ALASKA DEPARTMENT OF FISH & GAME

1960-61 Pittman-Robertson Project Report

DIVISION OF GAME VOLUME II, No. 2

MOOSE MANAGEMENT INVESTIGATIONS

Work Plan B

Juneau, Alaska

MOOSE MANAGEMENT INVESTIGATIONS

Photo # 1

In Southeastern Alaska topography restricts moose to small, segrated herds, while in the flat valleys of Southcentral and Interior Alaska they maintain a wide-spread distribution. (Photo by Harry Merriam)

Photo # 2

Recovery of animals which were tagged during a moose-calf tagging operation will reveal movement patterns, supply biologists with known-age specimens, and show degree of hunting pressure on various age classes. (Photo by Jack Didrickson)

Photo # 3

Moose wagon patrols are exercised in Southcentral Alaska where collisions between moose and vehicles are common. The animals are weighed, examined, and salvagable meat donated to charitable institutions. (Photo by John Crawford)

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ANNUAL REPORT OF PROGRESS, 1960-1961

FEDERAL AID IN WILDLIFE RESTORATION PROJECT W-6-R-2

GAME INVESTIGATIONS OF ALASKA

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ANNUAL REPORT OF PROGRESS
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State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 1-a Title: Moose Investigations, Southeast Alaska

PERIOD COVERED: July 1, 1960 to June 30, 1961

ABSTRACT:

Five hundred sixty-seven moose were observed in ten separate counts flown in Southeast Alaska during the fall and winter of 1960-61. Composition counts showed a ratio of 32 calves per 100 adults. The minimum hunter harvest for all Southeast Alaska (south of Cape Fairweather) was 118 moose. Hunter success on both the Stikine and Chilkat Rivers averaged 30 per cent. Eighty-six per cent of the kill on the Stikine River and 53 per cent of the Chilkat River kill consisted of 1-1/2 year old animals. Six additional moose calves were transplanted from the Anchorage area to Berner's Bay.

OBJECTIVES:

1. To determine seasonal population distribution and movements.

2. To obtain an estimate of total numbers or establish population density indices of resident moose populations.

3. To determine herd composition.

4. To collect and evaluate hunter harvest data.

5. To utilize the information obtained from the first three objectives directly in the management of the Southeast Alaska moose populations.

TECHNIQUES:

The 1960 moose hunting season in Game Management Units 1 through 4 (except Berner's Bay Closed Area) extended from September 15 through October 15, inclusive. The legal limit was one bull per hunter.

Aerial composition counts were flown over the Stikine River valley in September to determine sex and age ratios. Flights were made in the evening using a Piper Cruiser aircraft on floats. Other counts were made over the same area in January and March in a Cessna 180 at which time there was complete snow cover and moose were readily observed. Since bulls had shed their antlers prior to the January and March counts, only ratios of calves to adults and total counts could be obtained. Flights were made at a sufficiently low elevation (500 feet above the ground) to distinguish calves from adults. Counts over Berner's Bay and the Chilkat and Taku River valleys were flown by Protection Officer Fred Wolstad, incidental to patrols in those areas. Only total counts were obtained.

Hunter-harvest information from the Chilkat and Taku River valleys was obtained by Protection Aids Alex Brogle and Bob Fowler, respectively. Field data from the Stikine River were collected by Protection Aid Mike Hay and Game Biologist Loren Croxton. A central camp was established at Shakes Slough on the Stikine River from which patrols were made up and down the river by skiff. All hunting camps were checked approximately three times a week and hunters questioned as to success, location of kills and amount of time spent hunting. Lower jaws were secured from hunter-killed moose and ages determined by tooth wear and replacement. Additional harvest information was gained through post-season hunter interviews in Petersburg and Wrangell.

FINDINGS:

Aerial composition counts for moose in Southeast Alaska are summarized in Table 1. Total kill and age composition of the kill are shown in Table 2. Figure 1 shows the locations of the major moose populations in Southeast Alaska.

Taku River:

Composition counts: One aerial count was made over the Taku River drainage in late March utilizing a helicopter. Thirty-eight moose were observed. No sex or age composition data were obtained.

Hunter harvest: Protection Aid Bob Fowler, who was stationed on Taku River during the moose hunting season, reported a minimum of 27 moose killed by hunters. Poor transportation facilities precluded the collection of moose jaws for aging.

Chilkat River:

Composition counts: Three aerial counts were flown over the Chilkat River moose range by protection personnel in conjunction with other duties. Counts were made in January, February and March of 1961 observing 89, 130 and 119 moose, respectively. No differentiation as to sex or age was made.

Hunter harvest: A minimum of 45 moose were taken during the 31 day moose season. Within this period of time approximately 150 hunters spent an average of four days each in the field enjoying a hunter success ratio of 30 per cent. An average of 13 man days were spent in the field for each moose killed. The greater portion (66 per cent) of the kill was made before October 1. The distribution of the kill was: lower Chilkat River, 42 per cent; upper Chilkat River, 40 per cent; and Klehini River drainage, 18 per cent.

Age classes were determined by examination of 17 lower jaws collected from hunter kills and are shown in Table 2. The largest portion of the kill (53 per cent) consisted of animals 1-1/2 years of age. This is a considerably lower proportion than that found on the Stikine River where, during the 1960 hunting season, 86 per cent of the kill was

Table 1. Moose composition counts in Southeast Alaska, 1960-1961.

Location	Date	No. Calves	No. Cows	No. Bulls	No. Adults	Uni-dentified	Calf-Adult Ratio	Total Count
Stikine River	9-9-60	4	7	4	11		36:100	15
Stikine River	1-9-61	5			17	34	29:100	56
Stikine River	3-2-61	22			71	6	31:100	99
Berner's Bay	1-17-61	4	2	2	4		100:100	8
Berner's Bay	2-15-61	3	3	2	5		60:100	8
Berner's Bay	3-23-61	2	2	1	3		67:100	5
Chilkat River	1-17-61					89		89
Chilkat River	2-15-61					130		130
Chilkat River	3-16-61					119		119
Taku River	3-20-61					38		38
TOTALS		40	14	9	111	416	36:100	567

Table 2. Hunter harvest of moose in Southeast Alaska in 1960 showing the total kill and the age composition of the kill.

Location	Total Kill	Total Jaw Sample	Age (Years) 1-1/2 %	1-1/2 No.	2-1/2 %	2-1/2 No.	3-1/2 %	3-1/2 No.	4-1/2 + %	4-1/2 + No.
Chilkat River	45	17	53	9	18	3	6	1	23	4
Stikine River	39	29	86	25	4	1			10	3
Thomas Bay	5	2	50	1	50	1				
Mitkof Island	2	1	100	1						
Taku River	27									
TOTALS	118	49	74	36	10	5	2	1	14	7

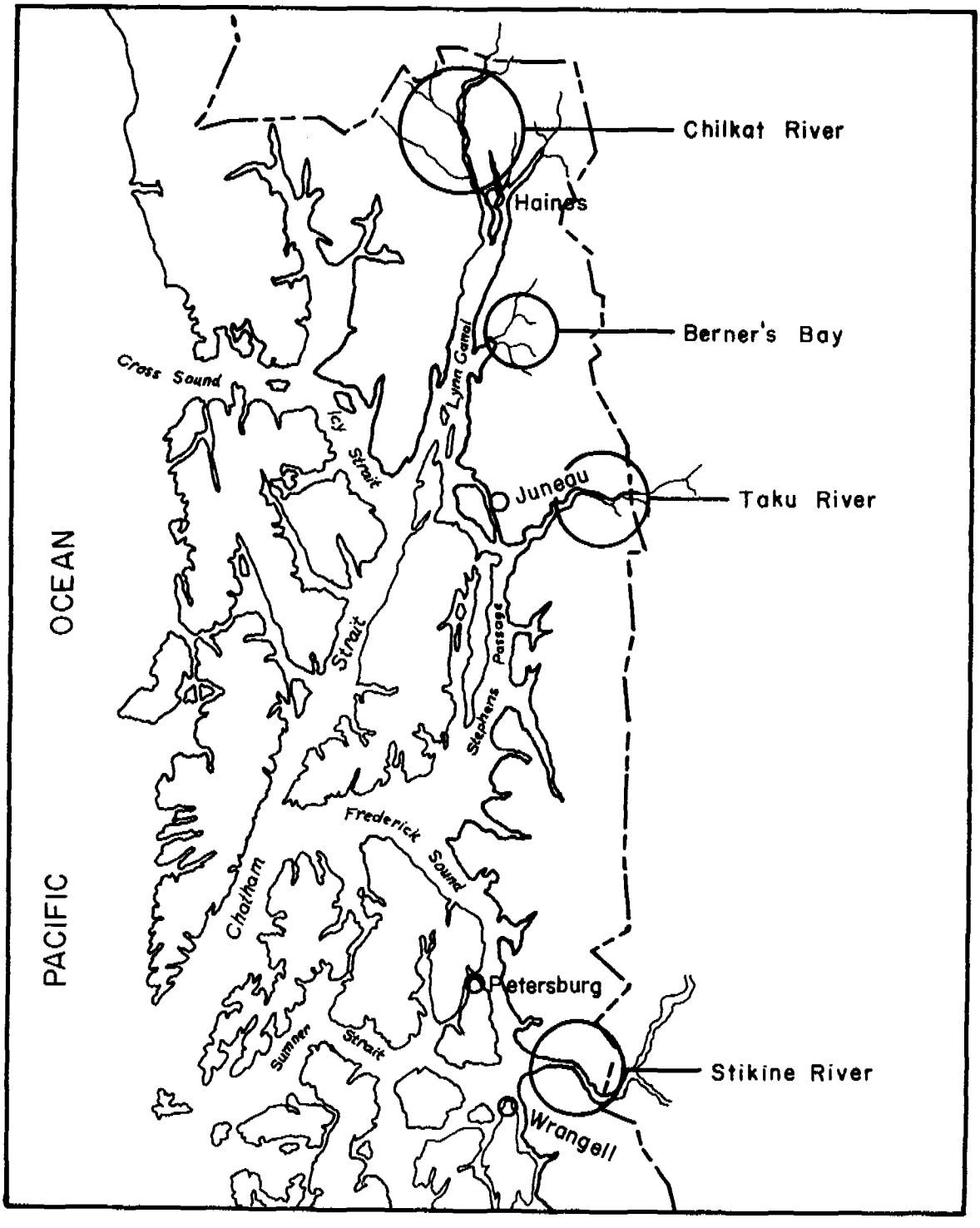

Figure 1. Map of Southeast Alaska showing the location of the major moose populations.

composed of 1-1/2 year old animals.

Stikine River:

Composition counts: Sex and age ratios of moose counted in the Stikine River Valley are included in Table 1. Three counts, one in September prior to the hunting season, one in January and the last in early March, were made. The optimum time to count moose in this area is in November and December. At this time leaves have fallen from the deciduous trees and snow cover is usually present providing excellent observation conditions. Bulls normally have not shed their antlers at this time and sex as well as age composition may be obtained. Unfortunately, turbulent air and poor visibility prevails at this season and counts must be made whenever satisfactory conditions avail. Although several counts were attempted, none were entirely successful until the final flight on March 22.

In the pre-hunting season count made on September 9, only 15 moose were observed, too small a sample on which to base conclusions. Covering the same area in the same manner in March, 99 animals were observed. Combining totals from counts made in September of 1958, 1959, and 1960, as shown in Table 3, the ratio of bulls per 100 cows is 29:100 and that of calves per 100 cows, 42:100. The ratio of calves per 100 adults was 31:100 for the combined 1960-61 counts which is slightly higher than that of the Interior of Alaska. The high proportion of calves to adults does not necessarily imply high production as this ratio increases as bulls are removed from the population. It is, therefore, frequently higher in an area which is heavily hunted. The count of 99 moose observed on the Stikine River on March 2 is the largest count to date. In the 3 counts made over the Stikine River valley in 1960-61, 170 moose were observed in 5 hours and 10 minutes observation time giving a sight rate of 0.6 moose per minute of observation time. Table 3 gives a summary of composition counts made on the Stikine River from 1952 through 1961. Though it has varied somewhat from year to year, the average ratio of calves to adults is 32:100.

Hunter harvest: In 1960, during the 31 day moose

Table 3. Summary of moose composition counts flown over the Stikine River valley from 1952 - 1961.

Date	No. Calves	No. Cows	No. Bulls	No. Adults	Uni-dentified	Calf-Adult Ratio	Observation Time	Total Count
March, 1952	24	25	15	102		24:100	26 days*	126
Jan., 1955	6			15	9	40:100	2.00 hrs.	30
Jan., 1956	10			26		38:100	1.50 hrs.	36
Feb., 1957	15			32		47:100		47
Dec., 1957	16			43	3	37:100		62
Sept., 1958	13	32	7	39		33:100	2.25 hrs.	52
Sept., 1959	6	16	5	21	1	29:100	1.00 hrs.	28
Dec., 1959					43		1.08 hrs.	43
Sept., 1960	4	7	4	11		36:100	2.25 hrs.	15
Jan., 1961	5			17	34	29:100	0.84 hrs.	56
March, 1961	22			71	6	31:100	2.08 hrs.	99
TOTALS	121			377		32:100		

* Count was made traveling on foot. All other counts were made from aircraft.

hunting season, 39 moose were killed on the Stikine River. This is the highest kill on record with the exception of 1957 when 40 moose were taken. Seventeen moose (44 per cent of the total kill) were taken on the upper river above Shakes Slough while 22 came from the lower river. An additional five moose were killed in Thomas Bay and two on Mitkof Island. Approximately 130 hunters participated in the hunt realizing a hunter success of 30 per cent, the highest on record. Each hunter spent an average of 5 days in the field and an average of 16.7 hunter days were required for each moose taken. The high hunter success on the Stikine is presumably due to high hunter efficiency rather than moose abundance. The majority of hunters are local residents who hunt the same area year after year. In 1960, 69 per cent of the kill was by hunters from Wrangell, 15 per cent from Petersburg, 13 per cent from Sitka and 3 per cent from Ketchikan. Still-hunting in the early morning and evening predominates; the hunter climbing to a vantage point in a "moose tree" 50 to 100 feet above the ground and watching meadows which moose frequent.

The age composition of the kill was determined from 29 lower moose jaws collected from hunter killed moose and is summarized in Table 2. Eighty-six per cent of the kill consisted of 1-1/2 year old animals. In spite of the heavy hunting pressure, the total kill has remained remarkably consistant. The average yearly kill from 1957 through 1960 is 36 moose. The length of the season was identical for each of these years. Bulls 1-1/2 years of age are undoubtedly active breeders in an area such as the Stikine River where a large portion of the legal bulls are removed each year.

Berner's Bay Transplant:

In 1958, 15 moose calves were successfully transplanted from the Anchorage area to Berner's Bay in Southeast Alaska. In June, 1960, three cows were observed in the transplant area, each with a single calf. Also in June, 1960, 11 additional moose calves were transported to Juneau from near Anchorage, where they were captured by Alaska Department of Fish and Game Biologists using helicopters provided by the U. S. Air Force. Six of these calves survived and were released in the Berner's Bay area in late August.

Three aerial counts, as shown in Table 1, were flown in

January, February and March during which time seven cows, five bulls and nine calves were counted. The maximum number of moose observed on any single flight was eight, four of which were calves. On each flight bull moose were observed which had not shed their antlers. On the flight of March 23, the antlers of the single bull observed fell from its head as it fled. No bull moose were observed in the Stikine River valley in January and March which still carried antlers.

RECOMMENDATIONS:

Aerial composition counts and the collection of harvest information should be continued. More information should be obtained from the Chilkat and Taku River areas. As composition counts are sometimes difficult or impossible to obtain, emphasis should be placed on gathering more comprehensive harvest data in the field.

SUBMITTED BY:

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June 30, 1961

APPROVED BY:

David R. Klein
P-R Coordinator

James W. Brooks, Director
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Volume 2 Report No. B-1b

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 1-b Title: Moose Investigations, Copper River Delta and Yakutat

PERIOD COVERED: July 1, 1960 to June 30, 1961

ABSTRACT:

Yakutat Area. An estimated 90 moose were killed during the 1960 Yakutat antlered moose season. Of these, kill information was collected from 77. The estimated hunting success of 59 per cent was considered low, due to the effects of lack of hunter interest, poor weather and transportation problems. The heaviest hunting pressure occurred in the vicinity of the Dangerous River, where 30 per cent of the moose were taken. The average weight of 25 moose meat shipments made by Pacific Northern Airlines was 758 pounds.

A herd composition survey conducted in November of 1960 indicated a bull to cow ratio of 80:100 and a cow to calf ratio of 100:28. This was based on a sample of 206 animals. The herd estimate for 1960-61 was 420 moose.

The utilization of current browse growth at the Italio River was found to be light. However, this use, when added to the stripping and trampling, was considered heavy.

Cordova Area. Kill information was collected from 25 bull moose harvested during the 1960 Cordova antlered moose season. These animals were harvested by permit which offered close observation of the hunt. The kills were distributed from Mile 7 to Mile 25 of the Copper River Highway. Young animals predominated in the harvest sample. Excellent antler development was noted on several of the bulls.

No confident population information was obtained this year. There is little variation in seasonal distribution of this herd.

Browse utilization study areas have been selected.

OBJECTIVES:

The objectives of this study are: to determine seasonal population distribution and movements; to obtain an estimate of total numbers or establish population density indices of the resident moose population; to determine herd composition; to collect and evaluate hunter harvest data from these areas; and to utilize the information obtained from the above objectives directly in the management of the Copper River and Yakutat moose herds.

PROCEDURES:

YAKUTAT AREA

The kill information collected during the 1960 Yakutat moose harvest included both age and weight data. Information was supplied largely by the public on a voluntary basis.

Age of Animals Harvested. Printed requests for moose jaws were posted in public places in and around Yakutat. These requests directed the hunter to jaw collection points at the airlines offices and the Yakutat office of the Alaska Department of Fish and Game. Department personnel at these points demonstrated the removal of moose jaws as often as possible to encourage both hunters and guides to collect these specimens.

As the jaws were turned in, they were tagged with the hunter's name and the date and location of kill, so they could be cross checked with the kill information forms kept by the airlines and the Department. The jaws were then cleaned and shipped to Cordova for further examination and storage.

Weights of Moose Meat Shipments. The airlines ticket agents at the Yakutat airport were provided with a form on which to record information about the moose meat shipments they made from Yakutat. Information requested included the date, location and sex of the kill, the name of the hunter and the weight of the meat shipped. The form was kept simple to encourage its maintenance by the agents, since they were under no obligation to keep it. To supplement this information, the same form was kept by local Department personnel.

Hunting Effort. An estimate of the number of hunters and the number of days they hunted was obtained by interviewing hunters, guides and airline ticket agents.

Population Characteristics. An aerial herd population transect was established to study the seasonal distribution, composition and trend of the Yakutat moose herd.

CORDOVA AREA

Hunter harvest information was obtained during the special permit hunt (August 20-28, 1960) in which 25 bulls were killed. Aerial counts were made on the Copper River Delta to delineate occupied range and obtain population counts.

FINDINGS:

MOOSE HARVEST FOR 1960 - YAKUTAT

Hunter harvest data was collected from 77 moose killed during the 1960 antlered moose seasons at Yakutat. This is approximately 87 per cent of the estimated kill. Such high accountability for the kill was possible because of the small local hunter population and the fact that visiting hunters with few exceptions, traveled by commercial airline and passed through the Yakutat airport.

Hunter Success. The estimated hunter success (Table 1) of 60 per cent is high. However, this figure does not represent the success that could have been achieved had the hunters shot all the legal moose they found without respect to salvaging of meat. Also, hunter success was lowered by the fact that several hunting parties were satisfied with killing one animal for division within the party. The inclement weather experienced during the season prevented several parties from hunting effectively. This aspect had to be considered with the whole, since there was no way to accurately evaluate the weather factors.

Hunting success was further affected by the hunters' choice of time and transportation. Had more hunters taken advantage of the snow conditions during the November season and employed ski-equipped airplanes, the success would likely have been raised.

Age of Animals Harvested. The collection of 40 moose jaws provided an indication of the age characteristics of the 1960 harvest. The results of ageing these jaws are shown in Table 2.

Weights of Moose Meat Shipments. The Pacific Northern Airlines recorded the weights of 25 moose meat shipments from the Yakutat area (Table 3). Only those weights were recorded that could be isolated from other baggage. In many cases this was not possible since hunters belonging to a party frequently mixed their baggage. Weights were of moose taken from Yakutat to the Dohn River, 60 miles east along the coast.

Area Distribution of the Harvest. Two controlling factors of the harvest were cost and accessibility. Because of these factors, the kill was largest in the vicinity of the Yakutat airport and the Dangerous River. Those hunters who could not afford an airplane charter hunted the road system around Yakutat. The airborne hunters, on the other hand, were concentrated in the vicinity of the Dangerous and Italio Rivers. The latter two areas offer the closest good hunting to Yakutat that is accessible by wheel plane.

Table 1. Moose harvest and hunter success on the Yakutat moose range during the 1960 seasons.

Bulls killed	87
Cows killed	2
Total moose killed	89
Estimated number of hunters	150
Estimated number of hunter days	450
Average number of days hunted per hunter	3
Average number of days hunted per moose killed	5
Per cent hunter success	60
Moose killed by seasons	
August 20 - September 30	77
November 1 - November 30	12

Table 2. Estimated age of 40 moose harvested during the 1960 Yakutat moose seasons.

Age Class	Estimated Age in Years*	Total Per Age Group
I	1-1/2	8
II	2-1/2	7
III	3-1/2	7
IV	4-1/2	7
V	5-1/2	5
	6-1/2	3
VI	7-1/2	1
	8-1/2	1
VIII	10-1/2	1

* Peterson, Randolf L. 1955. North American Moose. Univ. of Toronto Press, Toronto, Canada.

Table 3. Pounds of moose shipped from Yakutat by Pacific Northern Airlines during the 1960 moose seasons and the sources of the shipments.

Location	Pounds of Meat
Airport	1,594
Situk River	588
Dangerous River	15,401
Italio River	1,670
Alsek River	585
East River	324
Dohn River	293
Total	20,445

Chronological Distribution of the Kill. An early season of 42 days which ran from August 20 to September 30, was supplemented by a late season from November 1 to November 30. Together, they provided a total of 72 days of hunting. A comparison of the 77 moose kills that were recorded during both seasons (Figure 1) indicates that approximately 70 per cent of the kill occurred during the last three weeks of September.

Early hunting was avoided by some of the hunters on the grounds that the weather would be too warm to preserve meat. This was not a valid objection, since the principal factor in meat preservation at Yakutat is rapid evacuation. In late August and early September, the flying weather is better than it is later in the fall, and, since most of the hunters are transported by plane, they must consider good flying weather paramount to the temperature.

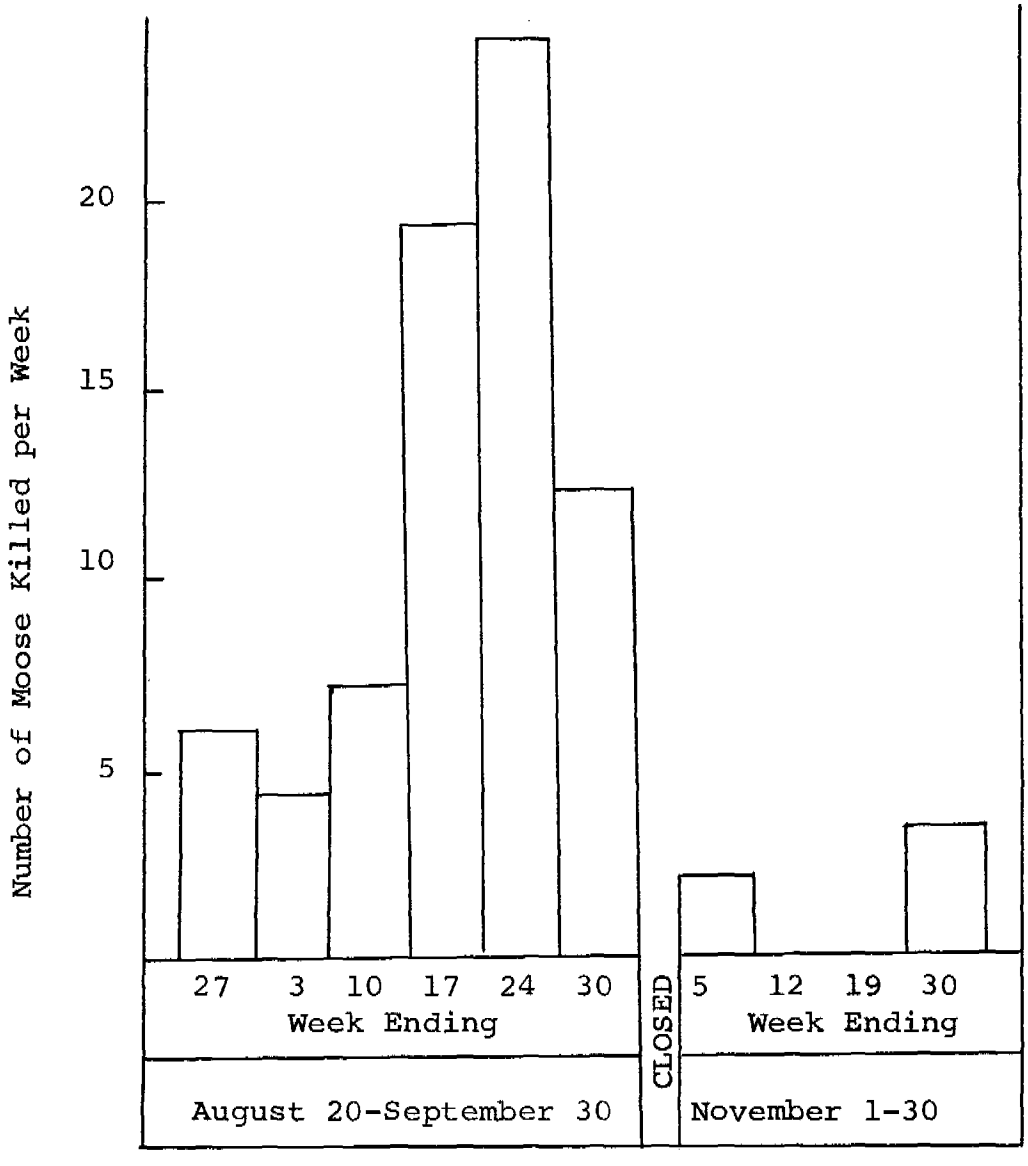
Few hunters took advantage of the November season. Only seven per cent of the hunting pressure occurred during that period.

Transportation. Access to the moose concentration is achieved through use of charter planes and by automobile. Hunters using the former killed 71 per cent of the total 1960 harvest.

Hunters desiring to use the local charter plane service could choose between three, wheel-equipped planes. Thus, as mentioned above, they could gain access to the ranges along the beach and to a lesser degree along the major rivers before snowfall in October. If these same planes were equipped with skis, nearly the entire area would be available to the hunters during the late season.

Hunters using the road system killed 29 per cent of the total harvest. Until late September, there is a good concentration of moose in the vicinity of the airport. Access to this area is provided by a fairly extensive system of roads that have been constructed by the Federal Government and private oil exploration companies. The latter group, along with the United States Forest Service, will gradually extend this system.

Figure 1. Chronological distribution by week of the Yakutat moose harvest during the two 1960 seasons estimated from the 77 kills that were recorded.



The hunting success drops along the road system following the rut. At this time, the moose move east down the coast to the mouth of the Setuk River and north toward the mountains in the vicinity of Setuk Lake. Coincident with this change in herd distribution, snow complicates the movement of the hunters on the unmaintained roads. These two factors serve to drastically reduce the harvest along the road system.

Special Transportation Problems. The handling and evacuation of harvested moose is a critical problem. There are two contributing factors to this problem.

1. Bad weather frequently delays the transportation of the meat from the hunting areas to Yakutat for several days. Mild wet weather makes it extremely difficult to preserve the meat.

2. At Yakutat adequate cold storage facilities are not available for holding meat until it can be transported by the scheduled airlines on to its final destination. Only two flights weekly leave Yakutat in each direction. Consequently, when several thousand pounds of meat are awaiting shipment, unfortunate timing often results in a further delay of three or four days before the meat can reach cold storage.

MOOSE HARVEST FOR 1960 - CORDOVA AREA

A special hunt was conducted by the Alaska Department of Fish and Game for the moose in the Cordova area on August 20, 1960. This was the first time these animals were harvested since their introduction in 1949.

This herd is the result of introductions made by the Cordova Chapter of the Izaak Walton League of America in cooperation with the Alaska Game Commission, who supplied calves from the Kenai-Anchorage area. The animals were transported to Mile 17 on the Copper River Highway where they were released. These introductions were made over a ten year period from August 1949, to August 1959, During this period six bull and 14 cow calves were released.

Mortality of the calves released was apparently low. As they matured, numerous reports of twins indicated that reproduction had been high. John Grove, District Forester, U. S. Forest Service, counted 41 moose west of the Copper River during an aerial count. In 1959, Harry Pinkham, Game Management Agent, U. S. Fish and Wildlife Service, counted 62 on a similar survey.

The author flew aerial counts of the herd in 1959. This survey was designed to be flown annually to provide a continuous estimate of the condition and trend of the moose population, rather than a complete enumeration and resulted in a count of 52 animals. Of the 52 animals seen, 16 were antlered and four were classified as calves. This was not used as an estimate of the herd composition, since some of the antlers had already been dropped and the pilot did not provide close enough examination of the animals.

Based upon these surveys a harvest of 25 bulls by permit was recommended. The hunt opened August 20, 1960. After nine days the desired kill of 25 bulls was obtained. At this time, the season was closed by special field announcement. Cooperation of the public was excellent. Each kill was promptly reported and all kill information required was submitted. The following information was gained from the hunts.

Age of Animals Harvested. Although no ear tags were recovered from the original stocked animals, two of the animals killed apparently once had been tagged. The jaws of all 25 moose killed were collected and aged (Table 4).

Response to Announcements. This hunt, although announced to the State through the Anchorage news mediums, generated only local interest. Of 132 valid applications, only two were from persons residing outside Prince William Sound.

Antler Development. Six of the 25 bulls had antler spreads over 60 inches. Of the antlers examined, none had started to lose the velvet prior to August 25, 1960.

Table 4. Age characteristics of 25 moose jaws collected during the 1960 Cordova moose hunt.

Age Class*	Estimated In Years	Total Per Age Group	Percent of Total
I	1	7	28
II	2	8	32
III	3	4	16
IV	4	3	12
V	5	1	4
	6	1	4
VI	8	1	4

* Peterson, Randolf L. 1955. North American Moose. Univ. of Toronto Press, Toronto, Canada.

Table 5. Summary of the moose population survey at Yakutat, 1960.

Young Males	Medium Males	Large Males
9	14	56
Females w/0	**Females w/1**	**Females w/2**
75	20	4

Total Males = 79
Total Females = 99
Total Calves = 28
Total Moose 206

HERD COMPOSITION SURVEYS - YAKUTAT

A herd composition survey conducted in November of 1960 at Yakutat indicated a bull to cow ratio of 80:100 and a cow to calf ratio of 100:28. This was based on a sample of 206 animals. The characteristics of this survey can be seen in Table 5.

An aerial survey was conducted of the moose in the Yakutat area early in March of 1961 to take advantage of a particularly heavy snowfall. From this, information on moose numbers and distribution was collected.

A total of 418 unclassified moose were counted as the result of this three hour survey which extended from Yakutat to the Alsek River. Last year, the U. S. Forest Service counted 345 moose in this same area.

A report of moose north of Yakutat Bay was investigated in conjunction with this study. Forty moose were counted in 1.7 hours of flying time, and their positions recorded on a map. This survey extended from the Sitkagi Bluffs to Bandas Point.

RECOMMENDATIONS:

This investigation should be continued.

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Volume 2 Report No. B-1c

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 1-c Title: Moose Investigations, Western Alaska

PERIOD COVERED: August 1, 1960 to June 1, 1961

ABSTRACT:

Bush pilots and other individuals sighted moose throughout the year in the central and western part of the Seward Peninsula; very small populations wintered in a few of these western drainages.

Moose occur throughout the Kobuk River drainage. During summer and fall, the animals utilize the willow stands bordering the main river, but in the winter they move into the small tributary drainages. Unsuitable snow conditions caused by high winds probably brings about this seasonal movement.

Aerial surveys in the Kobuk valley revealed a bull:cow ratio of 44:56. Few calves were seen, probably due to poor sighting conditions.

The 1960 moose harvests in the Seward Peninsula - Unalakleet and Kobuk - Selawik areas were approximately 50-60 and 90-100 animals, respectively.

PROCEDURES:

Hunters, fishermen, and bush pilots were contacted throughout the year regarding the number, sex, and location of moose sighted in the Seward Peninsula area. The data they supplied provided insight into moose distribution, and to a lesser degree, abundance and movement.

Aerial surveys were conducted in the Kobuk valley during September 21 and 22, 1960, and April 13, 1961, to obtain herd composition data. Poor sighting conditions during the first flight, and unsatisfactory flying conditions during the second hindered the surveys and severely limited the number of animals seen.

Store owners and managers at the villages of Kiana, Kobuk, Koyuk, Noorvik, Selawik, and Shungnak were contacted during the hunting season in an effort to obtain harvest information and moose jaws for ageing purposes. The first objective essentially was obtained, but the second was not. The primary reason for the failure of the jaw collections was the fact no remuneration was offered to the collectors, while another organization was paying a set fee for caribou jaws.

FINDINGS:

In general, only small, scattered moose populations exist in Northwest Alaska, but in certain areas these important populations provide the only readily available big game hunting.

Distribution and Movement

I conducted moose distribution and movement studies on the Seward Peninsula and the Kobuk River drainage during the study period.

Seward Peninsula: During summer, 1960, bush pilots and other individuals consistently reported moose in the western half of the Seward Peninsula. Generally, the animals occurred singly with the exception of a cow with calf and four animals in a small willow association near the confluence of the Kruzgamepa and Kuzitrine Rivers. The most westerly moose was reported 35 miles northeast of Wales in a small drainage emptying into Arctic Lagoon where a hunter from Wales killed a young bull during October.

Moose were noted in a western part of the Peninsula throughout the winter. One pilot reported seeing two animals and numerous tracks along the lower portion of the Kruzgamepa River, two or three animals along the American River, two along the Gold Run River, a small tributary of the Grand Central, and numerous tracks in the Kuzitrine drainage. His repeated sightings indicate that the animals made no extensive movements during the winter. In one instance, two animals remained in a 1/4 mile long drainage all winter. Apparently, small populations persisted throughout the year in the small drainages of western Seward Peninsula, a departure from the conditions reported in 1959-1960 (Harbo, 1960).

Kobuk River Drainage: Persistent reports from Noorvik and Kotzebue residents revealed that moose frequented the delta of the Kobuk River throughout the year, even venturing to the tip of the Baldwin Peninsula, the site of a hunter-killed moose during the fall moose season. The main moose concentrations in the Kobuk drainage occur further upriver, and in the tributary stream valleys.

During the summer and fall, moose occupy the extensive willow stands in the main valley of the Kobuk drainage. On September 21 and 22, 1960, during flights from Noorvik to Kiana and Kobuk to Noorvik, respectively, I counted 21 animals (9 bulls and 12 cows) in proximity to the main river; undoubtedly I missed sighting many other animals due to poor sighting conditions during the flight. Apparently the main valley is extensively used during these seasons.

Survey flights during winter reveal that few moose occupy the main valley then. Harbo (1960) reported sighting only three moose during two extensive flights on November 17 and December 9, 1960. On April 13, 1961, I sighted only one cow and calf during a 75 minute flight along the river. On that date, however, I counted 22 animals in small drainages emptying into the main river or into its larger tributaries. A change in moose distribution apparently occurs during early winter; snow conditions may be the causal factor.

Frequent strong winds in the main valley cause extensive drifting and packing of snow throughout the winter. The wind eventually deposits most of the snow in the willow thickets, creating accumulations of snow more than six feet deep. Such snow depths, especially of semi-compacted snow, seriously

hinder a moose's movements. In contrast, however, snow in the small drainages bordering the main valley remains undrifted and powdery. The moose sighted in such a habitat during the April 13 survey experienced no difficulty in traversing the two to three-foot layer of soft snow. Apparently such conditions are suitable for moose and perhaps favor the movement of moose into these areas.

Herd Composition

The absence of suitable snow cover on the Seward Peninsula during most of the winter prevented the successful completion of survey flights in that area. In the Kobuk drainage aerial surveys were made on September 21 and 22, 1960, and April 13, 1961 and the results are included in Table 1.

During the fall flights I saw 21 adults but no calves. Sighting conditions were unfavorable, however, for the willows and alders still retained their foliage, effectively camouflaging animals. Nearly all of the cows seen, and presumably any calves with them, were in such habitat. With such conditions, I could easily have overlooked the relatively small calves.

The male:female ratio for all surveys is 44:56. In most areas of Alaska, such a high representation of males in the population indicates low hunting pressures. A similar conclusion for the Kobuk drainage does not prevail,however, even though the area (Unit 23) was closed to moose hunting for several years prior to the 1960 opening. An evaluation of past hunting efforts indicates a substantial hunting effort, regardless of the hunting closures. For instance, during December, 1959, and January, 1960, Selawik hunters took 10 moose (Harbo, ibid). It seems doubtful that this illegal kill is restricted solely to bulls. Rather, the hunters probably are opportunists, taking whichever animals are available. Thus an even sex ratio might be maintained in the population even with heavy hunting pressures.

Harvest

I collected moose harvest data from the Seward Peninsula and Kobuk drainage during the 1960 hunting season. Often, verifying or refuting rumored moose kills, especially if the legality of the action was questionable, proved difficult. For one such incident near Nome during late September, I

Table 1. Results of moose surveys conducted in the Kobuk River Drainage during September 21 and 22, 1960, and April 13, 1961.

LOCATION	DATE	SURVEY TIME (HOURS)	ANIMALS SIGHTED				
			FEMALES	MALES	CALVES	UNKNOWN	TOTAL
Kobuk River							
Mouth to Trinity Creek	Sept. 21	1.6	1	1	0	0	2
Kobuk to Shungnak	Sept. 22	1.25	3	1	0	0	4
Shungnak to Ambler	Sept. 22	0.3	1	1	0	0	2
Ambler to Kiana	Sept. 22	1.3	7	6	0	0	13
Kiana to mouth Kobuk R.	Sept. 22	0.6	0	0	0	0	0
Hunt R. to mouth Kobuk R.	April 13	1.3	1	0	1	0	2
Tributaries to Kobuk River							
Head of Squirrel R. to Hunt R.	April 13	3.2	5	5	7	5	22
TOTAL			18	14	8	5	45

ascertained that two animals were taken, but the sex of the animals remained unknown. Rapid disposure of the meat in a cold storage plant permitted the owners to destroy all evidence of sex.

Harvests for the various villages contacted are listed in Table 2. Approximately 50-60 moose in the Unalakleet-Seward Peninsula area, and 95-100 in the Kobuk-Selawik area were taken during the 1960 season. Generally, the figure should be considered minimal, for if the illegal take were known, the totals perhaps would increase substantially (Harbo, ibid).

Table 2. The 1960 moose harvest for certain villages in Northwestern Alaska based on interviews with hunters and other individuals.

Kobuk - Selawik		Seward Peninsula-Unalakleet	
Ambler	10	Golovin	1
Kiana	11	Koyuk	24
Kobuk	10	Nome	7
Kotzebue	15	Unalakleet	12-18
Noorvik	20	Wales	1
Selawik	10	White Mountain	4
Shungnak	16	Total	49-55
Total	92		

The totals for the Kobuk-Selawik area undoubtedly would have been higher if an early influx of caribou into the area had not occurred.

CONCLUSIONS:

The effects of the present hunting practices and pressures are difficult to evaluate in Northwestern Alaska, for the size and composition of the illegal harvest essentially are unknown. In the Seward Peninsula area, the intensive and often indiscriminate hunting pressures on the low density, localized moose populations probably are restricting, or at least retarding, the establishment of resident herds in unoccupied habitat. The 1960 moose harvest in the Kobuk drainage does not appear excessive. Much of the area is relatively inaccessible, thus limiting the hunting effort in certain areas. Also, many of the native

hunters express a preference for caribou meat, lessening pressure on moose populations.

Additional information should be obtained concerning the size, phenology and compositon of the harvest. Efforts to obtain an adequate sample of lower jaws for ageing purposes, should be intensified.

Additional information regarding the movements and dispersal of the Kobuk herd should be obtained.

Adequate enforcement of the present regulations is needed in Northwestern Alaska.

Literature Cited

Harbo, S. J. 1960. Moose investigations, Western Alaska. Fed. Aid Reports. Alaska Dept. of Fish and Game. 15 pp. (Unpubl.)

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Volume 2 Report No. B-2a

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 2-a Title: Determination of Herd Status (data analysis), South-central Alaska

PERIOD COVERED: July 1, 1960 to December 1, 1961

ABSTRACT:

Pertinent information from the moose investigations projects in Southcentral Alaska is assembled and summarized in this report. Findings are condensed in the following statements:

Breeding:

1. A sample of 7,673 moose counted in the fall revealed bull to cow ratios higher than the past ten year average.

Production:

2. The total calf crop for 1961 was estimated at 99 calves per 100 cows.

3. Fall aerial counts revealed that 1960 calf survival was normal.

Mortality:

Hunter

4. An estimated kill figure of 2,300 moose was obtained for the general 1960 season.

5. An additional 395 moose were killed during the special antlerless hunt.

Other

6. A total of 132 mortality incidences were recorded in the Palmer, Portage, and Anchorage areas.

OBJECTIVES:

To compile and analyze all pertinent data resulting from field investigations of moose in Southcentral Alaska in accordance with the needs of management.

FINDINGS:

Breeding

During the fall of 1960, comprehensive herd composition counts were made in Southcentral Alaska. Specifically, counts were made in the lower Susitna-Matanuska Valleys, the upper Susitna-Copper River Valleys and on the Kenai Peninsula.

A total of 3,609 animals was observed and recorded by department personnel and 4,064 by the U. S. Fish and Wildlife Service. Counts showed bull-cow ratios to be generally higher than in the past few years as seen in Tables 1 through 3.

A low of 13 bulls per 100 cows was found in the Matanuska Valley, while the average for the entire lower Susitna and Matanuska Valley population was 54 bulls per 100 cows (Table 1). Ratios of 85 bulls per 100 cows were obtained in the upper Susitna-Copper River Valleys and 44 bulls per 100 cows on the Kenai Peninsula (Tables 2 and 3).

BREEDING

Table 1. Comparison of Moose Sex Ratios in the Lower Susitna-Matanuska Valleys, 1955-60.

Year	Total Bulls: 100 Cows	*Adult Bulls: 100 Cows	**Young Bulls: 100 Cows
1960	54	39	15
1959	34	31	3
1958	32	24	8
1957	31	24	7
1956	27	-	-
1955	28	-	-

Table 2. Comparison of Moose Sex Ratios in the Upper Susitna-Copper River Valleys, 1955-60.

Year	Total Bulls: 100 Cows	*Adult Bulls: 100 Cows	**Young Bulls: 100 Cows
1960	85	65	20
1959	67	57	10
1958	71	60	11
1957	69	53	16
1956	67	-	-
1955	98	-	-

* Adult Bulls - antlers with decided palmation ranging from small to large.

**Young Bulls - antlers spiked or forked with little or no palmation. These animals were considered yearlings. However, there is probably some overlap between this group and the adult class.

Table 3. Comparison of Moose Sex Ratios in the Kenai Peninsula, 1954-60.

Year	Total Bulls: 100 Cows	*Adult Bulls: 100 Cows	**Young Bulls: 100 Cows
1960	44	29	15
1959	-	-	-
1958	44	-	-
1957	43	-	-
1956	51	-	-
1955	50	-	-
1954	84	-	-

* Adult Bulls - antlers with decided palmation ranging from small to large.

**Young Bulls - antlers spiked or forked with little or no palmation. These animals were considered yearlings. However, there is probably some overlap between this group and the adult class.

The sex ratio information shows that the bull-cow ratio is high in almost all areas and that hunting pressure on the male segment of the population has not depressed it to any great extent. One of the exceptions is the highly depressed bull-cow ratio in the Matanuska Valley. It must be noted, however, that this area is small and supports a high human population. This is non-typical for most of the moose hunting areas in Alaska.

Production

Herd composition counts made during the fall of 1960 showed productivity to be high and compare favorably with the 10 year average. Extensive counts were made in the lower Susitna-Matanuska Valleys, the upper Susitna-Copper River Valleys, and on the Kenai Peninsula.

Of these areas, only the lower Susitna-Matanuska Valleys showed a decline in calf survival. Comparisons with the past ten years' results for this area are seen in Table 4. Calf survival was well above average for the upper Susitna-Copper River Valleys and the Kenai Peninsula as seen in Tables 5 and 6.

The total estimated 1961 calf crop, based on extensive spring aerial counts in the lower Susitna-Matanuska Valleys, was estimated at 99 calves per hundred cows. This shows a slight decrease when compared with the estimated calf crop for 1960 of 105 calves per 100 cows.

Calf tagging progress continued in 1961 with 254 animals tagged. Thirty-three sets of twins are included within this total.

Mortality

Hunter: The general moose season in Southcentral Alaska extended from August 20 through September 30. Late hunts running from November 1 through November 30 and November 20 through November 30 were additionally held in specified game management units. The season bag was one bull.

Table 4. Comparison of age ratios of moose in the Lower Susitna-Matanuska Valleys, 1950-60.

Year	Calves: 100 Cows	Twin Calves:100 Cows with Calves	Per Cent Calves
1960	35	9	18
1959	42	8	25
1958	42	8	24
1957	44	8	25
1956	40	6	24
1955	35	4	21
1954	30	2	16
1953	39	8	21
1952	44	10	24
1951	60	13	27
1950	-	-	16
Averages:	42	7	22

Table 5. Comparison of age ratios of moose in the Upper Susitna-Copper River Valleys, 1952-60.

Year	Calves: 100 Cows	Twin Calves:100 Cows with Calves	Per Cent Calves
1960	55	11	22
1959	51	2	24
1958	37	4	18
1957	42	6	23
1956	27	2	14
1955	52	10	21
1954	79	16	27
1953	90	17	29
1952	40	17	20
Averages:	52	10	22

Table 6. Comparison of age ratios of moose in the Kenai Peninsula, 1950-60.

Year	Calves: 100 Cows	Twin Calves:100 Cows with Calves	Per Cent Calves
1960	46	9	23
1959	-	-	-
1958	42	15	23
1957	35	12	20
1956	24	10	14
1955	19	10	13
1954	27	6	12
1953	26	7	14
1952	21	6	12
1951	23	16	12
1950	-	-	7
Averages:	27	10	14

A special permit hunt allowing the taking of antlerless moose only was held in early December. Hunts were held in several specified areas.

An estimate kill figure of 2,300 moose was obtained for the regular season. An additional 395 moose were bagged during the antlerless permit hunt.

Other: Examinations were made on 132 moose killed by other causes than hunting. Fifty-eight were killed by vehicle collisions, eight were railroad kills, four were illegal kills, and the remaining 66 were dead from miscellaneous causes.

Specimen materials were collected and weights and measurements taken from these animals.

RECOMMENDATIONS:

1. Reporting periods for various projects should be so altered that moose trends can be followed through one phase of their annual cycle.

2. Research needs should be further intensified in areas of high hunting pressure, and problem areas demanding the more urgent needs of management.

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Volume 2 Report No. B-2b

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-61 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 2-b Title: Abundance and Composition Surveys, Southcentral Alaska

PERIOD COVERED: October 1, 1960 to December 15, 1960

ABSTRACT:

During the fall of 1960 comprehensive herd composition counts were made in Southcentral Alaska. Specifically, counts were made in the lower Susitna-Matanuska Valleys, the upper Susitna-Copper River Valleys and the upper Kenai area. This report also includes the data recorded by the Fish and Wildlife Service on the Kenai National Moose Range. A total of 3,609 animals was observed and recorded by Department personnel and 4,064 by the U. S. Fish and Wildlife Service. Counts showed bull-cow ratios to be generally higher than in the past few years. A low of 13 bulls per 100 cows was found in the Matanuska area while the average for the entire lower Susitna and Matanuska Valley populations was 54 bulls per 100 cows. This was in contrast to ratios of 85 bulls per 100 cows in the upper Susitna-Copper River Valleys and 44 bulls per 100 cows on the Kenai Peninsula. Calf-cow ratios were higher than in most previous years in the upper Susitna-Copper River Valleys (55:100) and on the Kenai (46:100) but were slightly lower than the past four year averages in the lower Susitna-Matanuska Valleys (35:100).

OBJECTIVES:

To determine the herd composition of identifiable moose populations subjected to significant hunting pressure and/or wolf predation. To establish an index to moose abundance in the areas surveyed.

TECHNIQUES:

During November 1960, aerial counts were flown to determine the sex and age structure of several Southcentral Alaskan moose herds. Since the purpose of these flights was to determine herd composition rather than obtain total numbers, specific drainages in each area were flown rather than transects of the total area.

The techniques used in making the various counts were similar to those used in the past. The two main objectives were: to cover a specific area inhabited by moose in such a manner so that a representative cross section of that population would be sampled, and to obtain sex and age identification of as many of the animals observed as possible.

No specific flight pattern was attempted for all of the various areas covered. On the contrary, variations in flight patterns were adopted for specific areas as the need for different tactics became apparent. For example, in the upper Oshetna River drainage large numbers of adult bulls, non-bearing cows, and yearlings were found concentrated on the willow bars near the river. It was apparent that cows with calves must have been in the general vicinity. By following routine "searching" flight patterns over the open brush-covered hillsides it was found that this latter segment of the population was scattered at various elevations in the shallow brush covered draws. As soon as this was discovered the flight pattern was varied so that much time was spent combing these latter areas once the animals along the river had been counted. The normal procedure, however, and the one most often used once an area inhabited by moose had been located, was that of making parallel flights approximately one-fourth to one-half mile apart.

The various animal sex and age groups recorded were the same as those for past years. Specifically these were:

1. Young bulls - antler spiked or forked with little or no palmation. These animals were considered yearlings. However, there is probably some overlap between this group and the adult class.

2. Adult bulls - antlers with decided palmation ranging from small to large.

3. Cows - all antlerless moose other than calves.

4. Calves - young of the year.

5. Unidentified.

Aerial counts were made in the Matanuska Valley, the lower Susitna Valley, the upper Susitna Valley including the Lake Louise-Crosswind Lake flats, the upper Copper River drainage, and the Resurrection Creek and Resurrection River drainages on the Kenai Peninsula. Within each of these regions, herd composition was recorded for specific drainages so that sex and age ratio patterns could be compared with those of past years for comparable areas. All of the material gathered during this study has been compared with past years' data in an attempt to establish patterns of population behavior and change which will aid in managing the species.

A total of 63 hours and 5 minutes of flying time was expended during these counts. The flying time for the various areas is listed in Table 1 along with the dates flown. All of the flying was done using a 150 H.P. Supercub, a 150 H.P. Champion or a Cessna 170. The observers during the counts were Department Biologists Elmer Norberg, Albert Erickson and Tom O'Farrell. In addition,counts were also flown by the U. S. Fish and Wildlife Service.

FINDINGS:

The herd composition data obtained from the various aerial counts are summarized in Table 2. Totals of 2,010 animals were observed and categorized in the lower Susitna-Matanuska Valleys; 1,467 in the upper Susitna-Copper River Valleys; and 132 on the Kenai. The sample size obtained varied with the size of the areas sampled. In almost all of the larger areas, sample counts of 100 animals or more

Table 1. Dates and hours flown for moose herd composition counts, November 1960.

AREA	DATES FLOWN	HOURS FLOWN
Lower Susitna and Matanuska Valleys		
Matanuska	11/25/60	4 hrs - 45 min
Willow	11/23/60	5 hrs - 0 min
Talkeetna and Kashwitna	-	3 hrs - 0 min*
Mt. Susitna - Beluga	11/22/60 & 11/26/60	8 hrs - 10 min
Peters Hills	11/25/60	5 hrs - 15 min
Little Peters Hills	11/25/60	3 hrs - 25 min
Peters Creek, Eagle River, & Ship Creek	11/27/60	4 hrs - 30 min
Upper Susitna and Copper River Valleys		
Lake Louise Area	11/16/60	3 hrs - 0 min
Maclaren River & Clearwater Creek	11/17/60	3 hrs - 15 min
Alphabet Hills	11/16/60 & 11/17/60	3 hrs - 50 min
Oshetna River, Upper Tyone & Little Nelchina, Sanona Creek	11/12/60 & 11/13/60	5 hrs - 30 min
Black River, Goose & Gilbert Creeks	11/13/60	3 hrs - 40 min
Upper Gakona	11/18/60	2 hrs - 40 min*
Mt. Drum	11/18/60	2 hrs - 15 min
Kiana Lake	11/18/60	2 hrs - 15 min
Kenai Peninsula		
Resurrection River	11/26/60	1 hr - 35 min
Resurrection Creek	11/26/60	1 hr - 0 min

* Approximate Time

Table 2. Summary of moose population composition counts, November 1960.

Area	Young Bulls	Adult Bulls	Total Bulls	Cows w/o Calves	Cows w/1 Calf	Cows w/2 Calves	Total Cows	Total Calves	Uniden-tified	Total Moose
Lower Susitna-Matanuska Valleys										
Matanuska	30	4	34	201	59	5	265	69	5	373
Willow	44	64	108	146	58	6	210	70	-	388
Talkeetna & Kashwitna	18	49	67	53	24	3	80	30	-	177
Mt. Susitna-Beluga	29	122	151	131	65	6	202	77	15	445
Peters Hills	18	91	109	68	23	8	99	39	4	251
Little Peters Hills	6	47	53	10	13	4	27	21	4	105
Peters Creek	10	6	16	57	14	1	72	16	1	105
Eagle River	3	3	6	22	16	-	38	16	1	61
Ship Creek	7	14	21	16	28	-	44	28	2	95
TOTALS	165	400	566	704	300	33	1,037	366	32	2,010
Upper Susitna-Copper River Valleys										
Lake Louise	6	14	20	7	31	6	44	43	-	107
Maclaren River & Clearwater Creek	31	64	95	92	71	3	166	77	5	343
Alphabet Hills	10	56	66	47	54	7	108	68	17	259
Oshetna Rivers & Upper Tyone	27	57	84	29	27	6	62	39	9	194
Little Nelchina	-	2	2	-	2	1	3	4	-	9
Sanona Creek	6	29	35	12	17	-	29	17	-	81
Black River	10	19	29	25	10	4	39	18	-	86
Goose & Gilbert Creeks	2	12	14	17	12	2	21	16	2	53
Upper Gakona	13	41	54	38	6	-	44	6	-	104
Mt. Drum	8	32	40	34	14	2	50	18	2	110
Kiana Lake	8	58	66	8	16	3	27	22	6	121
TOTALS	121	384	505	309	260	34	593	328	41	1,467
Kenai Peninsula										
Resurrection River	3	1	4	24	6	1	31	8	0	43
Resurrection Creek	8	14	22	34	15	1	50	17	0	89
TOTALS	11	15	26	58	21	2	81	25	0	132
COMBINED TOTALS	297	799	1,097	1,071	581	69	1,711	719	73	3,609
U.S.F.W.S. COUNT	203	738	941	1,275	738	120	2,133	984	6	4,064

were obtained.

Sex Ratios

The sex and age ratio information calculated from the aerial count data is listed in Table 3. It should be noted that the heading for column 2 Table 3 is young bulls per 100 adult bulls, whereas the heading for column 2 Table 4 is young bulls per 100 total bulls. These data have been intermixed in the past. The age ratio information in column 2 Table 4 is at least in part a duplication of the values that have been obtained in the past for column 2 Table 3. The values for the 10-year average of young bulls per 100 total bulls in column 2 Table 4 were computed for the years 1957, 1958, and 1959 on the basis of the number of young bulls per 100 adult bulls. Since it is likely that the data prior to that time may have been accurately computed on the basis of the number of young bulls per 100 total bulls as the heading for the column implies there is little point in attempting to read meaning into these values.

Lower Susitna-Matanuska Valley Area: A total of 13 bulls per 100 cows was observed in the Matanuska Valley area (Table 3). This was the lowest bull-cow ratio obtained in the lower Susitna-Matanuska area and follows the trend of past years. The large number of bulls per 100 cows recorded in the Peters Hills and particularly in the Little Peters Hills areas probably means that the sample obtained was not representative of the population as a whole. In these areas there is a movement of animals from the lowland to the upland; the reason for this is not well understood. It does appear, however, that segments of the bull population arrive at the higher areas before the cows and calves.

The number of young bulls per 100 adult bulls varied greatly in the lower Susitna-Matanuska Valley area. As would be expected, the areas that were fairly heavily hunted had a high ratio of young bulls to old bulls. It is interesting to note that Ship Creek, which is partially protected from hunting by the presence of the Fort Richardson closed area, had a fairly low ratio of young bulls to old bulls while both Peters Creek and Eagle River had a high ratio of young to old bulls.

Table 3. Sex and age ratios of moose populations as determined from aerial count data, November 1960.

Area	Bulls/ 100 Cows	Young Bulls/ 100 Adult Bulls	Calves/ 100 Cows	Twin Calves/ 100 Cows w/Calves	% Calves in Herd	% Young Bulls in Herd	Young Bulls/ 100 Bull Calves	Young Bulls/ 100 Cows	Total Moose
Lower Susitna-Matanuska Valleys									
Matanuska	13	750	26	7	18	8	85	11	373
Willow	51	68	33	9	18	11	125	20	388
Talkeetna & Kashwitna	83	36	37	11	16	10	120	22	177
Mt.Susitna-Beluga	74	23	38	8	17	6	74	14	445
Peters Hills	110	19	39	25	15	7	90	18	251
Little Peters Hills	196	12	77	23	20	5	54	22	105
Peters Creek	22	166	22	6	15	9	125	13	105
Eagle River	15	100	42	-	26	5	37	7	61
Ship Creek	47	50	63	-	29	7	50	15	95
TOTALS	54	41	35	9	18	8	90	15	2,010
Upper Susitna-Copper River Valleys									
Lake Louise	45	42	97	16	40	5	27	13	107
Maclaren River & Clearwater Creek	39	48	46	4	22	9	79	18	343
Alphabet Hills	61	17	62	11	26	3	29	9	259
Oshetna Rvrs.&Upper Tyone	135	47	62	18	20	13	135	43	194
Little Nelchina	66	-	133	33	44	-	-	-	9
Sanona Creek	120	20	58	-	20	7	66	20	81
Black River	74	5	46	28	20	11	111	25	86
Goose & Gilbert Creeks	66	16	76	14	30	3	25	9	53
Upper Gakona	122	31	13	-	5	12	433	29	104
Mt. Drum	80	25	36	12	16	7	88	16	110
Kiana Lake	244	13	81	15	18	6	72	29	121
TOTALS	85	31	55	11	22	8	73	20	1,467
Kenai Peninsula									
Resurrection River	13	300	26	14	20	7	75	10	43
Resurrection Creek	44	57	34	6	19	9	90	16	89
TOTALS	32	73	30	8	18	8	84	13	132
U.S.F.W.S. COUNT	44	41	46	9	23	8	90	15	4,064

Table 4. Comparison of sex and age ratios in moose populations in Alaska, 1950-1960.

Area	Bulls/ 100 Cows	Young Bulls/ 100 Bulls	Calves/ 100 Cows	Twin Calves/ 100 Cows w/Calves	% Calves in Herd	% Young Bulls in Herd	Young Bulls/ 100 Bull Calves	Young Bulls/ 100 Cows	Total Moose in Sample
Lower Susitna-Matanuska Valleys									
1960	54	30	35	9	18	8	90	15	2,010
1959	34	41	42	8	25	3	29	3	1,670
1958	32	35	42	8	24	5	39	8	4,294
1957	31	28	44	8	25	4	31	7	2,374
1956	27	25	40	6	24	4	33		1,276
1955	28	25	35	4	21	4	39		2,850
1954	63	-	30	2	16	-	-		601
1953	48	14	39	8	21	3	33		2,700
1952	42	27	44	10	24	6	51		1,421
1951	61	28	60	13	27	8	56		1,867
1950	-	-	-	-	16	-	-		1,140
MEAN	41	26	42	7	22	5	40		2,058
Upper Susitna-Copper River Valleys									
1960	85	24	55	11	22	8	73	20	1,467
1959	67	24	51	2	24	5	41	10	251
1958	71	19	37	4	18	5	61	11	3,781
1957	69	30	42	6	23	5	76	16	2,386
1956	67	19	27	2	14	7	95		1,154
1955	98	29	52	10	21	12	108		2,500
1954	109	26	79	16	27	10	72		1,700
1953	107	36	90	17	29	12	85		1,100
1952	61	22	40	17	20	7	67		683
MEAN	83	26	52	10	22	8	80		1,900

Table 4 (cont.) Comparison of sex and age ratios in moose populations in Alaska, 1950-1960.

Area	Bulls/ 100 Cows	Young Bulls/ 100 Bulls	Calves/ 100 Cows	Twin Calves/ 100 Cows w/Calves	% Calves in Herd	% Young Bulls in Herd	Young Bulls/ 100 Bull Calves	Young Bulls/ 100 Cows	Total Moose in Sample
Kenai Peninsula									
1960	44	21	46	9	23	8	90	15	4,064
1960*	32	42	30	8	18	8	84	13	132
1958	44	21	42	15	23	5	43		3,371
1957	43	18	35	12	20	4	45		3,155
1956	51	13	24	10	14	4	54		3,786
1955	50	14	19	10	13	4	75		3,109
1954	84	14	27	6	12	6	90		2,048
1953	62	12	26	7	14	4	39		2,900
1952	50	33	21	6	12	10	156		1,136
1951	69	18	23	16	12	7	108		1,513
1950	-	-	-	-	7	-	-		1,158
MEAN	57	18	27	10	14	6	76		2,452

* Refers to Alaska Department of Fish and Game data for Resurrection River and Resurrection Creek.

The ten year sex ratio averages are recorded in Table 4. The 1960 value of 54 bulls per 100 cows is markedly different from that obtained since 1954 and could suggest an increased total moose population upon which the hunters had less of an impact than during the preceding 5 years.

Upper Susitna-Copper River Valley Area. Large variations in bull-cow ratios were also obtained in the upper Susitna and Copper River Valley area (Table 3). These variations are believed due to the fact that representative information was not obtained. These data do suggest, however, that the hunting pressure on moose in these areas has little effect on the population structure. The ten year average as shown in Table 4 also confirms this.

Kenai Peninsula: The sex and age ratio information for the Kenai Peninsula is quite revealing when the combined values for Resurrection Creek and Resurrection River and the values obtained by the U. S. Fish and Wildlife Service are viewed as a whole. These data indicate that a fairly large proportion of the bulls are being taken since the bull-cow ratio over the years has been depressed to a value of about 38 bulls per 100 females for the Kenai Peninsula as a whole.

Productivity

When productivity of the various moose populations is evaluated using the herd composition data it must be remembered that these values actually represent productivity and survival to about the age of six months. This information, however, is of value particularly when compared over a period of years.

In the lower Susitna-Matanuska Valley area the number of calves per 100 cows varied from a high of 77 calves per 100 cows to a low of 22 calves per 100 cows, with an average of 35. In this area there was an average of 9 sets of twin calves per 100 cows with calves (Table 3). In the upper Susitna-Copper River Valley area the productivity was higher, averaging 55 calves per 100 cows. In addition, the number of sets of twin calves was higher than in the lower area and averaged 11 sets of calves per 100 cows with calves. On the Kenai the indicated productivity was quite comparable to that of the lower Susitna-Matanuska area. The ten year

averages for these three areas follow similar trends (Table 4). The productivity value expressed as "calves as a per cent of the total herd" is the most constant value that has been obtained both for the various areas within the three regions sampled and for the ten year average. The ten year average for both the upper and lower Susitna is 22 calves per 100 adults. On the Kenai the ten year average is 14 but it should be noted that the percentage value has been increasing.

Discussion

The sex ratio information shows that the bull-cow ratio is high in almost all areas and that the hunting pressure on the male segment of the population has not depressed it to any great extent. One of the exceptions to this general pattern is the highly depressed bull-cow ratio in the Matanuska Valley. It must be remembered,however, that this area is an extremely small one and that it supports a high human population which is unusual for most of the moose hunting areas in Alaska. The other main exception to the general sex ratio pattern is the one observed on the Kenai Peninsula which is a comparatively large and important moose hunting area. In this area the bull-cow sex ratio is less than 50 bulls per 100 cows.

Productivity in all of the areas covered continues to be high and compares favorably with that of the 10 year average. On the Kenai, the indicated productivity has continued to increase during the past three years probably as a result of the mild winters during that period. No attempt was made to determine rate of survival for yearling bulls because of the many variables affecting these determinations.

RECOMMENDATIONS:

Counts to obtain herd composition information should be continued.

SUBMITTED BY:

Elmer R. Norberg
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APPROVED BY:

David R. Klein
P-R Coordinator

James W. Brooks, Director
Division of Game

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 2-c Title: Productivity Studies

PERIOD COVERED: May 1, 1961 to June 30, 1961

ABSTRACT:

The total estimated calf crop for 1961 is 99 calves per 100 females.

The ratio of calves to cows drops off steadily from a peak of 55:100 on June 7, 1961, to a low of 21:100 on July 7, 1961, indicating a 50 per cent reduction in calves for that month.

Tagged moose calves totaled 254 during 1961. Out of 49 sets of twins encountered, in 33 cases both animals were tagged, while in 16 instances only 1 twin was tagged.

OBJECTIVES:

To determine areas utilized for calving, patterns and dates of parturition, initial productivity, and survival of calves.

To tag as many calves as possible as an aid in the study of early mortality.

TECHNIQUES:

Piper Super Cubs were utilized to conduct aerial counts during April and May of 1961. Pilots were: Jim Edwards, Dave Mathieson, and Ed Williams, Safety Airways and Lee Holen, Alaska Float Plane, Inc.; Jack C. Didrickson, Game Biologist, Alaska Department of Fish and Game, was the observer on all flights.

Counting time totaled 25 hours and 20 minutes. The seven counts were initiated on May 5, 1961, and continued through June 28, 1961. Calves were not seen until the 18th of May. Three hundred feet was the general altitude flown while the counts were being conducted. In order to locate the maximum number of animals, the counts were flown between 3:00 a.m. and 8:00 a.m.

The moose calf counts were conducted in the lower Susitna and Matanuska River Valleys. Figure 1 describes the areas utilized for the count.

FINDINGS:

Progression of Calving

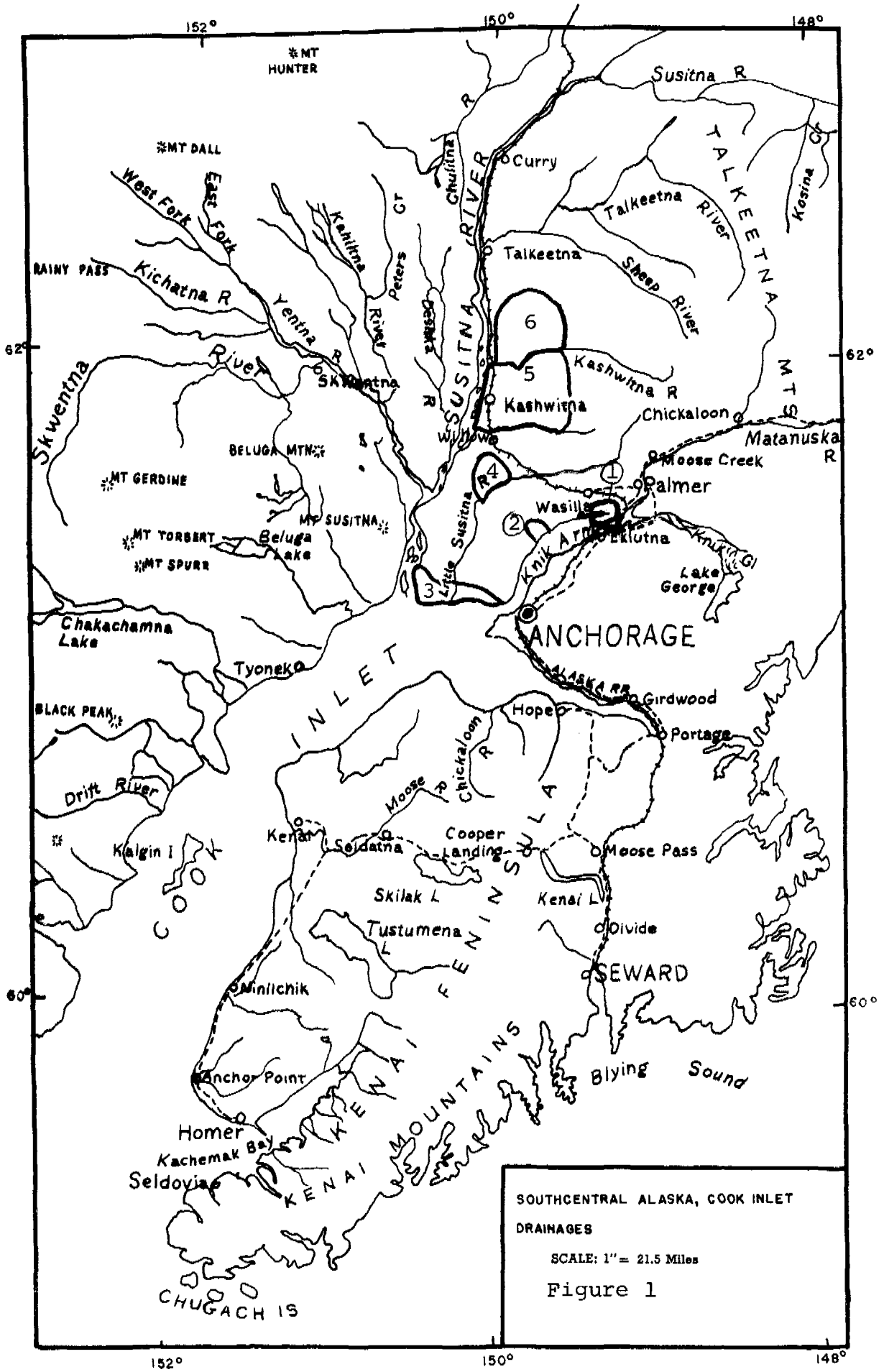
Periodic aerial counts were conducted beginning on May 5, 1961, and ending June 28, 1961, to determine calving patterns. The initial sighting of calves took place on May 18, 1961, when seven singletons were recorded. Table 1 represents the progression of calving in a chronological order.

Figure 2 illustrates the progression of calving graphically. The actual parturition:cow observations are similar to the information derived from the 1960 counts and can be found in the 1960 Federal Aid reports (B-2e). The peak of calving can only be estimated as calf counts were not made during that period. There is no reason to believe that the peak of calving changed appreciably in 1961 from the 1960 peak of May 20-27.

Figure 1. Moose calving areas in the lower Susitna Valley, May-June, 1960.

Key:

#1 Palmer Hay Flats
#2 Goose Bay
#3 Susitna Salt Flats
#4 Lake Nancy
#5 Willow
#6 Kashwitna



SOUTHCENTRAL ALASKA, COOK INLET DRAINAGES

SCALE: 1" = 21.5 Miles

Figure 1

Table 1. Progression of Moose Calving in the Lower Susitna and Matanuska Valleys During May and June, 1961.

Date	♀ w/o clf	♀ Status Unkn	Adult Bulls	♀ w/1 Clf	♀ w/2 Clfs	♀ w/3 Clfs	Tot Fem	Tot Clfs	Total Cows & Calves	Short Yrlngs ♀	Short Yrlngs ♂	Short Yrlngs ?	Total all Animals
5/5/61	30	0	0	0	0	0	30	0	30	0	0	6	36
5/15/61	18	0	0	0	0	0	18	0	18	11	1	0	30
5/18/61	42	0	5	7	0	0	49	7	56	23	6	1	91
5/22/61	53	0	10	29	7	1	90	46	136	17	18	5	186
6/7/61	10	11	13	16	7	0	44	30	74	11	6	4	108
6/14/61	20	5	19	18	6	0	49	30	79	26	23	0	147
6/28/61	33	1	25	13	3	0	50	19	69	15	10	0	119

Figure 2. Actual parturition:cow observations made in May and June, 1961, of the lower Susitna and the Matanuska Valley moose populations.

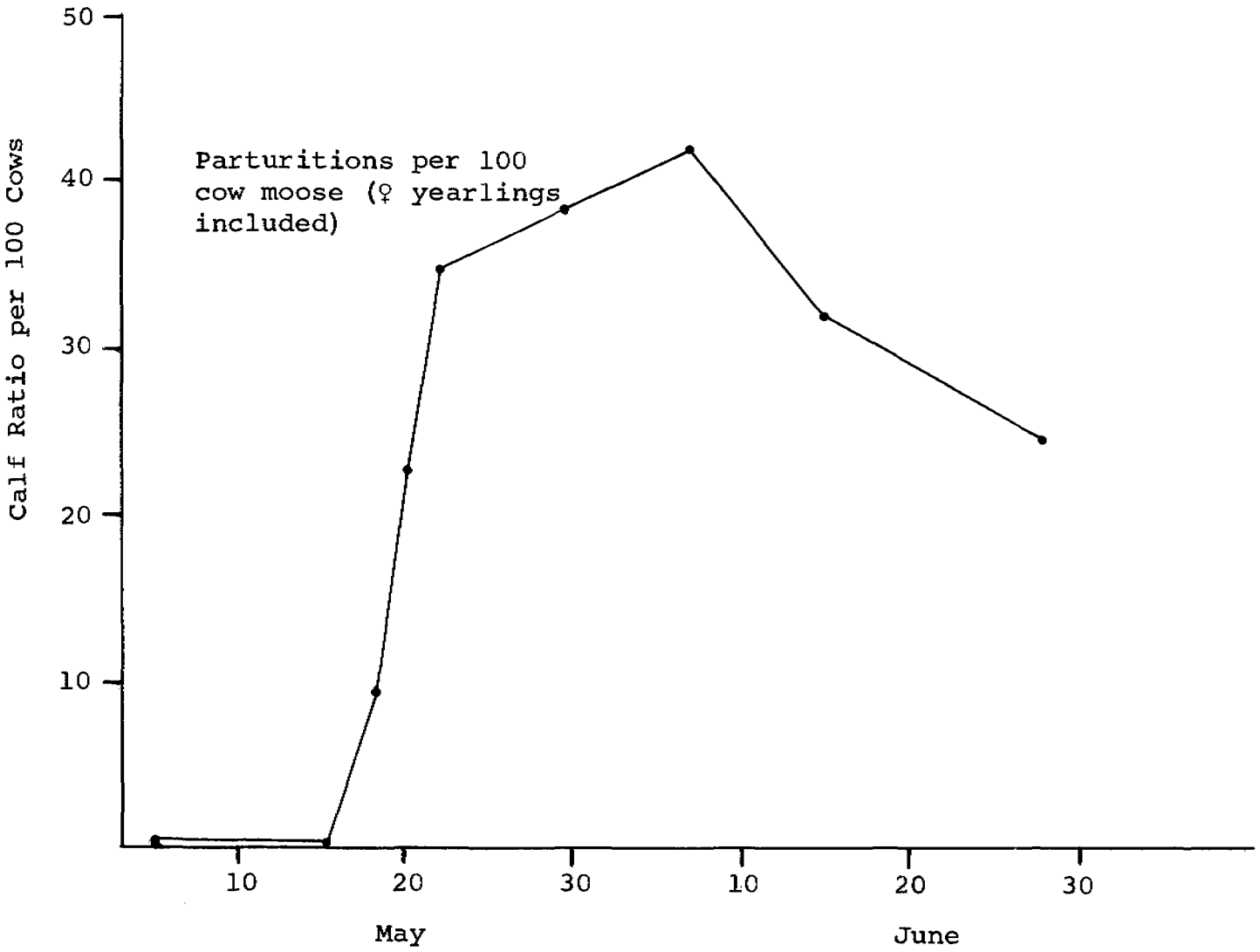


Figure 3 presents the estimated progression of calving with "status unknown" cows included in the "cows with calves" segment of the information. The peak of calving is shown in Figure 3 by plotting the estimated parturition increment derived from the curve in Figure 2. All curves are fitted visually and follow the technique described by Ronald O. Skoog, in the 1958 Federal Aid in Wildlife Restoration Report, U.S. Fish & Wildlife Service, 12(3).

In comparing the graphs to last year's information, the actual parturition per 100 cow moose (Figure 2) is somewhat less than last year's (1960) figures, dropping from 50 to 42 calves:100 females. Counting-time totaled only one half of last year's time and the number of animals counted per flight was down correspondingly. This year (1961) an attempt was made to sex yearlings and therefore only female yearlings were included as cows in computations and males and unknown yearlings were not. Last year (1960) all yearlings were included as cows.

Magnitude of Calving

The calf crop for 1961 has been estimated from the early June (peak) parturition counts and on the 100 *in utero* observations made on 100 cows collected in the study areas from 1956 to 1959. The parturition:cow ratio refers to the number of cows that have given birth at the time of the aerial counts. Twinning frequently occurs, thus the term calf:cow ratio is avoided in referring to moose reproductive capacities. Approximately 40 to 60 parturitions per 100 cows took place during the early part of June (see Table 2). The *in utero* examinations reveal 95 per cent of all females 24 months and older are pregnant. The average number of sets of twins per 100 parturitions between May 22, 1961, and June 7, 1961, was 21. The average number of singletons for that same period is 57 if we exclude female yearlings from the computation. The total estimated calf crop for 1961 has been derived as 99 calves per 100 cows. Due to the small sample sizes obtained during the composition counts this year, the reduction from 105 calves per 100 cows derived in 1960 would not suggest that an extreme deviation has occurred.

Figure 3. Estimated parturition:cow observations made in May and June, 1961, of the lower Susitna and Matanuska Valley moose populations.

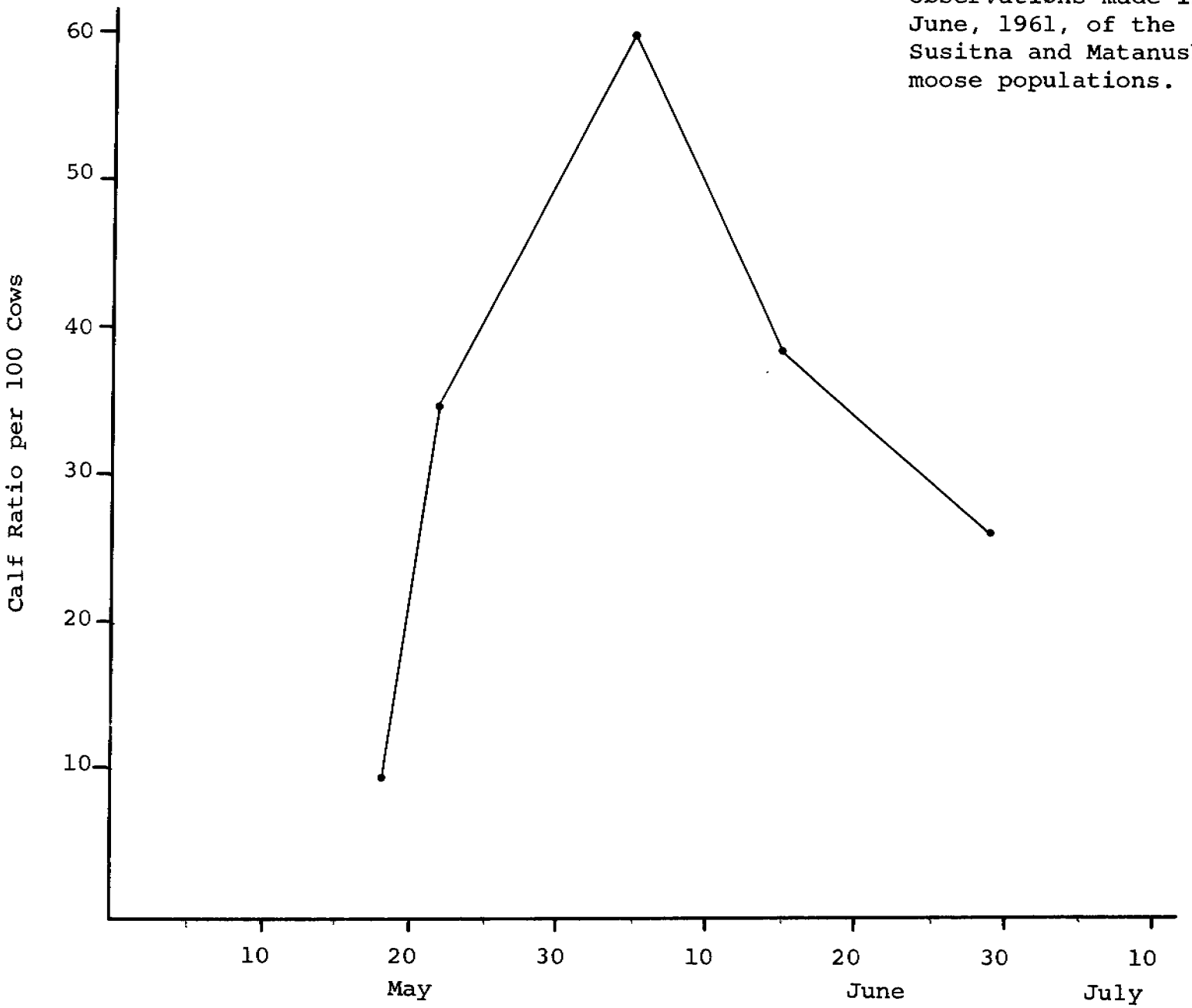


Table 2. Moose Calving Progression in the Lower Susitna and Matanuska Valleys Spring, 1961.

	Observed Parturitions 100 Cows	*Estimated Parturitions 100 Cows	Calves 100 Cows	**Twins 100 Parturitions	***Total Cows In Sample
5/5/61	0	0	0	0	36
5/15/61	0	0	0	0	29
5/18/61	9.7	9.7	9.7	0	72
5/22/61	34.9	34.9	43.4	7.5	106
6/7/61	41.8	60.0	54.5	12.7	55
6/14/61	32.0	38.7	42.9	8.0	75
6/28/61	24.6	26.2	29.2	4.6	65

*Computed by including unknown status females as having calves.
**One triplet group included as twins.
***Includes ♀ yearlings.

Calf Tagging

Referring to Table 3 a total of 254 moose calves were tagged during this operation which began on May 25, 1961, and continued through June 5, 1961.

Areas utilized during the tagging operation this year were similar to the 1960 tagging effort and included the Palmer Hay Flats, the Susitna Flats, Goose Bay, the Willow Flats, and the Chickaloon Flats on the upper Kenai Peninsula. In addition, the Moose River area on the Kenai Moose Range was also utilized during the 1961 tagging effort (Figure 4).

Alaskan Air Command H-21 helicopters accounted for 33 hours of flying time on this project. Colonel William M. Watts and Sgt. David L. Gray coordinated the operation with the Fish and Game office.

John Hakala, Refuge Manager of the Kenai National Moose Range, aided greatly when the tagging operation was under way in the Moose River area. Fish and Game participants included Elmer Norberg, Gerry Atwell, Tom O'Farrell, Al Erickson, Sterling Eide, and Jack Didrickson.

Calf Survival

Subsequent aerial calf counts were conducted in the Matanuska Valley to assess calf survival. The ratio of calves to cows dropped off steadily from a peak of 55:100 females on June 7, 1961, to a low of 21:100 females on July 7, 1961. These figures represent a 50 per cent reduction in calves in one month.

Reasons for the reduction are not evident. Some of the factors which influence the reduction are listed below:

1. More time had to be flown during the latter counts to acquire a minimal number of female moose.

Table 3. Moose Calves Tagged in Southcentral Alaska, 1961

Date	Females	Males	Sets of Twins Encountered	Sets of Twins Both Tagged	One Twin Tagged	Total Calves
5/25/61	13	24	8	7	1	37
5/26/61*	30	30	10	6	4	61
5/28/61	5	8	2	1	1	13
5/29/61	10	21	7	3	4	31
5/30/61	11	9	2	2	0	20
6/1/61	20	22	8	7	1	42
6/2/61	14	10	5	3	2	24
6/3/61	10	15	7	4	3	25
6/5/61	0	1	0	0	0	1
TOTALS	113	140	49	33	16	254
Per Cent: Of Total Calves	44.6	55.4	38.6			
Of Twins Encountered				67.4	32.6	

* One unknown sex moose calf was tagged on this date.

Figure 4. Moose calf tagging areas in Southcentral Alaska, May-June, 1961

Key:

#1 Palmer Hay Flats
#2 Goose Bay
#3 Susitna Flats
#4 Flathorn Lake
#5 Lake Nancy Flats
#6 Willow
#7 Kashwitna
#8 Chickaloon Flats
#9 Moose River Area

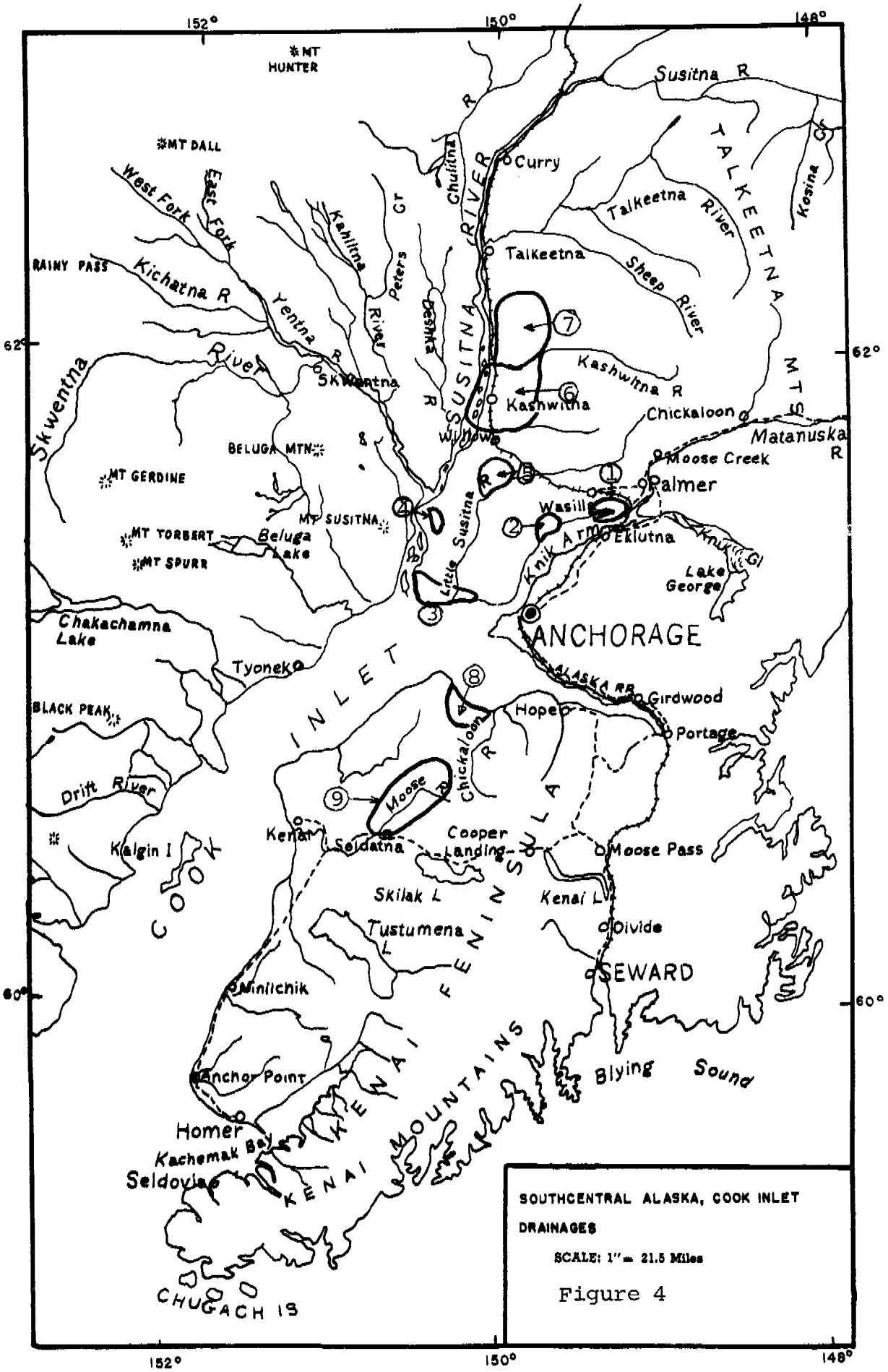

152°
150°
148°
62°
60°
MT HUNTER
MT DALL
RAINY PASS
West Fork
East Fork
Kichatna R
Yentna R
Skwentna River
Kahiltna
Peters Gr
Chulitna R
SUSITNA RIVER
Curry
Susitna R
TALKEETNA MTS
Talkeetna River
Sheep River
Kosina Cr
Talkeetna
Kashwitna R
Kashwitna
Chickaloon
Matanuska R
Moose Creek
Palmer
Wasilla
Eklutna
Knik Arm
Knik Gl
Lake George
ANCHORAGE
Little Susitna R
Beluga River
BELUGA MTN
MT GERDINE
MT SUSITNA
MT TORBERT
MT SPURR
Beluga Lake
Chakachamna Lake
Tyonek
INLET
COOK
BLACK PEAK
Drift River
Kalgin I
ALASKA RR
Girdwood
Hope
Portage
Chickaloon R
Moose R
Kenai
Soldatna
Cooper Landing
Moose Pass
Skilak L
Kenai L
Tustumena L
Divide
SEWARD
PENINSULA
Minilchik
Anchor Point
Homer
Kachemak Bay
Seldovia
KENAI MOUNTAINS
Blying Sound
CHUGACH IS
SOUTHCENTRAL ALASKA, COOK INLET DRAINAGES
SCALE: 1" = 21.5 Miles

Figure 4

This may be due to the female moose leaving the calving areas because the calves are ready to travel, the females are quite willing and ready to enter the periphery of the calving area, and these are usually quite heavily forested affording more protection.

2. Mortality - some dead calves were seen from the air, but the cause of death could not be ascertained. On occasion, a black bear was seen near a dead moose calf, but it is not known if the bear was involved in killing the calf, or came upon the carcass after death.

RECOMMENDATIONS:

Aerial parturiton counts should be continued to evaluate the more liberal regulations recently promulgated. Calf tagging should be continued, but tagging areas could be located nearer human population centers to increase the probability of tag return.

SUBMITTED BY:

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Game Biologist
June 30, 1961

APPROVED BY:

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P-R Coordinator

James W. Brooks, Director
Division of Game

Volume 2 Report No. B-2d

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 2-d Title: Characteristics of the Hunter Harvest

PERIOD COVERED: August 15, 1960 to April 30, 1961

ABSTRACT:

The general moose season in Southcentral Alaska extended from August 20 through September 30. Late hunts running from November 1 through November 30 and November 20 through November 30 were additionally held in specified game management areas. The season bag during the general seasons was one bull.

A special permit hunt allowing the taking of antlerless moose only was held in early December. Areas open to the taking of antlerless moose were located on the Kenai Peninsula and the Matanuska Valley area.

Results of the 1960 moose harvest in Southcentral Alaska were evaluated through means of check stations, hunter and guide interviews, questionnaires, and moose palatability surveys. Findings are summarized in the following statements:

1. An estimated kill of 2,300 moose was made during the 1960 season in Southcentral Alaska.

2. Three check stations intercepted 5,442 hunters who had expended 17,020 man-days in harvesting 824 moose during the general seasons.

3. Fifteen per cent of the hunters checked during the regular seasons were successful.

4. Hunters spent an average of 2 man-days hunting with most of the effort being exerted on weekends and holidays.

5. Average size of the hunting parties was two, but 31 per cent of the hunters checked out alone.

6. Three hundred and ninety-five of the 600 permit holders during the antlerless hunt were successful for a 66 per cent success ratio.

7. Residents comprised 97 per cent of the total hunters.

8. Seventy-three per cent of the resident hunting pressure originated from Southcentral Alaska.

9. Hunters bagging moose after the onset of the rut reported no significant difference in palatability rating from hunters rating their meat before the rut.

10. Moose hunters utilized private and commercial butchering facilities in a nearly equal ratio.

11. Private automobiles were the most important method of transportation utilized by hunters.

12. Seven per cent of all the hunters utilized the services of guides or outfitters. Success was 26 per cent higher for those hunters utilizing guides.

13. Seventy-five per cent of the hunters used no housing facilities or tents, 14 per cent used

trailers and camper units, and 11 per cent were housed in cabins and lodges.

14. Calves comprised 18 per cent of the kill during the antlerless moose hunt.

OBJECTIVES:

To obtain information indicative of the total hunter kill, areas hunted, age composition of the kill, hunter success, and the chronological distribution of the kill.

TECHNIQUES:

Check Stations.

Check stations were maintained at King Mountain, the Denali Highway, and the junction of the Seward and Sterling highways to obtain data on the kill. The check stations were open from August 20 through September 30, and the Kenai station was also open between November 20 and 30. Hunters voluntarily stopped at the closest station and filled out a card which gave: hunter's residence; date; method of butchering; area hunted; number of hunters in party; days out; residence; housing and messing facilities used; method of hunting; utilization of guides and outfitters; and species killed. All data gathered were coded for IBM machines and the final tabulations and correlations were done by the statistical branch in Juneau.

Moose Palatability Survey.

Hunters who bagged moose and went through a check station were also asked to fill out another form. This form was designed to evaluate the palatability of moose that were taken between August 20 and September 30. Since the last two or three weeks of the season overlap the onset of the rut, it was presumed that the bulls taken late would be too strong for human consumption.

The first half of the palatability sheet was filled out at the check station and it included the following questions: hunter's name, address and phone number; time since kill; location of hits; rutting condition,

method of butchering; condition of meat; and care during transportation.

In December hunters were contacted by phone or mail and asked how long they aged their meat and whether it was butchered privately or commercially. They were also asked to rate their meat as excellent, good, fair, or poor.

To test the effect, if any, of the rut, the data gathered prior to September 15 were separated from data gathered later in the season. The September 15 date was arbitrarily chosen, but it does closely correspond to the beginning of the rut.

Locker Plant Survey.

An estimate of the total kill was made by extrapolation of (1) the number of animals brought into commercial butchers, (2) the proportion of hunters who utilize private and commercial butchering facilities. The latter information was gathered on the check station cards. To gather data on the amount of meat that was brought into butchering plants, all locker plants and butcher shops throughout Southcentral Alaska were supplied with forms to record the following data: date, species, location, quarters butchered, and condition of meat. These forms were picked up or mailed into the Anchorage office at the end of the hunting season and the information was tabulated.

Kenai Peninsula Surveys.

Several techniques were combined to determine the moose kill on the Kenai. These techniques included: 20 per cent mail sample of Kenai residents; 20 per cent personal interview of Kenai residents; a check on the moose brought out of the Kenai by commercial transporters, and check stations on the Sterling Highway during all of the hunting seasons.

The mail survey was conducted by sending out 1,200 double post cards to a random sample of the 2,390 families on the Kenai who get their mail through general delivery, post office boxes, or star route boxes.

The personal interview survey was conducted in much the same manner as the mail survey in that a State representative contacted 20 per cent of the Kenai families who get their mail by the means described above.

A form was completed for each hunter in a family which included kill and check station information so duplication could be minimized in the final tabulation.

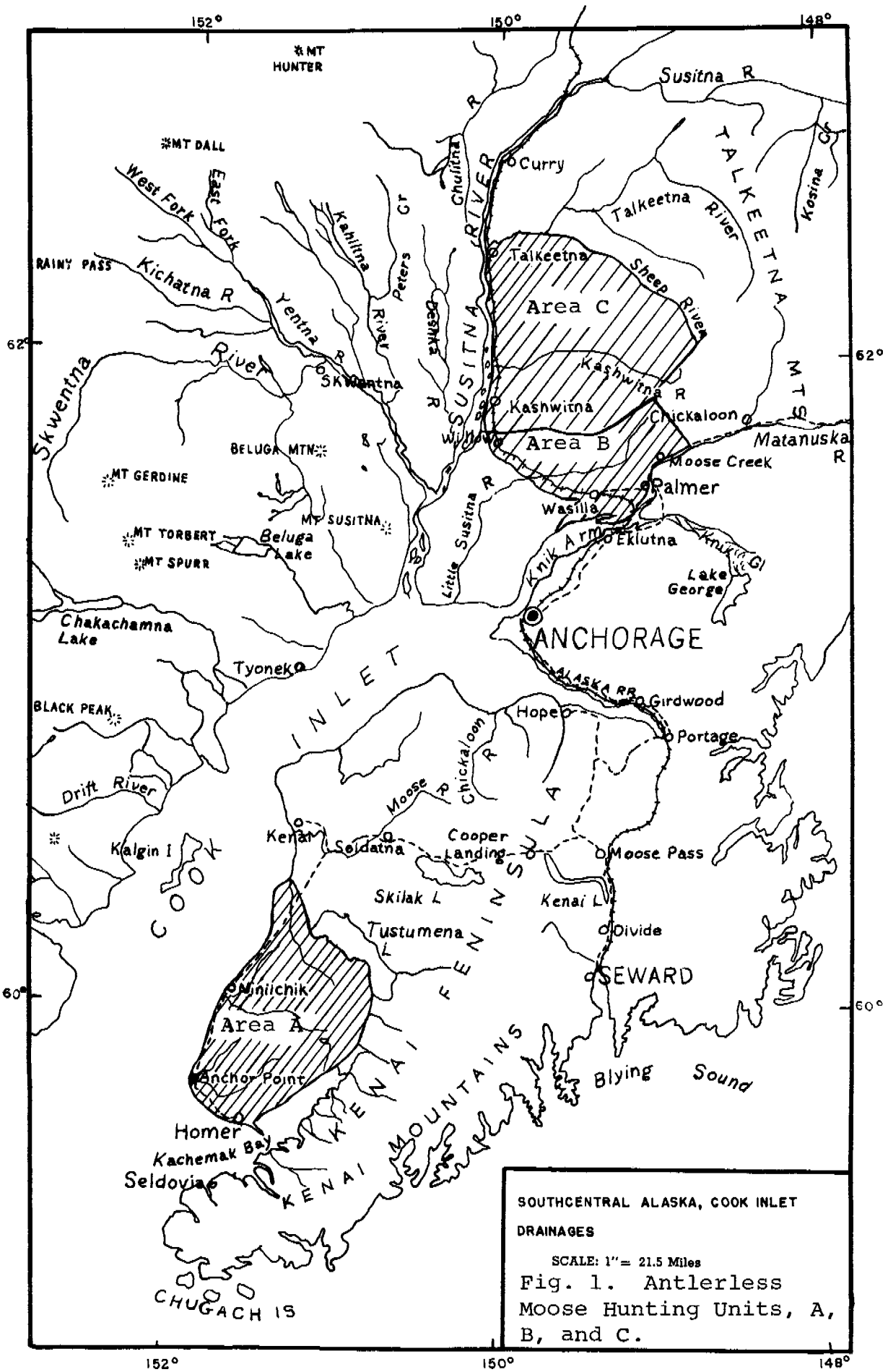
Commercial transporters and guides who had clients hunting on the Kenai were all contacted by a personal survey and the use of tally sheets. Each guide or outfitter was asked to tabulate the number of moose he helped bring off the Kenai. They were also asked to list those animals that probably went through a check station so there would be as little duplication of numbers as possible.

During the early and late bull seasons, a game checking station was maintained at Mile 38 on the Sterling Highway. Complete data were taken for each moose and hunter, including residence, so that Kenai residents who brought moose through the station would not be counted by two methods.

Antlerless Moose Hunts.

In December, 1960, the first antlerless moose hunts were conducted in the Matanuska Valley and on the Kenai Peninsula. Hunting units were delineated as Areas A, B, and C. Area A was located on the Kenai Peninsula between the Kasilof River and Homer. Area B was in the Matanuska Valley between Palmer and Willow. Area C was located between Willow and the Talkeetna River. Figure 1 shows the boundaries of the three units. The Kenai hunt was conducted between December 1 and 5 and the Matanuska hunts were conducted December 7 through 12.

Check stations were maintained in Anchorage, Kasilof, Seward, Palmer, Wasilla, and Homer, during the special hunts. Since checking out was mandatory, the kill figures are complete for these hunts. Hunt participants filled out a form which incorporated information



SOUTHCENTRAL ALASKA, COOK INLET DRAINAGES

SCALE: 1"= 21.5 Miles

Fig. 1. Antlerless Moose Hunting Units, A, B, and C.

on method used, area hunted, sex and age of kill, method of butchering and number and location of hits. These forms were then coded and tabulated by IBM machines.

All successful hunters were required to bring in the lower jaw of their animal so an estimate of the age structure of the kill could be made. All jaws were labeled, cleaned, and then placed into wear classes according to Peterson's method.

FINDINGS:

General Season

Kill.

An estimated 2,304 moose were killed in Southcentral Alaska. This figure was obtained by extrapolating from the 1,152 moose reported at lockers and the 50:50 ratio of private and commercial butchering facilities utilized as obtained by hunter survey.

Eight hundred and twenty-four moose were checked at the three check stations during the general hunts. Table 1 lists the kill recorded at each of the stations along with the number of hunters checked and the hunter success expressed in per cent.

Hunter Success.

Fifteen per cent of the hunters checked during the general seasons were successful. Resident hunters had a success ratio between 8 and 27 per cent depending upon areas hunted while 26 to 75 per cent of the non-residents were successful. Hunter success within individual units is seen in Table 1.

By plotting the number of moose reported at check stations by date (Figures 2 through 4), some interesting facts of the chronology of success are brought to light. On the Kenai Peninsula (Figure 2) hunters were most successful during the first week of the season. For the next three weeks the number of moose checked dropped to between 1 and 12 animals per day.

Table 1. Hunting Pressure and Hunter Success During the 1960 General Moose Season, Kenai, King Mountain and Denali Check Stations.

	Total Moose Hunters	No. Moose Killed	Hunter Success (Per Cent)
Kenai			
Resident	1,162	257	22
Non-resident	40	24	60
Unknown	40	11	28
Subtotal	1,242	292	23
King Mountain			
Resident	859	233	27
Non-resident	12	9	75
Unknown	57	11	19
Subtotal	928	253	27
Denali			
Resident	2,931	239	8
Non-resident	101	26	26
Unknown	240	14	6
Subtotal	3,272	279	8
Total	5,442	824	15

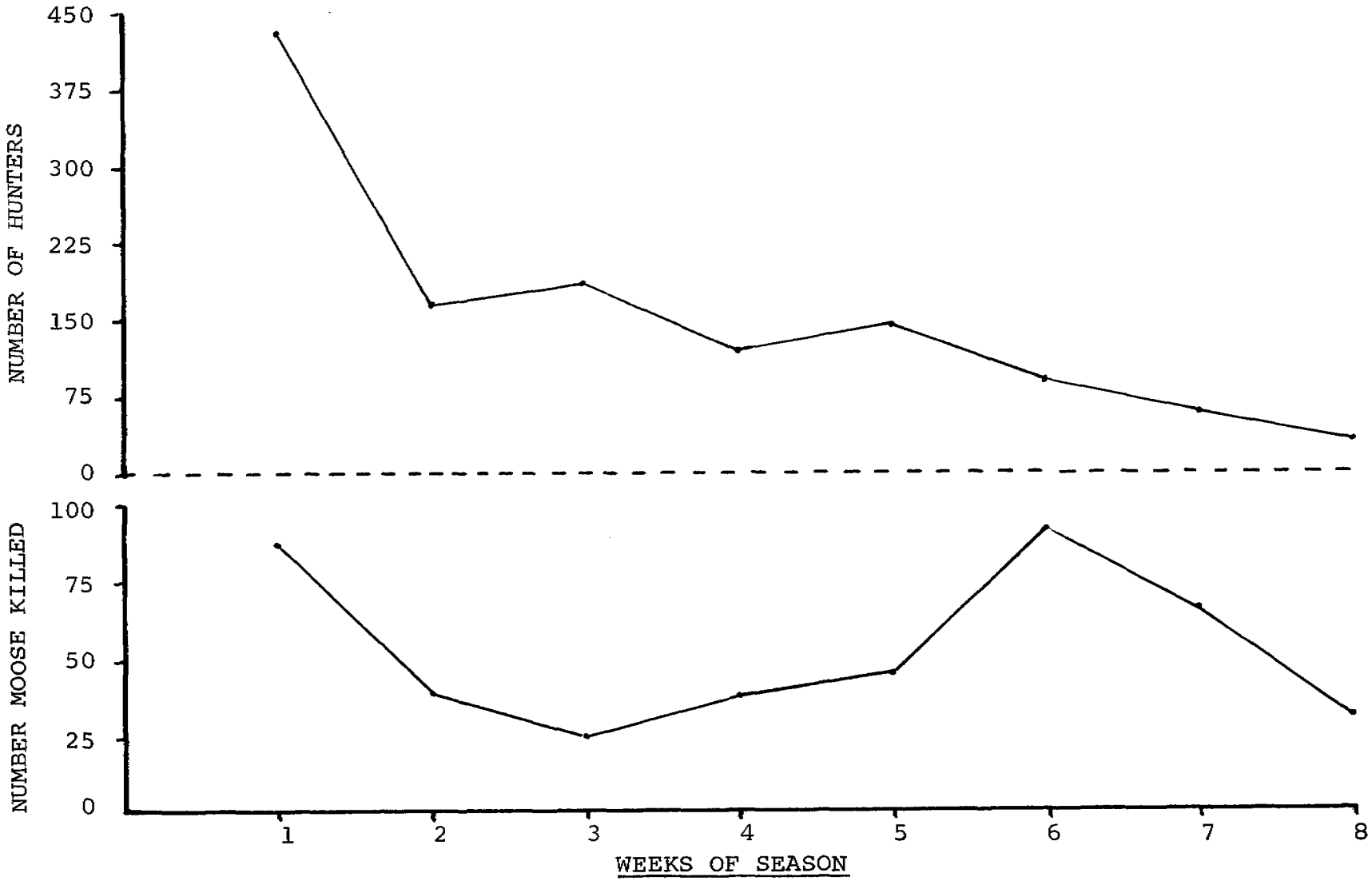


Figure 2 . Hunting Pressure and Kill, General Moose Season, 1960. Kenai Check Station, Southcentral Alaska.

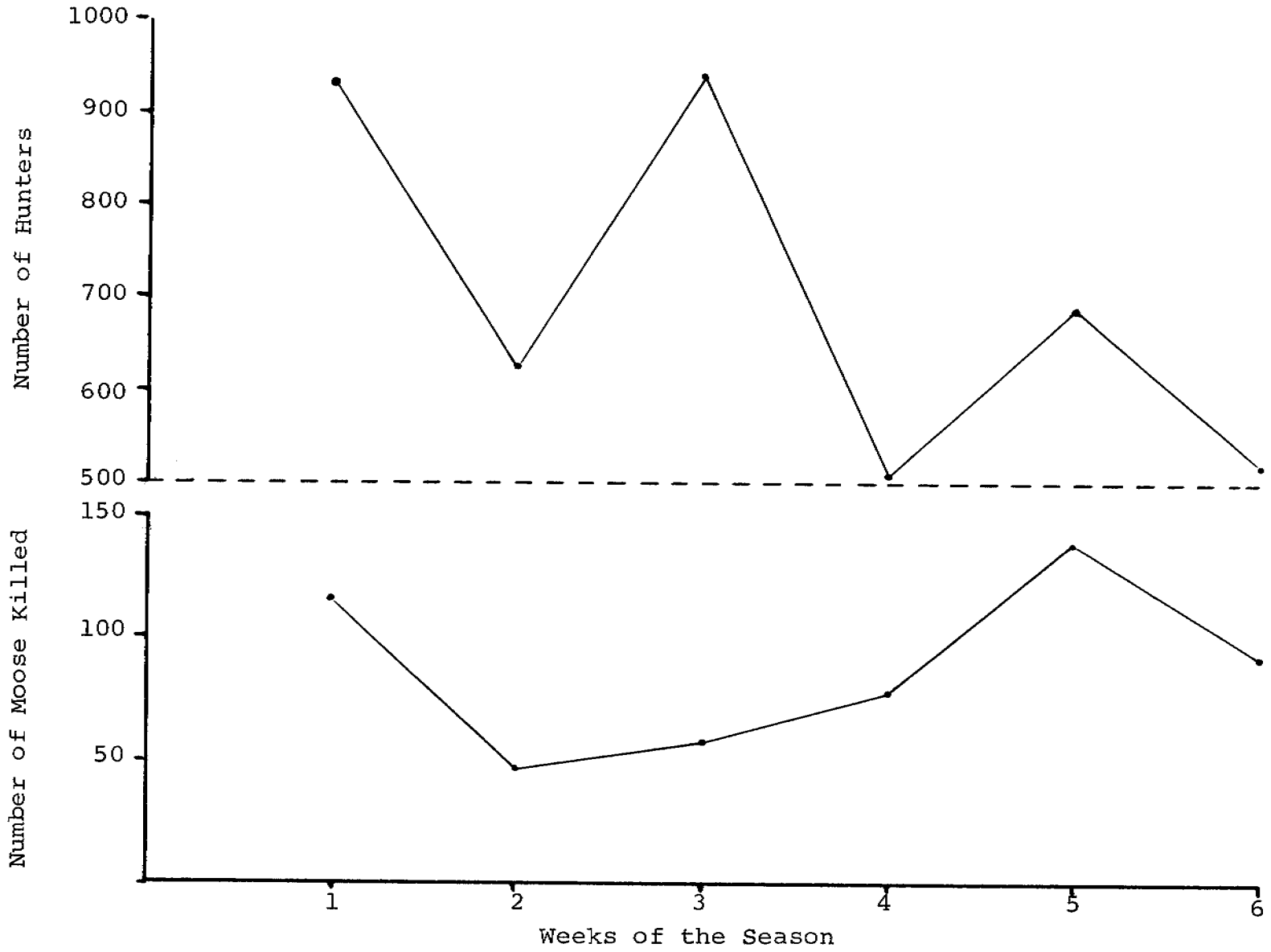


Figure 3. Hunting Pressure and Kill, General Moose Season, 1960. King Mountain and Denali Check Stations, Southcentral Alaska.

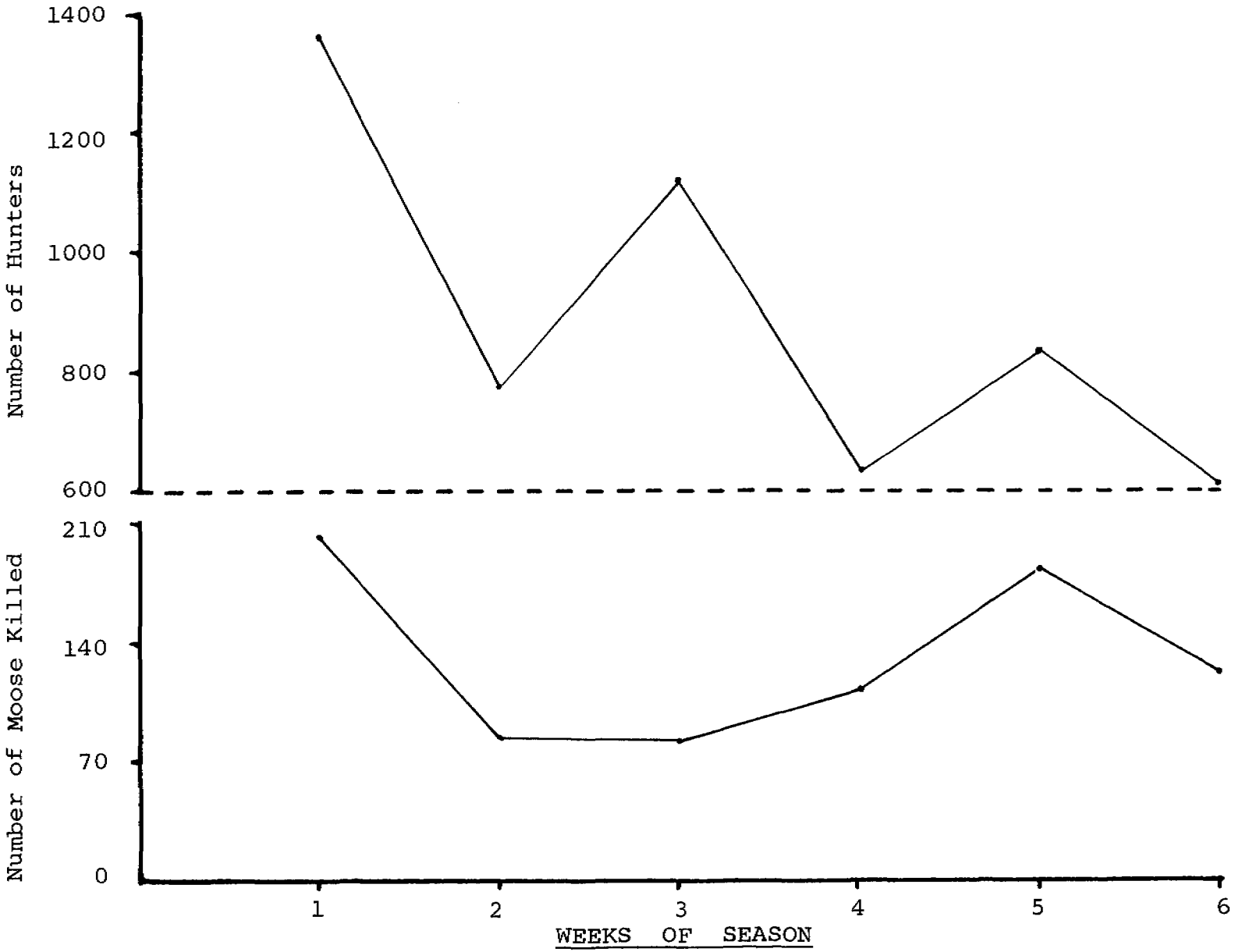


Figure 4. Hunting Pressure and Kill, General Moose Season, 1960. King Mountain, Denali, and Kenai Check Stations, Southcentral Alaska.

Hunters who checked into the King Mountain and Denali stations were successful during two periods: the first week and the last two weeks of the season. The great number of moose taken during the first few days of the season can be explained by referring to Figure 3 which shows that the high success corresponds to a period of heavy hunting pressure. The second peak of success came at the onset of the rut when bulls began to move around. The belief that the rut rather than a lack of effort in previous weeks was responsible in part for the increased kill is shown by the fact that during the Labor Day weekend fewer bulls were taken than the following week in spite of the tremendous amount of effort over the holiday.

The chronology of success points out the following facts: the first week of the season receives both a peak of effort and a peak of success; the period from the 19th of September to the end of the season is one of the most important parts of the season since success is very high; the onset of the rut helps the hunter success ratio; the number of moose killed is not directly proportionate to the amount of effort.

Hunting Pressure.

The greatest pressure was exerted on weekends, especially the long Labor Day weekend. During the middle of the week the number of hunters checked dropped to an average of 60 to 80 for all areas combined. As seen in Table 2, 54 per cent of the hunters were checked on weekends and holidays as opposed to 46 per cent on week days. This becomes more significant when one realizes that holidays and weekends comprised only 30 per cent of the total season.

The distribution of hunting pressure is graphically presented in Figures 2 through 4. These graphs show the number of hunters that checked into the three stations by week and the cumulative total for all stations. Of special interest is that most of the hunting pressure occurred during the first week of the season.

Table 2. Comparison of Hunting Pressure and Kill on Week Ends and Holidays with Week Days, General Moose Season, South-central Alaska, 1960.

	Check Station							
	Kenai		King Mt.		Denali		Total	
	No.	%	No.	%	No.	%	No.	%
Hunters Checked on Week Ends and Holidays	540	43	516	56	1,896	58	2,952	54
Hunters Checked on Week Days	702	57	412	44	1,376	42	2,490	46
Moose Checked on Week Ends and Holidays	120	41	107	42	110	39	337	41
Moose Checked on Week Days	172	59	146	58	169	61	487	59

Number of Hunters.

Check stations during the general hunt intercepted 5,442 moose hunters. An additional 1,134 hunters hunting other species of big game were also checked. Of the 5,442 moose hunters checked, 97 per cent were residents and three per cent were non-residents.

Hunting Distribution.

Moose were heavily hunted throughout Alaska along the road network. The 1960 check station data indicate several points where effort was concentrated. Table 3 presents a list of all the moose checked and location of kills. Along the Denali Highway moose hunting is heavy between Miles 10 and 90. From Miles 91 to 130, hunting pressure was less but still significant.

Moose hunting was fairly well distributed along the Richardson Highway and no points of hunter concentration were noted.

Along the Glenn Highway there were points of heavy pressure between Miles 81 and Mile 140. The area of greatest pressure was in the Lake Louise area where 91 moose were killed.

Over half of the moose killed on the Kenai Peninsula were shot north of the Sterling Highway, primarily in the East Forelands. One third was taken south of the Sterling Highway and north of Lake Tustamena with the remainder taken south of Tustamena.

Hunter Residency.

Ninety per cent of the resident hunting pressure came from the population centers of Anchorage, Fairbanks, Seward, Palmer, Fort Greely, Delta Junction, Glennallen, and Big Delta. Hunters checked were distributed in proportion to the population of towns along the highway system with the exception of the Kenai Peninsula. Because the Kenai check station was located near the junction of the Seward and Sterling Highways, hunters residing south and west of that location were not representatively sampled. Table 4 lists the origin of hunting pressure within Southcentral Alaska. It is significant that 73 per cent of the pressure was of local origin.

Table 3. Reported Kill Location of Moose Taken During General Season, Southcentral Alaska, Denali, King Mountain, and Kenai Check Stations.

Area	Moose Killed	Percent of Kill
Denali Highway		
Mile: 0-30	47	6
31-60	68	8
61-90	77	9
91-130	30	4
		27
Richardson Highway		
Mile: 126-195	25	3
Glenn Highway		
Mile: 50-80	8	T
81-110	42	5
111-140	46	6
141-160 (Lake Louise)	91	11
161-189	6	1
		23
Tok Cutoff	6	1
Talkeetna Mts.	19	2
Kenai Peninsula		
North of Sterling Hwy.	154	19
South of Sterling Hwy. and north of Tustamena	88	11
South of Tustamena	40	5
		35
Unknown	76	9

Table 4. Residency of Hunters Participating in 1960 Southcentral Alaska Hunts. Denali, King Mt., and Kenai Moose Checking Stations.

Area of Residence	Number of Hunters	Per Cent of Hunters
Southcentral	4,798	73
Central	1,466	21
Southeastern	28	T
Eastcentral	17	T
Northern	4	T
Northwestern	3	T
Out-of-State	249	5

The western states of California, Washington and Oregon accounted for 50 per cent of the out-of-state hunters and the mid-western states of Illinois, Michigan, and Minnesota accounted for 20 per cent of the out-of-state hunters. The percentage of out-of-state hunters who checked into the Kenai and King Mountain stations was 4 per cent but this dropped to 1 per cent on the Denali Highway. The variation on the Denali was probably due to a greater percentage of Alaskan hunters going into the area for the combination hunting available rather than a drop in the number of out-of-state hunters.

Effort.

Effort can be measured by the amount of time spent hunting. During the 1960 season hunters were asked how many days they were actively engaged in hunting. When the amount of time is multiplied by the number of hunters, an indicator of effort called "man-days" is obtained.

Hunters who stopped at check stations spent 17,020 man-days hunting game during the early 1960 season. The

breakdown according to areas was: Kenai, 3,040 man-days; King Mountain, 4,242 man-days, and Denali, 9,738 man-days. Because of the various species available, the Denali Highway area received the greatest pressure.

Hunters spent an average of 2 days pursuing game throughout the State. There was, however, a difference in the average number of days spent hunting according to the general area, residency and game sought. On the Kenai Peninsula residents spent an average of 2 days hunting, non-residents spent 4 days and parties of mixed residence spent 3 days.

Hunters who checked into King Mountain station averaged 3, 4, and 3 hunting days for residents, non-residents, and mixed parties, respectively. Residents spent an extra day hunting sheep only, but non-residents averaged 2 to 3 days over the average when hunting moose, sheep and goat. Mixed parties spent one day less than the average of 3 days while hunting caribou, but moose hunting consumed an average of 3 additional days.

In the Denali area hunters spent the same amount of time hunting as in the King Mountain area. Residents, however, did spend one day less than the average of 3 days while hunting caribou and sheep. Non-residents averaged one to 12 extra days when hunting moose and sheep. Mixed parties spent an average of 3 days hunting regardless of species sought.

Figure 5 shows the number of days hunters, by per cent, hunted as reported at the 3 stations and correlated to residence. Average number of days spent hunting correlated to area hunted and residency is seen in Table 5.

Size of Parties.

The number and size of all hunting parties were tabulated at the three check stations. Data gathered indicated that the average size of hunting parties during 1960 was 2 persons. This average was the same for all areas hunted. This average is not only the arithmetic mean but also the median and the mode indicating that

Figure 5. Number Days Hunted, Per Cent, for 6,133 Hunters Checked at Denali, King Mountain, and Kenai Check Stations. Southcentral Alaska, 1960.

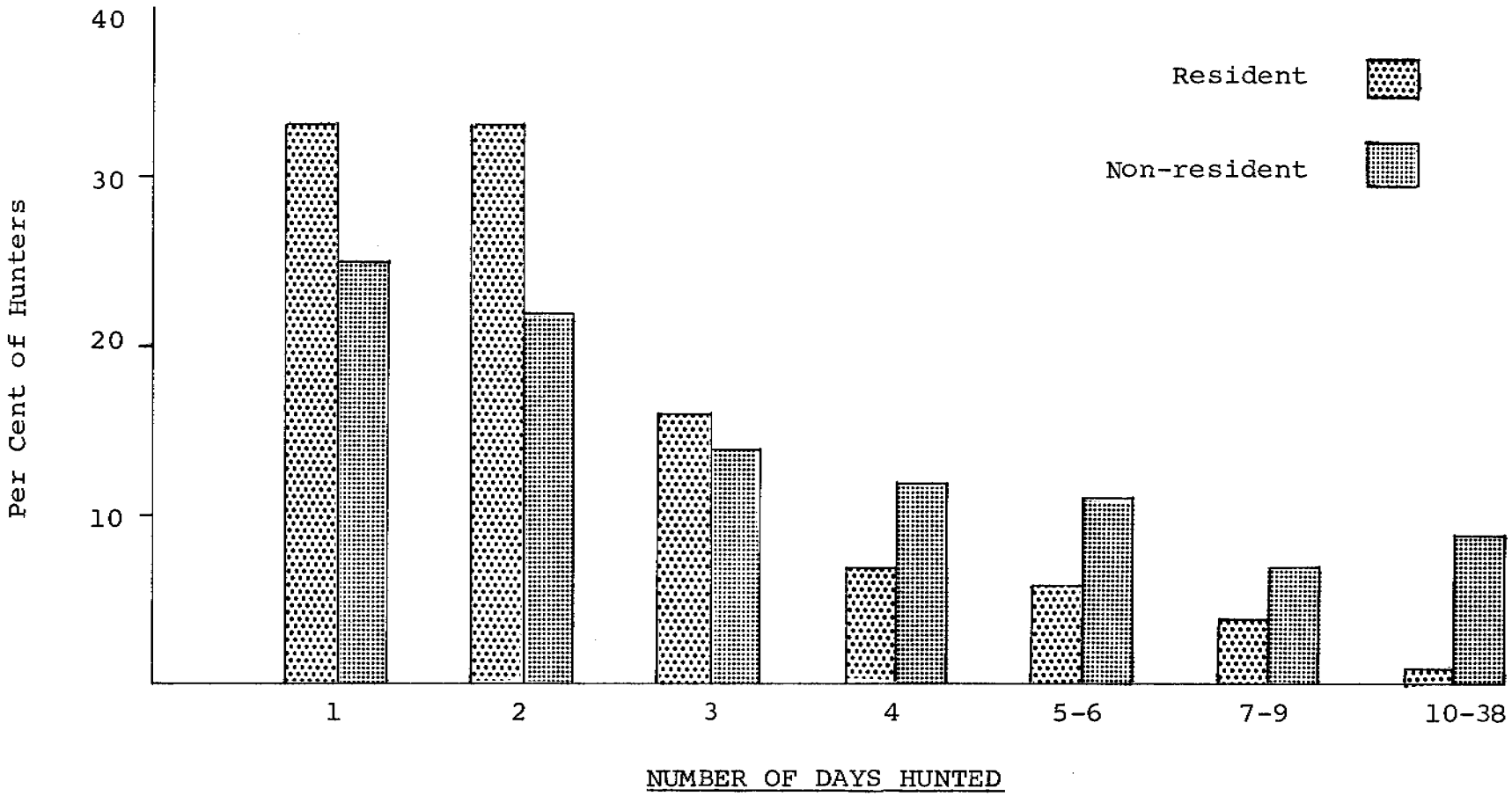


Table 5. Average Hunter-days Spent Moose Hunting in Various Harvest Areas by Residents and Non-residents. Southcentral Alaska, 1960.

Area	No. Residents	No. Non-residents	Residents Av. Hunting Days	Non-residents Aver. Hunting Days
Kenai	2,739	180	2	4
King Mt.	3,887	153	3	6
Denali	8,139	825	3	5

most hunters preferred to hunt with a companion. However, 31 per cent of the checked hunters went out alone. The largest party consisted of 9 hunters who went through the Denali check station. Table 6 illustrates the number and sizes of the 1960 hunting parties.

Table 6. Size of the Hunting Parties During the 1960 General Season as Reported at the Three Check Stations.

Check Station	No. in Party									Total Parties
	1	2	3	4	5	6	7	8	9	
Kenai	275	331	109	14	4	1	3	-	-	737
King Mt.	165	292	115	43	16	1	4	2	-	638
Denali	586	886	283	100	24	8	3	1	1	1,892

Utilization of Guides and Outfitters.

Residents and non-residents who hired guides or outfitters were more successful in obtaining game than hunters who used no commercial assistance. Table 7 lists the moose kill by hunters who hired guides. It also shows the success ratio expressed in per cent. Non-residents who hired guides were more successful than residents who hired help. This probably was due to non-residents hiring more guides than outfitters and spending more time in the field.

Table 7. Moose Kill by Hunters Employing Guides, General Moose Season, Kenai, Denali, and King Mt. Check Stations. Southcentral Alaska, 1960.

Residency	Number Hunters	Moose Killed	Hunter Success (%)
Resident	278	104	37
Non-resident	84	44	52
Total	362	148	41

On the Kenai Peninsula 3 per cent of the residents and 55 per cent of the non-residents utilized guides or outfitters to aid them in obtaining game (see Table 8). Residents used 5 different guides and 6 outfitters; non-residents used 11 guides. The 6 outfitters used by residents constituted 39 per cent of the hired aid. Because moose is the most sought-after game species on the Kenai, the majority of guides and outfitters were hired to hunt this animal.

Table 8. Number of Hunters Utilizing Guides or Outfitters During the General Moose Season, Southcentral Alaska, 1960.

Area		Number Guides	Number Outfitters
Kenai	Resident	21	15
	Non-resident	20	0
	Total	41	15
King Mountain	Resident	25	14
	Non-resident	10	2
	Total	35	16
Denali	Resident	169	34
	Non-resident	41	11
	Total	210	45
Combined	Residents	215	63
	Non-residents	71	13
TOTAL	Both	286	76

The percentages of utilization of guides and outfitters rose to 6 per cent and 63 per cent respectively for residents and non-residents who checked into the King Mountain station. Residents contracted 12 guides and 5 outfitters, with outfitters providing 23 per cent of the services. Eight per cent of the non-residents hired an outfitter while the rest of the out-of-state hunters used 15 guides. Almost half of the residents and non-residents who hired guides and outfitters in this area were seeking moose, caribou, or both species.

Percentage-wise, residents utilized guides most frequently in the Denali area and non-residents used them to a lesser degree than in the two other areas. Eight per cent of the resident hunters and 42 per cent of the non-resident hunters in the area utilized guides or outfitters. The majority of guides were hired to assist in hunting moose and caribou. Outfitters supplied 16 and 19 per cent of the services for residents and non-residents respectively.

Between 3 and 8 per cent of the resident and 40 to 60 per cent of the non-resident hunters hired guides or outfitters during the early season of 1960. Guides supplied 60 to 80 per cent of the services for residents and 81 to 100 per cent of the services for non-residents. Outfitters supplied the remainder of the contractual services.

Methods of Hunting.

Private automobiles were the most important means of transportation used by hunters in 1960. Airplanes, both private and commercial were the second most important type of transportation utilized. See Table 9.

On the Kenai Peninsula boats were an important means of harvesting game because of the extensive water network.

Hunters who checked through the King Mountain station reported using tracked vehicles and boats to a high degree. This was due to the fact that many hunters had been in the Lake Louise area.

Table 9. Methods of Hunter Transportation During the General Moose Season, Kenai, King Mountain, and Denali Check Stations, Southcentral Alaska, 1960.

Method	No. Moose	% of Moose
Car-foot	413	50
Plane	167	20
Tractor	146	18
Boat	58	7
Horse	24	3
Unknown	16	2

Denali area hunters depended on tracked vehicles to get around on the tundra in pursuit of moose and caribou.

The dependence on automobiles for transportation points out the importance of access if a high kill is desirable.

Housing Facilities Used.

Table 10 is a listing of the housing facilities used by residents and non-residents who were questioned at the 3 check stations.

If all residents are lumped regardless of area hunted, some idea of the proportion of the facilities used can be gained. Most of the hunters (74 per cent) used no facilities or pitched tents; 14 per cent camped in trailer or camper units, and 12 per cent used either cabin or lodge facilities.

Residents utilized tents, cars or no housing facilities while hunting in 1960. This indicates a dependence on the road system and cars for housing as well as hunting. Non-residents fell into the "none" column less frequently and showed a tendency to use tents more often. Since many non-residents came up the Alaska Highway, they used trailer and truck units more often than residents did.

Methods of Butchering.

Extrapolating from locker plant surveys to approximate the total kill requires that the investigator knows what proportion of the hunters use private or commercial butchering services. During the 1960 season hunters were asked whether they would butcher their game privately or commercially. Table 11 is a tabulation of the answers given.

The ratio between private and commercial butchering was 50:50 on the Kenai Peninsula. However, in the Denali and King Mountain areas the ratio of private to commercial was 75:25. This difference in butchering practices is partially due to the type or species of game sought. Moose, because of their large size, aren't

Table 10. Housing Facilities Used During the 1960 Hunting Season, Southcentral Alaska.

	No. of Hunters	Car or Tent		Trailer or Camper		Lodge or Cabin	
Kenai			%		%		%
Resident	1,149	832	(72)	110	(10)	207	(18)
Non-Res.	48	33	(69)	3	(6)	12	(25)
King Mountain							
Resident	1,253	952	(76)	111	(9)	190	(15)
Non-Res.	41	22	(54)	3	(7)	16	(39)
Denali							
Resident	3,262	2,452	(75)	512	(16)	298	(9)
Non-Res.	190	95	(50)	73	(38)	22	(12)
Total							
Resident	5,664	4,236	(75)	733	(13)	695	(12)
Non-Res.	279	150	(54)	79	(28)	50	(18)
ALL	5,943	4,386	(74)	812	(14)	745	(12)

Table 11. Butchering Methods Utilized for Big Game Animals.

	Private	% of Total	Commercial	% of Total
Kenai				
Residents	385	55	316	45
Non-Res.	11	26	30	74
Total	396	53	346	47
King Mountain				
Residents	785	76	250	24
Non-Res.	32	56	25	44
Total	817	75	275	25
Denali				
Residents	2,478	72	961	28
Non-Res.	177	57	133	43
Total	2,655	71	1,094	29
Residents	3,648	70	1,527	30
Non-Res.	220	54	188	46
TOTAL	3,868	69	1,715	31

often tackled by the "do-it-yourself" butcher. This point was brought out by the butchering ratio on the Kenai where moose is the important species sought and by the ratio obtained on the moose palatability survey which sampled moose from all of Southcentral. In both instances the ratio was 50:50. However, in the Denali and King Mountain areas, where caribou are taken in larger numbers than moose, the ratio of private to commercial changed to 75:25. The changes in butchering utilization may also reflect a difference in the number of city vs. rural hunters but the data on residence doesn't bear this out. In areas where moose alone are hunted, the ratio of butchering methods probably remains even, but in areas where caribou are taken, the ratio becomes heavy on the private side.

Moose Palatability.

Seven hundred and eighty-six palatability forms were filled out. This total includes 55 out-of-state kills which were not included in our survey. We sampled only the 731 hunters who gave Alaskan addresses.

September 15 was arbitrarily chosen as the date separating early and late season moose because it is 5 days before the old season closure and moose shot after that date should be showing signs of the rut. Hunters took 307 moose after September 15; this constitutes 41 per cent of the total kill and indicates that much late season hunting does take place.

Hunters were contacted in two ways: by telephone and letters. Forty-nine per cent of the contacts were by phone.

Of the 424 hunters who killed moose prior to September 15, 172 were contacted for a sample of 41 per cent. Seventy-two per cent (222) of the successful late season hunters were contacted because it was felt that their replies would be of greater value to the survey. These percentages indicate excellent cooperation from the hunters in replying to our phone calls and letters.

The taste of the meat was rated as either excellent, good, fair, or poor. Table 12 shows how the sampled hunters rated their meat.

Table 12. Taste of 1960 Moose Meat as Rated by 398 Hunters.

Killed:	Excellent	(%)	Good	(%)	Fair	(%)	Poor	(%)
Before 9/15	132	(77)	34	(20)	6	(3)	_	_
After 9/15	165	(74)	46	(21)	9	(4)	2	(1)
Total	297	(75)	80	(20)	15	(4)	2	(1)

These results show that hunters who shot their moose late were as satisfied with the quality of the meat as those who killed moose earlier.

If a hunter rated his meat as fair or poor we requested that he give a reason for the classification. Of the two poor ratings, one hunter reported that his meat was blown so badly that it was unusable. The other animal that was considered poor was so strong and tough that the hunter had to discard it. In checking over the forms for each of the above animals we found that both were handled and transported in apparently good condition.

Those who rated their meat as fair gave reasons such as: tough, strong, ruined by locker, handled improperly, etc.

Since so few hunters rated their meat as poor or fair, no correlation between handling, age of animals, or butchering could be shown.

Locker Plant Survey.

In its present form the locker plant survey serves little purpose and is so incomplete that any findings or results would have to be based on several large assumptions. The following discussion will be a breakdown of the parts of the form and what limited data they produced.

The column for recording dates actually yields little information since it only tells when meat was brought into the locker and this has no value by itself.

If all of the locker plants had been consistent in recording species and number of each species, some data could be gathered. This was not the case and many shops failed to get complete information. A tabulation of all forms shows that the following minimum number of each animal were brought in: 1,152 moose; 1,132 caribou; 46 sheep; 33 goat; 15 deer; 12 bear; and 1 elk. There were over 300 animals brought in that were listed as unknown. Since we don't know what per cent of these animals were already counted by check stations, we can't use the data as part of a total kill figure.

Locations were recorded in total by seven plants, partially by five other shops, and not at all by five others. In most cases the locations are so general that it would be impossible to break them down into areas smaller than Game Management Units. Data on location of kill would be useful, but by itself, without information on species, amount of animal butchered, and whether it was checked at a station, it has little value and duplicates to some degree the check station cards.

Some attempt was made to record the number of quarters butchered, but in most cases it was a feeble attempt at best. Some lockers completely skipped the column and others recorded a halved animal as two quarters, or a whole animal as one quarter. Any attempt to determine the number of animals as indicated by quarters would be worthless. A column indicating per cent of animal butchered may have worked better.

The rating of meat condition was so subjective that no attempt was made to tabulate the forms that listed it. Many lockers skipped that column altogether.

Some lockers partially listed poundage of game meat processed, but none did a complete job. A tabulation of

the poundage recorded indicates that a minimum of 418,000 pounds of game meat were processed by 6 out of the 17 lockers.

Aside from the partial tabulation of game species brought in, and poundage, little else was learned from the locker plant survey of 1960. The following things reduced the effectiveness of the survey:

1. The forms were not fully completed and there is no guarantee that each and every animal was recorded by the shops. It would be a difficult thing to assume that during the season-peaks all animals were dutifully recorded by a harassed butcher.

2. It is impossible to determine what per cent of each animal was brought in.

3. The locations of kills are too sketchy or completely lacking to be of any value.

4. It is impossible to determine the extent of the overlap between data gathered on the check stations and data gathered by this survey.

5. Poundage data are too limited to be used as an index to number of animals.

Checking station and moose palatability data show the ratio between private and commercial butchering as 50:50. If we assume that locker plant data constitute a minimum sample of commercially butchered moose, we can thus derive the minimum kill figure for Southcentral Alaska by multiplying 1,152, the number of moose brought into lockers, by 2. The result is 2,304 moose killed by hunters.

Kenai Peninsula Surveys

Mail Survey.

Of the 1,200 cards which were mailed out, 489 were returned. This constitutes a 20 per cent sample of the

Kenai residents. Of the 489 families who returned cards, 276 (56 per cent) had one or more members who hunted on the Kenai, 190 (39 per cent) had no hunters, and 23 (5 per cent) had members who hunted in areas other than the Kenai Peninsula.

The total moose reported by the mail survey was 241 animals, including 36 cows. Four (1 per cent) were killed in unknown areas, 35 (15 per cent) were killed in Game Management Unit 7, and 202 (85 per cent) were killed in Game Management Unit 15.

Since 241 moose were killed by 276 families who did hunt, it is assumed that the family hunting success was 87 per cent. This is a high percentage and it will be discussed later in this report.

By extrapolating from our 20 per cent mail sample and 205 kills (excluding antlerless kills) reported by this sample, we can estimate that approximately 1,025 moose were killed by Kenai residents during 1960.

Personal Interview

The State interviewer contacted 465 families on the Kenai for a sample of 20 per cent of the families. Twenty-one (4 per cent) reported hunting elsewhere, 207 (45 per cent) reported no hunters, and 237 (51 per cent) reported having one or more members who hunted on the Kenai.

The total moose kill reported on this survey was 168 animals including 19 antlerless moose. One moose (1 per cent) was shot in an unknown location, 23 (13 per cent) were shot in Unit 7, and 144 (86 per cent) were shot in Unit 15.

Since 237 families reported hunting, and 168 moose were killed (excluding antlerless moose) we arrive at an estimate of 748 moose killed by Kenai residents. These comparisons are seen in Table 13.

TABLE 13. COMPARISON OF MAIL AND PERSONAL INTERVIEW MOOSE SURVEYS

	Mail Survey	Personal Survey
Families Contacted	489	465
Families with Hunters	276 (56%)	237 (51%)
Families without Hunters	190 (39%)	207 (45%)
Families Hunted Elsewhere	23 (5%)	21 (4%)
Family Hunting Success	87%	71%
Unit Seven Kills	15%	13%
Unit Fifteen Kills	84%	86%
Unknown Areas	1%	1%
Antlerless Kills Reported	36	19
Estimate of Kill	1025	745
Estimate of Antlerless Kill	180	95
Actual Antlerless Kill by Kenai Residents	98	97

Commercial Transporters and Guide Survey.

After tabulating all moose taken off the Kenai by guides and transporters, and subtracting those moose that went through a check station or were entered on the other surveys, an estimated 160 moose were entered on the total kill figure.

Check Stations.

During the early and late moose seasons 280 moose were checked through. This total is exclusive of the moose reported in other surveys.

During the antlerless hunt, 137 moose were killed on the Kenai Peninsula; this is a complete kill figure.

Discussion

Since the two surveys differ significantly in their results, it is necessary to decide which method probably gives a more unbiased estimate.

If we compare the kill by game units, we can see that the percentages are for all practical purposes identical. This indicates that the samples of successful families are probably comparable.

But when we compare the success ratios of the two samples, we find that the mail survey is 16 per cent higher than the personal interview survey. A comparison of families that reported no hunters indicates that mail survey respondents had 6 per cent less non-hunting families. Both of these comparisons point out that the mail survey was biased by the fact that non-hunting families did not respond in proportion to the hunting families.

To check on the assumption that the mail survey was biased toward successful hunters, a comparison was made of the estimates of antlerless moose killed by Kenai residents using both survey results.

The mail survey recorded 36 cow moose killed by Kenai residents. If we extrapolate this figure using

our 20 per cent sample, we come up with an estimate of 180 antlerless moose shot by this group. This is 43 more animals than the total kill of all hunt participants, regardless of place of residence.

Only 19 antlerless moose were reported on the personal interview survey for a total of 95 kills by extrapolation. In actuality, 97 moose were shot by Kenai Peninsula residents during the antlerless hunts. This comparison of the two methods only adds more weight to the assumption that the personal survey was a better estimate of the moose killed on the Kenai by residents of the area.

Total Kill Estimate.

This estimate of total kill is based on the figures obtained from the personal interview, the check station data, and the guide-transporter survey. Some hunters

I.	Check Station	
	A. Early Season	269
	B. Late Season	11
II.	Guide-Transporters Survey.	160
III.	Personal Interview Survey	745
IV.	Cow Season	137
	Total	1,322

utilized trains for transportation while others drove up the Willow-Talkeetna road as far as they could. Hunters using tracked vehicles took 89 per cent of the moose harvested from the Purches and Peters Creek drainages. The Willow Creek drainage was the only other important harvest area since hunters were able to drive up much of the Willow Creek Road in pursuit of game.

Age and Sex of Moose Harvested.

When successful hunters checked out of the area they reported the sex of the animals they shot. Field personnel examined the sealed lower jaws and recorded the age as a calf, yearling, adult, or unknown age. Table 14 indicated the sex and age of the animals killed during the antlerless hunt.

Table 14. Sex and Age of Moose Harvested during the 1960 Anterless Moose Hunts, Southcentral Alaska.

Area	Calves				Yearlings				Adults				Age Unknown			
	Tot.	♂	♀	Unk.	Tot.	♂	♀	Unk.	Tot.	♂	♀	Unk.	Tot.	♂	♀	Unk.
A	18	12	6	-	13	3	10	-	84	1	83	-	22	3	19	-
B	24	12	12	-	7	3	4	-	104	-	102	2	13	-	10	3
C	18	8	10	-	12	4	8	-	76	2	74	-	4	-	3	1
TOTAL	60	32	28	-	32	10	22	-	264	3	259	2	39	3	32	4

Table 15. Permits Available and Validated; Moose Taken and the Success Ratio of the 1960 Anterless Moose Hunt, Southcentral Alaska.

Area	Permits Available	Permits Validated	Moose Taken	Success in Per Cent
A	150	150	137	91
B	200	201	148	74
C	250	246	110	45
TOTALS	600	547	395	66

Calves constituted approximately 16 per cent of the moose harvested. This percentage is similar to the proportion of calves recorded during the herd composition counts and indicates that people did not discriminate against calves, but rather they shot moose as they were available. Only the proportion of calves could be compared to the composition counts since the other age classifications of the counts and the hunt are dissimilar.

Calves were harvested in an even sex ratio. Since it was an antlerless hunt, yearlings and adults shot were almost all females; only 16 males were taken.

This, of course, is a minimum estimate since it does not include moose taken off the Kenai by car, that weren't checked in, or illegal kills. And since much of the information is based on surveys, the total estimate cannot be regarded as a maximum figure.

Antlerless Moose Hunts

Permits for the antlerless hunts were distributed through a public drawing as follows: Area A, 150 permits; Area B, 200 permits; Area C, 250 permits. Only Area C had more permits available than there were applicants. Table 15 shows the permits available and the number of permits validated for each area.

Hunter Residence.

Residents of Alaska comprised 99 per cent of the permit holders. That was due largely to the fact that the hunt was conducted during the winter when most non-residents had returned to the other states. Probably the lack of trophy value also contributed to the small non-resident participation. Table 16 indicates the residency of the hunters for the three areas.

Table 16. Residency of the Participants in the Antlerless Moose Hunts.

Area	Resident	Non-Resident	Residency Unknown
A	139	1	1
B	183	3	3
C	198	-	3

Table 17. Place of Residence in Alaska of the 1960 Anterless Moose Hunt Participants

Town	AREA A	AREA B	AREA C
Anchorage	35	149	187
Palmer	-	29	-
Wasilla	-	3	-
Chugiak	1	3	1
Eklutna	-	1	-
Sutton	-	2	2
Willow	-	1	5
Talkeetna	-	-	1
Skagway	-	-	1
Portage	1	-	1
Sunshine	-	-	3
Cohoe	2	-	-
Homer	23	-	-
Anchor Pt.	9	-	-
Kenai	6	-	-
Seward	33	1	-
Ninilchik	11	-	-
Sterling	3	-	-
Soldotna	4	-	-
Moose Pass	3	-	-
Clam Gulch	2	-	-
Seldovia	5	-	-
Kasilof	3	-	-
TOTAL	141	189	201

All of the hunt participants had Alaskan addresses. The distribution of the permit holders according to place of abode within the State is shown in Table 17. A review of the table shows that in area A, 74 per cent of the hunters resided in the immediate hunt area. In areas B and C, however, only 19 per cent and 4 per cent of the permit holders resided in the Matanuska Valley. The heavy participation in the Valley hunts by Anchorage residents was largely due to the proximity of the two areas.

Areas Hunted.

Concentrations of effort were noted in the three hunt areas. These concentrations were due mainly to availability or concentration of moose and access due to roads.

Concentrations of effort in area A occurred along the Cohoe Road, Miles 109-119 on the Sterling Highway and in the Homer, East Road area. Because of a heavy snowfall, moose were abundant in these readily accessible places.

In area B hunting effort was heaviest along the Buffalo Mine Road, and the triangle formed by the Fishhook, Wasilla-Fishhook, and Palmer-Wasilla Roads.

Most of area C was inaccessible to cars, yet most of the hunting was done where cars could be utilized. The most important points of concentration of effort were along the Alaska Railroad, the new road running north of Willow and the Willow Creek Road.

Methods Utilized.

Cars and trucks were the most important means of transportation used by antlerless-moose hunters. In areas A and B they were utilized by over 80 per cent of all hunters, but only in area C, the most inaccessible area, were tracked vehicles and planes used to any significant degree. Table 18 is a listing of the methods utilized by moose hunters in the three areas. These data show the importance of ready access by car hunters if a hunt is to be successful.

Table 18. Methods of Hunter Transportation during the Anterless Moose Season, Southcentral Alaska, 1960.

Method	Number of Moose Killed	Per Cent of Kill
Car-foot	371	70
Plane	53	10
Tracked Vehicles	37	7
Horse	1	T
Unknown	69	13
TOTAL	531	100

Moose Killed.

Three hundred and ninety-five moose were killed during the 1960 antlerless moose hunt. Figure 5 shows the distribution of the kill and the success ratio expressed in per cent. Hunters in the Kenai area were the most successful largely due to the ready access to concentrations of animals. Due to a lack of snow and generally foul hunting conditions, area B hunters were not as successful as area A hunters. The Willow-Talkeetna hunt area was the least productive area because of the access problem.

Date Killed.

Over half the moose killed in area A were shot in the first 2 days of the 5 day hunt. In areas B and C half the animals in each area were shot in the first 3 days of the 6 day hunts. Hunting success was greatest during the opening days of the hunts in spite of the fact that the hunts opened 2 and 3 days before weekends. This shows that most of the hunt participants were interested enough in obtaining a moose that they took leave from their jobs.

Interest in the hunt waned when the deadline arrived for unsuccessful hunters to check in their seals. The hunt regulations allowed hunters a period of three days after the season closure in which to report kills or return seals. Thirty-four hunters reported as late as three weeks after the season and fourteen failed to report at all and were cited by the Protection Division. Enforcement of the checkout time is important if specimens are being fathered from the kills so future hunts should emphasize and enforce closure regulations.

Location of Moose Kills.

In area A moose were harvested in 2 main locations. Most of the moose, 60 per cent, were killed in the Cohoe Road area. Twenty-four per cent of the moose were taken in the general vicinity of Homer, especially along the East Road system. Moose were concentrated in both of these areas so they were readily accessible to hunters. The remainder of the area A kill came from scattered locations along the Sterling Highway.

The majority of the area B kill was harvested from the triangle of the Fishhook, Fishhook-Wasilla and Palmer-Wasilla roads. This area also received the heaviest hunting effort. Twelve per cent of the kill came from the Buffalo Mine Road. The remainder of the moose taken in Area B were harvested in small numbers from the remainder of the road system.

The access problem in area C prevented the successful harvest of antlerless moose from most of the area. Forty-one per cent of the moose were taken along the Alaska Railroad right-of-way. Some hunters utilized trains for transportation while others drove up the Willow-Talkeetna road as far as they could. Hunters using tracked vehicles took 89 per cent of the moose harvested from the Purches and Peters Creek drainages. The Willow Creek drainage was the only other important harvest area since hunters were able to drive up much of the Willow Creek Road in pursuit of game.

Age and Sex of Moose Harvested.

When successful hunters checked out of the area they reported the sex of the animals they shot. Field personnel examined the sealed lower jaws and recorded the age as a calf, yearling, adult, or unknown age. Table 6 indicated the sex and age of the animals during the antlerless hunt.

Calves constituted approximately 16 per cent of the moose harvested. This percentage is similar to the proportion of calves recorded during the herd composition counts and indicates that people did not discriminate against calves, but rather they shot moose as they were available. Only the proportion of calves could be compared to the composition counts since the other age classifications of the counts and the hunt are dissimilar.

Calves were harvested in an even sex ratio. Since it was an antlerless hunt, yearlings and adults shot were almost all females; only 16 males were taken.

Butchering Methods Utilized.

Successful hunters were asked if they were going to butcher their own meat or have it done commercially. Table 19 is a tabulation of the reported methods of butchering utilized.

The majority of hunters stated that they planned to do their own butchering while the remainder were going to utilize commercial facilities or a combination of private and commercial facilities. Area A hunters indicated that they would butcher privately in a higher proportion than the area B and C hunters. This was due to the fact that the majority of area B and C hunters were urban residents who had readily available commercial facilities.

Weapons Used.

Half of the antlerless moose hunters used .30-06 caliber rifles to obtain their game. The only other calibers used to any degree were .270 and .300 H. and H. rifles. The various caliber rifles used by moose hunters are presented in Table 20. There was no apparent correlation between calibers utilized and rural and urban hunters.

Miscellaneous.

On the checkout form hunters were also asked to record the number of times they shot and hit their moose, where they hit the moose, and how far the animal traveled after the first hit. Tables 21, 22, and 23 show the data gathered. These data are based on the replies of the hunters and therefore they are probably biased to an unknown degree by human respect and pride.

Three quarters of the moose harvested were killed with one or two shots. This indicates a high degree of accurate shooting by the hunting public.

Half of the moose in areas A and B were killed by nervous system shots while the remainder were killed by heart and lung or combination shots. In area C the moose were killed in equal proportion by nervous system, heart, and lung, and combination shots. Of note is the

Table 19. Butchering Methods Utilized by Anterless Moose Hunters, Southcentral Alaska, 1960

Method	Number of Hunters	Per Cent of Hunters
Private	242	61
Commercial	130	33
Combination	10	3
Unknown	13	3
TOTAL	395	100

Table 20. Calibers of Weapons Used by Anterless Moose Hunt Participants.

Caliber	Area A	Area B	Area C
.30-06	69	79	76
.30-30	9	8	5
.308	7	5	8
.300 W.M.	1	4	6
8 mm.	2	3	3
6.5 mm.	3	1	-
6.5 x 55 mm.	-	-	2
.357	-	-	1
.300 sav.	3	8	6
.30-40	4	1	1
.32	2	2	-
.220 Swift	1	-	-
.280	-	1	-
.250-3000	-	1	-
.44	-	1	-
.300 H. & H.	12	20	19
.348	1	3	1
.375 H. & H.	1	1	4
.338	-	-	1
.270	12	14	15
7 mm.	3	-	1
.300 Ackley	-	-	1
.243	1	-	1
.303	1	4	1
.257	3	1	-
.25-35	1	-	-
.22 H.P.	1	-	-
.35	1	1	-
7 x 61 mm.	-	1	-
8 x 57 mm.	-	6	-
.264	-	1	-
Unknown	3	23	48

Table 21. Location of Hits Scored by Moose Hunters

	Location				
Area	Central Nervous	Heart & Lung	Stomach	Comb.	Unk.
A	75	24	-	38	-
B	72	38	1	33	4
C	38	30	2	39	1
TOTAL	185	92	3	110	5
	47%	23%	7%	28%	1.3%

Table 22. Number of Times Anterless Moose were Shot By Hunters

	Number of Hits						
Area	1	2	3	4	5	6	Unk.
A	58	41	28	4	5	1	-
B	70	55	13	4	1	1	4
C	43	47	15	2	-	2	1

Table 23. Distances Moose Traveled after being Shot.

	Distances in Yards					
Area	0-5	5-50	50-100	100-500	Over 500	Unk.
A	76	47	2	6	4	2
B	87	43	5	6	2	5
C	60	33	9	5	2	1

fact that such a high proportion of hunters chose to make head, neck, or back shots rather than the easier shoulder shot.

Since it appeared that most of the moose were killed by accurate, well-placed shots, it was not surprising that more than half of the beasts dropped within 5 yards of the place where they were first hit and ninety per cent of the animals dropped within 60 yards.

Age Structure of Kill.

The age structure of the kill can be best demonstrated by referring to Table 24. In Areas B and C there was an even greater proportion of older animals shot than on the Kenai Peninsula.

RECOMMENDATIONS:

If an accurate estimate of game harvested is desired, a sealing program for all species should be initiated as soon as possible.

When check stations are desired, they should be run on a sampling basis.

Personal interview surveys should be utilized rather than post card surveys whenever they are economically feasible.

The locker plant survey should be completely revised before it is used again.

Since hunters using automobiles are so important to the total harvest, effort should be expended to obtain or improve auto access into as many hunting areas as possible.

The moose season should not be cut back from September 30 for reasons of meat palatability only.

Table 24. Ages of Moose Killed on the 1960 Anterless Moose Hunts.

Age Class	Area A	Area B	Area C	Age Class Total	Per Cent of Age Class Total
Calf	22	23	21	66	18
I	19	13	8	40	10
II	4	7	6	17	4
III	28	23	11	62	17
IV	19	19	13	51	14
V	16	9	14	39	10
VI	13	6	8	27	7
VII	12	17	13	42	11
VIII	3	18	4	25	6
IX	-	9	4	13	3
TOTALS	136	144	102	382	100

SUBMITTED BY:

Thomas P. O'Farrell
Game Biologist
June 30, 1961

APPROVED BY:

David R. Klein
P-R Coordinator

James W. Brooks, Director
Division of Game

Volume 2 Report No. B-2e

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 2-e Title: Mortality Studies, Southcentral Alaska

PERIOD COVERED: July 1, 1960, to June 30, 1961

ABSTRACT:

Information relating to moose mortality other than hunting, was gathered by investigating reported kills. Mortality studies were intensified in the Anchorage and Palmer areas. Specimen material was collected and preserved, and data was gathered on weights, measurements, and presence of parasites. These activities revealed the following information:

1. Total moose checked numbered 132. Fifty-eight moose were killed by vehicle collisions, 8 were railroad kills, 4 were illegal kills, and the remaining 66 were killed by miscellaneous causes.

2. Seventy-two per cent of the moose examined for parasites had parasites present.

OBJECTIVES:

To record the incidence and effect of the various causes of mortality other than hunting, which operates

against moose subject to significant hunting pressure or wolf predation.

TECHNIQUES:

All possible instances of mortality resulting from accidents, predation, pathological causes, parasitism, and winter kill were investigated. Carcasses were examined in an attempt to determine the cause of death and condition of the animals.

When practical, reproductive data, weights, and measurements were recorded. Specimen material was additionally collected and preserved. Carcasses in salvagable condition were donated to charitable institutions after autopsy.

FINDINGS:

Road Kills

During this reporting period 58 moose were struck by motorized vehicles. These kills occurred primarily in the Palmer, Anchorage, and Portage areas. The majority of collisions took place near the outskirts of population centers. High speed and difficulty in seeing moose at night were the prime contributors to these accidents.

Of these 58 road kills, 26 were cows, 4 were bulls, 11 were female calves, 12 were male calves, the remainder were unidentified.

Railroad Kills

Eight kills were reported by the Alaska Railroad. These kills occurred in the Portage area.

Miscellaneous Kills

An additional 66 moose were examined within this reporting period. Of this number, 4 were illegal kills, 33 were collected by the Department, 15 were depredation

kills, and 14 were dead from unknown causes. The 33 Department collections consisted of 4 cripples, seven public safety kills, 18 kills at International Airport, and 2 dead from unknown causes.

Specimen Material

From the 132 moose examined, the following specimen material was collected and preserved:

Reproductive tracts.	100
Fetuses.	52
Jaws	113
Blood samples.	52

Weights were recorded on 54 moose and body measurements were taken on 92 animals.

Parasitism

Ninety-five moose were examined for parasites. Sixty-five of these animals had parasites present in the liver.

Meat Salvage

Thirty-nine carcasses were salvagable and were donated to various charitable institutions.

RECOMMENDATIONS:

1. The moose kill reporting system should be continued and expanded on the Alaska Railroad.

2. All available biological data should be obtained from moose carcasses when practical.

SUBMITTED BY:

John E. Crawford
Game Biologist

APPROVED BY:

David R. Klein
P-R Coordinator

James W. Brooks, Director
Division of Game

Volume 2 Report No. B-2g

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 2-g Title: Moose Investigations - Southcentral Alaska

PERIOD COVERED: January 1, 1961 to March 31, 1961

ABSTRACT:

Information obtained from aerial composition counts of moose populations inhabiting the Susitna and Copper River Drainages was compiled. Specimens obtained from the antlerless moose hunts held in the Lower Susitna and Matanuska River Valleys were processed. One publication "Narcosis of Moose with Nicotine" was completed.

OBJECTIVES:

To prepare for publication all biological data accumulated on the moose populations of the Susitna and Copper River Valleys under the U. S. Fish and Wildlife Service Federal Aid Project W-3-R and Alaska Department of Fish and Game Project W-6-R-1.

TECHNIQUES:

Materials (fetuses, ovaries, lower jaws) collected during the antlerless hunts held in Lower Susitna Valley were processed.

FINDINGS:

Compilation of information obtained from aerial composition counts and reproductive tracts was started. One publication "Narcosis of Moose with Nicotine" was accepted for publication in the Journal of Wildlife Management.

RECOMMENDATIONS:

Findings reported in the publications should be utilized in the development of management procedures.

SUBMITTED BY:

Robert A. Rausch
Game Biologist
March 31, 1961

APPROVED BY:

David R. Klein
P-R Coordinator

James W. Brooks, Director
Division of Game

Volume 2 Report No. B-3a

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 3-a Title: Determination of Herd Status (data analysis), Interior Alaska

PERIOD COVERED: July 1, 1960 to June 30, 1961

OBJECTIVES:

To compile and analyse all pertinent data resulting from field investigations of moose in Interior Alaska in accordance with the needs of management.

PROCEDURES:

The findings resulting from investigations of moose distributions, numbers, sex and age composition, productivity, harvest, etc., because of interrelationships, must be synthesized before herd status can be adequately clarified to serve the needs of management. This job therefore entails bringing together all data bearing on present herd characteristics and trends and assessing them according to past, present, and anticipated future environmental conditions and harvest demands. With this information for guidance, regulations may be directed more precisely and effectively toward improved resource management.

FINDINGS:

Sex and age composition data for 1960 of moose populations inhabiting the Tanana, Fortymile and Lower Koyukuk Valleys have been analysed. These data indicate that the effects of hunting, poaching, predation and other factors of mortality are not discernable upon the overall moose populations sampled.

Productivity at six months of age is "good" for all areas, and continues to be "excellent" for the Koyukuk Valley. Survival to 18 months in the Tanana and Fortymile areas is "good" at 70 per cent, which again is historically better than the 50 per cent exhibited by the Koyukuk Valley this year. The Koyukuk is believed to be overpopulated. Contributing to this situation is the unusual occurrence of the breeding of yearling cows. These conditions could further increase the present high numbers and cause a collapse of the moose population in this area.

We know little about moose populations in other parts of the Interior and Arctic Alaska; we do know that moose are plentiful. An attempt was made to obtain some facts about moose in the Yukon-Rampart area. We learned little about the population, but gained knowledge concerning improved sampling methods. Next year we hope to obtain information from the Kobuk, Innoko, Noatak, Colville and the Minchumina-Kantishna areas.

Hunters harvested some 2600 moose in the Interior and Arctic during 1960. Road access hunter success was 10 per cent, whereas guides and air taxi operators enjoyed a hunter success of 87 per cent. Checking station data revealed that the harvest of moose is directly related to the movement of moose rather than the hunter effort. This observation is applicable to road hunting.

Much groundwork has been done in connection with aerial sampling. The approach has been directed toward standardization so that the data can be analysed by accepted biometrical methods. In this manner we can obtain precise information on which to base our management program.

Analyses of herd composition data show that we can place confidence in the sex-ratio counts. An index to abundance is being probed and may be of value pending further field work.

The theoretical basis for a track census method is now on paper and will be tested in the field during the coming year. From these studies we hope to reduce the expenditures encumbered by prolonged aerial work so that we can direct our efforts toward presently unknown biological aspects of moose.

RECOMMENDATIONS:

Projects:

1. Adopt a standardized aerial observation technique.

2. Consolidate data on sex and age composition, natality, mortality, survival and abundance into one completion report.

3. Record data so that it can be handled by biometrical analysis.

4. Collect cows in the Koyukuk Valley to determine if yearling moose are breeding.

5. Adopt a tagging system for all moose taken.

Management:

1. Establish access to large unhunted moose populations.

2. Initiate either-sex moose hunting.

SUBMITTED BY:

Wallace W. Bentley
Game Biologist
September 30, 1961

APPROVED BY:

David R. Klein
P-R Coordinator

James W. Brooks, Director
Division of Game

Volume 2 Report No. B-3b

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 3-b Title: Abundance and Composition Surveys, Interior Alaska

PERIOD COVERED: October 1, 1960 to January 31, 1961

ABSTRACT:

Sex and age composition counts of moose populations inhabiting the Tanana, Fortymile and Lower Koyukuk Valleys were completed by aerial observation during the months of October, November, December and January. The information from Big Delta, which was counted in November incidental to the bison survey, is included.

The effects of hunting, poaching, predation and other factors of mortality are not discernable upon the overall moose populations sampled in the Interior, with the exception of the Big Delta area, if results are compared with last year's data. The latter area showed a bull-cow ratio of 38:100, which may have been depressed by hunting and sampling. The Fortymile area indicated a bull-cow ratio of 110:100, the Tanana 77:100, and the Koyukuk 92:100.

Productivity at six months is "good" for all areas, and continues to be "excellent" for the Koykuk Valley. Survival to 18 months in the Tanana and Fortymile areas is "good" at 70 per cent, which again is historically better than the 50

per cent exhibited by the Koyukuk Valley this year.

Definite areas have been delineated in the Tanana study area and the aerial observation technique has been standardized in an attempt to obtain uniform data so that a practical index to the relative abundance and composition of moose populations may be established.

Distribution, total numbers and numbers of moose observed per hour in the delineated areas in the Tanana Valley and the apparent pioneering to recent burns from well established areas suggest that the overall population is increasing.

OBJECTIVES:

1. To determine the sex and age composition of identifiable moose populations subject to either significant hunting pressure or wolf predation.

2. To establish an index to relative moose abundance in the areas where herd composition counts are conducted.

TECHNIQUES:

To establish practical indexes to the relative abundance and composition of moose, the technique used is outlined in the following points, (1) delineation of the areas to be counted, and (2) standardization of the flight pattern so that the observers could look at the entire area.

The Tanana Valley was divided as noted in Figure 1. Parallel transects were flown at approximately one mile intervals. The compass heading or reference point was flown in a direction so that the pilot always observed the area one-quarter of a mile into the sun's side of the aircraft, and the observer looked at the area three-quarter of a mile away from the sun. Therefore, at this latitude, the areas were, insofar as possible, longer in a north-south direction and the transects flown from east and west directions were as short as possible so that the pilot might avoid overlapping transects.

If this technique proves fruitful in establishing useful

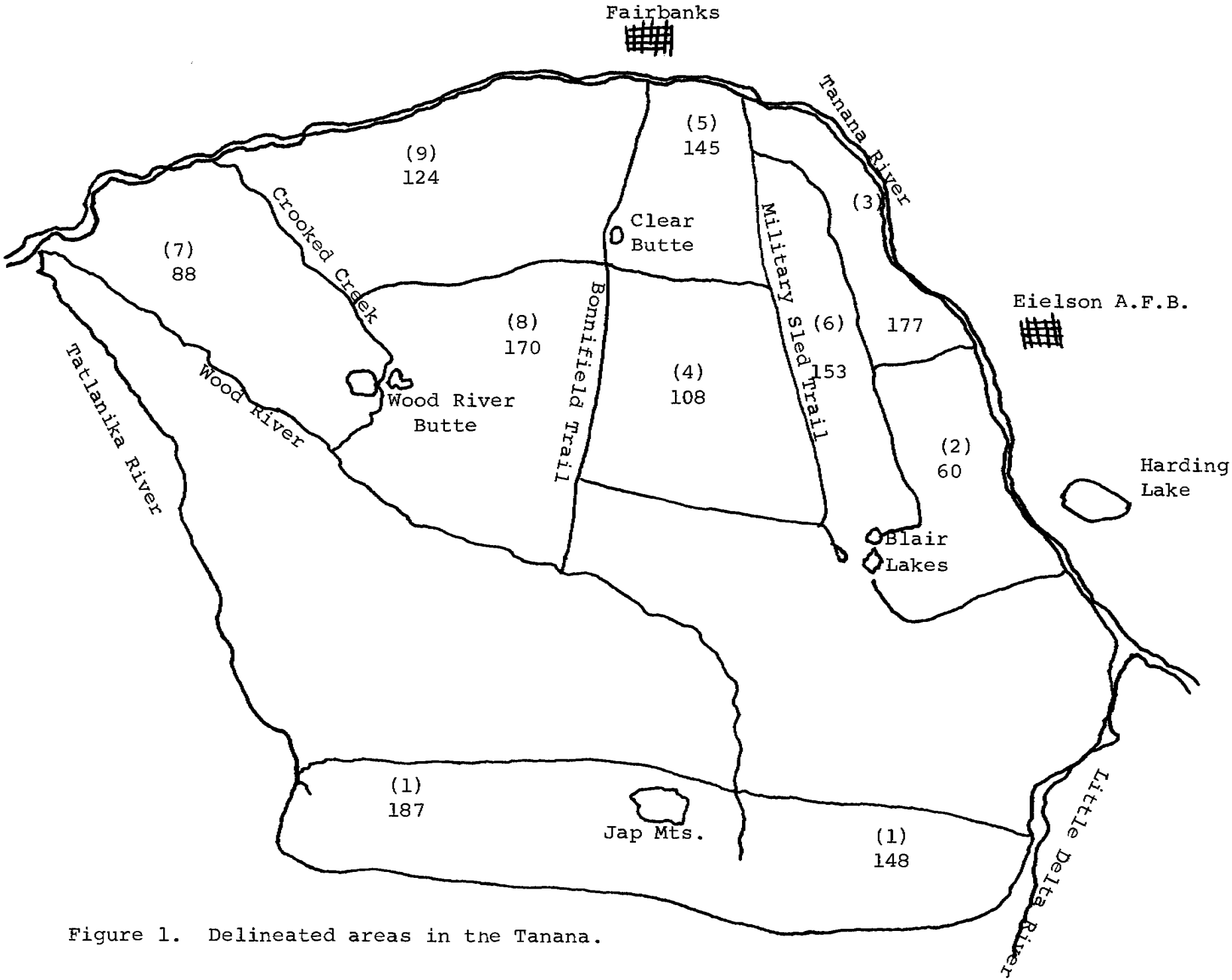


Figure 1. Delineated areas in the Tanana.

indexes, it will be applied to all areas under investigation in the Interior.

All aerial surveys during 1960 employed a PA-18, "Super Cub" type aircraft with the exception of those in the Big Delta area where several different types of helicopters and airplanes were utilized. Personnel piloting State airplanes were Frank Jones and the writer; observing were Bob Rausch and Peter Shepherd.

In the established areas of the Tanana, Fortymile and Koyukuk Rivers, categories of animals observed were recorded in the same manner as in the past with the exception that one more category was added, namely, the "extra large" or trophy bulls. The extra large or trophy bull is one that has an antler spread judged to exceed forty-eight inches.

FINDINGS:

In general, flying conditions were not optimum on the dates of the survey. Snow cover was insufficient in many cases, particularly during the Tanana survey in early November. Light conditions were reduced by shortening daylight hours and cloud cover. At this time, the sun's intensity was so reduced that visibility toward the southern horizon was difficult.

Flying time spent actually counting moose was 31.7 hours with 2394 animals being observed, for an average of 75.5 moose per hour (Big Delta area excluded). A comparison of moose seen per hour is presented in Table 1. In 1959 actual moose count time was 29.0 hours with 890 animals observed for an average of 30.6 seen per hour. Over two and one half times more moose were observed in both total numbers and number observed per hour during the 1960 survey.

It can be noted that the numbers of moose observed per hour cannot be used directly as an index to the abundance of moose. The fact that over 2-1/2 times more animals were seen in comparable hours flown in 1960 is far beyond the theoretical potential of a moose population to increment in one year. On the other hand, it is improbable that the entire difference is attributable to sampling error alone.

Table 1. Comparison of moose seen per hour in the Tanana, Fortymile and Koyukuk Valleys from 1957 to 1960.

AREA	YEAR	SAMPLE SIZE	HOURS FLOWN	NO. MOOSE SEEN PER HOUR
Tanana	1960	1350	20.7	65.0
	1959	264	12.7	20.8
	1958	427	11.8	36.0
	1957	242	9.8	24.7
Fortymile	1960	460	6.9	66.0
	1959	256	9.0	28.3
	1958	129	3.3	39.1
	1957	141	3.5	40.0
Koyukuk	1960	579	4.1	141.0
	1959	370	7.3	50.6
	1958	553	4.2	131.6
	1957	226	6.5	34.6

An Approach to Abundance Index

From the 1961 data obtained in the Tanana Valley study area, it may be possible to test statistically the usefulness of the survey technique for determining the usability of numbers of animals seen per hour as an index to the abundance of a moose population.

The area lends itself to this type of study because: (1) the area has shown little change in composition over the past four years, and (2) the moose population appears to be non-migratory.

The hypothesis, then, is that information obtained in 1960 regarding the number of moose observed per hour of actual observation time on a defined unit of area can be compared with information obtained in the same manner from two flights made during 1961 over the same defined area.

The statistical reasoning for observing the area twice within a brief span of time during 1961 is based on the probability that the results would be equal within certain confidence limits. In addition, any significant difference in observations could be evaluated, and the factor of moose movements would be minimized.

To determine whether the 1960 index of total moose counts is significantly different from the counts in 1961, we assume that all other factors involved are constant for both years, i.e., each individual has the same probability of being counted in 1960 as 1961 and that the only variability encountered will be due to the difference in population level:

Let A = number of moose counted in 1960
B = number of moose counted in 1961

To test if there is any difference, we have:

$$X^2 = \frac{\left[A - \frac{A + B}{2}\right]^2}{\frac{A + B}{2}} + \frac{\left[B - \frac{A + B}{2}\right]^2}{\frac{A + B}{2}}$$

This is X^2 with 1 degree of freedom at the .05 level; the acceptance region is $X^2 < 3.84$.

If the population remains static, the upper and lower limits of last year's count can be predicted now at the .05 fiducial limit at the acceptance region of $\hat{X}^2 < 3.84$.

A = 1350 = number of moose observed in 1960
B = index for 1961

Therefore,

$$3.84 = \frac{1350 - B^2}{1350 + B}$$

$$5184.0 + 3.84 = 1802500 - 2700B + B^2$$

$$0 = 1797316 - 2703.84B + B^2$$

By substitution in the linear quadratic formula,

$$B = \frac{2703.84 \pm (2703.84)^2 - (4)(1)(1797316)}{2}$$

$$= 1351.9 \pm 174.3$$

Using these assumptions, the 1961 population index at the .05 level should be greater than 1177.6 but less than 1526.2.

If the design of the standardization of aerial survey technique is correct and the statistical examination thereof is sound, then it may be concluded that the comparison of 1961 data with that obtained in 1960 will reflect the overall gain or loss in the total number of animals.

Productivity and Survival

A summary of the composition counts obtained from the moose populations in the Tanana, Fortymile, Big Delta and the Koyukuk valleys is presented in Table 2. The composition expressed as sex and age ratios is in Table 3. Table 4 shows a comparison of these data compiled during the past five years. Comparison of survival to 18 months of age is presented in Table 5.

Indexes to survival for this age class is derived by two methods. First, the bull-calf portion of the cow-calf

AREA	DATE	MALES			FEMALES			CALVES	UNID.	TOTAL
		EX. LARGE	LARGE	SMALL	W/0	W/1	W/2			
TANANA										
1.	Nov. 2	13	40	3	73	26	2	30	0	187
1.	Nov. 2	11	23	13	40	29	1	31	0	148
2.	Nov. 3	7	3	6	20	12	0	12	0	60
3.	Nov. 4	24	18	14	43	39	0	39	0	177
4.	Nov. 6	26	5	6	37	17	0	17	0	108
5.	Nov. 7	16	14	13	36	29	1	33	3	145
6.	Nov. 8	17	30	30	37	17	1	20	1	153
7.	Nov. 10	12	7	9	19	13	4	23	1	88
8.	Nov. 22	12	30	14	37	31	2	35	9	170
9.	Nov. 23	11	20	16	17	18	2	22	8	114
TOTALS		149	190	124	359	231	13	262	22	1350
FORTYMILE										
1.	Oct. 29	0	17	12	14	3	0	3	0	49
2.	Oct. 29	0	50	9	51	18	0	18	0	146
3.	Oct. 29	0	47	9	23	24	0	24	5	132
4.	Oct. 29	0	28	4	17	7	0	7	0	63
5.	Oct. 30	0	22	4	12	14	0	14	4	70
TOTALS		0	164	38	117	66	0	66	9	460

Table 2. Summary of Aerial Moose Population Composition Counts - Tanana, Forty-mile, Koyukuk, and Big Delta Valleys - 1960-61.

Table 2 continued.

AREA	DATE	MALES EX. LARGE	MALES LARGE	MALES SMALL	FEMALES W/0	FEMALES W/1	FEMALES W/2	CALVES	UNID.	TOTAL
KOYUKUK										
Koyukuk-Hughes										
	Jan. 8-9	11	148	28	62	102	42	186	0	579
BIG DELTA										
1.	Nov. 16	0	10	10	31	22	2	26	1	101
2.	Nov. 16	0	6	1	20	17	0	17	1	61
3.	Nov. 16	0	2	1	6	3	0	3	0	15
4.	Nov. 16	0	2	1	9	15	0	15	4	42
5.	Nov. 16	0	28	4	29	23	3	29	0	116
6.	Nov. 16	0	7	10	26	29	0	29	10	101
7.	Nov. 16	0	8	3	10	7	1	9	0	38
TOTALS		0	63	30	131	116	6	128	16	474

Table 3. Sex and Age Ratios – Tanana, Fortymile, Koyukuk and Big Delta Valleys, 1960.

Area	Total Bulls per 100 Cows	Yg. Bulls per 100 Ad. Bulls	Calves per 100 Cows	Sets Twins per 100 Cows w/ calves	Per cent Calves in Herd	Per cent Yg. Bulls in Herd	Yg. Bulls per 100 Cows	Total Moose
TANANA								
1.	55	6	30	8	16	2	3	187
1.	67	4	44	3	24	8	18	148
2.	80	60	60	0	20	10	19	60
3.	68	33	47	0	22	8	17	177
4.	68	19	31	0	16	6	11	108
5.	65	43	50	3	23	9	20	145
6.	140	64	36	5	13	20	54	153
7.	77	47	60	23	26	10	25	88
8.	80	33	50	6	21	9	20	170
9.	127	50	59	10	20	15	43	114
TOTALS	77	36	43	5	20	9	20	1350
FORTYMILE								
1.	170	70	17	0	6	24	70	49
2.	85	18	26	0	12	6	11	146
3.	118	19	51	0	20	7	19	132
4.	133	14	29	0	11	6	17	62
5.	100	18	53	0	21	6	15	70
TOTALS	110	23	36	0	14	8	21	460

Table 3 continued.

Area[1]	Total Bulls per 100 Cows	Yg. Bulls per 100 Ad. Bulls	Calves per 100 Cows	Sets Twins per 100 Cows w/calves	Per cent Calves in Herd	Per cent Yg. Bulls in Herd	Yg. Bulls per 100 Cows	Total Moose
KOYUKUK								
Koyukuk-Hughes	92	17	90	22	31	5	14	579
BIG DELTA								
1.	19	100	50	9	25	10	19	101
2.	19	16	46	0	36	2	3	61
3.	33	50	33	0	20	6	11	15
4.	12	50	62	0	36	2	4	42
5.	61	14	56	13	25	4	8	116
6.	30	142	51	0	29	10	19	101
7.	65	37	53	14	24	8	18	38
TOTALS	36	48	52	5	27	6	12	474

[1]See maps of areas in Figures 1, 2, and 3.

Table 4. Comparison of Sex and Age Ratios in Moose Populations in Interior Alaska During the Last Five Years.

Area	Year	Total Bulls per 100 Cows	Yg. Bulls per 100 Ad. Bulls	Calves per 100 Cows	Sets Twins per 100 Cows w/calves	Per cent Calves in Herd	Per cent Yg. Bulls in Herd	Yg. Bulls per 100 Cows	Total Ident. Moose
TANANA	1960	77	36	43	5	20	9	20	1328
"	1959	60	29	55	22	26	6	13	261
"	1958	53	49	43	9	22	9	17	419
"	1957	60	32	42	2	20	7	15	236
"	1956	83	25	47	5	20	7	16	405
"									
FORTYMILE	1960	110	23	36	0	14	8	21	460
"	1959	108	70	54	13	21	17	45	252
"	1958	63	56	45	8	22	11	23	129
"	1957	91	29	46	8	19	8	20	140
"	1956	66	30	53	0	24	7	15	129
KOYUKUK	1960	92	17	90	22	31	5	14	579
"	1959	100	28	55	21	22	8	22	354
"	1958	44	44	55	19	28	7	13	520
"	1957	80	25	66	23	28	6	16	216
BIG DELTA	1960	38	48	52	5	27	6	12	474

Table 5. Index to the Survival of Bull Calves to 18 Months of Age.

Area	Bull Calves per 100 Cows in 1959	Young Bulls per 100 Cows in 1960	Percentage of Bull Calves in Herd 1959	Percentage of Young Bulls in Herd 1960	Per cent of Survival Calves per 100 Cows	Per cent of Survival by Percentage of Young Bulls in Herd
TANANA	27.5	20	13	9	74	69
FORTYMILE	27	21	10.5	8	78	76
KOYUKUK	27.5	14	11	5	51	45

ratio (assuming 1:1 ratio of males to females at 6 months of age) of last year is divided into the young bulls per one hundred cows recorded during the current survey. Secondly, the bull-calf-percentage of the herd (again assuming 1:1 ratio) of last year is divided into the per cent of young bulls in the herd during the current year.

Productivity as used means the calves of the year present in the herd at the time of the survey, or those approximately 6 months of age and is expressed in terms of calves per one hundred cows. Survival, on the other hand, is used to mean the percentage of those calves six months of age that reach 18 months of age.

The index used to indicate productivity is the ratio of calves per 100 cows. It is often referred to as the cow-calf ratio. Descriptive terms indicating general trends were suggested by Rausch (1958) as being more meaningful in terms of general discussion. The following terms are indicated with their corresponding numerical values: poor, less than 20 calves per 100 cows; fair, 20-35 calves per 100 cows; good, 36-50 calves per 100 cows; and excellent, more than 50 calves per 100 cows.

Tanana Valley:

Productivity in the Tanana Valley continues to be "good." It can be seen in Table 4 that the ratio of calves per 100 cows has remained uniform since 1956, with the exception of 1959 when a ratio of 55:100 was recorded. The calf percentage of the herd has remained at approximately 20 per cent of the herd over the past few years. The twinning ratio has varied over the same period. It is difficult at this time to evaluate twinning in terms of productivity.

Survival to 18 months of age continues to be "good" at 70 per cent for the area.

Fortymile:

Productivity can be considered "good" for this area. Although the calf ratio was 36:100 and the bull-cow ratio was 100:100 it is believed that our sample was somewhat biased as

bull concentrations were more apparent than cows with calves. Cows with calves that were seen were rather inconspicuous by their concealment in willow draws.

Survival to 18 months of age continues to be high, which is comparable to the survival indexes found over the past five years.

Figure 2 depicts the areas flown.

Koyukuk:

Productivity in this area is phenomenal. The percentage of calves in the herd is at an all time high of 33 per cent. The rate of twinning is also high as 22 per cent of cows that gave birth to calves had twins. Indications are that mortality of calves is nil to low, and, to account for the large segment of the cow population capable of breeding, one would have to conclude that cows are breeding as yearlings.

Survival of calves to 18 months has been historically lower than the Tanana and Fortymile areas and is exhibited to be lower again in 1960. In Table 5 the survival of calves to the yearling stage is approximately 50 per cent.

The Effects of Hunting

Tanana:

If the effects of hunting were to be detectable, they would certainly be apparent in a heavily hunted area where bulls only were legal. Inspection of the bull-cow ratios in Table 4 reveals that over the past five years this ratio has remained fairly constant. In fact, there was an increase of bulls in 1960 over the figure recorded in 1959. If hunting pressure is increasing, it is not apparent in these data. Furthermore, it is possible that differential mortality of the sexes exist, which could account for the constancy of bull-cow ratios over the years as well as attributing any discrepancy to hunting, predation or otherwise. There will never be any direct proof that any hunting exists anywhere unless evidence is presented to the effect that an animal has been killed by hunting.

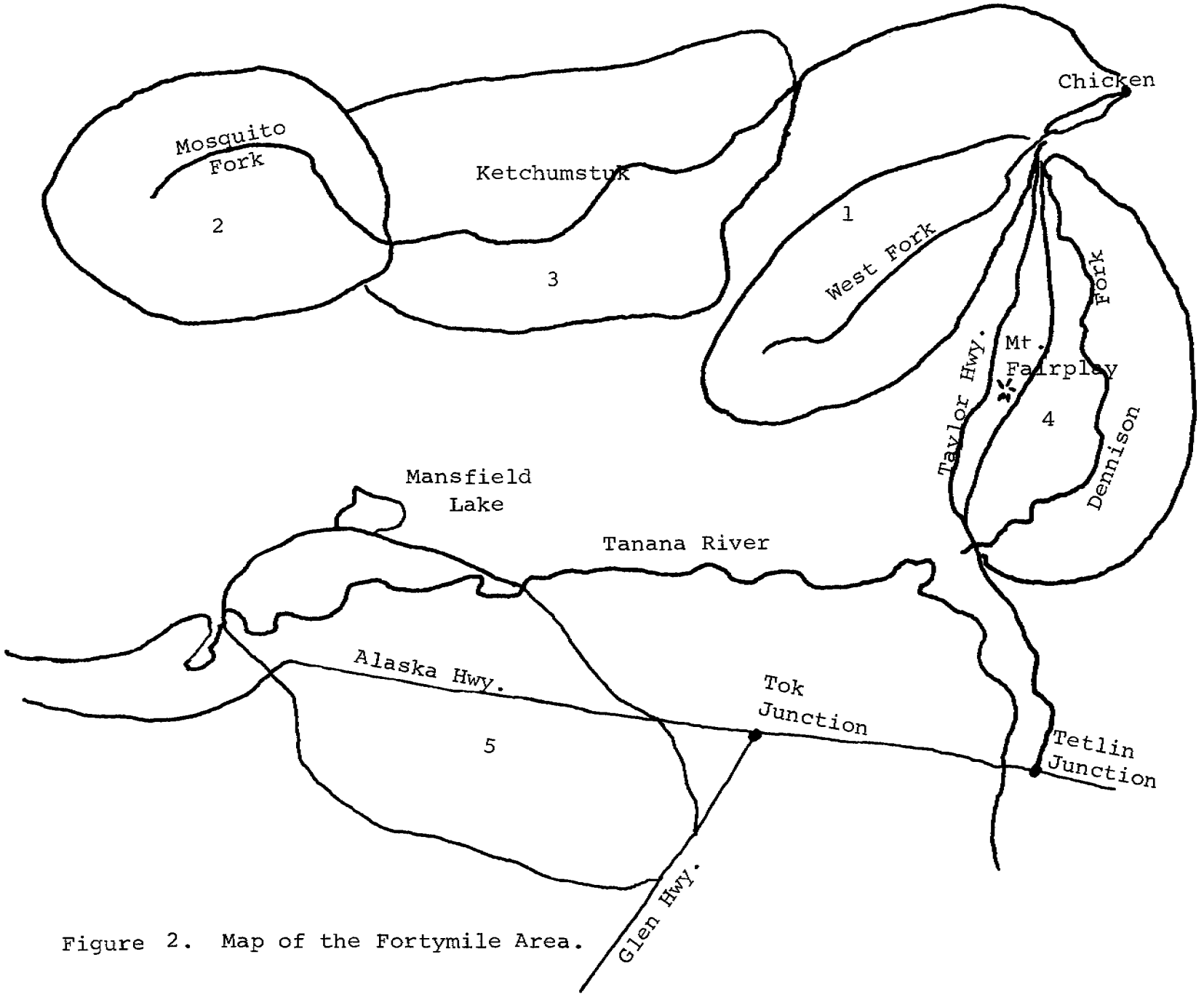


Figure 2. Map of the Fortymile Area.

Fortymile:

It can be concluded that the effects of hunting on this population are nil.

Koyukuk:

It can be concluded that hunting has no effect on this population.

Big Delta:

The Big Delta moose population appears to be important because it is in an area that is readily accessible to hunters. The count was made incidental to the bison count and cannot be entirely conclusive, as many pilots, observers and aircraft were used. Nonetheless, the information recorded shows that the bull segment of the sample is depressed for some reason. A 38:100 bull-cow ratio could indicate that hunting may be responsible for this low figure. Also, sampling and movements of moose may be a factor.

Figure 3 indicates the areas flown in Big Delta.

DISCUSSION

Koyukuk:

A cow-calf ratio of 100:90 was obtained for this area. In Table 4 it can be seen that this figure is higher than any other area. This suggested that the yearling cows are breeding, particularly after comparing ratios of other areas and survival indexes.

The possible occurrence of breeding yearling cows in the Koyukuk should be verified by collecting a sample of this age class. Although survival to 6 months appears to be phenomenal, it cannot be overlooked that there must be some mortality from the time of parturition to age 6 months. With this taken into consideration, one must again conclude that the yearling cow is breeding.

Twinning declines are suggested as a measure of productivity (Rausch, R. A., 1958). Twinning declines are

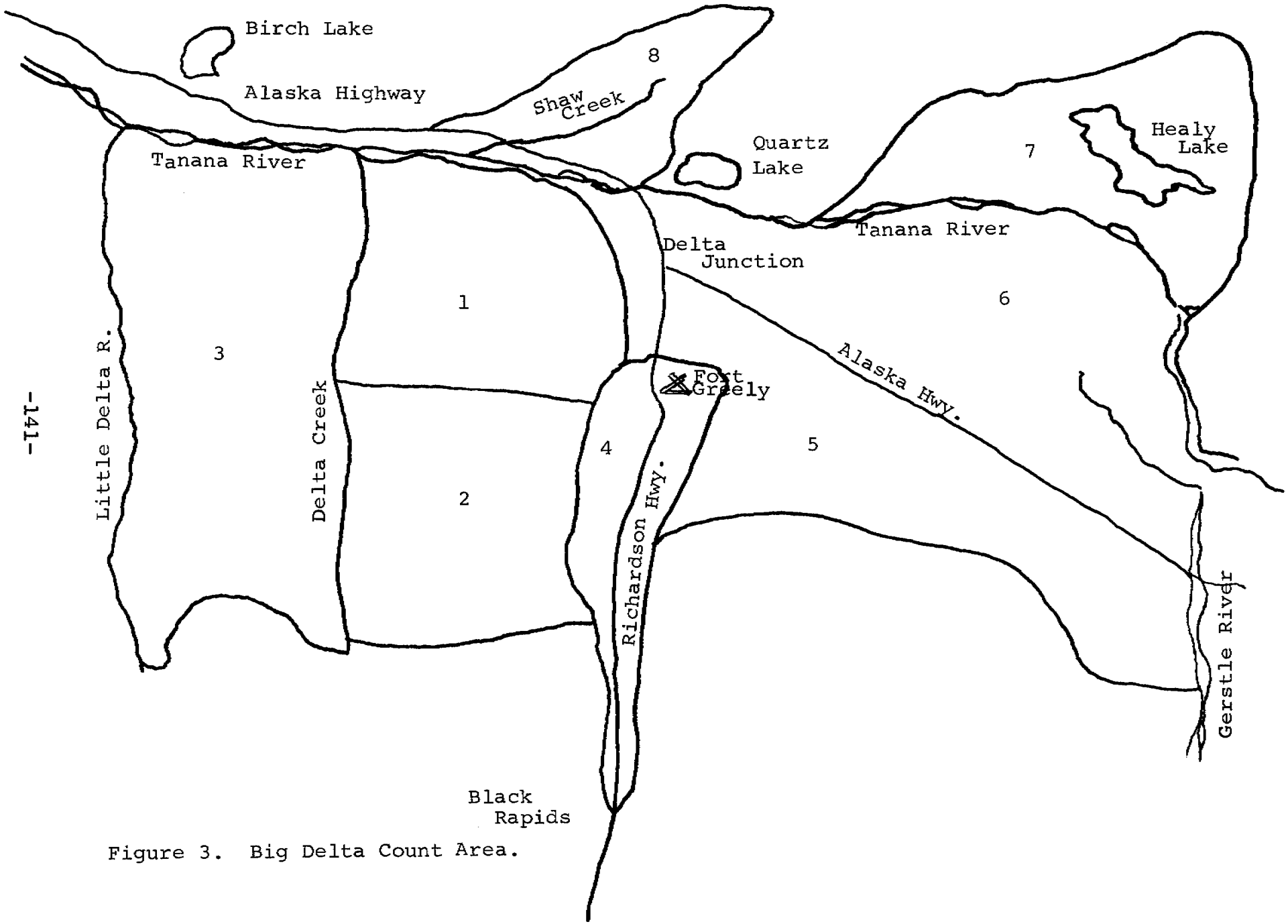


Figure 3. Big Delta Count Area.

interpreted as an advance warning of a range decline. There is no decline in the productivity indicated in the Koyukuk. Although these data indicate that the survival to 18 months is below that exhibited in the Tanana and Fortymile, it is possibly due to heavy predation moving into the area in the spring time. If this is taking place, or some other factor of mortality is evident, it is a desirable situation insofar as the good of the population is concerned. Liberalizing the take by hunting in this area should be encouraged.

Data analysis:

There is no attempt to show that comparing data from year to year is relevant insofar as abundance of moose is concerned. It is hoped that standardization of the study areas may yield more adequate data as the Tanana study site may reveal.

The analysis of composition data as to year and air crew involved shows that the information obtained is reliable to the degree of the inseparable variables such as crew, year and sample size.

The writer is of the opinion that aircraft sampling is not sensitive enough to detect small changes in herd compositions. The airplane is, however, a satisfactory tool to detect large changes in herd compositions. The employment of aerial observation is a unique method to cover a large area in a comparative short length of time as compared to the trying task involved in an attempt to duplicate such an effort from the ground over the Alaskan terrain. Therefore, this year's work is directed toward determining the advantage of refining the aerial observation methods in terms of obtaining more precise data to portray the population under study as it actually exists.

As previously stated, there will never be any direct proof that any hunting exists anywhere on moose populations in the Interior unless evidence is presented to the effect that an animal has been killed by hunting. This could be accomplished through a record of every moose killed in Alaska by a tagging system that is enforced by the power of the State. Furthermore, this data can be used to check the

validity of aerial sampling by ruling out one more variable; and vice versa.

RECOMMENDATIONS:

Project:

1. Adopt a standardized aerial observation technique for all phases of moose work.

2. Consolidate sex and age composition, natality, mortality, survival and abundance into one completion report.

3. Change all ratio data so that it can be handled by biometrical analysis.

4. Authorize the collection of cows in the Koyukuk Valley to determine if the yearling segment is breeding, which is suspected to be the case.

5. Adopt a tagging system for all moose taken.

Management:

1. Establish access to heavy unhunted moose populations.

2. Work toward initiating either-sex hunting so that it may be eventually incorporated into general statewide hunting regulations.

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Volume 2 Report No. B-3c

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 3-c Title: Moose Data Collection - Interior and Arctic Alaska

PERIOD COVERED: July 1, 1960 to June 30, 1961

ABSTRACT:

Calving patterns were studied in the Tanana Flats. It was learned that calving begins about May 17th and ends approximately June 2nd with a sharp increase beginning on the 22nd and/or the 23rd of May and reaching a maximum on the 26th and/or 27th of May, depending on whether calculations are based on parturitions counts and/or ratios of calves per 100 cows.

Movements of the herd within the study area from grass-sedge communities to wooded areas adjacent to water courses were noted in association with the progression of calving.

Evening flights are more productive than early morning flights and would eliminate some of the discrepencies noted in obtaining accurate chronological data.

Studies made in the fall of 1959 and in the spring of 1960 indicated that a large amount of mortality had taken place, which was not substantiated by subsequent studies conducted during the fall of 1960. Likewise, no mortality was

detected in this study. Pimlott (1959) found that there was no more mortality in calves than in any other age class. This could well be the case in the Tanana Flats, that is, mortality occurs, but is not detected because it is uniform or occurs at parturition.

Based on a "model" population (Rausch, 1959) with a pregnancy rate of 95 per cent for adults and no pregnancies noted for Age Class I, the theoretical potential would not exceed a cow-calf (new-born) ratio of 100:84, providing no mortality took place. If these Susitna data are applicable in any degree to the Tanana Flats data, we could expect an undetected mortality rate of approximately 20 calves per 100 cows.

The index used to indicate productivity is the ratio of calves per 100 cows. It is often referred to as the cow-calf ratio. Descriptive terms indicating general trends were suggested by Rausch (1959) as being more meaningful in terms of general discussion. The following terms with their corresponding numerical values are: poor, less than 20 calves per 100 cows; fair, 20 to 35 calves per 100 cows; good, 36 to 50 calves per 100 cows; and excellent, more than 50 calves per 100 cows.

For the Tanana Flats, productivity at two weeks after the end of calving is considered to be excellent, with a cow-calf ratio of 100:60 observed on June 16, 1961.

Any future tagging operations can be timed to coincide with the advent of calving so that a maximum number of animals can be tagged with the least amount of effort.

From a research point of view, it is doubtful that the project merits any further efforts. Productivity and mortality information can be obtained from very few flights and incorporated in Project 3-b, Abundance and Composition, which gets under way in the fall.

OBJECTIVES:

1. To collect in a systematic manner historical and biological data pertaining to the moose populations of Interior and Arctic Alaska in those areas where

specific investigations are not in progress.

2. To develop a fund of background data to be used as a source of information upon which to base future investigations necessary for moose management.

PROCEDURES USED:

Aerial surveys will be used to determine calving patterns, initial productivity, and survival to the yearling age.

TECHNIQUES:

Location of the Study Area

The area selected is in the Tanana Flats and is encompassed by the Bonnifield Trail, Blair Lakes, the military sled trail to Blair Lakes and the Salchakat Slough. The calving study area is adjacent to that of the proposed 1961 cow moose hunt area.

Equipment and Method

The delineated area was flown systematically so that an intensive search for moose could be conducted thoughout the entire area. A PA-18 Piper "Super-Cub" was employed, the writer piloting and Robert A. Rausch observing. The aircraft was flown in slow flight (55-65 mph) and at altitudes low enough to insure identification of the animals and/or to cause a cow to reveal the location of her calf. The term applicable for this type of an operation is "buzzing."

FINDINGS:

A reconnaissance flight was made on May 15, 1961, in which no new-born calves were observed. Compilations of subsequent observations are presented in Table 1. Sample size for eight flights totaled 3030 moose observed.

Moose categories recorded during observation were bulls, cows without calves, cows with last year's calves (yearlings), cows with newborn calves, and lone yearlings. Bulls are recorded as a matter of record and are not included in any calculation because they are not relevant to this project.

Table 1. Compilation of Moose Calving Data for the Tanana Flats, 1961.

Date	Cow-calf Ratio	Bulls	W/0	W/1	W/2	W/1 (Newborn)	W/2	Year-lings	Sample Size
May 17 Morning	100:5	142	203	58-58	5-10	8-8	3-6	11	512
May 19 Morning	100:5	60	112	41-41	0	9-9	0	13	295
May 22 Morning	100:28	146	116	41-41	3-6	43-43	8-16	20	483
May 25 Morning	100:21	217	125	34-34	2-4	29-29	6-12	36	528
May 29 Morning	100:20	100	81			18-18	3-6	35	237
June 9 Evening	100:57	90	26	8-8	0	36-36	3-6	35	248
June 16 Evening	100:60	150	26	9-9	2-4	32-32	7-14	40	423
July 1 Morning	100:34	163	84	8-8	0	45-45	1-2	47	403

Lone yearlings are recorded as a matter of interest because their increase is apparent with the advent of calving. The increase in lone yearlings indicates that cows are breaking family ties with their previous offspring because of the imminent advent of their new-born. The patterns of the number of lone yearlings and the cow-calf ratios are not consistent, indicating the need for further study.

Data Analysis

The heavy calving is calculated to begin on May 22nd or 23rd; and to attain a peak on the 26th or 27th of May, depending on whether calculations are figured from ratios or parturitions of calves per 100 cows.

According to Pimlott (1959), very little mortality occurs in calves. He suggests that mortality is no greater in that age class than in any other age class. In this study we have found no quantitative data to substantiate the high mortality among calves that was noted by Norberg (1960) during the same period last year.

It seems certain that some mortality occurs but escapes detection. The explanation for this could be as follows:

Based on a "model" population, (Rausch 1959), with a pregnancy rate of 95 per cent and 0 per cent of Age Class I, the theoretical potential would not exceed a cow-calf (newborn) ratio of 100:84, providing no mortality took place. Rausch made approximately 100 in utero observations on cows collected in his study area. In his sample, 95 per cent of the cows over 24 months of age were pregnant. In Age Class I, the yearling class, which constituted an estimated 12 per cent of the cow sample, none were pregnant. Thus, it is calculated that approximately 88 per cent were potential breeders. Ninety-five per cent of this figure would reveal a theoretical parturition percentage of approximately 84 per cent, or a cow-calf ratio of 100:84. If these Susitna data are applicable in any degree to the Tanana Flats data, we could expect an undetected mortality rate of approximately 20 calves per 100 cows. And we could conclude that mortality occurs, but is uniform and therefore not detected by our counts. These may well have been the cases in Pimlott's assumptions.

Productivity at two weeks after the end of calving is considered to be "excellent" for the Tanana Flats, with a cow-calf ratio of 100:60 observed on June 16, 1961.

DISCUSSION:

An apparent lag is noted in observations. For example, the high cow-calf ratios recorded in June showed that the majority of the calves were at least two weeks of age or older. The observations in latter May indicated a much lower cow-calf ratio. This would suggest that calves were secluded at this time; otherwise, a higher ratio should have been recorded. The data recorded at the time of the observations throughout the study may not be indicative of the calf status, but rather of the status of some days prior to the survey.

Factors responsible for this apparent lag seem to be the phenology of the season and the behavior of the cow moose with calf. These are due to the rapid increase of new leaf-age and the seclusion of the calf following parturition. As the calf reaches two weeks of age, it ventures more into the open with the cow. Many times the calf will be hidden, but the cow's reaction to low passes by the aircraft will soon betray the location of her calf. Sometimes no amount of buzzing will reveal the location of the calf.

At the time observations indicated that parturition was occurring, (May 17th on), most of the herd was in open grass-sedge flat areas. Calving did not appear to have taken place in any particular type of area. As the calving season progressed, a definite shift of the population occurred from the grass-sedge areas to the adjacent wooded stream areas, where calving seemed to become more secretive and more difficult to observe. It is not known whether the advent of heavy insect activity and/or a change in the feeding habits were factors causing this movement.

Evaluating the data of the morning and evening counts suggests that the evening flights have produced more significant results. During the morning flights in the latter part of June and first part of July, it was apparent that a large number of cows were standing in ponds feeding on aquatic vegetation and for the most part were believed to have calves

hidden in the near-by wooded areas. On several occasions calves were located some distance away from feeding cows. In one instance the calf was located over one-quarter mile away. On the other hand, in the evening the calves, which had been hidden and bedded down during the early morning and days, came out with the cows. Apparently, the calf accompanies its mother until past midnight, at which time it is usually hidden and bedded down through the early hours. This would account for the lower morning counts. It is suggested that morning flights might be responsible for some of the discrepancies noted in the chronological data as well as for indicating the great amount of mortality recorded by observers in the past.

RECOMMENDATIONS:

Delete this project and incorporate in Project 3-b.

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ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 3-d Title: Characteristics of the Hunter Harvest - Interior Alaska

PERIOD COVERED: August 15, 1960 to May 1, 1961

ABSTRACT:

Moose harvest data for the Interior and Arctic areas during 1960 show that approximately 2700 animals were taken. It is recognized that some duplication may exist, but that error would more than be off-set by the unknown take.

Hunter success was calculated to be 10 per cent for road access hunters and 87 per cent for hunters who employed professional guides and air-taxi operators.

Checking station data show that the harvest of moose is effected more by their movements than by hunter effort.

Village interviews indicate that approximately 1500 moose were taken by natives during 1960 (some out of season and of either sex).

It is recommended that we open the legal season on moose to either sex in the Interior and Arctic areas.

Unless the Department adopts some kind of tag return system for animals taken (similar to that of beaver and bear) we will have no alternative but to repeat the method of harvest investigations used during 1960.

OBJECTIVES:

To obtain information indicative of the total hunter kill, areas hunted, age composition of the kill, hunter success, and the chronological distribution of the kill.

TECHNIQUES USED:

Data relative to the current hunter harvest of moose have been obtained from established hunter checking stations, post-season hunter interviews and village and mail-card surveys.

FINDINGS:

Checking Stations:

Information obtained from the Steese and Taylor Highway checking stations concerning the harvest of moose during the 1960 hunting season is presented in Table 1.

Table 1. Number of Moose Checked During the 1960 Hunting Season.

Station	Number of Hunters	Number of Moose	Hunter Success
Steese Hwy.	682	39	5.7 per cent
Taylor Hwy.	534	78	14.6 per cent
TOTALS	1216	117	10.1 per cent

An average hunter success figure of 10 per cent was predicted before the advent of the hunting season. It is felt that this percentage is a realistic hunter success figure for hunters who utilize existing roads as access to moose populations in the Interior.

Chronological distribution of the hunter effort and

moose harvest from the Taylor Highway can be noted in Figure 1. It can be seen that from the advent of the hunting season August 20, to September 15, a period of 25 days, 38 per cent of the total number of moose were taken by 290 hunters, whereas during the remaining 15 days of the season, September 15 to September 30, 62 per cent of the total number of moose were taken by 244 hunters. These observations indicate that the availability of moose is the governing factor in moose take. Availability then is directly concerned with the movement of moose, which increases with the onset of the rut, and in this case, persisted through the hunting season. The assumption that the increased number of hunters present (also compared in Fig. 1) because of the anticipated caribou crossing would increase the hunting pressure on moose at this time is not valid. In 1960 the Steese-Fortymile caribou herd crossing did not commence until October 9. This period was after the close of the moose hunting season.

In summary of Figure 1, it may be concluded that the hunter success during the last 15 days of the 1960 moose hunting season was 100 per cent greater than the first 25 days of the season. These data are by and large applicable to road access hunting. The use of professional guides, air-taxi operators who employ airplanes, riverboats, swamp buggies and horses for access give different hunter success results as will be shown in another section of this report.

Village Interview Survey:

Village interviews by Department personnel have been conducted throughout the Interior of Alaska. By and large the results are indicative of the yearly take of moose. Table 2 indicates the yearly harvest of moose for the respective areas listed.

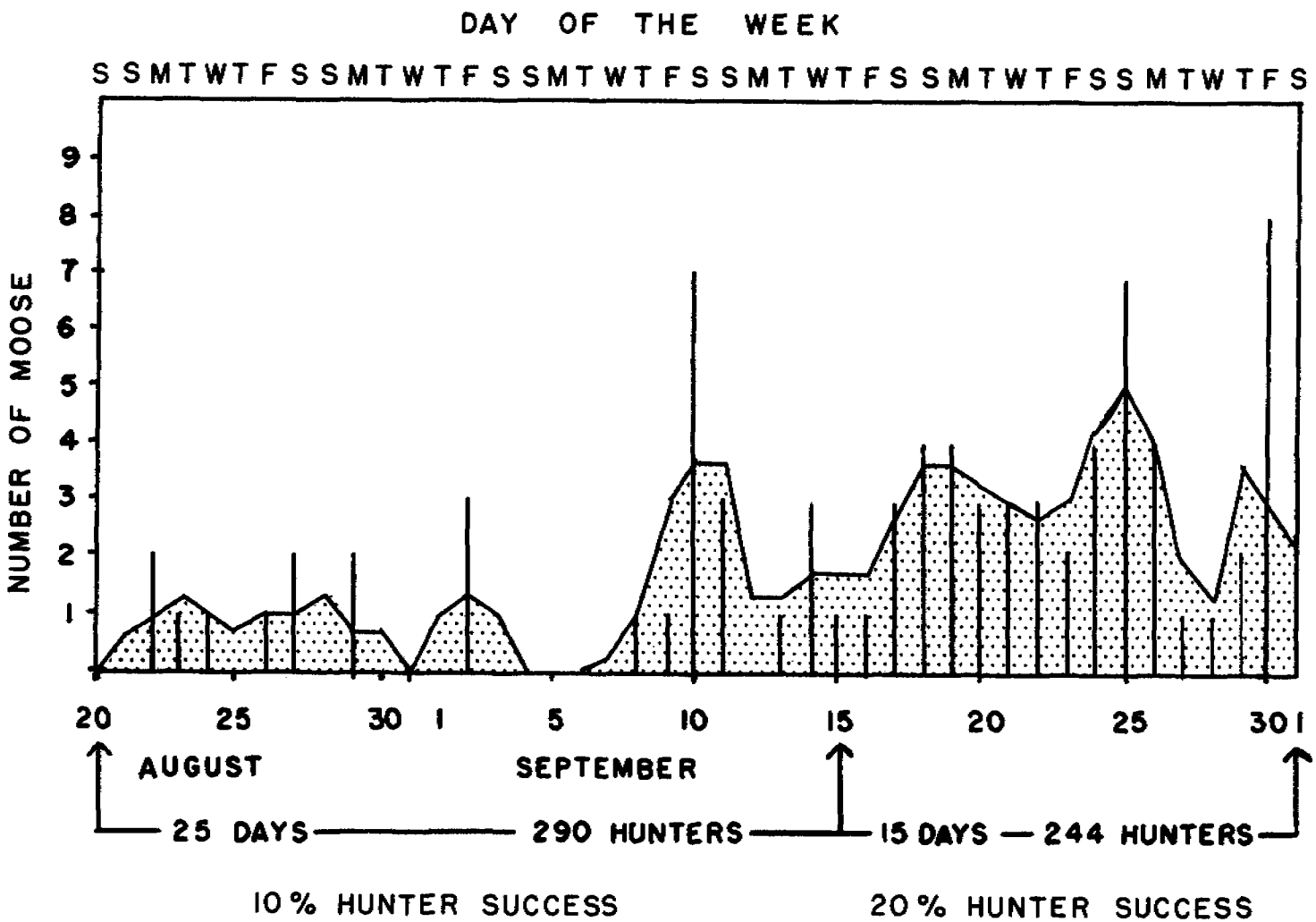

Fig. 1. Chronological and rounded harvest of 78 moose checked at the Taylor Highway checking station, 1960.

Table 2. Village Moose Harvest Survey.

VILLAGE	NUMBER OF MOOSE
Upper Yukon and Lower Tanana River Drainages	
Kaltag	50
Nulato	80
Galena	150
Koyukuk	60
Ruby	30
Tanana	80
Fort Yukon	115
Eagle	20
Beaver	15
Stevens Village	20
Rampart	10
Venetie	25
Chalkyitsik	14
Manley Hot Springs	14
Central City	6
Circle City	22
Sub Total	791
Kuskokwim River System	
Farewell	5
Nikoloi	7
Medfra	11
Tokatna	4
McGrath	55
Stony River	7
Sleetmute	39
Red Devil	5
Crooked Creek	21
Little Russian River	3
Aniak	36
Kalskag, Upper & Lower	22
Akiak	8
Tuluksak	7
Napukiak	6
Bethel	65
Sub Total	301

Table 2. Continued

VILLAGE	NUMBER OF MOOSE
Lower Yukon River	
St. Marys	15
Anvik	21
Holikachuk	20
Shageluk	24
Holy Cross	38
Marshall	5
Pilot Station	1
Alakanuk	6
Sub Total	130
Big Delta and Upper Tanana	
U. A. R. L. Pump Station	20
Tetlin	30
Northway	18
Chicken	5
A. C. S. Station	5
Tanacross	14
Fortymile	1
Mentasta	9
Dot Lake	4
D. P. W. Station	8
Tok	34
Misc. (Ft. Greely)	41
	201
Kotzebue-Nome Area	
Koyuk	24
White Mountain	4
Selawik	10
Kiana	11
Wales	1
Kotzebue	15
Nome	7
Golovin	1
Noorvick	10

Table 2. Continued

VILLAGE		NUMBER OF MOOSE
Unalakleet		15
Kobuk		10
Shungnak		20
Ambler		10
	Sub Total	138
Fairbanks-Big Delta		
Big Delta		150
Fairbanks		498
Military (Wainwright-Eielson)		200
	Sub Total	848
Miscellaneous		
Field interview		15
Gold Strip		17
Blair Lakes		27
	Sub Total	59

The Fairbanks, Ft. Wainwright and Eielson Air Force Base moose take figures are based on 6969 hunting licenses sold by dealers in the Fairbanks area and the hunter success figure of 10 per cent. The 10 per cent figure is based on data derived from the information obtained from checking stations. It is recognized that an unknown percentage of licensed hunters utilize means other than road systems. However, rather than exaggerate the total take estimate, the calculated hunter success figure was employed. Table 3 is a summary of all harvest data.

Table 3. Summary of Moose Harvest Data in the Interior and Arctic.

AREA	NUMBER OF MOOSE
Upper Yukon and Lower Tanana	791
Kuskokwim River System	301
Lower Yukon River	130

Table 3. Continued

AREA	NUMBER OF MOOSE
Big Delta and Upper Tanana	201
Fairbanks-Big Delta-Military	848
Field Interviews	59
Kotzebue-Nome area	130
Checking Stations	117
Mail-card Survey	91
Grand Total	2668

Mail-card Survey

In order to ascertain the number of moose taken and the success of hunters employing registered guides and air-taxi operators, stamped return post-cards were mailed to all guides and air-taxi operators doing business in the Interior. It was found that 68 individuals do business as guides and/or air-taxi operators in the Interior (licensed by the State). These data are presented in Table 4.

Table 4. Results from Cards Returned by Guides and Air-taxi Operators.

	FILE NO.	NO. HUNTERS	NO. OF MOOSE	GAME MGMT. UNIT
	11	3	2	20
	14	2	1	24
	9	1	1	20
	29	8	7	13
	4	8	8	20
	31	14	11	20
	50	5	4	20
	22	2	2	13
	25	16	16	13, 12
	3	2	2	19
	59	4	4	21
	24	21	15	13
	6	7	7	20-25
	47	6	6	21, 20
	18	4	4	23, 24
	27	1	1	25
TOTAL	16	104	91	

Out of 68 operators sampled, 34 returned their post-cards. Only one-half who returned their cards operated last year, this amounted to 16 operators as indicated in Table 4. These operators obtained 104 clients who took 91 moose, which gave an average hunter success figure of 87 per cent. Some erasures and changing of data were noted on some of the cards. Telephone follow-up to some of these operators revealed that they were apprehensive of the questionnaire and played down the actual number of moose they took for fear that the Department would think they were taking too many animals and would consequently cut the bag limit. I feel that we should have sent a cover notice with the questionnaire explaining their purpose.

The hunter success of operators who use airplanes, river-boats, track vehicles and horses indicates that access to good moose hunting should be one of our primary objectives for obtaining an adequate harvest.

RECOMMENDATIONS:

1. A mail return tagging system similar to that of bear and beaver is recommended for moose.

2. Village interviews indicate that about 1500 moose were taken by the natives last year (some out of season and of either sex). Apparently this has been going on for decades and has not harmed the resource except in the immediate vicinity of the villages. It is my recommendation that we open the legal season to either-sex moose in the Interior and Arctic areas.

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September 30, 1961

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Volume 2 Report No. B-3e

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 3-e Title: Moose Population Inventories - Interior and Arctic Alaska

PERIOD COVERED: July, 1960 to April 1, 1961

ABSTRACT:

The estimated population of moose inhabiting the Yukon-Rampart impoundment area was 1212. This figure was extrapolated from a 25 per cent area sample of 303 observed moose. The amount of actual aerial count time expended to survey the 10,800 square miles of the impoundment was 51.35 hours. Approximately three times this amount of flying time was expended in connection with the survey. Moose observed per hour of count time were 5.88, the lowest figure ever recorded for any area in the Interior.

The figure 1212 represents an estimate based on moose seen and cannot under any circumstances be construed as a reliable population value because of the unknown factor of moose missed by the observers.

It was apparent at the start of the survey that the small number of moose seen did not account for the preponderance of fresh tracks observed. Therefore, in one section surveyed, a preliminary estimate based on fresh tracks showed that, for every moose seen, over three were missed.

In this connection we believe that there are possibilities for estimating total populations of moose by their track configurations. Preliminary experiments involving this approach have been done by Russian biologists. Considering the many questionable population enumeration methods which are now before the wildlife profession, we are of the opinion that a track census method is worthy of development.

OBJECTIVES:

1. To collect in a systematic manner historical and biological data pertaining to moose populations of Interior and Arctic Alaska in those areas where specific investigations are not in progress.

2. To develop a fund of background information upon which to base future investigations necessary for moose management.

PROCEDURES USED:

The Yukon-Rampart moose survey was conducted under the direction of the U. S. Fish and Wildlife Service, River Basins Studies Branch, with the cooperation of the Alaska Department of Fish and Game. The entire survey was an aerial operation utilizing two types of airplanes; the Piper PA-18 or "Super Cub", and the Cessna 180. Transects were laid out in a north to south direction and placed at two mile intervals to include the high water mark of the proposed Rampart Dam impoundment area. Observation coverage was one-quarter mile on either side of each aircraft during actual transect flying, which would encompass a 25 per cent sample of the approximate 10,800 square miles of impoundment area. The mechanics of observers, aircraft and altitude flown to insure a one-quarter mile coverage are those described by Watson and Scott (1956) as employed during the 1955 Nelchina caribou herd census.

Figure 1 shows the location of the area surveyed. The transects were laid out as described starting with transect number 1 near Eagle on the Yukon River and terminating with number 281 adjacent to the proposed dam site. Areas C and F were flown by PA-18s and the remainder flown by Cessna

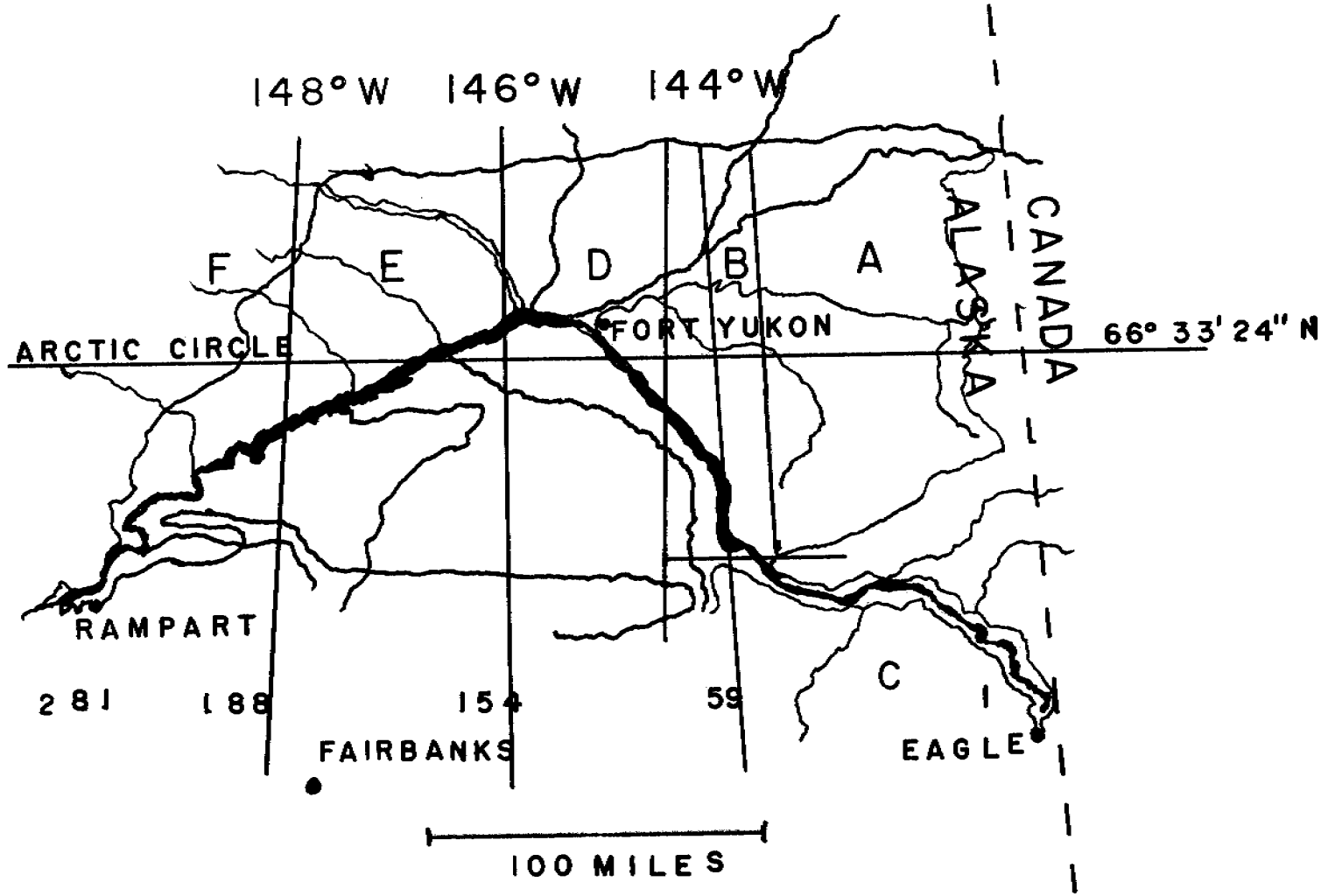

Figure 1. Yukon-Rampart Impoundment Area Showing Transect Divisions

180s. Meterological conditions during the week of March 20th, 1961, were not optimum for flying transects. It was believed that conducting moose counts at this time of the year would not be productive. The results bear out this prediction; therefore, by and large, the most valuable information obtained from the survey was the fact that the effort revealed problems that would need solving before the next survey is conducted.

Watson and Scott (1956) found that observers were comparable in their percentage estimates of caribou missed on a given transect during the 1955 Nelchina survey. This comparability does not hold when moose are being counted. For example, if no moose were observed on a given transect, an observer would estimate that "100 per cent" were missed. Obviously, the net result is zero moose. On the other hand, if an accurate account of fresh tracks were kept and recorded as to individual and grouped tracks, a modified Semyonov (1956) method could have been employed. In this connection a record of fresh tracks was kept for transects numbered 1 through 59. However, the fact that the design of the transects placed them two miles apart introduces a large error in the Semyonov method, which allows for no transect to be closer than the maximum radius of a group or single moose's daily activity of travel. The Semyonov method will be discussed in a subsequent section.

FINDINGS:

The results of the survey are as follows:

Sample Area	Number Moose Seen	Transect Flight Time	Moose Observed Per Hour	Total Sample Estimate
25 per cent	303	51.35 hr.	5.88	1212

The sample estimate for the 10,800 square mile area of the impoundment area is 1212 moose. It must be kept in mind that this figure represents only a sample size estimate and is in no way a total population estimate. The problem involved in the Lincoln index type of extrapolation of a population is the unknown portion of the animals missed in sampling. The question then is: what percentage of the

actual population does the sample represent?

Track census

We believe that there are possibilities for estimating total populations of moose by their track configurations. Preliminary experiments involving this approach have been done by Russian game biologists and the results have been satisfactory according to their needs for proper moose management. After reviewing a Canadian translation of Semyonov's paper, we are of the opinion that there is considerable latitude for improvement of the method that would, in effect, serve our needs for information concerning certain moose populations.

Ecological basis of the census method

It is a well known fact among experienced air crews that one can clearly see tracks not only of large animals such as moose but also of smaller animals such as foxes, wolves, rabbits and even ptarmigan. Although species identification of tracks of a number of small animals by an aerial observer is frequently possible only by consideration of the place of their occurrence, the mode of travel, and the distribution of footprints on the snow, there is no great difficulty in distinguishing fresh moose tracks from old, or group tracks from single ones. Fresh moose tracks are characterized by clear-cut outlines and sharply defined shadows; they "sparkle" or "shine", according to the old-timer's expression. Old tracks, on the other hand, have indistinct outlines and soft shadows.

It is known that the activity of an animal in search of food, or of the sheltered conditions necessary for resting, is limited to a definite area. Each animal that "settles" for some time, as it were, occupies a definite territory in its particular habitat. The extent, form, and location of that territory in the habitat depends mainly on the amount and distribution of food supplies and shelter conditions necessary for the life of the individual animal, and on the abundance of the species to which it belongs. The area and boundaries of an individual territory are determined by the length and pattern of the tracks made over an extended period by the animal occupying it. For moose that territory could

be called "area of long-term activity."

Any animal, including moose in search of food and shelter, commonly covers its individual territory by sections over a period of several days, depending on the nature of snow cover, temperature, direction and force of wind, etc., and distribution of food and shelter there. To that area of the habitat in which the activity of a moose is confined during a 24-hour period we apply the term "area of daily activity." That area is defined in extent and configuration by the tracks made in one day. The extent of their activities is greatly reduced in periods of deep snow cover.

Areas of daily activity of groups and single moose, even when they live in immediate proximity to each other, are as a rule distinct, and only in exceptional cases do they overlap. The number of areas is related to the distribution of the moose in a district and consequently is a definite indicator of their population density. Therefore, we can adopt the count of areas of daily activity as the basis of the method of censusing moose from the air.

The daily tracks of moose are clear-cut and simple in pattern. A flight of one or two minutes over these tracks is sufficient for an observer to determine the location of the moose's daily travels, and by the design traced to determine the boundaries and location in the transect strip of its area of daily activity. During a day's travel, in most cases, moose leave meandering, looped tracks of ring-shaped, bow-shaped and L-shaped patterns, and less frequently linear tracks more or less winding but in general direction following a straight line. The nature of daily tracks can be noted in Table 1 by Semyonov.

Upon examining the contents of Table 1, we see that there is almost no substantial difference between groups of moose and single moose with respect to maximum length of daily tracks and extent of area of daily activity. Consequently, in aerial counting there is no need to record separately areas of daily activity of groups and single moose, or to determine by their tracks the number of moose living within the observed area of daily activity. It is much simpler to use an index of the average numerical

Table 1. Length and area of daily tracks of moose during a period of deep snow (depth 3 to 4 feet) (Semyonov, 1956).

	GROUP OF MOOSE	SINGLE MOOSE
Length of Daily Tracks		
No. of observations	21	15
Maximum length	7.0 km.	7.5 km.
Minimum length	0.5 km.	1.0 km.
Average length*	3.9 km.	3.5 km.
Form of Daily Tracks		
Linear (approx. one direction)	7 (33.3%)	3 (20%)
Ring-shaped, bow-shaped, looped, etc.	14 (66.7%)	12 (80%)
Extent of Area of Daily Activity		
Maximum extent	3.22 $km.^2$	5.28 $km.^2$
Minimum extent	0.04 $km.^2$	0.08 $km.^2$
Average extent*	1.40 $km.^2$	1.52 $km.^2$

* These are the statistical summation averages.

status of groups of moose and single moose for each observation, and to apply it to all areas of daily activity studied during a flight. In Russia, the biologist determined the average numerical value for grouped moose by mail questionnaires sent to all foresters, trappers, hunters, farmers, etc., living in the district to be surveyed.

There are some weaknesses in their system. First, the time lapse interval for preparing an index from the summation of these data may well be different from the actual index because of an adverse weather change in the interim. Secondly, they tabulated single observations (one moose)

with these data to derive an index for grouped moose. Lastly, it is obvious that no index is needed in the case of one single track observation; hence one moose would have an index of one. The index for grouped moose could be obtained by aerial observation immediately prior to the transect survey.

The most productive time to obtain area activity and grouped indexes is immediately following a fresh snow. It follows then that the time to fly the transects is promptly following the next snowfall. However, the Russians found the period between 10:00 a.m. and 4:00 p.m. the best time to conduct a track census. This is valid because by 10 a.m. a moose has concluded most of its feeding and browsing and is ready to bed down; hence, his tracks mark his previous activities.

On coming across fresh tracks of moose, the observers must study the location of the day's tracks and their pattern and determine whether the area of daily activity of the animal lies wholly or partly within the transect strip; if partly, then he must estimate how much lies in the strip--one-quarter (.25), one-half (.50), or three-quarters (.75). The observer makes that estimate by comparing his observation with information on the average extent of the area of daily activity of moose obtained in prior aerial observations.

By examination of the following mathematical format the reasoning behind the track census method can be clearly illustrated:

$$P = \frac{\sum x}{n}\left[E_1 + .25\,P_1 + .50\,P_1 + .75\,P_1\right] + \left[E_2 + .25\,P_2 + .50\,P_2 + .75\,P_2\right]$$

P = population on census strip

$\frac{\sum x}{n}$ = average statistical mean of moose per group observation

E_1 = numbers of groups entirely within the census strip

P_1 = numbers of groups partially within the strip, i.e. .25, .50, or .75

E_2 = numbers of singles entirely within the census strip

P_2 = numbers of singles partially within the strip, i.e. .25, .50, or .75

To ascertain the total population of an area surveyed is only a matter of dividing the area of the transects into the overall area and multiplying the quotient by the number of moose derived from the calculations obtained from the transects. This may be noted as follows:

$$\frac{A}{a} (P) = \text{entire population}$$

where A = entire area

a = area of transects

P = population on transects

Table 2 is an illustration of the above method and technique of numerical census of moose by aerial survey of their tracks. These calculations are based on data obtained from an aerial transect flown in a Russian province of the same latitude and moose habitat as is prevalent in Alaska.

Table 2. Results of moose census from the air on Transect No. 1 (Semyonov, 1956).

Transect Length (km.)	Area of Census Strip ($km.^2$)	Areas of Daily Activity: Groups Within Census Strip				Singles Within Census Strip				Total Number Moose	Moose Density Per 10 $km.^2$
		All	.25	.50	.75	All	.25	.50	.75		
250	250	8	0	5	0	3	0	2	0	41	1.6

By substituting in the preceding formula and using 3.5 as an index to the average number of moose per group observation, one arrives at the total moose figure noted in Table 2.

Considering the track data obtained from transect number 1 to 59 of the Yukon-Rampart survey, we were able to determine that the average number of moose per group observation was 3.1 and that one-fourth of the 111 track observations were group

tracks. Because we did not have any previous experience in determining what percentage of tracks were within the transect, we assumed for purposes of calculation that a minimum of 25 per cent were within the transects. Total extrapolation on this basis gave us a realistic figure of 484 moose that "used" the area covered by the transects from near Eagle on the Yukon River to Circle City, including a small portion of Birch Creek adjacent to Circle Hot Springs. In this area 47 moose actually were seen.

DISCUSSION:

It is recognized that considerable field work will be needed to overcome some of the critical points inherent in the track census method. Referring to those previously mentioned, the sample size of the area encompassed by the transects should be increased considerably over the one per cent employed by the Russian biologists. Transects should be plotted to insure that a proportionate sample is obtained from each habitat type. A certain amount of field work will be needed for observers to become proficient in determining the extent of the moose's daily activity travels. Once we have calculated an index for daily activity we can then apply this in practice and thus make quick decisions regarding the portion of the moose's tracks that are encompassed within the transect.

Since exacting preliminary field work will be required to insure proficiency, it is apparent that the entire operation should be conducted by the use of slower "Super Cub" airplanes with the only duty of the Cessna 180's being to provide gasoline caches. At this point we feel that the method should be limited to areas where moose are not as densely distributed as they are in the Tanana, Kenai or Susitna areas.

The possibility of exploring the relationship of actual animals sighted to the track configurations recorded may reveal a mathematical consistency that could well open the door to an entirely new approach in the field of enumeration of animal populations in northern areas.

RECOMMENDATIONS:

1. We are of the opinion that the track census method should be developed.

2. If the development of the track census method is satisfactory, the application of the technique should be extended to all areas in the Interior where applicable.

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SUBMITTED BY:

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September 30, 1961

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ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: B Moose Management Investigations

Job No: 3-f Title: Final Reports on Moose Investigations pertaining to Composition Data

PERIOD COVERED: January 1, 1961 to March 31, 1961

ABSTRACT:

Statistical analyses of the Tanana Valley moose herd composition data in respect to year involved, aircrew, and sample size indicate that there is no appreciable error in different aircrew's observing ability insofar as herd composition data are concerned.

For the Tanana Valley moose herd different aircrews were used each year in the flights to obtain composition data. Thus, in the statistical analysis it was impossible to separate variability due to observer and due to year. A chi-square test of independence was used to test changes in composition with respect to year and observer. The analysis indicated there is no reason to believe there is appreciable error in the ability of aircrews to observe composition, or, that there is a significant shift in the sex ratio between years. However, as previously pointed out, because the variability of year and aircrew are confounded it is impossible to measure their respective contribution. Also, for the purpose of clarification of the analysis, the data traditionally recorded as a ratio to 100 females, was changed

to per cent notation.

It is suggested that this project will not be concluded until the statistical theory is examined by field experiment. This phase of the project can be accomplished by multiple flying of the same specific areas by different aircrews on a simultaneous basis. If the statistical format is validated by field test, then the entire array of composition data can be analysed with confidence.

OBJECTIVES:

To review, compile, analyse and prepare a final report on all herd composition data accumulated on the moose population of the Tanana, Fortymile and Koyukuk Valleys. This will include all investigations conducted by Federal Aid in Wildlife restoration programs under the authority of the U. S. Fish and Wildlife Service prior to July 1, 1959. (Project W-3-R).

TECHNIQUES USED:

In Table 1 it can be noted that the sample size of identifiable moose varies from year to year and from area to area. With all the apparent variables such as light, snow, observers, aircraft and time of day in respect to moose movements and feeding habits, one would conclude that the reliability of these composition data would leave something to be desired. Discounting these variables, the factor of sample size, and its affect on the reliablility must be considered. For example, suppose a 95 per cent confidence level is used and a sample of 100 animals is taken from an infinite population. If the sample is divided into three categories such as bulls, cows and calves, the reliablility for these proportions will be plus or minus 10 per cent. When the sample is increased to 1000, the reliability changes to plus or minus 3 per cent, and if the sample size is increased to 3000 animals the reliablility is contained at 1 per cent. Any increase in sample size above this number will not appreciably increase the reliability as to the existing ratios of bulls to cows to calves (Hickey, J. J. 1957).

The bull-cow-calf ratios (in Table 1) expressed as bulls

Table 1. Comparison of Sex and Age Ratios in Moose Populations in Interior Alaska During the Last Five Years.

Area	Year	Total Bulls per 100 Cows	Yg. Bulls per 100 Ad. Bulls	Calves per 100 Cows	Sets Twins per 100 Cows w/calves	Per Cent Calves in Herd	Per Cent Yg. Bulls in Herd	Yg. Bulls Per 100 Cows	Total Ident. Moose
TANANA	1960	77	36	43	5	20	9	20	1328
	1959	60	29	55	22	26	6	13	261
	1958	53	49	43	9	22	9	17	419
	1957	60	32	42	2	20	7	15	236
	1956	83	25	47	5	20	7	16	405
FORTYMILE	1960	110	23	36	0	14	8	21	460
	1959	108	70	54	13	21	17	45	252
	1958	63	56	45	8	22	11	23	129
	1957	91	29	46	8	19	8	20	140
	1956	66	30	53	0	24	7	15	129
KOYUKUK	1960	92	17	90	22	31	5	14	579
	1959	100	28	55	21	22	8	22	354
	1958	44	44	55	19	28	7	13	520
	1957	80	25	66	23	28	6	16	216

per 100 cows and calves per 100 cows has been found to be a nonsymmetrical notation and are not conducive to biometrical analysis. As traditionally recorded, they cannot be handled with methods based on the normal probability distribution and the binomial probability distribution and derivations thereof, such as testing variability of data. Hickey (1957) says that the standard procedure of listing sex ratios as the number of males per 100 females is not recommended and the practice should be resolutely condemned, as the asymetrical confidence limits set an intellectual trap into which all but the most biometrically minded are apt to fall.

To test the validity of composition data by year and aircrew involved, the data for the Tanana have been analysed. Symmetrical percentages have been changed to actual numbers of animals involved because both are relative to one another. The chi-square test for independence is employed where the individual probabilities are unknown, and the estimation of probabilities is based on the marginal totals (Wadsworth & Bryon, 1960).

The following contingency table set up for the Tanana data is based on the formula:

(Wadsworth & Bryon, 1960, p. 246) $$\hat{X} = \sum_i \sum_j \frac{(O_{ij} - Na_i \; b_j)^2}{Na_i \; b_j}$$

Aircrew & Year	1960 B	1959 C	1958 D	1957 E	Totals
Adult Bulls	344	57	77	53	531
Calves	260	67	92	49	468
Cows	603	121	214	116	1054
Young Bulls	121	16	36	18	191
Totals	1328	261	419	236	2244

Continuation of table

Expected Values				
Adult Bulls	314.24	61.76	99.14	55.84
Calves	276.96	54.43	87.38	49.21
Cows	623.75	122.59	196.80	110.84
Yg. Bulls	113.03	22.22	35.66	20.09
$(O - E)^2$:				
	2.8184	.3668	4.9444	.14444
	1.0385	2.9029	.2442	.0009
	.6902	.2062	1.5032	.2402
	.5620	1.7411	.0032	.2174

Summation $X^2 = 17.6240$

with 9 deg. freedom $X^2.01 = 21.67$

$X^2.05 = 16.92$

Bearing in mind the inseparable variables such as observing conditions, year, area, sample sizes affecting reliability, and animal habits in respect to time of day, one would expect the observers to record different ratios of sex and age class. But this significant result indicates there is apparently no basis for this conclusion.

These data indicate that it makes no appreciable difference what air crew is flying and observing insofar as herd composition data are concerned. It can be stated that 4 per cent of the time a larger variation could be expected from random draws from a common population than was found from these data. However, the sample size, based on marginal totals for the Tanana area, indicates that the reliability of bulls to cows to calves is contained between about 2 and

9 per cent.

These data also suggest that the herd composition in the Tanana area has remained relatively stable over the past four years.

Validity Test

It is suggested that this project will not be concluded until the statistical theory is examined by field experiment. This phase of the project can be accomplished by multiple flying of the same specific areas by different aircrews on a simultaneous basis. A delineated area may be flown on the same day at the same time by two different crews. One crew would start the count at one time and the second crew could follow a few minutes later on the same transect. The following day the crews could repeat the count in reverse order. If the information obtained from this field test is comparable insofar as composition data are concerned, then it would be safe to conclude that the composition data are reliable based on the statistical theory and actual test.

RECOMMENDATIONS:

The statistical theory employed should be examined by field experiment by multiple flying of the same specific areas by different aircrews on a simultaneous basis.

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