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JUNEAU, ALASKA

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REPORT ON 1965-66 MOOSE STUDIES

by
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Annual Project Segment Report
Federal Aid in Wildlife Restoration
Project W-15-R-1, Work Plan K

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-15-R-1 TITLE: Alaska Wildlife Investigations

WORK PLAN: K TITLE: Big Game Investigations

JOB NO.: 1, 2, 3, 4, 5, 6, 7, 8 TITLE: Moose

PERIOD COVERED: July 1, 1965 to June 30, 1966.

Moose Publications

Two publications were completed during this report period: "Annual Assessments of Moose Calf Production and Mortality in Southcentral Alaska", by R.A. Rausch and Arthur Bratlie; "Management Opportunities Derived From A Mandatory Moose Harvest Report System in Alaska", by R. A. Rausch, Arthur Bratlie, Patricia Crow and Jack Didrickson. These papers were presented at the 45th and 46th annual Conferences of the Western Association of Game and Fish Commissioners.

Some progress was made in analyzing the reproductive and age determination data for the period 1956-65. The data were placed on IBM cards and programmed for computer analysis at the University of Alaska computer center.

Harvest Statistics

Approximately 33,000 persons obtained moose harvest tickets in 1965. A 94 percent return of harvest tickets indicated a harvest of approximately 8,700 moose. Game Management Units 13, 14, 15, and 20 provided 75 percent of the harvest. Game Management Unit 14 provided the largest harvest, 2,262 moose. This represents a 71 percent increase over the 1964 yield, but it does not represent an over-exploitation of the population.

Range Inventories

An initial type mapping of the Matanuska Valley was attempted. Due to personnel changes and the lack of suitable recent photos, no significant progress was accomplished.

Sex and Age Composition

Aerial counts of identifiable moose populations and of moose in areas where little work has been done reflect considerable variation in the sex and age composition of the various populations. In some relatively unhunted populations the bull:cow ratio approaches 80:100, whereas in the more heavily hunted areas of Southcentral Alaska, such as the Matanuska Valley, some populations contain fewer than 10 males:100 females at the end of the hunting season.

A major effort was expended in Game Management Unit 13 to assess the well being of this important recreational area's moose population. Some 6,200 animals were observed in slightly over one hundred hours of counting time. Although there is considerable variation with this large area, calf production was fair to poor. The best production was observed on those areas where antlerless moose have been harvested for several years. This observation coincides with findings from Southcentral Alaska where the data clearly shows the heavily hunted Matanuska Valley is the most productive area.

Production

Aerial counts of the progression of calving were made in the Matanuska Valley, Tanana, Yakutat and Haines areas. The peak of calving throughout the State appeared to occur between May 28 and June 6.

The aerial counts showed considerable variation in production of twin calves from area to area and generally support the observations made on specimen material collected last fall. Information on pregnancy rates was obtained from collections during the 1965 hunting season and indicate a uniformly high rate of conception in animals two years old and older throughout the State with slight variations.

Incidence of twin fetuses varied considerably from area to area with the highest recorded twinning rate observed in the Yakutat area.

Data from the area near Homer, showed fewer twins in utero and a low conception rate among adult females conceiving. The size of the fetuses varied greatly, possibly indicating a lengthy span of conception, perhaps due to the removal of a large proportion of male moose during the hunting season.

Other areas showed intermediate rates of conception and twinning.

Moose calves were tagged in the Matanuska Valley and on the Tanana Flats. One hundred and eighty-seven calves were tagged in the Matanuska Valley bringing the total to 1,431 calves tagged since 1960. This effort terminates the tagging program in the Matanuska-Susitna Valley. In the Tanana Flats 230 calves were tagged initiating a new program.

A pilot program of tagging adults was started in the Matanuska Valley with good success using succinylcholine chloride.

Estimates of initial production of calves was made using the Lincoln Index, counting tagged versus untagged calves on the tagging areas. Although the standard error was quite large for some areas, the estimates are a valuable index to

the initial production of calves and the efforts to refine the counts will reduce the standard error.

Survival of calves in the Tanana Valley is believed to be poor. Seven dead or dying calves were found during counting and tagging operations. The reasons for this unusual mortality are believed to be related to malnutrition of the females during the severe winter that preceded parturition.

Range Productivity Relationships

This project is designed to last for 15 or 20 years to assess the relationship of moose to their range. Four, one square mile plots were selected on the Kenai National Moose Range for construction of moose pens. The pen sites were surveyed and arrangements made for construction of the fences and for accomplishing the initial assessment of the vegetation.

RECOMMENDATIONS

In general Alaskan moose populations are under-exploited and most populations reflect undesirable effects attendant with over-population. There are some basic solutions to this problem: (1) creation of access, and (2) manipulation of seasons and bag limits.

Creating access to lightly harvested or unharvested moose populations could include building roads, airfields, and trails. Prior to launching an ambitious program to generate increased utilization of moose through better access, some basic management decisions should be made in concert with land management agencies. These decisions should include long range policies regarding utilization of the resource. For example, should moose be utilized only as a meat animal or should consideration be given to trophy concepts? Further delay in arriving at decisions relating to these concepts, or before decisions are reached relating to specific land areas, can only lead to increased management problems.

Data on moose populations, their relative abundance, and exploitation are available to facilitate the foregoing recommendation in regards to season and bag limit manipulation.

In areas where moose are being managed as a primary meat-recreational animal, harvests approaching 25 to 30 percent of the total population can be achieved. If the areas are readily accessible there is a good possibility that present techniques of harvesting adult male moose during August and September will have to change in favor of harvesting during October and November, following the rut, if maximum herd productivity is desired.

Consideration of the data on the chronology and magnitude of harvest should strongly influence setting of seasons. For example, September seasons on antlerless moose in lowland areas will not yield the desired results as few animals will be taken and those taken are not representative of all segments of the population.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

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WORK PLAN: K TITLE: Big Game Investigations

JOB NO.: 1, 2, 3, 4, 5, 6, 7, 8 TITLE: Moose

PERIOD COVERED: July 1, 1965 to June 30, 1966.

OBJECTIVES

To obtain and evaluate information on the status of Alaska's moose populations in terms of productivity, trends of abundance, fertility, movements, sex and age composition, and harvest to guide annual management decisions.

To obtain information on basic relationships of climatology and range, and the physiological response of moose to these environmental components in order to facilitate future management.

TECHNIQUES

Moose Publications

Research techniques and data were reviewed and written up for a paper entitled "Annual Assessments of Moose Calf Production and Mortality in Southcentral Alaska", by R. A. Rausch and Arthur Bratlie, presented at the 45th Annual Conference of the Western Association of Game and Fish Commissioners in 1965. A second paper, entitled "Management Opportunities Derived from a Mandatory Moose Harvest Report System in Alaska", by R. A. Rausch, Arthur Bratlie, Patricia Crow, and Jack Didrickson, was prepared for presentation at the 46th Annual Conference of the Western Association of Game and Fish Commissioners, 1966.

Harvest Statistics

Characteristics of the 1965 moose harvest were determined from harvest ticket data and from age determination of the harvest based upon moose jaw collections from areas receiving the greatest hunter use. Jaws were collected by means of check stations, collecting trips by biologists, public participation, and a few by protection officers.

Studies on Dental Characteristics of Moose Jaws

In conjunction with processing of moose jaws, the incidence and characteristics of anomalies found among the moose jaw collections were studied.

Additionally, the progression and pattern of tooth eruption among calves and yearlings were described, and measurements reflecting eruption of the first

incisor and the second molar and growth of the jaw and the diastema were taken.

Non-hunting Moose Mortality

Moose which died from causes other than hunting were collected whenever possible. Jaws and other specimens and standard body measurements were collected whenever possible.

Range Inventories

The distribution, character, and delineation of the vegetation types within the lower Susitna and Matanuska Valleys were studied through aerial photo interpretation.

Sex and Age Composition

The relative proportions of several age and sex classes of moose in various populations throughout the state were sampled by aerial counts. Ideally aerial counts should be made as soon as a complete snow cover is present to aid in seeing moose and before bulls shed their antlers, i.e. between middle to late October and the end of November. Weather and other factors may preclude accomplishing aerial counts during this time. During 1965-1966 most sex and age counts were made from mid-October through mid-January. One area was surveyed in late March.

Most of the aerial counting was done with PA-18, 150 Supercub aircraft, but a helicopter was used on one occasion. Whenever possible, moose representing known, more or less discrete, populations were counted, but in some cases the areas surveyed were given arbitrary boundaries. Areas to be counted were flown in a transect pattern with .5 to 1 mile between transect lines and at altitudes of about 300 feet or less, depending upon terrain and vegetative cover. Moose observed were recorded in one of four categories:

1. Young bulls - antler spikes or forks with little or no palm development. Considered to be yearlings.

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

3. Cows - Antlerless moose other than calves.

4. Calves - Young of the year, distinguished by their size, short rostrum, and light patch on each shoulder.

Department personnel taking part in the counts included R. A. Rausch, Arthur Bratlie, Jack Didrickson, Loyal Johnson, John Crawford, Howard Wood, Robert Hinman, Richard Bishop, and Keith Koontz.

Matanuska Valley Population Estimate

In an attempt to obtain a more accurate quantitative estimate of the Matanuska Valley moose population than has been possible with methods used in the past and to test the usefulness of the techniques in censusing moose, an aerial census technique using stratified random sampling procedures was devised with the aid of Sam Harbo, biometrician at the University of Alaska.

The Matanuska Valley was stratified into areas of high, medium, and low densities of moose and divided into one-square-mile plots. The areas of different density were sampled with proportionate intensity; high density areas were sampled most intensively, etc. The number of square-mile plots representing the appropriate proportion of the total number of plots (sampling intensity) in each stratum were then selected by a random procedure.

One quarter of the area was then censused and variances for each stratification were computed to use as a basis for determining the sampling intensity required on the remaining three-quarters of the area. This was done by estimating the variance of the remaining quarters on the basis of the variance found on the quarter censused. If the estimated variance of the three quarters did not fall within acceptable limits, the sampling intensity (proportion of plots censused) were to be raised to reduce the confidence limits. Although the variance, and therefore the confidence limits, were too large in this case, time and funds were not available to repeat the procedure with greater sampling intensity. Department personnel involved included R. A. Rausch, Arthur Bratlie, Jack Didrickson, and Robert Hinman.

Production

Progression of Calving

The progression of calving was investigated by aerial counts in several areas of the State from the last week in May through the second week in June.

PA-18, 150 Supercub aircraft were used for most of the counting but Hiller 12-E, a Hiller C-2, and a Bell G-2 helicopter were also used. A Taylorcraft was found unsuitable for this work.

The counts were conducted similarly to the fall composition counts but on somewhat different areas which reflects changes in the spatial distribution of moose from fall and early winter to spring. These areas are discussed under "Findings".

Department personnel taking part in the parturition counts included R. A. Rausch, Arthur Bratlie, Jack Didrickson, Phillip Havens, Robert LeResche, Emmet Soldin, John Crawford, Jim Faro, Skip Wallen, Loyal Johnson, Richard Bishop, and Sandra Kogl.

Calf Tagging

Moose calves were tagged from May 27 to June 2, 1966 on various parts of the Matanuska-Susitna-Knik Valley areas and from May 30 to June 4, 1966 on the Tanana Flats. Tagging with monel cattle ear tags and colored streamers was accomplished by two-men crews working from Hiller 12-E or 12E4 helicopters.

A Supercub with pilot and observer located calves to be tagged, radioed the information to the helicopter, and noted the tagging location of individual calves on a prepared grid map of the tagging area. Air-to-Air radio communication was not entirely satisfactory on a frequency of 3411.5 kc, but worked well on 122.8 mc.

Department personnel participating in tagging operations included Arthur Bratlie, Jack Didrickson, Robert Hinman, Ronald Somerville, Phillip Havens, Robert LeResche, Rex Thomas, R. A. Rausch, Sam Snyder, Richard Bishop, Scott Grundy, John Gilbert, and David Chattin.

Tagging of Adult Moose

A pilot study on techniques of tagging adult moose during the winter was begun in the Matanuska Valley during February 1966.

The objectives were to determine the movements of adult moose in the Matanuska Valley, to test the performance of "Cap-Chur" and "Paxarms" syringe firing weapons in the winter, to test doses of succinylcholine chloride on various age and sex classes, to test the use of color coded collars on moose, and to determine the feasibility of tagging numbers of moose in the Matanuska Valley during the winter.

Post-tagging Parturition Counts

Parturition counts were continued after tagging was completed in order to obtain an estimate of the calf crop in tagging areas, to assess survival of calves, and to observe early movements of tagged calves.

Range Productivity Relationships

Techniques involved in the initial phase of this study related primarily to the location, surveying preliminary vegetation, and soil analysis, and construction of the enclosure to be used in these studies.

The specific location of the study enclosure on the Kenai National Moose Range was selected within an area supporting good moose habitat composed of various vegetative types. Particular emphasis was placed on including a portion of the area which experienced a major forest fire in 1947.

Willard Troyer, Refuge Manager, Kenai National Moose Range, Robert A. Rausch, Leader Big Game Project, Alaska Department of Fish and Game, and Robert Hinman, Game Biologist, Alaska Department of Fish and Game, collaborated to select the area for the enclosure and delineate the approximate boundaries. Department biologists Ronald Somerville and Jay Bergstrand, Robert Hinman, and Phillip Havens surveyed the fence line. They were assisted by the staff of the Kenai National Moose Refuge.

Preliminary vegetion analysis techniques included aerial photography of the enclosure site from an altitude of 1,500 feet using both panchromatic and modified infra-red film, through the cooperation of the Bureau of Land Management. Photograph scale was 1"=250'. Mr. Tom Hazzard and Mr. Bob Olendorf conducted the aerial photography.

A soil survey was completed by Mr. Freeman A. Stephens, of the U.S. Forest Service.

Construction of the enclosure was under supervision of Robert Hinman, and involved building an access road, clearing fence lines, cutting and treating fence posts, and other numerous jobs.

In addition, Hinman was responsible for general coordination of all aspects of the project in the field.

Calf Survival

The study of factors affecting survival was done through the Alaska Cooperative Wildlife Research Unit by Robert LeResche. The annual report of the Wildlife Research Unit should be consulted for the description of this study.

FINDINGS

Moose Publications

Publications produced under this job have been noted in "Techniques" and copies are appended to this report.

Harvest Statistics and Characteristics of the Harvest

About 94 percent of the 1965 moose harvest ticket report cards were returned by moose hunters. Table 1 shows the breakdown of successful, unsuccessful, and other categories of hunters. Figure 1 shows the 26 administrative game management units.

About 6 percent of the tickets were outstanding at the time of compilation. The final IBM compilation is not yet available. From the return of harvest tickets by successful hunters, the harvest by Game Management Unit (Table 2) and sub-unit (Table 3) was compiled. In Figure 2 through 5 the sub-unit divisions of units contributing the bulk of the harvest are illustrated.

TABLE 1

SUMMARY OF MOOSE HARVEST TICKET PROGRAM. COMPILED THROUGH FEBRUARY 15,1966

Tickets issued by vendors	32,924	
Ticket stubs returned by hunters	30,864	(93.8%)
Tickets outstanding	2,060	(6.2%)
Successful hunters		
Male moose	6,040	
Female moose	2,470	
Sex unknown	104	
Total kill	8,620	
Unsuccessful and did not hunt	22,244	
Could not contact because of insufficient address, deceased, moved, etc.	862	
No response to reminder letters	1,198	
TOTALS	32,924	

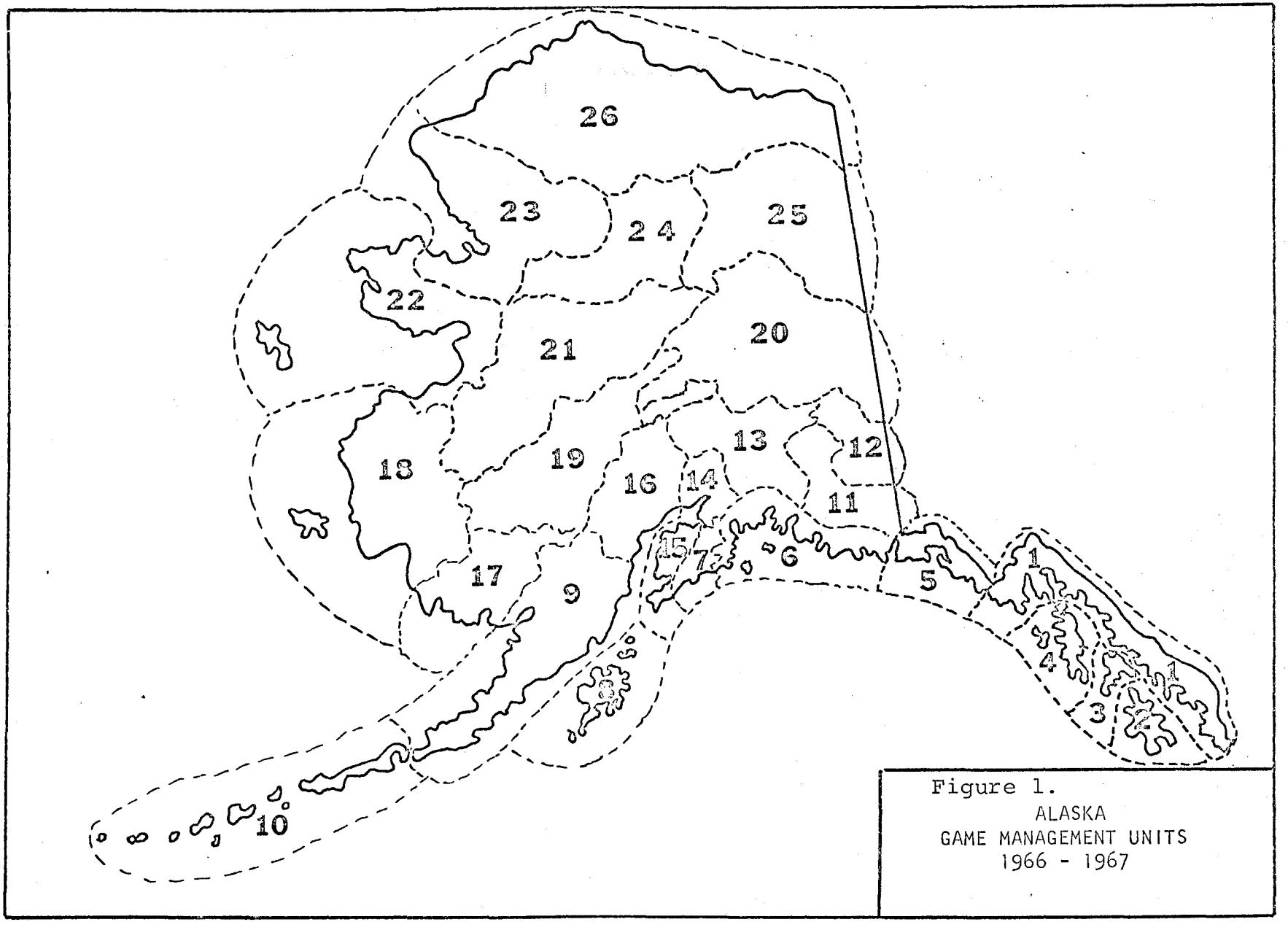


Figure 1.
ALASKA
GAME MANAGEMENT UNITS
1966 - 1967

TABLE 2

STATE WIDE MOOSE HARVEST COMPILATION, 1965*

Unit	♂	♂	♀	♀	Sex Unknown	Total
1	128	0	35	0	4	176
5	153	0	125	0	4	282
6	24	0	0	0	0	24
7	60		1	0	0	61
9	200	13	63	5	4	285
11	116	0	70	0	2	188
12	151	0	33	0	6	190
13	1318	0	3	0	10	1331
14	1127	0	1125	0	10	2262
15	841	0	731	0	12	1584
16	333	0	52	0	7	392
17	41	0	1	0	0	42
18	28	0	0	0	2	30
19	114	7	27	1	1	150
20	1050	0	140	0	33	1223
21	87	9	30	1	1	128
22	52	3	3	0	2	60
23	44	0	0	0	1	45
24	58	8	14	0	4	84
25	51	1	1	0	0	53
26	0	0	0	0	1	1
No Unit	32	0	9	0	0	41
TOTALS	5976	41	2419	7	104	8591

* Totals through Feb. 15, 1966 --- approximately 6% of tickets were outstanding.

TABLE 3

SUBUNIT BREAKDOWN OF 1965 MOOSE HARVEST IN MAJOR PRODUCING UNITS, FEB. 15, 1966

Unit	Subunit	♂	♀	Sex Unknown	Total Moose
1	A	28	1	1	30
	B	34	0	2	36
	C	66	34	1	101
	TOTAL	128	35	4	167
7	A	17	0	0	17
	B	10	0	0	10
	C	21	0	0	21
	D	6	0	0	6
	E	3	0	0	3
	Other	3	1	0	4
	TOTAL	60	1	0	61
13	A	196	1	0	197
	B	183	0	0	183
	C	114	0	1	115
	D	123	0	1	124
	E	49	0	1	50
	F	299	0	1	300
	G	107	0	1	108
	H	1	0	0	1
	I	163	1	3	167
	Other	83	1	2	86
	TOTAL	1318	3	10	1331
14	A	580	661	6	1247
	B	191	184	2	377
	C	44	27	0	71
	D	78	44	0	122
	E	118	102	1	221
	F	82	52	1	135
	Fort Rich.	11	38	0	49
	Other	23	17	0	40
	TOTAL	1127	1125	10	2262
15	A	365	299	5	669
	B	183	193	1	377
	C	248	224	4	476
	Other	45	15	2	62
	TOTAL	841	731	12	1584
20	A	171	47	6	224
	B	273	4	8	285
	C	606	89	19	714
	TOTAL	1050	140	33	1223

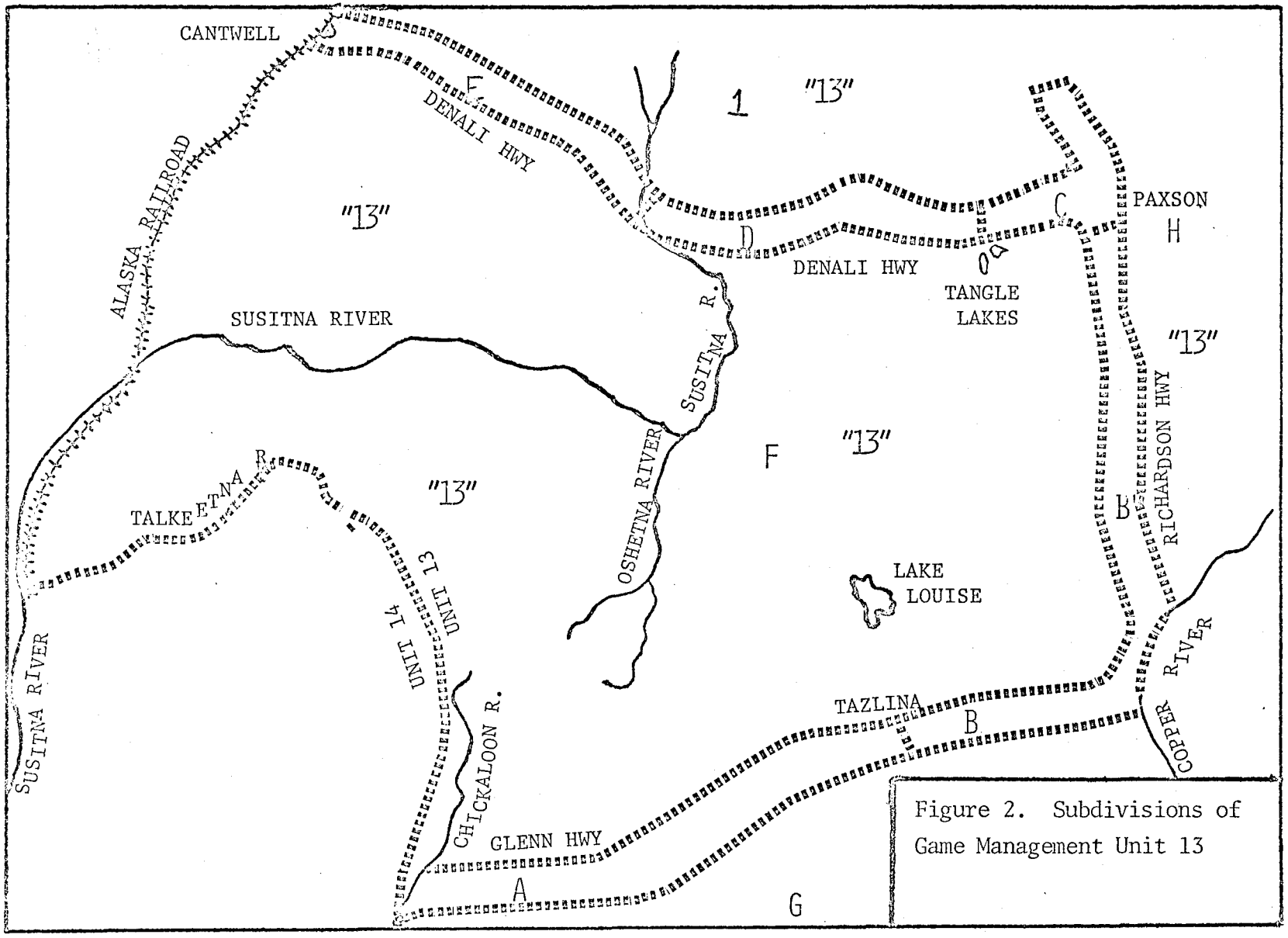


Figure 2. Subdivisions of Game Management Unit 13

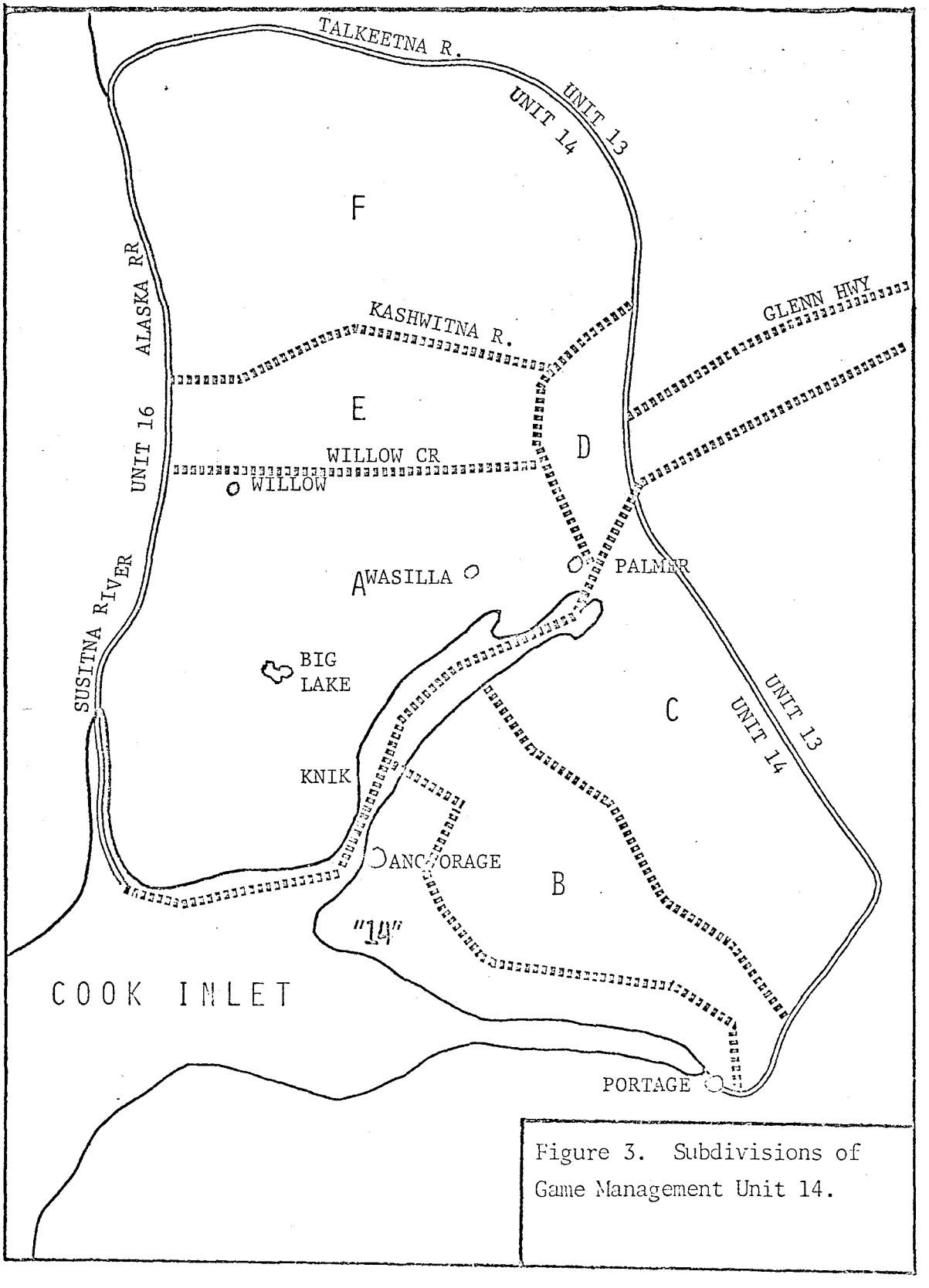


Figure 3. Subdivisions of Game Management Unit 14.

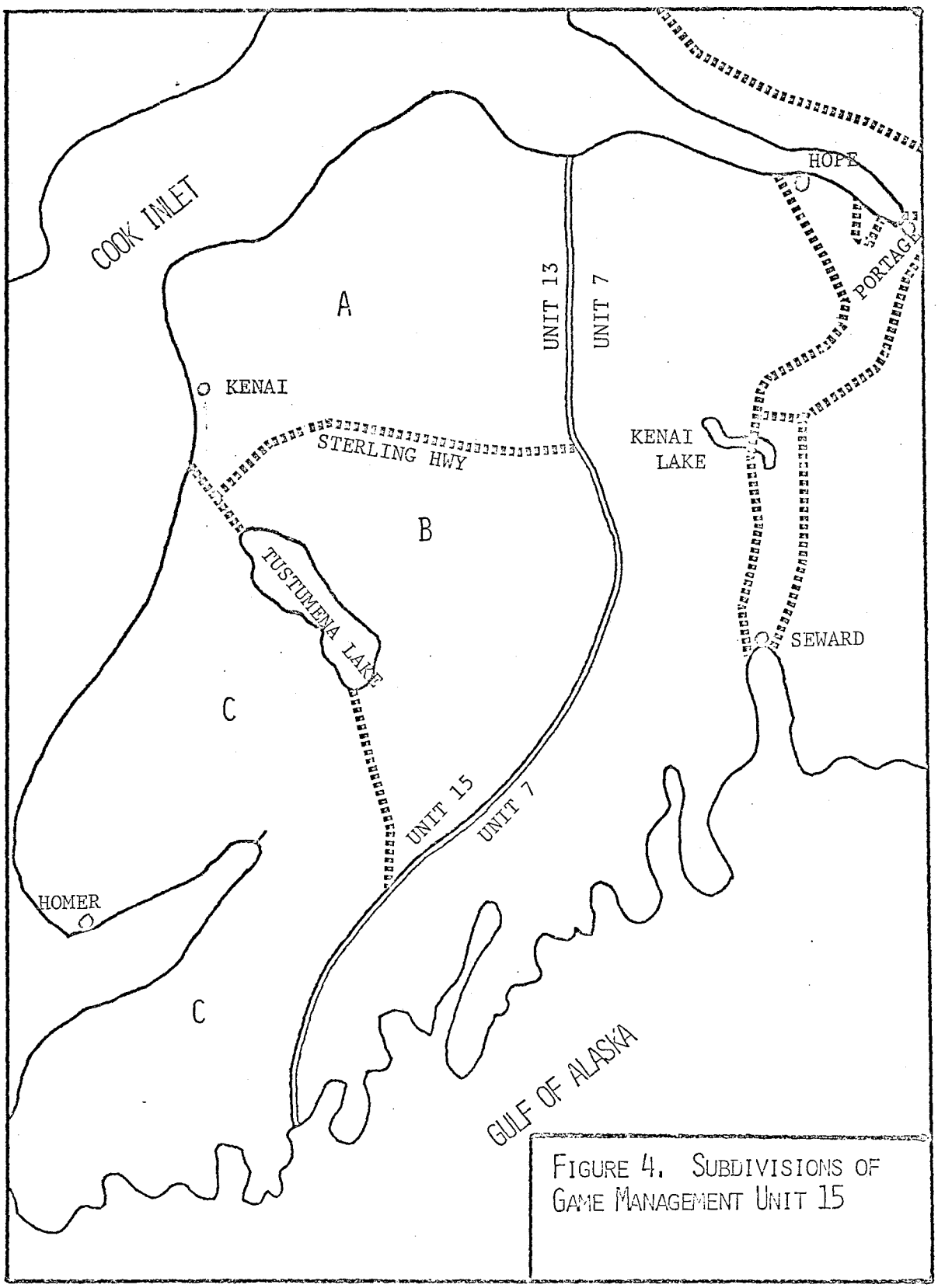


FIGURE 4. SUBDIVISIONS OF GAME MANAGEMENT UNIT 15

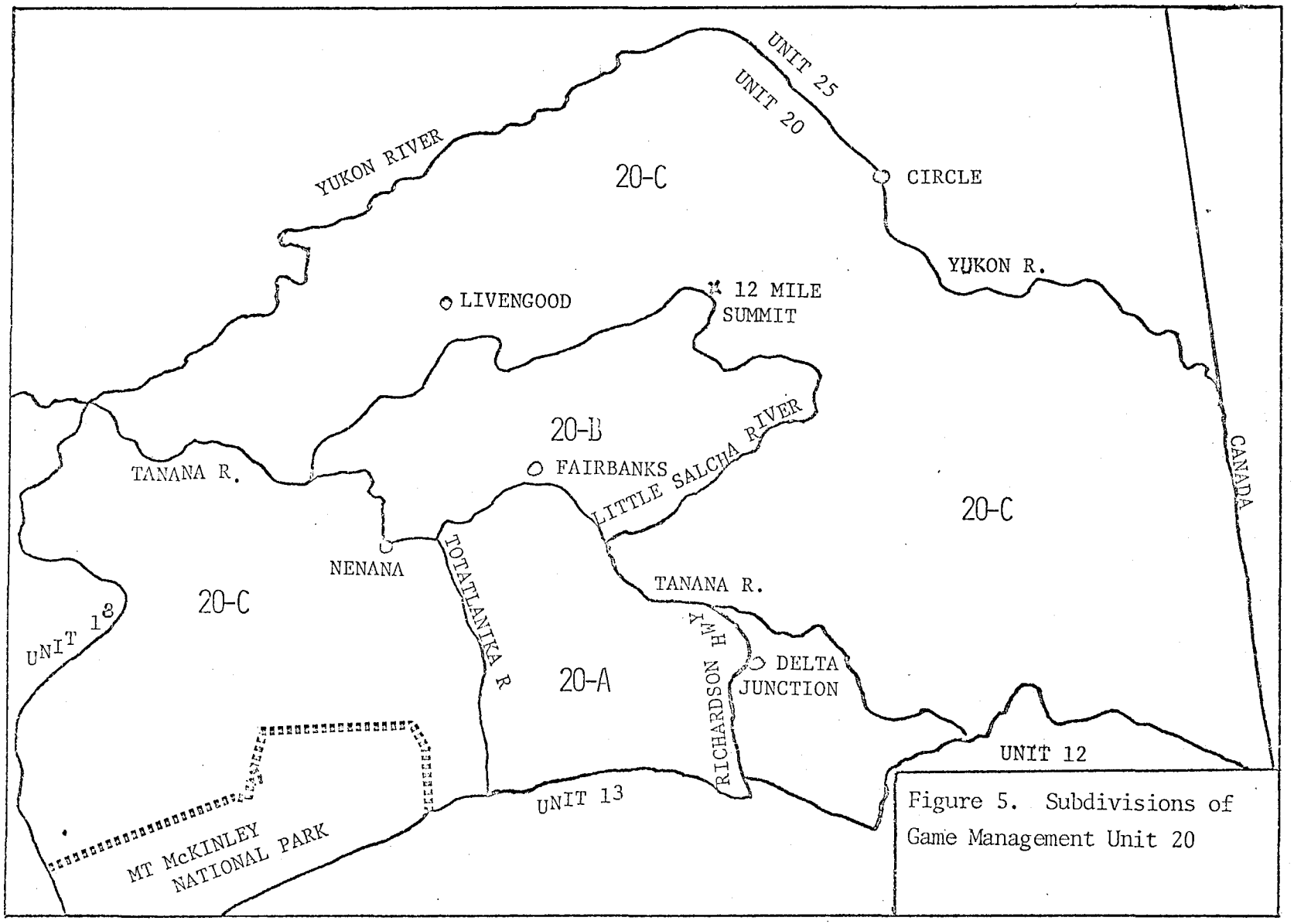


Figure 5. Subdivisions of Game Management Unit 20

Units 13, 14, 15, and 20 contributed 74.5 percent of the harvest. Other areas contributed minor percentages.

In Figure 6 the chronology of the moose harvest in percent by weekly periods is presented for the more important Game Management Units. Within the framework of the regulations, the distribution of the harvest of bulls shows a substantial percentage of the harvest occurring in the first few days of the season. Another "peak" in the male harvest is common toward the latter part of September when the bulls are coming into the rut and moving about more. In the southcentral areas, high percentages of males taken in late November reflect movements of moose from higher, less accessible areas down to lower more accessible areas in response to increasing snow depth at higher elevations.

In Unit 15 the 1965 harvest of males was about 30 percent lower than the 1964 harvest, and the harvest of males and antlerless moose was 24 percent lower in 1965. Moose were as abundant in 1965 as in 1964 and with appropriate seasons a similar harvest could have been achieved. Intensive harvesting of males in some areas prior to the breeding season may have contributed to the lower pregnancy rates and broad span or conception dates noted under "Production".

In Unit 14 the harvest of 2,262 moose represents a 71 percent increase over 1964, yet the residual population was high (three to four moose per square mile in sub-unit 14A) after the hunting season. The data in Table 4 show that since 1960 when antlerless moose hunts were begun the annual harvest has doubled or nearly tripled in some cases. The estimated residual population in 1965, however, is the same as that estimated in 1954. The similarity of the population estimates may reflect the conservation of the 1950's combined with the effects of improved census techniques.

The proportion of bull moose in the population in accessible areas of Unit 13 is lower compared with inaccessible areas, but the reduction is not serious at this time. The total harvest in Unit 13 was lower in 1965 than in 1964, coincident with the absence of an antlerless moose season. The harvest of male moose increased slightly in 1965 (Table 2).

In sub-unit 20A the population was scarcely utilized in 1965. The conditions prevailing on the Tanana Flats already discussed show that the population could sustain a much higher harvest of both sexes, and would benefit thereby. Access problems are the chief limiting factors on the harvest in sub-unit 20A, and this is also true of much of sub-unit 20C. In sub-unit 20B antlered moose receive heavier pressure, while the antlerless segment receives little pressure.

The Yakutat area (Unit 5) continues to produce moose rapidly and although the 1965 harvest was up about 5 percent, this population is capable of sustaining much higher harvests.

Except in localized areas, most other units receive light hunting pressure and the moose populations are largely unutilized.

Age Composition of the Harvest

Moose jaws from hunter kills collected from areas receiving relatively heavy hunting pressure in various parts of the state provided a means of assessing the age distribution of the harvest by sex. Figure 7 illustrates the age composition of the harvest in various major areas.

Figure 6. Chronology of Moose Harvest, Expressed in Percent by Period

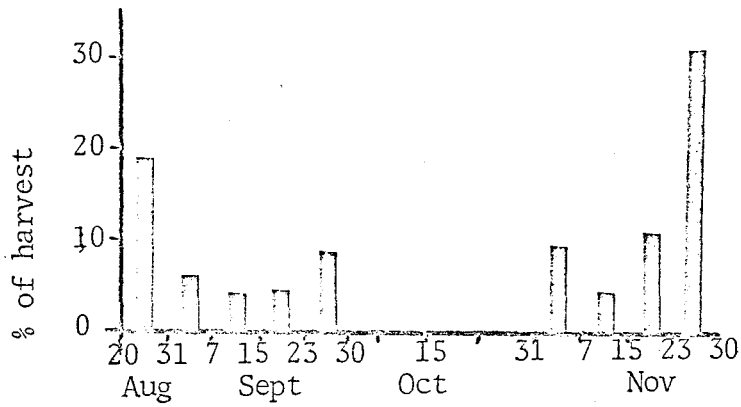
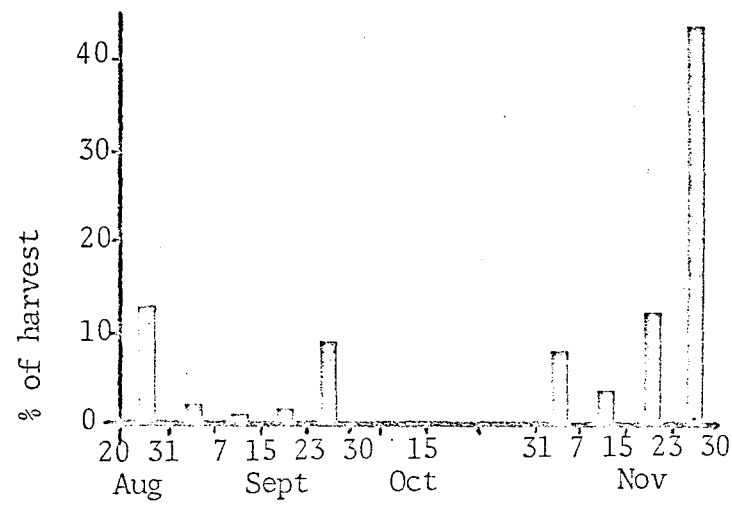
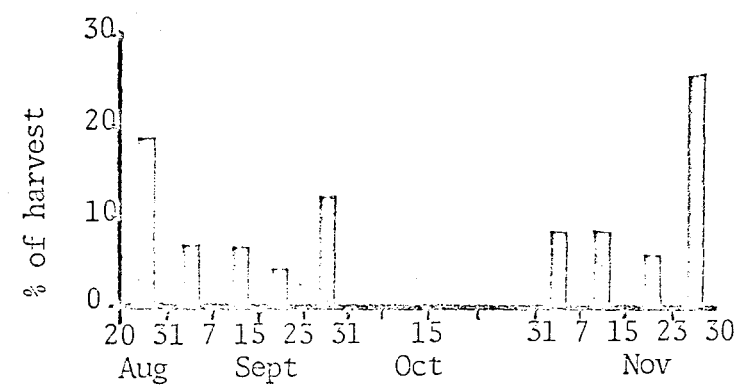
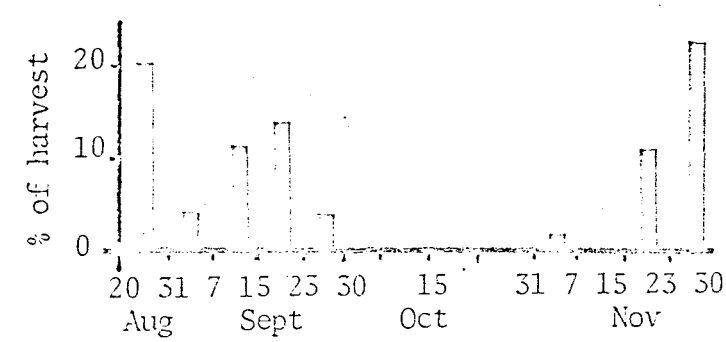
Unit or Subunit		Sample Size
15A males		343
15B males		172
15C males		240
15 other males		40

Figure 6. CHRONOLOGY OF MOOSE HARVEST, EXPRESSED IN PERCENT BY PERIOD (continued)

Unit or Subunit		Sample Size
15	composite summary, male harvest	795
	5 males	150
	5 females	119
13A	males	189
13B	males	174

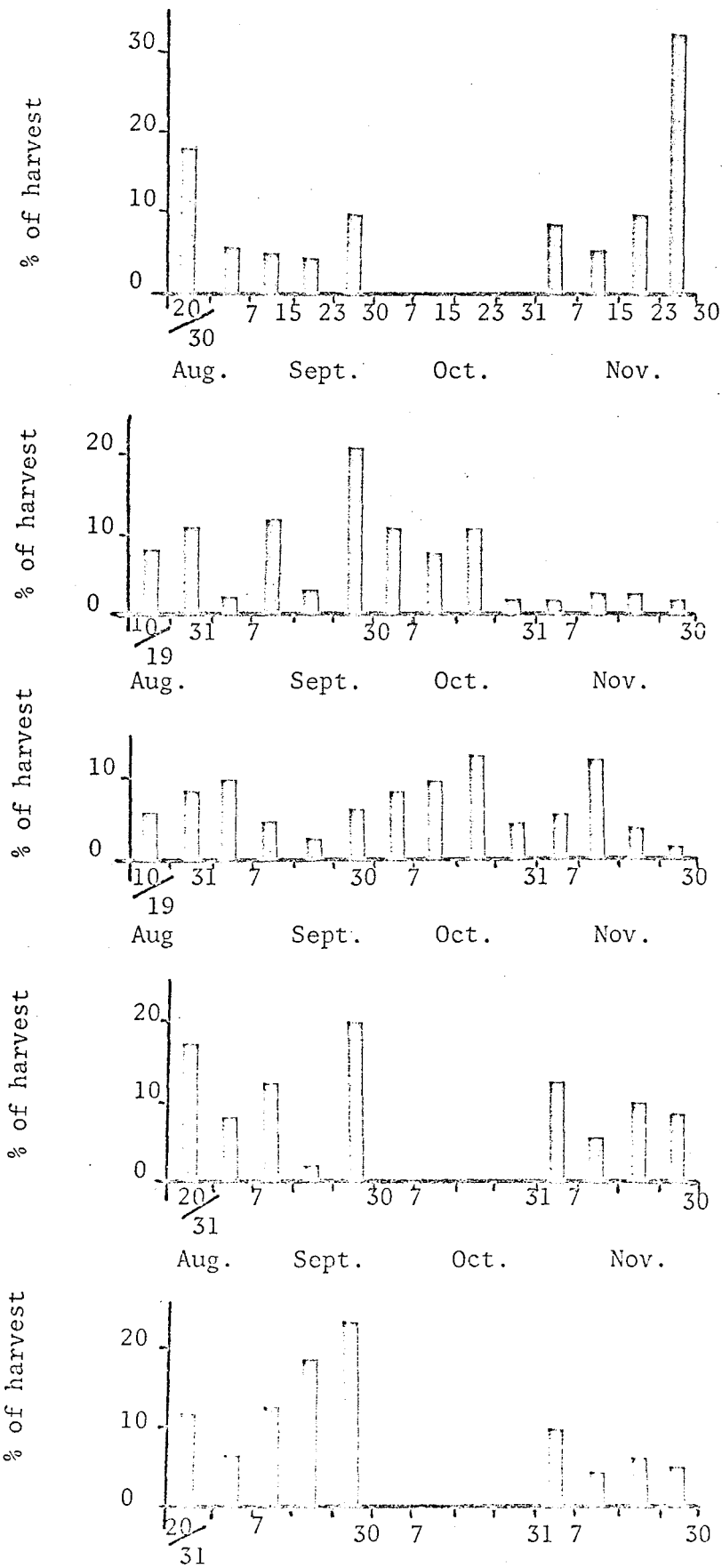


Figure 6. CHRONOLOGY OF MOOSE HARVEST, EXPRESSED IN PERCENT BY PERIOD (continued)

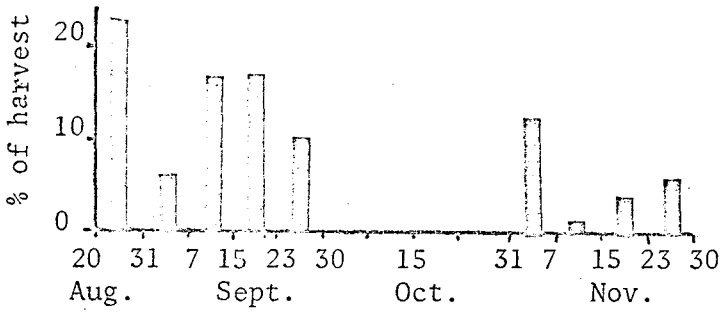
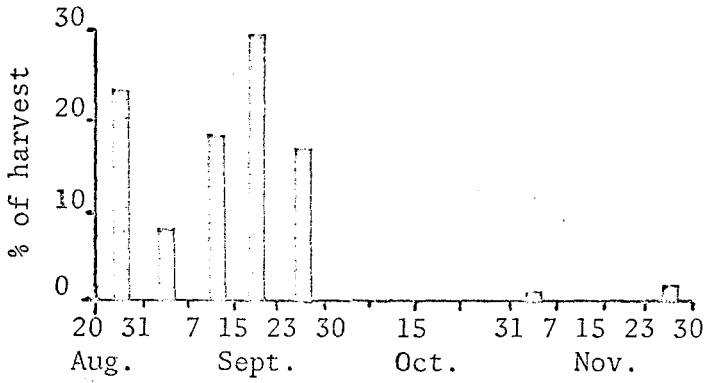
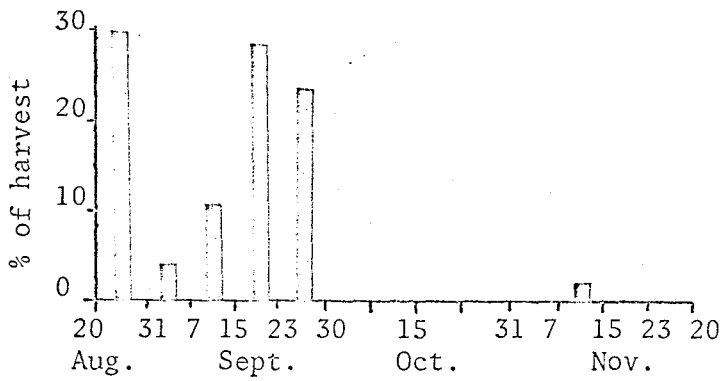
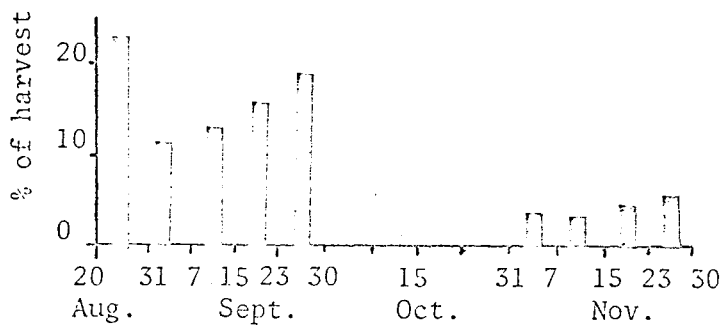
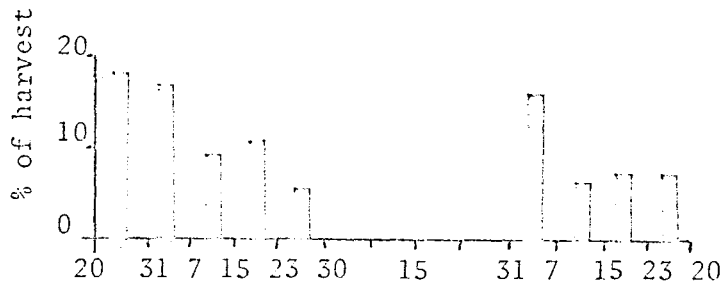
Unit or Subunit		Sample Size
13C males		110
13D males		108
13E males		46
13F males		284
13G males		103

Figure 6. CHRONOLOGY OF MOOSE HARVEST, EXPRESSED IN PERCENT BY PERIOD (continued)

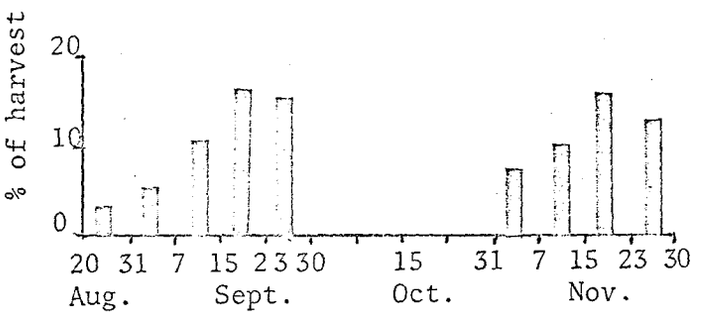
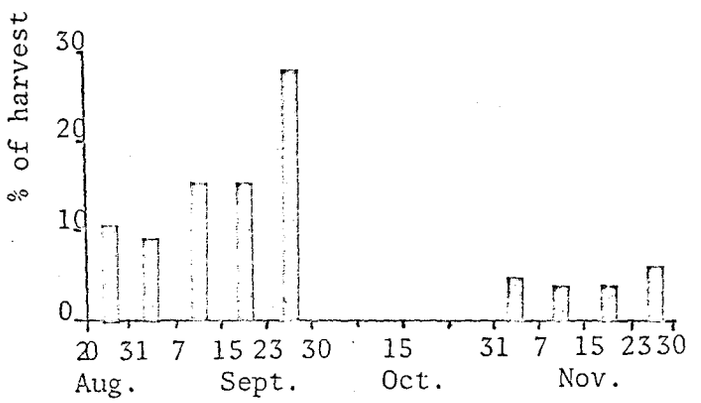
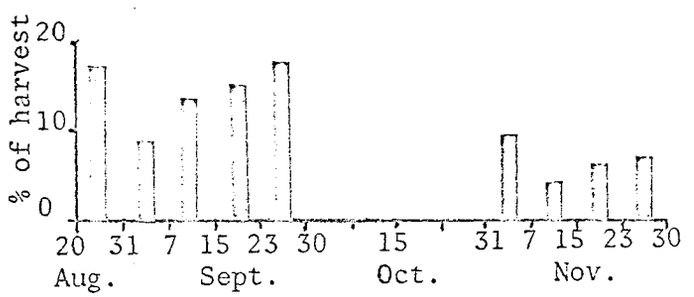
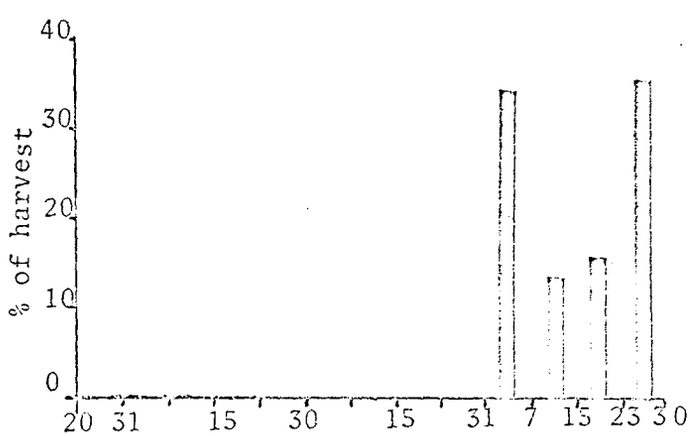
Unit or Subunit		Sample Size
13I males		157
13 other males		81
13 composite males		1284
14A males		567

Figure 6. CHRONOLOGY OF MOOSE HARVEST, EXPRESSED IN PERCENT BY PERIOD (continued)

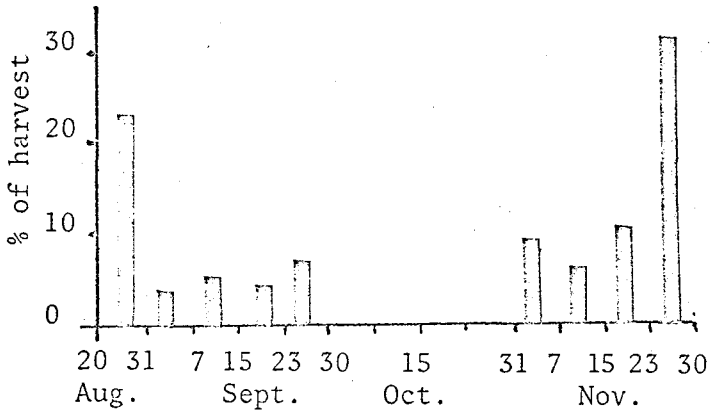
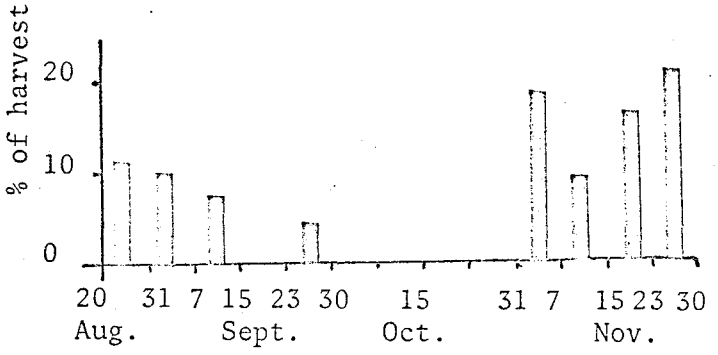
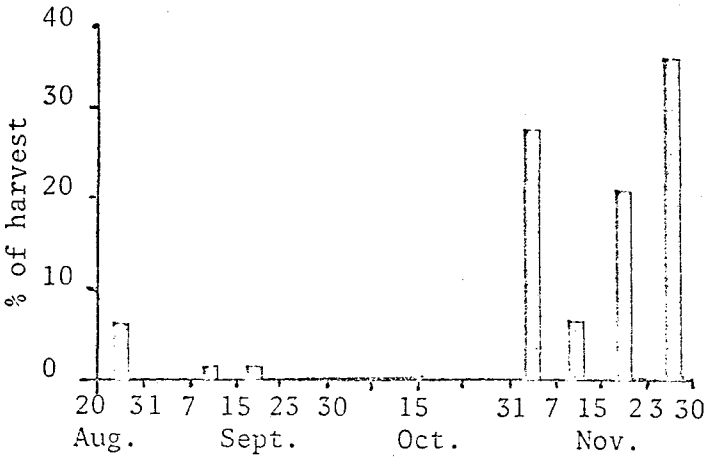
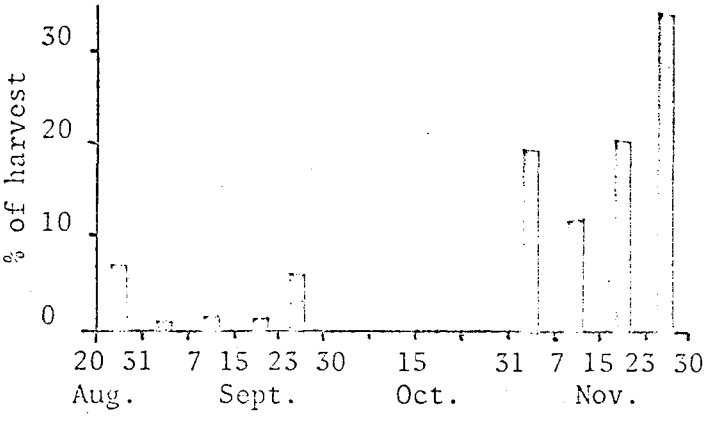
Unit or Subunit		Sample Size
14B males		186
14C males		42
14D males		76
14E males		116

Figure 6. CHRONOLOGY OF MOOSE HARVEST, EXPRESSED IN PERCENT BY PERIOD (continued)

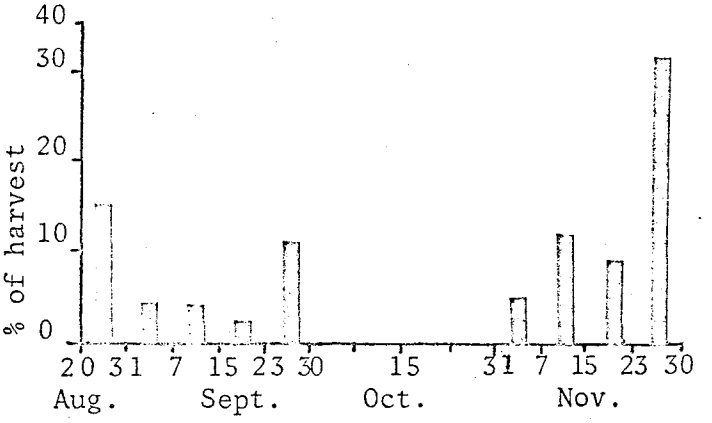
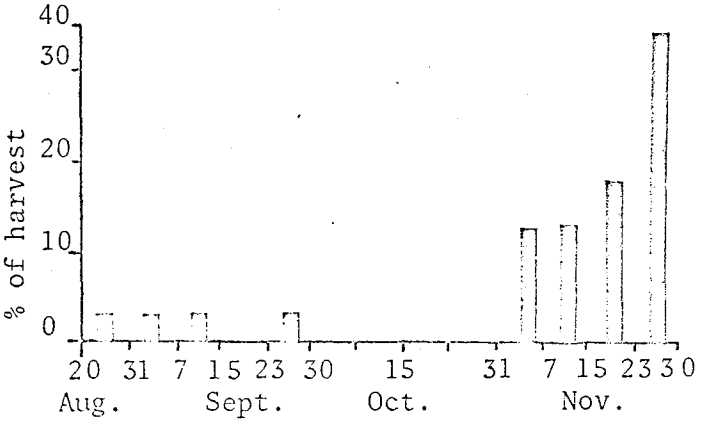
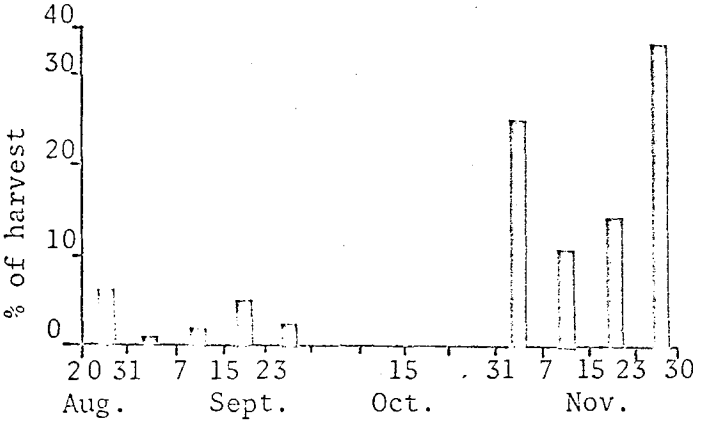
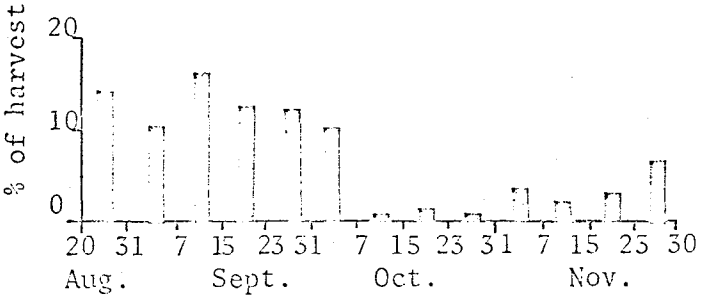
Unit or Subunit		Sample Size
14F males		81
14 other males		22
14 composite males		1090
20A males		164

Figure 6. CHRONOLOGY OF MOOSE HARVEST, EXPRESSED IN PERCENT BY PERIOD (continued)

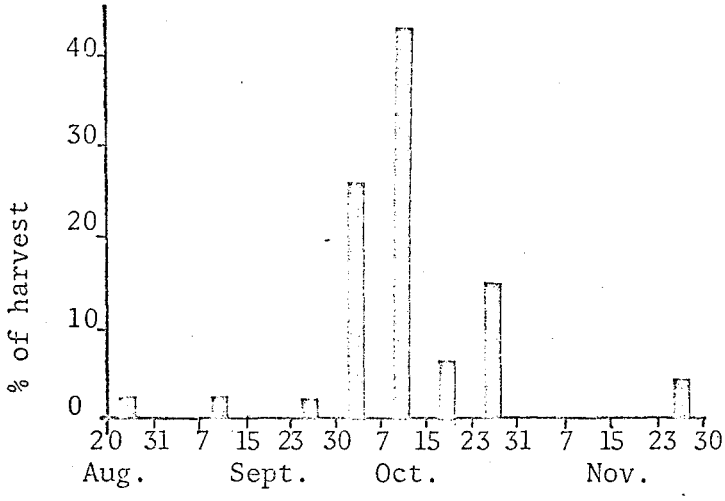
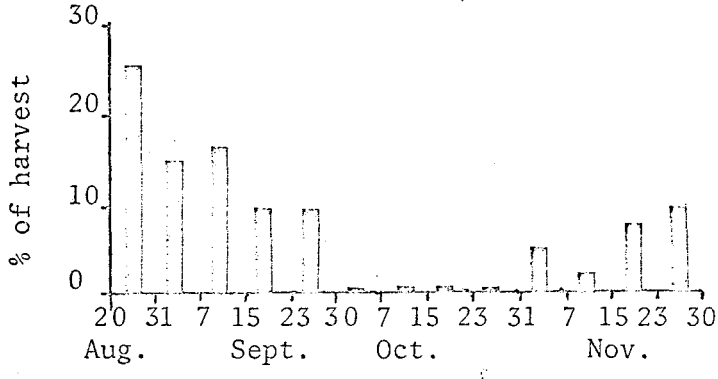
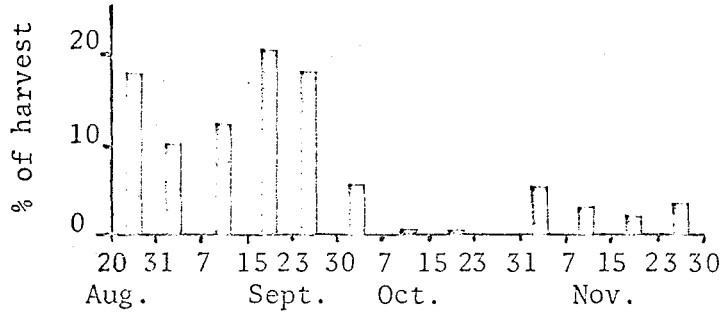
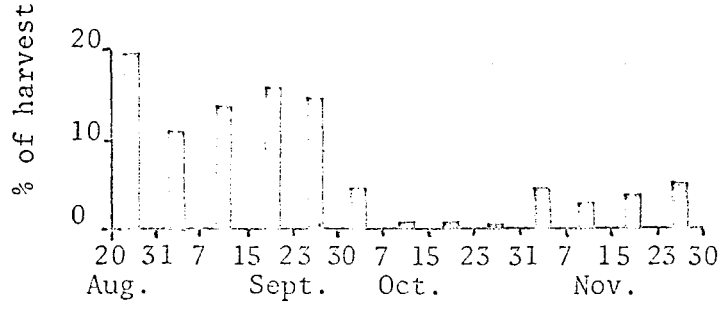
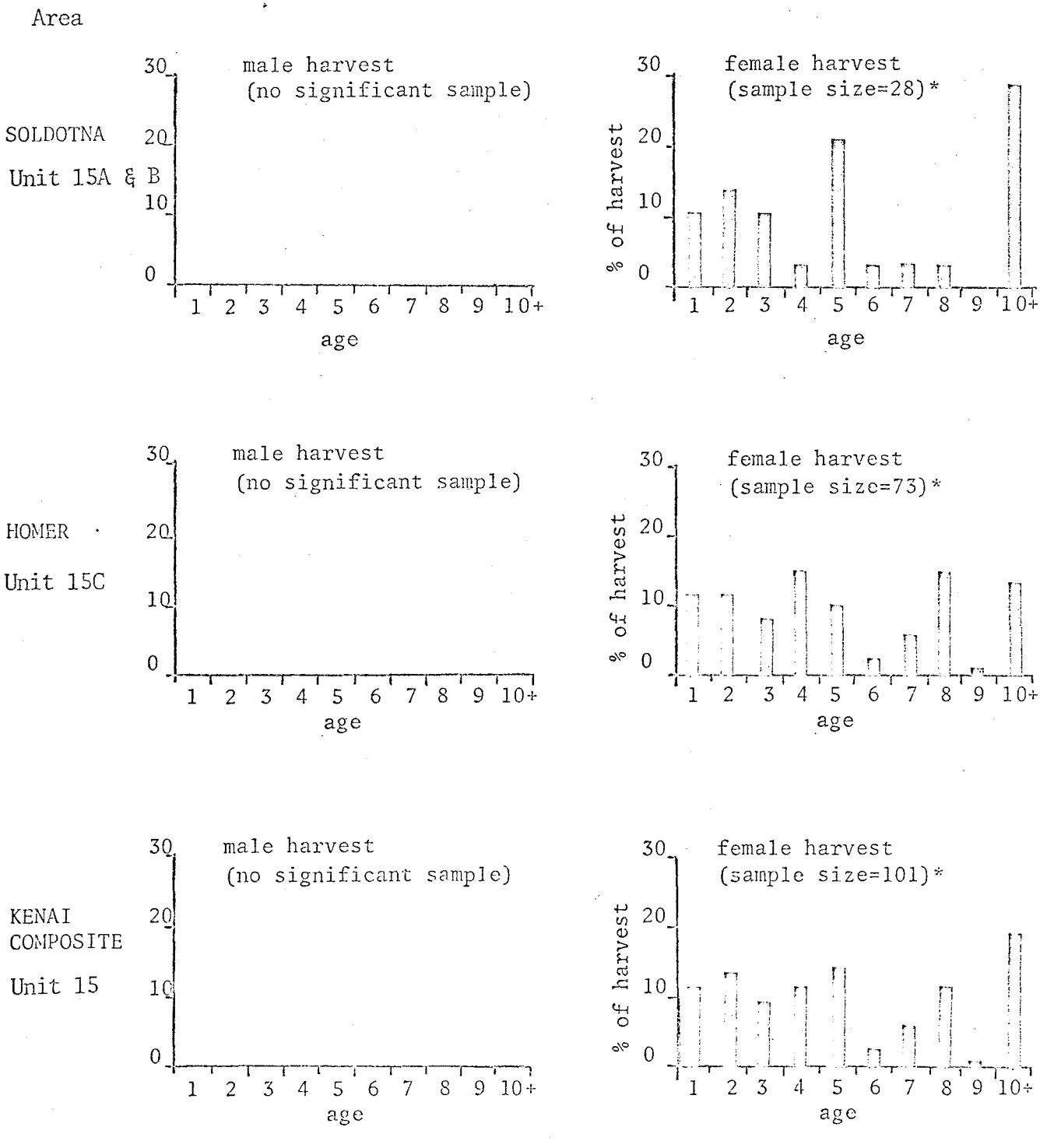
Unit or Subunit		Sample Size
20A females		47
20B males		273
20C males		597
20 composite males		1031

Figure 7. AGE COMPOSITION OF MOOSE HARVESTED FALL, 1965
(AGE DETERMINATION BASED ON CEMENTUM DEPOSITION)



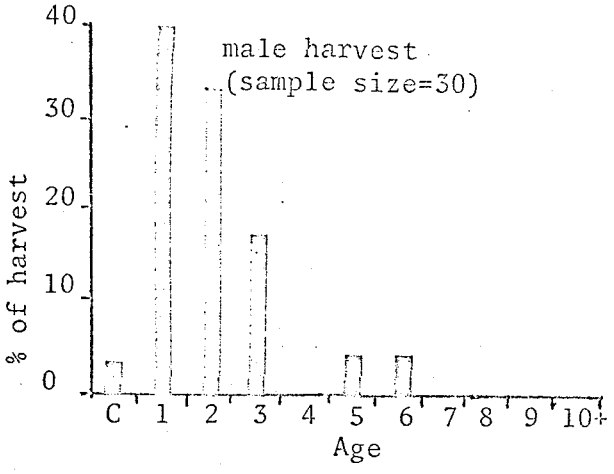
*calves deleted from sample.

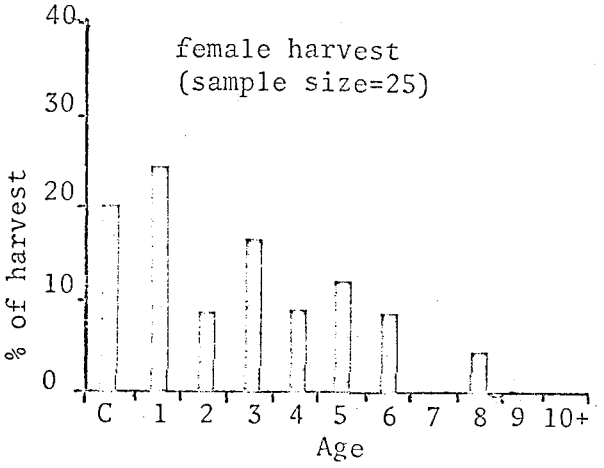
Figure 7. AGE COMPOSITION OF MOOSE HARVESTED FALL 1965, CONTINUED

Area

Haines

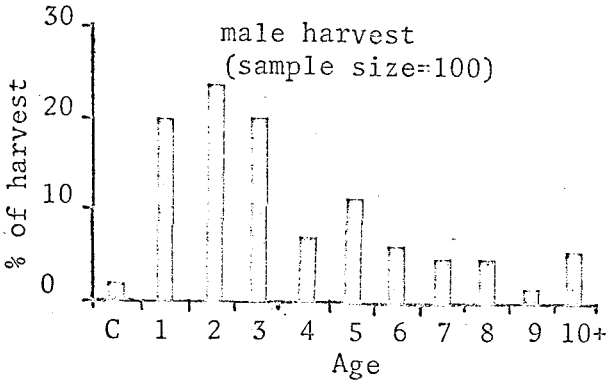
Unit 1

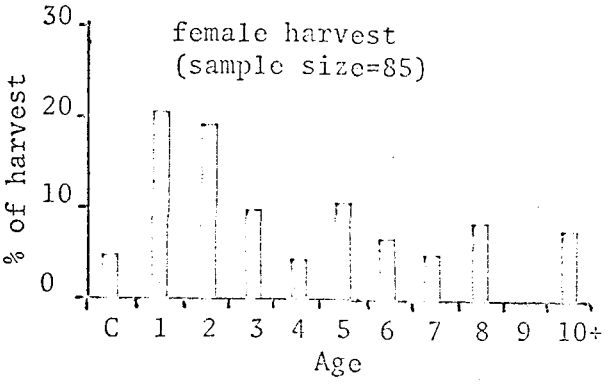




Yakutat

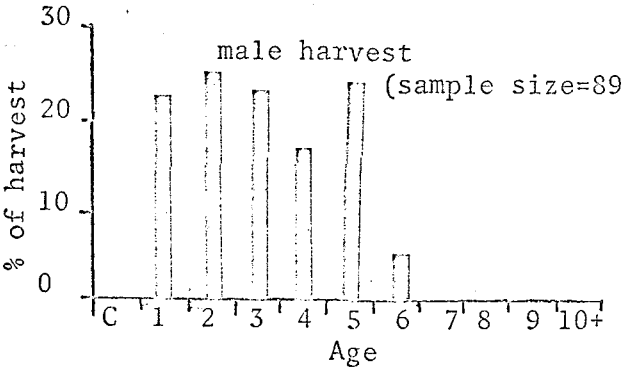
Unit 5

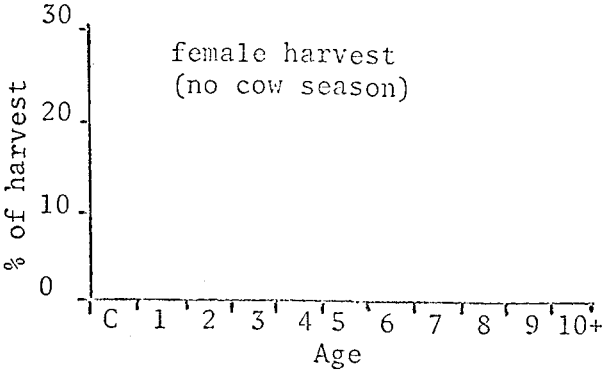




Denali

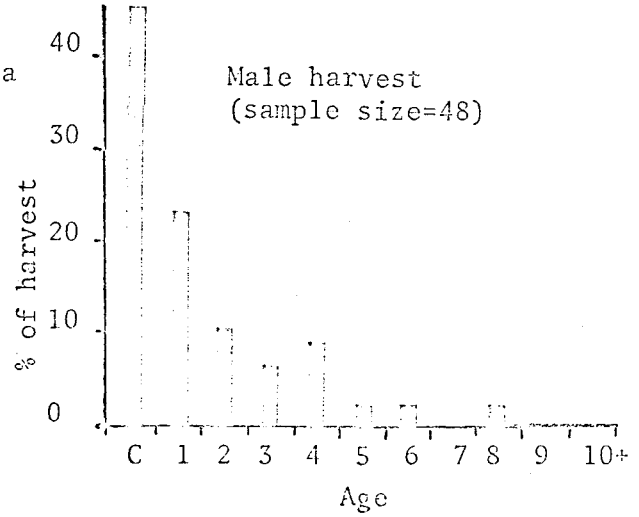
Unit 13





Matanuska

Subunit 14A



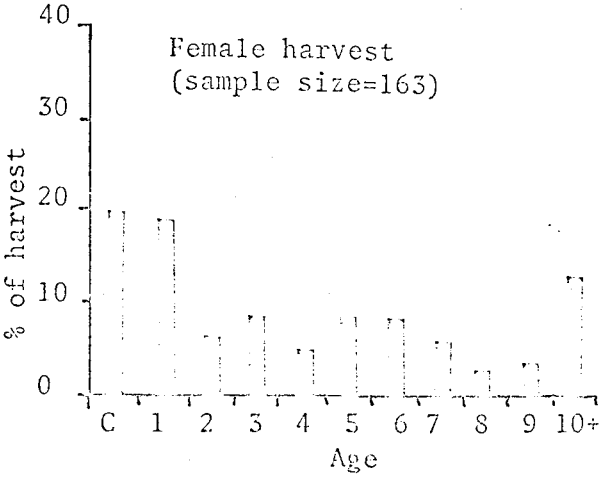
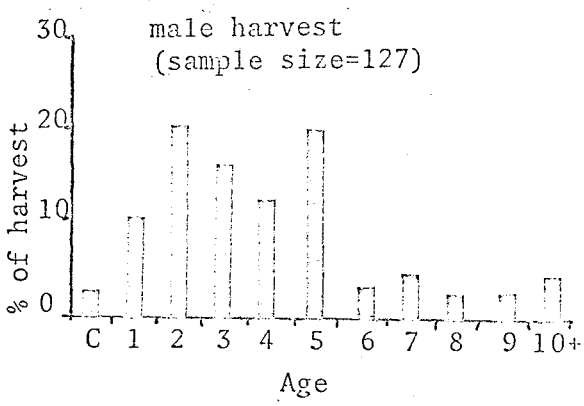
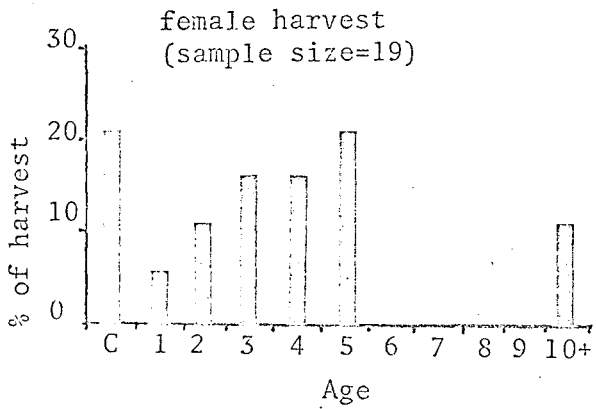


Figure 7. AGE COMPOSITION OF MOOSE HARVESTED FALL 1965, CONTINUED

Area

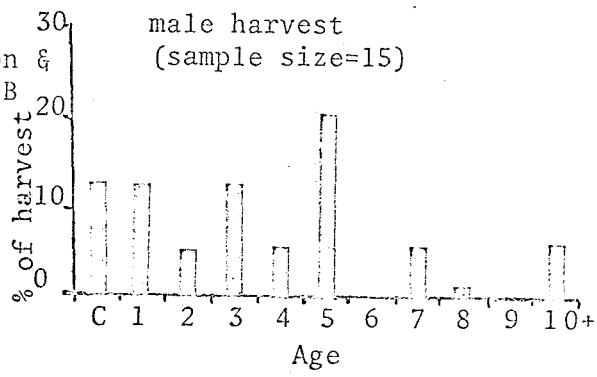
Unit 20

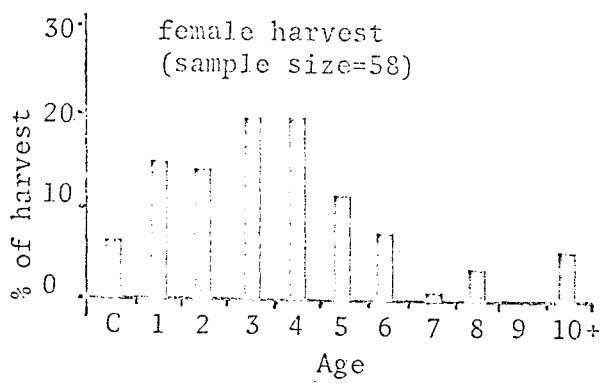




Ft.Richardson & Elmendorf AFB

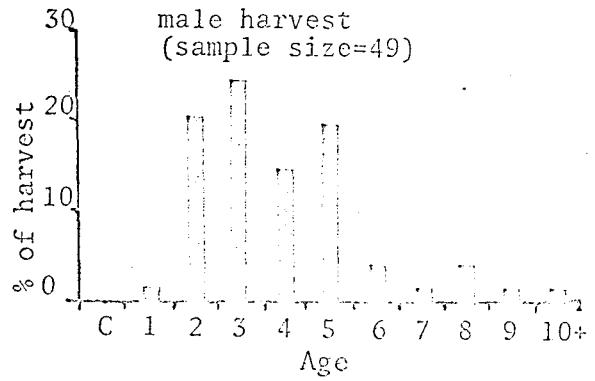
Subunit of Unit 14

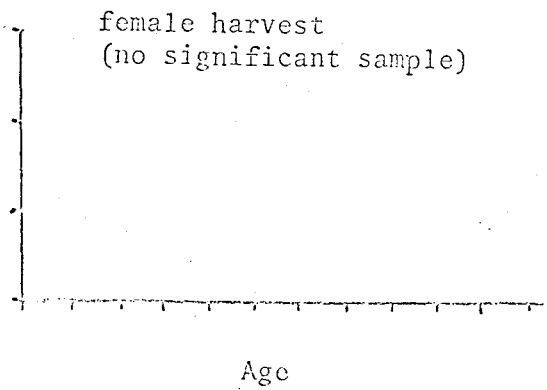




Taylor Hwy.

Subunit 20C





Generally the female population segment provides more insight into the overall population status as the harvest of males, particularly in lightly hunted areas, is biased toward the larger, hence, older animals.

In the heavily exploited areas the age composition of the male harvest may reflect the true age distribution of the population segment as hunters take the first available legal moose. In the Matanuska Valley few male moose live beyond eighteen months and intensive hunting is undoubtedly the mortality factor.

TABLE 4

MOOSE HARVESTS 1954 - 1965 MATANUSKA VALLEY, ALASKA

Year	Males	Antlerless (Cows and Calves)	
1954	275	0	
1955	275	0	
1956	275	0	
1957	275	0	
1958	300	0	
1959	300	0	
		0	
TOTAL	1700		
1960	300	150	x
1961	300	300	x
1962	350	1000	xx
1963	350	300	xxx
1964	250	275	xxx
1965	580	660	xxx
TOTAL	2130	2685	

Combined ♂ and ♀ harvest - 4,815

x permit hunts
xx registration hunt
xxx harvest tickets

Several patterns of age distribution are evident in the female population segment. In the Matanuska Valley where female moose have been harvested at varying intensities since 1960, the proportion of young animals, particularly calves and yearlings, is impressive. The rather uniform distribution among age classes two-years-old and older is rather surprising.

In Yakutat and Haines both herds seem highly productive with relatively few old (10+) animals.

The situation is reversed on the Kenai Peninsula where the harvests of female moose have been insignificant in relation to the total population. Here production, as measured by calves and yearlings in the harvest, is lower and seemingly the survival of various cohorts was erratic.

The extreme variation of survival of some year classes can, in some instances be correlated with unusual weather or moose population densities. For example, the nine-year-class on the Kenai is extremely weak. The class represents calves born in the spring of 1956. The winter of 1955-56 preceding the birth of this cohort was extremely severe and die-off of moose was noted in several parts of Southcentral Alaska. Presumably pregnant cows were in poor condition and failed to rear many calves or produced stillborn calves. Another example is found in the Denali Highway data. The four-year-class of males is weak and corresponds to the calves born in 1961. An exceptional accumulation of snow occurred during the winter of 1961-62 when these animals were calves and thousands of moose perished. The trend in the Denali area was first detected in 1964 when a cow season was held. These data reflect the reduction of the 1961 cohort more clearly than do the 1965 data.

In general it would appear that few, if any, of the populations checked are being fully exploited by hunting or hunting and predation. The precision in assessing population age structure provided by employing the cementum age determination technique should provide considerable insight into the dynamics of moose populations if adequate samples of materials can be collected from antlerless seasons or natural mortalities.

Non-hunting Moose Mortality

Alaska Railroad Kills

On April 22, 1966 , Game Biologists counted dead moose by airplane along the Alaska Railroad right-of-way from Wasilla to Talkeetna. From Wasilla to Willow four dead moose were seen. From Willow to Talkeetna 20 moose carcasses were observed.

From May 4 through 6 biologists walked from Willow to Talkeetna, about 40 miles, and counted 39 moose carcasses. From March 1965 to March 1966, the Alaska Railroad reported 12 moose killed. Data on the carcasses observed are presented in Table 5.

Anchorage Area

The Department recovered 32 dead moose of which 23 had been killed by motor vehicles. The balance were either "Nuisance" moose or were threatening the life

or property of citizens (Table 6). Biological specimens were collected from the majority of the moose. Measurements obtained of several moose are presented in Table 7.

Interior Alaska

In Table 8 the reported non-hunting mortality is presented by month, age and sex, and cause of death. Most of the mortality may be attributed to road kills, although a number of moose are shot and left illegally each year. During the winter a number were found dead or were weak and were dispatched. Not all of them could be examined but it seems likely they were starving. Most were taken in or near Fairbanks. As usual a few moose adopted yards, gardens, or shrubbery on private property and the Department was asked to remove them.

TABLE 5

ACCIDENTAL A.R.R. MOOSE KILLS - 1966

Accession Number	Animal	Sex	Age	Date Checked	Location	Salvaged ?	Remarks
24491	Moose	?	?	5/4/66	M.P. 186	Yes	Gut pile only remains
24492	Moose	?	?	5/4/66	M.P. 190	Yes	Hair left from fire
24493	Moose	♀	A	5/4/66	M.P. 191	Yes	
24494	Moose	♀	A	5/4/66	M.P. 191	Partial	Hindquarters salvaged
24495	Moose	♀	C	5/4/66	M.P. 191	Partial	Hindquarters salvaged
24496	Moose	♀	A	5/4/66	M.P. 192	Yes	Lower jaw missing
24497	Moose	♂	C	5/4/66	M.P. 192	No	
24498	Moose	♀	A	5/4/66	M.P. 193	No	
24499	Moose	♀	C	5/4/66	M.P. 194	No	Head was missing
24500	Moose	♀	A	5/4/66	M.P. 195	No	
24501	Moose	♂	A	5/4/66	M.P. 196	No	Found moose under bridge
24502	Moose	♀	C	5/4/66	M.P. 196	No	Head was missing
24503	Moose	?	A	5/4/66	M.P. 197	No	Very old kill
24504	Moose	♀	A	5/4/66	M.P. 197	No	
24505	Moose	?	A	5/4/66	M.P. 198	No	Moose was under water
24506	Moose	♀	A	5/4/66	M.P. 198	No	
24507	Moose	♂	C	5/4/66	M.P. 198	No	
24508	Moose	?	?	5/5/66	M.P. 199	Yes	Only hair remained and few bones
24509	Moose	?	?	5/5/66	M.P. 199	No	Only bones remained
24510	Moose	?	A	5/5/66	M.P. 199	Yes	
24511	Moose	?	?	5/5/66	M.P. 200	Partial	Head gone - close to active homestead
24512	Moose	?	?	5/5/66	M.P. 200	No	
24513	Moose	?	A	5/5/66	M.P. 201	Yes	
24514	Moose	?	A	5/5/66	M.P. 203	No	Found under bridge in stream
24515	Moose	?	A	5/5/66	M.P. 203	No	Found under bridge in stream
24516	Moose	?	A	5/5/66	M.P. 203	No	Found under bridge in stream

Table 5. (contd.) ACCIDENTAL A.R.R. MOOSE KILLS - 1966

Accession Number	Animal	Sex	Age	Date Checked	Location	Salvaged ?	Remarks
24517	Moose	?	C	5/5/66	M.P. 203	No	Old bone pile
24518	Moose	?	?	5/5/66	M.P. 204	No	Moose was across stream
24519	Moose	?	A	5/5/66	M.P. 206	No	Head was missing
24520	Moose	?	?	5/5/66	M.P. 207	Yes	Lower jaw was only thing found
24521	Moose	♂	A	5/5/66	M.P. 208	No	
24522	Moose	♀	A	5/5/66	M.P. 209	No	Could not get jaw
24523	Moose	?	A	5/5/66	M.P. 210	No	
24524	Moose	?	C	5/5/66	M.P. 210	No	
24525	Moose	?	A	5/5/66	M.P. 212	No	
24526	Moose	?	A	5/5/66	M.P. 213	No	Head was gone
24527	Moose	?	?	5/5/66	M.P. 215	Yes	Only hair and few small bones found
24528	Moose	?	A	5/6/66	M.P. 221	Partial	Head was gone
24529	Moose	?	A	5/6/66	M.P. 224	No	

TOTAL: 39 Moose; 4 ♂, 10 ♀ ,25 unknown
23 Adult, 7 calves, 9 unknown
Salvaged (by%): yes = 23.07%
no = 66.60%
partial = 10.33%

TABLE 6

REPORTED NON-HUNTING MOOSE MORTALITY, OCTOBER 1965 -- MARCH 1966, ANCHORAGE AREA

Date	Adults		Calves		Specimens				Cause of Death		
	♂	♀	♂	♀	None	Jaw	Repro.	Other	Road Kill	Illegal Kill	Other
1965 Oct.	0	0	1	0	1	0	0	0	1	0	0
Nov.		5	2	1	5	3	1	0	8	0	0
Dec.	0	5	3	3	3	6	2	1	9	0	2#
Jan.	1	3	0	0	1	3	2	0	3	0	1!
Feb.	2	3	0	1	1	5	2	0	1	0	5*
Mar.	1	1	0	0	0	2	1	0	1	0	1**
TOTALS	4	16	6	5	11	19	8	1	23	0	9

* 4 Dept. kills, 1 citizen kill
! Nuisance Moose
1 Dept. Kill, 1 cause unknown
** Citizen Kill

TABLE 7.

MEASUREMENTS OF MOOSE CARCASSES, ANCHORAGE, OCTOBER 1965--MARCH 1966
ALL MEASUREMENTS TO THE NEAREST CM.

Accession Number	Date	Total Weight	Body Weight	Total Length	Girth	Fore Leg	Hind Foot	Ear	Sex	Age
20011	31 Oct. 65				165	146	68	22.9		Calf
20013	6 Nov. 65			255	163	137	79	25.4		Calf
20015	1 Dec. 65			234	229	157	79	26.0		13
20022	16 Jan. 66			208		146	75	25.8		Adult
20023	24 Jan. 66			188	193	147	77	24.1		Adult
20024	26 Jan. 66			203	185	150	81	24.8		1
20025	4 Feb. 66			178	183	157	79	25.4		Adult
20026	19 Feb. 66			201	151	133	70	22.2		Calf
20028	28 Feb. 66			254		165	80	24.8		Adult
20029	28 Feb. 66			229	188	162	80	24.8		Adult
20030	8 Mar. 66			193	180	158	76	22.9		Adult
20031	14 Mar. 66				221	165	81	25.4		Adult

TABLE 8

REPORTED NON-HUNTING MOOSE MORTALITY, INTERIOR ALASKA, 1 JULY 1965 THROUGH 1 JULY 1966

Year	Month	Adults		Calves		Specimens				Cause of Death			Area
		♂	♀	♂	♀	None	Jaw	Repro.	Other	Road Kill	Illegal Kill	Other	
1965													
	July	0	2	0	0	1	1	0	0	1	1	0	Fairbanks
	Aug.	0	2	0	0	0	2	0	0	1	1	0	
	Sept.	0	6	0	0	0	6	0	0	2	4	0	
	Oct.												
	Nov.												
	Dec.	0	0	0	3	2	1	0	0	3	0	0	
		0	10	0	3	3	10	0	0	7	6	0	Totals, Fairbanks Area 1965
1966	Jan.	1	1	1	1	3	1	0	0	3	0	1*	Fairbanks
	Feb.	0	5	1	3	6	3	1	1	5	2	2*	
	Mar.	0	3	4	1	3	2	0	5	1	0	7**	
	April	1	2	0	0	0	3	0	0	1	0	2***	
	May	0	1	0	0	0	1	1	0	1	0	1***	
		2	12	6	5	12	10	2	6	11	2	13	Total, Fairbanks 1966
		2	22	6	8	15	20	2	6	18	8	13	Total, Fairbanks 1965-1966
1965	Aug.	0	2	0	0	0	2	0	0	1	1	0	Tok

* "Nuisance" moose in town, removed by Dept.
** 2 "nuisance" moose, 5 weak, possibly starving animals
*** Defense of life and property

Studies on Dental Characteristics of Moose Jaws

Anomalies

Among the moose jaws collected during 1965 and 1966 a number of anomalies in the form of supernumerary teeth and unusual structures or patterns of wear of the teeth or jaws were noted and photographed. Twenty-two anomalous jaws were processed from the 1965-66 harvest of which nine were collected in Unit 5 (Yakutat). The most common anomaly was the presence of one supernumerary incisor, formed in 12 of the 22 jaws examined.

Collections are being continued in order to obtain large enough samples to show trends and frequencies of various types of anomalies.

Tooth Eruption

A study of the eruption of teeth in calf and yearling moose was continued this year. In total, 270 yearling jaws and 161 calf jaws were measured and the progression and pattern of eruption were noted. The data has been compiled but it is not analyzed at this time. Specimens from the summer period are needed to complete an analysis of the progression and pattern of eruption throughout the year.

Sex and Age Composition

The aerial composition counts and moose sex and age ratios are summarized in Tables 9 through 32. Figures 8 through 13 illustrate the major counting areas and their subdivisions.

Counts made after bulls have dropped their antlers provide less data than earlier counts, but the percentage of calves and relative abundance of moose may be determined and compared from one year to the next in such areas.

Matanuska Valley

Data from the Matanuska Valley (Table 9 and 10) reflect relatively low numbers of bulls in the population which is consistent with known hunting pressure and harvest of bulls in this area. Consistent with the philosophy guiding the management of this area, however, production as measured by the number of calves: 100 cows is good. The incidence of twins per 100 cows with calves also reflects good production.

Numbers of moose observed indicate that the population is maintaining itself at a high level although the harvest has increased markedly, as discussed under "Harvest Statistics."

Lower Susitna Valley

The proportion of young bulls:100 adult bulls in this area reflects a higher survival of older bulls than is found in the Matanuska Valley (Table 12). The relative proportion of bulls to cows, however, is lower than in the adjacent Matanuska area, which may reflect more difficult overall survival in this area of deep snow cover. Calf production is considered fair at 31 calves:100 cows, even though the production of twins is comparable to that in the Matanuska Valley.

TABLE 9

MOOSE POPULATION COMPOSITION COUNTS, MATANUSKA VALLEY, 1965

Area	Flying Time	Young ♂	Adult ♂	Total ♂	♀ W/0	♀ W/1	♀ W/2	♀ Total	Unid. Adults	Calves	Total Moose	Calf % in Herd	Moose per Hour
MATANUSKA VALLEY													
1. Above Timberline	2.00	30	17	47	114	76	6	196	1	88	332	26.5	166.0
1. Below Timberline	3.80	8	2	10	29	22	2	53	1	26	90	28.9	23.7
TOTAL THIS AREA	5.80	38	19	57	143	98	8	249	2	114	422	27.0	72.8
2.	2.40	1	1	2	14	11	0	25	0	11	38	28.0	19.0
3.	1.00	2	1	3	17	13	1	31	0	15	49	30.6	49.0
4.	1.70	0	1	1	11	26	0	37	0	26	64	40.6	37.0
5. Above Timerline		21	12	33	76	75	7	158	5	89	285	31.2	
5. Below Timberline		23	6	29	63	57	4	124	0	65	218	29.8	
TOTAL THIS AREA	4.25	44	18	62	139	132	11	282	5	154	503	30.6	118.0
6.	1.25	2	0	2	2	2	0	4	0	2	8		6.0
7. All Counts Above Timberline	2.50	21	40	61		34	4	149	0	42	252		100.8
TOTAL ALL AREAS	19.80	108	80	188	336	316	24	767	7	334	1336	25.0	67.0

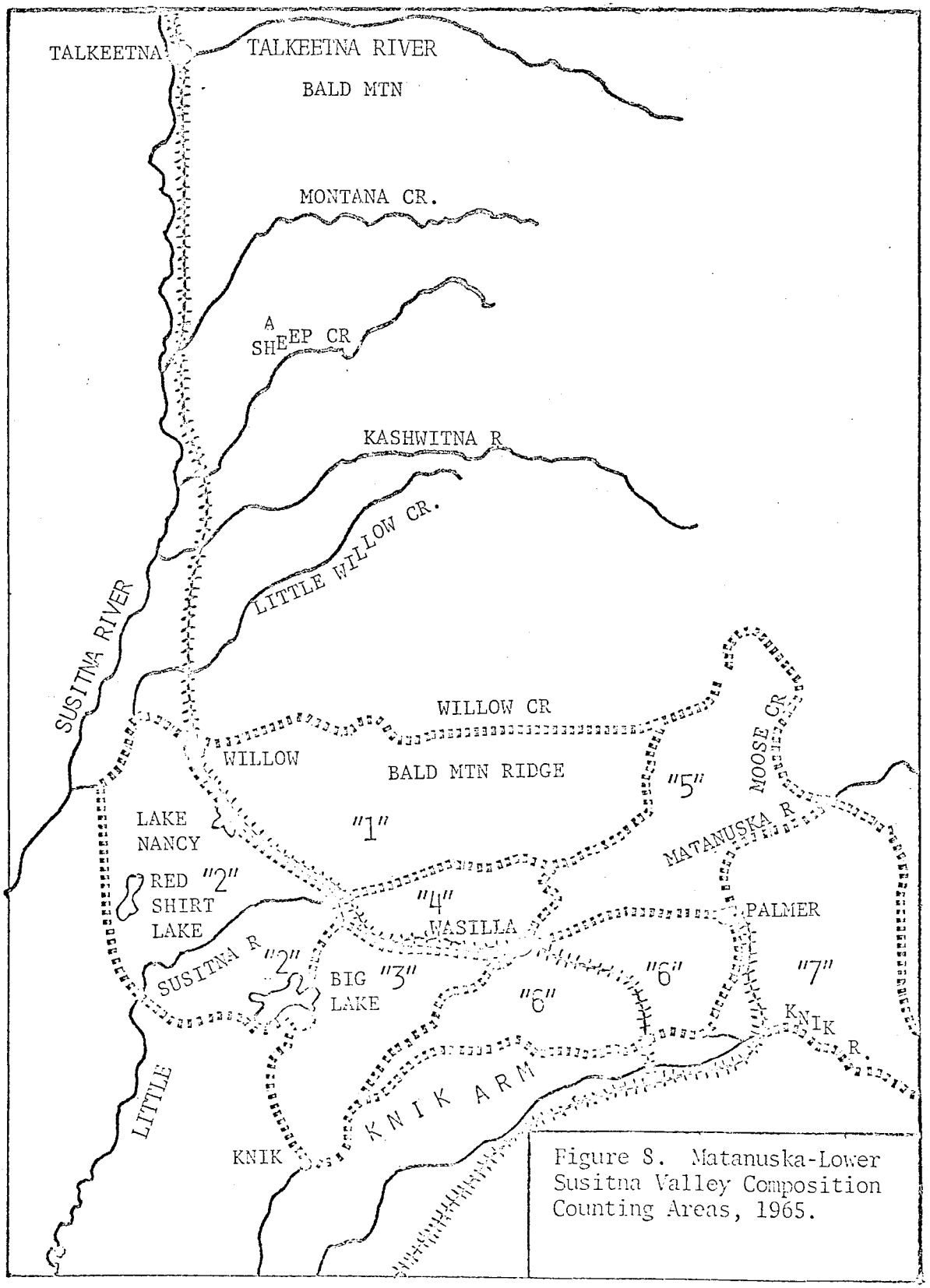


Figure 8. Matanuska-Lower Susitna Valley Composition Counting Areas, 1965.

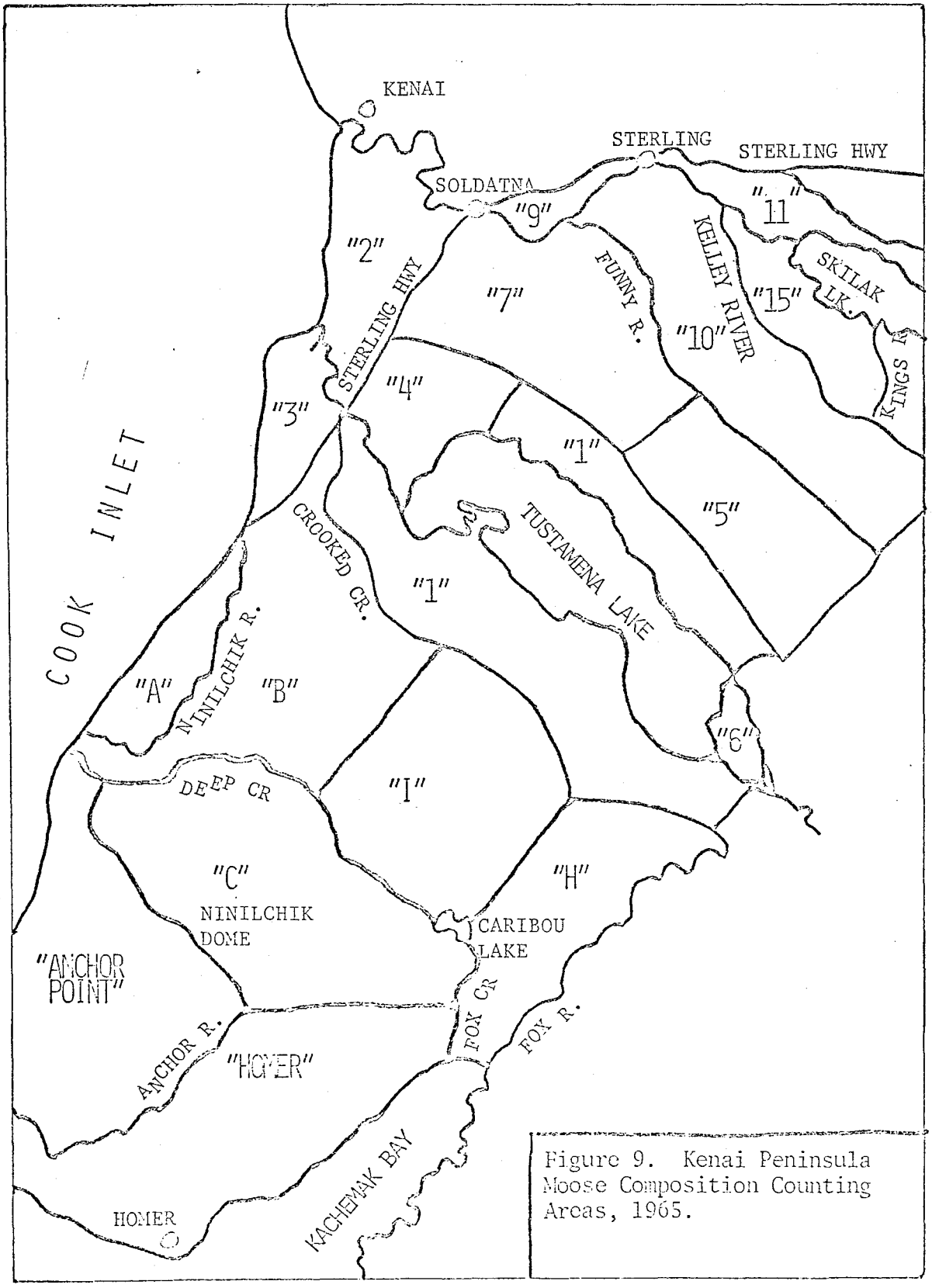


Figure 9. Kenai Peninsula Moose Composition Counting Areas, 1965.

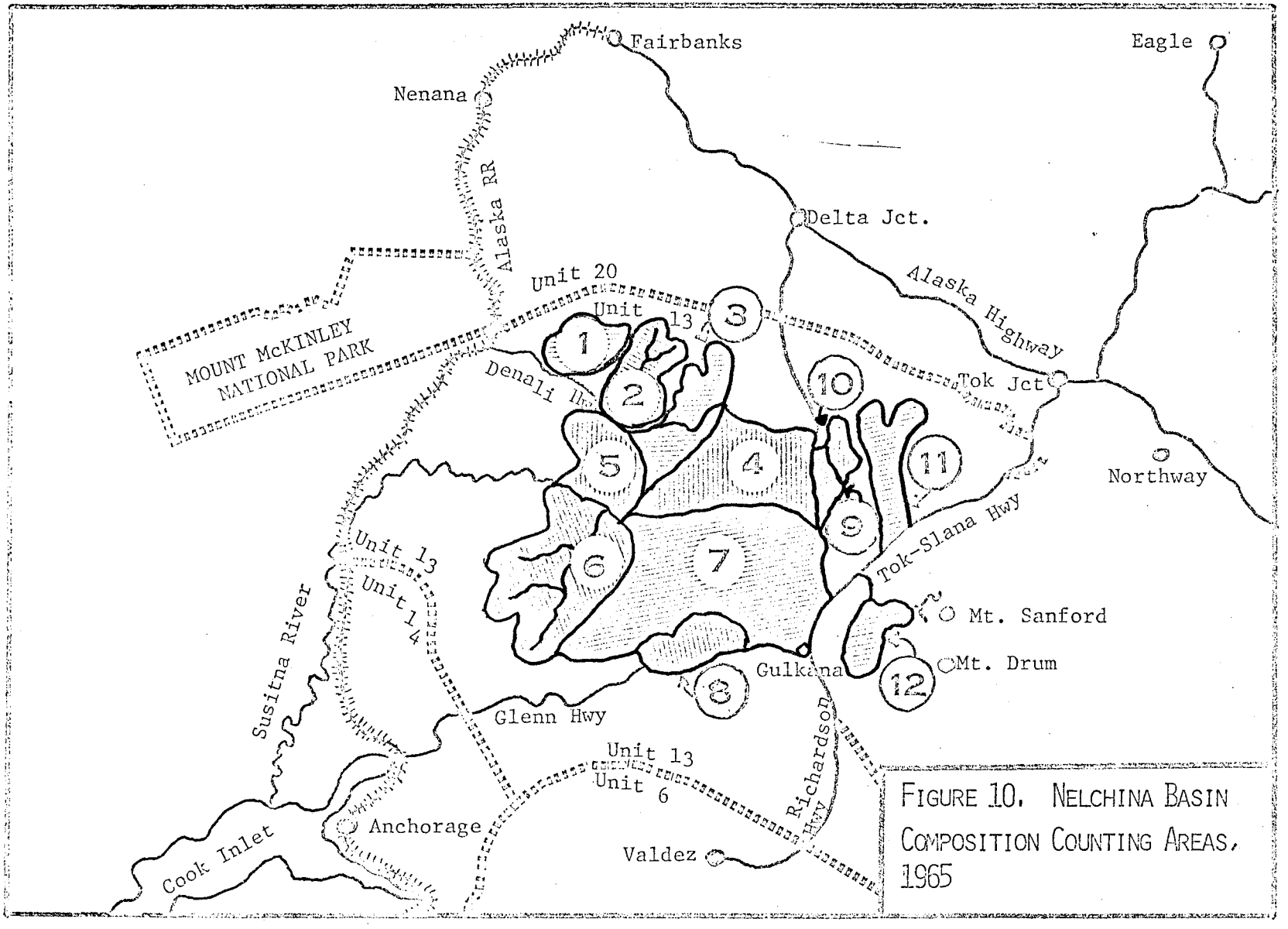


FIGURE 10. NELCHINA BASIN COMPOSITION COUNTING AREAS, 1965

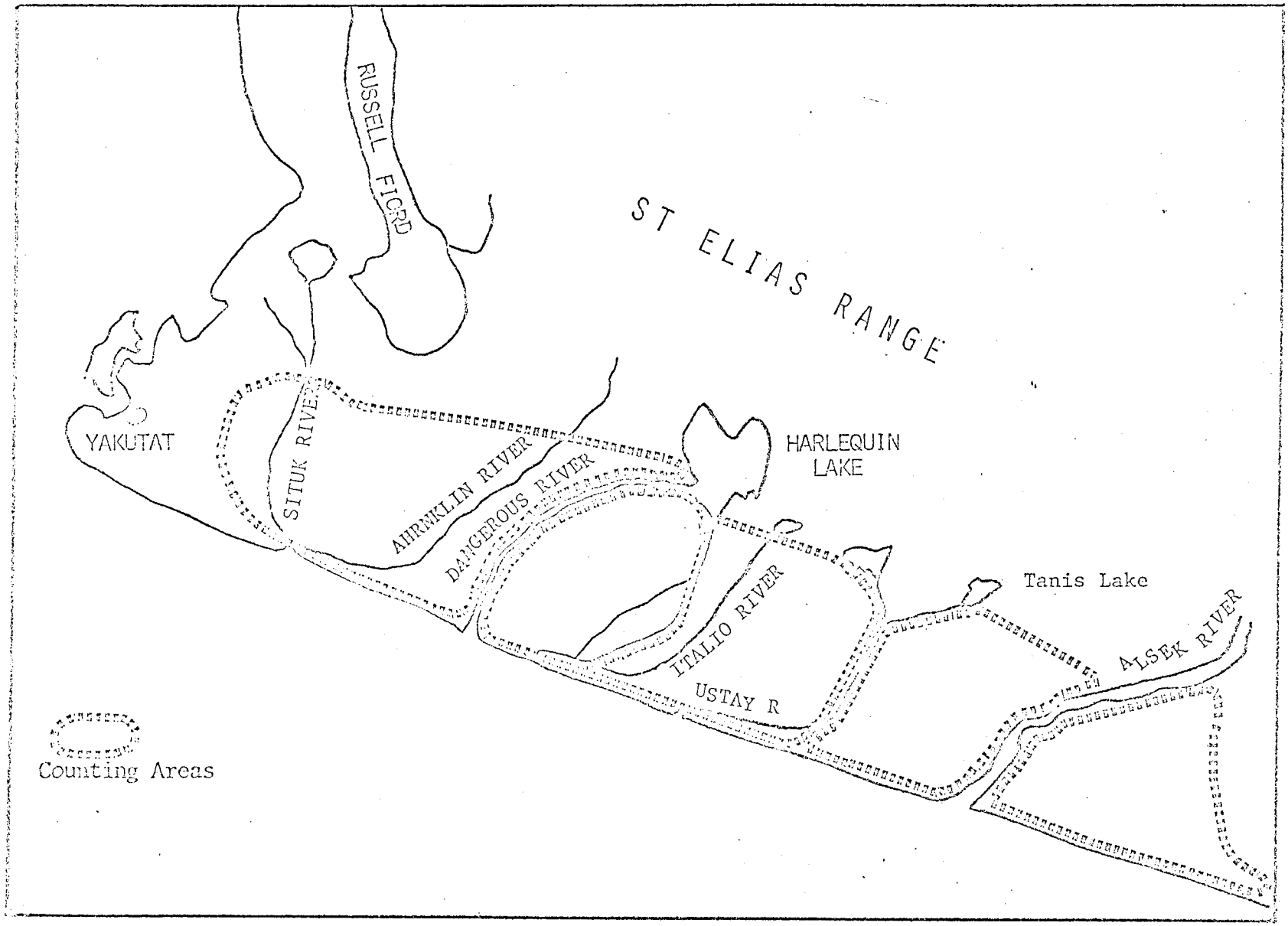


Figure 11. Yakutat composition count areas, 1965.

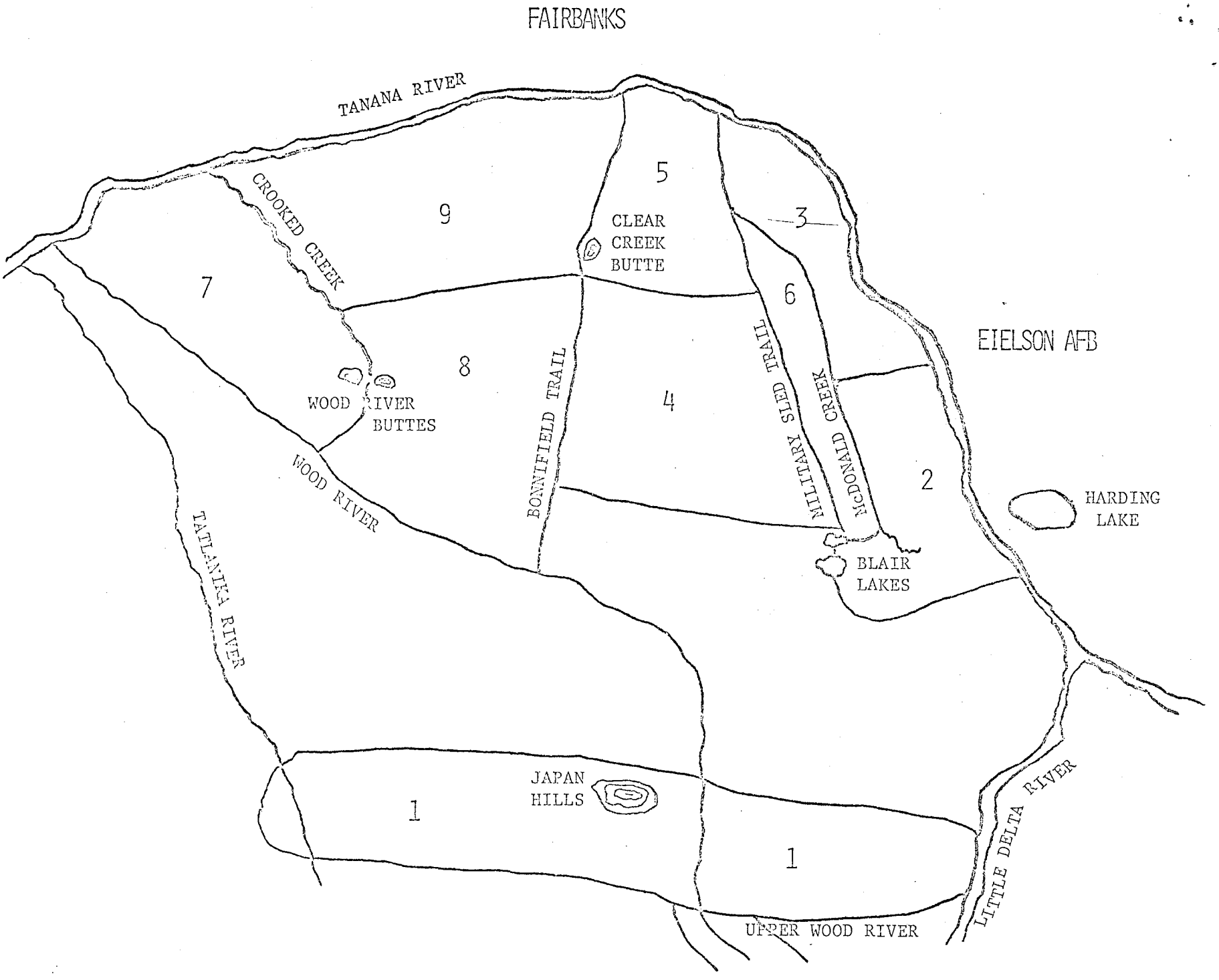


Figure 12. Tanana Flats and Upper Wood River Composition Counting Areas, 1965

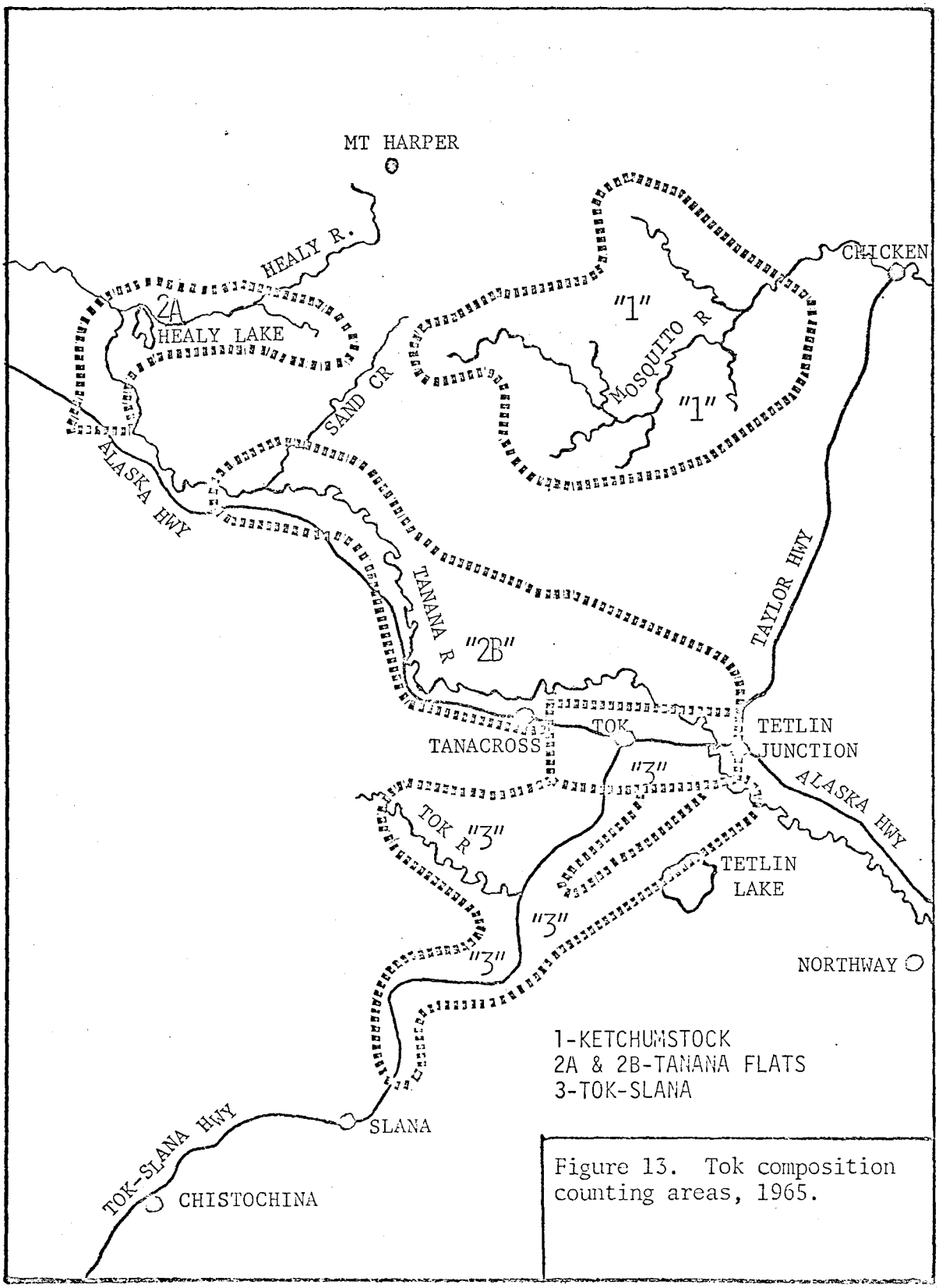


Figure 13. Tok composition counting areas, 1965.

TABLE 10

MOOSE SEX AND AGE COMPOSITION, MATANUSKA VALLEY, 1965

Area	Total Bulls per 100 Cows	Young Bulls per 100 Adult Bulls	Calves per 100 Cows	Twin Calves per 100 Cows w/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls per 100 Bull Calves	Young Bulls per 100 Cows	Moose per Hour	Total Moose
MATANUSKA VALLEY										
1. Above Timberline	24	176	45	7	27	9	68	15	166	332
1. Below Timberline	4	400	49	8	29	9	62	15	23.7	90
TOTAL THIS AREA	8	200	46	8	27	9	67	15	73	422
2.	8	200	44	0	28	3	18	4	19	38
3.	10	200	48	7	31	4	26	6	49	49
4.	3	0	70	0	41	0	0	0	37	64
5. Above Timberline	21	175	56	9	31	8	47	13	--	285
5. Below Timberline	23	383	52	7	30	11	70	19	--	218
TOTAL THIS AREA	22	24	55	8	31	9	57	16	118	503
6.	50	--	50	0	25	25	200	50	6	8
7. All Counts Above Timberline	41	66	28	11	17	8	100	14	100	252
TOTAL ALL AREAS	25	135	44	7	25	8	65	14	67	1336

TABLE 11

MOOSE POPULATION COMPOSITION COUNTS, LOWER SUSITNA RIVER, 1965

Area	Flying Time**	Young	Adult	Total	W/O	W/1	W/2	Total	Unid. Adults*	Total Adults	Calves	Total Moose
Willow-Little Willow above timberline. Bratlie & Didrickson 4 orange tags 2 white tags	3.33	31	48	79	369	144	7	520	4	603	158	761
Willow-Little Willow below timberline Bratlie & Didrickson	0.85	5	5	10	35	21	1	57	1	68	23	91
TOTALS THIS AREA	4.18	36	53	89	404	165	8	577	5	671	181	852
Little Willow-Kashwitna above timberline Bratlie & Didrickson	0.75	3	9	12	37	11	4	52	1	65	19	84
Little Willow-Kashwitna below timberline Bratlie & Didrickson	1.5	1	5	6	34	22	1	57	0	63	24	87
TOTALS THIS AREA	2.25	4	14	18	71	33	5	109	1	128	43	171
Kashwitna-Montana above timberline Bratilie & Didrickson	2.15	17	61	78	203	74	2	279	0	357	78	435
Montana-Talkeetna above timberline Bratlie & Didrickson	0.5	4	17	21	51	16	1	68	0	89	18	107
Montana-Talkeetna below timberline Bratlie & Didrickson	0.5	1	4	5	8	5	1	14	0	19	7	26
TOTALS THIS AREA	1.0	5	21	26	59	21	2	82	0	108	25	133
TOTALS ALL AREAS	9.58	62	149	211	737	293	17	1047	6	1264	327	1591

*. All are Yearlings. ** Flying time in hours and hundredths

TABLE 12

MOOSE SEX AND AGE COMPOSITION, LOWER SUSITNA VALLEY, 1965

Area	Total Bulls per 100 Cows	Young Bulls per 100 Adult Bulls	Calves per 100 Cows	Twin Calves per 100 Cows w/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls per 100 Bull Calves	Young Bulls per 100 Cows	Moose per Hour	Total Moose
Willow-Little Willow above Timberline	15	65	30	5	21	4	4	6	229	761
Willow-Little Willow below Timberline	18	100	40	5	25	5	43	9	107	91
TOTAL THIS AREA	51	68	31	5	21	4	4	6	204	852
Little Willow-Kashwitna above Timberline	17	29	39	13	25	2	18	36	71	71
Kashwitna-Montana	28	28	28	3	18	4	44	6	202	435
Montana-Talkeetna above Timberline	31	24	26	6	17	4	44	6	214	107
Montana-Talkeetna below Timberline		25	36	17	27	4	28	7	52	26
TOTAL THIS AREA	32	24	30	9	19	4	40	6	133	133
TOTAL ALL AREAS	20	42	31	8	21	4	39	6	166	1591

Homer

In portions of this area the proportion of bulls is quite low, and may reflect excessive pressure on the male segment of the population (Tables 13 and 14). The numbers of moose and moose seen per hour suggest that there has been no significant change in the total population. As discussed under "Production", the wide-range in fetus sizes from in utero examinations, and the possibility that many cows had not bred, may indicate a shortage of breeding bulls in areas subject to heavy hunting pressure. Calf production ranges from poor to good, depending on the area.

Chugach National Forest

Limited data on sex and age composition are available for this area due to the counts being conducted after most males had shed their antlers. The overall percentage of calves in the area is somewhat low, although in the Quartz and Portage Creek areas better survival of calves is suggested (Tables 15 and 16).

Nelchina Basin

Within the Nelchina Basin the characteristics of moose populations in the various areas present strong contrasts (Tables 17 and 18). In areas accessible to hunters, the proportion of bulls in the population is low, compared to more inaccessible areas.

The proportion of calves in the population likewise is variable. In general, production appears best in areas where hunting pressure is greater, and proportions of bulls are somewhat depressed. Evidently, the maximum production of harvestable animals in accessible areas is not being attained by limiting the harvest to bulls.

Yakutat

Although the in utero examinations (see "Production") indicate that pregnancy and twinning rates are phenomenally high in this area, the proportion of calves (Tables 19 and 20) surviving to six months represents only fair production. This suggests that mortality among calves between birth and six months of age is fairly high. Although it is difficult to measure moose populations in absolute terms, generally speaking, the moose population is known to be high in the area, and in some places the browse shows the effects of a high population. A situation similar to that on the Tanana Flats may be developing in the Yakutat area.

TABLE 13

MOOSE POPULATION COMPOSITION COUNTS - HOMER AREA, DECEMBER 1965

Area	Date	Flying Time	Large ♂	Small ♂	Total ♂	♀ W/0	♀ W/1	♀ W/2	Total ♀	Lone Calf	Total Calves	Unid. Adults	Total Adults	Total Moose	Moose Per Hour
H	11/30 12/ 1.	2.50	9	5	14	56	21	2	79	0	25	0	93	118	47
A.P.	12/1,2	5.28	22	24	46	196	106	6	308	3	121	0	354	475	90
Hom.	12/2,4	5.62	8	7	15	189	83	5	277	1	94	0	292	386	69
C	12/8,9	3.80	39	23	62	155	32	2	189	4	40	0	251	291	77
3	12/16	3.50	0	4	4	20	10	0	30	1	11	0	34	45	13
A	12/17	3.50	8	12	20	45	21	2	68	2	27	0	88	115	33
B	12/17	2.75	0	0	0	21	6	0	27	0	6	0	27	33	12
1	12/21	3.50	2	0	2	41	7	2	48	0	7	0	50	57	16
I	12/16 12/17	2.67	177	37	214	104	27	1	138	1	30	3	349	379	142
Unit Totals		33.12	265	112	377	827	313	20	1158	12	351	3	1538	1899	57

TABLE 14

MOOSE SEX AND AGE COMPOSITION, HOMER AREA, 1965

Area	Total Bulls Per 100 Cows	Young Bulls Per 100 Adult Bulls	Calves Per 100 Cows	Twin Calves Per 100 Cows W/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls Per 100 Cows	Moose Per Hour	Total Moose
Kenai Peninsula Below Tustemena Lake									
H	18	55	32	9	21	4	6	47	118
A.P.	15	109	39	5	25	5	8	90	475
Homer	5	87	34	6	24	1.8	2.5	69	386
C	33	59	16	6	14	8	12	77	291
3	13	8	36	0	24	9	13	13	45
A	29	150	40	8	23	10	18	33	115
B	-	-	22	-	18	-	-	12	33
1	4	-	15	22	15	-	-	16	57
1	162	21	29	3.5	8	10	28	142	379
TOTALS	33	42	31	6	19	6	10	57	1899

TABLE 15

MOOSE POPULATION COMPOSITION COUNTS, UNIT 7 - CHUGACH NATIONAL FOREST, HELICOPTER COUNTS, JANUARY 1966

Area	Date	Flying Time	Adult ♂	Young ♂	Total ♂	♀ W/O	♀ W/1	♀ W/2	Total ♀	Lone Calf	Total Calves	Total Adults	Total Moose	Moose per Hour
Quartz Creek	1/11-1/12	3.25	1	0	1	76	30	1	107	2	34	108	142	43
Juneau Creek	1/11	2.25	0	6	6	145	20	0	165	1	21	171	192	85
Trail River	1/12-1/13	2.67	1	0	1	36	10	0	46	1	11	47	58	21
Twenty-Mile	1/14	1.50	2	0	2	62	14	3	79	0	20	81	101	67
Portage Creek	1/14	.90	0	2	2	28	13	3	44	0	19	46	65	72
Placer Creek	1/14	.75	0	2	2	15	6	0	21	0	6	23	29	41
TOTALS		11.33	4	10	14	362	93	7	462	4	111	476	587	52

TABLE 16

MOOSE SEX AND AGE COMPOSITION, CHUGACH FOREST, JANUARY 1966*

Area	Calves per 100 Cows	Twin Calves per 100 Cows w/Calf	Calves % in Herd	Moose per Hour	Total Moose
Quartz Creek	34	3	24	43	142
Juneau Creek	13	0	11	85	192
Trail River	24	0	19	21	58
Twenty Mile	25	21	20	67	101
Portage Creek	43	23	29	72	65
Placer Creek	29	0	21	41	29
	—	—	—	—	—
	—	—	—	—	—
TOATALS	23	7	19	52	587

* Counts made after males had shed antlers, most meaningful statistic is percent calves in total herd as many males counted as females.

TABLE 17

MOOSE POPULATION COMPOSITION COUNTS, NELCHINA BASIN, 1965

Area	Flying Time	Young ♂	Adult ♂	Total ♂	♀ W/1	♀ W/2	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose per Hour	♀ W/0
1. Wells Creek, Upper Nenana	4.3	32	54	86	25	1	184	0	271	27	297	9.1	69	158
2. East Drainages of Maclaren River	4.8	23	70	93	44	4	181	0	274	52	326	16.0	68	133
3. Upper Susitna	9.2	60	121	181	51	2	309	0	490	54	544	9.9	59	256
4. West Fork, Maclaren River	1.1	9	44	53	40	1	180	0	233	42	275	15.3	250	139
5. Alphabet Hills	13.6	98	276	374	310	4	921	2	1297	318	1615	19.5	118	607
6. Clearwater Maclaren above Denali Hwy.	5.3	42	62	104	89	1	336	0	440	91	531	17.1	100	246
7. Middle Susitna, Jay Cr. & Coal Cr.	6.3	32	108	140	38	0	234	0	374	38	412	9.5	65	196
8. Paxson Lake to Sourdough	3.75	7	37	44	50	0	148	0	192	50	242	20.7	64.5	98
9. Paxson to Sourdough East of Highway	3.2	7	20	27	47	2	88	0	115	51	116	30.7	52	39
10. Gakona Glacier	2.2	38	128	166	57	1	291	0	457	59	516	11.4	235	233
11. Mt. Drum and Mt. Sanford Areas	3.3	34	74	108	25	0	134	1	243	25	268	8.6	81	109
12. Lake Louise Flats	5.5	4	9	13	11	1	40	0	53	13	66	18.7	12	28

(continued)

TABLE 17. (Contd.) MOOSE POPULATION COMPOSITION COUNTS, NELCHINA BASIN, 1965.

Area	Flying Time	Young ♂	Adult ♂	Total ♂	♀ W/1	♀ W/2	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose Per Hour	♀ W/0
13. Big Oshetna	2.4	5	10	15	19	0	86	0	101	19	120	15.8	50	67
14. Black River-Goose Creek	3.5	20	33	53	40	0	185	0	238	40	278	14.3	80	145
15. Klutina - Tazlina Areas	4.1	14	55	69	10	1	99	0	168	12	179	6.7	44	88
16. Chistochina Area	3.0	35	136	171	38	2	151	0	322	42	364	11.6	121	111
TOTALS ALL AREAS	89.2	460	1237	1697	894	20	3567	3	5267	933	6700	15.0	70	2653

TABLE 18

MOOSE SEX AND AGE COMPOSITION, NELCHINA BASIN, 1965

Area	Total Bulls Per 100 Cows	Young Bulls Per 100 Adult Bulls	Calves Per 100 Cows	Twin Calves Per 100 Cows w/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls Per 100 Bull Calves	Young Bulls Per 100 Cows	Moose Per Hour	Total Moose
1. Wells Creek, Upper Nenana	47	17	15	4	9	11	237	17	69	297
2. East Drainages of Maclaren River	13	33	29	8	16	7	88	13	68	326
3. Upper Susitna	59	50	17	4	10	11	222	19	59	544
4. West Fork, Maclaren River	29	20	23	3	15	3	43	5	250	275
5. Alphabet Hills	41	36	36	12	20	6	62	11	118	1615
6. Clearwater Maclaren above Denali Hwy.	31	68	27	1	17	8	92	13	100	531
7. Middle Susitna, Jay Cr. & Coal Cr.	60	30	16	0	10	8	168	14	65	412
8. Paxson Lake to Sourdough	30	19	34	0	21	3	28	5	65	242
9. Paxson to Sourdough East of Highway	31	35	58	4	31	4	27	8	52	116
10. Gakona Glacier	57	30	20	2	11	7	128	13	235	516
11. Mt. Drum and Mt. Sanford Areas	85	43	19	0	9	13	272	25	81	268
12. Lake Louise Flats	33	44	33	8	19	6	53	10	12	66
13. Big Oshetna	12	50	22	0	16	4	50	6	50	120
14. Black River-Goose Cr.	29	61	22	0	14	7	100	11	80	278
15. Klutina-Tazlina Areas	70	25	12	9	7	8	58	14	44	179
16. Chistochina Area	113	26	28	5	12	10	167	23	121	364
TOTAL ALL AREAS	48	37	26	2	15	7	98	13	70	6200

TABLE 19

MOOSE POPULATION COMPOSITION COUNTS, YAKUTAT, 1965

Area	Flying Time	Young ♂	Adult ♂	Total ♂	♀ W/1	♀ W/2	♀ W/0	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose Per Hour
East River to Alsek River		7	22	29	6	0	17	23		52	6	58	10.3	18.3
Alsek River to Tanis River		8	37	45	18	1	54	73		118	20	138	14.5	46.0
Dangerous River to Situk River		11	28	39	16	1	76	93		132	18	150	10.4	56.2
Italio River to Dangerous River		4	22	26	16	0	49	65		91	16	107	15.0	32.9
Italio River to Tanis River		1	18	19	14	2	31	47		66	18	84	21.4	33.6
TOTAL	13.50	31	127	158	70	4	227	301		459	78	537	14.5	40.2

TABLE 20

MOOSE SEX AND AGE COMPOSITION, YAKUTAT, 1965

Area	Total Bulls Per 100 Cows	Young Bulls Per 100 Adult Bulls	Calves Per 100 Cows	Twin Calves Per 100 Cows w/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls Per 100 Bull Calves	Young Bulls Per 100 Cows	Moose Per Hour	Total Moose
East River to Alsek River	126	32	26	0	10	12	233	30	18	88
Alsek River to Tanis River	62	22	27	5	15	6	80	11	45	138
Dangerous River to Situk River	42	39	19	6	10	7	122	12	56	150
Mid Italio River to Dangerous River	40	18	25	0	15	4	50	6	33	107
Mid Italio River to Tanis River	40	6	38	13	21	1	11	2	34	84
TOTAL ALL AREAS	52	24	25	5	16	6	79	10	40	537

Tanana Flats

A comparison of the composition counts of 1965 with those of 1962 (Tables 21 and 22) shows a decline in calves per 100 female moose from 42 considered "good" in 1962 to 26 "fair" in 1965. The incidence of twins per 100 females with calves also declined sharply, from 4.7 to 0.7. The percentage of calves in the herd also declined, all of which strongly suggests a marked decline in productivity between 1962 and 1965. Other ratios were similar in the two years except that young males:100 male calves increase considerably which may also reflect poor calf production. The areas where counting was done are shown in Figure 12.

Several factors exist which probably affect the decline in productivity. Basically it appears that the moose population exceeds the carrying capacity of the winter range. Preferred browse species over much of the area reflect heavy use. In other areas browse is no longer available to moose due to growth of the plants.

The reproductive performance of moose reflects the condition of the range quite rapidly and it it likely that the characteristics of the population on the Tanana Flats are symptomatic of insufficient food during the winter.

Upper Wood River

The moose population on the Upper Wood River and area 1 (Figure 12) may constitute a population somewhat distinct from those on the Tanana Flats and are treated separately in this report. However, the characteristics of the sample are not greatly different than those of the Tanana Flats, particularly the proportion of calves found (Tables 23 and 24).

Tok

Because of the small sample sizes in the sub-areas of area 3 near Tok the total for area 3 is probably most meaningful (Table 25 through 28). Only sub-areas 2B and 3 were surveyed (Figure 13).

Calf production was only fair although the proportion of twin calves was comparatively high. Other than the high twin incidence the characteristics of the population were similar to the Tanana Flats. The condition of the range in that area is not well known at this time and no conclusions can be drawn about the relationship between production and range conditions. The sample from 2B, although small, exhibits similar characteristics to area 3.

Yukon-Koyukuk River Valleys

Moose composition counts were conducted in portions of the Yukon and Koyukuk River Valleys late in March 1966 (Table 29). A figure of this area is not included. At that time moose were concentrated on or near the bars and islands supporting willow stands along the Yukon River. Young willow stands showed heavy use wherever they were found. Moose were abundant in concentrations along the Yukon, and were abundant and distributed throughout much of that part of the Koyukuk surveyed. Although the percentage of calves found was not high (about 20 percent) the incidence of twins was relatively good - about 7 percent. The animals appeared to be in good condition.

TABLE 21

MOOSE POPULATION COMPOSITION COUNTS, TANANA FLATS, INTERIOR ALASKA, 1965

Area	Flying Time (hrs)	Young ♂	Adult ♂	Total ♂	♀ W/1	♀ W/2	♀ W/0	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose Per Hour
2	7.7	15	73	88	35	0	126	161	0	249	36	285	13	37
3	1.9	3	13	16	18	0	34	52	0	68	18	86	21	45
4	2.0	3	15	18	3	0	33	36	1	54	3	57	5	29
5	2.8	7	19	26	29	0	40	69	0	95	29	124	23	44
6	2.9	6	30	36	14	0	46	60	0	96	14	110	13	38
7	1.8	3	4	7	2	0	37	39	0	46	4	50	8	28
8	2.3	3	17	20	14	0	46	60	1	81	14	95	15	41
9	3.3	6	19	25	34	1	83	118	0	143	39	182	22	55
TOTAL Area 2 through 9	24.7	46	190	236	149	1	445	595	1	832	157	989	16	40

TABLE 22

SEX AND AGE COMPOSITION RATIOS, TANANA FLATS, 1965 and 1962

Area	Total♂ per 100 ♀	Young♂ per 100 Adult♂	Calves per 100 Cows	Incidence of Twin Calves per 100 Cows w/Calf	Calf % in Total Herd	Young♂ % in Total Herd	Young♂ per 100 Bull Calves	Young♂ per 100 ♀	Moose per Hour	Total Moose
2	54	20	22	0	13	5	83	9	37	285
3	31	23	35	0	21	3	33	6	45	86
4	50	20	8	0	5	5	200	8	29	57
5	38	37	42	0	23	6	46	10	44	124
6	60	20	23	0	13	5	86	10	38	110
7	18	75	10	0	8	6	150	8	28	50
8	33	18	23	0	15	3	43	5	41	95
9	21	32	33	2.8	22	3	30	5	55	182
TOTALS, 1965	40	24	26	.7	16	5	58	8	40	989
TOTALS, 1962	43.2	9.3	42	4.7	22.1	4	38	12.5	--	891

TABLE 23

MOOSE POPULATION COMPOSITION COUNTS, UPPER WOOD RIVER, 1965

Area	Flying Time (hrs)	Young ♂	Adult ♂	Total ♂	♀ W/1	♀ W/2	♀ W/0	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose Per Hour
1 Foothills Japan Hills	5.2	5	66	71	50	0	173	223	6	300	50	350	14	67
Upper Wood River	2.3	15	124	139	40	3	161	204	0	343	46	389	12	169
TOTALS	7.5	20	190	210	90	3	334	427	6	643	96	739	13	98

TABLE 24

MOOSE SEX AND AGE COMPOSITION RATIOS, UPPER WOOD RIVER, 1965

Area	Total ♂ per 100 ♀	Young ♂ per 100 Adult ♂	Calves per 100 Cows	Incidence of Twin Calves per 100 Cows w/Calf	Calf % in Total Herd	Young ♂ % in Total Herd	Young ♂ per 100 Bull Calves	Young ♂ per 100 ♀	Moose per Hour	Total Moose
1 Foothills Japan Hills	32	8	22	0	14	1	20	2	67	350
Upper Wood River	68	12	23	6	12	4	65	7	169	389
Totals	49	11	22	3	13	3	41	5	98	739

TABLE 25

MOOSE POPULATION COMPOSITION COUNTS, TOK AREA, AREA 3

Area & Date	Flying Time (hrs)	Young ♂	Adult ♂	Total ♂	♀ W/0	♀ W/1	♀ W/2	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose Per Hour
Slana #3 11-11-65	2.8	23	20	43	63	20	1	84	0	127	22	149	14.8	53
Nebesna & Tanacross Area #3 11-23-65	.3	1	3	4	4	0	1	5	0	9	2	11	18.2	33
Tok River (Little Tok) 11-23-65	1.5	12	18	40	62	12	1	75	3	118	14	132	10.6	88
Nebesna Road 11-9-65	3.8	14	13	27	56	22	2	80	0	107	26	133	19.5	35
Tok R. Drainage #3 11-12-65	3.3	32	85	117	45	18	2	65	0	182	23	205	11.2	62
TOTAL AREA #3	11.7	82	139	231	230	72	7	309	3	543	87	630	13.8	54

TABLE 26

MOOSE SEX AND AGE COMPOSITION, TOK AREA, AREA 1

Area	Total Bulls per 100 Cows	Young Bulls per 100 Adult	Calves per 100 Cows	Twin Calves per 100 Cows w/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls per 100 Bull Calves	Young Bulls per 100 Cows	Moose per Hour	Total Moose
TOTAL AREA #3	45	59	28	9	13.8	13.0	18.9	26	54	630

TABLE 27

MOOSE POPULATION COMPOSITION COUNTS, AREA 2B, TOK AREA, 1965

Area & Date	Flying Time (hrs)	Young ♂	Adult ♂	Total ♂	♀ W/0	♀ W/1	♀ W/2	Total ♀	Unid. Adults	Total Adults	Calves	Total Moose	Calf % in Herd	Moose Per Hour
Tanana Valley Tok to Midway Lake 11-15-65	3.3	3	9	12	8	8	0	16	0	28	8	36	22	11
Tanana Hills to Cathedral Rapids 11-25-65	1.5	2	4	6	9	8	0	17	0	23	8	31	26	21
Tanana Hills Wolf Lake 11-24-65	.1	0	8	8	2	0	0	2	1	11	0	11	0	138
Alaska Range 7 Mile Hill West	3.3	18	28	46	54	18	0	72	1	73	18	91	20	28
TOTAL AREA #2B	8.2	23	49	72	73	34	0	107	2	135	34	169	20	21

TABLE 28

MOOSE SEX AND AGE COMPOSITION, TOK AREA 2B, 1965

Area	Total Bulls per 100 Cows	Young Bulls per 100 Adult	Calves per 100 Cows	Incidence of Twin Calves per 100 Cows w/Calf	Calf % in Total Herd	Young Bulls % in Total Herd	Young Bulls per 100 Bull Calves	Young Bulls per 100 Cows	Moose per Hour	Total Moose
TOTAL AREA 2B	67	47	32	0	20	14	135	21.5	21	169

TABLE 29

MOOSE POPULATION COMPOSITION COUNTS, INTERIOR ARCTIC ALASKA, SPRING, 1966

Area	Date	Adult W/O Calves	Cows W/1 Calf	Cows W/2 Calves	Lone Calves	Percent Calves in Herd	Incidence of Twins per 100 Cows w/ Calves	Total Moose	Moose per Hour
Koyukuk River- Mouth to Roundabout Mt.	3/28	251	79	7	0	21.7	8.1	430	195
Koyukuk River- Roundabout Mt. to E. of Winthrop Point	3/28	140	47	1	1	21.0	2.1	238	298
TOTAL- Koyukuk River		391	126	8	1	21.4	6.0	668	223
Yukon River- Tanana to Galena	3/26	111	23	1	5	18.2	4.2	165	70
Yukon River- Galena to Koyukuk	3/26	37	2	1	1	11.1	33.0	45	90
Yukon River- Tanana to Koyukuk combined		148	25	2	6	16.7	7.4	210	81
Yukon River- Koyukuk to Kaltag	3/27	No Moose Observed							

Table 29 (contd) - MOOSE POPULATION COMPOSITION COUNTS, INTERIOR ARCTIC ALASKA, SPRING, 1966

Area	Date	Adult W/0 Calves	Cows W/1 Calf	Cows W/2 Calves	Lone Calves	Percent Calves in Herd	Incidence of Twins per 100 Cows w/ Calves	Total Moose	Moose per Hour
Yukon River- Kaltag to Long Mt.	3/27	309	82	7	0	19.4	7.4	210	81
TOTAL- Yukon River	3/26-27	457	107	9	6	18.6	7.8	704	112
Combined Koyukuk and Yukon Rivers	3/26-28	848	233	17	7	20.0	6.8	1372	148

Cordova

A small sample of moose observed in the Martin River Valley in January shows a high percentage of calves in that area, and a high incidence of twins (Table 30). A figure of this area is not included in this report.

Berner's Bay

A brief survey of the Berner's Bay moose population resulted in a small sample with fair production of calves (Table 31). A figure of this area is not included in this report.

Matanuska Valley Population Estimate

The results of a census employing a stratified random square mile technique are summarized in Table 32 and shown in Figure 14. While the precision of the estimate is not what we had hoped for, the estimate is believed to be within 15 percent of the total population and represents the best estimate of this herd that we have had.

Stratifying proved to be the major stumbling block. The vegetation types in the Matanuska Valley are most heterogeneous due to the influence of clearing land for agricultural purposes. Thus a square mile of "old field" reverting to willow and birch might occur within a stand of mature white spruce. Normally the latter would not support many moose during the winter and the type would be classed as low density habitat. However, the cleared land might contain 20 to 30 moose, thus introducing considerable variance into the low density counts.

Another problem not satisfactorily handled by the random-square technique is the tendency for social aggregations of 5 to 25 moose to occur within the moose population. These groups were scattered throughout the high density stratum. In reality, the high density winter browse contained areas of low density moose populations because of the tendency of some moose to travel and feed in loose aggregations.

Aerial random samples will be attempted during the next segment if weather conditions are favorable.

Production

Matanuska and Lower Susitna Valleys

Progression of Calving

Summaries of moose parturition counts for the Southcentral areas are given in Table 34. In Table 35 the parturitions per 100 cows are given by date for all Southcentral areas combined. Because of inclement weather and rapid foliage development, the peak of calving was hard to determine closely.

Table 36 shows the cumulative estimated parturitions per 100 females based on cows observed with calves and "Questionable" cows, i.e. those cows which may have had a calf with them, but this was not definitely determined. It is likely that the peak of calving occurred near the date of the highest observed parturitions per 100 females, i.e. May 28.

TABLE 30

MOOSE POPULATION COMPOSITION COUNT, CORDOVA, JANUARY 1966

Area	Date	Flying Time (Hr.)	Adult ♂	Young ♂	Total ♂	♀ W/0	♀ W/1	♀ W/2	Total ♀	Unid Adult	Total Adult	Calves	Total Moose	Calf % in Herd	Moose Per Hour
Martin River Valley	1/66	2.58	8	8	16	1	19	5	25	23	64	29	93	31	36.1

TABLE 31

MOOSE POPULATION COMPOSITION COUNT, BERNER'S BAY, 1966

Date	Counting Time (Hr.)	Adults W/0 Calf	♀ /1 Calf	♀ /2 Calves	Lone Calves	% Calves In Herd	Twins Per 100 ♀ W/ Calves	Total Moose	Moose per Hour
1/28/66	.96	15	6	3	1	35	33	37	33

TABLE 32

MATANUSKA VALLEY MOOSE CENSUS COMPUTATIONS

February 21-27, 1966

I

High Density (131 of 186 sq. miles sampled)

$$S^2H = \frac{(X^2_{H_1} + \text{------}X^2_{H_n}) - \frac{(X_{H_1} + \text{------}X_{H_n})^2}{n(\text{NO. sampled in high})}}{n - 1} =$$

$$\frac{23{,}991 - \frac{1{,}731{,}856}{131}}{131 - 1} = \frac{23{,}991 - 13{,}220}{131 - 1} = \frac{10{,}771}{130} = 82.85$$

Medium Density (22 of 78 sampled)

$$S^2M = \frac{4{,}141 - \frac{57{,}121}{22}}{22 - 1} = \frac{4{,}141 - 2{,}596}{22 - 1} = \frac{1{,}545}{21} = 73.57$$

Low Density (20 of 143 sampled)

$$S^2_L = \frac{279 - \frac{1{,}089}{20}}{20 - 1} = \frac{279 - 544.5}{20 - 1} = 13.97$$

High Density V(Est. population) =

$$(N_H \text{ in Area})^2 \left(\frac{S^2_H}{\text{No. High Sampled}}\right)\left(\frac{N_H - n_H}{N_H}\right) =$$

$$(186)^2 \left(\frac{82.85}{131}\right)\left(\frac{186 - 131}{186}\right) = (34{,}596)\ (.632)\ (.295) = (.186)\ (34{,}596) = 6{,}434$$

Medium Density

$$(6{,}084) \left(\frac{73.57}{22}\right)\left(\frac{78 - 72}{78}\right) = (6084)\ (3.34)\ (.705) = 14{,}297$$

Table 32 (contd) Matanuska Valley Moose Census Computations

Low Density

$$(20,449)\left(\frac{13.97}{20}\right)\left(\frac{143 - 20}{143}\right) = 20,449(.69)\ (.86) = (.593)\ (20,449) = 12,126$$

II

Total Population Estimate

High Density = 1,867

Medium Density = 850

Low Density = 236

Total Population 2,953

III

$2.6\sqrt{V(\text{Est. Population})} \leq .05\ (\text{Est. Population})$

V(High) = 6,434

V(Medium) = 14,297

V(Low) = 12,126

Total V = 32,857 $\sqrt{32,857} = 181$-

(181) (2.5758) = 466

(.05) (2,953) = 147.65

466 = 15.7% of Population Est.

Population est. = 2,953 466 at .90 confidence level

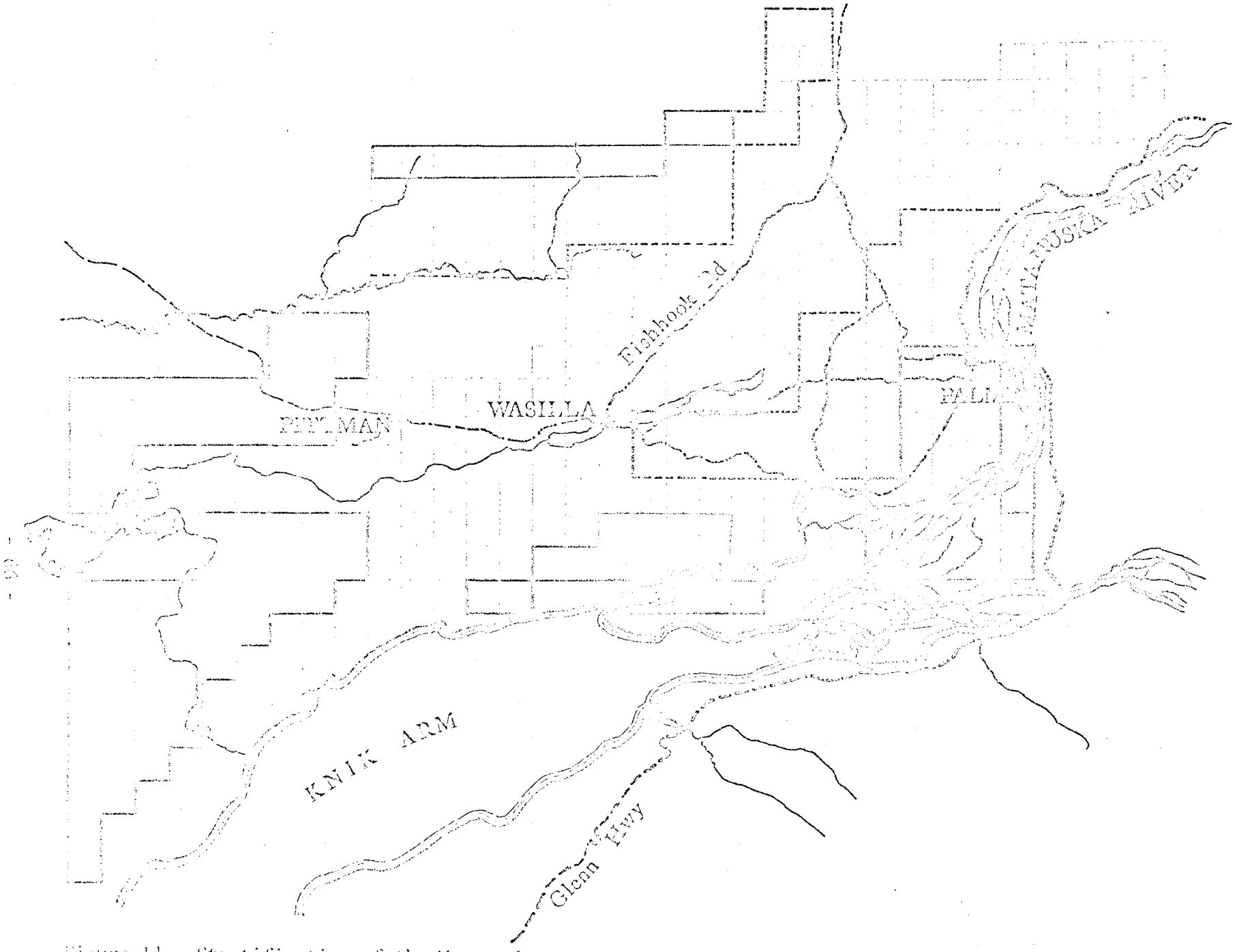


Figure 14. Stratification of the Matanuska Valley, with respect to moose population density. Solid heavy border = low density; broken border = medium density; light border = high density.

TABLE 33

COMPUTATIONS OF 1966 CENSUS OF MATANUSKA VALLEY MOOSE POPULATIONS BY STRATA; HIGH DENSITY

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min.)	X^2
1	7	2	9	25	81
2	20	6	26	25	676
3	14	6	20	19	400
4	20	7	27	15	729
5	9	2	11	14	121
6	5	2	7	12	49
7				8	
8				14	
9	2		2	8	4
10	4		4	9	16
11	13		13	13	169
12	6	1	7	11	49
13	11	2	13	17	169
14	11	2	13	13	169
15	11	2	13	17	169
16	19	6	25	10	625
17	1	1	2	9	4
18				6	
19				6	
20				7	
21	23	1	24	13	576
22	5		5	9	25
23	1		1	6	1
24	8		8	12	64
25	1		1	10	1
26	11		11	17	121
27	17	4	21	17	441
28					
29			2		4
30					
31					
32			8		64
33					
34			9		81
35			10		100
36			1		1
37			3		9
38			26		676
39			6		36
40					
41			6		36
42					
43					
44			5		25
45					
46			12		144
47			3		9
48					
49			3		9
50			1		1

TABLE 33 (contd.)

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min)	X^2
51			3		9
52			3		9
53			18		324
54	3	2	5	7	25
55	11	5	16	11	256
56			27		729
57					
58					
59			3		9
60			18		324
61	30	8	38	20	1444
62	11	3	14	10	196
63					
64	10	5	15	15	225
65	13	4	17	10	289
66	6	3	9	7	81
67	3	2	5	12	25
68	3		3		9
69					
70	31	6	37	10	1369
71	17	8	25	13	625
72	9	2	11	7	121
73			1		1
74	11	2	13	9	169
75	8	1	9		81
76	3		3		9
77	3		3	9	9
78	7		7	12	49
79					
80					
81	3	1	4	7	16
82					
83					
84					
85	1		1	5	1
86	2		2	10	4
87	8	1	9	8	81
88	29	6	35	8	1225
89					
90	14	6	20	16	400
91	5	1	6		36
92	8	3	11	13	121
93	8	2	10	7	100
94	4	2	6	7	36
95					
96			4		16
97			10		100
98					
99	4	1	5	9	25
100	10	2	12	12	144

TABLE 33 (Contd.)

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min.)	X^2
101					
102	14	3	17	--	289
103	7	3	10	--	100
104	5	2	7	--	49
105					
106					
107			3		9
108					
109			1		1
110					
111					
112					
113					
114					
115	2		2	--	4
116	6		6	13	36
117	10	2	12	--	144
118	3	2	5	8	25
119					
120					
121					
122					
123					
124			1		1
125					
126					
127					
128					
129					
130	4		4	12	16
131	4	1	5	10	25
132	4	4	8	10	64
133	13	4	17	9	289
134	7		7	13	49
135	2	1	3	12	9
136	17	5	22	10	484
137	30	10	40	10	1600
138	13	4	17	--	289
139	17	9	26	5	676
140	18	5	23	7	529
141	23	8	31	10	961
142					
143					
144			12		144
145			2		4
146			2		4
147			4		16
148			9		81
149			9		81
150			9		81

TABLE 33 (contd.)

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min.)	X^2
151			11		121
152			13		169
153					
154	17	8	25	8	625
155	23	7	30	9	900
156	22	6	28	6	784
157					
158			3		9
159			4		16
160					
161			3		9
162			10		100
163			5		25
164			4		16
165	6	2	8	5	64
166	7	2	9	15	81
167	10	1	11	6	121
168	6	4	10	10	100
169					
170			3		9
171					
172			1		1
173					
174					
175					
176					
177					
178					
179	5	2	7	3	49
180					
181					
182	2	2	4	--	16
183					
184					
185	6	1	7	9	49
186	10	1	11	12	121

Total Moose = 1,316
X Moose sq. mile = 10.04
$1,316^2 = 1,731,856$
Sum $X^2 = 23,991$
Pop. Estimate (10.04) (186) = 1,867

TABLE 33 (contd) MEDIUM DENSITY

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min.)	X^2
1					
2	8	3	11	15	121
3	18	8	26	15	676
4					
5	13	3	16	12	256
6	21	8	29	18	841
7	3		3	13	9
8					
9					
10					
11					
12	9	3	12	8	144
13					
14	6	3	9	8	81
15					
16	12	5	17	15	289
17					
18	14	3	17	14	289
19					
20	8	5	13	10	169
21					
22	13	4	17	8	289
23					
24	4		4	12	16
25					
26					
27	11	4	15	7	225
28					
29					
30	1		1	6	1
31	18	6	24	15	576
32					
33	3		3	15	9
34	3	1	4	12	16
35	2		2	10	4
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					

TABLE 33 (Contd.)

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min.)	X^2
51					
52					
53					
54	7		7	12	49
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69				6	
70					
71	5	4	9	7	81
72					
73					
74				7	
75					

Total Moose = 239
X Moose sq. mile = 10.9
Square Miles flown, 22 of 78
239^2 = 57,121
Sum X^2 = 4,141
Pop. Estimate (10.9) (78) = 850

TABLE 33 (contd.) LOW DENSITY

Plot No.	Adults	Calves	Total Moose (X)	Time (Flying) (Min.)	X^2
3			2		4
12				7	
27			2		4
29				6	
32A	1		1	9	1
33				5	
35				5	
36				3	
41				6	
43				7	
46				6	
52				6	
57					
61					
65					
74					
77					
78				14	
87	1		1	5	1
88	1	1	2	4	4
89	1	1	2	5	4
90					
91					
99					
100	11	3	14	6	196
104	6	2	8	4	64
115				4	
124	1		1	4	1
126					
141				17	
127					

Total Moose = 33
X Moose sq. Mile = 1.65
33^2 = 1,089
Sum X^2 = 279
Pop. Estimate, (1.65) (143) = 236

TABLE 34

SUMMARY OF MOOSE PARTURITION COUNTS, MATANUSKA AND LOWER SUSITNA VALLEY, MAY 20 THROUGH MAY 26, 1966 (PRE-TAGGING)

Area and Crew	Date and Flying Time	Newborn Calves ♀/0	♀/1	♀/2	♀/?	Yearlings W/0 ♀	♀/1	♀/2	*	Total ♀	Total Calves	Total Yrlgs. ♂	
Palmer Hay Flats Bratlie-Didrickson	5/21 1.5 hrs.	20	2	0	1	5	7	1	0	31	2	14	1
Jim Swan Bratlie-Didrickson	5/21 0.6 hrs.	13	1	0	0	2	2	0	0	16	1	4	0
Fishhook Swamp Bratlie-Didrickson	5/21 0.2 hrs.	0	0	0	0	0	0	0	0	0	0	0	0
Goose Bay Bratlie-Didrickson	5/22 0.3 hrs.	1	0	0	0	0	1	0	0	2	0	1	0
Palmer Hay Flats Bratlie-Didrickson	5/22 1.7 hrs.	25	4	1	1	4	7	2	1	39	6	15	0
Palmer Hay Flats Bratlie-Didrickson	5/23 2.2 hrs.	21	6	1	0	7	4	2	1	34	8	15	1
Jim Swan Bratlie-Didrickson	5/23 0.8 hrs.	11	3	0	1	4	3	0	1	18	3	7	2
Deception Creek Bratlie-Didrickson	5/24 0.3 hrs.	1	1	0	0	1	0	0	0	2	1	1	0
Willow-Kash. Bratlie-Didrickson	5/24 1.8 hrs.	12	16	3	0	1	0	0	0	31	22	1	0
Palmer Hay Flats Bratlie-Didrickson	5/24 1.7 hrs.	15	9	4	0	9	7	1	5	36	17	18	2
Goose Bay Bratlie-Didrickson	5/24 0.2 hrs.	1	1	0	0	0	0	0	0	2	1	0	0

*Tagged Yearlings

TABLE 34 (contd.) SUMMARY OF MOOSE PARTURITION COUNTS, MATANUSKA AND LOWER SUSITNA VALLEY
MAY 20 THROUGH MAY 26, 1966 (PRE-TAGGING)

Area and Crew	Date and Flying Time	New Born Calves ♀/0	♀/1	♀/2	♀/?	Yearlings W/0 ♀	♀/1	♀/2	*	Total ♀	Total Calves	Total Yrlgs	♂
Lake Nancy Bratlie-Didrickson	5/25 0.9 hrs.	3	5	0	1	0	0	0	0	9	5	0	0
Willow Flats Bratlie-Didrickson	5/25 0.5 hrs.	1	3	1	0	0	0	0	0	5	5	0	0
Willow-Kash. Bratlie-Didrickson	5/25 2.7 hrs.	10	24	3	1	1	0	0	0	38	30	1	1
Kash.-Montana Bratlie-Didrickson	5/25 0.8 hrs.	5	7	3	0	2	0	0	0	15	13	2	3
West Big Susitna Bratlie-Didrickson	5/26 1.5 hrs.	7	6	3	0	5	0	4	0	20	12	13	0
East Big Susitna Bratlie-Didrickson	5/26 0.6 hrs.	9	3	1	0	6	3	0	4	16	5	9	2
					(During Tagging)								
Palmer Hay Flats Bratlie-Didrickson	5/27 3.3 hrs.	13	8	8	1	14	2	0	6	32	24	16	3
Jim-Swan Bratlie-Didrickson	5/27 1.2 hrs.	18	12	1	0	5	1	0	0	32	14	7	3
Lake Nancy Bratlie-Didrickson	5/28 1.0 hrs.	0	5	0	1	0	0	0	0	6	5	0	0
Willow Flats Bratlie-Didrickson	5/28 0.7 hrs.	1	6	0	1	0	0	0	0	8	6	0	0
Willow-Kash. Bratlie-Didrickson	5/28 2.6 hrs.	4	23	2	0	1	0	0	0	29	27	1	1

*Tagged Yearlings

TABLE 34 (cont'd.) SUMMARY OF MOOSE PARTURITION COUNTS, MATANUSKA AND LOWER SUSITNA VALLEY

Area and Crew	Date and Flying Time	Newborn Calves ♀/0	♀/1	♀/2	♀/?	Yearlings W/0 ♀	♀/1	♀/2	*	Total ♀	Total Calves	Total Yrlgs	♂
Kash-Montana Bratlie-Didrickson	5/28 1.8 hrs.	3	11	7	0	2	0	0	0	21	25	2	0
Goose Bay Lyons-Didrickson	5/29 0.2 hrs.	0	1	0	0	1	0	0	0	1	1	1	0
Palmer Hay Flats Lyons-Didrickson	5/29 2.8 hrs.	15	15	2	1	18	2	0	7	35	19	20	1
Big Lake Lyons-Didrickson	5/29 1.8 hrs.	6	1	1	0	2	0	0	0	8	3	2	0
Lake Nancy Lyons-Didrickson	5/30 0.6 hrs.	4	3	1	0	1	0	0	0	8	5	1	0
Willow-Kash. Lyons-Didrickson	5/30 3.0 hrs.	14	16	0	0	5	0	0	0	30	16	5	1
Kash.-Montana Lyons Didrickson	5/30 1.7 hrs.	1	9	2	1	4	0	0	0	13	13	4	2
Palmer Hay Flats Lee-Didrickson	6/1 2.9 hrs.	12	13	4	0	8	4	0	5	33	21	12	3
Willow-Kash. Lee-Didrickson	6/1 1.7 hrs.	7	9	2	1	3	0	0	0	19	13	3	0
Nancy Lake Lee-Didrickson	6/1 0.4 hrs.	0	2	0	0	1	0	0	0	2	2	1	0
Willow Flats Lee-Didrickson	6/1 0.4 hrs.	0	2	0	0	1	0	0	0	2	2	1	0

*Tagged Yearlings

TABLE 34 (cont'd.) SUMMARY OF MOOSE PARTURITION COUNTS, MATANUSKA AND LOWER SUSITNA VALLEY
MAY 20 THROUGH MAY 26, 1966 (PRE-TAGGING)

Area and Crew	Date and Flying Time	Newborn Calves ♀/0	♀/1	♀/2	♀/?	Yearlings W/0 ♀	♀/1	♀/2	*	Total ♀	Total Calves	Total Yrlgs	♂
Willow Flats Lee-Didrickson	6/1 0.2 hrs.	0	0	0	0	1	0	0	0	0	0	1	0
(After Tagging)													
		* **	* **	* **		* **	* **	* **					
Palmer Hay Flats Soldin-Didrickson	6/2 2.7 hrs.	9 4	6 4	4 4	4	14 4	3 4	0 0		38	26	25	1
Willow Flats Soldin-Didrickson	6/2 0.4 hrs.	0 3	0 0	0 2		0 0	0 0	0 0		5	3	0	0
Willow-Kashwitna Lee-LeResche	6/2 2.9 hrs.	11 21	9 4	1*[3]	7	1 0	1 0	0 0		54	39	2	0
Kashwitna-Montana Lee-LeResche	6/2 1.2 hrs.	0 5	1 2	2	4	0 0	0 0	0 0		14	14	0	0
Palmer Hay Flats Soldin-Didrickson	6/3 2.9 hrs.	14 4	8 1	0	4	17 5	1 0	0 0		32	14	23	0
Kashwitna-Montana Lee-LeResche	6/3 1.9 hrs.	7 8	0 1	1	3	0 0	1 0	0 0		21	12	1	2
Willow-Kashwitna Lee-LeResche	6/3 3.2 hrs.	19 24	4 3	2	7	4 0	1 0	0 0		60	38	5	10

* Not Tagged
** Tagged
*3 One Twin Remaining

TABLE 35

PARTURITION RATIOS, MATANUSKA-SUSITNA VALLEYS, 1966

Date	Estimated Parturition/100♀	Observed Parturitions /100♀	Observed Calves/100♀	Observed Twins: 100 Parturitions	Total Cows in Sample
5/21	8.5	6.4	6.4	0	47
5/22	14.6	12.2	14.6	20	41
5/23	21.2	19.2	21.2	10	52
5/24	47.9	47.9	57.7	21	71
5/25	71.6	68.7	79.1	15	67
5/26	36.1	36.1	47.2	31	36
5/27	46.9	45.3	59.4	31	64
5/28	87.5	84.4	98.4	17	64
5/29	47.7	45.5	52.3	15	44
5/30	62.7	60.8	58.8	10	51
6/1	57.4	55.6	67.3	20	54
6/2	74.8	59.5	73.9	26	111
6/3	63.7	49.6	56.6	14	113
				TOTAL	815

*Derived from total observed parturitions plus "questionable" cows, i.e., those which responded to aircraft as though they might have a calf, but the calf was not seen.

TABLE 36

SUMMARY OF MOOSE PARTURITION COUNTS, MATANUSKA AND SUSITNA VALLEYS, 1966

Date	Newborn Calves ♀/0	♀/1	♀/2	♀/?	Yearlings W/O♀	♀/1	♀/2	Tagged	Total ♀	Total Calves	Total Yrlgs.	Calves: 100 ♀	Yearlings 100 ♀	♂	Total Moose
5/21	33	3	0	0	7	9	1	0	47	3	18	6.4	38.3	1	69
5/22	26	4	1	1	4	8	2	1	41	6	16	14.6	39.0	0	63
5/23	32	9	1	1	11	7	2	2	52	11	22	21.2	42.3	3	88
5/24	29	27	7	0	11	7	1	5	71	41	20	57.7	28.2	2	134
5/25	19	39	7	2	3	0	0	0	67	53	3	79.1	4.4	4	127
5/26	16	9	4	0	11	3	4	4	36	17	22	47.2	61.1	2	77
5/27	31	20	9	1	19	3	0	6	64	38	23	59.4	35.9	6	131
5/28	8	45	9	2	3	0	0	0	64	63	3	98.4	4.7	1	131
5/29	21	17	3	1	21	2	0	7	44	23	23	53.5	53.5	1	91
5/30	19	28	2	1	10	0	0	0	51	34	10	66.7	20.6	3	98
6/1	19	24	6	1	13	4	0	5	54	36	17	66.6	31.5	3	110
6/2	20	49	17	17	19	8	0	8	111	82	27	73.9	24.3	1	221
6/3	40	48	8	14	26	3	0	5	113	64	29	56.6	25.7	12	218
TOTAL	313	322	75	41	158	54	10	43	815	471	233		28.6	39	1558

Magnitude of Calving

The calf:cow ratio at birth is based upon observed parturitions, examination of reproductive tracts collected in the fall, and standard productivity estimates made by Rausch (Rausch, R. A., 1959. Moose calving studies. pp. 27-41. In Job Completion Reports, U. S. Fish and Wildlife Service, 57 pp., Federal Aid in Wildlife Restoration, Alaska, Vol. 13, No. 2. Project W-3-R-13). Data obtained from reproductive tracts collected in the fall antlerless moose hunts indicate that 69 percent of females collected were pregnant, including calves and yearlings. Approximately 93 percent of all moose two years old or older were pregnant (Table 37). The twinning rate of 19 twins per 100 parturitions was calculated from Table 27.

According to Rausch's (1959) work based on normal winter survival, 12 percent of the adult cow population would be comprised of 24 month old cows, which were considered to be nonproductive. By deducting the 12 percent from a figure of 100 cows, 88 cows would remain of which 93 percent would be pregnant, or 82 pregnant cows. If 19 percent of 16 bore twins, 65 bore singletons in a cohort of 100 cows, and the production of calves per 100 cows equals 65 plus 32 or 97 calves per 100 cows.

Calf Survival

Although the last count on June 3 indicated a considerably lower ratio of calves to cows (57:100 females) weather and foliage affected this count adversely, and it is likely that survival to that date was excellent.

Tanana Flats

Progression of Calving

The results of aerial parturition counts on three areas of the Tanana Flats are summarized in Table 38. Although the data might seem to suggest that the peak of calving occurred near the end of the first week in June, no counts were conducted during tagging (May 30 to June 5). It appears that during this period the rate of calving was probably optimal, and that the peak of calving passed before counts were resumed on June 6. A slow increase in the rate of calving is indicated up to May 30. When counting commenced again on June 6, the rate of calving appeared to be declining. It is likely that the peak of calving occurred about June 1. High mortality of newborn calves in this area may have confounded the results to some extent. A hypothetical curve of the progression of calving is shown in Figure 15.

Magnitude of Calving

An estimate of the natality or magnitude of calving on the Tanana Flats is difficult to derive since few data from fall reproductive tracts were available.

In a collection of seven cows without calves taken in early June, five had borne calves and were in various stages of lactation. Of a mere handful of moose reproductive tracts examined from the fall of 1965, all adults were pregnant. Past years' data indicate fall pregnancy rates of 82 percent or higher among female moose two years old or older. This figure will be used as a basis for estimating natality. Thus, 82 cows out of 100 should be pregnant. Parturition counts (Table 38) indicate the overall rate of twinning in 1966 as 7.0 per 100 births in area 1, where the data is considered to be most reliable. Seven percent of

TABLE 37

MOOSE PREGNANCY RATES, MATANUSKA VALLEY, 1965

Cementum Age Class	Not Pregnant	Pregnant	1 Fetus	2 Fetuses	At Least 1 Fetus	% Pregnant	Twins/100 Pregnancies
Calf	21					0	---
1	21	5	4			19.2	0
2	1	7	7				0
3	2	13	10	3			23
4		13	12	1			8
5	2	17	13	4			24
6		10	6	4			40
7		10	9	1			10
8		8	8				0
9		6	6				0
10		7	3	3	1		43
11		4	4		1		0
12		7	5	1			14
13		4	3	1			25
14	4	2	2				0
15		2	2				0
UNKNOWN	20	49	38	9	2	71.0	18
TOTALS	71	164	132	28	2	69.8	17
Totals Excluding Calves, Yearling & Unknown	9	115	96	19	2	92.7	17

TABLE 58

PARTURITION COUNTS, DENALI HERD, 1976

Area	Date	Newborn ♀/0	♀/1	♀/2	♀/?	Yearlings W/0♀	♀/1	♀/2	Totals ♀	Yrlgs	Calves	♂	Moose	♂: 100 ♀	Births :100 ♀	Yrlg 100♀	Air-craft
I	17 & 20 May	206	2	0	0	3	17	2	227	24	2	116	369	51	0.9	10.6	S
	21 May	190	12	0	0	4	18	1	221	34	12	143	400	75	5.4	11.0	H
	25 May	213	28	3	0	3	10	0	254	13	34	137	438	54	12.2	5.0	S
	29 May	182	41	5	1	5	14	0	243	19	51	234	547	96	18.9	7.8	S
		Calf Tagging Operations															
	6 June	118	74	4	1	2	6	1	204	10	82	166	462	81	38.0	4.9	S
	10 June	59	41	3	0	2	4	0	107	6	47	126	286	118	41.1	5.6	S
	14 June	138	49	4	0	5	11	1	203	17	57	219	496	108	26.1	8.4	H
	21 June	96	44	3	6	4	13	0	162	17	49	178	406	148	29.0	8.9	H
TOTALS		1202	291	22	8	28	93	5	1621	130	334	1319	3404	81		8.0	

S = Supercub

H = Helicopter

TABLE 38 (cont'd.) PARTURITION COUNTS, TANANA FLATS, 1966

Area	Date	Newborn ♀/0	♀/1	♀/2	♀/?	Yearlings W/0 ♀	♀/1	♀/2	Totals ♀	Yrlgs	Calves	♂	Moose	♂: 100 ♀	Births : 100 ♀	Yrlg 100♀	Aircraft
II	18 & 19 May	202	0	0	0	1	9	0	211	10	0	66	287	1	0.0	4.7	S
	27 May	79	22	2	0	2	2	0	115	4	26	86	231	75	22.6	3.5	S
III	19 & 20 May	120	0	0	0	4	5	0	125	9	0	26	160	21	0.0	7.2	S
	8 June Count #1	34	4	2	0	0	2	1	43	3	8	52	106	121	18.8	7.0	S
	8 June	20	7	0	0	2	0	0	27	2	7	36	72	133	25.3	9.3	S

S = Supercub

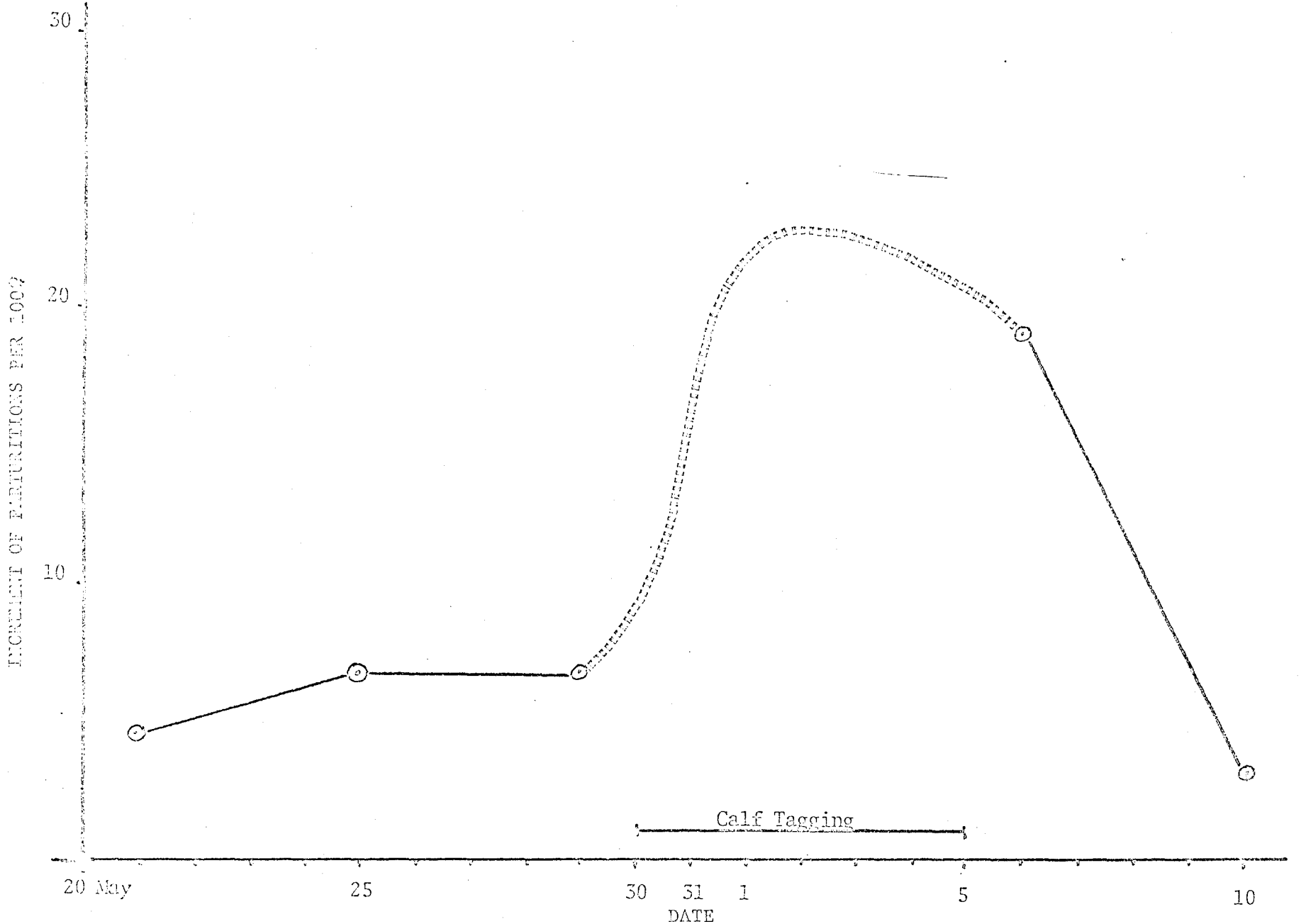


Figure 15. Progression of calving, Tanana Flats, 1966. Dotted line indicates hypothetical progression

82 is about 6; therefore 76 cows bore singletons and 6 bore twins for a total of 88 calves per 100 cows.

Although this estimate is not high it may represent a maximum for the Tanana Flats. Other factors suggesting that reproduction and calf survival were poor in this area will be discussed below.

Calf Survival

Parturition counts, continued through June 21, showed a decline in the calves per 100 cows in later counts as a result of foliage development and calf mortality. During the course of aerial counts and tagging operations on the Tanana Flats, considerable evidence of high calf mortality was noted. Seven dead calves were found, of which three were autopsied. Two of the three apparently were born dead or died soon after birth. The third appeared to have died soon after birth. A fourth calf collected alive but in weak condition was examined by a veterinarian, who diagnosed the illness as pneumonia probably contracted because of its poor condition in utero. An analysis of its blood revealed symptoms of hemolytic anemia and starvation.

Five of seven adult cows collected to assess the poor condition of moose in the area were found to have had calves but lost them sometime after parturition. While the extent of calf mortality cannot be measured exactly, it can be considered high in this area.

Yakutat

Progression of Calving

Aerial parturition counts were done in the Yakutat area from May 21 through June 10 (Tables 39 and 40 and Figure 16). As the season progressed the weather deteriorated to the point where for several days in early June it was not possible to make counts. As a result the peak of calving cannot be determined closely for this area, but it appears that the peak probably occurred between June 1 and June 6.

Magnitude of Calving

Data obtained from 1965 collections of reproductive tracts indicated an overall pregnancy rate of about 89 percent, and a twinning ratio of 64:100 pregnancies (Table 41). Using these figures, calves per 100 females could equal (89 - 64) + 64(2) = 153.

A comparison of the data in Table 40 with the proportion of yearling females in the harvest for the last two years (see Figure 7 "Characteristics of Harvest," page 32) suggests that yearling females represent about 20 percent of the female population. If pregnancy rates are recalculated on the basis of 20 yearlings per 100 females with 60 percent pregnancy among yearlings and 92.4 percent pregnancy among other ages, the adjusted overall percentage pregnant is 86, and the twins per 100 cows would then equal (86 - 55) + (55)2 = 141 calves per 100 cows.

The overall incidence of twins seen in the spring parturition counts was 41.7:100 parturitions. Using this estimate of twin production and the adjusted ratio of yearlings:older moose, the calf:cow ratio would be about (86 - 42) + (42)2 = 132 calves per 100 cows. This is considered a conservative estimate since the probability of overlooking one of a set of twins and the possibility of somewhat higher mortality affecting one of a set of twins would depress the twins per 100 parturitions figure.

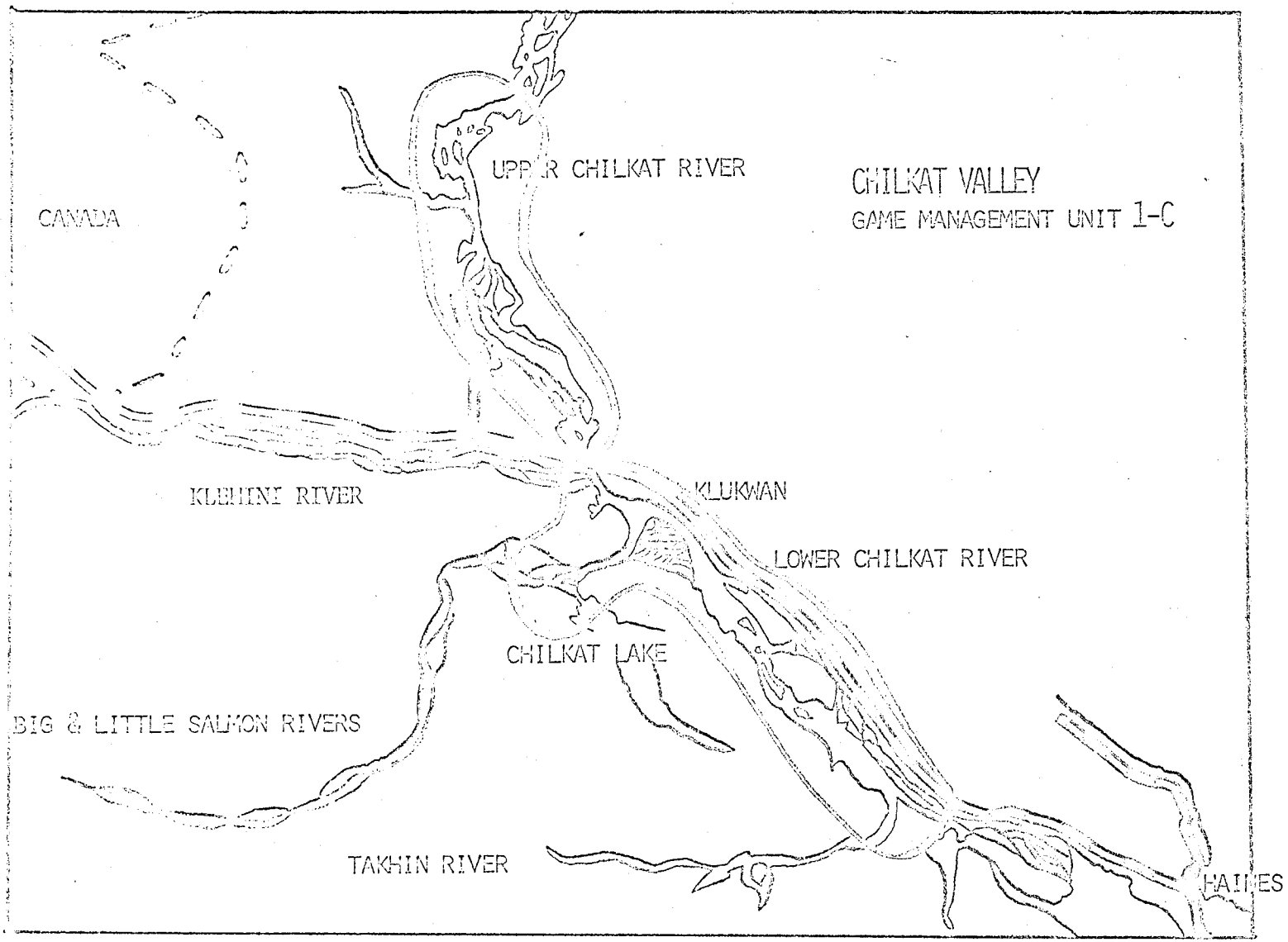


FIGURE 19, MOOSE PARTURITION COUNTS, HAINES AREA, 1966

TABLE 39

MOOSE PARTURITION COUNTS, YAKUTAT, 1966.

Date	Newborn ♀/0	♀/1	♀/2	♀/?	Yearling W/0♀	♀/1	♀/2	Total ♀	Total Yrlg	Total Calves	♂	Total Moose	Count Time	Moose/ Hour	Observer Pilot Aircraft
21 May	117	1	1	3	0	11	2	135	15	3	40	193	4.0	48	Johnson Various Supercub
24 May	61	3	6	1	2	10	1	82	14	15	57	168	3.7	45	"
25 May	98	5	3	2	6	22	2	132	32	11	59	234	3.8	62	"
28 May	86	8	9	3	5	6	2	114	15	26	88	243	5.5	44	"
31 May	20	4	3	2	1	2	1	32	5	10	24	71	2.3	31	"
6 June	69	21	10	3	3	11	2	116	18	41	71	246	4.7	52	"
8 June	18	3	3	0	1	2	0	26	3	9	29	67	1.5	39	"
9 June	27	2	3	2	0	3	1	38	5	8	16	67	1.7	39	"
9 June	9	4	3	1	1	1	0	18	2	10	23	53	2.0	27	"
10 June	13	12	4	0	2	1	0	30	3	20	28	81	2.8	29	"

TABLE 40

ESTIMATED AND OBSERVED PARTURITION RATES, PROGRESSION AS INDICATED BY INCREMENT OF PARTURITIONS:100 COWS, AND INCIDENCE OF TWIN BIRTHS, YAKUTAT, 1966

Date	Total ♀	Observed Parturitions	Estimated Parturitions: 100 ♀ *	Observed Parturitions: 100♀	Increment Of Observed Parturitions :100 ♀ Between Counts	Observed Twin Births	Incidence of Twins:100 Observed Parturitions
21 May	135	2	3.7	1.5		1	50.0
24 May	82	9	12.2	11.0	+9.5	6	66.7
25 May	132	8	7.6	6.0	-5.0	3	37.5
28 May	114	17	17.5	14.9	+8.9	9	52.9
31 May	32	7	28.1	21.9	+7.0	3	42.9
6 June	116	31	29.3	26.7	+4.8	10	32.3
8 June	26	6	23.1	23.1	-3.6	3	50.0
9 June	38	5	18.4	13.2	-9.9	3	60.0
9 June	18	7	44.4	38.9	+25.7	3	42.9
10 June	30	16	53.3	53.3	+14.4	4	25.0
TOTALS	723	108				45	41.7

*Estimated Parturitions = Observed Parturitions +"♀/?".

TABLE 41

MOOSE PREGNANCY RATES, YAKUTAT, UNIT 5, 1965

Cementum Age Class	Not Pregnant	Pregnant	1 Fetus	2 Fetuses	3 Fetuses	At Least 1 Fetus	% Pregnant	Twins/100 Pregnancies
1	2	3	3				60	0
2	1	7	2	5				71
3	1	4		4				100
4		3		1		2		33
5	1	4		4				100
6		3		3				100
7		3	1	2				67
8		3	2	1				33
9		4	1	3				75
10								0
11								0
12								0
13		1		1				100
14		2		1	1			50
15								0
UNKNOWN		2	2					0
TOTALS	5	39	11	25	1	2	88.6	64
Totals Excluding Yearlings	3	36	8	25	1	2	92.4	69

A good estimate of the magnitude of calving is probably the middle figure of those derived above, i.e. 141 calves per 100 cows, which is a very high rate of production.

Calf Survival

Although the effects of weather caused variation in the data from parturition counts, parturitions per 100 cows reached 53.3 on June 10.

On June 6 while doing the parturition count, Loyal Johnson observed a cow which had died with the second of a set of twins partly born. The first-born twin was alive nearby.

Anchorage Area

The antlerless hunts on Fort Richardson and Elmendorf Air Force Base provided the first opportunity to obtain a sample of reproductive material from this herd during the hunting season. Past samples had depended upon highway and illegally killed animals. Parturition counts were not made in this area. The pregnancy rate of females two years old or more was 87 percent.

The rate of twinning was 18 per 100 pregnancies. An estimate of the magnitude of calving based on this data and the proportion of yearling females in the 1965 harvest (Table 42) suggests a figure of 92 calves per 100 cows. Production is good although not as good as some of the better areas, for example the Matanuska-Susitna Valley.

Kenai

Spring parturition counts for the Kenai Peninsula in 1966 are not available at this time, but a collection of female reproductive tracts from the 1965 fall hunts was analyzed (Tables 43 and 44). Productivity information on the Kenai is not as encouraging as in some of the better areas. A wide range in fetus sizes was found which reflects a prolonged period of conception. A substantial proportion of the animals examined may not have been bred. The harvest of male moose prior to the breeding season may be sufficient in local areas to create shortages of males during the peak of estrus. The age composition of antlerless moose harvested (Table 45) indicates relatively light utilization of antlerless moose in proportion to the total population.

Haines

Rapid foliage development and the behavior of moose in the Chilkat Valley contributed to the difficulty of obtaining representative data on the Chilkat moose population. In addition only a low performance aircraft was available for the work. As a result of all these factors it is difficult to evaluate the data obtained. It does appear that yearling survival was very good and that calf production was good (Table 46).

Information about the calving areas and the daily movements of the moose was obtained which will provide guidelines for increasing the efficiency of future counts. Calving areas are illustrated in Figure 17.

A small sample of reproductive tracts was obtained from the Haines area during the 1965 hunting season (Table 47). Pregnancy rates for moose older than yearlings were moderate, but no evidence of twins was found.

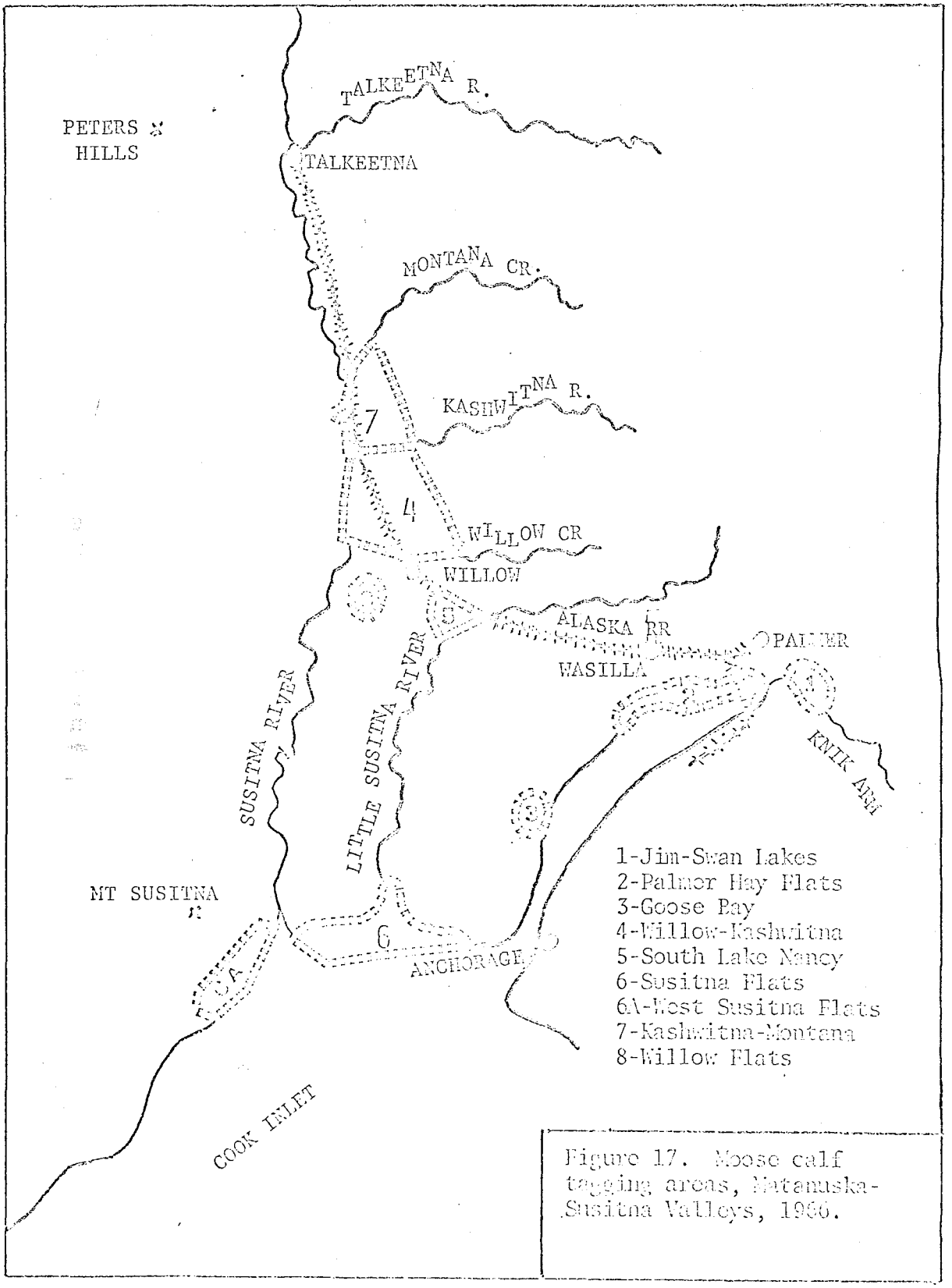


Figure 17. Moose calf tagging areas, Matanuska-Susitna Valleys, 1986.

TABLE 42

MOOSE PREGNANCY RATES
FORT RICHARDSON (DEC. 1965) AND ELMENDORF (JAN. 1966)

ementum Age Class	Not Pregnant	Pregnant	One Fetus	Two Fetuses	At Least One Fetus	Percent Pregnant	Twins/100 Pregnancies
Calf	1						0
1	4	2	2			33.3	0
2		5	4	1			20
3	2	9	8	1			11
4	1	8	8				0
5		7	5	2			29
6		4	3	1			25
7		1	1				0
8							0
9							0
10		1		1			100
11		1	1				0
Unknown	3	4	3	1		57.1	25
Totals	11	42	35	7		79.2	17
Totals excluding calves & yearlings	6	40	33	7		87.0	18

TABLE 43

MOOSE PREGNANCY RATES - KENAI RIVER NORTH, NOV. 1965

Cementum Age Class	Not Pregnant	Pregnant	One Fetus	Two Fetuses	At Least One Fetus	Percent Pregnant	Twins/100 Pregnancies
1	2			1		0	0
2		2	2				0
3		1		1			100
4							
5		5	3	1	1		20
6							
7							
8							
9							
10	2	3	1	1	1		33
11		1					100
Unknown		4	4			100	0
Totals	4	16	10	4	2	80	25
Totals Excl. Yearlings	2	16	10	4	2	89	25

TABLE 44

MOOSE PREGNANCY RATES - KENAI RIVER SOUTH, NOV. 1965

Cementum Age Class	Not Pregnant	Pregnant	One Fetus	Two Fetuses	At Least One Fetus	Percent Pregnant	Twins/100 Pregnancies
1	6	1	1			14	0
2		4	3		1		0
3		5	3		2		0
4		10	3	2	5		20
5		6	4	2			33
6		2	1	1			50
7		4	3		1		0
8	2	6	3	1	2		17
9							
10							
11		1			1		0
12		2	2				0
Unknown	3	16	13	1	2	84	6
Totals	11	57	36	7	14	84	12
Totals Excl. Yearlings	5	56	35	7	14	92	13

TABLE 45

COMPOSITE SUMMARY OF
MOOSE PREGNANCY RATES, UNIT 15, NOV. 1965

Cementum Age Class	Not Pregnant	Pregnant	One Fetus	Two Fetuses	At Least One Fetus	Percent Pregnant	Twins/100 Pregnancies
1	8	1	1			13	0
2		6	5		1		0
3		6	3	1	2		17
4		10	3	2	5		20
5		11	7	3	1		27
6		2	1	1			50
7		4	3		1		0
8	2	6	3	1	2		17
9							
10	2	3	1	1	1		33
11		2		1	1		50
12		2	2				0
Unknown	3	20	17	1	2	87	5
Totals	15	73	46	11	16	83	15
Total Excl. Yearlings	7	72	45	11	16	91	15

TABLE 46

MOOSE PARTURITION COUNTS, CHILKAT RIVER, 1966

Date	Newborn F/0	F/1	F/2	F/?	Yearlings W/OM	F/1	F/2	Total F	Total Yrlg.	Total Calves	M	Total Moose	Count Time	Moose/ Hr.	Observer Pilot Aircraft
2 Jun	22	7	3	0	14	5	4	41	23	13	24	101	2.5	40	Faro, Fox Taylorcraft
	M:100F=59				Yearlings:100F=56					%Yearlings in herd=23					
	Calves:100F=32									%Calves in herd=13					
3 Jun	7	2	4	2	17	7	0	23	24	10	16	73	2.6	28	Faro, Fox Taylorcraft
	M:100F=70				Yearlings:100F=104					%Yearlings in herd=33					
	Calves:100F=43									%Calves in herd=14					

TABLE 47

MOOSE PREGNANCY RATES, HAINES 1965

Cementum Age Class	Not Pregnant	Pregnant	One Fetus	Two Fetuses	At least 1 Fetus	% Pregnant	Twins/100 Pregnancies
C	2	0				0	
1	1	0				0	
2	0	0				0	
3	0	1			1		0
4	0	1			1		0
5	0	2			2		0
6	0	0					
7	0	0					
8	0	1			1		0
Unknown	1	1	1			50.	0
TOTALS	4	6	1		5	60	0
Totals Excluding Calves & Yearlings	1	6	1		5	85.7	0

MOOSE CALF TAGGING SUMMARY, MATANUSKA-SUSITNA VALLEYS, 1966

Area	Total Calves Tagged	Male	Female	Sets of Twins	One of Set	Color Marker
Palmer Hay Flats	57	29	28	13	1	Green
Jim-Swan Lakes Flats	12	5	7	1	0	White
Goose Bay	3	2	1	0	1	Blue
Willow-Kashwitna	61	29	32	7	4	Pink & Red
Kashwitna-Montana		10	19	6	3	White
Willow Flats	11	4	7	3	0	Yellow & Pink
South, Lake Nancy Flats	14	7	7	2	0	Yellow
TOTALS	187	86	101	32	9	

TABLE 49

MOOSE CALVES TAGGED BY AREA EACH YEAR, SOUTHCENTRAL ALASKA, MAY 1960-JUNE 1966

Area**	Total All Years ♂	♀	Total*	1960 ♂	♀	Total*	1961 ♂	♀	Total*	1962 ♂	♀	Total*	1963 ♂	♀	Total*	1964 ♂	♀	Total*	1965 ♂	♀	Total*
1.	163	180	344	29	41	70	13	23	37	24	27	51	17	20	37	21	21	42	30	20	50
2.	174	185	360	29	28	57	28	36	65	-	-	-	22	22	44	33	44	77	33	23	56
3.	22	14	36	7	6	13	2	3	5	-	-	-	6	1	7	5	3	8	-	-	-
4.	36	34	71	8	3	11	16	13	29	-	-	-	1	2	3	4	9	14	-	-	-
5.	3	2	5	1	2	3	1	0	1	-	-	-	-	-	-	-	-	-	1	0	1
6.	137	121	258	25	14	39	22	19	41	17	20	37	14	14	28	29	25	54	30	29	59
7.	43	46	89	8	0	8	30	46	76	-	-	-	5	0	5	-	-	-	-	-	-
8.	0	2	2	-	-	-	-	-	-	0	2	2	-	-	-	-	-	-	-	-	-
9.	99	84	186	-	-	-	-	-	-	17	13	30	21	16	37	23	23	48	33	25	59
10.	4	1	5	-	-	-	-	-	-	-	-	-	-	-	-	4	1	5	-	-	-
11.	7	12	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	12	19
12.	12	21	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	4
13.	7	12	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	7	12
TOTALS	707	714	1428	107	94	201	112	140	254	58	62	120	86	75	161	119	126	248	141	118	260

* difference in sum of ♂ + ♀ is due to calves of ? sex

** 1. Palmer Hay Flats
2. Willow-Kashwitna
3. Goose Bay
4. South Lake Nancy
** 5. Anchorage side of Knik Arm
6. Susitna Flats
7. Chickaloon
8. Eagle Bay
** 9. Jim-Swan Lakes
10. Flat Horn Lake
11. Deception Creek
12. Kashwitna-Montana Cr.
13. Willow Flats

TABLE 49 (contd.) MOOSE CALVES TAGGED BY AREA EACH YEAR, SOUTHCENTRAL ALASKA, MAY 1960 - JUNE 1966

Area	♂	♀	Total
1.	29	28	57
2.	29	32	61
3.	2	1	3
4.	7	7	14
5.	-	-	
6.	-	-	
7.	-	-	-
8.	-	-	-
9.	5	7	12
10.	-	-	-
11.	-	-	-
12.	10	19	29
13.	2	5	8
TOTALS	84	99	184

TABLE 50

TAGGED MOOSE CALVES RECOVERED IN 1965, SOUTHCENTRAL ALASKA

Tagging Data					Recovery Data		
Spec #	Tag Number	Date	Sex	Location	Date	Miles from Tag Site	Location
124-63	2276,2277	5/29/63	M	Goose Bay #4	11/10/65	10 *	Mile 18 Knik Road
123-63	2273,2274	5/29/63	M	Goose Bay #4	11/21/65	8 *	7 mi. W. of Nike Site on Goose Bay Road
156-63	2542,2543	5/31/63	M	Palmer Hay Flats # 15	11/21/65	6 *	1 mi. from Wasilla on Williwaw Lodge Road
15-150-60	427,428	6/3/60	M	Little Willow Creek	11/23/65	9 *	9 mi. N. of Willow Creek along highway
43-64	1620,1621	5/28/64	F	Palmer Hay Flats #26	11/27/65	13 * 2	Fishhook Road 6 1/2 mi. from Glenn Highway
24-64	1580,1581	/64	F	Palmer Hay Flats #14	11/27/65	4 * 2	1 mi. N. of Ready Lake
79-63	1514,1515	6/5/63	F	Palmer Hay Flats #6	11/27/65	3 * 2	2 mi. down Lakeview Rd. from Fishhook
86-63	2144,2145	5/28/63	F	Jim-Swan Lakes #4	11/27/65	7 * 1	Lazy Mtn. Rd. R2ET19N Sec 23
7-234-64	3017,3018	6/5/64	F	Palmer Hay Flats #6	11/27/65	14 * 1	2 1/2 mi. up Buffalo M. Rd.
10-64	1551,1552	5/27/64	M	Susitna Flats #9	6/1/65	1 1/2	Susitna Flats #3
109-63	2240,2241	5/29/63	M	Willow-Kashwitna #109	11/27/65	7 *	1 1/2 mi. N. Little Willow
33-61-65	3255,3256	5/28/65	F	Palmer Hay Flats #24	11/27/65	13 * 1	1/2 mi. from Truck Rd. and Glenn Highway

* jaw recovered
* 1 head recovered
* 2 head and repro. recovered

Calf Tagging

Matanuska Valley

From May 27 to June 2, 187 moose calves were ear tagged in the Matanuska-Susitna Valleys (Table 48 and Figure 17). A total of 1,431 calves have been tagged in these areas since 1960. This was the last year of the tagging program in the Matanuska-Susitna Valleys. A summary of moose tagged from May 1960 through June 1966 is given in Table 49. Returns of specimens and records of tagged moose from that area continue to provide information on movements and survival and a means of assessing age determination techniques. A summary of tagged moose recovered in 1965 is given in Table 50.

Tanana Flats

From May 30 through June 5, 230 calves were tagged on the Tanana Flats (Table 51, and Figure 18).

TABLE 51

SUMMARY OF TAGGING RESULTS, TANANA FLATS, 1966

Area	Number Tagged		Incidence of		Total Calves Tagged
	Male	Female	Singletons	Twins	
I	73	63	112	12	136
II	17	17	20	8	34
III	32	28	47	7	60

The incidence of twin births appears higher among the tagged calves than the incidence shown by aerial count but this is probably due to a bias of the crew in favor of twins.

Based on a calculated chi-square value of 0.02, the sex ratio of tagged calves is not significantly different at the .05 confidence level.

Using the Lincoln Index method, data from post-tagging parturition counts were used to estimate the number of calves on two of the three areas.

In Tables 52 and 53 pertinent data are reviewed. Several factors affected the counts and subsequent estimates, some of which are functions of the numerical data while others are related to methods, phenology, and timing relative to the calving period. Small samples of calves and particularly of tagged calves tended to inflate estimates in some cases, and resulted in wider confidence intervals.

As June progressed foliage development reduced visibility increasingly. Recruitment and mortality were operating during this period, particularly the latter. Estimates from surveys number 1, 3, and 4 in Area I are considered to represent the calf population with reasonable accuracy and precision. Survey number two was done less intensively than the other three surveys. As a result fewer calves were found which inflated the calf estimate and the standard error was quite large.

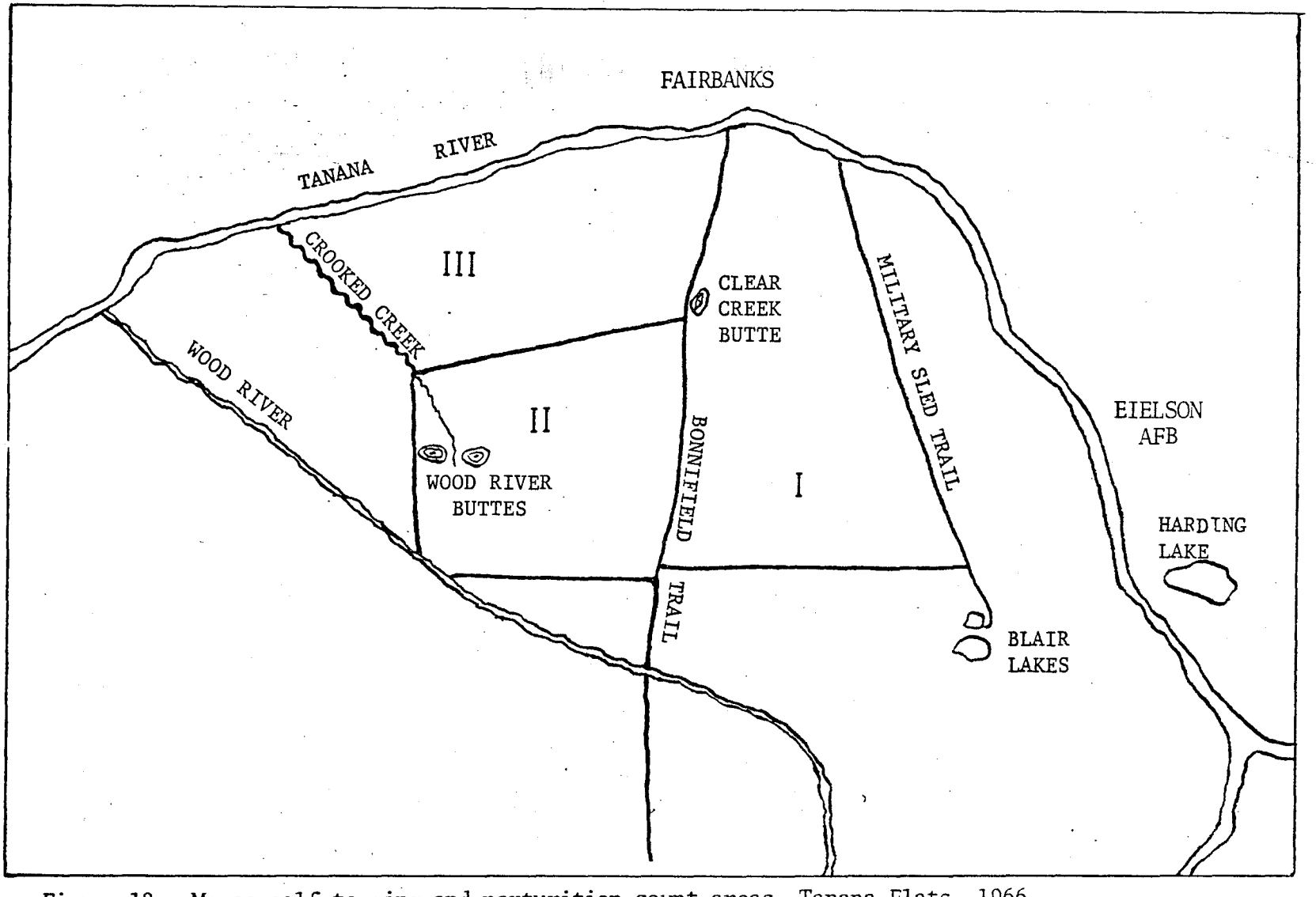


Figure 18. Moose calf tagging and parturition count areas, Tanana Flats, 1966.

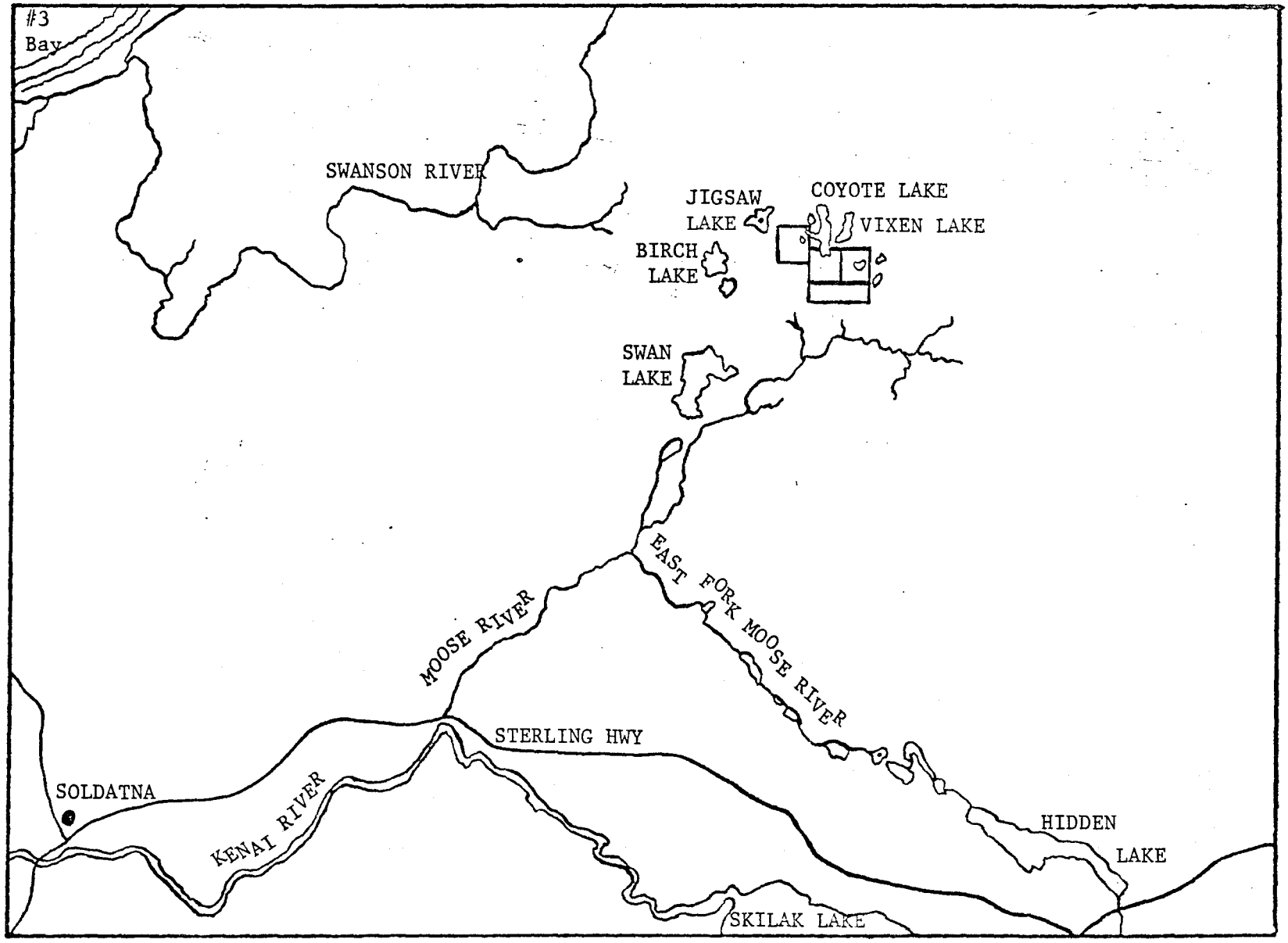


Figure 19. Location of Moose Enclosure, Kenai National Moose Range.

TABLE 52

LINCOLN INDEX ESTIMATES OF CALF PRODUCTION ON SELECTED AREAS OF THE MATANUSKA-SUSITNA VALLEYS, 1966.

Area	Survey No.	Dates	Calves Counted	Tagged Calves Counted	Percent Tagged Counted	Calves :100♀	Total Moose	Est. Total Calves	Standard Error	95% Confidence Limits of Estimate
Palmer Hay Flats	1 & 2	2-3 June	40	22	55	57.1	159	104	14.82	74-134
Willow Kashwitna & Kashwitna-Montana	1 & 2	2-3 June	103	25	24	69.1	272	371	64.53	242-500

In addition to obtaining a good estimate of calves in Area I from surveys 1, 3, and 4, the results of all the surveys provided valuable insight into the effects of several non-numerical variables involved in aerial counts, and provided a basis for more closely estimating the number of tagged calves needed to narrow the confidence limits in future operations.

In Area 3 the two surveys were done in immediate succession. Foliage development, mortality, and characteristics of the vegetation affected the counts and the estimate of 420 calves should be accepted only with appropriate qualifications. Again, these surveys were valuable from the standpoint of data obtained and in providing a basis for evaluating the characteristics of data that can be obtained under particular circumstances.

Estimate of Calf Population

The calf populations on the Palmer Hay Flats and the Willow-Kashwitna-Montana area were estimated by applying the Lincoln Index to the tagged:untagged calf data obtained from aerial counts (Table 53).

On the Palmer Hay Flats the observed ratio of tagged:untagged calf was high which greatly reduced the standard error and the confidence limits. In the Willow-Kashwitna-Montana area the proportion of tagged calves observed was lower; consequently, the standard error and confidence limits are larger.

A significant point in evaluating the technique is that in two successive days the tagged:untagged calf ratio observed was quite similar in the Palmer Hay Flats - 53 percent (June 2) and 57 percent (June 3) tagged. In the Willow-Kashwitna area the percentages are 26 and 21 for similar dates, and the Kashwitna-Montana area percentages were 35 and 16. In the latter two areas foul weather and foliage development made aerial counting difficult on June 3 and may have affected the percentages of tagged calves observed.

In estimating the number of calves by the Lincoln Index, data for Palmer Hay Flats counts were accumulated for both dates. The Willow-Kashwitna and Kashwitna-Montana data were combined for both areas and dates.

The estimated number of calves as presented in Table 52 are considered realistic estimates of the calves in the respective areas, based upon familiarity with characteristics of the respective populations.

Adult Moose Tagging

The pilot study on tagging adult moose provided valuable information on several facets of moose capture and tagging using a syringe gun and tranquilizer drugs in the winter.

Finding and Approaching Moose

In the Matanuska Valley where roads and moose were abundant and frequently contiguous, an automobile was found to be the most efficient method of contacting substantial numbers of moose within range of the capture weapon per unit time. Spot lighting, or "jacklighting" moose at night was not feasible.

TABLE 53

LINCOLN INDEX ESTIMATES OF CALF PRODUCTION ON THE TANANA FLATS, 1966

Area	Survey #	Date	Calves Counted	Tagged Calves Counted	Percent Tagged Counted	Calves :100♀	Total Moose	Est. Total Calves	Stand Err	95%
I	1	6 Jun	78	19	24	38.1	459	558	111.4	335-780
	2	10 Jun	47	7	15	43.9	286	913	318.4	277-1549
	3	14 Jun	54	14	26	26.1	493	525	120.6	283-767
	4	21 Jun	49	11	22	30.2	406	606	160.9	284-928
III	1	8 Jun	0	0	0	18.8	106	---	----	-------
	2	8 Jun	7	1	14.3	25.3	72	420	122.9	174-666

Syringe Gun Operation

The two syringe, or dart guns available were the "Paxarms" weapon, manufactured in New Zealand, and the Palmer "Cap-Chur" gun. The dart is propelled by a .22 blank cartridge in the Paxarms weapon and features a power control device by which the power delivered to the dart may be controlled according to the estimated range or other conditions. The Paxarms weapon proved to be more accurate, but the variable power control was easily moved accidentally, and resulted in excessive or inadequate power on occasion.

The "Cap-Chur" gun used a blank 32 gauge shotgun shell for propulsive power. Accuracy was fair compared to the Paxarms weapon and the shells were found to vary considerably in performance, some being adequate to propel the dart while others were essentially "duds". Because of the better performance of the Cap-Chur darts, however, that weapon was useful for this project. Modification of the Paxarms weapon to fire the Cap-Chur dart is underway so that good characteristics of both systems may be utilized.

Syringes

The injection of the drug in the Paxarms dart depends upon air pressure developed when the drug is forced into the dart. In cold temperatures pressure is sufficiently reduced to preclude proper injection of the drug. In the Cap-Chur dart a primer is exploded upon contact with the animal which results in positive expulsion of the drug. Additionally, the Cap-Chur dart can be loaded with drugs more precisely, and the drug is expelled more completely. Residual drug solution in the Paxarms dart contributes to freezing of the plunger mechanism.

Freezing of the drug solution in the syringe body or in the needle was a common problem even when the drug was used in up to a 50 percent alcohol solution. By keeping the darts and the gun near the car heater until needed this problem was largely obviated.

Marking

A collar of hollow polyethylene rope with colored plastic strips threaded through it, and a numbered plastic pendant attached, was placed on the tranquilized moose. The coding of the collar is based on collar color, and color and placement of plastic strips attached to the collar. Yellow polyethylene rope was used for the collar. Plastic strips were yellow, blue, orange, white and pink, 3 x 5 inches in size. The coding of the color is as follows:

1. The pendant number is stamped in yellow on a black 3.5 x 2.25 inch nylon pendant.

2. The year of tagging is represented by a colored strip on the collar located at the median dorsal line of the neck, e.g. a yellow strip indicates 1965-66.

3. The area is denoted by four plastic strips, two on each side of the medial dorsal year strip.

4. The collar rope is color coded by year.

5. A pair of differently colored plastic strips were threaded through the collar; "above" being high on the side of the collar, "below" being low on the collar, nearer the pendant (Table 54).

6. In addition, the two strips were either on the left or on the right as part of the coding. Left or right refers to one's left or right as one faces the moose.

The combination of colors "above" or "below" and "left" or "right" keys out the individual. A shortage of plastic tags made it necessary to duplicate some combinations. In addition to the color-coded collar, numbered metal tags were attached to the ears.

Drugs

Liquid Sucostrin was used until powdered succinylcholine chloride was available. Dosages remained the same for both the powdered and liquid forms as follows: for adults, 22 mg.; for calves 6 to 9 months old, 11 to 12 mg. Drug doses for adults were started at 15 mg. and raised until a workable dose was found. No ill effects were noted from using a 25 to 50 percent alcohol solution with the drug in an attempt to prevent freezing of the drug in the syringe.

Tagging Results and Movements of Moose

Thirty-five moose were tagged (Table 54). Two later died; one from apparent damage to the spinal cord by the dart, and the other apparently was hit by a vehicle one month after tagging. The collar and tags were intact.

Specimen number one was seen six days after tagging about one mile east of the tagging site with the tags and collars intact. Speciman number 32 was seen 50 days after tagging during which time she had disassociated from her yearling, given birth to a calf which was ear-tagged, and lost the calf to a yearling grizzly and/or two coyotes which were seen in the area during aerial counts.

Range Productivity Relationships

This project is designed to last for 15 or 20 years to assess the relationship of moose to their range. Four one square mile plots (See Figure 19) were selected on the Kenai National Moose Range for construction of moose pens. The pens were surveyed and arrangements for construction of the fences and initial vegetation work were made.

TABLE 54

ADULT MOOSE TAGGED AND COLLARED IN MATANUSKA VALLEY-WINTER 1965-66

Specimen #	Ear Tag # L	Ear Tag # R	Tagging Date	Sex	Age	Location	Collar Color: Pendant #	Year	Area	Collar	Above	Below	Left or Right	Remarks
1	3777	3776	2/10/66	♀	A	T17N R2W Sec 9SW 1/4	60	Y	B	Y	Y	O	R	First moose drugged had to be hit twice
2	3778	3779	2/11/66	♀	A	T19N R1E Sec.34 NE 1/4	61	Y	B	Y	Y	W	L	
3	3780	3781	2/15/66	♀	A	T18N R2E Sec 19 NW 1/4	62	Y	B	Y	Y	W	R	
4	3782	3783	2/16/66	♀	A	T17N R2W Sec 2 SE 1/4	63	Y	B	Y	Y	B	L	Has some color combination on color as moose #30 (but pendant different)
5	3784	3785	2/17/66	♀	A	T 17N R1E Sec 9 NW 1/4	64	Y	B	Y	Y	B	R	
6	3786	3787	2/19/66	♂	A	T18N R1E Sec 14 NE 1/4	65	Y	B	Y	Y	Y	L	A yearling, it was found dead over a month later, possibly hit by a car. Collar and tags intact
7	3789	3790	2/18/66	♀	A	T17N R2E Sec 14 NW 1/4	66	Y	B	Y	Y	Y	R	
8	none	none	3/2/66	♀	A	T18N R2E Sec 10 NW 1/4	67	Y	B	Y	Y	P	L	Moose recovered from drug before tags could be placed in ears
9	3791	3792	3/3/66	♂	A	T18N R2E Sec 26 NW 1/4	68	Y	B	Y	Y	[illegible]	R	

TABLE 54 (Contd.) ADULT MOOSE TAGGED AND COLLARED IN MATANUSKA VALLEY - WINTER 1965-66

Specimen #	Ear Tag # L	Ear Tag # R	Tagging Date	Sex	Age	Location	Collar Color: Pendant #	Year	Area	Collar	Above	Below	Left or Right	Remarks
10	3793	3794	3/3/66	♀	A	T17N R2E Sec 24 SW 1/4	'69	Y	B	Y	W	P	L	
11	3795	3796	3/4/66	♂	calf	T19N R1E Sec 14 NW 1/4	70	Y	B	Y	Y	P	R	Used 12 mg succinylcholine chloride
12	3799	3798	3/8/66	♀	A	T19N R2E Sec 28 NE 1/4	71	Y	B	Y	W	B	L	
13	3797	3800	3/10/66	♀	A	T17N R3W Sec 29 NE 1/4	72	Y	B	Y	W	B	R	
14	4163	4164	3/11/66	♀	A	T18N R2E Sec 32 SW 1/4	73	Y	B	Y	W	Y	L	This ♀ lived for 3 days, but would not get up. Believe mechanical injury to spine by dart.
15	4165	4166	3/11/66	♂	A	T17N R1E Sec 3 SE 1/4	74	Y	B	Y	W	Y	R	
16	4167	none	3/15/66	♀	A	T17N R1E Sec 10 SE 1/4	75	Y	B	Y	B	O	L	Began mixing drugs w/50% 100 proof ethyl alcohol to keep from freezing
17	4173	4174	3/16/66	♀	A	T17N R1E Sec 1 NW 1/4	76	Y	B	Y	B	O	R	♀# protected this ♀ so we drugged her also
18	4175	4181	3/16/66	♀	A	T17N R1E Sec 1 NW 1/4	77	Y	B	Y	B	P	L	Protected ♀ #; would not allow us to approach until we drugged her too.
19	4184	4186	3/16/66	♀	A	T17N R1E Sec 8 SE 1/4	78	Y	B	Y	]	W	L	

TABLE 54 (Contd.) ADULT MOOSE TAGGED AND COLLARED IN MATANUSKA VALLEY - WINTER 1965 - 66

Specimen #	Ear Tag # L	R	Tagging Date	Sex	Age	Location	Collar Color Pendant #	Year	Area	Collar	Above	Below	Left or Right	Remarks
20	4182	4183	3/16/66	♀	calf	T17N R1E Sec 16 NE 1/4	79	Y	B	Y	B	P	R	Used 11 mg of "Pax Immo A" successfully.
21	4187	4188	3/17/66	♂	A	T15N R3W Sec 9 NW 1/4	80	Y	B	Y	B	W	R	
22	4170	4171	3/18/66	♀	A	T18N R2E Sec 31 SE 1/4	81	Y	B	Y	B	Y	L	
23	4172	4189	3/18/66	♂	A	T18N R1E Sec 35 SW 1/4	82	Y	B	Y	B	Y	R	This ♂ was with another ♂ which had its rt. spike antler intact.
24	4190	4191	3/23/66	♀	A	T18N R2E Sec 31 SW 1/4	83	Y	B	Y	Y	O	L	
25	4193	4194	3/23/66	♀	A	T18N R1E Sec 34 SE 1/4	84	Y	B	Y	Y	O	R	Very old ♀ ,many old scars & hairless nodules on her body. Believed to be pregnant.
26	4195	4196	3/24/66	♀	A	T18N R1E Sec 36 SW 1/4	85	Y	B	Y]	Y	P	L	Blind in rt. eye. Physical damage to cornea at some time in the past.
27	4197	4198	3/25/66	♀	A	T17N R1E Sec 1 NE 1/4	86	Y	B	Y	Y	P	R	
28	3801	3802	3/29/66	♀	A	T18N R2E Sec 32 SE 1/4	87	Y	B	Y	Y	W	L	Also drugged her calf, #29.
29	3803	3804	3/29/66	♂	calf	T18N R2E Sec 32 SE 1/4	88	Y	B	Y	Y	W	R	Calf of ♀#28.

TABLE 54 (Contd.) ADULT MOOSE TAGGED AND COLLARED IN MATANUSKA VALLEY - WINTER 1965 - 66

Specimen #	Ear Tag # L	Ear Tag # R	Tagging Date	Sex	Age	Location	Collar Color Pendant #	Year	Area	Collar	Above	Below	Left or Right	Remarks
30	3805	3806	4/5/66	♀	A	T17N R2W Sec 7 NW 1/4	89	Y	B	Y	Y	B	L	Moose # 4 has same color combination collar (but pendant # different).
31	3809	3810	4/6/66	♀	A	T17N R2E Sec 26 NE 1/4	90	Y	B	Y	Y	B	R	This ♀ had a bad abscess in rt. nostril. Also favored her left foreleg
32	3811	3812	4/12/66	♀	A	T16N R2E Sec 10 NE 1/4	91	Y	B	Y	O	O	L	
33	3813	3814	4/12/66	♀	A	T17N R1E Sec 34 SE 1/4	92	Y	B	Y	O	O	R	
34	3815	3816	4/13/66	♂	calf	T18N R2E Sec 20 SE 1/4	93	Y	B	Y	B	B	L	In a general debilitated condition, but moved off after drugs wore off.
35	3807	3808	4/16/66	♀	A	T17N R1E Sec 32 NE 1/4	94	Y	B	Y	B	B	R	

ACKNOWLEDGEMENTS

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ANNUAL ASSESSMENTS OF MOOSE CALF PRODUCTION AND MORTALITY IN SOUTHCENTRAL ALASKA[1]

by
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and
Arthur Bratlie

In Alaska, where people still hunt to obtain food as well as for recreation, moose are sought by more hunters than any other big game species for which accurate records are available. Some 30,000 persons annually obtain moose harvest tickets and approximately 9,000 animals are harvested each year. The annual harvest could be much larger if more of the herds were accessible. The lack of access has directed intensive hunting pressure upon local herds accessible to the human population centers of Anchorage and Fairbanks.

The advent of antlerless (any sex or age) seasons in 1960 brought the realization that annual harvests from accessible areas could exceed the annual increment to the herd; thus a precise knowledge of population status became paramount to the success of management endeavors. The research program inaugurated included studies designed to measure annual harvests, to identify discrete populations, to reveal dynamics of the various populations and to assess the relationship of moose to the available range. This paper reports on techniques used to assess initial production of calves (potential and realized) and their subsequent survival through their first 12 months. This period was chosen because calves can be identified positively from light aircraft or helicopters until they are 12-14 months old and because yearlings (12-24 months old), particularly males, are an important age class to the harvest. Often their availability determines the success of the hunting season in some local areas. Yearling males may comprise 50 to 80 percent of the harvest of males in the Matanuska Valley, where many years of intensive hunting of only males has removed most of them. In past years as few as 5 males per 100 females, excluding calves, remained at the end of the hunting season. Therefore, a calf-crop failure could create havoc with the following hunting season and should be detected sufficiently in advance of the proposed season to allow for adjustments of seasons and bag limits. The areas chosen for study include most of the areas readily accessible by automobile as preliminary analysis of harvest tickets (95 per cent are returned) show that 60 to 80 percent of the moose reported are harvested within a few miles of the highway system.

For the purpose of this discussion, two areas in southcentral Alaska, the Matanuska Valley and the Lower Susitna Valley, are used with selected references to other areas. These areas are within 50 miles of the largest population center within Alaska -- Anchorage.

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[1] A contribution from Pittman-Robertson Research, Project W-6-R-6, Alaska Department of Fish and Game. (Presented at the 45th annual Conference of Western Association, State Fish and Game Commissioners, Anchorage, Alaska)

The attempts to assess production and survival of calves have been largely confined to four techniques:

1) Assessment of fertility (pregnancy rates) by area and age class.

2) Estimates of natality (number of live births) by aerial counts in May and June.

3) Fall sex and age composition counts conducted largely in November and December.

4) Survival counts conducted in April, May and early June.

Fertility Rates

Fertility rate as used here refers to the proportion of female moose that are gravid. Yearling females exhibit a variable rate of fertility from range to range and no instance of calf moose bearing young has been recorded. These two generally non-productive age classes are included in the fertility rate computations because they are counted as adults for purposes of computing survival rates.

Generally, macroscoping evidence of pregnancy, an embryo or placental tissue, can be found in uteri from animals taken after mid-November (most moose breed between September 20 and October 10 but macroscopic evidence in the cornu is not usually present for approximately 3-4 weeks). In case of early pregnancy, where only a few strands of fetal membrane can be located, additional evidence confirming the pregnancy is obtainable by sectioning the ovaries to determine if a primary corpus luteum is present. Collections of uteri and ovaries have been obtained from animals killed and turned in by hunters; those collected by Department of Fish and Game field personnel during antlerless seasons; from highway kills and railroad killed animals. The bulk of the collections for most years have been made in November and December, during antlerless seasons. The uteri and ovaries are fixed in a 10 percent formalin solution and examined in the laboratory.

The ratio of newborn calves per 100 cows, as mentioned earlier, includes two non-productive age classes, yearlings and calves, because these age classes are counted as adults when the fall sex and age composition counts and spring survival counts are made. Yearlings do produce some calves, but with the exception of the 1964 sample, fewer than 10 percent of those examined were gravid. The number of fetuses per 100 total females, (adults, yearlings and calves) in the sample, forms the basic unit for comparison with the subsequent production and survival checks. The data is recorded in such a manner as to allow for a percentage breakdown which is more amenable to statistical analysis. The incidence of twin fetuses is also recorded.

Computations based upon the age composition of the Matanuska Valley moose populations (Rausch, 1957, 8th Alaska Science Conference, pp.41-49, and 1959, unpublished Master's thesis) show that 90 to 110 calves should be born for every 100 females including the usually non-productive females, if in utero mortality is low. We have found little evidence of resorption, abortion or stillbirth even during or following severe winters when literally thousands of moose perish.

Natality

The incidence and timing of parturition is obtained by making periodic aerial surveys of calving grounds from May 15 to June 15. Concentrations of parturient cows have been found only in association with wet marshy areas representing tidal flats

bogs created by fires and subsequent slumping and thawing of permafrost areas, flooding by beaver, low land areas associated with major rivers and shallow, partially filled lakes. All of the calving centers examined to date can be characterized as having openings with abundant early spring forage including horsetail (Equisetum spp.), sedges (Carex spp.) and aquatic vegetation. Almost without exception the areas are interspersed with "islands," elevated areas with better drainage that have a dense cover of trees or shrubs 10 to 60 feet tall. Most cows give birth on these "islands."

Counts made since 1957 have shown that on the Alaskan range calving commences around May 15th--peaks between May 23rd and May 28th and is largely completed by June 10th. The estimate of initial calf production is based upon the highest counts, usually obtained in late May or early June. These counts are compared to the fertility index for the particular area as a check on initial calf production. The technique of observing cows with newborn calves does, in all probability, slightly underestimate the initial production of calves because of:

1) calves born after the counts are completed,
2) early mortality, and
3) the questionable category female.

The last bias, that of #3, can be partially evaluated because cows with calves exhibit definite behavioral patterns when "buzzed" by a low flying aircraft and their physical appearance also aides in determining if they have given birth. When buzzed, cows with calves almost invariably glance toward the calf's position, which may be from a few feet to 1/4-mile from the female. Following this, she engages in displacement feeding and ignores the aircraft with a "Who, ME? expression," seemingly implying, "I'm really not here." Their physical appearance is slab sided, whereas pregnant moose are obviously rotund when viewed dorsally.

The behavioral characteristics are reliable and frequently calves are spotted on the 4th or 5th low level pass when the cow finally runs to the calf or the calf becomes alarmed and moves to the cow, or occasionally the observers will spot the rust-colored calf which blends perfectly with the understory.

Still some questionable category females remain and they are computed both as having a calf and as cows without calves. For purposes of this paper, we have included them as having calves.

Fall Sex and Age Composition Counts

The fall counts utilize light aircraft, principally the Supercub, PA-18, and are timed to coincide with the period immediately after the breeding season--mid-October to late November when the animals are grouped homogeneously and males have not shed their antlers. Suitable snow cover does not always coincide with the desired period and some counts are made after the males have shed antlers. The counts attempt either to total count an area if it is small with good boundaries or strip count with the strips approximately 1/4 of a mile wide on predetermined units which coincide with the areas previously subjected to fertility and natality studies. The fall counts provide a measure of the survival of calves from birth to 6 to 10 months, depending upon when the counts are made. We recognize six categories of animals on the fall aerial counts: Adult males, sub-adult males (generally yearlings), females without calves, females with one calf, females with two calves, and calves that are by themselves.

Spring Survival Counts

The fourth and final portion of this attempt to trace a calf through its first year of life is made in April, May or early June--most frequently in May or early June concurrent with the natality or parturition counts, and represents the final assessment of survival. These counts again employ light aircraft or occasionally helicopters and generally are made on the calving grounds or adjacent to the calving grounds. The objective of this survey is to measure the survival of calves from November through May--the critical winter period.

Discussion

Mortality of calves during the first 12 months of life, as revealed by these assessments, varies from 30 to 80 percent of the observed fertility rates. Tables 1 and 2 indicate several examples of mortality as revealed by these techniques. The reasons for the different mortality rates between the Matanuska Valley and Lower Susitna areas are not clearly understood at this time, but are believed to represent differences in the environmental conditions between the two areas. The former area is windblown, seldom having deep snow and all foodstuffs available are available throughout the year. The area north of Willow to Talkeetna experiences deep snow cover and a winter of longer duration. In addition, the winter range is decadent. It would appear that the severe environmental conditions have resulted in a high annual mortality of calves with relatively little change in fertility rates. The fact that a larger percentage of yearling females are producing calves on ranges where moose populations were reduced through hunting does suggest that the crowded conditions existing prior to the herd reduction may have delayed the age of sexual maturity of female moose, but once matured the fertility rates were consistently at or above 90 percent.

The nature and timing of calf mortality is not known. In some instances it seems to be a gradual attrition throughout the year, Matanuska Valley Tables 1 and 2; in others, Willow-Talkeetna area, the loss of calves in 1964 seems to have occurred between June and March when the sex and age composition counts were made. Still other surveys indicate that calves perished during the period from December to June. We have speculated that calf survival may be directly related to severity of the winter. In 1964-65 snow accumulation was quite deep on the Willow-Talkeetna area and persisted into June. Nearly 50 percent of the calving area was snow covered in late May and few calves survived to the time when the fall counts were made. Survival of calves in other areas of the state also suggest natural phenomena may, at times, be responsible for the wide variations in calf survival. In interior Alaska, the moose populations on the Koyukuk River exhibited the highest survival recorded, ranging from 60-90 calves per 100 cows on sizeable samples for three years, then a late spring followed by extensive, prolonged flooding preceded calf survival figures of 10 calves: 100 females. Floods have occurred during two of the last three years and calf survival has been uniformly low. We suspect that mortality factors affecting calves vary from area to area. Fertility rates and incidence of twinning also vary but on the areas examined in Alaska mortality of calves rather than reduced fertility rates seems to be the reason for widely fluctuating rates of moose calf survival.

TABLE 1

ESTIMATED PRODUCTION AND SURVIVAL OF MOOSE CALVES.*

Area	Year	Fetuses	Calves at Birth	Calves (6-9 Mo.)	Yearling Calves (11-13 Mo.)	Percent Mortality
Matanuska Valley	1963-64	86	70	50	40	57
Matanuska Valley	1964-65	80	61	?	?	--
Willow-Talkeetna	1963-64	93	81	16	16	81
Willow-Talkeetna	1964-65	91	86	?	?	--

*All figures based on ratio of 100 total females.

TABLE 2

ESTIMATED PRODUCTION AND SURVIVAL OF CALF MOOSE IN THREE LOCAL POPULATIONS IN SOUTHCENTRAL ALASKA, 1958.

Area	Cows older than 24 months.	Cows 24 months (Class I).	Cows 11 to 12 months (Short yearlings).	Pregnant cows (95% of cows older 24 months).	Singletons.	Sets of twins.	Calves/100 cows (Class I and older).	Calves/100 total cows.	Sets twins/100 total cows.	Calves/100 total cows in November.	Twins/100 total cows in November.	Percent mortality of calves (birth to 6 mos.).	Percent mortality of one of twins.	Sample size, fall 1958, cows only.
Matanuska Valley	88	12	20	84	59	25	109	91	21	47	2.6	48	88	373
Willow	88	12	20	84	59	25	109	91	21	42	3.1	54	85	476
Kashwitna	88	12	20	84	59	25	109	91	21	35	3.7	61	82	570

MANAGEMENT OPPORTUNITIES DERIVED FROM A MANDATORY MOOSE HARVEST REPORT SYSTEM IN ALASKA*

by

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A mandatory moose harvest ticket system was inaugurated in Alaska in 1963. Under the system, each moose hunter is required to obtain a no-cost, non-transferable moose harvest ticket prior to going afield. Vendors, however, receive 15¢ from Federal Aid funds for each ticket issued.

The ticket consists of three parts: the overlay, the harvest ticket and the report card. The overlay, which is completed by the issuing vendor, provides a record of how many tickets were issued and to whom they were issued. Procedures at issuance includes recording the ticket number on the permittee's hunting license and his name, date, address and license number on the overlay. The harvest ticket portion is punched by the hunter for month and date prior to attaching it to the animal. The report card must be mailed to the Department of Fish and Game within 15 days after taking an animal, or within 30 days after the close of the season if the hunter was unsuccessful or did not hunt. The approximately 30,000 tickets issued annually, (Table 1) are available at all department offices and at all license vendors in the state.

Prior to statehood, Alaska was divided into 26 administrative game management units to facilitate establishing seasons and bag limits on all species of game. In recognition of the abundance of moose, seasons and bag limits have been progressively liberalized during the past six years whenever and wherever the public would accept such regulation changes. These changes have resulted in variations in local seasons. Consequently, after statehood some game units were subdivided to accomplish the degree of management desired, as studies revealed identifiable moose populations. Geographic designations used in recording moose harvest ticket compilations do not necessarily conform to the subunits designated in the regulations because it is necessary to recognize harvests from the identifiable populations to provide the necessary tools for precision in management.

Moose seasons run from August 1 through December 31 in some parts of Alaska. Therefore, the report cards are not available or due from some successful hunters until January 15, and from unsuccessful hunters until January 30. This is only a few weeks before regulation proposals for the following season are due, leaving little time for compilation and analysis. Because the information from the tickets is essential when formulating recommendations for the following year's seasons and bag limits, pressure is exerted upon the ticket holders to return their tickets promptly. This pressure includes publicity throughout the hunting season and two reminder letters, one sent before expiration of the 30-day grace period after the season closes, and a second sent to those who fail to respond to the first letter.

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*Presented at the 46th Annual Conference of Western Association of State Game and Fish Commissioners, Butte Montana, July 14, 1966.

A contribution from Alaska Federal Aid Project W-15-R.

Another pressure is the possibility of prosecution for failing to return the report card, although by administrative policy no prosecutions have occurred since 1964, and only a very few prior to that year.

The technique of constant pressure is effective, indicated by returns each year of 93 to 95 per cent of all tickets issued.

Voluntary returns are probably sufficient for an accurate estimate of the statewide harvest. As a matter of fact, in 1962, before the advent of the mandatory system, a 10 percent sample of all licensed moose hunters yielded a statewide estimate of harvest very similar to the 1963 estimate, which was based on 93 percent return of all harvest tickets. For management purposes, however, a statewide estimate of harvest is not adequate because, as stated previously, it does not provide data in sufficient detail to manage local or identifiable populations. The moose harvest ticket system, with the type of data provided by the report cards, supplies this detailed information without having to resort to registration or lottery type hunts.

Implications to Management

As research findings identify more populations, and as these moose become accessible through construction of roads, airfields and trails, manipulation of these populations becomes possible. Achieving adequate harvests consistent with the state's constitutional provision for the sustained yield concept will require seasons allowing for variations in hunting pressure. These are influenced by factors such as weather, holidays, quality of meat and traditional hunting periods. The information provided by the report cards measures some of these factors.

For example, the supposed variation in the quality of the meat affects the harvest in various sections of the state. Many people in interior Alaska object to seasons on male moose during the rut. On the contrary, Southeastern Alaskans traditionally hunt during the period September 15 through October 15, which happens to coincide with the breeding season, and they are satisfied with the quality of the meat.

The report cards reveal that the peak of the harvest in certain areas occurs at different times during the season. For example, in 1965 more than 50 percent of the harvest of male moose in Subunit 14F occurred during November, whereas in Unit 20 70 percent of the male moose harvest occurred between August 20 and September 30. Both Subunit 14F and Unit 20 have identical seasons for male moose, and both are near large human population centers, which in this case are 500 miles apart. Reasons for variation in time of harvest between Subunit 14F and Game Management Unit 20 are due, primarily, to differences in terrain and accessibility. Unit 20 is made up of large river valleys and relatively low mountains, with access roads traversing both lowland and mountain areas. In Subunit 14F most of the roads are in the valleys and moose consequently are not available to hunters until November migrations bring them to the lowlands. The need for the proper timing of hunting seasons is apparent in this instance.

Weather and terrain are two of the most important factors contributing to the harvest, aside from accessibility. In areas where moose migrate seasonally, moving to lowlands in late November, large harvests of both male and female moose can be achieved with relatively short seasons if the hunter access to the lowlands is good. This seasonal migration follows the breeding season and is perhaps

stimulated by an accumulation of snow. Large harvests followed the two consecutive years when either snow or cold weather preceded the opening of the antlerless seasons on the Kenai Peninsula and in the Matanuska Valley. For example, in 1965 approximately 1,000 moose were harvested on a 400 square mile area in the Matanuska Valley in one day. This harvest represents 11 percent of the statewide harvest, which was spread over 140 days.

The area from Willow to Talkeetna is an example of the importance of access. In this area, which is adjacent to the Matanuska Valley and has a moose population similar in size to that of the Valley, only 354 moose were harvested in 71 days. Here only one road traverses the area. In situations where access roads traverse alpine areas where moose congregate during the rut, large harvests occur in late September (Fig. 1).

The report cards show there is some indication that age composition of the harvest varies with the progression of the season. Pimlott (1959, J. Wildl. Mgmt. (4):381-401) showed that yearling moose were more susceptible to hunting than any other age classes. In some areas of Alaska male-only seasons have prevailed for so many years that the remaining harvestable group of males is primarily yearlings. This is reflected in the chronology of the harvest in Subunit 20B (Fig. 2) during the period August 20-31.

Management Opportunities

Harvest tickets have provided a nearly complete picture of the sex composition, area, and chronology of the moose harvest. This data, when correlated with the age composition of the harvest and productivity of the individual populations, allows us the opportunity to intensively manage these identifiable populations. For example, our 122 tag returns from 1,244 tagged moose show that the Matanuska Valley herd is quite discrete, with little interchange between it and adjoining populations. Census techniques show a population of 4,000 moose in the Valley, producing a harvestable crop of about 1,000 animals annually. The chronology of this harvest suggests an adequate number of hunters and sufficient access present to fully utilize the resource.

Information from the harvest ticket returns, when combined with research findings, provides the game manager a wealth of information about the harvestability of various identifiable moose populations. This information allows the manager to satisfy the hunting preferences of the local sportsman while fully utilizing the annual production of moose if access is adequate. In situations with limited access, very long seasons of up to 140 days and multiple bag limits are possible.

The moose report card, correlated with other research findings, which can be coupled with the emergency regulatory power allowing the Commissioner to open or close seasons at any time, offers unparalleled opportunities for managing identifiable moose populations on a sustained yield basis.

FIGURE 1

CHRONOLOGY OF MALE MOOSE IN SUBUNIT 2C, ALASKA, 1965

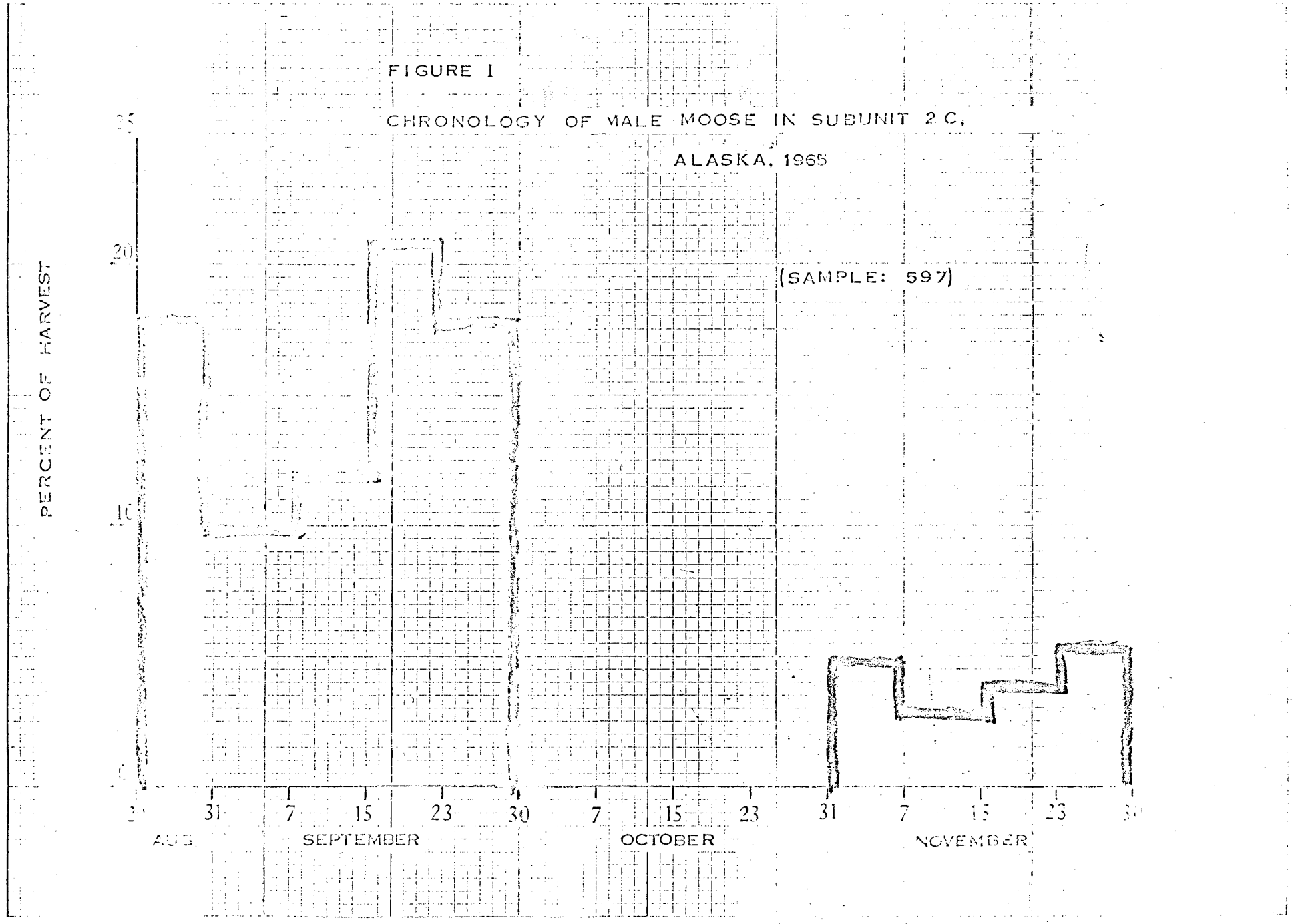

FIGURE II

CHRONOLOGY OF MALE HARVEST IN SUBUNIT 20B, ALASKA, 1965

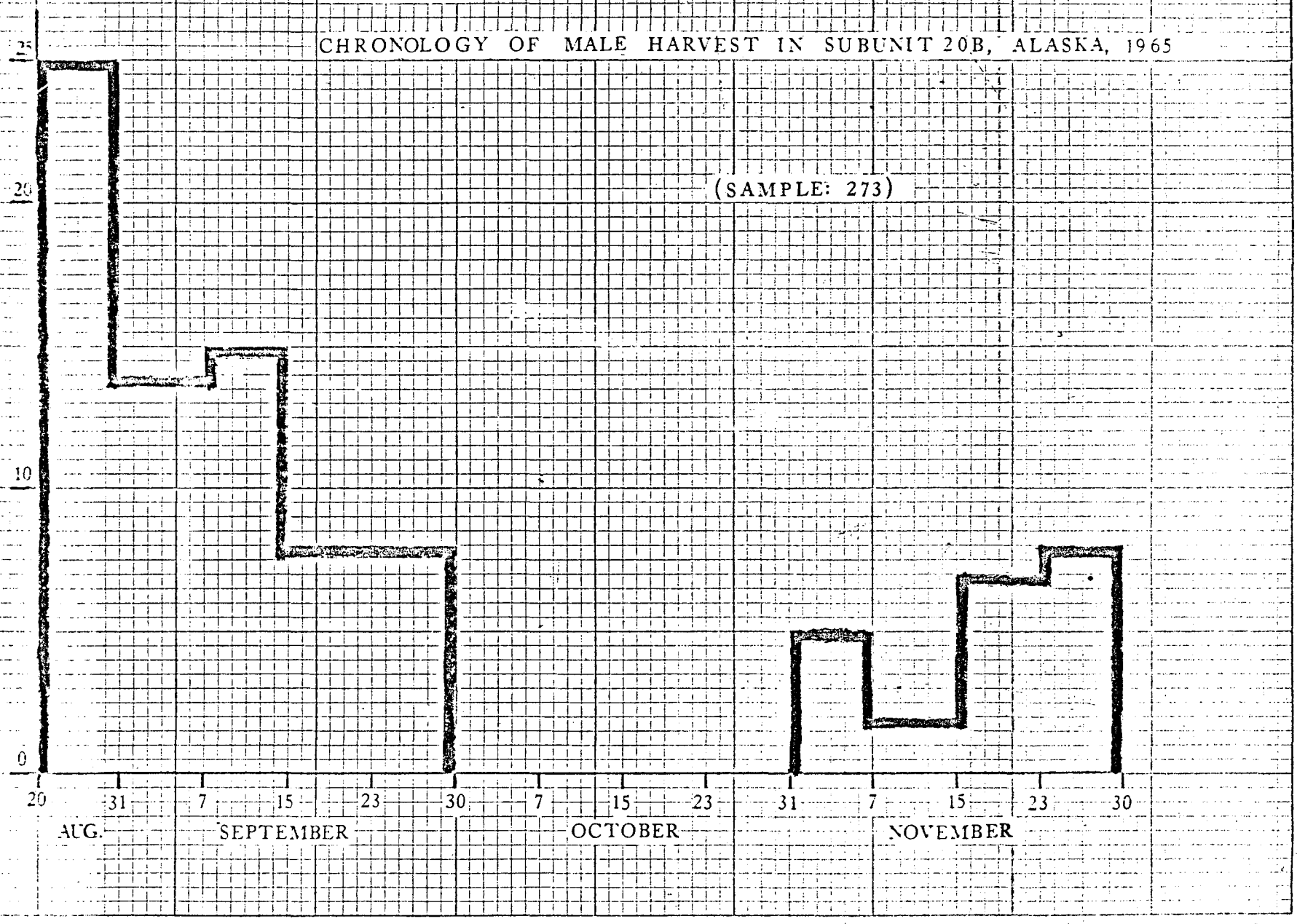

TABLE 1

HARVEST TICKET COMPILATIONS, 1963-65, ALASKA

	1963	1964	1965
Tickets Issued	32,412	29,904	32,924
Tickets Returned	30,563	27,731	30,864
Successful	8,861	8,770	8,620
Unsuccessful	16,287	12,365	22,244*
Did Not Hunt	5,415	6,386	---
Could Not Contact	385	791	862
Arrived to Late to Compile	257	---	---
No Response	1,207	1,382	1,198

*Total of Unsuccessful & Did Not Hunt

TABLE 2

MOOSE HARVEST TICKET RETURNS, SOUTHCENTRAL ALASKA, 1965

	Successful		Unsuccessful		Did Not Hunt	
	Number	%	Number	%	Number	%
Voluntary	4,647	75	2,891	32	1,200	29
1st Mailing	1,348	12	5,671	63	2,649	65
2nd Mailing	164	3	487	5	278	6
TOTAL TICKET RETURNS	6,159		9,049		4,127	

APPENDIX I

STATEWIDE MOOSE HARVEST TICKET COMPILATION, ALASKA, 1965*

Unit	♂	♂	♀	♀	Sex Unk.	Total
1	128	0	35	0	4	176
5	153	0	125	0	4	282
6	24	0	0	0	0	24
7	60	0	1	0	0	61
9	200	13	63	5	4	285
11	116	0	70	0	2	188
12	151	0	33	0	6	190
13	1,318	0	3	0	10	1,331
14	1,127	0	1,125	0	10	2,262
15	841	0	731	0	12	1,584
16	333	0	52	0	7	392
17	41	0	1	0	0	42
18	28	0	0	0	2	30
19	114	7	27	1	1	150
20	1,050	0	140	0	33	1,223
21	87	9	30	1	1	128
22	52	3	3	0	2	60
23	44	0	0	0	1	45
24	58	8	14	0	4	84
25	51	1	1	0	0	53
26	0	0	0	0	1	1
No Unit	32	0	9	0	0	41
TOTALS	5,976	41	2,419	7	104	8,591

*Totals through Feb. 15, 1966 - approximately 10% of tickets were outstanding.

APPENDIX I (Cont)

MOOSE HARVEST SUBUNIT BREAKDOWN, ALASKA, 1965

UNIT	SUBUNIT	♂	♀	SEX UNK.	TOTAL MOOSE
1	A	28	1	1	30
	B	34	0	2	36
	C	66	34	1	101
	Total	128	35	4	167
7	A	17	0	0	17
	B	10	0	0	10
	C	21	0	0	21
	D	6	0	0	6
	E	3	0	0	3
	Other	3	1	0	4
	Total	60	1	0	61
13	A	196	1	0	197
	B	183	0	0	183
	C	114	0	1	115
	D	123	0	1	124
	E	49	0	1	50
	F	299	0	1	300
	G	107	0	1	108
	H	1	0	0	1
	I	163	1	3	167
	Other	83	1	2	86
	Total	1,318	3	10	1,331
14	A	580	661	6	1,247
	B	191	184	2	377
	C	44	27	0	71
	D	78	44	0	122
	E	118	102	1	221
	F	82	52	1	135
	Fort Rich.	11	38	0	49
	Other	23	17	0	40
	Total	1,127	1,125	10	2,262
15	A	365	299	5	669
	B	183	193	1	377
	C	248	224	4	476
	Other	45	15	2	62
	Total	841	731	12	1,584
20	A	171	47	6	224
	B	273	4	8	285
	C	606	89	19	714
	Total	1,050	140	33	1,223