples.

The data in Table 1 do agree with the apparent fact that the population density was significantly higher in the Wrangell Mountain study area. Higher densities of course, at least theoretically, favor increased transmission of parasites.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT NO.:	W-6-R-5 & 6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	D(6-R-5)	TITLE:	Statewide Data Collections
	M(6-R-6)	TITLE:	Disease and Parasite Studies
	P(15-R-1)	TITLE:	Disease, Parasite & Data Collections
JOB NO.:	6(6-R-5), 3(6-R-6)		
AND:	3(15-R-1)	TITLE:	Alternate Host Species

PERIOD COVERED: January 1, 1964 to December 31, 1965

ABSTRACT

Twenty-one specimens of twelve species of fish, birds and mammals and 197 specimens of lynx were available for examination. Of particular interest were two mountain goat kids that evidently starved to death following a prickly encounter with a porcupine. Numerous quills around the mouth evidently significantly interfered with normal feeding.

Two species of tapeworms and two or three species of roundworms have been common parasites of lynx in the Delta Junction and Fairbanks areas during the past three years. During this time there have been significant changes in the incidence rates of these parasites.

RECOMMENDATIONS

No recommendations relating to management can be made at this time.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT NO.:	W-6-R-5 & 6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	D(6-R-5)	TITLE:	Statewide Data Collections
	M(6-R-6)	TITLE:	Disease & Parasite Studies
	P(15-R-1)	TITLE:	Disease, Parasite and Data Collections
JOB NO.:	6(6-R-5), 3(6-R-6)		
AND:	3(15-R-1)	TITLE:	Alternate Host Species

PERIOD COVERED: January 1, 1964 to December 31, 1965

OBJECTIVES

Tc determine the incidence and distribution of potential pathogens in Alaskan wildlife species, and alternate host species.

To determine the extent that such organisms may contribute to mortality or lowered productivity or economic value in the host species.

To determine the extent that wildlife pathogens depreciate the value of game animals for use as food by humans or may be a threat to domestic animal industry.

PROCEDURES

Field collections of host species will be conducted largely in conjunction with other investigations. Members of all divisions of the Department, as well as the public and other State or Federal organizations, have been requested to send in suspected pathological specimens or in certain instances to obtain material of special interest. Such material will be handled in our laboratory, or in some cases referred to other specialists for diagnosis. Material will be emphasized which offers the possibility of contributing information of greatest originality or immediate application to problems at hand. In each instance an effort will be made to correlate data on pathogens with all other variables.

FINDINGS

The results of the post mortem examination of twenty-one specimens twelve species of fish, birds, and mammals (except lynx) are given in Table 1. Because considerably more information was obtained on lynx (197 specimens), it is summarized separately in Table 2. The large sample of lynx was made available by the Wolf, Wolverine and Lynx Work Plan as a by product of their studies on other facets of lynx biology. The data on miscellaneous species in Table 1 is self-explanatory and does not require further elaboration at this time. The lynx data, however, are of particular interest. It appears from a careful search of the literature that relatively little is known about this important fur-bearer. Only twelve published technical papers which deal at least in part with lynx parasites have come to my attention, and these are based for the most part on very few animals. Alaskan lynx parasites are touched on by Rausch et al. (1956) who reported the occurence of *Trichinella spiralis* in 4 of 17 specimens; Dunagan (1957) in an unpublished, mimeographed report presents observations on the occurence of five other species of parasites in 4 of 10 Alaskan lynx. Accordingly, the present findings based on 197 individual autopsies represent the first quantitatively valid description of the common kinds of helminths of this host species anywhere in its circumpolar distribution (I am assuming that *Lynx lynx* of Eurasia and *Lynx canadensis* of North America are at least ecological equivalents if not in fact conspecific as claimed by others, see: Rausch, 1953).

As noted in footnotes 3 and 4 of Table 2, the exact species composition of the cestodes and intestinal roundworms observed is not yet known. The laborious chore of sorting the vast quantities of specimens collected will be deferred until the collection phase of the study is terminated after we have examined enough lynx during the low point in their cycle. A preliminary graphical analysis of the "Fairbanks" data is given in Figure 1. The data will be interpreted in light of the apparent fact (Rausch, *viva voce*) that rabbit populations were generally "high" in central Alaska during 1962 and 1963.

Tapeworms

The two or more species of worms likely involved no doubt

Table 1. Observations on parasites and diseases in miscellaneous wildlife species 1964 - 1965.

Host Species	Autopsy Number	Condition Observed
Alces g. gigas	1629	Pedunculated, infectious warts.
" " "	1632	Foot worm, specimens imcomplete.
" " "	2077	Two Hydatid cysts in wall of ventricle.
" " "	2138	Intramuscular abscess of shoulder.
" " "	2139	Numerous necrotic foci in kidneys, no organism isolated.
" " "	7000	Hydatid cysts (lungs) and cysticerci (liver).
" " "	7001	Five cysticerci per cubic inch of liver in heavy infection.
Anas acuta	2060	Heavy infection of breast muscles by *Sarcocystis rileyi*.
Canis latrans	1633	Moderate infection of *Taenia* spp. tapeworms.
Enhydra lutris	1625	*Orthosplanchnus fraterculus* (gall bladder). *Corynosoma macrosomum* (intestine).
Euarctos americanus	1628	Roundworms, *Ascaris* spp., in stomach and body cavity.
" "	2057	Animal extremely emaciated, fibrous tumor of bowel present.
Grus canadensis	1631	Lice.

Table 1. Continued

Host Species	Autopsy Number	Condition Observed
Haliaeetus leucocephalus	1844	Negative.
Lepus americanus	1630	Tapeworm cysts, Multiceps spp., back muscle.
Lutra canadensis	1990	Roundworms, Ascaris sp.(?), intestine.
" "	1991	Negative.
Oreamnos americanus (kid)	1879	Porcupine quills in jaw and piercing heart - death from starvation.
" " (kid)	1883	Sibling of #1879, also starving, Eimeria parva present in moderate numbers.
" " (adult)	2058	Abscess of subscapular lymph node. Nothing isolated.
Salmo gairdnerii	1627	Severe adhesions of internal organs due to numerous roundworm larvae.

Table 2. The distribution and intensity[1] of the common worm parasites of Alaskan lynx during host and prey population changes.

Date	Delta Junction Area			Fairbanks Area		
	Cestodes[3]	Nematodes[4]	Stomach Cysts[5]	Cestodes[3]	Nematodes[4]	Stomach Cysts[4]
1963 Sample size[6]	——	——	——	19.8(0-77) 3 52	27.5(0-105) 5 52	0.2(0-2) 43 52
1964 Sample size[6]	65.8(0-175) 2 15	34.8(0-85) -4 15	1.2(0-3) 3 15	52.0(0-185) 2 68	28.0(0-100) 3 62	0.5(0-2) 36 69
1965 Sample size[6]	23.7(0-95) 2 37	16.4(0-100) 7 36	1.3(0-3) 5 37	17.8(0-41) 1 33	13.9(0-48) 4 34	1.4(0-13) 10 34

1. Values given are average and range of numbers of worms per infection followed by number of animals in sample free of the specific kind of parasite.

2. Dates are given on a fiscal year basis (ie. 1963 includes the period from July, 1962, to June 30, 1963, etc.).

3. Probably includes at least two species (i. e. *Taenia laticollis* and *T. macrocystis*).

4. Probably includes two species (i.e. *Toxocara cati and Toxaxcaris leonina*).

5. A species of spiruroid nematode, probably *Cyclicospirura subaequalis*.

6. Number of animals examined for each kind of parasite.

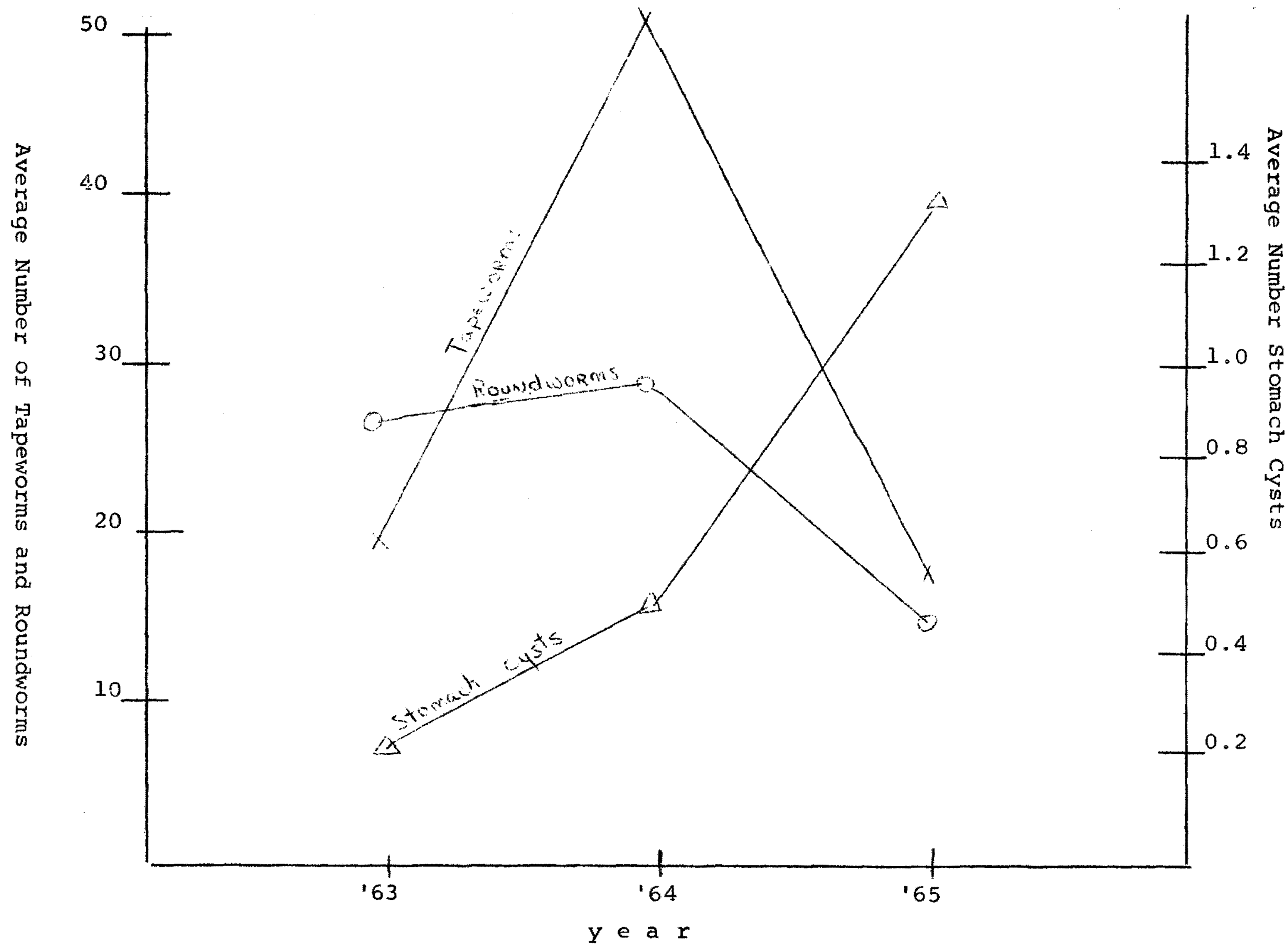

Figure 1. Variation of the intensities of worm burdens in lynx taken in the Fairbanks collection area.

utilize the snowshoe hare as the intermediate host. The year or so delay in the "peaking out" of the average tapeworm burdens in lynx (1964) after the hare population (1962-62) probably involves the time required for the larval tapeworm levels in hares to reach a maximum. The abrupt decline in lynx-tapeworm burdens in 1965 suggests that:

1) hare populations also delined (this was apparently the case).

2) either heavier infected lynx are more susceptible to trapping or other forms of natural removal from the population or,

3) the life expectancy of these species of cestodes is relatively short (less than one year) at least in heavy infections. This latter hypotheses appears to be the most tenable. Now that hare populations are quite low and lynx evidently are declining significantly, the cestode data from 1966 should show an even further decline.

Nematodes

These parasites are transmitted directly, perhaps frequently prenatally. Accordingly, increased host density and nutrition would be expected to result in a more immediate, but less variable response (the life cycle is less complicated) in parasite densities. If this conclusion is valid, average nematode population densities should be relatively higher than comparable tapeworm densities during periods when hare and/or lynx populations are low. The 1966 data should be informative in this regard.

Stomach Cysts

The change in average burden of stomach cysts in Fairbanks lynx is primarily a matter of increasing incidence (per cent infected) rather than increasing number of worms per infection. This is easily seen in Table 2 and Figure 1. The kind of roundworm evidently involved in this instance, a spiruroid, utilizes an insect as the intermediate host. Accordingly, assuming sufficient longevity of the adult worm in the lynx, one would expect a slower population buildup during successive summers of this kind of parasite. Presumably infection occurs through the accidental (non-prey-related) ingestion of cyst-bearing insects. It seems likely that if the intermedieate host in this case was a preferred host species that average burdens per infected animal would be higher as in the case of the cestode-hare (parasite-intermediate-host) system. Unless the intermediate-host species was of very low abundance and incapable of bearing many larvae. Accordingly, we may hypothesize that the stomach-cyst-worm because of a more hazardous life cycle is never present in high densities and that it responds to increased final and/or intermediate host densities by an increase in incidence, rather than intensity, of infection.

In summary it should be noted that none of the infections observed were clearly associated with any notable lack of mesenteric or other visceral fat.

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-6-R-5 and 6 TITLE: Alaska Wildlife Investigations
W-15-R-1 TITLE: Big Game Investigations

WORK PLANS: D (6-R-5) TITLE: Statewide Data Collections
M (6-R-6) TITLE: Disease and Parasite Studies
P-(15-R-1) TITLE: Disease, Parasite & Data Collections

JOB NO. 4 (both projects) TITLE: Radiological Survey

PERIOD COVERED: January 1, 1964 to December 31, 1965

ABSTRACT

Cesium 137 levels in Alaskan caribou and caribou eaters appears to have peaked and gone into a decline during 1965. However, even at the highest average levels in humans (1200 nC, Anaktuvuk Pass, 1964), the radiation exposure resulting, about 0.2 rads per year, is of the same order as the unavoidable natural background radiation which varies from 0.13—0.26 rads per year in the United States, and is as high as 1.5 rads per year in some populated areas of the world. According to the Advisory Committee of the National Academy of Sciences to the Federal Radiation Council, these exposures are one-fifth to one-five-hundredth of the lowest radiation doses now known to be associated with somatic damage in man. The lowest radiation dose thus far associated with abnormalities in the hereditary apparatus are about 6-10 times the highest average human exposure thus far found in Alaska. Accordingly, it appears that anyone that experiences any reasonable benefit from the use of caribou (or reindeer) are well justified in assuming the apparently small additional health risk involved. We commonly accept many other health hazards of far greater magnitude and certainty in our modern way of life.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-6-R-5 and 6 TITLE: Alaska Wildlife Investigations
W-15-R-1 TITLE: Big Game Investigations

WORK PLANS: D (6-R-5) TITLE: Statewide Data Collections
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P (15-R-1) TITLE: Disease, Parasite & Data Collections

JOB NO. 4 (both projects) TITLE: Radiological Survey

PERIOD COVERED: January 1, 1964 to December 31, 1965

OBJECTIVES

To determine the levels of strontium-90 and cesium-137 in Alaskan game species and in vegetation on game ranges in Alaska.

To periodically evaluate and summarize the available data and compile up-to-date reports on the problem of concentrations of radio elements in the caribou-lichen-human food chain in Alaska.

METHODS

Samples of bone, meat, and rumen will be taken from live animals from each of three main caribou herds in Alaska four times each year. These samples will be collected in conjunction with other studies whenever possible.

Reports and published literature will be reviewed and summarized.

FINDINGS

The results of the radiation measurements by the U.S. Public Health Service on the caribou specimens collected during the study period are summarized in Table 1 (cesium-137) and Table 2 (strontium-90). The uniformly low levels of strontium-90 in meat samples taken throughout the study period indicate that this contaminant is responsible for only a very small fraction of the radiation exposure (i.e. 0.005 rad/year vs: average natural background exposure of 0.13 rad/year; Hungate et al., 1964) to which caribou-eaters are subjected. Accordingly, no further consideration of the strontium-90 appears warranted at this time.

Although, as will be seen later, there are good reasons to believe that cesium-137 levels in caribou meat also do not pose any significant threat to the health of caribou-eaters or their future descendants, the absolute quantities of radiation exposure from this source are comparatively much higher than that from strontium-90. Therefore, it seems worthwhile to consider the potential health hazards of cesium-137 at further length even though they appear to be relatively slight in comparison with commonly accepted everyday hazards to health and life. In order to evaluate the effects of cesium-137 on the welfare of Alaskan caribou-eaters in the most meaningful and conservative fashion possible, we will appeal to the most authoritative opinions available (the Advisory Committee Report on Cesium-137 to the Federal Radiation Council from the National Academy of Sciences, 1964) and will consider in light of this report the possible consequences of a radiation dose equal to the maximum individual body burden of cesium-137 thus far observed in Alaskans. Since cesium-137 levels now appear to be dropping in caribou and humans (Coleman, 1965; Hungate, personal communication), <u>average</u> human body burdens will not likely ever approach the highest individual level (i.e. 2200 nanocuries) that has been observed in one individual. The highest average level observed (1200 nanocuries) was reported for the summer of 1964 (Hungate, op. cit.) These high individual and average cesium-137 burdens if maintained for a full year would result in maximum radiation doses of 0.37 rads/year and 0.2 rads/year respectively. These values fall within the range of natural background radiation dose to which all life is exposed and which varies from 0.13-0.26 rads/year or so in the United States.

The Advisory Committee of the National Academy of Sciences in their special report (Federal Radiation Council - 1964) divide the possible health effects of cesium-137 into four categories. Their conclusions concerning each category are quoted below. I have also included appropriate remarks of my own illustrating the application of these expert opinions to our Alaska situation.

1) <u>Carcinogenetic effects on the exposed embryo and fetus</u>.

"An association between cancer incidence in childhood and antenatal diagnostic x-ray examination has been reported, which implies that the frequency of cancer may be increased by a single exposure of the fetus to high dose-rate whole body radiation at dose levels of

2-5 rads. If this interpretation is verified, similar carcinogenic effects on the fetus and embryo might result from 25 rads delivered over a period of weeks by cesium-137. The reported association between prenatal exposure and cancer involves a dose of radiation smaller than that associated with any other comparable injury in man. For comparison purposes, it is worth noting that the highest individual cesium-137 burden reported in man in Alaska to date is 2200 nC, and that if this burden was maintained for a year (very unlikely), the total radiation dose would amount to only about 0.4 rads. This is one-fifth the lowest dose associated with any health effect thus far. The dose rate comparison is even more striking:

0.4 rads/year vs: 2 rads/few seconds

2) Effects on the development of the exposed embryo and fetus.

" Disturbances of growth have been noted in developing embryos of experimental animals after a single x-ray dose as low as 10-20 rads." This may be compared withthe individual PAG value of 0.5 rads per year which is one-twentieth the dose at a much lower dose rate: year vs: seconds. In this regard the higher body burden averages derived from observations on men only (eg. Bruce et al.,1965) are not applicable,

3) Carcingenic effects on the exposed child and adult.

"A dose-dependent increase in the incidence of leukemia, thyroid tumors, and, to a lesser extent, other neoplasms has been observed in man as dose levels of about 100 rads and more. The excess incidence of cancer demonstrably associated with high doses, however, is of the order of one additional neoplasm per million person-years of risk per rad, which can reasonably be assumed to represent an upper limit of any effect that might occur at lower doses and dose rates." Thus a radiation dose equal to the PAG value (0.5 rad) for individuals can be conservatively estimated to result in about one additional neoplasm per two million person-years. Assuming that Bruce et al. (1965) estimate of the average cesium -137 burden (50 n.C for non-caribou-eating Alaskan (based on adult males only) is a reasonable upper limit, the average, yearly radiation dose (about 0.0083 rads) would be expected to produce a single additional neoplasm per 120 million person-years. Taking Alaska's population as being about 250,000, it may take about 480 years (or longer) for this event to occur, if population gain offsets lower contamination levels. Among caribou-eaters in which the average burden reported by Bruce et al. (op. cit.) amounted to 275 nC cesium-137, the event (a single additional neoplasm) may occur once in about 22 years. It must be remembered that these calculations require that the radionuclide burdens be dietarily maintained throughout the 480 or 22 years respectively. Assuming no further atmospheric testing, the cesium-137 levels in caribou, which already appear to be dropping (Coleman-1965), will likely fall to a level requiring many more years of dietary intake to result in the estimated single, additional neoplasm. Among the 200 odd residents of Anaktuvuk Pass in which the highest, mean cesium-137 burden reported is about 1200 nC (i.e. 0.2 rads/year)) (Hungate et al., 1964), a single, additional neoplasm may be expected (assuming all other factors constant) once every 25,000 years. Since average cesium-137 burdens of Anaktuvuk Pass residents have now begun to decline (Coleman - op.cit., Hungate, personal communication), it may take even longer for this event to occur, even if the village population increases significantly. It should also be noted that the value 1200 nC applies to measurements made during mid-summer 1964. A comparable mid-winter value observed during January, 1964, amounted to about 1/3 this value (i.e. 450 nC) Hungate et al., 1964). Accordingly a more realistic, high yearly average might be about 800 nC or <u>0.16 rads</u>, at which yearly dose rate an additional neoplasm would be expected about once every 30,000 years. Assuming no further atmospheric testing, the physical half-life of cesium-137, that is 30 years, will also lengthen the period within which the carcinogenic effect may be expected to occur.

4. <u>Genetic Effects</u>.

The lowest level of irradiation that has been associated with abnormalities in the hereditary apparatus are about 10 times background. Doses of this order to radiation workers have resulted in a significant increase in abnormal chromosomes in circulating white blood cells. Similarly, irradiation of human somatic cells <u>in vitro</u> with doses down to about 12 rads may cause about 1% chromosomal abnormalities. On the other hand, thus far there is "no conclusive evidence of any substantial increase to overt genetic effects in the offspring of the Japanese A-bomb survivors". Accordingly, even though, "it is assumed that any increase in radiation exposure to the germ cells causes some increase in the mutation rate, as long as the group exposed is small, the average dose to the population will not be greatly changed."

While one cannot predict with absolute certainty (as seems to be required by some observers) the long term, genetic effects of chronic, low level radiation on populations, it does appear possible to attain a relatively realistic perspective in this regard. The maximum yearly dose from cesium-137 observed in Alaska is most certainly less than 0.4 rads, which figure is derived from the maximum, <u>instantaneous</u> cesium burden thus far observed. Since cesium levels are now declining in both caribou and people (Coleman - op. cit.; Hungate, personal communication), it appears unlikely that this dose level will again be reached except possibly in unusual individuals. The available facts suggest that average dose levels have never significantly exceeded natural background levels, which may vary considerably. Accordingly, if we are to act on the assumption that we must respond defensively to this level of contamination we are faced with the logical necessity of initiating remedial actions against natural background radiation.

It is important to remember that the maximum individual and average dose levels occurred in a unique population comprised of the 200 or so residents of Anaktuvuk Pass. These people no longer intermarry. Thus while the established marriages may at the worst result in doubling of mutant gene "burdens", new marriages probably do not. One should also keep in mind Hanson et al (op. cit.) observation that Eskimo wives appear to have only one-half the cesium burden observed in their respective husbands. Indeed if we are to be actively concerned with remedial actions among the small native populations of Anaktuvuk Pass (200) or even the circumpolar Arctic (110,000; Snow and Wolfe, op. cit.), we must be even more concerned about the populational effects of world-wide natural background, which may attain average yearly levels of 1.5 rads in some unusually mineralized areas. In terms of the welfare of the human race (the only meaningful population unit in any long-term consideration), the size of the population unit at risk may in some instances be the primary consideration. In this respect, the genetic damage to humanity from cesium-137 may have been greater in terms of the absolute production of additional, undesirable mutant genes because of the use of dried milk by millions, than because of the use of caribou and reindeer by the relatively few. Comparing only the Arctic circumpolar, native population (110,000) with the total population of the "south 48" (150,000,000), it may be calculated that the absolute exposure to cesium-137 in 1962 was about 2.5×10^3 person-rad-years (Arctic) vs: 5×10^5 person-rad-years (south 48). These calculations employ the average mean cesium burden of Arctic peoples (126 nC) in 1962 reported by Snow and Wolfe (op. cit.) and the average cesium burden (13.5 nC) of residents of the "south 48" reported by Bruce et al. (op. cit.).

In summary, it seems reasonable to conclude that the dangers of genetic damage to humanity from cesium-137 contamination in meat or milk have been no greater than (meat) or considerably less than (milk) than that arising from natural background radiations to which we all are exposed throughout our lives. Accordingly, our response to the cesium contamination situation (other than continued research activities) should be directed toward preventing further contamination of our environment, at least by the improper testing or use of nuclear devices.

TABLE 1. SUMMARY OF AVERAGE CONCENTRATIONS IN PICOCURIES PER KILOGRAM OF CESIUM-137 IN MUSCLE AND RUMEN CONTNENT FROM CARIBOU KILLED IN ALASKA

HERD	WINTER 1963 - 1964		SPRING - 1964		SUMMER - 1964		FALL - 1964	
	Muscle	Rumen	Muscle	Rumen	Muscle	Rumen	Muscle	Rumen
ARCTIC	4,860 (3)	4,430 (3)	13,800 (5)	4,440 (5)	700 (5)	1,470 (5)	6,330 (5)	5,080 (5_
NELCHINA	21,800 (5)	4,880 (5)	5,560 (5)	8,400 (5)	14,300 (1)	8,900 (1)	4,250 (9)	3,030 (9)
ALASKA PENINSULA	44,800 (5)	7,920 (5)	14,800 (5)	1,840 (5)	1,680 (4)	690 (5)	4,630 (5)	5,890 (5)
AVERAGE FOR CARIBOU HERDS	24,000	5,700	11,000	4,900	5,600	3,700	5,300	4,700

HERD	WINTER 1964 - 1965		SPRING - 1965	
	Muscle	Rumen	Muscle	Rumen
ARCTIC	3,900 (5)	4,100 (5)	9,600 (5)	8,400 (5)
NELCHINA	14,000 (5)	7,200 (5)	27,600 (5)	8,600 (5)
ALASKA PENINSULA	18,000 (5)	4,900 (5)	NS	NS
AVERAGE FOR CARIBOU HERDS	12,000	5,400	18,600	8,500

Figures in parenthesis represent the number of animals in each sample.
NS - No samples collected.

TABLE 2. SUMMARY OF AVERAGE CONCENTRATIONS IN PICOCURIES PER KILOGRAM OF STRONTIUM-90 IN MUSCLE, RUMEN CONTENT AND BONE FROM CARIBOU KILLED IN ALASKA

HERD	WINTER 1963 - 1964 Muscle	Rumen	Bone [1]	SPRING - 1964 Muscle	Rumen	Bone [1]	SUMMER - 1964 Muscle	Rumen	Bone [1]
ARCTIC	17. (3)	4,440 (3)	225 (3)	400 (5)	1,680 (5)	143 (5)	40 (5)	1,700 (5)	137 (5)
NELCHINA	33 (5)	5,150 (5)	117 (5)	54 (5)	1,550 (5)	143 (5)	31 (1)	346 (1)	28 (1) [950 (1)]
ALASKA PENINSULA	84 (5)	5,700 (5)	118 (5)	14 (5)	1,370 (5)	116 (5)	5 (4)	311 (5)	115 (4)
AVERAGE FOR CARIBOU HERDS	45	5,100	150	160	1,500	130	25	450	93 [950]

HERD	FALL - 1964 Muscle	Rumen	Bone [1]	WINTER 1964 - 1965 Muscle	Rumen	Bone [1]	SPRING - 1965 Muscle	Rumen	Bone [1]
ARCTIC	19 (5)	4,500 (5)	128 (5) [230 (5)]	19 (5)	4, 020 (5)	125 (5) [120 (5)]			NS
NELCHINA	20 (9)	207 (9)	84 (9) [830 (9)]	30 (5)	4,430 (5)	69 (5) [76 (5)]			NS
ALASKA PENINSULA	11. (5)	825 (5)	114 (4) [350 (5)]	31 (5)	NS	169 (5) [86 (5)]	NS	NS	NS
AVERAGE FOR CARIBOU HERDS	17	1,800	110 [470]	27	4,200	120 [94]			

NS - No samples collected.
BLANK - No sample analyses report to date.
[1] Concentrations for bone samples are expressed in pCi/gram of ash.
Figures in parenthesis represent the number of animals in each sample. Figures in brackets are bone marrow samples

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT:	W-6-R-6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLAN:	D(W-6-R)	TITLE:	Statewide Data Collections
AND:	P(W-15-R)	TITLE:	Disease, Parasite & Data Collections
JOB NO.:	1 and 3(W-6-R)		
AND	5(W-15-R)	TITLE:	Elk and Goat

PERIOD COVERED: January 1, 1965 to December 31, 1965

ABSTRACT

In 1965, 309 hunters harvested 142 elk during a 153 day either-sex season. Males comprised sixty-three percent of the harvest. A composition count of 926 elk revealed 21 percent calves, 15 percent branched antlered males, and 64 percent females and yearlings. A composition count of 1,320 goats in Southeast Alaska revealed 35 kids per 100 adults.

Goats introduced to Kodiak Island in 1952 and 1953 apparently are increasing. Thirty-five were positively identified, and additional sightings were reported.

RECOMMENDATIONS

No recommendations relating to management can be made at this time.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT:	W-6-R-6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLAN:	D(W-6-R)	TITLE:	Statewide Data Collections
AND:	P(W-15-R)	TITLE:	Disease, Parasite & Data Collections
JOB NO.:	1 and 3(W-6-R)		
AND:	5(W-15-R)	TITLE:	Elk and Goat

PERIOD COVERED: January 1, 1965 to December 31, 1965

OBJECTIVES

To assess the annual harvest of elk and to conduct population trend surveys of elk and goat.

TECHNIQUES

1. Elk harvest data including hunting effort, distribution and success was obtained from in-the-field checks, hunter harvest forms retained by the Navy recreation camp, commercial airlines and meat cutting establishments and by hunter interviews. Elk jaws were obtained from successful hunters, when available, for age classification. 2. Systematic aerial surveys utilizing two Piper PA18 aircraft were conducted on selected goat and elk ranges during August and September to obtain herd size, distribution, and sex and age composition. 3. Aerial flights were made of the Afognak and Raspberry coastline in February to determine areas of winter utilization by elk. These areas were checked on foot in May and June to determine winter mortality.

FINDINGS

Elk Hunter Harvest

In 1965 there was a 153-day either-sex hunting season from August 1 through December 31 allowing a bag limit of two elk on

Raspberry Island and Tonki Cape and one elk in the remainder of Unit 8. During this season, 309 hunters harvested 142 elk for a hunter/kill ratio of approximately 46 percent. Table 1 shows the hunter/kill on the Afognak Island group from 1962 through 1965.

Table 1. Elk kills on the Afognak Island Group, 1962-65.

Year	Kill	Number of hunters	Hunter/kill ratio
1965	142	309	46%
1964	60	105	57%
1963	85	160	53%
1962	110	185	59%

Composition of the Harvest

Sixty-three per cent of the elk taken in 1965 were males and 37% were females. Eighteen jaws were collected, but the complete absence of calf or yearling jaws indicated the age composition of the harvest could not have been correctly calculated from this sample.

Distribution of the Harvest by Area

For the second consecutive year the Raspberry Island herd contributed nearly one-half of the elk to the harvest. Table 2 shows the harvest by area for the 1963-65 elk seasons. The two-elk bag limit in the Tonki and Raspberry Island areas allowed a total of fourteen hunters to bag their second elk during 1965. Eleven of these were from the Raspberry Straits herd and three were from Tonki Cape.

Table 2. Distribution of elk harvest on the Afognak Island Group from 1963 through 1965.

Area	Number Harvested (and percent of total harvest) 1963	1964	1965
Raspberry Island	11 (13)	28 (47)	64 (45)
Malina	29 (34)	16 (27)	32 (23)
Raspberry Strait-Afognak Lake	11 (13)	12 (20)	24 (17)
Interior	15 (18)	4 (6)	6 (4)
Tonki Cape	19 (22)	0 (0)	16 (11)

Chronological Distribution of the Harvest

The peak of the elk harvest occurred between Mid-October and Mid-November. During this one-month period, nearly half of the 1965 elk harvest occurred. Weather and vegetative cover appear to be the controlling factors in chronological distribution of the harvest. Figure 1 shows this distribution.

Afognak Lake Range Studies - 1965

The cooperative U. S. Forest Serivce and Alaska Department of Fish and Game elk range investigation showed 7% of the willow in the Muskomee Valley to be heavily browsed. Plant trend was 80% progressive. The vigor factor ranged from fair to good and overall the willow range seems to be improving since the last heavy use by elk in 1962.

Observation of the elderberry range in the Muskomee Valley showed 25% of the live stems had been heavily browsed as compared with 11% on Afognak Mountain. Plant trend was 28% progressive in Muskomee Valley and 60% progressive on Afognak Mountain. The total vigor factor (Total viable stems divided by Total dead stems) was .396. In comparison, six plants located in a permanent exclosure on Afognak Mountain had a vigor factor of .336. These figures seem to support Batchelors original assumption that elderberry is a seral plant and is destined to leave the plant community with natural plant succession. Overall, the elderberry range appears to be in poor to fair condition but this condition is not necessarily a reflection of over utilization by elk.

To help evaluate the plant trend and condition, one new permanent transect consisting of 30 stations was established and photographs of elk browse were taken to begin an elk browse photograph file on an annual basis.

Mortality Studies

On June 4, 1965, Ben Ballenger found the remains of three elk near Tonki Lake on Afognak Island. Examination of the marrow of the femur bone indicated the animals had died while in a condition of malnutrition. One of the animals was a yearling but jaws were not present for the other two. The sex could not be identified on any of the animals.

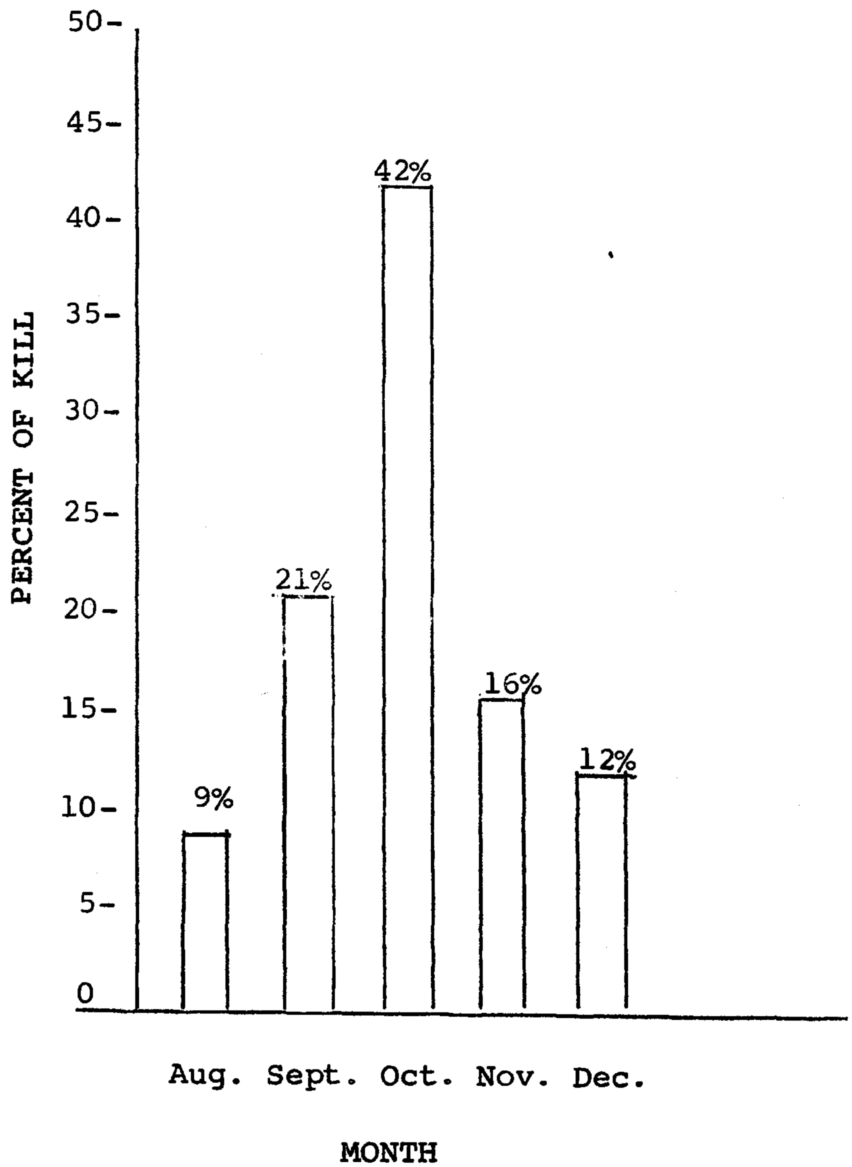
Elk Composition Counts

The results of August elk composition counts are shown in Table 3. Since it is difficult for observers to distinguish between yearling and adult elk, both male and female yearlings were included with the females during the count.

Table 3. 1965 Elk Composition Counts.

	Total	Branch antlered males		Calves		Females (including yearling elk)		Calves/ 100 females
		No.	%	No.	%	No.	%	
Raspberry Island	230	41	(18)	47	(20)	142	(62)	33
Raspberry Straits-Afognak Lake	151	16	(11)	44	(29)	91	(60)	48
Malina	205	13	(6)	44	(21)	148	(73)	28
Interior	95	34	(36)	16	(17)	45	(47)	36
Tonki Cape	245	35	(14)	48	(20)	162	(66)	30
Total	926	139	(15)	199	(21)	588	(64)	34

Figure 1. Chronological elk harvest on the Afognak Island Group in 1965.



Goat Abundance and Distribution

In 1959, surveys were initiated in Southeast Alaska to determine distribution and abundance of mountain goats. Each year a segment of range has been checked. Counts made in 1965 complete the coverage of Southeast Alaska with the exception of a small area near Skagway and another in upper Portland Canal. More than 3,700 goats have been observed during these counts. Table 4 gives the data from these counts, made in 1965 and Table 5 gives the maximum number of goats counted in each area from 1959 to 1965.

Goat Composition Counts

A total of 1,285 goats were observed in Southeastern Alaska during 1965. Thirty-five goats were observed on Kodiak Island. Table 4 shows the distribution and age composition of goats in Southeastern Alaska and Kodiak Island. The large number of goats in many of these herds made it difficult for observers to accurately classify all of the goats in some of the concentrations.

Table 4. Distribution and age composition of goats observed in Southeastern Alaska and Kodiak Island, Alaska.

Location	Total	No. Adults	No. Kids	No. Unident.	Kid/Adult Ratio
			Southeastern		
Haines					
Kicking Horse River	65	-	-	65	-
Chunekukleik Mt.	258	159	23	76	-
Takshanuk Mts.	157	69	12	76	-
Bradford Canal					
Stikine River to Bradford	157	120	37	-	31/100

Table 4 (cont'd)

Location	Total	No. Adults	No. Kids	No. Unident.	Kid/Adult Ratio
Behm Canal					
Smeaton Bay to Boca de Quadra	100	61	20	19	-
Portland Canal					
South Humpback Lake	291	213	67	11	-
North Humpback Lake	257	179	61	17	-
Kodiak					
Crown Mountain	35	22	13	-	59/100
Total	1,320	823	233	264	35/100

The Kodiak Island population on Crown Mountain numbered 35 animals. This population is the result of a transplant of 7 male and 11 female goats during 1952 and 1953. Table 6 shows the results of goat counts since the transplant. Airline pilots, fishermen and deer hunters reported an additional 22 goats during 1965 (19 Jap Bay, 1 Red River, 1 Kiluda Bay, and 1 in Barbara Cove) but these observations could not be verified by Department personnel.

Table 5. Maximum number of mountain goats counted in each area of Southeast Alaska from 1959 to 1965.

	Area	Maximum Count
1.	Haines	480
2.	Juneau	466
3.	Sumdum	843
4.	Petersburg	572
5.	Bradfield Canal	390
6.	Behm Canal	375
7.	Portland Canal	548
8.	Baranof Island	118
	Total	3,792

Table 6. Results of goat population trend surveys on Kodiak Island, 1956-1965.

Year	Total	Adults	Kids
1956	5	-	5
1957	4	-	4
1958	6	4	2
1959	7	-	-
1960	-	-	-
1961	-	-	-
1962	22	14	8
1963	26	18	8
1964	26	13	13
1965	35	22	13

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT NO:	W-6-R-6	TITLE:	Alaska Wildlife Investigations
AND:	W-15-R-1	TITLE:	Big Game Investigations
WORK PLANS:	D(W-6-R)	TITLE:	Statewide Data Collections
AND:	P(W-15-R)	TITLE:	Disease, Parasite & Data Collections
JOB NO.:	2(W-6-R)		
AND:	6(W-15-R)	TITLE:	Bison

Period Covered: January 1, 1965 to December 31, 1965

ABSTRACT

Calf production of the Big Delta herd in 1965 was comparable with production in 1964. The percentage of calves observed from aircraft was 17.8 percent in June, and 21.1 percent in July.

The separate calving group of bison located on the Tanana River was not observed, but tracks and information from others indicated that the animals were still in the area.

Calf production of the Copper River herd was comparable with production in 1964. The percentages of calves observed from aircraft was 22.6 percent in July, and 18.3 percent in September. No animals were found on the Upper Chitina, but reports from local residents indicated 11 animals were in the area.

Three thousand one hundred and twenty one applications were received for permits to harvest twenty bison from the Big Delta herd. The hunt began on September 13, and on September 17, nineteen bison had been taken.

Most of the herd was in areas inaccessible to hunters, and the last bison wasn't taken until September 30 when the animals moved into areas easily reached by hunters. The sex ratio of the kill was seventeen males and three females.

Forty-two persons registered for the Copper River hunt, but because of inclement weather, only 28 participated. The hunt began October 11, and terminated October 17. The sex ratio of the kill was 9 males and 2 females.

Eighteen bison were transplanted from the Big Delta herd to the Farewell airstrip on August 10 and 11. The released animals consisted of the following:

4	yearling	males
1	calf	male
2	yearling	females
3	calves	females
8	adult	females

RECOMMENDATIONS

An annual permit hunt should be continued in both the Big Delta and Copper River herds, if current investigations indicate that no harmful effects will result.

Further investigations to determine whether intermingling is taking place between the Big Delta herd and the so-called Healy Lake herd is recommended.

Investigations to determine losses resulting from all causes should be intensified.

Herd composition, calf production, and herd movement studies, should be continued.

OBJECTIVES

To determine population structure and production, and to implement management of the Big Delta and Copper River bison herds.

TECHNIQUES

Aerial surveys of the Big Delta Bison range were made in June and July, and ground counts were made in July and August. Aerial surveys of the Copper River bison range were made in July and September, and one ground observation was made in July.

A controlled hunt was conducted in the Big Delta herd in September resulting in a harvest of twenty animals. A controlled hunt in the Copper River herd in October resulted in a harvest of eleven animals.

A sample of these animals was examined for parasitism and general health.

Forty animals from the Big Delta herd were trapped in August. They were examined for general health, and twenty eight were given a brucellosis test. All brucellosis test results were negative. Eighteen of these captured animals were transplanted to Farewell.

FINDINGS

Calf Production

On June 25, 29, and July 26, flights were made in the Big Delta bison range to determine the location and calf production of the herd. No animals were found on Jarvis Creek or in the Delta Clearwater area, and only 1 lone bull was observed on the Tanana River. On June 29, one hundred eighty five bison were found on the Delta River. Thirty three or eighteen percent were calves. On July 26, a flight revealed one hundred eighty bison on the Delta River, of which thirty eight or twenty one percent were calves. These two observations are believed to be of the same group of animals. On July 29, a ground count on the Fort Greely army reservation revealed an isolated group of bison consisting of fourteen animals. Four of these were calves, or twenty eight percent calves. On August 3, another isolated group of bison were observed on the reservation. These consisted of forty two animals, twelve of which were calves, or twenty eight percent calves. A further examination of these forty two animals showed the following:

12 calves
9 bulls older than 1 year
5 yearling bulls
3 yearling females
13 females older than 1 year

Close examination indicates that ninety two percent of these bison though capable of producing succeeded.

On August 9, another ground observation on Fort Greely revealed a group of bison consisting of 10 animals. Closer examination showed the following:

2 calves
3 bulls older than 1 year
1 yearling bull
2 yearling females
2 adult females

In this group, all females normally considered capable of producing calves succeeded.

On July 2, the range of the Copper River bison herd was flown. Eighty four bison were observed on the Dadina River, of which nineteen were calves, or approximately twenty three percent calves. On September 24, the range was flown, and seventy one bison were observed on the Copper River. Of these seventy one animals, thirteen were calves, or eighteen percent calves.

A ground observation on July 22 of a small group of bison thirty four miles upstream from Gibralter Mountain on the Copper River revealed the following:

2 adult bulls
2 yearling bulls
1 adult cow
1 calf

Counting calves in a group of bison from the air is difficult, and usually results in an under count. Even counting calves in a group of animals from the ground is difficult when there are more than a dozen animals in the group. It is believed that the aerial observations of calves is conservative. Because of the mixture of bulls, cows, and yearlings in the groups observed on the ground, it seems likely from these ground counts that when eighteen to twenty percent of a herd consists of calves, that probably over ninety percent of the cows thought capable of producing calves have succeeded. The calf counts this year compare favorably with the counts in previous years. See Table 1 and 2.

The group of bison observed in 1964 and 1965 in the Healy Lake area was not found this year. However, tracks were observed indicating that the herd is still in the area. Also, reports from people in that area indicate that this herd is present.

Counts made in 1965 are believed inadequate for determining total numbers of bison in the Big Delta and Copper River herds. A more intensive census is planned for the Big Delta herd in April, 1966.

Harvest

Big Delta Herd

A permit hunt for twenty animals was approved for the Big Delta herd. Twenty persons were selected to hunt and five persons selected as alternates from 3,121 applications received. The public drawing was held on August 31.

The organization of the hunt was similar to the 1963 and 1964 hunts. Four persons hunted each day beginning on September 13. Each hunter was accompanied by a Department of Fish and Game employee. Weather conditions were excellent for hunting. Temperatures were mild with no snow.

By September 17, nineteen bison were harvested. The last animal was taken on September 30. Most of the herd was in areas inaccessible to hunters during the period of the hunt.

The sex ratio of the kill was seventeen males and three females.

Copper River Herd

The hunt opened on October 11. Forty-two persons registered for the hunt, but only twenty eight actually got into the field. On the day following the opening date, the area experienced a severe storm with wind velocities reaching 50 knots with driving snow. Two days later the skies cleared and the temperature dropped to -21°F. It remained between -8° F and -15°F for the remainder of the bison season. The season was closed on October 17.

The sex ratio of the kill was 9 males and 2 females.

Figure 1 is a copy of the registration blank the Copper River bison hunters were required to fill out prior to hunting. The only explanation required regarding this form is the line entitled "plan to return by". This information was taken in the interest of public safety: in the event someone should become lost in the difficult terrain, a search could be initiated with some knowledge of the participant's intent to hunt a certain area.

Figure 2 is a copy of the instructions issued to the hunters before the Copper River bison hunt took place, and is self explanatory.

Figure 3 is a map of the area open to bison hunting in the Copper river system. It was used to acquaint the hunters with the boundaries of the hunt area.

Transplant

On August 3, forty bison were captured in the corral constructed by the Alaska Department of Fish and Game on the Fort Greely Army Reservation. They consisted of twenty eight animals, yearlings or older, and twelve calves. The twenty eight animals which were yearlings or older were tested for brucellosis. All test results were negative. All animals were ear tagged with the following exceptions: four large bulls and eight calves.

On August 10 and 11, eighteen of these animals were moved by C-123 aircraft furnished by the Air National Guard to the Farewell airstrip located approximately 250 miles S. W. of Fairbanks and released on the airstrip. The released animals consisted of the following:

4 yearling males
1 calf, male
2 yearling females
3 calf females
8 adult females

All animals transplanted to Farewell appeared to be in good physical condition with the exception of one 2 year old cow that received an injured neck during shipment. The animal was unable to straighten out its neck after release from the transfer crate. It had been in a position where the neck was in a curled condition for approximately 10 hours. Upon release, it wobbled around for a few minutes unable to straighten its neck, then walked 1/2 mile away and disappeared. It was, however, seen to graze as it walked away.

Figure 1. BISON HUNT REGISTRATION

COPPER RIVER

DATE: ____________________

NAME: ________________________________
Last First Initial

ADDRESS: __________________________ PHONE: ____________

RESIDENT ( ) NON RESIDENT ( ) HUNTING LICENSE NO. __________
NON RESIDENT TAG NO. __________

TRANSPORTATION TYPE:

Aircraft No. __________ Boat __________

Ground Vehicle ________ Foot __________

INTENDED HUNTING AREA (Drainage Preferred): ____________________

____

____

PLAN TO RETURN BY: ____

****

SUCCESSFUL: No ( ) Yes ( )

SEX: ♀ ( ) ♂ ( )

DATE OF KILL: ____________________

AREA OF KILL: ____

____

____

Figure 2. HUNTER INSTRUCTIONS

Copper River Bison Hunt, 1965

1. The hunt will begin on October 11, 1965 at 1:00 a.m. and end by field announcement when 15 mature bison have been taken.

2. The area you may hunt bison in is bounded on the west by the west bank of the Copper River; on the north by the north bank of the Sanford River and the Sanford Glacier; on the east by the boundary between Game Management Units 11 and 12, and on the south by the southern bank of the Kotsina River, and upstream along the southernmost bank of the Kotsina River to Granite Peak, thence along a line due north to the boundary line between Game Management Units 11 and 12.

3. Befcre your hunt begins, you just register into the hunting area in person at one of the two check stations maintained by the Alaska Department of Fish and Game at Gulkana Airfield and Chistochina. Registration for the hunt will begin at 7:00 a.m., October 10, 1965.

4. When your hunt ends, you must check out through the same check station where you're originally registered.

5. Successful hunters must report their bison kill to the Alaska Department of Fish and Game Check Station within twenty-four (24) hours.

6. Bison hunters are required to have a transistor radio in camp and to tune into Station KCAM (790 on the radio dial) at 8:00 p.m. each day for the latest developments concerning the bison hunt. A rebroadcast will be made at 9:30 p.m. on the "Caribou Clatter" program.

7. When fifteen (15) bison are taken, the season will be closed by field announcement. The closure will be announced over Station KCAM (790 on the radio dial) at 8:00 p.m. and 9:30 p.m. of the day of the closure.

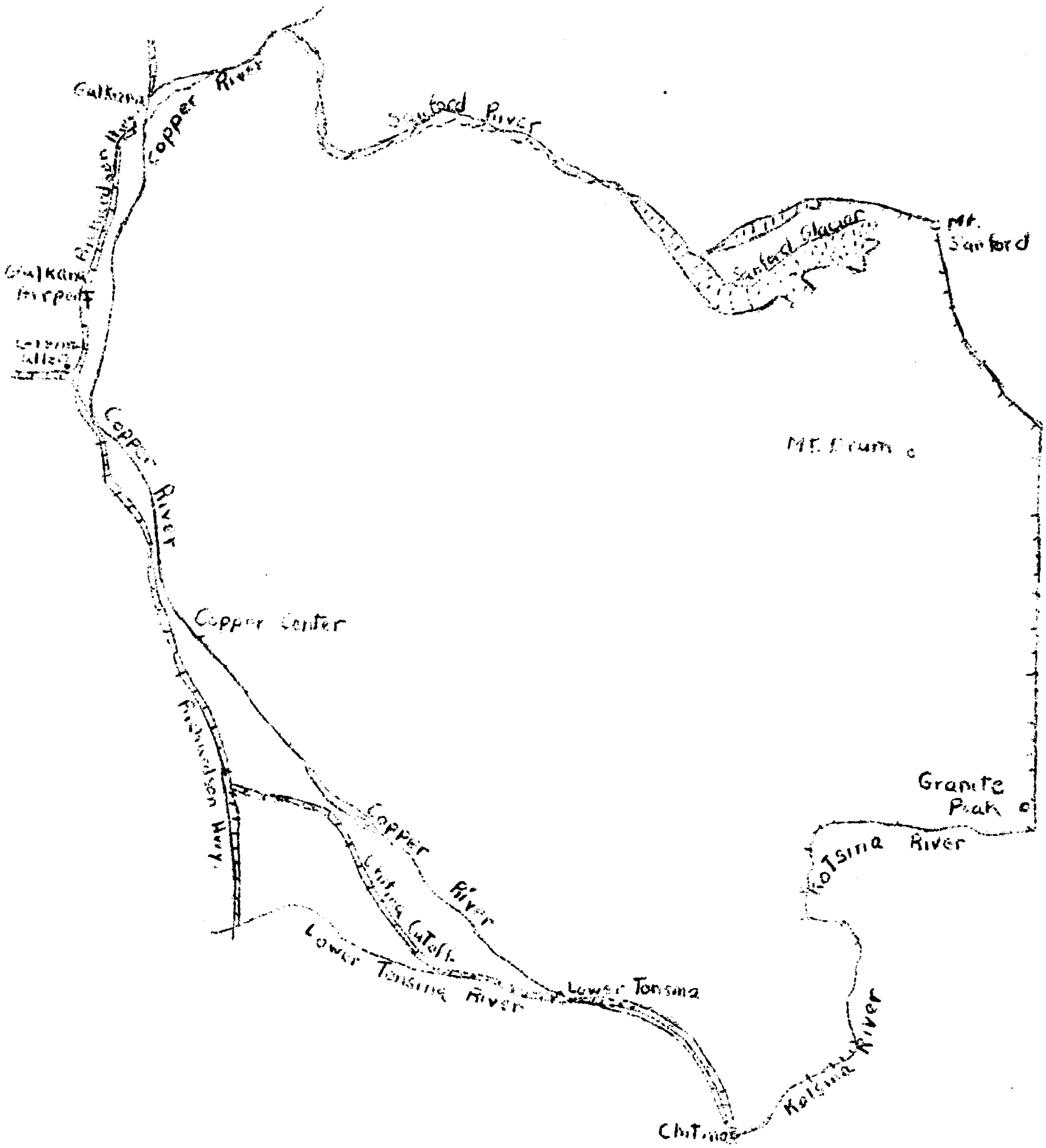
   On the day of the hunt closure an attempt will be made to contact all hunters in the field by a loud speaker system from an aircraft or by dropping a red streamer to hunters afield.

8. Any person who shall participate in this hunt contrary to provisions as herein defined shall be in violation of Title 16, Alaska Statutes, as amended, relating to fish and game resources.

Table 2. 1964 Calf production counts.

Area and Herd	Date 1964	Total Number Bison Observed	Adults	Calves	Percent Calves In the Total Number Observed
Healy Lake Herd- Tanana River	June 2	63	48	15	24
Big Delta Herd- Delta River	June 3	149	121	28	19
Big Delta Herd- Delta River ana Jarvis Creek	July 28 and Aug.	265	221	44	17
Copper River Herd- Dadina River	July 29	97	80	17	17.5
Chitina River Herd- Chitina River	July 30	12	7	5	42

Figure 3. COPPER RIVER BISON HUNT AREA, 1964



The area open to bison hunting as shown above is bounded on the west by the west bank of the Copper River; on the north by the north bank of the Sanford River and the Sanford Glacier; on the east by the boundary between Game Management Units 11 and 12, and on the south by the southern bank of the Kotsina River, and upstream along the southernmost bank of the Kotsina River to Granite Peak, thence along a line due north to the boundary line between Game Management Units 11 and 12.

Table 1. 1965 Calf Production Counts

Area and Herd	Method of Count	Date 1965	Total Number Bison Observed	Yearlings or Older	Calves	Percent Calves In the Total Number Observed
Big Delta Herd-Delta River	Aircraft	June 29	185	152	33	17.8
"	Aircraft	July 26	180	142	38	21.1
"	Ground	July 29	14	10	4	28.6
"	Ground	Aug. 3	42	28	12	28.6
"	Ground	Aug. 9	10	8	2	20.0
Copper River Herd-Dadina River	Aircraft	July 2	84	65	19	22.6
Copper River Herd-Copper River	Aircraft	Sept.24	71	58	13	18.3
"	Ground	July 22	6	5	1	16.7

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