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JUNEAU, ALASKA

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DALL SHEEP REPORT

by
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Volume IX
Annual Project Segment Report
Federal Aid in Wildlife Restoration
Project W-15-R-2 and 3, Work Plan N

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FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-15-R-2 and 3 TITLE: Big Game Investigations

WORK PLAN: N TITLE: Dall Sheep

JOB NO: 1 (W-15-R-2); 3, 4, 5, 6, 7 and 8 (W-15-R-3)

PERIOD COVERED: January 1, 1967 to December 31, 1967

ABSTRACT

Life History and Ecology

Two ground trips were made into Dry Creek and another up Eagle River for familiarization and classification purposes. Ecological observations were recorded but data are too limited for analyses at present.

Distribution and Abundance

Over 7500 sheep were enumerated on eight aerial surveys of segments of sheep habitat. Results of these surveys are listed. Further flights were made over several of the areas to note distribution changes and to develop more accurate classification techniques.

With the exception of totals counted, distributions noted, and proportions of rams observed during rutting season flights, classifications obtained during these flights are considered to be inadequate due to inherent faults in the methods and timing used.

Four study areas were tentatively selected for use in further investigations.

Hunter-Harvest Information

The reported harvest of Dall sheep rams in 1967 was 915 as of 8 December 1967. Based on this 87% return of the 7050 sheep harvest tickets issued, 2777 or 39% of ticket holders actually hunted, a few less than 3375 ticket holders did not hunt, and about 900 ticket holders did not report prior to analyses. Of the 2777 hunters, 915 or 33% killed a sheep. Of 2207 resident Alaskan hunters, 503 (23%) killed a sheep, while of 570 non-residents, 412 (72%) killed a sheep.

Mean number of days hunted was 4 days for successful and 5 days for unsuccessful hunters.

The mean length of longest horn as reported by 452 resident hunters was 33.0 inches (83.8 cm) and by 378 non-resident hunters was 33.8 inches (85.9 cm).

Range and Habitat Investigations

Some literature pertaining to habitat investigations was reviewed. Otherwise this job was inactive during the year.

Movement Studies

Data collections were begun and some literature pertaining to marking and movements studies was reviewed. No conclusions are possible from the data in hand.

Experimental Sheep Transplant

An attempt was made to capture Dall sheep on the Kenai Peninsula with the aid of a helicopter and drugs (sernylan and succinylcholine chloride) administered with a dart syringe. The animals' response to the drugs was erratic. A total of 14 sheep were killed. These succumbed to the following causes: mechanical injury 4, bloat after capture 5, overdose of sernylan 1, overdose of succinylcholine chloride 3, exhaustion during transport 1.

Two animals, an adult ewe and a male lamb, were released on Kodiak Island. The lamb was sighted in alpine habitat five days later.

Problems encountered included an inadequate helicopter, bad weather, poor response to drugs and shock. Future transplants should await perfection of handling and capturing techniques.

RECOMMENDATIONS

Aerial surveys and ground studies should be continued as necessary on the selected study areas in order to continue compilation of life history and ecological data.

Aerial distribution and abundance surveys should be continued until an inventory of Alaskan sheep populations has been completed.

An additional study area should be located in the Wrangell Mountains, and eventually one in the Brooks Range. Thus, in conjunction with the U.S. Fish and Wildlife Service's Kenai sheep study, all major sheep ranges in the State would be represented by sample areas wherein populations, habitats and related facotrs could be studied and compared.

Collection of harvest data should be continued with more emphasis on determination of trends in trophy quality as well as in quantity.

Examination of past and current harvest data does not indicate the need for any important changes in sheep hunting management at the present time.

No further Dall sheep transplants should be attempted until suitable methods of capture and handling have been developed.

WORK PLAN SEGMENT REPORT

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STATE: Alaska

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PERIOD COVERED: January 1, 1967 to December 31, 1967

OBJECTIVES

To determine the basic life history and ecology of the Dall sheep in Alaska, including their physical characteristics, reproduction, food habits and range relationships, population dynamics, mortality factors, movements and general habits and behavior.

To assess the distribution and abundance of sheep in Alaska and note major changes thereto.

To determine methods of capturing and marking sheep for future identification.

To determine and to quantitatively and qualitatively evaluate the hunter harvest of Dall sheep.

To establish Dall sheep on Kodiak Island.

TECHNIQUES

Life History and Ecology

During three familiarization trips on foot into study areas, binoculars and spotting scope were used to observe sheep. Pertinent data concerning them and their habitat were recorded on printed forms.

Available literature was reviewed throughout the year in order to obtain a working knowledge of past research done on Dall sheep.

Distribution and Abundance

Selected segments of sheep range were surveyed by air in the summer and fall of 1967, utilizing a Piper PA-18-150 Supercub airplane; both pilot and observer counted sheep.

Routes were chosen and flown so as to give maximum coverage of the portions of sheep habitat involved, and all flights but those in the Wrangell Mountains series were plotted en route on U.S.G.S. 1:250,000 quadrangle maps.

Sheep observed were recorded on mimeographed forms and were listed by group size and by sex and age classes where such classification was made. Groups were also plotted directly on the maps, giving a pictorial record of the exact route covered and the location of observed sheep along that route.

The southeastern slope of the Wrangell Mountains from Nadina River to Anderson Glacier was flown in a Cessna 180, a faster and less satisfactory aircraft for sheep counting. However, this segment was intended primarily as a trend count and was presumably comparable to a similar count made in 1963 by the same personnel.

Flights were made to locate sheep concentrations and areas which would be suitable for intensive, long-term studies. During these flights, distributions were plotted and gross numbers recorded without attempting classification of sheep by sex and age.

Four areas were chosen as future study sites. We then flew more intensive surveys of two of these to classify the sheep present and record distribution in more detail. Two other aerial counts were made during the rutting season to determine whether rams could be more accurately counted at this time than during other seasons.

Personnel involved in these jobs included Lyman Nichols and James Erickson, assigned to the sheep work plan; Ron Somerville and Joe Blum of the Lands section, who assisted in the Lake Clark survey and one trip into Dry Creek; and Frank Jones and Bill Griffin, of

the Game Management staff, who conducted the Wrangell Mountains and Chisana-Nabesna surveys. Frank Jones also accompanied us on our first trip into Dry Creek to show us the area where he had previously worked on sheep.

Hunter-Harvest Information

Sheep hunters are required to obtain a harvest ticket and report card (Figure IV) before hunting and they must fill in the report card after killing a sheep or after the season ends. Data obtained from the 1967 report cards were coded and punched on IBM cards. Desired anlyses were programmed and the cards were processed at the University of Alaska with an IBM 360 computer.

Reliable conclusions based on these data are possible only if the data received on hunter report cards are reliable. A hunter was classified a resident or non-resident of Alaska on the basis of his reported address; some erroneous classifications were undoubtedly made.

Sheep horns (165 sets) were measured at taxidermy shops in Anchorage and Fairbanks by N. Shanahan, L. Jennings and J.S. Grundy, as well as J.A. Erickson and L. Nichols. Measurements of longest horns were compared to hunter-reported longest-horn measurements of the same animals in an attempt to evaluate reliablity of hunter-reported measurements.

Hunters and guides were often questioned about sheep; some ideas of availability, hunting pressure, regional harvest, etc., were obtained.

Past reports by L.J. Palmer and R.F. Scott, of the U.S. Fish and Wildlife Service, for the 1939-1941 and 1949-1956 periods, respectively, were reviewed for data pertinent to the objectives of this job.

Patricia M. Crow, with the help of Jean McCoy, was responsible for the operation of the harvest ticket system until the completion of the computer analyses.

Range and Habitat Investigation

(Inactive.)

Movement Studies

Periodic aerial observations were made of sheep in the Chugach Range adjacent to Anchorage, and their distribution during transitional movements from summer to winter ranges was mapped. These flights and others in different areas yielded information about ram movements before, during and after the supposed rutting period.

A partial review of capture and marking methods was initiated as was a review of the movements of Dall sheep.

Experimental Sheep Transplant

We were directed to capture "up to 20" Dall sheep on the Kenai National Moose Range and transplant these to Kodiak Island. We decided to release them on the Kodiak National Wildlife Refuge since such a program was already covered by an agreement, formulated in 1964, between the Department of Fish and Game and the U.S. Bureau of Sport Fisheries and Wildlife.

At the request of the Kenai Moose Range manager, capturing attempts were kept to the south of the Killey River. Suitable terrain and sheep herds were found in the vicinity of Green Lake, near the foot of Tustumena Glacier. The lake itself provided a base of operations accessible to float plane transportation.

It was decided to capture the sheep during the summer when they should be in their best physical condition, and when the Kodiak habitat should be in the best condition to receive them, thus enabling them to become well acclimatized before winter. The capturing phase of the transplant was therefore restricted to the period between July 1, 1967, when funds became available, and August 10, when the sheep hunting season opened. We were directed to cease operations no later than August 7, so as not to interfere with hunting.

The immobilization of sheep was accomplished by shooting them with darts loaded with the drug sernylan (phencyclidine hydrochloride) from a CO_2 powered Palmer Cap-Chur Gun. The drug anectine (succinylcholine chloride) was also tried as an immobilizing agent, while tranvet (propiopromaizine hydrochloride) was administered to captured sheep by hand syringe and in several cases was included with sernylan in the dart, in an effort to tranquilize the animals

for ease in handling. Darts were fired at close range from a hovering helicopter, first from a Bell G-4, which proved unsatisfactory, and later from a Bell 206A "Jet Ranger", which performed very well.

After an animal was shot with a dart, it was left alone until it went down, or at least exhibited advanced ataxia, whereupon the helicopter again approached and deposited the shooter as close to the victim as possible. In most cases, it was necessary for the shooter to actually run down the incompletely immobilized animal and capture it by hand, which led to some interesting chases among the alpine boulder fields and meadows.

The captured, and often struggling sheep was then hog-tied, blindfolded, loaded into the helicopter, and flown rapidly back to the shore of Green Lake where it was unloaded, allowing the helicopter to return for more. One or two men remained at Green Lake to care for captured sheep, which were given an intramuscular injection of 1 cc (50 mg) of tranvet, if it seemed advisable, and 2 cc of bicillin to prevent infection. They were also kept carefully propped up and were frequently moved in an effort to prevent bloat. Those that could do so were encouraged to stand and walk around.

A float-equipped Cessna 185 was used to carry the sheep from Green Lake to the town of Homer, where they were placed individually in wooden crates. The floatplane was also used to haul fuel to the helicopter which was left overnight at Green Lake, and to ferry personnel to and from Homer where they were quartered.

A number of sheep died during capturing operations, while en route to Homer, or after arriving at Homer. Carcasses of sheep which died in the field were brought to the Department of Fish and Game office in Homer for necropsy, where possible, and disposal. Unfortunately, time was always pressing, and complete necropsy was not always possible. Results of those examinations made were recorded on appropriate forms, and various biological specimens were preserved for future study.

At the end of the time period alloted for capturing operations, the three surviving sheep were tagged with metal ear tags, which had colored plastic streamers attached for ease of identification. Blood samples were taken and tested for the presence of Brucellosis by a representative of the U.S. Department of Agriculture (all showed negative reaction).

The three animals were transported directly to the release site in a Department Grumman Goose amphibian, which necessitated tying them again. Two sheep survived this ordeal and were placed in the holding pen, held for 24 hours, and released. Follow-up observations were conducted by the two men who remained at the release site for five days after the release.

Personnel involved in the transplant included: Lyman Nichols, James Erickson, Bud Burris, and Bob Nehus (a temporary employee), who conducted the capture and transplant phases; Karl Schneider and Ben Ballanger, who built the release pen; and Bud Lofstedt, owner of Kenai Air Service, who flew the jet helicopter. In addition, variou members of the Homer staff of the Fish and Game Department gave considerable help and moral support in the frustrating process of trying to keep some of the dying sheep alive.

FINDINGS

Life History and Ecology and Distribution and Abundance

General Distribution Surveys

In order to determine distribution and approximate numbers of Dall sheep in the State, as well as to enumerate and study trends in specific populations of interest, a series of aerial surveys has been started.

Eight surveys were flown during the summer and fall of 1967 for the purposes of determining overall populations, mapping distributions, classifying by sex and age, noting trend in herd size and makeup, and picking areas for detailed study. Areas covered by these surveys are shown in Figure I.

Table I. lists the results of these surveys by area, and shows the dates of each, the personnel conducting each, the total number of sheep counted in each area, and the ratios of legal rams (those with a 3/4 or larger horn curl) and all rams to total sheep counted, and proportions of lambs to ewes, where classifications were made. Several of the flights were made with the objective of locating study areas rather than obtaining classifications. On these flights the areas involved were closely covered for overall sheep abundance,but classification was not attempted.

More time and effort was expended on those surveys where detailed classification was attempted, but for reasons which will be discussed later, such classifications may be misleading due to inaccuracies difficult to avoid.

The southwest slope of the Wrangell Mountains was not covered as adequately as other sections surveyed, but was flown over a route similar to that of a survey conducted in 1963. Thus a comparison in sheep counted over the same route on different years was possible. The results of the Chisana-Nabesna portion are also shown in comparison with those obtained from a count conducted there in 1962. However, more area was covered in 1967 than in 1962, so the totals counted are not comparable, while the proportions of observed sex and age classes may be.

Study Area Selection and Surveys

Four areas were selected as study areas, upon which further work will be conducted. These are shown in Figure II a and Figure II b. At least one more area in the Wrangell Mountains will probably be chosen during the coming segment.

The Dry Creek study area, on the north slope of the Alaska Range, includes all drainages flowing into Dry Creek. It was formerly used for sheep research by Jones and Viereck, with some earlier work carried out there by L.J. Palmer and R.F. Scott. Consequently, there is a good bit of historical information available which makes further study here well worthwhile.

The area includes two well-used natural mineral licks which tend to concentrate sheep and which should be of value in planned trapping, marking and movements studies as well as in other phases of the investigations. Principal work planned for this area will be winter range, movements, ecological and behavioral studies. The study area, as formerly and presently described, is not too useful for examination of population dynamics and productivity because there are no topographical features bounding it which prevent free animal movement into and out of it. Thus, it may be difficult to determine the causes of observed population changes. We will probably enlarge the area to include everything between the Wood River and the West Fork of the Little Delta River, at leass for aerial survey purposes, so as to be able to draw conclusions regarding the enclosed population.

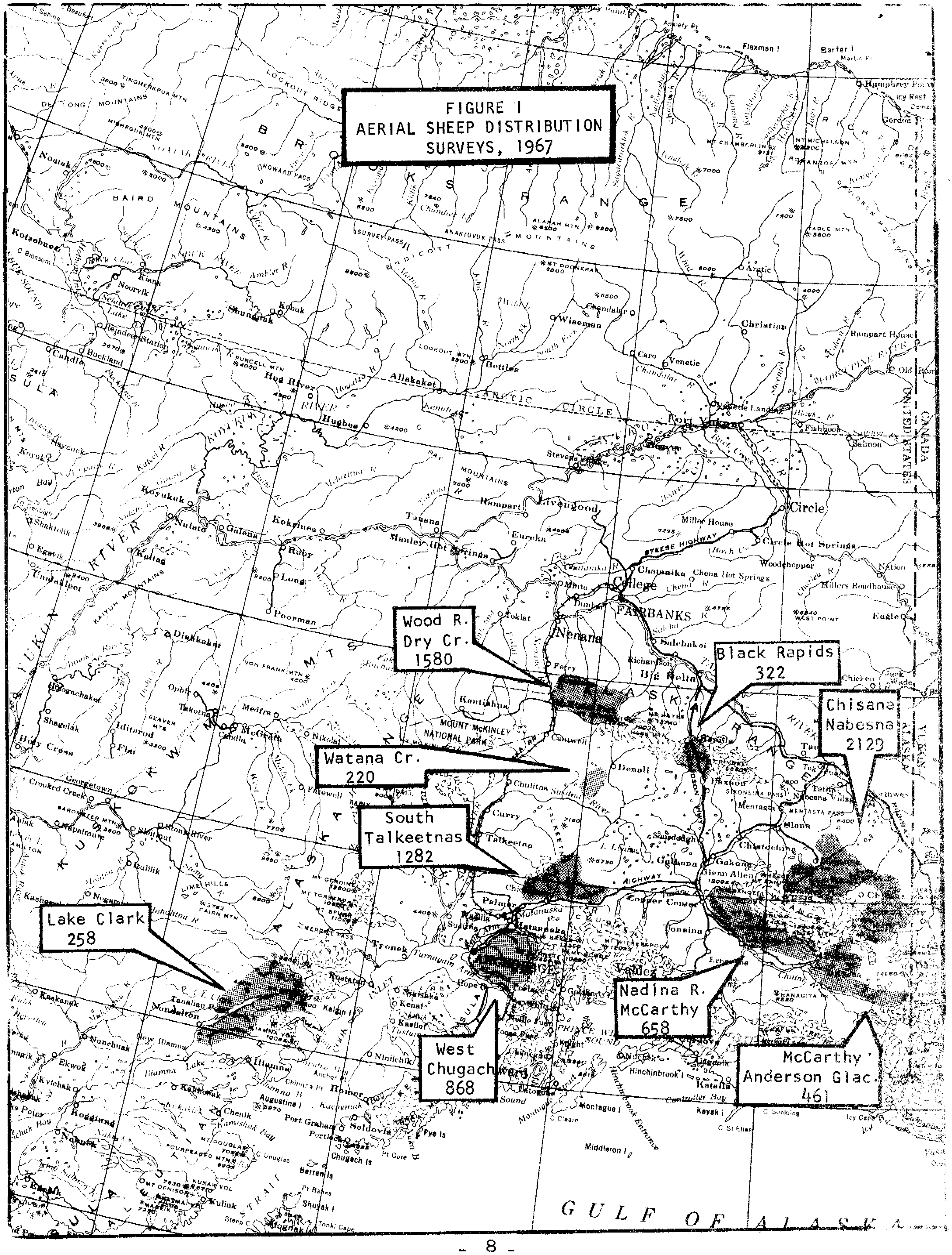


FIGURE 1
AERIAL SHEEP DISTRIBUTION
SURVEYS, 1967
Wood R.
Dry Cr.
1580
Black Rapids
322
Chisana
Nabesna
2129
Watana Cr.
220
South
Talkeetnas
1282
Lake Clark
258
Nadina R.
McCarthy
658
West
Chugach
868
McCarthy
Anderson Glac.
461
GULF OF ALASKA

Table I. General Sheep Distribution Surveys

Area Surveyed	Dates & Personnel	Legal Rams as Percentage of Total Sheep	All Rams as Percentage of Total Sheep	Lambs as Percentage of Ewes	Total Sheep Counted	Remarks
Alaska Range-Wood R.,W.Fk. Little Delta, Healy Cr., Totatlanika R.,Tatlanika Cr.	6/13-14/67 Jones & Nichols	9.0%	32.0%	25.0%	1580	Good coverage, fairly accurate classification.
Alaska Range- Lake Clark drainages & Twin Lakes area	6/22-28/67 Nichols Somerville Blum	10.1%	16.7%	9.0%	258	Good coverage,but some areas missed due to weather. Fairly accurate classification.
Alaska Range-Black Rapids area,Delta R. drainages	8/31/67 Nichols Erickson	7.1%	10.9%	--	322	Survey covered a limited area on both sides of Rich Hwy.Only rams classified.
Talkeetna Mts.-Southern drainages from Moose Cr. to Caribou Cr.	9/14-15/67 Nichols Erickson	--	--	--	1198	Good coverage for total but no attempt to classify.
Talkeetna Mts.-Sheep Mt. closed area	9/15/67 Nichols Erickson	--	49%	--	84	Good coverage for total; classified rams only
Talkeetna Mts.-Watana Cr. drainages	9/8/67 Nichols Erickson	--	--	--	220	Good coverage for total, but no attempt to classify.
Wrangell Mts.-southwest slope from Nadina R. to Anderson Glacier	8/3-4/67 Jones	7.2%	20.6%	39.0%	1119	Poor coverage,a trend count only.Classification accuracy unknown.
Wrangell Mts.-southwest slope from Nadina R. to Anderson Glacier	8/63 Jones	13.0%	29.1%	47.5%	1210	Comparable to 1967 count.

Table I. General Sheep Distribution Surveys(continued)

Area Surveyed	Dates & Personnel	Legal Rams as Percentage of Total Sheep	All Rams as Percentage of Total Sheep	Lambs as Percentage of Ewes	Total Sheep Counted	Remarks
Wrangell-Nutzotin Mts. Chisana/Nabesna areas	8/5-7/67 Jones Griffin	12.2%	25.4%	35.6%	2129	Good coverage for total; fairly accurate classification.
Wrangell-Nutzotin Mts. Chisana/Nabesna areas	7/14-17/62 Jones	12.6%	27.6%	48.1%	1298	Less coverage than in 1967.
Chugach Mts.-Knik R. to Turnagain Arm	7/11-14/67 Nichols Erickson	8.2%	16.8%	15.2%	868	Good coverage for totals fairly accurate classification.

TOTAL COUNTED IN 1967 = 7578

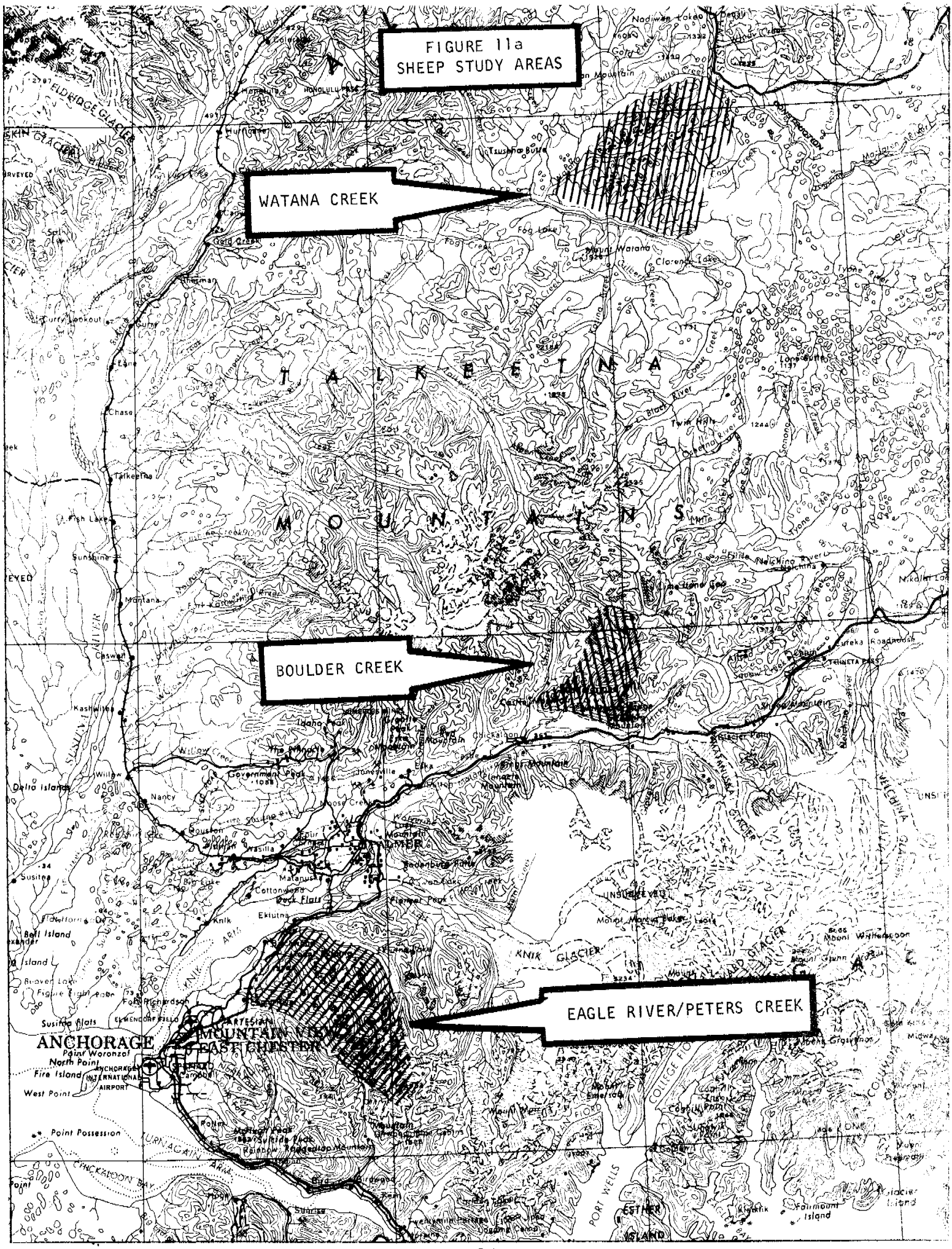


FIGURE 11a
SHEEP STUDY AREAS
WATANA CREEK
BOULDER CREEK
EAGLE RIVER/PETERS CREEK
T A L K E E T N A
M O U N T A I N S
ANCHORAGE
MOUNTAIN VIEW
EAST CHESTER
KNIK GLACIER
ESTHER ISLAND

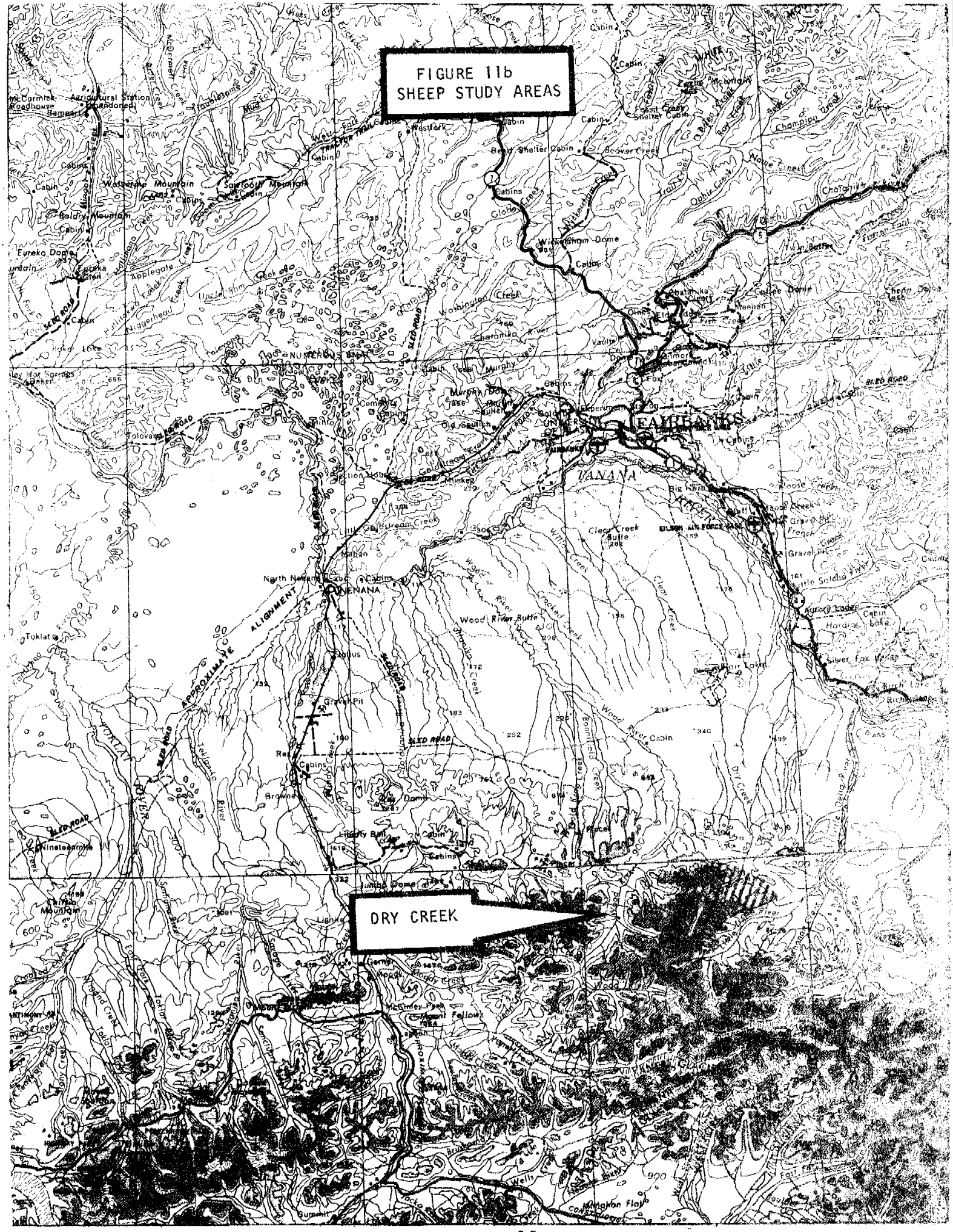


FIGURE 11b
SHEEP STUDY AREAS
DRY CREEK
FAIRBANKS
NENANA
APPROXIMATE ALIGNMENT
SLED ROAD
TOKLAT RIVER

Table II. Aerial Classification Counts, Selected Study Areas

Area Counted	Dates & Personnel	Young Rams	Legal Rams	Unclas. Rams	Total Rams	Ewes	Lambs	Yrlgs.	Unid.	Total	Remarks
Wood River drainages only	6/13-14/67 Jones Nichols	79	97 (15.5%)*	127	296 (42.2%)*	249	58 (23.3%)**	5	19	627	Good coverage fairly accurate classification.
Dry Creek drainages only	6/13-14/67 Jones Nichols	35	32 (6.5%)	45	112 (22.7%)	281	73 (26.0%)	3	25	494	Good coverage fairly accurate classification.
Dry Creek drainages only	9/21/67 Nichols Erickson	-		13	13 (3.5%)	109	33 (30.3%)	-	221	376	Good coverage; fair to poor classification accuracy
Boulder Creek drainages only	9/15/67 Nichols Erickson	-	-	-	-	-	-	-	453	453	Good coverage, no classification.
Boulder Creek drainages only	10/20/67 Nichols Erickson	3	15 (3.8%)	4	22 (5.6%)	43	12 (27.9%)	-	315	392	Good coverage; poor classification accuracy due to snow conditions.
Eagle River - Peters Creek Area	7/11-14/67 Nichols Erickson	23	20 (6.7%)	-	43 (14.4%)	28	22 (78.6%)	-	205	298	Good coverage; poor classification accuracy.
Eagle River-Peters Creek Area	10/19/67 Nichols Erickson	3	8 (7.5%)	2	13 (12.1%)	28	5 (17.8%)	-	61	107	Poor coverage and classification accuracy due to snow conditions.

Table II. Aerial Classification Counts, Selected Study Areas (continued)

Area Counted	Dates & Personnel	Young Rams	Legal Rams	Unclas. Rams	Total Rams	Ewes	Lambs	Yrlgs.	Unid.	Total	Remarks
Eagle River - Peters Creek Area	11/7/67 Nichols Erickson	5	21 (12.4%)	-	26 (15.4%)	-	-	-	143	169	Poor coverage for total; ram classification only.
Eagle River - Peters Creek Area	11/29/67 Nichols Erickson	14	11 (8.0%)	-	25 (18.1%)	44	5 (11.4%)	1	63***	138	Poor coverage for total; very good ram classification accuracy.
Wrangell Mts. - Dadina R. to Kluvesna R.	11/30/67 12/1/67 Nichols Erickson	27	48 (15.9%)	-	75 (24.8%)	-	-	-	227***	302	Poor coverage for total; very good ram classification accuracy.

* Figures in parentheses show ratios of legal rams and total rams to total sheep counted.

** Figures in parentheses show ratios of lambs to ewes classified.

***"Unidentified" includes only ewes, lambs and very young rams, but no identifiable rams.

Table III. Ground Classification Counts, Selected Study Areas

Area Counted	Dates & Personnel	Young Rams	Legal Rams	Unclas. Rams	Total Rams	Ewes	Lambs	Yrlgs.	Unid.	Total	Remarks
Eagle River-north side only, from road end to glacier foot	5/23-25/67	31	18 (26.5%)	-	49 (72.1%)	12	-	6	1	68	Accurate classification; poor coverage for totals
Dry Creek	6/9-10/67 Nichols Erickson Jones	41	24 (7.6%)	-	65 (20.4%)	158	56 (35.4%)	18	21	318	Accurate classification; fair coverage for totals
Dry Creek	9/22-26/67 Erickson Blum	16	14 (5.0%)	-	30 (10.6%)	177	75 (42.3%)	-	-	282	Accurate classification; fair coverage for totals

Two aerial surveys of Dry Creek were conducted during the year: one in early June as part of an overall survey of sheep between Healy Creek and the West Fork of the Little Delta, and the other, a distribution survey only, in September of Dry Creek alone. The results of these surveys are shown in Table II. Although Wood River is not yet included in the study area, the results of the aerial survey covering its drainages are also shown in the table.

A two-day ground classification count was made in Dry Creek in eary June, and another in September. The area was partially covered by personnel on foot during each count, and sheep were examined through binoculars and spotting scope for identification. Each observation, whether of one sheep or a group,was listed on an observation form designed for the purpose (see Figure III), along with other pertinent information. Gross results of the counts are shown in Table III. Analysis of other information recorded on these forms has not yet been attempted due to the limited data obtained during these two trips. It will be included with future data in analysis after a meaningful amount has been collected.

Another study area, consisting of all drainages of Boulder Creek, in the southern Talkeetna Mountains, was selected primarily for aerial herd composition studies. This area receives heavy hunting pressure and contains a large number of sheep for its size. Thus, it should yield information on the effects of such pressure on herd composition and size. It was also covered previously by Scott's aerial surveys, so some comparative data are already available on populations as well as on hunter harvest.

This area, like Dry Creek, is not well bounded topographically, and may have to be enlarged in the future after something is learned of sheep movements here in order to obtain valid population information.

Two surveys of this area were flown, the results of which are also listed in Table II. The first was part of the general coverage of the southern Talkeetnas, when no classification was attempted. The second was in mid-October and classification was tried, but snow conditions made it so difficult to determine sex and age class that results were poor.

A third area selected for further study includes the mountains surrounding Watana Creek, which are isolated from surrounding sheep habitat by topography and distance. This area, almost

all of which is alpine habitat of a type well suited to aerial survey, should be especially valuable for observing population changes and interpreting the causes thereof, since it appears unlikely that any significant egress or influx of sheep would occur. Although this habitat sample is quite large in size, it appears to be relatively accessible by foot travel for periodic checks of sheep and factors relating to them.

One aerial survey was made here during the segment, and this to count overall numbers, only. Results are shown in Table 1.

The fourth area selected lies between Eagle River and Eklutna Lake in the Chugach Mountains, and includes the entire Peters Creek drainage. Some past data on populations and hunter harvests here are available through Scott's reports; the area is well bounded by deep river valleys and glaciers which semi-isolate its sheep herds; it contains several natural mineral licks with attendant concentrations of sheep and which should be helpful during trapping attempts; and it is close to Anchorage with reasonably good access by air. It should be particularly useful as a testing ground for aerial survey and capturing methods due to its availability, as well as being a suitable area for movements, herd dynamics, hunting effects, behavioral and general ecological studies.

Four aerial surveys were conducted here and the results are listed in Table II.

Discussion: Surveys conducted during this segment were preliminary, and personnel, for the most part, were inexperienced. Emphasis was on developing techniques, gaining experience and learning the limitations of the methods employed as well as on learning the country and actually counting and classifying sheep. We feel that much of the data obtained, other than those concerning gross numbers and distributions, may be misleading and subject to erroneous interpretation if taken at face value. The results of the summer and early fall classification counts made, though listed in Tables I, II, and III, should not be accepted as very accurate, nor should other than very general conclusions regarding sex and age compositions of the various herds be drawn.

It is well understood that weather, turbulence, light conditions, terrain and snow cover directly affect the accuracy of any aerial big game count. These factors, therefore, must be as nearly optimum as possible before even minimum accuracy

NOTES

No._____

SHEEP OBSERVATION FORM

DATE_____ TIME_____ OBSERVER_____

MT. RANGE_____ DRAINAGE_____

SPECIFIC LOCATION_____

WEATHER_____

SNOW CONDITIONS_____

TOPOGRAPHY_____

DIST. TO NEAREST CLIFFS_____ ALTITUDE_____

RANGE TYPE & COMPOSITION_____

RANGE CONDITION*_____

NO. OF SHEEP_____ SEX & AGE_____

COMP. OF GROUP_____

RAMS: ¼ ½ ¾

4/4 4/4+ UNCLAS:

EWES: LAMBS:

YRLGS: UNCLAS:

ACTIVITY_____

METHOD OF OBSERVATION: NAKED EYE_____

BINOCULARS_____ SPOT. SCOPE_____

FIGURE III
SHEEP OBSERVATION FORM

can be expected. Furthermore, the animal species involved must lend itself to aerial observation.

Dall sheep, being white against a green or brownish background in summer, and living almost exclusively in open, alpine habitat, are one of the easiest species to see from the air and so are well suited to this form of enumeration. They have been so counted and classified for many years and these classifications have been generally considered accurate for just this reason.

When counting conditions are good and routes are carefully chosen and flown, very good accuracy may be obtained on total counts. To be sure, an unknown percentage of animals is missed, but this percentage is probably quite small when conditions are ideal. Less careful coverage will, naturally, increase the percentage of missed animals by an unknown amount, and so will decrease the value of interpretations based on these counts.

Classification by sex and age groupings during summer surveys is considerably more difficult than total counts because of the difficulty in differentiating between ewes and young rams, ewes and yearlings and even ewes and lambs. This is particularly true when groups of sheep bunch up as they often do when approached closely enough by plane to enable accurate determination of sex or age. Consequently, it has been the custom on aerial surveys to classify sheep as "rams", "yearlings" and "lambs" when these classes are obvious, with others lumped as "ewes and mixed young animals" or "unidentified". Rams usually are further classified by estimated curl of their horns; we have been using "legal" (3/4 curl or larger) or "sub-legal" as criteria.

This method of classification leads to bias in favor of those animals more easily identified such as "legal rams" and "lambs", which are obvious when observed. The more difficult to identify young rams and yearlings may not be seen as such and are then lumped in the "ewe and mixed young" class. Thus, observed percentages of rams may indicate a fairly accurate proportion of legal rams to total sheep seen (offset to an unknown amount by the fact that larger rams seem to inhabit rougher habitat in the summer and so are more easily missed altogether) while the proportions of younger rams and total rams to total sheep seen are below the true value by an unknown amount. The observed proportions of lambs and yearlings to ewes are likewise lower than is actually the case.

This may be illustrated by comparing results of the June aerial survey of Dry Creek, for example, with those of the ground classification conducted there a few days earlier. The observed proportion of lambs to ewes was 35.4% on the ground count but only 26.0% on the aerial count. At the same time, the proportions of yearlings to ewes were observed at 11.4% and 1.1% from ground and air, respectively. Classification from the ground is more accurate than from the air, and should reveal more nearly correct proportions providing an adequate sample is examined.

Two aerial surveys were flown in late November and early December during the rutting season in order to see whether more accurate proportions of rams could be determined than in the summer when rams remain segregated from ewes. During both of these surveys, totals of each group seen were counted, then careful classification of all rams in the group was made by making repeated low, slow passes until we were satisfied with the accuracy. The relatively pure white background of heavy snow at this season aided considerably in that rams' horns were much better defined than against a darker, summer background. It was possible to classify rams as such down to two-year-olds in most cases, and differentiation between legal and sub-legal animals was simplified because horn tips were easily visible.

Rams were found to be well distributed among the ewe bands, with few bunches of ewes observed without rams and few rams seen unaccompanied by ewes. We feel that we got a more adequate and random sample of animals at this time than in the summer, as well as a much more accurate classification by sex.

Results of these two surveys, one in the Eagle River-Peters Creek study area, and one in a randomly-picked section of the southwest slope of the Wrangell Mountains, are listed in Table II. Comparison of the results of the ram count in Eagle River-Peters Creek with those of previous counts there shows higher percentages of legal and total rams seen during the rut. This difference is particularly noteworthy when comparing the July count, which was made under nearly "ideal" conditions, with the winter count, made after a number of legal rams had been removed by hunting and which must have been present in July. Actual percentages of legal and total rams must have been even higher prior to the hunting season than observed in November.

Differences in observed proportions of rams are even more striking when comparing the findings of the winter count in the Wrangells with those of the summer count there, although the summer count did include a larger sample of sheep.

The point is that it does not seem practicable, nor perhaps possible to obtain accurate classifications by sex and age from any one aerial survey. When a general survey is made in the summer ---the best time in which to obtain estimates of total numbers and distribution---an accurate picture of ram abundance and yearling survival is generally not obtained, nor is time usually available to stay with each group of animals long enough to accurately count even lambs. Thus, distribution and abundance surveys, where large areas are to be covered in limited time, should be confined to a careful search for total numbers and herd distribution, only. Additional time taken for partial classification is wasted for the most part, since the degree of accuracy cannot be determined.

Classified aerial counts of sample areas, such as our study areas, made at the time when each segment of the population is most readily identified and observed, and carefully conducted for best possible accuracy, should yield the best picture of herd composition by sex and age class. Counts in late spring, but before lambing season, should be made to determine lamb survival to yearling class. Counts after mid-June should be directed towards enumerating lambs and total numbers on the sample area, and rutting season counts should give ram proportions. Comparison of the findings can then be made in order to compute composition for the given area with a reasonable degree of accuracy.

Ground surveys, such as the preliminary ones made during this segment, make possible very careful classification of animals seen, and are valuable in checking accuracy of aerial counts if sufficient numbers are encountered. The problem here is in obtaining an adequate sample in a given time. Surveys on foot of sheep and their habitat are, of course, necessary in order to obtain ecological information of all types, and should be conducted at every opportunity within the study areas.

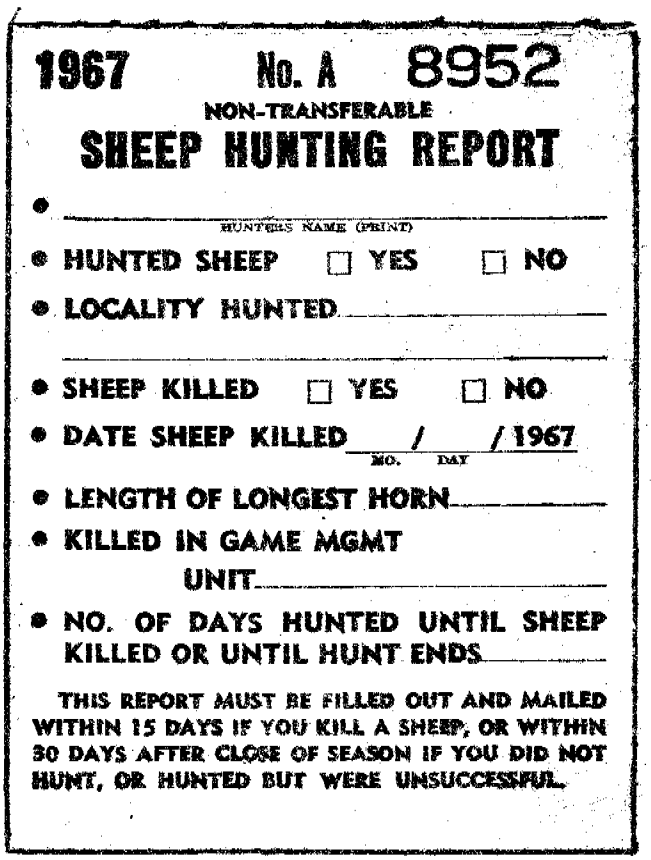
More work is needed in order to test the suggested seasonal aerial counts before final methods of herd classification are decided upon. Further surveys will also be needed in order to resolve study area boundaries. This work is planned during the next segment along with more intensive life history and ecological studies.

Hunter Harvest Information

General Summary of 1967 Harvest Statistics

The reported issue of sheep harvest tickets for 1967 was 7050, but only 2777, or 39% of ticket holders reported that they hunted. Of these, 915, or 33%, killed a sheep. A few less than 3375 ticket holders did not hunt. About 900 ticket holders did not report at all prior to computer analyses in December. Letters were sent on 8 November 1967 to remind 3172 delinquent ticket holders to send in their report cards (Figure IV). Approximately 87% of the 7050 tickets issued had been returned by 8 December 1967 when the data were readied for computer analyses. By 15 January 1968, after most of this report had been prepared, 195 additional tickets had been received, bringing the overall return to 90%. In this late return there were 66 hunters (34% of 195) of whom 7 (11% of 66) were successful. The total reported harvest to 15 January 1968 was 922 rams for the 1967 season. The reported kills of sheep for 1962 through 1967 are shown in Table IV. (See "Alaska Game Management Units, 1967-68 Edition" published by Alaska Department of Fish and Game, Juneau.)

Figure IV. The 1967 Sheep Hunting Report Card.



1967 No. A 8952

NON-TRANSFERABLE

SHEEP HUNTING REPORT

- _____
  HUNTER'S NAME (PRINT)
- HUNTED SHEEP ☐ YES ☐ NO
- LOCALITY HUNTED _____
  _____
- SHEEP KILLED ☐ YES ☐ NO
- DATE SHEEP KILLED ___ / ___ / 1967
  MO. DAY
- LENGTH OF LONGEST HORN _____
- KILLED IN GAME MGMT UNIT _____
- NO. OF DAYS HUNTED UNTIL SHEEP KILLED OR UNTIL HUNT ENDS _____

THIS REPORT MUST BE FILLED OUT AND MAILED WITHIN 15 DAYS IF YOU KILL A SHEEP, OR WITHIN 30 DAYS AFTER CLOSE OF SEASON IF YOU DID NOT HUNT, OR HUNTED BUT WERE UNSUCCESSFUL.

Table IV. Reported kill of Dall sheep rams in Game Management Units for the years 1962 through 1967 in Alaska.

Game Mgmt.Unit	1962**	1963	1964	1965	1966	1967
7	15	25	8	22	18	21
9	0	1	2	0	0	6
11	117	131	151	131	125	149
12	92	149	128	141	180	165
13	107	132	156	143	154	152
14	99	110	67	62	49	72
15	35	43	26	35	48	47
16	4	15	20	16	6	4
17	9	1	12	11	9	7
19	24	27	26	44	66	48
20	74	157	182	165	148	132
21*	0	0	2	3	1	0
22*	0	0	2	0	0	1
23	7	20	15	11	13	14
24	38	52	57	43	47	24
25	12	23	20	19	38	30
26	28	83	41	26	35	37
?	6	1	4	13	18	6
TOTAL	667	970***	919***	885	955	915 ‡

* Very doubtful that any sheep exist in Units 21 and 22; probably incorrect reporting by hunters.

** 1962 was first year of harvest ticket regulation. Coverage is known to have been incomplete.

*** Includes at least 17 second sheep legal in Brooks Range in 1963 and 1964.

‡ Reported kill by 8 December 1967.

Quantity and Quality Considerations, 1967 and Previous Years

Table V shows in more meaningful terms than Table IV the origins of the sheep that were killed in 1967. More specific localities than these are available through hunter reports, but in many ways are unusable because sample sizes are too small.

Figure V and Table IV show that the reported harvest has not changed much since the 1963 season. (The 1962 coverage of the harvest tickets was known to be incomplete.) The changes in the number of harvest tickets issued and non-resident tags sold (Fig. VI) over the past five years are not well correlated with the number of hunters or with the kill of sheep. Robert A. Rausch, Alaska Department of Fish and Game, Fairbanks, has pointed out (personal communication) that one hypothesis for explaining the relatively unchanging kill is that a stable number of consistently successful residents and a slowly increasing number of non-residents, a high percentage of whom are successful, are responsible for a majority of the kill each year. The fluctuation in hunter numbers is then largely a result of the variation in the numbers of mostly inexperienced, mostly unsuccessful, hunters. It is hoped that parts of this hypothesis can be tested soon. The kills of sheep and number of hunters are similar for 1964 and 1967 as seen in Figure V. The autumns of both 1964 and 1967 were times when many people were preoccupied with the impacts of natural disasters in Alaska. The extent to which these disasters affected the numbers of hunters will remain largely unknown.

Resident hunters as a group are less successful than non-residents (Table V). Non-residents are required to be "guided" on a sheep hunt whereas residents are almost always "unguided".

Table V shows the distribution of hunting pressure in absolute terms. The areas of sheep habitats and the numbers of sheep present are needed before hunting pressure can be put in meaningful relative terms. A partial picture of hunting pressure relative to sheep numbers is given in Tables VI and VII.

Scott (1951) presented data concerned with a sheep hunt in the western Chugach and southern Talkeetna Mountains in 1951. A comparison of these data with the data from the 1967 season in the same area is shown in Table VI.

Several areas hunted in 1967 were closed in 1951 and are indicated as such in the Table. In 1949, the entire Territory was closed to sheep hunting. In 1950, 20 permits were issued for three-quarter curl rams in specified areas of the Chugach Mountains west of Nelchina Glacier and 20 in the southern Talkeetna Mountains. The 1951 season was open to an unlimited number of free permits for three-quarter curl rams in the Chugach and Talkeetna areas described above. It seems likely that there were proportionally more legal rams in the 1951 populations than in the 1967 populations because of closures and restrictions prior to the 1951 hunt.

Table V. Reported kill of Dall sheep rams, numbers of hunters, and success of hunters for eight mountain areas in Alaska, 1967.

AREA	ALL HUNTERS			RESIDENTS			NON-RESIDENTS		
	Kill	No. Hunters	Success	Kill	No. Hunters	Success	Kill	No. Hunters	Success
Kenai Mountains	68	358	19%	56	335	17%	12	23	52%
Chugach Range	115	521	22%	67	455	15%	48	66	73%
Talkeetna-Chulitna Mtns.-Watana Cr. Hills	84	272	31%	50	224	22%	34	48	71%
Wrangell-Mentasta-Nutzotin Mtns.	315	609	52%	152	417	36%	163	192	85%
Alaska Range E. of McKinley Pk.	120	310	39%	73	231	32%	47	79	59%
Alaska Range W. of McKinley Pk.	65	97	67%	27	47	52%	38	50	76%
Tanana Hills-White Mtns.	8	23	35%	4	17	24%	4	6	67%
Brooks Range	105	156	67%	56	100	56%	49	56	88%
Unknown Mtns. (Codes 0610, 1310,1410,2010, 2110,2210,2710)	35	431	8%	18	381	5%	17	50	34%
All of Alaska	915	2777	33%	503	2207	23%	412	570	72%

Figure V. Number of hunters, kill of sheep, and percent of hunters successful, 1962 through 1967, Alaska.

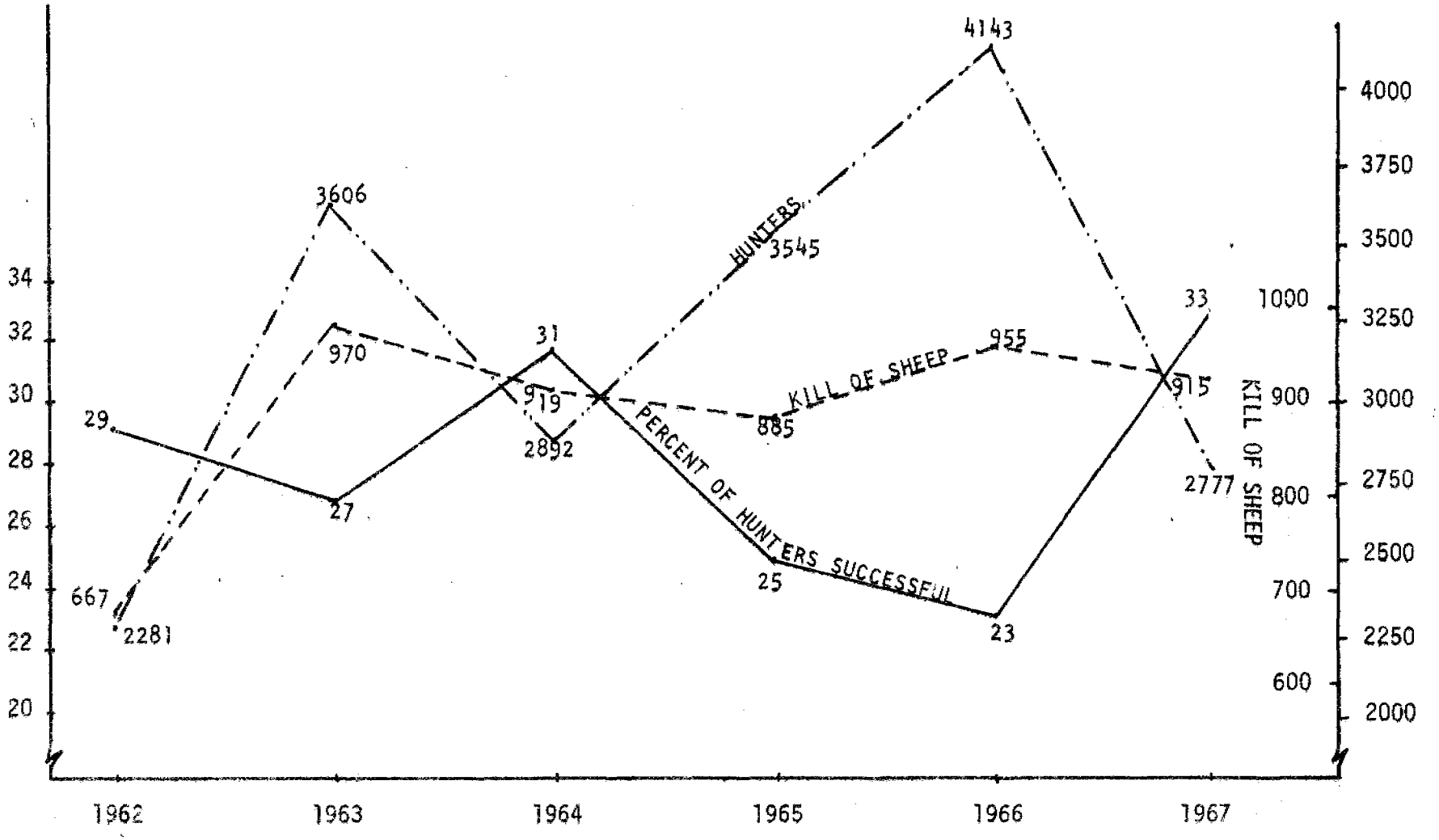
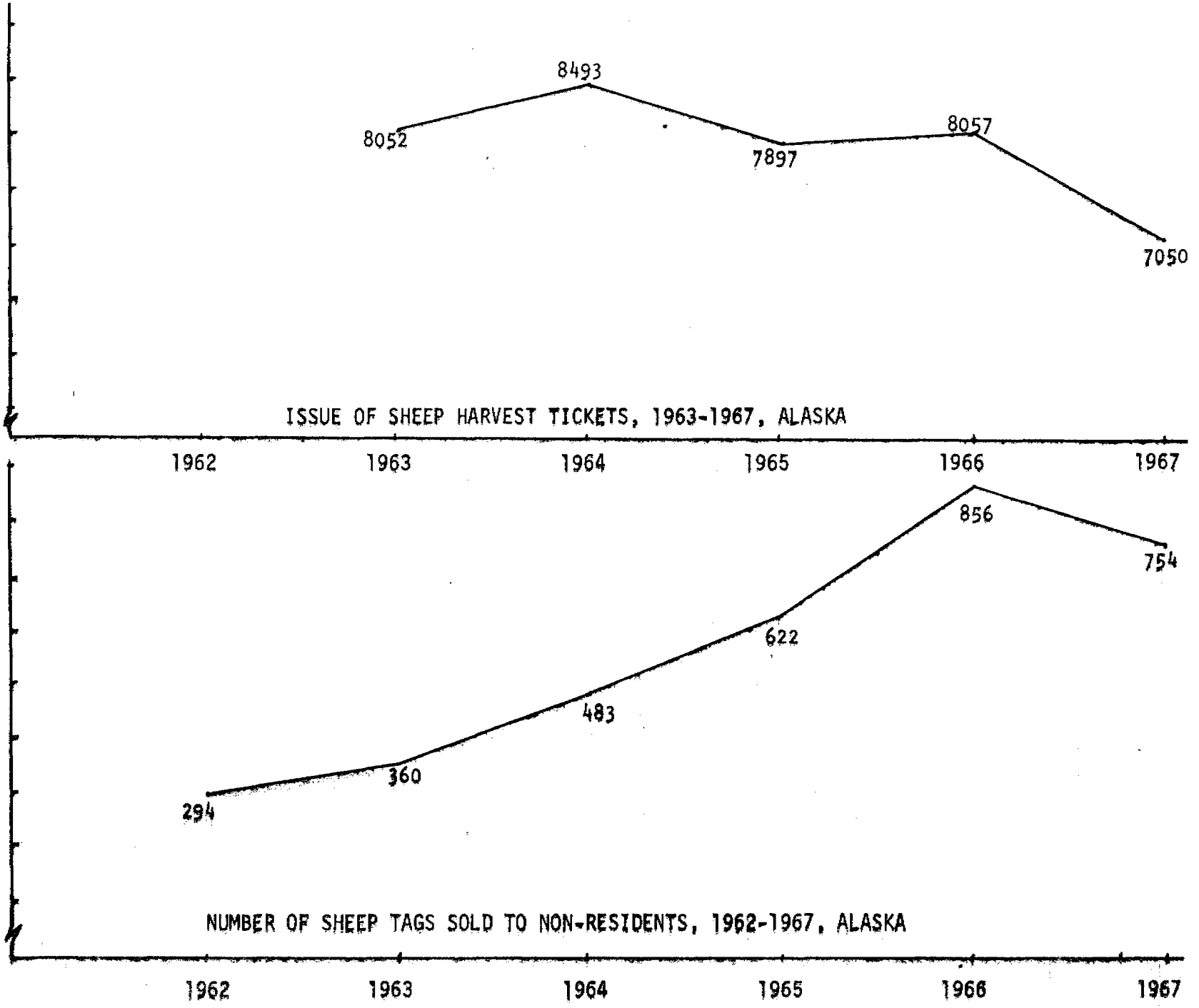


Figure VI. Issue of sheep harvest tickets and sale of sheep tags to non-residents, 1962-1967, Alaska.



Scott (1951) estimated the 1951 sheep population in the Chugach Range adjacent to Anchorage, to be 505, based upon a direct count of 446 from a 165 hp. Stinson airplane. He assumed that he had seen from 70 to 100% of the sheep, depending on the drainage he was in. Lyman Nichols and I counted 868 sheep in the same area, 11-14 July 1967, with a 150 hp. Supercub airplane. The 868 is considered a minimum estimate; we have no quantitative base for expanding it. (Scott's 1951 expansion of 446 to 505 was apparently purely subjective, and in most cases consisted of rounding up to the next highest 10 or 5.)

Table VI. Comparison of 1951 and 1967 sheep seasons in the Chugach and Talkeetna Mountains, Alaska. 1951 data from Scott (1951).

AREAS	No. of Hunters* 1951	No. of Hunters* 1967	Rams Killed 1951	Rams Killed 1967	% Success 1951	% Success 1967
Crow Pass, Ship Cr. Eagle River	(Closed)	128	--	17	--	13
Peters Creek	31	21	15	4	50	19
Eklutna River	(Closed)	131	--	14	--	11
Goat Creek and Knik R. (1951)						
Knik R., Pioneer Pk.-** Friday Cr. and Lake George (1967)	55	47	2	11	4	23
Wolverine Cr.	12	11	3	0	25	0
Carpenter Cr.	17	1	2	0	11	0
Carbon Cr.	9	2	1	2	11	100
Coal Cr.	10	7	0	5	0	71
Upper Matanuska R.	5	26	0	15	0	58
Other	6	--	0	--	0	--
WESTERN CHUGACH TOTALS	145	374	23	68	16	18
Moose Creek	3	0	0	0	0	0
Eska Cr.-Granite Cr.	3	2	2	1	67	50
Chickaloon River-Boulder Creek	66	83	43	32	65	39
Hicks Cr.-Caribou Cr.-Alfred Cr.-Pinochle Cr.	52	54	19	7	37	13
SOUTHERN TALKEETNA TOTALS	124	139	64	40	52	29

* Overall totals are about 15% non-resident in 1967, about 2% non-resident in 1950.

** Similar areas

Table VII. Estimates of sheep numbers, 1951 and 1967, Western Chugach and Southern Talkeetna Mountains, Alaska. 1949-1951

AREA	1949-51 BEST COUNT	DATE	1951 ESTIMATE	1967 BEST COUNT & MIN.ESTIMATE	DATE
Crow Creek	-	-	-	1	11 July 67
Bird Creek	7	14 Jan.51	10	11	11 July 67
Indian Creek	18	14 Jan.50	20	15	11 July 67
Falls Creek	-	-	-	2	11 July 67
Campbell Cr.	-	-	-	1	11 July 67
Ship Creek	57	14 Jan.50	60	165	11-12 July 67
Eagle Lake	12	14 Jan.50	12	13	12 July 67
Eagle River	81	20 Dec.50	85	108	12-13 July 67
Peters Creek	125	9 July 50	125	229	13 July 67
Eklutna River	67	9 July 50	75	161	13-14 July 67
Knik River	32	18 May 49	40	95	14 July 67
Hunter Creek	47	9 July 50	50	51	14 July 67
Big Timber Cr.-L.George	-	-	-	16	14 July 67
WESTERN CHUGACH	446		505	868	
Eska Creek	24	15 Jan.51	25	13	20 Oct.67
Granite Cr.	31	15 Jan.51	31	11	14 Sept.67
Red Mtn.-Young Cr.	39	15 Jan.51	40	19	14 Sept.67
Kings River	-	-	-	63	14 Sept.67
Chickaloon River	142	15-16 Jan.51	175	272	14 Sept.67
Boulder Creek	102	15 Jan.51	115	374	15 Sept.67
Anthracite Ridge	28	15 Jan.51	30	56	14 Sept. 67
Hicks Creek	-	-	-	73	14 Sept.67
Pinochle Creek	23	16 Jan.51	25	9	14 Sept.67
Caribou Creek	87	16 Jan.51	100	321	14 Sept.67
Alfred Creek	20	16 Jan.51	25	-	
Sheep Mountain	57	16 Jan.51	60	84	15 Sept.67
SOUTHERN TALKEETNA	553		626	1295	

Hunter effort appears to be a poor means of estimating availability of harvestable sheep, mainly because hunters are not distributed randomly in sheep habitat, but also because hunters' efficiencies differ from area to area and probably from year to year within areas. Accessible areas close to urban centers probably attract the less efficient hunters, while less accessible (physically and monetarily) areas, far from urban centers are hunted by more efficient hunters. It appears that aerial classification of sex ratio and ram size is a better method of estimating availability of harvestable sheep(see discussion, p.23 , this report).

Year-to-year, area-to-area, and long-term comparisons of horn size and hunter effort are hampered by poor sampling technique. The help of a qualified statistician is needed to design a system of gathering data to which valid statistical tests can be applied to show if horn quantity (trophy quality) and hunting effort are changing.

Most people expect that horns which hunters take to taxidermy shops for mounting would be larger than average, or biased toward the "trophy" heads. Present data indicate that it is not true in most cases. Table VIII shows the distribution of curl sizes for horns at taxidermy shops. These curl estimations are subjective, ocular estimates.

The reliability of the horn measurements made by hunters appears to be good (Table IX); although most samples are small. For 100 sets of horns measured by hunters and by ADF&G personnel, the mean difference was 0.9 inches inches; the hunters' measurements were larger. Quantitative information on shrinkage of horns is needed because most hunters measure sheep horns shortly after the sheep was killed and the measurements at taxidermy shops are made after one to seven weeks of drying has occurred. Probably there is a bias toward larger horns in the guided-hunt reports from Scott (1951) in Table IX.

Tables X and XI show the time required to kill a sheep and the length of the longest horn for various game management units and residency classes. Where relatively large samples are available they indicate that most successful hunters killed a sheep after hunting three or four days while a few required five, six or more days. Scott (1951) indicated that of 84 successful hunters in the 1951 permit hunt in the Chugach and Talkeetna Mountains, 46% spent one day, 17% two days, 11% three days, 10% four days, 11% five days, and 6% six to nine days for an overall mean of 2.48 or two days (rounded as the computer-analysed 1967 data were). The 1967 figures for 65 resident hunters in Unit 13 (parts of Chugach and Talkeetna Mountains but not strictly the same as area in 1951) were 30% one day, 12% two days, 17% three days, 14% four days, 3% five days and 23% six to 15 days for an overall rounded mean of four days. The variability in the reported time required to kill a sheep is much greater in 1967 than in 1951.

From Table IX the mean difference for 100 compared measurements of the same horns was 0.9 inches (2.3 cm); the hunters' measurements exceeded

those of ADF&G personnel. If this mean difference of 0.9 inches is subtracted from the overall mean of 830 hunter-reported lengths of longest horn, 33.4 inches (84.9 cm) from Table X, the result is 32.5 inches. Again from Table IX the mean length of 145 horns measured by ADF&G at taxidermy shops was 32.7 inches. The adjusted hunter measurements are only 0.2 inch (0.5 cm) different from those obtained at taxidermy shops in 1967.

Table VIII. Distribution of curl sizes as estimated by ADF&G personnel at taxidermy shops for sheep killed in the 1967 season, Alaska.

		PERCENT OF SAMPLE WITH HORN CURL						
AREA		1/2+ 210°*	3/4- 240°	3/4 270°	3/4+ 300°	4/4- 330°	4/4 360°	4/4+ 390°+
Kenai Mountains	(15)**	0	13	27	33	13	7	7
Chugach Range	(23)	0	9	17	35	17	13	9
Talkeetna-Chulitna Mtns.-Watana Cr. Hills	(14)	0	14	7	21	21	28	7
Wrangell-Mentasta-Nutzotin Mtns.	(44)	2	2	4	38	14	9	30
Unknown Mtns.	(22)	4	14	9	32	9	23	9

* Approximate degrees of a circle described by the outer curl of the horn.

** Numbers in parentheses are sample sizes.

Table IX. Mean length of longest horn as measured by ADF&G and mean lengths and difference in lengths of the same horns as measured by hunters and then by ADF&G at taxidermy shops. Sheep were killed in various mountain ranges, 1967 season, Alaska. Horn-length data from Scott (1951) are included for comparison.

Area	n	n	Mean Length of Longest Horn, 1967 (cm)	(in)	Measured By	Hunters' Mean Difference (in)	Guided Hunt Rpts. 1951 and before from Scott (1951) (in)	n
Kenai Mtns.		(15)	80.7	31.8	ADF&G		34.5	(50)
	(12)		79.5	31.3	ADF&G	+1.6		
			83.6	32.9	Hunter			
Chugach Range		(24)	83.9	33.0	ADF&G		31.2	(16)
	(23)		82.8	32.6	ADF&G	+0.7		
			84.6	33.3	Hunter			
Talkeetna-Chulitna Mtns. Watana Creek Hills		(14)	82.8	32.6	ADF&G		34.8	(38)
	(12)		83.7	33.1	ADF&G	+1.3		
			87.5	34.4	Hunter			
Wrangell-Mentasta-Nutzotin Mtns.		(49)	82.9	32.6	ADF&G		35.7	(25)
	(44)		84.1	33.1	ADF&G	+0.9		
			86.4	34.0	Hunter			
Alaska Range East of McKinley Park		(16)	84.3	33.2	ADF&G		34.7	(50)
	(9)		82.9	32.6	ADF&G	-0.2		
			82.3	32.4	Hunter			
Alaska Range West of McKinley Park			-	-		-	34.9	(50)
Unknown Mountains		(27)	84.0	33.1	ADF&G			
Total	100					+0.9		
		145		32.7				

Table X. Mean number of days hunted by successful and unsuccessful hunters and mean length of longest horn as reported by hunters, 1967 season, Alaska.

Game Mgmt. Unit**	Mean No. Days Hunted Until Successful Rounded to Nearest Day* Residents	Non-Res.	Mean No. Days Hunted By Unsuccessfuls Rounded to Nearest Day Residents	Non-Res.	Mean Length Longest Horn (Inches) Residents	Non-Res.
7	3 (16)*	3 (4)	4 (103)	4 (2)	32.4 (13)	34.8 (4)
15	3 (36)	3 (8)	5 (108)	6 (9)	32.0 (34)	32.0 (8)
9	2 (2)	5 (4)	- -	- -	39.4 (2)	26.9 (4)
16	10 (1)	5 (3)	- -	- -	- -	33.8 (3)
17	3 (2)	5 (5)	2 (1)	- -	28.8 (2)	32.8 (5)
19	3 (22)	6 (26)	6 (10)	7 (9)	35.0 (22)	36.0 (22)
11	4 (66)	4 (74)	5 (61)	6 (10)	34.6 (66)	33.9 (72)
12	3 (77)	4 (78)	4 (128)	10 (12)	33.4 (74)	33.4 (81)
13	4 (65)	4 (75)	5 (180)	6 (4)	31.5 (63)	34.1 (76)
14	4 (55)	4 (14)	4 (288)	7 (14)	32.5 (52)	33.0 (11)
20	3 (76)	5 (50)	4 (141)	8 (30)	33.4 (73)	34.2 (48)
23	3 (13)	2 (1)	5 (1)	- -	31.5 (11)	33.5 (1)
24	3 (10)	3 (13)	8 (15)	9 (3)	34.1 (9)	33.1 (11)
25	5 (19)	5 (8)	7 (11)	4 (1)	32.5 (19)	34.0 (11)
26	3 (11)	3 (21)	7 (10)	- -	31.2 (12)	32.8 (21)
Weighted Means & Totals	3(471) 4(855)	4(384)	4(1057) 5(1149)	8 (92)	33.0 (452) 33.4 (830)	33.8 (378)

* Numbers in parentheses are sample sizes.

** Unit groupings include adjacent, usually similar Units.

Table XI. Mean number of days hunted until successful and mean length of longest horn as reported by hunters, listed in descending order, with the various game management units, residency, and sample sizes associated with those means, 1967 sheep season, Alaska.

Length ($\bar{y}$) of Longest Horn*	Game Mgmt. Unit	Resident or Non-Resident	n	No. Days ($\bar{y}$ rounded) Until Successful*	Game Mgmt. Unit	Resident or Non-Resident	n
36.0	19	N-R	(22)	3	26	N-R	(21)
35.0	19	R	(22)	3	20	R	(76)
34.6	11	R	(66)	3	19	R	(22)
34.2	20	N-R	(48)	3	15	R	(36)
34.1	13	N-R	(76)	3	12	R	(77)
33.9	11	N-R	(72)	4	14	R	(55)
33.4	12	R	(74)	4	13	N-R	(75)
33.4	12	N-R	(81)	4	13	R	(65)
33.4	20	R	(73)	4	12	N-R	(78)
32.8	26	N-R	(21)	4	11	N-R	(74)
32.5	14	R	(52)	4	11	R	(66)
32.0	15	R	(34)	5	20	N-R	(50)
31.5	13	R	(63)	6	19	N-R	(26)

*Means included only where sample sizes exceeded 20.

Suggested Revisions and Additions for This Job

Several shortcomings are evident in the gathering and treatment of hunter harvest data. The following is a list of recommendations for correcting some of these in future work.

1. Statistically valid sampling and data testing procedures should be sought and used. The mean, standard deviation, and sample size should be programmed as part of all computer-analyses of data of sufficient sample size to be useful.

2. When the more useful statistics are identified for each objective, computer programs should be obtained for significance tests of annually summarized data. Thus part of each year's print out would be a comparison of current statistics with those from previous years.

3. Precision (repeatability) in measurements should be emphasized and imprecise measurements (e.g. horn base circumference) should be avoided.

4. Traditional Boone and Crockett measurements should be obtained only if they are biologically meaningful (e.g. horn circumference or diameter should be measured at horn annuli not at "quarters".)

5. Regressions should be calculated for the horn length - age and horn length-curl relationships for each mountain range because hunters are providing only horn length and probably cannot reliably provide age or curl information.

6. Horn curl should be measured with a protractor rather than being subjectively estimated.

7. We should consider providing each of next year's sheep hunters with an informative, low-cost letter summarizing the information of interest to hunters that was derived from the Sheep Hunting Report cards of 1967. The letters could be distributed with the harvest tickets and would probably provide incentives to hunters for more complete cooperation in this data-gathering device.

8. All statistics should be analysed on a mountain range basis rather than a game management unit basis. Kill, however, should also be presented on a game management unit basis for comparison with past-years' data.

9. Days hunted should be presented in number of hunters hunting one day, number hunting two days, etc. for each mountain range, in addition to being presented as mean number of days hunted per area.

10. We should attempt to measure all of the readily available horns in future seasons.

11. Horn measurements should be recorded in such a way that a key punch operator can punch data directly from a recording form, thereby speeding the process and avoiding transcription errors.

12. Methods of transport of sheep hunters should be learned for use when and if management by restriction of methods and means becomes desirable or necessary.

13. The area codes should be revised to allow known or expected populations of sheep to be analysed as a unit.

Range and Habitat Investigations

Some literature pertaining to habitat investigations was reviewed. This job was otherwise inactive during the year. It will be active during the next reporting segment.

Movement Studies

The job was largely inactive in 1967; nothing conclusive can be said from the data in hand. These data and those collected during the next segment will be reported in the 1968 segment report.

Experimental Sheep Transplant

Capturing Phase: Field operations were started on July 27, 1967, when the first attempts were made to dart sheep from the Bell G-4 helicopter, the only machine available at the time. It was soon discovered that adequate performance could not be obtained at the altitudes involved, approximately 4,000 feet above sea level. In order to successfully and accurately place darts in the hindquarter or shoulder area, it was necessary for the helicopter to be flown at a slow, hovering speed behind the animal being pursued, and not more than 15 yards from it. Deflection shots, with the machine and target moving at different speeds or angles, were found to be almost impossible to make in view of the low velocity of the dart-syringes and the rapidly changing angles and distances of "lead" that had to be estimated.

The helicopter could not be flown slow or close enough to fulfill these requirements, and the only chances offered were as it passed by dodging animals at a greater speed. A number of

"desperation shots" were attempted during the four days this machine was used, but these invariably resulted in misses and lost syringes. Only one animal was hit, and this one in the flank with no apparent result.

Herding the sheep by helicopter past hidden shooters was also tried with equally poor results. One ewe was hit in this manner (Table XV, No. 14), but at too close a range as she ran by, resulting in a poorly placed flank hit in which the dart penetrated completely into the abdominal cavity. This animal escaped and apparently died later in some inaccessible cliffs.

The only sheep captured (Table XII, No. 1) was a male lamb which was hit accidently by a dart shot at another sheep while stalking them on foot. This lamb received only a partial injection of sernylan, but was promptly immobilized and just as promptly recovered after capture. He was held in a crate at Homer and rapidly became adjusted to captivity and the presence of people, surviving in good health to be released on Kodiak.

After four unsuccessful days, the helicopter was sent home, and another one brought out by the owner of the air service involved. This machine, a Bell 206A turbine-powered "Jet Ranger", was capable of excellent performance at the required altitudes, was skillfully piloted, and had a high cruise speed (130 plus m.p.h.) which considerably shortened the time between capture and deposit of sheep at Green Lake. With this helicopter and pilot, we could consistently follow bounding sheep, maintaining constant distance and angle from them at no more than 20 to 30 feet away. Shooting accuracy was greatly improved and hits became relatively simple to make, while loss of darts was reduced. It was actually found necessary to reduce the power of the CO_2 gun to its minimum setting in view of the close range shots then possible. With higher power, and consequently more velocity, the darts would hit so hard at these short ranges that they would rebound from the animal before complete injection despite a barb on the needle, and would usually be lost.

During the next two days, eight ewes were captured using sernylan. Of the eight, only two survived (Table XII, No. 2, 3). The remainder, (Table XIII) with one exception, died within a few hours as a result of bloat. The one exception (Table XV, No. 15) was a ewe which was in very poor condition when captured. Unliek the others, she was completely immobilized by 200 mg. of sernylan, was easily captured, and appeared to recover from the effects of the drug with no bloating. Unfortunately, the point of the dart penetrated her shoulder sufficiently to puncture a lung, causing slow, but serious internal hemorrhaging. Death was attributed to mechanical injury, intensified by her poor and weakened condition.

The two ewes that survived initial capturing and crating appeared to be in equally healthy condition as the five that died; drug dosages were similar except that tranvet was given both surviving ewes; handling was similar. The use of tranvet may or may not have been a factor in their survival. It did help calm the animals to some degree for handling. Both had to be chased at some length on foot before capture could be effected, as did the others which died after capture. However, neither exhibited the rapid and severe bloating tendency which led to the death of the other five.

The animals that did not survive capture by sernylan, all adult ewes, were not given injections of tranvet initially in the belief this drug was not immediately necessary and that it might add to their bloating problems. Furthermore, when it was found that a dosage of 3cc of sernylan was probably necessary for sufficient immobilization to effect capture, the additional dose of 1cc of tranvet could not be included in the 3cc syringes then available. By the time these sheep reached Green Lake, bloating was evident and all efforts were directed towards reducing this and encouraging their recovery from the drug effects rather than towards further tranquilization. Whether or not the administration of tranvet would have aided survival is not known.

By the time these sheep had been unloaded from the helicopter at Green Lake, bloat was usually evident. They were handled as carefully as possible under the circumstances, propped on their briskets with head held up, and their flanks massaged to encourage eructation.

Pressure of time made it necessary to move them again after a comparatively short recovery period, when they had to be loaded into the floatplane, flown to Homer (a 30-40 minute flight), unloaded, trucked to the compound and there placed in crates. By this time, and despite all our efforts, bloat was invariably far advanced, and the animal soon expired. Several actually died in the plane while enroute.

Necropsy showed rumen contents in the lungs of each sheep, undoubtedly forced up the esophagus by the pressure of rumen gases during the latter stages of the bloating process and then inhaled. The amount of rumen fluid in the lungs, and the sudden and final choking, indicated that the direct cause of death was probably asphyxiation by drowning.

Only two sheep escaped after being properly hit with sernylan loaded darts (Table XVI, No. 17, 18), and it is not known whether they received complete injections. Two other animals were shot with sernylan on the last day of the capturing operation. One was an adult ram, which received 300 mg. The ram was only partially immobilized and required considerable chasing, finally being caught by means of a home made bola. Shortly after capture, the ram died (Table XIV, No. 9), possibly as a direct result of the drug, or as a result of the stress of the chase, which was actually no worse than for some of the ewes.

The other was an adult ewe (Table XV, No. 16), injected with 200 mg. of sernylan, run down on foot after ataxia was observed, and captured. She was then blindfolded, restrained, and immediately given a drench of turpentine by means of a stomach tube. This was done on the recommendation of a veterinarian in an attempt to prevent bloating. This ewe was successfully transported to Homer and crated; bloating did not occur. Unfortunately and unknown to us, the needle of the dart had penetrated her lung and she died the next day of internal bleeding.

At the end of the second day of operations with the new helicopter, after six out of the eight sheep captured during these two days had died, it was decided to switch drugs to anectine which had worked successfully in the spring of 1965, during previous transplant operations. This drug, mixed daily from fresh powder, proved very erratic in its results on sheep this time. Previously used dosages of 20-24 mg. for an adult ewe did not generally produce any ataxia, much less immobilization. However, one ewe died quickly from a dose of 24 mg. (See Tables XIV and XVI). Increasing the dosage to as much as 40 mg. of anectine led to two more deaths, while other ewes of approximately the same size escaped with little or no apparent effect.

Table XII. Sheep successfully captured.

No.	Age & Sex	Weight	Immobilizing Drug & Dose	mg/lb/	Remarks
1.	Lamb male	Est.45 lbs.	Serynlan 100 mg	?	Ataxia in 7 minutes.Down in 8 minutes. Captured and survived. Did not receive entire drug dose. Tagged in left ear with orange metal tag #001 with green streamer attached. Released on Kodiak.
2.	Adult ewe	110 lbs.	Sernylan 200 mg Tranvet 50 mg	1.8 0.45	Ataxia in 10-15 minutes. Never went down;had to be run down for capture. Remained excitable, given an additional 50 mg tranvet 45 minutes after capture. Became calm after another 45 minutes. Tagged in right ear with orange metal tag #002 with red streamer attached; in left ear with #003 with blue streamer. Released on Kodiak.
3.	Adult ewe	Est.120 lbs.	Sernylan 300 mg	2.5	Ataxia in 10 minutes.Never went down. Had to be run down for capture. Given 25 mg tranvet at capture. Remained groggy and listless. Given 2 cc ACTH 3 hours after capture,and 1 cc ACTH next day. Survived capture, but died before reaching Kodiak.

Table XIII. Sheep captured but died later due to secondary drug effects.

No.	Age & Sex	Weight	Drug & Dose	mg/lb.	Necropsy Form No. & Remarks
4.	Adult ewe	135 lbs.	Sernylan 300 mg.	2.2	S-2-N Bloated,drowned; rumen contents in lungs.
5.	Adult ewe	134 lbs.	Sernylan 300 mg.	2.2	S-3-N Bloated, drowned; rumen contents in lungs.
6.	Adult ewe	122 lbs.	Sernylan 300 mg.	2.5	S-4-N Bloated, drowned; rumen contents in lungs.
7.	Adult ewe	117 lbs.	Sernylan 300 mg.	2.6	S-5-N Bloated, drowned; rumen contents in lungs.
8.	Adult ewe	-	Sernylan 300 mg.	-	S-6-N Bloated, drowned; rumen contents in lungs.

Table XIV. Sheep captured but died promptly due to direct drug effects.

No.	Age & Sex	Weight	Drug & Dose	mg/lb.	Necropsy Form No. & Remarks
9.	Adult ram	(Est. 175 lbs.)	Sernylan 300 mg.	1.7	S-8-N Never went down; had to be chased hard for capture. Captured 30 minutes after injection. Died 48 minutes after injection. No detailed necropsy.
10.	Adult ewe	(Est. 120 lbs.)	Anectine 24 mg.	0.20	Down in 22 minutes. Died immediately. Not retrieved due to weather.
11.	Adult ewe	(Est. 90 lbs.)	Anectine 40 mg.	0.44	Down in 8 minutes. Dead 15 minutes after injection. No detailed necropsy.
12.	Adult ewe	(Est. 115 lbs.)	Anectine 37.5 mg.	0.33	Down and died in 28 minutes. No detailed necropsy.

Table XV. Sheep killed by mechanical injury of dart.

No.	Age & Sex	Weight	Drug & Dose	Necropsy Form No. & Remarks
13.	Lamb female	44 lbs.	Sernylan	S-1-N Dart struck carotid artery. Promptly bled to death.
14.	Adult ewe	-	Sernylan	Dart penetrated abdomen. Sheep later seen in cliffs, apparently very sick or dead. Probably died, could not recover.
15.	Adult ewe	88 lbs.	Sernylan 200 mg.	S-7-N 2.3 mg/lb. Sheep in very poor condition. Captured and appeared to recover from drug effects. Died from internal hemorrhage due to dart injury or fall.
16.	Adult ewe	(Est. 120 lbs.)	Sernylan 200 mg.	1.7 mg/lb. Captured after moderate chase. Drenched with stomach tube and turpentine. No bloat occurred. Dart punctured lung; died of hemorrhage next day. No detailed necropsy.

Table XVI. Sheep hit but not captured.

No.	Age & Sex	Estim. Weight	Drug & Dose	Estim. mg/lb.	Remarks
17	Adult ewe	100-130 lbs.	Sernylan 300 mg	2.3-3.0	No apparent effects, escaped.
18.	Adult ewe	100-130 lbs.	Sernylan 300 mg	2.3-3.0	No apparent effects, escaped.
19.	Adult ewe	100-130 lbs.	Anectine 20 mg	0.15-0.20	No apparent effects; escaped.
20.	Adult ewe	100-130 lbs.	Anectine 24 mg	0.18-0.24	No apparent effects; escaped.
21.	Adult ewe	100-130 lbs.	Anectine 20 mg	0.15-0.20	Slight ataxia after 9 minutes, escaped.
22.	Adult ewe	100-130 lbs.	Anectine 20 mg	0.15-0.20	No apparent effects; escaped.
23.	Adult ewe	100-130 lbs.	Anectine 22 mg	0.17-0.22	No apparent effects; escaped.
24.	Adult ewe	100-130 lbs.	Anectine 24 mg.	0.18-0.24	No apparent effects; escaped.
25.	Adult ewe	100-130 lbs.	Anectine 32 mg	0.25-0.32	No apparent effects; escaped.
26.	Adult ewe	100-130 lbs.	Anectine 32 mg	0.25-0.32	No apparent effects; escaped.
27.	Adult ewe	100-130 lbs.	Anectine 37.5 mg	0.29-0.38	No apparent effects; escaped.

On August 6, because of the approach of the sheep hunting season, due to open August 10, it was necessary to suspend capturing operations. The helicopter contract was terminated and equipment was moved out of the field. Because of the weather and the problems with drugs, only two full days and three half-days had actually been devoted to capturing attempts while the jet helicopter was available.

Discussion of Drugs Used: During the spring of 1965, a similar capture and transplant project was carried out. At this time, three sheep were injected with sernylan. A 125 lb. ewe was captured using 50 mg., or 0.4 mg/lb. Another ewe, estimated to weigh 140 lbs. (perhaps a bit optimistic?) was hit with 65 mg., or approximately 0.5 mg/lb., and could not be captured. A ram, estimated at 165 lbs., received 50 mg., or 0.3 mg/lb., and also escaped. The captured ewe survived and showed no tendency towards bloat.

In the spring of 1967, two adult bighorn ewes (Ovis canadensis) were injected with sernylan during an experimental trapping and marking field trip in Canada. One ewe, weighing 130 lbs., was hit with 80 mg., or 0.6 mg/lb., and was successfully captured. The second, which weighed 125 lbs., was given 100 mg. of sernylan plus 40 mg. of tranvet, which was 0.8 mg/lb. of sernylan and 0.3 mg/lb. of tranvet. This animal was also successfully captured, and was markedly easier to handle than the first. Both were handled, then allowed to recover on the spot; no moving was attempted, nor were they tied or otherwise restrained for more than a half-hour each. Recovery was complete, and no bloat was evident. Both captures could be considered "ideal".

As in the case with the 1965 Dall sheep capture, the season was early spring, forage was dry or just beginning to green up, and the animals were thin. Dosages necessary for immobilization were much lower than during the summer of 1967, when up to four times as much sernylan was required. During the summer operation, forage was green and lush, and all animals, except the one ewe previously described, were in good condition. This thin ewe appeared to react more favorably to the drug than did the others, nor did she bloat. Thus, it would appear that sernylan tends to promote bloat-formation more in fat animals on green forage than in thin animals on dry forage. Larger per-pound dosages were required in the summer for immobilization of the fatter animals, and it is possible that this factor was more important in bloat-formation than forage condition.

Except for the bloat problem, sernylan appears to be a useful immobilizing drug with a wide latitude of safety. It should be possible to prevent bloat with prompt application of a suitable preventative drench, given immediately upon capture. Unfortunately, we did not have time to adequately try this approach.

As indicated by the death of the one ram shot, adult males, at least, do not appear as tolerant of sernylan as do ewes. The ram died of a lesser per-pound dosage, 1.7 mg/lb., than that given to the successfully captured ewes or to the ewes which escaped with no outward effects. More

work is certainly needed in order to verify this apparent difference in tolerance.

Anectine exhibited a similar but even more unreliable pattern than sernylan. Thirteen sheep were successfully captured in the 1965 project with dosages of 25 mg. for adult ewes, 20 mg. for yearling ewes or rams, and 15 mg. for adult rams. The differential sex tolerance was also evident. These sheep were thin and on drier range, and the drug worked well. In the summer 1967 attempt, nine adult ewes were injected and escaped with dosages ranging from 20 mg. to 37.5 mg., while three were killed with similar dosages from 24 mg. to 40 mg. None was successfully immobilized. Therefore, it seems that sheep reaction to anectine is too variable for successful results in the summer when the animals are fat, and when the drug is administered under conditions of stress.

Unfortunately, this project was undertaken with no time available for experimentation with capturing methods, and with limited past experience in Dall sheep immobilization, none of which had been accomplished during the summer. The adverse reaction to the drugs used was not anticipated, nor was there time to develop better methods after the problems were discovered.

Holding and Transporting: As each animal was captured, it was blindfolded and kept that way during initial holding and shipment to the Homer compound. The blindfolds did seem to lessen struggling in most cases, especially during the early recovery period. It is probable that they did help during transport, although it was difficult to assess the value due to the effects of the sernylan and tranvet previously administered, as well as the effects of bloat-induced struggling.

In order to carry the animals in the helicopter and the floatplane, it was necessary to hogtie them securely. Despite blindfold and drugs, most went through periodic spells of violent struggling. Obviously, this would have been extremely dangerous if not restrained. Such restraint was probably detrimental and contributed to bloat formation, but was unavoidable under the circumstances.

Upon reaching Homer, each surviving sheep was placed in a separate crate which had been provided with bedding and containers for grain and water. The crates were dark inside, and the adult animals did no further struggling unless the feeding doors were opened.

The ewes remained lethargic while crated, and, to our knowledge, refused to eat any of the alfalfa hay, alfalfa pellets or rolled oats which were provided. They were observed to drink water, however. One ewe was held in captivity for eight days; the second was held for seven days. By the end of this period, and probably as a result of inactivity and starvation, both were considerably weakened.

The two-month-old lamb, on the other hand, reacted differently to captivity. He rapidly became used to the presence of humans and readily accepted confinement in a crate. Although he did not appear to eat the grain, hay, or pellets, he did eat quantities of green forage brought to him, forage refused by the adult ewes. He also became quite aggressive towards anyone reaching into his crate to change food or water. At the end of his 12 days of captivity, he was still strong and comparatively tame.

A Grumman Goose amphibian was used to transport the sheep directly from Homer to the release pen on Kodiak Island. Unfortunately, the crates were too large for the plane's door so the three animals had to be removed from their crates, tied and placed on the floor of the plane.

Despite blindfolds and injections of tranvet, both adult ewes struggled continually after being placed in the plane. It was necessary for a man to constantly hold each animal to prevent its floundering around and hurting itself. The struggle was exhausting for both man and beast, and was extended by the necessity to abort the trip due to bad weather after reaching Kodiak, and return to Homer. The ewes were replaced in their crates overnight. During the night, one died, undoubtedly as a result of its weakened condition and exhaustion brought about by the struggle of un-crated transport.

The remaining ewe and lamb were again loaded in the Goose the next day, and this time flown successfully to the holding pen at Three Saints Bay, Kodiak. Throughout both attempts, the lamb remained calm and did not struggle; he was blindfolded and loosely hobbled but not tied.

Release and Follow Up: The release pen, constructed of nylon netting, steel posts and wire, was located on the west shore of the mouth of Three Saints Bay, Kodiak Island, about two miles south of the abandoned village site of Nunamiut. It had been built on a small flat between the ocean and a steep mountainside which rose over 1,000 feet and well into the alpine. The flat was covered with a dense stand of beach rye grass; the

mountainside was a tangled jungle of devils' club, salmon berry, alder, etc., forming an almost impenetrable barrier between beach and alpine.

Upon reaching the site, the ewe and male lamb were released into the pen, and we set up camp nearby in order to protect them from possible bear predation. Since there was no palatable feed within the pen, we decided to release the animals the next day after a minimal period of acclimatization.

Consequently, about noon of August 10, the pen was opened and the sheep moved out, immediately running for the hillside and entering the jungle. As expected, they soon became tangled in the brush and stopped, apparently bewildered by the dense mass and lack of visibility. There was no open access to the alpine from the release site. We then chopped a pathway from the sheep to a bear trail, which appeared to extend straight up the mountain to the alpine, and which seemed to be the only means of the animals' penetrating the brush. During the attempt to drive them to the bear trail, the sheep became separated, the ewe running up the narrow beach past the trail, and the lamb disappearing into the jungle above the pen. After proceeding up the beach about one-half mile, the ewe turned into the brush and was not seen again.

Further attempts to locate the lamb were unsuccessful, nor could the ewe be tracked back into the brush when this was tried the next day. Fresh bear tracks were noted where the ewe turned into the brush, but no birds, odor or other signs of a kill were noted during the following days.

The last and only additional sighting was made on August 15, when the lamb was seen feeding in the alpine directly above camp. It had successfully negotiated the jungle-covered slope, and reached what was presumed to be suitable sheep habitat. We left the area on that date without having seen the ewe again, and with no idea of her fate. Should she have reached the high, alpine meadows, it is reasonably certain she would eventually join the male lamb since she could only have gone onto the same mountain.

Evaluation: It is readily apparent that this project has been largely a failure due to a number of causes, the primary one being that it was attempted before we were adequately prepared to undertake it. Although the helicopter and dart gun method had been used with success several years previously, the drugs used had not been tried under the conditions now present. The unsatisfactory reactions to the drugs came as a surprise, and

sufficient time was not available to allow for experimentation and improvement.

We did not know of the inadequacy of the first helicopter until it was tried, and lost several days until the other could be procured. It was a mistake to remove the weakened ewes from their crates for shipment, but we had no choice at the time. And finally, the site for the release had been poorly picked, again because lack of time prevented a proper selection.

Should a similar project be planned in the future, ample time and funds should be made available for planning, experimentation if necessary, and carrying out all phases of the work.

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APPENDIX

Costs of Experimental Sheep Transplant
(Salaries and labor not included)

Miscellaneous Supplies, Drugs and Tools	$ 186.16
Crate and Fencing Materials, including Nylon Nets	1,279.79
Feed for Sheep	30.45
Travel and Per Diem	1,258.25
Telephone	101.95
Vehicle Rental	428.83
Freight	48.36
Aircraft Rental	1,518.50
Helicopter Charter	5,929.34
TOTAL COSTS	$ 10,773.43

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