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Lower Susitna Valley Moose Population Identity and Movement Study

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SUMMARY

During winter large numbers of moose aggregate on floodplains of the lower Susitna River, Skwentna River, Alexander Creek, and Moose Creek in Game Management Subunits 14B, 16A, and 16B, Southcentral Alaska (62°N, 150°W). Aerial surveys in post-rut concentration areas revealed dense concentrations of moose in remote areas of Subunit 14B in the western foothills of the Talkeetna Mountains, east of known winter concentration areas. Managers speculated that moose that were surveyed in these post-rut concentrations stayed in remote areas in autumn and therefore were largely unavailable to hunters in autumn hunting seasons. To investigate the assertion that moose in winter concentration areas near railway and roadway systems in Subunit 14B are migratory moose from post-rut concentration areas in remote portions of Subunit 14B, I studied movements and distribution of unmarked moose and radiocollared moose studies in the lower Susitna River valley (25,000 km^2) in Southcentral Alaska during April 1980–February 1991. Objectives of this study were to: (1) describe seasonal and annual distribution, movements, and home range of moose radiocollared in winter concentration areas, post-rut concentration areas and late winter range, (2) examine the relationship between numbers of moose in post-rut concentration areas and numbers of moose in winter and late winter range, and (3) assess the efficacy of autumn surveys in post-rut concentration areas and winter hunts in winter concentration areas and late winter range as tools for managing moose.

Moose movements in early winter though spring were correlated with accumulation of snow which actuates migration of moose to winter concentration areas, limits movements of moose in those areas, and induces moose to leave in spring. Precise distance and chronology of moose long distance movements was correlated generally with magnitude and timing of snow accumulation, which varied greatly among years. Moose migrated in early winter (17 Nov) if snow accumulations were deep in early winter. Moose migrations were delayed if normal accumulation of snow was in late winter (16 Jan). In a low snow winter, moose that migrated in a normal snow winter did not migrate. I confirmed strong traditional movements in several radiocollared moose monitored in 5+ consecutive years, although some moose were nonmigratory in all years. In January through April, moose home ranges were smaller in 1984–1985 and 1989–1990, years with deepest snow, than in the other years. In males and females, home ranges in January through April were largest in 1983–1984, a year with low snow in early winter and normal snow in late winter.

The percent of calf moose in winter surveys varied in relation to snow pack depth among years and within a year among areas, with fewer calves seen as the winter proceeded, especially in years of high snow accumulation. With few exceptions, extreme highs and lows in number of train–killed moose were positively correlated with year to year variation in snow pack depth.

Before my studies, managers of moose made incorrect inferences about the direction of migrations of moose in the western foothills of the Talkeetna Mountains and the direction and distance of migrations of moose in the low relief region west of the Susitna River floodplain. Moose in the Talkeetna Mountains migrated perpendicular to prominent river drainages, whereas moose in low relief areas west of the Susitna River migrated perpendicular to river drainages and covered greater distances than presupposed. Managers must have knowledge about moose traditional movements to implement harvests, surveys, and habitat management in the appropriate season and location

Key words: home range, migration, moose, snow.

CONTENTS

BACKGROUND

Knowledge about moose movements is basic to effective management of moose. Movements of moose affect size and configuration of home ranges, seasonal distribution of populations, timing and duration of habitat utilization, and potential for colonizing new habitat. With an understanding of movements, managers can more effectively survey moose, address moose–landuse conflicts, and manipulate hunter harvest to control size and composition of moose populations. In Alaska, density of resource users, moose-human conflicts, and consumptive and nonconsumptive demand for moose are greatest near Anchorage in the lower Susitna River Valley (LSRV) in Southcentral Alaska. To satisfy large and increasing demands by resource users, managers in Game Management Subunit (GMS) 14B in Southcentral Alaska are compelled to be scrupulous in management of moose. Prior to 1986, in LSRV moose population data were mainly gathered on nonrandom ("high grade") aerial surveys conducted in late autumn–early winter above timberline in postrut concentration areas (PCA) (Lynch 1975). Aerial surveys in PCA in LSRV revealed dense concentrations of moose in remote portions of Subunit 14B in the western foothills of the Talkeetna Mountains. Managers speculated that moose that were surveyed in these PCA stayed in remote portions of Subunit 14B in autumn and were inaccessible to hunters in autumn open-hunting seasons.

These inferences prompted managers to contend that the moose population in Subunit 14B was underharvested. Data from autumn–winter surveys of moose in PCA in Subunit 14B (ADF&G files, Rausch 1954) and numbers of train moose-kills in winter in lowland winter range (LWR) near the Susitna River (Rausch 1954) showed correlations between chronologies of autumn–winter decreases in numbers of moose in remote portions of Subunit 14B and autumn–winter increases of moose in accessible lower elevations near railway and highway systems that pass along the western boundary of Subunit 14B. These observations lead managers to conclude that winter aggregations of moose in accessible low elevation areas in Subunit 14B were composed of migratory moose from PCA in remote, high elevation areas in Subunit 14B. Based on these data, managers implemented moose hunts in winter in moose winter concentration areas (WCA) and LWR in Subunit 14B to harvest moose that were inaccessible to hunters in autumn.

OBJECTIVE

To investigate the assertion that moose in WCA near railway and roadway systems in Subunit 14B are migratory moose from PCA in remote portions of Subunit 14B, I studied location, movements, and distribution of unmarked moose and marked radiocollared moose in a series of interrelated studies in LSRV in Southcentral Alaska during April 1980–February 1991. The objective of this study was to (1) describe seasonal and annual distribution, movements, and home range of moose radiocollared in WCA, PCA, and LWR, (2) examine the relationship between numbers of moose in PCA and numbers of moose in WCA and LWR, and (3) assess efficacy autumn surveys in PCA and winter hunts in WCA and LWR as tools for managing moose in the Lower Susitna River Valley in Southcentral Alaska.

STUDY AREA

The study area, located in LSRV in Southcentral Alaska, encompassed 25,000 km^2. The area included portions of Subunits 13E, 14A, 14B, 16A, and 16B. Viereck and Little (1972) and Modafferi (1991) describe geography and climate of the LSRV. Snow accumulation is a highly variable component of weather in LSRV.

METHODS

BACKGROUND

To investigate movements and distribution of moose in Southcentral Alaska, I reviewed and compiled aerial survey information on location of unmarked moose and marked radiocollared moose collected in previous studies. These studies were conducted in PCA, WCA, and LWR in LSRV from April 1980 through February 1991 (Arneson 1981; Modafferi 1982, 1983, 1984, 1987, 1988*a*, 1988*b*, 1990, 1991, 1992). Studies in April 1980 through November 1985 were mainly on moose in WCA in lowland floodplains. These studies were focused on unmarked and marked radiocollared moose in the floodplain of the Susitna River between Portage Creek and Cook Inlet. Subsidiary studies were conducted on unmarked moose in floodplains of Alexander Creek, Moose Creek, and Deshka River and on marked radiocollared moose in an old homestead abutting the west bank of Susitna River at Montana Creek. Studies during December 1985 through February 1992 were focused on unmarked moose and marked radiocollared moose in PCA above timberline in the western foothills of the Talkeetna Mountains. We conducted supplementary studies on moose captured and radiocollared in WCA in floodplains of Yentna River near Lake Creek, Skwentna River near Skwentna, Alexander Creek, and on moose captured and radiocollared in LWR in lowland mixed birch–spruce forests west of the Talkeetna Mountains between Sheep Creek and Little Susitna River. A study on relationship between train moose-kills and snowpack depth (Modafferi 1991) provided indirect information on movements and winter distribution of unmarked moose in PCA and WCA in LSRV. In an interim study, I evaluated methods for analyzing radiofix data from radiocollared moose for information on movements and home range (Modafferi 1994).

TRAIN MOOSE-KILLS

The Alaska Railroad Corporation provided location and date of kill data on moose killed in collisions with trains in the Alaska Railway between Willow Creek (railroad milemark 188) and Talkeetna River (railroad milemark 227) from October through April in 1980–1991.

SNOW PACK DEPTH

I used snow pack depth measurements to assess snow accumulation in the study area. I received snow depth data from Alaska Climatological Data Reports, US Department of Commerce, Data Information Service, National Climate Center, Asheville, North Carolina. Snow depth data from Willow and Talkeetna were used as indices of snow pack depth in WCA and in PCA in LSRV. Snow depth data presented were maximum snow pack depth recorded each 10 days, month, or winter (Oct–Apr) during October through April in 1980–1991.

CAPTURE AND RADIOCOLLARING PROCEDURES

Moose were captured for radiocollaring by approaching and darting either from a helicopter or on foot or snow machine. Moose were immobilized with etorphine hydrochloride (M99, Lemmon Co., Sellersville, Pennsylvania) with or without xylaxine hydrochloride (Rompun, Haver–Lockhart, Shawnee, Kans.) or carfentanil citrate (Wildlnil, Wildl. Lab., Fort Collins, Colorado, USA). M99 and Wildnil were antangonized with diprenorphine (M50-50, Lemmon Co., Sellersville, Pennsylvania, USA) and naloxone hydrochloride (Dupont Pharmaceuticals, Garden City, New Jersey, USA). Immobilized moose were marked with ear tags, a visual-numbered canvas collar (Franzmann et al. 1974), and radio transmitter with or without a mortality (motion) option (Telonics, Mesa, Arizona, USA). Capture procedures took place in PCA, WCA, and LWR in LSRV in Southcentral Alaska. In PCA, moose were captured for marking in December and January with capture procedures beginning after aerial surveys indicated peak numbers of moose were present in PCA. In WCA and LWR, moose capture and marking took place in January through April with capture procedures commencing after numbers of moose in PCA decreased and numbers of moose in WCA increased. Radio collars were allocated among moose within areas in relation to distribution and abundance of moose within specific PCA, WCA, and LWR areas. We estimated age of captured moose mainly by incisor wear. However, in studies before February 1985, a first incisor tooth was removed from captured moose for cementum aging (Sergeant and Pimlott 1959). Marked moose were >18 months of age; few moose were <30 months. All marked moose were considered adults.

AERIAL SURVEYS AND SURVEY DATA

We conducted aerial surveys to determine location and verify survival of marked moose 1–5 times each month, using telemetry equipped Cessna-152, -180, -185, or Piper Super Cub (PA-18) fixed-wing aircraft and standard aerial radiotracking procedures (Ballard et al. 1991). All marked moose were not radiotracked on each survey. However, I frequently radiotracked >60 moose during a 1-day survey. I searched intensively at the location of each radio-fix to confirm the geographic location and that the marked moose was alive. Marked moose were telemetry monitored from capture to death or loss of signal contact. Moose radio-fix locations (audio-visual or audio) were recorded on 1:63,360-scale USGS topographic maps during surveys. Radio-fix data were later transferred to translucent overlays of topographic maps for computer digitization and conversion to UTM values of X, Y coordinates. Elevation of marked moose (radio-fix locations) was determined from records of radio-fixes plotted on topographic maps.

We determined distribution and abundance of moose in PCA, WCA, and old homesteads by counting moose (unmarked and marked) on aerial surveys. Surveys were flown in PA-18 aircraft at about 100 m above ground level, at a search intensity of 2–3 minutes per km^2. We conducted survey flights at 2- to 3-week intervals with weather permitting and snow cover sufficient to observe moose. Areas surveyed were traversed in a parallel transect search pattern. Sufficient snow cover and low vegetative cover in PCA, WCA, and old homesteads led to very high observability of moose. Live moose observed on aerial surveys were classified and counted as calf, nonantlered adult, small antlered adult, and large antlered adult; we also counted dead moose. WCA surveyed were floodplains of the Susitna River, Alexander Creek, Deshka River, Moose Creek, and Yentna River. PCA surveyed were Sunshine Mountain, Wolverine Mountain, Witna Mountain, Willow Mountain, Brownie Mountain, Moss Mountain, and Bald Mountain. PCA were located above timberline between 550 m and 1200 m elevation in the western foothills of the Talkeetna Mountains. Elevation of WCA ranged from 15 m to 300 m. Old homesteads (n = 14) surveyed were located near the Susitna River and the Parks Highway between Willow and Talkeetna at elevations ranging 70 m to 110 m.

Processing and Analysis of Radio-fix Data

To study life home range, radio-fix data from marked moose were combined across years; this was >200 radio-fixes spanning >9 years for some moose. Annual and life home range was determined for moose with >16 radio-fixes in 365 consecutive days. To study annual home range, I used the calendar year of 7 May through 6 May the following year. A Julian calendar year of 1 to 365 was used to describe the calendar year. To study annual movements, the following year I used the calendar year of 1 June through 31 May. To link data on radio-fix-locations, movements, and home range of radiocollared moose to management and biology of moose, the data were analyzed in relation to moose biological and management seasons, based on phenological seasons and seasonal events with relevance to ecology and management of moose. Biological and management seasons were delineated with calendar dates. Biological and management seasons identified were calving (10–31 May), summer (13 Jul–15 Aug), rut (15 Sep–5 Oct), post-rut (11 Oct–7 Nov), winter (19 Jan–31 Mar), hunt (20 Aug–30 Sep), survey (7 Nov–21 Dec). In several analyses, date intervals delineating winter season were defined by movements of moose or were confined to a limited portion of winter (e.g., late winter, Jan–Apr) versus the entire winter (i.e., 23 Nov–Apr). To describe home range and movements of moose captured in specific seasons and geographic areas, lifetime radiofix data from individual moose grouped by season and geographical area of capture were analyzed by location of capture and location in summer (7 May–30 Sep) and winter (1 Jan–31 Mar).

I used CALHOME (version 1) (Kie et al. 1996), a computer software program for estimating home range size, to determine size of moose lifetime and seasonal home ranges and to identify core areas (discrete utilization distributions) in home ranges with radio-fix data that were multimodally distributed. We used adaptive kernel (AK) and minimum convex polygon (MCP) methods to determine size of home ranges to analyze for year effects annual home range and philopatry to winter home range. In AK analyses, I selected 50 X 50 cell grid size and 98% utilization distribution. The 50 X 50 cell grid, the maximum number of cells, provided the smoothest fit. I used the 98% utilization distribution because experience from monitoring moose and preliminary analyses indicated that very few radio-fixes were clearly extraneous to all other radio-fixes. In other moose studies, 95% and 90% of the radio-fixes were used in calculations of annual home ranges (Cederlund and Okarma 1988 and Cederlund and Sand 1994, respectively). Bandwidth used in lifetime home range analyses was that with the lowest LSCV between the optimum value determined by the program and the optimum value times 0.55 (see Modafferi 1994). Area and linear measurements were used to evaluate size of life annual and seasonal home ranges. The area measurement was area (km^2) of a 100% minimum convex polygon (MCP). The linear measurement was greatest width (km) of the MCP. Greatest width was the distance between the 2 radio-fixes with the greatest W; where W = square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y = coordinates of radio-fixes.

Linear distance between consecutive radio-fixes, a measure of moose movement, was used to describe seasonal and annual movements of moose. Linear distance between consecutive radio-fixes was also used to determine the first date and last date moose were in winter range and nonwinter range and the number of days moose were in winter range and nonwinter range. First date in winter range was the date of the second radio-fix in the pair of radio-fixes that delimited the first relatively long distance movement after 1 October. The radio-fix marking the first date in winter range was normally followed by a series of short distance movements. Last date in winter range was the date of the first radio-fix in the pair of radio-fixes that delimited the first long distance movement after 15 March. First date in nonwinter range was the date of the second radio-fix in the former pair of radio-fixes. First date was normally the date of the second radio-fix in the pair of radio-fixes that delimited the first relatively long distance movement after 15 March. Last date in nonwinter range was the date of the first radio-fix in the pair of radio-fixes that delimited the first relatively long distance movement after 1 October. Number of days in winter (nonwinter) range was the Julian date of the last date in winter (nonwinter) range, minus the Julian date of the first date in winter (nonwinter) range.

To obtain information on terminal winter home range, analyses were performed on radiofix data from 3 samples of moose selected on information revealed in adaptive kernel analysis of moose lifetime radiofix data. For terminal winter home range of radiocollared moose, the home range polygon was identified in AK analyses and was described by radiofixes obtained after autumn–winter migration was completed and before winter–spring migration was initiated. Terminal home range polygons did not overlap with polygons of other seasonal ranges or include radiofixes from other seasons. Information on terminal winter home range was obtained from analyses on component radiofixes of a terminal home range polygon. For baseline information on terminal winter home range, I selected 5 moose that had a terminal winter range polygon that was disjunct from polygons of other seasonal ranges in AK analyses of radiofix data in 1982–1983, a normal snow year, and in 1984–1985, a deep snow year. Radiofix data from this sample of moose were used to determine size of terminal home range size. I used radiofix and date data from this sample of moose (i.e., migratory moose) to establish date intervals that were used to select radiofix data (i.e., terminal winter home range radiofixes) from moose without disjunct winter home ranges (i.e., nonmigratory moose). I used these data in analyses of terminal winter home range size in nonmigratory moose. Six nonmigratory moose (i.e., moose without disjunct winter and nonwinter seasonal home range polygons) were selected to provide data for analyses on size of terminal winter home range in 1982–1983 and 1984–1985. Radiofix data collected from 8 migratory moose (and 16 nonmigratory moose) in another deep snow winter, 1989–1990, were analyzed for information on terminal winter range. As in the 1982–1983 and 1984–1985 data, AK analyses were applied to the 1989–1990 data to identify the terminal winter home range radiofixes for use in analyzing size of terminal home range in 1989–1990.

I used nucleoli and nuclei to describe measures of midpoints in life seasonal home ranges within life home ranges and to quantify spatial relationships among the seasonal home ranges within life home ranges. A nucleolus was described by X,Y coordinates, where X and Y coordinates were the mean of the X's and mean of the Y's of radiofixes in a seasonal home range in a calendar. A nuclei was described by X,Y coordinates, where the X and Y coordinates were the mean of the X's and mean of the Y's of nucleoli n calendar years within a given season. I used distance between nuclei of seasonal home ranges (i.e., distance between centers of seasonal home ranges) to quantify distance between seasonal home ranges and movements of moose between seasonal home ranges. Distance between seasonal home ranges was the mean of distance values across calendar years within a given season. Annual movement of moose was the sum of distances between chronologically consecutive seasonal home ranges in a calendar year (e.g., calving home range through calving home range the following calendar year). To determine relative contribution of seasonal movements (i.e., between chronologically consecutive seasonal ranges) to annual movements, I analyzed radiofix data collected in 4 consecutive calendar years, 1981–1985. In these analyses, I first determined the distance between nuclei of chronologically consecutive seasonal ranges in each calendar year and then summed these values within each calendar year. Percent composition of movements between seasonal ranges in annual movements was the mean of the calendar year values across the 4 calendar years.

I determined central points in life seasonal home ranges to plot for showing graphically the spatial relationships among seasonal ranges in a life home range and to quantify relationship between rut season home ranges versus management event home ranges and other seasonal ranges. Central points in life seasonal home ranges were center points in discrete utilization distributions (polygons) identified in adaptive kernel analyses (98% points; bandwidth = 0.55 times optimum bandwidth) of life seasonal home range radiofix data. Central points were described by X,Y coordinates, where X and Y were the mean of the X's and mean of the Y's of the radiofixes in a life seasonal home range. Central points were identified in utilization distributions with $\geq$2 radiofixes. The central point in the utilization distribution with the greatest number of radiofixes was the primary centroid; the central point in other utilization distributions was a satellite centroid. Biological seasons studied were calving (10 May–31 May), summer (13 Jul–15 Aug), rut (15 Sep–5 Oct), post-rut (11 Oct–7 Nov), winter (19 Jan–31 Mar). Management event seasons studied were hunt (20 August–30 September) and survey (7 Nov–21 Dec). Hunt season was the calendar period of open hunting season. Survey season was the calendar period moose managers conduct aerial surveys to determine moose population status. To study spatial relationships between biological season home ranges and management season home ranges, I compared distances between centroids of biological season home ranges and centroids of hunt and survey home ranges. To study spatial relationships among all seasonal home ranges (biological and management seasons), I assumed the rut seasonal range was the focal point in the life and annual home range of moose and compared distance between the rut range centroid versus centroids of each other seasonal home range.

To study size of seasonal home ranges, I used area and greatest width of 100% MCP of life seasonal home ranges as measures of the size of seasonal home ranges.

In this study, the term migratory identified moose with life home range radiofix data that were multimodally distributed; the term nonmigratory identified moose with life home range radiofix data that was not multimodally distributed.

I used ArcView (1992), a geographic information system software, to manipulate radiofix data and to produce figures showing location of moose radiofixes in the study area.

I used data on location of capture and location of radiofixes in summer (7 May–30 Sep) and in winter (1 Jan–31 Mar) from 210 moose captured and radiocollared in 21 geographical areas to represent summer and winter home ranges and seasonal distribution of moose grouped by geographic area.

RESULTS

TRAIN MOOSE-KILLS

Numbers of moose killed in collisions with trains in Subunit 14B in winter during 1980–1991 varied greatly among years (Fig 1A), ranging from 3 in 1985–1986 to 351 moose in 1989–1990. With few exceptions, extreme highs and lows in number of moose-kills were correlated with yearly fluctuations in snowpack depth (Fig 1B); notable exceptions were in low number of moose-kills in 1980–1981, 1983–1984, and 1990–1991, years with relatively deep accumulations of snow.

SNOWPACK DEPTH

During 1980–91, mean maximum annual snowpack depth at Talkeetna was 102 cm. Maximum annual snowpack depth varied greatly among years (Fig 1B). Snowpack depth generally increased from October through February and decreased afterwards. However, in some years, differences in chronology and amplitude of snowfall resulted in large deviations from the general trend in annual snow accumulation (e.g., in 1980–1985) (Fig 2). Notable deviations from the normal trend in annual snow accumulation were a low accumulation in 1981–1982 (46 cm) and 1985–1986 (28 cm); an early accumulation in 1982–1983 (41 cm by 31 October); a late accumulation in 1983–1984 (<31 cm through December; and a deep accumulation in 1984–1985 (157 cm) and 1989–1990 (226 cm).

Aerial Surveys of Unmarked Moose

WCA

We conducted 35 surveys in 4 sections of Susitna River floodplain between Portage Creek and Cook Inlet in October through April in 1981–1985 (Appendix A). Survey data gathered in 1984–1985 were recompiled by 6 subsections of the floodplain (Appendix B). Numbers of moose in 2 sections of the floodplain varied widely within a year (Oct–Apr) and among years 1981–1985 (Fig 3A–B). Normally numbers of moose were highest in December through February and lower in October through November and March through April. Magnitude and chronology of highs and lows in numbers of moose varied in relationship with amplitude and timing of snow accumulation (Fig 3C). Numbers of moose were lowest in a low snow year, 1981–1982; numbers were higher than normal in early January in a normal snow year with early snow, 1982–1983. Moose numbers were lower in December through January in a normal snow year with late snow, 1983–1984, and highest in a deep snow year, 1984–1985.

We conducted 49 aerial surveys in 14 old homesteads, located near the Susitna River floodplain and the Parks Highway in winter in November through April in 1981–1985 (Appendix C). In a deep snow winter, 1984–1985, numbers of moose in old homesteads increased from 43 in early December to 379 in February (Fig 4). In a normal snow winter, 1983–1984, the highest number of moose was 231 in March. Difference in chronology and amplitude in peak numbers of moose in 1983–1984 versus 1984–1985 was correlated with chronology and amplitude of accumulations of snow (Fig 3C). In 1983–1984 numbers of moose peaked after increases in snow accumulation in December through January. In 1984–1985, with larger increases in snowpack depth in December and February, numbers of moose increased in January and peaked in February. Fluctuations in numbers of moose in 2 homesteads located about 2 km apart on opposite sides (west–east) of the Susitna River near Montana provide evidence that in early winter moose moved across the Susitna River from Subunit 16A to Subunit 14B (Fig 5). In each year during 1981–1985, numbers of moose were at peak levels earlier in winter in Montana west than in Montana east. In each year, numbers of moose in Montana east peaked after a decrease in numbers of moose in Montana west.

Twelve aerial surveys were conducted in lowland floodplain WCA in Alexander Creek, Deshka River, Moose Creek, and Yentna River in November thorough April in 1984–1985 (Fig 6). Moose Creek and Deshka River were surveyed on 5 March 1984, and Alexander Creek was surveyed on 18 February 1987. In Deshka River, number of moose decreased from mid-December through April (Appendix D). Number of moose in Alexander Creek and Moose Creek increased to peak levels in January and late February, respectively. In Alexander Creek numbers of moose remained relatively high through mid April.

Percent calf moose observed on aerial surveys in WCA varied greatly in winter (Nov–Apr), among winters, and among areas within a winter. In 1982–1983 percent calf moose in Susitna River floodplain remained relatively high through February, decreasing to 20% in March and April. In 1984–1985 percent calf moose in floodplains of Alexander Creek, Deshka River, and Moose Creek was less than 13% in March through April (Fig 7). In the Susitna River floodplain, percent calves was less north of Yentna River than south of Yentna River in 1984–

1985 (Fig 8). In 1984–1985 in all areas surveyed except south of Yentna River (Fig 8), percent calf moose in late March was less than 6 percent in 1984–1985. Data gathered in mid to late March in 1982–1985 and 1990 show that percent calf moose varied in relation to snowpack depth among years and within a year among areas (Table 1). Decrease in percent calf moose was less precipitous in a normal snow year, 1982–1983 than in a deep snow year, 1984–1985; percent calf moose in March was more than 2 times higher in 1982–1983 than in 1984–1985 (Fig 7). Trends in percent calf moose in old homesteads were similar in 1983–1984 and 1984–1985 (Fig 8).

PCA

We conducted 42 aerial surveys in 7 timberline PCA in LSRV in Southcentral Alaska in October through April in 1985–91 (Appendix E). Trends in numbers of moose in PCA were fundamentally similar among years with numbers of moose highest in October through early December and lower in mid December through April (Fig 9). However, numbers of moose varied widely by date among years. In 1988–1989 and 1989–90, numbers of moose in PCA peaked in early winter and then decreased precipitously, whereas, in 1985–1986, numbers of moose peaked later in winter and remained relatively high through March in 1986. Chronology and magnitude of highs and lows in numbers of moose varied in a negative relationship with timing and amplitude of snowpack depth (Fig 10D). Snowpack depth generally increased from October through February and decreased afterwards. Notable exceptions to the general trend in snow accumulation were a low accumulation in 1985–1986, a relatively early (December) accumulation in 1988–1991, and a deep accumulation in 1989–1990, and to a lesser extent among post-rut areas (Fig 10). Number of moose in PCA tracked trends in snow accumulation with numbers of moose highest through winter in 1985–1986 and lower in early winter (November through December) in 1988–91. In 1985 numbers of moose increased in October through mid November, whereas in 1988 and 1989 number of moose peaked in October and began to decrease before mid November (Fig 11). In 1987–1988 and 1989–1990 numbers of moose decreased less precipitously in Brownie and than in Bald or Willow (Fig 12). In 1990–1991, rate of decrease in moose numbers was similar among Bald, Willow, and Brownie PCA.

Capture, Radiocollaring, and Telemetry Monitoring of Radiocollared Moose

We darted 204 moose with tranquilizers, captured, and fitted them with visual and radiotransmitting neck collars during April 1980 through April 1990. Due to transmitter failure and moose deaths from capture problems, radiofix data from 187 of the 204 radiocollared moose were telemetry monitored with aircraft for information on distribution, movements, and home range. Of the 187 moose monitored, 118 were captured in WCA, 48 were captured in PCA, and 21 were captured in LWR (Table 2). Number of radiocollared moose monitored in a calendar year ranged from 39 to 112 moose (Fig 13A). Number of years individual moose were monitored ranged from less than 1 to more than 10 calendar years (Fig 13B). Individual moose were radiotracked for radiofix locations 11 to 36 times a calendar year (Fig 14A). Of 9838 moose radiofix locations, number of radiofixes in a month ranged from 528 in October to 1220 in May (Fig 14B). Number of radiofixes of individual moose ranged from less than 15 radiofixes to 202 radiofixes (Fig 14C).

DISTRIBUTION, MOVEMENTS, AND HOME RANGE OF RADIOCOLLARED MOOSE

Elevation in Winter

In Bald, Willow, and Brownie PCA, moose were in higher elevation in 1985–1986 than in 1986–1991 (Fig 15A). In 1986–1991 radiocollared moose were in higher elevation in Brownie than in Willow or in Bald. In all years, winter elevation of moose in Brownie was higher than 400 m. Winter elevation of moose in Bald was higher than 200 m in 1 of 6 years (i.e., 1985–1986). Except for 1985–1986, winter elevation of moose in Willow was intermediate to Bald (lower) and Brownie (higher). In all areas, winter elevation of moose was highest in the year with lowest snow (i.e., 1985–1986) (Fig 6B). In all but 1 year (1987–1988), yearly changes in moose winter elevation in Willow were negatively correlated with changes in snow pack depth.

Elevation in Winter Versus Elevation in Autumn

In 1986–1989 moose in Brownie PCA were in higher elevation in winter than in autumn (Table 3). In years with deepest accumulation of snow, 1989–1991 (Fig 11), there was no difference in moose elevation in winter versus in autumn. In Moss–Bald during 1986–1991, no collared moose were in higher elevation in winter, in contrast to autumn. In Sunshine–Wolverine and Witna–Willow, collared moose showed preference for lower elevation in winter than in autumn.

Nearness to the Parks Highway in Winter

There were area effects in data on proximity of moose to the Parks Highway in winter (Table 4). Of 85 moose winter radiofixes in Wolverine, Brownie, Moss, and Bald PCA, none was ≤2 km away from the Parks Highway. In 1986–91, Fourteen of 82 (17.1%) winter radiofixes in Sunshine, Witna, and Willow PCA were ≤2 km away from the Parks Highway; in the deep snow winters of 1990 and 1991, 4 of 36 (11.1%) winter radiofixes were ≤2 km from the Parks Highway. In 1986–1988, low and normal snow winters, 17.7 percent of 130 winter radiofixes were ≤2 km from the Parks Highway.

Nearness to the Parks Highway in Winter Versus Autumn

There were area effects in the data on nearness of moose to the Parks Highway in autumn versus in winter (Table 5). In 1986–1991, in Sunshine–Wolverine, 4 of 19 (21.1%) moose-year radiofixes were nearer to the Parks Highway in autumn than in winter. In Brownie and Moss-Bald, 1 of 47 (2.1%) moose-year radiofixes were nearer to the Parks Highway in autumn than in winter. In Willow–Witna, 56.9% of 51 moose-year radio-fixes were nearer to the Parks Highway in autumn than in winter.

Dispersal from WCA in the Susitna River floodplain in Subunit 16A to Subunits 14A, 14B, or PCA in those Subunits

Moose radiocollared in the Susitna River floodplain WCA in Subunit 16A were more frequently radiotracked and located in Subunits 16A or 16B than in Subunits 14A or 14B. Collared moose were radiotracked to Subunits 14A and 14B, or timberline PCA in those subunits in each of the following seasons: calving, summer, autumn (hunt) and early winter (post-rut) (Table 6). Among the 4 seasons, collared moose were most frequently radiolocated in Subunits 14A or 14B, or PCA in those subunits in the post-rut season; 35.1% were in post-rut areas in at least 1 year. Thirty-five of 40 (87.5%) moose monitored were not radiolocated in the PCA during either of the 4 seasons (Table 7). Five of 40 (12.5%) moose were radiolocated in the PCA in at least 1 of the 4 seasons. One moose was radiotracked in the PCA in each season.

Radiocollared moose that were not radiotracked in the PCA were an average of 23.4 km, 26.6 km, 28.0 km and 28.5 km away from the PCA in post-rut, calving, hunt, and summer seasons, respectively (Table 8). Maximum distances collared moose were away from the PCA ranged from 39.6 km to 45.6 km among the 4 seasons. Two of 32 (6.3%) collared moose were not radio-located outside the PCA.

Destination by Subunit of Radiocollared Moose that Dispersed from WCA in the Susitna River Floodplain in Subunits 16A and 16B

Moose radiocollared in WCA in the Susitna River floodplain between Talkeetna River and Yentna River stayed in Subunit 16A or dispersed to Subunits 16B, 14A, 14B, or 13E (Fig 16A). Collared moose were radiotracked in Subunits 16A and 14A in each month. Dispersal of moose from Subunit 16A was highest in February with 46% of the moose-year radiofixes in other subunits. Dispersal of moose from Subunit 16A was lowest in June with 82% of the moose-year radiofixes in Subunit 16A. Moose radiocollared in WCA in the Susitna River floodplain between Yentna River and Cook Inlet in Subunit 16B stayed in 16B or dispersed to Subunits 16A or 14A (Fig 16B). Collared moose were radiolocated in Subunit 14A each month. No moose were radio-located in Subunit 16A in winter, October through March. Dispersal rate of moose to Subunits 16A or 14A was not greater than 19% in any month.

Annual Movements of Individuals

During the calendar year 1 June through 31 May the following year, 32 moose (25 females and 7 males) captured and radiocollared in WCA in the Susitna River floodplain were radiotracked for radiofix location 26, 35, 24, 24, and 23 times in 1980–1985, respectively. Distance between chronologically consecutive radiofixes varied widely within individuals within calendar years, within individuals among calendar years, and within calendar years among individuals (Fig 17A–AF; Table 9). In 7 moose, distance between consecutive radiofixes was never greater then 10 km; in 12 moose distance between at least 1 pair of consecutive radiofixes was greater than 25 km. Distance between consecutive radiofixes was generally greatest in early winter, in mid-October through January, and in late winter (spring), in April through May. In winter (i.e., early winter through spring), radiofixes were generally a short distance apart. Moose movements in early winter though spring were correlated with accumulation of snow which actuates migration of moose to WCA, limits movements of moose in WCA, and induces moose to leave WCA in spring. Precise distance and chronology of moose long distance movements was correlated generally with magnitude and timing of snow accumulation, which varied greatly among years. In 1981–1982, a low snow winter, all moose did not show short distance winter movements bracketed by long distance movements (e.g., M3110, F3240, F3260, M3270, F3552). In 1982–1983, a year snow accumulated in early winter, 11 moose showed long distance movements in late October, whereas in 1983–1984 those moose showed long distance after October. Radiofix data from 17 moose showed relatively long distance movements in summer in July through August. Data from 2 female moose (F3220, F3230) that did not show normal winter movement patterns showed longest movements between April through October or November. Radiofix data from 16 moose did not show long distance migratory movements in either early or late winter.

Spring Season Movements of Females with Neonates, Males, and Females without Neonates

During 16 April through 1 July, radiocollared moose were radiotracked for radio-fix locations 9, 8, and 10 times in 1981–1983, respectively. In May through mid June, with 1 exception, distance between chronologically consecutive radio-fixes was less for females with neonates than for males or females without neonates (Fig 18). In each year, distance between consecutive radio-fixes in late April through June decreased in early May, increased in late May, decreased in early June, and increased in late June. In 1982 and 1983 distance between consecutive radio-fixes decreased from >8 km in April through early May to <4 km during mid to late May. In all years, the distance between consecutive radio-fixes for females with neonates was lowest in early to mid May and highest in late June. In males and females without neonates, distances between radio-fixes were less during 11–21 May than before or after that time. In 1981 and 1983 distance between radio-fixes decreased after 10 June for males and for females without neonates.

Spring Season Home Range Size in Females and Males

Radiofix data from 33, 43, and 37 radiocollared moose telemetry monitored with aircraft in May–June in 1981–1983, respectively, showed that in each year home range size was smaller for females than for males (Table 10). In each year, the smallest and largest home range was in females. Frequency distributions of area and greatest width values of sizes of home ranges were skewed more toward lower values in females than in males (Fig 19). In 1981–1983 more than 51% of female home ranges were less than 10 km^2; less than 23% of male home ranges were less than 10 km^2. In each year, more than 64% of female home ranges were less than <10 km in greatest width; in 2 of the years less than 17% of male home ranges were less than 10 km in greatest width.

Autumn Through Early-Winter Movements and Home Range Size in Females and Males

In 1981, 32 (25 females, 7 males) radiocollared moose were radiotracked for radio-fix location 13 times in during 17 August –14 December. Except during 17–24 August and 9–17 November, distance between chronologically consecutive radio-fixes was greater in males than in females (Fig 20A). The distance between consecutive radio-fixes for females differed little during late August through late September, increased gradually during 28 September through mid-November, and then increased by nearly 100% during mid-November through early December. Distance between radio-fixes for males increased by 3 times during late August through mid September, was relatively stable during mid-September through mid-October, and then increased to high points in mid October through early November and in late November through early December. For females and males, distance between consecutive radio-fixes decreased in 9–17 November and 2–14 December. For females, the total of distances between radio-fixes was similar in pre-rut versus rut seasons (Fig 20B). For males, total distance moved within seasons increased during the pre- and post-rut season. In each season, home range area was more than 2 times larger for males than for females (Fig 20C; Appendix F). Home range area for females in pre-rut and in rut seasons was less than 5 km^2. For females and males, home range area was more the 2 times larger in post-rut than in pre-rut or rut seasons. In females, home range greatest width was 4.1 km and 4.5 km in pre-rut and rut seasons, respectively (Fig 21; Appendix G).

Winter Movements of Females and Males

In 1981–1985, 24–32 female and 3–8 male moose adults were radiotracked for radio-fix locations 4–13 times in December through April. Trends in distance between chronologically consecutive radio-fixes were generally similar among sexes, highly variable by date within years, and varied among years (Fig 22). Winter chronological distance data reveal that a series of short distances between radio-fixes were usually bracketed by long distances between radio-fixes; the short distances represented movements in WCA and the long distances represented migratory movements to and from WCA. Within year and among year differences in chronology and size of long and small distances could be explained by differences in chronology and amplitude of snow accumulation (Fig 23). In 1981–1982, a low snow winter, 2 peaks occurred in distance between radio-fixes in January through February. In 1982–1983, with a deep accumulation of snow in early winter, there was a high peak in distance between radio-fixes in December. In 1983–1984, with deep accumulation of snow in late winter, there was a noticeable peak in distance between radio-fixes in February. In 1984–1985, with a very deep accumulation of snow in early winter and in late winter, there was a peak in distance between radio-fixes in early winter, in December–January followed by a general decrease through winter. In all years, except 1984–1985, there was a large increase in distance between radio-fixes in April. Though not supported by data in Fig 22, I presume there was a peak in distance between radio-fixes after late April in 1984–1985.

Chronology of Seasonal Movements between Winter Range and Nonwinter Range

In 1980–1991, first and last dates of radiocollared moose in winter range were from 17 November to 19 January (average = 21 December) and from 4–29 April (average = 14 April), respectively (Fig 24; Appendix H). The range among last dates (25 days) in winter range was less than the range among first dates in winter range (63 days). Exceptionally late last dates in winter range were in 1985 and 1990, years with deep snow in winter. Earliest first dates in winter range were in 1982–1983, 1989–1990, and 1990–1991, years with deep snow in early winter. Late first dates in winter range were in 1980–1981, 1985–1986, and 1983–1984, years with low snow in early winter. First date and last date in nonwinter range were from 24 April to 10 May (average = 1 May) and from 3 November to 31 December (average = 28 Nov), respectively (Fig 25; Appendix I). The range among first dates in nonwinter range (11 days) was less than the range among last dates in nonwinter range (58 days). Latest first dates in nonwinter range were in 1985 and 1989, years with deep accumulations of snow. Early last dates in nonwinter range were in 1982–1983 and 1989–1990, years with deep snow in early winter; late last dates were in 1980, 1983, and 1985, years with low snow in early winter.

Length of Time in Winter and Nonwinter Season Home Ranges

In 1980–90, radiocollared moose were in winter range and in nonwinter range an average of 110 days (range = 92–146 days) and 206 days (range = 183–237 days), respectively (Fig 26; Appendix J). Number of days in winter range was lowest in 1980–1981, 1985–1986, and 1986–1987, years with low snow in early winter. Number of days in winter range was highest in 1982–1983, 1984–1985, and 1989–1990, years with deep snow in early winter. Length of time moose were in nonwinter range was influenced by accumulation of snow in late winter and in early winter in the following year. Moose were in nonwinter range longer in 1980–1985, years with low snow winters, than in 1988–1990, years with deep snow winters. In consecutive winter to nonwinter seasons, the ratio, number of days in winter range:number of days in nonwinter range, was >2 times greater in 1989–90 (0.95) than in 1980–1981 (0.41).

Size of Winter (Nov–Apr) and Late Winter (Jan–Apr) Seasonal Home Ranges in Females and Males

In November through April, female (n = 24–62) and male (n = 3–7) moose adults were radiotracked for radio-fix location 14–15, 9–11, 10–12, 9–13, and 5–10 times a year in 1981–1985 and 1989–1990, respectively. In females, home range area was largest in 1983–1984, a year with low snow in early winter, and smallest in 1989–1990, a year with deep snow in early and late winter (Fig 27). In males, home range area was largest in 1982–1983, a year with normal snow accumulation, and smallest in 1989–1990, a year with deep snow accumulation (Fig 28). In 3 of 5 years, winter home range area was larger in females than in males (Appendix K). Except for males in 1983–1984, moose home range area was larger in November through April than in January through April. In January through April, moose home range area was smaller in 1984–1985 and 1989–1990, years with deepest snow, than in the other years. In males and females, home range area in January through April was largest in 1983–1984, a year with low snow in early winter and normal snow in late winter. For females and males, home range greatest width was smaller in years with deepest snow, 1984–1985 and 1989–1990, than in years with less snow (Fig 29; Fig 30). Except for males in 1983–1984, moose home range greatest width was larger in November through April than in January through April (Appendix L). Within sex categories, home range area and greatest width were smaller in November through January in 1989–90 than in January through April in 3 other years.

Seventeen radiocollared female moose adults were telemetry monitored each winter, November through April, in 1981–1985. Home range data on these 17 moose show that winter home range size (area and greatest width) was ranked larger (e.g., more " L" values) versus smaller (e.g., less "S " values) in 1981–1982 than in the rest of the years (Table 11; Table 12). Late winter (LW) home ranges in 1984–1985 were ranked smaller (e.g., more "S" values) versus larger (e.g., less "L" values) than in the rest of the years. LW home range size (area and greatest width) was smallest in 1984–1985 and greatly smaller in 1982–1983 than in the other years (Fig 31). LW home range size in 1982 and in 1984, years with low snow or late snow, was greater than all-winter (AW) home range size in years with deeper snow in early winter. Within years, the ratio home range size in LW:home range size in AW was largest in 1981–1982, a year with low snow, and smallest in 1984–1985, a year with early and deep snow (Fig 32). Percent difference in size of LW and AL home ranges was significantly greater in 1983–1984, a year with accumulation of snow in late winter, than in 1982–1983 and 1984–1985, years with early accumulations of snow.

Size of Terminal Winter Home Range in Migratory and Nonmigratory Females

Mean size of terminal winter home range of migratory and nonmigratory moose telemetry monitored in 1982–1983, 1984–1985, and 1989–1990 ranged from 5.1 to 21.8 km^2 in area and from 4.3 to 10.5 km in greatest width (Table 13; Fig 33; Appendix M). Smallest terminal home ranges were 0.3 km^2 in area and 0.9 km in greatest width; largest terminal home ranges were 71.4 km^2 in area and 18.5 km in greatest width. Twenty-five of 45 (55%) home ranges were less than 7.6 km^2; 13 (28%) home ranges were less than 4 km^2, and 4 (8%)were less than 2 km^2. Twenty-eight of 45 (62%) home ranges were less than 6.9 km, 16 home ranges were less than 5 km, and 8 home ranges were less than 2.6 km. In migratory moose, home range size (i.e., area and greatest width) was not smaller in 1984–1985, a deep snow winter, than in 1982–1983, a normal snow winter, whereas for nonmigratory moose range size was larger in 1982–1983 than in 1984–1985. In 1989–1990, a deep snow winter, home range size was larger in migratory moose than for nonmigratory moose. Home range size was larger in moose sampled in 1982–1983 than in moose sampled in either 1984–1985 or 1989–1990 (Fig 34).

Annual and Life Home Range: Configuration, Year-to-Year Uniformity, and Size

Radio-fix data collected in 4 consecutive calendar years, 7 May through 6 May the following year, in 1981–1985, show that location and configuration of annual home ranges in nonmigratory (Figs 35–37) and migratory (Figs 38–40) moose were generally similar among years (Table 14). However, radio-fix data collected during 1985–1988 provided evidence that migratory moose home range location and configuration differed greatly among years with different accumulations of snow (Figs 41–43). Differences in location of winter radio-fixes (Fig 44–46) and in winter home range size (Table 15) show that yearly differences in annual home range location and size were a consequence of moose being nonphilopatric to a terminal winter home range in a low snow year, 1985–1986, or migrating to a different terminal winter home range in deep snow years, 1986–1988.

Despite yearly consistency in general location and configuration of moose annual home ranges, large year-to-year differences in size were not uncommon (Table 15). In a sample of 6 migratory and 6 nonmigratory moose, monitored in 4 consecutive years, the mean of the maximum percent difference (largest–smallest/largest home range) between home range size in any 2 of the 4 calendar years was 54.4% (range = 13.5–74.8%) in nonmigratory moose and 44.6% (range = 28.8–62.8%) in migratory moose.

In migratory and nonmigratory moose, there were large differences in estimates of life home range size obtained with 1- versus 2-calendar years of data (Fig 47; Table 16). Mean percent difference between life home range size estimated with 2- versus 3-calendar years of data was 6.4% (range = 0.6–10.4%) in nonmigratory moose and 8.4% (range = 0.4–18.7%) in migratory moose. There was little difference between life home range size estimates based on

3- versus 4-calendar years of data. Difference between life home range estimates based on 4- versus 8+-calendar years of data was greater then difference in estimates based on 3- versus 4-calendar years of data. Outlier radio-fixes that were not included in 98% MCP calculations of life range size were most frequently in winter months (Nov–Feb) versus nonwinter months (Apr–Oct) (Fig 48). There were no outlier radio-fixes in August.

Calculated with 98% MCP methods, life home range size ranged from 23–1108 km^2 for females and from 19–1098 km^2 for males (Fig 49). Calculated with AK methods, life home range size ranged from 29–1464 km^2 for females and from 32–2214 km^2 for males (Fig 50). In MCP analyses, mean life home range size was 241 km^2 in females and 277 km^2 in males (Fig 51; Appendix N). In AK analyses, mean home range size was 304 km^2 for females and 405 km^2 for males. In both AK and MCP analyses, life home range of moose with a unimodal distribution of radio-fixes (i.e., nonmigratory moose) was larger for males than for females. In both AK and MCP analyses, life home range of moose with a multimodal distribution of radio-fixes (i.e., migratory moose) was larger for females than for males.

Relationship between Life, Life Season, and Life Management Season Home Ranges in Nonmigratory and Migratory Moose

Biological and management season life home ranges were larger for migratory moose than for nonmigratory moose (Fig 52; Table 17). Of the seasonal life home ranges in nonmigratory moose, rut range was smallest and winter range largest; in migratory moose post-rut range was smallest and winter range was largest. In migratory and nonmigratory moose, the second largest seasonal home range was rut home range. Life season home ranges were more than 6 times larger in migratory moose than in nonmigratory moose. Hunt and survey season life home ranges were 4.9 and 5.4 times, respectively, larger in migratory moose versus nonmigratory moose.

Spatial Relationship among the Seasonal Home Ranges in an Annual Home Range

Graphical plots of centroids of biological and management season life home ranges and life home range radiofix locations show location of centroids of seasonal home ranges in the life home range of 5 migratory and 5 nonmigratory radiocollared female moose adults (Fig 53). In moose with multiple core-use areas, normally a winter season centroid was spatially separated from centroids of other seasons. In several moose, calving and survey season centroids were not closely associated with centroids in other seasons. In moose with life ranges without multiple core-use areas, winter season home range centroids were usually on the periphery of centroids of other seasonal home ranges.

Distances between centroids of chronologically consecutive seasonal home ranges differed greatly among migratory and nonmigratory moose and among moose within migratory and nonmigratory categories (Fig 54). In nonmigratory moose, the distance between post-rut and winter seasonal range centroids was greater than distance between other consecutive seasonal home ranges (Appendix Q). For one migratory moose, rut-to-post-rut, post-rut-to-winter, and winter-to-calving distances were >40 km, >5 km, and >40 km, respectively; in the other migratory moose, the rut-to-post-rut distance was less than 7 km and the post-rut-to-winter distance was greater than 10 km. In nonmigratory moose, distance between each consecutive seasonal range was less than 4 km. For migratory and nonmigratory moose, post-rut-to-winter and winter-to-calving distances were greater than the distance between any other pair of chronologically consecutive seasonal ranges in a calendar year. In migratory and nonmigratory moose, post-rut-to-winter range and winter-to-calving range distances were each greater than 20% and combined more than 50% of the distance between consecutive seasonal ranges in a calendar year (Fig 55).

Distance from the rut seasonal home range centroid to centroids of each other biological and management season home range was greater in migratory than in nonmigratory moose (Fig 56; Appendix O). In migratory and nonmigratory moose, the distance between rut home range and winter home range was greater than the distance between rut home range and any other biological or management season home range.

Data from 5 of 6 moose (i.e., excepting 153220) studied show a general relationship between the distance between hunt range centroids and centroids of other seasonal ranges (Fig 57). Closest to the hunt range centroid was the rut seasonal range centroid; distance from the hunt range centroid to rut, post-rut, and survey seasonal range centroids were greater, increasing from rut to post-rut to winter seasonal range centroid. Hunt range centroids were closer to summer range centroids than to calving range centroids. Distance between the survey seasonal home range centroid and centroids of other seasonal ranges was greater in migratory moose than in nonmigratory moose (Fig 58). In nonmigratory moose no season range centroid was more than 5 km from the survey range centroid. In migratory moose, distance between the survey range centroid and centroids of many of the other seasonal ranges was more than 10 km. In one migratory moose the hunt range centroid was 56.8 km from the survey range centroid. In nonmigratory moose, hunt range centroids were less than 3 km from survey range centroids. In migratory moose, hunt range centroids were 6.8 km to 56.8 km from survey range centroids. In nonmigratory moose, all seasonal range centroids were less than 3.6 km from centroids of the hunt range. In migratory moose, the survey range centroid was 6.7 km to 60.5 km from centroids of other season ranges.

Winter and Summer Seasonal Range of Moose Grouped According to Geographic Area and Season of Capture

Characteristics of summer and winter ranges of moose greatly differed among groups of moose captured in different geographic areas in LSRV. In moose captured in Susitna River floodplain (SRF) WCA between Chase and Portage Creek, the perimeters of winter range and summer range were mostly within 5 km of the SRF and the location and breadth of winter and summer ranges were similar (Fig 59A).

Summer range of moose captured in SRF WCA between Kashwitna River and Talkeetna River extended 10 km east and 20 km west of the SRF (Fig 59B). Summer season radiofixes that were farthest from the SRF were mainly in low snow years that accommodated early migration of moose from the WCA winter range to spring–summer range, resulting in winter season radiofixes being located in a summer range.

Summer range of moose captured in SRF WCA between Willow Creek and Kashwitna River was remote and mainly west of the SRF (Fig 59C). Radiofixes in summer and winter seasons were as far as 30 km from the SRF.

Summer range and winter range of moose captured in SRF WCA between Yentna River and Willow Creek were mainly west of the SRF (Fig 59D). Winter season and summer season radiofixes were located about 20 km west of the SRF. Winter and summer season radiofixes were farther than 20 km from the SRF. Winter season radiofixes that were far to the east of the SRF were probably from captured moose that were intercepted (at capture on the SRF) while migrating across the SRF to a winter season range far east of the SRF.

Summer range of moose captured in SRF WCA between Cook Inlet and Yentna River was mainly extended west of the SRF; radiofixes were as far as 25 km from SRF (Fig 59E). Winter season radiofixes were mainly within 3 km of SRF.

Summer range of moose captured in the Coleman old homestead on the west bank of SRF opposite Montana were mainly west of the SRF (Fig 59F); some summer season radiofixes were 20 km from the SRF. Winter season radiofixes were mainly within 3 km of the SRF. Winter season radiofixes of one moose were 30 km south of the capture site.

Summer season and winter season radiofixes of moose captured in SRF WCA between Talkeetna River and Chase were 40 km east, 15 km south, and 40 km north of the SRF (Fig 59G). Winter season radiofixes extend farther west from the SRF than summer season radiofixes. Summer season radiofixes were mainly west and less than 10 km from SRF.

Summer range of moose captured in SRF WCA between Cook Inlet and Portage Creek was mainly west of SRF; summer range east of the SRF was mainly between Sheep Creek and Montana Creek North Fork and in Talkeetna River (Fig 59H). There was little evidence of summer range between Sheep Creek and Little Susitna River. Winter season radiofixes were east and west of SRF except between Kashwitna River and Little Susitna River. Winter season radiofixes far to the west of SRF were probably from migratory moose that migrated earlier than normal from winter range in a low snow winter. Winter season radiofixes far west of SRF were probably from captured moose intercepted at capture while migrating across SRF to winter range far east of SRF.

Summer range of moose captured in the Talkeetna Mountains PCA on Bald Mountain was mainly between Willow Creek and Little Susitna River (i.e., near the PCA). A moose radiolocated on Susitna River and near Hiline Lake was a 2-year-old male. Winter season radiofixes overlapped summer range with an extension south of Little Susitna River and into residential areas of Palmer and Wasilla (Fig 59I). Summer season radiofixes near Little Susitna River were mainly from migratory moose that delayed migrations in early winter or in late winter because of low snow or deep snow, respectively.

Summer range of moose captured in the Talkeetna Mountains PCA on Moss Mountain was mainly between Purchase Creek and Little Susitna River; winter range extended south of Little Susitna River near Wasilla. Summer season radiofixes near Little Susitna River were probably from moose that delayed autumn-winter or winter-spring migrations because of low or deep snow, respectively.

Summer range of moose captured in the Talkeetna Mountains PCA on Willow Mountain was mainly near the PCA, north across Little Willow Creek to Kashwitna River, or east of the PCA and across SRF. Summer season radiofixes were also located south across Willow Creek to Little Susitna River (Fig 59K). Summer season radiofixes east of SRF were mostly in early summer before parturition. Summer season radiofixes south of Willow Creek were mainly from moose intercepted while migrating to or from winter range south of Little Susitna River. Winter range extended north and east of the PCA to Kashwitna River and the highway and railway corridor near Sheep Creek and Kashwitna River, southwest to Willow Creek, and south across Little Susitna River to residential areas in Wasilla and Palmer.

Summer range of moose captured in the Talkeetna Mountains PCA on Witna Mountain extended east across SRF with most radiofixes between the PCA and SRF (Fig 59L). Radiofixes east of SRF were in early summer. Winter season radiofixes were east of the PCA along Kashwitna River and Sheep Creek near the Parks Highway and the Alaska Railway.

Summer range of moose captured in the Talkeetna Mountains PCA near Brownie Mountain was mainly near the PCA or east of the PCA along Kashwitna River and North Fork Kashwitna River (Fig 59M). Summer season radiofixes were east of the PCA in lower elevation near Little Willow Creek and in SRF near Sheep Creek and north of Kashwitna River near Sheep Creek. Winter season radiofixes were located near the PCA or in higher elevations along Kashwitna River and North Fork Kashwitna River. No winter season radiofixes were in lower elevations east of the PCA.

Summer range of moose captured in the Talkeetna Mountains PCA on Wolverine Mountain was mostly outside of the PCA. Summer season radiofixes mainly extended west from the PCA between North Fork Kashwitna–Kashwitna River and Sheep Creek and east from the PCA up Sheep Creek drainage (Fig 59N). Summer season radiofixes were also on Sheep River east of Talkeetna River north of North Fork Montana Creek and west of SRF near Rabideus Creek. Winter season radiofixes were within the summer season range except for radiofixes near North Fork Montana Creek and Rabideus Creek. Winter season radiofixes were in the PCA.

Summer range of moose captured in the Talkeetna Mountains PCA on Sunshine Mountain mainly extended west of the PCA between Sheep Creek and Montana Creek to SRF (Fig 59O). Several summer season radiofixes were between the South and the North Fork of Montana Creek. Winter season radiofixes overlapped the summer season range and extended east in the drainages of the North and South Fork of Montana Creek.

Summer range of moose captured in timberline PCA in the western foothills of the Talkeetna Mountains between Little Susitna River and South Fork Montana Creek was mainly east of the SRF between Little Susitna River and South Fork Montana Creek (Fig 59P). Summer season radiofixes west of SRF were near Deshka River and Trapper Creek, Hiline Lake, and Rabideus Creek. Other summer season radiofixes were near North Fork Montana Creek and

Sheep River east of Talkeetna River. Main differences between summer season and winter season ranges were that nonwinter radiofixes were not west of SRF and many winter season radiofixes were south of Little Susitna River near Knik, Wasilla, and Palmer.

Summer range of moose captured in LWR between Willow Creek and Kashwitna River was mainly bordered on the south and north by Willow Creek and North Fork Kashwitna River, respectively (Fig 59Q). The eastern boundary of the summer range was roughly the 1000 m elevation contour and the western boundary was a north–south line about 10 km east of the SRF. Other summer season radiofixes were in the Kashwitna River drainage to SRF and west of SRF near Kahiltna River and Yentna River. Except for summer season radiofixes east of the SRF and winter season radiofixes along the Kashwitna River upstream from North Fork Kashwitna River, winter range was similar to the summer range.

There was little difference in summer and winter range of moose captured in a personal use wood cutting area near Shrock Road (Fig 59R). Summer and winter season radiofixes were located near the wood cutting site and east near Nancy Lake.

Summer range of moose captured in Alexander Creek floodplain WCA extended mainly west from the capture sites to West Fork Coal Creek and Beluga River; summer season radiofixes were also in the SRF near Bell Island and east of Yentna River near Fish Creek (Fig 59S). Discounting a single radiofix east of SRF near Little Susitna River and one near Talachulitna River, winter season radiofixes were mainly within 5 km of Alexander Creek and 3 km of Sucker Creek.

Winter range of moose captured in Skwentna River floodplain near Skwentna was mainly within 4 km of capture sites in the Skwentna River floodplain (Fig 59T); winter season radiofixes were also south of old Skwentna near Sevenmile Lake. Summer season radiofixes were south of Skwentna to the headwaters of Clear Creek, near Trinity Lakes in the watersheds of Saturday Creek and Talachulitna Creek, north through Skwentna to the northern side of Yenlo Hills.

Winter range of moose captured in Skwentna River floodplain near Old Skwentna was mainly northwest and southeast of the Skwentna River floodplain within 10 km of their capture sites (Fig 59U). Winter season radiofixes were also in the Skwentna River floodplain east to Skwentna. Summer season radiofixes generally overlapped the summer range.

Winter range of moose captured in Yentna River floodplain between Lake Creek and McDougall was mainly within 5 km of the floodplain between McDougal and Skwentna (Fig 59V). Winter season radiofixes were also along Lake Creek and north of Skwentna to the southeastern foothills of Yenlo Hills. Summer season home range included winter season range and extended to the Kahiltna River and then north for about 10 km between Yentna and Kahiltna Rivers. Summer season radiofixes were located about 10 km northwest of Skwentna and 35 km southwest of McDougall near Talachulitna River on the southeastern slopes of Beluga Mountain.

Winter range of moose captured in floodplains of the Yentna and Skwentna Rivers near Old Skwentna, Skwentna, and McDougall was mainly within 10 km of the Skwentna River–Yentna River floodplain between Old Skwentna and McDougall (Fig 59W). Summer range of these moose extended southwest to Talachulitna Creek near Trinity Lakes, northwest to Shell Hills, north to the north slope of Yenlo Hills, northeast to the Kahiltna River and southeast to the confluence of Moose Creek and Yentna River.

Winter range of moose captured in the Parks Highways and Alaska Railway transportation corridor between Pittman and Sheep Creek extended from Wasilla to Susitna Station on Susitna River to the mouth of Deshka River to Spink Creek to Willow Mountain (Fig 59X). Summer Range of these moose extended from the mouth of Little Susitna River to Susitna Station to Lockwood Lake to Tokositna River near Ruth Creek to Willow Mountain. The moose radio-located on Tokositna River was a 2-year-old male.

DISCUSSION

This study documents home range and movement patterns of adult moose in lower Susitna River Valley (LSRV) in Southcentral Alaska. Data presented show that movements and home ranges of adult moose in lower Susitna River Valley (LSRV) were affected by experience, weather, area, season, year, age, sex, and maternal status. My findings provide a foundation for managers to more effectively study and survey moose, address moose–land use conflicts, and manage hunter harvest of moose in LSRV.

My studies documented timely and recurring concentration of moose during the post-rut and late winter periods. In winter large numbers of moose aggregate on floodplains of lower Susitna River, Skwentna River, Alexander Creek, and Moose Creek. Moose in winter concentration areas were distributed over a greatly expanded and different area in summer and autumn seasons. These findings show that managers must be knowledgeable about yearly distribution of migratory populations to effectively incorporate winter season surveys and autumn season hunts in a management program. Concentration of moose in late winter in lowland drainages (i.e., winter concentration areas) is well documented (Edwards and Ritcey 1956, Knowlton 1960, Sandegren et al. 1985, Van Ballenberghe 1973, Modafferi 1988*b*). However, less reported and probably not of less importance is the movement and concentration of moose in the post-rut and early winter seasons in timberline habitats (i.e., post-rut concentration areas). Peek et al. (1976) noted differences between early winter habitat and late winter habitat of moose in Minnesota. Thompson et al. (1981) documented recurring use of specific areas in early winter by large numbers of moose. I identified moose post-rut concentration areas near timberline in the western foothills of the Talkeetna Mountains in LSRV, and I documented seasonal concentration of moose in these areas. Radiofix data indicated that moose in these areas in the post-rut season were distributed over a much broader area in the remainder of the year. These data indicate that managers must be knowledgeable about yearly distribution of moose to effectively incorporate early winter surveys and autumn hunts in a regional management program. Managers must preserve the integrity of habitats in post-rut and winter concentration areas.

I found that chronology and amplitude of snowfall and accumulation of snow have profound influences on migratory behavior of moose. Moose migrated in early winter (17 November) if snow accumulations were deep in early winter. Moose migrations were delayed if normal accumulation of snow was in late winter (16 January). In a low snow winter, moose that migrated in a normal snow winter did not migrate. My observations support findings in previous studies (Coady 1974, Sandegren et al. 1985, Van Ballenberghe 1977). If migratory behaviors of moose offspring are affected by those of their dam (Sandegren et al. 1988), and year-to-year migratory patterns of moose adults are affected by snow conditions, then snow conditions in a neonate's first winter can affect migratory behavior of the neonate and entire year-classes of neonates. This rationale can explain the extreme differences in migratory behaviors of moose captured side by side in the same WCA or PCA. If moose migratory behaviors are learned by experience, how does one explain snow-related migratory–nonmigratory behavior of an individual moose?

The fact that I have frequently observed yearling moose near a dam through their second winter leads me to speculate that with exposure to consecutive low snow and deep snow winters or deep snow and low snow winters, a yearling could experience a migratory behavior in the deep snow winter and nonmigratory behavior in the low snow winter in its first two years of life, thereby learning snow-related migratory and nonmigratory behaviors. I further speculate that moose with consistent migratory or nonmigratory behavior, experienced either consecutive deep snow winters or consecutive low snow winters, respectively, in their first 2 winters. Differences in migratory behavior of same sex moose captured side by side in lowland WCA or in timberline PCA can be explained by differences in the migratory behavior of their dams and/or differing snow conditions in their first two years of life.

Although migrations and winter distribution of moose may be influenced by snowpack depth and a variety of other factors, such as forage availability, plant phenology, local geography, learned behavior, elevation, canopy cover, social pressures, etc., and river drainage length and direction of flow may indicate maximum distance and direction that moose migrate from WCA (Sandegren and Sweanor 1988), moose managers must be extremely cautious in presuming movement patterns of moose without conducting appropriate field studies. In LSRV winter season moose hunts implemented to harvest moose that were not accessible to hunters in autumn mainly impacted moose from another local moose population. Prior to my studies, managers of moose in LSRV made incorrect inferences about the direction of migrations of moose in the western foothills of the Talkeetna Mountains and the direction and distance of migrations of moose in the low relief region west of the Susitna River floodplain. Moose in the Talkeetna Mountains migrated perpendicular to prominent river drainages, whereas moose in low relief areas west of the Susitna River migrated perpendicular to river drainages and migrated greater distances than presupposed.

In a review of studies in North America, LeResche (1974) reported that moose tend to return to the same seasonal home ranges year after year. In contrast, Houston (1968) noted that in some populations winter severity could influence return of moose to traditional winter home ranges. My studies support both of these assertions. Year-to-year philopatry to spatially separated summer and winter home ranges was common in moose radiotracked in LSRV. I confirmed strong traditional movements in several radiocollared moose monitored in 5+ consecutive years. Radio-fix data from moose that migrated a long distance between summer and winter home ranges showed traditional use of certain sites located between summer and winter home ranges. Several migratory moose showed year-after-year philopatry to 3 spatially separated, distinct seasonal ranges. My data indicate that to effectively manage migratory populations, managers must have knowledge about moose traditional movements to implement harvests, surveys, and habitat management in the appropriate season and location.

Many studies demonstrated that movements and home ranges of moose were attuned to a variety of environmental factors (Phillips et al. 1973; Van Ballenberghe 1974; Sandegren et al. 1982; Cederlund and Sand 1994). Moose in LSRV exhibited appreciable plasticity in their seasonal movements and home range size to utilize different, spatially separated habitats in different seasons and in different weather conditions. By altering the timing, rate, and extent of seasonal movements and size of seasonal home ranges, moose optimized interactions with other moose and use of different habitats and environments. Such movement behaviors enable moose to optimally exploit a patchy environment under highly variable weather conditions.

Learned migratory behavior linked with absolute philopatry to seasonal ranges may limit dispersal, impede moose from colonization of new areas, and restrict expansion of moose range. However, of the many studies that document expansion of moose range through dispersal (Houston 1968; Mercer and Kitchen 1968; Peek 1974; Pulliainen 1974; Coady 1980), most indicated that dispersal was more common in yearling and 2-year-old moose (Peek 1974; Lynch 1976; Houston 1978). Two of the longest movements I documented for moose in LSRV were in 2-year-old males. One male captured in Bald Mountain PCA in December was radiolocated in September near Hiline Lake, a distance of 100 km. A male captured near Nancy Lake in April was radiotracked in the following January to Coffee Creek, a distance of 110 km. Except for one female with a calving range about 85 km from the winter ranges, seasonal home ranges of other moose I studied were normally less than 60 km apart. Movement patterns of adult female moose in LSRV were consistent year after year; I had no evidence of dispersal movements.

Seasonal movements and size and configuration of home range of moose have been widely studied (Goddard 1970; Mould 1979; Lynch and Morgantini 1984; Courtois and Crete 1988; Leptich and Gilbert 1989; Cederlund and Sand 1994). Specific objectives of these investigations varied widely, ranging from providing information on ecology or behavior to studying management implications of movements or spatial distribution. Analytical methods used to assess, quantify, and present the data varied widely among studies. In analyzing radiofix data for information on seasonal movements and configuration of home range of moose, I utilized methodologies similar to those used in the previous studies, and I developed new techniques to more accurately describe seasonal movements and size and configuration of home ranges of radiocollared moose. Techniques that I developed used measurements of linear distance between centers of seasonal home ranges to describe seasonal and annual movements, spatial relationships among seasonal home ranges, and size and configuration of annual home ranges.

LITERATURE CITED

ARNESON PD. 1981. Big game studies. Volume II. Moose. Ann. Prog. Rep. Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Juneau. 64pp.

BALLARD WB, JS WHITMAN, AND DJ REED. 1991. Population dynamics of moose in south-central Alaska. *Wildl. Monogr.* 114. 49pp.

ÇEDERLUND G. AND H OKARMA. 1988. Home range and habitat use of adult female moose. *J. Wildl. Manage.* 52:336–343.

——— AND H SAND. 1994. Home-range size in relation to age and sex in moose. *J. Mammal.* 75:1005–1012.

COADY JW. 1974. The influence of snow on the behaviour of moose. Nat. Can 101:417–436.

COURTOIS R. AND M CRETE. 1988. Space utilization by female moose in southwestern Quebec. *Alces* 24.

EDWARDS RY AND RW RITCEY. 1956. The migrations of a moose herd J. Mammal. 37:486–494.

FRANZMANN AW, PD ARNESON, RE LERESCHE, AND JL DAVIS. 1974. Developing and testing new techniques of moose management. Alaska Dep. Fish and Game. Fed. Aid. Wildl. Rest. Final Rep., Grants W-17-2, W-17-3, W-17-4, W-17-5, and W-17-6. 54pp.

GODDARD J. 1970. Movements of moose in a heavily hunted area Ontario. *J. Wildl. Manage.* 34:439–445.

KIE JG, JA BALDWIN, AND CJ EVANS. 1996. Calhome. a program for estimating animal home ranges. *Wildl. Soc. Bulletin* 24:342–344.

KNOWLTON FF. 1960. Food Habits, movements, and populations of moose in the Graveley mountains, Montana. *J. Wildl. Manage.* 24:162–170.

LEPTICH DJ AND JR GILBERT. 1989. Summer home-range and habitat use by moose in northern Maine. *J. Wildl. Manage.* 53:880–885.

LERESCHE RL. 1974. Moose migrations in North America. *Can Nat.* (Quebec). 101:393–415.

LYNCH GM. 1975. Best timing of moose surveys in Alberta. N. Amer. Moose Conf. and Workshop. 11:141–153.

MODAFFERI RD. 1982. Big game studies. Vol. II. Moose-Downstream. Final Phase I Rep. Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Juneau. 114pp.

———. 1983. Big game studies. Vol. II. Moose-Downstream. Proj. Rep. Phase II Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Juneau. 114pp.

———. 1984. Big game studies. Vol. II. Moose-Downstream. Proj. Rep. Phase II Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Juneau. 116pp.

———. 1987. Lower Susitna Valley moose population identity and movement study. Alaska Dep. Fish and Game. Fed. Aid. Wildl. Rest. Prog. Rep. Grants W-22-5. Job 1.38R. Juneau. 17pp

———. 1988*a*. Lower Susitna Valley moose population identity and movement study. Alaska Dep. Fish and Game. Fed. Aid. Wildl. Rest. Prog. Rep. Grants W-22-5 and Job 1.38R. Juneau. 60pp.

———. 1988*b*. Big game studies. Vol. I. Moose-Downstream. Final Rep. Susitna Hydroelectric Proj. Alaska Dep. Fish and Game. Juneau. 211pp.

———. 1990. Lower Susitna Valley moose population identity and movement study. Alaska Dep. Fish and Game. Fed. Aid. Wildl. Rest. Prog. Rep. Grants W-23-2 Job 1B. 1.38. Juneau. 46pp.

———. 1991. Train moose-kill in Alaska: Characteristics and relationship with snowpack depth and moose distribution in lower Susitna Valley. *Alces* 27:193–207.

———. 1992. Lower Susitna Valley moose population identity and movement study. Alaska Dep. Fish and Game. Fed. Aid. Wildl. Rest. Prog. Rep. Grants W-23-2 Job 1B. 1.38. Juneau. 39pp.

PHILLIPS RL, WE BERG, AND DB SINIFF. 1973. moose movement patterns and range use in northwestern Minnesota. *J. Wildl. Manage.* 266–278.

SANDEGREN F, R BERGSTROM, G CEDERLUND, AND E DANSIE. 1982. Spring migration of females moose in Central Sweden. *Alces* 18:210–234.

———, R BERGSTROM, AND PY SWEANOR. 1985. Seasonal moose migration related to snow in Sweden. *Alces* 21: 321–338.

SWEANOR PY AND F SANDEGREN. 1988. Migratory behavior of related moose. *Holarctic Ecol.* 11:190–193.

VAN BALLENBERGHE V. 1977. Migratory behavior of moose in southcentral Alaska. XIII Int. Congr. Game Biol. Atlanta, Georgia. 103–109.

VIERECK LA AND EL LITTLE, JR. 1972. Alaska Trees and Shrubs. US Dept. Agric. Forest Serv. Handbook No.410. 265pp.

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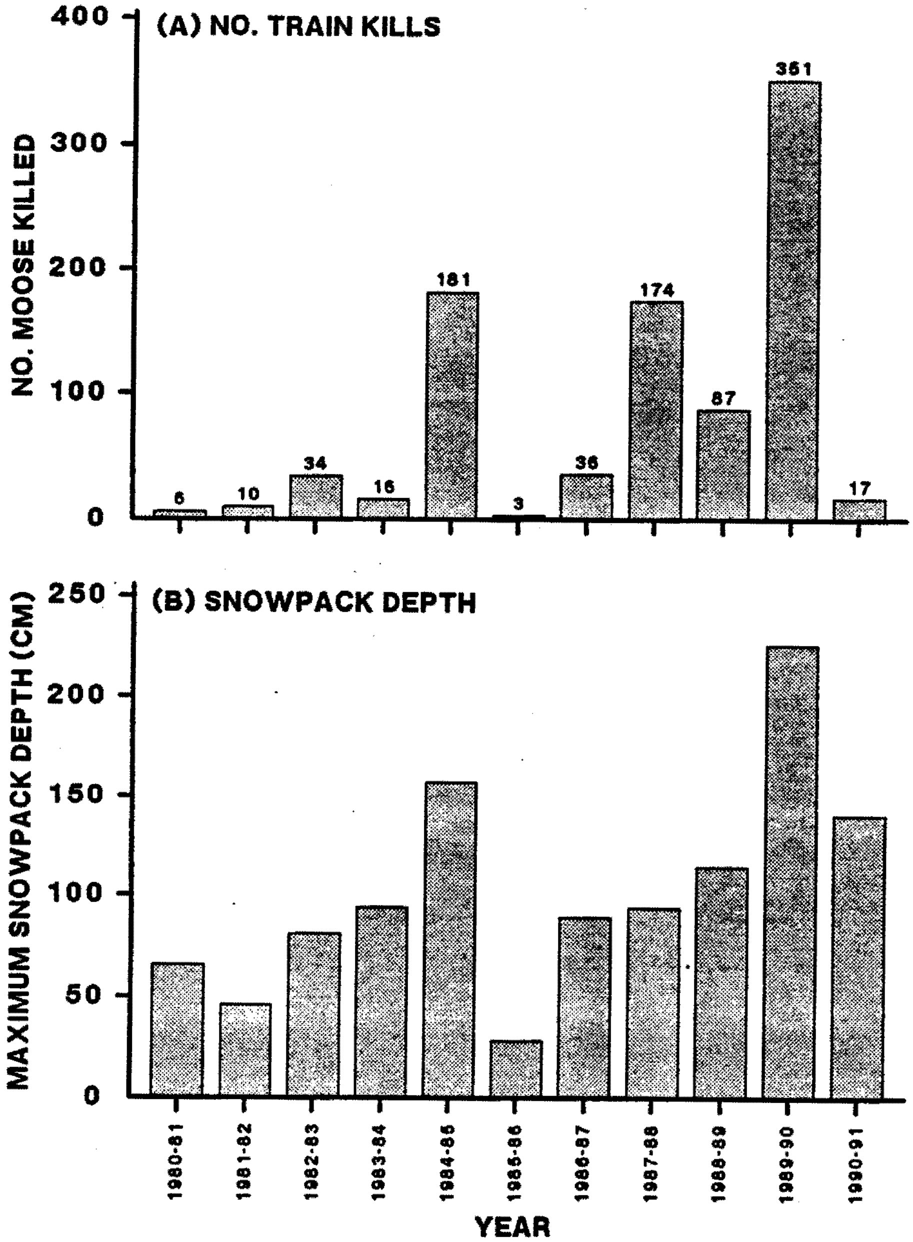

Figure 1 Moose killed in collisions with trains in Unit 14B (A) and snow pack depth in Talkeetna (B) in lower Susitna River Valley in Southcentral Alaska, 1980–1991. Snow pack depth was maximum depth of snow in Oct–Apr.

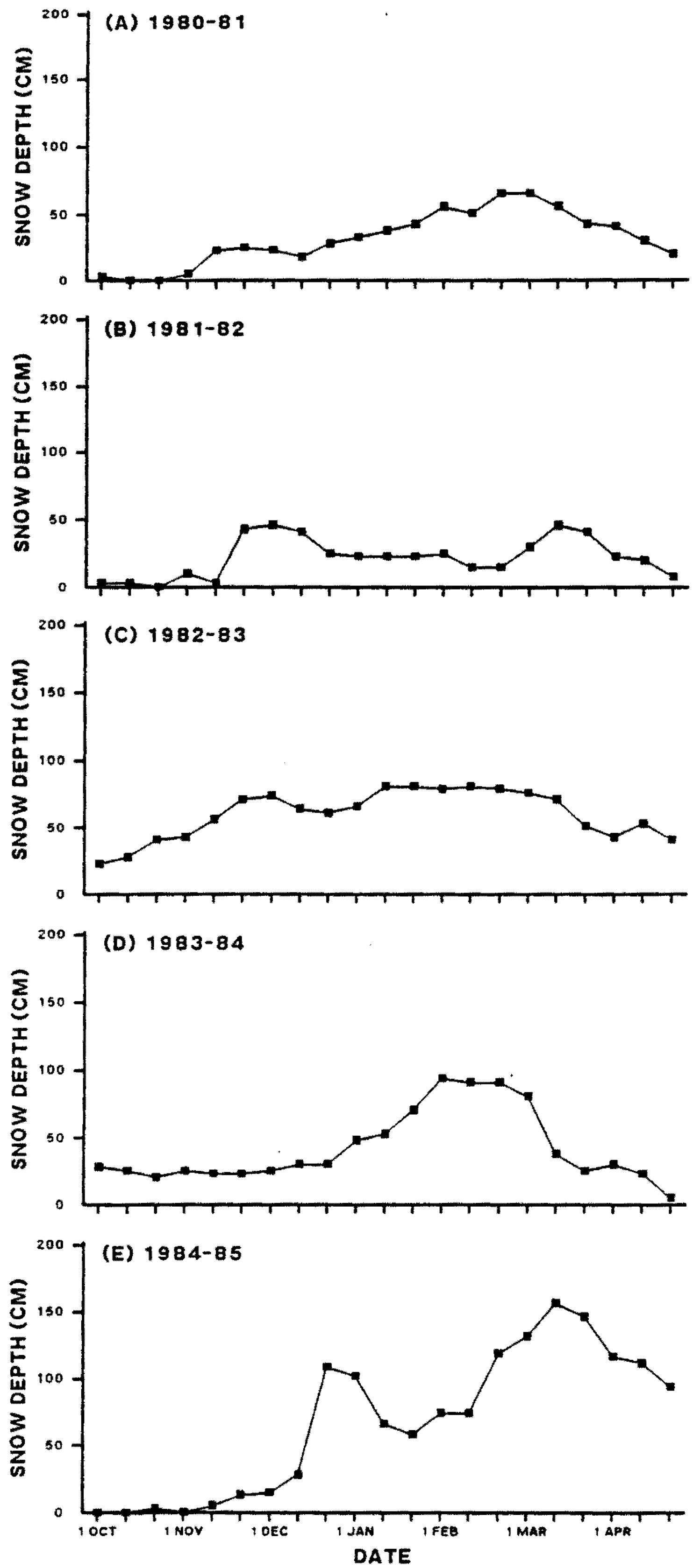

Figure 2 Maximum snow pack depth in Talkeetna in 10-day intervals, Oct–Apr from 1980–1985

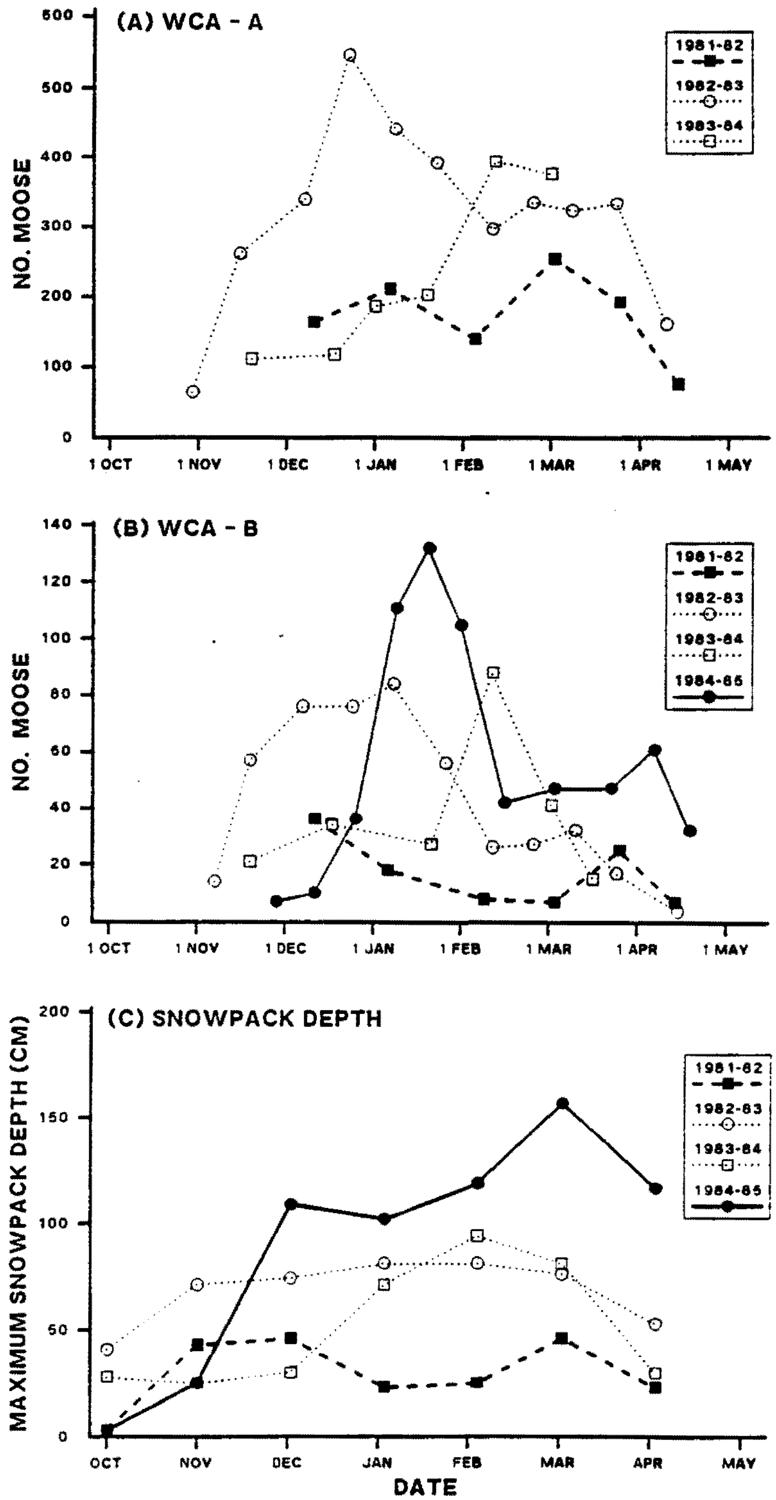

Figure 3 Moose in winter concentration areas (WCA) in Susitna River floodplain (A–B) and snow pack depth in Talkeetna (C) in lower Susitna River Valley in Southcentral Alaska, Oct–Apr from 1981–1985. WCA were (A) between Yentna River and Talkeetna River and (B) between Talkeetna River and Portage Creek. Snow pack depth was monthly maximum depth of snow.

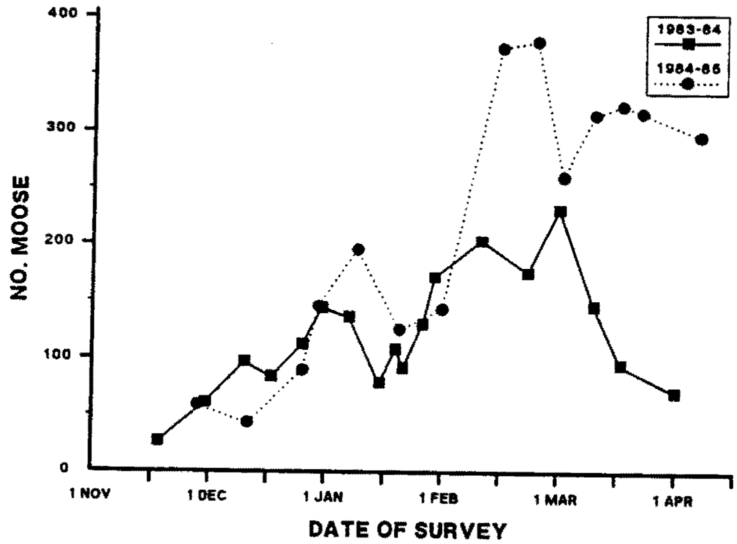

Figure 4 Moose in old homesteads (n=14) located near the Susitna River floodplain and the Parks Highway between Talkeetna and Willow in lower Susitna River Valley in Southcentral Alaska in Nov–Apr 1983–1984, a normal snow winter, and in 1984–1985, a deep snow winter.

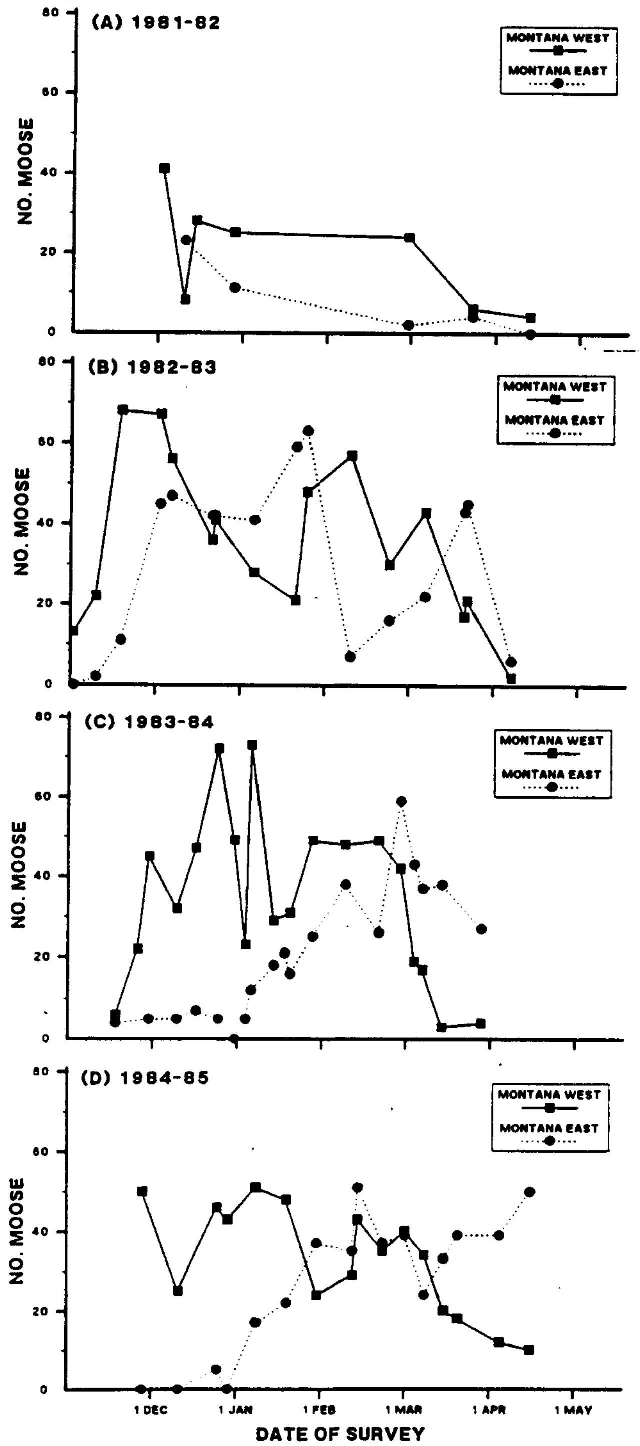

Figure 5 Moose in 2 old homesteads located about 2 km apart on opposite sides (west-east) of the Susitna River near Montana Creek in Nov–Apr in 1981–1985 (A–D)

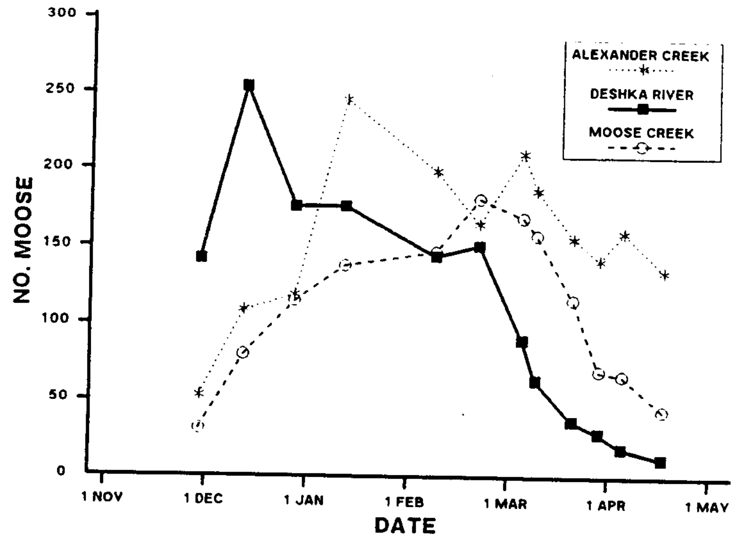

Figure 6 Moose in 3 lowland floodplain winter concentration areas located in Units 16A and 16B in lower Susitna River Valley in Southcentral Alaska, 29 Nov–16 Apr 1985

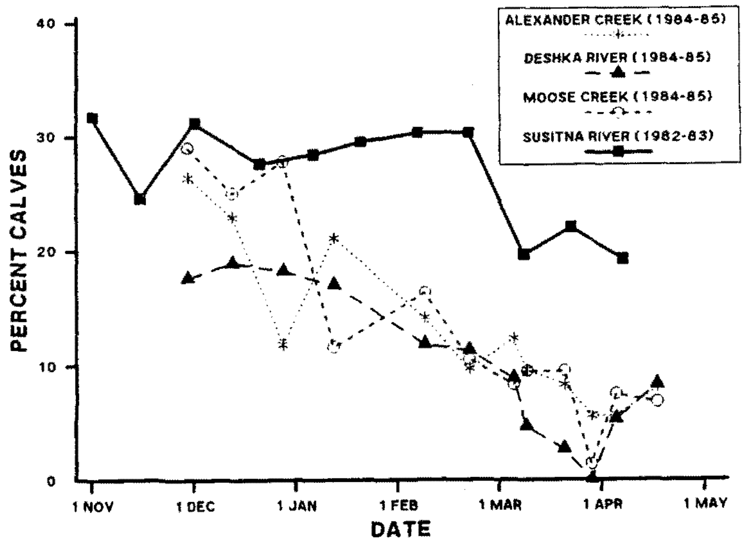

Figure 7 Percent calf moose in lowland floodplain winter concentration areas in a deep snow winter (1984–1985) and a normal snow winter (1982–1983) in lower Susitna River Valley in Southcentral Alaska. In 1982–1983 data were from the Susitna River floodplain between Yentna River and Montana Creek. In 1984–1985 data were from Alexander Creek, Deshka River, and Moose Creek. Maximum snow pack depth in Talkeetna during Nov–Apr was 81 cm in 1982–1983 and 157 cm in 1984–1985

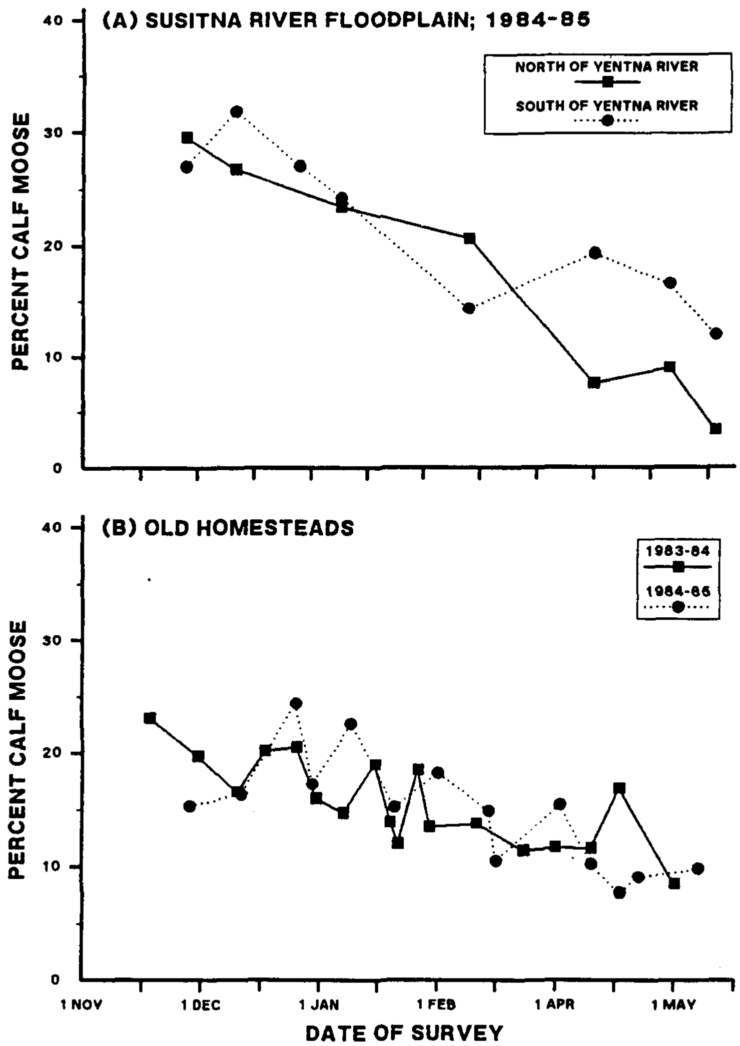

Figure 8 Percent calf moose in (A) 2 sections of the Susitna River floodplain and (B) old homesteads in winter, Nov–Apr from 1983–1985. The section of the Susitna River floodplain north of the Yentna River included separate areas near Kashwitna River, Caswell Creek, and Delta Islands. The section of the Susitna River floodplain south of the Yentna River included 3 islands near Alexander Creek. Old homesteads (n=14) were located near the Susitna River floodplain and the Parks Highway between Talkeetna and Willow. Maximum snow pack depth was normal (94 cm) in 1983–1984 and deep (157 cm) in 1984–1985. In March 1985 snow pack depth was >100 cm north of the Yentna River, <100 cm south of the Yentna River, and >100 cm near the old homesteads.

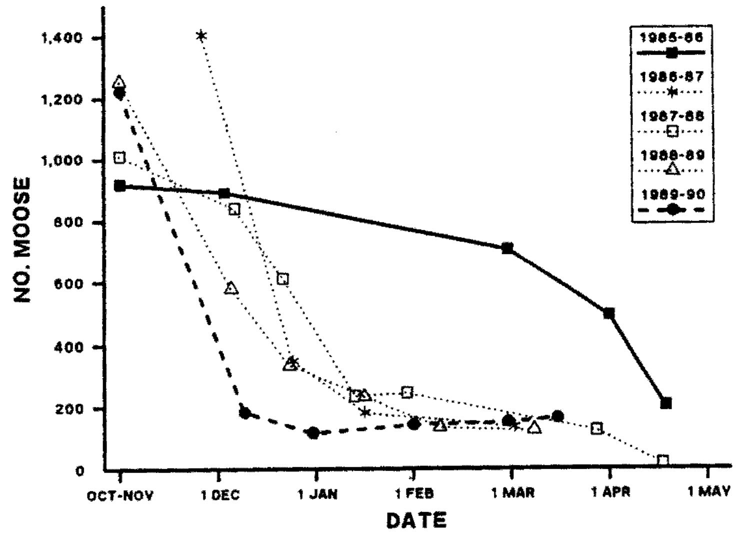

Figure 9 Moose in 7 timberline post-rut concentration areas in Units 14A and 14B in the western foothills of the Talkeetna Mountains in the lower Susitna River Valley in Southcentral Alaska in years with low (1985–1986), normal (1986–1989), and early-deep accumulations of snow.

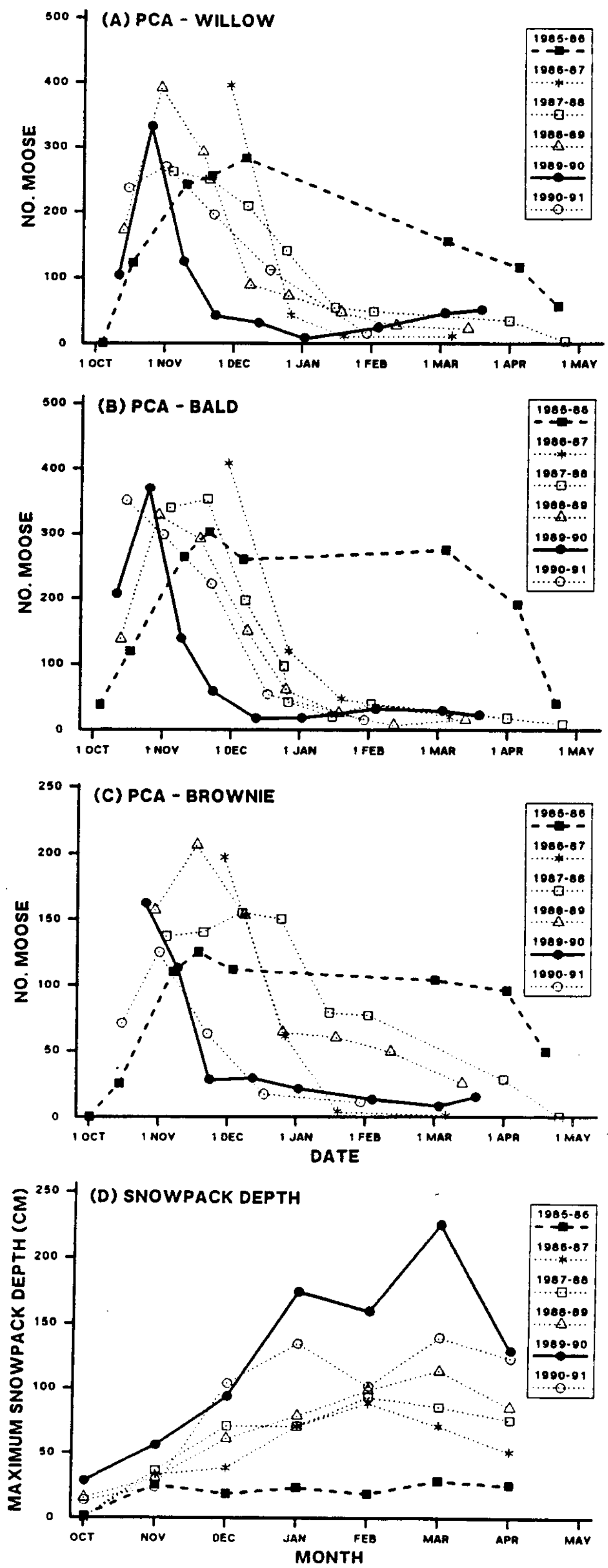

Figure 10 Moose in 3 (A–C) post-rut concentration areas (PCA) in the western foothills of Talkeetna Mountains and snow pack depth in Talkeetna (D) in lower Susitna River Valley in Southcentral Alaska, Oct–Apr from 1985–1991. PCA were above timberline on Willow Mountain (A), Bald Mountain (B), and Brownie Mountain (C) in Units 14A and 14B. Snow pack depth was the monthly maximum depth of snow in Oct–Apr.

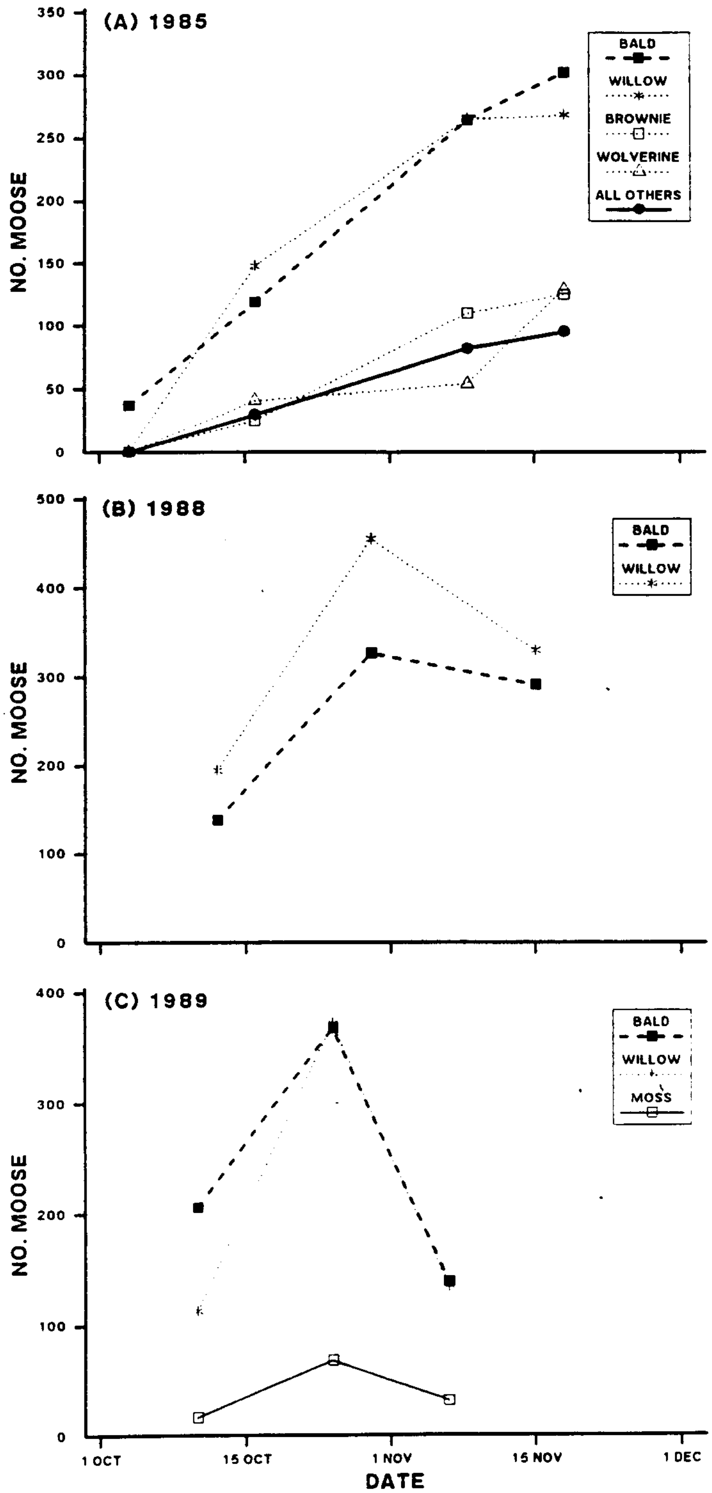

Figure 11 Chronology of arrival and peak numbers of moose in 3 post-rut concentration areas in Units 14A and 14B in the western foothills of the Talkeetna Mountains in lower Susitna River Valley in Southcentral Alaska during early Oct–mid Nov in 1985 (A), 1988 (B), and 1989 (C).

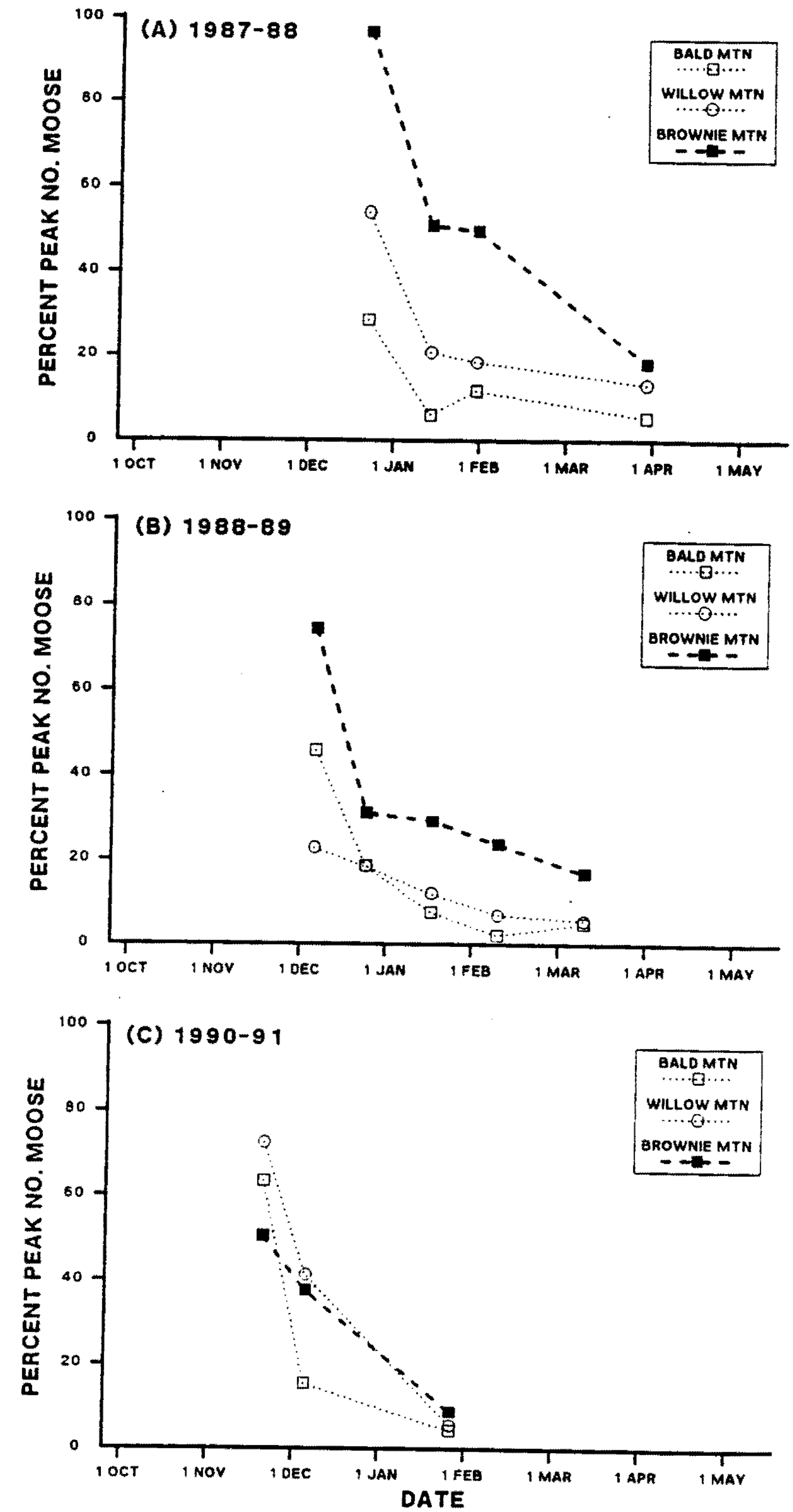

Figure 12 Year and area differences in dispersal of moose from post-rut concentration areas (PCA) in the western foothills of Talkeetna Mountains in Southcentral Alaska, Oct–Apr, 1987–1989 and 1990–1991. PCAs were above timberline on Willow Mountain (A), Bald Mountain (B), and Brownie Mountain (C) in Units 14A and 14B.

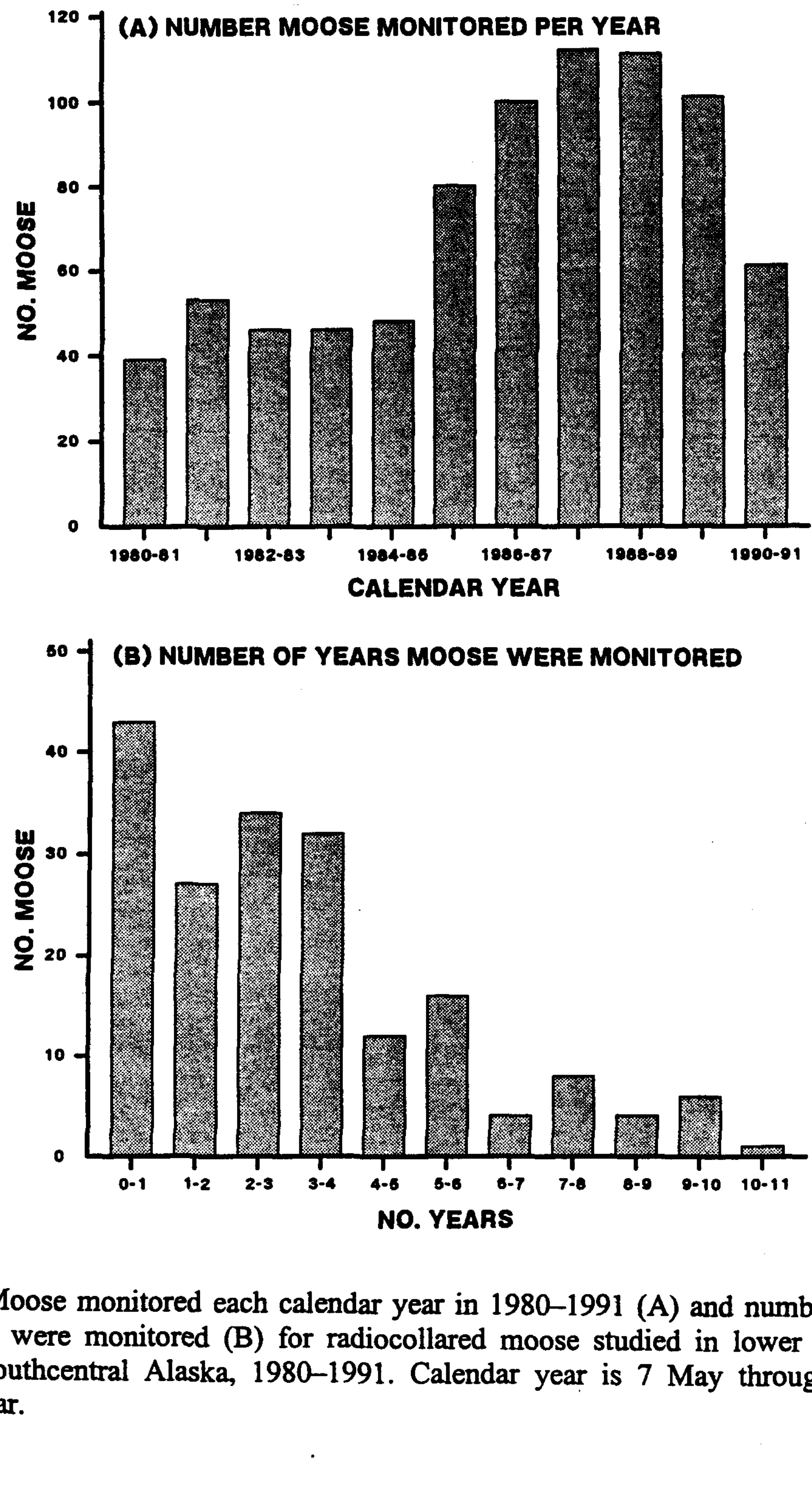

Figure 13 Moose monitored each calendar year in 1980–1991 (A) and number of calendar years moose were monitored (B) for radiocollared moose studied in lower Susitna River Valley in Southcentral Alaska, 1980–1991. Calendar year is 7 May through 6 May the following year.

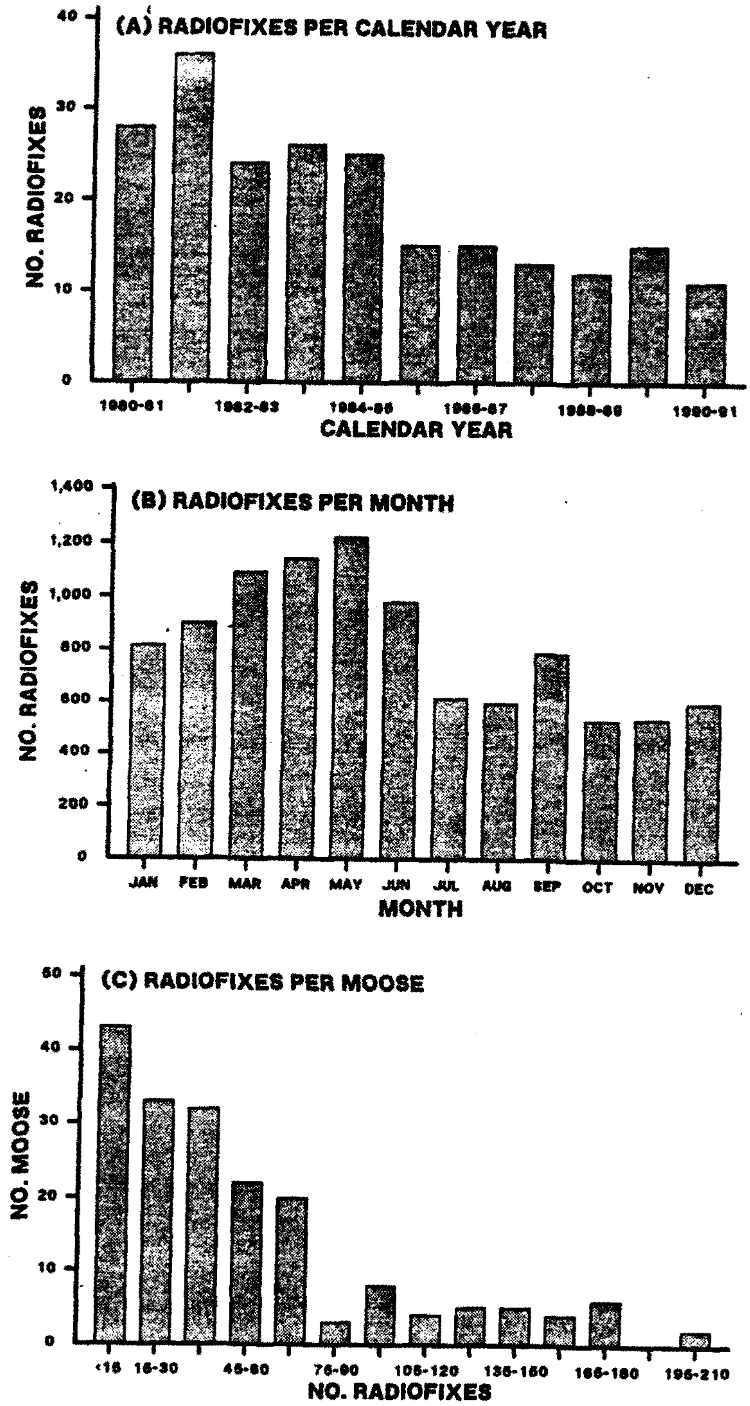

Figure 14 Distribution of monitoring effort (radio-fixes) among calendar years (A), among months (B), and among individual moose (C) for radiocollared moose studied in lower Susitna River Valley in Southcentral Alaska, 1980–1991

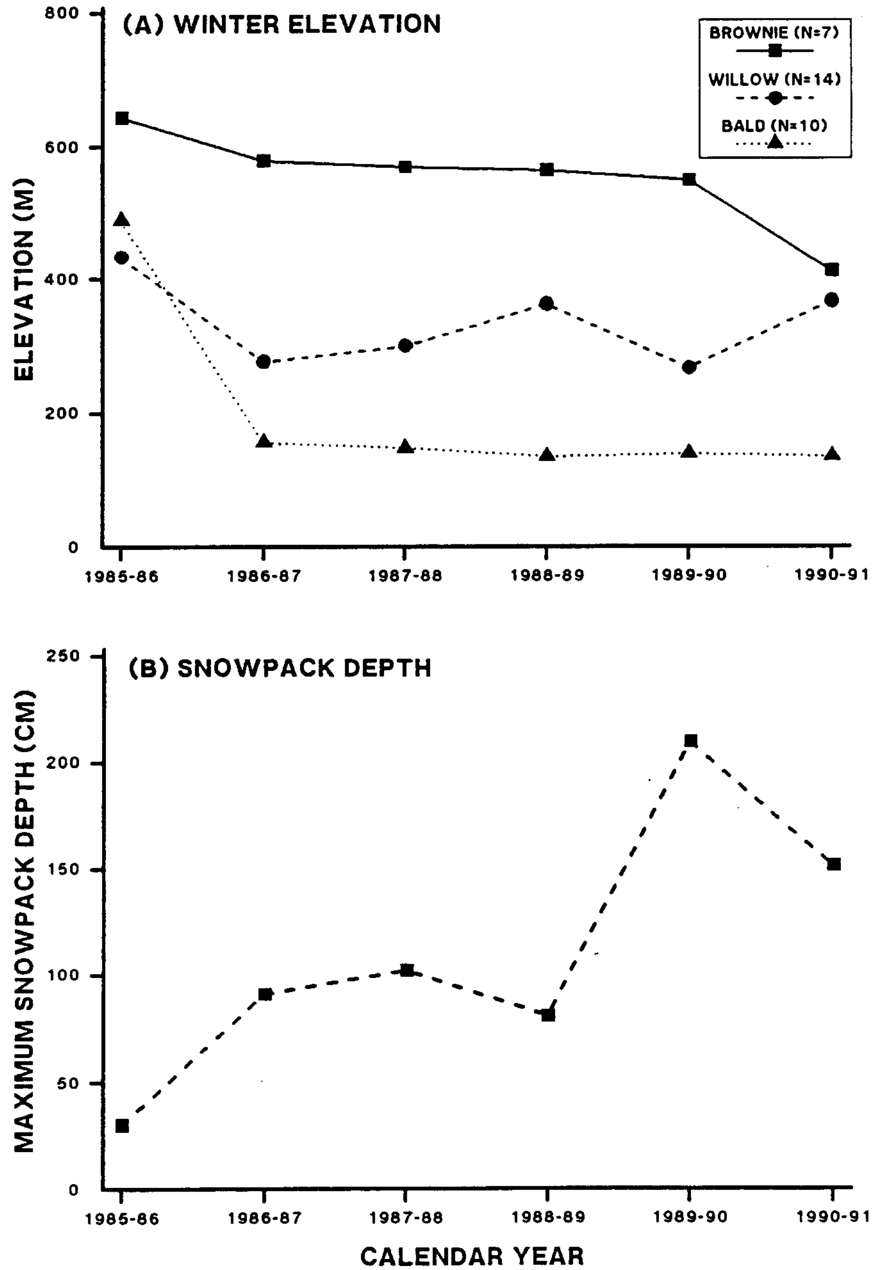

Figure 15 Minimum winter (20 Jan–20 Mar) elevation (A) of radiocollared moose in 3 post-rut concentration areas (PCA) in the western foothills of Talkeetna Mountains and snow pack depth (B) in Talkeetna, lower Susitna River Valley, Southcentral Alaska, 1985–1991. PCAs were above timberline on Brownie Mountain, Willow Mountain, and Bald Mountain in Units 14A and 14B. Snow pack depth was maximum depth of snow during Oct–Apr.

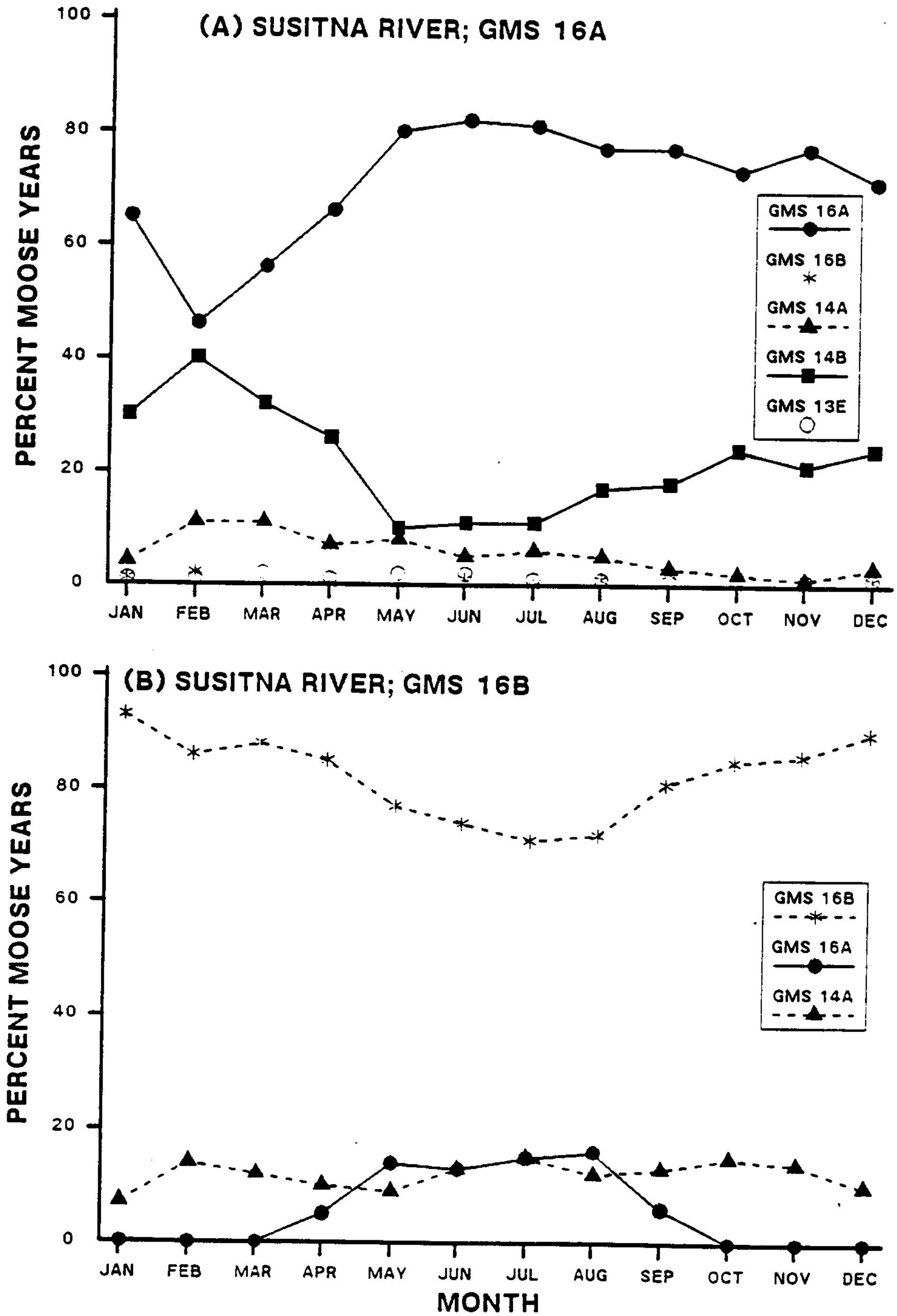

Figure 16 Destination Game Management Subunit (GMS) of radiocollared moose adults that dispersed from winter concentration areas in the Susitna River floodplain in GMSs 16B (A) and 16A (B), lower Susitna River Valley, Southcentral Alaska, Apr 1980–Jun 1985

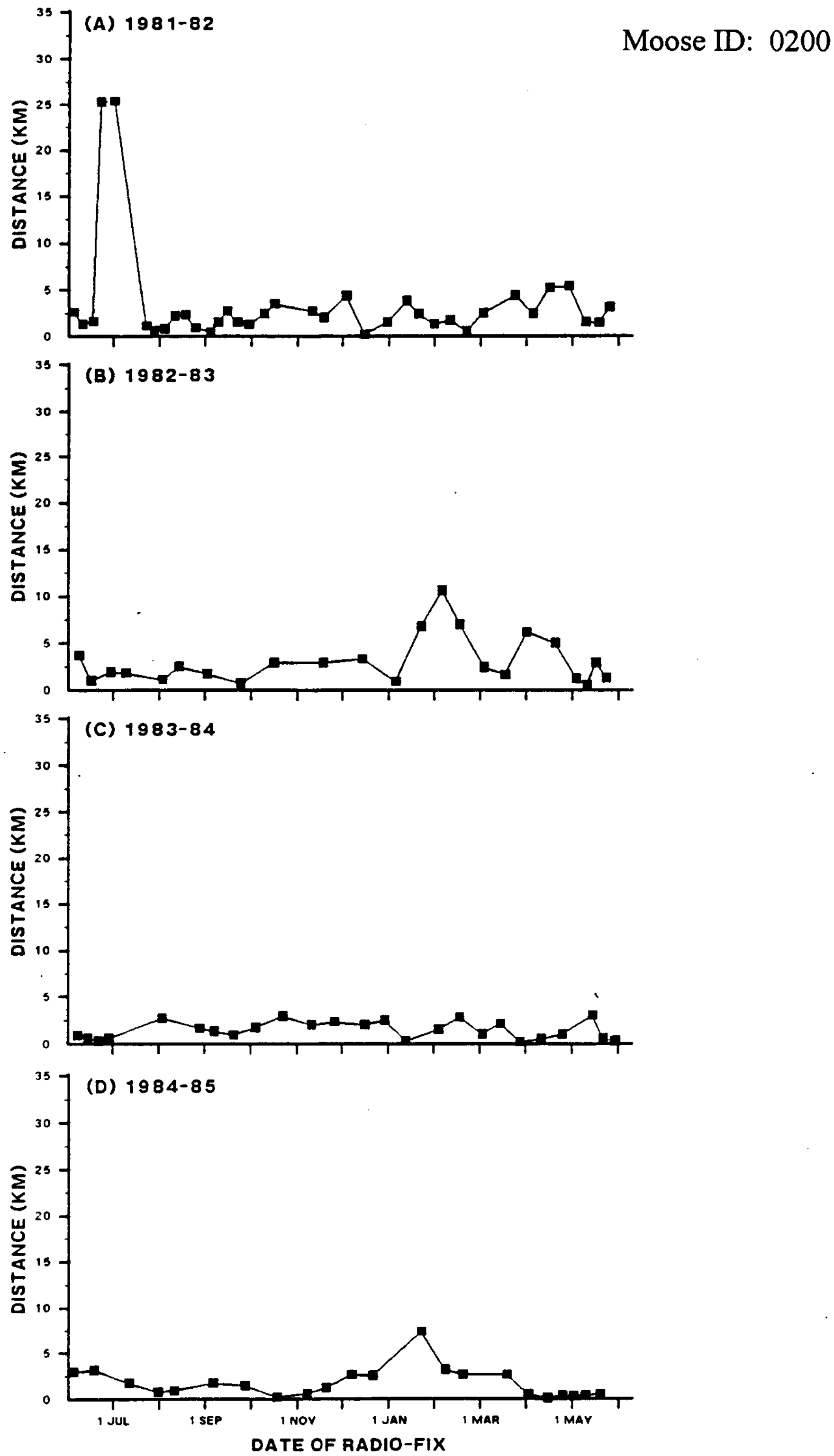

Figure 17 Chronological plots (A–AF) of the distance between consecutive radio-fixes in radiocollared moose (25 females, 7 males) telemetry monitored with aircraft in lower Susitna River Valley, Southcentral Alaska, 1 Jun–31 May 1981–1985. Distance is kilometer to previous radio-fix.

Figure 17 Continued

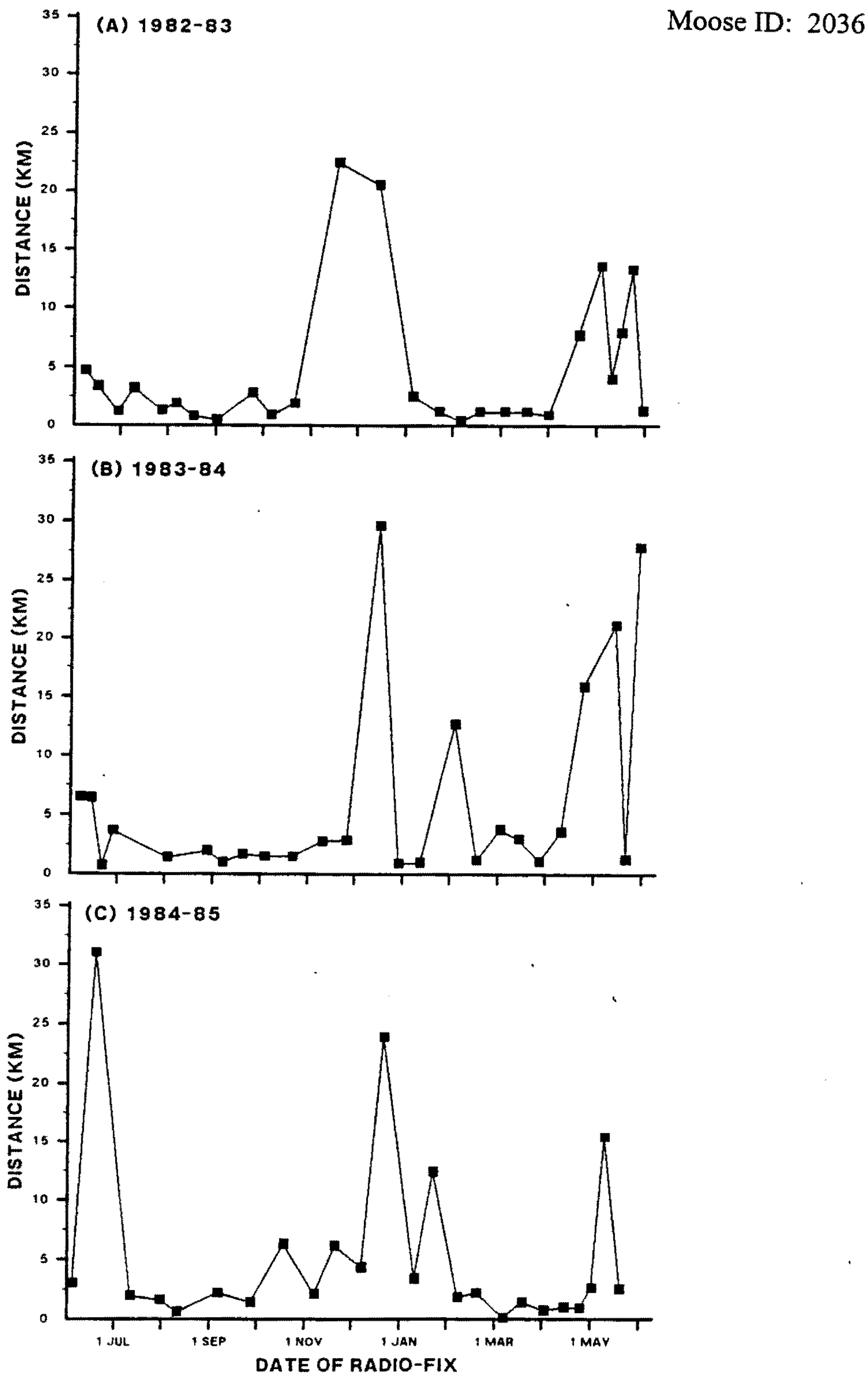

Figure 17 Continued

Moose ID: 2045

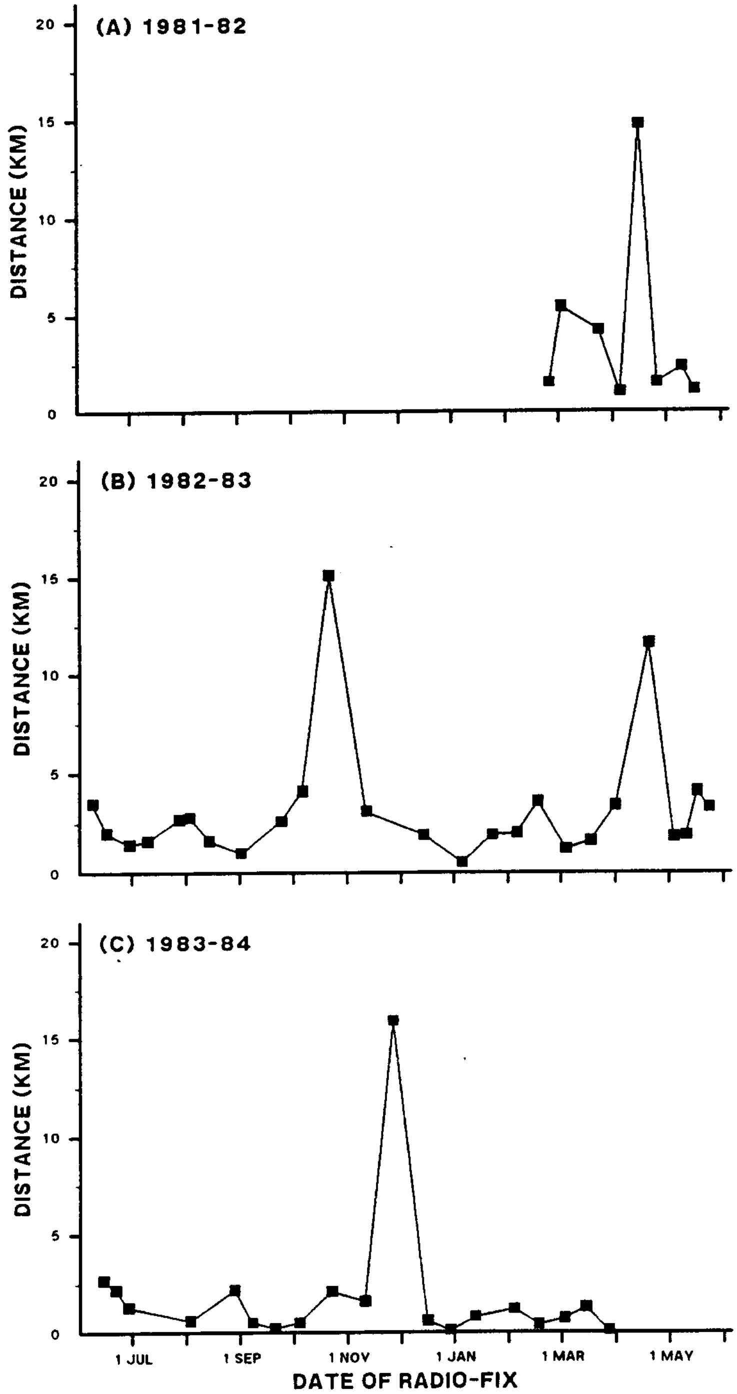

Figure 17 Continued

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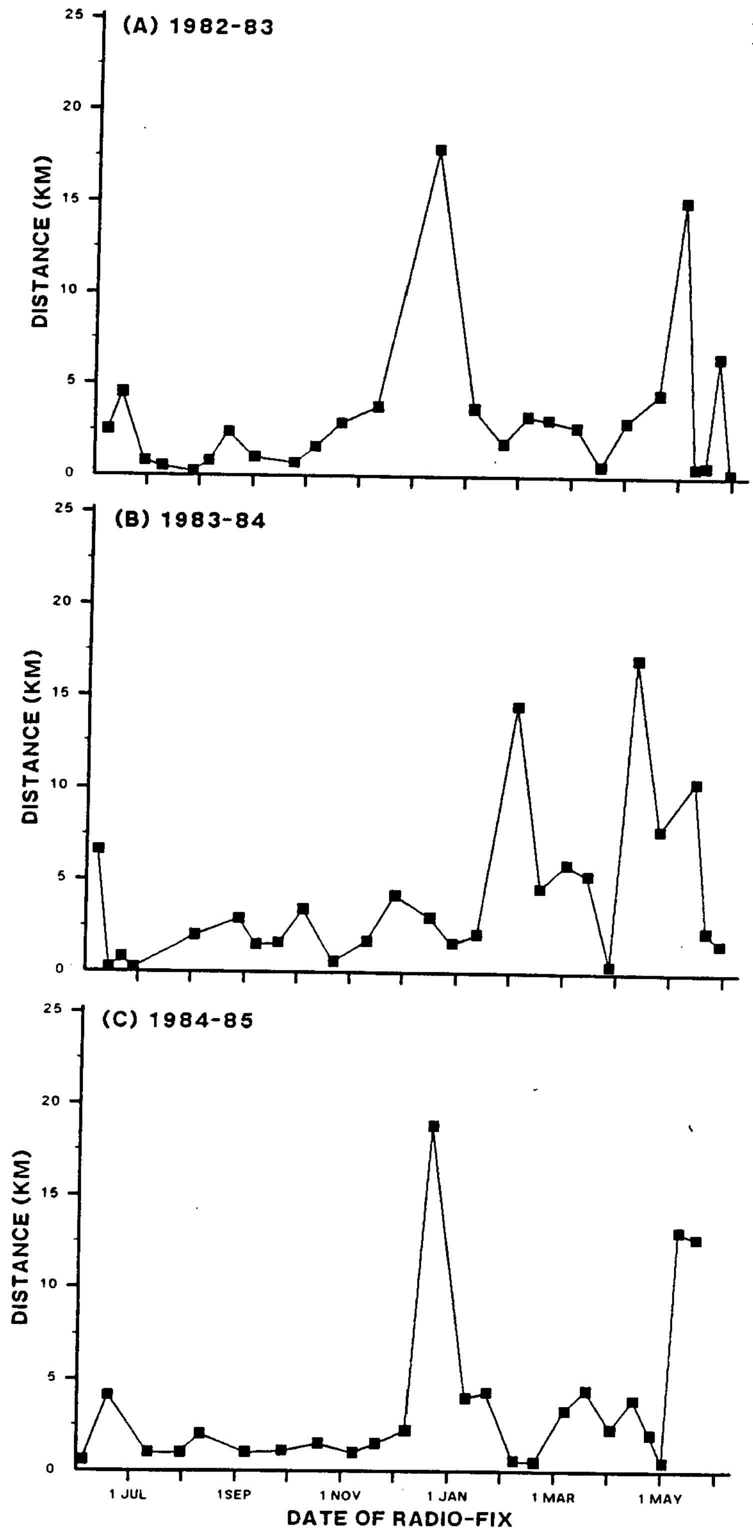

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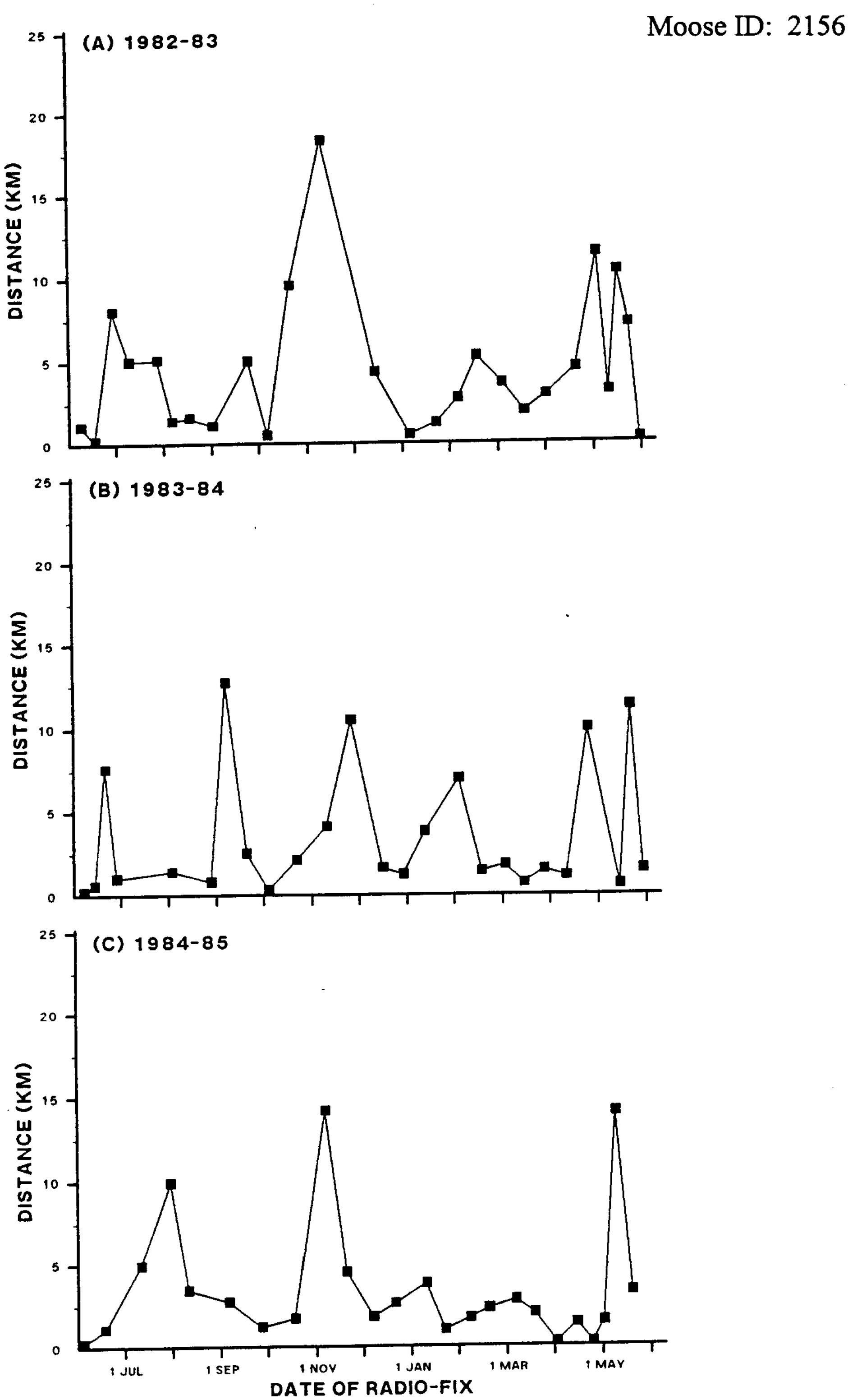

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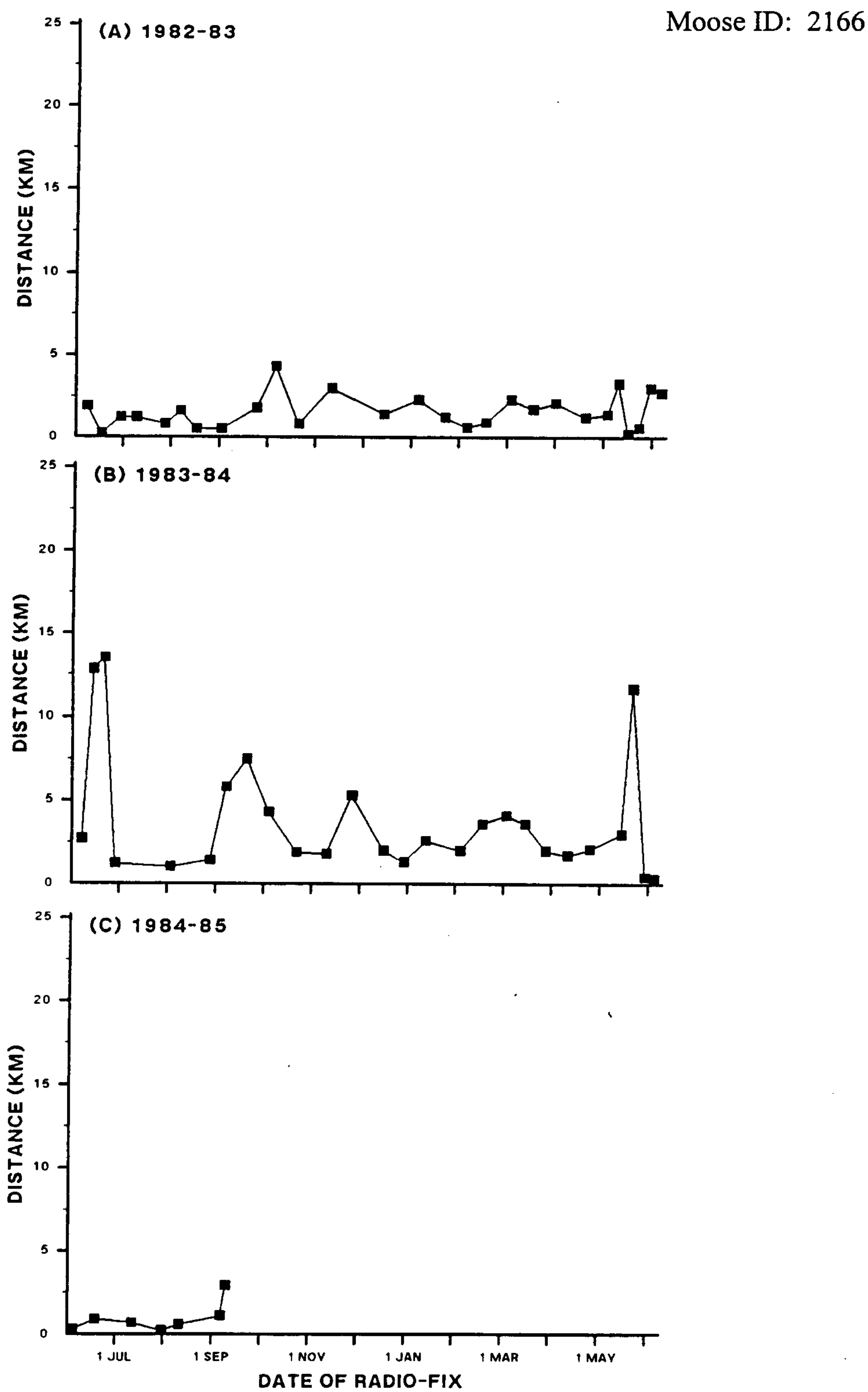

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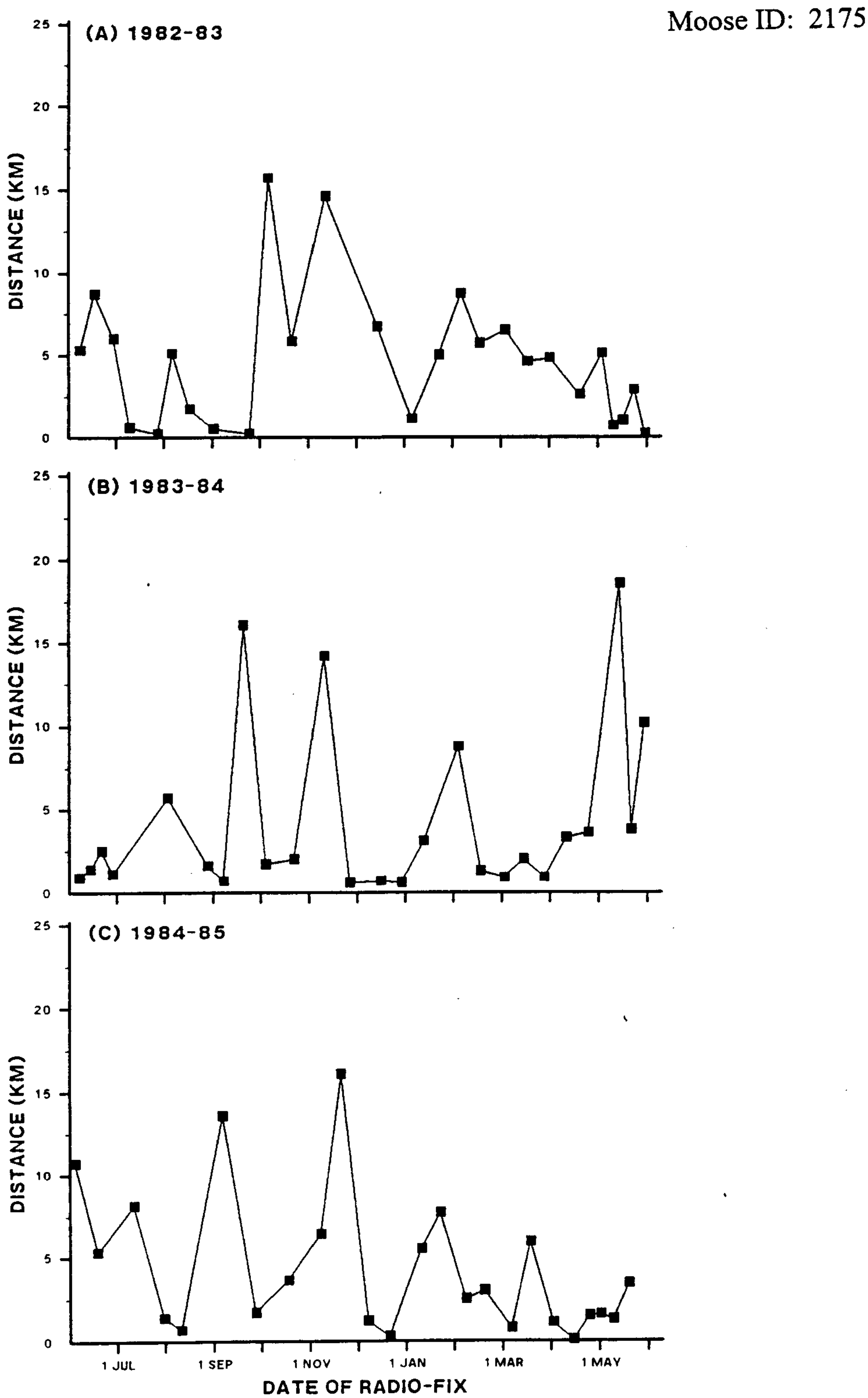
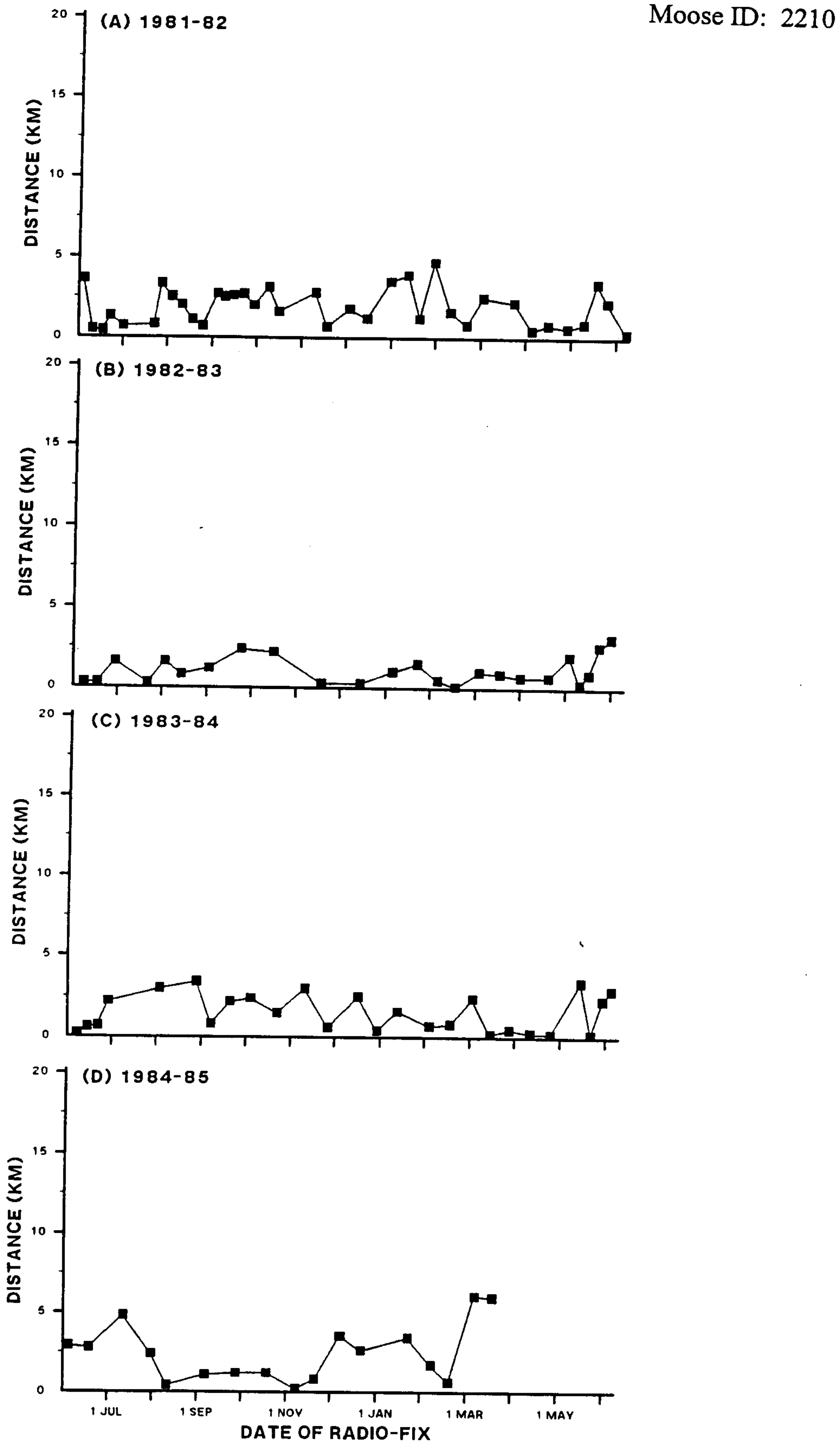


Figure 17 Continued



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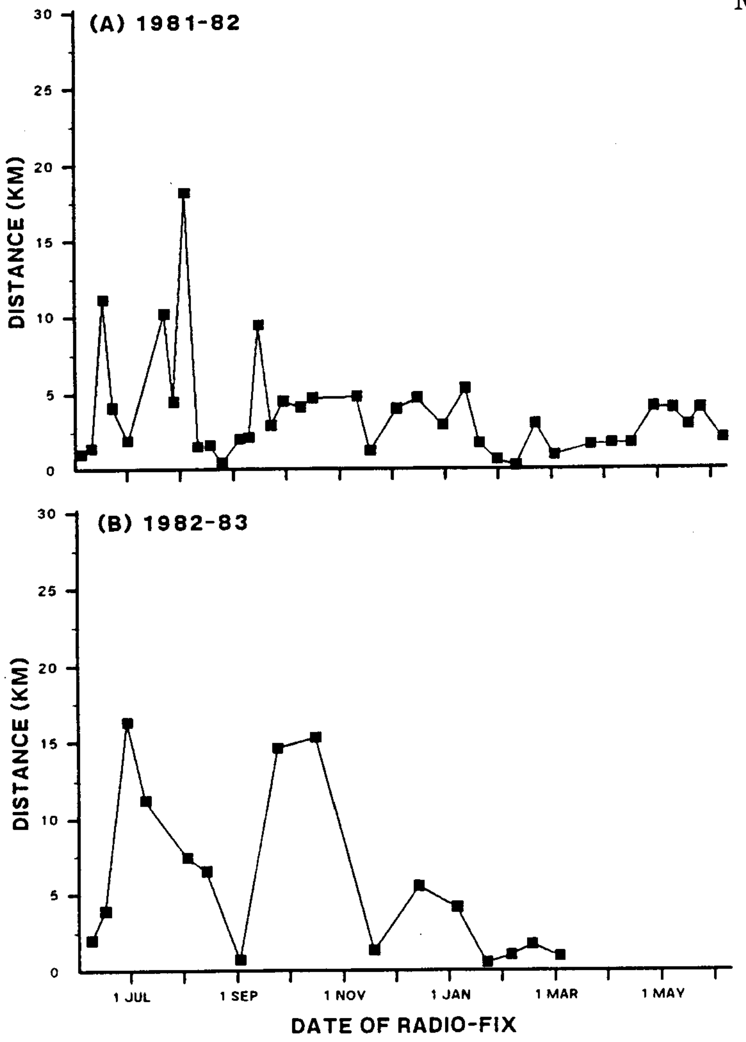

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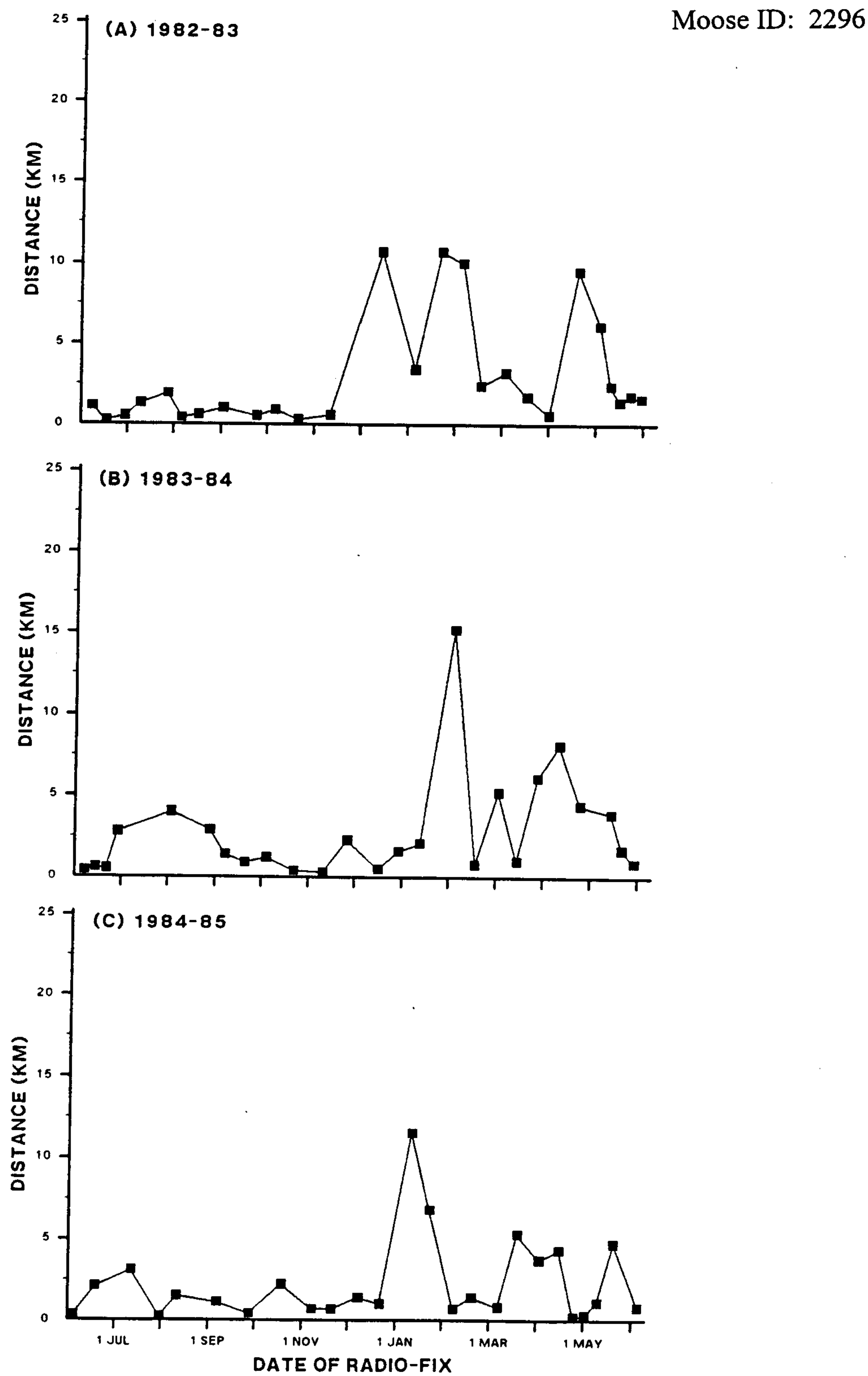

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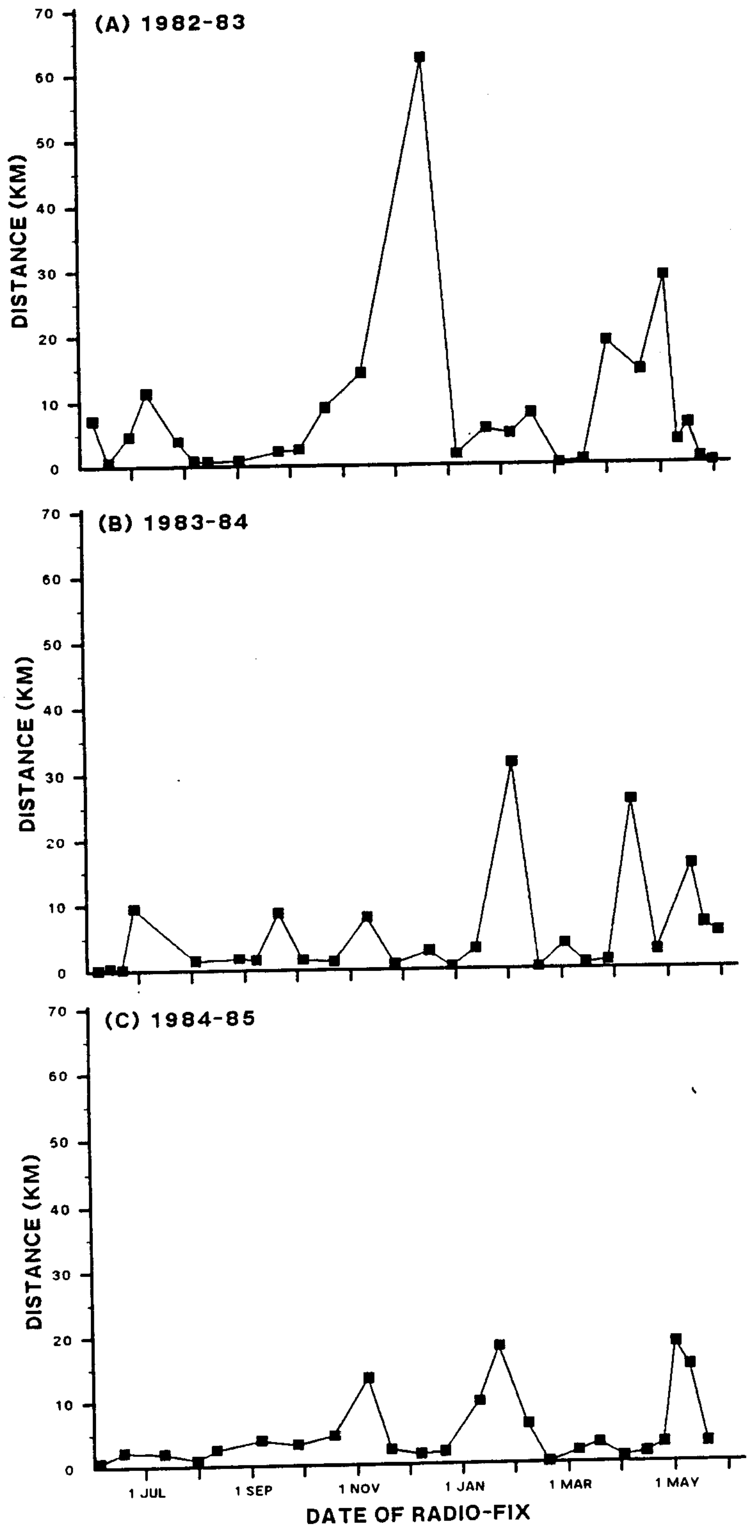

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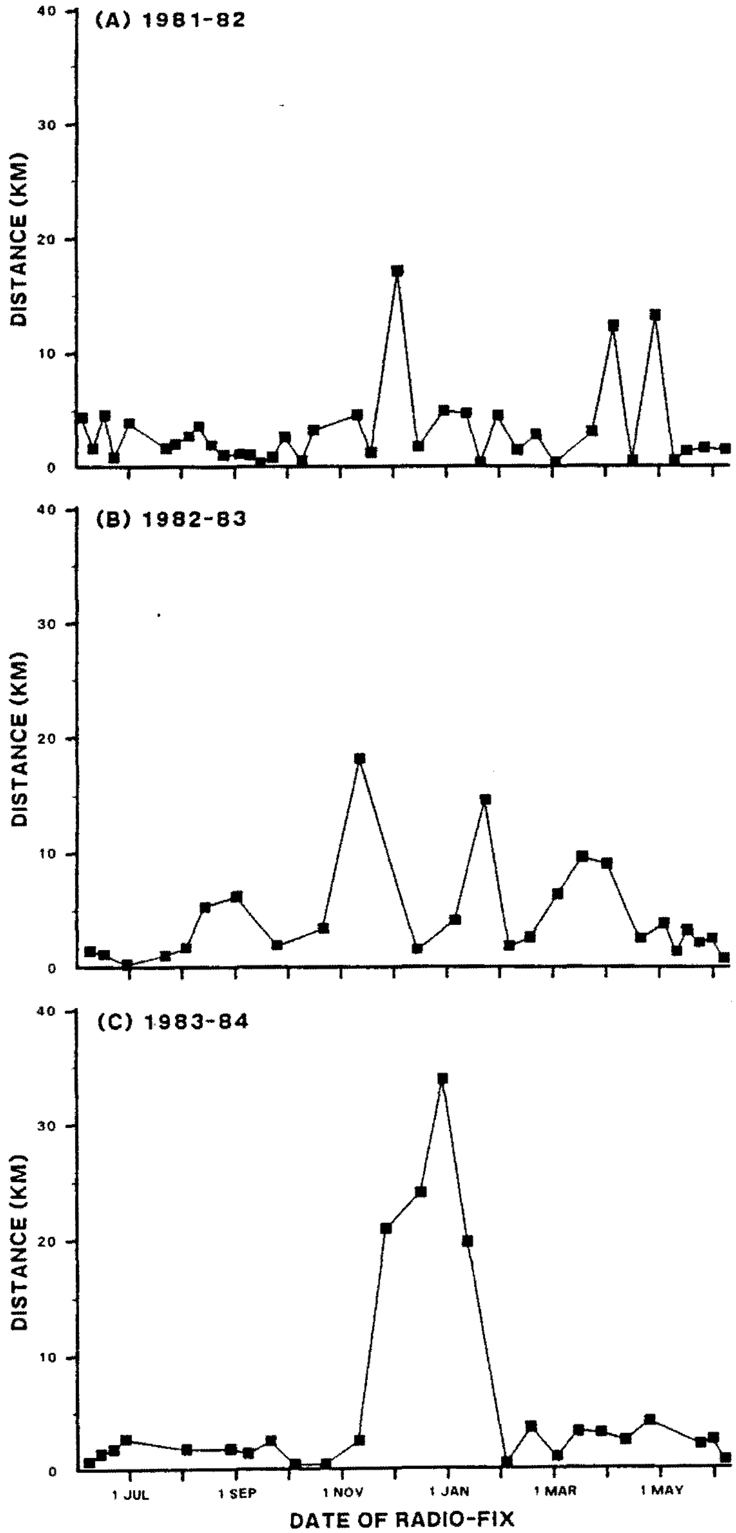

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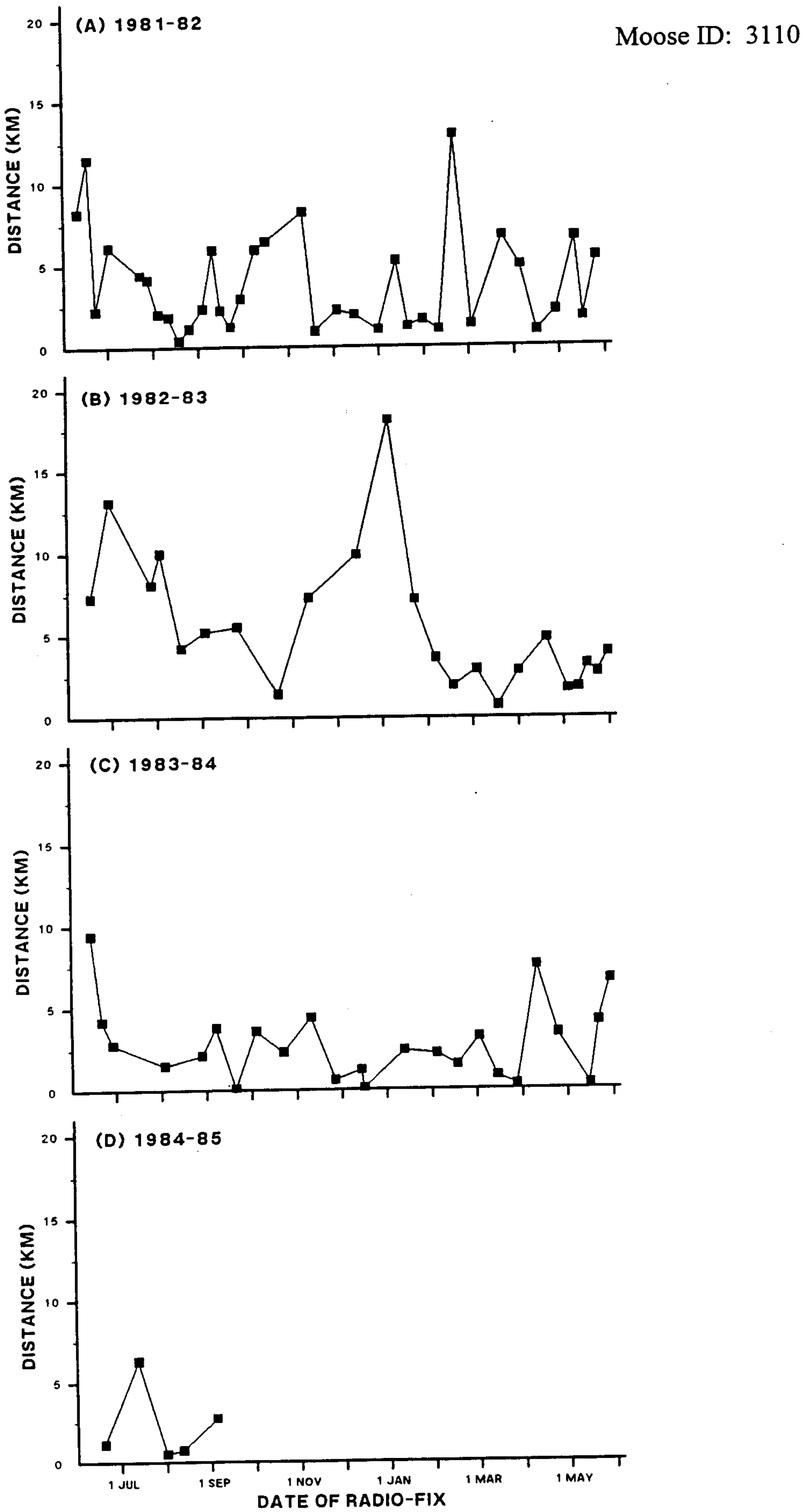

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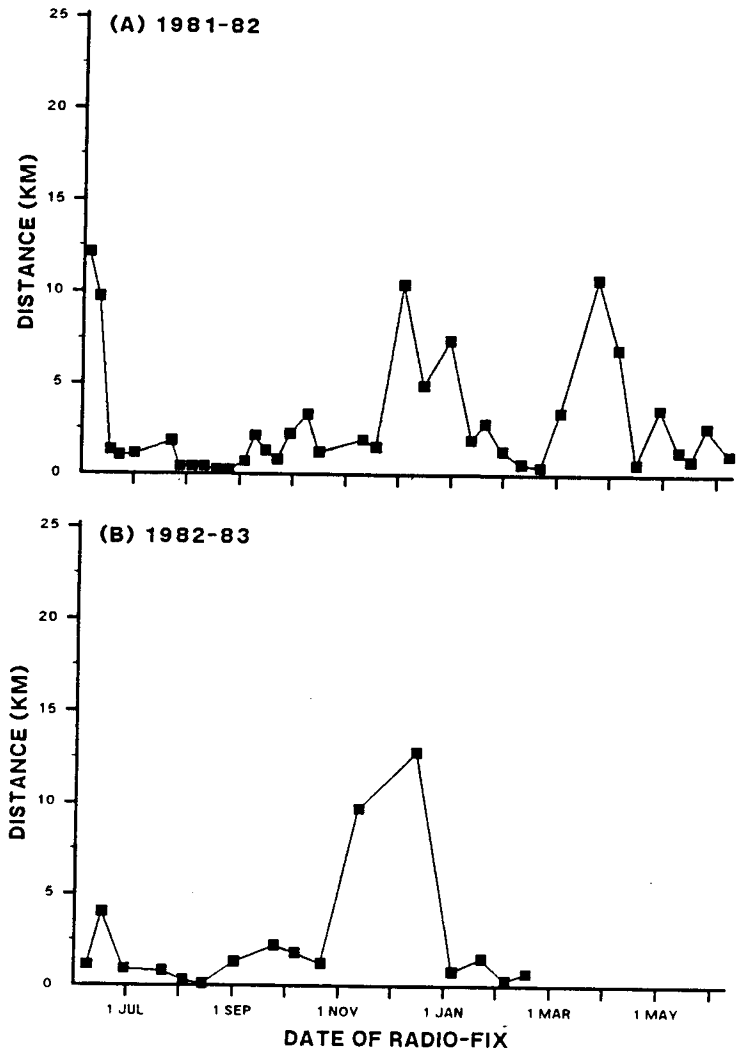

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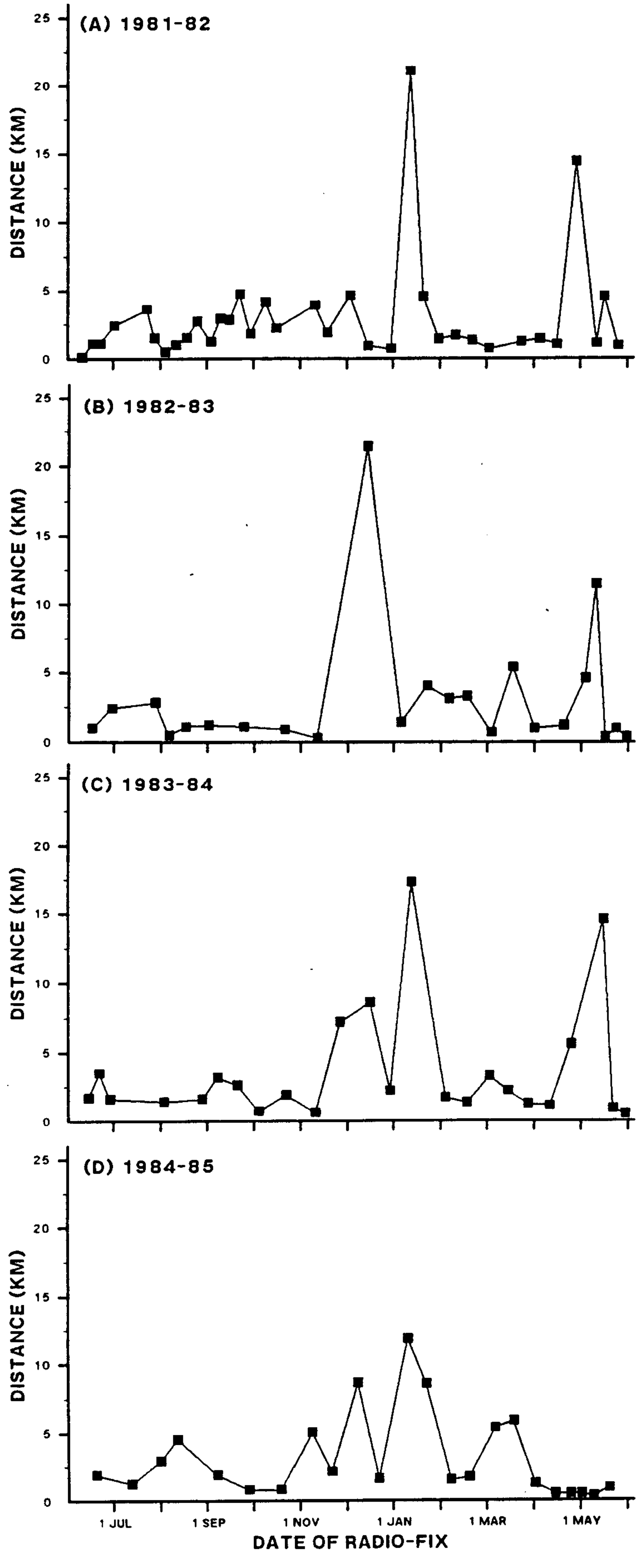

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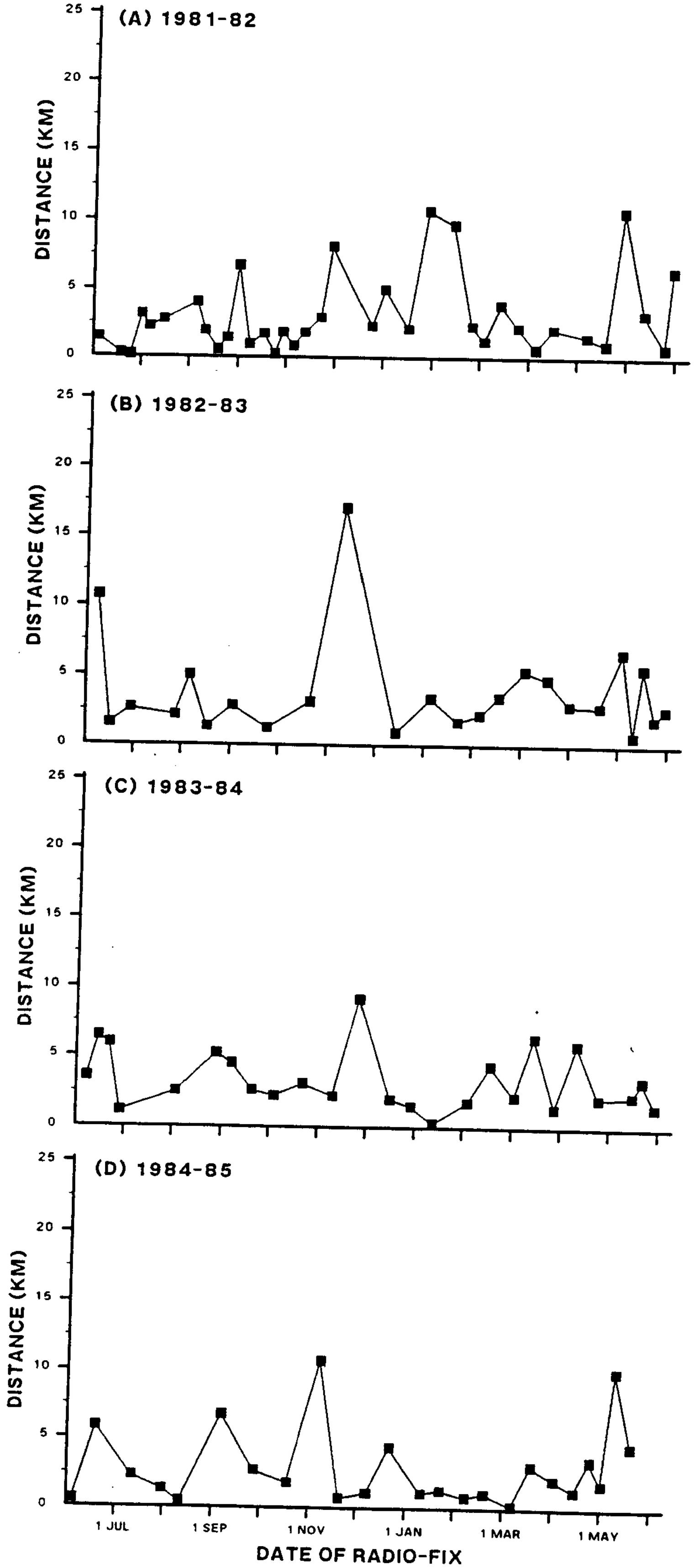

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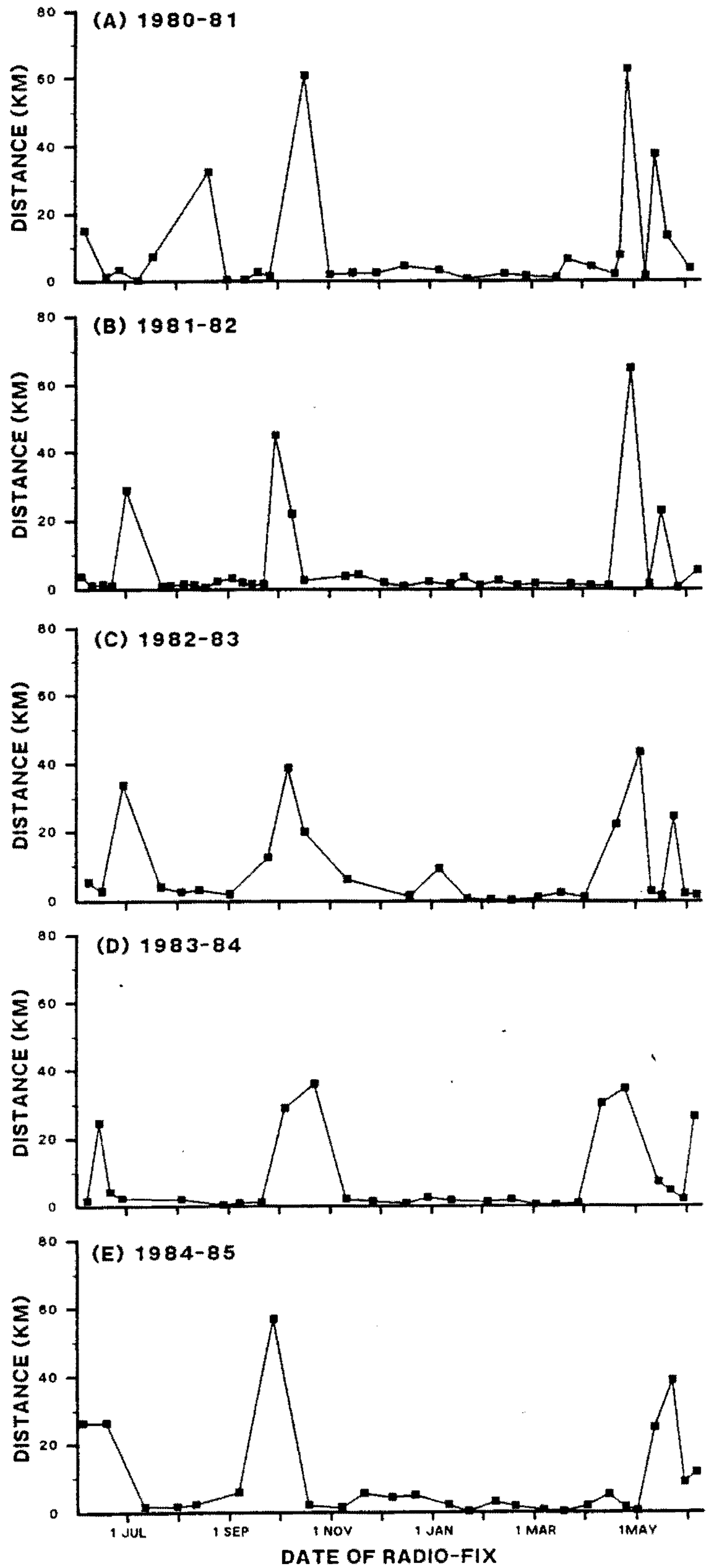

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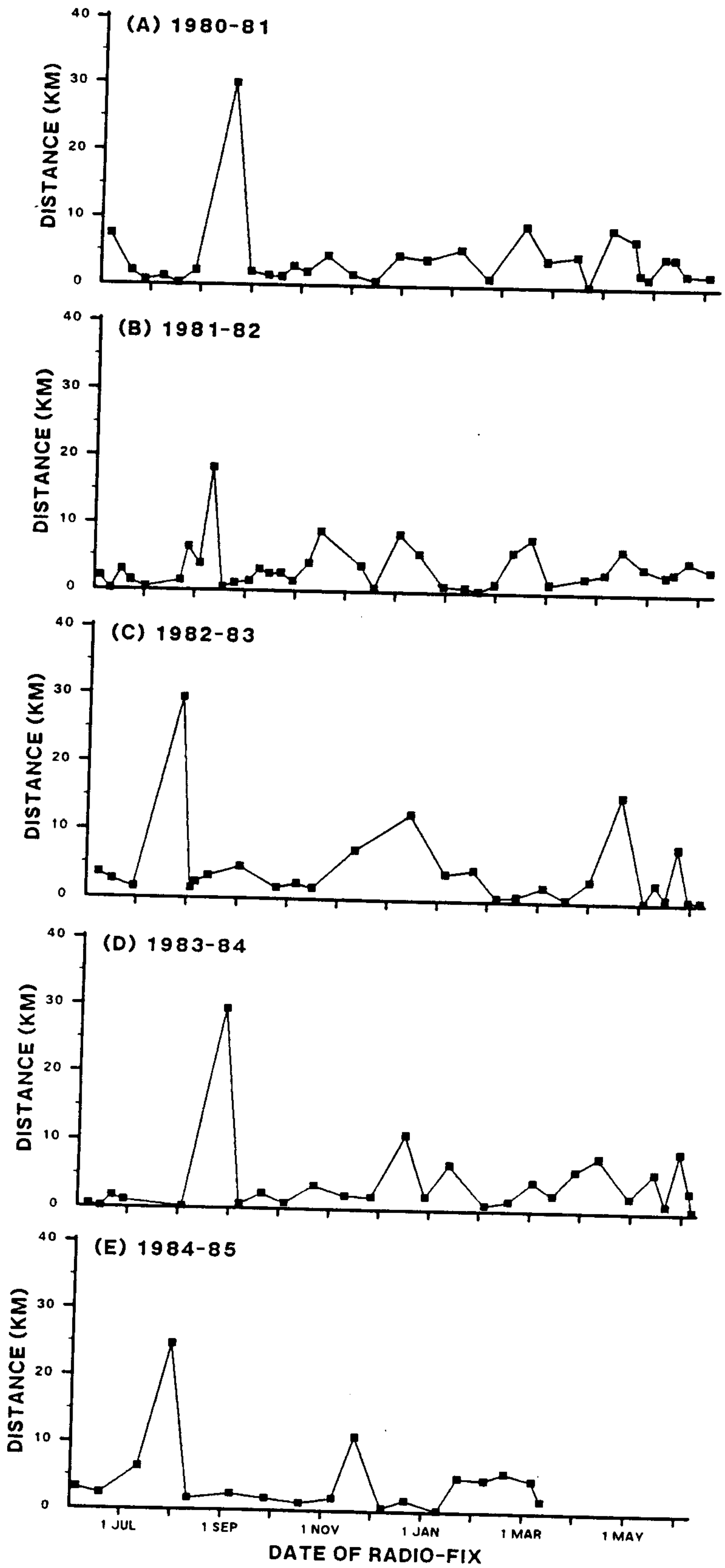

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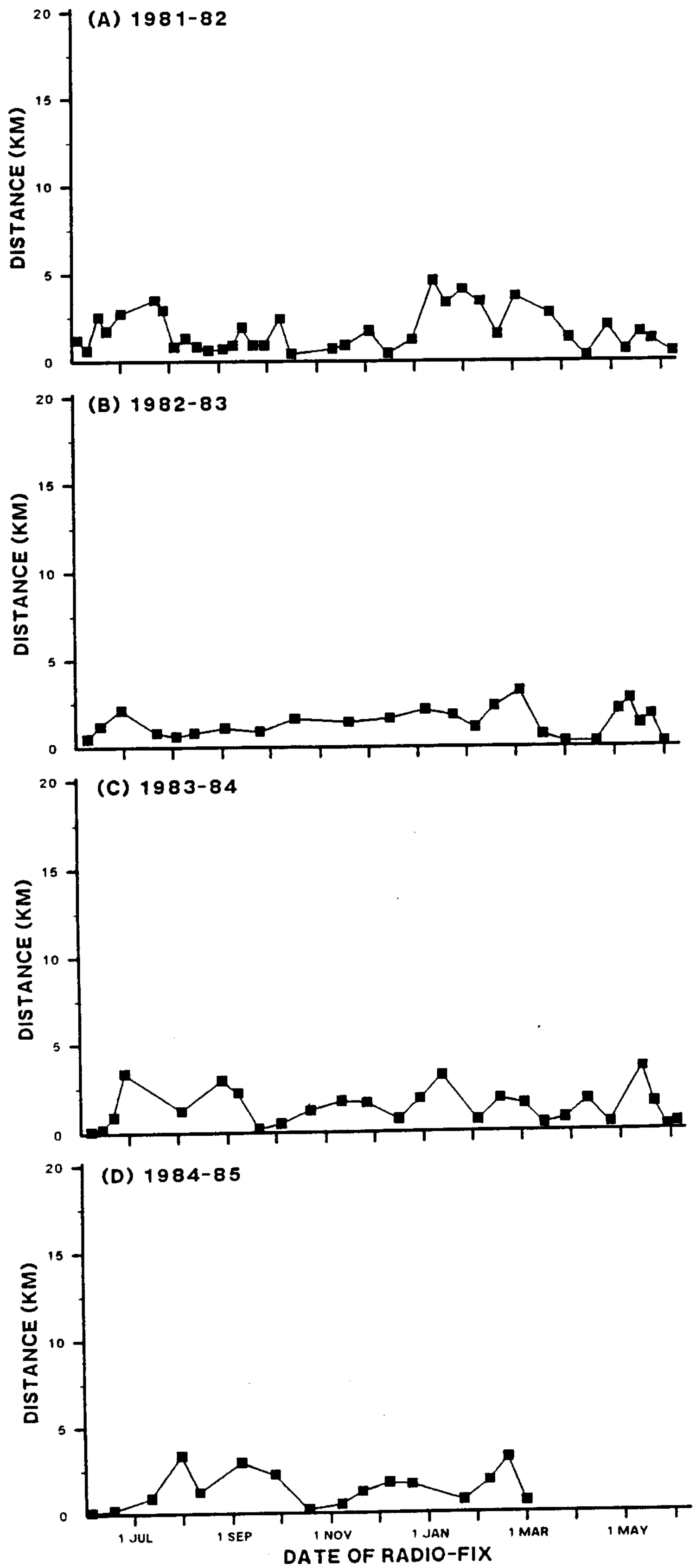

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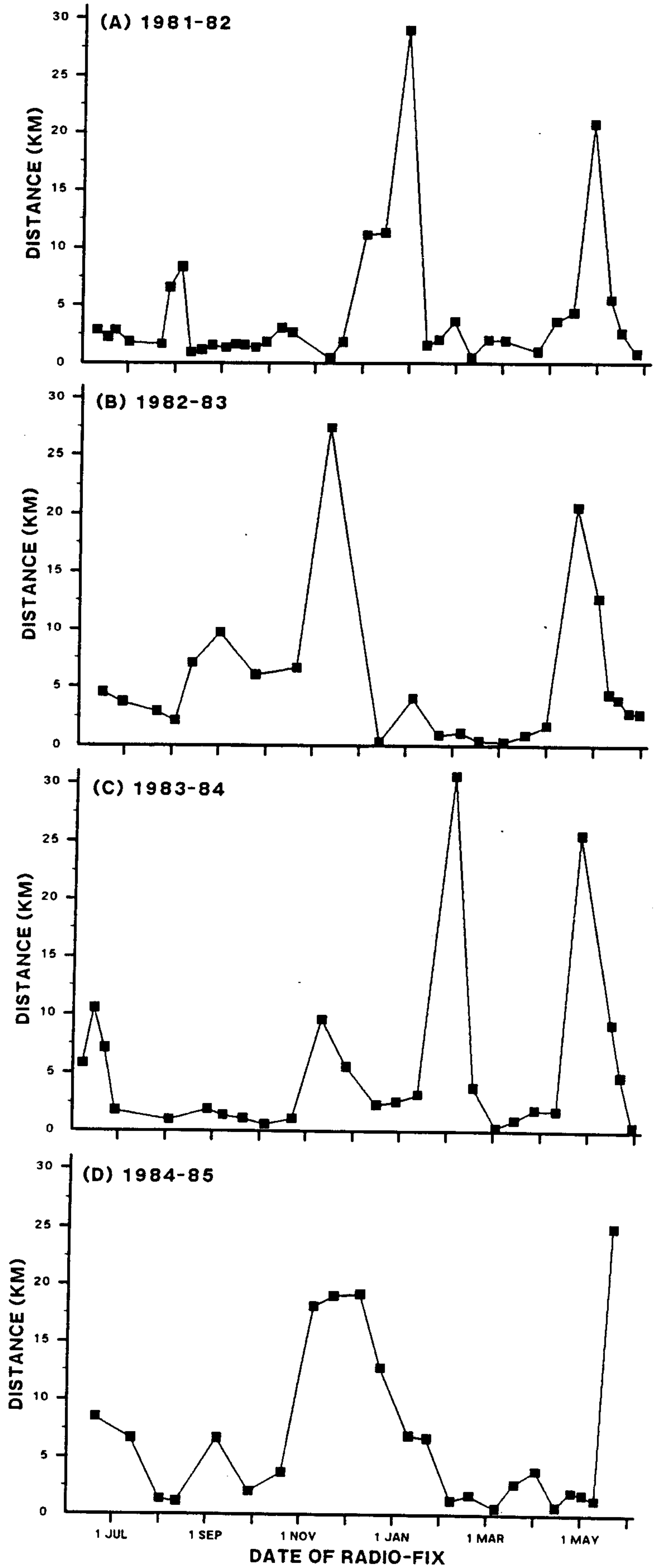

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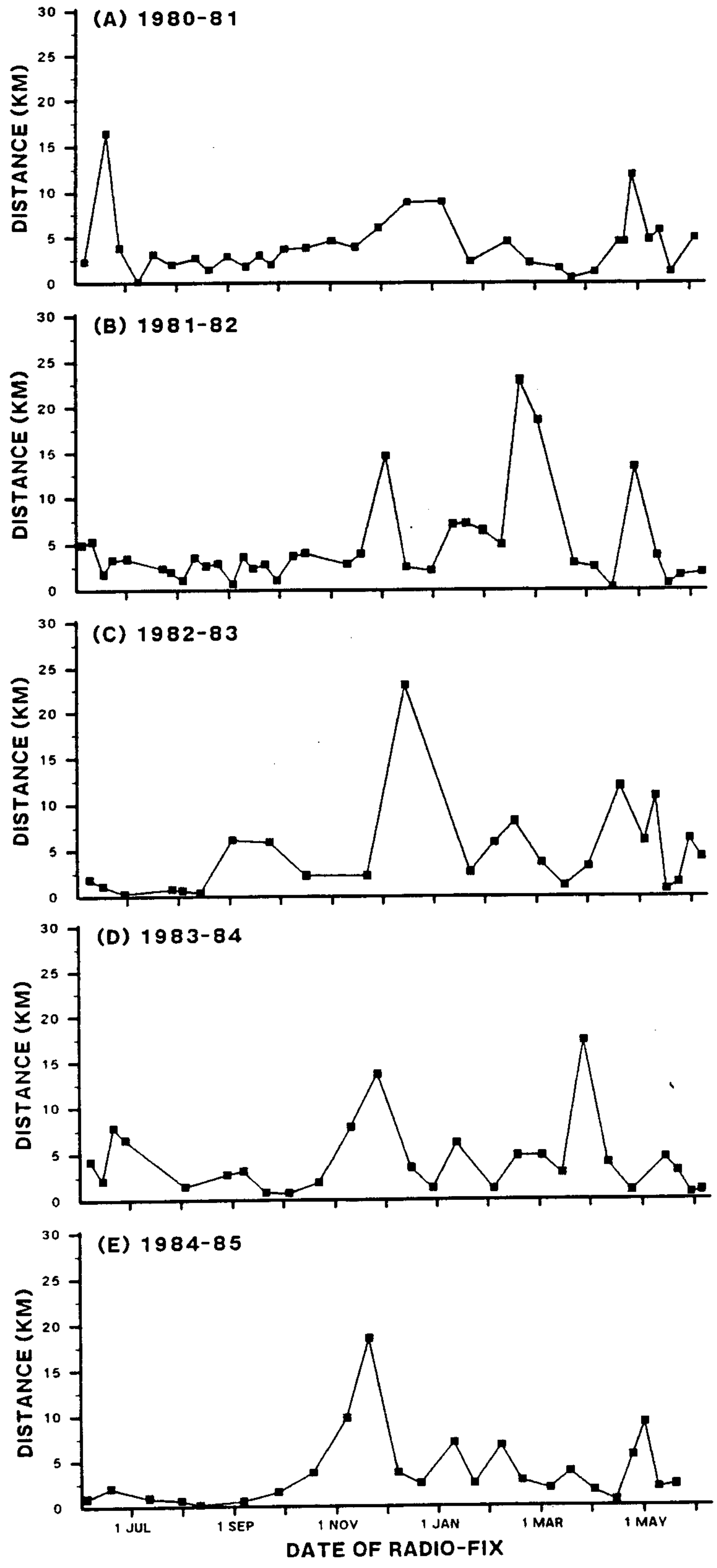
Moose ID: 3260



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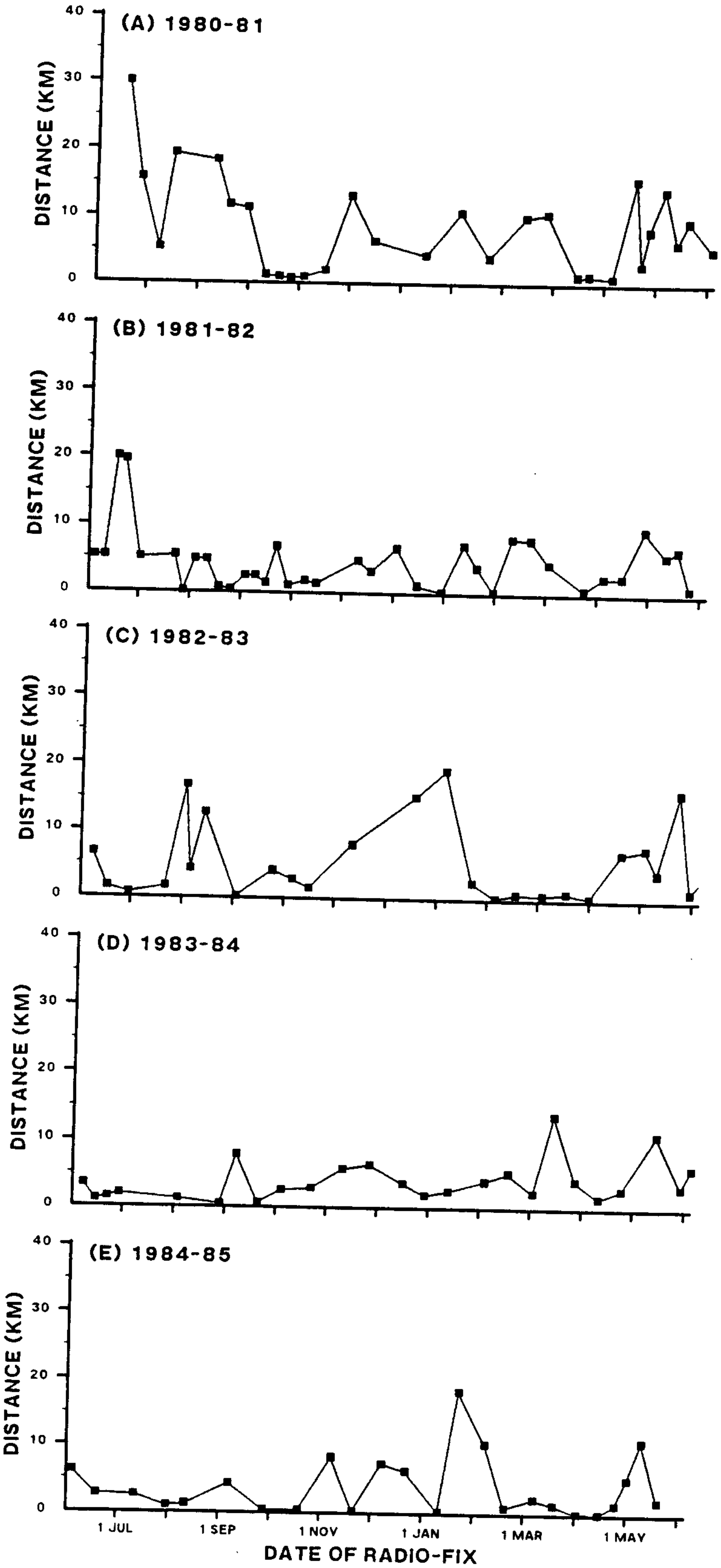

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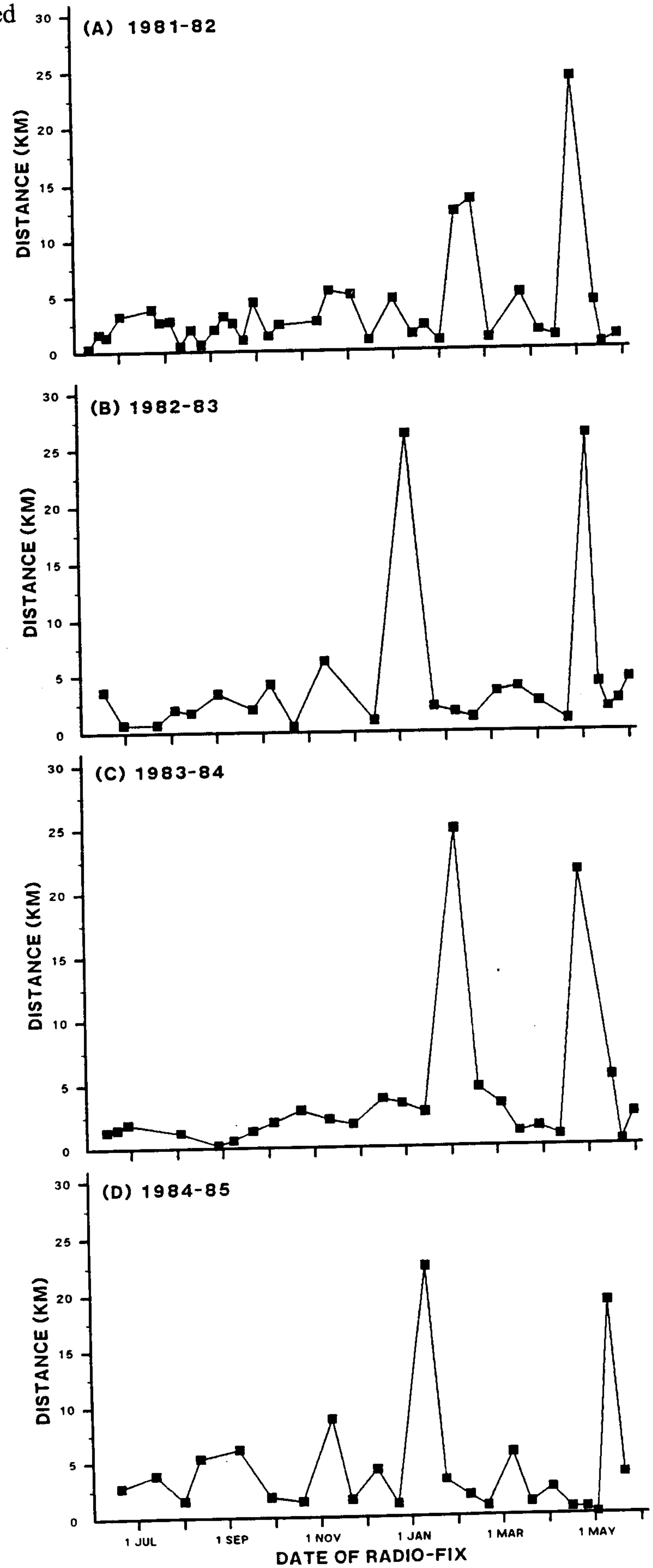

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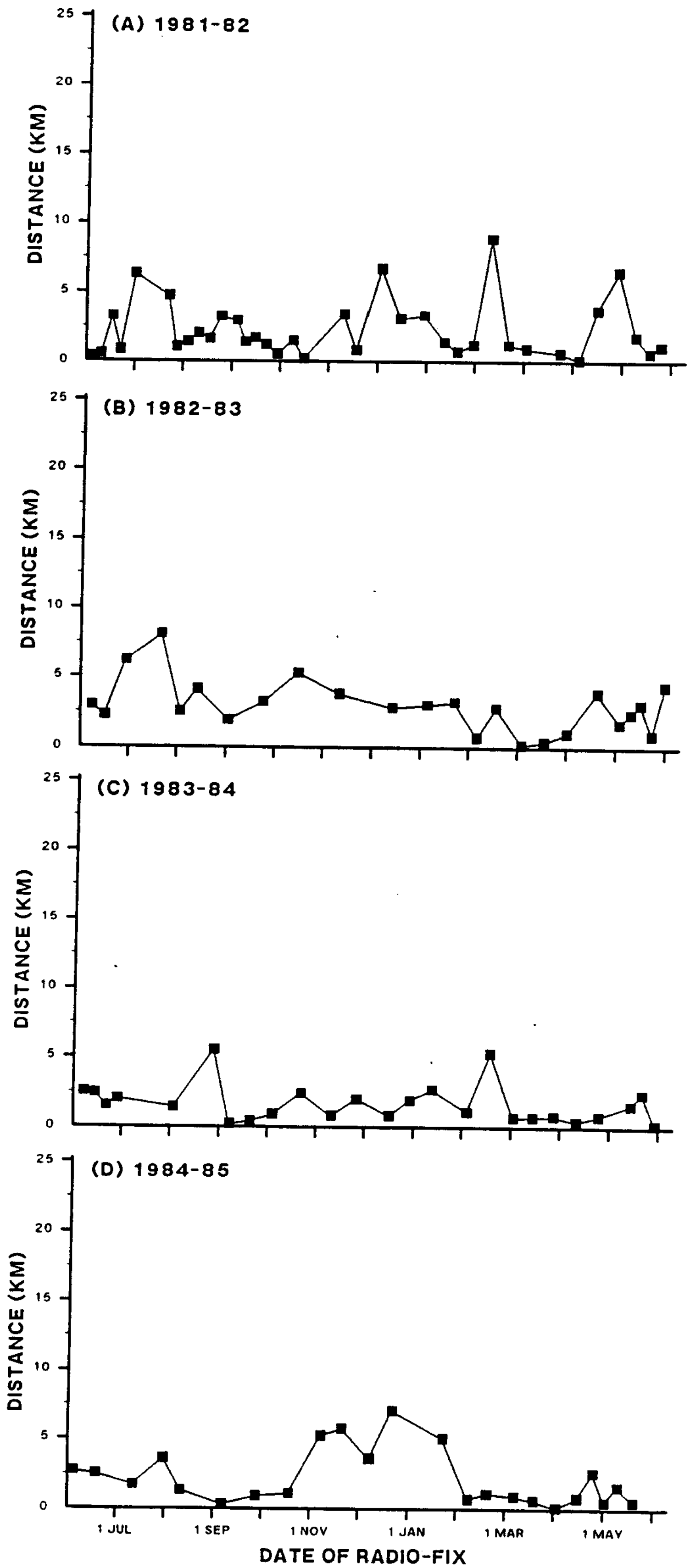

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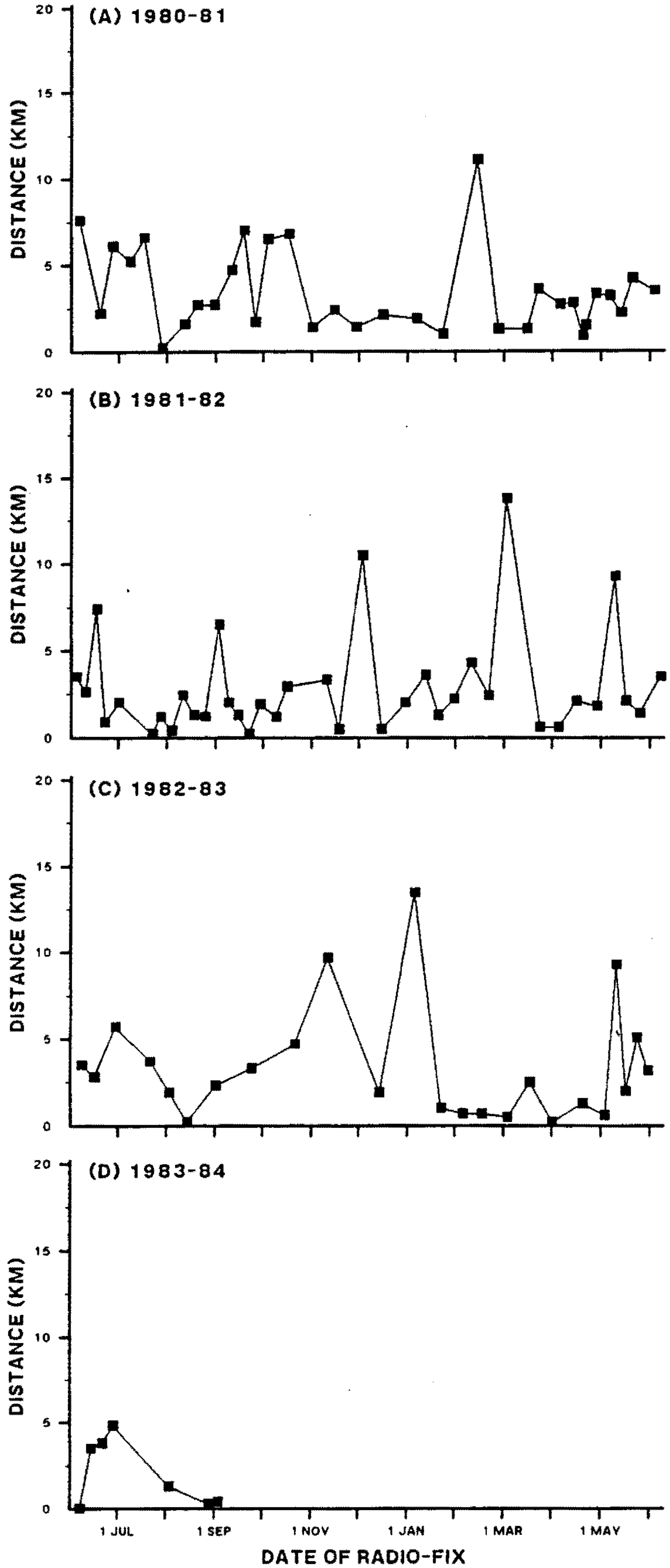
Moose ID: 3310



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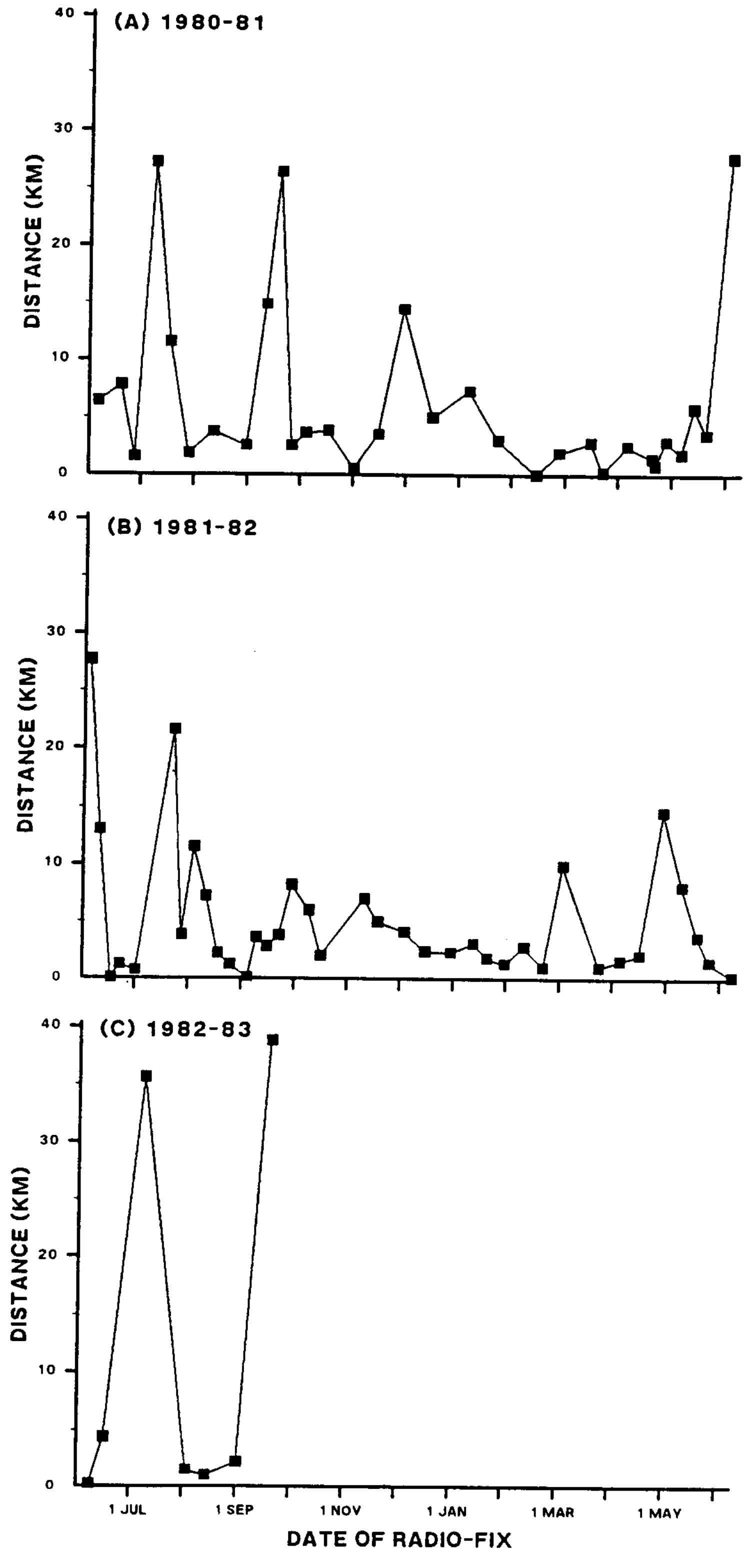

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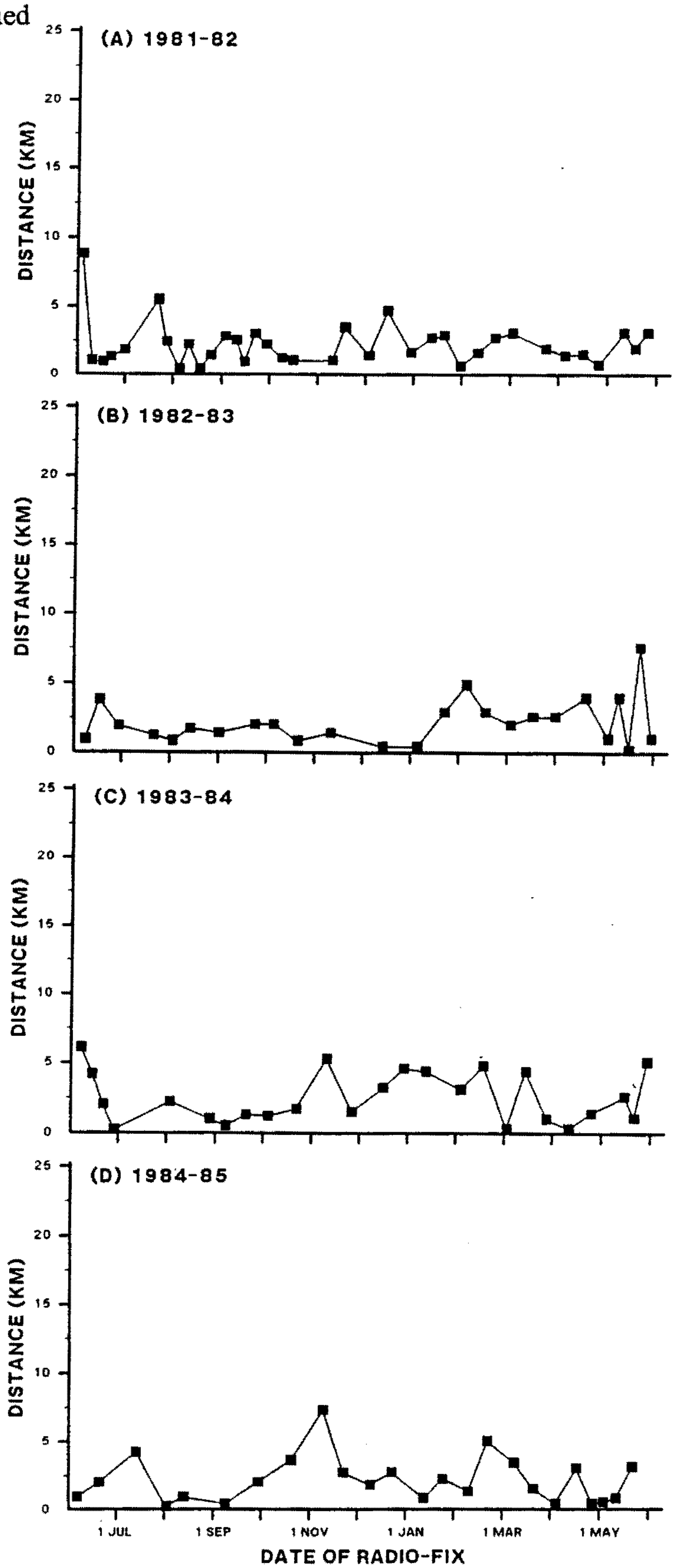

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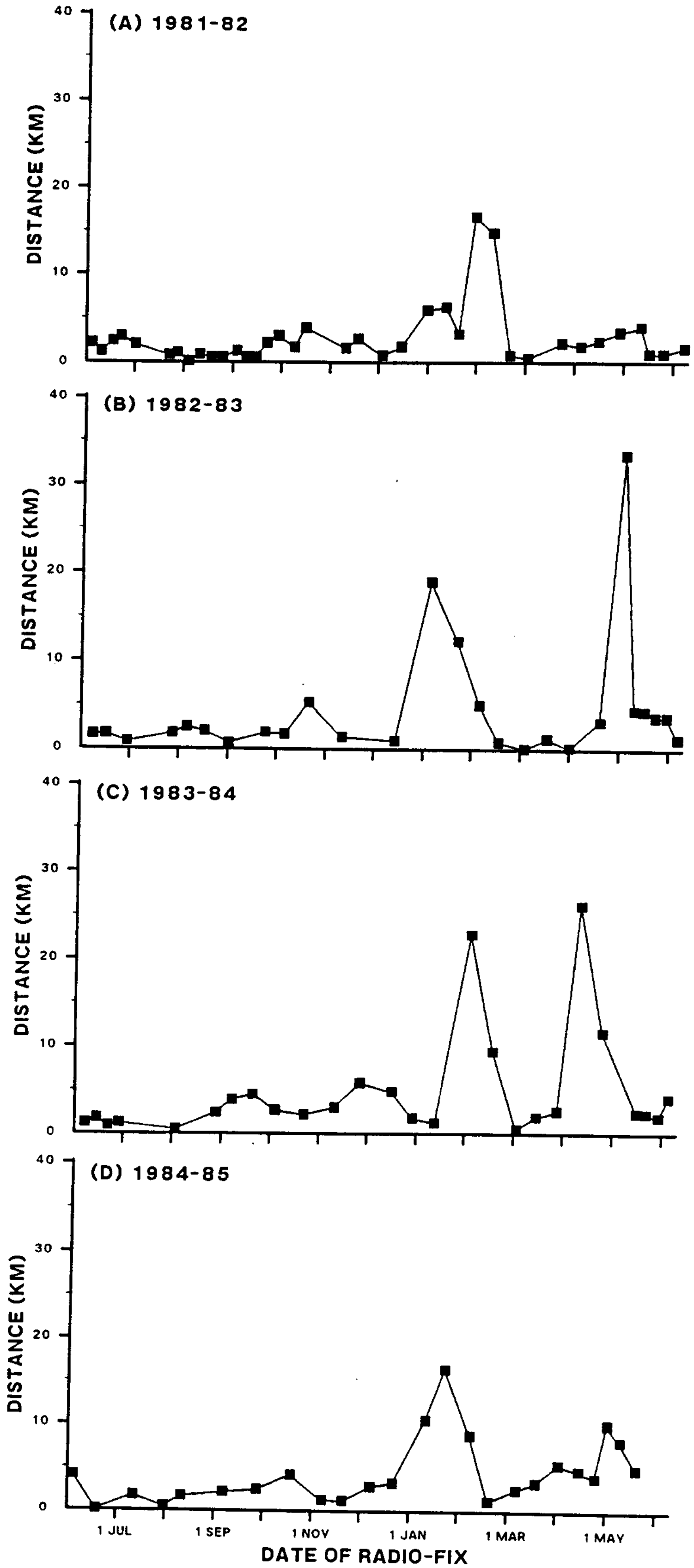

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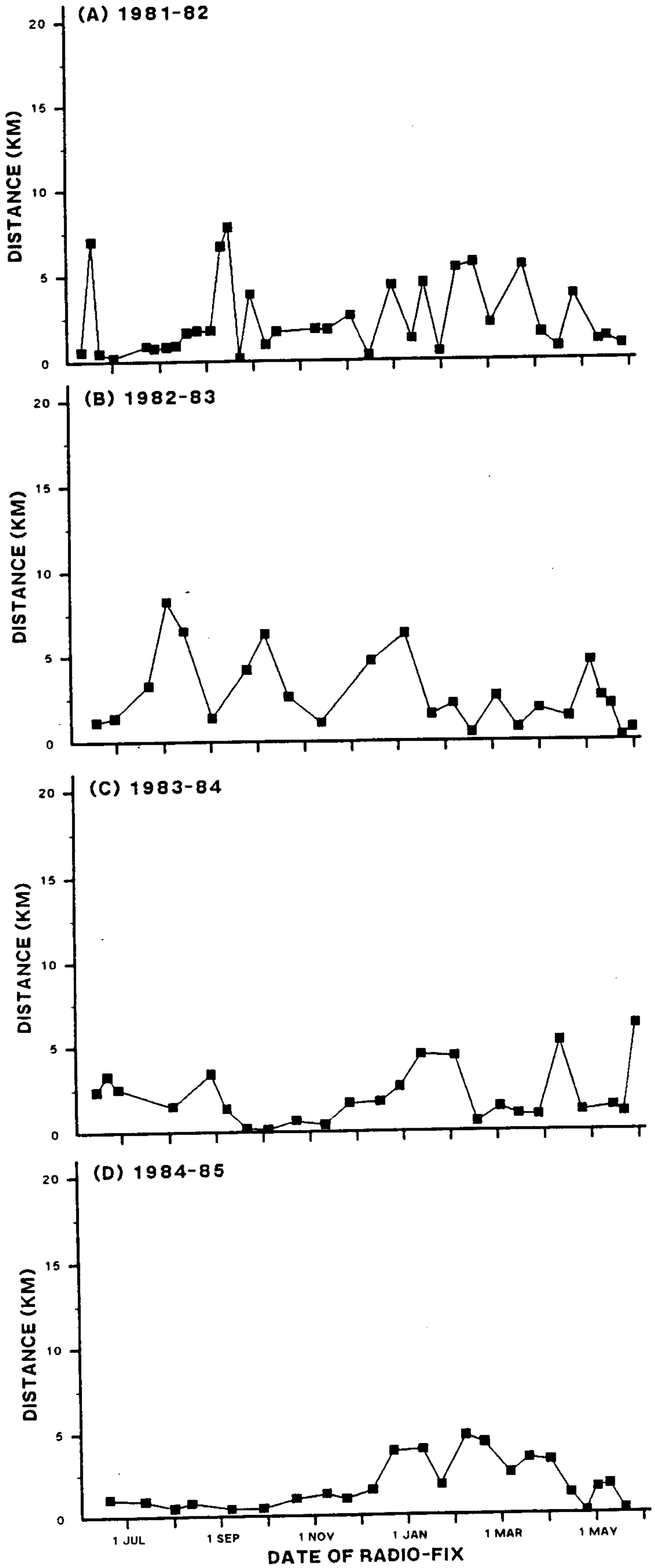

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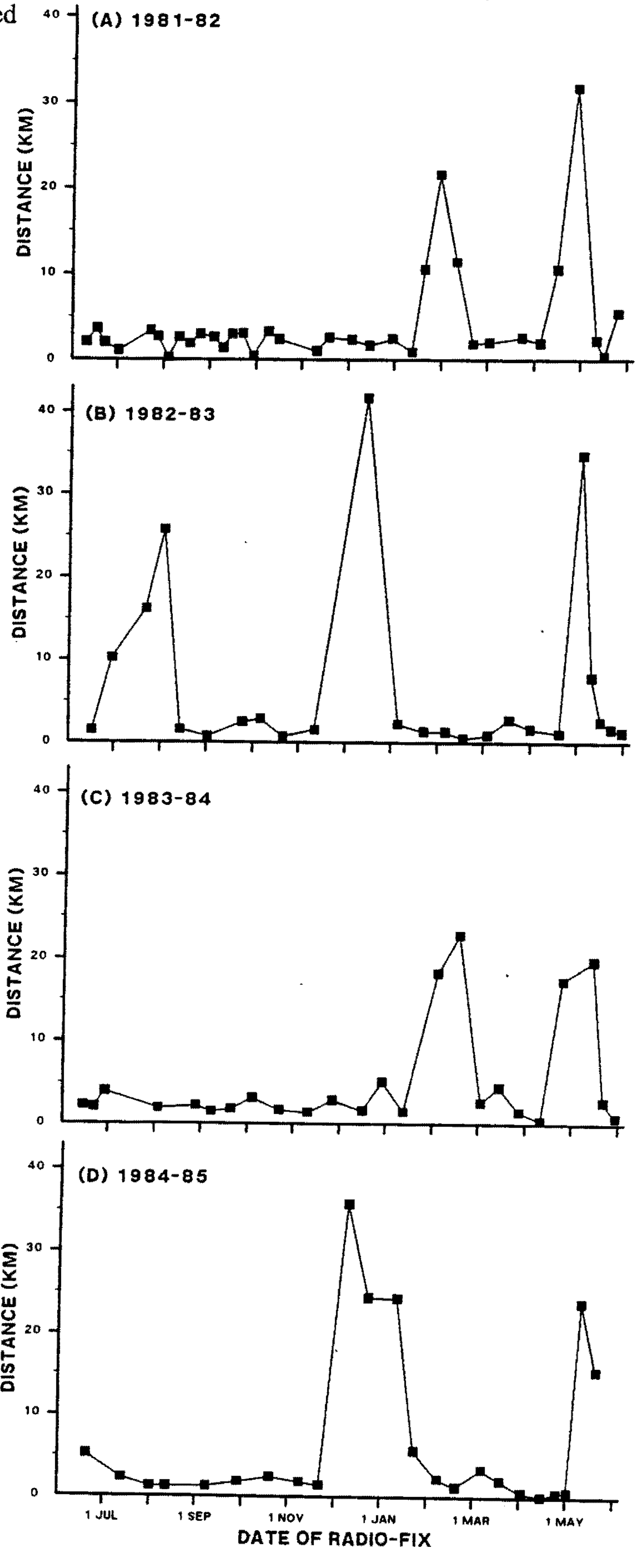
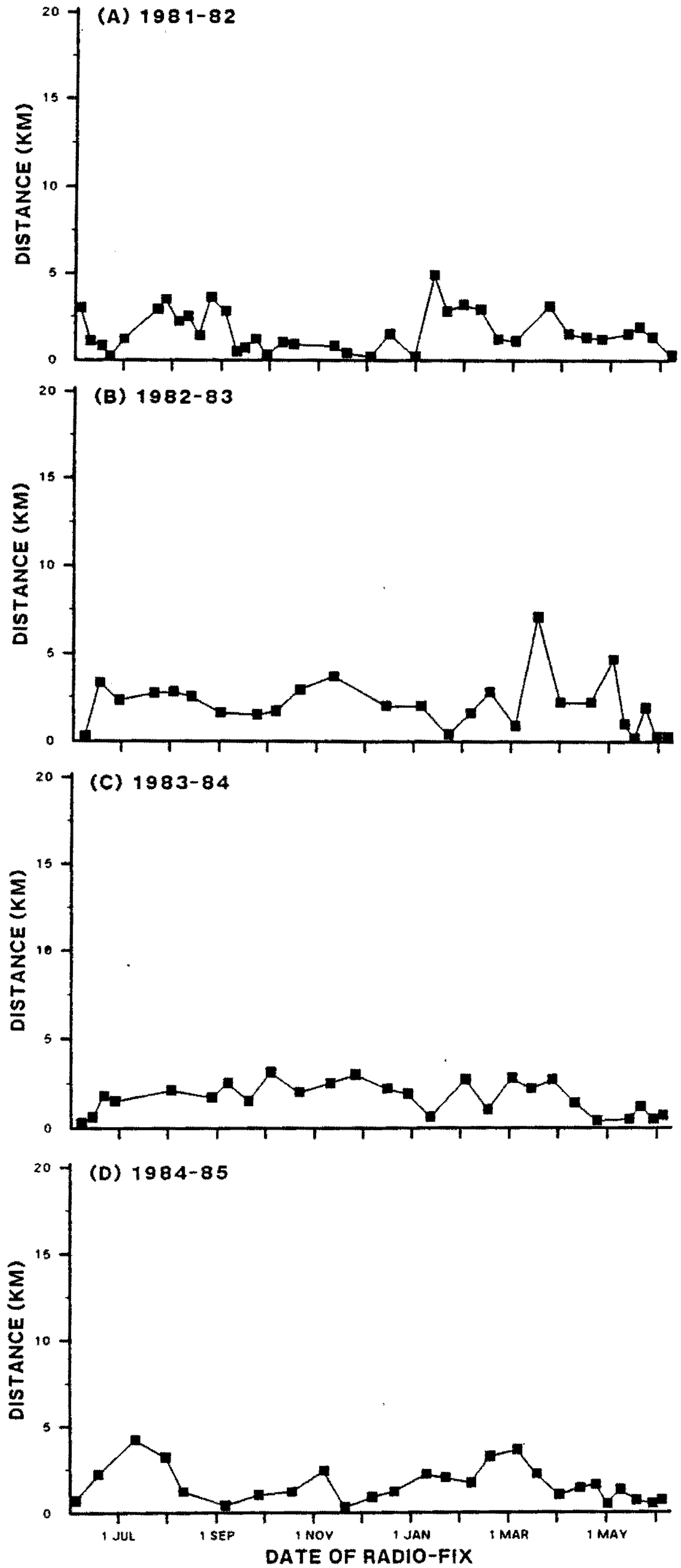
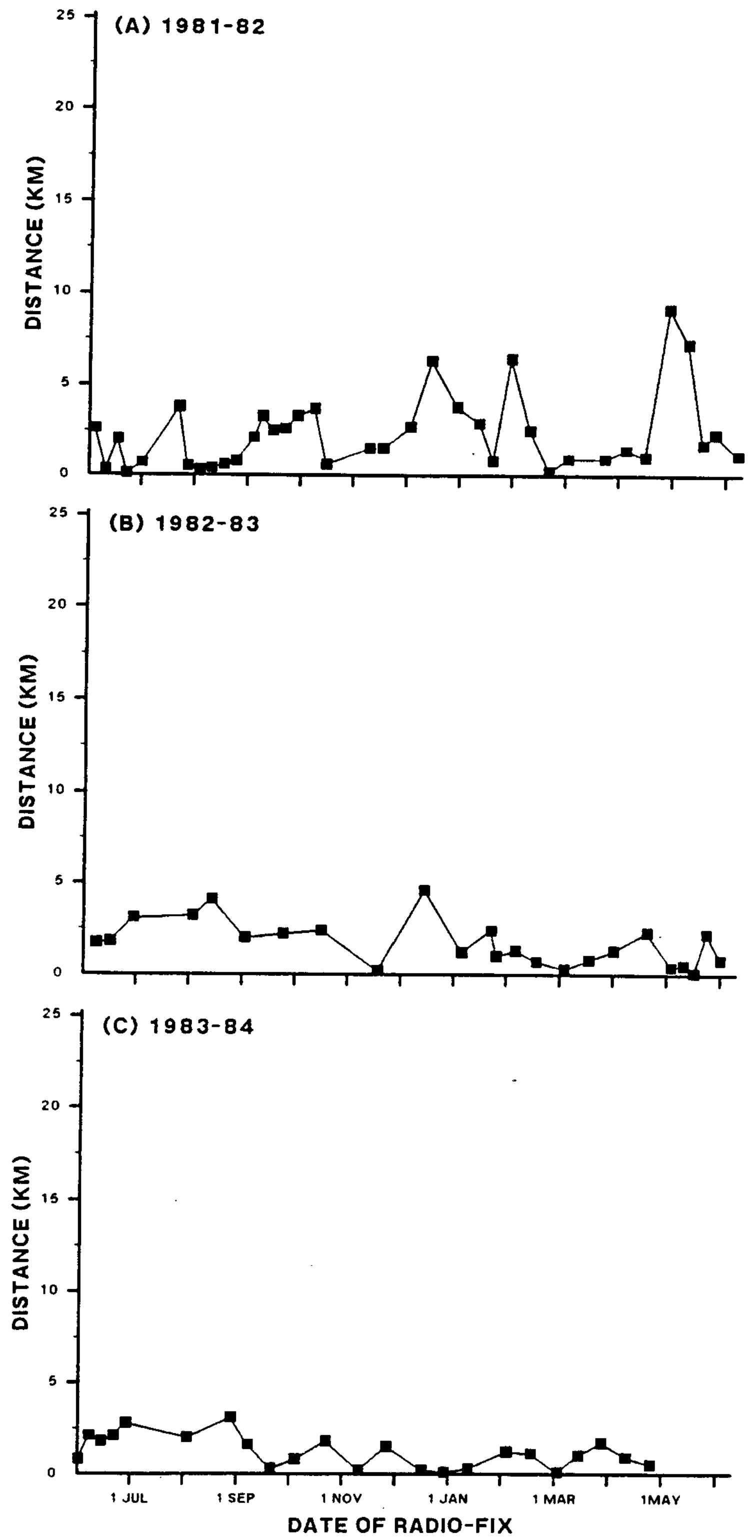


Figure 17 Continued

Moose ID: 3692




(A) 1981-82
(B) 1982-83
(C) 1983-84
DISTANCE (KM)
0
5
10
15
20
25
1 JUL
1 SEP
1 NOV
1 JAN
1 MAR
1MAY
DATE OF RADIO-FIX

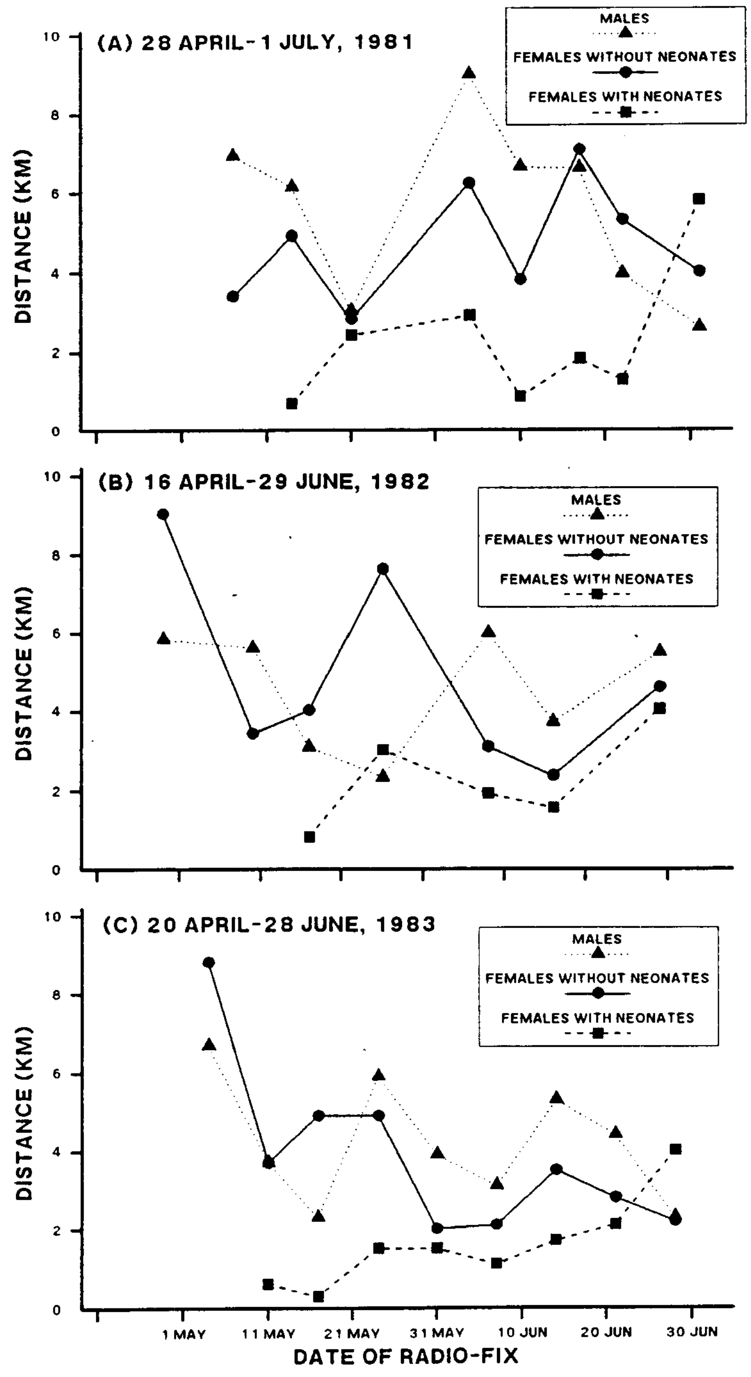


Figure 18 Chronological plots of the distance between consecutive radio-fixes in radiocollared moose males, females without neonates, and females with neonates monitored with aircraft in lower Susitna River Valley in Southcentral Alaska, Apr–Jul from 1981–1983. Distance is kilometer to previous radio-fix. *N*=27 females, 7 males in 1981; 35 females, 11 males in 1982; and 33 females, 6 males in 1983.

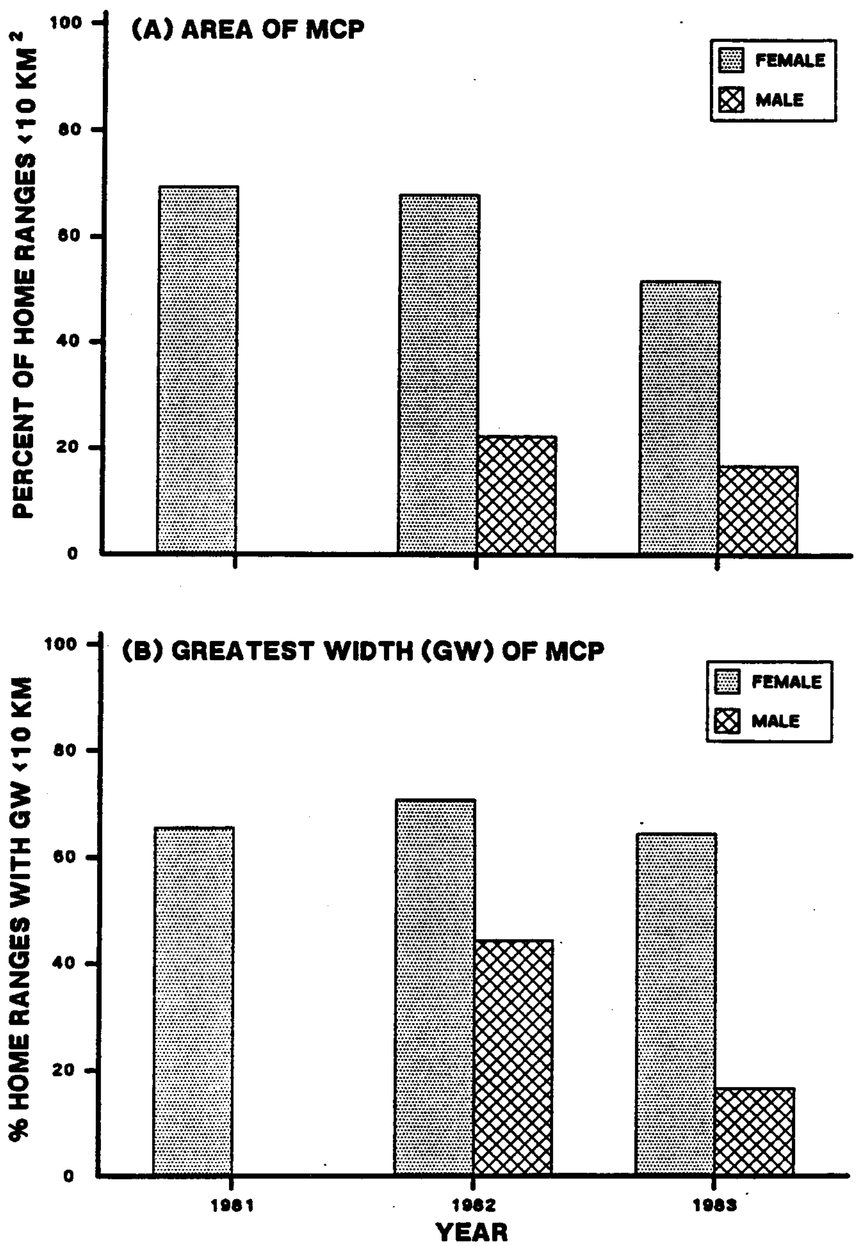


Figure 19 Home range size in radiocollared adult moose females and males monitored with aircraft in lower Susitna River Valley in Southcentral Alaska, 1 May–30 Jun, 1981–1983. (A) Area (km^2) of 100% minimum convex polygon. (B) Greatest width (GW) of minimum convex polygon; where GW=distance between the 2 radio-fixes with greatest W and where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radio-fixes. Number of radio-fixes equals 6 in 1981, 7 in 1982, and 6 in 1983. Number of moose equals 27 females, 7 males in 1981; 35 females, 11 males in 1982; and 33 females, 6 males in 1983.

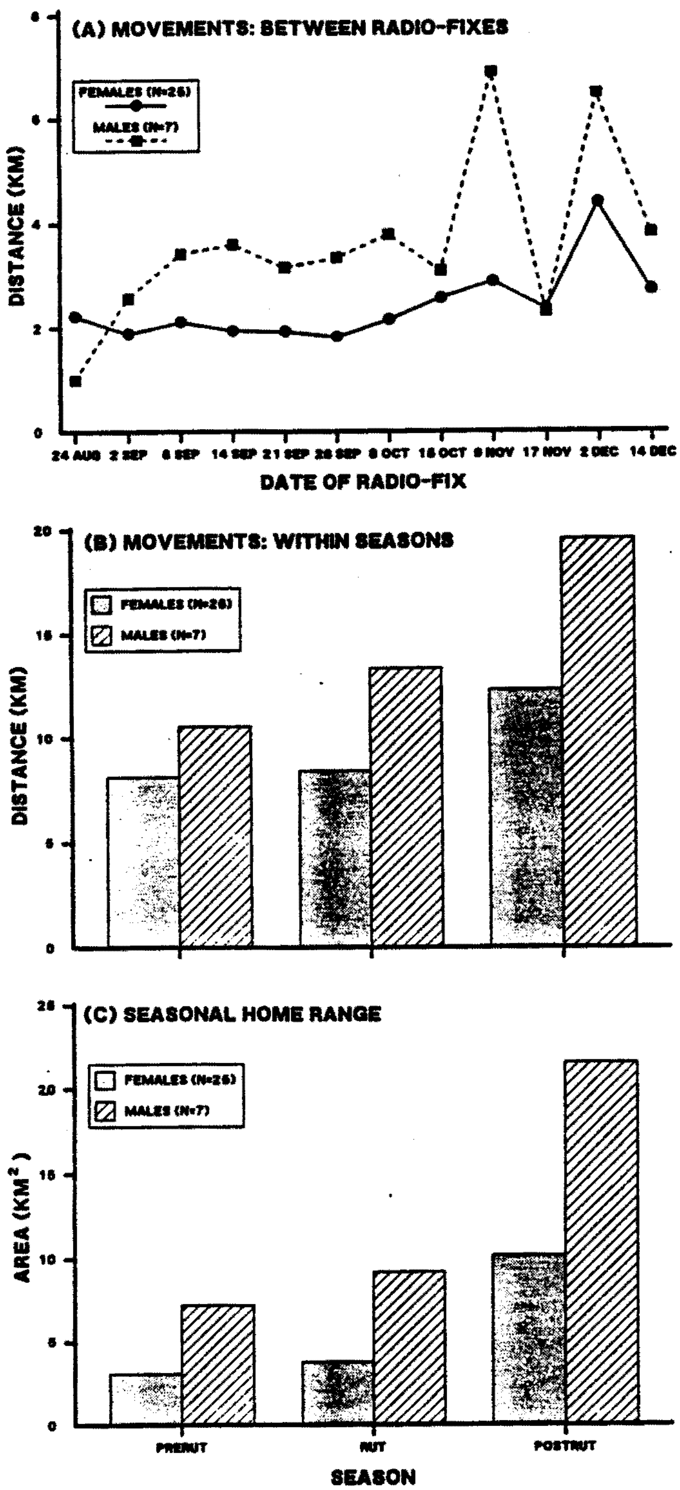
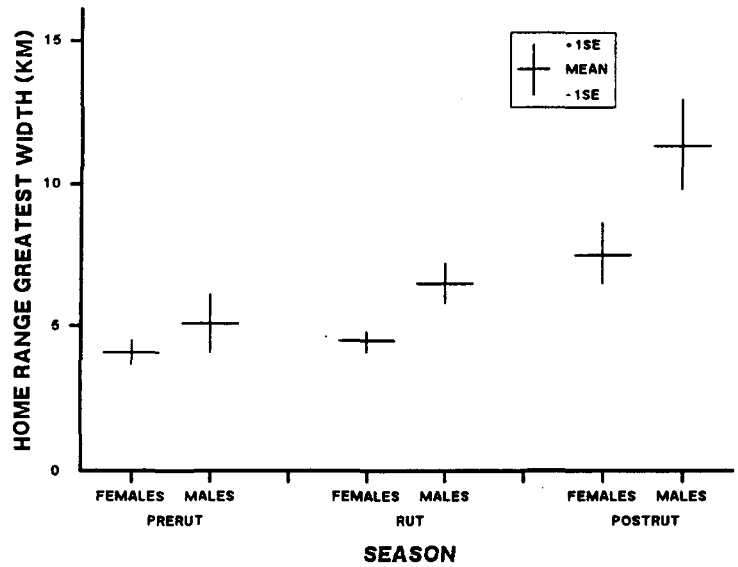


Figure 20 Chronological plots of the distance between consecutive radio-fixes (A), sum of distances between radio-fixes in a season (B), and size of seasonal home ranges (C) among radiocollared adult moose females and males telemetry monitored with aircraft in lower Susitna River Valley in Southcentral Alaska, in pre-rut, rut, and post-rut seasons, 17 Aug–14 Dec 1981. Home range size equals area (km^2) of 100% minimum convex polygon. Seasons were pre-rut (17 Aug–14 Sep), rut (14 Sep–15 Oct), and post-rut (15 Oct–14 Dec).



. Figure 21 Pre-rut, rut, and post-rut home range size (greatest width) in radiocollared adult moose females and males telemetry monitored with aircraft in lower Susitna River Valley in Southcentral Alaska in 1981. Greatest width equals distance between 2 radio-fixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X, Y=coordinates of radio-fixes. Number of radio-fixes equals 5 in each season. Seasons were pre-rut (17 Aug–14 Sep), rut (14 Sep–15 Oct), and post-rut (15 Oct–14 Dec).

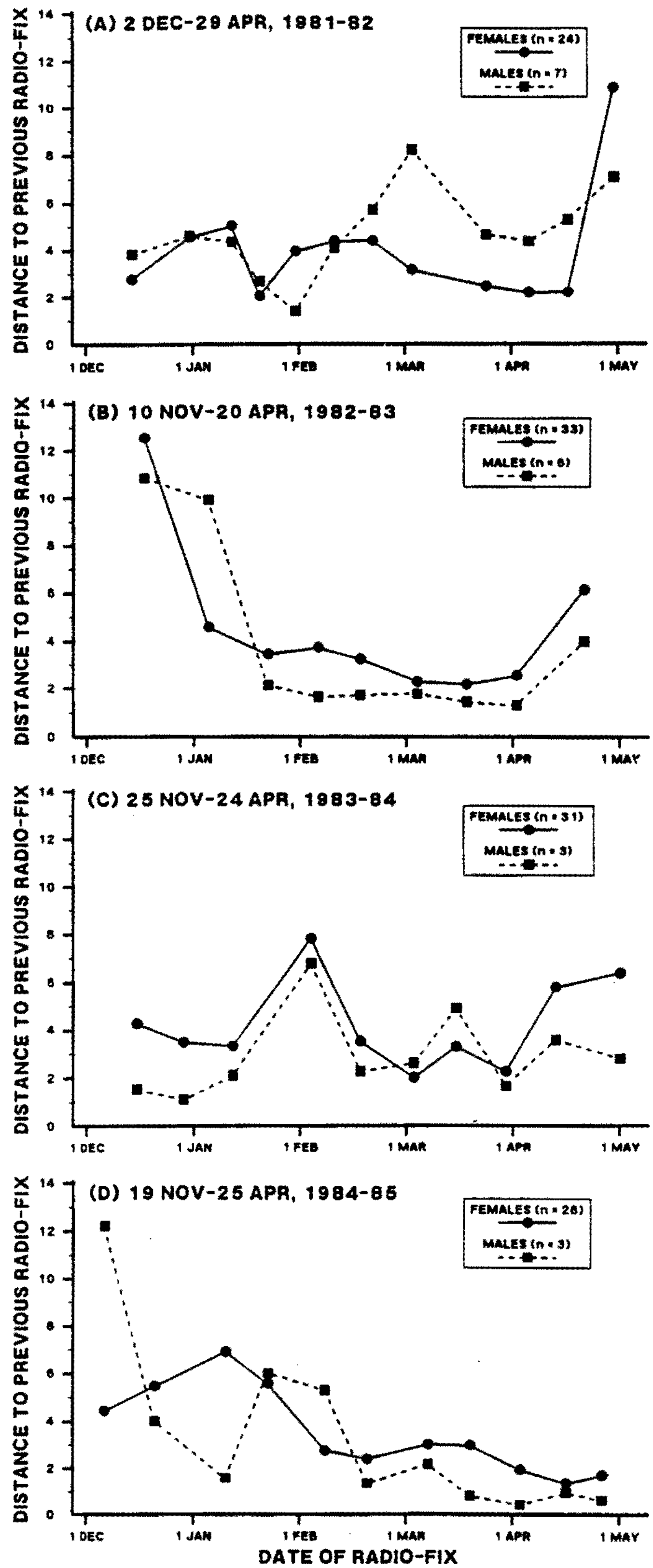


Figure 22 Chronological plots of the distance between consecutive radio-fixes in adult moose females and males monitored with aircraft in lower Susitna River Valley in Southcentral Alaska in December through April 1981–1985. *N*=smallest number of moose monitored.

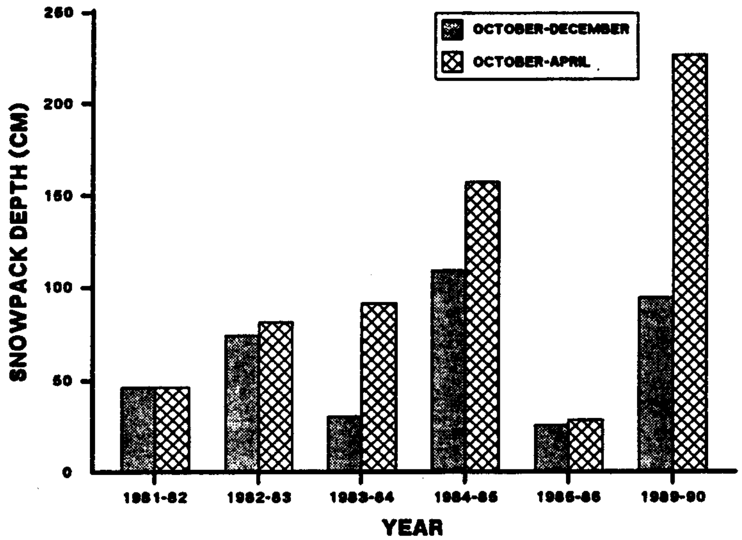


Figure 23 Maximum snow pack depth (cm) in winter (Oct–Apr) and in late winter (Jan–Apr) in Talkeetna in lower Susitna River Valley in Southcentral Alaska in 1981–1986 and 1989–1990.

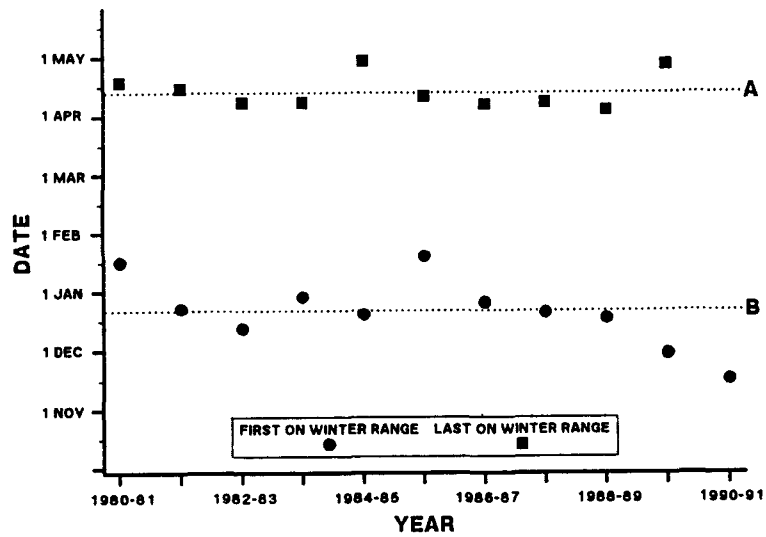


Figure 24 First and last dates radiocollared moose adults were in terminal winter range in lower Susitna River Valley in Southcentral Alaska, 1 October 1980–31 November 1990. Dotted lines mark means of (A) last dates in winter range and (B) first dates in winter range.

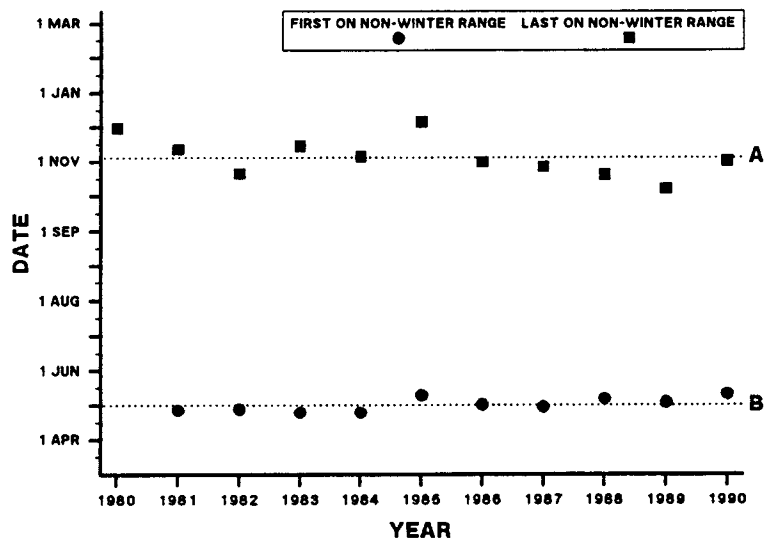


Figure 25 First and last dates radiocollared moose adults were in nonwinter range in lower Susitna River Valley in Southcentral Alaska, 1 October 1980–31 November 1990. Dotted lines mark means of (A) last dates in winter range and (B) first dates in winter range.

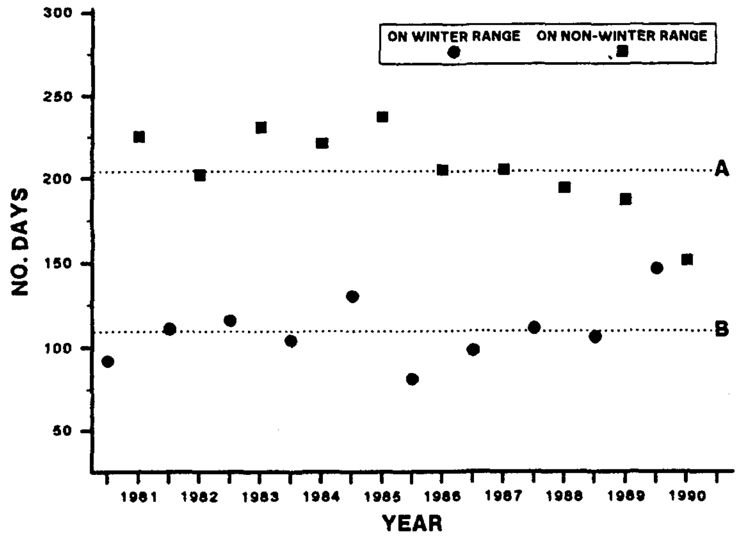


Figure 26 Days radiocollared moose adults were in terminal winter range and nonwinter range in lower Susitna River Valley in Southcentral Alaska during 1 October 1980 through 31 November 1990. Dotted line marks means of (A) number of days moose were in terminal winter range and (B) number of days moose were in nonwinter range.

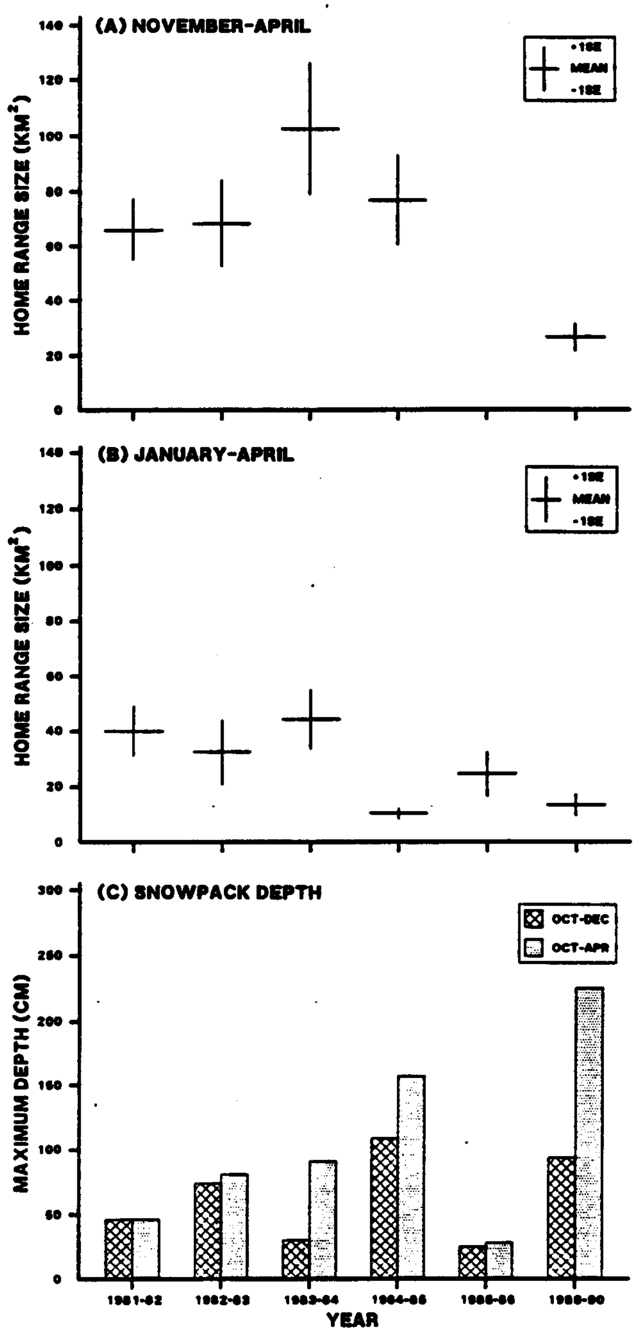


Figure 27 Home range area in winter (Nov–Apr) (A), and in late winter (Jan–Apr) (B) in radiocollared adult female moose and maximum snow pack depth in Talkeetna (C), in lower Susitna River Valley in Southcentral Alaska in 1981–1986 and 1989–1990. In November through April 1981–1982, 24 moose were monitored 15 times; in 1982–1983, 33 moose were monitored 10–11 times; in 1983–1984, 31 moose were monitored 12 times; in 1984–1985, 30 moose were monitored 9–13 times; and in 1989–1990, 62 moose were monitored 5–10 times. In January through April in 1981–1982, 25 moose were monitored 6–9 times; in 1982–1983, 33 moose were monitored 7 times; in 1983–1984, 35 moose were monitored 8 times; in 1984–1985, 32 moose were monitored 7–8 times; in 1985–1986, 15 moose were monitored 6 times; and in 1989–1990; 61 moose were monitored 4–6 times. Area equals square kilometers of 100% of minimum convex polygon of radio-fixes.

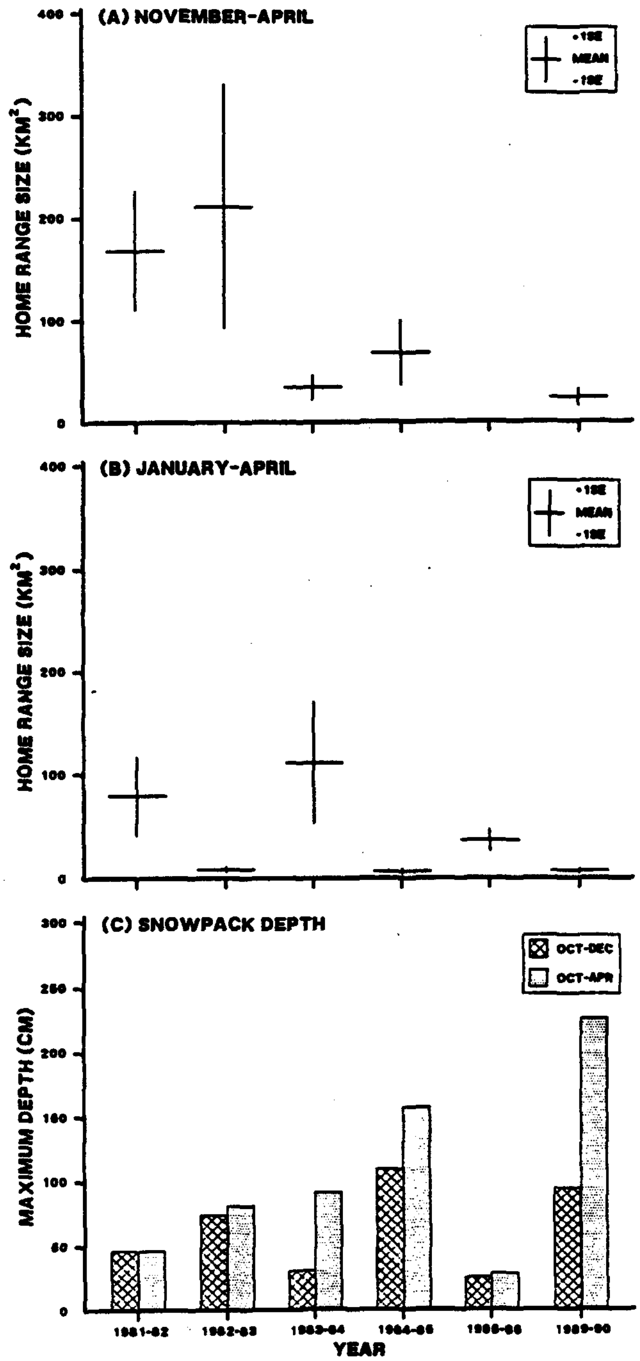


Figure 28 Home range area in winter (Nov–Apr), and in late winter (Jan–Apr) (B), in radiocollared adult male moose and maximum snow pack depth in Talkeetna (C), in lower Susitna River Valley in Southcentral Alaska in 1981–1986 and 1989–1990. In November through April: 1981–1982, 7 moose were monitored 15 times; 1982–1983, 6 moose were monitored 10 times; in 1983–1984, 4 moose were monitored 10–12 times; in 1984–1985, 3 moose were monitored 13 times; and in 1989–1990, 9 moose were monitored 5–8 times. In January through April: in 1981–1982, 7 moose were monitored 9 times; in 1982–1983, 6 moose were monitored 7 times; in 1983–1984, 6 moose were monitored 8 times; in 1984–1985, 5 moose were monitored 8 times; in 1985–1986, 17 moose were monitored 6 times; and in 1989–1990, 9 moose were monitored 4–6 items. Area equals square kilometer of 100% convex polygon of radio-fixes.

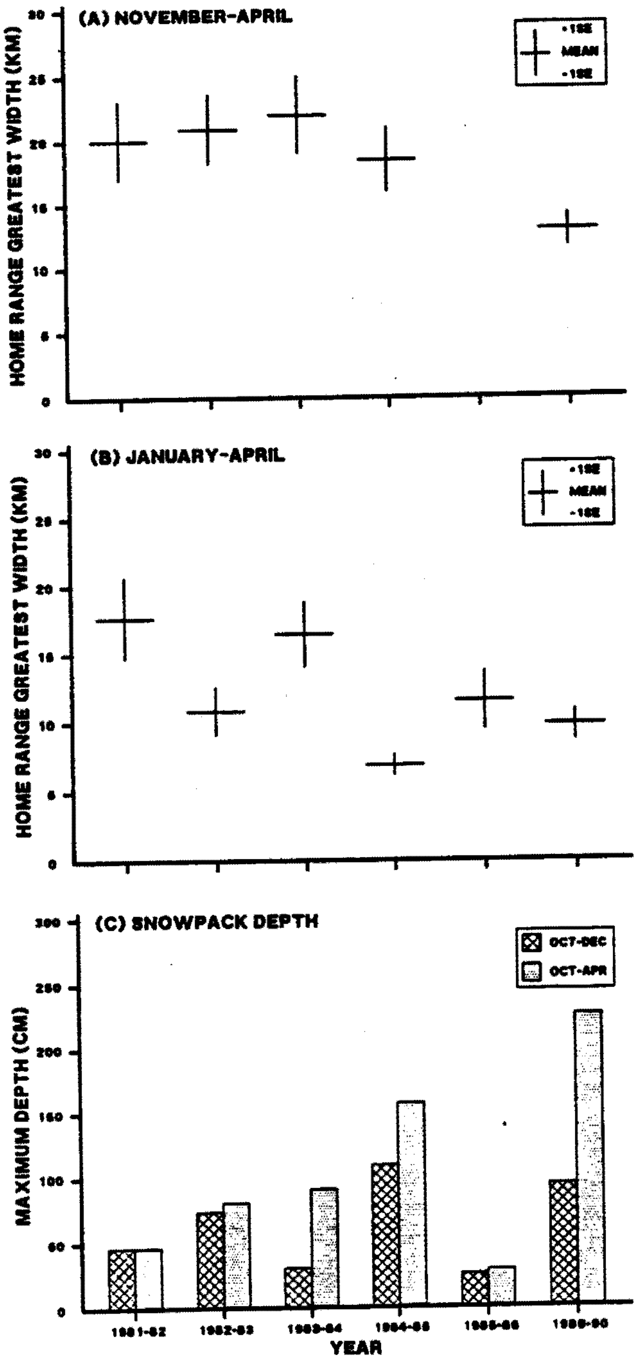


Figure 29 Home range greatest width in winter (Nov–Apr) (A), and in late winter (Jan–April) (B), in radiocollared adult female moose and maximum snow pack depth in Talkeetna (C), in lower Susitna River Valley in Southcentral Alaska in 1981–1986 and 1989–1990. In November through April: in 1981–1982, 24 moose were monitored 15 times; in 1982–1983, 33 moose were monitored 10–11 times; in 1983–1984, 31 moose were monitored 12 times; in 1984–1985, 30 moose were monitored 9–13 times; and in 1989–1990, 62 moose were monitored 5–10 times. In January through April: in 1981–1982, 25 moose were monitored 6–9 times; in 1982–1983, 33 moose were monitored 7 times; in 1983–1984, 35 moose were monitored 8 times; in 1984–1985, 32 moose were monitored 7–8 times; in 1985–1986, 15 moose were monitored 6 times; and in 1989–1990, 61 moose were monitored 4–6 times. Greatest width equals distance between 2 radio-fixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radio-fixes.

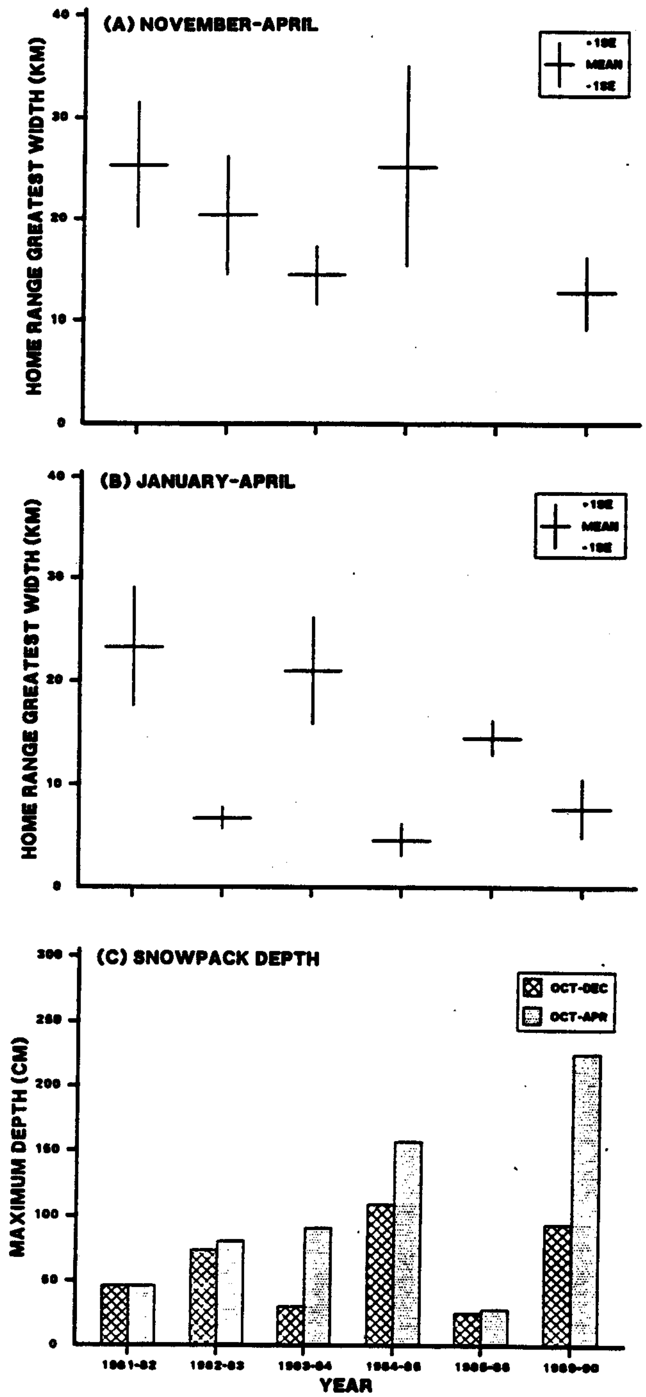


Figure 30 Home range greatest width in winter, Nov–April, and in late winter Jan–Apr, in radiocollared adult male moose and maximum snow pack depth in Talkeetna, in lower Susitna River Valley, Southcentral Alaska, 1981–1986 and 1989–1990. In Nov–Apr: 1981–1982, 7 moose were monitored 15 times; in 1982–1983, 6 moose were monitored 10 times; in 1983–1984, 4 moose were monitored 10–12 times; in 1984–1985, 3 moose were monitored 13 times; and in 1989–1990, 9 moose were monitored 5–8 times. In Jan–Apr: in 1981–1982, 7 moose were monitored 9 times; in 1982–1983, 6 moose were monitored 7 times; in 1983–1984, 6 moose were monitored 8 times; in 1984–1985, 5 moose were monitored 8 times; in 1985–1986, 17 moose were monitored 6 times; and in 1989–1990, 9 moose were monitored 4–6 times. Greatest width equals distance between 2 radio-fixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radio-fixes.

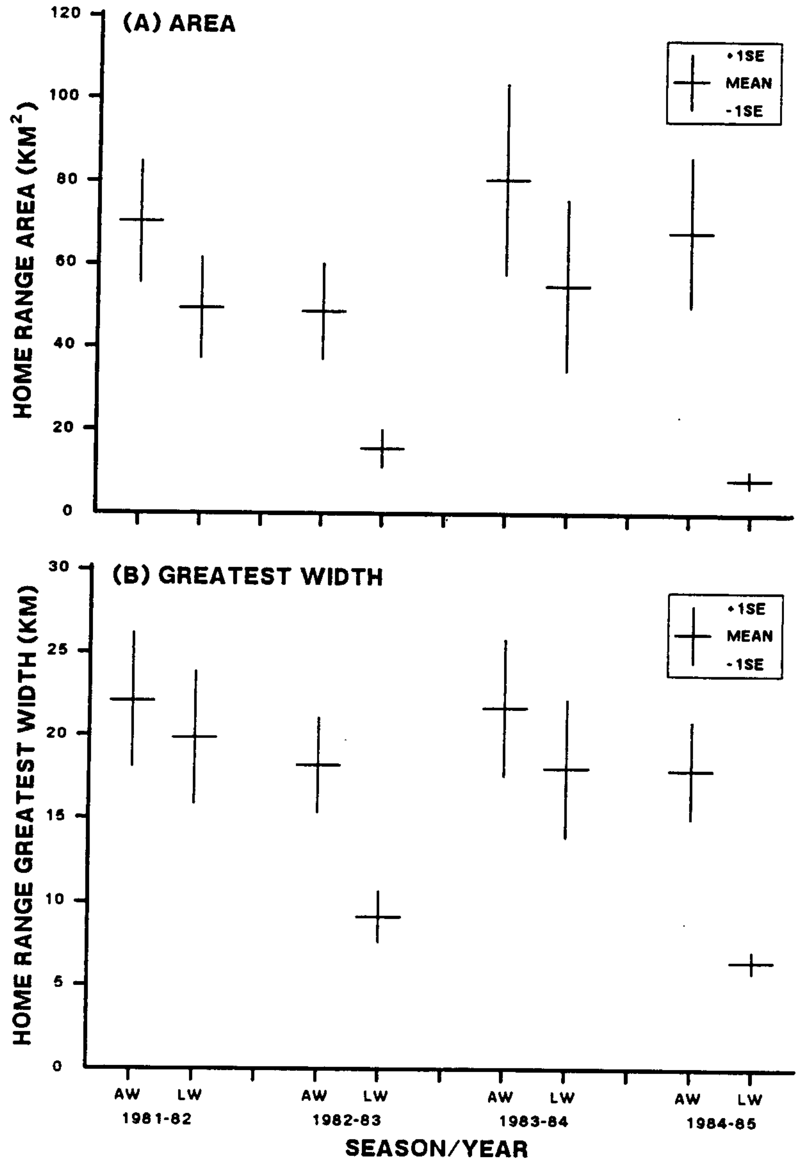


Figure 31 Home range area (A) and greatest width (B) in Nov–Apr (all winter, AW) and in mid-January through April (late winter, LW), in 17 radiocollared adult female moose telemetry monitored in lower Susitna River Valley in Southcentral Alaska in 1981–1985. (A) Area equals square kilometer of 100% minimum convex polygon. (B) Greatest width equals greatest distance between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radio-fixes.

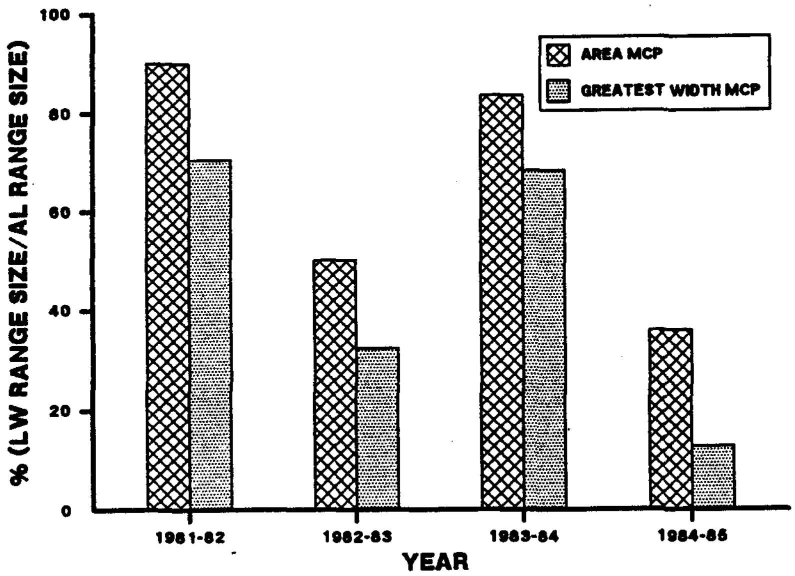


Figure 32 Indices of Nov–April (all winter, AW) home range size to mid-January through April (late winter, LW) home range size in 17 radiocollared moose female adults telemetry monitored in lower Susitna River Valley Southcentral Alaska during 1981–1985. Indices were based on measurements of area equals square kilometer of 100% minimum convex polygon and greatest width equals greatest distance between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radio-fixes.

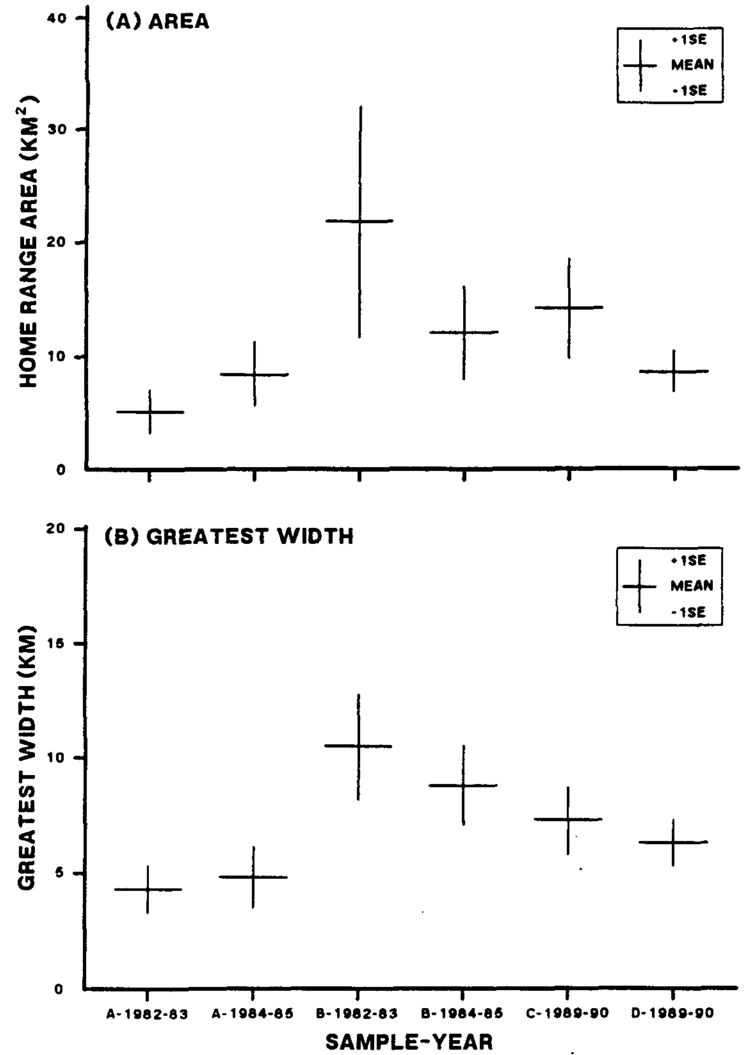


Figure 33 Terminal winter home range size (area [A]); greatest width (B) in migratory and nonmigratory radiocollared adult female moose monitored in lower Susitna River Valley in Southcentral Alaska in 1982–1983, 1984–1985, and 1989–1990. Area equals square kilometer of 100% minimum convex polygon. Greatest width equals greatest distance (km) between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes. Sample A was migratory moose, *n*=6; sample B was nonmigratory moose, *n*=6; sample C was migratory moose, *n*=8; sample D was nonmigratory moose, *n*=16. Maximum snow pack depth at Talkeetna was normal (81 cm) in 1982–1983, deep (157 cm) in 1984–1985, and extremely deep (226 cm) in 1989–1990.

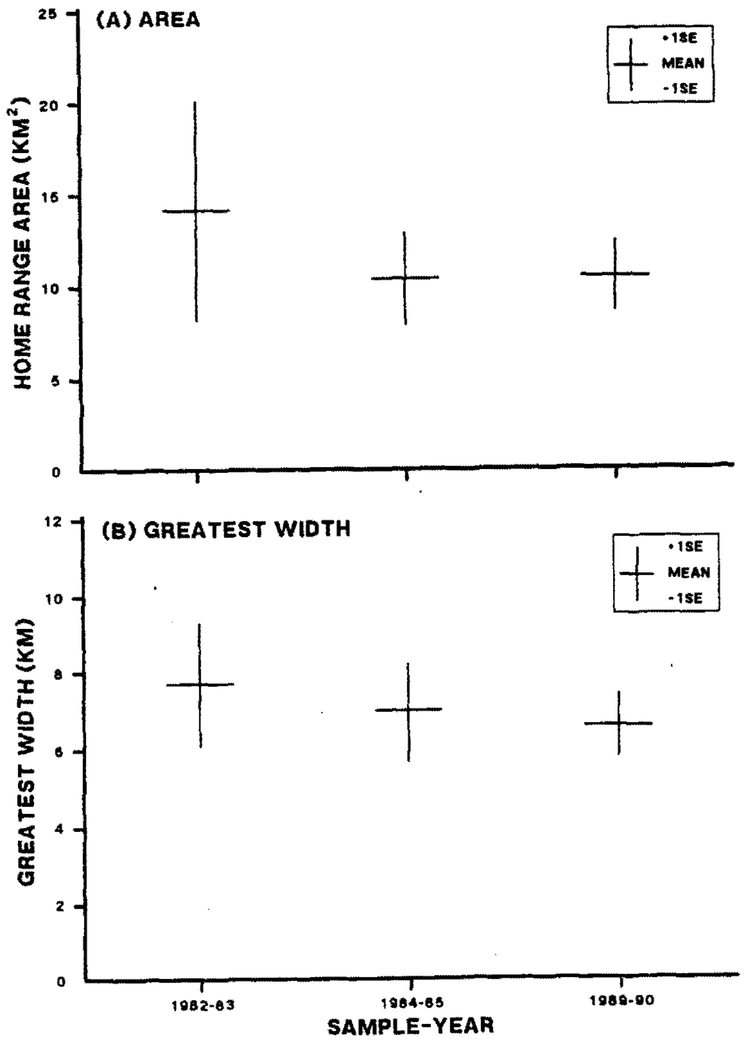


Figure 34 Terminal winter home range size (area [A] and greatest width [B]) in migratory and nonmigratory radiocollared adult female moose monitored in lower Susitna River Valley in Southcentral Alaska in 1982–1983, 1984–1985 and 1989–1990. Area equals square kilometer of 100% minimum convex polygon. N=11 in 1982–1983; 11 in 1984–1985; and 24 in 1989–1990. Maximum snow pack depth was normal (81 cm) in 1982–1983, deep (157 cm) in 1984–1985, and extremely deep (226 cm) in 1989–1990.

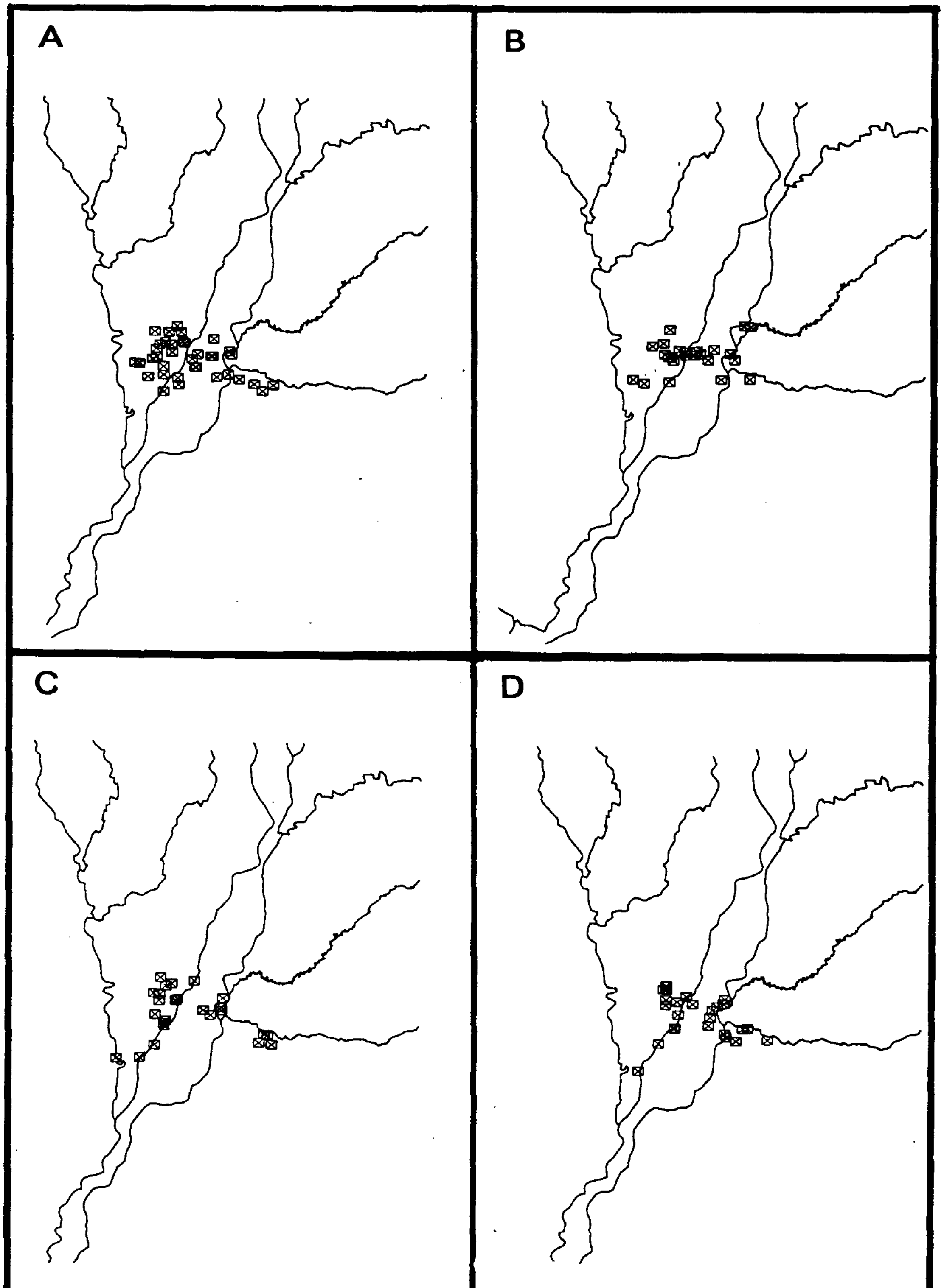
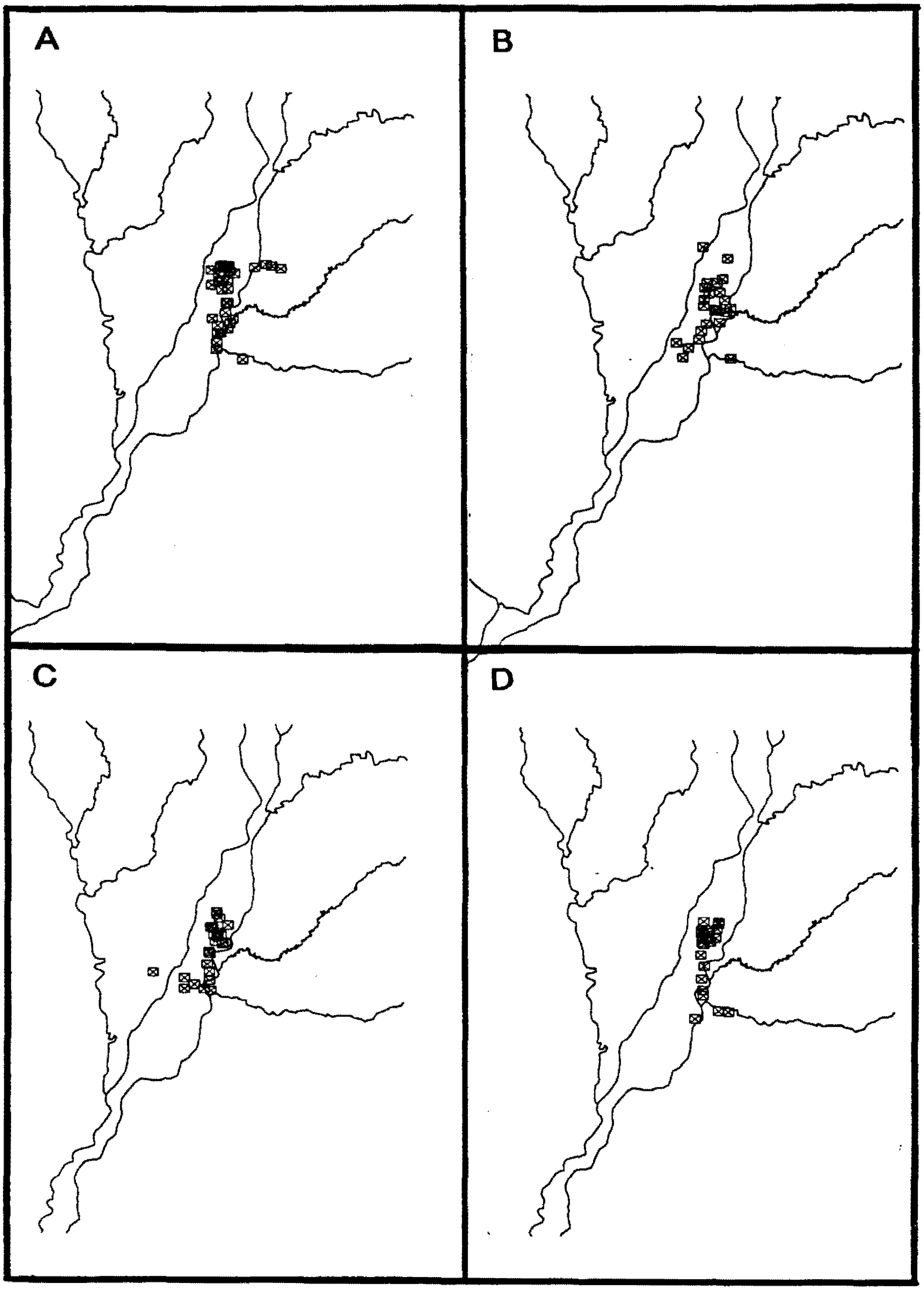


Figure 35 Graphical plots of radiofix locations in 3 nonmigratory moose (153340, 153552, and 153692, respectively) monitored in 4 consecutive calendar years, 1981–1985, (A–D, respectively) in lower Susitna River Valley, in Southcentral Alaska. Calendar years equals 7 May–6 May the following year. Nonmigratory equals in adaptive kernel home range analysis utilization distribution of radio-fixes was unimodal.

Figure 35 Continued



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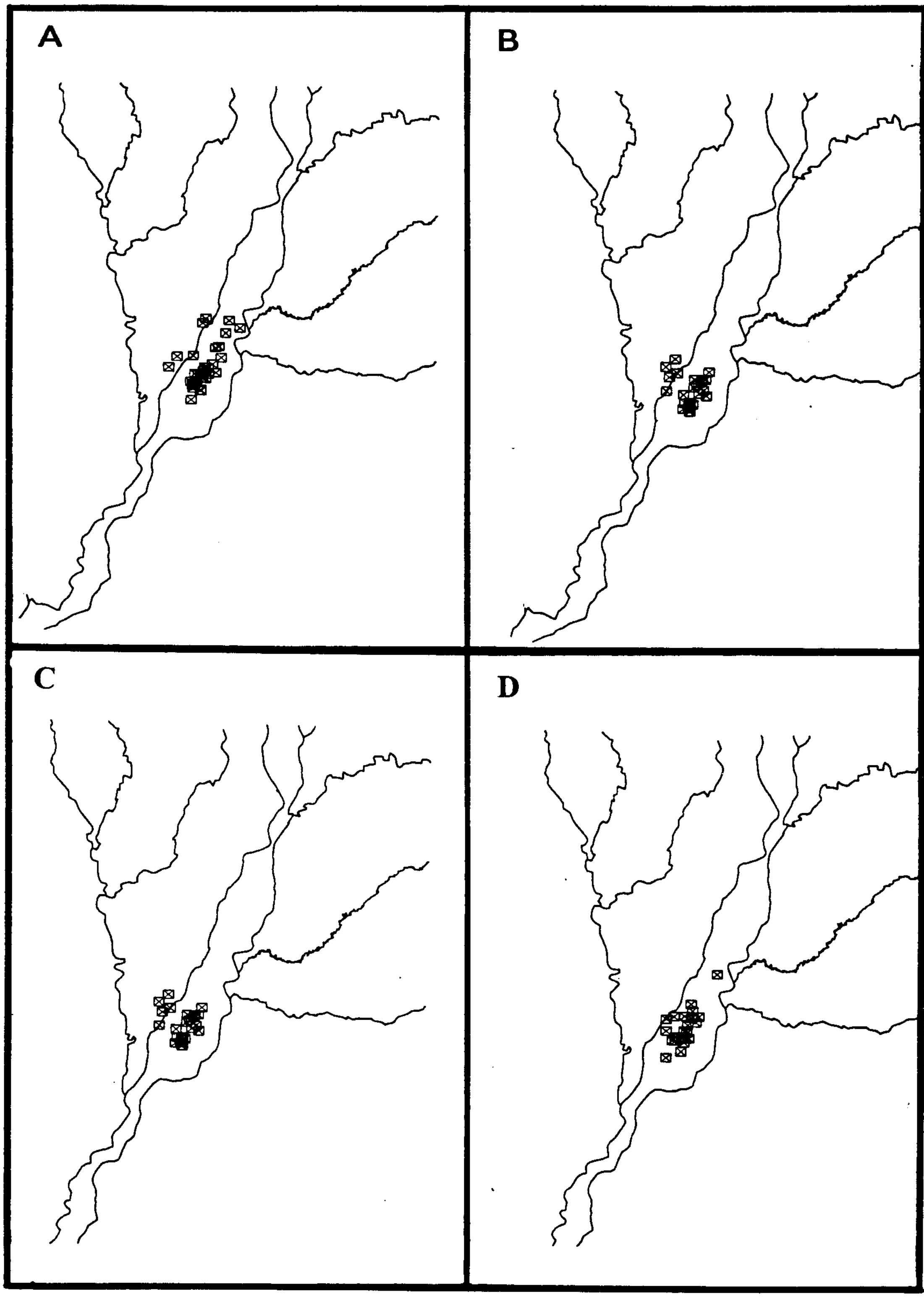


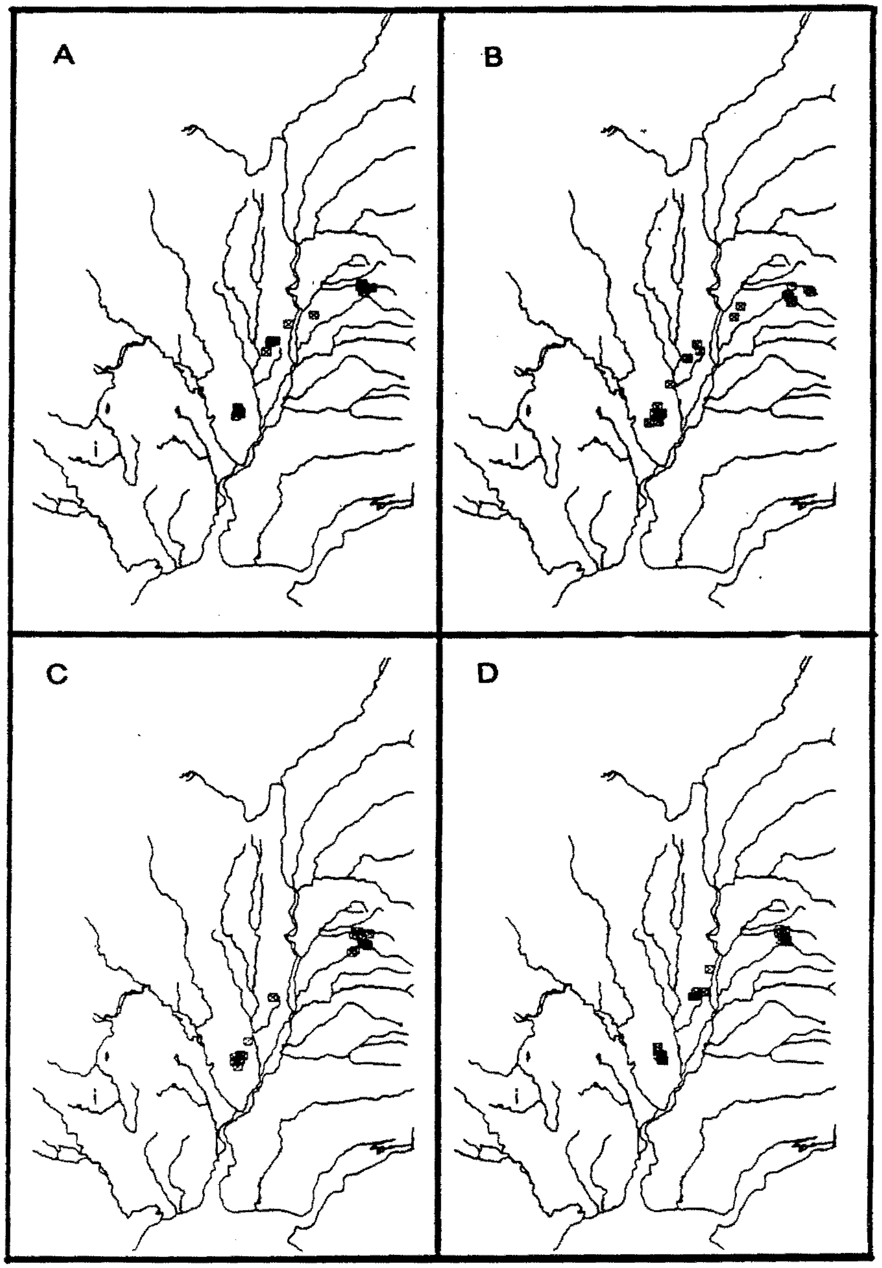


Figure 36 Graphical plots of radio-fix locations in 3 migratory moose (153220, 153252, and 153582, respectively) that were philopatric to winter and nonwinter season home ranges, in lower Susitna River Valley, in Southcentral Alaska, during 4 consecutive calendar years, 1981–1985 (A–D, respectively). Migratory equals in adaptive kernel home range analysis utilization distribution of radio-fixes was multimodal. Calendar year equals 7 May through 6 May the following year. Philopatric equals utilization distributions of radio-fixes in winter and nonwinter seasons were sympatric among calendar years.

Figure 36 Continued

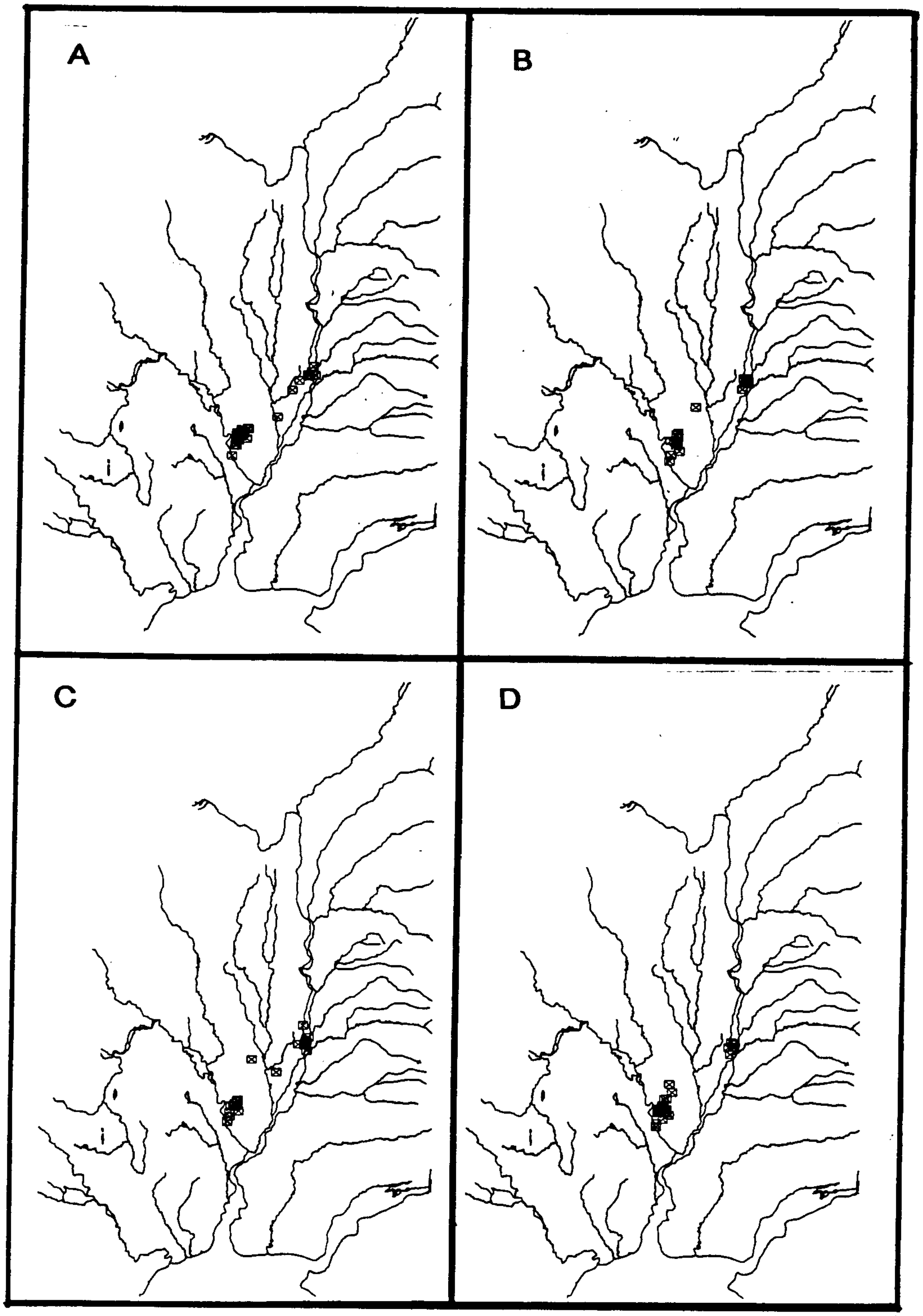
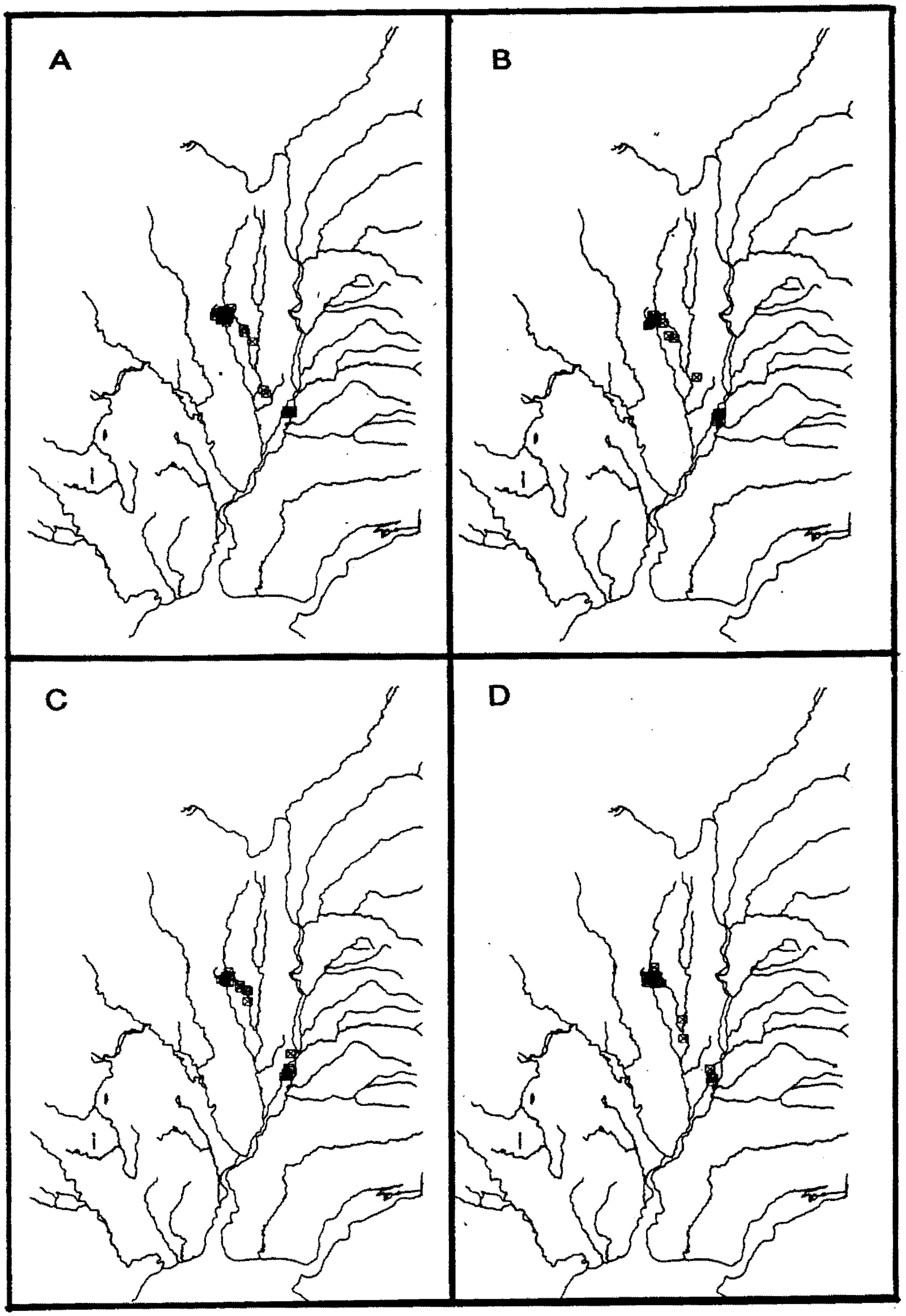


Figure 36 Continued



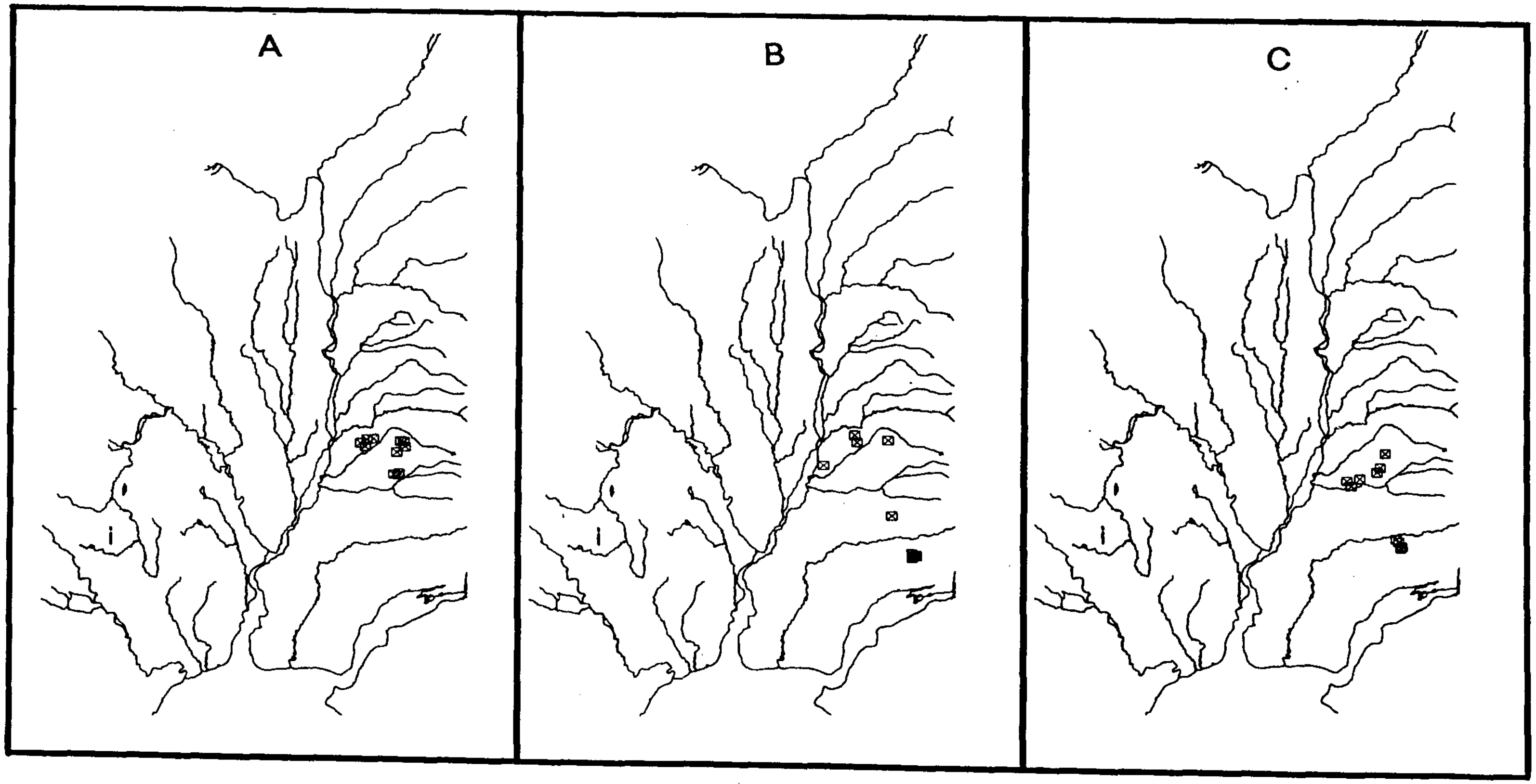


Figure 37 Graphical plots of radio-fix locations in 3 migratory moose (152210, 152960, and 153640, respectively) that were nonphilopatric to winter season (23 Dec–6 May, the following year) home range in lower Susitna River Valley in Southcentral Alaska in winter-summer and summer-winter seasons in consecutive years in 1985–1987. Winter-summer season equals 23 Dec–30 Sep 1985–1986 (A); summer-winter season equals 7 May–6 May the following year, in 1986–1987 (B) and 1987–1988 (C). Migratory equals in adaptive kernel home range analysis utilization distribution of radio-fixes was multimodal. Nonphilopatric equals utilization distributions of winter season radio-fixes were not sympatric among calendar years.

Figure 37 Continued

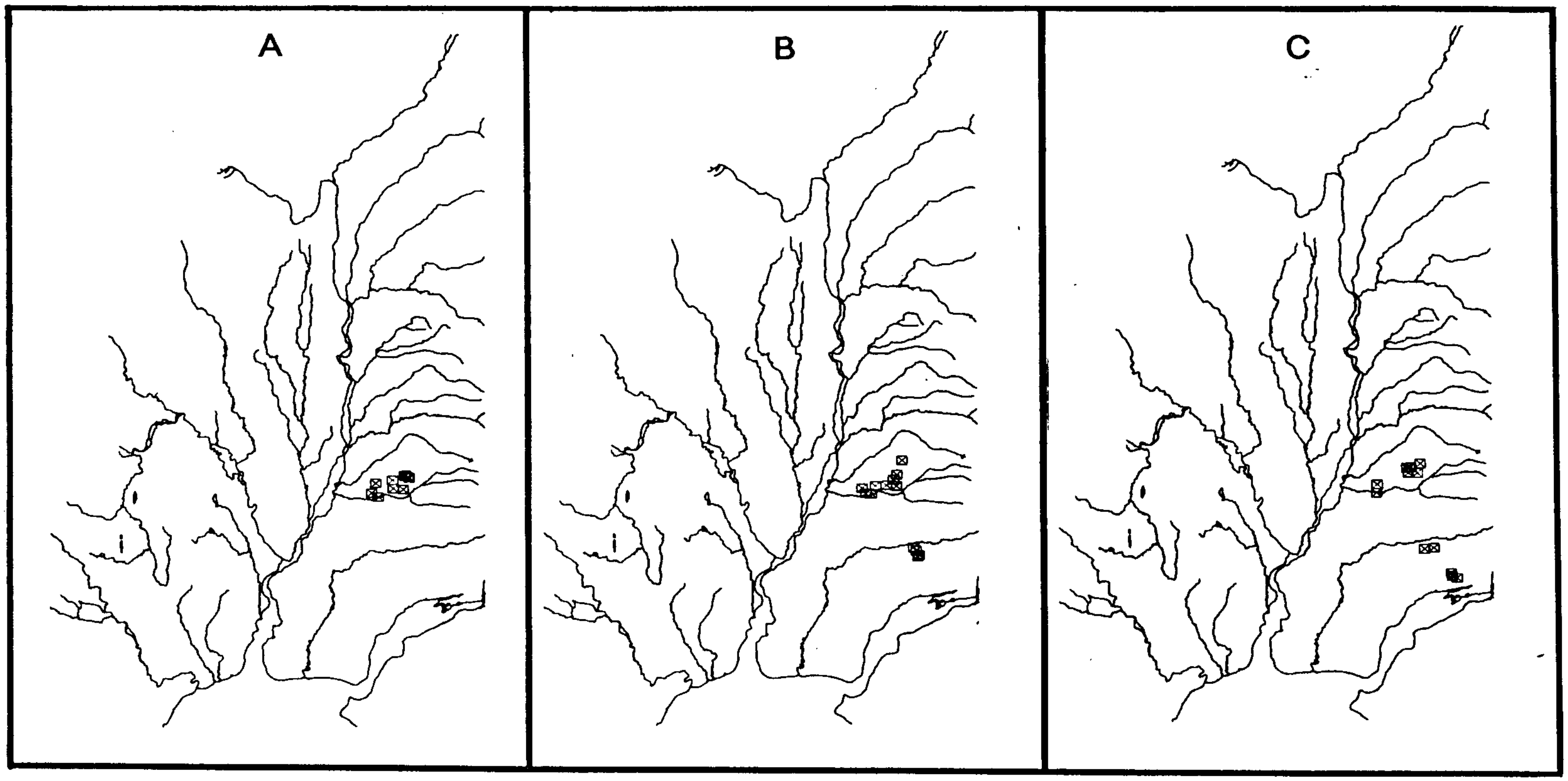
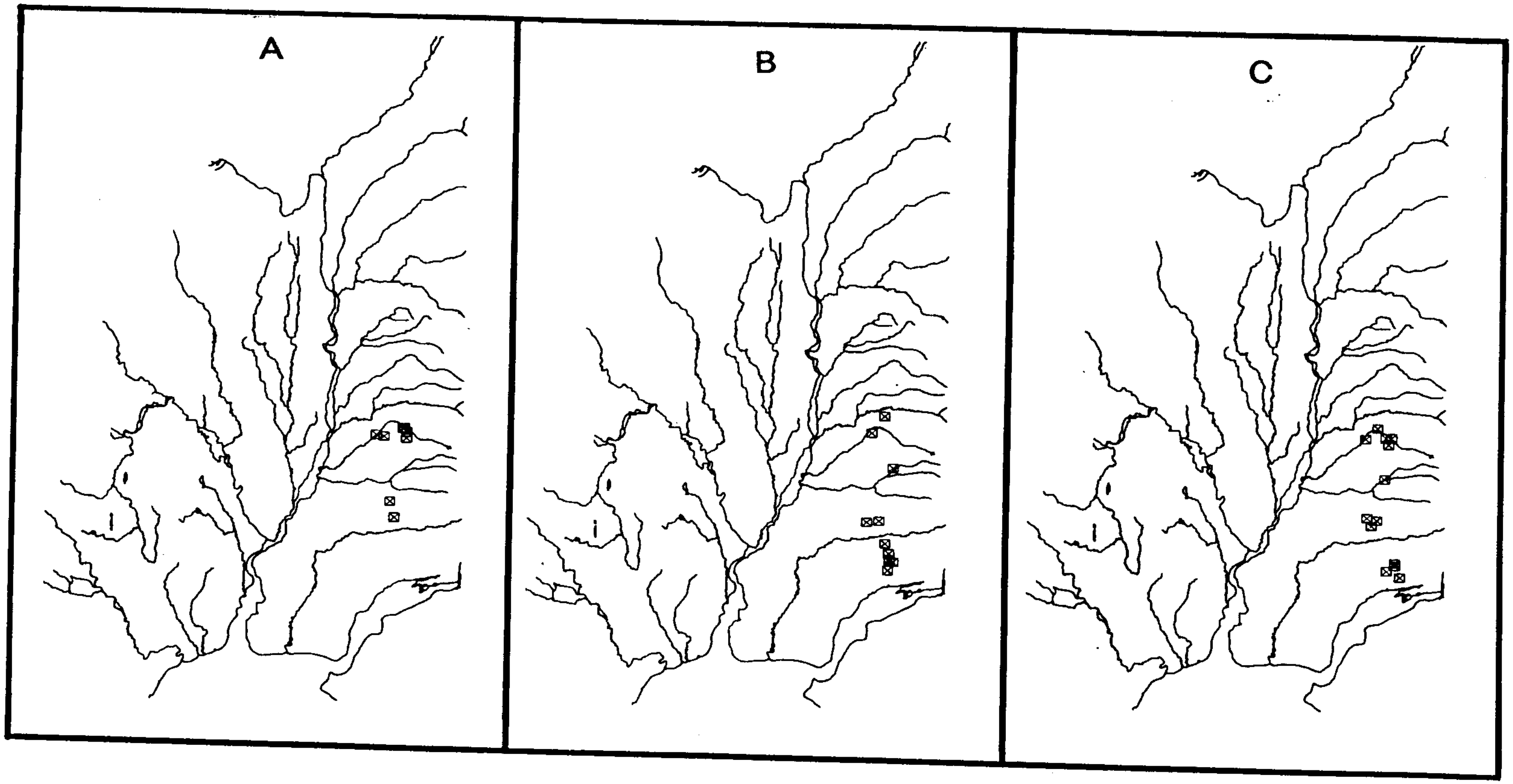


Figure 37 Continued



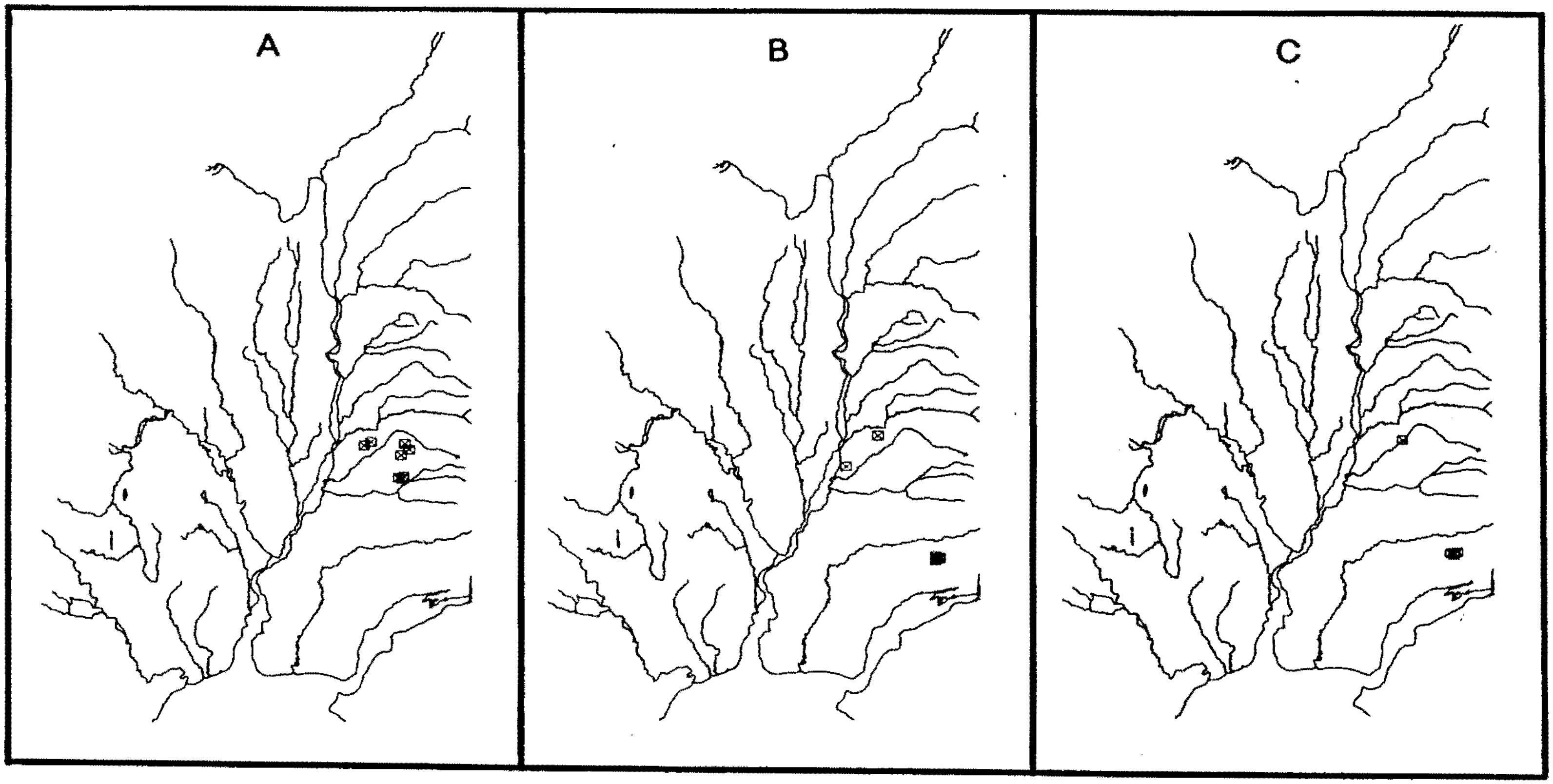


Figure 38 Graphical plots of winter season radio-fix locations in 3 migratory moose (152210, 152960, and 153640, respectively) that were nonphilopatric to terminal winter home range in lower Susitna River Valley, in Southcentral Alaska, during 3 consecutive years, 1985–1987 (A–C, respectively). Winter season equals 25 Dec–6 May, the following year. Migratory=multimodal utilization distribution in adaptive kernel home range analysis. Nonphilopatric=utilization distributions of radiofixes in winter season were not sympatric among calendar years.

Figure 38 Continued

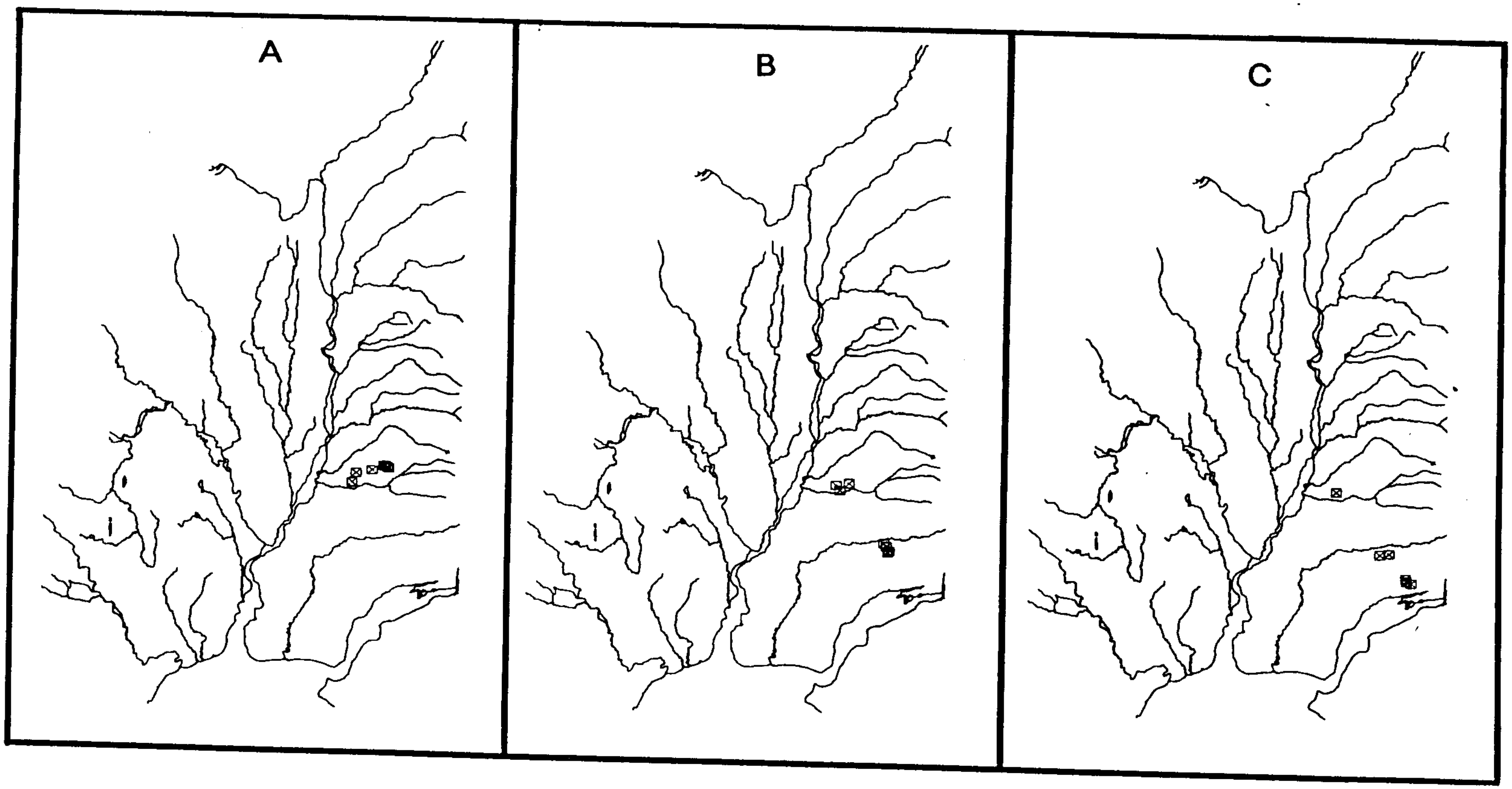
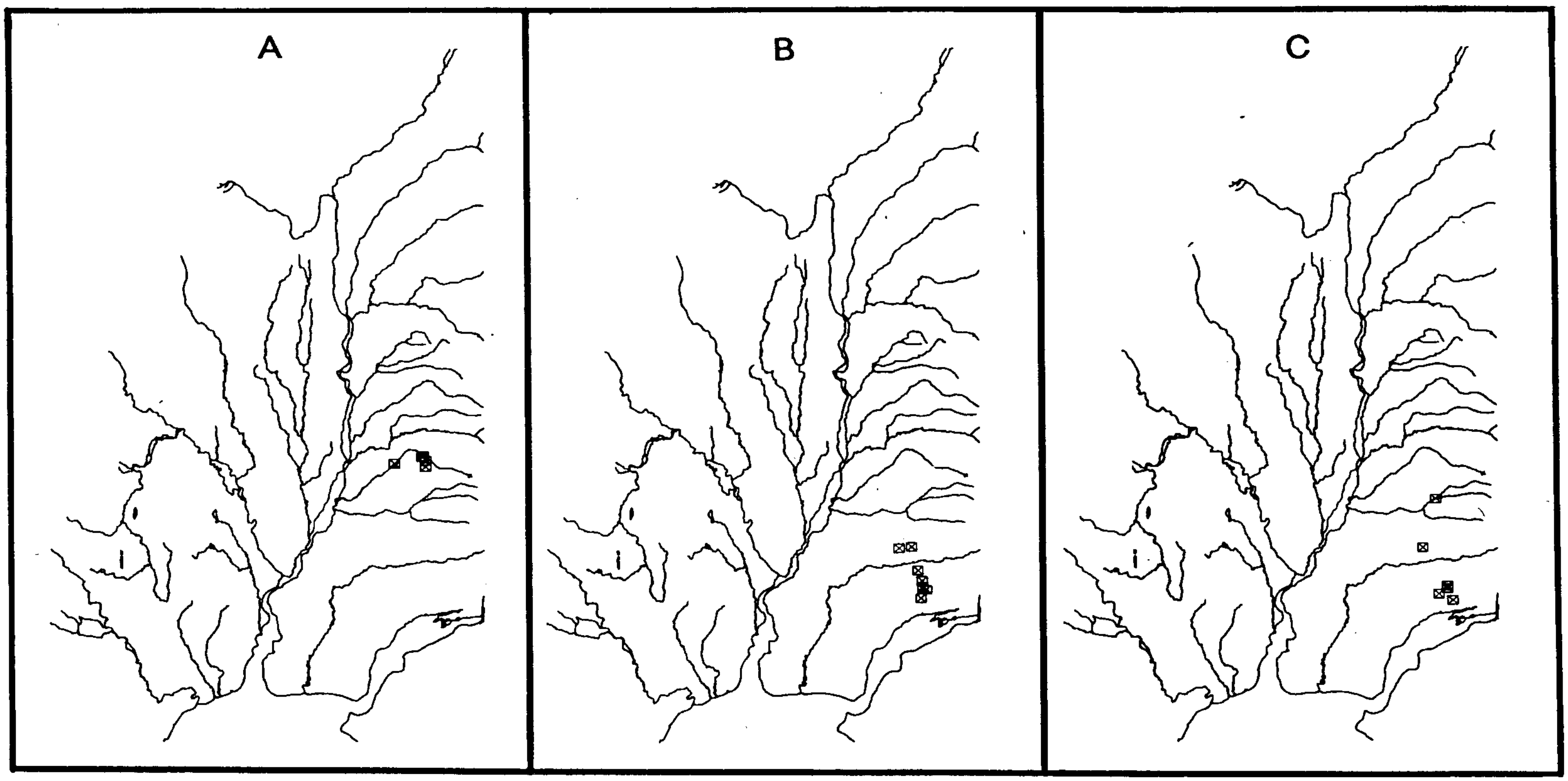


Figure 38 Continued



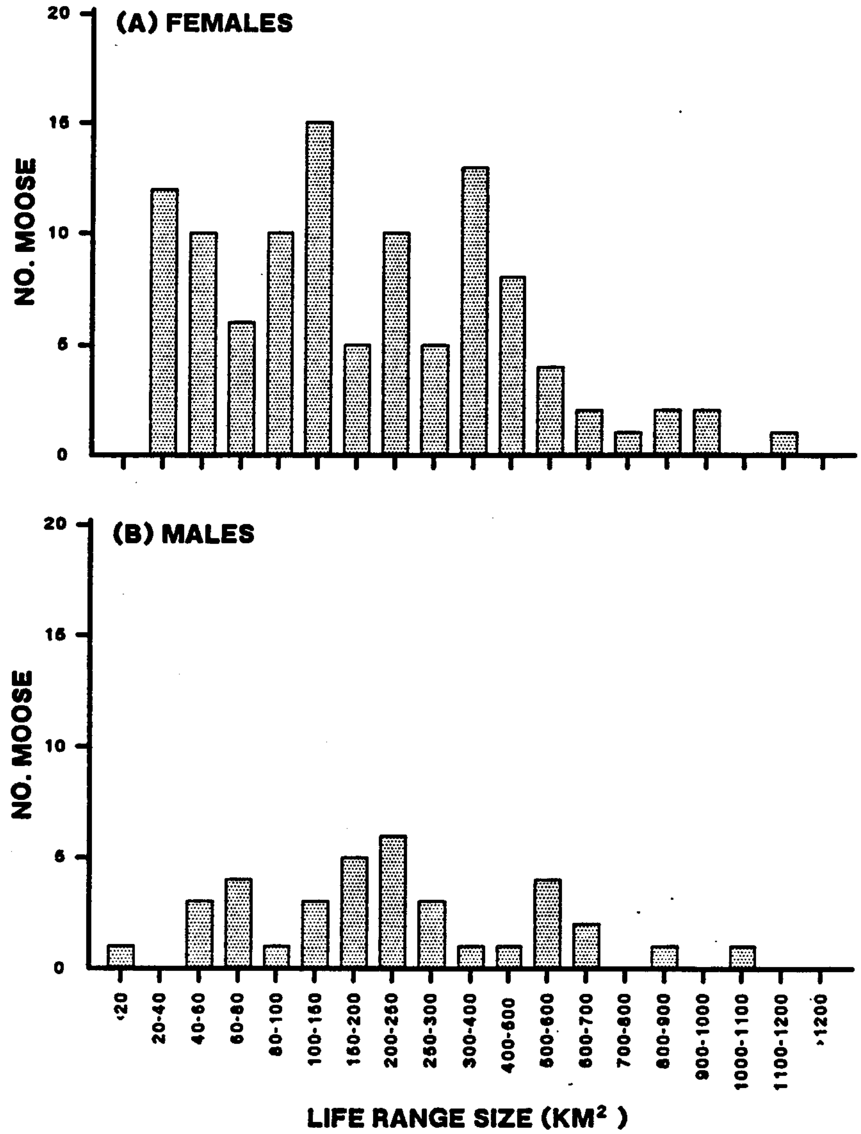


Figure 39 Histograms of life home range size in radiocollared (A) female (*n*=106) and (B) male (*n*=36) moose adults telemetry monitored with aircraft in lower Susitna River valley in Southcentral Alaska during April 1980 through January 1991. Home range size equals area (km^2) of 98% minimum convex polygon.

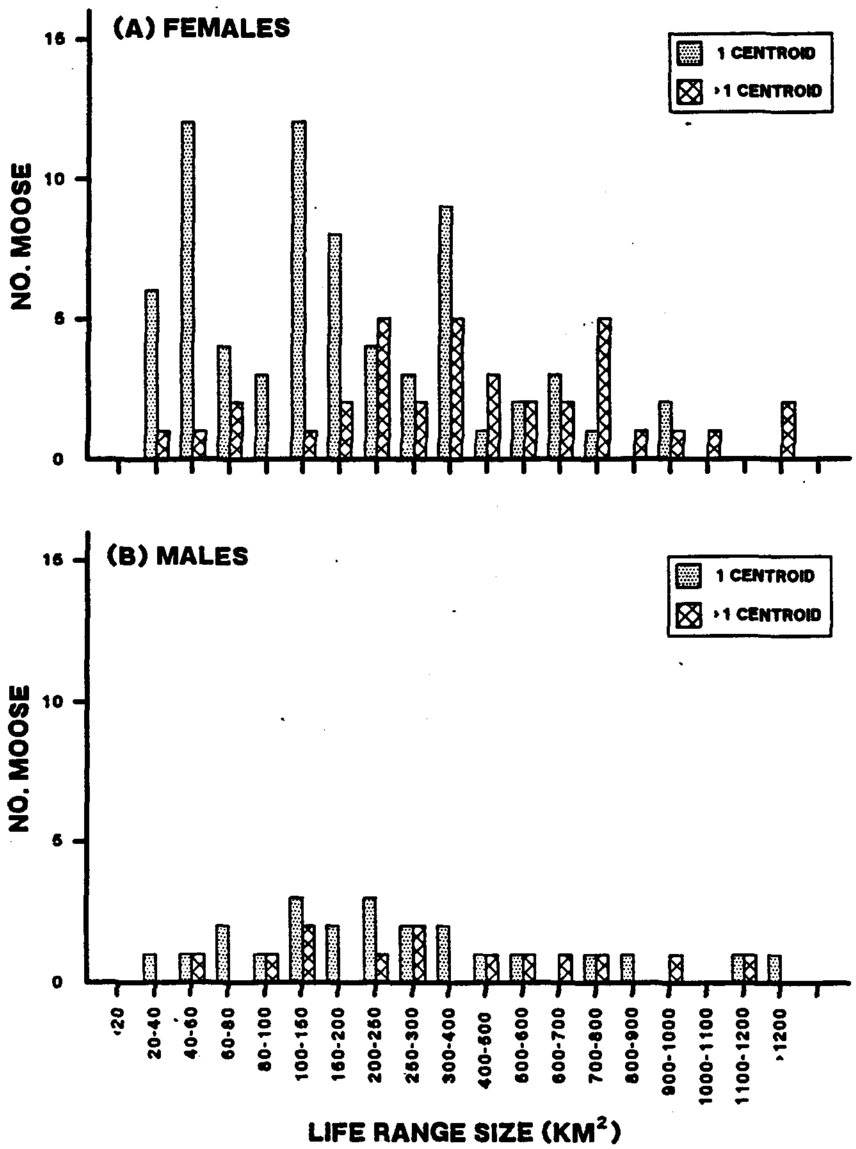


Figure 40 Histograms of life home range size in radiocollared (A) female (*n*=106) and (B) male (*n*=36) moose adults telemetry monitored with aircraft in lower Susitna River valley in Southcentral Alaska during Apr 1980–Jan 1991. Home range size equals area (km^2) 98% adaptive kernel. Bandwidth used in adaptive kernel analysis was bandwidth with lowest LSCV between optimum bandwidth and 0.55 times the optimum bandwidth. Number of centroids equals number of discrete polygons with >2 radio-fixes.

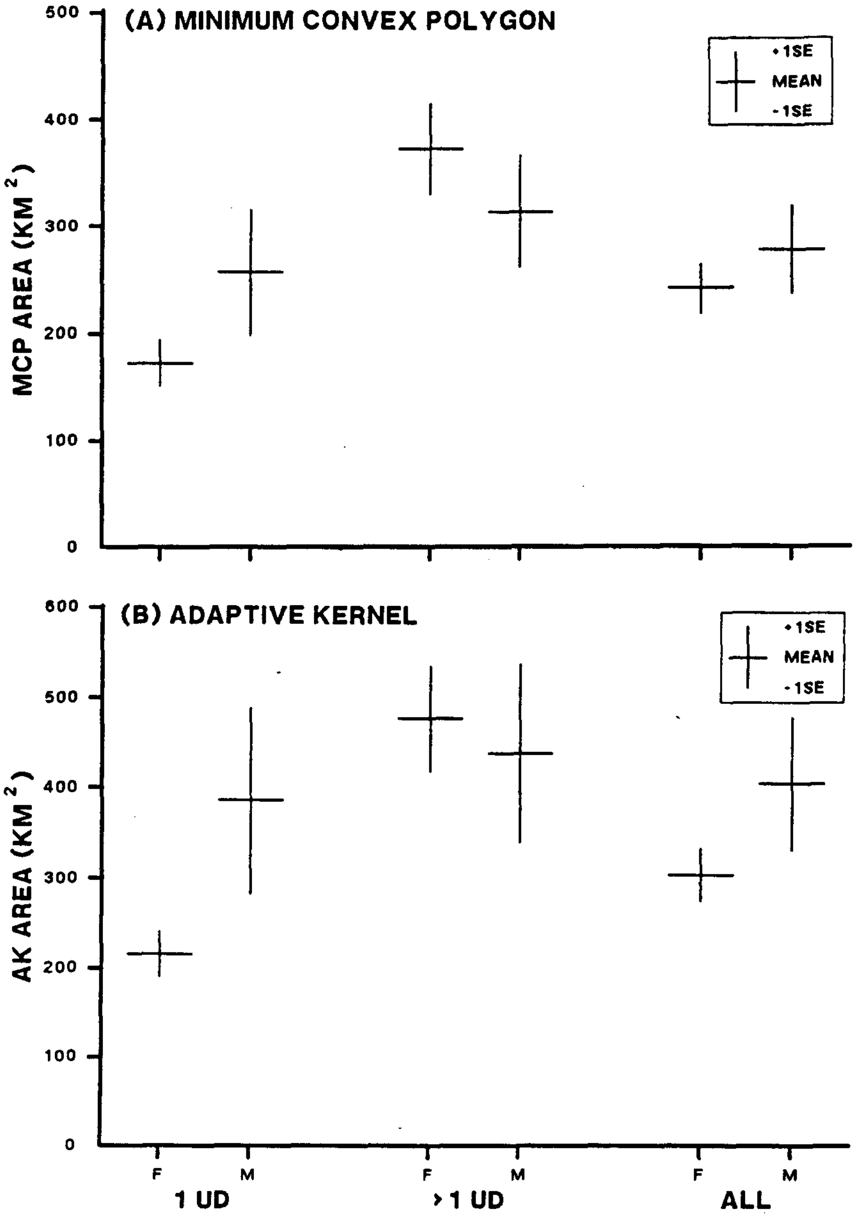


Figure 41 Life home range size in radiocollared female (F) and male (M) moose adults telemetry monitored with aircraft in lower Susitna River valley in Southcentral Alaska during Apr 1980–Jan 1991. Home range size calculated with minimum convex polygon (A) and adaptive kernel methods. Number utilization distributions (UD) was determined in adaptive kernel analyses. Number of males with 1 and >1 UD was 23 and 13 moose, respectively; number females with 1 and >1UD was 106 and 36 moose, respectively. Bandwidth used in adaptive kernel analysis was bandwidth with lowest LSCV between optimum bandwidth and 0.55 times the optimum bandwidth.

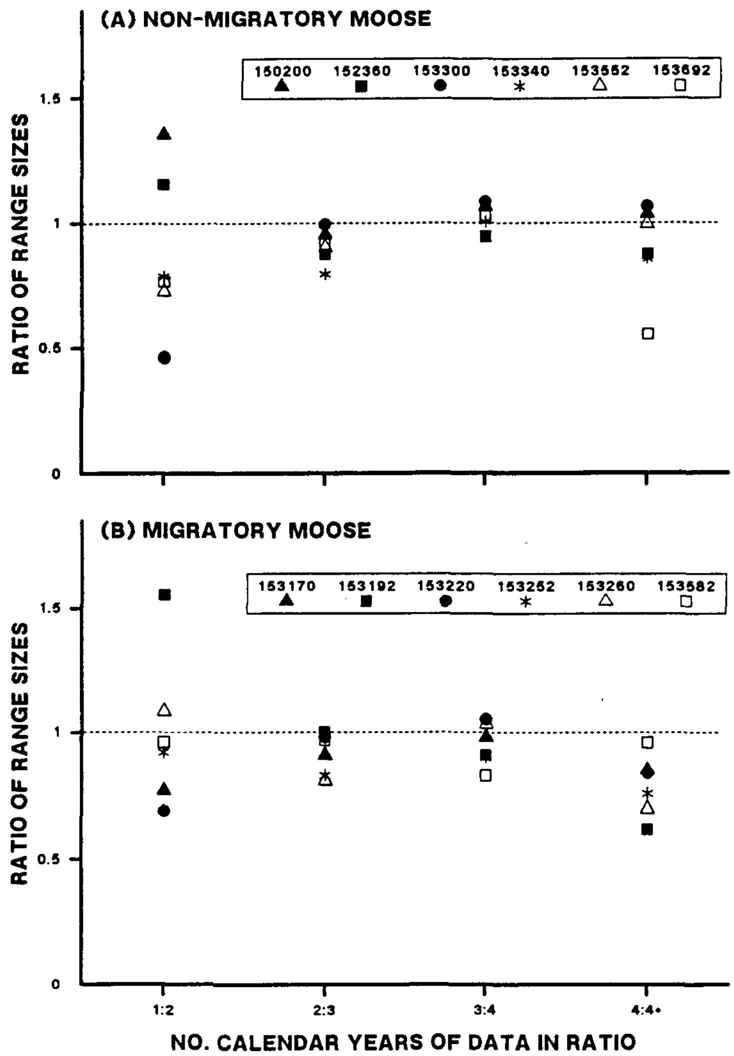


Figure 42 Relationship between number of radio-fixes and home range size (A) nonmigratory (n=6) and (B) migratory (n=6) radiocollared female moose adults monitored with aircraft in lower Susitna River valley in Southcentral Alaska, 1980–1991. Home range size was 98% minimum convex polygon. Ratio of home range sizes in: 1:2 was ratio of home range size in calendar year (CY) 1:home range size in CYs 1+2; 2:3=was ratio of home range size in CYs 1+2:home range size in CYs 1+2+3; and etc. Calendar year equals 7 May–6 May the following year. Nonmigratory (migratory) moose=moose with unimodal (multimodal) distribution of radio-fixes. Least number of radio-fixes in was 36 in CY 1, 58 in CYs (1+2), 85 in CYs (1+2+3), 108 in CYSs (1+2+3+4), and 140 in CY (1+2+3+4+). .

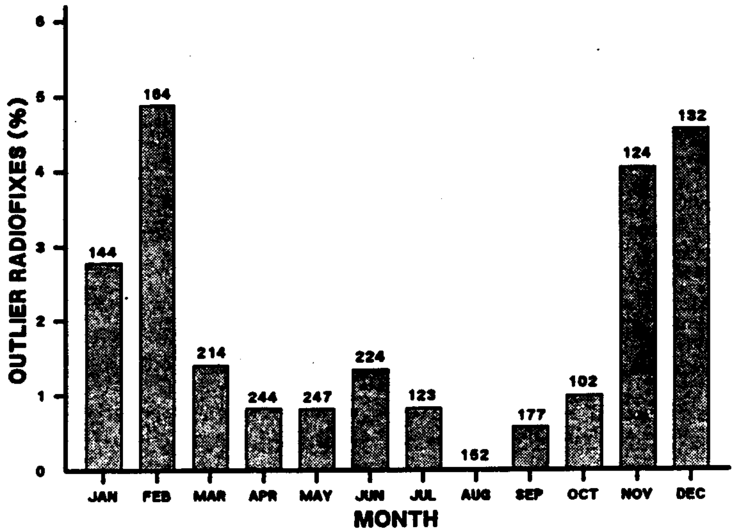
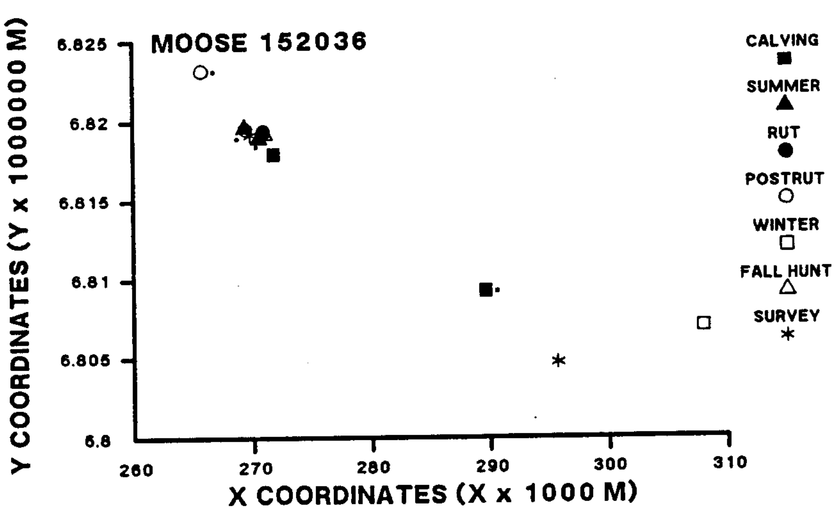


Figure 43 Frequency by month of outlier radio-fixes in 98% minimum convex polygons of life home range of nonmigratory (n=6) and migratory (n=6) radiocollared moose adults monitored with aircraft in lower Susitna River valley in Southcentral Alaska in 1980–1991. Numbers above bars= number of radio-fixes.



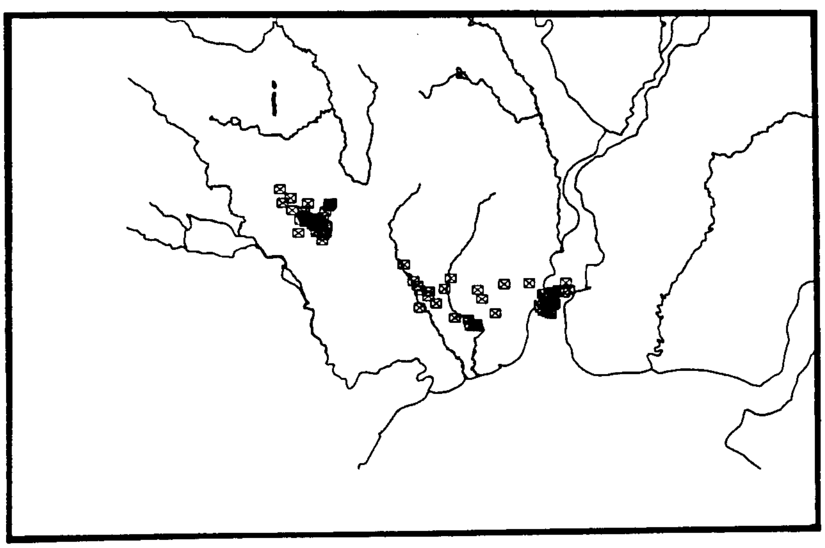
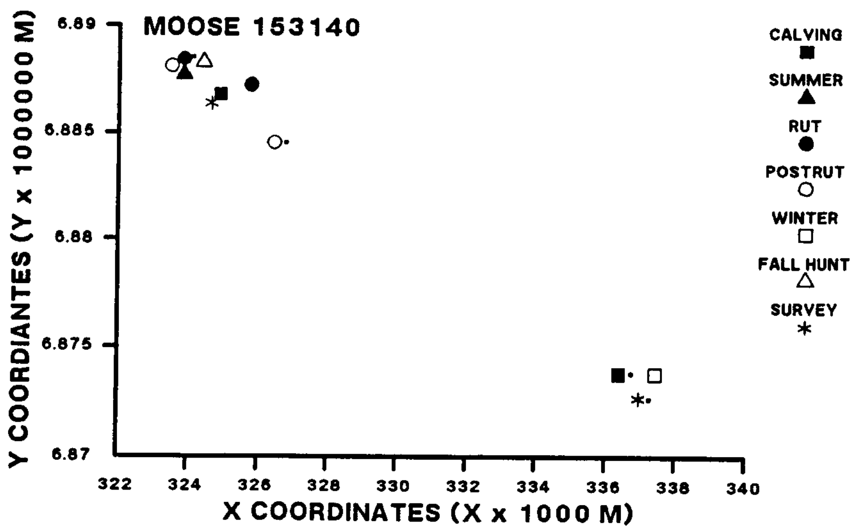
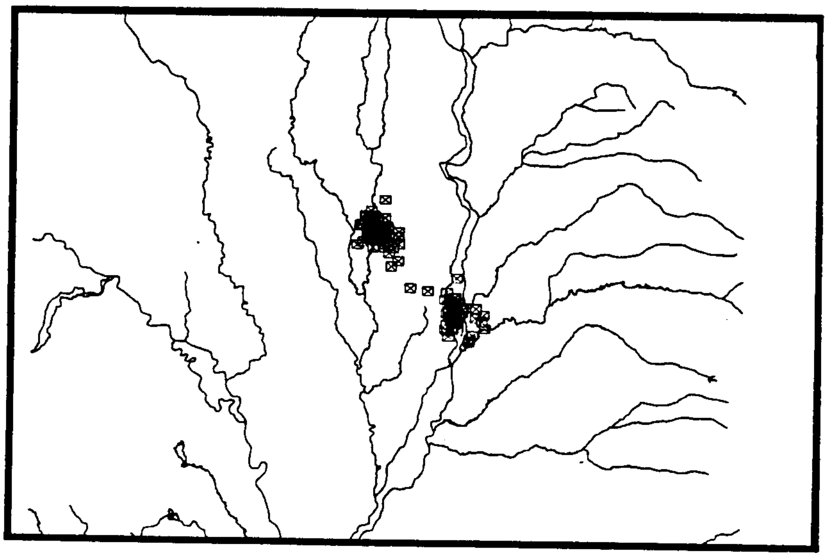


Figure 44 (A–L). Graphical examples of spatial relationships among seasonal home range centroids (top) and life home range radio-fixes (bottom) in 6 migratory (A–E) and 6 nonmigratory (F–J) radiocollared female moose adults monitored with aircraft in lower Susitna River valley in Southcentral Alaska in 1981–1991. Migratory equals moose with multimodal utilization distribution of radio-fixes in adaptive kernel analysis of life home ranges. Seasonal home ranges were=calving, summer, rut, post-rut, winter, hunt, and survey. Marks (top) show location of centroids of seasonal ranges. Marks with dots were secondary centroids.

Figure 44 Continued (B)





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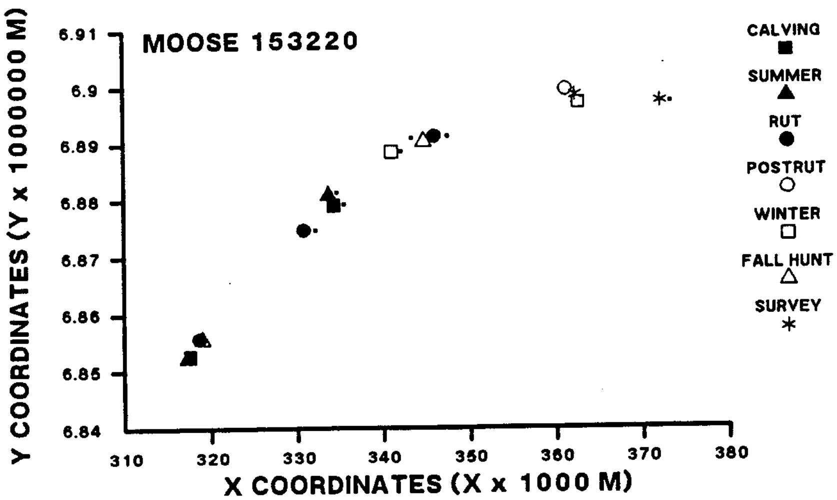


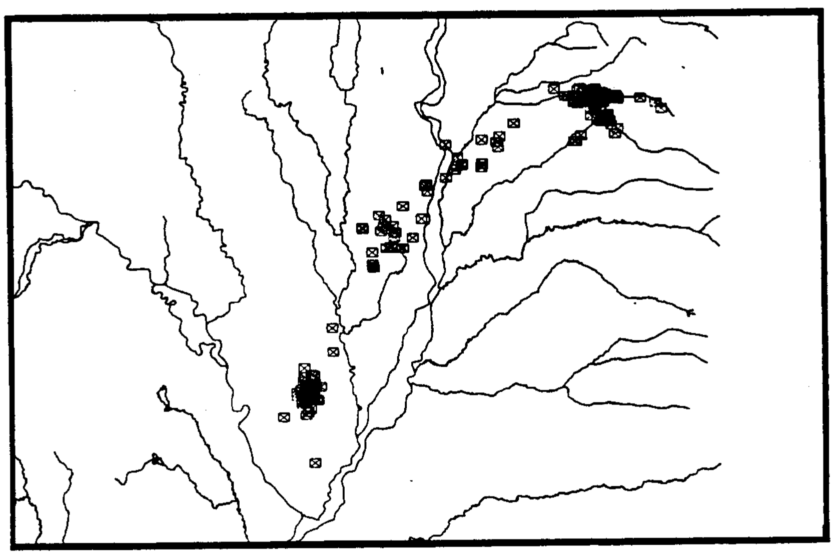
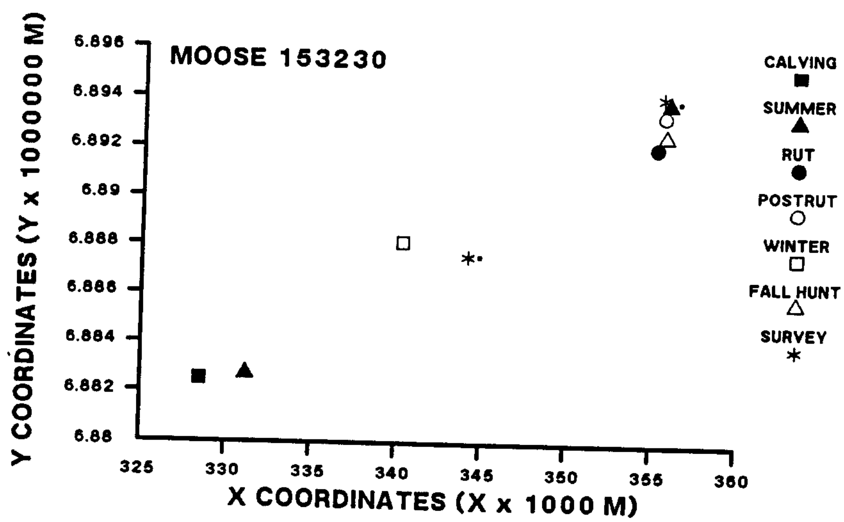
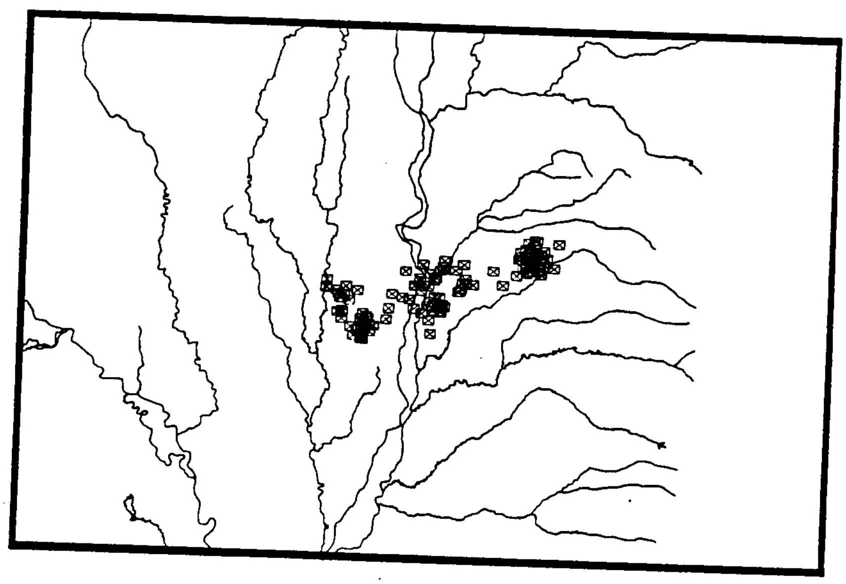


Figure 44 Continued (D)





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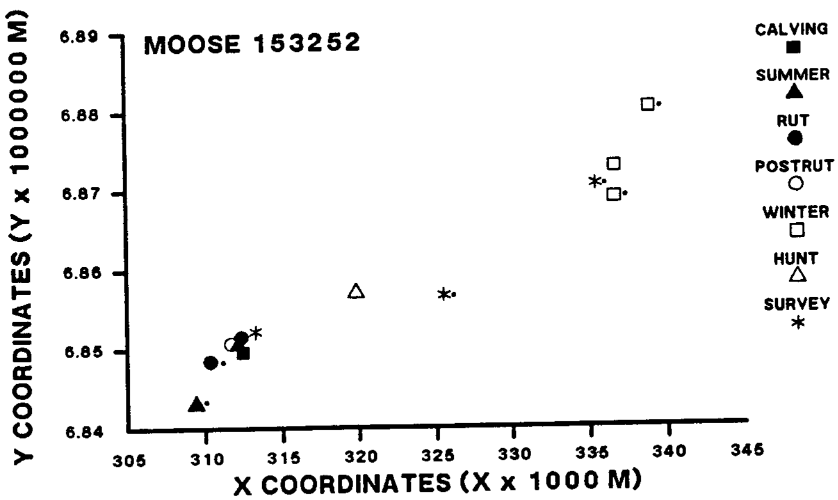

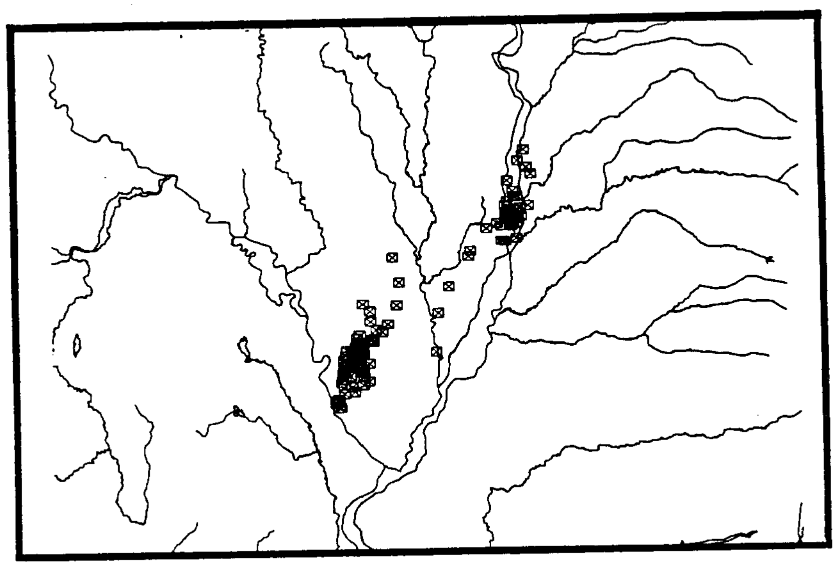

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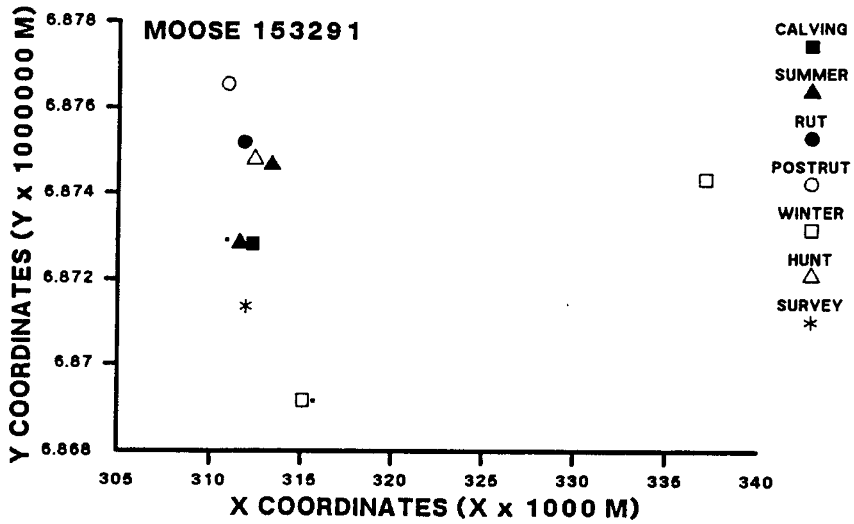

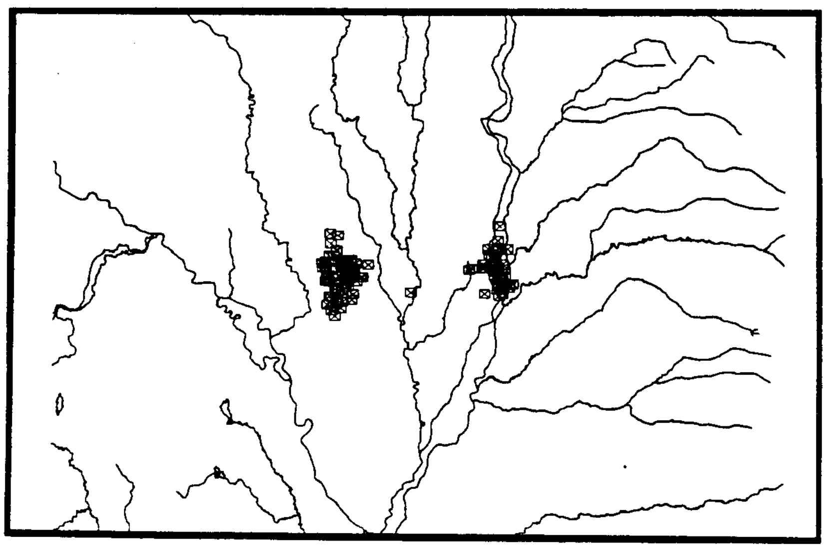

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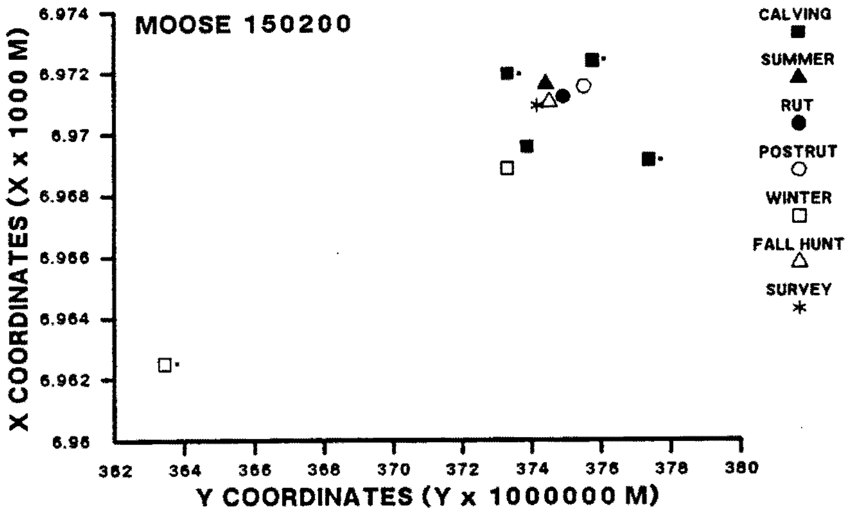

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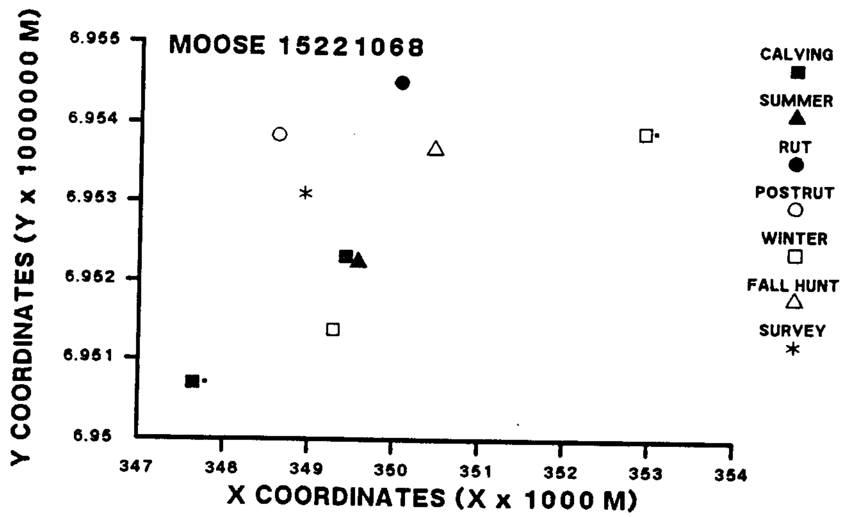

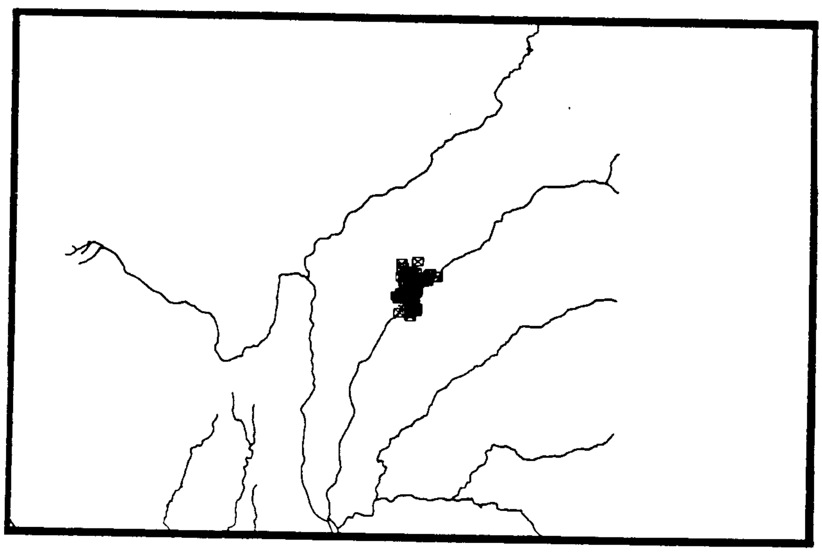

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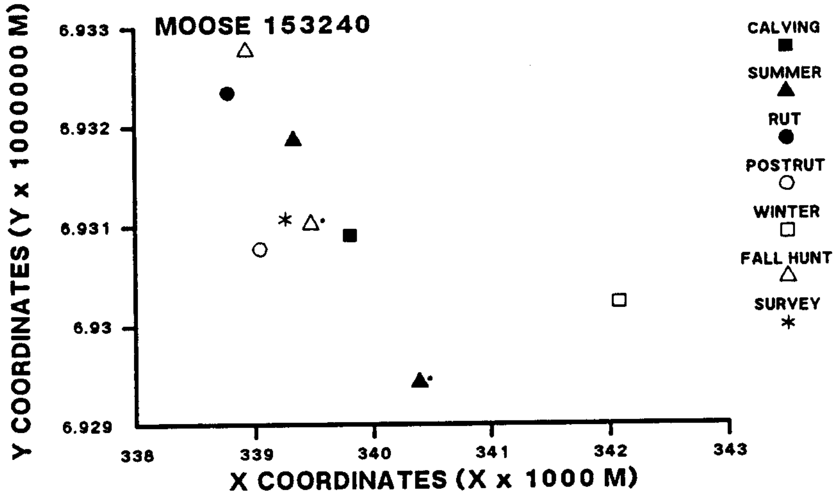

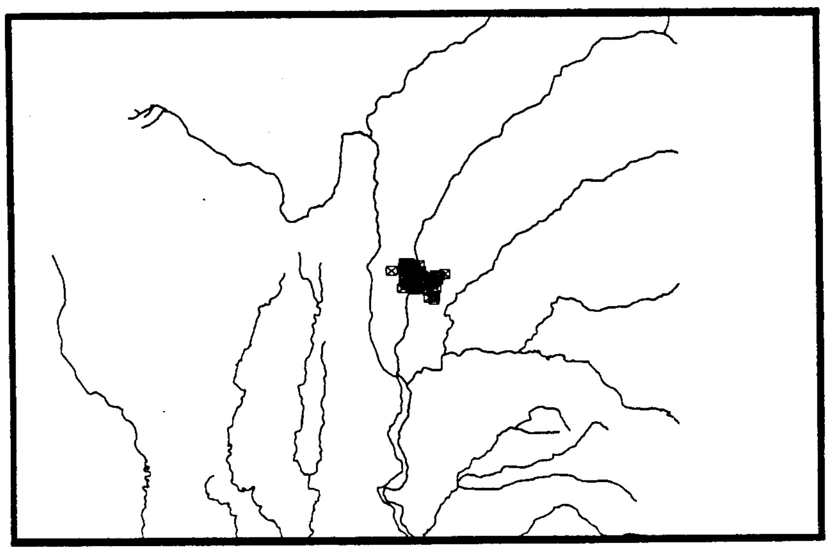

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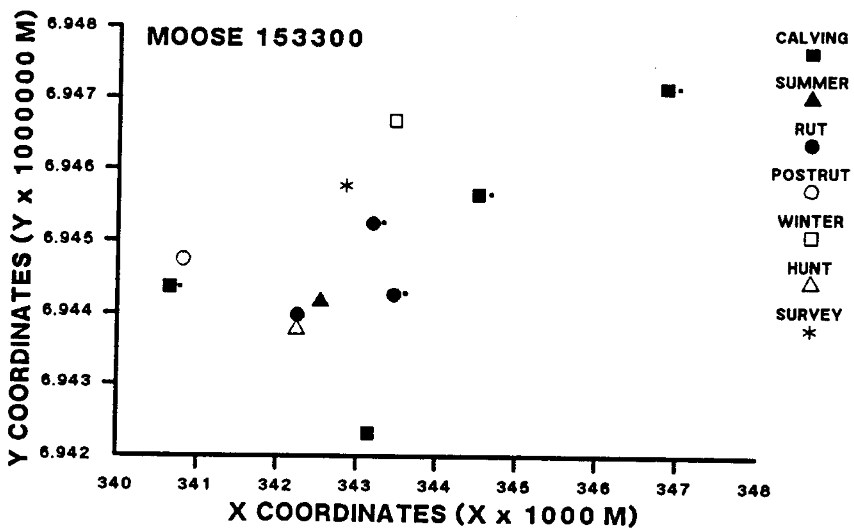

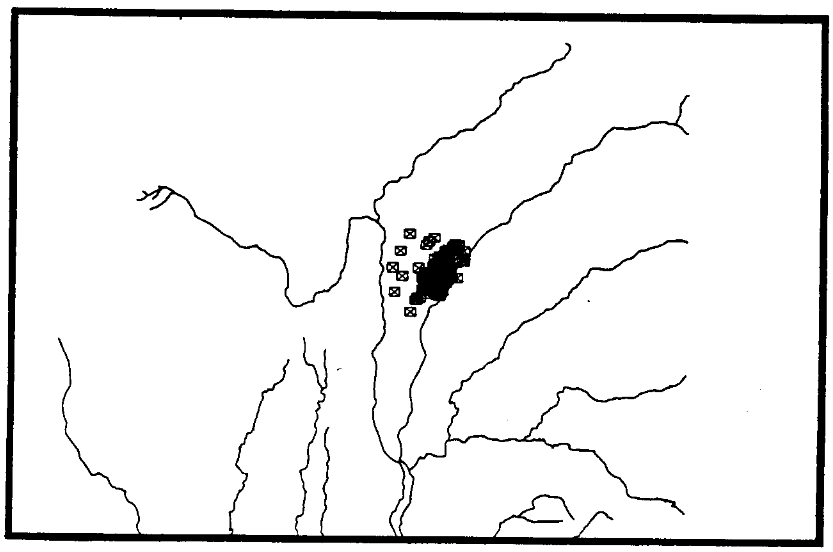

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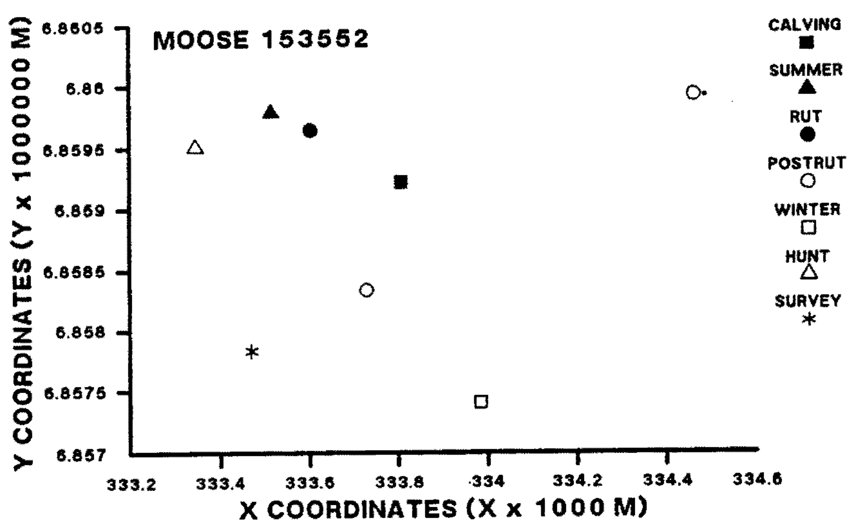

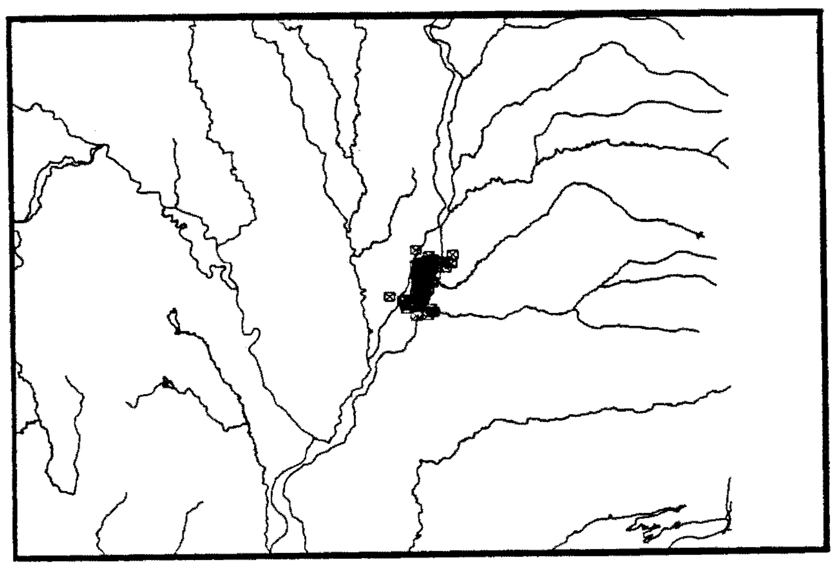

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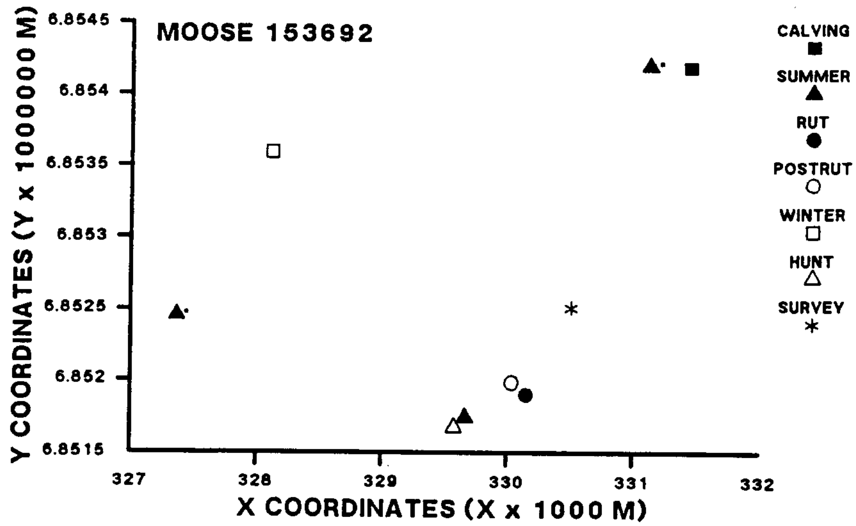
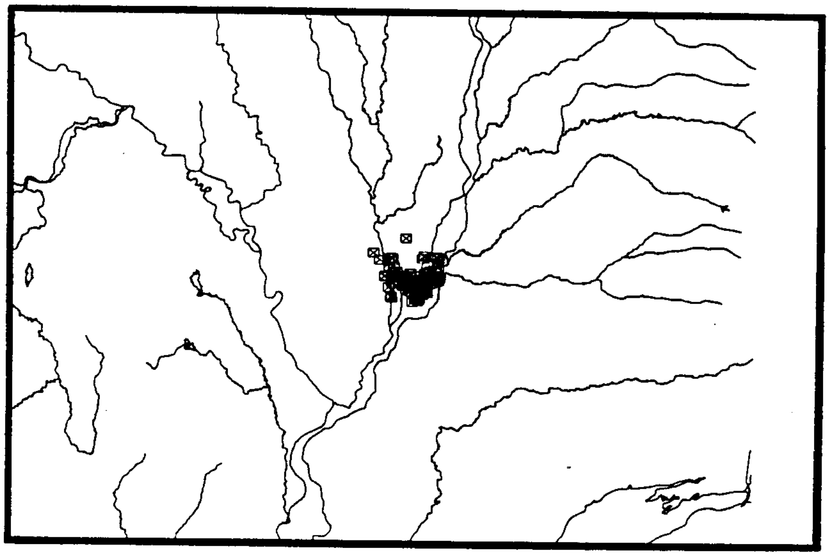




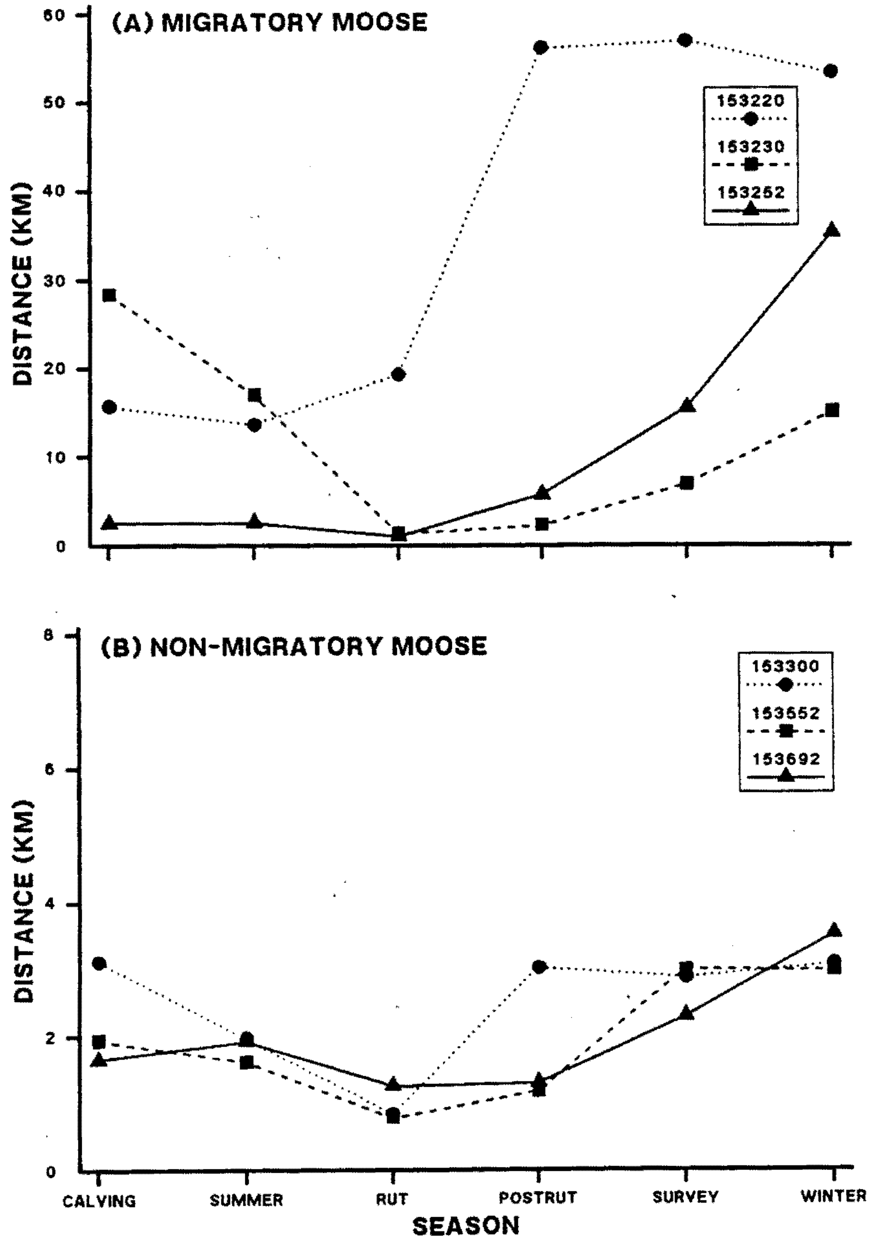


Figure 45 Distance between centroids of hunt home range (hunting season) centroids and centroids of other seasonal home ranges in (A) migratory (n=3) and (B) nonmigratory (n=3) radiocollared adult female moose monitored with aircraft in lower Susitna River Valley in 1981–1985. Migratory (nonmigratory) equals moose with multimodal (unimodal) utilization distribution of radio-fixes in adaptive kernel analysis of life home ranges. Distance values=mean of 4 calendar years, 7–31 May the following year, 1981–1985.

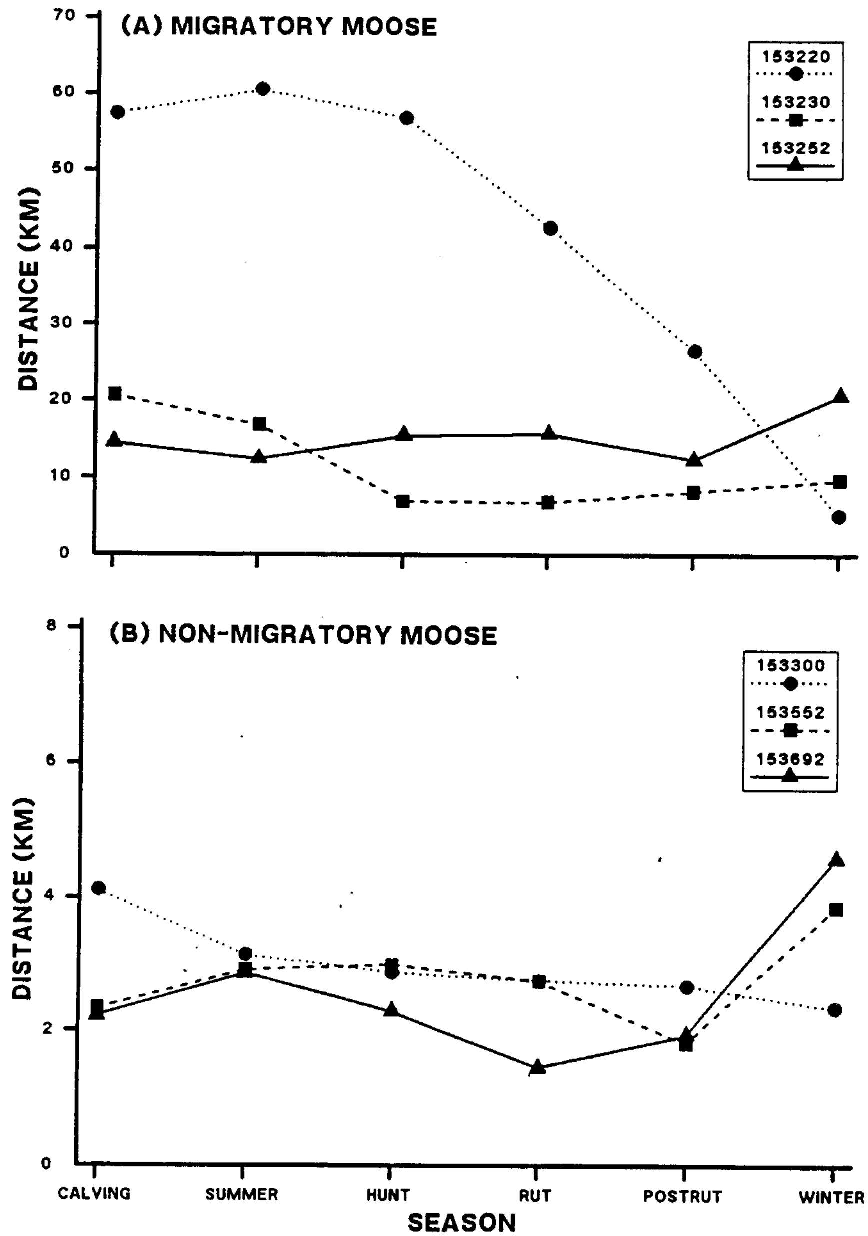


Figure 46 Distance between centroids of survey home range (survey season) and centroids of other seasonal home ranges in (A) migratory (n=3) and (B) nonmigratory (n=3) radiocollared adult female moose monitored with aircraft in lower Susitna River Valley in 1981–1985. Migratory (nonmigratory) equals moose with multimodal (unimodal) utilization distribution of radio-fixes in adaptive kernel analysis of life home ranges. Distance values=mean of 4 calendar years, 7–31 May the following year, 1981–1985.

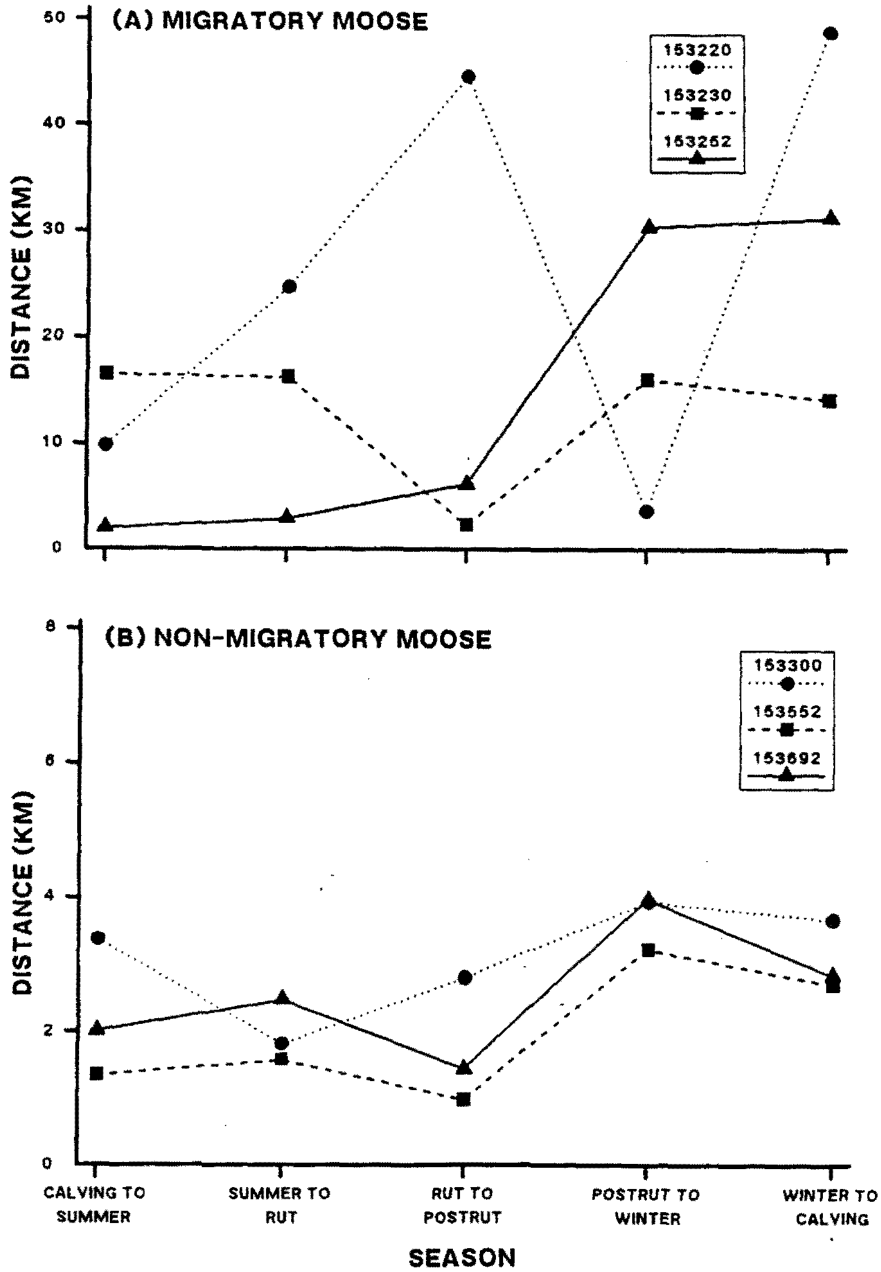


Figure 47 Distance between centroids of consecutive seasonal home ranges in life home ranges in (A) migratory (n=3) and (B) nonmigratory (n=3) radiocollared adult female moose monitored with aircraft in lower Susitna River Valley in 1981–1985. Centroids were center points of radio-fixes in primary polygons in adaptive kernel analyses of seasonal home ranges in a calendar year. Migratory (nonmigratory) equals moose with multimodal (unimodal) utilization distribution of radio-fixes in adaptive kernel analysis of life home ranges. Distance values=mean of values in 4 calendar years (7–31 May the following year) in 1981–1985.

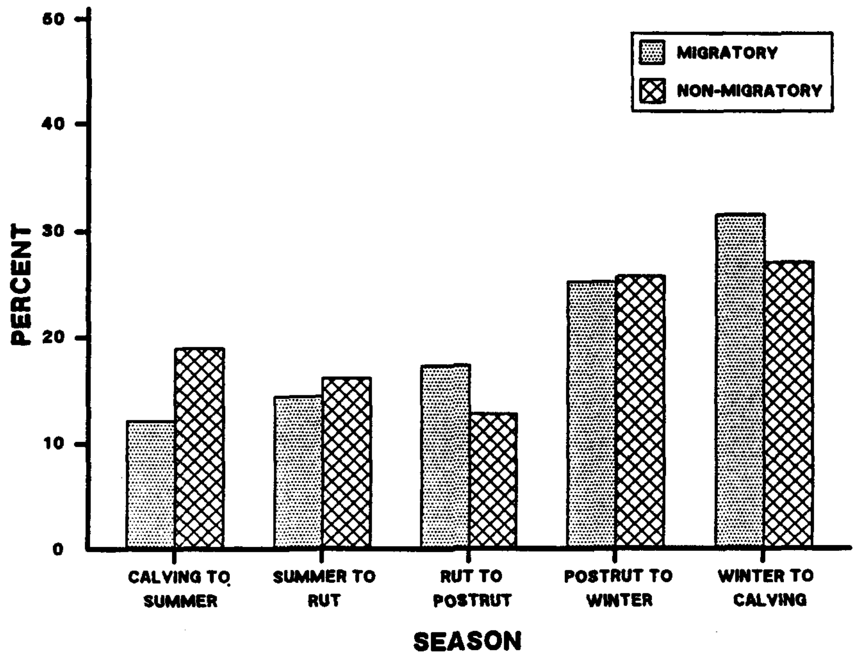


Figure 48 Percent seasonal movement composition in movements in a calendar year in 3 migratory (A) and 3 nonmigratory (B) radiocollared moose monitored with aircraft in lower Susitna River Valley in 1981–1985. Seasonal movements were movements between chronologically consecutive seasonal home ranges in a calendar year. Seasonal home ranges were calving, summer rut, postrut, winter, and calving the following calendar year. Percent is a mean calculated across 4 consecutive calendar years, 7–31 May the following year, 1981–1985.

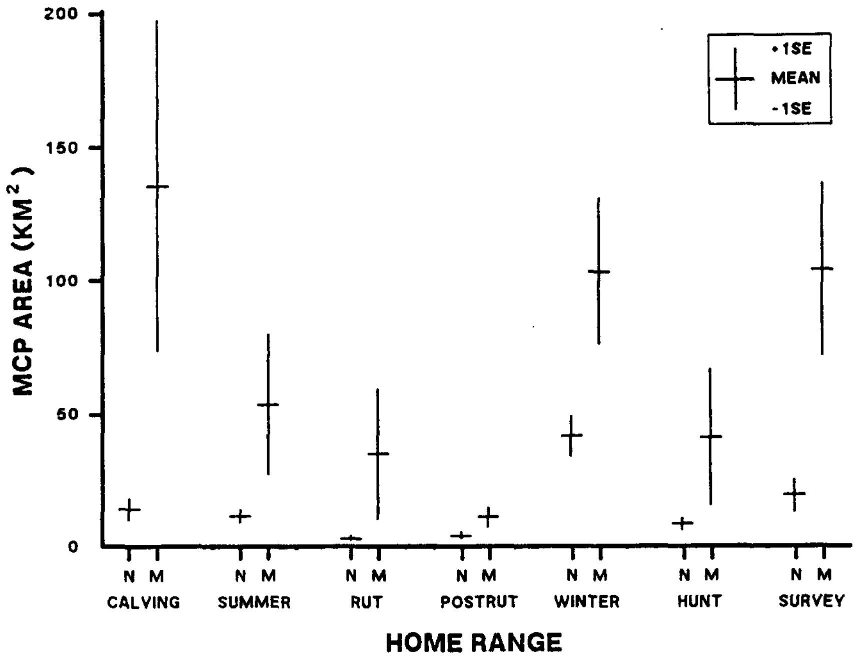


Figure 49 Size of life, life-seasonal, seasonal, and management event home ranges in 6 nonmigratory (N) and 6 migratory (M) radiocollared female moose adults telemetry monitored with aircraft in lower Susitna River Valley in Southcentral Alaska in 1980–1991. Size was area square kilometer of 100% minimum convex polygon.

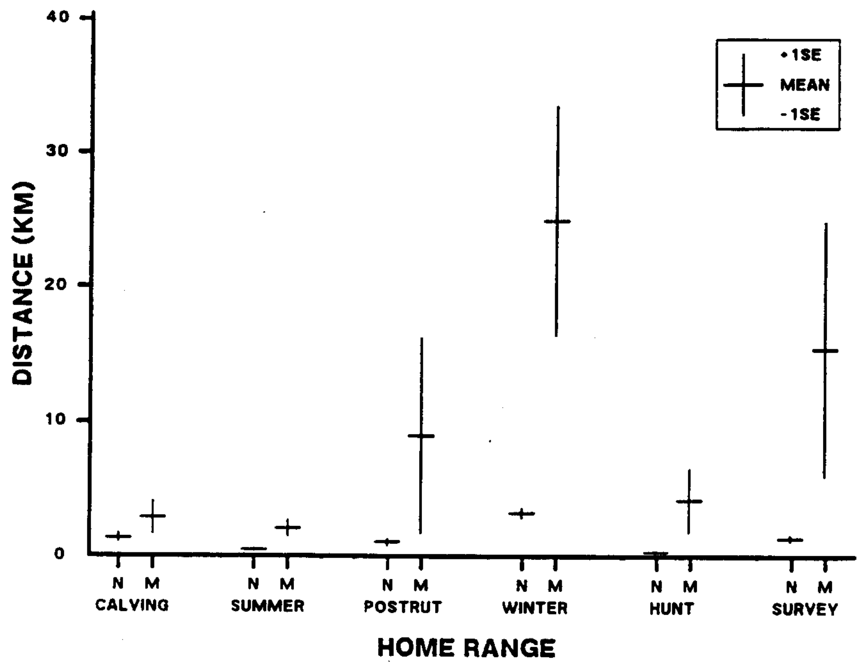


Figure 50 Distance (km) between rut seasonal home range centroids and centroids of other seasonal home ranges in 6 nonmigratory (N) and 6 migratory (M) radiocollared female moose adults telemetry monitored with aircraft in lower Susitna River Valley in Southcentral Alaska in 1980–1991. Centroids were center points of radio-fixes in primary polygons in adaptive kernel analyses of life seasonal home ranges.

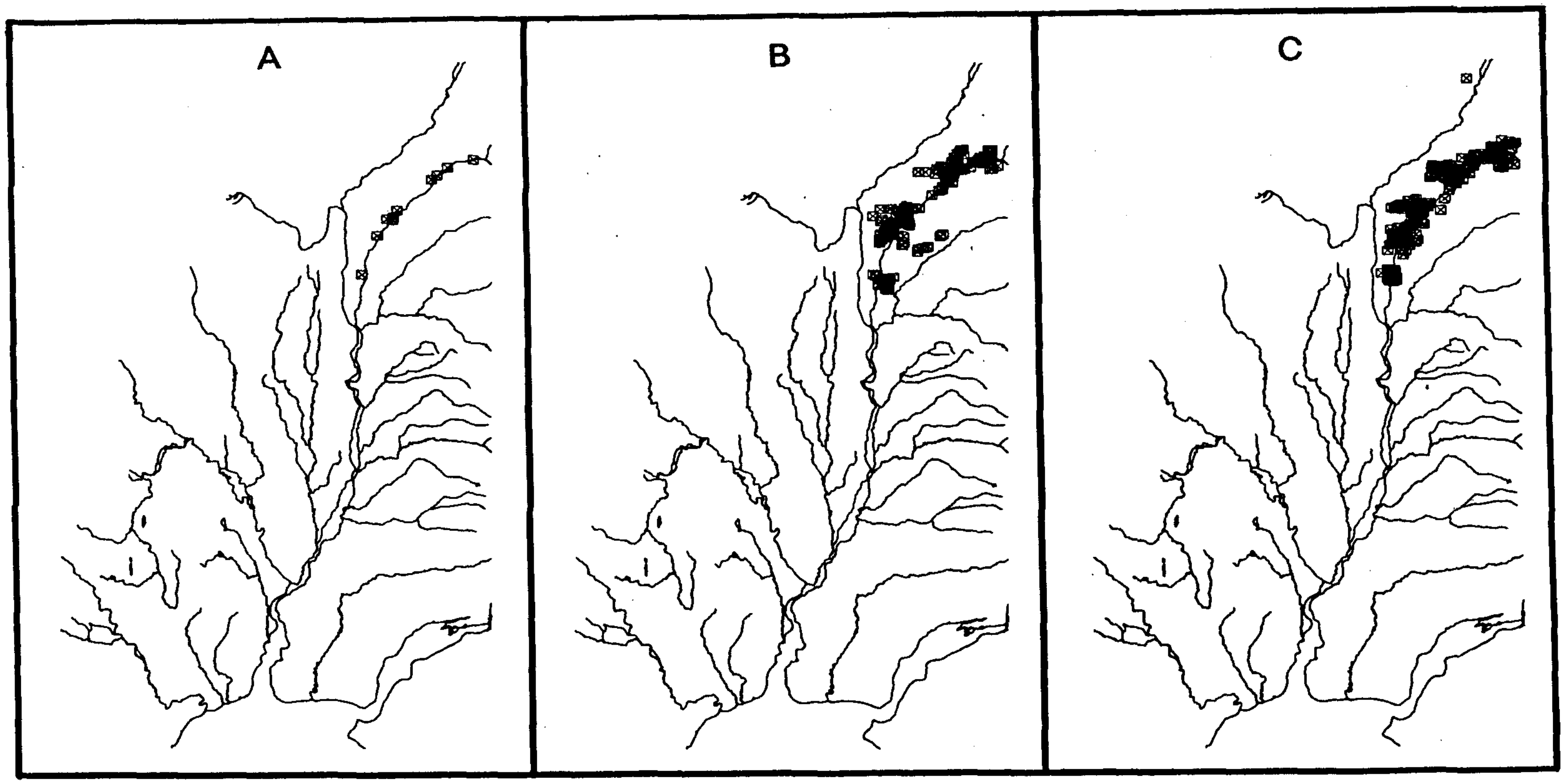


Figure 51 Graphic plots (A through X) showing location of capture (A) and locations of winter (1 Jan–31 Mar) and summer (7 May–30 Sep) radio-fixes of female and male moose adults radiocollared and telemetry monitored with aircraft in the lower Susitna River Valley in Southcentral Alaska in 1980–1991. Moose radio-fix data in plots were grouped according to the geographic area in which moose were captured.

Figure 51 Continued (B)

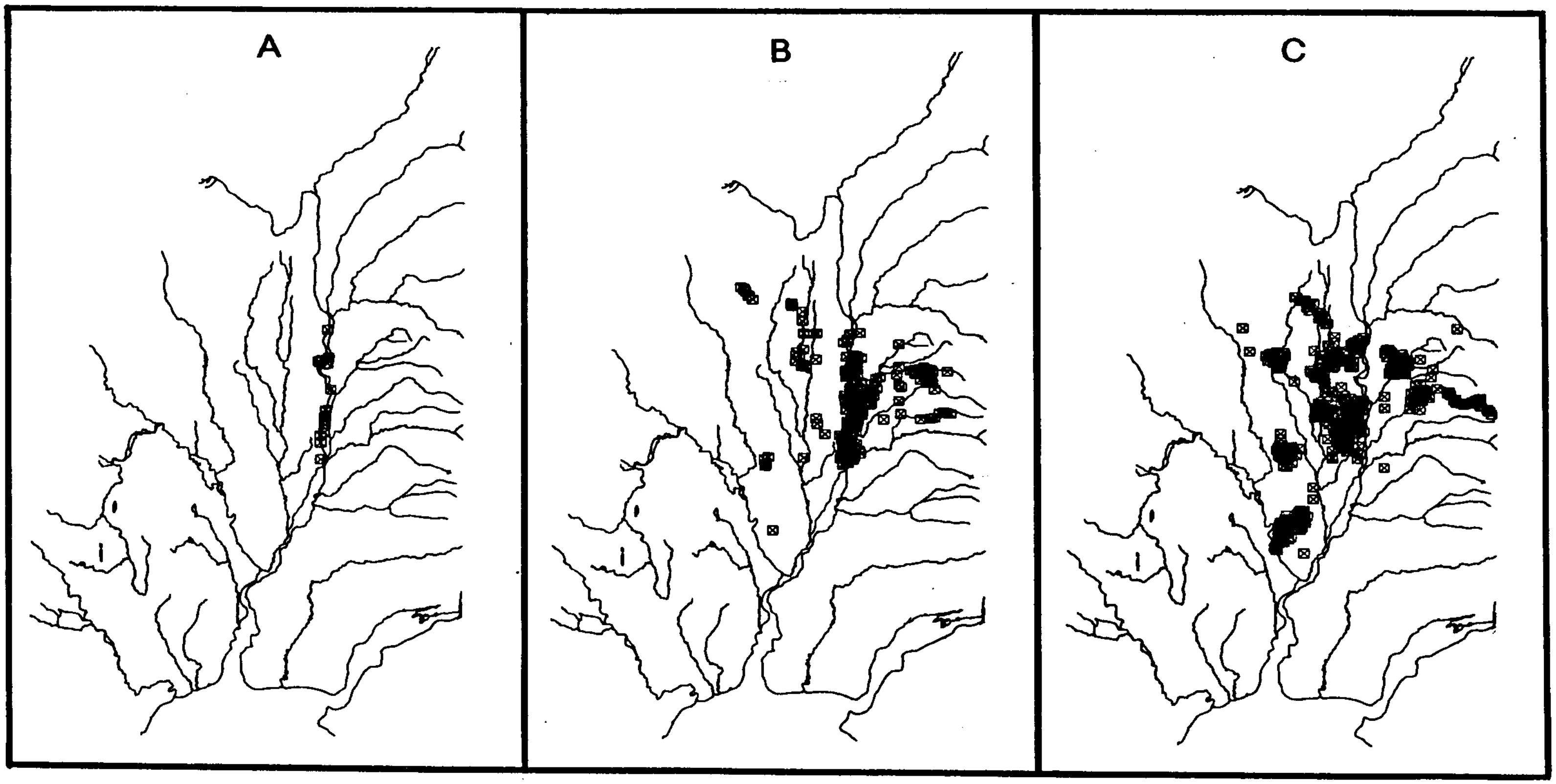
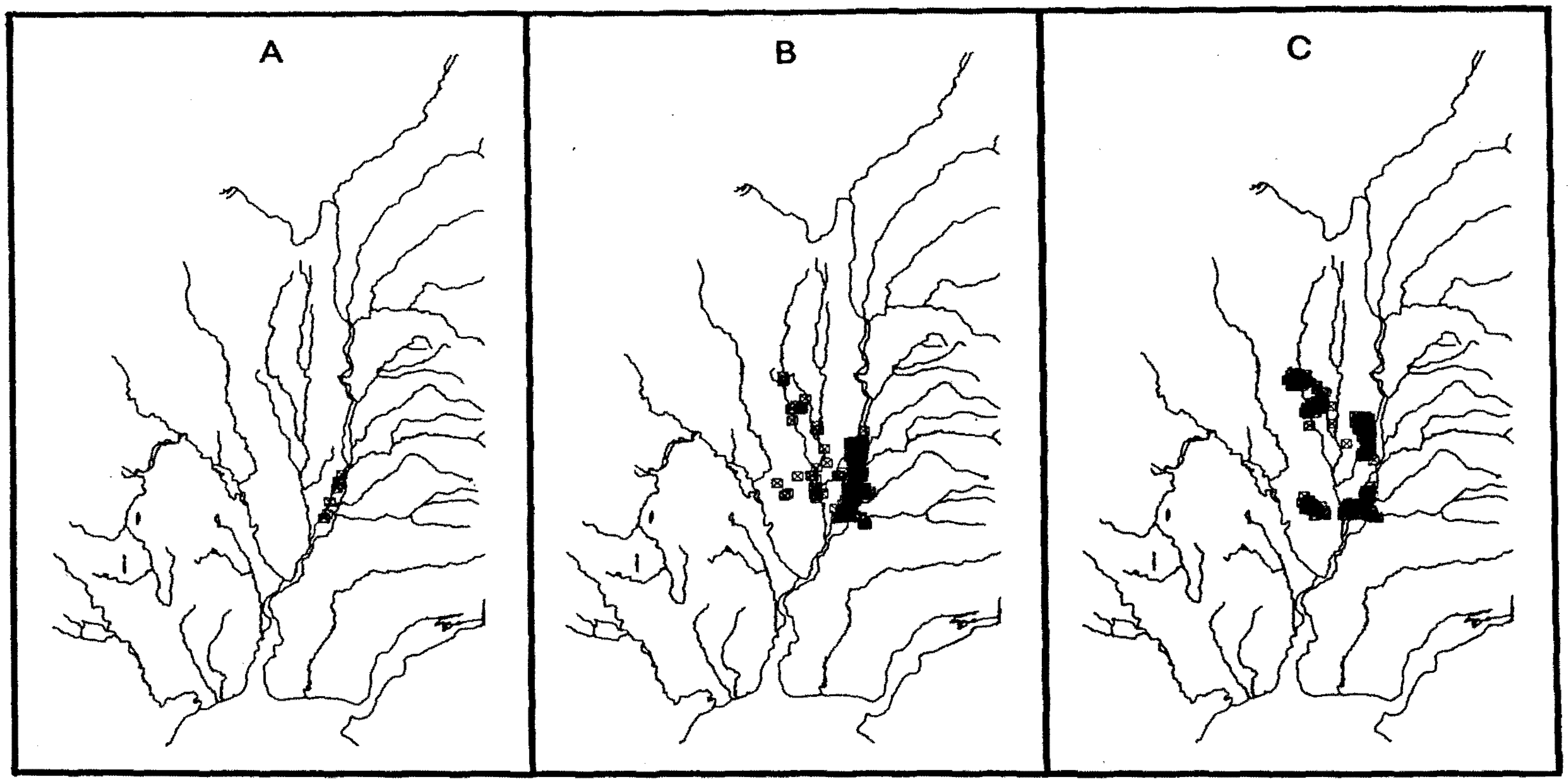


Figure 51 Continued (C)



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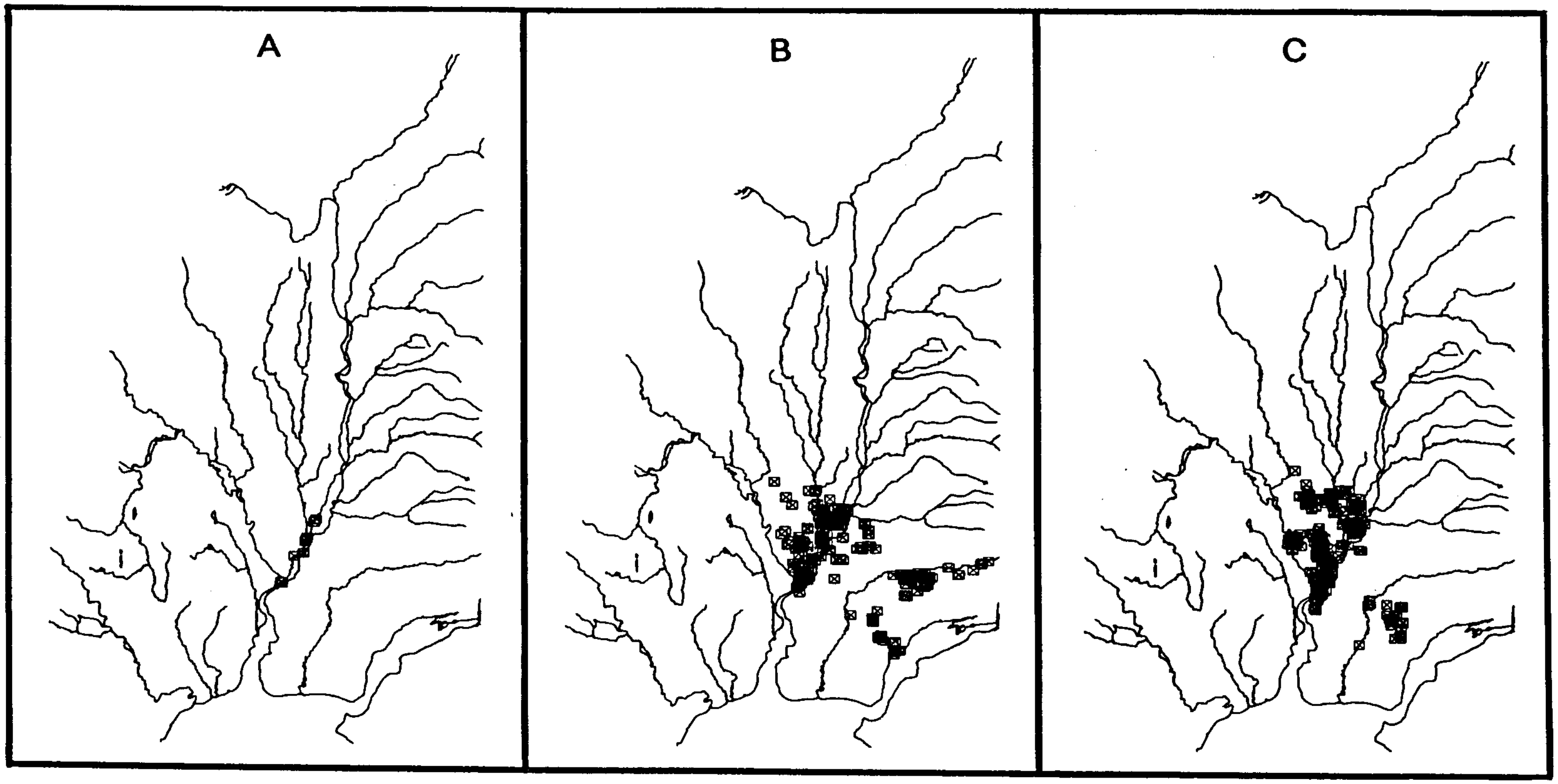

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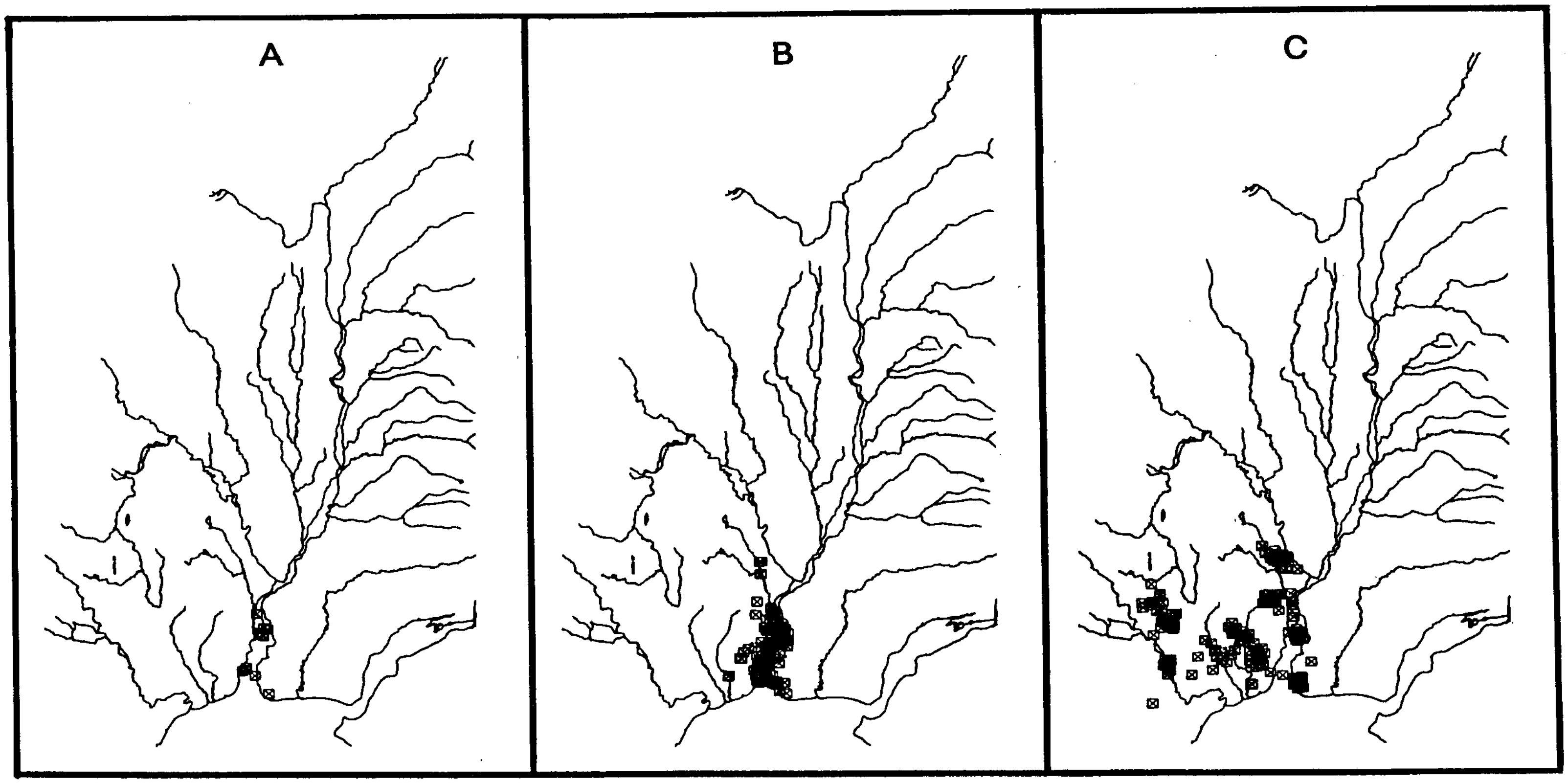

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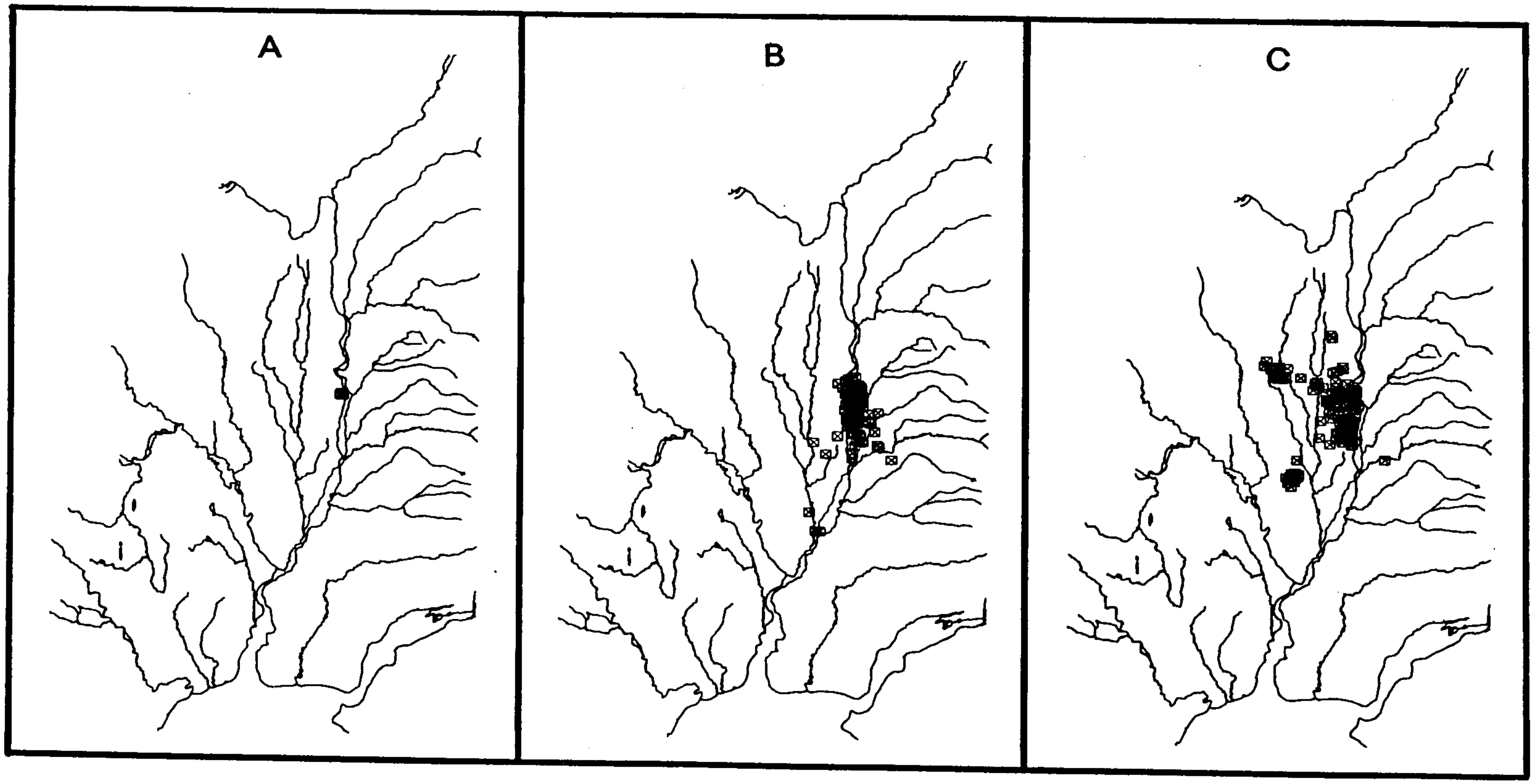

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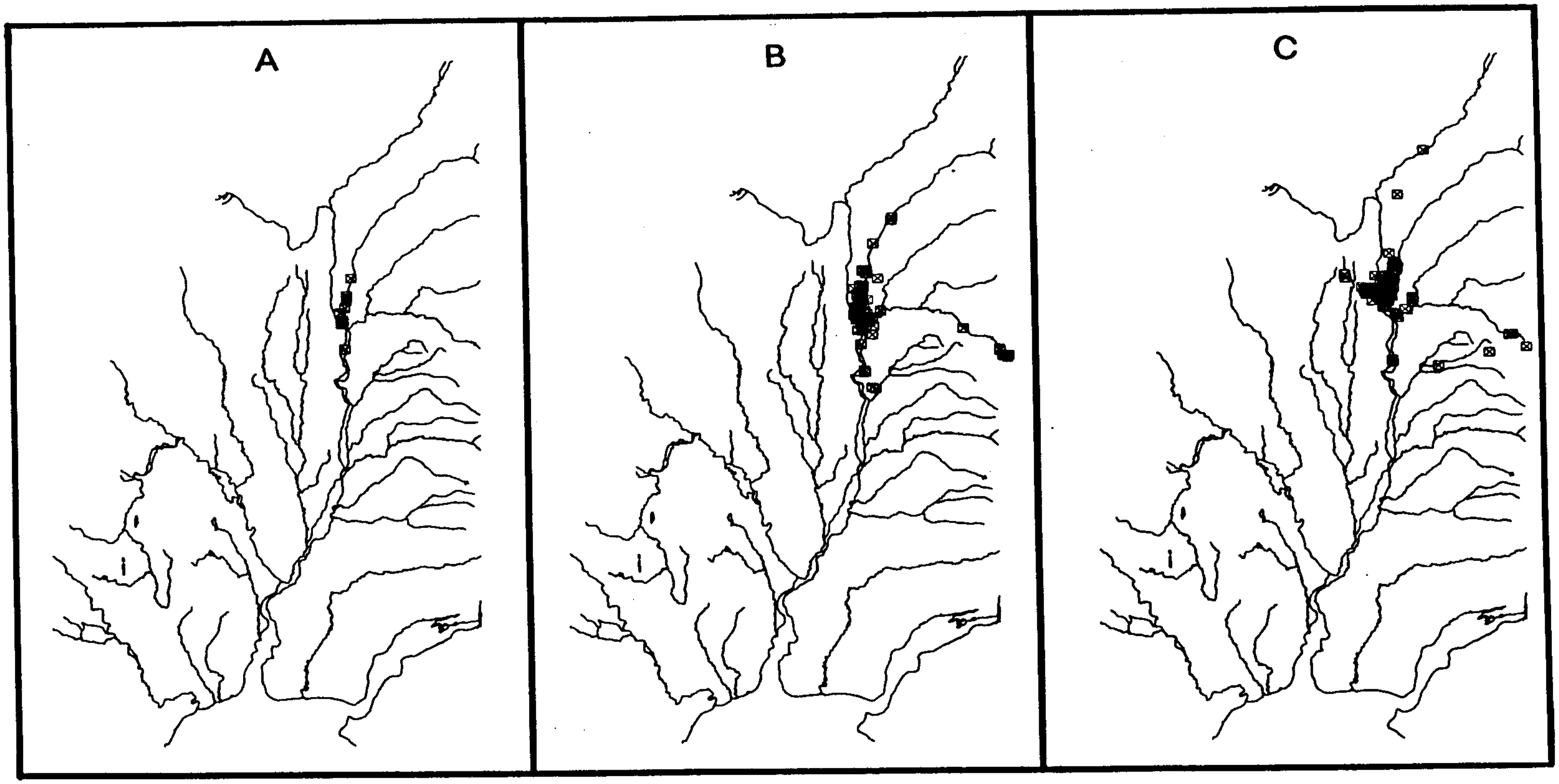

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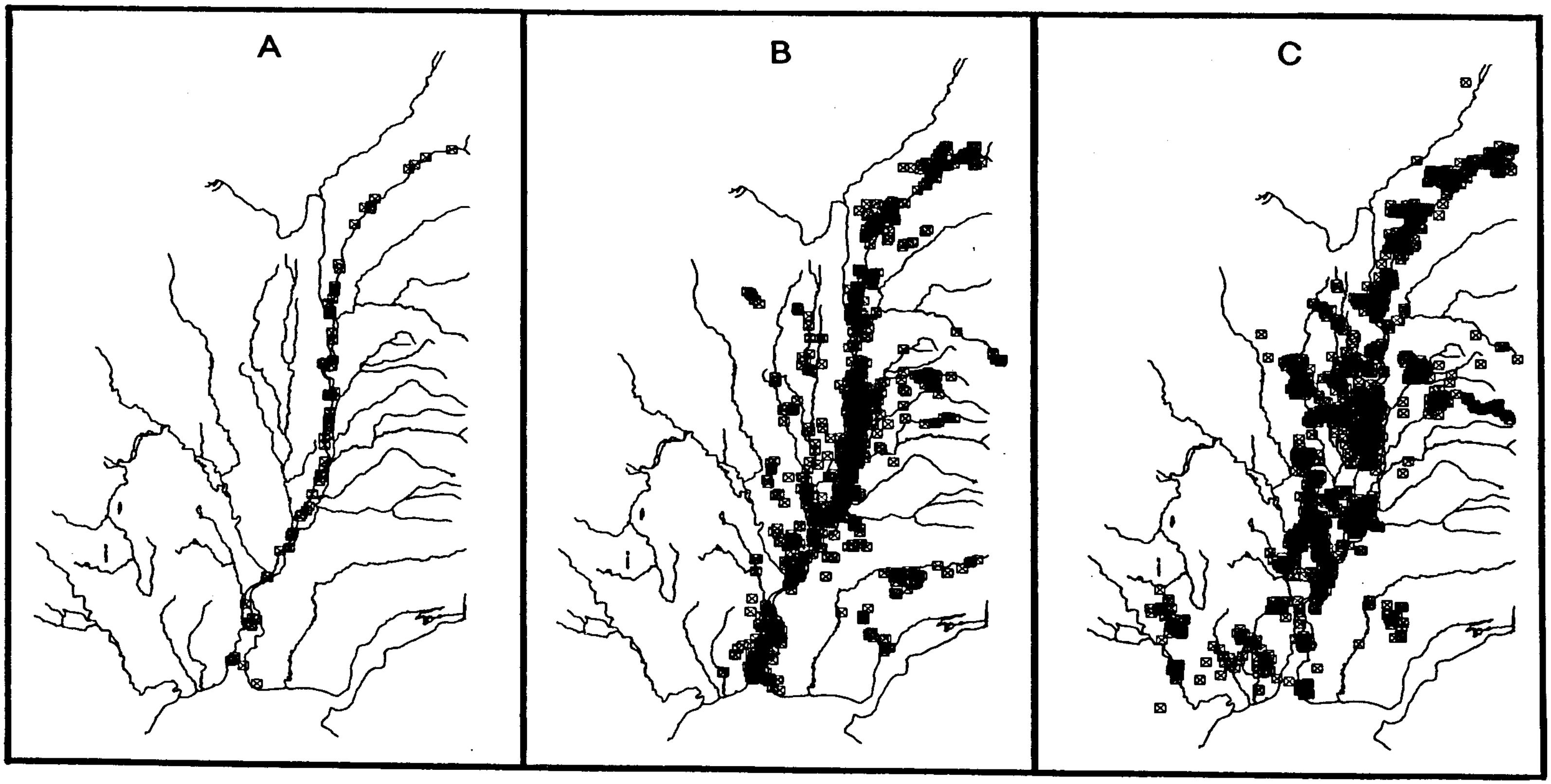

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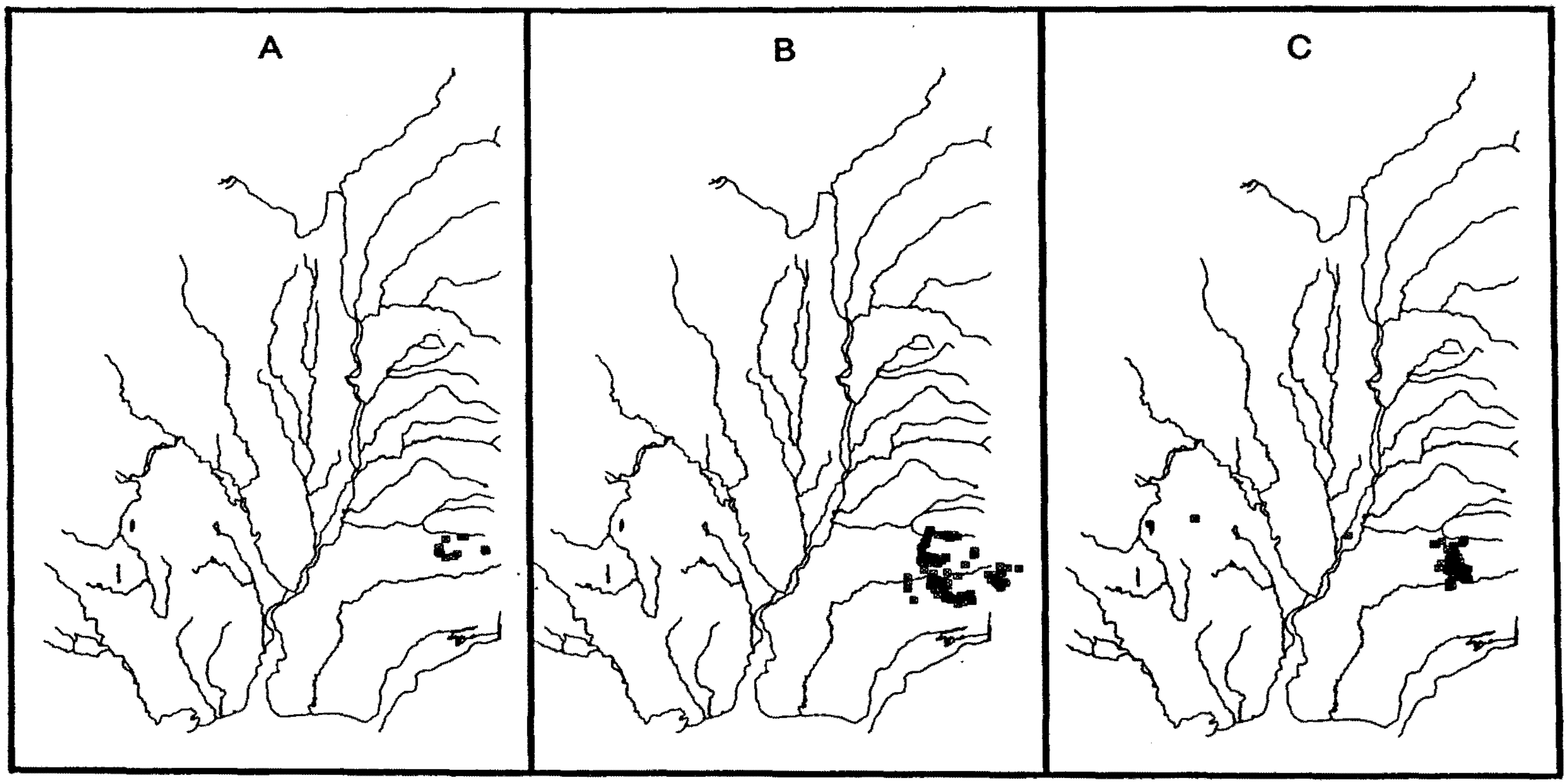

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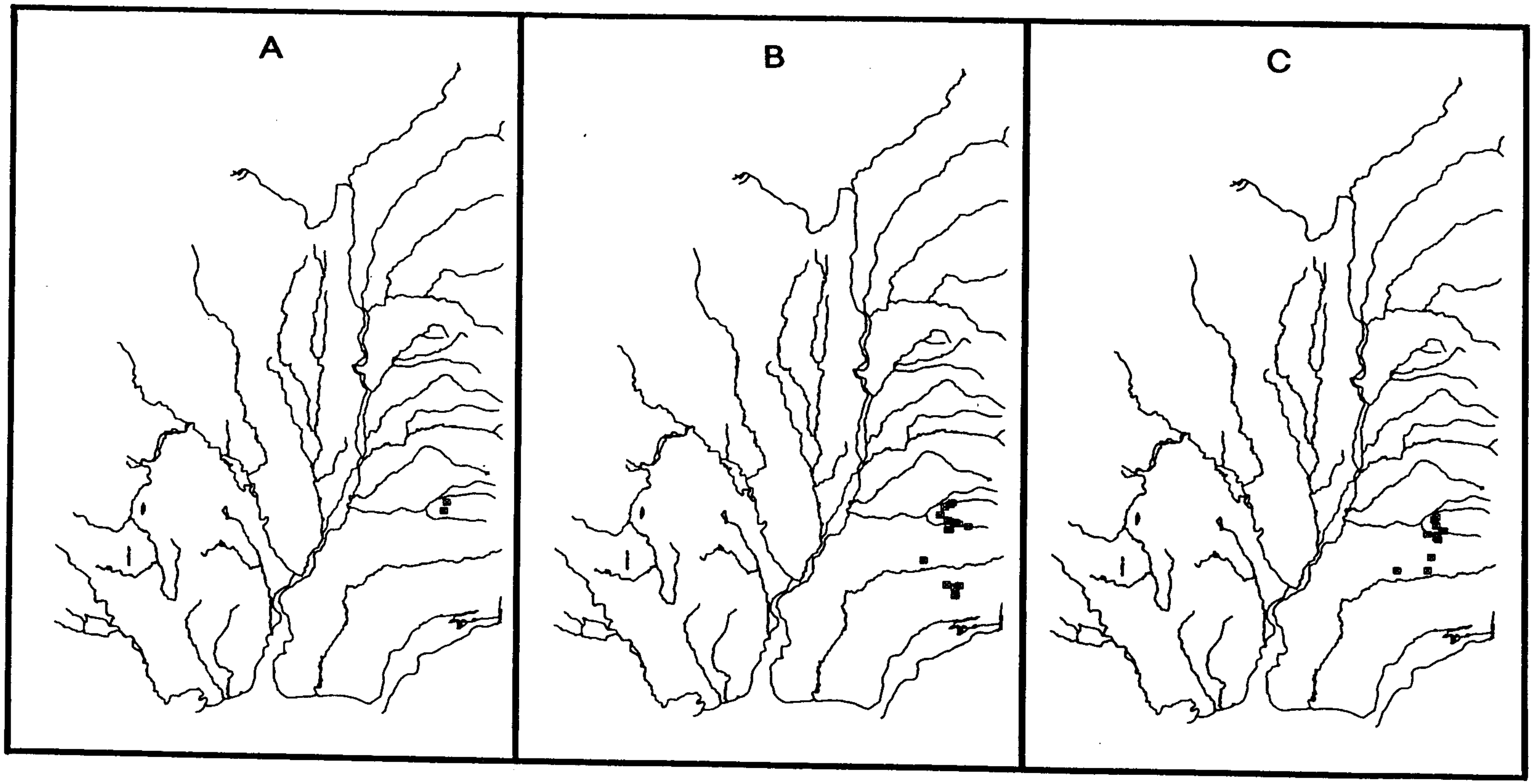
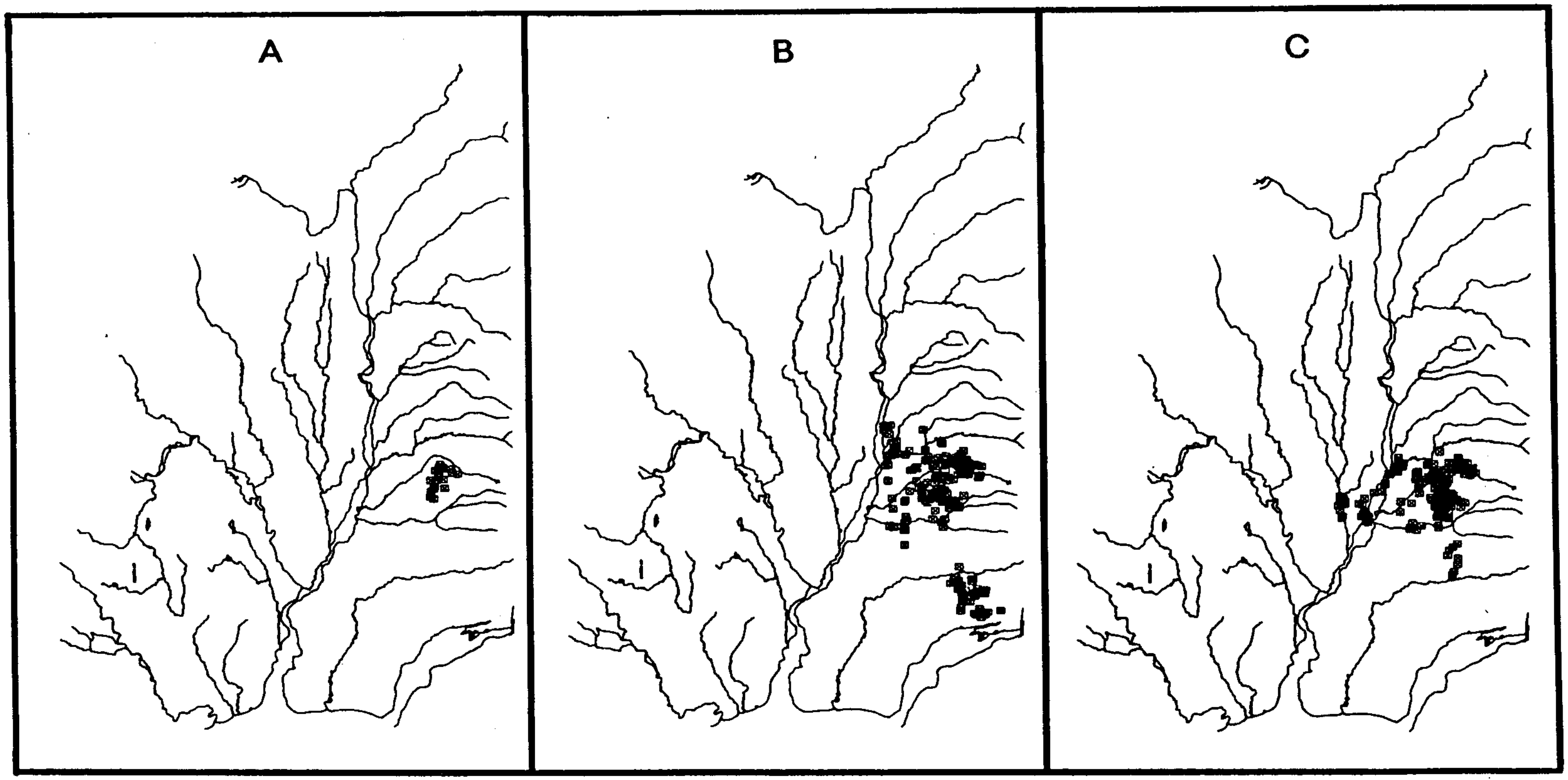


Figure 51 Continued (K)



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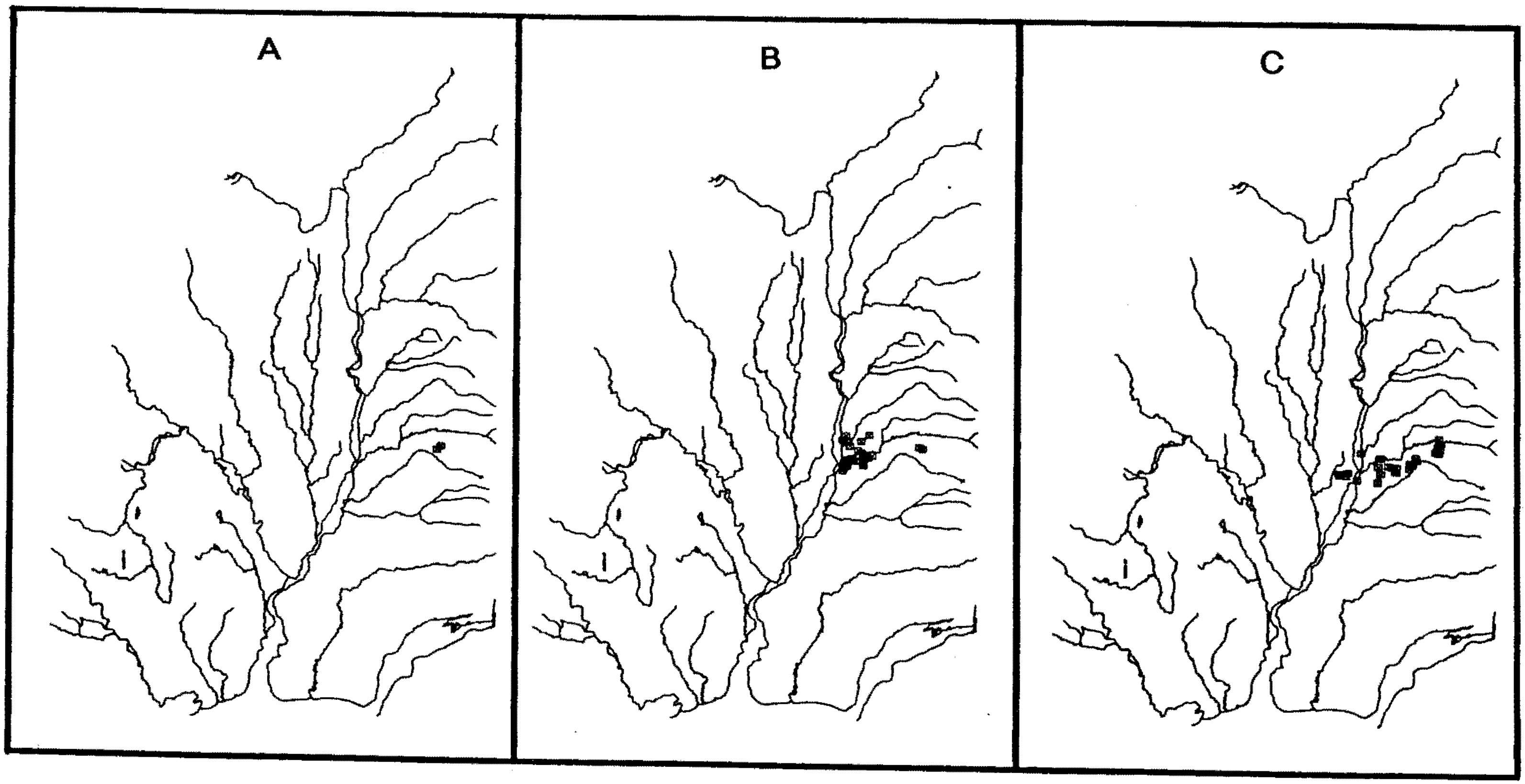

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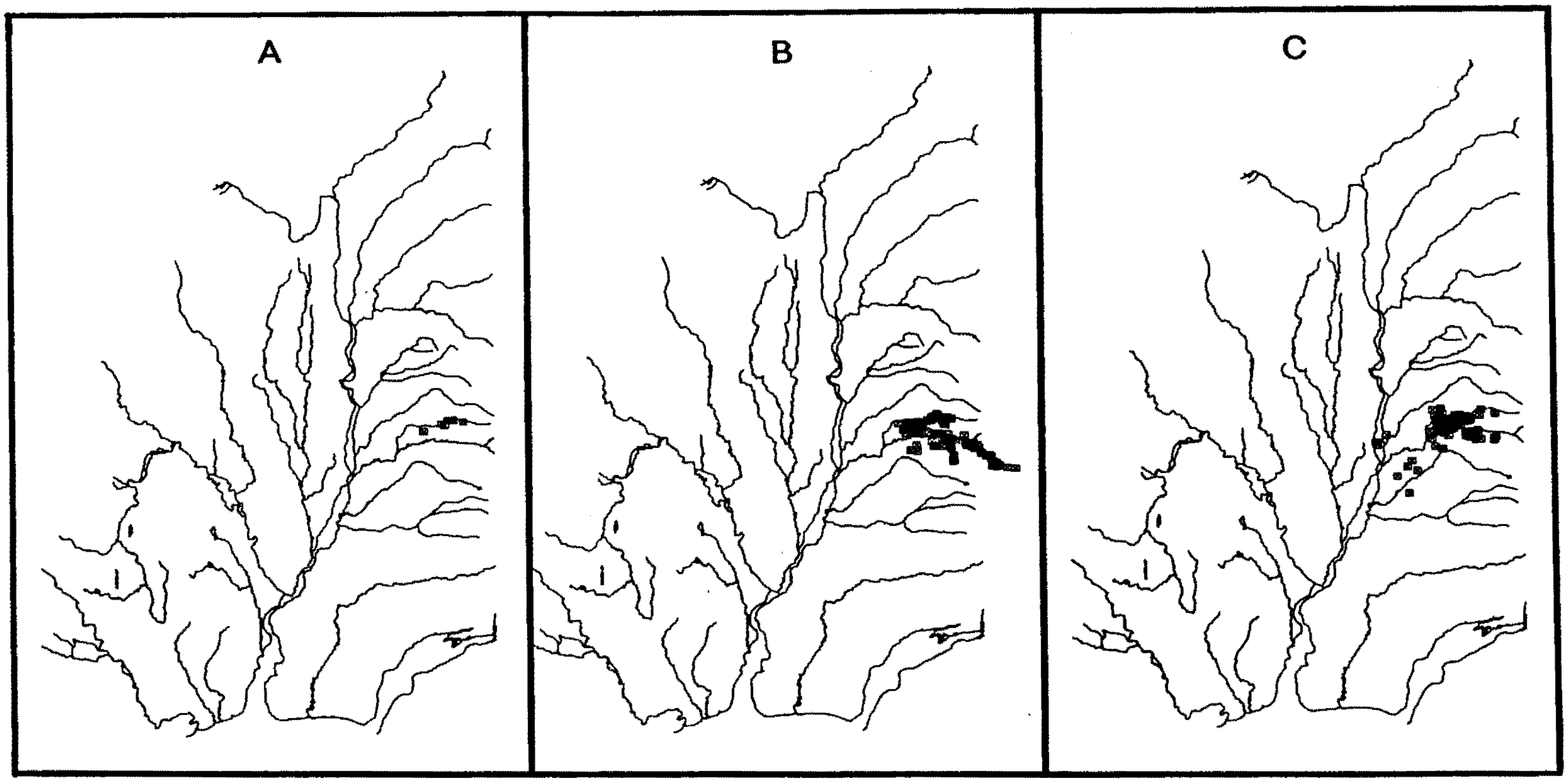

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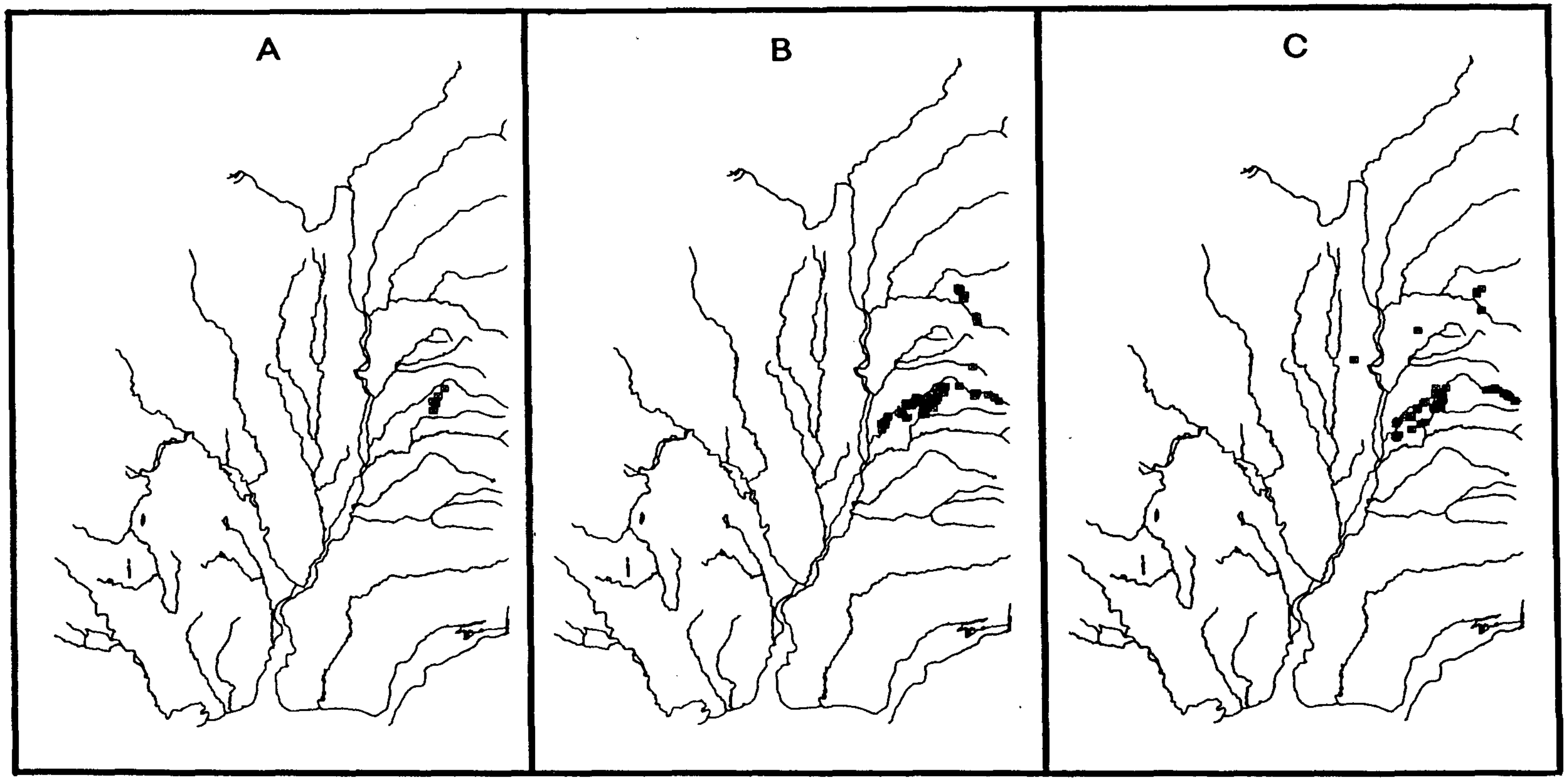
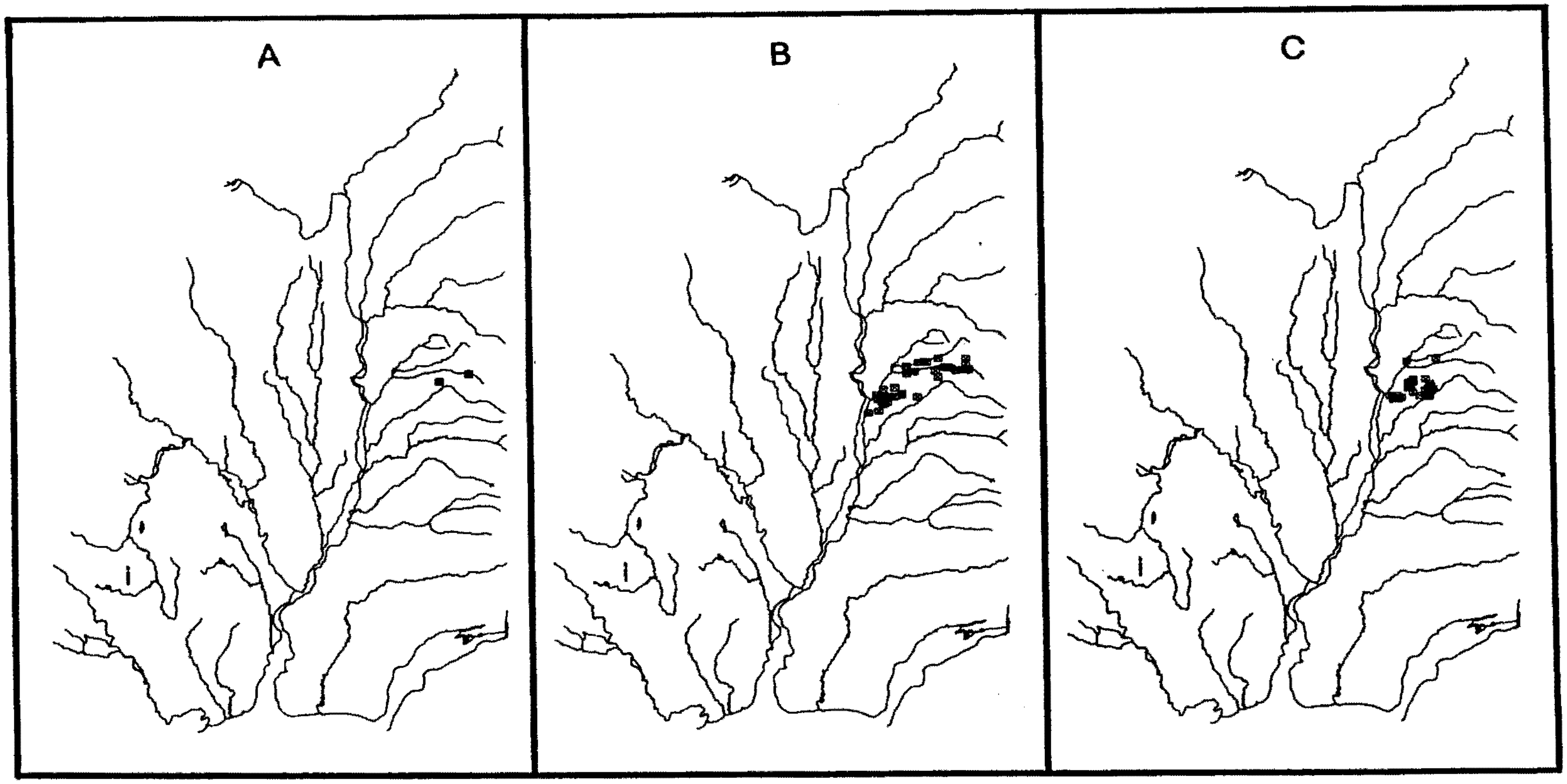


Figure 51 Continued (O)



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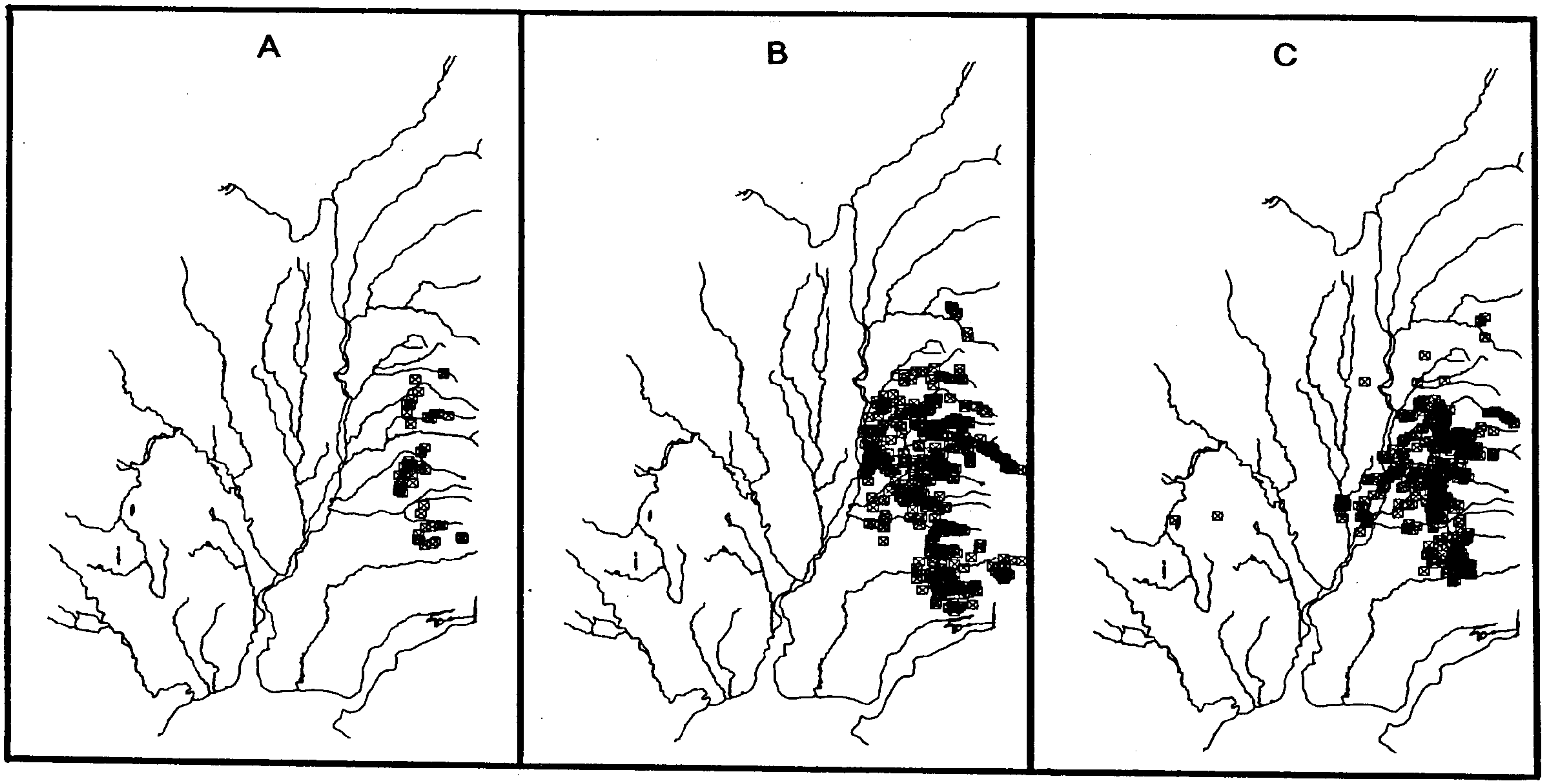

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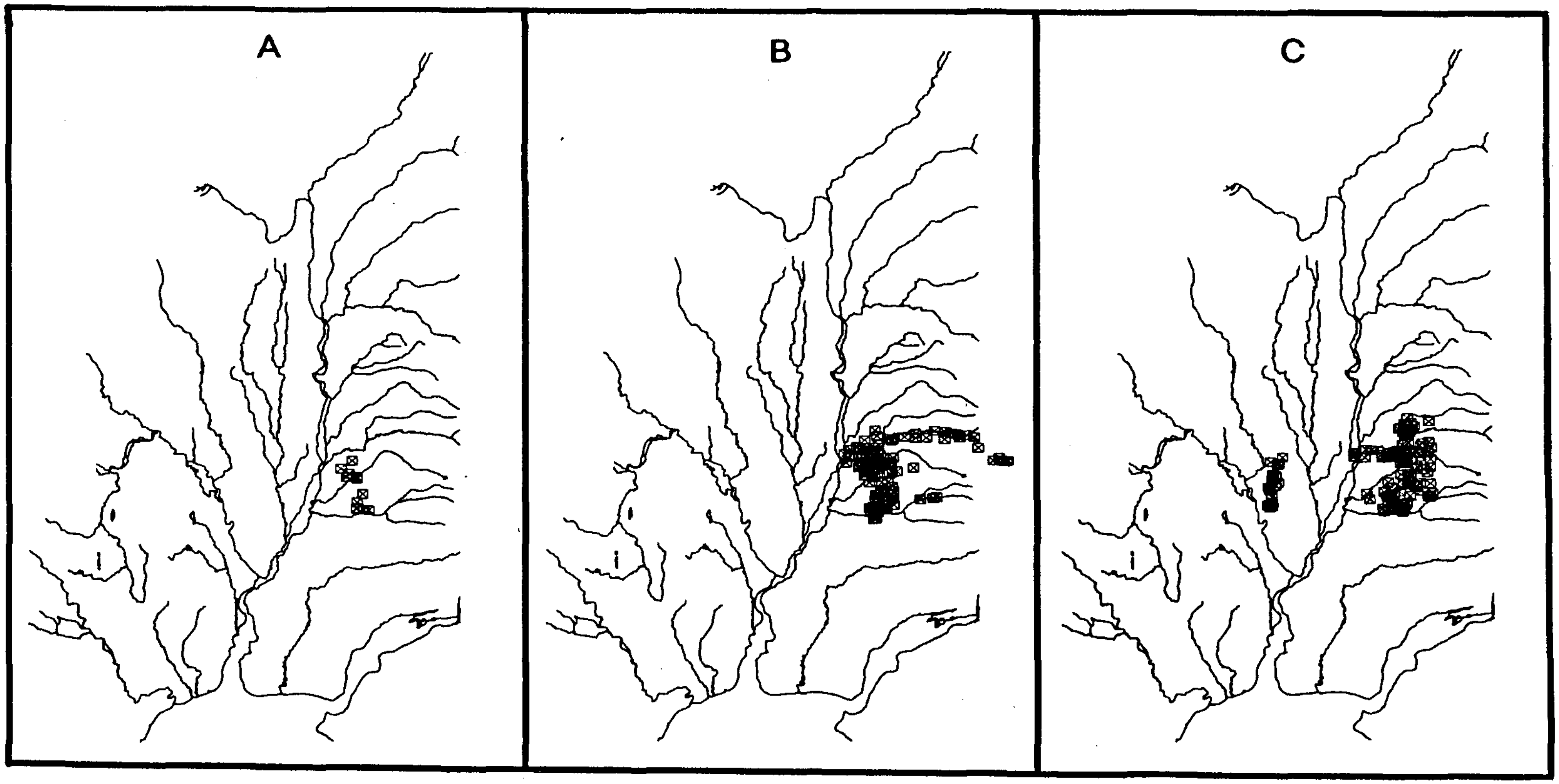

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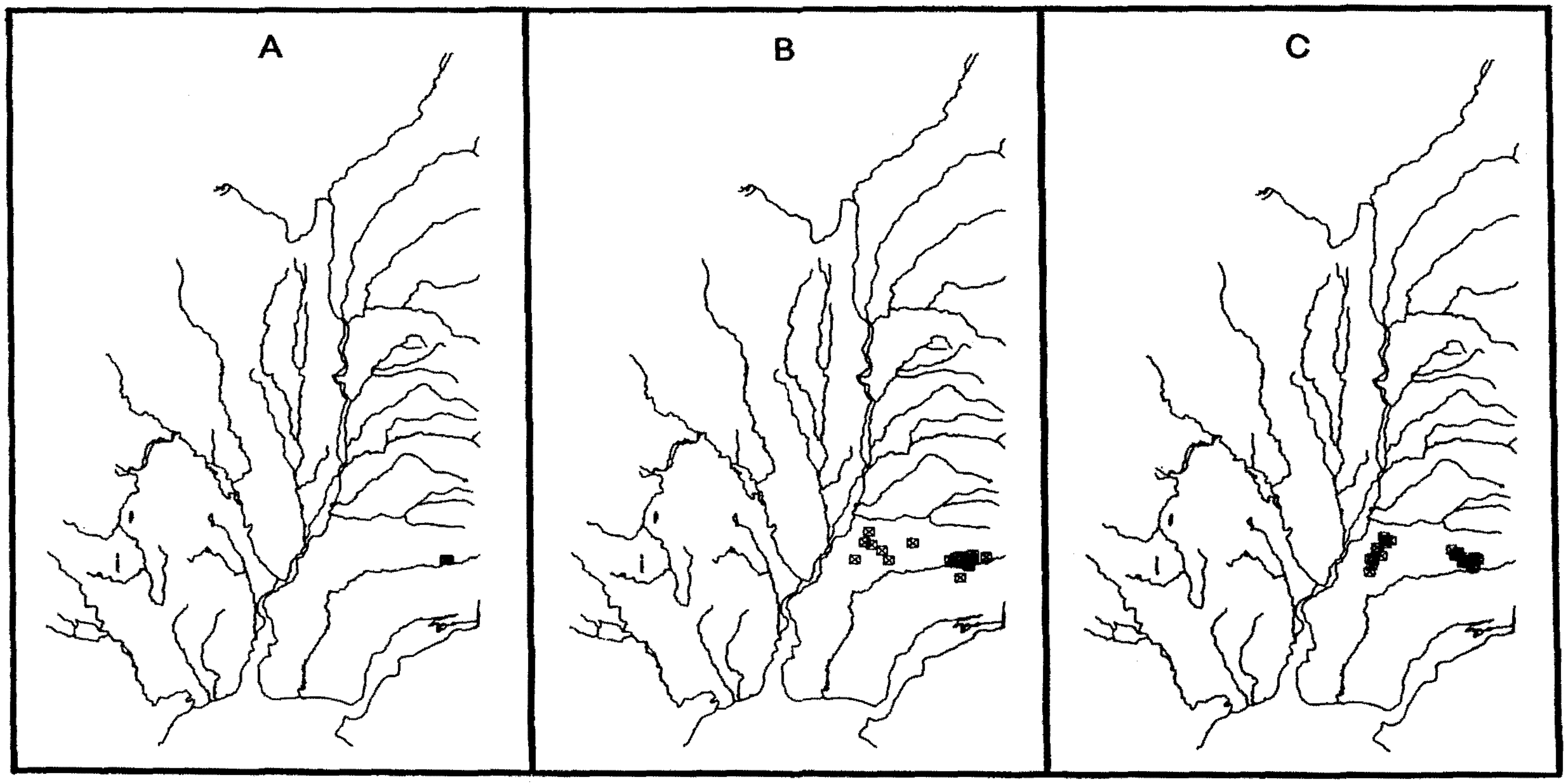

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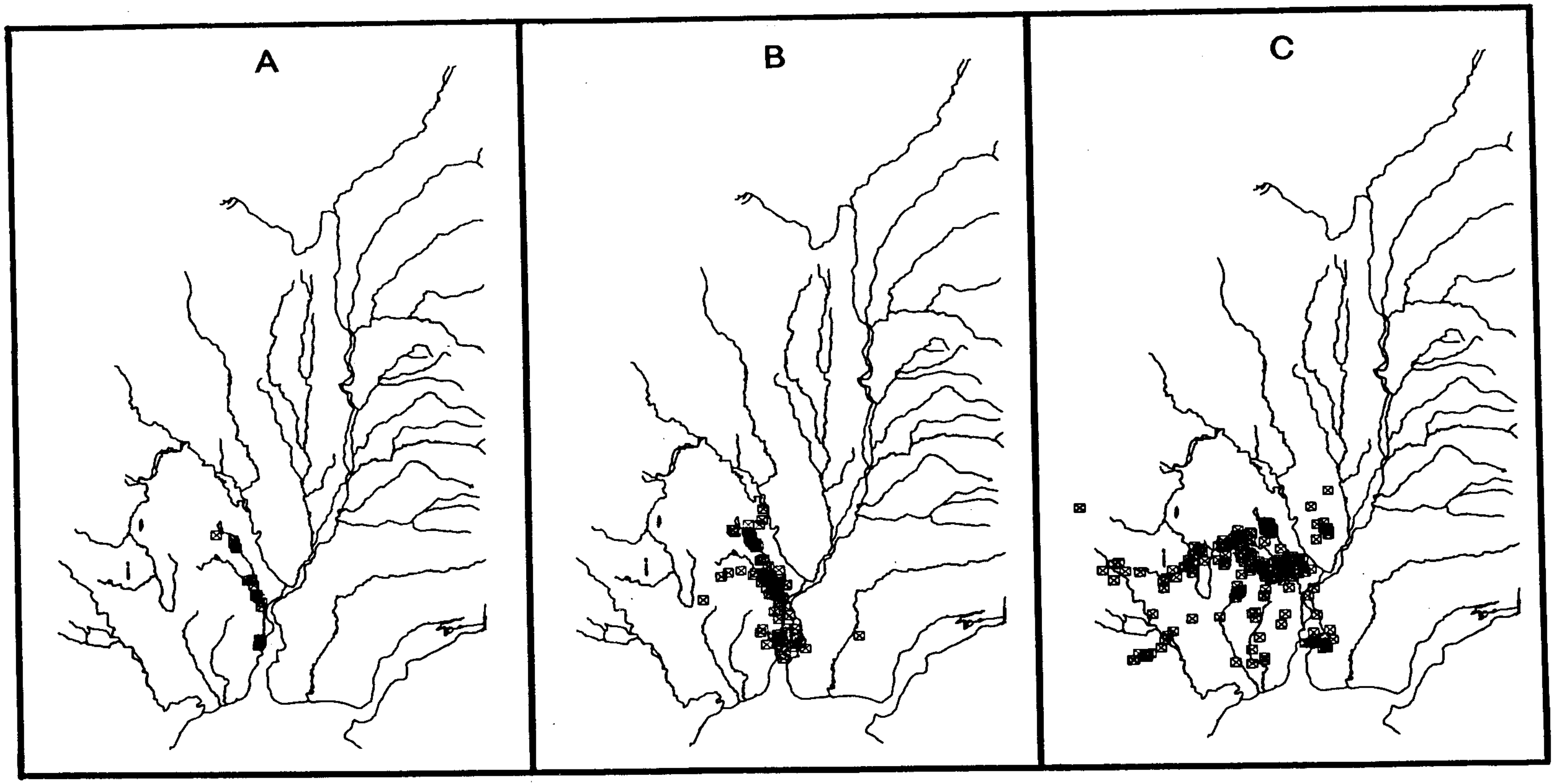

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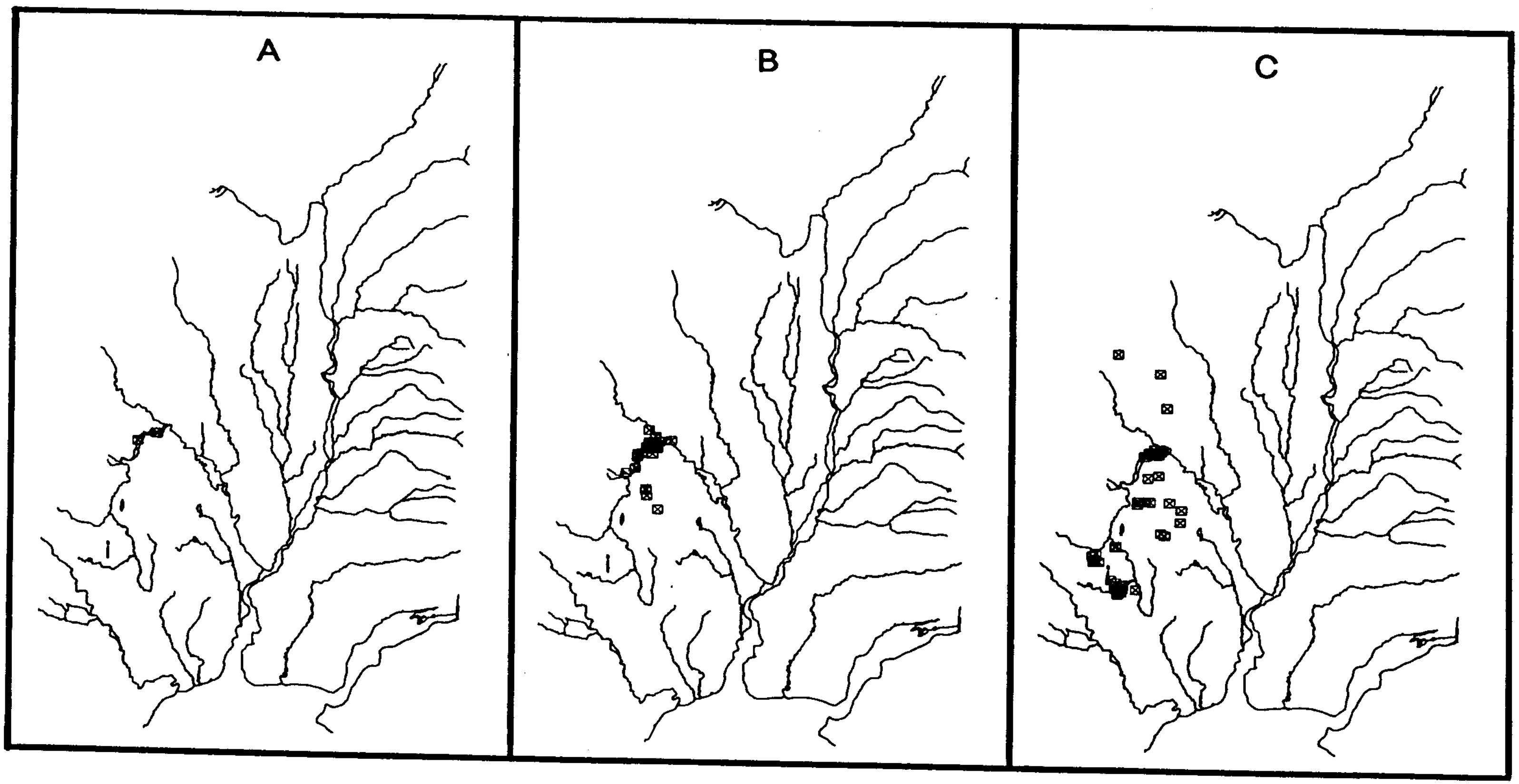


Figure 51 Continued (U)

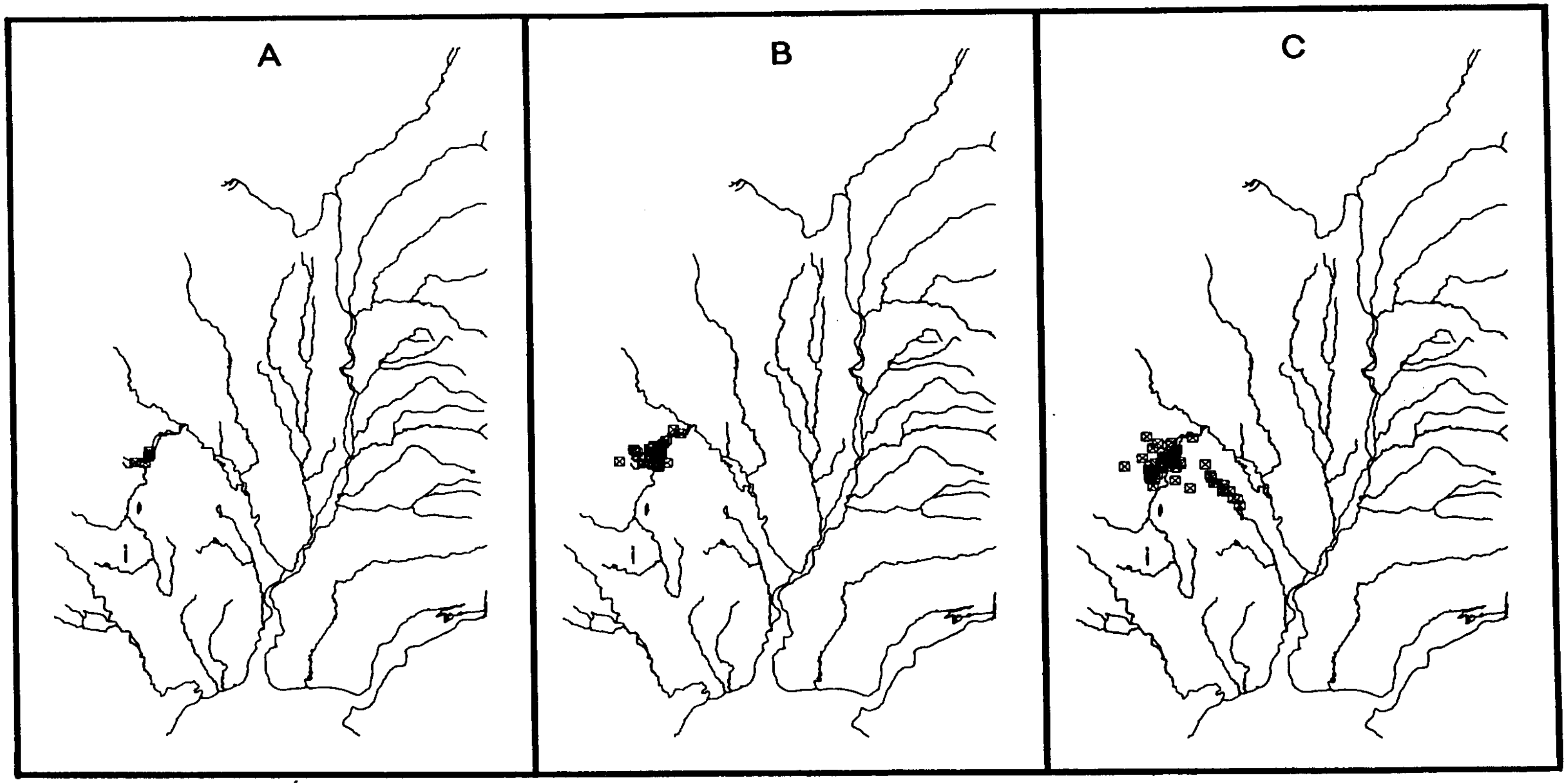
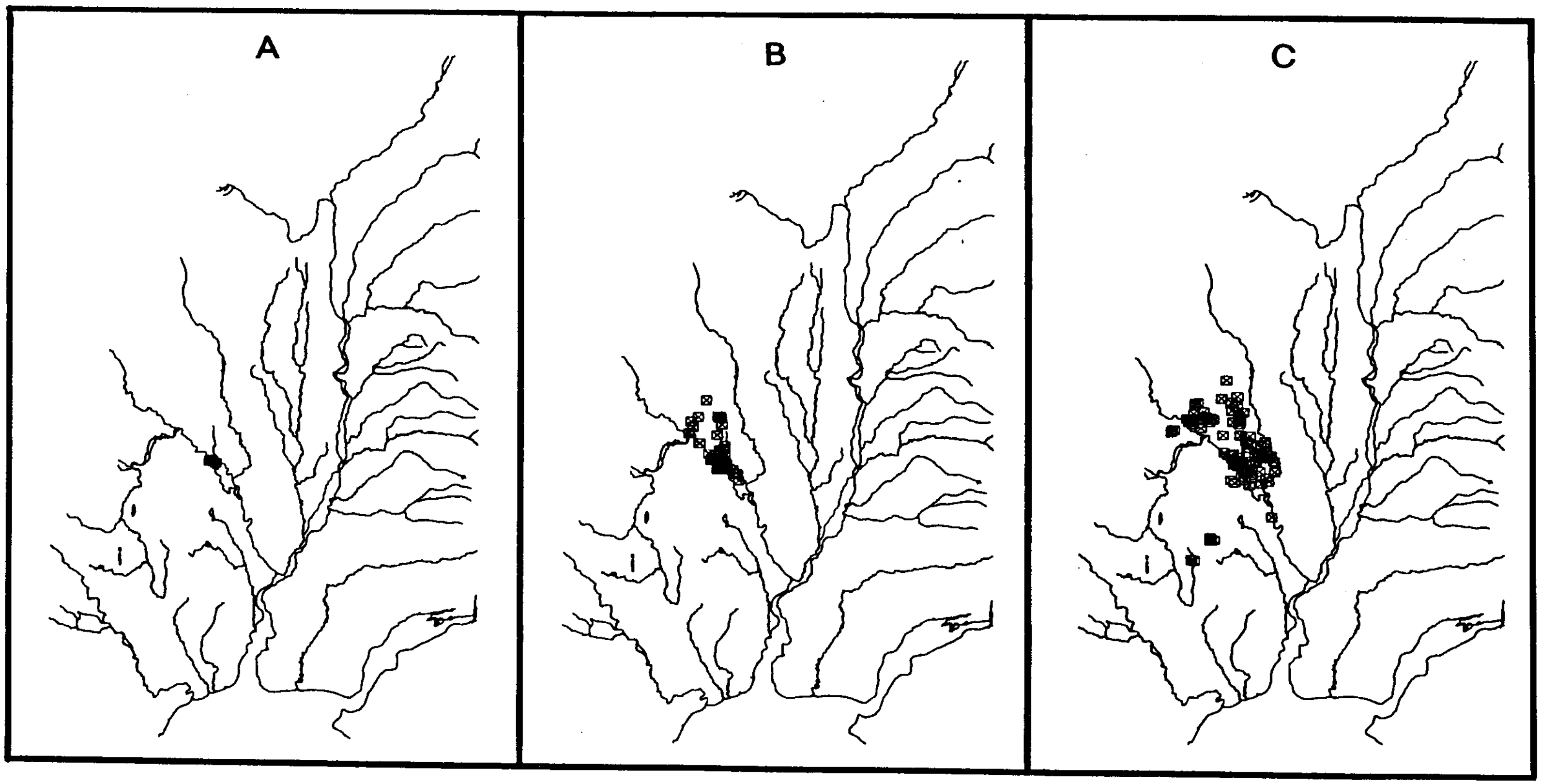


Figure 51 Continued (V)



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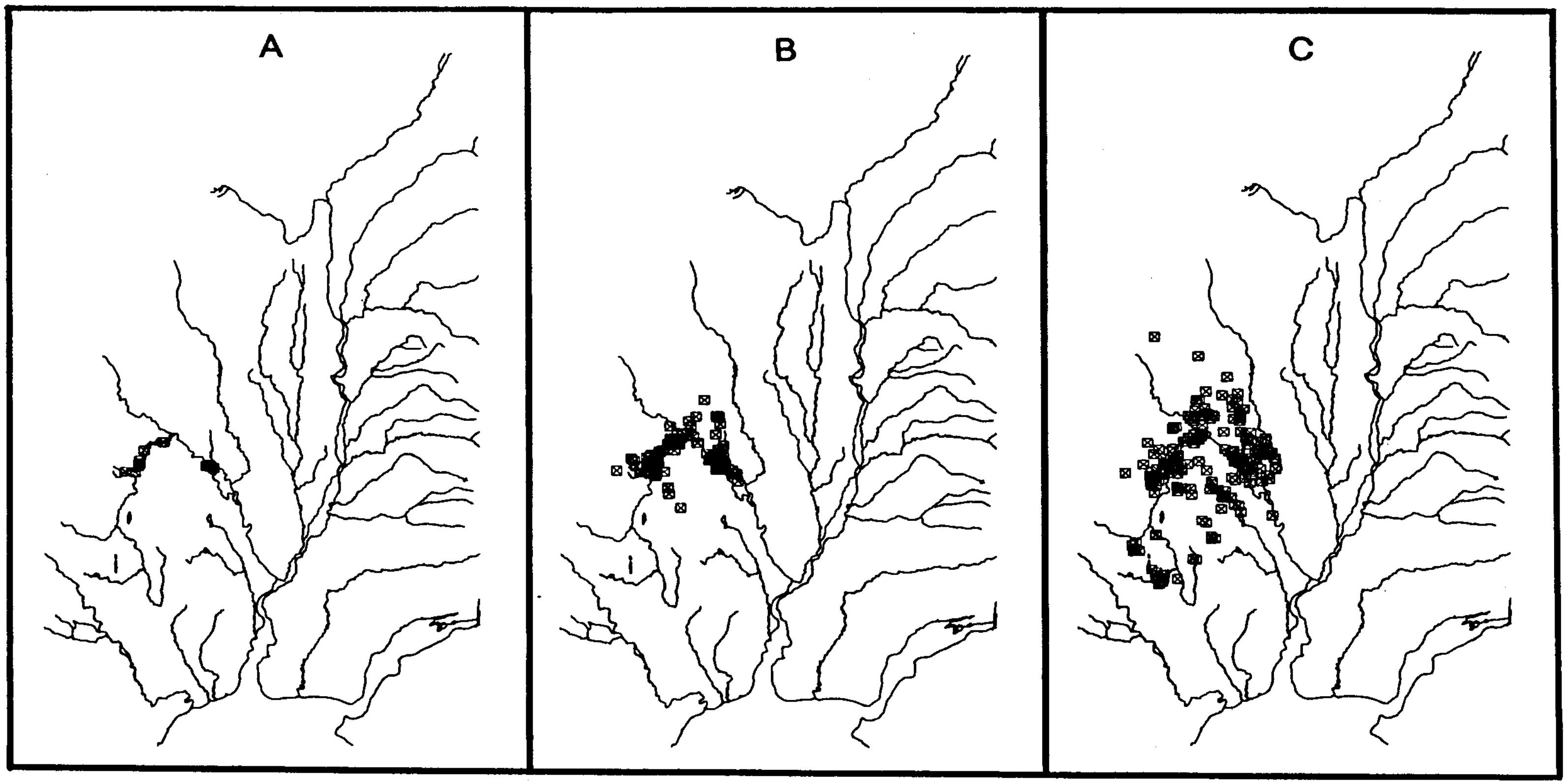

Figure 51 Continued (X)

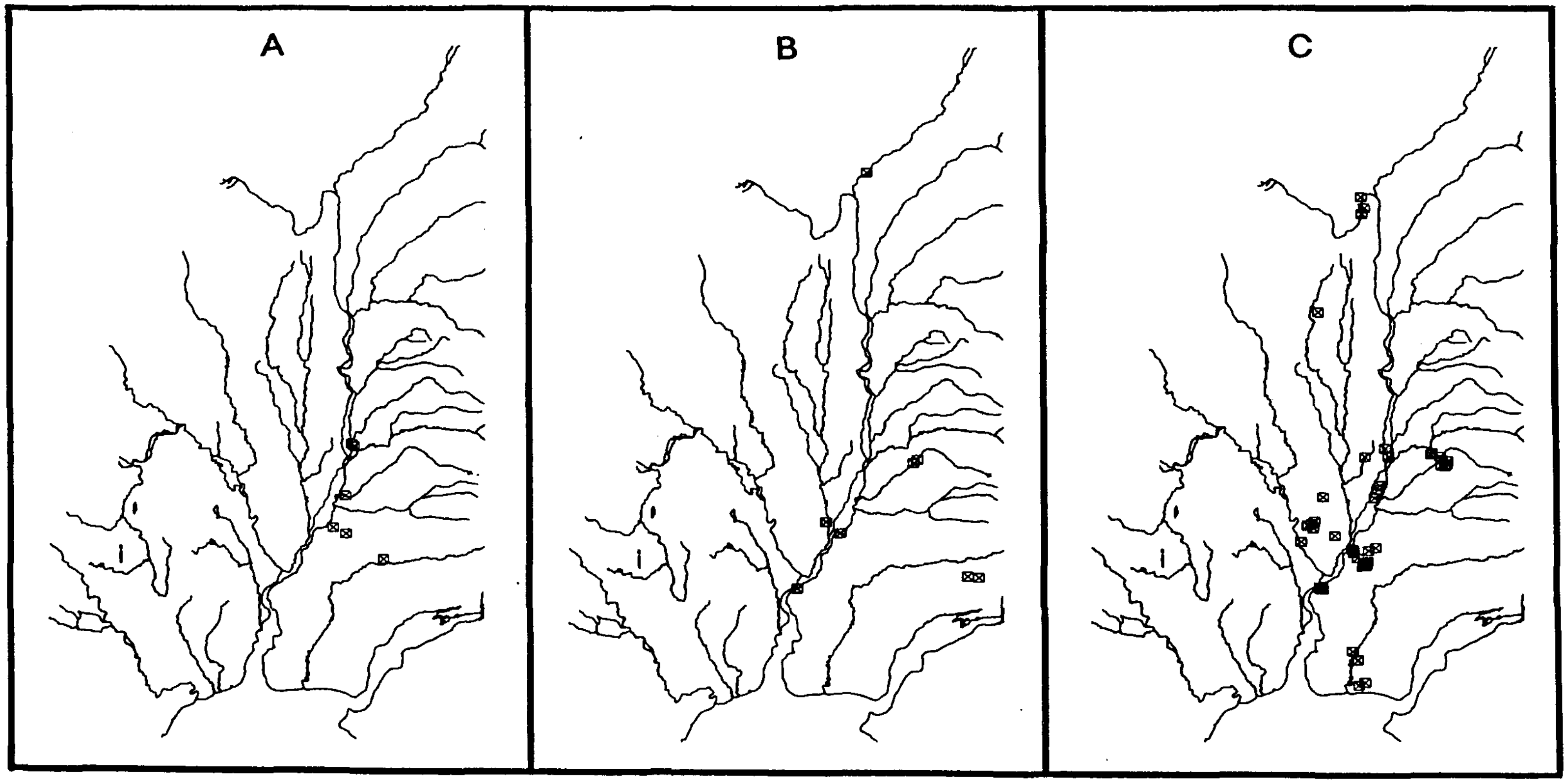

Table 1. Snowpack depth in Talkeetna and percent calf moose in winter concentration areas in lower Susitna River Valley, in March, 1982-85 and 1990. (D:\gmu16srv\calftabl.doc)

Year	Date	Snowpack depth (cm)	Winter concentration area	Location	No. moose	Percent calves
1982	24 March	46	Susitna River floodplain	Yentna River to Montana Creek	166	20.5
				Montana Creek to Talkeetna River	25	36.0
				Talkeetna River to Portage Creek	25	20.0
1983	23 March	81	Susitna River floodplain	Yentna River to Montana Creek	377	16.2
				Montana Creek to Talkeetna River	55	27.3
				Talkeetna River to Portage Creek	17	6.0
1984	23 March	94	Susitna River floodplain	Talkeetna River to Portage Creek	15	27.0
1985	21 March	157	Susitna River floodplain	Talkeetna River to Portage Creek	47	10.6
				Rabideux Creek to Talkeetna River	53	5.7
				Deshka River Islands	31	6.5
			Alexander Creek floodplain	Susitna River to Alexander Lake	142	5.6
			Moose Creek floodplain	Deshka to headwater	70	1.4
			Deshka River	Susitna River to headwater	29	0.0
1990	15 March	226	Susitna River floodplain	Montana Creek to Kashwitna River	64	2.4
				Talkeetna to Portage Creek	50	4.0
		69	Wasilla, Palmer, and vicinity	Fairview Loop	300	17.0
				Little Susitna River; Shrock/Pittman Road	92	16.3

Table 2. Information on location and date of capture, sex, and figures that show capture locations (A), and winter (B) and summer (C) radiofix locations of female and male moose adults that were radiocollared and telemetry monitored for radiofix locations in lower Susitna River Valley in south-central Alaska during 1980-91. Winter was 1 January through 31 March; summer was 7 May through 30 September.

Location[a]	Date	No. moose Captured	No. moose Females	Fig. 59
WCA; SRF; Talkeetna River to Portage Creek	March 1981	11	9	A
WCA; SRF, Kashwitna River to Talkeetna River	April 1980, March 1981	17	11	B
WCA; SRF, Willow Creek to Kashwitna River	March 1981	7	7	C
WCA; SRF, Yentna River to Willow Creek	March 1981	9	6	D
WCA; SRF, Cook Inlet to Yentna River	February-March 1982	11	6	E
WCA, Coleman homestead, west of Susitna River at Montana	January-February 1984	7	4	F
WCA; SRF, Talkeetna River to Chase	January 1985	12	9	G
WCA; all SRF and Coleman homestead; Figs. FA-G	March 1980-January 1985	74	52	H
PCA, Bald Mountain	December 1985	10	5	I
PCA, Moss Mountain	December 1985	2	1	J
PCA, Willow Mountain	December 1985, 1988; February 1986	19	10	K
PCA, Witna Mountain	January 1986	2	2	L
PCA, Brownie Mountain	January 1986	7	4	M
PCA, Wolverine Mountain	February 1986	5	3	N
PCA, Sunshine Mountain	January-February 1986	3	0	O
PCA, all TPR; Figs. FI-O	December 1985-December 1988	48	25	P
LWR, Kashwitna Corridor Forest	January 1987, February 1989	12	12	Q
LWR, Shrock Road, personal-use wood cutting area	February-March 1988	3	3	R
WCA, Alexander Creek floodplain, Susitna River to Alexander Lake	March 1987	19	15	S
WCA, Skwentna River floodplain, Skwentna	February 1988, March 1989	6	4	T
WCA, Skwentna River floodplain, Old Skwentna	February 1988, March 1989	9	5	U
WCA, Yentna River floodplain, Lake Creek to McDougall	February 1988	10	7	V
WCA; Skwentna River and Yentna River floodplains; Figs. FT-V	February 1988; March 1989	25	16	W
LWR, Transportation corridor, Pittman to Sheep Creek	April 1990	6	3	X

[a] WCA=winter concentration area; SRF=Susitna River floodplain; PCA=timberline postrut concentration area; LWR=lowland winter range.

Table 3. Autumn (20 August through 30 September) versus winter (20 January through 20 March) elevation of telemetry monitored moose adults radio-collared in alpine postrut concentration areas (PCA) in the western foothills of the Talkeetna Mountains in GMSs 14A and 14B in south-central Alaska, 1986-91. Elevation used in comparisons = lowest elevation in each season.

	Calendar year[a]											
	1986-87		1987-88		1988-89		1989-90		1990-91		1986-91	
PCA	L[b]	H[c]	L	H	L	H	L	H	L	H	L	H
Sunshine-Wolverine	4	2	4	0	3	1	3	0	1	1	15	4
Brownie	1	6	2	4	0	5	2	2	2	2	7	19
Witna-Willow	8	4	6	4	7	5[d]	5	4	3	2	29	19
Moss-Bald	6	0	5	0	4	0	4	0	4	0	23	0
All	19	12	17	8	14	11	14	6	10	5	74	42

[a] Calendar year=16 May through 15 May the following year.
[b] L=No. moose at lower elevation in winter than in autumn.
[c] H=No. moose at higher elevation in winter than in autumn.
[d] 1 moose was at the same elevation in autumn and in winter.

Table 4. Nearness ($\leq$2 km)of telemetry monitored radiocollared moose adults to the Parks Highway in Game Management Subunit (GMS) 14B in winter (1 January through 28 February), lower Susitna River valley, south-central Alaska, 1986-91. Nearness=distance between Parks Highway and radiofix nearest to the Parks Highway. Monitored moose were captured and radio-collared in 7 timberline postrut concentration areas (PCA) in GMS 14A and 14B above 500 m elevation in the western foothills of the Talkeetna Mountains.

		Year													
GMS	PCA	1986		1987		1988		1989		1990		1991		1986-91	
		$\leq$[a]	>[b]	$\leq$	>	$\leq$	>	$\leq$	>	$\leq$	>	$\leq$	>	$\leq$	>
14B	Sunshine	0	3	1	1	1	1	0	2	0	1	0	1	2	9
	Wolverine	0	6	0	4	0	2	0	2	0	3	0	1	0	18
	Brownie	0	6	0	7	0	6	0	5	0	4	0	4	0	32
	Witna	1	0	1	0	0	2	2	0	1	0	1	0	6	2
	Willow	1	13	2	9	0	14	1	11	2	6	0	4	6	57
	All	2	28	4	21	1	25	3	20	3	14	1	10	14	118
14A	Moss	0	2	0	1	0	0	0	0	0	0	0	0	0	3
	Bald	0	10	0	5	0	5	0	4	0	4	0	4	0	32
	All	0	12	0	6	0	4	0	4	0	4	0	4	0	35
All		2	40	4	27	1	29	3	24	3	18	1	14	14	153

[a] No. moose radiotracked 1 time $\leq$2 km from the Parks Highway.
[b] No. moose not radiotracked 1 time $\leq$2 km away from the Parks Highway.

Table 5. Nearness of telemetry monitored moose adults to the Parks Highway in GMS 14B in autumn (20 August through 30 September) versus in winter (20 January through 20 March) in lower Susitna River Valley in south-central Alaska, 1986-91. Nearness=comparison of radiofixes nearest to highway in each season. Monitored moose were captured and radiocollared timberline postrut concentration areas (PCA) in Game Management Subunits 14 A and 14B in the western foothills of the Talkeetna Mountains Alaska, 1986-91.

	Calendar year[a]											
	1986-87		1987-88		1988-89		1989-90		1990-91		1986-91	
PCA	N[b]	F[c]	N	F	N	F	N	F	N	F	N	F
Sunshine-Wolverine	1	5	1	3	1	3	0	3	1	1	4	15
Brownie	6	0	6	0	5	0	3	0	4	0	24	0
Willow-Witna	7	5	8	3	7	7	4	5	3	2	29	22
Moss-Bald	5	1	5	0	4	0	4	0	4	0	22	1
All	19	11	20	6	17	10	11	8	12	3	79	38

[a] Calendar year=16 May through 15 May the following year.
[b] N=No. moose radiotracked 1 time nearer to Parks Highway in autumn than in winter.
[c] F= No. moose not radio-tracked 1 time nearer to Parks Highway in autumn than in winter.

Table 6. Dispersal of telemetry monitored radiocollared moose adults from a winter concentration area (WCA) in Game Management Subunit (GMS) 16A to GMS 14A and GMS 14B or postrut concentration areas (PCA) in those GMS in 4 seasons, lower Susitna River Valley, south-central Alaska, 1980-90. Monitored moose were radiocollared in winter in WCA in the Susitna River floodplain between Talkeetna River and Yentna River.

		% in GMS 14A or 14B[a]			% in postrut area in GMS 14A or 14B[b]		
Season[c]	No. moose-seasons	one year[d]	every year[e]	>75% of the years	one year	every year	>75% of the years
Calving	40	25.0	5.0	7.5	5.0	2.5	2.5
Summer	38	18.4	7.9	7.9	7.9	2.6	2.6
Autumn	37	16.2	13.5	13.5	8.1	8.1	8.1
Early winter	37	35.1	13.5	13.5	16.2	8.1	8.1

[a] Moose not radiotracked to GMS 14A or GMS 14B were radiotracked to GMS 16A, 16B, or 13E.
[b] Postrut area=the portion of GMS 14A or 14B east of UTM X=354,000.0. The postrut area is mainly above timberline (i.e., 500 m elevation).
[c] Calving=7 May through 15 June; summer=1 July through 15 August; autumn=20 August through 30 September, the hunting season; early winter=1 November through 15 December, postrut period.
[d] One year=moose radiotracked to area at least 1 time.
[e] Every year= moose radiotracked to area at least 1 time each year monitored. Moose were telemetry monitored in 1-9 years.

Table 7. Movement of radiocollared moose adults from winter concentration areas (WCA) in GMS 16A to postrut concentration areas (PCA) in GMS 14A and 14B in 4 seasons during 1980-90. The WCA was in the Susitna River floodplain between the Talkeetna River and the Yentna River. The PCA was in the western foothills of the Talkeetna Mountains east of UTM X=354,000.0, mainly above timberline, above 500 m in elevation.

		Season[a]			
No. moose	% moose	Calving	Summer	Hunt	Postrut
29	72.5	N[b]	N	N	N
3	7.5	N	N	N	-
1	2.5	N	N	-	-
2	5.0	N	-	-	-
1	2.5	N	N	N	R
2	5.0	N	R	R	R
1	2.5	R	R	R	R
1	2.5	R	N	N	R

[a] Calving=7 May through 15 June; summer=1 July through 15 August; hunt=20 August through 30 September; postrut=7 November through 21-December.
[b] N=moose not radio-located in PCA; R=moose radio-located in PCA at least 1 time; -=moose not monitored in that season.

Table 8. Nearness (km) of moose adults radio-collared in winter concentration areas (WCA) in GMS 16A to timberline postrut concentration areas (PCA) in remote portions of Game Managment Subunits (GMS)14A and 14B during 4 seasons in south-central Alaska, 1980-90. The WCA was the Susitna River floodplain between the Talkeetna River and the Yentna River. The PCA was in the western foothills of the Talkeetna Mountains east of UTM X=354,000.0. The PCA was mainly above timberline, above 500 m in elevation.

Seasonal period	Seasonal period[b]	No. moose: In PCA only	No. moose: Not in PCA area[c]	Nearness statistics for moose not in PCA[a]: Mean	SE	Range
Calving	Calving	0	38	26.6	1.6	0.1-44.5
Summer	Summer	1	36	28.5	1.7	5.4-45.4
Autumn	Autumn	0	36	28.0	1.9	0.1-45.6
Postrut	Postrut	2	32	23.4	1.6	1.4-39.6

[a] Nearness=distance between moose radio-fixes and postrut area boundary. The mean was determined by first calculating the mean of nearness values within seasons and years and then calculating the mean of means within seasons across years.
[b] Calving=7 May through 15 June; summer=1 July through 15 August; autumn (hunt)=20 August through 30 September; Postrut=7 November through 21-December.
[c] Radiocollared moose no radiofixes located in PCA in any year.

Table 9. Classification of movements of radiocollared moose adults (24 F, 8 M) monitored in lower Susitna River Valley in south-central Alaska in 1980-85. Moose were captured for radiocollaring in the Susitna River floodplain, a lowland winter concentration area. (d:\ GMU16SRV\CALFTABL.DOC

				Movements							
Fig. No.	Moose Id.	Sex	Year[a]	Long distance in early and in late winter	Relatively long distance in[b] Winter	Spring	Summer	Autumn	All relatively short distance	Different among years	Correlated with accmulation of snow in early (E) and/or late (L) winter[c]
A	0200	F	1981-85	-	-	X	-	-	X	X	-
B	2036	F	1982-85	X	-	X	-	-	-	X	E/L
C	2045	M	1981-84	X	-	-	-	-	-		E
D	2135	F	1982-85	X	-	X	-	-	-		E/L
E	2156	F	1982-85	X	X	X	X	X	-		L
F	2166	M	1982-85	-	-	X	-	X	X	X	-
G	2175	F	1982-85	X	X	X	X	X	-		-
H	2210	F	1981-85	-	-	-	-	-	X		-
I	2280	M	1981-83	-	-	X	X	X	-		-
J	2296	F	1982-85	X	X	-	-	-	-		E/L
K	2306	F	1982-85	X	-	X	-	-	-		E/L
L	3100	F	1981-84	X	X	-	-	-	-	X	E/L
M	3110	M	1981-85	-	X	X	X	X	-	X	-
N	3130	M	1981-83	X	-	-	-	-	-		E/L
O	3140	F	1981-85	X	-	-	-	-	-		-
P	3192	F	1981-85	X	X	X	X	X	-		-
Q	3220	F	1980-85	-	-	X	X	X	-		L
R	3230	F	1980-85	-	-	-	X	X	-		-
S	3240	F	1981-82	-	X	-	-	X	-		-
T	3252	F	1981-85	X	-	X	X	X	X		E/L
U	3260	F	1980-85	-	-	X	-	X	-	X	L
V	3270	M	1980-85	-	X	X	X	X	-	X	-
W	3291	F	1981-85	X	-	-	-	-	-		E/L

Table 9. Continued.

Fig. No.	Moose Id.	Sex	Year[a]	Movements: Long distance in early and in late winter	Relatively long distance in[b]: Winter	Spring	Summer	Autumn	All relatively short distance	Different Year-to-year	Correlated with accmulation of snow in early (E) and/or late (L) winter[c]
X	3300	F	1981-85	-	-	-	X	X	X	X	
Y	3310	M	1980-84	X	-	X	X	X	X		-
Z	3320	M	1980-84	-	-	X	X	X	-		-
AA	3340	F	1981-85	-	X	X	X	-	X		-
AB	3430	F	1981-85	X	-	-	-	-	-	X	E/L
AC	3552	F	1981-85	-	X	X	X	X	X	X	-
AD	3582	F	1981-85	X	-	X	X	-	X	X	E/L
AE	3692	F	1981-85	-	X	-	X	-	X		-
AF	3813	F	1981-84	-	-	X	X	-	X	X	-

[a] Years moose were monitored, calendar year=1 June through 31 May.

[b] Winter=January through April; Spring=May through June; Summer=July through August; Autumn=September.

[c] E=movement to winter range earlier in 1982-83 than in 1983-84, in 1982-83 snow accumulation was deep in early winter whereas in 1983-84 snow accumulation was low in early winter and became deep in late winter; L=movement away from winter range later in 1984-85 than in other years, snow accumulation was deep in late winter-early spring in 1984-85. (See Fig. .)

Table 10. Measurements of spring home range size in radiocollared female and male moose adults telemetry monitored with aircraft in lower Susitna River Valley in south-central Alaska during 1 May through June, 1981-83.

			Area of MCP[a] (km^2)			Greatest width[b] (km) of MCP		
Sex	Year	N	Mean	SE	Range	Mean	SE	Range
Female	1981	26	38.5	27.0	1.2-709.9	11.8	2.8	3.0-69.6
	1982	34	15.4	3.8	1.0-98.2	9.1	1.6	1.8-33.8
	1983	31	20.6	5.8	1.5-167.1	9.2	1.4	2.5-33.2
Male	1981	7	44.2	17.7	10.0-146.3	17.8	4.5	6.7-42.8
	1982	9	22.4	5.6	2.5-49.3	11.6	2.1	2.2-20.8
	1983	6	38.2	9.5	8.6-76.0	14.8	2.8	4.4-24.0

[a] MCP=Minimum convex polygon; no. radiofixes= 6 in 1981, 7 in 1983, and 6 in 1983.
[b] Greatest width=distance between 2 radiofixes with greatest D; where D=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes.

Table 11. All-winter (AW) and late-winter (LW) home range size (area, km^2) in 17 radiocollared female moose adults telemetry monitored with aircraft in 4 consecutive years in lower Susitna River Valley in south-central Alaska in 1 November through 30 April, 1981-85.

Data		Year[a]						
	1981-82		1982-83		1983-84		1984-85	
	AW	LW	AW	LW	AW	LW	AW	LW
Moose No.: 19	28^L	16	7^S	7	20	17^L	16	3^S
22	122	97	54	37	374^L	345^L	29^S	9^S
23	124^L	67^L	116	26	117	48	63^S	15^S
26	162^L	95^L	131	71	113	53	82^S	11^S
37	19	9	13^S	10^L	34^L	7^S	31	7
42	24	19	40^L	37^L	8^S	2^S	16	3
45	68^S	36	150	5^S	142	134^L	172^L	33
56	170^L	163^L	95^S	6^S	106	75	145	8
57	56^L	33^L	21^S	10^S	27	21	26	15
59	103	44	5^S	18	167	106^L	271^L	4^S
62	58	33^L	48^S	12	74	11	81^L	9^S
63	13	13^L	4^S	1^S	13	1	26^L	11
68	14	11^L	1^S	1^S	6	2	19^L	4
73	25	21^L	37^L	6	7^S	7	15	2^S
85	18	13	18	7	19^L	15^L	12^S	4^S
88	178^L	161^L	72^S	3	136	85	145	2^S
90	11	11	12^L	11^L	7^S	5^S	8	7
Sum ^{S} values	1	0	9	5	3	3	4	9
Sum ^{L} values	6	9	3	3	3	5	5	0
Mean	70.3	49.4	48.5	15.6	80.7	55.0	68.0	8.5
SD	14.7	12.2	11.6	4.4	22.9	20.6	18.0	1.9
Minimum	11.3	8.8	1.4	0.6	6.0	1.1	7.5	2.1
Maximum	178.2	162.6	149.7	71.4	374.0	344.7	270.8	33.3

[a] MCP = Minimum convex polygon. No. radio-fixes=14-15 in 1981-82, 9-10 in 1982-83, and 10-12 in 1983-84, and 9-13 in 1984-85. All-winter=November through April; late-winter=mid-Janaury through April. $^{S(L)}$=Smallest (largest) home range area within moose among years.

Table 12. All-winter (AW) and late-winter (LW) home range size (greatest width, km) in 17 radiocollared female moose adults telemetry monitored with aircraft in 4 consecutive years in lower Susitna River Valley in south-central Alaska in 1 November through 30 April, 1981-85.

		Year[a]							
Data		1981-82		1982-83		1983-84		1984-85	
		AW	LW	AW	LW	AW	LW	AW	LW
Moose No.:	19	24^{L}	15	10	10	18	18^{L}	9^{S}	7^{S}
	22	67^{L}	66^{L}	30	3	63	61	8^{S}	5^{S}
	23	29	16	26	19^{L}	30^{L}	14	18^{S}	8^{S}
	26	34^{L}	34^{L}	23	19	23^{S}	23	25	7^{S}
	37	6	5^{S}	5^{S}	5	12^{L}	7^{L}	11	5
	42	8	6	17^{L}	17^{L}	6	4^{S}	16	6
	45	20^{S}	20	33	5^{S}	39^{L}	37^{L}	35	16
	56	28	28^{L}	29^{L}	6	27	25	26^{S}	6^{S}
	57	21^{L}	21^{L}	16	16	13^{S}	13	13	8^{S}
	59	34	32	21^{S}	21	36^{L}	34^{L}	38	5^{S}
	62	21^{S}	17^{L}	24	7	25^{L}	7	25	6^{S}
	63	9^{L}	8^{L}	4^{S}	3	8	2^{S}	9	5
	68	7^{L}	7^{L}	2^{S}	2^{S}	5	3	6	6
	73	10^{L}	9^{L}	10	8	6^{S}	5	9	3^{S}
	85	7	7	9^{L}	6^{S}	7^{S}	7	8	7^{L}
	88	45	42	44	3^{S}	46^{L}	43^{L}	43^{S}	3
	90	6	6	9^{L}	8^{L}	4^{S}	4^{S}	7	6
Sum ^{S} values		2	1	4	4	6	3	5	9
Sum ^{L} values		7	8	4	3	6	5	0	1
Mean		22.1	19.9	18.2	9.1	21.7	18.1	18.0	6.4
SD		4.0	4.0	2.9	1.5	4.1	4.1	2.9	0.7
Minimum		6.0	4.9	2.0	1.6	4.4	1.8	6.0	3.3
Maximum		66.8	66.0	43.9	20.7	63.2	61.4	43.0	15.7

[a] MCP = Minimum convex polygon. No. radio-fixes=14-15 in 1981-82, 9-10 in 1982-83, and 10-12 in 1983-84, and 9-13 in 1984-85. All-winter=November through April; late-winter LW=mid-Janaury through April. $^{S(L)}$=Smallest (largest) home range area within moose among years.

Table 13. Terminal winter home range size (area, km^2 and greatest width, km) in migratory and non-migratory radio-collared moose adults in lower Susitna River Valley in south-central Alaska, 1982-83, 1984-85 and 1989-90. Home range=100% minimum convex polygon (MCP). Area ws km^2 of MCP. Greatest width was the distance between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes.

	1982-83[b]				1984-85[c]				1989-90			
Measurement/Group[a]	N	Mean	SE	Range	N	Mean	SE	Range	N	Mean	SE	Range
Area												
Migratory	5	5.1	1.9	1.4-11.7	5	8.4	2.8	2.4-18.1	8	14.1	4.3	0.3-39.0
Non-migratory	6	21.8	10.2	7.0-71.4	6	12.0	4.0	4.1-28.9	15	8.6	1.8	1.6-22.9
All	11	14.2	6.0	1.4-71.4	11	10.4	2.5	2.4-28.9	23	10.5	1.9	0.3-39.0
Greatest width												
Migratory	5	4.3	1.0	2.1-6.8	5	4.8	1.3	1.7-9.2	8	7.3	1.4	0.9-13.5
Non-migratory	6	10.5	2.2	4.9-18.5	6	8.8	1.7	5.0-15.9	15	6.3	1.0	2.3-16.4
All	11	7.7	1.6	2.1-18.5	11	7.0	1.2	1.7-15.9	23	6.6	0.8	0.9-16.4

[a] Maximum snow accumulation was early and normal (81 cm) in 1982-83, relatively late and deep (157 cm) in 1984-85, and early and extremely deep (226 cm) in 1989-90.

[b] Migratory moose were moose with winter home ranges that were disjunct from non-winter home ranges; non-migratory moose were moose with winter home ranges that were not disjunct from non-winter home ranges. In migratory moose, dates of migratory movements were used to identify radiofixes used in calculating terminal winter home range. Dates of migratory movements in migratory moose were used to delineate radiofixes used in calculating winter home range MCP in non-migratory moose.

Table 14. Year-to-year homogeneity of annual home range size (area, km^2 and greatest width, km) in 3 migratory and 3 non-migratory radiocollared moose adults telemetry monitored in lower Susitna River Valley in 4 consecutive calendar years in 1981-85. Calendar year=7 May through 6 May the following year.

	Area (km^2)[a]					Greatest width (km)[b]				
Moose No.	1981-82	1982-83	1983-84	1984-85	Mean	1981-82	1982-83	1983-84	1984-85	Mean
Non-migratory moose[c]										
153340	37.1	35.4	47.3	39.3	39.7	11.2	10.3	12.4	10.6	11.1
153552	30.3	29.8	20.4	15.6	24.1	8.1	9.5	7.3	8.2	8.3
153692	19.4	18.5	10.2	10.0	14.5	6.1	8.6	4.4	7.9	6.8
Migratory moose										
153220	508.9	706.1	559.6	503.0	569.4	68.7	76.2	63.4	68.8	69.3
153252	175.7	195.8	197.8	311.0	220.1	43.2	40.3	39.6	43.6	41.7
153582	234.0	186.5	151.6	233.7	201.5	45.2	45.0	46.1	43.0	44.8

[a] Area=area of 100% minimum convex polygon.

[b] Greatest width=distance between 2 radiofixes with greatest D; where D=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes.

[c] Non-migratory=moose with radiofix data that were unimodal. see Figures 29-31; migratory=moose with radiofix data that were multimodal, see Figures 32-34.

Table 15. Comparison of home range size (area, km^2 and greatest width, km) in 3 migratory radiocollared female moose adults telemetry monitored with aircraft in lower Susitna River valley, in south-central Alaska in calendar periods in 23 December 1985 through 6 May 1988. Home range was 98% minimum convex polygon.

		Area (km2)[b]			Greatest width (km)[c]		
Calendar Period[a]	Moose No.	1985-86	1986-87	1987-88	1985-86	1986-87	1987-88
Calendar year							
	152210	97.1	521.1	327.7	16.3	43.9	44.0
	152960	46.8	225.1	356.7	12.9	30.9	39.2
	153640	155.1	317.9	379.1	24.5	50.8	49.6
Winter season							
	152210	94.4	328.5	42.7	16.3	43.9	40.2
	152960	21.7	62.9	54.92	12.9	28.0	39.2
	153640	17.8	52.4	137.2	9.7	17.3	30.3

[a] Calendar year=23 December through 30 September the following year in 1985-86, 7 May thorugh 6 May the following year in 1986-88, see Figures 35-37. Winter season=23 December through 6 May the following year, 1985-88, see Figures 38-40.

[b] Area was area of minimum convex polygon.

[c] Greatest width=distance between 2 radiofixes with greatest D; where D=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes.

Table 16. Annual and cummulative-annual home range size (km^2) in 6 migratory and 6 non-migratory radiocollared female moose adults telemetry monitored more than 4 consecutive calendar years in lower Susitna River valley in south-central Alaska in April 1980 through January 1991. Home range=98% minimum convex polygon.

	Calendar year[a] (No. radiofixes)						Calendar years combined (No. radiofixes)					All calendar year monitored (No. radiofixes/no. years)	
Moose	1981-82 (36)	1982-83 (22-24)	1983-84 (26-27)	1984-85 (23-25)	Mean	% D 1:1	1981-83 (58-60)	1981-84 (85-86)	1981-85 (108-111)	% D 2:3	% D 3:4	1980-91 (140-204)	
Non-migratory													
150200	92.5	64.5	12.5	16.1	46.4	86.5	68.7	72.5	68.3	5.2	5.6	66.4	(163/11)
152360	29.2	14.4	17.9	31.1	23.2	53.7	25.5	29.4	31.3	13.3	6.5	35.8	(140/8)
153300	38.5	68.2	18.0	23.4	37.0	63.7	82.8	83.3	77.4	0.6	7.0	72.8	(172/11)
153340	37.1	35.4	47.3	39.3	39.8	25.2	47.5	59.8	59.8	20.6	0.0	70.2	(154/9)
153552	30.3	29.8	20.4	15.6	24.0	48.5	42.2	47.1	44.5	10.4	5.5	45.0	(67/10)
153692	19.4	18.5	10.2	10.0	14.5	48.5	25.4	27.9	27.4	9.0	1.8	50.0	(172/10)
Migratory													
153170	66.8	76.4	39.2	50.1	58.1	48.7	87.0	95.8	97.7	9.2	2.0	115.6	(171/10)
153192	77.4	28.8	30.5	51.8	47.1	62.8	50.0	50.2	55.0	0.4	9.6	88.8	(173/10)
153220	508.9	706.1	559.6	503.0	569.4	28.8	734.4	752.6	717.2	2.4	4.7	850.5	(197/10)
153252	175.7	195.8	197.8	311.0	200.1	43.5	191.1	229.0	255.5	16.6	11.6	334.1	(160/10)
153260	197.6	146.9	161.9	102.0	152.1	48.4	182.3	224.1	217.0	18.7	3.2	311.4	(204/11)
153582	234.0	186.5	151.6	233.7	201.5	35.2	244.2	251.4	304.0	2.9	21.2	318.2	(174/10)

[a] Calendar year=6 May through 7 May the following year.

Table 17. Area (km^2) of life, life-seasonal, seasonal, and management event home ranges in 6 non-migratory and 6 migratory radiocollared moose telemetry monitored with aircraft in lower Susitna River Valley in south-central Alaska in 1980-91. Area=km^2 of 100% MCP Migratory moose were moose with winter home ranges that were disjunct from non-winter home ranges; non-migratory moose were moose with winter home ranges that were not disjunct from non-winter home ranges. Life home range (HR)=all radiofixes (RF); calving HR=RF in 10 May through 31 May; summer HR=RF in 13 July through 15 August; rut HR=RF in 15 September through 5 October; post rut HR=RF in 11 October-7 November; winter HR=RF in 19 Janaury through 31 March; hunt HR=RF in 20 August through 30 September; survey HR=RF in 7 November through 21 December; life-seasonal HR=RF in 6 seasonal periods.

Moose	Life	n	Life-seasonal	n	Calving	n	Summer	n	Rut	n	Postrut	n	Winter	n	Hunt	n	Survey	n
Non-migratory																		
150200	286.9	163	75.9	85	14.5	18	4.6	17	2.8	8	3.1	6	60.6	36	5.3	16	16.1	16
153240	29.2	111	23.5	58	4.8	11	5.9	12	0.5	6	0.4	5	18.4	24	5.9	13	5.6	12
153300	90.5	172	60.5	91	14.1	17	19.5	19	3.2	11	8.6	6	29.4	38	5.1	20	46.1	17
153340	82.2	154	74.9	80	32.7	16	13.7	16	3.1	9	7.1	6	36.4	33	5.9	17	20.6	14
153552	63.7	167	45.0	88	6.6	17	9.8	17	7.0	11	2.2	6	39.0	37	18.6	18	19.4	16
153692	70.6	172	70.2	91	10.8	17	14.3	17	2.5	11	3.5	7	65.5	39	8.8	18	7.1	18
Mean	103.9		58.3		13.9		11.3		3.2		4.1		41.6		8.3		19.2	
SE	37.6		8.4		4.1		2.3		0.9		1.3		7.4		2.1		6.0	
Migratory																		
153140	178.0	150	156.1	76	51.4	15	14.6	14	7.1	8	3.7	6	35.9	33	16.2	16	56.9	15
153211	348.1	121	260.9	66	69.7	16	21.8	8	8.4	8	8.6	6	62.5	28	11.8	11	46.5	11
153220	1202.0	197	795.1	103	442.4	17	175.4	20	157.5	14	7.6	9	144.0	43	167.5	23	24.0	22
153252	479.4	160	390.6	83	104.9	16	15.5	17	14.0	9	24.7	6	33.3	35	18.3	17	232.0	15
153291	336.3	150	321.5	78	68.7	15	17.2	16	14.3	9	17.3	6	163.9	32	19.6	17	108.2	13
153582	396.0	174	284.6	91	75.1	17	76.4	17	7.9	11	3.5	7	179.9	39	11.1	18	155.3	19
Mean	490.0		368.1		135.4		53.5		34.9		10.9		103.3		40.8		103.8	
SE	148.0		91.0		61.8		26.2		24.6		3.4		27.3		25.4		32.1	

Appendix A. Numbers of moose antlered adults, non-antlered adults, calves, and carcasses in winter concentration areas in 4 sections of the Susitna River floodplain between Cook Inlet and Portage Creek in lower Susitna River Valley in south-central Alaska in 1981-85. (d:\gmu16srv\surivsvs.doc)

Section of river	Date	No. moose[a]				
		With antlers	Without antlers	With 1 calf	With 2 calves	Lone calves
Cook Inlet to Yentna River	9-Dec-81	22	35	27	4	0
	4-Jan-82	1	43	24	1	1
	2-Feb-82	1	54	17	1	0
	2-Mar-82	0	68	15	3	0
	23-Mar-82	0	25	8	0	0
	12-Apr-82	ISC				
	29-Oct-82	16	25	20	2	2
	10-Nov-82	27	53	36	2	1
	1-Dec-82	52	220	61	6	0
	20-Dec-82	20	163	62	1	2
	6-Jan-83	ISC				
	20-Jan-83	ISC				
	9-Feb-83	0	118	42	1	1
	22-Feb-83	0	133	38	1	0
	7-Mar-83	0	124	31	1	1
	22-Mar-83	ISC				
	7-Apr-83	0	80	16	0	0
	13-Apr-83	ISC				
	14-Dec-83	10	43	28	6	0
	29-Dec-83	10	52	29	3	0
	19-Jan-84	13	122	67	7	0
	3-Feb-84	7	160	59	6	1
	21-Feb-84	1	232	70	10	0
	15-Mar-84	ISC				
Yentna River to Montana Creek	9-Dec-81	10	55	32	5	3
	4-Jan-82	10	87	42	3	1
	2-Feb-82	0	68	32	0	2
	1-Mar-82	0	165	35	1	0
	24-Mar-82	0	100	30	2	0
	12-Apr-82	0	24	12	3	1
	29-Oct-82	7	18	13	3	0
	15-Nov-82	37	87	46	5	1
	1-Dec-82	22	101	67	11	2
	20-Dec-82	15	204	104	10	3
	6-Jan-83	6	160	73	11	4
	20-Jan-83	1	146	77	8	4
	7-Feb-83	1	107	63	4	5
	22-Feb-83	0	146	77	8	4
	8-Mar-83	0	161	46	2	1
	22-Mar-83	0	158	56	2	1
	7-Apr-83	0	82	22	1	1

Appendix A. Continued.

	13-Apr-83	ISC				
	16-Dec-83	8	33	27	2	2
	29-Dec-83	10	53	33	5	0
	17-Jan-84	7	78	37	3	1
	4-Feb-84	1	180	46	4	1
	21-Feb-84	0	214	52	2	1
	15-Mar-84	ISC				
Montana Creek to Talkeetna River	10-Dec-81	3	4	3	1	0
	28-Dec-82	2	8	4	0	1
	6-Feb-82	0	2	1	0	0
	1-Mar-82	0	10	2	1	0
	24-Mar-82	0	9	5	2	0
	12-Apr-82	0	12	3	0	0
	6-Nov-82	0	2	1	0	0
	18-Nov-82	0	8	10	0	0
	6-Dec-82	10	16	9	0	2
	21-Dec-82	5	28	20	4	1
	5-Jan-83	3	43	19	3	1
	24-Jan-83	0	40	8	2	0
	9-Feb-83	0	25	8	1	0
	23-Feb-83	0	28	16	1	2
	8-Mar-83	0	38	10	1	1
	23-Mar-83	0	26	13	1	0
	8-Apr-83	0	21	4	0	1
	17-Nov-83	0	3	2	2	2
	9-Dec-83	1	7	1	1	1
	29-Dec-83	0	17	9	2	0
	13-Jan-84	6	14	8	2	1
	8-Feb-84	0	52	26	1	0
	28-Feb-84	0	40	5	0	0
	15-Mar-84	ISC				
Talkeetna River to Portage Creek	10-Dec-81	8	12	8	0	0
	28-Dec-82	3	7	4	0	0
	6-Feb-82	0	8	0	0	0
	1-Mar-82	0	7	0	0	0
	24-Mar-82	0	16	3	1	0
	12-Apr-82	0	5	1	0	0
	6-Nov-82	3	7	4	0	0
	18-Nov-82	14	23	10	0	0
	2-Dec-82	9	42	11	1	0
	21-Dec-82	11	36	13	1	0
	5-Jan-83	4	45	16	1	0
	24-Jan-83	0	21	13	3	0
	9-Feb-83	0	8	6	2	0
	23-Feb-83	0	17	5	0	0
	8-Mar-83	0	24	4	0	0
	23-Mar-83	0	13	2	0	0
	8-Apr-83	0	2	1	0	0
	17-Nov-83	1	5	6	1	0
	14-Dec-83	0	5	10	3	0

Appendix A. Continued.

	5-Jan-84	IFR				
	13-Jan-84	0	9	6	2	0
	8-Feb-84	2	46	20	0	0
	1-Mar-84	0	35	3	0	0
	15-Mar-84	0	9	0	2	0
	27-Nov-84	0	7	0	0	0
	10-Dec-84	1	3	3	0	0
	24-Dec-84	6	23	2	1	0
	7-Jan-85	13	54	19	2	0
	18-Jan-85	5	99	14	0	0
	29-Jan-85	3	71	14	1	0
	13-Feb-85	0	36	3	0	0
	2-Mar-85	0	37	5	0	0
	21-Mar-85	0	37	5	0	0
	5-Apr-85	0	49	6	0	0
	17-Apr-85	0	28	2	0	0
Talkeetna River to Rabideux Creek	27-Nov-84	0	1	0	0	0
	10-Dec-84	1	5	1	0	0
	24-Dec-84	0	7	0	2	0
	7-Jan-85	8	34	12	3	0
	18-Jan-85	1	44	24	1	0
	29-Jan-85	0	45	18	0	0
	13-Feb-85	0	40	10	0	0
	2-Mar-85	0	40	3	0	0
	21-Mar-85	0	47	3	0	0
	5-Apr-85	0	48	1	0	0
	17-Apr-85	0	37	0	0	0

[a] ISC=insufficient snow cover to conduct aerial survey; IFR=aerial survey cancelled because of weather.

Appendix B. Numbers of moose antlered adults, non-antlered adults, calves, and carcasses in winter concentration areas in 6 subsections of the Susitna River floodplain in Lower Susitna River Valley in south-central Alaska in 1984-85. (d:\gmu16srv\rivsurvs.doc)

		No. moose					
Subsection[a]	Date	With antlers	Without antlers	With 1 calf	With 2 calves	Lone calves	Carcasses
Kashwitna floodplain	28-Nov-84	1	3	3	0	0	0
	11-Dec-84	2	3	2	0	0	0
	8-Jan-85	0	13	7	0	0	0
	11-Feb-85	0	15	5	0	0	0
	16-Mar-85	0	25	3	0	0	0
	5-Apr-85	0	29	3	0	0	0
	17-Apr-85	0	27	1	0	0	4
Caswell floodplain	28-Nov-84	0	1	3	0	0	0
	11-Dec-84	1	3	4	0	0	0
	8-Jan-85	2	16	6	1	0	0
	11-Feb-85	0	24	9	0	0	0
	16-Mar-85	0	29	1	0	0	1
	5-Apr-85	0	42	5	0	0	3
	17-Apr-85	0	57	1	0	0	5
Delta Islands	28-Nov-84	4	9	7	0	0	0
	11-Dec-84	0	5	2	0	0	0
	8-Jan-85	1	17	6	0	0	0
	11-Feb-85	0	10	3	0	0	0
	16-Mar-85	0	14	2	0	0	0
	5-Apr-85	0	3	0	0	0	0
	17-Apr-85	0	3	0	0	0	1
Alexander Island	28-Nov-84	0	2	1	0	0	0
	11-Dec-84	0	1	2	0	0	0
	28-Dec-84	0	10	4	1	0	0
	8-Jan-85	1	10	1	1	0	0
	11-Feb-85	1	26	7	1	0	0
	16-Mar-85	0	27	9	2	0	0
	5-Apr-85	0	21	7	0	0	0
	17-Apr-85	0	27	4	0	0	0
Beaver Island	28-Nov-84	1	7	0	0	0	0
	11-Dec-84	0	5	0	0	0	0
	28-Dec-84	1	12	5	1	0	0
	8-Jan-85	0	12	1	0	0	0
	11-Feb-85	0	9	0	0	0	0
	16-Mar-85	0	25	7	0	0	0
	5-Apr-85	0	11	2	0	0	0
	17-Apr-85	0	11	1	0	0	0

Appendix B. Continued.

Bell Island	28-Nov-84	0	3	4	1	0	0
	11-Dec-84	2	11	6	3	0	0
	28-Dec-84	2	27	12	1	1	0
	8-Jan-85	4	37	18	3	0	0
	11-Feb-85	1	88	9	3	0	0
	16-Mar-85	0	61	12	1	0	0
	5-Apr-85	0	43	8	0	1	0
	17-Apr-85	0	27	5	0	0	0

[a] Kashwitna floodplain, Caswell floodplain, and Delta Islands were located north of the Yentna River. Alexander Island, Beaver Island, and Bell Island were located south of the Yentna River. In March, snow depth was >100 cm in areas north of the Yentna River and <100 cm in areas south of the Yentna River.

Appendix C. Number of moose antlered adults, non-antlered adults, calves, and carcasses in winter concentration areas in old homesteads located near the Susitna River floodplain and the Parks Highway between Talkeetna and Willow in lower Susitna River Valley in south-central Alaska in 1984-85. (d:\gmu16srv\rivsurvs.doc)

		No. moose					
Old homestead[a]	Date	With antlers	Without antlers	With 1 calf	With 2 calves	Lone calves	Carcasses
Talkeeetna cut-off	7-Jan-85	0	0	0	0	0	0
	19-Jan-85	1	3	1	0	0	0
	29-Jan-85	0	4	4	0	0	0
	11-Feb-85	0	5	1	0	0	0
	13-Feb-85	0	5	0	0	0	0
	22-Feb-85	0	6	1	0	0	0
	2-Mar-85	0	15	4	0	0	0
	9-Mar-85	0	4	1	0	0	0
	16-Mar-85	0	6	1	0	0	0
	21-Mar-85	0	13	4	0	0	0
	5-Apr-85	0	5	1	0	0	0
Talkeetna west	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	1	2	0	0	0
	24-Dec-84	0	1	3	1	0	0
	7-Jan-85		2	13	3	2	0
	18-Jan-85	0	7	2	0	0	0
	29-Jan-85	0	7	2	2	0	0
	13-Feb-85	0	12	3	0	0	0
	22-Feb-85	0	12	0	0	0	0
	1-Mar-85	0	13	2	0	0	0
	9-Mar-85	0	16	2	0	0	0
	21-Mar-85	0	14	1	1	1	0
	5-Apr-85	0	7	2	0	0	0
Montana west	27-Nov-84	25	16	3	1	0	0
	10-Dec-84	14	11	0	0	0	0
	24-Dec-84	9	20	7	1	0	0
	28-Dec-84	5	27	4	1	0	0
	7-Jan-85	3	33	6	1	0	0
	18-Jan-85	1	37	5	0	0	0
	29-Jan-85	0	14	5	0	0	0
	11-Feb-85	0	23	3	0	0	0
	13-Feb-85	0	39	2	0	0	0
	22-Feb-85	0	29	3	0	0	1
	2-Mar-85	0	32	4	1	0	0
	9-Mar-85	0	30	2	0	0	1
	16-Mar-85	0	18	1	0	0	0
	21-Mar-85	0	18	0	1	0	4
	5-Apr-85	0	10	1	0	0	3

Appendix C. Continued.

Montana middle	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	0	0	0	0	0
	24-Dec-84	1	4	0	0	0	0
	28-Dec-84	3	7	0	0	0	0
	7-Jan-85	3	6	4	0	0	0
	18-Jan-85	1	13	4	0	0	0
	29-Jan-85	1	26	5	0	0	0
	11-Feb-85	0	31	2	0	0	0
	13-Feb-85	0	43	4	0	0	0
	22-Feb-85	0	27	5	0	0	0
	2-Mar-85	0	31	4	0	0	0
	9-Mar-85	0	20	2	0	0	0
	16-Mar-85	0	27	3	0	0	0
	21-Mar-85	0	37	1	0	0	0
	5-Apr-85	0	35	2	0	0	0
Montana south	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	0	0	0	0	0
	24-Dec-84	0	1	0	0	0	0
	28-Dec-84	0	0	0	0	0	0
	7-Jan-85	0	3	1	0	0	0
	18-Jan-85	0	7	1	0	0	0
	29-Jan-85	0	7	4	1	0	0
	11-Feb-85	0	4	4	0	0	0
	13-Feb-85	0	9	1	0	0	0
	22-Feb-85	0	1	0	0	0	0
	2-Mar-85	0	6	0	0	0	0
	9-Mar-85	0	1	0	0	0	0
	16-Mar-85	0	1	0	0	0	0
	21-Mar-85	0	0	0	0	0	0
	5-Apr-85	0	4	0	0	0	0
Montana north	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	0	0	0	0	0
	24-Dec-84	0	0	0	0	0	0
	28-Dec-84	0	0	0	0	0	0
	7-Jan-85	0	1	0	0	0	0
	18-Jan-85	0	2	0	0	0	0
	29-Jan-85	0	4	0	0	0	0
	11-Feb-85	0	4	0	0	0	0
	13-Feb-85	0	1	0	0	0	0
	22-Feb-85	0	5	1	0	0	0
	2-Mar-85	0	13	0	1	0	0
	9-Mar-85	0	3	0	0	0	0
	16-Mar-85	0	0	2	0	0	0
	21-Mar-85	0	0	2	0	0	0
	5-Apr-85	0	0	0	0	0	0

Appendix C. Continued.

Montana east	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	0	0	0	0	0
	24-Dec-84	2	3	0	0	0	0
	28-Dec-84	1	1	0	0	0	0
	7-Jan-85	0	0	0	0	0	0
	19-Jan-85	0	0	1	0	0	0
	29-Jan-85	0	2	0	0	0	0
	11-Feb-85	0	2	0	0	0	0
	13-Feb-85	0	6	0	0	0	0
	22-Feb-85	0	2	1	0	0	0
	2-Mar-85	0	6	0	0	0	0
	9-Mar-85	0	0	0	0	0	0
	16-Mar-85	0	0	0	0	0	0
	21-Mar-85	0	0	0	0	0	0
	5-Apr-85	0	0	0	0	0	0
Willow Creek	27-Nov-84	0	0	0	0	0	0
	11-Dec-84	0	0	0	0	0	0
	24-Dec-84	0	0	0	0	0	0
	28-Dec-84	1	2	0	0	0	0
	7-Jan-85	0	1	0	0	0	0
	18-Jan-85	0	0	1	0	0	0
	29-Jan-85	0	0	0	0	0	0
	11-Feb-85	0	0	0	0	0	0
	13-Feb-85	0	0	0	0	0	0
	22-Feb-85	0	2	0	0	0	0
	1-Mar-85	0	1	0	0	0	0
	9-Mar-85	0	2	0	1	1	0
	16-Mar-85	0	4	0	0	0	0
	21-Mar-85	0	2	0	0	0	0
	5-Apr-85	0	1	0	0	0	0
Goose Creek	11-Dec-84	1	2	0	0	0	0
	24-Dec-84	1	0	0	0	0	0
	28-Dec-84	0	0	0	0	0	0
	7-Jan-85	0	3	0	0	0	0
	18-Jan-85	0	5	1	0	0	0
	29-Jan-85	0	7	0	0	0	0
	11-Feb-85	0	6	5	0	0	0
	13-Feb-85	0	9	1	0	0	0
	22-Feb-85	0	3	0	0	0	0
	2-Mar-85	0	5	3	0	0	0
	9-Mar-85	0	3	0	0	0	0
	16-Mar-85	0	8	0	0	0	0
	21-Mar-85	0	7	0	0	0	0
	5-Apr-85	0	1	0	0	0	0

Appendix C. Continued.

Chandalar east	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	0	0	0	0	0
	24-Dec-84	0	0	0	0	0	0
	28-Dec-84	0	0	1	0	0	0
	7-Jan-85	0	0	0	0	0	0
	18-Jan-85	0	0	0	0	0	0
	29-Jan-85	0	0	0	0	0	0
	11-Feb-85	0	7	0	0	0	0
	13-Feb-85	0	6	1	0	0	0
	22-Feb-85	0	4	1	0	0	0
	1-Mar-85	0	7	3	0	0	0
	9-Mar-85	0	4	1	0	0	0
	16-Mar-85	0	2	0	0	0	0
	21-Mar-85	0	4	0	0	0	0
	5-Apr-85	0	1	0	0	0	0
Chandalar west	27-Nov-84	0	0	0	0	0	0
	10-Dec-84	0	0	0	0	0	0
	24-Dec-84	0	0	0	0	0	0
	28-Dec-84	0	0	1	0	0	0
	7-Jan-85	0	0	0	0	0	0
	18-Jan-85	0	0	1	0	0	0
	29-Jan-85	0	7	0	0	0	0
	11-Feb-85	0	22	0	0	0	0
	13-Feb-85	0	20	1	0	0	0
	22-Feb-85	0	19	3	0	0	0
	1-Mar-85	0	27	8	0	1	0
	9-Mar-85	0	42	4	0	0	0
	16-Mar-85	0	41	1	1	0	0
	21-Mar-85	0	32	4	0	0	3
	5-Apr-85	0	27	1	0	0	2
Kashwitna Lake	27-Nov-84	1	1	2	0	0	0
	11-Dec-84	0	1	2	1	0	0
	24-Dec-84	1	3	1	1	0	0
	28-Dec-84	1	4	0	0	0	0
	7-Jan-85	0	4	0	0	0	0
	18-Jan-85	0	4	1	0	0	0
	29-Jan-85	0	5	0	0	0	0
	11-Feb-85	0	4	1	0	0	0
	13-Feb-85	0	9	2	0	0	0
	22-Feb-85	0	2	1	0	0	0
	1-Mar-85	0	4	2	0	0	0
	9-Mar-85	0	4	1	0	0	0
	16-Mar-85	0	6	1	0	0	0
	21-Mar-85	0	2	0	0	0	0
	5-Apr-85	0	1	0	0	0	2

Appendix C. Continued.

Kashwitna bluffs	27-Nov-84	0	0	0	0	0	0
	11-Dec-84	0	0	0	0	0	0
	24-Dec-84	0	0	0	0	0	0
	28-Dec-84	0	1	0	0	0	0
	7-Jan-85	1	2	0	0	0	0
	18-Jan-85	1	5	0	0	0	0
	29-Jan-85	0	9	1	0	0	0
	11-Feb-85	0	16	1	0	0	0
	13-Feb-85	0	12	5	0	0	0
	22-Feb-85	0	19	4	0	0	0
	1-Mar-85	0	24	4	0	0	0
	9-Mar-85	0	19	1	0	0	0
	16-Mar-85	0	18	1	0	0	0
	21-Mar-85	0	16	1	0	0	0
	5-Apr-85	0	9	2	0	0	0
Kashwitna Lake east	27-Nov-84	0	0	0	1	0	0
	11-Dec-84	0	0	1	0	0	0
	24-Dec-84	0	0	0	0	0	0
	28-Dec-84	0	0	0	0	0	0
	7-Jan-85	0	0	0	1	0	0
	18-Jan-85	0	0	1	0	0	0
	29-Jan-85	0	1	1	0	0	0
	11-Feb-85	0	2	1	0	0	0
	13-Feb-85	0	3	1	0	0	0
	22-Feb-85	0	0	0	0	0	0
	1-Mar-85	0	0	0	0	1	0
	9-Mar-85	0	1	0	0	0	0
	16-Mar-85	0	0	0	0	0	0
	21-Mar-85	0	2	0	0	0	0
	5-Apr-85	0	0	0	0	0	0

Appendix D. Number of moose antlered adults, non-antlered adults, calfs, and carcasses in winter concentration areas in floodplains lowland drainages of Alexander Creek, Deshka River, Moose Creek, and Yentna River in lower Susitna River Valley in south-central Alaska in 1984-85 and 1987. (d:\gmu16srv\rivsurvs.doc)

		No. moose					
Drainage[a]	Date	With antlers	Without antlers	With 1 calf	With 2 calves	Lone calves	Carcasses
Alexander Creek	29-Nov-84	12	14	12	1	0	0
	12-Dec-84	17	47	18	3	1	0
	27-Dec-84	11	80	14	0	0	0
	11-Jan-85	3	144	42	5	0	0
	7-Feb-85	0	146	25	1	1	2
	20-Feb-85	0	135	12	2	0	3
	5-Mar-85	0	162	23	1	1	0
	9-Mar-84	0	155	13	2	1	1
	20-Mar-85	1	129	13	0	0	3
	28-Mar-85	0	126	8	0	0	7
	4-Apr-85	0	142	9	0	0	6
	16-Apr-85	0	114	9	1	0	6
	18-Feb-87	0	104	20	1	0	0
Deshka River	5-Mar-84	0	0	31	3	0	13
	29-Nov-84	46	49	19	3	0	0
	12-Dec-84	56	106	40	4	0	0
	27-Dec-84	21	96	25	3	1	0
	11-Jan-85	5	113	26	2	0	0
	7-Feb-85	0	110	17	0	0	0
	20-Feb-85	0	117	17	0	0	4
	5-Mar-85	1	73	8	0	0	4
	9-Mar-84	0	58	3	0	0	2
	20-Mar-85	0	35	1	0	0	1
	28-Mar-85	0	29	0	0	0	2
	4-Apr-85	0	17	1	0	0	9
	16-Apr-85	0	10	1	0	0	6
Deshka Islands	20-Mar-85	0	0	34	5	0	0
	28-Mar-85	0	0	27	2	0	3
	4-Apr-85	0	0	23	4	0	1

Appendix D. Continued.

Moose Creek	5-Mar-84	0	0	41	7	1	0
	29-Nov-84	5	10	8	0	1	0
	12-Dec-84	11	32	17	1	1	0
	27-Dec-84	13	43	22	5	0	0
	11-Jan-85	8	98	16	0	0	0
	7-Feb-85	0	100	22	0	0	0
	20-Feb-85	0	143	19	0	0	1
	5-Mar-85	0	141	14	0	0	0
	9-Mar-84	0	129	13	1	0	2
	20-Mar-85	0	97	8	1	1	3
	28-Mar-85	0	68	1	0	0	13
	4-Apr-85	0	57	5	0	0	10
	16-Apr-85	0	38	3	0	0	18
Yentna River	22-Feb-85	0	0	123	9	1	9

[a] Deshka Islands were islands in the Susitna River at the mouth of Deshka River. Yentna River was the Yentna River from the Susitna River to Skwentna.

Appendix E. Number of moose large antlered adults, small antlered adults, non-antlered adults, and calfs in timberline postrut concentration areas (PCA) in Game Management Subunits 14A and 14B in the western foothills of the Talkeetna Mountains in lower Susitna River Valley in south-central Alaska, October through April, 1985-91. (d:\gmu16srv\prutsvs.doc)

		No. moose[c]					
PCA[a]	Date[b]	With antlers[d]		Without antlers			
		Large	Small	With 0 calves	With 1 calf	With 2 calves	Lone calves
Bald Mountain	4-Oct-85	1	4	28	2	0	0
	17-Oct-85	12	3	83	9	1	0
	8-Nov-85	58	7	133	30	2	0
	18-Nov-85	48	18	144	43	2	0
	3-Dec-85	36	22	139	30	1	0
	28-Feb-86	0	0	212	27	3	0
	31-Mar-86	0	0	160	14	1	0
	17-Apr-86	0	2	27	4	1	0
	26-Nov-86	33	14	206	71	4	1
	24-Dec-86	5	2	65	21	2	0
	15-Jan-87	0	1	28	9	0	0
	2-Mar-87	0	0	12	4	0	0
	2-Nov-87	29	22	143	69	2	1
	17-Nov-87	39	24	135	71	4	0
	4-Dec-87	15	12	75	41	4	0
	21-Dec-87	5	4	42	20	2	0
	12-Jan-88	0	0	10	5	0	0
	28-Jan-88	0	0	24	6	1	0
	27-Mar-88	0	0	8	5	0	0
	20-Apr-88	0	2	5	1	0	0
	13-Oct-88	17	4	38	35	3	0
	28-Oct-88	37	17	121	71	3	1
	15-Nov-88	32	29	101	60	3	0
	5-Dec-88	15	12	49	34	2	0
	23-Dec-88	2	2	27	15	0	0
	15-Jan-89	0	0	19	3	0	0
	7-Feb-89	0	0	5	1	0	0
	8-Mar-89	0	0	7	4	0	1
	11-Oct-89	19	9	108	30	3	1
	25-Oct-89	38	17	156	74	3	0
	7-Nov-89	20	3	58	27	1	1
	20-Nov-89	11	3	20	9	2	0
	9-Dec-89	2	0	7	4	0	0
	30-Dec-89	0	0	18	0	0	0
	30-Jan-90	0	0	20	4	1	0

Appendix E. Continued.

	28-Feb-90	0	0	18	4	1	0
	15-Mar-90	0	0	13	3	1	0
	15-Oct-90	39	8	136	77	4	1
	30-Oct-90	35	11	120	60	4	0
	19-Nov-90	34	10	105	35	1	0
	14-Dec-90	0	2	22	15	0	0
	25-Jan-91	0	1	10	2	0	0
Moss Mountain	4-Oct-85	0	0	0	0	0	0
	17-Oct-85	4	0	8	2	1	0
	8-Nov-85	5	2	16	4	2	0
	18-Nov-85	3	4	27	8	0	0
	3-Dec-85	5	1	29	8	1	0
	28-Feb-86	0	0	17	8	0	0
	31-Mar-86	0	0	18	4	0	0
	17-Apr-86	0	0	5	5	0	0
	26-Nov-86	8	2	22	3	0	0
	24-Dec-86	6	2	31	3	0	0
	15-Jan-87	0	0	11	0	0	0
	2-Mar-87	0	0	5	2	0	0
	2-Nov-87	5	1	19	8	0	0
	17-Nov-87	2	3	17	4	0	0
	4-Dec-87	0	0	11	6	0	0
	21-Dec-87	1	1	4	5	0	0
	12-Jan-88	0	0	4	0	1	0
	28-Jan-88	0	0	9	1	0	0
	27-Mar-88	0	0	5	3	0	0
	20-Apr-88	0	0	0	0	0	0
	13-Oct-88	2	0	6	3	0	0
	28-Oct-88	2	2	17	8	0	0
	15-Nov-88	3	1	13	8	0	0
	5-Dec-88	4	1	1	5	2	0
	23-Dec-88	0	0	7	3	0	0
	15-Jan-89	0	0	6	0	0	0
	7-Feb-89	0	0	1	1	0	0
	8-Mar-89	0	0	3	2	0	0
	11-Oct-89	4	1	16	3	0	0
	25-Oct-89	5	1	26	6	0	0
	7-Nov-89	2	2	14	5	1	0
	20-Nov-89	1	0	8	4	0	0
	9-Dec-89	0	0	7	2	0	0
	30-Dec-89	0	0	5	3	0	0
	30-Jan-90	0	0	4	1	1	0
	28-Feb-90	0	0	9	0	1	0
	15-Mar-90	0	0	12	3	1	0

Appendix E. Continued.

	15-Oct-90	4	1	17	8	0	0
	30-Oct-90	5	3	19	5	0	0
	19-Nov-90	2	1	8	4	0	0
	14-Dec-90	1	0	8	6	0	0
	25-Jan-91	0	0	10	5	1	0
Willow Mountain	4-Oct-85	1	0	2	1	0	0
	17-Oct-85	13	0	83	26	0	0
	8-Nov-85	56	5	158	20	2	0
	18-Nov-85	59	22	160	12	1	0
	3-Dec-85	53	17	184	27	1	1
	28-Feb-86	0	0	147	7	1	0
	31-Mar-86	0	0	111	5	0	0
	17-Apr-86	0	2	51	3	0	0
	26-Nov-86	91	17	195	87	5	0
	24-Dec-86	4	2	35	1	0	0
	15-Jan-87	0	0	7	4	0	0
	2-Mar-87	0	0	8	3	0	1
	2-Nov-87	66	17	146	30	2	1
	17-Nov-87	67	24	131	27	0	1
	4-Dec-87	41	19	123	25	0	0
	21-Dec-87	18	7	107	9	0	0
	12-Jan-88	0	0	48	6	0	0
	28-Jan-88	0	0	45	3	0	1
	27-Mar-88	0	0	28	6	0	0
	20-Apr-88	0	1	2	0	0	0
	13-Oct-88	36	6	109	20	1	0
	28-Oct-88	72	42	213	62	1	1
	15-Nov-88	61	29	163	37	1	0
	5-Dec-88	24	11	39	14	1	0
	23-Dec-88	5	4	47	16	0	0
	15-Jan-89	1	0	41	5	0	1
	7-Feb-89	0	0	19	8	0	1
	8-Mar-89	0	0	15	7	0	0
	11-Oct-89	21	9	64	8	1	0
	25-Oct-89	82	18	191	40	0	1
	7-Nov-89	43	1	70	9	1	0
	20-Nov-89	8	2	27	5	0	0
	9-Dec-89	2	0	26	3	0	0
	30-Dec-89	0	0	6	2	0	1
	30-Jan-90	0	0	20	4	0	0
	28-Feb-90	0	0	44	2	0	0
	15-Mar-90	0	0	49	2	0	2
	15-Oct-90	44	5	178	8	1	0
	30-Oct-90	45	22	185	16	1	0
	19-Nov-90	51	12	120	12	0	0
	14-Dec-90	20	10	76	5	0	0
	25-Jan-91	0	0	13	2	0	0

Appendix E. Continued.

Witna Mountain	4-Oct-85	0	0	0	0	0	0
	17-Oct-85	2	0	7	0	0	0
	8-Nov-85	5	2	13	2	0	0
	18-Nov-85	5	1	3	5	0	0
	3-Dec-85	8	2	6	2	0	0
	28-Feb-86	2	0	32	4	1	0
	31-Mar-86	0	0	13	0	0	0
	17-Apr-86	0	1	8	1	0	0
	26-Nov-86	23	2	50	13	0	0
	24-Dec-86	0	0	4	1	0	0
	15-Jan-87	0	0	9	0	0	0
	2-Mar-87	0	0	14	6	0	0
	2-Nov-87	19	5	29	3	1	0
	17-Nov-87	18	6	21	8	0	0
	4-Dec-87	13	3	22	2	0	0
	21-Dec-87	6	2	25	0	0	0
	12-Jan-88	1	0	16	0	0	0
	28-Jan-88	0	0	13	1	0	0
	27-Mar-88	0	0	8	0	0	0
	20-Apr-88	0	0	0	0	0	0
	13-Oct-88	IFR					
	28-Oct-88	27	4	34	5	0	0
	15-Nov-88	20	5	50	8	0	0
	5-Dec-88	9	3	6	1	0	0
	23-Dec-88	4	0	11	1	0	0
	15-Jan-89	2	1	13	2	0	0
	7-Feb-89	0	1	5	1	0	0
	8-Mar-89	0	0	9	2	0	0
	11-Oct-89	2	0	14	0	0	0
	25-Oct-89	17	3	36	6	0	0
	7-Nov-89	13	1	11	3	0	0
	20-Nov-89	6	2	15	2	0	0
	9-Dec-89	2	0	7	2	0	0
	30-Dec-89	1	0	13	1	0	0
	30-Jan-90	0	0	23	0	0	0
	28-Feb-90	0	0	19	0	0	0
	15-Mar-90	0	0	10	0	0	0
	15-Oct-90	2	2	9	3	0	0
	30-Oct-90	4	1	29	1	1	0
	19-Nov-90	10	4	14	0	0	0
	14-Dec-90	5	2	8	0	0	0
	25-Jan-91	0	0	6	0	0	0

Appendix E. Continued.

Brownie Mountain	4-Oct-85	0	0	0	0	0	0
	17-Oct-85	4	0	15	3	0	0
	8-Nov-85	37	0	67	3	0	0
	18-Nov-85	39	2	58	13	0	0
	3-Dec-85	32	7	63	5	0	0
	28-Feb-86	1	0	95	4	0	0
	31-Mar-86	0	0	78	9	0	0
	17-Apr-86	0	18	27	2	0	0
	26-Nov-86	36	4	119	19	0	0
	24-Dec-86	15	3	33	5	0	0
	15-Jan-87	1	1	31	4	0	0
	2-Mar-87	0	0	28	1	0	0
	2-Nov-87	35	5	63	17	0	0
	17-Nov-87	35	10	67	14	0	0
	4-Dec-87	41	17	70	12	1	0
	21-Dec-87	33	5	74	16	2	0
	12-Jan-88	4	4	59	6	0	0
	28-Jan-88	0	0	65	6	0	0
	27-Mar-88	0	0	26	1	0	0
	20-Apr-88	0	0	0	0	0	0
	13-Oct-88	IFR					
	28-Oct-88	31	12	88	13	0	0
	15-Nov-88	32	13	101	28	1	1
	5-Dec-88	31	6	85	14	1	0
	23-Dec-88	19	2	37	3	0	0
	15-Jan-89	2	1	45	6	0	0
	7-Feb-89	0	1	40	4	0	0
	8-Mar-89	0	0	21	2	0	0
	11-Oct-89	IFR					
	25-Oct-89	12	4	101	21	1	0
	7-Nov-89	23	2	54	14	2	0
	20-Nov-89	8	1	17	1	0	0
	9-Dec-89	4	1	20	2	0	0
	30-Dec-89	0	0	17	2	0	0
	30-Jan-90	0	0	13	0	0	0
	28-Feb-90	0	0	8	0	0	0
	15-Mar-90	0	0	15	0	0	0
	15-Oct-90	9	1	42	8	1	0
	30-Oct-90	12	7	86	7	2	0
	19-Nov-90	11	0	38	7	0	0
	14-Dec-90	2	0	11	2	0	0
	25-Jan-91	0	0	7	2	0	0

Appendix E. Continued.

Wolverine Mountain	4-Oct-85	0	0	0	0	0	0
	17-Oct-85	6	1	26	4	0	0
	8-Nov-85	5	0	41	4	0	0
	18-Nov-85	19	4	78	9	3	1
	3-Dec-85	17	5	56	6	1	0
	28-Feb-86	0	0	24	4	0	0
	31-Mar-86	0	0	13	3	1	0
	17-Apr-86	0	7	5	1	0	0
	26-Nov-86	22	0	82	22	0	0
	24-Dec-86	1	0	15	1	0	0
	15-Jan-87	0	0	4	2	0	0
	2-Mar-87	0	0	14	0	0	0
	2-Nov-87	IFR					
	17-Nov-87	24	10	66	6	0	0
	4-Dec-87	22	3	73	15	2	0
	21-Dec-87	13	7	57	9	0	0
	12-Jan-88	0	0	10	4	0	0
	28-Jan-88	0	0	12	4	0	0
	27-Mar-88	0	0	3	1	0	0
	20-Apr-88	0	0	2	0	0	0
	13-Oct-88	IFR					
	28-Oct-88	25	8	63	20	0	1
	15-Nov-88	28	14	83	14	2	0
	5-Dec-88	10	4	36	8	1	0
	23-Dec-88	2	4	20	3	0	0
	15-Jan-89	0	0	9	1	0	0
	7-Feb-89	0	0	4	1	0	0
	8-Mar-89	0	0	5	9	1	0
	11-Oct-89	IFR					
	25-Oct-89	22	3	80	14	2	0
	7-Nov-89	17	1	56	9	0	0
	20-Nov-89	6	0	11	2	1	0
	9-Dec-89	2	0	16	2	0	0
	30-Dec-89	0	0	6	2	0	0
	30-Jan-90	0	0	6	1	0	0
	28-Feb-90	0	0	7	1	0	0
	15-Mar-90	0	0	22	5	0	0
	15-Oct-90	7	2	48	4	0	0
	30-Oct-90	8	2	47	2	0	0
	19-Nov-90	5	5	22	2	0	1
	14-Dec-90	8	3	15	4	0	0
	25-Jan-91	0	0	4	1	0	0

Appendix E. Continued.

Sunshine Mountain	4-Oct-85	0	0	0	0	0	0
	17-Oct-85	0	0	0	1	0	0
	8-Nov-85	7	3	9	1	0	0
	18-Nov-85	6	2	16	1	0	0
	3-Dec-85	9	2	20	4	0	0
	28-Feb-86	0	0	46	2	0	0
	31-Mar-86	0	0	19	1	0	0
	17-Apr-86	0	2	12	0	0	0
	26-Nov-86	2	0	10	3	1	0
	24-Dec-86	6	1	35	7	0	0
	15-Jan-87	3	0	27	8	1	1
	2-Mar-87	0	0	11	4	0	0
	2-Nov-87	IFR					
	17-Nov-87	14	6	6	6	0	0
	4-Dec-87	14	4	29	5	0	0
	21-Dec-87	13	7	33	9	0	0
	12-Jan-88	2	1	22	4	0	0
	28-Jan-88	0	0	19	5	0	0
	27-Mar-88	0	0	7	2	0	0
	20-Apr-88	0	0	2	0	0	0
	13-Oct-88	IFR					
	28-Oct-88	10	6	22	10	2	0
	15-Nov-88	17	6	17	7	3	0
	5-Dec-88	10	7	25	7	2	0
	23-Dec-88	13	4	24	5	3	0
	15-Jan-89	3	3	28	7	3	0
	7-Feb-89	0	1	7	4	2	0
	8-Mar-89	0	0	5	9	1	0
	11-Oct-89	IFR					
	25-Oct-89	12	3	35	7	1	1
	7-Nov-89	IFR					
	20-Nov-89	7	2	14	7	0	1
	9-Dec-89	8	2	30	8	0	0
	30-Dec-89	0	1	15	5	1	1
	30-Jan-90	0	1	20	3	0	1
	28-Feb-90	0	0	22	1	0	0
	15-Mar-90	0	0	22	5	0	0
	15-Oct-90	7	2	48	4	0	0
	30-Oct-90	8	2	47	2	0	0
	19-Nov-90	5	5	22	2	0	1
	14-Dec-90	8	3	15	4	0	0
	25-Jan-91	0	0	4	1	0	0

Appendix E. Continued.

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[a] PCA were above timberline, mainly above 650 m in elevation. Maximum elevation surveyed was about 1100 m to 1200 m. In most years, moose were distributed mainly between timberline and 930 m elevation; few moose were above 1000 m elevation. In low snow years, moose were distributed between timberline and 1050 m elevation. In deep snow years, moose were mainly in lower elevations in PCA or forced out of PCA. Bald Mountain=49 km^2; Moss Mountain=27 km^2; Willow Mountain=119 km^2; Witna Mountain=29 km^2; Brownie Mountain=48 km^2; Wolverine Mountain=48 km^2; Sunshine Mountain=49 km^2. Location of areas shown in Appendix F.

[b] Aerial surveys were conducted when snow cover was sufficient to count moose.

[c] IFR=aerial survey cancelled because of weather.

[d] Small=pinnately compound antlers and <30 inch maximum spread; Large=Palmately compound antlers and >30 inch maximum spread.

Appendix F. Size (area and greatest width (GW)) of spring season home ranges in female and male moose adults radiocollared in winter concentration areas in the Susitna River floodplain in lower Susitna River Valley in south-central Alaska in 1 May through 30 June in 1981-83. Home range=100% minimum convex polygon (MCP). Area was km^2 of MCP. GW=distance between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes. No. radiofixes were 5 in each season.

			Area			GW		
Sex	Year	N	Mean	SE	Range	Mean	SE	Range
Female	1981	26	38.5	27.0	1.2-709.9	11.8	2.8	3.0-69.6
	1982	34	15.4	3.8	1.0-98.2	9.1	1.6	1.8-33.8
	1983	31	20.6	5.8	1.5-167.1	9.2	1.4	2.5-33.2
Male	1981	7	44.2	17.7	10.0-146.3	17.8	4.5	6.7-42.8
	1982	9	22.4	5.6	2.5-49.3	11.6	2.1	2.2-20.8
	1983	6	38.2	9.5	8.6-76.0	14.8	2.8	4.4-24.0

Appendix G. Size (area and greatest width (GW)) of prerut, rut, and postrut season home ranges in female and male moose adults radiocollared in winter concentration areas in the Susitna River floodplain in lower Susitna River Valley in south-central Alaska in 17 August through 15 October in 1981. Home range=100% minimum convex polygon (MCP). Area was km^2 of MCP. GW=distance between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes. No. radiofixes=5 in each season.

			Area			GW		
Sex	Season[a]	N[b]	Mean	SE	Range	Mean	SE	Range
Female	Prerut	25	3.1	0.43	0.29-8.3	4.1	0.39	1.1-8.9
	Rut	24	3.8	0.52	0.68-10.5	4.5	0.37	1.8-8.8
	Postrut	25	10.2	2.6	0.21-54.8	7.5	1.1	1.7-19.3
Male	Prerut	7	7.2	1.8	0.42-16.3	5.1	1.0	0.2-8.4
	Rut	7	9.2	1.6	4.5-14.9	6.5	0.73	3.5-8.6
	Postrut	7	21.6	6.5	1.6-53.0	11.3	1.6	6.7-18.3

[a] Prerut=17 August through 14 September, rut=14 September through 15 October, postrut=15 October through 14 December.
[b] One female with a rut range maximum width of 271.9 km^2 was not included in calculations.

Appendix H. First and last dates radiocollared moose adults were in winter range in lower Susitna River Valley in south-central Alaska in 1 January 1980 through 31 November 1991. Dates in winter range wee ascertained by comparing the distances between chronologically consecutive radiofixes.

	First date in winter range[a]				Last date in winter range[b]			
Year	Date	J-date	SE	N	Date	J-date	SE	N
1980-81	16 Jan	257	15.0	6	18 Apr	349	2.4	31
1981-82	23 Dec	233	5.7	31	15 Apr	346	1.6	41
1982-83	13 Dec	223	3.5	39	8 Apr	339	2.8	37
1983-84	29 Dec	239	6.2	33	8 Apr	339	2.6	36
1984-85	20 Dec	230	4.6	34	29 Apr	360	1.8	32
1985-86	19 Jan	260	7.5	16	11 Apr	342	2.0	33
1986-87	26 Dec	236	3.3	46	7 Apr	338	1.9	65
1987-88	21 Dec	231	3.4	62	8 Apr	339	2.4	61
1988-89	18 Dec	228	3.4	66	4 Apr	335	1.8	58
1989-90	30 Nov	210	2.7	49	27 Apr	358	2.6	38
1990-91	17 Nov	197	24.0	4				

[a] First date=J-date of the first radiofix after the first long distance movement after 1 October (i.e., J-date of the radiofix marking the first short distance movement) where J-date=Julian calendar date and J-date 150=1 October.

[b] Last date=J-date of the radiofix immediately preceeding the first long distance movement after 15 March (i.e., J-date of the radiofix marking last short distance movement).

Appendix I. First and last dates radiocollared moose adults were in non-winter range in lower Susitna RiverValley in south-central Alaska in 1 October 1980 through 1 Janaury 1991. Dates in winter range were ascertained by comparing the distances between chronologically consecutive radiofixes.

	First date in non-winter range[a]				Last date in non-winter range[b]			
Year	Date	J-date	SE	N	Date	J-date	SE	N
1980					26 Dec	236	15.4	6
1981	25 Apr	356	2.3	31	7 Dec	217	6.3	31
1982	27 Apr	357	1.5	41	16 Nov	196	3.5	39
1983	24 Apr	354	2.5	33	10 Dec	222	6.1	33
1984	24 Apr	354	2.8	36	1 Dec	211	4.4	34
1985	9 May	369	1.8	32	31 Dec	241	7.9	15
1986	1 May	361	2.2	35	26 Nov	206	5.0	41
1987	29 Apr	359	1.9	64	22 Nov	202	3.4	44
1988	6 May	366	2.0	71	15 Nov	195	3.4	71
1989	3 May	363	1.8	58	3 Nov	183	3.1	36
1990	10 May	370	2.2	37	27 Nov	207	50.0	5

[a] First date=J-date of the radiofix immediately after the first long distance movement after 15 March (;.i.e., J-date of the radiofix marking the first short distance movement, where J-date=Julian calendar date and J-date 150= 1 October.

[b] Last date=J-date of the radiofix immediately preceeding the first long distance movement after 1 October (i.e., J-date of the radiofix marking the last short distance movement).

Appendix J. Number of days radiocollared moose adults were in winter range and non-winter range in lower Susitna River in 1 November 1980 through 31 October 1991. Number of days in winter ranges was ascertained by comparing the distances between chronologically consecutive radiofixes. No. days was the mean determined for No. moose.

	Days in winter range[b]			Days in non-winter range[c]		
Calendar year[a]	No. days	SE	No. moose	No. days	SE	No. moose
1980-81	92	21.9	6	226	7.0	31
1981-82	111	5.7	29	203	3.9	37
1982-83	116	4.7	37	230	6.4	33
1983-84	104	9.8	33	221	4.9	33
1984-85	130	5.1	29	237	12.8	8
1985-86	81	7.4	16	209	5.8	31
1986-87	98	4.2	43	207	6.1	43
1987-88	111	4.1	52	193	3.8	64
1989-90	106	3.9	57	183	3.4	35
1990-91	146	4.3	36	154	23.3	4

[a] Calendar year=1 November through 31May, the following year. In a normal year, winter was 1 December through 31 April the following year and non-winter was 1 May through 31 November.
[b] Days in winter range=J-date (Julian calendar date) of last date minus J-date of first date, where first date=J-date of the first radiofix immediately after the first long distance movement after 1 October(i.e., J-date of radiofix of the first short distance movement) and last date=J-date of the radiofix immediately preceeding the first long distance movement after 15 March (i.e., J-date of the radiofix of last short distance movement).
[c] Days in non-winter range=J-date of last date minus J-date of first date, where first date=J-date of firstradiofix after first long distance movement after 15 March and last date=J-date of the radiofix immediately preceeding the first long distance movement after 1 October.

Appendix K. Area (km^2) of winter (November through April) and late winter (January through April) season home range size (km^2) in female and male moose adults radiocollared in winter concentration areas and postrut concentration areas in lower Susitna River Valley in south-central Alaska in 1981-86 and 1989-90. Home range=100% minimum convex polygon.

		November through April					January through April				
Sex	Year[a]	No. moose	No. radiofixes	Mean	SE	Range	No. moose	No. radiofixes	Mean	SE	Range
Female	1981-82	24	15	66.0	11.1	11.3-178.2	25	6-9	40.0	9.0	7.3-162.2
	1982-83	33	10-11	68.3	15.8	1.4-423.8	33	7	32.4	11.5	0.6-357.7
	1983-84	31	12	102.6	23.5	2.0-595.5	35	8	44.4	10.6	1.1-344.7
	1984-85	30	9-13	76.7	16.2	7.5-343.1	32	7-8	10.2	1.9	1.1-41.3
	1985-86	-	-	-	-	-	15	6	24.5	7.8	4.4-102.3
	1989-90	62	5-10	26.6	4.7	0.9-243.7	61	4-6	13.4	3.8	0.1-208.7
Male	1981-82	7	15	168.5	57.9	31.3-426.0	7	9	79.1	37.9	20.3-303.5
	1982-83	6	10	211.3	118.9	13.0-780.3	7	7	8.4	2.6	1.4-16.8
	1983-84	4	10-12	33.5	11.7	15.9-67.0	6	8	111.5	58.8	16.4-392.1
	1984-85	3	13	67.4	31.7	6.4-112.5	5	8	6.3	2.7	2.0-15.0
	1985-86	-	-	-	-	-	17	6	36.4	10.2	1.5-172.4
	1989-90	9	5-8	23.2	8.1	0.5-64.5	9	4-6	6.9	2.2	0.1-20.6

[a] Snowpack depth varied greatly among years and between seasons within calendar years. In general, snow accumulation was low in 1981-82, early and normal in 1982-83, late and normal in 1983-84, deep in 1984-85, low in 1985-86, and very deep in 1989-90.

Appendix L. Greatest width (km) of winter (November through April) and late winter (January through April) season home ranges in female and male moose adults radiocollared in winter concentration areas and postrut concentration areas in lower Susitna River Valley in south-central Alaska in 1981-86 and 1989-90. Home range=100% minimum convex polygon. Greatest width=distance between 2 radiofixes with greatest W; where W=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes.

		November through April					January through April				
Sex	Year[a]	No. moose	No. radiofixes	Mean	SE	Range	No. moose	No. radiofixes	Mean	SE	Range
Female	1981-82	24	15	20.0	3.0	4.9-66.8	25	6-9	17.6	2.9	4.1-66.0
	1982-83	33	10-11	20.9	2.7	2.0-63.7	33	7	10.8	1.7	1.6-48.2
	1983-84	31	12	22.0	3.0	2.0-63.3	35	8	16.5	2.3	1.8-61.4
	1984-85	30	9-13	18.5	2.5	5.0-49.5	32	7-8	6.9	0.8	1.9-22.7
	1985-86	-	-	-	-	-	15	6	11.6	2.1	4.4-34.3
	1989-90	62	5-10	12.9	1.2	2.2-41.4	61	4-6	9.8	1.1	0.9-39.3
Male	1981-82	7	15	25.3	6.1	9.9-51.5	7	9	23.3	5.7	6.7-47.23
	1982-83	6	10	20.4	5.8	6.0-40.1	7	7	6.7	1.1	2.5-9.5
	1983-84	4	10-12	14.4	2.8	9.7-21.5	6	8	21.0	5.2	9.7-43.7
	1984-85	3	13	25.2	9.8	5.5-35.5	5	8	4.6	1.6	1.6-10.3
	1985-86	-	-	-	-	-	17	6	14.5	1.7	3.5-29.6
	1989-90	9	5-8	12.7	3.5	2.2-32.5	9	4-6	7.7	2.8	0.5-29.0

[a] Snowpack depth varied greatly among years and between seasons within calendar years. In general, snow accumulation was low in 1981-82, early and normal in 1982-83, late and normal in 1983-84, deep in 1984-85, low in 1985-86, and very deep in 1989-90.

Appendix M. Area (km^2) and greatest width (km) of terminal winter season home range in 4 samples (A-D) of radiocollared moose adults telemetry monitored in lower Susitna River valley in south-central Alaska in a winter with early normal accumulations of snow, 1982-83, and 2 winters with deep accumulations of snow, 1984-85 a late snow winter and 1989-90, an early snow winter.

	Snow accumulation											
	Normal						Deep					
			No.		Home range size				No.		Home range size	
Sample/ Moose Id. No.	Radio-fix Nos.	Dates of radio-fixes	Days	Radio-fixes	Area	Width	Radio-fix Nos.	Dates of radio-fixes	Days	Radio-fixes	Area	Width
Sample A; winter home range disjunct from non-winter home range; calendar years:												
	1982-83:						1984-85:					
153140	57-65	13 Dec-20 Apr	128	9	11.7	6.8	109-117	21 Jan- 2 May	101	9	10.1	1.7
153211	21-25	4 Jan-4 Mar	59	5	1.4	2.1	72-79	21 Jan-25 Apr	94	8	3.9	3.7
153252	58-64	4 Jan-1 Apr	87	7	1.8	2.2	107-117	20 Dec-2 May	133	11	18.1	9.2
153291	59-66	4 Jan-20 Apr	106	8	6.6	6.3	110-118	21 Jan-2 May	101	9	7.5	6.0
153582	59-67	13 Dec-20 Apr	128	9	3.8	4.2	111-119	21 Jan-2 May	101	9	2.4	3.4
Sample B; winter home range non disjunct from non-winter home range; calendar years:												
	1982-83:						1984-85:					
153170	59-67	4 Jan- 20 Apr	106	9	21.3	15.6	110-118	21 Jan-2 May	101	9	19.2	11.4
153192	58-65	4 Jan-20 Apr	106	9	7.0	10.2	109-117	21 Jan-2 May	101	9	4.1	6.5
153260	80-86	21 Jan-20 Apr	89	7	71.4	18.5	131-139	21 Jan-2 May	101	9	28.9	15.9
153340	60-67	4 Jan-20 Apr	106	8	12.6	4.9	111-119	21 Jan-2 May	101	9	7.2	5.0
153552	60-67	4 Jan-20 Apr	106	8	7.1	5.6	111-119	21 Jan-2 May	101	9	5.7	8.0
153692	60-67	4 Jan-20 Apr	106	8	11.2	8.0	111-119	21 Jan-2 May	101	9	7.1	5.8
Sample C; winter home range disjunct from non-winter home range; calendar year:												
							1989-90:					
152166							53-58	25 Nov-9 Apr	135	6	3.3	3.6

Appendix M. Continued.

152191	53-60	25 Nov-25 Apr	151	8	6.5	6.3
152810	34-38	12 Dec-9 Apr	118	5	17.3	11.2
152860	55-60	25 Nov-9 Apr	135	6	11.8	5.9
153123	84-90	21 Nov-25 Apr	155	7	39.0	13.5
153263	87-93	21 Nov-25 Apr	155	7	21.6	9.5
153311	62-68	21 Dec-25 Apr	125	7	0.3	0.9
153640	52-57	12 Dec-25 Apr	134	6	12.8	7.4
Sample D: winter home range not disjunct from non-winter home range						
	1989-90:					
152440	11-17	21 Nov-25 Apr	155	7	6.8	6.4
152720	16-22	26 Nov-26 Apr	151	7	3.0	2.4
152750	30-36	21 Nov-25 Apr	155	7	5.5	4.1
152780	16-22	26 Nov-26 Apr	151	7	11.0	6.8
153021	28-33	25 Nov-26 Apr	152	6	19.2	8.2
153070	38-44	25 Nov-25 Apr	151	7	22.9	9.9
153081	38-44	25 Nov-25 Apr	151	7	12.2	16.4
153142	11-17	21 Nov-25 Apr	155	7	2.8	4.0
153192	166-172	25 Nov-25 Apr	151	7	6.2	4.9
153222	11-17	21 Nov-25 Apr	155	7	13.7	7.5
153231	11-17	21 Nov-25 Apr	155	7	3.4	5.4
153300	158-162	20 Nov-25 Apr	156	5	2.0	2.3
153692	166-171	25 Nov-10 Apr	136	6	16.5	11.0
153830	27-32	25 Nov-26 Apr	152	6	1.6	2.4
153870	16-20	26 Nov-26 Apr	151	5	2.8	2.5

[a] Radio-fix Nos.= numbers of radio-fixes used in calculations; Dates of radio-fixes=inclusive dates of radio-fixes used in calculations; No. days=number of days encompassing radio-fixes; No. radio-fixes= number of radio-fixes used in home range calculations; Area= area (km^2) of 100% minimum convex polygon (MCP) formed by radio-fixes; Greatest width=distance between 2 radiofixes with greatest D; where D=square root of $((X_1-X_2)^2+(Y_1-Y_2)^2)$ and X,Y=coordinates of radiofixes.

Appendix N. Results of minimum convex polygon and adaptive kernel methods of estimating life home range size (km2) in migratory and non-migratory radiocollared female and male moose adults telemetry monitored with aircraft in lower Susitna River Valley in south-central Alaska during April 1980 through January 1991.

			Minimum convex polygon				Adaptive kernel			
Sex	No. UD[a]	N	Mean	SE	Min	Max	Mean	SE	Min	Max
Females	1	70	173	21.1	23	805	216	25.3	29	959
	>1	36	372	43.1	34	1108	477	58.3	33	1464
	1 and >1	116	241	22.1	23	1108	304	28.4	29	1464
Males	1	23	257	57.8	19	1098	386	102.1	32	2214
	>1	13	313	52.0	98	631	438	98.2	49	1154
	1 and >1	36	277	41.1	19	1098	405	73.5	32	2214

[a] No. UD=No. Utilization distributions; (1)=unimodal, non-migratory moose; (>1) multimodal, migratory moose.

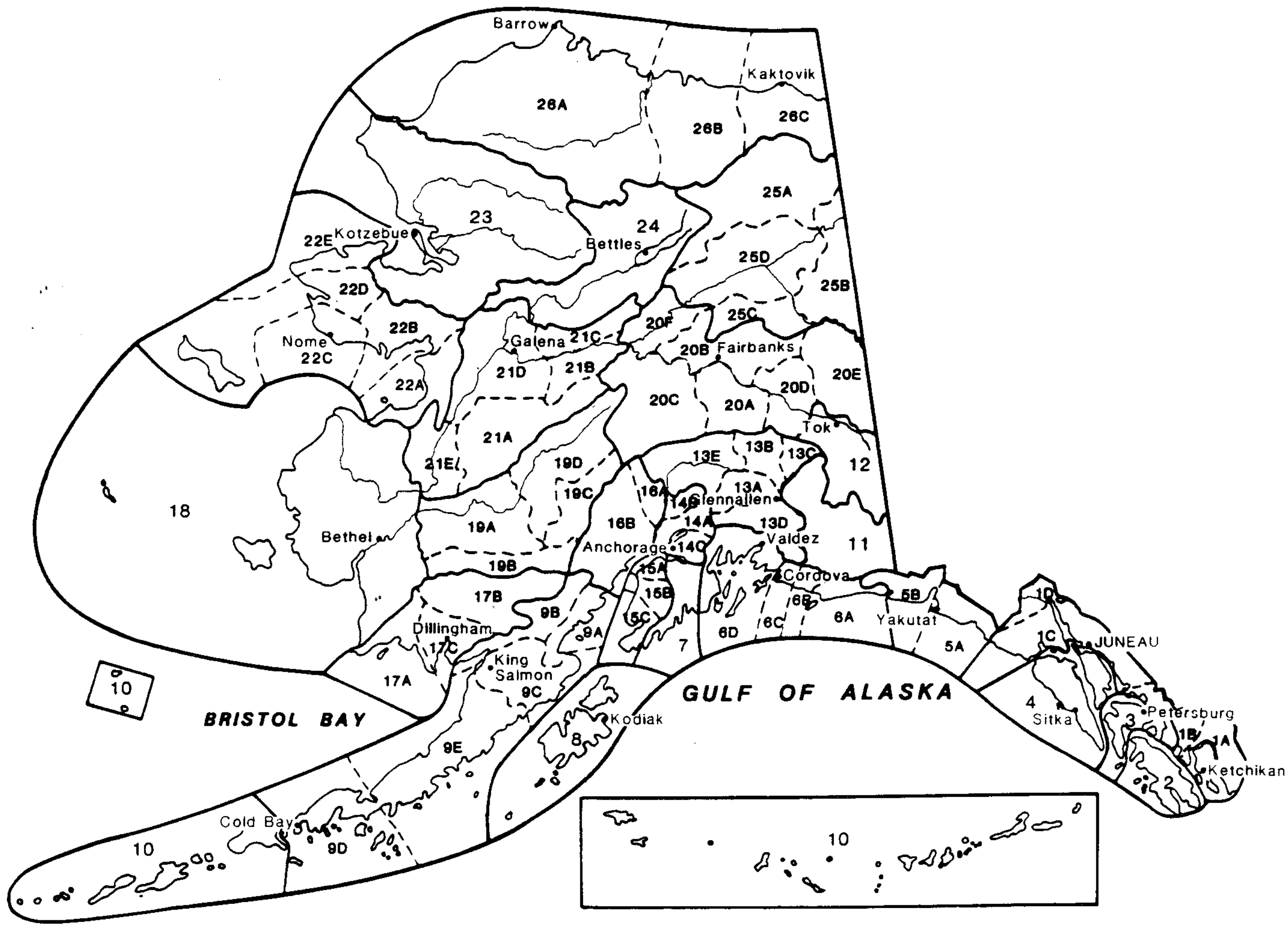
Appendix O. Area (km^2) of life, life-seasonal, seasonal, and management event home ranges in 6 non-migratory and 6 migratory radiocollared moose telemetry monitored with aircraft in lower Susitna River Valley in south-central Alaska in 1980-91. Area=km^2 of 100% MCP Migratory moose were moose with winter home ranges that were disjunct from non-winter home ranges; non-migratory moose were moose with winter home ranges that were not disjunct from non-winter home ranges. Life home range (HR)=all radiofixes (RF); calving HR=RF in 10 May through 31 May; summer HR=RF in 13 July through 15 August; rut HR=RF in 15 September through 5 October; post rut HR=RF in 11 October-7 November; winter HR=RF in 19 Janaury through 31 March; hunt HR=RF in 20 August through 30 September; survey HR=RF in 7 November through 21 December; life-seasonal HR=RF in 6 seasonal periods.

Moose	Life	n	Life-seasonal	n	Calving	n	Summer	n	Rut	n	Postrut	n	Winter	n	Hunt	n	Survey	n
Non-migratory																		
150200	286.9	163	75.9	85	14.5	18	4.6	17	2.8	8	3.1	6	60.6	36	5.3	16	16.1	16
153240	29.2	111	23.5	58	4.8	11	5.9	12	0.5	6	0.4	5	18.4	24	5.9	13	5.6	12
153300	90.5	172	60.5	91	14.1	17	19.5	19	3.2	11	8.6	6	29.4	38	5.1	20	46.1	17
153340	82.2	154	74.9	80	32.7	16	13.7	16	3.1	9	7.1	6	36.4	33	5.9	17	20.6	14
153552	63.7	167	45.0	88	6.6	17	9.8	17	7.0	11	2.2	6	39.0	37	18.6	18	19.4	16
153692	70.6	172	70.2	91	10.8	17	14.3	17	2.5	11	3.5	7	65.5	39	8.8	18	7.1	18
Mean	103.9		58.3		13.9		11.3		3.2		4.1		41.6		8.3		19.2	
SE	37.6		8.4		4.1		2.3		0.9		1.3		7.4		2.1		6.0	
Migratory																		
153140	178.0	150	156.1	76	51.4	15	14.6	14	7.1	8	3.7	6	35.9	33	16.2	16	56.9	15
153211	348.1	121	260.9	66	69.7	16	21.8	8	8.4	8	8.6	6	62.5	28	11.8	11	46.5	11
153220	1202.0	197	795.1	103	442.4	17	175.4	20	157.5	14	7.6	9	144.0	43	167.5	23	24.0	22
153252	479.4	160	390.6	83	104.9	16	15.5	17	14.0	9	24.7	6	33.3	35	18.3	17	232.0	15
153291	336.3	150	321.5	78	68.7	15	17.2	16	14.3	9	17.3	6	163.9	32	19.6	17	108.2	13
153582	396.0	174	284.6	91	75.1	17	76.4	17	7.9	11	3.5	7	179.9	39	11.1	18	155.3	19
Mean	490.0		368.1		135.4		53.5		34.9		10.9		103.3		40.8		103.8	
SE	148.0		91.0		61.8		26.2		24.6		3.4		27.3		25.4		32.1	

Appendix P. Distance (km) between centroids of rut seasonal home ranges and centroids of other seasonal home ranges in life home ranges of non-migratory and migratory radiocollared female moose adults telemetry monitored with aircraft in lower Susitna River Valley in south-central Alaska in 1980-91. Centroids of home ranges were mid-points of radiofixes in the primary polygons in adaptive kernal analyses of life seasonal home ranges. Centroids were described by X,Y coordinates where X and Y were means of X and Y coordinates, respectively. A primary polygon was the polygons that encompassed the greatest number of radiofixes. Migratory moose were moose with winter home ranges that were disjunct from non-winter home ranges; non-migratory moose were moose with winter home ranges that were not disjunct from non-winter home ranges.

Moose	Calving	Summer	Postrut	Winter	Hunt	Survey
Non-migratory						
150200	1.9	0.7	0.7	2.8	0.4	0.8
153240	1.8	0.7	1.6	3.9	0.5	1.4
153300	1.9	0.3	1.6	3.0	0.2	1.9
153340	1.7	0.4	1.0	4.6	0.0	1.4
153552	0.5	0.2	1.3	2.3	0.3	1.8
153692	0.3	0.5	0.1	2.6	0.6	0.7
Mean	1.36	0.48	1.06	3.20	0.34	1.33
SE	0.30	0.84	0.24	0.35	0.09	0.20
Migratory						
153140	1.0	2.0	2.4	17.8	1.7	1.4
153211	8.4	3.7	3.7	13.1	0.1	6.7
153220	3.3	3.8	61.1	60.5	0.4	61.2
153252	3.4	0.3	1.4	41.9	0.4	1.5
153291	2.4	2.0	1.8	25.3	13.4	7.8
153582	3.3	0.3	1.4	41.9	0.4	1.5
Mean	2.85	2.08	8.94	24.92	4.15	15.34
SE	1.21	0.61	7.18	8.51	2.34	9.42

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.

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