MOOSE MANAGEMENT STUDIES

Volume 13, number 2
Job Completion Reports

May 1, 1959

Note from Alaska Library Resources and Information Services:

This document is related to later moose study documents that had been used as supporting documentation by the Susitna Hydroelectric Project and that appear in the Susitna Hydroelectric Project document index. Job numbers 1, 2, and 3 cover the Susitna River basin.

Therefore, Alaska Library Resources and Information Services has assigned APA no. 4116 to this document and has included it in the Susitna Hydroelectric Project collection. Pages for Job numbers 4 and 5 are included to make the document complete.

There is a blur on p. 6. That line reads:
"Rivers to the Cook Inlet, the Little Susitna River, the Knik River,"

U.S. Fish and Wildlife Service

Federal Aid In Wildlife Restoration

ALASKA

JOB COMPLETION REPORTS

NOT FOR PUBLICATION

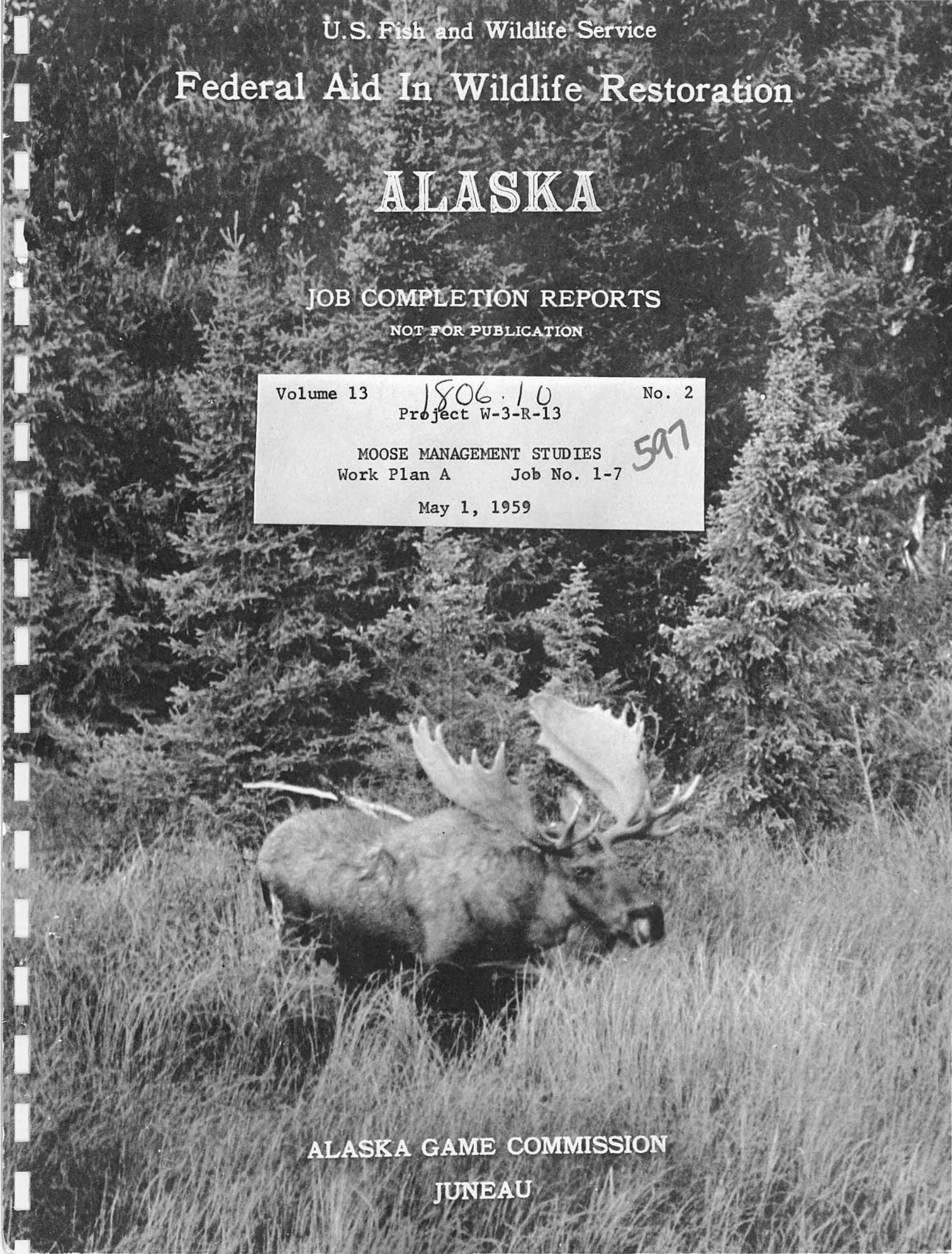
Volume 13 No. 2

Project W-3-R-13

MOOSE MANAGEMENT STUDIES

Work Plan A Job No. 1-7

May 1, 1959



ALASKA GAME COMMISSION

JUNEAU

Volume 13 Number 2

JOB COMPLETION REPORTS

Project W-3-R-13 Alaska May 1, 1959

Wildlife Investigations

Work Plan A

MOOSE MANAGEMENT STUDIES

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Not for Publication

(The results described in these reports are preliminary and often fragmentary in nature. Conclusions are subject to change with further investigation and interpretation).

C O N T E N T S

SUMMARY

Job. No. 1.--Herd Composition Surveys--Susitna and Copper River Valleys

Sex and age composition counts of moose populations inhabiting the Lower Susitna and Matanuska Valleys, and the Upper Susitna and Copper River Valleys were conducted in October and November of 1958 with the following results:

1. Eight thousand seventy-five moose were tallied in 64.1 hours of flight time actually counting moose.

2. Productivity in both areas is good with an average of 42 and 37 calves per 100 cows respectively.

3. Survival of yearling bulls varies greatly from one local population to another. The factors affecting this survival are hunting and probably local environmental conditions.

4. The effects of hunting are reflected by the bull:cow ratios. These reveal that in areas accessible by road or to swamp buggies the bull segment of the population is reduced. This reduction, however, has not been demonstrated to affect the pregnancy rate; thus hunting of bulls only does not control herd size.

Job No. 2.--Moose Calving Studies

Aerial counts of moose inhabiting calving areas are most successful in the early morning, between 3 a.m. and 7 a.m. Pregnant moose seek a variety of vegetation types for calving, but apparently concentrate in lowland, marshy areas that provide a variety of early-spring food and escape cover.

Moose calves first were seen on May 11, in 1958. Calving progressed rapidly and peaked on May 25 or 26. The final crop, estimated from aerial counts and from in utero observations, was 109 calves per 100 cows of Age Class I or older (24 months or older at the time of the parturition counts).

Twins occur in about 30 percent of the pregnancies, and two sets of triplets were observed.

Aerial counts made when the calves were about six months old revealed a calf mortality of 45 to 60 percent. Mortality approximating this magnitude has been relatively constant in the Valley areas for a number of years and may be normal under the environmental conditions existing on the study areas. Survival of twin varies considerably from area to area. Specific factors affecting overall calf survival and survival of twins are not known.

Job No.3--Distribution, Movements, and Dynamics of Railbelt Moose Populations.

No work accomplished on this job.

Job No.4--Herd Composition in Interior Alaska

Aerial composition counts were conducted during November and December in the Tanana, Fortymile, and lower Koyukuk Valleys. Eleven hundred nine moose were tallied in 19.3 hours of aerial counting for an average of 57.4 moose per hour.

Productivity indicated by calf:cow ratios, twins per 100 cows and the calf percent of the total herd remains "good" in all three areas.

Survival of moose to the yearling stage in the Tanana and Fortymile area is higher than that observed in the Koyukuk.

The effects of hunting in all three areas has little effect on the moose populations as a whole. Hunting pressure is quite localized in all three areas, since access is limited to those areas immediately adjacent to the roads and rivers.

There is still a decided need for study to provide data which will enable the investigator to better evaluate the effect of the many variables affecting composition counts from year to year.

Job No. 5--Southeast Alaska Moose Studies

Thirty-one moose were killed on the Alaska portion of the Stikine River during the 1958 legal season. Age composition of the kill continued to reflect the heavy cropping of bulls. Hunter success continued high for the area at 23 percent. Composition counts showed minimum ratios of 41 calves per 100 cows which are comparable to heavily hunted areas in the Matanuska Valley. An estimate of the moose population on the Stikine River based on pre-hunting season sex and age ratios and age distribution of the hunter-kill indicate a post hunting season population of 310.

JOB NO. 1.--Herd Composition Surveys--Susitna and Copper River Valleys

PERIOD COVERED: September 1, 1958, to November 26, 1958

ABSTRACT

Sex and age composition counts of moose populations inhabiting the Lower Susitna and Matanuska Valleys, and the Upper Susitna and Copper River Valleys were conducted in October and November of 1958 with the following results:

1. Eight thousand seventy-five moose were tallied in 64.1 hours of flight time actually counting moose.

2. Productivity in both areas is good with an average of 42 and 37 calves per 100 cows respectively.

3. Survival of yearling bulls varies greatly from one local population to another. The factors affecting this survival are hunting and probably local environmental conditions.

4. The effects of hunting are reflected by the bull:cow ratios. These reveal that in areas accessible by road or to swamp buggies the bull segment of the population is reduced. This reduction, however, has not been demonstrated to affect the pregnancy rate; thus hunting of bulls only does not control herd size.

OBJECTIVES

To determine age and sex composition of identifiable local moose population as an indication of relative productivity, survival, and effects of hunting.

TECHNIQUES USED

Coverage

Aerial surveys to determine sex and age composition of local identifiable moose populations were conducted during late October and November. The Upper Susitna and Copper River Valleys were surveyed between October 26, and November 2, using a Supercub 150, piloted by Gene Stolz of the Aircraft Division. Flying time, actually spent counting moose, totaled 35.5 hours.

Snow cover in the Lower Susitna Valley was not adequate for counting moose until November 12, and the counts were completed on November 26.

The counts were made with a Supercub 150, except on the Fort Richardson Area where the desirability for maintaining V. H. F. radio contact with the Military Control towers prompted the use of a Cessna 180. The planes were piloted by the following Game Management personnel: Jim Branson, agent in charge, agents Rudy Switzer, Wallace Smith, and Buck Stewart. A total of 28.6 hours were spent actually counting moose.

The counts were made within each predetermined local area from an altitude of 300 to 600 feet depending upon terrain, ground cover, and moose visability factors, (principally light and snow conditions). Each moose seen was inspected and assigned to a sex and age category. If doubt concerning its category existed, a low level inspection pass was made. Neither total counts nor systematic samples were practicable due to the large area involved. An attempt was made, however, to spend a proportionate amount of time counting in each cover type, and at the various altitudinal levels within each local area. The sex and age distribution patterns of the moose populations were not known exactly, prior to counting, therefore present techniques do not always produce a truly representative sample. Some of the local populations represented in the data have, however, been studied for a number of years. The knowledge obtained relative to the seasonal distribution of moose has resulted in modification of counting techniques, yielding more representative samples. As knowledge of population characteristics accumulates the problems of sampling techniques should diminish.

Data Recorded

Moose sex and age determinations by aerial observers are limited to five categories:

1. Young bulls--bulls with spike or forked antlers, usually with little or no antler-palm development. These animals are predominantly "yearlings", approximately eighteen months old. There is some overlap with two-and three-year-old moose. The errors are believed compensating however, because unusually small antlered two-and three-year-olds are counted as yearlings and large antlered yearlings are placed in the next higher age category.

2. Medium bulls--bulls having some antler-palm development, but not massive appearing; probably two-and three-year-old animals. The medium-bull category's most useful function is to create an awareness of the size differential between young and adult bulls, and it does not provide clear-cut data useful in determining population trends. Animals in the medium-bull category are considered adults in calculating sex and age ratios.

3. Adult Bulls--all bulls having greater antler development than the preceeding age category.

4. Cows--all cows, including yearlings.

5. Calves--young of the year, generally five to seven months old when the counts are made.

Methods of Analysis

The data from the 1958 sex and age composition counts were analyzed to determine current productivity, survival, and effects of hunting in each identifiable population as well as for the moose herds in general. The indicators of population status were first described in Federal Aid Progress and Completion Reports as follows: Federal Aid in Wildlife Restoration (Alaska), 10 (3) 7-11, restated and modified in 12 (1) 3-6. The indicators are again stated, with several additions, below. Each are evaluated by examining one or more indices provided by the appropriate sex or age ratios.

Productivity--the initial incidence of live births to females in the population, and the subsequent survival of these young to the date of the aerial count about six months later. The most significant index used is the ratio of calves per 100 cows.

A secondary indicator of productivity is the ratio of twins per 100 cows with calves. The full significance of this ratio is not fully understood at present. Nevertheless, in certain areas the ratio of twins per 100 cows with calves approaches 25 per 100 and adds a significant number of individuals to the herd. In some populations, such as the Mts. Susitna-Beluga area, the high incidence of twinning is concurrent with excellent productivity. The Matanuska Valley populations which have a sustained record of good to excellent productivity have a relatively low ratio of twins per 100 cows.

The observed variations in twinning rates may reflect a number of survival factors rather than differences in twinning rates at natality. In the Matanuska Valley examination of the contents of nearly 100 uteri taken from cows collected during the period when moose are normally pregnant, revealed 27 sets of twins per 100 pregnancies. Aerial counts made on the same areas during May and June 1958, indicated 33 sets of twins per 100 cows with calves. The data obtained from the in utero and calving area observations suggest that in the Valley areas mortality rates for twins are greater than they are for singletons.

The reasons for certain other areas having higher ratios of twins are not known, but may reflect better survival of twins or a higher initial incidence of twinning due to environmental conditions or a different population age structure.

The principal index to productivity is the ratio of calves per 100 cows. In comparing productivity trends from year to year, and by areas, it is believed that descriptive terms indicating the general trends are more meaningful than the numerical ratios; for this reason the terms poor, fair, good, and excellent are used in the general discussion of productivity in this report. The terms correspond to the following numerical values:

Poor----------below 20 calves per 100 cows
Fair----------20 to 35 calves per 100 cows
Good----------36 to 50 calves per 100 cows
Excellent----------more than 50 calves per 100 cows

The foregoing categories pertain only to productivity at approximately six months as measured by the calf:cow ratio. They do not necessarily indicate the overall well-being of the herd. A population having poor productivity, at six months, could have excellent survival during the remaining portion of the year and be increasing; conversely a population could have excellent productivity, poor survival and be decreasing.

Survival--The survival of the calves recorded on the fall sex and age counts to approximately the same date one year later--i. e., survival from approximately 6 to 18 months of age; and as survival of calves recorded on the spring or parturition counts to the same date one year later--i. e., survival from birth to 12 months.

Survival between 6 and 18 months can be measured by two indices, each using a different population segment as its comparison base. The first index is the ratio of young (yearling) bulls per 100 bull calves. In computing the young bull:bull calf ratio it is necessary to assume that calf production and survival to the time of the counts remains constant from year to year, and that the sex ratio of moose calves is 100:100. Calf production and survival to the time of the counts could vary considerably from year to year and cause an error in the index. Sex composition data obtained from examination of moose fetuses and calves indicate, essentially, a 100to 100 ratio.

The second index to survival from 6 to 18 months is provided by the ratio of young bulls per 100 cows as compared to the previous year's ratio of bull calves per 100 cows. Theoretically, the difference between these ratios represents the mortality during the period between 6 and 18 months. The percentage obtained from these methods should not, at present, be interpreted as absolute, because the aerial surveys possess a number of seemingly inherent variables that have not been fully evaluated. The comparison does, however, yield data useful in interpreting population trends.

Cow moose are probably the most constant population segment in Alaska where they are not hunted. They are therefore used as the base for comparing young bulls with last year's bull calves. The use of the female population segment as the comparison base for the survival index assumes that natural mortality of adult females is approximately equal to the annual recruitment of yearling females, which are counted as adults by aerial observers. In populations experiencing either a rapid increase or decrease the described index will be biased. Most of the moose populations in South Central Alaska, however, appear to be nearly stable or increasing slowly, the index is therefore believed to provide a reliable index to survival, providing that the various sex and age components of each population are sampled proportionately.

A comparison base comprised of only those females two years and older could be used, but at present it is not considered necessary. The segment of the female population two years and older is computed by assuming a 100 to 100 sex ratio in yearling moose and then subtracting a number equal to the number of young males counted from the total females counted. The previous year's mortality is offset by the recruitment of last year's yearling females to the base or

comparison segment of the female population. The foregoing method provides an older and perhaps more stable age group for comparison purposes, but does not provide for differential sex survival rates to two years. In some areas hunting is a major decimating factor to yearling bulls, and would cause a significant error to the survival index in the areas experiencing intense hunting pressure.

An index to survival of moose from 6 months to 12 months is provided by aerial counts made in May and early June of 1957 and 1958. The fall counts have a number of previously discussed variables that are difficult to quantitate, and that tend to reduce the value of the survival indices. The spring counts possess fewer known, variations, and mortality of moose from 12 to 18 months is believed minimal, except to hunting. Thus, the spring survival counts serve as an index to "effective survival". This provides a measure of calves surviving to one year, and under our existing regulations, a measure of the yearling bulls which will be available to hunters the following fall. The spring survival index is the ratio of calves per 100 cows in the spring as compared to the same ratio obtained from the previous falls' sex and age count. Calf moose remain with the cow until she bears another calf, usually the following spring. At parturition the female drives the last year's calf away. The calf does not leave the immediate area for several days, however, and spring calf:cow counts are feasible until early June.

Effects of Hunting--The extent to which hunting reduces the male segment of the population is measured, primarily, by the ratio of bulls per 100 cows. Another index is the ratio of young bulls per 100 adult bulls, however, hunting tends to lower both the number and average age of the bull segment of the population; thus, the yearlings constitute a greater portion of the bull population as hunting pressure increases.

FINDINGS

Sex and Age Composition of the Lower Susitna Valley Moose Populations

The general areas of the Lower Susitna and Matanuska Valleys are illustrated in Figure 1. The areas include the drainages of the Big Susitna River from the Talkeetna and Kahiltna Rivers to the Cook Inlet, the Little Susitna River, the Knik River,

and the Matanuska River. Several additional drainages adjacent to Anchorage are also included in the surveys.

The Lower Susitna and Matanuska Valleys support some of Alaska's most abundant, accessible, and valuable moose populations, as well as some of the least accessible. Whenever possible the areas outlined in Figure 1 represent identifiable moose populations believed to be resident within a specific geographic unit. The Matanuska Valley and Willow areas represent local identifiable populations which have been studied for several years. The basis for classifying them as identifiable populations was reported in the following reports: Federal Aid in Wildlife Restoration (Alaska) 11 (2): 19-22., and 12 (1): 28-110.

The study areas are as follows: Matanuska Valley, Willow area, Kashwitna area, Susitna Flats, Mts. Susitna and Beluga, Kahiltna glacier area, and Fort Richardson area.

Each population indicator is discussed separately below, as it applies to the general area and to certain local areas.

Productivity

Productivity throughout the Lower Susitna and Matanuska Valley areas is considered good. The combined, and weighted average calf:cow ratio for the entire area is 42 calves per 100 cows (Tables 1 and 2), and compares favorably with the 1957 calf:cow ratio of 44 calves per 100 cows (see Table 7). The calf: cow ratios are remarkably similar in the local areas comprising this general area. The Kashwitna and Susitna Flats areas are exceptions with calf:cow ratios of 35 and 32 calves per 100 cows, respectively. The Kashwitna calf:cow ratios for 1957 and 1958 are identical. The reasons for the relatively low productivity in the Kashwitna area are not clear, but it is believed to reflect poor survival of calves rather than a low birth rate. Studies of moose pregnancy rates, through examination of railroad-killed moose, reveal that at least 90 percent of all females Age Class II and above are pregnant. Aerial surveys made at parturition time, May and early June, also revealed a uniformly high calf:cow ratio in 1958.

The mortality factors affecting calves are not fully known. One theory is that the combination of deep snow and insufficient winter browse adversely affects the females ability to care for

Figure 1. Moose populations in the Lower Susitna and Matanuska Valley areas.

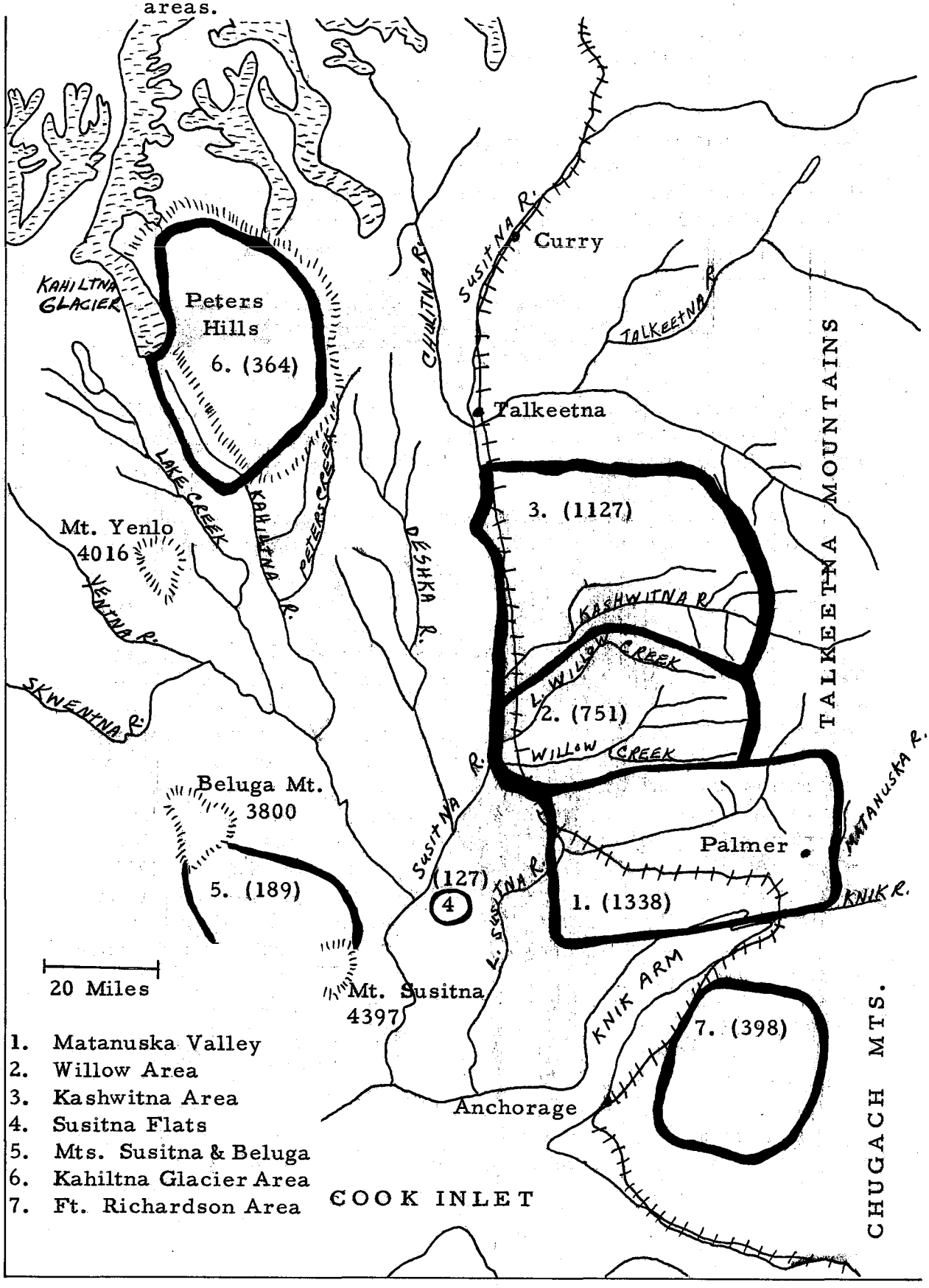

Table 1. Summary of moose population composition counts--Lower Susitna-Matanuska Valleys--November and December 1958.

Area	Yearling ♂	Medium ♂	Large ♂	Total Males	Females W/O	Females W/1	Females W/2	Total Females	Total Calves	Total Moose
Matanuska Valley	25	23	6	54	487	361	25	873	411	1338
Willow Area	22	17	37	76	292	169	15	476	199	751
Kashwitna Area	84	71	201	356	390	159	21	570	201	1127
Susitna Flats	14	13	14	41	45	19	1	65	21	127
Mt. Susitna-Beluga	8	11	43	62	52	27	7	86	41	189
Kahiltna Glacier Area	30	25	82	137	95	57	6	158	69	364
Ft. Richardson Area	22	21	28	71	139	85	6	230	97	398
Totals	205	181	411	797	1500	877	81	2458	1039	4294

Table 2. Sex and age ratios in Lower Susitna & Matanuska Valley moose populations--Nov. & Dec. 1958

	Total Bulls/ 100 Cows	Young Bulls/100 Adult Bulls	Calves/100 Cows	Twin Calves/100 Cows W/Calf	Calf Percent in Total Herd	Young Bulls Percent in Total Herd	Young Bulls/100 Bull Calves	Young Bulls/100 Cows	Moose Per Hour	Total Moose
Matanuska Valley	6	86	47	6	31	2	11	3		1338
Willow Area	16	41	42	8	26	3	22	5		751
Kashwitna Area	62	31	35	12	18	7	84	15		1127
Susitna Flats	63	52	32	5	17	11	133	22		127
Mt. Susitna & Beluga	72	15	48	26	22	4	39	9		189
Kahiltna Area	87	28	44	10	19	8	87	19		364
Ft. Richardson	31	43	42	7	24	6	45	10		398
Totals	32	35	42	8	24	5	39	8	150	4294

the newborn calves. Quantitative data on the Kashwitna area supporting the above theory is lacking. The Willow area which is adjacent to the Kashwitna area experienced severe winters in 1954-55 and 1955-56. Productivity as shown by calf:cow ratios obtained the following falls was only fair. Since 1956-57, winters have been relatively mild and the calf:cow ratios in 1957 and 1958 were 35 and 42 calves per 100 cows, respectively, whereas the 1956 fall counts revealed only 27 calves per 100 cows. In all probability snow depths in the Kashwitna and Willow areas are similar. Data indicating the comparative availability of winter browse are not available, nevertheless the calf:cow ratios are somewhat different, although, it is possible that the difference is related to sampling error.

The Matanuska Valley and Kenai areas also seem to reflect increased productivity of calves following warm winters. The Matanuska Valley has had relatively mild winters since the severe winter of 1954-55, and calf production increased from 34 per 100 cows in 1955 to 53, 50 and 47 calves per 100 cows in 1956, 57, and 58, respectively. Productivity on the Kenai has been even more dramatic, increasing from a low of 19 calves per 100 cows in 1955 to 24, 35, and 42 calves per 100 cows in 1956, 57, and 58, respectively.

Refuge Supervisor Spencer, reports that the increased productivity on the Kenai is concurrent with increased production of browse on a large burn which occurred in 1947. The relative importance of the mild winters as compared to that of an increased supply of browse are seemingly impossible to separate. In all of the areas discussed, factors other than mild winters and the resulting increased availability of browse may be affecting the survival of calves, however, if such factors are present they are not currently known.

The incidence of twinning in the Lower Susitna and Matanuska Valley areas, unlike the calf:cow ratios, is quite variable. The ratio of twins per 100 cows varies from a high of 26 per 100 in the Mt. Susitna and Beluga area to a low of 6 per 100 in the Matanuska Valley areas. The problems of interpreting the significance of twins are discussed in the Section on Techniques.

Survival

Survival of moose calves to 12 months in the Lower Susitna Valley and Matanuska areas as revealed by spring aerial counts (Table 3) is unusually good. The areas surveyed had a fall calf: cow ratio of 50:100, and the following spring a calf (11 to 12 months):ratio of 45:100; a measurable mortality of 10 percent from November to May. This low mortality may well reflect the mild winter of 1957-58. The mortality figure cannot be considered exact, because it is impossible to determine if the fall and spring counts are equally representative of the populations sampled. In my opinion they are equal.

Survival of young bulls to 18 months is only fair. The 1957 bull calf:cow ratio was 22:100, and the comparable ratio, young bulls per 100 cows, in 1958 is 8:100, this indicates that more than 50 percent of last year's young bulls were removed by hunting or other mortality factors (Table 4). Examination of survival by area (Table 4) reveals that young bull survival varies greatly. The areas that are accessible and receive intense hunting pressure, notably the Matanuska Valley and Willow areas, have young bull:cow ratios of about 5 per 100. Comparison of the young bull:cow ratio with the previous years bull calf:cow ratios in the Matanuska Valley and Willow areas reveal a mortality of 70 to 90 percent, with hunting probably the most important decimating factor.

Survival in the more inaccessible areas, such as the Kahiltna Glacier and Kashwitna areas was good. These areas had an indicated survival of male calves, as measured by the young bull:cow ratio, and the young bull:bull calf ratio, of approximately 85 percent.

The indices to survival of 18 months are influenced by hunting pressure and do not adequately measure survival of female moose, which are not hunted. It is believed that the spring aerial counts are a better index to survival of female moose, because mortality between 12 and 18 months is considered minimal.

Table 3. Survival of moose calves to 12 months as measured by the yearling:cow ratio obtained from aerial counts made in the Matanuska Valley and Lower Willow areas.

Date	Total Females	Total Yearlings	Yearling:100 females
May 7, 1958	60	31	52
May 9, 1958	85	25	29
May 12, 1958	166	67	40
May 16, 1958	112	61	52
May 19, 1958	101	40	40
May 21, 1958	106	53	50
May 24, 1958	87	44	50
May 27, 1958	79	32	41
June 3, 1958	84	42	50
Average yearling:female ratio			45

Table 4. An index to the survival of Bull Calves to 18 months.

Area	Bull calves:100 Cows 1957	Young bulls:100 Cows 1958	Indicated percent survival
L. Susitna & Matanuska Valleys			
Matanuska Valley	25	3	12
Willow	17	5	29
Kashwitna	17	15	88
Kahiltna Glacier	21	19	90
Susitna & Beluga Mts.	27	9	33
Ft. Richardson	22	10	45
Totals	22	8	36
Upper Susitna - Copper River Valleys			
Lake Louise	33	7	33
Maclaren River & Clearwater Creek	18	12	67
Alphabet Ridge	18	11	61
Oshetna Rivers & Tyone Cr.	27	13	48
Little Nelchina	24	7	29
Oshetna & Nelchina combined	26	11	42
Clarence L. & Black River	25	11	44
Mt. Drum & Wrangell Mts.	20	12	60
Upper Gakona River	22	13	59
Kiana River and Lower Chugach Mts.	12	10	83
Totals	21	11	52

The Effects of Hunting

In order to more effectively demonstrate the effects of hunting on the bull segment of the various populations, and because hunting pressure varies in direct proportion to accessibility, certain of the areas experiencing different levels of hunting pressure are discussed separately.

Matanuska Valley. The Matanuska Valley represents an area of nearly unlimited accessibility by car and foot in the lowlands, and a corresponding accessibility to swamp buggies and tracked vehicles in the timberline areas. The Valley has an overall bull: cow ratio of 6:100. The bull:cow ratio has declined steadily for a number of years. The ratio in 1956, 57, and 58 was 10, 8, and 6 per 100, respectively. These figures indicate unusual hunter efficiency in harvesting bulls. This past fall 1338 moose were represented in the Matanuska Valley sample; only 54 were males, Age Class I or older. There is no indication that this harvest of males has in any way lowered the annual calf crop. A sample of 22 females Age Class II and older collected during late 1958 and early 1959 revealed a 100 percent incidence of pregnancy. In all probability the hunter harvest will not significantly reduce the bull percentage below its present level, because the principal of diminishing returns seems to apply to hunting as it does to other fields of endeavor.

Willow Area. The Willow area has been hunted intensively for a number of years. The bull:cow ratio of 16:100 reflects this utilization. The area has an expanding system of roads and trails, providing hunters better access to the moose population. Hunter-success in 1958 was good and the decrease in the bull:cow ratio from 28:100 in 1957 to 16:100 in 1958 may reflect increased hunting pressure.

Kashwitna Area. The bull:cow ratio is 62 per 100. Hunting is limited to the areas adjacent to the railroad, and to the few lakes suitable for float or ski-equipped airplanes. The bull moose concentrate in the foothills of the Talkeetna mountains during the first season and most of the second season, and are not generally available to hunters. Apparently, hunting is not greatly affecting the male portion of the population at present.

Susitna and Beluga Mountains and Kahiltna Flats. These areas are accessible only by airplane, and have very few lakes or landing strips suitable for safe airplane operations. The bull:cow ratios are 72 and 87 per 100 respectively, and reflect the limited accessibility to hunting.

Fort Richardson. The Fort Richardson military reservation which is closed to hunting has a bull:cow ratio of 31:100. The moose population inhabiting Fort Richardson apparently is hunted intensively on the periphery of the closed area. During the first season many of the moose are located outside of the reserve; particularly in the Chugach mountains and Eagle River areas where hunting is legal. The legal kill apparently is sufficient to significantly affect the bull:cow ratio.

Sex and Age Composition in the Upper Susitna and Copper River Valleys

The local areas comprising this region are illustrated in Figure 2. In general the region includes most of the tributaries of the Susitna River above Deadman Creek, the Nelchina Basin, and the Copper River and its tributaries from the Tazlina River to the Sanford River.

The populations identified in Figure 2 and Tables 5 and 6 represent, primarily, geographical divisions. When more detailed studies are possible, segregation of some of these areas into local identifiable populations seems probable.

The areas covered are as follows: Lake Louise, Maclaren River and Clearwater Creek, Alphabet Ridge, The Oshetnas and Little Nelchina Rivers, Clarence Lake and Black River, Mount Drum and Wrangell Mts., Upper Gakona River, and Kiana River and Lower Chugach Mts.

In Tables 5 and 6 several of the above areas have been subdivided; however, the combined totals for each geographic area are used to analyze the population trend indicators. Productivity, survival and effects of hunting, the indicators of population trends, are again discussed in order.

Key to Moose populations in Upper Susitna & Copper River Valleys:

1. Lake Louise Area
2. Maclaren River and Clearwater Creek Area
3. Alphabet Ridge Area
4. Oshetna Rivers Area
5. Little Nelchina Area
6. Clarence Lake and Black River Area
7. Mt. Drum and Wrangell Mts. Area
8. Upper Gakona River Area
9. Kiana River and Lower Chugach Mts. Area

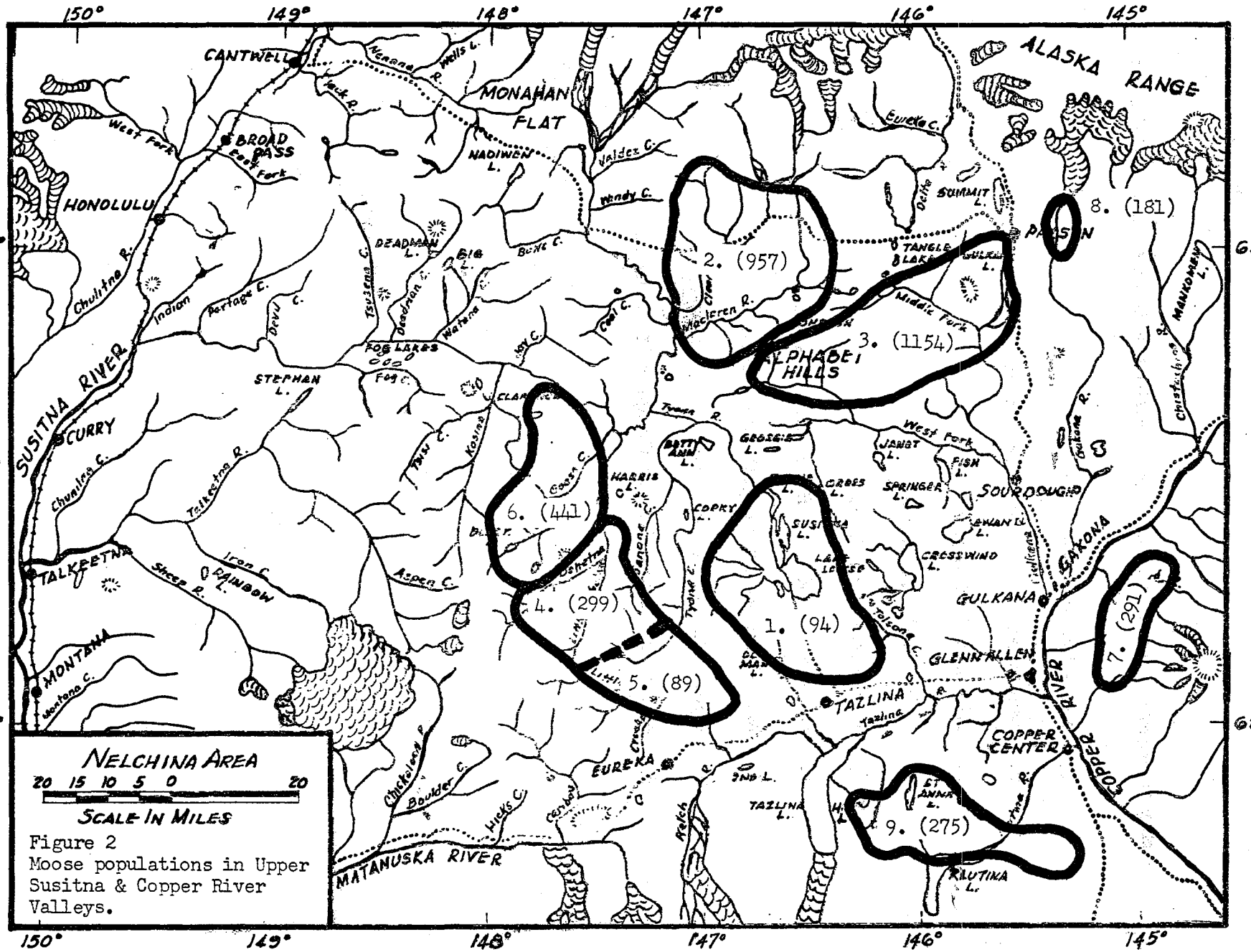

Figure 2
Moose populations in Upper Susitna & Copper River Valleys.

Table 5. Summary of Moose Population Composition Counts--Upper Susitna & Copper River Valleys

Area	Young Males	Medium Males	Large Males	Total Males	Females w/o	Females w/1	Females w/2	Total Females	Total Calves	Total Moose
Lake Louise	3	6	19	28	26	17	2	45	21	94
Maclaren River Clear Creek	61	53	118	232	316	194	7	517	208	957
Alphabet Ridge	63	87	237	387	371	192	4	567	200	1154
Oshetna Rivers & Tyone Creek	17	28	48	93	69	58	7	134	72	299
Little Nelchina	3	9	15	27	26	18	0	44	18	89
Oshetna & Nelchina areas combined	20	37	63	120	95	76	7	178	90	388
Clarence Lake & Black River	22	26	123	171	129	63	5	197	73	441
Mt. Drum Wrangell Mt. area	13	33	103	149	71	34	1	106	36	291
Upper Gakona River	11	11	39	61	50	32	2	84	36	181
Kiana River & Lower Chugach Mts.	13	23	99	135	109	14	1	124	16	275
Totals	206	276	801	1283	1167	622	29	1818	680	3781

Table 6. Sex and age ratios in Upper Susitna and Copper River Valleys--November 1958

	Total Bulls/ 100 Cows	Young Bulls/100 Adult Bulls	Calves/100 Cows	Twin Calves/100 Cows w/Calf	Calf Percent in Total Herd	Young Bulls Percent in Total Herd	Young Bulls/100 Bull Calves	Young Bulls/ 100 Cows	Moose Per Hour	Total Moose
Lake Louise	62	12	47	10	22	4	29	7		94
Maclaren R. Clear Creek	45	36	40	3	22	6	59	12		957
Alphabet Ridge	68	19	35	2	17	5	63	11		1154
Oshetna Rivers & Tyone Creek	69	22	53	11	24	6	47	13		299
Little Nelchina	61	13	41	0	20	3	33	7		89
Oshetna-Nelchina Combined	67	20	50	8	23	5	44	11		388
Clarence Lake and Black R.	62	15	37	7	17	5	60	11		441
Mt. Drum-Wrangell Mt.	140	10	34	3	12	4	72	12		291
Upper Gakona R.	73	22	43	6	20	6	61	13		181
Kiana River & L. Chugach Mt.	108	11	13	7	6	5	162	10		275
Totals	71	19	37	4	18	5	61	11	106	3781

Productivity

Productivity in the Upper Susitna and Copper River Valleys is considered good. The 1958 fall counts indicate an overall average of 37 calves per 100 cows (Table 6). The 1958 calf: cow average is slightly lower than that of 1957, which was 42 calves per 100 cows. The counts, however, are not directly comparable, because the 1958 counts include relatively large samples from two areas not represented in the 1957 counts. Productivity in the Upper Susitna and Copper River Valleys varies considerably from one local area to another and possibly reflects the need for further investigation to delimit the boundaries of the local populations. The calf:cow ratios range from a high of 53 per 100 in the Oshetna Rivers and Tyone Creek area to a low of 13 per 100 in the Kiana River and Lower Chugach Mts. area. The sample from the latter area, however, is believed non-representative of the entire population. Despite the non-uniform rates of productivity the overall calf production appears good.

Survival

Survival as measured by the index provided by the ratio of the 1957 bull calves compared to the 1958 young bulls is in excess of 50 percent for the entire region (Table 4). Survival in the areas accessible to hunters is reduced; Lake Louise and the Little Nelchina areas had an indicated survival of 33 and 29 percent respectively. Both of these areas are accessible to hunters and the population boundaries are not well defined.

The low productivity and high survival rates of the Kiana River and Lower Chugach Mts. area is believed to reflect a non-representative sample. Inclement weather prevented adequate coverage of the lowland portions of the area. Previous studies have indicated that during October most of the bulls are usually at or above timberline, whereas cows with calves frequent the areas below timberline. The bull:cow ratio of 108 bulls per 100 cows also suggests disproportionate sampling.

In the areas where large samples were obtained, and where hunting is limited to the areas along the few roads and numerous lakes, approximately 60 percent of the 1957 bull calves survived. Good examples of such areas are the Alphabet Ridge, and Maclaren River and Clearwater Creek areas where 1154 and 957 moose were counted, respectively.

Effects of Hunting

The bull:cow ratio for the entire Upper Susitna and Copper River Valley areas is 71:100, and compares favorably with the same ratio for 1957 which was 69 bulls per 100 cows. The effects of hunting are largely masked by combining the accessible areas with those subjected to a lesser hunting pressure, and for this reason several of the areas representing varying degrees of hunting pressure are discussed separately below.

Lake Louise. Aerial hunting is intense in this area and the bull:cow ratio is 62:100, as compared to last year's ratio of 49:100. It is believed that the small sample of 94 moose counted in 1958 is probably non-representative of the existing bull:cow ratio.

Maclaren River and Clearwater Creek Area. The bull:cow ratio in this popular hunting area is 45:100 and compares favorably with the 1957 ratio of 43:100. The Maclaren and Clearwater areas have been readily accessible to foot and swamp buggy hunters for only three seasons. In 1956 the bull:cow ratio was 62:100, and initially it was believed that the increased accessibility to hunting would quickly lower the bull:cow ratio, however, much of the area is closed to hunting and the effective radius of foot and swamp buggy hunters is relatively small, considering the entire area. Hunter success in 1958 was considered good, but it appears that the hunter take may be approaching a plateau or maximum under the present regulations and restricted accessibility.

If additional roads are constructed, or if the present road system is maintained during the second season, when many of the bulls inhabiting the Denali reserve move into the legal areas, the annual harvest will definitely increase, and a further reduction of the bull:cow ratio would be expected. The reduction of the bull population segment is not undesirable from a management standpoint.

The moose population inhabiting the Maclaren and Clearwater areas are considered together this year because an early snowfall had precipitated a movement of the moose from the highland areas north of the Denali Highway to the lowland areas between the confluence of the Maclaren and Susitna Rivers. This altitudinal migration was apparent during the counts and separation of the two populations was impossible.

Alphabet Ridge. Hunting, although intense in the accessible portions of this area is not reducing the bull population segment rapidly. The bull:cow ratio in 1957 and 1958 are 81 and 68 per 100 respectively. The ratio indicates a reduction in the bull population which may reflect increased hunting; however, the 1957 counts were believed to have sampled the sexes disproportionately, in favor of males.

Oshetna and Little Nelchina Rivers. The bull:cow ratio for this area in 1957 and 1958 is 78 and 67 respectively. Again the 1957 samples are believed to over-represent the bull population segment. Hunting pressure in these areas, particularly, the Little Nelchina River are is increasing, and a decrease in the overall bull:cow ratio is expected. There are numerous airstrips in this area, and the number of commercially operated swamp buggies is increasing yearly.

Clarence Lake-Black River Area. No roads or trails traverse this area and relatively few airplane hunters utilize this moose population; the bull:cow ratio is 62:100.

Upper Gakona, Mount Drum and Wrangell Mts., and Kenai River and Lower Chugach Mts. All of these areas are relatively inaccessible to hunters, except by airplane, and hunting does not appear to be influencing the bull:cow ratios. The bull:cow ratios for 1958 are 73, 140, and 108 per 100, respectively. The effects of disproportionate sampling in the latter two areas were discussed previously and are not elaborated on in this section.

Evaluation of Aerial Sex and Age Counts

Since the inception of aerial sex and age counts of the various moose populations in 1950, efforts have been made to recognize and evaluate the effects of the variables seemingly inherent in aerial counts. A summation of the results of investigations to determine the reliability of the counts was presented in the 1957 Federal Aid in Wildlife Restoration (Alaska) 12 (1): 15-16 report. No new studies were conducted in 1958.

A knowledge of the range or identity of local or geographic populations appears to be one of the most important criteria for obtaining reliable composition counts. Some populations are defined particularly well, either by prominent terrain features which act as a barrier to movements of moose or through studies of seasonal movements of moose. Other populations, such as

Table 7. Comparison of sex and age ratios in moose populations of Alaska.

Area	Total Bulls/ 100 Cows	Young Bulls/ 100 Total Bulls	Calves/ 100 Cows	Twin Calves/ 100 Cows w/Calf	Calf Percent in Total Herd	Young Bull Percent in Total Herd	Young Bulls/ 100 Bull Calves	Total Moose in Sample
Susitna - Matanuska Valley								
1958	32	35	42	8	24	5	39	4294
1957	31	28	44	8	25	4	31	2374
1956	27	25	40	6	24	4	33	1276
1955	28	25	35	4	21	4	39	2850
1954*	63	--	30	2	16	--	--	601
1953	48	14	39	8	21	3	33	2700
1952	42	27	44	10	24	6	51	1421
1951	61	28	60	13	27	8	56	1867
1950	--	--	--	--	16	--	--	1140
Mean	41	26	42	7	22	5	40	2058
Upper Susitna - Copper River Basin								
1958	71	19	37	4	18	5	61	3781
1957	69	30	42	6	23	5	76	2386
1956	67	19	27	2	14	7	95	1154
1955	98	29	52	10	21	12	108	2500
1954	109	26	79	16	27	10	72	1700
1953	107	36	90	17	29	12	85	1100
1952	61	22	40	17	20	7	67	683
Mean	83	26	52	10	22	8	80	1900

Table 7. (Continued)

Area	Total Bulls/ 100 Cows	Young Bulls/ 100 Total Bulls	Calves/ 100 Cows	Twin Calves/ 100 Cows w/Calf	Calf Percent in Total Herd	Young Bull Percent in Total Herd	Young Bulls/ 100 Bull Calves	Total Moose in Sample
Kenai**								
1958	44	21	42	15	23	5	43	3371
1957	43	18	35	12	20	4	45	3155
1956	51	13	24	10	14	4	54	3786
1955	50	14	19	10	13	4	75	3109
1954	84	14	27	6	12	6	90	2048
1953	62	12	26	7	14	4	39	2900
1952	50	33	21	6	12	10	156	1136
1951	69	18	23	16	12	7	108	1513
1950	--	--	--	--	7	--	--	1158
Mean	57	18	27	10	14	6	76	2452
Tanana Valley***								
1958	53	49	43	9	22	9	80	419
1957	60	32	42	2	20	7	71	236****
1956	84	20	47	6	20	7	71	405
1955	123	40	53	13	19	18	186	410
1954	85	35	47	5	20	13	127	109
Mean	81	35	46	7	20	9	107	316

* Limited sample may not be representative.
** Data from Refuge Supervisor Spencer.
*** Young bull-adult bull identification uncertain.
**** Does not include some areas as previous years.

those inhabiting the Mount Drum and Wrangell Mts., and Kiana River and Lower Chugach Mts. areas, are not well defined, and much of the population data pertaining to these herds is inadequate.

The number of moose counted per hour of aerial counting time has been used as an index to relative moose density, and as a check on the reliability of the aerial counts. The data is presented in Tables 2 and 6. The overall moose per hour of counting figure for the Lower Susitna and Matanuska Valley areas for 1957 and 1958 was 123 and 150 respectively. The increase in the number of moose counted in 1958 is believed to reflect the good survival of moose during the 1957-58 winter, and to the better counting conditions in 1958. In 1957 the counts, in some areas were hampered by poor snow cover. The moose per hour figure in the Upper Susitna and Copper River Valleys in 1957 and 1958 were 102 and 106 respectively. Counting conditions were approximately identical both years. A summation of moose sex and age composition surveys conducted in Alaska from 1950 through 1958 is presented in Table 7.

RECOMMENDATIONS

The results of the 1958 sex and age composition counts suggest the following recommendations.

1. Sex and age composition counts should be continued. The sample size could probably be reduced if the counts were made when the moose are more homogeneously distributed during the rut--in late September and early October.

2. Survival of moose to 12 months should be measured by spring calf:cow counts made in late May and early June.

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Date: January 31, 1959

JOB NO. 2--Moose Calving Studies.

PERIOD COVERED: May 1, 1958, to July 1, 1958.

ABSTRACT

Aerial counts of moose inhabiting calving areas are most successful in the early morning, between 3 a.m. and 7 a.m. Pregnant moose seek a variety of vegetation types for calving, but apparently concentrate in lowland, marshy areas that provide a variety of early-spring food and escape cover.

Moose calves first were seen on May 11, in 1958. Calving progressed rapidly and peaked on May 25 or 26. The final crop, estimated from aerial counts and from in utero observations, was 109 calves per 100 cows of Age Class I or older(24 months or older at the time of the parturition counts).

Twins occur in about 30 percent of the pregnancies, and two sets of triplets were observed.

Aerial counts made when the calves were about six months old revealed a calf mortality of 45 to 60 percent. Mortality approximating this magnitude has been relatively constant in the Valley areas for a number of years and may be normal under the environmental conditions existing on the study areas. Survival of twins varies considerably from area to area. Specific factors affecting overall calf survival and survival of twins are not known.

OBJECTIVES

To determine the areas, pattern and dates of moose parturition, initial productivity and calf survival.

TECHNIQUES USED

This project attempts to assess some of the problems seemingly inherent to aerial calf:cow observations made in the spring; and to determine the calving areas, the progression and magnitude of calving, and calf survival.

Eleven periodic counts were made on moose calving between May 7 and June 17, 1958. The counts were made with a supercub, piloted by Division of Predator Control assistant district supervisor Burkholder, and Aircraft Division pilots Smith and Wardleigh. The observer was P.R. Biologist Rausch. A total of 40 hours of flight time was expended on this project.

FINDINGS

Several problems encountered in making aerial observations of moose calving were discussed in the 1957 Federal Aid, Alaska, 12(1): 60 report. The problem believed most critical to making accurate parturition:cow observations was the tendency for some cows to hide their calves, and the failure of these cows to exhibit a response pattern to aerial buzzing that would enable the observer to determine the presence or absence of a calf.

The term parturition:cow ratio as used in this report refers to the number of cows that have given birth at the time of the aerial counts. The term is more exact than a calf:cow ratio, because moose frequently have twins. Thus, a calf:cow ratio would over estimate the incidence of calving.

The counts made in 1958 attempted to assess the problem of "questionable cows"(those cows that appear and respond as if a calf is present although not visible to the observer), by making the counts in early morning, by continuous circling of questionable cows, and by consideration of the cows' physical appearance.

The counts usually were started at dawn, 3 a.m. and were completed approximately four hours later. The early morning counts seem to coincide with the activity periods of the moose inhabiting the study areas, as most moose observed were standing and feeding. Flying conditions are generally better in the early morning. Turbulence was seldom encountered, and light intensity was increasing, whereas light intensity was decreasing during 1957 evening flights. Counts made during midday are unsuccessful, because most moose are lying down and are particularly difficult to see.

Animals responding in a manner that indicated a calf was possibly present were circled repeatedly at low elevation until the calf was seen, or the observer was satisfied that no calf was

present. Frequently, particularly in June when some of the calves were several weeks old, the calf was not seen until the fourth or fifth pass. Some of the calves were located several hundred yards from the cow. Again, these calves appeared to be the older animals; newborn calves generally were found close to the cow.

The physical appearance of pregnant cows and those that have given birth is quite different. The difference is readily apparent if the observer obtains a dorsal view of the animal. The abdomen of pregnant cows is quite obviously "round" in May. Weights of a few complete uteri collected from pregnant cows in April and May ranged from 100 to 175 pounds, and equalled 12 to 20 percent of the animals total weight. Thus, the reasons for the difference in dorsal profiles is obvious. The physical appearance of cows suckling young apparently deteriorates rapidly. Their ribs become prominent and their coats ragged, often large patches of hair are shed. Other moose seldom exhibit "patchy" shedding in early June. The non-pregnant two-year-olds frequently retain a glossy, dark coat of hair until mid-June.

The combination of early-morning counts, persistent circling of questionable cows, and evaluation of the cows' physical appearance reduced the questionable cow segment considerably in 1958. The questionable cow category did, however, increase on the June counts(Tables 1 and 2). The reasons for this increase are not known, but probably include the following: the previously discussed increasing independence of the older calves, the emerging leaves and grasses which form complete canopies in some vegetation types, and the probability of early-calf-mortality. The latter seems the most important factor, although a difficult one to quantitate. Cows, seen in early June, that act and look as if they have given birth, but that have no apparent calf could be cows that have lost their calves. Calf mortality from May to November is high (see Calf Survival), and it is logical to assume that some calf mortality occurs during and and immediately following the calving period. It is not known how long a cow will frequent an area where she has lost a calf, or how long she will act as if she has a calf. Unfortunately, specific mortality factors affecting calf moose are not well known (see Calf Survival). Continued refinement of present counting techniques should provide adequate data on the progression and peak of calving. Counts of moose calves beyond mid-June may not be practical until knowledge of specific mortality factors is gained.

Table 1. Summation of Aerial Surveys on the Progress of Calving in the Lower Susitna and Matanuska Valley Moose Populations--May and June 1958.

Date	female without calf	female status unknown	female with 1 calf	female with 2 calves	female with 3 calves	total females	calves	total cows & calves	short yearlings (11 to 12 mo.)	total all animals
May 7	60	0	0	0	0	60	0	60	31	91
May 9	85	0	0	0	0	85	0	85	25	110
May 12	166	0	0	1	0	167	2	169	67	236
May 16	107	1	4	0	0	112	10	122	61	183
May 19	91	1	3	6	0	101	15	116	40	156
May 21	78	0	18	10	0	106	38	144	53	197
May 24	53	1	25	8	0	87	41	128	41	169
May 27	15	5	32	27	0	79	86	165	32	197
June 3	16	10	44	14	1	85	75	160	25	185
June 5	9	8	33	11	0	61	56	117	--	--
June 17	6	10	7	7	1	30	21	51	--	--

Table 2. Progress of calving in the Lower Susitna and Matanuska valleys as indicated by the various parturition:cow ratios.

Date	Observed Parturitions: 100 cows	*Estimated Parturitions: 100 cows	Calves: 100 cows	**Twins: 100 partu-ritions	Total cows in sample
May 7	0	0	0	0	60
May 9	0	0	0	0	85
May 12	.5	.5	.5	--	167
May 16	3.5	4.0	3.5	0	112
May 19	9.0	10.0	15.0	66.6	101
May 21	26.0	26.0	35.8	35.7	106
May 24	37.9	39.0	47.1	24.2	87
May 27	74.6	81.0	108.8	45.7	79
June 3	69.4	81.1	88.2	25.4	85
June 5	72.1	85.2	90.1	25.0	61
June 17	48.3***	80.6	77.3	53.0	31

* Computed by including unknown status fem ales as having calves.
** Triplets included in twin:singleton ratio as twins.
*** Count not completed due to adverse weather.

Calving Areas.

Cows about to give birth seek a variety of habitat types. Certain vegetation types or communities, however, appear to attract relatively large numbers of moose. The types of vegetation vary widely, but all possess several common features. The calving areas illustrated in Figure 1 have an abundance of early-spring-vegetation. Some of the more common varieties are sedge, calamagrostis, pond weed, various grasses, including salt grass in some instances, and aquatic species, such as pond lily. The areas are either open or have a number of openings. Many of them have dense borders of alder, birch, or willow. If the areas are extensive and are not broken into a patch-work of bordered openings, then clumps of spruce or alder are usually interspersed throughout. The areas are wet; frequently new born calves have been observed standing belly-deep in near freezing water.

Not all moose calves are born in areas similar to those described above. Newborn moose calves have been observed in mature Birch-Spruce forests, and well above timberline on Willow mountain. The only known concentration areas, however, occur in the lowland areas shown in Figure 1.

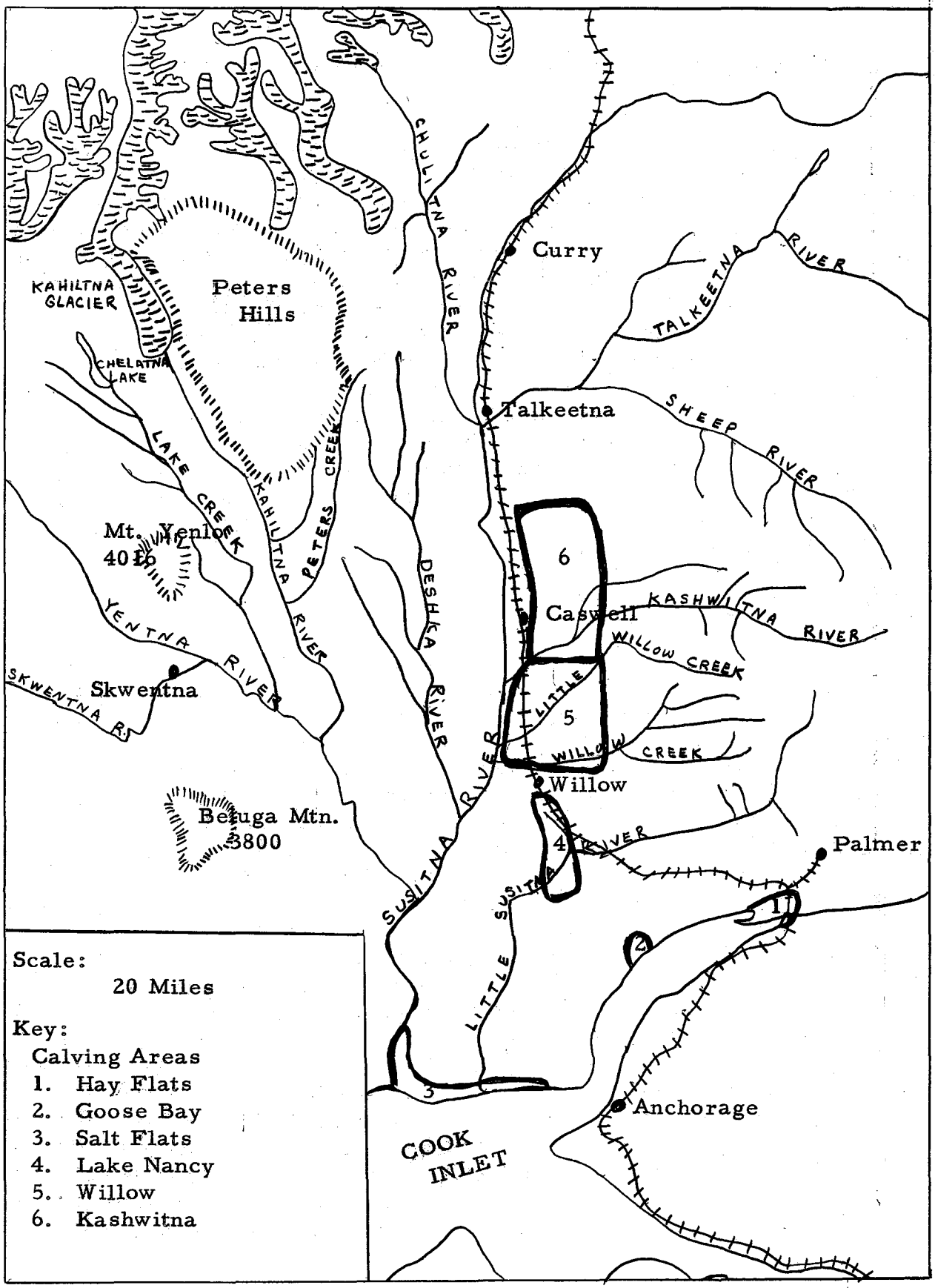
Aerial observations of actual parturition were made on six occasions. The areas chosen showed no consistent pattern. Most of the cows were in brush or marsh areas and the ground was water soaked. Much evidence of trampling was evident, and small willows and alders were broken.

The factors making the calving concentration areas attractive to moose are not known. However, the soft, quagmire underfooting could give the long legged moose an advantage over certain predators, and the early-spring vegetation provides a lush diet at a critical period.

Progression of Calving.

To determine the pattern of calving activity, periodic parturition:cow counts were made from the air. Flights began on May 7, and calves first were sighted on May 12, when a count of 166 cows revealed one cow with twins. A minimum of 100 cows were tallied on each count from May 12 through May 21, when the removal of over 20 calves from one of the principal parturition

Figure 1. Moose calving-concentration-areas in the Lower Susitna Valley.



areas for a stocking project eliminated this area from the parturition counts.

Figure 2 presents a graphical interpretation of the data obtained, illustrating the approximate progression of calving. Figure 3 presents the estimated progression of calving, with the questionable cows included with the cows with calves segment of the population. Figure 4 depicts the peak of calving as revealed by plotting the daily parturition increments derived from the curve in Figure 2. All curves are fitted visually and follow the technique described by R. O. Skoog in the 1958 Federal Aid, Alaska 12(3):56-70 report. Moose calving progressed rapidly and probably reached a peak on May 25 or 26. The present parturition data are not complete and more parturition counts would probably establish the progression and peak of calving more accurately. The present data of progression and peak, however, seem logical when compared to the observations on moose productivity reported in the 1958, Federal Aid, Alaska 12(1):56-109 report.

Magnitude of Calving.

A final calf count was impossible because of adverse weather, and because of the previously discussed counting difficulties encountered in mid-June. An estimate of the calf crop is made, however, based on the parturition counts made in early June, and on the in utero observations made on some 100 cows collected in the study areas from 1956 to 1959. The estimated parturition:cow ratio on June 3 and 5, Table 2 and Figure 3, indicated 80 to 85 parturitions per 100 cows. The in utero examinations revealed that 95 percent of all females older than 24 months were pregnant. The observers making the parturition counts, however, cannot distinguish the non-reproducing Class I cows(12-24 months) from older cows, and this necessitated an estimate of the percent Class I cows in the female population segment. Limited population age composition data from 1956 showed that Class I females comprised only 6 percent of the female segment. A favorable winter in 1956 and 1957, the winter when the 1958 Class I individuals were fetuses and calves, respectively, suggest that the 1958 Class I segment is probably larger than that of 1956. An arbitrary value of 12 percent, doubling the 1956 figure, was assigned to the 1958 parturition count data (Table 3). Thus, of every 100 cows counted in 1958, 88 were potentially pregnant, and 84 or 95 percent of

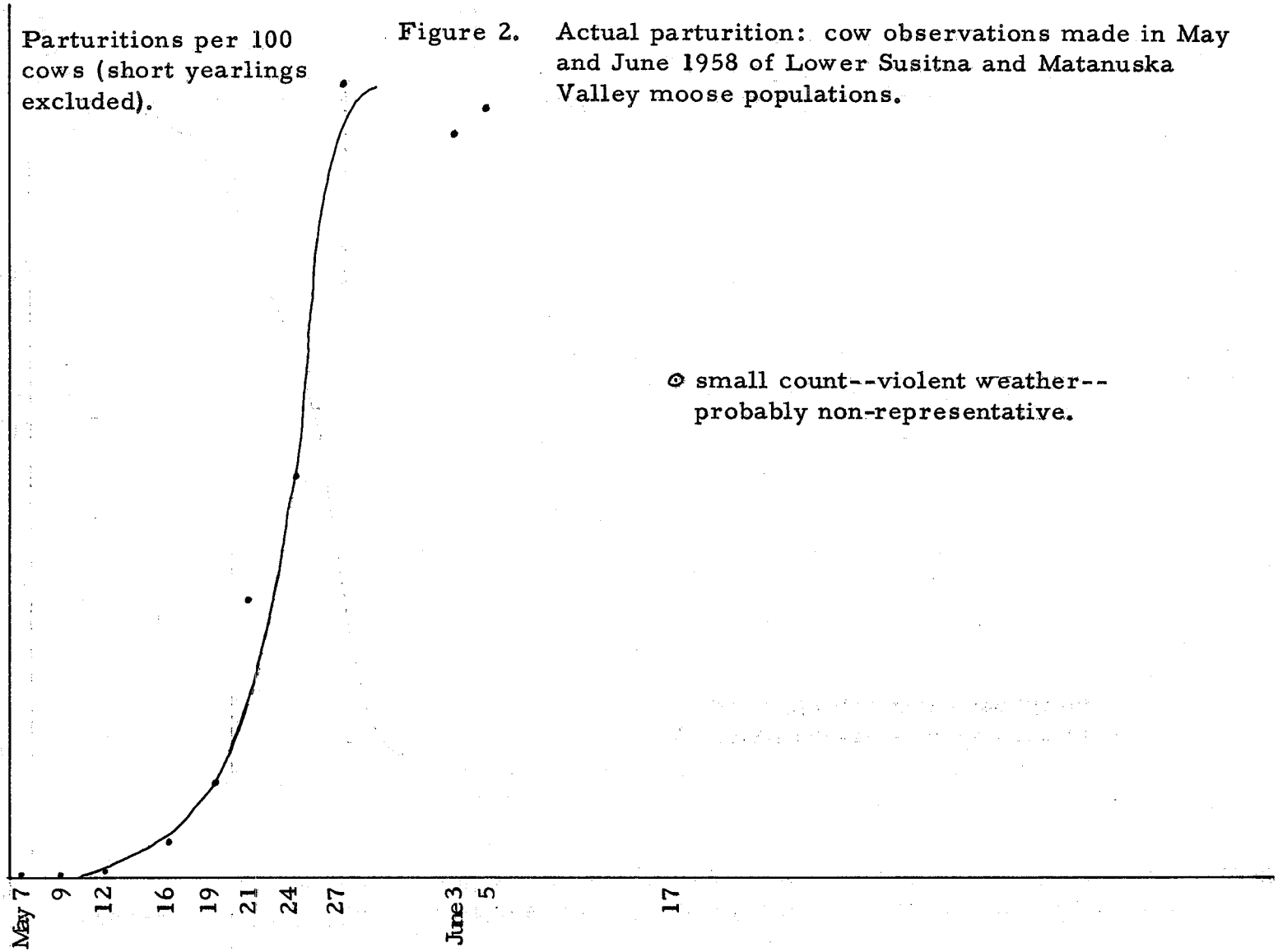


Figure 2. Actual parturition: cow observations made in May and June 1958 of Lower Susitna and Matanuska Valley moose populations.

Figure 3. Estimated parturitions per 100 cows based on aerial surveys made of the Lower Susitna and Matanuska Valley moose populations in May & June of 1958.

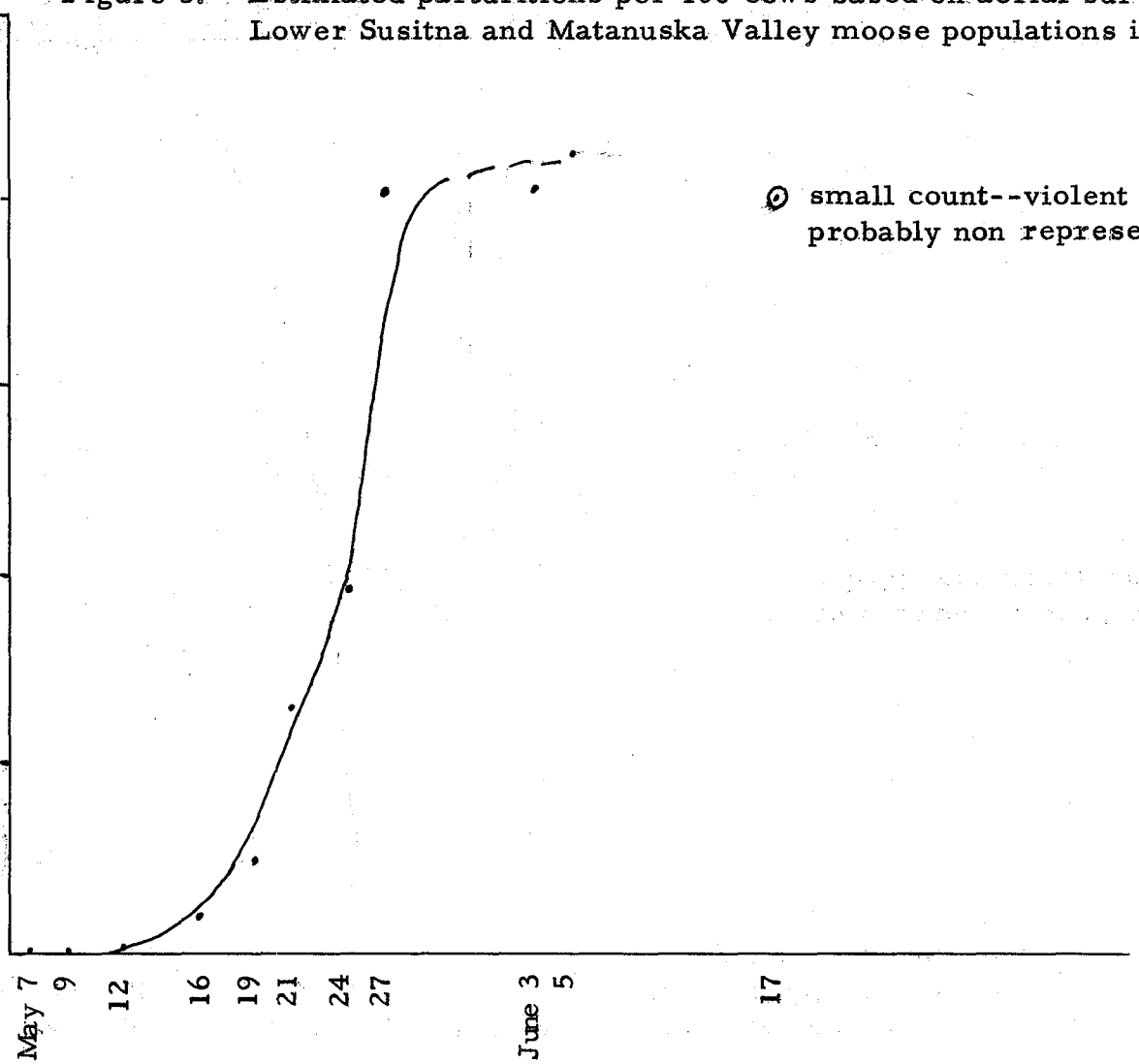


Figure 4. Progression and peak of moose calving, Lower Susitna Valley, 1958.

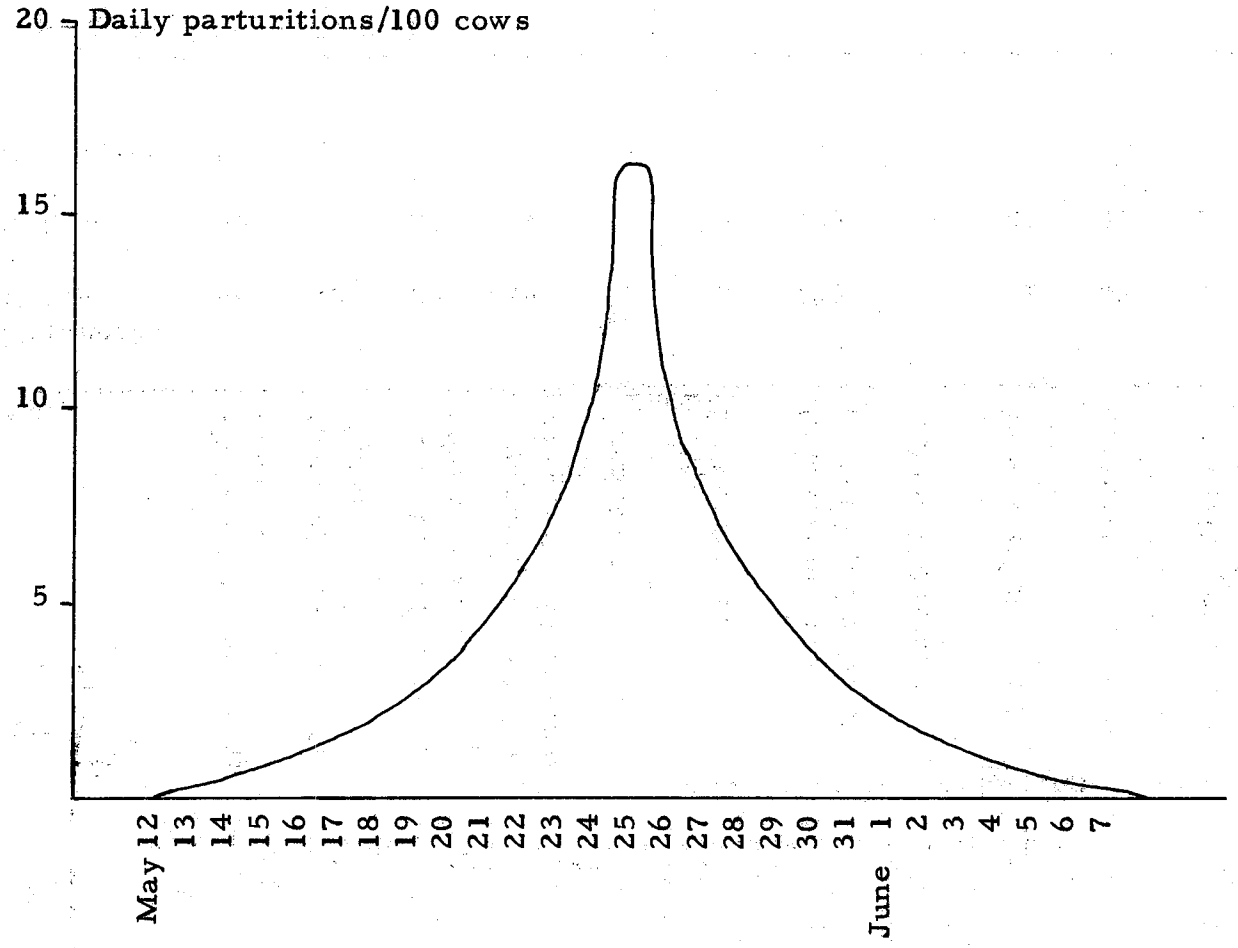


Table 3. Estimated production and survival of calf moose in three local populations in South Central Alaska, 1958.

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	873
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

these were considered pregnant (Table 3). The average of the twin:singleton ratio from May 21 to June 3 indicates 31 sets of twins per 100 parturitions; in utero data, collected over a three year period indicates 27 sets. For convenience of computation an arbitrary value of 30 sets of twins per 100 parturitions was assigned to the calf crop data (Table 4). Thus, the final estimated calf crop in 1958 was 109 calves per 100 cows, including the Class I individuals.

Survival.

Calf moose mortality, from birth to six months, of 45 to 60 percent in the areas studied may be normal for the species under the existing environmental conditions. The adjusted calf crop, based on parturition counts and in utero examinations, is estimated to be 91 calves per 100 total cows, including the short yearlings, 11 to 12 months old at the time of parturition counts, as cows (Table 3). Aerial sex and age counts made in October and November of 1958 when the calves-of-the-year were five to six months old revealed an overall calf:cow ratio of 42 per 100, and indicates a calf mortality of 53 percent.

Table 3 presents the estimated initial calf production and survival of three local, contiguous moose herds, Matanuska Valley, Willow and Kashwitna. The initial production figures are based on data presented in the section on Magnitude of Calving, and calf production is assumed to be similar in all three areas. The fall calf:cow ratios were obtained from aerial sex and age composition counts made in October and November, 1958. These counts indicate a calf mortality of 48, 54 and 61 percent in the Matanuska Valley, Willow, and Kashwitna areas, respectively.

Table 4 presents an estimation of calf mortality from parturition to six months in three local areas. The data is based on a theoretical sample of 100 pregnant cows, which give birth to 130 calves (see Magnitude of Calving). Mortality of calves is measured by the fall sex and age counts. These counts reveal that both twins seldom survive to six months. Mortality of one twin ranged from 88 percent in the Matanuska Valley to 82 percent in the Kashwitna area. In an effort to measure the relative survival of singletons and "the twin remaining" with that of both twins, the known instances in which one of twins died were subtracted from the total known mortality. The remaining mortality was assigned equally to singletons and "the remaining twin"(Table 4.

Table 4. Estimated mortality of calf moose in three local areas in South Central Alaska, 1958.

Area	Calves produced by 100 pregnant cows	No. single births	No. sets twins	Percent mortality all calves	Percent* mortality twins	Known No. twins dead	Known No. dead calves	Dead calves fr. singleton and remaining twins	Percent mortality singletons & remaining twins
Matanuska Valley	130	70	30	48	88	26	62	36	38
Willow	130	70	30	54	85	26	70	44	46
Kashwitna	130	70	30	61	82	25	79	54	57

* Mortality of at least one of twins.

For example--in the Matanuska Valley 100 cows produced 130 calves, comprised of 30 sets of twins and 70 singletons. Aerial counts six months later, in November, revealed a calf mortality of 48 percent and twin mortality of 88 percent. Thus, of the original 130 calves 62 had died, and of the original 30 sets of twins 26 had lost at least one. In computing the percent mortality of singletons and the remaining twin the 26 known dead twins are subtracted from the known loss of 62, leaving 36 unaccounted dead calves which must have come from the 70 singletons and 26 "remaining twins". Thus, singletons and "remaining twins" in the Matanuska Valley suffered 38 percent mortality. The 26 "remaining twins" had a mortality of 38 percent or 10 calves and the 30 original sets had a mortality of 88 percent or 26 calves. Thus, of the original 30 sets of twins or 60 calves 36 or 60 percent died as compared to 26 or 38 percent of the 70 singletons. Cows giving birth to twins reared .8 calves per cow; cows giving birth to singletons reared .6 calves per cow.

Mortality of twins in the Willow and Kashwitna areas was similar to that of the Matanuska Valley; mortality of singletons and "the remaining twin", however, was somewhat greater. The reasons for the apparent variations in survival of calves from area to area are not known, but possibly reflect differences in local environmental conditions.

RECOMMENDATIONS

The parturition counts should be continued for at least one more year to more accurately determine the progression and peak of calving. Larger periodic samples, preferably between 150 and 200 cows each, are desirable.

A study to determine and quantitate the factors affecting survival of moose calves should be inaugurated.

Prepared by:

Robert A. Rausch
Wildlife Management Biologist

Approved by:

Sigurd T. Olson
Acting Supervisor of Game Restoration

Date: January 31, 1959

JOB NO. 3--Distribution, Movements, and Dynamics of Railbelt Moose Populations.

PERIOD COVERED: July 1, 1958, to June 30, 1959.

OBJECTIVES

To determine the patterns of distribution, seasonal movements and population identities of moose in the Railbelt area from Turnagain Arm to the Alaska Range, and the factors affecting them.

To obtain data on reproduction, mortality and age structure as a basis for interpreting the dynamics of these populations.

TECHNIQUES USED AND FINDINGS

No work was done on this project. The scheduled end of Federal Aid in Game Restoration as a function of the U. S. Fish and Wildlife Service on June 30, 1959, necessitated a curtailment of field activities, and this project was dropped.

Prepared by:

Robert A. Rausch
Wildlife Management Biologist

Approved by:

Sigurd T. Olson
Acting Supervisor of Game Restoration

Date: April 17, 1959

JOB NO. 4: Herd Composition in Interior Alaska

PERIOD COVERED: October 15 to December 6, 1958

ABSTRACT

Aerial composition counts were conducted during November and December in the Tanana, Fortymile, and lower Koyukuk Valleys. Eleven hundred nine moose were tallied in 19.3 hours of aerial counting for an average of 57.4 moose per hour.

Productivity indicated by calf:cow ratios, twins per 100 cows and the calf percent of the total herd remains "good" in all three areas.

Survival of moose to the yearling stage in the Tanana and Fortymile areas is higher than that observed in the Koyukuk.

The effects of hunting in all three areas has little effect on the moose populations as a whole. Hunting pressure is quite localized in all three areas, since access is limited to those areas immediately adjacent to the roads and rivers.

There is still a decided need for study to provide data which will enable the investigator to better evaluate the effect of the many variables affecting composition counts from year to year.

OBJECTIVES

To determine age and sex composition of local moose populations as an index to productivity and survival in areas subject to significant hunting pressure or wolf predation.

TECHNIQUES USED

Aerial composition counts were conducted in the Tanana Valley in the following areas: Salchaket Slough, Chena River, Chatanika River, Shaw Creek and Goodpaster River. The Mosquito Fork-Kechumstuck Flats were included in the Fortymile counts. Only the flats immediately adjacent to the river between the villages of Hughes and Koyukuk Station were included in the Koyukuk counts. Coverage was therefore similar to 1957 with one exception; severe turbulence caused by high winds draining out of the hills prevented aerial counting along any of the tributaries of the Koyukuk River. (See Federal Aid Job Completion Report - Vol. 12, No. 1. pp. 122, 123, 124, Fig. 1,2, and 3.)

The counts were accomplished using a tri-pacer in the Tanana Valley, a super-cub in the Fortymile, and a Cessna 180 in the Koyukuk area. The aircraft were flown at altitudes varying from 500-700 feet above the ground while counting. Moose were tallied in the following categories:

1. Young bulls - antlers spiked or forked with little or no palmation. There is probably some overlap between this class and the adult class. These moose are considered as "yearlings". (17-18 months)

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

3. Cows - all antlerless moose including yearlings.

4. Calves - young of the year (5-6 months).

5. Unidentified - moose which could not be classified due to poor visibility or flying conditions.

The Tanana Valley survey was conducted October 27-28 by Wilbur J. Libby of the Alaska Department of Fish and Game as part of a program designed to acquaint state personnel with the current Federal Aid program. It will also serve to establish continuity of activity during that period when the Bureau of Sportsfish and Wildlife relinquishes its responsibilities in the Federal Aid program to the State of Alaska. Counts were conducted in the Fortymile on November 25 by personnel from the Tok Station. Jack Frost, Game Management Agent, and Art Brazda, District Agent, acting as observer and pilot, respectively. The counts in the Koyukuk area were accomplished December 4-5 by personnel from the Fairbanks Station. Sig Olson, Wildlife Management Biologist, and Joe Miner, District Agent, were observer and pilot.

Techniques of counting and analysis of data were similar to those employed in previous years and will not be reiterated here. The data were analyzed to determine current productivity, survival and effects of hunting using the same principles and methods described in the 1957 Job Completion Report (Moose Management Studies, Project W-3-R-12, Work Plan A, Jobs No. 1 and 6, Vol. 12, April 1, 1958).

The areas involved in the Tanana Valley include several separate drainages into the Tanana River, however, they are fairly contiguous and it is believed that the moose populations are not clearly identifiable with the possible exception of the Salchaket area.

The Fortymile area is considered as a single unit in the area covered. There is an indication that composition varies within the moose population along the Koyukuk River. Experience, however, is too limited to divide this area into separate populations. Counts are presented currently, however, from three areas along the lower Koyukuk, since the composition in each of these areas was different, particularly with reference to the male component of the population. Overall evaluation for each area, however, has been based on the weighted averages for the entire area in each in each case.

The field data for this study are in the files of the Federal Aid to Wildlife Restoration Office at Fairbanks.

FINDINGS

A summary of the composition counts obtained from the moose populations in the Tanana, Fortymile and Koyukuk river valleys is presented in Table 1. The composition of the moose populations in each of the areas are expressed as sex and age ratios in Table 2. Table 3 presents a comparison of these ratios for the past three years (1956, 1957 and 1958). The comparison of the current young bull:cow ratio expressed as an index to calf survival is presented for each area in Table 4.

In general, circumstances were very favorable for conducting herd composition counts during the fall of 1958. The snow cover was complete, and with the exception of areas of local turbulence, flying conditions were good. The total flying time expended during the survey was 28.2 hours with 19.3 hours spent actually counting moose. The total number of moose seen per flying hour was 57.4, 26.7 moore moose per hour than observed in 1957. The actual number of moose seen per hour by area varied from 36 in the Tanana Valley to 131.6 in the Koyukuk River area. A comparison of the moose seen per hour for 1957 and 1958 is presented in Table 5.

Table 5. Comparison of moose seen per hour in the Tanana, Fortymile and Koyukuk Valleys 1957 vs. 1958

AREA	TOTAL NO. MOOSE SEEN		NO. HOURS FLOWN		NO. MOOSE SEEN PER HOUR	
	1957	1958	1957	1958	1957	1958
Tanana	242	427	9.8	11.8	24.7	36.0
Fortymile	141	129	3.5	3.3	40.0	39.1
Koyukuk	226	553	6.5	4.2	34.6	131.6
TOTALS	609	1109	19.8	19.3	30.7	57.4

The number of moose seen per hour in 1958 increased 31 percent in the Tanana Valley, remained almost the same in the Fortymile and increased 302 percent in the Koyukuk! In 1957 snow cover was only partial in the Tanana Valley and temperatures ranged from zero to 20° F. In 1958 complete snow cover and temperatures ranging downward from zero to -20° F. improved sighting conditions and undoubtedly increased the number of moose seen per hour. Sighting conditions in the Fortymile area were almost exactly the same in 1957 and 1958 and the similarity in counts for both years is understandable. In the Koyukuk Valley, partial snow cover, high winds, and lack of good light restricted visibility to a great extent in 1957. In 1958, two to three feet of snow and excellent visibility improved sighting conditions immeasurably. It was also apparent that there were relatively few moose in the hills bordering the river. Nearly all moose were found in the willow flats adjacent to the river, perhaps as a result of deeper snow. Greater familiarity with the area may have also influenced the count favorable. Although there is no readily available yard stick to measure the actual increase in this area, herd composition data from 1957 indicates population densities in the Koyukuk are increasing. All the above reasons have contributed in part to the spectacular increase in the number of moose seen per hour in this area.

Table 1. Summary of Moose Population Composition Counts - Tanana Valley, Fortymile, and Koyukuk Valleys. October 27, 1958 - December 6, 1958

AREA	MALE			FEMALE				TOTAL CALVES	TOTAL IDENT. MOOSE	TOTAL UNID. MOOSE	TOTAL MOOSE	TIME OBS.	MOOSE SEEN PER HOUR
	YOUNG	ADULT	TOTAL	W/O	W/1	W/2	TOTAL						
TANANA VALLEY													
Chena R.-Chatanika R., Shaw C., Salcha R., Goodpaster R.	16	45	61	67	44	3	114	50	225	8	233	9.0	26
Tanana River (Salchaket)	21	31	52	61	32	5	98	42	192	2	194	2.8	69
Above areas	37	76	113	128	76	8	212	92	417	10	427	11.8	36
FORTYMILE													
Kechumstuk and Mosquito Fork	14	25	39	36	24	2	62	28	129	0	129	3.3	39
KOYUKUK													
Hughes to Hog River	12	33	45	32	19	4	55	27	127	3	130	1.1	118
Dalke River to Kateel	13	25	38	87	59	16	162	91	291	23	314	2.0	157
Kateel R. to Koyukuk Sta.	10	21	31	22	20	3	45	26	102	7	109	1.1	99
Above Areas Combined	35	79	114	141	98	23	262	144	520	33	553	4.2	132
GRAND TOTAL	86	180	266	305	198	33	536	264	1066	46	1109	19.3	57.4

Table 2. Sex and Age Ratios - Tanana Valley, Fortymile, and Koyukuk Valley 1958

AREA	TOTAL BULLS PER COWS	YOUNG BULLS PER 100 AD. BULLS	CALVES PER 100 COWS	TWIN CALVES 100 COWS W/CALVES	CALF % OF TOTAL HERD	YG. BULL % OF TOTAL HERD	YG. BULL PER 100 BULL CALVES	YG. BULL PER 100 COWS	TOTAL MOOSE
TANANA									
Chena R., Chatanika R., Salcha, Shaw Cr., and Goodpaster R.	53	37	44	6	22	7	64	14	227
Tanana Valley (Salchaket)	53	67	43	14	22	11	100	21	192
Above areas combined	53	49	43	9	22	9	80	17	419
FORTYMILE									
Kechumstuck and Mosquito Fork	63	56	45	8	22	11	100	23	129
KOYUKUK R.									
Hughes to Hog River	82	36	49	17	21	9	92	22	127
Dalke River to Kateel R.	23	52	56	21	31	4	29	8	291
Kateel R. to Mouth of Koyukuk	69	48	58	13	25	10	77	22	102
Above areas combined	44	44	55	19	28	7	49	13	520

Table 3. Comparison of Sex and Age Ratios in Moose Populations in Interior Alaska

AREA	YEAR	TOTAL BULLS PER 100 COWS	YOUNG BULLS PER 100 AD. BULLS	CALVES PER 100 COWS	TWIN CALVES 100 COWS W/CALVES	CALF % OF TOTAL HERD	YG.BULL % OF TOTAL HERD	YG.BULL PER 100 BULL CALVES	YG.BULL PER 100 COWS	TOTAL MOOSE IN SAMPLE
Tanana Valley	1958	53	49	43	9	22	9	80	17	419
	1957	60	32	42	2	20	7	69	15	236
	1956	83	25	47	5	20	7	71	16	405
Fortymile	1958	63	56	45	8	22	11	100	23	129
	1957	91	29	46	8	19	8	89	20	140
	1956	66	30	53	0	24	7	60	15	129
Koyukuk	1958	44	44	55	19	28	7	49	13	520
	1957	80	25	66	23	28	6	48	16	216
	1956	NO DATA AVAILABLE								

Table 4. Index to the Survival of Bull Calves to 18 Months

AREA	Bull Calves per 100 Cows 1957	Young Bulls per 100 Cows 1958	Indicated % Survival
TANANA			
Chena, Chatanika, Salcha, Shaw Goodpaster	22	14	64
Salchaket	18	21	100
Above combined	21	17	81
FORTYMILE	23	23	100
KOYUKUK	27	13	48

It is very evident that several variable factors influence the number of moose seen per unit of effort. Insufficient data are presently on hand to properly evaluate the precise effect any one or combination of these might have on the final results. When and if real values for these factors can be applied to the counts, the numbers of moose seen per hour will become a more realistic index to trends in moose population densities from one year to another.

Productivity

Tanana Valley - Productivity in the Tanana Valley continues to be "good". The calf:cow ratio of 43:100 has changed only slightly from 1956 and 1957 (47:100, 42:100, respectively). Nine sets of twins per 100 cows with calves is another indication of satisfactory reproduction. This is the highest twin ratio recorded since 1955 when the ratio was 13:100. Calves comprised 22 percent of the total herd. During the past three years this percentage has been quite constant ranging between 19 and 22 percent.

Fortymile - The level of productivity showed little change from previous years and is rated "good". The calf:cow ratio of 45:100 was only one calf less than in 1957. The number of twin calves per hundred cows with calves was 8:100 and did not change from the previous year. The percent of calves in the total herd increased slightly over 1957 (19 percent in 1957 to 22 percent in 1958). This could reflect the reduced bull count however, since only 63 bulls per 100 cows were observed in 1958 as compared to 91 per 100 cows in 1957.

Koyukuk - Productivity continues to be "excellent" in this population despite the downward trend from 1957. The combined and weighted average calf:cow ratio for the entire area declined from 66:100 to 55:100. The incidence of twin calves per 100 cows with calves declined from 23 to 19 and perhaps is a secondary indicator of a downward trend in productivity. The twin calf ratio, however, still remains perhaps the highest of any population presently under observation. It is possible that the factors governing survival are more favorable in this area than elsewhere, resulting in better calf survival. The fact remains, nevertheless, that the overall rate of calf production is better than in other areas.

Productivity varied somewhat from one segment of the river to another. Between Hughes and Hog River, the calf:cow ratio was 49:100 as compared to 56:100 in the area between the Dalke and Kateel Rivers and 58:100 from the Kateel River to Koyukuk Station. The ratio of twin calves per 100 cows with calves were 17, 21, and 13, respectively. Generally, the variation in productivity indices is not significant enough to cause concern, since the rate is "good" or "excellent" in all areas.

The percentage of calves in the total herd for the entire area (28%) remained the same as that for 1957. This is the highest percentage of calves obtained in any area thus far. Although this figure depends on changes in the composition of the herd from year to year, it provides a general indication of the annual increment of young animals.

Survival

Tanana Valley - The survival of calves to the yearling (18 months) stage is good in the Tanana Valley. The ratio of young bulls to bull calves is 80:100, 11 percent higher than in 1956. The index to survival of bull calves to 18 months (based on the comparison of the ratio of bull calves:100 cows in 1957 to the young bull:cow ratio in 1958), shows that 81 percent of the bull calves survived, a figure similar to the ratio of young bulls to bull calves in 1958. No index to survival of females to the yearling stage has been developed, however, it can be assumed that since females are not hunted that survival was equal to or better than that for males.

Fortymile - The ratio of bull calves to cows in 1957 and the ratio of young bulls to cows in 1958 are the same (23:100). Similarly, the ratio of yearling bulls to bull calves in 1958 is 100:100. This suggests bias in sampling since it is assumed that if the calf crop is uniform from year to year the young bull mortality should become apparent after a years' time. The extent of the error cannot, however, be evaluated. One thing is very evident, the incidence of young bulls in this moose population is very high indicating excellent survival.

Koyukuk - The survival index, based on the comparison of the previous years' bull calf:100 cow ratio with the current year's young bull:100 cows ratio (Table 3), indicates that 48 percent of the bull calves six months of age survived to be 18 months of age. The young bull:bull calf ratio of 49:100 indicates a similar level of survival. The latter ratio is almost the same as in 1957 (48:100). This is the lowest survival level shown for any of the interior moose populations under observation. Hunting, predation, and weather are all contributing factors to the comparatively low survival rate, but to what extent each one, or a combination of them are responsible, is unknown.

Effects of Hunting

Tanana Valley - The comparatively high bull:cow ratio continues to reflect the relatively inconsequential effects of hunting. The ratio for the entire area decreased from 60 bulls:100 cows in 1957 to 53:100 in 1958. This may be the result of the very successful current hunting season, a disproportionate sampling of bulls or both. The patterns of hunting do not vary significantly from year to year in the Tanana area. All hunting is accomplished by boat and car, therefore, only those areas immediately adjacent to the routes of travel are hunted leaving the areas away from roads and navigable waterways almost untouched. The ratio of bulls per 100 cows decreased from 68:100 to 53:100 in the tributary areas and increased from 44:100 to 53:100 in the Salchaket area. This suggests errors in counting rather than a significant change due to hunting.

Fortymile - The ratio of bulls to cows was 63:100 in 1958 as compared to 91:100 in 1957 and 66:100 in 1956. The difference in sex ratios from year to year is probably the result of errors or bias in counting rather than actual changes brought about by mortality or other factors acting positively or negatively. Hunting has little influence on this

population. The kill occurs largely during the latter half of September and only those areas immediately adjacent to the Taylor Highway are affected.

Koyukuk - The ratio of bulls to cows for the entire area dropped from 80:100 in 1957 to 44:100 in 1958. The extreme difference in the two years is remarkable. The decline is very probably due to differences in conditions under which the counts were conducted each year rather than mortality factor. Differential sex distribution could effectively distort the bull:cow ratio. It is interesting to note that the bull:cow ratio between Hughes and Hog River was 82:100 and from the Kateel River to Koyukuk Station was 69:100. These ratios are more in line with that obtained in 1957. The middle portion of the area between the two aforementioned areas (Kateel River to the Dalke River), however, produced a bull:cow ratio 23:100. Why the decided variation in this one particular area exists is not understood. It may be the result of a difference in sex distribution due to prevailing weather conditions at this time of the year. The fact that the upper and lower areas have either hills or mountains adjacent to the river while the center area consists entirely of flats may have some effect on sex distribution. Hunting pressure is probably greatest on the upper and lower section, however, the bull:cow ratios are the highest in these areas. Thus it is apparent that hunting has little to do with the bull:cow ratio. Until the distribution of the various segments of the moose population is better understood and the extent of the population, or populations as the case may be, are determined in the Koyukuk, the value of the bull:cow ratio will remain rather vague and nebulous.

RECOMMENDATIONS

Composition counts in the future should be made with the following problems in mind:

1. All counts should be conducted within as short a period of time as possible and approximately at the same time in order to be comparable.
2. Counts should be made in test areas during the rut (September 15- October 10) to determine whether or not such counts are feasible and desirable in the Interior where population densities are much less than in south-central Alaska.
3. In the Koyukuk, counts should be made both on the adjacent flats and the adjacent uplands to determine whether or not differential sex distribution occurs. If it does, under what conditions.
4. A better knowledge of movements is necessary to determine the effect on distribution during the time counts are conducted.

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Approved by:

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DATE: January 31, 1959

Job No. 5 Southeast Alaska Moose Studies

PERIOD COVERED: September 15 - December 31, 1958

ABSTRACT

Thirty-one moose were killed on the Alaska portion of the Stikine River during the 1958 legal season. Age composition of the kill continued to reflect the heavy cropping of bulls. Hunter success continued high for the area at 23 percent. Composition counts showed minimum ratios of 41 calves per 100 cows which are comparable to heavily hunted areas in the Matanuska Valley. An estimate of the moose population on the Stikine River based on pre-hunting season sex and age ratios and age distribution of the hunter-kill indicate a post hunting season population of 310.

OBJECTIVES

To obtain an estimate of total numbers and sex and age composition of the Stikine Valley moose population, and to record characteristics of the annual kill by hunters.

TECHNIQUES USED

Aerial composition counts were flown over the Stikine River valley on September 11 and 12, which was just prior to the opening of the hunting season. Accurate identification of animals was possible through the use of a Hiller B-2 helicopter. The helicopter was piloted by Joe Soloy, with Chuck Graham, John Schwartz and Dave Klein as observers.

Additional sex and age composition data was obtained by interviewing hunters at the close of the hunting season. Collection of this information from Wrangell hunters was done by Game Management Agent Bill Sholes.

During the legal open season, (Sept. 15 - Oct. 15), jaws were collected from moose killed by hunters and a record of all moose taken was kept. Jaws were segregated into age class groupings by examination of tooth replacement and wear.

FINDINGS

Composition Counts: In conducting the aerial counts, it was found that the helicopter is an effective tool in securing accurate identification of sex and age of animals observed. In this respect and the slow speed, extreme visibility and maneuverability, the advantage of the use of the helicopter over the small plane is considerable for aerial game counting. Results of the aerial counts are included in Table 1. These counts represent only the sample of the total herd that was in open areas where observation was possible. Comparison of the ratios in Table 1 with composition ratios from the Matanuska Valley, Susitna and Copper River valleys are quite similar.

Calf-cow ratios and calf percentages appear similar to the mean values for the south-central Alaska herds. Ratios of bulls per 100 cows, while lower than most of the areas distant from Anchorage, are never-the-less higher than bull ratios in heavily hunted portions of the Matanuska Valley.

Sex and age ratios of moose seen by hunters are included in Table 1. These were obtained by interviewing 25 moose hunters from Wrangell and Petersburg. Some variation exists in the bull:cow ratios obtained by the aerial and ground counts, however, calf:cow ratios are surprisingly similar in view of the relatively small sample sizes involved. A possible explanation for the greater ratio of bulls observed by the hunters is that when bulls were observed, hunters generally made no further effort to see other moose and concentrated on getting the bulls. This was not the case when cows or calves were seen first.

TABLE 1. SEX AND AGE RATIOS - STIKINE RIVER MOOSE, 1958

Type of Count	Cows & 1 Calf	Cows & 2 Calves	Total Cows	Total Calves	Total Bulls	Total Moose Observed
Aerial Count Sept. 11 & 12	11	1	32	13	7	52
Hunter Observations Sept. 15-Oct.15			93	46	35	174

Type of Count	Calves/ 100 Cows	Twin Calves/ 100 Cows	Calf % in Total Herd	Bulls/ 100 Cows	Moose/ Hr. Flying
Aerial Count Sept. 11 & 12	41	8	25	22	23
Hunter Observations. Sept. 15-Oct. 15	49		26	38	

The Hunter Harvest: This year the total legal harvest of moose on the Stikine River, within Alaska, was 31 bulls. Twenty-three of these were taken by Wrangell hunters, seven by Petersburg hunters and one by a hunter from another area. Out of approximately 135 persons hunting the area 70 percent were from Wrangell, 22 percent from Petersburg and 8 percent from other areas. Six moose were taken in the Muddy River-Thomas Bay area by Petersburg hunters, including one cow accidentally shot.

This year's kill on the Stikine River is less than in 1957 but higher than the yearly average since 1952. Table 2 shows a summary of the annual moose kill on the Stikine River from 1952-1958 in

comparison with the length of seasons, numbers of hunters and hunter success.

The moose kill on the adjacent British Columbia side of the border was lower than in previous years with only three bulls taken. These were taken in the Iskut River area by Wrangell hunters employing Canadian guides.

TABLE 2 TOTAL MOOSE KILL AND HUNTER SUCCESS RATIOS ON THE STIKINE RIVER, ALASKA 1952-1958

Year	Length of season	Est. No. of Hunters	No. of Moose Taken	Percent Success
1952	Sept. 15-Oct. 14	300	31	10
1953	Sept. 15-Oct. 30	100	12	12
1954	Sept. 15-Oct. 5	125	14	11
1955	Sept. 15-Oct. 5	150	16	11
1956	Sept. 15-Oct. 5	125	30	24
1957	Sept. 15-Oct. 15	160	40	25
1958	Sept. 15-Oct. 15	135	31	23
	Averages	156	25	17

The age composition of the kill continues to show a large proportion of young animals. Table 3 shows the yearly age distribution represented in the harvest as determined from samples of moose jaws collected. It is interesting to note that no bulls over 2½ years of age showed up in this year's jaw sample.

The fact that virtually the entire kill is made up of young animals quite likely contributes to the apparent high quality meat obtained, even though the hunting season occurs during the rut. The physiological changes which accompany the rut in male ungulates is not as pronounced in young animals as in the older bulls.

TABLE 3 AGE CLASS REPRESENTATION OF HUNTER-KILLED MOOSE ON THE STIKINE RIVER 1954, 1955, 1957 & 1958

	1954		1955		1957		1958	
Age Class	%	Jaws	%	Jaws	%	Jaws	%	Jaws
I (15-17 mo.)	8	1	58	7	57	12	59	13
II (2 yrs. 3-5 mos.)	33	4	8	1	29	6	41	9
III (3 yrs. & older)	58	7	33	4	14	3	0	0
TOTALS		12		12		21		22

Population Estimate: It is possible to arrive at a minimum population estimate for the Stikine River herd by using the age proportions represented in the kill and the pre-hunting season sex and age ratios as a basis for computation. Age distribution represented in the annual kill for the past three recorded years shows approximately 40 percent of the bulls taken to be over 1½ years of age (Table 3). The average yearly kill for this same period has been 33 bulls (Table 2). Therefore, at least 13 bulls (40% of 33), 1½ years of age, or older, had to remain unharvested each year in order to show up in the following year's kill. This value of 13, plus the average take of 33, equals 46, or the minimum number of bulls present prior to the hunting season. Using the sex and age ratios obtained from the pre-hunting season aerial counts in Table 1, the 46 bulls at a bull:cow ratio of 22/100 indicates 210 cows of 1½ years or older. The calf:cow ratio of 41/100 at 210 cows yields 86 calves. Adding the bulls, cows and calves, the total pre-hunting season population was 340 with 310 remaining after the close of the season. Table 4 outlines the procedure used in arriving at this estimate.

The population structure, which apparently exists on the Stikine River, is typical of a heavily hunted moose herd. However, the adequate calf ratios and the maintenance of a large harvest with no decrease in hunter-success indicates that bulls are not being overharvested. Rausch (Fed. Aid Rep. 4/1/58) reports that 1½ year old bulls participate in the rut in the Matanuska Valley where hunting pressure has removed a large portion of bulls. Bull:cow ratios of less than 10 per 100, with the remaining bulls predominantly 1½ years old, indicate that the young bulls in that area must effectively service the cows in order to maintain the calf ratio of 50 per 100 cows. Quite likely, a similar situation exists on the Stikine where 1½ year old bulls are also the only significant age group remaining after the harvest.

TABLE 4 STIKINE RIVER MOOSE POPULATION ESTIMATE

Assumptions:

1.) Age ratios show 40% of the bulls harvested each year to be over 1½ years of age.

2.) The average yearly kill is 33 bulls.

3.) Pre-hunting season sex and age ratios:

22 bulls per 100 cows

41 calves per 100 cows

40% x 33 =	13	min. no. bulls remaining unharvested each year.
13 + 33 =	46	min. pre-hunting season bull population.
$\frac{46}{22}$ x 100 =	210	total no. cows
$\frac{210}{100}$ x 41 =	86	total no. calves.
	342	total no. moose prior to hunting season.

RECOMMENDATIONS

Annual aerial composition counts and the collection of harvest information should be continued to maintain a current knowledge of the welfare of this important herd.

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Approved by: Sigurd T. Olson
Acting Supervisor,
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Date: January 31, 1959