GLENN HIGHWAY MOOSE MONITORING STUDY

PROGRESS REPORT

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INTRODUCTION

The Glenn Highway, serves as the only highway transportation link between Anchorage, Eagle River/Chugiak, and the Matanuska-Susitna Borough. The area between Anchorage and Eagle River approximately 10 miles to the north, is a moose (*Alces alces*) winter range of approximately 7,600 acres. The highway essentially bisects this winter range resulting in numerous moose/vehicle accidents in recent years. Since 1977, an annual average of over 35 moose/vehicle collisions have been reported along this portion of the highway.

The Alaska Department of Transportation and Public Facilities (ADOT/PF) widened the Glenn Highway from 4 lanes to 6 lanes from Muldoon Drive to Hiland Drive during the summer and fall of 1987, as phase 1 of an ultimate 8 lane upgrade. To mitigate the impacts of this highway upgrade on moose movements, ADOT/PF agreed to fence the Glenn Highway along a portion of the project and raise and lengthen the Ship Creek bridge to allow passage of moose underneath.

Elsewhere in the U. S., Canada, and Europe, fencing has proven to be the most effective method of reducing wildlife/vehicle collisions along highways. One-way gates were designed and constructed at various locations along the fence to allow passage of moose from the highway corridor should an animal gain access in to the corridor.

One-way gates have been constructed for and used by deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) elsewhere in the U. S. and Canada (Reed et al. 1974; Jakimchuk pers. comm.). One-way gates have not been specifically designed for moose.

A number of underpasses for wildlife such as deer, elk, and mountain goats (*Oreamnos americanus*) have been built and used (Reed et al. 1975, 1979; Reed 1981; Olbrich 1984; Singer and Doherty 1985; Jakimchuk pers. comm.). To date, documentation describing underpasses built specifically for by moose is lacking.

The Glenn Highway moose monitoring project was designed to assess the impacts of a moose-proof fence constructed along the highway on subpopulations of moose ecologically affiliated with the area.

Primary objectives of this study includes the following: 1) to determine distribution, movement patterns, and abundance of moose prior to and following construction of a moose-proof fence and an underpass along the Glenn Highway; 2) to determine magnitude, frequency, and timing of use of a highway underpass and one-way gates by moose; 3) to develop an information base from which to make recommendations for additional mitigation of other project-related impacts; and 4) to provide baseline data that can be used to determine the impacts of a moose-proof fence upon moose subpopulations and the use by moose of an underpass and one-way gates.

STUDY AREA

The study area has been defined by the movements of radio-collared moose as determined by radio tracking survey locations and public sightings of visual collars. Present boundaries may have to be expanded as the study progresses. The study area consists of Elmendorf Air Force Base (EAFB) and Fort Richardson Army Base (FRAB), where the majority of moose are located. It extends south to Klatt Road and west to Point Campbell in the city of Anchorage, north to the Peters Creek Drainage, and includes the Ship Creek, upper Bird Creek, and Eagle River drainages to the east.

Anchorage is a sprawling city of about 250,000 people. Although much of the area is developed, greenbelts, municipal parks, and other lightly developed areas are spread throughout portions of the city. EAFB and FRAB are primarily undeveloped lands with generally localized developed areas.

The undeveloped areas of EAFB are covered with 96.5% vegetation and 3.5% open water or tidal flats. The predominant cover is forest and woodland (78%) of which the largest component is a mixed forest of birch (*Betula paperifera*) and white spruce (*Picea glauca*). Thinleaf alder (*Alnus tenuifolia*) shrub community types cover 16% of EAFB (Rothe et al. 1983).

Below 500 ft., the undeveloped portions of FRAB contain a complex mosaic of old growth and even-age second-growth forests because of numerous fires within the past 100 years. These forests are composed primarily of 60-80 year-old even-age class birch and white spruce and 80-200 year-old uneven-age class birch and white spruce. There are some 200-250 year-old even-age birch and white spruce and 60-80 year old aspen (*Populus tremuloides*) and white spruce. Disturbed areas, especially those along the outwash plain, contain pole-size stands of balsam popular (*Populus balsamifera*), willow (*Salix* spp.), birch, and aspen. Pure stands of thinleaf alder occupy about 1,200 acres of FRAB (Bennett 1983).

The subalpine areas of the study area are composed of alder (*Alnus* spp.) and willow interspersed with spruce stands and open grasslands.

METHODS

To provide individually identifiable animals that could be located regularly, moose were captured and tagged with visual and radio transmitting collars. Each collar featured a discrete number and radio frequency.

Moose were captured for tagging during the spring and winter of 1986, 1987, and 1988 primarily on FRAB south of Eagle River. Some animals were captured in the Ship Creek drainage in order to determine movements of moose wintering in this drainage.

Moose were immobilized with carfentanil citrate diluted with water (4.5-6cc @ 2 mg/cc) administered intramuscularly with Palmer Cap-chur equipment from a hovering Bell 206B helicopter or from the ground. Immobilized moose were revived with intramuscular injections of naloxone hydrochloride (10-11cc @ 50 mg/cc).

General health of captured moose was assessed by assigning individuals a condition rating based on physical conformation and any other obvious indicators that may have been present (Franzmann 1977). Condition was rated on a scale from 1 to 10; for example, a rating of 7 indicated the animal was in average health with no evidence of rump fat, but well fleshed.

Radio relocation flights were originally conducted in a Cessna 185, but were switched to a Piper PA-18 Supercub, a slower more maneuverable aircraft. Because moose are difficult to observe from a fixed-wing aircraft through the dense foliage they frequent during the spring and summer, 1 flight was conducted with a Hughes 300-C helicopter to determine if study animals were accompanied by calves. Flights were conducted at intervals ranging from 2-3 weeks, however, inclement weather or military training activities occasionally altered this schedule. In addition to the relocation flights, several attempts were made from the ground to determine which side of the Glenn Highway collared animals were on.

Relocations (audio-visual or audio) of moose were plotted on 1:63,360 scale USGS topographic maps and later transferred to mylar overlays for computer digitization. Data were also collected to describe moose locations relative to the Glenn Highway (east or west), vegetation types utilized, behavioral activity, and whether other animals were present. The number of highway crossings were determined from plotted relocations.

The underpass and one-way gates were monitored by track counts when snow had accumulated and by public eyewitness accounts. Future monitoring of the underpass will be accomplished by video cameras activated by motion detectors and recorded on video cassette. Bait composed of assorted vegetables culled from local supermarkets and a moose ration developed at the Alaska Department of Fish and Game (ADF&G) Moose Research Center (Schwartz et al. 1985) was placed in the underpass to entice moose into it.

RESULTS AND DISCUSSION

Radio-collaring

Initially, 12 radio-collars were placed on moose (8 females and 4 males) on 19 April 1986 using a helicopter. Ten animals were collared along Ship Creek on both sides of the Glenn Highway and 2 others were collared just south of the new Municipality of Anchorage land fill.

Because of a capture related mortality (female collared south of the land fill, see mortality section) 1 collar was placed on another female on 29 April 1986 approximately 0.5 mi west of the FRAB gate 2 interchange using ground tagging methods.

From 23 December 1986 through 23 January 1987, 32 additional collars were placed on moose (21 females and 11 males), 21 using ground tagging methods and 11 using helicopter methods. Five animals were collared in the Ship Creek drainage, 6 on Hiland Mountain above the weigh station and the remainder in the lowlands of FRAB. On 1 March 1987, 3 collars, retrieved from dead animals (3 females, 2 from Ship Creek and 1 from Hiland Mountain, see mortality section), were replaced on moose (2 females and 1 male) using ground tagging methods in the lowlands of FRAB.

From 12 January through 16 January 1988, 10 collars obtained as a result of mortalities (see mortality section) or that had been shed were replaced on moose (7 females and 3 males), 6 using helicopter methods and 4 from the ground. Three collars were placed on animals located in the Ship Creek drainage, 3 on Hiland Mountain, and 4 on FRAB lowland moose west of the Glenn Highway.

Movements

These findings should be considered preliminary because of a somewhat limited sample size of tagged moose relocations.

The majority of movements from the most heavily used winter ranges, which are on FRAB south of Eagle River, to spring ranges in 1987 began during the last 2 weeks of March and were generally completed by mid April. The most noticeable movement was a general shift toward the forested coastal area on EAFB and the vicinity of Eagle River Flats on FRAB. The majority of animals that made this movement were females. Most of the collared females that made this movement remained near the coast through October.

Collared bull moose tended to remain at higher elevations than females from March through August. Particular factors involved in such segregation have not been identified, but might be related to nutritional requirements of pregnant or lactating cows and the presence of early growing nutritious food (LeResche and Davis 1973). Cover requirements for calves may also play a role as well as the possible relative absence of predators (Stringham 1974 and Ballard et al. 1980). During September and October, bulls tended to move to lower elevations and the cows to higher elevations in response to the rutting period. Males dropped from an average elevation of 760 ft in August to 435 ft. and 355 ft., respectively during September and October. Females on the other hand went from an average elevation of 400 ft. in August to 470 ft. and 550 ft., respectively during September and October. Both sexes tended toward upper elevations during November, December, and January (Figures 1 and 2).

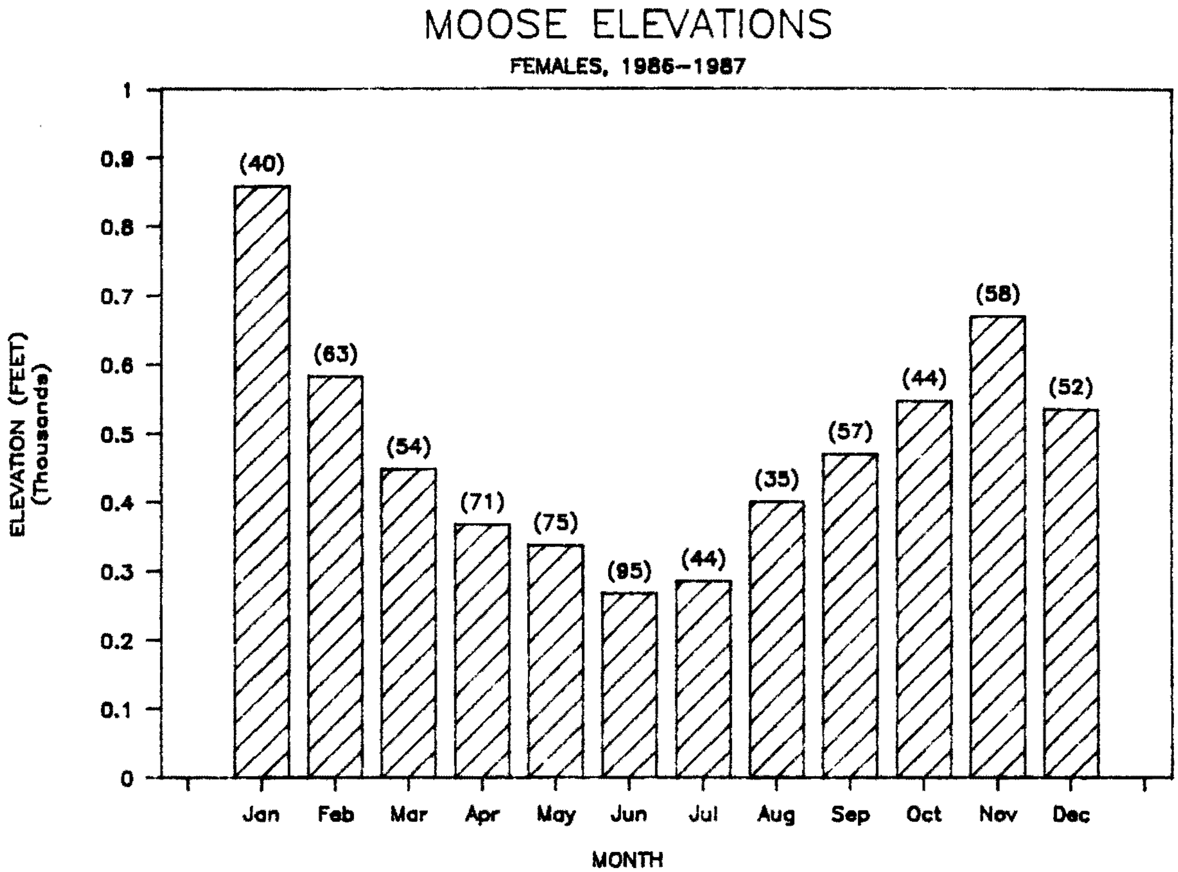

Figure 1. Average months elevational use by radio-collared female moose. Numbers in parenthesis are sample sizes.

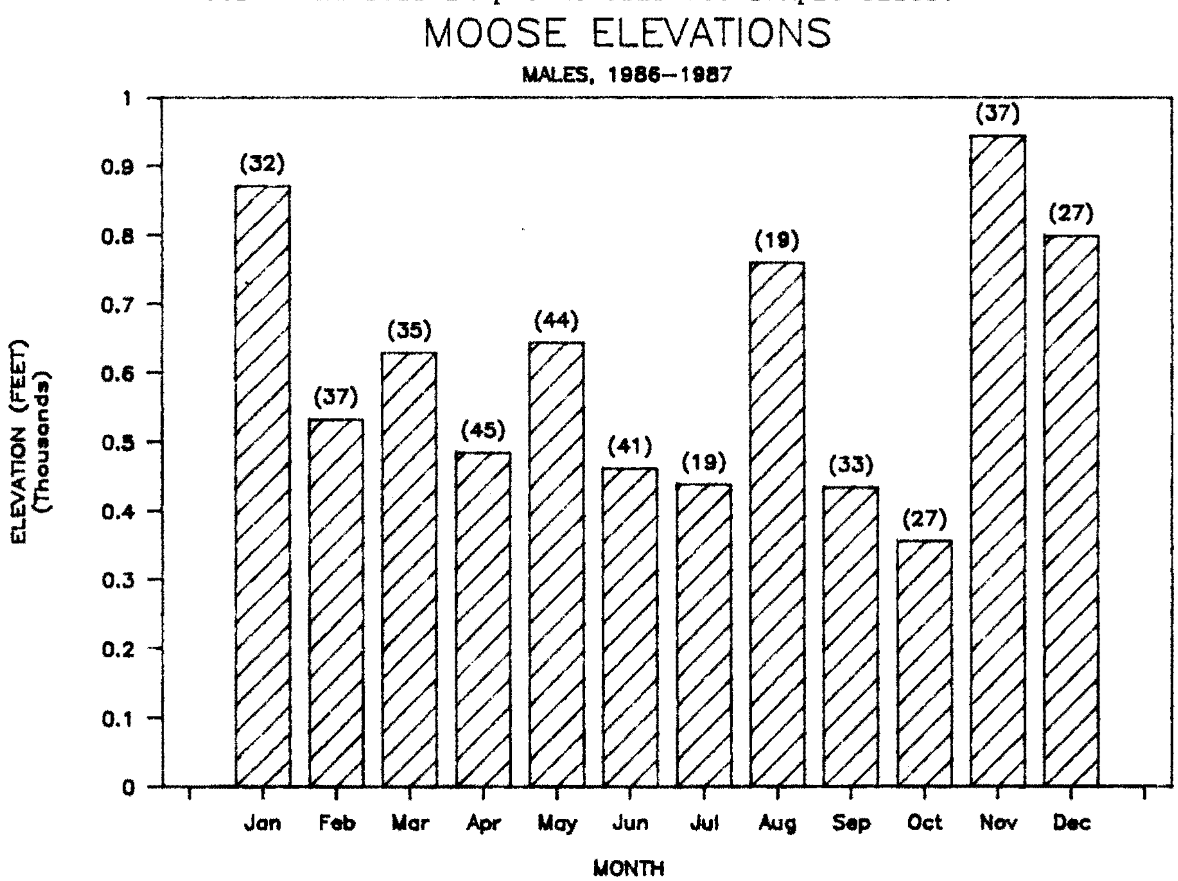

Figure 2. Average months elevational use by radio-collared male moose. Numbers in parenthesis are sample sizes.

It was previously believed that moose generally moved from lowland winter ranges on FRAB to upper elevation spring and summer ranges. Because of annual differences in winter severity, these movement patterns could differ substantially from year to year.

Monthly accident records from 1977 through 1986 (Figure 3) indicate major movements occur during the rut in October and when moose move to upper elevations in December. The increase in accidents that occurs from February to March may reflect movement to spring range near the coast.

Highway crossings by collared moose were noticeably highest during the months of January through mid April when animals were concentrated on winter ranges near the Glenn Highway and when spring movement occurred. Crossings gradually decreased from April through June to a low in July. There was a significant increase in crossings noted in September and crossings remain relatively constant through December (Figure 4). A total of 137 crossings of the highway by radio-collared moose had been documented through December 1987.

Assuming the radio collared moose are representative of the moose population and based on a census estimate of 600 moose wintering on or near FRAB, preliminary estimates of moose crossings of the highway range from 1,400 to 1,800 in the course of a year. These are very

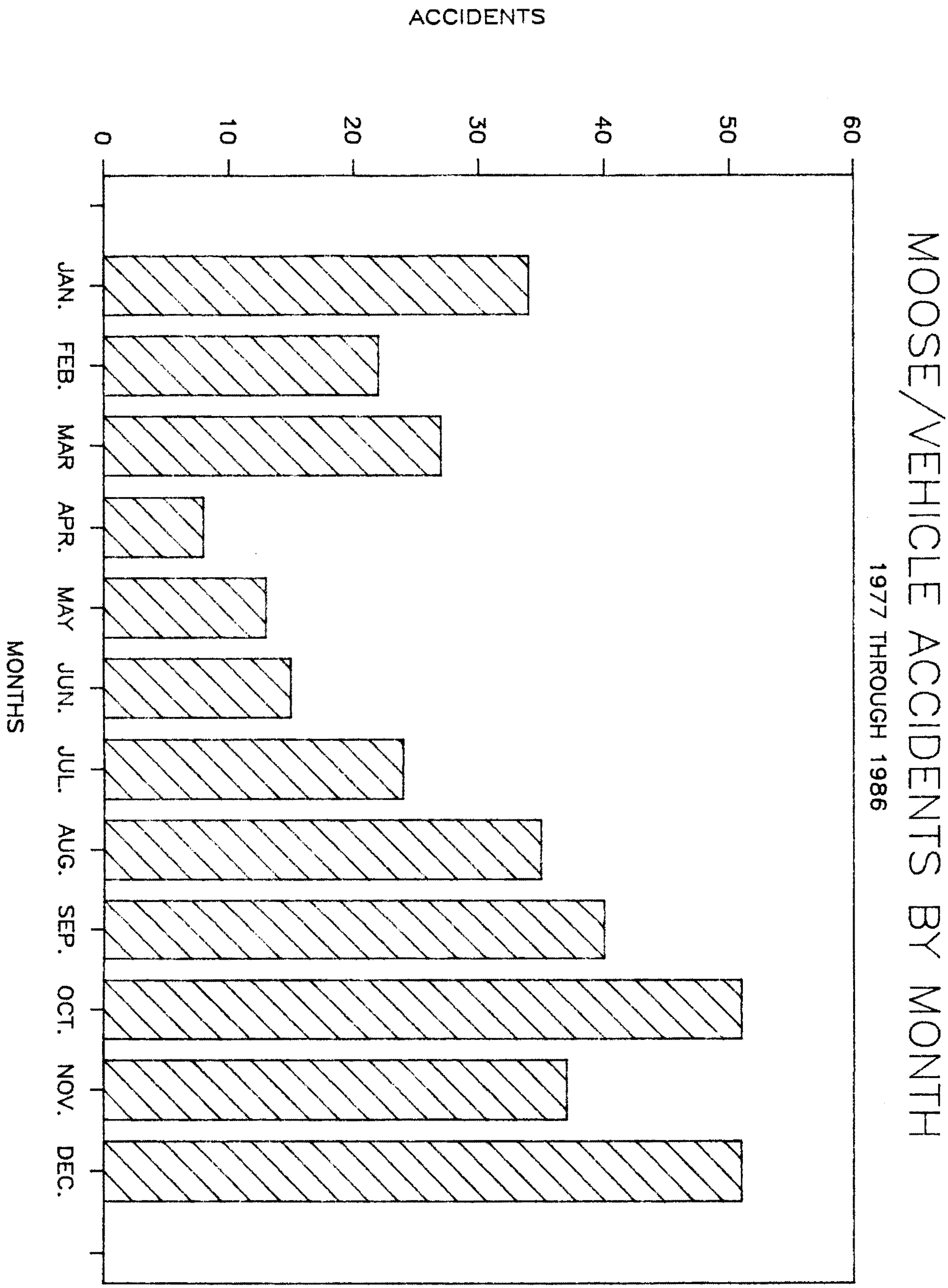

Figure 3. Monthly moose/vehicle accidents from milepost 132-140.2 on the Glenn Highway, 1977-1986.

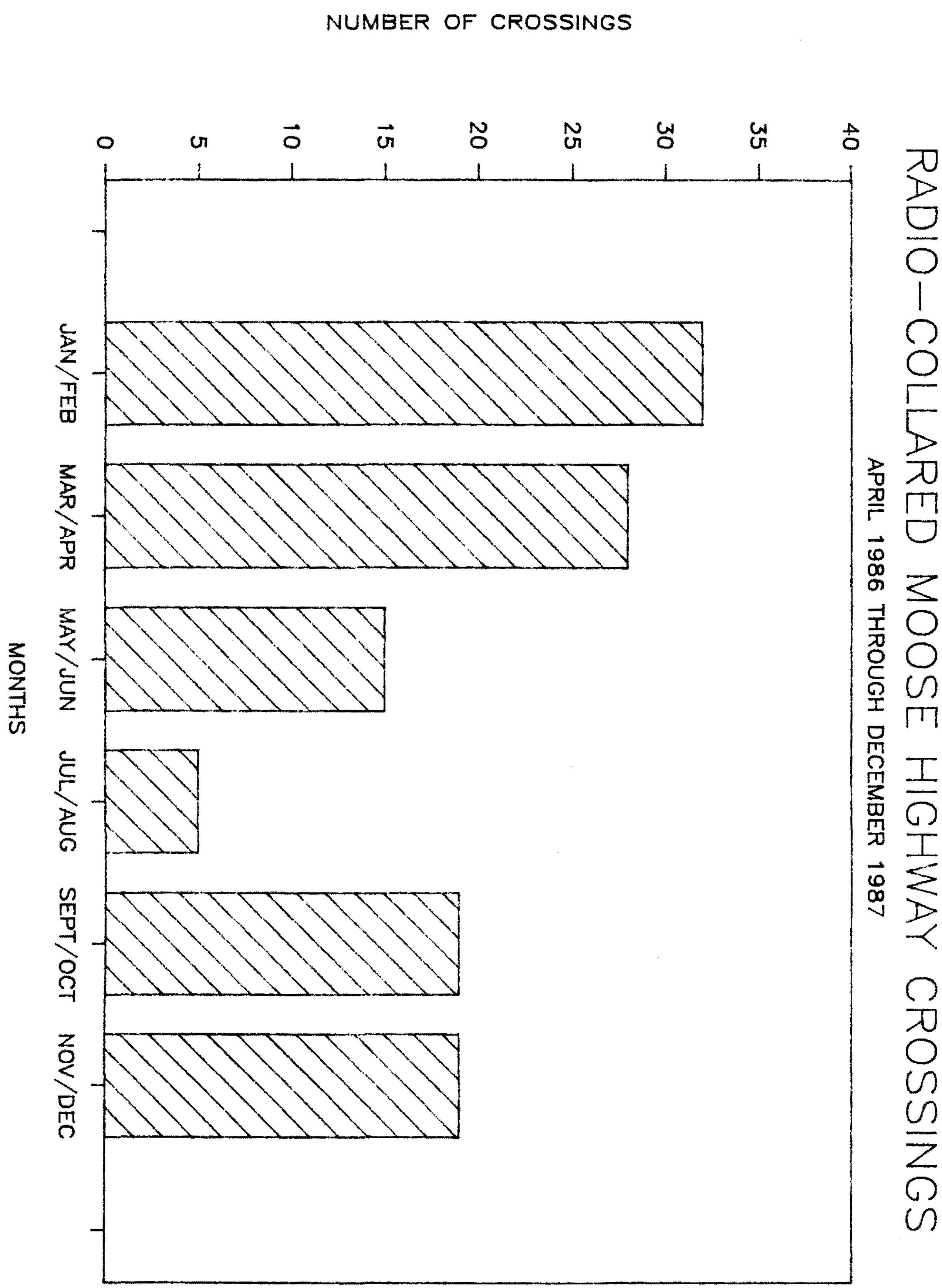

Figure 4. Documented crossings of the Glenn Highway by radio-collared moose.

likely minimal estimates because the frequency of relocating radio-collared animals would allow animals to cross and recross the highway in the period between relocations flights and would go undetected.

During a 1-year period (June 1986 through May 1987), the number of documented crossings by individual collared moose ranged from 0 to 13.

Based on Alaska Department of Public Safety accident records from 1977 through 1986, a Chi-square goodness of fit test shows that moose/vehicle collisions do not occur randomly. In an analysis using a log-linear model, significantly more accidents occurred in the areas between mile posts 133 and 134 and mile posts 137 and 138 (Figure 5). The first highway section includes the area in the vicinity of Ship Creek and the second section includes 1-mile stretch approximately halfway between the Fort Richardson main interchange and the scale house.

Preliminary indications from mapped relocations of collared moose and highway accident reports indicate an east/west seasonal movement corridor along Ship Creek (Figure 6).

Currently, the fence does not appear to be severely limiting movement by moose because of its relatively short length. Movement patterns may be substantially changed when the fence is lengthened.

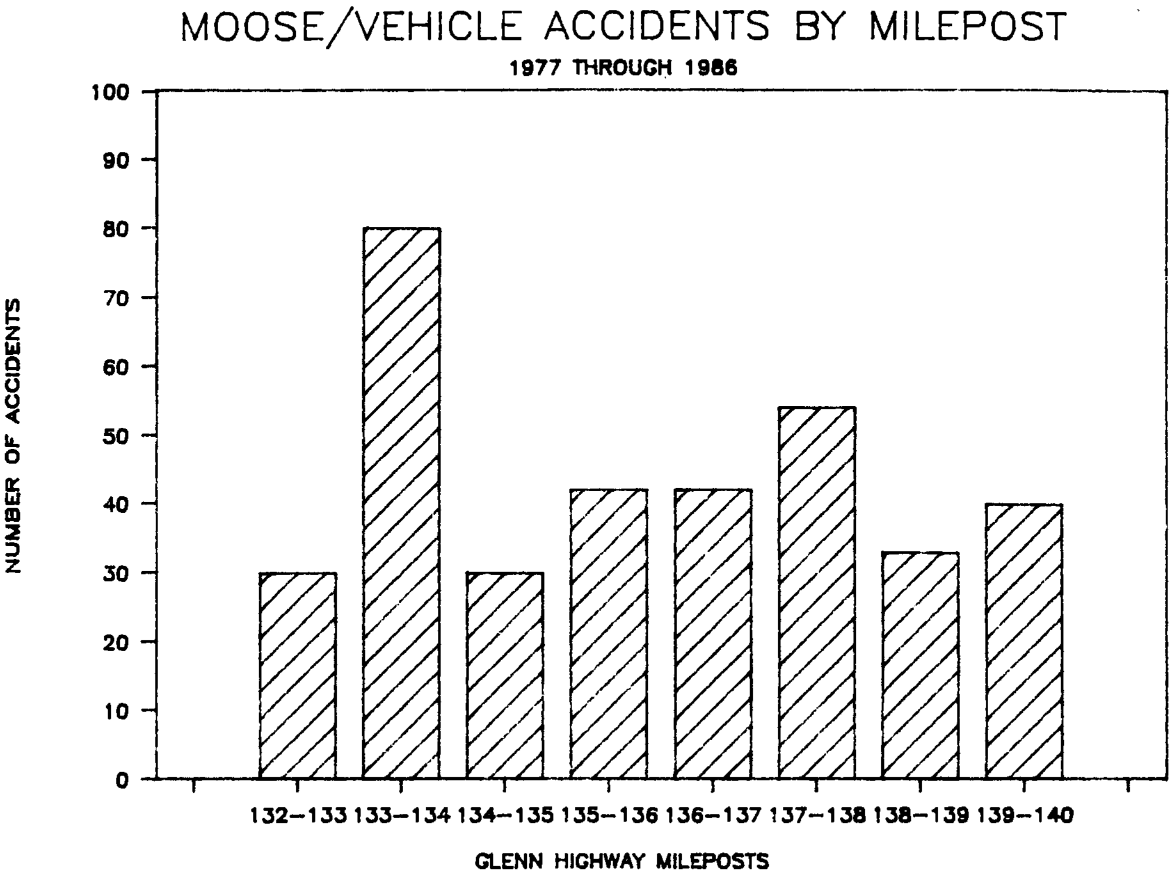

Figure 5. Moose/vehicle accidents on the Glenn Highway by milepost, 1977-1986.

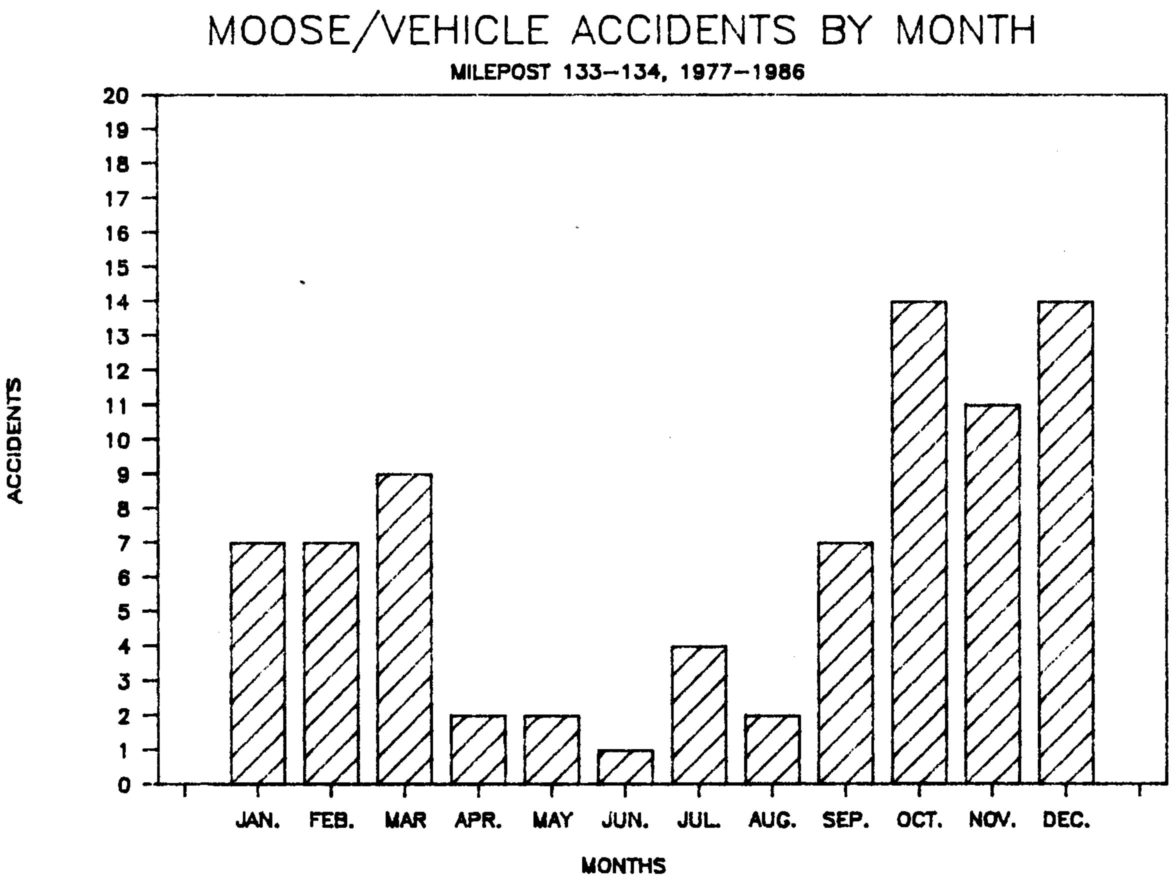

Figure 6. Monthly moose/vehicle accidents between milepost 133 and 134 (Ship Creek), 1977-1986.

Fencing

The Glenn Highway fence is a 9-foot tall structure, with 8 feet of wire mesh placed 1 foot off the ground. Phase 1 fencing was constructed on either side of the highway from the Muldoon interchange to the Arctic Valley exit, a distance of about 1.5 miles in 1987. A phase 2 fencing to the main Fort Richardson (Gate 2) interchange should be constructed in 1988. A final phase of fencing will be constructed to the Hiland interchange if the phase 1 and 2 fencing proves effective in reducing moose/vehicle accidents.

Underpass

The Ship Creek Bridge was replaced during highway construction. Modifications to the bridge for the moose underpass include raising and lengthening the bridge to allow for a path 10 feet wide with a minimum 10.5 feet of clearance above the path.

Four moose were confirmed to have used the underpass before it became iced over because of glaciation along Ship Creek. Three of these crossing were documented by track counts in late November after baiting was initiated. The fourth crossing occurred in mid October just after the fence was in place and was witnessed by an ADOT/PF maintenance crew.

There are several possibilities or combination of events that caused the icing of the underpass. During the heavy snowfalls that occurred in early December, ADOT/PF maintenance crews frequently plowed the Glenn Highway. As snow was pushed up against the bridge railing, it was eventually forced over the railing and into Ship Creek partially damming it just downstream from the underpass. There is also a possibility that water may have been released from the Ship Creek dam and water flooded the underpass and quickly turned to ice in cold weather. A third possibility is that the natural channel of the creek (thalweg) was altered during highway construction.

One-way gates

The Reed et al. (1974) one-way gate was designed to accommodate deer. These gates were modified to accommodate both deer and elk in Canada (Jakimchuk 1986), and further modified to specifically accommodate moose for the Glenn Highway project.

Use of one-way gates was documented by track counts and eyewitness (ADOT/PF maintenance crews and members of the public) accounts. Eyewitnesses have observed 7 moose including 2 cows, 2 calves, 2 bulls, and 1 unknown sex use the one-way gates. There are a total of 10 gates currently installed including 3 sets of double gates to allow passage of moose approaching from either direction parallel to the fence and 4 single gates at the 4 corners at the fences junction with the Ship Creek bridge. During our inspection of moose tracks at these gates on 7 January 1988, we found 9 of the 10 were recently used. We estimate that a minimum of 25-30 moose have used the one-way gates. This also suggests that a relatively large number of moose are gaining access to the fenced highway corridor.

MORTALITIES

A total of 48 moose were captured and radio-collared during 1986 and 1987 and there have been 9 known mortalities since. There were 2 capture related mortalities, 1 probable wolf predation, 2 were struck by highway vehicles, 2 were killed by hunters during an October/ November archery moose hunt, and 2 have been poached. One additional stationary radio collar has yet to be investigated.

Census

On 10-12 December 1987, a moose census was conducted on EAFB, FRAB, and the Ship Creek drainage. The census was based on a technique developed by Gasaway et. al (1986) with 1 modification. Because the area to be censused was relatively small, all sample units (14) were counted rather than a stratified random sampling of sample units. The sample units ranged in size from 6-15 square miles. Using PA-18 Piper Supercubs, 17 hours were spent in the census area and 486 moose were observed. Search effort ranged from 4-8 minutes per square mile. In each sample unit, an intensive search plot of approximately 1 square mile was randomly selected to be recounted immediately after the standard search at a more intensive 8-18 minutes per square mile in order to determine a sightability correction factor. Nine additional moose were seen in the intensive search plots.

Based on the intensive search plots, a correction factor of 1.22 was calculated for a population estimate of 593 moose. During the census, all radio-collared moose seen were noted (28). The day following the census, a radio relocation flight was made to determine how many radio collared moose were located in the census area during the census (35). A Lincoln Index (Chapman 1952) population estimate of 609 was obtained based on a formula described by Beall (1974). The formula used was:

$$x = a(n+1) / (r+1)$$

Where: x = population estimate

a = number tagged in population

n = number animals seen

r = number tagged seen

RECOMMENDATIONS

Underpass

There are several possible solutions that could prevent icing of the underpass in the future. Road crews from ADOT/PF could push snow across the bridge rather than to the side. This need only occur in the southbound lane. Water release from the Ship Creek Dam could be done more gradually especially during freezing weather. The thalweg should be checked to determine if it has been altered and whether alterations to its location need to be made. The concrete abutment adjacent to the pathway could be approximately 8-10 inches higher and 10-15 yds. longer on the down stream side. It appears this would prevent flooding.

In addition to these measures, an access gate to allow vehicular access to the underpass should be installed in the fence south of Ship Creek near the underpass to simplify maintenance of the underpass.

One-way Gates

A number of problems have associated with the operation of the one-way gates have been noted. The viscosity of the lubricant currently used in the hinges declines at temperatures below 30°F causing the gates to stick open. A lubricant that remains nonviscous to -20°F has been applied to some hinges and alleviated this problem. Future gate hinges should be lubricated with a dry molybdenum based powder.

The rubber hose boots used to protect the hinges from precipitation were too tight and had to be split in order to allow freer movement of the joint. These boots should be replaced with lighter rubber hose that is half again larger in diameter. When fastened above the joint with hose clamps, this would form a bell shaped covering over the joint keeping moisture out and allow free movement.

The gates, when swung all the way open, remain open because the joint passes its midpoint. Members of the public have opened the gates for various reasons allowing moose to enter the highway corridor. Stops similar to those used to prevent the gates from being swung inward, could be welded to the gates preventing them from being swung all the way open yet allowing passage of moose.

Tracks of a calf moose were observed to have gone through the opening between the tines on the gates the "wrong" way in late December. Bending the tines closer together appears to have solved this problem.

The number of moose using one-way gates indicate a relatively large number of moose are gaining access to the highway corridor. The greatest number appear to be entering from the west side of the Glenn Highway at the Muldoon interchange. An extension of the fence to the Bartlet High School entrance would likely help reduce this significantly

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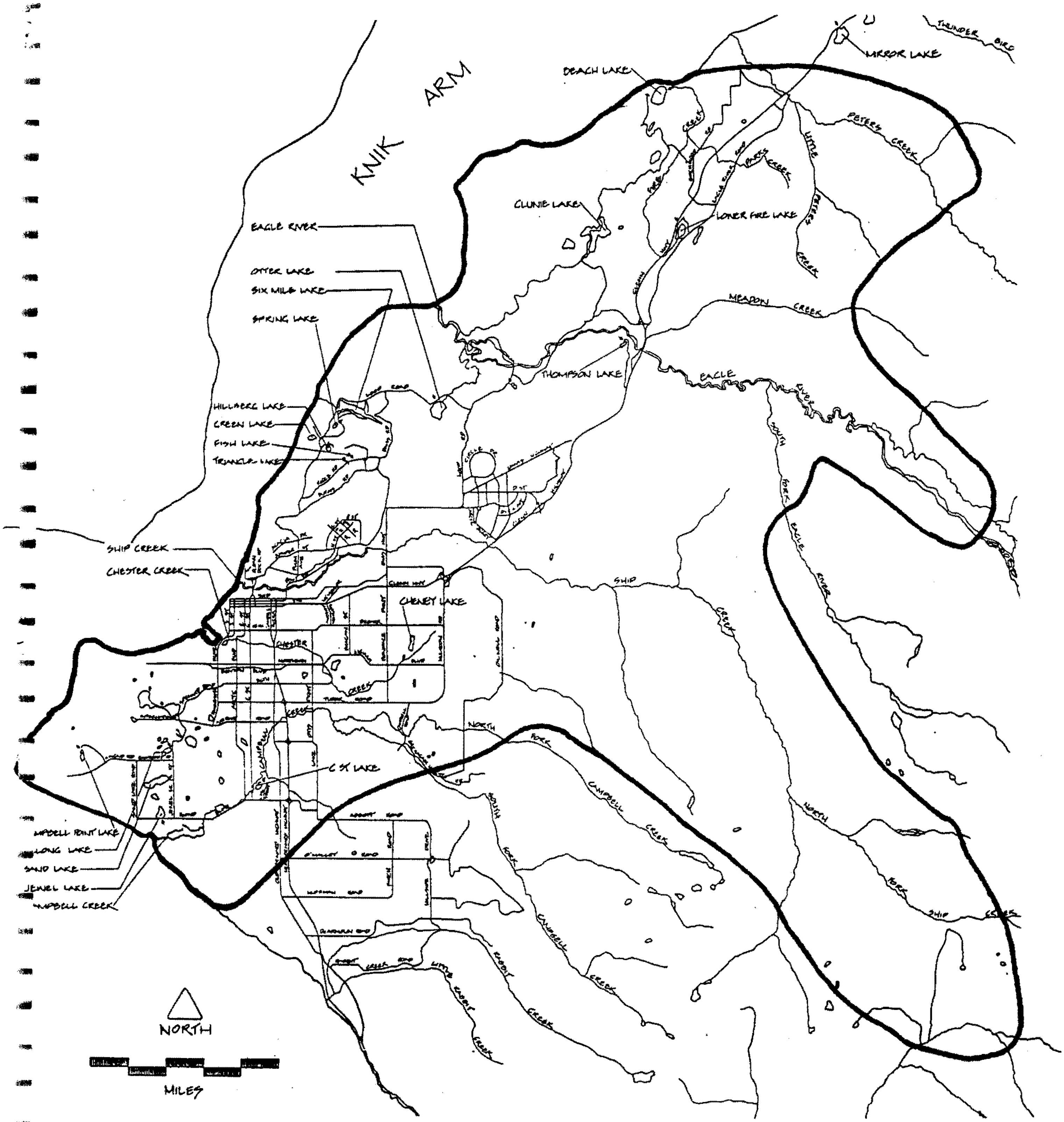

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