

STATUS AND MANAGEMENT OF THE
MOUNTAIN GOAT IN ALASKA¹

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The mountain goat (*Oreamnos americanus*) is distributed along the coastal mountains of the Alaska mainland from Portland Canal in southeastern Alaska to Cook Inlet in southcentral Alaska (see Fig. 1, Johnson, these proceedings). Within recent times the goat has naturally extended its range northward and inland to the Chugach, Kenai, Wrangell and Talkeetna Mountains. Some evidence exists to indicate that the goat has extended its distribution into the Alaska Range (Klein 1953). Recent transplants have further extended the goat's distribution to Kodiak and Baranof Islands (Burris and McKnight 1973).

HISTORY

Mention of the mountain goat and its utilization can be found in accounts of early Alaskan history. The Tlingit Indians of southeastern Alaska were probably the first humans to have regular contact with this species in Alaska. De LaGuna (1972) documented the importance of the goat to this tribe for both ceremonial and ornamental purposes. Example included the use of the hair for blankets, use of the fat for perfume, and most importantly, utilization of the meat for sustenance. In addition, goats were also sold, as evidenced by the account of Tichmenew in Krause (1956) which refers to the selling of 2,774 goats to the Russians at the market in Sitka, Alaska during the winter of 1861.

The mountain goat was often referred to by early explorers. Initially, various accounts referred to the species as "white bear" (Cook 1784) or misidentified him as a Dall sheep (*Ovis dalli*) (Seton 1929). Mountain goats were occasionally relied upon for food by those seeking gold and by early Alaskan homesteaders (Klein 1953 and Moore 1968). Even today the goat occasionally serves as an important food item.

INTRODUCTIONS

Interest in establishing goat populations on various islands began early in the century (Elkins and Nelson 1954). The first transplant occurred in 1923 when 18 animals were moved from Tracy Arm on the southeast mainland to Baranof Island (Burris and McKnight 1973). The population expanded rapidly and by 1949 the first hunting season was initiated. Since that time the population has increased to approximately 200 to 300 animals allowing an annual harvest of 20 to 30 (Burris and McKnight *op. cit.*). Goat transplants to both Kodiak and Chichagof Islands were attempted in the early 1950's; however, apparently only the Kodiak transplant was successful as Department biologists have been unable to locate goats on Chichagof Island (Burris and McKnight *op. cit.*).

CENSUSING

Prior to statehood in 1959 management of the mountain goat was under the jurisdiction of the United States Territorial Government, Alaska Game Commission. Before statehood goats were censused only on a highly irregular basis with the use of fixed-wing aircraft. At that time goat populations were probably under no appreciable hunting pressure and public reports indicated they were present in abundant numbers (Merriam 1960), thus routine censusing was probably unnecessary.

Regular censusing of mountain goats from fixed-wing aircraft was initiated in 1959 (Merriam 1960). Since that time much of the goat's range in Alaska has been censused at least once. Surveys have traditionally been conducted with the use of either Piper (PA - 18) supercubs or Cessna 180's from late July through September. Some of the problems associated with such surveys and the resulting data are discussed in Appendix 1. Even with these problems, however, the survey data

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collected since 1959 appear to provide trends to population abundance. Data collected from the surveys indicate that statewide populations remained fairly stable up to 1970 when declines were first noticed on the Kenai Peninsula. It is noteworthy that the first signs of decline occurred in areas where goats overlapped range with Dall sheep. However, these areas also received the greatest hunting pressure. Early in the 1970's it became evident that populations had declined statewide. The statewide decline was suspected to be the result of severe winters.

In recent years helicopters have been used to census goats on an experimental basis. Results of these surveys have varied from good (Appendix 1) to rather poor counts (Didrickson, pers. comm.). Even if future studies indicate desirable results from helicopter surveys it is doubtful that their use would become widespread due to the high cost involved with censusing relatively large areas.

Ground surveys have been utilized to a limited extent to supplement data obtained from aerial counts (unpubl., and Smith, pers. comm.). Such surveys have provided higher counts and probably more accurate age composition data than those acquired with fixed-wing aircraft, but only for relatively small areas (unpubl.). To date, manpower and funding limitations have precluded their widespread application. However, as hunting pressure increases and more definitive population data are needed, their use will probably increase.

Based upon aerial survey data (McKnight 1976) it is estimated that Alaska's current goat population is between 15,000 and 25,000 animals. Approximately 5,000 of that total has actually been counted by fixed-wing aircraft (McKnight *op. cit.*).

MANAGEMENT

Alaska's sport hunting seasons and bag limits are determined annually by the Board of Game each spring on the basis of current harvest and goat population statistics as collected by the Department. Regulations are established on a game management unit (GMU) basis. There are 26 units in Alaska, some of which are divided into subunits. Mountain goats occur in 11 of these units (Fig. 1).

A review of Alaska goat hunting seasons and bag limits from 1925 through 1952 is contained in Klein (1953:103). During the 1950's and 1960's seasons and bag limits fluctuated somewhat according to unit and subunit but for the most part they remained fairly liberal. Beginning in the early 1970's goat hunting regulations were made markedly more restrictive: the January season was eliminated in 1972; seasons adjacent to popular access corridors were shortened and no hunting the same day airborne was initiated in 1974; statewide bag limit was reduced to one in 1975; and the Kenai Peninsula and surrounding area were placed on permit hunting in 1976.

Prior to 1972 the Department assessed annual harvests by conducting post-season hunter interviews in selected communities. Estimated harvests from 1962 until 1972 appeared relatively constant at between 500 and 600 annually (McKnight 1973). Beginning with the 1972 season, annual harvests were estimated by returns from a "mandatory" harvest report-ticket program. Based upon an average of 615 goats were annually harvested statewide (Table 1). Fifty-seven percent of this harvest was comprised of male goats. An unknown percent was comprised of kids since Alaska hunting regulations do not restrict age or sex of the harvest. Crippling loss and irretrievable kills occur but their significance is unknown.

Most hunting effort has occurred in the readily accessible portions of the goat's range (McKnight 1976). Airplanes, boats and highway vehicles are the most popular modes of transportation to hunt areas (McKnight *op. cit.*). In some cases easy access has resulted in excessively high harvests, particularly on the Kenai Peninsula which is connected to metropolitan Anchorage by an extensive road system.

Although annual harvests have appeared to be well within sustained yield levels statewide, in some areas harvests have appeared excessive. Reductions in season length and bag limits have reduced harvests to acceptable levels in most situations. In some cases, however, it was necessary to place goat hunting on a permit basis. Harvests on the Kenai Peninsula and surrounding area were limited by closing individual hunt areas when the kill exceeded approximately 10 percent of the numbers of goats observed on the most recently conducted aerial survey.

There is a paucity of data on total populations, sex and age composition, crippling loss, and percent of harvest comprised of kids. Initiation of permit hunts in southcentral Alaska, however, will help to acquire this much needed information. All successful hunters were required to bring their permit and goat horns to a Department office within five days after killing a goat. At that time Department personnel determined the sex and age of the animal according to methods described by Brandborg (1955). Hunters were asked questions related to their hunting success. Continuation of the permit system in future years will hopefully reduce harvests in heavily hunted areas and redistribute hunting effort to other lightly hunted areas. The system will allow flexibility in management and continue to provide hunting opportunity in areas which might otherwise be closed if management were on a unit basis.

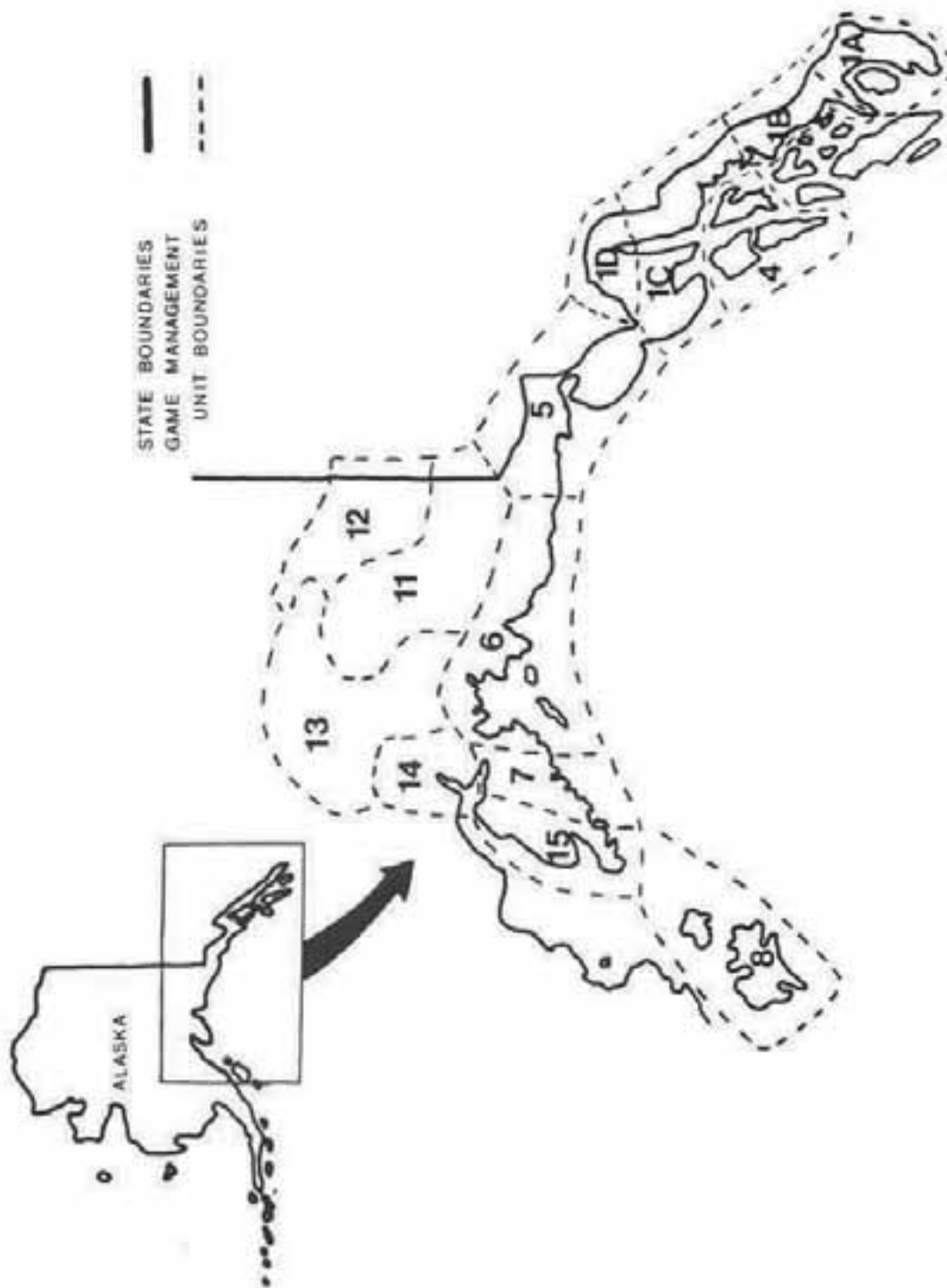


Figure 1. Alaska Game Management Units.

Table 1. Alaska mountain goat harvest statistics derived from harvest reports, 1972 - 1975.

	Harvest Year				
	1972-73	1973-74	1974-75	1975-76	1976-77
Total mt. goat hunters:	1,586	1,783	1,521	1,475	1,320
No. successful hunters:	556 (35.1%)	703 (39.4%)	539 (35.4%)	542 (36.7%)	436 (33.0%)
No. unsuccessful hunters:	1,030 (64.9%)	1,080 (60.6%)	982 (64.6%)	933 (63.3%)	884 (67.0%)
Total mt. goat harvest:	630	822	619	569	436
Males taken:	338 (53.7%)	472 (57.6%)	346 (55.9%)	329 (57.8%)	247 (56.7%)
Females taken:	293 (44.9%)	331 (40.4%)	260 (42.0%)	232 (40.8%)	188 (43.1%)
Unknown sex taken:	9 (1.4%)	16 (2.0%)	13 (2.1%)	8 (1.4%)	1 (0.2%)
No. harvest reports issued:	11,757	12,874	11,171	9,961	8,675
Outstanding harvest report holders:	3,123 (26.6%)	3,659 (28.4%)	3,363 (28.4%)	2,750 (27.6%)	2,579 (29.7%)

Non-consumptive use of mountain goats in Alaska has appeared to increase in popularity in recent years. Primary activities have been roadside viewing and photography. The Department maintains several areas which are closed to goat hunting. Although these areas serve as the focal point for year-around non-consumptive use, most such use occurs in areas open to hunting. Management for non-consumptive users to date has consisted of providing roadside pull-off areas and calling attention to the various opportunities which are available throughout the goat's range. Future management will probably consist of regulating numbers of non-consumptive users and providing interpretive literature. All non-consumptive use management is financed through revenues received from the sale of hunting licenses and non-resident tags and the State's apportionment of Pittman-Robertson funds.

Within the past decade Alaska's human population has grown significantly (Yankee 1974). In addition to increasing hunting pressure, the increased human population has resulted in increased commercial "development" which in many cases could prove detrimental to goat habitat. Currently large scale plans are proposed and being implemented for clear-cut logging in and adjacent to goat winter and summer habitat (U.S.D.A. 1975). Much remains to be learned about the goat's habitat requirements before the impact of land management practices can be predicted. The importance of mature forest to goats is not yet understood, but use of this habitat is documented. Relatively common observations of goats on saltwater beaches (Klein 1953, unpubl.) indicate, in many instances, movements of considerable distance through the forest zone. Clear-cut logging in goat travel corridors and in or adjacent to wintering areas may prove detrimental to goat populations.

Extension of road systems through or adjacent to goat habitat could result in at least two problems: the blocking of migration and/or goat automobile encounters, and secondly, overharvest if hunting is not tightly controlled or eliminated altogether. The latter situation has resulted in the closure of at least two areas prior to final road construction in an effort to assess impact (Ballard 1976 and LeRoux, pers. comm.).

Possibly of greatest importance to the hunter is the possible loss of large hunting areas due to the Alaska Native Claims Settlement Act. Federal withdrawals of 80 million acres, a considerable amount of which will be placed in the National Park System which prohibits hunting, and native withdrawals of 40 million acres will undoubtedly reduce public hunting opportunities.

Klein (1953) and Heljord (1971) have been the only two investigators to conduct in-depth studies of the goat in Alaska. Although their studies contributed significant knowledge about

certain facets of goat ecology much remains unknown. Better information on productivity, mortality, habitat requirements, influence of predation, census techniques, and effects of sport hunting is needed to insure proper management of this resource.

During fiscal year 1977 the Department initiated a long-term study on goat ecology and management on the Kenai Peninsula under the direction of Mr. Lyman Nichols, Game Biologist at Cooper Landing, Alaska. Results from this study should eventually provide for a more sound basis upon which to manage mountain goats.

Limited data suggest, and most Department biologists are of the opinion, that winter weather is the primary limiting factor on goat populations. In addition to limiting forage availability, it is thought that excessive snow accumulations contribute to mortality through avalanches and accidental falls. In some portions of the goat's range it is felt that wolf (*Canis lupus*) predation is becoming an increasingly significant goat limiting factor (Johnson and Ballard, unpubl.). Sport hunting except in limited, easily accessible areas is thought to result in an insignificant amount of mortality.

Future prospects for the mountain goat in Alaska appear good. Populations are expected to eventually rebound from their current low level; however, fluctuations will doubtless continue to occur. Hunter interest and harvest will probably increase in areas both closed and open to sport hunting. Research activities will probably be significantly intensified in an effort to manage goats on a more sound scientific basis and to more accurately predict the results of land management practices.

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APPENDIX I. Censusing of Mountain Goat from Cessna 180 Aircraft and Helicopter.

Effective management of any wildlife species depends upon the availability, reliability and validity of population indices. Since 1959 the Alaska Department of Fish and Game has conducted aerial surveys of mountain goats (*Oreamnos americanus*) using fixed-wing aircraft. Results of these surveys have varied greatly in total numbers and kid-adult ratios during the same survey year and between years thus creating doubt as to whether the data reflect true population trends.

Although considerable literature exists concerning accuracy and reliability of aerial censuses, few references concerning serial censusing of mountain goat populations can be found. The purpose of this paper is to report on goat counts performed from Cessna 180 aircraft and helicopter over two study areas in Southeast Alaska. Counts were initiated to measure daily variation and to determine problems associated with such surveys. Counts were intended to duplicate normal surveying procedure and thus no attempt was made to control survey variables.

MATERIALS AND METHODS

During late July and August 1974, a series of flights with a Cessna 180 aircraft on floats, one flight with helicopter (Hiller 12E), and one ground count were conducted by the same observer over two study areas located on the lower Chilkat Range in Southeast Alaska: Area 1 - William Henry Mountain and Area 2 - Endicott River to Sullivan River. Area 1 encompassed about 41.3km² while Area 2 encompassed about 63.8km². Vegetation and topography of the study areas were similar to that described by Palmer (1942).

All aerial surveys were initiated at the highest point on each area. From that point the area was circled until completely surveyed, then the area of search was lowered 300 (92m) to 400 (122m) feet in altitude and another circle begun. Goats were aged as either adult or kid. If age composition was not readily discernible, the aircraft was circled over the animals until classified to the satisfaction of the observer. Each study area was surveyed until the observer felt adequate coverage had been obtained. Data on goat numbers and age composition at each location were recorded on standard forms and topographic maps. Presurvey records were made on percent cloud cover and air temperature.

Efforts were made to duplicate normal surveying procedures which meant initiation and conclusion of surveys were dependent on the availability of pilot, aircraft and flying weather.

RESULTS

The highest goat count for each study area was attained with the helicopter (Table 1). Counts from a Cessna 180 averaged 66 percent of those observed from a helicopter. Total counts from Cessna 180 ranged from 20 to 44 goats for Area 1 and 18 to 59 goats for Area 2. Mean number of goats observed from Cessna 180 was 36.6 and 39.6 for Areas 1 and 2, respectively. No significant difference between areas for mean number of goats observed was detected ($t=0.47$, $df=12$, $P>0.05$) even though Area 2 was larger and more time was expended surveying it. Also, no significant differences

between variances of the means were detected for number of adults ($F=1.16$, $df=6$, $P>0.05$) and total numbers ($F=3.52$, $df=6$, $P>0.05$), however, a significant difference was detected for numbers of kids ($F=9.58$, $df=6$, $P<0.05$).

Table 1. Summary of mountain goat counts over two study areas in Southeast Alaska.

Date of Survey	Pilot Number	Initiation Time	Survey Time in Minutes	Percent Cloud Cover	Air Temperature	Number of Adults Observed	Number of Kids Observed	Total Number Observed	Kid per Hundred Adult Ratio
Area 1: William Henry Mountain									
7/28/74 ^a	1	13:10	45	20	50	29	7	36	24.1
7/29/74 ^b	2	12:15	40	40	48	38	17	55	44.7
7/31/74 ^a	3	15:35	40	0	55	14	6	20	42.9
8/2-6/74 ^c						33	15	48	45.5
8/10/74 ^a	4	15:35	40	10	50	28	10	38	35.7
8/11/74 ^a	4	15:38	52	0	59	25	10	35	40.0
8/19/74 ^a	4	14:40	43	100	49	31	10	41	32.3
8/29/74 ^a	4	14:20	45	0	65	35	9	44	25.7
8/30/74 ^a	1	18:38	34	0	70	33	9	42	27.3
Area 2: Endicott River									
7/28/74 ^a	1	14:05	40	20	54	26	9	35	34.6
7/29/74 ^a	2	10:55	75	60	49	42	19	61	45.2
7/31/74 ^a	3	16:15	55	5	50	17	1	18	5.9
8/10/74 ^a	4	16:20	50	0	48	31	13	44	41.9
8/11/74 ^a	4	16:33	80	0	55	44	15	59	34.1
8/19/74 ^a	4	15:25	55	100	52	43	14	57	32.6
8/29/74 ^a	4	15:15	70	0	65	21	6	27	28.6
8/30/74 ^a	1	19:17	52	0	69	28	9	37	32.1

^aCessna 180
^bHelicopter
^cGround Count

Ratios of total numbers of goats observed from Cessna 180 and helicopter surveys between each area were compared with a heterogeneity Chi-square analysis. No significant difference was detected ($X^2=12.97$, $P>0.05$), indicating that the factors which influence fluctuation in total counts were operating at the same magnitude on both areas.

Ratios of adults to kids for each area were also subjected to a heterogeneity Chi-square analysis to determine if ratios from Cessna surveys were consistent regardless of fluctuations in total numbers. No significant differences were detected for either study area ($X^2=3.81$, $P>0.75$ for Area 1 and $X^2=4.23$, $P>0.75$ for Area 2). However, examination of Table 1 reveals that the kid-adult ratio for the survey conducted 31 July 1974 on Area 2 was totally unacceptable even though not statistically significant.

An attempt was made to correlate air temperature and percent cloud cover with numbers of goats observed each day. Such large variations were present that no significant ($P > 0.05$) trends were detected, although this may have been the result of small sample size. Gross examination of combined data for all surveys indicate that more goats were observed when cloud cover exceeded 20 percent.

The relationship between total goats observed versus initiation time and surveying time per Cessna 180 survey for each area were also assessed. No relationship was detected for initiation time, however, there appeared to be a relationship for amount of time spent surveying. Data for Area 2 indicated that as surveying time increased the numbers of observed goats also increased, while the reverse was true for Area 1; less goats were observed as surveying time increased.

DISCUSSION

Results from this study indicate that total counts from a Cessna 180 during July and August may not reflect annual trends in total numbers or productivity. Counts can only be considered as minimum population values. Management decisions based upon single Cessna 180 surveys alone must be viewed with skepticism.

Because helicopter surveys produced both the largest total counts and kid counts, it appears that helicopter surveys may provide more reliable population statistics than Cessna 180 surveys. During the helicopter surveys several goats were observed that were under a canopy of deciduous vegetation. They were noticed only because they shook the vegetation as they fled from the helicopter. During Cessna 180 surveys kids often hid under nannies but during helicopter surveys nannies were forced to run and thus more kids were observed. The ability to thoroughly search vegetated areas and get a closer look at all goats observed undoubtedly produces more complete counts. Daily variation associated with such surveys and their effects on goat behaviour have not been determined, therefore, the resulting data also should be viewed with caution.

Lowest goat counts were attained on 31 July 1974, two days after the helicopter surveys were conducted. Although there were no firm data indicating that helicopter surveys were the cause of the low counts, it does appear to be a possibility. Noted reactions of surveyed goats (Ballard 1975) indicated that goats respond adversely to helicopters. Chadwick (1973) reported that goats in Montana appeared to move out of areas which received frequent helicopter use. He also stated that helicopters seem to terrify goats. Conceivably this fear could alter goat behaviour for a period of time after a single encounter with a helicopter.

Except for one survey, considerably more time was expended surveying Area 2 than Area 1 because it was larger. Even so, as surveying time on Area 2 increased, the number of goat observations increased; the reverse appeared to be true for Area 1. Also, kid counts exhibited more variation for Area 2 than Area 1. It was felt that at least a portion of the differences between the results for the two areas could be attributed to differences in topography and goat reactions to the survey vehicle. Area 2 had more rock outcroppings with more potential places of concealment than did Area 1; therefore, more survey time resulted in a better count. On many occasions, goats appeared uneasy at the sight of the survey vehicle; although goat groups may not have fled, kids frequently would seek cover under the nanny and thus would be unobservable unless the nanny started to run. Goats on Area 1 reacted to aircraft more strangely than those on Area 2 (Ballard, 1975). Area 2 goats were not forced to run because of an abundance of cover, resulting in a lower opportunity to observe kids.

Other investigators have mentioned the importance of pilot experience in obtaining accurate and precise counts (Erickson and Siniff, 1963; Siniff and Skoog, 1964; LeResche and Rausch, 1974). The lowest counts during this study occurred with pilot number 3. Pilot number 3 had the most surveying experience and, thus, low counts based on pilot experience alone would not have been expected.

Merriam (1965) speculated that fixed-wing survey initiation time influenced the number of goats counted. He indicated that goats were more active and more observable in early morning and late evening hours. Data from this study indicated no such relationship, however, it is quite possible that surveys were not initiated early or late enough in the day to observe goats during their peak activity periods.

Both areas were open to hunting during August 1974. Minimum harvest based on a 60.8 percent response of hunter reports, indicated that 4 and 0 goats were harvested from Area 1 and Area 2, respectively. No doubt a reduction in goat numbers while the study was in progress accounted for some of the variation in total numbers. Also, the influence of disturbance by hunting upon goat behaviour is unknown.

Causes of variations in total numbers between Cessna 180 and helicopter counts were not determined in this study. Erickson and Siniff (1963) and LeResche and Rausch (1974) enumerated a variety of factors which they felt influenced the accuracy and precision of their surveys on brown

bears (*Ursus arctos*) and moose (*Alces alces*), respectively. LeResche and Rausch (*op. cit.*) believed all of the factors were interrelated and any statements concerning aerial counts must consider them all. No doubt the same situation applies to aerial censusing of goats.

In summary, the results of this study indicate that counts conducted from Cessna 180 aircraft may not reflect population trends and can only be interpreted as minimum population values. Higher counts occur on days when cloud cover exceeds 20 percent. Although two surveys were conducted, helicopters provided the highest counts and thus may be superior to other aircraft. Additional research into the refinement of aerial censusing of mountain goats is needed. Future studies should focus on determining percent of population actually observed, comparing the efficacy of various survey vehicles, and determining the season, time of day and weather conditions for optimum surveying.

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