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Division of Wildlife Conservation

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1 July 1995 - 30 June 1997

# MOOSE

Mary V. Hicks, Editor

Whitten

Grants W-24-4 and W-24-5
Study 1.0
December 1998

STATE OF ALASKA
Tony Knowles, Governor

DEPARTMENT OF FISH AND GAME
Frank Rue, Commissioner

DIVISION OF WILDLIFE CONSERVATION
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## LOCATION

**GAME MANAGEMENT UNIT:** Unit 1A (5,300 $mi^2$)
Unit 1B (3,000 $mi^2$)
Unit 2 (3,600 $mi^2$)
Unit 3 (3,000 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Southeast mainland and adjacent islands from Cape Fanshaw and Frederick Sound south to the Canada border

## BACKGROUND

Most of the Unit 1A moose population is localized in the Unuk River drainage and appears stable. Good habitat is limited and moose numbers are low. The harvest is sporadic, ranging from 0–8 each year. The Chickamin River supports a few moose and did so before a supplemental transplant in the early 1960s. A short-term increase followed the release, but moose populations have probably returned to pre-translocation levels. Three bulls have been taken from the Chickamin drainage in the past 15 years. Moose are occasionally reported from other parts of Subunit 1A.

Moose in Units 1B and 3 are believed to be the *Alces alces andersonii* subspecies. They emigrated from interior British Columbia via the Coast Range and the Stikine River Valley around the turn of the 20th century.

Moose inhabit several areas of Unit 1B, primarily near Thomas Bay and along the Stikine River. Suitable habitat adjacent to Bradfield Canal has not been colonized, but moose do occur around Virginia Lake, Mill Creek, and Aaron Creek on the mainland. LeConte Bay and Glacier divide Unit 1B for moose management purposes north and west of the Stikine River.

The moose population in Thomas Bay is isolated from populations in Canada by the Coast Mountains. These moose occupy a heavily logged area. The Thomas Bay population may decline significantly as conifer regrowth in clearcut areas matures and reduces forage production. The average annual harvest of Thomas Bay moose during the decades of the 1950s, 1960s, 1970s, and 1980s was 5, 8, 10, and 18, respectively. The season was closed and no harvest occurred in 1982 and 1983.

Moose inhabiting the Alaska portion of the Stikine drainage represent the westernmost tip of a mainland population emanating from Canada. The Alaska portion of this population was estimated at 300 animals in 1983 (Craighead et al. 1984). Since 1983 winters have been mild and the population, based on harvest, probably increased until 1989. Average annual harvest of Stikine River moose from the 1950s to the 1970s was about 27. From 1980 through 1989 the average annual harvest was 42.

Although present-day rumors suggest that moose occurred sporadically on Prince of Wales Island as far back as the 1940s, ADF&G received its first most plausible report in 1987 when the U.S. Forest Service reported a cow and calf sighting near Snakey Lakes. During fall 1991 a cow moose was struck by a pickup truck near Control Lake. In June1993 a Forest Service employee photographed a cow moose walking along the 30 road, located roughly one-half mile south of Ratz Harbor. Additional reports indicate that a population of moose (size and composition unknown) inhabits the Snakey Lakes/Thorne River area of Prince of Wales Island. There is no open hunting season.

Moose inhabit the major islands of Unit 3. Increased sightings of moose during the 1980s and 1990s indicate growing populations. From 1960–67 the season was open from September 15–October 15 with a limit of 1 bull. The season was closed and reopened on Wrangell Island in 1990, and Mitkof Island was opened in 1991. All of Unit 3 was opened in 1993.

## MANAGEMENT DIRECTION

### MANAGEMENT OBJECTIVES

The following moose management objectives for Units 1A, 1B, 2, and 3 are based on biological data and information from the public.

*Unit 1A*

Unuk/Chickamin

| | Plan Objective | 1995 | 1996 |
|---|---|---|---|
| Posthunt numbers | 35 | N/A | N/A |
| Annual hunter kill | 3 | 2 | 4 |
| Number of hunters | 20 | 45 | 36 |
| Hunter-days of effort | 90 | 243 | 203 |
| Hunter success | 15% | 4% | 11% |

*Unit 1B*

Stikine River

| | Plan Objective | 1995 | 1996 |
|---|---|---|---|
| Posthunt numbers | 450 | N/A | N/A |
| Annual hunter kill | 40 | 5 | 18 |
| Number of hunters | 300 | 95 | 130 |
| Hunter-days of effort | 2100 | 542 | 896 |
| Hunter success | 13% | 5% | 14% |

Thomas Bay

| | Plan Objective | 1995 | 1996 |
|---|---|---|---|
| Posthunt numbers | 200 | N/A | N/A |
| Annual hunter kill | 20 | 14 | 25 |
| Number of hunters | 160 | 127 | 148 |
| Hunter-days of effort | 675 | 608 | 818 |
| Hunter success | 12% | 11% | 16% |

*Unit 2*

No objectives have been developed.

*Unit 3*

During the formulation of the Region I moose plan in the late 1980s, we were unaware that by the mid-1990s a moose population would be established and support an annual harvest. Unit 3 moose harvest is often opportunistic, and habitat management, more than other factors, will undoubtedly affect moose numbers and hunting opportunity. We cannot estimate how long Unit 3 habitat will support a viable moose population. The issue of rebuilding the Sitka black-tailed deer population on the Unit 3 islands compounds the complexity of establishing moose management goals. Now moose numbers are high enough to support a hunting season in Unit 3, and we intend to continue the hunt as long as hunting does not affect the integrity of the population. We established the following draft goals for Unit 3 moose, which include a crude estimate of population size based on harvest, limited knowledge of habitat and moose movements, and anecdotal information from people in the field.

| | Plan Objective | 1995 | 1996 |
|---|---|---|---|
| Posthunt numbers | 300 | N/A | N/A |
| Annual hunter kill | 30 | 13 | 24 |
| Number of hunters | 350 | 337 | 353 |
| Hunter-days of effort | 1750 | 1493 | 1976 |
| Hunter success | 9% | 4% | 7% |

## METHODS

No moose surveys were flown along Unuk River during the 1995–97 seasons.

Late winter surveys and fall rutting surveys were flown along the Stikine River valley. Hunters and harvested moose were checked in the field on the Stikine River and Thomas Bay hunts. Field data were used to reconcile written hunter reports. In Wrangell and Petersburg we attended public meetings that discussed moose management.

Hunters in Units 1B and 3 were asked to report on their registration permit the total number of moose (bulls, cows, and calves), wolves, and bears they saw during the hunting season.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

Data are insufficient to make a quantitative determination of population trends during the past five years. Moose populations appeared stable at low density in Unit 1A. The Thomas Bay population in northern Unit 1B seemed stable at high density. The Stikine River population in Unit 1B (moderate density) appeared to be increasing. More reports of moose in Unit 2 may indicate more moose or be a function of increased human access into once remote areas. The number of moose in Unit 3 (low to moderate density) appeared to be increasing.

According to Craighead, the Stikine River population was estimated at 300 moose and increasing in 1983. Post-1983 harvest levels indicated the Stikine population slowly increased and then began to decrease in 1988. The percentage of calves surviving to late winter declined from 1980 to 1989 and remained low until 1994. In 1995 and 1996 the percentage of calves surviving to late winter increased to 18% and 22%, respectively (Table 1). Hunters took 57 bulls in 1988, and the kill has dropped each succeeding year to a low of 3 in 1994 (taken under a Federal permit; the State season was closed by emergency order in 1994.)

In the late 1970s the Thomas Bay population was estimated at 180 moose (ADF&G files, Petersburg). Based on increased harvest and observed habitat use, the current population is higher.

No population data are available for Units 2 or 3.

*Population Composition*

Table 1 shows the results of all surveys made in the Stikine River valley since 1988/89. Dense coniferous forest and inclement weather make adequate surveys difficult. No attempt was made to differentiate between bulls and cows, but adults and calves were differentiated during late winter aerial surveys.

*Distribution and Movements*

Moose have been seen crossing Dry Straits between Farm Island on the Stikine River delta and Mitkof Island. At low tide moose easily cross this strait and move back and forth along this passage. Radio telemetry of Stikine moose found no evidence of extensive seasonal migration (Craighead et. al., 1984). Rutting surveys in 1995 and 1996 identified Dry Wash, Andrew Island, and Barnes Lake as important rutting areas on the Stikine River. Moose appear to be well distributed in the Alaska portion of the Stikine River valley, Thomas and Farragut bays, and on the islands of Mitkof, Wrangell, and Kupreanof. Moose have been reported on Etolin, Zarembo, and Kuiu islands. Moose seem absent from the Bradfield Canal area where several river valleys have suitable habitat.

**MORTALITY**

*Harvest*

Season and Bag Limit.

| | | |
|---|---|---|
| Unit 1A | Sep 15–Oct 15 | 1 bull by registration permit only |
| Unit 1B | Sep 15–Oct 15 | 1 bull with spike/fork-50"/3 brow tine antlers, by registration permit only |
| Unit 2 | No open season | |

| | | |
|---|---|---|
| Unit 3 | Sep 15–Oct 15 | 1 bull with spike/fork-50"/3 brow tine antlers, by registration permit only |

Board of Game Actions and Emergency Orders. Action by the Board of Game effective July 1, 1995 put all of Units 1B and 3 and that portion of 1C south of Point Hobart under 1 registration permit (RM038). A legal moose for this registration permit hunt is a bull with a spike/fork or 50-inch antlers or three brow tines on at least one side. The last week of the 1995 season was closed by emergency order effective October 8. The closure was due to the high percentage of illegal moose taken.

Hunter Harvest. During 1995–96, 78 individuals obtained registration permits for hunting moose in Unit 1A, of which 45 actually hunted. Three moose were reported harvested, including 1 illegal cow (Table 2). During 1996–97, 63 individuals obtained registration permits, 36 hunted, and hunters harvested 4 moose.

The moose harvest on the Stikine portion of Unit 1B was 5 in 1995 before the season was closed by emergency order (Table 3). The moose harvest increased to 18 in 1996.

In 1995 14 moose were harvested in Thomas Bay before the emergency closure (Table 4). In 1996 hunters harvested 25 moose.

The Unit 3 kill was 13 in 1995 before the emergency closure (Table 5). The 1996 harvest of 24 was the highest ever recorded.

Hunter Residency and Success. Unit 1A moose hunters continue to be primarily Ketchikan and Metlakatla residents. Many of these moose hunters own cabins on the Unuk River.

All 1995 and 1996 successful hunters on the Stikine were local residents from Petersburg or Wrangell (Table 6). The success rate was 4% and 14% for 1995 and 1996, respectively.

Petersburg residents continued to dominate the Thomas Bay hunt (Table 7). The success rate was 11% in 1995 and 16% in 1996.

Harvest Chronology. Harvest chronology for Units 1A, 1B, and 3 remains fairly consistent. Most bulls are killed in the first half of the season, and the kill rate declines throughout the season (Table 8). Most hunters are in the field early in the season, then effort drops except on weekends. Inclement weather does not seem to slow hunting effort early in the season.

Transport Methods. There were no apparent changes in trends of transportation used by hunters in Units 1A and 1B. Most hunters used boats and one or two hunters used airplanes (Table 9). Hunters in Unit 3 relied on highway vehicles and the extensive road system to reach the field. Motorized land vehicles are prohibited for moose hunting in the Thomas Bay hunt and the Stikine Wilderness. In Thomas Bay vehicles may be used for any purpose except the moose hunting.

*Other Mortality*

Wolves, black bears, and brown bears are moose calf predators, and wolves and brown bears take adult moose. The extent of predation on these moose populations is unknown, but some years few calves are recruited into the Stikine population.

### HABITAT

Thomas Bay moose have used young-aged clearcuts since logging began in the 1950s. Conifer re-growth in the clearcuts is progressively reducing moose habitat, and canopy closure is reducing moose habitat value. The U.S. Forest Service cleared a 100-acre plot along the Patterson River to investigate the feasibility of improving moose habitat. Regrowth has been browsed heavily during the summer, leaving little winter habitat. Pre-commercial thinning on Forest Service land has been successful in extending the habitat value of clear-cuts an estimated 20–30 years. In March 1997 the Alaska Department of Fish and Game developed a plan to enhance the moose habitat on State land at Thomas Bay. The plan calls for opening up 10 miles of State logging roads and treating 386 acres of clearcuts primarily by pre-commercial thinning and partial strip clearing.

Stikine moose range lies mostly within the USFS Stikine/LeConte Wilderness area and the Stikine River drainage. Moose habitat in this area, identified by Craighead (1984), is designated wilderness and cannot be manipulated mechanically for habitat improvement. In 1984 Craighead reported that 19 transects were surveyed to determine the condition and availability of moose winter browse in the Stikine River corridor. The transects were revisited in June 1991 and in June 1997. The preferred browse species were willow (*Salix* spp.) and red osier dogwood (*Cornus stolonifera*). The total percent available browse heavily used was 62.2% *Salix* spp. and 63.9% *Cornus* spp. in June 1997 (Elze 1997). In 1991 the percentage in the heavy use category was 15.8% for *Salix* spp. and 13.8% for *Cornus* spp. (Stoneman 1992). In 1997 most plants recorded were in the heavily used category compared to 1991 when most plants were in the zero–moderate use categories (Stoneman, 1992).

## CONCLUSIONS AND RECOMMENDATIONS

Generally throughout these units, although we did not meet population and harvest objectives, the percent successful hunters objective was met in some areas. The small Unuk and Chickamin River moose populations attract very few hunters. The change to a registration permit has provided more accurate reporting. The Unit 1B Stikine moose population size, harvest, and hunter number objectives were not met, but the percent successful hunters was met in 1996. The Stikine moose population reached a low in 1994 and has been increasing since then. In Thomas Bay the harvest and number of hunters did not meet the management objectives. Unlike in the Stikine hunt, in 1996 Thomas Bay's percent of successful hunters did not meet the management objective. We recommend that Unit 2 remain closed to the taking of moose. In Unit 3 the harvest continues to increase and the moose population is growing on the islands.

We recommend that Units 1B and 3 remain unified under one registration permit with season dates from September 15–October 15 and a bag limit of one bull with spike/fork or 50" antlers or with at least 3 brow tines on 1 antler.

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Table 1 Unit 1B Stikine area aerial moose surveys, 1989–96

| Regulatory Year Month/Day | Adults | Calves | (%) | Unidentified | Total Moose | Moose per/hour |
|---|---|---|---|---|---|---|
| 1989/90 | | | | | | |
| 07/27 | 45 | 14 | (23) | 2 | 61 | 31 |
| 03/02 | 27 | 2 | (7) | 0 | 29 | 16 |
| 03/08 | 61 | 5 | (8) | 0 | 66 | 36 |
| 1990/91 | | | | | | |
| 07/20 | 23 | 3 | (11) | 2 | 28 | 22 |
| 07/25 | 10 | 1 | (9) | 0 | 11 | 10 |
| 07/27 | 30 | 0 | (0) | 0 | 30 | 12 |
| 08/11 | 8 | 3 | (23) | 2 | 13 | 6 |
| 08/18 | 26 | 3 | (10) | 0 | 29 | 12 |
| 12/15[a] | 70 | 12 | (15) | 0 | 82 | 50 |
| 02/20[a] | 38 | 6 | (14) | 0 | 44 | 34 |
| 03/05[a] | 89 | 5 | (5) | 0 | 94 | 32 |
| 05/19[b] | 0 | 0 | (0) | 2 | 2 | 2 |
| 1991/92 | | | | | | |
| 03/03[c] | 6 | 0 | (0) | 0 | 6 | 18 |
| 1992/93 | | | | | | |
| 12/19[a] | 59 | 12 | (16) | 2 | 73 | 21 |
| 03/25[a] | 73 | 7 | (9) | 0 | 80 | 34 |
| 1993/94 | | | | | | |
| 02/10[a,d] | 46 | 4 | (8) | 0 | 50 | 39 |
| 1994/95 | | | | | | |
| 03/02 | 34 | 0 | (0) | 0 | 34 | |
| 04/08 | 30 | 1 | (3) | 0 | 31 | |
| 1995/96 | | | | | | |
| 02/25 | 76 | 17 | (18) | 0 | 93 | 26 |
| 1996/97 | | | | | | |
| 3/08 | 122 | 35 | (22) | 0 | 157 | 47 |

[a] Helicopter survey.
[b] River stage high, full leaf-out in lower river, moose not visible.
[c] Helicopter survey aborted due to weather.
[d] Farm Island to 15 Mile Island only, then abandoned due to weather.

Table 2 Unit 1A moose harvest, 1986–96

| | Hunter Harvest | | | | | |
|---|---|---|---|---|---|---|
| Regulatory | Reported | | | | | |
| Year | M | (%) | F | (%) | Unk. | Total |
| 1986/87 | 0 | (0) | 0 | (0) | 0 | 0 |
| 1987/88 | 2 | (100) | 0 | (0) | 0 | 2 |
| 1988/89 | 6 | (100) | 0 | (0) | 0 | 6 |
| 1989/90 | 1 | (100) | 0 | (0) | 0 | 1 |
| 1990/91 | 5 | (100) | 0 | (0) | 0 | 5 |
| 1991/92[a] | 3 | (75) | 1 | (25) | 0 | 4 |
| 1992/93 | 5 | (100) | 0 | (0) | 0 | 5 |
| 1993/94 | 3 | (100) | 0 | (0) | 0 | 3 |
| 1994/95 | 6 | (100) | 0 | (0) | 0 | 6 |
| 1995/96[a] | 2 | (67) | 1 | (33) | 0 | 3 |
| 1996/97 | 4 | (100) | 0 | (0) | 0 | 4 |

[a] Illegal cow kills

Table 3 Unit 1B (Stikine) moose harvest, 1986–96

| | Hunter Harvest | | | | | |
|---|---|---|---|---|---|---|
| Regulatory | Reported | | | | | |
| Year | M | (%) | F | (%) | Unk. | Total |
| 1986/87 | 41 | (100) | 0 | (0) | 0 | 41 |
| 1987/88 | 47 | (100) | 0 | (0) | 0 | 47 |
| 1988/89 | 57 | (100) | 0 | (0) | 0 | 57 |
| 1989/90 | 38 | (100) | 0 | (0) | 0 | 38 |
| 1990/91 | 36 | (97) | 1 | (3) | 0 | 37 |
| 1991/92 | 24 | (96) | 1 | (4) | 0 | 25 |
| 1992/93 | 18 | (95) | 1 | (5) | 0 | 19 |
| 1993/94 | 14 | (100) | 0 | (0) | 0 | 14 |
| 1994/95[a] | State Season Closed By Emergency Order | | | | | 3 |
| 1995/96 | 5 | (100) | 0 | (0) | 0 | 5 |
| 1996/97 | 18 | (100) | 0 | (0) | 0 | 18 |

[a] Taken under Federal Permit.

Table 4 Unit 1B (Thomas Bay) moose harvest, 1986–96

| Regulatory Year | Hunter Harvest Reported M | (%) | F | (%) | Unk. | Total |
|---|---|---|---|---|---|---|
| 1986/87 | 15 | (100) | 0 | (0) | 0 | 15 |
| 1987/88 | 22 | (100) | 0 | (0) | 0 | 22 |
| 1988/89 | 27 | (100) | 0 | (0) | 0 | 27 |
| 1989/90 | 20 | (100) | 0 | (0) | 0 | 20 |
| 1990/91 | 25 | (100) | 0 | (0) | 0 | 25 |
| 1991/92 | 15 | (100) | 0 | (0) | 0 | 15 |
| 1992/93[a] | 27 | (96) | 1 | (4) | 0 | 28 |
| 1993/94 | 27 | (100) | 0 | (0) | 0 | 27 |
| 1994/95 | 11 | (100) | 0 | (0) | 0 | 11 |
| 1995/96[b] | 15 | (100) | 0 | (0) | 0 | 15 |
| 1996/97[c] | 24 | (94) | 1 | (6) | 0 | 25 |

[a] Includes illegal kill
[b] Includes one moose harvested in Port Houghton
[c] Includes DLP

Table 5 Unit 3 moose harvest, 1990–96

| Regulatory Year | Hunter Harvest Reported M | (%) | F | (%) | Unk. | Total | Illegal | Total |
|---|---|---|---|---|---|---|---|---|
| 1990/91[a] | 3 | (100) | 0 | (0) | 0 | 3 | 0 | 3 |
| 1991/92[b] | 10 | (100) | 0 | (0) | 0 | 10 | 0 | 10 |
| 1992/93 | 17 | (100) | 0 | (0) | 0 | 17 | 0 | 17 |
| 1993/94 | 13 | (100) | 0 | (0) | 0 | 13 | 0 | 13 |
| 1994/95 | 19 | (100) | 0 | (0) | 0 | 19 | 0 | 19 |
| 1995/96 | 13 | (100) | 0 | (0) | 0 | 13 | 0 | 13 |
| 1996/97 | 21 | (100) | 0 | (0) | 0 | 21 | 3 | 24 |

[a] Wrangell Island only
[b] Wrangell and Mitkof islands

Table 6 Unit 1B (Stikine) moose hunter residency and success, 1986–96

| Regulatory Year | Successful: Local Resident[a] | Successful: Nonlocal Resident | Successful: Non-Resident | Successful: Unk. | Successful: Total | Successful: (%) | Unsuccessful: Local Resident[a] | Unsuccessful: Nonlocal Resident | Unsuccessful: Non-Resident | Unsuccessful: Unk. | Unsuccessful: Total | Unsuccessful: (%) | Total Hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986/87 | 28 | 9 | 1 | 3 | 41 | (17) | 150 | 46 | 2 | 1 | 199 | (83) | 240 |
| 1987/88 | 37 | 7 | 1 | 2 | 47 | (21) | 127 | 49 | 0 | 5 | 181 | (79) | 228 |
| 1988/89[b] | 41 | 16 | 0 | 0 | 57 | (19) | 167 | 74 | 4 | 3 | 248 | (81) | 305 |
| 1989/90[b] | 23 | 15 | 0 | 0 | 38 | (13) | 170 | 106 | 7 | 0 | 283 | (87) | 321 |
| 1990/91[b] | 36 | 0 | 1 | 0 | 37 | (12) | 215 | 27 | 1 | 0 | 243 | (88) | 280 |
| 1991/92[b] | 23 | 1 | 1 | 0 | 25 | (12) | 146 | 34 | 5 | 5 | 190 | (88) | 215 |
| 1992/93 | 16 | 2 | 0 | 1 | 19 | (8) | 183 | 24 | 3 | 1 | 211 | (92) | 229 |
| 1993/94 | 14 | 0 | 0 | 0 | 14 | (10) | 121 | 6 | 0 | 0 | 127 | (90) | 141 |
| 1994/95[c] | State Season Closed By Emergency Order | | | | 3 | | | | | | | | |
| 1995/96 | 5 | 0 | 0 | 0 | 5 | (4) | 91 | 6 | 0 | 0 | 97 | (96) | 102 |
| 1996/97 | 18 | 0 | 0 | 0 | 18 | (14) | 105 | 7 | 0 | 0 | 112 | (86) | 130 |

[a] Residents of Petersburg and Wrangell

[b] Unsuccessful hunter data expanded to correct for nonreporting hunters

[c] Three moose taken under federal permit

Table 7 Unit 1B (Thomas Bay) moose hunter residency and success, 1986–96

| Regulatory Year | Successful | | | | | Unsuccessful | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[a] Resident | Nonlocal Resident | Non-Resident | Total | (%) | Local[a] Resident | Nonlocal Resident | Non-Resident | Total | (%) | Total Hunters |
| 1986/87 | 13 | 2 | 0 | 15 | (10) | 116 | 22 | 1 | 139 | (90) | 154 |
| 1987/88 | 21 | 0 | 1 | 22 | (20) | 79 | 7 | 2 | 88 | (80) | 110 |
| 1988/89 | 27 | 0 | 0 | 27 | (23) | 87 | 5 | 1 | 93 | (77) | 120 |
| 1989/90[b] | 18 | 2 | 0 | 20 | (14) | 119 | 7 | 0 | 126 | (86) | 146 |
| 1990/91[b] | 23 | 2 | 0 | 25 | (15) | 126 | 10 | 1 | 137 | (85) | 162 |
| 1991/92[b] | 14 | 1 | 0 | 15 | (12) | 96 | 12 | 0 | 108 | (88) | 123 |
| 1992/93[b] | 25 | 2 | 1 | 28 | (25) | 77 | 6 | 0 | 83 | (75) | 111 |
| 1993/94[b] | 26 | 1 | 0 | 27 | (20) | 103 | 4 | 1 | 108 | (80) | 135 |
| 1994/95 | 11 | 0 | 0 | 11 | (9) | 108 | 9 | 0 | 117 | (91) | 128 |
| 1995/96 | 14 | 1 | 0 | 15 | (11) | 108 | 8 | 0 | 116 | (89) | 131 |
| 1996/97 | 23 | 2 | 0 | 25 | (16) | 107 | 15 | 1 | 123 | (84) | 148 |

[a] Residents of Petersburg and Wrangell
[b] Includes illegal kill

Table 8 Harvest chronology in Units 1B and 3, 1990–96

| Area | Year | 15–21 Sep | 22–28 Sep | 29 Sep–5 Oct | 6–15 Oct |
|---|---|---|---|---|---|
| Thomas Bay | 1993/94 | 0 | 0 | 19 | 8 |
| | 1994/95 | 0 | 0 | 9 | 2 |
| | 1995/96 | 8 | 3 | 2 | 2 |
| | 1996/97 | 11 | 5 | 3 | 6 |
| Stikine | 1993/94 | 5 | 1 | 4 | 4 |
| | 1994/95 | State Season Closed by EO | | | |
| | 1995/96 | 3 | 1 | 0 | 1 |
| | 1996/97 | 6 | 6 | 2 | 4 |
| Unit 3 | 1993/94 | 0 | 0 | 7 | 6 |
| | 1994/95 | 0 | 0 | 15 | 4 |
| | 1995/96 | 4 | 1 | 5 | 3 |
| | 1996/97 | 9 | 6 | 4 | 5 |

Table 9 Successful hunter transport methods by area, 1990–96

| Area | Year | Airplane | Boat | Highway Vehicle | 3- 4-Wheeler | Horse | Unknown | Total |
|---|---|---|---|---|---|---|---|---|
| Thomas Bay | 1990/91 | 1 | 22 | 0 | 2 | 0 | 0 | 25 |
| | 1991/92 | 1 | 14 | 0 | 0 | 0 | 0 | 15 |
| | 1992/93 | 0 | 27 | 0 | 0 | 1 | 0 | 28 |
| | 1993/94 | 4 | 23 | 0 | 0 | 0 | 0 | 27 |
| | 1994/95 | 1 | 9 | 0 | 0 | 0 | 1 | 11 |
| | 1995/96 | 3 | 11 | 1 | 0 | 0 | 0 | 15 |
| | 1996/97 | 0 | 25 | 0 | 0 | 0 | 0 | 25 |
| Stikine | 1993/94 | 1 | 13 | 0 | 0 | 0 | 0 | 14 |
| | 1994/95 | State Season Closed by EO | | | | | | |
| | 1995/96 | 0 | 5 | 0 | 0 | 0 | 0 | 5 |
| | 1996/97 | 2 | 16 | 0 | 0 | 0 | 0 | 18 |
| Unit 3 | 1993/94 | 1 | 0 | 12 | 0 | 0 | 0 | 13 |
| | 1994/95 | 0 | 3 | 16 | 0 | 0 | 0 | 19 |
| | 1995/96 | 1 | 1 | 11 | 0 | 0 | 0 | 13 |
| | 1996/97 | 1 | 5 | 17 | 1 | 0 | 0 | 24 |

# LOCATION

**GAME MANAGEMENT UNIT:** 1C (7,600 mi$^2$)

**GEOGRAPHIC DESCRIPTION:** The Southeast Alaska mainland and the islands of Lynn Canal and Stephens Passage lying between Cape Fanshaw and the latitude of Eldred Rock, including Sullivan Island and the drainages of Berners Bay

# BACKGROUND

Moose were first documented in western Unit 1C in 1962 on the Bartlett River. In 1963 moose were observed in the Chilkat Mountain range; these moose probably originated from the Chilkat Valley population near Haines. By 1965 moose were first seen in the Endicott River valley and St. James Bay areas. Moose had probably moved into the Adams Inlet area (Glacier Bay) by that time because sightings were recorded for nearby Gustavus by 1968.

Swarth (1922) states that a moose was killed at the mouth of the Stikine River "some years" before 1919. If moose appeared at the same time on the Taku River, then presumably they first inhabited the lower part of the river near the turn of the century. In 1960 ADF&G biologists observed 38 moose on the Taku; 27 moose were harvested there. Moose also live near the Whiting and Speel rivers south of the Taku; these animals may have originated from the Taku population, the Whiting itself, or from other sources. In recent years moose and their sign have been seen regularly in the Port Houghton area. These moose probably moved across the Fanshaw Peninsula from the Farragut Bay/Thomas Bay population.

Moose did not naturally inhabit the Berners Bay area. Fifteen calves from the Anchorage area were released at Berners Bay in 1958. In 1960 we translocated another 6 calves. In June 1960 we observed 3 cows with a single calf each, indicating that the 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 5–23 animals.

# MANAGEMENT DIRECTION

**MANAGEMENT OBJECTIVES**

The following objectives identified by staff were based on biological data and information from the public.

Taku Area: Maintain a posthunt population of 150 moose, an annual harvest of 20, and a hunter success rate of 20% by 1994.

Berners Bay: Maintain a posthunt population of 90 moose, an annual harvest of 8, and a hunter success rate of 80% by 1994.

Chilkat Range: Maintain a posthunt population of 150 moose, an annual harvest of 10, and a hunter success rate of 15% by 1994.

## METHODS

Aerial surveys were not conducted throughout most of Unit 1C during the report period due to a combination of factors, including loss of staff positions, poor weather, and commitments to other telemetry flights near Juneau. Moose survey efforts were concentrated in Units 1D and 5A during this period.

Department staff collected incisors from moose taken in Unit 1C from successful hunters who brought in jaws as a condition of their permit. Data collected from drawing and registration permits included the length of hunt, hunter residency, hunt location, commercial services used, and transport means (for all hunters), and date of kill (for successful hunters).

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

Moose are occupying the Berners Bay area near the estimated carrying capacity (100–150 animals) and are being harvested selectively to adjust the bull to cow ratio (Table 1). In the Taku area some evidence indicates that moose numbers may be decreasing, although animals moving down river from Canada may supplement the population. Population dynamics are not well understood for the Chilkat Range moose population, but harvest levels and anecdotal comments from hunters in the field indicate that moose numbers are stable or increasing. The effect of this harvest level to the population is unknown. It is believed that moose moving from the Adams Inlet area within Glacier Bay National Park may be supplementing the harvest in the Endicott River area. An influx of moose from the park is also supporting an increasing harvest on state land at Gustavus.

*Population Size*

In Berners Bay the number of moose observed in fall and winter surveys has increased since 1986 (Table 1). An estimated 100–150 moose probably inhabit Berners Bay drainages.

Recent survey data for the Chilkat Range are scarce. A late winter survey of Adams Inlet within Glacier Bay National Park in 1993 found 79 adults and 11 calves. Another survey flown of the Gustavus Forelands in April 1997 found only 20 moose under very poor viewing conditions (Table 1). The Endicott River valley and the St. James Bay portion of the Chilkat Range support an unknown number of moose and receive hunting pressure each fall. We believe that earlier in the century animals in these areas emigrated to Adams Inlet in Glacier Bay, where willow communities pioneered following glacial retreat. Moose from Adams Inlet may now be moving back to the east, supplementing the population along the western shore of Lynn Canal. Moose numbers have apparently increased in the Gustavus Forelands, where glacial retreat has improved moose habitat.

We estimate there are about 150 moose between Taku River and Cape Fanshaw. Moose from Canada quite possibly supplement the Taku population, but the harvest in Canada has apparently increased in recent years. No surveys have been flown in the Taku area since 1988 (Table 1). Further south on the mainland, a few moose have been harvested in the Port Houghton area. These moose are undoubtedly an extension of the group using Thomas and Farragut bays south of the Fanshaw Peninsula and are disjunct from other Unit 1C populations. Most, if not all, of the effort directed at Port Houghton moose comes from Petersburg residents. In 1995 Port Houghton was included in the antler restriction moose hunt conducted in Units 1B and 3, and any Port Houghton moose taken are included in the management report covering those units.

*Population Composition*

No surveys of Berners Bay were flown during this report period. The 1994 survey that included 75 moose, a bull to cow ratio of 38:100, and a calf to cow ratio of 29:100 is our best estimate of this population's status.

Mean age of harvested male Berners Bay moose was 1.7 years for both years of this report period and represents the lowest mean age on record for the Berners Bay hunt. The average age of females was the second highest on record, with only the 1994 mean of 6.6 years being higher.

Mean age of harvested Chilkat Range bull moose in 1995 and 1996 (4.4 and 4.6 years, respectively) was considerably greater than that of Taku River moose (2.1 and 1.6 years). The same relationship was evident over the last 5 years (Table 3). Also, a greater number of age classes were represented in the Chilkat Range harvest.

## MORTALITY

*Harvest*

| Season and Bag Limits. | Resident and nonresident hunters | |
|---|---|---|
| Unit 1C, Berners Bay drainages only | Sep 15–Oct 15 | 1 moose by drawing permit. Up to 20 permits will be issued. |
| Unit 1C, except Berners Bay drainages | Sep 15–Oct 15 | 1 bull by registration permit only |

Board of Game Actions and Emergency Orders. The Board of Game increased the number of Berners Bay permits at the spring 1993 meeting. We now issue up to 20 drawing permits for the area, with the number and sex of moose to be taken based on aerial survey results. No emergency orders were issued during the period.

Hunter Harvest. The Berners Bay drawing permit hunt was managed for a harvest of 15 moose each year during the previous report period (Table 4). The ratio of male to female moose established for the harvest has been based on aerial survey data. Based on the number of moose seen during surveys, we provided permits for 8 bulls and 7 cows in 1995 and 9 bulls and 8 cows in 1996. Poaching in Berners Bay is minimal because of closeness to Juneau and people who spend considerable time there.

The balance of Unit 1C is managed using a registration permit with no hunt quota. The known Taku area harvest has ranged between 14–20 moose since 1990, and the take in the Chilkat

Range (exclusive of Gustavus) has ranged between 6–17 (Table 5). The Gustavus harvest, treated in this report separately from the rest of the Chilkat Range area for the first time, has climbed dramatically to 30 bulls in 1996. Harvest in Unit 1C outside of Berners Bay continues to increase, largely due to the influence of the Gustavus hunt. A total of 49 and 66 moose were harvested in 1995 and 1996, respectively, in this area. During the same period, harvest in the Taku area has remained at more historic levels. Coupled with the Berners Bay harvest, the total harvest in Unit 1C is at an historic high.

In the Taku area some portion of the moose harvest claimed by Alaska hunters is probably taken in British Columbia. The magnitude of this take is unknown. Other illegal take (e.g., killed out of season, females, etc.), likely occurs on the Taku River within Alaska as well, as it undoubtedly does in the Endicott drainage and other sites in the Chilkat Range.

Permit Hunts. Over 1500 applications were submitted for the Berners Bay moose drawing each year of the report period. The proximity of the hunt to Juneau and the high success rate explain the popularity of this hunt. In 1995, 1648 hunters applied for 8 bull and 7 cow permits, for a combined success rate of 0.9%. In 1996, 1568 hunters applied for 9 bull and 8 cow permits, for a success rate of 1.1%.

Since the registration permit hunt was implemented for Unit 1C excluding Berners Bay, over 200 permits have been issued annually. In 1995 we issued 380 permits. The following season a record 396 were issued (Table 4). Of these permittees, 288 actually hunted in 1995 and 281 hunted in 1996. During the report period the numbers of hunters using the Chilkat Range, the Gustavus area, and the Taku area were split almost exactly in thirds. Reporting compliance has remained high over the years.

Hunter Residency and Success. Most moose harvested in Unit 1C continue to be taken by local residents (Table 6). In 1995 and 1996, 55 (89%) and 73 (95%) moose, respectively, were taken by residents of the subunit. This is probably because moose habitats are not readily accessible by highway vehicle, residents from elsewhere in Alaska have better opportunities for moose hunting closer to home, and nonresidents eager to take moose focus on areas with larger moose populations. In 1995, 21% of all Unit 1C hunters were successful. In 1996 the success rate climbed to 26%, with hunters of the Gustavus area being more successful than either Chilkat Range or Taku hunters (Table 5).

Harvest Chronology. Unlike the preceding few seasons, moose harvest was heavily weighted toward the early part of both seasons of the report period. Forty-five percent of the moose killed in 1995 were taken during the first week of the season, and 55% were taken during that period in 1996. Although there was a surge in moose kills during the third week of the 1996 season (26%), at no time did the rate of take approach that of the first week.

Transport Methods. Boats continue to be the most common form of transportation for moose hunters in Unit 1C (Table 7); 58% of all successful hunters used boats this reporting period. Airplanes and highway vehicles were also used, with 21% and 4% of moose hunters using these means, respectively. The predominant use of boats is not surprising, since most hunting areas are removed from highway access points, seasons are closed before the winter season, and aircraft landing sites are limited. Gustavus hunters primarily used highway vehicles.

*Other Mortality*

No natural mortality was documented during the report period. Three bull moose were illegally harvested in the Chilkat range in 1996, and a cow was wounded and later destroyed at Gustavus in 1996.

### HABITAT

No habitat assessment or enhancement activities were carried out during the period.

## CONCLUSIONS AND RECOMMENDATIONS

All management objectives were surpassed for Berners Bay. Hunter success was nearly 100% during the reporting period, and the harvest exceeded 8 animals each year. Management objectives for hunter success and harvest were reached for the Chilkat Range, with the harvest objective (10 animals) approximately tripled in 1995 and five times the objective in 1996. The increased 1996 harvest was reflected in hunter success, which went from 17% in 1995 to 28% in 1996. Almost all of this increase can be attributed to the Gustavus hunt. However, the status of the moose population throughout the Chilkat Range remains unknown, as surveys have not been conducted successfully due to limited snow cover and dense forest canopy. Staff should consider keeping management objectives for the Gustavus area separate from the remainder of the Chilkat Range. Management objectives for the Taku River area were not met during this report period. The status of the population is unknown, harvest was below 20 moose during both years of the reporting period, and hunter success was about 16%.

Although no surveys were performed, anecdotal evidence suggests that the Unit 1C moose population is moderately dense yet healthy. A 1992 survey of Adams Inlet in the Chilkat Range indicated high numbers of overwintering moose. Rising effort and harvest in the Gustavus area increase the importance of acquiring moose population data there. Decreasing effort in the Taku area indicates the population may be declining, increasing the importance of acquiring survey data. We believe that a continuation of the permit registration system should accommodate current population objectives in Unit 1C.

Throughout the subunit jaws from moose kills should continue to be collected for age analysis. Areas supporting winter browse should be analyzed to estimate the status of moose populations in relation to carrying capacity. Once population and carrying capacity estimates are made for the Taku, Gustavus, and Chilkat Range populations, we can consider revising management objectives for those areas as necessary.

## LITERATURE CITED

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Table 1 Unit 1C aerial survey data

| Year | Bulls | Cows | Calves | Unknown | Total moose | Count time (hrs) | Bulls per 100F | Calves per 100F | Calves % in herd | Moose per hour |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Berners Bay | | | | | |
| 1990 | 14 | 53 | 18 | | 85 | 2.6 | 26 | 34 | 21 | 33 |
| 1991[1] | --- | --- | 11 | | 61 | 1.2 | | | 18 | 50 |
| 1992 | 14 | 61 | 8 | | 83 | 2.8 | 23 | 13 | 10 | 29 |
| 1993[1] | --- | --- | 12 | 45 | 67 | 2.8 | --- | --- | 18 | 24 |
| 1994 | 17 | 45 | 13 | | 75 | 2.0 | 38 | 29 | 17 | 38 |
| 1995 | | | | | No Survey | | | | | |
| 1996 | | | | | No Survey | | | | | |
| | | | | | Chilkat Range | | | | | |
| 1968 | 1 | 2 | 1 | | 4 | | 50 | 50 | 25 | |
| 1975 | 0 | 3 | 2 | | 5 | | 0 | 67 | 40 | |
| 1986 | 3 | 10 | 6 | | 19 | 1.5 | 30 | 60 | 32 | |
| 1987–91 | | | | | No Surveys | | | | | |
| 1992[2] | --- | --- | 11 | 79 | 97 | 1.3 | --- | --- | 13 | 75 |
| 1993–94 | | | | | No Survey | | | | | |
| 1995 | | | | | No Survey | | | | | |
| 1996[3] | | | | 20 | | | | | | |
| | | | | | Taku | | | | | |
| 1978 | 3 | 30 | 15 | | 49 | 3.4 | 10 | 50 | 31 | 14 |
| 1983 | 2 | 40 | 12 | | 54 | 1.7 | 5 | 30 | 22 | 32 |
| 1986 | 2 | 42 | 1 | | 45 | 1.8 | 5 | 2 | 2 | 25 |
| 1987 | | | | | No Survey | | | | | |
| 1988[1] | 2 | 16 | 4 | | 22 | 1.6 | 13 | 25 | 18 | 14 |
| 1989–1996 | | | | | | No Surveys | | | | |

[1] Late winter survey; sex and age information unreliable.
[2] Late winter survey of Adams Inlet only; sex and age information unreliable.
[3] April survey with marginal snow cover.

Table 2 Unit 1C age at harvest of Berners Bay moose, 1990–96

| | | | | | | | | Age | Class | | | | | | | | Total | % | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 0.5 | 1.5 | 2.5 | 3.5 | 4.5 | 5.5 | 6.5 | 7.5 | 8.5 | 9.5 | 10.5 | 11.5 | 12.5 | 13.5 | 14.5 | 15.5 | Kill | Aged | Age |
| | | | | | | | | | Males | | | | | | | | | | |
| 1990 | 0 | 0 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 100 | 3.5 |
| 1991 | 0 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 100 | 3.3 |
| 1992 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 20 | 3.5 |
| 1993 | 0 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 100 | 4.3 |
| 1994 | 0 | 2 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 88 | 4.7 |
| 1995 | 0 | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 100 | 1.7 |
| 1996 | 0 | 5 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 100 | 1.7 |
| | | | | | | | | | Females | | | | | | | | | | |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | --- |
| 1991 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 100 | 1.8 |
| 1992 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 75 | 1.7 |
| 1993 | 0 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 7 | 100 | 5.9 |
| 1994 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 71 | 6.6 |
| 1995 | 0 | 1 | 1 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 100 | 3.5 |
| 1996 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 7 | 100 | 6.1 |

Table 3 Moose age at harvest , Unit 1C excluding Berners Bay, 1990–96

| Year | 0.5 | 1.5 | 2.5 | 3.5 | 4.5 | 5.5 | 6.5 | Age Class 7.5 | 8.5 | 9.5 | 10.5 | 11.5 | 12.5 | 13.5 | 14.5 | 15.5 | Total Kill | % Aged | Mean Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Chilkat Range | | | | | | | | | | | |
| 1990 | 0 | 6 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 69 | 2.3 |
| 1991 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 100 | 3.3 |
| 1992 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 56 | 2.9 |
| 1993 | 0 | 5 | 0 | 2 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 17 | 71 | 3.8 |
| 1994 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 7 | 100 | 4.8 |
| 1995 | 0 | 3 | 3 | 2 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 93 | 4.4 |
| 1996 | 0 | 3 | 4 | 5 | 1 | 3 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 98 | 4.6 |
| | | | | | | | | Gustavus | | | | | | | | | | | |
| 1990 | 0 | 1 | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 88 | 3.5 |
| 1991 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 83 | 3.1 |
| 1992 | 0 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 64 | 3.9 |
| 1993 | 0 | 3 | 5 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 100 | 2.8 |
| 1994 | 0 | 7 | 4 | 1 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 85 | 3.1 |
| 1995 | 0 | 4 | 9 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 90 | 2.8 |
| 1996 | 0 | 18 | 5 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 97 | 2.2 |
| | | | | | | | | Taku | | | | | | | | | | | |
| 1990 | 0 | 9 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 60 | 1.8 |
| 1991 | 0 | 5 | 4 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 78 | 2.6 |
| 1992 | 0 | 3 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 53 | 2.9 |
| 1993 | 0 | 3 | 4 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 73 | 2.4 |
| 1994 | 0 | 8 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 88 | 1.7 |
| 1995 | 0 | 7 | 4 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 100 | 2.1 |
| 1996 | 0 | 10 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 93 | 1.6 |

Table 4 Unit 1C hunter effort and success, 1990–1996

| | | Successful Hunters | | | Unsuccessful Hunters | | | Total Hunters | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Permits Issued[1] | Nr Hunters | Nr Days | Avg nr Days | Nr Hunters | Nr Days | Avg nr Days | Nr Hunters | Nr Days | Avg nr Days |
| | | | | | Berners Bay | | | | | |
| 1990 | 5 | 5 | 14 | 2.8 | 0 | 0 | 0.0 | 5 | 14 | 2.8 |
| 1991 | 10 | 10 | 20 | 2.0 | 0 | 0 | 0.0 | 10 | 20 | 2.0 |
| 1992 | 10 | 9 | 23 | 2.6 | 0 | 0 | 0.0 | 9 | 23 | 2.6 |
| 1993 | 15 | 14 | 29 | 2.1 | 1 | 7 | 7.0 | 15 | 36 | 2.4 |
| 1994 | 15 | 14 | 38 | 2.7 | 0 | 0 | — | 14 | 38 | 2.7 |
| 1995 | 15 | 13 | 40 | 3.1 | 1 | 6 | 6.0 | 14 | 46 | 3.3 |
| 1996 | 17 | 14 | 35 | 2.5 | 0 | 0 | — | 14 | 35 | 2.5 |
| | | | | | Chilkat Range | | | | | |
| 1990[1] | 331 | 16 | 57 | 3.6 | 94 | 267 | 2.8 | 106 | 350 | 3.3 |
| 1991 | 316 | 6 | 17 | 2.8 | 37 | 143 | 3.9 | 43 | 160 | 3.7 |
| 1992 | 317 | 9 | 41 | 4.6 | 62 | 234 | 3.8 | 71 | 275 | 3.9 |
| 1993 | 352 | 17 | 69 | 4.1 | 62 | 259 | 4.2 | 79 | 328 | 4.2 |
| 1994 | 346 | 7 | 15 | 2.1 | 47 | 173 | 3.7 | 54 | 188 | 3.5 |
| 1995 | 380 | 13 | 34 | 2.6 | 96 | 375 | 3.9 | 109 | 409 | 3.8 |
| 1996 | 396 | 17 | 31 | 1.8 | 65 | 308 | 4.7 | 82 | 339 | 4.1 |
| | | | | | Gustavus | | | | | |
| 1990[2] | — | 8 | 26 | | Unk | Unk | — | Unk | Unk | — |
| 1991 | — | 6 | 21 | 3.5 | 29 | 163 | 5.6 | 35 | 184 | 5.3 |
| 1992 | — | 11 | 38 | 3.5 | 36 | 163 | 4.5 | 47 | 201 | 4.3 |
| 1993 | — | 13 | 59 | 4.5 | 45 | 229 | 5.1 | 58 | 288 | 5.0 |
| 1994 | — | 20 | 96 | 4.8 | 64 | 281 | 4.4 | 84 | 377 | 4.5 |
| 1995 | — | 21 | 90 | 4.3 | 69 | 294 | 4.3 | 90 | 384 | 4.3 |
| 1996 | — | 30 | 115 | 3.8 | 65 | 331 | 5.1 | 95 | 446 | 4.7 |
| | | | | | Taku | | | | | |
| 1990 | — | 20 | 89 | 4.5 | 94 | 339 | 4.0 | 114 | 424 | 4.0 |
| 1991 | — | 14 | 52 | 3.7 | 88 | 358 | 4.1 | 102 | 410 | 4.0 |
| 1992 | — | 19 | 79 | 4.2 | 104 | 409 | 3.9 | 123 | 488 | 4.0 |
| 1993 | — | 16 | 40 | 2.7 | 77 | 318 | 4.4 | 93 | 358 | 4.1 |
| 1994 | — | 17 | 40 | 2.4 | 70 | 323 | 4.8 | 87 | 363 | 4.3 |
| 1995 | — | 14 | 48 | 3.4 | 71 | 254 | 3.6 | 85 | 302 | 3.6 |
| 1996 | — | 15 | 57 | 4.4 | 85 | 320 | 3.8 | 100 | 377 | 3.8 |

[1] Number given for the Chilkat Range from 1988 through 1994 is actually the number of permits issued for Unit 1C excluding Berners Bay; only permittees who hunted may be categorized to either the Chilkat Range or Taku area.

[2] Effort information for unsuccessful hunters at Gustavus is combined with the Chilkat Range for 1990.

Table 5 Unit 1C historical harvests, number of hunters, and success, 1990–96

| Year | Nr Males | Nr Females | Nr Unknown | Total Kill | Nr Hunters | % Success |
|---|---|---|---|---|---|---|
| | | | Berners Bay | | | |
| 1990 | 5 | 0 | 0 | 5 | 5 | 100 |
| 1991 | 5 | 5 | 0 | 10 | 10 | 100 |
| 1992 | 5 | 4 | 0 | 9 | 9 | 100 |
| 1993 | 7 | 7 | 0 | 14 | 15 | 93 |
| 1994 | 8 | 6 | 0 | 14 | 14 | 100 |
| 1995 | 7 | 6 | 0 | 13 | 14 | 93 |
| 1996 | 7 | 7 | 0 | 14 | 14 | 100 |
| | | | Chilkat Range | | | |
| 1990 | 16 | 0 | 0 | 16 | 106 [1] | 23 |
| 1991 | 6 | 0 | 0 | 6 | 47 | 13 |
| 1992 | 11 | 0 | 0 | 11 | 42 | 26 |
| 1993 | 17 | 0 | 0 | 17 | 90 | 19 |
| 1994 | 7 | 0 | 0 | 8 | 56 | 14 |
| 1995 | 13 | 0 | 0 | 13 | 109 | 12 |
| 1996 | 17 | 0 | 0 | 17 | 82 | 21 |
| | | | Gustavus | | | |
| 1990 | 8 | 0 | 0 | 8 | N/A | N/A |
| 1991 | 6 | 0 | 0 | 6 | 35 | 17 |
| 1992 | 9 | 0 | 0 | 9 | 47 | 19 |
| 1993 | 13 | 0 | 0 | 13 | 58 | 22 |
| 1994 | 19 | 0 | 0 | 19 | 84 | 23 |
| 1995 | 21 | 0 | 0 | 0 | 90 | 23 |
| 1996 | 30 | 0 | 0 | 29 | 95 | 31 |
| | | | Taku | | | |
| 1990 | 20 | 0 | 0 | 20 | 114 [2] | 18 |
| 1991 | 14 | 0 | 0 | 14 | 102 | 14 |
| 1992 | 19 | 0 | 0 | 19 | 123 | 15 |
| 1993 | 16 | 0 | 0 | 16 | 93 | 17 |
| 1994 | 17 | 0 | 0 | 17 | 87 | 18 |
| 1995 | 14 | 0 | 0 | 14 | 85 | 16 |
| 1996 | 15 | 0 | 0 | 15 | 97 | 15 |

[1] Twelve of the 106 hunters were assigned to the Chilkat Range (based on proportion hunting in each area) as they reported no specific area within GMU 1C.

[2] Twelve of the 114 hunters were assigned to the Taku (based on proportion hunting in each area) as they reported no specific area within GMU 1C.

Table 6 Unit 1C annual moose kill by community of residence, 1990–96

| Year | Total kill | Gustavus | Juneau | Sitka | Wrangell | Petersburg | Haines | Other Alaska | Non-resident |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Berners Bay | | | | |
| 1990 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 10 | 0 | 9 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1992 | 9 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 14 | 0 | 13 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1994 | 14 | 0 | 13 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1995 | 13 | 0 | 11 | 0 | 0 | 0 | 0 | 2 | 0 |
| 1996 | 14 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | Chilkat Range | | | | |
| 1990 | 16 | 0 | 13 | 0 | 0 | 0 | 3 | 0 | 0 |
| 1991 | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 9 | 0 | 8 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1993 | 17 | 0 | 11 | 0 | 0 | 0 | 5 | 1 | 0 |
| 1994 | 7 | 0 | 6 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1995 | 13 | 2 | 10 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1996 | 17 | 0 | 14 | 0 | 0 | 0 | 0 | 3 | 0 |
| | | | | | Gustavus | | | | |
| 1990 | 8 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 11 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1993 | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 20 | 15 | 4 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1995 | 21 | 13 | 7 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1996 | 30 | 22 | 7 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | | | | Taku | | | | |
| 1990 | 20 | 0 | 18 | 1 | 0 | 1 | 0 | 0 | 0 |
| 1991 | 14 | 0 | 13 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1992 | 19 | 0 | 15 | 0 | 0 | 2 | 0 | 1 | 1 |
| 1993 | 15 | 0 | 12 | 0 | 0 | 2 | 1 | 0 | 0 |
| 1994 | 17 | 0 | 10 | 0 | 0 | 2 | 0 | 2 | 0 |
| 1995 | 14 | 0 | 12 | 1 | 0 | 0 | 0 | 1 | 0 |
| 1996 | 15 | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 7 Unit 1C transport methods used by successful moose hunters, 1993–96

| | Airplane | | Boat | | 3/4 wheeler | | Hwy vehicle | | Foot | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Total | (%) | Total | ( %) | Total | (%) | Total | (%) | Total | (%) |
| | | | | | Berners Bay | | | | | |
| 1993 | 0 | --- | 14 | (100) | 0 | --- | 0 | --- | 0 | --- |
| 1994 | 0 | --- | 14 | (100) | 0 | --- | 0 | --- | 0 | --- |
| 1995 | 1 | (8) | 12 | (92) | 0 | --- | 0 | --- | 0 | --- |
| 1996 | 1 | (7) | 13 | (93) | 0 | --- | 0 | --- | 0 | --- |
| | | | | | Chilkat Range | | | | | |
| 1993 | 5 | (29) | 12 | (71) | 0 | (0) | 0 | (24) | 0 | (0) |
| 1994 | 0 | (4) | 7 | (37) | 0 | --- | 0 | (41) | 0 | (19) |
| 1995 | 5 | (24) | 9 | (47) | 1 | (3) | 0 | (6) | 7 | (21) |
| 1996 | 10 | (24) | 8 | (33) | 0 | (7) | 0 | (9) | 0 | (27) |
| | | | | | Gustavus | | | | | |
| 1993 | 1 | (8) | 4 | (31) | 1 | (8) | 4 | (31) | 3 | (23) |
| 1994 | 1 | (5) | 3 | (15) | 0 | (0) | 11 | (55) | 5 | (25) |
| 1995 | 3 | (14) | 7 | (33) | 0 | (0) | 2 | (10) | 0 | (0) |
| 1996 | 1 | (3) | 7 | (23) | 3 | (10) | 4 | (13) | 12 | (40) |
| | | | | | Taku River | | | | | |
| 1993 | 4 | (25) | 11 | (69) | 0 | --- | 0 | --- | 1 | (6) |
| 1994 | 3 | (18) | 14 | (82) | 0 | --- | 0 | --- | 0 | --- |
| 1995 | 2 | (14) | 12 | (86) | 0 | --- | 0 | --- | 0 | --- |
| 1996 | 6 | (33) | 12 | (67) | 0 | --- | 0 | --- | 0 | --- |
| | | | | | Unitwide | | | | | |
| 1995–96 Total/(%) | 29 | (21) | 80 | (58) | 4 | (3) | 6 | (4) | 19 | (14) |

Table 8 Commercial services used by hunters, Unit 1C, 1991–1996

| Year | Unit residents | | Other AK residents | | Non-residents | | Total use | | Transport type | Non-guided services | Other services |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No | Yes | No | Yes | No | Yes | No | Yes | | | |
| | | | | | Berners Bay | | | | | | |
| 1991 | 6 | 2 | 0 | 0 | 0 | 0 | 6 | 2 | 0 | 0 | 2 |
| 1992 | 9 | 1 | 0 | 0 | 0 | 0 | 9 | 1 | 0 | 0 | 1 |
| 1993 | 13 | 0 | 1 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| 1994 | 11 | 0 | 1 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 |
| 1995 | 13 | 0 | 1 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| 1996 | 12 | 1 | 0 | 0 | 0 | 0 | 12 | 1 | 1 | 0 | 0 |
| | | | | | Chilkat Range | | | | | | |
| 1992 | 88 | 6 | 12 | 4 | 0 | 1 | 100 | 11 | 10 | 1 | 0 |
| 1993 | 37 | 2 | 20 | 7 | 0 | 0 | 57 | 10 | 5 | 3 | 2 |
| 1994 | 26 | 5 | 19 | 0 | 0 | 0 | 45 | 4 | 0 | 0 | 0 |
| 1995 | 72 | 2 | 29 | 0 | 0 | 0 | 101 | 2 | 2 | 0 | 0 |
| 1996 | 56 | 5 | 13 | 0 | 0 | 0 | 64 | 5 | 5 | 0 | 0 |
| | | | | | Gustavus | | | | | | |
| 1992 | 8 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 |
| 1993 | 55 | 4 | 3 | 0 | 0 | 0 | 58 | 4 | 4 | 0 | 0 |
| 1994 | 81 | 1 | 0 | 0 | 1 | 0 | 82 | 2 | 2 | 0 | 0 |
| 1995 | 80 | 0 | 10 | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 0 |
| 1996 | 78 | 3 | 12 | 1 | 0 | 1 | 95 | 5 | 5 | 0 | 0 |
| | | | | | Chilkat Range | | | | | | |
| 1992 | 96 | 6 | 12 | 4 | 0 | 1 | 108 | 11 | 10 | 1 | 0 |
| 1993 | 92 | 6 | 23 | 7 | 0 | 0 | 115 | 14 | 9 | 3 | 2 |
| 1994 | 107 | 6 | 19 | 0 | 1 | 0 | 127 | 6 | 0 | 0 | 0 |
| 1995 | 152 | 2 | 39 | 0 | 0 | 0 | 191 | 2 | 2 | 0 | 0 |
| 1996 | 134 | 8 | 25 | 1 | 0 | 1 | 159 | 10 | 10 | 0 | 0 |
| | | | | | Taku Area | | | | | | |
| 1992 | 56 | 8 | 8 | 2 | 0 | 0 | 64 | 10 | 7 | 0 | 3 |
| 1993 | 61 | 7 | 71 | 7 | 0 | 0 | 132 | 14 | 12 | 2 | 0 |
| 1994 | 50 | 4 | 23 | 3 | 0 | 0 | 73 | 7 | 7 | 0 | 0 |
| 1995 | 70 | 5 | 9 | 0 | 0 | 0 | 79 | 5 | 3 | 0 | 2 |
| 1996 | 71 | 5 | 3 | 1 | 0 | 2 | 74 | 8 | 2 | 2 | 4 |

## LOCATION

**GAME MANAGEMENT UNIT:** 1D (2,700 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** The Southeast Alaska mainland north of the latitude of Eldred Rock, excluding Sullivan Island and the drainages of Berners Bay

## BACKGROUND

In Unit 1D most moose inhabit the Chilkat River watershed and the Chilkat Peninsula. Within this area there is an estimated 200–250 $mi^2$ of summer range, 110–120 $mi^2$ of winter range, and 80 $mi^2$ of preferred winter range. Small areas of moose habitat are also located in the Chilkoot, Katzehin, and Warm Pass valleys, and along the western shore of Lynn Canal.

Moose immigrated to the Chilkat River valley from Canada Canadian drainages around 1930. Moose populations peaked in the Chilkat Valley in the mid-1960s, when as many as 700 animals may have been present. Possibly because of range overuse and overharvest, by the early 1970s the moose population had sharply declined to 400–500 animals. Survey data collected during the mid-1980s indicated that the population had declined further, with approximately 400 moose remaining in the Chilkat drainage. Recent surveys indicate the moose population is now between 300 and 400 moose.

Residents of Unit 1D have expressed concern over the decrease in moose numbers, subsequent decline in hunting opportunity, and the "stampede" quality of registration permit hunts with low harvest quotas. Harvest objectives have been formulated based on survey data and harvest trends. Efforts were made to introduce regulatory measures (e.g., a spike-fork requirement) to slow the pace of the hunt, but these were preempted when a Tier II subsistence hunt was implemented for the area by the Board of Game in the 1990/1991 regulatory year. Widespread dissatisfaction with the allocation of 20 Tier II permits and concern over the status of the population contributed to local opposition to holding a hunt in 1991, and no permits were issued that year. In 1992 the season was closed by emergency order before Tier II permits were issued.

In March 1993 the Board of Game authorized a Tier II antler restriction hunt for Unit 1D. This hunt allowed more hunters the opportunity to hunt for legal moose while affording protection to bulls that did not meet harvest requirements. Our objective is to spare a large proportion of the young and middle-aged bulls from harvest to bolster the breeding age segment of the population while still allowing many local hunters the opportunity to hunt and harvest moose meat.

## MANAGEMENT DIRECTION

### MANAGEMENT OBJECTIVES

The following objectives have been formulated based on existing biological data and information from the public. They are presented in the Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94 (ADF&G 1991). Management objectives for moose in the Chilkat River valley include a posthunt population of 450 and a posthunt bull to cow ratio of 26:100; 250 hunters expending 500 hunter days, and a harvest of 30 moose for a hunter success rate of 12%.

## METHODS

We conducted aerial surveys of the Chilkat River valley in December 1996 (Table 1). Areas covered included Murphy Flats to the Turtle Rock area and the Klehini, Tahkin, and Kelsall river valleys.

Incisors were collected from moose taken in Unit 1D from successful hunters who brought in jaws as a condition of their permit. Data collected via Tier II permits included the length of hunt, hunt location, and transport means (for all hunters), and date of kill (for successful hunters).

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

Winter surveys flown in good viewing conditions in Regulatory Year 1996 indicate that the Chilkat valley moose population is about 350 animals. The 1996 count of 207 moose was the highest since 1988 and produced the second highest moose/hour ratio since 1982 (Table 1).

*Population Composition*

The survey flown on December 16, 1996 revealed 207 moose, with a bull cow ratio of 40:100 and a calf cow ratio of 26:100. Calves were estimated to compose 16% of the herd. Based on anecdotal evidence, it appears that poor calf survival because of snow, predators, or other factors may have significantly reduced recruitment in some years.

### MORTALITY

*Harvest*

| Season and Bag Limits. | Resident and nonresident hunters | |
|---|---|---|
| Unit 1D | Sep 15–Oct 15 | 1 moose by Tier II permit. Up to 200 permits may be issued. |

Board of Game Actions and Emergency Orders. The Board of Game approved a change in the timing of this hunt before the 1995 season. Emergency orders were used to close the 1995 and 1996 seasons, in part as a response to the number of illegally harvested animals. The closures were also implemented to limit harvest to a level the population could sustain. Despite the theoretical "self-limiting" aspect of spike-fork/50 inch/3 brow tine hunts, we felt it wise to kill no more than 30 bulls per year, preferably no more than 2 dozen bulls. Emergency orders were issued to close the season after 5 days in 1995 and after 14 days in 1996.

Hunter Harvest. Harvest levels remained at about 20 animals between 1985 and the early 1990s. In both 1995 and 1996 the season was managed for a harvest of about 25 bulls. A total of 24 legal bulls were taken in 1995 and 23 in 1996. There was also an illegal take of 3 bulls in 1995 and 2 bulls and 2 cows in 1996.

Permit Hunts. All moose hunting within the subunit is conducted under a Tier II subsistence permit system. A total of 200 permits were issued in 1995 and 181 in 1996. There were nearly 300 applicants for these permits each year (Table 3).

Hunter Residency and Success. During the report period, the moose hunt in Unit 1D was limited largely to residents of the subunit although all Alaskans are eligible to apply for Tier II permits. Most permits were issued to residents of the subunit. All but 1 of the bull moose harvested in 1995 and 1996 were taken by residents of Haines/Klukwan (Table 4). Hunter success was 17% during 1995 and 1996 (Table 5). Successful hunters spent an average of 2.1 and 3.3 days in the field during 1995 and 1996, respectively (Table 3). Total hunter days expended were 459 in 1995 and 805 in 1996.

Harvest Chronology. In 1995 the Tier II moose season opened on September 15, two weeks earlier than in the recent past. Despite this shift bulls were quite active and therefore vulnerable to hunters. As a result the 1995 moose season was closed after only 5 days. In 1996 warm conditions slowed the pace of the hunt, and it was not necessary to terminate the hunt until 14 days had elapsed.

Transport Methods. Historically most hunters have used either boats or highway vehicles to hunt moose in Unit 1D (Table 6). Boats were used predominantly in 1995, while boats and highway vehicles were used at the same frequency in 1996, with airplanes being used as well by 13% of the successful hunters. Only 1 hunter reported using commercial services during the report period (Table 7). This is not surprising because virtually all hunters reside within or very near the subunit.

*Other Mortality*

Discussions with area residents suggest the brown bear population has increased in recent years and that predation by bears may be partly responsible for the poor recruitment rates. Data in support of this assertion is not available. Wolf predation during this report period did not seem to pose any serious threat to the moose population. In some years deep snow conditions probably contribute to calf mortality, although conditions during this period were relatively mild. Deteriorating range conditions (Hundertmark et al., 1983) may also play a role in low calf production and survival.

We estimate that 3–5 moose are struck and killed by highway vehicles in the subunit each winter. Poaching also occurs, but we do not know the number of moose lost to this activity.

## HABITAT

Nearly all moose habitat in this subunit lies within the Haines State Forest, managed under the multiple-use guidelines of the Haines State Forest Management Plan of 1986. The plan's goals include an annual harvest of up to 8.8 million board feet of timber (approximately 300–580 acres). Timber harvests occurred during the report period in the Chilkat River valley above Wells Bridge in areas that do not contain critical moose winter range. However, logging operations adjacent to important early winter habitat probably affected the availability of late winter habitat by removal of forest canopy. While some increased browse production may occur in logged areas, the extent and value of deciduous reproduction in these areas has not been determined. The long-term usefulness of cutover areas to moose will be reduced if a) timber harvest occurs in high value wintering areas and b) they are managed to produce second growth coniferous stands rather than deciduous browse species.

Habitat changes within nonforested portions of the area are also of concern. Research in the early 1980s showed a low proportion of young willow plants in shrub stands in the Chilkat River valley, and it is suspected that postglacial land uplift is causing permanent habitat change. Removal of decadent alder and cottonwood overstories in order to release willow, red-osier dogwood, and other browse species may counteract long-term changes, at least for awhile. There is some degree of local interest in mechanically changing vegetation in areas close to Haines.

## CONCLUSIONS AND RECOMMENDATIONS

Harvest objectives contained in the Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94 (ADF&G 1991) were not met during the report period. Although the posthunt bull to cow ratio of 26:100 seems to have been met in 1996, the number of moose has not rebounded to the management objective of 450 animals. Calf survival will be a critical factor in achieving this objective in the future. The hunter effort objective was met in both years, with the number of days expended approaching the targeted 500 in 1995 and exceeding the target by 300 days in 1996 (Table 3).

The implementation of an antler restriction hunt increased the age of harvested moose and, if calf survival is adequate, allows more young bulls to reach breeding age. We hope this will lead to maximum calf production and allow the Unit 1D moose population to stabilize near the carrying capacity of the habitat. The new hunt format also allowed more people to hunt moose, while reducing the impact of the harvest upon the moose population. Although the difficulties of judging a legal bull cause complaints, in general the local community is supportive of the hunt because more people have an opportunity to hunt without endangering the safety of the moose population. In the future we will try to slow the pace of the hunt, which should reduce the number of animals taken illegally.

The effect of predation upon moose calf survival in this area is unknown. The healthy brown bear population (as well as the less prominent black bear population) probably accounts for substantial summer mortality, based on anecdotal accounts. Winter wolf predation does not appear to be a serious problem except when moose movements are restricted by extremely deep snow. We should continue exploring methods to ascertain the extent of predation, especially if calf survival is a key factor in moose population recovery in this area.

McCarthy (ADF&G, 1990) called for investigation into the relationship between timber harvest and moose habitat in the Chilkat River valley. Other means of converting decadent hardwood stands to encourage browse species growth should be pursued and tried on a pilot basis. Volunteer efforts might effect enough habitat that we could monitor browse growth and subsequent moose use before we engage in a large-scale habitat enhancement effort. The possibility of using prescribed fire to accomplish favorable habitat changes should also be investigated.

Recent surveys indicate that moose numbers in Unit 1D are no longer declining and that the present hunting scheme is working. But predation, deep snows, and mediocre habitat point to the need for regular surveys to better understand the status and trend of the moose population.

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Table 1 Unit 1D aerial survey data, 1982–1996

| Regulatory Year | Total males | Total females | Total calves | Unk | Total moose | Count time (hrs) | Bulls Per 100 F | Calves per 100 F | Calves % in herd | Moose per hour |
|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 34 | 115 | 51 | --- | 200 | 4.8 | 30 | 44 | 36 | 42 |
| 1983 | 16 | 148 | 47 | --- | 211 | 5.8 | 11 | 32 | 22 | 36 |
| 1984 | 15 | 135 | 37 | --- | 187 | 5.2 | 11 | 27 | 20 | 36 |
| 1985 | 23 | 155 | 29 | --- | 207 | 5.5 | 15 | 19 | 14 | 38 |
| 1986 | 33 | 93 | 13 | --- | 139 | 3.5 | 36 | 14 | 14 | 40 |
| 1987[1] | --- | --- | 29 | 174 | 203 | --- | --- | --- | 14 | 53 |
| 1988[2] | --- | --- | 31 | 206 | 252 | 4.4 | --- | --- | 12 | 57 |
| 1989 | 18 | 45 | 10 | --- | 73 | 1.5 | 40 | 22 | 14 | 48 |
| 1990[3] | 18 | 67 | 6 | --- | 91 | 3.5 | 30 | 9 | 7 | 26 |
| 1991 | 23 | 138 | 22 | --- | 183 | 7.8 | 17 | 17 | 13 | 23 |
| 1992 | 27 | 98 | 21 | --- | 149 | 2.9 | 28 | 21 | 14 | 52 |
| 1993 | --- | --- | 19 | 157 | 176 | 5.8 | --- | --- | 11 | 31 |
| 1994 | 41 | 77 | 27 | --- | 149 | 4.3 | 53 | 35 | 18 | 35 |
| 1995 | | | | | No Survey | | | | | |
| 1996 | 48 | 121 | 31 | 7 | 207 | 3.8 | 40 | 26 | 16 | 54 |

[1] Late winter survey, sex and age ratios unreliable. In a second late winter survey a total of 215 moose (29 calves) were counted at the rate of 57 moose per hour.

[2] Late winter survey, sex and age ratios unreliable.

[3] Numbers are for survey flown on 12/14/1990. A second survey, flown only in the Chilkat Valley on 3/22/1991, documented 28 moose in 2.9 hours.

Table 2 Unit 1D age structure of moose harvests, 1983–1996

| | Age Class | | | | | | | | | | | | | | | | Total | % | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | 0.5 | 1.5 | 2.5 | 3.5 | 4.5 | 5.5 | 6.5 | 7.5 | 8.5 | 9.5 | 10.5 | 11.5 | 12.5 | 13.5 | 14.5 | 15.5 | kill | Aged | age |
| 1983 | 1 | 3 | 7 | 10 | 6 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 62 | 50 | 3.8 |
| 1984 | 2 | 15 | 12 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36 | 94 | 2.3 |
| 1985 | 0 | 7 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 93 | 2.3 |
| 1986 | Season Closed | | | | | | | | | | | | | | | | | | |
| 1987 | 0 | 3 | 6 | 7 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 91 | 3.2 |
| 1988 | 0 | 6 | 5 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 94 | 2.9 |
| 1989 | 0 | 10 | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 100 | 2.3 |
| 1990 | | | | | | | | | | | | | | | | | 19 | 0 | 0.0 |
| 1991 | Season Closed | | | | | | | | | | | | | | | | | | |
| 1992 | Season Closed | | | | | | | | | | | | | | | | | | |
| 1993 | 0 | 2 | 3 | 3 | 4 | 2 | 3 | 1 | 4 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 24 | 100 | 5.1 |
| 1994 | 0 | 0 | 0 | 1 | 1 | 8 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 17 | 94 | 5.7 |
| 1995 | 0 | 0 | 1 | 5 | 4 | 3 | 5 | 3 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 27 | 100 | 5.6 |
| 1996 | 0 | 5 | 2 | 3 | 2 | 4 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 78 | 4.0 |

Table 3 Unit 1D hunter effort and success, ,1983–1996

| | | Successful Hunters | | | Unsuccessful Hunters | | | Total Hunters | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Permits issued | Nr hunters | Total Nr days | Avg. Nr days | Nr hunters | Total Nr Days | Avg. Nr days | Nr hunters | Total Nr days | Avg. Nr days |
| 1983 | --- | 62 | --- | --- | 292 | --- | --- | 354 | --- | --- |
| 1984 | --- | 35 | 149 | 4.3 | 314 | 1540 | 4.9 | 349 | 1689 | 4.8 |
| 1985 | --- | 14 | 43 | 3.1 | 29 | 109 | 3.8 | 43 | 152 | 3.5 |
| 1986 | | | | | Season Closed | | | | | |
| 1987 | 294 | 22 | 22 | 1.0 | 208 | 208 | 1.0 | 230 | 230 | 1.0 |
| 1988 | 259 | 18 | 18 | 1.0 | 188 | 188 | 1.0 | 206 | 206 | 1.0 |
| 1989 | 272 | 18 | 18 | 1.0 | 208 | 208 | 1.0 | 226 | 226 | 1.0 |
| 1990 | 20 | 19 | 48 | 2.5 | 1 | 7 | 7.0 | 20 | 55 | 28 |
| 1991 | | | | | Season Closed | | | | | |
| 1992 | | | | | Season Closed | | | | | |
| 1993 | 176 | 24 | 45 | 1.9 | 83 | 182 | 2.3 | 107 | 227 | 2.2 |
| 1994 | 200 | 17 | 20 | 1.2 | 130 | 284 | 2.2 | 147 | 304 | 2.1 |
| 1995 | 200 | 27 | 58 | 2.1 | 130 | 401 | 3.1 | 157 | 459 | 3.0 |
| 1996 | 181 | 24 | 70 | 3.3 | 121 | 735 | 6.1 | 145 | 805 | 5.7 |

Table 4 Unit 1D annual moose kill by community of residence, 1984–1996

| Regulatory Year | Total Kill[1] | Haines | Skagway | Juneau | Sitka | Other Alaska | Non-Resident |
|---|---|---|---|---|---|---|---|
| 1984 | 35 | 23 | 1 | 7 | 2 | 1 | 0 |
| 1985 | 14 | 14 | 0 | 0 | 0 | 0 | 0 |
| 1986 | | | Season Closed | | | | |
| 1987 | 22 | 22 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 18 | 18 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 18 | 18 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 19 | 19 | 0 | 0 | 0 | 0 | 0 |
| 1991 | | | Season Closed | | | | |
| 1992 | | | Season Closed | | | | |
| 1993 | 24 | 22 | 0 | 2 | 0 | 0 | 0 |
| 1994 | 17 | 17 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 25 | 24 | 0 | 1 | 0 | 0 | 0 |
| 1996 | 23 | 22 | 0 | 0 | 0 | 1 | 0 |

[1] Legal kills only

Table 5 Unit 1D historical harvests, number of hunters, and success, 1980–1996

| Regulatory Year | Nr Males | Nr Females | Nr Unknown | Total Kill | Nr Hunters | % Success[1] |
|---|---|---|---|---|---|---|
| 1980 | 48 | 0 | 0 | 48 | 342 | 14 |
| 1981 | 36 | 2 | 0 | 38 | 315 | 11 |
| 1982 | 24 | 1 | 0 | 25 | 267 | 9 |
| 1983 | 62 | 0 | 0 | 62 | 354 | 17 |
| 1984 | 35 | 1 | 0 | 36 | 349 | 10 |
| 1985 | 14 | 0 | 0 | 14 | 43 | 33 |
| 1986 | | | Season Closed | | | |
| 1987 | 22 | 0 | 0 | 22 | 230 | 10 |
| 1988 | 18 | 0 | 0 | 18 | 206 | 9 |
| 1989 | 18 | 1 | 0 | 19 | 226 | 8 |
| 1990 | 19 | 0 | 0 | 19 | 20 | 95 |
| 1991 | | | Season Closed | | | |
| 1992 | | | Season Closed | | | |
| 1993 | 24 | 0 | 0 | 24 | 107 | 22 |
| 1994[2] | 18 | 0 | 0 | 17 | 147 | 12 |
| 1995[3] | 27 | 0 | 0 | 27 | 157 | 17 |
| 1996[4] | 25 | 2 | 0 | 27 | 145 | 17 |

[1] Success calculated based on legal animals only.
[2] Includes 1 illegal bull.
[3] Includes 2 illegal bulls.
[4] Includes 3 illegal bulls and 2 cows.

Table 6 Unit 1D successful hunter transport methods, 1987–1996

| Year | Airplane Total | Airplane (%) | Boat Total | Boat (%) | ORV Total | ORV (%) | Highway vehicle Total | Highway vehicle (%) | Other Total | Other (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1987 | 3 | (14) | 12 | (12) | 1 | (5) | 6 | (27) | 0 | --- |
| 1988 | 0 | --- | 16 | (88) | 1 | (6) | 1 | (6) | 0 | --- |
| 1989 | 2 | (11) | 10 | (55) | 2 | (11) | 4 | (22) | 1 | (1) |
| 1990 | 0 | --- | 10 | (58) | 0 | --- | 7 | (37) | 2 | (8) |
| 1991–2 | | | | | Season Closed | | | | | |
| 1993 | 0 | --- | 13 | (54) | 0 | --- | 10 | (45) | 1 | (4) |
| 1994 | 0 | --- | 13 | (81) | 0 | --- | 3 | (19) | 0 | --- |
| 1995 | 0 | --- | 5 | (22) | 0 | --- | 15 | (65) | 3 | (13) |
| 1996 | 3 | (13) | 10 | (42) | 0 | --- | 10 | (42) | 1 | (4) |

Table 7 Unit 1D commercial services used by hunters, 1993–1996

| Year | Unit residents No | Unit residents Yes | Other AK residents No | Other AK residents Yes | Total use No | Total use Yes | Other services |
|---|---|---|---|---|---|---|---|
| 1993 | 60 | 1 | 3 | 1 | 73 | 2 | 2 |
| 1994 | 104 | 1 | 3 | 0 | 107 | 1 | 1 |
| 1995 | 97 | 0 | 3 | 0 | 100 | 0 | |
| 1996 | 82 | 1 | 5 | 0 | 87 | 1 | |

# LOCATION

**GAME MANAGEMENT UNIT:** 5 (5,800 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Cape Fairweather to Icy Bay, eastern Gulf of Alaska coast

# BACKGROUND

Moose were first documented along the lower Alsek River in eastern Game Management Unit 5 in the late 1920s or early 1930s. Range expansion to the west followed, with animals documented on the Malaspina Forelands west of Yakutat Bay by the 1950s. The glaciers and waters of Icy Bay curtailed westward movement of this moose population.

The moose population in Unit 5 grew rapidly and peaked in the early 1960s, with population estimates exceeding 2000 animals. The population began adjustments downward to a more realistic carrying capacity in the mid-1960s. Poor reproductive success and severe winters during 1971–73 depressed moose numbers enough that Unit 5A hunting seasons were closed from 1974–1977. Since 1978, Unit 5 moose hunting has been managed under a registration permit system. In 1991 a federal subsistence season was instituted, running concurrently with the state season until 1996. This federal season restricted hunting on federal public lands to local resident hunters only during the first week of the season. In 1996 the Federal Subsistence Board lengthened the subsistence season by one week, starting it a week earlier than the state season. Although the concurrent seasons have been managed under the state's registration permit system, the new "early hunt" is conducted under a separate federal registration permit managed by the U.S. Forest Service and the National Park Service. The federal government also began authorizing Yakutat residents to kill moose (either sex) for ceremonial purposes in a separate permit program in 1995.

# MANAGEMENT DIRECTION

**MANAGEMENT OBJECTIVES**

Staff identified the following objectives based on existing biological data and information from the public; these objectives are included in the Strategic Plan for Management of Moose in region I, Southeast Alaska (ADF&G, 1991). They are compared with estimates of current population and use levels (these estimates include data from both state and federal hunts).

| | Current (1996) | Plan Objective |
|---|---|---|
| *Unit 5A Yakutat Forelands* | | |
| Posthunt moose numbers | 800 | 1,000 |
| Annual hunter kill | 60 | 70 |
| Number of hunters | 190 | 250 |

| | | |
|---|---|---|
| Hunter-days of effort | 574 | 1,025 |
| Hunter success | 32% | 28% |

*Unit 5A Nunatak Bench*

| | | |
|---|---|---|
| Posthunt moose numbers | 30 | 50 |
| Annual hunter kill | 0 | 5 |
| Number of hunters | 4 | 10 |
| Hunter-days of effort | 100 | 60 |
| Hunter success | 0% | 50% |

*Unit 5B Malaspina Forelands*

| | | |
|---|---|---|
| Posthunt moose numbers | Unknown | 250 |
| Annual hunter kill | 16 | 25 |
| Number of hunters | 31 | 50 |
| Hunter-days of effort | 146 | 200 |
| Hunter success | 52% | 50% |

## METHODS

Early winter aerial surveys of Units 5A and 5B were conducted in 1995, and a fall survey was conducted in 1996 in Unit 5A. Ages of harvested moose were determined from incisors submitted by hunters under the terms of the registration permit. Other data collected included the number of days hunted, hunter residency, kill date and location, and transport type.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

Since the hunting closures in the mid-70s, the Unit 5A moose population slowly increased; now it may be near the habitat's carrying capacity. The Nunatak Bench moose population re-established following the retreat of the Hubbard Glacier and the subsidence of waters of Russell Fiord in 1986. Based on the 1994 surveys, the Board of Game reopened moose hunting in this area, beginning with the 1995 season. The Unit 5B moose population appears healthy at moderate densities.

*Population Size*

Aerial surveys were accomplished in the Yakutat Forelands, Nunatak Bench, and the Malaspina Forelands in the winter of 1995, but only the Yakutat Forelands were surveyed in 1996. It is generally assumed that because moose use forested areas in the Yakutat area, especially east of the Dangerous River, the animals counted in surveys comprise roughly one-half of moose present. Given the wide range of survey effort from year to year for these populations, perhaps the best gauge of moose numbers is the number of moose observed/hour of survey time (Table 1).

Because of poor weather conditions in 1996, only that portion of the Yakutat Forelands west of the Dangerous River was surveyed. The more comprehensive survey of 1995 is a more accurate assessment of the status of the Unit 5A moose population. We counted 466 moose during the 1995 survey of the Yakutat Forelands (Table 1). Total survey time was comparable to the previous 5 years, while the sighting rate was the highest since 1990. Because this was a January survey, composition data are unreliable because of antler loss. Based on this survey, the Yakutat Forelands population is estimated to be 600–800 animals.

We counted 33 moose during an aerial survey of Nunatak Bench in 1995, a slight increase from the 1994 survey (Table 1). Before 1986, when the blockage of Russell Fiord by the Hubbard Glacier caused flooding of much of this population's winter range, there were an estimated 50 animals in this area. Brushy vegetation has invaded the shoreline since saltwater levels have receded, and moose have reoccupied Nunatak Bench. Based on this survey, we estimate 50 moose are in the area.

Moose population dynamics in Unit 5B are not as well understood as those in Unit 5A. Only a portion of the subunit has been surveyed since 1982, and the most recent effort (1995) occurred after antler drop, when accurate sex composition is not possible to determine. We counted 109 moose in this 1995 survey, the highest moose/hour count of any survey conducted here. The population is estimated to be approximately 250 moose (Table 1).

*Population Composition*

We were unable to attain reliable composition data during this report period for any of the 3 moose populations in Unit 5 (Table 5). This results from the lack of early winter snow cover and poor flying conditions, which caused delays in the survey.

Age at harvest of Unit 5A moose has changed over time (Table 2). Mean age at harvest decreased from 6.0 to 3.0 years by 1987 and has remained at that level. Most animals taken before 1985 were at least 3.5 years old; most animals taken since 1987 have been less than 3.5. From 1994–1996 over 40% of harvested bulls were age 1.5 (Table 2). In contrast, the mean age of moose harvested from the Malaspina Forelands has remained above 3.0 for all years except 1993 and 1995. The mean age of harvested animals in 1996 was 5.4. Thus, the distribution of ages of harvested animals varies with no discernible pattern.

## MORTALITY

*Harvest*

| Season and Bag Limits. | Resident and nonresident hunters | |
|---|---|---|
| Unit 5A, except Nunatak Bench | Oct 15–Nov 15 | 1 moose by registration permit. Up to 60 bulls may be taken; season will close west of Dangerous River when 30 bulls have been taken in that area. |
| Unit 5A, Nunatak Bench | Oct 15–Nov 15 | 1 moose by registration permit; up to 5 moose may |

be taken.

| | | |
|---|---|---|
| Unit 5B, Malaspina Forelands | Sep 1–Dec 15 | 1 bull by registration Permit; up to 25 bulls may be taken. |

Board of Game Actions and Emergency Orders. In 1995 that portion of Unit 5A west of the Dangerous River was closed by emergency order on October 17, when the harvest target of 30 bulls was reached. The remaining portion of the Yakutat Forelands remained open until the scheduled November 15 closure. Because of hunting pressure near Yakutat, this is the usual pattern of hunt management, although this was the shortest period ever needed to reach the harvest target on the west side of the Dangerous River. In 1996 that portion of Unit 5A west of the Dangerous River was closed on October 24, when the harvest target of 30 bulls was achieved. The portion of the subunit east of the Dangerous River closed on October 29, when the quota of 60 bulls for the entire subunit was reached.

Hunter Harvest. In 1990 the hunt quota for the Yakutat Forelands was increased to 60 bulls, and the area has been managed for that number ever since. The Malaspina Forelands hunt has been managed for a quota of 25 bull moose since 1978. Harvest has remained relatively constant since 1988, with 57–77 moose being taken within Unit 5 each year from 1988–1996. A total of 62 moose (45 bulls taken in state and federal registration hunts. Three bulls and 2 cows taken on federal ceremonial permits) were legally killed in Unit 5 during 1995. Seventy-seven legal animals (76 bulls in state and federal hunts, and 1 cow taken for ceremonial purposes) were taken in 1996 (Table 3).

Permit Hunts. During this 2-year period state regulations provided for 3 registration permit hunts within Unit 5: RM061 (Yakutat Forelands) and RM059 (Nunatak Bench) in Unit 5A, and RM062 (Malaspina Forelands) in Unit 5B. There was also a Federal registration hunt for Unit 5A. In 1995 the federal hunt ran concurrently with the state hunt and prohibited hunting on federal public lands except by Yakutat residents from October 15 through October 21. In 1996 the federal hunt began a week before the state hunt, with the nonlocal restriction covering a span of 2 weeks.

Despite the fact there is a block of nonfederal land around Yakutat where nonlocals can legally hunt during the first week of the state season, local residents have always harvested most moose taken on the Yakutat Forelands before October 22. Additionally, they take most of the moose west of the Dangerous River during the entire season (Table 4). The advent of the early federal hunt reinforced this tendency. The total number of permits (both state and federal) issued for the Yakutat Forelands increased in 1996, in part due to Yakutat residents' obtaining both kinds of permits (Table 5). Combining state and federal registration permits, 45 bull moose were taken in 1995 and 60 were killed in 1996 in the RM061 hunt area.

Fifty-six permits and 55 permits were issued for Hunt RM062 in Unit 5B during 1995 and 1996, respectively (Table 5), both below the 1988–1992 mean of 59. Twelve bulls were taken in Unit 5B in 1995, while the 1996 harvest was 16 bulls. Alaska Native corporation lands west of the Wrangell–St. Elias National Park boundary at Yana Stream were closed to hunters other than clients of a single guide, which effectively halved the area in Unit 5B where the general public can take moose.

The Nunatak Bench hunt remained open for moose hunting during the report period but received very little effort and produced no harvest.

Staff from the Division of Fish and Wildlife Protection and both fisheries divisions of the Department of Fish and Game continued to assist with permit issuance and monitoring of these permit hunts. Enforcement personnel from the U.S. Forest Service also helped monitor the hunt in Unit 5A during the report period. Although reminder cards and certified letters were used to increase compliance with permit reporting requirements for the state permit hunts, a few permittees were cited for failing to report their hunts

Hunter Residency and Success. Local residents hunt primarily in Unit 5A on the Yakutat Forelands (Table 4). Starting under state regulations in 1987, local residents were able to hunt for the first week of the season before it opened to nonlocal hunters. In 1991 new federal subsistence regulations allowed local residents exclusive hunting rights on federal lands for the first week of the concurrent state/federal seasons. Most recently, the implementation of a federal season in 1996 that precedes the state season by 1 week has further enhanced opportunity for local hunters. The first portion of the moose hunt traditionally accounts for most of the Unit 5A harvest, and since most of the easily accessible land is under federal management, harvest by Yakutat residents predominates. Local hunters took 66% of the bulls harvested in Unit 5A during 1995 (69% if bulls taken under federal ceremonial permits are included) and 73% in 1996. Most moose taken by local hunters were taken during this first week of the season. Later in the season use by nonlocal hunters in areas further from Yakutat and accessible only by air increased. Nonlocal Alaskans hunting in Unit 5A took 15 moose (33% of bulls taken under registration permits, 31% of all bulls killed) in 1995 and 11 (18%) in 1996. Nonresidents did not take any moose in Unit 5A during 1995 but took 4 in 1996 (Table 4).

Since 1986, overall success of hunters in Unit 5A has ranged from 19 to 32% (Table 3). During this report period, hunter success was 25% in 1995 and 32% in 1996. The average number of days expended by hunters on the Yakutat Forelands reached an all-time high in 1993 (Table 5) but returned to historic levels this report period.

The Malaspina Forelands hunt (Unit 5B) is less dominated by local use, although it is an important alternative for Yakutat hunters who fail to take a moose during the Unit 5A hunt. Local residents took 4 of 12 moose (33%) harvested in 1995 and 6 of 16 moose (38%) in 1996. Nonlocal state residents killed 3 moose in 1996, while nonresidents took 4 moose in 1995 and 6 in 1996. Effort by successful hunters on the Malaspina Forelands was extremely high in 1994 (15.6 days/hunter) but declined to levels of previous years during this report period (Table 5).

Harvest Chronology. The early season moose harvest in Unit 5 is relatively low, due in part to the fact that only Unit 5B is open from September 1 through October 8 (Table 4), and this area typically accounts for only a small portion of the total Unit 5 moose harvest. Most of the Unit 5 harvest takes place during the first weeks of the Unit 5A season, when habitat adjacent to Yakutat and easily accessible by boat or highway vehicle is open. In 1995 that portion of Unit 5A west of the Dangerous River opened on October 15 and was closed by emergency order on

October 17 when the harvest target of 30 bulls was reached. That portion east of the Dangerous River remained open until the scheduled November 15 closure. The following year the new opening date for the federal registration hunt was October 8, followed by the state season on October 15; the portion of Unit 5A west of the Dangerous River was closed on October 24, when the harvest target was approached. The remainder of the hunt area was closed on October 29, when the quota of 60 bulls for the entire subunit was reached. The quota of 25 bulls for the Malaspina Forelands area (Unit 5B) has not been reached since 1981. While the season is longer here than in Unit 5A, the area is more difficult to access. No moose were harvested on Nunatak Bench during this report period.

Transport Methods. Transport methods used during the report period were similar to recent years (Table 6). Aircraft continue to be the most popular single means of transportation among successful hunters, with 36% of all successful Unit 5 hunters using aircraft to access the field. Boat access is the second most important means of transport; 22% of successful hunters used this method. Highway vehicles were used 17% by successful hunters. Three- and 4-wheelers accounted for 18% of the transportation used and is probably underrepresented because some hunts reported under other modes probably include the use of off-road vehicles. Many unsuccessful hunters also use these machines for access. Habitat impacts, wounding loss, animal harassment, and fair chase ethics are all concerns involved with the use of 3- or 4-wheelers. Virtually every fish camp has one or more of these machines present. Although these off-road vehicles have been used in Yakutat for many years, more hunters seem to be using them as a primary method of access. These machines are commonly used to drag whole moose from a kill site to the nearest road. Rutted meadows from wheeled vehicles are now a common sight in Unit 5A.

Despite the importance of aircraft for hunter transportation, relatively few Yakutat resident hunters use them. Combining hunts via highway vehicles, boats, 3- and 4-wheelers, and foot surpasses the number of successful hunts supported by airplane access. The use of aircraft increases later in the season as nonlocal hunters begin hunting in nonroaded portions of the unit.

Commercial Services. Commercial services were used by 11% of Unit 5 moose hunters during the report period (Table 7). Nonlocal hunters were more likely to use commercial services, with transport to the field being used the most. Commercial services were used by a higher percentage of Unit 5B hunters than in Unit 5A. This undoubtedly reflects the fact that the Malaspina Forelands are much more difficult to access.

*Other Mortality*

Two female moose were killed during the 1995 hunting season, and 1 was killed in 1996. Reports of natural mortality during the report period seemed similar to most recent years. Anecdotal information and apparent increases in wolf populations indicate that wolf predation might have increased. However, at this time there is no evidence a higher percentage of moose are being taken by predators.

## HABITAT

ADF&G staff undertook no habitat assessment or enhancement procedures during the period.

## CONCLUSIONS AND RECOMMENDATIONS

We should conduct complete fall sex and age composition counts of all Unit 5 moose populations. Age data on harvested moose should continue to be collected and carefully scrutinized.

Most management goals for Unit 5 moose hunts were not met during this report period. Although the Nunatak Bench was open throughout the period, no harvest was reported in that hunt. Management goals regarding hunter success were attained in 1996 but not in 1995 for RM061 (Yakutat Forelands) and for RM062 (Malaspina Forelands) (Table 3). Hunter success for RM062 was 43% in 1995 and an all-ime high of 52% in 1996. Hunter effort was below management objectives for all hunts. We believe the moose population in the Yakutat Forelands has not increased to a level capable of supporting a harvest of 70 animals.

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Table 1 Unit 5 aerial survey data, 1984–1996

| Year | M | F | Calves | Unk | Total | Count time (hrs) | M Per 100 F | Calves per 100 F | % calves in herd | Moose per hour |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 5A Yakutat Forelands | | | | | |
| 1984 | 90 | 229 | 60 | --- | 379 | 12.1 | 39 | 26 | 16 | 31 |
| 1985 | 50 | 168 | 41 | --- | 259 | 11.0 | 30 | 24 | 16 | 24 |
| 1986 | 34 | 166 | 60 | --- | 260 | 11.3 | 20 | 36 | 23 | 23 |
| 1987 | --- | --- | 83 | --- | 322 | 11.2 | --- | --- | 26 | 29 |
| 1988 | 91 | 339 | 85 | --- | 515 | 10.3 | 27 | 25 | 17 | 50 |
| 1989 | | | | | No Survey | | | | | |
| 1990 | 43 | 309 | 93 | --- | 445 | 6.8 | 14 | 30 | 21 | 66 |
| 1991[1] | --- | --- | --- | --- | 204 | 8.0 | --- | --- | --- | 26 |
| 1992 | --- | --- | 37 | --- | 196 | 5.9 | --- | --- | 19 | 33 |
| 1993[2] | --- | --- | --- | --- | 219 | 6.3 | --- | --- | --- | 35 |
| 1994[3] | 51 | 124 | 51 | 158 | 397 | 9.3 | 20 | 32 | 21 | 41 |
| 1995 | 14 | 71 | 78 | 303 | 466 | 8.5 | --- | --- | 17 | 55 |
| 1996 | 10 | 68 | 8 | --- | 86 | 1.9 | 15 | 12 | 9 | 45 |
| | | | | | 5A Nunatak Bench | | | | | |
| 1984 | 10 | 13 | 4 | --- | 27 | 0.5 | 77 | 31 | 15 | 54 |
| 1985 | | | | | No Survey | | | | | |
| 1986 | 5 | 4 | 1 | --- | 10 | 0.5 | 125 | 25 | 10 | 20 |
| 1987–93 | | | | | | | | | No Survey | |
| 1994 | 3 | 18 | --- | --- | 25 | 0.3 | 16 | 22 | 16 | 75 |
| 1995 | 5 | 6 | 6 | 16 | 33 | 0.3 | --- | --- | 18 | 110 |
| 1996 | | | | | No Survey | | | | | |
| | | | | | 5B Malaspina Forelands | | | | | |
| 1981[4] | 21 | 88 | 25 | --- | 134 | 3.1 | 24 | 28 | 19 | 43 |
| 1982 | 26 | 103 | 16 | --- | 145 | 8.4 | 25 | 16 | 11 | 17 |
| 1983 | --- | --- | 21 | --- | 66 | 1.8 | --- | --- | 32 | 37 |
| 1984–86 | | | | | No Survey | | | | | |
| 1987[5] | --- | --- | 14 | --- | 69 | 2.8 | --- | --- | 20 | 25 |
| 1988–94 | | | | | | No Survey | | | | |
| 1995 | 4 | 10 | 11 | 84 | 109 | 1.75 | --- | --- | 10 | 62 |
| 1996 | | | | | No Survey | | | | | |

[1] Natl. Park Service survey using a PA-18 done from 3/1 to 3/5, 1991, between Glacier Bay Preserve and the Dangerous River.

[2] USFS survey using a C-185 done from 2/14 to 2/17, 1994, between Yakutat and Dry Bay.

[3] Age and sex ratios reflect flights made in a PA-18 (5.5 hrs. from 12/2 to 12/3, 1994); total numbers include flights in both PA-18 and C-185 (3.62 hrs. from 12/6 to 12/7, 1994

[4] Bancas Point to Sitkagi Bluffs only.

[5] Sex and age ratios unreliable.

Table 2 Unit 5 age structure of moose harvests, 1984–1996

| Year | Age Class 0.5 | 1.5 | 2.5 | 3.5 | 4.5 | 5.5 | 6.5 | 7.5 | 8.5 | 9.5 | 10.5 | 11.5 | 12.5 | 13.5 | 14.5 | 15.5 | Total Kill | % Aged | Mean Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yakutat Forelands** | | | | | | | | | | | | | | | | | | | |
| 1984 | 2 | 13 | 11 | 6 | 7 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 96 | 3.2 |
| 1985 | 1 | 15 | 10 | 10 | 2 | 1 | 3 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 46 | 100 | 3.4 |
| 1986 | 3 | 10 | 13 | 8 | 4 | 9 | 3 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 54 | 98 | 3.6 |
| 1987 | 1 | 14 | 7 | 3 | 7 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 95 | 3.0 |
| 1988 | 0 | 17 | 16 | 5 | 2 | 3 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 47 | 98 | 2.9 |
| 1989 | 0 | 10 | 16 | 7 | 5 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 | 96 | 3.1 |
| 1990 | 0 | 16 | 18 | 14 | 4 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 | 100 | 2.9 |
| 1991 | 0 | 20 | 18 | 7 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 | 100 | 2.7 |
| 1992 | 0 | 13 | 5 | 5 | 3 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 60 | 3.0 |
| 1993 | 0 | 12 | 7 | 14 | 3 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 84 | 2.8 |
| 1994 | 0 | 23 | 8 | 6 | 5 | 4 | 0 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 60 | 90 | 2.9 |
| 1995 | 0 | 20 | 12 | 4 | 2 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 | 96 | 2.2 |
| 1996 | 0 | 19 | 12 | 9 | 5 | 2 | 5 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 92 | 2.8 |
| **5A Nunatak Bench (No Data)** | | | | | | | | | | | | | | | | | | | |
| **5B Malaspina Forelands** | | | | | | | | | | | | | | | | | | | |
| 1990 | 0 | 5 | 2 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 100 | 3.2 |
| 1991 | 0 | 3 | 3 | 1 | 2 | 2 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 88 | 4.5 |
| 1992 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 86 | 3.3 |
| 1993 | 0 | 2 | 4 | 3 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 87 | 2.8 |
| 1994 | 0 | 0 | 0 | 1 | 3 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 100 | 4.9 |
| 1995 | 0 | 2 | 5 | 1 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 100 | 2.9 |
| 1996 | 0 | 1 | 2 | 1 | 2 | 3 | 1 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 16 | 88 | 5.4 |

Table 3 Unit 5 historical harvests, hunters, and success, 1984–1996

| Year | Nr MM | Nr FF | Nr unk | Total kill | Nr hunters | % success |
|---|---|---|---|---|---|---|
| | | | 5A Yakutat Forelands | | | |
| 1984 | 49 | 0 | 0 | 49 | 230 | 21 |
| 1985 | 46 | 0 | 0 | 46 | 129 | 36 |
| 1986 | 54 | 0 | 0 | 54 | 198 | 27 |
| 1987 | 38 | 0 | 0 | 38 | 199 | 19 |
| 1988 | 47 | 0 | 0 | 47 | 153 | 31 |
| 1989 | 45 | 0 | 0 | 45 | 163 | 28 |
| 1990 | 57 | 0 | 0 | 57 | 178 | 32 |
| 1991 | 52 | 0 | 0 | 52 | 175 | 30 |
| 1992 | 50 | 0 | 0 | 50 | 199 | 25 |
| 1993 | 50 | 1[1] | 0 | 51 | 204 | 25 |
| 1994 | 60 | 1[1] | 0 | 61 | 208 | 29 |
| 1995 | 48[2] | 2 | 0 | 50 | 185 | 24 |
| 1996 | 60[3] | 1 | 0 | 61 | 190 | 32 |
| | | | 5A Nunatak Bench | | | |
| 1984 | 3 | 3 | 0 | 6 | 14 | 43 |
| 1985 | 2 | 0 | 0 | 2 | 3 | 67 |
| 1986–19944 | | | Season Closed | | | |
| 1995 | | | No moose harvested | | | |
| 1996 | | | No moose harvested | | | |
| | | | 5B Malaspina Forelands | | | |
| 1984 | 15 | 0 | 0 | 15 | 50 | 30 |
| 1985 | 13 | 0 | 0 | 13 | 62 | 21 |
| 1986 | 9 | 0 | 0 | 9 | 34 | 26 |
| 1987 | 8 | 0 | 0 | 8 | 34 | 24 |
| 1988 | 11 | 0 | 0 | 11 | 40 | 28 |
| 1989 | 12 | 0 | 0 | 12 | 44 | 27 |
| 1990 | 14 | 0 | 0 | 14 | 49 | 40 |
| 1991 | 17 | 0 | 0 | 17 | 39 | 44 |
| 1992 | 7 | 0 | 0 | 7 | 25 | 28 |
| 1993 | 15 | 0 | 0 | 15 | 31 | 48 |
| 1994 | 7 | 0 | 0 | 7 | 26 | 27 |
| 1995 | 12 | 0 | 0 | 12 | 28 | 43 |
| 1996 | 16 | 0 | 0 | 16 | 31 | 52 |

[1] **Illegal kill not included in the calculation of hunter success.**
[2] Includes 3 bulls harvested under ceremonial permits; not included in hunter success ratios.
[3] Includes all bulls harvested under both state and federal registration permits.

Table 4 Unit 5 annual moose kill by community, 1984–1996

| Year | Total Kill | Yakutat | Juneau | Ketchikan | Sitka | Pelican | Hoonah | Petersburg | Haines | Wrangell | Other Alaska | Non-resident |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **5A Yakutat Forelands** | | | | | | |
| 1984 | 49 | 18 | 16 | 2 | 6 | 0 | 2 | 1 | 0 | 1 | 1 | 2 |
| 1985 | 44 | 28 | 13 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 54 | 22 | 16 | 1 | 4 | 1 | 3 | 0 | 4 | 0 | 2 | 1 |
| 1987 | 38 | 27 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 1 |
| 1988 | 47 | 38 | 6 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1989 | 45 | 40 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| 1990 | 50 | 45 | 11 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 2 |
| 1991 | 52 | 28 | 15 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 5 | 2 |
| 1992 | 50 | 32 | 7 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 2 | 3 |
| 1993 | 50 | 31 | 11 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 2 | 2 |
| 1994 | 60[1] | 38 | 14 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 3 | 2 |
| 1995 | 50[2] | 35 | 14 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 60 | 45 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 4 |
| | | | | | | **5A Nunatak Bench** | | | | | | |
| 1980–96 | | | | | | (No Data) | | | | | | |
| | | | | | | **5B Malaspina Forelands** | | | | | | |
| 1984 | 15 | 5 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 1985 | 13 | 8 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 1986 | 9 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 1987 | 8 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1988 | 11 | 5 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1989 | 12 | 7 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1990 | 14 | 9 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1991[2] | 17 | 7 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| 1992 | 7 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 15 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 1994 | 7 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1995 | 12 | 4 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 1996 | 16 | 6 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 6 |

[1] Does not include the single known illegal kill.

[2] Includes 5 moose harvested under ceremonial permits, 3 bulls, and 2 cows.

[2] Includes one kill by hunter of unknown residency.

Table 5 Unit 5 hunter effort and success, 1990–1996

| | | Successful Hunters | | | Unsuccessful Hunters | | | Total Hunters | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Permits issued | Nr hunters | Total days | Avg days | Nr hunters | Total days | Avg days | Nr hunters | Total days | Avg days |
| | | | | | 5A Yakutat Forelands | | | | | |
| 1984 | — | 49 | 132 | 2.7 | 181 | 978 | 5.4 | 230 | 1110 | 4.8 |
| 1985 | — | 44 | 117 | 2.7 | 84 | 457 | 5.4 | 128 | 574 | 4.6 |
| 1986 | — | 54 | 171 | 2.7 | 143 | 696 | 4.9 | 197 | 867 | 3.6 |
| 1987 | — | 38 | 109 | 2.9 | 161 | 948 | 5.9 | 199 | 1057 | 5.6 |
| 1988 | 206 | 47 | 95 | 2.0 | 106 | 281 | 2.7 | 153 | 376 | 2.4 |
| 1989 | 213 | 45 | 107 | 2.4 | 118 | 620 | 5.3 | 163 | 727 | 4.3 |
| 1990 | 213 | 57 | 110 | 1.9 | 122 | 497 | 4.2 | 178 | 607 | 3.5 |
| 1991 | 236 | 52 | 162 | 3.1 | 123 | 425 | 3.4 | 175 | 587 | 3.6 |
| 1992 | 238 | 50 | 130 | 2.6 | 149 | 771 | 6.0 | 199 | 901 | 4.5 |
| 1993 | 239 | 50 | 204 | 4.1 | 154 | 979 | 6.5 | 204 | 1183 | 5.9 |
| 1994 | 268 | 60 | 167 | 2.9 | 148 | 712 | 4.8 | 208 | 879 | 4.4 |
| 1995 | 245 | 45 | 99 | 2.3 | 140 | 471 | 3.4 | 185 | 570 | 3.1 |
| 1996 | 277 | 60 | 147 | 2.6 | 76 | 427 | 3.6 | 190 | 574 | 3.0 |
| | | | | | 5A Nunatak Bench | | | | | |
| 1984 | — | 6 | 27 | 4.5 | 8 | 24 | 3.0 | 14 | 51 | 3.6 |
| 1985 | — | 2 | 44 | 22.0 | 1 | 10 | 10.0 | 3 | 32 | 10.7 |
| 1986–94 | | | | | Season Closed | | | | | |
| 1995 | 19 | 0 | 0 | 0 | 3 | 3 | 1.0 | 3 | 3 | 1.0 |
| 1996 | 9 | 0 | 0 | 0 | 3 | 4 | 1.3 | 3 | 4 | 1.3 |
| | | | | | 5B Malaspina Forelands | | | | | |
| 1984 | — | 15 | 40 | 2.7 | 40 | 191 | 4.8 | 55 | 231 | 4.2 |
| 1985 | — | 13 | 34 | 2.6 | 49 | 226 | 4.6 | 62 | 260 | 4.2 |
| 1986 | — | 9 | 40 | 4.4 | 27 | 139 | 5.1 | 36 | 179 | 5.0 |
| 1987 | — | 8 | 56 | 2.8 | 16 | 83 | 5.2 | 24 | 139 | 5.8 |
| 1988 | 58 | 11 | 39 | 3.5 | 29 | 120 | 4.1 | 40 | 159 | 4.0 |
| 1989 | 65 | 12 | 47 | 3.9 | 32 | 143 | 4.7 | 44 | 190 | 4.3 |
| 1990 | 60 | 14 | 53 | 3.8 | 35 | 80 | 2.4 | 49 | 133 | 2.8 |
| 1991 | 60 | 17 | 51 | 3.0 | 22 | 90 | 4.5 | 39 | 141 | 3.8 |
| 1992 | 52 | 7 | 22 | 3.1 | 18 | 61 | 3.4 | 25 | 83 | 3.3 |
| 1993 | 54 | 15 | 30 | 2.0 | 16 | 91 | 5.7 | 31 | 121 | 3.9 |
| 1994 | 42 | 7 | 109 | 15.6 | 19 | 26 | 1.9 | 26 | 135 | 6.4 |
| 1995 | 56 | 12 | 46 | 3.8 | 15 | 57 | 3.8 | 27 | 103 | 3.8 |
| 1996 | 55 | 16 | 71 | 4.4 | 14 | 75 | 5.4 | 30 | 146 | 4.9 |

Table 6 Unit 5 transport methods of successful hunters, 1990–1996

| | Airplane | | Boat | | 3- or 4-wheeler | | ORV | | Highway vehicle | | Foot | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Total | (%) | Total | (%) | Total | (%) | Total | (%) | Total | (%) | Total | (%) |
| 5A Yakutat Forelands | | | | | | | | | | | | |
| 1990 | 29 | (51) | 10 | (18) | 7 | (12) | 0 | --- | 11 | (19) | 0 | --- |
| 1991 | 29 | (56) | 6 | (12) | 7 | (13) | 0 | --- | 10 | (19) | 0 | --- |
| 1992 | 22 | (44) | 8 | (16) | 9 | (18) | 0 | --- | 11 | (22) | 0 | --- |
| 1993 | 25 | (50) | 12 | (24) | 6 | (12) | 0 | --- | 5 | (10) | 2 | (4) |
| 1994 | 24 | (41) | 15 | (25) | 9 | (15) | 0 | --- | 9 | (15) | 2 | (3) |
| 1995 | 15 | (37) | 11 | (27) | 9 | (23) | 1 | (3) | 4 | (10) | 0 | --- |
| 1996 | 13 | (22) | 15 | (26) | 10 | (17) | 0 | --- | 16 | (28) | 4 | (7) |
| 5B Malaspina Forelands | | | | | | | | | | | | |
| 1990 | 9 | (69) | 4 | (31) | 0 | --- | 0 | --- | 0 | --- | 0 | --- |
| 1991 | 14 | (82) | 2 | (12) | 0 | --- | 1 | (6) | 0 | --- | 0 | --- |
| 1992 | 5 | (100) | 0 | --- | 0 | --- | 0 | --- | 0 | --- | 0 | --- |
| 1993 | 12 | (80) | 0 | --- | 3 | (20) | 0 | --- | 0 | --- | 0 | --- |
| 1994 | 5 | (71) | 2 | (29) | 0 | --- | 0 | --- | 0 | --- | 0 | --- |
| 1995 | 8 | (89) | 0 | --- | 0 | --- | 1 | (11) | 0 | --- | 0 | --- |
| 1996 | 8 | (58) | 1 | (7) | 3 | (21) | 0 | --- | 0 | --- | 2 | (14) |

Table 7 Unit 5 hunter commercial services, 1992–1996

| Year | Unit residents No | Unit residents Yes | Other AK residents No | Other AK residents Yes | Nonresidents No | Nonresidents Yes | Total use No | Total use Yes | Transport | Registered guide | Other Services |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 5A Yakutat Forelands | | | | | | |
| 1991[1] | 11 | 7 | 0 | 13 | 0 | 3 | 11 | 23 | 19 | 2 | 2 |
| 1992 | 123 | 8 | 40 | 17 | 5 | 1 | 168 | 26 | 22 | 0 | 4 |
| 1993 | 122 | 11 | 26 | 18 | 3 | 2 | 151 | 31 | 28 | 2 | 1 |
| 1994 | 131 | 9 | 26 | 24 | 0 | 0 | 157 | 33 | 32 | 1 | 0 |
| 1995 | 111 | 9 | 21 | 26 | 3 | 3 | 135 | 38 | 36 | 1 | 0 |
| 1996 | 44 | 1 | 16 | 18 | 4 | 2 | 64 | 21 | 19 | 1 | 1 |
| | | | | | 5B Malaspina Forelands | | | | | | |
| 1991 | 1 | 4 | 0 | 9 | 0 | 0 | 1 | 13 | 9 | 0 | 4 |
| 1992 | 2 | 3 | 3 | 5 | 0 | 4 | 5 | 12 | 5 | 7 | 0 |
| 1993 | 1 | 5 | 6 | 7 | 0 | 7 | 7 | 19 | 13 | 6 | 0 |
| 1994 | 6 | 0 | 0 | 8 | 1 | 1 | 7 | 9 | 8 | 1 | 0 |
| 1995 | 6 | 9 | 1 | 5 | 3 | 4 | 10 | 18 | 15 | 2 | 1 |
| 1996[2] | 3 | 1 | 2 | 9 | 0 | 9 | 5 | 19 | 11 | 8 | 1 |

[1] Use of commercial services was not collected for each individual hunter, particularly local residents, and was not included in percentage calculations.
[2] Does not include effort data for federal permit hunts.

## LOCATION

**GAME MANAGEMENT UNIT:** Unit 6 (10,140 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Prince William Sound and North Gulf Coast

## BACKGROUND

Moose populations in most of Unit 6 originated from translocations. During 1949 through 1958, 24 moose calves were released on the western Copper River Delta in Unit 6C (Burris & McKnight 1973). This small population rapidly extended eastward, first occupying Unit 6B and then advancing by the late 1960s into the Bering River area in Unit 6A. Moose may also have reached Unit 6A through dispersal westward from the Malaspina Glacier forelands in Unit 5A. The introduced population reached a record high of approximately 1600 in 1988 (Griese 1990), then declined to about 1227 by 1994 as part of a planned reduction (Nowlin in press*a*). The only moose endemic to the unit are small populations in the Lowe River drainage and Kings Bay in Unit 6D. These populations never grew and today include only about 40 animals.

Harvest of the introduced population began with 25 bulls killed in 1960. Reported take through regulatory year 1996–97 was 3652. Total harvest of the endemic moose population in Unit 6D during the same period was approximately 37 moose.

Population objectives were relatively conservative in the 1970s and early 1980s because we were concerned about mortality during severe winters. Objectives were established at 0.9–1.2 moose/$mi^2$ after a severe winter in 1971–72 and remained conservative under management plans written in 1976 (Rausch 1977). We revised objectives in 1994 using new information about carrying capacity of the winter ranges (MacCracken 1992) and refined estimates of population size (Nowlin *a*).

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

Our primary and secondary management goals in Unit 6A (East) are to take large moose and to provide for optimum harvest. Primary and secondary goals for the remainder of the unit are to provide for optimum harvest and to provide for the greatest opportunity to participate in hunting.

### POSTHUNT MANAGEMENT OBJECTIVES

Our management objective for Unit 6A (East) is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 30:100. Our objective for Units 6A (West) and 6B is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 15:100 in each unit. In Unit 6C our objective is to increase the population to 400 moose by the year 2006 and maintain a minimum bull:cow ratio of 15:100.

## METHODS

We completed a modified (Gasaway et al. 1986) census to estimate moose population size and composition. Size was compared between years using a two-tailed *t*-test ($P<0.10$). Density stratifications were based upon prior knowledge of moose distribution from radio telemetry data (MacCracken 1992) and from stratification flights in a Cessna 185 aircraft (Nowlin 1995). We used Piper Super Cub (PA-18) and Bellanca Scout aircraft for searches of sample units. Sex and age ratio estimates were only from censuses conducted before mid-December. Population estimates were not corrected for sightability. U.S. Forest Service (FS), Cordova Ranger District, assisted during some censuses by providing observers. Corrections calculated during previous censuses indicated we observed >89% of the moose present.

Areas censused included only important moose habitat. Viereck et al. (1986) described the habitat types present, and MacCracken (1992) identified types that were most important for moose. Important types were below 500 ft elevation in river valleys and deltas of the coastal plain and included open tall-willow (*Salix sp.*), closed tall alder-willow (*Alnus sinuata-Salix sp.*), low sweetgale-willow (*Myrica gale-Salix sp.*), woodland spruce (*Picea sitkensis*) and aquatic (wet forb-herbaceous).

Hunters participating in drawing or registration permit hunts were required to report and were sent no more than 2 reminder letters. Hunters participating in general moose hunts were sent a reminder letter if they failed to return their hunt report.

We summarized data by unit, except for Unit 6A that was divided into eastern and western portions. The eastern portion was all drainages into the Gulf of Alaska between Cape Suckling and the head of Icy Bay. The western portion was all drainages into the Gulf between Cape Suckling and Palm Point.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

We completed censuses in Units 6A (East) (13–14 January 1996), 6A (West) (13–15 January 1996), 6B (14 December 1996) and 6C (15 December 1996). No estimates of bull:cow ratios were obtained because many bulls had shed antlers when we conducted the censuses. We estimated total number in other units where censuses were not completed. Those estimates were based upon previous censuses, productivity and survival, and anecdotal information.

#### *Population Size*

The posthunt moose population in Unit 6 during 1996–97 was probably 1207. Populations in each unit were 290 in 6A (East), 310 in 6A (West), 308 in 6B, 259 in 6C, and 40 in 6D.

Numbers declined by about 171 moose over the past 5 years, with most of the reduction occurring in Units 6A (East) and 6C. We estimated 1378 animals unitwide during 1992–93. Censuses indicated Unit 6A (East) declined from 416 to 282 moose ($P \leq 0.10$) between 1992–93 and 1995–96 (Table 1). Censuses also indicated the population in Unit 6C declined from

299 to 259 ($P \leq 0.10$) between 1992–93 and 1996–97. We detected no other significant changes.

We planned the reduction in Unit 6A (East) because moose numbers were probably higher than could be supported by the winter food supply. We increased harvest, and calf survival declined. We planned to increase the population in Unit 6C by decreasing harvest of cows to $\leq 5$ each year beginning in 1995–96 (Nowlin in press*a*). That strategy did not result in an increase. However, it may have prevented a decline over the past 2 years. Census results indicated no significant difference ($P \leq 0.10$) in the population between 1994–95 and 1996–97.

*Population Composition*

Proportion of calves in unit populations during this reporting period was 6–17% (Table 1). The lowest calf survival was during 1996–97 in Unit 6B (6%). This prompted cancellation of the moose hunts in Unit 6B and more conservative harvests in Units 6A (West) and 6A (East) during 1997–98. No censuses were completed in the latter 2 units to verify lower survival. However, historical records indicated survival in those units would be the same or less than in Unit 6B.

Over the past 5 years, calf survival has declined in Units 6B and 6C. It may have also declined in Units 6A (East) and (West). However, no data were collected to verify this assumption.

## MORTALITY

*Harvest*

Season and Bag Limit. In Unit 6A (East), the bag limit for all hunters was 1 moose. The bull moose season during this entire reporting period was 1 September–31 October, and hunters were restricted to bulls with 50-inch antlers or antlers with 3 or more brow tines on at least 1 side. The antlerless season during 1995–96 was 1 November–31 December by harvest ticket. During 1996–97, the antlerless season was 15 November–31 December, with harvest of no more than 20 animals authorized by registration permit. We cancelled the antlerless hunt during 1996–97 to allow the population to increase.

In Unit 6A (West), the season for all hunters was 1 September–31 October, with a bag limit of 1 moose. Residents were allowed to take up to 30 bulls by registration permit, and nonresidents were allowed to take up to 5 bulls by drawing permit. We established an annual allowable harvest for bulls that included both hunts. When that harvest level was reached, both hunts were closed by emergency order. Both residents and nonresidents were allowed harvest of up to 30 antlerless moose by drawing permit.

The season in Unit 6B was open for resident hunters only and was 27 August–31 October, with a bag limit of 1 moose. Take of 30 bull moose was authorized by registration permit, and harvest of 30 antlerless moose was authorized by drawing permit. No motorized vehicles were allowed for transportation from 15 August–31 August, with the exception of highway vehicles on the maintained surface of the Copper River Highway. Also, moose could not be taken until after 3:00 a.m. following the day on which an airboat was used for transportation. All airboats were required to display an ADF&G identification number. Airboat restrictions were in effect only while the registration permit hunt for bulls was open.

In Unit 6C the season was open for resident hunters only and was 1 September–31 October, with a bag limit of 1 moose by drawing permit. Up to 40 drawing permits were authorized, 20 for bulls and 20 for antlerless moose. The season in Unit 6D for all hunters was 1–30 September, and the bag limit was 1 bull by harvest ticket.

Board of Game Actions and Emergency Orders. The Board made major regulatory changes in all units, except 6D, during 1995–96. The Copper River/Prince William Sound Fish and Game Advisory Committee proposed the changes. We supported their proposals, except restriction of nonresidents in Unit 6A (West).

In Unit 6A (East), the bull season was changed from 1 September–31 December to 1 September–31 October, and the bag limit was restricted to bulls with 50-inch antlers or antlers with 3 or more brow tines. The change was designed to reduce harvest and to assure a supply of large antlered bulls, while providing maximum opportunity to hunt. Decreasing the kill was necessary to stabilize the population after several years of heavy harvest. The antlerless season was changed from 15 November–31 December to 1 November–31 December. This change provided additional opportunity to take antlerless moose. However, this change was reversed the following year, and a registration permit hunt was implemented when we were unable to adequately control the kill.

In Unit 6A (West), the season for bulls and antlerless moose was changed from 1 September–5 October to 1 September–31 October. The change allowed people who received drawing permits more time to hunt. The registration permit hunt for bulls was restricted to resident hunters, and a drawing permit hunt with 5 permits issued was created for nonresidents only. Nonresidents were restricted because of local concern about their harvest.

In Unit 6B, the season for bulls and antlerless moose was changed from 27 August–30 September to 27 August–31 October. The change allowed more opportunity for drawing permit winners to hunt. Use of airboats for transportation was restricted for both bull and antlerless hunts while the registration permit hunt for bulls was in progress. Restrictions were implemented because hunters using airboats were so efficient at locating and killing bulls that harvest could not be controlled (Nowlin in press*a*). Changing to a drawing permit hunt to establish control of the harvest was not an acceptable alternative for local people.

In Unit 6C the season for bulls and antlerless moose was changed from 1 September–30 September to 1 September–31 October. As in other units, the change allowed people who received drawing permits more time to hunt.

We issued emergency orders each year to close the registration permit hunts for bull moose in Units 6A (West) (12 September 1995 and 23 September 1996) and 6B (17 September 1995 and 7 September 1996). The purpose was to limit harvest to $\leq$30 bulls, as authorized in regulations for each hunt. These were normal management actions.

Hunter Harvest. Reported moose harvest for Unit 6 was 110 in 1995–96 and 95 in 1996–97 (Table 2). These were the lowest kills in 5 years. We purposefully lowered harvests in all units except 6D. Lower harvests in Units 6A (West) and 6A (East) were necessary to stabilize the populations after our planned reduction in numbers. Kill was decreased in Unit 6B because of lower calf survival. Harvest was also decreased in Unit 6C to allow a population increase (Nowlin in press*a*).

Composition of the kill was 66% males and 34% females during 1995–96 and 79% males and 21% females during 1996–97. The values for 1995–96 were similar to previous years. Proportion of females during 1997–98 was the lowest in 5 years.

Permit Hunts. During this reporting period, Unit 6A (West) had 1 registration and 2 drawing permit hunts, Unit 6B had 1 registration and 1 drawing permit hunt, and Unit 6C had 2 drawing hunts (Table 3). Success was very high in drawing hunts (71–100%) and somewhat lower in registration hunts (15–63%). Lower success in registration hunts was due to unlimited hunter participation, and to closures by emergency order when the allowable harvest was reached.

Harvest in all hunts was as expected and administration presented no unusual problems. Problems controlling harvest in Unit 6B that were caused by airboats (Nowlin in press*a*) during the last reporting period were resolved. Prohibiting same-day-airboating decreased the efficiency of hunters and allowed us to reassert control of the harvest without resorting to a drawing permit hunt.

Hunter Residency and Success. Local residents were 75% and 70%, respectively, of all hunters reporting residency in Unit 6 during 1995–96 and 1996–97 (Table 4). This was the highest proportion of local hunters in 5 years. Alaska residents from other parts of the state were 13% and 17% of hunters, while nonresidents were 12% and 13%, respectively. More conservative seasons across the unit discouraged nonlocal hunters from participating.

Hunter success during 1995–96 and 1996–97 was 39% and 38%, respectively. This was the lowest success rate in 5 years. More conservative seasons and airboat restrictions were responsible for this low rate.

Harvest Chronology. Most of the Unit 6 harvest over the past 2 years occurred during September (Table 5). During 1995–96, 65% of the moose were taken during this period, and 82% were harvested during this time in 1996–97. The harvest pattern has not changed over the past 5 years.

Transport Methods. Boats, primarily airboats, were the most commonly used transport method during this reporting period (Table 6). Airplanes and highway vehicles followed them in decreasing order of importance. This pattern of use has not changed over the past 5 years.

*Other Mortality*

Calf survival was very low in Unit 6B during 1996–97 and has declined over much of the unit during the past 5 years. Weather and/or predation by brown bears and wolves were possible causes of calf mortality. Circumstantial evidence was found in Unit 6C that calf survival was correlated with thermal stress during calving and that brown bears were responsible for some neonatal mortality (MacCracken et al. 1997). Brown bears and radio-collared wolves were observed feeding on neonatal moose in various parts of the unit (Carnes et al. 1996). In addition, brown bear populations in Units 6A (East), 6A (West), 6B and 6C increased (Nowlin in press*b*).

It is unlikely that habitat was a major factor in lower calf survival. A moose twinning rate of 40% (MacCracken et al. 1997) and a high level of lipid reserves in females during March (Stephenson 1995) were documented in Unit 6C, indicating an intermediate to high-quality habitat. We found no indication of fat-depleted bone marrow in moose killed by wolves in Unit 6 (Carnes et al. 1996). Moreover, the moose population was reduced in Units 6A (East) and 6A (West) to assure an adequate supply of winter forage.

The Copper River/Prince William Sound Fish and Game Advisory Committee felt that brown bear predation was an important cause of low calf survival and that reducing the brown bear population would increase recruitment. They proposed increasing the harvest of brown bears by changing the bag limit for resident hunters from 1 bear every 4 regulatory years to 1 bear every year. The Board of Game passed the proposal for Units 6A (East), 6A (West), 6B, and 6C. The new regulation took effect in 1997–98.

We opposed the change in bag limit for brown bears. Wolves and bears can limit moose populations in other areas (National Research Council 1997, Ballard & Van Ballenberghe 1997, Van Ballenberghe & Ballard 1994, Gasaway et al. 1990). However, low calf survival might not persist and predation might not be the most important factor. Also, if predation was the cause of low calf survival, the most important predator is unknown.

## CONCLUSIONS AND RECOMMENDATIONS

Population goals were achieved in all units, except 6C. Optimum harvest was not reached in that unit because too many moose were harvested to allow a population increase. Population objectives of 300–350 moose were achieved in Unit 6A (West) and in Unit 6B. I did not make progress achieving my objective of 400 moose by the year 2006 in Unit 6C. The population was stable at 259 moose, in spite of reduced cow harvest. The model used as a guide for planning the increase should be reevaluated if the next census shows no positive change in numbers. Calf survival that was lower than planned is also a problem. In Unit 6A (East) I did not achieve my objective of 300–350 moose. The population dropped to 253 because I delayed reducing harvest to stabilize numbers during my planned reduction.

The current season and bag limit should allow an increase. The requirement for minimum antler size in the bull harvest will limit kill of bulls to a few large animals. The registration permit hunt for antlerless moose will allow cancellation of the hunt or restriction of the kill to a small number of animals. Harvest of antlerless moose should be increased substantially only when a census shows numbers have increased and we have achieved the population objective.

Success in achieving objectives for bull:cow ratios could not be evaluated because we completed no censuses before mid-December when a significant number of bulls drop their antlers.

An objective to harvest a minimum number of large antlered bulls should be established for Unit 6A (East). The number harvested and size of antlers should be based on census and harvest data obtained during the next reporting period. Establishing this objective will be important for evaluating management progress.

Calf survival should be monitored closely during the next reporting period. We should conduct aerial composition surveys if censuses cannot be completed. A calf mortality study should be implemented if low survival persists. Neonatal calves should be radiocollared, relocated twice per day, and examined immediately if they are killed. Such monitoring will allow us to determine the importance of predation and to evaluate effects of individual predators on calf survival.

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Table 1 Unit 6 moose estimated population composition and size, 1992–96

| Unit | Regulatory year | Bulls: 100 cows | Calves(%) | Adults | Population size | Population 90% C.I. | Total moose observed |
|---|---|---|---|---|---|---|---|
| 6A (East) | 1992–93 | - | 8 | 384 | 416[a] | 373-459 | 378 |
| | 1995–96 | - | 10 | 253 | 282[b] | 249-316 | 162 |
| 6A (West) | 1992–93 | 23 | 12 | 259 | 295[a] | 255-334 | 273 |
| | 1995–96 | - | 14 | 271 | 316[a] | 272-361 | 221 |
| 6B | 1992–93 | 19 | 17 | 271 | 328[a] | 268-387 | 203 |
| | 1994–95 | 22 | 10 | 266 | 296[a] | 244-347 | 182 |
| | 1996–97 | - | 6 | 289 | 308[a] | 249-367 | 167 |
| 6C | 1992–93 | 26 | 25 | 225 | 299[a] | 263-335 | 204 |
| | 1994–95 | 27 | 14 | 242 | 281[a,b] | 205-358 | 236 |
| | 1996–97 | - | 17 | 214 | 259[b] | 232-287 | 216 |

[a,b] Population sizes with different letters within a unit are significantly different ($p$<0.10).

Table 2 Unit 6 moose harvest and accidental death, 1992–96

| | | Hunter harvest | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Regulatory | Reported | | | | | Estimated | | | Accidental | |
| Unit | year | M | (%) | F | (%) | Total | [a] Unreported | Illegal | Total | death | Total |
| 6A (East) | 1992–93 | 35 | (69) | 16 | (31) | 52 | 4 | 2 | 6 | 0 | 58 |
| | 1993–94 | 44 | (66) | 23 | (34) | 67 | 3 | 1 | 4 | 0 | 71 |
| | 1994–95 | 29 | (76) | 9 | (24) | 39 | 2 | 1 | 3 | 0 | 42 |
| | 1995–96 | 9 | (38) | 15 | (63) | 25 | 2 | 2 | 4 | 0 | 29 |
| | 1996–97 | 16 | (100) | 0 | (0) | 16 | 2 | 2 | 4 | 0 | 20 |
| 6A (West) | 1992–93 | 50 | (61) | 32 | (39) | 82 | 4 | 1 | 5 | 0 | 87 |
| | 1993–94 | 21 | (84) | 4 | (16) | 25 | 0 | 2 | 2 | 0 | 27 |
| | 1994–95 | 25 | (83) | 5 | (17) | 30 | 0 | 2 | 2 | 0 | 32 |
| | 1995–96 | 23 | (72) | 9 | (28) | 32 | 0 | 2 | 2 | 0 | 34 |
| | 1996–97 | 24 | (73) | 9 | (27) | 33 | 0 | 2 | 2 | 0 | 35 |
| 6A TOTAL | 1992–93 | 85 | (64) | 48 | (36) | 134 | 8 | 3 | 11 | 0 | 145 |
| | 1993–94 | 65 | (71) | 27 | (29) | 92 | 3 | 3 | 6 | 0 | 98 |
| | 1994–95 | 54 | (79) | 14 | (21) | 69 | 2 | 3 | 5 | 0 | 74 |
| | 1995–96 | 32 | (57) | 24 | (43) | 57 | 2 | 4 | 6 | 0 | 63 |
| | 1996–97 | 40 | (82) | 9 | (18) | 49 | 2 | 4 | 6 | 0 | 55 |

Table 2 Continued

| Unit | Regulatory year | Hunter harvest: Reported M | (%) | F | (%) | Total[a] | Estimated: Unreported | Illegal | Total | Accidental death | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6B | 1992–93 | 29 | (71) | 12 | (29) | 41 | 0 | 1 | 1 | 0 | 42 |
| | 1993–94 | 27 | (63) | 16 | (37) | 43 | 0 | 0 | 0 | 0 | 43 |
| | 1994–95 | 32 | (73) | 12 | (27) | 44 | 0 | 1 | 1 | 1 | 46 |
| | 1995–96 | 21 | (70) | 9 | (30) | 30 | 0 | 1 | 1 | 0 | 31 |
| | 1996–97 | 16 | (73) | 6 | (27) | 22 | 0 | 3 | 3 | 0 | 25 |
| 6C | 1992–93 | 19 | (59) | 13 | (41) | 32 | 1 | 3 | 4 | 1 | 37 |
| | 1993–94 | 18 | (64) | 10 | (36) | 28 | 0 | 4 | 4 | 0 | 32 |
| | 1994–95 | 20 | (57) | 15 | (43) | 35 | 0 | 2 | 2 | 2 | 39 |
| | 1995–96 | 17 | (81) | 4 | (19) | 21 | 1 | 1 | 2 | 1 | 24 |
| | 1996–97 | 18 | (78) | 5 | (22) | 23 | 1 | 1 | 2 | 0 | 25 |
| 6D | 1992–93 | 2 | (100) | 0 | (0) | 2 | 0 | 0 | 0 | 0 | 2 |
| | 1993–94 | 0 | (0) | 0 | (0) | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1994–95 | 1 | (100) | 0 | (0) | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1995–96 | 2 | (100) | 0 | (0) | 2 | 0 | 1 | 1 | 0 | 3 |
| | 1996–97 | 1 | (100) | 0 | (0) | 1 | 0 | 0 | 0 | 0 | 1 |

Table 2 Continued

| Unit | Regulatory year | Hunter harvest: Reported M | (%) | F | (%) | Total[a] | Estimated: Unreported | Illegal | Total | Accidental death | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit 6 TOTAL | 1992–93 | 135 | (65) | 73 | (35) | 209 | 9 | 7 | 16 | 1 | 226 |
| | 1993–94 | 110 | (67) | 53 | (33) | 163 | 3 | 7 | 10 | 0 | 173 |
| | 1994–95 | 107 | (72) | 41 | (28) | 149 | 2 | 6 | 8 | 3 | 160 |
| | 1995–96 | 72 | (66) | 37 | (34) | 110 | 3 | 7 | 10 | 1 | 121 |
| | 1996–97 | 75 | (79) | 20 | (21) | 95 | 3 | 8 | 11 | 0 | 106 |

[a] Totals may include moose of unknown sex and unit.

Table 3 Unit 6 moose harvest data by permit hunt, 1992–96

| Unit/hunt no. | Regulatory year | Legal moose | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls | (%) | Cows | (%) | Total reported harvest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6A/RM160[a] | 1993–94 | Bull | 101 | 60 | 48 | 53 | 21 | (100) | 0 | (0) | 21 |
| | 1994–95 | Bull | 86 | 43 | 49 | 51 | 25 | (100) | 0 | (0) | 25 |
| | 1995–95 | Bull | 67 | 55 | 37 | 63 | 19 | (100) | 0 | (0) | 19 |
| | 1996–97 | Bull | 73 | 40 | 55 | 45 | 20 | (100) | 0 | (0) | 20 |
| 6A/DM160[b] | 1995–96 | Bull | 5 | 40 | 0 | 100 | 3 | (100) | 0 | (0) | 3 |
| | 1996–97 | Bull | 5 | 20 | 0 | 100 | 4 | (100) | 0 | (0) | 4 |
| 6A/DM162 | 1993–94 | Antlerles | 15 | 33 | 40 | 40 | 0 | (0) | 4 | (100) | 4 |
| | 1994–95 | Antlerles | 20 | 55 | 44 | 56 | 0 | (0) | 5 | (100) | 5 |
| | 1995–96 | Antlerles | 20 | 30 | 29 | 71 | 1 | (10) | 9 | (90) | 10 |
| | 1996–97 | Antlerles | 15 | 27 | 18 | 82 | 0 | (0) | 9 | (100) | 9 |
| 6B/R964 | 1992–93 | Antlered | 186 | 40 | 75 | 25 | 28 | (100) | 0 | (0) | 28 |
| 6B/RM164 | 1993–94 | Bull | 229 | 34 | 82 | 18 | 27 | (100) | 0 | (0) | 27 |
| | 1994–95 | Bull | 164 | 34 | 70 | 30 | 32 | (100) | 0 | (0) | 32 |
| | 1995–96 | Bull | 191 | 38 | 82 | 18 | 21 | (100) | 0 | (0) | 21 |
| | 1996–97 | Bull | 172 | 37 | 85 | 15 | 16 | (100) | 0 | (0) | 16 |
| 6B/D966 | 1992–93 | Antlerles | 20 | 15 | 24 | 76 | 1 | (8) | 12 | (92) | 13 |

Table 3 Continued

| Unit/hunt no. | Regulatory year | Legal moose | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls | (%) | Cows | (%) | Total reported harvest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6B/DM166 | 1993–94 | Antlerles | 20 | 15 | 6 | 94 | 0 | (0) | 16 | (100) | 16 |
| | 1994–95 | Antlerles | 20 | 10 | 28 | 67 | 0 | (0) | 12 | (100) | 12 |
| | 1995–96 | Antlerles | 10 | 10 | 0 | 100 | 0 | (0) | 9 | (100) | 9 |
| | 1996–97 | Antlerles | 10 | 20 | 25 | 75 | 0 | (0) | 6 | (100) | 6 |
| 6C/D967 | 1992–93 | Antlered | 20 | 0 | 5 | 95 | 19 | (100) | 0 | (0) | 19 |
| 6C/DM167 | 1993–94 | Bull | 20 | 5 | 5 | 95 | 18 | (100) | 0 | (0) | 18 |
| | 1994–95 | Bull | 20 | 0 | 0 | 100 | 20 | (100) | 0 | (0) | 20 |
| | 1995–96 | Bull | 20 | 10 | 6 | 94 | 17 | (100) | 0 | (0) | 17 |
| | 1996–97 | Bull | 20 | 10 | 0 | 100 | 18 | (100) | 0 | (0) | 18 |
| 6C/D968 | 1992–93 | Antlerles | 15 | 0 | 13 | 87 | 0 | (0) | 13 | (100) | 13 |
| 6C/DM168 | 1993–94 | Antlerles | 10 | 0 | 0 | 100 | 0 | (0) | 10 | (100) | 10 |
| | 1994–95 | Antlerles | 15 | 0 | 0 | 100 | 0 | (0) | 15 | (100) | 15 |
| | 1995–96 | Antlerles | 5 | 0 | 20 | 80 | 0 | (0) | 4 | (100) | 4 |
| | 1994–95 | Antlerles | 5 | 0 | 0 | 100 | 0 | (0) | 5 | (100) | 5 |

[a] R or RM prefix was a registration permit hunt

[b] D or DM prefix was a drawing permit hunt.

Table 4 Unit 6 moose hunter residency and success, 1992–96

| | | Successful | | | | | Unsuccessful | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | Regulatory year | Local resident [a] | Nonlocal resident | Nonresident | Total | (%) [b] | Local resident | Nonlocal resident | Nonresident | Total | (%) [b] | Total hunter |
| 6A (East) | 1992–93 | 7 | 18 | 27 | 52 | (69) | 5 | 10 | 8 | 23 | (31) | 75 |
| | 1993–94 | 12 | 28 | 26 | 67 | (52) | 12 | 24 | 23 | 61 | (48) | 128 |
| | 1994–95 | 9 | 7 | 21 | 39 | (53) | 12 | 12 | 11 | 35 | (47) | 74 |
| | 1995–96 | 16 | 2 | 7 | 25 | (36) | 12 | 12 | 20 | 44 | (64) | 69 |
| | 1996–97 | 1 | 0 | 15 | 16 | (41) | 5 | 6 | 12 | 23 | (59) | 39 |
| 6A (West) | 1992–93 | 64 | 12 | 6 | 82 | (65) | 22 | 15 | 7 | 45 | (35) | 127 |
| | 1993–94 | 15 | 2 | 8 | 25 | (50) | 15 | 2 | 8 | 25 | (50) | 50 |
| | 1994–95 | 18 | 3 | 9 | 30 | (52) | 15 | 8 | 5 | 28 | (48) | 58 |
| | 1995–96 | 28 | 1 | 3 | 32 | (67) | 11 | 5 | 0 | 16 | (33) | 48 |
| | 1996–97 | 24 | 5 | 4 | 33 | (57) | 22 | 3 | 0 | 25 | (43) | 58 |
| 6A TOTAL | 1992–93 | 71 | 30 | 33 | 134 | (66) | 27 | 25 | 15 | 68 | (34) | 202 |
| | 1993–94 | 27 | 30 | 34 | 92 | (52) | 27 | 26 | 31 | 86 | (48) | 178 |
| | 1994–95 | 27 | 10 | 30 | 69 | (52) | 27 | 20 | 16 | 63 | (48) | 132 |
| | 1995–96 | 44 | 3 | 10 | 57 | (49) | 23 | 17 | 20 | 60 | (51) | 117 |
| | 1996–97 | 25 | 5 | 19 | 49 | (51) | 27 | 9 | 12 | 48 | (49) | 97 |

Table 4 Continued

| Unit | Regulatory year | Successful | | | | | Unsuccessful | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Local resident[a] | Nonlocal resident | Nonresident | Total | (%)[b] | Local resident | Nonlocal resident | Nonresident | Total | (%)[b] | Total hunter |
| 6B | 1992–93 | 38 | 3 | -[c] | 41 | (32) | 78 | 10 | -[c] | 88 | (68) | 129 |
| | 1993–94 | 43 | 0 | -[c] | 43 | (25) | 113 | 13 | -[c] | 126 | (75) | 169 |
| | 1994–95 | 41 | 3 | -[c] | 44 | (35) | 68 | 13 | -[c] | 81 | (65) | 125 |
| | 1995–96 | 27 | 3 | -[c] | 30 | (23) | 92 | 6 | -[c] | 98 | (77) | 128 |
| | 1996–97 | 17 | 5 | -[c] | 22 | (19) | 84 | 11 | -[c] | 95 | (81) | 117 |
| 6C | 1992–93 | 28 | 4 | -[c] | 32 | (91) | 2 | 1 | -[c] | 3 | (9) | 35 |
| | 1993–94 | 25 | 3 | -[c] | 28 | (97) | 1 | 0 | -[c] | 1 | (3) | 29 |
| | 1994–95 | 27 | 8 | -[c] | 35 | (100) | 0 | 0 | -[c] | 0 | (0) | 35 |
| | 1995–96 | 17 | 4 | -[c] | 21 | (91) | 0 | 2 | -[c] | 2 | (9) | 23 |
| | 1996–97 | 16 | 7 | -[c] | 23 | (100) | 0 | 0 | -[c] | 0 | (0) | 23 |
| 6D | 1992–93 | 2 | 0 | 0 | 2 | (17) | 8 | 2 | 0 | 10 | (83) | 12 |
| | 1993–94 | 0 | 0 | 0 | 0 | (0) | 11 | 4 | 0 | 15 | (100) | 15 |
| | 1994–95 | 1 | 0 | 0 | 1 | (4) | 14 | 7 | 2 | 23 | (96) | 24 |
| | 1995–96 | 0 | 0 | 2 | 2 | (13) | 9 | 3 | 1 | 13 | (87) | 15 |
| | 1996–97 | 1 | 0 | 0 | 1 | (8) | 4 | 6 | 2 | 12 | (92) | 13 |

Table 4 Continued

| Unit | Regulatory year | Successful: Local resident [a] | Successful: Nonlocal resident | Successful: Nonresident | Successful: Total | Successful: (%) [b] | Unsuccessful: Local resident | Unsuccessful: Nonlocal resident | Unsuccessful: Nonresident | Unsuccessful: Total | Unsuccessful: (%) [b] | Total hunter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit 6 | 1992–93 | 139 | 37 | 33 | 209 | (55) | 115 | 38 | 15 | 169 | (45) | 378 |
| TOTAL | 1993–94 | 95 | 33 | 34 | 163 | (42) | 152 | 43 | 31 | 228 | (58) | 391 |
| | 1994–95 | 96 | 21 | 30 | 149 | (47) | 109 | 40 | 18 | 167 | (53) | 316 |
| | 1995–96 | 88 | 10 | 12 | 110 | (39) | 124 | 28 | 21 | 173 | (61) | 283 |
| | 1996–97 | 59 | 17 | 19 | 95 | (38) | 115 | 26 | 14 | 155 | (62) | 250 |

[a] Resident of Unit 6.

[b] Totals may include harvest by hunters of unknown residency and may include harvest from unknown units.

[c] Nonresidents ineligible to receive permits.

Table 5 Unit 6 moose harvest percent by time period, 1992–96

| Unit | Regulatory year | Harvest periods | | | | | | | n |
|---|---|---|---|---|---|---|---|---|---|
| | | 8/20-8/31 | 9/1-9/15 | 9/16-9/30 | 10/1-10/15 | 10/16-10/31 | 11/1-11/30 | 12/1-12/31 | |
| 6A (East) | 1992–93 | 0 | 23 | 25 | 23 | 21 | 2 | 6 | 52 |
| | 1993–94 | 0 | 18 | 18 | 34 | 7 | 13 | 9 | 67 |
| | 1994–95 | 0 | 8 | 26 | 18 | 15 | 26 | 8 | 39 |
| | 1995–96 | 0 | 12 | 4 | 8 | 8 | 44 | 24 | 25 |
| | 1996–97 | 0 | 25 | 31 | 31 | 13 | 0 | 0 | 16 |
| 6A (West) | 1992–93 | 4 | 10 | 64 | 10 | 5 | 3 | 4 | 77 |
| | 1993–94 | 0 | 92 | 0 | 8 | 0 | 0 | 0 | 25 |
| | 1994–95 | 0 | 93 | 3 | 3 | 0 | 0 | 0 | 30 |
| | 1995–96 | 0 | 97 | 0 | 3 | 0 | 0 | 0 | 32 |
| | 1996–97 | 0 | 76 | 18 | 3 | 3 | 0 | 0 | 33 |
| 6A TOTAL | 1992–93 | 2 | 16 | 48 | 16 | 12 | 2 | 5 | 129 |
| | 1993–94 | 0 | 38 | 13 | 27 | 5 | 10 | 7 | 92 |
| | 1994–95 | 0 | 45 | 16 | 12 | 9 | 14 | 4 | 69 |
| | 1995–96 | 0 | 60 | 2 | 5 | 4 | 19 | 11 | 57 |
| | 1996–97 | 0 | 59 | 22 | 12 | 6 | 0 | 0 | 49 |

Table 5 Continued

| Unit | Regulatory year | Harvest periods | | | | | | | n |
|---|---|---|---|---|---|---|---|---|---|
| | | 8/20-8/31 | 9/1-9/15 | 9/16-9/30 | 10/1-10/15 | 10/16-10/31 | 11/1-11/30 | 12/1-12/31 | |
| 6B | 1992–93 | 0 | 80 | 20 | 0 | 0 | 0 | 0 | 41 |
| | 1993–94 | 2 | 77 | 21 | 0 | 0 | 0 | 0 | 43 |
| | 1994–95 | 11 | 68 | 20 | 0 | 0 | 0 | 0 | 44 |
| | 1995–96 | 7 | 30 | 40 | 13 | 10 | 0 | 0 | 30 |
| | 1996–97 | 9 | 68 | 18 | 5 | 0 | 0 | 0 | 22 |
| 6C | 1992–93 | 0 | 69 | 31 | 0 | 0 | 0 | 0 | 32 |
| | 1993–94 | 0 | 64 | 36 | 0 | 0 | 0 | 0 | 28 |
| | 1994–95 | 0 | 46 | 54 | 0 | 0 | 0 | 0 | 35 |
| | 1995–96 | 0 | 43 | 24 | 24 | 10 | 0 | 0 | 21 |
| | 1996–97 | 0 | 65 | 13 | 9 | 13 | 0 | 0 | 23 |
| 6D | 1992–93 | 0 | 50 | 50 | 0 | 0 | 0 | 0 | 2 |
| | 1993–94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1994–95 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 1 |
| | 1995–96 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1996–97 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 1 |
| Unit 6 TOTAL | 1992–93 | 1 | 37 | 40 | 10 | 7 | 1 | 3 | 204 |
| | 1993–94 | 1 | 53 | 19 | 15 | 3 | 6 | 4 | 163 |
| | 1994–95 | 3 | 52 | 26 | 5 | 4 | 7 | 2 | 149 |
| | 1995–96 | 2 | 48 | 17 | 11 | 6 | 10 | 6 | 108 |
| | 1996–97 | 2 | 63 | 19 | 9 | 6 | 0 | 0 | 95 |

Table 6 Unit 6 moose harvest percent by transport method, 1992–96

| Unit | Regulatory year | Airplane | Boat | 3- or 4-wheeler | ORV | Highway Vehicle | *n* |
|---|---|---|---|---|---|---|---|
| 6A (East) | 1992–93 | 78 | 8 | 12 | 0 | 2 | 51 |
| | 1993–94 | 77 | 17 | 2 | 2 | 3 | 66 |
| | 1994–95 | 74 | 11 | 6 | 3 | 6 | 70 |
| | 1995–96 | 54 | 29 | 8 | 8 | 0 | 24 |
| | 1996–97 | 88 | 0 | 6 | 0 | 6 | 16 |
| 6A (West) | 1992–93 | 32 | 67 | 0 | 1 | 0 | 81 |
| | 1993–94 | 20 | 80 | 0 | 0 | 0 | 25 |
| | 1994–95 | 40 | 60 | 0 | 0 | 0 | 30 |
| | 1995–96 | 19 | 81 | 0 | 0 | 0 | 32 |
| | 1996–97 | 30 | 70 | 0 | 0 | 0 | 33 |
| 6A TOTAL | 1992–93 | 50 | 44 | 5 | 1 | 1 | 132 |
| | 1993–94 | 62 | 34 | 1 | 1 | 2 | 91 |
| | 1994–95 | 64 | 26 | 4 | 2 | 4 | 100 |
| | 1995–96 | 34 | 59 | 4 | 4 | 0 | 56 |
| | 1996–97 | 49 | 47 | 2 | 0 | 2 | 49 |

Table 6 Continued

| Unit | Regulatory year | Airplane | Boat | 3- or 4-wheeler | ORV | Highway Vehicle | *n* |
|---|---|---|---|---|---|---|---|
| 6B | 1992–93 | 20 | 70 | 0 | 8 | 3 | 40 |
| | 1993–94 | 7 | 77 | 0 | 2 | 14 | 43 |
| | 1994–95 | 7 | 79 | 0 | 2 | 12 | 42 |
| | 1995–96 | 30 | 57 | 0 | 0 | 13 | 30 |
| | 1996–97 | 27 | 73 | 0 | 0 | 0 | 22 |
| 6C | 1992–93 | 0 | 28 | 0 | 0 | 72 | 32 |
| | 1993–94 | 0 | 50 | 0 | 0 | 50 | 28 |
| | 1994–95 | 0 | 32 | 0 | 3 | 65 | 34 |
| | 1995–96 | 0 | 20 | 0 | 5 | 75 | 20 |
| | 1996–97 | 0 | 43 | 0 | 0 | 57 | 23 |
| 6D | 1992–93 | 0 | 0 | 0 | 0 | 100 | 2 |
| | 1993–94 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1994–95 | 100 | 0 | 0 | 0 | 0 | 1 |
| | 1995–96 | 0 | 0 | 0 | 0 | 100 | 2 |
| | 1996–97 | 0 | 0 | 0 | 0 | 100 | 1 |
| Unit 6 TOTAL | 1992–93 | 36 | 46 | 3 | 2 | 13 | 206 |
| | 1993–94 | 36 | 48 | 1 | 1 | 14 | 162 |
| | 1994–95 | 38 | 40 | 2 | 2 | 18 | 177 |
| | 1995–96 | 26 | 50 | 2 | 3 | 19 | 108 |
| | 1996–97 | 32 | 52 | 1 | 0 | 16 | 95 |

# LOCATION

**GAME MANAGEMENT UNIT:** 7 ( 3,520 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Eastern Kenai Peninsula

# BACKGROUND

The Unit 7 moose population irrupted most recently during the 1960s after wildfires in adjacent Unit 15A created large areas of early seral vegetation. Wolf numbers were simultaneously reduced to low levels. A rapid population decline followed in the early 1970s after 3 severe winters in 4 years. The population has fluctuated at low levels since as predator densities stabilized and habitat progressed into less desirable climax stages.

Since 1980, spruce bark beetles (*Dendroctonus rufipennis*) have established in many old-growth spruce stands in Unit 7. Nearly half a million acres of land on the Kenai peninsula were infected with spruce bark beetles in 1995 (Peterson 1996). Between 15 and 25 thousand acres of land were logged on the Kenai peninsula during 1995 and 1996 (Steve Albert ADF&G pers. commun.). Reduction of old-growth forests may be beneficial to the moose population by enhancing nutritional quality and availability of winter food plants.

# MANAGEMENT DIRECTION

**MANAGEMENT OBJECTIVE**

To maintain a healthy population of moose with a minimum bull to cow ratio of 15:100.

# METHODS

We completed aerial sex and age composition surveys in late October because of favorable early snow conditions. Because most of Unit 7 is mountainous, we surveyed moose by flying elevational contours. All information was entered in the Wildlife Information Data Base (WIDB).We collected annual moose harvest data through the statewide harvest reporting system.

# RESULTS AND DISCUSSION

**POPULATION STATUS AND TREND**

*Population Size*

Terrain features and extensive mature spruce forest prevent application of the moose census technique described by Gasaway et al. (1986). Standard sex and age aerial surveys combined with harvest reports indicate that the moose population has remained relatively stable since the mid-1980s. The 1994–95 winter was considered moderately severe in most of the region. Documented winter mortality was predominantly calves of the year. Winter severity was reflected by the lower than average hunter harvest in 1995. The 1995–96 winter was mild and calf survival was considered good. Poor snow conditions prevented us from completing any surveys in 1995. We believe the moose population remained stable at approximately 1000 animals.

*Population Composition*

Four of 32 count areas, excluding Portage and Placer River drainages, were surveyed during 1996 fall sex and age composition surveys. We surveyed 198 moose with ratios of 13 calves:100 cows and 41 bulls:100 cows (Table 1).

## MORTALITY

*Harvest*

Season and Bag Limit. A moose hunting season occurred in the Placer River drainage and that portion of Placer Creek drainage (Bear Valley) outside the Portage Glacier Closed Area and that portion of Unit 14C within the Twentymile River drainage. The bag limit was 1 moose by drawing permit only with 40 permits for antlered moose and 10 permits for antlerless moose. The season was 20 August–30 September for hunt DM210 (Bulls only) and 20 August–10 October for hunt DM211 (antlerless). The remainder of Unit 7 moose season was from 20 August–20 September in 1995 and 1996 for 1 bull with spike-fork or 50-inch antlers.

Board of Game Action and Emergency Orders. During the Spring 1993 Board of Game Meeting, the Board extended the general moose season by 11 days, creating a new season opening of 20 August. In addition, the board made it illegal for the public to feed moose. There were no other board actions that affect Unit 7.

Hunter Harvest. In 1995, 331 hunters reported hunting in Unit 7 during the 20 August–20 September season and harvesting 42 bull moose (Tables 2 and 3). Sixteen (38%) hunters reported taking spike/fork bulls (less than 35") compared to 25 (60%) hunters who harvested large bulls (greater than 39") defined as a 50-inch antler spread or having 3 brow tines on at least 1 antler. One additional moose was reported but not classified.

In 1996, 340 hunters reported hunting in Unit 7 during the 20 August–20 September season and harvesting 59 bull moose. Twenty (34%) hunters reported taking spike/fork bulls compared to 39 (66%) hunters who harvested large bulls. Three additional moose were reported but not classified. One moose was reported with an antler spread greater than 65 inches.

Permit Hunts. Permit hunt results for Unit 7 (hunts DM210 and DM211) were included in the management report for Unit 14C.

Hunter Residency and Success. Successful hunters averaged 6.4 and 6.5 days hunting in 1995 and 1996, respectively. Hunter success in 1995 was 13.0%. Twenty-one (50%) successful hunters were unit residents, 17 (40%) were nonunit residents, and 4 (10%) were nonresidents (Table 3). Residency reported for unsuccessful hunters was as follows: unit residents 148 (51%), nonunit residents 133 (46%), and nonresidents 8 (3%).

Hunter success in 1996 was 18%. Twenty-four (39%) successful hunters were unit residents, 29 (48%) were nonunit residents, and 8 (13%) were nonresidents (Table 3). Reported residency for unsuccessful hunters was as follows: unit residents 141 (53%), nonunit residents 130 (44%), and nonresidents 13 (3%).

Harvest Chronology. Beginning in 1993 the general open season for Unit 7 was 20 August–20 September (32 days). Harvest chronology indicates the highest percentage occurred during the first 5 and last 5 days of the season (Table 4). A few more moose were taken near the end of the season when moose were probably moving to alpine and subalpine rutting areas.

Transport Methods. In 1995, 57% of successful hunters reported highway vehicles as their means of transportation (Table 5). Horses were the second most common transportation means (19%) for successful hunters. Hunters using ATVs, boats, aircraft accounted for 7%, 5%, and 5%, respectively, of the reported harvest.

In 1996, 56% of successful hunters reported highway vehicles as their means of transportation (Table 5). The second most common transportation means for successful hunters was by horseback (21%). Hunters using ATVs, boats, and aircraft accounted for 8%, 7%, or 7%, respectively, of the reported harvest. There was a slight increase in the use of ATVs for moose hunting over previous years. Hunters are probably taking advantage of the increase in the number of logging roads in this unit.

*Other Mortality*

In addition to reported harvest in Unit 7, 22 moose were killed, 4 by trains and 18 by motor vehicles during the 1995–96 winter. There were 8 reported train kills for the 1996–97 winter. At least 27 moose were killed in Unit 7 by motor vehicles during this same winter (Table 2). Approximately 75% of these animals were salvaged for human use. The "Give Moose a Brake" program (Del Frate and Spraker, 1991) continued its awareness activities throughout the peninsula. Crippling loss by hunters is unknown but probably less than 10% of the reported harvest.

Effects of predation by wolves and bears are unknown. The unit supports an estimated 50 wolves, a ratio of 1 wolf per 20 moose. Black bears are abundant throughout the unit, and brown bears are common in all drainages supporting salmon.

### HABITAT

*Assessment*

Reduction of some old-growth forest in response to spruce bark beetle infestations through logging and prescribed burning by the US Forest Service was a priority in Unit 7. Logging prescriptions and reforestation techniques that encourage hardwood production were recommended. If hardwood production increases in these affected areas, moose will probably benefit from the higher quality habitat. However, if site preparation is not adequate, grass (*Calamagrostis* sp.) will compete with both spruce and hardwood seedlings and habitat will decline.

## CONCLUSIONS AND RECOMMENDATIONS

Winter conditions in Unit 7 during 1994–95 were moderately severe, and many calves were lost throughout the region, lowering harvest rates in 1995. The following winter was mild with higher calf survival. Human-caused moose mortality, including road or train kills and harvest, represented approximately 10% of the estimated moose population of 1000.

The harvest of moose under spike-fork/50 inch regulations fluctuated in response to previous winter severity. Spike-forks are almost always yearlings, and the proportion of young animals in the harvest should provide a "barometer" of the health of that particular cohort. By properly evaluating the severity of a particular winter, we can also forecast the upcoming harvest. Schwartz et al. (1992) reported a thorough review of the selective harvest system.

The bull to cow ratios have been higher than the recommended minimum objective of 15 bulls per 100 cows since the selective harvest program began. Adequate bull to cow ratios are desired to minimize the length of the rut and ensure that most cows conceive during their first estrous cycle (Schwartz et al. 1994). Given the low moose density and rugged terrain of Unit 7, a higher bull to cow ratio may be necessary to maintain a healthy population.

Under the current selective harvest system and current harvest patterns, I recommend no changes in regulations. If bull to cow ratios continue above objective levels, specific drainages may be designated for late season permit hunts. Additional funding for more intensive survey efforts would be necessary. However, to avoid shifts in hunting pressure, Unit 7 and 15 general open season lengths and bag limits should be kept consistent.

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Table 1 Unit 7 fall aerial moose composition counts and estimated population size, 1992–1997

| Regulatory year | Bulls: 100 Cows | Yearling bulls: 100 Cows | Calves: 100 Cows | Calves (%) | Adults | moose observed | Moose /hour | population size |
|---|---|---|---|---|---|---|---|---|
| 1992–93 | 34 | 7 | 18 | 12 | 218 | 248 | 24 | 1000 |
| 1993–94[a] | -- | -- | -- | -- | -- | -- | -- | -- |
| 1994–95 | 34 | 18 | 31 | 19 | 367 | 453 | 40 | 1000 |
| 1995–96 | -- | -- | -- | -- | -- | -- | -- | -- |
| 1996–97 | 41 | 4 | 13 | 9 | 181 | 198 | 23 | 1000 |

[a] No surveys completed.

Table 2 Unit 7 moose harvest[a] and accidental death, 1992–97

| Regulatory | Reported | | | | Estimated | | | Accidental death | | | Grand |
|---|---|---|---|---|---|---|---|---|---|---|---|
| year | M | F | Unk. | Total | Unreported | Illegal | Total | Road | Train | Total | Total |
| 1992–93 | 54 | 0 | 0 | 54 | | | 20 | 31 | 0 | 31 | 105 |
| 1993–94 | 62 | 0 | 0 | 62 | | | 20 | 30 | 4 | 34 | 96 |
| 1994–95 | 56 | 0 | 0 | 56 | | | 20 | 34 | 18 | 52 | 108 |
| 1995–96 | 42 | 0 | 0 | 42 | | | 20 | 18 | 4 | 22 | 84 |
| 1996–97 | 61 | 0 | 0 | 61 | | | 20 | 27 | 8 | 35 | 116 |

[a]Excludes permit hunt harvest.

Table 3 Unit 7 moose hunter[a] residency and success, 1992–97

| Regulatory year | Successful | | | | Unsuccessful | | | | Total Hunters |
|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Total[c](%) | Local[b] resident | Nonlocal resident | Nonresident | Total[c](%) | |
| 1992–93 | 24 | 26 | 4 | 54 (12) | 166 | 205 | 6 | 379 (88) | 433 |
| 1993–94 | 19 | 28 | 14 | 62 (15) | 156 | 185 | 5 | 351 (85) | 413 |
| 1994–95 | 22 | 27 | 4 | 56 (13) | 141 | 203 | 13 | 369 (87) | 425 |
| 1995–96 | 21 | 17 | 4 | 42 (13) | 148 | 133 | 6 | 289 (87) | 331 |
| 1996–97 | 24 | 29 | 8 | 61 (18) | 157 | 130 | 8 | 295 (82) | 340 |

[a] Excludes hunters in permit hunts.
[b] Local = residents of Unit 7.
[c] Total columns include hunters that did not specify residency



Table 4 Unit 7 moose harvest[a] chronology percent by time period, 1992–97

| Regulatory year | Harvest periods | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8/20–25 | 8/26–8/31 | 9/1–9/5 | 9/6–9/10 | 9/11–9/15 | 9/16–9/20 | Unknown | *n* |
| 1992–93[b] | -- | -- | 26 | 11 | 26 | 30 | 7 | 54 |
| 1993–94[c] | 15 | 3 | 11 | 6 | 32 | 27 | 5 | 62 |
| 1994–95[c] | 25 | 13 | 18 | 11 | 7 | 21 | 5 | 56 |
| 1995–96[c] | 26 | 14 | 7 | 5 | 10 | 33 | 5 | 42 |
| 1996–97[c] | 20 | 10 | 15 | 15 | 11 | 25 | 3 | 61 |

[a] Excludes permit hunt harvest.
[b] General open season Sep 1–Sept. 20;
[c] General open season Aug. 20–Sep 20.

Table 5 Unit 7 moose harvest[a] percent by transport method, 1992–97

| Regulatory year | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unknown | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | Percent of harvest | | | | | | | | |
| 1992–93 | 16 | 13 | 13 | 4 | 0 | 0 | 51 | 4 | 55 |
| 1993–94 | 15 | 19 | 18 | 0 | 0 | 3 | 40 | 5 | 62 |
| 1994–95 | 9 | 20 | 16 | 4 | 0 | 0 | 45 | 7 | 56 |
| 1995–96 | 5 | 19 | 5 | 7 | 0 | 0 | 57 | 7 | 42 |
| 1996–97 | 7 | 21 | 7 | 5 | 0 | 3 | 56 | 2 | 61 |

[a] Excludes permit hunt harvest.

# LOCATION

**GAME MANAGEMENT UNIT:** 9 (33,600 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Alaska Peninsula

# BACKGROUND

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

# MANAGEMENT DIRECTION

## POPULATION OBJECTIVES

Population objectives for moose in Unit 9 are to 1)maintain existing densities in areas with moderate (0.5–1.5 moose/$mi^2$) or high (1.5–2.5 moose/$mi^2$) densities; 2)increase low-density populations (where habitat conditions are not limiting) to 0.5 moose/$mi^2$ by 1995; 3) 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

We scheduled fall sex and age composition aerial surveys throughout Units 9B, 9C, and 9E during November through early December when adequate snow cover was available. We collected harvest data from harvest tickets, monitored harvests, and checked hunters primarily within the Naknek River drainage.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

Results of fall sex and age composition surveys in Units 9B, 9C, and the central portion of 9E indicated that populations in most of Unit 9 have stabilized over the past 10 years. Very low moose densities and unreliable snow conditions in Unit 9A and the southern portion of 9E precluded efficient surveys for monitoring trends in population size or composition. Although no recent surveys have been specifically directed toward moose in Unit 9D, incidental observations south of Port Moller showed no noticeable expansion of moose in that area.

*Population Size*

A 1983 census in the central portion of Unit 9E resulted in an estimate of 1148 moose (90% CI = ±16%) in the 1314-$mi^2$ study area. Extrapolation of this census to the remainder of Unit 9E provided a rough estimate of approximately 2500 moose. The area of Unit 9C outside of Katmai National Park had approximately 500–600 moose. There were approximately 2000 moose in Unit 9B. Units 9A and 9D probably contained less than 300 and 50 moose, respectively.

*Population Composition*

Unfavorable snow and flying conditions prevented trend surveys during 1995 and hampered efforts in 1996. With the U.S. Fish and Wildlife Service, we surveyed 4 trend areas in central 9E in 1996 and classified 328 moose. Ratios for these 4 areas were 49.7 bulls and 27.6 calves:100 cows. Forty percent of all bulls seen ($n$ = 92) had antlers with ≥50" spread. Total sample sizes and ratios from these areas indicate the population is relatively stable and harvests are not reducing the number of bulls below management objectives.

## MORTALITY

*Harvest*

Seasons and Bag Limit. No changes to state or federal moose hunting regulations occurred during 1995–96 or 1996–97. In Unit 9A resident and nonresident hunters could hunt from 1–15 September, and the bag limit was 1 bull. In Unit 9B nonresidents could hunt from 5–15 September with a bag limit of 1 bull with ≥50-inch antlers or ≥3 brow tines, and resident hunters could hunt from 1–15 September and 1–31 December, with a bag limit of 1 bull. The season dates in Unit 9C were the same as for Unit 9B; however, within the southern portion of the Naknek drainage, federal lands were open in December only to local rural residents and a subsistence registration permit was required to take antlerless moose. The state season within the Naknek drainage was open to any resident in December and the bag limit was 1 bull. In the remainder of Unit 9C, residents could take any moose during the December season. There was no open season in Unit 9D. The state season for resident hunters in Unit 9E was 10–20 September and 1–31 December; the season for resident and nonresident hunters was 10–20 September. The bag limit in Unit 9E was 1 bull; however, moose taken from 10–20 September must have an antler spread of ≥50 inches or at ≥3 brow tines on at least 1 antler. The federal subsistence seasons in Unit 9E were 1–20 September and 1–31 December with a bag limit of 1 bull.

Board of Game Actions and Emergency Orders. No regulatory actions were implemented during 1995–96 or 1996–97.

Hunter Harvest. During 1995 hunters reported killing 181 moose, including 176 bulls and 5 cows. In 1996 the reported harvest was 227 moose, including 219 bulls and 8 cows (Table 1). The Unit 9 harvest over the past 14 years has averaged 225 (range 173–300) and showed a steady increase through 1987 followed by a decline.

Permit Hunts. In 1992 a federal subsistence registration hunt was established during December on all federal land within the Naknek drainage. Only bulls were legal on federal land north of the river. The permit requirement for the federal lands north of the Naknek River was dropped in

1994. South of the Naknek River, nonlocal state residents were excluded from hunting on federal lands. Subsistence hunters could kill 1 moose, and a quota of 5 antlerless moose was set. The Becharof National Wildlife Refuge office issued 18 permits in 1995 and 2 cows were killed. In 1996 6 cows were taken.

Hunter Residency and Success. The number of moose hunters using Unit 9 increased during 1981–87 and peaked at 645. Since then the number leveled off at a mean of 579 for the period 1990–94. In 1995 and 1996, 493 and 555 moose hunters used Unit 9, respectively (Table 2). While there have been fluctuations in the proportion of the 3 residency categories, overall no group has shown an increase. Most subsistence hunters did not get moose harvest tickets and consequently were not represented in the local resident category. Since 1988 the success rates have been relatively stable but dropped slightly in 1995 for all 3 residency groups. These rates rebounded in 1996. Nonresidents have a higher success rate (49%, range = 43–59%) than either residents of Unit 9 (34%, range = 28–50%) or other Alaska residents (30%, range = 19–34%) because virtually all of them flew out to hunt, and many of them employed guides.

Harvest Chronology. Since 1988 approximately 88% of the total moose harvest occurred during September. Harvest levels in December have remained low, but during 1992–96 varied (range = 9–21% of total), depending on weather and travel conditions (Table 3).

Transportation Methods. Aircraft continued as the most common method of transportation in Unit 9; boats were the second most common transport mode (Table 4). No major change in transportation type occurred in the past 5 years.

*Other Mortality*

Given the continued low calf production, bear predation of neonatal moose remained the apparent primary cause of natural mortality. Bear:moose ratios in Unit 9 ranged from >1:1 to 1:10, and they were much higher than anywhere else within the indigenous range of moose. Winter conditions during 1995–96 and 1996–97 were mild with virtually no snow, and winter mortality seemed insignificant.

## CONCLUSIONS AND RECOMMENDATIONS

Hunting regulations have been restricted in all units, except the Branch River Drainage in 9C, to eliminate antlerless moose hunting because of low calf:cow ratios. Additionally, fall seasons have recently been shortened and moved to the first half of September in the northern 3 units to maintain bull:cow ratios at prescribed levels. Harvests have remained relatively stable for 14 years, despite major changes to moose regulations (i.e., the spite/fork-50" regulation) in other parts of Alaska. The recent average harvest of 225 moose per year appears to be within sustainable levels. Local residents in Units 9B and 9E would like to reinstitute cow hunts; but unless productivity improves, this request will be difficult to justify on biological grounds. Local residents have also voiced concern over what is perceived as increasing competition from other hunters, including a growing effort by air taxi operations during the December hunt in Unit 9B. These allocation questions will be addressed at the 1999 Board of Game meeting.

Brown bear predation on neonatal moose was the major limiting factor preventing the increase in moose densities in Unit 9. However, very high bear:moose ratios would require substantial reduction in bear densities to achieve a measurable improvement in moose calf survival. ADF&G has placed a priority on managing bears in Unit 9, and any drastic reduction in bear numbers would probably be opposed by a large segment of the public.


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Table 1 Unit 9 moose harvest[a] and accidental death, 1992–96

| Regulatory year | Hunter Harvest: Reported M | F | Unk. | Total | Estimated Unreported | Illegal | Total | Accidental death Road | Train | Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992/93 | 205 | 1 | 1 | 207 | -- | -- | 100 | -- | -- | -- | 307 |
| 1993/94 | 222 | 2 | 0 | 224 | -- | -- | 100 | -- | -- | -- | 324 |
| 1994/95 | 227 | 7[b] | 0 | 234 | -- | -- | 100 | -- | -- | -- | 334 |
| 1995/96 | 176 | 5 | 0 | 181 | -- | -- | 100 | -- | -- | -- | 281 |
| 1996/97 | 219 | 8 | 0 | 227 | -- | -- | 100 | -- | -- | -- | 327 |

[a] Includes permit hunt harvest.

[b] Includes 1 taken under federal subsistence permit



Table 2 Unit 9 moose hunter[a] residency and success, 1992–96

| Regulatory year | Successful Local[b] resident | Nonlocal resident | Nonresident | Total (%) | Unsuccessful Local[b] resident | Nonlocal resident | Nonresident | Total(%) | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| 1992/93 | 45 | 59 | 97 | 207 (37) | 114 | 115 | 111 | 352 (63) | 559 |
| 1993/94 | 38 | 59 | 118 | 224 (39) | 99 | 115 | 120 | 347 (61) | 571 |
| 1994/95 | 62 | 51 | 108 | 233 (40) | 63 | 142 | 142 | 354 (60) | 587 |
| 1995/96 | 37 | 42 | 92 | 181 (37) | 90 | 107 | 105 | 311 (63) | 493 |
| 1996/97 | 49 | 56 | 121 | 231 (42) | 93 | 108 | 117 | 324 (58) | 555 |

[a]Excludes hunters in permit hunts.

[b]Resident of Unit 9.

Table 3 Unit 9 moose harvest[a] chronology percent, 1992–96

| Regulatory year | Harvest periods 9/1-9/4 | 9/5-9/9 | 9/10-9/14 | 9/15-9/20 | 9/21-9/25 | 12/1-12/15 | 12/16-12/31 | *n* |
|---|---|---|---|---|---|---|---|---|
| 1992/93 | 7 | 20 | 47 | 16 | <1 | 5 | 4 | 207 |
| 1993/94 | 8 | 16 | 40 | 19 | <1 | 6 | 6 | 224 |
| 1994/95 | 4 | 19 | 31 | 20 | 0 | 10 | 11 | 233 |
| 1995/96 | 7 | 21 | 42 | 20 | 0 | 3 | 6 | 181 |
| 1996/97 | 9 | 21 | 41 | 18 | 0 | 5 | 5 | 227 |

[a]Excludes permit hunt harvest.

Table 4 Unit 9 moose harvest[a] percent by transport method, 1992–96

| Regulatory year | Percent of harvest Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | *n* |
|---|---|---|---|---|---|---|---|---|
| 1992/93 | 62 | -- | 25 | 5 | 4 | 1 | 1 | 206 |
| 1993/94 | 58 | -- | 22 | 6 | 7 | 1 | 3 | 224 |
| 1994/95 | 57 | -- | 19 | 4 | 17 | 1 | 2 | 227 |
| 1995/96 | 65 | -- | 25 | 9 | 0 | 0 | 2 | 181 |
| 1996/97 | 64 | -- | 20 | 5 | 7 | 1 | 3 | 227 |

[a]Excludes permit hunt harvest.

## LOCATION

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

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

## BACKGROUND

Moose abundance in Unit 11 was generally considered low from the early 1900s until the 1940s, increased during the 1950s, and reached a peak population in the early 1960s. When moose were most abundant, we observed between 85 and 120 moose per hour during fall composition counts. The moose population declined from the late 1960s until 1979, when the population was considered to have reached its lowest level. In 1979 only 12 moose per hour were observed during fall counts. Moose numbers stabilized, then started increasing in Unit 11 during the early to mid-1980s and were probably the highest in 1987 when we observed 55 moose per hour. Moose numbers declined between 1990 and 1991 following severe winters.

Moose harvests in Unit 11 averaged approximately 164 (123–242) per year from 1963 until 1974. Either-sex bag limits were in effect until 1974, and up to 50% of the harvest were cows. During this period, hunting seasons were long and split to provide for fall and winter hunting. The moose harvest and the total number of hunters peaked in the early 1970s. In response to declining moose numbers, the 1974 fall moose season was shortened, the winter season was closed, and the harvesting of cows was prohibited. Between 1975 and 1989, fall seasons remained 1–20 September. In 1990 the moose season was shortened in response to deep snow conditions and to align it with the Unit 13 season.

Most of Unit 11 was included in Wrangell–Saint Elias National Monument in December 1978. In 1980 monument status was changed to park/preserve with passage of the Alaska National Interest Lands Conservation Act.

## MANAGEMENT DIRECTION

### POPULATION OBJECTIVE

- Allow the population to fluctuate as dictated by available habitat and predation rates
- Maintain a population with a posthunt minimum of 30 bulls:100 cows with 10–15 adult bulls:100 cows.

### HUMAN USE OBJECTIVE

Allow human harvest of bulls when they do not conflict with management goals for the unit or population objectives for the herd.

## METHODS

An aerial survey was conducted every year during the late fall to determine sex and age composition and population trends on a count area along the western slopes of Mount Drum. We monitored harvests and hunting pressures through a harvest ticket reporting system; we also monitored the average reported antler length in the harvest. Predation and overwinter mortalities were monitored in the field whenever possible and by reports from hunters and trappers.

Large portions of Unit 11 are classified as limited suppression zones, where wildfire is allowed to burn. Unfavorable weather conditions for burning have occurred in recent years and little or no habitat was impacted by wildlife during this reporting period.

Logging of spruce killed by bark beetles occurred in Unit 11 near Chitina. Total areas logged are probably not large enough to influence moose abundance even if browse availability increased due to the logging.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

The number of moose observed during fall sex and age composition counts in Count Area (CA) 11 (the western slopes of Mount Drum) decreased between 1990 and 1992, as reflected by the 75% decline in the number of moose counted per hour. Since 1992 counts have fluctuated yearly with no population trends evident. Moose movement is thought to account for much of the yearly variation in the count results, not actual changes in moose abundance.

#### *Population Size*

An accurate population estimate is not available for all of Unit 11 because a complete census has never been conducted. Moose numbers observed during the 1997 fall composition counts in CA 11 resulted in a density estimate of 0.4 moose per $mi^2$. Density estimates from 0.1 to 0.4 moose/$mi^2$ were calculated in 1986 during late winter stratification surveys when 20% of the estimated 5200 $mi^2$ of moose habitat in the unit was surveyed. Based on these density estimates, an extrapolated population estimate of 2500 was obtained. During the fall of 1993, NPS biologists conducted a Gasaway census in portions of Unit 11. The density estimate was 0.58 moose/$mi^2$ and the extrapolated population estimate from this survey was 3000 moose (Route, pers. commun.).

#### *Population Composition*

A bull:cow ratio of 128:100 was obtained in CA 11 in 1997 (Table 1). Between 1991 and 1996 the bull:cow ratio was fairly stable at about 92 bulls/100 cows. These bull:cow ratios have been among the highest ever observed in CA-11. This adult bull:cow ratio greatly exceeds the current management goal of maintaining no less than 15 adult bulls:100 cows.

The calculated calf:cow ratio in CA-11 was 9:100 in 1997, down 57 percent from the 1995 and 1996 figures of 21:100. Calf production in CA-11 during 1997 was among the lowest ever observed. Calf ratios in excess of 20 calves:100 cows are above average for Unit 11, based on recent trends in calf production and survival.

#### *Distribution and Movement*

Data from past fall composition and winter stratification surveys, field observations, and reports from the public indicated that the highest moose numbers in the unit are along the slopes of Mts. Sanford, Drum, and Wrangell. Portions of Unit 11 south of the Chitina River have the lowest density of moose in the unit.

Fall rutting and postrutting concentrations normally occur in upland habitats to elevations as high as 4000 ft. Migrations to lower elevations are initiated by snowfall, but usually do not occur until late November–early December. 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 Unit 11 move to lower elevations in a westerly direction across the Copper River to winter in eastern Unit 13.

## MORTALITY

*Harvest*

Seasons and Bag Limit.

*State*

| | | |
|---|---|---|
| Unit 11 | 20 Aug–20 Sep | 1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least 1 side. |

*Federal Subsistence*

| | | |
|---|---|---|
| Unit 11 | 25 Aug–20 Sep | 1 bull |

Board of Game Actions and Emergency Orders. During the spring 1993 board meeting; the Unit 11 season was set at 20 August to 20 September, and the bag limit was changed to 1 bull with spike-fork antlers or antlers with a minimum 50-inch width or 3 brow tines. These changes were effective beginning with the 1993 season. This action aligns the state moose season and bag limit in all game management units on the road system in southcentral Alaska. The federal subsistence season starts 5 days later than the state's season, and the bag limit is any bull for rural residents of Units 11 and 13.

Human-induced Mortality. Hunters reported killing 38 bull moose in both 1995 and 1996. The harvest has slowly been increasing since bottoming out in 1992 (Table 2). Although the current harvest is the highest in 4 years, it is still below the average annual harvest of 51 reported during the last half of the 1980s. Only 100 individuals reported hunting in Unit 11 during 1996. This is the lowest reported hunting pressure for this unit. During 1993–96 the average number of hunters that reported hunting in Unit 11 was 118 (range = 100–125). This is a 30% decrease compared to the previous 4-year (1989–92) average of 168 (range = 147–187).

The mean antler spread reported for bulls harvested during 1995 and 1996 was 49 and 45.6 inches, respectively. Both figures exceeded the 5-year mean of 44 inches obtained between 1985 and 1989 under the 36-inch regulation and before federal subsistence harvests of any bull. An increase in the average antler size was expected since the minimum legal spread increased from 36 to 50 inches. Such a large average antler size indicates that hunting pressure in Unit 11 has not been heavy enough to crop bulls before they reach maturity and adequate numbers of mature bulls are available for breeding.

Illegal and unreported harvests of both bulls and cows have been documented in Unit 11 and, in some years, may be as much as 20% of the reported harvest. Poaching activity is assumed to be greatest along the Nabesna and McCarthy Roads where vehicle access allows for hunting and transporting illegally taken moose without being observed. It is also unknown how many small moose are taken and reported as legal under federal subsistence. With two different bag limits enforced for the same area, it is impossible to limit the harvest of small bulls because they could be legal under the federal subsistence bag limit.

Hunter Residency and Success. Local residents accounted for 47 % ($n = 18$) of the moose harvest in 1996, nonlocal Alaskan residents took 39% ($n = 15$), while nonresidents took only 13% ($n = 5$) (Table 3). Since establishing a federal subsistence moose hunt in 1990, local residents have had the highest success ratio every year except 1992. One reason for higher success rates for local subsistence hunters is that NPS regulations allow only local rural residents to hunt in those portions of the unit designated as Park. Because nonlocal residents and nonresidents can hunt only on preserve lands, they are excluded from much of the unit. Also, local residents can take any size bull under current federal subsistence regulations, while nonlocals must take a spike-fork or 50-inch bull under state regulations.

The overall hunter success rate in 1996 was 38%, the highest in over 25 years, and more than double the 14% success rate reported in 1992 when severe weather restricted hunting effort. Successful hunters spent an average of 6.5 days to kill a moose in 1996, while unsuccessful hunters averaged 12.4 days in the field. From 1990 through 1994, successful hunters averaged 5.6 days hunting and unsuccessful hunters 7.1 days. Hunting effort for successful hunters fluctuates between years with no evident trend. However, during the last 4 years unsuccessful hunters have been spending more time in the field than previously reported.

Harvest Chronology. Chronology data indicate more moose are taken during the later portion of the season in Unit 11 (Table 4). Bull moose are more vulnerable in the latter part of the season because their movements increase at the onset of rut in mid-September, which is also during leaf fall.

Transportation Methods. Unit 11 moose hunters prefer using aircraft, 3- or 4-wheelers, and highway vehicles (Table 5). NPS regulations limit transportation methods in Unit 11. Aircraft cannot be used in portions of the unit designated as park, and all vehicle use for sport hunting is restricted to existing trails except by permit. Only subsistence hunters do not need a permit and are not limited to existing trails. The effect of these rules is to limit hunting opportunity in the more remote portions of the unit.

Preliminary 1997 Harvest. Preliminary moose harvest figures are from harvest report forms and represent only a minimum estimate of the kill. To date, 31 bulls have been reported from Unit 11, indicating little overall change in harvest trends for this unit.

*Natural Mortality*

Predator-prey studies have not been conducted in Unit 11. Wolves and brown bears are abundant, but predation rates are unknown. Field observations of wolf kills during winter, coupled with reports by hunters and trappers of suspected wolf predation, indicate that wolves are important predators of moose in the unit. Brown bear predation was less apparent because it does not occur during winter when it would be easier to detect. The low calf:cow ratios observed during fall counts indicate early calf mortality similar to that observed in areas with high brown bear predation on neonatal moose calves. Because this unit has a very low-density moose population, predation could limit recruitment and maintain moose at current low densities. 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 before the mid-1940s when the Bureau of Land Management (BLM) instituted fire suppression activities. The beneficial effects of those fires in creating moose habitat have long since passed. Only one fire, the Wilson Camp Fire, has burned enough acreage in the past 30 years to produce a substantial amount of moose browse. That fire occurred in 1981 and covered 13,000 acres. Recent fire starts have either received initial fire suppression activities, or if not put out, have not had favorable burning conditions or fuel supplies. Currently, vast areas within the unit support stands of mature spruce, much of which has been killed by spruce bark beetles and has limited value as moose habitat. Habitat types currently used most by moose in the unit are climax upland and riparian willow communities. Recent observations of light browse use on range transects indicate that moose are not limited by the amount of available browse.

*Enhancement*

Habitat manipulation to benefit moose is not currently an option because most of the unit is included in Wrangell–Saint Elias National Park and Preserve. Although NPS regulations prohibit habitat manipulation, Unit 11 is included in the Copper River Fire Management Plan with most remote areas under the limited suppression category.

## CONCLUSIONS AND RECOMMENDATIONS

Moose numbers were stable during this reporting period. The moose population in Unit 11 declined between 1990 and 1992 because of severe winters. The size of the Unit 11 moose population, based on moose per hour figures, is lower than during the late 1980s before the decline. Calf production and/or survival to fall fluctuated greatly between years during this reporting period. Reasons for such large variation in calf production/survival are unknown. Calf recruitment to fall during this reporting period has not been high enough to allow for an increase in the Unit 11 moose population.

The moose harvest has increased over the last 4 years after bottoming out in 1992. The harvest in 1992 was especially low because of an early winter with deep snow and record cold temperature during moose season. Most hunters, in fact, could not travel during the last week of the season. The 1995 and 1996 harvests are still below the bull harvest level reached in the mid and late 1980s. Hunting pressure declined over this reporting period. Currently, the number of hunters that reported hunting moose in Unit 11 is the lowest ever reported.

I recommend a research program be established to investigate factors limiting growth of the moose population. Unit 11 has the potential to support more moose. The population objective of maintaining moose at existing densities (i.e., 0.1 and 0.7 moose/mi$^2$) needs to be reconsidered and perhaps increased. We also need to explore options available to managers to enhance the moose population consistent with NPS regulations.

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Table 1 Moose composition counts in Count Area 11 of Unit 11, 1992–1997

| Year | Males: 100 females | Yearling males: 100 females | Calves: 100 females | Calf % | Adults | Total moose | Moose /hour | Density moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| 1992 | 64 | 0 | 4 | 2 | 41 | 42 | 13 | 0.1 |
| 1993 | No data, fall count not completed. | | | | | | | |
| 1994 | 91 | 8 | 25 | 11 | 101 | 114 | 24 | 0.4 |
| 1995 | 92 | 10 | 21 | 10 | 136 | 151 | 34 | 0.5 |
| 1996 | 92 | 11 | 21 | 10 | 121 | 134 | 30 | 0.5 |
| 1997 | 128 | 4 | 9 | 4 | 107 | 111 | 29 | 0.4 |

Table 2 Annual moose harvest in Unit 11, 1992–1996

| | Reported | | | Estimated | | | |
|---|---|---|---|---|---|---|---|
| Year | M | F | Total[a] | Unreported | Illegal | Total | Total |
| 1992 | 23 | 0 | 23 | 5 | 5 | 10 | 33 |
| 1993 | 30 | 0 | 30 | 5 | 5 | 10 | 40 |
| 1994 | 36 | 0 | 36 | 5 | 5 | 10 | 46 |
| 1995 | 37 | 0 | 38 | 5 | 5 | 10 | 48 |
| 1996 | 38 | 0 | 38 | 5 | 5 | 10 | 48 |

[a] Includes unknown sex.

Table 3 Moose hunter residency and success in Unit 11, 1992–96

| | Successful | | | | Unsuccessful | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Local resident | Nonlocal resident | Non resident | Total[a] | Local resident | Nonlocal resident | Non-resident | Total[a] |
| 1992 | 9 | 11 | 3 | 23 | 59 | 73 | 4 | 139 |
| 1993 | 15 | 9 | 4 | 30 | 31 | 52 | 8 | 91 |
| 1994 | 20 | 11 | 5 | 36 | 45 | 38 | 6 | 89 |
| 1995 | 23 | 8 | 7 | 38 | 44 | 36 | 5 | 86 |
| 1996 | 18 | 15 | 5 | 38 | 53 | 6 | 2 | 62 |

[a] Includes unspecified residency.

Table 4 Moose harvest chronology percent by time period in Unit 11, 1992–96

| | Season | Week of Season | | | | |
|---|---|---|---|---|---|---|
| Year | dates | 1st | 2nd | 3rd | 4th | 5th |
| 1992 | 1-15 Sep a/ | 5 | 30 | 45 | 20 | 0 |
| | Aug. 25-Sep 20b/ | | | | | |
| 1993 | 20 Aug. - 20 Sep | 0 | 13 | 10 | 53 | 23 |
| 1994 | 20 Aug. - 20 Sep | 2 | 2 | 25 | 11 | 53 |
| 1995 | 20 Aug.-20 Sep | 8 | 11 | 40 | 40 | |
| 1996 | 20 Aug.-20 Sep | 5 | 8 | 11 | 54 | 22 |

[a] State hunt.
[b] Federal subsistence hunt

Table 5 Successful moose hunter transport methods (%) in Unit 11, 1992–96

| Year | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unknown |
|---|---|---|---|---|---|---|---|---|
| 1992 | 35 | 4 | 9 | 22 | 0 | 0 | 30 | 0 |
| 1993 | 40 | 0 | 7 | 20 | 0 | 7 | 23 | 3 |
| 1994 | 42 | 8 | 8 | 28 | 0 | 6 | 8 | 0 |
| 1995 | 42 | 3 | 0 | 15 | 0 | 3 | 34 | 3 |
| 1996 | 21 | 10 | 3 | 26 | 3 | 8 | 26 | 3 |

## LOCATION

**GAME MANAGEMENT UNIT:** 12 (10,000 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Upper Tanana and White River drainages

## BACKGROUND

The Unit 12 moose population irrupted during the 1950s through the mid-1960s and declined rapidly during the early 1970s, similar to populations in adjacent road accessible areas. Several severe winters, high predation by wolves and grizzly bears, and high localized cow moose harvests all contributed to the population decline. Cow moose hunts were stopped after 1974, and the Nabesna Road moose season was closed entirely from 1974 through 1981. Between 1986 and 1991, the Little Tok River drainage was closed to moose hunting because of low yearling recruitment and a declining bull:cow ratio. Between the mid-1970s and early 1980s, the Unit 12 moose density was probably between 0.2 and 0.4 moose/$mi^2$.

In response to the declining area moose populations, wolf control programs were conducted in adjacent Units 20D (1980), 20E (1981–1983), and extreme northern Unit 12 (1981–1983). Beginning in 1982, attempts were made to reduce the grizzly bear population by liberalizing harvest regulations. Moose habitat enhancement programs were conducted during the late 1980s. Between 1982 and 1989, the moose population in Unit 12 increased, due probably to favorable climate and these management programs. However, the population remained at a low density (0.4–0.6 moose/$mi^2$).

Unit 12 has been an important moose hunting area for local residents, hunters from Southcentral Alaska, and guided nonresidents and an important wildlife viewing area for tourists driving the Alaska Highway. During the 1960s when the Unit 12 moose population was high, hunting seasons and bag limits were liberal and hunter participation and success were high. Moose were commonly viewed while traveling the area's highways. During that period, needs of consumptive and nonconsumptive users were met. Since the unit's moose population declined to a low level, the hunting season and bag limit have become very restrictive, and the total harvest declined by over 40%. Also, the Upper Tanana Valley is the first area in Alaska visited by thousands of travelers driving the Alaska Highway. Most of these travelers are here to view Alaska's wildlife. Since the mid-1970s, few tourists have observed moose in Unit 12, a fact we hear often in the area office.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population in concert with other components of the ecosystem.
- Continued sustained opportunities for subsistence use of moose.
- Maximize sustained opportunities to participate in hunting moose.
- Maximize opportunities for the nonconsumptive use of moose.

## MANAGEMENT OBJECTIVES

- Maintain a minimum posthunting sex ratio of 40 bulls:100 cows east of the Nabesna River and a minimum ratio of 20 bulls:100 cows in the remainder of the unit.

# METHODS

## CENSUSES AND COMPOSITION SURVEYS

Moose population size was estimated in a 1120 $mi^2$ area in northwestern Unit 12 during November 1994 and October 1997. Methods followed standard Gasaway census techniques (Gasaway et al. 1986), except that we stratified the area using historic count data collected during contour counts or censuses. The area was divided into 34 high and 42 low/medium strata sample units in 1994. Based on 1994 and 1996 survey results, we restratified the area into 37 high and 39 low/medium strata sample units in 1997. We flew 24 random sample units (16 high; 8 low/medium) covering approximately 32% of the study area during 1994 and 28 random units (19 high; 9 low/medium) covering 37% of the area during 1997. Standard search intensity was about 4.25 min/$mi^2$ in 1994 and 3.45 min/$mi^2$ in 1997. Portions of 12 (1994; 8 high, 4 low) and 14 units (1997; 9 high, 5 low) were resampled at a search intensity of 12 min/$mi^2$ to determine a sightability correction factor.

Standard contour counts were conducted in October and November 1993–1997. All moose observed were classified as either large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), small bulls (spike, cerviform, or palmate-antlered [no brow separation] yearling bulls), cows without calves, cows with 1 calf, cows with 2 calves, lone calves, or unidentified moose.

## HARVEST

Harvest was estimated using harvest report cards. Information obtained from the reports was used to determine total harvest, hunter residency and success rates, harvest chronology, and transportation mode.

## FOOD HABITS

During May and June 1993 and 1996, we estimated browse use by moose in at least 6 different areas in Unit 12. In each study area we sampled 50 to 100 points. Use of current growth was categorized as none (0%), low (1–25%), medium (26–75%), and high (76–100%). Mean percentage of twigs browsed was then estimated following procedures outlined by Gasaway et al. (1992).

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

### *Population Size*

Based on data collected during annual November moose contour surveys and 4 area-specific censuses (1989, 1990, 1994, and 1997), the moose population in Unit 12 increased slowly from

1982 to 1989 and remained relatively stable during 1989–1993. Increased calf survival has allowed the Unit 12 population to grow slightly since 1993. The most apparent increase occurred in the northwest portion of the unit within the area affected by the Tok wildfire (155 $mi^2$). This area supported 0.19 moose/$mi^2$ in 1989 but increased to 0.6 moose/$mi^2$ by 1994 and about 1.0 moose/$mi^2$ in 1997. Within the census area (1119 $mi^2$) in northwestern Unit 12, estimated moose density was 0.9 moose/$mi^2$ (± 15%, 80% CI) in 1994 and 1.1 moose/$mi^2$ (± 15%, 80% CI) in 1997. Overall, moose densities ranged from 0.03/$mi^2$ (10/1000 $km^2$) in the Northway Flats to 2.3/$mi^2$ (888/1000 $km^2$) along the north side of the Nutzotin Mountains. The 1997 population estimate in Unit 12 was 3500–4000 moose. The estimated density was 0.6 to 0.7 moose/$mi^2$ (231–270/1000 $km^2$) of suitable moose habitat.

Past research indicated that predation by both wolves and bears was the primary factor maintaining the area moose populations at low densities (0.2–1.0 moose/$mi^2$, Gasaway et al. 1992). I expect the moose population to remain within this density range for an extended time because predator management is not an option on federal lands, or most of Unit 12. Environmental conditions and habitat changes will cause small-scale population fluctuations.

*Population Composition*

Results of moose composition surveys conducted in Unit 12 during 1988–1997 are presented in Table 1. Composition data since 1994 are not directly comparable with previous years because sampling techniques have changed. Instead of annually counting all traditional count areas in Unit 12, we now census a much larger area every 3 years. This census area includes many of the traditional count areas. Benefits of the new survey schedule include confidence limits around composition estimates and, because more area and habitats are being sampled, there is less chance for weather anomalies to affect the count. The disadvantage is that a composition estimate for most of Unit 12 is not obtained annually. To protect against missing a catastrophic decline in the area's moose population between censuses, at least 3 traditional count areas within the Tok River drainages and along the Alaska Range are sampled annually. In addition, US Fish and Wildlife (Tetlin National Wildlife Refuge) staff annually survey traditional count areas along the north face of the Wrangell Mountains.

Bull:cow ratios range from about 20–25:100 along the north side of the Alaska Range and Tok River drainages to over 80:100 along the Nutzotin Mountains. The 1997 bull:cow ratio within the census area was 36:100, compared to 39:100 in 1994. The census area encompasses the Tok River drainages, the Front Range, and other areas lightly harvested. A greater number of large bulls were observed in 1997, but fewer yearling bulls were observed compared to 1994. Within the Tok River drainages, the bull:cow ratio appears to have stabilized around 22–26:100, down from the low 30s:100 in the late 1980s.

Primary factors affecting the bull:cow ratio are hunter access and calf recruitment. Increases in hunter numbers and access trails allowed harvest to reduce or limit bull numbers. In addition, even though calf survival to 5 months appears to be adequate ($\bar{x}$ = 30 calves:100 cows), yearling bull recruitment is low (8.2 yearling bulls:100 cows). Since few bulls are being recruited annually, harvest has an additive impact on the bull population.

The 1997 bull:cow ratio in southcentral to southeastern Unit 12 was 87:100, equaling the 5-year average. The 1997 yearling bull:100 cow ratio was 22:100 exceeding the 5-year average of 11:100 but similar to levels between 1987 and 1991 (21:100).

The 1997 calf:cow ratio (Table 1) within the census area in northwestern Unit 12 was 41:100 compared to 39:100 in 1994. Calf:cow ratios within the Tok River drainages and along the north face of the Alaska Range (subset of the census area) increased to 35 and 31:100 in 1993 and 1996 compared to the average calf survival between 1990 and 1992 (27:100 cows). Improved calf survival was probably a result of the combination of moderate to high grizzly bear, black bear, and wolf harvests and favorable weather.

During 1996 and 1997 calf survival in southeastern Unit 12 was 36 and 31:100 cows, respectively, exceeding the previous 5-year average of 23:100. Calf survival is normally lower in this area compared to northwestern Unit 12 but has been similar the past 2 years. Apparently, environmental conditions have favored increased survival rates unitwide. Little bear and wolf harvest occurs in this area because of land ownership status and limited access. The largest wolf packs and highest wolf density occur in this portion of Unit 12.

*Distribution and Movements*

Moose are throughout Unit 12 below an elevation of about 4000 feet. In total the amount of suitable habitat is 6000 $mi^2$ (15,540 $km^2$). Most moose in Unit 12 migrate between seasonal ranges. The longest known movements are for moose that rut in the Tok River area, including Dry Tok Creek. Many cows migrate as far south as the Gakona River for calving, return to the Tok River for the rut, and then move north to the area burned by the 1990 Tok Wildfire or to the Tanana River during mid to late winter. Moose radiocollared around Tok in March calved and summered south of the Alaska Range. These moose could have higher calf survival than resident Unit 12 moose.

Moose distribution has changed in Unit 12 over the past 5 years. Very few resident moose now exist on the Northway Flats, near Tanacross, or north of Tok along the Tanana River. Year-round poaching and harvest for funeral or ceremonial potlatches contributed to the decline of resident moose in these lowland areas near human settlements. Also, some of these moose may now be spending more time in the 1990 Tok River burned area. Use of the Tok River valley and the Tetlin Hills by moose has increased substantially since 1989. Densities have increased from 0.19 moose/$mi^2$ to about 1 moose/$mi^2$. Moose use this area throughout the year. Increased use of this area is a result of improved habitat from the 1990 Tok River fire and moderate harvests of predators.

The current Fish and Wildlife Protection officer conducted intensive public awareness campaigns that explain the limiting effects on local moose numbers from poaching. His efforts resulted in a substantial decline in the number of poaching cases. We are working with the local villages to improve potlatch moose harvest reporting and, hopefully, we will develop a strategy that will limit this harvest to sustainable levels.

Local residents have observed the increase in moose in the area burned by the 1990 Tok wildfire. As a result, more residents, including Natives, are more receptive in using fire or other habitat enhancement techniques to benefit moose.

## MORTALITY

### *Harvest*

Season and Bag Limit. Seasons and bag limits in Unit 12 during regulatory year 1997 were as follows:

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| 1 bull with spike-fork antlers | 20 Aug–28 Aug | No open season |
| Unit 12, that portion drained by the Little Tok River upstream from and including the first eastern tributary from the headwaters of Tuck Creek. 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 1 side. | 1 Sep–15 Sep | 5 Sep–15 Sep |
| Unit 12, that portion lying east of the Nabesna River and south of the winter trail running southeast from Pickeral Lake to the Canadian border. 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | 1 Sep–30 Sep | 1 Sep–30 Sep |
| Remainder of Unit 12. | | |
| Resident Hunters: 1 bull. | 1 Sep–15 Sep | |
| Nonresident Hunters: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | | 5 Sep–15 Sep |

Board of Game Actions and Emergency Orders. In spring 1993 the Board of Game restricted the bag limit in the Little Tok River drainage to 1 bull with either spike-fork antlers or 50-inch antlers (with 4 or more brow tines on 1 side) for both residents and nonresidents. In spring 1995 the board authorized a spike-fork season 20–28 August in Unit 12 for residents only. The board adopted no new regulations for Unit 12 since 1995 but will consider proposals during spring 1998.

Hunter Harvest. Total reported harvest in Unit 12 was 118 (117 bulls; 1 unknown sex) in 1995 and 124 bulls in 1996 (Table 2). The 5-year average moose harvest was 98. During 1996 most harvest occurred in the Tok River (43), the northwestern portion of the unit (22), and the Tetlin River (16). Local residents were responsible for most of the harvest in the Tok (53%) and Tanana River (75%) drainages. Nonresidents took 3% of the total harvest from these 2 areas. Most harvest that occurs along the Tetlin (16) and Chisana (14) Rivers was by nonresidents (42%). Since enacting antler size restrictions within most of the Little Tok River drainage in 1993, harvest has declined to an average of 5 per year compared to 10 to 20 bulls per year during 1991 and 1992. Four to 5 spike-fork bulls were harvested annually during the August season.

Reported harvest represented about 3.0 to 3.5% of the prehunt Unit 12 population and probably had little impact on population dynamics. Currently in Unit 12, out-of-season take either by poachers or for funeral or ceremonial potlatches may be as high as 40 moose of either sex annually. Five to 10 years ago this take was probably as high as 60 moose annually. Most of this harvest occurs near communities and along the road system. Thus, the total Unit 12 annual human-induced harvest is probably closer to 4 to 5% of the population. At the current harvest rate, the moose population around human settlements will continually be maintained at very low levels.

Antler size was reported for 107 harvested bulls resulting in a mean of 46.8 inches, equaling the average antler size taken in 1995 but exceeding the 5-year average of 45.5. Nine bulls (9%) were judged to be yearlings (antlers <30 inches), 43 (40%) were 2 to 4 years old (antler spread 30.0–49.9 inches), and 55 (51%) were mature bulls (antler spread >50 inches). Antler spreads were estimated for 119 bulls observed during the census in northwestern Unit 12. Of these, 31% were yearlings, 35% were 2 to 4 years old, and 34% were mature bulls. Antler size was reported for 43 bulls ($\bar{x}$ = 46.3 inches) harvested within the census area, 5 (12%) were yearlings, 18 (42%) were 2 to 4 years old, and 20 (47%) were mature bulls. Seven of the 20 mature bulls were taken under regulation requiring bulls with antlers 50 inches or larger, which may explain the higher than expected mature bull harvest. Based on conversations with many local hunters, it is apparent that yearling distribution does not bring yearlings in contact with hunters; therefore, hunters are not passing up yearling bulls in favor of larger bulls.

Hunter Residency and Success. In Unit 12, local residents, nonlocal residents, and nonresidents accounted for 61%, 31%, and 7% of the moose hunters, respectively. These percentages have been consistent the past 3 years. Local hunters harvested 62 (50%), nonlocals 41 (33%), and nonresidents 20 (16%) of the 124 bulls reported (Table 3). Local and nonlocal harvest has ranged between 47–50% and 28–33%, respectively, since 1994.

During 1996, 512 hunters reported hunting moose in Unit 12, exceeding the 5-year average of 446. Most of the increase in hunters can be explained by increased participation and better reporting by local residents. The area's human population has grown slightly due to recent logging and road construction projects, and many of the newcomers are participating in local hunts. The overall unit success rate was 24%. Success rate has ranged between 15–27% since 1981 and averaged 23%.

Harvest Chronology. In that portion of Unit 12 where the moose season is 1–15 September or 5–15 September, the greatest moose harvest takes place during 7–13 September (Table 4) and on 14 or 15 September. During 1996, 26 moose were taken during these last 2 days. The harvest decline during the third week of the season since 1991 (Table 4) resulted from shortening the season to 15 days in most of Unit 12.

The number of hunters who participated in the 1–30 September season in southern Unit 12 and the total harvest for this season remained similar with past years. Most of these hunters are guided nonresidents or residents of Chisana.

Transport Methods. In Unit 12 during the past 5 years, the transportation type used by most hunters was highway vehicles (40%), followed by boats (18%), 3- or 4-wheelers (16%), airplanes (7%), other ORVs (7%), and horses (5%). Method of transport was unknown for 7% of the hunters. Hunters using highway vehicles have the lowest average success rate (12.4%), but traditionally take the greatest number of moose annually (Table 5). Hunters using horses have the highest success rate (67.2%). Horses are primarily used by guides to transport nonresident hunters into the most remote sections of the unit. Success rates of hunters using airplanes during the past 5 years accounted for 37% of the harvest but 46 and 55% during 1995 and 1996. Success rates for hunters using 4-wheelers (23%), ORVs (26%), or boats (22%) are similar and are near the unit's average success rate. These transportation types are not as beneficial to hunters in Unit 12 compared to some other areas because of crowded hunting conditions along major rivers and the few trails.

*Other Mortality*

Predation by wolves and grizzly bears is the greatest source of mortality for moose in Unit 12 and has maintained the population at a low density (0.4–0.7 moose/mi$^2$) since the mid-1970s. In contrast with other areas that contain sympatric moose, wolf, and grizzly bear populations, wolves, rather than bears, were the primary predators on moose calves on the Northway–Tetlin Flats, based on research conducted during the late 1980s. Wolf predation also appeared to be the greatest source of adult mortality. However, in other areas of Unit 12, fall composition data indicate that bear predation on moose calves to 5 months of age was high. In most of Unit 12, the grizzly bear population is currently stable at an estimated natural Interior grizzly bear density (16–20 bears/1000 km$^2$). The grizzly bear population probably declined in portions of the unit since the mid-1980s due to increased harvest by hunters.

Wolf populations have increased in Unit 12 at least since 1989 when tens of thousands of Nelchina caribou started to winter in or migrate through Unit 12. Between 1989 and 1992, the fall Unit 12 wolf population increased 30 to 40%, and during 1992–1993, there were 230–243 wolves in a minimum of 28 packs.

Between 1992 and 1994, the wolf population declined in Unit 12 due to increased harvest by trappers. The estimated decline within the unit was about 25%, but most of the decline occurred within the western portion of the unit where over 40% of the harvest occurred and the estimated wolf population decline was 30 to 40%. Wolf harvest declined substantially (13–24% harvest rate) in 1994 through 1996 due to low pelt prices. The wolf population has increased about 14% during those years. Considering the status and trend of major moose predators in Unit 12, I expect the moose population to remain at low density (0.2–1.0 moose/mi$^2$) for an extended period.

## HABITAT

### *Assessment*

Only about 6000 mi$^2$ in Unit 12 are considered to be moose habitat. However, excessive wildfire suppression for nearly 30 years has allowed vast areas of potentially good moose habitat to become choked in spruce forests that lack high-quality deciduous moose browse. In response, habitat enhancement work has been conducted in Unit 12 since 1982. Over 1600 acres of old-age, decadent willows have been intentionally disturbed to stimulate crown-sprouting of new leaders. This work has produced an estimated 2 million pounds of additional browse each year for wintering moose. In eastern Unit 12 the US Fish and Wildlife Service has completed several prescribed fires to benefit moose on the Tetlin National Wildlife Refuge. In 1998, we have scheduled the following habitat enhancement programs: 1) mechanically crush 200 acres of decadent willow and aspen within the Tok and Tanana River valleys to stimulate crown growth; 2) in cooperation with state forestry, determine suitable logging sites in terms of marketable trees, historic winter moose use, and potential to regenerate quality moose browse species; and 3) design and oversee implementation of scarification techniques to promote willow and aspen regeneration in logging sites. The proposed timber sale is 1000 acres in the Tok River valley. Cut areas will be 80–200 acres in size.

Browse studies have shown that use of preferred browse species is low in relation to availability. Also, disturbed sites were being used far more heavily than adjacent undisturbed areas. Currently, habitat is not limiting the moose population in Unit 12, but medium to large-scale creation of early seral species can cause the moose population to increase, as evidenced by the 1969 Ladue burn in eastern Unit 20E, the 1990 Tok burn, and the Teslin burn in the Yukon.

From June to September 1990, a wildfire burned approximately 97,000 acres of primarily decadent black spruce muskeg in the Tetlin Hills and adjacent Tok River lowlands. Quality moose browse species have recolonized much of this area and, in response, the area's moose population is increasing rapidly (0.19 moose/mi$^2$ in 1990 to 1.0 moose/mi$^2$ by 1997). Quality moose winter browse supplies are expected to continue for the next 15 to 20 years.

## NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Throughout most of Unit 12, moose densities are low and can support only limited harvest. However, we can increase hunter opportunity without negatively limiting the population's ability to grow. In Unit 12 we initiated an early spike-fork season. This antler class represents about 15% of the bulls, but makes up only 2% of the harvest. By offering an early season hunt dedicated to this age class and antler configuration, we have increased hunter opportunity and possibly reduced poaching. In Units 12 and 20E, the early spike-fork season is popular and participation rate is high, even though success has been low. Minimal violations were documented. Based on success rates during the first 3 years of the early spike-fork season, it is apparent the season can be lengthened without jeopardizing this age class.

Another possible management technique that may increase local hunter satisfaction would be to split the hunting season into 2 periods. The first season would occur between 20 and 30 August. Benefits would be that 1) most families could hunt together before school begins, 2) this time period is optimum for drying moose meat and would be appreciated by Natives, and 3) because the moose season opens on 20 August throughout Southcentral Alaska, I do not expect that Units 12 and 20E would receive excessive hunting pressure. The season would be closed between 1 September and about 14 September. This period is traditionally the most hunted, and most of the harvest occurs during this time. Even though success rates after 14 September are usually higher, the number of hunters afield is lower. Mid to late September moose hunting is enjoyed and desired by many hunters but normally cannot occur because of the high harvest in early September. A high success hunt in late September is feasible under a split season because the August hunt would have lower success rate, the leaves are still on the trees, and moose are more sedentary and quiet. The local advisory committees are considering the idea and plan to solicit public comment.

The advisory committees are also considering a floating controlled use area that covers both Units 12 and 20E. Area residents are concerned about the possible impact of additional restrictions for moose hunting in adjacent units, primarily Unit 13. Initiating a controlled use area would enact trail or vehicle restrictions only when necessary to protect against overharvest. Restrictions would be temporary and relaxed as soon as the moose population recovers to a level that can support a greater number of hunters. The benefits are that restrictions will only be enacted if access is the cause of the population's decline and are directed toward the primary mechanism (i.e., airplanes, ATVs, etc.). Theoretically, seasons and bag limits could remain consistent, reducing hunter confusion. This idea may be submitted to the Board of Game within the next 2 years.

Since the 1960s, moose composition and population trend in Units 12 and 20E were primarily estimated using contour trend counts. Moose populations in these units have been at a low density since the mid-1970s and concentrated in relatively small areas. Trend count surveys are sufficient most years, but occasionally weather or some other factor causes a shift in distribution and produces results that are difficult to interpret. In an attempt to improve our monitoring of the area's moose population, we subdivided Units 12 and 20E into 3 major management areas and each year we census 1 of the 3 areas using a Gasaway-like census. During the off census years, we conduct 2 to 4 trend counts to track calf and bull ratios to ensure against missing events that might have affected population status.

The 3 areas we sample are about 1200 $mi^2$ each and have been censused at least twice during the past 8 years. During census years, we stratify the area using data collected during past censuses and trend count surveys unless there has been a major alteration in the habitat (wildfire) or a particular area is known for periodic use by moose. These areas are stratified from the air before the census. Under this approach, we hope to obtain an unbiased population and composition estimate for 1 to 2 management areas annually, keep abreast of any anomalies in other portions of the management area, and spend less money on moose counts. We have now completed 2 of these censuses in northwestern Unit 12 and 1 each in central and eastern Unit 20E with good results. Precision estimates were ± 16% in Unit 12 during 1994 and 1997 and ± 28.5% and ± 19.9% in central and eastern Unit 20E, respectively. The primary problem in central Unit 20E was a significant change in moose distribution within 3 traditional count areas. Had we not stratified and counted the entire area, we would not have distinguished this shift in distribution from a change in moose population size. The technique has proved useful in statistically detecting changes in the moose population.

## CONCLUSIONS AND RECOMMENDATIONS

Moose are far less numerous in Unit 12 than they were in the 1960s. The population increased during the late 1980s, stabilized or slightly declined during 1989–1993, and increased slightly since 1993. Moose numbers, especially near the road system, are very low, primarily impacting subsistence hunters and nonconsumptive users. Every year hundreds of Alaska Highway travelers comment on the lack of wildlife in the Upper Tanana Valley. Habitat is not limiting, but predation and possibly out-of-season take in certain areas are maintaining the moose population at low densities. Since 1991 the moose population has grown within the area affected by the Tok wildfire. Residents of Tetlin and Tok and a growing number of nonlocal residents are beginning to use this area.

In more accessible areas of Unit 12, the bull:cow ratio has declined to 20–30:100 due to moderate harvest rates and low yearling recruitment. In the Little Tok River, an antler restriction regulation was adopted to protect the bull:cow ratio but still allow maximum hunter opportunity. Harvest may need to be similarly restricted in the Tok River drainage and along the north face of the Alaska Range because of high harvest rates.

An August spike-fork season was implemented in 1995. Survey data indicated this antler configuration represented about 15% of the bull population annually but composed only 2% of the harvest. By offering a season strictly for spike-forks, more hunting opportunity is offered without limiting the population's ability to grow. Public support of this season is high. The actual harvest during the early season has ranged from 3–5 spike-fork bulls. A proposal to extend the spike-fork season will be presented to the Board of Game in March 1998.

A new moose surveying technique was begun in Units 12 and 20E, yielding precision estimates of 16 to 28.5%. Benefits include a statistically valid estimate that is comparable between years and less expensive compared to trend surveys.

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Table 1 Unit 12 aerial moose composition counts, 1988–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/hr |
|---|---|---|---|---|---|---|---|---|
| 1988–1989 | 64 | 18 | 33 | 189 | 17 | 943 | 1133 | 40 |
| 1989–1990[a] | 50 | 13 | 30 | 223 | 17 | 1094 | 1317 | 44 |
| 1990–1991 | 47 | 12 | 25 | 185 | 15 | 1071 | 1256 | 40 |
| 1991–1992 | 49 | 12 | 24 | 200 | 14 | 1264 | 1472 | 44 |
| 1992–1993 | 45 | 10 | 26 | 165 | 15 | 906 | 1071 | 32 |
| 1993–1994[b] | 26 | 7 | 36 | 187 | 22 | 662 | 850 | 57 |
| 1994–1995[c] | 38 | 16 | 39 | 87 | 21 | 327 | 414 | |
| 1994–1995[d] | 97 | 13 | 25 | 47 | 11 | 374 | 421 | 44 |
| 1995–1996[d] | 82 | 12 | 26 | 65 | 12 | 461 | 526 | 51 |
| 1996–1997 | 39 | 9 | 32 | 236 | 23 | 1022 | 1258 | 57 |
| 1997–1998[c] | 36 | 11 | 41 | 138 | 23 | 458 | 596 | |
| 1997–1998[d] | 87 | 22 | 31 | 73 | 14 | 439 | 512 | 39 |

[a] Tok and Dry Tok were not surveyed. These survey areas normally yield a sample of 400+ moose.
[b] Cheslina and the northern face of the Nutzotin Mountains were not surveyed. These survey areas normally have about 100 bulls:100 cows.
[c] Based on census results from northwestern Unit 12.
[d] Cheslina, Kalukna, Nabesna, and Chisana count areas were sampled using contour survey techniques.

Table 2 Unit 12 moose harvest and accidental death, 1990–1996

| Regulatory year | Harvest by hunters: Reported M (%) | Reported F (%) | Reported Unk | Reported Total | Estimated Unreported | Estimated Illegal | Estimated Total | Accidental death Road | Accidental death Train | Accidental death Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990–1991 | 94 (96) | 0 (0) | 4 | 98 | 15–20 | 30–40 | 45–60 | 4–5 | | 4–5 | 147–163 |
| 1991–1992 | 109 (99) | 0 (0) | 1 | 110 | 15–20 | 30–40 | 45–60 | 4–5 | | 4–5 | 159–175 |
| 1992–1993 | 71 (100) | 0 (0) | 0 | 71 | 15–20 | 30–40 | 45–60 | 4–5 | | 4–5 | 120–136 |
| 1993–1994 | 91 (100) | 0 (0) | 0 | 91 | 15–20 | 30–45 | 45–65 | 5–7 | | 5–7 | 141–163 |
| 1994–1995 | 87 (100) | 0 (0) | 1 | 88 | 15–20 | 30–45 | 45–65 | 7 | | 7 | 140–160 |
| 1995–1996 | 117 (100) | 0 (0) | 1 | 118 | 20–25 | 5–10 | 25–35 | 3–5 | | 3–5 | 146–158 |
| 1996–1997 | 124 (100) | 0 (0) | 0 | 124 | 20–25 | 3–10 | 23–35 | 3–5 | | 3–5 | 150–164 |

Table 3 Unit 12 moose hunter residency and success, 1990–1996

| Regulatory year | Successful: Local resident[a] | Successful: Nonlocal resident | Successful: Nonresident | Successful: Total (%) | Unsuccessful: Local resident[b] | Unsuccessful: Nonlocal resident | Unsuccessful: Nonresident | Unsuccessful: Total (%) | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| 1990–1991 | 45 | 26 | 17 | 98 (23) | 186 | 131 | 15 | 332 (77) | 430 |
| 1991–1992 | 48 | 49 | 13 | 110 (27) | 160 | 132 | 9 | 305 (73) | 415 |
| 1992–1993 | 23 | 35 | 12 | 71 (15) | 222 | 164 | 13 | 408 (85) | 479 |
| 1993–1994 | 38 | 33 | 18 | 91 (24) | 186 | 90 | 12 | 289 (76) | 380 |
| 1994–1995 | 43 | 28 | 17 | 88 (19) | 240 | 118 | 15 | 374 (81) | 462 |
| 1995–1996 | 55 | 34 | 26 | 118 (24) | 249 | 113 | 16 | 378 (76) | 496 |
| 1996–1997 | 62 | 41 | 20 | 124 (24) | 251 | 119 | 14 | 384 (76) | 512 |

[a] Residents of Units 12 and Units 20E and eastern 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

[b] Total may include hunters who did not specify whether or not they were residents.

Table 4 Unit 12 moose harvest chronology by time period, 1990–1996

| Regulatory year | Harvest periods | | | | | Total[a] |
|---|---|---|---|---|---|---|
| | 9/1–9/6 | 9/7–9/13 | 9/14–9/20 | 9/21–9/27 | 9/28–10/5 | |
| 1990–1991 | 18 | 41 | 28 | 4 | 3 | 98 |
| 1991–1992 | 34 | 45 | 22 | 4 | 1 | 110 |
| 1992–1993 | 25 | 31 | 6 | 4 | 4 | 71 |
| 1993–1994 | 29 | 40 | 16 | 4 | 0 | 91 |
| 1994–1995 | 25 | 26 | 25 | 3 | 4 | 88 |
| 1995–1996 | 33 | 52 | 17 | 5 | 6 | 118[b] |
| 1996–1997 | 39 | 44 | 27 | 7 | 1 | 124[b] |

[a] Difference between total and summation of harvests by week represents moose taken on unknown dates.
[b] Four moose were taken during the early spike/fork season in 1995 and 1 in 1996 and 1 moose was taken during a federal hunt in November 1995.

Table 5 Unit 12 moose harvest percent by transport method, 1990–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | |
| 1990–1991 | 17 | 15 | 21 | 11 | 0 | 6 | 23 | 5 | 98 |
| 1991–1992 | 10 | 14 | 10 | 25 | 0 | 14 | 25 | 2 | 110 |
| 1992–1993 | 18 | 23 | 10 | 11 | 0 | 10 | 28 | 0 | 71 |
| 1993–1994 | 8 | 19 | 15 | 22 | 0 | 16 | 18 | 2 | 91 |
| 1994–1995 | 10 | 20 | 19 | 18 | 0 | 7 | 23 | 2 | 88 |
| 1995–1996 | 10 | 13 | 28 | 17 | 0 | 6 | 22 | 4 | 118 |
| 1996–1997 | 13 | 9 | 22 | 19 | 0 | 7 | 28 | 2 | 124 |

# LOCATION

**GAME MANAGEMENT UNIT:** 13 (23,376 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Nelchina and Upper Susitna Rivers

# BACKGROUND

Moose densities in Unit 13 were low during the early 1900s but started to increase by the 1940s. Moose were abundant throughout the 1950s, and the population peaked in the mid-1960s. For the next 10 years, moose numbers declined and reached a population low by 1975. Factors contributing to the decline were severe winters, increased predation, and large human harvests of both bulls and cows. The number of moose counted during fall surveys started to increase in 1978 and climbed at an average annual rate of 5% until 1987 when the population peaked again. Moose numbers declined during the early 1990s because of a series of severe winters and increased predation.

Historically Unit 13 has been an important area for moose hunting in Alaska. Annual harvests were large, averaging over 1200 bulls and 200 cows during the late 1960s and early 1970s. Hunting seasons were long, with both fall and winter hunts. As moose numbers began to decline, we reduced harvests by eliminating both the cow season and winter season in 1972 and reducing fall bull seasons to 20 days in 1975. Harvests in the late 1970s averaged 775 bulls per year, but bull:cow ratios in the population were low. In 1980 the bag limit was changed from any bull to bulls with an antler spread of at least 36 inches or 3 brow tines on at least 1 antler. Under this management regime, the 1980 bull harvest dropped to 557, down 34% from the 1979 harvest of 848. From 1981 through 1988 the harvest increased, peaking in 1988 with a harvest of 1259 moose. However, starting in 1990, seasons were reduced in length in response to population declines attributed to severe winters. Moose seasons were again liberalized in 1993.

# MANAGEMENT DIRECTION

**POPULATION OBJECTIVE**

To increase the unit moose population to between 20,000–25,000 moose with a minimum of 25–30 calves:100 cows in the fall.

**HUMAN USE OBJECTIVE**

Increase the yearly moose harvest of bulls and cows to a combined total between 1200 and 2000 animals.

# METHODS

We conducted aerial surveys during fall to learn sex and age composition and population trends in count areas throughout the unit. Censuses have been conducted periodically in different portions of the unit for population estimates. Surveys were flown during calving season to determine percent twins at birth. We monitored harvests by requiring permit and harvest ticket reports from all hunters and monitored habitat conditions periodically by examining browse utilization transects in different parts of the unit. Attempts at habitat improvement include updating the Copper River Fire Management Plan. In this plan large portions of the unit are included in a limited fire suppression category in which wildfires are allowed to burn. In addition, staff evaluated and responded to land-use proposals that could affect moose habitat.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

The number of moose counted per hour during fall sex and age trend counts on established count areas is the most reliable indicator of long-term trends in moose numbers. By using the number of moose observed per hour, we try to account for different survey conditions and moose movements between years that may influence the number of moose counted. Moose per hour data for the current reporting period are included in Table 1. The number of moose counted per hour in Unit 13 declined 21% from 1988 to 1994. The 1997 total of 56 moose per hour is similar to the 55 moose per hour figure in 1994. This indicates that moose numbers have been relatively stable in Unit 13 during the current reporting period. Moose per hour figures of 44 and 49 for 1995 and 1996, respectively, are lower than that obtained in 1994 and 1997. However, count conditions were poor over portions of the unit during both years. The low moose/hour figures in 1995 and 1996 were due, in part, to decreased conditions to observe moose, thereby increasing the estimate of decline in moose numbers.

Moose are not evenly distributed throughout the unit and moose numbers in the five units are often subjected to different population influences. Compared to the last report period (1992–94) the number of moose counted per hour declined by 11% in Units 13A and 13E, while 13D declined 17%. Most of the decline in Subunits 13A and 13E were in the bull and calf segment of the population. Moose per hour figures increased in 13B and 13C by 2 and 3%, respectively. These figures indicate the trend of declining moose numbers continues in 13E and 13D but at a lower rate than previously reported (18 and 24%, respectively). In 13A the decline increased slightly from the 6% observed during the last reporting period. In 13B and 13C, where declines of 29% and 30% were observed during the last reporting period, moose per hour figures indicate a stable population and possibly some increase in moose numbers.

### *Population Size*

A unit population estimate for moose is not available. Density estimates from fall composition counts range from a low of 0.2 moose/mi$^2$ in 13D to a high of 2.5 moose/mi$^2$ in 13C. A unit average of 1.4 moose per mi$^2$ was observed in Unit 13 during 1997.

### *Population Composition*

Population composition data collected during fall sex and age composition counts from 1992 through 1997 are presented in Table 1. The bull:cow ratio in Unit 13 was stable at 25 bulls/100 cows between 1990 and 1992–93, then declined 32% to 17bulls/100 cows by 1995. The bull:cow ratio has been relatively stable since 1994. The unit yearling bull:cow ratio declined from 12 yearlings:100 cows in 1988 to 4:100 in 1994, then increased slightly to 6:100 during the past 3 years. There were 12 large (i.e., >1-year-old) bulls:100 cows observed unitwide in 1997. During fall counts, grouping of bulls by antler size showed 29% yearlings, 50% of bulls had antlers 30–39 inches, 15% had antlers 40–49 inches, and only 6% of bulls had >50-inch antlers. These data indicate that 79% of the Unit 13 posthunt bull population left to breed was 3 years old and younger. This is especially important because in portions of Unit 13 where bull:cow ratios are the lowest, the age structure of the few remaining bulls is also the youngest.

Comparison of the bull:cow ratio by unit shows a decline in all units except 13D from the highs observed during the 1980s. The largest observed decline in the bull:cow ratio was 71% in Unit 13A between 1992 and 1997, a decrease from 38 bulls to 11 bulls:100 cows. This current ratio is among the lowest reported for Unit 13. The reason the decline was so great in 13A is that prior to 1993, large bulls were increasing because hunting regulations prohibited taking them under a spike/fork-only harvest strategy. Most of the decline occurred in 1993, the first year hunting of large bulls in 13A was allowed by expanding the spike-fork regulation to include large bulls with 3 brow tines or 50-inch spread. The second biggest decline (48%) in the bull:cow ratio occurred in 13E where it dropped from 27:100 in the late 1980s to 14:100 in 1997. Again, most of the decline occurred by 1993. During the last 4 years, the 13E bull:cow ratio has fluctuated between 14 and 17 bulls:100 cows. In Unit 13B the bull:cow ratio declined 25% from the late 1980s but has been fluctuating between 18 and 22 bulls:100 cows over the past few years with no apparent trend. However, some heavily hunted portions of 13B have a bull:cow ratio as low as 12:100. Unit 13C exhibits a trend similar to that in 13B, where an initial decline of 15% occurred from levels in the late 1980s, but yearly fluctuations currently indicate a relatively stable bull:cow ratio. The bull:cow ratio in 13D is the highest in the unit, but yearly fluctuations preclude detecting an overall trend in the ratios.

Table 1 shows calf:cow ratio figures for Unit 13 during the past 6 years. Calf production and/or survival have been low, ranging from 17–19 calves:100 cows in 3 of the last 4 years. Between 1978 and 1988 calf production and survival were high, varying from 22 to 31 calves:100 cows per year. The 26 calves:100 cows observed in 1996 approaches the calf:cow ratios of the mid-1980s, when moose numbers were increasing in Unit 13.

In moose populations adult cows are the least vulnerable sex and age class to wolf and bear predation, severe winters, and (under current hunting regulations) human harvests. Because of this, monitoring trends in cow abundance indicate trends that may not be as influenced by changes in harvests or yearly fluctuations due to weather or predation. The measurement used in determining trends in cow abundance is the number of cows counted per hour. Between 1986 and 1988 the fall sex and age composition data showed an average cow per hour figure of 47. The 1997 estimate of cows per hour was 41, down by 13%. The cow per hour figure has actually been stable over the last 6 years, following a steep decline between 1988 and 1990. Comparing changes in cows per hour data since 1990 versus moose per hour data leads to the conclusion that the decline in the unit moose population after 1990 has been primarily due to fewer bulls and calves in the population. However, even though the cow base has been relatively stable, the age structure of the cow base is getting older. Lower calf recruitment for the last 7 years reflects a cow population comprising increasingly older individuals. The eventual outcome of a population with older individuals is that mortality increases, as older cows become more susceptible to severe winters and predation. If a series of severe winters occurred, the cow base would decline more precipitously than if the age of cows was evenly distributed rather than biased toward older individuals.

*Productivity*

In 13A West radiocollared moose subjected to ultrasound pregnancy exams during November exhibited an average pregnancy rate of 88% that was maintained until spring in all but 1 year. (Testa 1997). These pregnancy rates approach those observed during the 1980s when calf recruitment to fall was higher. Fall in utero twinning rate was 27% for these same radiocollared cows in 13A that were pregnancy checked by ultrasound, while twinning rate at birth based on calf observations declined to 13%. Twinning rates are obtained in other units by aerial surveys in early June, just past the peak of parturition. In 13E twinning rates fell from a high of 39% in 1995 to a low of 12% in 1997. However, in 13B the twinning rate rose from 20% in 1996 to 42% in 1997, while 13C was stable at 33% a year. In recent years Unit 13A consistently had lower twinning rates than the other 3 units.

Ballard et al. 1991 considered twinning rate as an index of productivity, thus providing insight regarding range condition and carrying capacity. Generally speaking, twinning rates below 20% indicate low productivity, while higher rates reflect average productivity. Unit 13A may be an example of this, with twinning rates consistently lower than in other units and with its range under heaviest use. Unfortunately, variation in observed twinning rates in Unit 13 makes drawing such conclusions difficult. Reasons for variation in twinning rates are unknown; however, there are other factors than long-term carrying capacity of a range that influence the number of twins counted during postcalving aerial surveys. Early neonatal predation reduces counts because a cow with 2 calves is less able to defend both than is a cow with only a single calf. Count conditions also affect survey results. Severe winters with deep snows and droughts lower productivity when browse production and quality are lowered.

*Distribution and Movements*

Data from fall composition surveys, censuses, and stratification flights indicated that in recent years moose densities were highest in Units 13A, 13B, and 13C (Table 2). Moose were most abundant along the southern slopes of the Alaska Range in 13B and 13C and the eastern Talkeetna Mountains in 13A. Unit 13D and the Lake Louise Flats have the lowest observed density.

Fall rutting and postrutting concentrations are in subalpine habitats. The distribution of wintering moose depends on snow depth. Moose move down to wintering areas at lower elevations as snow depth increases. Known winter concentration areas include the upper Susitna River, Lake Louise Flats, the Tulsona Creek burn, and the Copper River floodplain in Unit 13C.

## MORTALITY

*Harvest*

<u>Season and Bag Limit</u>. Season dates and bag limits for the general state moose hunt in 1992 were 1–14 September; however, use of motorized vehicles (except boats) off a maintained highway or road was prohibited during 1–7 September. The bag limit was 1 bull with 3 brow tines or 36-inch antlers with the exception of 13A West, where the bag limit was 1 bull with a spike or forked antler on 1 side. In a small portion of 13A West north of the Black River, bulls having 50-inch spreads or 3 brow tines could also be taken along with spike/fork bulls, but this harvest was low. Between 1993 and 1996 the general season dates were 20 August–20 September, and the bag

limit was 1 bull with a spike/fork antler on 1 side or 3 brow tines on 1 side or a spread of 50 inches or more. Three cow hunts were held in portions of 13A West during 1993 and 1994, and 25 drawing permits were issued for each area. Season dates were 1–15 September. A Tier II subsistence permit hunt was established in 1995 with 150 Tier II permits issued. Permits were limited to 1 per household. The season dates were 1–15 August. A federal subsistence hunt was established in 1990 for Unit 13 residents with only 1 permit issued per household and a bag limit of any bull. This hunt has been held since on federal lands open to subsistence hunting, with current season dates of 20 August–20 September.

Board of Game Actions and Emergency Orders. Cow harvests were not requested or authorized in 1996. Because of intensive management legislation for moose and caribou in 1996, the board changed the moose management objectives for Unit 13. The moose population objective was established as 20,000 to 25,000 moose. Composition objectives adopted include a calf:cow ratio of 30 calves:100 cows and a yearling bull ratio of 10:100 during fall composition counts. The human-use objective established for the Unit 13 moose hunt was to provide a human harvest of 1200 to 2000 moose per year. This range was adopted in relation to board findings that human consumption of moose is the preferred use of moose in Unit 13. Subsistence need was set at 600 moose each year. In 1997 the board increased the Tier II season by 4 days with season dates of 1–19 August.

Hunter Harvest. In 1996–97 reported harvest for Unit 13 was 1027 moose from the combined state and federal subsistence seasons (Table 3). There was an initial harvest increase in 1993 that resulted from changes in season length and bag limits. In 1994 harvests declined 25% from 1993 but increased 2% in 1995 and 5% in 1996. During the last 3 years, the harvest has averaged 986 moose annually.

During 1996 6102 hunters reported hunting in Unit 13. The highest hunting pressure ever reported in Unit 13 was in 1995 with 6215 hunters reporting. For the last 4 years with longer seasons and spike/fork 50-inch bag limit, Unit 13 has averaged 6046 hunters annually.

We gathered preliminary harvest figures for the 1997 moose season by hand tabulating harvest report forms. To date, 831 bull moose have been reported taken in Unit 13 during the 1997 season under the general state hunt. This figure is down a little from the prior year's take at this time for the general hunt, indicating the harvest may decline a little from that reported in 1996.

General Hunt. Harvest ticket returns from 1996 showed 951 bulls taken by 5627 hunters during the general state hunt (Table 4). Unit harvest for all hunters reporting harvest locations in this hunt during 1996 includes 13A – 211; 13B – 274; 13C – 165; 13D – 68; 13E – 212. Harvest in Units 13B and 13C have increased slightly the last 2 years, while harvests display little trend in the 3 remaining units.

We determined antler measurements for bulls harvested under the general state hunt from harvest ticket returns. This antler composition data of the bull harvest is available through the 1997 season. In 1993, the first year under the spike/fork 50" regulation, 18% of the harvest was reported to be spike/forked bulls, 31% were bulls with antlers less than 50 inches, and 51% had antlers greater than 50-inch spreads. The latest antler composition data from 1997 indicates 41% of the harvest was spike/forked bulls, 33% <50 inches and 26% ≥50 inches. These data indicate the yearling bull harvest has doubled, and yearlings went from the least to the most important age class in the harvest. The harvest of large bulls has declined, and large bulls now compose the smallest portion of the harvest. This trend of increasing yearling harvests and declining large bull harvests supports conclusions based on composition data indicating the bull population is skewed against large, mature bulls because of the current selective harvest strategy.

Harvest data providing the number of brow tines on harvested bulls having antlers larger than spike-fork in Unit 13 are also available from 1993 through 1997. During this 5-year period, the percent of bulls with <50-inch spreads with 3 brow tines averaged 76%; 24% had 4 brow tines or more. The proportion of bulls having a spread of ≥50 inches with 3 brow tines averaged 57%, while 43% had 4 brow tines or more. No trend was detected in the percentages of brow tines over this 5-year period. These data indicate that the percent of the bull population having 4 or more brow tines is much lower than that having 3 brow tines. The percent of the yearly take by spike and fork antler class category is also available. Over the last 5 years, spikes composed 46% of the yearling harvest and forks 54%.

Permit Hunts. The current federal subsistence hunt replaced a previous state registration subsistence hunt in 1990. The Bureau of Land Management (BLM) assumed management of subsistence moose hunting on federal land in 1990, following the McDowell decision, and issues registration permits to applicants who are rural residents of Unit 13. Areas open for this hunt are only 2 very small tracks of federal land in 13B and 13D. Harvests under this permit hunt are presented in Table 5. This is a very popular hunt for Unit 13 residents, shown by the high number of households getting permits. Harvests are low and have been relatively stable the last 5 years with no trend evident. Since the amount of federal land open for this hunt is extremely limited, the any-bull bag limit has resulted in a low bull:cow ratio on federal lands surveyed, but because harvests are so concentrated, this hunt does not influence bull:cow ratios on state lands.

Cow moose hunts were held by drawing permit in 13A West in 1993 and 1994, and 36 and 39 cows were taken, respectively (Table 4). Low calf recruitment has resulted in cancellations of this hunt since 1995.

A state subsistence moose hunt for any bull was started in 1995 with participation decided under the Tier II permitting system. One hundred fifty permits were issued and the harvest in 1995 was 26 bulls, with 33 taken in 1996 (Table 5). This subsistence take is only 3% of the unit harvest, barely influencing age composition of bulls remaining after the hunting season. Antler composition data from this harvest show a smaller average size of harvested bulls.

Illegal Harvests. Unreported and illegal harvest estimates are given in Table 3. These estimates were first derived during the 1980s under the 36-inch regulation and were thought to change little through the last reporting period. However, I have subsequently changed my thinking on unreported and illegal harvests for the period since 1993. I now feel that estimates of illegal take should be much higher because of the spike–fork 50" regulation. What I do not know is what percent of the reported harvest is actually illegal under this regulation, but it could be as high as 10% of the reported take. I believe a number of yearlings reported as forks are illegal because of the difficulty distinguishing small paddles and palms from forks. Also, I believe a number of sub-50-inch bulls are harvested because so few hunters (probably less than 10%) can tell a 50-inch bull from a 45-inch bull in the field. This assumption is based on 5 years of field experience monitoring this hunt. Many of the illegal bulls taken are honest mistakes. However, once an illegal bull is taken, I think most are subsequently reported as legal. This increased illegal take is important because it often comes from heavily hunted areas where very few legal bulls remain. Composition data confirm that illegal take has increased. Current bull ratios in some areas are lower than expected given the number of bulls that should be protected under a spike–fork 50" regulation. Testa (pers. commun.) estimated a minimum bull:cow ratio of 14:100 in Unit 13A, based on modeling of population data, but the ratio observed is below 10:100 in portions of 13A.

Hunter Residency and Success. Local residents of Unit 13 accounted for 9% of the 1996 moose harvested under the general season, according to harvest ticket returns (Table 4). During this 5-year reporting period, local residents averaged between 7 and 10% of the harvest. Nonresident moose hunters averaged 9% of the unitwide moose harvest between 1993 and 1996. Alaskans residing outside Unit 13 took the remainder of the harvest. During the last 2 years, under the Tier II permit hunt, unit residents harvested 68% of the moose.

The success rate for moose hunters in the Unit 13 general hunt was 17% during 1996, similar to the 16% observed in 1994 and 1995 (Table 4). The success rate for these last 3 years is down from the 22% observed in 1993. Hunter success for the 10-year period before 1993 averaged 24%. The hunter success rate for the Tier II subsistence permit hunt was 25% and 12% for the federal subsistence hunt (Table 5). The highest success rate reported by Unit 13 moose hunters was for the permit cow hunts, running from 43% to as high as 86% in one area.

Successful moose hunters in the general hunt reported spending an average of 8.2 days hunting in 1996, down slightly from 10.2 days reported in 1995. In 1989 harvest ticket returns show that 3556 hunters reported an average of 5.9 days hunting for a total of 21,240 days hunting moose in Unit 13. Harvest reports in 1996 indicate that 5522 hunters spent 8.7 days hunting for a total of 48,226 days afield. This represents a 127% increase in hunting effort in Unit 13. Tier II hunters reported averaging 8.2 days in the field over the last 2 years.

Harvest Chronology. Chronology data for the general hunt is presented in Table 6. The last 2 weeks of the season have accounted for more than half the harvest in every year since 1994. This harvest pattern is predictable because moose are more vulnerable later in September. Leaf fall starts occurring at this time and onset of the rut initiates calling and increased bull movements.

Transport Methods. During the last 3 years of this reporting period, 4-wheelers have been the most important method of transportation (Table 7). It is obvious that Unit 13 is an important 4-wheeler and off-road vehicle area for moose hunters. In the last 4 years hunters using either 4-wheelers or ORV's are the largest group of hunters and have averaged 57% of the total moose harvest. As a group, aircraft and ORV users other than 4-wheelers have the highest rate of success, while those using a 4-wheeler had a lower one.

*Other Mortality*

Brown bears, considered relatively abundant, are major predators of moose calves in Unit 13 and kill a high percentage of annual calf production (Ballard et al. 1981). Although brown bears kill adult moose, the rate is much lower than calves. Brown bear predation on calves is so high that it may be the single most important factor in influencing calf recruitment. Because bears kill so many calves, changes in bear predation can be very important in influencing moose population trends. Research in the upper Susitna River showed that a 60% reduction in bear numbers during calving resulted in increased calf survival that carried over as spring recruitment (Ballard et al. 1987). Additional work has not been conducted to determine if lesser reductions in bear density due to increased sport harvest would also result in increased moose calf survival. However, in an effort to use sport harvest to reduce bear numbers and possibly improve neonatal moose calf survival, the Board of Game liberalized bear seasons and bag limits in 1995. Consequently, brown bear harvests have increased in Unit 13 as they did when brown bear seasons were liberalized in the 1980s. The effect of increased sport harvests on the Unit 13 brown bear population is unclear. The higher current harvest rates, along with those of the mid-1980s, were originally thought to exceed calculated sustainable levels. However, brown bear censuses designed to detect changes in bear numbers due to increased harvests do not indicate a decline in bear numbers but do indicate a reduction in the percent boars in the population (Miller 1988, Miller 1995). We have not been able to detect an increase in moose calf survival since bear harvests have been liberalized.

Wolf numbers in Unit 13 increased in 1990 and have been high ever since. Before 1990, spring estimates of wolf numbers in Unit 13, after hunting and trapping seasons, averaged 150 wolves. Since 1993 spring estimates have averaged 215 wolves. The fall 1996 estimate was approximately 400 wolves (9.3 wolves:1000 $km^2$). As a result of the increase in wolf numbers, coupled with a decline in moose from the late 1980s, wolf predation probably has more influence on moose abundance. Increased predation on caribou by wolves during the winter has not reduced predation on moose because most of the Nelchina caribou herd leaves Unit 13 for 6–7 months and winters in Units 12 and 20 and Canada. Even when caribou are present, Unit 13 wolves seek out moose (Ballard et al. 1987).

Natural mortality attributed to deep snow conditions increased in the late 1980s. Between 1989 and 1994 every winter was classified as severe, based on deep snow depths observed at 17 snow courses scattered throughout the unit. Snow depths did vary considerably between units, with 13A consistently having less snow pack. Snow depths in 1995 and 1996, amid mild and average winters, were much lower than those in the late 1980s. Observations of winter mortality in Unit 13 over the years have led to the conclusion that moose mortality due to deep snow conditions has not been density dependent. Instead, there appears to be a threshold effect allowing calf mortality to increase once snow reaches a certain depth. As snow depths increase, yearlings, then adult bulls, and finally adult cows die, regardless of moose densities. In addition to killing moose, deep snows often make it easier for wolves to take moose, which increases predation rates.

## HABITAT

### *Assessment*

Unit 13 has numerous areas where habitat improvement could produce more favorable browse conditions for moose. Because of the size and remoteness of much of the unit, wildfire is considered the only feasible tool for extensive habitat improvement. Wildfires occurred throughout much of Unit 13 before 1950, when fire suppression activities were initiated. Since then, negligible acreage has burned. Current fire suppression policies are presented in the Copper River Fire Management Plan, which sets aside large portions of the unit as let-burn areas where wildfires will not be suppressed. However, this plan has often been ignored and some wildfires have been suppressed, even if they occurred in an area designated as limited suppression. The current level of fire suppression has resulted in fewer fires and reduced seral habitat available as moose browse. The effect has been to lower the moose carrying capacity over extensive portions of Unit 13. Currently, climax upland and riparian willow communities are the most important habitat types for moose in the unit. Evaluation of browse in important moose areas from 1983 to 1986 indicates browse species were able to withstand the level of use occurring at that time. Current estimates of moose numbers are lower now, and browse is being evaluated in 13A as part of an ongoing research project. Preliminary indications are that current browse utilization rates are sustainable (Collins 1997).

The use of prescribed fires to replace wildfires as a method of improving moose habitat has not been successful in Unit 13. The climate in Unit 13 typically limits the use of prescribed fire to only the very driest years, when the danger of an escaped fire increases. Also, scattered cabins and private land ownership in the Basin increase the liability associated with the use of prescribed fire. In spite of problems associated with controlled burns, work with DNR is ongoing to select a possible site for a burn.

Habitat improvement by mechanical methods such as crushing is an alternative to burning. To be effective, mechanical treatment must be done on riparian habitats where moose concentrate during critical winter months. However, mechanical treatment is expensive, and costs limit mechanical treatment to small but important concentration areas near the road system where access for heavy equipment is available. One such small site was crushed in 1993, and initial regeneration of willows is good. Additional sites for mechanical treatment have been identified along the Copper River in Unit 13C where moose winter during deep snow years. Work continues toward gaining permission from landowners to crush this area.

## CONCLUSIONS AND RECOMMENDATIONS

Changes in moose per hour figures during fall moose counts indicate that unitwide moose numbers declined between 1988 and 1994 but have since stabilized. Although this decline included all sex and age classes of moose, the magnitude of the decline varied by sex and age class.

The calf segment of the Unit 13 moose population declined in 1989, and annual calf production/survival has been very low in 6 of the last 9 years. Calf production/survival to fall in 1997 is estimated at 25–30% below historic levels observed between 1978 and 1988. Cows exhibited the smallest decline, and their numbers have been relatively stable unitwide during this reporting period. However, the age structure of the cow population is changing due to the decline in calf recruitment. The risk of a major decline in cows during the next severe winter increases every year because the average cow in the population is getting older and thus more susceptible to a severe winter. Because of the lowered recruitment into the cow base, cow seasons were stopped, and it is recommended that cow harvests occur only after recruitment improves.

Increased human harvests under the spike/fork 50-inch regulation have reduced the bull:cow ratios unitwide. In some portions of the unit, the bull:cow ratio is as low as has ever been observed historically. In addition, and possibly even more importantly, harvests under this regulation have greatly skewed the age structure of the Unit 13 bull population so that almost

80% of the bulls left to breed are estimated at only 3 years of age or younger. Fall in utero pregnancy rates in 13A indicate this low bull:cow ratio has not, as of yet, reduced productivity. However, long-term effects of having breeding accomplished by very young bulls is unknown. It certainly has disrupted the normal rut pattern of Alaskan moose where large, mature bulls exhibit rutting behavior that ensures an effective and efficient breeding season. Any harvest strategy that maintains most of the breeding bull population in the very young cohorts should not be considered a suitable long-term regulation.

Productivity of Unit 13 moose during this reporting period probably hasn't changed. In utero pregnancy rates during fall and early spring, coupled with birth rates for pregnancy-checked radiocollared cows, approach those observed in Unit 13 moose during prior years. Twinning rates fluctuate between units and years and are low to average for an Interior moose population on mature range. Calf survival to fall is very low in Unit 13. The most important cause of neonatal moose calf loss is brown bear predation during the first 2 months of life. Based on the high rate of neonatal calf loss, changes in brown bear predation on calves probably has more effect on recruitment than any other factor including weather, with the possible exception of a winter with extreme deep snow fall. Because of the influence that brown bear predation has on recruitment, I recommend emphasizing research designed to determine what, if any, changes in bear abundance or behavior could result in a reduction of moose calf predation by brown bears.

Harvest in Unit 13 just prior to this reporting period has been controlled by defining a legal animal based on antler size and configuration, changing season length and dates, and limiting ORV use. Between 1980 and 1992 the 36-inch regulation was sufficient in protecting enough bulls to ensure a bull:cow ratio above 20:100. When severe winters and increased predation resulted in a decline in moose starting in 1989, additional harvest restrictions were begun. During the years between 1990 and 1992, the moose season was shortened, effectively reducing the harvest. Even though calf recruitment was low during this period, the bull:cow ratio was stabilized because of the lower harvest. In 1992 the moose season was lengthened by 1 week, but ORV use was restricted during the extension. Management actions that reduced the season and limited vehicle use were successful in reducing harvest and maintaining relatively stable bull:cow ratios between 1990 and 1992 when recruitment and survival was low.

Moose management changed in 1993 throughout Southcentral Alaska, including Unit 13, when the region adopted a uniform season and bag limit. Before this, moose hunting regulations varied by unit or subunit, which included a 36-inch bag limit, adjusting season dates, and restricting ORV use. By adopting a spike-fork 50" 3 brow tine regulation, it was thought that enough bulls would be protected to maintain an adequate bull:cow ratio yet provide greatly increased hunting opportunity. The season was extended 2 weeks and ORV restrictions were dropped. The immediate response to these liberalizations was a dramatic increase in hunting pressure, both in the total number of hunters in the field and the amount of time spent hunting. The use of ORV's, especially 4-wheelers, increased to become the most important transportation method in terms of use and number of harvested moose. With the increased use of ORV's, new trails were developed and the unhunted portion of the unit that served as a refugia for bulls during the hunting season diminished. Part of the reason Unit 13 saw such an increase in ORV use and hunting pressure is that the terrain is relatively open, compared to other units, allowing both easy travel and increased visibility, allowing hunters reasonable opportunity to determine if antlers were legal.

After adopting the regionwide moose season and bag limit, the Unit 13 moose harvest increased to the level observed during the late 1980s. This resulted in an immediate drop in the bull:cow ratio. In the most heavily hunted portion of the unit, the bull:cow ratio is as low as 11:100. Harvest composition data, based on antler size of harvested bulls, indicate a decline in older bulls in the harvest. Younger age classes, especially yearlings, compose a larger portion of the take. This finding confirms conclusions based on survey data that indicate most of the bull population is made up of young ($\leq$3 years) individuals.

Based on current harvest and results of fall composition surveys, I believe the spike/fork 50" bag limit is not restrictive enough in limiting harvests to maintain either adequate bull numbers or an even age distribution of bulls in Unit 13. The desire to simplify the regulations by having uniform moose seasons and bag limits is not sufficient reason to allow any unit to be overharvested because the uniform regulation is not adequately protecting large bulls. The current low bull:cow ratio and young age structure of the bulls left to breed after the hunting season are not acceptable long-term management objectives. Therefore, I recommend reducing the harvest until the bull:cow ratio increases to a minimum of 20 bulls:100 in all areas. I also recommend increasing the number of posthunt mature bulls left in the population to go through the rut.

To increase the number and age structure of bulls in Unit 13, I recommend reducing the bag limit, shortening the season, restricting ORV use during a portion of the season, and redirecting hunter effort to other units. The bag limit should be reduced by eliminating the forked yearling as a legal animal. This would provide for increased bull recruitment, especially during the current period of low calf recruitment. Since we are recruiting fewer yearlings, we must harvest a lower percentage of the ones we do recruit. Maintaining a spike-yearling in the bag limit will allow some harvest of young bulls. This harvest would be even more focused on the poorer yearling, thus cropping poorer individuals from the gene pool. Also, enforcement problems would be greatly reduced because many of the illegal bulls taken are yearlings with paddles and palms that were mistaken for forked antlers.

I recommend a season reduction of 12 days with season dates of 1–20 September. Shortening the season in 1990–92 was a successful management tool that lowered hunting pressure and reduced the harvest. I also recommend eliminating ORV use during the first week of the season if the moose season is not reduced to 1–20 September. ORV's have become the most important method of transport; reducing their use would allow hunters without ORV's to compete. This would also reduce overall harvest.

Finally, I recommend redirecting hunters back to other units such as Units 14, 15, 16, and 20 that have higher bull:cow ratios and calf recruitment. Hunters have concentrated in Unit 13 because it has more open habitat than these other units, which are predominantly forested. ORV access is easier in nonforested areas and there are extensive ORV trail systems. But even more important is the effect of the spike–fork 50-inch regulation on concentrating hunters in the open habitats of Unit 13. When you combine increased visibility of moose with the opportunity to use a 4-wheeler, hunting effort will increase. Moose are more visible in open habitats, thus a hunter can observe the antler and is more comfortable in determining if the bull is legal. The impact of the 50-inch regulation has been to discourage hunting in timbered areas because it is almost impossible to get an unobstructed view of the antler and be absolutely sure a bull is legal.

Because of this, I consider the spike-fork 50-inch regulation an overall failure as a regionwide moose hunting regulation. While it does provide for uniform enforcement, it also provides unrealistically high protection of bulls in forested habitats. Some areas have bull:cow ratios so high that winter hunts are allowed. It is time to redirect hunting pressure to units with extended seasons or additional permit hunts due to high bull:cow ratios. Because hunting is more difficult in these areas, it will be necessary to adopt regulations that force hunters out of Unit 13 and back into other areas. To accomplish this, I recommend adopting a unit-specific moose harvest ticket. A hunter must choose which roadside unit he wants to hunt moose in that year, and only 1 harvest ticket would be issued for a road-accessible unit. Couple this restriction with a shorter season, reduced bag limit, and possible ORV restrictions, then hunting pressure in Unit 13 should be lowered enough to reduce the harvest and allow the bull segment of the population to recover.

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Table 1 Unit 13 fall aerial moose composition counts and estimated population size, 1992–97

| Year | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves % | Adults | Total moose observed | Moose /hour | Density moose $mi^2$ (range) |
|---|---|---|---|---|---|---|---|---|
| 1992/93 | 25 | 9 | 24 | 16 | 5398 | 6438 | 61 | 1.6 (1.1–2.5) |
| 1993/94 | 23 | 8 | 25 | 17 | 4072 | 4905 | 60 | 1.4 (0.4–2.8) |
| 1994/95 | 18 | 4 | 17 | 12 | 4255 | 4854 | 55 | 1.3 (0.3–2.8) |
| 1995/96 | 17 | 6 | 19 | 14 | 4259 | 4951 | 44 | 1.4 (0.8–3.4) |
| 1996/97 | 19 | 6 | 26 | 18 | 4856 | 5929 | 49 | 1.2 (0.2–3.0) |
| 1997/98 | 18 | 6 | 19 | 14 | 5359 | 6209 | 56 | 1.4 (0.2–3.3) |

Table 2 Unit 13 fall aerial moose composition counts, 1997

| Unit | Bulls: 100 Cows | Yearling Bulls:100 Cows | Calves: 100 Cows | Calves % | Total Moose Observed | Moose /hour | Density moose $mi^2$ (range) |
|---|---|---|---|---|---|---|---|
| 13A | 11 | 4 | 21 | 16 | 1232 | 55 | 1.3 |
| 13B | 20 | 5 | 18 | 13 | 2619 | 60 | 1.7 |
| 13C | 24 | 12 | 22 | 15 | 592 | 78 | 2.5 |
| 13D[a] | 67 | 8 | 31 | 16 | 77 | 14 | 0.2 |
| 13E | 14 | 5 | 16 | 12 | 1459 | 49 | 1.1 |

[a] 13D almost 50% decline moose/hour.

Table 3 Unit 13 moose harvest[a] and accidental death, 1992–97

| Regulatory year | Reported | | | Estimated | | | Accidental | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | Total[b] | Unreported | Illegal | Total | Road | Train[c] | Total | |
| 1992/93 | 624 | 0 | 627 | 25 | 10 | 35 | 50 | 93 | 143 | 805 |
| 1993/94 | 1240 | 34 | 1278 | 25 | 10 | 35 | 50 | 25 | 75 | 1388 |
| 1994/95 | 904 | 40 | 955 | 25 | 10 | 35 | 50 | 29 | 79 | 1069 |
| 1995/96 | 963 | 0 | 977 | 25 | 10 | 35 | 50 | 13 | 63 | 1075 |
| 1996/97 | 1018 | 1 | 1027 | 25 | 10 | 35 | 50 | 15 | 65 | 1127 |

[a] Includes permit hunt harvest, harvest tickets and federal subsistence hunts.

[b] Includes unknown sex.

[c] 13E – the Alaska Railroad.

Table 4 Unit 13 moose hunter residency and success for general harvest ticket hunt only, 1992–96

| Regulatory Year | Successful | | | | Unsuccessful | | | | Total Hunters |
|---|---|---|---|---|---|---|---|---|---|
| | Local[a] Resident | Nonlocal Resident | Non-resident | Total[b] | Local[a] Resident | Nonlocal Resident | Non-resident | Total[b] | |
| 1992/93 | 42 | 516 | 0 | 571 | 331 | 1799 | 10 | 202 | 2773 |
| 1993/94 | 89 | 992 | 78 | 1191 | 447 | 3532 | 83 | 175 | 5366 |
| 1994/95 | 83 | 707 | 87 | 886 | 480 | 4077 | 160 | 765 | 5651 |
| 1995/96 | 90 | 716 | 90 | 908 | 414 | 4103 | 104 | 670 | 5578 |
| 1996/97 | 85 | 765 | 84 | 951 | 402 | 4099 | 122 | 676 | 5627 |

[a] Residents of Unit 13

[b] Includes unspecified residency

Table 5 Unit 13 moose harvest data by hunt, 1992–96

| Hunt No. | Regulatory year | Permits issued | Percent Did not Hunt | Percent Unsuccessf Hunters | Percent Successful Hunters | Bulls | Cows | Unknown | Harvest |
|---|---|---|---|---|---|---|---|---|---|
| Tier II | 1995/96 | 150 | 15 | 78 | 22 | 26 | 0 | 0 | 26 |
| TM300 | 1996/97 | 150 | 13 | 75 | 25 | 32 | 1 | 0 | 33 |
| BLM SUBSISTENCE | | | | | | | | | |
| 913 | 1992/93 | 659 | 29 | 87 | 13 | 56 | 0 | 0 | 56 |
| | 1993/94 | 550 | 32 | 86 | 14 | 51 | 0 | 0 | 51 |
| | 1994/95 | 541 | 28 | 92 | 8 | 30 | 0 | 0 | 30 |
| | 1995/96 | 527 | 23 | 88 | 12 | 44 | 0 | 0 | 44 |
| | 1996/97 | 500 | 26 | 88 | 12 | 43 | 0 | 0 | 43 |
| DRAWING PERMITS – COWS | | | | | | | | | |
| DM 306 | 1993/94 | 25 | 33 | 38 | 62 | 3 | 7 | 0 | 10 |
| | 1994/95 | 25 | 25 | 44 | 56 | 0 | 10 | 0 | 10 |
| DM 308 | 1993/94 | 25 | 24 | 57 | 43 | 0 | 8 | 0 | 8 |
| | 1994/95 | 25 | 17 | 50 | 50 | 0 | 10 | 0 | 10 |
| DM 310 | 1993/94 | 25 | 16 | 15 | 85 | 1 | 17 | 0 | 18 |
| | 1994/95 | 25 | 12 | 14 | 86 | 2 | 17 | 0 | 19 |

Table 6 Unit 13 moose harvest chronology percent by week for general harvest ticket hunt, 1992–96

| Year | Season dates | Week of Season 1st | 2nd | 3rd | 4th | 5th | *n* |
|---|---|---|---|---|---|---|---|
| 1992 | 1-14 Sept. | 6 | 28 | 66 | | | 535 |
| 1993 | 20 Aug.-20 Sept. | 21 | 11 | 22 | 26 | 20 | 1132 |
| 1994 | 20 Aug.-20 Sept. | 17 | 10 | 19 | 27 | 27 | 841 |
| 1995 | 20 Aug.-20 Sept. | 14 | 9 | 21 | 32 | 24 | 840 |
| 1996 | 20 Aug.-20 Sept. | 10 | 9 | 21 | 35 | 25 | 910 |

Table 7 Unit 13 moose harvest percent by transport method for general harvest ticket hunt, 1992–96

| Regulatory Year | Percent of Harvest: Airplane | Horse | Boat | 3-or 4-wheeler | Snowmachine | ORV | Highway Vehicle | Unknown | *n* |
|---|---|---|---|---|---|---|---|---|---|
| 1992/93 | 16 | 5 | 10 | 18 | 0 | 25 | 23 | 3 | 571 |
| 1993/94 | 16 | 3 | 6 | 30 | 0 | 29 | 14 | 2 | 1191 |
| 1994/95 | 15 | 3 | 8 | 36 | 0 | 21 | 16 | 1 | 886 |
| 1995/96 | 14 | 4 | 10 | 32 | 0 | 22 | 16 | 2 | 908 |
| 1996/97 | 12 | 3 | 7 | 36 | 0 | 23 | 17 | 1 | 951 |

## LOCATION

**GAME MANAGEMENT UNIT:** 14A (2,561 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Matanuska Valley

## BACKGROUND

Moose were scarce in the Matanuska Valley as "colonists" arrived and settled during the 1930s (M. Sherrod pers. commun.) but probably grew to numbers approaching 7000 during the 1960s (Griese 1995). Moose numbers peaked in the late 1960s but declined in the early 1970s, following 2 deep snow winters and large cow harvests. The population again peaked during the late 1980s and following the deep snow winter of 1989–90, stabilized between 5000 and 6000 (posthunt).

In the 37 years following statehood (1960–97), hunters reported a harvest of more than 22,010 moose in Unit 14A. Annual harvest levels in the first 12 years (1960–71) ranged from 200–1300. The harvest was predominantly bulls, averaging 350 annually, but harvest of antlerless moose reached high levels during 1962–63, 1965–66, and 1971–72. The antlerless moose harvest was highest, reaching 1131 in 1962–63. Antlerless moose seasons were eliminated during 1972–77, and the mean annual harvest of bulls declined to 251 (range = 167–346). Antlerless seasons were again allowed beginning in 1978. Since 1978 annual cow harvest has ranged from zero (1990) to 284. Annual harvest of bulls during 1979–1992 averaged 367 (range 201–530). Following enactment of antler restrictions, bull harvest declined to 233 during 1993 but increased during the next 3–4 years as bulls protected by antler restrictions matured and became legal. Thirty-four days were added to the season length. Hunters reported taking 554 bulls during 1996–97.

In 1993 bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as "spike-fork–50-inch" (SF50). Retaining this strategy for a full 5 years was recommended for full evaluation (Griese 1995).

Growth of the human population, associated soil and vegetation disturbance, and promoting dense stands of browse have attracted moose to roadways and subdivisions and increased conflicts between man and moose. During the early 1980s nonhunting mortality became responsible for up to 25% of total annual moose mortality. Motorists were killing 100–250 moose on roadways annually. Trains killed 4–45 moose annually (100 moose were killed by trains in 1989–90). Illegal harvest was assumed to have increased proportionally to the human population (Griese 1996). During the 1990s highway vehicles killed from 85 to 260 moose annually.

Habitat enhancement efforts were aided by a major wildfire. An arsonist created a 37,000 acre fire during June 1996 that produced beneficial habitat changes for moose in the Big Lake area. During 1993 a cooperative effort between state agencies resulted in a 900-acre controlled burn to enhance wintering moose habitat near Willow (Collins 1996).

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- To produce high yields of moose for humans and to provide maximum opportunity to participate in hunting for moose

- To provide opportunities for nonconsumptive uses.

### POPULATION OBJECTIVES

To maintain a posthunt population of 5000–5500 moose with a sex ratio of 20–25 bulls:100 cows.

### HUMAN USE OBJECTIVE

To achieve and maintain an average (3-year) annual hunter harvest of 600–700 moose.

## METHODS

During 10–17 November 1996, all 19 sample units (SU) in the Matanuska River drainage east of Moose Creek were surveyed at 4–6 min./mi$^2$, and 8 were subsampled at 10–12 min./mi$^2$ to obtain a sightability correction factor (SCF). An additional 14.4 hours of aerial sex and age composition data were collected from the remainder of the subunit on 2 December. The data from both surveys were combined after applying the SCF to the Matanuska River SU and after weighting observations from the remainder of the subunit by a factor of 2.7. The expansion factor was a product of previously observed moose distribution.

After a failed attempt at a Gasaway et al. (1986) stratified random survey (SRS), we attempted a Becker survey (E. Becker pers. commun.) during 6–12 December 1997. After sampling 13 SU the survey was discontinued because antler-drop appeared to be biasing composition data.

We aerially sampled a portion of the primary wintering habitat in the subunit during late March 1996 to assess percent short-yearlings in the population and potential recruitment. We conducted a similar aerial survey during 1997. Sudden, early melting snow during late winter 1998 prevented a similar survey.

We determined hunter effort and harvest composition from the general season and permit hunts by successful hunters' harvest and permit reports. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Department of Public Safety provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property (DLP). Age categories (calf, yearling, adult) and sex of moose from road and railroad mortalities were taken from reports by charities receiving the carcasses. We required the charities to surrender moose incisors.

To evaluate the appropriateness of SF50 antler restrictions, we collected moose incisors and antler characteristics (i.e., width, number of main palm points, and number of brow palm points) from successful any-bull permit holders and a small number of bulls harvested during the general season. We graphically compared antler width to both moose age and maximum number of brow tines on either side and fitted a 3rd or 4th order polynomial regression line provided by Microsoft® Excel software. We also graphically evaluated composition of legal/illegal antler configuration by age of moose.

In March 1996 and February 1997, we captured and radiotagged an additional 11 and 17 cow moose, respectively, in the lower Matanuska River adjacent to the Glenn Highway in the continuing effort to identify the seasonal distribution of these moose (Griese and Masteller, 1996). Using standard helicopter-assisted capture methods, we captured moose from Sutton to the Palmer Hay Flats State Game Refuge. From a fixed-wing aircraft we radiotracked and located tagged moose 20 times between July 1995 and May 1998, delineating distribution during mid-winter, calving, midsummer, hunting, rutting and post-rutting seasons. Location data were collected using global positioning system equipment. Wildlife Forever, a hunter sponsored organization, provided $4000 to begin this project, and Safari Club International provided an additional $2500. Data were evaluated using ARCVIEW® GIS software.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

We believe moose numbers in Unit 14A remained stable at high densities since the last statistical estimation during fall 1993 (Table 1). A minor and temporary decline probably occurred during the prolonged moderate snow winter of 1994/95 (Griese and Masteller 1996), as evidenced by a lower percentage of short-yearlings during April (Table 2). The high proportion of calves and bulls during fall 1996 indicated a recovery.

#### *Population Size*

An absence of snow during fall 1995 eliminated the opportunity to conduct sex and age composition surveys. Again in fall 1996 and 1997 infrequent snow events prevented completion of an intended Gasaway et. al (1986) SRS. However, simple population modeling indicated the population remained in the range of 5000 to 6000.

#### *Population Composition*

During fall 1996 we observed 23 bulls:100 cows which was within objective levels (20–25 bulls:100 cows) (Table 1). Reaching and maintaining objective levels was a product of the ongoing SF50. We believe composition data for fall 1997 are erroneous because of the lateness of the survey and because antler-drop had begun. An alternative hypothesis is that a large number of medium-size bulls were killed illegally, and calves suffered abnormally high summer mortality for Unit 14A. Previously, we noted a declining trend in the proportion of calves during 1991–1994 (Griese and Masteller 1996).

#### *Distribution and Movements*

Relocation data from the 59 radiotagged cow moose will be formally analyzed during 1998. The final report will be submitted as an appendix to the next Unit 14A management report.

In the preliminary findings we confirmed that snow depth predicted extent of winter movement. Other than in winter, individual cows were consistent in their seasonal distribution. Cows captured on winter range east of Moose Creek exhibited short-range elevational movements, while cows west of Moose Creek were more likely to calve, summer, and breed in western Units 14A and 14B and (in 2 instances) just west of the Susitna River in 16 B.

## MORTALITY

### *Harvest*

Season and Bag Limit. During 1995–1997 the open season for resident and nonresident hunters included an archery-only season during 10–17 August, a general season from 20 August–20 September, any-bull and antlerless drawing permit hunts during 20 August–20 September and 1–15 November, and a general 'spike-fork-only' season during 20 November–15 December. During the archery-only and early fall general season, the bag limit was 1 bull with antlers having either a spike (1 point) or fork (2 points) on at least 1 side, or having a minimum of 3 brow tines on at least 1 side, or having a total antler width of 50 inches or greater. The Department offered 200–500 permits for antlerless moose, 50–100 any-bull permits for the 20 August–20 September period, 70 antlerless permits, and 20–30 any-bull permits for the 1–15 November hunt (Table 5).

Board of Game Actions and Emergency Orders. Following the adoption of the SF50, we expected slow recovery of the bull:cow ratio. However, we observed 21 bulls:100 cows after only 2 years. Concerned that the restriction would unnecessarily eliminate future harvest opportunities, we proposed the board adopt additional hunting opportunities. The board, during their 1995 March meeting, consequently added 34 days to the hunting season, including an 8-day (10–17 August) archery-only season and a 26-day spike-fork, bull-only season beginning 20 November. The board also provided the department the option to issue up to 300 any-bull permits, to be divided between the early season, 20 August–20 September, and a late season, 1–15 November.

Hunter Harvest. The additional hunting opportunities in Unit 14A precipitated the highest annual moose harvest since 1971 (1018 moose including 479 cows) and the highest bull harvest since 1965 (658). In spite of antler restrictions, during 1996, the fourth year of the SF50, hunters reported taking 554 bulls (Table 3). When added to the highest cow harvest, 284, since 1971, the total reported hunter harvest reached 846. The following year harvest declined to 741 moose.

During the 4$^{th}$ and 5$^{th}$ year of the SF50 management strategy, composition of bulls in the general harvest was heavily weighted toward yearlings. Antler sizes reported by hunters for 1996 and 1997, combined, indicated bulls with less than a 30-inch antler spread composed 79% of the reported harvest (for which measurements were provided). Another 10% of the measured antlers were in the 35–49.9 inches category; most are assumed to have 3 or more brow tines on at least 1 side. Those antlers reaching or exceeding 50 inches in width were reported to be 11%. Twelve percent of the total reported harvest was without measurements.

The continued strong showing of yearling bulls in the harvest reflects the substantial increase in opportunity to take bulls during the November–December spike-fork-only season. This late hunt, which became popular during 1996 when snow conditions allowed hunters wide access to the subunit, allowed the annual harvest of spike-fork bulls to increase 150%. Without this additional yearling bull harvest, composition of the bull harvest might well have been 60% spike-forks, 20% 3-brow tines <50-inches, 20% 50-inch antlers.

Accidental human-caused moose mortality during the 5-year period 1993–1997 averaged 195 moose (Table 3). Approximately 10% were reported killed in the unit by the Alaska Railroad Corporation, while highway vehicles killed the remainder.

Adding to recent accidental mortality was a higher than normal "illegal harvest." The number of illegal moose, primarily bulls, has increased in units where the SF50 regulation has been in effect (Schwartz et al. 1992). Enforcement officers (C. Yoder, pers. commun.) indicated higher illegal bull harvests, especially with the additional spike-fork-only season; consequently, we increased our estimate of illegal harvest (Table 3).

Permit Hunts. The department issued a record number of drawing permits for moose in Unit 14A during 1996–97, resulting in a near record number of cow moose being harvested. We issued 570 permits for antlerless moose and 130 any-bull permits for the early-fall and late-fall hunt periods (Table 4). Permittees hunting during the late season experienced an extremely high success rate of 97% because snow conditions moved moose to low elevations, concentrating them in areas with easy access to hunters. Seventy antlerless moose permits and 30 any-bull permits produced a harvest of 26 bulls cows and 58 bulls. Early fall antlerless moose permittees experienced 52% success, the highest recorded in this hunt. High success by permittees is probably the result of a modification in hunter strategies. Lower success by bull hunters, a pattern begun with the enactment of the SF50 restriction, makes cow permits more attractive as evidenced by the lower nonparticipation rate (Table 4).

We issued only 270 antlerless moose permits for fall 1995 in reaction to the effects of the preceding severe winter when a record number of moose were killed on roads in the unit and overwinter calf survival was below average (Table 2). That year we also began issuing any-bull permits to take advantage of the rapidly recovering bull population. During 1997 we again issued in excess of 500 antlerless moose permits. Even though lower success by hunters kept the cow harvest to 250, it was second highest cow harvest since 1971.

Antler–age comparison. A sample of 322 sets of antlers and incisors of moose from any-bull permit hunts in Units 14A, 14B, and 16A confirmed previous assumptions about antler configuration and bull age (Griese and Masteller 1996). A comparison of antler width to age indicated the average bull's antler width reaches 50 inches at age 5 (Figure 1). Minimal overlap in antler width existed between spike–fork and 3-brow-tine antlers. These findings support dividing hunter reported antler width, when only width information is provided, at 34.99 inches to separate spike–fork and 3-or-more-brow-tine antlers. Interestingly, the least combined overlap of antler width between age classes 1 and 2 was at 32 inches. We concluded that 45–50% of yearling males had a spike-fork antler configuration and that 5–15% of a bull cohort in the Susitna–Matanuska moose population may never meet 50-inch or 3-brow-tine qualifications. Although Figure 2 depicts only 44% spike-forks at age 1 and as much as 19% non-50-inch antlers for mature bulls (age7+), we assumed that sampling biases probably existed and became more pronounced toward the end of the early fall general season, when fewer legal SF50 bulls remained to be sampled. We expected even fewer legal bulls to be available, especially during the late fall permit season. Fifty-nine percent of the sample came from the November permit hunt period.

We added 30 antler configuration data points (ages were not available), for a total N = 352 and compared maximum number of brow tines on either side to antler width. That comparison indicated that the 3-brow-tine alternative definition for "50-inches" is appropriate (Figure 3).

Hunter Residency and Success. Adding the late-fall spike-fork-only hunting opportunity greatly increased hunter participation in the subunit but did little to improve overall hunter success. The number of hunters participating in the early and late general seasons reached levels not seen since winter hunts held during the 1960s and 1970s. Almost 4000 hunters reported hunting in the subunit during 1996 (Table 5). Hunter success increased to 12% for 1996 and 1997, and residency distribution changed little from previous years. Adding the late-fall spike-fork-only hunt did confuse further comparison of early fall hunter effort because hunters are not required to indicate dates of unsuccessful hunting effort.

Harvest Chronology. Substantial modifications to the general season including the addition of the early archery-only and late-fall spike-fork-only hunts dispersed the chronology of harvest. Although harvest during the early August archery-only season remained less than 10, the November–December spike-fork-only season accounted for 75–200 bulls harvested (Table 6). These additional close-to-home opportunities perhaps reduced the "necessity" to hunt hard during September when insects and heat can detract from hunting. It may also be allowing hunters to hunt in other units and/or for other species during September and August. Reported harvest during the traditional 1–20 September period accounted for an average of 139 moose during 1995—1997. Prior to SF50, hunters were killing 300–500 bulls in that 3-week period.

Transport Methods. The most notable change to hunter transport methods was the addition of snowmachine use as snow conditions allowed. Lack of snow during the first year of the late-fall spike-fork-only season, 1995, forced hunters to remain with highway and 3- and 4-wheeler transportation (Table 7). But ample snow during the succeeding winters of 1996 and 1997 greatly increased their use among successful hunters. The portion of successful hunters using boats declined because of freezing waterways.

*Natural Mortality*

Adult cow moose mortality had previously been assumed to be 6–9% for the subunit in average winter years (Griese and Masteller 1996). Modafferi and Becker (1997) calculated an annual, adult cow mortality from radiotagged moose in a study area overlapping Unit 14A. They presented an annual mortality of 8% (10% including hunting) for mild-moderate winters and as high as 30–35% in years with deep-snow winters. However, a high adult mortality of cows radio-tagged in association with the Glenn Highway and Palmer Hay Flats State Game Refuge indicated portions of the moose subpopulation are subject to greater mortality levels even during mild winters. Preliminary calculations suggested an annual adult cow mortality of 19% when including hunting mortality. When excluding legal hunting kills, the annual mortality reached 15%. This segment of the subpopulation is subject to high levels of human interaction, winter antlerless-moose hunting, potentially numerous busy highway crossings, and even winter wolf predation. The higher mortality rate should have been expected. Previous observed mortality rates were calculated from moose whose movement routes crossed fewer major highways and wintered farther from high human use areas (Modafferi and Becker 1997).

During winter 1994–95 calf mortality through April reached an estimated 40–50% because of the prolonged moderately deep-snow conditions. Winter calf mortality in subsequent winters was low.

### HABITAT

*Enhancement*

While department activities to enhance moose habitat were minimal, an arson-caused wildfire burned approximately 37,000 acres in the subunit near Big Lake in early June 1996. The beneficial effect of this major vegetation change should be realized by the year 2005. The location of the fire, while not ideal, could potentially reduce the number of moose moving east into the Palmer–Wasilla developed area.

## CONCLUSIONS AND RECOMMENDATIONS

The population size objective may have been met during 1997; however, lack of a complete population estimating survey prevented confirmation.

Bull:cow ratios were maintained within objective levels as the result of the SF50. While inadequate survey data collected during fall 1997 indicated bull:cow ratios fell below objectives, we speculate that early antler drop negatively biased the December data.

The human-use objective (a 3-year-average of 600–700 moose harvested by hunters) was attained during fall 1996 when hunters harvested 616 moose. After the fall harvest of 1997, the 3-year-average reached 686 moose. Addition of the new spike-fork-only hunting season and increased cow harvest through permit hunts were primarily responsible for meeting objectives.

The effects of the SF50 have been generally positive for the moose population and for hunters; therefore, we recommend continuation of this program in Subunit 14A. After 5 years, SF50 and the numerous new hunting opportunities have provided numerous benefits: 1) a greater variety of hunting opportunity; 2) an increase in bull:cow ratios to within 20–25:100; 3) greater annual hunter participation (to exceed 4000, including permit hunters); 4) season dates that are effectively weather-proofed; 5) an increased number of bulls for viewing during the summer and early winter, and 6) an increase in hunters' awareness of their target, increasing hunter safety.

However, SF50 also caused individual hunter success to decrease to 9–12%, reduced hunter comfort with identifying a legal animal, increased the number of illegal moose reported during the hunting season, and, because of the new late-fall hunting seasons, prolonged moose harassment by aggressive hunters on snowmachines. Antler-age data indicated the current legal bag limit restrictions were appropriate for this moose population. The intent of the SF50 was to allow a 50% harvest of yearling bulls (the smaller yearlings), protect bulls during ages 2 through 4, and allow most bulls to become legal at age 5. These objectives were achieved.

Modification to future hunting regulations should address the prolonged period when hunters on snowmachines intentionally or unintentionally harass moose during the 20 November–15 December spike-fork-only season. At that time of year, bulls are intent on recovering body weight lost during the rut and continual inspection of nonlegal moose by hunters may force moose from preferred feeding areas, especially those in the subalpine zone. The current 26-day season should be reduced to 10–15 days, but it should include the Thanksgiving weekend.

In the face of the Board of Game's judgement of the effectiveness of the SF50, it is imperative that we collect statistically verified population parameters during fall 1998. Every effort should be made to complete a Gasaway et. al (1986) stratified random survey. Such a survey is overdue in Unit 14A.

The population identity study initiated during 1994 has provided useful management information. We have learned that adult cow mortality in this area of the subunit may be higher than that previously observed. We have also learned of different movement patterns by moose in the Matanuska River drainage and the Lower Susitna River valley moose. There would be substantial benefits to maintaining radio tags on a sample of moose, especially those in the Palmer–Sutton subpopulation. The movements of these moose have not been evaluated during a significant, deep-snow winter.

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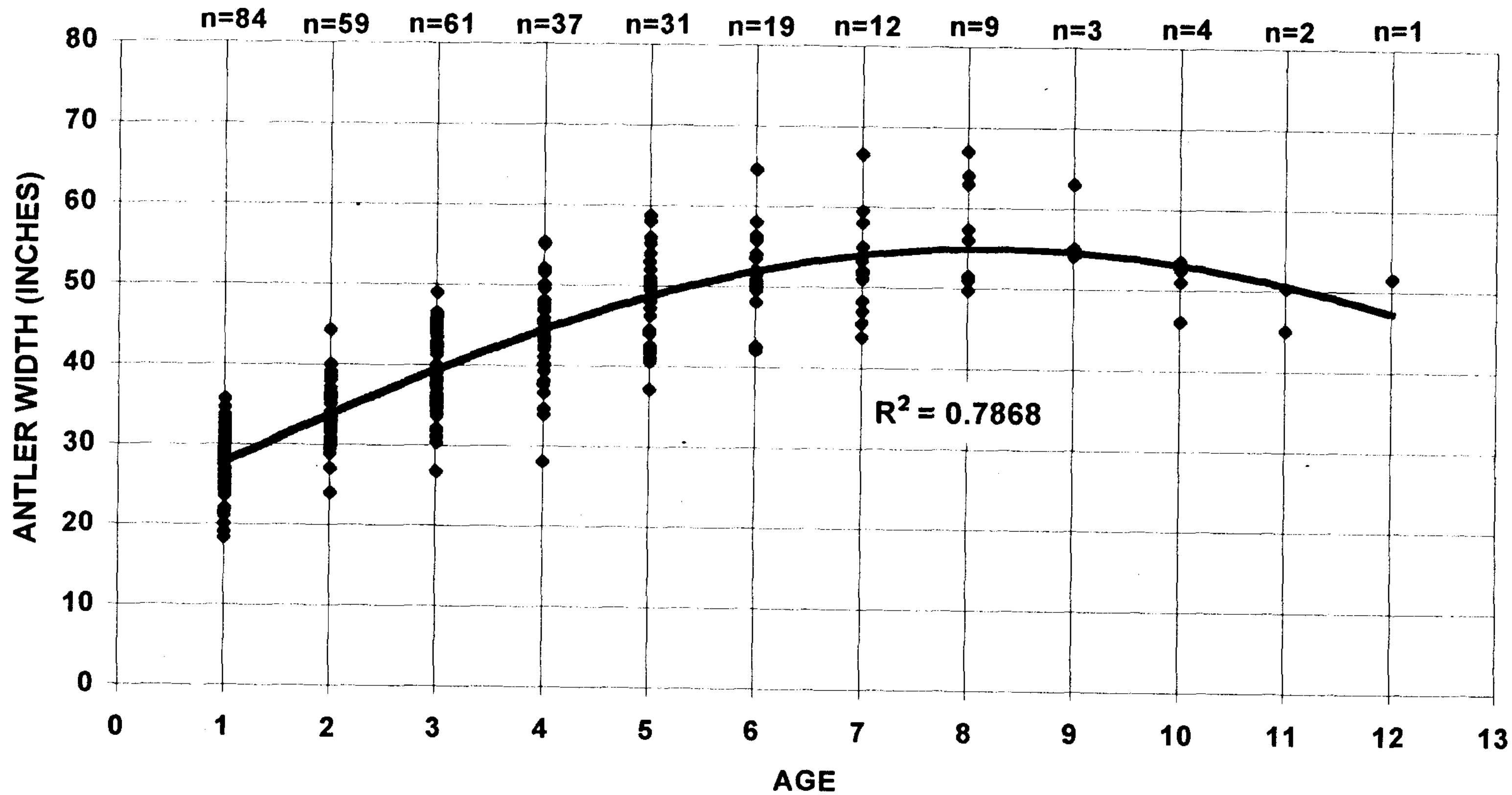


Figure 1. The relationship of age versus antler width for bull moose (N=322) harvested during early and late fall any-bull permit hunts in Game Management Subunits 14A, 14B and 16A, 1993–1997.

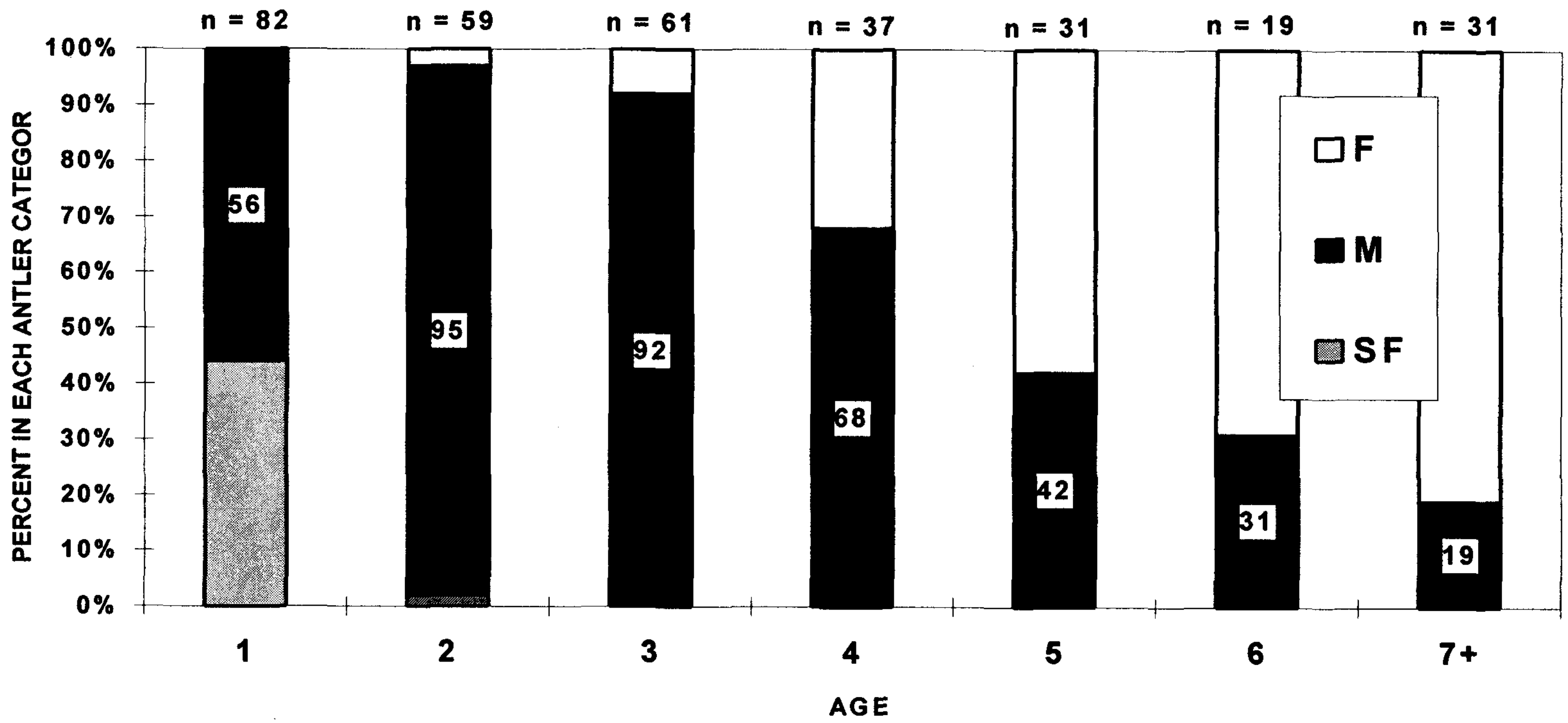


Figure 2. The relationship of age versus "spike-fork-50 inch" (SF50) antler configuration category for bulls (N=320) harvested during early and late fall any-bull permit hunts in Game Management Units 14A, 14B and 16A, 1993–1997. **F** is a "50-inch or 3-brow-tine" antlered bull; **M** is a medium size antlered bull, not legal under SF50 restrictions; and **SF** is a "spike-fork" antlered bull.

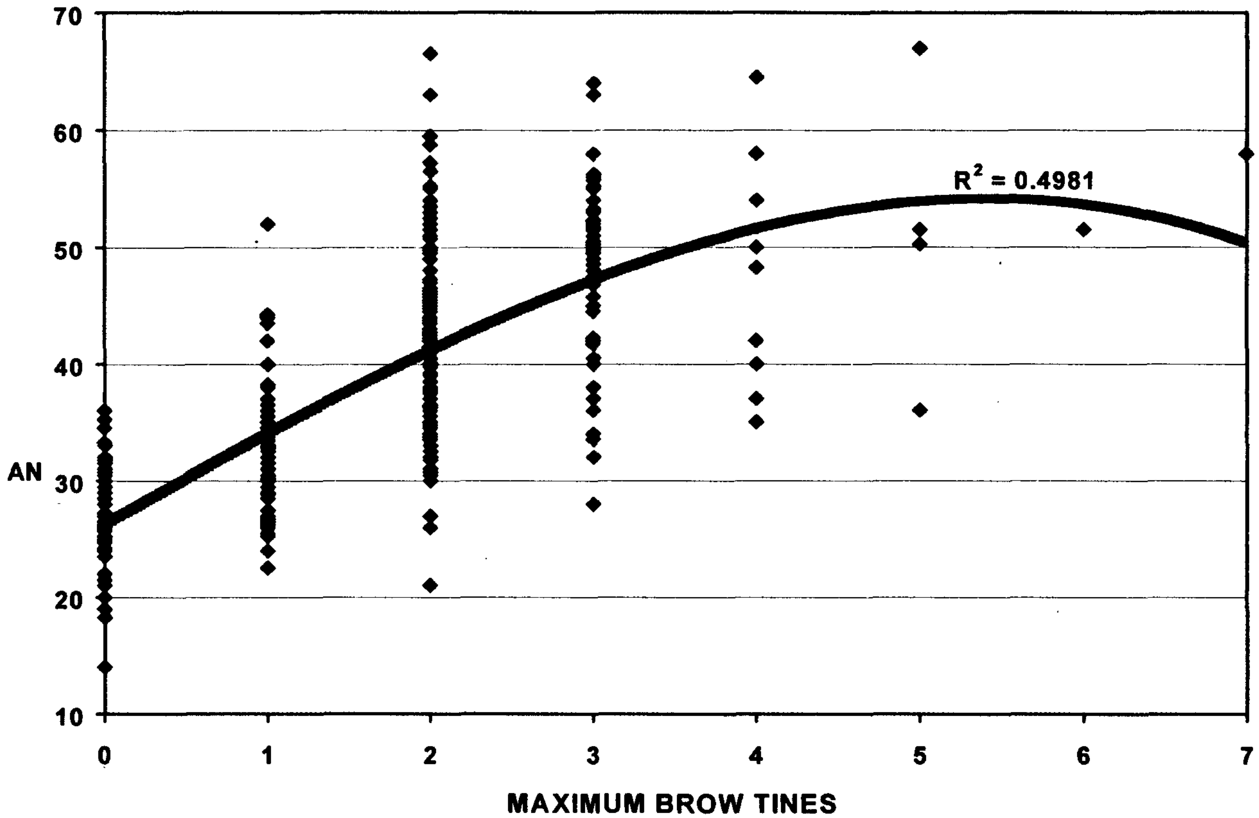


Figure 3. The relationship of antler width to maximum number of brow tines from either side of antlers for bulls (N=352) harvested during early and late fall any-bull permit hunts in Game Management Units 14A, 14B and 16A, 1993–1997.

Table 1 Unit 14A fall aerial moose composition surveys and censuses, 1991–97

| Regulatory year | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves(%) | Adults observed | Total moose observed | Moose /mi.$^2$ | Estimated population size |
|---|---|---|---|---|---|---|---|---|
| 1991/92 [a] | 14 | 5 | 39 | 26 | 1,110 | 1,472 | 3.7 | 5,885±706[b] |
| 1992/93[c] | 9 | 6 | 40 | 27 | 697 | 934 | n/a | 5,200-6,200 |
| 1993/94[d] | 16 | 11 | 37 | 24 | 942 | 1,232 | 3.6 | 5,672±798[b] |
| 1994/95[c] | 21 | 8 | 35 | 22 | 1,098 | 1,398 | n/a | 5,500-6,500 |
| 1995/96[e] | -- | -- | -- | -- | -- | -- | -- | 5,000-5,500 |
| 1996/97[f] | 23 | 6 | 42 | 25 | 1,696 | 2,290 | n/a | 5,500-6,500 |
| 1997/98[g] | 14 | 5 | 30 | 21 | 611 | 774 | n/a | 5,000-6,000 |

[a] Gasaway, et al (1986) census.

[b] 80% confidence intervals.

[c] A sampling of 1991 surveyed units (Griese and Masteller,1996).

[d] Becker survey.

[e] No surveys flown.

[f] Combined results of "census" of Matanuska River drainage east of Moose Creek and composition surveys in CAs 1-7 &Pt. MacKenzie

[g] Incomplete Becker survey, cut short due to apparent antler drop.

Table 2 Unit 14A late winter aerial moose composition surveys, 1990–97

| Regulatory year | Date | Count areas | Total moose | Calves[a] | Percent calves |
|---|---|---|---|---|---|
| 1990/91 | 03/04-11 | 5,6&8 | 1,348 | 167 | 12 |
| 1991/92 | 02/25 | 7 | 121 | 26 | 21 |
| | 04/10 | 3,4,5,6 & 8 | 546 | 76 | 14 |
| 1992/93 | 03/24 | 4,5,6,7 & 8 | 693 | 131 | 19 |
| 1993/94 | 03/05-09 | 4,5,6,7 & 8 | 981 | 175 | 18 |
| 1994/95 | 04/03-04 | 4,5,6,7, 8 & Pt. McKenzie | 518 | 75 | 14 |
| 1995/96 | 03/28 | 6 & Pt. McKenzie | 471 | 85 | 18 |
| 1996/97 | 04/08-09 | 5,6,8 & Pt. MacKenzie | 226 | 53 | 23 |
| 1997/98 | no count | | | | |

[a] Calves = short yearlings

Table 3 Unit 14A moose harvest[a] and accidental death, 1990–94

| Regulatory year | Reported | | | Estimated | | | Accidental deaths[e] | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | Total[b] | Unreported[c] | Illegal[d] | Total | Road | Train | Total | |
| 1991/92 | 490 | 39 | 534 | 25 | 25 | 50 | 166 | 15 | 181 | 765 |
| 1992/93 | 530 | 157 | 694 | 27 | 30 | 57 | 132 | 7 | 139 | 890 |
| 1993/94 | 233 | 204 | 438 | 12 | 40 | 52 | 166 | 18 | 193 | 683 |
| 1994/95 | 281 | 242 | 532 | 14 | 60 | 74 | 260 | 40 | 300 | 906 |
| 1995/96 | 335 | 128 | 471 | 16 | 65 | 81 | 85 | 11 | 96 | 648 |
| 1996/97 | 554 | 284 | 846 | 26 | 65 | 91 | 185 | 17 | 202 | 1,139 |
| 1997/98 | 488 | 249 | 741 | 23 | 60 | 83 | 168 | 16 | 184 | 1,008 |

[a] Includes permit hunt harvest.

[b] Total includes moose of unknown sex.

[c] This estimate was derived by taking a minimum of 5% of the reported kill under harvest tickets.

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

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

Table 4 Moose harvest data by permit hunts in Unit 14A, 1992–97

| Hunt(s) | Regulatory year | Applicants | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls | Cows | Total |
|---|---|---|---|---|---|---|---|---|---|
| 411 (Any bull – early fall) | | | | | | | | | |
| | 1995/96 | 1,521 | 70 | 16 | 54 | 29 | 20 | 0 | 20 |
| | 1996/97 | 1,978 | 100 | 10 | 53 | 37 | 37 | 0 | 37 |
| | 1997/98 | 1,414 | 50 | 6 | 70 | 24 | 12 | 0 | 12 |
| 412 (Any bull – late fall) | | | | | | | | | |
| | 1995/96 | 1,078 | 20 | 5 | 35 | 60 | 12 | 0 | 12 |
| | 1996/97 | 1,235 | 30 | 4 | 11 | 86 | 24 | 0 | 24 |
| | 1997/98 | 1,162 | 20 | 20 | 25 | 55 | 11 | 0 | 11 |
| 418 (Antlerless - late fall) | | | | | | | | | |
| | 1993/94 | 3,760 | 70 | 13 | 40 | 47 | 3 | 30 | 33 |
| | 1994/95 | 5,464 | 100 | 10 | 13 | 77 | 5 | 71 | 76 |
| | 1995/96 | 4,781 | 70 | 14 | 31 | 54 | 2 | 36 | 38 |
| | 1996/97 | 3,866 | 70 | 14 | 0 | 86 | 2 | 58 | 60 |
| | 1997/98 | 3,252 | 70 | 4 | 20 | 76 | 0 | 53 | 53 |
| 419 & 420 (Antlerless - early fall) | | | | | | | | | |
| | 1992/93 | 11,000 | 400 | 12 | 49 | 39 | 3 | 154 | 157 |
| | 1993/94 | 10,390 | 400 | 10 | 44 | 46 | 4 | 174 | 179 |
| | 1994/95 | 11,185 | 400 | 10 | 46 | 44 | 4 | 169 | 174 |
| | 1995/96 | 10,075 | 200 | 7 | 48 | 46 | 1 | 90 | 91 |
| | 1996/97 | 10,447 | 500 | 8 | 44 | 48 | 3 | 225 | 231 |
| | 1997/98 | 8,675 | 450 | 8 | 48 | 44 | 1 | 195 | 197 |

Table 5 Unit 14A moose hunter[a] residency and success, 1990–97

| | Successful | | | | | Unsuccessful | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Local[b] resident | Nonlocal resident | Nonres. | Unk. | Total (%) | Local[b] resident | Nonlocal resident | Nonres. | Unk. | Total (%) | Total hunters |
| 1990/91 | 242 | 3 | 8 | 6 | 259 (14) | 1,466 | 22 | 14 | 26 | 1,528 (86) | 1,787 |
| 1991/92 | 469 | 11 | 9 | 6 | 495 (17) | 2,286 | 39 | 12 | 23 | 2,360 (83) | 2,855 |
| 1992/93 | 500 | 12 | 12 | 15 | 539 (16) | 2,629 | 50 | 24 | 102 | 2,805 (84) | 3,344 |
| 1993/94 | 215 | 4 | 1 | 6 | 226 (9) | 2,291 | 59 | 11 | 68 | 2,429 (91) | 2,655 |
| 1994/95 | 274 | 6 | 1 | 1 | 282 (11) | 2,208 | 46 | 4 | 18 | 2,286 (89) | 2,568 |
| 1995/96 | 294 | 11 | 2 | 3 | 310 (9) | 2,997 | 84 | 22 | 17 | 3,120 (91) | 3,430 |
| 1996/97 | 471 | 11 | 11 | 1 | 494 (12) | 3,324 | 79 | 40 | 21 | 3,464 (88) | 3,958 |
| 1997/98 | 435 | 21 | 5 | 7 | 468 (12) | 3,161 | 68 | 43 | 18 | 3,299 (88) | 3,758 |

[a] Does not include hunters participating in drawing permit hunts.
[b] Unit 14 residents.

Table 6 Unit 14A moose harvest chronology[a], 1992–97

| Regulatory | August | | | September | | | November | December | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| year | 10-17 | 20-26 | 27-31 | 1-7 | 8-14 | 15-20 | 20-30 | 1-7 | 8-15 | Unknown | Total |
| 1992/93[b] | -- | -- | -- | 260 | 120 | 144 | -- | -- | -- | 15 | 539 |
| 1993/94[c] | -- | 76 | 17 | 24 | 37 | 68 | -- | -- | -- | 6 | 227 |
| 1994/95[c] | -- | 63 | 31 | 50 | 44 | 87 | -- | -- | -- | 16 | 279 |
| 1995/96[d] | 3 | 69 | 20 | 47 | 31 | 45 | 41 | 8 | 36 | 20 | 310 |
| 1996/97[d] | 8 | 88 | 20 | 43 | 50 | 66 | 133 | 30 | 39 | 17 | 494 |
| 1997/98[d] | 3 | 85 | 22 | 35 | 41 | 61 | 110 | 41 | 51 | 19 | 468 |

[a] Does not include harvest from drawing permit hunts.
[b] Open season = Sep 1–20.
[c] Open season = Aug 20–Sep 20 (SF/50 –"spike-fork/50-inch").
[d] Open season = Aug 10–17 (Archery only), Aug 20–Sep 20 (Gen.SF/50), Nov 20–Dec 15 (SF).

Table 7 Unit 14A percent transport methods[a] of successful moose hunters, 1992–97

| Regulatory year | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unk. | Sample size |
|---|---|---|---|---|---|---|---|---|---|
| 1992/93 | 4 | 5 | 13 | 22 | 0 | 7 | 42 | 5 | 539 |
| 1993/94 | 4 | 5 | 12 | 23 | 0 | 7 | 43 | 6 | 228 |
| 1994/95 | 4 | 3 | 13 | 26 | 0 | 7 | 40 | 7 | 292 |
| 1995/96 | 2 | 3 | 10 | 29 | 1 | 2 | 41 | 7 | 310 |
| 1996/97 | 2 | 3 | 7 | 21 | 16 | 7 | 40 | 4 | 494 |
| 1997/98 | 3 | 3 | 6 | 29 | 18 | 4 | 34 | 3 | 468 |

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

## LOCATION

**GAME MANAGEMENT UNIT:** 14B (2,152 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Western Talkeetna Mountains

## BACKGROUND

Masteller (1995) described a Unit 14B moose population that recently peaked in number during the mid-1980s, reaching 2566–3062 animals in fall 1987. Following the deep-snow winter of 1989–90, the population declined 35% to 1548–2042 moose during fall 1990. The number of moose was even lower during fall 1992, with a range of 1404–1760. He described population composition after 1989 that averaged 26 bulls:100 cows and 23 calves:100 cows. During fall 1994, the number of moose increased to 1809-2864 with 31 bulls:100 cows (Griese 1996).

Masteller (1995) identified an annual accidental mortality that exceeded hunter harvest. Because wintering areas are associated with the main transportation route between Fairbanks and Anchorage, accidental mortality (which includes moose from Units 16A, 13E and 14A (Modafferi 1992)) often exceeded Unit 14B hunter harvest. He indicated that during 1989/90 411 moose died in auto–train collisions and previous peaks in accidental mortality occurred during 1970/71, 1978/79, 1982/83, 1984/85 and 1987/88. Griese (1996) reported an accidental kill of at least 90 moose during the winter 1994/95, the highest recorded since 1989/90.

While hunter harvest of moose in Unit 14B has always been affected by poor hunter access, weather related population changes and season and bag limit restrictions have caused the large changes in harvest. From 1966 to 1970 hunters killed an average of 144 moose annually, predominantly bulls. Liberal cow seasons allowed peak harvests to reach 372, 534, and 347 moose during 1971, 1984 and 1987, respectively (Griese 1993). There have been no cow seasons since 1987. Harvest during the 10–day season of fall 1992 was 34 bulls. Antler restrictions, enacted fall 1993, continued the lower harvest. Harvests averaged 34 moose during 1993–1994 (Griese 1996).

To meet population objectives, Masteller (1995) recommended a public opinion survey to help develop management direction. He also suggested a controlled use area be established in the Willow Mountain Critical Habitat Area (WMCHA) that restricted ORV use to provide diversity in hunting opportunity. However, he identified postseason snowmachine use as the potential for biological impacts within the WMCHA.

## MANAGEMENT DIRECTION

### MANAGEMENT GOAL

- Produce high yields of moose for humans
- Provide maximum opportunity to hunt moose

### MANAGEMENT OBJECTIVE

- Manage 2500–2800 moose, with a sex ratio of no less than 20 bulls:100 cows during the rut
- Achieve and maintain an average annual harvest of 200–300 moose by 1997

## METHODS

Because of the lack of timely survey conditions and higher survey priorities within Units 14 and 16, composition surveys were not conducted in Unit 14B. Since 1994 we have planned to conduct a Gasaway et al (1986) survey.

We monitored harvest with harvest reports and permit reports from persons who reported hunting in the unit. Permittees who had taken bulls were required to provide antlers for measurement and lower front teeth for age determination. The ARC provided numbers of moose killed by trains, and the Department of Public Safety provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property (DLP).

Antler–age data collected from any-bull permit hunts were evaluated and presented in the Unit 14A management report.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

Since 1994 we have not measured population status. We believe, however, moose numbers probably declined as much as 15% as a result of the long deep-snow winter of 1994–95. Mild winters since have allowed a recovery to levels approaching 2500 moose.

#### *Population Size*

During October–November 1994, under ideal counting conditions, the moose population in Unit 14B was estimated at 2337 +/- 527 (80% CI) moose (Table 1). We have been unable to measure population size since this estimate.

### POPULATION COMPOSITION

The last measure of the bull:cow ratio was in fall 1994, when it was 31 bulls:100 cows (Table 1). At that same time calves were 12% of the population.

### MORTALITY

#### *Harvest*

Season and Bag Limit. During falls 1993–1994 the open season in Unit 14B for resident and nonresident hunters was 20 August–20 September. The bag limit wasl bull with a spike or fork antler on at least 1 side or with an antler spread that measured at least 50 inches or with antlers that had 3 or more brow tines on at least 1 side.

During falls 1995–1997 the general open season was 10–17 August (for archery-only hunters), 20 August–20 September and 20 November–15 December for all resident and nonresident hunters. During the 2 early seasons, the bag limit was 1 bull with a spike or fork antler on at least 1 side or with an antler spread that measured at least 50 inches or with antlers that had 3 or more brow tines on at least 1 side. The late season bag limit was 1 bull with spike or fork antlers only. Drawing permits to take any bull were issued for the 20 August–20 September and 1–15

November periods. We issued 100 any-bull permits for the early hunt and 30 any-bull permits for the November hunt.

Board of Game Actions and Emergency Orders. The board adopted the SF50 selective harvest strategy beginning in fall 1993. They extended hunting opportunities in fall 1995–96 in response to the population safeguards offered by SF50 antler restrictions. In addition to the existing 20 August–20 September SF50 season, the board added a 10–17 August SF50-bull hunt for archery hunters only. Bowhunters were required to attend the state sanctioned bowhunter education course. In addition, the board allowed permits to be issued to take any bull during the periods of 20 August–20 September and 1–15 November. Finally, the board added a spike or fork bull-only season for 20 November–15 December. These hunts provided 81 days of hunting opportunity in the unit.

Hunter Harvest. The extended hunting opportunities allowed a substantial increase in reported harvest that reached 90 bulls during 1996/97 (Table 2). A third of the annual reported harvest during the period came from the any-bull permit hunters (Table 3).

Hunter Residency and Success. The number of hunters seeking moose in Unit 14B peaked at 555 during 1996/97 and 95% were residents of Unit 14 (Table 4). This level of interest is far below the 1039 hunters reporting for 1988/89 (Masteller 1995). Unit residents were responsible for 89% of the reported harvest during 1995–1997, while nonresidents took 7%.

Combined hunter success was 10% during 1995–1997. This compares to a combined hunter success of 13% during 1991–1993 and 16% reported for 1988—1989 (Masteller 1995). The difference is a product of the SF50 antler restrictions and subpopulation size.

Harvest Chronology. During 1995–1997 Unit 14B hunters reported taking an average of 1.9 moose/day during 15–20 September, their most productive period. The extended hunter opportunities accounted for an additional 44 moose harvested during 1995–1997, 29% of the total harvest (Table 4). Bowhunters apparently harvested an average of 1 bull/year.

Transport Methods. New opportunities to access Unit 14B when snow was on the ground produced a large proportion of hunters using snow machines (Table 6). Too little snow during the hunt period led to a low percentage (9) of successful hunters using snowmachines during 1995–96.

*Other Mortality*

Snow depth throughout the winter of 1995–96 remained low. Consequently, accidental mortality was below 30 moose (Table 2). Likewise, equally mild winters during 1996/97 and 1997/98 resulted in few moose deaths on highways and railroad tracks. During 1994/95 deep snow caused the deaths of 90 moose, which contrasts sharply to the 411 moose deaths reported during winter of 1989/90 (Griese 1993).

### HABITAT

*Enhancement*

Although we had no enhancement projects, sites in Unit 14B are possibilities for future controlled burns.

## CONCLUSIONS AND RECOMMENDATIONS

While we are hopeful that the number of moose in Unit 14B is approaching population objectives, human-use objectives were clearly not met. Determining whether the population objectives have been met would require a Gasaway et al (1986) survey. Human-use objectives, set during 1992, did not account for enactment of the SF50 regulation.

Hunter harvest under the SF50 regulation, even when adding any-bull permits and 34 additional hunting days to the general season, is unlikely to produce more than 100 moose in the harvest. Reaching 200 bulls in the harvest would require relaxation of antler restrictions or a substantial increase in access opportunities. The nature of vegetation and terrain eliminate many access opportunities.

The SF50 regulation was adopted for Unit 14B because it shared common boundaries with Units 13A and 14A, where hunting pressure and access had allowed overharvest of bulls. Concern for enforcement of the antler restriction along the boundary and the concern for false reporting were principal reasons for its inclusion in the program. However, preexisting healthy bull:cow ratios due to previous low hunter success, a function of hunters' limited access, indicated Unit 14B would be a poor candidate for this harvest strategy. Ongoing evaluation (begun in 1993) of the SF50 after 5 years of application will probably confirm the biological inappropriateness of the restrictions.

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Table 1 Unit 14B fall aerial moose composition surveys, 1992–1997

| Regulatory year | Yearling Bulls: 100 cows | bulls: 100 cows | Calves: 100 cows | Calves (%) | Adults observed | moose observed | Observable moose/mi$^2$ | Population estimate |
|---|---|---|---|---|---|---|---|---|
| 1992/93[a] | 27.2 | 4.4 | 21.7 | 14.5 | 580 | 659 | 1.1 | 1,582 ± 178[b] |
| 1993/94[c] | -- | -- | -- | -- | -- | -- | -- | -- |
| 1994/95[d] | 31.1 | 8.2 | 17.3 | 12.0 | 862 | 969 | 2.2 | 2,336 ± 527[b] |
| 1995/96[c] | -- | -- | -- | -- | -- | -- | -- | -- |
| 1996/97[c] | -- | -- | -- | -- | -- | -- | -- | -- |
| 1997/98[c] | -- | -- | -- | -- | -- | -- | -- | -- |

[a] These data derived from "Becker Surveys" conducted in November. SCF estimated at 1.40, 1.35 and 1.25 for low, medium- and high-density strata, respectively.

[b] 80% CI

[c] No surveys conducted.

[d] These data derived from "Becker Surveys" conducted in late October/early November. SCF estimated at 1.00, 1.41 and 1.00 for low, medium and high density strata, respectively.

Table 2 Subunit 14B annual moose harvest and accidental death, 1992–97

| Regulatory | Reported | | | Estimated | | | Accidental[d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| year | M | F | Total[a] | Unreported[b] | Illegal[c] | Total | Road | Train | Total | Total |
| 1992/93 | 34 | 0 | 34 | 2 | 5 | 7 | 10 | 24 | 34 | 75 |
| 1993/94 | 30 | 0 | 31 | 3 | 15 | 18 | 15 | 13 | 24 | 73 |
| 1994/95 | 36 | 0 | 36 | 4 | 15 | 19 | 34 | 56 | 90 | 145 |
| 1995/96 | 55 | 0 | 55 | 5 | 20 | 25 | 6 | 21 | 27 | 107 |
| 1996/97 | 90 | 0 | 90 | 9 | 20 | 29 | 10 | 7 | 17 | 136 |
| 1997/98 | 72 | 2 | 74 | 7 | 20 | 27 | 13 | 14 | 27 | 128 |

[a] Total includes moose of unknown sex.

[b] This estimate was derived by taking 5% of the total reported kill prior to SF-50 (1993) and up to 10% after.

[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 Unit 14B moose harvest data by permit hunt, 1992–97

| Hunt no. | Regulatory year | Applicants | % Permits issued | % hunt | % did not hunt | Harvest: unsuccessful hunters | Harvest: successful Bulls | Cows | Total |
|---|---|---|---|---|---|---|---|---|---|
| DM415 | | | | | | | | | |
| | 1995/96 | 896 | 100 | 20 | 73 | 6 | 6 | 0 | 6 |
| | 1996/97 | 913 | 100 | 16 | 67 | 12 | 12 | 0 | 12 |
| | 1997/98 | 949 | 100 | 14 | 73 | 13 | 12 | 1 | 13 |
| DM416 | | | | | | | | | |
| | 1995/96 | 642 | 30 | 23 | 53 | 23 | 7 | 0 | 7 |
| | 1996/97 | 790 | 30 | 10 | 27 | 63 | 19 | 0 | 19 |
| | 1997/98 | 783 | 30 | 10 | 47 | 40 | 12 | 0 | 12 |

Table 4 Unit 14B moose hunter residency and success 1992–97

| Regulatory year | Successful | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[a] resident | Nonlocal resident | Nonres | Unk | Total (%) | Local[a] resident | Nonlocal resident | Nonres | Unk | Total | |
| 1992/93 | 31 | 0 | 3 | 0 | 34 (11) | 259 | 10 | 5 | 6 | 280 | 314 |
| 1993/94 | 27 | 1 | 2 | 1 | 31 (10) | 279 | 3 | 2 | 11 | 295 | 326 |
| 1994/95 | 35 | 0 | 1 | 0 | 36 (11) | 290 | 8 | 3 | 4 | 305 | 341 |
| 1995/96 | 36 | 1 | 2 | 3 | 42 (9) | 411 | 13 | 5 | 12 | 441 | 483 |
| 1996/97 | 54 | 2 | 3 | 0 | 59 (11) | 471 | 12 | 9 | 4 | 496 | 555 |
| 1997/98 | 43 | 1 | 5 | 0 | 49 (10) | 393 | 18 | 9 | 2 | 422 | 471 |

[a] Unit 14 residents.

Table 5 Unit 14B moose harvest chronology[a], 1992–97

| Regulatory | August | | | September | | | November | December | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| year | 10-17 | 20-26 | 27-31 | 1-7 | 8-14 | 15-20 | 20-30 | 1-7 | 8-15 | Unknown | Total |
| 1992/93[b] | -- | -- | -- | 24 | 5 | -- | -- | -- | -- | 5 | 34 |
| 1993/94[c] | -- | 5 | 2 | 5 | 6 | 12 | -- | -- | -- | 1 | 31 |
| 1994/95[c] | -- | 8 | 1 | 1 | 5 | 19 | -- | -- | -- | 2 | 36 |
| 1995/96[d] | 2 | 3 | 0 | 4 | 9 | 13 | 2 | 2 | 7 | 0 | 42 |
| 1996/97[d] | 0 | 15 | 2 | 3 | 8 | 12 | 9 | 1 | 8 | 1 | 59 |
| 1997/98[d] | 1 | 7 | 1 | 6 | 11 | 9 | 3 | 3 | 6 | 2 | 49 |

[a] Does not include harvest from drawing permit hunts.
[b] Open season = Sep 1–10.
[c] Open season = Aug 20–Sep 20 (SF/50 –"spike-fork/ 50-inch").
[d] Open season = Aug 10–17 (Archery-only), Aug 20-Sep 20 (Gen.SF/50), Nov 20-Dec 15 (SF-only).

Table 6 Transport method used by successful moose hunters in Unit 14B, 1992–97

| Regulatory year | Percent of successful moose hunters | | | | | | | | Nr moose harvested |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unk | |
| 1992/93 | 26 | 0 | 0 | 41 | 0 | 15 | 15 | 3 | 34 |
| 1993/94 | 23 | 0 | 6 | 32 | 0 | 10 | 23 | 6 | 31 |
| 1994/95 | 8 | 6 | 6 | 36 | 0 | 14 | 25 | 6 | 36 |
| 1995/96 | 9 | 0 | 5 | 38 | 9 | 11 | 25 | 2 | 55 |
| 1996/97 | 8 | 0 | 4 | 28 | 28 | 16 | 23 | 3 | 90 |
| 1997/98 | 11 | 1 | 9 | 27 | 24 | 9 | 16 | 1 | 74 |

## LOCATION

**GAME MANAGEMENT UNIT:** 14C (1,912 $mi^2$) and Portage and Placer river drainages in Unit 7

**GEOGRAPHIC DESCRIPTION:** Anchorage Area

## BACKGROUND

Moose were uncommon in the Anchorage area before the 1940s. They increased in the late 1940s as brushy regrowth replaced mature forests cut or burned during the development of Anchorage and the Fort Richardson Military Reservation. Numbers increased considerably during the early 1950s, and by the late 1950s and early 1960s moose were abundant. The moose population has remained high during the past 4 decades.

Prime browse occurs in open-canopied, second-growth willow, birch, and aspen stands on burned-over military lands and on several hundred acres of military lands that have been rehabilitated during the last 2 decades. Parks, greenbelts, and residential areas in the Anchorage Bowl also contain browse. Quality riparian habitat abounds along area streams and rivers. Extensive stands of subalpine willow are on south-facing slopes in most drainages in the area. However, during the last 2 decades, overabundant moose have reduced the distribution and density of browse species.

Annual harvests have fluctuated dramatically in recent decades. A record harvest of nearly 500 moose (50% females) occurred in 1965, while hunters harvested only 18 moose in 1978. Diverse harvests were often due to changes in seasons and bag limits as much as changes in the moose population. Annual harvests increased steadily during the late 1980s and early 1990s but began to decline in 1992. The 5-year mean harvest during this reporting period is 139 moose (18% cows).

## MANAGEMENT DIRECTION

### MANAGEMENT OBJECTIVE

- Maintain a population of 2000 moose
- Maintain a posthunting sex ratio of no less than 25 bulls:100 cows.

## METHODS

We conducted aerial surveys annually, except in 1995, in most hunt areas to estimate sex and age composition during fall and early winter (Table 1). Fall surveys were not flown in 1995 because snow cover was not adequate until late December or early January, after most bulls had shed antlers. Hunters were required to report their success on either harvest or permit reports, depending on whether they participated in the general season or a special permit hunt. The reports require information on days hunted, hired services, harvest date and location, sex of the animal taken, method of transportation, and antler configuration.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

Moose populations were relatively stable during the 1980s. Population stability was partially due to a series of mild winters beginning in 1979–80.

Moose are adversely affected by snow depths from 70–90 cm (28–36 inches), which impede movement, and depths greater than 90 cm, which restrict movement to the extent that adequate food intake may be unattainable (Coady 1974). Mean snow depths in Anchorage area lowlands are not normally challenging to wintering moose. However, since 1988 the Anchorage area has had a series of severe winters. Continued severe winters will exacerbate overbrowsing, which may result in substantial losses of moose in subsequent years.

Vehicles and trains collided with moose more frequently than average in 1991–92 and 1994–95 (Table 2) because moose were using cleared areas as movement corridors. Natural mortality probably increased during the severe winters as well. The unit's moose population has been maintained near the management objective of 2000 by reducing harvests.

Deep snows during the winter of 1994–95 caused a substantial decline in the unit's moose population. Vehicle collisions and starvation killed most of the moose. No aerial surveys were conducted in fall of 1995. However, the fall 1996 surveys found the moose population still 25–30% below the fall 1994 estimate.

### *Population Size*

We estimate a fall 1996 population of 1450 moose in Unit 14C, including the Placer and Portage river drainages (Table 1). About 200 moose inhabit the Anchorage Management Area (excluding the Hillside count area). The population has increased since the decline of 1994–95.

### *Population Composition*

The bull:cow ratio ranged from 32:100 to 42:100. It has increased on Fort Richardson and in the Peters Creek drainage and remained stable in the Twentymile, Portage, and Placer drainages. After declining in the early 1990s, the bull:cow ratio rebounded to previous levels in the Knik River and Hunter Creek drainages (Table 1). The declines in the Knik River and Hunter Creek drainages were probably due to increased hunting pressure for bulls after the remainder of Southcentral Alaska adopted a spike-fork/50-inch bull regulation. When Unit 14C adopted the spike-fork/50-inch regulation, the bull:cow ratio increased in these count areas. The percentage of calves in the population ranged from 18–21%. The unit has 10 yearling bulls per 100 cows.

### *Distribution and Movements*

Moose are year-long residents, ranging from sea level to an elevation of 3500 feet. During winters with substantial snow accumulation, most moose are at elevations below 1500 feet. Movements of several miles or more by both sexes occur during the breeding season in late September through October and again before green-up in late March and early April.

## MORTALITY

### *Harvest*

Season and Bag Limit. The open seasons for resident and nonresident hunters in the Fort Richardson Management Area were 5 September–15 November and 15 December–15 January in 1995–96, and 3 September–15 November and 15 December–15 January in 1996–97. The bag limit was 1 moose by drawing permit. Hunting was limited to archery only, except in the fall season when muzzleloading rifles were permitted north of Eagle River. We issued up to 110 permits for bulls and antlerless moose and 25 for muzzleloading rifle hunters. We issued an additional 15 drawing permits for both sexes for Elmendorf Air Force Base in 1995 and 1996. The bag limit was 1 moose, and the season was 5–30 September in 1995 and 3–30 September in 1996. There was no open season in the Anchorage Management Area. The open season for resident and nonresident hunters in the Peters Creek Management Area was 5–30 September in 1995 and 3–30 September in 1996. The bag limit was 1 moose by drawing permit and archery only; 10 permits were issued in 1995 and 1996. The open season for resident and nonresident hunters in the Eklutna Lake Management Area was 5–30 September in 1995 and 3–30 September in 1996. The bag limit was 1 bull by archery only. The hunt was administered by registration permit for 10 bulls. The open season for resident hunters in the remainder of Unit 14C was 5–20 September in 1995 and 3–20 September in 1996. The bag limit was 1 bull moose; however, hunters could take antlerless moose by drawing permit only (20 permits were issued in 1995 and 1996). The open season for the Twentymile River area was 20 August–30 September for bulls and 20 August–31 October for antlerless moose in 1995 and 1996. The bag limit was 1 moose by drawing permit with 40 permits for bulls and 10 permits for antlerless moose issued in 1995 and 1996.

Board of Game Actions and Emergency Orders. In 1995 the Board of Game adopted a spike-fork/50-inch regulation for the remainder of Unit 14C. In 1995 and 1996 the board considered several proposals for a moose hunt in the Anchorage Management Area but delayed a final decision until the March 1997 meeting in Anchorage. In March 1997 the Board of Game considered several proposals for hunting with shotguns and muzzleloaders in Chugach State Park and bow hunts in several municipal parks. None was approved. All antlerless moose hunts were reauthorized annually. No emergency orders were issued during the past 5 years.

Hunter Harvest. During the 1995–96 and 1996–97 seasons, 95 and 104 moose were harvested, respectively, with a 2-year mean of 75 bulls and 25 cows annually (Table 2). Approximately 23% of the bulls were taken during the general season. The remaining moose were taken in permit hunts.

Permit Hunts. During the 1995–96 season, we issued 392 permits to hunt moose in Unit 14C. Of these, 82 hunters (21%) were successful. In 1996–97, 397 permits were issued and 82 hunters (21%) were successful (Table 4). Drawing permit hunts were very popular. In 1995, 7305 hunters applied for 215 available drawing permits (2869 of the applications were for the 50 permits available for the Placer/Twentymile hunts), and in 1996, 5939 hunters applied for 220 available drawing permits (2018 of the applications were for the 45 permits available for the Placer/Twentymile hunts). An additional 187 hunters in 1995 and 182 hunters in 1996 received registration permits for the Eklutna Valley archery hunt. Despite its popularity, the success rate for this hunt, while never high, remains 1–3% in the 1990s (Table 4).

Hunter Residency and Success. Residents of Unit 14 accounted for 87% and 83% of the moose harvested in Unit 14C in 1995 and 1996, respectively (Table 3). Nonresidents accounted for 1% and 2% of the total harvest, respectively.

Harvest Chronology. It is difficult to compare annual harvests for the first week in September (Table 5) because season opening dates are variable (i.e., the day after Labor Day). After the general season was shortened by 10 days (from 30 September to 20 September) in 1990, harvests shifted primarily to the second week in September, rather than being compressed into the third week, as might be expected (Table 5). The second week in September is essentially the opening week of moose hunting for much of the unit when the day after Labor Day is later than usual (e.g., 8 September in 1992). Therefore, many hunters have switched from late to early season hunts since 1990. In recent years, a permit archery hunt has been held on military land from mid-December through mid-January, after many moose summering in the Fort Richardson–Elmendorf–Ship Creek area become accessible in lowland areas of Fort Richardson.

Transport Methods. Approximately two-thirds of all successful moose hunters reached their kill sites by highway vehicle (Table 6). The high proportion of walk-in hunters is due to moose habitat being near roads and trails and prohibition of motorized off-road vehicles in most of Chugach State Park.

### *Other Mortality*

Moose killed by vehicles and trains accounted for 35–58% of known annual mortality during the reporting period. Vehicles killed at least 239 moose and trains killed 22 in 1994–95, a record high because of near-record snow depths that forced many moose into town. During this report period, a mean of at least 147 moose were killed in collisions annually (Table 2). These are conservative figures because not all collisions are reported and some moose, never found, die from injuries.

Significant natural mortality was low in the Anchorage area from the mid-1950s to the late 1980s due to moderate annual snowpacks and relatively low numbers of predators. More moose have starved in recent winters due to 1) greater than average snowpacks that cover potential browse and require greater expenditure of energy and 2) overbrowsing in previous winters. In recent years, 2 packs of wolves have occupied the Knik and Twentymile River drainages, and 2 packs are taking moose on Fort Richardson, Elmendorf Air Force Base, the Anchorage Hillside, and Eagle River Valley.

## HABITAT

### *Assessment*

Large tracts of subalpine and riparian habitat are protected throughout the 500,000-acre Chugach State Park and Chugach National Forest land between Girdwood and Portage. Several thousand acres of lowland habitat are on military lands between lower Ship Creek and Eagle River. Extensive urbanization has reduced winter range on portions of the military reservation and on private lands throughout the unit. However, roads and trails associated with development provide movement corridors, which reduce energy expenditures for moose during years of heavy snowfall.

*Enhancement*

Extensive habitat enhancement on military, state, and municipal lands is probably not economically feasible because burning, the most cost-effective method, is difficult to do safely in a densely populated area. Habitat enhancement is not a desirable alternative in Chugach State Park. The Chugach National Forest enhanced moose habitat in a limited area near Portage, primarily to enhance viewing opportunity. Winter habitat will inevitably decrease over time in the Anchorage area, as will the number of moose that depend on winter habitat.

## CONCLUSIONS AND RECOMMENDATIONS

One of 2 population objectives for the unit was met. The bull:cow ratio exceeded 25:100. The fall 1996 population was below 2000 moose. The moose population has rebounded in subsequent years, reaching 2000 or more animals by fall 1998.

Existing management programs were developed in cooperation with staffs from Fort Richardson, Elmendorf Air Force Base, and Chugach State Park. Through restrictions on harvest methods and compromises on open and closed areas, management regimes have been developed and are acceptable to all parties.

Current regulations adequately address management concerns by providing for substantial hunting opportunities and harvests from a productive moose population in an area where several land management agencies have limited access modes.

Nuisance moose in residential areas remain a significant problem. A recent study by the Alaska Department of Transportation and Public Facilities estimated rural moose-vehicle collisions cost an average of $15,150 for vehicle repairs; emergency, medical, and legal services, and lost wages (ADOTPF 1995). Moose-vehicle collisions may cost Anchorage residents $2.2 million, based on the number of moose-vehicle collisions reported during this 5-year report period. Moose also cause considerable damage to ornamental plants, vegetable gardens, and fruit trees in winter and spring. Some residents continue to feed local moose, despite the regulation prohibiting feeding, and when a handout is not immediately forthcoming, these moose are often highly aggressive toward people. Area staff spend considerable time listening and responding to complaints about property damage, public safety, and injured moose. On the other hand, much damage is tolerated by residents, and moose are considered a desirable species by many residents and visitors. Public education regarding moose behavior and biology may improve public tolerance and reduce conflicts.

Planning for a moose hunt in the Anchorage Management Area is underway. A consultant conducted 3 focus group sessions in February 1996 to compare attitudes of hunters, Anchorage residents, and Hillside residents regarding wildlife in Anchorage and, specifically, a moose hunt in Chugach State Park near the Hillside area (Craciun & Associates 1996*a,b*). A random sample of 2200 Anchorage residents, from a list of registered voters, was mailed a detailed survey of attitudes, experiences, and expectations about wildlife in Anchorage in 1996. Much of the survey focused on moose and possible changes in management. The response rate was 59%. Most residents enjoyed watching moose in Anchorage (96%), had moose eat their trees, shrubs, or gardens (89%), and most had been in a vehicle that swerved or braked to avoid hitting a moose (72%). Many residents have also been charged by a moose in their neighborhood (16%) or on a local trail (14%); others have been in a vehicle that hit a moose (11%) or had a pet injured or killed by a moose (4%). Residents were asked how often they saw moose in their neighborhood in an average winter. Only 2% never saw moose, 43% saw moose a few times per month, and 33% saw moose at least a few times a week. When asked how often they wanted to see moose in their neighborhood, 22% wanted fewer sightings, 53% were seeing what they wanted, and 25% wanted more. Forty-two percent believed there were an acceptable number of moose/vehicle collisions, but 54% believed there were too many collisions. Nearly two-thirds of the respondents believed the number of moose encounters on trails and in neighborhoods and the number of moose eating ornamental shrubs and gardens was acceptable.

Residents were asked several questions about moose hunting. Sixty-one percent would accept a new moose hunt near Anchorage to reduce the number of moose. Given specifics about a moose hunt in Chugach State Park adjacent to Hillside residential areas, 51% "voted" in favor of the hunt. People who supported the hypothetical hunt believed it would reduce the number of vehicle accidents, reduce the number of potentially dangerous encounters, keep moose below the carrying capacity, and provide good hunting opportunities for Anchorage hunters. People who opposed the hypothetical hunt believed it would generate conflict, cost a lot to administer, prevent nonhunters from using the park, and might injure a hunter or someone else. These data indicate that if the hunt is to be seriously considered, additional attention toward the cost, hunt safety, and temporary loss of park access might help allay some opponents' concerns. Hunt supporters strongly believe this hunt would prevent overpopulation; hunt opponents and undecided residents are only weakly convinced. Emphasizing the biological necessity for reducing the moose population would generate more support from some opponents and undecided residents.

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Table 1 Unit 14C fall aerial moose composition counts and estimated population size, 1992–96

| Area | Regulatory year | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves (%) | Total moose observed | Moose /hour | Estimated population size[a] |
|---|---|---|---|---|---|---|---|---|
| Twentymile River | 1992/93 | 35 | 11 | 47 | 26 | 232 | 73 | |
| Portage River | 1993/94 | 40 | 10 | 50 | 26 | 207 | 77 | |
| Placer River | 1994/95 | 38 | 9 | 47 | 25 | 207 | 74 | |
| | 1995/96[b] | -- | -- | -- | 20 | 199 | 57 | |
| | 1996/97 | 37 | 11 | 40 | 23 | 168 | 56 | 250 |
| Hillside | 1992/93 | -- | -- | -- | -- | -- | -- | |
| | 1993/94 | -- | -- | -- | -- | -- | -- | |
| | 1994/95 | -- | -- | -- | -- | -- | -- | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | 30 | 11 | 40 | 23 | 90 | 47 | 125 |
| Anchorage Bowl (except Hillside) | 1992/93 | -- | -- | -- | -- | -- | -- | |
| | 1993/94 | -- | -- | -- | -- | -- | -- | |
| | 1994/95 | -- | -- | -- | -- | -- | -- | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | -- | -- | -- | -- | -- | -- | 200[c] |
| Fort Richardson | 1992/93 | 35 | 12 | 33 | 20 | 355 | -- | |
| Elmendorf AFB | 1993/94 | 47 | 16 | 30 | 17 | 468 | 35 | |
| Off-base Ship Cr. | 1994/95 | 40 | 16 | 28 | 17 | 401 | -- | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | 57 | 10 | 31 | 16 | 294 | 24 | 340 |

Table 1 Continued

| Area | Regulatory year | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves (%) | Total moose observed | Moose /hour | Estimated population size[a] |
|---|---|---|---|---|---|---|---|---|
| Eagle River | 1992/93 | -- | -- | -- | -- | -- | -- | |
| | 1993/94 | -- | -- | -- | -- | -- | -- | |
| | 1994/95 | -- | -- | -- | -- | -- | -- | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | -- | -- | -- | -- | -- | -- | 120[d] |
| Peters Creek | 1992/93 | -- | -- | -- | -- | -- | -- | |
| | 1993/94 | 23 | 13 | 23 | 16 | 58 | 25 | |
| | 1994/95 | 21 | 3 | 29 | 19 | 57 | 43 | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | 44 | 11 | 39 | 21 | 33 | 19 | 50 |
| Eklutna River Thunderbird Cr. | 1992/93 | 18 | 3 | 21 | 15 | 92 | 32 | |
| | 1993/94 | -- | -- | -- | -- | -- | -- | |
| | 1994/95 | -- | -- | -- | -- | -- | -- | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | -- | -- | -- | -- | -- | -- | 110 |
| Bird Creek Indian River | 1992/93 | -- | -- | -- | -- | -- | -- | |
| | 1993/94 | -- | -- | -- | -- | -- | -- | |
| | 1994/95 | -- | -- | -- | -- | -- | -- | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | -- | -- | -- | -- | -- | -- | 100[c] |

Table 1 Continued

| Area | Regulatory year | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves (%) | Total moose observed | Moose /hour | Estimated population size[a] |
|---|---|---|---|---|---|---|---|---|
| Hunter Creek | 1992/93 | -- | -- | -- | -- | -- | -- | |
| Knik River | 1993/94 | 16 | 5 | 18 | 13 | 164 | 86 | |
| | 1994/95 | 11 | 4 | 18 | 14 | 150 | 39 | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | 27 | 6 | 15 | 13 | 112 | 45 | 150 |
| Unit 14C | 1992/93 | 32 | 10 | 36 | 21 | 679 | 111 | |
| Total | 1993/94 | 37 | 12 | 31 | 18 | 897 | 44 | |
| | 1994/95 | 33 | 11 | 31 | 19 | 846 | 41 | |
| | 1995/96[b] | -- | -- | -- | -- | -- | -- | |
| | 1996/97 | 42 | 10 | 31 | 18 | 697 | 32 | 1450 |

[a] Estimate based on most recent count, using sightability index of 0.87 except for Fort Richardson.
[b] Fall surveys not conducted due to lack of snow; aerial survey of Twentymile/Portage/Placer on March 8 not comparable to other years.
[c] No aerial surveys; estimate is best guess.
[d] Last surveyed in 1987.
[e] Last surveyed in 1988.

Table 2 Unit 14C moose harvest and accidental death, 1992–1996

| | Hunter harvest | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | Estimated | | | Accidental death[b] | | | |
| Regulatory year | M (%) | F (%) | Total[a] | Unreported | Illegal | Total | Road | Train | Total | **Total** |
| 1992/93 | 116 (67) | 53 (33) | 170 | 10 | 10 | 20 | 90 | 10 | 100 | 290 |
| 1993/94 | 115 (74) | 40 (26) | 158 | 10 | 10 | 20 | 100 | 9 | 109 | 287 |
| 1994/95 | 132 (80) | 33 (20) | 166 | 10 | 10 | 20 | 239 | 22 | 261 | 447 |
| 1995/96 | 62 (65) | 33 (35) | 95 | 10 | 10 | 20 | 114 | 2 | 116 | 231 |
| 1996/97 | 88 (85) | 16 (15) | 104 | 10 | 10 | 10 | 136 | 11 | 147 | 271 |

[a] Includes those with unreported sex.

[b] Reported deaths only.

Table 3 Unit 14C moose hunter residency and success, 1992–96

| | Successful | | | | Unsuccessful | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Local resident[a] | Nonlocal resident | Nonresident | Total (%)[b] | Local resident[a] | Nonlocal resident | Nonresident | Total (%)[b] | Total hunters |
| 1992/93 | 162 | 2 | 3 | 170 (24) | 489 | 21 | 7 | 530 (76) | 700 |
| 1993/94 | 130 | 23 | 0 | 158 (25) | 431 | 35 | 2 | 478 (75) | 636 |
| 1994/95 | 154 | 9 | 2 | 166 (24) | 488 | 20 | 6 | 519 (76) | 685 |
| 1995/96 | 83 | 10 | 1 | 95 (20) | 352 | 16 | 3 | 372 (80) | 467 |
| 1996/97 | 86 | 14 | 2 | 104 (21) | 352 | 22 | 4 | 381 (79) | 485 |

[a] Residents of Unit 14 (majority from Unit 14C).
[b] Includes hunters with unspecified residency.

Table 4 Unit 14C moose harvest data by permit hunt, 1992–96

| Hunt no.[a] /Area | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Total harvest[b] |
|---|---|---|---|---|---|---|---|---|
| DM210, 211 | 1992/93 | 130 | 12 | 36 | 64 | 46 | 54 | 73 |
| Twentymile | 1993/94 | 75 | 16 | 51 | 49 | 61 | 39 | 31 |
| Portage | 1994/95 | 50 | 6 | 52 | 48 | 68 | 32 | 22 |
| Placer | 1995/96 | 50 | 22 | 46 | 54 | 76 | 24 | 21 |
| (910, 911) | 1996/97 | 50 | 10 | 47 | 53 | 88 | 12 | 24 |
| DM424,425,427 | 1992/93 | 125 | 15 | 64 | 36 | 61 | 39 | 38 |
| Fort Richardson | 1993/94 | 75 | 28 | 47 | 53 | 60 | 40 | 36 |
| (archery only) | 1994/95 | 77 | 16 | 41 | 59 | 58 | 42 | 38 |
| | 1995/96 | 75 | 12 | 59 | 41 | 56 | 44 | 27 |
| (924,925,927) | 1996/97 | 85 | 7 | 65 | 35 | 89 | 11 | 28 |
| DM422,423 | 1992/93 | 25 | 0 | 44 | 56 | 57 | 43 | 14 |
| Fort Richardson | 1993/94 | 25 | 4 | 46 | 54 | 77 | 23 | 13 |
| (muzzleloader) | 1994/95 | 25 | 13 | 38 | 62 | 69 | 31 | 13 |
| | 1995/96 | 25 | 24 | 32 | 68 | 62 | 38 | 13 |
| (922,923) | 1996/97 | 25 | 0 | 68 | 32 | 88 | 12 | 8 |
| RM445[c] | 1992/93 | 229 | 24 | 99 | 1 | 100 | 0 | 2 |
| Eklutna | 1993/94 | 232 | 26 | 98 | 2 | 100 | 0 | 3 |
| (archery only) | 1994/95 | 234 | 22 | 99 | 1 | 100 | 0 | 2 |
| | 1995/96 | 187 | 27 | 99 | 1 | 100 | 0 | 1 |
| (975) | 1996/97 | 182 | 29 | 97 | 3 | 100 | 0 | 4 |

Table 4 Continued

| Hunt no.[a] /Area | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Total harvest[b] |
|---|---|---|---|---|---|---|---|---|
| DM441 | 1992/93 | 15 | 20 | 42 | 58 | 14 | 86 | 7 |
| Hunter | 1993/94 | 10 | 0 | 70 | 30 | 0 | 100 | 3 |
| Knik | 1994/95 | 5 | 20 | 100 | 0 | 0 | 0 | 0 |
| | 1995/96 | 5 | 20 | 25 | 75 | 0 | 100 | 3 |
| (941) | 1996/97 | 5 | 0 | 40 | 60 | 0 | 100 | 3 |
| DM428, 429 | 1992/93 | 15 | 0 | 13 | 87 | 46 | 54 | 13 |
| Elmendorf AFB | 1993/94 | 15 | 0 | 13 | 87 | 77 | 23 | 13 |
| (archery only) | 1994/95 | 15 | 13 | 8 | 92 | 67 | 33 | 12 |
| | 1995/96 | 15 | 7 | 14 | 86 | 67 | 33 | 12 |
| (921,929) | 1996/97 | 15 | 7 | 14 | 86 | 67 | 33 | 12 |
| DM442 | 1992/93 | 10 | 20 | 100 | 0 | 0 | 0 | 0 |
| Ship | 1993/94 | 0 | -- | -- | -- | -- | -- | -- |
| | 1994/95 | 10 | 40 | 100 | 0 | 0 | 0 | 0 |
| | 1995/96 | 10 | 30 | 57 | 43 | 0 | 100 | 3 |
| (942) | 1996/97 | 10 | 20 | 88 | 12 | 0 | 100 | 1 |
| DM443 | | | | | | | | |
| Peters and | 1992/93 | 15 | 7 | 57 | 43 | 0 | 100 | 6 |
| Little Peters | 1993/94 | 10 | 0 | 70 | 30 | 0 | 100 | 3 |
| | 1994/95 | 10 | 20 | 88 | 12 | 0 | 100 | 1 |
| | 1995/96 | 10 | 20 | 100 | 0 | 0 | 0 | 0 |
| (943) | 1996/97 | 10 | 30 | 86 | 14 | 0 | 100 | 1 |

Table 4 Continued

| Hunt no.[a] /Area | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Total harvest[b] |
|---|---|---|---|---|---|---|---|---|
| DM448, 449 | 1992/93 | 25 | 12 | 86 | 14 | 67 | 33 | 3 |
| Birchwood[d] | 1993/94 | 15 | 7 | 79 | 21 | 67 | 33 | 3 |
| (archery only) | 1994/95 | 15 | 20 | 67 | 33 | 75 | 25 | 4 |
| | 1995/96 | 15 | 13 | 85 | 15 | 50 | 50 | 2 |
| (948,949) | 1996/97 | 15 | 33 | 90 | 10 | 100 | 0 | 1 |
| Totals for all | 1992/93 | 589 | 16 | 68 | 32 | 48 | 52 | 158 |
| permit hunts | 1993/94 | 457 | 17 | 71 | 29 | 63 | 37 | 105 |
| | 1994/95 | 441 | 18 | 72 | 28 | 63 | 37 | 92 |
| | 1995/96 | 392 | 22 | 73 | 27 | 60 | 40 | 82 |
| | 1996/97 | 397 | 19 | 75 | 25 | 81 | 19 | 82 |

[a] Hunt numbers in parentheses are prior to 1993-94.
[b] Includes moose with unspecified sex.
[c] Registration hunt.
[d] Formerly Peters Creek Management Area.

Table 5 Unit 14C moose harvest[a] chronology, 1992-96

| Regulatory year | Percent of harvest | | | | | |
|---|---|---|---|---|---|---|
| | 9/1-9/7 | 9/8-9/14 | 9/15-9/21 | 9/22-9/28 | 9/29-10/5 | $n$ |
| 1992/93[b] | -- | 73 | 27 | -- | -- | 51 |
| 1993/94[c] | 15 | 56 | 29 | -- | -- | 48 |
| 1994/95[d] | 26 | 32 | 42 | -- | -- | 69 |
| 1995/96[e] | 46 | 36 | 18 | -- | -- | 11 |
| 1996/97[f] | 24 | 48 | 29 | -- | -- | 21 |

[a] Excludes permit hunt harvests.
[b] Season 9/8-9/20
[c] Season 9/7-9/20
[d] Season 9/6-9/20
[e] Season 9/5-9/20
[f] Season 9/3-9/20



Table 6 Unit 14C moose harvest percent by transport method, 1992–96

| Regulatory year | Percent of harvest | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Off-road vehicle | Highway vehicle | Unknown | $n$ |
| 1992/93 | 6 | 9 | 17 | 2 | 0 | 1 | 59 | 5 | 172 |
| 1993/94 | 9 | 9 | 13 | 1 | 0 | 3 | 63 | 3 | 140 |
| 1994/95 | 7 | 6 | 10 | 2 | 0 | 1 | 71 | 3 | 154 |
| 1995/96 | 1 | 3 | 21 | 1 | 0 | 2 | 68 | 3 | 95 |
| 1996/97 | 8 | 4 | 24 | 1 | 0 | 0 | 63 | 1 | 104 |

# LOCATION

**GAME MANAGEMENT UNIT:** 15A (1,314 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Northern Kenai Peninsula

# BACKGROUND

Historical records and reports from residents indicate moose were abundant throughout the century in Unit 15A. The most recent population peak occurred in 1971. The near absence of wolves from 1913 to 1968 and increased moose survival following a 500 $mi^2$ forest fire in 1947 were 2 events that increased moose numbers throughout the 1950s and 1960s. Although seasons were long and either-sex harvest allowed, the moose population increased beyond its carrying capacity and extensive overbrowsing occurred by the late 1960s. Harsh winters from 1971 to 1974 reduced the moose population over the entire Kenai Peninsula. Estimates for Units 15A and 15B indicate the combined population estimate declined from 7900 in 1971 to 3375 by 1975. Unit 15A represents approximately 75% of these estimates or a decline from 5925 to 2531 moose. By 1982, the moose population estimate for 15A had increased to 3041.

In 1987 and 1990 estimation methods described by Gasaway (1986) were used in the unit for the first time. They indicated a stable population trend in the range of 3014–3850 moose. Although a census has not been completed since 1990, the population is probably stable due to recent mild winters.

No large wildfires have occurred since the fires in 1947 and 1969 on the Kenai Peninsula. Consequently, less browse associated with successional forest stages was available to moose and a gradual decline in moose population size is anticipated during normal winters. Small wildfires and intentional habitat improvement efforts have temporarily reversed this general trend in local areas.

Increased human presence and impact of the Alaska National Interest Lands Conservation Act on the Kenai Peninsula have increased the necessity for cooperative interagency management of renewable resources. To this end, the department works closely with a variety of agencies and landholders, while still clearly retaining management authority for wildlife on nonfederal lands and nonsubsistence wildlife species on federal lands. The Kenai National Wildlife Refuge is the largest landholder in Unit 15A and actively participates in a variety of cooperative moose management programs. These include support of the ADF&G Moose Research Center near Sterling, cooperative management of Skilak Loop as a wildlife viewing area, and recent attempts to provide increased access for hunters in wheelchairs. Close coordination and cooperation should continue.

A selective harvest strategy with a spike/fork-50 inch bag limit was initiated on the Kenai Peninsula in 1987. The proportion of males in the population has subsequently increased, and hunters seem generally satisfied with the selective harvest strategy. We completed a 5-year evaluation of selective harvest on the Kenai in 1992, and a 10-year evaluation is scheduled for completion in 1999.

## MANAGEMENT DIRECTION

### MANAGEMENT OBJECTIVES

Maintain a healthy population of moose with a posthunting bull to cow ratio of at least 15:100 in Unit 15A, excepting the Skilak Loop Wildlife Management Area (SLWMA).

Primary moose management objectives in Skilak Loop Wildlife Management Area (SLWMA) are listed:

- View moose in a natural setting throughout the year.
- Provide opportunities to view all components of the moose community, including their behavior and habitat.
- Provide opportunities to harvest moose when a reduction in numbers is desirable to achieve other objectives.
- Achieve and maintain the resident population at 130 animals or a density of 1.8 to 2.0 moose per $mi^2$. Resident moose in excess of 130 will be available for harvest.
- Increase the bull to cow ratio to at least 40 bulls:100 cows.

In addition to the resident population, moose from surrounding areas commonly winter in SLWMA. Winter populations reach 300 animals. Habitat will be managed to provide for 130 resident and up to 170 additional wintering moose.

## METHODS

We conducted aerial surveys in November and December of each year in selected trend count areas to ascertain sex and age composition. In 1995 weather conditions were not acceptable to conduct fall sex and age composition surveys. In 1996 we counted 7 of 13 count areas in Unit 15A.

A population estimate for Unit 15A was developed from data collected in February 1990. The techniques used were described in Gasaway (1986). The first estimate using these techniques was conducted in 1987. The 1987 results were not strictly comparable with the 1990 estimates. Poor weather prevented us from completing a small number of sample units containing unexpectedly high densities of moose in 1987. The 1987 calculation subsequently underestimated the 15A moose population (Taylor 1990). A complete census of Unit 15A has not been conducted since 1990.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

The February 1990 estimate for moose wintering in the unit was 3432 ± 12.18% (3014–3850) at the 90% CI. The 1987 estimate was 2702 ± 9.6% (2441–2963) at the 90% CI. These data indicated a substantial 3-year population increase. However, the 1987 calculation significantly underestimated the Unit 15A population size when some sample units containing high densities of moose were not counted (Taylor 1990). The 1990 survey was more complete and the estimate of 3014–3850 moose was consequently more accurate. The population size is still believed to be between 3000 and 3800 moose in Unit 15A.

*Population Composition*

Poor weather prevented us from completing a fall sex and age composition survey in 1995. In 1996, we observed 1467 moose in fall composition surveys, compared to 1199 in 1994 (Table 1). Calves composed 24% of the 1996 sample and occurred in the proportion of 39:100 cows. Calf composition data have remained relatively stable since 1992. Bulls were observed at a ratio of 26:100 cows, 2 bulls:100 cows more than in 1994. Yearling bulls increased from 5:100 in 1992 to 9:100 in 1994 then declined by 1:100 in 1996, following the mild winter of 1995/96. The winter of 1994/95 was extremely harsh, causing a minimum of 178 moose, primarily calves, to die from starvation.

### MORATLITY

*Harvest*

Season and Bag Limit. The general open season in Unit 15A was from August 20 to September 20. In spring of 1995 the Board of Game approved an archery season for Unit 15A with a season from August 10 to 17. Archery hunters were restricted to the same bag limit used during the general season. Bag limit was 1 bull with spike/fork or 50 inch antlers or at least 3 brow tines on 1 antler. Forty permits were issued in a drawing permit hunt in Skilak Loop Wildlife Management Area for antlerless moose and 20 for spike/fork bulls in 1995. The antlerless season was from September 15–30 and the spike/fork bull season from September 21–30. The bag limit for the antlerless season prohibited harvesting of calves and females accompanied by calves. A hunting season was not authorized for SLWMA during the fall of 1996.

Board of Game Actions and Emergency Orders. In spring 1995 the Board of Game reestablished the archery hunt previously held in Unit 15A. The season was August 10 to 17 with the same bag limit as the general season. The board also authorized 2 permit hunts in Skilak Loop Wildlife Management Area. Forty permits were issued for taking antlerless moose and 20 for bulls with spike/fork antlers.

Hunter Harvest. In 1995, 117 moose (115 bulls and 2 of unreported sex) were harvested by 1135 hunters during the nonpermit seasons (Table 2). The 1995 harvest declined by 51% when compared to the 1994 harvest of 238 moose. This reduction in harvest reflects severe winter losses sustained by the 15A moose population from deep snows during the winter of 1994/95.

In 1996, 260 moose (257 bulls and 3 of unspecified sex) were harvested by 1424 hunters during the nonpermit seasons. The 1996 harvest increased by 55% compared to 1995. The winter of 1995/96 was one of the mildest on record, resulting in high moose survival.

Results of an August 10–17 archery season were included in the total harvest figures for Unit 15A. However, information requested on harvest ticket reports did not include the time spent hunting by unsuccessful hunters; therefore, it was not possible to determine how many hunters went afield during the archery season. Data collected at field checkstations were used to estimate hunter participation. An estimated 200 to 250 archery hunters participated during the 10–17 August 1995 and 1996 archery-only hunts in 15A. They reported a harvest of 13 and 31 bulls for the years 1995 and 1996, respectively. Archers primarily harvested bulls in the spike/fork category. The highest previous reported harvest for archers was in 1989, when 18 bulls were taken in Unit 15A. Archers were required to follow the same antler restrictions required for the general season.

Of the 117 moose harvested in 1995, 99 (85%) were reported with antler spread data. Because the current bag limit was designed to focus harvest on a portion of the yearlings and on mature bulls, we assumed that bulls <35 inches met the yearling (spike-fork) requirement and $\geq$35 inches were mature bulls (having 3 brow tines or an antler spread >50 in.). Sixty-five percent ($N = 64$) of the harvest was spike/fork bulls and 35 percent ($N = 35$) were mature bulls. Eighteen percent ($N = 18$) of the reported harvest was bulls with an antler spread $\geq$50 in. In 1996, 244 (94%) of the 260 moose harvested were reported with antler spread data. The harvest comprised 150 (62%) yearlings and 94 (39%) mature bulls.

Permit Hunts. We received 1325 applications for 40 permits issued to hunt antlerless moose and 631 for 20 permits for spike/fork bulls in SLWMA in 1995. Permits were not issued for either of these hunts in 1996. Sixteen permit holders hunted in 1995, harvesting 7 moose (Table 3). All moose harvested were females and ranged in age from 1 to 11 years with a mean age of 4. Thirteen hunters reported hunting in the bull hunt, harvesting only 1 yearling bull moose (Table 4).

Hunter Residency and Success. The 1995 hunter success was 10%, compared to 19% in 1996. In 1995, 99 (85%) successful hunters were unit residents, 13 (11%) were nonunit residents, and 4 (3%) were nonresidents ($N = 116$). One (1%, $N = 117$) successful hunter failed to report residency. Residency reported for unsuccessful hunters was as follows: unit residents 871, nonunit state residents 133, nonresidents 11, and unspecified residency 3 (Table 5). Successful hunters averaged 7.4 days, compared to 8.0 days for all hunters.

In 1996, 208 (81%) successful hunters were unit residents, 41 (16%) were nonunit residents, and 9 (4%) were nonresidents ($N = 258$) (Table 5). Two (5%, $N = 260$) successful hunters failed to report their residency. Residency reported for unsuccessful hunters was as follows: unit residents 1005, nonunit residents 136, nonresidents 19, and unspecified residency 4. Successful hunters averaged 5.8 days, compared to 7.5 days for all hunters.

Transport Methods. Fifty-seven percent of the 1995 successful hunters reported highway vehicles as their primary means of transportation. Boats were the second most common (17%) means of transportation. Hunters using ATV's or horses combined accounted for 13% of the reported harvest. Hunters using aircraft as their means of access reported the lowest percentage at 9%. The 1996 transportation data compared closely with 1996, when 66% of successful hunters reported using highway vehicles (Table 6). In 1996, aircraft were used least (9%) compared to ATVs and horses combined.

Chronology of Harvest. Eleven percent of the 1995 and 12% of the 1996 harvest occurred during the August 10–17 archery season (Table 7). Twenty percent of the 1995 and 26% of the 1996 harvest occurred during the first 5 days of the general hunt season. The highest percentage of harvest in 1995 occurred during the last 5 days of the season, compared to the second highest harvest in 1996 during this period.

*Other Mortality*

Crippling loss by hunters and loss to predation was unknown. In 1995, 90 moose were reported killed in 15A by vehicle/wildlife accidents, compared to 160 in 1996. About 50% of moose killed by vehicles each year are calves. A public awareness program, begun in 1990 to reduce the number of vehicle/wildlife collisions (Del Frate and Spraker 1991), and the mild winter of 1995/96 that reduced the concentration of moose reduced the number of vehicle/wildlife collisions in 1995/96.

### HABITAT

*Assessment*

The 1969 burn (85,000 ac) is still providing browse for most of the moose wintering in Unit 15A. However, this areas, plus small areas of improved habitat north of Skilak Lake, only comprise 10–15% of moose habitat in the unit. The remaining moose habitat is unproductive, due to forest succession and browse heights not optimal for moose.

*Enhancement*

In May 1991 approximately 8320 acres burned in the southeastern portion of 15A near Pothole lake. This burn is expected to increase available moose habitat; however, this may only benefit animals in the immediate area of the burn due to its small size. Substantial statewide publicity regarding the beneficial effects of wildfire for forest succession wildlife derived from the Pothole Lake fire.

A 10,369-acre area in the Mystery Creek Road vicinity was to be burned by U.S. Fish and Wildlife Service in the fall of 1991. Unfavorable weather conditions and other factors have prevented this prescribed burn project from being completed. Approximately 40% of this area is scheduled to be left untreated as scattered islands for wildlife cover and seed source for re-vegetation.

## CONCLUSIONS AND RECOMMENDATIONS

A 10-year review of the selective harvest strategy is scheduled for completion in 1999. The bull to cow ratio increased from a 5-year (1982–86) average of 13:100 to 22:100 in 1991, but declined to 16:100 in 1992 following the severe winter of 1991/92. In 1994/95 the ratio rebounded to 24:100 then remained relatively stable at 26:100 in the 1996–97 fall composition surveys. Over the past 5 years hunter effort has averaged 1324 hunters per season, with a range from 1135 to 1427. The interest in archery hunting has increased with the archers harvesting 11 and 12% of the harvest in the past 2 years, respectively.

With an increase in the number of bulls, the opportunity for viewing and photography increased. Public perception of improved population health and public support for continuation of the program has also increased.

During the past 6 years, moose in Unit 15A have been impacted by 2 severe winters, 1991/92 and 1994/95. The number of available bulls following these winters declined as did the harvest. In 1995/96, the harvest declined by 51% compared to the previous year. In 1996/97, following an extremely mild winter and high survival, the harvest rebounded to the highest reported harvest since selective harvest started in 1987. In 1995 hunter success decreased (10%) because very few yearling moose were available to hunters. The number of moose killed by automobiles declined substantially from the severe winter of 1994/95 to the winter of 1995/96. The reduction may have been partially caused by weather conditions and reduced moose population size. However, the department was conducting, at the same time, a substantial community awareness effort to reduce vehicle/wildlife accidents. The "Give Moose a Brake Program" may also have contributed to reduced moose kills by vehicles in 1995/96.

Unlike other game management units in Alaska, no emergency reduction in the 1995/96 moose season or bag limit was necessary due to effects of the previous winter. In addition to a reduction in harvest following a severe winter, the number of hunters has also decreased. The conservative nature of the spike/fork-50 inch bag limit on the Kenai Peninsula allowed the department to continue to offer the same recreational opportunity as in previous years. No changes in management objectives or bag limits are recommended at this time.

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Table 1 Unit 15A aerial moose composition counts and estimated population size, 1992–96

| Regulatory year | Bulls: 100 Cows | Yearling bulls: 100 Cows | Calves: 100 Cows | Calves (%) | Adults | Total moose observed | Moose /hour | Estimated population size |
|---|---|---|---|---|---|---|---|---|
| 1992/93 | 16 | 5 | 36 | 23 | 1,019 | 1,331 | -- | |
| 1993/94[a] | | | | | | | | |
| 1994/95 | 24 | 9 | 32 | 20 | 955 | 1,199 | -- | |
| 1995/96[a] | | | | | | | | |
| 1996/97 | 26 | 8 | 39 | 24 | 1,120 | 1,467 | -- | |

[a] No data available.

Table 2 Unit 15A moose harvest[a] and accidental death, 1992–96

| Regulatory year | Hunter Harvest | | | | | | | Accidental death | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated | | | | | | |
| | M (%) | F (%) | Unk. | Total | Unreported | Illegal | Total | Road | Train | Total | |
| 1992/93 | 141 | 2 | 0 | 143 | | | 40 | 99 | 0 | 99 | 282 |
| 1993/94 | 229 | 2 | 1 | 232 | | | 40 | 119 | 0 | 119 | 391 |
| 1994/95 | 233 | 2 | 3 | 238 | | | 40 | 168 | 0 | 346[b] | 584 |
| 1995/96 | 115 | 0 | 2 | 117 | | | 40 | 90 | 0 | 90 | 247 |
| 1996/97 | 257 | 0 | 3 | 260 | | | 40 | 160 | 0 | 160 | 460 |

[a] Excludes permit hunt harvest.
[b] 178 moose died due to starvation during winter.

Table 3 Unit 15A harvest data by permit hunt DM524, Skilak Loop Antlerless Moose, 1992–96

| Hunt No. /Area | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Unk. | Total harvest |
|---|---|---|---|---|---|---|---|---|---|
| DM524 | 1990/91 | 20 | 15 | 50 | 35 | 0 | 7 | 0 | 7 |
| Skilak | 1991/92 | 20 | 0 | 45 | 55 | 0 | 11 | 0 | 11 |
| Loop | 1992/93 | 20 | 0 | 70 | 30 | 0 | 6 | 0 | 6 |
| Antlerless | 1993/94 | 30 | 7 | 62 | 38 | 0 | 10 | 0 | 10 |
| | 1994/95 | 30 | 13 | 50 | 50 | 0 | 13 | 0 | 13 |
| | 1995/96 | 40 | 20 | 78 | 22 | 0 | 7 | 0 | 7 |
| | 1996/97 | No | Season | | | | | | |

Table 4 Unit 15A harvest data by permit hunt, DM526, Skilak Loop Spike/Fork bull moose, 1995–96

| Hunt No. /Area | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Unk. | Total harvest |
|---|---|---|---|---|---|---|---|---|---|
| DM526 | 1995/96 | 20 | 35 | 92 | 8 | 1 | 0 | 0 | 1 |
| Skilak | 1996/97 | No | Season | | | | | | |
| Loop | | | | | | | | | |
| Spike/Fork | | | | | | | | | |

Table 5 Unit 15A moose hunter[a] residency and success, 1992–96

| | Successful | | | | Unsuccessful | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Local[b] resident | Nonlocal resident | Nonresident | Total (%) | Local[b] resident | Nonlocal resident | Nonresident | Total(%) | Total hunters |
| 1992/93 | 121 | 14 | 2 | 143 (12) | 874 | 171 | 15 | 1064 | 1,207 |
| 1993/94 | 193 | 27 | 8 | 232 (16) | 968 | 193 | 13 | 1195 | 1,427 |
| 1994/95 | 197 | 30 | 5 | 238 (17) | 943 | 204 | 15 | 1187 | 1,425 |
| 1995/96 | 99 | 13 | 4 | 117 (10) | 871 | 133 | 11 | 1018 | 1135 |
| 1996/97 | 208 | 41 | 9 | 260 (19) | 1005 | 136 | 19 | 1164 | 1424 |

[a] Excludes hunters in permit hunts.

[b] Local = residents of Unit 15.

Table 6 Unit 15A moose harvest[a] percent by transport method, 1992–96

| Regulatory year | Percent of harvest | | | | | | | Unknown | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | | |
| 1992/93 | 13 | 3 | 12 | 5 | 0 | 4 | 59 | 4 | 143 |
| 1993/94 | 10 | 2 | 12 | 4 | 0 | 7 | 59 | 6 | 232 |
| 1994/95 | 6 | 1 | 15 | 6 | 0 | 4 | 63 | 4 | 238 |
| 1995/96 | 9 | 3 | 17 | 8 | 0 | 2 | 57 | 4 | 117 |
| 1996/97 | 6 | 3 | 11 | 8 | 0 | 2 | 66 | 4 | 260 |

[a] Excludes permit hunt harvest.

Table 7 Unit 15A moose harvest[a] chronology percent by week, 1992–96

| Regulatory year | Harvest periods | | | | | | | Unk | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | 8/10–8/19 | 8/20–25 | 8/26–8/31 | 9/1–9/5 | 9/6–9/10 | 9/11–9/15 | 9/16–9/20 | | |
| 1992/93 | -- | -- | 8[b] | 33[c] | 18 | 13 | 25 | 4 | 143 |
| 1993/94[d] | -- | 35 | 7 | 10 | 8 | 13 | 23 | 5 | 232 |
| 1994/95[d] | -- | 34 | 11 | 8 | 6 | 15 | 21 | 6 | 238 |
| 1995/96 | 11[e] | 20 | 10 | 10 | 9 | 15 | 21 | 5 | 117 |
| 1996/97 | 12[e] | 26 | 10 | 6 | 7 | 18 | 18 | 4 | 260 |

a Excludes permit hunt harvest.
b Archery season - 8/25–29, 92; 8/10–17, 95 and 96, S/F-50”.
c General open season Sep 1-Sep 20; S/F-50”.
d General open season Aug 20-Sep 20, S/F-50”; archery season (Aug 25–29) was closed in 1993 and 1994.
e Archery season August 10–17, S/F-50”.

# LOCATION

**GAME MANAGEMENT UNIT:** 15B (1,121 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Kenai Peninsula

# BACKGROUND

Historical records and reports from Kenai Peninsula residents indicate moose in Unit 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 believed to be one of the primary reasons for the growth of this population. A wildfire that burned approximately 500 $mi^2$ in Unit 15A in 1947 also benefited moose with improved winter range. A series of harsh winters from 1971 to 1974 subsequently reduced the moose population in Unit 15B. Population estimates show a decline from 1975 moose in 1971 to 843 by 1975. A census in February 1990 indicated a slight increase since 1975, placing the current moose population at 1042. Because habitat conditions are generally declining with plant succession and predation effects unchanged, we attribute the slight increase in population to moderate winters and reduced harvest due to the selective harvest program initiated in 1987.

# MANAGEMENT DIRECTION

## MANAGEMENT OBJECTIVES

*Central Kenai Peninsula*

- Maintain a population of moose with a bull to cow ratio of 15:100
- Allow for maximum opportunity to participate in hunting in 15B West

*In 15B East*

- Maintain a population of moose with a bull to cow ratio of 40:100
- Provide for the opportunity to harvest a large antlered bull under aesthetically pleasing conditions

# METHODS

We aerial survey in November and December of each year in selected trend count areas to determine the sex and age composition of the moose population.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

*Population Size*

A 1990 census of the 650.4 $mi^2$ of suitable moose habitat in Unit 15B revealed a population estimate of 1042 moose, with a 90% confidence interval ranging from 779 to 1305 or $\pm$25%. The estimated mean density was 1.2 moose/$mi^2$, with a range of 0.3 to 3.0. Because the census was conducted during February, after most bulls had shed their antlers, composition by sex was not determined. However, age composition of the population was completed, and calves comprised 9.5% of the population. The range for estimated percent calves of the population was 6.8 to 12.2 % or ± 28% at 90% CI.

This estimate indicates a slight increase in population size, compared to 843 animals estimated in 1975. Winters have been normal or mild since the mid-seventies with the exceptions of 1989/90 and 1994/95 when record snow depths were reported and 1991/92 when slightly higher than normal snow depths were recorded. Although a census has not been completed since 1990, the moose density in 15B is believed to be unchanged due to the generally normal winters since that time.

*Population Composition*

We collected insufficient data to determine sex and age composition for the entire unit. Aerial surveys were completed in the 4 count areas in 15B West in 1996, and we observed 224 moose (Table 1). Composition for this 15B West count was 39 calves and 33 bulls per 100 cows, and calves comprised 23% of moose observed (Table 1).

## MORTALITY

*Harvest*

Season and Bag Limit

| | Resident Open Season | Nonresident Open Season |
|---|---|---|
| *Unit 15B* that portion bounded by a line running from the mouth of Shantatalik Cr. on Tustumena Lake, northward to the west fork of Funny R. to the Kenai Nat'l Wildlife Refuge; then east along the refuge boundary to its junction with the Kenai R. and Skilak Lake; then south along the western side of Skilak R., Skilak Glacier and Harding Icefield; then west along the Unit 15B boundary to the mouth of Shantatalik Cr. One bull with 50 inch antlers by drawing permit only; up to 100 permits will be issued. | Sep 1–Sep 20<br>Sep 26–Oct 15 | Sep 1–Sep 20<br>Sep 26–Oct 15 |
| *Remainder of Unit 15B* One bull with spike-fork or 50-inch antlers | Aug 20–Sep 20 | Aug 20–Sep 20 |

Board of Game Actions and Emergency Orders. No Board of Game action or emergency orders were issued during this reporting period.

Hunter Harvest. In Unit 15B West, 284 hunters hunted, harvesting 35 bull moose in 1995. In 1996, 56 moose (55 bulls and 1 of unspecified sex) were harvested by 324 hunters (Table 2 and 4). The mean harvest during this 2-year period (46) represents a 10% decrease when compared to the mean harvest (51) from 1993 to 1994.

Of the 35 moose reported by hunters in 1995, 34 (97%) included antler spread data. Because the current bag limit is designed to focus harvest on yearling and mature bulls, we assumed an antler spread <35 inches met the yearling (spike-fork) requirement and antlers ≥35 inches wide were from mature bulls. The harvest comprised 20 (59%) spike-fork and 14 (41%) mature bulls. Six (18%) of the harvested bulls had an antler spread ≥50 inches. Successful hunters averaged 8.5 days afield, compared to 15.0 for all hunters.

Fifty-two (93%) of the 56 moose harvested in 1996 were reported with an antler spread. Thirty-five (67%) of these were yearling and 17 (33%) were mature bulls. Thirteen (25%) of these bulls had an antler spread 50 inches or larger. Successful hunters averaged 9.0 days afield, compared to 7.1 for all hunters.

In addition to harvest, 70 moose were reported killed in 15B West by vehicles from July 1, 1995 to June 30, 1996. In the same period for 1996–97, 80 moose were killed in vehicle/wildlife accidents. Moose killed by vehicles comprised 50% calves, 40% cows, and 10% bulls. Mortality from starvation was minimal during this reporting period due to mild winters. (Table 2).

Permit Hunts. Unit 15B East is managed as an area where hunters are able to view and harvest large antlered bulls. Hunters are allowed to harvest bulls with an antler spread of 50 inches or larger or bulls with antlers having 3 brow tines on at least 1 antler. It was also mandatory for successful hunters to present the antlers of their harvested bull for an official measurement by department staff. Hunters were selected by a random drawing with 100 permits issued for two separate seasons. A total of 2071 and 2399 applications were received during 1995 and 1996, respectively. Permittees reported harvesting 23 bull moose in 1995 and 27 in 1996 (Table 3). In 1995, 65 (65%) of the 100 permit holders hunted, yielding a success rate for hunters of 35 percent. In 1996, 69 (69%) of the permit holders hunted, resulting in a success rate for hunters of 39 percent. The mean antler spread from bulls harvested during 1995 was 52.0 inches with a range of 39 to 70.75 ($n$ = 19). Sixty-three percent (12 of 19) of these bulls had an antler spread of 50 inches or larger and 16% (3 of 19) were 60 inches or larger. The mean age of bulls in the harvest was 5.7 years, with a range of 3 to 11. The average antler of a bull harvested in 1996 was 52.6 inches with a range of 41 to 70.5. Sixty-five percent (11 of 17) of the bulls taken had an antler spread of 50 inches or larger and 12% (2 of 17) had a spread 60 inches or more. In 1995 and 1996, successful hunters averaged hunting 4.0 days and observed an average of 4 sublegal and 4 legal bulls per hunt.

Hunter Residency and Success. Thirty-four (97%) of the 35 successful hunters in 1995 were unit residents and 1 (3%) was a nonresident (Table 4). Unsuccessful hunters comprised 215 (86%)

unit residents, 26 (10%) nonunit state residents, and 8 (3%) nonresidents. Hunter success was 12 % ($n = 35$).

In 1996, 46 (82%) of 56 successful hunters were unit residents, 8 (14%) nonunit residents, 1 (2%) nonresident, and 1 (2%) hunter did not report residency. 324 hunters reported as unsuccessful, with similar residency percentages as unsuccessful hunters in 1995. Hunter success was 17% for 1996, ($n = 56$).

Transport Methods. In Unit 15B West, 60 and 66% of successful hunters reported highway vehicles as their primary means of transportation in 1995 and 1996, respectively (Table 5). The second most common transportation means was horses, at 20% in 1995 and 13% in 1996. Successful hunters did not use aircraft in either year. In Unit 15B East, over 90% of successful hunters used horses as their primary transport method to access their hunting area in each year.

Harvest Chronology. Twenty percent of 1995 and 33 percent of 1996 harvest occurred during the first 5 days of the season (Table 6). In 1995 the highest harvest (40%) occurred during the last 5 days of the season. In 1996 the highest harvest occurred during the first 5 days of the season and the second highest (19%) during the last 5 days.

*Natural Mortality*

The extent of weather-related mortality and predation by wolves and bears is unknown in Unit 15B. However, due to the moderately high density of black and brown bears and wolves, predation alone is believed to be controlling moose numbers at this time.

## HABITAT

*Assessment and Enhancement*

The last large acreage habitat enhancement occurred when a wildfire burned most of the unit in about 1890. No significant habitat enhancement, with the exception of the 1947 wildfire that burned 30,600 (8%) of the 398,000 acres below timberline, has occurred in this unit since 1890. The U.S. Fish and Wildlife Service enhanced approximately 3,700 acres of primarily winter habitat using a variety of mechanical tree removal techniques in 1968. Since 1968, 5 wildfires and 1 controlled burn have occurred, resulting in 11,500 acres burned or 3% of the acres below timberline. Several small areas (less than 50 acres) have also been designated as wood cutting areas for noncommercial use. Judging from the relative density of moose in the wood cutting areas, I believe these small logged areas provide additional moose browse. However, the quality of moose habitat in Unit 15B is relatively poor and declining due to natural plant succession.

# CONCLUSIONS AND RECOMMENDATIONS

The reported harvest in Unit 15B West of 35 moose in 1995 and 56 in 1996 indicates a normal harvest when compared with a mean of 49 moose killed annually from 1990 to 1994. The mean annual harvest since the initiation of the selective harvest program in 1987 to 1996 was 47, ranging from 39 to 56. A mean of 72 bulls was harvested annually during the 5-year period (1982–86) before the selective harvest program began. A comparison of these mean harvests indicates a mean reduction of 55% in harvest during the first 10 years of the program. A similar comparison of hunting effort shows a decline from a mean of 389 (range = 258–487) for the 5 years before selective harvest to a 10-year mean of 302 (range = 272–350) once the program began. A population modeling effort using estimated recruitment and mortalities parameters predicted the harvest would approach the 72 moose mean harvest reported before the selective harvest program by 1991. The current level with no upward trend does not suggest this objective harvest will be met. One possible explanation was moderate to severe winters resulting in high calf mortality during 1987/88, 1989/90, 1991/92, and 1994/95. The model prediction was based on normal winter mortality. Although winter mortality was not determined for these years, it was significant, reducing the number of bulls available for harvest. The decline in hunting effort also reduced harvest.

The permit hunt in 15B East continues to provide excellent hunting opportunities and is popular among resident hunters. The harvest of 23 bulls during 1995 and 27 in 1996 (mean = 25) indicates a slight decline when compared with the mean harvest from the previous 5 years of 28 moose. The harvest decline began in 1992, following the moderately severe winter of 1991/92 and continued through 1994. This decline in harvest is the result of 2 factors: the loss of mature bulls during the winter of 1991/92 and the increased price charged by outfitters to transport hunters into the area. Since only older bulls can be harvested in this area, the loss of bulls in these older age classes will take several years to replace. The only practical means of access into this area is by horse, but the cost of contracting with a local outfitter has increased beyond what most hunters are willing to pay. Although the number of hunters reported going afield has not declined, the number of hunters hunting in areas accessible by horse has declined. These remote areas have higher moose densities and provide a greater opportunity to harvest a moose.

Harvest levels are well within acceptable guidelines to maintain a minimum bull to cow ratio of 40 to 100. Since the objective for this area is to provide an opportunity to take a large bull and hunt under aesthetically pleasing conditions, I recommend no change in season. I would further recommend that the bag limit be maintained to preserve this area as a control area to evaluate changes in the male segment of the moose subpopulations in adjacent areas where both small and large bulls are harvested.

Summer and winter moose range on the Kenai National Wildlife Refuge in Unit 15B continue to deteriorate due to wilderness lands management policies that favor advanced forest succession. The department and U.S. Fish and Wildlife Service should cooperate on selected habitat enhancement projects (mechanical manipulation and prescribed burns) to improve moose habitat in the Slikok and Coal Lake areas.

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**SUBMITTED BY:**
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Table 1 Unit 15B aerial moose composition counts and estimated population size, 1992–96

| Regulatory year | Bulls: 100 Cows | Yearling bulls: 100 Cows | Calves: 100 Cows | Calves (%) | Adults | Total moose observed | Moose /hour | Estimated population size |
|---|---|---|---|---|---|---|---|---|
| 1992/93[a] | 50 | -- | 20 | 12 | 126 | 143 | -- | 1,042 |
| 1993/94[b] | | | | | | | | |
| 1994/95[a] | 57 | 15 | 29 | 15 | 414 | 489 | -- | |
| 1995/96[b] | | | | | | | | |
| 1996/97[c] | 33 | 17 | 39 | 23 | 173 | 224 | -- | |

[a] Survey data from 15B East permit area only.
[b] No data available.
[c] Survey data from 15B West and 15B-902.

Table 2 Unit 15B moose harvest[a] and accidental death, 1992–96

| Regulatory year | Hunter Harvest | | | | | | | Accidental death | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated | | | | | | |
| | M(%) | F (%) | Unk. | Total | Unreported | Illegal | Total | Road | Train | Total | |
| 1992/93 | 47 | 0 | 1 | 48 | | | 20 | 42 | | 42 | 110 |
| 1993/94 | 45 | 0 | 1 | 46 | | | 20 | 77 | | 77 | 143 |
| 1994/95 | 56 | 0 | 0 | 56 | | | 20 | 59 | | 94[b] | 170 |
| 1995/96 | 35 | 0 | 0 | 35 | | | 20 | 70 | | 70 | 125 |
| 1996/97 | 55 | 0 | 1 | 56 | | | 20 | 80 | | 80 | 156 |

[a] Excludes permit hunt harvest.
[b] Thirty-five moose died due to starvation during winter.

Table 3 Unit 15B East moose harvest data by permit hunt, 1992–96

| Hunt No. /Area | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Unk. | Total harvest |
|---|---|---|---|---|---|---|---|---|---|
| Totals for | 1990/91 | 100 | 29 | 56 | 44 | 31(100) | 0 | 0 | 31 |
| all permit | 1991/92 | 100 | 34 | 42 | 58 | 38(100) | 0 | 0 | 38 |
| hunts | 1992/93 | 100 | 24 | 66 | 34 | 26(100) | 0 | 0 | 26 |
| DM530-DM539 | 1993/94 | 100 | 31 | 65 | 35 | 24(100) | 0 | 0 | 24 |
| | 1994/95 | 100 | 34 | 68 | 32 | 21(100) | 0 | 0 | 21 |
| | 1995/96 | 100 | 35 | 42 | 35 | 23(100) | 0 | 0 | 23 |
| | 1996/97 | 100 | 31 | 42 | 39 | 27(100) | 0 | 0 | 27 |

Table 4 Unit 15B West moose hunter[a] residency and success, 1992–96

| Regulatory year | Successful | | | | Unsuccessful | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Total (%) | Local[b] resident | Nonlocal resident | Nonresident | Total(%) | |
| 1992/93 | 40 | 6 | 1 | 48 (15) | 247 | 24 | 1 | 272 | 320 |
| 1993/94 | 39 | 6 | 1 | 46 (13) | 269 | 32 | 1 | 304 | 350 |
| 1994/95 | 46 | 4 | 1 | 56 (17) | 222 | 31 | 2 | 267 | 323 |
| 1995/96 | 34 | 0 | 1 | 35 (12) | 215 | 26 | 8 | 249 | 284 |
| 1996/97 | 46 | 8 | 1 | 56 (17) | 248 | 17 | 2 | 268 | 324 |

[a] Excludes hunters in permit hunts.

[b] Local = residents of Unit 15B

Table 5 Unit 15B moose harvest[a] percent by transport method, 1992–96

| Regulatory year | Percent of harvest | | | | | | | Unknown | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | | |
| 1992/93 | 4 | 6 | 2 | 8 | 0 | 2 | 67 | 10 | 48 |
| 1993/94 | 0 | 7 | 9 | 2 | 0 | 0 | 65 | 17 | 46 |
| 1994/95 | 2 | 11 | 4 | 2 | 0 | 0 | 66 | 16 | 56 |
| 1995/96 | 0 | 20 | 0 | 11 | 0 | 0 | 60 | 9 | 35 |
| 1996/97 | 0 | 13 | 5 | 4 | 0 | 2 | 66 | 11 | 56 |

[a] Excludes permit hunt harvest.



Table 6 Unit 15B moose harvest[a] chronology percent by time period, 1992–96

| Regulatory year | Harvest periods | | | | | | Unknown | *n* |
|---|---|---|---|---|---|---|---|---|
| | 8/20-25 | 8/26-8/31 | 9/1-9/5 | 9/6-9/10 | 9/11-9/15 | 9/16-9/20 | | |
| 1992/93[b] | -- | -- | 48 | 13 | 19 | 17 | 4 | 48 |
| 1993/94[c] | 37 | 17 | 4 | 9 | 9 | 15 | 9 | 46 |
| 1994/95[c] | 30 | 5 | 5 | 9 | 4 | 39 | 7 | 56 |
| 1995/96[c] | 20 | 9 | 9 | 6 | 17 | 40 | 0 | 35 |
| 1996/97[c] | 33 | 2 | 11 | 15 | 13 | 19 | 7 | 56 |

[a] Excludes permit hunt harvest.
[b] General open season Sept. 1–20, S/F-50".
[c] General open season Aug. 20-Sept. 20, S/F-50".

# LOCATION

**GAME MANAGEMENT UNIT:** 15 C ( 2,441 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Southern Kenai Peninsula

# BACKGROUND

Moose are considered the region's most economically important wildlife species because of their popularity as a big game animal and their visible presence in developed areas. A rapid population decline occurred in the early 1970s after 3 severe winters in 4 years. The population increased during the 1980s in spite of high predator densities. In some areas the moose population has approached or exceeded carrying capacity.

Declining availability and quality of winter habitat are serious factors limiting moose on the lower Kenai Peninsula. During heavy snow accumulations, moose in Unit 15C are restricted to low elevation riparian habitats and south-facing benchlands. Some of the region's most important winter ranges include the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, the lower reaches of Fox River and Sheep Creek, and the Homer Bench. Community development in these areas is a serious threat to moose habitat.

Recently, spruce bark beetles (*Dendroctonus rufipennis*) have established in many old-growth spruce stands in Unit 15. Nearly half a million acres of land on the Kenai Peninsula were infected with spruce bark beetles in 1995 (Peterson 1996). Between 15,000 and 25,000 acres of land were logged on the Kenai Peninsula during 1995 and 1996 (Steve Albert ADF&G pers. commun.). Several prescriptive logging cuts have been initiated in response. To date, most logging has occurred on private land, although state timber sales have been planned. Reduction of old-growth forests may be beneficial to the moose population by enhancing nutritional quality and availability of winter food plants.

# MANAGEMENT DIRECTION

**MANAGEMENT OBJECTIVES**

- Maintain a population of 3000 moose
- Maintain a minimum posthunting sex ratio of 15 bulls:100 cows.

# METHODS

We collected annual moose harvest data through the statewide harvest reporting system and reported through the Wildlife Information Database (WIDB) software. We documented winter moose mortalities by reports from the public and from Homer Bench coincident with ADF&G field activities. Whenever practical, we inspected carcasses to determine their location, sex, age class, and approximate time and cause of death. A leg bone was collected to examine bone marrow for fat content.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

Results from aerial surveys and harvest reports indicate the moose population has remained relatively stable since the mid 1980s. The 1995–96 and 1996–97 winters were normal to mild with very little winter mortality. We believe the moose population is stable to slightly increasing at 2500–3000 animals.

*Population Size*

A complete Gasaway (1986) style census was completed during late winter of 1992 under optimal snow conditions. The lowland portion of Unit 15C (1190 $mi^2$) was censused, and a population estimate of 2079 moose was calculated from survey results. Confidence intervals around the estimated population ranged from $\pm$ 19.81% for 80% CI (1677–2491) to $\pm$ 31.48% for 95% CI (1425–2734). Low sightings of moose caused the high CI. The true population for the census area probably was near the upper confidence limits. We estimated an additional 200–300 moose in the mountainous portion of Unit 15C outside the census area.

*Population Composition*

Poor survey conditions precluded moose surveys in 1995. Only 1 count area was surveyed during 1996 fall sex and age composition surveys. Poor snow conditions in lower elevations precluded further surveys. We classified 343 moose with ratios of 28 calves:100 cows and 29 bulls:100 cows. Calf percentage was 22%, reflecting good neonatal survival in this unit where predation is normally high (Table 1).

### MORTALITY

*Harvest*

Season and Bag Limit. There was a Tier II subsistence season from 1–30 September in a portion of Unit 15C southwest of a line from Point Pogibshi to the point of land between Rocky and Windy Bay. The bag limit was 1 bull. Since 1993 only 1 moose has been taken annually.

Beginning in 1995, the Board of Game authorized limited drawing permit hunts for antlerless moose near Homer. In 1995 hunters had to be assisted by department personnel. Thirty permits were divided into 8 hunts of 3–4 permits between 20 October and 19 November. Hunters could not take calves or cows accompanied by calves. In 1996 the department assistance program was discontinued and the hunts restructured. Forty permits were divided between 2 hunt periods during the same dates as above. The remainder of Unit 15C moose season was from 20 August–20 September for 1 bull with spike-fork or 50-inch antlers.

Board of Game Action and Emergency Orders. During the Spring 1993 Board of Game Meeting, the board extended the general moose season by 11 days, creating a new season opening of 20 August. In addition, the board made it illegal for the public to feed moose. The Board of Game considered proposals to change or eliminate the Lower Kenai Controlled Use Area during the spring 1994 Board of Game meeting. The board amended the proposal and allowed a 2-day "window" during the last 10 days of the general season for hunters to use motorized vehicles.

A limited entry antlerless moose season was proposed for the Spring 1993 meeting. The local advisory committee failed to support this hunt; therefore, the board did not consider the proposal without committee support. A modified version of this proposal was again proposed to the board for the Spring of 1995 meeting with the support of the local advisory committees. The board passed this proposal, creating a series of antlerless moose hunts for the 1995 season. Hunters were restricted to taking cows without calves and had to be accompanied by department personnel. Antlerless moose hunts must be authorized annually. With input from the Advisory committees, the board reauthorized the antlerless hunts each year with moderate changes (see above).

Hunter Harvest. In 1995 hunters (973) harvested 192 moose during the general season (Table 2). One hundred thirteen (59%) hunters reported taking spike/fork bulls (<35 inches) compared to 72 (38%) hunters who harvested bulls with an antler spread of at least 50 inches or having 3 brow tines on at least 1 antler. Seven (4%) indicated either unknown size or illegal classification.

In 1996 1459 hunters harvested 347 moose during the general season (Table 2). Two hundred three (59%) hunters reported taking spike/fork bulls compared to 131 (38%) hunters who harvested bulls with an antler spread of at least 50 inches or having 3 brow tines on at least 1 antler. Thirteen reports (4%) indicated either unknown size or illegal classification. Successful hunters averaged 6.5 and 6.4 days hunting in 1995 and 1996, respectively.

Permit Hunts. There was 1 moose harvested in both 1995 and 1996 for hunt TM549 (Table 3). Sixteen antlerless moose were taken from DM541 through DM548 with a 59% success rate. Twenty two antlerless moose were taken in 1996 from DM549 and DM550 with a 65% success rate.

Hunter Residency and Success. Hunter success in 1995 was 20%. One hundred seventy-one (89%) successful hunters were Unit 15 residents, 17 (9%) were nonunit residents, and 4 (2%) were nonresidents (Table 4). Residency reported for unsuccessful hunters was 696 (89%) unit residents, 77 (10%) nonunit residents, and 8 (<1%) nonresidents.

Hunter success in 1996 was 24%. Three hundred three (87%) successful hunters were unit residents, 33 (10%) were nonunit residents, and 11 (3%) were nonresidents (Table 4). Residency reported for unsuccessful hunters was 993 (89%) unit residents, 100 (9%) nonunit residents, and 12 (1%) nonresidents.

Harvest Chronology. Reported chronology of harvest indicates the highest percentage of moose harvested occurred during the first 5 days of the season in all years. When the season began 20 August, this trend did not change (Table 5).

Transport Methods. In 1995 40% of successful hunters reported ATVs (ORVs and 4- wheelers) as their means of transportation (Table 6). The second most common transportation means for successful hunters was highway vehicles (40%). Hunters using horses (7%), aircraft (4%), or boats (5%) were the least common transport modes.

In 1996 42% of successful hunters reported highway vehicles as their means of transportation (Table 6). Hunters using highway vehicles increased in both years and may be a result of the increase in logging roads. The second most common transportation for successful hunters was ATVs (38%). Hunters using horses (7%), boats (4%), or aircraft (3%) were least common.

*Other Mortality*

In addition to reported harvest, a minimum of 63 moose were killed in Unit 15C by motor vehicles during 1995. At least 44 moose were killed in 1996 by motor vehicles (Table 2). Approximately 75% of these animals were salvaged for human use. The "Give Moose A Brake" program (Del Frate and Spraker 1991) continued its awareness activities throughout the peninsula. Crippling loss by hunters is unknown but is believed to be less than 10% of the reported harvest.

Both the 1995–96 and 1996–97 winters were considered mild with only 1 case of winter-related mortality reported. The moose population that winters on the Homer Bench continues to be at or above carrying capacity. Additional winter mortality is expected under normal or poor winter conditions.

## HABITAT

*Assessment*

Reduction of some old-growth forest in response to spruce bark beetle infestations through logging has begun in Unit 15C. We recommended logging prescriptions and reforestation techniques that encourage hardwood production. If hardwood production increases in these affected areas, moose will probably benefit from higher quality early seral stage habitat. However, if site preparation is not adequate, grass (*Calamagrostis* spp.) will compete with hardwood and spruce seedlings, creating less desirable moose habitat.

*Enhancement*

As part of licensing requirements, the Alaska Energy Authority (AEA) produced a mitigation plan to maintain or improve habitat within the Bradley Lake hydroelectric area. Moose were significantly affected through project construction and operation. Mitigation focused on compensation for habitat lost from the rising lake. Four options were considered, 3 of which were implemented. A total of 456 acres of land in the Fritz Creek drainage near Homer was purchased for $345,279. The AEA secured 2 interagency Land Management Agreements (137 acres) with the Department of Natural Resources. A $150,000 trust fund was established to provide money for moose management. Trustees were selected (1 each) from ADF&G, AEA, and the Homer Fish and Game Advisory Committee. An operational plan will be drafted to direct use of these lands and funds.

The department initiated 2 habitat enhancement projects on the Homer Bench. The public was encouraged to plant cuttings in a willow shoot-planting program. We also scarified abandoned hay fields. Approximately 24 acres were scarified using a Percheron disc trencher, pulled by a 518 log skidder during late June 1993. An average of 1.5 acres per hour was scarified at a cost of approximately $36.00 per acre, including the cost of equipment mobilization. We visited this area in 1995 and willow shoot densities had increased. It appears that disc trenching of hayfields allows willow seed to germinate and grow with less competition from the grass.

## CONCLUSIONS AND RECOMMENDATIONS

Both the 1995–96 and 1996–97 winters were mild with little documented mortality. Human-caused moose mortality, including road kills and harvest, represented 11–17% of the estimated moose population of 2500.

We identified 2 solutions to address the problems of declining habitat quality and starvation of moose in the Homer area. Habitat enhancement and population reduction within the affected areas would achieve these results. We believe both should occur simultaneously. In response to public outcry about moose calves' starving to death during the 1991–92 winter, we initiated a habitat enhancement program. The objective of the program was to enhance moose habitat near Homer by replacing undesirable plants with beneficial browse species. Approximately $185,000 remains in a moose-mitigation trust that has been set aside for use in the Homer area. We recommend a portion of this money be allocated to habitat enhancement as soon as possible. We also began population reduction efforts.

In 1995 we resubmitted the proposal for a limited antlerless moose hunt near the Homer benchlands (no more than 50 antlerless moose). The Board of Game authorized this hunt during their spring meeting with support from the local Advisory Committee. The goal of this program was to reduce the wintering moose population in the Homer area to allow browse to regenerate. We recommend that the program continue until the wintering population is approximately 360 animals.

The harvest of moose and hunter success under spike-fork/50 inch regulations fluctuated in response to previous winter severity. Spike-forks are almost always yearlings, and the proportion of young animals in the harvest should provide a "barometer" of the health of that particular cohort. By properly evaluating severity of a particular winter, we can also forecast the upcoming harvest. Schwartz et al. (1992) thoroughly reviewed the selective harvest system.

Impact of predation by wolves and bears is unknown. The unit supports an estimated 50–70 wolves in 5 to 6 packs, a ratio of at least 1 wolf:35 moose and no more than 1 wolf:50 moose. Bears exert additional pressure on Unit 15 moose. Black bear are abundant throughout the unit, and brown bear are common in all drainages supporting salmon. Predation should prevent the moose population from increasing, except in years with mild winters.

Bull to cow ratios have been higher than the recommended objectives of a minimum of 15 bulls per 100 cows since the selective harvest program was initiated. Adequate bull to cow ratios minimize the length of the rut and ensure that most cows conceive during their first estrous cycle (Schwartz et al 1994).

Hunter numbers have increased during the last 10 years. Some hunters have complained of overcrowded hunting conditions. To avoid shifts in hunting pressure, Unit 15C season length or bag limit should not be altered until similar changes are recommended for the remainder of Unit 15 and Unit 7.

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Table 1 Unit 15C fall aerial moose composition counts and estimated population size, 1992–97

| Regulatory year | Bulls: 100 Cows | Yearling bulls: 100 Cows | Calves: 100 Cows | Calves (%) | Adults | Total Moose observed | Moose /hour | Estimated Population size |
|---|---|---|---|---|---|---|---|---|
| 1992/93 | 28 | 10 | 33 | 21 | 663 | 834 | 62 | 2500 |
| 1993/94[a] | | | | | | | | |
| 1994/95 | 19 | 7 | 41 | 26 | 1,283 | 1,727 | 91 | 2500 |
| 1995/96[a] | | | | | | | | |
| 1996/97 | 29 | 11 | 37 | 22 | 285 | 343 | 73 | 2500 |

[a] No surveys conducted.

Table 2 Unit 15C moose harvest[a] and accidental death, 1992–97

| Regulatory year | Hunter Harvest: Reported M | F | Unk. | Total | Estimated Unreported | Illegal | Total | Accidental death Road | Train | Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992/93 | 185 | 0 | 0 | 185 | | | 30 | 45 | -- | 45 | 260 |
| 1993/94 | 270 | 0 | 0 | 270 | | | 30 | 75 | -- | 75 | 375 |
| 1994/95 | 307 | 0 | 0 | 307 | | | 30 | 53 | -- | 53 | 390 |
| 1995/96 | 192 | 0 | 0 | 192 | | | 30 | 63 | -- | 63 | 285 |
| 1996/97 | 347 | 0 | 0 | 347 | | | 30 | 44 | -- | 44 | 421 |

[a]Excludes permit hunt harvest.

Table 3 Unit 15C moose harvest data by permit hunt, 1992–97

| Hunt No. /Area | Regulatory year[1] | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Unk | Total harvest |
|---|---|---|---|---|---|---|---|---|---|
| TM549 | 1992/93 | 8 | 12 | 50 | 38 | 3 | 0 | 0 | 3 |
| Point | 1993/94 | 5 | 0 | 80 | 20 | 1 | 0 | 0 | 1 |
| Pogibshi | 1994/95 | 5 | 20 | 75 | 25 | 1 | 0 | 0 | 1 |
| | 1995/96 | 4 | 0 | 75 | 25 | 1 | 0 | 0 | 1 |
| | 1996/97 | 4 | 0 | 75 | 25 | 1 | 0 | 0 | 1 |
| DM541 DM548[b] | 1995/96 | 30 | 10 | 41 | 59 | 0 | 16 | 0 | 16 |
| DM549-DM550[c] | 1996/97 | 40 | 15 | 35 | 65 | 0 | 22 | 0 | 22 |

[a] Tier II moose hunt 940T changed to TM549.

[b] DM541-DM548 was for antlerless moose however cows accompanied by calves or calves were protected. Hunt was split to allow for department personnel to assist hunters. DM541-546 had 3 permits each and DM547-DM548 4 permits each

[c] DM549-DM550 was for antlerless moose however cows accompanied by calves or calves were protected. Two hunts of 20 permits each.

Table 4 Unit 15C moose hunter[a] residency and success, 1992–97

| Regulatory year | Successful | | | | Unsuccessful | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Total[c] (%) | Local[b] resident | Nonlocal resident | Nonresident | Total[c] (%) | Total hunters |
| 1992/93 | 163 | 13 | 7 | 185 (16) | 850 | 127 | 7 | 988 (84) | 1171 |
| 1993/94 | 230 | 28 | 6 | 270 (21) | 854 | 159 | 8 | 1044 (79) | 1314 |
| 1994/95 | 252 | 31 | 9 | 307 (22) | 910 | 143 | 21 | 1120 (78) | 1427 |
| 1995/96 | 171 | 17 | 4 | 192 (20) | 696 | 77 | 4 | 781 (80) | 973 |
| 1996/97 | 303 | 33 | 11 | 347 (24) | 993 | 100 | 12 | 1112 (76) | 1459 |

[a] Excludes hunters in permit hunts.
[b] Local = residents of Unit 15.
[c] Total columns include hunters that did not specify residency.



Table 5 Unit 15C moose harvest[a] chronology percent by weeks, 1992–97

| Regulatory year | Harvest periods | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8/20-25 | 8/26-8/31 | 9/1-9/5 | 9/6-9/10 | 9/11-9/15 | 9/16-9/20 | Unknown | *n* |
| 1992/93[b] | -- | -- | 43 | 18 | 14 | 21 | 4 | 185 |
| 1993/94[c] | 29 | 12 | 14 | 17 | 9 | 14 | 4 | 270 |
| 1994/95[c] | 34 | 11 | 16 | 10 | 11 | 13 | 4 | 307 |
| 1995/96[c] | 26 | 10 | 10 | 13 | 14 | 21 | 6 | 192 |
| 1996/97[c] | 33 | 12 | 11 | 14 | 9 | 14 | 4 | 347 |

[a] Excludes permit hunt harvest.
[b] General open season Sep 1-Sep 20.
[c] General open season Aug 20-Sep 20.

Table 6 Unit 15C moose harvest[a] percent by transport method, 1992–97

| Regulatory year | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unknown | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | Percent of harvest | | | | | | | | |
| 1992/93 | 4 | 17 | 3 | 24 | 0 | 14 | 31 | 7 | 185 |
| 1993/94 | 3 | 12 | 3 | 35 | 0 | 12 | 30 | 5 | 270 |
| 1994/95 | 2 | 9 | 5 | 35 | 0 | 7 | 38 | 5 | 307 |
| 1995/96 | 4 | 7 | 5 | 33 | 0 | 7 | 40 | 4 | 192 |
| 1996/97 | 3 | 7 | 4 | 37 | 0 | 8 | 39 | 2 | 347 |

[a] Excludes permit hunt harvest.

# LOCATION

**GAME MANAGEMENT UNIT:** 16A (1,850 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** West-side Susitna River (Kahiltna River to Chulitna River)

# BACKGROUND

Moose in Unit 16A are a subpopulation of the Matanuska–Lower Susitna Valley moose population. Griese (1995) described a low-density, pre-1940 subpopulation that responded to habitat changes and reduced predator populations by substantially increasing densities only to be negatively influenced by periodic deep-snow winters. Significant winter die-offs occurred at least once each decade beginning with the 1950s. The most recent die-off was during 1989/90, when 30–40% of 4000–5000 moose died from starvation and accidents on highways and the adjacent railroad. Recovery form this low level was slowed by subsequent deep-snow winters and increasing predator populations.

After the unit was established in 1973, historical annual hunter harvest fluctuated as a result of annual moose densities, bag limits, and improving hunter access. Since establishment of the unit, harvest did not exceed 308 moose (52 cows), reported for 1984/85 (Griese 1995). Harvest declined to 37 bulls during a 10-day season in 1990/91, but annual harvest rose to 140 moose as the 2 subsequent fall seasons were increased to 15 days. Harvest once again fell below 100 bulls with enactment of the spike-fork-50-inch selective harvest strategy (SF50 SHS) during fall 1993. During 1993–1994 harvest was divided between the SF50 general season (66–70 bulls) and a late any-bull permit hunt (28–49 bulls).

# MANAGEMENT DIRECTION

## MANAGEMENT GOALS

- Produce moderate, sustainable levels of moose for humans, while allowing sustainable harvest levels of predators to meet desirable predator–prey ratios

- Enhance wildlife viewing opportunities within state and national parks

## MANAGEMENT OBJECTIVES

- Maintain a posthunt population of 3500–4000 moose, with a sex ratio of 20–25 bulls:100 cows during the rut

- Achieve a minimum 3-year-average annual harvest of 300 moose.

# METHODS

During November 19–24 1996, we conducted a Becker survey (E. Becker pers. commun.) in Unit 16A, surveying 26 sample units (SU). We conducted a subsample of 17 SU to establish sightability correction factors (SCF) at each of 3 strata of moose density. We applied a SCF by stratum using MOOSEPOP (D. Reed pers. commun.).

We monitored harvest of moose with harvest reports and permit reports from any person who reported hunting in the unit. Bulls taken by permittees were required to provide antlers for measurement and lower front teeth for age determination. We measured antler width, number of points per brow palm, and number of points per main palm on each side. The Department of Public Safety (DPS) provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property (DLP).

Antler-age data collected from any-bull permit hunts were evaluated and presented in the Unit 14A management report. We evaluated harvest composition from the Unit 16A general season harvest by antler width class. We used 34.9 inches as the separation between spike-fork antlered bulls and those larger bulls with 3 or more brow tines.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

The subpopulation of moose in Unit 16A showed evidence of steady recovery through 1996–97, reaching population objective levels. Mild winter conditions during 1997–98 also allowed continued growth.

*Population Size*

During November 1996, under fair to good counting conditions, the moose population in Unit 16A was estimated at 3636 +/- 614 (80% CI) moose (Table 1). MOOSEPOP calculated SCF to be 1.25, 1.30, and 1.0 for high, medium and low-density strata, respectively. Because 1996–97 winter conditions were mild to moderate, we believe the 1997–98 posthunt population was within 3500–4000 moose

### POPULATION COMPOSITION

We estimated the November 1996 subpopulation included 33 bulls and 35 calves:100 cows (Table 1). We also observed 12 yearling bulls:100 cows at the beginning of the 20 November–15 December spike-fork (SF) hunt. Subpopulation composition during November 1996 was very similar to that observed during fall 1988, which was prior to the 1989/90 die-off and during a period when the any-bull bag limit was producing a harvest of 300 moose (Griese 1995).

### MORTALITY

*Harvest*

Season and Bag Limit. During falls 1993–1994 the open season in Unit 16A for resident and nonresident hunters was 20 August–20 September. The bag limit was 1 bull with a spike or fork antler on at least 1 side or with an antler spread that measured at least 50 inches or with antlers that had 3 or more brow tines on at least 1 side. We also issued 100 permits to take any bull during a 1–15 November hunt period. Permits were divided between 2 hunts, one north of Petersville Road (DM554) and one south (DM556).

During falls 1995–1997 the general open season was 20 August–20 September and 20 November–15 December for all resident and nonresident hunters. During the early season the bag limit was 1 bull with a spike or fork antler on at least 1 side or with an antler spread that measured at least 50 inches or with antlers that had 3 or more brow tines on at least 1 side. The late season bag limit was 1 bull with spike or fork antlers only. Drawing permits to take any bull were issued for the 20 August–20 September and 1–15 November special hunt periods. We issued 100 any-bull permits for the early hunt (DM552) and 100 any-bull permits for the November hunt (DM556).

Board of Game Actions and Emergency Orders. The board adopted the SF50 regulation in fall 1993. They extended hunting opportunities in fall 1995 in response to the population safeguards offered by SF50 antler restrictions. In addition to the existing 20 August–20 September SF50 season, the board allowed permits to be issued to take any bull during the periods of 20 August–20 September. The board also added a spike or fork bull-only season for the period of 20 November–15 December. The result was 73 days of hunting opportunity in the unit.

Hunter Harvest. The 1995–1997 average annual harvest was 177, which was 59% of the human use objectives for the unit.

Extended hunting opportunities allowed an increase in hunter harvest that reached 199 bulls during 1996–97 (Table 2). During 1995–1997, the any-bull permit harvest averaged 58 (Table 3), comprising slightly less than a third of the harvest during the later 2 years. The late SF-only hunt allowed the harvest of that antler class (1.0–34.9 inches) to double from an average of 26 (1993–1995) to an average of 55 (1996–1997). Although the late SF-only hunt began during 1995, the lack of snow during that fall essentially negated the new opportunity, thus SF harvest for that year was averaged with the previous 2 years.

In addition to the increased SF-antlered bull component, a strong increase in bulls in the 50-inch-or-greater antler class added substantially to the overall harvest. Harvest from this antler class during 1993–1994 averaged 21 bulls, while during 1996–1997 it averaged 48 bulls. Those bulls in the 35.0–49.9-inch antler class, assumed to be bulls with 3 or more brow tines, increased steadily between 1993 and 1997. This antler class produced 17–27 bulls.

Hunter Residency and Success. The number of hunters seeking moose in Unit 16A during the general open seasons peaked at 767 during 1997–98 (Table 4). During 1988–1989, Unit 16A hunters numbered 1172–1292 (Griese 1995). During 1995–1997, Unit 16 residents composed 10% of general season hunters, and nonresidents were 3%. The bulk of hunters going to Unit 16A were nonunit Alaskans residents. Unit residents were also responsible for 10% of the harvest, while nonresidents had a disproportionate 6%, indicating higher hunter success.

Combined hunter success was 16% during 1995–1997. This compares to a combined hunter success of 11% during 1993–1994 and 24% reported for 1988–1989 (Griese 1995). The difference is a product of the SF50 antler restrictions, the late SF-only hunting opportunity, and subpopulation size.

Harvest Chronology. During 1995–1997, Unit 16A hunters reported taking an average 6.2 moose/day during 15–20 September, which was their most productive period. The second most productive period was 8–14 September with 3.1 moose/day. The late SF-only season accounted for an additional 73 moose harvested during 1995–1997 (Table 4), 21% of the harvest.

Transport Methods. New opportunities to access Unit 16A when snow was on the ground produced a large proportion of hunters who used snowmachines to access the hunt area (Table 6). The late SF-only hunt and the November any-bull permit hunt provided new ground access opportunities for hunters. By 1996–97, 25% of successful hunters were using snowmachines. The low percentage (7) of successful hunters using snowmachines during 1995–96 was a function of too little snow during the hunt period.

The proportional use of boats and airplanes consequently declined with the addition of the late fall hunts. During 1989–90, 27% of successful hunters used boats, and 14% used airplanes (Griese 1995). By 1997–98 only 12% used boats and 8% used airplanes (Table 6).

*Other Mortality*

Although snow depth remained low throughout the winter of 1995–96, accidental mortality on highways was relatively high. DPS reported 15 moose deaths during that year (Table 2). During 1997–98, another relatively mild winter, DPS reported 14 moose killed. These levels, while not high compared to those typically observed in Units 14A and 14B, are equal to the number reported in Unit 16A during the harsh 1989–90 winter. Apparently, roadkill statistics within Unit 16A may not be used as verification of winter severity (Modafferi 1991).

### HABITAT

*Enhancement*

An 18,000-acre area east of the lower end of Kroto Creek (Deshka River) has been prepared for a controlled burn since 1994 (W. Collins pers. commun.). The burn has been delayed because of concern for public criticism in the wake of the 1995 Miller's Reach/Big Lake wild fire. In addition, ideal conditions for such a burn have not coincided with fire crew presence. Nonetheless, this controlled burn remains the single highest priority for habitat improvement within the Matanuska–Lower Susitna Valley area. When burned, this site would have high potential for benefiting moose in Unit 16A. Not only would it bolster winter food sources, it should also reduce the number of the unit's moose moving east and being subject to mortality in the highway and railroad corridor in Unit 14B.

## CONCLUSIONS AND RECOMMENDATIONS

The Unit16A moose subpopulation reached minimum objective levels during 1996–97 while hunter harvest of moose remained well below human use objectives. We believe the subpopulation reached a posthunt level near 3600 moose during 1996–97. We observed 33 bulls:100 cows, which was above the desired composition range of 20–25 bulls:100 cows. The higher proportion of bulls was caused by a combination of SF50 regulation limitations and limited access to much of the unit. These limitations on hunters consequently limited total harvest and caused the latest human-use measurement to be 59% of objective levels.

Hunter harvest under the SF50 regulation, even when adding any-bull permits and additional hunting days to the late SF-only general season, is unlikely to reach the current human-use objective of 300 moose. This moose subpopulation currently has a surplus of bulls that, if made available to hunters, would bring human-use levels to a 3-year average of only 250 moose. Upon reaching a subpopulation level of 4000 moose, the opportunity to issue cow permits would allow human use to possibly reach or exceed 300 moose annually, if future winters had no more than moderate snow-depths and no greater predator influence. To allow hunters to take the existing surplus would require relaxation of antler restrictions or a substantial increase in access opportunities.

The SF50 regulation was adopted for Unit 16A because it shared common boundaries with Units 13E and 14A where hunting pressure and access had allowed an overharvest of bulls. Concern for enforcement of the antler restriction along the boundary and concern for false reporting were principal reasons for its inclusion in the program. However, preexisting healthy bull:cow ratios due to previous low hunter success, a function of hunters' limited access, indicated Unit 16A would be a poor candidate for this harvest strategy. Ongoing evaluation (begun in 1993) of the SF50 regulation after 5 years of application will probably confirm the biological inappropriateness of the restrictions.

The highest priority management activity for Unit 16A is the 18,000-acre controlled burn planned for the area east of the Deshka River. This project is currently funded, and we wait for proper weather conditions and Department of Natural Resources and Division of Forestry fire crews to be available.

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MODAFFERI, R. D. 1991. Train moose-kill in Alaska: characteristics and relationship with snowpack depth and moose distribution in lower Susitna Valley. Alces 27:197–203.

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Table 1 Unit 16A fall aerial moose composition surveys, 1992–1997

| Regulatory year | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves (%) | Adults observed | Moose observed | Observable moose/mi$^2$ | Population estimate |
|---|---|---|---|---|---|---|---|---|
| 1992/93[a] | 36 | 11 | 32 | 19 | 779 | 963 | 1.7 | 2,900 ± 564[b] |
| 1993/94[a] | 24 | 10 | 24 | 16 | 698 | 828 | 1.9 | 3,284 ± 903[b] |
| 1994/95[c] | 36 | 11 | 33 | 19 | 804 | 981 | -- | 3,000–3,600 |
| 1995/96[d] | -- | -- | -- | -- | -- | -- | -- | -- |
| 1996/97[a] | 33 | 12 | 35 | 21 | 974 | 1,234 | 2.1 | 3,636 + 614[b] |
| 1997/98[d] | -- | -- | -- | -- | -- | -- | -- | -- |

[a] These data derived from "Becker Surveys" conducted in November. SCF estimated by strata.

[b] 80% C.I.

[c] These data obtained during sex and age composition survey of sample of SU surveyed during 1990/91.

[d] No surveys conducted.

Table 2 Unit 16A annual moose harvest and accidental death, 1992–97

| Regulatory | Reported | | | Estimated | | | Accidental[d] | | | Grand |
|---|---|---|---|---|---|---|---|---|---|---|
| year | M | F | Total[a] | Unreported[b] | Illegal[c] | Total | Road | Train | Total | total |
| 1992/93 | 136 | 0 | 138 | 7 | 5 | 12 | 9 | 0 | 9 | 159 |
| 1993/94 | 96 | 0 | 98 | 7 | 20 | 27 | 9 | 0 | 9 | 134 |
| 1994/95 | 115 | 0 | 115 | 7 | 20 | 27 | 4 | 0 | 4 | 146 |
| 1995/96 | 134 | 0 | 134 | 8 | 25 | 33 | 15 | 0 | 15 | 182 |
| 1996/97 | 197 | 1 | 199 | 14 | 25 | 39 | 4 | 0 | 4 | 242 |
| 1997/98 | 198 | 0 | 198 | 14 | 25 | 39 | 14 | 0 | 14 | 251 |

[a] Total includes moose of unknown sex.

[b] This estimate was derived by taking 5% of the total reported kill prior to SF-50 (1993) and up to 10% after.

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

[d] Roadkill is minimum number; in most years actual kill was probably higher. While there is no RR in the unit up to 60% of moose killed on RR in Unit 14B is from Unit 16A.

Table 3 Unit 16A moose harvest data by permit hunt, 1992–97

| Hunt no. | Regulatory year | Applicants | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Harvest | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Bulls | Cows | Total |
| DM554 and DM556 (1—15 November) | | | | | | | | | |
| | 1993/94 | 1,310 | 100 | 20 | 64 | 36 | 28 | 0 | 28 |
| | 1994/95 | 1,715 | 100 | 12 | 51 | 49 | 49 | 0 | 49 |
| | 1995/96[a] | 1,349 | 100 | 17 | 53 | 30 | 30 | 0 | 30 |
| | 1996/97[a] | 1,188 | 100 | 17 | 39 | 44 | 44 | 0 | 44 |
| | 1997/98[a] | 1,192 | 99 | 11 | 48 | 41 | 40 | 0 | 40 |
| DM552 (20 August—20 September) | | | | | | | | | |
| | 1995/96 | 711 | 100 | 22 | 53 | 25 | 25 | 0 | 25 |
| | 1996/97 | 774 | 100 | 15 | 65 | 20 | 19 | 0 | 19 |
| | 1997/98 | 652 | 99 | 10 | 72 | 18 | 16 | 0 | 17 |

[a] DM556 only.

Table 4 Unit 16A moose hunter residency and success, 1992–97

| Regulatory year | Successful | | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[a] resident | Nonlocal resident | Nonres | Unk | Total | (%) | Local[a] resident | Nonlocal resident | Nonres | Unk | Total | |
| 1992/93 | 7 | 126 | 4 | 1 | 138 | (16) | 34 | 630 | 24 | 21 | 709 | 847 |
| 1993/94 | 5 | 62 | 1 | 2 | 70 | (11) | 37 | 529 | 6 | 13 | 548 | 618 |
| 1994/95 | 6 | 57 | 2 | 1 | 66 | (12) | 32 | 488 | 8 | 4 | 500 | 566 |
| 1995/96 | 7 | 65 | 6 | 1 | 79 | (12) | 62 | 516 | 16 | 6 | 600 | 679 |
| 1996/97 | 13 | 116 | 4 | 3 | 136 | (19) | 53 | 513 | 12 | 8 | 586 | 725 |
| 1997/98 | 16 | 113 | 11 | 1 | 141 | (18) | 54 | 598 | 25 | 3 | 626 | 767 |

[a] Unit 16 residents.

Table 5 Unit 16A moose harvest chronology[a], 1992–97

| year | 20–26 | 27–31 | 1–7 | 8–14 | 15–20 | 20–30 | 1–7 | 8-15 | Unknown | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1992/93[b] | -- | -- | 75 | 51 | 6 | -- | -- | -- | 5 | 138 |
| 1993/94[c] | 13 | 4 | 8 | 19 | 24 | -- | -- | -- | 2 | 70 |
| 1994/95[c] | 6 | 4 | 11 | 13 | 29 | -- | -- | -- | 1 | 64 |
| 1995/96[d] | 8 | 1 | 11 | 12 | 35 | 5 | 1 | 4 | 2 | 79 |
| 1996/97[d] | 5 | 5 | 19 | 25 | 41 | 18 | 6 | 10 | 7 | 136 |
| 1997/98[d] | 20 | 7 | 11 | 29 | 36 | 17 | 4 | 8 | 9 | 141 |

[a] Does not include harvest from drawing permit hunts.
[b] Open season = Sep 1–15.
[c] Open season = Aug 20–Sep 20 (SF/50 –"spike-fork/ 50-inch").
[d] Open season = Aug 20–Sep 20 (Gen.SF/50), Nov 20–Dec 15 (SF-only).



Table 6 Transport method used by successful moose hunters[a] in Unit 16A, 1992–97

| | Percent of successful moose hunters | | | | | | | | Number |
|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unk | moose harvested |
| 1992/93 | 16 | 0 | 21 | 28 | 0 | 14 | 18 | 3 | 138 |
| 1993/94 | 13 | 0 | 23 | 34 | 0 | 11 | 19 | 0 | 70 |
| 1994/95 | 21 | 0 | 17 | 33 | 0 | 8 | 20 | 1 | 66 |
| 1995/96 | 7 | 0 | 16 | 24 | 7 | 12 | 32 | 1 | 134 |
| 1996/97 | 8 | 0 | 16 | 24 | 25 | 7 | 19 | 3 | 199 |
| 1997/98 | 8 | 0 | 12 | 28 | 23 | 6 | 19 | 4 | 198 |

[a] Includes general season and drawing permit hunters.

# LOCATION

**GAME MANAGEMENT UNIT:** 16B (10,405 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** West Side of Cook Inlet and Kalgin Island

# BACKGROUND

The recent history of the Unit 16B moose population was described by Griese (1996) Moose were uncommon before 1940 but grew to peak densities during the 1950s, the late 1960s, late 1970s, and mid 1980s. Their numbers were primarily controlled by winter die-offs occurring in response to deep snow. The most significant die-offs occurred during the winters of 1971–72 and 1989–90. Harkness (1993) estimated the population following the last die-off at 7300–7500

Following the severe winter of 1989–90, moose numbers in the unit continued to decline in response to continued deep snow winters and growing predator influence. Faro (1989) implied that predation on neonatal moose calves by bears influenced recruitment and caused the current declining trend. Masteller (in press) identified a growing wolf population, estimated at 50–75 wolves in 11–13 packs during 1996, that was influencing moose numbers. The moose:wolf ratio has declined from 200:1 to 100:1.

Since 1972, when Unit 16B was separated from 16A, hunter harvest of moose has declined from a high of 842 in 1973 to only 99 moose during a short 1990 season. For the period 1972–1992, annual reported harvest averaged 426 moose. Peaks in harvest also occurred during 1978 (589 total and 147 cows) and 1984 (616 total and 173 cows). Harvest subsequent to the 1984 peak reflected a general population decline. During fall 1989 the harvest was 345 moose, including 32 cows and not until 1997 did harvest again reach that level.

Hunting seasons for mainland Unit 16B have reflected a Board of Game effort to take advantage of a poorly accessed, underused moose resource. During 1962–74 hunting seasons in Unit 16B were liberal, including August 20–September 30 and November 1–30 seasons for either-sex moose. Through 1989, except 1975, 5–20-day antlerless moose hunts were held during September, but late season hunts were absent during 1976–82. Increasing numbers of hunters and lower moose recruitment caused late season hunts to be converted to permit hunts beginning in 1983. To assure local residents an opportunity to meet subsistence needs, permits were issued in the unit or, in later years, as Tier II permits. During 1992 the Board of Game adopted antler restrictions for bull moose beginning fall 1993 for most of Southcentral Alaska, including mainland Unit 16B (Griese 1995).

The Kalgin Island moose population resulted from a translocation of calves during 1957–59. Numbers grew to a peak density of 7 moose/$mi^2$ during 1981 (Taylor 1983) but was reduced to 1 moose/$mi^2$ by 1985. High moose densities severely degraded habitat and caused the adoption of restrictive population objectives that maintained moose densities at less than 1 moose/$mi^2$ while vegetation recovered (Faro 1990). During fall 1991 harvest was restricted to bulls only, but the Board of Game again authorized cow hunts by permit only in 1995–96 (Griese 1996).

# MANAGEMENT DIRECTION

## Management Goals

- Produce high yields of moose for humans and provide maximum opportunity to hunt moose

## Population Objectives

*Unit 16B (excluding Kalgin Island)*

- Maintain a minimum late-fall moose population of 6500 with a sex ratio of 20–25 bulls:100 cows

*Kalgin Island*

- Maintain a posthunt population of 20–40 moose with a sex ratio of no less than 15 bulls:100 cows

## Human Use Objectives

- Achieve and maintain a minimum 3-year average harvest of 300 moose by 1999.

# METHODS

During 1–2 November 1996, a "Becker" aerial survey (E. Becker, pers commun.) was conducted in the portion of Unit 16B north of the Skwentna River (northern subpopulation), excluding those SU within the boundary of Denali National Park/Preserve (DNP). Estimated subpopulation size and composition were calculated using MOOSEPOP (D. Reed, pers commun.). We applied a sightability correction factor (SCF) of 1.24, which was the average SCF from previous surveys in this area. DNP staff surveyed the 26 SU within DNP. The sum of data from the DNP SU was multiplied by the same SCF and then added to the remainder of the subpopulation data.

During 8–9 November 1996 we conducted a trend area composition survey of the unit's southern subpopulation, which includes the mainland drainages south of Beluga River and Beluga Lake. Portions of trend areas were surveyed at 2–4 min./$mi^2$. We surveyed Kalgin Island on 8 November at 5–7 min./$mi^2$.

During aerial surveys in fall 1997, we repeated our 1996 methods when surveying the southern subpopulation and Kalgin Island. We surveyed the southern subpopulation on 25 November and 3 December and surveyed Kalgin Island on 27 February. The late date prevented sex composition estimates for Kalgin Island.

We visited Kalgin Island during 9–10 July 1997, making a ground survey of the island's vegetation. We made visual estimates of stem density and previous browsing intensity. We covered 5–6 miles by foot, not including 2.5 miles on the beach.

We collected harvest and hunter effort data from harvest and Tier II permit reports.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

### *Population size*

Our most recent estimate of the unit late fall population was 5530–7540 moose. We combined Kalgin Island and southern subpopulation estimates for 1997 with the estimate for the northern subpopulation from 1996 and the estimate from the middle subpopulation from 1994 (Table 1). A reliable range estimate of the number of moose in the unit is hampered by the absence of recent survey data from the middle subpopulation (Beluga River to Skwentna River). The middle subpopulation was last adequately surveyed during fall 1994, when we estimated 3000–4000 moose.

Trend. Kalgin Island was estimated to have 55–65 moose after the 1994–95 hunting season (Griese 1996), but the survey of 1997 indicated a population of 30–40 moose (Table 1). The approximately 40% population reduction was intentional to bring the number of moose to within the objective density of 1.0–2.0 moose/mi$^2$.

We believe the mainland moose subpopulations remained stable near our combined estimate of 6410 moose for fall 1994. The winter of 1994–95 was moderate in severity (Griese 1996), probably reducing the adult population by 5–10%. Despite increasing predation levels by wolves and bears, winters during 1995–1997 were relatively mild, enhancing population recruitment. We received no reports from the public describing starvation or "winter-killed" moose, and spring brown bear hunters did not report seeing evidence of bears killing winter-stressed moose during 1997 or 1998.

### *Population Composition*

Bull:cow ratios depicted in Table 1 indicate all surveyed subpopulations during 1995–97 exceeded population objectives of 20–25 bulls:100 cows. Ratios of bulls:cows observed during this period ranged from 32:100 in the southern subpopulation to 67:100 on Kalgin Island during 1996. The ratio increased for the southern subpopulation to 37:100 in 1997.

We consistently observed 7–8 yearling bulls:100 cows among surveyed mainland subpopulations and between years (Table 1). This level of recruitment into the bull segment is average for the mainland portion of the unit for the 1990s. However, Kalgin Island displayed a highly unusual 67 yearling bulls:100 cows during 1996, perhaps a function of low sample size, high productivity, and almost no nonhunting mortality.

We observed consistent calf recruitment (through fall) in the southern subpopulation between 1996 and 1997, while calf recruitment in the northern subpopulation improved from the 1992–1994 period (Table 1). The southern subpopulation's 13–14 calves:100 cows was half of the ratio observed during 1994. During 1992–1994, the calf:cow ratio in the northern subpopulation remained low at 12–16 calves:100 cows. The 23 calves:100 cows observed during 1996 duplicated the observations of 1990.

Overwinter calf survival in February–March 1996 survey results (Table 1) was higher than normal survival for the northern and southern subpopulations. Despite a winter with little snow on the ground until early February, percent calves observed for northern and southern subpopulations reached only 6–7%. The relatively low calf percentage values for the middle subpopulation also indicate possible low calf recruitment the previous spring. The winter of 1994–95 produced deeper, more persistent snow depths than average, which may have affected calf nutrition in utero.

## MORTALITY

### *Harvest*

Season and Bag Limit. During 1995–96, 1996–97, and 1997–98, the resident and nonresident open season on Kalgin Island was 20 August–20 September with a bag limit of 1 bull or 1 antlerless moose by drawing permit only (up to 100 permits may be issued).

During 1995–96 and 1996–97 within that portion of the unit including the mainland drainages south and west of, and including, the Kustatan River drainage, the season for resident hunters was 20 August–30 September with a bag limit of 1 bull with SF50 antlers. The nonresident season was closed in this portion of the unit during both years.

During 1995–96 and 1996–97, between the Kustatan River drainage and Beluga River, Beluga Lake and Triumvirate Glacier ("remainder of the unit"), residents could hunt during 20 August–30 September for 1 bull with SF50 antlers or hunt during 1 December–15 January and, during 1995–96 only, 15 February–1 March (E.R. #96-96-BOG) for any bull by Tier II permit only. The nonresident hunting season was closed. The extension of the season into late February came in response to a request from the village of Tyonek. The board adopted an emergency regulation because too few moose had been harvested in the village as a result of the mild winter; snow had not pushed the moose close to the village. We issued 60 permits each year for this hunt (TM 569).

During 1995–96 and 1996–97 in the portion of the unit north and east of Beluga River, Beluga Lake, and Triumvirate Glacier (16B North), the resident and nonresident season was 20 August–30 September with a bag limit of 1 bull with SF50 antlers. In addition, residents could hunt during 15 November–31 December and, during 1995–96 only, 1–14 November by Tier II permit for any bull. We issued 200 permits for 2 hunt areas (TM565 and TM567). Flooding conditions during the last 10 days of the September general season prompted locals to call their legislative representative and request a longer season. Political pressure caused us to issue an emergency order (E.O. 02-11-95) to open the Tier II hunt early.

During 1997–98 in the mainland drainages south and west of the Beluga River, Beluga Lake, and Triumvirate Glacier (16B South), residents (only) could hunt for SF50 antlered bulls during 20 August–30 September or for any bull by Tier II permit only during 15 November–28 February. We issued 60 permits for TM569.

During 1997–98 in 16B North, residents and nonresidents were allowed to hunt 1 bull with SF50 antlers during 20 August–30 September. Residents could also hunt during the 15 November–28 February any-bull Tier II hunt. Again we issued 200 permits for hunts TM565 and TM 567.

During 1995–1997 the federal government offered a more liberal bag limit for qualified rural residents of the unit. Qualified residents could obtain a permit to take any moose during 25–30 September or 1 December–28 February. The permit allowed an alternative bag limit, not an additional moose. Registration permits were unlimited.

Board of Game Actions and Emergency Orders. In 1992 a group of local residents from 16B North filed a class action suit bringing to question the method for allocating Tier II permits. After changes to regulations by the Board during March of 1994 they amended that suit. The complainants first argued that the point system for allocation was unfair to local residents. Their amended suit argued that subsistence hunting and general season hunting could not occur in the same population unless subsistence needs were met first. Following the Board's actions to liberalize seasons during March 1995 (Griese 1996), a superior court judge ruled in June 1995 that the issue be remanded back to the board. She required the board to properly set subsistence levels, not schedule general and Tier II hunts on the same population, and to correct the department's appeal process (for point system scoring). After a temporary stay, to allow the fall 1995 hunt to occur, the board met in April 1996 to establish new findings. Those findings were adopted, and the complainants agreed to the findings in August 1996.

The April 1996 Board of Game findings for Unit 16B North identified moose subpopulations and their status, a harvestable surplus of 330 bulls, and a subsistence harvest of 160–180 moose with up to 90 moose being taken by Alaskan residents accessing the unit by aircraft. They also found that the current season length and time periods were adequate to meet subsistence needs by providing an ample winter season. Finally, they clarified that the fall hunt and winter Tier II hunt did occur on 2 unique moose subpopulations by nature of antler restrictions and winter mixing of moose generally not available during the fall season.

An emergency order was issued during fall 1995 that extended the late seasonTier II hunt in 16B North. Flooding during the last 10 days of the fall SF50 prevented some locals from hunting. Political influence on the department caused us to open the Tier II hunt 14 days early. After the 1995–96 winter Tier II hunt south of Beluga River, Beluga Lake, and Triumvirate Glacier (excluding Redoubt Bay drainages), the Tyonek village requested an extension to their hunt because hunter success had been low. Lack of snow, which normally forces moose to the village, was the cause of the poor success. The Board of Game responded by adding 15 February–1 March to the existing season.

At their March 1997 meeting, the board adopted regulations combining 2 areas and further liberalizing seasons in the unit. Seasons and bag limits in 16B South were made uniform. All Tier II hunts in the unit were given the same season dates, which reduced confusion and, because of the length, should eliminate the need for future emergency orders. Because of their actions for 16B South, the board was required to establish new findings.

The board adopted new findings for 16B South during April 1997. Those findings were that the subpopulation was near 1200 moose with a harvestable surplus of 105 bulls, the 1993 findings for a subsistence harvest of 39–47 moose was adequate and below the harvestable surplus, and recent season increases would enhance the opportunity for subsistence hunters to be successful. Again the board found that by nature of differences in antler formation or lack of antlers during winter that the winter and fall hunts were being directed at 2 unique portions of the subpopulation.

Hunter Harvest. Reported hunter harvest reached 305 moose during 1996–97 and grew to 328 during 1997–98 (Table 2) due to extended season lengths for both the general SF50 and Tier II hunts. The added opportunities actually began during 1995–96, but a winter essentially free of snow through the hunting seasons hindered a higher harvest. Winter permit harvest was responsible for a third of the total harvest during 1996–97 and 1997–98.

On Kalgin Island hunter interest, generated by the antlerless moose permit hunts and the opportunity to take any bull, resulted in a bull harvest ranging from 12–17 during 1995–1997. The addition of antlerless moose harvest by permit generated a total harvest that reached 28 moose during 1997–98.

Hunter Residency and Success. General season hunter success increased during the 5 years of SF50, reaching 32% during 1997–98 (Table 3). Success increased in spite of numbers of hunters again reaching into the 700s. Harvest by nonlocal residents more than doubled during the 5-year SF50 regulation, while unit resident harvest remained less than 20. Nonresident harvest remained constant through 1996–97 but increased by almost 25% during 1997–98.

Permit Hunts. The Kalgin Island antlerless moose hunt, and its 50–60 permittees, produced a consistent 17–19% permittee success rate (Table 4). We intended this new hunt to reduce the moose density on the island. With the bull harvest during the general season, these hunts have successfully reduced moose density to objective levels.

Tier II winter hunts for any-bull have produced varying rates of success since 1992, and season length and snow depth/presence were primarily responsible (Table 4). Lack of snow during early winter 1995–96 reduced hunter interest and success, producing the lowest permit success rate in years. Only during 1997–98 was season length similar for all Tier II hunts. During that fall, hunters in TM565 fared the best, producing a permittee success rate of 51%. Only 10% of TM569 permittees reported success.

Harvest Chronology. Harvest chronology in the general harvest for 1995–1997 reflected the addition of the very attractive 21–30 September period (Table 5). Over 1/3 of the reported harvest was in the additional 10 days. Despite the contribution of that period, the average number of moose killed/day was highest (8.1) during the 17–20 September period. During 21–30 September, hunters averaged 7.2 moose/day. The third most productive period was 10–16 September with 5.5 moose/day.

Transport Methods. The lack of snow on the ground during the winter Tier II hunt of 1995–96 resulted in a dramatic decline in the portion of successful hunters using snowmachines (Table 6). Better conditions the following years once again increased their use. Successful hunters using highway vehicles, presumably in the Tyonek–Beluga area, had their best showing in years during 1997–98.

*Other Mortality*

Effects of predation by wolves and bears were apparent in southern and northern subpopulations during 1995–1997 (Table 1). We observed a pack of 32–35 wolves during the 1995–96 winter survey (Griese 1996) and only 6% calves in this somewhat restricted subpopulation. In subsequent fall surveys, we observed no more than 10% calves in the same population, indicating that bears, too, are likely key factors in the low recruitment. The northern subpopulation produced only 7% calves during February 1995 and 14% during November 1996, probably effects of bear and wolf predation.

### HABITAT

*Assessment*

It appeared that Kalgin Island may not have possessed a high moose density potential even at the time of translocation. The island's woody vegetation was predominantly *Picea glauca* and *Alnus* sp. with an understory dominated by *Calamagrostis canadensis and Dryopteris* sp. We found low stem densities of palatable browse species in our investigation of the northern one-third of Kalgin Island. We estimated 75 stems/acre of *Salix* sp., 30–50 stems/acre of *Betula papyrifera,* and 50–200 stems/acre of *Viburnum edule*. The highest frequency of palatable species was on the bluff faces at the beach edge. At those transition sites browse species had grown beyond the reach of moose or were on slopes too steep to access. Considering the intensity of browsing, I believe the potential for regeneration or seeding seemed low. Browsing intensity on palatable species was heavy, ≥80%, and recurrent. Consequently, we concluded that moose densities should be managed closer to 1 moose/mi$^2$ than to 2 moose/mi$^2$. Recent spruce-bark beetle infestation reduced the living spruce component to 20% or less. A controlled burn could enhance the island's potential for higher moose densities.

## CONCLUSIONS AND RECOMMENDATIONS

With the exception of desired bull:cow ratios, we were very close to meeting both population and human use objectives in Unit 16B. The moose population was at or just below population objectives (6500 moose), but all subpopulations, except perhaps the middle, had bull:cow ratios exceeding the objective. When last surveyed, moose numbers on Kalgin Island were within density objectives, but bull:cow ratios were unusually high, far above the minimum of 15:100. The most recent 3-year average (1995–97) hunter harvest in the unit was 278 moose. The low harvest reported for 1995–96 (200) was primarily responsible for the average harvest not meeting the human use objectives of 300. Harvest during both 1996–97 and 1997–98 reached or exceeded 300 moose. We expect to reach the human use objective following the 1998–99 hunting season.

Since the 1980s (Faro 1989), we have known that bear populations influence fall calf numbers in Unit 16B. Recently, wolves have increased in numbers, and few effective harvest options are available for limiting their numbers (Griese 1996). Growing numbers of wolves reduce the likelihood of future moose population growth. A severe deep-snow winter could place the moose population in Unit 16B at a level that may not recover to objective levels, given current levels of predation.

Our evaluation of habitat on Kalgin Island points to the need to maintain low moose densities and possibly for future controlled burns. We should also consider controlled burns on the mainland. For 3 years we have identified a potential controlled burn site near Sucker Creek on the north side of Mount Susitna. Success with a planned controlled burn in Unit 16A may dictate our actions in the more remote Sucker Creek site.

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Table 1 Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, 1992–1997

| Regulatory year | Area | Date | Bulls: 100 cows | Yearling bulls: 100 cows | Calves: 100 cows | Calves(%) | Adults | Total moose observed | Moose observed/mi² | Population estimate |
|---|---|---|---|---|---|---|---|---|---|---|
| 1992–93 | Southern [a] | 12/15 | 36 | 5 | 12 | 12 | 109 | 124 | -- | -- |
| 1993–94 | Northern [b] | 11/15-20 | 50 | 10 | 16 | 10 | 374 | 416 | 1.1 | 2,006±432 [c] |
| | Middle [b] | 11/28-12/3 | 21 | 9 | 25 | 17 | 391 | 463 | 1.4 | 3,653±1,965 [c] |
| 1994–95 | Northern [d] | 11/13-18 | 42 | 10 | 12 | 7 | 405 | 431 | 1.0 | 1,400–2,400 |
| | Middle [d] | 11/18–25 | 26 | 4 | 24 | 16 | 314 | 374 | -- | 3,000–4,000 |
| | Southern [e] | 11/29–12/2 | 25 | 5 | 25 | 17 | 220 | 261 | 1.0 | 810–1,210 |
| | Kalgin Is. [f] | 11/18 | 35 | 15 | 65 | 33 | 27 | 40 | 1.7 | 55–65 |
| 1995–96 | Northern [a] | 2/27–28 | -- | -- | -- | 7 | 298 | 321 | -- | -- |
| | Middle [a] | 2/27–28 | -- | -- | -- | 12 | 855 | 969 | -- | -- |
| | Southern [a] | 2/29–3/3 | -- | -- | -- | 6 | 505 | 537 | 0.8 | 1,081±145 [c] |
| | Kalgin Is. [f] | 2/9 -- | -- | -- | 28 | 26 | 36 | 1.5 | 50-60 | |
| 1996–97 | Northern [b] | 11/1–2 | 38 | 7 | 23 | 14 | 422 | 484 | 1.2 | 1,590–2,240 |
| | Southern [a] | 11/8–9 | 32 | 7 | 14 | 10 | 305 | 338 | -- | 900–1,200 |
| | Kalgin Is. [f] | 11/8 | 67 | 27 | 60 | 26 | 25 | 35 | 1.5 | 45–55 |
| 1997–98 | Southern [a] | 11/25, 12/3 | 37 | 8 | 13 | 9 | 544 | 591 | -- | 900–1,300 |
| | Kalgin Is [f] | 2/27 | -- | -- | -- | 23 | 17 | 22 | 0.9 | 30–40 |

[a] Data from trend area composition survey (2–4 min./mi²)
[b] Data from Becker survey.
[c] 80% confidence intervals
[d] Data from sex and age composition survey (4–7 min./mi²) of sample units previously surveyed during 1990 survey.
[e] Data from J. VerHoef's regression sampling method for 1/3 of area (612 ± 151 (80% CI)) plus 350–550 estimated for remainder of area.
[f] Data from sex and composition survey (5–7 min./mi²)
[g] Data from a Gasaway, et al (1986) random stratified survey.

Table 2 Unit 16B annual moose harvest and accidental death, 1992–97

| Regulatory year | Reported M | Reported F | Reported Unk | Reported Total | Estimated Unreported | Estimated Illegal[a] | Estimated Total | Accidental Road | Accidental Other | Accidental Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992–93 | 234 | 1 | 3 | 238 | 20 | 25 | 45 | 0 | 0 | 0 | 283 |
| 1993–94 | 155 | 21 | 0 | 176 | 15 | 35 | 50 | 0 | 0 | 0 | 226 |
| 1994–95 | 230 | 0 | 0 | 230 | 15 | 35 | 50 | 2 | 3 | 5 | 285 |
| 1995–96 | 187 | 11 | 2 | 200 | 15 | 25 | 40 | 0 | 0 | 0 | 240 |
| 1996–97 | 293 | 9 | 3 | 305 | 20 | 25 | 45 | 1 | 0 | 1 | 351 |
| 1997–98 | 314 | 13 | 1 | 328 | 20 | 25 | 45 | 1 | 0 | 1 | 374 |

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

Table 3 Unit 16B moose hunter[a] residency and success 1992–97

| Regulatory year | Successful Local[b] resident | Successful Nonlocal resident | Successful Nonres | Successful Total | (%) | Unsuccessful Local[b] resident | Unsuccessful Nonlocal resident | Unsuccessful Nonres | Unsuccessful Total | (%) | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992–93 | 14 | 136 | 38 | 193 | (25) | 26 | 480 | 53 | 570 | (75) | 763 |
| 1993–94 | 15 | 78 | 36 | 132 | (23) | 28 | 358 | 40 | 437 | (77) | 570 |
| 1994–95 | 5 | 82 | 38 | 126 | (23) | 23 | 352 | 35 | 413 | (77) | 539 |
| 1995–96 | 4 | 116 | 38 | 161 | (25) | 28 | 406 | 44 | 485 | (75) | 646 |
| 1996–97 | 11 | 145 | 39 | 199 | (30) | 24 | 410 | 31 | 465 | (70) | 664 |
| 1997–98 | 12 | 165 | 48 | 229 | (32) | 21 | 419 | 36 | 479 | (68) | 708 |

[a] Does not include individuals participating in permit hunts.

[b] Unit 16 residents.

Table 4 Unit 16B moose harvest data by permit hunt, 1992–97

| Hunt No.[a] | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Harvest | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Bulls | Cows | Total |
| DM571 | 1995–96 | 50 | 34 | 48 | 18 | 0 | 9 | 9 |
| | 1996–97 | 60 | 35 | 47 | 17 | 2 | 8 | 10 |
| | 1997–98 | 61 | 53 | 28 | 19 | 0 | 11 | 11 |
| TM565 | 1993–94 | 30 | 13 | 10 | 73 | 7 | 15 | 22 |
| | 1994–95 | 138 | 32 | 23 | 40 | 55 | 0 | 55 |
| | 1995–96 | 140 | 40 | 46 | 10 | 14 | 0 | 14 |
| | 1996–97 | 141 | 26 | 38 | 35 | 49 | 0 | 49 |
| | 1997–98 | 139 | 30 | 32 | 37 | 50 | 1 | 51 |
| TM567 | 1993–94 | 15 | 33 | 0 | 67 | 4 | 6 | 10 |
| | 1994–95 | 59 | 19 | 14 | 66 | 39 | 0 | 39 |
| | 1995–96 | 60 | 30 | 58 | 7 | 4 | 0 | 4 |
| | 1996–97 | 61 | 18 | 30 | 49 | 30 | 0 | 30 |
| | 1997–98 | 60 | 12 | 38 | 48 | 29 | 0 | 29 |
| TM569 | 1993–94 | 60 | 45 | 35 | 20 | 12 | 0 | 12 |
| | 1994–95 | 58 | 43 | 29 | 17 | 10 | 0 | 10 |
| | 1995–96 | 60 | 32 | 47 | 18 | 8 | 1 | 11 |
| | 1996–97 | 60 | 45 | 25 | 28 | 16 | 0 | 17 |
| | 1997–98 | 59 | 53 | 24 | 17 | 9 | 1 | 10 |
| Total all State permit hunts | 1992–93[b] | 150 | 29 | 41 | 29 | 43 | 0 | 43 |
| | 1993–94 | 105 | 35 | 23 | 42 | 23 | 21 | 44 |
| | 1994–95 | 255 | 33 | 24 | 43 | 104 | 0 | 104 |
| | 1995–96 | 310 | 37 | 51 | 13 | 26 | 10 | 38 |
| | 1996–97 | 322 | 30 | 36 | 34 | 97 | 8 | 106 |
| | 1997–98 | 319 | 35 | 32 | 33 | 88 | 13 | 101 |

Table 4 Continued

| Hunt No.[a] | Regulatory year | Permits issued | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Harvest Bulls | Harvest Cows | Harvest Total |
|---|---|---|---|---|---|---|---|---|
| Federal | 1992–93 | 3 | 0 | 67 | 33 | 2 | 0 | 2 |
| | 1993–94 | n/a | n/a | n/a | n/a | 0 | 0 | 0 |
| | 1994–95 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 1995–96 | 4 | 25 | 50 | 25 | 0 | 1 | 1 |
| | 1996–97 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 1997–98 | 2 | 50 | 50 | 0 | 0 | 0 | 0 |

[a] T(M) = Tier II permit, D(M) = drawing permit.
[b] Hunt 979T was replaced by 3 hunts (TM565,TM567 and TM569)



Table 5 Moose harvest chronology during general season in Unit 16B, 1992–97

| Regulatory year | Percent of Harvest 8/20–26 | 8/27–9/2 | 9/3–9 | 9/10–16 | 9/17–20 | 9/21–30 | 1/10–23 | Unk | *N* |
|---|---|---|---|---|---|---|---|---|---|
| 1992–93[a] | -- | 7 | 26 | 39 | 24 | -- | -- | 4 | 191 |
| 1993–94[b] | 8 | 8 | 7 | 30 | 36 | -- | 7 | 5 | 132 |
| 1994–95[c] | 13 | 13 | 19 | 32 | 22 | -- | -- | 2 | 125 |
| 1995–96[d] | 9 | 4 | 14 | 22 | 14 | 35 | -- | 2 | 161 |
| 1996–97[d] | 5 | 12 | 8 | 22 | 14 | 38 | -- | 3 | 199 |
| 1997–98[d] | 5 | 7 | 11 | 16 | 20 | 37 | -- | 3 | 229 |

[a] Season dates = 1–20 September
[b] Season dates = 20 August–20 September, 10–23 January
[c] Season dates = 20 August–20 September
[d] Season dates = 20 August–30 September

Table 6 Successful moose hunter[a] transport methods in Unit 16B, 1992–97

| Regulatory year | Percent of harvest | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | *n* |
| 1992–93 | 52 | 3 | 15 | 3 | 16 | 3 | 2 | 238 |
| 1993–94 | 43 | 9 | 15 | 1 | 22 | 1 | 3 | 176 |
| 1994–95 | 33 | 7 | 10 | 2 | 39 | 1 | 2 | 230 |
| 1995–96 | 61 | 8 | 18 | 3 | 6 | 2 | 1 | 200 |
| 1996–97 | 44 | 6 | 14 | 4 | 25 | 2 | 3 | 305 |
| 1997–98 | 50 | 5 | 16 | 3 | 21 | 2 | 4 | 329 |

[a] All unit hunts except federal.

# LOCATION

**GAME MANAGEMENT UNIT:** 17 (18,800 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Northern Bristol Bay

# BACKGROUND

Moose appear to be relatively new inhabitants in the Bristol Bay area, possibly immigrating into the area from middle Kuskokwim River drainages during the last century. Until recently, populations were low and moose were found primarily in the Nushagak/Mulchatna River system. Local residents harvested moose opportunistically; however, caribou, reindeer, and beaver were historically the main sources of game meat. The department began collecting data on the Unit 17 moose population in 1971. At that time, Faro (1973) reported that moose were not abundant in the unit and that animals close to the villages were subject to heavy hunting pressure.

Hunting seasons have varied over the years, but the bag limit has always been restricted to bulls. A general disregard for seasons and bag limits by unit residents was suspected to be the principle factor contributing to historically low densities of moose in the unit (Taylor 1990).

In the last decade moose populations throughout Unit 17 have increased substantially in number and range. Reasons for this increase include: 1) moderate snowfalls in several successive winters; 2) low predation rates by wolves; and 3) decreased human harvest of female moose. The reduction in the female harvest was caused in part by a positive response by unit residents to department education efforts and an abundance of an alternative big game resource as the Mulchatna caribou herd grew and extended their range (Van Daele 1995).

Moose are now common along the Nushagak/Mulchatna Rivers and all of their major tributaries. They also are throughout the Wood/Tikchik Lakes area. Moose have successfully extended their range westward into the Togiak and Kulukak River drainages of Unit 17A. Within the past 3 years, a viable population has become established in the unit.

# MANAGEMENT DIRECTION

## MANAGEMENT OBJECTIVES

*Unit 17A*

Establish a minimum population of 100 moose, with a target population of 600–1000 moose

*Unit 17B*

Achieve and maintain a density of 1 moose/$mi^2$ on habitat considered good moose range

*Unit 17C*

Maintain a minimum density of 0.5 moose/$mi^2$

## METHODS

Aerial surveys of trend count areas in Units 17B and 17C have been used to sample the sex and age composition of the moose population and to collect data on the population trend in representative portions of the unit. Optimal survey periods were from 1 November through 15 December. During this time moose are established on their winter ranges and bulls still retain their antlers. In most years, however, suitable weather conditions, snow cover, and survey aircraft were not available during the optimal period. Late winter surveys of the upper Nushagak and Mulchatna River drainages were initiated in 1992/93 to investigate population trends.

Moose populations in Unit 17A were monitored in cooperation with personnel from the Togiak National Wildlife Refuge (TNWR). Late winter aerial surveys of the Togiak River drainage were conducted annually. Movements along the border of Units 17A and 17C were monitored during a radiotelemetry study from 1989 to 1994.

Aerial censuses of the population have been conducted in 3 portions of Unit 17. A portion of Unit 17C was censused in 1983. In 1987 the upper Mulchatna River area in Unit 17B was censused, and in 1995 western 17C and most of 17A were censused.

We collected harvest data by means of harvest ticket reports and registration permit reports. Non-reporting hunters were contacted by telephone and/or were sent 1 reminder letter. We monitored harvest and maintained an enforcement presence along the Nushagak and Mulchatna Rivers during the September portion of the hunting season.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

The population size in Unit 17A is probably between 350–450 moose. In February 1995, I worked with staff from the TNWR to census the moose population in units 17A and 17C West. The 1395 $mi^2$ study area contained an estimated 458 moose (+\-11.95% at 90% CI). We also derived an estimate of 100.9 moose (+\- 21.11% at 90% CI) for the Unit 17A portion of the study area (1042 $mi^2$) (Aderman et al. 1995). We have seen a continued increase in the number of moose in the unit since that census.

The moose population in Unit 17B was estimated to be 2500–3000 moose in 1987 (Taylor 1990). That estimate was based on extrapolations from a census in the upper Mulchatna area. Assuming that 50% of the unit is "good moose habitat," we established the management goal for the unit at 4900 moose. Survey data for this unit were inconsistent and difficult to interpret. Taylor (1988) noted that trend count data were of limited use in estimating moose density in Unit 17 and periodic censuses were the only objective method of assessing trends. Lacking such information, we initiated late winter surveys of major drainages to investigate population trends (Tables 1 & 2). From the available data, it appeared the moose population size in the unit was stable to increasing. Lacking census data, we cannot evaluate how close we are to the management objective.

The moose population in Unit 17C was estimated to be 1400–1700 moose in 1987 (Taylor 1990). That estimate was based on extrapolations from the moose census conducted in Unit 17C in 1983. The management objective for the unit is about 1750 moose. Survey data indicated the size of unit population has been increasing since the extrapolated estimates were made and the population probably meets the management objective.

*Population Composition*

Bull:cow ratios in all areas of Units 17B and 17C have historically been high, but no composition data were collected during this reporting period. Calf production and survival have fluctuated between areas and years. In 1997–98, late winter survey data indicated minimum calf percentages of 19.4% in the Mulchatna drainages and 24.9% in the upper Nushagak drainages.

*Distribution and Movements*

Much of Unit 17 is wet or alpine tundra, and moose are along the riparian areas in Units 17B and 17C. We know little about specific movement patterns, except that they are influenced primarily by the rutting season in late September and by snow conditions in early winter.

Data from a joint ADF&G–TNWR radiotelemetry study indicated that most moose radiocollared in Unit 17C stayed in the unit, but there was some movement into Unit 17A. One radiocollared moose and her calf moved from Weary River to Kulukak River (Jemison 1994). During the February 1995 census, 29 moose moved into 17A from the upper Sunshine Valley in 17C (Aderman et al. 1995).

## MORTALITY

*Harvest*

Season and Bag Limit. Unit 17A was closed to moose hunting.

Unit 17B was divided into 2 sections: the Mulchatna River drainage upstream and including the Chilchitna River, and the remainder of the unit. The upstream section was open for resident/subsistence and nonresident hunters from 1–15 September. The remainder of Unit 17B was open to all hunters during 1–15 September and for resident/subsistence hunters with a registration permit from 20 August to 15 September and during 1–31 December. The nonresident bag limit was 1 bull with 50" or greater antler spread or with 3 or more brow tines on at least 1 side. The bag limit for residents was 1 bull with spike/fork or 50" antlers (3+ brow tines). Registration permit holders could take 1 bull, regardless of antler size.

Unit 17C was also divided into 2 sections: the Iowithla River drainage, Sunshine Valley, and all portions of the unit west of the Wood River and south of Aleknagik Lake, and the remainder of the unit. Open season for resident hunters was from 1–15 September throughout the unit. An additional season was open in the remainder of the unit for resident/subsistence hunters with a registration permit from 20 August to 15 September and during 1–31 December. Nonresidents were prohibited from hunting in Unit 17C. The bag limits in 17C were the same as in 17B.

The registration hunt permits (RM583) were valid for both 17B and 17C. Permits were available to any Alaska resident who applied in person at Dillingham.

Board of Game Actions and Emergency Orders. In March 1997 the Board of Game made several changes to moose hunting regulations in Unit 17. A fall registration hunt (RM 573) for residents only was established in Unit 17A with restrictions on aircraft access and permits (issued only in Togiak village), and a harvest goal of 10 moose. This was the first authorized hunt in the unit since 1980. In Unit 17B, nonresident seasons was reduced by 5 days, remaining open during 5–15 September, and nonresidents were restricted to bulls with 50" antlers or 4 or brow tines on at least 1 side (previously 3 brow tines).

To reduce the number of instances of hunters failing to salvage meat from moose and caribou, the board passed a regulation requiring that hunters keep the meat of the legs and ribs on the bone until the meat was taken out of the unit or until it was processed for human consumption. This controversial regulation raised the ire of many nonlocal hunters and caught the attention of the Alaska State Legislature, prompting efforts to investigate and possibly rescind the regulation. ADF&G and Fish and Wildlife Protection staff and local residents all testified that fewer incidences of wasted meat were evident during the 1997–98 hunting season than had been seen in recent years. How much of this reduction was due to the new regulation was undetermined.

Hunter Harvest. Moose harvests in Unit 17 have increased 700% over the past 15 years (1982/83–49; 1996/97–392), primarily because of 550% increase in hunters afield (1982/83–149; 1994/95–968). The total harvest in the past 5 years in Unit 17B has ranged from 150 to 203, with an annual average harvest of 164.8 moose. In Unit 17C the 5-year mean annual harvest was 101.6, with a range of 78 to 127 moose (Table 3).

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the last 5 seasons, over 50% of the harvest has consisted of moose with antler spreads of 50" or greater. The largest antlers reported for each of these seasons have exceeded 70" (Table 4).

General Hunt. Unit 17A has not had an open moose hunting season since 1980–81; however, from 10 to 25 moose, of both sexes, were probably killed annually (Table 5). The reported harvest in the past 5 years for the general moose season in Unit 17B has ranged from 126 to 167, with a mean annual harvest of 145.4 moose (Table 6). In Unit 17C, the 5-year mean annual harvest has been 34.2 moose, with a range of 18 to 56 (Table 7).

Permit Hunts. Longer seasons and more liberal bag limits enticed many resident hunters to participate in the registration hunt (RM583) rather than the general hunt. Over 500 hunters have signed up for permits in the Dillingham office in recent years and, combined, have harvested 160 moose (Tables 8 and 9).

Hunter Residency and Success. The 5-year mean number of moose hunters participating in the general moose hunting season in Unit 17 was 505. Resident participation in the general hunt declined in 1993–94 and 1994–95 due to increased interest in the registration hunt but rebounded in recent years. Nonresident participation continued to increase even with more restrictive regulations. Hunter success ranged from 33 to 41% (Table 10). The 5-year mean annual hunter success for the unit was 36.4%.

Nonresidents accounted for 53% of reporting hunters, residents of Unit 17 composed 14%, and other residents of Alaska made up 34% of the total number of hunters in the general hunt from 1992/93 to 1996/97 (Table 10). The number of unit residents participating in the hunt was probably underreported because many individuals fail to obtain or submit harvest tickets.

The percentage of local residents participating in the registration hunt declined from 90% in 1992/93 to 65% in 1996/97. Hunter success in the registration hunt ranged from 27% to 44%, with a 5-year mean of 39% (Table 11).

Harvest Chronology. Because of changes in seasons and weather, chronology data did not indicate consistent patterns (Table 12 and 13). Unit residents were the main participants in the August and December seasons. These seasons were originally established to provide local residents with an opportunity to harvest moose not rutting. The regulatory intent was to discourage the illegal killing of female moose and harvests during closed seasons.

Transport Methods. Aircraft were the primary means of access for moose hunters in the general hunt in Unit 17 (5-yr mean = 68%, Table 14). Most participants in the registration hunt used boats for access (5-yr mean = 69%, Table 15). In 1990–91 off-road vehicles, including 3- and 4-wheelers, became prohibited modes of transportation for big game hunters in Unit 17B.

*Other Mortality*

During this reporting period there was little evidence of significant natural mortality. Predation by wolves and bears occurred regularly, and wolf numbers appeared to be increasing unitwide; however, predation did not appear to be limiting the moose population. Snow depths were below normal during each winter from 1993 to 1996, so moose were able to find abundant forage on winter ranges in riparian areas and winter mortality was light. During the spring of 1994, I received several reports from Nushagak River villagers of moose carcasses floating downstream during breakup. They speculated that the moose had fallen through thin ice earlier in the winter.

There were 2 reports of moose being killed by motor vehicles on the Lake Road near Dillingham (1 male, 1 female) during this reporting period. In both cases there was considerable damage to the vehicle, minor injuries to the occupants, and the meat was salvaged for human consumption.

A calf moose estimated to be a couple days old was abandoned in May 1997 after its mother and twin sibling were chased off by loose dogs near the Nerka subdivision in Dillingham. Our attempts to reunite the family were frustrated by the loose dogs and a group of well-meaning, but overly protective, neighbors. We eventually captured the calf and transported her to the Anchorage Zoo, where "Hilary" became a popular attraction with media and zoo patrons.

Illegal harvest continued to be a problem in Unit 17A. Unit residents actively pursued moose with aircraft and snowmachines during the winter and spring. Both male and female moose were taken, but reduced snow levels from 1994 to 1996 reduced the illegal harvest. Illegal harvests in Units 17B and 17C have decreased dramatically in the past 10 years. There has also been a significant decline in the number of female moose taken. It is now common to see moose near Nushagak River villages throughout the winters. During the 1997/98 winter survey, 36 moose were within one-half mile of the village of Koliganek.

## HABITAT

### *Assessment*

No formal habitat monitoring programs were conducted in Unit 17. Winter range condition was subjectively assessed while monitoring the September hunting season. Moose winter ranges along the Nushagak and Mulchatna Rivers, and along the lower reaches of the major tributaries to those rivers, were in very good to excellent condition. Although there was evidence of heavy browsing, willow stands on gravel bars were abundant and included a good mix of brush heights. Winter range conditions in the middle and upper reaches of the tributaries have not been assessed but were probably not as productive.

### *Enhancement*

No habitat enhancement activities have been documented in Unit 17. Because of the relative inaccessibility of most of the unit, and the occurrence of natural habitat change, man-caused habitat enhancement activity was not practical or necessary.

Lightning caused wildfires are not uncommon in the unit each summer, particularly in Unit 17B. During the summer of 1997 the unit experienced the most active fire season in recorded history. Extremely dry conditions and a plethora of lightning strikes resulted in fires consuming significant acreage. Spruce/birch forest habitat was the most affected, but moist tundra habitats were also impacted. Smoke was thick during most of July, at times restricting air travel. Most fires were monitored and fire crews attempted to contain those that threatened villages and structures. The fires burned a complex mosaic of habitats and should enhance moose browse in the future.

In most years the most important natural force responsible for enhancing moose habitat was the scouring of gravel bars and low-lying riparian areas by ice and water during spring thaw. This was especially true for the Nushagak and Mulchatna Rivers and the lower reaches of the major tributaries to those rivers.

## NONREGULATORY MANAGEMENT PROBLEMS

Dramatic increases in the number of caribou in the Mulchatna herd continued to impact the moose population in the unit, even though there was little direct competition between these ungulates. Short-term impacts of large caribou populations include decreased illegal moose harvest by local residents and increased hunting pressure by other residents and nonresidents interested in combination hunts for moose and caribou. The most significant long-term impact on moose may be the response of predator populations to abundant prey resources. Wolf numbers increased in the unit during this reporting period. There were few instances of wolves following the caribou herd, so when the herd moved out of a pack's territory, moose became the primary source of meat for wolves. The same prey shift can be expected when the caribou herd crashes.

## CONCLUSIONS AND RECOMMENDATIONS

Predation by wolves, bears, and humans continued to increase in recent years; however, good browse conditions and a continuing series of mild winters resulted in stable moose populations in Unit 17 during this reporting period. The population in Unit 17C appeared to be at or approaching the management objective, and survey data indicate that the population was healthy and productive. Although objective habitat evaluations were lacking, it appeared that browse quality and quantity were sufficient to support the population on most of the winter ranges.

Fall trend counts are notoriously unreliable in providing consistent data on moose populations in Unit 17. Suitable survey conditions, including complete snow coverage, light winds, and moose movements onto winter range, rarely occur before antler drop. Late winter surveys of the major drainages were initiated in 1992 to supplement fall composition counts. Periodic censuses of portions of the unit would provide the best population information.

Moose harvest has increased in Units 17B and 17C during the past decade. This increase was partially caused by the increase in the number of hunters afield as the number of caribou in the area attracted more nonlocal hunters to the Nushagak/Mulchatna River drainages. The increased harvest was also a result of improved hunter success. Hunting methods and harvest chronology have remained consistent in recent years, so the increased success may indicate a greater density of moose in the unit.

The moose population in Unit 17A has increased dramatically in the past couple of years. Unit residents anxious to take advantage of this increase were given that opportunity during the 1997/98 season. We worked with local residents and with staff from TNWR and developed a draft moose management guideline that establishes a target of 600–1000 moose in the unit. We also intend to enter into a cooperative moose research project with TNWR in March 1998 to: 1) document population trends, 2) evaluate the moose habitat in the unit and estimate carrying capacity, and 3) develop appropriate management goals and regulatory proposals. It is critical that these cooperative efforts be coupled with continued efforts to curtail illegal harvest of moose in the Togiak valley.

The Board of Game had considered impacts of liberalized caribou seasons on the Unit 17 moose population and adjusted the moose season for 1993/94; the board adjusted it again in 1997. The board and the department will need to continue managing these 2 ungulate populations and monitoring predator populations.

Recommended management actions for the next few years include:

1 Establish 5 moose census areas within Unit 17 and attempt to census 1 area each winter on a rotating basis;

2 Develop a final moose management plan for Unit 17A in cooperation with Togiak National Wildlife Refuge, local advisory committees, and local citizen groups;

3 Continue to manage Unit 17 moose populations conservatively as long as large numbers of hunters are attracted to the area in pursuit of Mulchatna caribou;

4 Retain current antler restrictions for at least 5 years and reevaluate effects of these regulations before the 1999 Board of Game meeting; and

5 Continue to seek cost-effective and accurate methods to obtain bull:cow ratios within the unit.

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Table 1 Unit 17B, Upper Mulchatna river drainages moose trend count areas, late winter aerial moose counts, 1992/93–1997/98

| Regulatory year | Survey area | | | | Survey Total | Moose/ hour | Relative Snow Level[b] |
|---|---|---|---|---|---|---|---|
| | Mulchatna River[a] | Mosquito River | Stuyahok River | Old Man River | | | |
| 1992/93[c] | 304 | 64 | 13 | 126 | 507 | 194.3 | moderate |
| 1993/94[d] | 201 | 47 | 6 | 102 | 356 | 114.5 | low |
| 1994/95[fe] | 354 | 96 | 9 | 83 | 542 | 140.1 | moderate |
| 1995/96[f] | 62[f] | 14 | 4 | --- | 90 | 52.9 | very low |
| 1996/97[g] | --- | -- | -- | --- | 0 | --- | bare ground |
| 1997/98[h] | 354 | 96 | 9 | 83 | 484 | 258.1 | deep |

[a] Survey area encompasses the Mulchatna River from its mouth to Red Veils, including all riparian habitat within 1 mile of the river.
[b] Subjective evaluation of snow depths within the vicinity of the survey area (actual depths are recorded in field notes)
[c] Mulchatna River drainages surveyed on 25 Jan. 1993, other drainages surveyed on 9 Feb. 1993.
[d] Mulchatna River drainages surveyed on 15 Mar. 1994, other drainages not surveyed.
[e] Mulchatna River drainages surveyed on 23 Feb. 1995, other drainages surveyed 24 Jan. 1995.
[f] All drainages surveyed on 11 March 1996. Mulchatna and Old Man surveys were aborted due to bare ground.
[g] No survey conducted due to extremely low snow levels and a preponderance of bare ground.
[h] All drainages surveyed on 23 January 1998.

Table 2 Units 17B and 17C, Upper Nushagak, Nuyakuk, and Wood river drainages moose trend count areas, late winter aerial moose counts, 1992/93–1997/98

| Regulatory year | Survey area: Nushagak River[a] | Nuyakuk River[b] | King Salmon River[b] | Wood River[c] | Survey Total | Moose/ hour[d] | Relative Snow Level[e] |
|---|---|---|---|---|---|---|---|
| 1992/93[f] | 319 | 12 | -- | 19 | 350 | 203.2 | moderate |
| 1993/94[g] | --- | -- | -- | -- | 0 | --- | low |
| 1994/95[h] | 484 | 4 | -- | 42 | 530 | 281.4 | moderate |
| 1995/96[i] | 401 | 7 | 26 | --- | 434 | 253.8 | very low |
| 1996/97[j] | --- | -- | -- | --- | 0 | --- | bare ground |
| 1997/98[k] | 882 | -- | -- | -- | 882 | 363.0 | deep |

[a] Survey area encompasses the Nushagak River from its Koliganek to Big Bend, including all riparian habitat within 1 mile of the river. Entire survey area is within unit 17B.

[b] Survey area within unit 17B.

[c] Survey area within unit 17C.

[d] Moose per hour analysis only includes the Nushagak River portion of the survey.

[e] Subjective evaluation of snow depths within the vicinity of the survey area (actual depths are recorded in field notes)

[f] All areas surveyed on 3 February 1993.

[g] No survey conducted.

[h] All areas surveyed on 24 January 1995.

[i] All areas surveyed on 6 March 1996.

[j] No survey conducted due to extremely low snow levels and a preponderance of bare ground.

[k] All drainages surveyed on 5 February 1998.

Table 3 Moose harvest data for all hunts in Unit 17, 1964/65–1996/97

| Regulatory year | Reported harvest | Hunters afield | Success rate | Unit[a] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 17A | 17B | 17C | Unk |
| 1964/65 | 32 | --- | --- | --- | --- | --- | --- |
| 1965/66 | 42 | --- | --- | --- | --- | --- | --- |
| 1966/67 | 26 | 90 | 29% | --- | --- | --- | --- |
| 1967/68 | 38 | 77 | 49% | --- | --- | --- | --- |
| 1968/69 | 46 | 66 | 70% | --- | --- | --- | --- |
| 1969/70 | 15 | 31 | 48% | --- | --- | --- | --- |
| 1970/71 | 25 | 35 | 71% | --- | --- | --- | --- |
| 1971/72 | 37 | 63 | 59% | --- | --- | --- | --- |
| 1972/73 | 38 | 74 | 51% | --- | --- | --- | --- |
| 1973/74 | 42 | 93 | 45% | --- | --- | --- | --- |
| 1974/75 | 69 | 119 | 58% | --- | --- | --- | --- |
| 1975/76 | 115 | 207 | 56% | --- | --- | --- | --- |
| 1976/77 | 49 | 168 | 29% | --- | --- | --- | --- |
| 1977/78 | 54 | 113 | 48% | --- | --- | --- | --- |
| 1978/79 | 65 | 160 | 41% | --- | --- | --- | --- |
| 1979/80 | 33 | 68 | 49% | --- | --- | --- | --- |
| 1980/81 | 89 | 212 | 42% | --- | --- | --- | --- |
| 1981/82 | 76 | 209 | 36% | --- | --- | --- | --- |
| 1982/83 | 49 | 149 | 33% | --- | --- | --- | --- |
| 1983/84 | 127 | 293 | 43% | 0 | 72 | 48 | 0 |
| 1984/85 | 158 | 344 | 46% | 0 | 86 | 70 | 0 |
| 1985/86 | 148 | 401 | 37% | 0 | 94 | 52 | 0 |
| 1986/87 | 202 | 486 | 42% | 0 | 122 | 73 | 0 |
| 1987/88 | 207 | 499 | 42% | 0 | 152 | 42 | 0 |
| 1988/89 | 187 | 457 | 41% | 0 | 157 | 28 | 0 |
| 1989/90 | 175 | 438 | 40% | 0 | 122 | 48 | 0 |
| 1990/91 | 225 | 489 | 46% | 0 | 178 | 44 | 0 |
| 1991/92 | 268 | 590 | 45% | 0 | 172 | 85 | 0 |
| 1992/93 | 263 | 561 | 47% | 0 | 160 | 90 | 13 |
| 1993/94 | 249 | 705 | 35% | 1 | 150 | 78 | 20 |
| 1994/95 | 296 | 800 | 37% | 0 | 167 | 94 | 69 |
| 1995/96 | 350 | 931 | 38% | 0 | 194 | 119 | 57 |
| 1996/97 | 392 | 968 | 41% | 0 | 203 | 127 | 62 |

[a] Harvest data not broken down by unit prior to 1983/84.

Table 4 Unit 17 moose antler sizes (percent) in the reported harvest, 1992/93–1996/97

| Regulatory year | Antler size | | | Largest antlers |
|---|---|---|---|---|
| | <30" | 30–50" | >50" | |
| 1992/93 | 6 | 36 | 57 | 80" |
| 1993/94 | 3 | 30 | 68 | 73" |
| 1994/95 | 9 | 29 | 62 | 73" |
| 1995/96 | 7 | 35 | 57 | 78" |
| 1996/97 | 9 | 26 | 65 | 75" |

Table 5 Unit 17A moose harvest[a] and accidental death, 1992–1997

| Regulatory year | Hunter Harvest | | | | | | | Accidental death | Grand total |
|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated | | | | |
| | M (%) | F (%) | Unk. | Total | Unreported | Illegal | Total | | |
| 1992/93 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 | 15 |
| 1993/94 | 1 (100) | 0 | 0 | 1 | 0 | 20 | 20 | 0 | 21 |
| 1994/95 | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 0 | 25 |
| 1995/96 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | 0 | 15 |
| 1996/97 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 | 10 |

[a] Excludes permit hunt harvest.

Table 6 Unit 17B moose harvest[a] and accidental death, 1992/93–1996/97

| Regulatory year | Hunter Harvest | | | | | | | Accidental death | Grand total |
|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated[b] | | | | |
| | M (%) | F (%) | Unk. | Total | Unreported | Illegal | Total | | |
| 1992/93 | 152 (100) | 0 | 0 | 152 | 0 | 0 | 0 | 0 | 152 |
| 1993/94 | 125 (100) | 0 | 1 | 126 | 0 | 0 | 0 | 0 | 126 |
| 1994/95 | 132 (100) | 0 | 0 | 132 | 0 | 0 | 0 | 0 | 132 |
| 1995/96 | 149 (100) | 0 | 1 | 150 | 0 | 0 | 0 | 0 | 150 |
| 1996/97 | 167 (100) | 0 | 0 | 167 | 0 | 0 | 0 | 0 | 167 |

[a] Excludes permit hunt harvest.

[b] No estimates of unreported/illegal harvests have been made for this unit.

Table 7 Unit 17C moose harvest[a] and accidental death, 1992/93–1996/97

| Regulatory year | Hunter Harvest | | | | | | | Accidental death | Grand total |
|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated[b] | | | | |
| | M (%) | F (%) | Unk. | Total | Unreported | Illegal | Total | | |
| 1992/93 | 56(100) | 0 | 0 | 56[c] | 0 | 0 | 0 | 0 | 56 |
| 1993/94 | 18 (100) | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 18 |
| 1994/95 | 28 (100) | 0 | 0 | 28[d] | 0 | 0 | 0 | 1[e] | 29 |
| 1995/96 | 32(100) | 0 | 0 | 32[f] | 0 | 0 | 0 | 0 | 32 |
| 1996/97 | 37(100) | 0 | 1 | 37[g] | 0 | 0 | 0 | 2[h] | 40 |

[a] Excludes permit hunt harvest.

[b] No estimates of unreported/illegal harvests have been made for this unit.

[c] Does not include 3 bulls from an unspecified portion of Unit 17.

[d] Does not include 1 bulls from an unspecified portion of Unit 17.

[e] Includes 1 bull killed in defense of life or property.

[f] Does not include 3 bulls from an unspecified portion of Unit 17.

[g] Does not include 11 bulls from an unspecified portion of Unit 17.

[h] Includes 1 bull and 1 cow killed in motor vehicle accidents near Dillingham.

Table 8 Unit 17B moose harvest data by permit hunt, 1992/93–1996/97

| Hunt No /Area | Regulatory year | Permits issued[a] | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Unk. | Total harvest |
|---|---|---|---|---|---|---|---|---|---|
| 983 | 1992/93 | 277 | 30 | 49 | 18 | 8(100) | 0 | 0 | 8 |
| 583 | 1993/94 | 433 | 19 | 38 | 24 | 23 (100) | 0 | 1 | 24 |
| | 1994/95 | 438 | 18 | 40 | 31 | 35 (100) | 0 | 0 | 35 |
| | 1995/96 | 521 | 21 | 44 | 32 | 44 (100) | 0 | 0 | 44 |
| | 1996/97 | 546 | 20 | 46 | 32 | 36 (100) | 0 | 0 | 36 |

[a] Registration permits were valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17B.

Table 9 Unit 17C moose harvest data by permit hunt, 1992/93–1996/97

| Hunt No /Area | Regulatory year | Permits issued[a] | Percent did not hunt | Percent unsuccessful hunters | Percent successful hunters | Bulls (%) | Cows (%) | Unk. | Total harvest |
|---|---|---|---|---|---|---|---|---|---|
| 983 | 1992/93 | 277[b] | 30 | 49 | 18 | 31[b] (100) | 0 | 3 | 34 |
| 583 | 1993/94 | 433 | 19 | 38 | 24 | 59[c] (100) | 1 | 0 | 60 |
| | 1994/95 | 438 | 18 | 40 | 31 | 65[d] (100) | 0 | 1 | 66 |
| | 1995/96 | 521 | 21 | 44 | 32 | 87[e] (100) | 0 | 0 | 87 |
| | 1996/97 | 546 | 20 | 46 | 32 | 89[f] (99) | 0 | 1 | 90 |

[a] Registration permits were valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17B.

[b] Not included are 8 bulls from an unspecified portion of Unit 17.

[c] Not included are 20 bulls from an unspecified portion of Unit 17 and 1 bull from Unit 17A.

[d] Not included are 34 bulls from an unspecified portion of Unit 17.

[e] Not included are 33 bulls from an unspecified portion of Unit 17 and 1unknown sex.

[f] Not included are 51 bulls from an unspecified portion of Unit 17.

Table 10 Unit 17 moose hunter[a] residency and success, 1992/93–1996/97

| Regulatory year | Successful | | | | Unsuccessful | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| | Local resident | Nonlocal resident | Nonresident | Total (%) | Local resident | Nonlocal resident | Nonresident | Total(%) | |
| 1992/93 | 61 | 79 | 64 | 212(41)[b] | 65 | 114 | 124[b] | 310 (59)[b] | 522 |
| 1993/94 | 21 | 28 | 93 | 144 (33)[c] | 27 | 117 | 142[c] | 292 (67)[c] | 436 |
| 1994/95 | 22 | 41 | 91 | 161 (33)[d] | 24 | 117 | 180[d] | 329 (67)[d] | 490 |
| 1995/96 | 28 | 40 | 114 | 185(35)[e] | 32 | 135 | 169[e] | 350 (65)[e] | 535 |
| 1996/97 | 19 | 51 | 143 | 215(40)[f] | 40 | 110 | 173[f] | 327 (60)[f] | 542 |

[a] Excludes hunters in permit hunts.
[b] Includes 8 successful and 7 unsuccessful hunters of unknown residency.
[c] Includes 2 successful and 6 unsuccessful hunters of unknown residency.
[d] Includes 7 successful and 8 unsuccessful hunters of unknown residency.
[e] Includes 3 successful and 14 unsuccessful hunters of unknown residency.
[f] Includes 2 successful and 4 unsuccessful hunters of unknown residency.



Table 11 Unit 17 moose hunter residency and success by permit hunt, 1992/93–1996/97

| Regulatory year | Successful | | | | Unsuccessful | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| | Local resident | Nonlocal resident | Nonresident | Total (%) | Local resident | Nonlocal resident | Nonresident | Total(%) | |
| 1992/93 | 43 | 7 | 0 | 50 (27) | 122 | 11 | 0 | 133 (73) | 183 |
| 1993/94 | 84 | 21 | 0 | 105 (39) | 130 | 33 | 0 | 164 (61)[a] | 269[a] |
| 1994/95 | 106 | 29 | 0 | 135 (44) | 128 | 45 | 0 | 175 (56)[b] | 310[b] |
| 1995/96 | 116 | 48 | 0 | 165 (42)[c] | 130 | 98 | 0 | 231 (58)[c] | 396[c] |
| 1996/97 | 118 | 59 | 0 | 177 (42) | 156 | 91 | 0 | 249 (59)[d] | 426[d] |

[a] Includes 0 successful and 1 unsuccessful hunters of unknown residency.
[b] Includes 0 successful and 2 unsuccessful hunters of unknown residency.
[c] Includes 1 successful and 3 unsuccessful hunters of unknown residency.
[d] Includes 0 successful and 2 unsuccessful hunters of unknown residency.

Table 12 Unit 17 moose harvest[a] chronology percent by month, 1992/93–1996/97

| Regulatory year | Harvest periods | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aug 10-20 | Aug 21-31 | Sep 1-10 | Sep 11-20 | Sep 21-30 | Dec 1-10 | Dec 11-20 | Dec 21-31 | Unk. | $n$[b] |
| 1992/93[c] | 0 | 3 | 44 | 41 | 0 | 2 | 2 | 4 | 3 | 212 |
| 1993/94[d] | 1 | 2 | 54 | 35 | 0 | 0 | 1 | 1 | 6 | 144 |
| 1994/95[d] | 1 | 3 | 47 | 37 | 3 | 1 | 2 | 3 | 5 | 161 |
| 1995/96[d] | 4 | 4 | 53 | 30 | 1 | 0 | 1 | 1 | 7 | 185 |
| 1996/97[d] | 1 | 3 | 62 | 28 | 0 | 1 | 0 | 1 | 4 | 215 |

[a] Excludes permit hunt harvest.

[b] Reported harvest

[c] General season dates: Unit 17B (upstream) - Sep 1–20
Unit 17B (remainder) - Residents: Sep 1–20, Dec 1–31
Nonresidents: Sep 5–15
Unit 17C (Iowithla, etc.) - Residents: Sep 1–15
Unit 17C (remainder) - Residents: Sep 1–15, Dec 1–31

[d] General season dates Unit 17B - Sep 1–15
Unit 17C - Residents: Sep 1–15

Table 13 Unit 17 moose harvest by permit, chronology percent by month, 1992/93–1996/97

| Regulatory year | Harvest periods | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aug 10-20 | Aug 21-31 | Sep 1-10 | Sep 11-20 | Sep 21-30 | Dec 1-10 | Dec 11-20 | Dec 21-31 | Unk. | *n*[a] |
| 1992/93[b] | 20 | 72 | 2 | 0 | 0 | 0 | 0 | 0 | 6 | 50 |
| 1993/94[c] | 9 | 40 | 19 | 10 | 2 | 3 | 6 | 5 | 8 | 105 |
| 1994/95[c] | 7 | 30 | 29 | 10 | 1 | 2 | 7 | 8 | 6 | 135 |
| 1995/96[c] | 15 | 33 | 26 | 14 | 1 | 2 | 1 | 4 | 6 | 165 |
| 1996/97[c] | 7 | 33 | 23 | 20 | 1 | 2 | 5 | 3 | 5 | 177 |

[a] Reported harvest
[b] Registration permits valid for Aug 20–31.
[c] Registration permits valid for any bull, Aug 20–Sep 15 and Dec 1–31.



Table 14 Unit 17 moose harvest[a] percent by transport method, 1992/93–1996/97

| Regulatory year | Percent of harvest | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unknown | *n* |
| 1992/93 | 64 | 0 | 29 | 0 | 2 | 0 | 1 | 3 | 522 |
| 1993/94 | 71 | 0 | 26 | 0 | 9 | 0 | 0 | 1 | 436 |
| 1994/95 | 71 | 0 | 22 | 0 | 2 | 0 | 1 | 3 | 490 |
| 1995/96 | 66 | 0 | 29 | 0 | 1 | 0 | 0 | 3 | 535 |
| 1996/97 | 70 | 0 | 26 | 0 | 2 | 0 | 0 | 1 | 542 |

[a] Excludes permit hunt harvest.

Table 15 Unit 17 moose harvest by permit hunt, percent by transport method, 1992/93–1996/97

| Regulatory year | Percent of harvest | | | | | | | | n |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | ORV | Highway vehicle | Unknown | |
| 1992/93 | 9 | 0 | 83 | 1 | 0 | 1 | 1.6 | 5 | 185 |
| 1993/94 | 15 | 0 | 73 | 0 | 6 | 0 | 4 | 3 | 269 |
| 1994/95 | 18 | 0 | 59 | 0 | 12 | 0 | 3 | 8 | 310 |
| 1995/96 | 25 | 0 | 68 | 0 | 4 | 0 | 1 | 2 | 396 |
| 1996/97 | 26 | 0 | 63 | 0 | 6 | 0 | 2 | 3 | 426 |

## LOCATION

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

**GEOGRAPHIC DESCRIPTION:** Yukon–Kuskokwim Delta

## BACKGROUND

Moose were thought to have begun immigrating to the Yukon–Kuskokwim Delta during the mid-to-late 1940s and have since colonized the riparian corridors of the Yukon and Kuskokwim Rivers in low to moderate numbers (Helmericks 1944, Alaska Dep Fish and Game 1976). Further expansion of the range and numbers of moose on the Kuskokwim River is limited by spring flooding, availability of winter habitat, and hunting pressure. The Yukon population occupies most of the available riparian habitat, and the population is growing. Most of the Yukon–Kuskokwim Delta is lowland treeless tundra, not suitable as winter habitat for moose. During the winter, moose are confined to riparian zones (forest and willow habitats) along the major rivers.

Moose densities are moderate and growing in the Yukon River drainage but very low in the entire lower Kuskokwim River drainage. Although moose are now more common than in the past, overall densities are low in Unit 18 relative to habitat availability.

Heavy hunting pressure from communities along the Kuskokwim River has effectively limited moose population growth in that riparian corridor. Moose population growth along the Yukon River has been slowed for similar reasons. Extensive habitat is available for moose colonization and range expansion along a portion of the lower Kuskokwim River. Moose densities in adjacent Units 19A and 21E remain higher than moose densities in Unit 18.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS AND OBJECTIVES

- Allow the lower Yukon River moose population to increase above its estimated size of 2000–3000 moose. Allow the lower Kuskokwim River moose population to increase above its estimated size of 200–300 moose to at least 1000–2000 moose.

- Maintain the current age and sex structure for both populations, with a minimum of 30 bulls:100 cows.

- Conduct fall sex and age composition surveys and winter recruitment surveys of both populations.

- Allow a harvest of bull moose without hindering a high rate of population increase.

- Improve harvest reporting and compliance with hunting regulations.

- Minimize conflicts among user groups harvesting moose in Unit 18.

## METHODS

Moose harvests in Unit 18 are monitored using hunter checkstations and harvest ticket hunter reports. In late August through September 1995 and 1996, we operated a hunter checkstation at Paimiut Slough along the Yukon River near the border of Units 18 and 21E. In 1996 we started using a hunter checkstation on the Kuskokwim River below the village of Lower Kalskag. Hunting activity and harvest is monitored at checkstations through the voluntary cooperation of hunters from communities along these rivers.

We use 5 census areas to estimate the size of the moose population in Unit 18. Gasaway census methods (Gasaway 1986) are used in 4 areas and intensive surveys are used in 1 area. The census areas are delineated along the vegetated corridors of the Yukon and Kuskokwim rivers (Fig 1) as follows:

- The Yukon River from Pilot Station upriver to old Paimiut Village, previously censused with Gasaway methods in late February and early March 1992; this area will be censused again in winter 1998.
- The Kuskokwim River corridor between Kalskag and Kwethluk, previously censused with Gasaway methods in March 1993.
- The Yukon River downstream of Mountain Village, where moose populations on 1700 $mi^2$ of forested habitat were estimated with intensive surveys in March 1994.
- The Yukon River from Pilot Station downstream to Mountain Village, censused with Gasaway methods in March 1995.
- The tributaries of the lower Kuskokwim River, planned for census with Gasaway methods in Winter 1999.

We have delineated 5 moose census areas to be regularly surveyed in Unit 18. All censuses will be repeated on an annual rotational basis beginning with the first census area (Table 1). However, no survey work was done in 1995 due to poor weather and none was completed in 1996 due to poor snow conditions and the loss of the area biologist in a fatal aircraft accident while conducting a moose composition count in the Yukon River drainage.

Enforcement efforts have been increased during the winter months along the lower Yukon and lower Kuskokwim rivers and adjacent subunits during the reporting period.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

#### *Population Size*

No censuses were completed during this reporting period. Based on other survey information, we believe the moose population in Unit 18 is between 2000 and 3000 moose.

In the Yukon drainage we estimate the moose population to be between 2000 and 2500. The number of moose along the riparian corridor of the Yukon River, especially on islands located upriver of Marshall, appears to have increased during the reporting period.

A Gasaway-type census of the Yukon River area (Fig 1, Area 1) consisting of 159 polygons was completed in March 1992. The sample size was 39 polygons ranging in size from 6.0 to 20.6 $mi^2$. A population estimate of 994 moose (±12.5% standard deviation at 80% CI) was calculated. During this reporting period, hunters, pilots, and local residents have frequently reported more moose than previously observed along the Yukon.

Moose densities apparently remain very low in the Kuskokwim drainage. We believe the population is approximately 200–300 moose. A Gasaway-type moose census was conducted between Kalskag and Kwethluk along the riparian corridor of the Kuskokwim River during March 1993 (Fig 1, Area 2). The census area comprised 41 polygons, and the sample consisted of 18 polygons ranging in size from 6.1 to 23.4 $mi^2$. We calculated a population estimate of 217 moose (±27.6% standard deviation at 80% CI) (Table 1). We have no reason to believe this figure has substantially changed.

Moose in the riparian zone of the Yukon River area downstream of Mountain Village (Fig 1, Area 3) were counted using intensive aerial surveys on 16–17 March 1994. We believed the moose densities were too low for a Gasaway-type census, so we modified the technique and surveyed 19 polygons ranging in size from 41 to 156 $mi^2$, for a total survey area of 1700 $mi^2$. The polygons followed the vegetation boundaries of the riparian zone in the area. Four aircraft were used for a total survey time of 38.7 hrs, with an average survey time of 1.36 min/$mi^2$ in each polygon. Even though average survey times were low, viewing was considered very good, and we counted 65 moose during the survey. The average moose density, 0.04 moose/$mi^2$, is surprising, considering that moose were not present in this area when it was surveyed in 1988. Although no additional census work was done during this reporting period, Fish and Game Advisory Committee members from this area reported observing more moose in this area.

During March 1995 a Gasaway-type census was attempted along the lower Yukon River between Pilot Station and Mountain Village (Fig 1, Area 4). This area was located downstream of census Area 1 (census completed in 1992) and upstream from census Area 3 (surveyed intensively in 1994). We sampled the vegetated river corridor between Mountain Village and Pilot Station, including the Andreafsky River, the Atchuelinguk River, and the upper Kashunak River. The census area consists of 111 polygons, and the sample consisted of 29 polygons ranging in size from 5.4 to 31.4 $mi^2$. Densities of moose were very low and only 2 strata (low- and medium-density) could be classified. The population estimate of 52 moose, (± 46% at 80% CI) has high variability because of moose low density. Although a Gasaway-type census is not often applied to low-density populations, we find the results useful for comparison to neighboring census areas and to future counts from this area. At the time of the census, we thought the population was higher than the census estimate revealed. Considering the low degree of confidence in the estimate, it may not be profitable to repeat the Gasaway-type census if the moose population here remains at low density.

We suspect hunting pressure may have slowed immigration of moose into the lower Yukon River below Mountain Village, thereby slowing further population growth. However, the Lower Yukon moose population appears to have grown, but at a reduced rate.

*Population Composition*

Collection of population composition and recruitment information on moose in Unit 18 was limited during this reporting period due to poor weather in 1995 and the death of the Unit 18 Area Biologist in 1996. Lack of snow cover before antler drop on bulls has often hindered our ability to obtain annual moose population composition information.

Age composition information is available from 50 incisors of hunter-killed moose harvested in the Yukon drainage between Russian Mission and the Innoko River during the Fall 1995 season. This area represents the eastern portion of Unit 18 and the western portion of Unit 21E. Of the teeth collected, 70% were from male moose between 1 and 3 years of age. This percentage is similar to the previous reporting period (1993–1995). If this sample is representative of the composition of the local moose population, recruitment appears favorable for this and the previous reporting period.

*Distribution and Movements*

Small numbers of moose move during late summer to coastal regions from the mouth of the Kuskokwim to Scammon Bay, Nelson Island and the lower Yukon Delta. The Yukon Delta Wildlife Refuge staff sporadically monitored the locations of radiocollared moose in Unit 18 and portions of Unit 19A during the previous reporting period. Their last flight to monitor these moose took place on November 1994. These radiotelemetry data indicate most moose move relatively short distances. Bulls tend to remain away from riparian zones during summer, fall, and early winter until snow depths push them closer to the river. Only 1 collared moose along the Lower Yukon showed signs of long distance movement. Little or no movement occurred among the remaining 5 collared moose resident along the Yukon River.

In the Kuskokwim drainage, cow moose collared near Aniak had moved into the Russian and Horn Mountain area north of the Kuskokwim and east to the Holukuk River. Very little other movement occurred among collared moose elsewhere in the drainage.

There is anecdotal evidence that moose on the Lower Yukon downstream from Mountain Village have established a resident population exhibiting little movement. There is also a persistent local belief that additional moose have entered Unit 18 in response to large fires in adjacent subunits. We have no direct evidence to support this belief.

In response to fall hunting pressure and the advent of winter weather, some moose apparently retreat from tundra regions to the forested regions of the Yukon River. Other moose are found in alpine and subalpine regions of the Kilbuck and Andreafsky Mountains during summer but descend to yards along the Aniak River, forested tributaries of the Kuskokwim, and along the lowlands and islands of the Yukon and Kuskokwim Rivers during late winter.

The density of moose at locations along the Yukon and Kuskokwim Rivers is related to the distance upriver from the mouths of these drainages. The further upriver on both drainages, the greater the number of moose. This is evident from both aerial survey and harvest data. We believe this distribution and density is related to the presence of quality habitat and escape cover in the upriver, forested portions of these drainages.

### MORTALITY

*Harvest*

Season and Bag Limits. Seasons and bag limits have changed little since 1988 with the exception of additional winter seasons and new federal moose hunting regulations on federal land (Table 2). The Yukon River Delta was closed to moose hunting in 1988–1989 and was opened for 20 days in the fall of 1994–1995 with a bag limit of 1 bull. For both regulatory years in this reporting period, the open season for subsistence and resident hunters in the remainder of Unit 18 was a 30-day fall season with an additional 10-day winter season to be opened by emergency order within the period December 20 to January 20. The bag limit was 1 bull.

| Units and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Unit 18, that portion north and west of a line from Cape Romanzof to Kuzilvak Mountain, and then to Mountain Village, and west of (but not including) the Andreafsky drainage<br><br>1 bull | 5 Sep–25 Sep | 5 Sep–25 Sep |
| Remainder of Unit 18<br><br>1 bull per regulatory year; during the period Dec 1–Feb 28, a 10-day season may be announced by emergency order | 1 Sep–30 Sep<br>1 Dec–28 Feb<br>(To be announced) | 1 Sep–30 Sep |

Board of Game Actions and Emergency Orders. During 1995 the Board of Game adopted a regulatory proposal effective for the 1995–1996 season that changed the winter moose season from 'To-Be-Announced by Emergency Order between December 20 and January 20' to 'To-Be-Announced by Emergency Order between December 1 and February 28.' The winter season dates were changed to make state regulations more consistent with Federal subsistence regulations and to accommodate local hunters who desired an open season when weather and snow conditions are adequate for snowmachine travel (Table 2).

Emergency orders were issued during the reporting period to open the winter moose seasons. In 1994–1995, 1995–1996, and 1996–1997, the winter moose seasons were Dec 20–Dec 29, Dec 28–Jan 6, and Dec 27–Jan 5, respectively (Table 2).

Human-Induced Mortality. Hunting remains the most significant source of moose mortality in Unit 18. Historical harvest records indicate that above-average reported harvest occurred during the 1995–1996 regulatory year, with above-average harvests continuing during the 1996–1997 hunting season. During the 1995–1996 open season, 302 hunters reported a harvest of 74 moose. For the 1996–1997 season, 346 hunters reported a harvest of 97 moose (Table 3).

Hunters took 71 bull moose in Unit 18 during the September 1995 season, and only 3 were reported during the December–January 1995–1996 season. All of the moose reported harvested in 1996 were taken during the fall season. Harvest reporting for moose taken in the winter season has typically been very poor.

Local residents heavily use the moose population in Unit 18, and the annual combined reported and unreported harvest is estimated to equal or exceed 5–10% of the population on the Yukon River. Harvest may exceed the annual recruitment on the Kuskokwim River, and estimated unreported harvest may equal or exceed the reported harvest in the Kuskokwim drainage. We estimate unitwide harvest, including unreported harvest, is approximately 100–200 moose annually.

Many Unit 18 residents are aware that hunting opportunities are better in adjacent Units 19A, 19B, and 21E. Harvest reports collected since 1980 show that hunters from Unit 18 regularly use large boats during the fall season to access hunting areas upriver in adjoining units (Table 4). On the Kuskokwim River, many of the residents hunting moose between Kalskag and McGrath (Unit 19A) are from Unit 18. Similarly, on the Yukon River, a large number of hunters use boats to travel from Unit 18 into Unit 21E. During the fall season, nearly all of the hunters at the Paimiut hunter checkstation who reported hunting in Unit 21E were residents of Unit 18. As a consequence, fall moose hunting activities in the central Kuskokwim region of Unit 19A and the Innoko and Iditarod regions of Units 21E have become controversial allocation issues between the residents of Units 18 and the upriver residents of Units 19A and 21E. The concern among upriver residents is that continued heavy influx of hunters from downriver communities in addition to harvest pressure by local residents may restrict moose seasons and bag limits.

The reported harvest of moose in Unit 18, as described in previous years, does not reflect the actual harvest but only that of people who operate within the regulatory system. The percentage of local residents hunting in season with valid hunting licenses and harvest tickets is increasing, particularly during the fall. We believe that harvest reporting on the Yukon River has improved in the last 11 years because of the presence of the Paimiut hunter checkstation, the acceptance of harvest tickets, and the willingness of most hunters to harvest only bulls. Although reporting has improved along the Yukon River, in Unit 18 there are hunters who do not report. Because of the unreported harvest, moose harvest data from Unit 18 must be regarded as incomplete and should be viewed as minimum estimates.

During the 1995–1996 season, approximately 85% (64 moose) of the reported harvest was in the Yukon drainage with the remainder in the Kuskokwim River drainage. During the 1996–1997 season, 72% of the harvest (70 moose) was reported taken in the Yukon drainage (Table 4).

During September 1994, 10 moose were harvested downstream of Mountain Village during the first open season since 1987. In 1995 and in 1996, there were 19 moose reported harvested from this area each year. This is particularly interesting since as late as 1988, no moose were observed during a March survey of the lower Yukon Delta.

During September 1995 and 1996, we operated the Paimiut checkstation for the tenth and eleventh consecutive years, respectively, at the junction of Twelve-Mile Slough and Paimiut Slough on the Yukon River. The checkstation is located near the border of Units 18 and 21E. We estimate between 80–100 moose were harvested from an area extending from the upper Innoko River and Iditarod River in Unit 21E to Russian Mission in Unit 18. Most of these moose were brought through or processed near the Paimiut checkstation. The moose examined at the check-station each season were primarily young bulls in good condition.

During 1995 hunters reported that 69 of 74 moose taken in Unit 18 were predominantly young bulls with an average antler width of 37 inches. During 1996 hunters reported that 50 moose taken in Unit 18 had an average antler width of 37.5 inches. Tooth sectioning data indicated that the moose examined at the Paimiut checkstation during fall 1995 had an average age of 2.7 years.

Moose during winter are concentrated on islands with large cottonwood stands and bushy willow fringes along the Yukon and the Kuskokwim Rivers and their tributaries. These moose are vulnerable to snowmachine hunting and harassment by snowmachine travelers. We believe much of the winter harvest is taken during the closed season and not reported. Surveillance by Fish and Wildlife Protection on the Yukon River near Russian Mission revealed that several moose, including females, were illegally harvested during these two winters.

Much of the habitat in Unit 18 is marginal for moose and cannot support large densities of moose or heavy harvests. However, areas along the Yukon and Kuskokwim River corridors have adequate browse and should support larger densities of moose. Moose along the main river corridors and numerous forested tributaries in Unit 18 have high calf production that offsets mortality from severe winters, floods, predation, regulated hunting, poaching, disease, competition, and accidental deaths. However, moose populations in the poorer mountain and tundra habitat in Unit 18 have lower initial calf production and survival that cannot withstand significant natural and hunting mortality.

Hunter Residency and Success. As reported in past years, Alaska residents accounted for most of the hunting activity in Unit 18. No nonresidents hunted in Unit 18 during the 1995–1996 or 1996–1997 seasons. Hunter success rate based on harvest reports was 24% for the 1995–1996 season and 28% for the 1994–1995 season. Successful hunters spent an average of 8.9 days hunting moose in Unit 18 in 1995–1996.

Table 5 shows the breakdown of hunters who visited the Kuskokwim River checkstation by residence community and hunt location. Hunters from nearly all of the Kuskokwim villages visited the checkstation while very few hunters from elsewhere in Alaska and no nonresidents visited the checkstation. Similar information can be found in previous management reports for hunters using the Yukon River.

Transport Methods. During the reporting period moose hunters most frequently used boats in Unit 18. Other minor reported modes of transportation were snowmachines and aircraft. There has been virtually no change in the method of access reported by moose hunters in Unit 18 since moose harvest reporting began.

*Natural Mortality*

Little information is available indicating that predation by bears or wolves is a significant source of moose mortality in Unit 18. Black and grizzly bears are along the major river corridors and large tributaries in Unit 18. The effect they may have on moose numbers, particularly through predation on calves, is unknown.

We estimate 75–100 wolves in 8–10 packs reside in Unit 18. There are at least 2 wolf packs in the Kilbuck Mountains and at least 2 packs near Russian Mission and Paimiut Slough. Throughout most of Unit 18, the distribution of wolves reflects the distribution of moose, especially in the Yukon drainage. In the lower Kuskokwim drainage, caribou have become an alternative prey for wolves, and the distribution of wolves is not as closely linked to moose. Several wolf packs in the Kilbuck Mountains follow caribou into and out of Unit 18. Wolf numbers may be increasing in the unit as ungulate numbers increase, but overall numbers of wolves remain very low.

## HABITAT

*Assessment*

We estimate a minimum of 8000 $mi^2$ of moose habitat in Unit 18. Approximately 4500 $mi^2$ of this habitat is along the riparian zone of the Yukon River, and the remaining 3500 $mi^2$ is along the Johnson and Kuskokwim Rivers and tributaries. The islands and adjacent sloughs along the Yukon River corridor from Paimiut to Mountain Village represent the most productive moose habitat in Unit 18. No overbrowsing is evident in this area. However, some heavy browsing is evident in the better winter yarding areas upstream of Paimiut on the Innoko River, and moose may move downriver into the better browsing areas between Paimiut and Pilot Station. The narrow bands of willows downriver from Mountain Village in the Yukon Delta proper are overgrown and senescent, except for the expanse of willows toward Kusilvak Mountain and Kashunak River and those islands in the Yukon flooded each spring. Because the Yukon Delta has many mouths fringed by willows and cottonwoods and yet supports very few moose, the availability of forage is not a limiting factor. Lack of escape cover from hunters, predators, and weather may be the most significant limiting factors affecting moose numbers in these low-density areas.

The riparian habitat along the Kuskokwim River in Unit 18 downstream of Kalskag is very good moose habitat. Between Lower Kalskag and Akiachak, the forest and brush along the Kuskokwim may provide sufficient escape cover for moose. Occasionally, aircraft pilots in this area observe moose in meadows surrounded by thick willow, spruce, and cottonwood-mixed forest. Downstream of Akiachak toward the mouth of the Kuskokwim, the riparian corridor narrows, lacking escape cover. Along the Kanektok, Goodnews, and Arolik Rivers, moose are rarely in the riparian corridor because cover and browse are very sparse.

Tributaries of the Kuskokwim bordered by spruce and cottonwood, interspersed with willow and alder, extend onto the tundra along the Gweek and Johnson Rivers to the west and along the Tuluksak, Kisaralik, Kasigluk and Kwethluk Rivers to the east. Each of these tributaries supports small, low-density moose populations.

## CONCLUSIONS AND RECOMMENDATIONS

Within the last 60 years, moose have colonized the Yukon–Kuskokwim Delta in moderate densities along the Yukon River from Paimiut to Pilot Station but remain at very low densities throughout the remainder of the unit. Although much of Unit 18 is lowland tundra, unsuitable as moose winter habitat, moose should be present in higher numbers in riparian habitat. Although calf production and yearling recruitment are high during years without major flooding, hunting pressure from unit residents has slowed moose population growth.

The illegal harvest, particularly of cows and calves, remains the most serious moose management problem in Unit 18. Although compliance is improving, a poorly developed cash economy and high density of people and villages along the major rivers complicate moose management considerably. Approximately 25,000 rural residents live in 42 communities throughout Unit 18, and we need continued effort to curb illegal harvest of moose.

Differing state and federal seasons and bag limits for moose had previously hampered our ability to effectively manage moose and enforce hunting regulations. However, recently there has been very good cooperation among federal and state wildlife managers to work toward common solutions for moose management. In general, throughout Unit 18, state and federal seasons now coincide. This will make moose management easier in the future.

Recent actions by user groups within the unit, especially along the lower Yukon, to shoulder responsibility for the growth of local moose populations are welcome signs of increasing participation with management systems. However, some members of local Fish and Game Advisory Committees and the recently established Federal Subsistence Regional Advisory Council continue to submit or support proposals liberalizing moose seasons and harvest opportunities in Unit 18, regardless of the biological status of the moose population.

The growth of the Mulchatna caribou herd and recent movements of the Western Arctic caribou herd into Unit 18 may eventually reduce hunting pressure on the local moose population (Table 5). However, we anticipate the demand for moose will continue to exceed the supply.

We recommend monitoring and inventory of the moose population remain a priority in Unit 18, especially the continuation of the Gasaway censuses along the Yukon and Kuskokwim Rivers. We should continue to attempt fall composition counts in the Yukon and Kuskokwim drainages, despite the fact that poor winter weather and snow conditions regularly prevent completion of composition counts before bulls drop their antlers. We should continue to conduct censuses in the 5 census areas delineated in Unit 18 at intervals of 5 years or less. The census results, with annual composition surveys, will provide the department with baseline demographic information and recruitment rates to properly manage the moose population in Unit 18.

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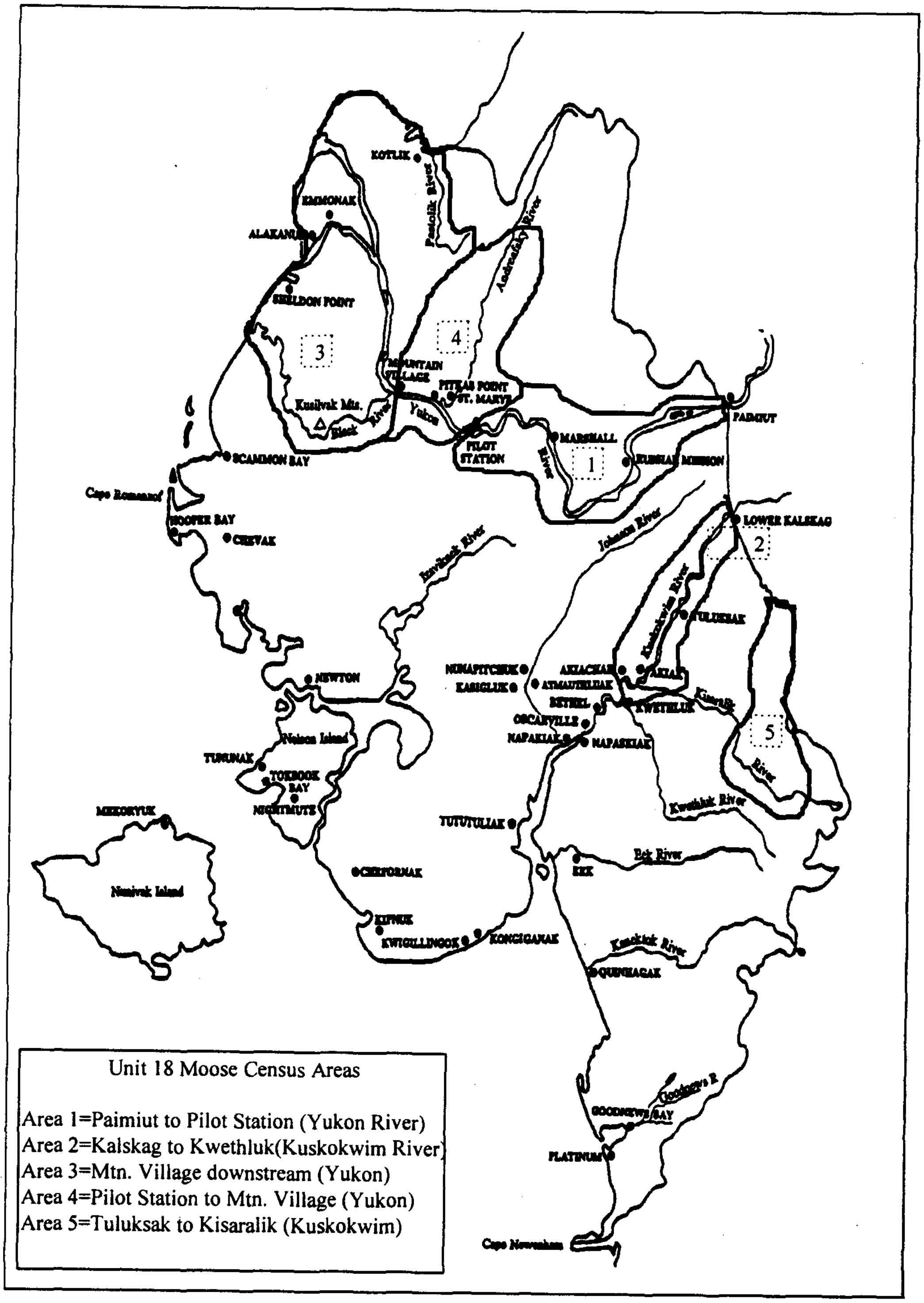


Figure 1. Game Management Unit 18, showing major drainages,communities, and census areas

Table 1 Unit 18 moose census area results, 1992–1997

| Census Area | Date | Total Area ($mi^2$) | Total polygons (N) | Area sampled ($mi^2$) | Polygons Sampled (n) | Population estimate | 80% confidence interval (%) |
|---|---|---|---|---|---|---|---|
| 1. Yukon River: Paimiut to Pilot Station | March 1992 | 1,558 | 159 | 628 | 39 | 994 | ± 12.5 |
| 2. Kuskokwim River: Kalskag to Kwethluk | March 1993 | 648 | 41 | 249 | 18 | 217 | ± 27.6 |
| 3. Yukon River: downriver from Mountain Village | March 1994 | 1,700 | 19 | 1,700 | 19 | 65 | not applicable |
| 4. Yukon River: Pilot Station to Mountain Village | March 1995 | 1,984 | 97 | 513 | 29 | 52 | ± 46.3 |
| 5. Kuskokwim River: (NYAC block) Tuluksak to Kisaralik – proposed | March 1998 | 892 | 65 | (proposed) | (proposed) | (proposed) | (proposed) |

Table 2 Summary of moose hunting regulations and harvest in Unit 18, 1961–1997

| Regulatory year | Season dates | Reported Harvest | Bag limit and area affected |
|---|---|---|---|
| 1961–1962 | 20 Aug–30 Sep | 73 | 1 bull |
| | 20 Nov–10 Dec | | |
| 1962–1975 | 20 Aug–31 Dec | 134 | 1 bull |
| 1975–1982[a] | 1 Sep–20 Sep | 20 | 1 bull; Yukon River Delta |
| | 1 Sep–31 Dec | 122 | 1 bull; remainder of Unit 18 |
| 1982–1985 | 1 Sep–20 Sep | 20 | 1 bull; Yukon River Delta redefined[c] |
| | 1 Sep–30 Sep | 77 | 1 bull; remainder Unit 18 |
| | 15 Nov–31 Dec | | |
| 1985–1988[de] | 1 Sep–20 Sep | 20 | 1 bull; Yukon River Delta[c] |
| | 1 Sep–30 Sep | 40 | 1 bull; remainder of Unit 18 |
| | 1 Feb–10 Feb | | |
| 1988–1992[f] | CLOSED | | Yukon River Delta[c] |
| | 1 Sep–30 Sep | 41 | 1 bull; remainder Unit 18 |
| | 20 Dec–30 Dec[g] | | |
| 1993–1994 | CLOSED | | Yukon River Delta[c] |
| | 1 Sep–30 Sep | 40+ | 1 bull; remainder Unit 18 |
| | Winter Season TBA[h] | | |
| 1994–1995 | 5 Sep–25 Sep | 10 | Yukon River Delta[c] |
| | 1 Sep–30 Sep | 40+ | 1 bull; remainder of Unit 18 |
| | Winter Season TBA[i] | | |
| 1995–1996 | 5 Sep–25 Sep | 19 | Yukon River Delta[c] |
| | 1 Sep–30 Sep | 71 | 1 bull; remainder of Unit 18 |
| | Winter Season TBA[j] | 3 | |
| 1996–1997 | 5 Sep–25 Sep | 19 | Yukon River Delta[c] |
| | 1 Sep–30 Sep | 97 | 1 bull; remainder of Unit 18 |
| | Winter Season TBA[j] | | |

[a] The Alaska Board of Game established the Kalskag Controlled Use Area in 1977, incorporating a triangular-shaped region from Russian Mission upriver to the old Paimiut village site, south to Lower Kalskag, and northwest back to Russian Mission.

[b] That area north & west of a line from Cape Romanzof to Mountain Village, & west of & excluding the Andreafsky River drainage.

[c] That portion north & west of a line from Cape Romanzof to Kusilvak Mountain, to Mountain Village, & west of & excluding the Andreafsky River drainage.

[d] In 1985–1989, hunting regulations were divided into subsistence and general hunts.

[e] In 1987, residents of communities within Unit 18 and upper Kalskag were found to have customary and traditional uses of moose in Unit 18.

Table 2 Continued

[f] In 1990, all hunts became general hunts and federal regulations took place. The 1990 federal regulations were the same as the state regulations, except for the Kanektok and Goodnews River drainages, and only Unit 18 residents and residents of Upper Kalskag could hunt moose in Unit 18 under federal regulations. In 1991 the federal season was 15–24 Dec, which overlapped the state season.

[g] The fall season for state and federal lands is the same; the federal winter season was 31 Dec–9 Jan (1992–1993).

[h] The 10-day state winter season was To Be Announced by Emergency Order between 20 Dec–20 Jan; the federal winter season was also a To Be Announced season by the Refuge Manager between 1 Dec–28 Feb State season dates were 20–29 Dec 1993 while the federal season was 21–30 Dec 1993. The federal season was also extended from 4–10 Feb 1994.

[i] The federal fall season in the Kuskokwim drainage was from 25 Aug–25 Sep, while the state fall season was 1–30 Sep 1994. An Emergency Order was written to close the last 5 days of the state season so that both the federal and state fall seasons would end on 25 Sep 1994. State season: 20–29 Dec 1994; federal season 21–30 Dec 1994. The USFWS extended the winter hunt from 4–10 Feb 1994.

[j] In 1995 and 1996, both the state and the federal winter seasons coincided, 28 Dec1995–6 Jan 1996 and 27 Dec 1996–5 Jan 1997.

Table 3 Fall and winter moose harvests for Unit 18, 1978–1997

| Regulatory | Fall harvest | | Winter harvest | | Unknown harvest | | Total |
|---|---|---|---|---|---|---|---|
| Year | (N) | (%) | (N) | (%) | (N) | (%) | Harvest (N) |
| 1978–1979 | 42 | 88 | 6 | 12 | 0 | 0 | 48 |
| 1979–1980 | 11 | 92 | 1 | 8 | 0 | 0 | 12 |
| 1980–1981 | 45 | 94 | 3 | 6 | 0 | 0 | 48 |
| 1981–1982 | 72 | 90 | 8 | 10 | 0 | 0 | 80 |
| 1982–1983 | 54 | 93 | 4 | 7 | 0 | 0 | 58 |
| 1983–1984 | 61 | 97 | 2 | 3 | 0 | 0 | 63 |
| 1984–1985 | 63 | 87 | 7 | 10 | 2 | 3 | 72 |
| 1985–1986 | 43 | 83 | 8 | 15 | 1 | 2 | 52 |
| 1986–1987 | 54 | 90 | 6 | 10 | 0 | 0 | 60 |
| 1987–1988 | 40 | 83 | 8 | 17 | 0 | 0 | 48 |
| 1988–1989 | 67 | 98 | 0 | 2 | 0 | 0 | 68 |
| 1989–1990 | 31 | 94 | 1 | 3 | 1 | 3 | 33 |
| 1990–1991 | 55 | 90 | 6 | 10 | 0 | 0 | 61 |
| 1991–1992 | 63 | 94 | 4 | 6 | 0 | 0 | 67 |
| 1992–1993 | 64 | 83 | 13 | 17 | 0 | 0 | 77 |
| 1993–1994 | 93 | 97 | 3 | 3 | 0 | 0 | 96 |
| 1994–1995 | 76 | 87 | 11 | 13 | 0 | 0 | 87 |
| 1995–1996 | 71 | 96 | 3 | 4 | 0 | 0 | 74 |
| 1996–1997 | 97 | 100 | 0 | 0 | 0 | 0 | 97 |

Table 4 Moose harvest in the Yukon River, Kuskokwim River and Johnson River drainages, Unit 18, 1981–1997

| | Moose harvest (%) | | |
|---|---|---|---|
| Regulatory year | Yukon River | Kuskokwim River | Johnson River |
| 1981–1982 | 57 | 32 | 11 |
| 1982–1983 | 58 | 36 | 6 |
| 1983–1984 | 63 | 33 | 4 |
| 1984–1985 | 62 | 32 | 6 |
| 1985–1986 | 67 | 17 | 16 |
| 1986–1987 | 66 | 34 | 0 |
| 1987–1988 | 52 | 42 | 6 |
| 1988–1989 | 81 | 19 | 0 |
| 1989–1990 | 55 | 39 | 6 |
| 1990–1991 | 80 | 15 | 5 |
| 1991–1992 | 75 | 24 | 1 |
| 1992–1993 | 64 | 33 | 3 |
| 1993–1994 | 77 | 24 | 2 |
| 1994–1995 | 86 | 14 | 0 |
| 1995–1996 | 85 | 15 | 0 |
| 1996–1997 | 72 | 28 | 0 |
| Average | 69 | 27 | 4 |

Table 5 Number of hunters by community and harvest reports for moose and caribou[a] at the Kuskokwim hunter checkstation near Kalskag, Alaska, 1996

| | Unit 18 | | | Unit 19A below Sleetmute | | | Unit 19A remainder | | | Unit 19D | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Community | Hunters | Moose | Caribou | Hunters | Moose | Caribou | Hunters | Moose | Caribou | Hunters | Moose | Caribou |
| Bethel | 36 | 16 | 21 | 39 | 30 | 15 | 24 | 12 | 3 | 3 | 1 | |
| Chefornak | | | | 2 | 1 | | | | | | | |
| Napakiak | 3 | 3 | | 5 | 5 | | | | | | | |
| Napaskiak | 2 | 1 | 2 | 8 | 1 | 6 | 2 | 2 | | | | |
| Kongiganak | 1 | | 1 | 6 | 3 | 2 | 2 | 1 | | | | |
| Atmautluak | 2 | 1 | 1 | | | | | | | | | |
| Akiachak | 1 | 1 | | 5 | 1 | 2 | | | | | | |
| Kasigluk | 1 | 1 | | | | | | | | | | |
| Akiak | 1 | | 1 | | | | | | | | | |
| Kwigillingok | 5 | 1 | | | | | | | | | | |
| Tuntutuliak | 1 | | 1 | 3 | 3 | | 3 | 1 | | | | |
| L. Kalskag | 3 | 3 | | | | | | | | 1 | 1 | |
| Toksook Bay | 1 | | 1 | | | | | | | | | |
| Kwethluk | 2 | 1 | 1 | 5 | 2 | 1 | 1 | 1 | | | | |
| Tuluksak | 4 | | 4 | 2 | 2 | 1 | 4 | 1 | | | | |
| Eek | 2 | | 2 | | | | | | | | | |
| U. Kalskag | 4 | 4 | | | | | | | | | | |
| Anchorage | | | | 1 | 1 | | | | | | | |
| Total | 69 | 32 | 35 | 76 | 49 | 27 | 36 | 18 | 3 | 4 | 2 | 0 |

[a]No moose or caribou harvests were reported from Subunit 19B at the checkstation. Forty-one moose were taken in the Holitna/Hoholitna Controlled Use Area by hunters reporting at the checkstation. Five moose were reported taken from the Napaimiut area, 4 from the Tatlawiksak River, 1 from Whitefish Lake, 12 from between Crooked Creek and Red Devil, 4 from near Kalskag, 1 from near Sleetmute, 5 from Oskawalik River, 10 from Stoney River, 4 from Swift River, 3 from the Devil's Elbow area, and 4 from the Venesale/Selatna area.

## LOCATION

**GAME MANAGEMENT UNIT:** 19 (36,486 $mi^2$); 21A and 21E (23,270 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** All of the drainages into the Kuskokwim River upstream from Lower Kalskag; Yukon River drainage from Paimiut upstream to, but not including, the Blackburn Creek drainage; the entire Innoko River drainage; and the Nowitna River drainage upstream from the confluence of the Little Mud and Nowitna Rivers

## BACKGROUND

Moose are a relatively recent faunal addition to western Interior Alaska. Their initial occurrence in oral history was apparently sometime after the turn of the century. As recent as the 1970s, populations were probably at record highs. Currently, moose are throughout this area, with the exception of the rugged peaks of the Alaska Range. The major factors influencing moose abundance in the area include predation, weather, and hunting. Hunting pressure is thought to be moderate except in a few easily accessible areas. Failure to report harvests, particularly those harvests by local residents, is a chronic problem.

Unit 19, as well as Units 21A and 21E, can be conveniently divided into 2 regions that have distinct differences in moose habitat, user access, and hunting practices. Units 19A, 19D, and 21E are generally lower elevation areas that are accessible by boat. Hunters are generally local residents hunting for food and living in either Unit 19, Unit 21, or adjacent Unit 18. Units 19B, 19C, and 21A are generally higher elevation areas where access is largely restricted to aircraft. Few people live in these areas, and those traveling there to hunt are mainly seeking large bulls for their trophy quality, although acquisition of meat is also an important consideration.

Aerial composition surveys have been the primary means of assessing population status and trend in this large area. There is a history of surveys dating back several decades. Unfortunately, these data are of limited value because of inconsistencies in survey areas and methods and because of annual variations in snow and weather conditions that affect moose movements and timing and quality of surveys.

## MANAGEMENT DIRECTION

Subunit boundaries within the area were designed to provide for 2 major uses of the resource. The lowland areas along the Kuskokwim River (Units 19A and 19D) and along the Yukon and lower Innoko Rivers (Unit 21E) have been managed in an attempt to provide a sustained, relatively high harvest of moose. The higher elevation portions (Units 19B, 19C, and 21A) are managed largely for trophy quality animals. Because topography directly affects access, management of the area should continue to be based on these premises.

## MANAGEMENT GOALS AND OBJECTIVES

- Annually assess population status, bull:cow ratios, and trend in portions of the area where harvest levels make significant impacts on moose populations.
- Maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C, and 21A.
- Assess accuracy of harvest reporting in selected portions of the area.
- Encourage landowners to reduce fire suppression efforts on wildfires that do not threaten human life, property, or valuable resources, so that fire can fulfill its natural rôle in maintaining young, highly productive, and diverse habitats.

# METHODS

Population composition surveys have continued in selected portions of the area using standard aerial survey techniques. A census of the Holitna/Hoholitna Controlled Use Area was planned for fall 1992, but was thwarted by early, deep snow conditions that caused moose to move from areas where they are normally distributed during October/November. Instead, moose concentrated in winter habitat in the lowland riparian areas. Population estimation surveys were conducted in the Lime Village Management Area in March 1992 and in a portion of the Unit 19D-East Intensive Management Zone in spring 1996. Information received from harvest tickets was used to monitor hunter demographics and harvest parameters.

Late winter/spring aerial surveys were conducted periodically during 1991–1997 to assess the effects of severe weather conditions on moose in Unit 19D. Mortality rates and causes were assessed. Data were collected on condition of moose as reflected in marrow fat contents. Calving rates and timing have also been monitored in portions of Unit 19D.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

### *Population Size and Trend*

Historical data from composition/trend surveys indicate moose numbers are moderate and that populations are largely stable or declining. No trend data were collected during fall 1995 due to inadequate snow cover in the various survey areas. In March 1992 a population estimation survey in the Lime Village Management Area portion of Units 19A and 19D revealed a population density of 0.73 ± 16.6% moose/mi$^2$. In February 1996, the moose population density in an 1819-mi$^2$ area in 19D-East was estimated at 0.42 ± 24.6% moose/mi$^2$.

Historical data are available from 2 areas within Unit 19. However, changes in survey areas, timing of surveys, and survey conditions frustrate attempts to compare the data over time. In Unit 19A, the lower reaches of the Holitna/Hoholitna Rivers have been surveyed 17 times since 1976 (Table 1). However, some of these surveys were conducted in late winter, when moose distribution and observability were entirely different than conditions during early winter. The only other long-term data set is from the Farewell (Bear Creek) Burn/Alaska Range foothills area (Table 2). Eighteen surveys were completed in this portion of Unit 19C between 1976 and 1997.

In early winters 1987 and 1988, 6 additional composition/trend count areas were established in Unit 19, as well as 3 count areas in Units 21A and 21E. This will significantly broaden our ability to assess moose population trends in the area if funding and weather patterns allow them to be surveyed periodically. Unfortunately, snow conditions were poor during both 1991 and 1995, and few surveys were completed.

In Unit 19A, trend data are available only from the Holitna/Hoholitna River trend area. The situation there should not be extrapolated to the remaining portions of the subunit. An additional survey area was established in 1988 in the Kiokluk/Chuilnuk Mountains but has not been repeated. An early spring survey of moose distribution was conducted in the lower Aniak River drainage in 1997.

Moose per hour figures from the Holitna/Hoholitna River count area (Table 1) have increased dramatically since 1976 when the first fall surveys were completed. Four surveys completed between 1976 and 1984 averaged 39 moose/hour. Surveys completed during the 4-year period 1987–1990 averaged 126 moose/hour. Standardization of the survey route in 1987 to include early winter concentration areas partially explains the observed 3-fold increase. Because of standardization, future data should better reflect trends in the population. No counts were conducted in this area in 1991 or 1993, but counts during intervening years revealed continued population growth.

In early March 1997, a cursory moose survey was conducted in the lower Aniak River drainage. We spent 62 minutes on the survey and tallied 310 moose, including 57 calves (18.4% calves, twinning percentage = 14%, moose per hour = 300.1). About 36 linear miles of riparian corridor were surveyed, equating to 18 square miles of acreage. This equates to an observed density of about 17 moose per square mile.

Moose population trend data in Unit 19B are available from 2 survey areas: Cairn Mountain/Sparrevohn Hills and Upper Stoney River. The Cairn Mountain/Sparrevohn Hills count area was surveyed 6 times between 1982 and 1992. Moose per hour figures indicated the moose population was increasing. In the Upper Stoney River, 5 surveys between 1982 and 1990 revealed wildly fluctuating moose per hour figures, indicating this count area is probably in a poor location for obtaining meaningful trend data. Surveys there have been discontinued.

The Farewell Burn and Windy/Pingston count areas have been used to document moose population trends in Unit 19C. The Farewell Burn Count Area (Table 2) has been surveyed 15 times during the period 1973–1996. Moose per hour figures dropped from 94 to 31 between 1974 and 1979 surveys. This drop was undoubtedly due in large part to the occurrence of the 1977 Bear Creek Burn. However, during the period 1983–1989, moose per hour figures increased dramatically from 22 to 194, even in the face of increased hunting pressure. This can be explained by the tremendous habitat enrichment that occurred on the area due to the Bear Creek Burn. As spruce reinvades the burn, willow growth will continue to decline.

Habitat deterioration has probably influenced the 1990–1996 declines in moose per hour data from the count area.

The Windy/Pingston count area was surveyed 8 times between 1984 and 1996. Moose per hour figures have fluctuated widely at relatively high levels. The trend count area thus far has not proved to be a good indicator of moose population trends in the area because local snow conditions vary greatly and apparently affect moose abundance and composition on the site.

Unit 19D also contains 2 established composition/trend count areas. The White Mountains Count Area was established in 1988 and the Candle/Wilson Count Area in 1989. In the White Mountains, 6 surveys from 1988–1997 indicate a stable population (Table 3). In the Candle/Wilson area (Table 4), 6 complete surveys and 1 partial survey indicated a low-density moose population that continues to decline (Table 4). Because of concern for the low densities in this important subsistence hunting area, 2 additional count areas were established in November 1994 and 1 in 1997. Preliminary data indicate moose densities in Unit 19D-East are extremely low and the population continues to decline.

*Population Composition*

In Unit 19A, bull:cow ratios from 10 fall surveys between 1976 and 1997 in the Holitna River drainage reveal a decline (Table 1) and are assumed to be an accurate reflection of actual bull:cow ratios. Hunting pressure is intense and probably largely responsible for the declines in bull:cow ratios. However, because the overall population is increasing, the absolute number of bulls available is also increasing. Calf:cow ratios in this area have remained relatively high, indicating favorable range conditions, low neonatal mortality rates, and sufficient bull:cow ratios.

Unit 19B bull:cow ratios appear to be higher than in Unit 19A, probably as a result of less intensive hunting pressures. Bulls per 100 cows in the Cairn–Sparrevohn Count Area between 1982 and 1992 ranged from 131 to 51, with an average of about 80. This is a relatively low-density area, and the survey area is located largely in a rut/post-rut area. Obviously, concentrations of cows with calves do not generally partake in the post-rut aggregations, thus bull:cow ratios observed are probably not an accurate reflection of the population. Calf:cow ratios in the same area have ranged from 24 to 41 calves per 100 cows, with no apparent trend in the direction.

Unit 19C is represented by the Farewell and the Windy–Pingston Count Areas. In 16 surveys conducted in the Farewell area from 1973 to 1997, we have seen notable increases in the moose population. This is due in large part to the Bear Creek Burn that occurred in 1977. By 1983 moose numbers had increased dramatically, and bull:cow ratios averaged over 50:100. Despite recent increases in the hunting pressure in the area, bull:cow ratios remain at moderate to high levels (Table 2). Like the Cairn–Sparrevohn Area in Unit 19B, the Farewell Count Area is located in a rut/post-rut area, and consequently calf percentages in the herd are relatively low. Since 1987, calves per 100 cows has averaged 20. In the Windy–Pingston count area, bull:cow ratios have remained very high, ranging from a low of 59 to a high of 148. During 7 surveys between 1984 and 1994, bull:cow ratios averaged 89:100 and calf:cow ratios ranged from 22:100 to 40:100, averaging 28:100.

In Unit 19D, the situation is bleak. Moose per hour figures, as indicated above, are quite low. Bull:cow ratios in the Candle-Wilson Count Area have been highly variable, probably a reflection of the low sample sizes rather than an indication of actual population fluctuations (Table 4). Calf:cow ratios likewise have been highly variable. In a population estimation survey completed in early spring 1996 following a mild winter, calves composed 17% of the population.

The Katlitna Burn moose survey area was established in 1997 to further document population trends in Unit 19D-East. This small count area was established in a 1985 burn and encompasses only 14.5 $mi^2$. A total of 43 minutes was spent counting 38 moose; ratios were 29.2 bulls per 100 cows and 29.2 calves per 100 cows. The observed moose density was 2.62/$mi^2$.

The Unit 21 sex and age composition data have been gathered from 2 count areas. The Holy Cross Count area has extremely high moose densities, and, despite high hunter interest, bull:cow ratios have remained at moderate levels, averaging about 28:100 when 6 fall surveys are combined between 1987 and 1996 (Table 5). Calf:cow ratios in the area during the same period ranged from 22:100 to 63:100, with no discernible trends. Bull:cow ratios in the North Fork Innoko River Count Area in Unit 21A ranged from 52:100 to 86:100 between 1980 and 1997. Calves per 100 cows ranged from 0:100 to 41:100, with recent lows probably a reflection of high predation rates and high winter mortality due to deep, long-lasting snows.

### MORTALITY

*Harvest*

<u>Seasons and Bag Limits</u>.

Unit 19A is within the Lime Village Management Area. Residents may take 2 moose of either sex by Tier II permit between 10 August and 25 September or from 20 November to 31 March. The Lime Village Management Area is closed to nonresidents.

Unit 19A outside of the Lime Village Management Area and upstream of the Kolmakof and Holokuk Rivers has a bag limit for residents of 1 bull from 1–20 September or from 20-30 November, and either sex may be harvested between 1 and 10 February. Nonresidents may take 1 bull having antlers at least 50 inches (or at least 4 brow tines on 1 or both sides) from 1–20 September.

Unit 19A outside of the Lime Village Management Area and downstream of the Kolmakof and Holokuk drainages has a resident open season of 1–20 September and 20–30 November for any bull for residents. Nonresidents are allowed to harvest bulls 50 inches or greater, or with at least 4 brow tines on 1 or both sides from 1–20 September.

Units 19B and 19C have resident seasons from 1–25 September for any bull. Nonresidents are allowed to harvest 50-inch plus bulls during the same time period. In addition, a registration hunt was established by the Board of Game in March 1997 that opens a resident moose hunt from 15 January–15 February.

Unit 19D, upstream from and including the Selatna River drainage, resident hunters may take 1 bull moose between 1–25 September or between 1–31 December. Nonresidents are not allowed to participate in the hunt. An additional 20–31 August season was established in spring 1997.

Unit 19D (remainder) residents are allowed 1 bull between 1–25 September or 1–31 December. Nonresidents must comply with the 50-inch antler regulation and may hunt only from 1–25 September.

Unit 21A resident hunters may harvest 1 bull between 5–25 September or during the month of November. Nonresidents may participate only in the 5–25 September season, with a 50-inch minimum antler restriction on bulls harvested.

Unit 21E resident hunters may hunt any bull from 5–25 September, or any moose from 1–10 February. Nonresidents have the same September seasons but must select a bull with at least 50-inch antlers.

Season dates during the past 10-year period have generally become more restrictive. In 1990 nonresident hunters were restricted to harvesting bull moose having antlers at least 50 inches in spread or with a minimum of 3 brow tines on at least 1 side. Brow tine limits were changed to a minimum of 4 on at least 1 side beginning with the 1993–1994 season throughout those areas of the Interior where 50-inch regulations had been established.

Board of Game Actions and Emergency Orders. During their March 1997 meeting, the Board of Game established a registration permit hunt for moose in Unit 19C. This season was designed to allow residents of Unit 19D an additional opportunity to harvest moose during winter when access by snowmobile is possible. Additionally, the board established a 20–31 August season in Unit 19D-East at the request of proposals from the Village of Nikolai.

No Emergency Orders have been enacted concerning moose seasons or bag limits in the area during this reporting period.

Hunter Harvest. Reported annual moose harvest in Unit 19A seems relatively stable, with an actual harvest probably in excess of 200 moose annually. The average reported annual harvest during the 5-year period 1992–1996 was 150. Most were bulls (98%), and during the February seasons there was light harvesting of cows. Hunters have a poor reporting rate in this area. Based on data collected in 1988 at the Holitna River checkstation, only 45% of the actual harvest was reported. Reported annual harvests in Units 19B and 19C are probably much better and have averaged 151 and 127 moose, respectively, over the past 5 years. In Unit 19D, compliance with reporting requirements has also been poor, averaging 106 reported annual harvests of moose between 1992 and 1996, a slight decline from the previous 5-year average of 122 moose. Overall, reported moose harvests for Unit 19 began a 3-year decline in the 1989–1990 season but have largely rebounded since that time, with the current 5-year annual reported mean moose harvest being 561 (Table 6).

In Unit 21A, reported moose harvests have declined somewhat since the late 1980s. The reported annual harvest of 116 moose in the 1995–1996 season was the lowest since the early 1980s but probably reflects a decline in effort rather than an actual decline in moose populations. The 1996–1997 reported harvest increased to 130. In Unit 21E, reported harvests generally increased through the late 1980s, and although reported harvests vary greatly from year to year, that harvest has largely remained stable from 1990–1995. The reported harvest of 188 moose in 1996–1997 was the highest on record, probably reflecting better compliance with reporting requirements rather than a significant increase in the actual harvest. Combined harvest data for Units 21A and 21E are shown in Table 7.

Permit Hunts. Beginning with the 1990–1991 season, a Tier II drawing permit hunt was established for moose hunting in the Lime Village Management Area. During 1990, 10 permits were issued with a harvest quota of 25 either-sex moose. The bag limit was changed to 28 moose with a limit of 2 per permit for the 1993–1994 regulatory year. Harvests have been light; for example, the 1995–1996 hunt included 7 moose harvested, 1 unsuccessful hunter, and 7 permittees that did not attempt to hunt.

Hunter Residency and Success. Local residents continue to account for the major portion of the harvests in Units 19A, 19D, and 21E, while most hunters in Units 19B, 19C, and 21A were nonlocal Alaska residents or nonresidents of the state (Tables 8 and 9). This segregation by residence location is caused largely by access differences. Access (Table 10) is largely by boat in Units 19A, 19D, and 21E, while aircraft provide most moose hunting access in Units 19B, 19C, and 21A.

In Unit 19A during the past 10 regulatory years (1986–1987 through 1995–1996), hunter residence has not changed dramatically. Hunters from Unit 19 have accounted for 24% of reporting hunters. Those residing in Unit 18 have accounted for 47% of reporting hunters, while hunters from other locations in Alaska have accounted for 10%. Nonresident hunters account for very few of the total hunters, averaging less than 12% over the past 10 years. Over these 10 years, Unit 19B hunters have consisted largely of nonlocal Alaskan (45%) and nonresident (50%) hunters, rather than Unit 19 residents (2%). Very few people live in the subunit. Likewise, hunters in Unit 19C are primarily nonlocal Alaskans (65%) and nonresidents (33%). Unit residents account for less than 2% of the reporting hunters. Unit 19D hunters are largely local residents (51%). Alaska residents from other areas make up an additional 35% of the reporting hunters. Nonresidents only account for 12% of the hunters who have reported during the previous 10-year period. Unit 21A hunters consist largely of nonlocals (50%) and nonresidents (35%). Hunters reporting from Unit 21E are generally from Unit 18 (40%) or from 1 of 4 villages in the subunit (30%). Nonresidents generally make up less than 5% of all hunters in the subunit.

Harvest Chronology. Most of Unit 19, 21A, and 21E moose harvests are during September. During the most recent hunting season for which complete data are available (1996–1997), 97% of reported harvests were during September. Winter harvests (Dec and Feb) are variable from year to year, largely dependent on snow conditions. Heavy early winter snows tend to concentrate moose along riparian corridors and enable hunters easier access with snowmachines. Years with lighter snowpack generally have higher proportions of moose taken during winter seasons. In Units 21A and 21E, virtually the legal harvest occurs during September, with winter seasons contributing little additional harvest.

Transport Methods. As in previous years, the Unit 19A, 19D, and 21E most common method of transport is by boat (1995–1996 data, 78%, 72%, and 82%, respectively). In Units 19B, 19C, and 21A, the use of aircraft for transportation is predominant, with 87%, 81%, and 71% of all access being provided by aircraft. Because of the access differences, "local" hunters are largely separated from "nonlocal" hunters (Table 10).

### *Other Mortality*

Illegal harvests, defense of life or property kills, wounding loss, and funeral potlatch harvests probably account for an additional 100–150 moose deaths annually in Unit 19 and probably 50–75 additional kills in Units 21A and 21E. Of much greater importance to the dynamics of the moose population, however, is predation mortality. Although poorly documented, predation on calves, yearlings, and adults by wolves has been extremely high in recent years, as has calf mortality by black bears. Starvation during recent years has also undoubtedly affected survival rates of calf cohorts in certain areas.

Bone marrow samples from moose killed by hunters ($n = 7$), from moose killed by wolves ($n = 40$), and from moose killed by other natural causes ($n = 3$) were collected during winters 1993–1994, 1994–1995, and 1995–1996. Samples were collected in November–December ($n = 20$), January–February ($n = 16$) and March–April ($n = 14$) from both adult ($n = 32$) and calf ($n = 18$) moose. Among the total sample, pooled for all years and for all months, marrow fat percentages averaged 79% among adult moose and 27.5% among calves. Fat contents of less than 20% in adult moose and of less than 10% in calf moose are considered evidence of death from malnutrition, while fat contents at winter's end of greater than 55% indicate good to excellent condition. Samples taken from both adult and calf moose killed by wolves during March and April 1994 all exceeded 50% marrow fat, indicating that nutritional status of all moose was high during the average winter 1993–1994.

## HABITAT

### *Assessment*

It is unlikely the moose population is limited by available habitat. In Alaska optimal moose forage is generally associated with willow bands and in seral growth stages following wildfires. In Unit 19D-East alone, over 2300 linear miles of riparian habitat is maintained by shifting rivers in a wide band along the Kuskokwim River and its major tributaries. Additional riparian habitat is along smaller creeks and around hundreds of boreal lakes and ponds. Limited suppression of naturally occurring wildfires has created a mosaic of vegetation successional stages. During most summers hundreds of square miles of boreal forest burns in small isolated fires throughout the area increase potential for rejuvenation of moose winter forage plants. In addition, climax stands of subalpine willow persist in bands around the treeline of the boreal forest in the hills that lie along the north side of the Kuskokwim drainages.

The rates at which moose produce twin calves are reliable indicators of nutritional condition. Aerial surveys of moose were conducted during June 1991, 1992, 1994, and 1996 in the McGrath area. An average of 22 cows with newborn calves was observed during those surveys and an average of 28% (range 18–33%) of those cows had twins. That level of twinning compared to other rates documented throughout North America indicates that productivity was not food-limited (Gasaway et al. 1992).

*Enhancement*

Ongoing assessment efforts continue to document browse utilization on heavily used winter ranges along the Kuskokwim River. Habitat enhancement efforts have continued as well. Close cooperation with Alaska Department of Natural Resources fire management personnel has resulted in relatively high-acreage burns in recent years. Education efforts in schools and on radio programs have also continued in an effort to dispel myths concerning wildfires and to allow more areas to burn. In cooperation with the U.S. Bureau of Land Management and Alaska Department of Natural Resources, a prescribed fire plan is in final stages for portions of Units 19C and 19D in the Farewell area.

## CONCLUSIONS AND RECOMMENDATIONS

As early as 1980 Alaska Department of Fish and Game biologists recognized resident moose populations were diminished in the upper Kuskokwim River drainages. At the time, the situation was characterized as a "predator problem." In 1989 a series of severe winters began. Four of 7 winters between 1989 and 1995 were "severe," with deep, persistent snow. Those conditions commonly contribute to increased overwinter mortality of moose through increased vulnerability to wolf predation and decreased access to moose forage. Many areas throughout the management area have very high populations of wolves, and their impact on moose populations is substantial. Even if future winter conditions remain relatively mild, some moose populations will probably not increase to desired densities without increased harvest of wolves. Moose management in the area is currently compromised by the inability to manage predator populations. Harvest is probably having relatively little impact on these moose populations compared to predation (Gasaway et al. 1992).

A comprehensive moose census in the upper Kuskokwim River in spring 1996 documented densities at 0.28–0.46 moose per square mile in an 1800-$mi^2$ area (90% CI). During February 1995, a wolf population estimate in roughly the same area documented 164 wolves in a 5200-$mi^2$ portion of 19D-East. Wolves, however, are not expected to persist at the densities documented during that census. Based on other North American research on the relationships of wolves and moose (Keith 1983; Fuller 1989; Gasaway et al. 1992), the current moose population would be expected to support a wolf population of roughly half of the 1995 level. Wolves will probably decline naturally through mechanisms of reduced productivity (Boertje and Stephenson 1992), dispersal, and increased mortality (Meire et al. 1996). However, wolves are expected to persist and wolf predation on moose during winter will probably continue to be a significant factor limiting moose population growth for decades (Gasaway et al. 1992). Moose densities are expected to remain at predation-limited densities of 0.2 to 1.0

moose/mi$^2$ over large areas (>2000 mi$^2$ of moose habitat) unless predation is substantially reduced (Gasaway et al. 1992).

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Table 1 Holitna/Hoholitna Count Area (Unit 19A) fall aerial moose composition counts, 1987–1997

| Regulatory year | Bulls:100 cows | Yearling bulls:100 cows | Calves: 100 cows | Calves | Percent calves | Adults | Moose | Moose/ hour |
|---|---|---|---|---|---|---|---|---|
| 1987–1988 | 22 | 4 | 72 | 50 | 36 | 84 | 140 | 85 |
| 1988–1989 | 31 | 16 | 56 | 103 | 30 | 240 | 343 | 95 |
| 1989–1990 | 24 | 13 | 55 | 160 | 30 | 361 | 528 | 163 |
| 1990–1991 | 26 | 10 | 52 | 139 | 29 | 336 | 475 | 162 |
| 1991–1992[a] | | | | | | | | |
| 1992–1993 | 31 | 15 | 63 | 172 | 32 | 360 | 542 | 169 |
| 1993–1994[a] | | | | | | | | |
| 1994–1995 | 14 | 2 | 42 | 209 | 27 | 568 | 778 | 251 |
| 1995–1996[a] | | | | | | | | |
| 1996–1997 | 22 | 10 | 50 | 146 | 29 | 355 | 502 | 152 |
| 1997–1998 | 14 | 11 | 34 | 85 | 23 | 286 | 371 | 169 |

[a] No survey.

Table 2 Farewell Burn Count Area (Unit 19C) fall aerial moose composition counts, 1987–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves: 100 Cows | Calves | Percent calves | Adults | Moose | Moose/ hour |
|---|---|---|---|---|---|---|---|---|
| 1987–1988 | 53 | 10 | 19 | 32 | 13 | 207 | 242 | 115 |
| 1988–1989 | 58 | 20 | 34 | 47 | 18 | 218 | 265 | 126 |
| 1989–1990 | 47 | 15 | 22 | 55 | 13 | 361 | 416 | 194 |
| 1990–1991 | 43 | 8 | 26 | 58 | 16 | 315 | 373 | 159 |
| 1991–1992 | 44 | 8 | 29 | 59 | 17 | 293 | 352 | 156 |
| 1992–1993 | 46 | 8 | 38 | 58 | 21 | 220 | 278 | 100 |
| 1993–1994[a] | | | | | | | | |
| 1994–1995 | 52 | 10 | 19 | 45 | 11 | 353 | 404 | 170 |
| 1995–1996[a] | | | | | | | | |
| 1996–1997 | 46 | 11 | 15 | 43 | 10 | 411 | 454 | 158 |
| 1997–1998 | 30 | 10 | 27 | 75 | 17 | 368 | 443 | 174 |

[a] No survey.

Table 3 White Mountains (Unit 19D) fall aerial moose composition counts, 1987–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves: 100 Cows | Calves | Percent calves | Adults | Moose | Moose/ hour |
|---|---|---|---|---|---|---|---|---|
| 1987–1988[a] | | | | | | | | |
| 1988–1989 | 189 | 27 | 17 | 5 | 11 | 84 | 89 | 40 |
| 1989–1990 | 157 | 14 | 33 | 7 | 11 | 55 | 62 | 29 |
| 1990–1991 | 96 | 6 | 46 | 15 | 19 | 63 | 78 | 34 |
| 1991–1992[a] | | | | | | | | |
| 1992–1993 | 133 | 0 | 40 | 11 | 14 | 63 | 74 | 37 |
| 1993–1994 | 50 | 11 | 34 | 9 | 18 | 39 | 48 | 60 |
| 1994–1995[a] | | | | | | | | |
| 1995–1996[a] | | | | | | | | |
| 1996–1997 | 157 | 36 | 43 | 6 | 14 | 36 | 42 | 19 |
| 1997–1998[a] | | | | | | | | |

[a] No survey.

Table 4 Candle/Wilson A, B, C, and D count areas (Unit 19D) fall aerial moose composition counts, 1988–1997

| Regulatory Year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves: 100 Cows | Calves | Percent calves | Adults | Moose | Moose/ hour |
|---|---|---|---|---|---|---|---|---|
| A and B | | | | | | | | |
| 1988–1989[a] | | | | | | | | |
| 1989–1990 | 14 | 6 | 34 | 17 | 23 | 56 | 73 | 34 |
| 1990–1991 | 34 | 6 | 23 | 11 | 14 | 63 | 74 | 39 |
| 1991–1992 | 20 | 0 | 31 | 14 | 20 | 53 | 67 | 37 |
| 1992–1993 | 4 | 2 | 28 | 12 | 21 | 45 | 57 | 34 |
| 1993–1994 | 14 | 9 | 28 | 6 | 20 | 24 | 30 | 12 |
| 1994–1995 | 18 | 3 | 21 | 13 | 15 | 72 | 85 | 47 |
| 1995–1996[a] | | | | | | | | |
| 1996–1997 | 16 | 5 | 38 | 14 | 25 | 43 | 57 | 26 |
| 1997–1998 | 16 | 6 | 53 | 17 | 31 | 37 | 54 | 25 |
| C and D | | | | | | | | |
| 1988–1989[a] | | | | | | | | |
| 1989–1990 | 25 | 5 | 70 | 14 | 35 | 25 | 39 | 41 |
| 1990–1991 | 11 | 0 | 27 | 7 | 19 | 29 | 36 | 40 |
| 1991–1992[a] | | | | | | | | |
| 1992–1993 | 17 | 4 | 26 | 6 | 18 | 27 | 33 | 22 |
| 1993–1994 | 37 | 18 | 50 | 8 | 26 | 22 | 30 | 30 |
| 1994–1995 | 23 | 6 | 10 | 3 | 7 | 38 | 41 | 32 |
| 1995–1996[a] | | | | | | | | |
| 1996–1997 | 21 | 11 | 26 | 5 | 18 | 23 | 28 | 15 |
| 1997–1998 | 6 | 6 | 50 | 8 | 32 | 17 | 25 | 11 |

[a] No survey.

Table 5 Holy Cross (Unit 21E) fall aerial moose composition counts, 1987–1997

| Regulatory year | Bulls: Cows | Yearling bulls:100 Cows | Calves: 100 Cows | Calves | Percent calves | Adults | Moose | Moose/ hour |
|---|---|---|---|---|---|---|---|---|
| 1987–1988 | 19 | 9 | 43 | 150 | 26 | 420 | 570 | 83 |
| 1988–1989[a] | | | | | | | | |
| 1989–1990 | 31 | 12 | 45 | 148 | 25 | 432 | 584 | 161 |
| 1990–1991 | 29 | 7 | 51 | 211 | 28 | 536 | 758 | 253 |
| 1991–1992[a] | | | | | | | | |
| 1992–1993 | 26 | 5 | 22 | 67 | 14 | 412 | 483 | 163 |
| 1993–1994[a] | | | | | | | | |
| 1994–1995 | 29 | 9 | 63 | 216 | 32 | 444 | 674 | 234 |
| 1995–1996[a] | | | | | | | | |
| 1996–1997 | 30 | 11 | 34 | 158 | 21 | 604 | 762 | 186 |
| 1997–1998[a] | | | | | | | | |

[a] No survey.

Table 6 Unit 19 moose harvest, 1986–1996

| Regulatory year | Harvest by hunters | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Reported | | | | | | Estimated unreported | |
| | M | % | F | % | Unk | Total | | |
| 1986–1987 | 454 | 98 | 8 | 2 | 2 | 464 | 153 | 617 |
| 1987–1988 | 530 | 97 | 17 | 3 | 2 | 549 | 181 | 730 |
| 1988–1989 | 615 | 98 | 15 | 2 | 7 | 637 | 210 | 847 |
| 1989–1990 | 546 | 99 | 7 | 1 | 6 | 559 | 184 | 743 |
| 1990–1991 | 383 | 95 | 20 | 5 | 1 | 404 | 133 | 537 |
| 1991–1992 | 461 | 97 | 13 | 2 | 2 | 476 | 157 | 633 |
| 1992–1993 | 485 | 96 | 22 | 4 | 3 | 510 | 168 | 678 |
| 1993–1994 | 539 | 99 | 2 | 1 | 2 | 543 | 179 | 722 |
| 1994–1995 | 588 | 99 | 8 | 1 | 0 | 596 | 197 | 793 |
| 1995–1996 | 522 | 99 | 1 | 1 | 6 | 529 | 175 | 704 |
| 1996–1997 | 615 | 99 | 7 | 1 | 3 | 625 | 197 | 822 |

Table 7 Units 21A and 21E moose harvest, 1986–1996

| Regulatory year | Harvest by hunters | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reported | | | | | | Estimated | |
| | M | % | F | % | Unk | Total | unreported | Total |
| 1986–1987 | 227 | 95 | 11 | 5 | 0 | 238 | 79 | 317 |
| 1987–1988 | 251 | 98 | 6 | 2 | 0 | 257 | 85 | 342 |
| 1988–1989 | 306 | 98 | 6 | 2 | 5 | 317 | 105 | 422 |
| 1989–1990 | 277 | 99 | 1 | <1 | 0 | 278 | 92 | 370 |
| 1990–1991 | 304 | 99 | 3 | 1 | 3 | 310 | 102 | 412 |
| 1991–1992 | 284 | 99 | 4 | 1 | 0 | 288 | 95 | 383 |
| 1992–1993 | 222 | 99 | 2 | <1 | 0 | 224 | 74 | 298 |
| 1993–1994 | 240 | 98 | 3 | 1 | 0 | 243 | 80 | 323 |
| 1994–1995 | 276 | 97 | 10 | 3 | 0 | 286 | 94 | 380 |
| 1995–1996 | 272 | 98 | 6 | 2 | 0 | 278 | 92 | 370 |
| 1996–1997 | 303 | 95 | 15 | 5 | 0 | 318 | 100 | 418 |

Table 8 Unit 19 moose hunter residency and success, 1986–1996

| | Successful | | | | | | Unsuccessful | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Local resident | Nonlocal resident | Nonresident | Unk | Total | % | Local resident | Nonlocal resident | Nonresident | Unk | Total | % | Total hunters |
| 1986–1987 | 89 | 191 | 119 | 47 | 446 | 54 | 101 | 183 | 77 | 15 | 376 | 46 | 822 |
| 1987–1988 | 121 | 245 | 162 | 21 | 549 | 54 | 95 | 280 | 94 | 6 | 475 | 46 | 1024 |
| 1988–1989 | 110 | 285 | 188 | 54 | 637 | 54 | 132 | 271 | 105 | 28 | 536 | 46 | 1173 |
| 1989–1990 | 114 | 134 | 185 | 36 | 469 | 45 | 95 | 305 | 162 | 5 | 567 | 55 | 1036 |
| 1990–1991 | 81 | 189 | 111 | 23 | 404 | 37 | 94 | 329 | 232 | 20 | 675 | 63 | 1079 |
| 1991–1992 | 87 | 259 | 123 | 7 | 476 | 47 | 122 | 266 | 141 | 5 | 534 | 53 | 1010 |
| 1992–1993 | 100 | 256 | 113 | 41 | 510 | 48 | 123 | 257 | 149 | 18 | 547 | 52 | 1057 |
| 1993–1994 | 89 | 271 | 153 | 30 | 543 | 53 | 57 | 247 | 166 | 6 | 476 | 47 | 1018 |
| 1994–1995 | 121 | 276 | 181 | 18 | 596 | 45 | 124 | 368 | 224 | 16 | 732 | 55 | 1328 |
| 1995–1996 | 89 | 262 | 173 | 5 | 529 | 44 | 155 | 325 | 197 | 4 | 681 | 56 | 1210 |
| 1996–1997 | 110 | 290 | 211 | 14 | 625 | 52 | 118 | 257 | 200 | 3 | 573 | 48 | 1198 |

Table 9 Units 21A and 21E moose hunter residency and success, 1986–1996

| Regulatory year | Successful | | | | | | Unsuccessful | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local resident | Nonlocal resident | Nonresident | Unk | Total | % | Local resident | Nonlocal resident | Nonresident | Unk | Total | % | Total hunters |
| 1986–1987 | 43 | 135 | 45 | 15 | 238 | 75 | 10 | 63 | 7 | 0 | 80 | 25 | 318 |
| 1987–1988 | 21 | 164 | 43 | 29 | 257 | 68 | 9 | 83 | 20 | 9 | 121 | 32 | 378 |
| 1988–1989 | 13 | 177 | 69 | 58 | 317 | 75 | 2 | 62 | 28 | 16 | 108 | 25 | 425 |
| 1989–1990 | 19 | 178 | 53 | 28 | 278 | 73 | 9 | 66 | 18 | 9 | 102 | 27 | 380 |
| 1990–1991 | 40 | 203 | 52 | 15 | 310 | 72 | 13 | 80 | 25 | 3 | 121 | 28 | 431 |
| 1991–1992 | 41 | 200 | 42 | 4 | 287 | 64 | 22 | 104 | 34 | 0 | 160 | 36 | 447 |
| 1992–1993 | 20 | 152 | 35 | 19 | 226 | 63 | 8 | 91 | 26 | 5 | 130 | 37 | 356 |
| 1993–1994 | 39 | 141 | 45 | 14 | 239 | 67 | 9 | 71 | 36 | 1 | 117 | 33 | 356 |
| 1994–1995 | 35 | 184 | 47 | 17 | 283 | 67 | 8 | 87 | 43 | 2 | 140 | 33 | 423 |
| 1995–1996 | 35 | 197 | 46 | 1 | 279 | 71 | 7 | 74 | 31 | 3 | 115 | 29 | 394 |
| 1996–1997 | 32 | 243 | 71 | 4 | 318 | 74 | 4 | 83 | 31 | 0 | 114 | 26 | 432 |

Table 10 Unit 19 moose harvest percent by transport method, 1986–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-Wheeler | Snowmachine | Other ORV | Highway Vehicle | Unknown | Total |
| 1987–1987 | 44 | <1 | 44 | 2 | 3 | <1 | 1 | 5 | 822 |
| 1987–1988 | 38 | <1 | 44 | 3 | 7 | 2 | <1 | 5 | 1024 |
| 1988–1989 | 45 | <1 | 43 | 2 | 5 | 1 | <1 | 4 | 1173 |
| 1989–1990 | 47 | <1 | 41 | 2 | 2 | <1 | <1 | 5 | 1036 |
| 1990–1991 | 53 | 1 | 35 | 2 | 4 | <1 | <1 | 4 | 1079 |
| 1991–1992 | 49 | <1 | 41 | 3 | 4 | <1 | <1 | 1 | 1010 |
| 1992–1993 | 41 | 1 | 45 | 2 | 9 | 0 | <1 | 2 | 1057 |
| 1993–1994 | 57 | 1 | 33 | 3 | 2 | <1 | <1 | 3 | 1019 |
| 1994–1995 | 52 | 1 | 35 | 2 | 4 | <1 | <1 | 4 | 1328 |
| 1995–1996 | 50 | 2 | 37 | 3 | 1 | <1 | <1 | 5 | 1210 |
| 1996–1997 | 51 | 2 | 39 | 5 | 2 | <1 | <1 | <1 | 1198 |

# LOCATION

**GAME MANAGEMENT UNIT:** 20A (6796 mi$^2$)

**GEOGRAPHIC DESCRIPTION:** Tanana Flats, Central Alaska Range

# BACKGROUND

Moose are throughout the foothills of the Alaska Range and the Tanana Flats at exceptionally high densities relative to similarly sized areas throughout North America. Unit 20A moose are a world-class wildlife resource. Gasaway et al. (1983) presented a detailed history of the Unit 20A moose population through 1978, while Boertje et al. (1996) presented a history through 1995.

Preferred moose habitat comprises riparian willow, poorly drained meadows, shallow lakes, early successional forest, and subalpine shrub communities. Approximately 5040 mi$^2$ of the subunit is comprised of moose habitat.

Moose numbers increased in Unit 20A during the 1950s and reached high densities in the early 1960s, perhaps 4–5 moose/mi$^2$. Annual moose harvests averaged 311 moose between 1963 and 1969 (McNay 1993). From 1969 to 1974, harvest increased to an average of 617 moose per year. Cow moose comprised 34% of the annual harvest from 1963 to 1974.

Similar to numerous other ungulate populations in Alaska, the moose population declined beginning in the late 1960s and reached its lowest point in the mid-1970s. Beginning in 1975, seasons and harvests were dramatically reduced and taking of cows was prohibited. In late winter 1976 the division implemented a program to reduce wolf numbers. During 1975–1978 mean annual moose harvest was limited to 64 bulls.

During wolf reduction efforts in Unit 20A (1976–1982), the moose population increased rapidly and has increased most years since 1982. From 1979 to 1982 harvests averaged 226 bulls/year (McNay 1993). During 1983–1993 the mean annual harvest increased to 358 bulls. A wolf control program to reduce effects of predation on the declining Delta Caribou Herd began in October 1993 but was discontinued in December 1994. Division staff reduced wolf numbers by trapping and snaring and may have influenced moose population dynamics.

Regulations provide a variety of hunting opportunities in Unit 20A, but most of the harvest is during a 1–25 September bulls-only season. The southwestern portion of the subunit currently includes the Wood River Controlled Use Area (no motorized access except aircraft), the Ferry Trail Management Area (harvest limited to bulls with spike-fork or 50-inch antlers), the Healy Lignite Management Area (bowhunting only), and the Yanert Controlled Use Area (no motorized access except aircraft, with harvest limited to bulls with spike-fork or 50-inch antlers). Approximately one-third of Unit 20A is military land, including 1003 mi$^2$ of Fort Wainwright Army property, 893 mi$^2$ of Fort Greely Army property, and 17 mi$^2$ of Clear Air Force Station property.

# MANAGEMENT DIRECTION

## MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide the greatest sustained opportunity to participate in hunting moose.
- Provide an opportunity to view and photograph moose.

## MANAGEMENT OBJECTIVES

- Manage for a November population of between 10,000 and 12,000 adult (i.e., excluding calves) moose.
- Manage for at least 30 bulls:100 cows overall and at least 20 bulls:100 cows in the Tanana Flats, Western Foothills, and Eastern Foothills areas.
- Allow harvest of cow moose when the population is above the population objective of 10,000 adult moose.
- Document uses of moose in Unit 20A.

# METHODS

## WEATHER

We evaluated weather through National Weather Service records and personal observations.

## POPULATION STATUS AND TREND

A subunit survey scheduled for 1995 was not conducted due to lack of snow. In substitution, we estimated the proportion of calves in the population in early February 1996. We completed an extensive survey in 1996 and a low-effort survey in 1997.

### *February 1996*

On 2–3 February we surveyed 3 areas in Unit 20A to determine calf:adult moose ratios. Four survey units near Walker Dome and 3+ near the Japan Hills were counted on 2 February. Four survey units near Salchaket Slough were surveyed on 3 February. We selected survey units within the old trend count areas that contained high numbers of moose during previous surveys. Survey units were flown at about 4 min/mi$^2$, and we classified moose as calves or adults.

Three observers in PA18 and Scout aircraft flew with highly experienced charter pilots. Conditions were adequate. Two to 4 inches of new snow fell 2 days before the start of the survey; however, the snowpack remained quite shallow. Skies were generally clear, and light intensity was moderate.

*November 1996*

We conducted a moose survey in all suitable moose habitat in Unit 20A on 1–8 November 1996. Seven pilots and 11 observers participated. Five or 6 planes flew every day except 2 and 3 November when weather suspended operations. Generally we experienced good to excellent conditions: lots of fresh snow before and during the survey and moderate intensity flat light. Observers reported poor conditions for a few survey units (SU) where snow reduced visibility and fresh snow blanketed moose.

We used existing data for stratification of survey units into 2 strata. In addition, we considered 2 geographic regions, foothills and flats, as blocks. This essentially created 4 strata: foothills high, foothills low, flats high, and flats low. This design increased precision by accounting for differences in moose distribution and density among the geographic areas. In addition, it simplifies comparison of the subpopulations with previous estimates.

We sampled 102 of 402 SUs at 4–6 minutes/mi$^2$ and conducted 38 sightability correction factor (SCF) intensive searches at 12–15 minutes/mi$^2$. These SCF plots were randomly selected, 2-mi$^2$ portions of SUs. The 102 standard samples were allocated among the 4 strata based on simulations conducted from earlier data sets. We began the survey by flying SCF plots in every third SU regardless of strata. Later in the survey, we used optimization routines in MOOSEPOP to allocate SCF plots among strata.

We grouped SUs into clusters that could easily be completed in a single day and assigned the clusters so that difficult survey areas were completed as early in the survey as possible. We also assigned clusters so that aircraft worked closely enough together to maintain communications, yet far enough apart to maintain safe spacing. We employed highly experienced pilots; however, observer experience varied markedly. Two observers had little experience in aircraft and no moose survey experience. Airsickness did not appear to be much of a problem, partly due to new medication and generally calm winds. Two observers reported moderate airsickness on 1 occasion each, and another 2 reported mild airsickness on 1 occasion.

We analyzed the data using MOOSEPOP software and calculated estimates using both pooled and unpooled SCFs. We also calculated separate estimates for the flats, foothills, western foothills, and central flats for comparisons with previous surveys.

*November 1997*

We conducted a low effort moose survey throughout Unit 20A during the month of November. We employed methods similar to the November 1996 survey; however, effort was reduced to 27 sampling units. We employed the November 1996 stratification without modification and randomly selected survey units for sampling. Sampling effort was weighted as heavily as possible to high-density strata while maintaining a minimum sample size of 6 units in the low strata. We surveyed selected units at 4–6 minutes/mi$^2$. We did not estimate sightability.

Due to a long spell of windy and warm weather, the survey dates were from 2–25 November. Although the data sheets generally indicated good survey conditions, we considered the survey conditions below average. We aborted operations on many units due to wind. In addition, the extent of snow cover and snow depth were not as good as in 1996.

*Short Yearling and Twinning Surveys*

We estimated overwinter survival of calves on the central Tanana Flats on 2 May 1996 by classifying 258 moose from a Scout. We did not estimate short yearlings in 1997.

We estimated twinning rates on the central Tanana Flats on 20, 22, 24, and 26 May 1996. An experienced observer flew up to 2.8 hours in the same survey area each day with contract pilots. We conducted the same survey 19, 21, and 25 May 1997. We terminated surveys and did not include data from surveys when less than 15% of the cows had calves. We calculated twinning rate as the proportion of cows with twins from the sample of all cows with calves.

*Population Modeling*

To further evaluate population dynamics, we constructed a Leslie matrix projection consisting of 2 age classes: fall calves and adults. Numbers of calves were estimated from empirical composition data. Other empirical entries were cow harvest, bull harvest, and yearling bull harvest data. We iteratively input sex- and age-class specific survival rate estimates that resulted in population projections similar to survey estimates and solved for annual growth rates and other parameters. In addition we used survival rate estimates from the ongoing research project (Boertje et al. 1998) where applicable.

### HARVEST

We estimated annual harvest from harvest report cards. We considered bulls with antler spreads less than 30 inches to be yearlings.

## RESULTS AND DISCUSSION

### WEATHER

Unusual weather may have influenced aspects of moose population dynamics during the last few years. Winter 1990–1991 had the highest snowfall on record in Fairbanks (147.3 inches) and was closely followed by 1992–1993 (139.1 inches). These record snowfalls are well over twice as high as the long-term average (68 inches). Winter 1993–1994 was a relatively mild snow year, as were 1994–1995 and 1995–1996. Snow was abundant in autumn 1996; however, the season was generally mild.

Summer 1992 was probably the shortest on record. It was bracketed with snowfall in mid May, and in September 24 inches of snow fell (3 times the previous record) amid cold temperatures (13 degrees colder than previous record). In contrast, 1993 was probably the longest summer on record, with an early spring leafout, warm summer, and late fall. Snow was so scarce in 1995 that we couldn't conduct surveys until February 1996. Fall 1996 had good early snowfall, with much more moderate snowfall during the remainder of the winter.

## POPULATION STATUS AND TREND

### *Population Size*

We estimated 11,172 moose (± 12.7% at 90% CI) in Unit 20A using unpooled SCFs. Using pooled SCF data, we estimated 11,532 moose (± 13% at 90% CI). Comparing the pooled SCF estimate and the 1988 estimate of 9296 moose reveals an average annual finite growth rate of 1.027.

We estimated 11,248 (± 27%, 90% CI) moose in Unit 20A in 1997 without a sightability correction. This compares to an uncorrected estimate of 9790 in 1996. Assuming a SCF of about 1.15, our corrected estimates are 11,500 for 1996 and 13,000 for 1997. Although a striking increase ($r = 0.139$), it is not significant ($P = 0.43$, df = 9.44).

### *Population Composition*

In November 1996 we classified 3343 moose and estimated 42 calves:100 cows, 39 bulls:100 cows, and 12 yearling bulls:100 cows. In November 1997, we classified 1037 moose and estimated 34 calves:100 cows and 33 bulls:100 cows (Table 1). Early May surveys indicate relatively low mortality of calves to 12 months of age (Table 2), compared to most moose survey areas.

### *Twinning Rates*

Twinning rates were 18% in 1996 ($N = 40$) and 10% in 1997 ($N = 29$) (Table 3). Twinning rates can be affected by numerous factors, including timing of survey, sightability, and number of pregnant yearlings. Replication of twinning rate surveys indicates substantial variation in observed twinning rates, and only some twinning rates can be explained by timing of the surveys. Recent data indicate yearlings in Unit 20A are not pregnant (Boertje et al. 1998).

### *Bull:Cow Ratios*

Since 1988 the bag limit in the southwestern portion of Unit 20A has been limited to 1 bull with spike-fork or 50 inch antlers (subsequently referred to as SF50). This antler restriction was adopted in response to declining bull:cow ratios (17–21:100). Numerous trails provide motorized access in this area. Bull:cow ratios have improved recently, presumably because of the antler restriction. Bull:cow ratios exceeded the management objective for the Western Foothills of 20 bulls:100 cows in 1993 (31 bulls:100 cows in the Walker Dome trend area), 1994 (26 bulls:100 cows in the Ferry Trail Management Area [FTMA], and in 1996 (23:100 in the FTMA). The November 1997 data were inadequate to assess ratios in the FTMA.

### *Distribution and Movements*

The moose population is distributed throughout Unit 20A, consisting of nonmigratory and migratory subpopulations (Gasaway et al. 1983). From February to April some bull and cow moose migrate from the surrounding foothills (Alaska Range and Chena and Salcha River drainages) to calving areas on the Tanana Flats in Unit 20A. They remain there for the summer and return to the foothills from August through October. Although we do not know what proportion of the moose migrate, Gasaway et al. (1983) estimated that the seasonal migrants probably increase the density of moose on the Tanana Flats 2- to 4-fold over the density of resident moose. However, the moose population in Unit 20A has grown much more rapidly than surrounding areas so the proportion of seasonal immigrants on the flats is now probably reduced.

## MORTALITY

### *Harvest*

Season and Bag Limit. Seasons and bag limits in Unit 20A during regulatory years 1995 and 1996 were as follows:

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| Ferry Trail Management Area and the Yanert Controlled Use Area: 1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines. | 1 Sep–25 Sep | 1 Sep–25 Sep |
| Remainder of 20A. | 1 Sep–25 Sep | 1 Sep–25 Sep |

In 1996 the board extended seasons as follows:

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| Ferry Trail Management Area and the Yanert Controlled Use Area: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines | 1 Sep–25 Sep | 1 Sep–25 Sep |
| Northeast portion of the Wood River Controlled Use Area: 1 bull or 1 antlerless moose by drawing permit or 1 bull by muzzleloader by drawing permit. | 1 Sep–25 Sep<br>1 Sep–25 Sep<br>1 Nov–30 Nov | 1 Sep–25 Sep<br>1 Sep–25 Sep<br>1 Nov–30 Nov |
| Remainder of 20A: 1 bull or in northcentral Tanana Flats, 1 antlerless moose by drawing permit. | 1 Sep–25 Sep<br>1 Sep–25 Sep | 1 Sep–25 Sep<br>1 Sep–25 Sep |

Board of Game Actions and Emergency Orders. In 1991 and 1992, 50-inch antlers were defined as antlers with at least a 50-inch spread or with at least 3 brow tines on at least 1 antler. In 1993–

1995 the bag limit was redefined as 1 bull with a spike-fork antler configuration, 50-inch antler spread, or antlers with 4 or more brow tines on 1 side. In 1996 the board reduced the brow tine requirement to 3 tines.

The board also created 3 antlerless hunts by drawing permit 1996. Two (DM760 and DM762) are on the Tanana Flats near Fairbanks where moose densities are high. DM760 runs from 1–10 September, and DM762 runs from 11 Sep–25 Sep. The third antlerless hunt occurs during the regular season in a portion of the Wood River Controlled Use Area.

The department proposed antlerless hunts to 1) take advantage of harvest potential in areas of high and increasing moose density, and 2) slow population growth so that the population doesn't grow too quickly and reach densities that make the population vulnerable to severe weather-driven declines.

Opposition to antlerless hunts by some advisory committees was high. However, reducing the scope of the hunt areas and limiting the number of permits issued to 300 resulted in approval by the committees for 3 consecutive years. In addition, we indicated that the antlerless harvest would be kept low enough so that the population could continue to increase. Some committee members stated that moose numbers have historically been much higher, that more moose were desired, and that the range could support more moose. Moose are undoubtedly distributed differently from previous high numbers. However, moose are above levels previously sustained in Alaska and are at high densities relative to similarly sized areas in North America. A graduate student is currently determining whether moose annually consume all the current annual growth of shrubs in the Tanana Flats. A 0% pregnancy rate among yearlings indicates a higher moose density is not desirable.

The board also created a muzzleloader only drawing hunt for bulls in November in response to a proposal from the muzzleloader's association. This hunt allows the department to issue up to 75 permits for a portion of the Wood River Controlled Use Area.

The board created the Nenana Controlled Use Area in portions of 20A and 20C. The use of airboats for hunting or transporting moose hunters or their gear is prohibited.

Harvest by Hunters. Moose harvest continued to increase in Unit 20A even before the increased opportunities were created in 1996 (Table 4). Current reported harvests are similar to the highest reported for the last 25 years.

In 1996, 56 hunters killed 25 cow moose in DM760, 51 killed 27 in DM762, and 43 killed 9 in DM764. Some permittees killed bull moose instead of filling their antlerless permit. Thirty-two hunters took 10 bull moose during the muzzleloader permit hunt (DM766).

Hunter Success and Residency. Overall success rates during general hunts in the last 5 years averaged 30% (Table 4). Nonresidents had higher success rates than residents.

Harvest Chronology. Moose harvest in Unit 20A has traditionally been well distributed throughout the season (Table 5), but more are killed during the first 5 days compared to any other 5 days of the season.

Transport Methods. During the last 11 years 28 to 40% of successful moose hunters used airplanes, 25 to 37% used boats, 13 to 30% used ORVs or 3- or 4-wheelers, and 2 to 6% used horses (Table 6). Hunting by horseback is popular in the Yanert Controlled Use Area and in the Montana Creek drainage. Hunters increasingly used 3- and 4-wheelers; the Ferry Trail Management Area continues to be a popular place for 3- and 4-wheelers. In addition, hunters are increasingly using boats to transport these vehicles to the Tanana Flats.

Airboat use remains controversial. Beginning in 1997, airboats will be distinguished as a transportation category on harvest report cards.

*Other Mortality*

A study of moose mortality began in 1996 and a progress report is available (Boertje et al. 1998).

The number of moose killed in accidents with motor vehicles and trains has been substantial in some years but was not excessive this reporting period.

### HABITAT

There has been considerable discussion in recent years regarding the potential for Unit 20A to support more moose. We remain concerned about the population exceeding habitat capacity and becoming unproductive, resulting in reduced harvests. Also, with severe weather and predation interactions, the moose population may decline dramatically. The research implemented in 1996 is evaluating many factors influencing the status of the moose population relative to habitat, predators, and sustainable harvest.

In moose populations on good range or below carrying capacity, yearling ovulation and pregnancy occur, but at rates that vary with population density (Schwartz 1992). By radiocollaring short-yearling cows, we documented 0% yearling pregnancy rates, which indicates a higher moose density is not desirable.

### NONREGULATORY PROBLEMS/ISSUES

An electric intertie to be constructed from Healy to Fairbanks has been proposed that potentially bisects important moose habitat in western Unit 20A. Construction on routes bisecting Unit 20A will likely have 2 main effects on moose. Access may be improved by the intertie corridor and changes in regulations to prevent local overharvest of bulls may be necessary. More importantly, increased fire suppression near the corridor may adversely affect habitat capacity for moose over time. The division has forwarded these concerns, and currently the line has been routed to allow minimal effects on fire suppression. However, the current location probably has greater impacts on access and aesthetics than proposed alternative routes.

## CONCLUSIONS AND RECOMMENDATIONS

### POPULATION TREND

Integrating the 1988 and 1996 surveys with the smaller areas surveyed in 1991, 1993, and 1994 and composition data (Table 1) indicates the population experienced more rapid growth from

1988–1990 and 1993–1996 than during 1990–1993. The moose population may have even declined during 1990–1993; however, survey data are equivocal and radiotelemetry data were absent during this period.

It is important to determine the status of the Unit 20A moose population relative to nutrient/climate limitations, increasing predator numbers, and interactive effects of those factors (Boertje et al. 1996). Antlerless moose harvest should be evaluated as a tool to prevent an overabundance of moose that are vulnerable to the synergistic effects of adverse weather and increased predation.

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Table 1 Unit 20A fall aerial moose composition counts and estimated population size, 1990–1997

| Regulatory year | Bulls:100 Cows | Yearlings[a]: 100 Cows | Calves:100 Cows | Percent calves | Adults | Moose observed | Moose/mi$^2$ | Estimated[a] population size |
|---|---|---|---|---|---|---|---|---|
| 1990–1991[b] | 23, 24, 26 | 17 | 52 | | | 292, 180, 158 | 2.1 | 10,500 |
| 1991–1992[c] | 22, 32 | 16 | 37 | | | 949, 1531 | 2.3 | 11,500 |
| 1992–1993[b] | 28, 31, 36 | 15 | 39 | | | 107, 105, 137 | 2.3 | 11,600 |
| 1993–1994[c] | 29, 30 | 21 | 42 | | | 852, 883 | 2.4 | 12,300 |
| 1994–1995[d] | 35 | 25 | 52 | | | 1391 | 2.7 | 13,800 |
| 1995–1996 | | | | 28 | | | | |
| 1996–1997 | 39 | 24 | 42 | | | 3343 | 1.9 | 11,500 |
| 1997–1998 | 33 | | 34 | | | 1037 | 2.6 | 13,000 |

[a] From Boertje et al. 1996.
[b] Windy, Walker Dome, and Japan Hills trend areas, respectively.
[c] Central Tanana Flats and Western Foothills, respectively.
[d] Central Tanana Flats and Western Foothills combined

Table 2 Precalving moose surveys in Unit 20A, 1977–1995

| Date | Area[a] | Survey time (hrs) | Moose Bulls | Moose w/0 | Moose w/1[b] | Moose w/2[b] | Moose Lone yrlgs | Moose Unk | Moose Total | Yrlgs | Cows | Yrlgs: 100 Cows | % yrlgs | Bulls:100 Cows |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/17–21/77 | 1,2,3 | 8.1 | 43 | 103 | 38 | 2 | 18 | 0 | 280 | 60 | 159 | 38 | 21 | 15 |
| 5/9–11/78 | 1,2,3 | 13.1 | 52 | 173 | 55 | 7 | 1 | 0 | 357 | 70 | 235 | 30 | 20 | 15 |
| 5/9–10/79 | 1,2,3 | 14.0 | 65 | 194 | 61 | 6 | 2 | 0 | 401 | 75 | 261 | 29 | 19 | 16 |
| 5/9–15/80 | 1,2,3 | 7.7 | 67 | 107 | 37 | 9 | 8 | 1 | 280 | 63 | 150 | 42 | 23 | 24 |
| 5/11–12/81 | 1,2,3 | 11.2 | 52 | 165 | 53 | 7 | 4 | 0 | 348 | 71 | 225 | 32 | 20 | 23 |
| 1982[c] | | | | | | | | | | | | | | |
| 5/9–11/83 | 1,2,3 | 21.5 | 126 | 301 | 114 | 5 | 9 | 3 | 690 | 133 | 428 | 31 | 19 | 29 |
| 5/14–16/84 | 1,3AB | 13.0 | 133 | 255 | 103 | 6 | 3 | 0 | 615 | 119 | 363 | 33 | 19 | 37 |
| 1985[c] | | | | | | | | | | | | | | |
| 1986[c] | | | | | | | | | | | | | | |
| 5/12–14/87 | 1ABCD | | 104 | 248 | 73 | 0 | 10 | 0 | 508 | 83 | 321 | 26 | 16 | 32 |
| 1988[c] | | | | | | | | | | | | | | |
| 1989[c] | | | | | | | | | | | | | | |
| 5/4/90 | --[d] | 2.0 | 37 | 85 | 16 | 0 | 0 | 0 | 154 | 16 | 101 | 16 | 10 | 37 |
| 1991[c] | | | | | | | | | | | | | | |
| 1992[c] | | | | | | | | | | | | | | |
| 5/5/93 | 1ABCDE | 10.3 | 67 | 237 | 92 | 0 | 3 | 0 | 491 | 95 | 329 | 29 | 19 | 20 |
| 5/4–5/94 | 1ABCDE | 8.2 | 103 | 430 | 87 | 2 | 4 | 1 | 718 | 95 | 519 | 18 | 13 | 20 |
| 5/8–9/95 | 1ABCDE[e] | 6.2 | 67 | 301 | 134 | 2 | 6 | 0 | 648 | 144 | 437 | 33 | 22 | 15 |

[a] Boundaries for each numbered/lettered area were not checked and are assumed to be consistent from year-to-year.
[b] With short-yearlings (11-month-olds).
[c] No survey.
[d] Boundaries of survey area included approximately 50 mi$^2$ of NE Tanana Flats in sample units 118, 119, most of 125, and all of the NE half of 120.
[e] The northern portions of 1A and 1E were not surveyed, nor was the portion of 1A in Restricted Area 2211.

Table 3 Results of twinning rate surveys for moose in the Tanana Flats, 1987–1997

| Year | Date | Cows w/Single calf | Cows w/Twins | Cows Total | % Twins[a] |
|---|---|---|---|---|---|
| 1987 | | 45 | 5 | 50 | 10 |
| 1988 | | 52 | 8 | 60 | 13 |
| 1989 | 20–24 May[b] | 43 | 8 | 51 | 16 |
| 1990 | 24 May | 25 | 7 | 32 | 22 |
| 1991 | 20–21 May | 19 | 5 | 24 | 21 |
| 1992[c] | | | | | |
| 1993 | 28 May | 28 | 0 | 28 | 0 |
| 1994 | 22 May | 42 | 9 | 51 | 18 |
| 1995 | 22 May | 43 | 3 | 46 | 7 |
| 1996 | 26 May | 33 | 7 | 40 | 18 |
| 1997 | 21 May | 26 | 3 | 29 | 10 |

[a] Percentage of cows with calves that had twins.
[b] Includes data from surveys when paired helicopter/fixed-wing observations were made (20–21 May) and when only fixed-wing observations were made (24 May).
[c] No calving surveys done.

Table 4 Unit 20A moose hunter[a] residency and success, 1990–1996

| Regulatory year | Successful: Local[b] resident | Successful: Nonlocal resident | Successful: Nonresident | Successful: Total (%) | Unsuccessful: Local[b] resident | Unsuccessful: Nonlocal resident | Unsuccessful: Nonresident | Unsuccessful: Total (%) | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| 1990–1991 | 257 | 43 | 61 | 370 (31) | 651 | 122 | 52 | 840 (69) | 1210 |
| 1991–1992 | 264 | 62 | 48 | 382 (33) | 566 | 148 | 48 | 772 (67) | 1154 |
| 1992–1993 | 150 | 51 | 32 | 246 (25) | 549 | 113 | 59 | 736 (75) | 982 |
| 1993–1994 | 281 | 54 | 39 | 386 (34) | 571 | 108 | 32 | 735 (66) | 1121 |
| 1994–1995 | 270 | 67 | 45 | 399 (34) | 605 | 103 | 43 | 767 (66) | 1166 |
| 1995–1996 | 390 | 68 | 64 | 526 (37) | 709 | 107 | 37 | 861 (62) | 1387 |
| 1996–1997 | 427 | 102 | 73 | 607 (37) | 830 | 134 | 61 | 1029 (62) | 1636 |

[a] Excludes hunters in permit hunts.
[b] Residents of Unit 20.

Table 5 Unit 20A moose harvest[a] chronology percent by time period, 1990–1996

| Regulatory year | Harvest periods | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9/1–9/5 | 9/6–9/10 | 9/11–9/15 | 9/16–9/20 | 9/21–9/25 | Unk/Other | *n* |
| 1990–1991 | 27 | 12 | 27 | 29 | 1 | 3 | 370 |
| 1991–1992 | 24 | 19 | 28 | 25 | 0 | 3 | 382 |
| 1992–1993 | 45 | 24 | 13 | 16 | 0 | 2 | 246 |
| 1993–1994 | 34 | 19 | 25 | 17 | 1 | 4 | 386 |
| 1994–1995 | 27 | 20 | 23 | 25 | 0 | 5 | 382 |
| 1995–1996 | 19 | 17 | 21 | 22 | 15 | 4 | 526 |
| 1996–1997 | 26 | 15 | 19 | 22 | 14 | 4 | 607 |

[a] Excludes permit hunt harvest.

Table 6 Unit 20A moose harvest[a] percent by transport method, 1990–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1990–1991 | 37 | 6 | 31 | 9 | 0 | 9 | 4 | 3 | 370 |
| 1991–1992 | 34 | 5 | 29 | 14 | 0 | 10 | 5 | 3 | 382 |
| 1992–1993 | 33 | 4 | 27 | 16 | 2 | 10 | 7 | 2 | 246 |
| 1993–1994 | 34 | 2 | 37 | 12 | 0 | 6 | 7 | 2 | 386 |
| 1994–1995 | 29 | 3 | 33 | 22 | 0 | 8 | 5 | 0 | 399 |
| 1995–1996 | 30 | 4 | 35 | 17 | 0 | 7 | 4 | 2 | 526 |
| 1996–1997 | 28 | 3 | 32 | 20 | 0 | 10 | 4 | 3 | 607 |

[a] Excludes permit hunt harvest.

# LOCATION

**GAME MANAGEMENT UNIT:** 20B (9114 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Drainages into the north bank of the Tanana River between Delta Creek and Manley Hot Springs

# BACKGROUND

Moose numbers increased in Unit 20B throughout the 1950s and early 1960s after extensive wildfires improved moose habitat and federal predator reduction programs reduced wolf predation on moose (McNay 1993). Moose numbers declined following severe winters in 1965, 1970, 1971, and 1974. Increasing wolf predation and liberal either-sex hunting seasons contributed to the moose population decline. By 1976 moose densities were low and the hunting season had been reduced to 10 days in most of Unit 20B. Moose populations again increased following wolf reduction programs conducted from 1980 to 1986. Hunting seasons were extended from 10 days in 1981 to 20 days from 1983 to 1987. Reported harvests increased to approximately 300 bulls per year from 1983 to 1986. Harvests increased further from 377 bulls in 1987 and 1988 to 493 in 1992, despite a 5-day reduction in the season.

Demand for moose hunting opportunities is high and increasing in Unit 20B. Extensive road systems and trails provide overland access, and numerous waterways such as the Tolovana, Tatalina, Chatanika, Goldstream, Salcha, and Chena Rivers provide boat access.

There are 3 permit moose hunts in Unit 20B, 2 in the Minto Flats Management Area (MFMA) and 1 in the Fairbanks Management Area (FMA). The MFMA was established in 1979 to restrict harvest in a low-density moose population. In 1988 the Alaska Legislature established the Minto Flats State Game Refuge to ensure the protection and enhancement of habitat, the conservation of fish and wildlife, and continuation of hunting, fishing, trapping, and other compatible public uses within approximately 500,000 acres of the Minto Flats area.

The FMA was established in 1983 to provide moose hunting opportunities around the Fairbanks urban area by bow and arrow only. The area was closed to hunting in the late 1970s and early 1980s. Although boundaries of the FMA have changed several times, the FMA currently includes 217 $mi^2$, with about 50 $mi^2$ heavily inhabited by people. Even though harvest is generally low, this hunt is very popular.

For management purposes Unit 20B has been divided into 3 geographic zones: 20B West (3955 $mi^2$), roughly west of a line from Fairbanks along the Elliott Highway to Washington Creek, then north; Unit 20B East (2392 $mi^2$) including the Little Salcha and Salcha River drainages; and Unit 20B Central (2741 $mi^2$), the remainder. The Unit 20B Central boundary was shifted westward in 1993. Game management unit boundaries changed in 1981, increasing the size of Unit 20B and creating Unit 25C. Before 1981 the eastern and western portions of present-day Unit 20B and all of Unit 25C were considered part of Unit 20C.

## MANAGEMENT DIRECTION

### Management Goals

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide for continued subsistence use of moose by Alaska residents who have customarily and traditionally used the population.
- Provide the greatest sustained opportunity to participate in hunting moose.
- Provide an opportunity to view and photograph moose.
- Protect human life and property in human-moose interactions.

### Management Objectives

- Manage for a minimum bull:cow ratio of 20:100 in each count area and an overall Unit 20B bull:cow ratio of at least 30:100.

## METHODS

### Population Status and Trend

We did not conduct a unit population estimation survey in Unit 20B during this reporting period. We conducted 1 February and 1 November survey in the MFMA. In February 1996 we surveyed the MFMA to determine the proportion of calves. We surveyed 8 high-density units at 4 min/mi$^2$ and classified moose as calves or adults.

*November 1996*

We surveyed the MFMA on 19–25 November 1996 using Jay Ver Hoef's regression modification to the standard Gasaway et al. (1986) technique. We chose this technique for 3 reasons: 1) it was likely to give us a good estimate at a reasonable cost, 2) it was a chance to try out a promising technique in a simple situation, and 3) a regression type data set was needed from an area where a standard Gasaway et al. (1986) technique had previously been conducted so that GIS-based moose survey software could be developed for conducting either analysis.

We stratified the southern half of the MFMA with the Beaver on 19 November. A few SUs on the eastern hills were not stratifiable because of high winds. Winds prevented continuation of the survey until 21 November when 4 pilot-observer teams each conducted 3 standard searches, 2 with sightability correction factor plots, in the southern portion of the MFMA. At the same time, the stratification team stratified the northern portion of the MFMA in the Beaver. Fuel and daylight limitations prevented stratification of some of the western SUs. On 22 November, 4 pilot-observer teams were assigned 3 standard searches and 2 SCF plots each in the northern half of the MFMA. One standard search and 1 SCF plot were not completed because 1 aircraft was detained while freeing a moose caught in a snare. The remaining standard search was completed on 25 November.

### HARVEST

We estimated harvest based on harvest report cards. This included data from report cards from the general season, the FMA registration or drawing hunts, and the MFMA Tier II permit hunt. One mail-out of reminder letters was sent to nonreporting general season hunters, and up to 2 mail-outs were sent to permit holders who failed to report. We considered bulls with antler spreads of <30 inches to be yearlings.

We estimated mortality from reports of illegal harvest, Department of Public Safety records of collisions with motor-vehicles, Alaska Railroad records of collisions with trains, and public reports of winter-killed moose along roadways and on private property.

## RESULTS AND DISCUSSION

### WEATHER

Snow was so scarce in 1995 that we could not conduct surveys until February 1996. Fall 1996 had good early snowfall, with much more moderate snowfall during the remainder of the winter.

### POPULATION STATUS AND TREND

*Population Size*

The 1990 overall Unit 20B moose population was estimated to include 9800 moose (about 1.1 moose/mi$^2$): 3400 in Unit 20B West, 4200 in Unit 20B Central, and 2200 in Unit 20B East (McNay 1993). Excluding calves, this included approximately 7600 adult moose: 2500 in Unit 20B West, 3300 in Unit 20B Central, and 1800 in Unit 20B East. At that time, the moose population was increasing and expected to reach 10,000 adult moose (excluding calves) by 1993. Because of changes in priorities, we have been unable to complete surveys planned to verify population status in Unit 20B since 1990. Qualitative information indicates moose numbers continue to increase in the Fairbanks Management Area.

*Minto Flats Management Area*

Moose were distributed unevenly during the February 1996 survey; however, we observed 275 moose. Calf production and survival was good in all units and averaged 28%. A conservative bull:cow ratio of 30:100 equates to approximately 50 calves:100 cows.

In November 1996 we found corrected density of 2.98 moose/mi$^2$ or 2627 moose (90% CI: 2249–3005 or ± 14%) in 898 mi$^2$ of the MFMA. This is not directly comparable to the 967 mi$^2$ surveyed in 1989 and 1994. Part of the area we failed to survey in 1996 typically has had low densities. The corrected density in 1989 was 1.67 moose/mi$^2$. No SCF data were collected in 1994. Applying a typical Interior SCF of 1.13 yields an estimate of 2.95 moose/mi$^2$ in 1994. The SCFs for 1996 were 1.20 and 1.16 on 21 and 22 November, respectively.

*Population Composition*

Bull:Cow Ratios. In 1990 McNay (1993) estimated that the overall Unit 20B bull:cow ratio averaged 40:100, which was well above our management objective of at least 30:100. The ratios varied by harvest intensity within the unit. For instance, the less intensively harvested Salcha River and Minto Flats had ratios of 44:100 (1990) and 49:100 (1989), respectively. The MFMA had 47:100 in 1994 (Table 1). In contrast, the more intensively harvested Chena River had 28:100 (1990), and the most intensively harvested FMA had only 9–14:100 (1989–1994).

During the last 2 surveys bull:cow ratios in the FMA (9:100 in 1993, 14:100 in 1994) were far below our objective of at least 20:100. Hunting pressure during fall, prior to our surveys, is very high and most bulls killed are yearlings. Therefore, low yearling bull:cow ratios observed during the same surveys (4:100 in 1993, 3:100 in 1994) do not necessarily reflect poor calf recruitment from the previous year but result in part from the high proportion of yearlings killed in September.

We estimated 46.7 calves:100 and 13.5 yearling bulls:100 and 27.3 total bulls:100 in the MFMA in 1996.

Calf:Cow Ratios. Calf production and summer calf survival has been good in all areas surveyed (Table 1).

*Distribution and Movements*

Moose are distributed throughout Unit 20B, consisting of nonmigratory and migratory subpopulations (Gasaway et al. 1983). From February to April, some bull and cow moose migrate from the Chena and Salcha River drainages to calving areas on the Tanana Flats in Unit 20A. They remain there for the summer and return to the foothills from August through October. Although we do not know what proportion of the moose migrate, Gasaway et al. (1983) estimated that seasonal migrants probably increase the density of moose on the Tanana Flats 2- to 4-fold over the density of resident moose. Therefore, the summer densities in Unit 20B are probably much lower than during winter.

## MORTALITY

*Harvest*

Season and Bag Limit.

Seasons and bag limits were as follows:

| Unit and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Fairbanks Mgmt Area. 1 antlerless moose by bow and | 1–30 Sep | 1–30 Sep |

| Unit and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| arrow by drawing permit. OR 1 bull with antlers by bow and arrow. | 1–30 Sep or 21–27 Nov | 1–30 Sep 21–27 Nov |
| Minto Flats Mgmt Area. 1 moose by Tier II permit only. | 1–20 Sep or 10 Jan–28 Feb | No open season |
| OR 1 bull with spike-fork or 50-inch antlers, or with at least 4 brow tines on at least 1 side | 11–20 Sep[a] | No open season |
| Middle Fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek. 1 bull. | 1–20 Sep | 1–20 Sep |
| Remainder of Unit 20B. 1 bull. | 1–15 Sep | 5–15 Sep |

[a] 6–20 Sep in 1995–1996.

In 1995–1996, 60 MFMA Tier II permits could be issued. The number of Tier II permits was increased to 100 in 1996–1997.

<u>Board of Game Actions and Emergency Orders</u>. In the MFMA, the department issued 150 Tier II permits per year from 1990–1991 through 1992–1993 to provide for an annual harvest quota of 50 bulls. However, harvests only ranged from 28–42 per year. In spring 1993 we calculated a new harvest quota of 100 bulls and recommended the board authorize up to 250 permits. The board passed our recommendation, and the department issued 200 permits in 1993–1994 and 1994–1995. In spring 1995 the board approved changes for the MFMA and FMA. The Tier II bag limit was changed from any bull to any moose, and the number of permits was reduced to 60. A general hunt for spike-fork or 50-inch bulls with 4 or more brow tines was added in a shorter season than the Tier II hunt. The MFMA general season was further reduced in 1996.

The board also approved a drawing hunt for antlerless moose in the FMA for the 1995–1996 regulatory year and replaced the registration hunt with a general season.

Hunter Harvest.

*General Season* — In the general season, reported harvests ranged from 299 to 621 bulls per year since 1984 (Table 2). The increases are due to greater opportunity through more general seasons, increased effort, and increasing moose numbers. Large antlered bulls composed moderate portions of the harvest, except in the FMA (Table 3).

Hunter Residency and Success. Primarily local residents hunt moose in Unit 20B (Table 2). Participation by nonlocal residents and nonresidents was relatively low.

Hunter success is generally lower in Unit 20B than elsewhere in Unit 20. From 1984–1995 only 14 to 19% of the general season hunters per year have been successful (Table 2). However, during this reporting period, success rates approached 22%.

Harvest Chronology. More bulls were killed during the first 5 days of the season than during any other 5-day period (Table 4).

Transport Methods. Highway vehicles were the primary method of transportation for successful hunters. Airplane access has been used by 6% or less of the Unit 20B general season successful hunters since 1984 (Table 5).

*Other Mortality*

We have been collecting more systematic information on nonhunting mortality of moose because of its potential influence on harvest quotas and population trends. Motor vehicle and railroad kills continue to be an important source of mortality. Mitigation measures, including public education, are continuing.

## HABITAT

*Assessment/Enhancement*

The department is conducting moose habitat enhancement for portions of the area near Fairbanks. These efforts include regeneration of decadent willows by mechanical crushing, planting willows in recently logged areas, and prescribed fire. In addition, habitat improvement projects for grouse in Unit 20B should benefit moose.

## NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

The number of moose killed in accidents with motor vehicles and trains has been substantial some years. We should continue efforts to educate the public and promote safety programs.

Within the Fairbanks urban area, we also receive a considerable number of complaints about human/moose conflicts, such as moose in gardens or yards, moose attacking dogs along dogsled trails, and moose "trapped" within the confines of the urban area. Departmental policy for the treatment of nuisance moose should be formalized for public consideration.

## CONCLUSIONS AND RECOMMENDATIONS

Opportunity, effort, and harvest have increased. We need to collect unitwide data to determine the status of the population, reevaluate objectives, and gain public approval for management objectives.

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Table 1 Unit 20B fall aerial moose composition counts, 1993–1996

| Count area | Regulatory year | Bulls:100 Cows | Yearlings: 100 Cows | Calves:100 Cows | Percent calves | Moose observed | Moose/mi$^2$ |
|---|---|---|---|---|---|---|---|
| FMA[a] | 1993–1994 | 9 | | 30 | 27 | 65 | 1.3 |
| FMA | 1994–1995 | 14 | | 61 | 40 | 165 | 2.6[b] |
| 20B Central[c] | 1994–1995 | 18 | 5 | 47 | 28 | 428 | 1.3[b] |
| MFMA[d] | 1994–1995 | 47 | 11 | 47 | 24 | 489 | 2.9[e] |
| MFMA | Feb 1996 | | | | 28 | 275 | |
| MFMA | Nov 1996 | 27 | 27 | 47 | 27 | | 3.0 |

[a] Fairbanks Management Area.
[b] Corrected for sightability (SCF = 1.23).
[c] A 642-mi$^2$ count area north and west of Fairbanks.
[d] Minto Flats Management Area.
[e] Corrected for sightability (SCF = 1.13).

Table 2 Unit 20B moose hunter[a] residency and success, 1990–1996

| Area/Regulatory year | Successful | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total | |
| All hunts: | | | | | | | | | | | |
| 1990–1991 | 371 | 31 | 8 | 29 | 439 | 1699 | 114 | 82 | 294 | 2189 | 2628 |
| 1991–1992 | 393 | 43 | 17 | 40 | 493 | 1198 | 115 | 93 | 255 | 2451 | 2944 |
| 1992–1993 | 297 | 25 | 15 | 9 | 346 | 2059 | 131 | 179 | 55 | 2424 | 2770 |
| 1993–1994 | 468 | 30 | 21 | 14 | 533 | 2101 | 92 | 100 | 40 | 2333 | 2866 |
| 1994–1995 | 428 | 17 | 27 | 3 | 475 | 2281 | 136 | 87 | 23 | 2527 | 3002 |
| 1995–1996 | 492 | 47 | 36 | 5 | 580 | 1813 | 110 | 111 | 21 | 2055 | 2635 |
| 1996–1997 | 580 | 49 | 46 | 3 | 678 | 2022 | 113 | 124 | 8 | 2267 | 2945 |
| General hunt: | | | | | | | | | | | |
| 1990–1991 | 343 | 31 | 8 | 5 | 387 | 1164 | 107 | 82 | 36 | 1871 | 2258 |
| 1991–1992 | 359 | 41 | 17 | 12 | 429 | 1194 | 110 | 93 | 24 | 2170 | 2599 |
| 1992–1993 | 229 | 24 | 15 | 9 | 277 | 1726 | 114 | 166 | 53 | 2059 | 2336 |
| 1993–1994 | 376 | 27 | 21 | 14 | 438 | 1683 | 70 | 93 | 40 | 1886 | 2324 |
| 1994–1995 | 334 | 17 | 27 | 3 | 381 | 1869 | 104 | 83 | 23 | 2079 | 2460 |
| 1995–1996 | 450 | 45 | 36 | 5 | 536 | 1794 | 109 | 111 | 21 | 2035 | 2571 |
| 1996–1997 | 525 | 47 | 46 | 3 | 621 | 1986 | 112 | 124 | 8 | 2230 | 2851 |
| MFMA: | | | | | | | | | | | |
| 1990–1991 | 21 | | | | 21 | 48 | 7 | | | 55 | 76 |
| 1991–1992 | 34 | 2 | | | 36 | 43 | 5 | | | 48 | 84 |
| 1992–1993 | 41 | 1 | | | 42 | 64 | 2 | | | 66 | 108 |
| 1993–1994 | 44 | 3 | | | 47 | 74 | 3 | | | 77 | 124 |
| 1994–1995 | 49 | | | | 49 | 81 | 5 | | | 86 | 135 |
| 1995–1996 | 32 | 2 | | | 34 | 14 | 1 | | | 15 | 49 |
| 1996–1997 | 48 | 2 | | | 50 | 29 | 1 | | | 30 | 80 |

FMA:

Table 2 Continued

| Area/Regulatory year | Successful: Local[b] resident | Nonlocal resident | Nonresident | Unk | Total | Unsuccessful: Local[b] resident | Nonlocal resident | Nonresident | Unk | Total | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990–1991 | | | | 23 | 23 | | | | 258 | 258 | 281 |
| 1991–1992 | | | | 28 | 28 | 1 | | | 231 | 232 | 260 |
| 1992–1993 | 23 | | | | 23 | 263 | 15 | 13 | 2 | 293 | 316 |
| 1993–1994 | 48 | | | | 48 | 344 | 19 | 7 | | 370 | 418 |
| 1994–1995 | 45 | | | | 45 | 331 | 27 | 4 | | 362 | 407 |
| 1995–1996 | 10 | | | | 10 | 5 | | | | 5 | 15 |
| 1996–1997 | 7 | | | | 7 | 7 | | | | 7 | 14 |

[a] Excludes hunters in permit hunts.
[b] Residents of Unit 20.

Table 3 Antler spread of moose harvested in Unit 20B, 1988–1996

| Hunt | Regulatory year | % Moose harvested by antler spread[a] | | | | Moose[b] |
|---|---|---|---|---|---|---|
| | | <30" | 30–39" | 40–49" | 50"+ | |
| General season (includes FMA and MFMA general hunts after 1994) | 1988 | 36 | 36 | 17 | 11 | 312 |
| | 1989 | 35 | 39 | 17 | 9 | 397 |
| | 1990 | 24 | 37 | 18 | 20 | 371 |
| | 1991 | 27 | 28 | 21 | 23 | 397 |
| | 1992 | 33 | 30 | 20 | 17 | 255 |
| | 1993 | 26 | 36 | 20 | 18 | 414 |
| | 1994 | 21 | 33 | 20 | 26 | 360 |
| | 1995 | 36 | 25 | 17 | 22 | 505 |
| | 1996 | 38 | 28 | 13 | 20 | 589 |
| Fairbanks Mgmt Area | 1990 | 38 | 62 | 0 | 0 | 16 |
| | 1991 | 61 | 29 | 7 | 4 | 28 |
| | 1992 | 75 | 15 | 10 | 0 | 20 |
| | 1993 | 39 | 43 | 11 | 7 | 46 |
| | 1994 | 62 | 28 | 10 | 0 | 40 |
| Minto Mgmt Area (TM785) | 1990 | 5 | 20 | 20 | 30 | 20 |
| | 1991 | 24 | 31 | 21 | 24 | 29 |
| | 1992 | 26 | 26 | 26 | 22 | 27 |
| | 1993 | 16 | 34 | 19 | 31 | 32 |
| | 1994 | 22 | 28 | 28 | 22 | 32 |
| | 1995 | 10 | 60 | 10 | 20 | 10 |
| | 1996 | 35 | 29 | 12 | 24 | 17 |

[a] Percent of moose with known antler spread.
[b] Only includes moose with antler spreads reported.

Table 4 Unit 20B moose harvest[a] chronology percent by week, general hunt, 1990–1996

| Regulatory year | Harvest periods | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9/1–9/5 | 9/6–9/10 | 9/11–9/15 | 9/16–9/20 | 9/21–9/25 | Unk/Other | *n* |
| 1990–1991 | 32 | 22 | 29 | 5 | 1 | 4 | 439 |
| 1991–1992 | 33 | 22 | 29 | 6 | 2 | 5 | 493 |
| 1992–1993 | 37 | 27 | 18 | 6 | 0 | 11 | 346 |
| 1993–1994 | 37 | 27 | 27 | 5 | 0 | 4 | 438 |
| 1994–1995 | 34 | 23 | 32 | 7 | 0 | 2 | 381 |
| 1995–1996 | 31 | 25 | 31 | 5 | 2 | 4 | 536 |
| 1996–1997 | 37 | 25 | 26 | 5 | 1 | 4 | 621 |

[a] Excludes permit hunt harvest.



Table 5 Unit 20B moose harvest[a] percent by transport method, general hunt, 1990–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1990–1991 | 3 | | 30 | 14 | | 9 | 35 | 9 | 439 |
| 1991–1992 | 5 | 1 | 24 | 18 | 1 | 6 | 37 | 9 | 493 |
| 1992–1993 | 4 | | 19 | 19 | 6 | 6 | 41 | 4 | 346 |
| 1993–1994 | 5 | | 21 | 24 | | 6 | 41 | 3 | 438 |
| 1994–1995 | 6 | | 24 | 25 | | 6 | 37 | 3 | 381 |
| 1995–1996 | 4 | | 27 | 21 | | 5 | 40 | 3 | 536 |
| 1996–1997 | 3 | | 26 | 22 | | 3 | 43 | 2 | 621 |

[a] Excludes permit hunt harvest.

## LOCATION

**GAME MANAGEMENT UNIT:** 20C (11,822 $mi^2$), 20F (6318 $mi^2$), and 25C (5252 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Unit 20C includes drainages into the west bank of the Nenana River and into the south bank of the Tanana River west of the Nenana River. Most of Denali National Park and Preserve (DNPP) is within Unit 20C. Unit 20F includes drainages into the north bank of the Tanana River west of Manley and into the Yukon River approximately between the village of Tanana and the Dalton Highway bridge. Unit 25C includes drainages into the south bank of the Yukon River upstream from Circle to, but not including the Charley River drainage. The subunit also includes the Birch Creek drainage upstream from the Steese Highway bridge, the Preacher Creek drainage upstream from and including the Rock Creek drainage, and the Beaver Creek drainage upstream from and including the Moose Creek drainage

## BACKGROUND

Moose densities in Units 20C, 20F, and 25C have been low for many years, presumably because of combined predation from wolves and bears (Gasaway et al. 1992). Wolf and bear populations are lightly harvested. Moose harvest is low relative to population size and probably a minor factor affecting population dynamics relative to predation.

These areas contain large tracts of mature black spruce (poor quality moose habitat). However, many riparian areas, subalpine hills, and old burns have suitable moose habitat capable of supporting more moose.

Trends in moose populations have been difficult to identify, but densities probably fluctuate between 0.1 and 1 moose/$mi^2$ in areas >800 $mi^2$ based on Alaska and Yukon studies (Gasaway et al. 1992). Approximately 26% (6034 $mi^2$) of the area has been stratified to determine overall moose density and distribution. Surveys to determine density and composition were often inconclusive because of small sample sizes or poor survey conditions.

Moose within Denali National Park and Preserve (DNPP) have been studied more intensively than moose in the rest of the subunits. These studies include moose composition surveys and population estimation surveys (censuses) conducted by DNPP biologists since 1970 and a study of the movements and behavior of radiocollared moose.

Moose are an important source of food for many local rural residents. In addition, hunters throughout the Interior hunt moose in these subunits for food and/or trophies.

## MANAGEMENT DIRECTION

The management objectives listed in the FY97 moose performance reports for this area were to:

- Provide for a sustained yield harvest of these low-density populations
- Estimate hunting mortality and document nonhunting mortality when possible
- Estimate moose densities in Units 20C, 20F, and 25C by 1998
- Cooperate with BLM to superstratify approximately 1000 $mi^2$ in central Unit 25C in November 1997
- Promote moose habitat enhancement by allowing natural fires to alter vegetation

## METHODS

We estimated annual moose mortality with data from harvest report cards, reports to our office of nonhunting mortality of moose, records of moose/motor vehicle collisions (Fish and Wildlife Protection log sheets), and records of moose/train collisions (Alaska Railroad summary sheets). The Alaska Railroad travels through Unit 20C between railroad mileposts 327 (Windy) and 371 (Ferry).

Moose composition and density trend information was collected in the O'Brien Creek trend area in Unit 25C. No censuses were conducted during this reporting period. The last census was conducted during November 1994, when DNPP biologists completed population estimation surveys (Gasaway et al. 1986) in the Lake Minchumina Area (1007 $mi^2$).

To estimate unreported harvest, I used information from a Subsistence Division study conducted in 1987 to assess wild resource use in the village of Tanana. This study estimated that residents of Tanana harvested 0.5 moose per household and approximately half of the hunting effort was spent in Units 20F and 20C (Case and Halpin 1987).

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

We estimate that 3500–4500 moose inhabit Unit 20C, 2000 within Denali National Park (DNP) and 1500–2500 outside DNP (but including Denali National Preserve). For these estimates we assume an average density of 0.58 moose/$mi^2$ inside DNP (October 1991 census; T Meier, pers commun) and 0.25 moose/$mi^2$ outside DNP. During the November 1994 survey of the Lake Minchumina area, DNP biologists estimated the density at 0.34 moose/$mi^2$ (K Stahlnecker, pers commun)

We estimate that 1000–2000 moose inhabit Unit 20F. We assume 0.25–0.50 moose/$mi^2$, with roughly 4250 $mi^2$ of moose habitat (McNay 1990).

Population estimation surveys have not been conducted in Unit 25C. Densities are believed low with a total estimated population of 500–2000 moose. This low estimate is based on the fact that nearly half the subunit contains mountainous habitat unsuitable for moose or open mountainous tundra interspersed by small drainages with localized, good moose habitat. The Bureau of Land Management (BLM) and the department have planned a cooperative census for November 1997.

*Population Composition*

We did not collect any data in Units 20C or 20F during this reporting period. We collected composition data in Unit 25C for the O'Brien Creek trend area during November 1996; BLM paid for this survey. In this survey we observed 60 moose. The bull:cow ratio was 119:100 and the calf:cow ratio was 11:100. Composition data based on small sample sizes is equivocal (Table 1), and interpretation of such data requires caution.

*Distribution and Movements*

No data on distribution and movement were collected in Units 20C, 20F, and 25C during this reporting period.

## MORTALITY

*Harvest*

Season and Bag Limit.

| Unit and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Unit 20C | | |
| Resident Hunters: 1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken | 1 Sep–20 Sep | |
| Nonresident Hunters: 1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken. | | 5 Sep–15 Sep |
| Unit 20F, drained by the Yukon River excluding the Tanana River drainage downstream from the drainage of Hess Creek. | | |
| Resident Hunters: 1 bull. | 1 Sep–20 Sep or | No open season |

| Unit and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| | 1 Dec–10 Dec | |
| Unit 20F, drained by the Tanana River. | | |
| Resident Hunters: 1 bull. | 1 Sep–20 Sep | No open season |
| Remainder of Unit 20F. | | |
| Resident Hunters: 1 bull. | 1 Sep–15 Sep | No open season |
| Unit 25C. | | |
| Resident Hunters: 1 bull. | 1 Sep–15 Sep | |
| Nonresident Hunters: 1 bull. | | 5 Sep–15 Sep |

Table 2 summarizes changes in the hunting seasons since 1984. In 1993 the Federal Subsistence Board created a 1–30 September moose season for local residents (Cantwell, Lake Minchumina, Nikolai, and Telida) on federal public lands within the Denali National Preserve.

Board of Game Actions and Emergency Orders. No Board of Game actions were taken during this reporting period.

Hunter Harvest. In 1996, 121 moose were reported killed with 382 hunters in the field in Unit 20C, 39 moose were reported killed with 122 hunters in Unit 20F, and 56 moose were reported killed with 197 hunters in the field in Unit 25C (Table 3). In 1997, 123 moose were reported killed with 355 hunters in the field in Unit 20C. Hunters reported 30 moose were killed with 130 hunters in the field in Unit 20F, with none reported taken during the December season; and 58 moose were reported killed with 214 hunters in the field in Unit 25C (Table 3).

*Nuchalawoyya Potlatch* — In spring 1989, the Board of Game authorized the department to issue permits to take up to 3 moose/year for the Nuchalawoyya Potlatch in June. No potlatch was held in 1996 or 1997 and no moose were taken.

*Federal Permit Hunt 790* — In 1992 the Federal Subsistence Board created a 1–25 September moose season on federal public land in Unit 20F for qualifying local subsistence users by federal registration permit. The federal public land is located within the Dalton Highway Corridor. In 1996, 2 permits were issued with 1 successful permittee. During the 1997 season 3 permits were issued and all 3 permittees reported that they did not hunt (C Miller, FWS pers commun, Apr 1998).

*Unreported Harvest* — The number of unreported kills in Units 20C, 20F, and 25C is not easily estimated. Harvest report card returns from Tanana, Rampart, Manley, Livengood, Central, Circle, and Circle Hot Springs within these subunits are minimal. For example, Subsistence

Division research information from the village of Tanana illustrates the magnitude of the nonreporting problem. In Tanana only 10 to 20% of the actual harvest is reported.

Hunter Residency and Success. During the last 5 years, 6% (178/2918) of the hunters reporting in Units 20C and 25C have been nonresidents (Table 3). There is no nonresident season in Unit 20F. The 5-year average success rate for hunters was 32% (592/1856) in Unit 20C, 25% (151/614) in Unit 20F, and 25% (263/1062) in Unit 25C. Most successful hunters during 1996–1997 were "nonlocal" hunters, primarily from the Fairbanks area (Table 4). During 1996 within Unit 20C, 65% (80/123) of successful hunters were from communities other than Nenana, Tanana, Manley Hot Springs, Healy, Clear, Anderson, Lake Minchumina, or Denali Park. In Unit 20F, 79% (27/34) of successful hunters were from communities other than Tanana or Manley Hot Springs. In Unit 25C, 97% (56/58) of successful hunters were from communities other than Central, Circle, or Circle Hot Springs (Table 4).

Harvest Chronology. The harvest in Unit 20C is fairly evenly distributed throughout the season with a slight increase during the second week of the 20-day season. In Unit 20F the harvest increased during the second week and decreased the last 5 days of the 15-day season. In Unit 25C the harvest increased during the last week of the 15-day season (Table 5).

Transport Methods. In Unit 20C most successful hunters used boats, airplanes, and 3- or 4-wheelers for transportation. Use of 3- or 4-wheelers increased in recent years. During the last 5 years, boat use ranged from 26 to 44%, airplane use ranged from 22 to 32%, and 3- or 4-wheeler use ranged from 12 to 21%. Extensive river systems, many lakes, gravel bars, and an increasing trail system make these transport methods most useful. In Unit 20F, boats are the primary mode of transportation for successful hunters with use ranging from 38 to 57% over the last 5 years. In Unit 25C successful moose hunters used highway vehicles, boats, and 3- or 4-wheelers about equally. This results from road access along the Steese Highway, several rivers that flow through the unit, and the extensive trail system throughout the subunit (Table 6).

## HABITAT

### *Enhancement*

BLM is reclaiming mine tailings within the White Mountains National Recreation Area in Unit 25C. Native willows are being planted to enhance the revegetation process and increase moose browse.

The most recent habitat improvement was the 1995 burn that started near Wickersham Dome in Unit 20B and traveled to upper Beaver Creek in Unit 25C. The recent burn in the Noodor Dome Area is also providing good moose habitat.

## NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Harvest reporting in these subunits is poor. We need to contact more people in these remote areas to emphasize the importance and benefits of reporting harvest. It would be especially helpful to contact young people in the village schools to establish harvest reporting as a responsibility of all hunters and to promote the positive aspects of reporting.

Fire is an integral part of Interior ecosystems and essential to producing good moose habitat in climax spruce forests. The department should continue to coordinate wildlife needs with fire suppression activities and encourage more controlled burns to enhance habitat. Eastern Unit 25C should be evaluated for its potential for a controlled burn. This area presently contains wide expanses of black spruce with only small areas of moose habitat.

Collisions with trains are a significant mortality factor for moose in some areas. Efforts to reduce these mortalities should continue.

## CONCLUSIONS AND RECOMMENDATIONS

Low-density moose populations are in Units 20C, 20F, and 25C. Hunting pressure is relatively low. Current regulations are addressing our management objectives and no regulatory changes are recommended at this time.

We are meeting our objective to estimate hunting and nonhunting mortality and striving to gather information on reporting rate from rural communities for a more comprehensive total estimate of mortality.

We will be cooperating with BLM for a Unit 25C census during fall 1997 and may begin to put some effort into density estimates in Units 20C and 20F in the next few years. We are making progress on our objective to promote natural fires to enhance moose habitat through the department's efforts on the Interagency Fire Management Team.

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Table 1 Unit 25C, O'Brien Creek count area fall aerial moose composition counts, 1986–1996

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves: 100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi$^2$ | Survey area size (mi$^2$) |
|---|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 103 | 13 | 21 | 8 | 9 | 77 | 85 | 1.49 | 57.0 |
| 1987–1988 | 77 | 11 | 28 | 13 | 14 | 83 | 96 | 1.68 | 57.0 |
| 1988–1989 | 129 | 37 | 33 | 16 | 13 | 112 | 128 | 2.25 | 57.0 |
| 1996–1997 | 119 | -- | 11 | 3 | 5 | 57 | 60 | 1.05 | 57.0 |

Table 2 Moose hunting seasons for Units 20C, 20F, and 25C, 1990–1996

| | Unit 20C | | Unit 20F | | Unit 25C | |
|---|---|---|---|---|---|---|
| Regulatory year | Season[a] | Hunters allowed[b] | Season | Hunters allowed[b] | Season | Hunters allowed[b] |
| 1990–1991 | 1–15 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N[c] | 1–10 Dec | R (Tier II) | 5–15 Sep | N[c] |
| 1991–1992 | 1–20 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N | 1–10 Dec[d] | R | 5–15 Sep | N |
| | | | 1–25 Sep | FS[e] | | |
| 1992–1993 | 1–20 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N | 1–10 Dec[f] | R | 5–15 Sep | N |
| | 1–30 Sep | FS[g] | 1–25 Sep | FS[e] | | |
| 1993–1994 | 1–20 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N | 1–10 Dec[f] | R | 5–15 Sep | N |
| | 1–30 Sep | FS[g] | 1–25 Sep | FS[e] | | |
| 1994–1995 | 1–20 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N | 1–10 Dec[f] | R | 5–15 Sep | N |
| | 1–30 Sep | FS[g] | 1–25 Sep | FS[e] | | |
| 1995–1996 | 1–20 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N | 1–10 Dec[f] | R | 5–15 Sep | N |
| | 1–30 Sep | FS[g] | 1–25 Sep | FS[e] | | |
| 1996–1997 | 1–20 Sep | R | 1–15 Sep | R | 1–15 Sep | R |
| | 5–15 Sep | N | 1–10 Dec[f] | R | 5–15 Sep | N |
| | 1–30 Sep | FS[g] | 1–25 Sep | FS[e] | | |

[a] Since 1987 the taking of white-phased or partial albino (more than 50%) white moose has been prohibited.
[b] A = all, R = residents, N = nonresidents, and S = subsistence.
[c] Bag limit bulls with ≥50-inch antler spread.
[d] Only that portion of Unit 20F drained by the Yukon River downstream from the mouth of Hess Creek.
[e] Federal subsistence season for residents of Minto, Manley, and Stevens Village to hunt moose in Unit 20F on federal public lands.
[f] Only that portion of Unit 20F drained by the Yukon River excluding the Tanana River drainage downstream from the drainage of Hess Creek.
[g] Federal subsistence season for residents of Cantwell, Lake Minchumina, Telida, and Nikolai to hunt moose in Unit 20C on federal public lands within DNPP.

Table 3 Number of successful and unsuccessful moose hunters by Alaska residency, Units 20C and 20F, 1990–1996

| Regulatory year | Successful hunters | | | | Unsuccessful hunters | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| | Resident | Nonresident | Unk | Total (%) | Resident | Nonresident | Unk | Total (%) | |
| Unit 20C | | | | | | | | | |
| 1990–1991 | 108 | 4 | 4 | 116 (38) | 178 | 6 | 5 | 189 (62) | 305 |
| 1991–1992 | 131 | 9 | 2 | 142 (37) | 229 | 2 | 3 | 234 (63) | 376 |
| 1992–1993 | 56[a] | 5 | 5 | 66 (21) | 228 | 9 | 8 | 245 (79) | 311 |
| 1993–1994 | 118 | 9 | 3 | 130 (33) | 247 | 9 | 3 | 259 (67) | 389 |
| 1994–1995 | 131 | 9 | 12 | 152 (36) | 241 | 9 | 17 | 267 (64) | 419 |
| 1995–1996 | 108 | 9 | 4 | 121 (32) | 254 | 7 | 0 | 261 (68) | 382 |
| 1996–1997 | 114 | 9 | 0 | 123 (35) | 221 | 11 | 0 | 232 (65) | 355 |
| Unit 20F | | | | | | | | | |
| 1990–1991[b] | 38[c] | 0 | 0 | 38 (31) | 84 | 0 | 2 | 86 (69) | 124 |
| 1991–1992 | 36 | 1 | 0 | 37 (24) | 109 | 3 | 6 | 118 (76) | 155 |
| 1992–1993 | 25 | 0 | 2 | 27 (20) | 104 | 1 | 2 | 107 (80) | 134 |
| 1993–1994 | 22 | 0 | 2 | 24 (26) | 65 | 1 | 1 | 67 (74) | 91 |
| 1994–1995 | 29 | 2 | 0 | 31 (23) | 100 | 3 | 3 | 106 (77) | 137 |
| 1995–1996 | 39 | 0 | 0 | 39 (32) | 83 | 0 | 0 | 83 (68) | 122 |
| 1996–1997 | 30 | 0 | 0 | 30 (23) | 99 | 1 | 0 | 100 (77) | 130 |
| Unit 25C | | | | | | | | | |
| 1990–1991 | 38 | 4 | 1 | 43 (23) | 129 | 7 | 7 | 143 (77) | 186 |
| 1991–1992 | 43 | 3 | 0 | 46 (28) | 108 | 7 | 3 | 118 (72) | 164 |
| 1992–1993 | 32[d] | 7 | 0 | 39 (19) | 161 | 5 | 1 | 167 (81) | 206 |
| 1993–1994 | 47 | 7 | 1 | 55 (25) | 157 | 7 | 0 | 164 (75) | 219 |
| 1994–1995 | 45 | 9 | 1 | 55 (24) | 158 | 12 | 1 | 171 (76) | 226 |
| 1995–1996 | 51 | 5 | 0 | 56 (28) | 130 | 11 | 0 | 141 (72) | 197 |
| 1996–1997 | 47 | 11 | 0 | 58 (27) | 138 | 18 | 0 | 156 (73) | 214 |

[a] Thirty-seven percent were "local" residents (Nenana, Tanana, Manley Hot Springs, Healy, Clear, Anderson, Lake Minchumina, and Denali Park).
[b] Excludes hunters in permit hunts.
[c] Twenty-six percent were "local" residents (Tanana, Rampart, Manley Hot Springs).
[d] Thirty-six were "local" residents (Central, Circle, Circle Hot Springs).

Table 4 Residency of successful moose hunters in Units 20C and 20F, 1996–1997

| Unit | Town | Successful hunters |
|---|---|---|
| 20C | Nonlocal | |
| | Fairbanks, North Pole, Salcha, Two Rivers | 48 |
| | Wasilla, Palmer, Eagle River | 17 |
| | Nonresidents | 9 |
| | Other residents/unknown | 6 |
| | Subtotal | 80 |
| | | |
| | Local | |
| | Denali Park | 2 |
| | Nenana | 10 |
| | Tanana | 1 |
| | Manley Hot Springs | 4 |
| | Healy/Clear/Anderson | 16 |
| | Lake Minchumina | 9 |
| | Kantishna | 1 |
| | Subtotal | 43 |
| | | |
| 20F | Nonlocal | |
| | Fairbanks, North Pole, Eielson | 18 |
| | Anchorage, Eagle River, Chugiak | 4 |
| | Other residents, unknown | 5 |
| | Subtotal | 27 |
| | | |
| | Local | |
| | Tanana | 6 |
| | Manley Hot Springs | 1 |
| | Subtotal | 7 |
| | | |
| 25C | Nonlocal | |
| | Fairbanks, North Pole, Ft. Wainwright, Salcha Two Rivers | 37 |
| | Anchorage, Wasilla | 5 |
| | Nonresidents | 11 |
| | Other residents, unknown | 3 |
| | Subtotal | 56 |
| | | |
| | Local | |
| | Central | 2 |
| | Subtotal | 2 |

Table 5 Moose harvest chronology by time period

| Regulatory year | Harvest periods | | | | | |
|---|---|---|---|---|---|---|
| | 9/1–9/7 | 9/8–9/15 | 9/16–9/20 | 9/21–9/30 | 12/1–12/10 | *n* |
| Unit 20C | | | | | | |
| 1992–1993 | 28 | 15 | 19 | | | 62 |
| 1993–1994 | 40 | 53 | 32 | 3 | | 128 |
| 1994–1995 | 32 | 70 | 40 | 1 | | 143 |
| 1995–1996 | 33 | 49 | 35 | 3 | | 120 |
| 1996–1997 | 37 | 52 | 31 | 4 | | 124 |
| Unit 20F | | | | | | |
| 1992–1993 | 9 | 10 | 2 | 1 | 4 | 26 |
| 1993–1994 | 8 | 12 | 1 | | 3 | 24 |
| 1994–1995 | 15 | 15 | | | 1 | 31 |
| 1995–1996 | 7 | 19 | 14 | | 1 | 41 |
| 1996–1997 | 6 | 23 | 6 | | 0 | 35 |
| Unit 25C | | | | | | |
| 1992–1993 | 20 | 19 | | | | 39 |
| 1993–1994 | 23 | 25 | 6 | 1 | | 55 |
| 1994–1995 | 27 | 23 | 1 | 1 | | 52 |
| 1995–1996 | 23 | 29 | 3 | | | 55 |
| 1996–1997 | 20 | 34 | 1 | 1 | | 58 |

Table 6 Units 20C, 20F, and 25C moose harvest[a] percent by transport method, 1990–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse/Dogsled | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unk/other | *n* |
| Unit 20C | | | | | | | | | |
| 1990–1991 | 24 | 0 | 41 | 11 | 0 | 11 | 9 | 3 | 116 |
| 1991–1992 | 23 | 0 | 39 | 20 | 0 | 7 | 8 | 3 | 142 |
| 1992–1993 | 32 | 0 | 32 | 12 | 6 | 8 | 10 | 0 | 66 |
| 1993–1994 | 22 | 2 | 44 | 15 | 1 | 13 | 3 | 0 | 130 |
| 1994–1995 | 26 | 1 | 37 | 21 | 0 | 7 | 5 | 1 | 152 |
| 1995–1996 | 29 | 0 | 37 | 14 | 0 | 12 | 7 | 0 | 121 |
| 1996–1997 | 28 | 0 | 26 | 21 | 0 | 11 | 8 | 6 | 127 |
| Unit 20F | | | | | | | | | |
| 1990–1991 | 11 | 0 | 63 | 16 | 0 | 0 | 11 | 0 | 38 |
| 1991–1992 | 8 | 3 | 57 | 11 | 3 | 3 | 14 | 3 | 37 |
| 1992–1993 | 7 | 4 | 44 | 7 | 15 | 0 | 19 | 4 | 27 |
| 1993–1994 | 4 | 4 | 38 | 13 | 8 | 4 | 29 | 0 | 24 |
| 1994–1995 | 3 | 0 | 39 | 23 | 0 | 13 | 22 | 0 | 31 |
| 1995–1996 | 3 | 0 | 54 | 20 | 0 | 3 | 22 | 0 | 41 |
| 1996–1997 | 3 | 3 | 57 | 14 | 6 | 0 | 17 | 0 | 35 |
| Unit 25C | | | | | | | | | |
| 1990–1991 | 2 | 0 | 9 | 35 | 0 | 14 | 37 | 2 | 43 |
| 1991–1992 | 11 | 0 | 22 | 44 | 0 | 0 | 20 | 4 | 46 |
| 1992–1993 | 18 | 0 | 13 | 33 | 0 | 8 | 26 | 3 | 39 |
| 1993–1994 | 9 | 0 | 36 | 24 | 0 | 5 | 24 | 2 | 55 |
| 1994–1995 | 13 | 0 | 24 | 38 | 0 | 9 | 15 | 1 | 55 |
| 1995–1996 | 9 | 0 | 29 | 25 | 0 | 9 | 27 | 2 | 56 |
| 1996–1997 | 9 | 0 | 22 | 36 | 0 | 5 | 28 | 0 | 58 |

[a] Excludes permit hunt harvest.

## LOCATION

**GAME MANAGEMENT UNIT:** 20D (5633 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Central Tanana Valley near Delta Junction

## BACKGROUND

Unit 20D was created in 1971 from a portion of Unit 20C. From 1962 to 1970 the moose hunting season in the area that is currently Unit 20D consisted of a 70- to 72-day bull season and a 1- to 8-day antlerless moose season. Most (51–74%) of the harvest from 1964 to 1970 came from the highly accessible areas near Delta Junction (Clearwater Lake, Donnelly Dome, and the Delta farming area). However, several severe winters in the mid-1960s and early 1970s killed many moose throughout this subunit and other portions of Interior Alaska and set the stage for predation and hunting to compound and aggravate already widespread population declines. Recruitment of yearlings to the population was poor, which caused intense bulls-only hunting to depress the bull:cow ratio to only 4:100 in the more accessible portions of the subunit. The moose hunting season was closed from 1971 through 1973 because the depressed moose population could no longer support any significant harvest (McIlroy 1974).

Despite restrictions on hunting, the moose population in Unit 20D continued to decline because of chronically high moose mortality from other causes. 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. When limited moose hunting was resumed in 1974, it was conducted under a registration permit system designed to minimize harvest. In combination with continued hunting restrictions and mild winters, the moose population decline in the western portion of the subunit was gradually reversed by wolf control efforts in adjacent Unit 20A (1976–1982) and western Unit 20D (1980–1983).

In 1978 moving the eastern boundary from the Johnson River to the Robertson River enlarged the subunit. In 1981 it was further enlarged to include all drainages north of the Tanana River from the mouth of the Robertson River to Banner Creek.

In 1983 the remaining closed area around Delta Junction was formally named the Delta Junction Management Area (DJMA). The name of the DJMA was changed to the Delta Junction Closed Area (DJCA) in 1990 to more accurately reflect its status as an area closed to hunting.

For convenience, Unit 20D has been unofficially subdivided into 4 areas for moose management purposes: southwestern Unit 20D, the area south of the Tanana River from the Johnson River to the Delta River; southeastern Unit 20D, the area south of the Tanana River from the Robertson River to the Johnson River; northwestern Unit 20D, the area north of the Tanana River from Banner Creek to and including the Volkmar River; and northeastern Unit 20D, the area north of the Tanana River and east of the Volkmar River.

As moose populations recovered during the mid 1970s and early 1980s, hunting opportunities were increased in southwestern Unit 20D by first eliminating the registration permit requirement and then lengthening the season. Antler restrictions were implemented in 1988 to stabilize the increasing harvest and improve the age structure in the bull segment of the population. In southeastern and northern Unit 20D, the seasons were also increased.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS AND OBJECTIVES

- Increase the fall moose population to 8000–10,000 moose with an annual reported sustainable harvest of 240 to 500 moose per year by the year 2002 as stated by 5 AAC 92.125 Wolf Predation Control Implementation Plans. The commissioner has not authorized department efforts in reducing predation in this area, except as part of the Fortymile Management Plan, (i.e., 2 or 3 wolf packs will be translocated from this area, except for sterilized dominant wolf pairs in winters 1997–1998 through 2000–2001). No other active management was initiated toward this management objective.

- Continue to monitor use of moose in Unit 20D.

## METHODS

In fall 1996 a population estimation survey (census) was flown in the Goodpaster and Shaw Creek drainages of northwestern Unit 20D to estimate population size and sex and age composition. The census was based on techniques described by Gasaway et al. (1986). The survey area was subdivided into sample units (SUs) averaging approximately 12 $mi^2$ each. Most SUs were stratified into a low-density- and high-density stratum; however, 2 SUs were stratified into a very high stratum that was sampled in its entirety. Stratification was based on preexisting information about the area, rather than a precensus reconnaissance flight. We surveyed sample units with Piper PA-18 or a Robinson R-22 aircraft, using survey techniques described by Gasaway et al. (1986). Intensive searches were flown in most low- and high-strata SUs, and optimal allocation of effort was monitored and adjusted using the Moosepop software program (Moose Population Estimation Survey Software, Version 2.0, RA DeLong and DJ Reed, ADF&G, Fairbanks, Alaska).

We monitored harvest of moose during the general hunting season by requiring hunters to acquire moose harvest tickets and report the following hunting activities: the location and time of hunt, mode of transportation, place and time of kill, the antler spread and number of brow tines on harvested moose, and the type of weapon used to kill the moose. Hunters participating in permit hunts provided the same information through permit report forms.

Trends in data were analyzed by plotting polynomial regression trendlines using Microsoft®Excel software. Microsoft®Excel calculates the least squares fit through points using the equation $y = b + c_1x + c_2x^2 + \ldots + c_6x^6$.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*1995–1996*

Population status and surveys for the 1995–1996 regulatory period have already been discussed by DuBois (1996).

*1996–1997*

Results of the 1996 population estimation survey resulted in a mean population estimate of 1143 moose ± 32.8 % at the 90% confidence interval (CI) (Table 1) for the Goodpaster and Shaw Creek drainages of northwestern Unit 20D. The resulting mean density, corrected for sightability of moose during the survey, was 0.6 moose/mi$^2$. Density of moose in each stratum corrected for sightability was 0.3 moose/mi$^2$ in the low stratum, 1.1 moose/mi$^2$ in the high stratum, and 3.9 moose/mi$^2$ in the 2 SUs comprising the very high stratum (Table 1).

Unit 20D has been adopted for intensive management by the Alaska Board of Game which established a population goal of 8000 to 10,000 moose based on a unitwide target density of 1.7 moose/mi$^2$. If a density of 1.7 moose/mi$^2$ were applied to the survey area, a population goal of 3150 moose would result for the Goodpaster River and Shaw Creek drainages. The population estimate of 1143 moose ± 32.8% is well below the population objective for this area.

Because this was the first population estimate ever completed in this portion of Unit 20D, accurate population trends cannot be determined for this area. However, based on moose density estimates statewide, this population naturally fluctuates between about 0.2 to 1.0 moose/mi$^2$ and is limited at these densities by the combined effects of wolf and bear predation (Gasaway et al. 1992). Current bulls-only harvests probably account for <5% of the annual mortality. Harvest is therefore having an insignificant impact on the moose population dynamics (Gasaway et al. 1992).

*Population Composition*

1995–1996. Population composition for the 1995–1996 regulatory period are discussed in DuBois (1996).

1996–1997. Composition data was collected for the Goodpaster River and Shaw Creek drainages during the 1996 population estimation survey. The mean bull:cow ratio was 47.3 bulls:100 cows (Table 2). The mean estimate of calf survival was somewhat low with 24.3 calves:100 cows, and calves composed 14.2% of the population. Recruitment was also relatively low with a mean estimate of 3.7 yearling bulls:100 cows.

*Distribution and Movements*

No data were collected on moose distribution or movements during this reporting period.

## MORTALITY

*Harvest*

Season and Bag Limit. Table 3 lists moose hunting seasons in Unit 20D during the 1995–1996 and 1996–1997 regulatory years. A noteworthy change in the moose hunting season occurred during the 1996–1997 season when the Delta Junction Closed Area was changed to the Delta Junction Management Area and a drawing was conducted for 5 permits.

Board of Game Actions and Emergency Orders. At the March 1996 meeting of the board, 2 regulatory proposals were adopted. The board adopted a proposal submitted by the Delta Fish and Game Advisory Committee and the department to change the status of the Delta Junction Closed Area to the Delta Junction Management Area (DJMA). A permit hunt was also established for the DJMA with a maximum of 10 permits to be issued annually. The board also adopted a proposal submitted by the public to change the eastern boundary of the antler restriction area in southwest Unit 20D from the east bank of the Johnson River to the west bank of the Johnson River. This change was made to simplify regulations by aligning moose regulatory boundaries along the Johnson River with the Tok Management Area boundary.

The board rejected 3 proposals from the public to 1) establish an archery season in the Delta Junction Closed Area, 2) close moose hunting in Unit 20D, and 3) establish a drawing permit hunt for antlerless moose by black powder or archery hunters.

*Human-Induced Mortality*

Estimated moose mortality from all human causes in Unit 20D during 1995–1996 totaled 207 moose (Table 4). Total mortality included 138 moose reported killed by hunters during the general hunting season, an estimate of 24 unreported hunter kills, illegal harvest of 20 moose, and 25 road kills. Most illegal kills and road kills were in southwestern Unit 20D. Total reported hunting mortality of 138 moose did not meet the harvest objective.

Estimated moose mortality from all human causes increased significantly during 1996–1997 and totaled 313 moose. This total includes 210 moose reported killed by hunters during the general hunting season, 1 moose killed during the southeastern Unit 20D Tier II hunt (hunt TM787), 3 moose killed during the new permit drawing hunt DM790 in the Delta Junction Management Area, an estimated 38 moose harvested but unreported, 22 moose killed illegally, and 39 road kills (Table 4). Most illegal kills and road kills were in southwestern Unit 20D.

Total mortality during 1996–1997 was the highest recorded since at least 1986–1987. The total harvest by hunters was 214 moose and did not meet the management objective but was only 26 moose less than the low range of the objective. Known and estimated illegal kills and road kills all increased during this period, resulting in the high mortality rate. Based on polynomial regressions, the trend in moose harvest during the general hunting season has been increasing in recent years ($y = 1.58x^2 - 9.01 + 138.81$). The trend in moose killed on roads has been increasing sharply since 1990–1991 ($y = 0.31x^2 - 2.10x + 22.467$).

Southwestern Unit 20D. Reported harvest during the 1995 general hunting season was similar to recent previous years and totaled 60 moose. The number of hunters remained fairly constant ($n$ = 301, Table 5). Hunter success was 20%.

Reported harvest increased significantly and totaled 102 moose during the 1996 general season (Table 5), which was the highest reported harvest of bulls in southwest Unit 20D since 1964. Three hundred twenty hunters reported, but this number did not exceed the range of 244–339 hunters reported in this area since antler restrictions took effect in 1988. The high harvest resulted in 32% hunter success. The increased harvest was not confined to southwest Unit 20D. Harvest also increased in northwestern Unit 20D as discussed below. I do not have an explanation for the increased number of moose harvested in 1996 except that the hunting season had 3 weekends and weather was generally favorable for hunting.

A polynomial regression of moose harvest since antler restrictions were implemented in southwest Unit 20D in 1988 indicates that harvest trend has been increasing in recent years ($y = 1.24x^2 - 9.03x + 71.36$).

Southeastern Unit 20D. Both the harvest of moose and the number of hunters have remained low in southeastern Unit 20D. Thirty-two hunters killed 14 moose during the 1995 general hunting season (Table 5) for a 44% success rate. The numbers of hunters and harvest is low in this area partly because of access restrictions in the Macomb Plateau Controlled Use Area (MPCUA), making moose hunting difficult. Low harvest continued during the 1996 general season with 40 hunters reporting 13 moose killed for a 33% hunter success rate (Table 5).

Northwestern Unit 20D. During the 1995 general season, 237 hunters killed 50 moose (Table 5). Hunters had a 21% success rate. The number of hunters and harvest increased during the 1996 hunting season. A harvest of 72 moose was reported by 267 hunters (Table 5), the highest reported harvest in this area since at least 1984. The increased harvest in northwest Unit 20D coincided with an increased harvest in southwest Unit 20D and may be related to 3 weekends occurring within the hunting season. Hunters had a 27% success rate.

Based on polynomial regression, the trend in northwest Unit 20D moose harvest has been decreasing in recent years ($y = -0.25x^2 + 5.36x + 33.81$), with the exception of 1996. The trend in number of hunters has been increasing ($y = 0.59x^2 + 0.11x + 199.57$) with 1996 and 1994 having the highest number of hunters reported since 1985.

Northeastern Unit 20D. Number of hunters and harvest remained low in this area during the 1995 general season, with 42 hunters harvesting 12 moose (Table 5). Hunters had a 29% success rate. This area is difficult to access during the hunting season except along the Tanana River, a few small creeks flowing into the Tanana River, and a few ridgetop airstrips. Poor access and low moose numbers cause low hunter effort and harvest. During the 1996 general season, 35 hunters harvested 15 moose with a 43% success rate (Table 5).

Permit Hunts. Tier II permit hunt number TM787 was conducted during the 1995–1996 and 1996–1997 hunting season from 1 January to 15 February each year. Fifteen permits were issued each year with a harvest quota of 5 bulls. Participation in the hunt was low with 47%

and 53% of permittees not hunting in 1995–1996 and 1996–1997, respectively. No moose were killed during the 1995–1996 hunt, and 1 bull was killed during the 1996–1997 hunt (Table 8).

Permit hunt DM790 was conducted for the first time during the 1996–1997 season in the Delta Junction Management Area. We received 355 applications for 5 drawing permits. All 5 permittees hunted, and hunters harvested 3 bull moose (Table 9).

Hunter Residency. Most moose hunters in Unit 20D are local residents. During the 1995 general hunting season, 80% of successful hunters and 84% of the unsuccessful hunters were residents of the subunit (Table 6). During the 1996 general season, 80% of successful hunters and 89% of unsuccessful hunters were residents of the subunit (Table 6).

Hunter Effort. Hunting effort increased in most of Unit 20D during 1995 to a mean of 6.3 days hunted by successful hunters and 6.9 days for unsuccessful hunters (Table 7). During 1996, mean days hunted declined from 1995 levels to 5.0 days for successful hunters and 6.6 for unsuccessful hunters (Table 7).

Harvest Chronology. Harvest chronology remained similar to previous years with most harvest occurring during the first 5 days of the 15-day season. During the 1995 general hunting season, 41% of reported harvest occurred during the first 5 days of the season (1–5 Sep). Harvest rates during the next 2 5-day periods were 20% and 33%. Harvest patterns were similar in 1996, with 51% of moose harvested from 1–5 September, 23% from 6–10 September, and 23% from 11–15 September (Table 10).

Transport Methods. Successful hunters continue using highway vehicles, 3- or 4-wheelers, and boats as the most common modes of transportation in Unit 20D. Highway vehicles, 3- or 4-wheelers, and boats were used by 79% of successful hunters during the 1995 general season and 86% of successful hunters during the 1996 general season (Table 11).

*Natural Mortality*

No estimates of natural mortality were calculated during this reporting period. However, predation by wolves, grizzly bears, and black bears is believed significant in Unit 20D. Predation is thought to limit moose population growth in the northern half of Unit 20D and account for reduced calf survival in portions of southern Unit 20D.

## HABITAT

*Assessment*

No habitat assessment was done during this reporting period.

*Enhancement*

No habitat enhancement was performed during this reporting period.

## CONCLUSIONS AND RECOMMENDATIONS

The population objective for Unit 20D was approved by the Board of Game in 1997, but little action toward achieving this goal has begun. Accurate trends in the northern Unit 20D moose population are unknown at this time but will be determined during future population surveys in the unit. Attaining the harvest goal will depend in large part on first attaining the population objective. No regulatory changes are anticipated for Unit 20D at this time, but I want to work toward public approval of a bull:cow ratio in portions of Unit 20D by the year 2000.

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Table 1 Results of a moose population estimation survey in the Goodpaster River and Shaw Creek drainages of northwestern Unit 20D, November 1996

| Statistic | Strata: Low | High | Very High | Total |
|---|---|---|---|---|
| Sample Units (*N*) | 99 | 45 | 2 | 146 |
| Nr surveyed (*n*) | 7 | 15 | 2 | 24 |
| | | | | |
| Total survey area ($mi^2$) | 1134 | 703 | 14 | 1851 |
| Stratum as % of total | 61.3 | 38 | 0.8 | |
| Area surveyed ($mi^2$) | 84.7 | 181.5 | 14 | 280.2 |
| | | | | |
| Nr moose observed | 19 | 167 | 45 | 231 |
| Observed density ($moose/mi^2$) | 0.2 | 0.9 | 3.2 | 0.5 |
| | | | | |
| Uncorrected population estimate | 254 | 647 | 45 | 946 |
| Variance | 13,705.81 | 11,273.23 | 0 | 24,979.05 |
| Degrees of freedom | 6 | 14 | 1 | 15 |
| | | | | |
| Observed sightability correction factor (SCF) | | | | 1.21 |
| Variance | | | | 0.01078 |
| Degrees of freedom | | | | 15 |
| | | | | |
| Correction population estimate | | | | 1143 |
| Variance | | | | 45,829.16 |
| Degrees of freedom | | | | 15 |
| | | | | |
| Corrected density estimates ($moose/mi^2$) | 0.3 | 1.1 | 3.9 | 0.6 |
| | | | | |
| 90% Confidence Interval | | | | ± 32.8% |

Table 2 Moose composition data collected during a population estimation survey in the Goodpaster River and Shaw Creek drainages of northwestern Unit 20D, November 1996

| Survey | $\bar{x}$ Bulls:100 Cows (90% CI) | $\bar{x}$ Yearling bulls:100 cows (90% CI) | $\bar{x}$ Calves:100 Cows (90% CI) | $\bar{x}$ Total calves (90% CI) | Percent calves (90% CI) | $\bar{x}$ Adults (90% CI) | Total moose observed | Observed $\bar{x}$ moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| 1996 | 47.3 | 3.7 | 24.3 | 162 | 14.2 | | | |
| NW Unit 20D | (27.6–67.1) | (1.2–6.1) | (15.6–33.0) | (68–255) | (9.9–16.0) | 981 | 231 | 0.5 |

Table 3 Moose hunting seasons and bag limits in Unit 20D during 1995–1996 and 1996–1997

| Year | Area | Season | | Bag limit |
|---|---|---|---|---|
| 1995–1996 | South of Tanana River and West of Johnson River, except Delta Junction Closed Area | Resident: | 1–15 Sep | 1 bull with spike-fork or 50-inch antlers or 4 or more brow tines |
| | | Nonresident: | 5–15 Sep | 1 bull with 50-inch antlers[a] |
| | South of Tanana River and East of Johnson River | Resident: | 1–15 Sep | 1 bull |
| | | | 1 Jan–15 Feb | 1 bull by Tier II permit |
| | | Nonresident: | No open season | |
| | Remainder of 20D (North of Tanana River) | Resident: | 1–15 Sep | 1 bull |
| | | Nonresident: | 1–15 Sep | 1 bull |
| 1996–1997 | South of Tanana River and West of Johnson River, except Delta Junction Management Area | Resident: | 1–15 Sep | 1 bull with spike-fork or 50-inch antlers or 4 or more brow tines |
| | | Nonresident: | 5–15 Sep | 1 bull with 50-inch antlers[a] |
| | Within Delta Junction Management Area | Resident: | 1–15 Sep | 1 bull with spike-fork or 50-inch antlers or 4 or more brow tines by drawing permits |
| | | Nonresident: | 5–15 Sep | 1 bull with 50-inch antlers[a] by drawing permit |
| | South of Tanana River and East of Johnson River | Resident: | 1–15 Sep | 1 bull |
| | | | 1 Jan–15 Feb | 1 bull by Tier II permit |
| | | Nonresident: | No open season | |
| | Remainder of 20D (North of Tanana River) | Resident: | 1–15 Sep | 1 bull |
| | | Nonresident: | 1–15 Sep | 1 bull |

[a] 50-inch antlers defined as having a spread of at least 50 inches or at least 4 brow tines on 1 side.

Table 4 Estimate of moose mortality in Unit 20D, 1986–1987 through 1996–1997

| Regulatory year | Harvest by hunters | | | | | | | Accidental death | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reported | | | | Estimated | | | | | | |
| | M | F | Unk | Total | Unreported[a] | Illegal | Total | Road | Train[b] | Total | |
| 1986–1987 | 130 | 0 | 0 | 130 | 23 | 4 | 27 | 15 | 0 | 15 | 172 |
| 1987–1988 | 126 | 0 | 0 | 126 | 22 | 10 | 32 | 26 | 0 | 26 | 184 |
| 1988–1989 | 126 | 0 | 0 | 126 | 22 | 13 | 35 | 27 | 0 | 27 | 188 |
| 1989–1990 | 128 | 0 | 0 | 128 | 23 | 9 | 31 | 16 | 0 | 16 | 176 |
| 1990–1991 | 118 | 1 | 0 | 119 | 21 | 4 | 25 | 11 | 0 | 11 | 155 |
| 1991–1992 | 143 | 1 | 0 | 144 | 25 | 11 | 36 | 13 | 0 | 13 | 193 |
| 1992–1993 | 143 | 0 | 1 | 144 | 25 | 5 | 30 | 32 | 0 | 32 | 206 |
| 1993–1994 | 154 | 0 | 1 | 155 | 27 | 14 | 41 | 30 | 0 | 30 | 226 |
| 1994–1995 | 128 | 0 | 0 | 128 | 23 | 7 | 30 | 31 | 0 | 31 | 189 |
| 1995–1996 | 138 | 0 | 0 | 138 | 24 | 20 | 44 | 25 | 0 | 25 | 207 |
| 1996–1997 | 214 | 0 | 0 | 214 | 38 | 22 | 60 | 39 | 0 | 39 | 313 |

[a] Based on 17.7% unreported harvest estimated by Gasaway et al. (1992).
[b] Not applicable in Unit 20D.

Table 5 Annual reported harvest of moose and number of hunters during the general open season in southwestern, southeastern, northwestern, and northeastern Unit 20D from 1984 to 1996

| | Moose harvest | | | | | | Hunters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SW | SE | NW | NE | Unk | Total | SW | SE | NW | NE | Unk | Total |
| 1984 | 39[a] | 9[b] | 40[c] | 14[c] | 0 | 102 | 236[a] | 47[b] | 294[c] | 48[c] | 10 | 635 |
| 1985 | 48[d] | 8[b] | 60[d] | 14[d] | 0 | 130 | 236[d] | 37[b] | 272[d] | 50[d] | 9 | 604 |
| 1986 | 76[d] | 10[b] | 40[d] | 10[d] | 1 | 137 | 250[d] | 45[b] | 232[d] | 57[d] | 12 | 596 |
| 1987 | 66[d] | 8[b] | 43[d] | 9[d] | 0 | 126 | 296[d] | 35[b] | 208[d] | 35[d] | 17 | 591 |
| 1988 | 60[e] | 12[b] | 39[d] | 12[d] | 3 | 126 | 244[e] | 45[b] | 201[d] | 37[d] | 28 | 555 |
| 1989 | 60[e] | 11[b] | 41[d] | 10[d] | 5 | 127 | 303[e] | 47[b] | 191[d] | 39[d] | 40 | 620 |
| 1990 | 58[f] | 9[c] | 40[g] | 7[d] | 4 | 118 | 270[f] | 29[c] | 195[g] | 26[d] | 28 | 548 |
| 1991 | 54[f] | 12[c] | 66[g] | 9[d] | 3 | 144 | 331[f] | 51[c] | 231[g] | 26[d] | 19 | 658 |
| 1992 | 59[f] | 12[c] | 58[g] | 5[d] | 9 | 143 | 329[f] | 49[c] | 257[g] | 34[d] | 48 | 717 |
| 1993 | 74[h] | 9[c] | 58[c] | 11[c] | 2 | 154 | 323 | 33 | 257 | 29 | 16 | 690 |
| 1994 | 61[h] | 7[c] | 49[c] | 9[c] | 2 | 128 | 339 | 42 | 267 | 33 | 28 | 709 |
| 1995 | 60[h] | 14[c] | 50[c] | 12[c] | 2 | 138 | 301 | 32 | 237 | 42 | 33 | 645 |
| 1996 | 102[h] | 13[c] | 72[c] | 15[c] | 5 | 210 | 320 | 40 | 267 | 35 | 31 | 693 |

[a] Season 1–6 Sep; 1 bull.
[b] Season 1–20 Sep; 1 bull.
[c] Season 1–15 Sep; 1 bull.
[d] Season 1–10 Sep; 1 bull.
[e] Season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 3 brow tines on 1 antler.
[f] Subsistence/resident season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 3 brow tines on 1 antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on 1 antler.
[g] West of pipeline season 1–15 Sep; 1 bull. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on 1 side. Remainder area 1–10 Sep; 1 bull.
[h] Resident season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 4 brow tines on 1 antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 4 brow tines on 1 antler.

Table 6 Unit 20D moose hunter residency and success during the general hunting season[a], 1986–1987 through 1996–1997

| Regulatory year | Successful | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total (%) | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total (%) | |
| 1986–1987 | 121 | 15 | 1 | 1 | 138 (23) | 409 | 45 | 12 | 0 | 466 (77) | 604 |
| 1987–1988 | 96 | 13 | 7 | 10 | 126 (21) | 375 | 24 | 17 | 31 | 447 (79) | 591 |
| 1988–1989 | 93 | 13 | 9 | 11 | 126 (23) | 333 | 36 | 31 | 29 | 429 (77) | 555 |
| 1989–1990 | 96 | 18 | 8 | 5 | 127 (20) | 404 | 57 | 23 | 9 | 493 (80) | 620 |
| 1990–1991 | 98 | 10 | 4 | 6 | 118 (22) | 351 | 51 | 24 | 4 | 430 (78) | 548 |
| 1991–1992 | 118 | 21 | 4 | 1 | 144 (22) | 443 | 51 | 13 | 7 | 514 (78) | 658 |
| 1992–1993 | 107 | 25 | 8 | 3 | 143 (20) | 462 | 61 | 37 | 14 | 574 (80) | 717 |
| 1993–1994 | 126 | 24 | 2 | 2 | 154 (22) | 452 | 63 | 17 | 4 | 536 (78) | 690 |
| 1994–1995 | 104 | 20 | 2 | 2 | 128 (18) | 503 | 62 | 11 | 5 | 581 (82) | 709 |
| 1995–1996 | 113 | 16 | 9 | 4 | 142 (21) | 447 | 55 | 20 | 13 | 535 (79) | 677 |
| 1996–1997 | 168 | 30 | 11 | 1 | 210 (29) | 460 | 39 | 14 | 2 | 515 (71) | 725 |

[a] Excludes hunters in permit hunts.
[b] Local means reside in Unit 20D.

Table 7 Mean days hunted for successful and unsuccessful hunters in southwest, southeast, northwest, and northeast Unit 20D during the general hunting season[a], 1986–1987 through 1996–1997

| Regulatory | Successful hunters | | | | | Unsuccessful hunters | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| year | SW | SE | NW | NE | Total | SW | SE | NW | NE | Total |
| 1986–1987 | 3.8 | 3.0 | 5.3 | 4.1 | 3.9 | 5.5 | 10.5 | 6.1 | 7.0 | 6.0 |
| 1987–1988 | 4.4 | 7.3 | 4.8 | 3.9 | 4.7 | 5.3 | 7.5 | 6.7 | 6.5 | 6.1 |
| 1988–1989 | 4.6 | 6.2 | 5.3 | 4.5 | 5.0 | 5.9 | 6.3 | 5.8 | 6.5 | 6.0 |
| 1989–1990 | 4.7 | 4.5 | 4.1 | 5.1 | 4.6 | 9.7 | 5.7 | 5.9 | 5.3 | 5.9 |
| 1990–1991 | 4.9 | 6.6 | 3.9 | 6.5 | 4.7 | 3.5 | 5.6 | 5.8 | 6.3 | 5.9 |
| 1991–1992 | 6.0 | 4.9 | 5.5 | 4.2 | 5.6 | 5.9 | 7.0 | 6.8 | 5.6 | 6.3 |
| 1992–1993 | 4.7 | 5.7 | 5.4 | 4.9 | 5.0 | 5.9 | 5.1 | 6.8 | 5.2 | 6.2 |
| 1993–1994 | 5.4 | 4.4 | 6.2 | 7.5 | 5.7 | 6.2 | 7.5 | 6.6 | 9.4 | 6.5 |
| 1994–1995 | 5.1 | 6.3 | 5.9 | 4.2 | 5.4 | 5.9 | 4.9 | 6.2 | 7.2 | 6.1 |
| 1995–1996 | 7.2 | 5.4 | 5.6 | 4.5 | 6.3 | 6.9 | 4.9 | 7.2 | 7.2 | 6.9 |
| 1996–1997 | 4.9 | 4.2 | 4.9 | 6.6 | 5.0 | 6.5 | 5.0 | 6.7 | 6.9 | 6.6 |

[a] Excludes permit hunt harvest.



Table 8 Moose harvest data for Unit 20D Tier II permit hunt, 1989–1990 through 1996–1997

| Hunt number | Regulatory year | Permits issued | Did not hunt (%) | Unsuccessful hunters (%) | Successful hunters (%) | Percent bulls | Percent cows | Unk | Harvest |
|---|---|---|---|---|---|---|---|---|---|
| 988 | 1989–1990 | 15 | 27 | 91 | 9 | 100 | 0 | 0 | 1 |
| 987T | 1990–1991 | 15 | 20 | 86 | 14 | 100 | 0 | 0 | 1 |
| 987T | 1991–1992 | 15 | 67 | 100 | 0 | 0 | 0 | 0 | 0 |
| 987T | 1992–1993 | 15 | 20 | 91 | 9 | 100 | 0 | 0 | 1 |
| 787 | 1993–1994 | 15 | 47 | 100 | 0 | 0 | 0 | 0 | 0 |
| 787 | 1994–1995 | 15 | 27 | 91 | 9 | 100 | 0 | 0 | 1 |
| TM787 | 1995–1996 | 15 | 47 | 100 | 0 | 0 | 0 | 0 | 0 |
| TM787 | 1996–1997 | 15 | 53 | 86 | 14 | 100 | 0 | 0 | 1 |

Table 9 Moose harvest data for Unit 20D drawing permit in the Delta Junction Management Area, 1996–1997

| Hunt /Area | Regulatory year | Permits issued | Did not hunt (%) | Unsuccessful hunters (%) | Successful hunters (%) | Percent bulls | Percent cows | Unk | Harvest |
|---|---|---|---|---|---|---|---|---|---|
| DM790 | 1996–1997 | 5 | 0 | 40 | 60 | 100 | 0 | 0 | 3 |

Table 10 Percent moose harvested chronologically in Unit 20D general hunting season[a] 1990–1991 through 1996–1997

| Regulatory year | Harvest periods | | | | *n* |
|---|---|---|---|---|---|
| | 9/1–9/5 | 9/6–9/10 | 9/11–9/15 | Unk | |
| 1990–1991 | 57 | 20 | 23 | 0 | 109 |
| 1991–1992 | 60 | 23 | 16 | 10 | 144 |
| 1992–1993 | 52 | 31 | 18 | 8 | 143 |
| 1993–1994 | 42 | 26 | 28 | 4 | 154 |
| 1994–1995 | 45 | 25 | 22 | 8 | 128 |
| 1995–1996 | 41 | 20 | 33 | 6 | 138 |
| 1996–1997 | 51 | 23 | 23 | 3 | 208 |

[a] Excludes permit hunt harvest.

Table 11 Percent of Unit 20D moose harvested with different transportation methods during the general hunting season[a], 1987–1988 through 1996–1997

| Regulatory year | Method of transportation: Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | n |
|---|---|---|---|---|---|---|---|---|---|
| 1987–1988 | 8 | 2 | 27 | 20 | 0 | 8 | 29 | 6 | 126 |
| 1988–1989 | 10 | 2 | 24 | 18 | 0 | 9 | 29 | 9 | 126 |
| 1989–1990 | 10 | 3 | 29 | 13 | 0 | 12 | 29 | 3 | 127 |
| 1990–1991 | 7 | 0 | 25 | 20 | 0 | 12 | 33 | 3 | 118 |
| 1991–1992 | 13 | 3 | 23 | 25 | 0 | 8 | 24 | 3 | 144 |
| 1992–1993 | 8 | 1 | 26 | 18 | <1 | 8 | 36 | 1 | 143 |
| 1993–1994 | 6 | 1 | 30 | 25 | 1 | 7 | 29 | 2 | 154 |
| 1994–1995 | 4 | 2 | 29 | 28 | 0 | 11 | 23 | 3 | 128 |
| 1995–1996 | 6 | 2 | 33 | 18 | 0 | 8 | 28 | 5 | 142 |
| 1996–1997 | 4 | <1 | 27 | 28 | 0 | 8 | 31 | 2 | 210 |

[a] Excludes permit hunt harvest.

## LOCATION

**GAME MANAGEMENT UNIT:** 20E (11,000 mi$^2$)

**GEOGRAPHIC DESCRIPTION:** Charley, Fortymile, and Ladue River drainages

## BACKGROUND

During the 1950s to the early 1960s, coincident with the federal predator control program, the moose population in Unit 20E increased to a minimum of 12,000 moose. The population declined rapidly between 1965 and 1976, reaching an estimated low of 2200 moose. Between 1976 and the early 1990s, the moose population in Unit 20E remained at low densities (0.2–0.5 moose/mi$^2$). Gasaway et al. (1992) evaluated the roles that predation, nutrition, snow, harvest, and disease played in the decline and in limiting the moose population at low densities. They determined predation was the primary limiting factor and other variables had little to no impact.

In response to declining moose and caribou populations, the Alaska Department of Fish and Game initiated more intensive predator management. Between 1981 and 1983, the wolf population was reduced by 54% in a 3800-mi$^2$ area of Unit 20E. In 1981 grizzly bear hunting regulations were liberalized, causing moderate harvest increases in portions of the subunit and probably local declines in grizzly bear numbers.

Between 1981 and 1990 the moose population increased by about 4 to 5% per year. The increase was probably due to combined effects of favorable climate, the wolf reduction program, elevated public harvest of grizzly bears and wolves, and an increase in the area's caribou population that was alternate prey for predators and hunters.

Unit 20E has been popular among local hunters and hunters from Fairbanks and Southeast Alaska. Historically, harvest was low in relation to the moose population and largely restricted to the Taylor Highway corridor and the Mosquito Fork drainage. During the last population high, the hunting season was long and the bag limit was 1 moose. As moose numbers began to decline, harvests were reduced by shortening season length in 1973 and by eliminating cow seasons in 1974. However, the population continued to decline unitwide, and in 1977 moose hunting in Unit 20E (then a portion of Unit 20C) was terminated. In 1982 a 10-day bulls-only season was opened and continued until 1991. During that period, hunter success was approximately one-half of that reported in 1970.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population in concert with other components of the ecosystem

- Continued sustained opportunities for subsistence use of moose

- Maximize sustained opportunities to participate in hunting moose
- Maximize opportunities for the nonconsumptive use of moose

### Management Objectives

- Maintain a posthunting ratio of at least 40 bulls:100 cows in all survey areas

## METHODS

### Population Census

We conducted moose population estimation surveys (Gasaway et al. 1986; Mark McNay, pers commun; Jay Ver Hoef, pers commun) in southwestern Unit 20E (Mosquito Flats) in 1981, 1988, 1992, and 1995 and in southeastern Unit 20E (Ladue River) in 1992 and 1996. I calculated population growth rates by comparing the 1992 and 1995 Mosquito Flats superstratification and mini-census results with identical portions of the 1981 and 1988 census areas and by comparing the 1992 and 1996 Ladue River superstratification and census results. I also compared population density and trend between the Mosquito Flats and Ladue River census areas. The 2 study areas differ in habitat quality, grizzly bear densities, human use, and management directions.

### Composition Surveys

Sex and age composition was estimated in October and November 1993, 1994, 1996, and 1997, using aerial contour and transect surveys, and in 1995 and 1996 while conducting censuses in the Mosquito Flats and Ladue River. All moose observed were classified as large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), yearling bulls (spike, cerviform, or small palmate antlers without brow separation), cows without calves, cows with 1 calf, cows with 2 calves, lone calves, or unidentified moose.

### Harvest

We estimated harvest using harvest report cards. Information obtained from the reports was used to determine total harvest, hunter residency and success, harvest chronology, and transportation mode.

## RESULTS AND DISCUSSION

### Population Status and Trend

*Population Size*

During fall 1981 and 1988, censuses were conducted in a 2978-$mi^2$ (7700 $km^2$) area in southwestern Unit 20E. We estimated population sizes of 601 ± 17.1% (90% CI) in 1981 and 1149 ± 13.2% (90% CI) in 1988. Mean densities were 0.23 and 0.39 moose/$mi^2$ in 1981 and 1988, respectively. Based on census results, the estimated annual finite rate of growth between 1981 and 1988 was 1.09.

In 1992 and 1995, we censused a 964-mi$^2$ portion of the 1981 and 1988 study area. In this area (referred to as the Mosquito Flats Study Area [MFSA]), we estimated a population size of 406 ± 24% (90% CI) moose and a density of 0.44 moose/mi$^2$ in 1992 and 666 ± 38% (90% CI) moose and a density of 0.69 moose/mi$^2$ in 1995. Using the boundaries of the MFSA, the estimated population size and density for 1981 was 355 and 0.39 moose/mi$^2$, and 601 and 0.66 moose/mi$^2$ for 1988. The annual rate of increase between 1981 and 1988 was 1.08, and between 1988 and 1995 it was 1.01. Based on census data, the moose population in Unit 20E increased through the 1980s until 1988. Between 1988 and 1995, the population remained stable at least in the southwestern portion of the subunit.

In the Ladue River Study Area (LRSA), the 1992 estimated moose population was 652 ± 21% (90% CI). Mean density was 0.89 moose/mi$^2$, 29% greater than the density found in the adjacent MFSA. The LRSA was not censused during 1981 or 1988 and, consequently, the area's population size and trend prior to 1992 is not known. We censused this area again in 1996 (944 ± 26%, 90% CI), but results are not directly comparable because during 1992 we did not estimate a sightability correction factor. Based on estimates generated from observed moose, moose numbers in LRSA increased by 12.9% between 1992 and 1996, an annual rate of increase of 1.03.

The National Park Service conducted censuses in northern Unit 20E within the Yukon-Charley Rivers National Preserve west of Washington Creek and south of the Yukon River in 1994 and 1997 and found about 0.30 moose/mi$^2$ during both years. Periodic surveys indicate moose densities are lower east of Washington Creek. Incorporating census and trend count data, the total 1997 population estimate for Unit 20E was 5700–6000 moose (0.57–0.6 moose/mi$^2$ of moose habitat).

There has been much public and scientific debate over whether predator management is biologically justifiable to obtain an elevated moose population in the Upper Tanana/Fortymile River Valleys. Gasaway et al. (1992) reported that the Unit 20E moose population was being maintained at a low density dynamic equilibrium by wolf and grizzly bear predation. They determined predator management was necessary to increase the moose population and maintain it at a higher abundance level. They recommended altering wolf and bear predation simultaneously. Reducing predation of only 1 species may result in compensatory predation by another species. Opponents of wolf control have argued a wolf control program in Unit 20E would not work because grizzly bear predation is the primary limiting factor on the moose population. They based their conclusions on results of the wolf control program conducted in Unit 20E between 1981 and 1983. Unfortunately, this program was terminated prematurely due to political decisions and, therefore, results are nebulous and difficult to interpret. In an attempt to better predict the outcome of a wolf control program on the subunit's moose population, I entered the current population status and trend data for moose and their predators into a predator-prey model (McNay 1993).

The model predicts that with the current management program the moose population in Unit 20E will remain relatively stable. If 80% of the wolves were removed, the model predicted the moose population would increase 12% annually. This removal rate has been shown to be effective in the Finlayson Study Area in the Yukon (Robert Hayes, pers commun). A combination of a nonlethal wolf control program (fertility control and relocation) and public trapping was implemented in western Unit 20E in winter 1997–1998. If successful, the program will cause a 60–80% reduction in the wolf population. The project area currently supports very low moose densities and natural grizzly and black bear densities. We have established a moose census area within the primary wolf control area to monitor effects of the program on moose population trend. We surveyed the area in 1996, prior to initial treatment.

*Population Composition*

During 1997 we completed 6 standard contour surveys in eastern and central Unit 20E (Table 1). The 5-year averages for bulls, yearling bulls, and calves:100 cows, and moose/hour within the central portion were 64, 13, 24:100, and 38/hour, respectively. The greatest variance has been in calf survival, ranging from 15 to 35:100. The number of yearling recruits between 1988 and 1997 indicates moose numbers in this area were stable to slightly increasing and indicative of a low-density population.

Within eastern Unit 20E, the 5-year averages for bulls, yearling bulls, and calves:100 cows, and moose/hour were 63, 12, 23:100 and 54/hour, respectively. Moose numbers in this area increased slowly during this period.

Based on census results throughout the unit and on traditional fall moose composition surveys, the bull:cow ratio is well above the management objective and is indicative of a lightly harvested population. Access into Unit 20E is limited and harvest is generally concentrated along the few access routes. In more popular hunting areas (Nine Mile Trail, Mitchell's Ranch, and along the Taylor Highway), bull populations declined but still meet or exceed the management objective of 40:100 in all but the Nine Mile Trail area. The bull population in the Nine Mile area has stabilized, probably because of regulations enacted in 1993.

To protect against an overharvest of bulls in a specific area and to increase hunter opportunity within the larger area of eastern Unit 20E, the Board of Game created a controlled use area in 1993. This area was designed to give greater protection to bulls in fall in the most heavily hunted areas of the Nine Mile Trail. The area also offers excellent moose hunting off the trail, but it is difficult to access in fall. The bull:cow ratio in this area is between 60 and 80:100. To allow for greater hunting opportunity, the board created a winter permit hunt for Alaskan residents without transportation restrictions into this area. During the first 2 seasons (1995 and 1996) only 4 and 6 moose, respectively, were taken with no impact on the bull populations. Hunt popularity is increasing based on preliminary participation data in 1997. Annual harvests are expected to increase. If hunters begin to concentrate along the easier access routes resulting in concentrated harvests, some type of access restriction may be proposed.

In Unit 20E the average calf:cow ratios increased from 12.7:100 between 1973 and 1982 to 19.3:100 between 1982 and 1988 and 28.7 between 1989 and 1993. Average calf ratios declined between 1994 and 1997 to 21.5:100. Between 1982 and 1989, grizzly bear harvests were high and caused an estimated 30% reduction in the bear population in the central portion of Unit 20E. Since grizzly bears were the predominant predator on moose calves in this subunit (Gasaway et al. 1992), the increase in calf survival was attributed in part to a decline in the subunit's grizzly bear population (Boertje et al. 1995). In contrast, the grizzly bear population throughout the remainder of the subunit was lightly harvested and probably remained stable. If conditions were similar between the 2 areas, there should be a difference in calf recruitment between the areas that received high versus low bear harvests. I presented this analysis for the years 1981 to 1993 in Gardner (1997) and found no significant difference between the 2 areas.

Eastern Unit 20E moose have increased to moderate levels in large burned areas (1966 and 1969 burn) and presumably live under different ecological conditions than moose in central Unit 20E. In addition, I offer the following 5 possibilities why moose calf survival in the low bear harvest area was comparable with the high harvest area: 1) the treatment was not adequate to cause an increase in calf survival, 2) effects of the bear harvest extend further than I estimated, 3) harvested bears were younger and not as efficient predators as the remaining older bears, 4) the burns in eastern Unit 20E were large enough to cause a decrease in the hunting efficiency of predators, and 5) compensatory wolf predation negated the effects of reduced bear predation.

*Distribution and Movements*

Moose are distributed throughout Unit 20E below elevations of 4500 feet. Most radiocollared moose moved seasonally from lowland summer habitat to upland rutting areas, where they remained until winter conditions caused them to move back to lower elevations. In fall 1988 and 1992, early deep snowfall (>22 inches) caused moose to move to lower elevations earlier than in previous years. During 1995, low snowfall allowed moose to remain at higher elevations until at least January 1996.

## MORTALITY

*Harvest*

Season and Bag Limit.

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| Unit 20E, in the Ladue River Controlled Use Area. | | |
| 1 bull per regulatory year, only as follows: | | |
| 1 bull with spike-fork antlers. | 20 Aug–28 Aug | |
| 1 bull. | 1 Sep–15 Sep | |
| 1 bull by drawing permit only. | 1 Nov–30 Nov | |
| Nonresident Hunters: 1 bull with 50" antlers or with 4 or more brow tines on at least 1 | | 5 Sep–15 Sep |

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| side. | | |
| Unit 20E, that portion draining into the Yukon River upstream from and including the Charley River drainages to and including the Boundary Creek drainages and the Taylor Highway from mile 145 to Eagle. | | |
| Resident Hunters: 1 bull with spike-fork antlers. | 20 Aug–28 Aug | |
| 1 bull. | 5 Sep–25 Sep | |
| Nonresident Hunters: 1 bull with 50" antlers or with 4 or more brow tines on at least 1 side. | | 5 Sep–25 Sep |
| Remainder of Unit 20E Resident Hunters: 1 bull with spike-fork antlers. | 20 Aug–28 Aug | |
| 1 bull. | 1 Sep–15 Sep | |
| Nonresident Hunters: 1 bull with 50" antlers or with 4 or more brow tines on at least 1 side. | | 5 Sep–15 Sep |

Board of Game Actions and Emergency Orders. During the spring 1993 meeting, the Board of Game created the Ladue River Controlled Use Area that limited use of motorized vehicles to designated trails or strips during September. In spring 1994 the board adopted a November drawing permit hunt for Alaskan residents in the Ladue River Controlled Use Area and created an August hunt for spike-fork bulls for residents in Unit 20E. During the early spike-fork bull hunt in Unit 20E, up to 1 bull has been taken annually. The hunt is popular with local hunters and an extension of the spike-fork season will be proposed to the board in March 1998.

Hunter Harvest. During 1996 the total reported harvest in Unit 20E was 117 bulls (Table 2) or about 2.0% of the estimated population. The average reported harvest for the last 5 years was 110 (range 69–140), a 93% increase from the previous 5 years. Higher harvests and participation rates began in 1991. Greater harvest by nonlocal residents explains most of the increase. Probable causes for the higher harvest are: 1) hunters displaced by stricter regulations throughout Southcentral Alaska, especially in nearby Unit 13; 2) the Fortymile caribou season was open concurrently with the moose season, which attracted hunters interested in hunting both species; 3) maintaining a 1 bull bag limit with relatively liberal season dates gives hunters a false impression on the number of moose in the area; and 4) more hunters are coming to the area looking for a large antlered bull. The preliminary reported harvest during 1997 was 93 bulls.

Of the 117 moose harvested in 1996, 29 (25%) were taken in the Dennison/West Fork drainages and 26 (22%) were taken in the Mosquito Fork. In northern Unit 20E, 30 (30%) were taken along the Yukon, Charley, and Seventymile Rivers (16, 9, and 5 moose, respectively). Traditionally, 60–70% of the annual harvest comes from these 5 drainages. The harvest of the remaining 32 moose in 1996 was distributed almost evenly across the subunit. If greater restrictions become necessary to protect the bull population in Unit 20E, they will probably be in the Mosquito, Dennison/West Fork or Yukon drainages; access restrictions rather than antler or season length restrictions would be effective.

During 1996 the mean antler spread of bulls taken in Unit 20E was 47.0 inches, similar to the 5-year mean of 46.8 inches. Ten bulls (9.1%) were judged to be yearlings (antlers <30 inches), 44 (40.0%) were 2 to 4 years old (antler spread 30.0–49.9 inches), and 56 (50.9%) were mature bulls (antler spread >50 inches). Of the mature bulls, 26 (46.4%) had antler spreads >60 inches. Antler spreads were estimated for 234 and 294 bulls observed during posthunting aerial surveys in 1996 and 1997, respectively. Age composition was 17–22% yearlings, 37–38% 2- to 4-year-olds, and 40–46% mature bulls. Based on 1996 harvest results, hunters are either 1) selecting for larger bulls or 2) large antlered bulls are more vulnerable to harvest than medium or yearling bulls. Because moose density is low in Unit 20E and most hunters are state residents primarily in search of meat, I doubt that many hunters are selective.

Hunter Residency and Success. Of the 117 bulls harvested in 1996, 40 (34.2%) were taken by residents of Units 12 and 20E (Table 3), including 15 taken by residents of Chicken and Eagle. Nonlocal residents reported taking 70 moose in Unit 20E. During 1995 and 1996, hunters from Southcentral Alaska represented 31–36% of the total hunters and are taking 30–33% of the harvest. The remaining harvest is primarily split between hunters from Southeast Alaska (14) and Interior Alaska (14). Historically, most nonlocal hunters were from Interior and Southeast Alaska, but during the past 6 years most of the nonlocal hunters have been from Southcentral Alaska. Nonresident hunters were prohibited from hunting moose in Unit 20E between 1984 and 1991. Since 1991, nonresidents have represented 6% of the hunters and have accounted for an average of 7.0% of the harvest.

During 1996, 403 hunters reported hunting moose in Unit 20E. Since 1991, an average of 417 hunters hunted moose annually in Unit 20E compared to the 1984–1990 average of 258 hunters (range = 151–350). Most of the increase can be explained by more nonlocal hunters, primarily from Southcentral Alaska. Reasons for the increased use by Southcentral hunters probably include: 1) implementation of the spike-fork or 50-inches or larger antler restrictions enacted throughout Southcentral Alaska, 2) during the early 1990s, Nelchina caribou permits were difficult to obtain for recent residents, and 3) Unit 20E hunters can hunt caribou and moose concurrently.

Hunter success was 29%, slightly above the 5-year average of 27%. Success rate of local residents was 29% compared with a 30% success rate for nonlocals. Both local and nonlocal resident success rates have averaged 27% the past 5 years.

Harvest Chronology. Traditionally, most of the harvest has occurred during the first week of the season (Table 4). However, during 1995 and 1996 most harvest occurred the second week and on 14 and 15 September (14). Since 1991, 10–20 hunters have taken a moose during the longer season offered in the northern portion of the subunit.

Transport Methods. For the past 5 years in Unit 20E, moose hunters have preferred using highway vehicles (32%). They also have used 4-wheelers (24%), boats (16%), aircraft (12%), and other ORVs (8%). Hunters using highway vehicles had the lowest success rate (19%), while hunters using airplanes (45%) and ORVs (39%) had the highest success rates. Hunters using 4-wheelers had a success rate of 29%, equaling the unit's average, which was an increase from 23% for the previous 5 years. The number of hunters using 4-wheelers are increasing. During the past 3 years an average of 120 hunters used a 4-wheeler compared to 82 between 1991 and 1993. Hunters who used highway vehicles to access the area are now changing to 4-wheelers. The number of hunters using the other transportation types is constant. Hunters using highway vehicles were responsible for the greatest harvest (Table 5).

The increasing number of hunters who use 3- or 4-wheelers has become a concern in certain areas of Unit 20E. This group of hunters tend to have a greater effect on moose because they tend to concentrate their efforts more than other hunters.

*Other Mortality*

Predation by wolves and grizzly bears is the greatest source of mortality for moose in Unit 20E and is presently maintaining the population at a low density (0.57–0.6 moose/mi$^2$). Using the model presented by McNay (1993), I estimated about 28% of the postcalving moose population is being killed by wolves and grizzly bears and about 1% is being harvested by humans.

## HABITAT

*Assessment*

Presently in Unit 20E, availability of browse is not limiting moose population growth. Recent browse studies have found that moose are not using most of the preferred browse plants. Use of current year's growth has been less than 5% (Boertje et al. 1985). Over 10% of the subunit, primarily the southeast portion, has burned within the last 25 years, offering excellent browse. However, much of central Unit 20E supports climax forest and does not offer substantial amounts of moose browse.

*Enhancement*

Implementation of the Alaska Interagency Fire Management Plan is expected to restore a near-natural wildfire regime to over 60% of Unit 20E. Under the plan, much state and federal land was accorded limited fire protection. Unfortunately, nearly all land selected by Native corporations was accorded modified or full-suppression status. Vegetation communities in these areas will continue to degrade to the detriment of moose and other wildlife species that fare best in a fire-shaped environment. More acceptance to fire as a management tool is apparent, especially locally because of well known increase in moose numbers within the area burned by the 1990 Tok Wildfire. Based on discussions with Native corporation leaders, they are more open to allowing fires to burn on their land, except in areas where there is marketable timber. We plan to initiate a prescribed burn in 10,000 acres of eastcentral Unit 20E in 1998. To date, there has been no opposition.

## CONCLUSIONS AND RECOMMENDATIONS

Between 1981 and 1988, the moose population in Unit 20E increased 5% to 9% annually, reaching a density of 0.33 to 0.49 moose/mi$^2$. Between 1988 and 1997 the population growth rate slowed considerably and is estimated at 0.57–0.6 moose/mi$^2$. Recent research has shown that predation by wolves and grizzly bears was the primary factor limiting the subunit's moose population. Combined wolf and bear predation is taking about 28% of the postcalving moose population annually.

To reduce effects of predation on the area's moose population, grizzly bear hunting regulations were liberalized in 1981. As a result, bear harvest increased and caused bear numbers to decline as much as 30% in parts of the subunit. Moose calf survival increased during this period. However, we do not know how much of the increase in moose calf survival was due to the grizzly bear population decline. I recommend retention of liberal bear regulations, but results of this management technique on moose population growth needs to be studied. In the western portion of the unit, nonlethal wolf control was implemented in fall 1997 to primarily benefit the Fortymile caribou herd. Within the treatment area, wolf numbers will be reduced 60–80%. We will be monitoring the moose population in a portion of the treatment area to determine effects of the program on moose population trend.

Human-induced mortality is having little effect on the subunit's moose population. Annual harvest rates have historically been less than 2% of the fall population estimate but increased to 2–2.5% during 1995 and 1996. The bull:cow ratio declined in portions of Unit 20E due to moderate harvest rates in more accessible areas, but the subunit bull:cow ratio is indicative of a lightly harvested population. If current harvest trends continue, additional hunting restrictions may be necessary to protect the bull segment of the population, but I foresee this only in the most accessible areas of Unit 20E.

The number of moose hunters in Unit 20E is increasing. Most of the additional hunters are from Southcentral Alaska. The preferred transportation type is becoming 4-wheelers; 24% of the hunters are now using 4-wheelers to gain access and are taking 29% of the harvest. Most of Unit 20E is lightly harvested, but this may change depending on board decisions in other areas of the state. The best method of preventing or correcting effects of overharvest in Unit 20E is through access restrictions and not through season and bag limit changes.

An early season spike-fork hunt was authorized by the board in 1994 and began during August 1995. The rationale for the hunt was that this class of bulls traditionally represents 11.3% of the bull population in Unit 20E but on average only contributes about 1.5% of the harvest. Primarily local residents use this hunt. Increasing opportunity to harvest this bull class by locals may protect a larger bull later in the season.

The board also authorized a winter permit hunt in eastern Unit 20E. Harvest was low the first 2 years due to severe weather and most hunters' lack of knowledge of the area. More nonlocal hunters are becoming aware of the quality of the hunt and the chance of seeing large trophy bulls. As a result more people are applying for the hunt, and based on preliminary hunt data, the participation and harvest rate increased substantially during 1997. I expect the popularity of the hunt will continue to grow.

Federal, state, and Native land managers with responsibilities for managing wildlife habitat on their lands need to be continually persuaded to allow a natural fire regime. Degradation of habitat diversity and quality will continue as long as naturally ignited wildfires are suppressed. Allowing a more natural fire regime will benefit the subunit's moose population and eventually subsistence and nonconsumptive users. More acceptance of fire and other habitat manipulation techniques is apparent. We plan to implement a large prescribed fire in central Unit 20E in summer 1998.

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Table 1 Unit 20E aerial moose composition counts, 1988–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/hr |
|---|---|---|---|---|---|---|---|---|
| 1988–1989 | 78 | 13 | 22 | 117 | 11 | 931 | 1048[a] | 30 |
| 1989–1990 | 56 | 11 | 43 | 43 | 21 | 158 | 201 | 22 |
| 1990–1991 | 64 | 9 | 30 | 105 | 16 | 566 | 671 | 30 |
| 1991–1992 | 65 | 14 | 28 | 120 | 14 | 714 | 834 | 42 |
| 1992–1993[a] | 59 | 11 | 17 | 19 | 12 | 141 | 160 | |
| 1992–1993[b] | 75 | 15 | 28 | 32 | 14 | 200 | 232 | |
| 1993–1994 | 63 | 10 | 28 | 126 | 15 | 727 | 854 | 40 |
| 1994–1995[c] | 74 | 16 | 23 | 65 | 12 | 488 | 553 | 48 |
| 1995–1996[a] | 70 | 16 | 15 | 29 | 8 | 329 | 358 | |
| 1996–1997[b] | 61 | 10 | 19 | 44 | 10 | 377 | 421 | |
| 1996–1997[d] | 56 | 6 | 27 | 47 | 15 | 270 | 317 | 45 |
| 1997–1998[c] | 61 | 14 | 26 | 70 | 14 | 438 | 508 | 49 |

[a] Census results from the Mosquito Flats Study Area.
[b] Census results from the Ladue River Study Area.
[c] Partial survey only; sampled Nine Mile Trail, Prindle Volcano, Sixtymile Butte, and Ketchumstuk.
[d] Survey areas were within the Mosquito Flats Study Area.

Table 2 Unit 20E moose harvest and accidental death, 1990–1996

| Regulatory year | Harvest by hunters: Reported M (%) | F (%) | Unk | Total | Estimated: Unreported | Illegal | Total | Accidental death: Road | Train | Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990–1991 | 46 (100) | 0 (0) | 0 | 46 | 0–5 | 5–15 | 9–22 | 0 | | 0 | 54–61 |
| 1991–1992 | 90 (99) | 0 (0) | 1 | 91 | 0–5 | 5–15 | 9–22 | 0 | | 0 | 100–113 |
| 1992–1993 | 68 (99) | 0 (0) | 1 | 69 | 0–5 | 5–15 | 9–22 | 1 | | 1 | 79–92 |
| 1993–1994 | 128 (100) | 0 (0) | 1 | 129 | 0–5 | 5–15 | 5–20 | 0 | | 0 | 134–149 |
| 1994–1995 | 93 (100) | 0 (0) | 1 | 94 | 0–5 | 5–15 | 5–20 | 0 | | 0 | 99–114 |
| 1995–1996 | 139 (99) | 0 (0) | 1 | 140 | 0–5 | 5–10 | 5–15 | 0 | 0 | 0 | 145–155 |
| 1996–1997 | 116 (99) | 0 (0) | 1 | 117 | 0–5 | 5–10 | 5–15 | 0 | 0 | 0 | 122–132 |

Table 3 Unit 20E moose hunter residency and success, 1990–1996

| Regulatory year | Successful: Local[a] resident | Nonlocal resident | Nonresident | Total[b] (%) | Unsuccessful: Local[a] resident | Nonlocal resident | Nonresident | Total (%) | Total hunters |
|---|---|---|---|---|---|---|---|---|---|
| 1990–1991 | 16 | 28 | | 46 (16) | 65 | 176 | 2 | 249 (84) | 295 |
| 1991–1992 | 34 | 54 | 3 | 91 (21) | 112 | 219 | 9 | 343 (79) | 434 |
| 1992–1993 | 15 | 45 | 4 | 69 (24) | 52 | 135 | 9 | 220 (76) | 289 |
| 1993–1994 | 38 | 77 | 14 | 129 (30) | 93 | 188 | 17 | 300 (70) | 429 |
| 1994–1995 | 27 | 58 | 9 | 94 (19) | 97 | 272 | 17 | 393 (81) | 487 |
| 1995–1996 | 36 | 93 | 9 | 140 (31) | 72 | 208 | 34 | 318 (69) | 458 |
| 1996–1997 | 40 | 70 | 7 | 117 (29) | 97 | 165 | 24 | 286 (71) | 403 |

[a] Residents of Unit 12 and Units 20E and eastern 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

[b] Difference in total and sum of residency categories equals numbers with unknown residency.

Table 4 Unit 20E moose harvest chronology by time period, 1990–1996

| Regulatory year | Harvest periods | | | | | |
|---|---|---|---|---|---|---|
| | 9/1–9/6 | 9/7–9/13 | 9/14–9/20 | 9/21–9/27 | 9/28–10/5 | Total[a] |
| 1990–1991 | 20 | 9 | 7 | 6 | 0 | 46 |
| 1991–1992 | 25 | 26 | 22 | 14 | 0 | 91 |
| 1992–1993 | 29 | 28 | 5 | 5 | 0 | 69 |
| 1993–1994 | 52 | 40 | 24 | 8 | 0 | 129 |
| 1994–1995 | 47 | 21 | 16 | 8 | 0 | 94 |
| 1995–1996 | 46 | 58 | 27 | 3 | 0 | 140 |
| 1996–1997 | 33 | 49 | 23 | 6 | 0 | 117 |

[a] Difference between total and summation of harvests by week represents moose taken on unknown dates.

Table 5 Unit 20E moose harvest and percent by transport method, 1990–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1990–1991 | 7 (15) | 3 (7) | 10 (22) | 6 (13) | 0 (0) | 8 (17) | 7 (15) | 5 (11) | 46 |
| 1991–1992 | 11 (12) | 2 (2) | 18 (20) | 10 (11) | 0 (0) | 15 (16) | 35 (38) | 0 (0) | 91 |
| 1992–1993 | 17 (25) | 1 (1) | 4 (6) | 21 (30) | 1 (1) | 7 (10) | 15 (22) | 3 (4) | 69 |
| 1993–1994 | 31 (24) | 0 (0) | 15 (12) | 34 (26) | 0 (0) | 15 (12) | 32 (25) | 2 (2) | 129 |
| 1994–1995 | 24 (26) | 0 (0) | 14 (15) | 26 (28) | 0 (0) | 13 (14) | 15 (16) | 2 (2) | 94 |
| 1995–1996 | 29 (21) | 0 (0) | 19 (14) | 39 (28) | 1 (1) | 16 (11) | 34 (24) | 2 (1) | 140 |
| 1996–1997 | 26 (22) | 3 (3) | 18 (15) | 26 (22) | 0 (0) | 13 (11) | 30 (26) | 1 (1) | 117 |

## LOCATION

**GAME MANAGEMENT UNIT:** 21B (4871 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Lower Nowitna River, Yukon River between Melozitna and Tozitna Rivers

## BACKGROUND

Although the establishment of moose in this portion of Interior Alaska occurred fairly recently in geologic time, moose were present early enough to be mentioned in even the earliest human accounts of the area. Moose had become fairly abundant by the time gold seekers converged on the area in the early 1900s. The village of Ruby had a population of 10,000 people during the 1910 Gold Rush, and many moose were hunted to supply the townsfolk and miners with meat. The area was believed to have supported a large moose population from the early 1900s to late 1970s. Several severe winters in the late 1960s and early 1970s initiated widespread declines in moose populations throughout the Interior.

Historically, naturally occurring wildfires have been a major force affecting the productivity and diversity of moose habitat in this area. Large fires burned a major portion of the area before the 1950s when effective fire suppression substantially altered this fire regime. The 1982 Tanana-Minchumina Fire Plan provided a mechanism for returning to a natural fire regime in most of this area by allowing some fires to burn with minimal interference.

The Nowitna River drainage to the east of Ruby is a popular hunting area for residents of Ruby, Tanana, and, to a lesser extent, Galena. It is also a popular hunting area for Fairbanks residents who use boats and aircraft for access. Because of its long history of use by both local and nonlocal hunters, this area has been the focus of much of the management effort in Unit 21B over the years.

Aerial moose surveys in 1977–1979 indicated moose numbers were declining in the Nowitna. Wolves were abundant compared to the number of moose available, and predation by wolves was believed responsible for the decline in moose numbers. Thus, a wolf control program was approved to augment the harvest by hunters and trappers. Total harvest from the drainage, including part of Unit 21A, during the 3 years of the program was 61 wolves (ADF&G 1983). Hunting restrictions were also implemented while the wolf control program was in effect.

Using methods described by Gasaway et al. (1986), we conducted a moose population estimation survey in 1980 and estimated 2386 ± 429 moose in a 2774-$mi^2$ portion of the subunit in the lower Nowitna drainage. A 1986 population estimation survey conducted in a 1556-$mi^2$ portion of the 1980 survey area indicated a reduction in moose numbers. A 1990 population estimation survey in the 1980 survey area indicated a decline that was significant at the 80% level but not at the 90% level. Results of a 1995 population estimation survey in a 1338-$mi^2$ portion of the subunit were not significantly different from previous surveys.

Since 1981, hunters have had a 20-day season and a bag limit of 1 bull moose per hunter per season. Harvest reports indicate the number of hunters and harvest from Unit 21B has averaged 143 hunters and 65 bulls annually over the last 7 years. A moose hunter checkstation has been operated at the mouth of the river from 1979 to 1983 and from 1988 to the present. A registration hunt was established in 1996 for the Nowitna River drainage portion of Unit 21B.

Besides the lower portion of the Nowitna drainage, Unit 21B includes the area east of the Ruby–Poorman Road, the banks of the Yukon River from Ruby to Tanana, the Blind River, and the Boney River. These areas produce from 36 to 46% of the reported Unit 21B harvest.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem
- Provide for continued use of moose by local Alaskan residents who have customarily and traditionally used the population
- Provide the greatest sustained opportunity to participate in hunting moose
- Provide an opportunity to view and photograph moose
- Provide for scientific and educational use of moose

### MANAGEMENT OBJECTIVES

*Floodplain area of the Yukon and Nowitna Rivers*

- Conduct annual trend area surveys
- Maintain an average annual harvest of 40 moose from the desired population of 1000–1600 moose
- Monitor harvest with harvest reports and checkstations

*Remainder of the Nowitna drainage*

- Conduct annual trend area surveys
- Maintain an average annual harvest of 20 moose from the desired population of 1100–1300 moose
- Monitor harvest with harvest reports and check stations

*Remainder of Unit 21B*

- Conduct annual trend area surveys.
- Maintain a minimum annual harvest of 30 moose from the desired population of 1600–1700 moose.
- Monitor harvest with harvest reports

## METHODS

Established trend count areas were surveyed from Piper PA-18 (or equivalent) aircraft to assess population status and trend by cooperative efforts with FWS. Contiguous survey units of approximately 12 $mi^2$ each were searched at a rate of at least 4 $min/mi^2$ to ensure reasonably high sightability, minimal bias, and data comparability between years. A moose population estimation survey was conducted in November 1995 using a regression survey method developed by ADF&G biometricians that uses a probability sample (Särndal et al. 1992:p 93) and regression estimator (Särndal et al. 1992:p 245).

We monitored hunter harvest by checking moose harvest reports and collecting information on hunter residency, moose ages, and antler sizes at a moose hunter checkstation. We monitored mortality due to predation by interviewing wolf trappers.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

The population estimation survey in November 1995 covered a 1338-$mi^2$ area. The area surveyed was based on a polygon of moose calf radio relocations. It was thought that by using these relocations the survey area would approximate more closely the area used by moose occupying the floodplain of the Nowitna River. We surveyed the area because Tanana residents reported that moose were difficult to find during the September hunting season. Results of the survey using the linear regression program indicate that 908 ± 19% moose were present (Table 1). Unfortunately, only 2 of the past 4 censuses have used the same survey area, which makes comparisons difficult. By comparing moose density it seems the Nowitna moose population declined from 1980 to 1986 but slowly increased by 1995 (Table 2). If the data are compared using a subset of the previous census areas common to all 4 censuses, the population seems to have declined, increased, and declined again (Table 3). However, the differences between the various censuses were not statistically different (O Huntington, FWS, pers commun).

Using the results of the 1990 and 1995 population estimation surveys, there are an estimated 2324 to 3530 moose in the subunit. A density of 0.20 moose/$mi^2$ was applied to the portion of the Little Mud River drainage not included in the population estimation survey, and a density of 0.64 moose/$mi^2$ was applied to the remainder of the subunit. Higher moose densities (2.0 moose/$mi^2$) are in favorable habitat along the Nowitna floodplain and immediately adjacent to the Yukon River. Densities are low to moderate (0.2–0.9 moose/$mi^2$) away from the river.

Survey data collected in fall 1996 from established trend areas along the lower Nowitna showed an increase in moose density from the past several years. (Tables 4 and 5).

*Population Composition*

Composition data are available from aerial surveys conducted with FWS staff in established trend areas on the Nowitna National Wildlife Refuge (Tables 4 and 5). The fall 1996 survey results indicate bull:cow ratios along the river increased from the previous year while calf:cow ratios decreased. Overwinter survival of calves to yearling age indicates poor recruitment. The occurrence of twin calves among moose observed in these early winter surveys was very poor in the last several years, ranging from 0 to 6%. A population with these attributes may stabilize in numbers.

The 1995 population estimation data indicate the sex and age composition over the entire area was not as depressed as that along the river. The bull:100 cow ratio was 32, the yearling bull:100 cow was 7.4, and the calf:cow ratio was 28. These ratios indicate a stable population.

*Distribution and Movements*

Based on the movements of radiocollared cow–calf pairs, most cows spend their summer months around open grass and brush meadows on the floodplain, but away from the river. In October they move to the riparian areas, where they remain until early May. Relatively few cow moose winter in the hills to the north and south of the Nowitna River.

## MORTALITY

*Harvest*

Season and Bag Limit.

| Unit and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Unit 21B that portion within the Nowitna River drainage: | | |
| Resident Hunters: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by permit. | 5 Sep–20 Sep | |
| Resident Hunters: 1 bull by permit. | 5 Sep–25 Sep | |
| Nonresident Hunters: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | | 5 Sep–20 Sep |

| Unit and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Remainder of Unit 21B: | | |
| Resident Hunters: 1 bull | 5 Sep–25 Sep | |
| Nonresident Hunters: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | | 5 Sep–25 Sep |

Board of Game Actions and Emergency Orders. In March 1996 the Board of Game established subsistence and general registration hunts for the Nowitna River drainage in Unit 21B. This action was to counter the possibility of the Federal Subsistence Board closing federally managed lands in the Nowitna River drainage to nonlocal hunters because of perceived declines in moose. Two separate registration hunts were established. The subsistence registration hunt was open to all Alaskan residents, with a season of 5 September through 25 September and a bag limit of 1 bull moose. All the meat had to remain on the bones, the head had to be salvaged, and the antlers were to be cut to destroy the trophy value. The general registration hunt was open to all hunters, with a season of 5 September through 20 September and a bag limit of 1 bull moose with spike fork antlers or antlers at least 50 inches wide, or 4 brow tines on at least 1 side for residents. For nonresidents the bag limit was 1 bull with antlers at least 50 inches wide, or 4 brow tines on at least 1 side. Seasons and bag limits for the remainder of the subunit remained as before.

Harvest. Reported harvest for the subunit remained fairly stable and averaged 65 (range 46–81) moose annually over the past 7 years (Table 6). The unreported harvest is estimated at 5 moose per year in the Ruby area and 10 moose per year in the Tanana area. The Nowitna drainage has produced from 56 to 86% of the subunit's reported harvest during the last 7 years (Tables 7 and 8).

Check-station Results. Since 1988 a moose hunter checkstation has been located at the mouth of the Nowitna. Beginning in 1996 the checkstation became mandatory as it was the only place Nowitna River registration hunt permits were available. Table 7 indicates residency, harvest, and success of hunters passing through the checkstation.

Hunter Residency and Transportation Methods. Based on harvest reports (Table 8), most hunters were Alaskan residents who resided outside the subunit. Most hunters used boats for access (Table 9).

*Other Mortality*

Predation mortality on moose calves is significant in the subunit (Osborne et al. 1991). During calf mortality studies of radiocollared newborn moose, black bears were the main predator, killing 38% of all calves. Wolves killed 11% of all calves, unidentified predators killed 8%, grizzly bears killed 2%, and 5% died from other natural causes.

### HABITAT

*Assessment*

No new data were collected on habitat conditions during this report period. Prior observations indicated browse availability is not currently limiting the moose population in the subunit. Regeneration from a fire that burned in 1986 east of the Nowitna River in the Little Mud River drainage provides excellent moose browse. During November 1995 surveys, this area was classified as a high moose density area. Several adjacent sample units were classed as medium. There is a dense stand of black spruce between the burn and the Nowitna River that should be considered for a prescription burn.

## CONCLUSIONS AND RECOMMENDATIONS

Statistical comparison of the 1980, 1986, 1990, and 1995 population estimation surveys indicates the population has fluctuated over the past 15 years. An analysis of the 1990 and 1995 population estimation surveys showed no significant difference in the number of moose. Reanalysis of the data from the 1990 through 1996 surveys of permanent trend count areas shows the density of moose along the heavily hunted Nowitna River to be relatively stable, unlike Osborne's finding (Osborne 1996). Bull:cow ratios in fall 1996 improved slightly from the previous 2 years. Away from the river, the ratio of bulls to cows is slightly higher.

Predators remain abundant and continue to be the primary factor controlling moose abundance in the area. Currently the harvest of wolves within the subunit is very low and few black bears are harvested. The moose calf mortality study indicated black bears were the major predator on moose calves (Osborne et al. 1991). Efforts should be made to increase the harvest of predators if more moose are desired.

I recommend a prescribed burn in the upland area east of the Nowitna floodplain and north of the Little Mud River to Bering Creek. This area is adjacent to several old burns that are currently reaching peak browse production.

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Table 1 Moose population estimation for Nowitna drainage Unit 21B using a regression survey method, November 1995

| Unit | Area $mi^2$ | Population | 90% CI[a] | Density | SCF[b] | Variance |
|---|---|---|---|---|---|---|
| Upnovi | 365.9 | 96.3 | 16.8 | 0.26 | 1.00 | 96.8 |
| Midnovi | 443.8 | 253.3 | 30.6 | 0.57 | 1.05 | 2232.2 |
| Mouth | 528.3 | 533.8 | 15.4 | 1.01 | 1.29 | 3082.9 |
| Combined | 1338.0 | 908.0 | 19.0 | 0.68 | 1.21 | 11090.6 |

[a] Confidence interval (% ±).
[b] Sightability correction factor.

Table 2 Data from moose populations estimation surveys 1980–1995 in Unit 21B

| Year | Area ($mi^2$) | Corrected density | 90% CI | Population estimate | Method |
|---|---|---|---|---|---|
| 1980 | 2701 | 0.72 | 23.3 | 1956 | Moosepop |
| 1986 | 1596 | 0.55 | 23.8 | 878 | Moosepop |
| 1990 | 2701 | 0.64 | 13.8 | 1719 | Moosepop |
| 1995 | 1338 | 0.66 | 19.0 | 908 | Regression |

Table 3 Subset of data (minimum area sampled) from moose population estimation surveys 1980–1995, Unit 21B using "MOOSEPOP" (Gasaway et al. 1986)

| Year | Area ($mi^2$) | Corrected density | 90% CI | Population estimate |
|---|---|---|---|---|
| 1980 | 1338 | 0.82 | 28 | 1100 |
| 1986 | 1338 | 0.66 | 28 | 881 |
| 1990 | 1338 | 1.04 | 23 | 1385 |
| 1995 | 1338 | 0.64 | 20 | 1031 |

Table 4 Unit 21B Nowitna/Sulatna confluence trend count area (75.5 $mi^2$) aerial moose composition counts, 1991–1996[a]

| Regulatory year | Bulls:100 cows | Yrlg bulls: 100 cows | Calves:100 cows | Percent twinning | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|
| 1991–1992 | 21 | 9 | 29 | 8 | 20 | 200 | 2.7 |
| 1992–1993 | 18 | 1 | 48 | 7 | 29 | 171 | 2.3 |
| 1993–1994 | 22 | 7 | 20 | 0 | 14 | 195 | 2.6 |
| 1994–1995 | 16 | 6 | 20 | 4 | 15 | 191 | 2.5 |
| 1995–1996 | 15 | 4 | 33 | 6 | 22 | 148 | 2.0 |
| 1996–1997 | 18 | 8 | 23 | 6 | 13 | 216 | 2.9 |

[a] Huntington and Spindler 1997.

Table 5 Unit 21B Nowitna Mouth trend area (59.0 $mi^2$) aerial moose composition counts, 1990–1996[a]

| Regulatory year | Bulls:100 cows | Yrlg bulls:100 cows | Calves:100 cows | Percent twinning | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|
| 1992–1993 | 21 | 0 | 31 | 0 | 20 | 138 | 2.9 |
| 1993–1994 | 32 | 6 | 32 | 6 | 20 | 189 | 3.2 |
| 1994–1995 | 19 | 8 | 23 | 0 | 22 | 148 | 2.5 |
| 1995–1996 | 16 | 5 | 26 | 0 | 18 | 116 | 2.0 |
| 1996–1997 | 21 | 7 | 22 | 0 | 16 | 185 | 3.1 |

[a] Huntington and Spindler 1997.

Table 6 Unit 21B moose harvest, 1990–1996

| Regulatory year | Harvest by hunters | | | | Unreported | Total |
|---|---|---|---|---|---|---|
| | Bull | Cow | Unk | Total | | |
| 1990–1991 | 81 | 0 | 0 | 81 | 15 | 96 |
| 1991–1992 | 65 | 0 | 0 | 65 | 15 | 80 |
| 1992–1993 | 46 | 0 | 0 | 46 | 15 | 61 |
| 1993–1994 | 71 | 1 | 0 | 72 | 15 | 87 |
| 1994–1995 | 63 | 0 | 0 | 63 | 15 | 78 |
| 1995–1996 | 66 | 0 | 0 | 66 | 15 | 81 |
| 1996–1997 | 63 | 0 | 0 | 63 | 15 | 78 |

Table 7 Residency ($N$), harvest ($n$) and success (S%) of moose hunters stopping at the Nowitna River hunter check station, Unit 21B, 1990–1997

| | Local villages[a] | | | Fairbanks | | | Other residents | | | Nonresident | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | $N$ | $n$ | S% | $N$ | $n$ | S% | $N$ | $n$ | S% | $N$ | $n$ | S% | $N$ | $n$ | S% |
| 1990–1991 | 23 | 7 | 30 | 67 | 32 | 48 | 26 | 12 | 46 | 14 | 4 | 29 | 130 | 54 | 42 |
| 1991–1992 | 21 | 9 | 43 | 72 | 24 | 33 | 44 | 11 | 25 | 17 | 2 | 12 | 154 | 46 | 30 |
| 1992–1993 | 24 | 3 | 12 | 38 | 19 | 50 | 53 | 10 | 19 | 10 | 2 | 20 | 125 | 34 | 27 |
| 1993–1994 | 19 | 7 | 37 | 58 | 26 | 45 | 35 | 19 | 54 | 20 | 1 | 5 | 133 | 53 | 40 |
| 1994–1995 | 16 | 6 | 37 | 63 | 27 | 43 | 41 | 16 | 39 | 13 | 5 | 38 | 134 | 54 | 40 |
| 1995–1996 | 16 | 3 | 19 | 63 | 24 | 38 | 44 | 9 | 20 | 9 | 2 | 22 | 132 | 38 | 29 |
| 1996–1997 | 19 | 2 | 11 | 54 | 21 | 39 | 36 | 12 | 33 | 20 | 2 | 10 | 129 | 37 | 29 |
| 1997–1998 | 17 | 1 | 6 | 38 | 20 | 53 | 43 | 14 | 33 | 7 | 3 | 43 | 104 | 38 | 37 |

[a] Tanana, Ruby, and Galena.



Table 8 Unit 21B moose hunter residency and success, 1990–1996

| | Successful | | | | | Unsuccessful | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory year | Local resident[a] | Nonlocal resident | Nonresident | Unk | Total | Local resident[a] | Nonlocal Resident | Nonresident | Unk | Total | Hunters |
| 1990–1991 | 22 | 48 | 8 | 3 | 81 | 10 | 41 | 1 | 1 | 53 | 134 |
| 1991–1992 | 21 | 34 | 8 | 2 | 65 | 21 | 56 | 8 | 1 | 86 | 151 |
| 1992–1993 | 12 | 31 | 2 | 1 | 46 | 24 | 55 | 10 | 1 | 90 | 136 |
| 1993–1994 | 23 | 45 | 3 | 1 | 72 | 7 | 47 | 11 | 0 | 65 | 137 |
| 1994–1995 | 12 | 44 | 5 | 2 | 63 | 7 | 44 | 2 | 0 | 53 | 116 |
| 1995–1996 | 15 | 43 | 8 | 0 | 66 | 11 | 60 | 6 | 0 | 77 | 143 |
| 1996–1997 | 16 | 44 | 3 | 0 | 63 | 38 | 68 | 17 | 0 | 123 | 186 |

[a] Tanana, Ruby, and Galena.

Table 9 Unit 21B moose harvest percent by transport method, 1990–1996

| Regulatory year | Airplane | Horse | Boat | 3- or 4-wheeler | Snowgo | ORV | Highway vehicle | Unk | *n* |
|---|---|---|---|---|---|---|---|---|---|
| | Harvest percent by transport method | | | | | | | | |
| 1990–1991 | 11 | 1 | 78 | 0 | 0 | 2 | 6 | 1 | 81 |
| 1991–1992 | 9 | 1 | 75 | 0 | 0 | 0 | 10 | 4 | 65 |
| 1992–1993 | 10 | 0 | 76 | 1 | 0 | 0 | 8 | 4 | 46 |
| 1993–1994 | 9 | 0 | 82 | 3 | 1 | 0 | 3 | 1 | 72 |
| 1994–1995 | 21 | 0 | 69 | 2 | 0 | 0 | 6 | 3 | 63 |
| 1995–1996 | 12 | 0 | 79 | 3 | 0 | 0 | 4 | 1 | 66 |
| 1996–1997 | 4 | 0 | 92 | 2 | 0 | 0 | 0 | 2 | 63 |

## LOCATION

**GAME MANAGEMENT UNIT:** 21C (3671 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Dulbi River above Cottonwood Creek and Melozitna River above Grayling Creek

## BACKGROUND

Moose have inhabited Unit 21C throughout historic times. Moose densities are generally low, and population trends are unknown. Because human use is low and not believed to adversely impact the moose population, there has been little need to extensively monitor the moose population in this area.

Terrain in the subunit is quite mountainous with peaks as high as 5000 feet. Two large rivers, the Melozitna and the Dulbi, drain the mountain ranges referred to as the Kokrines Hills. Numerous fires have burned the area in the past, producing large expanses of excellent winter habitat.

Annual moose harvests have ranged from 9 to 30 bulls during the past 15 years. Aircraft provide the only practical access to most of the subunit. A waterfall near the mouth of the Melozitna River restricts travel up that river and extensive sandbars impede boat access into the upper Dulbi River.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem

- Provide a sustained opportunity to hunt moose

- Document uses of moose

## METHODS

A survey was attempted in November 1995 to assess moose density and to stratify the subunit for future moose population estimation surveys. The subunit was divided into 4 sections based on Uniform Coding Unit drainages. Maps of the sample units were drawn and areas calculated. We monitored harvest levels by reviewing the moose harvest reports submitted by hunters. We monitored mortality due to predation by interviewing wolf trappers.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

A moose stratification survey was attempted in November 1995. The 4 sections to be surveyed were the lower Melozitna River (1470.3 $mi^2$ in 121 sample units); upper Melozitna River (600.2

mi$^2$ in 49 sample units); Little Melozitna River (576.5 mi$^2$ in 47 sample units); and that portion of the Dulbi River drainage that was not surveyed in 1987, (142.5 mi$^2$ in 12 sample units). Seventeen units (approximately 200 mi$^2$) were surveyed on 20 November 1995 before turbulence caused unsafe flying conditions. Over the next 2 days, continuous turbulence prevented completion of the surveys. No information was collected on sex or age composition, and we attempted no further surveys.

### MORTALITY

*Harvest*

Season and Bag Limit.

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| Unit 21C | | |
| Resident and Nonresident Hunters: 1 bull. | 5 Sep–25 Sep | 5 Sep–25 Sep |

Board of Game Actions and Emergency Orders. Seasons and bag limits have remained the same during the past 10 years. No changes were made during this reporting period.

Hunter Harvest. The harvest in the subunit has been relatively stable, ranging from 9 to 27 (average 20) moose annually for the past 7 years (Table 1). An additional big game guiding operation was established in the Melozitna drainage in fall 1996. At least 1 other guide operates in the mid to upper Dulbi River.

Hunter Residency and Transportation Methods. Currently, no one lives within the subunit. Hunters who reported hunting in Unit 21C were either state residents residing outside the subunit or nonresidents (Table 1). Hunters mainly used aircraft for transport (Table 2).

*Other Mortality*

There are at least 50 to 60 wolves in the subunit. Grizzly bear habitat is excellent, probably with a moderate bear density. Moose and caribou are available as prey for wolves and bears. The Melozitna River also has a major salmon run. Predation is probably the main limiting factor on moose in the subunit.

## CONCLUSIONS AND RECOMMENDATIONS

The moose population is probably low. Human use of the population also remains low. A reasonable estimate of current moose density would be 0.5 to 1.0 moose/mi$^2$, based on the scant survey data to date, the stratification, and densities observed elsewhere in the Interior where wolves and bears are lightly harvested (Gasaway et al. 1992). If this estimate were correct, it would mean that reported harvest (9 to 27 moose/yr) is only 0.3 to 1.5% of the projected population of 1836–3671 moose each year. The existing hunting pressure could be sustained even if the population experienced a substantial reduction. Conversely, if the population remains at these levels, it is capable of sustaining more than double the current harvest without management actions. I recommend minimal commitment of management effort in the subunit until hunting pressure significantly increases.

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 Unit 21C moose hunter residency and success, 1990–1996

| Regulatory year | Successful | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local resident | Nonlocal resident | Nonresident | Unk | Total | Local resident | Nonlocal resident | Nonresiden | Unk | Total | |
| 1990–1991 | 1 | 18 | 5 | 1 | 25 | 0 | 9 | 3 | 0 | 12 | 37 |
| 1991–1992 | 0 | 15 | 5 | 0 | 20 | 0 | 17 | 3 | 0 | 20 | 40 |
| 1992–1993 | 0 | 7 | 2 | 0 | 9 | 0 | 15 | 7 | 0 | 22 | 31 |
| 1993–1994 | 0 | 11 | 9 | 0 | 20 | 0 | 13 | 6 | 0 | 19 | 39 |
| 1994–1995 | 0 | 17 | 10 | 0 | 27 | 4 | 14 | 2 | 0 | 20 | 47 |
| 1995–1996 | 0 | 12 | 13 | 0 | 25 | 0 | 13 | 3 | 0 | 16 | 41 |
| 1996–1997 | 0 | 10 | 5 | 0 | 15 | 0 | 9 | 3 | 0 | 12 | 27 |

Table 2 Unit 21C moose harvest percent by transport method, 1990–1996

| Regulatory year | Harvest percent by transport method | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowgo | ORV | Unknown | |
| 1990–1991 | 90 | 0 | 10 | 0 | 0 | 0 | 0 | 21 |
| 1991–1992 | 83 | 0 | 4 | 0 | 0 | 0 | 13 | 23 |
| 1992–1993 | 89 | 0 | 11 | 0 | 0 | 0 | 0 | 9 |
| 1993–1994 | 70 | 10 | 20 | 0 | 0 | 0 | 0 | 20 |
| 1994–1995 | 89 | 0 | 11 | 0 | 0 | 0 | 0 | 27 |
| 1995–1996 | 84 | 0 | 4 | 0 | 0 | 0 | 12 | 25 |
| 1996–1997 | 93 | 7 | 0 | 0 | 0 | 0 | 0 | 15 |

# LOCATION

**GAME MANAGEMENT UNIT:** 21D (12,113 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Yukon River from Blackburn to Ruby and Koyukuk River drainage below Dulbi Slough

# BACKGROUND

Within historic times moose are a relatively new addition to the fauna of Unit 21D. Natives first reported seeing occasional moose tracks during winters in the 1930s. During the 1940s and early 1950s, numbers of moose and wolves slowly increased (Huntington 1993). Then during the 1950s, federal wolf control and aerial shooting reduced the wolf population, causing a rapid expansion of the moose population during the late 1950s and on through the 1960s. Statehood in 1959 brought an end to federal wolf control. Legal aerial shooting was halted with the passage of the Airborne Hunting Act in 1972. Wolves once again became abundant, with ample food and reduced harvest. The moose population reached peak numbers about 1970 (S Huntington, pers commun to T Osborne, ADF&G) and then either stabilized or declined in areas in response to increased predation and hunting.

In 1979 the Koyukuk Controlled Use Area (KCUA) was established, and aircraft was prohibited to reduce participation by hunters from outside the subunit. However, by 1986 the number of hunters arriving by boat from outside the subunit equaled the number of hunters who previously accessed the area by aircraft.

A moose hunter checkstation has been operated on the Koyukuk River since 1983. At this checkstation we have been able to accurately determine the number of hunters using the river to access the KCUA within Unit 21D. It has also been used to educate local residents on licensing and reporting requirements and to inform nonlocal hunters about regulations specific to the area and the locations of private property near the river.

Large (100,000–200,000 acres) fires during 1974 and 1977 in the uplands along the Koyukuk River improved moose winter habitat in the subunit. Between 1972 and 1996 trappers were able to use aircraft to land and shoot wolves. The presence of numerous large lakes and rivers near moose winter concentration areas made this "land-and-shoot" trapping method particularly effective in Unit 21D. The combination of reduced predation and good winter habitat is generally considered the most important factor contributing to the high-density moose populations in some areas of Unit 21D. The approval of Ballot Measure 3 in the 1996 general election eliminated this method of trapping.

Moose trend count areas (TCAs) established in 1981 in the Three Day Slough and Yukon floodplain areas indicated generally increasing moose densities through 1993 (Tables 1–8). Initially, this increase was thought to be due to better surveys, but a population estimation survey of the Kaiyuh Flats and the lower Koyukuk River in 1987 confirmed the trend (Osborne 1996). Moose densities were high along the Yukon River floodplain (3–6 moose/$mi^2$) and very high on the Koyukuk River in the Three Day Slough trend count area, where densities reached 13.3

moose/mi$^2$ in early winter 1993. Since 1993, densities in the Three Day Slough trend count area have declined. Nineteen moose radiocollared in 1984 in the Three Day Slough area provided basic information on movement patterns. We do not know movement patterns of moose in the rest of the subunit.

Two population estimation surveys in the subunit during November 1987 found 6340 moose over a 4883-mi$^2$ area. Extrapolation of these data indicated a subunit population of 9000 to 10,000 moose in a 12,113-mi$^2$ area. Preliminary results from fall 1997 population estimation surveys in the lower Koyukuk drainage and the Kaiyuh flats show moose numbers similar to the 1987 estimate (O Huntington, FWS, pers commun).

There are 4 villages within the subunit (Kaltag, Nulato, Koyukuk, and Galena), and the residents of each village have traditional hunting areas. However, the area used by Galena residents overlaps those used by residents of some of the other villages. Galena residents have larger boats that allow them to travel farther than their relatives from the other villages. Although Huslia is only 30 miles from Unit 21D, its residents rarely hunt for moose within the subunit. Nonresidents and Alaskans residing outside Unit 21D have mainly hunted the Koyukuk River between the Kateel River and the Unit 24 boundary where competition with residents of Unit 21D was less likely.

The reported harvest before 1981 was largely inaccurate because many local residents either did not obtain licenses or failed to report. In 1981 the previous Galena area biologist initiated a program that made it easier for residents of the subunit to obtain hunting licenses and harvest reports. Educational and enforcement efforts have contributed greatly to increasing the local residents' reporting rate.

The fall hunting season dates changed numerous times between 1975 and 1981. From 1981 through 1996 there was a 21-day fall season for the entire subunit. Cows were allowed to be taken during the last 5 days. A 10-day season in early March also provided hunting opportunity for Alaska residents only. In 1990 reporting at the checkstation by hunters traveling on the Koyukuk River was mandatory. In 1991 nonresidents were restricted to bulls with an antler spread of 50+ inches or at least 3 brow tines on 1 side. In 1992 the minimum number of brow tines on 1 side was increased to 4. Also in 1992, meat of the hindquarters, forequarters, and ribs of any moose taken in the KCUA had to remain on the bone until the moose had been transported out of the controlled use area. In 1996, due to increasing moose hunter numbers and moose harvests, subsistence and general registration hunts were established for the KCUA, downstream from Huslia.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem

- Provide for continued use of moose by local Alaskan residents who have customarily and traditionally used the population

- Provide the greatest sustained opportunity to participate in hunting moose
- Provide an opportunity to view and photograph moose
- Provide for scientific and educational use of moose

### MANAGEMENT OBJECTIVES

*Koyukuk River Drainage*

- Maintain a posthunt ratio of at least 30 bulls:100 cows in the population being monitored by the Three Day Slough TCA
- Develop guidelines for maximum winter browse use within the Three Day Slough area

## METHODS

Established trend count areas were surveyed from Piper PA-18 (or equivalent) aircraft to assess population status and trend. Contiguous survey units of approximately 12 $mi^2$ each were searched at a rate of approximately 5 min/$mi^2$ to ensure reasonably high sightability, minimal bias, and data comparability among years. A moose population estimation survey was conducted in the lower Koyukuk River area and in the Kaiyuh Flats area during fall 1997. These surveys were flown by ADF&G staff and staff from the US Fish and Wildlife Service (FWS) Koyukuk/Nowitna National Wildlife Refuge Complex

Twinning surveys were flown in May using standard search techniques to determine the percentage of moose calves that were twins versus singles.

We monitored hunting mortality and harvest distribution through harvest tickets and checkstations. Local residents were encouraged to increase their harvest reporting through school visits and checkstations. Predation was monitored by interviewing trappers and conducting track surveys in cooperation with FWS.

No habitat assessment work was conducted during this reporting period.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

The unit moose population is healthy, though some areas may be experiencing decreased density from intense hunting pressure. Little is known of the trends in upland areas west of the Koyukuk River or south of the Yukon River.

*Population Composition*

The following guidelines are used to interpret sex and age indices within Units 21 and 24:

- Bull:cow ratios in some of the high-density trend count areas are in excess of 30–40 bulls:100 cows after the fall hunting season. For high-density areas, ratios of 15 bulls:100 cows are sufficient for breeding (C Schwartz, ADF&G, pers commun), with higher ratios providing increased hunting opportunity and high quality hunting experiences. High numbers of bulls are sometimes misleading in terms of harvest effects on the population because the area is subject to either-sex hunting, which can inflate bull ratios.

- The calf:cow ratio observed during November surveys provides an index to calf survival during the 5 months following birth. Black bears, grizzly bears, and wolves are the primary predators that reduce calf numbers. A November calf:cow ratio of 30–40 calves:100 cows will usually allow a population to remain stable in the face of moderate predation and hunting levels. Calf:cow ratios may imply population change if subsequent overwinter mortality is either consistent or negligible. Ratios of 20 calves:100 cows or less may indicate a decreasing population, and ratios of more than 40:100 cows are in growing populations.

- The percentage of yearling bulls within the herd provides an index to the addition (recruitment) of young adults to the breeding population. It can also provide an indication of overwinter survival of calves, if the calf:cow ratio for the previous fall is known. Generally, the yearling bull percentage averages 4 to 8%, with anything less indicating poor recruitment and anything higher good recruitment.

- The number of twins born in May is a good indicator of herd nutritional status. In general, the twinning rate ranges from 25 to 90% in populations below carrying capacity, from 5 to 25% in populations near carrying capacity, and below 5% in those above carrying capacity (Gasaway et al. 1992).

Since 1995 the posthunt bull:cow ratio for the Three Day Slough trend count area has decreased, with the fall 1997 ratio being the lowest recorded (Table 1). The ratio decreased by one third from the previous 10-year average of 35:100 cows. Bull:cow ratios vary widely between other trend count areas (Tables 2–8). The percentage of large bulls (≥50") observed in the Three Day Slough trend count areas has varied from 16 to 28% in the 1990s, while the percentage of large bulls in the harvest from Three Day Slough has varied from 45 to 68% (Table 9). Yearling ratios in fall 1997 were similar to the average for the past 10 years; however, fall 1997 calf ratios were lower than the average for the same period. Calf twinning rates over the last 2 years indicate the herd is probably below carrying capacity for the area (Table 10).

*Distribution and Movements*

Movement patterns of moose in the Three Day Slough area are based on data from radiocollared animals (Osborne and Spindler 1993). Most adult and young moose remain in the floodplain area of Three Day Slough from late August until May each year. During May most moose move 10 to 60 miles in either a northerly or southerly direction to upland areas where they spend the summer. In August they return to the floodplain area.

Moose movements are unknown in other portions of the subunit. However, local residents suspect some moose observed on the Kaiyuh Flats migrate seasonally.

**MORTALITY**

*Harvest*

Season and Bag Limit.

| Units and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Unit 21D, the Koyukuk Controlled Use Area: | | |
| Resident Hunters: 1 antlerless moose, or 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by permit. | 5 Sep–25 Sep | |
| Resident Hunters: 1 moose by permit. | 1 Sep–25 Sep | |
| Resident Hunters: 1 moose. Moose may not be taken within 1/2 mile of the Yukon River. | 1 Feb–10 Feb | |
| Nonresident Hunters: 1 antlerless moose, or 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side. | | 5 Sep–25 Sep |
| Remainder of Unit 21D. | | |
| Resident Hunters: 1 moose per regulatory year; however, antlerless moose may be taken only during the periods 21 Sep–25 Sep and 1 Feb–10 Feb. Moose may not be taken within 1/2 mile of the Yukon River during the 1 Feb–10 Feb season. | 5 Sep–25 Sep<br>1 Feb–10 Feb | |
| Nonresident Hunters: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | | 5 Sep–25 Sep |

Board of Game Actions and Emergency Orders. Board of Game actions during this reporting period included changing the restriction on taking moose within 5 miles of the Yukon River during the 1–10 Feb season to 1/2 mile for all of Unit 21D, effective with the 1995–1996 regulatory year. The Board of Game approved annual reauthorization of antlerless moose hunting seasons. Subsistence and general registration hunts were established in the Koyukuk CUA portion of Unit 21D by the Board of Game in March 1996. This action was to counter the closure of moose hunting on federally managed lands within 1/2 mile of the Koyukuk River, from the Kateel River to 40 miles upstream from the mouth of the Koyukuk to all but local rural residents by the Federal Subsistence Board. This closure was prompted by perceived declines in moose availability for local residents and the continued increase in moose hunters in the area. Two separate registration hunts were established for the Koyukuk CUA portion of Unit 21D. The subsistence registration hunt was open to all Alaska residents, with a season and bag limit of 1 September through 25 September and 1 moose. All the meat had to remain on the bones, the head had to be salvaged, and the antlers cut to destroy the trophy value. The general registration hunt was open to all hunters, with a season of 5 September through 25 September and a bag limit of either 1 antlerless moose or 1 bull with antlers at least 50 inches wide, or at least 4 brow tines on at least 1 side. Seasons and bag limits for the rest of the unit remained as before.

Moose hunter numbers and moose harvests for the 1996 season in the lower Koyukuk River were record highs, despite new hunting regulations. The increase in hunters and harvest (instead of the expected decrease) heightened concerns for the area. The Middle Yukon River Fish and Game Advisory Committee and the Western Interior Regional Federal Subsistence Council both petitioned the Board of Game to take up the Koyukuk moose issue at their next meeting even though it was not on the board's schedule. They asked the board to accept proposals, open discussion on moose hunting in the area, and to address the problems associated with increased hunter numbers and increased harvest. The Board of Game decided to allow the Department of Fish and Game to modify the registration requirements under "5 AAC 92.052 Discretionary Permit Hunts and Conditions." The general registration hunt within the Koyukuk CUA portion of Unit 21D was restricted to upstream from and including the Gisasa River. The department also limited the number of general registration permits available at any one time to a maximum of 250, available on a first-come, first-served basis. Similar modifications of the registration hunt requirements also occurred in nearby parts of Unit 24. Because the number of cow moose taken in the downstream portion of the registration hunts during 1996 was considered greater than the sustainable cow harvest, taking antlerless moose downstream of the Gisasa River was prohibited before September 1997. Seasons and bag limits for the rest of the unit remained as before.

Hunter Harvest. The reported harvest of moose in Unit 21D increased substantially since the late 1980s (Tables 11–12). Increased hunter numbers occurred in both the lower Koyukuk River drainage and in the remainder of the unit. Moose hunters and harvest in the Koyukuk River checkstation and the remainder of the unit reached record highs in 1996. Statewide, 1996 moose hunter numbers and harvest increased 16 and 24%, respectively (ADF&G harvest data). So this increase was not limited to just Unit 21D. Interest in hunting the Koyukuk River has grown in the last few years, and the bull segment of the population may not be able to sustain the increased harvest.

Because of the relatively high density of moose (by Interior Alaska standards) in the lower Koyukuk River and reduced bull:cow ratio, cow harvest regulations were liberalized. This resulted in a unit harvest of 111 cows in 1996, a dramatic increase from the 1988–1995 average of 24. Most of this cow harvest came from the lower Koyukuk River, the area targeted for increased cow harvest. Preliminary 1997 checkstation data indicate the cow harvest declined to almost half the 1996 numbers. However, the percent success for hunters through the checkstation changed little, indicating the relative ease with which moose hunters can harvest moose in the area.

Checkstation Results. In 1990 stopping at the moose hunter checkstation on the Koyukuk River was mandatory. Data have been collected on residency (Table 13), harvest chronology, age structure of harvest, antler size, brow tine numbers, and method of transportation. Genetic material has also been collected for antler growth studies conducted at the Kenai Moose Research Center.

The Three Day Slough area is well known as an excellent area to hunt for large (≥50-inch antlers) moose. One-fifth to one-third of the bulls observed in the Three Day Slough TCA have large antler spreads, although the percentage has decreased in recent years (Table 9).

The regulation requiring meat to be left on the bone has greatly aided enforcement efforts to stop waste of moose meat. The Board of Game passed this regulation in 1992 to address the rapid increase of moose hunter numbers and harvest in the KCUA and the growing problem of some hunters removing only part of the meat from the carcass to enable them to carry lighter loads in their boats. All hunters coming through the checkstation are notified of this regulation. Many hunters have enthusiastically endorsed the regulation and comment that it should be adopted in other game management units.

Hunter Residency and Success. During 1995–96,. 90 local residents reported being successful, compared to 203 nonlocal residents. Fifty-four nonresidents were successful. During 1996–97 141 local residents were successful, compared to 231 nonlocal residents. Seventy-five nonresidents were successful. The subunit hunter residency and success may be misleading as unit residents often do not report unsuccessful hunt information. (Table 14)

Transportation Methods. The presence of the KCUA and the area's extensive river system make boats the primary transportation method during the reporting period (91%). Snowmachines were the main transportation method during the winter hunt (2 and 4% during 1995–96 and 1996–97, respectively). (Table 15)

*Other Mortality*

Unit 21D has high populations of wolves and black bears. Grizzly bears are common in the upland areas of the Nulato Hills and Kaiyuh Mountain. Wolves and grizzly bears prey heavily on both calf and adult moose. Black bears are a substantial source of mortality for moose calves (Osborne et al. 1991).

A wolf survey in 1994 estimated 208 to 304 wolves in 37 packs (Becker et al. 1998). Local residents with intimate knowledge of the unit's game populations report wolf numbers have substantially increased since 1994. Packs in excess of 20 wolves were observed during fall 1997 moose surveys.

### HABITAT

*Assessment*

Feltleaf willow is an important species for moose due to its high annual biomass production. Chemical analysis of 2 to 8 mm diameter twigs typically browsed by moose found crude protein ranging from 8 to 12%, twice as much as found in the same willow species on the Tanana River (Kielland 1997). Browse consumption in Three Day Slough survey areas was 24 to 28% of the annual twig production; abundant high quality forage may thus partly explain the sustained high numbers of moose in the Three Day Slough area.

## CONCLUSIONS AND RECOMMENDATIONS

Moose are numerous in the riparian lowlands of Unit 21D. I currently estimate there are 9000 to 10,000 moose in the subunit. Unit populations are believed stable and seem capable of supporting current predation and harvest if spread over the entire unit.

Prior growth of the moose population has been attributed to the steady and consistent harvest of wolves in the area. Growth of the moose population has attracted more moose hunters, especially within the KCUA.

All hunters in the KCUA use boats, and during years with low water levels there is competition for camping sites and moose calling areas, as well as other issues associated with crowded hunting conditions. In prior years the area was known as a wild site where people had the opportunity to select a bull, watch bulls rut, and hunt and observe other wildlife such as bears and waterfowl. Increased boat traffic and crowded conditions have made cows more wary and is compromising our goal of viewing and photographing moose.

The regulation requiring meat to be left on the bone of legs and ribs has dramatically reduced the number of meat waste complaints received at the checkstation and in Galena. Although the Board of Game passed this regulation to reduce hunter numbers, its usefulness as an enforcement tool has proven invaluable. It is much easier to count legs to determine if all the required meat has been salvaged. This regulation also resulted in much less moose meat being spoiled.

The drop in the bull:cow ratio within some areas of the KCUA is cause for concern because the number of hunters targeting this area is steadily increasing. At present, habitat is not limiting moose populations in the area, and additional cows could be taken in some areas without reducing the population. Causes for concern are the likely effects of the apparent increase in unit wolf numbers on the moose population. Present management philosophies and restrictive wolf harvest regulations, with increased hunter numbers, will require future conservative moose hunting regulations.

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Table 1 Unit 21D Three Day Slough trend count area aerial moose composition counts, 1981–1997

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1981–1982[a] | 85.1 | 35 | 12 | 42 | 10 | 24 | 327 | 3.8 |
| 1982–1983[a] | 85.1 | 43 | 13 | 24 | 2 | 14 | 415 | 4.9 |
| 1983–1984 | 84.8 | 31 | 9 | 37 | 12 | 22 | 530 | 6.3 |
| 1984–1985 | 57.8 | 30 | 13 | 31 | 10 | 19 | 332 | 5.7 |
| 1985–1986 | 83.3 | 39 | 11 | 17 | 4 | 11 | 501 | 6.0 |
| 1986–1987 | 83.3 | 39 | 7 | 45 | 13 | 25 | 660 | 7.9 |
| 1987–1988[a] | 83.3 | 36 | 13 | 32 | 11 | 19 | 791 | 9.5 |
| 1988–1989 | 83.3 | 33 | 13 | 45 | 14 | 25 | 832 | 10.0 |
| 1989–1990 | 83.3 | 28 | 8 | 25 | 11 | 16 | 763 | 9.2 |
| 1990–1991 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 1991–1992[a] | 83.3 | 34 | 10 | 31 | 6 | 19 | 909 | 10.9 |
| 1992–1993 | 83.3 | 35 | 10 | 31 | 7 | 18 | 1088 | 13.1 |
| 1993–1994[a] | 83.3 | 38 | 8 | 25 | 4 | 16 | 1106 | 13.3 |
| 1994–1995 | 83.3 | 36 | 9 | 28 | 5 | 17 | 1026 | 12.3 |
| 1995–1996 | 83.3 | 23 | 7 | 36 | 6 | 23 | 1054 | 12.7 |
| 1996–1997 | 83.3 | 24 | 8 | 23 | 4 | 15 | 928 | 11.1 |
| 1997–1998 | 83.3 | 20 | 9 | 24 | 3 | 17 | 721 | 8.7 |

[a] Huntington and Spindler 1997.

Table 2 Unit 21D Dulbi River Mouth trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1982–1983 | 42.1 | 36 | 7 | 29 | 12 | 17 | 166 | 3.9 |
| 1983–1984 | 57.1 | 39 | 7 | 29 | 8 | 17 | 230 | 4.0 |
| 1984–1985 | 42.1 | 36 | 4 | 44 | 10 | 24 | 184 | 4.4 |
| 1987–1988 | 38.9 | 55 | 17 | 44 | 15 | 22 | 283 | 7.3 |
| 1992–1993 | 51.7 | 41 | 6 | 43 | 21 | 23 | 271 | 5.2 |
| 1996–1997 | 51.7 | 34 | 11 | 36 | 6 | 21 | 281 | 5.4 |
| 1997–1998[a] | 52.4 | 28 | 6 | 32 | 4 | 20 | 283 | 5.4 |

[a] Preliminary.

Table 3 Unit 21D Kateel River mouth trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey Area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1984–1985 | 47.8 | 21 | 8 | 54 | 5 | 31 | 68 | 1.4 |
| 1987–1988 | 38.0 | 41 | 20 | 41 | 12 | 23 | 84 | 2.2 |
| 1996–1997 | 49.4 | 46 | 15 | 29 | 14 | 16 | 152 | 3.1 |
| 1997–1998[a] | 61.1 | 26 | 10 | 34 | 0 | 21 | 188 | 3.1 |

[a] Preliminary

Table 4 Unit 21D Long Stretch (Koyukuk River) trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1984–1985 | 51.5 | 94 | 31 | 31 | 25 | 14 | 36 | 0.7 |
| 1996–1997 | 51.3 | 36 | 6 | 61 | 25 | 31 | 65 | 1.3 |
| 1997–1998[a] | 62.5 | 47 | 7 | 33 | 0 | 18 | 77 | 1.2 |

[a] Preliminary

Table 5 Unit 21D Koyukuk River mouth trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1984–1985 | 65.5 | 27 | 10 | 41 | 5 | 25 | 183 | 2.8 |
| 1987–1988 | 37.8 | 28 | 8 | 49 | 12 | 28 | 69 | 1.8 |
| 1993–1994 | 51.2 | 43 | 10 | 36 | 6 | 20 | 175 | 3.4 |
| 1996–1997 | 51.2 | 42 | 6 | 45 | 7 | 24 | 181 | 5.1 |
| 1997–1998[a] | 66.5 | 35 | 6 | 50 | 10 | 27 | 284 | 4.3 |

[a] Preliminary

Table 6 Unit 21D Squirrel Creek trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1981–1982 | 40.7 | 93 | 49 | 34 | 8 | 15 | 93 | 2.3 |
| 1982–1983 | 37.3 | 57 | 18 | 41 | 0 | 21 | 87 | 2.3 |
| 1983–1984 | 37.3 | 58 | 14 | 35 | 14 | 18 | 137 | 3.7 |
| 1985–1986 | 49.3 | 78 | 30 | 11 | 13 | 6 | 185 | 3.8 |
| 1987–1988 | 38.4 | 76 | 20 | 67 | 20 | 27 | 131 | 3.4 |
| 1993–1994 | 37.2 | 49 | 4 | 22 | 0 | 13 | 195 | 5.2 |
| 1995–1996 | 48.8 | 43 | 14 | 31 | 8 | 18 | 222 | 4.6 |
| 1997–1998[a] | 48.6 | 54 | 24 | 32 | 8 | 17 | 253 | 5.2 |

[a] Preliminary

Table 7 Unit 21D Pilot Mountain Slough trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1983–1984 | 36.5 | 21 | 8 | 52 | 11 | 30 | 133 | 3.6 |
| 1984–1985 | 36.5 | 11 | 2 | 47 | 39 | 30 | 84 | 2.3 |
| 1985–1986 | 36.5 | 27 | 11 | 9 | 0 | 7 | 90 | 2.5 |
| 1987–1988 | 35.7 | 36 | 18 | 49 | 11 | 26 | 185 | 5.2 |
| 1991–1992 | 23.2 | 24 | 8 | 54 | 14 | 30 | 161 | 6.9 |
| 1993–1994 | 35.4 | 21 | 1 | 39 | 10 | 24 | 135 | 3.8 |
| 1995–1996 | 34.3 | 20 | 14 | 57 | 14 | 32 | 203 | 5.9 |
| 1997–1998[a] | 48.7 | 12 | 4 | 32 | 11 | 22 | 222 | 4.6 |

[a] Preliminary



Table 8 Unit 21D Kaiyuh Slough trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 Cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1985–1986 | 50.8 | 54 | 17 | 8 | 0 | 5 | 78 | 1.5 |
| 1987–1988 | 39.1 | 28 | 7 | 33 | 7 | 20 | 74 | 1.9 |
| 1992–1993 | 50.8 | 36 | 18 | 24 | 22 | 15 | 72 | 1.4 |
| 1994–1995 | 50.8 | 44 | 12 | 31 | 0 | 18 | 119 | 2.3 |
| 1996–1997 | 50.8 | 70 | 13 | 70 | 7 | 29 | 110 | 2.2 |
| 1997–1998[a] | 63.4 | 35 | 12 | 39 | 10 | 23 | 146 | 2.3 |

[a] Preliminary

Table 9 Bull moose harvest and percentage of large[a] bulls in the harvest from the Three Day Slough (TDS) area compared with percentage of large bulls observed during the early winter aerial survey of the Three Day Slough trend count area, Unit 21D, 1988–1997

| Regulatory year | % large bull in harvest (Sep) | Bulls measured (Sep) | % large bulls TDS (Nov) |
|---|---|---|---|
| 1988–1989 | 61 | 96 | 33 |
| 1989–1990 | 51 | 95 | 28 |
| 1990–1991 | 54 | 91 | --[b] |
| 1991–1992 | 45 | 134 | 15 |
| 1992–1993 | 54 | 88 | 15 |
| 1993–1994 | 53 | 107 | 18 |
| 1994–1995 | 67 | 88 | 28 |
| 1995–1996 | 61 | 150 | 27 |
| 1996–1997 | 68 | 123 | 20 |
| 1997–1998[c] | 63 | 120 | 16 |

[a] 50-inch or greater antler spread.

[b] No survey.

[c] Preliminary.

Table 10 Summary of May aerial moose twinning surveys from Three Day Slough TCA, Unit 21D, 1990–1996

| Regulatory year | Cows w/o calves | Cows w/1 calf | Cows w/twins | Twinning %[a] | Yearlings | Dates in May |
|---|---|---|---|---|---|---|
| 1989–1990 | --[a] | 24 | 21 | 44 | -- | 21–25 |
| 1990–1991 | -- | -- | -- | -- | -- | -- |
| 1991–1992 | -- | 22 | 23 | 51 | -- | 22–23 |
| 1992–1993 | 296 | 23 | 19 | 44 | 100 | 23–25 |
| 1993–1994 | 110 | 39 | 11 | 22 | 55 | 23–24 |
| 1994–1995 | 78 | 37 | 18 | 33 | 38 | 22 |
| 1995–1996 | 200 | 39 | 13 | 26[b] | 51 | 22,24 |
| 1996–1997 | 180 | 30 | 9 | 23 | 58 | 23–24 |

[a] Percent of cows with calves that had twins.

[b] Including 1 cow w/3 calves.

Table 11 Unit 21D moose harvest, 1988–1996

| Regulatory year | Harvest by hunters Bull | Cow | Unk | Total | Unreported | Potlatch stickdance | Total |
|---|---|---|---|---|---|---|---|
| 1988–1989 | 229 | 20 | 2 | 251 | 40 | 3 | 294 |
| 1989–1990 | 185 | 23 | 0 | 208 | 40 | 4 | 252 |
| 1990–1991 | 258 | 24 | 1 | 283 | 40 | 4 | 327 |
| 1991–1992 | 269 | 34 | 0 | 303 | 40 | 11 | 354 |
| 1992–1993 | 193 | 22 | 1 | 216 | 40 | 11 | 267 |
| 1993–1994 | 235 | 23 | 2 | 260 | 40 | 9 | 309 |
| 1994–1995 | 248 | 26 | 1 | 275 | 40 | 8 | 323 |
| 1995–1996 | 329 | 21 | 1 | 351 | 40 | 4 | 395 |
| 1996–1997 | 338 | 111 | 1 | 450 | 40 | 4 | 494 |

Table 12 Sex of moose checked at Ella's Cabin, 1987–1997

| Year | Bull | Cow | % cow | Total |
|---|---|---|---|---|
| 1987 | 135 | 10 | 7 | 145 |
| 1988 | 172 | 9 | 5 | 181 |
| 1989 | 150 | 8 | 5 | 158 |
| 1990 | 177 | 6 | 3 | 183 |
| 1991 | 199 | 10 | 5 | 209 |
| 1992 | 161 | 6 | 4 | 167 |
| 1993 | 179 | 6 | 3 | 185 |
| 1994 | 192 | 10 | 5 | 202 |
| 1995 | 279 | 8 | 3 | 287 |
| 1996 | 263 | 90 | 26 | 353 |
| 1997[a] | 257 | 49 | 14 | 306 |

[a] Preliminary

Table 13 Moose harvest by hunters who stopped at the Koyukuk River check station[a] 1987–1997

| Regulatory | Unit 21 resident | | Alaska resident[ab] | | Nonresident | | Total | |
|---|---|---|---|---|---|---|---|---|
| year | Hunter | Moose | Hunter | Moose | Hunter | Moose | Hunter | Moose |
| 1983–1984[c] | 132 | 43 | 29 | 20 | 3 | 2 | 164 | 65 |
| 1984–1985[c] | 92 | 61 | 67 | 36 | 9 | 9 | 168 | 106 |
| 1985–1986[c] | 117 | 32 | 74 | 37 | 4 | 3 | 195 | 72 |
| 1986–1987[c] | 140 | 48 | 80 | 51 | 9 | 7 | 229 | 106 |
| 1987–1988[c] | 151 | 68 | 92 | 61 | 21 | 16 | 264 | 145 |
| 1988–1989[c] | 158 | 73 | 121 | 88 | 20 | 20 | 299 | 181 |
| 1989–1990 | 154 | 55 | 125 | 89 | 23 | 14 | 302 | 158 |
| 1990–1991 | 137 | 48 | 133 | 105 | 36 | 30 | 306 | 183 |
| 1991–1992 | 136 | 49 | 189 | 121 | 55 | 38 | 380 | 209 |
| 1992–1993 | 145 | 45 | 173 | 103 | 39 | 19 | 357 | 167 |
| 1993–1994 | 115 | 48 | 132 | 109 | 34 | 28 | 281 | 185 |
| 1994–1995 | 106 | 34 | 194 | 127 | 56 | 41 | 356 | 202 |
| 1995–1996 | 124 | 49 | 260 | 188 | 63 | 50 | 446 | 287 |
| 1996–1997 | 213 | 90 | 306 | 198 | 89 | 66 | 608 | 353 |
| 1997–1998[d] | 157 | 66 | 278 | 185 | 89 | 55 | 524 | 306 |

[a] Includes hunters from both Units 21D and 24.
[b] Other than Unit 21 residents.
[c] Check not mandatory prior to 1990.
[d] Preliminary.

Table 14 Unit 21D moose hunter residency and success, 1988–1996

| Regulatory year | Successful: Local[a] resident | Nonlocal resident | Nonresident | Unk | Total | Unsuccessful: Local[a] resident | Nonlocal resident | Nonresident | Unk | Total | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988–1989 | 94 | 99 | 27 | 31 | 251 | 30 | 34 | 3 | 10 | 77 | 328 |
| 1989–1990 | 82 | 98 | 22 | 6 | 208 | 52 | 50 | 9 | 4 | 115 | 323 |
| 1990–1991 | 103 | 135 | 35 | 10 | 283 | 34 | 27 | 4 | 6 | 71 | 354 |
| 1991–1992 | 105 | 150 | 42 | 6 | 303 | 60 | 97 | 16 | 3 | 176 | 479 |
| 1992–1993 | 72 | 111 | 23 | 10 | 216 | 56 | 82 | 14 | 15 | 167 | 383 |
| 1993–1994 | 87 | 141 | 24 | 8 | 260 | 55 | 27 | 7 | 2 | 91 | 351 |
| 1994–1995 | 80 | 148 | 44 | 3 | 275 | 47 | 68 | 13 | 0 | 128 | 403 |
| 1995–1996 | 90 | 203 | 54 | 4 | 351 | 41 | 77 | 9 | 0 | 127 | 478 |
| 1996–1997 | 141 | 231 | 75 | 3 | 450 | 133 | 149 | 33 | 0 | 315[b] | 765 |

[a] Subunit resident only.

[b] Includes hunters who reported hunting both in registration hunts (RM830 or RM832) and also general hunts in Unit 21D. Does not include 12 hunters who failed to return registration permit cards.



Table 15 Unit 21D moose harvest percent by transport method, 1988–1996

| Regulatory year | Harvest percent by transport method: Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1988–1989 | 6 | 1 | 78 | 1 | 13 | 0 | 1 | 8 | 251 |
| 1989–1990 | 5 | 0 | 82 | 1 | 7 | 1 | 2 | 2 | 208 |
| 1990–1991 | 4 | 0 | 88 | 0 | 3 | 0 | 2 | 2 | 283 |
| 1991–1992 | 5 | 0 | 86 | 0 | 5 | 0 | 2 | 2 | 303 |
| 1992–1993 | 3 | 0 | 88 | 1 | 3 | 0 | 2 | 3 | 216 |
| 1993–1994 | 3 | 0 | 88 | 1 | 5 | 0 | 1 | 2 | 260 |
| 1994–1995 | 4 | 0 | 85 | 0 | 7 | 1 | 2 | 1 | 275 |
| 1995–1996 | 3 | 0 | 91 | 1 | 2 | 1 | 2 | 0 | 351 |
| 1996–1997 | 2 | 0 | 91 | 1 | 4 | 0 | 2 | 1 | 450 |

## LOCATION

**GAME MANAGEMENT UNIT:** 22 (25,230 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Seward Peninsula and the adjacent mainland drained by all streams flowing into Norton Sound

## BACKGROUND

Before 1930 very few moose were observed on the Seward Peninsula. However, by the late 1960s much of the suitable habitat in Unit 22 contained moose. Numbers increased during the 1970s and early 1980s and peaked during the late 1980s. Severe winters in 1989, 1990, and 1992 caused a decline in moose densities. Current data indicate that Unit 22 moose populations are stable but below previous peak densities in portions of the unit.

Demand for moose is high, primarily by recreational and subsistence hunters residing in the unit. Gravel roads, trails, and navigable rivers provide hunters with easy access to suitable moose habitat. Annual harvests reported from 1969 through 1996 ranged from a low of 44 moose in 1972 to a high of 408 moose in 1986 (Table 1). In recent years unit residents account for 70% or more of the annual reported harvest.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

The management goal for Unit 22 is to maintain a minimum population size of 5700–7300 moose. In Unit 22A, the goal is to increase population size from the current estimate of 600–800 moose to a minimum of 1000 moose. In Units 22B and 22D, the goal is to stabilize the population size at 1500–2500 and 2500–3000 moose, respectively, with a minimum bull:cow ratio of 30:100. In Unit 22C, the goal is to maintain the existing population of 480 animals with a minimum bull:cow ratio of 20:100. In Unit 22E, the goal is to maintain the existing population of 250–350 moose.

### MANAGEMENT OBJECTIVES

- Estimate moose abundance, sex and age composition, and yearling recruitment and determine trends in population size and composition.
    - Complete censuses in the 5 subunits of Unit 22 to estimate moose abundance.
    - Complete aerial surveys throughout the unit during late fall and early spring to provide an index of moose population status and trends, sex and age composition, and yearling recruitment.
    - Continue the radiotelemetry project in western 22B to investigate low moose recruitment.
- Monitor human and natural mortality factors affecting the population.

- Evaluate hunting mortality by analyzing all moose harvest data.

- Improve harvest reporting through public contacts and improved communication.

- Develop a moose management plan, with special emphasis on areas adjacent to the road system.

## METHODS

We conducted aerial surveys in the spring and fall to estimate sex composition and short yearling recruitment in portions of Unit 22 during the report period. A thorough survey of all riparian and willow-rich moose habitat in Unit 22E was completed during March 1996 to estimate population size and productivity. In March 1997 a modified Gasaway et al. (1986) census developed by department staff was completed for Unit 22D. We summarized harvests from harvest reports returned by hunters.

Work continued on a moose telemetry study begun in 1995 in the Niukluk and Fish River drainages of Unit 22B to investigate poor calf survival in the area. Twenty-seven cows were radiocollared during April 1995 and an additional 10 cows were collared during April 1996. Radiotracking flights were conducted at periodic intervals throughout the reporting period to determine calving success and timing of calf mortality.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

We do not have a full understanding of the factors limiting population size, productivity, and recruitment of the moose population in Unit 22. Although moose numbers in Units 22A, 22C, and 22E increased during the late 1980s, densities have never been as high as the densities observed in Units 22B and 22D.

In Unit 22A the moose population is believed to have remained stable at 600–800 moose between 1989 and 1994 when the last census was completed. The population probably remains below the management goal of 1000 moose for the unit, and moose densities are lower in Unit 22A than in many other parts of the unit.

In Unit 22C moose numbers increased by 18% between the censuses in 1990 and 1995. Calf recruitment is highest in Unit 22C and frequently exceeds 20%. However, the bull:cow ratio is low, varying between 10–20 bulls:100 cows.

Moose densities in Units 22B and 22D have declined since the dramatic increases observed in the late 1980s. Calf survival, particularly in western Unit 22B, has also declined. The winters of 1989, 1990, and 1992 were particularly severe on moose, and limited observations indicate winter mortality was higher than normal during these years. Census results from western 22B show a 54% decline in moose density over the 5-year period from 1987 to 1992. In Unit 22D census data from the Kuzitrin and American River census areas show a 35% decline in moose numbers between 1988 and 1993.

*Population Size*

A 16–18 March 1996 survey of moose habitat in Unit 22E was completed to determine population size and short yearling recruitment. This survey resulted in a direct count of 196 moose (164 adults and 32 calves) and an estimated recruitment rate of 16%. Compared to the previous estimate of 226 moose and 8% recruitment in April 1991, the population has remained relatively stable and recruitment has doubled.

A census of Unit 22B was scheduled for March 1997, but inadequate snow cover forced postponement of the census until spring of 1998.

A modified Gasaway census in Unit 22D was completed during March 1997. The Kuzitrin, Kougarok, and Pilgrim River drainages of Unit 22D yielded an estimated population of 1251 moose ± 13.9% at the 90% confidence level. Calf recruitment was 18.5%. The census of the American and Agiapuk River drainages yielded an estimate of 578 moose ± 12.7% at the 90% confidence level. Calves composed 22% of the estimate.

The population estimates for the census areas in Unit 22D have not changed significantly since the 1993 census. Although the population decline appears to have stabilized, the population size is 35% below the management goal based on the 1988 population levels. However, we believe population recovery may be in progress since recruitment rates in the Kougarok, Kuzitrin, and Pilgrim River drainages increased from 14.4% in 1993 to 18.5% in 1997 and from 15.8% to 22% in the American and Agiapuk River drainages.

*Population Composition*

Fall composition counts were not conducted in any portion of Unit 22 in 1995 due to lack of snow cover. In 1996 a fall composition count was completed in the Snake River drainage in Unit 22C; all other counts were not possible due to weather and time constraints.

The number of moose observed in the Snake River count area increased 61% between 1994 and 1996 (Table 2). This may be explained by the timing of the surveys rather than a dramatic increase in population size. In 1992 and 1994 the surveys were conducted at the end of October, but the 1996 survey was at the end of November after winter movements had drawn moose from the surrounding high country into the Snake River valley. The decline in percentage of calves since 1994 is probably the result of an influx of wintering adults into the area rather than a decline in the number of calves. The composition count data shows that the overall number of calves in the survey area has remained stable since 1992. Throughout the 1990s calf recruitment in Unit 22C has remained relatively high compared to the surrounding count areas. The 1995 census of Unit 22C yielded an estimated recruitment rate of 20%, nearly identical to the 21% recruitment rate estimated in the 1990 census. The bull:cow ratio has remained extremely low, reflecting heavy hunting pressure from Nome residents. The Snake River drainage is located near Nome and is one of the most accessible and heavily hunted drainages in Unit 22; consequently, the low bull:cow ratio is not surprising.

In March 1997 a survey of the Niukluk drainage indicated a calf recruitment rate of 7% (Table 3). This shows the pattern of low recruitment throughout western Unit 22B has continued since the severe winters in 1989 and 1990 reduced moose populations in the area. Since 1991 the percentage of calves observed during spring surveys in the Niukluk River count area has ranged from 7–9%. The percentage of calves in the Fish River count area remained extremely low at 4–6% through the last recruitment survey in spring 1995.

The overall number of moose observed during the 1997 spring Niukluk survey was significantly lower than in previous surveys, but this may be in part attributed to poor survey conditions. Snow cover was patchy and lack of recent snowfall left a distracting maze of tracks, making observations difficult. Inadequate snow cover, weather, and time constraints prevented additional spring moose survey work in 1996 and 1997.

*Radiotelemetry study*

In April 1995 the department began a radiotelemetry study to investigate high calf mortality and low calf recruitment in western Unit 22B. Twenty-seven cow moose in the Fish and Niukluk River drainages were radiocollared in April 1995. During April 1996 an additional 10 collars were placed on cow moose in the upper Niukluk River and Boston Creek drainages (Table 4). The cows were located periodically throughout the year to determine calving success and subsequent calf survival.

By mid-June 1995, 11 radiocollared cows (41%, $n = 27$) were observed with 16 calves (including 5 sets of twins and 6 single calves)(Table 5). Only 2 calves (13%) survived to 1 year of age. Calf mortality occurred largely during the summer, with 13 calves disappearing between early June and the end of August. The remaining calf accompanied a cow and was last seen alive in early October. The cow was found dead the following March, and it is not known what happened to the calf. Three of the 27 cows collared in 1995 died during the first year of the study. One cow died several days after collaring due to injury or stress during capture. The other 2 died between early October 1995 and March 1996, presumably of natural causes.

In 1996, 50% of the radiocollared cows (16 of 32 cows) were observed with calves (Table 6). Two cows appeared to be pregnant during early June but were never seen with calves. The 16 cows seen with calves bore 24 known calves: 8 sets of twins and 8 single calves. Seven calves (29%) survived for at least 1 year. In 1996 all of the calf mortality occurred during the summer months, and 53% of calf mortality occurred during the first month after birth. Two radiocollared cows died during the second year of the study. One cow was harvested along the Fish River during the winter antlerless moose hunting season. The second cow died of natural causes and was found in early June with a sow bear and 2 cubs feeding on the carcass.

In the spring of 1997, 57% of the radiocollared cows (17 of 30 cows) were seen with calves (Table 7). An additional cow that looked pregnant in early June was never seen with a calf. The 17 cows seen with calves produced 26 known calves: 9 sets of twins and 8 single calves. Survival statistics for these calves will be presented in the next segment report.

The percentage of cows seen with calves in this study is unusually low compared to calving rates seen in similar studies in other parts of the state. Only 41–57% of collared cows in the Unit 22B study were seen with calves. In Southcentral and Interior Alaska 70–80% of collared cows bore calves during the calving period. Several factors may account for the low calving rate seen in western Unit 22B. Observation flights were made as frequently as possible to observe the collared cows during the calving period, but flights were sometimes delayed by poor flying weather. Some calves may have been lost to predators or weakness at birth within days or hours of birth and might have never been seen. Twice in June 1996 and once in June 1997, cows that appeared decidedly swollen and pregnant were never seen with calves.

Another factor possibly contributing to the low rate of calf production seen in this study is the age structure of the collared cows. Twenty seven percent of the cows were 10 years old or older at the time of collaring. Moose of this age may be less capable of carrying a calf to full term than a younger cow, particularly during a harsh winter. It is not known whether the age structure seen in the collaring study is representative of the moose population in western Unit 22B.

Most of the collared cows were in mediocre to poor condition, compared to those handled in other parts of Alaska. This was particularly noticeable in 1995 after a harsh winter. The percentage of cows bearing calves over the last 3 years has been directly proportional to the severity of the winter. Only 41% of the cows were seen with calves following the stressful, snowy winter of 1995. In 1996, 50% of collared cows calved following a relatively mild winter with late and relatively light snowfall. During the winter of 1996–1997, snowfall in the study area was unusually light, and moose were lively and in good condition at the end of the winter. In the following spring (1997), at least 57% of collared cows calved successfully.

During 1995 and 1996 most of the calf mortality occurred during the summer months. Probably, most mortality is caused by predation: bear densities are believed to be increasing and there are reports of small resident wolf packs in the study area. However, several other factors may contribute to reduced survival of calves. Timing of calving is an important factor to be considered in Unit 22B. In both 1995 and 1996, calving was delayed slightly compared to other populations observed in Alaska. In Unit 22B most calves were born during the first 2 weeks of June, and very few were seen during May. In other populations in Alaska, calving generally begins earlier, during the last week of May. Delayed calving commonly occurs among female moose that are in poor condition (Machida 1996). In 1997, following a relatively easy winter, 35% of the collared cows were seen with calves during May, and an unusually high number of noncollared cows in the study area were also seen with calves during the last week of May. It appears that cows came through the mild winter in better condition than in previous years of the study, resulting in earlier calving and better calf survival.

## MORTALITY

### *Harvest*

Season and Bag Limit. The season and bag limit was the same for both regulatory years in the reporting period.

| Units and Bag Limits | Resident/Subsistence Hunters | Nonresident Hunters |
|---|---|---|
| Unit 22A | 1 Aug–30 Sep | 1 Aug–30 Sep |
| 1 bull | 1 Dec–31 Jan | |

| | | |
|---|---|---|
| Unit 22B<br>1 moose; however, antlerless moose may be taken only from 1 Dec–31 Dec. No person may take a cow accompanied by a calf | 1 Aug–31 Jan | 1 Aug–31 Jan |
| Unit 22C<br>1 bull | 1 Sep–14 Sep | 1 Sep–14 Sep |
| Unit 22D<br>1 moose; however, antlerless moose may be taken only from 1 Dec–31 Dec. No person may take a cow accompanied by a calf | 1 Aug–31 Jan | 1 Aug–31 Jan |
| Unit 22E<br>1 moose | 1 Aug–31 Mar | 1 Aug–31 Mar |

Board of Game Actions and Emergency Orders. In March 1997 the Board of Game closed the antlerless moose season for the 1997–1998 regulatory year in portions of Units 22B and 22D. The antlerless season was closed in areas showing depressed population numbers to aid in the recovery of these populations. The regulation closes antlerless moose hunting in the portion of Unit 22B including the Niukluk River drainage and the Fish River drainage north and west of the Fish River and the portion of Unit 22D including the Kougarok, Kuzitrin, and Pilgrim River drainages. These areas are easily accessible and significantly impacted by Nome area hunters.

No emergency orders affecting moose hunting regulations were enacted during the reporting period.

Hunter Harvest. During the 1995–1996 season, 469 hunters reported a harvest of 185 moose (169 males, 13 females and 3 of unknown sex). A harvest of 198 moose (176 males, 20 females and 2 unknown) was reported taken by 456 hunters during the 1996–1997 season (Table 1). Hunter harvests in Unit 22 have declined by more than 50% over the last 10 years. During the 1986–1987 regulatory year, a harvest of 408 moose was reported; a harvest of 198 moose was reported during the 1996–1997 regulatory year. In addition, the number of individuals hunting moose in Unit 22 has declined by 65% from a peak of 1292 hunters during 1983–1984 to 456 during 1996–1997. Declining numbers of moose in areas accessible to hunters is responsible for the reduction in hunter effort and harvest.

Although the size of the harvest and the number of hunters have declined in Unit 22 during recent years, hunter success rates have remained relatively stable over the last 12 years, ranging from 39–50%. Hunter success was 39% for the 1995–1996 season and 43% for the 1996–1997 season (Table 1).

Hunter Residency and Success. Unit 22 residents accounted for 72% of the harvest during 1995–1996 and 74% during 1996–1997 (Table 8). The proportion of the harvest attributable to local residents has remained remarkably constant during the last 7 years, ranging from 70–74% of the harvest. Alaska residents accounted for 86 and 94% of the reported harvest, respectively, during the 1995–1996 and 1996–1997 regulatory years.

Harvest Chronology. Most of the hunter effort and reported harvest (74% during the 1995–1996 and 1996–1997 regulatory years) occurred during August, September, and October when access from roads and rivers is most favorable (Table 9). Some hunting activity also occurred during December when antlerless moose can be taken from Units 22B and 22D. Only in Unit 22E does this harvest pattern differ, with most of the harvest occurring during January, February, and March when hunting is possible by snowmachine.. There are no roads in Unit 22E, and river access to moose habitat is limited. Nelson (1995) and Machida (1996) reported similar harvest patterns for the previous reporting periods.

Transport Methods. Hunters using highway vehicles, off-road vehicles, 4-wheelers, and boats equipped with jet units, and snow machines accounted for over 90% of the harvest in Unit 22 during the reporting period (Table 10). Only 8% of the successful hunters during 1995–1996 and 4% during 1996–1997 reported using aircraft for access. Nelson (1995) and Machida (1996) reported a similar pattern of aircraft use during the previous reporting period.

The number of moose harvested by hunters using only highway vehicles for transportation has declined by 56% since 1991. Hunters using highway vehicles accounted for 30% of the harvest (90 moose) during the 1991–1992 season. During the reporting period hunters using highway vehicles accounted for 13% of the harvest (24 moose) in 1995–1996 and 20% of the harvest (40 moose) in 1996–1997. Moose densities are now very low along the road corridor, and hunters often must travel to areas far from the road system for successful hunts.

Four-wheel-drive 4-wheelers, which became widely available during the late 1980s, have improved access to remote areas, particularly in areas characterized by open terrain, such as Unit 22D. Harvest data indicate that hunters using 4-wheelers harvested more moose than did hunters using any other method of transportation this reporting period. In 1996–1997 hunters using 4-wheelers accounted for 30% of the harvest, those using snow machines 24%, highway vehicles 20%, and boats 18%. This contrasts with the previous reporting period when successful hunters were most likely to have used boats than snow machines for transport (Table 10). In Unit 22E 85% of successful hunters used snow machines for transportation during the reporting period.

*Other Mortality*

We conducted no surveys to determine natural mortality rates among Seward Peninsula moose. Observations by staff indicate that winter conditions during the reporting period were relatively easy on moose throughout Unit 22. During the winter of 1995–1996, there was almost no snow cover until late December, and snow cover remained very light until mid February. During the April 1996 radiocollaring project, moose that were observed and handled were in good condition. The snow cover during the winter 1996–1997 was light, forage was accessible, and after winter, moose were in good shape.

Staff observations and reports by the public indicate that brown bear numbers are increasing throughout Unit 22. Wolves are also becoming more numerous on the Seward Peninsula, especially in areas occupied by wintering caribou from the Western Arctic herd. We do not know the degree to which this increase in predators is affecting the ability of depressed moose populations to recover. Weather and availability of winter forage are also significant factors affecting moose mortality.

### HABITAT

*Assessment*

No browse surveys or quantitative range assessments were undertaken to determine the availability and quality of winter range in Unit 22. During winters of heavy snow accumulation, winter ranges (particularly in portions of Units 22B, 22C, 22D, and 22E) have been heavily browsed. When willows in lowland riparian habitats are not available to moose because of heavy snowfall, moose are forced to browse on large-diameter, less nutritious, willow branches. This most recently occurred in the winter of 1994–1995 when overwinter mortality was believed to have been substantial, particularly in Units 22B and 22C.

## CONCLUSIONS AND RECOMMENDATIONS

The moose population on the Seward Peninsula grew steadily in size from the 1960s, through the early 1980s, and began to decline during the late 1980s and early 1990s. Noticeable declines in density and productivity are evident in portions of Unit 22, particularly in Units 22B and 22D. Data from censuses and surveys during the late 1980s show the population reached a maximum size of 7000–10,000 moose on the Seward Peninsula. Subsequent declines caused by winter mortality, reduced productivity, and increased natural mortality reduced the population size to between 5000 and 7000 animals (Nelson 1995). Census results from Unit 22D indicate that moose populations in the Kuzitrin and American River census areas have stabilized but have not started to increase toward previously higher densities. The scheduled census of Unit 22B was postponed due to inadequate snow cover, so the status of that population is unknown. However, results from the radiotelemetry study and a spring 1997 recruitment survey in the Niukluk drainage indicate that recruitment is still very low, probably preventing recovery of the population in western Unit 22B.

Preliminary results from the research study in western Unit 22B indicate that several factors are contributing to low recruitment in that portion of the unit. Calving rates were unusually low. Cows handled during collaring in April 1995 and 1996 were in relatively poor condition compared to cows handled in other parts of the state. Because winter range conditions in western Unit 22B are relatively poor and the area frequently receives a substantial amount of snow, cows in this region may not routinely be in good enough condition to produce as many calves as cows in other parts of the unit or state. In 2 of 3 years, calving was slightly delayed compared to other populations; this is understandable because delayed calving is common among females in poor condition. A relatively high percent of the cows in this study were 10 years old or older and may not be as productive as younger cows, especially during harsh winters.

Most calf mortality occurred during the summer months, much of it during the first month after birth. Predators, especially bears, are believed to be increasing in numbers in the area and are probably responsible for most of these losses. However, the factors of a population dominated by older cows, frequent severe winter snow conditions, and poor winter range quality may, in combination, be producing less vigorous calves at birth and with subsequent lowered survival.

Interest in hunting moose in Unit 22 was moderate throughout the 1970s. However, this interest sharply increased during the early 1980s and peaked in 1983 when 1292 individuals reportedly hunted in Unit 22 (Table 1). Although hunter effort has since declined, hunter success rates have remained high.

Reported harvests fell to a 20-year low during the 1995–1996 season in response to decreasing numbers of available moose. Most of the decline was borne by individuals who hunted on the Nome road system and only used a highway vehicle as transportation to access hunting areas. Observations by the public, staff, and harvest reports indicate that moose numbers along the road corridor are low, particularly in Units 22B and 22D.

Since their introduction during the 1980s, the use of 4-wheelers has become extremely popular among Seward Peninsula residents, particularly among those who have access to the Nome road system. Although they are very efficient for use in open terrain, which characterizes much of western Unit 22, their range is limited to within 20 to 30 miles of the road. Their use has allowed hunters using the road system to extend their area available for hunting.

Although moose numbers appear to be recovering in portions of Unit 22, large areas accessible to hunters still have very few moose. During the fall of 1995 and 1996 in Units 22B, 22C, and 22D, large concentrations of rutting moose were observed only in remote areas characterized by poor access. This pattern has become increasingly noticeable during the last 5 years. Because of open terrain throughout much of Unit 22, moose are very vulnerable to hunters, particularly during the rutting period. To increase moose densities in areas accessible to hunters, more regulatory restrictions may be necessary. The antlerless season closure in western Unit 22B and in the Kougarok, Kuzitrin, and Pilgrim River drainages of Unit 22D will go into effect for the fall 1997 hunting season to help alleviate this problem. Further restrictions may be necessary, including (but not limited to) antler size restrictions for bulls, shorter seasons, and vehicle access restrictions.

Development of a cooperative moose management plan should be undertaken in the future with special emphasis on areas adjacent to the road system. Input from all interested parties is essential to ensure that recommendations and future regulations will be acceptable to the widest possible range of users.

Compliance with regulations and harvest reporting is thought to be reasonably high in the Nome area. However, illegal and unreported harvest remain problems in the remainder of the unit where some residents take moose out of season or do not acquire licenses and harvest tickets before hunting moose. It is difficult to accurately measure the illegal and unreported harvest. However, Nelson (1995) estimated the illegal harvest ranged from 10 to 20% of the reported harvest. Public education programs and a visible enforcement effort must be maintained to gain compliance with current regulations. Consideration should be given to developing an alternate method of harvest assessment, such as village-based harvest surveys.

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Table 1 Unit 22 historical moose harvest by sex, hunter effort, and success rate for regulatory years 1969–1996

| Regulatory year | Males | Females | Unknown sex | Total harvest | Total hunters[a] | Percent success |
|---|---|---|---|---|---|---|
| 1969–1970 | 69 | 1 | 2 | 72 | 182 | 40 |
| 1970–1971 | 70 | 0 | 1 | 71 | 139 | 51 |
| 1971–1972 | 59 | 0 | 1 | 60 | 168 | 36 |
| 1972–1973 | 44 | 0 | 0 | 44 | 99 | 44 |
| 1973–1974 | 103 | 32 | 1 | 136 | 317 | 43 |
| 1974–1975 | 149 | 72 | 1 | 222 | 479 | 46 |
| 1975–1976 | 136 | 0 | 2 | 138 | 389 | 25 |
| 1976–1977 | 186 | 51 | 3 | 240 | 611 | 39 |
| 1977–1978 | 151 | 88 | 5 | 244 | 457 | 53 |
| 1978–1979 | 198 | 97 | 2 | 297 | 596 | 50 |
| 1979–1980 | 193 | 75 | 2 | 270 | 760 | 36 |
| 1980–1981 | 156 | 71 | 1 | 228 | 492 | 46 |
| 1981–1982 | 225 | 72 | 1 | 298 | 696 | 43 |
| 1982–1983 | 244 | 100 | 0 | 344 | 904 | 38 |
| 1983–1984 | 291 | 68 | 46 | 405 | 1292 | 31 |
| 1984–1985 | 298 | 91 | 6 | 395 | 1086 | 36 |
| 1985–1986 | 279 | 92 | 3 | 374 | 876 | 43 |
| 1986–1987 | 306 | 101 | 1 | 408 | 892 | 46 |
| 1987–1988 | 286 | 20 | 4 | 310 | 775 | 40 |
| 1988–1989 | 332 | 36 | 7 | 375 | 748 | 50 |
| 1989–1990 | 208 | 82 | 0 | 290 | 713 | 41 |
| 1990–1991 | 280 | 70 | 0 | 350 | 700 | 50 |
| 1991–1992 | 207 | 95 | 0 | 302 | 656 | 46 |
| 1992–1993 | 217 | 72 | 0 | 289 | 645 | 45 |
| 1993–1994 | 225 | 21 | 1 | 247 | 553 | 45 |
| 1994–1995 | 201 | 10 | 0 | 211 | 486 | 43 |
| 1995–1996 | 169 | 13 | 3 | 185 | 469 | 39 |
| 1996–1997 | 176 | 20 | 2 | 198 | 456 | 43 |

[a] Minimum known number of hunters.

Table 2 Unit 22 aerial moose fall composition survey, 1992, 1994, and 1996

| Survey area: Snake River (Unit 22C) | Bulls per 100 cows | Yearling bulls per 100 cows | Calves per 100 cows | Calves | Calves (%) | Adults | Total |
|---|---|---|---|---|---|---|---|
| 1992 | 11 | 3 | 30 | 11 | 21 | 41 | 52 |
| 1994 | 14 | 11 | 32 | 12 | 22 | 42 | 54 |
| 1996 | 15 | | 20 | 13 | 15 | 75 | 88 |

Table 3 Unit 22 short yearling recruitment surveys, spring 1991–1997

| Survey area | No. calves | No. adults | Total | Percent calves |
|---|---|---|---|---|
| Fish River (Unit 22B) | | | | |
| 1991 | 12 | 202 | 214 | 6 |
| 1993 | 11 | 227 | 238 | 5 |
| 1994 | 15 | 255 | 270 | 6 |
| 1995 | 16 | 384 | 400 | 4 |
| Niukluk River (Unit 22B) | | | | |
| 1991 | 30 | 319 | 349 | 9 |
| 1995 | 13 | 133 | 146 | 9 |
| 1997 | 6 | 77 | 83 | 7 |
| Snake River (Unit 22C) | | | | |
| 1993 | 15 | 63 | 78 | 19 |
| 1994 | 18 | 39 | 57 | 32 |
| Lower Kougarok River (Unit 22D) | | | | |
| 1991 | 14 | 103 | 117 | 12 |
| 1994 | 33 | 153 | 186 | 18 |
| 1995 | 42 | 227 | 269 | 16 |
| Kuzitrin/Noxapaga River (Unit 22D) | | | | |
| 1991 | 23 | 191 | 214 | 11 |
| 1994 | 16 | 71 | 87 | 18 |
| American River (Unit 22D) | | | | |
| 1995 | 51 | 248 | 299 | 17 |

Table 4 Estimated age, body condition, and presence of calves at collaring of Unit 22B cow moose, 1995–1996

| Moose ID | Collar date | Estimated age, yrs | Body condition[a] | Cow with calf | Comments |
|---|---|---|---|---|---|
| 9501 | 4/7/95 | 5 | 6 | No | |
| 9502 | 4/7/95 | 4 | 4 | No | |
| 9503 | 4/7/95 | 4 | 4 | No | |
| 9504 | 4/7/95 | 4 | 7 | No | Teeth badly fractured |
| 9505 | 4/7/95 | 9–10 | 5 | No | |
| 9506 | 4/7/95 | 4–5 | 7 | No | |
| 9507 | 4/7/95 | 4 | 4 | No | |
| 9508 | 4/7/95 | 6 | 5 | No | |
| 9509 | 4/7/95 | 8 | 4 | No | |
| 9510 | 4/7/95 | 6 | 4 | No | |
| 9511 | 4/7/95 | 6 | 4 | No | |
| 9512 | 4/7/95 | 4 | 5 | No | Teeth broken |
| 9513 | 4/7/95 | 4 | 5 | No | |
| 9514 | 4/7/95 | 5 | 6 | yes | |
| 9515 | 4/7/95 | 12 | 4 | No | |
| 9516 | 4/8/95 | 8 | 5 | yes | |
| 9517 | 4/8/95 | 4 | 5 | No | Teeth missing and broken |
| 9518 | 4/8/95 | 10 | 4 | No | |
| 9519 | 4/8/95 | 7 | 5 | No | Teeth very broken |
| 9520 | 4/8/95 | 8 | 4 | No | |
| 9521 | 4/8/95 | 10 | 5 | No | Mortality on Fish River 4/11/95 |
| 9522 | 4/8/95 | 10 | 4 | No | |
| 9523 | 4/8/95 | 10 | 6 | No | |
| 9524 | 4/8/95 | 6 | 4 | No | |
| 9525 | 4/8/95 | 4 | 5 | No | |
| 9526 | 4/8/95 | 7 | 5 | No | |
| 9527 | 4/8/95 | 6 | 4 | No | |
| 9601 | 4/9/96 | 3 | 4 | No | |
| 9602 | 4/9/96 | 5 | 5 | No | |
| 9603 | 4/9/96 | 10–12 | 5 | No | |
| 9604 | 4/9/96 | 7–9 | 7 | No | |
| 9605 | 4/9/96 | 8–10 | 7 | No | |
| 9606 | 4/9/96 | 6–8 | 4 | No | Only 4 incisors, others broken off |
| 9607 | 4/9/96 | 5 | 6 | No | |
| 9608 | 4/9/96 | 5 | 6 | No | |
| 9609 | 4/9/96 | 8–10 | 7 | No | |
| 9610 | 4/9/96 | 8–10 | 7 | No | |

[a] Classes for assessing moose condition:

1. Point of no return. Weak, walks with difficulty, can't trot or canter.
2. Malnutrition obvious. Scapula evident. Head and neck low, walks normally but trots with difficulty.
3. Hide fits loosely about neck and shoulder. Head carried low. Walking and running posture normal.
4. Condition in which all 3 of the characteristics listed in Class 6 are evident.
5. Condition in which 2 of the characteristics listed in Class 6 are evident.
6. Beginning to show 1 of following: definition of neck from shoulder or upper foreleg distinct from chest rib or rib cage prominent.
7. No evidence of rump fat but well fleshed. Bones of back and loin extended. Shoulders slightly angular.
8. Fat, with slight evidence of rump fat but well fleshed. Bones of back and loin not prominent.
9. Fat moose, evidence of rump fat by feel. Fleshed over back and loin. Shoulders round and full.
10. Prime, fat animal. Thick firm rump fat by sight. Back and loin well fleshed.

Table 5 Calving success of collared moose, Unit 22B, 1995

| Date collared | ID | No. calves | Date calf first observed | Date calf last seen | Date calf observed missing | Date 2nd calf last seen | Date 2nd calf observed missing | No. calves surviving 1 year | Date cow mortality discovered | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 4/7/95 | 9501 | 0 | | | | | | | | |
| 4/7/95 | 9502 | 1 | 6/5/95 | | | | | 1 | | |
| 4/7/95 | 9503 | 0 | | | | | | | | |
| 4/7/95 | 9504 | 0 | | | | | | | | |
| 4/7/95 | 9505 | 1 | 6/5/98 | 6/5/95 | 7/26/95 | | | 0 | | |
| 4/7/95 | 9506 | 0 | | | | | | | | |
| 4/7/95 | 9507 | 0 | | | | | | | | |
| 4/7/95 | 9508 | 0 | | | | | | | | |
| 4/7/95 | 9509 | 0 | | | | | | | 5/1/95 | |
| 4/7/95 | 9510 | 1 | 5/30/95 | 5/30/95 | 7/29/95 | | | 0 | | |
| 4/7/95 | 9511 | 1 | 6/6/95 | 6/6/95 | 7/27/95 | | | 0 | | |
| 4/7/95 | 9512 | 2 | 6/6/95 | 6/6/95 | 7/26/95 | | 7/26/95 | 0 | 3/6/96 | |
| 4/7/95 | 9513 | 0 | | | | | | | | |
| 4/7/95 | 9514 | 2 | 6/8/95 | 6/8/95 | 7/27/95 | 6/8/95 | 7/27/95 | 0 | | |
| 4/7/95 | 9515 | 2 | 6/16/95 | 6/16/95 | 8/24/95 | 6/16/95 | 8/24/95 | 0 | | |
| 4/8/95 | 9516 | 0 | | | | | | | | |
| 4/8/95 | 9517 | 0 | | | | | | | | |
| 4/8/95 | 9518 | 0 | | | | | | | | |
| 4/8/95 | 9519 | 0 | | | | | | | | |
| 4/8/95 | 9520 | 2 | 6/6/95 | 6/6/95 | 8/24/95 | | | 1 | | |
| 4/8/95 | 9521 | 0 | | | | | | | 4/11/95 | Collar retrieved 4/13/95 |
| 4/8/95 | 9522 | 1 | 6/6/95 | 10/2/95 | 3/6/96 | | | 0 | 3/6/96 | |
| 4/8/95 | 9523 | 0 | | | | | | | | |
| 4/8/95 | 9524 | 2 | 6/6/95 | 6/6/95 | 7/29/95 | 6/6/95 | 7/29/95 | 0 | | |
| 4/8/95 | 9525 | 0 | | | | | | | 3/5/96 | |
| 4/8/95 | 9526 | 1 | 6/6/95 | 6/6/95 | 7/26/95 | | | 0 | | |
| 4/8/95 | 9527 | 0 | | | | | | | | |
| Total | 27 | 16 | | | | | | 2 | | |

Table 6 Calving success of collared moose, Unit 22B, 1996

| Date collared | ID | No. calves | Date calf first observed | Date calf last seen | Date calf observed missing | Date 2nd calf last seen | Date 2nd calf observed missing | No. calves surviving 1 year | Date cow mortality discovered | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 4/7/95 | 9501 | 0 | | | | | | | | |
| 4/7/95 | 9502 | 2 | 6/12/96 | 6/12/96 | 6/28/96 | 6/28/96 | 7/30/96 | 0 | | |
| 4/7/95 | 9503 | 1? | 1/24/97 | 1/24/97 | 5/5/97 | | | 1? | | Calf perhaps not hers |
| 4/7/95 | 9504 | 1 | 6/10/96 | 6/10/96 | 6/28/96 | | | 0 | | |
| 4/7/95 | 9505 | 1 | 6/4/96 | 6/28/96 | 7/19/96 | | | 0 | | |
| 4/7/95 | 9506 | 2 | 6/10/96 | 6/10/96 | 1/24/97 | | | 1 | | |
| 4/7/95 | 9507 | 0 | | | | | | | 1/24/97 | |
| 4/7/95 | 9508 | 0 | | | | | | | | 6/10/96 looked pregnant |
| 4/7/95 | 9510 | 2 | 6/4/96 | 6/4/96 | 6/28/96 | 9/3/96 | 9/23/96 | 0 | | |
| 4/7/95 | 9511 | 0 | | | | | | | | |
| 4/7/95 | 9513 | 0 | | | | | | | | |
| 4/7/95 | 9514 | 0 | | | | | | | | |
| 4/7/95 | 9515 | 2 | 6/5/96 | 6/5/96 | 6/28/96 | 6/5/96 | 6/28/96 | 0 | | |
| 4/8/95 | 9516 | 0 | | | | | | | | |
| 4/8/95 | 9517 | 1 | 6/5/96 | 6/5/96 | 6/28/96 | | | 0 | | |
| 4/8/95 | 9518 | 1 | 6/12/96 | | | | | 1 | | |
| 4/8/95 | 9519 | 0 | | | | | | | 6/12/96 | Sow and cubs on |
| 4/8/95 | 9520 | 2 | 6/5/96 | | | | | 2 | | |
| 4/8/95 | 9523 | 0 | | | | | | | | |
| 4/8/95 | 9524 | 2 | 6/4/96 | 6/4/96 | 7/30/96 | 6/4/96 | 7/30/96 | 0 | | |
| 4/8/95 | 9526 | 0 | | | | | | | | |
| 4/8/95 | 9527 | 0 | | | | | | | | |
| 4/9/96 | 9601 | 1 | 6/12/96 | | | | | 1 | | |
| 4/9/96 | 9602 | 0 | | | | | | | | |
| 4/9/96 | 9603 | 1 | 6/12/96 | | | | | 1 | | |
| 4/9/96 | 9604 | 1 | 9/27/96 | | | | | 1 | | |
| 4/9/96 | 9605 | 2 | 6/4/96 | 6/4/96 | 6/28/96 | 6/4/96 | 6/28/96 | 0 | | |
| 4/9/96 | 9606 | 1 | 6/21/96 | 6/21/96 | 6/28/96 | | | 0 | | |
| 4/9/96 | 9607 | 0 | | | | | | | | |
| 4/9/96 | 9608 | 2 | 6/5/96 | 6/28/96 | 8/12/96 | 6/28/96 | 8/12/96 | 0 | | |
| 4/9/96 | 9609 | 0 | | | | | | | | |
| 4/9/96 | 9610 | 0 | | | | | | | | 6/5/96 looked pregnant |
| Total | 32 | 24–25[a] | | | | | | 7–8 | | |

[a] 15–16 cows with 0 calves; 8–9 cows with 1 calf; 8 cows with 2 calves.

Table 7 Calving success of collared moose, Unit 22B, 1997

| Date collared | ID | No. Calves | Date calf First observed | Date calf last seen | Date calf observed missing | Date 2nd calf last seen | Date 2nd calf observed missing | No. calves surviving 1 year | Date cow mortality discovered | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 4/7/95 | 9501 | 0 | | | | | | | | |
| 4/7/95 | 9502 | 1 | 5/31/97 | | | | | | | |
| 4/7/95 | 9503 | 0 | | | | | | | | |
| 4/7/95 | 9504 | 2 | 6/6/97 | | | | | | | |
| 4/7/95 | 9505 | 1 | 5/30/97 | | | | | | | |
| 4/7/95 | 9506 | 2 | 5/31/97 | | | | | | | |
| 4/7/95 | 9508 | 2 | 6/6/97 | | | | | | | |
| 4/7/95 | 9510 | 0 | | | | | | | | |
| 4/7/95 | 9511 | 0 | | | | | | | | |
| 4/7/95 | 9513 | 1 | 5/30/97 | | | | | | | |
| 4/7/95 | 9514 | 0 | | | | | | | | |
| 4/7/95 | 9515 | 2 | 6/6/97 | | | | | | | |
| 4/8/95 | 9516 | 2 | 5/31/97 | | | | | | | |
| 4/8/95 | 9517 | 1 | 6/4/97 | | | | | | | |
| 4/8/95 | 9518 | 0 | | | | | | | | |
| 4/8/95 | 9520 | 0 | | | | | | | | |
| 4/8/95 | 9523 | 1 | 5/31/97 | | | | | | | |
| 4/8/95 | 9524 | 0 | | | | | | | | 6/4/97 looks pregnant |
| 4/8/95 | 9526 | 2 | 6/6/97 | | | | | | | |
| 4/8/95 | 9527 | 0 | | | | | | | | |
| 4/9/96 | 9601 | 0 | | | | | | | | |
| 4/9/96 | 9602 | 0 | | | | | | | | |
| 4/9/96 | 9603 | 2 | 6/4/97 | | | | | | | |
| 4/9/96 | 9604 | 1 | 6/10/97 | | | | | | | |
| 4/9/96 | 9605 | 0 | | | | | | | | |
| 4/9/96 | 9606 | 0 | | | | | | | | |
| 4/9/96 | 9607 | 1 | 6/4/97 | | | | | | | |
| 4/9/96 | 9608 | 2 | 6/4/97 | | | | | | | |
| 4/9/96 | 9609 | 1 | 6/7/97 | | | | | | | |
| 4/9/96 | 9610 | 2 | 6/7/97 | | | | | | | |
| Total | 30 | 26 | | | | | | | | |

Table 8 Residency and success of moose hunters in Unit 22, regulatory years 1995–1996 and 1996–1997

| Regulatory year/Unit | Residency of successful hunters | | | | | Residency of unsuccessful hunters | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Unit[a] | State[b] | Nonresident | Unknown | Total | Unit[a] | State[b] | Nonresident | Unknown | Total |
| 1995–1996 | | | | | | | | | | |
| 22A | 21 | 3 | 0 | 0 | 24 | 35 | 4 | 4 | 0 | 43 |
| 22B | 24 | 9 | 19 | 0 | 52 | 49 | 7 | 7 | 0 | 63 |
| 22C | 15 | 2 | 0 | 0 | 17 | 44 | 0 | 2 | 0 | 46 |
| 22D | 57 | 13 | 6 | 0 | 76 | 102 | 14 | 3 | 0 | 119 |
| 22E | 15 | 0 | 0 | 0 | 15 | 3 | 0 | 0 | 0 | 3 |
| 22 unknown | 1 | 0 | 0 | 0 | 1 | 6 | 1 | 1 | 2 | 10 |
| Total | 133 | 27 | 25 | 0 | 185 | 239 | 26 | 17 | 2 | 284 |
| 1996–1997 | | | | | | | | | | |
| 22A | 10 | 0 | 0 | 0 | 10 | 43 | 6 | 0 | 0 | 49 |
| 22B | 36 | 19 | 5 | 1 | 61 | 42 | 8 | 5 | 0 | 55 |
| 22C | 20 | 4 | 0 | 1 | 25 | 36 | 3 | 0 | 0 | 39 |
| 22D | 65 | 16 | 2 | 0 | 83 | 84 | 10 | 5 | 0 | 99 |
| 22E | 16 | 0 | 0 | 3 | 19 | 3 | 0 | 0 | 0 | 3 |
| 22 unknown | 0 | 0 | 0 | 0 | 0 | 12 | 1 | 0 | 0 | 13 |
| Total | 147 | 39 | 7 | 5 | 198 | 220 | 28 | 10 | 0 | 258 |

[a] Resident of Unit 22
[b] Other Alaska resident

Table 9 Chronology of Unit 22 moose harvest, regulatory years 1995–1996 and 1996–1997

| Regulatory year/ | Month of harvest | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Unit | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Unknown | Total |
| 1995–1996 | | | | | | | | | | |
| 22A | 7 | 14 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 24 |
| 22B | 1 | 20 | 17 | 6 | 4 | 0 | 0 | 0 | 4 | 52 |
| 22C | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 |
| 22D | 7 | 37 | 13 | 1 | 5 | 6 | 1 | 0 | 6 | 76 |
| 22E | 3 | 0 | 0 | 0 | 0 | 2 | 4 | 3 | 3 | 15 |
| Unknown | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Total | 18 | 87 | 31 | 7 | 9 | 9 | 5 | 3 | 16 | 185 |
| 1996–1997 | | | | | | | | | | |
| 22A | 3 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 10 |
| 22B | 3 | 27 | 12 | 5 | 11 | 0 | 0 | 0 | 3 | 61 |
| 22C | 0 | 24 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 22D | 7 | 41 | 20 | 1 | 12 | 0 | 1 | 0 | 1 | 83 |
| 22E | 1 | 0 | 1 | 0 | 3 | 1 | 3 | 9 | 1 | 19 |
| Total | 14 | 97 | 35 | 7 | 26 | 1 | 4 | 9 | 5 | 198 |

Table 10 Means of transportation reported by successful Unit 22 moose hunters, regulatory years 1993–1996

| Regulatory year/Unit | Aircraft | Horse | Boat | 3 or 4 Wheeler | Snowmobile | Off-road vehicle | Highway vehicle | Unknown | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1993–1994 | | | | | | | | | |
| 22A | 0 | 0 | 17 | 2 | 3 | 0 | 0 | 0 | 22 |
| 22B | 5 | 0 | 27 | 12 | 24 | 3 | 11 | 1 | 83 |
| 22C | 0 | 0 | 0 | 5 | 0 | 2 | 15 | 1 | 23 |
| 22D | 4 | 1 | 22 | 25 | 20 | 4 | 19 | 5 | 100 |
| 22E | 0 | 0 | 3 | 1 | 12 | 1 | 0 | 2 | 19 |
| Total | 9 | 1 | 69 | 45 | 59 | 10 | 45 | 9 | 247 |
| 1994–1995 | | | | | | | | | |
| 22A | 1 | 0 | 11 | 0 | 6 | 0 | 0 | 0 | 18 |
| 22B | 8 | 0 | 12 | 12 | 14 | 5 | 5 | 0 | 56 |
| 22C | 0 | 0 | 6 | 8 | 0 | 2 | 12 | 1 | 29 |
| 22D | 7 | 0 | 27 | 19 | 13 | 4 | 18 | 0 | 88 |
| 22E | 0 | 0 | 2 | 0 | 18 | 0 | 0 | 0 | 20 |
| Total | 16 | 0 | 58 | 39 | 51 | 11 | 35 | 1 | 211 |
| 1995–1996 | | | | | | | | | |
| 22A | 0 | 0 | 19 | 4 | 1 | 0 | 0 | 0 | 24 |
| 22B | 8 | 0 | 10 | 18 | 11 | 2 | 1 | 2 | 52 |
| 22C | 0 | 0 | 0 | 9 | 0 | 2 | 5 | 1 | 17 |
| 22D | 6 | 0 | 19 | 19 | 10 | 2 | 18 | 2 | 76 |
| 22E | 0 | 0 | 0 | 3 | 12 | 0 | 0 | 0 | 15 |
| Unknown | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Total | 14 | 0 | 48 | 53 | 34 | 6 | 24 | 6 | 185 |
| 1996–1997 | | | | | | | | | |
| 22A | 2 | 0 | 7 | 0 | 1 | 0 | 0 | 0 | 10 |
| 22B | 4 | 0 | 7 | 26 | 14 | 2 | 5 | 3 | 61 |
| 22C | 0 | 0 | 4 | 4 | 0 | 3 | 14 | 0 | 25 |
| 22D | 2 | 0 | 15 | 29 | 14 | 1 | 21 | 1 | 83 |
| 22E | 0 | 0 | 2 | 0 | 17 | 0 | 0 | 0 | 19 |
| Total | 8 | 0 | 35 | 59 | 46 | 6 | 40 | 4 | 198 |

## LOCATION

**GAME MANAGEMENT UNIT:** 23 (43,000 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Western Brooks Range and Kotzebue Sound

## BACKGROUND

Moose recolonized Unit 23 during the 1940s and currently rank second to caribou as a source of meat for most local residents. Moose are also avidly sought by nonlocal resident and nonresident hunters. Moose hunting provides significant income to guides, outfitters and transporters who operate within Unit 23. The wide distribution and abundance of moose along river corridors makes them important to nonconsumptive users, such as viewers and photographers.

From the time moose reappeared in Unit 23 through the late 1980s, public comments, trend count surveys, and opportunistic observations by department staff indicated moose populations increased throughout the region. The period of 1988–1989 through 1990–1991 was characterized by severe winters and extensive spring flooding. These factors, combined with high populations of black bears, grizzly bears, and wolves, probably caused moose populations to stabilize or decline throughout the Kotzebue Basin.

The history of Unit 23 moose surveys and rationale for the cooperative Noatak and Tagagawik moose telemetry projects have been previously reported (Dau 1996).

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS AND OBJECTIVES

- Develop an area management plan for Unit 23 by December 1999. This plan should consider moose in relation to other wildlife species, as well as social and biological aspects of management.

- Using radiotelemetry techniques, monitor the middle Noatak and Tagagawik moose populations to:

  - Improve survey and census techniques for monitoring population size and sex/age composition.

  - Indicate periods of high moose mortality in these areas.

- Monitor the size and sex/age composition of moose populations in the Noatak, Squirrel, upper Kobuk, Tagagawik and Northern Seward Peninsula drainages.

- Maintain a minimum November bull:cow ratio of 40:100 in each major Unit 23 drainage.

## METHODS

Population trend and sex/age composition data were obtained from aerial moose censuses (Dau 1996). In the reporting period, 3 fall moose censuses were conducted during November 1995 in Unit 23. The western Noatak River drainage census (covering 857.5 $mi^2$) was lead by National Park Service (NPS) and assisted by department staff. The Salmon River drainage census (covering 891.4 $mi^2$) was lead by NPS and assisted by ADF&G and Selawik Refuge (Refuge) staff. The upper Kobuk River drainage census (covering 1438.0 $mi^2$) was lead by department staff and assisted by NPS staff.

In 1997 2 spring moose censuses were also conducted during this reporting period. During March 1997 the lower Tagagawik River drainage census (covering 1000.9 $mi^2$) was lead by Refuge staff and assisted by NPS, department, and Bureau of Land Management (BLM) staff. This census used the standard Gasaway census technique (Gasaway 1986) with 5 pairs of pilot/observer teams. A Cessna C-206 was used for stratification, and 3 Piper PA-18 airplanes surveyed 33 sample units (SUs; 8 'low', 9 'medium' and 16 'high'). A sightability correction factor was estimated from 22 SUs.

During May 1997 department staff conducted the middle Noatak River drainage census (covering 1627.9 $mi^2$) to estimate calf recruitment and to evaluate the feasibility of modifying the Gasaway technique to reduce aircraft, staff, and weather requirements. Stratification was a 'desktop' approach, based on our understanding of moose distribution. Sample units were classified as 'high' or 'low,' determined by the relationship of moose to each other, rather than an arbitrary number of moose in each classification. Two Piper PA-18 airplanes and 4 pilots/observers surveyed 44 SUs (8 'low' and 36 'high'). A sightability correction factor was not estimated because it would probably not have contributed to accuracy of the ratio estimate.

Natural mortality, distribution, and movements of moose in the Noatak and Tagagawik River drainages were determined using standard radiotelemetry techniques (Dau and Ayres 1993, Dau 1996). Harvest information was derived from hunter harvest reports, the Noatak and Tagagawik moose telemetry projects, community harvest estimates (Subsistence Division, unpublished data), and casual conversations with local residents. The term "nonlocal hunter" refers collectively to Alaskan residents who reside outside Unit 23, nonresident, and alien hunters.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

Fall moose censuses conducted since 1992 (Table 1) indicate that Unit 23 moose densities are generally 0.5–1.0 moose $mi^2$. This is lower than most other portions of Alaska (Dau 1996). Census results are probably indicative of larger areas, but until this is confirmed, they should not be extrapolated to areas outside census boundaries. Rigorous moose censuses have been conducted in Unit 23 only since 1992, and no census area has been censused frequently enough to evaluate population trends. Moose populations in most of Unit 23 are probably stable; however, moose in the middle and lower Noatak River drainage may be slowly declining.

*Population Composition*

Fall census results indicate bull:cow ratios are above or near the population objective of 40:100 throughout Unit 23 (Table 1). Not surprisingly, areas heavily used by commercial operators and nonlocal hunters (e.g., the middle Noatak and Squirrel River drainages), have lower bull:cow ratios than areas lightly hunted, (e.g., the upper Kobuk and Salmon River drainages). Most nonlocal hunters target large bulls while local hunters select moose for quality of meat rather than sex or antler size.

In 1992 the moose bull:cow ratio in the Squirrel River drainage (37:100) was near the unit objective (Morkill and Dau 1993). Since then, the number of nonlocal hunters in the Squirrel River drainage appears to have increased substantially. In addition, during September 1996 and 1997, relatively few caribou migrated through the Squirrel River drainage. The lack of caribou reportedly increased hunting pressure on moose (Trooper C. Bedingfield, pers commun). These developments raise the concern that the Squirrel River drainage moose bull:cow ratio is or will soon be depressed below the unit objective. Indeed, during September 1997 guides reported more difficulty finding trophy bulls than in previous years. Fall censuses in this drainage were planned for 1996 and 1997 to evaluate the bull:cow ratio and density; however, poor weather in November 1996 and 1997 and the October 1997 Board of Game meeting precluded completion of the censuses.

The spring calf:adult ratio for the 1997 census of the lower Tagagawik River drainage was 20:100 (80% CI = 18–22 calves:100 adults). Density was 1.14 moose $mi^2$ (80% CI = 1.04–1.25 moose $mi^2$).

In contrast, the calf:adult ratio for the spring 1997 census of the middle Noatak River drainage was only 8:100 (80% CI = 2–13 calves:100 adults). This is consistent with reports of few moose calves in the middle Noatak River drainage from local residents and some long-time Unit 23 guides and transporters during recent years.

The 1997 spring middle Noatak moose census was conducted when spotty snow conditions reduced sightability of moose. Although we undoubtedly missed moose, we probably missed calves and adults equally so the estimated calf:adult ratio should be unbiased. Each plane surveyed 6–9 SUs/day over 6 plane-days. Four survey-days were required to complete the census over a 13-day period (2–14 May).

Using the 'desktop' stratification approach, we assumed most moose would be in riparian areas along the Noatak River and mid to low portions of the Kelly and Kugururok Rivers. Therefore, we classified 94 SUs outside these areas as 'low' and 36 SUs within them as 'high.' We surveyed 8 of 94 'low' SUs, and 7 contained ≤2 moose. One SU erroneously classified as 'low' was contiguous to a riparian corridor 'high' SU, and it contained 11 moose near the common boundary. Although most moose were within large riparian areas, they were not evenly distributed among all SUs within riparian corridors. We clearly misclassified 14 SUs as 'high' that contained ≤3 moose. Even so, because we counted all SUs classified as 'high,' this stratum did not contribute to the variance despite our poor "stratification." We assumed the calf:adult ratio was no different between 'high' and 'low' strata. Based on the 390 moose observed, this assumption appears correct (7.7 calves:100 adults in 'low' SUs; 7.4 calves:100 adults in 'high' SUs).

The benefit of 'desktop' stratification over a simple random sample is that it focused effort on areas likely to comprise moose. This increased the number of moose observed and minimized the time required to complete the census. In the future, 1 day of PA-18 stratification within large river corridors and questionable 'low' SUs would probably save more than 1 day of survey time and increase precision of the estimate. Because this is a nonrigorous approach, >1 plane could stratify. Even with cursory stratification, 'high' SUs will have a wide range in moose density and some SUs in both strata will probably be misclassified.

In the future, the following procedure should be used with nonrigorous censuses to estimate calf recruitment:

- Classify all SUs outside major riparian corridors as 'low'
- Fly an abbreviated stratification survey of SUs within major riparian corridors to save survey time (rather than increase precision)
- Survey all SUs classified as 'high' to eliminate the component of variance in the ratio estimate

We view spring censuses as complementary to rather than a substitute for fall censuses. Spring recruitment estimates from this approach are relatively imprecise "red flags" to compare with mortality estimates.

*Distribution and Movements*

Noatak Moose Telemetry Project. During 1995–1997, 64 of 98 (65%) radiocollared moose maintained year-round ranges within the specific Noatak tributary in which they were captured. Moose collared in the Kugururok River exhibited less fidelity to this drainage than moose collared in other drainages. Kugururok River drainage moose often moved into the Kelly River drainage during fall and returned in the winter. Moose collared in the lower Noatak River drainage regularly used the upper Squirrel River drainage. Telemetry results indicate a small but regular exchange of moose between the Kobuk and Noatak River drainages.

During this reporting period, 6 bulls and 7 cows at least temporarily emigrated from the Noatak River drainage. Of these, 1 bull and 1 cow died of natural causes on the North Slope; 2 cows traveled to the Wulik and Kivalina rivers; 2 bulls and 1 cow were located in the Salmon River drainage; and 3 bulls and 3 cows used the Squirrel River drainage. The greatest movement recorded was for a bull that remained within the Noatak River drainage. This bull was collared in the upper Kugururok River drainage and moved to near the mouth of the Noatak River, a straight-line distance of roughly 114 miles. The outermost locations of collared moose are Cape Thompson, headwaters of the Colville River, Pupik Hills, lower Salmon River, and Cape Krusenstern.

Tagagawik Moose Telemetry Project. Moose collared in the Tagagawik River drainage continued to show extreme fidelity to areas near their capture sites during this reporting period. Most collared moose remained in the Tagagawik River drainage and along the north side of the Selawik Hills. One cow moved from the Selawik River and across the Waring Mountains to the base of the Kallarichuk River in the Kobuk River drainage, a straight-line distance of 48 miles. Her locations overlapped those of a cow from the Noatak telemetry study captured on the Nimiuktuk River. A bull demonstrated seasonal movements between the west end of the Selawik Hills and Nimiuk Point (Baldwin Peninsula) until its death in March 1996.

## MORTALITY

### *Harvest*

Season and Bag Limit. The season and bag limit was the same for both regulatory years in the reporting period 1995–1996 and 1996–1997.

| Units and Bag Limits | Resident/Subsistence Hunters | Nonresident Hunters |
|---|---|---|
| Noatak River drainage One moose, however, Antlerless moose may be taken 1 Nov–31 Mar; cows with calves may not be taken. | 1 Aug–15 Sep 1 Oct–31 Mar | |
| 1 antlered moose with spike-fork or 50-inch antlers | | 1 Sep–15 Sep |
| Remainder of Unit 23 1 moose, cows with calves may not be taken | 1 Aug–31 Mar | |
| 1 antlered moose with spike-fork or 50-inch antlers. | | 1 Sep–20 Sep |

Board of Game Actions and Emergency Orders. The board reauthorized the Unit 23 antlerless moose season for the 1995–1996 and 1996–1997 regulatory years.

Hunter Harvest. A substantial number of moose harvested by unit residents are not reported each year. Community-based harvest assessments indicate approximately 177–343 moose are harvested by local residents annually (ADF&G Subsistence Division, unpublished data). In contrast, during the period 1984–1985 through 1994–1995, the mean annual reported harvest for Unit 23 residents was only 80 moose ($SD$ = 28). Harvest data for residents of Unit 23 probably reflect temporal harvest trends reasonably well but grossly underestimate local effort and harvest levels. Even when caribou are abundant, residents of Unit 23 harvest a substantial number of moose. If caribou become less available through shifts in distribution or population decline, harvest of moose by local residents will almost certainly increase. Harvest data for nonlocal hunters appear more accurate than for local hunters yet, even so, represent minimum estimates.

Harvest estimates do not include wounding losses or illegal kills. Every year, department staff receive reports from local residents of numerous moose killed annually for dog food and trap bait. The veracity of these reports is unconfirmed. However, their regularity and the large number of individuals who have made these reports over the past 10 years indicate illegal harvests cannot simply be dismissed as biologically insignificant.

Reported moose harvests during 1995–1996 and 1996–1997 were within the range of values previously recorded (Table 2, Fig 1). The total number of Unit 23 moose hunters was near the upper range of historic levels in both regulatory years. As in the past, the reported harvest of female moose was small during 1995–1996 and 1996–1997 in terms of absolute numbers (Table 2) and in relation to the total harvest (5% and 9%, respectively). Because local hunters select female moose after rut begins and because their compliance with reporting requirements is low, we underestimate the number of female moose harvested in relation to bulls.

No change in harvest among antler-width classes was evident during 1995–1996 or 1996–1997 compared to previous years (Table 3). From a sample of 11 bulls, individuals with antler widths >60 inches were 8–11 years old based on incisor cementum annuli. The youngest bull sampled was 5 years old with a 54-inch antler width.

Since the late 1980s we have been concerned about the status of moose in the middle and lower Noatak River drainage for several reasons: 1) overwinter mortality of moose was high throughout Unit 23 during the winter of 1990–1991 and especially high in the Noatak River drainage (Dau 1996); 2) this portion of the unit has the longest history of use by guides, transporters, and trophy moose hunters; and 3) since approximately 1990, we have received reports from various sources that moose abundance, bull:cow ratios, and the occurrence of truly large bulls is much lower than during the 1970s and 1980s. As a result, in 1992 the department and NPS initiated the Noatak moose telemetry project to delineate a census area and monitor moose mortality.

In addition, the Board of Game restricted moose hunting in the Noatak River drainage to a greater extent than in other portions of the unit. Regulatory restrictions included the elimination of antlerless moose hunting for nonresidents (unitwide, initiated during the 1992–1993 regulatory year), imposition of spike-fork/50 inch requirements for nonresidents (unitwide, initiated during the 1990–1991 regulatory year), closure of all moose hunting in the Noatak River drainage 16–30 September (initiated during the 1993–1994 regulatory year), and a 3-month reduction of the resident antlerless moose season (initiated during the 1993–1994 regulatory year). In addition, conflicts between local and nonlocal hunters in this area prompted the board to establish the Noatak Controlled Use Area (NCUA) during the 1988–1989 regulatory year, and substantially extend it during the 1994–1995 regulatory year.

These regulatory actions undoubtedly affected moose hunting and harvests in the Noatak River drainage as well as in the rest of the unit. In 1995–1996, 131 hunters (37% of unit moose hunters) took 71 moose in the Noatak River drainage (41% of Unit 23 harvest). In 1996–1997, 114 hunters (32% of Unit 23 moose hunters) took 57 moose in the Noatak River drainage (36% of unit harvest). During the 1995–1996 regulatory year, more moose were harvested in the

Noatak River drainage than in any other drainage (Table 4). This is consistent with the geographic pattern of harvest in years past. In 1996–1997 equal numbers of moose were taken in the Noatak and Kobuk River drainages. Since the 1991–1992 regulatory year, the proportion of Unit 23 moose harvested in the Noatak River drainage generally declined as this proportion increased in the Kobuk River drainage (Table 5). No trend in proportion of unitwide harvests is apparent for the Selawik, northern Seward Peninsula, or Wulik/Kivalina River drainages (Table 5).

Nonlocal hunters took 8 of 54 (15%) collared bulls and no collared cows in the Noatak telemetry project in fall 1995 (Table 6). In fall 1996, nonlocal hunters harvested 5 of 41 (12%) collared bulls. A resident of Unit 23 harvested 1 of 41 (2%) collared cows. Local hunters have harvested few collared moose during this project that is consistent with the low harvest rates indicated by harvest data. Since 1992, hunters have taken an average 16% of collared Noatak bulls annually. We probably overestimate bull harvests based on radiocollared individuals because we collar only large bulls which nonlocal hunters target. Only 1 collared cow has been harvested since this project was initiated in 1992.

Hunters harvested fewer collared bulls in the Tagagawik telemetry project than the Noatak project (Tables 6 and 7). In 1995 none of 19 collared bulls was harvested. In 1996, only 2 of 26 (8%) of collared bulls were taken. No collared cows have been harvested in the Tagagawik moose telemetry project.

Hunter Residency and Success. The total reported number of moose hunters in Unit 23 generally increased from the 1979–1980 to 1989–1990 regulatory year (Table 2, Fig 1). Since 1989–1990, this trend has stabilized with some annual variability. In contrast, the Unit 23 moose harvest has slowly declined since the 1988–1989 regulatory year, primarily as a result of a subtle decrease in success rate (Table 2).

After of long period of decline (1979–1980 to 1994–1995), the reported number of resident Unit 23 moose hunters stabilized during this reporting period (Table 2; Fig 2). Inupiat subsistence users prefer caribou over moose. The decline of local moose hunters reportedly corresponds with the growth and increased availability of Western Arctic caribou. The low and relatively stabile number of Unit 23 moose hunters during this reporting period may represent a baseline local demand for moose.

In contrast to the stabilized number of local resident hunters, the number of nonresident moose hunters in Unit 23 increased dramatically after the 1986–1987 regulatory year (Fig 2). From 1979–1980 through 1986–1987, the mean number of nonresident moose hunters in Unit 23 was 44 ($SD$ = 15), while from 1987–1988 through 1996–1997 it was 124 ($SD$ = 15). There are probably a number of reasons for this increase; the major reason being an expansion of transporter services in Unit 23 during this time.

Numbers of nonlocal Alaskan resident moose hunters in Unit 23 were higher during 1995–1996 and 1996–1997 than previously recorded (Table 2). Since 1979–1980, this number has steadily climbed (Fig 2). Until 1994–1995, the decrease in local resident moose hunters partially offset increases in nonlocal resident moose hunters.

As in the past, nonlocal hunters comprised the majority of moose hunters who reported hunting in Unit 23 during this reporting period (76% in each regulatory year). The number of nonlocal hunters in Unit 23 has approximately tripled since the 1979–1980 regulatory year (Fig 3). The low bull:cow ratios in the middle Noatak and Squirrel River drainages (as compared to the Salmon and upper Kobuk River drainages) are probably the result of intense trophy hunting by nonlocal hunters. In an attempt to find aesthetically pleasing hunting conditions (i.e., no crowding and low aircraft activity), nonlocal hunters began to use the northern Seward Peninsula, upper Kobuk, and upper Selawik River drainages to a greater extent during this reporting period than in previous years. Consistent with this change, transporters in Unit 23 began to use float-equipped aircraft to a greater degree during this reporting period than in the past. Guides continued to use 4-wheelers more than in previous reporting periods. These developments reduce the number of refugia available to moose in Unit 23.

Nonlocal hunter demand for transporter services in Unit 23 exceeds availability, despite recent establishment of new operators, expansion of some established transporters, an increased number of guides who transport "drop-off" hunters, and increasing numbers of village residents who transport nonlocal hunters via boat. As in the past, we continue to receive reports of individuals illegally transporting hunters via boat and airplane in the unit. The large disparity between transporter supply and demand by nonlocal hunters means Unit 23 could experience rapid and substantial increases in numbers of nonlocal hunters if transporter services suddenly increase (as they apparently did around 1987). This could cause overharvest of moose in high-use areas, further reductions in quality of hunting in Unit 23, and greater conflicts between local and nonlocal hunters.

During the 1994–1995 regulatory year, the NCUA was extended from roughly 650 $mi^2$ to 1600 $mi^2$, and its duration was reduced from 4 to 3 weeks. These regulatory actions were taken to reduce conflicts between local and nonlocal hunters during the period critical to subsistence hunters. This regulatory action was criticized because it would reduce 1) hunting opportunity for nonlocal hunters who largely rely on aircraft to access hunting areas, 2) hunter success, 3) aesthetic aspects of hunting the Noatak River drainage by grouping all hunters in the field because of time constrictions, and would 4) displace hunting to other portions of Unit 23.

The first criticism is partially correct because hunters who rely on aircraft to access hunting areas lost 3 weeks of opportunity within the expanded NCUA corridor. However, this was somewhat offset by shortening the period the NCUA is in effect. The second criticism does not appear to have yet developed. Moose hunter success in the Noatak River drainage during 5 years prior to expansion of the NCUA (1989–1990 through 1993–1994) was 54% ($SD$ = 12). After expansion (1994–1995 through 1996–1997), it was 51% ($SD$ = 3).

We have not attempted to measure hunter satisfaction in the Noatak River drainage (or anywhere in Unit 23) to evaluate the third criticism. However, department staff have received increasing reports of crowding and high aircraft activity from local and nonlocal hunters in the Noatak River drainage and other portions of Unit 23. Decreasing hunter satisfaction in the Noatak River drainage may be the result of the unitwide trend in increasing nonlocal hunters and commercial activity rather than a direct result of the expanded NCUA.

The long-term unit trend of increasing nonlocal moose hunters and the 16–30 September closure of the Noatak River drainage to all moose hunting that began in the 1993–1994 regulatory year both confound the impacts of the NCUA expansion on moose hunters and harvests at river drainage-199. Both factors make it impossible to simply compare numbers of hunters or moose harvested in the Noatak River drainage before 1993–1994 with subsequent years.

Moose hunting regulations were identical during the 1993–1994 and 1994–1995 regulatory years except that the NCUA was expanded in 1994–1995. Comparing numbers of hunters and moose harvested in the Noatak River drainage before and after the NCUA was expanded indicates this regulatory change did not reduce either parameter; in fact, both parameters increased. Ninety-six nonlocal moose hunters reported hunting the Noatak River drainage in the 1993–1994 regulatory year. During the 1994–1995 regulatory year, 99 nonlocal moose hunters used the Noatak River drainage. The mean number of nonlocal hunters during 1994–1995 through 1996–1997 (the 3 years after NCUA expansion) was 104 ($SD = 11$). Hunters harvested 48 moose in 1993–1994 and 56 in 1994–1995. The mean number of moose harvested during 1994–1995 through 1996–1997 (the 3 years after NCUA expansion) was 61 ($SD = 8$). These comparisons are not surprising because the expanded NCUA composes <13% of the entire drainage and the NCUA is in effect for only 3 weeks of the resident hunting season (but all of the nonresident hunting season).

In contrast, comparing proportions of hunters and moose harvests (vs. simply numbers) indicates that expansion of the NCUA *did* affect both parameters. Proportions are less sensitive to changes in hunting seasons and long-term trends in numbers of hunters than raw numbers. Prior to the expanded NCUA (1977–1978 through 1993–1994), an average 44% ($SD = 9$) of all Unit 23 moose hunters hunted the Noatak River drainage. After expansion of the NCUA (1994–1994 through 1996–1997), this percentage was 36% ($SD = 3$). Before expansion, 47% of the Unit 23 moose harvest came from the Noatak River drainage; after expansion, this percentage was 40%. These differences may partly be attributable to hunters voluntarily selecting less crowded portions of the unit for aesthetic reasons rather than being displaced from the Noatak River drainage as an effect of regulatory changes.

The 2 comparisons presented above are not necessarily conflicting. Expansion of the NCUA appears to have displaced some nonlocal hunters to other portions of Unit 23. However, due to the unit trend in increasing numbers of nonlocal hunters, numbers of hunters and moose harvested in the Noatak River drainage still increased, even after the NCUA was extended. Expansion of the NCUA merely slowed these trends in the Noatak River drainage relative to other portions of the unit; it did not stop or reverse them.

Harvest Chronology. Despite an 8-month moose season in most of the unit, an average 77% of the reported moose harvest occurred during the month of September between 1988–1989 and 1994–1995 (Fig 4). In 1995–1996, 78% of the harvest occurred during September, and in 1996–1997 this percentage was 72%. Virtually all sport hunting occurs during this time because weather is favorable for hunting and conducive to airplane and boat access, and bulls have completely developed antlers free of velvet.

Beginning in the 1993–1994 regulatory year, the Noatak River drainage was closed to all moose hunting 16–31 September on state and federal lands to reduce the moose harvest. This restriction appears to have reduced the total number of hunters by approximately 25%, lowered the success rate, and reduced the number of moose harvested in the Noatak River drainage by about 40%. For 5 years preceding this season restriction (1988–1989 through 1992–1993), an average of 156 ($SD$ = 17) hunters took an average of 97 ($SD$ = 14) moose in the Noatak River drainage, and the mean success rate was 63% ($SD$ = 13). After the season was restricted (1993–1994 through 1996–1997), an average of 121 hunters ($SD$ = 8) took an average of 58 ($SD$ = 10) moose in the Noatak River drainage, and the mean success rate was 48% ($SD$ = 7). Before the season was restricted (1988–1989 through 1992–1993), the proportion of Noatak moose harvested during September averaged 77%. After the 2-week season restriction, this proportion was 72% during 1993–1994, 72% in 1994–1995, 70% in 1995–1996, and 56% in 1996–1997. As with our assessment of the expanded NCUA, long-term unit increases in numbers of nonlocal hunters confound the effects of the 2-week season closure on moose hunter effort and harvest.

Transport Methods. As in the past, airplanes were the primary mode of transportation for hunters who reported hunting moose in Unit 23 (Table 8). Hunters using airplanes took 108 moose (62% of the total reported harvest) during 1995–1996 and 110 moose (69%) in 1996–1997. Sixty eight percent of all hunters reported using airplanes to access moose hunting areas in 1995–1996; in 1996–1997, this percentage fell to 66%. Most nonlocal hunters at least initially access hunting areas using airplanes. Snowmachines and boats were the next most commonly used means of transportation for taking moose during this reporting period. Local noncompliance with reporting requirements causes harvest data analysts to overestimate reliance on airplanes and underestimate use of boats and snowmachines for hunting moose.

*Other Mortality*

Noatak Moose Telemetry Study. Total mortality rates (natural mortality and hunter kills combined) were 21% and 19% during the 1995 and 1996 'collar years' (1 Apr–31 Mar), respectively. We have not collared immature moose or recollared adult moose annually. In addition, we have avoided collaring bulls <5 years old. As a result, the age structure of our collared sample of moose has been somewhat older than the population, especially for bulls. Therefore, we have probably overestimated annual mortality rates because nonlocal hunters select large (i.e., old) bulls, and old moose of both sexes are predisposed to other mortality sources.

Tagagawik Moose Telemetry Study. In 1995, 5 of 41 (12%) adult moose died of natural causes (Table 7). In 1996, 5 of 52 (10%) collared moose died natural deaths. Total mortality rates (natural mortality and hunter kills) were 12% and 13% in 1995 and 1996, respectively. Bull mortality exceeded cow mortality in 3 of 4 years of this project.

Both hunter and natural mortality for collared adult moose has been lower in the Tagagawik study than in the Noatak study (Tables 6 and 7). No hunters harvested collared moose in the Tagagawik study in 1995. Two (8% of collared bulls) bulls were harvested in 1996 and none was harvested in the 1997 fall season. No collared cows have been harvested in this project.

## HABITAT

### *Assessment*

Moose habitat was not been critically evaluated in Unit 23 during this or previous reporting periods. Opportunistic observations by department staff indicate that heavy, repeated use of riparian willow habitats has occurred in at least some portions of the Noatak River drainage. The effects of browse condition on moose are confounded by snow depth and hardness, timing of the onset of winter conditions, icing, and the frequency and intensity of winter storms.

# CONCLUSIONS AND RECOMMENDATIONS

Numbers of commercial operators, nonlocal hunters, and nonconsumptive users are increasing in Unit 23. In addition, greater use of float planes, boats, and 4-wheelers by commercial operators are reducing refugia available to moose. A high priority for the department should be initiation of a unitwide area management planning process to alleviate 2 major concerns raised by these trends: 1) increasing conflicts between local and nonlocal hunters, and 2) threats to resident wildlife populations, especially moose, from increasing harvest pressure. This plan should be developed and implemented in cooperation with other land management agencies, local organizations (e.g., NANA and the Northwest Arctic Borough), and principal user groups (sport hunters, subsistence users, commercial operators, and nonconsumptive users) to address biological and social aspects of wildlife management. Special funding for this process was requested for fiscal year 1999.

Moose bull:cow ratios are already near the unit objective of 40:100 in areas heavily hunted by nonlocal hunters (e.g., the lower and middle Noatak River and Squirrel River drainages). High priorities for the department should be to conduct fall censuses in each of these areas as soon as possible. If bull:cow ratios are below the unit objective, options for regulatory restrictions should be explored with fish and game advisory committees and the federal regional advisory council. Nonlocal hunting pressure is also expanding into other portions of the unit that historically received little use, such as the main Selawik and Kiwalik River corridors and the upper Kobuk River drainage. Bull:cow ratios should be monitored in these areas, but as a lower priority than the middle Noatak and Squirrel River drainages.

The middle Noatak moose telemetry project should be reassessed. The original Memorandum of Agreement (MOA) with NPS expired in 1995, and the project has begun to transition from a discrete study with 2 specific objectives to an ongoing monitoring program. A primary reason for maintaining a sample of collared moose in the Noatak River drainage has been to merely indicate periods of high mortality (e.g., winter of 1990–1991). We have accepted the biased age structure of the collared moose sample because 1) it satisfied this primary objective, 2) it minimized funding and personnel costs, 3) it minimized the likelihood of moose-capture mortality, and 4) its low intensity was supported by local residents. National Park Service staff are interested in intensifying the Noatak moose telemetry project, and we plan to discuss the benefits and costs of this with them in spring 1998. The cumulative effects of separate telemetry projects on moose and users should be considered in this assessment. As long as telemetry data enables mortality rates to be estimated, spring censuses should be conducted in the study area to estimate recruitment for comparison.

Department participation in the Tagagawik moose telemetry project should also be reevaluated. The Alaska Dep of Fish and Game involvement in all aspects of this cooperative project with Selawik Refuge staff has been minimal since 1996.

As in the past, local compliance with harvest reporting requirements continues to be poor. We should continue to inform the public of the need for accurate harvest information. Also, community-based harvest assessment techniques should be employed in Unit 23 villages to estimate moose harvest levels for local residents.

In summary, I recommend the following actions:

- Initiate an area management planning process for Unit 23 by December 1999
- Reassess the cooperative Noatak and Tagagawik moose telemetry projects
- Conduct fall censuses in the Squirrel, middle Noatak, and Tagagawik River drainages as soon as possible
- Conduct spring censuses in the Noatak moose telemetry study area to estimate recruitment to compare with mortality rates
- Conduct community-based moose harvest estimates in selected villages within Unit 23
- Maintain a minimum November bull:cow ratio of 40:100 in each major drainage of Unit 23

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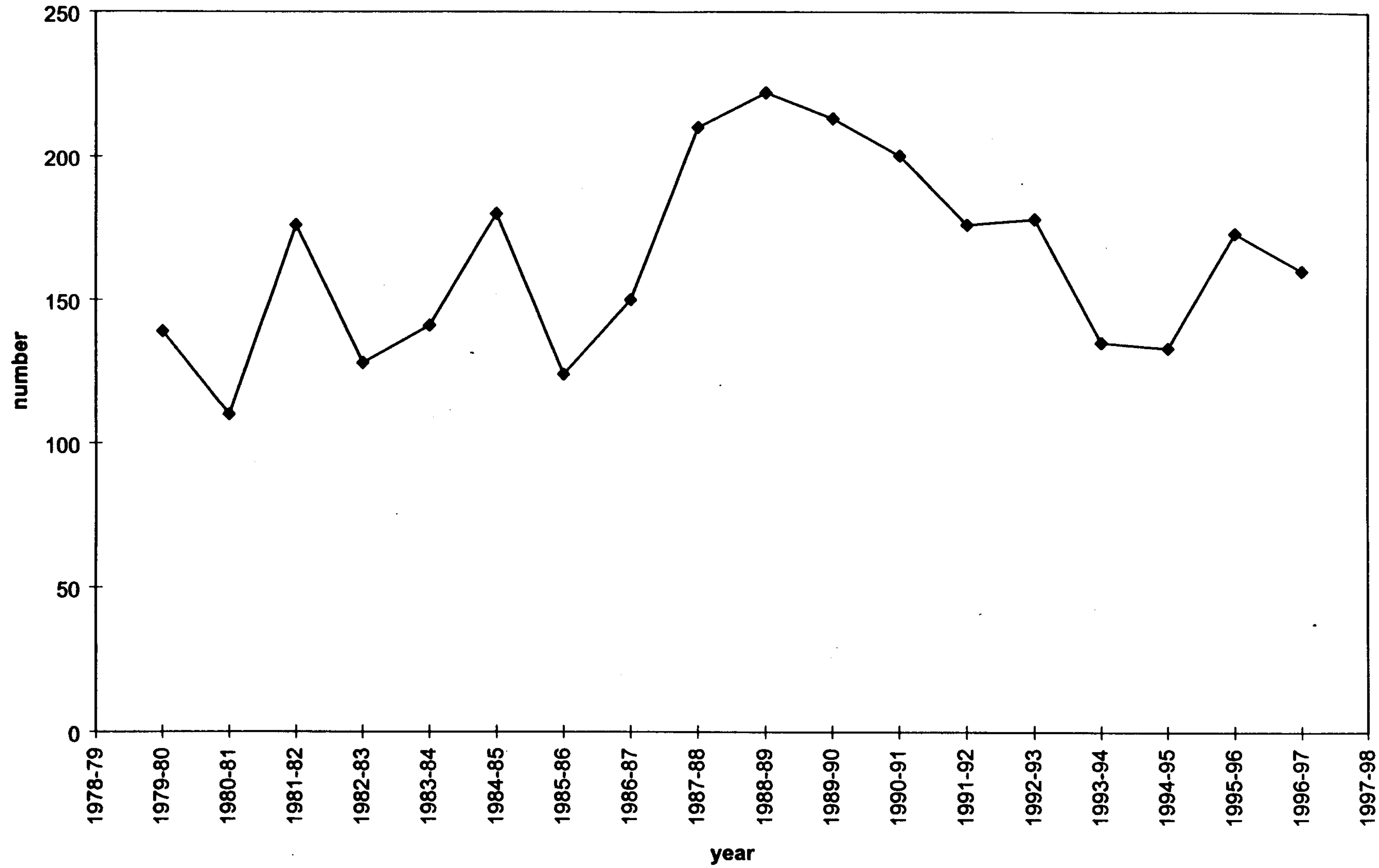


Figure 1 Game Management Unit 23 moose harvest levels, 1979-1980 through 1996-1997

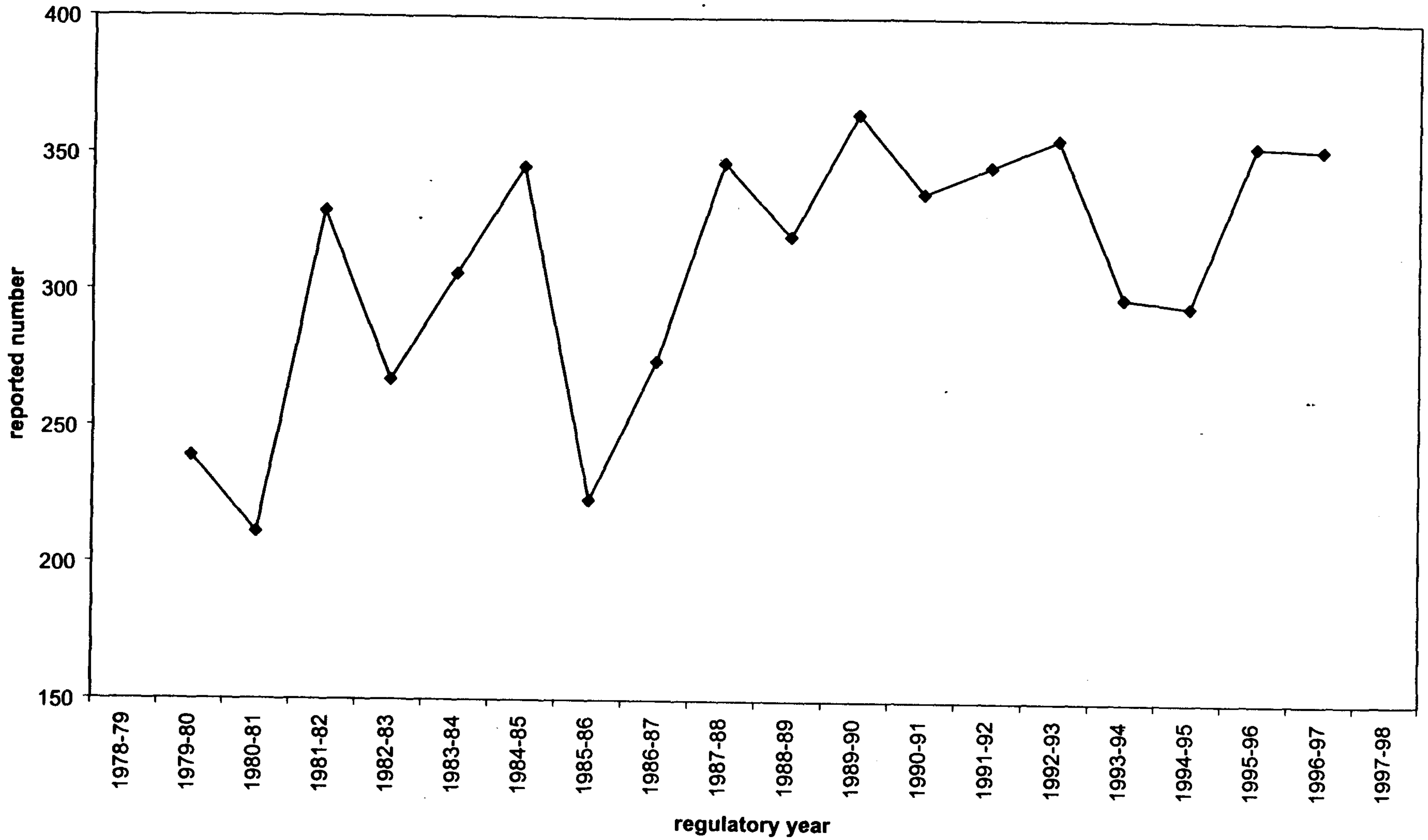


Figure 2 Reported number of moose hunters in Game Management Unit 23, 1979-1980 through 1996-1997.

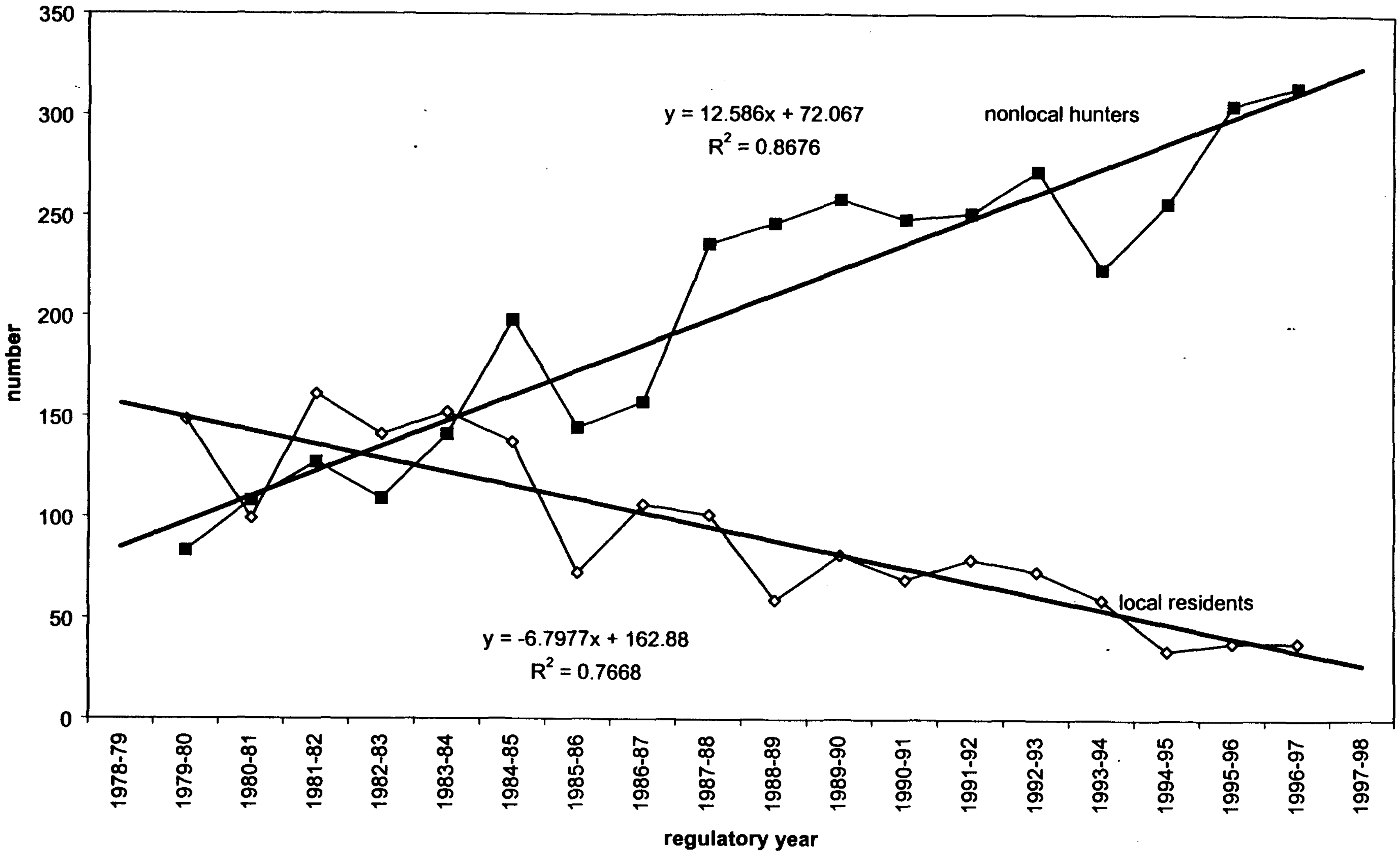


Figure 3 Numbers of local and nonlocal moose hunters in Unit 23

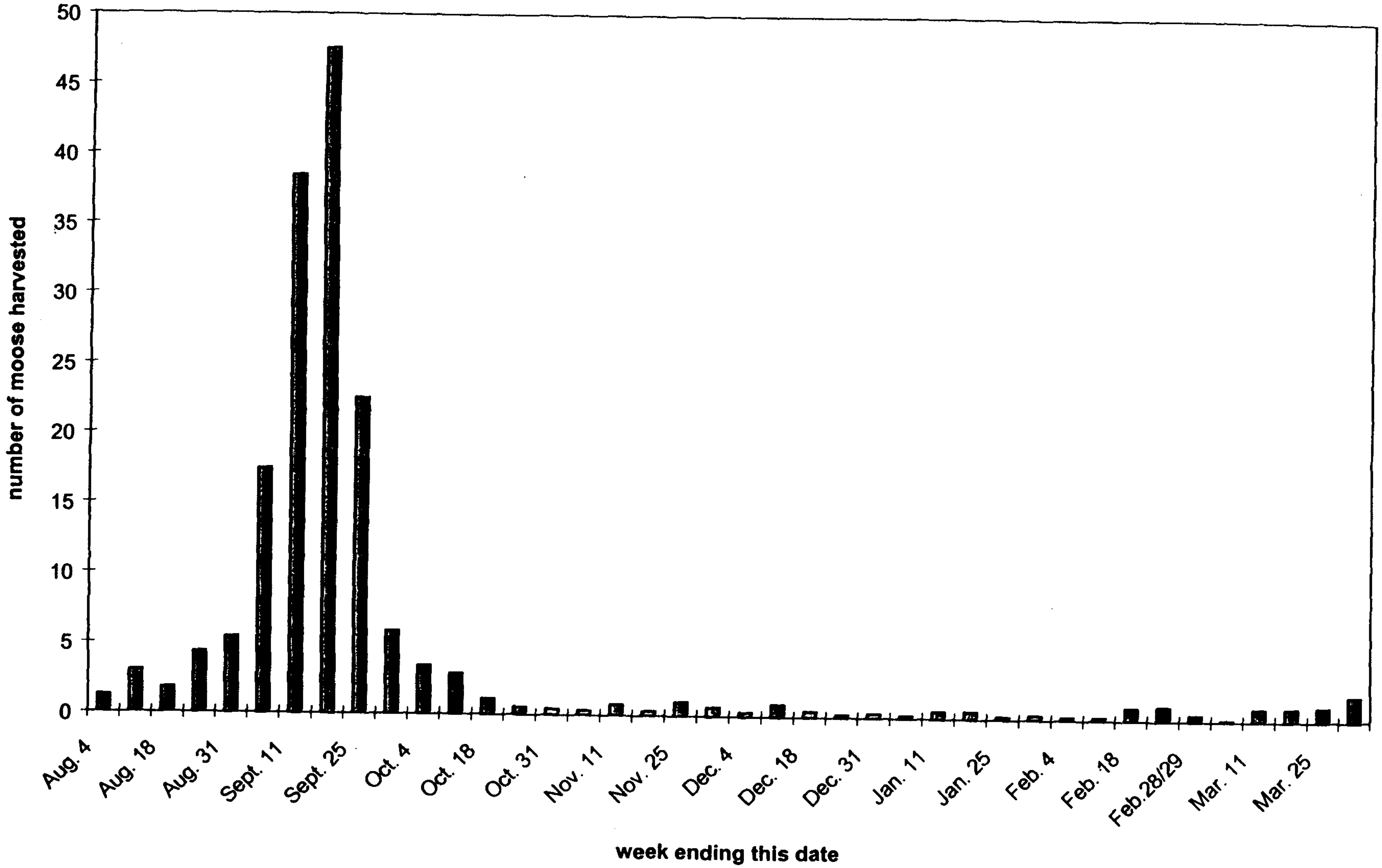


Figure 4 Chronology of mean number of moose harvested in Unit 23, 1979-80 through 1996-97

Table 1 Summary of Unit 23 fall moose censuses, 1992–1995

| Area | Year | Size ($mi^2$) | Nr adults | Nr calves | Total estimate | Total density (no. $mi^2$) | Adult density (no. $mi^2$) | Bulls: 100 Cows | Calves: 100 Cows | Method |
|---|---|---|---|---|---|---|---|---|---|---|
| Squirrel | 1992 | 1440.9 | 1110 | 262 | 1372 | 0.95 | 0.77 | 37 | 33 | Std. Gasaway |
| Middle Noatak | 1993 | 1627.9 | 956 | 169 | 1125 | 0.69 | 0.59 | 43 | 24 | Std. Gasaway |
| W. Noatak | 1993 | 857.5 | 855 | 122 | 977 | 1.14 | 1.00 | 49 | 21 | Std. Gasaway |
| W. Noatak | 1994 | 857.5 | 897 | 103 | 1000 | 1.16 | 1.05 | 40 | 16 | Std. Gasaway |
| W. Noatak | 1995 | 857.5 | 986 | 154 | 1140 | 1.33 | 1.15 | 34 | 21 | Simple Random |
| Salmon | 1995 | 891.4 | 594 | 186 | 780 | 0.87 | 0.67 | 78 | 56 | Mod. Gasaway |
| Upper Kobuk | 1995 | 1438.0 | 730 | 85 | 815 | 0.57 | 0.51 | 62 | 19 | Linear Regression |

Table 2 Numbers of moose hunter by residency and success, and moose harvest by sex for Unit 23, 1979–1980 through 1996–1997

| | Hunter Residency | | | | | Hunter Success | | | Sex of Moose Harvested | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Unit 23 resident | Nonlocal AK res. | Non residents | Unknown residents | Total No hunters | Success | Unsuccessful | Success rate | Males | Females | Unknown sex |
| 1979–1980 | 148 | 51 | 32 | 8 | 239 | 139 | 100 | 58 | 129 | 10 | 0 |
| 1980–1981 | 99 | 61 | 47 | 4 | 211 | 110 | 101 | 52 | 97 | 6 | 7 |
| 1981–1982 | 161 | 80 | 47 | 41 | 329 | 176 | 153 | 53 | 160 | 15 | 1 |
| 1982–1983 | 141 | 81 | 28 | 17 | 267 | 128 | 139 | 48 | 119 | 8 | 1 |
| 1983–1984 | 152 | 115 | 26 | 13 | 306 | 141 | 165 | 46 | 129 | 12 | 0 |
| 1984–1985 | 137 | 127 | 71 | 10 | 345 | 180 | 165 | 52 | 160 | 17 | 3 |
| 1985–1986 | 72 | 98 | 46 | 7 | 223 | 124 | 99 | 56 | 112 | 12 | 0 |
| 1986–1987 | 106 | 99 | 58 | 11 | 274 | 150 | 124 | 55 | 139 | 8 | 3 |
| 1987–1988 | 101 | 104 | 132 | 10 | 347 | 210 | 137 | 61 | 191 | 14 | 5 |
| 1988–1989 | 59 | 114 | 132 | 15 | 320 | 222 | 98 | 69 | 202 | 14 | 6 |
| 1989–1990 | 81 | 117 | 141 | 26 | 365 | 213 | 152 | 58 | 200 | 11 | 2 |
| 1990–1991 | 69 | 117 | 131 | 19 | 336 | 200 | 136 | 60 | 185 | 14 | 1 |
| 1991–1992 | 79 | 130 | 121 | 16 | 346 | 176 | 170 | 51 | 143 | 33 | 0 |
| 1992–1993 | 73 | 149 | 123 | 11 | 356 | 178 | 178 | 50 | 154 | 24 | 0 |
| 1993–1994 | 59 | 134 | 89 | 16 | 298 | 135 | 163 | 45 | 117 | 17 | 1 |
| 1994–1995 | 34 | 144 | 112 | 5 | 295 | 133 | 162 | 45 | 127 | 6 | 0 |
| 1995–1996 | 38 | 179 | 126 | 11 | 354 | 173 | 181 | 49 | 164 | 8 | 1 |
| 1996–1997 | 38 | 178 | 136 | 1 | 353 | 160 | 193 | 45 | 145 | 14 | 1 |

Table 3 Number and percentage (in parentheses) of harvested moose by antler-width classes, Unit 23, 1985–1986 through 1996–1997[a]

| Year | Moose antler-width classes in inches | | | | | | |
|---|---|---|---|---|---|---|---|
| | <20 | 20–<30 | 30–<40 | 40–<50 | 50–<60 | >60 | Total |
| 1985–1986 | 3 | 12 | 15 | 15 | 37 | 26 | 112 |
| | (3) | (11) | (14) | (14) | (34) | (24) | |
| 1986–1987 | 1 | 8 | 28 | 29 | 49 | 15 | 139 |
| | (1) | (6) | (21) | (22) | (38) | (11) | |
| 1987–1988 | 2 | 9 | 17 | 26 | 66 | 51 | 191 |
| | (1) | (5) | (10) | (15) | (38) | (30) | |
| 1988–1989 | 1 | 4 | 24 | 35 | 82 | 41 | 210 |
| | (1) | (2) | (11) | (16) | (38) | (19) | |
| 1989–1990 | 7 | 8 | 21 | 32 | 90 | 34 | 213 |
| | (4) | (4) | (11) | (17) | (47) | (18) | |
| 1990–1991[b] | 1 | 7 | 15 | 32 | 71 | 53 | 200 |
| | (1) | (4) | (8) | (17) | (40) | (30) | |
| 1991–1992 | 0 | 0 | 13 | 26 | 67 | 21 | 127 |
| | (0) | (0) | (10) | (20) | (53) | (17) | |
| 1992–1993 | 2 | 6 | 15 | 20 | 58 | 34 | 135 |
| | (1) | (4) | (11) | (15) | (43) | (25) | |
| 1993–1994 | 4 | 3 | 11 | 16 | 53 | 20 | 107 |
| | (4) | (3) | (10) | (15) | (50) | (19) | |
| 1994–1995 | 0 | 3 | 9 | 18 | 65 | 25 | 120 |
| | (0) | (2) | (8) | (15) | (54) | (21) | |
| 1995–1996 | 2 | 4 | 14 | 22 | 78 | 37 | 157 |
| | (1) | (3) | (9) | (14) | (50) | (24) | |
| 1996–1997 | 2 | 0 | 14 | 10 | 67 | 44 | 137 |
| | (1) | (0) | (10) | (7) | (49) | (32) | |

[a] Antlers of unknown size excluded.

[b] Nonresident hunters were restricted to bulls with spike/fork or ≥50 inch wide antlers beginning 1990–1991.

Table 4 Number of moose harvested in Unit 23 by sex and drainage, 1995–1996 and 1996–1997

| | 1995–1996 | | | | 1996–1997 | | | |
|---|---|---|---|---|---|---|---|---|
| Drainage | Males | Females | Unk. | Total | Males | Females | Unk. | Total |
| Noatak River | 68 | 3 | 0 | 71 | 52 | 5 | 0 | 57 |
| Kobuk River | 47 | 3 | 0 | 50 | 52 | 4 | 1 | 57 |
| Selawik River | 26 | 1 | 0 | 27 | 31 | 2 | 0 | 33 |
| Northern Seward Pen. | 16 | 1 | 0 | 17 | 8 | 2 | 0 | 10 |
| Kivalina/Wulik River | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 |
| Unspecified location | 2 | 0 | 1 | 3 | 1 | 1 | 0 | 2 |
| Total | 164 | 8 | 0 | 173 | 144 | 14 | 1 | 159 |

Table 5 Annual percentage of Unit 23 moose harvest by drainage, 1991–1992 through 1996–1997

| | Moose harvest (%) | | | | | |
|---|---|---|---|---|---|---|
| Regulatory year | Noatak | Kobuk | Selawik | N. Seward Peninsula | Wulik/Kivalina | Unknown |
| 1991–1992 | 49 | 22 | 14 | 8 | 2 | 2 |
| 1992–1993 | 47 | 15 | 20 | 15 | 4 | 0 |
| 1993–1994 | 36 | 27 | 19 | 13 | 2 | 2 |
| 1994–1995 | 43 | 23 | 20 | 10 | 5 | 0 |
| 1995–1996 | 41 | 29 | 16 | 10 | 3 | 2 |
| 1996–1997 | 36 | 36 | 21 | 6 | 0 | 1 |

Table 6 Number of radiocollared moose by collar-year (1 Apr–31 Mar) for the Noatak moose telemetry project, 1992–1993 through 1997–1998 (percentage of moose that died reported by category in parentheses)

| | Apr 92–Mar93 | Apr 93–Mar 94 | Apr 94–Mar 95 | Apr 95–Mar 96 | Apr 96–Mar 97 | Apr 97–Mar 98 |
|---|---|---|---|---|---|---|
| Existing collared moose | 0 | 33 | 37 | 45 | 82 | 66 |
| Bulls | 0 | 16 | 20 | 18 | 41 | 32 |
| Cows | 0 | 17 | 17 | 27 | 41 | 34 |
| Moose collared | 51 | 22 | 20 | 59 | 0 | 13 |
| Bulls | 26 | 14 | 10 | 37 | 0 | 0 |
| Cows | 25 | 8 | 10 | 22 | 0 | 13 |
| Capture mortalities | 6 | 1 | 0 | 0 | 0 | 1 |
| Bulls | 3 | 0 | 0 | 0 | 0 | 0 |
| Cows | 3 | 1 | 0 | 0 | 0 | 1 |
| Missing moose | 0 | 3 | 1 | 0 | 0 | 1 |
| Bulls | 0 | 2 | 1 | 0 | 0 | 1 |
| Cows | 0 | 1 | 0 | 0 | 0 | 0 |
| Total collared moose | 45 | 51 | 56 | 104 | 82 | 77 |
| Bulls | 23 | 28 | 29 | 55 | 41 | 31 |
| Cows | 22 | 23 | 27 | 49 | 41 | 46 |
| Harvest | 3 (7) | 4 (8) | 7 (12) | 8 (7) | 6 (7) | 6 (8) |
| Bulls | 3 (13) | 4 (14) | 7 (24) | 8 (13) | 5 (12) | 6 (19) |
| Cows | 0 (0) | 0 (0) | 0 ( 0) | 0 (0) | 1 (2) | 0 (0) |
| Natural mortality | 9 (20) | 10 (20) | 4 (7) | 14 (13) | 10 (12) | 6 (8) |
| Bulls | 4 (17) | 4 (14) | 4 (14) | 6 (6) | 4 (10) | 3 (10) |
| Cows | 5 (23) | 6 (26) | 0 (0) | 8 (8) | 6 (15) | 3 (7) |
| Total mortality | 12 (27) | 14 (27) | 11 (20) | 22 (21) | 16 (19) | 12 (16) |
| Bulls | 7 (30) | 8 (29) | 11 (38) | 14 (13) | 9 (22) | 9 (29) |
| Cows | 5 (23) | 6 (26) | 0 (0) | 8 (8) | 7 (17) | 3 (7) |
| Surviving moose | 33 | 37 | 45 | 82 | 66 | 65 |
| Bull | 16 | 20 | 18 | 41 | 32 | 22 |
| Cow | 17 | 17 | 27 | 41 | 43 | 43 |

Table 7 Number of radiocollared moose by collar-year (1 Apr–31 Mar) for the Tagagawik moose telemetry project, 1994–1995 through 1997–1998 (percentage of moose that died reported by category in parentheses)

| | Apr 94-Mar 95 | Apr 95-Mar 96 | Apr 96-Mar 97 | Apr 97-Mar 98 |
|---|---|---|---|---|
| Existing collared moose | 0 | 42 | 36 | 45 |
| Bulls | 0 | 23 | 18 | 21 |
| Cows | 0 | 19 | 18 | 24 |
| Moose collared | 50 | 0 | 16 | 18 |
| Bulls | 25 | 0 | 8 | 3 |
| Cows | 25 | 0 | 8 | 15 |
| Capture mortalities | 0 | 0 | 0 | 1 |
| Bulls | 0 | 0 | 0 | 0 |
| Cows | 0 | 0 | 0 | 1 |
| Missing moose | 0 | 1 | 0 | 1 |
| Bulls | 0 | 1 | 0 | 1 |
| Cows | 0 | 0 | 0 | 0 |
| Total collared moose | 50 | 41 | 52 | 61 |
| Bulls | 25 | 22 | 26 | 23 |
| Cows | 25 | 19 | 26 | 38 |
| Harvest | 1 (2) | 0 (0) | 2 (4) | 0 (0) |
| Bulls | 1 (4) | 0 (0) | 2 (8) | 0 (0) |
| Cows | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Natural mortality | 7 (14) | 5 (12) | 5 (10) | 5 (8) |
| Bulls | 1 (4) | 4 (18) | 3 (11) | 3 (12) |
| Cows | 6 (24) | 1 (5) | 2 (8) | 2 (5) |
| Total mortality | 8 (16) | 5 (12) | 7 (13) | 5 (8) |
| Bulls | 2 (8) | 4 (18) | 5 (19) | 3 (12) |
| Cows | 6 (24) | 1 (5) | 2 (8) | 2 (5) |
| Surviving collared moose | 42 | 36 | 45 | 56 |
| Bulls | 23 | 18 | 21 | 20 |
| Cows | 19 | 18 | 24 | 36 |

Table 8 Number of moose hunters by transportation method in Unit 23, 1995–1996 and 1996–1997

| Transportation method | Successful | Unsuccessful | Total |
|---|---|---|---|
| 1995–1996 | | | |
| Aircraft | 108 | 132 | 240 |
| Horse/dog team | 0 | 0 | 0 |
| Boat | 35 | 41 | 76 |
| 3- and 4-wheeler | 14 | 2 | 16 |
| Snowmachine | 10 | 1 | 11 |
| Off-road vehicle | 0 | 0 | 0 |
| Highway vehicle | 0 | 1 | 1 |
| Unknown | 6 | 4 | 10 |
| Total | 173 | 181 | 354 |
| 1996–1997 | | | |
| Aircraft | 110 | 124 | 234 |
| Horse/dog team | 0 | 1 | 1 |
| Boat | 25 | 51 | 76 |
| 3- and 4-wheeler | 8 | 8 | 16 |
| Snowmachine | 15 | 3 | 18 |
| Off-road vehicle | 0 | 0 | 0 |
| Highway vehicle | 0 | 2 | 2 |
| Unknown | 2 | 4 | 6 |
| Total | 160 | 193 | 353 |

# LOCATION

**GAME MANAGEMENT UNIT:** 24 (26,055 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Koyukuk River drainage above Dulbi River

# BACKGROUND

Moose are a recent addition to the fauna of Unit 24, having moved into the area during the 1930s through the 1950s (Huntington 1993). Colonization was slow until predator control efforts in the 1950s allowed rapid expansion of local populations, especially in the southern third of the unit. During the early 1970s the population reached a peak, and mortality started to exceed recruitment in some areas.

Naturally occurring wildfires and floods have been major forces affecting the productivity and diversity of moose habitat in this area. Habitat is excellent along most of the Koyukuk River lowlands, providing extensive areas of winter browse. Lightning-caused fire is a frequent event and large areas of the burned uplands are producing good moose browse. Browse availability is not limiting the size of the moose population at current moose densities.

The main Koyukuk River and major tributaries are popular moose hunting areas for unit residents, other Alaska residents, and nonresidents. Because of the long history of use, higher moose densities, and increased hunting activity in the lower portion of the Koyukuk within Unit 24, the area has been the focus of much of the management effort in the unit over the years. Hunting activity has also been increasing in other areas of the unit, including rivers accessible from the Dalton Highway. Two controlled use areas (CUA), the Koyukuk Controlled Use Area and the Kanuti Controlled Use Area, restrict use of aircraft for moose hunting activities. The Dalton Highway Corridor Management Area (DHCMA) prohibits use of off-road vehicles and firearms for hunting within 5 miles either side of the Dalton Highway.

Moose hunting seasons in Unit 24 are diverse and reflect the various moose densities and consumptive use patterns. In addition to the usual September hunting season, open seasons in December and March also provide hunting opportunity for residents. Harvest reports indicate the annual number of hunters and harvest from Unit 24 have averaged 292 hunters and 147 moose since 1988. A registration moose hunt was established in 1996 in the Koyukuk Controlled Use Area, downstream from Huslia.

Historical reported harvests during the past 25 years have ranged from 44 to 174, but did not exceed 100 moose until 1980. Unreported harvests during this period probably ranged from 160 to 300 moose per year. Since 1980 reported harvests have exceeded 100 moose each year. Local residents have become more aware of the importance of harvest reporting, increasing compliance with reporting requirements. Access to the unit has become easier with the opening of the Dalton Highway.

# MANAGEMENT DIRECTION

## MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem
- Provide for continued use of moose by local Alaskan residents who have customarily and traditionally used the population
- Provide the greatest sustained opportunity to participate in hunting moose
- Provide an opportunity to view and photograph moose
- Provide for scientific and educational use of moose
- Document uses of moose

# METHODS

Established trend count areas were surveyed from small fixed-wing aircraft to assess population status and trend. Contiguous survey units of approximately 12 $mi^2$ each were searched at a rate of at least 5 $min/mi^2$ to ensure reasonably high sightability, minimal bias, and data comparability between years. No moose population estimation surveys were conducted in Unit 24 during this reporting period.

We monitored hunter harvest by checking moose harvest reports and collecting information on hunter residency, moose ages, and antler sizes at a moose hunter checkstation operated on the lower Koyukuk River and at the Dalton Highway bridge. Mortality due to predation was monitored by interviewing wolf trappers. Local residents were encouraged to increase their harvest reporting through school visits, checkstations, and attendance by staff at village meetings.

# RESULTS AND DISCUSSION

## POPULATION STATUS AND TREND

Status and trends of the moose population in an area as large and diverse as Unit 24 is difficult to determine with any degree of certainty. Most often, generalities have to be given for the population, and trends are discernible only for the few areas surveyed.

Moose are numerous in the Koyukuk River lowlands in the southern third of the unit (south of Hughes). The population is believed to be increasing in the Dulbi Slough, Huslia River Flats, and Treat Island areas (Tables 1–3). We found moose densities exceeding 5 $moose/mi^2$ in these areas. Further up river in the Batza Slough and Mathews Slough trend count areas, moose densities are 1.6 and 0.4 $moose/mi^2$, respectively (Tables 4 and 5).

Moose densities are relatively low in the middle third of the unit (Hughes to Bettles, including the Kanuti Controlled Use Area [CUA] and the South Fork drainage); no surveys were conducted this reporting period (Table 6). This population may have increased between 1989 and 1993, possibly from several factors favorable to moose. Large burns in the mid and late 1970s produced excellent moose browse. Before the mid-1990s, large numbers of caribou wintered in the area providing alternate meat for hunters and prey for wolves. The harvest of wolves by hunters and trappers also tended to moderate the predation rate.

Moose densities are moderate in the northern third of the unit (north of Bettles, including the Gates of the Arctic National Park), and moose numbers are probably stable in most other areas. However, moose numbers may be slowly declining within the park.

*Population Size*

There are an estimated 5000 to 7000 moose in the southern portion of Unit 24, based on the results of 1988 and 1989 population estimation surveys and extrapolations of density estimates obtained during trend count surveys.

There are an estimated 3000 to 4000 moose in the middle portion of Unit 24. This estimate is based on population estimation surveys of the Kanuti National Wildlife Refuge in 1993 and the Dalton Highway Corridor in 1991. These surveys indicated a rather low overall early winter density of 0.42–0.76 moose/mi$^2$.

There are an estimated 3000 to 4150 moose in the northern portion of Unit 24, including approximately 1500 to 2000 moose within the Gates of the Arctic National Park. This estimate is based on the distribution of moose seen during a 1987 stratification survey and a density estimate of 0.42 moose/mi$^2$ by Dale et al. (1995) in the Alatna River drainage, within the Gates of the Arctic National Park, during their study of wolf predation in 1990.

By extrapolation, we estimate the unit population is between 11,000 and 15,000 moose.

*Population Composition*

Composition data are available from aerial surveys conducted in cooperation with FWS staff from the Koyukuk National Wildlife Refuge and Kanuti National Wildlife Refuge (Tables 1–6). Results from the most recent survey in each count area indicate bull:cow ratios exceeding 30 bulls:100 cows, excepting Dulbi Slough. Even at 24 bulls:100 cows in the Dulbi Slough area, the bull:cow ratio is sufficient to ensure breeding of all available cows. The most recent trend count surveys indicate good calf:cow ratios, with the exception of Mathews Slough.

*Distribution and Movements*

We have little data on movements of moose within the unit. Thirteen moose radiocollared in winter 1984 in northern Unit 21D had a summer migration into the southwestern parts of Unit 24. Moose are at treeline in the northern part of the unit during early winter and move into the river bottoms during late winter and summer.

### MORTALITY

*Harvest*

Season and Bag Limit.

| Units and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| Unit 24, the Koyukuk Controlled Use Area, downstream from Huslia: | | |
| Resident Hunters: 1 antlerless moose or 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by permit. | 5 Sep–25 Sep | |
| Resident Hunters: 1 moose by permit. | 1 Sep–25 Sep | |
| Resident Hunters: 1 moose. | 1 Dec–10 Dec | |
| Resident Hunters: 1 moose. | 1 Mar–10 Mar | |
| Nonresident Hunters: 1 antlerless moose, or 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by permit. | | 5 Sep–25 Sep |
| Unit 24, the Koyukuk Controlled Use Area, upstream from Huslia: | | |
| Resident Hunters: 1 moose per regulatory year; however, antlerless moose may be taken only during the periods 21 Sep–25 Sep, 1 Dec–10 Dec, and 1 Mar–10 Mar. | 1 Sep–25 Sep<br>1 Dec–10 Dec<br>1 Mar–10 Mar | |
| Nonresident Hunters: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | | 5 Sep–25 Sep |
| Unit 24, the John River drainage within the Gates of the Arctic National Park | | |
| Resident Hunters: 1 moose. | 1 Aug–31 Dec | No open season |
| Remainder of Unit 24. | | |
| Resident Hunters: 1 bull. | 1 Sep–25 Sep | |
| Nonresident Hunters: 1 bull with 50-inch antlers or antlers | | 5 Sep–25 Sep |

| Units and Bag Limits | Resident Open Season (Subsistence and General Hunts) | Nonresident Open Season |
|---|---|---|
| with 4 or more brow tines on 1 side. | | |

Board of Game Actions and Emergency Orders. Subsistence and general registration hunts were established in the Koyukuk CUA downstream of Huslia by the Board of Game in March 1996. This action was to counter the closure of moose hunting on federally managed lands within one-half mile of the Koyukuk River in nearby Unit 21D, from the Kateel River to 40 miles upstream from the mouth of the Koyukuk, to all but local rural residents by the Federal Subsistence Board. This closure was prompted by a continued increase in moose hunters and perceived declines in moose availability for local residents. Two separate registration hunts were established. The subsistence registration hunt was open to all Alaska residents, with a season of 1 September through 25 September and a bag limit of 1 moose. All the meat had to remain on the bones, the head had to be salvaged, and the antlers cut to destroy the trophy value. The general registration hunt was open to all hunters, with a season of 5 September through 25 September and a bag limit of either 1 antlerless moose, or 1 bull with antlers at least 50 inches wide, or at least 4 brow tines on at least 1 side. Season and bag limits for the remainder of the unit remained as before.

Moose hunter numbers and moose harvests for the 1996 season in the lower Koyukuk River area increased in spite of the new hunting regulations. The increase in hunters and harvest (instead of the hoped for decrease) heightened concerns for the area. The Middle Yukon River Fish and Game Advisory Committee and the Western Interior Regional Federal Subsistence Council both petitioned the Board of Game to take up the Koyukuk moose issue at their next meeting even though it was not on the board's schedule. They asked the board to accept proposals, open discussion on moose hunting in the area, and to address the problems associated with increased hunter numbers and increased harvest. The Board of Game decided to allow the Department of Fish and Game to modify the registration hunt requirements. The general registration hunt within Unit 24 was restricted to that portion of the Koyukuk River downstream from and including Dulbi Slough. Also, the department limited the number of general registration permits available at any one time to a maximum of 250. Similar modifications of the registration hunt requirement also occurred in nearby Unit 21D. Season and bag limits for the remainder of the unit remained as before.

Hunter Harvest. Hunting seasons in the unit are diverse and reflect various moose densities and consumptive use patterns. Annual reported harvest since 1988 averaged 146 moose (range = 123–174; Table 7). Generally, over 95% of reported harvest occurs during the September portion of the hunting season.

Illegal and unreported harvests by local residents continue to hamper department efforts to manage moose. During some years, the actual harvest is estimated to be about twice the reported harvest (Table 7). Moose taken during winter are rarely reported even when the season is open. Hughes does not have a license vendor and that contributes to the problem of hunters hunting without licenses or harvest tickets. I am working to increase public awareness of the importance of accurate reporting and am attempting to obtain additional license vendors. Fortunately, most unreported harvest comes from the southern portion of the unit that has a large enough moose population to support the additional harvest.

The estimated annual harvest by residents of Unit 24 is about 172 moose according to Marcotte (1986) and Marcotte and Haynes (1985). They estimated residents of Huslia, Hughes, Allakaket/Alatna, Bettles, and Wiseman take 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. To estimate unreported harvest, we subtracted the number of moose reported for the above villages from 172 (Table 7).

Hunter Residency and Success. Based on harvest reports, there was an average of 290 moose hunters each year, and most were Alaska residents (Table 8). This average is probably minimal since unit residents often do not report unsuccessful hunt information.

Transport Methods. Boats continue to be the primary transportation method in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 CUAs (Table 9). Snowmachines were the main transportation method used during the winter hunt. Highway vehicles are only used on the Dalton Highway that crosses the eastern part of the unit.

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. Hunter effort and moose harvest for those accessing Unit 24 by the Dalton Highway is fairly stable at 90–130 hunters who take 40–70 moose each year (Table 10).

*Other Mortality*

A minimum of 400 to 440 wolves in 55 to 60 packs and a large population of black bears are in the middle and southern portions of the unit. Grizzly bears are common throughout the montane areas.

Predation on moose is high, except around the villages of Huslia, Allakaket, and Bettles where predators are kept at lower numbers. Predation is keeping the moose population low throughout much of the central portion of the unit.

## CONCLUSIONS AND RECOMMENDATIONS

Unit 24 is an area that is larger than some states, with a wide range of habitats available to moose. Moose densities range from quite high for northern Interior Alaska to the typical lows expected for an area at these latitudes. Hunting activity is typically concentrated in areas accessible by boat, with the potential for creating conflicts between local subsistence hunters and nonlocal hunters. The overall status of the moose population in this area relative to its habitat and human-use demands has not changed appreciably since the last reporting period. However, conflicts between user groups have the potential to greatly influence future management decisions.

Habitat is excellent throughout much of the unit, with an abundance of successional willow regrowth due to either fire or riverine erosion. Availability of browse is not currently limiting the moose population.

With the exception of limited areas around Allakaket, Bettles and Huslia, predation on moose by wolves and bears is the major factor limiting Unit 24 moose populations. Unit residents are meeting their wild food requirements, but hunting opportunities cannot be increased for people living outside the unit until moose numbers increase. Where predators have been lightly harvested for long periods, predation seems to keep moose densities low (0.1–1.0 moose/$mi^2$ in areas >800 $mi^2$, Gasaway et al. 1992).

We need to obtain population estimates for the Hogatza River drainage and the northern area including Gates of the Arctic National Park. A population estimation survey should be undertaken in cooperation with NPS some time in the future when funding is available. Trend data should also be collected in popular hunting areas such as the South Fork upstream from the Dalton Highway, the Alatna River, the John River, and the Kanuti area.

Increased harvest reporting and licensing by unit residents is a result of efforts by the previous Galena area biologist. More emphasis needs to be placed on education, enforcement, and the recruitment of license vendors.

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Table 1 Unit 24 Dulbi Slough trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 Cows | Yearling bulls:100 cows | Calves:100 cows | Twins:100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1982–1983 | 35.0 | 45 | 5 | 7 | 0 | 4.5 | 111 | 3.2 |
| 1983–1984 | 39.0 | 17 | 8 | 33 | 14 | 22.5 | 113 | 2.9 |
| 1984–1985 | 48.1 | 19 | 8 | 20 | 6 | 14.6 | 130 | 2.7 |
| 1985–1986 | 54.2 | 19 | 9 | 10 | 0 | 7.7 | 170 | 3.1 |
| 1989–1990 | 48.7 | 53 | 7 | 23 | 18 | 13.1 | 298 | 6.1 |
| 1996–1997 | 86.4 | 24 | 8 | 37 | 1 | 23.0 | 443 | 5.1 |

Table 2 Unit 24 Huslia River Flats trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 cows | Yearling bulls:100 cows | Calves:100 cows | Twins:100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1983–1984 | 80.0 | 36 | 7 | 23 | 3 | 14.6 | 212 | 2.7 |
| 1985–1986 | 64.5 | 45 | 17 | 10 | 25 | 6.7 | 254 | 3.9 |
| 1989–1990 | 38.2 | 50 | 2 | 30 | 7 | 16.7 | 90 | 2.4 |
| 1993–1994 | 80.2 | 81 | 15 | 24 | 8 | 11.8 | 483 | 6.0 |
| 1997–1998[a] | 80.2 | 58 | 15 | 24 | 9 | 13.2 | 438 | 5.5 |

[a] Preliminary.

Table 3 Unit 24 Treat Island trend count area aerial moose composition counts (Huntington and Spindler 1997)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 cows | Yearling bulls:100 cows | Calves:100 cows | Twins:100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1985–1986 | 41.0 | 35 | 13 | 17 | 5 | 10.9 | 192 | 4.7 |
| 1993–1994 | 40.3 | 39 | 11 | 25 | 7 | 15.1 | 317 | 7.9 |

Table 4 Unit 24 Batza Slough trend count area aerial moose composition counts

| Regulatory year | Survey area ($mi^2$) | Bulls:100 cows | Yearling bulls:100 cows | Calves:100 cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 52.9 | 39 | 2 | 11 | 0 | 7.6 | 66 | 1.3 |
| 1997–1998 | 46.5 | 51 | 2 | 21 | 0 | 12.2 | 74 | 1.6 |

Table 5 Unit 24 Mathews Slough trend count area aerial moose composition counts

| Regulatory year | Survey area ($mi^2$) | Bulls:100 cows | Yearling bulls:100 cows | Calves:100 cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1983–1984 | 61.9 | 85 | 19 | 15 | 0 | 7.4 | 54 | 1.0 |
| 1997–1998 | 61.9 | 60 | 7 | 7 | 0 | 4.0 | 25 | 0.4 |

Table 6 Unit 24 Kanuti National Wildlife Refuge, summary of population estimation surveys (Martin and Zirkle 1996)

| Regulatory year | Survey area ($mi^2$) | Bulls:100 cows | Yearling bulls:100 cows | Calves:100 cows | Twins/100 cows with calves | Percent calves | Moose | Moose/$mi^2$ |
|---|---|---|---|---|---|---|---|---|
| 1989–1990 | 2615 | 64 | 4.1 | 16.5 | n/a | 9.2 | 1172 (878–1467) | 0.45 |
| 1993–1994 | 2644 | 61 | 8.0 | 33.0 | n/a | 17.0 | 2010 (1372–2199) | 0.76 |

Table 7 Unit 24 moose hunter harvest success, 1988–1996

| Regulatory year | Harvest by hunters | | | | Unreported harvest | Total |
|---|---|---|---|---|---|---|
| | Bull | Cow | Unk | Total | | |
| 1988–1989 | 132 | 5 | 0 | 137 | 131 | 268 |
| 1989–1990 | 119 | 8 | 1 | 128 | 132 | 260 |
| 1990–1991 | 141 | 2 | 1 | 144 | 129 | 273 |
| 1991–1992 | 141 | 2 | 1 | 144 | 129 | 273 |
| 1992–1993 | 118 | 5 | 0 | 123 | 124 | 247 |
| 1993–1994 | 139 | 12 | 0 | 151 | 116 | 267 |
| 1994–1995 | 134 | 8 | 0 | 142 | 135 | 277 |
| 1995–1996 | 161 | 8 | 0 | 169 | 129 | 299 |
| 1996–1997 | 160 | 14 | 0 | 174 | 117 | 291 |

Table 8 Unit 24 moose hunter residency and success, 1988–1996

| Regulatory year | Successful | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[a] resident | Nonlocal resident | Nonresident | Unk | Total | Local[a] resident | Nonlocal resident | Nonresident | Unk | Total | |
| 1988–1989 | 41 | 57 | 16 | 23 | 137 | 13 | 63 | 18 | 25 | 119 | 256 |
| 1989–1990 | 40 | 68 | 17 | 3 | 140 | 28 | 107 | 16 | 4 | 155 | 283 |
| 1990–1991 | 43 | 71 | 22 | 8 | 144 | 17 | 81 | 16 | 9 | 123 | 267 |
| 1991–1992 | 43 | 77 | 23 | 1 | 144 | 14 | 138 | 16 | 3 | 171 | 315 |
| 1992–1993 | 48 | 62 | 7 | 6 | 123 | 27 | 129 | 27 | 3 | 186 | 309 |
| 1993–1994 | 56 | 68 | 25 | 2 | 151 | 24 | 94 | 23 | 1 | 142 | 293 |
| 1994–1995 | 37 | 78 | 25 | 2 | 142 | 10 | 90 | 21 | 3 | 124 | 266 |
| 1995–1996 | 43 | 97 | 30 | 0 | 170 | 12 | 93 | 18 | 0 | 123 | 293 |
| 1996–1997 | 55 | 83 | 34 | 2 | 174 | 28 | 89 | 27 | 1 | 145 | 319 |

[a] Unit resident only

Table 9 Unit 24 moose harvest percent by transport method, 1988–1996

| Regulatory year | Harvest percent by transport method | | | | | | | | Moose harvested |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | |
| 1988–1989 | 23 | 1 | 49 | 1 | 0 | 3 | 13 | 9 | 137 |
| 1989–1990 | 19 | 1 | 44 | 1 | 1 | 1 | 24 | 9 | 140 |
| 1990–1991 | 16 | 3 | 56 | 3 | 1 | 2 | 16 | 3 | 144 |
| 1991–1992 | 25 | 2 | 44 | 3 | 1 | 2 | 17 | 5 | 144 |
| 1992–1993 | 16 | 0 | 56 | 3 | 5 | 1 | 13 | 6 | 123 |
| 1993–1994 | 15 | 0 | 60 | 6 | 5 | 2 | 7 | 4 | 151 |
| 1994–1995 | 17 | 2 | 53 | 3 | 5 | | 12 | 4 | 142 |
| 1995–1996 | 13 | 2 | 59 | 2 | 6 | 2 | 15 | 2 | 170 |
| 1996–1997 | 13 | 1 | 61 | 2 | 6 | 1 | 13 | 3 | 174 |

Table 10 Unit 24 moose harvest by hunters who used the Dalton Highway for access, 1988–1996

| Regulatory year | Dalton Highway hunters | |
|---|---|---|
| | Successful | Unsuccessful |
| 1988–1989 | 50 | 44 |
| 1989–1990 | 57 | 35 |
| 1990–1991 | 67 | 61 |
| 1991–1992 | 55 | 33 |
| 1992–1993 | 27 | 100 |
| 1993–1994 | 36 | 61 |
| 1994–1995 | 60 | 42 |
| 1995–1996 | 41 | 37 |
| 1996–1997 | 43 | 55 |

## LOCATION

**GAME MANAGEMENT UNIT:** 25A, 25B, and 25D (49,000 mi²)

**GEOGRAPHIC DESCRIPTION:** Upper Yukon River Valley

## BACKGROUND

Moose have been scarce in the upper Yukon River valley during most of historic time. Long-time residents of the area report moose were hard to find in the early 1900s and have been more common in recent years (F Thomas, H Petersen, K Peter, pers commun). Compared with many other areas, moose density continues to be low, especially in the western and northern parts of Unit 25. Systematic surveys were done in the late 1970s, and more extensive surveys began in 1981 when ADF&G established a Fort Yukon office. Survey techniques were modified to reflect advances in sampling techniques and to accommodate the area's relatively low moose density.

Hunting in Unit 25D West has been regulated by permit systems since 1983, when a registration permit hunt was established. Winter seasons were added in 1984 to accommodate traditional hunting practices. In 1985 permits were limited to qualified Tier II applicants, and in 1986 permits were further limited to residents of Unit 25D West and a harvest quota was established. Regulations were largely unchanged until 1989. In 1991 a federal permit system was established for hunting by residents on federal land.

Unit 25D has been divided into Units 25D West and 25D East to allow the use of regulatory schemes that reflect the generally different status of moose populations. The boundary between the 2 areas lies along Preacher and Birch creeks south of the Yukon River and along the Hadweenzic River to the north. Lower density of moose in Unit 25D West and relatively high demand for moose by local residents have resulted in the use of permit systems that limit hunting largely to residents of Unit 25D West.

Trend surveys and observations by local residents indicate that moose numbers increased during the 1980s in Units 25D West and in 25D East. During the early 1990s, trend counts and census data as well as anecdotal information indicate that moose numbers were stable or declining in most areas. This means the complicated regulations governing moose hunting in the unit cannot be liberalized, and thus simplified, as was hoped. Composition surveys were last conducted in Unit 25A in 1991 and in Unit 25B in 1987. Reports from experienced guides and pilots indicate moose numbers in Unit 25B declined substantially in recent years.

Moose telemetry studies conducted in Unit 25D West from 1983 to 1987, in Unit 25D East from 1989 to 1991, and studies of moose population dynamics in similar habitat elsewhere indicate that predation by black bears, brown bears, and wolves is the primary cause of summer mortality; wolves and illegal hunting of both cow and bull moose are important sources of winter mortality. Predation and illegal hunting are major factors determining moose population welfare. Moose browse is abundant and used at a low rate. The area is characterized by low to moderate snowfall.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

*Unit 25 Overall*

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem

*Unit 25A*

- Provide an opportunity to hunt under aesthetically pleasing conditions and provide for subsistence use

*Units 25B and 25D*

- Provide for subsistence use and for the greatest opportunity to harvest moose

### MANAGEMENT OBJECTIVES

*Unit 25 Overall*

- Continue efforts to communicate with and educate local residents about moose management and the importance of not taking cow moose

- In cooperation with US Fish and Wildlife Service (FWS), monitor moose population status as funding permits

## METHODS

Moose composition surveys were flown in PA-18 aircraft about 500 ft above ground level at 70 miles per hour. We circled moose to determine sex, age, and antler size of bulls and to locate other moose. Moose habitat in established count areas was searched systematically at an intensity of at least 4 minutes/mi$^2$. A moose census (Gasaway et al. 1986) was conducted in November 1992 in Unit 25D West using multiple PA-18 aircraft and a C-185 for stratification. A mini-census using similar techniques was conducted in Unit 25D West in 1996 and in Unit 25D East in November 1995 and 1997. Mandatory harvest reports provided information on hunter effort, residency, success, transportation, and antler size. Informal visits with area residents provided insight into hunter effort and concerns about moose management issues. These discussions occurred at moose hunter checkstations on the Porcupine River, at local advisory committee and other meetings, and during interviews with residents in Fort Yukon.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

Extrapolations from trend surveys and stratification efforts resulted in estimates of 1253 moose in 1984 and 2000 moose in 1989 in a 5400-mi$^2$ area in Unit 25D East (Maclean and Golden 1991). Population density on the Yukon Flats has ranged from a low of 0.1 moose/mi$^2$ in the west in 1984 to 0.64 moose/mi$^2$ in the east in 1989 (ADF&G files). The 1992 census in Unit 25D West resulted in an estimate of 602 moose (± 22%) in an area of 4544 mi$^2$, a density of 0.12 moose/mi$^2$. A 1996 mini-census in a 1530 mi$^2$ portion of Unit 25D West resulted in an estimated density of 0.44 moose/mi$^2$ in areas supporting the highest moose densities. A population mini-census in Unit 25D East in 1995 resulted in an estimate of 704 moose (± 33%) in a 1534 mi$^2$ area (0.46 moose/mi$^2$) encompassing the core hunting areas adjacent to Fort Yukon. Estimated moose density varied considerably among 3 subunits in the sample area, ranging from 0.12 moose/mi$^2$ around Fort Yukon to 0.75 moose/mi$^2$ in the Graveyard Lakes area. A similar census in 1997 resulted in a density estimate of 0.40 moose/mi$^2$. Moose density is low relative to most other areas in Interior Alaska, especially in Unit 25D West, and is well below the level that could be sustained by existing habitat.

*Population Composition*

Trend surveys in Unit 25A in 1987, 1989, and 1991 indicated that populations in this area had high bull:cow ratios, ranging from 60 to 90 bulls:100 cows, and moderate calf and yearling survival (Table 1). Weather precluded more recent survey attempts, but moderate to low harvests related to poor weather indicate bull:cow ratios remain high.

Surveys have not been conducted in Unit 25B in recent years (Table 1). However, reports from hunters in the area indicate that moose declined south of the Porcupine River and in the upper Black River drainage, and continue to be scarce in the Porcupine River drainage to the north. Reports from some knowledgeable observers indicate moose numbers in northern Unit 25D East and southern Unit 25A have also declined in recent years.

Relatively good survey conditions in Unit 25D East allowed complete trend counts in 1994 and a mini-census in 1995 and 1997. Poor conditions limited surveys in 1990 and none was attempted in 1992. Although trends in indicators of population welfare are not uniform, it seems there has been a decline in the proportion of bulls and yearlings compared with the early and mid 1980s (Table 2). Moose density may have declined also. The increase in numbers that occurred during the 1980s has apparently slowed or stopped. The bull:cow ratio indicates the limited harvest is affecting the proportion of bulls. Extremely low calf survival in 1997 was most likely caused by flooding adjacent to the Black River in mid-June following almost 6 inches of rainfall between 9 and 15 June.

In Unit 25D West, trend counts in 1993 and 1994 and a mini-census in 1996 indicate moose density continues to be low (Table 3). Most indicators of population welfare have been fairly stable during the past several years, with moose persisting at a chronically low density. Reports from hunters and other long-time observers suggest abundance has declined over the last several years.

Bull, yearling, and calf:cow ratios continue to be relatively high in Unit 25D West, but composition data should be viewed with caution. Harvest of cow moose is known to be significant near settlements and major travel routes. Thus, sex ratio data cannot be interpreted as they would be in areas where cows are rarely taken.

*Distribution and Movements*

Moose are throughout the area, but density varies greatly. Large areas currently support low densities ranging from 0.1 to 0.3 moose/mi$^2$. Densities approach or exceed 1 moose/mi$^2$ in very limited areas in Unit 25D West and in more extensive areas in Unit 25D East in the lower reaches of the Black and Porcupine River drainages. During early winter, moose concentrate along the upper Sheenjek and Coleen Rivers in Unit 25A, but these concentrations are limited in extent. A stratification effort in November 1991 found moose were scarce in most of the middle and lower portions of these drainages in Unit 25A and in northern Unit 25B, with most sample units showing no sign of moose. Telemetry studies in Units 25D East and 25D West indicate some moose are migratory, often moving between higher elevation early winter range to low elevation late winter and summer ranges (Maclean and Golden 1991). In March 1995 FWS initiated a telemetry study to determine moose seasonal movements and distribution, fidelity to winter range, and relationship between fall moose concentrations and harvest in Unit 25A. Fifty-seven moose (44 females and 13 males) were radiocollared in the Sheenjek, Coleen, and Firth drainages and relocated approximately once each month (F Mauer, pers commun). A strong pattern of annual movement was evident during the first year of monitoring, with over 40 moose migrating to the Old Crow Flats in the Yukon during spring and remaining there until late August, when moose began moving back into Alaska. By early October only 1 moose remained in Canada, and all had returned to Alaska by early November. Most moose returned to areas where they were collared, but some were located in other drainages. Continued monitoring will provide greater insight into home range fidelity and movements.

*Mortality Harvest*

Seasons and Bag Limits.

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| Unit 25A | | |
| All hunters: 1 bull. | 5 Sep–25 Sep | 5 Sep–25 Sep |
| Unit 25B | | |
| Upstream from the Coleen River drainage: 1 bull. | | |
| Resident Hunters: 1 bull. | 20 Sep–30 Sep | |
| Nonresident Hunters: 1 bull with 50-inch antlers. | | 20 Sep–30 Sep |
| Remainder of Unit 25B | | |
| Resident Hunters: 1 bull. | 5 Sep–25 Sep<br>1 Dec–15 Dec | |
| Nonresident Hunters: 1 bull with 50-inch antlers. | | 5 Sep–25 Sep |
| Unit 25D West | | |
| All hunters, 1 bull by Tier II | 25 Aug–25 Sep | No open season |

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| subsistence hunting permit only; up to 125 permits will be issued. | 1 Dec–10 Dec<br>18 Feb–28 Feb | |
| Unit 25D East Remainder. | | |
| Resident Hunters: 1 bull. | 10 Sep–20 Sep | |
| Nonresident Hunters: 1 bull with 50-inch antlers. | 18 Feb–28 Feb | 10 Sep–20 Sep |

Board of Game Actions and Emergency Orders. In 1990 the Federal Subsistence Board was established and promulgated regulations for subsistence use on federal lands. These regulations took effect 1 July 1991. A federal subsistence moose permit system was established in Unit 25D West that provided an unlimited number of permits to residents of the subunit and allowed them to hunt bull moose on federal lands. The state Tier II permit system remained in effect and applied to both private and federal lands. Dual management also affected regulations in Units 25A, 25B, and 25D East. Seasons for eligible local residents are longer (generally from 25 August to 25 September and from 1 December to 20 December) on federal land than the state season. The state season applies to all hunters on private and state lands and nonlocal hunters on federal lands.

In 1993 there was a change in the way regulations were applied in Unit 25D West. The federal regulations dictated that federal permits were required on federal land and nonlocal residents were excluded from hunting moose on federal land. State Tier II permits applied only to hunting on private lands. A maximum of 30 federal permits and 125 state Tier II permits may be issued each year.

Hunter Harvest. Harvest of moose has varied considerably in most of Unit 25 during the past 5 years (Tables 4, 5, 6) largely because of weather conditions. Reported harvest for Units 25A, 25B, and 25D East has ranged from 98 moose in 1993 to only 54 in 1992. Low harvests in 1992 coincided with unusually cold or rainy weather during September. A near record early freeze-up in mid September greatly limited hunting effort, even at low elevation near Fort Yukon. An extensive flood in May 1992 also contributed to poor success in the Fort Yukon area. Local residents report that widespread flooding pushed moose back away from rivers. Moose were unusually scarce in flooded areas throughout summer and fall 1992.

The reported harvest in connection with the Tier II and federal permit hunts in Unit 25D West is very small (Table 7), with 10–16 moose reported taken annually in the last few years. The reporting rate has been poor for this hunt but has improved recently because of the use of reminder letters. The actual number of moose harvested in Unit 25D West is unknown, but verbal reports by village residents indicate the number of bulls harvested may approach the present quota of 35.

Unreported harvest, particularly by local residents, is common in the upper Yukon River valley. The previous area biologist estimated the unreported harvest at 100–200 moose annually. Some insight into the level of unreported harvest was provided by the results of a cooperative harvest monitoring study conducted by the Council of Athabascan Tribal Governments and funded by FWS. Interviews with members of each household in the communities of Arctic Village, Beaver, Birch Creek, Canyon Village, Circle, Chalkyitsik, Fort Yukon, Rampart, Stevens Village, and Venetie provided information on local moose harvest during 1993–1994 and 1994–1995 (FWS, unpubl data). A comparison of these data with local harvests reported on harvest tickets indicates only 25–35% of the harvest (bull moose) in Units 25A, 25B, and 25D East is reported on harvest tickets. In addition, the harvest of cow moose was 29 in 1993–1994 and 13 in 1994–1995. Combining the harvest reported by nonlocal residents with the more accurate data obtained in the CATG study indicates the total harvests of bull moose in Units 25A, 25B, and 25D East were 152 in 1993–1994 and 149 in 1994–1995. Reported harvests were 98 and 84 bulls, respectively. Current information indicates that cow moose may be taken at any time of year, especially in areas near and between communities. While the illegal taking of moose seems to have declined somewhat in recent years and is disapproved of by many residents, it is still common. Two educational videos were produced in 1993 in a cooperative effort between FWS and ADF&G. Effects of shooting cow moose are a central message in each. These videos will be used to educate people about moose management.

Permit Hunts. Although the Tier II moose permit hunt in Unit 25D West is largely supported by local residents, a number of problems are associated with it. These include confusion about differences in applicability of federal and state permits, boundaries of federal and private lands (which are subject to different seasons and permit requirements), and the fact that local residents have not submitted enough applications to acquire all 125 permits available. Increased efforts by community leaders and agencies are required if existing regulations are to accomplish the intended goal.

Data on moose populations in Unit 25D West indicate that liberalizing and simplifying regulations for Unit 25D West is not warranted. Efforts should be focused on making the present system function better. Increases in the number of local applicants, clarification of permit conditions, and better harvest reporting are all necessary.

Hunter Residency and Success. As in previous years, most hunters reporting from Units 25A, 25B, and 25D are Alaska residents (Tables 8, 9, 10). The proportion of nonresidents is greatest in the most remote portion of Unit 25A (Table 8), where guiding activity and float trips are more common. Local residents outnumber other hunters by a wide margin in Unit 25D East (Table 10). As described above, the number of local participants in moose hunting is underrepresented because of a low reporting rate. Success among reporting hunters is high, often approaching or exceeding 50% in Units 25A (Table 8), 30 to 50% in 25B (Table 9), and ranging from 23 to 36% in Unit 25D East (Table 10). Success in 1991 and 1992 was low due to weather but has since increased.

Harvest Chronology. Most moose taken in Unit 25 are killed during the first 3 weeks of September, with a few reported killed before and after this period (Tables 11, 12, and 13). A number of moose are also taken in late August when the state Tier II and federal subsistence seasons open on 25 August. A few moose are reported taken in the 1–10 December open season, but hunting is almost exclusively by local residents during this period. The number of moose killed is probably greater than reported.

Transport Methods. Aircraft are the most common transport mode in Unit 25A, being used by more than 50% of the successful hunters. Horses and boats each account for 2 to 28% of the remainder (Table 14). Boats are used by 75% of successful hunters in Unit 25B, with airplanes being used in 15% of successful hunts (Table 15). A similar pattern characterizes Units 25D East (Table 16). Snowmachines are used in taking a small percentage of the moose killed in both Units 25B and 25D, but the occurrence of both snowmachines and boats is probably underrepresented because local hunters often do not report.

### HABITAT

*Assessment and Enhancement*

No systematic evaluation of habitat took place during this period. However, previous work, empirical observations, and comparison with habitat elsewhere indicate that the upper Yukon River valley provides excellent moose habitat. Moose populations are well below densities that could be supported by the habitat.

The upper Yukon area has the shortest fire cycle in Alaska; extensive fires have created and maintained large areas of good habitat for moose. With the low snow accumulation typical of the area, conditions are more than adequate to support present moose numbers.

## CONCLUSIONS AND RECOMMENDATIONS

The overall status of the Unit 25 moose population has not changed dramatically in the last few years. However, signs of a decline in recruitment rates are evident in some areas, and a decline in numbers may have occurred in parts of the unit. Moderate progress has been made towards achieving management objectives in some areas. Objectives for Unit 25A are generally being met, and in the remainder of the unit, the harvest of moose seems to satisfy local subsistence needs and provide a moderate amount of hunting for other Alaskans and some nonresidents.

Political, biological, and logistical realities affecting moose management in Unit 25 indicate some basic questions need to be addressed by the public and various governmental agencies involved. A basic issue that remains unsettled is whether the local public wants and would support measures to increase moose numbers to levels commensurate with habitat potential. Moose are noticeably more abundant now than in the early 1900s; therefore, many local residents are currently satisfied with the low moose densities.

A study of local opinions about various moose management issues was conducted in Fort Yukon in 1995–1996 (Craig Fleener, ADF&G unpubl data). Representatives of 34 households were interviewed regarding their opinions about topics including the harvest of cow moose, enforcement of regulations, suitability of current regulations, need for further biological studies, predator control, and local involvement in moose management. The results indicated there is substantial concern about the status of moose, opposition to the taking of cow moose, and support for increased enforcement, biological studies, predator control, and local involvement in moose management.

At present, there are relatively narrow problems in individual subunits that should be addressed or more clearly monitored. Effects of increased hunting on concentrations of moose in the Sheenjek and Coleen drainages in Unit 25A are being evaluated. Air taxi operators who fly hunters to these areas are aware of potential problems and have agreed to distribute and limit hunting pressure. In cooperation with FWS, we should help users maintain the opportunity for high-quality hunting in these areas. Ongoing telemetry studies of moose movements and population identity will help evaluate effects of hunting in these areas.

More time should be spent monitoring the Tier II harvest in Unit 25D West. The actual harvest of moose is unknown, making it impossible to know whether the upper limit of 35 bulls is being exceeded. Confusion over state and federal permits is substantial, and a better understanding of the situation is important. A related problem is the potential to exceed the harvest quota because harvest reporting is not timely or uniform. Under a cooperative agreement between FWS and local governments, a harvest-monitoring program was initiated in 1993. This effort should contribute to our knowledge of wildlife harvests in the area. A final report is expected soon.

There is considerable confusion about the relatively long federal subsistence seasons and the short state general hunting season in Units 25A, 25B, and 25D East. While some confusion is inherent in the regulations, making maps available that show land status, hunting seasons, and bag limits would help clarify regulations. Such maps should be posted in public buildings in local communities beginning midsummer. I also recommend staff visits to local communities to explain regulations before the hunting season and hunter contact by riverboat during the hunting season, as we have done in the past.

Trend surveys in representative areas of various subunits should be continued to clarify trends in recruitment and moose numbers. A cooperative survey by ADF&G and FWS to determine wolf numbers on the Yukon Flats was conducted in early 1992 and ADF&G completed a wolf survey in Unit 25D West in 1997. Knowledge of wolf numbers will help in assessing the probable effects of wolf predation on moose numbers.

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Table 1 Units 25A and 25B early winter aerial moose composition counts, 1986–1996

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| Unit 25A | | | | | | | | |
| 1986–1987[a] | | | | | | | | |
| 1987–1988[b] | 63 | 9 | 33 | -- | 17 | -- | 149 | -- |
| 1988–1989[a] | | | | | | | | |
| 1989–1990[c] | 75 | 18 | 29 | 52 | 14 | -- | 367 | 1.01 |
| 1990–1991[a] | | | | | | | | |
| 1991–1992[d] | 55 | -- | 26 | 8 | 19 | 41 | 49 | -- |
| 1991–1992[c] | 91 | 13 | 31 | 44 | 14 | -- | 314 | 0.87 |
| 1992–1993[e] | | | | 8 | 15 | 44 | 52 | -- |
| 1993–1994[a] | | | | | | | | |
| 1994–1995[a] | | | | | | | | |
| 1995–1996[a] | | | | | | | | |
| 1996–1997[a] | | | | | | | | |
| Unit 25B[f] | | | | | | | | |
| 1987–1988 | 119 | 6 | 10 | 6 | 5 | 105 | 111 | |

[a] No survey.
[b] Upper Sheenjek River only.
[c] Includes upper Sheenjek and Coleen Rivers.
[d] Observed during moose stratification flights in lower Sheenjek, Coleen, and East Fork Chandalar Rivers.
[e] March 1993 survey in East Fork of Chandalar drainage around Arctic Village.
[f] The only early winter composition count in this area during 1986–1997.

Table 2 Unit 25D East early winter aerial moose composition counts, 1986–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi² |
|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 84 | 13 | 34 | 26 | 15 | 144 | 170 | 0.7 |
| 1987–1988 | 81 | 18 | 27 | 29 | 13 | 196 | 225 | 0.9 |
| 1988–1989[a] | | | | | | | | |
| 1989–1990 | 63 | 9 | 41 | 59 | 20 | 235 | 294 | 1.0 |
| 1990–1991[b] | 64 | 5 | 32 | 7 | 16 | 36 | 43 | 0.7 |
| 1991–1992[c] | 66 | 9 | 26 | 25 | 13 | 168 | 193 | 0.7 |
| 1992–1993[a] | | | | | | | | |
| 1993–1994 | 38 | 8 | 40 | 37 | 22 | 128 | 165 | 1.0 |
| 1994–1995 | 68 | 20 | 25 | 24 | 12 | 160 | 184 | 0.6 |
| 1995–1996[d] | 50 | 7 | 30 | 39 | 16 | 193 | 232 | 0.46 |
| 1996–1997[e] | 54 | 6 | 43 | 16 | 22 | 57 | 73 | -- |
| 1997–1998[d] | 61 | 18 | 13 | 14 | 8 | 169 | 183 | 0.40 |

[a] No survey.
[b] Poor survey conditions, partial count.
[c] Part of the Graveyard trend area was not completed.
[d] Based on composition observed in mini-census.
[e] Based on limited composition survey in Graveyard and Mardow trend count areas.

Table 3 Unit 25D West early winter aerial moose composition counts, 1986–1996

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 78 | 23 | 27 | 20 | 13 | 132 | 152 | 0.42 |
| 1987–1988 | 71 | 8 | 25 | 13 | 13 | 87 | 100 | 0.57 |
| 1988–1989 | 84 | 18 | 29 | 13 | 14 | 83 | 96 | 0.55 |
| 1989–1990[a] | | | | | | | | |
| 1990–1991[b] | 44 | 12 | 29 | 4 | 15 | 23 | 27 | -- |
| 1991–1992[c] | 98 | 8 | 31 | 15 | 13 | 97 | 112 | 0.47 |
| 1991–1992[d] | 146 | 8 | 46 | 6 | 16 | 32 | 38 | 0.22 |
| 1991–1992[e] | 81 | 8 | 25 | 9 | 12 | 65 | 74 | 1.15 |
| 1992–1993[f] | 71 | 12 | 25 | 48 | 13 | 345 | 393 | 0.12 |
| 1992–1993[g] | 70 | 11 | 19 | 5 | 10 | 46 | 51 | 0.47 |
| 1993–1994[h] | 51 | 14 | 30 | 17 | 16 | 86 | 103 | 0.50 |
| 1994–1995[i] | 115 | 23 | 45 | 9 | 14 | 56 | 65 | 0.63 |
| 1995–1996[a] | | | | | | | | |
| 1996–1997[j] | 54 | 11 | 42 | 57 | 17 | 273 | 330 | 0.44 |

[a] No survey.
[b] Poor survey conditions, only Meadow Creek area surveyed.
[c] Includes both low and high elevation surveys.
[d] Includes only low elevation count areas (Meadow Creek and Birch Creek).
[e] Mt Schwatka area only.
[f] Data from Unit 25D West census.
[g] Data from Meadow Creek and Mud Lakes trend areas within census area.
[h] Data from Meadow Creek and Mud Lakes trend areas. Mt Schwatka area not surveyed.
[i] Mud Lakes area not surveyed.
[j] Based on composition observed in mini-census.

Table 4 Unit 25A reported moose harvest and accidental death[b], 1986–1996

| Regulatory year | Reported[a] harvest M | F | Unk | Total |
|---|---|---|---|---|
| 1986–1987 | 47 | 0 | 0 | 47 |
| 1987–1988 | 41 | 0 | 0 | 41 |
| 1988–1989 | 39 | 0 | 0 | 39 |
| 1989–1990 | 25 | 0 | 0 | 25 |
| 1990–1991 | 56 | 0 | 0 | 56 |
| 1991–1992 | 47 | 0 | 0 | 47 |
| 1992–1993 | 17 | 0 | 0 | 17 |
| 1993–1994 | 27 | 0 | 0 | 27 |
| 1994–1995 | 24 | 0 | 0 | 24 |
| 1995–1996 | 37 | 0 | 0 | 37 |
| 1996–1997 | 39 | 0 | 0 | 39 |

[a] Source: moose harvest reports.
[b] No roads or railroads in subunit.

Table 5 Unit 25B reported moose harvest and accidental death[b], 1986–1996

| Regulatory year | Reported[a] harvest M | F | Unk | Total |
|---|---|---|---|---|
| 1986–1987 | 27 | 0 | 0 | 27 |
| 1987–1988 | 26 | 0 | 0 | 26 |
| 1988–1989 | 28 | 0 | 0 | 28 |
| 1989–1990 | 24 | 0 | 0 | 24 |
| 1990–1991 | 47 | 0 | 0 | 47 |
| 1991–1992 | 32 | 0 | 0 | 32 |
| 1992–1993 | 18 | 0 | 0 | 18 |
| 1993–1994 | 43 | 0 | 0 | 43 |
| 1994–1995 | 33 | 0 | 0 | 33 |
| 1995–1996 | 32 | 0 | 0 | 32 |
| 1996–1997 | 20 | 0 | 0 | 20 |

[a] Source: moose harvest reports.
[b] No roads or railroads in subunit.

Table 6 Unit 25D East reported moose harvest and accidental death[b], 1986–1996

| Regulatory year | Reported[a] | | | |
|---|---|---|---|---|
| | M | F | Unk | Total |
| 1986–1987 | 39 | 0 | 0 | 39 |
| 1987–1988 | 47 | 0 | 0 | 47 |
| 1988–1989 | 32 | 0 | 0 | 32 |
| 1989–1990 | 38 | 0 | 0 | 38 |
| 1990–1991 | 52 | 0 | 1 | 53 |
| 1991–1992 | 29 | 0 | 0 | 29 |
| 1992–1993 | 19 | 0 | 0 | 19 |
| 1993–1994 | 27 | 1 | 0 | 28 |
| 1994–1995 | 27 | 0 | 0 | 27 |
| 1995–1996 | 23 | 0 | 0 | 23 |
| 1996–1997 | 14 | 0 | 0 | 14 |

[a] Source: moose harvest reports.
[b] No roads or railroads in subunit.

Table 7 Unit 25D West moose harvest data by permit hunt, 1986–1996

| Hunt | Regulatory year | Permits issued | Did not hunt (%) | Unsuccessful hunters (%) | Successful hunters (%) | Bulls (%) | Cows (%) | Unk (%) | Harvest |
|---|---|---|---|---|---|---|---|---|---|
| 940 | 1989–1990 | 50 | 1 (2) | 8 (16) | 7 (14) | 7 (100) | 0 (0) | 0 (0) | 7 |
| | 1990–1991[a] | 60 | 9 (15) | 3 (5) | 4 (7) | 4 (100) | 0 (0) | 0 (0) | 4 |
| | 1991–1992[b] | 57 | 44 (77) | 13 (23) | 6 (11) | 6 (100) | 0 (0) | 0 (0) | 6 |
| | 1992–1993[c] | 95 | 67 (71) | 21 (22) | 5 (5) | 5 (100) | 0 (0) | 0 (0) | 5 |
| | 1993–1994[d] | 125 | 54 (43) | 40 (32) | 10 (8) | 10 (100) | 0 (0) | 0 (0) | 10 |
| | 1994–1995[e] | 120 | 63 (53) | 30 (25) | 10 (8) | 10 (100) | 0 (0) | 0 (0) | 10 |
| | 1995–1996[f] | 90 | 44 (49) | 27 (30) | 16 (18) | 16 (100) | 0 (0) | 0 (0) | 16 |
| | 1996–1997[g] | 91 | 32 (35) | 31 (34) | 10 (11) | 10 (100) | 0 (0) | 0 (0) | 10 |

[a] Additional harvest reported under federal permit system = 11.
[b] Additional harvest reported under federal permit system = 8.
[c] Additional harvest reported under federal permit system = 4.
[d] Additional harvest reported under federal permit system = 0.
[e] Additional harvest reported under federal permit system = 2.
[f] Additional harvest reported under federal permit system = 1.
[g] Additional harvest reported under federal permit system = 7.

Table 8 Unit 25A moose hunter residency and success, 1986–1996[a]

| Regulatory year | Successful: Local[b] resident | Successful: Nonlocal resident | Successful: Nonresident | Successful: Unk | Successful: Total (%) | Unsuccessful: Local[b] resident | Unsuccessful: Nonlocal resident | Unsuccessful: Nonresident | Unsuccessful: Unk | Unsuccessful: Total (%) | Hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 4 | 22 | 6 | 5 | 37 (60) | 2 | 13 | 10 | 0 | 25 (40) | 62 |
| 1987–1988 | 4 | 16 | 18 | 3 | 41 (61) | 4 | 14 | 3 | 5 | 26 (39) | 67 |
| 1988–1989 | 3 | 19 | 11 | 6 | 39 (59) | 2 | 15 | 9 | 3 | 29 (41) | 68 |
| 1989–1990 | 3 | 12 | 10 | 0 | 25 (52) | 4 | 14 | 5 | 0 | 23 (48) | 48 |
| 1990–1991 | 5 | 27 | 22 | 2 | 56 (72) | 1 | 16 | 5 | 0 | 22 (28) | 78 |
| 1991–1992 | 4 | 21 | 22 | 0 | 47 (57) | 0 | 22 | 13 | 0 | 35 (43) | 82 |
| 1992–1993 | 2 | 7 | 7 | 1 | 17 (35) | 5 | 20 | 6 | 0 | 31 (65) | 48 |
| 1993–1994 | 3 | 13 | 10 | 1 | 27 (51) | 0 | 18 | 8 | 0 | 26 (49) | 53 |
| 1994–1995 | 1 | 14 | 8 | 1 | 24 (55) | 2 | 13 | 5 | 0 | 20 (46) | 44 |
| 1995–1996 | 6 | 11 | 20 | 0 | 37 (62) | 2 | 11 | 10 | 0 | 23 (38) | 60 |
| 1996–1997 | 1 | 6 | 32 | 0 | 39 (58) | 2 | 16 | 9 | 1 | 28 (42) | 67 |

[a] Source: moose harvest reports.
[b] Resident of Unit 25A.

Table 9 Unit 25B moose hunter residency and success, 1986–1996[a]

| Regulatory year | Successful: Local[b] resident | Successful: Nonlocal resident | Successful: Nonresident | Successful: Unk | Successful: Total (%) | Unsuccessful: Local[b] resident | Unsuccessful: Nonlocal resident | Unsuccessful: Nonresident | Unsuccessful: Unk | Unsuccessful: Total (%) | Hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 9 | 10 | 3 | 5 | 27 (47) | 6 | 18 | 2 | 5 | 31 (54) | 58 |
| 1987–1988 | 9 | 10 | 1 | 6 | 26 (53) | 5 | 9 | 6 | 3 | 23 (47) | 49 |
| 1988–1989 | 9 | 9 | 8 | 2 | 28 (50) | 2 | 20 | 6 | 0 | 28 (50) | 56 |
| 1989–1990 | 7 | 16 | 1 | 0 | 24 (40) | 9 | 24 | 1 | 2 | 36 (60) | 60 |
| 1990–1991 | 9 | 31 | 5 | 2 | 47 (57) | 9 | 25 | 2 | 0 | 36 (43) | 83 |
| 1991–1992 | 9 | 17 | 4 | 2 | 32 (46) | 12 | 22 | 4 | 0 | 38 (54) | 70 |
| 1992–1993 | 6 | 9 | 2 | 1 | 18 (19) | 7 | 61 | 4 | 3 | 76 (81) | 94 |
| 1993–1994 | 13 | 24 | 6 | 0 | 43 (52) | 4 | 29 | 5 | 1 | 39 (48) | 82 |
| 1994–1995 | 6 | 19 | 5 | 3 | 33 (34) | 5 | 39 | 14 | 6 | 64 (66) | 97 |
| 1995–1996 | 6 | 24 | 2 | 0 | 32 (40) | 2 | 37 | 9 | 1 | 49 (60) | 81 |
| 1996–1997 | 6 | 10 | 3 | 1 | 20 (29) | 5 | 36 | 7 | 1 | 49 (71) | 69 |

[a] Source: moose harvest reports.
[b] Resident of Unit 25B.

Table 10 Unit 25D East moose hunter residency and success, 1986–1996[a]

| Regulatory year | Successful | | | | | Unsuccessful | | | | | Hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total (%) | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total (%) | |
| 1986–1987 | 23 | 10 | 1 | 5 | 39 (42) | 29 | 22 | 1 | 1 | 53 (58) | 92 |
| 1987–1988 | 24 | 16 | 6 | 1 | 47 (53) | 22 | 13 | 3 | 3 | 41 (47) | 88 |
| 1988–1989 | 18 | 5 | 4 | 5 | 32 (47) | 19 | 8 | 4 | 5 | 36 (53) | 68 |
| 1989–1990 | 24 | 11 | 2 | 1 | 38 (44) | 24 | 20 | 5 | 0 | 49 (56) | 87 |
| 1990–1991 | 35 | 17 | 0 | 1 | 53 (46) | 31 | 26 | 4 | 1 | 62 (54) | 115 |
| 1991–1992 | 17 | 11 | 1 | 0 | 29 (32) | 31 | 31 | 0 | 0 | 62 (68) | 91 |
| 1992–1993 | 10 | 8 | 1 | 0 | 19 (23) | 31 | 31 | 3 | 0 | 65 (77) | 84 |
| 1993–1994 | 14 | 10 | 3 | 1 | 28 (36) | 22 | 24 | 0 | 3 | 49 (64) | 77 |
| 1994–1995 | 16 | 9 | 0 | 2 | 27 (30) | 29 | 31 | 3 | 0 | 63 (70) | 90 |
| 1995–1996 | 17 | 5 | 1 | 0 | 23 (29) | 13 | 35 | 7 | 1 | 56 (71) | 79 |
| 1996–1997 | 7 | 6 | 1 | 0 | 14 (23) | 18 | 25 | 4 | 1 | 48 (77) | 62 |

[a] Source: moose harvest reports.

[b] Resident of Unit 25D.

Table 11 Unit 25A reported moose harvest chronology[a], percent by time period, 1986–1996

| Regulatory | Harvest periods | | | | | | |
|---|---|---|---|---|---|---|---|
| year | 9/1–9/7[b] | 9/8–9/14 | 9/15–9/21 | 9/22–9/28 | 9/29–10/5[c] | Unk | *n* |
| 1986–1987 | 32 | 43 | 13 | 11 | | 2 | 47 |
| 1987–1988 | 12 | 34 | 34 | 17 | | 2 | 41 |
| 1988–1989 | 10 | 54 | 31 | 3 | | 3 | 39 |
| 1989–1990 | 20 | 36 | 40 | 4 | | 0 | 25 |
| 1990–1991 | 21 | 54 | 20 | 4 | | 2 | 56 |
| 1991–1992 | 19 | 43 | 32 | 2 | | 4 | 47 |
| 1992–1993 | 12 | 41 | 35 | 12 | | -- | 17 |
| 1993–1994 | 30 | 48 | 19 | 4 | | 0 | 27 |
| 1994–1995 | 44 | 52 | 4 | 0 | | 0 | 24 |
| 1995–1996 | 35 | 38 | 16 | 8 | | 3 | 37 |
| 1996–1997 | 33 | 23 | 35 | 8 | | 0 | 39 |

[a] Source: moose harvest reports.
[b] Includes 1 moose reported taken in late Aug.
[c] No open season.

Table 12 Unit 25B reported moose harvest chronology[a], percent by time period, 1986–1996

| Regulatory | Harvest periods | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| year | 9/1–9/7 | 9/8–9/14 | 9/15–9/21 | 9/22–9/28 | 9/29–10/5 | Dec | Unk | *n* |
| 1986–1987 | 7 | 22 | 52 | 7 | -[b] | 0 | 11 | 27 |
| 1987–1988 | 8 | 19 | 39 | 19 | 4[b] | 8 | 4 | 26 |
| 1988–1989 | 4 | 41 | 44 | 4 | -[b] | 4 | 4 | 27 |
| 1989–1990 | 8 | 21 | 42 | 13 | -[b] | 17 | 0 | 24 |
| 1990–1991 | 11 | 28 | 34 | 13 | 2 | 11 | 2 | 47 |
| 1991–1992 | 3 | 41 | 38 | 13 | 0 | 3 | 3 | 32 |
| 1992–1993 | 11 | 44 | 17 | 0 | 0 | 28 | 0 | 18 |
| 1993–1994 | 12 | 33 | 35 | 12 | 0 | 7 | 2 | 43 |
| 1994–1995 | 3 | 38 | 44 | 13 | 0 | 3 | 0 | 33 |
| 1995–1996 | 28 | 38 | 25 | 3 | 0 | 6 | 0 | 32 |
| 1996–1997 | 25 | 35 | 15 | 5 | 0 | 10 | 10 | 20 |

[a] Source: moose harvest reports.
[b] No open season.

Table 13 Unit 25D East reported moose harvest chronology[a], percent by time period, 1986–1996

| Regulatory year | Harvest periods | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 9/1–9/7 | 9/8–9/14 | 9/15–9/21 | 9/22–9/28 | 9/29–10/5 | Dec | Unk | *n* |
| 1986–1987 | 0 | 56 | 31 | 3 | -[b] | 8 | 3 | 39 |
| 1987–1988 | 0 | 20 | 53 | 13 | -[b] | 7 | 7 | 45 |
| 1988–1989 | 0 | 47 | 31 | 3 | 3 | 13 | 3 | 32 |
| 1989–1990 | 0 | 45 | 24 | 11 | 3 | 13 | 3 | 38 |
| 1990–1991 | 8 | 37 | 40 | 2 | 2 | 6 | 6 | 52 |
| 1991–1992 | 17 | 55 | 24 | 3 | 0 | 0 | 0 | 29 |
| 1992–1993 | 0 | 42 | 53 | 5 | 0 | 0 | 0 | 19 |
| 1993–1994 | 18 | 32 | 29 | 0 | 4 | 11 | 7 | 28 |
| 1994–1995 | 8 | 54 | 27 | 8 | 0 | 0 | 0 | 27 |
| 1995–1996 | 13 | 43 | 35 | 0 | 0 | 4 | 4 | 23 |
| 1996–1997 | 7 | 50 | 29 | 0 | 0 | 0 | 14 | 14 |

[a] Source: moose harvest reports.
[b] No open season.

Table 14 Unit 25A moose harvest percent by transport method, 1986–1996[a]

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1986–1987 | 72 | 17 | 8 | 0 | 0 | 0 | 0 | 2 | 47 |
| 1987–1988 | 61 | 12 | 17 | 0 | 0 | 0 | 2 | 7 | 41 |
| 1988–1989 | 61 | 17 | 20 | 0 | 0 | 0 | 5 | 5 | 41 |
| 1989–1990 | 56 | 16 | 24 | 0 | 0 | 0 | 4 | 0 | 25 |
| 1990–1991 | 61 | 11 | 27 | 0 | 0 | 0 | 0 | 2 | 56 |
| 1991–1992 | 77 | 15 | 9 | 0 | 0 | 0 | 0 | 0 | 47 |
| 1992–1993 | 76 | 6 | 12 | 0 | 0 | 0 | 0 | 6 | 17 |
| 1993–1994 | 56 | 26 | 15 | 0 | 0 | 0 | 4 | 0 | 27 |
| 1994–1995 | 75 | 4 | 13 | 0 | 0 | 0 | 9 | 0 | 24 |
| 1995–1996 | 62 | 16 | 16 | 0 | 0 | 0 | 3 | 3 | 37 |
| 1996–1997 | 69 | 28 | 2 | 0 | 0 | 0 | 0 | 0 | 39 |

[a] Source: moose harvest reports.

Table 15 Unit 25B moose harvest percent by transport method, 1986–1996[a]

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1986–1987 | 30 | 0 | 63 | 0 | 0 | 0 | 0 | 7 | 27 |
| 1987–1988 | 27 | 0 | 65 | 0 | 4 | 0 | 0 | 4 | 26 |
| 1988–1989 | 29 | 0 | 61 | 0 | 4 | 0 | 0 | 7 | 28 |
| 1989–1990 | 21 | 0 | 75 | 0 | 0 | 0 | 0 | 4 | 24 |
| 1990–1991 | 23 | 0 | 68 | 0 | 6 | 2 | 0 | 0 | 47 |
| 1991–1992 | 9 | 0 | 78 | 0 | 0 | 0 | 0 | 12 | 32 |
| 1992–1993 | 22 | 6 | 61 | 0 | 11 | 0 | 0 | 0 | 18 |
| 1993–1994 | 12 | 2 | 77 | 2 | 2 | 2 | 0 | 2 | 43 |
| 1994–1995 | 22 | 0 | 73 | 0 | 0 | 0 | 0 | 6 | 33 |
| 1995–1996 | 9 | 3 | 75 | 3 | 3 | 0 | 0 | 6 | 32 |
| 1996–1997 | 15 | 5 | 75 | 0 | 0 | 0 | 0 | 5 | 20 |

[a] Source: moose harvest reports.

Table 16 Unit 25D East moose harvest percent by transport method, 1986–1996[a]

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1986–1987 | 13 | 0 | 67 | 0 | 5 | 0 | 3 | 13 | 39 |
| 1987–1988 | 17 | 0 | 66 | 0 | 6 | 0 | 2 | 8 | 47 |
| 1988–1989 | 28 | 0 | 47 | 0 | 16 | 0 | 0 | 9 | 32 |
| 1989–1990 | 26 | 0 | 51 | 0 | 13 | 0 | 3 | 8 | 39 |
| 1990–1991 | 26 | 0 | 64 | 2 | 2 | 0 | 0 | 6 | 53 |
| 1991–1992 | 21 | 0 | 72 | 0 | 0 | 7 | 0 | 0 | 29 |
| 1992–1993 | 42 | 0 | 53 | 0 | 0 | 5 | 0 | 0 | 19 |
| 1993–1994 | 14 | 0 | 75 | 0 | 4 | 0 | 0 | 7 | 28 |
| 1994–1995 | 8 | 0 | 78 | 4 | 0 | 0 | 0 | 11 | 27 |
| 1995–1996 | 26 | 0 | 61 | 0 | 0 | 0 | 4 | 9 | 23 |
| 1996–1997 | 21 | 0 | 71 | 0 | 0 | 0 | 0 | 7 | 14 |

[a] Source: moose harvest reports.

## LOCATION

**GAME MANAGEMENT UNIT:** 26A (56,000 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** Western North Slope

## BACKGROUND

Archaeological evidence indicates moose have been present on the North Slope either sporadically or at low densities for many years. Since 1940 moose populations have increased in size and have become well established in Unit 26A. Although moose are throughout the unit during summer, they are confined to riparian habitat along river corridors during winter. The largest winter concentrations of moose are in the inland portions of the Colville River drainage.

Since 1970 late winter surveys have been conducted annually to assess population status and short yearling recruitment. Complete surveys of all major drainages in Unit 26A were completed in 1970, 1977, 1984, 1991, and 1995. Throughout the period from 1970 to 1991, the population was stable and increased slowly to 1535 moose. Between 1991 and 1995 the population declined to 757 moose. Trend counts show the population began declining in 1992 and 1993.

Regular harvest by hunters using aircraft as transportation began in the early 1970s. North Slope hunters also travel up the Colville River by boat. The mean reported harvest from 1985 to 1993 was 59 moose per year, with a high of 67 in 1991. As the moose population declined, the harvest decreased to 40 during 1994–1995.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Allow the moose population to in Unit 26A to rebuild to a minimum of 1000 animals
- Investigate reasons for the population decline

### MANAGEMENT OBJECTIVES:

- Conduct spring surveys to monitor short yearling survival and population numbers
- Conduct fall trend counts to monitor sex and age composition in the population
- Census the population at intervals of 7 years or less
- Capture moose and take blood, fecal and hair samples to test for pregnancy, disease, parasites, and mineral deficiencies; attach radio collars to monitor population trends, study movements, and help determine causes of moose mortality

## METHODS

We used a Cessna 185 and a Piper PA–18 aircraft to survey trend count areas along the Colville, Chandler, and Anaktuvuk rivers during 1–2 November 1995, 19–21 April 1996, 5–7 November 1996, and 1–3 April 1997. For all surveys we flew over suitable riparian habitat and attempted to locate all the moose in the survey areas. We determined sex and age composition during the fall surveys and short yearling recruitment and total number of moose during spring surveys.

During summer and fall of 1995, we examined carcasses from dead moose along the Chandler and Anaktuvuk rivers. We gave sample kits to hunters during August and September of 1995 and asked them to take blood, tissue, and fecal samples from moose they harvested. Samples from the carcasses and hunter-killed moose were analyzed for signs of mineral deficiencies, disease, contaminants, and symptoms of starvation.

In a cooperative study with the North Slope Borough, we used a Hughes 500 helicopter and standard chemical immobilization techniques to capture moose and radio collar 30 female and 5 male moose from 22–25 April 1996 and 15 cow moose on 10–14 April 1997. Moose were immobilized using 4.6 mg carfentanil citrate and 170 mg xylazine in 3 cc darts. When the sampling procedure was finished, we reversed the effects of carfentanil by injecting 600 mg of Naltrexone intramuscularly. During immobilization, each moose was given a physical examination and we collected blood, fecal, and hair samples to test for pregnancy status, disease, mineral status, and contaminants. In addition, 8 moose that had been examined and had tested positive to exposure to diseases in 1996 were recaptured and sampled in 1997. We distributed the number of moose captured evenly between the Colville, Anaktuvuk, and Chandler Rivers.

Surveys to locate and observe radiocollared moose were flown daily from 27 May, 4 June, 13 June, 8 July, 28 July, 28 August, 5 November 1996 and on 3 March and 2 April 1997 to monitor calving success, calf mortality, and adult mortality. We obtained GPS locations for all moose that were observed during radiotracking surveys. All radiocollared moose were observed during 3–6 June 1997 to monitor calving success and calf survival.

Willow samples were collected from the Anaktuvuk, Chandler, and Colville rivers and are being analyzed for nutritional content and digestibility.

We compiled harvest data from harvest reports submitted by hunters. In addition, we gathered harvest data by contacting hunters near Umiat and Nuiqsut.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND:

*Population Size and Trend*

We counted 757 moose in the census conducted in April 1995. This indicated a decline of 51% from the 1535 moose counted in 1991. Census results of 1219, 1258, 1447, and 1535 in 1970, 1977, 1984, and 1991, respectively, indicate the population was stable and slowly increasing for at least 20 years before the recent decline (Table 1).

In April 1996 the trend count conducted in sections of the Anaktuvuk, Chandler, and Colville rivers indicated another substantial population decline. We counted 152 moose in the trend count area, compared to 307 moose in 1995 and 504 in 1994. We saw only 1 short yearling during this survey (Table 2).

During the April 1997 survey, we counted 188 moose in the trend count area, which indicated the first increase in the population in 6 years. The number of adults declined by 6 moose but was offset by the addition of 43 short yearlings. Calf survival was obviously much better during 1996–97, and adult mortality was lower than in the previous 3 years (Table 2).

*Population Composition*

The percentage of short yearlings was <1% in the 1996 spring trend area count, continuing the trend of very poor calf survival seen in 1994 and 1995. However, the percentage of short yearlings increased to 23% in the April 1997 trend count, indicating a dramatic increase over the previous 3 years.

The fall 1995 composition survey was considered incomplete due to inadequate snow cover and wide dispersal of moose. We observed only 20 cows, 14 bulls, and no calves.

During the fall 1996 composition surveys, we observed 161 moose in the following classes: 47 bulls (59 bulls,100 cows), 79 cows, and 35 calves (44 calves, 100 cows). This was a marked increase over the previous 3 years when there had been very few calves surviving the summer (Table 3). There was an obvious absence of bulls in the younger age groups that coincided with the poor calf survival of the previous 3 years (see below).

The estimated antler widths of bulls were:

| Inches | <30 | 30–39 | 40–49 | 50–59 | 60+ |
|---|---|---|---|---|---|
| Percent | 0% | 0% | 38% | 45% | 17% |

*Distribution and Movements*

Moose are widely dispersed during the summer months, ranging from the northern foothills of the Brooks Range Mountains to the arctic coast. During the fall, as snow cover accumulates, moose move to the riparian corridors of the large river systems, primarily the Colville River drainage. During April, when snow cover begins to disappear in the foothills, moose begin to move away from the riparian corridors.

We recorded GPS locations for all moose observed during radiotracking surveys and obtained distribution information. With the exception of 1 animal that was captured on a hillside, all moose were captured in the riparian corridors of major rivers from 22–25 April 1996.

By 13 June, 25 of 35 collared moose had moved away from the river bottoms into small tributaries or hills surrounding the major rivers. Eighteen of 20 cows seen with calves had moved away from the major rivers before calving. It appeared that most pregnant cows stayed on the major rivers until a few days before parturition and then moved away from the river bottoms to give birth. Three cows moved from the Anaktuvuk River to the Tuluga River to give birth. The mean distance that moose had moved away from the river bottoms was 8 miles and ranged from less than 1 mile to 18 miles. Four of 5 cows with negative pregnancy test results remained on the river bottom. Three cows with positive pregnancy test results were never seen with calves and none was observed leaving the river bottoms. Three of 5 bulls moved away from the river bottoms with 12 miles being the maximum distance traveled.

By 28 July, 16 of the cows with calves had returned to the riparian corridors and 18 had dispersed away from the river bottoms. Most of the cows were within 8 miles of the rivers, but 1 cow and calf were 107 miles north and another cow/calf pair were 36 miles north of the Colville River. We could locate only 2 of the bulls, found in the foothills of the Brooks Range, and we assumed the others had traveled out of the survey area.

We flew surveys on 5–8 November and found that the widely dispersed moose had moved back to within a few miles of the river bottoms. We found 20 moose on the river bottoms and 14 on tributaries and hills around the rivers. During surveys flown in March and April, we found 28 moose in the riparian habitat of the river bottoms and 4 moose in the areas adjacent to the rivers.

## MORTALITY

### *Harvest*

Season and Bag Limit. Unit 26A, 1995–1996

| Units and Bag Limits | Resident/Subsistence Hunters | Nonresident Hunters |
|---|---|---|
| Resident Hunters: | | |
| 1 moose** | 1 Aug–31 Aug | |
| OR 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side | 1 Sep–31 Dec | |
| Nonresident Hunters: | | 1 Sep–15 Sep |
| 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side. | | |
| Unit 26A: that portion in the Colville River drainage downstream from the Anaktuvuk River 1996–1997. | | |
| Resident Hunters: | | |
| 1 bull** | 1 Aug–31 Aug | |
| Remainder of Unit 26A | | |
| All Hunters | No open season | No open season |

**Hunters may not hunt moose during August using aircraft for transportation or for carrying meat.

Board of Game Actions and Emergency Orders. The Board of Game approved a department proposal for the 1995–1996 season to continue with a bag limit of 1 moose during the 1 Aug–21 Aug season when aircraft use was not allowed for moose hunting. The regulation also set a bag limit of 1 bull with 50-inch antlers or 4 or more brow tines on 1 side after August and reduced the length of the rest of the season to 1 Sep–31 Dec for residents and 5 Sep–15 Sep for nonresidents.

As the moose population continued to decline, the board further restricted the season and bag limit for the 1996–1997 regulatory year. The board approved a department proposal closing Unit 26A to moose hunting, except for a portion of the Colville River downstream from the mouth of the Anaktuvuk River. The portion of Unit 26A open to hunting had a bag limit of 1 bull from 1 Aug–31 Aug and no aircraft use allowed for moose hunting.

Hunter Harvest. Hunter harvest reports indicate 14 bull moose were harvested during fall of 1995, and no moose were taken in 1996 (Table 4). The low 1995 harvest and no harvest in 1996 were results of restrictive regulations and the declining numbers of moose. The antler width of moose harvested in 1995 was similar to previous size patterns with 50% of the moose harvested in the 50–59" category (Table 5).

Hunter Residency and Success. The total number of local residents, nonlocal residents, and nonresidents was much lower than the average number of hunters during 1995 and was limited to

6 residents in 1996 (Table 6). Hunter success rates, 33% in 1995 and 0% in 1996, were the lowest ever recorded in Unit 26A.

Harvest Chronology. During 1995 most of the harvest was during August (29%) (when local residents chose to hunt) and during the second week of September (50%) because nonresident hunters were prevented from hunting most of the first week of September (Table 7).

Transport Methods. As reported in previous years, most hunters used aircraft or boats for transportation (Table 8).

*Other Mortality*

Natural mortality appears to be the major cause of the decline of moose in Unit 26A. Fall surveys in 1993, 1994, and 1995 indicated low numbers of calves surviving the summer. Either productivity of cows (calving rate) was low, or summer calf mortality was high. In addition to low recruitment, the number of adults counted in the trend count area during spring counts declined from 424 in 1993 to 145 in 1997, indicating high adult mortality.

To learn more about the reasons for the population decline, we examined and sampled moose found dead during the summer of 1995, hunter-killed moose from the fall of 1995, and moose captured during the springs of 1996 and 1997 and learned the following:

- During the summer of 1995, approximately 38 dead moose were found along the Anaktuvuk and Chandler River drainages. Most of these animals were adults and did not appear to have been killed by predators.
- Nearly all of the moose that were found dead, the hunter-killed moose, and captured moose tested to be marginally deficient in copper.
- Blood samples indicated that 40 of 49 (82%) females tested during April 1996 and 1997 were pregnant. Thirty-one of these pregnant cows were later seen with a calf during aerial surveys, so at least 63% had calves. This is a minimum number because an unknown number may have had calves that died before they were seen during the survey. During 1996–1997, of the 29 collared cows, 11 calves (38 calves per 100 cows) survived the winter.
- There was a substantial survival advantage for calves born during the early part of the calving season. Of the 12 calves that were observed during surveys on 27 and 28 May 1996, 9 survived through April 1997. Of the 11 calves born after 28 May only 2 survived.
- Eight of 43 cows tested positive for antibodies to the bacterial disease brucellosis. One bull, that originally tested negative, was later found dead and *Brucella suis* Biovar 4 was detected in the cultured sample. This is the same strain of Brucella present in the caribou of northern Alaska. During 1996–1997, 4 of 6 cows with positive titers for exposure to *Brucella* had calves, and 2 of these calves survived the winter, similar to the survival rate for the rest of the population. We recaptured 5 of 6 females testing positive in 1996, and they all had high titers again in 1997, indicating that the disease was still active.
- During 1996, 6 cows tested positive for exposure to another bacteria, *Leptospira interrogans serovar pomona*, which causes abortions and weak calves. Most of these were located along the Anaktuvuk River. Five of these were pregnant, but none had a calf that survived the winter. One of these animals also had been exposed to *Brucella*. When moose were captured

in 1997, including 2 recaptures of positive titer moose from 1996, none of them had positive titers for Leptospirosis.

- Only 3 (9%) of the instrumented animals died during 1996–1997, so the adult mortality rate seems to have been much lower than in previous years. However, 2 of 5 bulls (40%) died, indicating that mortality may still be high for that segment of the population.

Wolf and grizzly bear numbers are at relatively high levels and have been mortality factors during the decline in numbers of moose. We used probability-sampling designs to estimate wolf densities within the range of the moose population during April 1992 and April 1994, and we found 4.2 and 4.1 wolves/1000 $km^2$, respectively. Traditional track surveys conducted during 1986 and 1987 in approximately the same area yielded density estimates of 2.6 wolves/1000 $km^2$ and 2.7–3.2 wolves/1000 $km^2$ (Trent 1988). These estimates indicate the number of wolves have increased and remained stable at higher densities during the period of moose population decline. Grizzly bear research conducted in the western portion of the Brooks Range in Unit 26A (Reynolds 1989) and reports from guides, pilots, and hunters indicate grizzly bear numbers are also increasing in Unit 26A. Bear predation may be a major cause of poor calf survival in the summer.

## CONCLUSIONS AND RECOMMENDATIONS

The moose population in Unit 26A continued to decline during 1995 and 1996. The number counted in the trend count area declined from 307 in 1995 to 152 in 1996. This follows a 51% decline in the number of moose counted during unitwide censuses, ranging from 1535 animals in 1991 to 757 animals in 1995. In addition, recruitment has been very low with the percentage of short yearlings counted during the springs of 1994, 1995, and 1996 at 3%, 2%, and <1%, respectively. In addition to poor recruitment, adult mortality has been high. During the summer of 1995, 38 dead adult moose were found along the Chandler and Anaktuvuk River drainages. Many of these moose probably had died during summer; neither people nor predators had killed them.

To determine causes of the population decline, we captured moose during April 1996 and 1997. We attached radio collars, and a veterinarian and a pathologist examined the moose for physical condition, pregnancy status, and evidence of disease. Whole blood, serum, feces, hair, and any suspicious tissues or lesions were collected to test for indications of disease, pregnancy status, contaminants, parasites, and mineral deficiencies. We used aerial surveys and radiotelemetry equipment to monitor the movements, productivity, and mortality of instrumented moose. Surveys were flown during and after calving season to evaluate the mortality rate of calves.

The decline was probably due to a combination of factors that may include the following:

- The population may have exceeded the carrying capacity of the range, resulting in poor nutrition of moose. The population had increased slowly but steadily for 20 years and may have gone beyond the limit of what the habitat could support. In addition, the snowshoe hare population irrupted just before and during the period of the moose population decline, placing more pressure on the willows. It is possible this triggered an herbaceous defense response in the willows that may have detrimentally affected the moose. Unfortunately, we had no browse assessment at the time the decline began. Starvation may have affected productivity and susceptibility to disease and weather factors.

- Nearly all of the moose that were found dead, the hunter killed moose, and captured moose tested marginally deficient in copper, which may also have affected productivity and susceptibility to disease and weather factors.
- Blood tests indicated that moose in the Colville River system had been exposed to 2 bacteria that can cause disease, abortions, and sick calves. During 1996–1997, 8 of 43 cows tested positive for antibodies to *Brucella* and 6 to *Leptospira*, one being exposed to both.
- Brucellosis was previously thought to be quite deadly to moose. Pregnancy rates, calf survival, and adult survival were about the same as for the rest of the population for cows with Brucellosis. However, 1 bull, that had originally tested negative and was later found dead, was sampled and *Brucella suis* Biovar 4 was cultured. Although the sampled cow moose had good survival and productivity, it is possible that Brucellosis had a major effect on the population and that most of the moose that survived are resistant to the disease.
- Five out of six of the cows that tested positive for exposure to *Leptospira* became pregnant, but none of the calves survived. Although the sample size is small, Leptospirosis may have affected calf survival. If the disease was more widespread through the population during the decline, it could have contributed to the poor calf survival. Five of 6 cows testing positive for exposure to *Leptospira* were located along the Anaktuvuk River, indicating that the disease was concentrated there.
- Widespread declines in moose numbers have occurred throughout northern and northwestern Alaska (Units 22, 23, 26A, 26B, 26C), indicating that weather may be a factor. Insect harassment, which is weather related, was intense during the summer of 1995 and may have led to starvation of some moose.
- Densities of bears and wolves were high during the period of the decline, and predation was one of the mortality factors. The low summer calf survival indicates that bear predation on calves may have been an important factor.
- Hunting was a contributing mortality factor during periods of poor recruitment in the Unit 26A moose population. Before 1991, a mean of 295 short yearlings was being added to the population each year and a mean of 58 moose per year was being harvested. However, there were high harvest rates and poor recruitment from 1993 to 1997 so hunter harvest may have contributed to the decline. Between 1991 and 1995 the number of adults in the population declined by 485 animals and hunters harvested 228 moose.

In response to the severe population decline, we changed the management goal from maintaining the population to rebuilding the population. In addition, the Board of Game passed regulations that greatly reduced hunting pressure in 1995 and eliminated hunting pressure for most of the area in 1996. While hunting was not the major cause of the decline, it is currently a contributing factor and one that can be changed to help begin rebuilding the population.

Calf survival was much better during 1996–1997 and adult mortality was lower than in the previous 3 years. Fall 1996 composition surveys indicated much higher summer calf survival than in the previous 3 falls. We observed 126 adults and 35 calves (22%), compared to 4%, 2%, and 0% calves during 1993, 1994, and 1995, respectively. Spring 1997 counts indicated that over winter survival was also good as we counted 145 adults and 43 short yearlings (23%). This compares to 3%, 2%, and <1% for previous years. The 1997 count indicated the first increase in the population in 6 years. Hopefully, this trend will continue and we are seeing the beginning of a population recovery. However, numbers are still quite low and regulations must remain restrictive to allow the population to recover.

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Table 1 Number of adult and calf moose from Unit 26A censuses, 1970–1995

| Year | Adults | Calves | Total | % Calves |
|---|---|---|---|---|
| 1970 | 911 | 308 | 1219 | 25 |
| 1977 | 991 | 267 | 1258 | 21 |
| 1984 | 1145 | 302 | 1447 | 21 |
| 1991 | 1231 | 304 | 1535 | 20 |
| 1995 | 746 | 11 | 757 | 1 |

Table 2 Unit 26A moose trend counts: Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, and Colville River between the mouths of Anaktuvuk and Killik rivers, 1970, 1974–1981, and 1983–1997

| Year | Total Moose | Adults | Calves | Short Yearling (%) |
|---|---|---|---|---|
| 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 |
| 1989 | 699 | 630 | 69 | 11 |
| 1990 | 618 | 543 | 74 | 12 |
| 1991 | 647 | 516 | 176 | 21 |
| 1992 | 510 | 416 | 133 | 18 |
| 1993 | 504 | 424 | 85 | 15 |
| 1994 | 407 | 396 | 11 | 3 |
| 1995 | 307 | 302 | 5 | 2 |
| 1996 | 152 | 151 | 1 | <1 |
| 1997 | 188 | 145 | 43 | 23 |

[a] Partial count due to incomplete snow cover and wide dispersal of moose.

Table 3 Unit 26A fall aerial moose composition counts 1983–1997

| Regulatory Year | Bulls:100 Cows | Calves:100 Cows | Calves (%) | Adults | Total Moose |
|---|---|---|---|---|---|
| 1983–1984 | 54 | 38 | 20 | 150 | 188 |
| 1986–1987 | 47 | 18 | 11 | 302 | 339 |
| 1987–1988 | 39 | 21 | 13 | 101 | 104 |
| 1990–1991 | 33 | 45 | 25 | 277 | 371 |
| 1991–1992 | 40 | 39 | 22 | 254 | 325 |
| 1992–1993 | 36 | 41 | 23 | 190 | 248 |
| 1993–1994 | 36 | 6 | 4 | 381 | 397 |
| 1994–1995 | 35 | 3 | 2 | 287 | 293 |
| 1995–1996[a] | 70 | 0 | 0 | 34 | 34 |
| 1996–1997 | 60 | 44 | 22 | 126 | 161 |

[a] Partial count due to incomplete snow cover and wide dispersal of moose.

Table 4 Unit 26A moose harvest, 1985–1997

| | Reported Hunter Harvest | | |
|---|---|---|---|
| Regulatory Year | Male | Female | Total |
| 1985–1986 | 50 | 15 | 65 |
| 1986–1987 | 46 | 6 | 52 |
| 1987–1988 | 49 | 13 | 62 |
| 1988–1989 | 51 | 6 | 57 |
| 1989–1990 | 41 | 3 | 44 |
| 1990–1991 | 60 | 4 | 64 |
| 1991–1992 | 59 | 8 | 67 |
| 1992–1993 | 52 | 8 | 60 |
| 1993–1994 | 53 | 8 | 61 |
| 1994–1995 | 36 | 4 | 40 |
| 1995–1996 | 14 | 0 | 14 |
| 1996–1997 | 0 | 0 | 0 |

Table 5 Percent antler width categories (inches) among moose harvested in Unit 26A, 1983–1996

| Year | <20 | 20–29 | 30–39 | 40–49 | 50–59 | 60+ | N |
|---|---|---|---|---|---|---|---|
| 1983 | 0 | 4 | 35 | 15 | 35 | 12 | 26 |
| 1984 | 3 | 5 | 18 | 33 | 30 | 13 | 40 |
| 1985 | 0 | 7 | 11 | 18 | 47 | 19 | 45 |
| 1986 | 0 | 7 | 18 | 29 | 42 | 4 | 45 |
| 1987 | 0 | 0 | 20 | 24 | 47 | 9 | 45 |
| 1988 | 2 | 2 | 0 | 27 | 55 | 14 | 49 |
| 1989 | 0 | 3 | 14 | 14 | 51 | 18 | 39 |
| 1990 | 0 | 4 | 15 | 10 | 59 | 12 | 57 |
| 1991 (16% unknown) | 0 | 3 | 3 | 13 | 49 | 16 | 56 |
| 1992 (13% unknown) | 0 | 2 | 5 | 7 | 48 | 25 | 52 |
| 1993 (15% unknown) | 3 | 2 | 5 | 11 | 49 | 15 | 53 |
| 1994 (10% unknown) | 1 | 2 | 8 | 9 | 62 | 8 | 40 |
| 1995 (7% unknown) | 0 | 7 | 14 | 7 | 50 | 15 | 14 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 6 Moose hunter residency and success, Unit 26A, 1987–1997

| Regulatory Year | Successful hunters: Local res[a] | Nonlocal res[b] | Nonres[c] | Unk[d] | Total | (%) | Total hunters: Local res[a] | Nonlocal res[b] | Nonres[c] | Unk[d] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985–1986 | – | – | – | – | 65 | 66 | 29 | 45 | 24 | 0 | 98 |
| 1986–1987 | – | – | – | – | 52 | 65 | 29 | 33 | 18 | 0 | 80 |
| 1987–1988 | – | – | – | – | 62 | 61 | 40 | 20 | 39 | 0 | 99 |
| 1988–1989 | – | – | – | – | 57 | 69 | 12 | 30 | 37 | 5 | 84 |
| 1989–1990 | 9 | 13 | 21 | 1 | 44 | 66 | 10 | 23 | 33 | 2 | 68 |
| 1990–1991 | 8 | 19 | 35 | 2 | 64 | 65 | 13 | 40 | 43 | 3 | 99 |
| 1991–1992 | 9 | 37 | 29 | 1 | 67 | 66 | 13 | 51 | 37 | 1 | 102 |
| 1992–1993 | 12 | 16 | 29 | 3 | 60 | 57 | 25 | 35 | 41 | 4 | 105 |
| 1993–1994 | 7 | 22 | 29 | 3 | 61 | 79 | 11 | 30 | 32 | 4 | 77 |
| 1994–1995 | 8 | 7 | 24 | 1 | 40 | 74 | 11 | 14 | 29 | 0 | 54 |
| 1995–1996 | 4 | 3 | 6 | 1 | 14 | 33 | 13 | 12 | 15 | 3 | 43 |
| 1996–1997 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 6 |

[a] Local resident hunters are residents of the North Slope Borough.

[b] Nonlocal resident hunters are residents of the State of Alaska, but not residing in the North Slope Borough.

[c] Nonresident hunters.

[d] Unknown residency.

Table 7 Percent chronology of moose harvest, Unit 26A, 1987–1997

| Regulatory Year | Harvest Periods | | | | | | |
|---|---|---|---|---|---|---|---|
| | Aug | 1–7 Sep | 8–14 Sep | 15–21 Sep | 22–31 Sep | Oct-Dec | N |
| 1987–1988 | 9 | 36 | 35 | 6 | 4 | 10 | 62 |
| 1988–1989 | 9 | 45 | 34 | 6 | 3 | 0 | 57 |
| 1989–1990 | 17 | 48 | 18 | 16 | 0 | 2 | 44 |
| 1990–1991 | 4 | 44 | 39 | 6 | 5 | 2 | 64 |
| 1991–1992 | 10 | 55 | 22 | 10 | 0 | 3 | 67 |
| 1992–1993 | 9 | 58 | 20 | 3 | 8 | 2 | 60 |
| 1993–1994 | 7 | 62 | 23 | 3 | 3 | 2 | 61 |
| 1994–1995 | 3 | 50 | 19 | 18 | 5 | 5 | 40 |
| 1995–1996 | 29 | 7 | 50 | 7 | 0 | 7 | 14 |
| 1996–1997 | – | – | – | – | – | – | 0 |

Table 8 Percent transport methods for moose harvest in Unit 26A, 1987–1997

| | Method of Transportation (%) | | | | | |
|---|---|---|---|---|---|---|
| Regulatory Year | Airplane | Boat | 3-or 4-wheeler | Snowmachine | ORV | N |
| 1987–1988 | 80 | 15 | 2 | 1 | 2 | 59 |
| 1988–1989 | 81 | 18 | 1 | – | – | 53 |
| 1989–1990 | 84 | 14 | 2 | – | – | 40 |
| 1990–1991 | 62 | 28 | 3 | 2 | 3 | 61 |
| 1991–1992 | 85 | 7 | 3 | 3 | 2 | 67 |
| 1992–1993 | 85 | 13 | 0 | 2 | 0 | 60 |
| 1993–1994 | 83 | 17 | 0 | 0 | 0 | 61 |
| 1994–1995 | 78 | 18 | 0 | 2 | 2 | 40 |
| 1995–1996 | 50 | 43 | 7 | 0 | 0 | 14 |
| 1996–1997 | – | – | – | – | – | 0 |

## LOCATION

**GAME MANAGEMENT UNIT:** Units 26B and 26C (26,000 $mi^2$)

**GEOGRAPHIC DESCRIPTION:** North Slope of the Brooks Range and Arctic Coastal Plain east of the Itkillik River

## BACKGROUND

Moose were scarce in arctic Alaska before the early 1950s when populations increased and reached high densities in the limited riparian habitat in major drainages (LeResche et al. 1974). Predation, as well as hunting by humans, probably contributed to the historical scarcity of moose. The reduction of wolf numbers by federal control programs during the late 1940s and early 1950s was probably important in allowing moose populations to increase and become established in most of the riparian shrub habitat on the North Slope. Moose are at the northern limit of their range in the eastern Arctic.

Composition surveys have been conducted by the staff of the US Fish and Wildlife Service (FWS) and Arctic National Wildlife Refuge (ANWR) (Martin and Garner 1984; Weiler and Liedberg 1987; Mauer and Akaran 1994; Mauer 1995, 1997). The Canning River has been surveyed almost annually since 1983, and areas to the west were surveyed in 1986, 1988, 1989, 1990, 1991, 1994, 1995, 1996 and 1997. No surveys were accomplished in Units 26B and 26C in 1992 or 1993 because of poor survey conditions.

Moose hunting regulations have become more restrictive during the last decade, and a precipitous decline in numbers led to a season closure in 1996. In 1987 the open season for most hunters was shortened to 1–30 September, and the previous bag limit of 1 moose was changed to 1 bull. At the same time, the season for qualified subsistence hunters residing in Unit 26 was lengthened to 1 August–31 December and the bag limit of 1 moose of either sex continued. Changes in season and bag limit during the late 1980s apparently reduced the harvest to a sustainable level in the DHMA and in the remainder of Unit 26B. A significant decline in moose numbers in the early 1990s led to a 50-inch minimum antler size limit for all nonlocal hunters in 1994, and a season closure in 1996.

Habitat severely limits the number of moose that can be sustained and harvested, and open habitat and the concentrated nature of moose distribution create the potential for excessive harvest in accessible areas. Although travel to the area is expensive and often logistically difficult, hunting pressure around the larger and better known aircraft landing sites is considerable. Concern about the excessive concentration of hunters has been expressed by guides, outfitters, hunters, and ANWR staff. The Dalton Highway in central Unit 26B provides unique opportunities for viewing and photography but also the potential to adversely affect moose populations and associated human uses by increasing access to certain areas.

Kaktovik and Nuiqsut are the only subsistence communities in the area, and residents took 5 to 10 moose annually before the season closure in 1996. The small subsistence harvest resulted from the scarcity of moose near Kaktovik and the fact that most hunting by Nuiqsut residents occurs in the Colville River drainage in adjacent Unit 26A.

Government agencies and the public have been concerned recently about increased hunting by people living outside the area. The opening of the Dalton Highway to commercial use in 1978, to the general public in 1995, and establishment of guide and outfitter bases at points along the road have increased hunting pressure on moose. National publicity about wildlife resources in ANWR may have also contributed to more hunters using the area.

The Dalton Highway Management Area (DHMA) continues to be closed by Alaska statute to the use of firearms and off-road vehicles within 5 miles of the highway north of the Yukon River. In 1987 the Board of Game prohibited use of motorized vehicles, except aircraft, boats, and licensed highway vehicles for transporting game or hunters in the DHMA, bringing hunting regulations into alignment with Alaska statutes. The board's actions also created a penalty for violations, something that had not been included in the statute passed by the legislature.

## MANAGEMENT DIRECTION

### MANAGEMENT GOALS

- Provide the greatest opportunity to hunt moose
- Provide sustained opportunities for subsistence use of moose

### MANAGEMENT OBJECTIVES

- Determine population distribution, composition, density, and trends
- Determine movements and habitat use in heavily harvested drainages
- Maintain an annual posthunting sex ratio of at least 50 bulls:100 cows
- Determine subsistence needs and harvest levels

## METHODS

Riparian willow habitat associated with drainages of Unit 26B is usually surveyed during early winter using Piper PA-18 aircraft at 70–90 miles/hour and at altitudes of 200–600 ft above ground level. Mandatory hunter harvest reports provided data on harvest characteristics and hunter effort.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

*Population Size*

A complete moose population survey has not been conducted in Units 26B and 26C, but the nature of terrain and vegetation makes it possible for trend surveys to account for a large percentage of the moose in areas supporting major concentrations. Total numbers observed in Unit 26B during years when the most complete surveys were done were 629 in 1988 and 600 in

1989. Before 1992 the total population had probably included 1000–1200 moose in Unit 26B and 700–800 in Unit 26C, for a total of 1700–2000 (F Mauer, FWS, pers commun).

Population surveys in 1994 indicated moose numbers declined by approximately 40% compared to those in the late 1980s. This decline continued and accelerated. Surveys in fall 1995 indicated moose have declined by about 60% since 1994, with an overall decline of 75% since the late 1980s. The results of surveys in 1996 and 1997 indicate the population remains at a low level (Mauer 1997). The reasons for the dramatic decline are not well understood, but available evidence indicates that predation, insect harassment, and range deterioration may all be involved. Calf survival and recruitment have been extremely low in the last few years. Unless conditions improve, moose populations on the North Slope are likely to persist at a relatively low density for the foreseeable future.

*Population Composition*

Survey results in Unit 26B indicate moose population status decreased dramatically between 1989 and 1995 (Table 1). Calf survival declined sharply in 1989, when only 5% of the moose seen were calves. The 1990 and 1991 surveys indicated survival returned to previous levels. Weather precluded surveys in 1992 and 1993, but in 1994 and 1995 composition data showed calf survival to fall was low. Calf survival improved in 1996 and 1997, but the total number of calves and adults is low compared to earlier years. A similar pattern is apparent in Unit 26A, where surveys indicate calf survival declined sharply beginning in 1993 but improved in 1996 and 1997.

No surveys have been completed in the Firth and Mancha areas in eastern Unit 26C since 1991, and the status of these populations is unknown (Table 2).

Surveys in the Canning River area (boundary between Units 26B and 26C) indicate moose numbers declined steadily after 1985. Various indices to population welfare including total numbers observed; calf:cow, bull:cow, and large bull:cow ratios; and yearling recruitment indicate that recruitment into the population has been chronically low and harvest of bulls has likely affected the population (Table 3). The number of moose observed during standardized trend counts has declined from a high of 203 in 1985 to 15 in 1997. The decline in total numbers, chronically poor calf survival and yearling recruitment, declining bull:cow ratios, and the small number of bulls in the population indicate that continued restrictions on moose hunting are appropriate. At this point hunting could contribute to a further decline in population status although other factors such as habitat quality, insect harassment, and increased predation by wolves and bears have probably been responsible for causing and perpetuating the decline.

*Distribution and Movements*

Moose are limited to narrow strips of shrub communities along drainages, except in summer when some dispersal occurs. The greatest concentrations occur along the Canning, Kavik, Ivishak, Toolik, Kuparuk, and Kongakut Rivers. Moose movements have not been intensively studied, but casual observations indicate there may be seasonal movements within or between North Slope drainages. Telemetry studies begun in 1995 show many moose that winter in the upper Kongakut River migrate south and east to summer on the Old Crow Flats in Canada (F Mauer, pers commun).

**MORTALITY**

*Harvest*

Season and Bag Limit.

| Units and Bag Limits | Resident Open Season | Nonresident Open Season |
|---|---|---|
| Units 26B and 26C | No open season | No open season |

Board of Game Actions and Emergency Orders. Beginning in 1990, all Alaska residents qualified as subsistence users under state law. To compensate for the large increase in hunters eligible for the subsistence season, the season was shortened to 5–15 September and 1 November–31 December and the 1-bull bag limit was extended to all hunters. Additionally, a 50-inch minimum antler size was established for nonresidents. A significant decline in moose numbers and calf survival first observed in 1994 prompted the board to apply the 50-inch minimum antler size to resident hunting as well in 1995. This regulation affected Unit 26B and the Canning River drainage in Unit 26C. An oversight in the proposal resulted in the 50-inch provision for nonresident hunters in Unit 26C East of the Canning River drainage being inadvertently deleted. A continued decline in moose numbers and recruitment led to the closure of the moose season in Units 26B and 26C in 1996.

Hunter/Trapper Harvest. The reported moose harvest in Unit 26B has ranged from 52 in 1986 to 16 in 1995 (Table 4). Before 1995, harvests in Unit 26B usually exceeded 30 moose and were fairly stable, despite a general increase in hunting activity adjacent to the Dalton Highway. Hunter reports and survey data indicate a decline in moose numbers was the major reason for the decline in harvest in 1995. In Unit 26C the harvest declined substantially from 17 in 1987 to 4 to 6 from 1991 to 1995 (Table 5), primarily because of the decline in moose numbers in the Canning River area.

Permit Hunts. There are no permit hunts in Units 26B and 26C.

Hunter Residency and Success. Based on reports from successful hunters, the proportion of resident hunters increased, and by 1993 they outnumbered nonresident hunters. Alaska residents living outside the area comprised all but a few of the resident hunters (Table 6). Although reporting by local residents was considered poor, relatively few people reside in the area and many of these did not emphasize moose hunting.

Hunter success declined to below 50% beginning in 1993 in Unit 20B. Nonresidents reported a higher success rate than Alaska residents, probably because nonresidents benefited from guide/outfitter services. Hunting success in the Canning River area declined dramatically after 1988, with 0 to 5 moose reported taken each year during 1989–1995 (Table 7). Moose hunting was curtailed beginning in 1996.

Harvest Chronology. Most moose killed in Units 26B and 26C were taken during the first 2 weeks of September (Table 8). The concentration of hunting activity in early autumn results from the relatively early onset of winter in the region.

Transport Methods. Aircraft continued as the predominant transport method and were used by over 70% of the successful moose hunters (Table 9) before the season closure in 1996.

*Natural Mortality*

Although there have been no intensive studies of natural sources of moose mortality in the eastern arctic, it is probable that predation by bears and wolves and periodic malnutrition during severe winters are most important. Wolves and bears are common in the region, particularly in the mountains and northern foothills of the Brooks Range, and incidental observations by biologists, hunters, and pilots suggest wolf numbers increased during the early 1990s. Winter 1989–1990 was unusually severe and noticeably affected calf survival and yearling recruitment. Similar losses can be expected when snow accumulation is exceptionally great. Incidental observations during summer 1995 indicate unusually high mortality from causes other than predation. Observations of intense harassment of moose by mosquitoes, which were unusually abundant due to an early spring and favorable moisture and temperature, indicate this may have contributed to the demise of both calf and adult moose. Mortality from this harassment is unconfirmed to date.

### HABITAT

*Assessment*

A habitat reconnaissance in April 1994 indicated that browsing intensity on favored species was relatively heavy, but forage was not in critically short supply.

*Enhancement*

Efforts to enhance habitat have not been contemplated and do not seem feasible. Fire is not a factor in maintaining moose habitat in this area.

## CONCLUSIONS AND RECOMMENDATIONS

As the moose population declined, more restrictive regulations were enacted and moose harvest is currently prohibited. We monitored population trend during the decline. Shortcomings exist in our knowledge of movements, habitat condition, causes and patterns of natural mortality, and definitive reasons for the precipitous decline in moose numbers and survival. A moose study begun in Unit 20A should lend insights into some of these factors.

The combination of low numbers and chronically low recruitment in Units 26B and 26C indicates the population should be managed conservatively. Although hunting was probably not a primary factor in initiating and maintaining the decline, it is a source of mortality that can be easily controlled. High calf survival and recruitment for many years is necessary for the population to return to the level in the late 1980s.

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Table 1 Unit 26B early winter aerial moose composition, 1986–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 57 | 9 | 29 | 87 | 15 | 477 | 564 | 1.33 |
| 1987–1988[a] | | | | | | | | |
| 1988–1989 | 59 | 30 | 21 | 75 | 12 | 534 | 629 | 1.42 |
| 1989–1990 | 54 | 13 | 9 | 32 | 5 | 568 | 600 | 1.35 |
| 1990–1991 | 59 | 7 | 26 | 63 | 14 | 383 | 446 | 1.54 |
| 1991–1992 | 47 | 10 | 21 | 66 | 13 | 352 | 518 | 1.48 |
| 1992–1993[a] | | | | | | | | |
| 1993–1994[a] | | | | | | | | |
| 1994–1995 | 39 | 8 | 5 | 14 | 4 | 367 | 381 | 1.06 |
| 1995–1996 | 66 | 11 | 8 | 7 | 5 | 138 | 145 | 0.40 |
| 1996–1997 | 61 | 5 | 22 | 16 | 11 | 125 | 141 | 0.40 |
| 1997–1998 | 69 | 4 | 30 | 14 | 14 | 83 | 97 | 0.27 |

[a] No survey.

Table 2 Unit 26C, Kongakut and Firth Rivers and Mancha Creek early winter aerial moose composition counts, 1987–1996

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| 1987–1988[a] | | | | | | | | |
| 1988–1989[a] | | | | | | | | |
| 1989–1990[b] | 114 | 7 | 24 | 17 | 10 | 152 | 169 | 0.47 |
| 1990–1991[a] | | | | | | | | |
| 1991–1992[c] | 85 | 10 | 34 | 63 | 15 | 343 | 406 | 0.47 |
| 1992–1993[a] | | | | | | | | |
| 1993–1994[a] | | | | | | | | |
| 1994–1995[a] | | | | | | | | |
| 1995–1996[a] | | | | | | | | |
| 1996–1997[a] | | | | | | | | |

[a] No survey.
[b] Firth/Mancha area only.
[c] Includes Kongakut and Firth/Mancha count areas.

Table 3 Canning River (on boundary of Units 26B and 26C) early winter aerial moose composition counts, 1986–1997

| Regulatory year | Bulls:100 Cows | Yearling bulls:100 Cows | Calves:100 Cows | Calves | Percent calves | Adults | Moose observed | Moose/mi$^2$ |
|---|---|---|---|---|---|---|---|---|
| 1986–1987 | 75 | 15 | 18 | 13 | 9 | 126 | 139 | 0.80 |
| 1987–1988[a] | | | | | | | | |
| 1988–1989 | 51 | 4 | 16 | 11 | 9 | 107 | 118 | 0.68 |
| 1989–1990 | 45 | 8 | 10 | 7 | 6 | 106 | 113 | 0.65 |
| 1990–1991 | 43 | 2 | 12 | 5 | 8 | 60 | 65 | 0.87 |
| 1991–1992 | 49 | 7 | 5 | 3 | 3 | 85 | 88 | 0.94 |
| 1992–1993[a] | | | | | | | | |
| 1993–1994[a] | | | | | | | | |
| 1994–1995 | 31 | 0 | 0 | 0 | 0 | 38 | 38 | 0.22 |
| 1995–1996 | 77 | 11 | 0 | 0 | 0 | 15 | 16 | 0.09 |
| 1996–1997 | 64 | 0 | 18 | 2 | 10 | 18 | 20 | 0.12 |
| 1997–1998 | 38 | 0 | 50 | 4 | 27 | 11 | 15 | 0.09 |

[a] No survey.

Table 4 Unit 26B moose harvest and accidental death[a], 1986–1996

| Regulatory year | Reported[b] harvest M (%) | F (%) | Unk | Total |
|---|---|---|---|---|
| 1986–1987 | 43 (83) | 9 (17) | 0 | 52 |
| 1987–1988 | 37 (100) | 0 (0) | 0 | 37 |
| 1988–1989 | 33 (100) | 0 (0) | 0 | 33 |
| 1989–1990 | 24 (100) | 0 (0) | 1 | 25 |
| 1990–1991 | 24 (100) | 0 (0) | 0 | 24 |
| 1991–1992 | 28 (100) | 0 (0) | 0 | 28 |
| 1992–1993 | 45 (100) | 0 (0) | 0 | 45 |
| 1993–1994 | 30 (100) | 0 (0) | 0 | 30 |
| 1994–1995 | 37 (100) | 0 (0) | 0 | 37 |
| 1995–1996 | 16 (100) | 0 (0) | 0 | 16 |
| 1996–1997[c] | | | | |

[a] Only 1 road and no railroads in subunit.
[b] Source: moose harvest reports.
[c] No open season.

Table 5 Unit 26C moose harvest and accidental death[a], 1986–1996

| Regulatory year | Reported[b] harvest M (%) | F (%) | Unk | Total |
|---|---|---|---|---|
| 1986–1987 | 6 (60) | 4 (40) | 0 | 10 |
| 1987–1988 | 16 (94) | 1 (5) | 0 | 17 |
| 1988–1989 | 10 (100) | 0 (0) | 0 | 10 |
| 1989–1990 | 1 (100) | 0 (0) | 0 | 1 |
| 1990–1991 | 3 (100) | 0 (0) | 0 | 3 |
| 1991–1992 | 6 (100) | 0 (0) | 0 | 6 |
| 1992–1993 | 4 (100) | 0 (0) | 0 | 4 |
| 1993–1994 | 4 (100) | 0 (0) | 0 | 4 |
| 1994–1995 | 6 (100) | 0 (0) | 0 | 6 |
| 1995–1996 | 4 (100) | 0 (0) | 0 | 4 |
| 1996–1997[c] | | | | |

[a] No roads or railroads in subunit.
[b] Source: moose harvest reports.
[c] No open season.

Table 6 Units 26B and 26C moose hunter residency and success, 1986–1996[a]

| Regulatory year | Successful | | | | | Unsuccessful | | | | | Total hunters |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total (%) | Local[b] resident | Nonlocal resident | Nonresident | Unk | Total (%) | |
| 1986–1987 | 0 | 33 | 20 | 9 | 62 (86) | 0 | 8 | 0 | 2 | 10 (14) | 72 |
| 1987–1988 | 0 | 21 | 22 | 11 | 54 (64) | 1 | 21 | 5 | 3 | 30 (36) | 84 |
| 1988–1989 | 0 | 13 | 26 | 4 | 43 (64) | 0 | 14 | 6 | 4 | 24 (36) | 67 |
| 1989–1990 | 0 | 11 | 15 | 0 | 26 (32) | 0 | 24 | 6 | 26 | 56 (68) | 82 |
| 1990–1991 | 0 | 7 | 18 | 2 | 27 (51) | 0 | 21 | 5 | 0 | 26 (49) | 53 |
| 1991–1992 | 1 | 11 | 19 | 3 | 34 (57) | 1 | 13 | 10 | 2 | 26 (43) | 60 |
| 1992–1993 | 0 | 23 | 25 | 1 | 49 (52) | 0 | 43 | 2 | 1 | 46 (48) | 95 |
| 1993–1994 | 2 | 23 | 8 | 1 | 34 (37) | 1 | 44 | 11 | 1 | 57 (63) | 91 |
| 1994–1995 | 0 | 24 | 19 | 0 | 43 (44) | 2 | 34 | 15 | 3 | 54 (56) | 97 |
| 1995–1996 | 0 | 3 | 17 | 0 | 20 (28) | 2 | 34 | 17 | 0 | 51 (72) | 71 |
| 1996–1997[c] | | | | | | | | | | | |

[a] Source: moose harvest reports.
[b] Reside in Units 26B or 26C.
[c] No open season.

Table 7 Number of moose hunters, moose harvest, and percent success in the Canning River drainage, 1983–1996[a]

| Regulatory year | Hunters | Harvest | Percent success |
|---|---|---|---|
| 1983–1984 | 3 | 1 | 34 |
| 1984–1985 | 8 | 7 | 88 |
| 1985–1986 | 8 | 6 | 75 |
| 1986–1987 | 15 | 6 | 40 |
| 1987–1988 | 36 | 14 | 40 |
| 1988–1989 | 17 | 8 | 47 |
| 1989–1990 | 10 | 1 | 10 |
| 1990–1991 | 8 | 1 | 13 |
| 1991–1992 | 5 | 0 | 0 |
| 1992–1993 | 1 | 1 | 100 |
| 1993–1994 | 5 | 2 | 40 |
| 1994–1995 | 6 | 5 | 83 |
| 1995–1996 | 5 | 3 | 60 |
| 1996–1997[b] | | | |

[a] Source: moose harvest reports.
[b] No open season.

Table 8 Units 26B and 26C moose harvest chronology, percent ($n$) by time period, 1986–1996[a]

| Regulatory year | Harvest periods | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 9/1–9/7 | 9/8–9/14 | 9/15–9/21 | 9/22–9/28 | 9/29–10/5 | Oct | Nov | Dec | $n$ |
| 1986–1987 | 41.1 | 23.2 | 10.7 | 8.9 | 0.0 | 3.6 | 3.3 | 7.1 | 56 |
| 1987–1988 | 36.5 | 32.7 | 23.1 | 5.8 | -[b] | -[c] | -[c] | 1.9 | 52 |
| 1988–1989 | 41.6 | 25.0 | 22.2 | 11.1 | -[b] | -[c] | -[c] | -[c] | 36 |
| 1989–1990 | 26.9 | 30.8 | 30.8 | 3.8 | 3.8 | -[c] | -[c] | -[c] | 26 |
| 1990–1991 | 37.1[d] | 51.8 | 3.7[e] | -[f] | -[f] | -[f] | -[g] | 2.0[g] | 27 |
| 1991–1992 | 52.9 | 41.2 | | | | | | 5.9 | 34 |
| 1992–1993 | 63.3 | 36.7 | | | | | | | 49 |
| 1993–1994 | 50.0 | 44.1 | 2.9 | | | | | 2.9 | 34 |
| 1994–1995 | 53.7 | 43.9 | 2.4 | | | | | 2.4 | 41 |
| 1995–1996 | 36.8 | 52.6 | 10.5 | | | | | | 19 |
| 1996–1997[f] | | | | | | | | | |

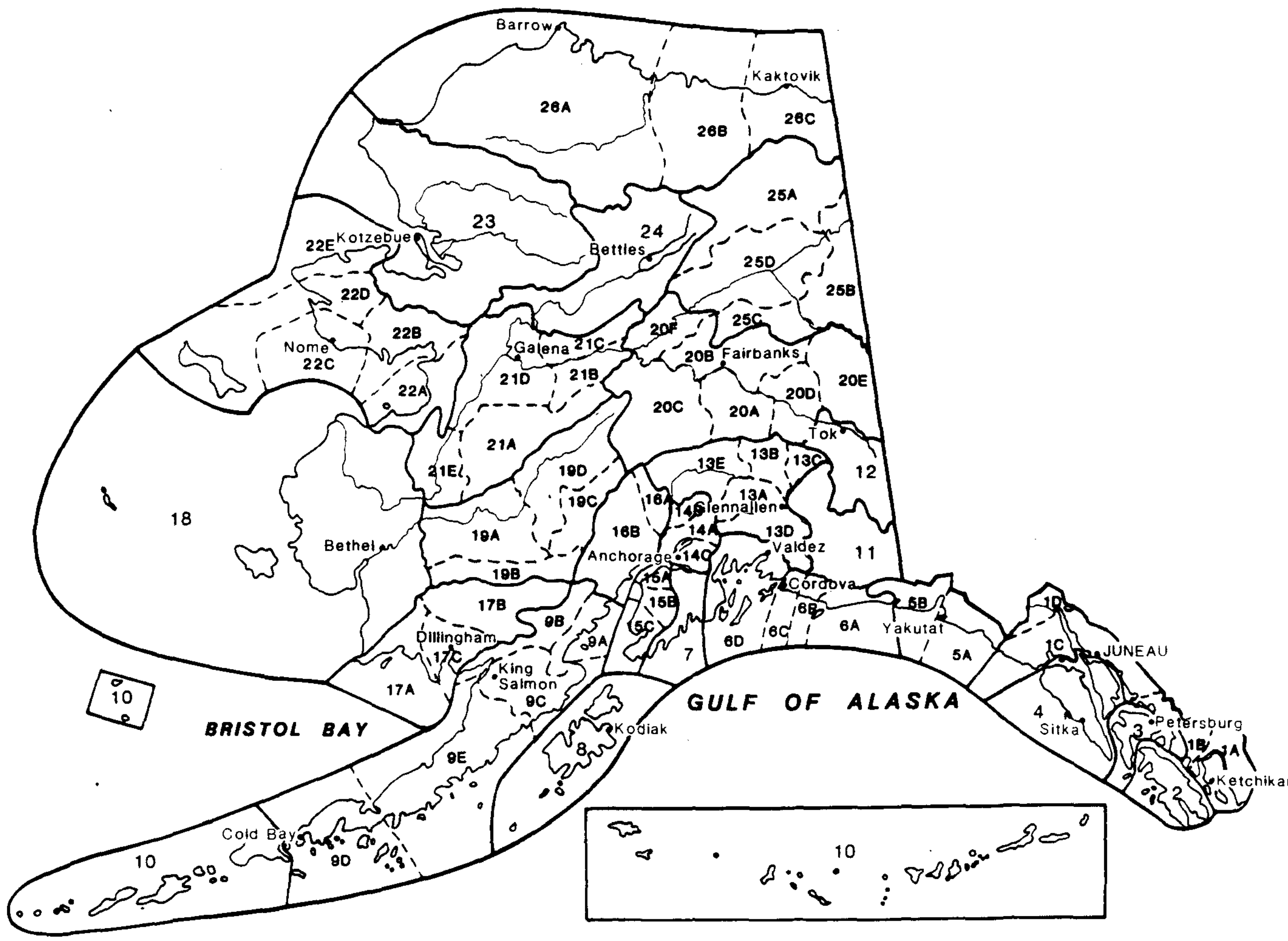
[a] Source: moose harvest reports.
[b] General season closed 30 Sep.
[c] Subsistence.
[d] General season opened 5 Sep.
[e] General season closed 15 Sep.
[f] No open season.
[g] Alaska resident only.

Table 9 Units 26B and 26C moose harvest percent by transport method, 1986–1996[a]

| Regulatory year | Harvest percent by transport method | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Airplane | Horse | Boat | 3- or 4-wheeler | Snowmachine | Other ORV | Highway vehicle | Unknown | *n* |
| 1986–1987 | 75 | 0 | 0 | 3 | 12 | 3 | 7 | | 60 |
| 1987–1988 | 94 | 0 | 4 | 0 | 2 | 0 | 0 | | 47 |
| 1988–1989 | 83 | 2 | 5 | 0 | 2 | 0 | 7 | | 41 |
| 1989–1990 | 96 | 0 | 4 | 0 | 0 | 0 | 0 | | 26 |
| 1990–1991 | 75 | 4 | 21 | 0 | 0 | 0 | 0 | | 24 |
| 1991–1992 | 76 | 0 | 15 | 0 | 6 | 0 | 0 | 3 | 34 |
| 1992–1993 | 84 | 0 | 8 | 0 | 0 | 0 | 8 | 0 | 49 |
| 1993–1994 | 71 | 0 | 21 | 0 | 3 | 0 | 6 | 0 | 34 |
| 1994–1995 | 74 | 0 | 19 | 0 | 2 | 0 | 5 | 2 | 43 |
| 1995–1996 | 90 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 20 |
| 1996–1997[b] | | | | | | | | | |

[a] Source: moose harvest reports.
[b] No open season.

# Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.

Whitten