Alaska Department of Fish and Game
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MOOSE

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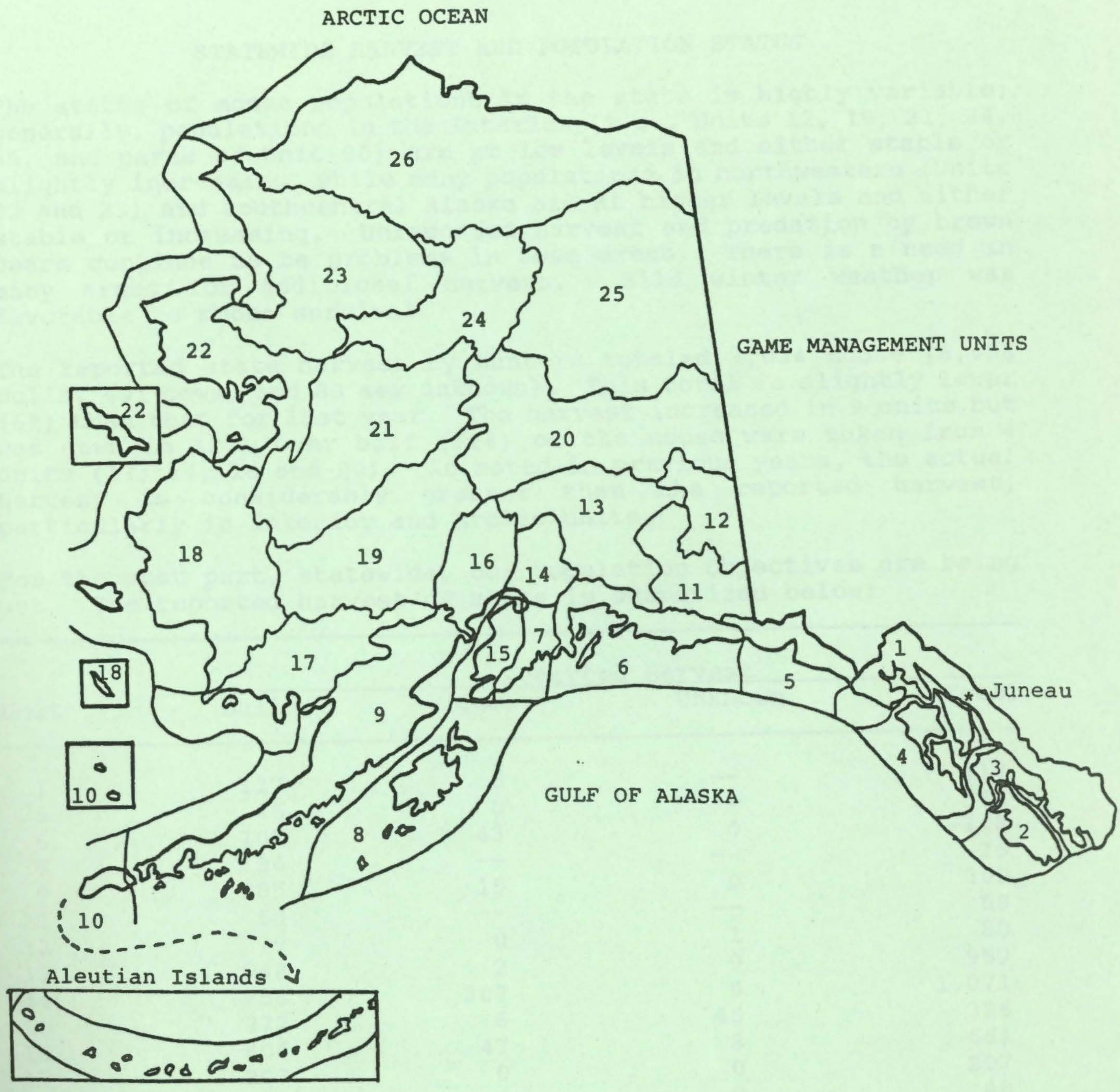
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STATEWIDE HARVEST AND POPULATION STATUS

The status of moose populations in the state is highly variable; generally, populations in the Interior (i.e., Units 12, 19, 21, 24, 25, and parts of Unit 20) are at low levels and either stable or slightly increasing, while many populations in northwestern (Units 22 and 23) and southcentral Alaska are at higher levels and either stable or increasing. Unreported harvest and predation by brown bears continue to be problems in some areas. There is a need in many areas for additional surveys. Mild winter weather was favorable to moose survival.

The reported state harvest by hunters totaled 7,034 moose (6,458 bulls, 491 cows, and 83 sex unknown). This total is slightly lower (6%) than that for last year. The harvest increased in 9 units but was down in 12. Over half (52%) of the moose were taken from 4 units (13, 14, 16 and 20). As noted in previous years, the actual harvest is considerably greater than the reported harvest, particularly in Interior and Arctic units.

For the most part, statewide, our population objectives are being met. The reported harvest of moose is summarized below:

Unit	Reported Harvest: Bulls	Cows	Unknown	Total
1	117	0	--	117
5	46	0	--	46
6	105	43	0	148
7	36	--	--	36
9	285	15	0	300
11	58	--	--	58
12	79	0	1	80
13	948	2	9	959
14	758	307	6	1,071
15	272	6	48	326
16	606	47	8	661
17	207	0	0	207
18	48	0	0	48
19	549	0	0	549
20	938	1	5	944
21	547	25	1	573
22	286	20	4	310
23	191	14	1	206
24	136	0	0	136
25	143	0	0	143
26	103	13	0	116
TOTAL	6,458	491	83	7,034

Steven R. Peterson
Senior Staff Biologist

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STUDY AREA

GAME MANAGEMENT UNIT: 1A, 1B, 2, and 3 (15,300 mi^2)

GEOGRAPHICAL DESCRIPTION: Southeast mainland and adjacent islands from Cape Fanshaw to the Canadian border.

BACKGROUND

The Unuk and Chickamin River drainages in Subunit 1A support small, apparently stable populations of moose. The Unuk moose herd is indigenous, while the Chickamin herd is the result of a 1963-64 transplant from Cook Inlet and the Chickaloon Flats. Although a hunting season exists for both populations, their remoteness and low numbers, as well as the difficulty in finding them result in little hunter interest. Accordingly, the harvest is very light and sporadic, normally not exceeding 2 or 3 animals per year.

Moose occur throughout Subunit 1B, wherever appropriate habitat exists; however, the primary concentrations occur in the Thomas Bay area in northern Subunit 1B and the Stikine River in southern Subunit 1B. Separate hunting regulations exist for each.

The Thomas Bay population is relatively isolated from populations in mainland Canada by the Coast Mountains. These moose are unique in Southeast Alaska, because they occupy an area that has been heavily logged. Sparse population trend information suggests that the Thomas Bay animals may be more susceptible to periodic reproductive failures and/or extreme neonatal mortality than other Southeast moose populations. Also, the Thomas Bay population is expected to undergo demo graphic changes, including perhaps a significant decline, as forest regrowth in clearcut areas matures. The average annual harvest of Thomas Bay moose during the decades of the 1950's, 60's, 70's, and the 80's (through 1987) was 5, 8, 10, and 15, respectively.

Moose inhabiting the American portion of the Stikine River represent only the western-most tip of a population that extends up the drainage into Canada. The American Stikine River population was estimated at 300 animals in 1983 (Craighead et al. 1984). Since 1983 winters have been mild and the population has remained stable or increased slightly. The average annual harvest of Stikine River moose during the decades of the 1950's, 60's, and 70's was about 27. From 1980-87 the average annual harvest was 39.

Reported sightings of moose are rare in Unit 2, and there does not appear to be any trend of increasing numbers. There is no open hunting season.

Moose exist in low densities on the major islands of Unit 3. An increasing number of sightings of moose during the 1980's suggest that the island population has increased slightly. There is no open hunting season.

POPULATION OBJECTIVES

To determine by 1990 the number of moose that can be harvested on a sustained-yield basis in Subunit 1A.

To provide for an annual harvest of at least 30 moose and a posthunting season population of at least 300 moose in the Stikine River (Subunit 1B).

To provide for an annual harvest of 15 moose and determine by 1990 the carrying capacity of the range in Thomas Bay.

METHODS

Fall and winter aerial surveys were scheduled in Unit 1B to estimate sex and age composition of the Stikine River and Thomas Bay moose populations. Registration permits for Thomas Bay (northern Subunit 1B) and harvest reports for Stikine River (southern Subunit 1B) and Subunit 1A were used to estimate harvest. Hunter check stations were maintained in the Thomas Bay and Stikine River areas to monitor and administer the hunt and to obtain additional harvest information. Reported sightings of moose were recorded to document the continuing expansion of moose into Unit 3.

RESULTS AND DISCUSSION

Population Status and Trend

The data are insufficient to make a quantitative determination of population trends during the past 5 years. Subjectively, however, the moose populations appeared to be stable in Subunit 1A (low numbers), Unit 2 (insignificant numbers), and Thomas Bay (moderate-to-high density). The Stikine River population in southern Subunit 1B (high density) appeared to increase. The number of moose in Unit 3 (low density) also appeared to increase.

Population Size:

A subjective estimate of the number of moose in Subunit 1A is 20-30 in the Unuk River drainage and about five in the Chickamin River drainage (R. Wood, ADF&G, Ketchikan, pers. commun.). The Stikine River population was about 300 and increasing in 1983 (Craighead et al. 1984). From 1984 to 1988 harvest levels and subjective impressions suggest the Stikine population has either slowly increased during the past 5 years or remained stable. The Thomas Bay population does not appear to be as numerous as it was in the late 1970's; i.e., about 180 animals (ADF&G files, Petersburg). The current population is probably about 100 moose (E. Young, ADF&G, Sitka, pers. commun.). No population estimates are available for Unit 3.

Population Composition:

Sex and age composition data of the Stikine River and Thomas Bay moose populations for the past 5 years are shown in Table 1. In 1987 the ratio of 24 bulls:100 cows for the Stikine River suggests that recent harvest levels have not been excessive; the 48 calves:100 cows ratio was substantially higher than those in 1982 and 1983, but historically, the observed calf:cow ratio has fluctuated widely (ADF&G files, Petersburg). The proportion of calves in the sample falls midway in the range of values obtained during the previous 5 years, which suggests either reproduction adequate to sustain a stable population or continued growth.

Meaningful interpretation of the Thomas Bay data is impossible because survey sample sizes were too small (Table 1); i.e., the largest sample since 1980 has been 22 moose. Thick vegetation has precluded successful surveys. This inherent limitation constitutes one of the main constraints on the Thomas Bay moose management program. In lieu of doing nothing, aerial surveys have provided an indication of the presence or absence of calves. The annual calf crop is of paramount importance because, if the intensive harvesting of bull moose is allowed to occur following a poor reproductive year, it could have serious consequences for the population.

Distribution and Movements:

Sightings of moose on Mitkof Island and to a lesser extent on Kupreanof and Kuiu Islands are the basis for the conclusion that the moose population is increasing in Unit 3. Both the Stikine River and Thomas Bay populations occur on the mainland directly opposite Mitkof and Kupreanof islands; hence, they are the logical sources of migrating moose. However, bulls, cows, and calves have been reported in Unit 3 (i.e., on the islands), suggesting that reproduction of the resident moose is also contributing to the overall increase.

<u>Mortality</u>

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters in Subunit 1A and 1B south of LeConte Glacier (Stikine River) is 15 September to 15 October. The bag limit is 1 bull moose. The open season for all hunters in Subunit 1B north of LeConte Glacier (Thomas Bay) is 1-15 October. The bag limit is 1 bull, with at least 3 tines or at least 1 antler, by registration permit only. There is no open season in Units 2 and 3.

Human-induced Mortality:

The 1987 harvest in the Stikine River was 3 less than the 50 recorded from the 1986 season (Table 2); however, harvests have generally increased since the early 1970's. The effect of hunting was apparent in the skewed age composition of bull moose harvested in 1987. About 80% were yearlings (ADF&G files, Petersburg). In contrast, other indices of population status continue to suggest that the population may be growing; however, each year's harvest has been heavily dependent on the previous year's calf production. This greatly increases the likelihood of having to close the season in the event of a reproductive or recruitment failure. This could occur during a year of higher-than-normal natural mortality; e.g., severe winter weather.

The 1987 moose harvest at Thomas Bay was a substantial increase over the relatively small increases that occurred during the previous 3 seasons (Table 2). While two of the moose were killed a few miles to the north at Farragut Bay, the total harvest was still noteworthy. The increase probably occurred because there were more legal moose (i.e., 3 tines on at least 1 antler) in the population. Mild winters and the conservative effect of the antler restriction are 2 possible explanations for the increase.

The unreported harvest (legal in every respect except the hunter failed to send in the harvest report) is believed to be near zero for the Stikine River hunt. The hunt is intensively monitored by ADF&G and FWP personnel in the field during the entire 30-day hunting season. The estimated illegal harvest was less than 3 and 5 moose for Thomas Bay and Stikine River areas, respectively.

<u>Hunter Residency and Success</u>. In the Stikine River area the only clear trend during the past 5 years has been the increase in number of local residents (Wrangell) who have killed moose (Table 3). There were no commensurate increases in success rates of nonlocal residents or nonresidents. Also, there appeared to be no substantial change in the numbers of unsuccessful hunters or the overall number of hunters.

Local residents (Petersburg) continued to dominate the Thomas Bay hunt (Table 3), consistent with the previous 3 years. Nonlocal resident and nonresident participation and success were relatively consistent. The decrease in the number of hunters in 1987 was attributable to very poor weather.

<u>Harvest Chronology</u>. The data in Table 5 indicate that most of the harvest in the Stikine River and Thomas Bay areas occurs early in the respective hunting seasons. Normally, as the seasons progress, the harvest decreases. The 1987 harvest chronology was consistent with this pattern. Comparison of the data is severely handicapped because the reporting periods change from one year to the next. The reporting periods should be standardized for future comparisons.

Transport Methods. The data in Table 6 indicate no apparent changes in the transportation methods used by hunters in the Stikine River and Thomas Bay areas. Normally, a few hunters use airplanes, and the remainder use boats; use of other methods are negligible.

Habitat

Since logging began in the Thomas Bay area in the 1950's, moose have made extensive use of clearcuts; however, conifer regrowth in these clearcuts has progressively reduced moose habitat. Because the rate of logging has been greatly reduced, no new habitat is being produced. In the absence of a habitat enhancement program, it is unlikely that the moose population can be sustained at the present level. The initial steps in the planning of an enhancement program have been taken; progress will be documented in future reports.

Game Board Actions and Emergency Orders

The hunting regulations for the Stikine River have remained unchanged for the past 5 years. The Thomas Bay season was closed in 1983; this closure was necessitated by low production of calves and low recruitment of yearlings in the early 1980's. During the most recent 4 years (1984-87) the hunting regulation has remained unchanged. The antler restriction (i.e., 3 tines on at least 1 antler) for the 1982 Thomas Bay hunt was designed to increase recruitment of yearling bulls into the adult segment of the population so that there would be an adequate number of mature bulls for breeding purposes. This was partially successful, because the harvest increased from 12 to 22 bulls. The proportion of yearlings in the harvest was about one-third of that in the Stikine River, which had no antler restriction (ADF&G files, Petersburg).

After 4 years of this harvest regime, the age structure of bulls was still strongly skewed toward young age classes. The Board of Game approved a regulatory change effective 1988, based on an ADF&G recommendation that it would be desirable to further develop an age structure of bulls that contained more older animals. This change will restrict harvest to spike or forked antlers on at least one side. The assumption is that some proportion of young bulls will survive the hunting season and be recruited into the older-age classes. This should enhance the reproductive performance of the population and ultimately increase the number of harvestable moose. If successful, it may eventually be possible to allow some harvest of the older age bulls as well.

CONCLUSIONS AND RECOMMENDATIONS

The Unuk and Chickamin River moose populations are relatively small, isolated, and difficult to hunt. Consequently, they are unattractive to most hunters. The Unuk River population has consistently supported an annual harvest of 2 to 3 animals, and as long as this level of harvest continues, the regulatory and management activity status quo should be maintained. I recommend the following population objective to replace the existing one: to provide for an average annual harvest of not more than 3 moose.

Although hunter participation and harvests have both increased and the population appears to be at least stable or perhaps increasing in the Stikine River, the high proportion of yearlings in the harvest and the increasing harvest trend are indications that regulatory change may be required in the near future. The Stikine River population objective of providing a harvest of at least 30 moose was accomplished. However, the status of the 2nd objective (i.e., posthunting season population of 300 moose) was not determined. The standard aerial survey techniques for determining population size, as well as the moose demography survey technique developed by Gasaway et al. (1987), may not be applicable because of the large amount of closed-canopy habitat used by the Stikine River moose. Routine use of indirect indications may be more practical; e.g., moose/hour or moose density in open-canopy and/or treeless habitat may be the only usable method in the absence of a detailed radiotelemetry study, such as that of Craighead et al. (1984). I do not have a satisfactory alternative population objective, but I will develop one during the next reporting period.

The Thomas Bay population objective of providing for a harvest of 15 moose was accomplished. No progress was made in determining the carrying capacity. I am doubtful that such a project is attainable with existing staff and funding levels. It may be more desirable to initiate a habitat enhancement program to address the ongoing moose habitat deterioration problem. I recommend the following population objective: provide for an annual harvest of 15 moose and initiate a habitat enhancement project.

Although there are no formally stated population objectives for moose in Units 2 and 3, it may be best to develop some to assist the public and other agencies in understanding the Department's intentions. I recommend the following objectives: maintain closed hunting season in Unit 2 and maintain closed hunting season and continue to monitor by indirect means the apparent increase in numbers of moose in Unit 3.

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Gasaway, W. C., S. D. DuBois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Institute of Arctic Biology No. 22. Biological Papers of the University of Alaska.

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Table 1. Annual sex and/or age composition surveys of moose in Unit 1B, 1982-1987.

Year/ month	Bulls: 100 cows	Calves: 100 cows	Calves: 100 adults	Total moose	Survey time(hr:min)
Stikine River					
1982/03	--	--	37	37	Unk
1982/11	3	23	22	39	3:48
1982/12	--	--	27	113	2:48
1983/08	14	21	19	38	1:54
1984	--	85	--	86	--
1987/08	24	48	29	45	3:00
Thomas Bay					
1982/01	--	--	33	8	2:00
1982/01	--	--	9	14	1:00
1982/03	--	--	13	21	4:30
1982/12	--	--	0	22	3:03
1983/01	--	--	0	7	1:00
1984	--	85	--	--	--
1986/09	100	33	17	7	1:10
1987	--	--	--	--	--

Table 2. Annual reported harvest of moose in Subunits 1A and 1B, 1983-1987.

	Male	Female	Total	Estimated total harvest
Subunit 1B				
1983	41	0	41	49
1984	53	0	53	61
1985	51	0	51	59
1986	65	0	65	73
1987	69	0	69	77
Stikine River			47	52
Thomas Bay			22	25
Subunit 1A				
1983	5	0	5	5
1984	7	0	7	0
1985	0	0	0	0
1986	0	0	0	0
1987	2	0	2	2
Chickamin	0	0	0	0
Unuk River	2	0	2	2

Table 3. Residency and hunting success for moose hunters in Subunit 1B, 1983-1987.

	Successful					Unsuccessful				
	Local res.	Nonloc. res.	Non-res.	Unk.	Total	Local res.	Nonloc. res.	Non-res.	Unk.	Total
Stikine River										
1983	21	10	1	0	32[a]	110	69	1	7	187[a]
1984	--	--	--	--	--	--	--	--	--	--
1985	23	6	0	2	31[a]	159	51	1	4	215[a]
1986	28	9	1	3	41[a]	150	46	2	1	199[a]
1987	37	7	1	2	47	127	49	0	5	181
Thomas Bay										
1983	No open season									
1984	11	1	0		12	74	7	0		81
1985	12	1	0		13	85	16	0		101
1986	13	2	0		15	116	22	1		139
1987	21	0	1		22	79	7	2		88

[a] Data are incomplete because of missing records.

Table 4. Permit data for moose registration hunt number 955, Thomas Bay, 1983-1987.

	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Total hunters
1983	No open season				
1984	130	39	79	12	91
1985	154	40	101	13	114
1986	201	47	139	15	154
1987	159	49	88	22	110

Table 5. Chronology of moose harvest in Subunit 1B, 1983-1987.

Number of moose harvested per period

Stikine River

	9/15-17	9/18-24	9/25-10/1	10/2-8	10/9-15	Unknown
1983	9	7	3	7	4	2
1984	No data					
	9/15-21	9/22-28	9/29-10/5	10/6-12	10/13-15	Unknown
1985	16	2	5	4	0	3
	9/15-20	9/21-27	9/28-10/4	10/5-11	10/12-15	Unknown
1986	18	3	8	6	4	1
	9/15-19	9/20-26	9/27-10/3	10/4-10	10/11-17	Unknown
1987	15	12	9	6	3	2

Thomas Bay

1983	No open season		
	10/1-6	10/7-13	10/14-15
1984	10	2	0
	10/1-5	10/6-12	10/13-15
1985	11	2	0
	10/1-4	10/5-11	10/12-15
1986	7	6	2
	10/1-3	10/4-10	10/11-15
1987	8	10	4

Table 6. Transport means used by successful moose hunters in Subunit 1B, 1983-1987.

	Airplane	Horse	Boat	3 or 4 wheeler	Snow machine	ORV	Unknown
Stikine River							
1983	1	0	30	0	0	0	1
1984	--	--	--	--	--	--	--
1985	3	0	27	0	0	0	1
1986	2	1	31	0	0	0	0
1987	3	0	41	0	0	0	0
Thomas Bay							
1983	No open season						
1984	1	0	7	0	0	0	4[a]
1985	1	0	12	0	0	0	0
1986	3	0	11	0	0	0	1
1987	1	0	21	0	0	0	0

[a] Highway vehicle.

STUDY AREA

GAME MANAGEMENT UNIT: 1C (6,500 mi^2)

GEOGRAPHICAL DESCRIPTION: Southeast mainland from Cape Fanshaw to Eldred Rock

BACKGROUND

In 1961 the first documented observations of moose in this area were made in western Subunit 1C on the Bartlett River. The following year, moose were seen near the mouth of the Sullivan River Point on the Chilkat Peninsula. These moose probably originated from the Chilkat Valley population. By 1965 the 1st sightings were made in the Endicott River and Saint James Bay areas. Moose were possibly established in the Adams Inlet area by that time, because by 1968 sightings had been recorded for the Gustavus area.

Swarth (1922) states that a moose was killed at the mouth of the Stikine "some years" before 1919. If moose appeared at about the same time in the Taku River drainage, then moose probably occurred in the lower part of the river near the turn of the century. In 1960, 38 moose were observed in the Taku River by ADF&G biologists. Twenty-seven moose were harvested from the Taku River during that year. Moose also occur on the Whiting and Speel Rivers, south of the Taku River. It is not known if these animals originated from the Taku River, the Whiting River, or from some other herd.

Moose did not occur naturally in Berners Bay. Fifteen calves from the Anchorage area were released there in 1958. A supplemental release of 6 more calves was made in 1960. In June 1960, 3 cows with a single calf each were observed, indicating that cows had bred at about 16 months of age. The first limited open season was held in 1963, when 4 bulls were killed. Since that time, the annual harvest has ranged from 5 to 23 animals.

POPULATION OBJECTIVES

To estimate the carrying capacity of the habitat and the annual sustainable harvest for the Taku River and Chilkat Range populations by 1990.

To maintain an annual harvest of up to 10 moose, a postseason population of 80, and a postseason ratio of 25 bulls:100 cows in Berners Bay.

METHODS

Aerial surveys to document fall sex and age composition were scheduled for the Taku River, Chilkat Range, and Berners Bay populations; however, a lack of snow cover precluded this effort.

Incisors were collected from moose taken from Berners Bay. Data collected from hunters included the length of hunt, hunter residency, harvest date and location, and transport means.

RESULTS AND DISCUSSION

Population Status and Trend

Available habitat for the Berners Bay moose herd will support around 100 animals. That level is being maintained with selective harvests that adjust the bull:cow ratio. Some evidence suggests the Taku River herd may be decreasing, although animals moving downriver from Canada may supplement this herd. While population dynamics are not well understood in the Chilkat Range herd, harvest levels and anecdotal comments from hunters in the field indicate that moose numbers are stable.

Population Size:

In Berners Bay the number of moose observed during fall surveys has decreased annually since 1984 (Table 1). No data were collected in 1987; however, comments received from trappers and others suggest a good number of calves were present in the late-winter period. Surveys between 1983 and 1986, which were conducted from helicopters, probably accounted for most of the moose present in the herd.

Survey data is not as complete for other portions of Subunit 1C (Table 2). If moose sightability in the Taku River drainage is similar to that in the Haines and Yakutat areas, the population is about 100 animals in the U.S. portion. Upriver (i.e., Canadian) moose may supplement this herd, but apparently the harvests have increased in recent years. The Endicott River portion of the Chilkat Range supports about 50 moose.

Population Composition:

Table 1 indicates that the calf proportion of the Berners Bay herd declined in 1985 and 1986 to 9% and 10%, respectively. The decline in total counts for the same period may have been caused by (1) a higher-than-normal number of animals missed during surveys, (2) a general population reduction, or (3) predation in the population.

In the Taku River valley, calf recruitment and the bull:cow ratio were very low in the last survey (Table 2). Hunter comments in 1987 ranged from "there are no moose" to "there are lots of calves." The transient nature of this moose herd probably encourages wide fluctuations in its composition. The small sample size of the 1986 survey precludes speculation on herd dynamics. Data from that year suggests excellent recruitment and a healthy bull:cow ratio.

Mortality

Season and Bag Limits:

The open season for resident hunters in the Berners Bay drainage only is 15 September to 15 October. The bag limit is 1 bull by drawing permit only. Up to 5 permits will be issued to Alaska residents only. The open season for subsistence, resident, and nonresident hunters for the remainder of Subunit 1C is 15 September to 15 October. The bag limit is 1 bull by registration permit only.

Human-induced Mortality:

From 1983 to 1987, the Berners Bay drawing-permit hunt has been managed for a harvest of 5 to 15 moose (Table 3). The ratio of male:female moose in the harvest has been established by aerial surveys conducted after the hunting season. When the 1985 fall survey documented a reduced calf percentage in the sample, the harvest quota was dropped from 14 moose to 5 bulls. All permittees were successful in 1987 (Table 5).

The balance of Subunit 1C is managed under a permit registration format with no quota. The known Taku River harvest has ranged from 11 to 26 moose since 1983; in the Chilkats, they have ranged from 5 to 10 (Table 3). The 24 moose harvested in 1987 represents the lowest harvest for the 5-year period (1983-1987).

Illegal harvests in the Berners Bay area are negligible because of its proximity to Juneau and large numbers of people spend recreational time there. On the Taku River, some are undoubtedly illegally harvested in British Columbia, but the magnitude of this harvest is unknown.

Hunter Residency and Success. As Table 4 indicates, most of the moose harvested in Subunit 1C are taken by local residents. In 1987, 23 of 25 moose (92%) were harvested by local residents. Because residents from Southcentral and Interior Alaska have better opportunities for moose hunting closer to home, hunting areas in Subunit 1C are not accessible by highway vehicle, and only Alaska residents can apply for the limited number of Berners Bay permits, local resident hunters generally account for most of the harvest.

Permit Hunts. Between 200 and 600 applications have been submitted for Berners Bay drawing permits over the previous 5 years (1983-87). The proximity to Juneau explains the popularity of this hunt.

Since the permit registration format was initiated for hunt No. 959, over 200 permits have been issued annually (Table 5). The number of applicants actually hunting has ranged from 106 to 205, testifying to the popularity of moose hunting in the Juneau area. Reporting compliance has remained high.

Harvest Chronology. Like the preceding 4 years, most of the 1987 harvest was bagged during the 1st week of the season (Table 6). While both the Berners Bay drawing-permit hunt and the rest of the subunit have identical season dates, most of the Berners Bay hunt occurs in the 1st few days of the season. Weather has a great deal to do with harvest chronology; prolonged periods of rain can discourage hunters from going afield, and winds can prevent access to hunting areas.

Transport Methods. Boats provided most of the access for moose hunters in Subunit 1C (Table 7). An average of 83% of the successful 1C hunters have used boats since 1984; in 1987 96% used this form of access.

Habitat

During mid-March I spent 6 days in a portion of Glacier Bay National Park. At that time, I observed areas that had been covered by ice as recently as 30 years ago. In Adams Inlet, which has been ice free for about 60 years, heavy browsing was noted on most willows as well as on some alder. Judging by pellet and track observations and the extent of browsing, it appeared that enough moose were present to be significantly affected by deep snow.

CONCLUSIONS AND RECOMMENDATIONS

While the absence of fall surveys in 1987 precludes an accurate evaluation of current population status, the data available on population trends and hunter efforts suggest a continued conservative management approach. In Berners Bay, the drawing-permit system should remain in effect.

In the remainder of Subunit 1C, jaws of harvested moose should be collected for age analysis. Once population and carrying-capacity estimates are made for the Taku River and Endicott populations, consideration can be given to the establishment of quotas of moose to be taken from those hunt areas.

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Table 1. Berners Bay historical moose survey data, Subunit 1C, 1974-1987.

Year	No. bulls	No. cows	No. calves	Unk sex/age	Total sample	No. ♂: 100 ♀	Calves: 100 ♀	% calves	Count time	Moose/ hour
1983	9	66	18	0	93	14	27	19	2.2	42
1984	22	60	19	0	101	37	32	19	2.2	46
1985	20	44	6	0	70	46	14	9	2.3	30
1986	15	46	7	0	68	33	15	10	1.6	41
1987	--	--	--	--	--	--	--	--	--	--

Table 2. Historical moose survey data in remainder of Subunit 1C, 1983-1987.

Year	No. bulls	No. cows	No. calves	Unk sex/age	Total sample	No. ♂: 100 ♀	Calves: 100 ♀	% calves	Count time	Moose/ hour
1983										
A	--	--	--	--	--	--	--	--	--	
B	2	40	12	0	54	5	30	22	1.7	32
1984										
A	--	--	--	--	--	--	--	--	--	
B	--	--	--	--	--	--	--	--	--	
1985										
A	--	--	--	--	--	--	--	--	--	
B	--	--	--	--	--	--	--	--	--	
1986										
A	3	10	6	0	19	30	60	32	1.5	13
B	2	42	1	0	45	5	2	2	1.8	25
1987										
A	--	--	--	--	--	--	--	--	--	
B	--	--	--	--	--	--	--	--	--	

A = Chilkat Range
B = Taku

1987 No Survey

Table 3. Annual harvest by hunt area in Subunit 1C, 1983-1987.

	Reported				Estimated		
Year	Berners	Taku	Chilkat range	Total	Unreported	Illegal	Total
1983	13	11	5	29	0	0	29
1984	13	18	6	37	0	1	38
1985	13	26	7	46	0	0	46
1986	5	15	10	30	0	0	30
1987	5	13	6	24	0	0	24

Table 4. Hunter residency and success in Subunit 1C, 1983-1987.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Nonres.	Total	Local res.	Nonlocal res.	Nonres.	Total
1983	NA	NA	NA	29	NA	NA	NA	91
1984	39	0	0	39	102	6	3	111
1985	42	3	1	33	145	16	1	162
1986	28	3	0	31	134	11	1	146
1987	23	0	2	25	164	20	1	185

Table 5. Harvest data by permit hunt in Subunit 1C, 1983-1987.

Hunt No.	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
901	1983	15	1	1	13	0	13	13
(Berners)	1984	15	0	1	14	1	13	14
	1985	14	0	0	13	8	5	13
	1986	7	0	2	5	5	0	5
	1987	5	0	0	5	5	0	5
959	1983	NA	NA	90	16	16	0	16
(all other	1984	217	79	110	25	25	0	25
herds)	1985	245	51	161	33	33	0	33
	1986	241	69	145	26	26	0	26
	1987	222	69	185	20	20	0	20
1987 totals for both hunts		227	69	185	25	25	0	25

Table 6. Harvest chronology in Subunit 1C, 1983-1987.

Year	Sept. 15-21	Sept. 22-28	Sept. 29-Oct. 5	Oct. 6-15
1983	13	6	4	5
1984	13	6	8	12
1985	19	7	4	16
1986	15	4	5	7
1987	13	4	3	5

Table 7. Successful hunter transport methods in Subunit 1C, 1983-1987.

Year	Airplane No.	Airplane %	Boat No.	Boat %	3- or 4-Wheeler	Snow machine	ORV	Highway vehicle
1983	NA							
1984	5	13	34	87	0	0	0	0
1985	7	16	37	84	0	0	0	0
1986	9	30	20	67	0	0	0	1(3)
1987	1	4	24	96	0	0	0	0

STUDY AREA

GAME MANAGEMENT UNIT: 1D (2,600 mi^2)

GEOGRAPHICAL DESCRIPTION: That portion of the Southeast Alaska mainland laying north of the latitude of Eldred Rock, excluding Sullivan Island and the drainages of Berners Bay

BACKGROUND

In Subunit 1D most moose inhabit the Chilkat River watershed and Chilkat Peninsula. Small pockets of moose are located in the Chilkoot, Katzehin, and Warm Pass valleys and in the western drainages of Lynn Canal.

Moose migrated into the Chilkat Valley from Canada sometime around 1930. Their numbers peaked in the mid-1960's, when as many as 700 animals may have been present. A sharp decline, possibly attributable to range overutilization, brought moose numbers down to less than 500 by the early 1970's. Census data collected since 1980 suggest that the population has declined to approximately 400 animals.

Residents of the subunit have expressed concern over the decrease in moose and subsequent decline in hunting opportunity. In 1986 the Department of Fish and Game worked closely with the area residents and fish and game advisory committees to formulate a comprehensive moose management plan for Subunit 1D.

POPULATION OBJECTIVES

To maintain a population capable of sustaining an annual harvest of 40 moose and a postseason ratio of 20 bulls:100 cows.

METHODS

A late-winter aerial survey of a portion of the Subunit 1D moose population was conducted. Harvest data were obtained from registration permit returns for the 1987 fall hunt. Successful hunters were asked to retain the front portion of the lower jaw to allow age determination by cementum annuli examination.

RESULTS AND DISCUSSION

Population Status and Trend

Moose densities in Subunit 1D declined sharply in the late 1960's and early 1970's. The rate of decrease moderated somewhat over the next decade. Since 1978 the population has fluctuated around a median of approximately 400 animals. Deteriorating range conditions, predation, and resultant poor calf survival, which may have contributed to past decreases, may now be constraining population growth. The Chilkat Valley segment of the population numbers approxmiately 400 animals, and its trend appears to be currently stable. The status and trend of moose elsewhere in the subunit is unknown.

Population Size and Composition:

An aerial survey was conducted on 1 February 1988. Survey conditions were good-to-excellent. The area surveyed included the Chilkat Valley from Murphy Flats to the vicinity of Turtle Rock; the Klehini, Kelsall, and Tahkin River valleys to the limit of moose tracks; and the Hidden Valley area of the Chilkoot drainage. A Helio-Courier aircraft was employed. Moose elsewhere in the subunit were not surveyed.

A total of 186 moose were observed in 3.5 hours of survey time: an average of 53 moose per hour (Table 1). While most moose in this subunit inhabit the Chilkat River drainage, smaller numbers of moose can be found on the Chilkat Peninsula and along the lower reaches of the Katzehin River. These areas were not surveyed. Assuming a sightability of 50%, I estimate the moose population in Subunit 1D to be 400 animals.

Composition data are restricted to calf:adult ratios because of the late-winter timing of the survey. Of 186 animals classified, 21 were identified as calves (11%); this is slightly lower than the 14% calves observed in the 1987 late-winter survey (Table 1) and the previous 5-year average (1984-87) of 14%. Some calves may have been mistakenly identified as adults.

Spring calf counts have not been conducted in recent years, and estimates of calf production and twinning rates are not available. The reasons for the drop in percentage of calves (i.e., from an average of 21% between 1981 and 1985 to the current 11%) is not known.

Mortality

Season and Bag Limit:

The open season for subsistence hunters only in Subunit 1D is 1 to 10 September. The bag limit is 1 bull by registration permit only; 15 bulls may be harvested by residents of Subunit 1D only.

Human-induced Mortality:

A total of 22 bulls were harvested in Subunit 1D in 1987. The season was designed to allow a 15-bull harvest, but even with excellent compliance, the quota was exceeded in a single day of the season. Ages were determined for 20 harvested moose (Table 2); mean age was 3.2 years, a slight increase over those for 1984 and 1985. The age structure data for the years prior to 1984 are uncertain because submission of jaws was not mandatory.

Hunter Residency and Success. Of 294 registrants for the 1987 moose hunt, 264 were Haines residents, 23 were Klukwan residents, and 3 hunters were from Skagway. A total of 230 indicated that they participated in the hunt, and 22 hunters (10%) were successful.

Transport Methods. Most (55%, n = 12) successful hunters, reported using boats to reach hunting areas. Highway vehicles (27%), planes (14%), and off-road vehicles (5%) were also used.

Natural Mortality:

There is little information available concerning natural mortality of moose in this subunit. Discussions with area recreationist suggest that the local brown bear population has increased in recent years, and predation may be partly responsible for the poor recruitment rates observed.

Range conditions could effect both calf production and survival. Hundertmark et al. (1983) noted a disproportionately small number of young forage plants (<1 m) in the Chilkat Valley and suggested that the transition from moist to dryer soil conditions in many locations, a result of postglacial isotatic rebound and silt deposition on river deltas, was responsible. If range characteristics are changing on a broad scale in the Chilkat Valley, nutrition and predation may be limiting natality rates and calf survival.

Habitat

In their 1983 study of winter habitat utilization by moose in the Chilkat Valley, Hundertmark et al. (1983) concluded that the estimated 200-250 mi^2 of summer range, 110-120 mi^2 of winter range, and 80 mi^2 of preferred winter range habitat were capable of sustaining the existing population of 400-450 moose. Nearly all of the moose range in Subunit 1D lies within the Haines State Forest and is managed under the multiple-use guidelines of the Haines State Forest Management Plan of 1986, whose goals include an annual harvest of up to 8.8 million board feet of timber (approximately 300 to 580 acres). While clear-cuts may benefit moose by supplying browse during winters of low snow accumulation, these areas become unusable during periods of deep snow. Hundertmark et al. (1983) determined that Chilkat Valley moose made extensive use of coniferous habitat in both summer and winter and that stands of uncut timber were therefore important. Proposals for timber harvest need to be evaluated with these tradeoffs and requirements in mind. Particular attention must be paid to size and spacing of cutting units, depth of edge adjacent to feeding areas, as well as projected increase in access afforded by logging-related road systems.

CONCLUSIONS AND RECOMMENDATIONS

Calf survival and, ultimately, recruitment are the primary areas of concern for the moose population in Subunit 1D. Without an increase in recruitment, population objectives will be difficult to attain.

Timber harvests will probably increase within the Haines State Forest in the near term as timber prices rebound. Logging may allow an indirect and inexpensive method of gaining insight into whatever effects range conditions may be having on calf production and recruitment. Ideally, cooperative planning between forest managers and Department staff would allow small timber sales to be scheduled in areas where browse rejuvenation may benefit moose. Utilization of cut-over areas could be monitored, and influences on calf production and recruitment examined.

The duration of availability of moose browse in second-growth stands in Southeast Alaska is not known (Hundertmark et al. 1983). Further, Peek et al. (1976) and Doerr et al. (1980) suggest that second-growth stands must be intensively managed to maintain characteristics beneficial to moose. While selectively placed clear-cuts may provide short-term benefits to moose, such an effort should be approached cautiously and the long-term, potentially detrimental effects considered. Increased human access, reduced forage availability after canopy closure, and loss of feeding, escape, and thermal cover should be considered prior to such prescriptions.

Mechanical crushing, chaining, and burning should be considered as methods to rejuvinate browse in areas where timber harvest is impractical or undesirable. Crushed areas have been determined to increase the diversity and quantity of woody browse species available to moose on the Kenai Peninsula (Schwartz and Franzmann 1980). Predation on moose calves by black bears in that study was also reduced; radio-collared black bears avoided crushed areas. Schwartz and Franzmann (1980) hypothesized that while moose calves in crushed areas would be subject to some predation attempts, improved nutrition would yield healthy, vigorous calves better able to outrun or elude predators.

The moose management plan for Subunit 1D specifically calls for the use of local expertise to the fullest extent possible in the management of this resource because local advisory committees and interested persons can provide valuable insights. Therefore, when habitat manipulation projects are in the planning or feasibility assessment phases, these people should be consulted.

Without sex and age composition data for the past 2 years, it is unclear what impact the harvest of 15 bulls may be having on the breeding population. It is of paramount importance that posthunting surveys be conducted in 1988. If over 200 hunters take to the field on opening day, the harvest will probably exceed the quota again in 1988. It would be difficult to close the season with more dispatch than was the case in 1987, yet the quota was exceeded by seven. If it becomes clear that control of the hunt is not possible through the registration permitting process, other alternatives, including drawing permits, should be considered.

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Table 1. Moose survey data for Subunit 1D, 1983-1987.

Year	Bulls	Cows	Calves	Unknown sex/age	Total	No. ♂: 100 ♀	No. Calves: 100 ♀	Percent calves	Moose/ hour
1983[a]	--	--	19	69	88	--	--	22	16
1983	16	148	47	0	211	11	32	22	36
1984[a]	--	--	11	77	88	--	--	13	23
1984	15	135	37	0	187	11	27	20	36
1985	23	155	29	0	207	15	19	14	38
1986	33	93	13	0	139	36	14	9	40
1987[a]	--	--	29	174	203	--	--	14	53
1988a	--	--	21	165	186	--	--	11	53

[a] Late winter survey, sex and age composition not available.

Table 2. Moose harvest by age class for Subunit 1D, 1982-87.

Known year	Age Class 0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5+[a]	n	Mean	Harvest
1982	0	1	8	5	2	1	0	0	0	0	17	3.1	17
1983	1	3	7	10	6	0	1	2	0	1	31	3.7	31
1984	2	15	12	2	2	1	0	0	0	0	34	2.2	34
1985	0	7	4	1	0	1	0	0	0	0	13	2.3	13
1986[b]	--	--	--	--	--	--	--	--	--	--	--	---	0
1987	0	3	6	7	3	1	0	0	0	0	20	3.2	22

[a] Includes animals 9.5 years and older.
[b] No open season.

Table 3. Successful hunter transport methods in Subunit 1D, 1984-87.

Year	Percent			
	Airplane	Boat	ORV	Highway vehicle
1984	14	49	9	29
1985	0	50	0	50
1986[a]	--	--	--	--
1987	14	55	5	27

[a] No open season in 1986.

Table 4. Hunter residency and success in Subunit 1D, 1984-87.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Nonres.	Total	Local res.	Nonlocal res.	Nonres.	Total
1984	24	10	1	35	298	12	4	314
1985	14	0	0	14	29	0	0	29
1986[a]	--	--	--	--	--	--	--	--
1987	22	0	0	22	208	0	0	208

[a] No open season in 1986.

Table 5. **Harvest data for permit hunt #959 in Subunit 1D, 1984-87.**

Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
1984	555	206	314	35	35	0	35
1985	43	0	29	14	14	0	14
1986[a]	--	--	--	--	--	--	--
1987	294	64	208	22	22	0	22

[a] No open season in 1986.

Table 6. Harvest chronology in Subunit 1D, 1984-87.

Year	September 1-7	8-15	16-23	24-30
1984[a]	--	8	20	7
1985[b]	--	4	14	--
1986[c]	--	--	--	--
1987[d]	22	--	--	--

[a] Season opened September 15 and closed September 27.
[b] Season opened September 15 and closed September 21.
[c] No open season in 1986.
[d] One day season, September 1.

STUDY AREA

GAME MANAGEMENT UNIT: 5 (6,235 mi^2)

GEOGRAPHICAL DESCRIPTION: Cape Fairweather to Icy Bay, eastern Gulf Coast

BACKGROUND

Observations of moose were first documented along the lower Alsek River in eastern Subunit 5A in the late 1920's or early 1930's. Range expansion to the west followed; animals were found on the Malaspina Forelands west of Yakutat Bay by the 1950's. The westward movement of this moose population was probably curtailed by the glaciers and ice-choked waters of Icy Bay.

The moose population in Unit 5 grew rapidly, peaking in the early 1960's with a population estimate exceeding 2,000 animals, declining to a level more consistent with its carrying capacity in the mid-1960's. Poor reproductive success and the severe winters of 1971-72 and 1972-73 depressed moose numbers enough that the Subunit 5A hunting seasons were closed between 1974 and 1977. Moose hunting has been regulated by registration permits since 1978.

POPULATION OBJECTIVES

To provide an annual harvest of at least 50 moose, a postseason population estimate of at least 800, and a bull:cow ratio of 20:100 in Subunit 5A (Yakutat Forelands Herd).

To provide an annual harvest of at least 25 moose, a postseason population of 250, and a bull:cow ratio of 20:100 (in Subunit 5B (Malaspina Forelands Herd).

METHODS

Although fall sex and age composition aerial surveys were scheduled for the entire unit, insufficient snow cover precluded this effort. Surveys were conducted in February when snow cover improved. Moose incisors collected by successful hunters were ground and read for age determination. Data from registration permits included the number of days hunted, hunter residency, harvest date and location, and transport type.

RESULTS AND DISCUSSION

Population Status and Trend

Since the hunting closures in the mid-70's, the moose population in Subunit 5A has apparently been slowly approaching carrying capacity. Some evidence suggests the population in Subunit 5B may have declined in recent years.

Population Size:

Population estimates have not been conducted for any of the 3 moose herds in the unit; however, the results of a 1977 mark-recapture study in Subunit 5A indicated that approximately one-half of 40 visually collared animals had been observed on a subsequent aerial survey. Therefore, it is generally assumed that the surveyed animals compose no more than one-half of the moose present in the area.

In Subunit 5A a total of 322 moose were classified in February 1988 (Table 1). Survey conditions were poor-to-fair; shrubs and trees were not well covered with snow. Light conditions were generally "flat," making visibility difficult. Most of the area between the Dangerous and the Ustay Rivers could not be surveyed because of turbulent winds. While impossible to accurately estimate how many animals may have been present there, it is believed that at least 400 moose would have been observed under better sightability and flying conditions. Compared with previous years data, the increased calf percentage in the 1988 sample (Table 2) suggests the population is growing.

Moose population dynamics in Subunit 5B are less well understood. Only a portion of the subunit has been surveyed since 1982, and the two most recent surveys were conducted at a time of year when sex was indistinguishable. The population is estimated to be approximately 250 moose.

The Nunatak bench herd was not surveyed in 1987. Before the 1986 flooding of this herd's winter range (i.e., the Hubbard Glacier's blockage of Russell Fjord), there were an estimated 50 animals in the area. Because the water level in the fjord has receded, moose may have returned, bolstering the herd back to its previous level.

Population Composition:

Only calf and adult data are available for this reporting period. Table 2 shows a declining bull:cow ratio and an increasing calf:cow ratio in Subunit 5A. The observed bull:cow ratio (i.e., 20:100) for 1986-87 was probably lower than what was actually present; therefore, the actual bull:cow ratio during the winter of 1986-87 was at least 20:100. The percentage of calves enumerated in the February 1988 survey was the highest ever recorded for Unit 5. Twenty-eight percent of adults observed with calves were accompanied by twins. This figure is twice as high as the fall 1986 level of 13%.

In Subunit 5B, 20% of the moose observed were calves. While this is a dramatic reduction from the percentage of calves observed during the last survey (Table 3), both surveys were completed under less-than-ideal late-winter conditions. No surveys were conducted in the Nunatak Bench area.

Mortality

Season and Bag Limits:

The open season for subsistence hunters in Subunit 5A is 15 October to 15 November; the open season for all hunters in Subunit 5A is 22 October to 15 November. There is no open season for Nunatak Bench. The bag limit is 1 bull by registration permit only; 50 bulls may be taken. The season will be closed in that portion west of the Dangerous River when 25 bulls have been taken in that areas. The open season for all hunters in Subunit 5B is 1 September to 15 November. The bag limit is 1 bull by registration permit only; 25 bulls may be taken.

Human-induced Mortality:

The Yakutat and Malaspina Forelands hunts have been managed since 1982 for quotas of 50 and 25 bull moose, respectively. The Nunatak Bench hunt had a quota of 10 moose until it was closed in 1986. As a result, the harvest for Unit 5 has been fairly constant, ranging from 46 to 70 moose since 1983 (Table 4). In 1987 the harvest of 38 bulls in Subunit 5A was the smallest since 1981, probably because of record fall rain. September and October 1987 were the wettest months on record (i.e., 48 and 49 in. of rain respectively), contributing to the total annual rainfall of over 251 inches (National Weather Service, Yakutat).

Illegal harvests are believed to be small in Subunit 5A, because of an active enforcement program. Word-of-mouth information suggests poaching may be fairly high in Subunit 5B because of its remoteness.

Hunter Residency and Success. The 1983-1987 average moose harvest for local residents within Unit 5 is 31 (Table 5). The proportion of the total take by local residents was noticeably higher in 1985 and 1987.

Permit Hunts. In 1985 hunt No. 961 (Subunit 5A), was a Tier II (i.e., subsistence) hunt, and the total number of permits issued was low, compared with other years (Table 6). There was a limit of 200 permits, and many nonlocals did not apply because they felt they would not qualify. In 1987 the 1st week of the 4-week season in Subunit 5A was restricted to local subsistence hunters only. This 1st week traditionally accounts for most of the total harvest.

While permit returns have improved, many hunters remain confused about the difference between harvest tickets and registration permits. With the passage of time and the streamlining of permits in recent years, hunters are apparently accepting the need for permits and now more closely follow permit conditions.

Harvest Chronology. The early seasonal harvest in Unit 5 is relatively low, because Subunit 5B is only open from 1 September through 14 October (Table 7). Most of the harvest in Subunit 5A (hunt No. 961) occurs during the 1st week of that season (1983-87, range = 53-94%, mean = 78%). The lower-than-average 1987 1st-week harvest of 20 moose (53%) in 1987 was probably due to inclement weather.

Transport Methods. Transportation has been consistent over the years. Boat access has been largely constant (Table 8), accounting for 22% to 35% (mean = 25%) of the transport methods used. Boat use was higher in 1987 because of the large amount of standing water during the season. Aircraft access has been the most popular form of transportation, ranging from 46% to 70% (mean = 60%).

Natural Mortality:

The only observed natural mortality during 1987-88 was 1 subadult moose observed on Malaspina Lake during aerial surveys in February; the carcass was attended by 4 wolves. Judging by the color of the blood-stained snow, it had been recently killed. Because the winter was mild, calf survivals were probably high.

Habitat Assessment:

While no quantitative data were collected, subjective evaluation of winter browse across the Yakutat Forelands suggests that moose are at or approaching carrying capacity. Moderate to heavily browsed large-trunked willow seem the rule, rather than the exception, in most areas.

CONCLUSIONS AND RECOMMENDATIONS

Based on midwinter surveys, calf survival was good between the spring of 1987 and February 1988. Because the population appears near carrying capacity, a limited cow season should be considered for Subunit 5A in 1989, assuming survey results in the fall of 1988 indicate the population can support such a harvest. Complete fall sex and age composition counts should be conducted for Subunit 5B and Nunatak Bench moose herds.

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Table 1. Moose-age composition in Subunit 5A, winter 1988.

Date	Location	Adults W/O	Adults W/1	Adults W/2	Total adults	Lone calves	Total calves	Total moose	Calf % in herd	Count time (hr)	Moose/ hour
2/2/88	Doame R.- Alsek R.	17	6	0	23	1	7	30	23	1.5	20.0
2/8/88	Alsek R.- Akwe R.	60	8	2	70	0	12	82	15	2.5	32.8
2/8/88	Akwe R.- Dangerous R.	22	4	2	28	0	8	36	22	0.5	72.0
2/3/88 2/4/88	Dangerous R. Situk R. (below Hwy)	61	20	13	94	0	46	140	33	4.3	32.6
2/3/88	Situk R.- Yakutat Bay (below Hwy)	7	6	1	14	0	8	22	36	1.3	16.9
2/2/88	North and west of highway	8	2	0	10	0	2	12	17	1.1	10.9
Total	Doame R.- Yakutat Bay	175	46	18	239	1	83	322	26	11.2	28.8

Table 2A. Moose survey data from the Yakutat Forelands (Subunit 5A) from 1983-84 to 1987-88.

Year	No. bulls	No. cows	No. calves	Unk sex/age	Total sample	♂: 100 ♀	Calves: 100 ♀	% calves	Count time	Moose/ hour
1983/84 F[a]	--	--	--	--	--	--	--	--	--	--
1983/84 W[b]	0	0	83	299	382	0	0	22	12.0	32
1984/85 F	90	229	60	0	379	39	26	16	12.1	31
1984/85 W	0	0	26	113	139	0	0	19	5.9	24
1985/86 F	50	168	41	0	259	30	24	16	11.0	24
1985/86 W	No Data									
1986/87 F	34	166	60	0	260	20	36	23	11.3	23
1986/87 W	--	--	--	--	--	--	--	--	--	--
1987/88 F	--	--	--	--	--	--	--	--	--	--
1987/88 W	0	0	83	239	322	0	0	26	11.2	29

[a] F = fall count
[b] W = winter count

Table 2B. Moose survey data from the Malaspina Forelands (Subunit 5B) from 1983-84 to 1987-88.

Year	No. bulls	No. cows	No. calves	Unk sex/age	Total sample	♂: 100 ♀	Calves: 100 ♀	% calves	Count time	Moose/ hour
1982/83 F[a]	26	103	16	0	145	25	16	11	8.4	17
1982/83 W[b]	--	--	--	--	--	--	--	--	--	--
1983/84 F	--	--	--	--	--	--	--	--	--	--
1983/84 W	0	0	21	45	66	0	0	32	1.8	37
1984/85 F	--	--	--	--	--	--	--	--	--	--
1984/85 W	--	--	--	--	--	--	--	--	--	--
1985/86 F	--	--	--	--	--	--	--	--	--	--
1985/86 W	--	--	--	--	--	--	--	--	--	--
1986/87 F	--	--	--	--	--	--	--	--	--	--
1986/87 W	--	--	--	--	--	--	--	--	--	--
1987/88 F	--	--	--	--	--	--	--	--	--	--
1987/88 W	0	0	14	55	69	0	0	20	2.8	25

[a] F = fall count
[b] W = winter count

Table 3. Annual harvest for Unit 5 from 1983 to 1987 and for Subunits 5A and 5B in 1987.

	Hunter Harvest	
Year	Reported	Estimated total harvest
1983	60	60
1984	70	70
1985	59	61
1986	63	63
1987	46	46
1987 Subunit A	38	38
Subunit B	8	8

Table 4. Hunter residency and success in Unit 5, 1983-87.

Year	Successful: Local res.	Successful: Nonlocal res.	Successful: Nonres.	Successful: Total	Unsuccessful: Local res.	Unsuccessful: Nonlocal res.	Unsuccessful: Nonres.	Unsuccessful: Total
1983	33	25	2	60	141	113	5	259
1984	29	36	5	70	153	72	16	241
1985	38	21	0	59	90	38	5	133
1986	25	33	5	63	104	65	9	178
1987	32	11	3	46	121	65	9	195

Table 5. Harvest data by permit hunt in Unit 5, 1983-87.

Hunt No.	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
960	1983	30	21	7	2	2	0	2
	1984	20	6	8	6	3	3	6
	1985	6	3	1	2	2	0	2
	1986	5[a]	5	0	0	0	0	0
	1987	0[b]	0	0	0	0	0	0
961	1983	279	44	188	47	47	0	47
	1984	287	57	181	49	49	0	49
	1985	146	26	76	44	44	0	44
	1986	271[c]	73	144	54	54	0	54
	1987	242	43	161	38	38	0	38
962	1983	86	31	44	11	11	0	11
	1984	54	4	35	15	15	0	15
	1985	94	32	49	13	13	0	13
	1986	42[c]	0	33	9	9	0	9
	1987	60	36	16	8	8	0	8
1987 totals all hunts		302	79	177	46	46	0	46

[a] Season closed prior to hunting effort
[b] Season closed
[c] 5A & B permits combined; all did-not-hunts coded to 961

Table 6. Harvest chronology in Unit 5, 1983-87.

Year	Sept. 1-15	Sept. 16-30	Oct. 1-15	Oct. 16-31	Nov. 1-15	Nov. 16-Feb. 15
1983	0	5	31	20	2	2
1984	4	4	17	33	6	6
1985	1	1	20	30	5	2
1986	0	4	23	36	0	0[a]
1987	1	2	4	37	2	0[a]

[a] Nunatak Bench hunt closed

Table 7. Successful hunter transport methods in Unit 5, 1983-87.

Year	Airplane		Boat		3- or 4-Wheeler		Snow machine		ORV		Highway vehicle	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
1983	28	(47)	15	(25)	5	(8)	0		0		12	(20)
1984	43	(62)	16	(23)	3	(4)	0		3	(4)	5	(7)
1985	30	(51)	13	(22)	5	(8)	0		0		11	(19)
1986	41	(65)	14	(22)	0		0		0		8	(13)
1987	19	(41)	16	(35)	2	(4)	0		4	(9)	5	(11)

Table 8. Yakutat historical snowfall records, 1949-1988.

Year	No. days with "x" inches snow on ground trace-14	15-29	30-44	45-60	60+	Total snowfall
1948-49	--	--	--	--	--	241
1949-50	--	--	--	--	--	122
1950-51	--	--	--	--	--	193
1951-52	84	35	41	33	3	242
1952-53	138	0	0	0	0	139
1953/54	128	53	7	0	0	190
1954-55	63	70	34	32	6	338
1955-56	83	57	22	30	21	278
1956-57	143	9	0	0	0	181
1957-58	106	2	6	8	1	121
1958-59	111	51	5	4	13	286
1959-60	119	30	23	0	0	246
1960-61	109	14	22	9	0	238
1961-62	119	47	3	6	0	207
1962-63	124	7	6	1	0	129
1963-64	160	25	7	0	0	286
1964-65	120	24	15	5	0	253
1965-66	76	62	22	20	0	219
1966-67	85	48	59	2	5	293
1967-68	115	17	0	0	0	177
1968-69	43	53	70	10	0	237
1969-70	103	5	0	0	0	130
1970-71	98	40	55	0	0	313
1971-72	48	16	21	12	119	317
1972-73	61	44	42	22	0	239
1973-74	65	75	23	0	0	178
1974-75	69	58	35	4	0	327
1975-76	16	80	85	10	0	403
1976-77	83	26	0	0	0	168
1977-78	126	31	2	0	0	124
1978-79	67	55	43	0	0	139
1979-80	101	24	2	0	0	129
1980-81	71	3	0	0	0	71
1981-82	84	81	0	0	0	175
1982-83	100	8	2	0	0	86
1983-84	99	12	0	0	0	136
1984-85	81	30	49	0	0	275
1985-86	128	14	0	0	0	166
1986-87	96	3	0	0	0	116
1987-88	129	5	0	0	0	135
Average	96.0	32.8	18.9	5.6	4.5	206.1

STUDY AREA

GAME MANAGEMENT UNIT: 6 (14,300 mi^2)

GEOGRAPHICAL DESCRIPTION: Prince William Sound and North Gulf Coast

BACKGROUND

Historically, moose were endemic to Unit 6 only in small numbers near Valdez and at the head of Kings Bay, and they never extended their range south of the Chugach Mountains. In 1949 the U.S. Fish and Wildlife Service funded the first moose transplant in Alaska to the Copper River Delta (Burris and McKnight 1973). The transplanting of 24 calves to Subunit 6C over a 9-year period was successful, resulting in a limited harvest of 25 bulls in 1960. Moose quickly expanded their range to Subunit 6B, and by the late 1960's they had reached the Bering Glacier outwash plain in Subunit 6A. A small group ($\pm$10) became established on the eastern end of Hinchinbrook Island in Subunit 6D. The total reported harvest of moose originating from this transplant through 1986 was 2241. Harvest of moose in Subunit 6D during the same period may have reached 25.

Limited investigations determined that (1) there were no major population exchanges of introduced moose across the Copper River (Reynolds 1975) and (2) individuals in this population were some of the largest in the state (Franzmann 1977). A study was initiated by the U. S. Forest Service to delineate and describe seasonal habitat needs (McCracken and VanBallenberghe 1988).

Previous management efforts included monitoring the harvest as well as surveying hunters after the season had closed. The annual collection of reliable sex and age ratio/data is not practical because of unreliable weather conditions during November and December. Attempts were made to assess spring productivity and subsequent predation on calves in Subunits 6B and 6C (Reynolds 1977). Following the severe winter and die-off of 1971-72, management guideline levels for the different populations were set to prevent population increases beyond the numbers surviving the die-off. These prescribed levels represented wintering densities of 0.9-1.2 moose/mi^2. Survey results in recent years suggested that wintering densities of each population are 0.9 moose/mi^2 in Subunit 6B, 1.3 moose/mi^2 in Subunit 6C, 1.7 moose/mi^2 in Subunit 6A west of Suckling Hills, and 2.6 moose/mi^2 east of Suckling Hills (Griese 1987a).

The moose harvest has been monitored either by field checks, permit reports, or harvest ticket hunter reports. Until 1986 only successful hunters using permits were required to report; since then all permittees have been required to report effort and success.

Five-year population objectives were established in 1987 for the major moose populations. These population objectives called for higher and stabler population densities than were set in the 1976 management plan (Rausch 1977).

POPULATION OBJECTIVES

To maintain observed moose densities in the fall at 1.8 to 2.0 moose/mi^2 and posthunting bull to cow ratios at 30:100.

METHODS

During December, aerial trend and composition surveys were conducted during December where there was adequate snow cover. Surveys were conducted in either a PA-12 Piper cub or a PA-18 Supercub at a search intensity of 1.5-1.7 minutes/mi^2. The aerial survey for Subunit 6C was originally conducted with a new pilot at a search intensity of 1.0 minuntes/mi^2, but it was partially resurveyed 6 days later with an experienced pilot at 1.5 minutes/mi^2 to establish a better density estimate. Survey conditions were excellent during the survey in Subunit 6B, fair in Subunit 6A, and poor in Subunit 6C. Sex and age composition was determined and recorded by group and uniform coding unit (UCU).

Population estimates were based on the number of moose observed, percentage of wintering habitat surveyed, and quality of survey conditions. Based on survey quality population estimates increased by increments. "Excellent" conditions produced 1.1 to 1.2 times the observed number of moose, "good" conditions produced 1.2 to 1.4 times the count, "fair" produced 1.4 to 1.7 times the count, and "poor" produced 1.7 to 2.0 times the count. These factors were subjective.

The moose harvest was monitored by 2 separate methods. Because hunters participating in drawing or registration permit hunts were required to report effort, they were sent as many as 2 reminder letters. Hunters participating in general moose hunts were sent only 1 reminder letter, if they failed to return their original hunt report. Hunter success and effort were recorded by UCU. The lower front teeth of moose were voluntarily provided by hunters for aging according to Gassaway et al. (1978).

RESULTS AND DISCUSSION

Population Status and Trend

Population estimates (Table 1) suggested much higher winter densities than those observed (Table 2): 1.3-1.6 moose/mi^2 in Subunits 6B and 6C, 1.6-1.9 moose/mi^2 in Subunit 6A west of Suckling Hills, and 3.5-4.2 moose/mi^2 east of Suckling Hills. Overall unit densities in winter habitat ranged from 1.8 to 2.1 moose/mi^2.

Moose populations were stable or increasing. Composition counts (Table 2) suggest that population levels were declining in Subunit 6A, increasing in 6B, and stable in Subunit 6C. Survey conditions may have caused a misinterpretation of the population trends in Subunit 6A.

Population Size

The population in Unit 6 is approximately 1,195 to 1,425 moose (Table 1).

Population Composition

Composition counts in December represented an inflation of the antlerless adult portion of the population because of extensive antler shedding. The unit ratios of 20 bulls:100 cows and 24 calves:100 cows were only minimum.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters in Subunit 6A west of Cape Suckling is 1 September to 15 October. The open season for resident and nonresident hunters in the remainder of Subunit 6A is 20 August to 31 December. The bag limit for Subunit 6A is 1 moose. The open season for Alaska residents only in Subunits 6B and 6C is 1-20 September. The bag limit in Subunit 6B is 1 bull by drawing permit only (15 permits). The bag limit in Subunit 6C is 1 moose by drawing permit only; up to 20 permits each for antlered and antlerless moose will be issued. The open season for resident and nonresident hunters in Subunit 6D is 1-30 September; the bag limit is 1 bull.

Human-induced Mortality:

The reported moose harvest during the fall of 1987 was 117, the lowest in 5 years (Table 3). Opportunities and efforts by residents of Unit 6 were reduced (Table 4). A substantial decline in hunting opportunity also occurred during the last 5 years in Subunit 6B (Table 5); the harvest in this subunit has declined from 74 moose in 1983 to only nine in 1987.

Of 117 moose in the reported harvest, 66% were males and 33% females (Table 2). The harvest of females in Subunit 6A peaked in 1986; however, it was limited in Subunits 6B and 6C because of low recruitment. The average ages of 13 bulls and 5 females were 2.9 (range = 1-8) and 4.6 (range = 1-15) years, respectively.

The illegal and unreported harvest consisted of approximately 21 moose, primarily from Subunit 6A (Table 3). An estimated 70% of hunters participating in the general hunt in Subunit 6A were successful.

Hunter Residency and Success. The reported harvest by residents of Unit 6 represented 58% of the 1987 harvest and an 11% decline from the previous 4-year trend (69%) (Table 4). While the nonresident harvest did not increase dramatically, it represented a 10% increase in the component from the previous 4-year trend. The increased harvest for nonresidents occurred in spite of regulations precluding them from hunting in Subunits 6B and 6C.

Hunter success was 65% for the 179 reporting hunters in Unit 6 (Table 4). Sixty-five percent, 75%, 89%, and 15% of hunters were successful in Subunits, 6A, 6B, 6C, and 6D, respectively. Drawing-permit hunts on the road system of Subunits 6B and 6C have displayed a combined rate of success of 92% for the previous 3 years (1986-88).

Permit Hunts. Three drawing-permit hunts were conducted in Subunits 6B and 6C, offering 30 bull and 15 cow permits (Table 5). Registration hunts were last conducted in Unit 6 in 1984. It became necessary to limit harvest levels in Subunits 6B and 6C because of increasing accessability and declining recruitment. However, populations began to exceed desirable winter densities in Subunit 6A, and permit requirements were discontinued to encourage greater harvest opportunities.

Harvest Chronology. Sixty-two percent of the reported harvest occurred during September; an additional 20%, in the first 2 weeks of October (Table 6). Permit hunts limited hunting effort to September in Subunits 6B and 6C. The previous 4-year harvest trend favored September and early October. To encourage a late-season harvest in Subunit 6A East the general hunt in Subunit 6A West was shortened. While the increase occurred, it was not substantial.

Transport Methods. The reported transport method used by hunters in Unit 6 shifted to equal success by boaters (i.e., primarily airboaters) and airplane users. The previous 4-year ratio was 7 airplane users to 10 boaters. Reduced opportunities to hunt in Subunits 6B and 6C account for that shift. Airboats were a popular method of transportation in Subunit 6B. The use of highway vehicles declined in 1987-88 because road-accessible permit hunts were restricted.

Natural Mortality:

Reports of as many as 10 moose dying of natural causes were received during the year. Most appeared to be the result of predation by wolves or bears. No winter starvation mortality was noted. Poor calf survival remains a problem in subunit 6B, and it seems to be an increasing problem in Subunit 6A and 6C.

Habitat Assessment:

The USFS identified 4 important habitat types on the Copper River delta where future habitat analysis would be conducted

(MacCracken 1988). Tall, open alder/willow seemed to be important habitat for calving, bedding, and winter feeding. Tall, closed alder/willow was used primarily by cows for bedding and feeding. Low sweetgale willow was used for winter feeding, especially by bulls. Woodland spruce was used primarily for bedding. While aquatic habitat was not identified for future investigation, it ranked 5th in importance, primarily for summer feeding.

Game Board Actions and Emergency Orders

Hunting regulations for moose have changed almost annually in recent years in response to varying levels of production and mortality. Hunter interest and demand increased substantially in Subunits 6C and 6B; however, at the same time recruitment rates for the moose populations were declining. As a result the Board of Game required drawing permits for Subunit 6C beginning in 1984. The number of drawing permits for Subunit 6C went from 36 to 40; however, in 1987 they were reduced to 30 because of low recruitment. In Subunit 6B the popular registration permit hunt was limited to a drawing for 15 bull permits in 1986, also because of low recruitment and high demand.

Rapidly expanding moose populations in Subunit 6A has caused the Board to adopt more liberal regulations that will be more enticing to hunters. The moose population in Subunit 6A east of Suckling Hills is hunted less than the western portion of the subunit. The Board created 2 separate season in 1987: eastern Subunit 6A opened 20 August and closed 31 December for either-sex moose, while western Subunit 6A opened 1 September and closed 15 October for either-sex moose. The intent was to entice hunters into the lightly hunted portion of the subunit.

Beginning in 1985, the Board awarded a subsistence priority to residents of Alaska. The Tier II system used in 1985 effectively awarded all drawing permits to Unit 6 residents. Since 1986 only Alaskan residents have been allowed to apply for drawing permits in Subunits 6B and 6C.

CONCLUSIONS AND RECOMMENDATIONS

While population objectives in Unit 6 were apparently attained, winter density estimates for Subunits 6B and 6C were less than 1.8 moose/mi^2. Sex composition of the moose herds appeared to fall short of 30 males:100 females; however, the December counts, which produced a ratio of 20:100, inflated the antlerless segment of the population. Realistically, the sex composition of Unit 6 was probably approaching the desired ratio. The sex composition in Subunit 6A appeared to be well below the unit goal.

The harvest of bulls from Subunit 6A, particularly that portion west of Suckling Hills, was not in proportion to antlerless moose to maintain the desired sex ratio. A solution would be to reduce hunting effort on bulls after 15 bulls have been taken and encourage the continued harvest of up to 25 antlerless moose. To overcome those limitations, I recommend that moose hunting in Subunit 6A west of Suckling Hills be regulated by registration permit, thereby allowing an emergency closure of the season to be determined by the sex ratio of the harvest. No changes in regulations have been proposed for the remainder of Subunit 6A.

The improved composition survey results for Subunit 6B indicated a higher-than-expected population. In view of the higher population level and ratio of bulls:cows, I recommend a registration hunt for up to 22 antlered moose and a concurrent drawing-permit hunt for up to 10 antlerless moose.

While the conditions of the composition survey conducted in Subunit 6C were less than "good", a low population level with lower-than-normal recruitment was indicated. I recommend that a drawing-permit hunt for only 10 antlered moose be conducted in 1988. Harvest of additional antlerless moose is not warranted, given the apparent lower recruitment for the last 2 years. No changes are recommended for Subunit 6D.

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Table 1. Moose population status, by subunit, as determined from aerial surveys, December 1987.

	Subunit					
	6A (East)	6A (West)	6B	6C	6D	Total
Moose observed	301	213	234	118	--	866
Estimated Population	420-510	300-360	260-290	200-235	15-30	1195-1425
% Calves	19%	19%	12%	13%	--	$\underline{x}$ = 16%

Table 2. Unit 6, moose composition counts by Subunit, 1983-87.

Subunit	Year	Males 100 females	Calves: 100 females	Calf% of herd	Adults	n	Moose /hr.	Moose /sq. mi.
6A East								
	1983[1]	33	36	22	245	311	80	--
	1984	--	--	--	--	--	--	--
	1985	35	28	17	286	346	99	3.3
	1986	12	26	19	244	301	97	2.8
	1987[1]	12	26	19	244	301	97	2.8
6A West								
	1983[1]	27	44	26	228	307	79	--
	1984	--	--	--	--	--	--	--
	1985	19	18	13	243	279	66	1.7
	1986[2]	14	44	28	183	254	71	1.4
	1987[1]	10	26	19	172	213	46	1.1
6A Subtotal								
	1983[1]	30	40	23	473	618	79	--
	1984	--	--	--	--	--	--	--
	1985	27	23	15	529	625	81	2.4
	1986[2]	14	44	28	183	254	71	1.4
	1987[1]	11	26	19	416	514	66	1.8
6B								
	1983[1]	28	28	18	147	179	45	--
	1984	64	32	16	151	180	43	1.1
	1985	33	8	6	159	169	39	0.9
	1986[3]	--	--	13	132	152	39	0.9
	1987[1]	40	20	12	205	234	50	1.3
6C								
	1983[1]	15	22	16	138	164	71	--
	1984	26	36	22	132	170	59	1.2
	1985[1]	19	37	24	139	194	51	1.4
	1986	--	--	--	--	--	--	--
	1987[1]	24	18	13	103	118	37	1.3[4]
6D - No Data	--	--	--	--	--	--	--	--
Total								
	1983[1]	27	39	21	758	961	73	--
	1984	44	34	19	283	350	49	1.1
	1985[1]	26	23	15	836	988	63	1.7
	1986[3]	--	--	22	315	406	54	1.2
	1987[1]	20	24	16	724	866	55	1.5

[1] All or part of area surveyed in December, cow segment inflated.

[2] All or part of area surveyed in January, cow segment greatly inflated.

[3] All or part of area surveyed in March, ratios are not meaningful.

[4] Portion of area resurveyed under improved conditions to provide more comparable density estimate.

Table 3. Unit 6, moose annual harvest and accidental mortality by subunit, 1983-87.

		Harvest						Accidental Mortality		
		Reported			Estimated					
Year	Subunit	M	F	Total	Unreported	Illegal	Total	Road	Other	Total
1983	6A (East)	10	3	14	2	1	17	0	0	17
	6A (West)	37	5	42	3	1	46	0	0	46
	Subtotal 6A	47	8	56	5	2	63	0	0	63
	6B	35	39	74	2	1	77	0	0	77
	6C	30	0	30	1	1	32	0	0	32
	6D	4	0	4	0	0	4	0	0	4
	Total	116	47	164	8	4	176	0	0	176
1984	6A (East)	16	1	17	2	3	22	0	0	22
	6A (West)	42	21	63	3	2	68	0	0	68
	Subtotal 6A	58	22	80	5	5	90	0	0	90
	6B	22	28	50	5	1	56	0	0	56
	6C	19	12	33	0	1	34	1	0	35
	6D	0	0	0	0	1	1	0	0	1
	Total	99	62	163	10	8	181	1	0	182
1985	6A (East)	17	10	27	4	3	34	0	0	34
	6A (West)	33	15	48	7	3	58	0	0	58
	Subtotal 6A	50	25	75	11	6	92	0	0	92
	6B	36	0	36	2	1	39	0	0	39
	6C	19	18	37	0	2	39	1	0	40
	6D	0	0	0	0	0	0	0	0	0
	Total	105	43	148	13	9	170	1	0	171

Table 3. Continued.

Year	Subunit	Harvest: Reported M	F	Total	Estimated Unreported	Illegal	Total	Accidental Mortality Road	Other	Total
1986	6A (East)	22	13	45	4	3	42	0	0	42
	6A (West)	33	34	67	6	2	75	0	0	75
	Subtotal 6A	55	47	102	10	5	117	0	0	117
	6B	9	0	9	0	1	10	0	0	10
	6C	21	16	37	0	1	38	0	0	38
	6D	0	0	0	0	0	0	0	0	0
	Total	85	63	148	10	7	165	0	0	165
1987	6A (East)	25	14	39	6	3	48	0	0	48
	6A (West)	28	14	42	7	1	50	0	0	50
	Subtotal 6A	53	28	81	13	4	98	0	0	98
	6B	9	0	9	0	0	9	0	0	9
	6C	14	11	25	0	2	27	1	0	28
	6D	2	0	2	0	2	4	0	0	4
	Total	78	39	117	13	8	138	1	0	139

Table 4. Unit 6. Moose hunter residency and success, 1983-87.

Year	Subunit	Successful				Unsuccessful		
		Local Res.	Nonlocal Res.	Nonres.	Total	Resident	Nonres.	Total
1983	6A(East)	3	6	5	14	[a]	[a]	[a]
	6A(West)	20	9	13	42	[a]	[a]	[a]
	Subtotal 6A	23	15	18	56	[a]	[a]	[a]
	6B	60	8	2	70	[a]	[a]	[a]
	6C	29	1	0	30	[a]	[a]	[a]
	6D	3	1	0	4	15	1	16
	Total	115	25	20	160	15	1	16
1984	6A(East)	2	9	6	17	[a]	[a]	[a]
	6A(West)	40	5	19	63	[a]	[a]	[a]
	Subtotal 6A	42	14	25	80	[a]	[a]	[a]
	6B	33	5	1	49	[a]	[a]	[a]
	6C	32	1	0	33	1	0	1
	6D	0	0	0	0	11	0	11
	Total	107	20	26	162	12	0	12
1985	6A(East)	5	12	11	28	15	1	16
	6A(West)	31	6	11	48	27	0	27
	Subtotal 6A	36	18	22	76	42	1	43
	6B	29	7	1	37	99	0	99
	6C	37	0	0	37	1	0	1
	6D	0	0	0	0	8	0	8
	Total	102	25	23	150	150	1	151
1986	6A(East)	9	12	10	34	13	2	17
	6A(West)	53	4	6	66	18	6	25
	Subtotal 6A	62	16	16	100	31	8	42
	6B	9	0	[b]	9	6	[b]	6
	6C	34	3	[b]	37	1	[b]	1
	6D	0	0	0	0	11	0	11
	Total	105	19	16	146	49	8	60
1987	6A(East)	6	12	21	39	13	7	20
	6A(West)	30	6	6	42	19	5	24
	Subtotal 6A	36	18	27	81	32	12	44
	6B	7	2	[b]	9	3	[b]	3
	6C	24	1	[b]	25	3	[b]	3
	6D	1	0	0	2	6	0	11
	Total	68	21	27	117	44	12	61

[a] Unsuccessful hunters not required to report
[b] Nonresidents were ineligible for permits

Table 5. Unit 6. Moose harvest by permit hunt, 1983-87.

Hunt No.	Subunit	Year	Legal moose	Permits issued 1/	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
965	6A	1983	Either sex	R-270	?? 2/	?? 2/	56	47	8	56
		1984	Either sex	R-393	?? 2/	?? 2/	81	59	22	81
966	6B	1983	Either sex	R-487	?? 2/	?? 2/	74	35	39	74
		1984	Either sex	R-371	?? 2/	?? 2/	50	22	28	50
		1985	Bull	R-249	74 3/	92 3/	37	36	0	37
		1986	Bull	D-15	0	6	9	9	0	9
		1987	Bull	D-15	3	3	9	9	0	9
967	6C	1983	Bull	R-573	?? 2/	?? 2/	30	30	0	30
		1984	Either sex	D-36	2	1	33	19	12	33
		1985	Bull	T-20	1	1	18	18	0	18
		1986	Bull	D-20	0	0	20	20	0	20
		1987	Bull	D-15	1	1	13	13	0	13
968	6C	1985	Cow	T-21	0	1	19	0	19	19
		1986	Cow	D-20	2	1	17	1	16	17
		1987	Cow	D-15	1	2	12	1	10	12

1/ R = registration; D = drawing; T = "Tier II"
2/ Hunters who did not hunt or were unsuccessful were not required to report
3/ Hunters who did not hunt or were unsuccessful were not required to report, however 2 letters inquiring of their effort resulted in all but 46 permittees reporting

Table 6. Unit 6. Moose harvest chronology, 1983-87.

Year	Subunit	Aug. 20-31	Sept. 1-15	Sept. 16-30	Oct. 1-15	Oct. 16-31	Nov. 1-30	Dec. 1-31
1983	6A(East)	--	3	6	2	1	2	0
	6A(West)	--	15	19	7	0	0	1
	Subtotal 6A	--	18	25	9	1	2	1
	6B	--	74	-- 1/	--	--	--	--
	6C	--	30	-- 2/	--	--	--	--
	6D	--	3	1	--	--	--	--
	Total	--	125	26	9	1	2	1
1984	6A(East)	--	5	4	6	1	0	0
	6A(West)	--	16	25	15	4	2	2
	Subtotal 6A	--	21	29	21	5	2	2
	6B	--	49	1 3/	--	--	--	--
	6C	--	10	22	--	--	--	--
	6D	--	0	0	--	--	--	--
	Total	--	80	52	21	5	2	2
1985	6A(East)	0	5	6	9	2	3	2
	6A(West)	0	4	17	19	3	4	0
	Subtotal 6A	0	9	23	28	5	7	2
	6B	--	24	12	--	--	--	--
	6C	--	21	12	4	--	--	--
	6D	--	0	0	--	--	--	--
	Total	0	54	47	32	5	7	2
1986	6A(East)	1	13	12	3	4	2	0
	6A(West)	1	19	24	7	9	4	0
	Subtotal 6A	2	32	36	10	13	6	0
	6B	--	7	2	--	--	--	--
	6C	--	22	15	--	--	--	--
	6D	--	0	0	--	--	--	--
	Total	2	61	53	10	13	6	0
1987	6A(East)	4	6	5	10	6	5	3
	6A(West)	--	14	11	14	1 4/	--	--
	Subtotal 6A	4	20	16	24	7	5	3
	6B	--	6	3	--	--	--	--
	6C	--	16	9	--	--	--	--
	6D	--	1	1	--	--	--	--
	Total	4	43	29	24	7	5	3

1/ Bull season closed by emergency order same day of opening, 10 September
2/ Either sex season closed by emergency order on 15 September.
3/ Either sex season closed by emergency order on 17 September.
4/ Either sex season ended 15 October, moose reported taken after season.

Table 7. Unit 6. Successful moose hunter transport methods by subunit, 1983-87.

Year	Subunit	Airplane	Horse	Boat or airboat	3- or 4-wheeler	ORV	Highway vehicle
1983	6A(East)	11	0	2	1	0	0
	6A(West)	21	0	20	1	0	0
	Subtotal 6A	32	0	22	2	0	0
	6B	17	0	53	0	0	4
	6C	0	0	12	5	0	5
	6D	1	0	0	0	0	3
	Total	50	0	87	7	0	12
1984	6A(East)	14	0	3	0	0	0
	6A(West)	31	0	31	1	0	0
	Subtotal 6A	45	0	34	1	0	0
	6B	8	0	40	0	0	2
	6C	0	0	7	0	0	26
	6D	0	0	0	0	0	0
	Total	53	0	81	1	0	28
1985	6A(East)	18	1	5	2	0	0
	6A(West)	20	1	21	0	1	0
	Subtotal 6A	38	2	26	2	1	0
	6B	7	0	24	0	0	5
	6C	0	0	9	1	0	27
	6D	0	0	0	0	0	0
	Total	45	2	59	3	1	32
1986	6A(East)	21	0	5	5	1	2
	6A(West)	17	0	39	2	2	0
	Subtotal 6A	38	0	44	7	3	2
	6B	0	0	8	0	0	1
	6C	1	0	8	1	0	28
	6D	0	0	0	0	0	0
	Total	39	0	60	8	3	31
1987	6A(East)	29	0	2	7	0	0
	6A(West)	14	0	24	0	1	0
	Subtotal 6A	43	0	26	7	1	0
	6B	1	0	7	0	0	1
	6C	0	0	11	0	1	13
	6D	2	0	0	0	0	0
	Total	46	0	44	7	2	14

STUDY AREA

GAME MANAGEMENT UNIT: 7 (4,423 mi^2)

GEOGRAPHICAL DESCRIPTION: East Kenai Peninsula

BACKGROUND

Unit 7 moose populations erupted most recently during the 1960's, after wildfires established widespread areas of early seral vegetation and natural predators had been reduced to low levels. In the early 1970's, a steep population decline was caused by several severe winters. Moose populations have since fluctuated at relatively low levels as forest habitats matured and wolf and bear populations recovered. Since 1980 the spruce bark beetle has infested approximately 36,000 acres of spruce forest in Unit 7 (USDA Forest Service 1988) and an additional 9,000 acres of forests and shrublands within the Chugach National Forest have been treated with prescribed fire (Dan Logan, USFS, pers. commun.). Limiting old-growth vegetation in these areas should increase moose populations by enhancing the nutritional quality and availability of winter food.

POPULATION OBJECTIVES

To maintain a viable population occupying all available habitat at a minimum ratio of 15 bulls:100 cows.

METHODS

Population trend and sex-age composition were assessed by aerial surveys conducted with a PA-18 super cub in standardized count areas during October and November. Since 1980 surveys were made only during years when there was extensive snow cover and moose sightability was high (i.e., 1980, 1981, 1982). Annual moose harvest data were collected through the statewide harvest ticket system.

RESULTS AND DISCUSSIONS

Population Status and Trend

The moose population has gradually declined in Unit 7 during this decade; however, they remain moderately abundant in suitable intermontane habitats.

Population Composition:

During the fall 1987 surveys, 267 moose were counted and classified, including 47 bulls, 161 cows, 53 calves, and 6 moose of unspecified sex and age (Table 1). Sample ratios were 29 bulls:100 cows, 33 calves:100 cows, and 19% calves.

Mortality

Season and Bag Limit:

Hunting is prohibited in that portion of Unit 7 drained by Resurrection Creek downstream from Rimrock and Highland Creeks including Palmer Creek. The open season for residents only in the Placer River drainage and that portion of Placer Creek outside the Portage Glacier area is from 1 to 30 September; the bag limit is 1 bull by drawing permit only and 20 permits for antlered moose will be issued to Alaska residents only. The open season for resident and nonresident hunters in the remainder of Unit 7 is from 1 to 20 September; the bag limit is 1 bull with a spike or fork antler on at least 1 side or with at least a 50-inch spread or at least 3 brow tines on 1 side.

Human-induced Mortality:

In 1987, 295 hunters reported killing 36 bulls in Unit 7. In 1986, 408 hunters killed 58 bulls. Antler spread in inches was reported for 27 bulls: 5 less than 30, one 30-39, five 40-49, and 16 bulls greater than 50 inches. Nineteen moose (52%) were harvested from 1 to 10 September, 12 (33%) were harvested from 11 to 20 September, and the harvest date was unknown for 5 bulls (13%).

Hunter Residency and Success. Hunter success was 14% in 1986 and 12% in 1987. Moose hunters in Unit 7 consisted of 207 (71%) Kenai Peninsula residents, 78 (26%) other Alaska residents, and 8 (3%) nonresidents.

Game Board Actions and Emergency Order

The 1st season requiring a spike or forked antler or at least a 50-inch antler spread reduced the reported number of hunters and the bull harvest in Unit 7 by 28% and 38%, respectively. These reductions were slightly smaller than those documented in Unit 15, because 10 days were also added to the Unit 7 season in 1987. The observed bull:cow ratio in the 1986 c surveys (i.e., 29:100) and high proportion of bulls with antler spreads ≥ 50 inches in the 1987 harvest (i.e., 44% of total harvest) reflect lower harvest rates in Unit 7 than in other parts of the Peninsula having a general hunting season. This situation is not unexpected, considering the isolated distribution of moose, difficult terrain, and limited access found there.

CONCLUSIONS AND RECOMMENDATIONS

Fall and winter composition surveys should be expanded in Unit 7 to better evaluate the geographic distribution and abundance of moose in relation to the U.S. Forest Services prescribed burning program and the current hunting season. Hunter education concerning the new spike/fork or 50-inch hunting requirement must be vigorously pursued during the next reporting period.

LITERATURE CITED

USDA Forest Service. 1988. Forest pest management report: forest insect and pest conditions in Alaska - 1988. Report R10-88C-1. Juneau. 16pp.

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SUBMITTED BY:

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Table 1. Summary of moose composition surveys conducted in Unit 7, Kenai Peninsula.

Time (hours)	Count Areas	Bulls			Cows				Lone calves	Total calves	Unk	Total
		Yearling	Large	Total	W/O	W/1	W/2	Total				
3.8	7-7 Resurrection Creek	8	24	32	68	36	2	106	1	41	6	185
1.6	7-11 Juneau Creek	8	7	15	43	12	0	55	0	12	0	82
Totals		16	31	47	111	48	2	161	1	53	6	267

STUDY AREA

GAME MANAGEMENT UNIT: 9 (45,400 mi^2)

GEOGRAPHIC DESCRIPTION: Alaska Peninsula

BACKGROUND

Moose were scarce on the Alaska Peninsula the mid-1900's; however, the population dramatically increased spreading southwestward during the 1950's and 60's. Unsuitable habitat south of Port Moller limited expansion into Subunit 9D. Even during the 1960's, when the population was growing, calf:cow ratios were relatively low; as the population reached its peak, the ratios declined. Evidence of range damage from overbrowsing was noted, and poor calf survival was believed to be caused by nutritional stress. Liberal hunting regulations were in effect from 1964 to 1973, to initially slow population growth and to subsequently (i.e., early 1970's) reduce the population so that willow stands could recover from heavy browsing. Even though a series of hunting restrictions were implemented after 1973, the population continued to decline, especially in Subunit 9E. By the early 1980's moose densities in Subunit 9E were approximately 60% below peak levels and calf:cow ratios remained extremely low, despite evidence that range conditions had improved (ADF&G files). Currently, brown bear predation on neonatal moose is the primary limiting factor.

POPULATION OBJECTIVES

To maintain moderate (0.5-1.5 moose/mi^2) or high (1.5-2.5 moose/mi^2) densities.

To increase low density populations (where habitat conditions are not limiting) to 0.5 moose/mi^2 by 1995.

To maintain sex ratios of at least 25 bulls:100 cows in medium-to-high density populations and at least 40 bulls:100 cows in low-density areas.

METHODS

Fall sex and age composition aerial surveys were scheduled throughout Subunits 9B, 9C, and 9E. In December harvests were monitored within the Naknek drainage during the subsistence season (i.e., registration permit only).

RESULTS AND DISCUSSION

Population Status and Trend

Results of fall sex and age composition surveys suggest that populations in most of Unit 9 have stabilized or are declining at a much lower rate than previously believed (i.e., 15-20 years ago). Very low moose densities and unreliable snow conditions in Subunit 9A precluded efficient surveys for monitoring trends in population size or composition. Although no recent surveys have been conducted in Subunit 9D, intensive early winter caribou surveys south of Port Moller showed no noticeable expansion of moose in that area. Fall trend counts in western Subunit 9B had lower sample sizes and fewer moose per hour of survey flight; however, very heavy snow cover may have altered moose distribution, compared with previous surveys in this area. Hunting pressure has increased dramatically in this area within the past 3 years, and some overall reduction in population size was expected. Survey results from Subunits 9C and 9E suggest a relatively stable population density.

Population Size:

In 1983 a population census conducted in a 1314-mi^2 study area in the central portion of Subunit 9E resulted in an estimate pf 1148 $\pm$16% moose (90% confidence level); a rough extrapolation to the remainder of Subunit 9E provided an estimate of approximately 2,500 moose. Subunit 9C, outside of Katmai National Park, contains approximately 500-600 moose, while Subunit 9B may have approximately 2,000 moose. A cooperative census planned for the area west of Lake Clark should help to refine this estimate. Subunits 9A and 9D probably contain less than 300 and 50 moose, respectively.

Population Composition:

Table 1 provides a summary of sex and age composition surveys conducted since 1983. Declines in bull:cow ratios have been detected in Subunits 9B and 9C because of rapidly growing fall harvests. Bull harvests in Subunit 9E have increased to a lesser extent, but the bull:cow ratio has not changed significantly. In recent years calf:cow ratios have been lower in the Katmai and Subunit 9E trend areas, theoretically reflecting higher bear densities than those farther north; however, the 1987 surveys in all subunits showed little difference in calf:cow ratios (i.e., 18 to 23 calves:100 cows).

<u>Mortality</u>

Season and Bag Limit:

The open season for all hunters in Subunit 9A is 5-25 September; the bag limit is 1 bull. The open season for nonresident hunters in Subunit 9B is 5-25 September. The open seasons for subsistence and resident hunters in portions of Subunit 9B draining into Lake Clark drainage and the remainder of Subunit 9B are September and 1-31 December. The bag limit in the Lake Clark drainage is 1 moose; however, antlerless moose may be taken from 16 to 31 December. The bag limit for the remainder of Subunit 9B is 1 bull. The open seasons for subsistence hunters in Subunit 9C, Naknek River drainage, are 5-20 September and 1-31 December. The open season for resident and nonresident hunters there is 10-20 September. The bag limit for the Naknek River drainage is 1 moose; however, antlerless moose may be taken by registration permit only. The open seasons for subsistence, resident, and nonresident hunters in the remainder of Subunit 9C are 5-20 September and 1-31 December, 10-20 September and 1-31 December, and 10-20 September, respectively. The bag limit for subsistence hunters in the remainder of Subunit 9C is 1 moose; however, antlerless moose may be taken only in December. Other hunters are limited to 1 bull. There is no open season in Subunit 9D. The open seasons for subsistence hunters in Subunit 9E are 10-20 September and 1-15 December; the season for resident and nonresident hunters is 10-20 September. The bag limit is 1 antlered moose; however, moose taken from 10 to 20 September must have an antler spread of at least 50 inches or have at least 3 brow tines on at least 1 antler.

Human-induced Mortality:

Fall moose harvests in Unit 9 have increase substantially in the past several years, primarily as a result of more nonresident hunters. In 1987 a total of 309 moose, including 15 cows and 294 bulls, were reported killed by hunters. This is a 79% increase over the 1983 reported harvest of 173 moose. From 1984 to 1988 all subunits except 9A have had increased harvests; Subunit 9B has had the greatest increase (Table 2). The unreported subsistence harvest has stabilized at slightly over 100 per year.

Hunter Residency and Success. The number of nonresident hunters tripled from 1983, while the number of resident hunters has remained relatively stable (Table 4). Some subsistence hunters do not get moose harvest tickets and, consequently, are not represented in the local resident category. Hunter success varies by residency; since 1983 the success rates for residents of Unit 9, other Alaskan residents, and nonresidents have averaged 33%, 39%, and 56%, respectively. Although the success rates have not indicated specific trends for any of the residency categories during past 5 years, they are considerably below the 74% success rate for all hunters reported during 1967-73, when the moose population had been at its peak.

Permit Hunts. Board of Game action in 1987 restricted the December registration hunt in the Naknek River drainage to subsistence users only, slightly reducing the number of permits issued (Table 3) but not significantly affecting the results. As in past years, weather and travel conditions affected the harvest more than other factors. December started with extremely cold temperatures that discouraged some hunters, but thereafter, conditions were better than they had been for the previous several years. Because an upper harvest limit of approximately 12 cows had been established, the harvest was monitored to ensure this level was not exceeded.

Harvest Chronology. Because of increased harvests and dropping bull:cow ratios in Subunit 9B, the 1988 fall season was shortened for all hunters. Only subsistence hunters were allowed to participate from 5 to 9 September, and all moose hunting ended on 20 September. This shortening of the season was effective in reducing the bull harvest, compared with those for the 1985 and 1986 seasons (Table 2). Some hunting pressure was shifted to Subunit 9B or Unit 17, where the seasons were longer. Although harvest levels in December have remained low (Table 5), optimum snow conditions in Subunit 9B increased the harvests there in 1987 and 1988.

Transportation Methods. Aircraft remains the most common method of transportation (Table 6) in Unit 9. Because of good snow cover in much of Unit 9 during the December 1987 season, snowmachines were used more frequently than usual.

Natural Mortality:

The historic differences in calf survival throughout Unit 9 that reflect brown bear abundance were not apparent this year; however, bear predation on neonatal moose is still the primary cause of natural mortality. Bear:moose ratios in Unit 9 are estimated to range from >1:1 to 1:10; generally they are much higher than those occurring elsewhere.

Game Board Actions and Emergency Orders

Several restrictions on the moose hunting seasons in Unit 9 have been implemented in response to increasing hunting pressure. Antlerless moose hunting was eliminated in Subunit 9E in 1983, and the December season was shortened to 15 days in 1984 and restricted to subsistence users only in 1987. In 1986 the fall season in Subunit 9C was shortened by 5 days for subsistence users and by 10 days for all other hunters and the December season in the Naknek drainage was restricted to subsistence hunters only. In 1984 the antlerless moose season was shortened by 16 days for the Lake Clark drainage and closed in the remainder of Subunit 9B.

At the 1987 Board of Game meeting, the Department proposed that the September seasons in Subunits 9A and 9B be aligned with that of 9C. The justification for submitting this proposal was to reduce bull harvests in Subunit 9B and minimize inadvertent shifting of hunting pressure within Unit 9 by having the nonsubsistence fall season run concurrently in all subunits. The Board adopted this recommended change for the 1988 season.

CONCLUSIONS AND RECOMMENDATIONS

Hunting regulations have been restricted in several subunits to eliminate antlerless moose hunting in areas with the lowest calf:cow ratios. Additionally, fall seasons have recently been shortened in the northern 3 subunits to maintain bull:cow ratios at prescribed levels.

Brown bear predation on neonatal moose is believed to be the major limiting factor preventing the increase in moose density in Unit 9. However, because of the priority placed on managing bears and the very high bear:moose ratios, a very substantial reduction in bear densities would probably be needed to achieve a measurable improvement in moose calf survival. Such a drastic reduction would probably be opposed by a large segment of the public.

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Table 1. Moose composition counts and population estimates in Unit 9, 1983-87.

Subunit	Year	Males: 100 females	Calves: 100 females	Calf% of herd	Adults	n	Moose /hr.	Moose /sq. mi.
9B, Lake Clark	1984	54	30	16	410	491	63	1.1/mi2
	1987	31	23	15	302	356	39	0.8/mi2
9B, Iliamna	1984	67	20	11	180	202	27	0.4/mi2
	1986	103	42	17	77	93	28	0.3/mi2
9C	1983	46	33	18	334	409	45	0.6/mi2
	1984	42	25	15	502	591	60	0.9/mi2
	1986	34	27	17	432	518	64	0.8/mi2
	1987	36	18	12	577	653	62	1.0/mi2
9E	1983	40	14	9	617	677	42	0.5/mi2
	1986	43	11	6	216	230	30	0.5/mi2
	1987	47	18	11	500	562	34	0.5/mi2

Table 2. Annual moose harvest in Unit 9, 1983-87.

Subunit	Year	Reported			Estimated	Total
		M	F	Total	Unreported/Illegal	
9A	1983	8		8	2	10
	1984	14		14	3	17
	1985	10		10	2	12
	1986	19		19	3	21
	1987	10		10	2	12
9B	1983	43	11	54	75	129
	1984	46	2	48	75	123
	1985	74	15	75	75	150
	1986	65	3	72	75	147
	1987	118	6	124	75	199
9C	1983	34	4	38	5	43
	1984	40	6	46	5	51
	1985	63	9	72	5	77
	1986	57	10	67	5	72
	1987	47	9	56	5	61
9E	1983	73		73	25	98
	1984	75		75	25	100
	1985	87		87	25	112
	1986	81		81	25	106
	1987	110		110	25	135

Table 3. Moose harvest data for permit hunt No. 972 in Subunit 9C (Naknek Drainage), 1983-87.

Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
1983	81	22	55	8	4	4	8
1984	75	21	44	11	6	5	11
1985	69	15	35	15	7	8	15
1986	78	18	45	13	3	10	13
1987	61	10	33	16	8	8	16

Table 4. Moose hunter residency and success in Unit 9, 1983-87.

	Successful				Unsuccessful			
Year	Local resident	Nonlocal resident	Nonresident	Total	Local resident	Nonlocal resident	Nonresident	Total
1983	31	90	48	173	93	96	40	236
1984	31	73	75	186	68	127	35	239
1985	44	83	103	242	68	128	78	283
1986	39	74	112	240	80	116	104	308
1987	47	89	152	300	97	135	102	345

Table 5. Moose harvest chronology percent ages by time period in Unit 9, 1983-87.

Subunit	Year	September				December	
		5-9	10-14	15-20	21-25	1-15	16-31
9A	1983	37	37	0	25	0	0
	1984	38	31	8	23	0	0
	1985	10	60	30	0	0	0
	1986	25	25	44	6	0	0
	1987	33	11	44	11	0	0
9B	1983	29	7	13	18	5	27
	1984	19	2	23	23	27	6
	1985	19	14	26	29	4	7
	1986	18	19	24	27	0	12
	1987	19	21	20	1	10	
9C	1983	24	18	30	6	21	0
	1984	20	17	22	13	15	13
	1985	23	11	31	25	7	3
	1986	23	23	16	16	16	6
	1987	9	27	25	0	9	29
9E	1983	0	49	36	0	1	4
	1984	1	56	37	0	6	0
	1985	1	56	40	0	2	0
	1986	0	53	42	0	5	0
	1987	3	56	40	0	1	0

Table 6. Successful moose hunter by transportation methods percentages in Unit 9, 1983-87.

Year	Airplane	Horse	Boat	3 or 4-wheeler	Snowmachine	ORV	Vehicle
1983	66%	0%	19%	0%	2%	6%	6%
1984	72%	0%	15%	3%	3%	2%	4%
1985	69%	0%	21%	1%	1%	0%	2%
1986	70%	0%	17%	7%	1%	2%	3%
1987	70%	0%	15%	6%	6%	0%	2%

STUDY AREA

GAME MANAGEMENT UNIT: 11 (13,300 mi^2)

GEOGRAPHICAL DESCRIPTION: Chitina Valley and the eastern half of the Copper River Basin

BACKGROUND

Moose numbers in Unit 11 were generally considered low from the early 1900's until the 1940's. Moose increased throughout the 1950's, reaching a peak population in the early 1960's. During this period of moose abundance, between 85 and 120 moose per hour were observed during fall composition counts. The moose population in Unit 11 entered a period of decline in the late 1960's or early 1970's that lasted until 1979, when it reached its lowest level. In 1979 only 12 moose per hour were observed during fall counts.

The moose harvest in Unit 11 averaged approximately 164 (range = 123-242) animals per year from 1963 until 1974. Either-sex bag limits were in effect until 1975, and the cow harvest often composed up to 40% of the total moose harvest. During this period, hunting seasons were long and split into fall and winter periods. The moose harvest peaked, as did the total number of hunters and hunter success rate, in the early 1970's. In response to declining moose numbers, the 1974 fall moose season was reduced in length, the winter season was closed, and the taking of cows was prohibited. Current seasons were established in 1975, and harvests have averaged 43 bulls per year since. Unit 11 was included in the Wrangell-Saint Elias National Monument in December 1978. In 1980 that status was changed when Congress passed the Alaska National Interest Lands Conservation Act (ANILCA); thereafter, it was included in Wrangell-Saint Elias National Park/Preserve.

POPULATION OBJECTIVES

To maintain the existing moose population with a posthunting sex ratio of no less than 15 adult bulls:100 cows.

METHODS

An aerial sex and age composition survey is conducted annually during the late fall to determine composition and population trends on a count area located along the western slopes of Mount Drum. Harvests and hunting pressure are monitored yearly through a harvest ticket reporting system. In addition to the total harvest figures, the average antler length in the harvest is monitored each year. Additional mortality from predation or overwinter loss is monitored by field observation whenever possible and by reports from hunters and trappers. Although no active habitat manipulation is being conducted, Unit 11 has been included in the Copper River Basin Fire Management Plan; large portions of the unit have been classified as limited suppression zones where wildfire would be allowed to burn once ignition occurs. Plant growth, composition, and utilization are monitored periodically in a large burn area where moose densities are the highest. Other methods of addressing moose habitat issues include monitoring land use patterns and evaluating any proposals that affect moose habitat.

RESULTS AND DISCUSSIONS

Population Status and Trend

The number of moose observed in Count Area (CA) 11 along the western slopes of Mount Drum has been increasing since 1979 (Table 1). Because the number of moose observed per hour in the fall counts has increased from 12 to 55 during this period, it presumably represents a population increase. Moose counts are not conducted elsewhere in the unit, and inferences about population status and trends must be drawn from general field observations and reports from the public. Although very limited, information pertaining to the lower Chitina River valley indicates that this area has not experienced an increase in moose numbers and the population is stable or still declining. In the northern portion of Unit 11 moose are believed to be stable.

Population Size:

An accurate population estimate is not available for Unit 11, because moose have never been censused there. In 1987 moose numbers observed during fall composition counts in CA 11 resulted in a density estimate of 0.7 moose/mi^2. Density estimates of 0.1 to 0.4 moose/mi^2 were obtained in 1986 during late-winter stratification flights, when 20% of the estimated 5200 mi^2 of moose habitat in the unit was surveyed. The lowest estimated moose densities were in the Chitina River Valley; the highest were in CA 11. If actual moose densities approach the estimates obtained during the 1986 stratification flights, the overall moose population in Unit 11 could number between 1,000 and 2,000 animals.

Population Composition:

A bull:cow ratio of 70:100 was observed in CA 11 in 1987, a decline of 11% from the previous year's ratio of 78 bulls:100 cows. Although the bull:cow ratio declined somewhat, the overall number of bulls and cows counted actually increased by 15% and 30%, respectively. Adult bulls composed a large portion of the bull population: 64 large bulls:100 cows, compared with 6 yearling bulls:100 cows. The observed adult bull:cow ratio meets the current management goal of maintaining no less than 15 adult bulls:100 cows.

The observed calf:cow ratio was 20:100 in 1987, somewhat higher than the 1986 figure of 14:100 but still below the 6-year (1981-86) average of 25 calves:100 cows. Although improved slightly, calf production or survival is still considered to be poor.

Distribution and Movements:

Data from fall composition surveys, winter stratification flights, field observations, and reports from the public indicate the highest densities of moose along the western slopes of Mount Drum. The Chitina River Valley and the upper reaches of the Copper River appear to have low and intermediate densities of moose, respectively.

Fall rutting and postrutting concentrations occur in upland habitats as high as elevations of 4,000 feet. Migrations to lower elevations are initiated by snowfall; moose move down in the winter as snow depth increases. By late winter, moose numbers in riparian habitats along the Copper and Chitina Rivers are at their highest levels for the year. Some moose from the western slopes of the unit are believed to move westerly across the Copper River to winter in eastern Unit 13.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters is 1 to 20 September. The bag limit is 1 bull.

Human-induced Mortality:

Hunters reported killing 58 bull moose in 1987 (Table 2), which was somewhat higher than the previous year's harvest of 49 and the 5-year (1982-86) mean of 45 bulls. Hunting pressure in 1987 was similar to that in 1986; 193 individuals reporting hunting in 1987, compared with 197 in 1986.

The mean antler spread reported for bulls harvested in Unit 11 during 1987 was 46 inches, equalling the 5-year (1982-86) mean. Over 60% of the harvest in 1987 was composed of bulls having reported antler spreads of 40 inches or more. These data suggest that hunting pressure in Unit 11 is not heavy enough to crop bulls before they reach maturity and are available for breeding purposes.

In some years, the illegal and unreported harvests of both bulls and cows and may approach 20% of the reported harvest. Recent poaching activity has been greater in the northern portion of Unit 11 along the Nabesna Road. The area around Slana is considered a problem area and is currently receiving increased enforcement emphasis.

Hunter Residency and Success. Local residents accounted for 46% of the bull harvest in 1987, nonlocal Alaskan residents took 44%, and nonresidents accounted for only 10% (Table 3). Hunter residency reported in 1987 is similar to that reported in prior years. Residency success rates in Unit 11 are influenced by National Park Service (NPS) regulations that allow only local residents to hunt in those portions of the unit designated as park. Nonlocals and nonresidents are allowed to hunt only in the portion designated as preserve, thus excluding them from a large part of the unit.

The overall hunter success rate was 30%, slightly higher than both the 25% rate reported for 1986 and the 5-year (1982-86) mean of 24%. This higher rate represents only a single year's increase, and no trend is yet apparent. Successful and unsuccessful hunters spent an average of 5.6 days and 6.4 days in the field, respectively.

Harvest Chronology. Harvest chronology data suggests that more moose are harvested during the first part of the season than during the last part (Table 4). Although hunting pressure is usually heavy early in the season, especially opening weekend, it drops off as the season progresses. If hunting pressure were greater during the later part of the season, harvests would increase substantially. Bull moose are more vulnerable later in the season, because they increase their activity level as the rut approaches. Also, they are more visible to hunters because leaf fall has usually occurred by mid-September.

Transport Methods. Transportation methods utilized by successful hunters have not changed substantially over the past 5 years. Aircraft, highway vehicles, and off-road vehicles have been the most popular methods reported (Table 5). Transportation methods that may be used by hunters in Unit 11 are limited by NPS regulations. Aircraft cannot be used in portions of the unit designated as park, and all vehicle use is restricted to existing trails, unless a permit is obtained. The effect of these rules is to limit hunting opportunity in the more remote portions of the unit.

Natural Mortality:

Predator-prey studies have not been conducted in Unit 11; therefore, sources and rates of predation are unknown. However, wolves and brown bears, both predators of moose, are considered abundant. Field observations of wolf kills during the winter and additional reports by hunters and trappers of suspected wolf predation suggest that wolves are important predators of moose. The importance of brown bear predation is less apparent, because it does not occur during the winter when it would be visible. The low calf:cow ratios observed during fall counts suggest early calf mortality similar to that observed in other areas with high brown bear predation on neonatal moose calves. Because the moose population has a very low density, predation could serve to limit recruitment. Moose populations can be suppressed at very low densities for long periods of time by predation, especially when alternative prey such as caribou and sheep are available, as they are in Unit 11 (Gasaway et al. 1983).

Habitat Assessment

Fires occurred throughout much of Unit 11 prior to the mid-1940's, when fire suppression activities were instituted by the Bureau of Land Management (BLM). The beneficial effects of these fires in creating moose habitat has long since passed. Only the Wilson Camp Fire has burned enough acreage in the unit in the past 30 years to be beneficial in producing a substantial amount of moose browse. That fire occurred in 1981 and covered 13,000 acres. Currently, vast areas within the unit support stands of mature spruce, which are of limited value as moose habitat. Habitat types most used by moose in the unit are the climax upland and riparian willow communities. Recent observations of light browse utilization on range transects suggest moose are not limited by the amount of browse available.

Enhancement:

Habitat manipulation to benefit moose in Unit 11 is not currently an option, because most of the unit is included in Wrangell-Saint Elias National Park and Preserve. NPS regulations prohibit habitat manipulation to specifically benefit any one species. However, Unit 11 is included in the Copper River Fire Management Plan, and since much of the unit is included in the limited suppression category, wildfires will not be suppressed should they occur.

Game Board Actions and Emergency Orders

The hunting regulations for moose have remained unchanged since 1975. Separate subsistence seasons have not been established, bull harvests are not limited by permits or antler restrictions, and everyone may participate in the hunt.

CONCLUSIONS AND RECOMMENDATIONS

It appears we are meeting our population objective of maintaining current moose numbers in the northern and western portions of the unit. Data from CA 11 suggest an increase in moose numbers along the western edge of the unit over the past 5 years. Portions of the Mount Drum area were burned in 1981 and, as a result, browse appears to be more abundant than in unburned areas. Whether the increase in available browse has resulted in increased moose production or attracted more moose into the count area is not known. Moose numbers in the remainder of the unit, especially the Chitina Valley, are either stable or decreasing slowly.

Hunting pressure and total annual harvest are relatively low and have remained fairly stable. Restrictive regulations by the NPS limiting hunter participation and transportation in much of the unit are important contributing factors in limiting harvests.

I recommend maintaining the existing bag limit as well as the timing and length of the hunting season. The current harvest rate of bulls appears to be within a sustainable range, because bull:cow ratios have changed little and the number of moose observed has increased. In addition, the mean antler length remains high, indicating a large proportion of the bull population is made up of adult animals. However, because of the low moose density and calf recruitment in the unit, any substantial increase in the bull harvest is expected to result in a decline in the bull:cow ratio. Cow hunts should be avoided as long as low moose densities persist.

I also recommend a research program be established to investigate factors limiting expansion of the moose population; Unit 11 can potentially support more moose. The population objective of maintaining moose at existing densities (0.1 to 0.7 moose/mi^2) needs to be reconsidered and modified. We also need to explore options available to managers to enhance the moose population, consistent with pertinent NPS regulations.

LITERATURE CITED

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Table 1. Moose composition counts for Unit 11, 1983-87.

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose/ hour	Density moose/mi²
1983	84	12	23	11	79	89	26	.3
1984	75	9	17	9	114	125	31	.4
1985	80	22	12	6	140	149	40	.5
1986	78	12	14	7	155	167	41	.6
1987	70	6	20	11	192	215	55	.7

Table 2. Annual moose harvest in Unit 11, 1983-87.

Year	Harvest						Grand total
	Reported			Estimated			
	M	F	Total[a]	Unreported	Illegal	Total	
1983	48	0	48	5	5	10	58
1984	41	0	41	5	5	10	51
1985	46	0	46	5	5	10	56
1986	48	0	49	5	5	10	59
1987	58	0	58	5	5	10	68

[a] Includes unknown sex.

Table 3. Moose hunter residency and success for Unit 11, 1983-87.

Year	Successful				Unsuccessful			
	Local resident	Nonlocal resident	Nonresident	Total[a]	Local resident	Nonlocal resident	Nonresident	Total[a]
1983	18	26	4	48	66	75	2	147
1984	17	18	4	39	75	104	3	182
1985	17	28	2	47	56	69	1	126
1986	20	23	2	45	69	39	1	109
1987	24	23	5	58	60	58	6	125

[a] Includes unspecified residency.

Table 4. Moose harvest chronology by calendar week for Unit 11, 1983-87.

Year	Season dates	Week of season 1st (%)	2nd (%)	3rd (%)	4th (%)
1983	1-20 Sep	17	45	28	10
1984	1-20 Sep	13	22	27	38
1985	1-20 Sep	41	25	34	--
1986	1-20 Sep	27	31	38	4
1987	1-20 Sep	24	29	42	5

Table 5. Methods of transportation used by successful moose hunters, expressed in percentage/year, 1983-87.

Year	Airplane	Horse	Boat	3 or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown
1983	38	4	6	0	0	25	25	2
1984	29	7	0	10	0	22	22	10
1985	25	4	0	9	2	32	13	5
1986	45	12	0	4	0	10	21	8
1987	36	10	3	5	0	16	16	4

STUDY AREA

GAME MANAGEMENT UNIT: 12 (8,500 mi^2)

GEOGRAPHICAL DESCRIPTION: Upper Tanana and White River drainages

BACKGROUND

In the mid-1960's moose were probably 2 to 3 times more numerous in Unit 12 than they are today. Moose numbers declined rapidly from 1966 to 1976. Several severe winters, an overstocked range, and heavy antlerless moose harvests contributed to the population decline. Antlerless harvests were stopped unitwide in 1975, and the Nabesna Road moose season was closed from 1974 to 1981. In 1986 the Little Tok River drainage was closed to moose hunting because of low rates of yearling recruitment and a deteriorating bull:cow ratio.

Wolf control in northern Unit 12 was conducted from 1981 to 1983. Wolf reductions in adjacent Subunit 20D in 1980 also benefited Unit 12 moose. Because of these wolf control measures, moose numbers increased rapidly in the Robertson River drainage and less dramatically in the upper Tanana River drainage. Moose in other portions of Unit 12 were not affected to any noticeable degree; they continue to exist at relatively low densities.

The primary and secondary strategic goals of the Yukon-Tanana Moose Management Plan (1976) are to provide (1) the greatest opportunity to participate in moose hunting and (2) an optimum harvest of moose. These goals haven't been met since the early 1970's.

POPULATION OBJECTIVES

To increase the moose population from an estimated 2,500-3,500 to 5,000-7,000 with an annual harvestable surplus of at least 3% by the year 2000.

To increase the overall hunter success rate to at least 35% without reducing participation from current levels (400 hunters/year) by the year 2000.

To maintain a posthunting season sex ratio of at least 40 bulls:100 cows.

Based upon population or subpopulation characteristics and use patterns, objectives also have been established for moose inhabiting specific portions of Unit 12.

Tetlin and Tok River drainages:

1. To maintain the present population of moose (1,200-1,500).

2. To increase harvestable surplus in the Little Tok River to at least 3% by the year 2000.

3. To increase the proportion of males in the population to 40 bulls:100 cows by the year 2000.

4. To increase the proportion of resident moose in the Unit 12 population by at least 50% by the year 2000.

5. To increase browse production on at least 100 acres/year for at least 10 years in known winter range.

Northwestern Unit 12 (Robertson River, upper Tanana Valley):

1. To increase the moose population from an estimated 400 to 800 moose by the year 2000.

2. To increase the proportion of males in the population to 40 bulls:100 cows along the north slope of the Alaska Range and the posthunting portion of Adult bulls ≥5 years to at least 20% of all bulls ≥17 months.

3. To increase browse production on at least 100 acres/year for at least 10 years in known winter range.

Eastern Unit 12 (Cheslina River to U.S.-Canada Border):

1. To increase the moose population from an estimated 1,200-1,300 to 2,200-2,500 by the year 2000.

2. To increase the proportion of males in the upper Chisana River area to 40 bulls:100 cows and the proportion of adult bulls ≥5 years in that population to at least 20% of all bulls ≥17 months.

METHODS

Sex and age composition was estimated in November and December using aerial contour and transect surveys. All moose observed were classified as large bulls (antlers ≥50 inches), medium bulls (antlers larger than yearlings but ≥50 inches), small bulls (spike, cerviform, or palmate-antlered yearling bulls ≤17 months), cows without calves, cows with 1 calf, cows with 2 calves, calves, or unidentified moose. The same areas are surveyed annually in a comparable manner.

Moose harvests were estimated from harvest reports. Overwinter browse use by moose was determined by standard ADF&G transect surveys funded by the USAF. Habitat improvement was accomplished by mechanical crushing of decadent willow stands with crawler tractors; this activity was funded by the state. Except for maintaining restrictive moose hunting regulations and liberal grizzly bear regulations, no action was taken in 1987 to increase moose numbers.

RESULTS AND DISCUSSION

Population Status and Trend

As a result of past land-and-shoot wolf harvests and wolf control as well as recent high grizzly bear harvests in Unit 13 and increasing grizzly bear harvests in the Tanana Valley, moose numbers increased in the Tok, Robertson, and portions of the Tanana River drainages. Moose numbers are probably stable in the eastern and southern portions of Unit 12. Further significant increase in moose abundance is not expected because wolf numbers have attained precontrol levels. Additionally, the loss of 1 month of trapping season and a prohibition against land-and-shoot taking of wolves is expected to reduce wolf harvests appreciably.

Population Size:

No estimate of moose abundance has been made since moose in the Tok River drainages were censused (Gasaway et al. 1981) in the fall of 1980. That effort indicated a population of 872, CI 90% = 839-905, for a density of 1.9 moose/mi^2 in the 450-mi^2 census area. Primarily migratory moose from adjacent Units 11 and 13 in the area have increased at the rate of approximately 5% annually since that time. Moose exist at lower densities in other portions of Unit 12. Based upon a variety of sources, an estimated 2,500-3,500 moose seasonally inhabit Unit 12.

Population Composition:

Eight hundred ninety-seven moose were classified according to sex and age in fall 1987; the Tok and Dry Tok drainages were not surveyed (Table 1). No clear trends in population composition are evident unitwide. The unitwide population may be characterized as having a moderately skewed sex ratio because of the bulls-only harvests and moderately low rates of early calf survival and yearling recruitment because of predation.

Moose inhabiting the Little Tok River drainage in the fall of 1987 exhibited poor calf survival to 5 months (16 calves:100 cows $\geq$2 years) and moderately poor survival of 1986 calves to 17 months (6% small bulls in herd). The bull:cow ratio improved from only 14:100 in 1983 to 31:100 in 1987, only 9 bulls:100 cows below the population management objective of 40. Limited moose hunting opportunity may be warranted in another year, if the improvement is real and continues.

Calf survival and yearling recruitment along the north slope of the Alaska Range were good in the fall of 1987: 44 calves:100 cows $\geq$2 years and 10% small bulls in the herd. The bull:cow ratio of 33 bulls:100 cows was below the management objective of 40, and older mature bulls composed only 8% of all bulls $\geq$17 months instead of the desired 20%. Although this rutting population is small ($\leq$120 estimated, 69 observed), it is important to local residents of Tok and Tanacross because of its proximity. A slight decrease in harvest rate would be expected to allow improvement in the sex ratio and age structure of bulls toward stated management objectives.

Data from eastern Unit 12 indicate that moose in that area generally exhibit good bull:cow ratios (i.e., 68-91 bulls:100 cows), calf survival to 5 months (i.e., 30-33 calves:100 cows $\geq$2 years), and yearling recruitment (i.e., 8-20% small bulls in herd); the exception appears to be the area southeast of Chisana, where an early October survey indicated a depressed bull:cow ratio (22:100), a paucity of old bulls, and poor calf survival (12 calves:100 cows $\geq$2 years). The special 50-inch antlered bull moose season in southeastern Unit 12 is designed to allow greater use of old bulls along the north slopes of the Nutzotin Mountains (68 bulls:100 cows) and to simultaneously afford protection for younger bulls near Chisana.

Distribution and Movements:

Moose occur throughout Unit 12 below an elevation of 4,000 feet. Densities are generally the greatest in northwestern, moderate in central, and lowest in the southeastern portions of Unit 12.

Most moose in Unit 12 migrate between seasonal ranges. Many cows migrate south as far as the Gakona River for calving, return to the Tok River for rutting, and then move north to the Tanana River during mid- to late winter. Unit 12 supports very few lowland resident moose in the Northway-Tetlin Flats (ADF&G files); however, a few residents may be found in the vicinity of Tok and Tanacross. According to long-time residents of Unit 12, the Tok River valley used to support a large population of resident moose, but cow harvests in the late 1960's and early 1970's reduced resident moose numbers noticeably. Year-round poaching of moose of both sexes has contributed to the decline of resident moose in lowland areas near human settlements in the past.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters of that portion lying east of the Nabesna River and south of the winter trail running southeast from Pickeral Lake to the Canadian border is 1 to 30 September. The bag limit is 1 bull with an antler spread of at least 50 inches or with at least 4 brow tines on at least one of the antlers. There is no open season in that portion of Unit 12 drained by the Little Tok River upstream from and including the first eastern tributary from the headwaters of Tuck Creek. The open season for subsistence hunters in the remainder of Unit 12 is 1 to 30 September. The open season for resident and nonresident hunters is 1 to 15 September. The bag limit is 1 bull.

Human-induced Mortality:

The total reported harvest of bull moose in Unit 12 during fall 1987 was 80, which is similar to the mean harvest of 82 for the past 5 years (Table 2). That level of harvest is approximately 2-3% of the estimated population. Recent harvests are only one-half of the mean harvest for 1963 to 1974 (i.e., 167). Out-of-season poaching may be as high as 40 moose of either sex and moose for Native funeral potlatches may account for 15 to 20 more; the requirement for reporting the harvesting of potlatch moose has been ignored. Only 4 or 5 moose are normally killed in highway collision accidents each year. The total human-induced mortality could be as high as 145 moose/year, representing 4-6% of the population.

Twenty-eight bulls were harvested in the Tok River drainage, 11 each in the Nabesna and Chisana drainages, 10 in the Tetlin drainage, 8 in the Tanana Valley, 5 in the Robertson River, and 64 in the White River drainage. Three successful hunters did not report a specific harvest location. The mean number of moose hunters who reported hunting in Unit 12 during the past 5 years is 381, but only 333 hunters reported hunting in 1987. The loss of the last 5 days of the season for all hunters in Unit 12, except local subsistence hunters, may well have deterred some nonlocal hunters from hunting there.

The mean antler spread of 75 bull moose was 45.5 inches SD = 12.35. The 8 bulls (11%) having antlers less than 30 inches were judged to be yearlings; 33 bulls with antlers from 30 to 49.99 inches were mostly 2- to 4-year olds, and 34 (45%) with antlers ≥50 inches were mature adults. All of the 8 bulls taken in the Tanana River area had antler widths ≤39.99 inches, indicating all were young moose. If harvests of these young animals could be reduced, perhaps by a spike-fork or a 50-inch antler restriction for a few years, the sex ratio and age structure of bulls could be improved. During post hunting surveys only 12 and 13 bulls were counted along the north slope of the Alaska Range in 1986 and 1987, respectively, suggesting that a high percentage of all bulls in this population are being harvested each year.

Hunter Residency and Success. Of the 333 hunters in Unit 12 in 1987, the residency of 122 was listed as unknown. Although 177 local residents reported hunting in 1986 and only 34 in 1987, the hunting effort by local residents in 1987 appeared to be comparable with previous years. The hunter success rate for moose hunters in Unit 12 in 1987 was 24%, compared with a 5-year mean of 21%; from 1969 to 1971 the mean success rate was 39%, so hunting success has declined by 15%, even though the number of hunters remained about the same. The present success rate is lower than the management objective of 35%. Successful hunters spent an average of 6.9 days afield and unsuccessful hunters spent 7.1 days.

Harvest Chronology. Sixteen, 26, 31, 5, and 1 moose were harvested during the 1st, 2nd, 3rd, and 4th weeks of the hunting season, population growth and/or increases in useful productivity for human use are to be realized.

Habitat

Assessment:

While much of Unit 12 is characterized by rugged glaciated mountains unsuitable for moose, approximately 4,000-5,000 mi^2 of it is considered to be moose habitat. Excessive wildfire suppression for nearly 30 years has allowed vast areas to become cloaked in spruce forests. Had fires been allowed to reach greater sizes in the past, a much greater proportion of Unit 12 would now be covered with early and midsuccessional deciduous vegetation types. Much good moose habitat is currently limited to subalpine brush fields in the Alaska Range and Mentasta, Nutzotin, and North Wrangell Mountains or to riparian areas along the Tanana, Chisana, Nabesna, Tok, and White Rivers. Measured browse-use during the mild winter of 1987-88 was low (≤30%) in all areas surveyed as part of the USAF Backscatter Radar moose investigations. Habitat is not limiting moose population growth throughout most of Unit 12.

Enhancement:

As of this reporting period, over 1,000 acres of old-age decadent willows have been intentionally disturbed since 1982 to stimulate crown-sprouting of new leaders. Approximately two-thirds of the area treated is in the Tok River drainage; the remainder (about 380 acres), which is in the Tanana drainage north of Tok, was crushed by crawler tractors in April 1988. This work has produced an estimated 2,000,000 pounds of additional browse each year for wintering moose. This work has been undertaken to provide future browse supplies for the increasing moose population in the Tok and Tanana River drainages.

Additional moose habitat enhancement has occurred in the lower Tok and upper Tanana River drainages as a result of logging in the Tanana State Forest. In the next few years more habitat enhancement may occur as partial mitigation for a proposed USAF Backscatter Radar site. Finally, preliminary plans are being formulated for a series of low-cost prescribed fires in the upper Tok and Robertson River drainages to enhance early winter and mild-winter habitat at higher elevations. Habitat management objectives have been achieved in Unit 12 for several years.

Game Board Actions and Emergency Orders

At the November 1987 meeting, the Board of Game put an end to land-and-shoot taking of wolves and reduced the wolf trapping season by 1 month. These actions are expected to reduce annual wolf harvests to the disadvantage of moose in Unit 12, further frustrating management efforts to meet management objectives through increased numbers and/or productivity of moose. In the long term these Board actions are expected to adversely impact wolves as prey populations decline.

At the March 1988 meeting, the Board took action to grant additional subsistence hunting privileges to local hunters by reducing the current 15-day resident and nonresident moose season in eastern Unit 12 to only 5 days. Local hunters are not expected to derive significant benefits; however, because nonlocal hunting pressure in the Northway area has been low, much of the pressure was directed up the Nabesna River, far from local hunting areas.

CONCLUSIONS AND RECOMMENDATIONS

Moose are far less numerous in Unit 12 than they were in the mid-to late 1960's, and both annual harvests and hunter success are about half of what they were then. Habitat is not currently limiting moose population growth, but excessive moose mortality attributable to predation is limiting it. Wolves have been identified as the most important moose predator in the Northway-Tetlin Flats, but low rates of calf survival to 5 months in the Little Tok River drainage and elsewhere suggest that grizzly bears may also be important predators. Out-of-season harvesting of either-sex moose near communities and transportation routes may also be a factor limiting moose population growth. Most management objectives for moose in Unit 12 are not being met because of insufficient numbers of moose to meet demand, particularly in accessible areas used by local hunters.

I recommend that land-and-shoot taking of wolves be reapproved and that the wolf trapping season be lengthened to maximize wolf harvests by the public, a policy already established by the Board. Furthermore, the Board should authorize and the Department should undertake efforts to further reduce predation by wolves and grizzly bears on moose to allow a moderate rate of moose population growth. Additional law enforcement and increased opportunities to satisfy local subsistence needs with Fortymile Herd caribou should be explored to reduce the out-of-season taking of moose in Unit 12. Moose seasons in Unit 12 should remain conservative to maintain or improve sex ratios, given the realities of poor yearling recruitment in most areas.

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Table 1. Moose sex and age ratios in Unit 12, 1983-87.

Year	Males: 100 females	Yrlg. males: 100 females	Yrlg. male % in herd	Calves:100 cows $\geq$2 yrs.	Calf % in herd	Twins:100 cows w/ calf	Moose/ hour	Total moose
1983	33	9	6	19	15	6	43	654
1984	46	9	5	26	14	6	34	1,271
1985	47	9	5	26	14	8	36	1,342
1986	41	10	6	24	13	6	36	1,312
1987[a]	55	11	6	27	13	9	37	897

[a] Tok and Dry Tok surveys were not completed, but normally yield a sample of 400+.

Table 2. Annual moose harvests in Unit 12, 1983-87.

Year	Reported				Estimated			Number of hunters	Success (%)
	M	F	Unk	Total	Unreported[a]	Illegal	Total		
1983	73	0	0	73	15-20	30-40	118-133	340	21
1984	84	0	0	84	15-20	30-40	129-144	415	20
1985	66	0	0	66	15-20	30-40	111-126	412	16
1986	105	0	0	105	15-20	30-40	150-165	403	26
1987	79	0	1	80	15-20	30-40	125-140	333	24

[a] Includes moose estimated taken for Native funeral potlatches but unreported.

STUDY AREA

GAME MANAGEMENT UNIT: 13 (23,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Nelchina and Upper Susitna Rivers

BACKGROUND

Moose numbers in Unit 13 were low during the early 1900's, but they started to increase during the 1940's. Moose were abundant throughout the 1950's and early 1960's, with the population peaking by the mid 1960's. During this period of moose abundance, as many as 124 moose per hour and 60 to 80 bulls:100 cows were observed during fall counts. The decline in the moose population from the mid- to late 1960's through the mid-1970's was aided by severe winters, increased predation, and high human harvests of both bulls and cows. The low point in the population probably occurred in 1975, when 41 moose per hour and 15 bulls:100 cows were observed during fall counts. Moose numbers have been increasing Unit 13 since 1976.

Historically, Unit 13 has been one of the most important moose producing areas in Alaska. During the late 1960's and early 1970's, annual moose harvests were high, averaging over 1,200 bulls and 200 cows and open seasons provided for both fall and winter hunts. As moose numbers began to decline, harvests were reduced by eliminating the cow and winter seasons in 1971 and 1972, respectively, and reducing the fall bull seasons to 20 days in 1975. Harvests in the late 1970's averaged around 775 bulls per year, but bull:cow ratios were low. Beginning in 1980, the bag limit was changed from any bull to one having an antler spread of at least 36 inches or 3 brow tines on one antler. Under this regulation, the bull harvest declined 34% the first year (i.e., from 848 to 557); however, it has increased since then and is now near historically high levels. In Subunit 13A the bag limit was again changed in 1986 to allow the taking of only bulls with spike or forked antlers, and in 1987 limited permit hunts for any bull were also established this area.

POPULATION OBJECTIVES

To maintain the existing moose population with a posthunting sex ratio of no less than 15 adult bulls:100 cows.

METHODS

Aerial sex and age composition surveys are conducted annually during the fall to determine population trends throughout the unit. Censuses are conducted periodically in different portions of the unit to obtain population estimates. Harvests are monitored by requiring harvest ticket and permit reports from all hunters. The age composition of the bull harvest is monitored by collecting and aging a sample of teeth. Natural mortality is monitored by field observation and by reports from the public. Habitat condition is periodically monitored by examination of browse utilization on transects located in different portions of the unit. Although no active habitat manipulation is being conducted, Unit 13 is included in the Copper River Fire Management Plan (i.e., limited suppression category); accordingly, wildfire would be allowed to burn once ignition occurs. In addition, staff evaluate and respond to land-use proposals that may affect moose habitat.

RESULTS AND DISCUSSION

Population Status and Trend

During the last 5 years, the number of moose observed in Unit 13 has increased at a rate of about 6% per year (Table 1); correspondingly, the number of moose observed per hour for all count areas has increased at a rate of about 8%. However, Subunits 13A, 13B, and 13E appear to have increasing moose populations, whereas moose numbers in Subunits 13C and 13D are stable.

Population Size:

A census was conducted on a 1,877-mi^2 area located in the western portion of Subunit 13A during November 1987, resulting in a population estimate of 5,913 (90% CI = ±725) moose and a density estimate of 3.1 moose/mi^2, which is higher than the 2.2 moose/mi^2 estimate obtained during the 1987 fall composition survey in count areas located within the census boundary. Density estimates obtained within the better moose habitat types in other subunits during fall composition surveys are presented in Table 2.

Population Composition:

Data collected during fall sex and age composition surveys are presented in Tables 1 and 2. There was little change in the bull:cow ratio from the previous year, but the calf:cow ratio declined and is currently below the 5-year mean of 27 calves:100 cows. There were 16 large (>1 year of age) bulls:100 cows observed unit-wide, thus exceeding the minimum management objective of 15:100.

Table 2 lists the 1987 composition survey data by subunit. Subunit 13E has the lowest total bull:cow and adult bull:cow ratios in the unit. Since 1984 the bull:cow ratio in 13A has increased 65% (i.e., from 17:100 to 28:100); large bulls compose 60% of the bull population, compared with only 16% in 1984. This increase is directly attributable to the spike-fork regulation that caused only a portion of the yearling bulls to be harvested and large bulls protected. Calf production or survival remained low in Subunit 13D, averaging only 13 calves:100 cows over the past 5 years. Subunit 13A also had a calf:cow ratio substantially lower than the unit average; however, a trend towards decreased production or survival is not yet evident.

Distribution and Movements:

Data from fall composition surveys, censuses, and stratification flights suggest that moose densities are highest in Subunits 13A and 13B, while Subunit 13D has the lowest density. Moose are especially abundant in the Alphabet Hills (Subunit 13B), the eastern Talkeetna Mountains (Subunit 13A), and the upper Susitna River (Subunit 13E).

Fall rutting and postrutting concentrations occur along subalpine habitats. Moose move down from fall postrutting areas during the winter as snow depths increase. Known winter concentration areas include the upper Susitna River, Lake Louise Flats, and the Tulsona Creek burn.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters in that portion of Subunit 13A west of the Lake Louise road, Lake Louise, Lake Susitna, and Tyrone River is 1 to 20 September. The bag limit is 1 bull with a spike or forked antler; however, 1 bull with any size antlers may be taken by drawing permit only; 100 permits will be issued. The open season for subsistence hunters in the remainder of Unit 13 is 25 August to 20 September. The bag limit is 1 bull by registration permit only; only 1 permit will be issued per household. The open season for resident and nonresident hunters in the remainder of Unit 13 is 1 to 20 September. The bag limit is 1 bull with 36-inch antlers.

Human-induced Mortality:

In 1987 the reported harvest in Unit 13 was 959 moose for the combined general and drawing-permit sport hunts and the subsistence hunt (Table 3). The 1987 harvest was 16% below the previous year's take of 1,140, but 11% above the 5-year (1982-86) mean of 866. A total of 4,202 individuals reported hunting in Unit 13 during 1987, down 7% from 1986, but well above (19%) the 5-year (1982-86) mean of 3,531 hunters.

In 1987 the general open sport harvest of 774 moose was substantially below (19%) the previous year's harvest of 961 (Table 4). Yearly harvest figures for the sport hunt between 1983 and 1985 were also higher than in the 1987 total, but during this period most unit residents participated in the sport hunt; whereas now, most qualify for and participate in the subsistence hunt. Although the number of reported hunters in the sport hunt declined 3% in 1987, it still exceeded (by 8%) the 5-year (1982-86) mean of 3,238 hunters. The mean reported antler spread for all bulls taken in the sport hunt was 43 inches, similar to mean averages observed since implementation of the 36-inch antler regulation.

Included under the general open sport hunt is a spike/fork regulation in effect for the western half of Subunit 13A. The purpose of this regulation is to direct hunting pressure to a portion of the yearling bull population, thus providing for increased survival of large bulls. This hunt has been held since 1985, and the annual figures for 1985, 1986, and 1987 are 70, 117, and 71 spike- or fork-antlered bulls, respectively.

Some illegal and unreported harvests of both bulls and cows have been documented, but we have no accurate indication of the numbers involved. Road kills occur during periods of deep snow and are expected to increase, should a deep snow winter occur. Overall, few moose are lost in accidents, compared with other units having more extensive road systems or a railroad.

Permit Hunts. Registration Hunt No. 913W is a subsistence hunt in which any antlered bull may be taken. Only residents of Unit 13 are eligible to hunt, and only 1 permit is issued per household. Permits are issued in Glennallen and Cantwell throughout the season. There were 29% fewer permits issued in 1987 than in 1986, when the number of permits per household had not been limited (Table 4). The 1987 harvest of 156 moose was only 13% lower than the previous year's take, suggesting that limiting the number of permits per household was effective in distributing the harvest among more households but ineffective in greatly reducing it. The mean antler spread of subsistence-killed bulls was 37 inches; however, because 58% of the bulls taken had antler spreads of less than 36 inches, they would not have been legal under the sport hunt's 36-inch minimum regulation.

Drawing Permit Hunt No. 914 is for antlered bulls, but the hunt area is restricted to Subunit 13A West. There are no residency restrictions, and anyone may apply. This hunt was established in 1987 to allow for a controlled harvest of a limited number of large bulls. In the first season 100 permits were issued, and hunters took 29 bulls having a mean antler spread of 44 inches.

Hunter Residency and Success. Residents of Unit 13, other Alaska residents, and nonresidents accounted for 22%, 70%, and 8% of the bull harvest in 1987, respectively (Table 5). Between 1983 and 1985, unit residents averaged 124 moose/year during the sport hunt. In 1986 and 1987 the harvests by locals increased by 73%, averaging 214 moose a year; most were taken in the subsistence hunt. In 1987 only 43 moose were taken by unit residents in the sport hunt. Although the number of nonresident hunters has increased 30% in the last 5 years, their success rate has declined by 29%.

The overall hunter success rate was 23%, down slightly from both the 25% experienced in 1986 and the 5-year (1982-86) mean of 24%. The highest reported success rate was 36% for drawing hunt No. 914, followed by 28% and 21% for subsistence and other sport hunters, respectively. Successful permittees in hunt No. 914 spent 3.6 days hunting, whereas successful subsistence and other sport hunters averaged 5.3 and 6.4 days, respectively. Overall, successful hunters spent 6.1 days hunting in 1987 (compared with 5.8 days in 1986), while unsuccessful hunters spent 6.3 days.

Harvest Chronology. Chronology data show that more moose are taken during the first part of the season (Table 6). Hunting pressure is usually greater early in the season, accounting for the larger take. Subsistence hunters took advantage of the early opening in 1987, and approximately 50% of the subsistence harvest occurred before the sport hunt opened.

Transport Methods. The only major trend evident in transportation methods used by successful hunters over the past few years has been the decline in popularity of both aircraft and off-road vehicles (ORV's) and the increase in 3- and 4-wheelers and horses (Table 7). Also, highway vehicles are more important to subsistence hunters; 42% of successful permittees reported their use, compared with 19% using ORV's and 12% aircraft.

Antler Growth vs. Age of Harvest. Between 1983 and 1986, teeth were collected from 295 harvested bulls with known antler measurements. Table 8 presents the percentage of bulls in each antler class by age group. These data suggest 31% and 84% of the 2-year-old and 3-year-old bulls, respectively, are legal (i.e., 36-inch regulation). Approximately half of the 4-year-old and 80% of the 5-year-old bulls have antlers 50 inches or greater.

Natural Mortality:

Predation on moose by brown bears and wolves occurs, directly influencing overall moose abundance in Unit 13. However, brown bear and wolf harvests by sport hunters and trappers have been relatively high over the past few years, and current predation rates, while influencing abundance, are not considered to be limiting the moose population. Mortality attributable to deep snow conditions has also been low, because winters have been relatively mild since 1978.

Habitat

Assessment:

Wildfires occurred throughout much of Unit 13 prior to 1950, when fire suppression activities were initiated. Since then little total acreage has burned. The overall effect of fire suppression has been to reduce the amount of seral habitat types available to moose, thus reducing the carrying capacity for moose in portions of the unit. Currently, climax upland and riparian willow communities are the most important habitat types for moose. Browse evaluation in these habitat types conducted from 1983 to 1986 suggested that browse species were able to withstand the level of use occurring at that time. As the moose population increases, additional browse evaluation will be necessary to monitor the effects of increased utilization on preferred plant species.

Enhancement:

Unit 13 has numerous areas, especially in Subunits 13A and 13D, where a program of habitat improvement could produce more favorable browse conditions for moose. Because of the size and remoteness of much of the unit, wildfire is the only feasible tool for extensive habitat improvement projects. To promote the occurrence of wildfire, the Copper River Fire Management Plan now allows for wildfire to burn in remote portions of the unit, rather than undergoing initial suppression. In addition, the use of prescribed burns to create moose habitat may be considered. The unit's climate of cool, wet summers will, however, severely limit this method in all but the very dry years. Mechanical treatment of habitat, such as crushing, is being looked at as an alternative to burning in sites where moose are known to concentrate. This method is expensive and, as a result, would be limited to small areas near the road system where good regeneration of preferred browse would occur.

Game Board Actions and Emergency Orders

In 1985 the Board established a hunt for only spike/fork-antlered bulls in Subunit 13A West to increase the number of large bulls. Because this regulation was successful in increasing the number of large bulls, the Board established a drawing-permit hunt (No. 914) in 1987 to allow some large bulls to be harvested. Also in 1987 the Board acted to distribute the subsistence moose harvest among more households by limiting the number of permits to only 1 per household. In November 1987 the Board made land-and-shoot wolf hunting and trapping illegal in Unit 13. This action may result in reduced wolf harvest in the more remote portions of the unit and, as a result, wolf predation on moose may increase.

During the 1988 spring Board meeting, cow moose seasons were established in Subunits 13A West and 13E; 50 drawing permits were available, respectively. One half of the permits in each area were reserved for unit residents. The Board also increased the number of permits available for large bulls in Subunit 13A West. Two permit hunts were created to better distribute the hunting pressure.

CONCLUSIONS AND RECOMMENDATIONS

Based on the increase in moose per hour and total moose counted, it appears that the population in Unit 13 is continuing to increase. Factors contributing to this increase include (1) a series of mild winters, (2) reduced predation, and (3) restricted human harvests. Surveys in count areas located in more favorable habitats suggest moose numbers are approaching the level observed in the late 1960's before the large decline in numbers occurred. In these areas, I recommend that cow hunts be instituted to reduce the rate of increase and eventually stabilize the population. In 1988 up to 75 drawing permits are to be issued for antlerless moose in Subunits

13A and 13E. Moose should be allowed to increase in those areas where moose densities are below those observed in the late 1960's.

The bull:cow ratio for all of Unit 13 did not change during 1987. This ratio continued to increase in Subunit 13A, where the harvest was restricted by drawing permit to spike/fork bulls. The bull harvest should be maintained at its current level in those areas where bull:cow ratios have stabilized. In Subunit 13A the harvest of large bulls should be increased; however, it must be distributed throughout the entire subunit. I recommend that 300 permits be issued for drawing hunt No. 914; at least 150 of these permits should be issued for the more remote portion of the subunit north of the Black River.

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SUBMITTED BY:

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Table 1. Moose composition counts for Unit 13, 1983-87.

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour	Density moose/mi^2 (range)
1983	24	12	25	17	4411	5298	56	1.2 (.6-2.1)
1984	25	13	28	18	5344	6549	65	1.5 (.7-2.3)
1985	32	15	29	18	5432	6614	67	1.6 (.6-2.9)
1986	27	12	30	19	5323	6582	70	1.6 (.5-3.1)
1987	28	12	26	17	5723	6892	78	2.0 (.6-2.9)

Table 2. Moose composition counts for Unit 13 Subunits 1987.

Subunit	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Total Adults	Moose moose	Density /hour	moose/mi²
13A	28	11	21	14	1833	2126	80	2.2
13B	27	12	30	19	2756	3403	76	2.3
13C	30	13	27	17	482	582	79	2.5
13D	61	9	12	7	193	207	37	0.6
13E	24	10	34	20	459	574	87	1.3

Table 3. Annual moose harvest and accidental death in Unit 13, 1983-87.

	Harvest									
	Reported			Estimated			Accidental			Grand
Year	M	F	Total[a]	Unreported	Illegal	Total	Road	Train	Total	Total
1983	885	4	904	25	10	35	30	--	30	969
1984	830	3	839	25	10	35	30	--	30	904
1985	812	4	823	25	10	35	30	--	30	888
1986	1120	3	1140	25	10	35	30	--	30	1205
1987	948	2	959	25	10	35	30	--	30	1024

[a] Includes unknown sex.

Table 4. Moose harvest data by hunt for Unit 13, 1983-87.

Hunt	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
<u>Sport</u>								
	1983	--	--	2,283	868	864	4	868
	1984	--	--	2,528	816	813	3	816
	1985	--	--	2,634	792	788	4	792
	1986	--	--	2,734	961	958	3	961
	1987	--	--	2,782	774	773	1	774
914	1987	99	19	51	29	29	0	29
<u>Subsistence</u>								
913W	1983	100	9	55	36	36	0	36
	1984	100	18	59	23	23	0	23
	1985	200	50	119	31	31	0	31
	1986	1079	277	623	179	179	0	179
	1987	767	277	410	156	155	1	156
1987 Totals All Hunts				3,243	959	957	2	959

Table 5. Moose hunter residency and success for all hunts in Unit 13, 1983-87.

	Successful				Unsuccessful			
Year	Local resident	Nonlocal resident	Nonresident	Total[a]	Local resident	Nonlocal resident	Nonresident	Total[a]
1983	123	682	84	904	368	1890	44	2338
1984	116	650	65	839	397	2115	51	2587
1985	135	598	60	823	598	2034	48	2753
1986	230	813	81	1140	936	2299	67	3355
1987	199	633	77	959	651	2323	89	3243

[a] Includes unspecified residency.

Table 6. Moose harvest chronology for all hunts in Unit 13, 1983-87.

Year	Season dates	Week of season 1st %	2nd %	3rd %	4th %	5th %
1983	1-20 Sept.	23	31	33	13	
1984	1-20 Sept.	12	38	32	18	
1985	1-20 Sept.	43	31	26	--	
1986	1-20 Sept.	41	30	29	--	
1987	25 Aug.-20 Sept.	6	36	24	30	4

Table 7. Methods of transportation by successful moose hunters, expressed in percentage/year for 1983-87.

Year	Airplane	Horse	3- or Boat	4-wheeler	Snowmachine	Highway ORV	vehicle	Unknown
1983	24	2	8	0	0	44	20	2
1984	26	3	7	7	0	35	16	6
1985	18	3	8	11	0	36	18	6
1986	18	4	9	12	0	28	22	7
1987	16	5	7	15	0	32	19	6

Table 8. Distribution of antler spread categories by age class from Unit 13 moose harvest, 1983-1986.

Age (years)	Antler spread (inches)						
	Spike/fork	0-29%	30-35%	36-39%	>40%	>50%	>60%
Calf	100						
1	26	67	7				
2	2	7	60	23	8		
3			16	30	43	11	
4			2	2	45	46	5
5+					20	73	7

STUDY AREA

GAME MANAGEMENT UNIT: 14A (2,701 mi^2)

GEOGRAPHICAL DESCRIPTION: Matanuska Valley

BACKGROUND

Moose numbers in the Matanuska Valley were relatively low in the early 1900's. During the period 1940 to 1969, moose numbers increased dramatically in response to 2 principal factors: (1) intensive predator control by the federal government prior to statehood and (2) clearing of land for agricultural development that resulted in a substantial increase in winter range (after abandonment of farms and/or growth of browse along roads and the edges of cleared areas). Moose numbers probably peaked in the late 1960's and then abruptly declined in the early 1970's, following several hard winters and high hunter harvests. From 1966 to 1970 the mean annual harvest was 390 moose, predominantly bulls. By 1970 the bull:cow ratio had declined to 9 bulls:100 cows and Department staff had recommended a larger harvest of cows (limited cow seasons were held only in 1966 and 1969). In 1971 early and late cow seasons (i.e., 20 days each in September and November) were authorized, resulting in nearly a 3-fold increase in the harvest: 1,018 moose, including 479 cows. This harvest, coupled with 2 consecutive hard winters with very high mortality, resulted in an abrupt decline in moose numbers. Cow seasons were eliminated during the next 5 years (1972-1977), and the mean annual harvest of bulls was reduced to 251 (range = 167-346). These actions, as well as milder winters, allowed the moose populations to recover and increase. Cow seasons were reinstated in 1978. While moose numbers were increasing during this period, so was hunting pressure. In 1980 there was a 65% increase in hunters (i.e., 1,053 to 1,735), followed by a 35% increase in 1981 and another 5-10% increase during the next 3 years, stabilizing at about 2,300-2,400 hunters annually after 1983. Although harvests from 1978 to 1982 fluctuated, they generally exhibited a rising trend: means of 297 bulls (range = 201-358), 82 cows (range = 53-129), and 381 total moose (range = 281-437).

During the early 1980's, a construction boom in the Matanuska-Susitna Valley (e.g., 3,500 new houses in 1983 alone) reduced the quantity and/or availability of moose browse on winter range. Because of increased development and loss of moose habitat, maintenance and improvement of winter range has become an ongoing management concern. Additionally, a substantial increase in human population in the Matanuska-Susitna Valley in the early 1980's resulted in higher winter moose mortality from highway vehicles and a higher incidence of illegal harvest. The increasing annual mortality (of which hunting was only a part) and a winter of prolonged deep snow (i.e., 1984-85) may have stabilized or caused a slight reduction in moose numbers. Since 1985 it appears the population has remained stable or increased slightly.

POPULATION OBJECTIVES

To maintain the existing moose population with a posthunting sex ratio of no less than 20 bulls:100 cows.

METHODS

Aerial sex and age composition surveys were conducted in early winter to determine population and trends in select count areas. Harvests were monitored by requiring (1) harvest reports from hunters who took bulls in the subunit and (2) drawing-permit reports from successful antlerless moose hunters.

RESULTS AND DISCUSSION

Population Status and Trend

Because traditional count areas in some years have lacked adequate snow cover, aerial moose surveys have been conducted sporadically. Even in years in which counts were done, variable snow conditions resulted in different densities of moose on winter and summer ranges that, in turn, resulted in variation in the composition ratios and observed numbers of moose. Lack of consistency in survey data made accurate interpretation of the status of the moose population during the past 5 years difficult. However, I believe that moose numbers were stable or slightly increasing between 1982 and 1984. The prolonged winter with deep snow in 1984-85 and high mortality from trains and highway vehicles probably caused reduction in the population. However, it is now increasing slightly, as a result of mild winters and good calf production and yearling survival.

Population Size:

In March 1986 a unit-wide population census was attempted in Subunit 14A; however, it had to be terminated prior to comple tion because of high winds and deteriorating snow conditions. Only 16 of 112 sample units were surveyed, representing only one-half of the sample units needed to achieve a population estimate with a high degree of statistical confidence. Using the results from this partial census, a population estimate of 2,823 moose was calculated (range = 1,698 to 3,948). Prior to this census, Didrickson (1987) estimated that Subunit 14A contained approximately 4,000 moose.

Population Composition:

Fall composition surveys have been conducted in only three of the last 6 years (Table 1). These data indicate bull:cow ratios have fluctuated between 16:100 and 25:100. These ratios may not accurately represent changes in composition of the moose population, because variable snow depth and other related environmental conditions may have affected moose density and composition in the survey count areas. The lowest bull:cow ratio of 16:100 cows (1986) was recorded in a year with light snow cover when only 873 moose were observed, compared with 1,600 to 2,000 in other years. Also, the count areas were predominantly in winter range along valley bottoms. A high percentage of bulls remained in the higher alpine areas, which biased the observed sex ratio. I believe the bull:cow ratio in all years in which counts were conducted was at least 20:100.

Subunit 14A continues to exhibit high calf production and survival. The percentage of calves in the moose population during December in 3 different survey years was 25-27%. In March 1986 when the population census was attempted, calves composed 22% of the population, indicating that survival of calves through late winter was quite high.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters is 1 to 20 September. The bag limit is 1 moose; however, antlerless moose may be taken by drawing permit only. Up to 400 permits will be issued.

Human-induced Mortality:

The combined reported harvest from the general season and permit hunts for 1987-88 was 566 moose: 425 bulls, 137 cows, and 4 unspecified sex (Table 2). The total harvest was only 11 moose higher (2%) than the previous reporting period (1986-87), but the bull harvest increased by 24 moose (6% higher). The 5-year trend shows a relatively stable cow harvest (range = 123-148) and an increasing bull harvest (343 to 425).

In addition to the reported hunter harvest, Subunit 14A also had a relatively high moose mortality because of other human causes, including unreported harvests, illegal harvests, and collisions with highway vehicles or trains. In the past 5 years, the mean mortality from these causes was 163 moose. From 1983 to 1987 the total annual moose mortality from all human causes, including hunting, ranged from 529 to 820 moose (Table 2); like hunter harvest, it has been increasing during the past 5 years.

Hunter Residency and Success. In 1987, 428 of 2,274 hunters who reported hunting in Subunit 14A were successful. Over the past 5 years the annual number of hunters participating in the general (bulls-only) hunt has remained relatively constant near the mean of 2,270, but hunter success rates have increased slightly from 16.5% in 1983 to 18.8% in 1987.

The number of moose taken by local (i.e., Subunits 14A and 14B) resident hunters, compared with that for nonlocal resident hunters, has changed over the past 5 years. In 1983 and 1984 nonlocal residents killed more moose than local residents. In the past 3 years, this situation has reversed; local residents killed more moose than nonlocals. The annual harvest by nonlocal residents during the past 5 years fluctuated between 139 and 202 (mean 178); whereas, the harvest by local residents increased gradually in the past 4 years from 154 to 221 (mean 189). The percentage of successful local residents increased from 7.2% in 1984 to 9.7% in 1987.

The number of nonresidents who hunted in Subunit 14A has been consistently low. In the past 5 years, the mean annual number of nonresident hunters was 22, harvesting an average of only 8 moose annually (Table 3).

Permit Hunts. Four-hundred antlerless moose permits have been issued annually in Subunit 14A since 1982. The number of moose harvested by permit holders has been relatively consistent during this period. In 1987 hunters took 138 moose: 10 males, 127 females, and 1 unspecified sex. This compares with an annual harvest that has ranged from 119 to 143 moose and a 5-year mean of 133 moose (Table 4). The number of hunters who did not hunt (mean 60) as well as the number of unsuccessful hunters (mean 133) have also remained fairly consistent. The greatest variability has occurred in the number of applicants for this hunt, ranging from 5,642 to 7,491. In 1985 there were only 1,277 applicants, but in that year only qualified subsistence hunters were eligible.

Harvest Chronology. Reported dates of harvest for the past 5 years show that 40-60% of the annual harvest occurred in the first week of the hunting season (Table 5). In the past 2 years a larger number of moose were harvested in the last week of the season, increasing from 77 in 1985 to 130 in 1987. Larger harvests at the end of the season occurred, in part, because of an overall increase in the annual harvest, but I believe a contributing factor may also have been that more hunters had a tendency to hunt in Subunit 14A during the last week of the season because they knew that other areas of the state (i.e., Subunit 14B in particular) would remain open for another 11 days.

Transport Methods. Highway and off-road-vehicles (ORV's) have been the predominate means of transportation among successful moose hunters because of good road and trail access in Subunit 14A, accounting for over 50% of the moose harvest (mean 167) in the past 5 years (Table 6). The major trend in transportation methods used by successful hunters is the dramatic increase in the use of 3- and 4-wheelers. In 1984 only 20 moose were reported killed using this method. In 1987 use of 3- and 4-wheelers by successful hunters had climbed to 70, the second-most-popular transportation method next to highway vehicles. Other transportation methods used to take moose, listed in descending order of importance, were boats (59), aircraft (25), and horses (14).

Game Board Actions and Emergency Orders

Alaska statutes require the Board of Game to reauthorize antlerless moose seasons annually. In 1982 the number of antlerless permits was increased from 150 to 400. In 1986 the antlerless season was shortened to 6-20 September, and then in 1987 it was lengthened back to 1-20 September. The Board of Game has not made any other major changes to the moose hunting regulations since 1982.

CONCLUSIONS AND RECOMMENDATIONS

Aerial composition counts conducted in years with good snow cover indicate that the population objective of 20 bulls:100 cows has been achieved and maintained. The major shortcoming in the moose management data is a firm estimate of the number of moose in Subunit 14A. An incomplete census in March 1986 indicated 2,823 moose ±1,125, but those figures are believed to be low. An accurate moose census is needed to establish a population base from which management data, such as annual harvests and other annual mortalities, can be more accurately evaluated.

The Board of Game, the Mat-Valley Advisory Committee, and some of the local citizens have annually requested a review of the antlerless moose season to determine if the harvest of cows (currently 137) is biologically sound. Although estimates on the size of the moose population are not precise, the existing cow season appears justified. Yearling recruitment is averaging 22% annually. If the moose population currently numbers 3,000-4,000, then approximately 660-880 yearlings are added annually. Assuming a 50:50 sex ratio, 330-440 yearling cows would be added to the population. In 1987, the number of cows harvested by hunters (137) and cow mortality from causes other than natural was estimated to be 170 (i.e., 820 minus 566 = 284 x 60% cows = 170). Using these figures, estimated cow mortality from human causes is approximately 307 (i.e., 137 +170), which is less than the estimated recruitment of 330-440. Therefore, the cow harvest appears to be below sustained yield, even allowing some mortality from natural causes. These data support a continuation of the antlerless season.

LITERATURE CITED

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Table 1. Moose composition counts for Subunit 14A, 1982-1987.

Year	Males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose/ hr	Population estimate
1982	19.9	40.3	25.1	1,533	2,055	58.9	3,000-4,000
1983[a]	--	--	--	--	--	--	--
1984[a]	--	--	--	--	--	--	--
1985[a]	--	--	--	--	--	--	--
1986	16.4	38.8	25.0	647	863	61.2 (est)	3,000-4,000
1987	25.6	47.3	27.3	1,225	1,686	n/a	3,000-4,000

[a] No surveys flown.

Table 2. Annual moose harvest and accidental death in Subunit 14A, 1983-1987.

	Harvest									
	Reported			Estimated			Accidental[d]			Grand
Year	M	F	Total[a]	Unreported[b]	Illegal[c]	Total	Road	Train	Total	total
1983	343	148	534	27	30	57	94	8	102	693
1984	311	139	460	23	37	60	51	33	84	604
1985	324	123	457	23	21	44	24	4	28	529
1986	401	134	555	28	26	54	112	22	134	743
1987	425	137	566	28	30	58	151	45	196	820
Mean	361	136	514	26	29	55	86	22	108	700

[a] Total includes moose of unknown sex.

[b] This estimate was derived by taking 5% of the total reported kill.

[c] Includes moose taken in defense of life or property.

[d] Road and train are minimum numbers; in most years actual kill was probably higher.

Table 3. Moose hunter residency and success for Subunit 14A, 1983-87[a].

	Successful					Unsuccessful					
Year	Local[b] resident	Nonlocal resident	Nonres	Unk	Total	Local[c] resident	Nonlocal resident	Nonres	Unk	Total	Total hunters
1983	179	202	5	5	391	1,930	unk	14	33	1,977	2,368
1984	154	163	4	0	321	1,898	unk	11	14	1,923	2,244
1985	172	139	9	10	330	1,558	unk	15	58	1,652	1,982
1986	223	203	6	4	436	1,969	45	10	20	2,044	2,480
1987	221	185	9	13	428	1,733	46	18	49	1,846	2,274
Mean	189	178	8	6	381	1,817	-	14	35	1,888	2,270

[a] Does not include hunters participating in drawing permit hunts.

[b] Includes only residents of Subunits 14(A) and 14(B).

[c] Includes <u>all</u> Alaskan residents from 1983-1985, and <u>all</u> Unit 14 residents in 1986 and 1987.

Table 4. Harvest data by permit hunt[a] for Subunit 14A, 1983-1987.

Year	# Applicants	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Males	Females	Total
1983	5,642	400	57	200	143	8	135	143
1985	6,643	400	77	184	139	7	132	139
1985	1,277[b]	400	55	218	127	6	121	127
1986	7,491	400	61	220	119	3	116	119
1987	6,631	400	51	211	138	10	127	138
Mean	5,537	400	60	207	133	7	126	133

[a] Permit hunts 919 and 920 combined.

[b] Only qualified subsistence hunters (Tier II) were eligible to apply.

Table 5. Moose harvest chronology[a] for Subunit 14A, 1983-1987.

Year	Before season opened	1st	(%)	2nd	3rd	4th	After season closed	Unknown	Total
1983	2	214	(54)	69	46	-	2	58	391
1984	4	187	(58)	61	45	-	8	16	321
1985	4	180	(55)	56	77	-	0	13	330
1986	6	167	(38)	97	131	-	7	28	436
1987	7	184	(43)	92	130	-	2	13	428

[a] Does not include harvest from drawing permit hunts.

Table 6. Successful moose hunter transport methods[a] in Subunit 14A, 1983-1987.

Year	Airplane	Horse	Boat	3- or 4- wheeler	Snowmachine	ORV	Vehicle	Unk	Total all methods
1983	22	16	47	0[b]	1	85	198	22	391
1984	18	6	44	20	0	61	145	27	321
1985	28	13	42	43	0	37	148	19	330
1986	27	14	56	71	1	56	173	38	436
1987	25	14	59	70	0	45	173	43	428
Mean	24	13	50	41	1	57	167	30	381

[a] Does not include transport data from drawing permit hunts.

[b] In 1983 use of 3- or 4- wheelers was reported as ORV use.

STUDY AREA

GAME MANAGEMENT UNIT: **14B (2,079 mi²)**

GEOGRAPHICAL DESCRIPTION: **Western Talkeetna Mountains (Willow to Talkeetna)**

BACKGROUND

Moose numbers in the lower Susitna Valley and western Talkeetna Mountains were relatively low in the early 1900's. Moose numbers increased substantially from 1940 to 1969 in response to the following factors: (1) persistent predator control efforts by the federal government prior to statehood and (2) clearing of land for agricultural and highway development, resulting in increased winter range after farms were abandoned and/or growth of browse occurred along roads and edges of cleared areas. Because access within Subunit 14B was limited and harvests were relatively low, moose numbers continued to increase through the 1960's, peaking in the latter part of the decade.

The mean annual harvest in 1966-1970 of 144 moose was predominantly bulls. During this period, limited cow seasons were held during 1966 and 1969, resulting in a harvest of 25 and 46 cows, respectively. Bull:cow ratios were low in some heavily hunted areas, and because harvests in remote areas of Subunit 14B were well below sustained yield, a harvest of up to 350 cows was authorized in 1971. This regulation resulted in a 4-fold increase in the annual harvest (from 82 to 372), of which 243 were cows. Snowfall during the winters of 1970 and 1971 was near record levels, resulting in a very high winter mortality, particularly calves. Two back-to-back hard winters with high moose mortality and the record harvest of moose resulted in an abrupt decline in the moose population.

Between 1972 and 1977 cow seasons were held on a limited basis only 2 times (by permit only), and in 1974 the late-winter bull season (1-20 November) was eliminated. From 1972 to 1977 the mean annual harvest of bulls and cows combined was only 51 moose. Restricted hunting seasons and a series of relatively mild winters allowed the Subunit 14B moose population to recover and gradually increase in number. Cow seasons were reinstated in 1978, when 100 permits were authorized during the 1-20 September season. In 1979 a late-winter antlerless season (15 Dec-15 Feb.) was also authorized (50 permits). Concurrent with the change in these regulations, or perhaps because of them, a corresponding increase in hunting pressure occurred. From 1978 to 1982 numbers of hunters increased from 368 to 997, a 2.7-fold increase in 4 years. At the same time moose harvests also increased from 115 in 1979 to 248 in 1982 (mean = 168), but staff felt that this moderate harvest was not excessive.

Access to most of Subunit 14B was difficult, particularly the Talkeetna Mountains, and remote moose populations were lightly hunted. In 1982 a general cow season (i.e., 10 to 20 September) was authorized east of the powerline intertie (i.e., located approximately 3 miles east of the Parks Highway), and in 1983 the entire subunit was opened to either-sex hunting from 1 to 30 September. These liberalizations, together with the fact that Subunit 14B was one of the few areas along the road system that remained open to moose hunting after 20 September, produced a significant increase in the number of hunters and a corresponding increase in the annual harvest. Although the winter hunt was eliminated in 1985 and the area and season length open for cows was reduced in 1985 and in subsequent years, higher hunter harvests from 1983 to 1987 and relatively high mortality from trains, highway vehicles, and severe winters (particularly the winter of 1984-85) may have exceeded annual recruitment in some years, resulting in a decline in moose numbers in portions of the subunit.

A construction boom in the early 1980's, which is still continuing today, accentuated moose management problems. Increased emphasis on agriculture, timber harvest, grazing, and land development has the potential to adversely impact moose populations because of large-scale loss of habitat. Increases in human population and hunters have contributed to complexities in moose management.

POPULATION OBJECTIVES

To maintain the existing moose population with a posthunting sex ratio of no less than 30 bulls:100 cows.

METHODS

In years when snow conditions were adequate, aerial sex and age composition surveys were conducted annually during early winter in select count areas to determine population and trends. In 1987 a complete population census was conducted in early December by stratified sampling. Sex and age composition was recorded during the census. Harvests of bulls and cows were monitored by requiring harvest reports from any person who successfully hunted in the subunit.

RESULTS AND DISCUSSION

Population Status and Trend

Although aerial surveys to determine moose population composition and trend have been conducted for many years in Subunit 14B, estimates of the moose population prior to 1983 are not available. Based on counts of about 1,800 moose in 1983 and 1984, observers believed at least 2,500 to 3,000 moose were present at that time, but the moose population may have numbered as high as 4,000-4,500. A prolonged winter with deep snow in 1984-85, coupled with high hunter harvest (534 in 1984) and relatively high mortality from trains and highway vehicles (261 in 1984), caused a significant reduction in moose numbers by the end of the winter. Since 1985 the annual mortality has probably been very near or slightly greater than annual recruitment and the population has remained stable or decreased slightly.

Population Size:

A population census in Subunit 14B was conducted between 5 and 8 December 1987. Because areas above an elevation of 3,500 feet were not considered to be suitable moose habitat, they were not censused. The remaining 1,072-mi^2 area was divided into 88 sample units, ranging in size from 7.7 to 20.4 mi^2; the majority of the sample units were between 10 and 14 mi^2. All 88 sample units were stratified to determine whether relative moose densities were low, medium, high, or "superhigh." All 22 sample units were classified as having "superhigh" and high densities and 16 randomly selected sample units from the low and medium density areas were censused. This stratified census resulted in a population estimate of 2,900 ±450 moose. Average density for all 88 sample units was calculated to be 2.7 moose/mi^2, and observed densities within strata were as follows: low, 0.6/mi^2; medium, 1.71/mi^2; high, 2.92/mi^2; and "superhigh", 7.66/mi^2. Moose densities (and numbers) in the southern half of Subunit 14B were considerably higher than those in the northern half.

Population Composition:

Fall composition surveys have been conducted in only three of the last 6 years, but composition data were also obtained in the 1987 census (Table 1). These data indicate bull:cow ratios have been relatively consistent, ranging from 34:100 to 43:100. The bull:cow ratio from the 1987 census was 36.8:100, which is probably the most accurate one because it was calculated from a random sample covering all habitats in Subunit 14B.

Calves observed in Subunit 14B during fall composition surveys have constituted 14.9-18.2% of the surveyed sample (Table 1). The census indicated that 17.4% of the population were calves (28 calves:100 cows). Compared with other areas in Alaska, this calf proportion would be classified as fair to good, but it is still lower than that in Subunit 14A, where winters are milder and predation is lower. No late-winter surveys have been conducted in Subunit 14B, but based on the calf proportion in December (17%), I estimate yearling recruitment was 12-14% of the population.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters in that portion of Subunit 14B including the Anchorage-Fairbanks powerline intertie corridor is 1 to 30 September; the bag limit is 1 moose. The open season for resident and nonresident hunters in the primarily because the hunting season was extended 10 days. With this change, Subunit 14B was one of the few areas on the road system that remained open to moose hunting after 20 September. The extended hunting season resulted in the attraction of late-season hunters. Hunters were also attracted to hunt in the final week of the season, because moose of either sex could be taken without a permit. Similar hunting regulations in Subunit 14B were in effect in 1984, and the chronology of the harvest also showed a secondary peak in the harvest during the final week of the season (Table 4).

Transport Methods. The major transportation trend was the dramatic increase in the use of 3- and 4-wheelers and a corresponding decrease in use of highway and off-road vehicles (ORV's). Access into Subunit 14B is primarily off the Parks Highway or Hatcher Pass Road, making highway vehicles a principal means of getting to the hunting area. In the early 1980's, access to most of the remote areas in Subunit 14B was limited; therefore, most moose were killed by hunters gaining access from the highway system using highway vehicles or specialized ORV's. With the improvement in 3- and 4-wheeler technology, use of these vehicles has increased, especially as new and better trails are pioneered into the back country. In 1984, 60 moose were killed using 3- or 4-wheelers; in 1987 hunters using this means of transportation killed 90 moose. In contrast, use of highway vehicles decreased from 202 in 1983 to 83 in 1987; ORV's showed a similar trend, decreasing from 123 to 76. In 1987 successful hunters used the following transportation methods to take moose (Table 5): 3- or 4-wheelers, 90 (26%); highway vehicles, 80 (27%); ORV's, 76 (22%); airplanes, 45 (13%); boats, 27 (8%); horses, 5 (1%); and unspecified, 21 (6%).

Game Board Actions and Emergency Orders

From 1978 to 1982 the Board began liberalizing cow seasons because of low harvests and concern that moose might be nearing winter range carrying capacity. Permit hunts for antlerless moose were conducted in the fall and late winter. After 4 years of consecutive cow seasons, some concern was expressed about the "excessive" harvest along the highway system. In 1982 the Board created 2 management strategies to harvest cows: (1) west of the powerline intertie, cows could only be taken by drawing permit (100 permits) and (2) east of the intertie an 11-day general cow season (10-20 September) was established during the middle of the regular bull season (1-30 September). In 1983 the Board established an either-sex, 30-day season throughout the unit. The late-winter antlerless season was also retained. These regulations remained in effect through 1984. In 1985 concern over high moose mortality from a severe winter and generally high harvests from the 2 previous years resulted in some restrictions to hunting. The late-winter antlerless season and the cow season west of the powerline were eliminated. The Board set a bag limit of 1 moose east of the powerline intertie and 1 bull in the remainder of Subunit 14B; also, the hunting season was shortened to 1-20 September throughout the subunit.

The Board reviewed the antlerless hunting season in 1986, and no changes were made. In 1987 the hunting season was lengthened from 1-20 September to 1-30 September, and the either-sex bag limit east of the powerline intertie was retained.

CONCLUSIONS AND RECOMMENDATIONS

Composition counts conducted in years with good snow cover and the results from the 1987 stratified census indicate that the population objective of 30 bulls:100 cows has been achieved and maintained. Completing the population census in Subunit 14B was a major milestone in the moose management program. As information from future censuses becomes available, trends in the moose population will be easier to determine. Because the census information provides a more precise estimate of the number of moose in Subunit 14B, it is now possible to more accurately evaluate the effects of hunting and other causes of mortality.

The Board of Game, the Mat-Valley Advisory Committee, and the local public annually request a review of the antlerless moose season to determine if the harvest of cows is biologically sound. The stratified census resulted in a population estimate of 2,900 ±450 moose. The composition data indicated that 61% were adult cows; therefore, 1,775 cows would be potentially available for breeding. Calves composed 17.4% of the population in December. Yearling recruitment was approximately 12-14% because of some losses of calves during the winter. If the Subunit 14B moose population numbers 2,900, approximately 348 to 406 yearlings (12-14% of 2,900) will be recruited annually. Assuming a 50:50 sex ratio, 174 to 203 yearling cows will be added to the population.

In 1987 hunters harvested at least 118 cows and 254 moose died from other human causes; however, this figure was unusually high. Using a 5-year mean is more realistic in determining the long-term effects on the moose population from these types of mortality. From 1983 to 1987 the mean mortality from human causes, other than reported hunting, was 163 moose (Table 2); of these, about 99 moose were cows (163 x 61% = 99). Using the foregoing figures, estimated mortality from all human causes was approximately 217 cows (118 +99), which is higher than the estimated recruitment of 174-203 cows. If some allowance is made for natural mortality (i.e., perhaps 1-3% of the cow population, or 18-53 cows), then it is probable that annual cow mortality (from all causes) exceeded annual recruitment. These data strongly suggest that (1) mortality of cows should be reduced and (2) continuation of the either-sex season, as it presently exists, is not a prudent management policy. Further, I recommend that the either-sex season east of the powerline intertie be modified to eliminate or significantly reduce the harvest of cows.

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Table 1. Moose composition counts in Subunit 14B, 1982-1987.

Year	Males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hr	Population estimate
1982	43.0	29.1	16.9	934	1,124	47.8	2,000-2,500
1983	33.8	23.4	14.9	1,556	1,828	47.5	2,500-3,000
1984	34.7	33.7	18.2	1,449	1,771	55.2	2,500-3,000
1985[a]	--	--	--	--	--	--	--
1986[a]	--	--	--	--	--	--	--
1987[b]	36.8	28.4	17.4	906	1,097	n/a	2,900 ± 362

[a] No surveys flown.

[b] These data were derived from a population census conducted in December 1987.

Table 2. Annual moose harvest and accidental death in Subunit 14B, 1983-87.

	Harvest									
	Reported			Estimated			Accidenta death[d]			
Year	M	F	Total[a]	Unreported[b]	Illegal[c]	Total	Road	Train	Total	Grand total
1983	219	228	464	23	20	43	39	21	60	567
1984	258	271	534	27	40	67	77	184	261	862
1985	126	88	216	11	22	33	5	4	9	258
1986	131	104	243	12	7	19	28	37	65	327
1987	227	118	347	17	25	42	43	173	216	625
Mean	192	162	361	18	23	41	38	84	122	528

[a] Total includes moose of unknown sex.

[b] This estimate was derived by taking 5% of the total reported kill.

[c] Includes moose taken in defense of life or property.

[d] Road and train are minimum numbers; in most years actual kill was probably higher.

Table 3. Moose hunter residency and success in Subunit 14B, 1983-87.

Year	Successful							Unsuccessful					Total hunters
	Local[a] resident	(%)	Nonlocal resident	(%)	Nonres	Unk	Total	Local[b] resident	Nonlocal resident	Nonres	Unk	Total	
1983	136	(32)	278	(65)	9	3	426	1,832	unk	23	23	1,878	2,304
1984	167	(37)	309	(63)	8	6	490	1,992	unk	22	20	2,034	2,524
1985	87	(40)	119	(55)	6	4	216	1,025	unk	17	24	1,066	1,282
1986	98	(40)	131	(53)	10	4	243	932	35	11	13	991	1,234
1987	133	(38)	182	(52)	8	24	347	1,312	50	23	54	1,439	1,786
Mean	124		204		8	8	344	1,419	--	19	27	1,482	1,826

[a] Includes <u>only</u> residents of Subunits 14(A) and 14(B).

[b] Includes <u>all</u> Alaska residents in 1983-1985, and <u>all</u> Unit 14 residents in 1986 and 1987.

Table 4. Moose harvest chronology for Subunit 14B, 1983-87.

Year	Before season opened	Weeks of Season 1st 1-6	(%)	2nd 7-13	3rd 14-20	4th 21-27	After season closed	Unknown	Total
1983	4	219	(51)	57	65	54	3	24	426
1984	1	204	(41)	59	79	122	3	22	490
1985	2	113	(52)	46	46	1	1	7	216
1986	1	97	(40)	66	63	0	3	13	243
1987	0	115	(33)	47	56	116	2	11	347

Table 5. Successful moose hunter transport methods for Subunit 14B, 1983-87.

Year	Airplane	Horse	Boat	3- or 4- wheeler	Snowmachine	ORV	Vehicle	Unk	Total all methods
1983	32	2	57	0	2	123	202	8	426
1984	53	4	39	60	0	127	163	44	490
1985	31	0	19	42	0	72	42	10	216
1986	26	6	23	53	0	59	59	16	243
1987	45	5	27	90	0	76	83	21	347
Mean	37	3	33	49	1	91	110	20	344

STUDY AREA

GAME MANAGEMENT UNIT: 14C (2,091 mi^2)

GEOGRAPHICAL DESCRIPTION: Anchorage area

BACKGROUND

Moose were uncommon in the Anchorage area prior to the 1940's. They began to increase in the late 1940's as brushy regrowth replaced mature forests that had been cut or burned during the development of Anchorage and Fort Richardson. Their range and numbers expanded considerably during the early 1950's, and by the late 1950's and early 1960's they were abundant throughout the subunit. The population has remained at a high level over the past 25-30 years.

Prime browse is prevalent in open-canopied second-growth willow, birch, and aspen stands on burned-over military lands and on several hundred acres that have been rehabilitated on Fort Richardson and Elmendorf Air Force Bases (AFB) over the past 13 years. Fringe residential areas throughout the Anchorage bowl also contain considerable browse. Quality riparian habitat is abundant along the area's streams and rivers. Extensive stands of subalpine willow also exist on south-facing slopes in most drainages.

Annual moose harvests have fluctuated dramatically over the past 10 years. A record harvest of nearly 500 moose (half of which were females) took place in 1965. Only 18 moose were killed in 1978. The large harvest fluctuations are attributable more to the curtailment of various hunts and the elimination of a cow harvest during certain years than to fluctuations in the moose population. During the 1980's, the harvest has stabilized at a mean of 145 (one-third of which have been cows), annually.

POPULATION OBJECTIVES

To maintain the existing moose population with a posthunting sex ratio of no less than 25 bulls:100 cows.

METHODS

Fall and early winter sex and age composition counts were conducted throughout the subunit. A population census was conducted on the 2 military reservations and adjacent lands in late fall. Spring aerial survival counts were conducted on military lands and in the Portage area.

RESULTS AND DISCUSSION

Population Status and Trend

Despite substantial overall mortality, numbers of moose have remained relatively stable during the 1980's. Population stability is partially attributable to a series of mild winters beginning in 1979-80; however, since the quantity of critical winter browse continues to decline as a consequence of both maturation and urbanization, a decline in the current population level appears likely. The inevitable return of more severe winters will reduce the population even further.

Population Size:

Numbers of moose have been determined by thorough composition counts throughout the mountainous portion of the subunit and by a stratified census conducted on Fort Richardson and Elmendorf AFB lands in December 1987. The current subunit population is estimated at 1,650 moose (Table 1).

Population Composition:

Population composition in Subunit 14C has remained relatively constant over the past 5 years (Table 2). The percentage of calves in the herd has fluctuated between 20% and 26% from 1983 to 1987. Since 1983 the bull:cow ratios have ranged from 33:100 to 48:100, excepting 1984 when 66 bulls:100 cows were observed. This substantial increase was attributed to large numbers of bulls observed in the Fort Richardson-Ship Creek, Hillside, and Eklutna count areas that fall. The reason for the increase is unknown.

Distribution and Movements:

Moose are year-long residents from sea level to an elevation of 3,000 feet throughout the subunit. During winters with substantial snow accumulation, the vast majority of moose are found at elevations below 1,500 feet. Extensive movements of several miles or more by both sexes occur during the breeding season in September and October and again prior to green-up in late April.

Mortality

Season and Bag Limit:

The open seasons for resident and nonresident hunters in that portion of Subunit 14C known as the Fort Richardson Management Area is 8 September to 31 October and 15 December to 15 January. The bag limit is 1 moose by drawing permit and bow and arrow only. Up to 90 permits will be issued. There is no open season in that portion of Subunit 14C known as the Anchorage Management Area. The open season for resident and nonresident hunters in that portion of Subunit 14C known as the Eklutna Lake Management Area is 8 to 30 September. The bag limit is 1 moose by bow and arrow and by registration permit only. Ten bulls and 15 cows may be taken.

The open season for resident and nonresident hunters in the remainder of Subunit 14C is 8 to 30 September. The bag limit is 1 moose; however, antlerless moose may be taken by drawing permit only. 50 permits will be issued to Alaska residents only.

Human-induced Mortality:

Total hunter harvest has remained relatively stable at a high level since the early 1980's. The mean annual harvest since 1981 has been 145 moose; one-third of these have been cows. During the 1970's, approximately one-half as many moose were taken annually, primarily because seasons were curtailed and fewer cows were taken. During the 1987-88 season, 158 moose were harvested, including 106 bulls and 52 cows (Table 3). Sixty-six of the bulls were taken during the general bull season by 248 hunters. The remaining moose were taken during special permit hunts.

Moose killed by highway vehicles and trains add substantially to the human-induced mortality; the 5-year (1983-87) mean is 125 moose annually (Table 3). During 1987-88, a record number (i.e., 28) were killed by trains. This substantial mortality occurred primarily in the Portage-Girdwood area because of record snowfall that persisted throughout much of the winter, forcing moose onto the railroad right-of-way.

Hunter Residency and Success. Residents of Subunit 14C account for approximately 80% of the moose harvest (Table 4). Residents of other units or subunits take slightly less than 20% of the total harvest. Nonresidents account for less than 1% of the annual take.

Permit Hunts. Table 5 contains harvest data for the individual permit hunts held in Subunit 14C. During the 1987-88 season, 362 hunters were issued hunting permits; of these, 92 (25%) were success ful. Sixty of the 92 hunted in the Fort Richardson drawing archery hunts. Drawing-permit moose hunts in the subunit are extremely popular. During 1987, 1882 applicants applied for the 160 available permits. An additional 204 hunters were issued registration permits for the Eklutna Valley hunt.

Harvest Chronology. Because of variable opening days tied to the timing of Labor Day, harvest comparisons during the 1st week of September are meaningless. Harvests during the 2nd, 3rd, and 4th weeks are comparable (Table 6). In recent years, a winter hunt on military land has been held from mid-December through mid-January after upland and lowland moose have mixed in accessible lowland areas of Fort Richardson.

Transport Methods. Approximately 70% of all successful moose hunters utilize highway vehicles and then walk to gain access to preferred hunting areas. Prohibition of motorized vehicles in most of Chugach State Park and the accessibility of lowland moose account for the high percentage of walk-in hunters. An additional 10% of successful hunters utilize boats, and 6-8% use horses.

Natural Mortality:

Because of relatively low numbers of predators and mild winters, natural mortality has been minimal in the large Fort Richardson and

Anchorage hillside populations. Natural mortality elsewhere in the subunit, where predators are more abundant, is comparable to other areas in Southcentral Alaska.

Habitat Assessment

Large tracts of subalpine and riparian habitat are preserved throughout the 500,000-acre Chugach State Park and on Forest Service lands from Girdwood to Portage. Several thousand acres of prime lowland habitat exist on military lands between lower Ship Creek and Eagle River. Extensive urbanization has significantly reduced winter range on private land from the Knik River to Potter Creek.

During severe winters when moose are concentrated on these and other lowland areas below an elevation of 500 feet, substantial starvation will occur. This likely would have been the case during the winter of 1987-88 had not snowfall subsided in early January. Some calf mortality was documented, despite minimal snowfall and warm temperatures, from February through April. On private property, no solution to the problem exists. On military and municipal lands, well planned habitat enhancement could alleviate the problem somewhat. Lack of funds and regulations limiting habitat alteration on these lands have precluded enhancement programs in recent years.

Game Board Actions and Emergency Orders

Game regulations have changed substantially over the past 5 years. Major revisions in 1987 involved the elimination of the Eagle River archery hunt and the conversion of the Fort Richardson gun hunt to archery only. Fort Richardson now has 3 separate archery hunts; two occur during September and October and one from mid-December through mid-January. A total of 90 permits are issued. Other recent changes include the suspension of cow hunting in the Portage area in 1986 and revision of the Anchorage Management Area hunt; it will only occur during the year following a survey in which more than 130 moose are counted. This regulation was adopted to eliminate the possibility of cancelling a hunt after permits had been issued. The general September bull season has remained consistent over the past 5 years, except for a 10-day season reduction in 1986. In 1987 the season was again closed on September 30. No Emergency Orders have been issued during the past 5 years.

CONCLUSIONS AND RECOMMENDATIONS

Under the current management scheme, major population objectives for the subunit are being met. The present ratio of bulls to cows exceeds 25:100, and approximately 1,650 moose occupy defined count units; an additional 100-150 reside in areas that have not been surveyed.

Existing management strategies have been developed over the past decade. During that period, numerous conflicts with the 2 major land managers (Fort Richardson and Chugach State Park) have arisen. Through restrictions on methods of take and compromise on open and closed areas, management strategies acceptable to all parties have been developed.

Current regulations adequately provide for substantial hunting opportunity and harvest from a productive population in an area where multiple land management agencies limit modes of access. No regulatory changes are recommended at this time.

Nuisance moose in residential areas remain a significant problem not easily dealt with. Public education regarding the habits of moose may improve public tolerance for moose and reduce conflict situations.

PREPARED BY:	SUBMITTED BY:
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Wildlife Biologist III	Management Coordinator

Table 1. Moose composition counts, Subunit 14C, 1983-87.

Drainage	Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Total moose	Moose/ hr.	Population estimate
Portage								
	83	41	7	44	24	200	67	--
	84	34	25	52	28	199	67	--
	85	24	11	44	26	168	47	--
	86	22	18	44	27	176	65	--
	87	30	13	50	28	189	57	240
Hillside								
	83	71	--	53	24	173	86	--
	84	106	12	38	16	83	83	--
	85	--	--	--	--	--	--	--
	86	37	22	35	19	83	66	--
	87	62	26	35	18	130	41	220
Fort Richardson								
	83	55	--	59	28	417	--	--
	84	65	--	39	18	260	--	--
	85	40	--	34	24	216	--	--
	86	47	--	60	29	474	50	--
	87	41	20	38	21	494	29	600
Eagle River								
	83	44	16	39	21	113	47	--
	84	22	5	24	17	121	33	--
	85	--	--	--	--	---	--	--
	86	--	--	--	--	---	--	--
	87	44	16	27	16	109	39	160
Peters Creek								
	83	39	25	43	24	51	51	--
	84	27	8	42	25	44	34	--
	85	--	--	--	--	--	--	--
	86	8	8	46	30	40	47	--
	87	14	6	39	25	55	39	80

- Continued -

Table 1. Continued.

Drainage	Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Total moose	Moose/ hr.	Population estimate
Eklutna								
	83	41	12	36	20	129	52	--
	84	61	16	43	17	152	52	--
	85	--	--	--	--	--	--	--
	86	45	16	23	13	104	41	--
	87	47	11	22	13	86	27	120
Bird								
	83	--	--	--	--	--	--	--
	84	83	26	35	16	50	50	--
	85	--	--	--	--	--	--	--
	86	--	--	--	--	--	--	--
	87	--	--	--	--	--	--	70
Hunter Creek								
	83	47	17	53	26	106	53	--
	84	--	--	--	--	---	--	--
	85	--	--	--	--	---	--	--
	86	41	15	49	26	152	91	--
	87	51	14	40	21	147	77	220
Subunit 14C Total	83	48	19	46	24	1,243	47	--
	84	66	11	52	20	931	66	--
	85	33	--	38	22	384	26	--
	86	39	18	48	26	1,029	56	--
	87	42	17	38	21	1,210	37	1650

Table 2. Annual moose harvest and accidental death, Subunit 14C, 1983-87.

	Harvest									
	Reported			Estimated			Accidental			Grand
Year	M	F	Total	Unreported	Illegal	Total	Road	Train[a]	Total	total
1983	128	96	224	10	10	244	159	3	162	406
1984	128	53	181	10	10	201	130	3	133	334
1985	91	37	128	10	10	148	87	3	90	238
1986	88	33	121	10	10	141	105	3	108	249
1987	106	52	158	10	10	178	105	28	133	311

[a] Estimated

Table 3. Moose hunter residency and success, Subunit 14C, 1985-87.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Nonres.	Total	Local res.	Nonlocal res.	Nonres.	Total
1985	87	26	3	116	275	69	5	349
1986	101	17	0	118	310	62	0	372
1987	97	22	0	119	282	84	3	369

Table 4. Harvest data by permit hunt, Subunit 14(C), 1983-87.

Permit Hunt	Year	Issued permits	Did not hunt	Unsucc. hunters	Succ. hunters	Bulls	Cows
Portage	1983	60	6	20	34	21	13
	1984	60	8	22	30	22	8
	1985	60	7	15	38	25	13
	1986	20	--	--	9	9	0
	1987	20	1	9	10	10	0
Fort Richardson (gun)	1983	40	5	3	32	17	15
	1984	50	12	25	13	13	0
	1985	--	--	--	--	--	--
	1986	35	4	0	31	16	15
	1987[a]	--	--	--	--	--	--
Fort Richardson (archery)	1983	25	0	4	21	12	9
	1984	25	1	4	20	11	9
	1985	--	--	--	--	--	--
	1986	15	0	10	5	5	0
	1987	90	6	23	60	24	36
Hillside	1983	211	29	141	41	19	22
	1984[b]	--	--	--	--	--	--
	1985[c]	12	0	4	8	2	6
	1986[b]	--	--	--	--	--	--
	1987[b]	--	--	--	--	--	--
Eagle River	1983	137	47	70	20	7	13
	1984	101	26	63	12	7	5
	1985	75	--	--	3	0	3
	1986	70	--	--	5	2	3
	1987[a]	--	--	--	--	--	--

- Continued -

Table 4. Continued.

Permit Hunt	Year	Issued permits	Did not hunt	Unsucc. hunters	Succ. hunters	Bulls	Cows
Eklutna	1983	117	52	58	7	2	5
	1984	116	21	84	11	4	7
	1985	100	--	--	6	1	5
	1986	183	27	131	14	9	5
	1987	204	33	154	13	6	7
14(C) Antlerless	1983	50	17	18	15	0	15
	1984	50	15	30	5	0	5
	1985	50	11	23	16	0	16
	1986	50	--	--	9	0	9
	1987	50	14	27	9	0	9

[a] Hunt eliminated.

[b] Special airport hunt.

[c] No hunt held.

Table 5. Moose harvest chronology percent by time period, Subunit 14(C), 1985-87.

Year	Harvest dates 9/1-9/7	9/8-9/14	9/15-9/21	9/22-9/28	9/29-10/5
1985	15	20	19	28	17
1986	30	25	25	16	4
1987	2	24	22	34	19

Table 6. Successful moose hunter transport methods, Subunit 14C, 1985-87.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle
1985	2	4	10	9	0	5	71
1986	1	8	12	7	0	4	68
1987	1	8	9	3	0	4	75

STUDY AREA

GAME MANAGEMENT SUBUNIT: 15A (1,538 mi^2)

GEOGRAPHICAL DESCRIPTION: Northern Kenai Peninsula

BACKGROUND

Historical records and reports from residents suggest moose were relatively abundant throughout the century. The most recent peak in the moose population occurred in 1971. The near absence of wolves from 1913 to 1968 and increased moose survival following the 500-mi^2 forest fire in 1947 are 2 events that stimulated the moose population to increase throughout the 1950's and 1960's. Although seasons were long and either-sex harvests were allowed, the moose population increased beyond its carrying capacity. Extensive overbrowsing occurred by the late 1960's, and harsh winters from 1971 to 1974 reduced the moose population throughout the Kenai Peninsula. Estimates for Subunits 15A and 15B indicate the population declined from 7,900 in 1971 to 3,375 in 1975; Subunit 15A represents approximately 75% of the decline (i.e., 5,925 to 2,531 moose).

By 1982, the population estimate for Subunit 15A had increased slightly to 3,041 moose. The population then declined gradually until 1987, when 2,702 were counted. A census was not conducted during 1988.

POPULATION OBJECTIVES

To maintain the existing moose population with a bull to cow ratio of 15:100.

METHODS

Aerial surveys have been conducted in November and December of each year in selected trend count areas to determine the sex and age composition of the moose population. The Department and the U.S. Fish and Wildlife Service completed a moose census in Subunit 15A during February 1987. Randomly selected survey units were intensively surveyed. Fall sex and age composition surveys were conducted in nine of the 13 count areas in Subunit 15A during 1987.

RESULTS AND DISCUSSION

Population Status and Trend

The 1987 population estimate for wintering moose was 2,702; the variance was 9.7% of the population estimate with 90% confidence limits. The density was 2.1 moose/mi^2 of moose habitat. Comparing this most recent estimate with the 1982 estimate of 3,041 moose suggests a decline of 11%, or approximately 2%/year.

Population Composition:

In Subunit 15A 1,026 moose were classified; calves composed 25% of the sample, occurring at a ratio of 39:100 cows. Bulls were observed at a ratio of 16 bulls:100 cows, 4 bulls:100 cows higher than observed in 1986. The number of moose observed per hour ranged from 10 to 117; the mean was 46. For each 100 cows observed with calves, eight had twins.

Mortality

Season and Bag Limit:

The open seasons for resident and nonresident hunters in Subunit 15A are 25-29 August and 1-20 September. The bag limit is 1 bull with spike-fork or 50-inch antlers; during 25-29 August season, moose may be taken by bow and arrow only.

Human-induced Mortality:

In August and September 1987, 150 moose (131 bulls, 3 cows, and 16 unspecifieds) were harvest by 1,135 hunters; hunter success was 13%. One hundred twenty-two successful hunters were unit residents, 23 were nonunit residents, and one was a nonresident; 4 successful hunters failed to report their residency. Reported residencies for unsuccessful hunters follow: unit residents = 800, nonunit state residents = 164, nonresidents = 6, and unspecified = 15. Sixty-two percent ($\underline{N}$ = 81 of 131) of the successful and 73% ($\underline{N}$ = 579 of 789) of the unsuccessful hunters reported highway vehicles as their means of transportation. The second-most common transportation means were boats; i.e., 20% ($\underline{N}$ = 26 of 131) and 12% ($\underline{N}$ = 91 of 789) for successful and unsuccessful hunters, respectively. Hunters using aircraft were the most successful (31%), followed by those using boats (22%). Crippling and predation losses are unknown.

Included in the total harvest figure for Subunit 15A are the results of the archery season; since required information on harvest ticket reports does not include when a person hunted, it was not possible to determine how many hunters participated during that season. Two field check stations were operated by the U.S. Fish and Wildlife Service on the Refuge portion of Subunit 15A; FWS staff estimated approximately 250 archers participated. Archers hunted primarily in the area burned in 1969, using the Swanson River Road as primary access. Ten bulls were harvested; additionally, 4 bulls were shot but not retrieved, suggesting a 29% minimum crippling loss reported by archers.

114 moose were reported killed in Subunit 15A by vehicles; 50% were calves (i.e., 36% males, 64% females). The adult moose (≥1 year) consisted of 49% males and 51% females.

Of the 150 moose in the harvest, antler-spread data was provided for 86 of them (57%). The current bag limit for moose is designed to focus the harvest on yearlings and mature bulls; bulls with antler spreads <30 inches meet the yearling (spike-fork) requirement and antler spreads ≥30 inches are considered mature bulls (i.e., having 3 brow tines or an antler spread >50 inches). Seventy-eight percent ($\underline{N}$ = 67 of 86) of the harvest were spike-fork bulls and 22% ($\underline{N}$ = 19 of 86) were mature bulls. Fifteen percent ($\underline{N}$ = 13 of 86) of the reported harvest were bulls with an antler spread ≥50 inches.

Assessment and Enhancement

LeTourneau tree crushers were not used during the reporting period; however, approximately 1,800 acres of previously crushed timber in the Skilak Loop Special Management Area was burned by State and FWS staff. The FWS and the Department also agreed to reestablish a hunting season for maintaining a population size objective of 2 moose/mi^2, or 130 moose in the management area.

The 1969, 85,000-acre burn is still providing moose browse; the majority of the moose in Subunit 15A winters there. However, this area, plus small areas of improved habitat north of Skilak Lake, only make up 10-15% of the moose habitat in Subunit 15A. The remaining moose habitat is not so productive because of the plant succession to mature forest.

CONCLUSIONS AND RECOMMENDATIONS

A proposal establishing a restrictive harvest strategy for bull moose was adopted during the 1987 spring Board of Game meeting. This proposal, specifying a legal bull as one with a specific antler size, was adopted for both Units 7 and 15. Apparently as a result of this action, both effort and harvest were half the previous levels; bull to cow ratios improved from 12:100 to 16:100 in the respective fall sex and age composition surveys. If a similar increase in the bull to cow ratio is observed during the 1988 fall survey, I recommend an increase in the length of the season to 1-25 September to better serve the demands of the public and maintain the selective harvest strategy objective of protecting bulls aged 2 to 4 years.

Since the new spike-fork, 50-inch regulations have only been in place 1 season, I recommend no changes for the 1988 season. However, if the number of harvested sublegal bulls increases, a change in bag limit from 3 to 4 brow tines may be necessary to reduce confusion by hunters who may knowingly shoot a bull with less than a 50-inch antler spread, thinking it had 3 brow tines. Moose with 4 brow tines on the Kenai Peninsula rarely have an antler spread of less than the 50 inches.

PREPARED BY:	SUBMITTED BY:
Ted Spraker	John N. Trent
Wildlife Biologist	Management Coordinator

STUDY AREA

GAME MANAGEMENT SUBUNIT: 15B (1,262 mi^2)

GEOGRAPHICAL DESCRIPTION: Kenai Peninsula

BACKGROUND

Historical records and reports from Kenai Peninsula residents suggest moose in Subunit 15B have been relatively abundant throughout the century, with the most recent peak in 1971. The near absence of wolves from 1913 to 1968 is one of the primary reasons for the expansion of this population. A wildfire that burned approximately 500 mi^2 in Subunit 15A in 1947 also benefitted moose with improved winter range. A series of harsh winters from 1971 to 1974 subsequentially reduced the moose population in Subunit 15(B). Population estimates suggest a decline from 1,975 moose in 1971 to 843 by 1975. Although there are no recent census data available, harvest and survey data indicate that the population is probably stable or slightly declining.

POPULATION OBJECTIVES

To maintain a ratio of 15 bulls:100 cows, while providing for a maximum opportunity to participate in hunting in Subunit 15B West.

To maintain a ratio of 40 bulls:100 cows and provide for the opportunity to harvest a trophy size bull under aesthetically pleasing conditions.

METHODS

Aerial surveys were conducted in November and December of the reporting period in selected trend count areas to determine the sex and age composition of the moose population.

RESULTS AND DISCUSSION

Population Status and Trend

Unsuitable snow conditions have prevented composition counts in Subunit 15B since 1983; however, there have been no major habitat improvements, and winters have been relatively mild, excepting 1987-88. Moose density has not changed significantly, and the population remains stable.

Mortality

Season and Bag Limit:

The open seasons for resident and nonresident hunters in that portion of Subunit 15B bounded by a line running from the mouth of Shantatalik Creek on Tustumenta Lake, northward to the west fork of Funny River to the Kenai National Wildlife Refuge; then east along the refuge boundary to its junction with the Kenai River and Skilak Lake; then south along the western side of Skilak River, Skilak Glacier and Harding Icefield; then west along the Subunit 15B boundary to the mouth of Shantatalik Creek are 1-20 September and 26 September to 15 October. The bag limit is 1 bull with 50-inch antlers by drawing permit only; up to 100 permits will be issued. The open season for resident and nonresident hunters in the remainder of Subunit 15B is 1-20 September; the bag limit is 1 bull with spike-fork or 50-inch antlers.

Human-induced Mortality:

In Subunit 15B West, 49 moose (40 bulls, 2 cows, and 7 unspecified) were harvested by 276 hunters. This moose harvest represents a 45% reduction from that of the previous year; however the reduction was anticipated, because 1988 was the first year of the selective harvest strategy.

Of the 49 moose harvested in Subunit 15B West, hunter provided antler spread data for 23 of them (47%). Since the current bag limit is designed to focus harvest on yearling and mature bulls, an assumption was made that antlers ≤30 inches met the yearling requirement (i.e., spike-fork) and antlers ≥30 inches represented mature bulls; 65% and 35% of the harvest were spike-fork and mature bulls, respectively. Seventeen percent ($\underline{N}$ = 4 of 23) of the harvest were bulls with an antler spread ≥50 inches. In addition to the human harvest, 82 moose were killed by vehicles; 45% were calves: 38% males, 62 % females. The adult (≥1 year of age) composition was also 38% males and 62% females.

Hunter Residency and Success. Hunter success was 18% in Subunit 15B. 43 successful hunters were unit residents, five were residents from outside the Subunit, and one hunter failed to report residency. Of the unsuccessful hunters, 203 were unit residents, 16 were residents from outside the Subunit, one was a nonresident, and seven were unspecified.

Permit Hunts. Subunit 15B East is administered as a trophy moose hunting area. Hunters are selected by drawing permit. Only bulls with an antler spread of at least 50 inches or with 3 brow tines are legal game. In September and October 1987, 99 of the 100 permittees reported harvesting 34 bull moose. Sixty-nine of the 99 permit holders hunted, resulting in a hunter success of 34%. Twenty-six successful hunters were unit residents, six were residents, one was a nonresident, and one failed to indicate residency. There were 33 unsuccessful hunters: 17 unit residents, 15 residents, and 1 nonresident. The mean antler spread from bulls harvested during 1987 was 54.3 inches (range = 38-68). Mean age was 7.5 years (range = 3-14).

Transport Methods. In Subunit 15(B) West, 73% (N = 30 of 41) of the successful and 74% (N = 131 of 178) unsuccessful hunters reported highway vehicles as their primary means of transportation. The second-most commonly used method of transportation was boats: 12% and 11% for successful and unsuccessful hunters, respectively. In Subunit 15B East, 63% of the successful hunters used horses as their primary transport method for accessing their hunting area.

Habitat Assessment and Enhancement

No significant habitat enhancement has occurred in Subunit 15B since a wildfire burned a large portion of it in about 1890. Approximately 2,000 acres of winter habitat on the refuge were enhanced using a variety of mechanical tree-removal techniques during the early 1950's by the U.S. Fish and Wildlife Service. Several small acreages (i.e., less than 50 acres) have also been designated as wood-cutting areas for noncommercial use. Judging from the relative density of moose found in the wood-cutting areas, I believe these small logged areas provide additional moose browse; however, the overall assessment of moose habitat quality is relatively poor and declining because of natural plant succession.

Game Board Actions and Emergency Orders

In response to a public desire for moose with larger antlers, the Alaska Board of Game initiated a selective harvest strategy on most of the Kenai Peninsula for the 1987 season. Subunit 15B West changed from a 1986 bag limit of 1 bull to the current requirement of 1 bull with spike-fork or 50-inch antlers. Subunit 15B East remained unchanged as a trophy moose hunting area with a bag limit of 1 bull with 50-inch antlers by drawing permit only.

CONCLUSIONS AND RECOMMENDATIONS

The reported harvest of 49 moose in Subunit 15B West was 45% lower than that for the previous year. This decline in harvest was due to the new selective harvest regulations adopted by the Board of Game. The harvests should increase, approximating the 1986 level in about 5 years as protected age classes of bulls mature and become legal. No change in regulations is recommended at this time for Subunit 15B West.

The trophy bull moose hunt in Subunit 15B East continues to provide excellent hunting opportunities, and it is popular among resident hunters. The harvest of 34 bulls during 1987 was well within acceptable guidelines for maintaining a minimum bull:cow ratio of 40:100. Since the objective for this area is to provide an opportunity to take a large bull under aesthetically pleasing condition, I recommend no change in season. I also recommend that the bag limit be maintained to preserve this area as a control for evaluating changes in the male segment of the moose subpopulations in adjacent the areas where both small and large bulls are harvested.

Summer and winter moose ranges on the Kenai National Wildlife Refuge in Subunit 15B continue to deteriorate because of wilderness lands management policies favoring advanced forest succession. The Department and the U.S. Fish and Wildlife Service should cooperate on selected habitat enhancement projects (i.e., mechanical manipulation and prescribed burnings) to improve moose habitat in the Slilok and Coal Lake areas.

PREPARED BY:

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SUBMITTED BY:

John N. Trent
Management Coordinator

STUDY AREA

GAME MANAGEMENT UNIT: 15C (3,414 mi^2)

GEOGRAPHICAL DESCRIPTION: Southern Kenai Peninsula

BACKGROUND

Declining availability of suitable winter habitat is a serious limiting factor for some moose on the southern Kenai Peninsula. Because of heavy snow accumulations in the uplands of Subunit 15C, moose are restricted to low-elevation riparian habitats and south-facing benchlands from December through April. Some of the region's most important winter ranges include the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, the lower reaches of the Fox River and Sheep Creek, and the Homer Bench. Human development and the attendant competition for space and other resources in these latter areas pose a serious long-term problem for moose. Local public awareness of this resource conflict resulted in the designation of the Anchor River/Fritz Creek Critical Habitat Area by the Alaska Legislature in 1985.

POPULATION OBJECTIVES

To maintain a population size of approximately 3,000 moose and a posthunting sex ratio of not less than 15 bulls:100 cows.

METHODS

Population trend and sex-age composition are assessed primarily by aerial surveys conducted in standardized count areas during October and November. Since 1980, aerial surveys were made only during years when there was extensive snow cover and moose sightability was high (i.e., 1982, 1983, and 1985). Surveys were made at an intensive rate of 4.5-6.5 minutes/mi^2.

Annual moose data were collected through the state-wide harvest ticket system. The moose hunt was usually monitored several times each season by fixed-winged flights in the Deep Creek, Anchor River, and Fox River drainages. In addition, remote portions of the Deep Creek and Anchor River drainages were monitored from the ground using a 3-wheeler (1-10 September) and horses (11-21 September).

RESULTS AND DISCUSSION

Population Status and Trend

Moose are moderately abundant and probably near the ecological carrying capacity of the coastal and boreal vegetation types in Subunit 15C. During the last decade, generally characterized by mild winters, moose populations appeared to maintain a stable trend with an estimated minimum density of between 2 and 3 moose/mi^2. There are currently an estimated 2,500-3,000 moose in Subunit 15C.

Mortality

Season and Bag Limit:

The open season for subsistence hunters in that portion of Subunit 15C southwest of a line from Point Pogibshi to the point of land between Rocky Bay and Windy Bay is 1-30 September; the bag limit is 1 bull. The open season for resident and nonresident hunters in the remainder of Subunit 15C is 1-20 September; the bag limit is 1 bull with a spike or fork antler on at least 1 side or with at least a 50-inch spread between antlers or at least 3 brow tines on 1 side.

Human-induced Mortality:

The 1987 reported harvest was 127 moose: 101 bulls, 1 cow, and 25 unspecifieds. This harvest was 50% lower than the 1986 harvest (N = 256) and 41% lower than the 2-year mean of 215 (Holdermann 1987, 1988). In 1987, 60% of the harvest occurred in the 1st half of the season (1-10 September) and 40% in the 2nd half (11-20 September), compared with the 2-year mean for the 1st half:2nd half of the season harvest ratio of 72%:28% (Table 1).

In 1987, 768 hunters reported hunting moose in Subunit 15C; this compares with 1,151 hunters and 1,075 hunters in 1986 and 1985, respectively. The success rate for moose hunters throughout Subunit 15C was 17%. The frequency of use of the various transportation types follow: highway vehicle > offroad vehicle > horse > boat > airplane. The relative order of horse and boat transport types were reversed in 1987, compared with the 2 previous seasons.

Fifty-five percent (N = 69) of the successful moose hunters did not report the antler spread of their moose in 1987, compared with only 12% for the previous 2 seasons. The apparent difference is accounted for by data-handling procedures for the 1987 season. Antler spread information was collected from 57 hunters: 30 bulls, <30 inches; 3 bulls, 30-39 inches; 5 bulls, 40-49 inches; and 19 bulls, >50 inches.

Hunter Residency:

Residency of hunters was as follows: Kenai Peninsula, 89%; other state residents, 10%; and nonresidents, 1%.

CONCLUSIONS AND RECOMMENDATIONS

During the initial selective bull season in Subunit 15C, hunter effort and harvest declined 31% and 41%, respectively. The extent of the decline in hunter effort was difficult to anticipate prior to the season. Hunters probably dropped out of the Subunit 15C hunt for 2 primary reasons: (1) local hunters were accustomed to a traditional any-bull season and were either uncertain about what constituted a legal bull under the new regulation or doubted their ability to correctly identify a legal bull in the field, and (2) the majority of hunters anticipated a lower harvest success under the new regulation. For these reasons, many hunters either decided not to hunt or to hunt elsewhere. Some of the moose hunters who have traditionally hunted in Subunit 15C shifted to Units 13 and 14 (D. Harkness and R. Tobey, ADF&G, pers. commun.). The observed reduction in harvest was close to the expected reduction, based on a general knowledge of the population's age structure for bulls and computer modelling (C. Schwartz, ADF&G files).

Although hunter attitudes regarding the new harvest system varied widely prior to the season, it is my impression that the vast majority of hunters complied with the antler regulation in 1987. This impression is based on numerous enforcement spot checks in remote portions of the subunit and at trail heads as well as conversations with hunters and enforcement officers during and after the season. I feel that the self-discipline demonstrated by hunters during the 1987 season, more than any other factor, helped to allay public skepticism regarding the feasibility of implementing the new harvest system. After the 1987 season, hunter sentiment shifted noticeably toward support of the new harvest system.

The higher percentage of successful moose hunters who did not report the sex and/or antler size of their moose was atypical and puzzling. It is probably safe to assume that the majority of unspecified sex harvests were bulls. Considering the practical value of obtaining complete and accurate harvest statistics in the future, I recommend that the Department pursue practical alternatives to improve harvest ticket reporting. Foremost, those individuals submitting delinquent reports should be interviewed to determine the cause(s) for omitting routine harvest information. Once the cause(s) are identified, appropriate measures can be taken to solve the problem. Improved data handling should reduce the "unknown" category for reported antler sizes.

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PREPARED BY:

David A. Holdermann
Game Biologist II

SUBMITTED BY:

Lawrence J. Van Daele
Survey-Inventory Coordinator

STUDY AREA

GAME MANAGEMENT UNIT: 16 (12,422 mi^2)

GEOGRAPHICAL DESCRIPTION: West side of Cook Inlet, excluding Kalgin Island

BACKGROUND

Moose were uncommon in Unit 16 until the 1940's, when the population expanded in response to habitat changes and reduced predator levels. Data are lacking, but moose populations have apparently increased dramatically since then. Although the population has previously declined because of severe winters, it has always recovered in response to milder winters. Moose are presently moderately abundant in the unit, providing a subsistence harvest for the local human population; moreover, Unit 16 is a popular sport hunting area for residents of the Kenai Peninsula, Anchorage, and Matanuska Valley communities.

POPULATION OBJECTIVES

To maintain a moose population of 10,000 with a posthunting sex ratio of no less than 20 bulls:100 cows.

METHODS

Fall sex and age composition surveys were conducted throughout the unit. Additional observations on distribution and survival were obtained in conjunction with the Alexander Creek moose identity study. Harvest data were obtained from harvest reports and permit hunt reports.

RESULTS AND DISCUSSION

Population Status and Trend

Moose are moderately abundant, but numbers are probably declining in some areas because of poor calf recruitment.

Population Size:

The moose population is estimated to include 10,000 animals: 3,000 moose in Subunit 16A and 7,000 in Subunit 16B.

Population Composition:

Fall sex and age survey data are presented in Tables 1 and 2. Less than 2 hours of aerial surveys were conducted in Subunit 16A, because poor weather precluded them. In Subunit 16B nearly 20 hours of surveys were conducted and 1,629 moose were observed. The overall bull:cow ratio was 32:100 and the calf:cow ratio was 19:100. Redoubt Bay values of 19 bulls:100 cows and less than 10 calves:100 cows are minimal because antlerless bulls may have been misclassified, artificially increasing the cow base. McArthur River bull:cow and calf:cow ratios were the lowest obtained for the count areas in Subunit 16B. Although ratios obtained from other areas were higher, the trend in recent years remains downward (Table 2).

Distribution and Movements:

In March and April 1987, 19 moose were collared with radio transmitters along the Alexander Creek winter range in Subunit 16B. Additionally, 3 moose collared as part of the Susitna hydroelectric project studies along the lower Susitna River were also monitored. These 22 collared moose were relocated 247 times prior to 31 December 1987; 19 collars remained functional. Movement data have not been analyzed. By late September, 1 moose had moved to the Chichatna River (35 miles southwest) and another to Trinity Lakes (25 miles northwest). Most moved shorter distances west towards the Susitna-Little Susitna Mountains. By December they had returned to the immediate Alexander Creek area. Collared moose relocation will continue until 1991.

Mortality

Season and Bag Limits:

The open season for resident and nonresident hunters in Subunit 16A is 1 to 30 September. The bag limit is 1 bull.

The open season for subsistence, resident, and nonresident hunters in that portion of Subunit 16B encompassing the Redoubt Bay drainages south and west of and including the Kustatan River drainage is 1 to 15 September; the bag limit is 1 bull.

The open seasons for subsistence hunters in the remainder of Subunit 16B are 1 to 30 September and 1 December to 28 February. The bag limit is 1 moose; however, antlerless moose may be taken only from 25 to 30 September, and 1 moose by registration permit only during the 1 December to 28 February season. A 2-week season within these dates will be announced by Emergency Order.

The open season for resident and nonresident hunters in the remainder of Subunit 16B is 1 to 30 September. The bag limit is 1 bull.

Human-induced Mortality:

Harvest data are presented in Table 3. The total estimated mortality was 409 moose from Subunit 16A and 471 from Subunit 16B. The combined sport and subsistence harvests were lower in 1987 (654 moose) than in 1986 (693 moose), but mortality by trains and cars in Subunit 16A was higher because deep snows concentrated moose along the Parks Highway transportation corridor. Research data from radiotelemetry studies indicate that up to 60% of the moose involved in winter accidents in Subunit 14B reside in Unit 16 during the remainder of the year.

Hunter Residency and Success. Unit 16 is hunted primarily by Alaskan residents during the general September moose season (Table 4). Although 95% of Unit 16 hunters are state residents, local (i.e., Unit 16) residents make up only 5% of that total. Permits for the winter hunt are restricted to unit residents. The combined harvest reported by local residents for both the fall and winter seasons in 1987 was 94 moose, or 14.4% of the harvest. Nonresidents composed 4.6% of all hunters (99 hunters), accounting for 7.5% of the harvest (49 moose).

Permit Hunts. Record harvests occurred in the winter permit hunts in Subunit 16B (Hunt Nos. 981 and 982) because deep snows concentrated moose on the winter range (Table 5). The 14-day seasons were opened after migratory and local moose had mixed on the winter range, and hunter success was high (78%). A total of 72 moose (31 bulls and 41 cows) was taken by 126 permittees in 1987, compared with 54 moose by 127 permittees in 1986. The permit hunts are open only to local hunters, and the harvest occurs near their homes. For the Skwentna-Alexander Creek area (Hunt No. 981), 70% of the hunters used snow machines. In the Beluga-Tyonek area (Hunt No. 982); the harvest was concentrated along the road system where 67% of the hunters used automobiles.

Transport Methods. Transportation means of successful hunters are presented in Table 6. Aircraft (37.3%), boats (21.3%), and automobiles (17.8%) were popular modes of transportation. Reported transport methods differed between subunits and between fall and winter seasons. Although the fall hunter numbers were similar, (i.e., 995, for Subunit 16A and 1,084, Subunit 16B), 83.3% of successful hunters reporting from Subunit 16B used aircraft, while 90.2% of the successful hunters in Subunit 16A used automobiles. Snow machines and automobiles were used by 41.3% and 48.9% of the successful winter hunters, respectively; only 1 hunter (1.1%) reported using aircraft.

Natural Mortality:

Snow fall during the 1987-88 winter began in mid-November, and snow accumulation persisted in many areas until late April. Even where snow depths were moderate, moose were stressed by the long period it persisted. Winter mortality occurred primarily in the calf cohort, but older animals also died.

Wolves are not abundant in Subunit 16B, but brown and black bears are common. Observations by the public and those made by ADF&G staff, in conjunction with moose radiotelemetry surveys, indicate bears are killing newborn calves.

Game Board Actions and Emergency Orders

Emergency Orders were used to set the 14-day seasons for hunt Nos. 981 and 982.

CONCLUSIONS AND RECOMMENDATIONS

Fall data obtained in 1987 for Subunit 16A are inadequate for monitoring the population status. Ratios obtained in recent years suggest that calf recruitment compensates for natural mortality and human harvest (Table 2).

The moose population in Subunit 16B appears to be declining because of poor survival of calves (Table 2). Fall ratios of approximately 25 calves:100 cows are generally considered necessary to maintain a moose population. The number of bulls appears to be adequate to produce high conception rates, so the low calf:cow ratio in the fall is probably due to postnatal mortality. Declining fall calf:cow ratios are believed to reflect increased predation by bears immediately following parturition. The cow moose harvest in Subunit 16B should continue to be limited to maximize calf production and compensate for the high postnatal mortality.

Hunting pressure in Unit 16 has been relatively stable for the past 3 fall seasons (i.e., 1985, 2,132 hunters; 1986, 2,079 hunters; and 1987, 2,133 hunters). Pressure has increased in Subunit 16A (1985, 682 hunters; 1986, 715 hunters; and 1987, 997 hunters) in response to liberalization of seasons (10-day season extension) and redirected effort by hunters responding to increasingly conservative regulations in other southcentral units also accessible by road. In addition to the Parks Highway and the Petersville Road, the local road and trail system is expanding because of mining, forestry, and recreational activities. Hunters are either hunting from the roads or using them to transport boats or all-terrain vehicles for further access to other areas. The harvest has been growing (i.e., 1985, 101 moose; 1986, 162 moose; and 1987, 224 moose), but it remains concentrated along the roads and larger stream systems. The fall transport data reflect hunting patterns similar to other road-accessible areas.

Fall hunting pressure in Subunit 16B has declined during the past 3 years (i.e., 1985, 1,402 hunters; 1986, 1,304 hunters; and 1987, 1,083 hunters), in response to the elimination of cow seasons and the expense associated with getting into roadless areas. Highway vehicles are used by Beluga-Tyonek area residents; however, the roads used are not connected to the main state system and are generally inaccessible to nonlocal hunters. Aircraft is the primary transportation means, and harvests are concentrated near landing areas. In coastal areas and along many waterways, boats are popular. Large areas of the subunit that have received little hunting pressure will become more heavily utilized as use of all-terrain vehicles increases.

The permit hunts are open only to local hunters, and the harvest occurs near their homes. For the Skwentna-Alexander Creek area (Hunt No. 981), 70% of the hunters used snow machines. In the Beluga-Tyonek area (Hunt No. 982) the harvest was concentrated along the road system, where 67% of the hunters used automobiles.

Most moose habitat in Unit 16 is composed of mature vegetative communities that have a lower carrying capacity than those consisting of earlier successional stages. However, habitat does not appear to be limiting the population. High moose densities developed in the 1950's and 1960's in similar habitat, and the population has recovered rapidly following extensive winter mortality. The major identifiable change has been the increasingly important role of grizzly bears as predators. Prior to the 1940's in a pristine habitat with "natural" grizzly bear populations, moose were not abundant. The current downward population trend is most evident in habitat that has been little impacted by human activities. Barring improvement in calf survival, moose densities will probably return to pre-1940's levels. Unless higher calf survival occurs, changes resulting from fire, timber harvest, or habitat enhancement may raise the carrying capacity but not the actual number of moose. A smaller moose population and stable-to-increasing human demands will require more conservative regulations in the future.

Current harvest by humans is not affecting moose populations in Unit 16, except for local subpopulations in high harvest areas. Reduction in the bull harvest and increased bull:cow ratios will not reverse the population trend, because existing bull:cow ratios are adequate to produce high conception rates. Management should be directed at maximizing the number of calves present in the fall. Since initial calf production is not limited by either carrying capacity or breeding success, a large cow base needs to be maintained to maximize the number of calf survivals. Therefore, cow harvests should continue to be minimal. The 1987 winter harvest of 45 cows from Subunit 16B does not significantly affect its moose population (i.e., 7,000).

A midwinter census of Subunit 16B should be conducted to determine if the population trend indicated in the fall data is correct. The existing seasons and bag limits should be maintained, unless data warrant further reductions.

PREPARED BY: | SUBMITTED BY:

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Game Biologist III

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Table 1. Moose composition counts in Unit 16 (excluding Kalgin Island), 1987.

Area	Date	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf% of herd	n	Moose /hr	Density
Peters Hills	12/ 4/87	40.0	13.3	53.3	27.6	29	25.2	0.5
SW Dutch	12/ 4/87	40.9	9.1	36.4	20.5	39	83.6	1.4
Total 16(A)		40.5	10.8	43.2	23.5	68	42.1	0.8
Alexander Cr	1/15/88	0.0	0.0	23.8	16.1	161	106.2	7.3
Mt Susitna	12/ 3/87	16.9	5.1	37.3	22.7	97	41.6	1.6
N Beluga Mt	11/21/87	35.1	12.4	32.0	18.9	164	56.2	2.7
Yenlo East	11/ 9/87	33.6	10.8	19.2	12.6	382	135.6	7.2
Sunflower G	11/11/87	30.9	11.8	9.1	6.5	154	111.3	2.5
Sunflower H	11/11/87	57.9	15.8	10.5	6.2	32	36.2	1.0
Sunflower J	11/11/87	51.0	13.0	10.4	6.5	310	216.3	8.1
Big River	12/ 4/87	18.0	2.0	7.0	5.6	125	71.4	0.9
Drift River	12/ 4/87	21.6	0.0	8.1	6.2	48	32.0	0.8
McArthur R.	12/ 4/87	19.7	3.4	12.8	9.6	156	50.6	1.5
Total 16(B)		31.9	8.9	18.3	11.3	1629	65.0	2.6
TOTAL Unit 16		32.2	8.6	19.2	11.8	1697	64.9	2.4

Table 2. Moose composition counts in Unit 16 (excluding Kalgin Island), 1983-87.

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf % of herd	n	Moose /hr	Density
Subunit 16A							
1983	50.5	18.2	30.3	16.8	179	52.6	1.4
1984	30.1	9.3	36.2	21.8	979	68.5	1.8
1985	36.1	9.9	31.6	18.8	441	51.3	1.3
1986	39.6	11.4	33.9	19.5	517	76.4	1.7
1987	40.5	10.8	43.2	23.5	68	42.1	.8
Subunit 16B							
1983	35.4	9.0	32.2	19.2	1458	52.1	1.0
1984	40.1	8.9	27.1	16.2	1971	65.5	1.3
1985	36.9	8.8	22.6	14.2	1123	56.7	.9
1986	35.6	7.7	22.8	14.4	1188	59.1	1.7
1987	31.9	8.9	18.4	11.3	1629	83.1	2.6
Subunits 16A and 16B (combined)							
1983	36.9	9.9	32.0	18.9	1637	52.1	1.1
1984	36.7	9.1	30.1	18.0	2950	66.4	1.4
1985	36.7	8.3	25.0	15.5	1564	55.1	.9
1986	36.8	8.8	26.0	15.8	1725	64.1	1.8
1987	32.2	8.9	19.2	11.8	1697	80.0	2.4

Table 3. Annual moose harvest and accidental death in Unit 16 (excluding Kalgin Island), 1983-87, and the harvest and accidental deaths in Subunits 16A and 16B, 1987.

	Harvest								
	Reported			Estimated			Accidental		Grand
Year	M	F	Total	Unreported	Illegal	Total	Road	Train	total
1983	585	199	789	45	25	859	2	10	871
1984	692	226	930	45	25	1000	40	115	1155
1985	389	103	496	35	35	566	1	2	569
1986	569	115	693	45	50	788	8	25	821
1987	601	45	654	45	50	749	50	90	889
Subunit									
A	223	--	224	15	30	269	50	90	409
B	369	45	421	30	20	471	--	--	471

Table 4. General moose season hunter residency and success in Unit 16 (excluding Kalgin Island), 1983-87.

Year	Successful				Unsuccessful			
	Local resident	Nonlocal resident	Nonresident	Total	Local resident	Nonlocal resident	Nonresident	Total
1983	17	551	48	636	30	1755	49	1858
1984	34	656	66	767	72	1785	55	1938
1985	21	375	47	454	54	1521	61	1678
1986	24	540	47	631	60	1332	38	1448
1987	22	491	49	582	64	1364	50	1550

Table 5. Moose permit hunt data for Unit 16 (excluding Kalgin Island), 1983-87.

Hunt No.	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
945	1983	150	32	79	39	0	38	39
	1984	150	36	81	33	2	31	33
946	1983	not held						
	1984	25	5	1	19	6	13	19
947	1983	191	122	37	26	17	9	26
	1984	200	104	62	34	17	17	34
981	1984	62	19	27	16	9	7	16
	1985	53	14	13	26	12	14	26
	1986	54	22	7	25	13	12	25
	1987	58	18	7	33	10	23	33
982	1983	164	34	93	32	13	19	32
	1984	74	17	21	36	5	26	31
	1985	41	13	12	16	8	8	16
	1986	73	19	18	29	17	12	29
	1987	68	14	13	39	21	18	39

Table 6. Successful moose hunter transport methods for Unit 16 (excluding Kalgin Island), 1983-87.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle
1983	360	6	139	0	15	92	110
1984	439	10	147	54	22	52	128
1985	248	3	97	11	16	20	45
1986	334	7	142	44	36	31	65
1987	269	12	112	51	35	30	99

STUDY AREA

GAME MANAGEMENT UNIT: 16B (23.3 mi^2)

GEOGRAPHICAL DESCRIPTION: Kalgin Island

BACKGROUND

Moose were translocated to Kalgin Island during the years 1957 through 1959. Population status was not monitored, but observations by commercial fishermen indicated the population increased through the 1960's, declined with hard winters of 1970-71 and 1971-72, and increased again in the 1970's. Hunting was initiated in 1971, continuing until 1979 when it was closed in response to public concerns about decreased moose numbers following a severe winter. In fall 1980 an aerial survey was conducted and 70 moose were observed. The Board of Game then authorized a drawing-permit hunt (i.e., 20 permits available); in September 1981, 9 moose were harvested from the island. In December 1981, 141 moose were observed, generating concerns that the island was overpopulated. Ground investigation determined the island was severely overbrowsed. Willow and young birch were absent, and moose were feeding almost entirely on nontypical browse (ferns, alders, and spruce). Unless winter browse was allowed to recover, significant mortality was expected in any winter with prolonged snow cover.

A long-term population objective of 1 moose/mi^2 was established, and a program was begun to reduce and maintain moose at this level through sport hunting. A hunt was permitted by Emergency Order in the winter of 1981, resulting in a harvest of 70 moose. Liberal, either-sex, fall seasons have continued the reduction each year. By 1986 the population had been reduced to 20-25 moose and vegetative recovery was beginning.

POPULATION OBJECTIVES

To maintain an overwinter density of 1 moose/mi^2 until the browse shows increased vigor and can support a higher population.

METHODS

Fall sex and age composition counts were conducted, and the permit hunt, harvest, and browse recovery on the island were monitored.

RESULTS AND DISCUSSION

Population Status and Trend

The population is stable or declining.

Population Size:

The 1987-88 overwinter population was estimated at 20-25 animals.

Population Composition:

The bull:cow ratio was 86:100 and the calf:cow ratio was 86:100 in 1987. These are the highest ratios obtained for the past 5 years (Table 1).

Mortality

Season and Bag Limits:

The open season for subsistence, resident, and nonresident hunters on Kalgin Island is 25 August to 20 September. The bag limit is 1 moose by registration permit only.

Human-induced Mortality:

Seven moose (i.e., 5 males and 2 females) were reported harvested in 1987 (Table 2). This is comparable to the 1986 harvest of 6 moose but well below previous years' harvests.

Hunter Residency and Success. Eighteen percent (7/40) of the moose hunters on Kalgin Island were successful in 1987. One nonresident and 6 nonlocal residents were successful in harvesting moose from the island (Table 3). Extensive stands of alders and spruce provide excellent moose escape cover and make hunting difficult.

Permit Hunts. Sixty-two permits were issued in 1987, representing the lowest number of permits issued in the past 5 years (Table 4). Interest in hunting Kalgin Island moose has declined, as the number of moose and hunter success rates have declined.

Transport Methods. Most successful hunters used boats (43%) or aircraft (29%) for transportation in 1987 (Table 5).

Natural Mortality:

Snow depths during the winter of 1986-87 were moderate, causing nutritional stress for the island's moose. No yearlings were harvested in 1987, and no yearling bulls were observed during the November survey. It appears that even though snow conditions were not extreme, the 1986 calf crop did not survive the winter. During the 1987-88 winter, snow was deeper and persisted until April, so the second loss of a calf cohort is suspected.

Habitat Assessment

Vegetation is recovering under lighter moose use; the greatest gains are evident in nonpreferred forage plants like alders, salmonberry, and highbush blueberry. Willow remains scarce, and recovery of birch is lacking. Summer use of fireweed and ferns remains heavy. Winter feeding is primarily on ground level forage, roots, or fern rhizomes.

CONCLUSIONS AND RECOMMENDATIONS

Kalgin Island is too small to provide distinct seasonal moose habitat. Except when snow in the open-canopy habitat is too deep to allow feeding, moose feed in the same areas year round. Snow forces moose into the thick-canopy spruce habitat to find exposed ground plants. The lack of taller browse, like willow and young birch, that would be available under moderate-to-deep snow is the limiting factor for the population. Summer forage is abundant, and hunters report that fall moose are in excellent condition. The loss of the 1986 calf crop during a winter that did not cause significant mortality in adjacent mainland areas supports the contention that winter browse is not yet adequate to support the Kalgin Island moose population.

Kalgin Island lacks predators that could help control moose numbers. Sport hunting can maintain the population below the carrying capacity so that browse recovery can be continued only if enough hunters hunt on the island. However, with fewer moose present, hunter success has lowered and interest in hunting on the island has declined (Table 4), despite liberal seasons, bag limits, and permit conditions. Unless the sport harvest equals recruitment, mild winters may allow short-term population growth and reverse vegetation recovery. Underharvesting rather than overharvesting remains the primary management concern. Fall hunting conditions are such that hunting cannot eliminate the population, so liberal hunting opportunities need to be maintained to encourage public hunting. I believe that permits are unnecessary; management data can be obtained from harvest ticket reports.

Even if its size is controlled by sport hunting, this moose population may not survive. The degree of habitat damage is so great that a severe winter in the immediate future could result in massive starvation, or repeated calf crop loses could occur because of a series of stressful winters. Because winter survival requires feeding through ice and frozen ground, tooth wear is extreme and few moose live more than 6 winters. This limits the reproductive life of cows to about one-third of that available under a more normal life span. If calf crops were lost in 3 or 4 successive winters, the population could disappear. Long-term survival of moose on Kalgin Island is dependent on developing winter browse conditions that will sustain moose in 2 or 3 feet of snow. Browse recovery of willow and birch is slow because these species are used year-round. The public should recognize that winters may ultimately determine the moose's future on the island, regardless of management.

PREPARED BY:	SUBMITTED BY:
James B. Faro	Gregory N. Bos
Game Biologist III	Management Coordinator

Table 1. Moose composition counts for Subunit 16B (Kalgin Island), 1983-87.

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf % of herd	_n_	Moose /hr	Density
1983	63	26	47	22.5	40	12.1	1.7
1984			no data				
1985	33	17	33	20.0	10	2.4	.4
1986	40	40	80	36.4	11	5.3	.5
1987	86	0	86	31.6	19	7.9	.8

Table 2. Annual moose harvest for Subunit 16B (Kalgin Island), 1983-87.

Year	Reported			Estimated		Total
	M	F	Total	Unreported	Illegal	
1983	23	33	56	0	0	56
1984	18	12	30	0	0	30
1985	10	9	19	0	0	19
1986	2	4	6	0	0	6
1987	5	2	7	0	0	7

Table 3. Moose hunter residency and success for Subunit 16B (Kalgin Island), 1983-87.

Year	Successful				Unsuccessful			
	Local resident	Nonlocal resident	Nonresident	Total	Local resident	Nonlocal resident	Nonresident	Total[a]
1983	0	56	0	56	0	202	2	204
1984	0	30	0	30	0	117	2	119
1985	0	19	0	19	0	223	0	223
1986	0	6	0	6	0	53	0	53
1987	0	6	1	7	0	32	1	33

[a] does not include unsuccessful hunters that did not report residency.

Table 4. Moose permit hunt data for Subunit 16B (Kalgin Island), 1983-87.

Hunt No.	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Bulls	Cows	Total
980	1983	316	101	148	56	23	33	56
	1984	213	64	119	30	18	12	30
	1985	406	161	215	19	10	9	19
	1986	125	67	52	6	2	4	6
	1987	62	21	34	7	5	2	7

Table 5. Successful moose hunter transport methods for Subunit 16B (Kalgin Island), 1983-87.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Highway vehicle
1983	22	0	32	1	0	0
1984	9	0	19	0	0	0
1985	2	0	14	2	0	0
1986	2	0	4	0	0	0
1987	2	0	3	1	0	0

STUDY AREA

GAME MANAGEMENT UNIT: 17 18,000 mi^2

GEOGRAPHICAL DESCRIPTION: Northern Bristol Bay

BACKGROUND

Historically, moose have never been abundant in Unit 17; much of it is open tundra with forested areas occurring only along the riparian portions of major drainages. West of the Wood-Tikchik Mountains riparian areas are limited to willow, alder, and occasional stands of cottonwood.

The human population of this area increased considerably during this century due to the commercial fishery activity in Bristol Bay. Moose hunting seasons have varied over the past several decades, but the bag limit has remained 1 bull since prior to statehood (i.e., 1959). A general disregard for bag limit restrictions by unit residents has probably been an important factor contributing to low moose densities in this unit.

POPULATION OBJECTIVES

To establish a minimum population of 100 moose in Subunit 17A.

To maintain a density of 1 moose/mi^2 on habitat considered good moose range in Subunit 17B.

To maintain a minimum density of 0.5 moose/mi^2 in Subunit 17C.

METHODS

Aerial sex and age composition counts during the fall were scheduled in trend areas throughout the unit. The aerial survey in Subunit 17A was scheduled to be conducted with the cooperation of Togiak Fish and Wildlife Refuge staff. An early season hunt for residents living in Subunits 17C and the lower portions of 17B was managed on a registration basis to provide accurate harvest data. Harvest monitoring and enforcement presence were maintained along the Mulchatna and upper Nushagak Rivers during the resident and nonresident hunting season in September.

RESULTS AND DISCUSSION

Population Status and Trend

Moose were scarce in the northern Bristol Bay area prior to 1900 (Faro 1976). The population in Subunit 17A has historically been extremely low (i.e., less than 1 moose/10 mi^2) (Taylor 1985). This subunit has a long history of illegal harvest of both sexes. While the riparian habitat along the Togiak and Kulukak Rivers and their tributaries provides excellent winter browse, adjacent lands are primarily tundra. The tundra provides little escape cover for moose and good travelling conditions for hunters using snowmachines or dog teams.

The first major survey of Subunit 17A was completed in January 1981. Only 3 moose, all yearlings, were observed in 5.5 survey hours, and the season was subsequently closed by the Board of Game. Populations adjacent to the east of the Togiak drainage have been increasing, and surveys since 1981 have shown a slight upward trend.

Few data are available for moose populations in Subunit 17B prior to the 1970's. Faro (1976) estimated the population within the Kvichak-Mulchatna drainages to be 1500 moose. Local residents reported high densities in the upper Nushagak drainage, particularly along the King Salmon and Tikchik Rivers in the early 1970's, but wolf densities were particularly high in this area from 1974 to 1976 and had severely depleted this population by 1977. A succession of mild winters from the mid-1970's through 1986 had a positive effect on moose populations in most drainages of Unit 17. The present moose density in Subunit 17B is estimated to be 0.8 moose per mi^2.

Moose densities in Subunit 17C were historically low. Faro (1976) estimated this subunit to contain 300 moose. Mild winters, closures of major wintering areas to late-season hunting, and increased use of the expanding Mulchatna Caribou Herd by unit residents as their primary meat source contributed to growth of this population from the late 1970's to the present. A 1983 population estimate for 1834 mi^2 of this subunit was 1,212 moose (±24%) (Taylor 1984).

Population Size:

Survey conditions in Unit 17 are generally poor before January. Composition data from trend areas only have limited use in estimating moose densities in the various subunits. Based on surveys conducted in 1986 in Subunit 17A and population estimates in the upper portion of Subunit 17B in 1986 and a portion of Subunit 17C in 1983, the posthunting season populations are as follows: Subunit 17A, 50 to 100 moose; Subunit 17B, 3300 moose; Subunit 17C, 1700 moose.

Population Composition:

Composition surveys were conducted in November and December in portions of Subunits 17B and 17C (Tables 1A, B, and C); However, snow depths in most count areas were insufficient to obtain reliable counts. The Mosquito Creek count area in Subunit 17B and the Iowithla and Sunshine count areas in Subunit 17C were the only areas surveyed during this reporting period that provided acceptable data.

Snow conditions have a major effect on sex and age composition counts in this unit, and it is difficult to interpret results.

Mosquito Creek is a wintering area for moose from the Nushagak Hills portions of Subunits 17B and 19B; the number of moose observed during surveys of these are strongly correlated to the snow depths along the Mulchatna, upper Nushagak, and South Fork of the Hoholitna Rivers. It is a windswept drainage, and moose congregate along its upper tributaries when snow gets deep in the riparian areas of the rivers mentioned above. The 1987 survey of the Iowithla River area was excellent, because sufficient snow depths provided good survey conditions prior to normal winter migrations to or from the area. Survey conditions were good to very good in the Sunshine Valley area, but this wintering area has been historically surveyed several weeks after the moose population has finished its migration to the valley.

Bull:cow ratios in all areas of Subunits 17B and 17C have remained consistently high (i.e., above 50:100) (Tables 1A, B, and C). Some counts reflected an unrealistic representation of the sexes because of sexual segregation and distribution during the surveys. Calf production and survival have fluctuated between areas and years but have generally been good to excellent (Tables 1A, B and C).

Distribution and Movements:

Much of Unit 17 is mesic and alpine tundra, and most moose are found along the riparian tributaries in the major drainages of Subunits 17B and 17C. Little is known about specific movement patterns, except that they are influenced primarily by the rutting season in late September and by snow conditions in the early winter. Extensive use of snowmachines during the January to March beaver trapping season displaces moose from many of their wintering areas, principally along the Nushagak River. Snow depths during the winter of 1987-88 were severe (i.e., >15 feet on the ground along the King Salmon River) in the upper Nushagak River area west of Sleitat Mountain, and virtually all moose from the upper Tikchik Lakes and Nushagak drainages above the Nuyakuk River migrated to the lower Nushagak and Mulchatna Rivers where snowdepths were less severe.

Mortality

Season and Bag Limit:

There is no open season in Subunit 17A. The open season in that portion of Subunit 17B that includes all drainages of the Mulchatna River upstream from and including the Chichitna River is 1-20 September for all hunters. The bag limit is 1 bull. The open season for subsistence hunters in the remainder of Subunit 17B is 20 August to 15 September and 10-31 December, for resident hunters it is 1-15 September, and for nonresident hunters it is 5-15 September. The bag limit is 1 bull; however, from 20 to 31 August moose may be taken by registration permit only. The open seasons for subsistence, resident, and nonresident hunters in Subunit 17C are 20 August to 15 September, 1 to 15 September, and

1-15 September, respectively. The bag limit for Subunit 17C is 1 bull; however, from 20-31 August moose may be taken by registration permit only. There is an additional winter subsistence season in Subunit 17C: 10-31 December.

Human-induced Mortality:

The 1987 reported harvest of 207 moose is the highest on record for Unit 17. Most (152) came from Subunit 17B; one was harvested in Subunit 17A where there is no open season, and 42 were taken in Subunit 17C. No subunit was specified for 12 moose. The reported harvest consisted entirely of bulls.

The number of moose killed illegally in Subunit 17A during this reporting period is unknown. Less-than-usual poaching activity during winter months, when most of it occurs, was reported by Togiak and Y-K Delta Fish and Wildlife Refuge personnel. Illegal hunting was a major problem in Subunit 17C during January in the Dillingham and Aleknagik areas. Heavy snowfalls at higher elevations forced moose to concentrate in areas much closer to these communities than normal, and it was widely known than no enforcement officer was stationed in Dillingham from December through March. One Dillingham resident was convicted of taking a cow moose during the December season and was sentenced to pay $1500 and serve 2 days in jail. This is the most severe penalty anyone has received for a wildlife violation in the Dillingham court to date.

Hunter Residency and Success. While the annual moose harvest by residents of Unit 17 has remained relatively stable in recent years, both the harvest and hunting pressure by nonresidents and other Alaska residents have increased rapidly (Table 2). In 1982 the reported harvest of 49 moose was taken by 39 residents, 5 nonresidents, and 5 hunters of unspecified residency. The 1987 harvest of 207 moose was taken by 77 residents of Unit 17, 56 Alaska residents, 70 nonresidents, and 4 hunters of unspecified residency. Hunter success of 46% in 1987 has remained relatively constant since 1982. Unit residents are concerned about the influx of hunters from other areas.

Permit Hunts. A registration permit hunt designed primarily to increase hunting opportunities for local residents was begun in 1983. Harvests have ranged from a high in 1986 of 51 moose to a low in 1987 of 30 moose (Table 3). The number of hunters participating in this hunt has declined slightly in the past 2 years.

Harvest Chronology. Because of different season opening dates for unit resident, other Alaska resident and nonresident hunters, the harvest is fairly uniformly spread throughout the fall season. Hunting pressure appears to be highest during the Labor Day weekend, but hunter success has been greater in the later portions of the season. Only 7% of the reported harvest occurred during the December season.

Transport Methods. Boat access was the only reported method of transportation for successful hunters during the registration permit hunt. During the regular season, aircraft access was reported by 62% of the successful hunters, boats by 25% and snowmachines by 8%.

Natural Mortality:

No natural mortality was documented during this reporting period. Snow depths were abnormally high in the Wood-Tikchik Mountains and the King Salmon River drainage. Some moose were stranded by deep snow in these areas, and it is probable that some starved. Wolf populations were high throughout most of Subunit 17B and parts of 17C, and several wolf-killed moose were reported by trappers.

Habitat Assessment

Winter range in most of Unit 17 is in very good to excellent condition. Exceptions occur in the upper portion of Subunit 17B in the Twin Lakes and Bonanza Hills areas. Moose densities here are at or approaching the present carrying capacity of the range. Browsing is much more evident along the Nushagak River than it was 9 years ago; however, this range could support substantially more moose. The moose population in 17A is far below carrying capacity of the habitat.

Game Board Actions and Emergency Orders

During this reporting period, the Board of Game deleted the requirements for the registration permit hunt for moose in Subunits 17B and 17C. The season dates for the registration hunt were included in the general open season for subsistence hunters. Additionally, the Board of Game extended the December subsistence season by 9 days from 10-31 December to 1-31 December. Both changes were supported by the Department.

CONCLUSIONS AND RECOMMENDATIONS

Hunting pressure and annual harvests are steadily increasing, particularly in Subunit 17B. Separating opening dates for local resident, other Alaska resident, and nonresident hunters reduces the potential for difficulties between these user groups; however, conflicts are certain to increase along the Mulchatna and Nushagak Rivers as the number of hunters grows.

Annual moose harvest data for unit residents were very poor prior to initiating the registration permit hunt in 1984. Issuing permits provided an opportunity to explain to all local moose hunters the (1) necessity for accurate harvest data and (2) function of harvest ticket system in reporting their results. It will be necessary during the 1988 season to visit each community in Unit 17 to explain why the registration permit requirement was deleted by the Board and how their harvest should be reported in order to maintain the data quality we achieved with the registration system.

Because of the highly variable distribution of moose in late fall and early winter as a result of variable snow conditions, trend count information for most areas in Unit 17 has been difficult to interpret. While some trend count areas are necessary, funds would be better spent on periodic census surveys of different portions of the unit.

Residents of the Togiak drainage have expressed an interest in working with the Department to increase the number of moose in Subunit 17A. During several informal meetings, village elders have agreed to prohibit, by village law, the taking of cow moose. Some village residents assisted the Department on the Togiak Refuge caribou transplant, and the concept of protecting these animals to provide a meat source for the future seems to be having a positive effect on their perception of the moose situation in the Togiak Valley. A cooperative effort between the Department and U.S. Fish and Wildlife Service to radio-collar 30 moose in the wintering areas adjacent to the eastern boundary of the Togiak Wildlife Refuge has been proposed for 1988-89. The objectives of this project are to determine the rate of moose immigration to the Togiak Valley and to stimulate interest among the subunit residents to protect the productive segment of this population and allow it to expand to a suitable density.

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Table 1a. Moose composition counts and population estimates in Subunit 17A, 1981-87.

Year	Males: 100 females	Calf: 100 females	Calves %	Adults	n	Moose /hr.	Est. pop. size/ density
1981	--	0	0	3	3	0.5	<20
1983	No Data	--	--	--	--	--	--
1984	No Data	--	--	--	--	--	--
1985	No Data	--	--	--	--	--	--
1986	37.5	100.0	33.3	16	27	2.2	--
1987	No Data	--	--	--	--	--	<100

Table 1b. Moose composition counts and population estimates in Subunit 17B, 1983-87.

Year	Males: 100 females	Calf: 100 females	Calves %	Adults	n	Moose /hr.	Est. pop. size/ density
1983[a]	--	--	27.0	40	55	--	--
1984[a]	110.7	35.9	14.2	393	458	67	--
1985[a]	85.6	21.0	10.0	180	200	26	--
1986	--	--	13.2	374	57	N/A	0.74/mi^2
1987	159.1	45.5	13.9	114	134	32	3300

a National Park Service data included in 1983-85 except for moose/hr. calculations.

Table 1c. Moose composition counts and population estimates in Subunit 17C, 1983-87.

Year	Males: 100 females	Calf: 100 females	Calf %	Adults	n	Moose /hr.	Est. pop. size/ density
1983	86.1	77.7	29.5	67	95	24	74/mi^2
1984	113.3	54.0	20.2	241	302	58	--
1985	No Data	--	--	--	--	--	--
1986	--	--	18.5	384	455	52	--
1987	73.4	37.1	17.6	215	261	64	1700

Table 2. Regular season hunter residency and success in Unit 17, 1983-87.

Year	Successful: Local res.	Successful: Nonlocal res.	Successful: Non-res.	Successful: Unknown res.	Successful: Total	Unsuccessful: Local res.	Unsuccessful: Nonlocal res.	Unsuccessful: Non-res.	Unsuccessful: Unknown res.	Unsuccessful: Total
1983	35	18	22	3	78	129	21	9	7	166
1984	58	21	38	1	118	105	51	32	1	186
1985	27	41	37	5	110	110	87	47	9	253
1986	65	36	45	5	151	99	91	92	2	284
1987	47	56	70	4	177	114	89	76	7	286

Table 3. Harvest data for registration permit hunt No. 983 in Unit 17, 1983-87.

Year	Permits issued	Did not hunt	Unsuc. hunters	Succes. hunters	Bulls	Cows	Total
1983	452	116	287	49	49	0	49
1984	316	101	175	40	40	0	40
1985	304	68	180	42	42	0	42
1986[a]	275	61	110	51	51	0	51
1987[b]	225	43	137	30	30	0	30

[a] Open to resident hunters only.

[b] Open to subsistence hunters only.

STUDY AREA

GAME MANAGEMENT UNIT: 18 (42,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

Moose densities in Unit 18 are moderate; they are increasing in the Yukon River drainage above Ohogamiut but are extremely low throughout the remainder of the unit. Although moose are more common than they have been in the past, densities remain very low, compared to habitat availability.

Hunter pressure has effectively limited moose population growth in most of Unit 18. Extensive habitat is available for further colonization along the major rivers, and moose densities in adjacent Subunits 19A and 21E are very high. Human populations in the unit, however, are very concentrated in the many communities along the lower Yukon and Kuskokwim Rivers; consequently hunters have access (i.e., snowmachine) to essentially all of the riparian winter habitat in the unit. Availability of escape cover from hunters is a critical factor limiting the viability of moose populations.

POPULATION OBJECTIVES

To increase the moose population currently estimated at 1,000 to 3,000-5,000 moose.

To maintain bull:cow ratios at 30 bulls:100 cows or higher.

METHODS

For purposes of monitoring moose hunting activity and collecting harvest information, a moose hunter check station has been seasonally in place for the last 3 years at Paimiut Slough along the Yukon River near the border of Unit 18 and Subunit 21E. The check station was opened late August through September 1987. The moose population along the Yukon River in Unit 18 was surveyed during February and March 1988 by ADF&G and U. S. Fish and Wildlife Service (USFWS) observers in 2 aircraft. Results were compared with aerial survey data from previous years. Additional reports from the USFWS and the public concerning moose range and distribution were compiled.

RESULTS AND DISCUSSION

Population Status and Trend

Total numbers of moose observed in winter surveys along the riparian corridor of the Yukon River, especially on islands located upriver from Russian Mission, increased substantially in 1988, representing the highest recorded in Unit 18 (Table 1). The 1988 density of 116 moose/hour is substantially higher than the 49 moose/hour observed in 1985 and the 50 moose/hour observed in 1987. Moose numbers between Russian Mission and Ohogamiut also increased to 88 moose/hour from 37 moose per hour in 1987 and 27 moose/hour in 1985 (Table 2). Moose densities, however, remained very low downriver of Ohogamiut (Table 3). Because snow depths were relatively deep during the 1987-88 winter, a larger proportion of the population probably wintered along the Yukon River, compared with prior years. How much of the observed increase in density was attributable to deep snow depths or to an actual population increase is unknown.

No moose were observed downriver of Mountain Village on the lower Yukon Delta during an aerial survey conducted in mid-March 1988. A commercial pilot reported 4 moose located near Three Fingers Lake between St. Mary's and Emmonak later in March. Nine adult moose and 1 calf were located in March 1988 during an aerial survey of the East Fork of the Andreafsky River, a tributary of the Yukon River. One adult moose was observed during a survey of the North Fork of the Andreafsky. No moose were observed during surveys of Kipunguluk, Kusilvak and Kashunuk Sloughs; i.e., the lower Yukon River.

Moose densities are believed to be extremely low along the Kuskokwim River and its tributaries in Unit 18, including the Johnson, Gweek, Tuluksak, Kisaralik, Kasigluk and Kwethluk River drainages. However, surveys in these drainages were not conducted this year.

Population Size:

Because censuses have not been conducted in Unit 18, accurate estimates of population size are not available; however, the size of the moose population in Unit 18 is approximately 500-800 in the Yukon drainage and 100-200 in the Kuskokwim River drainage. An overall estimate of 1,000 moose for Unit 18 may be overly generous for late winter, because of normally heavy harvests and the tendency of moose to move upriver into Subunits 21E and 19A as winter progresses. However, an estimate of 1,000 moose may be appropriate for late summer.

Population Composition:

Data obtained from Yukon fall surveys conducted between 1981 and 1984 indicated average ratios of 46 bulls:100 cows and 65 calves:100 cows as well as a population composed of 20% yearlings and 30% calves. Surveys conducted in August and September 1987 along the Yukon River indicated that calf production was good (i.e., 33-38% calves). Spring survey data indicated that yearling recruitment averaged 31% from 1981 to 1985; however, overall numbers remained low.

Distribution and Movements:

The moose population in Unit 18 is migratory, expanding in distribution during the summer to coastal regions near Nelson Island, Scammon Bay, and the lower Yukon Delta and retreating with the advent of winter and increased hunting activity to approximately 120 miles up the Yukon River. Although moose are found in alpine and subalpine regions of the Kilbuck and Andreafsky Mountains in the summer, they descend to the Tikchik Lakes, the forested tributaries of the Kuskokwim, and along the Yukon River in the winter. Brushy, revegetated areas in the upper Tuluksak River valley near the mining community of Nyac support the densest concentration of moose in the Kilbuck Mountains. Two radio-collared cow moose from Subunit 21E moved westward north of the Yukon River into Unit 18 during early 1987, and 1 radio-collared animal reached the Yukon Delta near Hamilton by late summer.

According to historical reports, moose were rare in the vicinity of Paimiut in 1942 (Helmericks 1944). Elders from Yukon River villages state that moose were uncommon around Holikachuk on the Innoko River as late as 1952. The Yukon lowlands between Holy Cross and Paimiut near the border of Unit 18 and Subunit 21E now support large numbers of moose, particularly during winter.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters in that portion of Unit 18 north and west of a line from Cape Romanzof to Kuzilvak Mountain and then to Mountain Village, and west of (but not including) the drainage of the Andreafsky River is from 1 to 20 September. The bag limit is 1 bull. The open seasons for subsistence and resident hunters in the remainder of Unit 18 are 1 to 30 September and 1 to 10 February. The bag limit is 1 bull. The open season for nonresident hunters in the remainder of Unit 18 is 1 to 30 September. The bag limit is 1 bull.

Human-induced Mortality:

Although reported harvests have declined slightly since 1981, hunting remains the most significant source of moose mortality in Unit 18. During the 1987-88 season, 144 hunters reported a harvest of 48 moose. The 1987-88 harvest was lower than the 60 moose reported in 1986-87 and the 52 moose in 1985-86, and it was substantially lower than the record 1981 harvest of 82 moose.

The reported harvest of moose in Unit 18, as in previous years, does not reflect the actual harvest, but only that of people who choose to operate legally within the regulatory system. Moose of both sexes are taken throughout the year in Unit 18, although only bulls can be legally taken. The out-of-season and unreported harvest may equal the legal harvest, particularly in the Kilbuck Mountains; however, the percentage of local residents hunting legally during the seasons is increasing, particularly during the fall. The out-of-season harvest occurring during the winter has probably also declined with the advent of the February season.

Moose during the February season were fairly accessible along the Yukon River because they were concentrated on islands with large cottonwood stands and brushy willow fringes. I believe, however, that excessive harvests did not occur in this area, because unusually cold weather hindered travel by snowmachines.

The estimated 1987-88 unit-wide harvest, including the unreported harvest, is approximately 80-100 moose. The actual harvest is estimated to exceed or equal 15% of the population size annually. The moose harvest in Unit 18 may have declined slightly from last year, reflecting worsening economic conditions, rather than decreasing demands for moose. Because moose were scarce, the economic cost of searching for them were high, particularly if extensive travel upriver was involved.

The number of people who reported hunting moose in Unit 18 has declined from 221 in 1985-86 and 171 in 1986-87 to 144 in 1987-88. I believe that many hunters, particularly during the fall, have chosen to hunt in Units 19 and 21, instead of Unit 18. Residents of Unit 18 are aware that hunting opportunities are significantly better in those units; consequently, moose hunting in the central Kuskokwim region of Unit 19A has resulted in an allocation dispute between the residents of Unit 18 and Subunit 19A. Residents of Subunit 21E have also voiced objections to the large number of Unit 18 residents hunting in the vicinity of the village of Holy Cross during the February season.

Approximately 40% of the harvest (15 moose) was reportedly taken in the Yukon River drainage upstream of Mountain Village. Nineteen percent of the harvest (8 moose) was reported from the Tuluksak River. Nine percent of the harvest (4 moose) was reported from the Kisaralik and Kwethluk Rivers, and the Kuskokwim and Johnson River drainages each accounted for an additional 7% of the reported harvest (3 moose each).

During September 1987, ADF&G and USFWS staff operated a check station near the border of Unit 18 and Subunit 21E for the 3rd consecutive year at the mouth of Twelve-mile and Paimiut Sloughs. The level of voluntary participation with the check station was similar to previous years. During the fall 1987 season, 169 hunters stopped at the check station in 70 boats, compared with 152 hunters in 72 boats in fall 1986. As in previous years, nearly all hunters reporting to the check station were residents of Unit 18. Hunters were from 16 communities along the Yukon River.

Information gathered from harvest ticket reports and hunter contacts indicate that approximately 107 moose were harvested in northeastern Unit 18 and Subunit 21E along the Yukon and Innoko Rivers and adjacent sloughs during September 1987. Approximately 76 of these moose were not brought to the check station. Boat traffic is not confined to a single watercourse near the check station, and hunters have many route options along the Yukon and Innoko Rivers. The 31 moose brought to the check station were taken from an area extending from the Innoko River in Subunit 21E to Kako Creek near Russian Mission. The moose processed through the check station were primarily young bulls in good condition. Average antler width of these moose was 40.5 inches. One very large bull (antlers 70.5 inches) was taken from Paimiut Slough in Subunit 21E. The moose reported harvested in the remainder of Unit 18 were also primarily young bulls with antler widths of 35-45 inches (25%) and 30-40 inches (19%). Only 12% of the bulls reported harvested in Unit 18 had antler spreads larger than 50 inches.

Harvest Chronology. Forty moose were reported taken in Unit 18 during the September 1987 season; eight, during the February 1988 season. I believe the actual harvest occurring in February was substantially higher than that reported. Although informed sources indicated that the village of Russian Mission accounted for 10 moose during the February season, only 1 moose was reported.

Weather conditions during the fall of 1987 were generally mild. Moose rutting activity began about September 20 in the vicinity of the check station. The majority of hunters, however, were afield during the 1st week of September, and a definite lull in hunting activity occurred between the 16th and 22nd of the month.

Hunter Residency and Success. Local residents accounted for most of the harvest in Unit 18. Only 8% of the reported harvest was taken by nonlocal hunters. Hunters reporting to the check station needed from 7 hours to 21 days ($\bar{x}$ = 3 days) to obtain a moose. Based on those contacted at the check station, the hunter success rate was approximately 20% and the success rate per boat was 44%. Harvest ticket results indicate that residents of Unit 18 reported an overall success rate of 25%, averaging 6.5 days afield/moose.

Transport Methods. Boats were the mode of transportation used most frequently by successful resident hunters in Unit 18 (57%). Other reported methods of transportation used by successful resident hunters were snowmachines (19%), highway vehicles (8%), aircraft (3%), and off-road vehicles (3%). Three of 4 successful nonlocal hunters used aircraft; the 4th one did not specify transportation means. Because harvest reporting rates are much poorer in the winter than in the fall, I suspect that snowmachines were used to obtain a larger percentage of the overall harvest.

All hunters reporting to the Paimiut check station used boats as transportation: 78% were commercial fishing vessels, 20% were personal craft, and the status of 2% is unknown. The largest boat was a 45-foot aluminum craft with twin 220-hp outboard; the smallest boat was a 14-foot skiff with a 28-hp outboard.

Natural Mortality:

Little information is available concerning predation by either bears or wolves. Local residents reported 3 moose were killed by wolves during the winter in the upper Kwethluk, Kasigluk, and Kisaralik River drainages. Staff from USFWS and ADF&G observed a pack of 7 wolves on a moose carcass in the upper Kisaralik drainage during a February 1988 aerial moose survey.

I believe that Unit 18 supports an estimated 25 to 50 wolves in 5 to 7 packs. The distribution of wolves is similar to the distribution of moose. Wolf numbers may be increasing slightly in the unit as ungulate numbers increase, but absolute numbers of wolves remain extremely low.

Grizzly bear densities are high in some portions of Unit 18, probably outnumbering moose in the Andreafsky and Kilbuck Mountains. Grizzly bears were observed on adult moose carcasses during deep-snow conditions in the Tikchik Lakes in May. Black bears are abundant in lowland habitats along the Yukon River. Predation by bears, particularly on newborn calves, may have a significant impact on moose population growth in Unit 18, although quantitative information is lacking.

Substantial loss of moose calves (e.g., 1985) may result from spring flooding of lowlands along the Yukon and Kuskokwim Rivers after winters with heavy snowfall. The moose population thereafter will exhibit significantly underrepresented age classes, but the high productivity observed in good years should compensate for these natural losses.

Habitat Assessment

The islands and adjacent sloughs along the lower Yukon and Innoko Rivers in Unit 18 and Subunit 21E appear to be productive moose habitat. Biologists from ADF&G and USFWS have noted that willowed winter habitat along the lower Innoko River in Subunit 21E has been heavily browsed. Conversely, willows along Paimiut Slough near the Subunit 21E has been only lightly browsed. This trend continues down the Yukon River, and little or no browsing is evident downstream of Ohogamiut. The large willow stands bordering the Yukon River downstream of Mountain Village are overgrown, senescent, and largely unused. Westward of Head of Passes on the Yukon Delta, willows extend along the branches of the Yukon River only in narrow "stringers". These provide moose with inadequate escape cover from hunters and may explain why the area is largely devoid of moose during winter.

The riparian habitat along the Kuskokwim and the Gweek River drainages resembles the Innoko bottomlands, 100 miles to the northeast, representing good moose habitat; it is composed of alders, abundant willows, spruces, and cottonwoods and is bordered by tundra. Between the villages of Lower Kalskag and Akiachak, the forest and brush along the Kuskokwim River may provide moose some escape cover from hunters. Between Akiachak and the mouth of the Kuskokwim River, the riparian corridor narrows and escape cover for moose is lacking. Tributaries bordered by spruce and cottonwood extend eastward from the Kuskokwim River to the Kilbuck Mountains. Each of these tributaries supports low numbers of moose, with the largest concentration found along the upper Tuluksak River near the community of Nyac.

Game Board Actions and Emergency Orders

The Coastal Yukon Mayor's Association, meeting in Emmonak in April 1987, passed a resolution calling for a moritorium on moose hunting on the lower Yukon Delta downstream of Mountain Village. Aware of a very low-density moose population on the Lower Yukon Delta, this association believed that excessive hunter harvest has been hindering moose population growth, and they sought the assistance of ADF&G in preparing a formal proposal for the Board of Game. In my estimation, this was exactly what was needed, although some staff maintain that the quality of the winter range on the Yukon Delta may be insufficient to support a substantial moose population. The Board of Game passed this proposal in spring 1988, closing the season on the Yukon Delta downstream of Mountain Village.

Local advisory committees recommended to the Board of Game in the spring of 1985 that a 1-10 February winter season for bulls only in Unit 18 replace the existing November-December bulls only season. The Board of Game passed the advisory committees' proposal. Lower Kuskokwim River residents proposed in 1987 that the February season be moved to 20-30 December to allow the harvesting of moose for Russian Orthodox Christmas celebrations. The Department supported this proposal, and it was passed by the Board of Game in the spring 1988.

CONCLUSIONS AND RECOMMENDATIONS

Moose have colonized Unit 18 during the last 40 years and are now found in moderate density along the Yukon River upriver from Ohogamiut; however they occur at very low densities in the remainder of the unit. Most of Unit 18 is lowland tundra, which is unsuitable as moose winter habitat. Moose are confined in winter to riparian habitats along major rivers, and many appear highly migratory. Extensive habitat is available for further colonization. Although calf production and yearling recruitment are normally good, heavy hunter harvest from the relatively dense human population residing in the unit has effectively limited moose population growth. The reported moose harvest, however, has declined in recent years, presumably in response to worsening economic conditions and the high cost of hunting.

The out-of-season harvest, particularly of cows and calves, remains the most serious moose management problem in Unit 18. Although compliance with seasons and regulations has improved markedly in recent years, a lack of alternative ungulate resources, a poorly developed cash economy, and a high density of people and villages along the major rivers complicates the problem considerably. Recent actions by local user groups to shoulder more responsibility for conserving local moose populations are welcome signs of increasing participation with the management system.

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Table 1. Lower Yukon River moose surveys (Paimiut to Russian Mission), midwinter 1980-1988.

Year	Total adults	Total calves	Percent calves	Total moose	Moose/hour
1980	38	11	22	49	15
1981	27	12	31	39	18
1982	22	15	41	37	19
1983	35	10	22	45	18
1984	43	20	32	63	29
1985	75	32	30	107	49
1987	101	5[a]	--	106	50
1988	155	54	26	209	116

[a] Many calves not identified (poor survey conditions).

Table 2. Lower Yukon moose surveys (Russian Mission to Ohogamiut), midwinter 1980-1988.

Year	Total adults	Total calves	Percent calves	Total moose	Moose/hour
1980	6	5	45	11	8
1981	20	27[a]	57[a]	47	16
1982	11	16[a]	59[a]	27	13
1983	6	1[a]	14[a]	7	7
1984	15	7	32	22	18
1985	33	21	39	54	27
1986	6	5[a]	45[a]	11	9
1987	30	15	33	45	37
1988	85	21	20	106	88

[a] Poor survey conditions (small sample size).

Table 3. Lower Yukon moose surveys (Ohogamiut to Pilot Station), midwinter 1981-1988.

Year	Total adults	Total calves	Percent calves	Total moose	Moose/ hour
1981	11	4	27	15	3
1982	8	9	53	17	10
1985	9	1[a]	10[a]	10	3
1988	24	8	27	30	8

[a] Poor survey conditions (small sample size).

STUDY AREA

GAME MANAGEMENT UNIT: 19 (36,850 mi^2)

GEOGRAPHICAL DESCRIPTION: Upper Kuskokwim River watershed, including all drainages into the Kuskokwim River upstream of Lower Kalskag

BACKGROUND

Unit 19 contains moose habitat that can conveniently be divided into 2 regions, each with distinct access provisions that ultimately segregate hunters. Subunits 19B and 19C are generally higher-elevation areas, and access is largely restricted to aircraft. Subunits 19A and 19D are generally lower-elevation areas, providing boat access for rural residents of Unit 18 and 19.

Moderate winter weather over the last several years has caused little mortality of the area's moose populations. Brown bear and wolf numbers are moderate. Although no formal range investigations have been recently conducted, incidental observations indicate moderate browsing levels. Overall hunting mortality is also moderate. Accordingly, the moose population appears to be stable or slightly increasing in Unit 19.

POPULATION OBJECTIVES

To develop statistically sound population estimates for the entire unit by 1993.

To facilitate a harvest representing not less than 45% reported annual hunter success.

To provide a harvest of not less than 500 animals annually.

To maintain a mean annual antler spread of not less than 48 inches in the reported harvest of bull moose.

METHODS

Fall and early winter population composition surveys were conducted in selected portions of the unit. Areas with the greatest hunting pressure were surveyed during late fall. Subunit 19A was divided into 8- to 12-mi^2 units, and attempts were made to stratify moose densities within portions of that subunit. Poor weather and other moose survey commitments precluded that effort. Four trend count areas within Unit 19 were surveyed.

A hunter check station was established in Subunit 19A at the mouth of the Holitna River to monitor the harvest. It was manned throughout the season, and information was collected on sociological (i.e., hunter residence, boat size, and history of use by individual hunters) as well as biological information. Harvest trends were evaluated in other portions of the unit, based on hunter harvest ticket reports.

RESULTS AND DISCUSSION

Population Status and Trend

Although no formal moose population censuses have been conducted in Unit 19, trend surveys have been sporadically conducted in scattered locations, and annual hunter harvest have been analyzed. Although statistically sound biological data are not available, I believe that moose populations are generally moderate; the recent trend is toward a slight increase in numbers.

Population Trend:

Two major areas within Unit 19 have been subjected to periodic trend surveys, producing historical data that can be used to depict population trends. Although data collection periods, extent of survey area, and weather conditions have not been consistent from year to year, the data indicate crude trends.

In Subunit 19A the lower reaches of the Holitna and/or Hoholitna Rivers were surveyed 12 times between 1976 and 1987. Because several of those surveys were conducted in late winter (February and March), lack of antlers on most bulls made collection of sex-specific classifications impossible. However, population trends are thought to be indicated by the percentage of calves observed and numbers of moose tabulated per hour of survey time.

Data concerning the percentage of calves observed and moose per hour for the Holitna-Hoholitna River drainage are not statistically significant, but correlation coefficiants were positive for both moose per hour ($r = 0.58$) and percentage calves in the subpopulation ($r = 0.64$) during the period 1976 through 1987 (Fig. 1).

Data collected from Subunit 19C in the Farewell Burn-Alaska Range foothills area were also subjected to regression analyses. As with the Holitna-Hoholitna River drainage data, season, area, and weather inconsistencies confounded its validity; I believe crude trends are evident (Fig. 2). Since 1980 moose-per-hour figures have increased. Previously (1973-79), trend data indicated a steady decline in moose per hour. From 11 surveys conducted between 1973 and 1987, the percentage of calves in the herd has generally declined; however, a recent increase (12% to 25% from 1985 to 1987, respectively) may indicate a slight rebound in calf production and/or survival.

A further indication of moose population trends may be gathered from hunter harvest reports. Success rate percentages in all subunits combined (Fig. 3) have not shown any significant trends, nor have mean antler sizes in Subunits 19B and 19C (where "trophy" animals are generally preferred).

Population Composition:

As mentioned above, composition surveys have been conducted at various intervals and locations in Unit 19. Unfortunately, lack of standardized survey conditions, survey areas, and/or weather conditions have largely precluded meaningful comparisons. As long as these inconsistencies are noted, some comparisons are available (Table 1).

As is evident from Table 1, subpopulations of moose within Unit 19 that are subject to differing climatic conditions, hunting regimes, and predation factors display a wide variation in herd composition. In Subunit 19A, where the harvest is largely by local residents for meat, there are few bulls remaining after the fall season (23 bulls:100 cows), but calf crops are extremely good (72 calves:100 cows). In Subunit 19C, where there is more harvest selection for large bulls, bull ratios are higher (72 bulls:100 cows), while calf crops are lower (25 calves:100 cows). Habitat differences within count areas also influence observed herd composition.

Although hunting pressure has increased dramatically in the Farewell Burn area of Subunit 19C, it appears that the moose subpopulation remains healthy. Bull:cow ratios remained high (53 bulls:100 cows), with an almost equal age distribution of remaining bulls. Of 72 bulls classified after the season on the Burn, 22 (31%) were judged to be yearlings, 24 (33%) middle-aged, and 26 (36%) older animals (>50-in antler spread). In the Alaska Range foothills above Farewell, bull:cow ratios were even higher; i.e., 111 bulls:100 cows. Relative ages of those bulls, as indicated by antler spreads, revealed a good age distribution (i.e., yearlings = 16%, young adults = 51%, old bulls = 33%).

Distribution and Movements:

During this reporting period, no specific information was collected on relative distribution or movements of moose in Unit 19. As mentioned earlier, plans for intensive stratification of Subunit 19A were not carried out. If weather permits, we will attempt to gather distribution information during the fall and winter of 1988-89.

Mortality

Season and Bag Limit:

The open subsistence seasons for residents of Lime Village only are 10 August to 25 September and 20 November to 31 March; the bag limit is 2 moose, only one of which may be antlerless. The open season for resident and nonresident hunters in Subunit 19A is 1-20 September. The open seasons for subsistence hunters in Subunit 19A are 1-20 September, 20-30 November, and 1-10 February. The bag limit for all hunters in Subunit 19A is 1 moose; however, antlerless moose may be taken by subsistence hunters from 20 to 30 November and from 1 to 10 February. The open season for all hunters in Subunit 19B and that portion of Subunit 19D in the upper Kuskokwim Controlled Use Area within the drainage of the North Fork upstream from the confluence of the South Fork to the mouth of the Swift Fork is 1-30 September; the bag limit is 1 bull. The open season for all hunters in Subunit 19C is 1 September to 10 October; the bag limit is 1 bull. The open season for resident and nonresident hunters in the remainder of Subunit 19D is 1 to 30 September; the bag limit is 1 bull. The open seasons for subsistence hunters in the remainder of the Upper Kuskokwim Controlled Use Area in Subunit 19D are 1 to 30 September and 1 December to 28 February; the bag limit is 1 bull. The open seasons for subsistence hunters in the remainder of Subunit 19D are 1 to 30 September and 1 to 15 December; the bag limit is 1 bull.

Human-induced Mortality:

Over the past 25 years (1963-87), the reported moose harvest has increased 3-fold (Fig. 4). I believe the near-record 1987-88 reported harvest of 549 moose in Unit 19 (Fig. 4) indicates (1) increased moose hunting pressure and harvest, (2) stable or increasing moose numbers, and (3) increased compliance with harvest-reporting requirements.

Although compliance with reporting requirements appears to be increasing, it is still low in some locations. Data collected at the Holitna River check station in Subunit 19A during fall 1987 showed that 76 successful moose hunters submitted their harvest reports. An additional 49 successful hunters stopping at the check station did not submit required harvest report cards. If these data are representative of the entire subunit, the reported harvest of 167 moose probably represents an actual harvest of 275 moose from Subunit 19A, which is 65% greater than the reported harvest. I suspect that reporting in Subunits 19B and 19C is more representative of the actual harvests. Reporting in Subunit 19D is probably lower, similar to that for 19A. Using these data, the estimated 1987-88 harvest in Unit 19 was approximately 781 moose, which is 42% higher than the reported harvest of 549 animals.

After talking with several hunters at the Holitna River check station, it was apparent that many people used hunting techniques that probably caused a high incidence of wounding loss. Many hunters were from tundra and coastal areas, and generally used small-caliber weapons. In addition, they often failed to follow and retrieve fatally wounded animals. Education must stress the need to change these hunting practices.

Hunter Residency and Success. Local residents accounted for the major portion of the moose harvests in Subunits 19A and 19D, while most hunters in 19B and 19C were nonlocal Alaska residents or nonresidents. This segregation by residence location is caused largely by the accessibility of the respective areas.

In Subunit 19A, rural residents of Unit 18 and Subunit 19A accounted for 80% of the reported hunters (Table 2), while other Alaskan urban hunters, nonresidents, and nonresident aliens accounted for the 20% remaining. Of all hunters reporting from Subunit 19D, residents of the subunit composed over half those reporting. Alaska residents totaled 173, or 72% of those who reported. In Subunits 19B and 19C, only 3% and 1.5% of the reporting hunters were from Unit 19, respectively.

Success rates reported by those returning harvest report cards were relatively consistent between subunits, ranging from 50% success in Subunit 19A to 62% in Subunit 19C. Throughout the entire unit, reported success rate for 1987-88 was 53.6%. During the last 9-year period (1979-87), success rates by all hunters has remained relatively stable, varying from a low of 49% (1981, 1982, 1985) to a high of 66% (1979).

Five hundred thirty-nine successful hunters spent a total of 3,742 days afield (mean days per hunter = 6.9), while 464 unsuccessful hunters spent a total of 3,848 days (mean days per hunter = 8.3), for a total of 7.6 days/hunter. Data from the past 4 years on the mean number of days spent hunting in Unit 19 have not changed significantly among years.

Harvest Chronology. As in previous years for which data are available, the vast majority of the harvest occurs during September (83%). In Subunit 19A, a significant portion of the annual harvest occurs in February (20%) by local residents. The season extends into October in Subunit 19C, so a significant portion of the subunit harvest (19%) also occurs during that month. The chronology of the harvest has not changed significantly during the past 10 years (Table 3).

Antler Spread and Age. Antler spreads as reported on harvest report cards are analyzed annually to detect differences in sizes of harvested animals. During the 1987-88 season, mean reported antler spread was calculated at 45.7 inches. This is not significantly different from the 7 previous years, and no trends in antler sizes are evident.

Because of differing access leading to a segregation of local resident and nonlocal hunters, mean antler sizes are larger in Subunits 19B and 19C (47.8 in and 52.6 in, respectively) than in Subunits 19A and 19D (42.2 in and 39.9 in, respectively). When mean antler sizes are analyzed by residency status of hunters, nonresidents (who often hunt with guides) harvest significantly larger bulls (mean = 54.4 in) than do residents (mean = 41.9 in).

Limited information is available on rates of growth of Unit 19 moose. However, during the 1987-88 moose season, teeth from 103 moose were collected from successful hunters from the Holitna and Hoholitna River drainages in Subunit 19A and analyzed through cementum annuli counts. Almost half of those harvested were yearlings and 2-year olds (Fig. 5). I would have suspected a much higher harvest of 2- and 3-year olds in a normal population, but poor survival of calves and yearlings in 1984 probably accounts for the low numbers harvested. The oldest moose from which data were collected was 8.5 years old.

Maximum antler spread was compared with cementum age of individual moose. Antler spreads ranged from 18 inches to 66 inches. Data from individual age classes of moose is presented in Table 4. An additional analysis was conducted from those Holitna-Hoholitna River moose that compared antler sizes with date of harvest (Fig. 6). The hypothesis tested was that younger, smaller bulls would be harvested early in the season, and as the season progressed, more larger bulls would become available because of increased movements associated with the rut. Although not statistically significant, there appeared to be a greater proportion of larger bulls harvested in the latter half of the 20-day season.

Moose antlers were subjected to several measurements at the Holitna River check station, and a comparison was made between total number of points and maximum antler spread (Fig. 7). As suspected, a high correlation existed between the 2 parameters.

<u>Hunter Profiles</u>. In addition to collecting biological information, individual hunters who stopped at the Holitna River check station in Subunit 19A were asked questions, in an attempt to gather some sociological data on customary and traditional uses in the area. One of the questions concerned the history of use by individuals in the area. Unit 19 hunters ($\underline{n}$ = 10) had been utilizing the Holitna drainage for an average of 6.6 years. Unit 18 hunters ($\underline{n}$ = 73) averaged 3.4 years of use, and nonresidents of the state ($\underline{n}$ = 4) all indicated they were hunting for the first time on the Holitna River.

Motor sizes were recorded for each boat that stopped at the check station. Unit 19 hunters had boats with motors of an average horsepower (hp) of 38. Boats from Unit 18 had motors that averaged 81 hp. The difference between Unit 19 and Unit 18 motors was significant ($P < 0.01$).

Transport Methods. Because of geographical differences, access to various parts of Unit 19 necessarily differs. In the lower elevation portions of the unit (Subunits 19A and 19D), major access is provided by boats. In the more mountainous areas (Subunits 19B and 19C) with less tree cover, access is largely limited to aircraft. Methods of transportation have not changed significantly during the past 4 years (Table 5). As indicated above, the predominant method of transportation for successful hunters in Subunits 19A and 19D are boats (73%). In Subunits 19B and 19C, aircraft provide the predominant access mean (72%).

Natural Mortality:

Little historical information on natural moose mortality is available from Unit 19; that which is available is largely anecdotal. During 1987-88, 2 factors may have led to significant natural mortality in certain cohorts of moose within Unit 19, but these causes are largely speculative and their impact on the population is difficult to assess. The 1st factor is predation. Wolf numbers, according to incidental discussions with area trappers, are quite high in many areas, accounting for a number of predation-related moose deaths. Secondly, spring flooding in lowland areas where moose are concentrated on calving areas also accounted for limited survival of calves. In early summer 1988, late runoff accompanied by heavy rainfall in the Holitna River drainage will probably influence calf survival in that area. Most of the riparian habitat downstream of the confluence of the Holitna River and Titnuk Creek was inundated soon after parturition; it will probably result in lowered calf crops in fall composition counts.

Habitat Assessment and Enhancement

Heavy winter concentrations of moose in the lower portions of the Holitna and Hoholitna River drainages affected available browse. During the early summer of 1988, browse immediately adjacent to the rivers was examined. Although the level of browsing was heavy in some areas, it did not appear to be detrimental to the range. Leader growth was good, and previous browsing levels were not sufficiently high to remove all current annual growth. I believe the area has the capability of supporting moose populations comparable with what currently exists without damaging browse species in the area. Cursory examinations of browse in other winter concentration areas along the Kuskokwim River have shown moderate browsing levels that can be sustained at current or slightly higher moose densities.

No moose browse enhancement efforts have been recently conducted in Unit 19. I am currently in the process of reviewing fire management plans to ensure compliance with earlier planning efforts. Naturally occurring wildfires must be allowed to burn (with limited fire suppression activities) in areas where fire may benefit moose populations.

Game Board Actions and Emergency Orders

The Board of Game took few actions directly in Unit 19. The current cow seasons in Subunit 19A were approved again for the 1987-88 season. The Board took action in neighboring Subunit 21E that will probably influence the moose harvest in Subunit 19A. The Board designated subsistence users in Subunit 21E as individuals living in the unit as well as residents of the village of Russian Mission. This effectively deletes the winter/spring use of the area by many residents of Bethel and other Yukon-Kuskokwim villages. I would suspect that many of those hunters who normally hunt in Subunit 21E will be redirected to Subunit 19A, where the late antlerless moose seasons remain open for all state residents. Monitoring of the moose hunting pressure in the Aniak, George, and Holitna River drainages should be increased to determine the number of hunters.

CONCLUSIONS AND RECOMMENDATIONS

In Subunit 19A the check station efforts should continue to document actual hunter effort and harvest. Placement of the check station should be at the mouth of the Holitna River to sample hunter effort and success in the Kuskokwim River above Sleetmute as well as the Holitna River drainage. An emphasis should be placed on education of all hunters regarding ethical hunting practices: following wounded moose, use of harvest tickets, compliance with reporting requirements, disposal of garbage, and respect for private property.

Moose composition counts should be conducted in the lower Holitna and Hoholitna Rivers to document the effects of the high spring waters on calf survival. Efforts to expand postseason moose stratification surveys in Subunit 19A should continue to determine advantageous placement of trend count areas.

In Subunit 19B, postseason reconnaissance flights need to be conducted to identify areas with trend count potential. Presently, the only indication of moose population status is gathered through analyses of hunter report returns and incidental discussions with hunters and guides who use the area.

In Subunit 19C, trend count areas on the Farewell Burn and the Alaska Range foothills should be standardized and continued. Analyses of hunter harvest reports will also continue to identify potential problems. The increased hunter effort in the Farewell Station area should be monitored closely to determine the effects of that increase on the existing moose herd. In cooperation with the Alaska Department of Natural Resources and the U.S. Bureau of Land Management, efforts to conduct a spring controlled burn in the Farewell area should be stressed.

In Subunit 19D efforts should focus on identification and delineation of standardized trend count areas along the Kuskokwim River and elsewhere in the subunit. Continued site-specific analyses of hunter harvest ticket reports should be stressed to identify potential overharvesting in localized areas.

At this time, no changes in seasons or bag limits are recommended for Unit 19.

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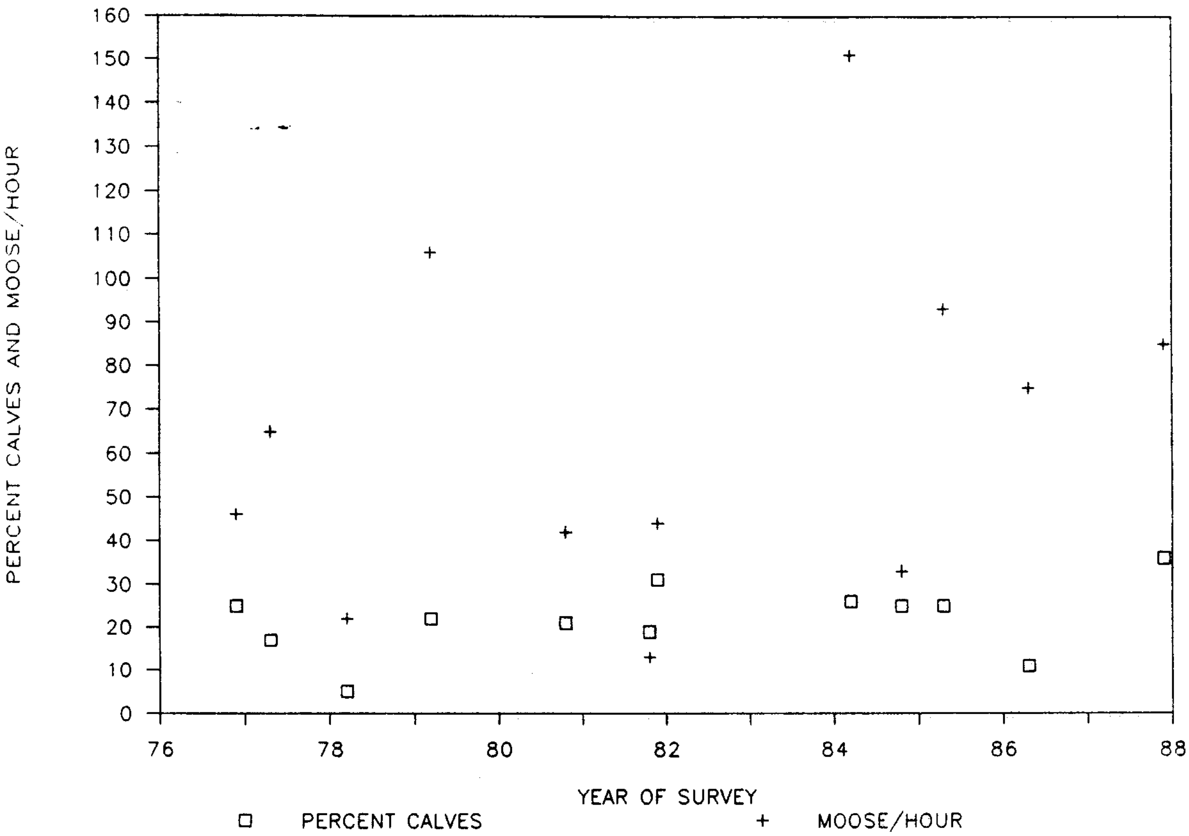

Figure 1. Historical calf percentage and moose per hour data collected in the Holitna-Hoholitna River area between 1976 and 1987 in Subunit 19A (Calf %:Y = (0.009) X-53.2, r = 0.64; Moose/hr:Y = (0.036) X-232.7, r = 0.58).

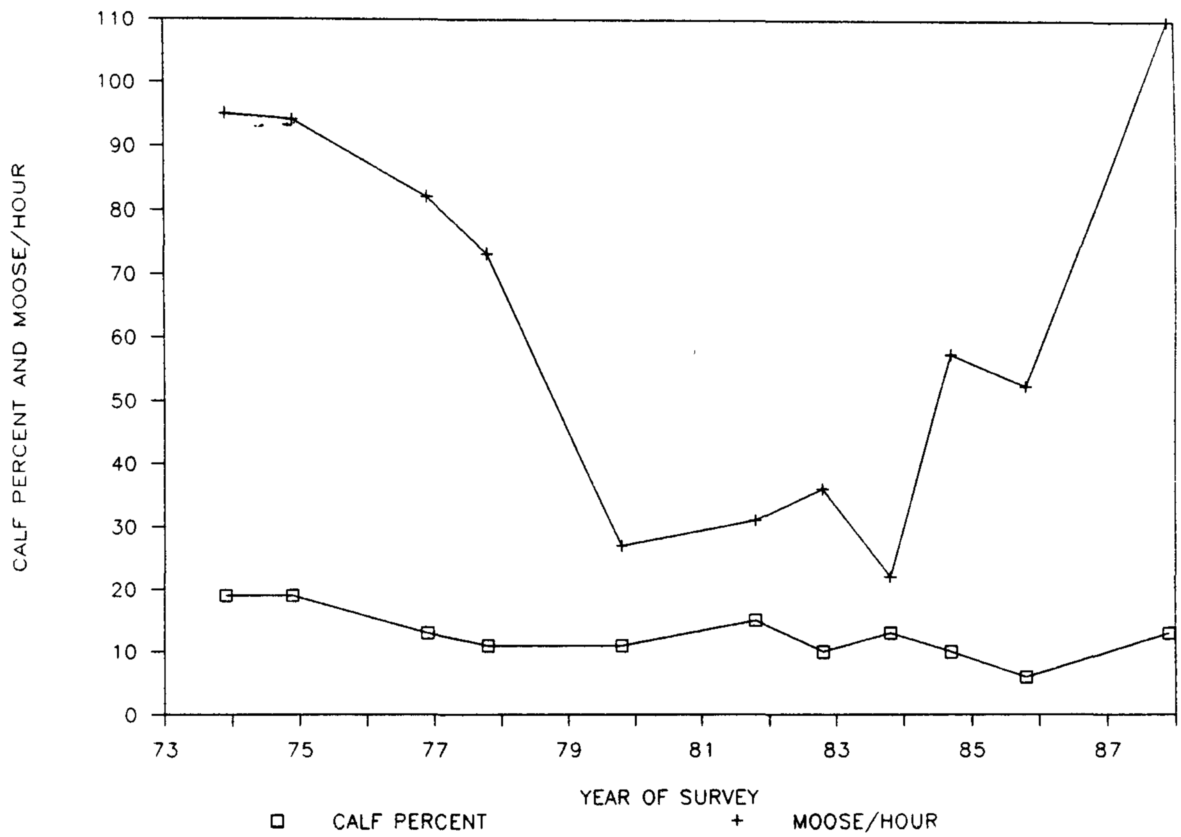

Figure 2. Historical moose per hour and calf percent data collected in the Farewell Burn-Alaska Range foothills area of Subunit 19C between 1973 and 1987.

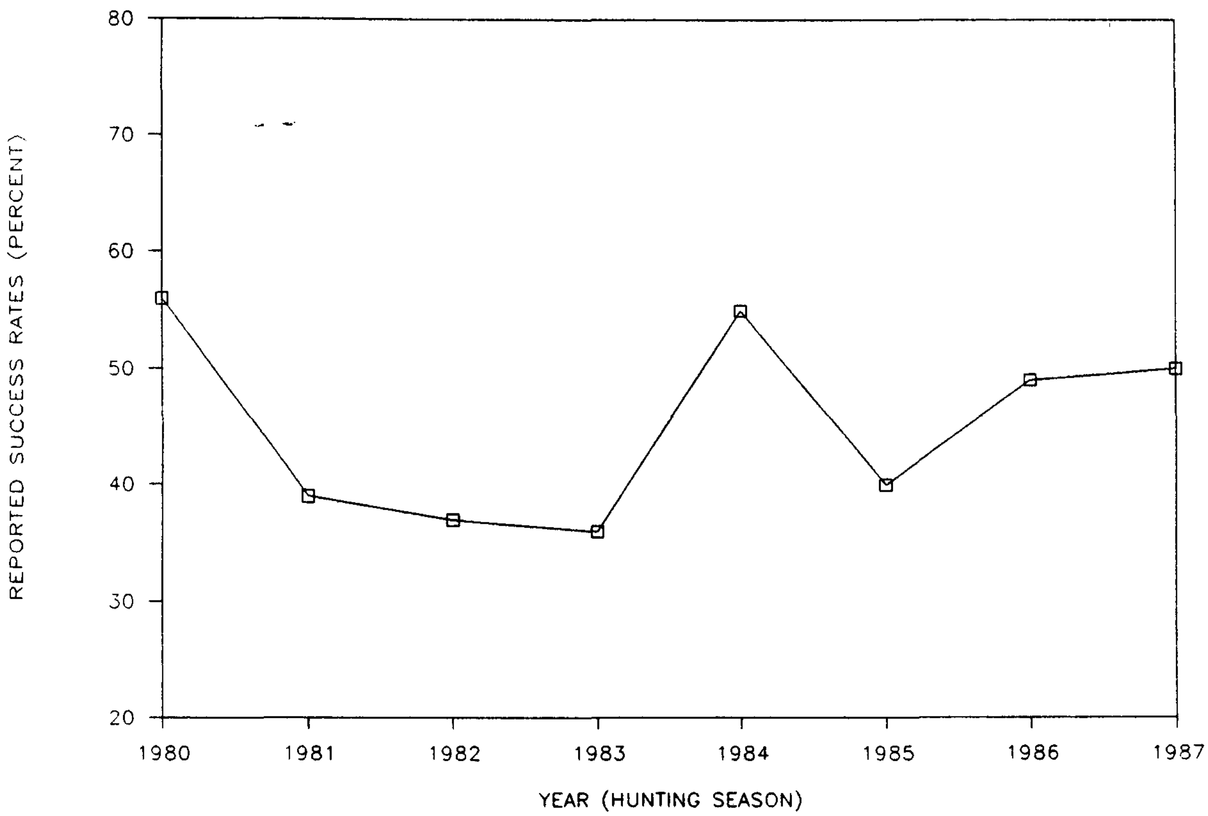

Figure 3. Reported success rates of moose hunters in Unit 19 from 1980 to 1987.

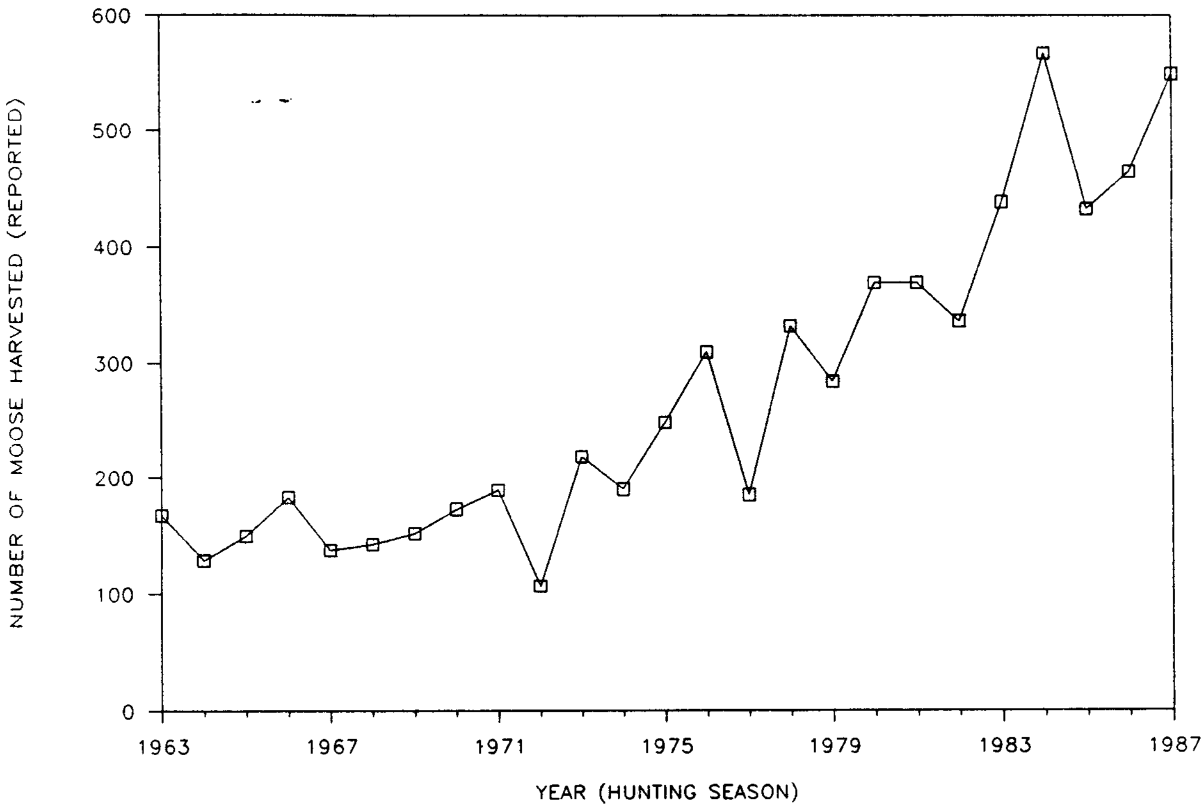

Figure 4. Reported numbers of moose harvested from Unit 19 during the period 1963-87.

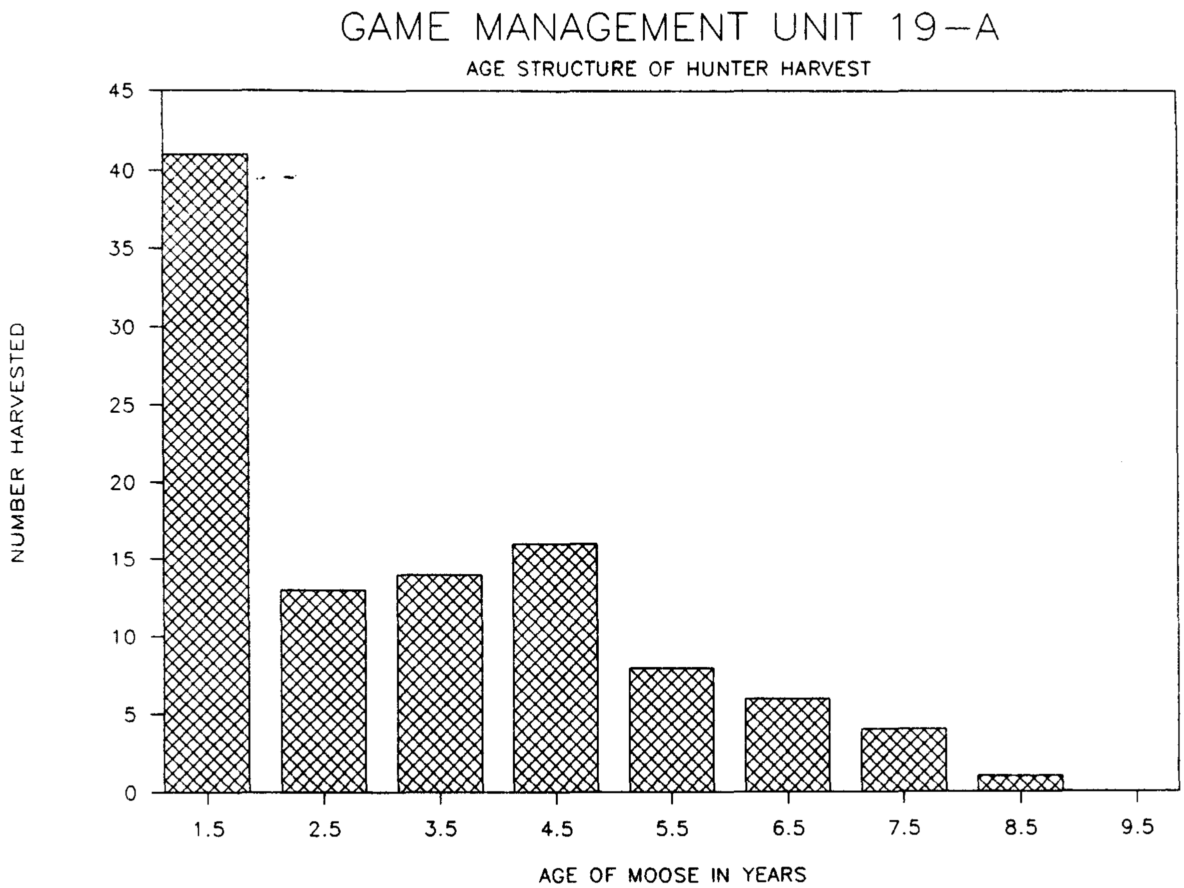

Figure 5. Age structure (as indicated by cementum annuli counts) of the bull moose harvest from the Holitna-Hoholitna River drainages in Subunit 19A during fall 1987.

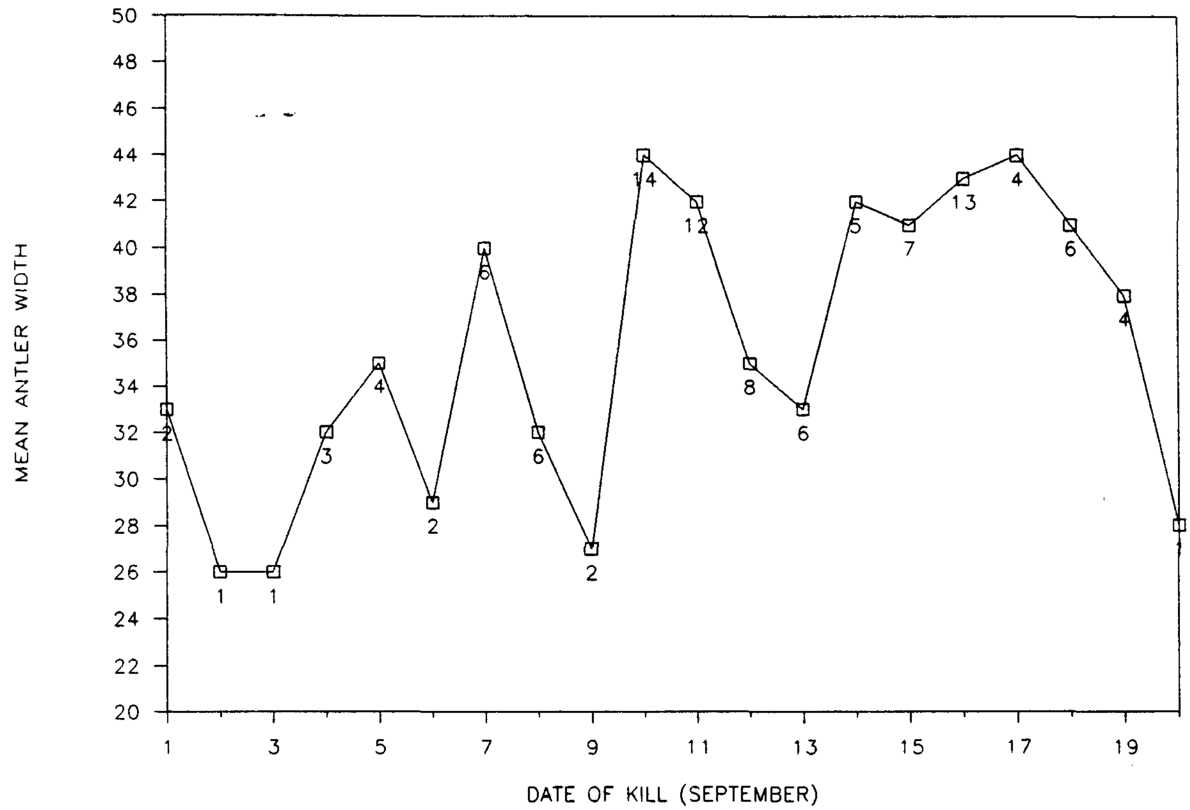

Figure 6. Antler spreads of 107 bull moose compared with reported date of kill of moose harvested from the Holitna-Hoholitna River drainages in Subunit 19A during fall 1987.

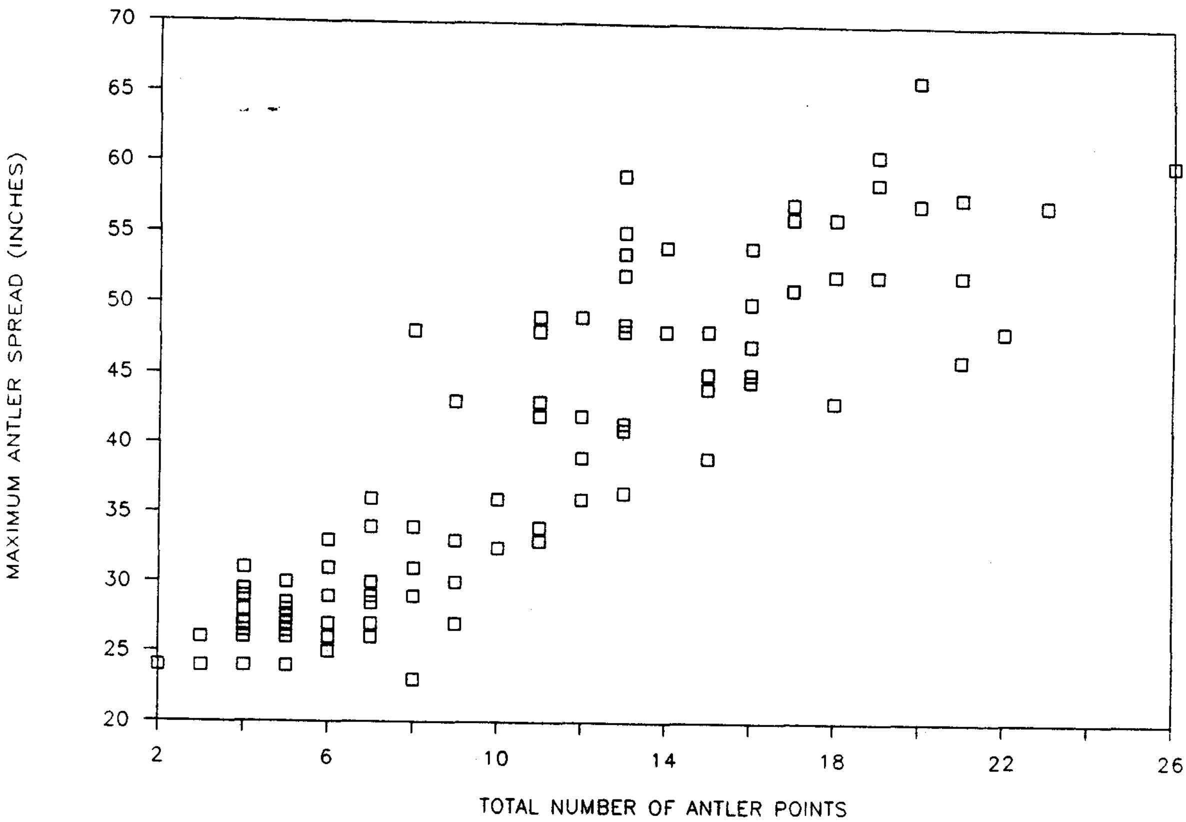

Figure 7. Comparison between total number of points and maximum antler spread of moose taken in the Holitna-Hoholitna River drainages of Subunit 19A during September 1987 ($Y = (1.7) X+20.4$, $r = 0.92$).

Table 1. Moose composition information in Unit 19, as determined from aerial surveys, fall and winter 1987-88.

Subunit	Specific area	Bulls/ 100 cows	Calves/ 100 cows	% Calves	n	Moose/ hour
19A	Holitna-Hoholitna	23	72	35.7	140	85
Subtotal		23	72	35.7	140	85
19C	Ak Range Foothills	111	29	11.8	153	103
19C	Farewell Burn	53	19	13.2	242	115
Subtotal		72	25	12.7	395	110
19D	Nixon-Takotna	36	36	17.4	23	11
Subtotal		36	36	17.4	23	11
Total		57.8	37.5	19.0	558	75.3

Table 2. Residency of hunters in Unit 19 during the 1987-88 moose season, as indicated by hunter harvest ticket reports.

	A		B		C		D		Z		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Unit 18	188	56.6	30	12.9	2	1.0	44	18.3	1	5.3	265	25.9
Unit 19	77	23.2	7	3.0	3	1.5	127	52.9	2	10.5	216	21.1
Ak-Rural	--	--	--	--	1	0.5	2	0.8	--	--	3	0.3
Tot-Rural	265	79.8	37	15.9	6	3.0	173	72.1	3	15.8	484	47.3
Ak Urban	23	6.9	81	34.9	107	53.2	40	16.7	6	31.6	257	25.1
Tot-Ak	288	86.7	118	50.8	113	56.2	213	88.8	9	47.4	741	72.4
Nonres	27	8.1	96	41.4	72	35.8	24	10.0	10	52.6	229	22.4
Aliens	2	0.6	11	4.7	12	6.0	2	0.8	--	--	27	2.6
Unknown	15	4.5	7	3.0	4	2.0	1	0.4	--	--	27	2.6
Total	332	99.9	232	99.9	201	100	240	99.9	19	100	1,024	100

Table 3. Reported historical harvest chronology of moose in Unit 19 during the period 1980-87 expressed as a percentage of total annual harvest.

	Month of Harvest										
Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unk	Total
1980	0.0	0.5	88.6	6.0	3.3	0.3	0.0	0.0	0.0	1.4	100.1
1981	0.0	0.3	84.8	5.7	1.4	0.3	0.3	4.3	0.3	2.7	100.1
1982	0.0	0.3	85.1	5.7	1.8	1.2	0.3	3.6	0.0	2.1	100.1
1983	0.0	0.2	87.4	5.5	0.8	0.2	0.2	1.6	0.0	3.9	99.8
1984	0.0	0.5	84.8	2.1	1.1	0.7	0.0	7.4	0.0	3.4	100.0
1985	0.0	0.7	88.2	2.1	0.5	0.5	0.2	5.1	0.5	2.1	99.9
1986	0.0	0.2	93.6	2.8	0.2	0.0	0.0	3.1	0.0	0.0	99.9
1987	0.2	0.5	83.4	5.1	0.9	0.7	0.2	6.2	0.0	2.7	99.9
MEAN	tr	0.5	86.8	4.2	1.2	0.5	0.1	4.2	0.1	2.4	100.0

Table 4. Moose age-antler size comparisons from the Holitna River check station from moose harvested in September in Subunit 19A, 1987 (all measurements are in inches).

	Age in years							
	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5
Minimum	23	27	32	43	48	48	49	60.5
Maximum	31	42	49	58.5	64	66	60.5	60.5
Mean	27.1	33.8	42.6	50.8	55.6	54.5	54.4	60.5
Number	41	13	14	16	8	6	4	1

Table 5. Method of transportation (depicted as a percentage) used by successful moose hunters in Unit 19 during the period 1984 to 1987.

Transport means	1984	1985	1986	1987
Aircraft	45	43	46	38
Horse	tr	1	tr	1
Boat	45	45	46	44
Motorbike	1	1	2	3
Snow machine	7	6	3	7
ORV	1	2	1	2
Highway	tr	1	1	tr
Unknown	--	--	--	5
Total	100	100	100	100

STUDY AREA

GAME MANAGEMENT UNIT: 20A (6,500 mi^2)

GEOGRAPHICAL DESCRIPTION: Tanana Flats, central Alaska Range

BACKGROUND

The number of moose increased in Subunit 20A during the 1950's, reaching high densities in the early 1960's that persisted until the early 1970's; then the population declined rapidly, reaching its lowest point in the mid-1970's. Following predator reduction that began in 1976, the moose population again increased.

Moose occur throughout the foothills of the Alaska Range and the Tanana Flats. Preferred moose habitat is composed of riparian willow, second-growth forest, and subalpine shrub communities. Habitat may have been a limiting factor to moose population growth during the 1960's when densities were high, but the amount of browse currently available does not appear to be limiting growth. During the 1960's, when average moose densities may have exceeded 3 moose/mi^2, moose undoubtedly affected browse production (W. Gasaway, pers. commun.).

Annual harvests averaged 311 moose between 1963 and 1969; from 1969 to 1974 they increased to an average of 617 moose. Cows made up an average of 34% of the annual harvest from 1963 to 1974. Beginning in 1975, seasons and harvests were dramatically reduced and the taking of cows was prohibited. From 1975 to 1978, the mean annual harvest was only 64 bulls. From 1979 to 1982 harvests increased, averaging 226 bulls/year. Since 1982 the annual harvest has averaged 374 bulls.

POPULATION OBJECTIVES

To increase the moose population from the present 8,000-10,000 moose to 12,000 moose.

To maintain an overall bull:cow ratio of at least 30 bulls:100 cows and a bull:cow ratio of at least 20 bulls:100 cows in each trend count area.

METHODS

Fall trend counts were flown in 6 areas throughout the study area in 1987. Trend counts are designed to yield information on both population density and population composition. Surveys were flown in small discreet areas (30-100 mi^2) at high survey intensities (4 min/mi^2). In addition, composition counts were flown over 3 larger areas (100-300 mi^2) at lower search intensities (1-2 min/mi^2). To assess twinning rates, surveys were flown over the northeastern Tanana Flats on 21, 23, and 24 May 1988 during the peak of calving.

One browse transect of approximately 500 meters was sampled at each of 6 sites during early May 1988. On each transect 100 plants were sampled. An estimate of height and percentage of current annual growth browsed was recorded for each plant. Transects started from arbitrarily selected points and ran in randomly selected compass directions within homogeneous habitat types. During sampling, if it appeared that the transect line would cross into a habitat type different than that originally selected for sampling, the transect direction was changed to ensure sampling was completed within the desired habitat type without encountering previously sampled plants.

RESULTS AND DISCUSSION

Population Status and Trend

The most recent estimate of 8,100 moose in Subunit 20A was derived from population estimation surveys of the Tanana Flats (1982) and the Alaska Range Foothills (1984). Current population size is probably between 8,000 and 10,000 moose.

Although it is unclear whether trend count surveys (i.e., high intensity surveys over small areas) consistently reflect population trends, from 1978 to 1984 increases in densities observed in trend count areas were similar to the increase documented by periodic population estimation surveys. Trend count data indicated a mean annual growth rate of 14%. Comparison of the 1978 and 1982-84 population estimates indicated a 15% mean annual growth. Since 1984 trend counts have indicated declining densities in the southwestern mountains and the central foothills, increasing densities in the western foothills, and stable densities on the Tanana Flats (Table 1). Combined data from those 5 trend areas surveyed in both 1984 and 1987 indicated an overall decline of 9%. However, factors such as a shift in distribution of moose with habitat succession, survey error, or random variation could have influenced the results. Therefore, those data do not provide strong evidence of a population decline. I believe that the moose overall population in Subunit 20A is stable.

Population Composition:

Composition data collected since 1983 for individual trend areas are given in Table 2. During 1987 the overall bull:cow and calf:cow ratios in Subunit 20A were 24:100 and 34:100, respectively. Calf:cow ratios during 1987 were higher than in recent years. Bull:cow ratios in the northeast Tanana Flats, western foothills, and southwestern mountains were at or below the minimum management objective of 20:100. Low-intensity composition surveys flown over the central Tanana Flats and the upper Yanert Valley during November 1987 revealed bull:cow ratios above the minimum management objective (Table 3). Consistently low twinning rates have been observed during fall surveys (Table 2). During 1987 and 1988, spring surveys were conducted on the Tanana Flats during the peak of calving to assess the level of twin production.

During 1987, 10% of the cows observed with calves during the peak of calving had twins ($\underline{n}$ = 50); during 1988, 13% had twins ($\underline{n}$ = 60). These data suggest low production of twins may be responsible for low twinning rates observed during fall surveys.

Distribution and Movements:

Gasaway et al. (1983) documented significant movement of moose from the surrounding hills to the Tanana Flats beginning in April. Moose numbers remained high on the Tanana Flats throughout the summer. Movement back into the hills begins in August and is completed by late October. A resident population of moose remains on the Tanana Flats.

Mortality

Season and Bag Limit:

The open season for the subsistence, resident, and nonresident hunters in the Yanert Controlled Use Area and in that portion of Subunit 20A south of the Rex Trail and west of the Wood River Controlled Use Area the season is 1-15 September. In the remainder of Subunit 20A the open season for all hunters is 1-20 September. The bag limit is 1 bull.

Human-induced Mortality:

Because of its proximity to Fairbanks and traditional ability to support a large moose population, demand by hunters for moose in Subunit 20A is high. During 1987, 1,070 hunters reported taking 301 bulls. The 1986 harvest of 420 bulls was reported by 1,312 hunters. The decline in harvest and hunters from 1986 to 1987 resulted from a shortened season in the western and northern portions of the subunit. A historical record of the harvest within the current boundaries of Subunit 20A is given in Table 4. A detailed history of the moose population through 1978 was published by Gasaway et al. (1983).

Distribution of the harvest during 1987 was similar to that of previous years. Fifty-eight percent of the moose were taken from the Tanana Flats (Table 5). Harvest declined in all areas during 1987, except in the western portion of the Tanana Flats.

Hunter Residency and Success. Overall, hunter success was 28% during 1987. That value is similar to success rates experienced during 1986 (32%) and 1985 (30%) (Table 6).

Local residents took a smaller share (68%) of the harvest during 1987 than those for the previous 2 years (1985, 77%; 1986, 75%); nonlocal residents took a larger share of the harvest (19%). The shift in the distribution of the harvest among users may reflect the increased outfitting activity in Subunit 20A. Nonresidents took 11%, 12%, and 13% of the moose harvest in Subunit 20A during 1985, 1986 and, 1987, respectively.

Harvest Chronology. Although moose hunting in the southwestern portion of Subunit 20A closed on 15 September, 41% of the total 1987 harvest was taken in the remainder of the subunit during the week of 14-20 September (Table 7). Many hunters prefer to hunt late in the season in the Fairbanks area because of increased movement and vocalization of bulls, cooler temperatures, and better hunting visibility after leaf drop.

Transport Methods Aircraft and boats were the methods of access used by 58% of the successful hunters during 1987 (Table 8). Traditionally, more hunters use boats, but success rates are higher for hunters using aircraft.

Natural Mortality:

Assuming the moose population in Subunit 20A has not grown since 1984, an estimate of natural mortality can be derived by constructing a simple model based on 1987 trend area composition values and harvest data (Table 9). These calculations suggest that adult natural mortality in the population was approximately 12%. The total natural mortality was 15%, excluding neonate and summer calf mortality. Natural mortality, assuming zero population growth, among adult bulls and adult cows was calculated as 17% and 10%, respectively.

The higher calculated natural mortality for adult bulls may be attributed to unreported legal hunting mortality, crippling losses, or poaching. If the natural mortality of adult bulls was actually equal to that for adult cows, the "unexplained" portion of the calculated mortality equaled approximately 90 bulls, or 30% of the reported legal harvest. Hunter field interviews should help determine if poor reporting could account for at least part of that unexplained mortality.

An overall natural mortality rate among adult and yearling moose of 15% (Table 9) is consistent with on expected rate of wolf predation, which was calculated at 5-11%. Gasaway et al. (1983) reviewed reported kill rates by wolves in North America and used 1 kill every 3 to 6 days as upper and lower estimates for kill rates in a primarily wolf-moose predation system. However, caribou and sheep are available to wolves in the foothills of Subunit 20A, and their presence presumably reduces wolf predation on moose. James Davis and Rodney Boertje (ADF&G biologists) collected wolf carcasses from trappers taken during winters 1986-87, 1987-88, and 1988-89. Thirty-four stomachs contained the remains of prey; 56% of those stomachs contained moose. Assuming that 56% of the kills were moose and that kills were made at a mean frequency of 1 kill every 3 to 6 days, then 475-950 moose may have been killed by the 24 wolf packs in Subunit 20A from October through April 1987-88. That represents 5-11% of the estimated population of 9,000 moose.

Habitat Assessment

Browse transects were completed during early May 1988 at 3 sites in southwestern Subunit 20A and at 3 sites on the Tanana Flats. Browsing of current annual growth was light at all sites (Table 10). All transects were in successional growth in either riparian or fire-altered sites, and virtually all of the sampled browse plants were short enough to be available to moose. Forage quantity is not currently limiting moose population growth in Subunit 20A.

A 14,000-acre fire which burned intermittently from mid-April through June 1988 on the northeastern Tanana Flats may result in improved browse availability. Willow in that portion of the subunit is in general old-aged, producing little available browse.

Game Board Actions and Emergency Orders

In response to declining bull:cow ratios, the September 1987 season was reduced from 20 to 15 days in southwestern Subunit 20A and from 30 to 20 days on the northern Tanana Flats.

Beginning in 1988 the southwestern portion of Subunit 20A, including the Yanert River drainage, will be open only to the taking of either bulls with spike/fork antlers or bulls with antler spreads of 50 or more inches. These regulations are necessary because of the continued decline in bull:cow ratios resulting from increased hunting pressure and persistently poor calf recruitment.

Residents of Cantwell, Minto, and Nenana have received subsistence use status for moose in Subunit 20A. Although residents of the Parks Highway between Cantwell and Nenana were determined to be rural residents, they were not given subsistence use status.

CONCLUSIONS AND RECOMMENDATIONS

The current estimate of 8,000-10,000 moose in Subunit 20A is below the population objective of 12,000 moose. The most recent, statistically dependable estimate was 8,100 moose derived from 1982 and 1984 data. Data from annual trend counts since 1984 were inadequate to clearly indicate population trend. I recommend a population estimation survey be conducted during the fall of 1988 and 1989 on the Tanana Flats and over the foothills, resepctively, to determine what progress, if any, has been made toward the population goal.

Overall 24 bulls:100 cows were observed in established trend areas during 1987. Three of the 5 trend areas had bull:cow ratios of 20:100 or less. To achieve the management objective (i.e., 30 bulls:100 cows) harvests must be reduced below the 1984-86 annual average of 390 bulls. An annual legal harvest of 250-300 adult (greater than 30-inch antler spread) bulls would allow for 5-10% annual growth in adult bull numbers, if other mortality sources do not exceed 10%. However, under the scenario of zero growth as presented in Table 9, other mortality sources were estimated at 17% of adult bull numbers prior to hunting.

I recommend harvests do not exceed 300 adult bulls until bull:cow ratios have increased to the management goal of 30:100 and until the population goal of 12,000 moose is reached. Investigation of harvest reporting rates through hunter interviews in the field will be continued in 1988 and 1989. The harvest goal will be reduced, if it is determined that nonreporting, crippling losses, poaching, and natural mortality sources combine to exceed 10% of the prehunting bull estimate.

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Table 1. Comparison of 1984 and 1987 trend count densities, Subunit 20A[a].

Size Trend area	Size (mi^2)	Area represented	1984 density (moose/mi^2)	1987 Density (moose/mi^2)	% change
Bear Creek	84.8	Tanana Flats	1.99	1.99	0
Japan Hills	61.5	Central Foothills	3.56	1.77	-50
Windy Creek	86.7	Western Foothills	1.66	2.08	+25
Moody Creek	20.4	Western Mountains	3.53	2.89	-18
Moose Creek	23.2	Lower Yanert	3.58	2.80	-22
Combined trend areas			2.42	2.21	-9

[a] Includes density of moose $\geq$2 years. Areas included are those for which identical survey areas were flown in both years.

Table 2. Fall moose composition data from trend count areas in Subunit 20A in which identical areas were flown between 1983 and 1987.

Trend area	Location/ date	Adult moose/mi^2	Bulls: 100 cows	Calves: 100 cows	% Calves	% Twins[a]	n	Search area
Bear Creek	NE Tanana Flats							
	1983	1.75	36	33	19	7	248	84.8
	1984	1.99	22	51	30	12	288	84.8
	1986	1.37	25	22	15	0	199	84.8
	1987	1.99	20	36	23	3	290	84.8
Windy Creek	SW Foothills							
	1985	1.7	23	30	19	6	186	86.7
	1987	2.1	20	35	23	2	258	86.7
Japan Hills	Central Foothills							
	1984	3.6	48	42	22	0	307	61.5
	1985	3.0	57	36	19	4	301	61.5
	1987	1.8	42	40	22	7	206	61.5
Moody Creek	SW Mountains							
	1984	4.2	23	15	11	20	113	20.4
	1985	3.5	32	22	14	15	105	20.4
	1987	2.9	27	23	15	18	84	20.4
Moose Creek	Yanert Valley							
	1984	3.6	19	15	11	20	107	23.2
	1987	2.8	13	23	17	8	83	23.2
Combined data	1987	2.2	24	34	21	5	921	276.6

[a] Twinning rate among cows that were observed with calves.

Table 3. Composition values from low intensity surveys in Subunit 20A, 1987.

Count area	Search area (mi^2)	Bulls: 100 cows	Calves: 100 cows	% Calves	% Twins	n
Tanana Flats	350	44	35	20	3	352
Yanert River	200	23	25	17	10	65

Table 4. Historical summary of moose harvest in Subunit 20A, 1963-87.

Year	Harvest	Percent females in harvest
1963	302	31
1964	274	26
1965	335	22
1966	216	24
1967	299	40
1968	377	31
1969	376	29
1970	449	33
1971	483	30
1972	699	41
1973	964	51
1974	489	47
1975	63	0
1976	62	0
1977	50	0
1978	80	0
1979	130	0
1980	207	0
1981	277	0
1982	291	0
1983	399	0
1984	390	0
1985	360	0
1986	420	0
1987	301	0

Table 5. Distribution of moose harvest in Subunit 20A, 1984-87.

Location (Uniform Code Units)	Year 1984	1985	1986	1987
Tanana Flats				
West of Wood River (0100, 0101, 0201, 0301)	48	32	43	50
Wood River (x of 0400, 0401)	31	31	34	25
East of Wood River (0500, 0501, 0502, 0503, 0504, 0506)	124	144	134	85
East of Little Delta River (0601, 0701, 0800, 0801)	22	14	17	12
Foothills and Mountains				
Western (0102, 0103, 0104, 0105, 0200, 0202)	52	45	57	40
Central (0300, 0302, x of 0400, 0402, 0403, 0404, 0405, 0505)	42	28	61	39
Eastern (0600, 0602, 0603, 0605, 0702, 0802, 0700)	27	37	40	27
Yanert Controlled Use Area (106, 107, 108)	32	21	22	15
Unknown location 20A (0000)	12	8	12	8
Total Tanana Flats	225	221	228	172
Total foothills and mountains	153	131	180	121
Total Subunit 20A harvest	390	360	420	301

Table 6. Hunter residency and success in Subunit 20A, 1985-87.

Year	Successful: Unit res.[a]	Successful: Other res.	Successful: Non res.	Successful: Unk	Successful: Total	Unsuccessful: Unit res.	Unsuccessful: Other res.	Unsuccessful: Non res.	Unsuccessful: Unk	Unsuccessful: Total
1985	265	39	40	16	360	695	97	27	36	855
1986	303	53	51	13	420	727	83	54	28	892
1987	178	51	34	38	301	565	106	31	67	769

[a] Includes residents of 20A, 20B, 20C, and 20D.

Table 7. Harvest chronology in Subunit 20A, 1987.

Week	Harvest	% of total reported 9/1-9/20	Cumulative % of harvest reported 9/1-9/20
9/1-9/6	80	28	28
9/7-9/13	88	31	59
9/14-9/20	119	41	100
Out of season or unknown	14	--	--
Total harvest	301	--	--

Table 8. Number of successful hunters and percentage () of total successful hunters by transport method, Subunit 20A, 1984 and 1987.

Year	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unknown
1984	136 (35)	24 (6)	112 (29)	28 (7)	40 (10)	34 (9)	16 (4)
1987	99 (33)	14 (5)	75 (25)	34 (11)	37 (12)	20 (6)	22 (7)

Table 9. Moose population and mortality estimates derived from 1987 harvest and composition data in Subunit 20A, assuming zero growth since 1984.

Estimate	Adults			Yearlings			Calves			Total
	Male	Female	Total	Male	Female	Total	Male	Female	Total	population
1987 prehunt population	1,044	4,587	5,631	517	517	1,034	868	868	1,736	8,401
Harvest	253	0	253	48	0	48	0	0	0	301
Posthunt population	791	4,587	5,378	469	517	986	868	868	1,736	8,100
Hunt mortality	24%	0	4%	9%	0	5%	0	0	0	4%
Expected prehunt population, 1988	1,260	5,104	6,364	868	868	1,736	868	868	1,736	9,836
Projected annual growth rate with zero natural mortality[a]	21%	11%	13%	68%	68%	68%	--	--	--	17%
Mortality (nonhunting) required to obtain zero growth. Assumes current hunting level	17%[b]	10%[b]	12%[b]	40%[c]	40%[c]	40%[c]	--[d]	--[d]	--[d]	15%[e]

[a] Growth and mortality rate estimates differ because growth was calculated as a function of 1987 prehunt population, mortality was calculated as a function of 1988 prehunt expected population. Assume current hunting mortality.

[b] Includes mortality of the posthunt yearling cohort from 1 October 1987-1 September 1988.

[c] Reflects mortality of posthunt calf cohort from 1 October 1987-1 September 1988.

[d] Prehunt calf mortality is already included in prehunt population estimate because that estimate is derived from posthunt composition value.

[e] Combined adult/yearling mortality to achieve zero growth.

Table 10. Summary of browse transects sampled in Subunit 20A, May 1988.

Sample location (community type)	Species	Frequency[a] of occurrence	Current browsing[a] Unbrowsed %	Low %	Moderate %	High %
Ferry Trail (young-age upland shrub/deciduous tree)	Willow	38	95	5	0	0
	Birch	7	86	14	0	0
	Aspen	38	100	0	0	0
	Poplar	9	89	11	0	0
	Dwarf birch	8	100	0	0	0
Wilson Creek (alpine willow--in ravine)	Willow	96	88	10	1	1
	Dwarf birch	4	100	0	0	0
Walker Creek (riparian willow)	Willow	80	50	24	11	15
	Poplar	16	75	25	0	0
	Aspen	1	100	0	0	0
	Dwarf birch	2	100	0	0	0
Clear Creek (mixed spruce/shrub successional upland forest)	Willow	95	85	13	1	1
	Alder	2	100	0	0	0
	Aspen	1	100	0	0	0
	Birch	1	100	0	0	0
	Poplar	1	100	0	0	0
Blair Lakes (upland hillside birch successional forest)	Birch	75	96	4	0	0
	Willow	20	95	5	0	0
	Aspen	3	100	0	0	0
	Alder	2	100	0	0	0
Dry Creek (mixed deciduous--upland successional)	Willow	73	89	5	3	3
	Aspen	12	75	25	0	0
	Poplar	10	80	10	10	0
	Birch	3	66	33	0	0
	Alder	2	100	0	0	0

[a] Unbrowsed = 0%, low = 1-25% current annual growth (c.a.g.) browsed, medium = 26-75% c.a.g. browsed, high = 76-100% c.a.g. browsed.

STUDY AREA

GAME MANAGEMENT UNIT: 20B, 25C (15,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Fairbanks and central Tanana Valley

BACKGROUND

In the 1950's extensive wildfires as well as poisoning and aerial shooting of wolves caused moose numbers to increase, peaking in Subunit 20B by 1965. Then 3 severe winters, increasing wolf predation, and liberal either-sex hunting seasons combined to reduce them. By 1976 moose densities were low and the hunting season had been reduced to 10 days in most of Subunit 20B.

Wolf control in Subunit 20A in the late 1970's and in central and western Subunit 20B in 1982-84 and 1984-86, respectively, allowed moose populations to recover. As moose increased, hunting seasons were extended from 10 days in 1981 to 20 days during the period to 1983-1987. Harvests increased and then stabilized from 1983 to 1986 at approximately 300 bulls per year.

Wolves were not controlled in Subunit 25C; consequently, the moose population did not increase during the early 1980's. Moose densities are now low in Subunit 25C, and the harvest has ranged from 25 to 32 bulls since 1983.

Demand for opportunity to hunt moose is high and expected to increase in both Subunits 20B and 25C. Extensive highway systems and numerous mining trails provide motorized access. Waterway access is available along the Tanana, Chena, Salcha, and Chatanika Rivers in Subunit 20B and along Beaver Creek, Birch Creek, and the Chatanika River in Subunit 25C.

Management unit boundaries were changed in 1981, increasing the size of Subunit 20B and creating Subunit 25C. Formerly, the eastern and western portions of present-day Subunit 20B and the entire area of Subunit 25C were managed as Subunit 20C.

POPULATION OBJECTIVES

To increase the Subunit 20B moose population to 10,000 by 1993, with 4,000 in western Subunit 20B and 6,000 distributed over central and eastern Subunit 20B.

To provide a minimal bull:cow ratio of 20:100 in each trend count area and an overall bull:cow ratio of at least 30:100, while sustaining an annual harvest of 250-300 bulls in Subunit 20B.

To increase survey coverage of the Subunit 25C moose population and derive a population estimate by 1990.

To provide an annual harvest of 30-50 bull moose, while allowing the overall bull:cow ratio in Subunit 25C to remain above 30:100.

METHODS

Aerial surveys were flown over 9 established trend areas in Subunit 20B and 1 trend area in Subunit 25C. Trend areas were each less than 100 mi^2, and they were flown at survey intensities of approximately 4 min/mi^2. It was assumed that most moose within the sampled area were seen and that substantial changes in moose density from year to year reflected population changes.

Measurements and weights from road-killed moose were recorded from carcasses salvaged by the Fairbanks Alternative Placement Center (FAPC) between 1 September 1987 and 30 August 1988. The entire remains of road-killed moose were transferred to the FAPC facility in Fairbanks, generally within 4 hours of the animals' deaths. Department biologists examined the carcasses within 12 hours of death.

RESULTS AND DISCUSSION

Population Size and Trend

The most recent population estimate of 6,900 moose in Subunit 20B was derived from a complete stratification in 1985. During that stratification, 1% of the area was classified as "very high" density, 6% as high density, 17% as medium density, 54% as low density, 17% as "very low" density, and 5% as nonmoose habitat. Density values for each strata were estimated from intensive aerial surveys conducted over approximately 10% of the total stratification area. Densities for the very high, high, medium, low, and very low strata were 5.7, 2.0, 1.4, 0.6, and 0.04 moose/mi^2, respectively.

Relative to the 1984-85 period, observed densities in established trend areas during 1987 were higher in western and lower in the western and central portions of Subunit 20B, respectively. Densities appeared to be declining and increasing in the lower and upper Salcha River drainages, respectively (Table 1). Therefore, distribution of the population appears to be changing; however, there is insufficient evidence to conclude that the overall population size has changed since 1985.

Distribution and Movements:

Radiotelemetry data have documented movement of moose from areas within Subunits 20B and 25C to the Tanana Flats in Subunit 20A from March until May. Those moose return to their wintering areas from August until October; however, some do not migrate. Ten female moose radio-collared on Minto Flats during March 1984 remained on the Minto Flats during all seasons. Their maximum movements from the capture sites ranged from 4.5 to 21.5 miles ($\bar{x}$ = 10.3). When last located in the summer of 1986, moose with functioning radio-collars were all within 10 miles of their original capture sites.

Because Fairbanks is located on a migration route (i.e., moose moving from Subunits 20B and 25C to Subunit 20A), there is a seasonal peak in vehicle-moose accidents during September. During 1987 a perimeter fence around Eielson AFB created a migration obstacle for moose moving onto the Tanana Flats during the spring. To reduce concentration of moose along the fence, the military made several openings in the fence, following recommendations of the Habitat and Wildlife Conservation Divisions.

Similar fencing around Fort Wainwright created a barrier to moose movement, contributing to moose concentrations in residential areas during both fall and spring. In response to concerns of local residents, I recommended changes to the military in the spring of 1988 that would allow free movement of moose around Fort Wainwright.

Population Composition:

During 1987, 776 moose were classified during 40 hours of aerial surveys of established trend areas (Table 1). Overall, the bull:cow ratio in Subunit 20B was 27:100 and the calf:cow ratio was 42:100. Calves made up 25% of the total sample. Yearlings, estimated by doubling the number of observed yearling males, composed 15% of the moose classified as yearlings or older.

In the lower portion of the Salcha River drainage bull:cow ratios declined below the minimum management objective of 20:100. Low calf recruitment there has created an older age structure among that subpopulation than in the remainder of Subunit 20B. Although bull:cow ratios were also at or below the minimum management objective in central Subunit 20B, good calf recruitment during recent years has provided the potential for continued population growth in the Chena River drainage. Composition data from Minto Flats indicated calf recruitment and incidence of twins have been consistently good since 1983. The Minto subpopulation is the youngest and most vigorous in Subunit 20B and has the greatest potential for continued growth.

Yearling recruitment is a better indication of real population recruitment than calf survival; however, hunting can substantially bias the yearling recruitment estimate, since the estimate of total yearlings is derived by doubling the number of yearling bulls observed during November surveys following the hunt. Therefore, composition data from the lightly hunted Minto Flats and the north fork of the Salcha River probably gave the best approximation of yearling recruitment. Based on composition data, 73% and 62% of the 1985 and 1986 calves in the upper Salcha River and Minto Flats survived to be yearlings in November 1986 and 1987, respectively. The estimated ratios of total yearlings to adults (>2 years old) was 21:100 and 23:100 in the upper Salcha River and Minto Flats, respectively.

In Subunit 25C, composition data have been collected since 1985 in only 1 trend area. Because that survey area was lightly hunted, bull:cow ratios were high. Calf:cow ratios were low during 1985 and 1986 but substantially higher in 1987 (Table 2). Greater survey effort is needed to effectively manage moose in Subunit 25C.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters in that portion of Subunit 20B within the Fairbanks Management Area is 1-30 September and 21-27 November. The bag limit is 1 bull by bow and arrow only.

The open season for subsistence hunters in that portion of Subunit 20B within the Minto Management Area is 1-20 September and 10 January to 28 February. The bag limit is 1 bull by registration permit only. The season will be closed when 15 bulls have been taken.

The open season for all hunters for the remainder of Subunit 20B is 1-20 September. The bag limit is 1 bull.

The open season for all hunters in Subunit 25C is 5-15 September. The bag limit is 1 bull.

Human-induced Mortality:

During the 1987 general season, 2,084 hunters reported harvesting 356 moose in Subunit 20B. An additional 118 hunters reported killing 17 bulls during the Minto registration hunt (Table 3). Other documented sources of human-induced mortality included poaching and highway vehicle and train deaths (Table 4). Total estimated human-induced mortality was 455 moose, or 7% of the estimated population during the 1987-88 regulatory year. Additional mortality from crippling loss, poaching, and unreported legal harvests probably put total human-induced mortality at 8-10% of the estimated Subunit 20B moose population. At least 34 of the 64 (53%) moose killed by highway vehicles were females (Table 5).

Mean antler spreads of bulls harvested in Subunits 20B and 25C in 1987 were 36.8 inches and 41.2 inches, respectively. In Subunit 20B the percentage of yearlings in the harvest was lowest in western Subunit 20B and highest in central Subunit 20B. Those values reflect the higher exploitation rate of moose in central Subunit 20B, where a larger proportion of the available bulls are yearlings. In western Subunit 20B the harvest is partly restricted by registration hunt No. 985, and survival of all age classes of bulls is higher than in the remainder of the subunit. That pattern is also reflected in mean antler sizes, which were highest among harvested bulls in Subunit 20B west and lowest in central Subunit 20B (Table 6).

During 1987, 20 bulls were reported killed by 260 hunters in the Fairbanks Management Area (Table 7). Although interest appears to be high in that archery hunt, I suspect some of the reported hunting pressure actually occurred in areas immediately adjacent to the archery area by hunters using firearms. The current harvest ticket system does not allow accurate calculation of archery-hunting activity.

No reports were received of moose taken for funeral potlatches, which is allowed under state regulations; however, an estimated 2 or 3 moose are taken each year by rural residents of Subunit 20B for that purpose. In Subunit 25C, 97 hunters reported harvesting 27 bulls during 1987 (Table 8). No data are available for the number of road-killed moose in Subunit 25C, but it was not believed to be high.

Assessment of Moose Condition. Tests were conducted on 35 moose carcasses between 1 September and 30 June 1987 to assess their physical condition (Table 9). The sample included 23 killed by vehicles, 5 killed by hunters, 4 killed by wolves, and 2 moose that died of malnutrition. Although the sample size was small, the data suggest cow moose maintained high fat reserves in their bone marrow at least through April. Calves had declining marrow and visceral fat reserves evident by December. All 3 age classes exhibited declining visceral fat (kidney fat index) by January (Table 10). The winter of 1987-88 was mild: shallow snow depth and mild temperatures.

Based on kidney and visceral fat indices, the physical condition of sampled moose appeared average; therefore, there is no evidence to indicate that reproductive performance was hampered by poor physical condition during the winter of 1987-88. Three pregnant females were necropsied, and each had a single fetus. The 3rd pregnant female was killed on 22 May, which is near the mean parturition date for moose on the Tanana Flats; its fetus was full term, weighing 18.0 kg and measuring a length of 103.0 cm.

Hunter Residency and Success. During 1987, 74% and 73% of the general season hunters in Subunits 20B and 25C were from Fairbanks, respectively. Local rural residents reporting accounted for only 5% and 4% of the hunting pressure in Subunits 20B and 25C, respectively (Table 11). Fairbanks hunters took 70% and 90% of the 20B and 25C harvest, respectively. Reporting rates among rural residents are believed to be lower than among urban-based hunters; therefore, both harvest and hunting pressure by rural residents were probably greater than those reflected by harvest ticket returns. During the next reporting period I will report on efforts to increase reporting rates among all hunters.

Permit Hunts. Since in 1979 hunting for moose within the Minto Management Area has been regulated by permit; since 1986 only residents of Minto and Nenana have been eligible for registration permits. During the 1987-88 regulatory year, 118 permittees reported taking 17 moose (Table 12); the harvest quota was 15 moose. Chronically late reporting has made proper administration of this hunt difficult. During the next reporting period proposals will be drafted to increase the annual quota of moose and/or reinstate participation in this hunt by the general public.

Chronology of Harvest. Between 1984 and 1987 the moose season lasted 3 weeks (i.e., 1 September to 20 September) and the harvest was distributed evenly among the three 1-week periods (Table 13). Approximately 10% of the 1984-87 harvests occurred on opening day, indicating a direct relationship between the overall percentage of moose harvested on an opening day and whether that opening occurred on a week day, weekend, or holiday. In 1984 and 1986, 13% and 12% of the harvest occurred on opening days that were on a Saturday and holiday (i.e., Labor Day), respectively. However, in 1987 opening day occurred on a Tuesday, accounting for only 7% of the harvest.

Transport Methods. From 1984-87 most hunters (58%) used highway vehicles for transportation. Boats (20%), three-wheelers (10%), and other off-road vehicles (9%) were also used. Aircraft were only used by 1% of the hunters; horses, by less than 1% of the hunters. Hunters using highway vehicles had the lowest success rate (14%), while hunters using aircraft had the highest success rate (29%). Patterns of transportation use has not substantially differed among years (Table 14).

Habitat Assessment and Enhancement

A prescribed burn was conducted by the Bureau of Land Management in Subunit 25C in the summer of 1987. The fire was designed to improve moose habitat, burning 1,800 acres of black spruce in the Bear Creek and Quartz Creek drainages. Fire is the most practical tool for enhancing moose habitat in Interior Alaska. Increased coordination with the land management and fire management agencies is needed to maximize the benefits to moose from naturally occurring fires.

During April 1987 the military proposed improvement of roads on Eielson Air Force Base that could potentially damage or destroy heavily used moose mineral licks. Inspection of the mineral licks by ADF&G biologists was followed by written recommendations to modify construction plans to protect the existing mineral licks. In the fall of 1988 the military postponed major road alterations in the mineral lick area.

Game Board Actions and Emergency Orders

An increase in harvest, declining bull:cow ratios, and evidence of low recruitment in some areas of Subunit 20B prompted the Department to recommend reducing the Subunit 20B harvest. A proposal was presented to the Board of Game in March 1987, including the following options:

1. Restrict the harvest in the eastern and central portions of Subunit 20B to bull moose having either a spike or fork antler, an antler spread of 50 inches or more, or at least 3 brow tines on either antler.

2. Reduce the season length from 20 days to 15 days.

3. Implement a drawing-permit system.

Although the problems associated with an increasing harvest did not affect all areas of Subunit 20B, the option to reduce the length of the season applied to all road-connected portions of the subunit. If the length of the season is reduced in only part of Subunit 20B, hunting pressure would be displaced along the road system to areas having traditionally lower harvests, thereby requiring harvest reductions in subsequent years.

Initially, the use of antler restrictions to reduce the harvest in portions of Subunit 20B was the Department's preferred alternative; however, public opinion appeared to be against that alternative. Those opposed to antler restrictions believed the average hunter would have difficulty identifying legal bulls under normal hunting conditions. The Board of Game acknowledged the need to reduce the moose harvest in Subunit 20B, adopting the reduced season length option to be implemented during the fall of 1988. The upper portions of the Chena and Salcha River drainages remained on a 20-day season.

CONCLUSIONS AND RECOMMENDATIONS

The current moose population in Subunit 20B is below the population objective of 10,000 moose. Numbers of moose are expected to continue to increase in western Subunit 20B, and recently improved calf recruitment should provide for population growth in central Subunit 20B. Poor calf recruitment in the lower Salcha River drainage has restricted growth; however, higher calf recruitment and good yearling survival in the upper Salcha River drainage in recent years has created the potential for an overall slow increase in moose numbers in eastern Subunit 20B.

Bull:cow ratios in central and eastern Subunit 20B are also below population objectives. Harvests in Subunit 20B will be reduced by a shortened hunting season beginning in 1988. Bull:cow ratios are then expected to increase.

The increasing moose population in western Subunit 20B is expected to reach the population objective of 4,000 moose in the early 1990's. A population survey of Subunit 20B west is planned for 1989. Dependent on the results of that survey, an increase in the allowable harvest may be warranted. Such an increase in harvest could include allowing general public participation in the Minto Flats Management Area, which is currently open only to subsistence hunters.

I suspect predation is significant in limiting moose population growth in both central and eastern Subunit 20B. However, there are little data available regarding current predator densities. Habitat may also be a limiting factor, especially in eastern Subunit 20B. Management activities during the next 3 years will include gathering information to assess the significance of predation and habitat on moose populations in eastern Subunit 20B. Selection and mapping of specific habitat-deficient areas are needed so that future decisions regarding fire suppression can be influenced by preestablished habitat improvement priorities. The winters of 1985-86 and 1986-87 were mild; however, population gains made during the past 2 years can easily be reversed by a series of severe winters.

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Table 1. Observed densities (moose/mi^2) in Subunit 20B trend areas 1983-1987, excluding calves.[a]

	Trend areas							
Year	Baker Creek	Hutlinana Creek	Tolovana River	Swanneck Slough	Tatalina River	Colorado/Sorrels Creek	98 Creek	No. Fork Salcha River
1983	0.5	--	--	--	--	1.3	--	--
1984	--	--	--	1.5	0.8	1.9	--	--
1985	1.1	1.1	1.0	1.4	0.8	--	3.5	2.6
1986	--	--	0.9	--	1.5	--	3.2	3.3
1987	--	0.7	1.2	1.7	1.1	1.6	2.0	--

[a] Densities calculated from only those portions of trend areas that were flown each year.

Table 2. Fall moose composition data, Subunits 20B and 25C, 1983 - 1987.

Trend areas	Location/ date	Bulls: 100 cows	Calves: 100 cows	% Calves	% Twins among cows w/calves	N	Search area (mi^2)
Baker Creek/ Hutlinana Cr.	Western 20B						
	1983 (Baker only)	140	0	0	0	24	50.0
	1985	109	23	10	16	123	99.3
	1987 (Hutlinana only)	107	29	12	0	33	39.5
Lwr Tolovana/ Swanneck Slough	Minto Flats						
	1985	57	47	23	23	118	75.7
	1986 (Tolovana only)	77	50	22	10	50	57.1
	1987	37	41	23	10	146	75.7
Tatalina River	Minto Flats						
	1983	39	43	24	43	42	38.3
	1984	41	41	23	13	40	38.3
	1985	35	44	24	29	111	51.8
	1986	29	39	23	14	104	61.3
	1987	38	58	29	26	102	62.0
Creamers/ Goldstream	Fairbanks Mgmt Area						
	1985	50	71	32	13	53	19.3
	1986 (Goldstream)	29	43	25	0	12	12.4
	1987	33	56	29	11	34	30.8
Sorrels Creek	Central 20B						
	1983	42	38	21	0	94	49.7
	1984	43	36	20	8	133	37.9
	1985	33	54	29	11	107	72.1
	1987	20	41	25	2	169	73.6
Colorado Creek	Central 20B						
	1983	45	39	21	0	81	79.8
	1984	22	58	32	11	66	41.0
	1985	14	29	20	0	132	104.7
	1986	39	61	31	0	36	31.0
	1987	19	53	31	4	98	92.8
Ninety-eight Creek	Eastern 20B						
	1984	27	23	15	0	84	33.6
	1985	18	37	24	9	299	88.7
	1986	23	23	16	3	230	77.2
	1987	16	32	22	5	193	65.2
No. Fork Salcha	Eastern 20B						
	1985	38	34	20	19	200	69.4
	1986	45	25	15	14	227	56.8
O'Brian Creek	Central 25C						
	1985	84	18	9	16	99	68.3
	1986	98	19	9	11	102	68.3
	1987	82	31	14	19	104	68.3

Table 3. Summary of harvest and hunting pressure in Subunit 20B by section and uniform code 1984- 1987[a].

Area (U.C.)	Regulatory year							
	1984		1985		1986		1987	
	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters
20B (East)								
Upper Salcha (0603, 0604, 0605)	5	12	7	24	7	24	7	21
Lower Salcha (0600, 0601, & Little Salcha 0602, 0683, 0684)	53	305	56	301	52	261	54	225
Total 20(B) East	58	317	63	325	59	285	61	246
20B (Central)								
French & Moose Cr. (0500, 0501, 0583, 0584)	17	176	21	227	18	211	25	216
Little Chena River (0403)	17	91	20	89	23	87	19	79
Chena River (0400, 0402, 0404, 0405, 0406, 0486)	80	543	66	588	60	483	68	515
Upper Chatanika River (0209, 0287)	22	80	15	84	19	87	18	109
Total 20(B) Central	136	890	122	988	120	868	130	919
Fairbanks Management Area (0401, 0482, 0483, 0484, 0213, 0485, 0487)	15	285	14	174	19	217	20	260
20B (West)								
Minto Mgmt Area (Permit Hunt 985)	12	100	6	60	9	118	17	118
Minto Flats (0201, 0205, 0210, 0281)	8	58	7	31	9	44	5	50
Washington Cr., Middle Chatanika (0208, 0207)	19	146	26	117	19	102	30	158
Upper Tatalina (0206)	3	13	3	16	6	24	12	34
Tolovana River and West Fork (0200, 0202, 0203, 0204)	31	180	24	184	27	142	37	95
Dugan Hills-Manley (0100, 0101, 0156, 0188)	12	75	12	54	10	79	25	83
Upper Goldstream (0211, 0212 0282)	21	83	18	81	10	91	14	70
Parks Highway (0300, 0301, 0385, 0285)	14	74	6	34	14	58	13	73
Total 20(B) West	120	729	102	577	104	658	153	681
Unknown Location 20(B) (0000)	4	103	1	97	13	96	9	96
Total GMU 20(B)	333	2,324	302	2,161	315	2,124	373	2,202

[a] A harvest corrected for double reporting by Minto successful hunters.

Table 4. Human-induced mortality in Subunit 20B, 1984-1987.[a]

	Mortality source				
	Known poaching	Legal reported hunting	Road kill[b]	Train kill	Total
1984	26	333	63	--	422
1985	18	302	81	--	401
1986	8	315	78	7	408
1987	15	373	64	3	455

[a] All statistics for regulatory year June-July. Dates reflect year in which hunting season occurred.

[b] Data updated and corrected in 1988 - Disagrees with previous S&I reports.

Table 5. Sex and age composition of road-killed moose in Subunit 20B, 1987-1988.

Period	Cows	Bulls	Yearlings M	Yearlings F	Yearlings Unk.	Calves	Unk	Total
July-Dec	22	6	1	1	1	13	1	45
Jan-June	10	3	--	2	1	2	1	19
Total (July-June)	32	9	1	3	2	15	2	64

Table 6. Mean antler size and percent ages of yearlings and large bulls in the 1987 harvest in Subunits 20B and 25C.

Area	Mean antler size (N)	% Yearlings (≤30")	% Large bulls (≥50")
20(B) East			
Upper Salcha	33.0 (5)	60	0
Lower & Little Salcha	38.4 (51)	27	25
Total 20(B) East	37.9 (56)	32	23
20(B) Central			
French & Moose Creek	30.9 (22)	50	4
Little Chena River	36.3 (18)	39	11
Chena River	32.9 (61)	46	8
Upper Chatanika	42.7 (16)	13	38
Total 20(B) Central	34.4 (117)	35	12
Fairbanks Management Area	31.9 (17)	47	12
20(B) West			
Minto Flats (includes MMA)	41.7 (11)	9	14
Washington Creek/ Mid Chatanika River	35.9 (32)	31	13
Upper Tatalina	40.6 (11)	27	27
Tolovana River & W. Fork	36.5 (39)	28	11
Dugan Hills-Manley	46.5 (24)	4	42
Upper Goldstream	33.9 (13)	38	0
Parks Highway	38.5 (12)	42	25
Total 20(B) West	38.7 (142)	25	18
Unknown Location 20(B)	39.8 (12)	33	33
Total GMU 20(B)	36.8 (344)	33	17
Total GMU 25(C)	41.21 (26)	19	31

Table 7. Fairbanks management area moose harvest and hunting pressure 1984-1987.[a]

Year	Harvest chronology			Total harvest	Total hunters
	Sep	Nov	Unknown		
1984	13	1	1	15	285
1985	13	1	0	14	174
1986	16	1	2	19	217
1987	17	1	2	20	260

[a] The current harvest reporting system is inadequate to identify archery only hunting. The data above probably includes some hunting activity by hunters using firearms, although it was coded to the archery hunting area.

Table 8. Harvest and hunting pressure in Subunit 25C, 1983-1987.

Year	Harvest	Total hunters	% Success
1983	26	130	20
1984	25	100	25
1985	29	101	29
1986	32	108	29
1987	27	97	28

Table 9. Measurements of moose that were either killed by hunters or road vehicles or died from natural causes in Subunits 20B and 25C, Sept 1987.

Date of mortality	Cause of death[a]	Accession #	Sex	Age	Weight[b] (lbs)	Lengths (mm) Hind foot	Lengths (mm) Femur	Lengths (mm) Meta-tarsal	Lengths (mm) Jaw	% Fat Femur	% Fat Meta-tarsal	% Fat Kidney[c]	Time since death (hrs)	Comments
Sep 1987														
11	R.K.	115839	M	Calf	424	--	343	418	332	75	76	43	2	Testes not descended Antlers 1/2"
12	H.K.	115840	M	Adult	--	--	--	488	--	--	91	347	1	Wood River 20(A) - 45" Antlers
14	R.K.	115841	F	Adult	--	--	445	446	478	94	93	174	10	
15	H.K.	115842	M	Adult	--	--	--	414	491	--	92	81	48	Gold King 20(A)
19	R.K.	115843	F	Adult	954	--	447	457	485	95	94	136	12	Lactating
20	H.K.	115844	M	Adult	--	--	--	--	488	--	--	--	--	Blair Lakes - 20(A)
22	R.K.	115845	F	Adult	940	--	470	468	509	88	86	56	--	Numerous lipomas on legs Erupting follicle ea ovary
23	R.K.	115846	F	Yrlg	575	--	399	--	417	89	91	68	--	Taenia hydatigena - liver
	H.K.	115604	M	--	--	--	476	--	--	94	--	--	--	Gold King 20(A) - 30" Antler
	H.K.	115605	M	Adult	--	--	--	--	491	--	--	--	--	Gold King 20(A) - 45" Antler
Oct 1987														
2	R.K.	115847	F	Adult	865	--	467	480	477	95	93	104	10	
10	R.K.	115848	F	Yrlg	516*	--	396	398	460	89	92	105	14	* Heart and liver missing - not weighed
22	R.K.	115849	F	Adult	845	--	464	487	491	92	89	72	--	
Nov 1987														
12	R.K.	115850	F	Adult	973	--	465	460	491	87	87	138	11.5	
20	R.K.	115851	M	Calf	445	--	364	357	--	71	76	25	30	
Dec 1987														
22	R.K.	115852	F	Calf	451	755	375	365	--	43	42	15	3	
22	R.K.	115853	F	Calf	408	738	--	361	352	40	52	14	3	
Jan 1988														
9	R.K.	115854	F	Yrlg	--	840	444	--	457	86	--	31	--	Not pregnant
10	R.K.	115855	F	Calf	--	686	355	--	--	27	--	10	--	
11	R.K.	115856	F	Adult	840	848	449	414	488	92	88	82	--	1 fetus 415.8 grams crown-rump length - 207mm round worms in adult connective tissue
14	R.K.	115857	M	Calf	420	715	363	355	345	28	15	13	8	
20	W.K.	115858	F	Adult	465	835	456	422	475	9	36	0	8	No fetus - extreme emaciated w/dehydration - scours

Table 9. Continued

Date of mortality	Cause of death[a]	Accession #	Sex	Age	Weight[b] (lbs)	Lengths (mm) Hind foot	Lengths (mm) Femur	Lengths (mm) Metatarsal	Lengths (mm) Jaw	% Fat Femur	% Fat Metatarsal	% Fat Kidney[c]	Time since death (hrs)	Comments
Feb 1988														
9	R.K.	115859	F	Calf	--	720	--	372	--	--	--	--	--	
10	P.K.	115835	F	Adult	--	--	--	--	--	88	--	--	--	Wolf kill Mystic Mtn 20(A)
10	P.K.	115836	-	Calf	--	--	--	356	--	--	28	--	--	Wolf Kill Snow Mtn Gulch 20(A)
10	P.K.	115837	F	Adult	--	--	--	--	484	--	87	--	--	Wolf Kill Tear Drop Lake 20(A)
--	W.K.	115860	M	Calf	236	--	332	328	--	5	8	0	--	Emaciated - malnutrition Unknown date
18	R.K.	115861	M	2 yr.	699	750	451	421	443	27	42	12	--	36" Antlers
Mar 1988														
4	R.K.	115862	F	Calf	421	750	381	381	377	32	19	7	--	
Apr 1988														
19	R.K.	115863	M	Calf	442	785	395	383	--	19	18	11	--	Antlers = 1"
20	R.K.	115864	F	Calf	424	725	382	--	376	23	--	14	8	
21	R.K.	115865	F	Adult	870	--	458	463	486	86	91	79	--	1 ♂ fetus = 12.2k; crown rump length = 655 mm total length = 938 mm
--	P.K.	115838	-	Adult	--	--	--	--	--	--	86(tarsal)	-	--	Wolf kill Dry Cr. 20(A)
May 1988														
22	R.K.	115866	F	Adult	787	805	455	413	463	54	68	11	4	1 fetus = 18.0 k, cr-rump = 715 mm, total length = 1030 mm
June 1988														
13	R.K.	115867	F	13 mo	437	765	392	416	382	34	23	8	12	Taenia on heart, filarial worms

[a] Cause of death: R.K. = Road Kill; H.K. = Hunter Kill; W.K. = Winter Kill; P.K. = Predator Kill

[b] Some blood & fluid loss at kill site; weights based on summed weights of all body parts; viscera, blood & body fluids stored and weighed in leak-proof containers.

[c] Kidney fat index = $\frac{\text{weight of fat}}{\text{weight of kidney w/o fat}} \times 100$ (averaged from both kidneys)

Table 10. Mean condition related measurements from 23 road-killed moose in Subunit 20B, Sept 1987-June 1988.

	Adult females						Yearlings						Calves					
	Mean whole wgt	(N)	% marrow fat	(N)	Kidney fat index	(N)	Mean whole wgt	(N)	% marrow fat	(N)	Kidney fat index	(N)	Mean whole wgt	(N)	% marrow fat	(N)	Kidney fat index	(N)
Sept-Oct	901	(4)	93	(5)	108	(5)	545	(2)	89	(2)	87	(2)	424	(1)	75	(1)	43	(1)
Nov-Dec	973	(1)	87	(1)	138	(1)	--		--		--		434	(3)	51	(3)	18	(3)
Jan-Feb	840	(1)	92	(1)	82	(1)	--		86	(1)	31	(1)	420	(1)	28	(2)	12	(2)
Mar-Apr	870	(1)	86	(1)	79	(1)	--		--		--		429	(3)	25	(4)	11	(3)
May-June	787	(1)	54	(1)	11	(1)	437[a]	(1)	34	(1)	8	(1)	--		--		--	

[a] 12-130 mo. old female killed 13 June.

Table 11. Distribution of harvest by hunters reporting residency in Subunits 20B and 25C, 1987.[a]

GMU	Residency	Total hunters	Harvest	% success	% of total harvest	% of total hunters
20(B)	Rural[b]	97	25	26	8	5
	Fairbanks[c]	1274	214	17	70	74
	Other Alaska Res.	242	52	21	17	14
	Non Resident	118	15	13	5	7
25(C)	Rural[d]	3	0	0	0	4
	Fairbanks[c]	56	19	34	90	73
	Other Alaska Res.	14	1	7	5	18
	Non Residents	4	1	25	5	5

[a] Does not include Minto Hunt 985, or hunters for which residency was not given.

[b] Includes Manley, Minto, Nenana, Livengood & Salcha.

[c] Includes Fairbanks, North Pole, Ft. Wainwright, Eielson, & Ester.

[d] Includes Central and Circle.

Table 12. Summary of Minto moose registration hunt #985, 1979-1987.

Year	Total hunters Minto	Total hunters Nenana	Total hunters Other	% Reporting	Harvest by hunter residency Minto	Harvest by hunter residency Nenana	Harvest by hunter residency Other	Total Harvest by season Unk.	Total Harvest by season Fall	Total Harvest by season Winter
1979	65	10	113	90	2	0	4		Sept Season Only	
1980	28	25	25	76	2	0	3		--	--
1981	34	25	25	68	2	0	5		6	1
1982	41	25	25	48[a]	2	0	4		5	2
1983	50	25	25	52	7	1	8		16	0
1984	No data - lost				6	1	2	3	9	3
1985	60 permits by Tier II drawing			43	4	0	2		6	0
1986	58	56	4	100	7	1	1		8	1
1987	49	69	0	86	12	5	0		16	1

[a] No reminder letter sent, telephone survey for harvest.

Table 13. Chronology of Harvest in Subunit 20B, 1984-1987.

Week	1984 Harvest	1984 % of total	1985 Harvest	1985 % of total	1986 Harvest	1986 % of total	1987 Harvest	1987 % of total	1984-1987 Combined % of total
(Sept 1) Opening Day	36	13	24	9	34	12	22	7	10
1[b]	134	46	97	35	99	34	101	30	36
2	82	28	97	35	100	34	128	38	34
3	77	26	79	29	91	31	104	31	30

[a] Dates for weeks are as follows 1984: 1 - 9/1-8
2 - 9/9-15
3 - 9/16-20

1985: 1 - 9/1-7
2 - 9/8-14
3 - 9/15-20

1986 & 1987:
1 - 9/1-6
2 - 9/7-13
3 - 9/14-20

[b] Week 1 data includes opening day harvest.

Table 14. Summary of hunter transport methods used by successful (S) and unsuccessful (US) hunters in Subunit 20B 1984-1987.[a]

Transport Method	1984 S	1984 US	1985 S	1985 US	1986 S	1986 US	1987 S	1987 US	1984-1987 Totals S	1984-1987 Totals US	Total	% of all hunters
Airplane	10	14	4	20	8	22	9	19	31	75	106	1
Horse	5	8	1	9	1	9	2	13	9	39	48	<1
Boat	63	352	69	304	66	299	85	265	283	1220	1503	21
3/4 Wheeler	36	160	19	154	53	166	44	141	152	621	773	11
Snowmachine	1	5	0	7	1	2	0	4	2	18	20	<1
Other ORV	38	161	29	143	35	117	30	106	132	527	659	9
Highway Vehicle	140	961	145	926	127	846	171	894	583	3627	4210	58

[a] Between 1984-1987, 12-14% of reporting hunters did not indicate a transport method on their harvest report.

STUDY AREA

GAME MANAGEMENT UNITS: 20C (11,822 mi^2) and 20F (6,318 mi^2)

GEOGRAPHICAL DESCRIPTION: Drainages into the south bank of the Tanana River west of the Nenana River, into the west bank of the Nenana River, and into the Central Yukon River

BACKGROUND

Moose in Subunits 20C and 20F have been at low densities for many years. Although the study area's habitat includes large tracts of mature black spruce, many of the riparian areas, subalpine hills, and old burns appear to have suitable habitat capable of supporting more moose.

Factors limiting growth of these moose populations are not well understood. Harvests have been low, relative to the population size, but the unreported harvest may be substantial. Predation is suspected as a major limiting factor, but data on predator populations are lacking. Trends in the populations have also been difficult to identify. Although portions of Subunits 20C and 20F were stratified in 1984 and 1985, respectively, composition surveys were often inconclusive because of small sample sizes or poor survey conditions.

Moose within Denali National Park and Preserve (DNP) have been studied intensively. A variety of moose surveys have been conducted by DNP biologists since 1970, and a study of radio-collared moose in the park has provided additional information on movements and behavior.

MANAGEMENT OBJECTIVES

To maintain an annual posthunting sex ratio of at least 30 bulls:100 cows.

To estimate densities by 1991.

To establish population objectives by 1992.

To promote habitat enhancement by allowing natural fires to alter vegetation succession.

METHODS

During 1987 aerial moose surveys were flown in 3 portions of Subunit 20C: the Lower Kantishna (29 Nov), Dune Lake (4 Dec), and the eastern count area of Denali National Park and Preserve (DNP) (30 and 31 Oct by DNP biologists). Because of the overall low moose density in Subunit 20C, Department survey areas were chosen in the medium- or high-density pockets to gather sample sizes large enough to yield meaningful composition data. Surveys were conducted in a Piper Super Cub at approximately 500 feet above ground level and 70 miles per hour. A low pass was flown over all moose to determine sex and ages, to look for additional moose, and to estimate antler size of bulls. No surveys have been conducted in Subunit 20F since 1985.

Surveys in DNP were flown by Park Service biologists in 1987, according to methods described by Haber (1977) and Troyer (1979). According to Dalle-Molle (1987) they also tried to maintain a minimum search effort, conducting intensive sightability checks at 12 min/mi^2 in randomly selected plots per Gasaway et al. (1986) and Dalle-Molle (1987).

Harvest ticket reports provided annual harvest information. The eastern boundary of Subunit 20C was moved westward in 1984. Data presented in this report are from the years after this change so that similar areas can be compared. Subunit 20F was established in 1981. The last 5 years of data from Subunit 20F were examined for this report.

RESULTS AND DISCUSSION

Population Status and Trend

Subunits 20C and 20F support low-density moose populations that are probably stable; however, postrutting concentrations result in some areas of medium and high densities of moose. Data are insufficient to adequately determine the status or recent trends in the moose population throughout much of these subunits. Many of the few surveys attempted have been inconclusive because of either low numbers of moose observed, poor survey conditions, or small survey areas.

Population status and trend are better understood in DNP because a variety of moose surveys have been conducted there since 1970; however, the variety of survey methods and areas make the results difficult to compare. In 1984 Singer (1984) attempted a total count of the pre-1980 park lands by searching contiguous counting blocks of approximately 12 mi^2 each at an intensity of 4-6 minutes/mi^2. He incorporated a correction factor for moose missed during the surveys; however, it was not derived in a manner that permitted calculation of confidence intervals as described by Gasaway et al. (1986). Singer (1984) concluded that between 1974 and 1984, numbers of moose were stable or had declined in the eastern park (where moose densities are highest), were stable or had increased in the central portion of the park, and had increased dramatically west of the McKinley River.

In 1986, after repeating surveys in Singer's (1984) survey areas, Meier (1986) concluded that moose numbers probably had not changed significantly. Similar comparisons for other portions of DNP suggested that moose numbers had declined in the Stampede area, had rapidly increased in the northwestern foothills of the Alaska Range, and had not changed much in the Kantishna area.

Population Size:

Approximately 3,000 moose probably reside in Subunit 20C; this was calculated by adding estimates based on 1984 stratification (388-574 moose in the Minchumina area, excluding DNP; 38-55 moose in the lower Kantishna) (ADF&G files) to estimates from 1986 surveys for DNP (1,528-2,272) (Meier 1986). The resulting estimate of approximately 2,500 moose (range = 1,954-2,901) was increased by several hundred moose to account for animals in unsurveyed areas that presumably had low densities of moose.

Adequate data are not available to estimate numbers of moose in most of Subunit 20F; however, in 1985 roughly 377-558 moose were residing in the portion of the subunit that includes the Tozitna River drainage between its mouth and the confluence with Ptarmigan Creek and the drainages along the north bank of the Yukon River from the mouth of the Tozitna up to Morelock Creek (ADF&G files). This estimate was based on the number of moose observed during a stratification survey in early December 1985.

Population Composition:

Within Subunit 20C, composition data are available from surveys in DNP and 4 relatively small areas outside DNP (Table 1). The 94-mi^2 Minchumina Trend Count Area (TCA) was not surveyed in 1987. This upland burn northeast of Minchumina was established to monitor status and trend of moose presumed to be available to hunters in the Lake Minchumina-Muddy River area in September. Moose are abundant in the lowland area near Minchumina during the hunting season but largely absent during the early winter period when surveys are conducted. Stratification of the Lake Minchumina-upper Kantishna River area in 1984 indicated that the Minchumina TCA was the only area in Subunit 20C where moose densities were high in November. Based on seasonal moose movement patterns observed elsewhere in the Interior (Dale Haggstrom, ADF&G biologist, pers. commun.), many moose observed in the TCA in November were the same ones available to hunters in September; however, data on moose movement patterns in this area are not available. Composition surveys were attempted in the Minchumina TCA in 1985 and 1986. Poor survey conditions in 1985 and failure to complete the survey in 1986 made interpretation of the data difficult. However, the consistently high bull:cow ratios (i.e., 92:100 in 1985 and 110:100 in 1986) suggest that harvest levels have not been excessive (Table 1).

Based on a 1984 stratification, the Lower Kantishna TCA was created in 1985. This TCA is used to monitor the status and trend of the subpopulation of moose in the lower Kantishna River, which is a popular hunting area for the residents of Nenana and other areas. In 1985 a small portion of the TCA (37 mi^2) was intensively surveyed (Table 1). Sixty-five bulls:100 cows, 4 yearling bulls:100 cows, and 24 calves:100 cows were observed. In 1987 a larger portion (147 mi^2) was surveyed less intensively; 23 bulls:100 cows, 6 yearling bulls:100 cows, and 58 calves:100 cows were observed. Results from the 1985 and 1987 surveys are difficult to compare because of small sample sizes and different methods of surveying; however, both surveys indicated poor yearling recruitment. Haggstrom (1986) suggested that poor calf and yearling survival 1985 might be due to predation by a large pack of wolves in the area. The 1987 bull:cow ratio was below our objective of 30 bulls:100 cows.

A small portion of the Dune Lake burn area was surveyed for the first time in 1987. The preponderance of bulls suggested that harvests have not been excessive; 16 of 31 moose observed were bulls (6 yrlgs, 5 medium, 5 large). Only 2 of 13 cows had calves, and none had twins.

Within DNP, 268 moose were observed during the 1987 survey of 217 mi^2 in the park's eastern count area (Table 1). The bull:cow ratio declined from 44:100 in 1986 to 34:100 in 1987. The calf:cow ratio increased from 18:100 to 23:100, which is the second highest since 1974. Conversely, the 1987 yearling bull:cow ratio of 3:100 was the second lowest recorded for that area since 1974. Caution is necessary in interpreting these results because of varying survey techniques used throughout this period.

In Subunit 20F, sex and age composition surveys have been attempted in 6 areas since 1975. However, in each case the number of moose observed and the areas surveyed were too small to yield meaningful composition data (Table 2).

Distribution and Movements:

In 1975 reconnaissance flights were made over the riparian areas of Hess Creek, the Ray River, and the Big Salt River to gather preliminary information on moose distribution and abundance. No substantial concentrations of moose were found, and no further surveys were planned. In 1981 a more intensive and systematic reconnaissance search was made in the Hess Creek drainage upstream from the Dalton Highway, but again very few moose were observed. In 1981 and 1982 subsequent composition surveys were conducted in one of the few areas that concentrations of moose had been seen (i.e., the divide between the Tolovana River and Hess Creek). In 1983 attempts were also made to survey the lower Tozitna River and upper Big Salt River. In all 3 years, however, numbers of moose observed and the areas sampled (Table 2) were too small for meaningful interpretation of the data.

In 1984 and 1985, stratification surveys of almost 5,000 mi^2, approximately 28% of Subunits 20C and 20F, confirmed the impression of overall low-density moose populations in these subunits. Numbers of moose seen in each density stratum were converted to approximate density estimates based on sightability of moose during stratification in several population estimation surveys previously conducted in Interior Alaska (ADF&G files). Seventy-five percent of the total area stratified had low moose densities (0.01-0.3 moose/mi^2), 19% had medium densities (0.3-0.8 moose/mi^2), and only 6% had high densities (1.0-2.8 moose/mi^2) (Table 3). Within DNP, the eastern park area continues to have the highest density of moose (1.4 moose/mi^2) (Meier 1986).

Moose may be distributed differently during these postrutting surveys than during the hunting season. For instance, there is indirect evidence that many moose found in the Minchumina Trend area in November were probably on the Muddy River drainage during September (Haggstrom 1986). Within DNP, 1986 surveys indicated a prevalence of bulls in the northwestern foothills of the Alaska Range and a relative scarcity of bulls in the flats to the north, suggesting an interchange of moose between these 2 areas (Meier 1986). However, according to data from radio-collared moose, most of the eastern park area moose are residents, with only a few venturing to the Toklat, Stampede, or Yanert areas. More data are necessary to determine movements and distribution of moose during seasons other than postrutting.

In general, moose are most abundant where willows are plentiful, such as in recently burned areas and in riparian zones. Areas with medium or high densities of moose in Subunit 20C include the burn in the hills north of Minchumina and southwest of Wien Lake, the foothills of the Alaska Range in southwestern Subunit 20C, the lower Kantishna River along the eastern floodplain, the low shrub area near Black Bear Lake, the northern subunit along the Tanana River, and possibly the burn near Dune Lake. In Subunit 20F, the highest densities of moose observed during the 1985 stratification tended to be in the headwaters of drainages of the Tozitna and Yukon Rivers, in the Fish Lake-Harpers Bend area, and near the mouth of the Tanana.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters in Subunit 20C is 1-15 September. The open season for subsistence hunters is 1-20 September. The bag limit is 1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken. The open season for resident and nonresident hunters in Subunit 20F is 1-15 September. The open seasons for subsistence hunters are 1-15 September and 1-10 December. The bag limit is 1 bull.

Human-induced Mortality:

Most harvests occur along waterways and within close proximity to villages. Unreported harvests may have been substantial in both subunits. Overall, harvests have been relatively light, compared with the number of moose in the subunits; however, the level of harvest may be adversely impacting some local subpopulations, particularly if moose remain in easily accessible areas throughout the year.

Subunit 20C. The 1987 reported harvest of 70 moose was 29% lower than the previous 3-year mean of 99 moose (range = 82-110) (Table 4). From 1984 to 1986 the mean annual number of moose hunters was 268 (range = 203-302); the success rate was of 27-52%. In 1987 there were 8% more hunters than the 3-year mean (1984-86), but the success rate was only 24%. The lower success rate and resulting low harvest was probably due to the elimination of the last 5 days of the season for all hunters, except those residing in the subunit. Moose hunters generally are most successful when the season is long enough to extend into the time period when bulls begin to exhibit rutting behavior.

Thirty-six percent of the harvest came from the Kantishna drainage (including 13% from Lake Minchumina), and 33% came from the Nenana drainage within approximately 15 miles of the Parks Highway (Table 6). Hunting pressure was highest in the latter area; over half the hunters hunted there. Mean antler spread of harvested bulls was 40 inches; however, the antler spreads fell mostly into the 30-39 inch (40%) or 50+ inch (37%) categories (Table 7).

Subunit 20F. The reported 1987 harvest of 20 moose was slightly lower than the previous 5-year mean of 22 moose (range = 15-34), but it was substantially (41%) lower than the harvest of 34 moose in 1986 (Table 5). No clear trend in annual harvest was evident. The majority of the harvest was from drainages nearest to Tanana and Manley Hot Springs (Table 6).

The number of moose hunters in 1987 (99) was the same as the previous 5-year mean. Hunter success rates have ranged from 15% to 26% since 1982, and it was 20% in 1987. Hess Creek had by far the most hunters, probably because of access from the Dalton Highway and Yukon River bridge.

Distribution of antler sizes among harvested bulls suggests that the population is not being overharvested. No size class was absent in the 1987 harvest (mean antler spread was 43 inches). Some large bulls were harvested, and 3 of 19 (16%) bulls harvested in 1987 were yearlings (<30-inch antlers) (Table 7). In 1986 most (55% of 31) bulls harvested had antlers ≥50 inches.

Hunter Residency and Success. During 1987 and the last 4 years combined, 97% of the moose hunters in Subunits 20C and 20F were Alaskan residents (Table 8). In Subunit 20C, 40% of the 1987 moose hunters were "local" residents (i.e., residents of Clear, Healy, Lake Minchumina, Manley Hot Springs, Nenana, or Tanana), and they accounted for 40% of the harvest. In Subunit 20F, only 18% of the hunters were local residents (i.e., residents of Tanana or Manley Hot Springs), but they took 55% of the 20 moose harvested. Fairbanks residents accounted for 37% and 52% of the hunters in Subunits 20C and 20F, respectively. Successful and unsuccessful hunters in both subunits spent an average of 5-6 days hunting moose.

Harvest Chronology. Most moose harvested in Subunit 20C were taken during the last week of the season (Table 9). No consistent trend in harvest chronology was found for Subunit 20F. Very few moose were reported taken during the late season in Subunit 20F.

Transport Methods. Boats were the most common mode of transportation for moose hunters in both subunits. In 1987 boats were used by 35% and 53% of the moose hunters in Subunits 20C and 20F, respectively (Table 10). Numerous lakes and gravel bars provide access by airplane. Although relatively few hunters used aircraft (4-9% of hunters since 1984), they had higher success rates than hunters using other types of transportation. Local residents have previously proposed a controlled-use area in southeastern Subunit 20F to prohibit the use of aircraft by moose hunters. However, such restrictions are inconsistent with the management goal of providing the greatest sustained opportunity to hunt, and they do not appear necessary at this time.

Natural Mortality:

Little is known about natural mortality among moose in these areas. Predation by wolves and bears probably accounts for much of it; however, we have little information on predators other than harvest data. In Subunit 20C, 3-12 wolves, 4-20 black bears, and 3-5 grizzly bears have been harvested annually during the last 5 years. In Subunit 20F, 1-6 wolves, 6-12 black bears, and 0-2 grizzly bears have been harvested annually during the last 5 years. According to notes on sealing certificates and observations of biologists, several large wolf packs occur in Subunits 20C and 20F. Numerous wolf tracks and a pack of 3 wolves were observed during the 1984 stratification of the Minchumina area in Subunit 20C; the observer's general impression was that wolves were common.

Within DNP, current studies of wolf movements in and adjacent to the park will hopefully provide information on the impact of predation. In addition to predation, another substantial cause of moose mortality in DNP is from injuries related to rutting behavior (Victor VanBallenberghe, USFS, pers. commun.).

Habitat

Habitat is probably not a limiting factor for growth of the low-density moose population in either subunit. Although much of the area is mature black-spruce or birch-aspen stands that provide little available browse, suitable habitat occurs in riparian and subalpine areas. Moose habitat could be enhanced by allowing natural fires to alter plant succession. In Subunit 20C a patchwork of burns of various ages have also created favorable moose habitat (1981 Dune Lake fire was 171,000 acres). In Subunit 20F, some of the riparian areas along major drainages and adjacent hillsides appear to be excellent moose habitat.

Game Board Actions and Emergency Orders

In 1987 the opportunity for subsistence harvest of moose in Subunit 20F was increased by excluding nonsubsistence hunters from the late season and by changing the late season from 1-10 November to 1-10 December to allow for more reliable access. In response to a proposal from the Clear-Healy Advisory Committee, the Board of Game also prohibited moose hunters in Subunit 20C from shooting moose that were white-phased or partially albino (i.e., more than 50% white) to protect this rare animal.

CONCLUSIONS AND RECOMMENDATIONS

Before establishing population objectives for moose in Subunits 20C and 20F by 1992, the dynamics of these populations need to be better understood. Significant progress has been made toward reviewing the available data so that gaps in our knowledge can be identified. Important data needs include estimates of moose density, unreported harvest, and predation rates.

Progress toward estimating moose densities in key areas of Subunits 20C and 20F has been slow. Widespread low densities of moose will continue to require time-consuming, expensive surveys to gather adequate sample sizes, if traditional survey methods are used. In the past we have intensively surveyed relatively small areas to derive precise estimates of moose density. During the next reporting period we will explore the feasibility and desirability of establishing a less-precise density estimate for a larger area using less intensive surveys. This broader picture with a revision in our current techniques may better meet our management needs.

The influence of mortality on population dynamics of moose can best be understood with accurate estimates of harvest by humans and other predators. I recommend that during the next few years we (1) assess hunting pressure and reporting rates by monitoring hunter distribution, access, and success; (2) increase harvest reporting rates and decrease illegal take of cows by improving communication with local residents via public meetings, informal visits, or letter; and (3) gather data on predator populations in Subunits 20C and 20F, including wolf surveys, to better understand the role predation plays in limiting moose population growth. Although growth of the moose populations in Subunits 20C and 20F do not appear to be food limited, I also recommend that we enhance moose habitat to further increase the carrying capacity by allowing natural fires to alter vegetation.

No changes in seasons or bag limits are recommended at this time.

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Table 1. Moose population surveys in Subunit 20C, 1984-87.

		Bulls			Cows/calves			Total	Area	
Date	Area[a]	Sm.	Med.	Lg.	w/o	w/1	w/2	Moose	(mi^2)	Comments
16 Nov 84	Lower Kantishna							38-55[b]	654	Stratification:
										77% low (0.01 moose/mi^2)
										23% med (0.3 moose/mi^2)
22 Nov 85	Lower Kantishna	1	5	5	13	4	0	32	37	
29 Nov 87	Lower Kantishna	1	4	1	13	11	2	47	147	Composition survey, not for density
19-26 Nov 84	Minchumina							795[b]	3,294	Stratification:
								1,177		80% low (0.06 moose/mi^2)
										14% med (0.6 moose/mi^2)
										5% high (2.8 moose/mi^2)
25-27 Nov 85	Minchumina	9	25	14	35	14	3	120	94	
23 Nov 86	Minchumina	10	13	10	23	7	0	70	33	
4-6 Dec 85	NW 20C (Tanana)							--	149[c]	Stratification: 68% low, 23% med, 9% high
4 Dec 87	Dune Lake	6	5	5	11	2	0	31	--	
30-31 Oct 87	Denali Nat'l Park[d] Eastern area	6	34	17	132	33	3	268	217	2 unknown

[a] Most composition surveys were done in areas where moose densities were highest so adequate sample sizes could be obtained.
[b] Estimated population
[c] This is the 20C portion; the total area stratified was 400 mi^2.
[d] Data from previous surveys also available.

Table 2. Moose population surveys in Subunit 20F, 1975-87.

Date	Area	Bulls			Cows/calves			Total moose	Area (mi^2)	Comments
		Sm.	Med.	Lg.	w/o	w/1	w/2			
14 Feb 75[a]	Hess Cr. (bridge mouth)	--	--	--	--	--	--	10	--	9 adults, 1 calf
1 Dec 81	Upper Hess Cr.							--	--	Stratification:
2 Dec 81	Upper Hess Cr.	1	2	0	4	2	0	11	30	Very few moose seen
2 Nov 82	Upper Hess Cr.	2	1	1	3	0	0	7	30	Inconclusive
										Inconclusive
14 Feb 75[a]	Big Salt (lower 10 mi)	--	--	--	--	--	--	7	--	7 adults, no calves
7-10 Nov 83	Big Salt	0	2	0	3	2	0	9	47	BLM surveyed
1983	Tozitna R.	0	1	1	4	1	1	11	36	BLM surveyed
1985	Lower Tozitna, Tanana R.							--	873	Stratification: 57% low, 30% med, 14% high densities
14 Feb 75[a]	Ray R. (mouth to Ray R. Hot Springs)	--	--	--	--	--	--	6	--	Abundance of willow in lower 10 mi, all 6 moose seen here

[a] All surveys on 14 February 1975 were done in a C-185 at 90-100 mph.

Table 3. Moose densities in portions of Subunits 20C and 20F as reflected by stratification flights.

Location	(year)	% of area in strata[a] Low	Med	High	Area (mi^2)
Lower Kantishna	(1984)	77	23	0	654
Minchumina (including portions in DNP)	(1984)	80	14	5	3,294
NW Subunit 20C	(1985)	68	23	9	149
Lower Tozitna/ Tanana R.	(1985)	57	30	14	873
Total		75	19	6	4,970

[a] For each area, density estimates (moose/mi^2) were calibrated independently as follows:

Lower Kantishna:	L=0.01	M=0.3		Dubois (1985b)
Minchumina:	L=0.06	M=0.6	H=2.8	Dubois (1985a)
NW Subunit 20C and lower Tozitna/ Tanana R.:	L=0.15-0.3	M=0.4-0.8	H=1.0	Osborne (1985)

Table 4. Moose hunting seasons for Subunits 20C and 20F, 1983-87. Bag limit was 1 bull in all cases.

Year	Subunit 20C	Subunit 20F
1983	1-20 Sept.	1-15 Sept.
1984	1-20 Sept.	1-15 Sept. 1-10 Nov.
1985	1-20 Sept.	1-15 Sept. 1-10 Nov.[a]
1986	1-20 Sept.	1-15 Sept. 1-10 Nov.[b]
1987	1-15 Sept.[c d] 1-20 Sept.[a d]	1-15 Sept. 1-10 Dec.[a]

[a] Season subsistence hunters only.
[b] Nonresidents not allowed to hunt during the November season.
[c] Season for residents of Alaska and nonresident.
[d] White-phased or partial albino (more than 50% white) moose may not be taken.

Table 5. Reported moose harvest in subunits 20C (1984-87)[a] and 20F (1981-87).

Year	Harvest				Number of hunters	Percent success
	Bulls	Cows	Unkown	Total		
20C						
1984	109	0	1	110	229	37
1985	81	0	1	82	302	27
1986	105	0	0	105	203	52
1987	66	1	3	70	290	24
20F						
1981	27	0	0	27	109	25
1982	17	0	0	17	76	22
1983	25	0	0	25	111	22
1984	14	0	1	15	98	15
1985	21	0	0	21	81	26
1986	34	0	0	34	129	26
1987	20	0	0	20	99	20

[a] Prior to 1984, Subunit 20C boundary prior to 1984 included portions of the current Subunit 20A.

Table 6. Distribution of reported moose harvest within Subunits 20C and 20F, 1984-87.

Drainage	1984	1985	1986	1987[a]
20C				
Tanana River	9	6	13	4 (12)
Chitanana River	0	2	2	1 (5)
Cosna River	1	1	3	5 (9)
Zitziana River	3	2	5	4 (10)
Kantishna R. (except Lake Minchumina)	36	31	28	16 (60)
Lake Minchumina	17	13	17	9 (20)
Nenana (includes Teklanika, Salvage River)	42	26	36	23 (134)
Unknown	2	1	1	8 (43)
Total	110	82	105	70 (290)
20F				
Tozitna River	3	4	4	4 (12)
Yukon River (minor drainages)	0	4	6	7 (15)
Hess Creek	5	3	11	1 (47)
Tanana River	6	10	8	5 (14)
Ray River	0	0	0	1 (4)
Unknown	1	-	3	2 (6)
Total	15	21	31	20 (98)

[a] Parentheses indicate total number of moose hunters in that area.

Table 7. Distribution of antler size in harvested moose in Subunits 20C and 20F, 1984-87.

	Antler size (inches)			
Year	<30	30-39.9	40-49.9	50+
20C				
1984	17	31	25	34
1985	14	21	19	25
1986	8	26	29	41
1987	8	25	6	23
20F				
1984	5	2	2	3
1985	4	6	6	3
1986	4	5	5	17
1987	3	7	5	4

Table 8. Number of successful and unsuccessful moose hunters by state residency, Subunits 20C and 20F, 1984-87.

	Successful hunters				Unsuccessful hunters				Total
Year	Res.	Nonres.	Unspec.	Total	Res.	Nonres.	Unspec.	Total	hunters
20C									
1984	105	4	1	110	182	5	2	189	299
1985	77	3	2	82	208	5	7	220	302
1986	98	3	4	105	196	4	3	203	308
1987	65	3	2	70	203	6	11	220	290
20F									
1984	15	0	0	15	79	1	3	83	98
1985	18	3	0	21	56	2	2	60	81
1986	33	1	--	34	92	2	1	95	129
1987	19	0	1	20	69	3	7	79	99

Table 9. Chronology of reported moose harvest in Subunits 20C and 20F, 1984-87.

1984		1985		1986		1987	
Week ending	No. of moose	Week ending	No. of moose	Week ending	No. of moose	Week ending	No. of moose
20C							
1 Sep	8	10 Aug	1	6 Sep	19	30 Aug	1
8 Sep	36	7 Sep	18	13 Sep	33	6 Sep	18
15 Sep	39	14 Sep	25	20 Sep	52	13 Sep	21
22 Sep	25	21 Sep	33	Unknown	1	20 Sep	26
29 Sep	1	28 Sep	1			8 Nov	1
Unknown	2	12 Oct	1			Unknown	3
		Unknown	3				
20F							
8 Sep	6	1 Sep	5	6 Sep	7	6 Sep	3
15 Sep	7	14 Sep	9	13 Sep	14	13 Sep	6
10 Nov	1	21 Sep	6	20 Sep	7	20 Sep	9
Unknown	1	9 Nov	1	27 Sep	1	8 Nov	1
				8 Nov	2	Unknown	1
				15 Nov	2		
				Unknown	1		

Table 10. Methods of transportation reported by moose hunters[a] in Subunits 20C and 20F, 1984-87.

Transport means	1984		1985		1986		1987	
	S	U	S	U	S	U	S	U
20C								
Aircraft	35	41	27	33	29	26	19	30
Horse	4	3	2	4	1	4	1	6
Boat	32	65	26	60	35	66	30	56
3- or 4-wheeler, ORV	26	22	11	45	26	44	14	46
Hwy vehicle	7	28	8	46	7	35	4	39
Total	104	159	74	188	98	175	68	177
20F								
Aircraft	3	4	4	3	3	1	3	4
Horse	--	--	--	--	1	0	--	--
Boat	10	32	13	19	13	46	6	41
3- or 4-wheeler, ORV	1	10	0	9	9	11	1	3
Hwy vehicle	0	27	4	23	6	20	4	18
Total	14	73	21	54	32	78	14	66

[a] S = Successful, U = Unsuccessful.

STUDY AREA

GAME MANAGEMENT UNIT: 20D (5,720 mi^2)

GEOGRAPHICAL DESCRIPTION: Central Tanana Valley near Delta Junction

BACKGROUND

The area currently identified as Subunit 20D was originally part of Subunit 20C. In July 1971 the area south of the Tanana River between the Johnson and Delta Rivers became the new Subunit 20D. In 1978 Subunit 20D was enlarged by moving the eastern boundary from the Johnson River to the Robertson River; it was further enlarged in 1981 to include all drainages north of the Tanana River from the mouth of the Robertson River to Banner Creek.

The moose population reached its highest level in about 1965. From 1962 to 1970, the moose hunting season in Subunit 20D consisted of a 70- to 72-day bull season and a 1- to 8-day antlerless moose season. However, several severe winters in the mid-1960's and early 1970's killed many moose, setting the stage for widespread population declines.

In 1971 the moose hunting season was closed in Subunit 20D because of excessive hunting pressure and declining harvests, particularly in the highly accessible areas near Delta Junction (McIlroy 1974). This latter area, which includes Clearwater Lake, Donnelly Dome, and the Delta farming area, contains approximately 27% of the moose habitat in Subunit 20D. It provided 51-74% of the harvest from 1964 to 1970.

In 1970 there was a ratio of only 4 bulls:100 cows in the area near Delta Junction. By 1972 the ratio was still only 9 bulls:100 cows in that area; however, elsewhere the bull:cow ratio had improved to 22-32 bulls:100 cows. Limited moose hunting resumed in the latter areas in 1974, under a registration permit system designed to keep harvests minimal. In 1983-84, the remaining closed area was formally named the Delta Junction Management Area (DJMA).

Despite restrictions on hunting, the moose population in Subunit 20D continued to decline because of the chronically high natural mortality. In 1973 the moose population in the area south of the Tanana River and between the Johnson and Delta Rivers was estimated at only 600. Wolf control efforts in adjacent Subunit 20A (1966-82) and in southwestern Subunit 20D (1980-83), as well as continued hunting restrictions and mild winters, gradually reversed the population trend. By November 1981 the population in this portion of the subunit had increased to approximately 1500-2300 moose. In 1982 the total estimate for the subunit finally began to show a net gain, as increases in the southern portion of the subunit began to offset continuing declines in moose numbers north of the Tanana River.

Table 1 lists moose hunting seasons in Subunit 20D since it was enlarged to its present size in 1981. The season in southwestern Subunit 20D was changed from a 5-15 September registration permit hunt to a 1-10 September open season. The season in southeastern Subunit 20D was changed from a 5-15 September to a 1-20 September open season. The seasons in both northeastern and northwestern Subunit 20D were changed from 5-15 September to 1-10 September. The area established as the DJMA in 1983 has remained closed to moose hunting since 1981.

In July 1986 the moose management plan for Subunit 20D West was developed for that portion which is now called southwestern Subunit 20D. Its goals and objectives superceded those of previous plans; however, the management goal for the DJMA did not change: to sustain opportunities for viewing and photographing moose. Elsewhere, in Subunit 20D, 2 goals were established: (1) provide maximum sustained opportunities to participate in hunting moose, and (2) continue to sustain opportunities for viewing, photographing, and enjoying moose.

Since 1986 research into predator-prey relationships has indicated that it is important to maintain higher bull:cow ratios in areas where predation by bears and wolves is a significant mortality factor on moose. Thus the bull:cow ratios specified in the moose management plan for Subunit 20D West have been modified.

MANAGEMENT OBJECTIVES

To attain a total population in Subunit 20D of 5,500-7,000 moose, with 1,600-2,400 in southwestern Subunit 20D, 3,000 in the northern portions of Subunit 20D, and the remainder in southeastern Subunit 20D.

To maintain an overall posthunting bull:cow ratio of 30-40 bulls:100 cows.

To increase the age structure of bulls in southwestern Subunit 20D by 1993 so that at least 20% of the bulls have an antler spread of 50 inches or larger.

METHODS

Aerial composition surveys were flown in a Piper Super Cub at an altitude of 300-500 feet above ground level and an airspeed of approximately 70 mph. A low pass was flown over all moose to determine sex and age, to look for additional moose, and to estimate antler size of bulls. Yearling bulls were identified by spiked or forked antlers or by a lack of brow development. Antler spread was estimated for older bulls. Bulls with an antler spread less than 50 inches were classified as medium bulls. Bulls with an antler spread of 50 inches or more were classified as large bulls.

Density of moose and composition data were collected from a trend count area (TCA) covering 106 mi^2. The TCA was subdivided into sample units (SU) with a mean area of approximately 12 mi^2. One SU was surveyed at a time; the search intensity was approximately 6-8 minutes/mi^2.

RESULTS AND DISCUSSION

Population Status and Trend

Moose density south of the Tanana River is medium to high, and numbers are either stable or increasing. The opposite situation exists north of the Tanana River, where moose density is medium to low and probably decreasing.

Population Size:

A population estimation survey conducted during November 1981 indicated that an early winter population of 591-1,214 moose existed in the portion of the subunit south of the Tanana River (Johnson 1983). However, 584 moose were seen on the 1981 stratification flight; 558 moose were subsequently seen during composition surveys in 1982. Since these totals of observed moose approach the lower range of the population estimate, D. Johnson (pers. commun.) believed it unlikely that the 1981 estimate was accurate. He subsequently revised the estimate, based on assumed sightability of moose seen during stratification flights. During previous population surveys in similar habitat types, the resulting estimates could have been approximated by multiplying the number of moose observed during stratification flights by a sightability correction value of 2.5-4.0. A revised population estimate of 1,460-2,336 was calculated using these correction factors (Johnson 1984).

Population estimates were later derived for 2 other portions of the subunit, using similar extrapolations of stratification data. Based on stratification flights conducted 29-30 October 1984 and 19-20 November 1985, 238 to 440 moose were estimated for the Goodpaster River drainage (approximately 1,520 mi^2) in northwestern Subunit 20D, and 717-1,062 moose were estimated for the Healy River, Sand Creek, and Billy Creek drainages (approximately 1,325 mi^2) in northeastern Subunit 20D, respectively. Based on these previous attempts to estimate moose numbers in various portions of the subunit, Johnson (1987) concluded that there were probably 1,300 moose in that portion of the subunit lying north of the Tanana River and 1,900 in that portion lying south of the Tanana River.

Because of financial limitations, the only moose density data collected during 1987 was from the Donnelly TCA in southwestern Subunit 20D. Observers in 1 plane spent 12.3 hours surveying 95 mi^2 a mean search intensity of 7.8 minutes/mi^2. High winds resulted in the survey being conducted on 29 November and 3 and 5

December, rather than on consecutive days. Sample Unit No. 83 was not searched. Snow conditions were good on 29 November and generally poor on 3 and 5 December.

There was no measurable change in density in the Donnelly TCA between 1986 and 1987 (Table 2). Comparisons of population density in the Donnelly TCA are only appropriate between 1986 and 1987, because of boundary changes between 1985 and 1986. From 1983 to 1985, 2 TCA's were surveyed in southwestern Subunit 20D. The Jarvis/Ober TCA included the headwaters of Jarvis and Ober Creeks. The Donnelly TCA was centered around Donnelly Dome, adjacent to the Jarvis/Ober TCA. The Jarvis/Ober and Donnelly TCA's were combined with slight boundary modifications in 1986 to form a single, larger TCA that was named the Donnelly TCA.

Population Composition:

Calf survival to 6 months of age continued to be good in southwestern Subunit 20D (Table 2). Forty-four calves:100 cows were observed, and calves composed 25% of the moose classified. Yearling survival to 18 months of age was fair (i.e., ratio of 12 yearling bulls:100 cows).

The ratio of 31 bulls:100 cows (Table 2) is near the lower limit for the population objective of 30-40 bulls:100 cows. Bull:cow ratios appear to be declining slowly. The decline is probably caused by increased hunting pressure in southwestern Subunit 20D due to increased popularity of three- and four-wheelers.

Antler spread data from the Donnelly TCA suggests a young age structure among bull moose occurring in southwestern Subunit 20D. Yearling bulls made up 49% of the moose observed during the survey, only 9% of the bulls had antlers with a spread of 50 inches or larger, and none of those had antlers wider than approximately 55 inches. In this area, the age of bull moose with 50-inch antler spreads would average 6 years (Gasaway et al. 1987); some attain that size at an even earlier age. The young bull age structure observed in this population has probably resulted from increased hunting pressure (Table 3) directed at older bulls and continued good recruitment of young moose into the population (Table 2).

I believe that a moose population that contains few old moose does not meet our population management objectives. I also believe that viewers and hunters want reasonable opportunity to encounter large-antlered moose. Therefore, I am considering management options that would direct more of the harvest pressure toward younger moose. Because most yearling bulls (63%) had at least 1 spike or forked antler, compared with 37% that had palmated antlers, a hunting regulation that restricts harvest to the easily identified spike or forked antler configurations might be a feasible way to increase the presence of older bulls in the population.

Mortality

Season and Bag Limit:

The open season for all hunters in that portion of Subunit 20D lying south of the north bank of the Tanana River and east of the east bank of the Johnson River is 1-20 September; the bag limit is 1 bull. The DJMA remained closed to moose hunting in 1987.

Human-induced Mortality:

Total human-induced mortality during 1987 was estimated to be 178 moose. The reported harvest totaled 126 (Table 3), other known mortalities totaled 38, and estimates of other unreported mortality totaled 14.

Harvest has remained fairly constant since 1985, when the current seasons and bag limits were adopted. The most significant change in harvest occurred in southwestern Subunit 20D,when a 6-day extension in season length increased the harvest from 38 moose in 1983 to 66 moose in 1987. The number of hunters in southwestern Subunit 20D has also increased steadily from 1983 to 1987.

The number of moose killed in the portion of Subunit 20D north of the Tanana River has remained fairly constant, despite a steady decline in the number of hunters from 1984 to 1987 (Table 3). The moose harvest remained constant because of increased efficiency among hunters and the influx of migratory moose from expanding populations to the south. I believe that many of the people who continue to hunt north of the Tanana River have hunted the area for a long time and are both familiar with the area and efficient at harvesting moose. Migratory moose from the expanding population in southwestern Subunit 20D are contributing significantly to the harvests coming from areas north of the Tanana River.

Both the harvest of moose and the number of hunters in southeastern Subunit 20D have remained low and constant (Table 3). Moose hunting is difficult in much of this area, because of access restrictions in the Macomb Plateau Controlled Use Area.

Fifty-two moose were killed by human-related activities other than legal hunting. Department of Public Safety records indicate that 26 moose were hit by vehicles (22 known dead, 4 presumed dead but unconfirmed), seven were killed and not salvaged (wanton waste), three were killed in a closed area (DJMA), and two were taken illegally with snares. An additional 7 moose may have been poached and not discovered, and 7 moose have been hit by large trucks along the Alaska and Richardson Highways and not reported. Most of the mortalities occurred in southwestern Subunit 20D.

Hunter Residency and Success. Eighty percent of the people hunting in Subunit 20D during 1987 resided there (Table 4).

Other Alaskan residents and nonresidents accounted for only 9% and 4% of the hunters, respectively. The proportion of hunters who reside in Subunit 20D has increased steadily since 1983, when only 39% lived in the subunit. The reason for this trend is unclear.

Hunter Effort. Successful hunters hunted a mean of 4.7 days during 1987, compared with 6.1 days for unsuccessful hunters (Table 5). There were no significant changes in hunting effort in Subunit 20D from previous years.

Harvest Chronology. Sixty-three percent of the moose killed in Subunit 20D were taken by 5 September. An additional 27% were killed from 6 to 12 September; however, the season closed on 10 September in southwestern and northern Subunit 20D. The season in southeastern Subunit 20D remained open until 20 September. Eight percent of the moose were killed from 13 to 19 September, and 2% were killed on 20 September.

Transportation Means. Most (44%) hunters in Subunit 20D used highway vehicles to access the area where they hunted in 1986 and 1987 (Table 6); however, hunters using horses, airplanes, and three- and four-wheelers were most successful. Little change was evident from transportation means and success rates reported during 1986.

Natural Mortality:

No estimates of natural mortality were calculated during 1987-88. Predation, which is probably significant because of the numerous wolves, grizzly bears, and black bears residing in Subunit 20D, is limiting moose population growth in northern Subunit 20D.

CONCLUSIONS AND RECOMMENDATIONS

Southwestern Subunit 20D is the most important moose hunting area in the subunit and possibly one of the most important in Interior Alaska. It receives the most hunting pressure and has the largest harvest of any other area in the subunit. The 1976 management plans for this area have undergone a more recent review by the public and have been revised; subsequently, a work plan has been developed for implementation of management goals and objectives contained in the plan.

The population objective for southwest Subunit 20D may have been met or exceeded; however, this is difficult to verify because of the poor accuracy of population estimates. The population has probably grown each year since then, based on sex and age composition data. Once the population objective is met, the management plan calls for cow moose hunting seasons to reduce population growth. However, before cow moose seasons are proposed, a population estimation survey should be conducted to calculate an accurate estimate of population size; browse surveys should be conducted to determine if the habitat will support additional moose; and the public should have the opportunity to review the population objectives in the management plan.

Methods should be explored to reverse the declining bull:cow ratio in southwest Subunit 20D and increase the average age of bulls. Possibilities for accomplishing these goals include reducing season length, imposing antler restrictions on the harvest of bulls, adopting access restrictions, or implementing a registration permit hunt.

Current knowledge of moose population dynamics is lacking for the portion of the subunit lying north of the Tanana River, even though this area received 42% of the hunting effort during 1987-88. Moose numbers appear to have declined in this portion, based on previous sex and age composition data. Predation has been the primary factor responsible for keeping moose densities low. During 1988-89 moose surveys should be flown to update our assessment of population status and trend. Measures should be explored to restore moose numbers to more moderate levels.

Although southeastern Subunit 20D has the longest hunting season in Subunit 20D, it also has the lowest hunting pressure and harvest. This probably occurs because access restrictions in the Macomb Plateau Controlled Use Area make moose hunting difficult, except in the Robertson River. Methods should be explored to increase hunting opportunity in southeastern Subunit 20D.

Adequate funding should be provided in 1988-89 to conduct aerial surveys in areas of Subunit 20D that were not surveyed during 1987-88. In addition to southwestern Subunit 20D, surveys should be flown in southeastern, northeastern, and northwestern Subunit 20D to collect data on population dynamics in these areas.

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Table 1. **Moose hunting season dates in Subunit 20D, 1981-1987.**

Year	Hunting Seasons[a] Southwest[b] Subunit 20D	Southeast Subunit 20D	Northern[c] Subunit 20D
1981	5-15 Sep by reg. permit	1-15 Sep	5-15 Sep
1982	5-15 Sep by reg. permit	5-15 Sep	5-15 Sep
1983	1-4 Sep	5-15 Sep	5-15 Sep
1984	1-6 Sep	1-20 Sep	1-15 Sep
1985	1-10 Sep	1-20 Sep	1-10 Sep
1986	1-10 Sep	1-20 Sep	1-10 Sep
1987	1-10 Sep	1-20 Sep	1-10 Sep

a The same seasons applied to all users: resident, nonresident, and subsistence.

b The Delta Junction Management Area was closed to moose hunting during this time period.

c The portion of the subunit lying north of the Tanana River.

Table 2. Sex and age composition and density of moose for the Donnelly Trend Count Area from 1983-87.[a]

Year[a]	Sample size	Total bulls: 100 cows	Yrlg bulls: 100 cows	Percent Yrlg bulls	Calves: 100 cows	Percent calves in herd	Moose/ mi^2
1983	131	35	12	6	57	29	--[b]
1984	217	41	13	7	41	23	--[b]
1985	131	42	18	10	34	19	--[b]
1986	353	30	15	7	40	24	3.4
1987	323	31	12	9	44	25	3.4

[a] Data for 1983-1985 is a pooling of the old Jarvis/Ober and Donnelly TCA's. The two areas were combined in 1986 to form the new Donnelly TCA.

[b] Not comparable to 1986-87 data because of changes in the survey area boundaries.

Table 3. Annual reported harvest of moose and number of hunters in southwestern, southeastern, northwestern, and northeastern Subunit 20D.

Year	Moose harvest						Number of hunters					
	SW	SE	NW	NE	Unk	Total	SW	SE	NW	NE	Unk	Total
1983	38	12	50		5	105	229	45	248		20	542
1984	39	9	40	14	0	102	236	47	294	48	10	635
1985	48	8	60	14	0	131	236	37	272	50	9	604
1986	76	10	40	10	1	138	250	45	232	57	12	596
1987	66	8	43	9	0	126	296	35	208	35	17	591

Table 4. Hunter residency and success for Subunit 20D, 1983-87.

	Successful					Unsuccessful				
Year	Local[a] res.	Non-local[b]	Non-res.	Unk	Total	Local[a] res.	Non-local[b]	Non-res	Unk	Total
1983	60	41	2	2	105	250	151	28	8	437
1984	60	36	7	1	104	283	236	12	0	531
1985	90	14	4	23	131	348	35	22	67	472
1986	121	14	1	2	138	409	33	12	4	458
1987	96	13	7	10	126	375	42	17	31	465

a Residents of Subunit 20D.
b Other Alaskan residents.

Table 5. Mean days hunted for successful and unsuccessful hunters in southwestern, southeastern, northwestern, and northeastern Subunit 20D from 1984 to 1987.

	Successful					Unsuccessful				
Year	SW	SE	NW	NE	Total	SW	SE	NW	NE	Total
1984	2.8	6.1	7.2	4.9	5.1	4.3	6.1	5.7	6.4	5.2
1985	4.6	6.7	4.1	5.2	4.6	4.4	5.0	6.1	6.9	5.3
1986	3.8	3.0	5.3	4.1	3.9	5.5	10.5	6.1	7.0	6.0
1987	4.4	7.3	4.8	3.9	4.7	5.3	7.5	6.7	6.5	6.1

Table 6. A comparison of transportation means and hunter success in Subunit 20D during the 1987 hunting season.

Transportation	Number of hunters	Percent of total	Percent successful
Highway vehicle	230	44	16
Boat	144	28	24
3-, 4-wheeler	72	14	35
ORVa	38	7	26
Airplane	29	6	35
Horse	5	1	40

a Off-road vehicles other than 3- or 4-wheelers.

STUDY AREA

GAME MANAGEMENT UNIT: 20E (11,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Charley, Fortymile, and Ladue River drainages

BACKGROUND

Moose were abundant in this area during the mid-1960's. The moose population increased to an estimated 12,000 by 1965, resulting from a federal predator control program conducted from 1948 to 1959. Moose numbers declined rapidly from 1965 to 1976. Factors that may have contributed to the decline include severe winters in the mid-1960's and early 1970's, overstocking of the range, and increasing numbers of wolves and grizzly bears following the end of predator control. Overhunting was not an important factor in the decline, because annual harvests were small in relation to the moose population and largely restricted to the Taylor Highway corridor and the Mosquito Fork drainage. Moose population declines occurred in remote, unhunted areas as well as in hunted areas.

The Taylor Highway provided access for many moose hunters throughout the 1960's and the early 1970's. It was a popular hunting area for local hunters as well as hunters from Fairbanks and Southeast Alaska. Historically, hunter success rates were about twice as great as current rates. Harvests were also greater. Hunting of antlerless moose was halted in 1974, but the population Subunit 20E (then a portion of 20C) was stopped completely in 1977.

The season remained closed for 5 years (1977-1981); a short, bulls-only season was restored in 1982. State wolf control was conducted from 1981 to 1983, and the fall wolf population was reduced by 49% as of the fall of 1982. Grizzly bear hunting regulations were also liberalized beginning in 1978 to increase the harvest.

Yearling recruitment and survival of calf moose have improved since reaching low points in 1976. The number of moose observed per survey hour was low during the period 1976-80, but it has increased since that time, roughly reflecting population trend. Therefore, most indications are that moose numbers have increased since 1980, albeit very slowly.

Since the moose season was restored in 1982, annual reported harvests of bull moose have increased. Nonresident hunters are not allowed to hunt in Subunit 20E, and hunter success for resident hunters has been approximately one-half of that reported in 1970.

Two strategic management plans currently apply to portions of Subunit 20E; i.e., the Charley River Moose Management and the Yukon-Tanana Moose Management Plans. The management goal for the Charley River plan is to provide an opportunity to hunt moose under aesthetically pleasing conditions. This goal has always been met, except when the season was closed from 1977 through 1981.

The Yukon-Tanana plan has primary and secondary goals. The primary strategic management goal is to provide the greatest opportunity to participate in hunting moose. The secondary goal is to provide for an optimum harvest of moose. Neither goal was met to any degree during the 5-year hunting closure. Since 1982, moose hunting opportunities have been restricted by short seasons, and nonresident hunters have been prohibited from hunting in recent years; therefore, the primary goal has not been attained. Similarly, the secondary goal of providing for an optimum harvest of moose has also been frustrated by depressed numbers of moose.

Because moose are an important prey species for both wolves and grizzly bears in Subunit 20E, attainment of management goals for those species is also being affected by depressed moose numbers. Management of wolves, grizzly bears, moose, and caribou to restore and maintain moderate densities of all these species in the long term will entail coordination of management actions to increase prey abundance. Operational plans for each species were written with this concept in mind. In simple terms, objectives are to maintain conservative ungulate harvests ($\leq$3%) while increasing the harvest of predators. These conclusions and management recommendations are based upon research on factors limiting moose conducted by ADF&G since 1984 (Boertje et al. 1987).

POPULATION OBJECTIVES

Charley River Drainage

To maintain current aesthetically pleasing moose hunting opportunities until 1990.

To maintain a posthunting sex ratio of at least 40 bulls:100 cows.

Remainder of Subunit 20E

To increase the moose population from an estimated 2,000-3,000 to 8,000-10,000, providing an annual harvestable surplus of at least 3% by the year 2000.

To increase the overall hunter success rate to at least 35%, while increasing hunter participation from 200 to 800 hunters by the year 2000.

To maintain a posthunting bull:cow ratio of at least 40 bulls:100 cows in all areas.

METHODS

Sex and age composition was estimated in November and December using aerial contour and transect surveys. All moose observed were classified as large bulls (antlers $\geq$50 inches), medium bulls (antlers larger than yearlings but <50 inches), small bulls (spike, cerviform, or palmate-antlered yearling bulls approximately 17 mo), cows without calves, cows with 1 calf, cows with 2 calves, calves, or unidentified moose. The same areas are surveyed annually in a comparable manner. Moose harvests were estimated from harvest reports. Except for maintaining restrictive moose hunting regulations and liberal grizzly bear regulations, no action was taken in 1987 to increase moose numbers.

Population Status and Trend

Moose numbers throughout much of Subunit 20E appear to be increasing slowly, based upon the gradually increasing number of moose observed per hour of survey. Thirty-seven moose per hour were observed in the fall of 1987, compared with 10-22 moose per hour observed during 1981-84. Much of this increase may be attributed to the good survey conditions in the fall of 1987. Rates of adult moose mortality reported by Boertje et al. (1987) and observed rates of yearling recruitment during fall surveys indicate that the rate of population growth is probably very low. Substantial improvement in the growth rate is not anticipated in the near future, because wolf numbers in Subunit 20E are approaching those prior to wolf control (i.e., 1981-83).

Population Size:

An initial determination of population size was based upon an intensive quadrat sampling effort conducted in 1981 (Gasaway et al. 1981). During October 1981, 646 moose ±27% (90% CI) were estimated in a 7,500-km^2 (2,900-mi^2) experimental area (Boertje et al. 1987). Extrapolation indicated a population of approximately 1,400-2,000 moose in all of Subunit 20E, assuming densities were comparable. No comparable effort has been conducted since 1981, but the moose population is believed to be larger.

Population Composition:

Six hundred ninety-four moose were classified during 19 hours in November and December (Table 1). While the bull:cow ratio of 79:100 is still good, it has declined slightly for 2 consecutive years. The proportion of yearling bulls in the samples has also declined somewhat since 1985. The changes in both the sex ratio and the proportion of yearlings in the herd have been slight but directional and may reflect slowly increasing bull harvests from 1982 through 1987 and a concurrent increase in wolf numbers during the same period (i.e., since wolf control efforts were halted in fall 1983). It is important to maintain a high proportion of males as buffer prey to females in moose populations heavily impacted by wolf predation (William Gasaway, ADF&G, pers. commun.).

Because of increased harvests of grizzly bears since 1981, survival of calves to 5 months during the past 2 years has been the highest recorded since 1971, but it is still quite low (Table 1). Most grizzly bear predation on calf moose occurs within the 1st weeks of life. It appears, however, that recent management efforts to improve early calf survival are being negated by increased overwinter loss of calves to wolf predation. Boertje et al. (1987) concluded that moose in Subunit 20E were large, healthy, and productive (i.e., 130 calves:100 cows ≥ 2 years and a 40-50% twinning rate) but that predation on calves by bears in summer an wolves year-round was limiting growth of this depressed population. Composition data suggest this is still the case. Population composition will continue to be monitored closely so that appropriate management recommendations can be made to keep annual moose harvests in line with productivity.

Distribution and Movements:

Moose are well distributed throughout Subunit 20E. While resident moose are known to exist in the Mosquito Flats, most moose probably make seasonal movements between lowland summer habitat and upland rutting areas where they remain until winter conditions cause them to move to lower elevations.

Mortality

Season and Bag Limit:

The open season for subsistence and resident hunters in that portion of Subunit 20E draining into the Yukon River within Alaska upstream from and including the Charley River drainage is 5 to 25 September; the bag limit is 1 bull. The open season for subsistence and resident hunters in the remainder of Subunit 20E is 1-10 September; the bag limit is 1 bull. There is no open season for nonresident hunters in Subunit 20E.

Human-induced Mortality:

The total reported harvest in Subunit 20E during the fall 1987 season was 54 moose (presumably all bulls). This was the greatest harvest reported during the last 6 years (Table 2). Reports from the Division of Fish and Wildlife Protection indicated that many moose were killed along the Taylor Highway after the season had closed on 10 September, because some hunters mistakenly believed that the 5-25 September season along the Yukon River corridor applied to the Taylor Highway as well. Wording changes in the 1988 hunting regulations should make this section of the regulations easier to understand.

The Yukon River serves as the boundary between Subunits 20E and 25B. Prior to 1984 the season throughout Subunit 20E had been 1-10 September, but most of the harvest along the Yukon River occurred after the data. We believed that Subunit 20E moose were either being reported falsely to Subunit 25B or were not being reported at all. This perceived reporting problem was believed to have been largely corrected when the season in northern Subunit 20E was aligned with the season in Subunit 25B.

Of 51 moose for which harvest location was reported, 18 (35%) were taken along the Yukon River in the northern portion of Subunit 20E and 33 (65%) were taken in the remainder of the subunit. The Mosquito Fork drainage received the greatest harvest; i.e., 16 bulls. Hunting pressure is increasing in Subunit 20E (Table 2); however, hunter density in 20E is very low, except along the Taylor Highway.

The mean antler spread of bulls taken in Subunit 20E was 49.2 inches. Three bulls (6%) were judged to have been yearlings (antlers <30 inches), 20 bulls (41%) were 2-4 years old (antler spread 30-40 inches), and 26 (53%) were mature bulls (antler spread ≥50 inches). Fifteen bulls (31%) had antler spreads ≥60 inches, and four (8%) had antler spreads ≥65 inches. Antler spreads were also estimated for 274 bulls observed during posthunting aerial surveys, suggesting a similar age composition to that of harvested bulls (12% yearlings; 38%, 2- to 4-year-olds; 50%, 5 years+). Assuming that moose hunters in Subunit 20E are not selecting large bulls and that antler spread correlates roughly with age classes, bull moose harvested in 1987 suggest an old age population with low recruitment.

Hunter Residency and Success. Nonresident hunters have been prohibited from hunting moose in Subunit 20E since 1984, even though the number of moose harvested by nonresidents from 1982-83 was insignificant. One bull was taken illegally by a nonresident during the 1987-88 reporting period. Of the 54 bulls reported taken, 10 (19%) were taken by residents of Unit 12 and Subunit 20E and seven of those by residents of Eagle in Subunit 20E. Alaskan residents from other parts of the state reported taking 31 moose; two were from Delta, six from Southeastern, 10 from Southcentral, and 12 from Fairbanks. Residency was not noted by 12 successful hunters.

Hunter success was 20% overall, with 265 hunters reporting. Success has ranged from 17% to 22% since 1982, but unsuccessful hunters are probably less likely to report then successful hunters, biasing rates on the high side. Thirty-two hunters from Unit 12 and Subunit 20E experienced a 31% rate of hunter success, probably because of their familiarity with moose distribution and movements in this area.

Harvest Chronology. The moose hunting seasons in Subunit 20E are so short that analysis of harvest chronology is of limited value. Nonetheless, of the 50 moose taken during the season with a known harvest data, 18 (36%) were taken 1-6 September, 16 (32%) 7-13 September, 12 (24%) 14-20 September, and four (8%) 20-25 September.

Transport Methods. Most hunters (85), whether successful or not, used highway vehicles, followed by three- or four-wheelers (49), boats (42), aircraft (40), or ORV's (21). Twenty-eight hunters did not specify means of transport. As expected, hunters using aircraft experienced the greatest rate of success (40%), followed by those using ORV's (29%), boats (24%), and highway vehicles

(14%). Surprisingly, hunters using the very popular three- and four-wheelers had the lowest rate of success at 12%.

Hunters using aircraft for access accounted for 30% of the harvest, followed by hunters using highway vehicles (22%), ORV's (19%), boats (11%), and three- or four-wheelers (11%). Transport means were not reported by 7% of successful hunters. Hunters who employed transport methods to access areas beyond the Taylor Highway generally experienced greater success than those who did not. Many subsistence hunters lack the means to hunt far from their highway vehicles. While there is some resentment among subsistence hunters toward hunters who can afford to use aircraft, there is virtually no actual competition for moose, because aircraft-borne hunters are hunting moose generally unavailable to subsistence hunters along the Taylor Highway corridor. Most competition for moose between local and nonlocal hunters occurs near or on the Taylor Highway.

Natural Mortality:

Predation by wolves and grizzly bears is the greatest source of mortality for moose in Subunit 20E. Grizzly bears and wolves prey upon both calves and adults to such an extent that they are controlling growth of this depleted, low-density moose population. Both predator species are abundant in Subunit 20E, relative to the moose population.

Boertje et al. (1987) reported that predators were responsible for 34 (89%) of 38 investigated adult moose deaths; other causes of death included antler wounds (2), drowning (1), and gunshot wounds (1). Adult moose mortality was minimally estimated to be at least 7%; however, it may have actually increased in response to the increasing population.

Calf mortality is also extremely high. Boertje et al. (1985) reported (82%) mortality among 33 neonates collared in spring 1984; most deaths (76%) occurred within 8 weeks of birth. Grizzly bears, wolves, and black bears killed 52%, 9%, and 3% of the calves, respectively. Four calves (12%) drowned. It is important to remember that wolf control efforts had reduced wolf numbers by approximately 50% by 1984. Since wolf numbers returned to near precontrol numbers by 1987, the percentage of calf moose now being killed by wolves is higher.

Habitat

Assessment:

Most of Subunit 20E is potential moose habitat, except areas above an elevation of 4,000 feet. Over 2 decades of successful fire suppression have produced an unnatural habitat mosaic, with more spruce forest and less brush land and deciduous forest than previously existed under the natural fire regime. Even so, the availability of browse far exceeds that necessary to support the current moose population. Of 2,820 browse plants examined during the mid-1980's, 86% had not been browsed during the previous winter, and use of current annual growth was less than 5% (Boertje et al. 1985). Food availability is not currently limiting moose population growth in Subunit 20E.

Enhancement:

Implementation of the Alaska Interagency Fire Management Plan is expected to restore a near-natural wildfire regime to over 60% of Subunit 20E. Unfortunately, a series of wet summers and/or insufficient occurrences of lightning strikes during dry conditions have produced few fire starts since 1984 when the plan went into effect. Under the plan, much state and federally owned land was accorded only limited fire protection, because values requiring a higher level of protection were largely absent. However, nearly all land selected by Native corporations was accorded modified or full suppression status. The habitat in these areas of higher fire protection will continue to degrade, to the detriment of moose and other wildlife species that fare best in a fire-shaped environment.

Game Board Actions and Emergency Orders

Moose hunting regulations were not changed in Subunit 20E during this reporting period. However, during the November 1987 meeting the Board of Game prohibited the harvesting of wolves by the land and shoot method. This restriction will reduce the annual take of wolves by the public in this area that, in turn, will further disadvantage the already depleted moose population.

CONCLUSIONS AND RECOMMENDATIONS

After several years of intensive research into factors limiting moose in Subunit 20E and extensive survey-inventory efforts, it can only be concluded that predation is limiting growth of this low-density moose population. Strategic goals and specific population management objectives are not being met and cannot be met until predation is reduced sufficiently to allow the moose population to grow at moderate rates (10% annual growth).

Liberalized hunting regulations for grizzly bears have resulted in increased bear harvest since 1981. Calf survival to 5 months has increased during the last 2 years to 27 and 24 calves:100 cows ≥ 2 years, respectively, but an increasing wolf population is responsible for declining survival of those calves to 17 months of age. The recent action taken by the Alaska Board of Game will have the effect of further reducing an already low annual harvest of wolves by the public, thereby aggravating this situation.

Annual harvests of bull moose have been maintained at less than 3% of the estimated moose population, but given the extent of predation, even this level of harvest may be sufficient to affect the sex ratio. If the apparent downward trends in the bull:cow ratio and yearling recruitment continue, recommendations will be made to reduce annual moose harvests.

I recommend a year-round hunting season for wolves as well as the restoration of same-day-airborne harvesting of wolves in Subunit 20E. Furthermore, I recommend a program to significantly reduce wolf predation on moose, to augment the benefits to calf survival that are resulting from reduction of the grizzly bear population.

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Table 1. Moose sex and age ratios in Subunit 20E, 1983-87.

Year	Males: 100 females	Yrlg males: 100 females	Yrlg male % in herd	Calves:100 cows $\geq$2 yrs	Calf % in herd	Twins:100 cows w/ calf	Moose/ hour	Total moose
1983[a]			NOT COMPARABLE					215
1984	68	12	6	11	12	0	22	383
1985	86	15	7	19	8	4	29	613
1986	80	12	6	27	18	7	29	701
1987	79	9	5	24	11	6	37	694

[a] Poor snow cover delayed surveys until January 1984.

Table 2. Annual moose harvests in Subunit 20E, 1982-87.

Year	Unreported				Estimated			Number of hunters	Success (%)
	M	F	Unk	Total	Unreported	Illegal	Total		
1982	19			19[a]	15	5-15	39-49	113	17
1983	31			31[a]	15	5-15	51-61	166	19
1984	29			29[a]	3-6	5-15	37-50	151	19
1985	49			49[b]	4-7	5-15	58-71	225	22
1986	46			46	4-7	5-15	55-68	233	20
1987	52		2	54	6-10[c]	5-15	65-79	265	20

[a] Yukon corridor harvest not included.
[b] Season along Yukon River lengthened; reporting improved.
[c] Confusing wording in the regulations resulted in some moose being killed after the season had closed.

STUDY AREA

GAME MANAGEMENT UNIT: 21A and 21E (23,673 mi^2)

GEOGRAPHICAL DESCRIPTION: Drainages of the Innoko River upstream from and including the Iditarod River drainage and that portion of the Nowitna River drainage upstream from the confluence of the Little Mud and Nowitna Rivers. Drainages of the Yukon River from a straight line drawn between Lower Kalskag and Paimiut Rivers upstream to but not including the Blackburn Creek drainage, and the Innoko River drainage downstream from the confluence of the Iditarod and Innoko Rivers.

BACKGROUND

Cooperative moose research is presently being conducted by the U.S. Fish and Wildlife Service (FWS), Innoko National Wildlife Refuge, U.S. Bureau of Land Management (BLM), and the Alaska Department of Fish and Game (ADF&G) staff in portions of the area. During the early spring of 1986, 24 moose were instrumented in Subunit 21E; an additional 36 moose were equipped with radio collars in Subunit 21A during early 1988. Movement, parturition, and calf and adult survival data have been collected.

Hunters in Subunit 21A are generally nonlocal, gaining access by aircraft and attempting to harvest large-antlered bulls. Conversely, Subunit 21E hunters generally access the area with boats and are primarily local rural residents. The 2 areas, with different hunting seasons and access opportunities, tend to favor a separation of primarily "sport hunters" and "meat hunters."

POPULATION OBJECTIVES

To provide a reported harvest of at least 150 bull moose, while maintaining greater than 50% reported success rates with mean bull antler spreads in excess of 48 inches in Subunit 21A.

To provide a reported harvest of at least 125 moose by the 1990-91 regulatory year, while maintaining reported hunter success rates in excess of 50% in Subunit 21E.

To encourage land management agencies (FWS, BLM, and ADNR) to allow naturally occurring wildfires to burn in those situations where human lives and property are not endangered, in an effort to produce and maintain additional high-quality moose range.

METHODS

An attempt was made to conduct a population estimate survey (Gasaway et al. 1986) of moose in part of the Paradise Controlled Use Area between the Yukon and Innoko Rivers during late fall 1987. An area of 2,200 mi^2 was delineated into 8- to 12-mi^2 sample units. Stratification was done from a Cessna 185 using 3 observers in addition to the pilot. Sampling was done from either Piper PA-18 Super Cub aircraft or aircraft with similar capabilities.

Sam Patten and Randy Kacyon from the ADF&G office in Bethel conducted a moose survey in the middle Yukon-lower Innoko River drainages of Subunit 21E during February 1988. During March 1988, 37 moose in the upper Innoko River area were immobilized by FWS and ADF&G biologists using standard helicopter darting techniques. A dose of 5 mg of Carfentanil citrate (Wildnil, Wildlife Lab, Ft. Collins, CO) was used to immobilize both bull and cow moose. Collars containing radio transmitters and visual markings were installed. After collaring, a 750-mg dose of naloxone hydrochloride (Naloxone, Wildlife Lab, Ft. Collins, CO) was administered intramuscularly as an antagonist. Moose were checked on a daily basis following the tagging effort. Movements, natality, and mortality rates will be collected over the next 3 years.

Tooth samples were collected for determination of ages. Blood sera were collected for disease analyses. Sera from cow moose were also used to determine pregnancy rates (PSPB test, Univ. of Idaho, Dep. of Animal Sci., Moscow, Idaho). Standard body measurements were recorded from most moose.

Ten instrumented cow moose in Subunit 21E were aerially monitored 1 or 2 times daily between 16 May and 4 June 1988 in an attempt to assess parturition dates, natality rates, and neonate mortality rates and factors. Personnel and aircraft charter costs were supplied by the BLM.

Sam Patten and Randy Kacyon (ADF&G, Bethel) operated a hunter check station throughout the fall hunting season on Paimiut Slough to assess hunter effort and rates of harvest. Hunter and harvest information were also gathered from harvest ticket returns. Analysis of harvest trends, hunter effort, hunter residency, harvest location, and bull antler sizes were investigated and compared with historical information.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

We were unable to complete the population survey in a portion of the Paradise Controlled Use Area because of extremely cold weather, aircraft mechanical problems, moose movements, and the onset of antler drop. No population estimate was developed, but valuable information was obtained on moose distribution, sex and age composition, and individual sample unit densities.

Stratification was attempted from 21 to 25 November 1987. A total of 1,711 mi^2 (143 sample units) of the original 2,200-mi^2 area were successfully stratified. According to relative density, stratification suggested that moose densities were low in 64% of the area, medium in 32% of the area, and high or super high in only 4% of the area. Eight hundred sixty-eight moose were observed during 13.7 hours of stratification work (63.4 moose/hr).

Eighteen sample units were completed before the survey was halted. Observed densities ranged from 0 to 12.5 moose/mi^2. Examination of these data indicated that a 4th stratum (super high) should have been delineated during the stratification.

I have subjectively divided the data obtained from sample units in the high-density stratum into high and super-high categories. Based on these limited data, I have roughly estimated that the low, medium, high, and super-high areas contained 0.2, 1.6, 4.1, and 9.5 moose/mi^2, respectively. I estimated that overall moose density averaged 1.0 moose/mi^2. Extrapolation of these density estimates to the total area stratified suggested that the area may have roughly contained 1,700 moose during late fall.

Any densities estimates for the survey area should not be considered representative of the remainder of the subunit because the survey area contains the best moose habitat in the subunit. However, densities over the remaining 6,176 mi^2 of the subunit are probably in excess of 0.2 moose/mi^2.

These calculations suggest a minimum estimate of approximately 3,000 moose for all of Subunit 21E; however, it should be reiterated that this estimate is not statistically bounded. At this time it is not clear what the moose population level is in Subunit 21A.

The February 1988 moose composition survey in the Paradise Controlled Use Area was divided into 2 sections: (1) Great Paimiut Island to Holy Cross and (2) Holy Cross to Carlo Island. Three hundred eight moose were observed in 113 minutes of survey (164 moose/hr) from Great Paimiut Island to Holy Cross, and 144 moose were observed in 36 minutes of survey (240 moose/hr) from Holy Cross to Carlo Island. The total area surveyed was approximately 30 mi^2, yielding a minimum density estimate of 15 moose/mi^2. These results should not be considered indicative of moose densities over a larger area, because the survey was not intensive enough to accurately estimate moose density and the riparian areas surveyed contain higher than normal moose densities during the late-winter period.

Population Composition:

Eight hundred thirty-two moose were classified during the attempted population survey in the Paradise Controlled Use Area. These data indicated that calf survival to 6 months of age was good (i.e., 45 calves per 100 cows, 21% occurrence of twins among cows with calves).

The bull:cow ratio (24:100) was only moderate; however, most bulls were small (45% yearlings, 44% larger than yearling but less than 50 inches, and 11% greater than 50 inches). Most sample units surveyed were located in lowland riparian areas. Our observations during the stratification flights suggested that bulls were more prevalent at higher elevations. Radiotelemetry data from collared bulls in the area also indicated that bulls tended to stay at higher elevations during late fall. Therefore, I suspect bull moose were underrepresented in the sample obtained from the lowland areas and the actual bull:cow ratio for the entire area was higher.

February 1988 data from Great Paimiut Island to Holy Cross and Holy Cross to Carlo Island suggested that calves composed 13% and 15% of the herds in the respective areas. This was considerably lower than the 26% observed during the population survey conducted during November and December 1987, suggesting that either substantial mortality had occurred among calves during the interval between surveys or that calves had been misclassified during the latter survey.

Daily montoring of 10 radio-collared cow moose in the lower Innoko River-middle Yukon River area revealed that one did not produce calves, eight had twins, and one had triplets. At parturition, this equates to production of 190 calves:100 cows. Early neonate mortality is relatively low; only 3 calves were lost during the 4-week-monitoring period. Causes of the deaths were not ascertained.

Distribution and Movements:

Radio-locations of instrumented moose in the lower Innoko River-middle Yukon River area indicated most adult moose are migratory over relatively short distances; however, bulls remained away from riparian zones during summer, fall, and early winter until snow depths pushed them down to lower elevations. One cow displayed a movement of over 100 kilometers, when moving from the Yukon River to the Andreafsky River. Relatively good moose habitat exists in scattered locations within Unit 18. As the Subunit 21E moose population continues to expand, dispersing individuals will continue to pioneer areas downstream of Holy Cross on the Yukon River as well as more upland areas such as the Andreafsky River. Recent regulatory changes will serve to protect those establishing populations.

Tagging Synopsis and Physiological Parameters:

One cow died during the radio-collaring operation in the upper Innoko River because an insufficient quantity of the antagonist (Naloxone) was initially administered, resulting in the death. The remaining 36 moose (16 bulls and 21 cows) were doing well 2 days after they had been immobilized.

Induction times averaged 6.6 minutes for all moose, although in some cases the hit location was not optimal or the internal dart charge malfunctioned and greatly increased the induction times. When those instances were discounted, induction times averaged 4.2 and 4.8 minutes for bulls and cows, respectively.

Physical condition of the moose was assessed in the field, according to standard criteria, and an index number was assigned each moose. Overall, condition of moose was good, with indices ranging from 6.0 to 8.5 ($\bar{x}$ = 7.2). As expected, bull condition indices were lower than cows, averaging 6.6 and 7.6, respectively.

Teeth collected for age determination have not been sectioned at this time. Analysis of blood sera from 17 cow moose indicated that all were pregnant.

Total length of moose ranged from 284 to 320 centimeters (mean = 301.5 cm). Although 6 moose lacked tails, those that had tails had a mean tail length of 7.2 centimeters. Chest circumference and hind-foot measurements averaged 205 and 89.3 centimeters, respectively. There were no significant differences between the sexes in any of the body measurements.

Mortality

Season and Bag Limit:

The open seasons for subsistence and resident hunters in Subunit 21A are 5-30 September and 1-30 November. The open season for nonresident hunters is 5-30 September. The bag limit is 1 bull. The open season for subsistence and resident hunters in Subunit 21E are 5-25 September and 1-10 February. The bag limit is 1 moose; however, antlerless moose may be taken only from 21-25 September and 1-5 February. The open season for nonresident hunters is 5-25 September; the bag limit is 1 bull.

Human-induced Mortality:

In Subunit 21A sport hunting continues to be the major source of documented mortality; the record harvest of 146 moose during 1987-88 probably reflects an actual increase in harvest rather than an increase in reporting. Harvests and success rates in Subunit 21A during the past 5 years have remained relatively stable (Table 1).

In Subunit 21E subsistence use of moose by residents of Units 18 and 21 accounts for the majority of the documented mortality. Local compliance with reporting requirements via hunter harvest tickets remains extremely poor. The reported harvest of 111 moose is not significantly different from harvests during the previous 2 years (Table 2), and it is below the record of 133 moose in 1984-85. Success rates have also declined during the past 5 years; however, this may be a reflection of better compliance with the reporting requirements, rather than an actual decline in hunter success. Illegal and unreported harvests of moose in Subunit 21E continued to be extremely high. The actual moose harvest in the area is at least 2 times higher than that reported.

Hunter Residency and Success. Nonresidents and Alaskan hunters who reside in locations other than Units 18, 19, and 21 continue to account for the majority of the harvest (77.5%) in Subunit 21A (Table 3). During 1987 hunters from Units 18 and 21 reported harvesting 15 and 4 moose, respectively. The residencies of hunters using Subunit 21A during 1987 was not substantially different from those of previous years.

Analysis of harvest ticket returns in Subunit 21E indicated that most hunters resided in Units 18 or 21 (Table 4). As with previous years, nonresidents accounted for a very small percentage of hunters in Subunit 21E (1.8%). A large proportion of hunters residing in Subunit 21E (i.e., Grayling, Anvik, Shageluk, and Holy Cross) typically do not obtain harvest tickets or fail to return harvest reports; the 1987-88 season was no exception. Residents of these villages probably harvested a minimum of 75-100 moose, but only 27 harvest reports (18 successful) were returned. The license vendor in Holy Cross, who normally issues most of the harvest tickets to area residents, was killed in early autumn, and his harvest ticket distribution records were not available to the Fish and Game staff. This undoubtedly accounted for a portion of the unreported harvest during 1987-88.

Harvest Chronology. The reported harvest in Subunit 21A occurs almost exclusively during the September season. Of a total reported harvest of 146 moose, 140 were attributable to the 25-day September season; only 2 moose were killed in November. Unlike the Subunit 21E harvest chronology, I believe the Subunit 21A data are reasonably accurate.

In Subunit 21E, 82% of the reported harvest occurred in September. An additional 14 moose (13%) were taken in February. There are numerous unreported moose harvests during and after the legal hunting seasons.

In Subunit 21E the Board of Game recently determined that the only customary and traditional users were residents of Subunit 21E and Russian Mission. This will probably substantially decrease the number of hunters in the area during the 10-day February subsistence season. There were reports of several Bethel area hunters taking advantage of that February season during the 1987-88 regulatory year; those hunters will no longer be allowed to hunt there. Those displaced hunters may become responsible for increased moose hunting effort in Subunit 19A near Kalskag and Aniak.

Transport Methods. In Subunit 21A approximately 61% of the successful hunters gained access to the area with aircraft. The Innoko River provided another route, and 28% of the hunters listed boats as their primary means of access. Conversely, 73% of the reporting hunters in Subunit 21E gained access to their respective hunting areas by boat. Access by aircraft in the Paradise Controlled Use Area is prohibited, thus allowing local users a place to hunt moose without competition from aircraft-assisted hunters. Additionally, the 10-day February season in Subunit 21E allows hunters to access the area with snowmachines, and 14% of the successful hunters listed them as their method of transport.

Natural Mortality:

Wolf numbers are moderate to high, and their effects on local moose populations are probably significant. Rough population estimates for wolves in Subunits 21A and 21E in 1987 were 166 and 86 wolves, respectively. Suspected numbers of packs are 21 and 10 for Subunits 21A and 21E, respectively. These moderate-to-high wolf densities, coupled with a relative scarcity of alternate prey species, make it highly likely that wolf predation is a primary factor limiting moose numbers. Brown bears are also present in the area, but they probably account for only a small amount of the total moose mortality. In Subunit 21E, and to a lesser extent in the lowland riparian areas of Subunit 21A, black bear numbers are seasonally quite high. Incidental observations of black bears on the calving grounds near Holikachuk and Shageluk indicated extremely high densities, although the amount of predation attributable to them is unknown.

High water levels in the late spring may also account for calf mortality during some years, although the extent of that mortality is unknown. During the winter of 1986, low calf:cow ratios were probably a result of high water levels during the late spring of 1985. During the spring of 1988, water levels in the vicinity of calving concentrations were moderate, and very little, if any, neonatal mortality is expected from this cause.

Habitat Assessment and Enhancement

No formal range investigations were conducted during this reporting period. Incidental observations indicate that overbrowsing is not a serious concern in Subunits 21A or 21E; however, heavy winter browsing levels by moose occur in the riparian habitat along the Yukon and Innoko Rivers.

No enhancement efforts have been conducted; however, during the summer of 1988, natural wildfires burned at least 20,000 acres in the Innoko River area near Cripple Landing in Subunit 21A. Moose browse is expected to become more abundant and of better quality during the early regrowth phase in which shrubs and saplings predominate.

Game Board Actions and Emergency Orders

The Board of Game made new determinations affecting customary and traditional users in Subunit 21E; only residents of Subunit 21E and Russian Mission may hunt during the February subsistence season. In addition, cow hunts were reauthorized by the Board of Game for the February hunt in Subunit 21E.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations appear to be doing well in both Subunits 21A and 21E. Although the reported harvest in Subunit 21E during the February season is inconsequential, I think the recent Board of Game hunting restrictions will reduce the reported and unreported harvests. The reported harvest has apparently stabilized during the past 4 years in Subunit 21A. Both mean antler sizes of harvested bulls and hunter success rates have remained relatively high. I do not recommend any further changes to existing regulations at this time.

Management plans call for increasing moose populations in Subunits 21A and 21E to 2,100-2,500 and 2,000-2,500 moose, respectively. I believe the moose population in Subunit 21E is higher than the management plan calls for; however, there is no justification for attempting to curtail the growth of the population. The population goal identified in the Subunit 21E work plan should be reviewed and possibly revised.

The absence of adequate harvest information is the greatest obstacle to management of moose populations in Subunit 21E and, to a lesser extent, Subunit 21A. Educational efforts should continue in Grayling, Anvik, Shageluk, and Holy Cross to emphasize the importance of using harvest tickets. Increased enforcement efforts are also needed.

Cooperative arrangements with the FWS and BLM should continue. Valuable information concerning moose movements, natality, and mortality rates is being collected at reasonable costs because of those arrangements. Continued support of existing fire management plans should be reiterated with the Alaska Department of Natural Resources, emphasizing the need for wildfires and the benefits realized in terms of moose browse enhancement. The Division of Fish and Wildlife Protection should be encouraged to continue their enforcement programs along the Innoko River during moose seasons.

Better information on the numbers of hunters utilizing outfitters in portions of Subunit 21A will probably be available during 1988-89 Senate Bill 191 will make it possible to document this growing business, allowing better enumeration of hunter effort and harvest levels. Efforts should focus on evaluation of these parameters in Subunit 21A.

Delineation of standardized moose composition and trend areas should be conducted during 1988-89. Historically, moose surveys have been conducted in select portions of the area, but standardized routes should be outlined and data collected annually.

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Table 1. Annual reported moose harvests in Subunit 21A during the 1982-87 regulatory years.

Year	Males	Females	Total
1982	103	0	103
1983	135	0	135
1984	136	0	136
1985	120	0	120
1986	126	0	126
1987	146	0	146

Table 2. Annual reported moose harvests in Subunit 21E during the 1982-87 regulatory years.

Year	Males	Females	Total
1982	69	0	69
1983	95	0	95
1984	133	0	133
1985	100	8	108
1986	101	11	112
1987	105	6	111

Table 3. Reported residency of moose hunters in Subunits 21A during the 1987-88 regulatory year.

Residency	Successful	Unsuccessful	Total	% of total
Unit 18	15	10	25	11.6
Unit 19	6	5	11	5.1
Unit 21	4	0	4	1.9
Other Alaska locations	73	35	108	49.3
Nonresidents	41	19	60	27.9
Unknown	7	0	7	3.3
Grand Total	146	69	215	100.0

Table 4. Reported residency of moose hunters in Subunits 21E during the 1987-88 regulatory year.

Residency	Successful	Unsuccessful	Total	% of total
Unit 18	52	21	73	44.8
Unit 19	4	2	6	3.7
Unit 21	18	8	26	16.0
Other Alaska locations	13	11	24	14.7
Nonresidents	2	1	3	1.8
Unknown	22	9	31	19.0
Grand Total	111	52	163	100.0

Table 1. Observed moose densities and sex and age ratios from aerial survey of comparable portions of established trend areas in Subunit 21B, 1985-88.

Year	Area[a] (mi^2)	Search effort (min/mi2)	Sample size	Total moose/ mi2	Adult[b] moose/ mi2	Cow[c] moose/ mi2	Bulls/ 100 cows	Yearling bulls/ 100 cows	Calves/ 100 cows	Twins/ 100 cows w/calves
1985	78	5.1	128	1.65	1.48	1.18	36	5	3	0
1986	81	4.5	168	2.08	1.44	1.14	39	7	43	11
1987	77	4.9	229	2.98	1.82	1.48	46	11	55	11
1988	77	5.6	267	3.48	2.15	1.87	48	17	38	15

[a] Consists of survey units 7, 29, 30, 35, 41 and 42 in each year.
[b] All moose greater than or equal to 18 mos. old.
[c] All female moose other than calves.

Table 2. Sex and age ratios from all moose observed during aerial survey of established trend areas in Subunit 21B, 1983-88.

Year	Area[1] (mi^2)	Search effort[2] (min/mi^2)	Sample size	Bulls/ 100 cows	Yearling bulls/ 100 cows	Calves/ 100 cows	Twins/ 100 cows w/calves
1983	118	4.8	205	38	9	46	9
1984	---	---	---	--	-	--	-
1985	146	4.9	225	24	5	5	0
1986	188	4.6	326	33	6	43	5
1987	196	4.5	446	41	13	53	13
1988	147	5.0	407	36	14	41	16

Table 3. Annual moose harvest, Subunit 21B, 1983-87.

Year	Ruby Rd.	Novi/ Sulatna	Yukon R.	Unreported harvest	Total harvest
1983	11	49	17	15	92
1984	16	52	28	15	112
1985	6	37	22	15	79
1986	9	51	19	15	94
1987	9	45	28	15	97

STUDY AREA

GAME MANAGEMENT UNIT: 21C ($3,600\ mi^2$)

GEOGRAPHICAL DESCRIPTION: Dulbi River above Cottonwood Creek and Melozitna River above Grayling Creek

BACKGROUND

Moose have occurred in Subunit 21C since historic times. The 1st survey conducted in the area was a 2-hour one in November 1980; 21 moose were seen. A trend count survey was conducted by Bureau of Land Management biologists at Sithdondit Creek near the headwaters of the Melozitna River in November 1983. Randomly selected survey units were counted during November 1987. Those data were not sufficient to infer population trend, but they did indicate that numbers were low.

The terrain is mountainous, with peaks as high as 5,000 ft. Two large drainages, the Melozitna and Dulbi Rivers, dissect the mountains. Numerous fires have burned in the area, producing large expanses of excellent winter habitat.

The harvests have ranged from 15 to 30 moose during the past 15 years. Aircraft provide the only practical access. A waterfall near the mouth restricts travel up the Melozitna River, and low water impedes boat access to the upper Dulbi River.

POPULATION OBJECTIVES

To increase the moose population to 2,500-3,000 in the Melozitna drainage and to 500-1,000 in the Dulbi River drainage so that hunting opportunities can be increased.

METHODS

The Dulbi River portion of Subunit 21C was included in a population estimation survey that was conducted in Subunit 21D; no other surveys were conducted. Hunting mortality was monitored through moose harvest reports, and predation was monitored by interviews with wolf trappers.

RESULTS AND DISCUSSION

Population Status and Trend

Moose densities are thought to be generally low. The population trend is unknown.

Population Size:

During November 1987 a population survey was conducted in the Dulbi River drainage by biologists from the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, and the Bureau of Land Management; 41% and 59% of the 865-mi^2 area was categorized as low and medium density survey units, respectively. The estimated population was from 544 to 720 moose. An adequate estimate of population size can not be made until a planned stratification survey is completed in November 1988 in the Melozitna River drainage.

Population Composition:

Eight survey units (101 mi^2) were searched in the Subunit 21C portion of the population estimation survey that was conducted in November 1987. Composition data from these survey units indicated good bull:cow and calf:cow ratios (Table 1); however, the ratio of yearling bulls:100 cows was low.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters is 5-25 September; the bag limit is 1 bull.

Human-induced Mortality:

The harvest has been stable, ranging from 25 to 30 moose annually for the past 10 years (Table 2). The seizure of an airplane in 1982 was precipitated by illegal hunting methods. There was a reduction in the harvest that year as well as in subsequent years, suggesting that some hunters had been shooting moose on the same day they had been airborne.

Hunter Residency and Transportation Methods. There is only 1 family residing within the subunit who usually account for 1 moose each year. The rest of the hunters were either nonlocal residents (19) or nonresidents (14). All hunters used aircraft for transportation.

Natural Mortality:

There are at least 50 to 60 wolves in Subunit 21C. Grizzly bear habitat is excellent, and the estimated density is 1 bear/40 mi^2. Moose and caribou are available as prey for wolves and grizzly bears. The Melozitna River also has a major salmon run. Predation is probably the main limiting factor on moose in the subunit.

Game Board Actions and Emergency Orders

The seasons and bag limits have remained the same during the past 5 years.

CONCLUSIONS AND RECOMMENDATIONS

The population goal in the Dulbi River drainage has been attained, mainly through natural wildfire and the difficult access to the area restricting hunting pressure. The population estimation survey in 1987, which was the 1st moose survey of the area, established a baseline population estimate.

The moose population in the Melozitna River drainage is low, and although the number of hunters is small, an increase in moose numbers would benefit hunters and their natural predators. Better survey data are needed to aid management decisions. A stratification survey of the area should be conducted to ascertain moose distribution and relative abundance and to determine areas for future trend surveys.

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Table 1. Moose composition in Subunit 21C, 1983-1987.

Area	Year	Bulls: 100 cows	Yearling bull %	Calves: 100 cows	Percent calves	Density moose/mi^2	Area (mi^2)	Sample size
Unit 21C	1983	131	6	23	9	0.6	49.7	33
	1984	---	-	--	-	---	---	--
	1985	---	-	--	-	---	---	--
	1986	---	-	--	-	---	---	--
	1987	81	4	35	16	0.7	100.7	67

Table 2. Annual harvest in Subunit 21C, 1983-1987.

Year	Reported	Estimated unreported	Total
1983	16	0	16
1984	15	0	15
1985	18	0	18
1986	28	0	28
1987	29	0	29

STUDY AREA

GAME MANAGEMENT UNIT: 21D (11,900 mi^2)

GEOGRAPHICAL DESCRIPTION: Yukon River from Blackburn to Ruby and Koyukuk River drainage below Dulbi Slough

BACKGROUND

Moose immigrated into Subunit 21D in the 1930's, when local Natives reported occasional tracks during winter. During the 1940's and the 1950's the number of moose slowly built up along with the number of wolves. Federal wolf control and aerial shooting reduced the wolf populations, allowing a rapid expansion in the moose population in the late 1950's and 1960's. The population reached a peak about 1970 and then stabilized or declined slightly because of increased predation and hunting pressure until 1979 with the establishment of the Koyukuk Controlled Use Area (KCUA), which prohibited the use of aircraft for hunting moose in the northern sector of the subunit. The KCUA limited numbers of hunters until 1986, when the number of hunters from outside the subunit using boats equaled the previous number of aircraft-borne hunters.

Large (i.e,. 100,000-200,000 acres) fires during 1974 and 1977 in the uplands along the Koyukuk River improved the summer habitat. Since 1980 trappers using aircraft to land near wolves have been able to consistently shoot enough wolves to stabilize predation on moose at a reduced level. The presence of numerous large lakes and rivers near moose winter concentration areas makes this a particularly effective trapping method.

Moose trend count areas (TCA's) established in the Three Day Slough and Yukon floodplain areas have indicated an increasing density of moose. Initially, I thought the increase was due to better surveys, but a population estimation survey of the Kaiyuh Flats and the eastern drainages of Koyukuk River in 1987 confirmed the trend. Moose densities were high along the Yukon River floodplain (i.e., 3-6 moose/mi^2) and very high between the Kateel River and Dulbi Slough (averaging 9 moose/mi^2) in early winter.

There are 4 villages within Subunit 21D (i.e., Kaltag, Nulato, Koyukuk, and Galena), and the residents of each one have traditional hunting areas. However, the area used by Galena residents overlaps those used by residents of some of the other villages, because many of the residents of Galena have larger boats. Although Huslia is only 30 miles from Subunit 21D, its residents rarely hunt within there. Nonresidents and Alaska residents from outside Subunit 21D mainly hunt the Koyukuk River between the Kateel River and the Unit 24 boundary, where competition with residents of Subunit 21D is not as likely to occur.

In 1981, I made it easier for residents of the subunit to obtain harvest reports. Since then, the report harvest has been about 200 moose annually; another 40 unreported moose are also harvested.

POPULATION OBJECTIVES

To maintain a moose population of 5,000-6,000.

To maintain at least 30 bulls:100 cows within the population being monitored by the Three Day Slough TCA.

To maintain an early winter density of at least 3 moose/mi^2 in floodplain areas along the Yukon River that are subject to both September and February hunting seasons.

METHODS

Three types of aerial survey techniques were used to monitor the population dynamics of moose in Subunit 21D: (1) stratification flights, (2) composition and trend surveys (annual), and (3) population estimation surveys (5-year intervals). Browse utilization surveys were conducted on foot using standardized ADF&G transect methods. Radio-collared moose provided mortality and movements.

Hunting mortality and distribution was monitored through harvest tickets and check stations. Local residents were encouraged to increase their reporting. Predation was monitored by interviewing wolf trappers, relocating radio-collared animals, and conducting track surveys.

RESULTS AND DISCUSSION

Population Status and Trend

Moose populations are healthy throughout most of Subunit 21D, except in the Yuki River drainage. Moose densities are increasing in most moose populations.

Population Size:

No population estimation surveys had been conducted within the subunit prior to 1987. The population was though to be between 5,000 and 6,000 moose. The population estimation survey conducted during November 1987 was a cooperative effort with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM), covering 1,575 mi^2 on the Kaiyuh Flats and a 3,306-mi^2 area north of Galena. This area included the eastern drainages of the Koyukuk River, Three Day Slough, the north bank of the Yukon River between Koyukuk and Galena, and most of the Bear Creek drainage. These areas were stratified before the population estimation survey. Roughly two-thirds of the Kaiyuh Flats area (Table 1) and one-half of the Galena area (Table 2) had low moose densities. The population estimates for the Kaiyuh Flats and the Galena area were

1,702 (±20%) (Table 3) and 4,538 moose (±14%) (Table 4), respectively. Some of the Dulbi River drainage in Subunit 21C was included in the population estimation surveys. About 3,000-4,000 moose occupy the remaining portions of the subunit, bringing the estimated population for the subunit up to about 9,000-10,000 moose.

Population Composition:

During the population estimation surveys, 3,036 moose were classified. Composition data were obtained from the Three Day Slough, Dulbi River, Squirrel Creek, and Kaiyuh Slough trend count areas. Moose sex and age ratios calculated from these data indicated average-to-excellent bull:cow ratios and calf survival indices (Table 5).

In past management reports, composition data have been presented with ratios and generalizations, such as poor, good and average. To better understand what the ratios mean within Unit 21, the following guide is used:

1. Usually the average bull:cow ratio is around 30-40 bulls:100 cows after hunting; higher numbers of bulls are good, but sometimes misleading, because the area is subject to either-sex hunting, which can inflate bull numbers. Ratios in the 20's or less would be poor.

2. The percentage of yearling bulls within the herd is an indication of overwinter survival of calves. Generally, the yearling bull percentage is low. The average ranges from 4% to 8%; anything less indicates poor recruitment, and anything higher indicates good recruitment.

3. The calf:cow ratio indicates the number of calves that have survived the summer; it may infer population change. Typical parturition ratios in late May are 120 calves:100 cows. Five months later (November), average ratios are about 30-40 calves:100 cows. Black bears, grizzly bears, and wolves are the primary predators that reduce calf numbers. The average ratios can support winter predation and moderate hunting and maintain a stable population level. Ratios of 20 calves:100 cows or less often indicate a decreasing population, and ratios of more than 40:100 cows are found in expanding populations.

As can be seen in the historical trend area summaries (Table 5), oscillations occur more commonly in the calf:cow and yearling segments. The 1985 calf cohort was severely affected by flooding and deep snows; however, the following year calf survival was better than average. The average posthunting bull:cow ratio for Three Day Slough reflects the heavy harvest of bulls in the area. The yearling and calf numbers are about average. The Squirrel Creek area has a high bull:cow ratio, but it is also subject to either-sex hunting and is close to Koyukuk. The 1987 calf:cow ratio was very high for Interior moose populations. the Kaiyuh

Slough area is between the hunting areas for Kaltag and Nulato. The reasons for the low bull:cow ratio are not known because either-sex hunting occurs.

Distribution and Movements:

Radiotelemetry data from 10 bull and 9 cow moose collared in October 1983 in the Three Day Slough area provided information on moose distribution and movements. Except for 1 bull, these moose remained in the floodplain area of Three Day Slough from late August until May. During May, 13 of the 19 collared moose moved from 10 to 16 miles in a northerly or southerly direction. Most stayed within small summer ranges before returning. One bull was only present in the Three Day Slough area during the summer months because it had a wintering area 20 miles northwest. Movements of other moose in the subunit are unknown; however, local residents suspect that moose on the Kaiyuh Flats are subject to seasonal movements.

Mortality

Season and Bag Limit:

The open seasons for subsistence hunts in Subunit 21D are 5-25 September and 1-5 February; the bag limit is 1 moose, although antlerless moose may be taken 21-25 September and 1-5 February. The open season for resident and nonresident hunting in Subunit 21D is 5-25 September. The bag limit is 2 bull.

Human-induced Mortality:

The reported harvest prior to 1981 was largely inaccurate because of nonreporting, probably because many hunters did not have hunting licenses. Educational and enforcement efforts have brought reporting of the September harvest by local residents up to 95% in Galena and 80% in Koyukuk and Nulato. During the 1987 hunting season, 205 moose were reported harvested (Table 6). In the September season 194 moose were harvested; during the February hunt, 9 moose were harvested.

The establishment of a moose hunter check station on the Koyukuk River has enabled me to accurately determine the number of hunters using the river and to help with education of residents on reporting requirements. The numbers of hunters who have been using the Koyukuk River have been increasing (Table 7), causing concern among local residents. In 1987, 84 of the hunters checked were from Galena, 40 were from Koyukuk, 23 were from Nulato, and four were from Huslia.

Most hunters who do not live in the area want to harvest bulls with 50+ inch antler spreads. The number of bulls harvested was analyzed to see what relationships there were between harvest of large bulls from the Koyukuk River in September and observations of large bulls on the trend count surveys in November at Three Day

Slough (Table 8). The Three Day Slough trend count area data numbers during years when bull harvests are higher. Elsewhere in the subunit hunting pressure is within the sustainable allowance of the moose population, with the possible exception of the Yuki River drainage.

Hunter Residency and Transportation Methods. A majority of the hunters are residents of the subunit (Table 7). Because most of the area is closed to the use of aircraft and rivers form the major transportation corridors, boats were the main method used. Snowmachines are the main transportation method during the winter season.

Natural Mortality:

Subunit 21D has high populations of wolves; black bears and grizzly bears are common is the upland areas of Nulato Hills and Kaiyuh Mountain. The estimated wolf population is about 175-190 in 25-30 packs. Interior wolf packs kill an average of 1 moose every 3 to 6 days (35-70/year) (Gasaway et al. 1983). Wolves in Subunit 21D probably kill from 1,000 to 1,900 moose per year, which amounts to about 10-19% of the standing crop. Black bears probably kill about 75% of the calves between parturition and October, as November calf:cow ratios are rarely above 30-40 calves:100 cows. The amount of predation by grizzly bears is unknown, but it must be a factor. I observe bears on moose kills every November at Three Day Slough.

Four (all bulls) of the 15 moose radio-collared at Three Day Slough were shot by hunters in September. None of the other radio-collared moose died during the reporting period.

Deaths due to drowning probably are fairly common in Subunit 21D, because 2 major rivers bisect the area. In November 1987 I observed a cow moose break through the ice into deep water and drown. Every year I receive from 5 to 10 reports about moose that have fallen through the ice.

Game Board Actions and Emergency Orders

The September season in Subunit 21D has remained the same for the past 5 years. However, changes have been made in the eligibility requirements for those who hunt antlerless moose. In 1987 cow moose could only be taken by residents who qualified as subsistence hunters.

The Board of Game has been refining the winter hunt with the assistance of the Middle Yukon Fish and Game Advisory Committee over the past 5 years. The winter hunt was resumed in 1981 after being suspended for 3 years. The hunt initially was 10 days long. Although it was lengthened to 30 days, it was later cut back to 10 days. For 4 years the hunt was administered as a registration hunt, with a 5-day shorter season in the area upstream from Bear Creek. In 1987 the registration permit requirement was deleted, the hunting period downstream from Bear Creek was reduced by 5 days, and participation was restricted to only those hunters who qualified as subsistence hunters. The object of all the changes was to produce a midwinter hunt that would allow local people who needed meat to hunt moose legally and in a manner that minimized the take of cow moose. The moose population in the hunt area is able to sustain an anticipated subsistence harvest of 40 moose annually.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations along the riparian lowlands in Subunit 21D are high, stable, and adequate to support current predation levels and human harvests. The population objectives were based on a subjective estimate of population size. The population estimation survey in 1987 allowed me to refine the estimate. My current population estimate of 9,000-10,000 moose is higher than the stated population objective of 5,000-6,000; however, the new estimate is not a justification for any further liberalization of the seasons or bag limits since natural predation is very high.

LITERATURE CITED

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Table 1. Moose stratification results from the Kaiyuh Flats population estimation survey, November 1987.

Strata	Units sampled	Moose seen	Area mi^2
Low	64	44	1,018.8
Medium	48	110	448.5
High	15	149	88.7
Total	127	303	1,556.0

Table 2. Moose stratification results from the Galena population estimation survey, November 1987.

Strata	Units sampled	Moose seen	Area mi^2
Low	126	65	1,543.0
Medium	96	524	1,212.1
High	28	442	352.8
Very high	14	535	197.8
Total	264	1,566	3,305.7

Table 3. Population estimates from the Kaiyuh Flats moose population estimation survey, November 1987.

	Low	Medium	High	Combined
Sample size (n)	8	19	15	42
Total stratum area (mi^2)	807.3	590.9	120.2	1,574.8
Total possible SU's	64	48	15	127
Density	0.26	1.13	3.51	
Population estimate	212	669	620	1,502
Variance V(T)	15,321	3,783	2,295	37,689
C.I.% of population estimate 90% level				20%
Sightability correction factor				1.13
Corrected population estimate				1,702
C.I.% of population estimate 95% level				25%
Upper limit				2,122
Lower limit				1,283

Table 4. Population estimates from the Galena area moose population estimation survey, November 1987.

	Low	Medium	High	Very high	Combined
Sample size (n)	6	21	13	14	42
Total stratum area (mi^2)	1,526.7	1,212.6	353.8	197.8	3,305.7
Total possible SU's	126	96	28	14	264
Density	0.18	1.1	2.5	8.9	
Population estimate	280	1,335	882	1,765	4,263
Variance V(T)	36,297	75,748	4,317	0	11,360
C.I.% of population estimate 90% level					13.4%
Sightability correction factor					1.06
Corrected population estimate					4,538
C.I.% of population estimate 95% level					17.3%
Upper limit					5,325
Lower limit					3,750

Table 5. Moose composition counts in Subunit 21D, 1983-87.

Area	Year	100 cows	bull %	100 cows	% calves	Density moose mi^2	Area (mi^2)	Sample size
Population Estimation Surveys:								
Kaiyuh	1987	55	8	49	24	1.6	460.3	731
Galena	1987	37	7	41	23	4.0	617.8	2,505
Trend Areas:								
Three Day Slough	1983	31	5	37	22	6.2	84.8	530
	1984	30	8	31	19	5.7	57.8	332
	1985	39	7	17	11	5.9	83.3	501
	1986	39	4	45	25	7.9	83.3	660
	1987	33	7	34	20	8.8	127.7	1,128
Dulbi River	1983	39	4	29	17	5.1	57.1	230
	1984	36	2	44	24	5.3	42.1	184
	1985	No Surveys						
	1986	No Surveys						
	1987	55	8	44	22	7.3	38.9	283
Squirrel Crk.	1983	58	7	35	18	3.7	37.3	137
	1984	No Surveys						
	1985	78	16	11	6	3.5	52.6	185
	1986	No Surveys						
	1987	76	8	67	27	3.4	38.4	131
Kaiyuh Slough	1983	74	10	59	25	1.6	39.8	
	1984	No Surveys						
	1985	54	10	8	5	1.5	51.0	78
	1986	No Surveys						
	1987	28	4	33	20	1.9	38.9	74

Table 6. Annual harvest from Subunit 21D, 1983-87.

Year	Reported Bulls	Reported Cows	Reported Unk	Estimated unreported	Nonresident	Total
1983	136	8	--	40	7	184
1984	171	27	--	40	15	238
1985	139	18	2	40	19	199
1986	152	21	--	40	20	213
1987	185	19	1	40	20	245

Table 7. Number of moose hunters by residency class checked through the Koyukuk River Station, Subunit 21D.[a]

Year	Residents of Subunit 21D	Other Alaska residents	Nonresidents	Total hunters
1983	132[b]	29	3	164
1984	92[b]	67	9	168
1985	117[b]	74	4	195
1986	140[b]	80	9	229
1987	151[c]	92	21	264

[a] Checking in and out is not mandatory and compliance was lower during the 1st year.
[b] Counts every trip made by hunter.
[c] Hunters counted only once.

Table 8. Comparison of harvest and survey information for Subunit 21D, 1981-87.

Year	% large bulls[a] in harvest[b]	($\underline{n}$)	Total bulls harvested[c]	% large bulls[a] observed during survey[d]	Bulls:100 cows during surveys[d]
1981	--		61	27	31
1982	66	(30)	74	26	47
1983	69	(42)	85	27	31
1984	59	(74)	116	14	30
1985	57	(49)	81	22	39
1986	58	(78)	90	33	39
1987	57	(109)	138	23	33

[a] Large bulls = 50 inches or more antler spread

[b] Based on antler measurements by ADF7G staff at the hunter check station on the Koyukuk River in September (sample sizes in parentheses).

[c] September season, Koyukuk River.

[d] November surveys, Three Day Slough trend count area.

STUDY AREA

GAME MANAGEMENT UNIT: 22 (23,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Seward Peninsula and that portion of the Nulato Hills draining west into Norton Sound.

BACKGROUND

Although historical data are scanty, it appears moose began immigrating into Unit 22 during the mid- to late 1930's, successfully expanding into much of the suitable habitat by the late 1960's. Moose numbers continued to increase at substantial rates during the 1970's and early 1980's, leveling off or declining slightly within some areas. Portions of suitable moose habitat in Unit 22 are easily accessible from Nome on numerous gravel roads and navigable rivers. Demand for moose, primarily by recreational and subsistence hunters residing in the unit, is high. Annual recorded harvest from 1969 to 1987 ranged from 60 in 1971 to 408 in 1986 (Table 1).

POPULATION OBJECTIVES

To protect, maintain, rehabilitate, enhance, and develop moose and their habitats.

To provide for the optimum sustained use, both consumptive and nonconsumptive, of moose consistent with the social, cultural, aesthetic, environmental, and economic needs.

To maintain and/or increase viable moose populations.

METHODS

Aerial surveys were conducted during November, March, and April to determine densities and sex and age composition in a number of drainages in Unit 22. A census using methods developed by Gasaway et al. (1986) was conducted in portions of Subunit 22D. Census data were used to calculate moose density and short-yearling recruitment. Hunter harvest reports returned under the statewide harvest ticket and registration permit systems were used to estimate harvest.

RESULTS AND DISCUSSION

Population Status and Trend

Although moose densities in Subunits 22A, 22C, and 22E appear to have increased in recent years, compared with those in Subunits 22B and 22D, they are low. It is not clear what factors (i.e., habitat, natural predation, overharvesting, or poor recruitment) are restricting herd growth. Moose densities in Subunits 22B and 22D have increased dramatically since the mid-1970's and now appear to be near or above winter range carrying capacity within some portions of these subunits. Calf survival, particularly in those areas of high moose density, appears to be declining, and the reason for this decline has not been determined.

Population Size:

Reliable data on total numbers of moose residing in Unit 22 are not available. Censuses conducted within a portion of Subunit 22B during March 1987 and portions of Subunit 22D during March 1988 yielded population estimates of 1,894 and 2,892 moose, respectively. Census results indicated there were approximately twice as many animals as were previously thought to inhabit those areas. Prior population estimates for Unit 22 ranged from 3,260 to 4,150 moose (Grauvogel 1986). Based on information obtained during the censuses as well as past survey data, I estimate that a minimum of 7,000 moose currently reside in Unit 22. A census is planned for a portion of Subunit 22A during the spring of 1989. These additional data will be of great assistance in estimating more accurately the moose population size for Unit 22.

Population Composition

Composition data for Unit 22 are limited. Inclement weather during the fall of 1987 and spring of 1988 prevented completion of some surveys. During late November, 10.2 hours were spent surveying portions of the Kuzitrin, Kougarok, Noxapaga, and American River drainages in Subunit 22D. During the surveys, 566 moose (55.5 moose/hr) were observed. Sex and age composition of these moose are as follows: males, 150 (71% adults, 29% yearlings); females, 323 (74% without calves 26% with calves); and calves, 93 (16%). The male:female ratio was 46:100; the ratio of yearling males:females was 13:100. The percentage of yearling males observed was 7.6%.

Also during the month of November, 5.7 hours of surveys were conducted in portions of the Fish and Niukluk Rivers in Subunit 22B. A total of 208 moose (36.5 moose/hr) were observed. Sex and age composition of these moose was as follows: males, 71 (82% adults, 18% yearlings); females, 117 (85% without calves and 15% with calves); and calves, 20 (10%). The ratios of males:females and yearling males:females were 61:100 and 11:100, respectively. Yearling males composed 6.3% of the sample.

In March 1988 censuses were conducted in 2 areas in Subunit 22D: (1) the Kuzitrin Census Area (1,456 mi^2), including segments draining into the Pilgrim, Kuzitrin, Kougarok, and Noxapaga Rivers and (2) the American Census Area (1,041 mi^2), including segments draining into the American and Agiapuk Rivers. The expanded population estimate for the Kuzitrin Census area was 1,951 moose. Confidence intervals (CI) surrounding this estimate were as follows: at 80% CI ($\pm$9.6%), 1,763-2,139 moose; at the 90% CI ($\pm$12.5%), 1,707-2,195 moose; and, at the 95% CI ($\pm$15.0%), 1658-2,244 moose. Estimated short yearling recruitment for the census area was 14.2%. Confidence intervals surrounding this percentage were as follows: at 80% ($\pm$9.1%), 12.9-15.5%; at 90% ($\pm$11.8%), 12.5-15.9%; and, at 95% ($\pm$14.3%), 12.0-16.3%.

The expanded population estimate for the American Census Area was 941 moose. Confidence intervals surrounding this estimate were as follows: at 80% (±8.7%), 859-1022 moose; at 90% (±11.3%), 834-1047 moose; and, at 95% (±13.7%), 812-1070 moose. Estimated short yearling recruitment for the census area was 16.9%. Confidence intervals surrounding this percentage were as follows: at 80% (±15.7%), 14.2-19.5%; at 90% (±20.1%), 13.4-20.3%; and at 95% (±24.8%), 12.7-21.1%.

In late March 1988, 6.0 hours were spent surveying portions of Subunit 22C. A total of 195 moose (32.5 moose/hr) were observed. Short yearlings constituted 32.8% (64 moose) of the total moose observed. Of the 131 adults, 54 (41%) were accompanied by short yearlings.

Mortality

Season and Bag Limit:

The open seasons for subsistence and resident hunters in Subunit 22A is 1 August to 30 September and 1 to 31 December. The bag limit is 1 bull. The open season for subsistence, resident, and nonresident hunters in Subunit 22B is 1 August to 14 September. The bag limit is 1 moose; however, antlerless moose may be taken by registration permit only from 1 to 31 December. The taking of calves and cows accompanied by calves is prohibited. The open season for all hunters in Subunit 22C is 1 to 14 September. The bag limit is 1 bull. The open season for all hunters in Subunit 22D for drainages into the north side of Port Clarence, the north side of Grantley Harbor, and the north side of Imuruk Basin, excluding the Kuzitrin, Pilgrim, and Kougarok River drainages is 1 Auguust to 31 January. The bag limit is 1 moose; however, antlerless moose may be taken by registration permit only from 15 September to 31 December. No person may take a calf or cow accompanied by a calf; only antlered moose may be taken 1-31 January. The open season for all hunters in the remainder of Subunit 22D is 1 August to 31 December. The bag limit is 1 moose; however, antlerless moose may be taken by registration permit only from 1 to 31 December. The bag limit is 1 moose; however, antlerless moose may be taken by registration permit only from 1 to 31 December. The taking of calves and cows accompanied by calves is prohibited. The open season for all hunters in Subunit 22E is 1 August to 31 March. The bag limit is 1 moose; however antlerless moose may be taken by registration permit only from 15 September to 31 March. The taking of calves and cows accompanied by calves is prohibited.

Harvest

Human-induced Mortality:

The reported harvest during the 1987-88 season was 310 moose: 286 males, 20 females, and 4 unspecifieds (Tables 1 and 2). This figure represents a 24% reduction from last year's record-high harvest of 408 moose. The 2 major factors contributing to this reduction in harvest were (1) a noticeable decrease (13%) in hunter effort and (2) a significant reduction in female harvest caused by a reduction in the length of the antlerless season in Subunit 22B and a portion of Subunit 22D. As in previous years, Subunits 22B and 22D accounted for most of the harvest: 34% from Subunit 22B and 40% from Subunit 22D.

Illegal and unreported harvests continue to present problems in Unit 22, because some local residents fail to acquire harvest tickets prior to hunting or take moose out of season. It is very difficult to determine the magnitude of this illegal harvest; however, I estimate it ranges from 10% to 20% of the reported annual harvest. If my assumptions concerning the size of the illegal harvest are correct, the estimated annual moose harvest within Unit 22 ranged between 340 and 371 moose.

Hunter Residency and Success. Local residents reportedly harvested 149 moose, representing 75% of the total harvest. A breakdown of the remaining harvest is as follows: other Alaskan residents, 33 (11%); nonresidents, 34 (11%); unknown residency status, 9 (3%). Hunter success during the reporting period was 40%. Although hunter success was 6% less than the previous year, it remained close to the 10-year average of 41%.

Permit Hunts. As might be expected, a shortening of the antlerless season in some areas greatly reduced the number of permit applicants and moose harvested. During the reporting period, 144 permits were issued to prospective hunters (Table 3) and 31 permittees were successful. Composition of this harvest by sex was 13 antlerless males and 18 females. A breakdown by subunit is as follows: Subunit 22B, 12; Subunit 22D West, 10; Subunit 22D East, 2; and, Subunit 22E, 7.

Harvest Chronology. Much of the known harvest (61%) took place during September and October when moose were moving and access to suitable habitat by highway and off-road vehicles and boats was favorable (Table 4). Another increase in harvest took place in late December and January when snow conditions were suitable for travel by snowmachine.

Transport Methods. Transport methods used by most successful hunters have not significantly changed during the past years. Highway vehicles, boats with jet units, and snowmachines continue to account for approximately 75% of the unit's annual harvest (Table 5). Off-road vehicles are gradually becoming more popular in some portions of the unit.

Natural Mortality:

Specific surveys to determine natural mortality rates of Seward Peninsula moose were not conducted during the reporting period; however, observations reported by local residents and biologists conducting other field activities were compiled. No less than 6 dead moose were observed in the spring of 1988 while conducting the moose census in portions of Subunit 22D. Also, in the fall of 1987 I observed 1 female grizzly bear and 2 yearling cubs feeding on a moose carcass in Subunit 22D. A local resident reported a dead cow moose in the Snake River drainage (22C). Although not verified, this moose was thought to have died while giving birth.

During the winter of 1987-88, snow was as deep or deeper than any recorded in the past 10 years. Moose in some portions of the unit were quite weak during late winter, and natural mortality was significantly higher than usual. It is not known whether the increase in annual snowfall had any effect on spring calf production.

Wolves prey on moose residing in Subunits 22A and 22B, although they are not considered a threat to the stability of the population. Grizzly bears prey on moose calves throughout most of the unit. Although specific data are lacking, the unit's bear population appears to have increased, particularly in those areas characterized by noticeably lower calf production. A grizzly bear study in Unit 22 is forthcoming. Although the study design will not specifically address predator-prey relationships, it will hopefully provide some insight into bear-moose relationships in Unit 22.

Habitat Assessment

Winter range in portions of Subunits 22B, 22C, 22D, and 22E has been heavily browsed in past years. Although lack of palatable browse has not yet been considered an influencing factor in moose mortality rates, it may become one in the near future. Several studies are nearing completion on moose-willow foraging relationships in the Kuzitrin River drainage (Subunit 22D). These data will be helpful in developing long-range management strategies for Unit 22 moose.

Those moose which utilize willowed riparian habitat in portions of Subunits 22B and 22D have a tendency to leave the river bottoms in late March and move onto adjacent hillsides, where they apparently feed on sedges and dwarf willows. They utilize these areas until spring thaws reduce snow cover in the adjacent valleys and ravines, and it is not uncommon to see herds of more than 50 moose placidly grazing in these areas.

Game Board Actions and Emergency Orders

No Emergency Orders were enacted pertaining to Unit 22 moose during the reporting period. At their spring meeting, the Board of Game did take action on 2 public proposals. One proposal requested a moratorium on antlerless moose hunting in specified portions of Subunit 22D. The other proposal sought to standardize the antlerless moose season in Subunit 22D by shortening the current one West, making it consistent with that in Subunit 22D East. The Board rejected these proposals. One additional action taken by the Board was to reauthorize, as required by law, antlerless moose seasons in Unit 22 for 1988-89.

CONCLUSIONS AND RECOMMENDATIONS

Prior to making any additional changes to current regulations, a moose census needs to be conducted to estimate population size and productivity. A sound moose management plan based on censuses, research programs, and public input is of the utmost importance, if we are to continue to wisely manage moose in Unit 22. Steps need to be taken to initiate such a plan.

In 1987, at the Department's request, the length of the antlerless season in Subunit 22B and the eastern portion of Subunit 22D was reduced by the Board of Game. This reduction significantly reduced the known harvest of females, particularly in the affected areas. In 1987, the reported harvest of cow moose in Unit 22 was 20. Based on the significant reduction of female harvest and the considerable confusion generated over the years by the registration permit system, I am recommending the antlerless permit requirement be removed in Unit 22 and that individuals be allowed to harvest female moose.

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Table 1. Historical moose harvest in Unit 22, 1969-87.

Regulatory year	Males	Females	Unknown sex	Total harvest	Hunters[a]	Percent success
1969	69	1	2	72	182	40
1970	70	0	1	71	139	51
1971	59	0	1	60	168	36
1972	44	0	0	44	99	44
1973	103	32	1	136	317	43
1974	149	72	1	222	479	46
1975	136	0	2	138	389	35
1976	186	51	3	240	611	39
1977	151	88	5	244	457	53
1978	198	97	2	297	596	50
1979	193	75	2	270	760	36
1980	156	71	1	228	492	46
1981	225	72	1	298	696	43
1982	244	100	0	344	904	38
1983	291	82	32	405	1292	31
1984	298	91	6	395	1086	36
1985	279	92	3	374	876	43
1986	306	101	1	408	892	46
1987	286	20	4	310	775	40

[a] Minimum known number of hunters.

Table 2. Moose harvest by subunit in Unit 22, 1987-88.

Subunit	Bulls	Cows	Unknown	Total
22A	28	0	0	28
22B	98	7	2	107
22C	26	0	0	26
22D	116	6	2	124
22E	18	7	0	25
Totals	286	20	4	310

Table 3. Antlerless permit data by subunit in Unit 22, 1987-88.

Permit area	Permits issued	Did not hunt or report	Unsuccessful hunters	Successful hunters	Antlerless bulls	Cows
22B (992)	57	20	25	12	5	7
22D W (991)	46	18	18	10	6	6
22D E (993)	20	12	6	2	0	2
22E (990)	21	8	6	7	2	5
Totals	144	58	55	31	13	18

Table 4. Chronology of moose harvest in Unit 22, 1987-88.

Subunit	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unk	Totals
22A	4	12	2	--	6	3	--	--	1	28
22B	6	31	21	14	5	29	--	--	1	107
22C	--	26	--	--	--	--	--	--	0	26
22D	15	45	41	1	11	5	--	--	6	124
22E	3	6	3	0	3	3	1	6	0	25
Totals	28	120	67	15	25	40	1	6	8	310

Table 5. Types of transportation used by successful and unsuccessful hunters during 1987-88 moose season.

Subunit	Airplane	Horse	Boat	ATV	Snowmachine	Off-road vehicle	Highway vehicle	Unknown	Totals
22A	4	0	57	9	13	1	1	19	109
22B	22	0	35	17	51	4	45	25	199
22C	0	0	7	4	0	3	40	12	66
22D	12	0	53	20	19	22	119	66	311
22E	2	0	11	2	11	0	0	7	33
22Z	2	0	2	0	1	1	41	10	57
Total	42	0	165	52	95	31	251	139	775

STUDY AREA

GAME MANAGEMENT UNIT: 23 (43,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Western Brooks Range and Kotzebue Sound

BACKGROUND

Moose were largely absent from northwestern Alaska prior to the turn of the century. Historical accounts suggest that moose were rarely seen prior to 1930 in the Noatak and Kobuk River drainages; however, by the early 1950's, moose were commonly observed there.

During the past 30 to 40 years, moose numbers have steadily increased throughout Unit 23. Hunting pressure on moose by local residents has remained relatively low, because most hunters residing in Unit 23 prefer to hunt caribou. Most of the reported moose harvest has been by nonresident and nonlocal resident hunters. The annual reported harvest during the past 10 years has averaged 157 moose, ranging from 213 moose in 1978-79 to 112 moose in 1980-81.

POPULATION OBJECTIVES

To conduct annual surveys in established trend count areas.

To monitor annual hunting mortality.

To develop practical and meaningful management guidelines.

METHODS

Between November 1987 and March 1988, aerial moose surveys were conducted in trend count areas established in 9 drainages in Unit 23. Trend count areas were established using available knowledge about moose movements and distribution patterns. When establishing trend count areas, efforts were made to include all three of the primary macrohabitats that exist in northwest Alaska: riparian, open tundra, and mountain. Additional trend count areas will be established in unsurveyed portions of the unit as time and funding allow.

Survey intensity varied from 1.4 to 4.1 minutes/mi^2. Sex and antler size information was recorded for moose observed during surveys conducted prior to 1 December. Because moose begin dropping their antlers after 1 December, moose observed after 30 November were simply classified as either adults or short yearlings. Harvest reports submitted by hunters under the statewide harvest ticket system were used to evaluate the sex and age structure of harvested moose.

RESULTS AND DISCUSSION

Population Status and Trend

During the past 20 years, the number of moose has increased dramatically throughout Unit 23. The population is believed to be stable, although signs of increasing numbers are evident in some drainages.

Population Size:

Moose densities were variable both within and between drainages. In the lower Noatak River Trend Count Area (TCA), for example, the density was estimated at 3.1 moose/mi^2, compared with 1.1 moose/mi^2 in the middle Noatak River TCA. The lower Kobuk River TCA supported 2.2 moose/mi^2, while the Buckland River TCA had the lowest observed density of 0.2 moose/mi^2.

Because of the high variability in observed densities among the different drainages, it is difficult to derive a meaningful unit-wide estimate of population size for Unit 23. Therefore, assessment of moose population status and resulting management decisions in Unit 23 were based on trends observed in established TCU's, rather than on unitwide population estimates.

Population Composition:

Fall survey data suggest that calf production during 1987 was good, and results from the spring of 1988 survey further suggest that short yearling survival was good as well (Tables 1 and 2). The middle Noatak and Kiwalik River drainages were especially noteworthy; 31% and 27% calves, respectively, were observed there. Short yearlings constituted 24.7% of the moose observed in the lower Kobuk River drainage, suggesting excellent overwinter survival of calves in this area. Seventeen percent of the bulls observed during fall surveys were yearlings.

The percentage of short yearlings observed in the Buckland River TCA was low (5%) (Table 2). Similar to observations in past years, adult moose in this area were scarce; however, the deep snow and the sparse vegetation characteristics of this area suggest that the winter habitat is marginal for moose.

The incidence of females accompanied by twin calves during fall surveys ranged from zero percent in the Wulik River drainage to 9% in the Inmachuk River drainage. During spring surveys, 9% of the females accompanied by short yearlings in the lower Kobuk River drainage had twins, compared with 5% in the lower Noatak River and none in the Buckland River drainage.

Adult bull:cow ratios were considered good in the surveyed areas; the highest ratios were observed in the Inmachuk River and Wrench Creek drainages: 81 bulls:100 cows and 80 bulls:100 cows, respectively (Table 1). The lowest ratio of 36 bulls:100 cows was observed in the middle Noatak River TCA, immediately adjacent to the Wrench Creek TCA.

Distribution and Movements

During the fall, moose are most concentrated in riparian habitats at elevations above 800 feet; however, once snowfall begins to accumulate at higher elevations during December, moose move down into riparian habitats along major rivers. Roughly 80-95% of the moose remain in this low elevation habitat until April or mid-May. Beginning in late May or early June, some moose begin moving back towards the higher elevation areas, while others remain in the lowlands feeding on aquatic vegetation, which becomes available as ponds and lakes thaw.

Mortality

Seasons and Bag Limits:

The open season for subsistence, resident, and nonresident hunters in that portion of Unit 23 on the Seward Peninsula west of and including the Buckland River drainage and that portion of the Noatak River drainage is 1 August to 31 March. The bag limit is 1 moose; however, antlerless moose may be taken only from 15 September to 31 March. The open season for all hunters in the remainder of Unit 23 is 31 August to 31 December. The bag limit is 1 moose; however, antlerless moose may be taken only from 15 September to 31 October.

Human-induced Mortality:

The 1987-88 reported moose harvest (Table 3) for Unit 23 was 206 moose (191 bulls, 14 cows, and 1 unspecified). Over half of the reported harvest (98 bulls and 9 cows) came from the Noatak River drainage; 45 moose (22%) were harvested in the Kobuk River drainage (Table 4).

Antler spreads of bulls reported harvested during the 1986-87 season ranged from 13 to 69.5 in ($\bar{x}$ = 51.6, SD = 11.9, N = 171) (Table 5). Sixty-eight percent of the bulls had antler spreads greater than or equal to 50 inches, and 30% had spreads of 60 inches or more.

Hunter Residency and Success. Nonresident hunters harvested 94 moose during the 1987-88 season (Table 6). This represented a substantial increase from the 46, 31, and 39 moose reported for the

1986-87, 1985-86, and 1984-85 seasons, respectively. Thirty-four nonresidents (26%) were unsuccessful.

Nonlocal Alaska residents from communities outside of Unit 23 reported a harvest of 50 moose during 1987-88. This was similar to the 45 reported during 1986-87 and the 53 reported during 1985-86. Forty-eight (49%) nonlocal resident hunters were unsuccessful.

Although 49 hunters residing in Unit 23 reported taking moose during 1987-88 and 52 were unsuccessful, these data are misleading because harvest reporting by Unit 23 residents is believed to be incomplete. Quimby and James (1985) estimated that the harvest reported by Unit 23 residents represented only 14-24% of their actual harvest; therefore, the actual harvest for 1987-88 by local residents probably lies somewhere between 204 and 350 moose. This is similar to the harvest estimated for 1986-87. Thirteen moose were harvested by hunters of unknown residency.

Harvest Chronology. Although the season in much of Unit 23 extends from 1 August to 31 March, most of the 1987-88 harvest (52%) occurred during 5 to 26 September (Table 7). Only 15 moose were reported harvested between 31 December and 31 March.

Transport Methods. Aircraft and boats were used most often by successful hunters, accounting for 52% and 23% of the reported harvest, respectively (Table 8). Only 1 successful hunter reported using a highway vehicle for transportation.

Natural Mortality:

Grizzly bear and wolf populations are healthy throughout the unit, accounting for some moose mortality each year. Warren Ballard (ADF&G, pers. commun.) observed a radio-collared pack of 11 wolves killing an adult moose during the spring of 1988. It was the only moose this pack was known to have killed during a 23-day observation period. Ongoing grizzly bear research in the Noatak and Wulik River drainages has resulted in observations of bears feeding on adult and calf moose.

During late May 1988 an adult moose was reported dead about 5 miles southeast of Kotzebue. Apparently, the moose died of natural causes although no necropsy was performed to confirm this.

Habitat Assessment

Winter range in several drainages, most notably the Noatak and Kobuk, remains heavily utilized; however, no evidence exists that suggests food shortage is a problem. Plans for assessing range condition are presently being formulated.

Game Board Actions and Emergency Orders

In the spring of 1987, the Board of Game enacted a regulatory change proposed by the Department and the Kotzebue Fish and Game Advisory Committee. The change extended the moose hunting season in the Noatak River drainage from 31 December to 31 March. No changes in population status have been noted as a result of this change.

Aerial survey data indicate that the lower Kobuk River drainage has a high density of moose. Although it may be appropriate to extend the hunting season in the Kobuk River drainage, survey data for the middle and upper reaches of the Kobuk drainage first need to be collected. Surveys in these areas are planned for the 1988-89 reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The size of the moose population in Unit 23 appears stable, although signs of increasing numbers are evident in some drainages. Winter range is heavily utilized in some areas, although the extent to which this affects plant production is unknown. I recommend that winter range condition be assessed in the Noatak and Kobuk River drainages. Assessment of other drainages can be conducted in the future as time and budgets allow.

Harvest reporting rates remain low throughout Unit 23. Continued efforts to inform local residents of the importance of harvest reporting are needed.

An extension of the moose hunting season in the Kobuk River drainage may be appropriate, given the high moose density observed in the lower portions of the drainage. However, the existing season should not be changed until survey data is collected in the middle and upper Kobuk drainage.

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Table 1. Moose trend count surveys conducted in Unit 23 during fall 1987.

Date	Drainage	Area (mi^2)	Time (hrs)	Bulls: 100 cows	Calves: 100 cows	Yearlings: 100 cows	Percent calves	Moose/ mi^2	Total sample
11/9-10/87	Tagagawik	175	7.3	40	33	18	19	2.0	360
11/11-17/87	Middle Noatak	166	8.4	36	61	6	31	1.1	190
11/17-23/87	Wrench		3.6	80	23	42	11		152
11/ 24/87	Nimiuktuk		2.5	65	27	12	14		101
11/ 25/87	Wulik		3.0	62	46	17	22		50
11/ 26/87	Kiwalik[a]		1.7	69	62	12	27		44
11/ 27/87	Inmachuk		3.7	81	34	10	16		82

[a] Not an intensive survey. Only areas likely to have moose were searched.

Table 2. Moose trend count surveys conducted in Unit 23 during winter/spring 1988.

Date	Drainage	Area (mi^2)	Time (hrs)	Adults	Short yearlings	Percent short yearlings	Moose/ mi^2	Total sample
03/18/88	Lower Kobuk	87[a]	6.0	146	48	25	2.2	194
03/23-24/88	Lower Noatak	138[b]	6.0	355	70	16	3.1	425
03/31/88	Buckland/ Bear Ck	131	2.4	19	1	5	0.2	20

[a] Only surveyed part of the 151 mi^2 trend count area.

[b] Only surveyed part of the 250 mi^2 trend count area.

Table 3. Annual reported moose harvest from Unit 23, 1978-1988.

Season	Male	Female	Unspecified	Total
1978-79	129	10	0	139
1979-80				
1980-81	97	6	9	112
1981-82	160	15	1	176
1982-83	119	8	1	128
1983-84	129	12	0	141
1984-85	160	17	3	180
1985-86	112	12	0	124
1986-87	139	8	0	147
1987-88	191	14	1	206
Total	1236	102	15	1353

Table 4. Location and numbers of moose killed by hunters in Unit 23, 1987-88.

Drainage/ area	Males	Females	Unspec.	Total	% hunter success
Noatak River	98	9	0	107	57
Kobuk River	43	2	0	45	53
Selawik River	21	0	1	22	95
Northern Seward Peninsula	20	2	0	22	65
Kivalina/Wulik Rivers	3	0	0	3	100
Unspecified	6	1	0	7	
Total	191	14	1	206	60

Table 5. Antler sizes of bull moose reported killed by hunters in Unit 23, 1985-1988.

Season	Unknown	Under 20 in.	20- 29.9 in.	30- 39.9 in.	40- 49.9 in.	50- 59.9 in.	60 in.
1985-86	4	3 (3%)	12 (11%)	15 (14%)	15 (14%)	37 (34%)	26 (24%)
1986-87	9	1 (1%)	8 (6%)	28 (21%)	29 (22%)	49 (38%)	15 (11%)
1987-88	20	2 (1%)	9 (5%)	17 (10%)	26 (15%)	66 (38%)	51 (30%)
Total	33	6 (1%)	29 (7%)	60 (15%)	70 (17%)	152 (37%)	92 (22%)

Table 6. Hunter residency status and success rate during 1987-88 moose season, Unit 23.

Residency status	Successful	Unsuccessful
Nonresident	94	34
Alaska non-local resident (outside Unit 23)	50	48
Alaska local resident (within Unit 23)	49	52
Unspecified	13	2
Total	206	136

Table 7. Chronology of moose harvest in Unit 23, 1987-88.

Week ending		Males	Females	Unspecified	Total
July	25	2	0	0	2
Aug	1	2	0	0	2
	8	7	0	0	7
	15	1	1	0	2
	22	10	0	0	10
	29	15	0	0	15
Sept	5	21	0	0	21
	12	25	0	0	25
	19	26	4	0	30
	26	27	5	0	32
Oct	3	16	0	0	16
	10	14	0	0	14
	17	2	0	0	2
	24	1	0	0	1
	31	1	0	0	1
Nov	7	2	0	0	2
	22	0	1	0	1
	28	1	0	0	1
Dec	12	5	0	0	5
	19	2	0	0	2
Jan	2	2	0	0	2
	9	1	0	0	1
	16	0	1	0	1
	30	1	0	0	1
Feb	20	1	0	0	1
Mar	19	0	2	0	2
Apr	2	1	0	0	1
Unknown		5	0	1	6
Total		191	14	1	206

Table 8. **Transportation means used by moose hunters in Unit 23, 1987-88.**

Vehicle	Successful	Unsuccessful	Total
Aircraft	108	57	165
Boat	48	44	92
Off-road vehicle	13	7	20
Snowmachine	18	4	22
Highway vehicle	1	3	4
Unknown	18	21	39
Total	206	136	342

STUDY AREA

GAME MANAGEMENT UNIT: 24 (24,150 mi^2)

GEOGRAPHICAL DESCRIPTION: Koyukuk River drainage above Dulbi River

BACKGROUND

Moose are a recent addition to Unit 24, having moved into the area in the 1930's. Colonization was slow; however, predator control efforts in the 1950's allowed rapid expansion of local populations, especially in the southern third of the unit. During the early 1970's the population peaked, and mortality began to exceed recruitment in some areas.

The habitat is excellent along most of the Koyukuk River lowlands, providing expansive areas of winter browse. Because lightning-caused fire is a frequent event, large areas of the uplands have been burned and good moose browse produced. Browse availability is not limiting the size of the moose population at current moose densities.

Historical reported harvests during the past 25 years have ranged from 44 to 134; however, they did not exceed 100 moose until 1980. The unreported harvests during this period ranged from 60 to 150 moose per year. Since 1980 the reported harvests have exceeded 100 moose for three reasons: (1) more local residents have become aware of the reporting requirement, (2) compliance has increased, and (3) access to the subunit has become easier with the opening of the Dalton Highway.

POPULATION OBJECTIVES

To maintain a population at the current level of 3,000-4,000 moose in the southern portion of Unit 24 (south of Hughes).

To increase the moose population to 5,000-6,000 in the middle portion of Unit 24 (Hughes to Bettles).

To increase the moose outside the park area to 3,000-3,500 in the northern portion of Unit 24 (north of Bettles).

To maintain the population in the Gates of the Arctic National Park at 1,300-1,500 moose.

METHODS

Three types of aerial survey techniques were used to monitor the population dynamics of moose in Unit 24: (1) stratification flights, (2) composition and trend surveys (annual), and (3) population estimation surveys (5-year intervals). Browse utilization surveys were conducted on foot using standardized ADF&G transect methods.

Hunting mortality and distribution were monitored through harvest tickets and check stations. Local residents were encouraged to report. Aerial wolf surveys and interviews with trappers were used to determine wolf distribution, abundance, and relative impact on moose populations.

RESULTS AND DISCUSSION

Population Status and Trend

Moose are numerous in the Koyukuk River lowlands in the southern third of the unit. The population is growing in the area around the village of Huslia. Elsewhere, moose numbers are stable.

Moose densities are low in the middle third of the unit, and the population is declining. This trend is caused by over-hunting within the Kanuti Controlled Use Area as well as by predation. Moose densities are moderate in the northern third of the unit and are probably stable in most areas; however, the moose population may be slowly declining within the park.

Population Size:

Population estimation surveys have not been conducted within Unit 24. Data collected from surveys of established trend count areas and from stratification flights have been used to extrapolate rough estimates of population size.

In the southern part of the unit, trend areas surveyed in 1985 revealed early winter densities of 3.1 to 4.6 moose/mi^2 along the Koyukuk River lowlands. The area is similar to adjacent Subunit 21D, where early winter densities of up to 9 moose/mi^2 were found in 1987. Based on these densities there are about 4,000-5,000 moose in the southern portion of Unit 24.

In the Kanuti National Wildlife Refuge (NWR) in the middle part of the unit, surveys of trend areas suggested early winter densities of 0.3 to 1.0 moose/mi^2. In addition, a stratification survey of 1,942 mi^2 of the South Fork Koyukuk River during October 1987 suggested densities ranging from 0.3 to 0.5 moose/mi^2. Based on the distribution of moose observed during the stratification surveys and the density estimates derived for each stratum, there are about 2,000-3,000 moose in the middle portion of Unit 24.

In the northern part of the unit, stratification surveys of 2,012 mi^2 within the Wild River, John River, and North Fork Koyukuk River drainages during October 1987 suggested densities ranging from 0.5 to 0.7 moose/mi^2. In the lower portions of the John River and Middle Fork Koyukuk River drainages, moose were not found above an elevation of 4,000 feet; and in the Tinayguk and upper portion of the North Fork Koyukuk River, moose were not found above 3,500 feet. Based on the distribution of moose observed during the surveys, there are about 3,000-4,150 moose in the northern portion of Unit 24, including approximately 1,500-2,000 moose within the Gates of the Arctic National Park. Population estimation surveys of the Kanuti Controlled Use Area and the southern part of the unit are planned for late 1988.

Population Composition:

Composition surveys were conducted by the U.S. Fish and Wildlife Service on the Kanuti NWR and along the Haul Road by ADF&G (Table 1). The results show that recruitment is poor, mortality is high during the summer, and very few calves survive their 1st winter. Bull:cow ratios (i.e., 97:100) are good; however because cow moose are taken illegally within the Kanuti NWR, they are misleading.

Mortality

Season and Bag Limit:

The hunting season and bag limit for the portion Unit 24 including the Gates of the Arctic National Park and the lands immediately adjacent to the park were different from those provided for the rest of the unit. The former area was described as the Alatna River drainage upstream from and including the Helpmejack Creek drainage, the John River drainage upstream from and including the Malemute Fork drainage and downstream from and including the Hunt Fork drainage, the Wild River drainage upstream from and including the Michigan Creek drainage, and the North Fork Koyukuk River drainage north of the Bettles/Coldfoot winter trail. Within this area, only hunters who qualified under federal regulations were allowed to hunt within the park, but all hunters could hunt outside the park boundaries. The bag limit was 1 moose regardless of whether the hunter was inside and outside the park. In this area, Alaska residents could hunt antlered moose from 25 August through 25 September and from 1 through 10 March and antlerless moose from 21 through 25 September and from 1 through 10 March. Nonresidents could hunt antlered moose from 5 through 25 September and antlerless moose from 21 through 25 September.

In the remainder of Unit 24, the open season for all hunters was 25 August through 25 September, regardless of residency or subsistence status. The bag limit for all hunters was 1 bull moose.

Human-induced Mortality:

The hunting seasons in the unit are diverse, reflecting the various moose densities and consumptive-use patterns. The annual reported harvest since 1980 has ranged from 106 to 136 moose. During the 1987-88 seasons, 136 moose were harvested (Table 2). Twelve moose were taken during August, two were taken during the December season in the Koyukuk Controlled Use Area, and three were taken during the March season in the northern portion of the unit.

Illegal and unreported harvests by local residents continue to hamper Department's efforts to manage moose. Moose taken during the winter are rarely reported, even when the season is open. The fact that neither Hughes nor Allakaket have license vendors contributes to the problem of hunters hunting without licenses or harvest tickets. About 172 moose are harvested annually by residents of Unit 24, according to Marcotte (1986), Marcotte and Haynes (1985), and my personal estimates; the residents of Huslia, Hughes, Allakaket/Alatna, Bettles, and Wiseman harvest 84, 33, 35, 10, and 5 moose, respectively. An additional 5 moose are probably taken by residents of the unit who do not live in one of the villages. I am attempting to increase public awareness of the importance of accurate reporting and to obtain additional license vendors. Fortunately, most of the unreported harvest comes from the Koyukuk Controlled Use Area, which has a large enough moose population to support the additional harvest.

The Dalton Highway was initially closed to the public at the Yukon River Bridge. The road was opened to public use throughout Unit 24 in 1981. Since that time the hunter effort and moose harvest have increased, except for 1985 when off-road vehicle restrictions were enforced (Table 2).

Natural Mortality:

A minimum of 400 to 440 wolves in 55 to 60 packs and a large population of black bears occur in the middle and southern portions of the unit. Grizzly bears are found throughout the montaine areas and are common in the Brooks Range.

Predation on moose is thought to be high, except around the villages of Huslia and Bettles, where predators are kept at lower numbers. Predation is keeping the moose population low throughout much of the unit.

<u>Habitat Assessment</u>

Winter moose browse within the Kanuti NWR was surveyed in April 1986, and a cursory survey has been conducted in the Koyukuk Controlled Use Area yearly since 1985. In the Kanuti NWR, winter browse is not a limiting factor to moose population growth. Survey data indicated that moose were only cropping 5-30% of the annual willow growth. Several large (300,000 acres) fires have burned in the middle portion of the unit. These areas are now in their most productive stage for moose browse.

In the Koyukuk Controlled Use Area, almost every willow has signs of past moose browse; however, no qualitative surveys have been conducted. The Koyukuk River is actively eroding its banks throughout most of the Controlled Use Area, and this action creates hundreds of acres yearly of extensive sand bars with willow regeneration.

Game Board Actions and Emergency Orders

During the last 5 years the game regulations have evolved from a simple 20-day season in September throughout the unit (plus a 10-day season during March in the Koyukuk Controlled Use Area) to a diverse system reflecting various moose densities and consumptive-use patterns.

In 1984 the Koyukuk Controlled Use Area had a 10-day season in December; the rest of the unit had the opening date moved back to 25 August to allow the hunting of non-rutting bulls; a 10-day season in March was added to the Gates of the Arctic National Park; and a 25 August-31 December season was added to the upper John River for Anaktuvuk Pass residents.

In 1985, after objections from the National Park Service, the boundary of the hunt in the Gates of the Arctic National Park was modified to follow topographic features south of the park boundary rather than the park boundary.

No changes have occurred in the hunting seasons since 1985. The Koyukuk River Fish and Game Advisory Committee has proposed a winter season for the Kanuti Controlled Use Area for several years, but the Department has not favored the proposal because of the low numbers of moose in the area.

CONCLUSIONS AND RECOMMENDATIONS

The population objectives in Unit 24 are being exceeded in the southern portion and within the Gates of the Arctic National Park. In the middle and northern portions of the unit, excluding the Gates of the Arctic National Park, the moose population is half the desired level.

The habitat is excellent throughout much of the unit, with an abundance of fire-induced successional willow regrowth or new willow habitat in riparian locations caused by topographic changes. Browse availability is not currently limiting the moose population.

With the exception of limited areas around Bettles and Huslia, predation on moose by wolves and grizzly bears is the major limiting factor on moose populations. Until management actions relieve the predation pressure, moose numbers will not increase in those areas where the population objectives are not being met.

Residents of Unit 24 are meeting their wild food requirements, but reporting and licensing procedures are not being followed. More emphasis needs to be placed on education, enforcement, and the recruitment of license vendors. Hunting opportunities cannot be increased for people living outside the unit until moose numbers expand.

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Table 1. Moose composition counts conducted in Unit 24, 1983-87.

Area	Year	Bulls: 100 cows	Yearling bull %	Calves: 100 cows	Percent calves	Density moose/mi^2	Area mi^2	Sample size
Unit 24	1983	39	6	28	17	1.5	385.7	575
	1984	48	6	24	14	0.8	411.2	342
	1985	47	10	14	9	1.6	393.1	924
	1986	70	5	29	15	0.7	319.9	219
	1987	69	11	27	14	1.0	312.5	335
Kanuti	1987	97	8	24	11	0.9	86.8	75
Nolitna	1987	69	14	35	17	1.4	78.6	112
Coldfoot	1987	33	3	21	12	1.3	78.1	104

Table 2. Annual harvest and Dalton Highway hunter success in Unit 24, 1983-87.

Year	Reported harvest	Estimated harvest	Total harvest	Dalton Highway Successful	Dalton Highway Unsuccessful
1983	120	117	237	26	26
1984	122	123	245	37	49
1985	114	127	241	28	70
1986	115	134	249	44	66
1987	136	123	259	42	39

STUDY AREA

GAME MANAGEMENT UNIT: 25A, 25B, and 25D (56,300 mi^2)

GEOGRAPHICAL DESCRIPTION: Upper Yukon River Valley

BACKGROUND

Moose habitat in the upper Yukon Valley varies from treeless tundra on the south slope of the Brooks Range in Subunit 25A to extensive wetlands on the Yukon Flats in Subunit 25D. Density is very low over most of the area, averaging about 0.1 to 0.3 moose/mi^2. Access is restricted primarily to aircraft, boats, snowmachines, and off-road vehicles. Highway vehicles can only be used on limited road systems around villages and on the Dalton Highway, which traverses small portions of the western edges of Subunits 25A and 25D. Most of the harvest in Subunit 25A is by recreational hunters seeking a high-quality wilderness experience. In Subunits 25B and 25D most of the harvest is by subsistence hunters.

Little is known about the history of Unit 26 moose populations. Systematic surveys were not conducted until the late 1970's, and intensive efforts were not begun until ADF&G established an area office in Fort Yukon in 1981. In addition, the early surveys were difficult to interpret, because of low sample sizes. This problem was overcome in 1983, when (1) survey techniques were modified to accommodate the very low density of moose and (2) a radio-telemetry study was initiated in western Subunit 25D. Results from the modified surveys are presented in this report, and radio-telemetry data are currently being analyzed for inclusion in later reports.

MANAGEMENT OBJECTIVES

To provide a posthunting season population sex ratio of at least 50 bulls:100 cows and an average antler size of at least 50 inches in the harvest in Subunit 25A.

To maintain a sustained harvest of 50 moose per year in Subunit 25B.

To increase the moose population to about 1,300 animals in Subunit 25D West.

To provide a stable population of approximately 2,300 moose in Subunit 25D East.

METHODS

Population size and distribution during early winter were surveyed within a 3,556-mi^2 portion of the Yukon River corridor between Eagle and Circle City. This area lies within the Yukon-Charley Rivers National Preserve, including portions of Subunits

25B, 20E, and 25C. This survey was a cooperative effort with the National Park Service (NPS). Estimates were made by first stratifying the area into 10- to 15-mi^2 blocks of high, medium, and low densities and then by surveying selected blocks from high and medium strata to estimate the number of moose present. Search intensity in all blocks was $\geq$4 minutes/mi^2. This method does not produce a statistically reliable population estimate, but it does provide a valuable and relatively inexpensive indication of the number of moose present.

Fall composition surveys were conducted in all subunits as part of a cooperative effort between the ADF&G, the U.S. Fish and Wildlife Service, and the NPS. In Subunit 25A, a population trend area established in 1982 on the upper Sheenjek River was modified and resurveyed; a new area was established on the upper Coleen River. In Subunit 25B, 2 new population trend areas were delineated and surveyed, (i.e., on the Nation and Kandik Rivers). Also, 6 previously established trend areas were resurveyed in Subunit 25D, three each in the western and eastern portions.

Aerial composition surveys were flown in a Piper Super Cub at an altitude of approximately 500 feet above ground level and at an airspeed of approximately 70 miles per hour. A low pass was flown over all moose to determine sex and age, look for additional moose, and estimate antler size of bulls. All moose habitat within established count areas was searched in a systematic manner at an intensity of at least 4 min/mi^2. Data on harvest size, hunter effort, antler size, and transportation methods were gathered from mandatory hunter harvest reports.

RESULTS AND DISCUSSION

Population Status and Trend

The average density in all subunits was low, averaging from 0.1 to 0.3 moose/mi^2. The trend was stable in most areas, except Subunit 25D West where moose numbers were increasing.

Population Size:

The only population estimate during the current year was for the Yukon River corridor between Eagle and Circle City. The east side of the corridor, which is within Subunit 25B, contains about 400 moose. No other population estimates have been obtained for this area; however, the trend is stable or downward, given the poor calf survival and yearling recruitment in this subunit.

Population Composition:

Composition surveys during the fall of 1987 in Subunit 25A were conducted in the upper Sheenjek and Coleen Rivers; these 2 areas are representative of much of the south slope of the Brooks Range and have received relatively heavy hunting pressure compared with other portions of the subunit. Also, some historical data are available for the Sheenjek River.

The data suggested a stable population that is able to sustain the current harvest of bulls only (Table 1). Recruitment was adequate (8% yearlings), and the bull:cow ratio was high (79:100). However, the bull:cow ratio for the Sheenjek River was higher in 1981 (70:100) than in 1987 (63:100). This difference could indicate a problem, if there is a downward trend.

Composition data collected in Subunit 25B, as part of the population estimate along the Yukon River corridor, suggested a stable or declining population. Both calf survival and yearling recruitment were poor, because calves and yearlings each composed only 5% of the population. Predation by grizzly bears and wolves was the major mortality factor. The bulls-only harvest in the area probably had a minor influence, because the yearly take averaged only 1-2% of the estimated population and the bull:cow ratio was very high (119:100).

In Subunit 25D West, the data indicated an increasing population for the last 5 years with a declining rate of growth. Calves and yearlings composed 26% and 20%, respectively, of the population in 1983, declining to 13% and 8%, respectively, in 1987. Population estimates of 800 in 1983 and 1,500 in 1986 also suggested a growing population.

In Subunit 25D East, both calf survival and yearling recruitment were good for the last 3 years, averaging 16% calves and 13% yearlings in the population. However, it is unlikely that numbers have grown substantially because of an either-sex harvest of approximately 4-5% of the population each year. Population size was an estimated at 2,100 moose in the fall of 1984.

Distribution and Movements:

The largest concentrations of moose were found in Subunit 25D. Exceptionally high densities (1-2 moose/mi^2) occurred in small areas near Mudd Lakes and around the lower mouth of Birch Creek and the lower reaches of the Porcupine and Black Rivers. Early winter concentrations were also found in Subunit 25A along the upper Sheenjek and Coleen Rivers. Elsewhere in the upper Yukon Valley, densities were generally low.

Moose movement patterns were determined only for Subunit 25D West. Sixty-eight radio-collared moose were relocated at weekly or monthly intervals between 1983 and 1987. Preliminary analysis of these data revealed that approximately half the moose population was migratory, spending spring and summer in the Yukon Flats, then moving to surrounding uplands during fall and winter. A more complete data analysis and final report are being prepared.

Mortality

Seasons and Bag Limits:

Seasons varied within the 3 subunits, but all shared a common bag limit of 1 bull. In Subunit 25A the open season for all hunters was 5-25 September. Subunit 25B was divided into 2 parts. The portion within the Porcupine River drainage upstream from, but excluding, the Coleen River drainage was open to all hunters from 20 to 30 September. The open season within the remainder of Subunit 25B was 5-25 September for all hunters and 1-15 December for subsistence users and other residents. Subunit 25D was also divided into 2 parts. In the western portion a registration permit hunt was in effect with a quota of 35 bulls. Only residents of the permit area were eligible to hunt within it, and the open season was 10-30 September, 1-10 December, and 18-28 February. In the eastern portion of Subunit 25D the open season for all hunters was 10-20 September; for subsistence hunters it was 10-30 September and 1-10 December.

Human-induced Mortality:

Human harvest of moose has changed little over the past 5 years in the upper Yukon Valley (Table 2). The total reported harvest has varied from a low of 106 moose in 1985 to a high of 132 during 1986. During 1987, 129 were taken. Among subunits, the only obvious trend was in 25D East, where the harvest rose from 27 to 47. This increase will likely have no significant impact on the population because bull:cow ratios in that area are high (81:100).

Unreported harvest by local villagers continues to be a chronic problem in Subunit 25D East. I estimate that it totals approximately 100 moose of either sex yearly. This compares with a total reported take of from 15 to 24 bulls annually over the past 5 years.

Management plans for Subunit 25A specify an objective of maintaining an average antler spread of at least 50 inches in the harvest. Over the past 5 years, that objective has been achieved. Average antler sizes have varied from 50 to 52 inches (Table 3).

Hunter Residency and Success. Most of the people who hunted in Subunits 25A, 25B, and 25D were residents of Alaska (Table 4). During the current year, 86% lived within the state and the remaining 14% were nonresidents. Among the resident hunters, 43% lived within Unit 25 and 57% lived elsewhere in the state. A large number (29%) of the hunters living in Unit 25 hunted in Subunit 25D East. Other Alaska residents used all 3 subunits in similar proportion. A similar pattern of use has occurred during the previous 4 years.

Hunter success during 1987 was highest in Subunit 25A (61%) and lower in the other areas (44-53%) (Table 2). Similar results were reported during the previous 4 years.

Harvest Chronology. Most moose were taken during the first 3 weeks of September, when weather conditions were more favorable than later in the season and many hunters, particularly subsistence users, preferred to take bulls before they were too heavily into the rut (Table 5). Seventy-one percent were harvested during this period in 1987; comparable amounts have been taken during the same period in previous years.

Transport Methods. Data on transport methods were collected in all areas, except for Subunit 25D West where permit reports did not require this information. During 1986 airplanes provided transport for most successful hunters in Subunit 25A (61%), while boats were most important in Subunits 25B (65%) and 25D East (66%) (Table 6). This was also the pattern during the previous 4 years.

Natural Mortality:

Very little is known about natural mortality in most of the upper Yukon Valley. The only exception is in Subunit 25D West, where mortalities among radio-collared animals were investigated. Preliminary analysis of the data indicated that mortality rates were very low and that wolf predation was the primary cause of death among moose older than 6 months. A more complete analysis and final report are being prepared.

CONCLUSIONS AND RECOMMENDATIONS

Management goals and objectives for moose are being achieved in the upper Yukon Valley. In Subunit 25A the population is able to provide high-quality recreational hunting. Bull:ratios are high, and average antler size in the harvest exceeds 50 inches. In Subunits 25B and 25D subsistence uses are being accommodated. Current harvest is within sustainable levels in Subunit 25B, and population objectives have been achieved in Subunit 25D.

Unreported harvest of moose in Subunit 25D East is a chronic problem. Management efforts will continue to be crippled because no reliable estimates of harvest are available and because local hunters see no advantage in complying with regulations. The solutions to this problem are to continue educating local hunters about the importance of reporting their harvest and searching for ways to modify regulations so they can accommodate traditional use patterns.

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Table 1. Moose sex and age ratios for Subunits 25A, 25B, and 25D, fall 1983-87.

Subunit	Year	Calves: 100 cows	Yearling Bulls: 100 cows	Bulls: 100 cows	%		N
					Calves	Yearlings	
25A	1987	35	8	79	16	8	179
25B	1987	10	6	119	5	5	111
25D(West)	1983	72	28	97	26	20	80
	1985	53	35	98	21	28	108
	1986	27	23	78	13	22	152
	1987	25	8	71	13	8	100
25D(East)	1984	44	12	76	20	11	226
	1986	34	13	84	15	12	170
	1987	27	18	81	13	17	225

Table 2. Total harvest, number of hunters and percent success in Subunits 25A, 25B, and 25D, 1983-87.

Subunit	Year	Total harvest	Number of hunters	Percent success
25A	1983	33	53	62
	1984	34	51	67
	1985	29	53	55
	1986	47	72	65
	1987	41	67	61
25B	1983	34	76	45
	1984	39	87	45
	1985	25	49	51
	1986	27	58	47
	1987	26	59	44
25D(West)	1983	13	48	27
	1984	16	47	34
	1985	20	41	49
	1986	15	46	32
	1987	13	29	49
25D(East)	1983	27	73	37
	1984	25	87	28
	1985	26	59	44
	1986	39	92	42
	1987	47	88	53

Table 3. Antler size in the harvest from Subunit 25A, 1983-87.

Regulatory year	Percent of total							Mean antler spread	Total known bull harvest
	≤44.9	45.0-49.9	50.0-54.9	55.0-59.9	60.0-64.9	≥65.0	Unk		
1983	15	9	15	15	15	9	21	52	33
1984	18	27	24	18	6	6	3	50	34
1985	21	14	17	24	24	0	0	51	29
1986	11	18	25	25	9	4	13	52	47
1987	17	12	12	34	12	5	7	51	41

Table 4. Hunter residency and success in Subunits 25A, 25B, and 25D, 1983-87.

	Successful					Unsuccessful				
Year	Unit 25 res	Other Alaskan res	Nonres	Unk	Tot	Unit 25 Res	Other Alaskan res	Nonres	Unk	Tot
Subunit 25A										
1983	4	14	14	1	33	4	11	4	1	20
1984	3	18	9	4	34	2	12	3	0	17
1985	2	12	14	1	29	3	13	6	2	24
1986	4	22	6	5	47	2	13	10	0	25
1987	4	16	18	3	41	4	14	3	5	26
Subunit 25B										
1983	11	23	0	0	34	19	14	8	1	42
1984	25	12	2	0	39	8	34	3	3	48
1985	7	11	2	5	25	1	19	4	0	24
1986	9	10	3	5	27	6	18	2	5	31
1987	9	10	1	6	26	5	19	6	3	33
Subunit 25D(East)										
1983	17	6	1	3	27	18	26	1	1	46
1984	15	7	3	0	25	38	21	3	0	62
1985	14	9	2	1	26	21	10	2	0	33
1986	23	10	1	5	39	29	22	1	1	53
1987	24	16	6	1	47	22	13	3	3	41
Unit 25-Subunit Unknown										
1983	0	3	0	1	4	0	6	1	0	7
1984	1	0	0	0	1	2	2	0	0	4
1985	3	2	1	0	6	1	3	1	0	5
1986	1	2	1	0	4					
1987	2	0	0	0	2	1	8	1	0	10

Table 5. Harvest chronology in Subunits 25A, 25B, and 25D 1983-87.

Subunit	Year	Week in September 1	2	3	4	5	Dec	Feb	Unk
25A	1983	0	14	5	9	1	--	--	4
	1984	0	14	8	9	0	--	--	3
	1985	5	13	6	3	1	--	--	1
	1986	15	20	6	5	0	--	--	1
	1987	5	14	14	7	0	--	--	1
25B	1983	0	2	16	11	1	2	--	2
	1984	0	1	14	9	7	3	--	5
	1985	1	8	4	5	2	3	--	2
	1986	2	6	14	2	0	0	--	3
	1987	2	5	10	5	1	2	--	1
25D(West)	1983	--	--	--	--	--	--	--	--
	1984	0	0	3	3	5	0	0	5
	1985	--	--	--	--	--	--	--	--
	1986	0	1	5	5	2	1	1	0
	1987	0	3	6	2	0	0	1	1
25D(East)	1983	0	3	16	3	0	2	--	3
	1984	0	1	13	7	0	2	--	2
	1985	0	12	9	1	0	0	--	4
	1986	0	22	12	1	0	3	--	1
	1987	0	9	24	6	0	3	--	3

Table 6. Successful hunter transport methods in Subunits 25A, 25B, and 25D, 1983-87

Subunit	Year	Air-plane	Horse	Boat	3- or 4-Wheeler	Snow-machine	Off-road vehicle	Highway vehicle	Unk
25A	1983	23	3	6	0	0	0	1	0
	1984	20	2	5	0	0	0	3	4
	1985	17	6	3	0	0	0	1	2
	1986	34	8	4	0	0	0	0	1
	1987	25	5	7	0	0	0	1	3
25B	1983	8	1	23	0	2	0	0	0
	1984	9	0	26	0	2	0	0	2
	1985	5	0	16	0	2	0	0	2
	1986	8	0	17	0	0	0	0	2
	1987	7	0	17	0	1	0	0	1
25D (East)	1983	6	0	13	0	2	1	1	4
	1984	2	1	15	1	3	0	0	3
	1985	4	0	20	0	0	1	0	1
	1986	5	0	26	0	2	0	1	5
	1987	8	0	31	0	3	0	1	4

STUDY AREA

GAME MANAGEMENT UNIT: 26A

GEOGRAPHICAL DESCRIPTION: Western North Slope

BACKGROUND

Since the 1940's, moose populations have become well established in most of the favorable habitat on the north slope. Animals ranging as far north as the arctic coast in summer but confined primarily to the inland riparian systems during the winter. Highest wintering densities occur in the central Colville River and its tributaries.

Regular harvest by airborne hunters began in the early 1970's. Annual late-winter surveys for assessing overwinter survival of calves began in 1970. Surveys of all drainages in Unit 26 were conducted in 1970, 1977, and 1984. The results of the most recent comprehensive survey (i.e., 1984) indicated that Subunit 26A contained 1,429-1,786 moose. Beginning in 1982 Subunit 26A became a separate administrative unit. Reported harvest has increased from 37 to 62 in 1983 and 1987, respectively. In the 1987 season, 118 individuals reported hunting this population. There are recent indications that hunting pressure is increasing and the percentage of calves surviving their first winter has declined.

POPULATION OBJECTIVES

To conduct spring trend counts annually to monitor short-yearling survival and fall counts biennially to monitor sex ratio trends.

To census the population at 7-year intervals.

To manage harvest for spatial and temporal separation of recreational and subsistence hunters.

To manage for a hunter success rate of not less than 50% for recreational hunters to help sustain a wilderness-style hunting experience with light aircraft.

To establish a management plan and an upper harvest limit for moose.

METHODS

I conducted the fall composition surveys on 25 and 26 November in a Cessna 185. Because of cold weather, poor light, an inexperienced pilot, and the onset of antler drop, only 30% (i.e., 1.5 cont areas) of the 5 count areas were surveyed. This survey should normally be conducted no later than the first week of November.

Spring composition surveys were conducted in 4 standard count areas during 18-24 April using a Piper PA-18 aircraft. Because spring thaw was early, snow and weather conditions were less than ideal. Counting conditions were rated from poor to good.

License and harvest ticket vending was again emphasized in Nuiqsut, the center for subsistence hunting by boat on the Colville River. I worked the first 5 days of September at Umiat, contacting hunters during the peak of the season.

RESULTS AND DISCUSSION

Population Status and Trend

Results of a 1984 census indicated that a late-winter population of 1,429-1,786 moose inhabited Subunit 26A. Similar counts in 1970 and 1977, as well as less extensive annual trend counts, indicate that in the last decade (1978-1987) the population has either been stable or has increased slightly; that trend may be changing. In the last two years (1987-88), the proportion of short-yearlings in the population (11%) has declined sharply from the mean of the previous 6 years (i.e., 1980-86, excluding 1985, 18%). Hunting pressure and harvest appear to be increasing, putting additional pressure on the population to either stabilize or decline.

Population Size:

A total of 1,429 moose were observed in the Subunit 26A during 1984. Of these, 1,418 were in the Colville River drainage, an increase of 13% since 1977. The 1984 census indicated the Subunit 26A population ranged from 1,429-1,786 moose.

Annual spring trend counts were flown systematically over the best winter habitat in Subunit 26A. The 5-year mean from (1984-88) is 752 moose. From 1986 to 1988, the size of the sample has declined from 866 to 682 in 1988 (Table 1); however, this recent decline does not necessarily reflect a decline in population size. The number of moose observed in the count areas varies from year to year and is dependent on snow depth and the timing of spring snow melt.

Population Composition:

In 1988, 602 adults and 82 short-yearlings were observed during the spring trend counts. The proportion of short-yearlings in the sample (12%) was the 2nd lowest observed in 5 years, substantially lower than the 5-year and 14-year means of 18%.

Because poor snow conditions caused the fall 1987 surveys to be aborted early, only 20 moose were observed. Composition ratios were 39 bulls:100 cows and 21 calves:100 cows. Because only a small portion of the area was surveyed, I believe that the number of bulls was underestimated.

Distribution and Movements:

Moose appear to be widely dispersed during the summer months and a few reach the arctic coast. As fall progresses and forbes are covered by snow, moose move back onto riparian corridors in big river systems, such as the Colville River. Moose were most concentrated in riparian habitat by February or March. Snow melt began in April in the northern foothills of the Brooks Range. At this time of year, many moose moved to higher elevations by travelling up drainages such as the Chandler and Anaktuvuk Rivers.

Mortality

Season and Bag Limit:

The open season for subsistence hunters in Subunit 26A is 1 August to 31 December. The open season for resident and nonresident hunters is 1 September to 31 December. The bag limit for all hunters is 1 moose.

Human-induced Mortality:

In Subunit 26A the reported harvest of 62 moose during fall 1987 represents an increase of 19% from the fall 1986 harvest of 52 moose (Table 3). Thirteen (21%) of the 62 moose were females.

According to my estimations, 19 additional moose were killed in the Subunit but not reported. The total estimated harvest for the Subunit, including the unreported kill, is 81 moose. This harvest represents 4.5-5.7% of the 1,429-1,786 moose inhabiting Subunit 26A at the time of the last unit-wide survey flown in 1984.

Hunter Residency and Success. Sixty-one percent of the reporting hunters were successful (Table 3). This is a decline of 4% from the 1986 success rate (66%) and a 13% decline from that for 1983 (74%). The 1987 success rate also represents a decline of 7% from the 5-year-mean success rate of 68%. In addition, patterns of hunter origin appear to be changing (Table 4). The trend of increased involvement by residents of Subunit 26A is continuing. Forty of the 99 reporting hunters were North Slope residents (Table 4). An additional 16 North Slope residents who did not report were known to have hunted moose in 1987. Thus 56 of 116 known moose hunters were residents of Subunit 26A. The proportion of nonresident hunters increased from 23% in 1986 to 39% in 1987, suggesting that guiding and outfitting activities are increasing in the area as well. Participation by hunters from the Fairbanks area and other non-local Alaska residents declined from these in 1986.

Of the 45 measured moose antlers, 21 (47%) were 50-59 inches (Table 5).

Harvest Chronology. Hunting activity peaked strongly during the first 2 weeks of September. Of 58 moose with reported dates of harvest, 9% were killed in August, 71% in the first 2 weeks in September, 10% in the remainder of September, and 10% in October. No moose were reported harvested in November or December.

Transport Methods. Of 94 hunters who reported method of transportation, 80% used aircraft, 15% used boats, and 5% used other methods.

Natural Mortality:

Little data are available on natural mortality. Grizzly bear and wolf predation probably does not significantly affect moose numbers. Predators are now more commonly encountered during spring trend counts; in 1988, we observed 2 grizzly bears, one of which was on a fresh moose carcass, a pack of 3 wolves, and 5 other moose carcasses. Residents at Umiat have indicated that bears were more abundant in 1988 that in prior years. The recent decline in the proportion of short-yearlings observed during surveys may be linked to wolf and grizzly bear predation. Aerial track counts of wolves on the trend count areas were flown in 1986 and 1987. The estimated wolf density for 1986 was 1 wolf/147 mi^2. In 1987, 11 or 12 packs were estimated to include 57 to 69 individuals. The estimated density was 1 wolf/119-144 mi^2.

Game Board Actions and Emergency Orders

For the past decade, the season has been 1 September to 31 December; the bag limit has been 1 moose. This harvest strategy allowed aircraft hunters to operate briefly in early September before snow cover and weather precluded flying. The long open either-sex season through December provided a maximum harvest opportunity for subsistence hunters using snowmachines.

Beginning in 1983 the Board of Game established a subsistence season on the lower Colville River that opened on 1 August but excluded the use of aircraft until 1 September. This season was requested by the community of Nuiqsut to allow harvest opportunities under optimal boating conditions. The regular 1 September-31 December season continued for other Alaska residents and nonresidents, and the bag limit remained at 1 moose. Only residents of Subunit 26A qualified as subsistence hunters.

The Board also restricted the season and bag limit in adjacent Subunit 26B. Moose in this Subunit were receiving increasing harvest pressure from hunters using the Dalton Highway. Regulatory restrictions in adjacent Subunit 26B and a more liberal season in

Subunit 26A suggest the potential for increased hunting pressure and harvest in Subunit 26A in the future.

CONCLUSIONS AND RECOMMENDATIONS

The percentage of short-yearlings in the population has remained low for the 2nd consecutive year. The number of moose in the spring trend count areas declined for the 3rd year since 1986. The proportion of bulls in the population appears to be declining as well. The reported harvests has increased to near-record levels during the past 5 years. The number of hunters in Subunit 26A in 1987 represented a record high 118. The estimated harvest of 81 moose represents approximately 4% to 5% of the estimated population. Greater proportions of subunit residents and nonresidents have been hunting in recent years, compared with nonlocal residents. The season within Subunit 26A has recently been liberalized, and in adjacent Subunit 26B it has been restricted. The potential thus exists for greater harvests in the future in Subunit 26A because of displaced hunting pressure. Observations indicate that predation may be an important source of natural mortality.

A growing potential for overharvesting and user conflict exists in Subunit 26A. This is especially true now that the season is more restrictive in adjacent Subunit 26B. No maximum allowable harvest has been identified for moose in Subunit 26A; this needs to be done as soon as possible. Any such estimate must consider the special circumstances of a population that has recently expanded onto the North Slope and is at the northern range limit for moose in Alaska.

A moose management plan needs to be developed for Subunit 26A. This plan should recognize the characteristics of moose populations and the felt needs of moose hunters in those areas. Particular attention should be given to identifying and preserving, where possible, the characteristics of moose hunting that are unique to the North Slope. In developing such a plan, meaningful public participation should be solicited, especially from residents of Subunit 26B. This management plan should discuss several specific objectives, including the spatial and temporal separation of subsistence hunters from recreational hunters, a high success rate, the identification of maximum allowable harvest guidelines.

I recommend that the Department meet its moose survey objectives for Subunit 26A in FY89 and FY90. Emphasis should be placed on obtaining spring short-yearling survival information. I also recommend conducting a composition survey in the fall of 1989. I further recommend that fall composition counts for the next several years be conducted annually instead of biennially. Planning should also begin for a spring 1991 census of the entire Subunit. The last census was in 1984.

It is also highly desirable to maintain a hunter contact and enforcement effort from 25 August to 15 September on the Colville River. These efforts should include the lower portion of the river near Nuiqsut as well as Umiat. No changes in seasons and bag limits are recommended at this time; however, continued surveillance of the moose population should be given a high priority.

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Table 1. Colville River trend counts: Anaktuvuk River, Chandler River, and Colville River between Anaktuvuk and Killik Rivers, 1970, 1974-81, and 1983-87.

Year	Total moose	Adults	Calves	Calf % of herd
1970	750	523	227	30
1974	544	458	86	16
1975	556	386	170	31
1976	650	494	156	24
1977	802	632	170	21
1978	767	623	144	19
1979	644	536	108	17
1980	841	676	165	20
1981	639	594	45	7
1983[a]	315	268	47	15
1984	756	590	166	22
1985	757	613	144	19
1986	866	678	188	22
1987	700	627	73	10
1988	684	602	82	12

[a] Partial count due to incomplete snow cover and wide dispersal of moose.

Table 2. Moose composition counts for Subunit 26A, 1983-87.

Year	Males: 100 females	Calves: 100 females	Calf % of herd	n	Moose /hr
1983	54	38	20	188	40
1984					
1985					
1986	47	18	11	339	49
1987	39	21	3	104	32

Table 3. Reported moose hunter success in Subunit 26A, 1983-87.

Year	Harvest	Sex M	Sex F	Unk	Hunters	Success rate (%)
1983	37	30	7	0	50	74
1984	50	42	7	1	66	76
1985	65	50	15	0	99	66
1986	52	46	6	0	80	65
1987	62	49	13	0	118[a]	61

[a] 16 hunters did not report harvest.

Table 4. Residence of reporting Subunit 26A hunters, 1983-86.

Year	North Slope (Unit 26) No.	(%)	Fairbanks area No.	(%)	Elsewhere in Alaska No.	(%)	Outside Alaska No.	(%)	Totals
1983	4	(9)	18	(40)	7	(16)	16	(36)	45
1984	12	(19)	26	(41)	16	(25)	10	(16)	64
1985	29	(30)	29	(30)	16	(16)	24	(24)	98
1986	29	(36)	21	(26)	12	(15)	18	(23)	80
1987	40	(40)	14	(14)	6	(7)	39	(39)	99

Table 5. Antler spread (inches) of moose harvested in Subunit 26A, 1987.

Year	Less than 20	20-29	30-39	40-49	50-59	60+	Total
1987	0	0	9	11	21	4	45

STUDY AREA

GAME MANAGEMENT UNIT: 26B and 26C (25,500 mi^2)

GEOGRAPHICAL DESCRIPTION: North slope of the Brooks Range and arctic coastal plain east of the Itkillik River

BACKGROUND

Moose are relatively recent arrivals in arctic Alaska; they were very scarce from the turn of the century through about 1930 (LeResche et al. 1974). Moose became common by the early 1950's; however, their numbers have been limited by wolf predation. Federal wolf control programs conducted at that time relieved predation pressure and sparked population growth that continued until the early 1980's. Today, the population in the eastern Arctic is stable at about 1200 moose.

Moose in the eastern Arctic exist in a treeless tundra at the northern limit of their range. Year-round habitat is limited to narrow strips of riparian willow along the major rivers. Thus the potential to produce and harvest large numbers of moose simply does not exist. Much of the area is pristine, arctic tundra, and travel to it is expensive and often logistically difficult. Most hunters, who expend the time and dollars to get there, expect to have an aesthetically pleasing experience. There are unique opportunities for viewing and photography along the Dalton Highway (Subunit 26B), but there is also the potential for impact on moose populations and quality of hunting experiences because more hunters have access to the area.

All the ADF&G goals are being achieved in the eastern Arctic; however, increasing harvest by recreational hunters is a source of concern. Interest in the area has probably increased for 2 reasons. First, access to moose populations in Subunit 26B dramatically improved when the Dalton Highway was opened for commercial use in 1978. Hunting guides and outfitters established staging points along the road, and the general public invented an array of commercial reasons to use the highway and thereby circumvent restrictions. Second, additional hunters have likely been attracted into the area because wildlife resources in the Arctic National Wildlife Refuge, which covers most of the eastern Arctic, have received national publicity as part of the controversy over oil development.

MANAGEMENT OBJECTIVES

To manage for a posthunting season sex ratio of no less than 50 bulls:100 cows.

To maintain an average antler size of at least 50 inches among harvested bull moose.

To maintain a hunter success rate of at least 40%.

To provide for a yearly subsistence harvest of up to 10 moose of either sex.

METHODS

No population surveys were conducted during the reporting period. Population data are available from surveys done during 1983-86 by the U.S. Fish and Wildlife Service (USFWS), Arctic National Wildlife Refuge (ANWR) (Martin and Garner 1984, Weiler and Leidberg 1987). Riparian willow strips were systematically searched during fall using a Piper PA-18 aircraft from 300-600 feet above ground level traveling at 70-90 miles per hour. The Canning River was surveyed each year from 1983 through 1986. Other drainages west of the Canning, from the Kavik to the Sagavanirktok Rivers, were surveyed during 1986. Data on harvest, hunter effort, antler size, transportation, etc., were gathered from mandatory hunter harvest reports.

RESULTS AND DISCUSSION

Population Status and Trend

No attempt has ever been made to accurately determine moose population size in the eastern Arctic. However, extrapolations from composition surveys conducted over the last 5 years and incidental observations indicate a stable population of approximately 1,200; i.e., 700 in Subunit 26B and 500 in Subunit 26C.

Population Composition:

Survey data from the Canning River showed no distinct trends for 1983-86 (Table 1). Calf survival to 6 months was good during all years, with the exception of a sharp decline in 1986. This decrease could be a source of concern if it continues. Recruitment into the yearling age class was also good during most years. The ratios of total bulls:100 cows and large bulls:100 cows were both high. The latter did show a decline during 1986, which may indicate that the harvest of large bulls ($\geq$50-in antlers) is greater than can be sustained by the population. The harvest of all bulls has increased substantially since 1984, with hunters concentrating on the larger animals.

Surveys from the Kavik River to Sagavanirktok River during 1986 indicated better calf and lower yearling survival than occurred in the Canning River area. Also, the ratios of total bulls:100 cows and large bulls:100 cows were lower. The differences in survival are difficult to explain, because the 2 areas are adjacent to one another and should have similar influencing factors. It is possible that survey results were somehow biased for either area. Lower sex ratios could be attributed to greater hunting pressure on males because of the easier access from the Dalton Highway.

Distribution and Movements:

Most moose are found in Subunit 26B and in western Subunit 26C. Year-round habitat is limited to strips of riparian willow along major rivers. The highest densities are probably found along the Canning, Kavik, and Shaviovik Rivers. Virtually nothing is known about moose movements.

Mortality

Seasons and Bag Limits:

The subsistence season is from 1 August to 31 December; the bag limit is 1 moose. The season for resident and nonresident hunters is from 1 September to 30 September; the bag limit is 1 bull. For all hunters, there was no open season within 2 miles of the Dalton Highway in Subunit 26B.

Human-induced Mortality:

The total reported harvest declined from 62 moose in 1986 to 54 moose (53 bulls, 1 cow) in 1987 (Table 2). Total harvests have been increasing since 1982. The 1987 decline can be attributed to a change in bag limit that restricted the harvest of females to subsistence hunters only. The total harvest of bulls actually increased by 4 animals. I expect the long-term upward trend to continue, unless additional harvest restrictions are implemented.

The most notable increases in harvest over the past 5 years occurred in Subunit 26B where the Dalton Highway allows access. Hunters had access to moose adjacent to the road and over a much broader area using aircraft that departed from staging points along the highway at Coldfoot, Galbraith Lake, Happy Valley, and Deadhorse. Guides and outfitters operated most of the aircraft and maintained base camps at many of these sites.

Near the Dalton Highway, harvest increased from 6 to 20 moose between 1983 and 1986; it then dropped to 15 moose in 1987 (Table 3). The harvest from those portions of Subunit 26B not adjacent to the road increased from 5 to 32 and then dropped to 22.

Restrictions on recreational travel on the Dalton Highway have not prevented a long-term increase in harvest. Enforcement of the highway use regulations is sporadic, and numerous legal loopholes are available. Only 1 Fish and Wildlife Protection Officer is assigned to the entire eastern Arctic and Brooks Range. A station on the highway at Chandalar Shelf for checking permits required to travel the road is not continuously manned, and no physical barrier is in place to force travelers to stop. Hunters can also be issued highway permits by simply filing mining claims located in Subunit 26B. They can also fly on regularly scheduled commercial jets to Deadhorse on the north end of the highway. Once there, they can rent vehicles to travel the road or meet guides and outfitters who will transport them to staging points.

Similarly, restrictions imposed on hunting within 5 miles of the road through establishment of the Dalton Highway Management Area (DHMA) have been only partially effective in limiting harvest. Hunting is prohibited; however, big and small game may be harvested by bow and arrow. Also, no motorized vehicles, except aircraft, boats, and licensed highway vehicles, may be used to transport game or hunters. Failure of this regulation is primarily due to lack of enforcement.

Away from the Dalton Highway in both Subunits 26B and 26C, increasing numbers of hunters may be causing crowding around larger and better known aircraft-landing sites. Concentration of hunters at these landing sites represents the most extreme case, but it illustrates a potential problem that has been emphasized by reports of crowding from transporters, guides, and outfitters and by concerns voiced by the ANWR staff.

In spite of increasing harvests, antler size showed a stable trend over the past 5 years (Table 4). It has averaged from 50.3 to 61.2 inches for all areas.

Subsistence harvest reported through the harvest ticket system has been very small. During the current year only 1 cow was reported killed, and during the previous 4 years only 1 other animal was reported taken. It is likely that the subsistence harvest is actually larger; however, it probably does not exceed 5-10 moose yearly, because Kaktovik and Nuiqsut are the only subsistence communities in the area and they rely primarily on whales, caribou, and sheep.

Hunter Residency and Success. Most moose hunters in the eastern Arctic were residents of Alaska (Table 2). During 1987, 61% of those who reported residency lived within and 39% lived outside Alaska. Among the Alaska residents, only 1 lived in the eastern Arctic. Similar percentages were reported over the previous 4 years.

Hunter success was very high (Table 3). Sixty-four percent of all hunters were successful during 1987, and success during the previous 4 years has varied from 65% to 86%. No trend was apparent.

Harvest Chronology. Most moose (89%) were taken during the first 3 weeks of September (Table 5). Over the previous 4 years, this period accounted for 54% to 67% of the total harvest. The substantial increase during the reporting period was because the open season for resident and nonresident hunters was restricted to the month of September.

Transport Methods. Airplanes were the most common means of transportation for successful hunters (Table 6). Over the past 5 years, 57% to 81% used aircraft; 1987-88 was typical.

Natural Mortality:

Very little is known about natural mortality of moose in the eastern Arctic. Reports from the public and incidental observations indicated that predation by wolves and brown bears was important. Habitat is limited, but its role in natural mortality is unknown.

Game Board Actions and Emergency Orders

The only regulation changes made over the last 5 years occurred in 1987. Seasons and bag limits for Subunits 26B and 26C were changed, and additional use restrictions were added to the DHMA.

The original hunting season for all hunters was 1 September through 31 December with a bag limit of 1 moose. The hunting season for most hunters was reduced to 1-30 September; the bag limit was 1 bull moose. The season for residents of Unit 26 who qualify as subsistence hunters was increased to 1 August through 31 December. The subsistence bag limit was 1 moose and was not restricted to bulls. These changes were proposed by the ADF&G because of concern over increasing harvest of cow moose, particularly along the Dalton Highway.

The DHMA originally specified that land extending within 5 miles on either side of the Dalton Highway from the Yukon River bridge to the Prudhoe Bay Closed Area be closed to hunting, except big game and small game could be taken by bow and arrow. The Board of Game added that no motorized vehicles, except aircraft, boats, and licensed highway vehicles, could be used to transport game or hunters. This action was taken to make the game regulations consistent with Alaska statutes, which already contained a restriction on use of motorized vehicles. It was also done to provide a penalty for violators, because none was included when the statute was originally passed by the Legislature.

CONCLUSIONS AND RECOMMENDATIONS

Management goals and objectives for moose in Subunits 26B and 26C are being achieved. The population is able to sustain the current subsistence harvest and continues to have the characteristics necessary to support high-quality hunting experiences. The relatively small subsistence demand is being easily satisfied, bull:cow ratios are high, hunter success is excellent, and antler size in the harvest is adequate.

The only major source of concern at the present time is the increasing harvest of bull moose. It is possible that the sustainable harvest is only about 40 to 45 bulls each year, if the estimates of population number and recruitment are correct.

During 1986-87 and 1987-88 the harvest has been 49 and 53 moose, respectively. If the harvest continues to increase, it may lead to a drop in the bull:cow ratio and, more specifically, to a decline in large antlered bulls, which will make it impossible to achieve our objective of maintaining an average antler size of 50 inches or greater in the harvest. The drop in the ratio of large bulls to cows seen in survey data collected during 1986 may be the 1st indicator of this problem. Aerial surveys will be continued and expanded to monitor this situation.

Failure to enforce the existing regulations and statutes in the DHMA is a major contributor to the increasing harvest in Subunit 26B. I recommend that the enforcement effort along the road be increased. This will be difficult for Division of Fish and Wildlife Protection, given recent funding cuts. However, both the Bureau of Land Management and the USFWS have expressed willingness to increase their efforts on lands under their jurisdiction.

Hunter crowding, both along the Dalton Highway and at aircraft landing areas elsewhere in both subunits, is also a source of concern. The question is: what density of hunters is compatible with the management goal of providing aesthetically pleasing moose hunting? Once this question is answered, specific user concentration objectives should be formulated to serve as a guide for decision making. I recommend a hunter survey be conducted in cooperation with the USFWS to find the answer.

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Table 1. Moose sex and age ratios for Subunits 26B and 26C, fall 1983-86[a].

Area	Year	Calves: 100 cows	Yearling bulls: 100 cows	Bulls: 100 cows	Large bulls[b]: 100 cows	%		Sample size
						Calves	Yearlings	
Canning River	1983	35	10	71	34	17	9	150
	1984	30	13	75	38	15	13	156
	1985	34	22	80	37	16	20	187
	1986	18	15	75	25	9	16	139
Kavik River to Sagavanirktok River	1986	33	8	56	16	17	9	478

[a] Modified from Martin and Garner 1984, and Weiler and Leidberg 1987.

[b] Antler size $\geq$50 inches.

Table 2. Hunter residency and success in Subunits 26B and 26C, 1983-87.

	Successful					Unsuccessful				
Year	Local res.[a]	Other res.	Nonres.	Unk.	Tot.	Local res.	Other res.	Nonres.	Unk	Tot.
1983	0	8	5	0	13	2	5	0	0	7
1984	0	10	8	4	22	2	5	2	0	9
1985	1	24	20	4	49	0	19	3	0	22
1986	0	33	20	9	62	0	8	0	2	10
1987	0	21	22	11	54	1	21	5	3	30

[a] Resident of Subunits 26B or 26C.

Table 3. Harvest composition and hunter numbers and success in Subunits 26B and 26C, 1983-87.

Year	Subunit	Harvest Male	Harvest Female	Harvest Total	No. of hunters	% Success
1983	26B (Dalton Hwy)	3	3	6	10	60
	26B(Remainder)[a]	5	0	5	6	83
	26C	2	0	2	4	50
1984	26B(Dalton Hwy)	6	0	6	13	46
	26B(Remainder)	9	0	9	10	90
	26C	7	0	7	8	88
1985	26B(Dalton Hwy)	8	7	15	22	68
	26B(Remainder)	24	2	26	39	67
	26C	7	1	8	10	80
1986	26B(Dalton Hwy)	18	2	20	21	95
	26B(Remainder)	25	7	32	32	100
	26C	6	4	10	19	53
1987	26B(Dalton Hwy)	15	0	15	21	71
	26B(Remainder)	22	0	22	35	63
	26C	16	1	17	28	61

[a] Those portions of Subunit 26B not adjacent to the Dalton Highway.

Table 4. Antler spreads[a] of bulls harvested from Subunits 26B and 26C, 1983-87.

Year	Subunit	Size Class ≤44.9	45.0 49.9	50.0-54.9	55.0-59.9	60.0-64.9	≥65.0	Unk	Mean antler spread	Total
1983	26B(Dalton Hwy)[b]	1	0	0	0	0	2	0	57.7	3
	26B(Remainder)	1	0	1	1	2	0	0	53.8	5
	26C	0	1	0	0	0	0	1	--	2
1984	26B(Dalton Hwy)	1	3	0	1	1	0	0	51.1	6
	26B(Remainder)	0	0	1	2	4	1	1	61.2	9
	26C	2	0	1	0	3	1	0	53.1	7
1985	26B(Dalton Hwy)	1	0	1	0	3	1	2	53.8	8
	26B(Remainder)	4	1	3	5	8	1	2	53.2	24
	26C	0	2	1	1	2	1	0	56.3	7
1986	26B(Dalton Hwy)	5	1	1	5	5	0	1	50.3	18
	26B(Remainder)	3	1	4	5	6	1	5	53.6	25
	26C	1	1	2	1	1	0	0	51.7	6
1987	26B(Dalton Hwy)	2	1	3	6	3	0	0	53.7	15
	26B(Remainder)	2	3	7	3	6	0	1	53.4	22
	26C	3	1	4	6	2	0	0	52.1	16

[a] Expressed in inches.

[b] Those portions of Subunit 26B not adjacent to the Dalton Highway.

Table 5. Harvest chronology in Subunits 26B and 26C, 1983-87.

Year	Aug	Week in September 1	2	3	4	5	Oct	Nov	Dec	Unk
1983	-	1	3	3	1	-	4	1	0	0
1984	-	2	7	5	3	1	3	0	1	0
1985	-	20	8	2	2	-	4	8	5	0
1986	-	23	13	6	5	-	2	3	4	6
1987	1	19	17	12	3	-	0	0	1	1

Table 6. Successful hunter transport methods in Subunits 26B and 26C, 1983-87.

Year	Air-plane	Horse	Boat	3- or 4-Wheeler	Snow-machine	Off-road vehicle	Highway vehicle	Unk
1983	9	0	1	0	1	2	0	0
1984	16	0	0	3	1	0	1	1
1985	28	0	0	1	12	0	3	5
1986	45	0	0	2	7	2	4	2
1987	44	0	2	0	1	0	0	7

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