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WILDLIFE RESEARCH UNIT STUDIES

by

David R. Klein, Leader

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Project Progress Report
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Project W-17-9, Jobs 19.18R, 19.20R, 19.21R, 19.23R, and 19.24R

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Craig M. Lowe and Dr. David R. Klein

Project No.: W-17-9 Project Title: Research Unit Studies

Job No: 19.18R Job Title: Ecology and Taxonomy of Harlan's Hawk in Alaska

Period Covered: July 1, 1976 - June 30, 1977

SUMMARY

(Thesis Abstract)

Red-tailed hawks (Buteo jamaicensis) were studied during four winters in Central Oklahoma. Most work was devoted to examining population densities, plumage characteristics, and social behavior. Densities of two areas varied from 2.9 to 5.9 redtails per square mile. Redtails were classified into four fairly distinct subspecies. Social status and niche utilization varied between age groups and subspecies.

During the springs and summers of 1975 and 1976, densities, plumage characteristics, nesting habitat, home range, clutch size, nesting success, food habits, molt patterns, and behavior of Interior Alaska redtails were investigated. Low densities and large home ranges were determined. Alaska redtails preferred white spruce (Picea glauca) for nesting. Clutches averaged 1.96; many nests failed during incubation. Snowshoe hares (Lepus americanus), waterfowl, and red squirrels (Tamiascuirus hudsonicus) were the principal prey. Males initiated the molt before, and completed the molt after, the females. Nesting behavior and success differed considerably in 1975 and 1976.

OBJECTIVES

1. To provide information on basic breeding ecology of Harlan's Hawk.
2. To collect data on adaptive strategies of this most northerly breeding red-tail during a period of low snowshoe hare populations.
3. To shed light on subspeciation and geographical variation in red-tails.
4. To determine the taxonomic position of Harlan's Hawks.

GENERAL

A draft of the thesis has been prepared but illness has delayed completion. The thesis should be completed by fall 1977. An abstract of the thesis is included as a project summary pending availability of the final copy.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Brian E. Lawhead, Dr. David R. Klein and Robert Stephenson (ADF&G)

Project No.: W-17-9 Project Title: Research Unit Studies

Job No.: 19.20R Job Title: Denning Ecology of the Gray Wolf in Southcentral Alaska.

Period Covered: July 1, 1976 - June 30, 1977

SUMMARY

Wolves in the Nelchina Basin preferred elevated den sites with sandy soil, moderate slope and a general southerly aspect. Such sites are characterized by distinct vegetational patterns and may or may not be located in close proximity to a permanent source of water. Visibility varies from good in alpine sites to very restricted in forested areas. Eight of twelve wolf dens had been previously used by foxes.

OBJECTIVES

To study the ecology and behavior of free-ranging gray wolves (Canis lupus) during the denning period, including: behavior of adults and pups, feeding habits, activity patterns, den site characteristics and local movements.

BACKGROUND

Concern over recent declines in populations of caribou (Rangifer tarandus) (Bos, 1975) and moose (Alces alces) (Bishop and Rausch 1974) in the Nelchina Basin of Southcentral Alaska, as well as a desire to better understand the role of wolves as predators of these and other species, led the Alaska Department of Fish and Game to undertake intensive studies of wolf ecology in this region. Using radio-collared animals, telemetry-assisted research has been carried out since 1975.

During the course of this work, it became possible to locate wolf dens with relative ease, thus facilitating the study of the characteristics and distribution of the dens in the study area. Such work was performed by R. O. Stephenson during the 1975 denning season and by this investigator during the 1976 season.

As originally conceived, the present study was to have been broader in scope than the title indicates. The initial study objectives were to have included behavior of adults and pups, feeding habits, activity patterns, local movements, and den site characteristics. Circumstances necessitated a narrowing of objectives to the study of den characteristics only.

PROCEDURES

As indicated above, dens were located during the course of radio-tracking flights by ADF&G personnel; in addition, local guides assisted in locating several dens. Dens were visited on foot, by floatplane, and by helicopter during the period May 22 to September 19, 1976.

Physiographic data were recorded on the den data form by Stephenson (1974) (Table 1). Elevation was determined from topographic maps which included the den areas. Slope was measured with a clinometer and aspect was determined with a standard compass. Distance to water was estimated as the straight-line distances to the nearest lake, pond, or stream. Those plant species that could not be identified in the field were collected for later identification at the University of Alaska Herbarium in Fairbanks. In addition to the information recorded on the data form, soil samples were taken for determination of color, moisture content, and bulk density. A Munsell Soil Color Chart was used to distinguish colors. Soil samples were dried at 95°C. for ten hours, prior to final weighing for moisture content and bulk density determination. Each den site was diagrammed outside as well as inside, if the burrows were large enough to accommodate the investigator. Each site was photographed.

TABLE 1

DEN-DATA FORM

Den No.:__________ Date:__________ Species:__________ Unit:__________

Drainage:__________ Elevation:__________ Lat.:__________ Long.:__________

Specific area:____

____

Activity Status:____

Scats: No. Pup__________________ No. Adult__________________

Apparent age:__________

Food remains:____

____

Macrorelief: ____

Microrelief: ____

Percent slope:__________ Aspect:__________ Wind exposure:__________

Entrances: No.:__________ Ht.:__________ Wdth.:__________
Apparent depth:__________ (Sketch construction on back)

Distance to water:____

View from den:____

Trails:____

Soil: Texture:__________ Friability:__________ Parent material:__________
Root penet.__________ Moisture:__________ Color:__________
Active frost zone:__________ Dry or wet frost:__________
Slumping?__________

Vegetation: Growth form:____
Plant cover (%):____
Comm. association:____
Species:____

Prey populations:____

____

Comments:____

____

Table 2. Physiographic characteristics of wolf dens in southcentral Alaska.

Den	1976 Activity Status*	Elevation (ft.)	Slope (°)	Aspect	Distance to Water (yds.)	Landform	Soil Type	No. Usable Entrances	No. Defunct Entrances	Former Fox Den?
Brushkana Creek	I	3300	15°	SSW	50	dune	sand	2	0	no
Clearwater Creek	A	2700	15°	S	100	knoll	sand	1	0	yes
Second Hill Lake	I	2400	22°	SW	500	knoll	sand	2	0	yes
Nickel Creek I	I	2250	20°	ESE	400	ridge	sand	2	0	--
Nickel Creek II	I	2250	35°	N	300	ridge	sand	2	0	--
Keg Creek	A	2650	15° 23°	S SW	45	ridge	sand	8	1	yes
Mendeltna Creek I	A	2800	28°	SSE	100	knoll	sand	4	0	yes
Mendeltna Creek II	A	2700	12°	W	50	low ridge	sand	3	0	yes
Sinona Creek	A	2250	0°	SW	10	top of cutbank	silt	1	0	no
St. Anne Lake	A	2150	22° 18° 10°	NW SSE WSW	800+	ridge	sand	4	0	yes
Hogan Hill	I	2235	14°	SW	45	low ridge	sand	1†	0	yes
Delta River	I	3050	--	E,S	150	river bluff	sand	5	0	yes

* I = Inactive
A = Active

-- = Not Determined

† Three holes, associated with two older, inactive dens, were found 80 and 180 yds. away in the same ridge system. They had not been used within the past several years.

FINDINGS

Table 2 summarizes selected physiographic data from the twelve wolf dens visited. Four red fox (Vulpes fulva) denning areas were visited for comparative purposes. Soil samples were taken at fourteen dens (eleven wolf and three fox dens).

Elevation ranged from 2150 ft. to 3300 ft.; this range includes most of the study area, except for high alpine country toward the four mountain ranges ringing the study area and some lowlands near the Copper River. Slope ranged from level (0°) to 35°. Twelve of sixteen burrow groups had a southerly component of aspect. Distance to water ranged from 10 yards to over 800 yards. As has been pointed out in several earlier quarterly reports, however, such figures may be misleading because of the variable availability of water throughout the denning season. Meltwater is undoubtedly available much closer to several of the dens early in the period than is indicated in the table. Since sampling visits were spread over the entire season, only bodies of water judged to be available throughout the period of den occupancy were used in making these estimates.

Dens were usually located on elevated sites, at least in terms of local relief. Land forms used tended to be ridges and knolls, both of which are quite common throughout the study area, despite its flat appearance from the air. Eleven of the wolf dens and all of the fox dens had been dug in sandy soil, and the twelfth wolf den was in silty soil. In most of the Nelchina region below treeline, such elevated sites with sandy soil are easily discernible from the air because of the vegetation they support. Aspen (Populus tremuloides) is the dominant tree species on such sites, accompanied by other species which prefer warm, dry soil conditions. This vegetation complex contrasts markedly with that of the surrounding black spruce-willow-muskeg community. Lush growths of grass are typical of den sites in the study area, presumably as a result of the fertilizing effect of the occupants' urine and feces.

Dimensions of 36 burrows were recorded; mean entrance height was 15.5 inches (range 9-24 inches) and mean entrance width was 18.9 inches (range 13-29 inches). The height average is probably somewhat depressed because of settling of the soil at some of the older dens. Entrance burrows usually, though by no means exclusively, exhibited greater width than height. Burrow depths ranged from 5 to 21 feet, and burrow systems usually had an inner chamber ranging from 4 to 15 feet in diameter and about 2 feet high. Very few burrows showed any signs of collapse.

Soil sample data have not been statistically treated at this writing. The hypothesis to be tested, with the moisture content data, is that soils in elevated sites on which dens are located have a lower moisture content than soils in surrounding areas. The data show such a trend for several dens, but are equivocal for several others; final statistical test results will be presented in the final project report. Conclusions concerning soil bulk density will likewise be deferred at this time.

DISCUSSION

Detailed discussion of findings, together with a review of the pertinent literature, will be reserved for the final report.

Wolves in the Nelchina Basin preferred elevated den sites with sandy soil, moderate slope, and a generally southerly aspect; such sites are characterized by distinct vegetational patterns, and may or may not be located in close proximity to a "permanent" source of water. Visibility from these dens is quite restricted in forested areas and quite good from alpine sites as would be expected; no obvious selection for visibility was noted.

An aspect of wolf denning that has not been discussed thus far is the use of former fox dens by wolves. Eight of twelve dens had been used by foxes in the past, as evidenced by small entrances and burrows approximately 8 to 10 inches in diameter. Small burrows were often seen continuing beyond those portions of burrows that had been enlarged by wolves. These findings support those of other workers who found wolves denning in sites previously used by foxes (Clark, 1971; Murie, 1944; Stephenson, 1974).

REFERENCES CITED

Bishop, R.H. and R.A. Rausch. Moose population fluctuations in Alaska, 1950-1972. Naturaliste Can. 101:559-593.

Bos, G. 1975. A partial analysis of the current population status of the Nelchina caribou herd, pp. 170-180. IN: Proc. 1st Intl. Reindeer and Caribou Symp., Biol. papers, Univ. of Alaska, Special Rept. No. 1. 551 pp.

Clark, K.R.F. 1971. Food habits and behavior of the tundra wolf on central Baffin Island. Ph.D. Thesis, Univ. of Toronto. 223 pp.

Murie, A. 1944. The wolves of Mt. McKinley. U. S. Natl. Park Serv. Fauna Series, No. 5. 238 pp.

Stephenson, R.O. 1974. Characteristics of wolf den sites. Ak. Dept. Fish & Game, Final Report, P-R Proj. W-17-2 to W-17-6. 27 pp.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Joseph Doerr, Dr. Sam Harbo, Dr. David Klein and James Davis (ADF&G)

Project No.: W-17-9 Project Title: Research Unit Studies

Job No.: 19.21R Job Title: Population Dynamics of the Western Arctic Caribou Herd

Period Covered: July 1, 1976 - June 30, 1977

SUMMARY

Comparison of samples of caribou teeth sectioned for age determination showed no significant difference in ages of animals from the Western Arctic herd killed in 1959-1961 vs. 1975-1977. Examination of these same samples of lower mandibles for lesions showed 2.9 percent incidence in 1975-1977 versus 7 percent in 1959-1961. A higher incidence of lesions was found among adult males than adult females, and the incidence also increased with age of the animals. Loss of the premolar teeth coincided most frequently with lesions. Using three measurement variables, it was possible to accurately separate mandibles from animals 3 years and older on the basis of sex.

In composition counts made during October in the Anaktuvuk and Ambler River areas, a significant difference was found between the two areas in the percent of calves, yearlings, cows and bulls. The combined data showed the following ratios: 56.4 calves:100 cows, 61.7 bulls:100 cows, and 29.7 yearlings:100 cows.

OBJECTIVES

1. To assess and evaluate important changes that may be occurring in the Western Arctic Caribou herd by critically analyzing data available on that herd, and by analyzing relevant past data on other Alaskan caribou herds that may provide insight into the relationships between population fluctuations and such parameters as sex ratios, age structures, and age specific mortality and recruitment rates.

2. To work in conjunction with the Alaska Department of Fish & Game in the investigation of current population parameters of the Western Arctic herd, concentrating primarily on productivity, calf survival, and age structure.

GENERAL

The aging of caribou teeth from the Western Arctic herd, a joint project of the Alaska Cooperative Wildlife Research Unit and the Alaska Department of Fish and Game, has been completed. Four steps were involved in aging the teeth: decalcification, sectioning, staining, and reading the prepared slides. The procedure used was similar to one described by Miller (1974). A six-percent nitric acid solution was used for decalcification. Martha Robus and Laurie Robertson of the Alaska Department of Fish and Game provided technical support. Twenty-four weeks were required for two workers to prepare and interpret approximately 1,750 slides.

Determination of annuli in the prepared slides was difficult. The summary of ages assigned by two readers is presented in Table 1. Slides produced from the 1959-1961 incisors were of poorer quality, mainly because of cracking in the cementum and reduced penetration of stain. The teeth had been stored dry for 16 to 18 years before the slides were prepared. The comparison of ages determined by the two readers for the 1959-1961 and the 1975-1977 incisors was not significantly different at the 0.05 confidence level (X^2 = 7.35, df = 3). Significantly poorer agreement in ages assigned was obtained for molariform teeth and incisiform teeth (X^2 = 39.91, df = 3, $P < .005$). Molars were considered unsuitable for age determination; ages based on slides of molar teeth were omitted from calculations.

The results of the two readers were averaged and the preliminary ages are shown in Tables 2 and 3. The data may have to be weighed according to the village where the animals were killed, herd size, and season of harvest.

During October 5-10, 1976, I accompanied Jim Davis and Bill Griffin of the Alaska Department of Fish and Game on fall reconnaissance flights of the Western Arctic Caribou Herd. Two main concentrations of migrating caribou were located. One group was moving south between Shanin Lake and Chandler Lake in the Anaktuvuk Pass area. The other concentration of caribou was located in the Redstone River - Miluet Creek area north of Ambler. Time and weather prevented obtaining an accurate count of caribou; however, later reconnaissance flights by the Alaska Department of Fish and Game revealed herd sizes of approximately 5,000 and 12,500 for the "Anaktuvuk Pass group" and the "Ambler group", respectively.

Table 1. Comparison of ages determined from cementum annuli by two readers[1].

Collection	Number	Agree	1 year difference	2 years difference	3+ years difference
1975-1976 (incisors)	326	148(45.4)[2]	131(40.2)	36(11.0)	11(3.4)
1959-1961 (incisors)	401	157(39.2)	161(40.1)	54(13.5)	29(7.2)
1959-1961 (molars)	88	17(19.3)	31(35.3)	23(26.1)	17(19.3)

[1]Readers were Martha Robus, Alaska Department of Fish and Game and Joe Doerr, Alaska Cooperative Wildlife Research Unit.

[2]Percentages in parenthesis.

Table 2. Ages of hunter-killed caribou from the Western Arctic Herd 1959-1961[1].

Age	Male	Female	Unknown	Total
2-3	14(10.8)[2]	38(21.6)	37(17.1)	89(17.0)
3-4	12(9.2)	29(16.5)	43(19.9)	84(16.1)
4-5	24(18.5)	33(18.8)	41(19.0)	98(18.8)
5-6	30(23.1)	19(10.8)	30(13.9)	79(15.1)
6-7	19(14.6)	25(14.2)	19(8.8)	63(12.1)
7-8	9(6.9)	13(7.4)	14(6.5)	36(6.9)
8-9	9(6.9)	11(6.2)	9(4.2)	29(5.6)
9-10	4(3.1)	5(2.8)	10(4.6)	19(3.6)
10-11	5(3.8)	1(.6)	5(2.3)	11(2.1)
11-12	4(3.1)	1(.6)	4(1.9)	9(1.7)
12-13	0(0)	1(.6)	2(.9)	3(.5)
13-14	0(0)	0(0)	1(.4)	1(.2)
14-15	0(0)	0(0)	1(.4)	1(.2)
Total	130	176	216	522

[1]Collected in the villages of Anaktuvuk Pass, Kivalina, Pt. Hope and Noatak.

[2]Percentages in parenthesis.

Table 3. Ages of hunter-killed caribou from the Western Arctic Herd 1975-1976[1].

Age	Male	Female	Unknown	Total
2-3	17(8.7)	14(15.7)	64(14.2)	95(12.9)
3-4	28(14.3)	11(12.4)	64(14.2)	103(14.0)
4-5	34(17.3)	16(18.0)	82(18.2)	132(17.9)
5-6	44(22.4)	9(10.1)	70(15.5)	123(16.7)
6-7	35(17.9)	11(12.4)	50(11.1)	96(13.0)
7-8	19(9.7)	6(6.7)	44(9.8)	69(9.4)
8-9	11(5.6)	5(5.6)	41(9.1)	57(7.7)
9-10	4(2.0)	9(10.1)	16(3.5)	29(3.9)
10-11	2(1.0)	5(5.6)	6(1.3)	13(1.8)
11-12	0(0)	2(2.2)	8(1.8)	10(1.4)
12-13	1(.5)	1(1.1)	4(.9)	6(.8)
13-14	0(0)	0(0)	2(.4)	2(.3)
14-15	1(.5)	0(0)	0(0)	1(.1)
Total	196	89	451	736

[1]Collected from Barrow, Pt. Hope, Kivalina, Noorvik, Selawik, Kiana, Ambler, Shungnak and in the Kiana Hills.

From October 16-18, 1976, I assisted Alaska Department of Fish and Game personnel in fall composition counts of the Western Arctic herd. A helicopter was used to transport observers into the field. The results are shown in Table 4. The areas where counts were taken are described as follows: Area 1, north of Nahtuk Mountain in an area from 67°35' N to 68°8' N, and 152°5' W to 153°37' W; Area 2, .8 km. north of the Kobuk River between Ambler and Shungnak (67°1' N, 157°37' W); Area 3, 2.4 km. south of the Kobuk River between Ambler and Shungnak (66°58' N., 157°43' W); Area 4, west of the Sheklukshuk Range (66°46'N, 157°58' W) and Area 5, southwest of the Sheklukshuk Range (66°44'N, 158°4' W).

The composition counts from Area 1 are from the "Anaktuvuk Pass group", and the counts from Areas 2-5 are from the "Ambler group". A significant difference was found in the percent of calves, yearlings, cows, and bulls between the two groups ($X^2 = 18.81$, df = 3, $P < .005$); however no significant difference was found at the .05 level in the percent of calves, cows, and bulls, when yearlings were removed ($X^2 = 4.23$, df = 2). The calf:cow and bull:cow ratios were therefore calculated from the total counts, while the yearling:cow ratio was weighted by group size. The estimated fall ratios for the two groups of caribou classified were 56.4 calves:100 cows, 61.7 bulls:100 cows, and 29.7 yearlings:100 cows.

Only 627 of 1,058 (59.3%) mandibles from a museum collection of 1959-1961 hunter-killed Western Arctic caribou had a recorded sex; the remaining 431 caribou had been listed as unknowns. In an attempt to sex-class the unknown mandibles, age-specific discriminate functions were developed, using three variables: mandible length, diastema length, and ratio of mandible to diastema. The data for the known sex caribou are presented in Tables 5-7. Because there was no significant difference in the three variables at the 0.05 level between males age 3-4 years and males age 5+ years, the two age classes were combined. The results of the discriminate analysis are shown in Table 8. Only caribou mandibles age 3 years and older showed significant sex-related differences, given the three variables used in the discriminate functions.

The known sex and unknown sex caribou were then classified as to sex using the discriminate functions. The results are presented in Tables 9 and 10. From the results of Table 9, it can be seen that correct classification of a given age and sex group, using the discriminate functions developed, ranges from 56.1 to 85.2 percent. The error in classification was assumed to be the same for unknown caribou as it was for known caribou. "Adjusted" values were then calculated for the unknown sex caribou and the results presented in Table 10.

One example will illustrate how the "adjusted" classification numbers were derived. Thirty-two unknown sex caribou age 5-6 years were classified as 17 males and 15 females (Table 10). No significant difference in the error of classifying caribou using the discriminate functions was found among age classes 5 years and older for males ($X^2 = 3.75$, df = 3, $P > .05$) or for females ($X^2 = 4.84$, df = 3, $P > .05$). Therefore, using Table 9, we can assume that only 56.1 percent of the <u>actual</u> males in the unknown collection were classified

Table 4. 1976 fall age and sex composition counts on the western arctic herd.

Date	Area	Calves	Yearlings	2^+Cows	2^+Bulls	Total	Observers
10/16/76	1	222	86	431	273	1012	J. Davis/ J. Doerr
10/17/76	2	884	484	1266	853	3487	J. Davis/ J. Doerr
10/17/76	3	55	57	151	61	324	H. Reynolds/ D. Schideler
10/18/76	3	19	16	69	37	141	D. Schideler/ J. Doerr
10/18/76	4	139	73	297	219	728	D. Schideler/ J. Doerr
10/18/76	5	298	170	653	327	1448	J. Davis/ H. Reynolds
TOTAL		1617	886	2867	1770	7140	

Table 5. Mandible lengths of 1959-1961 hunter-killed caribou from the Western Arctic Herd.

Age	Sex	Mean[a]	Range	n
0	Male	201.3	190-210	3
0	Female	197.3	173-212	36
1	Male	234.4	224-251	12
1	Female	233.4	215-245	34
2	Male	259	249-272	10
2	Female	251.8	239-268	21
3-4	Male	272.9	243-288	22
3-4	Female	255.1	240-276	30
5+	Male	269.6	235-308	67
5+	Female	259.1	241-294	57

[a]Measurements to the nearest mm.

Table 6. Diastema lengths of 1959-1961 hunter-killed caribou from the Western Arctic Herd.

Age	Sex	Mean[a]	Range	n
0	Male	70.8	62-77	5
0	Female	70.5	56-78	36
1	Male	895.9	81-91	12
1	Female	83.5	74-92	36
2	Male	94.6	87-104	10
2	Female	91.0	82-103	21
3-4	Male	102.3	86-112	22
3-4	Female	92.1	86-104	30
5+	Male	101.2	83-120	67
5+	Female	95.3	88-115	57

[a]Measurements to the nearest mm.

Table 7. Ratio of mandible length to diastema length of 1959-1961 hunter-killed caribou from the Western Arctic Herd.

Age	Sex	Mean	Range	n
0	Male	2.77	2.65-2.88	3
0	Female	2.80	2.64-3.09	35
1	Male	2.73	2.68-2.78	12
1	Female	2.80	2.76-2.84	34
2	Male	2.74	2.62-2.86	10
2	Female	2.77	2.66-2.90	21
3-4	Male	2.67	2.51-2.83	22
3-4	Female	2.77	2.65-2.93	30
5+	Male	2.67	2.42-2.90	67
5+	Female	2.72	2.51-2.90	57

Table 8. Results of age-specific discriminate analysis between Western Arctic male and female caribou jaws.

Age class of males[a]	Age class of females[a]	General Mahalanobis D^2 [b]	dF	Significance
0 (3)	0 (35)	___[c]	__	___
1 (12)	1 (34)	6.427	3	n.s.[d]
2 (10)	2 (21)	4.530	3	n.s.
3+ (106)	3-4 (30)	37.667	3	<.005
3+ (105)	5+ (54)	39.027	3	<.005

[a]Sample size in parenthesis

[b]The discriminate functions were tested with a general Mahalanobis D^2 to see if the three variables used were significantly different between the two sexes. The general Mahalanobis D^2 generated can be treated the same as a X^2 with the degrees of freedom indicated.

[c]The sample size of male calves was too small to make a discriminate function meaningful.

[d]Not significant at the .05 level.

Table 9. Results of classification of known sex caribou using the functions derived by discriminate analysis.

Known Age and Sex[a]	Classified as: Male[b]	Classified as: Female[b]
3-4 Male (22)	16 (72.7)	6 (27.3)
3-4 Female (30)	6 (20.0)	24 (80.0)
5+ Male (66)	37 (56.1)	29 (43.9)
5+ Female (54)	8 (14.8)	46 (85.2)

[a] Sample size in parenthesis

[b] Percentages in parenthesis.

Table 10. Results of classification of unknown sex caribou mandibles from the 1959-1961 Western Arctic Herd collection using the discriminate functions generated from known sex mandibles.

Age	n	Classified as: Males	Classified as: Females	"Adjusted" classification as:[a] Males	"Adjusted" classification as:[a] Females
3-4	59	26	33	27	32
5-6	32	17	15	30	2
7-8	23	8	15	11	12
9-10	15	6	9	9	6
11+	6	3	3	5	1
Total	135	60	75	82	53

[a] See text for discussion of how the unknown classification was "adjusted".

as males and 43.9 percent were classified as females. Similarly, we can assume 14.8 percent of the true females were incorrectly classified as males. If we let m equal the true number of males, and F equal the actual number of females, we have the following two equations:

$$.561\ m + .148\ F = 17$$

$$.439\ m + .852\ F = 15$$

Rounded to whole numbers the solutions to the equations are m = 30 and F = 2. Thus, after adjusting for the error in classification of the discriminate analysis, the sex ratio of caribou age 5-6 years is determined as 30 males:2 females. This sex ratio, however, is probably too inaccurate to be useful because, although significant sex-related differences exist given the three variables tested, too much overlap occurs. Consequently, the sex ratios from the discriminate analysis were rejected.

A joint study of mandibular lesions of the Western Arctic Caribou herd with Dr. Robert Dieterich of the Institute of Arctic Biology was completed. The major findings are summarized below:

1) The incidence of mandibular lesions in the Western Arctic Caribou herd was 7.0 percent in 1959-1961 and 2.9 percent in 1975-1977, based on the examination of 776 and 68 mandible pairs, respectively. The occurrence in the 1959-1961 collection is believed to be the highest percentage reported for free-ranging caribou herds in North America.

2) The occurrence of mandibular lesions in the 1959-1961 collection was significantly higher in 2+ males, as compared to 2+ females, for both mandible pairs ($P < .05$) as well as for single jaws ($P < .01$).

3) Incidence of mandibular lesions increased with age. In general, incidence was rare for calves to 3 year-olds, increased from 6 to 10 percent in 4-6 years-olds, and ranged from 8.4 to 28.1 percent in age classes seven years and older.

4) 55.7 percent of 97 mandibles showing lesions had all the teeth present, 34.0 percent were missing one tooth, 9.3 percent were missing two teeth and 1.0 percent were missing four teeth.

5) The tooth most commonly lost in jaws missing a single tooth was M1; in jaws from which two or more teeth were absent, P3 and P4 were the most commonly lost. These data suggest that infections in the region of the premolars are most apt to result in the loss of two or more teeth than are infections in the area of the molars.

6) Evidence suggests that tooth loss is determined by the nature of the lesion rather than by the age of the animal.

7) The chances of one mandible exhibiting lesions is 17.5 times higher if its opposing mandible has lesions than if the opposing mandible is normal. Caribou with lesions on both jaws were on the average 1.5 years older than caribou with one afflicted jaw.

8) In 80 out of 85 jaws (94%) the location of the disorder was in the dentoalveolar region; in 5 (6%) the location was in the mandible itself.

9) Radiographs of 65 mandibles suggested that 75.6% of all lesions are the result of dental abscesses, 22.0% are the result of trauma, and 2.4% showed actinycotic-like erosion of the internal mandibular structure prior to bone replacement. None of the radiographed mandibles showed the internal honeycomb structure which Miller et al. (1975) postulated was characteristic of invasions of actinomycosis.

10) Limited studies of mandibular lesions in wild caribou populations suggest that Alaskan herds exhibit higher incidences than the mainland barren-ground herds of Canada and that northern Alaskan herds have higher incidences than smaller, sub-Arctic Alaskan herds. There is also a tendency for lower incidence of mandibular disorders at lower population densities within a given herd.

11) An eleven-year-old female caribou with lesions in both mandibles was found to be bacteriologically negative for *Actinomyces*.

Plans for next year

Completion of thesis and preparation of papers for publication will occupy the remainder of 1977.

LITERATURE CITED

Miller, F. L. 1974. Age determination of caribou by annulations in dental cementum. J. Wildl. Mgt. 38(1):47-53.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: J. Larkin Fox, Dr. David R. Klein and Robert Pegau (ADF&G)

Project No.: W-17-9 Project Title: Research Unit Studies

Job No.: 19.23R Job Title: Assessment of Mountain Goat Aerial Survey Techniques

Period Covered: July 1, 1976 - June 30, 1977

SUMMARY

Preliminary results from the first season's data suggest that important weather-related differences in daily activity patterns of goats occur during mid to late morning and in late afternoon. A late afternoon (1900-2000 hrs.) activity peak in clear weather is evident, as is an earlier (1700-1800 hrs.) but less pronounced peak during cloudy weather. A mid- to late morning active period is demonstrable, though it appears successively later in partly cloudy and cloudy weather, than in clear weather. Total daily activity was greatest during partly cloudy weather. Groups averaged somewhat larger on clear days than on cloudy days, and goats were present at higher elevations under these conditions. A preference for west-facing slopes over south-facing slopes was shown during clear weather. In view of the frequency of clear weather versus high-overcast weather, when aerial surveys are possible, it appears that the best time for survey flights is late afternoon on clear days. Such timing would coincide with the occurence of large groupings, presence of goats on smooth, open slopes at higher elevations, and the late afternoon activity period.

OBJECTIVES

To assess daily and seasonal activity patterns and other factors influencing variability in results of aerial and ground surveys of mountain goat (Oreamnos americanus) populations as a basis for developing reliable techniques for both aerial and ground surveys.

GENERAL

The first summer's field data collection was completed by August 20, 1976. Two semesters of schoolwork followed (September 1976 - May 1977) in which coursework requirements were completed. Also during this time, partial organization and analysis of the data collected to date were completed. Study area mapping, including documentation of vegetation and terrain types, has been started to enable determination of relative abundance and distribution of the types in various study areas. In addition, use of Landsat imagery in delineation of goat habitat has been investigated. At this time, quality and coverage for Southeast Alaska do not indicate an ability to obtain better accuracy than from existing techniques.

Current data have been partially readied for computer analysis, pending addition of this summer's data collection. Some of the data have been organized and analyzed as preliminary results under objectives pertaining to survey variability. These results have been discussed in a paper, "Summer mountain goat activity and habitat preference in coastal Alaska as a basis for the assessment of survey techniques", which was presented at the First International Mountain Goat Symposium, February 19, 1977, in Kalispell, Montana. A version of that paper follows.

The study area is located in Southeast Alaska, 58°30'N, 134°35'W. Coastal ranges in the vicinity vary, from 2500 m high mountains within the huge icefields bordering British Columbia to more common peaks 1500 m to 2100 m high, which separate the ice from major river valleys and inside passages, except where the slopes are breached by glacial flows to sea-level. The treeline in the region, characterized by spruce (Picea sitchensis) and hemlock (Tsuga mertensiana) forest interspersed with thickets of alder (Alnus crispa), is generally about 800 m.; occasionally scrub and krummoltz approach 900 m. Precipitous cliffs virtually devoid of tree growth, sometimes span the drop from alpine to sea-level. The particular area of this study is relatively discrete alpine zone approximately 40 km^2, and is dominated by Stroller White Mountain (1570 m.), located some 25 km. northwest of Juneau. Bounded to the north and east by large glaciers and ice-fields, the study area drops off west and south to forested lowlands abutting the inland waterways of lower Lynn Canal (Fig. 1).

The study encompassed a period from June 15 - August 21, 1976, with several short interruptions through the end of July, and a hiatus of the first two weeks in August, when surveys were conducted elsewhere. Data consist of approximately 2000 point-in-time observations of goat groups taken in 15 minute intervals and categorized as to elevation, topography, slope exposure, slope angle, snow cover in vicinity, group composition, individual activity, basic vegetation type, and observer direction and distance.

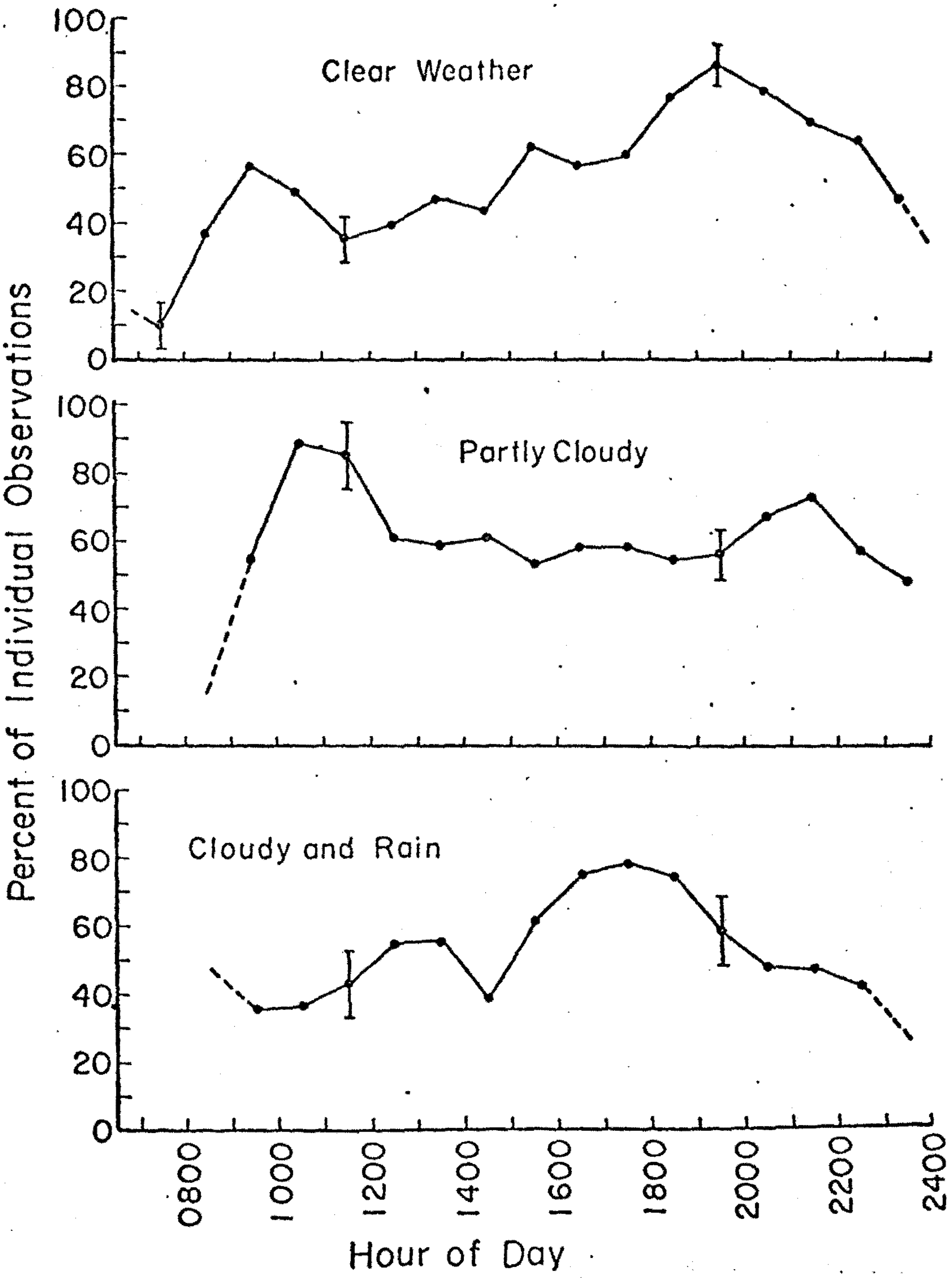

Figure 1. Daily activity pattern reflected in percent of active individuals.

Also recorded for each group was an estimate of distance from nearest ridgeline and distance to treeline, while movements were recorded at the 15 minute intervals noting direction, distance, vertical change and rate. Weather information was recorded at least every 2 hours during observations and included air temperature, wind speed and direction, humidity, cloud cover and precipitation type and rate. Major weather changes, as defined below, were also noted, and recorded in conjunction with group observations. Two specific time period types are defined.

Several definitions and explanations of data manipulation are necessary before continuing with the results. A group was defined as an individual or an aggregation of goats 100 m. or more from the nearest other individual or aggregation. The term "group observation" refers to one point-in-time recording of data concerning an observation of a particular group or individual. More than one group may have been in view at a particular point-in-time; thus, several "group observations" might have been taken at that time. Graphical presentations below are ordinated in terms of these individuals or "group observations". Major weather changes were divided into three types: clear, 0-50% cloud cover; partly cloudy, 51-95% cloud cover; and cloudy, 96-100% cloud cover (fog and rain included). For the calculations culminating in results given below, each weather type has been divided into two periods: 1-5 hours and 6 hours or more from the time of weather change. Unless otherwise specified observations during the transition period of 1-5 hours are not included in calculations pertaining to a particular weather type.

Weather types and observations within them were distributed as shown in Table 1. The material presented below is concerned with differences in goat activity or use patterns from one weather type to another, and, in general, no attempt has been made to construct overall summer patterns utilizing the differences in distribution outlined in that table. The relatively small percentage of clear weather over the summer, and the even smaller span of partly cloudy conditions, indicate that partly cloudy conditions are a rather short transition stage. Other weather parameters and cloud cover are related to the weather types distinguished here, and will be further analyzed after additional data gathering. For example, temperature and humidity are probably closely correlated with weather type, but additional factors, such as wind, and light conditions certainly affect the potential for aerial survey. It should also be pointed out that clear days in Southeast Alaska are commonly very clear with few clouds. If any clouds do occur, they are of the high cirrus type. Convectional afternoon cloudiness and thunder storms characteristic of continental mountains are generally lacking here, where the controlling factors are cyclonic weather patterns from the ocean, with usually rather abrupt changes between clear and stormy conditions.

About 9 $km.^2$ of the study area included habitat which could be relatively easily observed under good visibility conditions. Here family groups, consisting basically of adult females, kids and juveniles, were used as the predominant subjects of observation, usually totalling between 30 to 35 animals. Most of the 9 or 10 billies present were segregated on a nearby connected ridge system some 4 km. distant. Another 20-25 adult females and immature animals were located about 5 km. from the observation site; observations of this segment of the study population were attempted only on clear "survey" days.

Table 1. Distribution of weather types over the study period and within the time sampled.

Weather Type	Study Time Span 15 June-21 Aug.	Observation Time Span	Number of "Group Observations"
Clear	29%	39%	42%
Partly Cloudy	13%	32%	32%
Cloudy	58%	295	26%

Table 2. Group size under the different weather types

	Clear	Partly Cloudy	Cloudy
Mean Group Size	7.4	6.8	6.6
Sample Size	n=781	n=276	n=289
Standard Error	.21	.39	.34

Diurnal activity patterns appear to be somewhat different under the various weather types. The data are still relatively inconclusive in this regard; but further studies, it is hoped, will clarify the situation, especially since the largest problem in summing individual activity is the non-random factor introduced through group synchrony. Only a large sample will reduce such influence.

Daily activity patterns are displayed in Figure 1, where activity is reflected in a running average of active animals, summed for hour intervals under each of the weather types. Active animals are on their feet, as opposed to being bedded, and may be feeding, standing, walking, nursing, playing, etc. This representation includes all individual observations in each weather type, under the assumption that the animals react faster to weather change in their activity than, say, in their group size, habitat or elevation locus; sample size is also thus increased. No adjustment has been made for the change in day length, which will slightly affect the activity summation of the study, for periods equivalent to dawn and dusk.

Confidence limits ($p = .05$) have been generated for at least two points on the graph in each weather type, to provide a sample of variability within the data; serial correlation among the activity observations applies also to their variance, and a direct point-to-point comparison between weather types would not be extremely meaningful. For the present an approximation for the range in variance suffices to allow a few statements of comparison. Important differences among weather types in daily activity patterns appear as fluctuations during mid- to late morning and late afternoon. A late afternoon (1900-2000 hours) activity peak in clear weather is evident, as is an earlier (1700-1800 hours) but less pronounced peak during cloudy weather. A mid- to late morning active period is demonstrable, though this period appears successively later in partly cloudy and cloudy weather. Partly cloudy weather often occurs as a short transition between the other two weather types. Activity could conceivably reflect a composite of the clear and cloudy patterns at this point; however, the data are rather equivocal concerning such interpretation.

There are also slight differences in total daily activity under the various weather conditions. Through the hours 0800 - 2400, animals were overall less active in cloudy and rainy weather (53% active), than in clear weather (56% active), with activity during partly cloudy conditions being greatest (61% active).

Mean group size, as exhibited by the mean of all "group observations", was 7.0; Table 2 outlines the <u>means</u>, <u>sample sizes</u>, and <u>standard errors</u> for group size, relative to weather types. The mean for partly cloudy conditions is intermediate, and not significantly different from clear or cloudy weather, respectively ($t = 1.35$, $p > .5$; $t = .52$, $p > .5$).

However, a difference in means between clear and cloudy conditions is evident ($t = 2, p > .05$), indicating that groups are somewhat larger on clear days. Limited data on the size of billy groups shows a much smaller mean size of 2.2, which is significantly different ($t = 7.96, p < .005$) from the overall mean comprised mainly of adult female-immature groupings.

Groups in this study ranged in size from 1 to 30 individuals; the following evidences of habitat preference are given in terms of group use and require some qualification. In relating habitat use directly to survey accuracy, it is implicitly assumed that groups are the effective objects of search in a survey, and that groups of different size are equivalent in ease of location (the latter assumption is probably not valid). It should be apparent that group size may be related to habitat preference, a factor which will in turn affect ease of location in surveys. It is also necessary to recognize the potential separation of billy and adult female-immature group summering areas, so that adult:kid ratios do not reflect simply the relative survey time spent in each area. More data will be gathered on the billy groups, for example, to learn if these groups occur at higher elevations than the adult female-immature groups, as Brandborg (1955) and Ballard (1975) have suggested. Such relationships need to be tested and will be investigated as the study progresses. For the present, group data should provide acceptable criteria for the determination of habitat selection related to weather type.

Use of different elevation zones under the various weather types is displayed in Figure 2; percentage of "group observations" is that within a specific weather type. Note particularly the percent use according to weather within an elevation zone; differential selection of elevation is very evident under the different weather regimes ($X^2 = 348, p > .005$). Percent use between zones is not directly comparable because of variation in available terrain under the respective zones, although area is nearly equivalent from zone to zone, except above 1200 m. General use occurred between 750 m. and 1200 m., with virtually no use below 750 m. recorded. Under partly cloudy conditions (5 hours), goats are relatively higher, more closely approximating the distribution under clear weather and indicating that a notable movement to higher elevations occurs following clearer weather.

Knowledge of distributional changes in elevation use under different weather regimes is important for planning and assessing surveys, but general applicability may be somewhat limited by the effects of other habitat parameters on elevation range, even at the same latitude. The recording of group distances from treeline and ridgeline was initiated in an attempt to provide a more common basis for relating altitude information to other habitat data. Differences in distribution, relative to ridgeline, are evident under the various weather conditions ($X^2 = 137, p > .005$), as are use distribution differences relative to treeline ($X^2 = 280, p > .005$). Data on relative use of the limited area above 1200 m. indicate the preference for ridgetop areas on clear days. Such use of ridgetop zones is also indicated by ridgeline data, though the latter do not reflect weather-related elevation changes as strongly as do the distance-from-treeline data (Figure 3). This variation was probably the result of a lateral movement of goats toward the effluent end of a watershed. In cloudy weather,

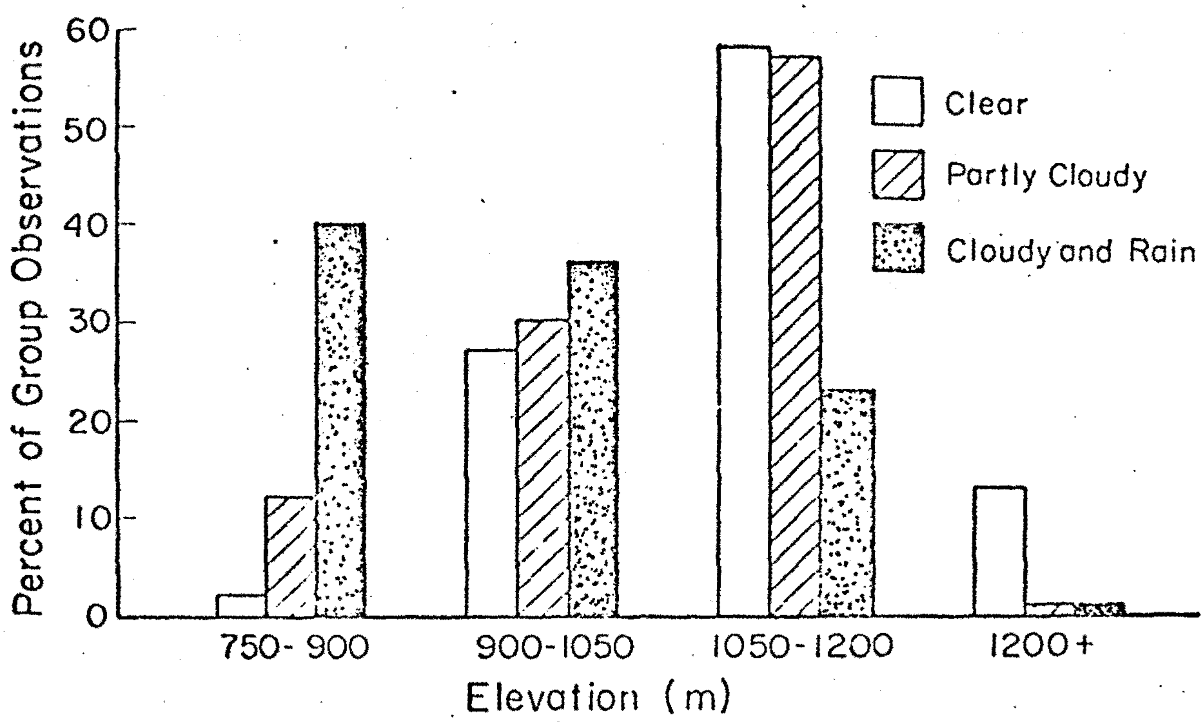

Figure 2. Differential use of elevation according to weather type.

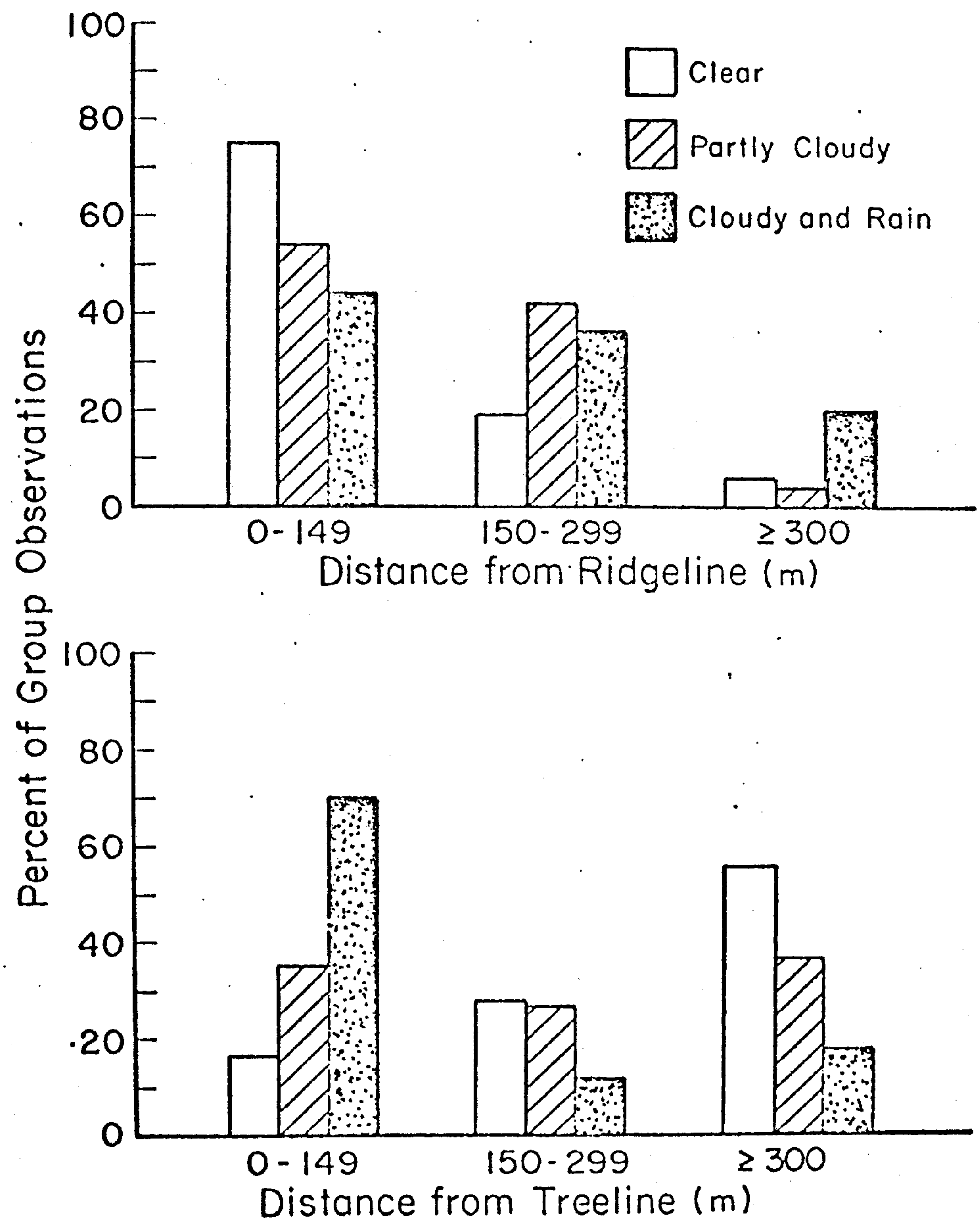

Figure 3. Differential use with respect to ridgeline (top) and treeline (bottom) according to weather type.

such movements would bring them somewhat closer to the descending ridgeline, without greatly changing the distance to treeline.

The obvious conclusions are that ridgeline data are more variable than treeline data, and that comparisons of distances from ridgeline (a factor determined primarily by height of ridge systems) between areas of different topography, would probably be equivocal. Distribution of suitable habitat, in this context, is important, especially cliff areas, in relation to elevation, ridgeline and treeline. An additional area surveyed, plus the Fish and Game aerial survey evaluation sites, seemed to indicate that goats will occupy treeline and forested cliff habitats on warm, clear days if the immediate alpine regions do not offer sufficient steep, broken terrain for shade, or high, narrow ridgelines for access to moving, cooling air. At this point, it would be wise to demonstrate that the elevation, ridgeline and treeline data are representative of the present study area, and indicative of trends which may apply to neighboring sites. However, these trends will have to be tested relative to their application validity.

Physical habitat selection is evident ($X^2 = 85$, $p > .005$) under the various weather conditions, a notable trend being toward greater use of smooth slopes and snowbanks during clear weather (see Figure 4). With regard to surveys, the greater use of smooth slopes (if above treeline) would tend to make the goats more visible; goats on snow are more difficult to locate. Use distribution of slope exposure differed ($X^2 = 243$, $p < .005$) according to weather type, most noticeably with west slopes being preferred to south slopes, and no increased use of northern slopes in clear weather.

Greater use of west slopes is possibly related to the comfortable temperatures of low sun angles in the late afternoon during clear weather. The lack of north aspect use is noteworthy in relation to findings explained by Chadwick (1973) in Montana, where an increased use of northern aspects in summer was postulated as being related to both forage quality and thermal characteristics on warm summer days. In Southeast Alaska it is doubtful that forage selection on north slopes is important, since new forage appears all summer on south slopes, adjacent to receding snowbanks. Regardless, the lack of prolonged clear weather makes such thermal selection comparatively unnecessary. In the way of corroborating evidence from Alaska, Hjeljord (1971) found only 11 percent use of northerly aspects among 42 feeding sites he examined in the coastal Southcentral region.

The overall use of slope exposure during this summer study period is shown in Figure 5. In general, the data reflect topography. The land slopes to the west and south, with peaks in the opposite directions abutting high icefields and glaciers and little available habitat. Much of the coastal region consists of mountains facing westward on the ocean. Slope exposure use delineated here probably applies to a good part of the region, although in some areas, river or inland waterway invaginations create more more easterly preferred habitat.

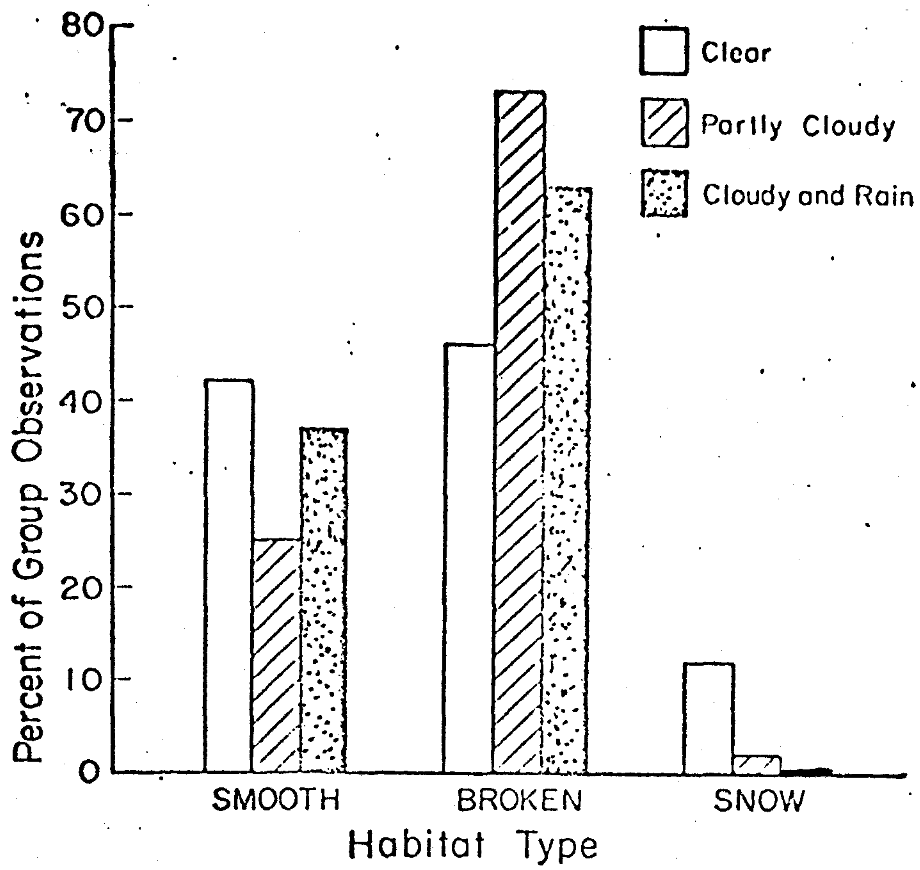

Figure 4. Physical habitat selection according to weather type.

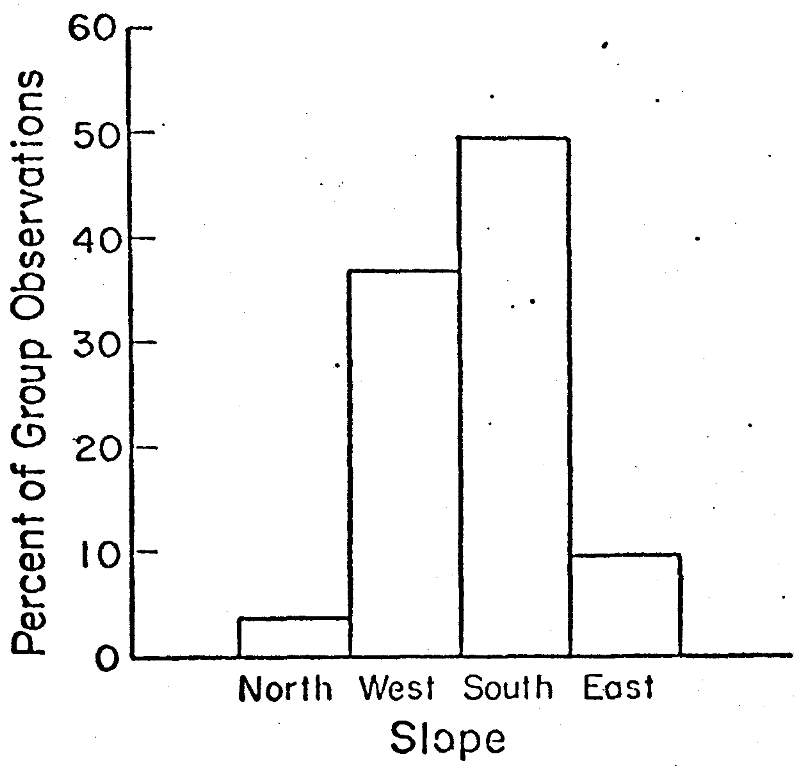

Figure 5. Overall use of slope exposure.

Weather greatly limits the number of days available for aerial surveys in Southeast and Southcentral Alaska by influencing daily goat activity patterns, sightings, and flight conditions. Clear weather is the logical condition for surveys and changes in activity or habitat use related to clear weather are the main subject of this study. There have been suggestions that partly cloudy or cloudy weather, in which the clouds are high and do not obstruct visibility, may provide good survey conditions for locating goats (Ballard, 1975). Such possibility deserves further investigation, especially in light of the evidence that goats are overall more active, and thus probably more observable, under partly cloudy conditions. However, presently recorded observed activity is greated in the late afternoon during clear weather. The capability of repeating surveys under similar conditions is an additional important criterion for test accuracy and yearly surveys. In Southeast Alaska, partly cloudy weather usually occurs as a short transition period, and is thus of negligible value for goat surveys.

It has already been pointed out that the results of this study are somewhat restricted to specific sites, especially in terms of use related to elevation, treeline and ridgeline, and will require a test of their applicability to other areas of goat habitat in the region. It is evident, though, from the study to date that on clear days, as opposed to the predominantly cloudy and rainy days of Southeast Alaska, goats tend to congregate in larger groupings; to move higher in their range, closer to ridgeline and farther from treeline; to use smoother, often more open habitat, including snowbanks, and to synchronize an activity period in the very late afternoon. Aerial surveys conducted on clear days should provide close to optimum results, timed well after (approximately 10 hours) cloudy-rainy conditions and performed during the later afternoon active period. If deemed desirable, ground counts could also conceivably be initiated with the appearance of clear weather, provided that the important vantage points could be reached before late afternoon for optimum counting conditions.

The important question then becomes: how accurate are counts taken under presumably optimum conditions? Previous aerial counts showed considerable variation in results over relatively short periods of weeks or month, thus indicating problems with accuracy from the air. Great differences (both increases and decreases) between past and present counts in selected discrete areas suggest that some of the major fluctuations may reflect actual changes in goat activity. Factors influencing these differences (e.g. predation, weather, immigration, emmigration) are not clear and warrant further inquiry -- especially the movement factor -- if a proper assessment of survey counts is to be made. Regarding the various aerial and ground counts in the study so far, the number of comparative counts is presently too small to permit meaningful conclusions about relative accuracy. It is evident here, however, as in the previous evaluation (Ballard, 1975), that a close approach to the total obtained in more intensive counts can be made in short surveys by fixed wing aircraft.

Finally, it is desirable (and should be feasible) to derive a statistically acceptable percent accuracy for aerial surveys, through comparative simultaneous ground and aerial counts. Such surveys should be conducted under a particular range of conditions permitting a few yearly replicate counts. In this way a more accurate estimate of numbers and adult-kid ratios in selected areas could be obtained.

LITERATURE CITED

Ballard, W. 1975. Mountain goat survey technique evaluation. Proj. W-17-7, Job 12.2R, Alaska Dept. of Fish and Game, Juneau. 21 pp.

Brandborg, S.M. 1955. Life history and management of the mountain goat in Idaho. P. R. Proj. 98-R, Idaho Fish and Game Dept., Bul. No. 2. 142 pp.

Hjeljord, O. G. 1971. Feeding ecology and habitat preference of the mountain goat in Alaska. M.S. Thesis, Univ. of Alaska, College.

Plans for next year

This summer's fieldwork will encompass substantial comparative observations in sites other than the main area as described in the paper above, and will continue through the end of August. Computer analysis of all data will follow in the fall with thesis preparation in the winter and spring, and projected completion by May.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Carol Linkswiler, Drs. David R. Klein, R. Dale Guthrie, Frederick C. Dean and William Gasaway (ADF&G)

Project No.: W-17-9 Project Title: Research Unit Studies

Job No.: 19.24R Job Title: Assessment of Daily and Seasonal Activity Patterns of Moose as they Influence Aerial Visibility

Period Covered: July 1, 1976 - June 30, 1977

SUMMARY

Observations of moose activity were conducted in Mt. McKinley National Park during July and August 1976, and on a part-time basis during September, October and March (1977). Daily observations were resumed during May and June 1977, and will continue through July and August. Preliminary analysis of data collected to date indicates a linear relationship between declining moose activity and increasing ambient temperature. During summer, moose activity peaks occur in morning and evening. This varied from May patterns, when morning activity was delayed and an additional peak was apparent from 2 - 3 p.m. Completion of data analysis and thesis preparation will take place in winter 1977-1978.

OBJECTIVES

To examine the behavior patterns of moose (Alces alces) in relation to aerial observability.

1. To determine the influence of environmental factors on the behavior of moose, including season of year, time of day, vegetation type and progression, snow conditions, and weather (wind, precipitation, sun, temperature, humidity, barometric pressure).

2. To determine the variation in moose behavior by sex and age class and conspecific relationship as it may affect observability.

3. To develop predictability for: a) optimum daily and seasonal timeing of aerial moose surveys and b) assessment of observability bias with regard to total numbers and sex and age composition.

GENERAL

Fieldwork was resumed on a full-time basis in May in Mt. McKinley National Park. Earlier field work was conducted full-time in July and August 1976 and part-time in September and October 1976 and March 1977. Total hours of observation through June 1977 will be approximately 750. Fieldwork will continue on a full-time basis in July and August 1977 and part-time thereafter until early November, when observations will be discontinued and time will be devoted entirely to data analysis.

Observations have been made on a daily basis, generally for 6-8 hours per day, during daylight hours. In an attempt to gain greater continuity of data, at least 3 days will have been spent consecutively at each study site by December 1977. The three-day periods to be spent at each site were selected randomly. Two main study sites were used during summer. One site near Igloo Mountain includes a large flat area and surrounding hills, with vegetation comprised of spruce and varying shrubs. There are a number of ponds in the area, one of which was heavily utilized by moose in July 1976. Approximately 30 percent of my observation time will have been spent at this site. The other site is a long, gradual north-facing slope covered with large stands of tall willow growth, with small belts of spruce near the base, and occasional small clearings. About 70 percent of my observations will have been made in this area or at a very similar site about a few miles farther out in the park. During fall, winter, and spring, moose have not used these locations as consistently as during summer, and are observed wherever located.

It is rarely possible to observe moose utilizing spruce habitats because of the density of the cover. The same problem exists in much of the tall shrubbery, particularly after leaf emergence, and as a consequence, observations in these areas are usually discontinuous. Much of the willow in the study sites is taller than the moose and extremely dense, so animals are visible only for short periods of time, or when they move into a clearing. When the vegetation is not leafed-out, it is often possible to obtain a continuous record of behavior for an animal.

Concurrently with behavioral observations, a number of environmental conditions are being measured. These include: wind speed and direction, temperature, humidity, barometric pressure, cloud cover, precipitation, and insect harassment. In September, analysis will begin to determine which of these factors or combinations of factors are correlated with variations in moose activity. Analysis of data for July - October 1976 showed a nearly linear relationship of increasing temperature with declining activity in the 40°-80°F range; below 40°F, however, the data were highly variable, possibly because nearly all activity taking place below 40°F occurred during the rut.

Most analysis to date has been of activity in relation to time of day. Data from 1976 showed activity peaks in the morning and evening; although behavior was quite variable in the fall, moose activity still tended to be lower at midday throughout the months of observations. Data for May 1977 are considerably different in that the morning activity peak is several hours later than for July - August 1976; there is also a fairly strong activity peak from 2-3 p.m., which is not apparent in summer 1976 observations. Data for June 1977 have not yet been examined.

Additional activity data are being provided by some of the park shuttle bus operators. As they drive along the park road, they use forms I have provided for recording their observations of moose. So far, they have noted the greatest number of active moose from 7-8 a.m. and from 12-1 p.m., both being times when my own data indicate rather low levels of activity. In addition, they report very few active animals in the evening, which my observation data indicates is the period of greatest activity. I believe this absence of an observed evening activity peak can be attributed to human perception rather than to moose behavior. Evening data are collected on incoming buses when the observers are tired and generally make less effort to look for wildlife.

Beginning the third week of May, cows were seen with new calves, and in two instances it was possible to collect activity data on these cows. Even several days after calving, these cows spent the major part of their time bedded down. Initially, I felt the twinning rate was quite high relative to any figures I had read in the literature. Most cows I have seen with calves have only one calf, and I am observing a number of cows with no calves.

Predation by grizzly bears (Ursus arctos) on young calves appears to have been significant, with 3 actual kills and a number of chases being witnessed by various people in the park. References to bear predation on moose calves in the literature have suggested that it is probably not very important, but events observed in the park this year suggest this is not the case, and evidently studies being done in other parts of Alaska are also indicating that bears are a significant predator on young calves (Gasaway, pers. comm.).

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