

ESTIMATED MOOSE POPULATION SIZE IN THE TOGIAK RIVER DRAINAGE (UNIT
17A) AND ADJACENT WOOD RIVER MOUNTAINS (WESTERN UNIT 17C),
SOUTHWEST ALASKA, 1995.

A Summary Report of an Aerial Survey Effort by Togiak National Wildlife Refuge
and the Alaska Department of Fish and Game

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A COOPERATIVE EFFORT BETWEEN

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and

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SUMMARY

From 14-21 February 1995, moose (*Alces alces*) were censused in the Togiak River drainage (Game Management Unit 17A) and adjacent Wood River Mountains (Game Management Unit 17C(west)). Estimated moose population for the 3,613.9 km² (1,395.3 mi²) study area was 457.9 moose +/- 8.32% (80% CI). Average density was 0.1267 moose/km² (0.3282 moose/mi²) or approximately 1 moose per 3 mi². Density of moose was higher in Unit 17C than in 17A.

Estimated moose population for Unit 17A portion of the study area was 100.9 moose +/- 16.15% (80% CI). Unit 17A study area was 2,698.7 km² (1,041.9 mi²) resulting in an average density of 0.0374 moose/km² (0.0969 moose/mi²) or approximately 1 moose per 10 mi². Movement of moose from Unit 17C to 17A was documented. Survey conditions were good and sightability of moose was high. Total cost of the survey, excluding wages, was \$10,950.

Management recommendations include: determination of population objectives and harvest levels; increased monitoring to determine age and sex distributions, seasonal movements, reproduction and mortality; and, analysis of winter food conditions.

BACKGROUND

Recent apparent increases in moose in the Togiak River drainage along with a deficiency of adequate information on present and historical abundance, necessitated the need to conduct a more thorough examination of this area. Little written information on moose abundance on or near the Togiak National Wildlife Refuge (TNWR) is available prior to the 1970's. In 1971 the Alaska Department of Fish and Game (ADF&G) began surveying moose in Game Management Unit (Unit) 17. In 1981, the first major survey of Unit 17A was conducted. During 5.5 survey hours, only 3 moose were observed, resulting in the Board of Game's decision to close the hunting season. To date the season has remained closed. The majority of Unit 17A lands is in TNWR.

Additional aerial surveys of the Togiak River drainage revealed 7 moose in 7.8 hours of flying during January 1987; 4 moose in 1.3 hours of flying during April 1991; 6 moose in 3.5 hours of flying in January 1992; and 84 moose in 10.8 hours of flying in January 1994. Unfortunately, unless methodologies and areas surveyed are similar from survey to survey, inferences made about population trends is limited. However, the general consensus from these surveys is that moose in the Togiak River drainage exist in a density well below what the habitat appears to be able to support.

Despite the closure of the hunting season, local residents continue to harvest moose. Estimates from 10 to >20 Unit 17A moose are taken each year, primarily during the winter and spring when conditions for traveling by snowmachine are generally excellent and moose are confined to the riparian corridors surrounded by open tundra. A joint Federal proposal submitted by the

Togiak Traditional Council and the Bristol Bay Native Association requested an August 20 - September 15 hunting season be opened in Unit 17A. The Nushagak Fish and Game Advisory Committee was successful in having the Board of Game close the winter hunt (December 1-31) for that portion of Unit 17C, south and west of the Wood River and Aleknagik Lakes, including Sunshine Valley, in 1990. This area has a healthy moose population and is thought to be a source for immigrating individuals into Unit 17A. The Federal Subsistence Board has currently deferred action on the joint proposal to open a fall moose hunt in Unit 17A, and will pursue the proposal again in the future.

OBJECTIVES

1. Determine moose density and distribution in Unit 17A and portions of Unit 17C.
2. Provide a summary of project results to: village residents, Togiak and Nushagak Fish and Game Advisory Committees, Bristol Bay and Yukon-Kuskokwim Delta Subsistence Advisory Councils, members of the State Board of Game and Federal Subsistence Board.

STUDY AREA AND METHODS

The study area included most of the Togiak River drainage (Game Management Unit 17A) and adjacent Wood River Mountains (Game Management Unit 17C(west)) between the villages of Togiak and Manokotak, northward to Upper Togiak Lake (Fig. 1). Total study area, excluding lakes larger than 65 ha (160 acres) and elevations above 305 m (1,000 ft) sea level, was 3,614 km² (1,395 mi²). High elevation areas were excluded because they were not used by moose during the late winter. The area is a mixture of Federal, State, Native Corporation and Native allotment lands with TNWR the primary landowner.

Vegetation in the study area ranges from white spruce (*Picea glauca*) dominated forest in the east to wet tundra in the west. Deciduous shrubs (*Salix spp.* and *Alnus crispa*) and cottonwood (*Populus balsamifera*) stands are prevalent in the riparian corridors. Most of the study area is treeless. A more detailed description of the biological and physical features of this area can be found in Togiak National Wildlife Refuge Final Comprehensive Conservation Plan, Wilderness Review and Environmental Impact Statement (1986).

Methodology followed that of Gasaway et al. (1986). They outlined the procedure as 6 steps.

1. Define the population of interest and select a survey area.
2. Delineate all possible sample units (SU's) on a topographic map of the survey area.
3. Stratify the survey area by conducting a preliminary aerial survey to determine

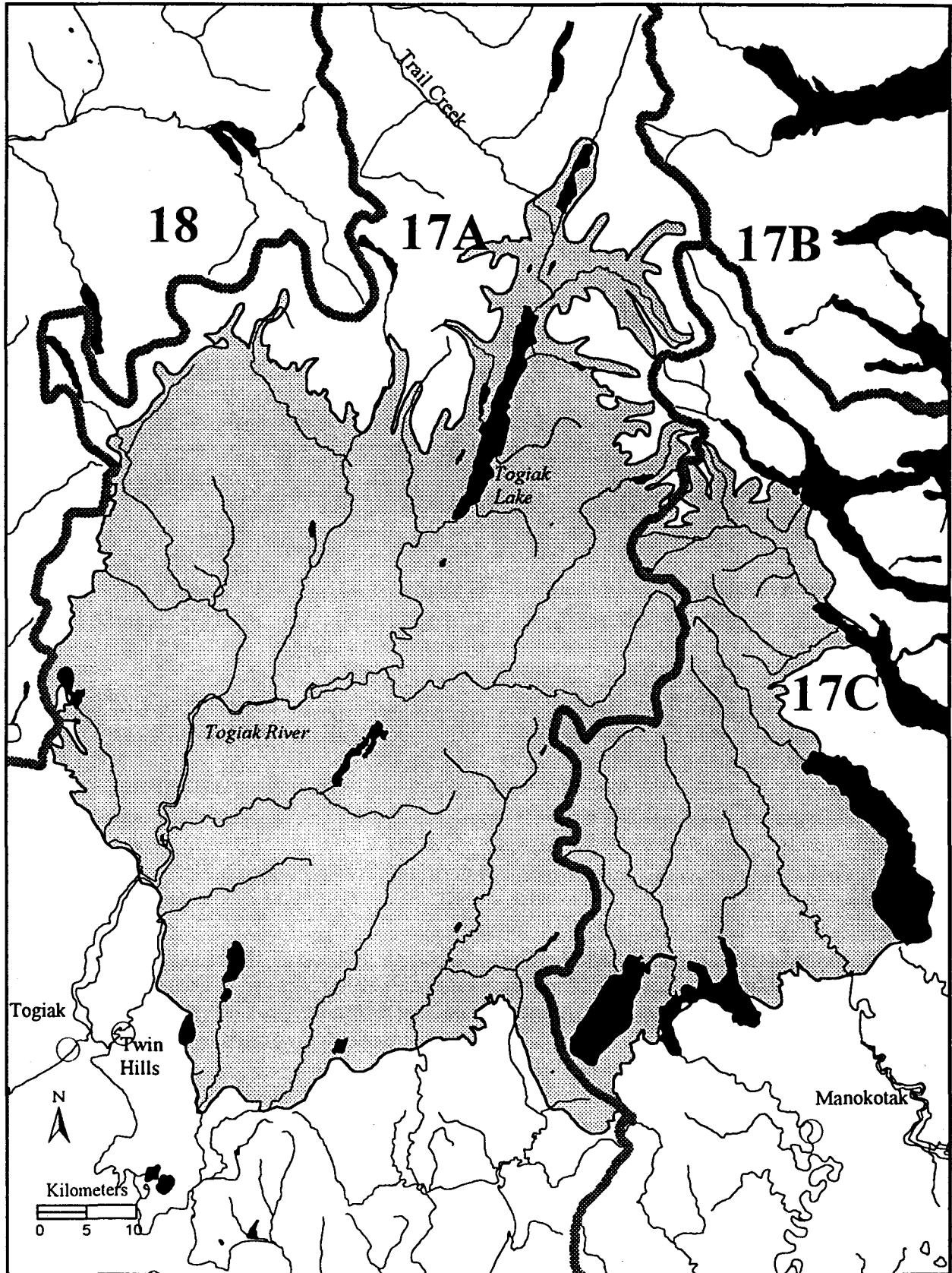


Figure 1. Location of February 1995 moose survey area (shaded) and game management unit boundaries (dark thick lines) in the Togiak River drainage and adjacent Wood River Mountains, southwest Alaska.

- relative moose densities.
4. Select a random sample of SU's from each stratum.
 5. Fly surveys of selected SU's and recount some areas using a more intensive search pattern to estimate the percentage of moose that were missed.
 6. Calculate an estimate of population size and confidence interval (CI) around the estimate.

Sample unit sizes were measured using a digital planimeter (*Tamaya Planix 5*) and taking the average of 3 similar measurements. The study area was divided into 102 SU's and stratified using two Cessna 185's. Based on the number of moose seen in the stratification flights, SU's were designated as either low, medium, high, or super high density. A table of 10,000 random digits (Steel and Torrie 1980) was used to randomly select 20 low density SU's. Up to 4 SuperCubs (PA-18) were used for standard searches of selected SU's. All medium, high, and super high density SU's were searched. In addition, intensive searches were conducted on portions of all medium, high, or super high density SU's to develop a correction factor for moose missed during the standard search. Data were analyzed using program MOOSEPOP.

RESULTS AND DISCUSSION

Stratification flights occurred primarily on 14, 16, and 17 February. Additionally, 4 SU's were stratified on 21 February, the last day of the survey. Of the 102 SU's, 84 were classified as low density (0-4 moose), 10 as medium density (5-14 moose), 5 as high density (15-30 moose), and 3 as super high density (>30 moose). Average SU size was 35.43 km² (13.68 mi²).

The population estimate for the entire study area is 457.9 moose +/- 8.32% (80% CI) and the overall density estimate is 0.1267 moose/km² (0.3282 moose/mi²). During stratification 358 moose were observed (Appendix A). Of the 410 moose counted in the standard searches, 323 were in Unit 17C SU's, 198 of which were in the 3 super high density SU's. Our intensive searches revealed we missed very few moose during the standard searches. Sightability correction factors of 1.023, 1.014, and 1.016 for medium, high, and super high density strata, respectively, accounted for only 6.8 moose of the estimated total. The moose that were missed were in coniferous habitat in Unit 17C.

Because of the apparent differences in moose densities between Unit 17C and 17A, we calculated a population estimate for the portion of our study area only within Unit 17A. Of the 74 SU's in Unit 17A, 65 were classified low density (0-4 moose), 5 as medium density (5-9 moose), and 4 as high density (>9 moose)(Appendix B). We conducted standard searches in 25 SU's (16 low, 5 medium, and 4 high) and calculated an estimate of 100.9 moose +/- 16.15% (80% CI). Total area in Unit 17A SU's was 2,698.7 km² (1,041.9 mi²) resulting in an average density of 0.0374 moose/km² (0.0969 moose/mi²) or approximately 1 moose per 10 mi². During stratification flights, 87 moose were counted, which was the same number seen in the standard searches. Of the 87 moose seen in the standard searches, 29 were recent immigrants from Unit 17C. Intensive searches failed to turn up any "new" moose, thus our sightability correction

factor was 1.000 across all strata.

Movement of 29 moose from Unit 17C into 17A was documented during this survey. During stratification on 16 February, no moose were observed in SU #73 (Unit 17A), while 63 were seen in adjacent SU #76 (Unit 17C). Standard searches of both SU #73 and #76 on 19 February revealed 29 and 40 moose present, respectively. Fresh tracks and a well worn trail through the pass leading to the animals were also evident. The furthest group of moose travelled approximately 10 km (6.2 mi) when we observed them. How often this sort of movement between Unit 17C and 17A occurs or whether it is really dispersal is unknown. Tracking flights of moose radio-collared in western Unit 17C did not show a pattern of immigration to Unit 17A (Jemison 1994). However, trend counts in this area (Appendices C and D) have shown an increase in moose numbers since radio-collars were deployed (1988) and it is possible that younger, non-collared moose, with less home range affinity, are now dispersing to Unit 17A.

Moose are distributed throughout Unit 17A, however, densities are greater in the more remote northern portions. Our study area did not include all Unit 17A. With the exception of the Trail Creek drainage to the north, the rest of Unit 17A outside the study area is considered as, at best, low moose density. Trail Creek was not included in our survey.

Other observations made during the moose survey flights include: numerous porcupines (*Erethizon dorsatum*); several large flocks of Willow ptarmigan (*Lagopus lagopus*); a few bald eagles (*Haliaeetus leucocephalus*); no wolves (*Canis lupus*) or caribou (*Rangifer tarandus*). Snowmachine tracks were evident throughout the survey and there appears few inaccessible areas.

RECOMMENDATIONS

1. Develop an interagency/community strategy for moose management in Unit 17A and adjacent areas. Such a strategy would involve biologists, advisory committee members and concerned citizens and would outline minimum and maximum population objectives and appropriate harvest levels.
2. Collect sex and age distribution information for Unit 17A moose population. This will entail conducting aerial surveys in November/December when complete snow cover exists and antler drop has not occurred. This information is critical to determining the reproductive potential and health of Unit 17A moose population.
3. Establish annual moose trend count areas in Unit 17A. Because moose habitat exists primarily along waterways and sightability is high with adequate snow, large areas can be surveyed in relatively short time. Ideally, counts would be conducted in fall/early winter.
4. Determine seasonal distribution and movements of moose in Unit 17A. To achieve this,

radio-collars would be deployed on young animals. Additional information on reproduction and mortality could be obtained with the use of radio-collars.

5. Conduct habitat analyses on Unit 17A moose winter range. Quantitative information on the condition of important browse species should be determined and a schedule for future monitoring established.

ACKNOWLEDGEMENTS

The involvement of the following people were instrumental in the safety and success of this project. Thanks are in order: to R. Kaycon (ADFG - Bethel) for project coordination, moose observation, data input and calculation; to local pilots T. Schlagel (Bay Air), T. Tucker (Tucker Aviation), R. Grant (Tikchik Airventures), and J. Harman (ADPS-FWP) for their skill and safe flying; to J. Dyasuk (TNWR) for his help during stratification; to R. Doyle (TNWR) for spending long hours in the back seat of a SuperCub; and to Yukon Delta NWR for use of their digital planimeter.

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Appendix A. Moose stratification, census data, and estimated population size for entire study area.

Sample Unit	Drainage	Area (m ²)	Stratification			Census Results		
			Date	Moose	Rating	Date	Moose	Team ^a
1 A	Nayorurun	3.61	16 FEB 95	0	L			
2 A	Nayorurun	6.17	16 FEB 95	2	L	20 FEB 95	0	LVD/JH
3 A	Nayorurun	9.60	14 FEB 95	0	L	20 FEB 95	0	LVD/JH
4 A	Kemuk	9.43	16 FEB 95	10	M	20 FEB 95	10	LVD/JH
5 A	Kemuk	20.80	14 FEB 95	4	L			
6 A	Kemuk	14.14	16 FEB 95	0	L	20 FEB 95	3	RK/RG
7 A	Kemuk	13.00	16 FEB 95	5	M	20 FEB 95	3	RK/RG
8 A	Kemuk	6.92	16 FEB 95	0	L	19 FEB 95	0	RD/MH
9 A	Nayorurun	19.82	14 FEB 95	2	L			
10 A	Nayorurun	13.08	14 FEB 95	0	L			
11 A	Nayorurun	8.31	14 FEB 95	0	L			
12 A	Mid-Togiak	12.29	14 FEB 95	0	L	20 FEB 95	0	LVD/JH
13 A	Nayorurun	14.10	14 FEB 95	0	L			
14 A	Mid-Togiak	12.88	14 FEB 95	0	L			
15 A	Gechiak	13.06	14 FEB 95	0	L			
16 A	Gechiak	16.98	21 FEB 95	0	L			
17 A	Mid-Togiak	10.23	21 FEB 95	0	L			
18 A	Gechiak	13.83	21 FEB 95	4	L			
19 A	Gechiak	20.91	21 FEB 95	0	L			
20 A	Pungokepuk	17.38	17 FEB 95	0	L			
21 A	Pungokepuk	16.30	17 FEB 95	0	L			
22 A	Lower Togiak	10.79	17 FEB 95	0	L			
23 A	Lower Togiak	8.23	17 FEB 95	0	L			
24 A	Lower Togiak	14.68	17 FEB 95	0	L			
25 A	Negukthlik	24.80	17 FEB 95	0	L			
26 A	Negukthlik	17.76	17 FEB 95	0	L			
27 A	Negukthlik	14.77	17 FEB 95	0	L			
28 A	Lower Togiak	18.40	17 FEB 95	0	L	20 FEB 95	0	AA/TS
29 A	Pungokepuk	12.99	17 FEB 95	0	L	19 FEB 95	0	RD/MH
30 A	Pungokepuk	20.27	17 FEB 95	0	L			
31 A	Pungokepuk	20.02	17 FEB 95	0	L	19 FEB 95	0	RD/MH
32 A	Mid-Togiak	10.00	17 FEB 95	0	L			
33 A	Nayorurun	17.40	17 FEB 95	0	L			
34 A	Kemuk	19.20	14 FEB 95	3	L			
35 A	Mid-Togiak	14.33	14 FEB 95	3	L			
36 A	Kemuk	18.25	16 FEB 95	0	L	19 FEB 95	0	RD/MH
37 A	Tshayagagak	14.93	14 FEB 95	3	L			
38 A	Mid-Togiak	7.83	16 FEB 95	0	L	21 FEB 95	0	RK/TS
39 A	Mid-Togiak	19.44	16 FEB 95	0	L			
40 A	Kipnaktuli	18.45	16 FEB 95	2	L			
41 A	Nanavochtshak	7.20	16 FEB 95	0	L			
42 A	Ougamautamuk	6.82	16 FEB 95	0	L			
43 A	Izavieknik	16.91	16 FEB 95	10	M	21 FEB 95	13	RK/TS
44 A	Izavieknik	11.55	16 FEB 95	7	M	21 FEB 95	0	AA/MH

Appendix A. continued

Sample Unit	Drainage	Area (mi ²)	Stratification			Census Results		
			Date	Moose	Rating	Date	Moose	Team ^a
45 A	Izavieknik	17.21	16 FEB 95	7	M	21 FEB 95	8	AA/MH
46 A	Sunday	12.88	16 FEB 95	0	L			
47 A	Bruin	13.52	16 FEB 95	0	L			
48 A	Jondik	15.33	16 FEB 95	4	L			
49 A	Ongivinuck	10.23	16 FEB 95	0	L	20 FEB 95	0	RD/MH
50 A	Ongivinuck	8.12	16 FEB 95	0	L	20 FEB 95	1	RD/MH
51 A	Pungokepuk	17.21	17 FEB 95	0	L			
52 A	Pungokepuk	10.18	17 FEB 95	0	L	21 FEB 95	0	LVD/RG
53 A	Ungalikthluk	15.98	17 FEB 95	0	L	20 FEB 95	0	AA/TS
54 A	Ungalikthluk	23.98	17 FEB 95	0	L			
55 A	Ungalikthluk	16.29	17 FEB 95	0	L			
56 A	Kulukuk	11.97	17 FEB 95	0	L			
57 A	Kulukuk	19.02	17 FEB 95	0	L			
58 A	Ungalikthluk	11.29	17 FEB 95	0	L			
59 A	Kulukuk	17.47	17 FEB 95	0	L	20 FEB 95	0	AA/TS
60 A	Kulukuk	14.31	16 FEB 95	0	L			
61 A	Kulukuk	11.31	16 FEB 95	0	L			
62 A	Kulukuk	14.64	16 FEB 95	0	L			
63 A	Kulukuk	16.95	16 FEB 95	0	L	20 FEB 95	0	AA/TS
64 A	Ongivinuck	14.83	16 FEB 95	10	M	19 FEB 95	7	RD/MH
65 A	Ongivinuck	9.69	16 FEB 95	2	M ^o	20 FEB 95	10	RD/MH
66 A	No Lake	16.45	16 FEB 95	0	L			
67 A	Ongivinuck	7.30	16 FEB 95	1	L			
68 A	Ongivinuck	16.66	16 FEB 95	2	L			
69 A	Jondik	16.99	16 FEB 95	6	M	19 FEB 95	3	AA/TS
70 C	Sunshine	18.49	16 FEB 95	27	H	19 FEB 95	13	AA/TS
71 C	Sunshine	16.83	16 FEB 95	63	SH	17 FEB 95	84	AA/TS
72 C	Sunshine	16.19	16 FEB 95	35	SH	17 FEB 95	74	AA/TS
73 A	No Lake	11.46	16 FEB 95	0	H ^c	19 FEB 95	29	AA/TS
74 A	No Lake	10.63	16 FEB 95	0	L			
75 C	Youth	9.58	16 FEB 95	21	H	19 FEB 95	26	AA/TS
76 C	Youth	15.15	16 FEB 95	63	SH	19 FEB 95	40	AA/TS
77 C	Killian	11.86	16 FEB 95	18	H	19 FEB 95	29	LVD/RG
78 C	Ongoke	12.15	16 FEB 95	0	L	19 FEB 95	0	LVD/RG
79 C	Weary	13.05	16 FEB 95	3	L			
80 C	Ongoke	10.44	16 FEB 95	3	L			
81 C	Ongoke	9.47	16 FEB 95	0	L			
82 C	Ongoke	15.50	16 FEB 95	1	L	21 FEB 95	4	LVD/RG
83 A	Kulukuk	17.10	16 FEB 95	0	L			
84 C	Francis	15.91	16 FEB 95	0	L			
85 A	Tithe	9.80	17 FEB 95	0	L			
86 A	Ualik	15.29	17 FEB 95	0	L			
87 C	Ongoke	8.60	16 FEB 95	0	L			
88 C	Ongoke	15.42	16 FEB 95	0	L	19 FEB 95	4	LVD/RG
89 C	Longarm	14.01	16 FEB 95	0	L			
90 C	Longarm	14.48	16 FEB 95	1	L			
91 C	Weary	12.56	16 FEB 95	0	L			

Appendix A. continued

Sample Unit	Drainage	Area (mi ²)	Stratification			Census Results		
			Date	Moose	Rating	Date	Moose	Team ^a
92 C	Nunavaugalik	17.55	16 FEB 95	4	L			
93 C	Weary	13.38	16 FEB 95	6	M	17 FEB 95	9	RD/MH
94 C	Weary	10.79	16 FEB 95	0	L	19 FEB 95	0	LVD/RG
95 C	Weary	10.60	16 FEB 95	0	L			
96 C	Ualik	10.90	17 FEB 95	0	L			
97 C	Nunavaugalik	11.77	16 FEB 95	0	L			
98 C	Ongoke	6.37	16 FEB 95	0	L			
99 C	Redleaf	5.89	17 FEB 95	0	L			
100 C	Ualik	11.24	16 FEB 95	0	L			
101 C	Weary	11.22	16 FEB 95	15	H	17 FEB 95	20	RD/AA
102 C	Nunavaugalik	13.99	16 FEB 95	11	M	17 FEB 95	20	RD/AA

Stratification Criteria			
Stratification classification	Moose seen	Number of Units	Area (Miles²)
LOW	0 - 4	84	1,147.58
MEDIUM	5 - 14	10	136.98
HIGH	15 - 30	5	62.61
SUPER HIGH	>30	3	48.17

- a - Team Members: AA - Andy Aderman (Togiak NWR), RD - Rob Doyle (Togiak NWR), RG - Rick Grant (pilot), JH - John Harman (FWP/pilot), MH - Mike Hinkes (Togiak NWR/pilot), RK - Randy Kaycon (ADFG - Bethel), TS - Tom Schlagel (pilot), and, LVD - Larry Van Daele (ADFG - Dillingham)
- b - Sample Unit 65 was originally classified as a "low" during the stratification when 2 moose were observed, however, a group of moose moved into the area from unit 64 prior to the census. Therefore, we reclassified unit 65 as a "medium" for the analysis.
- c - Sample Unit 73 was originally classified as "low" during the stratification when no moose were observed, however a group of 29 moose moved into the unit from sample unit 76 prior to the census (as evidenced by tracks). Therefore, we reclassified unit 73 as a "high" for the analysis.

Appendix A. continued

ESTIMATED POPULATION SIZE FOR ENTIRE STUDY AREA

Stratification type	Low	Medium	High	SuperHigh	TOTAL
# of SU's	84	10	5	3	102
Total area (mi ²)	1147.58	136.98	62.61	48.17	1395.34
# of SU's surveyed	20	10	5	3	38
Area surveyed (mi ²)	259.40	136.98	62.61	48.17	507.16
# of moose seen	12	83	117	198	410
Density (moose/mi ²)	0.0463	0.6059	1.8687	4.1104	0.3282
Estimate for total area (To)	53.1	83.0	117.0	198.0	
Variance of estimate V(To)	530.38	0.00	0.00	0.00	
Sightability correction (SCF)	1.000000	1.023893	1.014317	1.016141	
Variance of correction V(SCF)	0.0000000	0.0004797	0.0004549	0.0000197	
SCF degrees of freedom	0	9	4	2	
To degrees of freedom	19	9	4	2	

Total population size with correction (Te) = 457.9 Variance of Te = 540.69 Te degrees of freedom = 3

80% Confidence Interval around Te = (419.9, 496.0) is +/- 8.32%

90% Confidence Interval around Te = (403.2, 512.7) is +/- 11.95%

95% Confidence Interval around Te = (384.0, 531.9) is +/- 16.16%

Appendix B. Moose stratification, census data, and estimated population size for GMU 17A portion of study area.

Sample Unit	Drainage	Area (mi ²)	Stratification			Census Results		
			Date	Moose	Rating	Date	Moose	Team ^a
1 A	Nayorurun	3.61	16 FEB 95	0	L			
2 A	Nayorurun	6.17	16 FEB 95	2	L	20 FEB 95	0	LVD/JH
3 A	Nayorurun	9.60	14 FEB 95	0	L	20 FEB 95	0	LVD/JH
4 A	Kemuk	9.43	16 FEB 95	10	H	20 FEB 95	10	LVD/JH
5 A	Kemuk	20.80	14 FEB 95	4	L			
6 A	Kemuk	14.14	16 FEB 95	0	L	20 FEB 95	3	RK/RG
7 A	Kemuk	13.00	16 FEB 95	5	M	20 FEB 95	3	RK/RG
8 A	Kemuk	6.92	16 FEB 95	0	L	19 FEB 95	0	RD/MH
9 A	Nayorurun	19.82	14 FEB 95	2	L			
10 A	Nayorurun	13.08	14 FEB 95	0	L			
11 A	Nayorurun	8.31	14 FEB 95	0	L			
12 A	Mid-Togiak	12.29	14 FEB 95	0	L	20 FEB 95	0	LVD/JH
13 A	Nayorurun	14.10	14 FEB 95	0	L			
14 A	Mid-Togiak	12.88	14 FEB 95	0	L			
15 A	Gechiak	13.06	14 FEB 95	0	L			
16 A	Gechiak	16.98	21 FEB 95	0	L			
17 A	Mid-Togiak	10.23	21 FEB 95	0	L			
18 A	Gechiak	13.83	21 FEB 95	4	L			
19 A	Gechiak	20.91	21 FEB 95	0	L			
20 A	Pungokepuk	17.38	17 FEB 95	0	L			
21 A	Pungokepuk	16.30	17 FEB 95	0	L			
22 A	Lower Togiak	10.79	17 FEB 95	0	L			
23 A	Lower Togiak	8.23	17 FEB 95	0	L			
24 A	Lower Togiak	14.68	17 FEB 95	0	L			
25 A	Negukthlik	24.80	17 FEB 95	0	L			
26 A	Negukthlik	17.76	17 FEB 95	0	L			
27 A	Negukthlik	14.77	17 FEB 95	0	L			
28 A	Lower Togiak	18.40	17 FEB 95	0	L	20 FEB 95	0	AA/TS
29 A	Pungokepuk	12.99	17 FEB 95	0	L	19 FEB 95	0	RD/MH
30 A	Pungokepuk	20.27	17 FEB 95	0	L			
31 A	Pungokepuk	20.02	17 FEB 95	0	L	19 FEB 95	0	RD/MH
32 A	Mid-Togiak	10.00	17 FEB 95	0	L			
33 A	Nayorurun	17.40	17 FEB 95	0	L			
34 A	Kemuk	19.20	15 FEB 95	3	L			
35 A	Mid-Togiak	14.33	14 FEB 95	3	L			
36 A	Kemuk	18.25	16 FEB 95	0	L	19 FEB 95	0	RD/MH
37 A	Tshayagagak	14.93	14 FEB 95	3	L			
38 A	Mid-Togiak	7.83	16 FEB 95	0	L	21 FEB 95	0	RK/TS
39 A	Mid-Togiak	19.44	16 FEB 95	0	L			
40 A	Kipnaktuli	18.45	16 FEB 95	2	L			
41 A	Nanavochtshak	7.20	16 FEB 95	0	L			
42 A	Ougamautamuk	6.82	16 FEB 95	0	L			
43 A	Izavieknik	16.91	16 FEB 95	10	H	21 FEB 95	13	RK/TS
44 A	Izavieknik	11.55	16 FEB 95	7	M	21 FEB 95	0	AA/MH

Appendix B. continued

Sample Unit	Drainage	Area (mi ²)	Stratification			Census Results		
			Date	Moose	Rating	Date	Moose	Team ^a
45 A	Izavieknik	17.21	16 FEB 95	7	M	21 FEB 95	8	AA/MH
46 A	Sunday	12.88	16 FEB 95	0	L			
47 A	Bruin	13.52	16 FEB 95	0	L			
48 A	Jondik	15.33	16 FEB 95	4	L			
49 A	Ongivinuck	10.23	16 FEB 95	0	L	20 FEB 95	0	RD/MH
50 A	Ongivinuck	8.12	16 FEB 95	0	L	20 FEB 95	1	RD/MH
51 A	Pungokepuk	17.21	17 FEB 95	0	L			
52 A	Pungokepuk	10.18	17 FEB 95	0	L	21 FEB 95	0	LVD/RG
53 A	Ungalikthluk	15.98	17 FEB 95	0	L	20 FEB 95	0	AA/TS
54 A	Ungalikthluk	23.98	17 FEB 95	0	L			
55 A	Ungalikthluk	16.29	17 FEB 95	0	L			
56 A	Kulukuk	11.97	17 FEB 95	0	L			
57 A	Kulukuk	19.02	17 FEB 95	0	L			
58 A	Ungalikthluk	11.29	17 FEB 95	0	L			
59 A	Kulukuk	17.47	17 FEB 95	0	L	20 FEB 95	0	AA/TS
60 A	Kulukuk	14.31	16 FEB 95	0	L			
61 A	Kulukuk	11.31	16 FEB 95	0	L			
62 A	Kulukuk	14.64	16 FEB 95	0	L			
63 A	Kulukuk	16.95	16 FEB 95	0	L	20 FEB 95	0	AA/TS
64 A	Ongivinuck	14.83	16 FEB 95	10	H	19 FEB 95	7	RD/MH
65 A	Ongivinuck	9.69	16 FEB 95	2	M ^b	20 FEB 95	10	RD/MH
66 A	No Lake	16.45	16 FEB 95	0	L			
67 A	Ongivinuck	7.30	16 FEB 95	1	L			
68 A	Ongivinuck	16.66	16 FEB 95	2	L			
69 A	Jondik	16.99	16 FEB 95	6	M	19 FEB 95	3	AA/TS
73 A	No Lake	11.46	16 FEB 95	0	H ^c	19 FEB 95	29	AA/TS
74 A	No Lake	10.63	16 FEB 95	0	L			
83 A	Kulukuk	17.10	16 FEB 95	0	L			
85 A	Tithe	9.80	17 FEB 95	0	L			
86 A	Ualik	15.29	17 FEB 95	0	L			

Stratification Criteria			
Stratification classification	Moose seen	Number of Units	Area (Miles ²)
LOW	0 - 4	65	920.88
MEDIUM	5 - 9	5	68.44
HIGH	>9	4	52.63

a - Team Members: AA - Andy Aderman (Togiak NWR), RD - Rob Doyle (Togiak NWR), RG - Rick Grant (pilot), JH - John Harman (FWP/pilot), MH - Mike Hinkes (Togiak NWR/pilot), RK - Randy Kaycon (ADFG - Bethel), TS - Tom Schlagel (pilot), and, LVD - Larry Van Daele (ADFG - Dillingham)

b - Sample Unit 65 was originally classified as a "low" during the stratification when 2 moose were observed, however, a group of moose moved into the area from unit 64 prior to the census. Therefore, we reclassified unit 65 as a "medium" for the analysis.

c - Sample Unit 73 was originally classified as "low" during the stratification when no moose were observed, however a group of 29 moose moved into the unit from sample unit 76 prior to the census (as evidenced by tracks). Therefore, we reclassified unit 73 as a "high" for the analysis.

Appendix B. continued

ESTIMATED POPULATION SIZE FOR GMU 17A PORTION OF STUDY AREA

Stratification type	Low	Medium	High	TOTAL
# of SU's	65	5	4	74
Total area (mi ²)	920.88	68.44	52.63	1041.95
# of SU's surveyed	16	5	4	25
Area surveyed (mi ²)	205.54	68.44	52.63	326.61
# of moose seen	4	24	59	87
Density (moose/mi ²)	0.0195	0.3507	1.1210	0.0969
Estimate for total area (To)	17.9	24.0	59.0	100.9
Variance of estimate V(To)	147.71	0.00	0.00	147.71
To degrees of freedom	15	4	3	

Sightability correction (SCF) = 1.000000 Variance of correction V(SCF) = 0.0000000

Total population size with correction (Te) = 100.9 Variance of Te = 147.71 Te degrees of freedom = 15

80% Confidence Interval around Te = (84.6, 117.2) is +/- 16.15%

90% Confidence Interval around Te = (79.6, 122.2) is +/- 21.11%

95% Confidence Interval around Te = (75.0, 126.8) is +/- 25.66%

APPENDIX C.

MOOSE SEX AND AGE COMPOSITION, FALL COUNT

GMU/Subunit: 17C

Count Area: Sunshine Valley

Square Miles in Count Area: 33

Date	MALES					Total	Lone	FEMALES		Total	Total calves	Total moose	Count Time (hrs)	Survey Cond.
	Lrg	Med	Ylg	Unk	w/1			w/2						
13 DEC 90	3	17	11	0	31	33	11	5	49	21	101	2.0	G-VG	
21 NOV 91	3	10	25	0	38	25	15	3	43	21	102	1.8	G	
09 FEB 94	NO COMPOSITION DATA WAS COLLECTED										186	1.8	VG-EX	
29 NOV 94	7	31	27	0	65	69	22	3	94	28	187	2.3	G-VG	

MOOSE SEX AND AGE RATIOS, FALL COUNT

GMU/Subunit: 17C

Count Area: Sunshine Valley

Square Miles in Count Area: 33

Date	Total males:	Yrlg males:	Prct Yrlg males	Total calves:	Twins: 100 FF w/calf	Prct calves	Moose per hour	Search area (sq mi)	Moose per (sq mi)	Search Intensity min/sq mi	
	100 FF	100 FF	males	100 FF		calves					
13 DEC 90	63.3	22.4	10.9	42.9	31.3	20.8	51	33	3.1	3.6	
21 NOV 91	88.3	58.1	24.5	48.8	16.6	20.6	56	33	3.1	3.3	
09 FEB 94	NO COMPOSITION DATA WAS COLLECTED							57	33	3.1	3.3
29 NOV 94	69.1	28.7	14.4	29.8	12.0	15.0	81	33	5.7	4.2	

APPENDIX D.

MOOSE SEX AND AGE COMPOSITION, FALL COUNT

GMU/Subunit: 17C

Count Area: Weary River

Square Miles in Count Area:

Date	MALES					Total	Lone	FEMALES		Total	Total calves	Total moose	Count Time (hrs)	Survey Cond.
	Lrg	Med	Ylg	Unk	w/1			w/2						
21 NOV 91	1	2	0	0	3	0	0	2	1	2	6	1.8	G	
24 NOV 93	1	8	7	0	16	5	3	2	10	7	33	1.0	VG	
30 NOV 94	4	11	1	0	16	14	4	2	20	8	44	1.6	G-VG	

MOOSE SEX AND AGE RATIOS, FALL COUNT

GMU/Subunit: 17C

Count Area: Weary River

Square Miles in Count Area:

Date	Total males:	Yrlg males:	Prct Yrlg males	Total calves:	Twins: 100 FF w/calf	Prct calves	Moose per hour	Search area (sq mi)	Moose per (sq mi)	Search Intensity min/sq mi
	100 FF	100 FF	males	100 FF		calves				
21 NOV 91	300.0	0.0	0.0	200.0	100.0	33.3	3.3			
24 NOV 93	160.0	70.0	21.2	70.0	40.0	21.2	33.0			
30 NOV 94	80.0	5.0	2.3	40.0	33.3	18.2	27.5			