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MOUNTAIN GOAT MOVEMENTS STUDY

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Volume IV

Progress Report
Federal Aid in Wildlife Restoration
Project W-22-2, Job 12.5R

(Printed July 1984)

PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: None

Project No.: W-22-2 Project Title: Big Game Investigations

Job No.: 12.5R Job Title: Mountain Goat Fidelity to Given Area by Season and Seasonal Movements

Period Covered: 1 July 1982 through 30 June 1983

SUMMARY

Five of the mountain goats (Oreamnos americanus) initially radio-collared in 1979 were recollared in June 1982. One of these died, probably from mechanical injury. Body measurements and biological specimens were collected and are listed. During this report period, 14 tracking flights were made and collared goats located and plotted. Aerial counts were made of the study herd, including that portion occupying the north side of Trail Glacier, in spring and summer; from the results, population models were constructed. Classification of 2 portions of the herd was accomplished from the ground in summer; results were compared with those obtained from the air. The herd has increased each year following the winter die-off in 1979-80 and now numbers about 300 animals. During aerial counts, the observed ratio of kids to adults was 27 in 1982. Natality and mortality rates are discussed. There were 28 functioning radio collars on living goats as of 5/1/83.

Key words: fidelity, Kenai Mountains, mountain goat, Oreamnos americanus, season, seasonal movements.

CONTENTS

BACKGROUND

The background and justification for this study were presented previously (Nichols 1983).

OBJECTIVE

To determine the seasonal movements of mountain goats in the Kenai Mountains, and to assess the fidelity of goats to given areas within seasons and between years.

PROCEDURES

Capturing, tracking, and plotting procedures have been described in previous reports (Nichols 1980b, Nichols 1982, Nichols 1983, Schoen and Kirchhoff 1982). In brief, goats were captured by helicopters using drugged darts (M99), and equipped with radio collars of discrete frequencies. During collaring, morphometric information and biological specimens were obtained. Collared goats were relocated periodically using a Piper Super Cub aircraft equipped with dual, 3-element Yagi antennas connected to a scanning receiver. All telemetry equipment was purchased from Telonics, Inc., Mesa, Ariz. Each relocation site was plotted by date and goat number on segments of USGS 1:63,360 topographic maps, then replotted on large, base-map overlays in the office. Additional information on companions and habitat was recorded for each resighting. Aerial surveys, one in spring and one in summer, were conducted to obtain information on the entire study area population. Additional surveys of segments of the study herd were made from the ground in summer to obtain detailed sex and age composition data.

FINDINGS

Radio Collaring

Five goats were recaptured and fitted with new radio collars 23 June 1982. All had been collared originally in August 1979. These were breeding females, recollared to maintain continuity in the study of their reproductive history. Serial numbers, ages, reproductive status, and collar frequences are listed in Table 1. These animals were captured with the same helicopter-dart gun technique as used previously, again using the drug M99 (etorphine). Goat weights, dosages, and times to induction and recovery were recorded (Table 2), as were body measurements (Table 3). Blood specimens were collected and analyzed for the various component values (Table 4).

One animal, No. 11, appeared to recover from the capture and handling, but was found dead the next day. She had suffered a deep dart wound in the hind leg and may have bled internally. Additionally, she appeared somewhat sick when captured. This is the only loss from handling 49 goats captured with this technique.

Radio Tracking

Fourteen tracking flights (10 in spring, summer, and fall; 4 in winter) were made during this report period. Several additional flights were made to locate 1 individual (No. 15), which wandered far out of the study area for a short period in spring 1982 and 1983. Data collected on these flights are recorded in Table 5. The percentage of breeding-age females (4 years and older) with kids at heel dropped from 72% after parturition in mid-June 1982 to 60% in February 1983, a fairly steady decline throughout late summer and winter. Since a number of kids apparently leave their mothers in early spring, the observed percentage of adult females with kids is probably not a valid indicator of kid mortality after early April. As usual, weather made it impossible to carry out all planned bi-weekly summer and monthly winter flights.

Telemetry equipment continued to operate satisfactorily, and all collared animals could be located at will. All radio collars continued to function properly, including the remaining 6 installed in August 1979. As of this writing, these 6 transmitters have exceeded their specified 2-year battery life by 1.5 years.

Four collared goats were lost during the year, including the one previously mentioned. One was killed by a hunter, and 2 died during winter of unknown causes. At the end of April 1983, 28 collared goats were still alive (Table 6).

No further analysis of movement information has been attempted because access to a computer could not be obtained. A complete analysis is planned following final summer tracking in 1983, and will be included in the final report on this study.

Aerial Survey Results and Population Estimates

Two aerial surveys were flown over the entire study area including the north side of Trail Glacier, 1 in spring to determine overwinter survival of kids, and 1 in midsummer to determine current kid production and herd size. On 17 May 1982, a total of 136 goats (including 34 yearlings) was counted; survey flights on 5 and 13 August resulted in a total of 271 goats (214 nonkids and 57 kids).

The spring survey was made prior to the kidding season and when yearlings were still recognizable from the air by horn and body size and by facial characteristics (Nichols 1980a).

Ideal weather conditions (calm with a high overcast) did not occur when summer flights could be made. Previous study (Nichols 1980a) showed that attempts to census mountain goats on hot, summer days produced inaccurate and unpredictable results. It was learned during ground surveys that, following hot, sunny days, goats become active and visible during the last few hours of daylight. Therefore, the summer 1982 aerial census was conducted in several late-evening segments. During these flights, it was noted that goats were highly visible and count conditions were good. I believe that accuracy was comparable with that obtained under the best midday, overcast conditions. For example, on 2 August 1982, a hot, clear day, a midday survey revealed only 18 goats, including 5 kids in Ptarmigan Valley, and 46 with 12 kids in King's Bay Valley. Flights covering the same areas on 5 and 13 August, following similar clear, hot days but made in the evening from 1830-2145 hours, produced totals of 49 with 10 kids in Ptarmigan Valley and 76 with 14 kids in King's Bay Valley.

By combining results of the spring and summer aerial surveys (Nichols 1980a), population models for the study herd were compiled. The method yields herd composition by total, total adults (total less kids-of-the-year), yearlings, and kids. Radio tracking showed that goats moved freely across the former study area boundary of Trail Glacier Valley to and from its north rim. Therefore, the study area was expanded in 1982 to include the north side of Trail Glacier during aerial surveys. For practical purposes, this appears to be the northern limit of this herd. No movement further north has been detected.

Previous study has suggested that aerial surveys conducted under conditions of good visibility account for about 90% of the animals present (Nichols 1980a). Therefore, a population estimate may be obtained if we assume the observed totals represent about 90% of the true population. This correction was made in constructing population models for the former study area from 1977 through 1982, and for the area including north Trail Glacier in 1982 (Table 7). The herd appeared to be stable in size for the 1st 2 years of the study, then increased during the third. A sharp decline occurred over the severe winter of 1979-80, followed by 2 years of increasing numbers.

Attempts were made to estimate herd size by the Lincoln Index method using the radio-collared goats. In May 1982, the ratio of observed to total collared animals was 11:32; in August, it was 20:30. Observed totals during the 2 counts were 136 and 271 respectively, leading to estimates of 396 and 407 total goats. While these estimates agree closely, I do not believe the herd is this large, but rather that it is closer to the 300 estimated by aerial census. Goats that have been darted from a helicopter, handled, and collared tend to be more secretive than others when approached by an aircraft and might be more easily missed during surveys. Furthermore, not all animals were approached closely enough to observe collars with certainty during the counts. Thus, collared goats may not have had the same probability of being sighted as uncollared goats, and this necessary assumption for Lincoln Index use may not have been fulfilled. Should flight time and conditions permit, more care should be used in future surveys to accurately ascertain the presence of collars if the data are to be used for population estimates using the Lincoln Index.

Ground Survey Results

Field trips into upper Ptarmigan Valley and upper King's Bay Valley were made in July 1982 to obtain sex and age compositions of samples of the study herd. Similar classifications have been made in the past (Nichols 1982); however, none were made in 1981 due to inclement weather. Goats were classified by telescope in late evening when they were actively feeding and when most in each area appeared visible. Based upon physical characteristics previously outlined (Nichols 1980a), animals were classified as kids, yearlings, 2-year-old male or female, or "adult" male or female. It was not found possible to determine age above 2 years, so all older goats were considered "adult" even though females, at least, do not reach sexual maturity here until after age 3 (Nichols 1982). Based upon these classifications, population estimates for the Ptarmigan and King's Bay areas were constructed (Table 8). The lack of 2-year-old animals in the herd probably reflects the severe winter of 1979-80 and consequent low crop the following spring. The reason for the low ratio of yearlings to adult females in the King's Bay segment is unknown but may be merely a result of small sample size.

Herd Dynamics

Although the goat herd under study has shown some fluctuations over the period 1977-1982, the population appears to be increasing (Fig. 1). Since radio tracking showed that goats do cross the former study area boundary of Trail Glacier Valley, the herd is now assumed to include those animals on its north side. These were included in some past aerial counts, even though they were not thought to be part of the study herd at the time. The trend of the larger herd, which includes these additional goats, has been almost identical to that of the original portion of the herd (Fig. 1).

The herd appeared almost static between 1977 and 1978 and then increased between 1978 and 1979. Between 1979 and 1980, however, it decreased abruptly, reflecting the severe winter and consequent high mortality. This trend is similar for both total animals and total adults (Fig. 2), and somewhat similar for the numbers of kids produced. However, the yearling segment showed only a slight dip following the winter of 1979-80. For the 2 years after that severe winter, the herd seems to have increased rapidly. The total number of goats counted in 1981 was 32% greater than in 1980, and 16% greater in 1982 than in 1981. The number of kids produced did not increase substantially, while the yearling segment showed a steady rise during these 2 years. Thus, it appears that the herd increase may have been related more to improved survival of young (and probably older animals as well) than to increased natality.

The ratios of kids and yearlings to total adults as obtained from population models, ground surveys, and the collared portion of the herd have been compared (Table 9). These ratios, while not as accurate as ratios to adult females, do give an estimate of annual kid production and yearling survival. These ratios, except in 1982, show similar trends, including the drop following the severe winter of 1979-80 and recovery thereafter, and are in close agreement except for 1982. I do not know why there was such a discrepancy in 1982.

Ratios of kids and yearlings to total adults underestimate the more accurate ratios to breeding-age females. For example, the following comparisons were obtained from the known-aged radio-collared goats: females over age 4 in 1982 (18); females over age 4 with kids (13); kids:100 adult females (72); total adults (32); total adults with kids (13); and kids:100 total adults (41).

The ratio of kids to total adults represents about half of that to breeding-age nannies (in this case, those age 4 and over). The latter is a more nearly correct estimate of the true annual production of young. This difference should be considered when evaluating aerial surveys that typically produce only kid to total adult ratios.

The ratios of kids and yearlings to "adult" females and to total adults, as obtained during detailed classification surveys from the ground in Ptarmigan and King's Bay Valleys, were compared statistically. In this case, "adult" females were those aged 3 and above; it was impractical to classify animals above age 2. Thus, these ratios do not reflect accurate production by sexually mature females (here, age 4), but give a closer approximation than by using total adults only. No significant differences ($P > 0.05$) were found by area (Ptarmigan or King's Valley) or by age class (kids or yearlings) in the relationship between the ratios of kids or yearlings to adult females and to total adults. The mean difference between the ratios of kids or yearlings to adult females and the ratios to total adults was 2.22 ($N = 18$; CI [95%] = 1.66-2.78), i.e., the ratio of kids or yearlings to total adults multiplied by 2.22 = the ratio to adult females.

For example, if the ratio of kids to total adults was observed as 34:100 during an aerial survey, the ratio of kids to adult females would be approximately 75:100. This gives a more accurate approximation of reproductive success.

Any use of sex or age ratios incorporating unclassified adults does have inherent weaknesses despite the relationship noted previously. Changes in proportions of adult or subadult males or females, such as through differential mortality, selective hunting, etc., would affect the observed ratios of young to adults. This would not necessarily affect the ratio of young to breeding-age females, however. Thus, use of young:adult ratios to estimate actual production in terms of young:adult females may not always be valid.

The relationship between kid and yearling ratios to total adults, as observed during ground classifications and aerial surveys, was compared. No significant differences ($P > 0.05$) could be found between the ground and aerial counts. Thus, it appears that these ratios, as determined during flights made in late spring and again in summer, are reasonably valid.

Losses from natural mortality, exclusive of hunting, were calculated from the population models from 1977 to 1982 (Fig. 3). Overwinter mortality of kids to yearlings was about 50% when the herd size was static between 1977 and 1978, and remained so as the herd increased between 1978 and 1979. Losses between these age classes increased to nearly 60% as the herd declined sharply during the severe winter of 1979-80, but then mortality was minimal during the next 2 winters as the herd recovered. During the same periods, overall herd mortality was very low in winters during which the herd increased--less than 10%. However, winter losses in the herd as a whole were over 40% during the aforementioned bad winter.

If, during winters of high mortality, kids and yearlings died at the same relative rate as older animals, the ratios of these cohorts to adult goats should remain approximately constant even though numbers declined. During the 1979-80 winter, the ratio of kids to total adults declined, while the ratio of yearlings increased slightly (Fig. 4). This suggests that kids died at a somewhat greater rate than older animals, including yearlings. It appears that winters severe enough to cause high mortality may affect goats less than 1 year old, and probably very old goats to a greater extent than the more vigorous age classes. On the other hand, following milder winters, herd increases seem to occur more because of improved survival of all age classes than because of increased kid production.

RECOMMENDATIONS

I recommend that this study be continued at least 2 more years to fully utilize data from radio-collared goats in determining range use fidelity over a series of seasons.

No management recommendations regarding goat movements or home range fidelity can be made until data have been fully analyzed.

ACKNOWLEDGMENTS

I would like to thank Chuck Schwartz for his assistance in radio-collaring goats during June 1982, and offer condolences to all those who volunteered to do so but could not due to lack of space. It was fun. As in the past, it could not have been done without the expert piloting and able help of Vern Lofstedt, Kenai Air Alaska, Inc. I would also like to acknowledge Karl Schneider's continuing support of this study, and Al Franzmann's help in obtaining blood analyses.

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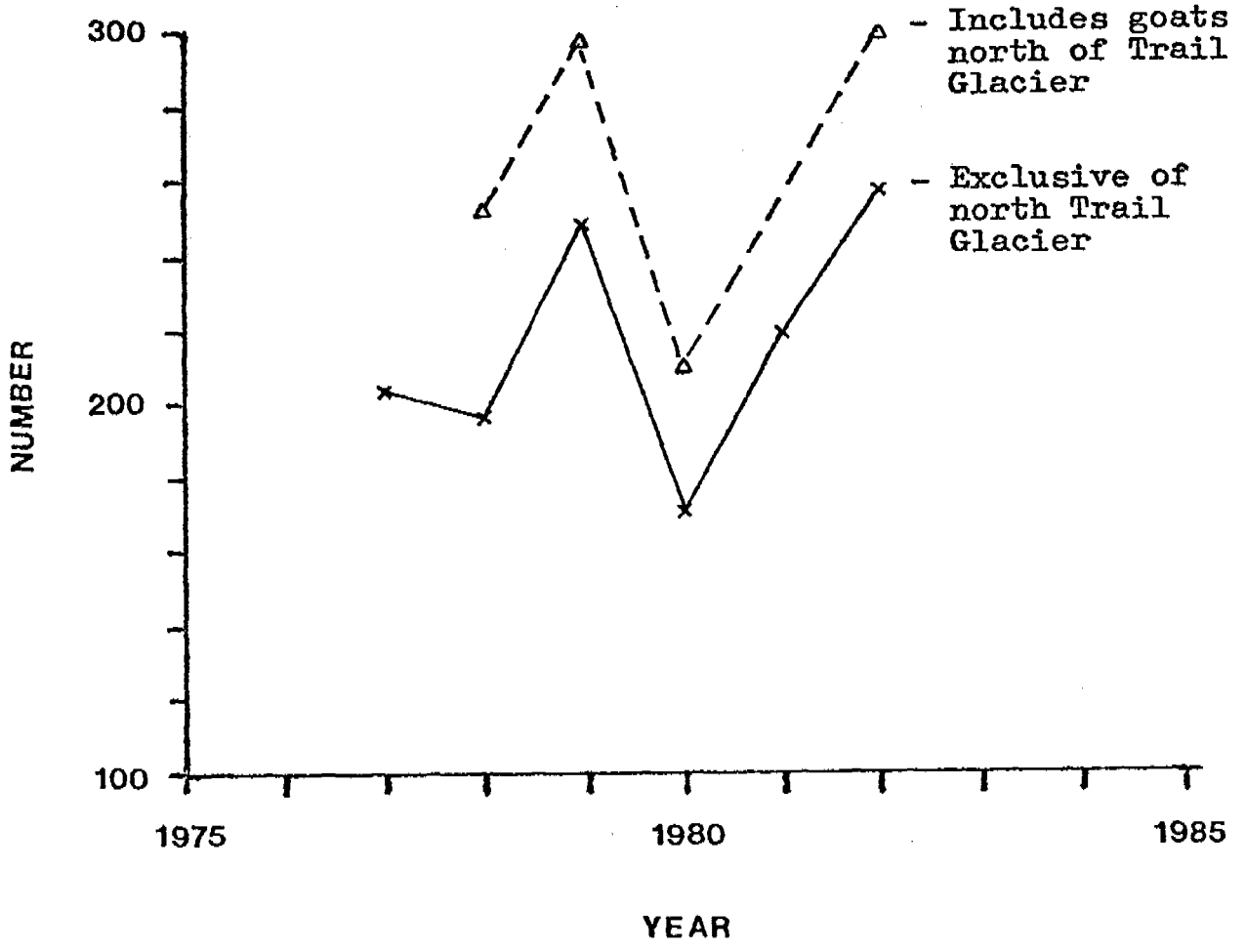

Fig. 1. Mountain goat population trends with and without herd segment north of Trail Glacier, Kenai Mountains, Alaska.

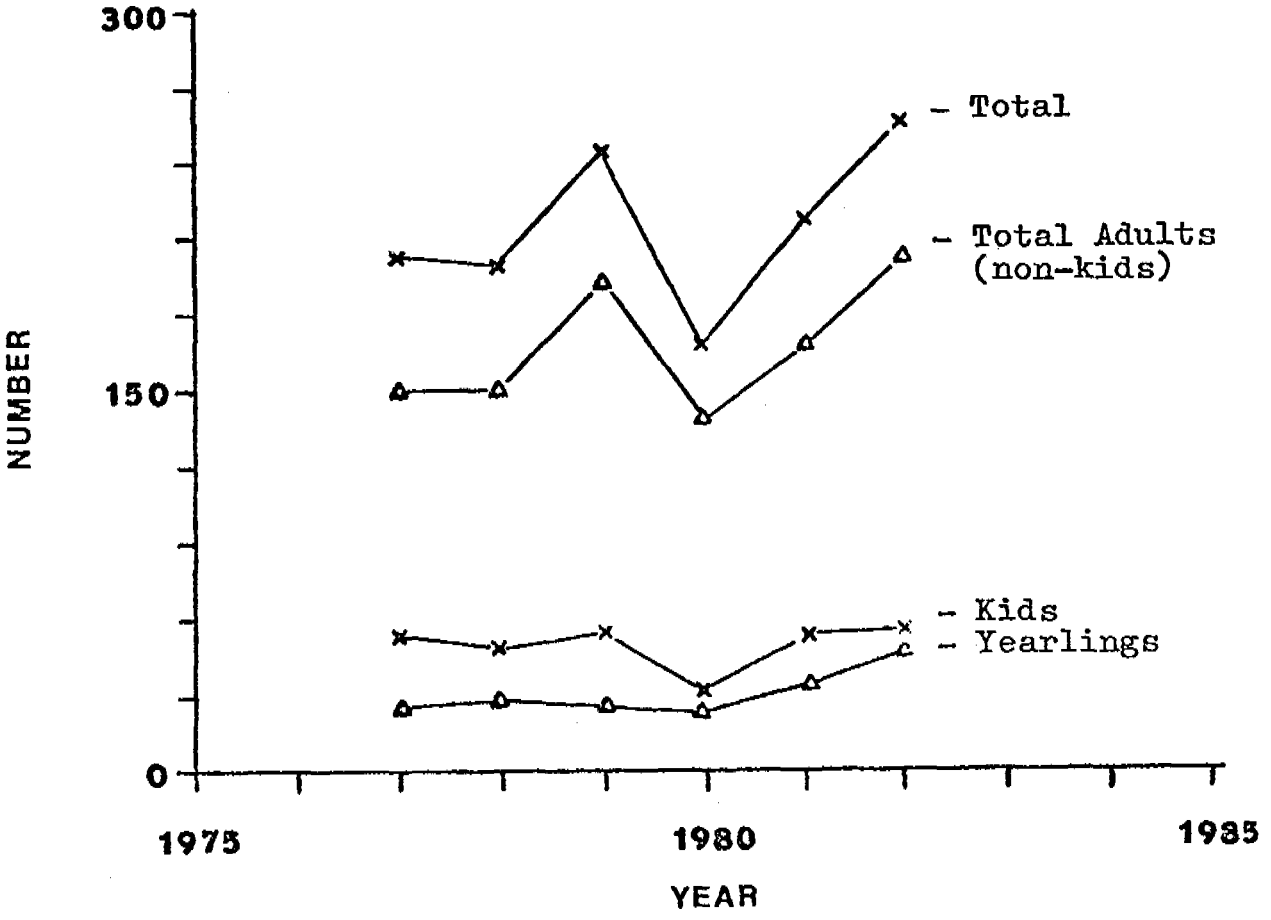

Fig. 2. Population trends in different age classes of mountain goats in the Kenai Mountains, Alaska.

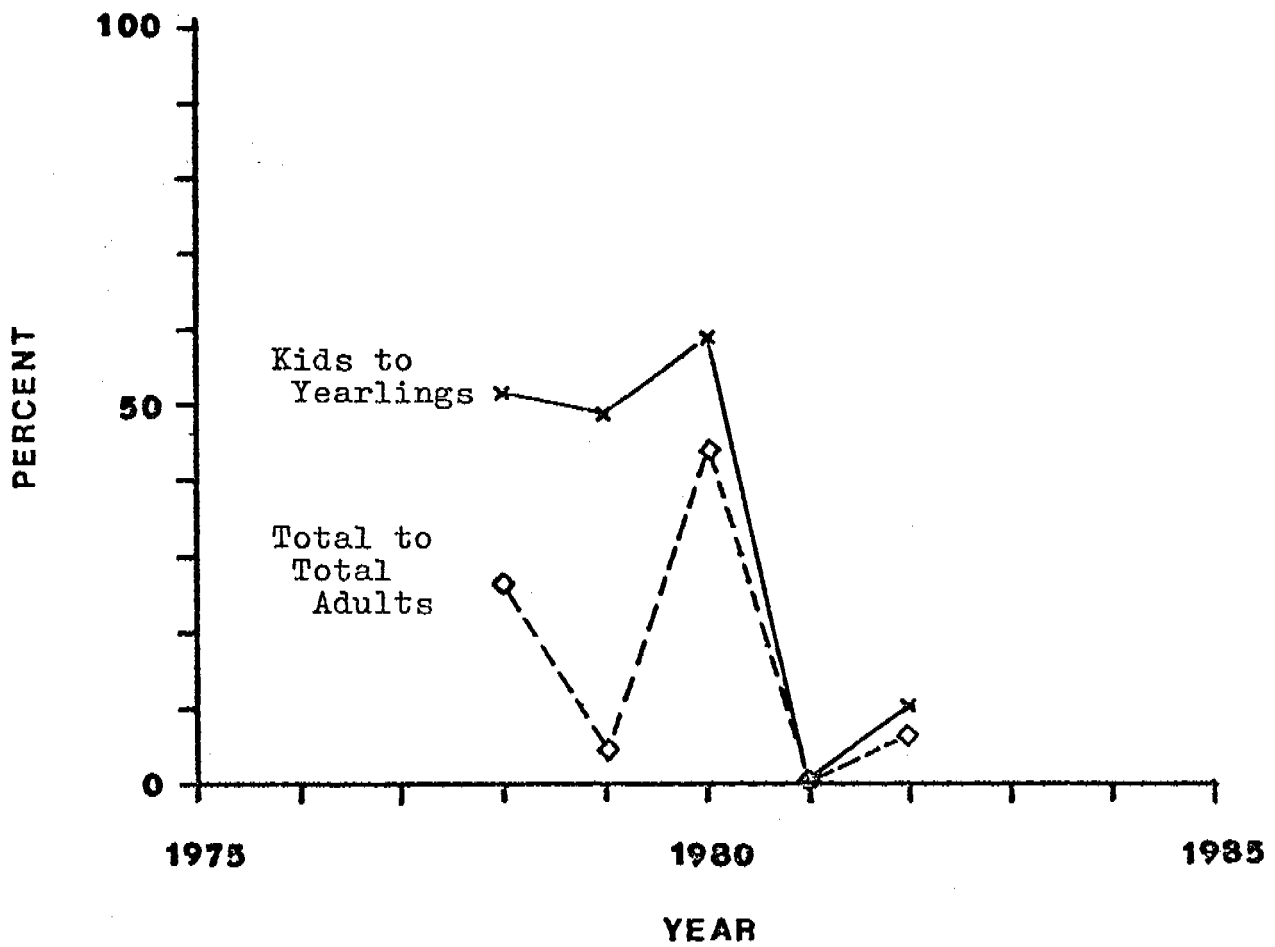

Fig. 3. Mountain goat mortality ratios between years in the Kenai Mountains, Alaska, including total and kids 1st year to total adults and yearlings 2nd year.

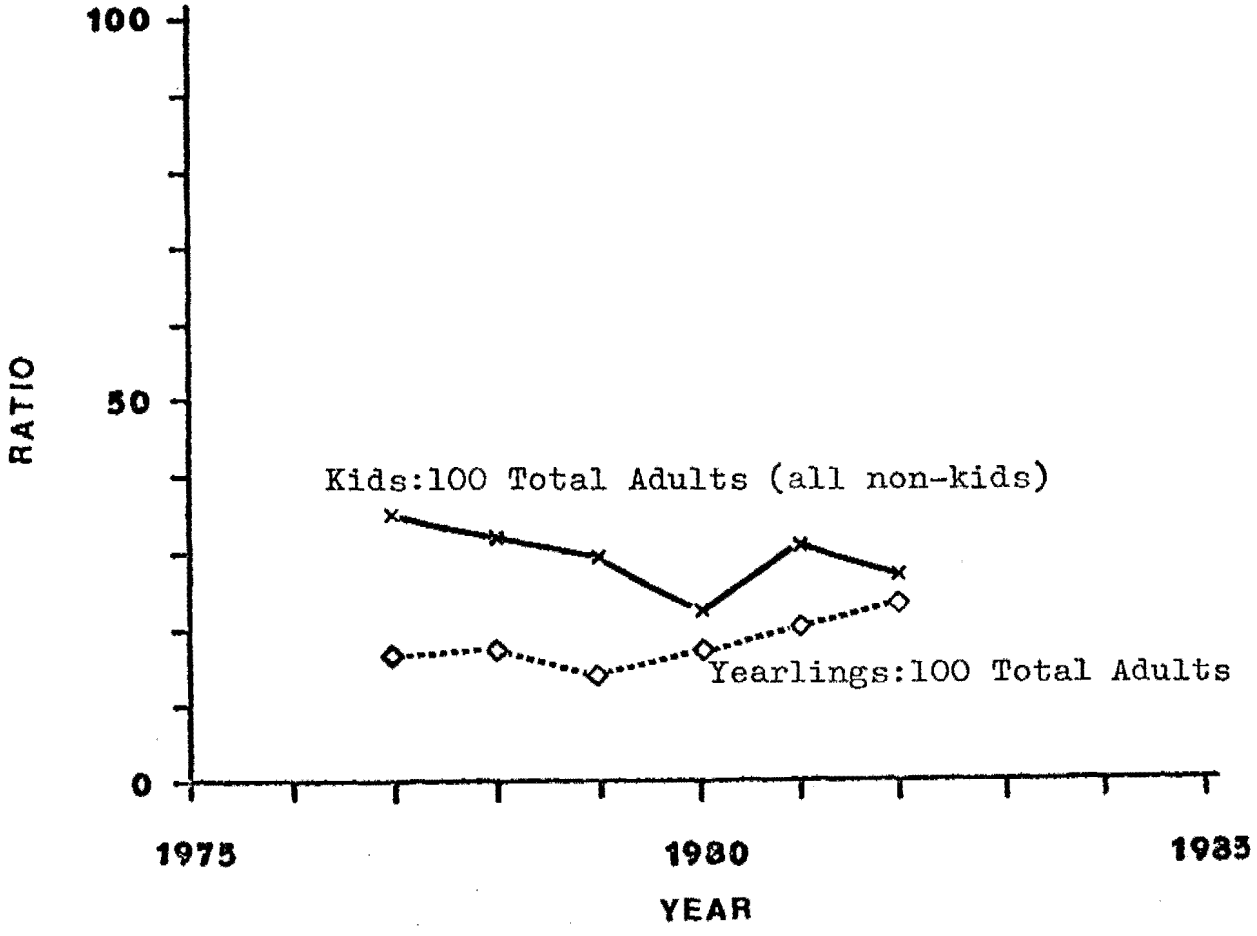

Fig. 4. Mountain goat trends in kids:100 total adults and yearlings:100 total adults for the Kenai Mountains, Alaska.

Table 1. Female mountain goats recollared 23 June 1982, Kenai Mountains, Alaska.

Serial Number	Accession Number	Age (yr)	Reproductive status
11	73511	8	With kid
4	73504	5	With kid
20	73520	8	With kid
19	73519	8	With kid
16	73516	10	With kid

Table 2. Drug dosages and reaction times of adult female mountain goats recaptured in June 1982, Kenai Mountains, Alaska.

Serial Number	Weight (lb)	M99 drug dosage (ml)	Time to down (min)	M50-50 antidote dosage (ml)	Time to recover (min)
11	127	4.0	6.6	4.0	1.8
4	134	4.0	4.8	4.0	1.5
20	129	4.0	7.1	4.0	0.9
19	133	4.0	10.0+	4.0	0.5
16	130	4.0	4.9	4.0	0.5

Table 3. Measurements (cm) of adult female mountain goats recollared 23 June 1982, Kenai Mountains, Alaska.

Accession Number	Total length	Head	Ear	Tail	Hind foot	Shoulder height	Chest girth	Neck girth	Longest horn length
73504	147	27.0	10	12	32.5	78	103	38	23.9
73511	156	27.0	10	--	33.0	83	106	42	23.2
73516	--	--	--	--	--	--	--	38	23.2
73519	159	25.5	9	13	32.0	82	110	37	20.7
73520	156	26.0	10	9	32.5	84	103	38	23.3

Table 4. Blood parameters from adult female mountain goats recollared 23 June 1982, Kenai Mountains, Alaska.

Blood values	Goat accession number				
	73504	73511	73516	73519	73520
Glucose mg/dl[a]	70	92	93	137	165
BUN[b] mg/dl	35	72	46	43	62
Creatinine mg/dl	1.4	1.4	1.3	1.3	1.2
Na mEq/l[c]	138	133	140	135	134
K mEq/l	7.4	8.9	7.5	7.6	9.4
Cl mEq/l	99	95	99	101	98
CO_2 mEq/l	18	11	22	9	7
Uric acid mg/dl	1.6	1.3	0.8	1.1	0.9
Total bilirubin mg/dl	0.2	0.1	0.1	0.2	0.1
Direct bilirubin mg/dl	0.0	0.0	0.0	0.0	0.0
Ionized calcium mg/dl	4.2	4.0	3.9	3.8	3.9
Calcium mg/dl	10.0	9.8	9.2	8.9	9.8
Phosphorus mg/dl	6.7	7.1	4.5	6.3	6.2
Alk phosphatase U/L[d]	142	122	87	112	138
LDH[e] U/L	586	642	582	560	591

Table 4. Continued.

Blood values	Goat accession number				
	73504	73511	73516	13519	13520
SGOT[f] U/L	78	120	51	59	97
SGPT[g] U/L	15	49	16	22	38
Cholesterol mg/dl	98	96	73	94	92
Triglycerides mg/dl	21	30	19	18	33
Total protein g/dl[h]	7.8	7.9	7.6	7.4	8.3
Albumin g/dl	3.3	3.4	3.1	3.2	3.3
Globulin g/dl	4.5	4.5	4.5	4.2	5.0
A/G ratio[i]	0.7	0.8	0.7	0.8	0.7
PCV[j] %	35	40	37	33	37
Hb[k] g/dl	16.0	15.5	16.5	15.0	15.0

[a] mg/dl = milligrams/deciliter
[b] BUN = blood urea nitrogen
[c] mEq/l = mil equivalents/liter
[d] U/L = Units/liter
[e] LDH = lactic dehydrogenase
[f] SGOT = serum glutamic oxalacetic transaminase
[g] SGPT = serum glutamic pyruvic transaminase
[h] g/dl = grams/deciliter
[i] A/G ratio = albumin/globulin ratio
[j] PCV = packed cell volume
[k] Hb = hemoglobin

Table 5. Radio tracking flights for mountain goats in the Kenai Mountains, Alaska, 1982-83.

Date	No. living collared goats	No. females over age 4	No. with kids	% with kids
4/22/82	32	14	--[a]	--
5/12/82	32	14	--[a]	--
6/1/82	32	18	9	50
6/16-6/19/82	31	18	13	72
6/25/82	31	17	12	71
7/7/82	31	17	12	71
8/2-8/3/82	31	17	12	71
8/17/82	31	17	11	65
9/1-9/16/82	31	17	11	65
10/1/82	31	17	11	65
11/17/82	29	15	10	67
1/5/83	29	15	10	67
2/9/83	29	15	9	60
4/25/83	28	15	5	a

[a] Too late in year for accurate percentage. Some kids already have left their mothers and could not be counted.

Table 6. Currently functioning (as of 5/1/83) collar frequencies, sex, and age (as of 6/1/82) of collared goats in the Kenai Mountains, Alaska.

Serial No.	Sex	Age (yr)
1	F	5
3	F	7
4	F	5
5	M	8
12	F	4
14	M	4
15	M	6
16	F	10
20	F	9
22	M	5
25	F	4
26	F	4
27	M	2
28	M	3
29	M	10
30	M	8
31	F	2
32	F	5
33	M	2
34	F	9
35	F	9
36	M	7
37	F	5
38	F	13
39	F	3
40	M	4
41	F	4
42	F	8

Table 7. Population estimates for the mountain goat study herd in the Kenai Mountains, summers of 1977-82.

Year	Total goats[a]	Total adults[b]	Yearlings	Kids	Estimated hunter harvest
1977	203	150	24	53	--[c]
1978	198	150	26	48	--[c]
1979	246	191	25	55	6
1980	169	138	23	31	5
1981	218	166	34	52	2
1982	257	202	47	55	7
1982a[d]	301	238	57	63	

[a] Totals corrected for counting error = total observed divided by 0.9 (Nichols 1980a).

[b] Total adults = total nonkids; includes yearlings.

[c] Harvest data unavailable.

[d] Study area expanded to include north side of Trail Glacier.

Table 8. Ground composition surveys for mountain goats in Ptarmigan Valley and King's Bay Valley, Kenai Mountains, Alaska, 1982.

Area	Adult males over age 3	2 yr old males	2 yr old females	Yrlg	Adult females over age 3	Kids	Total adults[a]	Total
Ptarmigan Valley 7/25/82	3	3	1	8 (47:100 F) (25:100 TA)	17	11 (65:100 F) (34:100 TA)	32	43
King's Bay Valley 7/27-7/28/82	10	1	0	2 (13:100 F) (7:100 TA)	15	10 (67:100 F) (36:100 TA)	28	38

[a] Total Adults (TA) = Total nonkids; includes yearlings.

Table 9. Ratios of mountain goat kids and yearlings to 100 Total Adults based on population models, ground classifications, and collared animals in the Kenai Mountains, Alaska, 1977-82.

Year	Population models		Ground classifications		Collared	
	Kids: Total Adults[a]	Yrlg: Total Adults	Kids: Total Adults	Yrlg: Total Adults	Kids: Total Adults	Yrlg: Total Adults
1977	35	16	36	21	--	--
1978	32	17	32	21	--	--
1979	29	13	32	25	34	--
1980	22	17	23[b]	27	18	7
1981	31	20	--	--	29	12
1982	27	23	35	17	41	25

[a] Total Adults = total nonkids; includes yearlings.
[b] Ptarmigan Valley only; King's Bay Valley not classified.