Alaska Department of Fish and Game
Division of Wildlife Conservation
Federal Aid in Wildlife Restoration
Research Progress Report

LOWER SUSITNA VALLEY MOOSE POPULATION IDENTITY AND MOVEMENT STUDY

by
Ronald D. Modafferi

Project W-23-2
Study 1.38
April 1990

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SUMMARY

Moose-related aerial-survey, marking, and radio-relocating activities were conducted in the lower Susitna valley in Southcentral Alaska from October 1985 to May 1989. The survey and relocation data gathered (April 1980 to May 1986) during previous moose studies in lowland riparian areas of the Susitna River Valley were incorporated into the database. Site specific information on herd size, sex/age composition, and distribution of moose were compiled from moose censuses and surveys conducted in the study area. Pertinent data from moose killed by collisions with rains and highway vehicles were collected. The computerized database of moose radio-relocations was updated, edited, and reorganized. This report primarily contains data, findings, and discussions related to 28 periodic aerial moose surveys conducted in 7 alpine habitat areas during 4 winters (1985-89) as well as snowpack depth measurements for several locations in the lower Susitna Valley. Biological and management implications of these findings are discussed.

Periodic aerial surveys conducted during each fall and winter from 1985 through 1989 monitored the annual increase, peak, and decrease of moose using the 7 subareas of alpine habitat in the western foothills of the Talkeetna Mountains. Few moose were observed in alpine habitats in early October; thereafter, their numbers increased, peaking between 28 October and 3 December. For the 3 areas studied during all surveys 99%, 100%, 97%, and 80% of the peak numbers of moose were observed on 18, 26, 17, and 15 November 1985 through 1988, respectively. For all subareas, annual maxima of 919, 1,405, 1,010, and 1,252 moose were observed between October 1985 and March 1989, respectively. During 1986 to 1988, moose numbers decreased dramatically during December; by January relatively few remained in the survey areas. In 1985 when snowpacks were less than half as deep as those from 1986 to 1988, moose numbers decreased gradually; many moose remained in alpine habitats through winter. During all winters, numbers of moose in the Sunshine survey area continued to increase or remained relatively stable after the areawide peak.

Differences in annual peak numbers were associated with snowpack depth and/or variation in moose mortality the previous fall and winter. Disappearance of moose from alpine habitats correlated with increasing snowpack depth measured at lower elevations nearby. Fewest moose were observed in alpine areas during the winter with least snow; 1985-86. Low moose numbers in 1985-86 were also associated with high levels of weather-related winter mortality, mortality from collisions with trains and highway vehicles, and hunting mortality from the preceeding fall and winter. Seasonal trends in moose numbers were not similar for all areas. Movement patterns for a radio-marked individuals provided evidence that area differences in moose migratory behavior and habitat use caused seasonal trends in moose numbers to vary between areas.

Shallow snowpacks and availability of early successional browse may make the Matanuska Valley one of the most favorable moose winter ranges in the lower Susitna Valley. Deep snowpacks in western and northern Subunit 16A make those areas relatively undesirable moose winter range and probably encourage moose to migrate easterly toward Subunits 14A and 14B. Moose from southern Subunit 14B probably migrate to Subunit 14A during the winter because of the typically deeper snowpacks in Subunits 16A and 14B. Moose may move to higher elevations (e.g., Sunshine) during the winter because of the relatively shallow snowpack in some windblown alpine habitats.

Because snowfall and snowpack affected moose migratory behavior and numbers of moose in alpine habitats, they can influence results of moose surveys. In 1988 following a substantial early snowfall, moose numbers in alpine areas had decreased 54% by 5 December. Aerial surveys conducted on 18, 26, 17, and 15 November 1985 to 1988 included 99%, 100%, 97%, and 80% of annual peak numbers of moose, respectively. This indicates that observability of moose on fall censuses or composition surveys can be maximized and fall-winter moose "subpopulation mixing" minimized by conducting surveys before early December. Because of moose migratory movements, population data obtained from December surveys may not be comparable between years and should be used cautiously when making judgements about "resident" fall posthunting populations.

Alpine habitats provide moose with forage during an important prewinter time period. Moose use of alpine habitats during the fall and early winter correlates with a period of high forage intake and positive energy balance. Postrut foraging prepare moose nutritionally for winter and is an important factor affecting overwinter survival and carrying capacity of an area. Postrut habitats of moose should be protected from alteration. Winter recreation and other human activities that might interfere with foraging patterns of moose in alpine postrut areas should be discouraged.

Key Words: Moose, Alces alces gigas, Susitna Valley, radiotelemetry, habitat, movements, aerial survey, population identity, Southcentral Alaska.

CONTENTS

BACKGROUND

Prior to statehood (i.e., 1959), the Susitna River Valley was ranked as the most productive moose (Alces alces) habitat in the territory (Chatelain 1951). Today, the innate potential of this area as habitat for moose is probably unsurpassed throughout the state.

Presently, the lower Susitna Valley is the focal point of more development than any other region in the state. Proposed and progressing projects involving grain and crop agriculture, dairy and grazing livestock, commercial forestry and logging, personal-use cutting of firewood, mineral and coal mining, land disposals, ranges and refuges, human recreation, human settlement, urban expansion, further development of the highway system, and increased railroad traffic in the region may greatly detract from the potential of the area to support moose.

Although development and its associated activities may tend to reduce the moose population in the Susitna Valley, resource users have demanded increased allocations to satisfy consumptive and nonconsumptive uses. Accordingly, this conflict has created a tremendous need by local, state, and federal land and resource management agencies for timely and accurate knowledge about moose populations in Subunits 14A, 14B, 16A, 16B, and 13E. These informational needs intensify in response to (1) increased pressures to develop additional lands, (2) increased numbers of users and types of resource use, and (3) a more complex system for allocating resources to potential users.

The Wildlife Conservation Division lacks the necessary information about moose populations in the lower Susitna Valley to accurately assess the ultimate impacts from these increasing resource demands. The Division is therefore unable to dispute or condone specific demands or provide recommendations to regulate or minimize negative impacts on moose populations or habitat. Additionally, the Division must be knowledgeable about moose subpopulation behavior in order to mitigate unavoidable negative impacts to moose subpopulations or habitat.

Because major decisions on land use and resource allocation in the lower Susitna Valley are being made, the Division should consolidate the existing database for the moose populations there and initiate studies to augment that database so that activities impacting moose and their habitat may be promptly recognized, evaluated, and minimized and/or mitigated. Habitats and environmental conditions of the lower Susitna Valley vary greatly. Because many resource use conflicts require site-specific knowledge, numerous interrelated substudies must be conducted to adequately understand movement patterns and identities of major moose subpopulations throughout the area. Initial substudies will be conducted in areas where immediate conflicts exist.

When I evaluated resource conflicts for the entire lower Susitna Valley, it was apparent that research efforts should begin in Subunits 14A and 14B in the western foothills of the Talkeetna Mountains for the following reasons: (1) this area possesses the largest, densest postrutting aggregation of moose in the region and, perhaps, the state; (2) it is the nucleus of development activities and resource use; (3) it provides recreations and resources to over half of Alaska's human population; (4) it has unique problems involving railroad and highway systems; and (5) recent information obtained from Susitna River hydroelectric environmental studies and a habitat suitability assessment project has indicated a lack of knowledge about moose in the area.

Historical information relating to moose populations in the Susitna Valley is limited to (1) harvest statistics (ADF&G files), (2) inconsistently conducted sex-age composition surveys (ADF&G files); (3) inconsistently collected data for train- and vehicle-killed moose (ADF&G files), (4) an outdated population movement study based on resightings of "visually collared" moose (ADF&G files), (5) studies on railroad mortality and productivity of the railbelt subpopulation (Rausch 1958 and 1959), (6) a sporadically monitored radiotelemetry population identity study in the Dutch and Peters Hills (Didrickson and Taylor 1978), (7) an incomplete study of moose-snowfall relationships in the Susitna Valley, and (8) a study of extensive moose mortality in a severe winter (1970-71) for which there is no final report.

Recent studies designed to assess the impact of a proposed hydroelectric project on moose have provided substantial amounts of data on populations in the areas adjacent to the Susitna River and downstream from Devil Canyon (Arneson 1981; Modafferi 1982, 1983, 1984). Circumstantial evidence and cursory examination of these studies suggest that traditional sex-age composition counts conducted in widely spaced alpine areas of Subunits 14A and 14B were biased and excluded samples from large segments of hunted moose subpopulations. These data also suggest that moose killed during late-winter hunting seasons in Subunit 14B originated in Subunit 16A and those killed during hunting seasons in Subunit 16A were included in composition surveys for Subunits 14A and 14B.

I believe that moose subpopulations in Subunit 16A remain largely unsurveyed because they occur in forested habitats and can be surveyed only during the winter when they occur in riparian habitats common to both Subunits 14B and 16A. Traditional composition surveys that have remained relatively insensitive to large annual changes in moose mortality rates indicate assumptions about movements and identities of moose subpopulations in Subunits 14A and 14B (i.e., western foothills of the Talkeetna Mountains) are incorrect.

A recent joint study conducted by Divisions of Wildlife Conservation and Habitat (ADF&G files) and designed to evaluate methods for assessing moose population status and habitat suitability was begun to identify important moose wintering areas and document moose-snowfall relationships in a large portion of the lower Susitna River Valley. Previous progress reports (Modafferi 1987, 1988a, and 1988b) relating to lower Susitna Valley moose population identity and movement studies have been published.

OBJECTIVES

Primary

To identify and delineate major moose subpopulations in the lower Susinta River Valley.

To more precisely delineate annual movement patterns and location, timing, and duration of use of seasonal habitats.

To assess effects of seasonal timing on results of annual fall, sex-age composition trend surveys.

Peripheral

To identify habitats and land areas that are important for maintaining the integrity of moose subpopulations in the lower Susitna Valley.

To locate winter range and calving areas used by lower Susitna Valley moose subpopulations.

To identify moose subpopulations that sustain "accidental" mortality on highway and railroad right-of-ways and mortality during open hunting seasons.

To determine moose natality rates and timing of calf and adult mortality.

STUDY AREA

The study area is located in the lower Susitna Valley in Southcentral Alaska (Fig. 1). The roughly 50,000-km^2 area bordered on the north and west by the Alaska Mountain Range, on the east by the Talkeetna Mountains, and on the south by Cook Inlet encompasses all watersheds of the Susitna River downstream from Devil Canyon and includes all or portions of Subunits 14A, 14B, 16A, 16B, and 13E (Fig. 2). Monthly mean temperatures vary from about 16 C in July to -13 C in January; maximum and minimum temperatures of 25 C and -35 C, respectively, are not uncommon. Total annual precipation varies from about 40 cm in the southern to over 85 cm in the northern and western portions of the area. Maximum depth of snow on the ground during the winter can vary from less than 20 cm in the southern to over 200 cm in the northern and western portions. Climatic conditions generally become more inclement away from the maritime influence of Cook Inlet. Elevations within the area range from sea level to rugged mountain peaks well above the 1200-m level. Vegetation in the area is diverse, typically varing with elevation: wet coastal tundra and marsh, open low-growing spruce forest, closed spruce hardwood forest, treeless bog, shruby thicket, and alpine tundra (Viereck and Little 1972). Dominant habitat and canopy types in the area are characterized as follows: (1) floodplains dominated by willow (Salix spp.) and poplars (Populus spp.), (2) lowlands dominated by a mixture of wet bogs and closed or open-mixed paper birch (Betula papyrifera)/white spruce (Picea glauca)/aspen (Populus tremuloides) forests, (3) midelevation dominated by mixed or pure stands of aspen/paper birch/white spruce, (4) higher elevation dominated by alder (Alnus spp.), willow, and birch shrub thickets or grasslands (Calamagrostis spp., and (5) alpine tundra dominated by sedge (Carex spp., ericaceous shrubs, prostrate willows, and dwarf herbs. Alpine winter moose surveys were conducted above timberline in the higher elevation and alpine tundra habitats, roughly between elevations of 600 m and 1200 m.

METHODS

Individual moose were captured and marked with ear tags and radio-transmitting neck collars. Each ear tag featured a discrete numeral, and each neck collar featured a discrete radio-transmitted frequency and a highly visible number.

Moose were typically immobilized with 4-6 mg carfentanil (Wildnil, Wildlife Laboratories, Ft. Collins, Co.) dissolved in 2-3 cc H_2O and administered with Palmer Cap-Chur equipment by personnel aboard a hovering Bell 206B or Hughes 500D helicopter. While immobilized, moose were marked with ear tags and neck collars and aged by visual inspection of wear on incisor teeth. Antler size and conformation were considered when assessing age of males. Moose were assigned to the following age categories: calves, yearlings, 2- to 5-year-olds, 6- to 12-year-olds, and >12-year-olds. Sex of marked moose and their association with young of the year were noted. Immobilized moose were revived with an intramuscular injection of 90 mg naloxone hydrochloride (Naloxone, Wildlife Laboratories, Ft. Collins, Co.) per mg of carfentanil administered.

Moose were surveyed, captured, and marked at different times and locations within the study area (Figs. 3 and 4, Appendix A). Aerial moose surveys were conducted periodically each winter between October 1985 and April 1989 to determine timing, magnitude, and duration of moose use of alpine habitats in the western foothills of the Talkeetna Mountains.

Surveys were initiated and periodically conducted through winter as long as weather permitted and snowcover was sufficient to observe moose. Numbers of antlered yearlings, antlered adults, nonantlered adults, and calves were counted on each survey. Survey data were totaled for 7 discrete alpine subareas separated by lower-elevation river drainages.

Forty-four moose were captured and marked in the Talkeetna Mountain alpine habitat survey areas between 23 December 1985 and 4 February 1986. Marking procedures were initiated after 18 November 1985, when aerial surveys indicated peak numbers of moose were present in alpine habitats (Modafferi 1987). Distribution of sampling effort between subareas roughly paralleled moose distribution observed during aerial surveys. On 14 December 1987 and 22 December 1988, 6 and 2 moose, respectively, were captured and radio-marked to replace those that had shed transmitting collars or died.

On 28 January 1987, 7 moose were captured and marked in the northern portion of lowland forest habitat in the Kashwitna corridor. Sampling effort roughly paralleled moose distribution observed on a 7 January 1987 survey conducted between Willow Creek and the Kashwitna River (Modafferi 1988a). This area roughly corresponds to the Kashwitna corridor forest, where the DNR, Division of Forestry staff initiated an active forest management program in 1988 by providing access and conducting sales to make timber available for commercial harvest. On 9 February 1989, 5 moose were captured and marked near timber sale sites in the southern portion of the Kashwitna corridor.

During February and March 1988, 6 moose were captured and marked in the Coal Creek area, where personal-use cutting of firewood had been permitted by the Division of Forestry. Captured moose frequented this area to feed on buds, catkins, and twigs that had been trimmed off birch trees cut for firewood.

Moose captured and radio-marked during previous studies along the Susitna River floodplain (Arneson 1980; Modafferi 1982, 1983, 1984) ranged within the study area. Information gathered from these moose was incorporated into the database. Twenty-one of these moose with operational radio transmitters were radio-relocated during this reporting period.

Survey flights in Cessna 180 or 185 and Piper PA-18 aircraft equipped with 2-element "H" or 3 element Yagi antennas (Telonics, Mesa, Az.) were conducted periodically to relocate radio-marked moose. Relocation points (audio-visual or audio) were noted on USGS topographic maps (1:63,360) and later transferred to translucent overlays of those maps for computer digitization and geoprocessing. Relocation surveys, conducted at about 2- to 4-week intervals, provided about 192, 49, 34, 18, and 6 relocations through 8 June 1989 for moose marked in the Susitna River, Talkeetna Mountain, northern Kashwitna corridor, southern Kashwitna corridor, and Coal Creek areas, respectively.

During the reporting period, transmitters on some moose marked along the Susitna River have exhibited weak, infrequent, and/or no signals. These transmitters are presumed to be weakening and expiring from battery failure. Parallel moose population identity and movement studies were initiated in other areas of the lower Susitna River Valley in March 1987 and February 1988 (Appendix B).

Additional information on herd size, composition, and distribution of moose in the lower Susitna River valley was obtained from stratified random moose censuses (Gasaway et al. 1986) conducted from 5 to 8 December 1987 in Subunits 14B and from 19 to 23 November 1988 in Subunit 14A. Other information on herd composition, distribution, and density was obtained from surveys related to forest management in the Susitna Regional Forest in Subunit 16A, the Kashwitna corridor in Subunit 14B, and the Matanuska Valley Moose Range and ski resort development in the Hatcher Pass area of Subunit 14A.

Data on moose killed by collisions with trains and highway vehicles were collected to evaluate the impact on moose populations in the lower Susitna River Valley. The Alaska Railroad and Department of Public Safety recorded and provided the ADF&G with data on locations and dates for all moose killed in their respective rights-of-way. Beginning in the fall of 1987, recipients of salvaged moose were required to provide the lower jaw as well as information on the sex, method, date, and lcoation of kill to the ADF&G.

To assess moose winter mortality in Subunit 16A, floodplains of Moose and Kroto Creeks were surveyed for moose carcasses on 18 March 1987, 20 April 1988, and 3 April 1989. Similar surveys were conducted 5 March 1984 and periodically between 29 November 1984 and 16 April 1985 during previous studies (Modafferi 1988c).

On 11 January 1988, I visited areas where moose concentrated in forested habitats in the Kashwitna corridor to determine food sources moose utilized. Snowpack depth data for Wasilla, Willow, Talkeetna, Skwentna, and Chulitna River Lodge were obtained from Alaska Climatological Data Reports published by the U.S. Department of Commerce, NOAA, National Environmental Satellite, Data, and Information Sevice, National Climate Data Center, Asheville, North Carolina. Tabular data for daily measurements of depth of snow on the ground were condensed to "maximum snowpack depth" values for monthly periods equivalent to 1-10, 11-20, and 21-31 calendar days. "Maximum snowpack depth" values equalled the greatest depth of snow recorded on the ground during each monthly period. Willow and Talkeetna snowpack depth data were used as an index to snowpack depths in alpine survey areas.

RESULTS AND DISCUSSION

Moose Postrutting Use of Alpine Habitats

Data from periodic surveys conducted in 7 areas during 4 winters in the western foothills of the Talkeetna Mountains documented trends in moose fall-winter use of alpine habitats (Table 1, Fig. 5). Data from Bald, Moss, and Willow Mountains, which were studied on every survey (Table 2, Fig. 6), indicated that (1) few moose occurred in alpine habitats in early October, (2) numbers varied seasonally, (3) annual peak levels occurred within a 37-day interval between 28 October and 3 December, (4) peak levels varied between years, and (5) patterns of seasonal variations differed among years (Fig. 2). Seasonal and annual variation in moose numbers were, in part, attributed to differences in snowpack depth and mortality the preceeding fall and winter.

Fall Arrival in Alpine Habitats

Data obtained during the 2 years when early snowfall enabled surveying suggest that few moose occurred in alpine habitats in early October. In 1985 only 7% of the annual peak number of moose were counted on October 4. By mid-October a major movement to these areas was underway; 42% of the annual peak was observed on 17 October 1985 and 46% on 13 October 1988. Moose numbers continue to increase until the annual peak occurs in late October to early December. Apparently, many moose spend the rut (i.e., late September to early October) below timberline in forested habitats before moving above timber in mid-October.

Winter Departure From Alpine Habitats

The annual peak use of alpine habitats is brief. In most years, the number of moose above timberline begins to decline in late November or early December, and by late April most moose are gone. In 1986, 1987, and 1988, the number of moose observed in alpine areas decreased by 92%, 87%, and 90%, respectively, between late October and late November (Figs. 5 and 6). In 1985 the number of moose were relatively stable between 18 November (620 moose observed) and the 3 December peak (626 moose observed); subsequently, numbers continued to decline gradually. On 28 February, 472 moose were observed above timberline, representing more moose than had been observed anytime after November for the years 1986 to 1989. On 31 March 1986, 54% of the annual peak number remained in alpine habitats.

Influence of Snowpack Depth on Alpine Habitat Use

Seasonal trends in moose numbers were correlated with winter snowpack depths recorded at lower elevations at Willow (Fig. 7) and Talkeetna (Fig. 8.). Extended seasonal occurrence of moose in alpine habitats in 1985 was associated with relatively mild winter conditions and shallow snowpack depths. The 1985-86 snowpack depths in portions of the lower Susitna Valley were the least recorded in the last 25 years (Clagett 1986). In 1985 snowpack depth values (i.e., depth of snow on ground) were relatively stable at Willow from mid-Novemeber through early December (Fig. 7); at Talkeetna they were decreasing from mid-November to mid-January (Fig. 8). Snowpack depth values for Talkeetna and Willow only once exceeded 15 inches during that entire winter. In contrast, during the 1986-87 and 1987-88 winters when moose numbers declined abruptly after late November, snowpack depth values at Willow and Talkeetna exceeded those for 1985 in late November and were typically 2- to 4 times greater through February. As they did in the winter of 1985, deeper snowpacks in 1986-88 discouraged moose from remaining in alpine habitats after early December. Data from 1986 to 1989 also illustrate differences in moose use of alpine habitats in relation to snowpack depth. Mid- and late-December snowpack depth values for 1986 were between those for 1985, 1987, or 1988. Moose numbers, peaked and began declining later in 1986 than in 1987 to 1988 but earlier than in 1985.

Annual Variation in Use of Alpine Habitats

Annual peaks in the number of moose for all subareas varied from 919 in 1985 to 1,405 in 1986 (Table 1). Annual peak winter levels were recorded on 18 November in 1985, 26 November in 1986, 17 November in 1987, and 28 October in 1988. Annual peaks for the Bald, Moss, and Willow subareas that were included on all surveys occurred in a 37-day interval; the median date was 15 November (Table 2).

Peak levels, timing of peak levels, and seasonal trends in the number of moose in alpine habitats appeared related to snowpack depths. The earliest annual peak and decline in numbers was recorded in 1988, when October snowpack depths exceeded those recorded for the previous 3 years (Figs. 3 and 4). The latest and lowest annual peak and most gradual decline in numbers occurred in 1985, when snow pack depth values were least (Figs. 3 and 4) and annual moose mortality the preceeding year had been rated as highest (ADF&G files). The pattern for moose use of alpine habitats documented in 1985 suggests that early snowfall initiates movements to alpine postrutting areas, fewer moose move to alpine areas when snowfall is light, and more moose remain in alpine areas for a longer time in winters with light snowfall and shallow snowpacks than in winters with heavy snowfall and deep snowpacks (e.g., 1986-89).

Low peak levels in the number of moose in 1985 were also associated with elevated moose mortality for the previous fall hunting season and winter. Extremely heavy snowfall in the winter of 1984-85 (Figs. 3 and 4), particularly mid-February to April, led to extensive moose mortality from "winter kill" (Modafferi 1988a), resulting in 365 moose fatalities because of collisions with vehicles and trains in Subunits 14A and 14B (ADF&G files). In the fall of 1984 the hunting mortality of 601 moose was also rated high for Subunit 14B (ADF&G files). In contrast, the high peak moose count in 1986-87 was preceeded by a mild winter with little "winter kill", 90% less moose mortality in highway and railway right-of-ways (37 moose) in Subunits 14A and 14B, and 59% less hunting mortality (249 moose) in Subunit 14B (ADF&G files).

Area Differences in Seasonal Use Patterns

Seasonal trends and timing of annual peaks for numbers of moose observed in alpine habitats differed among areas. Bald and Willow Mountain areas exhibited similar seasonal trends in moose numbers that also paralleled trends for the entire study area (Fig. 1); however, the trends differed from those for Sunshine Mountain (Figs. 9-12). For 3 years (1985-87), peak levels of moose on Sunshine Mountain occurred at least 1 month later than those on Bald or Willow Mountains (Table 3). In 1988 peak levels for the 3 areas were recorded at the same time; however, moose numbers on Sunshine Mountain decreased by only 11% over the next 3 months, while moose numbers decreased by 88% and 92% on Bald and Willow Mountains, respectively (Table 3). While moose numbers on Bald and Willow Mountains were decreasing after attaining peaks, moose numbers on Sunshine Mountain continued to increase in 1985, 1986, and 1987, remaining relatively stable in 1988 (Figs. 9-12).

Information from a radio-marked female moose indicated that she traditionally emigrates from the Sunshine area in May to calve over 30 miles away in Subunit 16A and for 7 consecutive years did not return to alpine habitat at Sunshine (Subunit 14B) earlier then 27 September. For 6 of the 7 years studied, this individual remained above timberline throughout the winter. If the behavior pattern of migrating to alpine habitat in late fall and remianing there through winter is common for moose in the Sunshine area, it could explain why moose numbers there attain peak levels later and decline less abruptly than at Bald and Willow Mountains.

Snowpack Depth and Moose Winter Range

Snowfall in the Susitna River drainage in 1984-85 was rated as the heaviest in the last 10 years (Clagett 1985). Winter snowpack depths varied greatly between different locations in the lower Susitna Valley (Fig. 13.). Snowpack depth data for January and February, when most moose are on winter range, indicated that the 1984-85 snowpack depths were very shallow at Wasilla, moderately deep at Willow and Talkeetna, deeper at Skwentna, and extremely deep at Chulitna (Fig. 13). Comparable data for the years 1985 to 1989 indicate that shallow snowpacks are common at Wasilla (Fig. 14) and uncommon at Willow and Talkeetna (Figs. 3 and 4).

Other factors being equal, shallow snowpack depths at Wasilla would make that area preferable moose winter range to areas near Willow, Talkeetna, Skwentna, or Chulitna. Winter snowpack depths may partly explain the extensive moose winter migrations into the Wasilla area (Subunit 14A), Willow Mountain (Subunit 14B) and the Kroto Creek area (Subunit 16A) (Modafferi 1988a, 1988c). If deep snowpacks affect moose near Skwentna similarly, moose from that portion of Subunit 16B may migrate easterly to Subunit 16A, where the snowpacks would be shallower.

BIOLOGICAL IMPLICATIONS

In July and August, before the open hunting season and the rut, it is not uncommon to observe moose above timberline in the Talkeetna Mountains. Some hunters believe that moose movements into timbered habitats in early September are influenced by the opening of hunting season and the activities of hunters. It is further speculated that over time, hunter selection of moose above timberline has or will lead to the reduction of moose that utilize alpine habitats accessible to hunters during the September hunting season. Observations of marked moose in more remote areas on the western side of the lower Susitna Valley, where activities of hunters probably have little influence on moose behavior or mortality, indicated that moose there also occur in forested habitats immediately prior to September (pers. comm., J. Faro, ADF&G). These observations suggest that moose naturally select forest habitats in late August or early September; however, hunting mortality may negatively affect moose populations that utilize alpine habitats during the September hunting season, or activities of hunters may delay the return of moose to those habitats in October. Extensive and long-term hunter selection for moose above timberline could eventually alter moose behavior patterns phenotypically or genetically.

Moose use of alpine postrutting habitat during October through early December correlates with a seasonal period of high forage intake and positive energy balance (Schwartz 1987). During this time period, moose deposit and store fat for winter. The decline in number of moose in alpine postrutting ranges indicates a movement of moose to winter range and parallels a seasonal decline in forage intake (Schwartz et al. 1984). While on winter range moose are in negative energy balance and lose condition. During this period moose utilize fat stores deposited previously while on summer and postrutting ranges.

Theoretically, quality of postrutting range influences the ability of moose to deposit fat; it also affects their prewinter nutritive condition. If the ability of moose to survive inclement winters is related to deposited fat levels, then postrutting range use and range quality are important components of overwinter moose survival and carrying capacity of an area.

In Alaska, as in Sweden (Sandegren et al. 1985), timing of snowfall and snowpack depths affect the length of time moose spend on postrutting and winter ranges. "Early" and severe winters with deep snowpacks shorten the time period moose use postrutting ranges and lengthen the time period they utilize winter ranges. "Late" or "mild" winters lengthen their use of postrutting ranges and shorten their use of winter ranges. Average winters result in a more equitable distribution of moose use between postrutting and winter ranges. A series of early or late winters could have a cumulative impact on winter or postrutting ranges.

Snowfall and snowpack depths appear to influence moose migratory patterns and locations of their winter ranges. Some moose migrate long distances from a postrutting range to winter ranges where snow pack depth is shallow. Some areas, regardless of vegetative type, are undesireable as moose winter range because of excessive snowpack depths (Modafferi 1988b). Areas with shallow snowpacks and preferred vegetative types are highly desireable for moose winter ranges. Typically shallow snowpack depths and the abundance of early successional browse around abandoned homesteads and rural residential developments make the Matanuska valley, particularly the Wasilla-Palmer area, a highly desireable moose winter range. Some moose migrate over 20 miles from the Kroto Creek area of Subunit 16A and the Willow Mountain area of Subunit 14B to winter in the Matanuska Valley of Subunit 14A (Modafferi 1988c).

Many moose migrate from alpine postrutting areas to lowland "snow-shadow" winter ranges. Some moose migrate from lowland areas (e.g., Subunit 16A) to winter on windblown areas at higher elevations near postrutting areas. Other moose migrate from midelevation alpine postrutting areas (e.g., Witna Mountain) to winter at higher elevations near the headwaters or tributaries of major drainages. In all cases, it appears moose seek areas with shallower winter snowpacks.

MANAGEMENT IMPLICATIONS

Herd Composition Trend Surveys

Many traditional fall moose sex-age composition trend survey count areas in Alaska include extensive areas of postrutting alpine habitat. Ideally, trend surveys should be conducted when maximum numbers of moose are most observable. If trend survey data are used to assess herd sex-age composition within a subunit, then surveys should also be conducted before moose initiate seasonal migrations and traverse subunit boundaries. Moose are most observable when not in forest habitats. Trend surveys should be scheduled when maximum numbers of moose are in relatively open-plant communities; i.e., alpine habitats. Since a decrease in moose numbers in alpine postrutting areas indicates the initiation of migratory behavior, scheduling surveys when numbers peak in alpine habitats would also preclude problems associated with migration across subunit boundaries.

Data gathered over a 4-year period in the western foothills of the Talkeetna Mountains indicated that maximum numbers of moose were observed in alpine habitat during the 37-day period between 28 October and 3 December. These data indicated that trend surveys probably should not be conducted before 28 October or after 3 December. Counts conducted only 2 days after that time interval in 1987 and 1988 were 33% and 66% lower than the annual maximum numbers observed. Population data obtained from surveys conducted after December 3 may vary greatly between years and not be representative of local posthuntting moose populations. The data further suggest that for most years, numbers of observable moose can be maximixed by conducting fall trend surveys and censuses during the last 2 weeks of November. By conducting surveys on 18, 26, 17, and 15 November 1985 through 1988, zero, zero, 3, and 20 percent of the maximum numbers of moose would not have been "captured" above timberline, respectively.

Area Moose Censuses

Random stratified census techniques (Gasaway et al. 1984) are commonly used to estimate moose population size within a unit. Because determination of sex-age composition is not a necessary component of censuses, they are frequently conducted in late winter or early spring when snowcover is usually adequate and moose are concentrated in shrub-dominated riparian or alpine winter ranges where observability is high.

There are shortcomings to conducting moose censuses during late winter. Data obtained in this study and others (Modafferi 1984, 1988a,1988b, 1988c) indicate that lower Susitna Valley moose commonly traverse long distances and subunit or unit boundaries when migrating from postrutting areas to winter ranges where subpopulations may become mixed. For example, moose from Subunits 16A and 14B are known to winter in the Wasilla/Palmer area of Subunit 14A. Timing of snowfall and snowpack depths affects the extent and timing of moose movements and interchange between units and subunits. Snowfall patterns can affect the timing and degree of population mixing and cause it to vary throughout the winter and from year to year. For example, in the mild 1985-86 winter moose migrations from postrutting areas were protracted and large numbers of moose remained in alpine postrutting areas throughout the winter; whereas, in the more inclement 1986 through 1989 winters, large numbers of moose abruptly migrated from postrutting areas. Data obtained during fall and winter censuses in subunits with highly migratory moose populations, as in the lower Susitna Valley, may not be directly comparable within or between years. Specifically, population data obtained from winter censuses in Subunits 14A, 14B, and 16A should be used cautiously to make judgements about "resident" fall posthunting populations.

Postrutting Habitat

Forage intake in moose increases from October through December (Schwartz 1984). Female moose are in positive energy balance in November and December while on postrutting ranges (Schwartz 1987). Forage on postrutting areas can influence nutritive condition and deposit fat levels of moose that arrive on winter ranges. High-quality forage and foraging conditions in postrutting areas would enable moose to enter winter in good nutritive condition and with adequate deposit of fat levels. Female moose are in negative energy balance from January through April while on winter range and rely in part on stored fat for energy. Postrutting range quality may be particularly important to moose that winter in areas with deep snowpacks and poor quality range.

Postrutting range quality could affect moose overwinter survival and productivity. Moose postrutting ranges (e.g., Willow Mountain Critical Habitat Area) can affect moose overwinter survival and productivity and should be protected from habitat alteration. Moose using these areas should be protected from human disturbance.

Increased use of ATV's and resurgence in use of snowmachines for winter recreation will likely increase human activities in moose postrutting and winter areas. Disturbance of moose in postrutting areas may interfere with their forgaing patterns and affect their ability to accumulate nutrient and energy reserves for winter. Wildlife managers should be cognizant of the levels of fall and winter recreational activities on moose postrutting and winter ranges and their potential indirect impact on moose.

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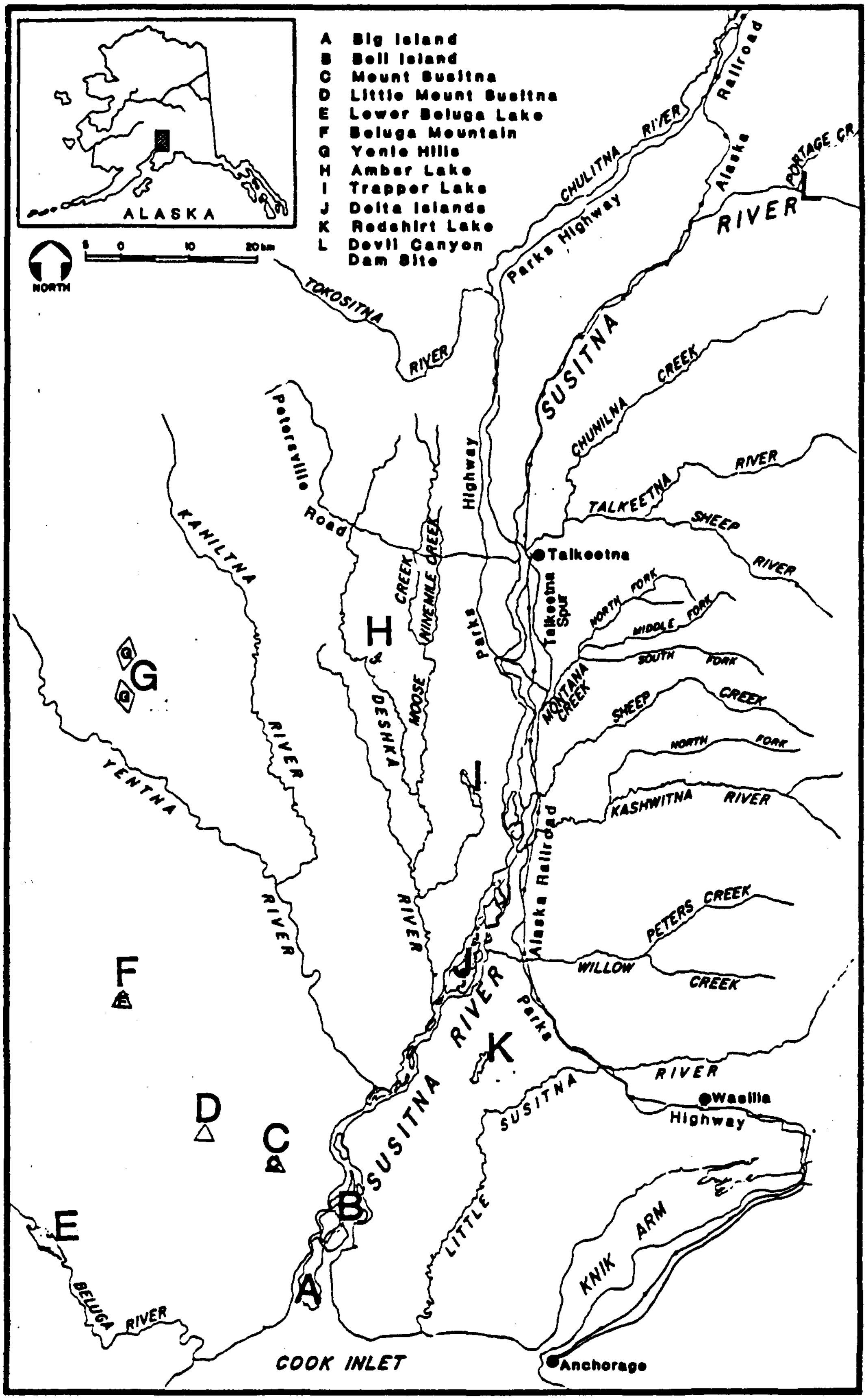

Figure 1. Map showing location of the study area in Alaska with names listed for rivers, lakes and other prominent landscape features.

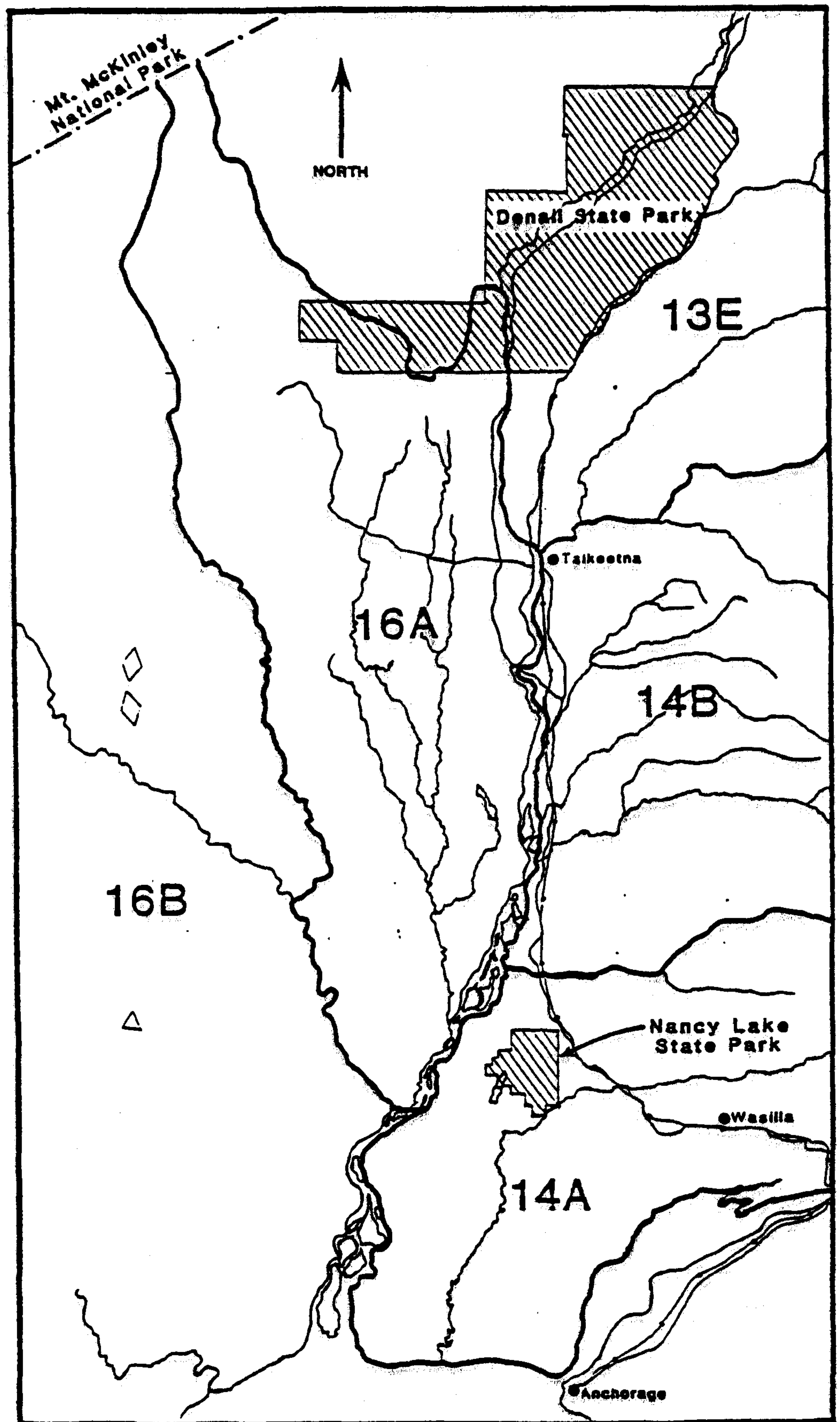

Fig. 2. Location of Game Management Subunits (13E, 14A, 14B, 16A and 16B) and state and national parks in the study area.

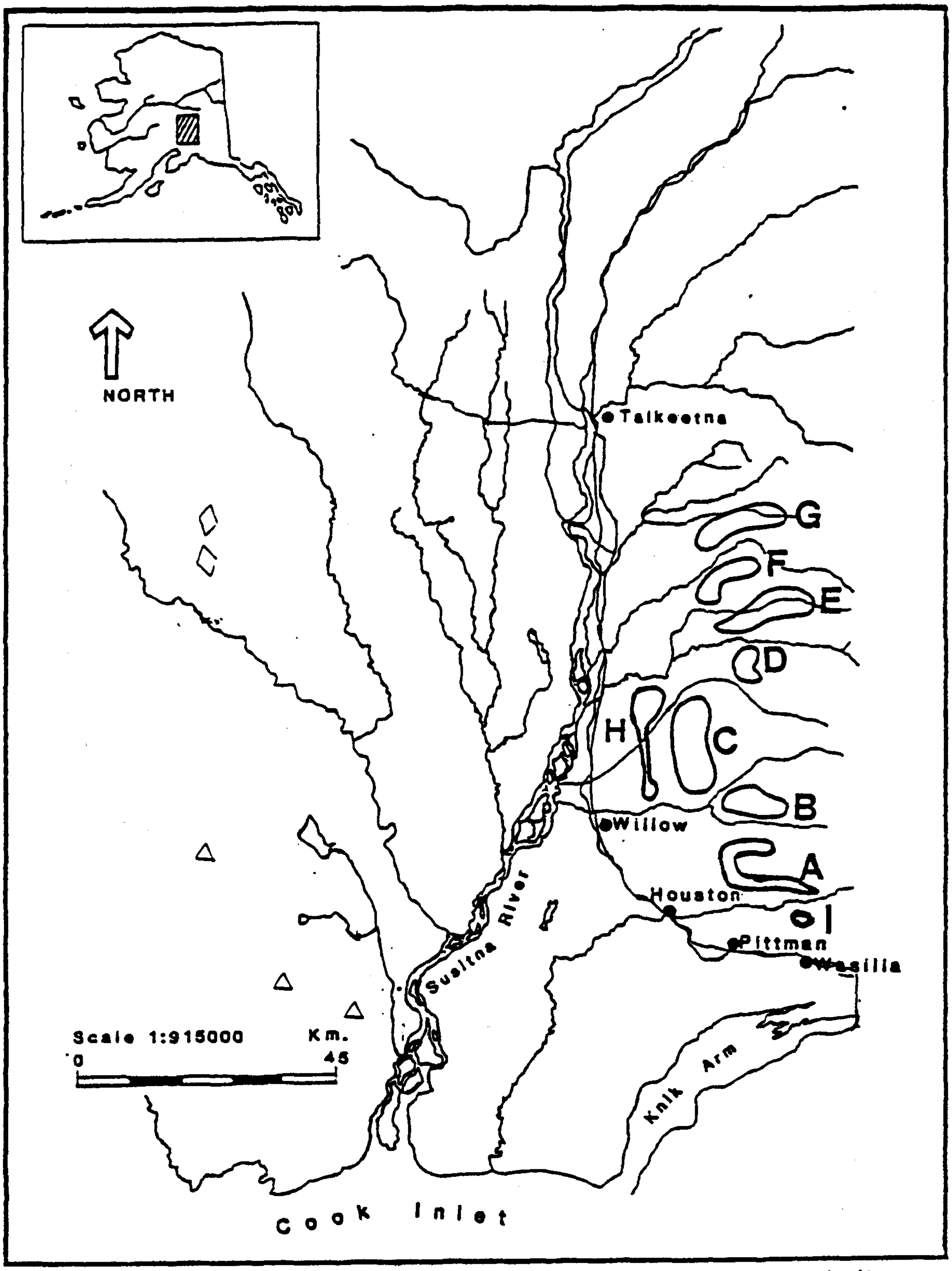

Fig. 3. Locations of Talkeetna Mountains alpine habitats (A-G), Kashwitna Corridor forested habitat (H) and the Coal Creek timber cut area (I) where moose were captured and radio-marked.

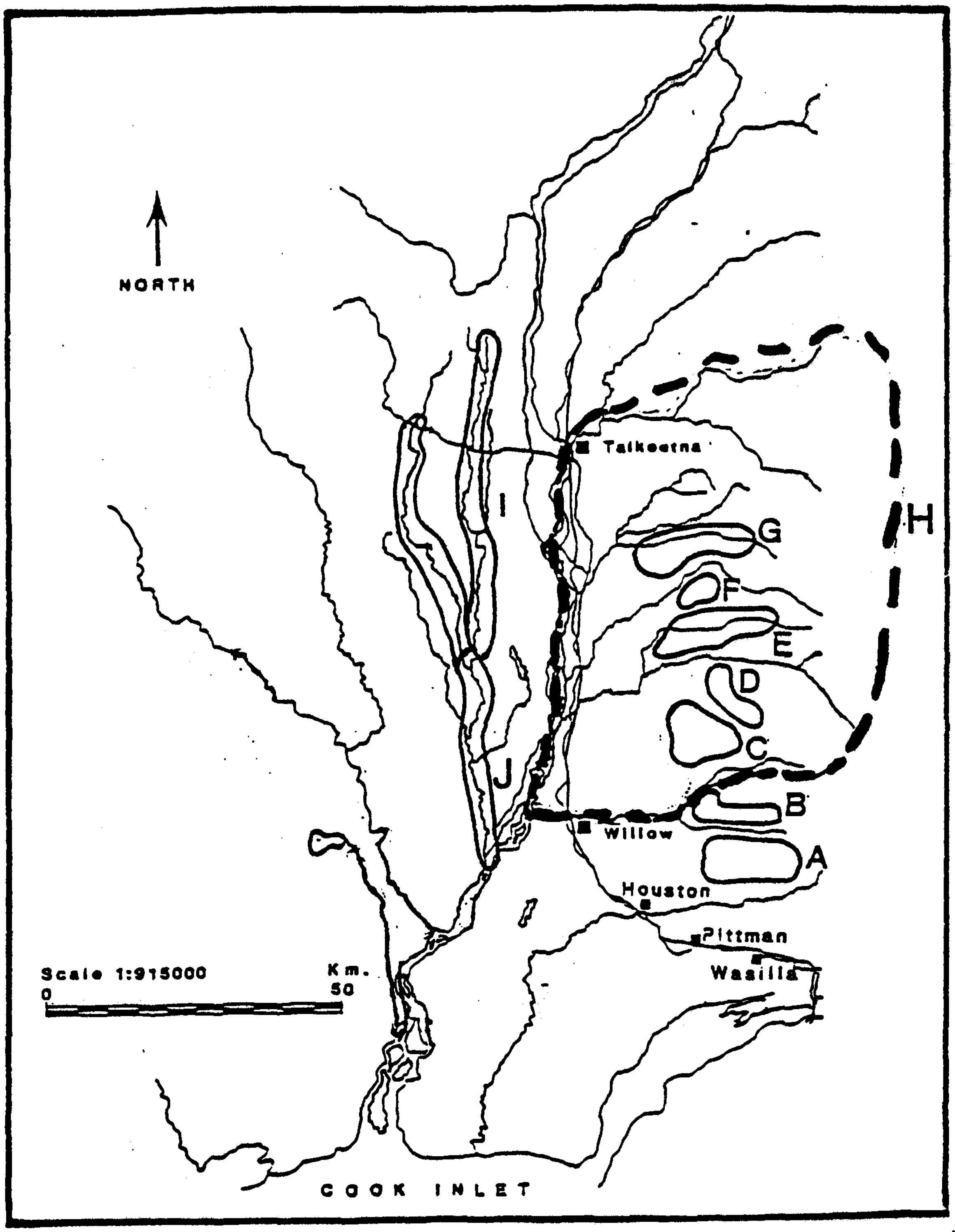

Fig. 4. Locations for Talkeetna Mountains subareas (A-G), Game Management Unit 14B (H) and Moose (I)/Kroto (J) Creeks where moose surveys were conducted.

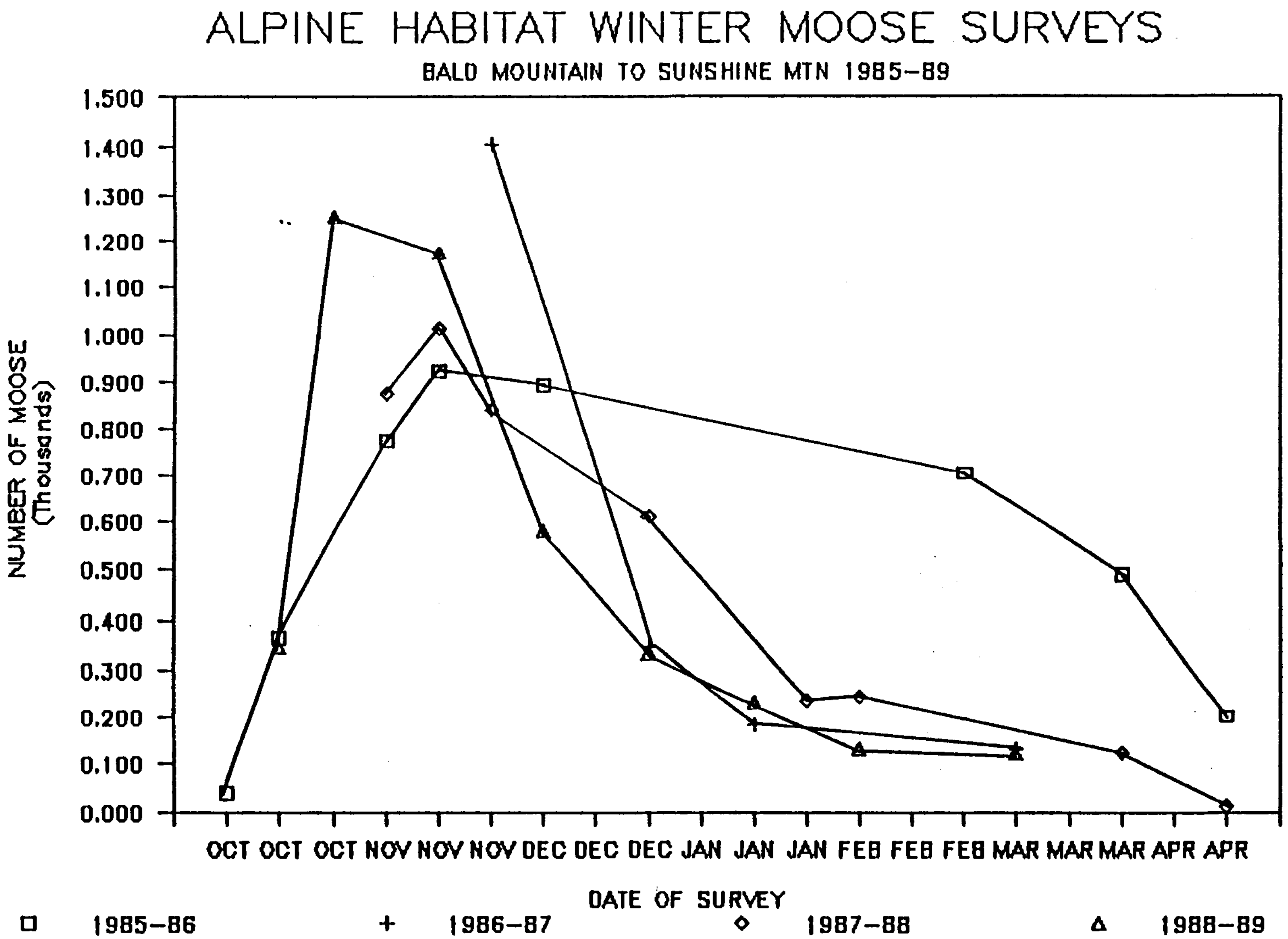

Figure 5. Winter trends in numbers of moose observed during 4 years in 7 alpine habitat areas in the western foothills of the Talkeetna Mountains, southcentral Alaska, October-April, 1985-89. Months are subdivided into periods of 1-10,11-20, and 21-31 calendar days.

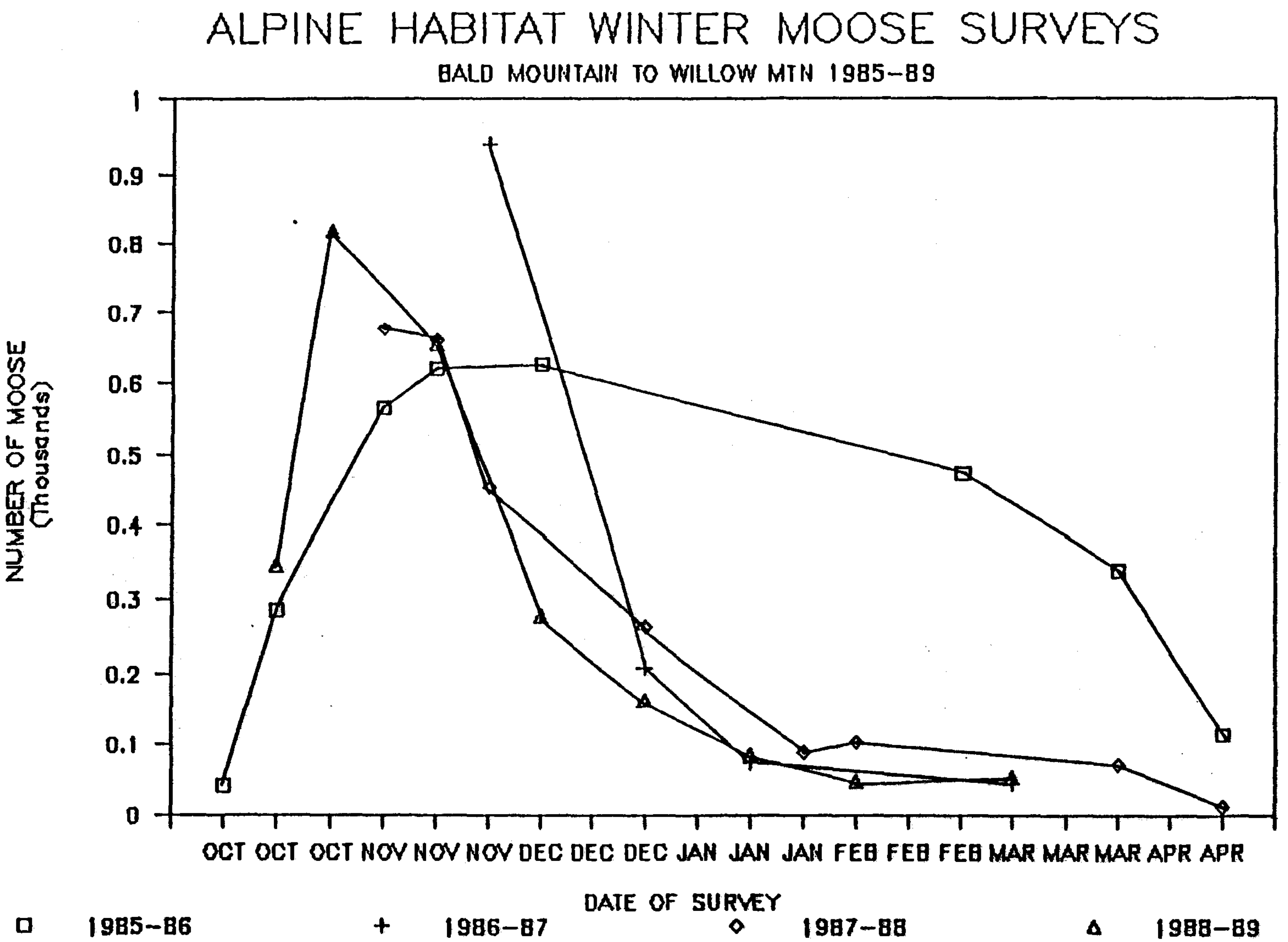

Figure 6. Effects of month and year on winter trends in numbers of moose observed during 4 years in 3 alpine habitat areas in the western foothills of the Talkeetna Mountains, October-April, southcentral Alaska, 1985-89. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days.

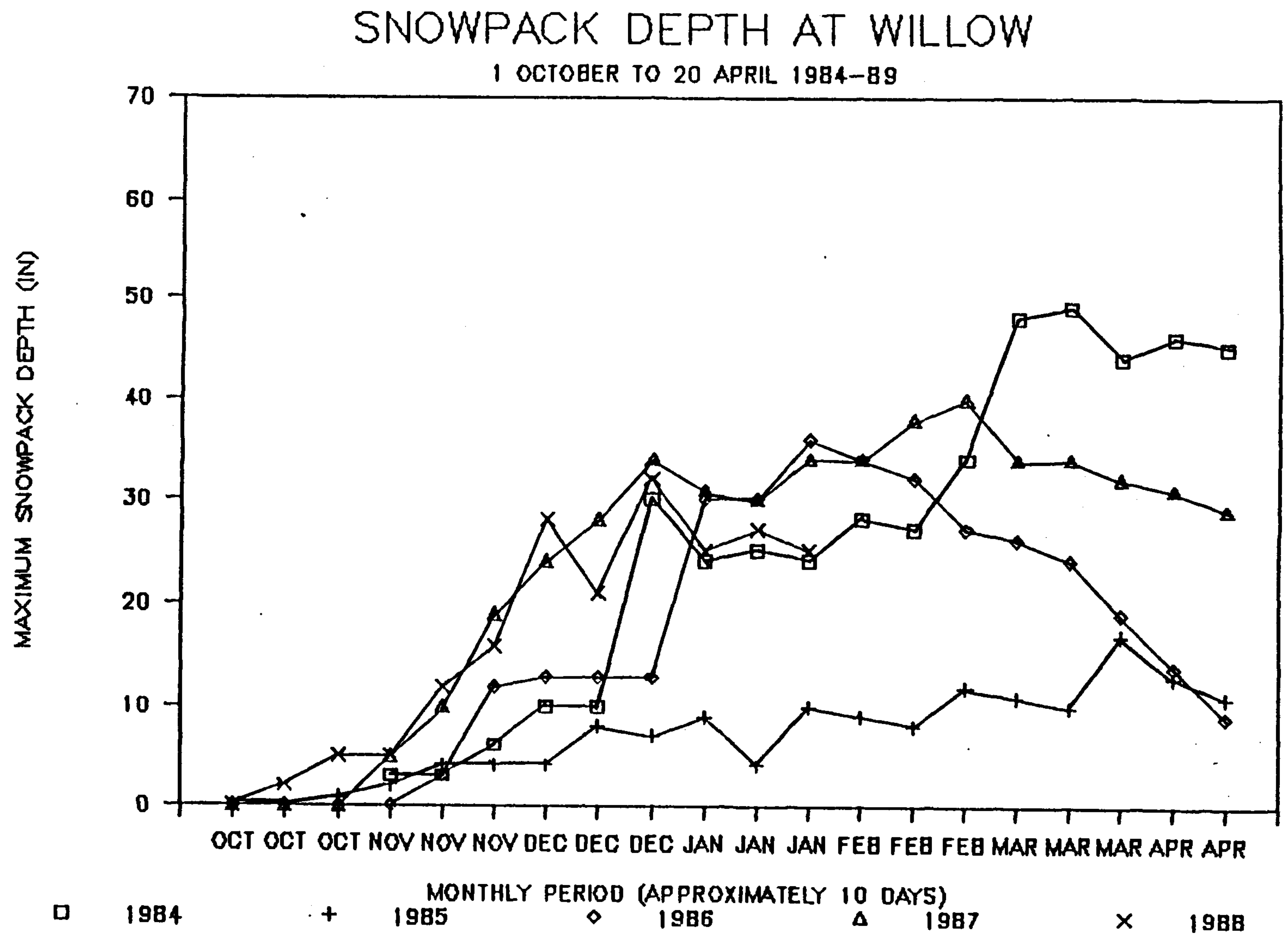

Figure 7. Effects of year and month on trends in snowpack depth recorded at Willow, southcentral Alaska, October-April, 1984-89. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days. Snowpack depth measurements represent maximum depths of snow recorded on ground during monthly period.

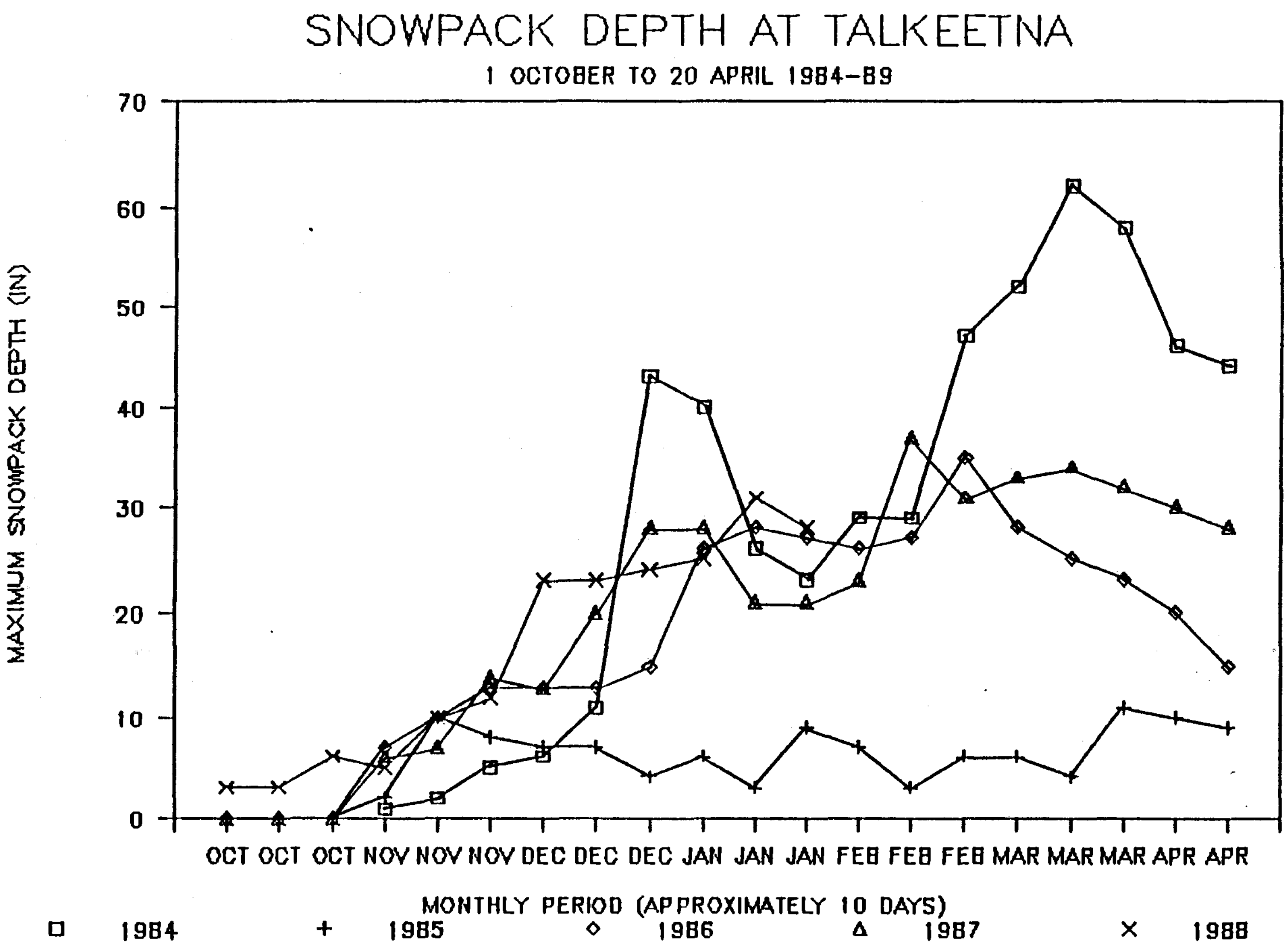

Figure 8. Effects of year and month on trends in snowpack depth recorded at Talkeetna, southcentral Alaska, October-April, 1984-89. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days. Snowpack depth measurements represent maximum depths of snow recorded on ground during monthly period.

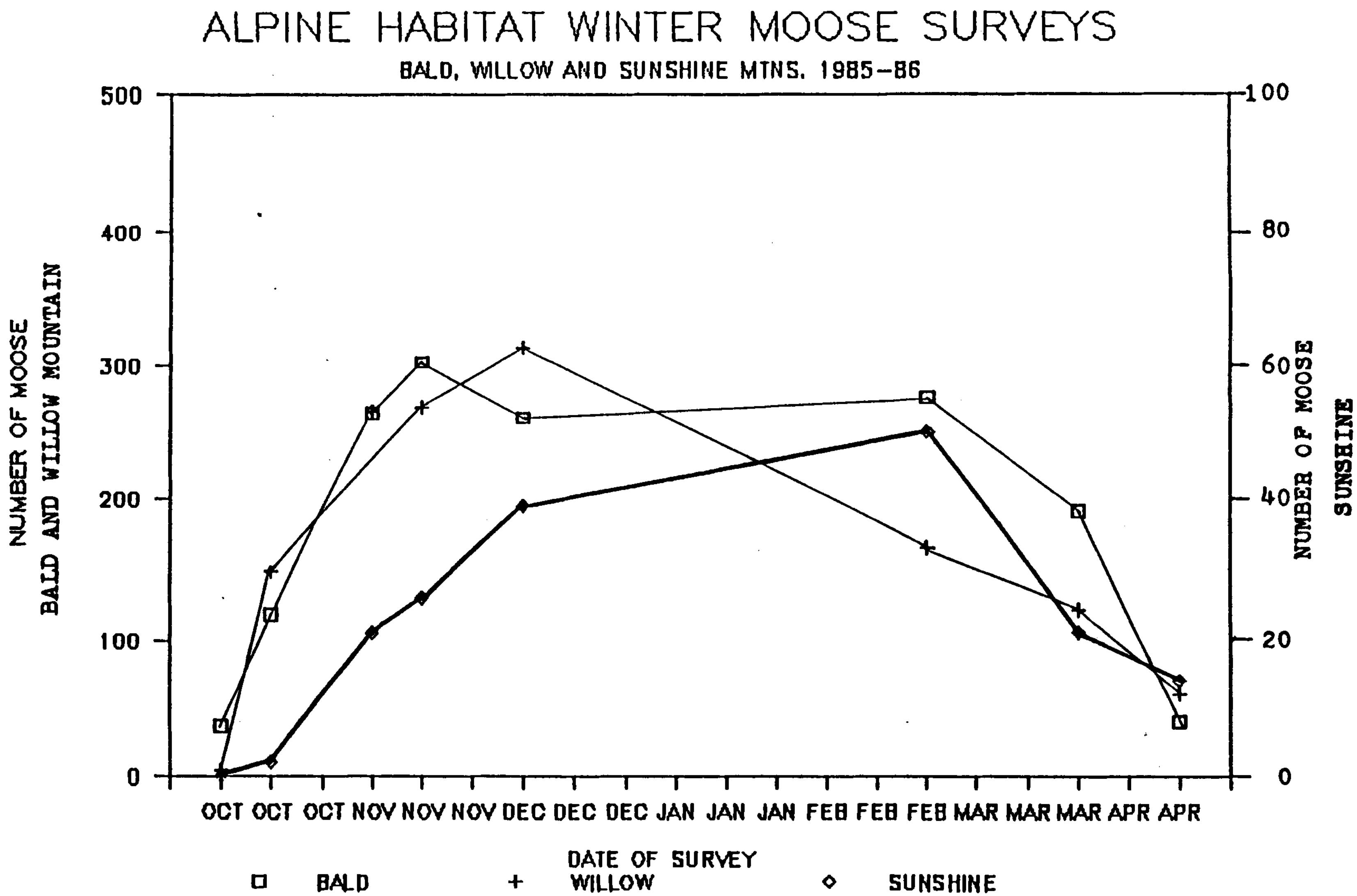

Figure 9. Effects of area on winter trends in numbers of moose observed in 3 alpine areas in the western foothills of the Talkeetna Mountains, southcentral Alaska, October-April, 1985-86. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days.

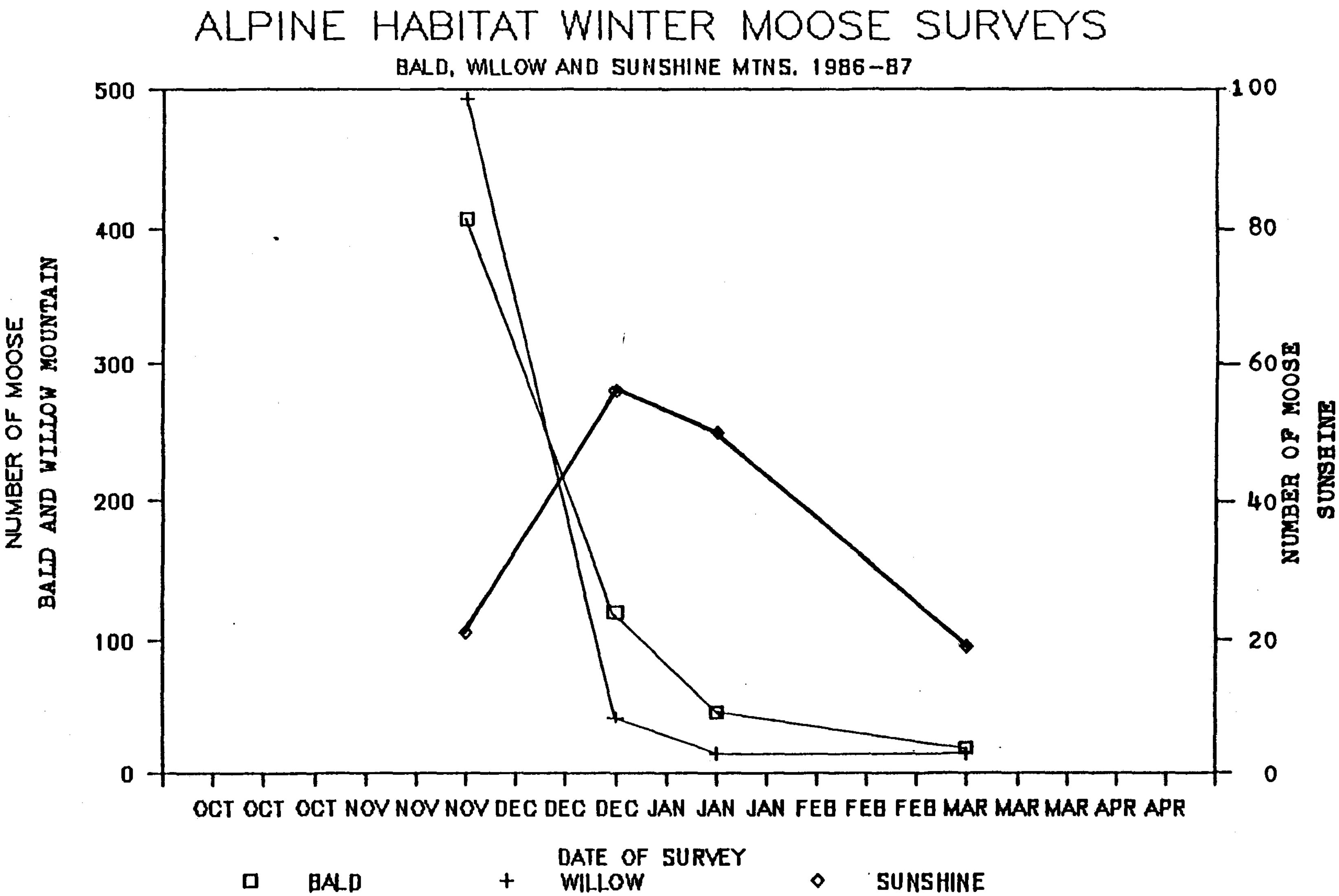

Figure 10. Effects of area on winter trends in numbers of moose observed in 3 alpine areas in the western foothills of the Talkeetna Mountains, southcentral Alaska, October-April, 1986-87. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days.

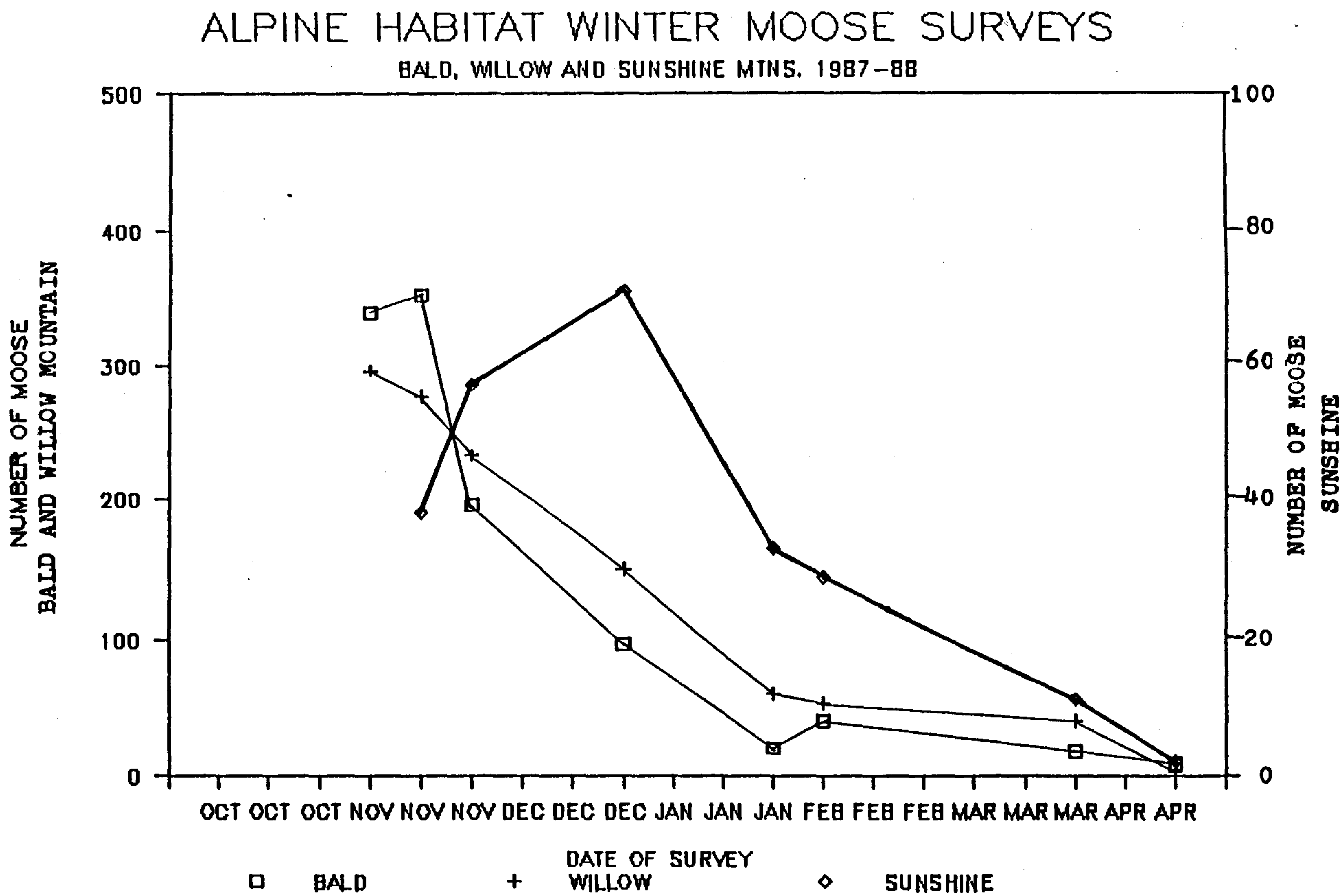

Figure 11. Effects of area on winter trends in numbers of moose observed in 3 alpine areas in the western foothills of the Talkeetna Mountains, southcentral Alaska, 1987-88. Months are subdivided into periods of 1-10, 11-21, and 21-31 calendar days.

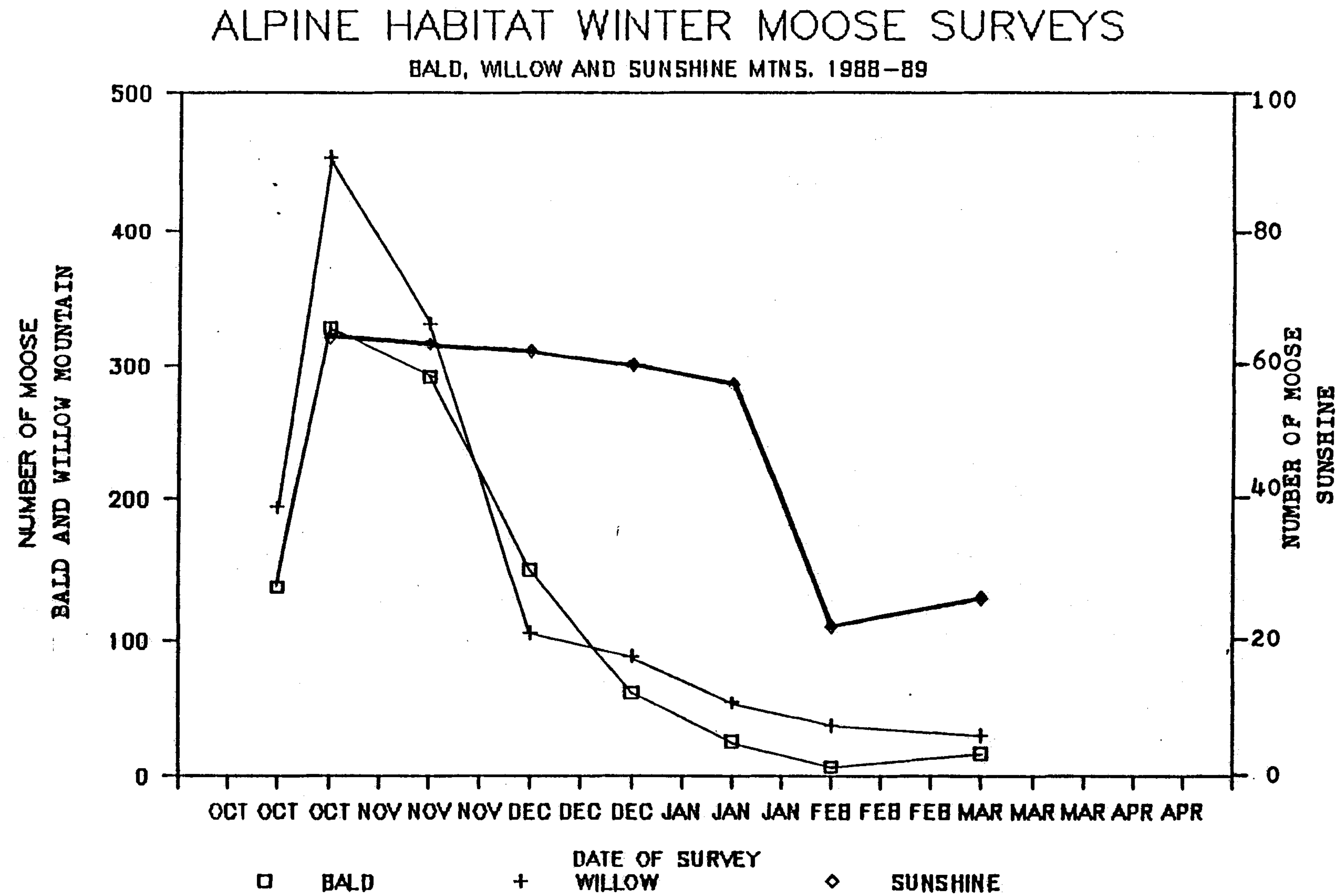

Figure 12. Effects of area on winter trends in numbers of moose observed in 3 alpine areas in the western foothills of the Talkeetna Mountains, southcentral Alaska, 1988-89. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days.

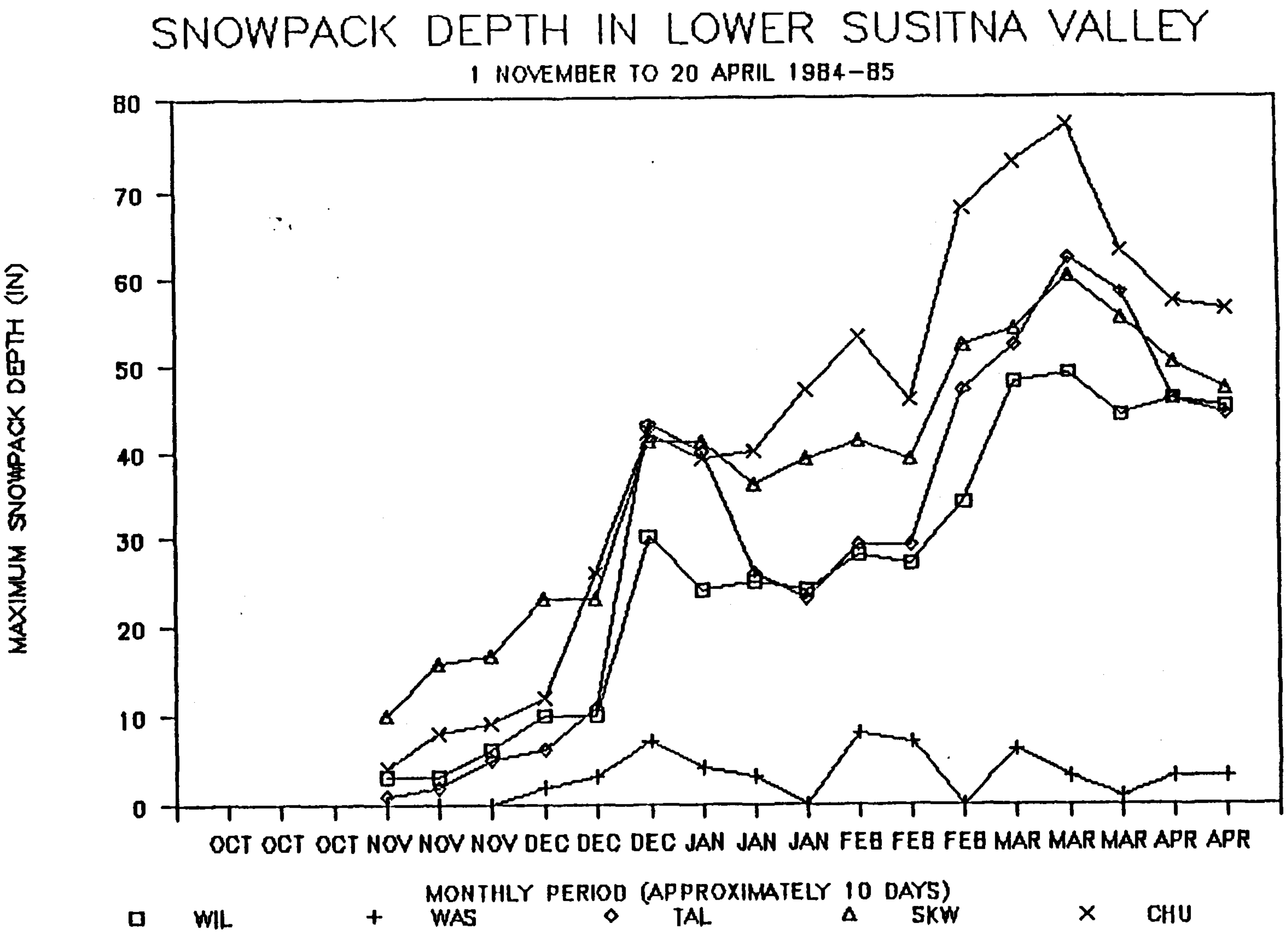

Figure 13. Effects of area on trends in snowpack depth recorded at 5 locations in the lower Susitna valley, southcentral Alaska, October-April, 1984-85. Snowpack depth represents the maximum depth of snow measured on the ground during monthly period. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days.

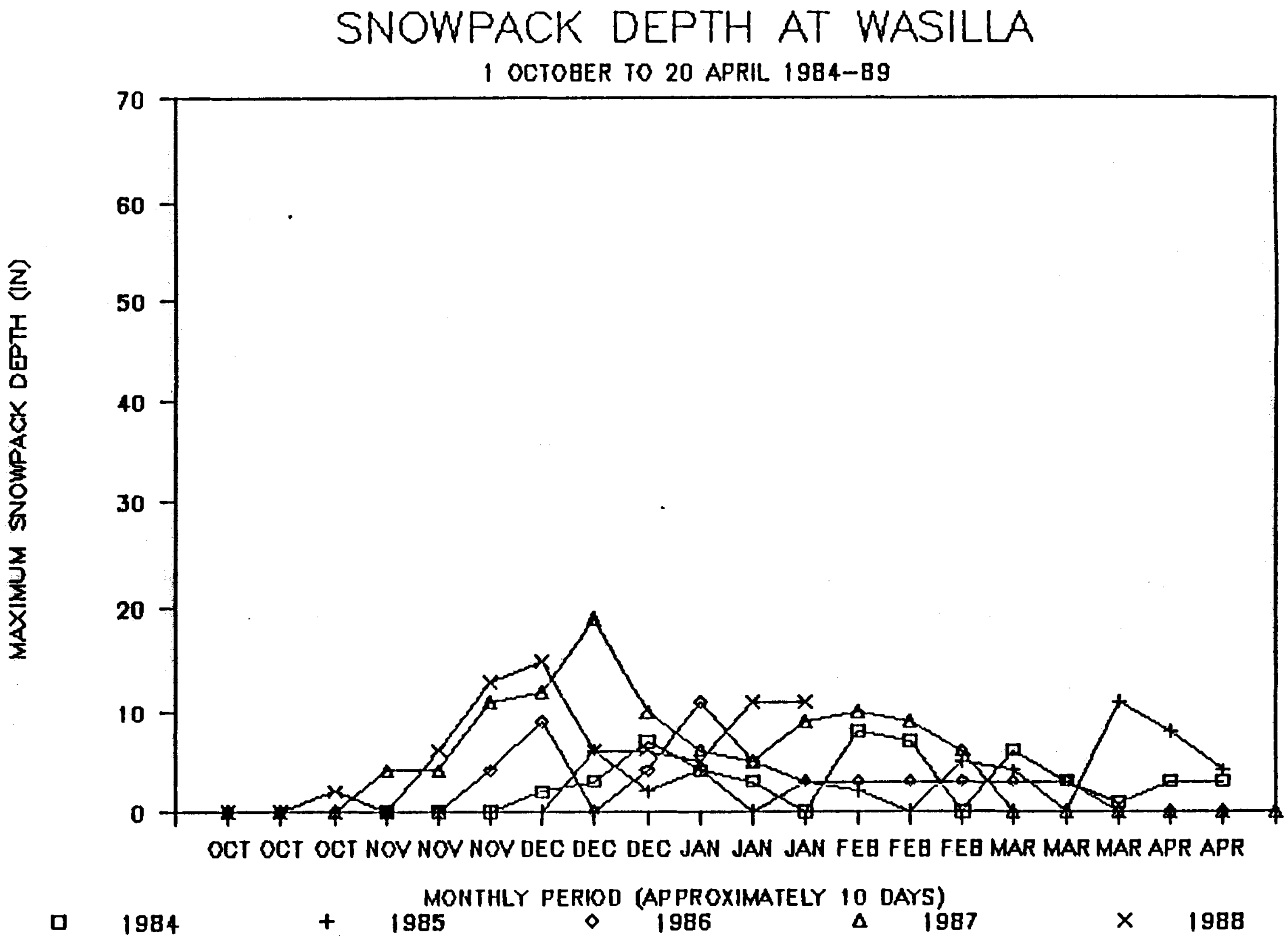

Figure 14. Effects of year on snowpack depth recorded at Wasilla, southcentral Alaska, October-April, 1984-89. Snowpack depth represents the maximum depth of snow measured on the ground during monthly period. Months are subdivided into periods of 1-10, 11-20, and 21-31 calendar days.

Table 1. Numbers of moose observed during 4 years in 7 alpine habitat areas in the western foothills of the Talkeetna Mountains, Southcentral Alaska, October-April, 1985-89.

Survey date	Number of moose	Areas surveyed[a]
1985-86		
4 Oct	42	ALL
17 Oct	363	ALL
8 Nov	775	ALL
18 Nov	919	ALL
3 Dec	890	ALL
28 Feb	703	ALL
31 Mar	490	ALL
17 Apr	202	ALL
1986-87		
26 Nov	1405	ALL
24 Dec	349	ALL
15 Jan	181	ALL
2 Mar	133	ALL
1987-88		
2 Nov	875	A-E
17 Nov	1010	ALL
4 Dec	840	ALL
21 Dec	610	ALL
12 Jan	234	ALL
28 Jan	244	ALL
27 Mar	121	ALL
20 Apr	16	ALL
1988-89		
13 Oct	346	A-C
28 Oct	1252	ALL
15 Nov	1173	ALL
5 Dec	581	ALL
23 Dec	335	ALL
15 Jan	232	ALL
7 Feb	131	ALL
8 Mar	121	ALL

[a] ALL = Bald, Moss, Willow, Witna, Brownie, Wolverine and Sunshine Mountain. A-E = Wolverine and Sunshine Mountain not surveyed. A-C = Witna, Brownie, Wolverine and Sunshine Mtn. not surveyed.

Table 2. Number and percentage of annual peak for moose observed during 4 years in alpine habitat on Bald, Moss and Willow Mountain in the western foothills of the Talkeetna Mountains, Southcentral Alaska, October-April, 1985-89.

Survey date	Number of moose	Percentage of annual peak
1985-86		
4 Oct	42	7
17 Oct	286	46
8 Nov	566	90
18 Nov	620	99
3 Dec	626[a]	100
28 Feb	472	75
31 Mar	338	54
17 Apr	114	18
1986-87		
26 Nov	938[a]	100
24 Dec	208	22
15 Jan	73	8
2 Mar	44	5
1987-88		
2 Nov	676[a]	100
17 Nov	659	97
4 Dec	452	67
21 Dec	263	39
12 Jan	87	13
28 Jan	102	15
27 Mar	69	10
20 Apr	12	2
1988-89		
13 Oct	346	42
28 Oct	819[a]	100
15 Nov	654	80
5 Dec	277	34
23 Dec	162	20
15 Jan	84	10
7 Feb	46	6
8 Mar	52	6

[a] Annual peak number of moose.

Table 3. Number of moose and timing of annual peak for moose observed on periodic surveys in alpine habitat on Bald, Willow and Sunshine Mountains in the western foothills of the Talkeetna Mountains, Southcentral Alaska, October-April 1985-89.

Survey date	Area		
	Bald	Willow	Sunshine
1985-86			
4 Oct	37	5	0
17 Oct	119	148	2
8 Nov	264	265	21
18 Nov	302[a]	268	26
3 Dec	260	312[a]	39
28 Feb	275	164	50[a]
31 Mar	191	121	21
17 Apr	40	59	14
1986-87			
26 Nov	4088[a]	492[a]	21
24 Dec	120	43	56[a]
15 Jan	47	15	50
2 Mar	20	15	19
1987-88			
2 Nov	339	296[a]	NS
17 Nov	352[a]	277	38
4 Dec	196	233	57
21 Dec	97	150	71[a]
12 Jan	20	60	33
28 Jan	39	52	29
27 Mar	18	40	11
20 Apr	9	3	2
1988-89			
13 Oct	138	194	NS[b]
28 Oct	327[a]	455[a]	64[a]
15 Nov	291	330	63
5 Dec	150	105	62
23 Dec	61	88	60
15 Jan	25	53	57
7 Feb	7	36	22
8 Mar	16	29	26

[a] Peak number of moose for annual count.
[b] NS = Area not surveyed.

APPENDIX A

Table A. Capture data and fate of radio-marked moose in subareas of the lower Susitna Valley, Southcentral Alaska, 1980-89.

Capture date	Sub-area	Sex	Age[a]	Number: Ear tags Left	Number: Ear tags Right	Number: Visual collar	Number: Trans-mitter	Status[b]
12/23/85	Bald Mt.	M	3	2354	1546	31	18135	HK
12/23/85	Bald Mt.	F	8	2360	1506	262	18136	CM
12/23/85	Bald Mt	F	8	2389	2388	33	18130	OK
12/23/85	Bald Mt.	F	5	2400	2395	27	10591	OK
12/23/85	Bald Mt.	F	5	1510	2485	29	10598	OK
12/23/85	Bald Mt.	F	2	2392	2399	371	6359	WK
12/23/85	Bald Mt.	M	1	2397	2396	35	18131	HK
12/23/85	Willow Mt.	F	10	1551	1524	34	18137	OK
12/23/85	Willow Mt.	F	6	1575	1570	36	18138	OK
12/23/85	Willow Mt.	F	4	2482	2440	3	6397	PK
12/23/85	Willow Mt.	F	4	2433	2368	9	6396	PK
12/23/85	Willow Mt.	M	8	1568	1569	8	6383	WM
12/23/85	Willow Mt.	M	4	2394	2391	32	18134	OK
12/23/85	Willow Mt.	M	5	2398	2393	5	6374	OK
12/26/85	Willow Mt.	M	6	1571	2497	28	6425	WM/PK
12/26/85	Bald Mt.	F	3	2357	1512	2	12807	IK
12/26/85	Bald Mt.	M	12	1573	1574	1	10498	HK
12/26/85	Bald Mt.	M	9	1501	1554	4	6372	OK
12/26/85	Bald Mt.	M	4	1504	2390	7	6356	HK
12/26/85	Moss Mt.	F	15	1538	1513	38	10498	IK
12/26/85	Moss Mt.	M	4	1517	1532	25	6438	HK
01/02/86	Brownie Mt	F	7	2387	2382	49	6460	OK
01/02/86	Brownie Mt	F	4	2380	2386	50	6495	OK
01/02/86	Brownie Mt	F	3	2378	2385	54	6499	OK
01/02/86	Brownie Mt	M	4	2381	2383	52	6454	WK
01/02/86	Brownie Mt	M	3	2379	2384	53	6504	OK
01/02/86	Witna Mt.	F	5	1508	1503	55	6402	OK
01/02/86	Wolverine Mt	F	9	2376	2377	51	6496	OK
01/07/86	Brownie Mt.	F	3	1562	2414	43	10496	OK
01/07/86	Brownie Mt.	M	8	1528	2409	30	6411	HK
01/07/86	Sunshine Mt	F	3	1511	1555	11	6410	OK
01/07/86	Sunshine Mt	M	5	1560	1561	47	6500	OK
01/07/86	Sunshine Mt	M	3	2411	2479	10	6494	HK
01/07/86	Wolverine Mt	F	18	1586	2436	481	6501	CM
01/07/86	Wolverine Mt	F	12	2423	2370	46	18133	HK
01/07/86	Wolverine Mt	M	5	1505	1509	441	10594	HK
02/04/86	Wolverine Mt	M	7	1698	2158	48	6501	IM
02/04/86	Wolverine Mt	F	13	2073	2150	581	23933	OK
02/04/86	Willow Mt.	F	8	2071	2106	721	6458	OK
02/04/86	Willow Mt.	F	4	2161	2116	60	6457	OK

Table A (cont.)

Capture date	Sub-area	Sex	Age[a]	Number: Ear tags Left	Ear tags Right	Visual collar	Transmitter	Status[b]
02/04/86	Willow Mt.	M	7	2162	2190	16	6365	HK
02/04/86	Willow Mt.	M	11	2200	2059	17	6380	OK
02/04/86	Willow Mt.	F	3	2156	1652	61	6517	OK
02/04/86	Willow Mt.	F	3	2101	2142	261	18136	OK
01/28/87	Kashwinta For.	F	8	42	50	21	26100	PK
01/28/87	Kashwitna For.	F	3	39	43	731	26101	OK
01/28/87	Kashwitna For.	F	1	62	44	24	26104	OK
01/28/87	Kashwitna For.	F	6	69	67	25	26106	OK
01/28/87	Kashwitna For.	F	18	80	45	15	26107	NS
01/28/87	Kashwitna For.	F	7	-	-	23	26109	OK
01/28/87	Kashwitna For.	F	4	66	38	14	26110	OK
12/14/87	Willow Mt.	F	12	3068	3032	793	5863	OK
12/14/87	Willow Mt.	F	3	2355	2495	78	5862	OK
12/14/87	Willow Mt.	M	3	3007	3094	97	29102	WM/PK
12/14/87	Witna Mt.	F	6	2359	3022	68	29101	OK
12/14/87	Witna Mt.	F	8	3048	2375	84	6454	CM
12/14/87	Willow Mt.	M	5	2489	3089	83	18129	WM/PK
02/13/88	Coal Ck.	F	16	3202	3212	95	6503	CM
02/15/88	Coal Ck.	F	3	3206	3260	72	6454	OK
03/12/88	Coal Ck.	F	3	3265	3211	80	29100	OK
03/13/88	Coal Ck.	F	1	-	-	70	26100	OK
02/14/88	Coal Ck.	M	3	3271	3266	95	29100	CM
12/21/88	Willow Mt.	F	4	2355	2495	78	10497	RC
12/21/88	Shrock/ Pittman	F	13	3068	3032	75	6425	RC
12/21/88	Willow Mt.	M	2	2419	2426	77	18133	OK
12/21/88	Willow Mt.	M	4	2406	2404	76	6430	NS
02/09/89	Kashwitna For.	F	6	094	081	1	6421	OK
02/09/89	Kashwitna For.	F	3	027	038	2	6420	OK
02/09/89	Kashwitna For.	F	10	063	002	3	6411	OK
02/09/89	Kashwitna For.	F	2	028	082	4	6414	OK
02/09/89	Kashwitna For.	F	3	001	3203	5	6396	OK
04/17/80	Susitna River	F	2	15753	15752	26	10603	OK

Table A (cont.)

Capture date	Sub-area	Sex	Age[a]	Number: Ear tags Left	Ear tags Right	Visual collar	Transmitter	Status[b]
04/17/80	Susitna River	F	5	15754	15755	22	10592	OK
02/24/82	Susitna River	F	6	16984	-	94	10597	OK
01/31/84	Susitna River	F	4	16	-	812	6424	OK
02/24/82	Susitna River	F	3	16704	-	100	10602	OK
01/31/84	Susitna River	F	7	6	17	61	6459	OK
03/10/81	Susitna River	F	13	1173	-	59	6423	OK
03/10/81	Susitna River	F	9	8452	-	85	6453	OK
03/10/81	Susitna River	F	5	8454	-	88	6456	OK
03/12/81	Susitna River	F	2	-	-	42	6409	OK
01/03/85	Susitna River	F	9	1636	1676	1	18127	OK
01/03/85	Susitna River	F	5	2052	1635	14	6429	OK
03/11/81	Susitna River	F	11	-	8463	73	6428	OK
01/31/84	Susitna River	F	4	22	19	18	6412	OK
03/10/81	Susitna River	F	5	8482	-	90	6466	OK
03/10/81	Susitna River	F	5	1157	-	19	6417	OK
03/10/81	Susitna River	F	10	8487	-	57	6415	OK
03/10/81	Susitna River	F	-	0	0	37	6432	NS
03/10/81	Susitna River	F	11	0	18407	56	6427	NS
03/10/81	Susitna River	F	6	0	15747	45	6441	NS
02/24/82	Susitna River	F	4	16702	0	96	10599	NS

[a] Age determined from incisor wear. Assigned age probably included within actual age intervals of:1, 2-3, 4-6, 7-12 and 12+ years.

[b] OK = moose alive and transmitter functional; HK = hunter kill;
WK = probable winter kill;
CM = capture or drug related mortality;
DR = Probable drowning in river; RC = Recaptured/recollared;
PK = predator kill, not documented but presumed to be most likely cause of death;
IK = probable illegal kill,
WM = probable hunting wound or fighting wound mortality;
IM = probable mortality from accidental injury or wounding
NS = No transmitter signal located, possible transmitter failure. Date for all OK = 05/23/89.

Appendix B

Alexander Creek and Skwentna River Moose Population Identity and Movement Substudy

by James B. Faro

SUMMARY

This report covers radiorelocation data from moose captured in the late winter of 1987 at Alexander Creek, 1988 at the mouth of Lake Creek on the Yentna River, and 1988 and 1989 at the lower Skwentna River. A total of 783 radio relocations have been obtained from these 3 samples. A detailed analysis of data is pending an increase in sample sizes and digitizing of point locations. General movement and habitat use patterns are described. Previous assumptions concerning movement patterns of these moose were not always supported by the data. Routinely counted fall trend areas can not be relied upon to provide information on the status of these subpopulations.

BACKGROUND

The Susitna River drainages are recognized as some of the most productive moose habitat in the state. Late fall aerial surveys in some areas were begun prior to statehood (i.e., 1959) with additional survey areas established in response to management needs and budget growth. A total of 35 sample units have been established, but fewer than 15 are surveyed annually. The 1984 and 1985 aerial census programs developed an estimate of approximately 10,000 animals for the Unit 16 population. Subpopulation identity data are necessary for resolving conflicts between sport and winter subsistence seasons and to respond to proposed land use programs, such as commercial timber harvest or recreational land disposals, that would alter existing habitat values for moose.

OBJECTIVES

Primary

To identify and delineate moose subpopulations providing major subsistence harvest in Unit 16B.

To more precisely delineate annual movement patterns and location, timing and duration of seasonal habitats.

To identify habitats and land areas that are important for maintaining the integrity of these moose sub-populations.

Peripheral

To identify location of calving and rutting areas of moose subpopulations providing major subsistence harvests in Subunit 16B.

STUDY AREA

The area of the study will be defined by moose movements from the capture area on Alexander Creek, Skwentna River, and Lake Creek winter ranges to include seasonal habitat utilized by radio-collared moose during other seasons of the year.

METHODS

To provide individually identifiable moose for periodic relocations, moose were captured and marked with ear tags and a combination of both visual and radio collars. Each radio collar had a discrete transmitting frequency, and individual animals were relocated utilizing a programmable receiver from a fixed-wing aircraft fitted with two-element Yagi antennae. Locations of relocated animals were plotted on 1/63,360-scale USGS topographic maps, and other pertinent data were recorded. Surveys were scheduled to identify calving areas, rutting concentrations, postrutting feeding areas, and winter range boundaries. This report covers the period ending 30 June 1989.

A total of 23 individual radio-collared moose (4 males and 19 females) provided data on the winter concentration of moose in the Alexander Creek-lower Susitna River area. Twenty of these radios were placed on moose in 1987 at Alexander Creek, and 3 animals with functional radios from studies on the lower Susitna River were incorporated into the sample. Attrition has occurred because of various mortality factors and shed collars; 15 animals continue to provide data, and a total 507 relocations points have been obtained.

In February 1988, 21 moose were radio-collared: 10 on the lower Skwentna River and the remainder on the Yentna River near the mouth of Lake Creek. Because of the loss of 4 moose from the Skwentna sample, 6 additional ones were radio-collared in February 1989, bringing the sample to 27 moose (11 males and 16 females). Data are available from 276 relocations, and as of June 1989, 23 radios (7 males and 16 females) remained active.

RESULTS AND DISCUSSION

Although movements of radio-collared moose have not been analyzed in detail, home ranges have not been plotted because locations have not yet been digitized, and data collections are still continuing; insights are possible from available information. The following preliminary analysis will generally combine data to compensate for small sample sizes, but some tentative comparisons have been made between the Alexander Creek and combined Skwentna-Lake Creek samples. In addition to geographic locations, seasonal movements of moose are documented by the vegetative community and the elevation level when relocated.

Gross Habitat Use Patterns

Habitats in the study areas are largely mature forest, muskeg-marsh, riparian flood plain, and alpine areas above tree level. Of 660 points with habitat information, 3 communities (i.e., riparian, spruce-hardwood forest, and open spruce-hardwood) accounted for 86% of the relocations (Table 1). Many factors influence vegetative communities, but there is a strong correlation with plant communities used by moose and elevation. Riparian community relocations generally represented low-elevation winter range; the mean elevation for all relocations occurring in the riparian community was 142 feet. The mature spruce-hardwood forest occurred from low elevation to some areas above 1,000 feet, providing environmental conditions allowed trees to maintain a closed canopy. Mean elevation of moose locations in this habitat type was 309 feet. At higher elevations, the forest canopy opened, creating the open spruce-hardwood community with scattered trees interspersed with grass. The mean elevation of locations in open forest was 1098 feet. Above tree line various alpine communities occurred. The relationship of the 3 preferred communities to elevation and month are presented in Table 2.

Alexander Creek

Seasonal habitat use data for Alexander Creek are presented in Table 3. Moose leave the winter range by late April or early May for upland habitats. While on the winter range, the riparian plant community was the primary area of moose use, but the adjacent closed-canopy forest was also important. The movement from winter range occurred in late April and early May, when most relocations occurred in the closed-canopy spruce-hardwood forest. Most moose moved west and north towards the Susitna-Beluga Mountains, although some moved as far west as the Talachulitna River and Tordrillo Mountains. A few remained in the forested low lands and did not move far from the winter range. By fall both the closed-canopy and open-canopy forest were important, but moose were observed in a greater variety of habitats than during other seasons. Arrival back on the winter range coincided with heavy snow, and riparian areas again provided critical moose habitat for the winter. Mean elevational data reflect the seasonal movement from the low-level winter areas to higher areas as spring, summer, and fall progressed and the return to lower elevations with snow. Home ranges of individual Alexander Creek moose have not been plotted.

Skwentna River-Lake Creek

Skwentna River-Lake Creek moose demonstrated similar seasonal movements to those observed from Alexander Creek (Table 4). Winter range use was primarily riparian habitat and adjacent forest. Most moose from the Skwentna River moved south and west towards Beluga Mountain and the Alaska Range drained by the Talachulitna River. In the summer and fall, there was some sharing of habitat with animals that had been radio-collared at Alexander Creek. Contrary to the Alexander Creek and Skwentna River samples, the Lake Creek moose appear to be more sedentary, relying on forested low lands for all their seasonal needs. As a result, the open spruce-hardwood communities and alpine areas were used less frequently, and mean-summer fall elevations for Skwentna-Lake Creek data were lower than those from the Alexander Creek sample. Higher mean winter elevations for these moose reflect the upstream location of their winter ranges. Home ranges of individual animals have not been plotted.

CONCLUSIONS

Previous assumptions concerning other seasonal areas used by these moose were not always supported by the data. Many Alexander Creek moose moved greater distances north and west than once believed. Skwentna moose can not be monitored using the Mount Yenlo fall trend areas. Lake Creek animals appeared dependent on adjacent lowland forest habitat and were not included in any of the fall trend area surveys. The importance of the mature closed-canopy spruce-hardwood forest in all areas appears to be greater than originally thought.

RECOMMENDATIONS

The emphasis of management is increasingly on winter concentrations, proposed land disposals, timber harvest, and expanding winter hunting seasons. These concentrations are dependent on habitat and events that are removed from the winter range. Therefore it is important that information on subpopulations be available. If the moose concentrations and subsistence uses they support are to be maintained, knowledge of migrational paths, calving and breeding areas, and where these subpopulations may be harvested during fall hunting season must be known. Data collection for the Alexander Creek sample should continue through 1990 to complete documentation of habitat preference. The Skwentna-Lake Creek relocations should continue through 1991.

PREPARED BY:

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SUBMITTED BY:

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Table B-1. Habitat in use for Alexander Creek and the Skwentna-Lake Creek moose radio relocations.

Type	All Data		Alexander Creek		Skwentna-Lake Creek Creek	
	No.	%	No.	%	No.	%
Alders	26	3.9	22	5.7	4	1.5
Alpine	25	3.8	19	4.9	6	2.2
Grass	7	1.1	7	1.8	--	--
Marsh	6	.9	6	1.6	--	--
Open spruce -hardwood	63	9.6	53	13.8	10	3.6
Riparian	198	30.0	111	28.8	87	31.6
Spruce-hardwood	306	46.4	149	38.7	157	57.1
Shrub	2	.3	2	.5	--	--
Spruce	13	2.0	9	2.3	4	1.5
Totals	660	100.1	385	99.9	275	100.0

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Shrub	2	.3	2	.5	--	--
Spruce	13	2.0	9	2.3	4	1.5
Totals	660	100.1	385	99.9	275	100.0

Table B-2. Habitat in use and mean elevation by month for Alexander Creek and the Skwentna-Lake Creek moose radio relocations.

Month	Percent of relocations by habitat type				Mean elevation in feet
	Open spruce-hardwood	Spruce-hardwood	Riparian	Other	
January	--	21.5	74.5	3.9	93
February	--	31.7	65.9	2.4	128
March	--	33.3	64.7	2.0	159
April	--	7.0	27.0	2.7	187
May	5.0	69.4	18.2	7.4	336
June	12.4	52.2	16.8	18.6	506
September	18.5	51.9	5.6	20.1	961
October	28.6	35.7	9.2	26.5	817
November	3.1	43.7	21.9	31.3	648
December	3.8	39.6	54.7	1.9	192

Table B-3. Habitat use and mean elevation of relocations by month for Alexander Creek sample.

Month	Percentage of relocations by habitat type: Open spruce-hardwood	Spruce-hardwood	All Riparian	Other	Mean elevation in feet
January	--	20.0	77.1	2.9	53
February	--	31.6	68.4	--	99
March	--	26.9	69.2	3.9	123
April	--	73.1	26.7	.2	138
May	4.9	77.1	8.2	14.7	303
June	21.8	40.0	10.9	27.3	595
September	22.2	36.1	8.3	35.4	695
October	32.5	28.8	8.8	29.9	966
November	--	42.9	21.4	35.7	637
December	5.7	25.7	68.6	--	163

Table B-4. Habitat use and mean elevation of relocations by month for Skwentna-Lake Creek sample.

Month	Percentage of relocations by habitat type: Open spruce-hardwood	Spruce-hardwood	Riparian	All other	Mean elevation in feet
January	--	25.0	68.8	6.2	144
February	--	31.8	63.6	4.6	153
March	--	40.0	60.0	--	192
April	--	68.2	27.3	4.5	220
May	5.0	61.7	28.3	5.0	354
June	3.5	69.8	22.4	4.3	447
September	11.1	83.3	--	5.6	537
October	11.1	66.7	11.1	10.1	636
November	5.6	44.4	22.2	27.8	658
December	--	66.7	27.8	5.5	191

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