Natural Resources Report #91-2

POPULATION DYNAMICS OF BLACK BEAR POPULATIONS, FORT WAINWRIGHT, ALASKA

FINAL REPORT TO THE U.S. ARMY

Submitted by

John L. Hechtel
Wildlife Biologist
Alaska Department of Fish and Game

April 1991

Sponsorship and Technical and Financial Assistance
by U.S. Army 6th Infantry Division (Light)

POPULATION DYNAMICS OF BLACK BEAR POPULATIONS
FORT WAINWRIGHT, ALASKA

CONTENTS

I. SUMMARY 1
II. BACKGROUND 2
III. OBJECTIVES 2
IV. STUDY AREA 3
V. METHODS 3
VI. RESULTS AND DISCUSSION 4
A. Black Bear Ecology 4
1. Bears Captured and Marked 4
2. Physical Characteristics 4
a. Color Phases 4
b. Bear Weights and Growth 5
c. Longevity 5
3. Population Dynamics 5
a. Reproductive Biology 6
1. Breeding season 6
2. Age at first litter 6
3. Litter size 7
4. Reproductive interval 7
b. Mortality 8
c. Emigration and Immigration 9
4. Movements and Home Ranges 10
5. Density 10
a. Need for a Refined Population Estimate . 11
6. Habitat Use 11
7. Denning 11
8. Serology 12
B. Black Bear Harvest 13
1. Regulations (Seasons, Bag Limits, Methods) . . 13
2. Reported Harvest 13
VII. CONCLUSIONS/RECOMMENDATIONS 15
A. Management Strategies 15
1. Tanana Flats Training Area 15
2. Yukon Maneuver Area 16
B. Research Recommendations 17
1. Black Bear Ecology 17
2. Black Bear Predation on Moose 18
VIII. CONCLUSIONS 18
IX. ACKNOWLEDGMENTS 19
X. LITERATURE CITED 19
XI. FIGURES 22
XII. TABLES 34
XIII. APPENDIX A 57

POPULATION DYNAMICS OF BLACK BEAR POPULATIONS, FORT WAINWRIGHT, ALASKA

SUMMARY

The U.S. Army and the Alaska Department of Fish and Game (ADF&G) began a cooperative study of black bear demographics on Fort Wainwright (FWA) lands during 1988. The general objective of the study was to gain information necessary for the sound management of black bears on military lands in Interior Alaska. By spring 1991, 45 individual black bears were captured 111 times in the Tanana Flats Training Area (TFTA) south of Fairbanks. Of 29 bears captured (excluding young in the den), 8 were adult females (mean age 12.0 years), 9 were subadult females (mean age 3.2 years), 4 were adult males (mean age 7.8 years), and 8 were subadult males (mean age 2.0 years). We also handled 4 cubs of the year, marked 12 yearlings, and radio-collared 3 2-year-olds that were denning with collared females. From 1988 through 1990, 29 radio-collared bears were located 916 times. The sightability of nondenning bears during tracking flights was approximately 49%. Mean home range sizes were 59.3 km^2 (22.9 mi^2) for adult females, 82.1 km^2 (31.7 mi^2) for subadult females, 595.9 km^2 (230.1 mi^2) for adult males, and 240.2 km^2 (92.7 mi^2) for subadult males. A density estimate of 46-67 bears/1,000 km^2 (12-17.5 bears/100 mi^2) was based on a proportional count of home ranges of radio-collared bears that overlap the core study area and adjusted for unmarked and hunter-killed bears. During winters 1988-89 through 1990-91, 37 dens were visited and 53 bears were handled in their dens. Of 47 den sites located, 15 were found in spruce habitat types, 9 in birch/aspen stands, 17 in alder/willow shrubs, 6 in heath meadows, and 0 in marshes. Despite the lack of major relief features and the poorly drained nature of the TFTA, there was no apparent shortage of or concentration of den sites. A mean of 169.6, 35.9, and 90.5 bears were taken annually in Game Management Unit (Unit) 20, and Subunits 20A and 20B, respectively, during the 1980-90 period. Hunters took an average of 11.2 and 9.8 bears from the TFTA and the Yukon Maneuver Area (YMA) annually during this period. Harvest intensity was primarily related to access. Overall harvest for Subunits 20A and 20B appears to be within sustainable harvest levels, but small localized areas of overharvest such as the YMA also exist. This is probably unavoidable in the immediate Fairbanks area and also probably reduces the potential for some bear/human conflicts in the more densely settled parts of the Fairbanks North Star Borough. As the demographics of Interior bears are better understood and the density estimate is refined, a review of the overall management strategy for black bears in Unit 20 will be warranted. No serious black bear conservation problems are apparent related to the FWA land management, and the military mission is compatible with the black bear resource and recreational use thereof. It would be wise to continue the research for another 2 years to better define the biological parameters for this highly utilized bear population.

BACKGROUND

Although black bears are widely distributed throughout Interior Alaska, little information is available on their population dynamics or habitat requirements other than Hatler (1967). Black bears are increasingly being recognized as an important food and recreational hunting resource. Liberal seasons and bag limits combined with increasing human population and more efficient means of access and harvest have raised concerns about the potential for local overharvest. The deployment of the 6th Infantry Division (Light) will substantially increase the Fairbanks North Star Borough human population, hunting pressure on black bears, and military operations on FWA lands. To address concerns of FWA resource specialists and ADF&G biologists, a cooperative research project on black bear population ecology was conducted in the TFTA of FWA from 1988 through winter 1990-91.

OBJECTIVES

The original aim of the project was to determine the size and relative health of black bear populations on 2 different portions of FWA (a lightly and a heavily hunted area), to develop a management strategy that would ensure continued viability of these populations, and to use information gained from this research to predict and minimize conflicts between bears and military activities. During 1988, unsuccessful trapping efforts in the heavily hunted western section of the YMA and manpower and financial constraints led to a reconsideration of the original project design. Biologists from FWA and ADF&G decided to concentrate subsequent capture and collaring efforts in the TFTA, while monitoring harvest in both the YMA and TFTA. A part of the proposal to assess the impact of black bear predation on other game species on FWA land was not funded and no data were collected toward this end.

Specific objectives of this black bear study were to:

1. Determine spatial and temporal patterns of black bear habitat use necessary to predict, prevent, and minimize conflicts between bears and military activities.

2. Determine the magnitude and effects of recreational hunting on black bear populations by comparing the 2 areas, one with high harvest pressure and the other with low harvest.

3. Develop a population data base for the TFTA to include sex and age composition, productivity, survival rates, emigration, and immigration based on captures and harvest records.

4. Evaluate the need for a statistically refined population estimate based on available methodology and estimated costs, considering the baseline population data collected during this study.

STUDY AREA

Two areas of FWA land were chosen as study sites: one in the central portion of the TFTA which is located south of Fairbanks; and the other in the western portion of the YMA, located southeast of Fairbanks (Fig. 1). Access to the Tanana Flats is limited to riverboats along certain creeks, to airboats along low-lying areas, and to aircraft at a few airstrips and float-plane lakes. The YMA has relatively good access by a system of roads and all-terrain vehicle trails. The Tanana Flats black bear subpopulation was considered to be lightly hunted and the Yukon Area subpopulation to be heavily hunted.

Tanana Flats is a wet area with little relief other than a few prominent buttes. Elevations range from 400 to 700 feet msl throughout most of the flats, to a high point of 1,406 feet msl in the Blair Lake Hills. The vegetation consists primarily of wet meadows, seral shrub stands, and deciduous, white spruce, and black spruce forests. The Yukon Area is an upland of greater relief, with most of the terrain over 1,000 feet msl and ridges over 3,000 feet msl. The Yukon Area is more heavily forested than the Tanana Flats and includes mid-elevation shrubfields and some alpine tundra. Portions of both have recently burned.

METHODS

From spring 1988 through the denning season of 1990-91, 45 bears were captured 111 times. Most of the summer captures (n = 49) were accomplished with barrel traps consisting of 2-1/2, 55-gallon drums welded together with a sheet metal drop gate door on one end (Schwartz et al. 1983). A few bears were caught using Aldrich foot snares (Flowers 1977) and standard helicopter darting techniques (Reynolds and Hechtel 1983) (n = 6 and n = 3, respectively). In-den immobilization was used to recollar previously marked individuals (n = 37) and to mark offspring of collared females (n = 16). Four cubs of the year were also examined, weighed, and measured, but not marked. Bears were immobilized with a 2:1 mixture of Ketamine/Xylazine (Parke-Davis, Morris Plains, NJ) or with Telezol (50% tiletamine and 50% zolazepam, A. H. Robbins Co., Richmond, VA). Drugs were administered with jab sticks to bears in barrel traps or dens and with Cap-Chur guns to bears in foot snares or when darted from helicopters.

Immobilized bears were measured, weighed, ear-tagged, and tattooed (Reynolds and Hechtel 1983). Blood samples were taken for serologic studies (Zarnke 1991, in press) and a lower premolar was extracted and aged by Matsons Lab (Milltown, MT). The mammae and vulva of females were examined to assess reproductive status (Alt 1989). All bears at least 2 years old were fitted with radiocollars (Telonics Inc., Mesa, AZ), and all collars used on young-age bears included a breakaway mechanism.

Radio-tracking flights were attempted 1-2 times per week during 1988 and once every 1-2 weeks during 1989 and 1990. Bear locations were either plotted directly on topographic maps or on air photos and later transferred to topographic maps. The locations were then digitized to build a computer dBASE file for use in determining home ranges using modified convex polygons (Mohr 1947).

Habitat use information and detailed den site characterizations were collected and are being analyzed by Martin Smith, a graduate student at the University of Alaska-Fairbanks, as part of the requirements for a Master of Science degree.

All bears harvested in the area must be taken to an ADF&G office for sealing where information on the location and date of kill, sex, and skull measurements are recorded and a premolar tooth is collected. All black bear teeth checked from Subunits 20A and 20B kills were aged until 1985, when budget cuts caused ADF&G to start archiving teeth for later aging. As part of this study, all archived teeth from Subunits 20A and 20B since 1985 were sent to Matsons Lab for aging, and the harvest data were analyzed for trends in the sex and age composition of the kill.

RESULTS AND DISCUSSION

Black Bear Ecology

Bears Captured and Marked:

During the course of this study, 45 individual bears were captured 111 times (Tables 1 and 2). Of the initial captures, 22 (48.9%) were in barrel traps, 4 (8.9%) were in Aldrich foot snares, 3 (6.7%) were darted from helicopters, and 16 (35.6%) were offspring of collared females captured in dens. Recaptures were 27 (40.9%) in barrel traps, 2 (3.0%) in Aldrich foot snares, and 37 (56.1%) in dens. No mortalities resulted from any of the capture work.

Of the 45 bears captured, 41 were marked (cubs of the year were not marked) and 32 were collared. As of winter 1990-91, 19 bears were still collared, 3 bears became lost presumably due to collar malfunction, 3 bears shed their collars, the collar was removed from one bear that had a wound the collar was irritating, and 6 bears were dead as of April 1991 (Table 3).

Physical Characteristics:

Color Phases--The 3 color phases of black bears in Interior Alaska are black, chocolate brown, and cinnamon. Brown phase black bears are not common in the Interior. From sealing records of 2,584 bears from Unit 20 since 1974, 275 (10.6%) were listed as cinnamon (including both brown and cinnamon phases). Three of 41 (7.3%) marked bears were "cinnamon" phase, and this proportion is not significantly different from the sealing records.

Bear Weights and Growth--Bears were usually weighed as part of each capture procedure. Multiple captures of individual bears provided the opportunity to document bear growth as well as seasonal weight gain and loss.

Weights of bears handled in dens during late winter recollaring efforts were used to project and examine growth curves for males and females (Fig. 2, Table 4). Only late winter weights were used, so that variation due to seasonal gains and losses would be minimized. The sexual dimorphism in adult weights is clear. Around age 6, the female growth curve levels off as their energy is channeled into reproduction, whereas adult males continue to grow.

The mean weight of 10 adult females ($\geq$6 years old) handled in dens during March and April was 60.7 kg (range 52-68). When May and June captures (n = 5) were included, the mean weight (range 61-69) was 62.5 kg. The summer (Jul-Aug) mean weight of adult females (n = 6) was 86.5 kg (range 66-109).

The mean weight of 3 adult males ($\geq$6 years old) handled in dens was 124.3 kg (range 95-148). The mean, including May and June captures (n = 3), is 125.0 kg (range 118-134). Only 2 adult male weights (127 and 159 kg) were obtained during summer, for an average of 143.0 kg.

The maximum amount of weight gain for adult bears that have ceased growing could best be obtained by capturing individual bears at their worst condition (lightest weight) just prior to gaining weight and recapturing them at their best condition (heaviest weight) just prior to losing weight. However, a comparison of the lightest and heaviest weights from multiple captures of adult bears can approximate it (Table 5). Data for 5 adult females show that their heaviest weights were on the average 45% higher than the lightest weights. Table 6 summarizes the data on average daily weight gains collected during the study. Some bears gained as much as 0.56 kg/day.

Longevity--Of the 41 marked bears, the oldest female was 23 years old when killed by a grizzly bear. She was in excellent condition and would probably have produced cubs the following year. The oldest marked male is 12 years old. Of 1,870 aged bears in the harvest records, 0.7% of the females were over 20 (1 was 21, 2 were 22, and the oldest was 24 years old), and 0.3% of the males were over 20 (3 were 20 and 1 was 22 years old).

Population Dynamics:

Aspects of the population biology of bears vary significantly on a geographic basis and are probably related to the nutritional state of the bears as a function of habitat productivity. Wildlife managers responsible for ensuring the sustainable harvest of black bears need to have information on productivity and mortality of populations similar to the ones they are

managing. Often, however, they must extrapolate from other areas. Because Interior black bears are close to their northern range limits and northern bears have never been adequately studied, biologists have recognized the potential dangers of extrapolation and have stressed the need for pertinent data. The current project has begun to answer some of the questions regarding the population dynamics of northern black bears.

Reproductive Biology--During this study, data on the specific reproductive parameters that contribute to the population's productivity were collected. These include the age at which females first produce offspring, the mean litter size, the reproductive interval, and the maximum age at which females produce young.

Breeding Season: The breeding season in bears can be determined from dates when females are captured while in estrus (indicated by vulval swelling) or inferred from sightings of breeding pairs during radio-tracking flights.

One breeding female (No. 312) that produced cubs the next winter was captured in a near-estrus state on 21 June 1989, but it was not known if she was pre- or post-estrus. One other female captured on 5 June 1988 did not show signs of estrus, but successfully bred that spring.

Table 7 lists dates when pairs of bears were observed consorting. No actual copulations were observed, and it could not be determined whether or not these pairings involved breeding. Schwartz and Franzmann (1991) reported that the breeding season for black bears was from mid-May to early July, and Alt (1989) reported a mid-June to mid-July peak in Pennsylvania. Data from the TFTA study area were not sufficient to identify the breeding season precisely, but the mid-May to mid-July range is reasonable.

Age at First Litter: None of 9 4-year-old radio-collared females had ever produced cubs. Two of 8 5-year-old females gave birth for the first time, and 2 of 4 6-year-old females produced their first litter (Table 8). If every female that has not produced cubs to date breeds in 1991, then the average age at first litter would be 6.0 years. This is probably a minimum figure because some of the young females handled in the dens appeared to be in poor condition and may not breed during spring 1991. Johnson (1982) presented some preliminary evidence that black bears in Unit 20 may breed as young as age 4, but sample sizes were small and the data were inconclusive. Miller (1987) reported that in the Susitna study bears first produced litters at a mean age of 6.4 years while on the Kenai Peninsula the age at first litter was 4.4 years. Alt (1989) summarized the data on mean age at first successful breeding (1 year less than age at first litter) and reported it varied from 2.7 years in his Pennsylvania study to 5.6 years in Alaska (Miller 1987). In general, the higher the

age at first litter, the lower the overall productivity. The TFTA bears are near the high end of the range.

Litter Size: The most accurate way to collect data on the mean litter size is to count cubs while they are still in the den with their mother. Data from summer radio-tracking flights may underestimate litter size if individual cubs or litters are lost before they are counted. Sightings of yearling litters also give minimum cub numbers and underestimate litter size if cubs were lost the first year.

During this study only 2 litters of 2 cubs each were handled in the dens. Another 6 litters were observed during summer tracking flights, but it was unclear whether 1 litter had 2 or 3 cubs. The mean litter size for all 8 litters was either 2.5 or 2.6 depending on whether No. 102 had 2 or 3 cubs. If 2 litters of 2 yearlings each are included in the sample the mean is 2.4 or 2.5. Alt (1989) reported that for 918 litters from black bear studies in the eastern U.S. the mean was 2.5, whereas it was only 1.9 for 304 litters from the western U.S. MacHutchon and Smith (1988) assumed a mean litter size in the Yukon of 1.88 based on what they considered a mean for Interior Alaskan studies. Preliminary indications are that the mean litter size for the TFTA is higher than expected, but sample sizes are small (2 single cub litters could reduce the mean to 2.2) and too much emphasis should not be placed on the data. It is interesting, however, that a high mean litter size (usually associated with high productivity) should occur in a bear population with a high age at first reproduction and long reproductive intervals (usually indications of low productivity).

Reproductive Interval: Because female bears keep their young for extended periods of time, another important aspect of productivity is a measure of the period between litters. Various biologists have used the period between 2 litters, or the interbirth interval, to express this. In bear populations where loss of entire litters is infrequent this is a reasonable index of the time it takes a female to successfully produce young. In populations where a bear loses her entire litter, breeds, and produces another litter the following year, the resulting productivity is equivalent to a female that skips a year. Interbirth interval overestimates the productivity. The use of "reproductive interval" or "the period between weaning of 1 litter by an adult female and the successful rearing and weaning of her subsequent litter" (Reynolds and Hechtel 1983) treats all events that result in an extended cycle equally. The important aspect of a female's cycle is how often she weans offspring. The reproductive interval makes a significant difference in the lifetime productivity of a bear. For example, if a female first has cubs at age 6 and has a litter every other year through age 20 she can produce 8 litters, whereas if she had a 3-year cycle instead of a 2-year cycle she would only produce 5 litters in the same lifetime.

Reproductive interval is difficult to determine because individual females must be followed long enough to document complete cycles, and the longer cycles are not completed during short-term research studies. Two categories of events result in extended cycles: (1) when adult females fail to produce a litter of cubs in a given year or lose a litter of cubs and breed again in the same season (Schwartz and Franzmann 1991), and (2) when a female weans her young a year later than normal. Black bear research has revealed a consistent pattern of 2-year cycles extended only by fallow years due to events of the first type. Miller (1987), however, had 2 documented cases (out of 25 cycles observed) of black bears that did not wean their young until they were 2-year-olds. Prior to this study, there were also indications that in Interior Alaska some females were keeping their young an extra year (Kelleyhouse 1989) but there are no documented cases. During this study, 1 of 2 females with yearlings kept their young the extra year. If black bears in the Interior regularly keep their young until they are 2 years old, the reduced productivity means more cautious management may be necessary.

Although no complete cycles were observed through April 1991 (Table 8), a figure of 2.6 years is the average for 9 incomplete cycles assuming they will all be completed in the minimum possible time. A 12-year-old female (No. 303) had mammae that indicated she had not just weaned young (when first captured in 1988), and it is reasonable to assume that her interval was 1 year longer. A 4-year cycle for No. 303 would make the average 2.7 years. The actual figure is probably higher because it is impossible to document cycles longer than the 3 years the study was conducted. Schwartz and Franzmann (1991) reported an overall average reproductive interval of 2.2 for the Kenai Peninsula, and Miller (1987) reported an estimate of 2.7 for the Susitna River area.

Mortality--Rates of natural and man-caused mortality are also crucial to understanding the population dynamics of black bears in the region. Now that 41 bears have been marked, more information is available on mortality rates, but to obtain a precise estimate it is necessary to follow a large sample for many years.

Of 6 litters totaling 15 cubs for which data are available, 4 cubs (2 entire litters of 2) were lost, giving a cub mortality rate of 27%. On one flight the pilot thought No. 102 actually had 3 cubs, but we never confirmed she had more than 2. If she actually lost a 3-cub litter, the cub mortality rate would be 31%. The other litter was presumed dead because their mother died early in the summer before they could be expected to survive on their own.

Two cases of natural mortality were recorded. In one instance a healthy 23-year-old female (No. 327) was dug out of her den and eaten by a grizzly bear on 9 October 1989. Grizzly predation on

black bears in dens has been documented elsewhere (Boertje et al. 1987, Ross et al. 1988). An 11-year-old female's (No. 311) chewed-up collar with a clump of black bear fur attached to it was found under the snow near where she denned. It appeared that something may have killed and eaten her.

A 5-year-old female (No. 312) that had her first litter of 2 cubs was found dead of unknown causes on 3 July 1990. An examination of the carcass revealed no obvious cause of death. Maggots had consumed all the soft tissue but the position and condition of the skeleton indicated that nothing had scavenged her. There were no broken bones and the body was laid out as if the bear had died while resting. A check of the site with a metal detector showed no sign of a bullet. It is possible that she was gut shot and later died from the wound, but the cause of death remains unknown.

Hunters killed 3 marked bears, 1 in 1989 and 2 in 1990. A 2-year-old male (No. 308) dispersed to the Nenana area in May and was shot by hunters on 10 September 1989. A 4-year-old female (No. 325) was shot at a bait station accessed by airboat on 18 May 1990. A 3-year-old male (No. 322) was killed in May 1990 after crossing the Tanana River and spending time in a subdivision where he got into some dog food and became a nuisance over the course of a week. Even though he was taken by a licensed hunter, the kill was more a defense of life or property (DLP) kill than a sport kill.

Emigration and Immigration--Although emigration and immigration can be important factors in the population dynamics of bears, they are difficult to document, especially in a short-term study. Unless all bears are marked in an area, it cannot be known for sure whether or not lone young-age bears being caught are immigrants or resident bears not previously captured. Following the offspring of resident bears until they establish permanent home ranges provides information on dispersal. A 2-year-old male (No. 308) left the Fairbanks area between 10 May and 27 May 1989 and moved 30 miles west-southwest to Nenana where he remained through 10 September 1989 when he was killed by a hunter. A 3-year-old male (No. 322) crossed the Tanana River in what may have been a dispersal movement, but was shot after causing problems in a subdivision. No young-age females left the study area. With increasing numbers of marked and collared offspring of radio-collared females, more information on dispersal movements can be collected over the next few years. This would provide insights into the origins of young bears being killed in some of the heavily hunted portions of Subunit 20B. Of bears whose birthplace was known, Rogers (1987) had only 3 of 31 females disperse, whereas all 20 males did (13 as 2-year, 5 as 3-year, and 2 as 4-year-olds). Alt (1978) had most of his males disperse as yearlings. Dispersing males tend to travel to areas with few dominant males and many mature females, thus recolonizing areas where adult males have been hunted out (Kemp 1972, 1976). If few

females are present the young males may move on after spending some time in an area (Rogers 1987).

Movements and Home Ranges:

White and Garrott (1990) discussed the merits and drawbacks of various methods of calculating home range. Admittedly there are problems with a simple technique such as minimum convex polygons (Mohr 1947), but with small sample sizes and cautious interpretation of the results the technique does provide a relative index of the amount of country used by individual bears. Table 9 presents the data on home range size for each bear tracked. The mean home range size for adult females ($\underline{n}$ = 7) was 59.3 km^2 (range 9.0-126.2) (Fig. 3), for adult males ($\underline{n}$ = 4) it was 595.9 (range 235.9-1,122.3) (Fig. 4), for subadult females ($\underline{n}$ = 9) it was 82.1 (range 19.6-245.0) (Fig. 5), and for subadult males ($\underline{n}$ = 8) it was 240.2 (range 29.1-442.2) (Fig. 6). The mean home range sizes for all females and all males (72.1 and 358.7 km^2, respectively) were larger than those reported for the Susitna River area (67.1 and 251.5 km^2, Miller 1987), the Kenai Peninsula (21 and 141 km^2 for adults, Schwartz et al. 1983), or Prince William Sound (10-30 and 70-100 km^2, Modafferi 1982). Figures 7 and 8 show the spatial relationships among male and female home ranges.

Density:

One of the objectives of this study was to evaluate the need for a statistically refined population estimate in light of the biological data collected during the course of this study.

Based on the work so far, a preliminary estimate of black bear density on the Tanana Flats was made by examining the home ranges of 25 collared bears in relation to a 100 mi^2 central portion of the study area. This is a similar approach to that used by Schwartz and Franzmann (1991) and Reynolds et al. (1987). Summing the proportion of each bear's home range that overlapped this core area gave a figure of approximately 12 whole bear equivalents per 100 mi^2 (46/1,000 km^2) during 1989. To get the best approximation using this technique all bears using the core area must be collared. Most bears using the core area were collared, and an estimate of the unmarked bears using the core area was made. During spring 1989, 3 unmarked bears sighted in the area could have been among the bears later captured nearby. An unmarked male and female seen consorting with radio-collared bears during 1990 are 2 additional bears that were never captured. There were also 8 unmarked bears killed by hunters in the vicinity in 1989 and 1990. An examination of gaps in the home ranges of each of the sex and age classes in relation to the 100 mi^2 core and consideration given to the unmarked bears sighted and killed in and near the core led to a subjective upward adjustment of the estimate to include uncollared bears. The proportional bear count was adjusted upward from 5.25 to 6.25 subadult females, from 2.5 to 5.0 adult females, from 0.75 to 2.0

adult males, and from 3.25 to 4.25 subadult males to make the total 17.5 whole bear equivalents per 100 mi^2 or 67 bears per 1,000 km^2. This density estimate does not include cubs of the year which could increase the figure to 86/1,000 km^2 (assuming 22% of the population are cubs). Admittedly this is a crude estimate of density but it is a reasonable first attempt. This compares with reported densities of 90/1,000 km^2 in the Susitna River area (Miller et al. 1987) and 205-265/1,000 km^2 on the Kenai Peninsula (Schwartz and Franzmann 1991).

Need for a Refined Population Estimate--Miller et al. (1987) proposed a form of mark-recapture for using a sample of radio-collared bears to get a statistical estimate of bear population density. While this technique seems promising for large samples of radio-collared bears with reasonable sightability, it is not a panacea. The technique is labor intensive and expensive. One of the objectives of this study was to examine the need for a statistically refined population estimate. With the number of bears collared, their sightability, and the preliminary density estimate previously described, it is not recommended that a mark-recapture estimate be attempted at this time. Additional funding would be better put to increasing the number of marked bears and expanding the area in which bears are collared and continuing to monitor the productivity, mortality, movements, home ranges, and dispersal patterns while refining the current density estimate. More information useful to ADF&G and FWA managers will accrue from this approach.

Habitat Use:

The seasonal habitat use patterns of the radio-collared bears are being analyzed by Martin Smith, a graduate student at the University of Alaska, as part of the requirements for a M.S. degree in wildlife management. Appendix A contains a preliminary report on the seasonal habitat use analyses conducted so far. A draft of the thesis is expected to be available for review by fall 1991.

Denning:

In addition to habitat use during spring and fall, characterization of 34 dens and denning habitat will be included in Smith's thesis. Appendix A Fig. 3 shows his preliminary analysis of den locations related to available habitat. In addition to Smith's work, another 13 dens were visited during spring 1991. Of those 13 dens, 4 of the dens were found in white spruce habitats, 1 was in a black spruce stand, 3 were in birch stands (2 in old open birch burns), 2 in alder/willow shrub types, and 3 in shrub Betula heath meadows.

Three of these bears used ground nests (one in black spruce, two in heath meadows) instead of dug dens during winter 1990-91. The record snowfall had completely covered the 2 young females but the snow over the top of them was just a thin icy crust

approximately 2 inches thick. An adult male (No. 318) was actually exposed; a depression in the snow was visible at a distance and the bear could be seen curled up at the bottom of the hole. Shortly before he was recaptured it had snowed and rained and his fur was wet. A large patch of fur on his left flank and upper arm was slipping, and the bare skin appeared to have a rash in places. It is not known what caused the problem or if it was related to his denning on the surface. No other bears whose collars were changed in previous years denned on the surface, although in summer 1990 M. Smith visited the site where No. 318 denned the previous year and reported it looked as if there was only a straw pile, rather than a dug den. Autumn 1990 was wet and a possible explanation for the 3 ground nests could be that the intended or prepared den sites of these bears flooded. There appeared to be available den sites near the ground-nesting bears and a totally plausible explanation for the behavior was not apparent. It would seem that the long, frigid Interior Alaska winters should preclude denning on the surface.

The habitat types for all 47 den sites from winters 1988-89 through 1990-91 are 17 in alder/willow shrub, 15 in spruce forest types, 9 in birch/aspen stands, and 6 in heath meadows. No dens were found in marsh habitat. No reuse of dens was documented during the study. Schwartz et al. (1987) summarized data on denning of 3 Alaskan black bear populations.

Special concerns about the possibility of limited denning habitat, den concentrations on the various buttes, and potential conflicts with the military's training mission were not realized. Despite the relatively poor relief and poorly drained soils, there appeared to be abundant sites with enough relief for bear dens scattered throughout the study area (Fig. 9). The variety and dispersion of the dens located to date may preclude any attempts to avoid denning habitat during winter training, but also limits the number of dens that might be impacted by the maneuvers.

Serology:

When mammals are exposed to disease agents, the immune system responds by producing specific antibodies. Antibodies localize in the liquid component of blood which is called serum. Serum can be separated from a blood clot and antibodies detected by means of sophisticated laboratory procedures. With some exceptions, the presence of antibody in serum indicates that the animal had been exposed to the agent in question. This whole process is referred to as "serologic testing."

Blood samples were collected from black bears which were captured on the Tanana Flats study area. Sera were tested for evidence of exposure to 3 disease agents: (1) Francisella tularensis, the causative agent of the disease known as tularemia; (2) Brucella suis IV, the cause of brucellosis; and (3) Coxiella burnetti, the

agent of Q fever. Serologic evidence of all 3 diseases has been found in free-ranging Alaska wildlife.

No evidence of either Q fever or brucellosis was found in any of the specimens. Nearly all of the sera had evidence of tularemia. R. Zarnke (pers. commun.) believes that these test results may be erroneous, and that there could actually be some other disease agent which is eliciting the antibody production. He hypothesizes that the antibody is related closely enough to tularemia antibody that it "cross reacts" and produces confusing test results. Additional samples and tests are necessary to clarify this situation, and if the study continues a resolution to the problem will be pursued.

Black Bear Harvest

Regulations (Seasons, Bag Limits, Methods):

The black bear sealing requirement was instituted in Unit 20 in 1974, and since then a 3-bear bag limit with no closed season has been in effect. Cubs (black bears in their first year of life) and females accompanied by cubs are protected. Bear baiting was prohibited in 1977 when a regulation in reaction to problems associated with the pipeline made it "unlawful to deliberately feed bears, wolves, foxes, or wolverines, or to deliberately leave human food or garbage in such a manner that it attracts such animals" (Alaska Administrative Code 5 AAC 92.230). The Board of Game exempted hunting black bears with bait from the feeding prohibition starting in 1982-83, but required permitting of baiters. After the 1983-84 season, permits were not required again until the 1988 season. Black bear hunting with dogs requires a permit, and only 2 permits were issued in 1990.

In addition to the state regulations, hunters need a permit to access military land. To obtain the permit the hunter must attend an orientation session. Active duty military hunters hunting on military land may hunt big game without a license, but must obey Alaska hunting regulations. Additionally, bait stations on military land must be registered/recorded with military police to aid in enforcement actions. Approximately 100 stations on FWA lands have been recorded each of the last 3 years.

Reported Harvest:

Since bears were required to be sealed in 1974, 2,624 bears have been taken by hunters in Unit 20. Mean annual harvest for Unit 20 and Subunits 20A and 20B is 169.6, 35.9, and 90.5, respectively (Tables 10 and 11). Mean annual harvest for the TFTA and YMA is 11.2 and 9.8, respectively (Table 11). No significant trends in the numbers of bears harvested were detected. For 5 years (1978-82) when baiting was prohibited the mean number killed was 138.8 (range 93-196), whereas from 1983 to 1987 the mean kill was 185.4 (range 121-205). Even though the

difference is not statistically significant, some of the increase may be due to the effects of baiting.

The percentage of females in the harvest is used by managers as an indicator of harvest pressure (Beecham 1986, MacHutchon and Smith 1988). The percentage of females in the harvest for Unit 20 and Subunits 20A and 20B can be found in Table 10. MacHutchon and Smith (1988) suggested that a harvest ratio "greater than 35% females is the threshold beyond which a more detailed assessment of the harvest is warranted" and Beecham (1986) stated a percentage of females over 40% was an indication of overharvest. The Unit 20 mean percentage of females is about 33% and is not uncommonly over 35%.

Figures 10, 11, and 12 show frequency distribution of the Unit 20 hunter kill for spring and fall and yearly harvests since 1974. Table 12 provides a percent breakdown of the sex and age structure of bears killed in Unit 20. Seventy-one percent of the bears killed were 6 years of age and younger. For females, 55.2% of those killed had not reached the mean age of first production of young (6.0 years). Tables 13, 14, and 15 summarize the mean ages of black bears killed on a yearly basis in Subunits 20A and 20B, in the TFTA, and in the YMA, respectively. Kolenosky (1986) stated that the most vulnerable age classes of black bears in Ontario were 2-6 years for males and 3-6 years for females. There was a significant decline in the mean age of males in Subunits 20B between 1980 and 1990 (from 6.5 years to 3.9 years, $P < 0.05$). Coupled with other subjective insights on the distribution of hunting pressure in areas with good access this tends to confirm the notion that localized parts of Subunits 20B are being overharvested.

Information from harvest data can suggest something is happening, but other information on the population itself is often needed to help interpret what is going on. Using the density estimates from this study along with land mass of the areas involved and a estimate of sustainable mortality from Miller (1990) permits an assessment of harvest rates for Subunits 20A and 20B and parts of FWA under consideration (Table 11). Not all of the larger areas are black bear habitat and the kills are not uniformly distributed, so the information for 20A and 20B is deceiving and not as instructive as the data from the TFTA and the YMA. The data from the YMA corroborated by the decline in mean male ages in 20B indicate that the harvest rate is probably excessive. Concerns about this possibility were one of the factors in initiating this study. The management implications are discussed elsewhere in this report.

All the harvest data interpretation makes underlying assumptions about hunter effort. Unfortunately, effort data are not regularly collected. J. Kerns of the Natural Resource Office of the Facilities Engineers has begun to collect such data for FWA lands (Balch and Kerns 1989, Kerns 1990). This work is important and useful, especially as the technique is refined and data from

a number of years allow some insights into trends. For 1989 he reported that for all of FWA, 20% of hunters sought black bears but that the success rate was only 11% (6% on Eielson Air Force Base) and suggested a depleted bear population and the need for continuing research.

CONCLUSIONS/RECOMMENDATIONS

Management Strategies

The U.S. Army is faced with the difficult challenge of "proper management and protection of the resources and values" of its military lands within the context of its preeminent military mission. Management of species such as black bears in Interior Alaska is a complex and difficult task even on nonmilitary lands. The prohibitive costs of periodic density estimates and the absence of a technique for determining trends are serious constraints. In addition, a suite of factors including limited personnel and funds, funding constraints, crises and perceptions of crises, and the interests and priorities of bureaucracies all contribute to a management "climate." For a long time northern black bears have fallen low on the priority list, although it was recognized that managers were handicapped by the lack of baseline data on density and population dynamics. There was no perceived need for immediate information because there were large tracts of intact habitat adjacent to areas of high harvest that were believed to minimize any impacts of local overharvest. Biologists at FWA and ADF&G have done a good job to date of managing black bears within the constraints of money, personnel, and knowledge available at the time. However, information gathered during this study should improve management.

The intensity and scale of management depend on practical considerations as well as the potential for and consequences of errors in management. If the possibilities and consequences of errors are small and reversible, then a flexible management strategy is allowable. The Draft Resource Management Plan for the YMA (Bureau of Land Management 1988) reviews many of the complex and conflicting factors the FWA resource managers must weigh and balance. Resource conflicts, recreational use, and access are some of the issues that must be considered. There are differences between the TFTA and the YMA also.

Tanana Flats Training Area:

The TFTA is accessible primarily via riverboat, airboat, and aircraft during summer and fall, and by snowmachine during winter (Kerns 1990). High moose densities make this area a popular hunting area for many military and civilian residents of the Fairbanks North Star Borough. Black bear harvest occurs mostly during fall incidental to moose hunting. Approximately 40 trespass cabins and shelters built to support hunters and trappers are situated in the area. Large-scale winter training exercises are also conducted in the TFTA. The current management

approach is adequate in light of the relatively poor access and low harvest levels for black bears. In the future, changing access and increasing effort are the factors that need monitoring. Management recommendations include:

1. There is no need for any change in the current approach to black bear management on the TFTA.

2. The military mission for the TFTA does not, at present, appear to be in conflict with the conservation and recreational use of the black bear on FWA lands, and there is no need for mitigative efforts.

3. Because harvest and effort data help to detect developing problems in the future, it is important to collect these data. The teeth collected during sealing from Subunits 20A and 20B should be aged each year, and the collection of data on hunter effort (Kerns 1990) should continue.

4. Because interpretation of effort and kill data also requires insights into the population itself, and the black bear research is just beginning to provide some of the needed data, the ADF&G/FWA black bear research project should continue for another 2 years, and the data should be used to interpret the harvest data.

Yukon Maneuver Area:

The YMA presents a different scenario than the TFTA. The YMA has good road and ORV access, a large demand for varied recreational use by military and civilians, and is frequently used for a variety of training activities by the Army and Air Force (Bureau of Land Management 1988). The level of harvest of black bears in the area has apparently depleted the local bear population (at least in the western portion of the YMA). Considering accessibility, the amount of recreational use taking place, and the potential for human/bear conflicts, this is not an unacceptable situation. Hunters are still able to kill bears (mostly young animals dispersing from adjacent areas). Reduced numbers of bears are occurring in the settled parts of the Fairbanks North Star Borough, where young bears that wander in are killed in defense of life or property as well as for sport harvest. Large areas of intact habitat are needed to maintain a natural level of bears, and other large tracts of FWA land serve that end. The YMA can be managed differently. Management recommendations include:

1. There is no need for a change in the current approach to black bear management on the YMA.

2. The military mission for the YMA does not appear to be causing any significant conflicts with the conservation and recreational use of the black bear on FWA lands, and there is no need for mitigative efforts.

3. Because the bears of the YMA are being heavily harvested, it is important to closely follow the kill data and to collect effort data. Aging of teeth and the harvest effort by the FWA Natural Resource Office should continue.

4. For the reasons mentioned under the TFTA section as well as the fact that the harvest in places like the YMA is probably dependent on dispersal from adjacent areas it is important to continue the current research to collect data on dispersal rates and patterns.

Research Recommendations

The first 2-1/2 years of research on the black bears of the TFTA have provided some important insights into the population dynamics of northern black bear populations useful to ADF&G and FWA resource managers. However, there are some serious limitations to short-term studies of bears due to their slow maturation, infrequent litters, low densities, and low natural mortality rates. The initial effort to capture a reasonable sample of bears is time-consuming and expensive. The later into the study that an individual bear is caught, the less information that can be collected from that bear. During a 2- to 3-year project, reproductive intervals longer than 3 years as well as the older ages at first reproduction will be missed, causing productivity to be overestimated. Dispersal and the establishment of land tenure in young bears is important but almost impossible to document in a 3-year study. The return in useful data relative to cost gets much higher each year after the third year. Even though the Army funding ran out in 1990, ADF&G continued to track the bears and change collars and mark offspring during spring 1991. The extra productivity data gathered demonstrated the worth of the additional effort. With minimal ADF&G funds for 1991, the bears will be checked occasionally and followed to dens in fall 1991. This gives the Army and ADF&G the option of continuing the project with minimal lost data. It would be more cost effective to continue funding the present study during 1992 to more accurately define the biological parameters for northern black bears by building up current samples than to institute another short-term study later. Research recommendations include:

Black Bear Ecology:

A. Continue the TFTA demographics research

1. Continue to recollar and monitor the 19 bears currently collared, as well as marking and collaring their offspring.

2. Increase the sample of marked bears and expand the capture area to the east toward McDonald and Bear Creeks.

3. Use the collared bears to refine productivity and mortality rate estimates.

4. Refine the density estimate based on the additional data.

5. Estimate sustainable harvest rates for Interior black bears using available modeling capabilities.

6. Explore further the impacts of hunting and the role of subadult dispersal on the TFTA bear population.

7. Document and examine yearly variation in movements, home ranges, and denning habitat.

8. Continue to monitor spatial and temporal use patterns to prevent or mitigate the impacts of military activities on the black bear resource.

Black Bear Predation on Moose:

A. An opportunity to investigate the impact of black bear predation on moose, another important big game resource on FWA, exists. This part of the original proposal was not funded but still could be a worthwhile, cost-effective project in conjunction with the continuation of the demographics work.

CONCLUSIONS

The 3-year cooperative research project has made important progress in developing the knowledge of the ecology of northern black bears and the impacts of hunting and military activity on the resource. Data on the spatial and temporal use patterns of radio-collared bears from this report and M. Smith's M.S. thesis (in prep.) have provided data on movements, home range, dispersal, and denning and have found no obvious conflicts with military activities. Analyses of the impacts of hunting have shown that the effects are directly related to access in the Fairbanks area where the demand for opportunity is great. The low and high harvest levels for the TFTA and the YMA, respectively, were documented and along with the preliminary population data base estimates from the research have provided a basis for an eventual estimation of sustainable harvest levels of black bears for Interior Alaska populations. After reviewing current management needs and the data collected as part of this study, a statistically refined mark-recapture population estimate is not warranted at this time. However, the benefits from continuing the population dynamics work are great and will help to refine the current density estimate. It is highly recommended that the black bear research be funded for 1992 and 1993.

ACKNOWLEDGMENTS

This study was undertaken as a cooperative effort between the U.S. Army 6th Infantry Division (Light) Alaska and the Alaska Department of Fish and Game. The 6th Combat Aviation Brigade, the Wildlife Enforcement Section of the Provost Marshal Office, the Natural Resource Office of the Facilities Engineers at Ft. Wainwright, and the Air Force Technical Applications Center, Detachment 460, Eielson AFB provided invaluable support. Jesse Collins and his welding class at Hutchison Career Center generously built 22 barrel traps. Kobuk Fuel and Feed, Carrs Foodland, Super Valu, and Alaska Airlines all donated large quantities of bait during the 1988 and 1989 trapping effort.

The success of the field work was also due to contributions by many hard-working individuals. Mark McNay, Bill Lentsch, Sandy Hamilton, John Schoen, and Pat Valkenburg flew radio-tracking flights. Many able volunteers assisted on the project and I would like to especially thank Toby Boudreau, Sarah Cheek, Ben Hatcher, Dean Johnson, Marty Smith, Mark Walter, Greg Wilker, and the late John Bevins. I am grateful to have learned most of what I know about bear capture from Harry Reynolds, who also helped initiate this study. Melissa Johnson provided top-notch clerical and morale support, and Laura McManus provided editorial assistance. Special thanks are extended to Junior Kerns who provided unflagging support for every aspect of the study and who deserves much of the credit for the project's success.

LITERATURE CITED

Alt, G. L. 1978. Dispersal patterns of black bears in northeastern Pennsylvania: A preliminary report. Pages 186-199 in R. D. Hugie, ed. Proc. Fourth Eastern Black Bear Workshop. Maine Dep. of Inland Fisheries and Wildlife, Orono.

_____. 1989. Reproductive biology of female black bears and early growth and development of cubs in northeastern Pennsylvania. Ph.D. Thesis. West Virginia Univ., Morgantown. 116pp.

Balch, T. A., and J. D. Kerns. 1989. Analysis of 1987 hunter sign-in logs for Fort Wainwright, Alaska. Natural Resource Report 89-2. Natural Resource Office, Fort Wainwright, Alaska.

Beecham, J. 1986. Black bear management plan, 1986-90. Idaho Dep. Fish and Game, Boise. 16pp.

Boertje, R. D., W. C. Gasaway, D. V. Grangaard, and D. G. Kelleyhouse. 1987. Predation on moose and caribou by radio-collared grizzly bears in east central Alaska. Can. J. Zool. 66:2492-2499.

Bureau of Land Management. 1988. Draft resource management plan and environmental impact statement for the Fort Wainwright Management Area. U.S. Dep. Inter., Alaska State Office, Anchorage. 104pp.

Flowers, R. 1977. The art and technique of snaring bears. Wash. Forestry Protection Association. Mimeo. 37pp.

Hatler, D. F. 1967. Some aspects in the ecology of the black bear (*Ursus americanus*) in Interior Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 111pp.

Johnson, D. M. 1982. Reproductive characteristics of black bears in Interior Alaska. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Final Rep. Proj. W-21-2. Juneau. 11pp.

Kelleyhouse, D. G. 1989. Unit 12 black bear survey-inventory progress report. Pages 51-55 in S. O. Morgan, ed. Annual report of survey-inventory activities. Part IV. Black Bear Vol. XIX. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Prog. Rep. Proj. W-23-1. Juneau. 117pp.

Kemp, G. A. 1972. Black bear population dynamics at Cold Lake, Alberta, 1968-70. Int. Conf. Bear Res. and Manage. 2:26-31.

_____. 1976. The dynamics and regulation of black bear (*Ursus americanus*) populations in northern Alberta. Pages 191-197 in M. R. Pelton, J. W. Lentfer, and G. E. Folk, Jr., eds. Bears: their biology and management. IUCN Publ., New Series, No. 40. Morges, Switzerland.

Kerns, J. D. 1990. Analysis of 1988 hunter harvest reports for Fort Wainwright, Alaska. Nat. Res. Rep. 90-1. 16pp.

Kolenosky, G. B. 1986. The effects of hunting on an Ontario black bear population. Int. Conf. Bear Res. and Manage. 6:45-55.

MacHutchon, A. G., and B. L. Smith. 1988. A review of the status and management of the black bear (*Ursus americanus*) in the Yukon. Fish and Wildlife Branch. Yukon Dep. Renewable Resources, Whitehorse. 109pp.

Miller, S. D. 1987. Susitna Hydroelectric Project Final Report. Big game studies. Vol. VI. Black Bear and Brown Bear. Alaska Dep. Fish and Game, Anchorage. 276pp.

_____. 1990. Impacts of increased hunting pressure on the density, structure, and dynamics of brown bear populations in Alaska's Game Management Unit 13. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Prog. Rep. Proj. W-23-2. Juneau. 54pp.

_____, E. F. Becker, and W. B. Ballard. 1987. Black and brown bear density estimates using modified capture-recapture techniques in Alaska. Int. Conf. Bear Res. and Manage. 7:23-35.

Modafferi, R. D. 1982. Black bear movements and home range study. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Final Rep. Proj. W-17-10, W-17-11, W-21-1, and W-21-2. Juneau. 73pp.

Mohr, C. O. 1947. Tables of equivalent populations of North American small mammals. Am. Midl. Nat. 37:223-249.

Reynolds, H. V., and J. L. Hechtel. 1983. Population dynamics of a hunted grizzly bear population in the northcentral Alaska Range. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Prog. Rep. Proj. W-22-6. Juneau. 52pp.

_____, _____, and D. J. Reed. 1987. Population dynamics of a hunted grizzly bear population in the northcentral Alaska Range. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Prog. Rep. Proj. W-22-5. Juneau. 59pp.

Rogers, L. L. 1987. Effects of food supply and kinship on social behavior, movements, and population dynamics of black bears in northeastern Minnesota. Wildl. Monogr. 97. 72pp.

Ross, P. I., G. E. Hornbeck, and B. L. Horejsi. 1988. Late denning black bears killed by grizzly bear. J. Mammal. 69(4):818-820.

Schwartz, C. C., and A. W. Franzmann. 1991. Interrelationship of black bears to moose and forest succession in the northern coniferous forest. Wildl. Monogr. 113. 58pp.

_____, _____, and D. C. Johnson. 1983. Black bear predation on moose. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Final Rep. Proj. W-17-10, W-17-11, W-21-1, W-21-2, and W-22-1. Juneau. 135pp.

_____, _____, and S. D. Miller. 1987. Denning ecology of three black bear populations in Alaska. Int. Conf. Bear Res. and Manage. 7:281-292.

White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Acad. Press, Inc. 383pp.

Zarnke, R. L. 1991. Serologic survey for microbial pathogens. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Restor. Final Rep. Proj. W-22-6, W-23-1, W-23-2, W-23-3, and W-23-4. Juneau. In press.

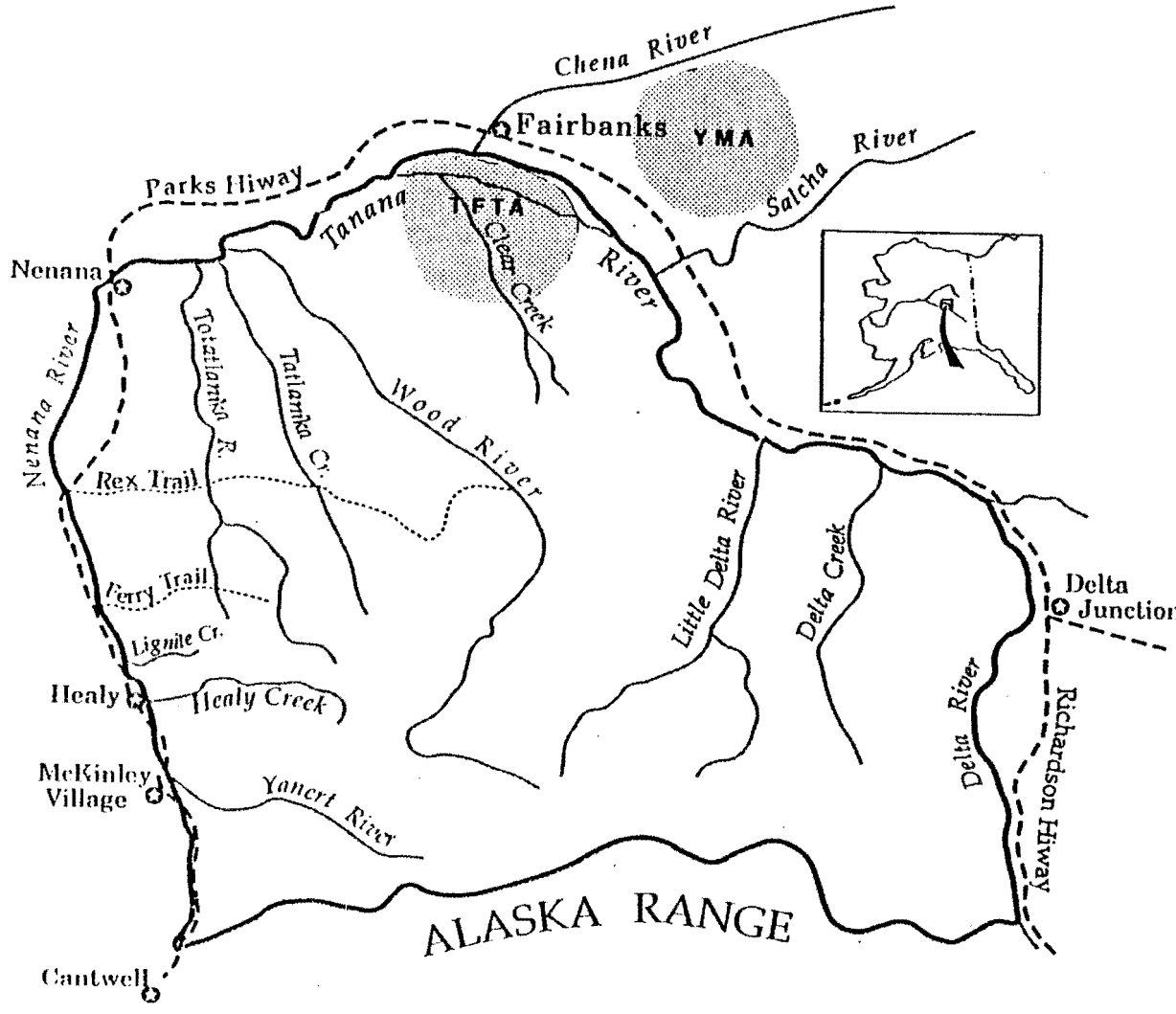

Fig. 1. Black bear study areas in the Tanana Flats Training Area (TFTA) and Yukon Maneuver Area (YMA) portions of Fort Wainwright, Alaska.

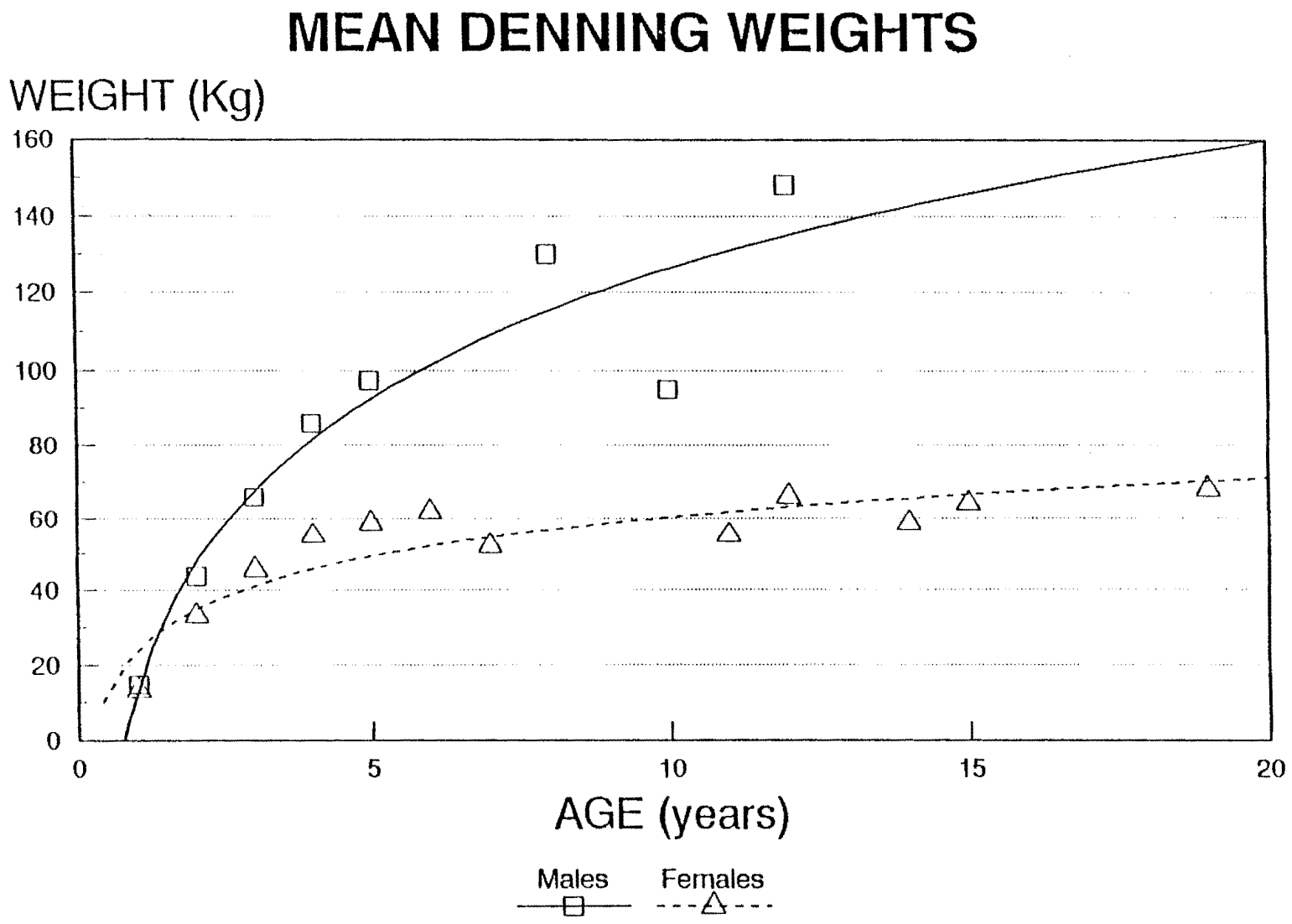

Fig. 2. Ages and weights of black bears handled in the den, Tanana Flats Training Area, 1988-91.

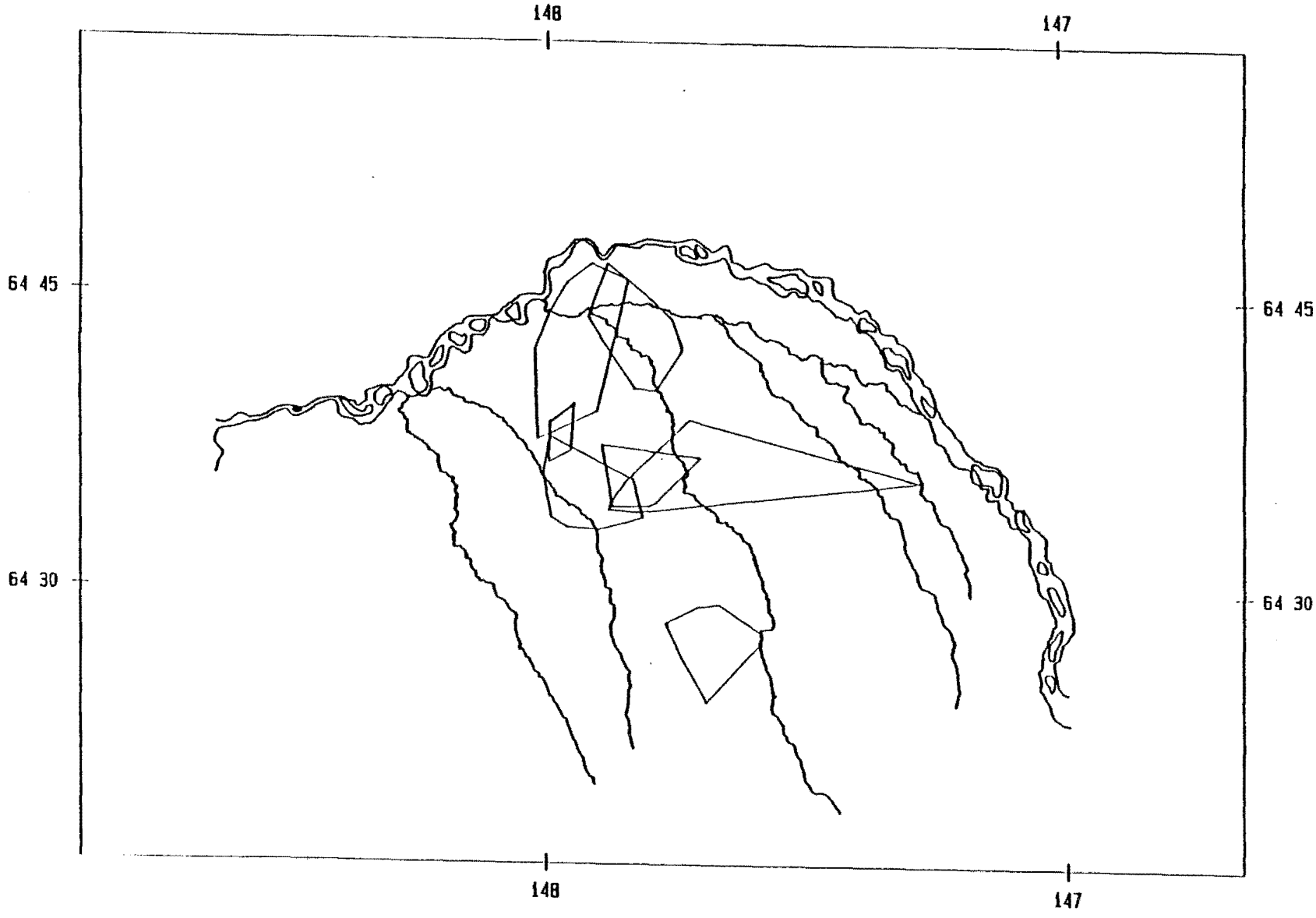

Fig. 3. Home ranges of 7 adult female black bears, Tanana Flats Training Area, 1988-90.

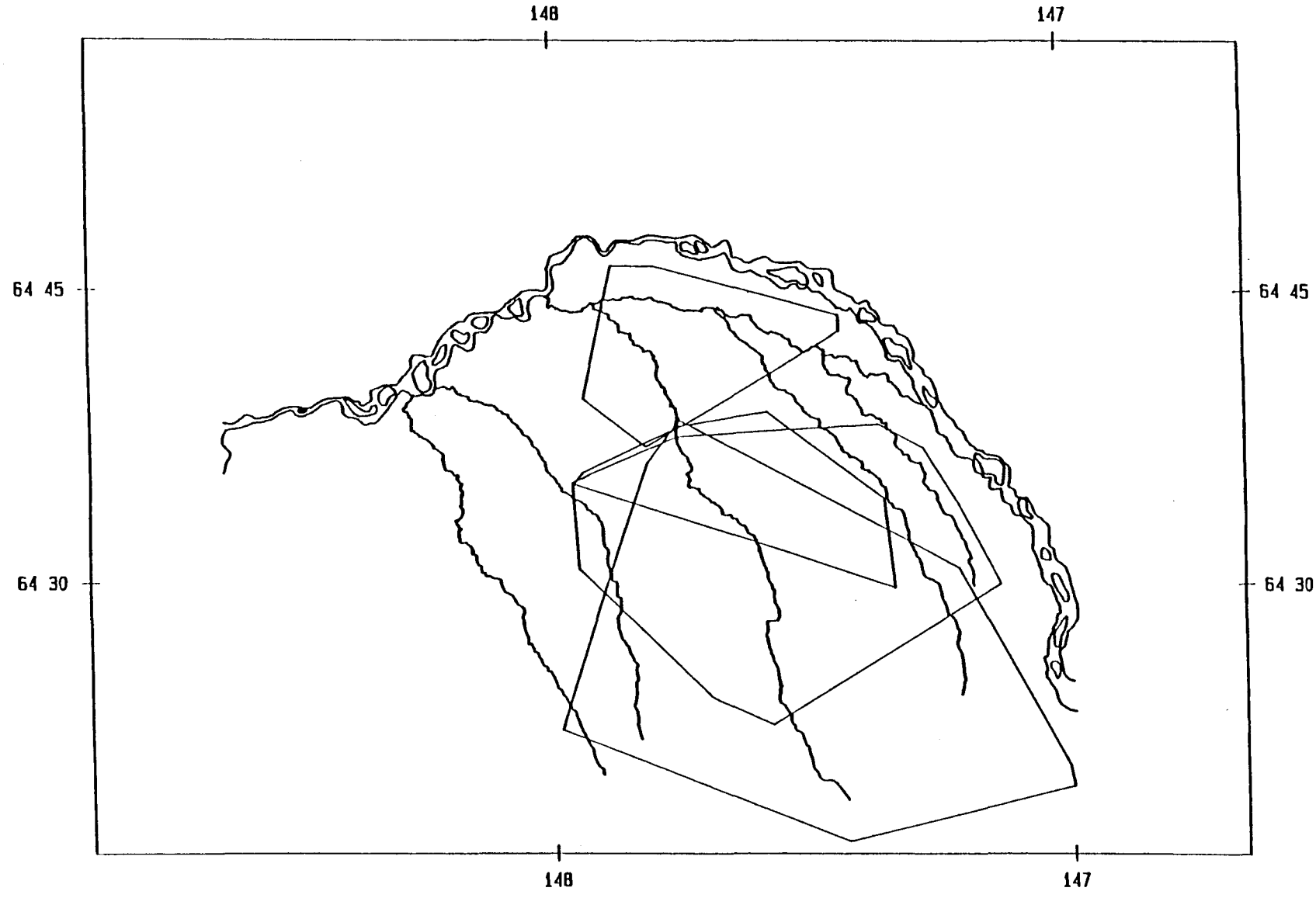

Fig. 4. Home ranges of 4 adult male black bears, Tanana Flats Training Area, 1988-90.

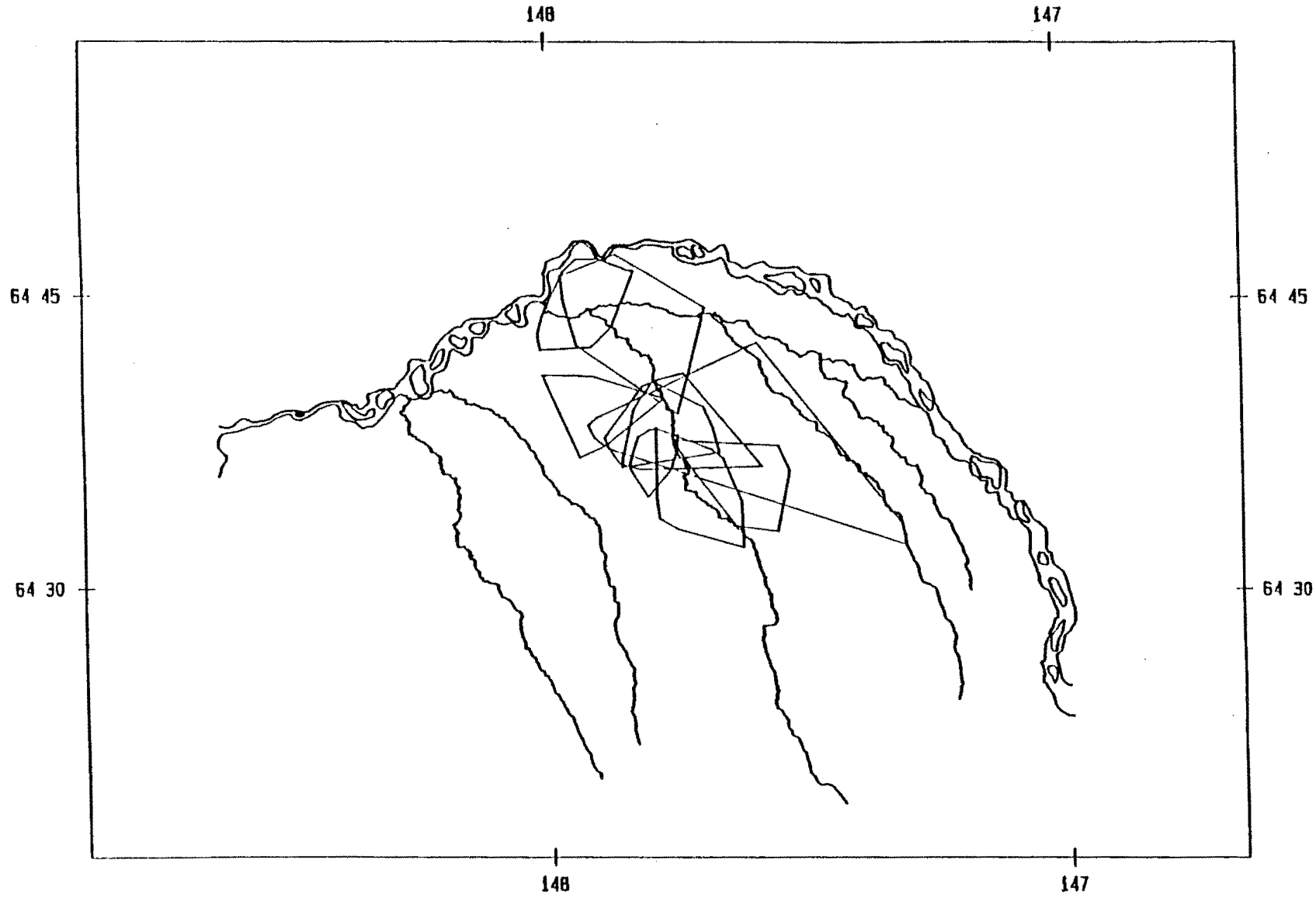

Fig. 5. Home ranges of 9 subadult female black bears, Tanana Flats Training Area, 1988-90.

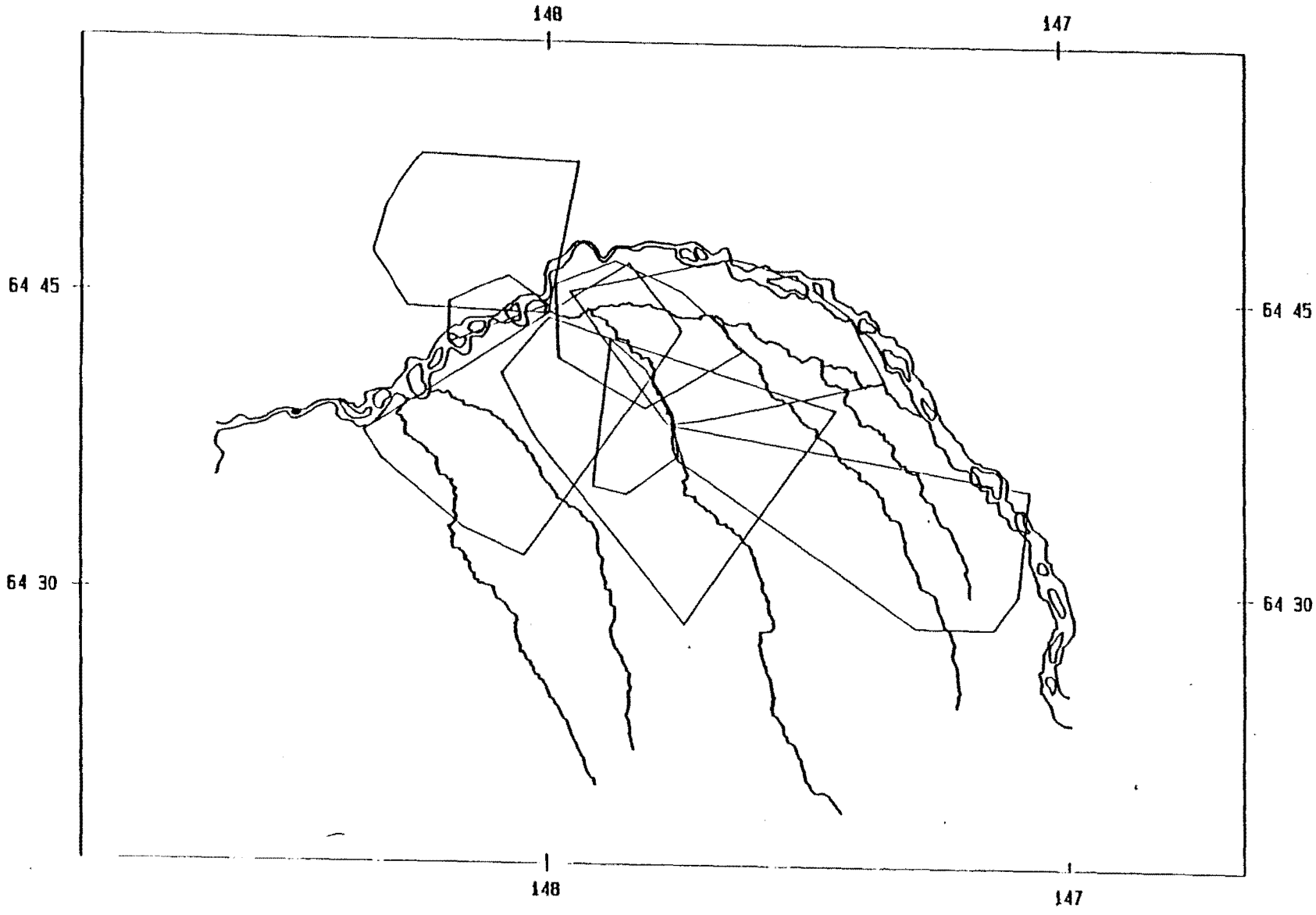

Fig. 6. Home ranges of 8 subadult male black bears, Tanana Flats Training Area, 1988-90.

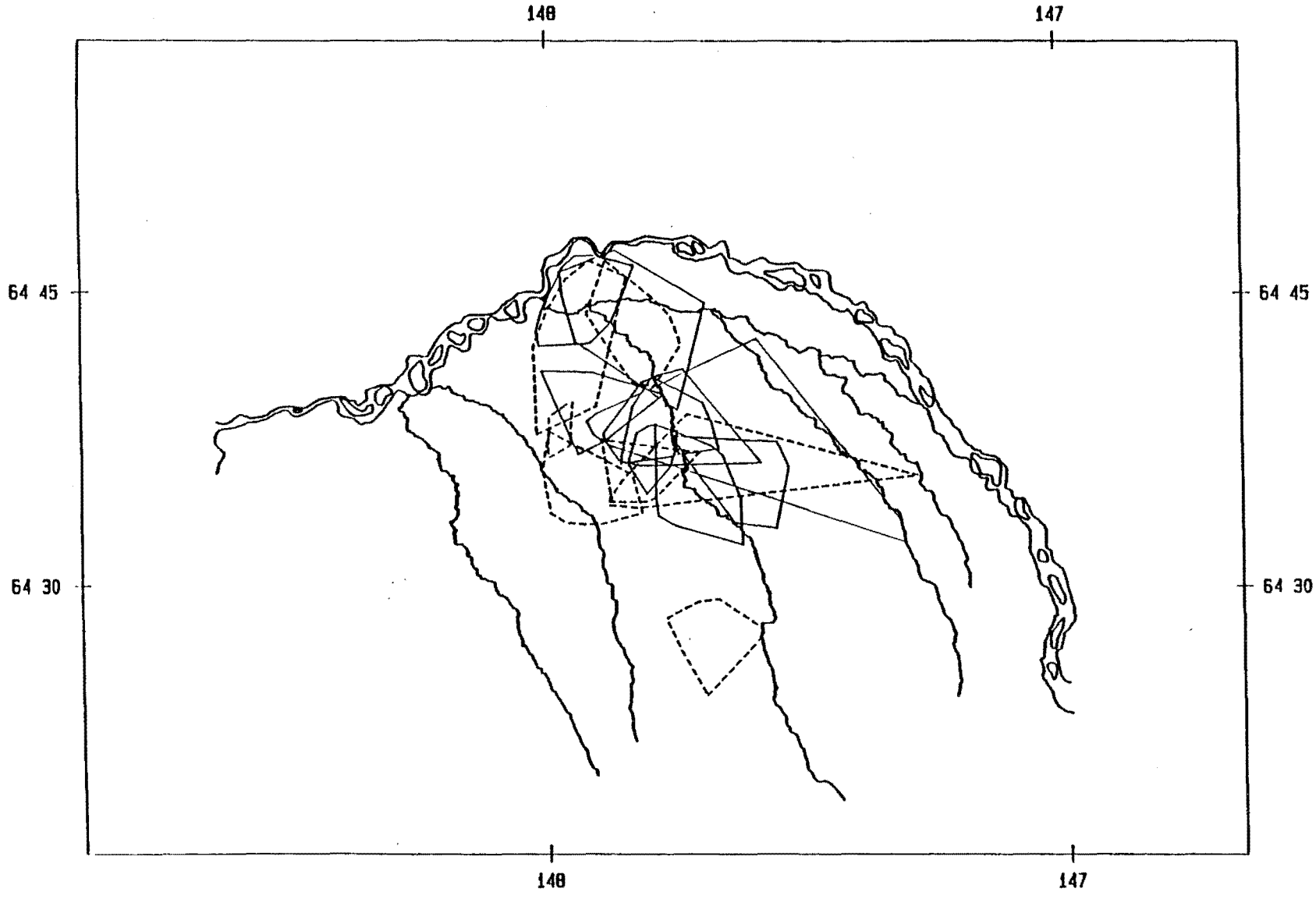

Fig. 7. Home ranges of all 16 radio-collared female black bears, Tanana Flats Training Area, 1988-90.

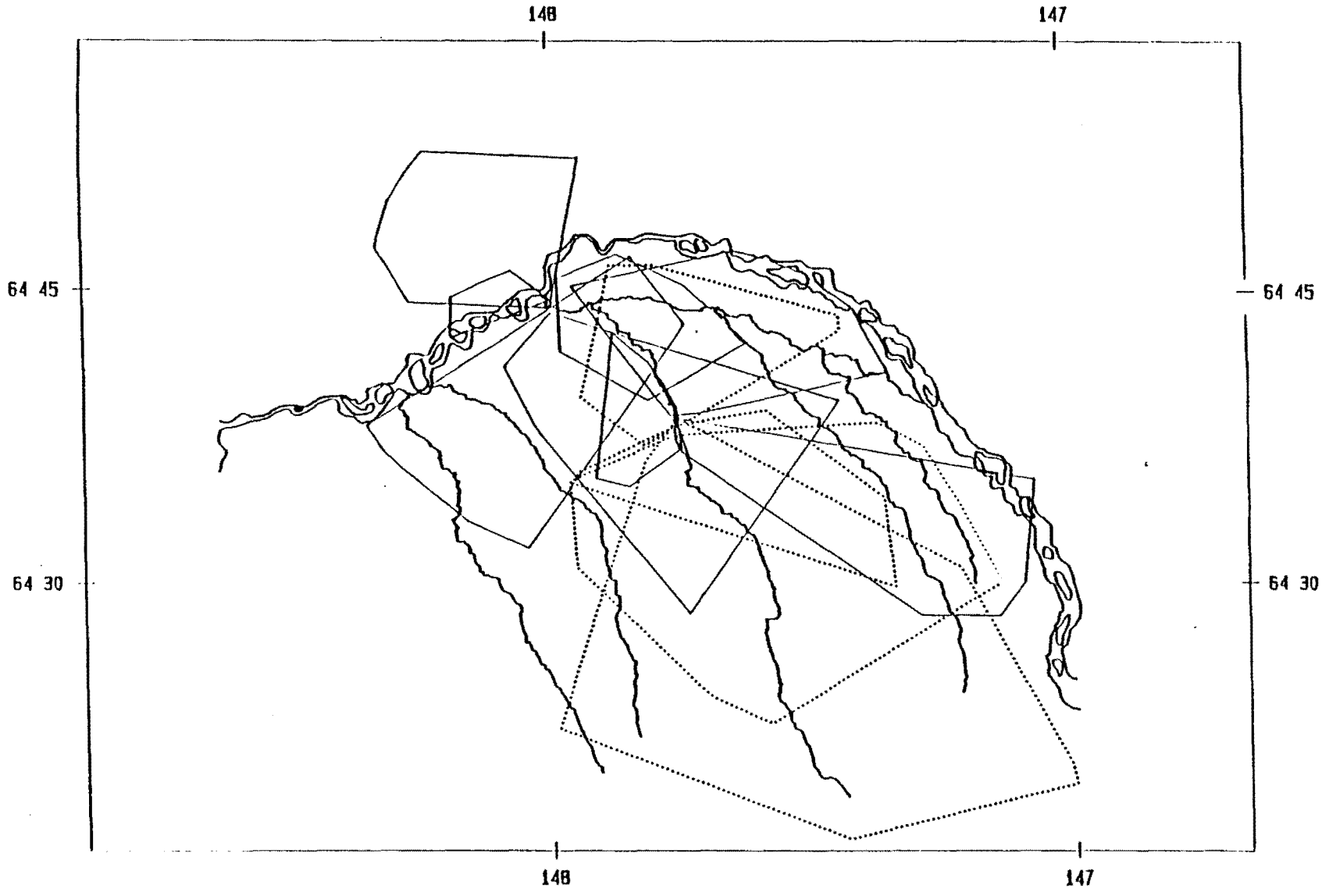

Fig. 8. Home ranges of all 12 male black bears, Tanana Flats Training Area, 1988-90.

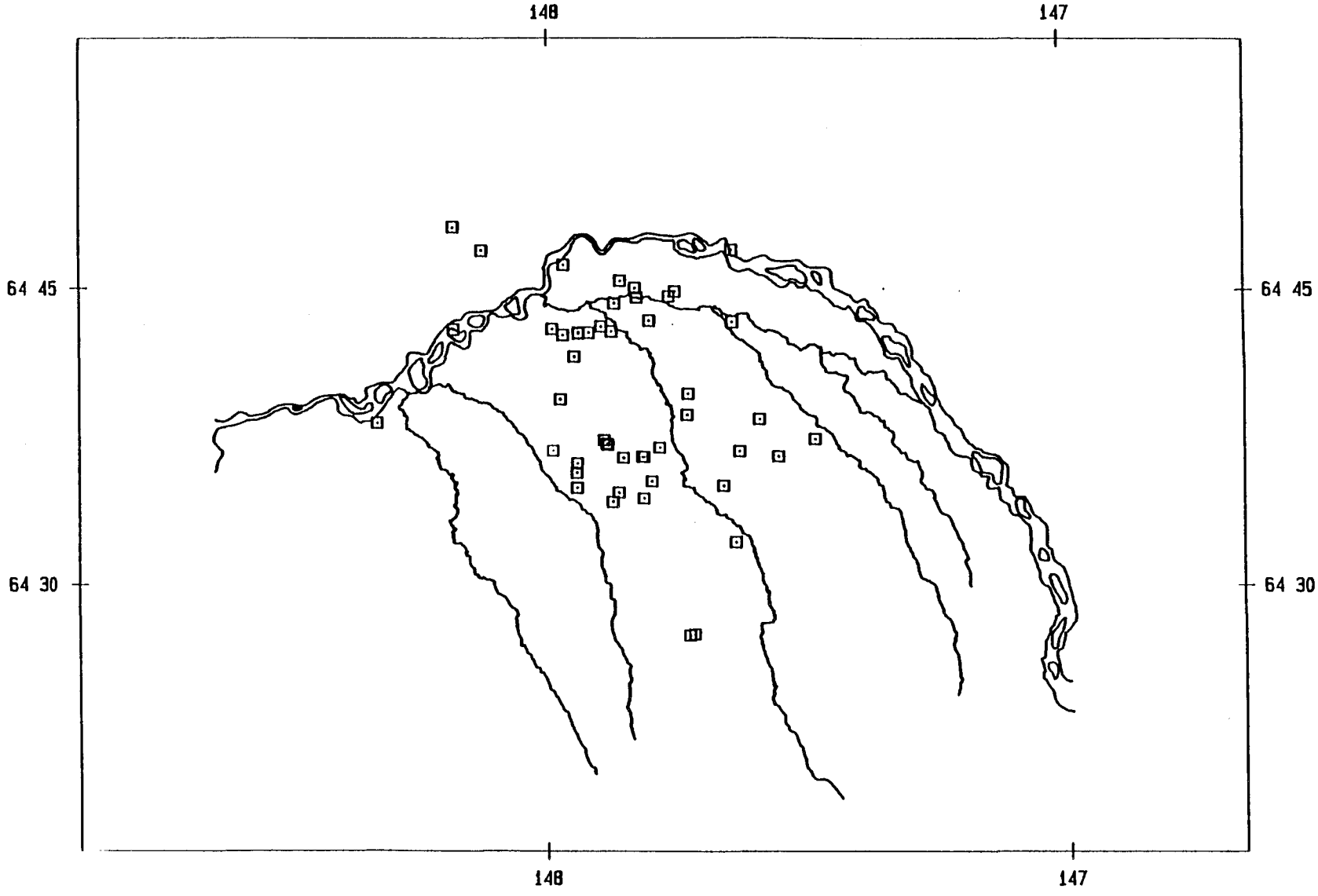

Fig. 9. Densities of collared black bears, Tanana Flats Training Area, 1988-91.

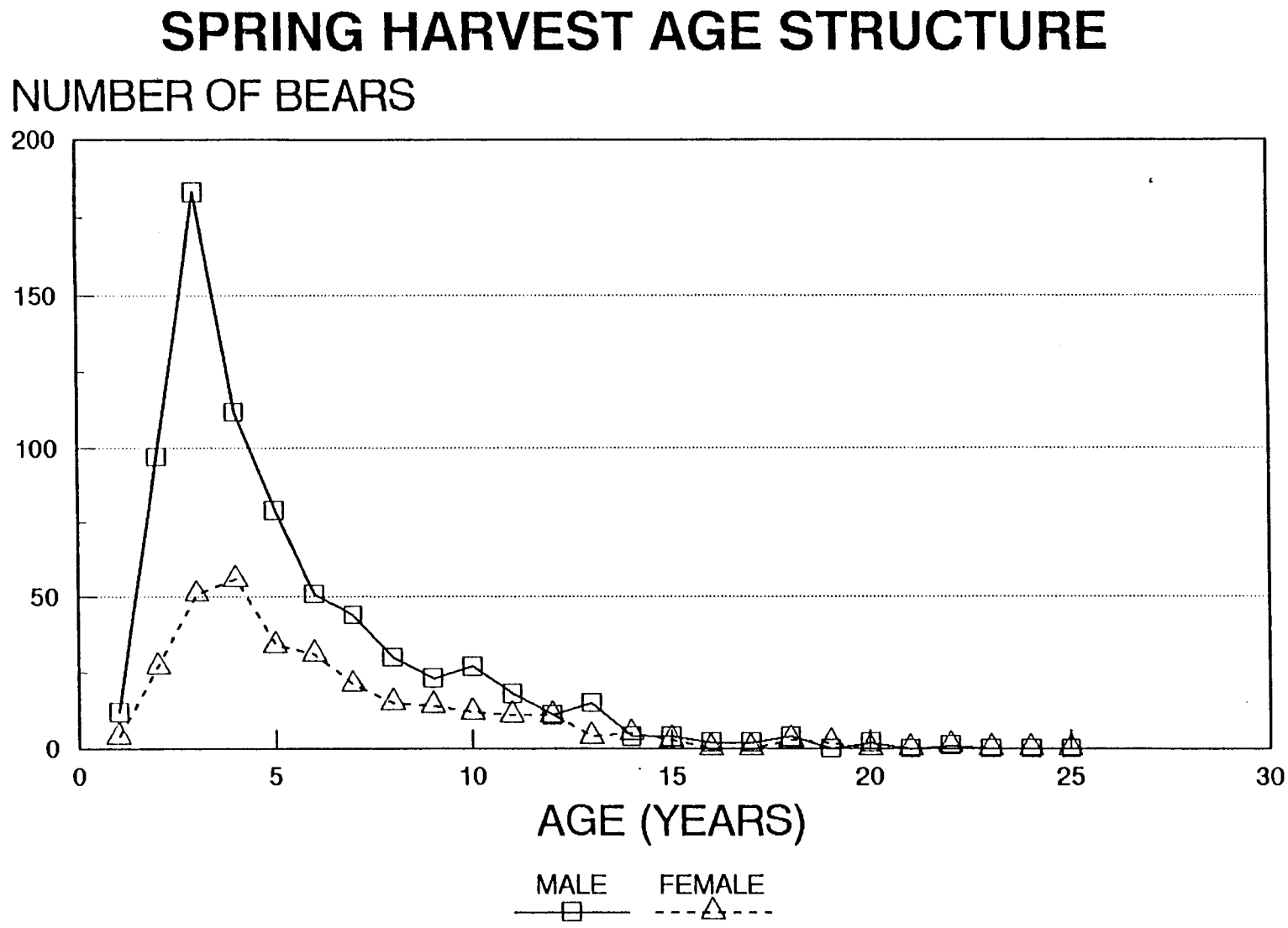

Fig. 10. Harvest age structure of black bears killed in Alaska Game Management Unit 20 during spring, 1974-90.

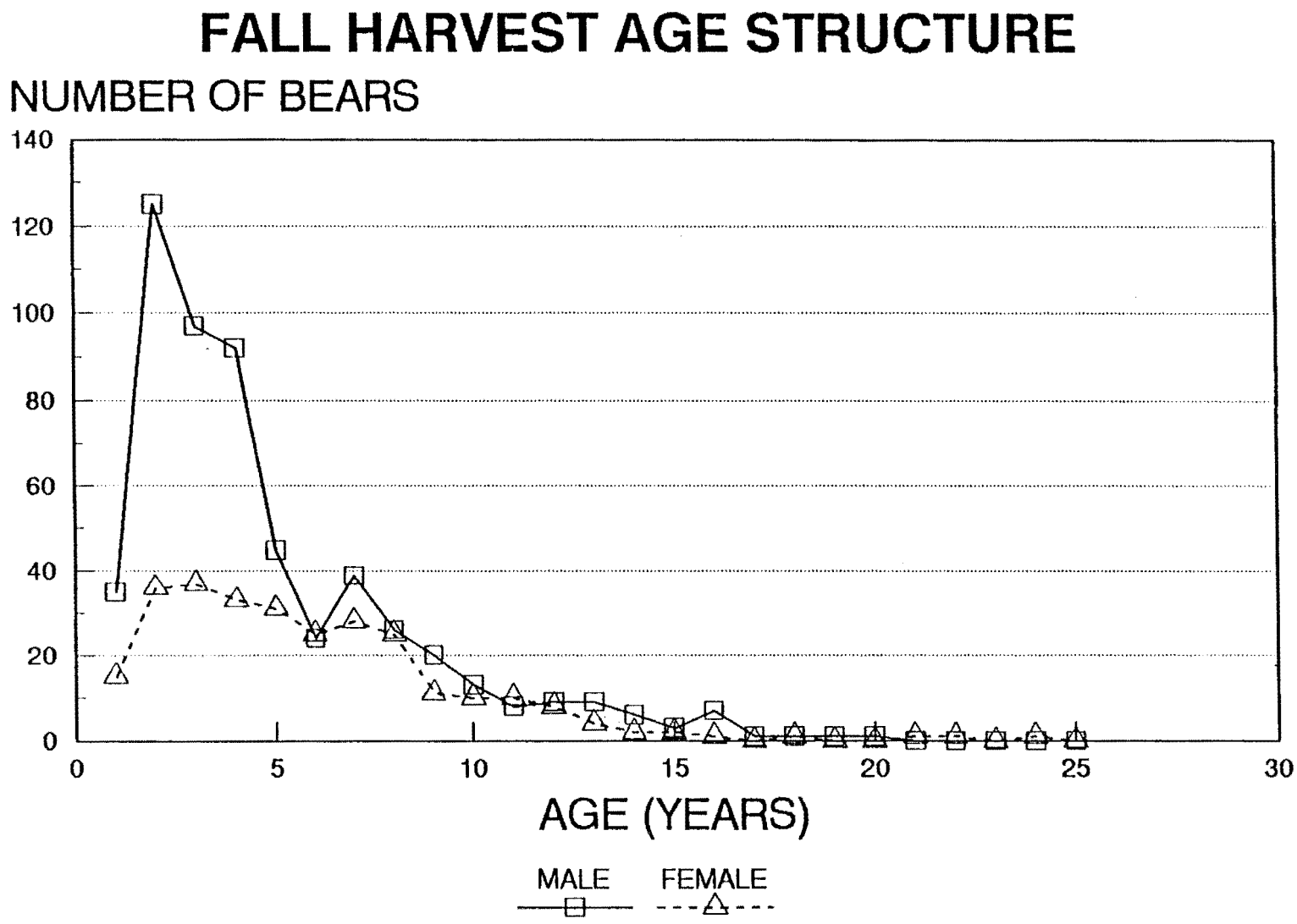

Fig. 11. Harvest age structure of black bears killed in Alaska Game Management Unit 20 during fall, 1974-90.

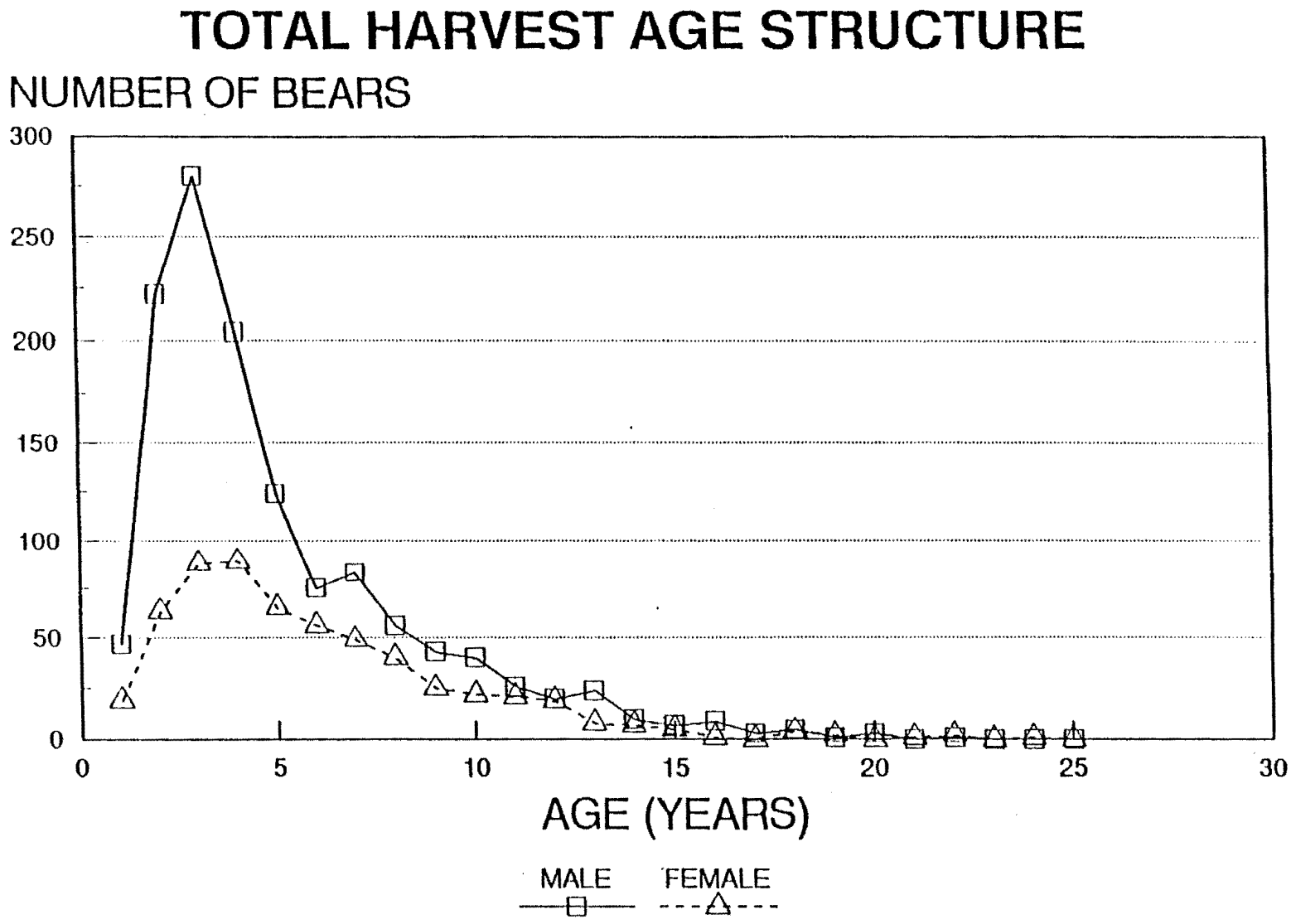

Fig. 12. Harvest age structure of black bears killed in Alaska Game Management Unit 20, 1974-90.

Table 1. Capture and marking characteristics of 41 black bears captured 107 times in the Tanana Flats Training Area, Fort Wainwright, Alaska, 1987-91.

Bear no.	Sex	Age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tag[b]	Markers[c]
040	F	6	5/12/90	68 (150)	SW Clear Cr Butte	4.0T/H	112/111	Gr/dG
		7	4/12/91	52 (115)	W of Clear Cr Butte	2.6T/M	288/289	Gr/mG
102	F	10	8/28/88	109 (240)	BLM airstrip	A/M	832/864	1G/O
		12	3/20/90	66 (145)	SW Clear Cr Butte	2.6T/L	580/831	1G/O
301	F	7	5/15/87	69 (151)	S Salmon Loaf	2.4T/H	361/362	W/W
302	F	17	5/18/87	61 (135)	SW Clear Cr Butte	3.0T/H	372/371	W/R
		19	3/30/89	68 (150)	SW Clear Cr Butte	2.8T/M	390/371	W/R
303	F	12	6/05/88	64 (140)	Clear Cr/Six Spruce	2.3KR/H	155/156	1B/1B
			6/11/88	-- --	Clear Cr/Six Spruce	1.3KR/M	155/156	1B/1B
			6/29/88	68 (150)	Clear Cr/Beaverville	1.8KR/L	155/156	1B/1B
			8/05/88	-- --	Salchaket/Lower Is	3.6KR/L	155/156	1B/1B
			8/23/88	91 (200)	Clear Cr/Waikiki	2.8T/L	926/156	1B/1B
		13	8/10/89	66 (145)	Clear Cr/Tree Stand	A/M	926/897	1B/1B
		14	3/24/90	65 (143)	Salchaket	2.6T/H	926/823	1B/1B
		15	3/13/91	64 (140)	S of Salchaket	2.6T/M	867/825	1B/1B
304	F	2	6/11/88	40 (87)	Salchaket/Beaver Bend	2.0KR/H	839/840	Y/Y
			8/06/88	49 (107)	Lower Duck Blind Slough	2.2T/M	--/840	-/Y
		3	3/24/89	43 (95)	S of Salchaket	2.2T/H	--/840	-/Y
		4	3/11/90	48 (105)	N of Airboat Trail	2.8T/M	--/840	-/-
		5	3/11/91	55 (120)	S of Tanana	2.1T/M	117/118	Y/Y
305	M	3	6/14/88	57 (125)	Clear Cr/Waikiki	1.5KR/M	177/176	1G/1G
			7/23/88	68 (150)	Clear Cr/Waikiki	3.3KR	807/808	1G/1G
			8/29/88	80 (175)	Salchaket/Lower Is	2.8T/H	807/808	1G/1G
		4	7/19/89	84 (185)	Clear Cr/Tree Stand	2.8T	878/--	1G/--
		5	3/17/90	98 (215)	Duck Blind Slough	A/M	878/581	1G/1G
306	M	2	6/26/88	55 (120)	Salchaket	2.2KR/M	873/874	1B/R
		3	3/17/89	77 (170)	Alder Cr	2.8T/M	873/874	1B/R
307	M	2	7/08/88	49 (107)	Duck Blind Slough	A/M	895/896	dB/dB
		3	3/16/89	77 (170)	Meridian Island	2.8T/H	895/896	dB/dB
		4	4/05/90	105 (230)	S of Salchaket	2.8T/H	809/810	dB/dB
		5	3/10/91	114 (250)	S of Salchaket	A/M	141/137	dB/dB

Table 1. Continued.

Bear no.	Sex	Age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tag[b]	Markers[c]
308	M	1	7/11/88	50 (110)	Salchaket/Bait Cache	2.2KR/L	184/185	mG/W
		2	3/18/89	50 (110)	Sam Charley Is	2.5T/H	184/185	mG/W
309	M	3	7/17/88	55 (120)	Salmon Loaf	3.2KR/L	821/822	O/dB
		4	6/22/89	66 (145)	Salmon Loaf	2.6T/L	870/857	O/dB
		5	4/05/90	80 (175)	NW of Clear Cr Buttes	2.8T/M	820/819	O/dB
310	F	2	7/20/88	55 (120)	Salchaket	A/L	893/894	Y/mG
		3	3/22/89	48 (105)	N of Salchaket	2.8T	893/894	Y/mG
			7/02/89	-- --	Salchaket/Lower Is	2.5T/L	893/938	Y/mG
		4	3/12/90	77 (170)	W end Tanana Airboat Trail	A/M	218/219	Y/mG
311	F	9	8/06/88	82 (180)	Salchaket	2.8T/L	905/906	lB/Y
		11	3/16/90	55 (120)	W of Airboat Trail	2.6T/M	905/906	lB/Y
312	F	3	8/09/88	57 (125)	Clear Cr/Burbot	2.4T/M	188/187	mG/R
		4	3/26/89	50 (110)	Clear Cr Butte	2.6T/M	188/187	mG/R
			6/21/89	61 (135)	Clear Cr/Tree Stand	2.1T/L	188/187	mG/R
			7/04/89	61 (135)	Clear Cr/Candyland	1.8T/M	188/187	mG/R
			7/23/89	-- --	Clear Cr/Empty Nest	2.1T/L	188/187	mG/R
			8/11/89	76 (167)	Clear Cr/Porky Pond	2.5T/L	188/187	mG/R
			8/18/89	-- --	Clear Cr/Upper Cache	2.2T/L	188/187	mG/R
		5	3/18/90	57 (125)	NE upper Cache	A/M	188/187	mG/R
313	M	2	8/10/88	61 (135)	Salchaket/Lower Is	A/M	827/871	O/lG
			8/25/88	66 (145)	Salchaket/Lower Is	3.0T/H	872/871	O/lG
		3	3/19/89	52 (115)	Salchaket	2.6T/L	872/871	O/lG
		4	3/25/90	67 (148)	W of Whiskey Is	A/M	813/814	O/lG
314	M	6	6/03/89	125 (275)	Clear Cr/Weird Spruce	5.0KR/L	879/880	mG/W
		8	3/30/91	130 (287)	S of Clear Cr Buttes	4.1T/L	134/133	mG/W
315	F	4	6/03/89	50 (110)	Clear Cr/Poipu	3.0KR/M	843/844	Y/dB
			6/22/89	57 (125)	Clear Cr/Poipu	2.2T/M	843/844	Y/dB
			8/26/89	86 (190)	Clear Cr/Poipu	3.6T/L	843/844	Y/dB
		5	3/22/90	64 (140)	S of Clear Cr Buttes	2.6T/M	200/201	-/dB
		6	3/17/91	64 (140)	S of Clear Cr Buttes	2.6T/M	829/830	Y/dB
316	F	4	6/09/89	64 (140)	Clear Cr/Scat Hill	A/M	861/862	W/O
			6/15/89	64 (140)	Clear Cr/Bush Meadow	2.8KR/M	861/862	W/O

Table 1. Continued.

Bear no.	Sex	Age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tag[b]	Markers[c]
317	F	4	6/11/89	57 (125)	Clear Cr/Scat Hill	3.5KR/M	899/900	mG/1B
			6/15/89	57 (125)	Clear Cr/Weird Spruce	2.8KR/M	899/851	mG/1B
		5	3/27/90	59 (130)	SW of Clear Cr Buttes	2.5T/M	899/851	mG/1B
		6	3/22/91	64 (140)	E of Clear Cr Buttes	2.6T/M	315/314	mG/1B
318	M	8	6/22/89	118 (260)	Clear Cr/Empty Nest	A/M	801/802	W/1B
			7/24/89	127 (280)	Clear Cr/Scat Hill	3.5T/M	300/802	W/1B
		10	3/26/91	95 (210)	E of Clear Cr Butte	4.2T/L	300/-	W/-
319	M	7	6/23/89	134 (295)	Clear Cr/Moose Carcass	4.6T/L	875/?	R/W
320	M	10	7/04/89	159 (350)[d]	Clear Cr/Moose Carcass	5.0T/L	815/816	mG/O
		12	3/12/91	148 (325)	S of Salchaket	5.6T/M	891/892	mG/O
321	F	4	7/04/89	59 (130)	Clear Cr/Upper Cache	2.5T/M	845/846	mG/mG
		6	3/28/91	57 (125)	W of Clear Cr Butte	2.6T/L	124/123	mG/mG
322	M	2	7/05/89	52 (115)	Clear Cr/Scat Hill	2.8T/M	182/183	O/W
			7/20/89	-- --	Clear Cr/Castor Corner	1.5T	182/908	O/W
		3	4/03/90	57 (125)	NW of Blair Lakes	A/M	866/865	O/W
323	F	3	7/19/89	45 (100)	SE Salmon Loaf	2.5T/M	877/286	1G/Y
			8/14/89	50 (110)	Clear Cr/Candyland	2.0T/L	877/286	1G/Y
			8/17/89	-- --	Clear Cr/Castor Corner	1.6T/L	877/286	1G/Y
			8/23/89	55 (120)	SE Salmon Loaf	A/M	877/286	1G/Y
		4	3/15/90	45 (100)	SW Clear Cr Butte	2.6T/M	877/286	1G/Y
		5	3/16/91	57 (125)		2.6T/H	860/859	1G/Y
324	M	1	7/20/89	39 (85)	Clear Cr/Porky Pond	1.8T/M	849/850	W/1G
			8/15/89	-- --	Clear Cr/Moose Carcass	1.7T/M	849/850	W/1G
		2	3/13/90	43 (95)	NE of Airboat Trail	2.6T/H	849/850	W/1G
325	F	3	7/21/89	57 (125)	Salmon Loaf	2.6T/M	837/838	R/1G
			7/23/89	-- --	SE Salmon Loaf	1.5T/L	837/838	R/1G
326	F	12	7/21/89	73 (160)	Clear Cr/Scat Hill	3.6T/L	909/910	1B/dB
		14	3/21/91	52 (115)	S of Clear Cr Buttes	2.6T/M	909/842	1B/dB
327	F	23	7/24/89	98 (215)	Clear Cr/Weird Spruce	2.8T/L	885/886	R/Y
328	M	1	3/16/90	14 (30)	W of Airboat Trail	0.5T/L	828/827	1B/1B
329	M	1	3/16/90	14 (30)	W of Airboat Trail	A/M	835/836	1G/1G
330	F	1	3/16/90	14 (30)	W of Airboat Trail	A/M	216/217	Y/Y

Table 1. Continued.

Bear no.	Sex	Age (yr)	Date of capture	Weight kg (lb)	Location	Drug dosage[a]	Ear tag[b]	Markers[c]
331	M	1	3/24/90	19 (41)	Salchaket	A/M	818/817	W/W
		2	3/13/91	40 (88)	S of Salchaket	1.4T/M	142/818	W/W
332	F	1	3/24/90	17 (37)	Salchaket	A/M	205/204	mG/mG
		2	3/13/91	33 (72)	S of Salchaket	1.4T/L	205/204	mG/mG
333	M	1	3/24/90	18 (40)	Salchaket	1.5T/M	883/884	R/R
		2	3/13/91	42 (93)	S of Salchaket	1.4T/M	138/884	R/R
334	F	1	3/21/91	11 (25)	S of Clear Cr Butte	1.5T/H	114/-	lG/-
335	M	1	3/21/91	12 (26)	S of Clear Cr Butte	1.0T/M	113/-	R/-
336	M	1	3/21/91	10 (23)	S of Clear Cr Butte	1.0T/M	-/805	-R
337	F	1	4/12/90	11 (24)	W of Clear Cr Butte	0.8T/M	318/-	dB/-
338	M	1	4/12/91	16 (35)	W of Clear Cr Butte	0.8T/M	-/319	-/O
339	F	1	4/12/91	13 (28)	W of Clear Cr Butte	0.8T/M	-/299	-/dB

[a] Dosage in ml of: Ketaset/Rompun (KR) where the Ketaset was freeze-dried and reconstituted in the Rompun to give approximately 200 mg Ketaset and 100 mg Rompun per ml of solution; Telazol (T) in concentration of 200 mg/ml. A denotes multiple injections with unknown effective dosage. Drug effects were as follows: L = light, M = optimum, H = heavy.

[b] Ear tag numbers, left/right.

[c] Markings designations:
Colors: R, red; lG, light green; mG, medium green; O, orange; lB, light blue; db, dark blue; W, white; Y, yellow; Gr, gray.
Marker types: One or 2 color combinations were used for ear flags, e.g., O/W is orange in left ear, white is right ear.

[d] Estimate.

Table 2. Physical attributes[a] of 45 black bears captured in the Tanana Flats Training Area, Fort Wainwright, Alaska, 1987-91.

Bear no.	Date	Sex	Age (yrs)	Measured weight	Total length	Neck	Girth	Head width	Head length
040	5/12/90	F	6	68	151	46	78	15.2	27.0
	4/12/91		7	52	156	40	66	15.6	27.0
102	8/28/88	F	10	109	156	54	98	17.8	26.9
	3/20/90		12	66	166	44	72	17.2	25.7
301	5/15/87	F	7	69	146	49	79	16.0	26.8
302	5/18/87	F	17	61	145	48	80	16.0	26.0
	3/30/89		19	68	150	48	77	--	--
303	6/05/88	F	12	64	148	43	72	15.2	25.1
	6/29/88			68	--	--	--	--	--
	8/23/88			91	148	47	84	16.0	25.3
	8/10/89		13	66	152	42	75	--	--
	3/24/90		14	65	156	43	71	15.8	25.3
	3/13/91		15	64	162	47	74	15.8	24.7
304	6/11/88	F	2	40	126	36	63	12.7	23.7
	8/06/88			49	--	37	63	13.4	24.9
	3/24/89		3	43	--	35	65	--	--
	3/11/90		4	48	157	39	69	14.9	26.2
	3/11/91		5	55	160	39	79	15.4	27.2
305	6/14/88	M	3	57	151	43	71	14.1	25.4
	7/23/88			68	159	46	74	14.6	26.4
	8/29/88			80	156	44	74	15.1	26.9
	7/19/89		4	84	175	48	80	16.1	27.9
	3/17/90		5	98	180	49	97	17.0	28.7
306	6/26/88	M	2	55	148	39	67	14.8	25.7
	3/17/89		3	77	--	--	--	--	--
307	7/08/88	M	2	49	155	38	61	14.0	23.6
	3/16/89		3	77	--	47	79	--	--
	4/05/90		4	105	173	56	88	18.4	28.9
	3/10/91		5	114	171	54	98	19.0	30.0
308	7/11/88	M	1	50	136	38	60	13.3	23.5
	3/18/89		2	50	--	--	--	--	--

Table 2. Continued.

Bear no.	Date	Sex	Age (yrs)	Measured weight	Total length	Neck	Girth	Head width	Head length
309	7/17/88	M	3	55	139	40	66	13.5	24.2
	6/22/89		4	66	--	44	73	15.1	25.8
	4/05/90		5	80	170	49	75	16.1	27.0
310	7/20/88	F	2	55	144	42	72	14.4	25.5
	3/22/89		3	48	--	41	71	--	--
	3/12/90		4	77	154	48	80	16.0	27.4
311	8/06/88	F	9	82	160	48	82	16.0	27.1
	3/16/90		11	55	146	42	68	15.8	27.0
312	8/09/88	F	3	57	146	40	69	13.8	24.0
	3/26/89		4	50	--	41	65	--	--
	6/21/89			61	153	46	69	14.0	25.0
	7/04/89			61	--	--	--	--	--
	8/11/89			76	--	--	78	--	--
	3/18/90		5	57	157	41	74	14.6	25.6
313	8/10/88	M	2	61	144	41	71	15.0	25.8
	8/25/88			66	140	41	70	15.0	26.0
	3/19/89		3	52	--	--	--	--	--
	3/25/90		4	67	161	46	73	17.1	28.3
314	6/03/89	M	6	125	189	58	97	18.7	29.8
	3/30/91		8	130	188	52	95	19.7	31.0
315	6/03/89	F	4	50	140	39	61	14.5	24.5
	6/22/89			57	--	--	--	--	--
	8/26/89			86	147	45	83	--	--
	3/22/90	F	5	64	146	40	70	15.4	25.5
	3/17/91		6	64	153	45	78	16.0	26.1
316	6/09/89	F	4	64	159	45	66	14.4	25.7
	6/15/89			64	--	--	--	--	--
317	6/11/89	F	4	57	137	39	69	14.0	24.7
	6/15/89			57	--	--	--	--	--
	3/27/90		5	59	150	45	70	14.6	24.9
	3/22/91		6	64	161	42	72	15.6	26.2

Table 2. Continued.

Bear no.	Date	Sex	Age (yrs)	Measured weight	Total length	Neck	Girth	Head width	Head length
318	6/22/89	M	8	118	181	60	91	18.7	29.9
	7/24/89			127	--	--	--	--	--
	3/26/91		10	95	187	51	87	18.8	30.4
319	6/23/89	M	7	134	191	66	99	17.8	27.9
320	7/04/89	M	10	159[b]	196	--	98	20.3	32.0
	3/12/91		12	148	197	61	109	21.0	32.1
321	7/04/89	F	4	60	151	42	66	14.7	24.7
	3/28/91		6	57	164	42	77	15.0	25.7
322	7/05/89	M	2	52	143	38	63	13.4	24.0
	4/03/90		3	57	160	39	70	14.7	25.7
323	7/19/89	F	3	46	--	37	65	13.1	23.3
	8/14/89			50	--	--	--	--	--
	8/23/89			55	--	--	--	--	--
	3/15/90		4	45	139	40	64	14.0	24.5
	3/16/91		5	57	145	40	66	14.8	26.0
324	7/20/89	M	1	39	132	32	54	12.3	22.6
	8/15/89			--	140	36	61	--	--
	3/13/90		2	43	143	35	60	14.1	24.4
325	7/21/89	F	3	57	150	39	66	14.2	24.7
326	7/21/89	F	12	73	144	44	78	16.3	26.2
	3/21/91		14	52	162	47	83	15.2	25.8
327	7/24/89	F	23	98	156	47	83	16.4	26.1
328	3/16/90	M	1	14	104	25	37	10.4	18.4
329	3/16/90	M	1	14	97	25	38	10.8	18.0
330	3/16/90	F	1	14	96	24	36	10.2	17.8
331	3/24/90	M	1	19	99	27	42	11.6	19.2
	3/13/91		2	40	142	36	58	14.1	24.1
332	3/24/90	F	1	17	94	27	40	10.6	18.6
	3/13/91		2	33	136	36	55	12.4	22.9
333	3/24/90	M	1	18	107	32	48	11.3	19.0
	3/13/91		2	42	135	44	68	13.5	23.4
334	3/21/91	F	1	11	96	25	38	9.8	17.3

Table 2. Continued.

Bear no.	Date	Sex	Age (yrs)	Measured weight	Total length	Neck	Girth	Head width	Head length
335	3/21/91	M	1	12	101	32	40	9.0	16.7
336	3/21/91	M	1	10	96	29	41	10.0	17.1
337	4/12/91	F	1	11	93	--	--	10.3	18.5
338	4/12/91	M	1	16	105	26	40	11.0	19.1
339	4/12/91	F	1	13	104	--	--	10.4	16.7
UM[c]	3/18/90	M	0.5	1.9	43	18	25	--	--
UM[c]	3/18/90	F	0.5	2.0	44	17	25	--	--
UM[d]	3/17/91	M	0.5	1.3	38	15	22	--	--
UM[d]	3/17/91	F	0.5	1.1	34	16	22	--	--

[a] Weights in kg; measurements in cm.

[b] Estimate.

[c] Unmarked offspring of bear no. 312.

[d] Unmarked offspring of bear no. 315.

Table 3. Status of 32 black bears radio-collared in the Tanana Flats Training Area, Fort Wainwright, Alaska, winter 1990-91.

Radiocollar functioning	Radiocollar nonfunctional?	Radiocollar shed	Radiocollar removed	Dead bear
040	301	306	313	308
102	302	309		311
303	316	324		312
304				322
305				325
307				327
310				
314				
315				
317				
318				
319				
320				
321				
323				
326				
331				
332				
333				

Table 4. Seasonal weights[a] for sex and age classes of black bears captured in the Tanana Flats Training Area, Fort Wainwright, Alaska, 1987-91.

Age class	Bear weights											
	Den[b]			Spring[c]			Summer[d]			Annual		
	n	x	Range	n	x	Range	n	x	Range	n	x	Range
	Males											
1	7	14.7	10-19		0		2	44.5	39-50	9	21.3	10-50
2	4	43.8	40-50	1	55		4	57.0	49-66	9	50.9	40-66
3	4	65.8	52-77	1	57		3	67.7	55-80	8	65.4	52-80
4	2	86.0	67-105	1	66		1	84.0		4	80.5	66-105
5	3	97.3	80-114		0			0		3	97.3	80-114
Adult (≥6)	3	124.3	95-148	3	125.7	118-134	2	143.0	127-159	8	129.5	95-159
	Females											
1	5	13.2	11-17		0			0		5	13.2	11-17
2	1	33.0		1	40.0		2	52.0	49-55	4	44.3	33-55
3	2	45.5	43-48		0		5	53.0	46-57	7	50.9	43-57
4	4	55.0	45-77	5	57.8	50-64	4	70.8	60-86	13	60.9	45-86
5	5	58.4	55-64		0			0		5	58.4	55-64
Adult (≥6)	10	60.7	52-68	5	66.0	61-69	6	86.5	66-109	21	69.3	52-109

[a] Weights in kg.

[b] Den = March-April.

[c] Spring = May-June.

[d] Summer = July-August.

Table 5. Seasonal weight[a] gains for adult female black bears, Tanana Flats Training Area, Fort Wainwright, Alaska, 1988-91.

Bear no.	Age in 1991	Lightest		Heaviest		x Weight	Observed % weight change	Ratio of heaviest to lightest weight
		Date	Weight	Date	Weight			
040	7	4/12/91	52	5/12/90	68	60.0	26.7	1:1.31
102	13	3/20/90	66	8/28/91	109	87.5	49.1	1:1.65
303	15	6/05/88	64	8/23/88	91	69.7	38.7	1:1.42
311	12[b]	3/16/90	55	8/06/88	82	68.5	39.4	1:1.49
326	14	3/21/91	52	7/21/89	73	62.5	33.6	1:1.40

[a] Measured in kg.

[b] Estimated age.

Table 6. Seasonal weight[a] gains for black bears captured in the Tanana Flats Training Area, Fort Wainwright, Alaska, 1988-89.

Bear no.	Sex	Date	Weight	Date	Weight	Change in weight	No. of days	Average weight gain/day
303	F	6/05/88	64	6/29/88	68	4	24	0.17
		6/29/88	68	8/23/88	91	23	55	0.42
304	F	6/11/88	40	8/06/88	49	9	56	0.16
305	M	6/14/88	57	7/23/88	68	11	39	0.28
		7/23/88	68	8/29/88	80	12	37	0.32
312	F	3/26/89	50	6/21/89	61	11	87	0.13
		6/21/89	61	7/04/89	61	0	13	0
		7/04/89	61	8/11/89	76	15	38	0.39
313	M	8/10/88	61	8/25/88	66	5	15	0.33
315	F	6/03/89	50	6/22/89	57	7	19	0.37
		6/22/89	57	8/26/89	86	29	65	0.45
316	F	6/09/89	64	6/15/89	64	0	6	0
317	F	6/11/89	57	6/15/89	57	0	4	0
318	M	6/22/89	118	7/24/89	127	9	32	0.28
323	F	7/19/89	46	8/14/89	50	4	26	0.15
		8/14/89	50	8/23/89	55	5	9	0.56

[a] Measured in kg.

Table 7. Dates of possible breeding activity from sightings of paired black bears, Tanana Flats Training Area, Fort Wainwright, Alaska, 1989-90.

Date	Bear				Comments
	Male	Age	Female	Age	
5/20/89	309	4	UM[a]	Unk[b]	
	313	3	UM	Unk	
6/03/89	305	4	310	3	No cubs produced
6/18/89	307	3	312	4	Produced 2 cubs
	309	4	UM	Unk	
7/29/89	307	3	321	4	No cubs produced
5/04/90	305	5	310	4	Produced cubs
5/18/90	309	5	325	4	325 killed by hunter
6/03/90	318	9	UM	Unk	
	320	11	UM	Unk	
	UM	-	323	4	No cubs produced
6/17/90	319	8	315	5	No cubs produced

[a] UM = unmarked.

[b] Unk = unknown.

Table 8. Reproductive status of female black bears, Tanana Flats Training Area, Fort Wainwright, Alaska, 1987-91.

Bear no.	Age in 1991[a]	Year of birth	Age at first litter	Offspring	Reproductive status[b] 1987	1988	1989	1990	1991[c]	Comments
040	7	84	6	337,338,339	Unk	Unk	B	3 cs	3 ylgs	
102	13	78	Unk	2UM	Unk	Unk/B	2 cs	B	Unk	
301	11	80	Unk		2 ylgs	Unk	Unk	Unk	Unk	Nonfunctional collar
302	21	70	Unk	2UM;2UM	2 ylgs	Unk/B	B	2 cs	2 ylgs	Nonfunctional collar
303	15	76	Unk	331,332,333	Unk	Unk/B	3 cs	3 ylgs	3 2yrs	Denned with 3 2 yrs
304	5	86	≥6		NB	NB	NB	NB	NC	
310	5	86	5	≥1 UM	NB	NB	NB	B	≥1 cs	Cubs heard in den, not captured
311	11	79	Unk	328,329,330	Unk	Unk/B	3 cs	3 ylgs/B? /Dead?		Probable mortality
312	5	85	5	2UM	NB	NB	B	2 cs/Dead		
315	6	85	6	2UM	NB	NB	NB	B	2 cs	
316	6	85	≥6		NB	NB	NB	B?	Unk	Nonfunctional collar
317	6	85	≥7		NB	NB	NB	NB	NC	
321	6	85	≥7		NB	NB	NB	NB	NC	
323	5	86	≥6		NB	NB	NB	NB	NC	
325	5	86	≥6		NB	NB	B?/Dead			Hunter kill; seen with male 309 the day she was shot.
326	14	77	Unk	334,335,336	Unk	Unk	Unk/B	3 cs	3 ylgs	
327	24	66	Unk		Unk	Unk/B? /Dead				Killed by grizzly in den

[a] Age in 1991 or in year of death.
[b] Unk = unknown; ylgs = yearlings; UM = Unmarked; 2 yrs = 2 year old; cs = cubs of the year; NB = never bred; B = bred; NC = no cubs.
[c] Status in den, spring 1991.

Table 9. Home range sizes for black bears in the Tanana Flats Training Area, Fort Wainwright, Alaska, 1987-90.

Bear no.	Sex	Age (yrs)	Year(s)	No. of locations	Home range mi^2	Home range km^2
040	F	6	1990	11	3.5	9.0
102	F	10-11	1988-89	14	14.0	36.3
		12	1990	9	11.8	30.5
		10-12	1988-90	23	17.3	44.7
302	F	17-18	1987-88	12	8.4	21.7
		19	1989	20	12.5	32.5
		20	1990	14	4.3	11.2
		17-20	1987-90	46	21.0	54.3
303	F	12	1988	15	10.4	26.9
		13	1989	21	15.3	39.6
		14	1990	15	7.2	18.7
		12-14	1988-90	51	22.0	57.0
304	F	2	1988	16	8.2	21.2
		3	1989	21	10.1	26.3
		4	1990	16	12.7	33.0
		2-4	1988-90	53	19.7	51.0
305	M	3	1988	12	8.9	23.0
		4	1989	19	45.5	117.7
		5	1990	14	9.6	24.7
		3-5	1988-90	45	56.0	145.1
306	M	2	1988	8	36.2	93.9
		3	1989	22	75.1	194.6
		2-3	1988-89	30	87.0	225.4
307	M	2	1988	11	34.3	88.9
		3	1989	20	88.6	229.4
		4	1990	14	19.0	49.1
		2-4	1988-90	44	108.0	279.8
308	M	1-2	1988-89	14	11.2	29.1
309	M	3	1988	14	27.9	72.4
		4	1989	23	31.2	80.9
		5	1990	15	46.1	119.4
		3-5	1988-90	52	170.7	442.2

Table 9. Continued.

Bear no.	Sex	Age (yrs)	Year(s)	No. of locations	Home range mi^2	Home range km^2
310	F	2	1988	11	6.5	16.8
		3	1989	21	34.2	88.6
		4	1990	15	10.0	25.9
		2-4	1988-90	46	44.5	115.3
311	F	9	1988	8	13.1	34.0
		10	1989	23	8.5	21.9
		11	1990	17	18.9	48.9
		9-11	1988-90	48	34.4	89.1
312	F	3	1988	7	10.5	27.3
		4	1989	26	18.4	47.6
		5	1990	6	1.0	2.5
		3-5	1988-90	39	18.8	48.8
313	M	2	1988	9	2.1	5.4
		3-4	1989-90	18	129.4	335.0
		2-4	1988-90	27	147.7	382.4
314	M	6	1989	15	150.5	389.8
		7	1990	10	75.5	195.7
		6-7	1989-90	25	296.1	766.8
315	F	4	1989	18	4.8	12.4
		5	1990	15	4.3	11.0
		4-5	1989-90	33	7.6	19.6
316	F	4	1989	15	15.5	40.2
		5	1990	16	20.8	54.0
		4-5	1989-90	31	25.2	65.3
317	F	4	1989	15	8.1	21.0
		5	1990	16	11.5	29.7
		4-5	1989-90	31	23.6	61.1
318	M	8	1989	14	85.9	222.5
		9	1990	14	33.4	86.6
		8-9	1989-90	28	99.8	258.5
319	M	7	1989	7	46.3	120.0
		8	1990	12	374.4	969.7
		7-8	1989-90	19	433.3	1122.3
320	M	10	1989	11	52.6	136.2
		11	1990	15	79.9	207.1
		10-11	1989-90	26	91.1	235.9

Table 9. Continued.

Bear no.	Sex	Age (yrs)	Year(s)	No. of locations	Home range mi^2	Home range km^2
321	F	4	1989	12	58.6	151.7
		5	1990	16	20.7	53.6
		4-5	1989-90	28	94.6	245.0
322	M	2-3	1989-90	11	132.4	342.9
323	F	3	1989	13	20.2	52.4
		4	1990	14	14.7	38.2
		3-4	1989-90	27	32.4	83.9
324	M	1	1989	11	5.7	14.8
		2	1990	6	22.8	59.0
		1-2	1989-90	17	28.7	74.4
325	F	3-4	1989-90	15	18.8	48.6
326	F	12	1989	10	2.3	5.9
		13	1990	15	6.8	17.5
		12-13	1989-90	25	13.6	35.1
327	F	23	1989	9	48.7	126.2

Table 10. Percentage of total black bear harvest during spring hunting season and percentage of females in the total harvest, Game Management Unit 20, Alaska, 1974-90.

Year	Subunit 20A		Subunit 20B		Subunits 20A & 20B		Total harvest Unit 20[a]
	% Spring harvest	% Females harvested	% Spring harvest	% Females harvested	% Spring harvest	% Females harvested	
1974	--	--	--	--	45	--	94
1975	--	--	--	--	64	22	99
1976	--	--	--	--	63	25	149
1977	--	--	--	--	55	29	188
1978	--	--	--	--	60	30	135
1979	--	--	--	--	57	34	93
1980	52	33	63	32	53	30	122
1981	32	33	34	38	37	29	196
1982	29	27	43	24	40	26	148
1983	42	22	46	35	46	30	194
1984	21	57	52	36	41	41	205
1985	56	22	58	43	56	39	121
1986	24	44	59	29	53	32	175
1987	33	31	57	36	51	36	232
1988	48	48	72	37	67	35	181
1989	69	28	81	33	79	33	183
1990	58	38	85	33	79	34	109

[a] 11-year mean (1980-90) for Game Management Unit 20 is 169.6.

Table 11. Estimated populations of black bears, sustainable harvests, and harvest rates, Game Management Unit 20, Alaska, 1980-90.

Location	Area		Estimated bear population		Sustainable[a] harvest	Actual harvest			
	mi^2	km^2	density of 12/100 mi^2	density of 17.5/100 mi^2		$\bar{x}$[b]	SD	Percentage of maximum population estimate	Harvest density bears/ 1,000 km^2
Subunit 20A[c] "Flats"	2,700	6,993	324	473	52-75	35.9	15.7	7.6	5
Est moose habitat	4,700	12,173	564	823	90-131	35.9	15.7	4.4	3
TFTA	1,003	2,598	120	176	19-28	11.2	5.8	6.4	4
Subunit 20B	9,090	23,545	1,091	1,591	173-253	90.5	20.5	5.7	4
YMA	406	1,052	49	71	8-11	9.8	3.0	13.8	9

[a] Estimated sustainable harvest based on 15.9% rate for "maximally productive populations" of black bears reported by Miller (1990). Actual rate for Interior black bears is probably lower.

[b] Actual harvest based on 11-year mean, 1980-90. YMA harvest includes half the bears killed along Chena Hot Springs Road, miles 16-35.

[c] Not all Subunit 20A is black bear habitat. Because no estimate of the actual black bear habitat is available, the area of the "Flats" and of moose habitat in Subunit 20A are used.

Table 12. Sex and age structure of 1,912 black bears killed in Game Management Unit 20, Alaska, 1974-90.

Sex	Age	n	% of Male harvest	% of Female harvest	% of Total harvest
Males	1-2 yr	269	21.0	--	14.1
	3-6 yr	683	53.2	--	35.7
	≥7 yr	331	25.8	--	17.3
All Males		1,283	100.0	--	67.1
Females	1-2 yr	82	--	14.0	4.3
	3-6 yr	298	--	50.8	15.6
	≥7 yr	201	--	35.3	10.8
All females		587	--	100.1	30.7
Unknown sex	1-2 yr	7	--	--	0.4
	3-6 yr	19	--	--	1.0
	≥7 yr	16	--	--	0.8
All unknown sex		42	--	--	2.2
All bears		1,912			

Table 13. Mean ages of black bears killed in Game Management Subunits 20A and 20B, Alaska, 1980-90.

Year	20A						20B					
	Male			Females			Males			Females		
	x	SD	n	x	SD	n	x	SD	n	x	SD	n
1980	5.4	1.8	12	3.8	1.0	4	6.5	5.1	41	6.0	2.3	15
1981	4.2	3.5	36	5.5	3.5	25	6.0	4.0	46	6.5	5.2	19
1982	4.3	2.8	23	4.3	2.7	9	4.5	2.8	50	5.6	2.6	18
1983	4.4	3.7	32	6.0	3.3	8	5.7	4.1	46	5.2	3.8	30
1984	3.0	1.3	8	7.0	4.9	12	4.9	2.7	48	6.8	3.6	29
1985	6.7	4.6	14	6.0	3.7	4	4.4	2.7	32	6.3	3.8	24
1986[a]	5.5	4.6	11	4.6	3.5	9	4.9	3.4	70	6.1	4.9	28
1987	4.8	3.7	22	5.5	4.1	1	5.9	4.4	63	7.2	4.4	42
1988	3.6	2.9	10	6.4	4.0	8	4.2	3.4	47	6.4	4.5	28
1989	5.1	2.9	18	7.2	3.1	5	3.6	2.3	65	5.1	3.0	28
1990	4.3	2.7	14	7.7	3.6	7	3.9	2.0	50	4.4	3.1	27

[a] Starting in 1986 all teeth have been aged by Matsons Lab, Milltown, MT.

Table 14. Summary of the yearly harvest of black bears in the Tanana Flats Training Area, Fort Wainwright, Alaska, 1974-90.

Year	Spring					Fall					
	Male		Female			Male		Female			
	n	x age	n	x age	Total	n	x age	n	x age	Total	Total
1974	--	--	--	--	--	1	5.0	--	--	1	1
1975	--	--	--	--	--	--	--	--	--	--	0
1976	1	5.0	--	--	1	1	2.0	--	--	1	2
1977	6	6.5	--	--	6	3	13.0[1]	1	7.0	4	10
1978	1	--	2	5.0	3	1	3.0	--	--	1	4
1979	6	4.7	2	5.5	8	--	--	--	--	--	8
1980	1	6.0	--	--	1	2	4.0	2	4.5	4	5
1981	6	2.7	2	--	8	12	1.7	5	4.0	17	25
1982	5	4.0	2	7.0	7	4	3.5	4	3.8	8	15
1983	9	4.8	2	7.0	11	2	6.0	1	9.0	3	14
1984	--	--	1	1.0	1	3	2.0	6	9.0	9	10
1985	2	2.0	1	5.0	3	3	6.7	1	2.0	4	7
1986	--	--	--	--	--	5	4.3	4	6.3	9	9
1987	2	1.0	--	--	2	5	1.8	5	7.0	10	12
1988	1	2.0	2	6.5	3	3	2.0	--	--	3	6
1989	5	5.4	6	7.0	11	2	4.0	1	4.0	3	14
1990	--	--	4	4.8	4	2	6.0	--	--	2	6
1980-90	31	4.1	20	5.7	51	43	3.3	29	6.2	72	123

[a] Only one of three was aged at 13 years.

Table 15. Summary of the yearly harvest of black bears in the Yukon Manuever Area, Fort Wainwright, Alaska, 1974-90.

Year	Spring					Fall					
	Male		Female			Male		Female			
	n	x age	n	x age	Total	n	x age	n	x age	Total	Total
1974	2	3.0	--	--	2	4	5.8	1	2.0	5	7
1975	2	6.5	1	7.0	3	1	3.0	1	6.0	2	5
1976	2	3.5	3	6.3	5	--	--	2	8.5	2	7
1977	4	2.0	2	6.0	6	9	4.6	-	--	9	15
1978	6	3.0	3	2.0	9	--	--	-	--	--	9
1979	--	--	--	--	--	1	5.0	-	--	1	1
1980	1	4.0	--	--	1	2	6.0	-	--	2	3
1981	2	3.5	1	--	3	6	5.8	-	--	6	9
1982	3	3.0	1	7.0	4	2	2.0	3	6.3	5	9
1983	3	8.7[a]	1	--	4	4	3.5	4	6.0	8	12
1984	4	7.0	2	6.5	6	--	--	3	5.0	3	9
1985	2	2.5	1	15.0	3	2	3.5	2	3.5	4	7
1986	4	3.5	3	5.0	7	3	4.0	2	6.5	5	12
1987	2	3.0	1	2.0	3	6	5.0	1	2.0	7	10
1988	5	4.2	1	3.0	6	2	1.5	1	3.0	3	9
1989	9	4.3	--	--	9	--	--	--	--	--	9
1990	6	3.3	1	2.0	7	1	2.0	1	1.0	2	9
1980-90	41	4.4	12	5.8	53	28	3.8	17	4.9	45	98

[a] Includes one 22-year-old male.

APPENDIX A

Project Title:

Habitat Use and Denning Ecology of the Black Bear in Interior Alaska

Investigator: Martin D. Smith

Advisors: Drs. Erich Follmann (Co-chair), Fred Dean (Co-chair), and Terry Bowyer

Funding: U.S. Army, 6th Light Infantry Brigade, and the Alaska Department of Fish and Game

Coordinators: Junior Kerns, Army Department of Natural Resources, and John Hechtel, Alaska Department of Fish and Game

Objectives:

The overall objective of this project is to provide a means by which the black bear population of the central Tanana Valley can be sustained or increased in the face of increasing human pressure. Specific objectives are:

1. Analysis of locations of radio-collared bears for habitat type preferences.

2. Analysis of bear den sites to describe habitat parameters.

Procedures:

The procedures will follow those discussed in previous reports (Vol. 40, No. 2, Vol. 41, No. 1 and Vol. 42, No. 1).

Results and Discussion:

Habitat use during the 1990 field season was obtained from an additional 241 locations on 25 black bears. Each aerial location determined what habitat type the bear was using. A Chi Square test failed to reject the null hypothesis of no difference between 1989 and 1990 habitat use ($x^2$4.94, p =.29). I therefore combined the two years data giving a total of 616 locations (Figure 1). To test which habitats were used significantly greater than or less than total available habitat, I constructed a 95% Bonferroni Joint Confidence Interval. Results showed habitats 1 (Marshland) and 2 (Heath Meadow) to be used less than available and habitats 3 (Willow/Alder) and 4 (Birch/Aspen) to be used greater than available. Habitat 5 (spruce) showed no significant difference between use and availability.

The locations were then divided into two seasons: Spring - den emergence through 15 July, and Fall - 16 July through den entrance (Figure 2). Chi Square tests showed habitat use from both seasons to vary significantly from available habitat (Spring: x^2 = 68.7, p<.005, Fall: x^2 = 29.3, p<.005). A 95% Bonferroni Joint Confidence Interval was constructed for each season and the results of observed use versus total availability are listed below.

	Spring	Fall
Habitat 1 - Marshland	used less	used less
Habitat 2 - Heath Meadow	used less	used less
Habitat 3 - Willow/Alder	used more	used more
Habitat 4 - Birch/Aspen	used more	used more
Habitat 5 - Spruce	no difference	no difference

An additional Chi Square Test compared spring habitat use with fall habitat use. The null hypothesis of no difference between seasons was rejected (x^2 = 90.11, p<.005). The follow-up 95% Bonferroni Joint Confidence Interval yielded the following results.

Habitat 1 - Marshland	use greater in spring
Habitat 2 - Heath Meadow	use greater in fall
Habitat 3 - Willow/Alder	no difference
Habitat 4 - Birch/Aspen	use greater in spring
Habitat 5 - Spruce	no difference

Vegetation sampling to characterize these habitat types was completed this past summer. Approximately 160 transects have been sampled within the five habitat types. These describe both the overstory/shub and the ground cover components of each type.

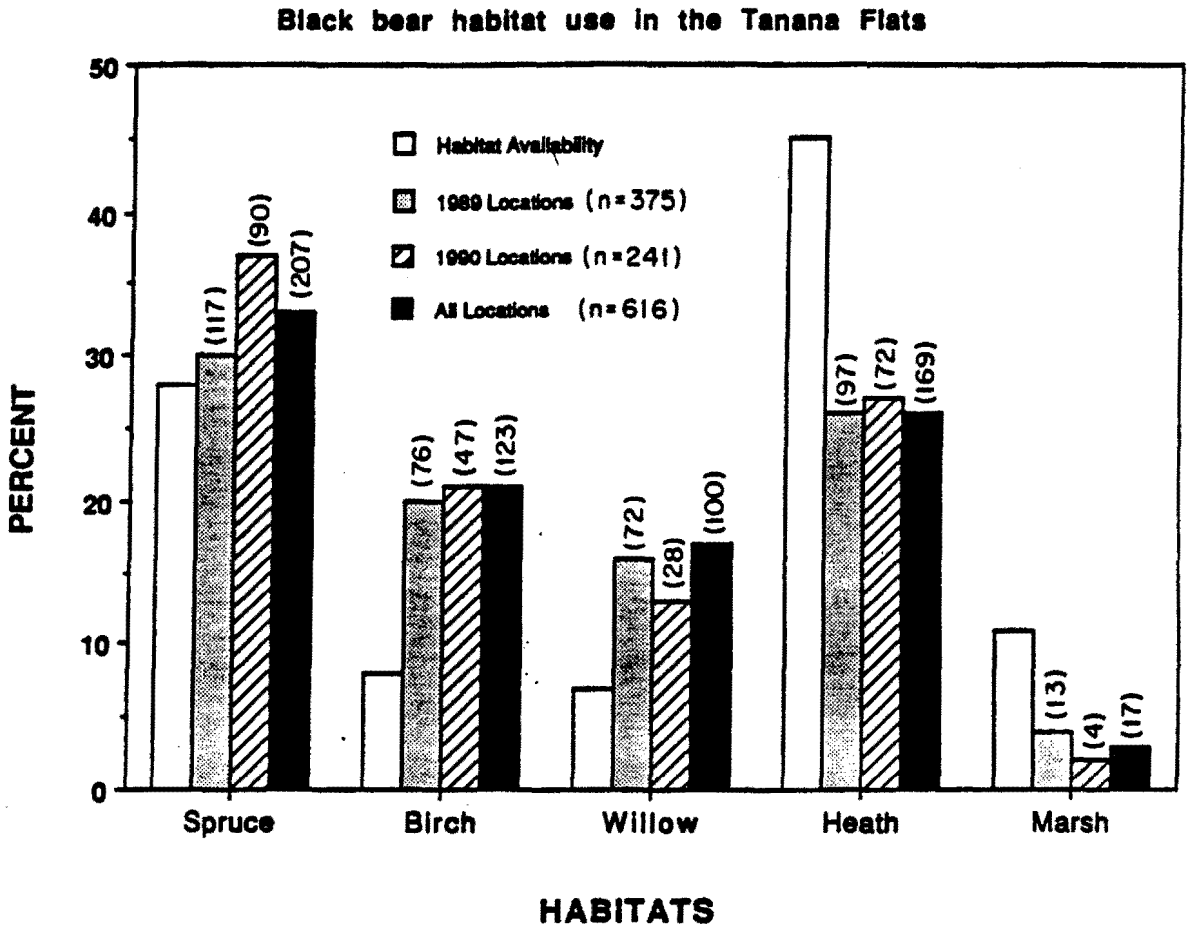

Fig. 1. Habitat use in relation to availability by black bears in the Tanana Flats.

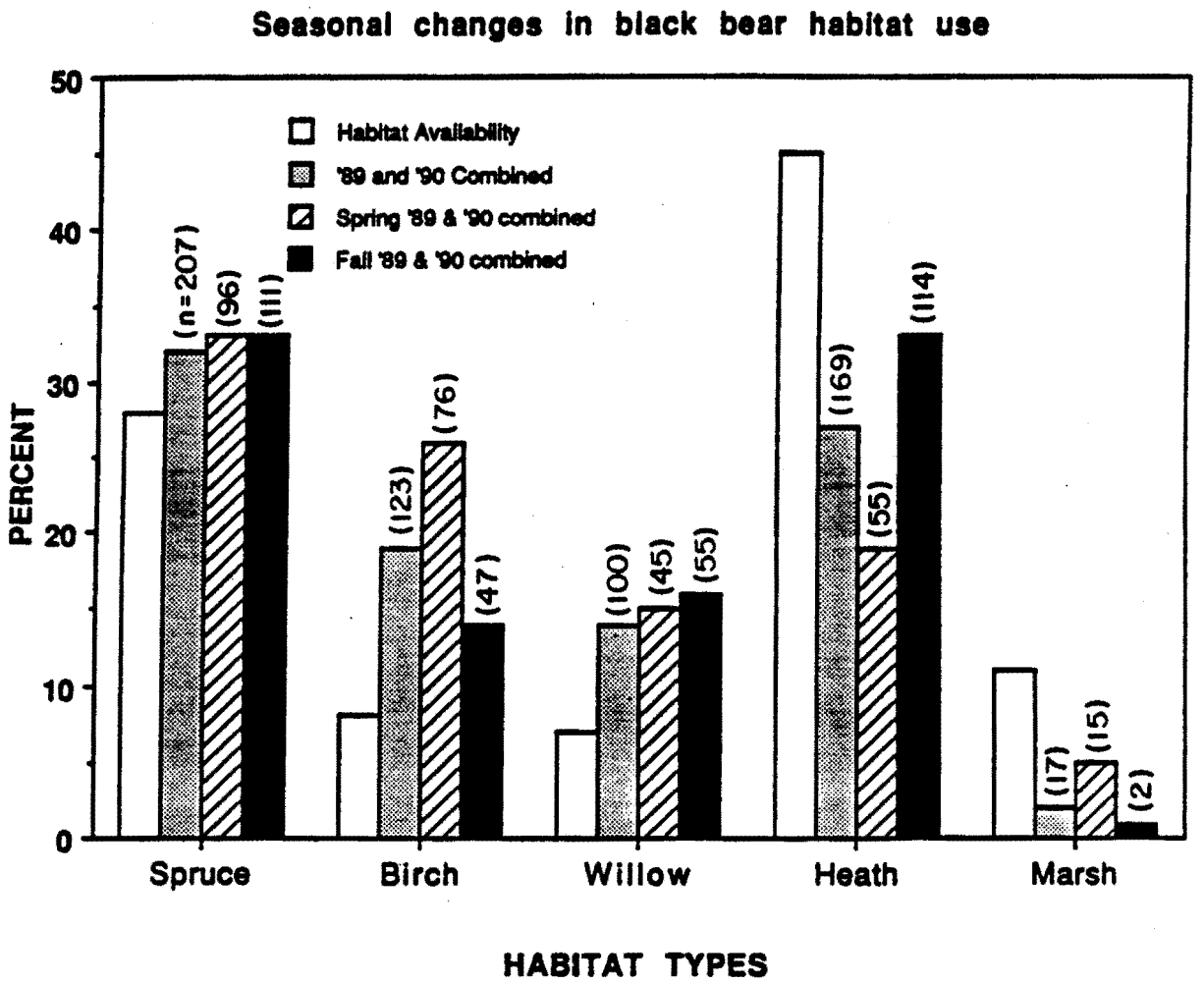

Fig. 2. Seasonal changes in habitat use by black bears in relation to availability in the Tanana Flats.

The stands sampled were randomly selected using the vegetation map prepared by Alaska Department of Fish and Game. Out of 80 stands visited only one was incorrectly classified. Statistical test to quantify these data have not yet been completed.

Additional plans for analysis of habitat use include comparisons between different sex and age classes of bears. I also plan to differentiate the seasonal catagories into finer units (i.e. 3 seasons or perhaps monthly). Another change in my analysis will involve using each individual bears home range as the basis for calculating "available" habitat. This should lead to a more biologically sound estimate of use versus availability since the entire study area is not realistically available for the bears to choose from.

Denning Ecology:

As a result of generous helicopter support from the U.S. Army we were able to return to 19 den sites for vegetation sampling. Six transmitters used to mark the dens failed before 1 was able to relocate them. The habitat types selected for dens are graphed against total available habitat and radio locations in Figure 3. A Chi Square test of den sites versus available habitat rejects the null hypothesis of no difference (x^2 = 247, $p<.005$). I also used Chi Square to test the null hypothesis of no difference between den site selection and habitat use, as determine by radio locations. This was also rejected ($x^2 = 87.6$, $p<.005$). A follow up test of a 95% Bonferroni Joint Confidence Interval showed habitat 3- (Willow/Alder) to be used greater then expected and habitat 2- (Heath Meadow) to be used less then expected. I also tested den sites versus fall locations and derived the same results.

The results from vegetation sampling at each den site have not yet been compiled. Analysis of the morphometric measurements of den characteristics is also continuing.

Further work will include a breakdown of den sites by sex and age classes of bears. Habitat selection for den sites will also be reevaluated by using only that habitat which falls within each bear's home range as 'available".

Plans for the next reporting period:

- Revise available habitat catagories
- Continue analysis of vegetation data
- Continue analysis of den characteristics

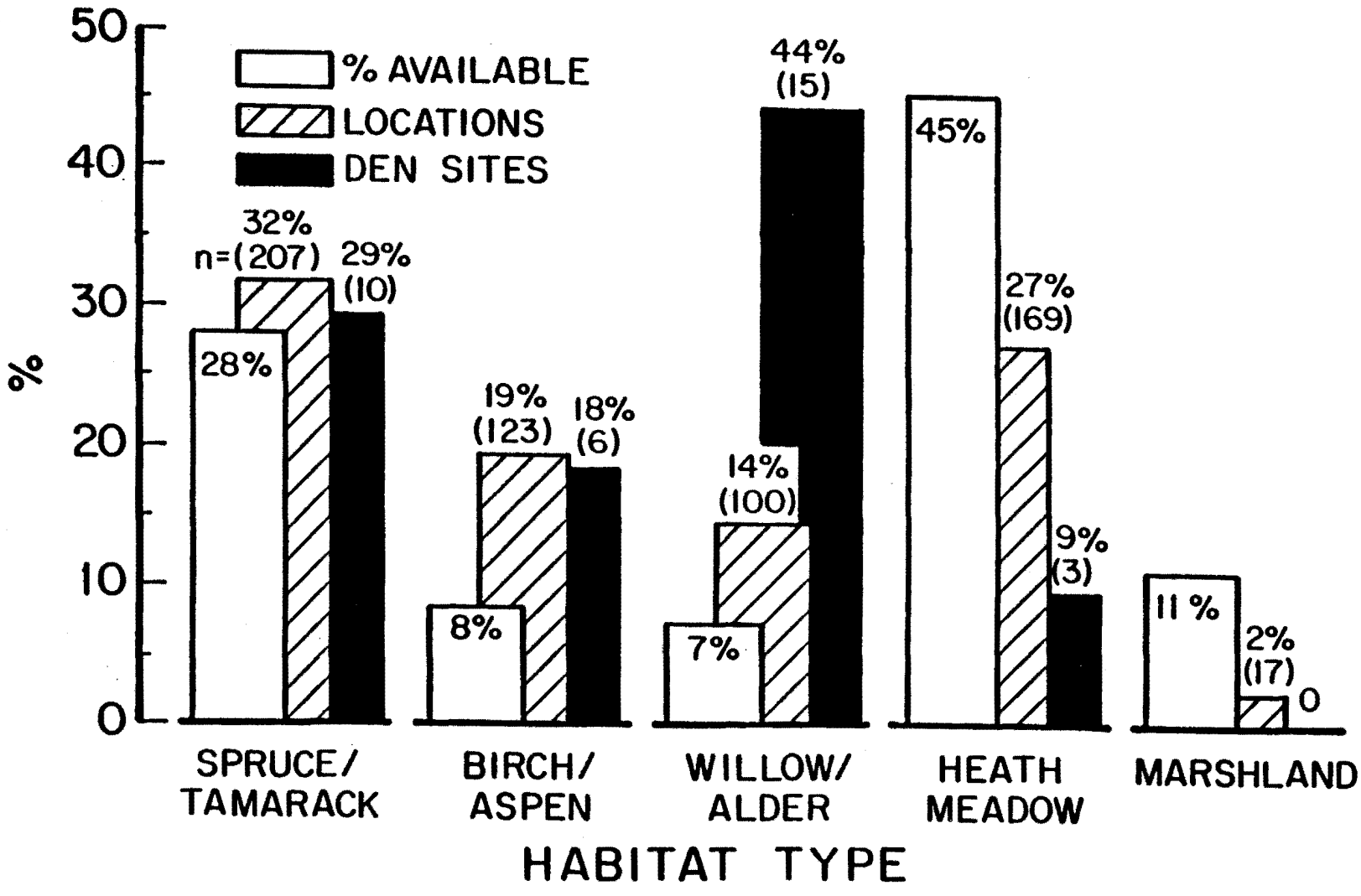

Fig. 3. Den site selection by black bears in relation to habitat type and its availability in the Tanana Flats.