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Impacts of Increased Hunting Pressure on the Density, Structure, and Dynamics of Brown Bear Populations in Alaska's Game Management Unit 13

by

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SUMMARY

During 1980-1990, brown bear (*Ursus arctos*) harvest regulations in Game Management Unit (GMU) 13 were designed to cause declines in brown bear density through harvesting in excess of sustainable levels. Primary management emphasis in this area was to produce moose (*Alces alces*) and caribou (*Rangifer tarandus*) rather than carnivores. Early predator-prey studies on the GMU 13 moose population, conducted after the population was depleted by severe winters and other factors, suggested that reduced bear numbers could result in increased moose calf recruitment and faster recovery of moose populations. These findings led to liberalized bear hunting regulations, increased harvests, and measured reductions in bear density. A season restriction designed to prevent further decline in bear numbers was initiated in 1990. However, current seasons remain more liberal and current harvests remain higher than prior to 1980. During the 1980s, annual reported harvests averaged 101 bears compared to 57 in the 1970s and 39 in the 1960s.

The current study was designed to document changes in bear density in GMU 13 and evaluate the bear population's response to increased hunting pressure. This was accomplished by conducting a density estimate in 1987 and comparing it with a 1979 estimate from the same heavily hunted area of the upper Susitna River Valley (UPSU), and comparing these with a 1985 estimate in a nearby area on the middle Susitna River (MIDSU) where there was thought to be less bear hunting.

In the UPSU study area along the Denali Highway, estimated bear density was reduced by 43% between 1979 and 1987, down from 10.5 (1979) to 6.0 bears ≥2 years old/1,000 km^2 (1987). The 1987 density estimate in the UPSU area was significantly lower than in the more lightly-hunted MIDSU area in 1985 (19.1 bears ≥2 years old/1,000 km^2) ($\underline{P}$ = 0.04). In the heavily-hunted UPSU area, the sex ratio of the population (≥5 years old)

changed from approximately 100 to 38 males/100 females between 1979 and 1987. In the more remote MIDSU area there were 77 males/100 females in the population of bears ≥5 years old in 1985. Mean and median age of males in the population declined along with population density. Mean age of males (≥2 years old) was 10.5, 7.1, and 4.1 in MIDSU (1985), UPSU (1979), and UPSU (1987) studies, respectively.

Sex and age composition of harvests were examined to detect trends associated with measured density changes. Data in these analyses were restricted to fall seasons which were considered more representative of the population; the data excluded kills from Subunit 13D where harvests were thought not to exceed sustainable levels by as much as in other subunits. The number and proportion of females in the harvest has increased in the kill of subadult, young adult, and old adult bears. During 1982-1988, the 3-year cumulative sex ratio for fall harvests was >60% females for bears >5 years old. This percentage declined during 1989-1991, perhaps in response to eliminating the early September hunting season in 1990. The proportion of young bears in the fall harvests has increased, especially for male bears. Both mean and median age of harvested males has declined since the mid 1970s. These changes concur with expected effects of high harvest. No trend was evident in number of days hunted by successful hunters.

Brown bear populations were reconstructed based on reported harvests, estimated population size, and assuming a 5% sustainable harvest level. In order to bracket the probable population trend, two reconstructions were calculated. The first assumed that the estimated GMU 13 population (1,228 bears) existed in 1980, before the increase in hunter harvests. The second reconstruction assumed that this population existed in 1987, after the period of largest reported harvests. Regardless of which scenario was used, these reconstructions indicated that harvests exceed sustainable levels in GMU 13 as a whole (where there has been a calculated 23-48% population decline), in GMU 13-excluding Subunit 13D (16-66% decline), in Subunit 13A (16-52% decline), in Subunit 13B (8-75% decline), and in Subunit 13E (25-70% decline). In Subunit 13C the reconstruction suggested the population declined (13-54%) but is now stable, in Subunit 13D the reconstructions suggested the population is now stable (5% decline to 7% increase).

Changes based on population reconstruction calculations were compared with the measured changes in population density in the UPSU area. The measured change indicated a 43% decline between 1979 and 1987 compared to a calculated decline in the reconstructed population of 42% during the same period in Subunit 13E where this study area occurs.

Available harvest data and population estimates were used to estimate what density and harvest rates would be required to sustain reported harvests. Based on an assumption that 5% of the population can be harvested without decline, the bear density would have to be 45 bears/1,000 km^2 in GMU 13 (excluding Subunit 13D). This calculated required density is significantly higher than the highest recorded density for an interior grizzly population in Alaska (34 bears/1,000 km^2 in Denali National Park [Dean 1987]). The sustainable harvest rate for GMU 13 (excluding Subunit 13D) would have to be 11.5% for the estimated population (857 bears) not to decline during the 1983-1986 period of peak harvests. The literature does not indicate that sustainable harvest rates for grizzly bears could be this high.

The 1988-1992 management objective for grizzly bears in GMU 13 was to maintain the bear population at existing, depleted, levels. To accomplish this, harvests would need to be reduced. Sustainable harvest levels were estimated using the midpoint of the two reconstructed population scenarios as the existing population and assuming that harvests of 5% of this population is sustainable. Under these assumptions, seasons need to be reduced to permit harvests of 25 bears in GMU 13 (excluding Subunit 13D) at the following levels:

Subunit	Avg. taken last 2 years (1990-92)	Sustainable harvest level
13A	13	8
13B	9.5	4
13C	5.5	4
13D	13+	19+
13E	36	10
Total GMU 13 (except 13D)	66	25

A conservative management strategy designed to assure that further reductions in bear populations do not occur, should reduce harvests below these levels in these subunits.

Analysis of moose calf survivorship measured by autumn calf:cow ratios during the period of bear reduction did not support the hypothesis that increased bear harvests during the 1980s resulted in increased moose calf survival (Miller and Ballard 1992).

Data were compiled on reproductive rates of radio-marked brown bears. Mean litter size was 2.1 newborns (range 1-4), 1.9 yearlings, and 1.8 two-year-olds. Mean age of first reproduction was 5.6 (range 4-9). Mean interval between weanings was 4.1 years: 58% of such intervals were 3 years; 21% were 4 years; and 21% were >4 years. Before 1987, all litters separated from their mothers at age 2 or younger. Since 1987, there were six instances (18% of weanings) where females did not separate from offspring until they were 3 or 4 years old.

Although alternative explanations are possible, the change in age of weaning and weaning interval since 1987 may be a response to increased hunting pressure. If so, the observed increase in age at weaning represents the opposite population response to heavy hunting pressure than what has been usually suggested. Increased hunting may result in reduced productivity rather than increased productivity. Data collected during 1981-1991 indicated no change in survivorship of newborn cubs associated with bear density declines in this study area ($\underline{P}$ = 0.42). No changes in litter size were associated with the period of increasing bear hunting and declining bear density ($\underline{P}$ >0.28).

The observed increase in age at weaning possibly resulted from breeding/conception failures associated with too few males remaining in the population to breed all estrous females. This change probably did not result from increased age of radio-marked females as 4 of the 6 cases of delayed weaning occurred for bears <15 years old. The conception failure theory was supported by data indicating that increasing numbers of females do not produce cubs on schedule after separation from 2-year-olds (31% before 1988 compared to 54% after) ($\underline{P}$ = 0.003). There was also an increase in the proportion of the adult female population not accompanied by offspring (7.4% before 1987 compared to 21.5% subsequently). The theory of breeding/conception failure was also supported by a decline in the frequency with which potentially breeding females were seen with males during the breeding season (42% of observations before 1988 compared to 24% subsequently) ($\underline{P}$ = 0.02). It is not possible to demonstrate, with available data, that these observations are responses to increased hunting and harvests of the 1980s. However, these observations form an intriguing hypothesis that merits further study.

During its fall 1992 meeting, the Alaska Board of Game changed the management objectives for GMU 13 when it adopted a grizzly bear population objective to "reduce significantly" and a harvest objective of ">125." The Board made these changes to enhance hunter harvests of moose and caribou in GMU 13. Some residents and hunters in GMU 13 testified that the bear population in GMU 13 was increasing. They based these views on frequent observations of bears and on concerns about bear damage to rural recreational cabins. The Board will consider changes designed to implement these objectives during spring 1993.

Key words: Age of first reproduction, Alaska, black bear, brown bear, compensatory mechanisms, density estimate, density dependence, harvest analysis, litter size, population trends, reproductive interval, reproductive rates, *Ursus americanus*, *Ursus arctos*.

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BACKGROUND

Little is known about trends in bear populations in Game Management Unit (GMU) 13 before the 1980s. Between 1948 and 1953, the federal government conducted a poisoning campaign directed at wolves which reduced wolf numbers in GMU 13 to as few as 12 (Rausch 1969, Ballard et al. 1987). Because the poison was distributed around carcasses of dead animals (J. Didrickson, ADF&G and Alaska Board of Game, pers. commun.), mortality to bears that scavenged these carcasses occurred "often" (Rausch 1969:126) and it is believed that bear populations were depleted. After statehood, bears were managed conservatively and bear populations probably increased gradually over the next 20 years.

Systematic brown bear studies in GMU 13 began in 1978. These studies yielded information on bear movements, predation rates on ungulates, and sex and age composition of the bear population (Spraker et al. 1981). Additional bear studies focused on the role of bear predation on moose calf survival (Ballard et al. 1980, 1990, 1991; Ballard and Larsen 1987; Ballard and Miller 1990). These studies resulted in a bear density estimate and bear population composition estimates for 1979 in a study area (UPSU) surrounding moose Count Area (CA) 3 near the Denali Highway in northern GMU 13 (Miller and Ballard 1982a). This bear density estimate was done during a bear transplant experiment (Ballard and Miller 1990) and was subsequently adjusted downward to correct for suspected lack of population closure (Miller 1990c). During 1980-1986, the Alaska Power Authority financed a major bear study in a nearby area that was similar in terms of bear habitat but where bear hunting was more difficult because of the absence of road access. In this area (MIDSU) south of the Denali Highway, a large 2-dam hydroelectric project was proposed but never built. The MIDSU studies were designed to evaluate the impacts on wildlife of the proposed project and included intensive studies of black bear, brown bear, moose, caribou, wolves, and other species. The bear studies significantly increased the amount of available information about bear biology, density (in 1985), population composition, movements, and predation rates (Miller 1987).

In addition to these research projects, Alaska Department of Fish and Game (ADF&G) management staff produced annual Federal Aid reports designed to track the status of bear populations in GMU 13 based on research findings, harvest data, incidental observations, and other available information. Excerpts from these reports demonstrate uncertainty about the status of this population during the heavy harvests of the 1980s (Appendix A).

The predator-prey research conducted in GMU 13 during the late 1970s and early 1980s indicated that brown bears were killing many moose calves and that an experimental reduction in bear densities increased calf survivorship (Ballard and Larsen 1987, Ballard and Miller 1989). This research was done during the early stages of the moose population's recovery from the severe winters of the early 1970s (Ballard et al. 1991). These calf mortality study results led the Alaska Board of Game to expand opportunity to hunt brown bears in GMU 13. This liberalization was intended to increase the number of moose available to hunters in GMU 13 and led to increased bear harvests starting in

1980. Similar liberalizations and increases in harvest occurred elsewhere in southcentral Alaska (Miller 1990b). In 1986, this project began evaluating the response of the brown bear population to increasing harvests in GMU 13.

Strong support for further reductions in bear numbers in GMU 13 comes from residents and owners of recreational cabins (especially in Subunit 13A) as well as from ungulate hunters. Transfers of small state land parcels to private ownership in the area during the early 1980s greatly increased human presence in bear habitat that was formerly lightly occupied by humans. These changes corresponded to an apparent increase in nuisance bear problems and property damage caused by bears, an increase interpreted by many locals to indicate bear population increases or, at least, to indicate that bear densities were higher than desired.

OBJECTIVES

Objectives for this study were to: 1) document changes in density and in the sex and age composition in a brown bear population subjected to heavy rates of harvest by hunters; 2) monitor changes in individual bear reproductive performance and survivorship in a population subjected to heavy harvest rates; and 3) investigate the hypothesis that brown bear cub survivorship is inversely related to hunting pressure or the proportion of adult males in the population.

STUDY AREAS AND METHODS

Brown bear density and population composition estimates were obtained from modified capture-mark-resight (CMR) techniques (Miller et al. 1987) in the UPSU area (Fig. 1) during 1987. These results were compared with data obtained using comparable procedures during Susitna dam project studies in the nearby but more lightly-harvested MIDSU area in 1985. The 1987 UPSU density and population composition results were also compared with data collected in the UPSU area during 1979 using different CMR procedures (Miller and Ballard 1982a, Miller 1990c). The CMR procedures used to estimate density included intensive aerial searches of a defined study area to determine ratios of radio-marked to unmarked bears. Unmarked bears found during these searches were captured and marked. Data on population composition was based on the sex and age of bears known to have been in the study area at least once during intensive searches. This procedure biases population composition towards males that have larger home ranges than females (Miller 1987, 1990c).

Changes in reproductive performance of individual bears was evaluated by aerial monitoring of radio-marked females to determine reproductive status (presence and age of offspring with adult females). During this study bears were monitored 1-4 times after emerging from dens in spring, 0-1 times during mid summer, and 0-2 times in autumn before entering dens. Both budget constraints and weather conditions caused variation in monitoring schedules. Data on reproductive performance was combined from both UPSU and MIDSU areas. In the MIDSU area, data were obtained from individuals first radio-marked during Susitna dam project studies. These bears were recollared in 1987 and 1990 as part of this study.

State regulation requires hunters to present hides and skulls from harvested bears to an ADF&G representative for sealing. During sealing a premolar tooth is removed for aging and the hide is examined to determine sex. Hunters are asked to provide information on where their kill was made. We used these data to analyze trends in numbers and sex-age composition of harvested bears.

Most data for harvest rates of marked bears were derived from radio-marked bears. The denominator (marks available to hunters) of the harvest rate primarily included radio-marked bears known to be alive in any year. Radio-marks were removed from all adult males by 1987 and some bears originally marked as subadults had only eartags and tatoos. When these bears were shot, they were included as having been available to hunters in the year shot and in all previous years since initial capture (except for cubs-of-the-year (COY) and yearling years during which bears are illegal to harvest).

Trends in cub survivorship were determined based on Spearman's rank correlation $\underline{r}_s$ calculated as Pearson's $\underline{r}$ on ranked annual survivorship values (Conover 1971:252). Significance of $\underline{r}_s$ was calculated based on the $\underline{t}$ distribution with (n - 2) df (Steel and Torrie 1960:409). Two-tailed Mann-Whitney $\underline{U}$ tests were used to determine differences in mean litter size for radio-marked bears lumped by different time periods.

RESULTS AND DISCUSSION

Table 1 presents capture data on bears captured in GMU 13 during 1980-1990. Current plans are to recollar 12 bears with still active collars during spring 1993. These bears were originally marked during 1980-1987. All presently radio marked bears are adult females. Radio-collars were removed from all males by 1987. No efforts have been made to mark new bears in the MIDSU area since 1985 or in the UPSU area since 1987.

Harvest and Regulation History

Table 2 shows brown bear hunting regulations and reported harvests in GMU 13. Average annual kill was 39 (17-63) in the 1960s, 57 (26-80) in the 1970s, and 101 (67-145) in the 1980s. Harvests increased in 1980 when spring seasons began and again during 1982-1986 when the bag limit was 1 bear per year (Table 2). Since bag limits in most adjacent units remained at 1 bear every 4 years, the 1 bear per year bag limit in GMU 13 during 1982-1986 probably induced some hunters to misreport kills made elsewhere as having come from GMU 13. Data in Table 2 were corrected for known instances of such "bootlegging", but there are probably additional instances that would inflate the reported harvests by an unknown amount.

Many bears shot in GMU 13 are taken incidental to autumn moose and caribou hunts. A bag limit of 1 bear per year encourages nonselective taking of bears by such hunters because this will not limit their opportunity to take a better bear in GMU 13 or elsewhere the following year. I suspect this is the primary reason reported harvests increased dramatically when the bag limit was first liberalized (Table 2).

In 1987, the Alaska Board of Game approved an ADF&G proposal to make bear regulations more conservative by changing bag limits back to 1 bear per 4 years as they were before 1982 (Table 2). The change was to eliminate incentives for hunters to misreport kills made elsewhere (where bag limits were 1 bear every 4 years) as having been made in GMU 13. It is uncertain how much of the reported harvest from GMU 13 during 1982-1986 actually came from elsewhere, but some did.

Concerns about continuing declines in the bear population prompted the Alaska Board of Game to approve an ADF&G proposal to eliminate the first 10 days of the September season in 1990 (except in Subunit 13D, Table 2). The first 10 days of the September seasons were eliminated because this was the period of highest kill of adult females (Miller 1990a). This decision was also influenced by analyses indicating that moose populations in much of GMU 13 were at or near carrying capacity and that reductions in bear density had had no impact on moose calf survivorship (Miller and Ballard 1992). The season reduction was intended to stabilize bear numbers at existing levels and to avoid either increases or decreases in bear numbers. The Board made these changes despite proposals from the public to further reduce bear numbers by liberalizing seasons and bag limits (Appendix B). Additional proposals (Appendix C) to liberalize bear hunting opportunity were considered and narrowly rejected by the Board of Game during spring 1992. Many GMU 13 ungulate hunters who believe reduced numbers of bears and other predators will increase moose and caribou (e.g. Appendix D) opposed the Board's decision. In response, the Board of Game advanced consideration of proposals to expand brown bear hunting opportunities in GMU 13 to its spring 1993 meeting, instead of considering them a year later when these proposals would normally be considered.

Measured Changes in Brown Bear Population Density

Exploitation of bear populations in excess of sustainable levels should result in declines in bear density. Available technology to measure such declines is insensitive to any but fairly substantial changes in bear numbers. As a result, differences in Alaskan bear populations related to hunting effort have only been documented in 3 portions of Alaska. In the northcentral Alaska Range, Reynolds and Boudreau (1992) reported a decline of 28% between 1981 and 1991 in response to increasing hunter harvests (6.5-14.3% of population). Results were obtained using intensive-capture-home-range-overlap techniques. Increases in bear numbers on the Alaska Peninsula following hunter-induced declines in the late 1960s were also documented using stream survey techniques (Sellers and McNay 1984, Miller and Sellers 1992).

Data illustrating differences and changes in bear density in GMU 13 were derived from 2 different study areas during 3 periods of intensive study (Miller 1988, 1990c). CMR techniques were used to measure declines in bear density between 1979 and 1987 in the UPSU area. CMR techniques were also used to compare bear density in the readily accessible UPSU area in 1987 with density in the more remote MIDSU area in 1985.

Figure 2 illustrates the differences in GMU 13 bear densities. The highest density (19.1 bears ≥2 years old/1,000 km^2) was in MIDSU (1985) where it was 3 times higher than in the UPSU (1979) area along the Denali Highway (6 bears ≥2 years old/1,000 km^2). Habitat conditions were estimated to be equivalent in both areas and differences in density were thought to result from different degrees of hunting pressure because of different degrees of area accessibility (Miller 1990c).

Density estimates for UPSU (in 1987) and MIDSU (in 1985) were directly comparable because identical CMR techniques were used; these density differences were significant ($\underline{P} = 0.04$) (Miller 1990c). The differences in the UPSU area between 1979 (10.5 bears ≥2 years old/1,000 km^2) and 1987 were not statistically significant. The CMR technique used to obtain the 1979 estimate in the UPSU area predated and was less precise than the technique used in the UPSU area in 1987 and in the MIDSU area in 1985. Because of these technical differences, the 1979 estimate had a large confidence interval which overlapped both the MIDSU (1985) and UPSU (1987) estimates (Fig. 2; Miller 1990c). Comparisons of point values for estimated density in the UPSU area in 1979 and 1987, however, indicated a 43% decline occurred during the 8-year intervening period of heavy bear harvests (Fig. 2; Miller 1988, 1990c). This level of indicated decline between 1979 and 1987 matched the calculated degree of decline in Subunit 13E using population reconstruction techniques. (See discussion on p. 12).

Measuring hunting effort in these areas or periods is impossible because no reports are required from unsuccessful brown bears hunters. The measured differences discussed above, however, correspond with subjective impressions of where hunting should have had the largest impact on bear density. Hunting impacts on bear density was expected to be lowest in the remoter MIDSU area in 1985, intermediate in the road-accessible UPSU area in 1979 (before liberalized hunting regulations), and largest in the UPSU area in 1987 (following the period of marked increases in reported bear harvests). Differences in population composition were measured against these expectations to test the conclusion that density differences resulted from differences in hunting pressure.

Measured Changes in Brown Bear Population Composition

Changes in the sex and age composition of bear populations are thought to be correlated with level of exploitation by hunters (Bunnell and Tait 1980, Fraser et al. 1982, Tait

1983, Harris 1984, Miller and Miller 1988, Miller 1990d, Garshelis 1990). Although impacts may vary depending on hunter selectivity, male bears tend to be more vulnerable than females because they are larger and preferred as trophies; because males move more and are more likely to encounter hunters; and because of legal or ethical constraints against shooting females with by offspring. Correspondingly, heavily hunted populations should have fewer males in older age classes than more lightly hunted populations. Differences in age composition may also reflect level of hunting but these relationships are more complicated. Young bears are probably less experienced at avoiding hunters and young male bears typically disperse from maternal home ranges (Schwartz and Franzmann 1992, Reynolds and Boudreau 1992) which should increase their vulnerability to hunters. As a result, heavily hunted populations should be younger, especially for males, than more lightly hunted populations. This would be expected to be most evident in GMU 13, where hunters are not highly selective for large trophy bears.

Sex ratio. The sex ratio of the population was estimated from the number of bears present in the study area at least once during density estimation (Miller 1990c). This technique overestimates the number of males in the population because males have larger home ranges than females and so that males from a larger area overlap the study area. The degree of overestimation directly relates to the length of the study period. The MIDSU (1985) and UPSU (1987) density estimates were directly comparable because they each involved 7 replications of the density estimation procedures. The UPSU (1979) estimate, however, was conducted over a period of 18 days which should result in a relatively larger bias in favor of males (Miller and Ballard 1982a, Miller 1990c). This bias was adjusted by calculating sex ratio for the UPSU (1979) data for the early part of the study (Ballard et al. 1980:Appendix V).

For bears ≥5 years old, there were 113, 77, and 38 males/100 females in the UPSU (1979), MIDSU (1985), and UPSU (1987) studies, respectively (Miller 1990c; Fig. 3). For the first 7 days of the UPSU (1979) study, the sex ratio of captured bears was 1:1 (6 males:6 females); for the first 12 days the ratio was the same (8:8). These results are consistent with the hypothesis that density differences documented in the UPSU area between 1979 and 1987 as well as differences between the sex ratio in the MIDSU area (in 1985) and in the UPSU (in 1987) reflect impacts of the exploitation rate on the population sex ratio. The higher number of males in the UPSU (1979) study than in the MIDSU (1985) study (Fig. 3) is not consistent with the expectation based on the relative density and suspected impact of harvest on sex ratio in these two studies (Fig. 2).

Age. Under GMU 13 hunting conditions, the mean and median age of males should be lowest in the most heavily exploited populations. This pattern was evident (Fig. 4). Only the first 7 days of study in UPSU (1979) were used to compare directly with the 7 days of study in MIDSU (1985) and UPSU (1987). The mean ages of males >2 years old in MIDSU (1985), UPSU (1979), and UPSU (1987) studies were 10.5, 7.1, and 4.1 years, respectively (Miller 1987c, Fig. 4). Median ages for these bear populations were 9, 5, and 2, respectively (Miller 1987c, Fig 4). These differences in male age show the same pattern and trend as for density differences in the three studies. Population age data support the hypothesis that density differences reflect differences caused by exploitation rates. This conclusion would be the same if age data from all 18 days of study in UPSU (1979) were used (Miller 1990c).

Trends in mean and median ages of females were more ambiguous. This was expected because it is unclear how female ages would change in response to increased hunting pressure. Simulation studies suggest that age of females in populations, and harvests, may increase slightly in response to heavy hunting pressure (Harris 1984, Miller and Miller 1987, 1988). This increasing trend may result from aging of adult females caused by protection afforded by legal and ethical constraints against shooting females accompanied by offspring and relatively high vulnerability of subadult female bears. Mean age of females was lowest in the UPSU (1979) study and about the same in the MIDSU (1985) and UPSU (1987) studies (Miller 1990c, Fig. 4).

Indirect Measures of Population Trend Based on Harvest Composition

Changes in population numbers are difficult to measure from the sex and age composition of harvested animals (Harris 1986, Tait 1983, Miller and Miller 1988, Miller 1990d). This is because different classes of bears are vulnerable to hunters in different ways depending on their sex, age, size, previous history, or geographic location. Males exit dens before females and tend to be heavily represented in early spring harvests regardless of their proportion in the population (Miller 1990g). This makes it difficult to establish meaningful harvest quotas based on harvest sex ratios. To illustrate this point, in spring harvests the male:female ratio is much higher than in fall even though the data derive from the same population. This reflects differences in relative vulnerability of the sexes in these 2 seasons rather than differences in population status. Where spring harvests increased relative to autumn harvests, the population status inferred from sex ratio data would appear more "favorable" than when the reverse was the case.

Under some circumstances, sex and age composition of harvested animals may reflect population trend even if these data are unable to measure the degree of change directly. To be useful in indicating trend, it is necessary to standardize the data so that changes reflect actual changes in bear populations in a homogeneous area rather than changes in hunter selectivity, hunting conditions, or results from non-representative portions of the management unit. For this reason, the following analyses of harvest data exclude spring harvests and concentrate on fall harvests which I believe reflect the population composition more accurately and are less influenced by weather and hunter selectivity. Subunit 13D was excluded from most of this analysis because it was believed to be relatively lightly harvested compared to other subunits; including these data would confuse interpretation of trends occurring in other more intensively harvested subunits.

For some analyses, harvest data were subdivided into categories based on whether hunters had access from the road system or whether the area was more remote requiring access by airplane or all-terrain vehicle (ATV). Harvested bears were coded to individual uniform coding units (UCUs) by the area biologist. Appendix E lists the breakdowns of UCUs used to subdivide the harvest into road system and remote categories.

Statistical tests were not applied to the harvest data because it is unclear what such tests would mean. The tests would show the significance of differences in harvest data, but it is unclear what this would mean with reference to the underlying population. For example, a significant change in mean age of harvested animals could reflect hunter selectivity changes as well as population structure changes. The following analyses should be viewed as an effort to understand what harvest statistic components changed in response to population density and structure changes documented above.

Interpretations of harvest data may be further complicated by incomplete or incorrect data. Some factors that may cause data to be incomplete or incorrect include misreporting of kill location by hunters, failure to report kills (especially kills of nuisance bears or bears killed in defense of life and property), and wounding losses. Misreporting of kill location was encouraged by regulations that permitted taking bears every year in GMU 13 during 1982-1986 (Table 2). During this period, regulations in most of the rest of Alaska permitted taking a bear every 4 years. Some hunters are known to have falsely reported kills made elsewhere as having come from GMU 13 but the magnitude of such "bootlegging" is unknown. Data were corrected for known instances of false reporting but unknown instances may have inflated harvest figures which could result in overestimating the degree of population decline based on population reconstruction. Wounding losses and other unreported kills, on the other hand, would result in an underestimation of population decline based on the population reconstruction techniques described below.

Sex ratio of kill. Under conditions of heavy harvests where male bears are more vulnerable than females, I would expect that the sex ratio of harvested adults should demonstrate a trend toward an increasing proportion of females (Harris 1984, Miller and Miller 1988). This trend was evident in fall harvest data from 1975 through 1986 (3-year running average for bears ≥5 years old), but the proportion of males harvested increased subsequently (Fig. 5). A similar, less marked, pattern was evident for subadults (Fig. 5). A similar, but earlier, trend toward an increasing proportion of females in the kill followed by a decline in recent years was evident in harvest data from road accessible areas (Fig. 6).

The increased proportion of females harvested concurs with observed data that indicates density declines. The recent increase in the proportion of males in fall harvests is not consistent with this interpretation and may reflect the elimination, in 1990, of the first 10 days of the September bear season (Table 2). The Alaska Board of Game decided to eliminate this portion of the season because harvest data indicated that the largest number of female bears were harvested in early September (Miller 1990a). Some recent increase in hunter harvests of male bears may reflect increased hunter kills of immigrant bears which would be predominantly male.

A regression of percent males in the harvest on age class should have a negative slope that is steeper when exploitation is heavier (Fraser et al. 1982). This analysis was used for the Unit 13 harvest data to suggest heavier harvests during 1980-1987 than during 1970-1979 (Figs. 15 and 16 in Miller 1988). A similar pattern was evident in comparing data for bears >5 years old between 1971-1980 and 1981-1990 (Fig. 7).

Percent of males in the adult bear harvest does not simply reflect availability because Alaskan hunting regulations prohibit shooting females with cubs or yearlings. Many females become illegal to shoot when they first produce offspring. The percent of males harvested should decline in each successive subadult age class and increase at the age when females first produce offspring. Research data from radio-marked bears in GMU 13 before 1986 suggest the mean age at first reproduction is 5.4 years, 25% of bears produced first litters at age 4, 60% by age 5, 89% by age 6, and 97% by age 7 (Table 14B in Miller 1988). Data on the sex ratio of bears harvested from 1971-80 show an increased proportion of males harvested at age 4, which is the age the research indicates that first reproduction occurs (Fig. 8). In harvest data obtained during 1981-1990, percent male bears harvested declined for ages 2, 3, and 4 and did not increase until age 5 (Fig. 8). These data are consistent with an interpretation that age of first reproduction may have increased in heavily harvested areas of GMU 13. Field studies of marked females would be required to determine if age at first reproduction actually increased.

Overall, the proportion of females in the kill of subadult (age 1-4), young adult (age 5-10), and old adult (age 11+) bears has increased (Fig. 9). This trend appears most marked for the oldest bears and least marked for the youngest ones (Fig. 9). I would expect this because the youngest bears should be closest to the sex ratio at birth as they cohorts have been exposed to the shortest period of sex-selective hunting.

Harvests during spring seasons are presented in Fig. 10 for purposes of comparison with fall harvests. There is a slight trend toward an increasing proportion of males in the spring harvests of bears ≥5 years old, no trend was evident in spring harvests of younger bears (Fig. 10).

Harvest numbers. Sex ratio data may be misleading without information on actual numbers of bears harvested. Over time, the number of females harvested has increased in all age classes; this increase has been most dramatic for subadult females (ages 1-4) (Fig. 11). No clear trend is evident in numbers of subadult and young adult males harvested, but the number of older males harvested appeared to decline (Fig. 12). In a different format, these trends are illustrated on subadult bears in Figure 13, for young adult bears in Figure 14, and for older adults in Figure 15.

Harvest age ratios. The proportion of young bears in fall harvests has increased; this trend is more marked for males than for females (Fig. 16). Before 1980, less than 60% of the fall harvest of males were <5 years old, since 1980 >65% were less than 5 years old (Fig. 16).

Since the mid-1970s, mean and median ages of harvested males during fall seasons have declined markedly (Fig. 17), this is especially so for adult males (Fig. 18). These data seem to be correlated with an increasing harvest rate and the declining population of males documented in the age composition data (Fig. 4).

Trends in age data for female bears of all ages were less clear (Fig. 19). An increasing trend in age of harvested adult female bears occurred until the early 1980s; a trend that declined (Fig. 20).

Trends in successful hunter effort. Successful bear hunters in Alaska report the number of days they hunted when they bring harvested bears in for sealing; no reports are required from unsuccessful hunters. Not counting improved hunter technology, reduced bear density could be reflected in increased number of days required for hunters to bag a bear. Such patterns might be obscured under conditions where many bears were taken opportunistically as is thought to be the case during fall seasons in GMU 13. However, successful effort should vary more during spring seasons because of differing snow cover conditions which influence aircraft landing and snowmachine access.

Effort by successful resident hunters in fall seasons increased from 1968-70 to 1986-88 but has since declined (Fig. 21). Effort by successful nonresidents remained constant (Fig. 21). Fall effort by resident hunters using aircraft for transportation increased from the mid-1970s through the mid-1980s and has since declined (Fig. 22). No trend is evident for residents hunters using other transportation types (Fig. 22).

These data are difficult to interpret because the decline in effort required to take a bear in recent years contradicts data that suggest a population decline. These data may reflect an increased willingness of hunters to take subadult bears opportunistically, but this willingness should have declined when the bag limit was changed from 1 bear every year to 1 bear every 4 years in fall 1987 (Table 2).

Estimated Brown Bear Population in GMU 13 Subunits

No techniques are available to estimate brown bear population size in large areas (Harris 1986, Miller 1990d), though experiments with tetracycline marking to estimate the total black bear population have been done in Minnesota (Garshelis et al. in press). Polar bear population size has been estimated using widespread mark-recapture Jolly-Seber techniques (DeMaster et al. 1980, Amstrup et al. 1986). Another approach is for knowledgeable persons to subjectively extrapolate from smaller areas where bear density has been empirically estimated (Miller 1990d). In 1987, 3 biologists (S. D. Miller, W. B. Ballard, and R. D. Tobey) did this for GMU 13 by extrapolating from results of bear density estimates obtained in 2 portions of northwestern GMU 13. These population estimates were converted to density estimates for each GMU 13 subunit and compared to estimated sustainable harvest densities (Miller 1990b).

The validity of a population estimate obtained by extrapolation from areas of known density depends on the knowledgeability of bear populations of those making the extrapolations. Prior to a study designed to estimate bear density in a study near Nome, Alaska, biologists were asked to guess the density and rank their level of familiarity with the area's bear population. Biologists with a high level of familiarity made better guesses about bear density than did persons with less or no familiarity with the area. This was true even when the persons with little familiarity with the study area were expert bear biologists (Miller and Nelson, unpublished data).

To derive an independent estimate of bear population size in GMU 13, an experienced pilot and hunting guide was asked to extrapolate from the known-density study areas in the same manner as was done by the 3 biologists in 1987. The pilot, Mr. Harley McMahan, has spent most of his life in GMU 13, has participated in MIDSU (1985) and UPSU (1987) density estimates in this unit as well as 2 similar estimates in GMU 9 (Alaska Peninsula). He is widely regarded by ADF&G staff as an expert observer of wildlife. Mr. McMahan was provided with a map of GMU 13, instructed to draw polygons on the map and estimate density in each polygon as a function of the density in the northwestern GMU 13 study areas (the same process previously followed by the 3 biologists). The area in each of these polygons that overlapped each subunit in GMU 13 was then determined and multiplied by this factor to obtain a population estimate for the portion of each polygon in a subunit. These polygon population estimates were summed to obtain a population estimate for each subunit and this population estimate was divided by the area of the subunit to obtain a subunit density estimate. As noted elsewhere (Miller 1990b), population estimates obtained in this way are more likely to be overestimated than an underestimated under circumstances where population numbers are declining. This is because one's recollection of relative density in an area would probably reflect earlier observations when there were more bears. The results of McMahan's work is presented and contrasted with the biologists' estimates in Table 3. Qualifications for and a description of McMahan's work was presented in Appendix A of Miller (1992). Although made independently, the GMU 13 estimates by McMahan (1,235) and by the 3 biologists (1,228) were remarkably similar. Compared to the biologists' estimate, McMahan's estimate was 2.5% higher in Subunit 13A, 19.9% higher in Subunit 13B, 6.8% higher in Subunit 13C, 32% lower in Subunit 13D, and 11% higher in Subunit 13E (Table 3). The estimate of the 3 biologists was used in subsequent calculations (Appendix C in Miller 1990b).

Population Reconstruction-Comparisons of Actual and Sustainable Harvests

Based on studies of reproductive and mortality rates of radio-marked bears in GMU 13, the upper limit for sustainable harvest levels was estimated as 8% of the population of bears >2 years old or 5.7% of the total bear population (Miller 1988, 1990b, d). The upper limit for sustainable harvest was calculated as 5.7% of the estimated population density (all bears) in each subunit. These values for the estimate for the 3 biologists and for McMahan were formerly illustrated as horizontal lines (Figures 1-6 in Miller 1990b).

This method of illustration obscures the reality that populations, and sustainable harvests, will decline when harvested in excess of sustainable levels and will increase when populations are harvested at less than this rate (except when near carrying capacity or other limiting factor).

To illustrate this point, I mathematically reconstructed the population based on the assumption that harvests of 5% of the estimated population were sustainable. Correspondingly, harvests in excess or below this would result in population declines or increases, respectively. The initial population size was based on the population estimate made in 1987 (Miller 1990b) (Table 3). Two population scenarios were calculated based on what date this population existed. The first scenario assumed this population existed in 1980, before the significant increase in bear harvests during the mid-1980s and the second scenario assumed this population existed in 1986 after the period of heaviest reported harvests. The first scenario reflects a presumption that a lag exists between a decline in population numbers and biologists' ability to recognize the decline based on the subjective criteria used to estimate population. If we assume that the population estimate and the sustainable harvest rate estimate are fairly accurate, not considering significant immigration or compensatory population responses, these 2 scenarios probably bracket the actual population trend.

Whether or not scenario 1 or scenario 2 is used, harvests exceed sustainable levels in most of GMU 13 (Figs. 23-36) and populations should still be declining (Figs. 37-43). However, under either scenario, these calculations suggest a stable to increasing population in Subunit 13D during recent years (Figs. 33, 34, and 42) and in Subunit 13C, the reconstructed population may now be stable following a decline (Figs. 31, 32, and 41).

The reconstructed population numbers (Figs. 23-43) are presented in Table 4. This calculated population reconstruction can be compared with measured changes in bear density obtained during 3 CMR density-estimates done in the upper Susitna study area during 1979 and 1987, and in the middle Susitna area in 1985 (Miller 1987) (Fig. 2, Miller 1990c). In the upper Susitna area, the point estimate for density declined from 10.5 in 1979 to 6.0 bears ≥2 years old/1,000 km^2 in 1987, a 43% decline. A 42% (372-217) calculated decline occurred between 1979 and 1987 in Subunit 13E where these studies were based (Table 4). The calculated and measured changes in density are similar enough to suggest that the calculated population reconstruction has some credibility.

Public Perceptions of Trends in Bear Numbers

The preceding analyses indicating a decline in bear numbers conflicts with the perceptions of some hunters and local residents in GMU 13. These views are evident in proposals received by the Board of Game (Appendices B and C) and by statements from local residents made to management staff based in GMU 13 (Appendix A and R. Tobey pers. commun.). Board of Game member and GMU 13 resident Ken Johns commented during the spring 1992 Board of Game meeting that grizzly bears were abundant in the Monihan

Flats area. This is the UPSU study area where the 1979 and 1987 density estimates were made in northern GMU 13. During the fall 1992 moose and caribou hunting seasons, ADF&G staff interviewed hunters along the Denali Highway and reported that most hunters had seen brown bears and some had had adverse encounters with them (B. Bartley, ADF&G, pers. commun.). A bear guide who conducts viewing and photographing tours along a salmon spawning stream used by many bears in the Su-hydro study area (Miller 1987) reported seeing record numbers of bears along this stream during summer 1992 (J. Bailey of Talkeetna pers. commun.). No downward trend in bears seen during summer caribou surveys has been evident although these observations vary highly between years (R. Tobey, ADF&G, pers. commun.). Many local residents with cabins or summer homes in Subunit 13A (especially the Lake Louise area) believe bear numbers have increased. These observations are based on increasing frequency of damage to their cabins caused by bears.

The increase in bear damage probably reflects the greatly increased number of summer cabins in this area that were built during the 1980s after small parcels of state lands were subdivided and distributed to private owners. The views of some local residents and hunters about trends in bear populations are probably influenced by their preferences for fewer bears regardless of what the actual bear population trend is. This preference may be based on the belief that fewer bears will result in more moose or caribou available for harvest (Appendices B, C, and D), concern about damage to their residences or livestock, and/or fear of bear attacks.

Estimated Required Density and Harvest Rates to Support Reported Harvest Levels

The preceding analysis is based on density estimates obtained from field studies and on harvest rate analyses based on productivity data derived from field studies and computer simulations (Miller 1988, 1990d). Given the disparity between predictions from this approach and public perception, it is worthwhile to reverse the process to estimate what density would have to be to sustain reported harvest levels given a harvest rate and what harvest rates would be necessary to sustain reported harvests given a density.

Based on reported harvests, mean annual brown bear harvest density in GMU 13 was 2.2 bears/1,000 km^2 during 1983-1986. If we assume a 5% harvest rate is sustainable (Miller 1988, 1990d), then population density GMU 13 would have to be 44.6 bears/1,000 km^2 to sustain this harvest level (Table 5). In different GMU 13 subunits, population density would have to be between 34 bears/1,000 km^2 (in 13D) and 46.6 bears/1,000 km^2 (in Subunit 13E) to sustain reported harvests (Table 5). The highest density estimate reported for brown bears in interior Alaska was 34 bears/1,000 km^2 for an unhunted population in Denali National Park (Dean 1987), the next highest was in the MIDSU area in GMU 13 (29.1 bears/1,000 km^2) (Miller et al. 1987, 1990c). Based on a sustainable harvest rate of 5% or less, the density required to sustain reported harvest levels was high.

If the 1987 brown bear population estimates for GMU 13 subunits (Table 3, Miller 1990b) are accepted, then the harvest rate that would be required to sustain reported harvest levels can be calculated. For GMU 13 (excluding Subunit 13D) a sustainable harvest rate would have to be 19.4% for reported harvests not to have caused a decline (Table 5). In the different GMU 13 subunits, sustainable harvest levels would have to be between 14% (in 13B) and 27% (in 13E) for the population not to have declined given estimated population sizes (Table 5). Sustainable harvest rate for the highly productive GMU 13 brown bear population was estimated to be less than 5.7% by Miller (1988). In the Yukon, sustainable harvest rates of only 2-3% and total man-caused mortality of <10% were recommended by Sidorowicz and Gilbert (1981). Maximum allowable man-caused mortality was estimated at 6% for Alberta grizzly bears (Nagy and Gunson 1990). Harvest rates of 6.5% of total population did not result in a decline in the number of adult females in a northcentral Alaska range study during 1981-1989 (although total population declined), but recent harvests of 14% caused a significant decline in adult females that will require reductions in harvests to avoid further declines (Reynolds and Boudreau 1992). A summary of sustainable harvest estimates provides no support for contentions that brown bear harvests in excess of 10% can be sustained (LeFranc et al. 1987:81). Based on available literature on sustainable harvest rates and on estimated population size, the reported GMU 13 harvests in the mid-1980s would have caused a decline in bear density in all GMU 13 subunits except Subunit 13D.

Harvest Rates of Radio-marked Bears

Status information from 1980 through 1992 is available for 104 bears marked during studies between 1980 and 1987 (Table 6). The individuals listed in Table 6 include those >2 years old when marked and those <3 years old that were subsequently determined to have survived based on subsequent recapture or harvest. Annual harvest rates of marked bears ranged from 3% to 17% with a cumulative value based on bear-years available of 8% (Table 6).

Effects of Reduced Brown Bear Densities on Moose Calf Survival

Data indicate that bears prey primarily on calf moose and, unlike wolves, only infrequently kill adult moose (Ballard et al. 1980, 1991; Ballard and Larsen 1987). This indicates that the primary effects of bear predation on moose population growth rates must be expressed through moose recruitment rates. The most direct measure of moose recruitment rate available is in autumn calf:cow ratios which occur after the period of heaviest bear predation. The impacts of the 1979 bear transplant experiment was found in a significant increase in moose calf:cow ratios that occurred in autumn after 49 bears were transplanted from the UPSU area (Ballard et al. 1980, Ballard and Miller 1990). In this same area, a 43% measured reduction in bear density (Fig. 2) occurred between 1979 and 1987; the above-mentioned changes in population composition and comparison of harvests with estimated harvests suggest that much of this reduction resulted from hunter harvests (Miller 1990c) although there may have been residual impact from the transplant

(Miller and Ballard 1982b). If the hunter-induced reduction in bear density influenced calf:cow ratios in the same manner as the bear transplant, as intended when bear seasons were liberalized, calf:cow ratios should have increased. An analysis of data suggest no increase in calf:cow ratios correlated with the increased bear hunting and decline in bear densities (Fig. 44, Miller and Ballard 1992).

The moose population recovery in this area began in 1975 (Ballard et al. 1991), 5-6 years before the hunter-induced reduction in bear numbers began. The population continued to grow until the severe winter of 1988/89 caused increased moose mortality and reductions in calf:cow ratios in spite of low bear densities (Miller and Ballard 1992, Fig. 44). Moose harvests and numbers of moose hunters in GMU 13 generally increased during the moose population recovery (Figs. 45 and 46).

Research in the study area has demonstrated that brown bears eat moose calves in spring but there is little predation on adult moose (Ballard et al. 1980, 1981, 1990a,b, 1991; Boertje et al. 1988). Analyses indicate that no basis exists to conclude that the increased bear hunting in GMU 13 that began in 1980 accelerated the growth of the moose population or resulted in increased numbers of moose available for sport hunters. The growth of the moose population in the study area between 1975 and 1988 has fostered the perception of some local residents and other uncritical observers that this growth was directly caused by the hunter-induced reduction in bear numbers.

While this report was in preparation, C. Schwartz (ADF&G, memo of 12/8/92)) conducted an analysis of the relationship between bear and wolf densities and moose population biology in GMU 13 using moose survey data. Preliminary results from this analysis reached conclusions similar to those of Miller and Ballard (1992): the significance of bear predation on moose recruitment (measured as yearling moose observed per hour of survey) was a negative function of moose density. At low moose densities (cows/hr), moose recruitment appeared to increase in response to reductions in bear numbers. At high moose densities, however, recruitment rates did not respond to reductions in bear density (C. Schwartz pers. commun.).

Analyses presented earlier in this report demonstrate a decline in the GMU 13 brown bear population in response to liberalized bear hunting regulations. Some who advocate for more GMU 13 bear harvests to benefit moose and caribou hunters believe the GMU 13 bear population has increased in recent years (Appendices B and C). The logic behind this position is difficult to follow because if bear populations did not decline, then it is necessary to accept that declines were not necessary to permit the moose population to recover.

Brown Bear Reproductive Biology

Brown bear reproductive biology was studied in GMU 13 as part of Susitna Hydroelectric studies during 1980-1985 (Miller 1987). In the current study, contact was continued with these bears through infrequent (2-7 times/year) monitoring of female radio-marked bears to obtain reproductive data. Additional data on reproductive rates was obtained during 1978-79 studies (Spraker et al. 1981) and from bears radio-marked in the upper Susitna area for the 1987 density estimate. Where appropriate, comparison data are presented from a study on the northcentral Alaska Range (Reynolds and Boudreau 1992).

Litter size. Mean litter size for 68 litters of newborn cubs was 2.1 (range 1-4) (Table 7), for 61 litters of yearlings mean litter size was 1.9 (range 1-3) (Table 8), and for 37 litters of 2-year-olds litter size was 1.8 (range 1-3) (Table 9). Litter size for litters of 3- and 4-year-old offspring (all these litters were observed since 1987) are provided in Table 10.

In the northcentral Alaska Range, mean litter size for cubs was 2.14 (n = 41 litters), and 2.05 for 38 litters of yearlings (Reynolds and Boudreau 1992).

Sex ratio of offspring. Sex ratio of 33 captured brown bear newborns and 26 brown bear yearlings were 50:50 (P = 0.60, 0.12, respectively) (Tables 11, 12). All these data were obtained before or during 1987.

The sex ratio for offspring first observed as COY was also near 50:50 In the northcentral Alaska Range study (16 males:13 females) and for those first observed as yearlings it was 21 males:19 females (Reynolds and Boudreau 1992).

Age of first reproduction. All data on age of first reproduction were obtained before 1987, after that year new subadults were not marked. To avoid underestimation bias based on failure to include marked females yet to produce their first litter, data were included for incomplete intervals by assuming such females would produce their first litter the next year. Mean age of first litter (n = 24) was 5.6 (range 4-9) with 25% of bears producing first litters at age 4; 58% at 4 or 5; 90% by age 6; 97% by age 7; and 100% by age 9 (Table 13).

In the northcentral Alaska Range study, mean age at first production of cubs was 6.3 years (range 5-7, n = 10) (Reynolds and Boudreau 1992).

Reproductive intervals. Intervals were calculated from weaning of 1 litter to weaning the next litter to avoid underestimation bias caused by losses of complete litters. Intervals were also included from production of a female's first litter to her first successful weaning of a litter. To avoid underestimation bias that would result from failure to include long incomplete intervals based on this definition, intervals were also included for incomplete data by assuming that the interval would be completed the following year (provided that the offspring were at least 2 years old). Using these definitions, mean interval length for 52 intervals was 4.1 years (range 3-9) (Table 14). Most intervals were 3 years (58%), 21% were 4 years, and 21% were >4 years (Table 15). As discussed in the next section, these results may mask recent increases in reproductive interval that may reflect compensatory responses to heavy hunting pressure.

Reproductive intervals were calculated in the same way by Reynolds and Boudreau (1992) for the northcentral Alaska Range study where mean reproductive interval was 4.1 years (range 3-10, $\underline{n}$ = 48).

Reproductive histories for individual radio-marked female brown bears are presented in Table 15. Data on black bear reproductive rates and the abstract of a paper contrasting these rates with those in a Kenai Peninsula study are presented in Appendix F.

Potential Compensatory Population Responses to Heavy Hunting Pressure

Under many kinds of hunting conditions, bear hunters exhibit a selection bias in favor of males (Bunnell and Tait 1980, 1981). This is because males usually have larger home ranges and more extensive movements, disperse from maternal areas as subadults, and are larger, preferred trophies. In Alaska, this bias toward harvest of males is strengthened by regulations which prohibit shooting brown bear females accompanied by offspring in their first and second years of life. This regulation effectively protects many females accompanied by offspring still with their mothers during their third or later years, because many hunters are unable to distinguish age of offspring and are reluctant to shoot females accompanied by offspring of whatever age. This is especially true during spring seasons when many females are still accompanied by their 2 year-old offspring. Some have suggested that this selectivity for males may result in increased survivorship of cubs because of reduced predation by adult males (McCullough 1981, Stringham 1983). Others have pointed out that available data do not support this relationship and recommend that managers not include such functions in their management planning (Miller 1990f, Reynolds and Boudreau 1992, Taylor in press, McLellan and Stringham in press, and Garshelis in press). An inverse relationship between litter size and level of hunting might exist in Montana (McLellan 1989, McLellan and Stringham in press).

Survivorship of newborn cubs. Based on data collected during 1981-1988 in this study area, no trend toward increased survivorship of newborn cubs was associated with measured declines in bear density and decline in the proportion of males in the population (Miller 1990f). The addition of data from 1989-1991 in this study area did not change this relationship (Fig. 47; $\underline{P}$ = 0.42). During 2 of the 3 years since 1989, no mortality of newborn cubs with radio-marked females occurred (Fig. 47). These data indicate a possible relationship between level of hunting and cub survivorship that only becomes evident under extreme overhunting conditions which have only recently occurred. Additional study is required before reaching any conclusion. No relationship between hunting pressure and cub survivorship was noted in a northcentral Alaska Range study where density was reduced by an estimated 38% for bears ≥2 years old (Reynolds and Boudreau 1992).

Litter size. Mean size for newborn litters of radio-marked females during 1978-1992 was 2.1 (range 1-4) (Table 7). Based on litter size data from Table 7, mean litter size during 1978-1985 (2.1, n = 34, sd = 0.649) was not different from that during 1988-1992 (2.2, n = 18, sd = 0.65) (P = 0.29); during 1987-92 (2.2, n = 26, sd = 0.694) (P = 0.33), or during 1986-1992 (2.1, n = 34, sd = 0.69) (P = 0.59). These data provide no support for the contention of McLellan (1989) and McLellan and Stringham (in press) that litter size may increase in response to hunting pressure.

Reproductive interval. Before 1987, all radio-marked females weaned their offspring during their third year of life (at age 2) except for one case where it appeared a yearling offspring was weaned (Table 16). In 1987, I saw the first instance of a bear entering a den with 2-year-old offspring and weaning these the following year (at age 3) (Table 16). In 1992 I saw the first instance of weaning at age 4, another instance of weaning at age 4 may occur in 1993. Since 1987, 6 instances of weaning at age 3 or greater have been observed (Table 16). Before 1987, 100% of the cubs separated from their mothers at age 2 or younger; after 1987, 18% of litters have separated at age 3 or older (Table 16). These data suggest that reproductive interval in GMU 13 may be longer than previously thought based on studies prior to 1987 (Miller 1987). Because reproductive interval is the single most significant factor in estimating productivity and sustainable harvest rates (Appendix C in Miller 1990a, Taylor et al. 1987) these values may have been overestimated in previous analyses (Miller 1987, 1988).

Productivity and reproductive interval may have changed, perhaps in response to heavy hunting in this area. A change in age at weaning and in reproductive interval could result if females did not conceive because of a shortage of males. Under such circumstances, a female who if pregnant, would not tolerate her 2-year-old offspring and would not enter a den with them, might continue to associate with these offspring and den with them. Such behavior could increase the likelihood these offspring would survive by extending the period of parental care at no cost in parental fitness associated with not producing new offspring. To my knowledge such a relationship has not been previously hypothesized. It has been thought that conception failure would probably not occur because bears may have recurrent estrus periods, are polygamous, and because only a proportion, <33%, of adult females are receptive to males in any spring breeding season (other adult females would be with newborn or yearling offspring).

If conception/breeding failures were occurring, the proportion of females "expected" to be with cubs (based on having had a litter of 2 year-olds the previous year) should decline. Annual data based on these expectations for each radio-marked adult female are in Tables 17 and 18. Two bears (#337 age 19 and #423 age 25) have been "expected" to have cubs each year since 1987 and 1988, respectively, but have failed to do so (Table 17). This may be a result of old age rather than conception failure. Since 1990, over 60% of bears "expected" to have cubs have failed to do so compared to <40% prior to 1990 (Table 18). Delayed weaning was first observed in 1987. During 1979-1987, 31% of 54 bears expected to have cubs failed to have them compared to 54% of 37 bears after 1987 (Table 18). The frequency of failure to have cubs differs in these 2 periods (X^2 = 8.74, 1 df, P = 0.003). Data interpretations are complicated because the mean age of bears that were expected to have cubs but did not, tended to be older than those expected to have cubs that did actually have cubs (Table 18). This relationship is not solely age-based, as 4 of the 6 delayed weaning cases occurred in bears <20 years-old and 3 of these in bears <15 years-old (Table 17).

If conception/breeding failures were occurring, it would be expected that the proportion of adult (≥6 years old) females accompanied by offspring (age 0-2) would increase. Before 1987, 7.4% of radio-marked adult females were without offspring in spring compared to 19.8% during 1987-1992 (Table 15). Excluding bears accompanied by 3- and 4 year-old offspring 21% of adult females were without offspring since 1986 (Table 19). Because observations are not independent (the same individual will have cubs in 1 year, yearlings and 2 year-olds during the next 2 years), these data are not appropriate for statistical testing.

If delayed weaning was caused by conception/breeding failure, and this in turn, caused by an insufficient number of males, I would expect the frequency of observation of potentially breeding females accompanied by males to decline. Data on observations of radio-marked bears between 1 May and 20 June were examined to evaluate this hypothesis (Tables 20 and 21). During 1978-1987, 42% of 497 observations of potentially breeding adult females during the breeding period were with a known or suspected male compared to 24% of 38 observations after 1987. These observations are not independent because many observations of the same individual frequently occurred in the same year. However, if this is ignored and observations are not independent is treated as if it were independent the frequency with which female bears were observed with a male was less in recent years than in the past ($X^2 = 5.15$, 1 df, $\underline{P} = 0.02$) (Table 21).

Limited data suggest that movements of some potentially breeding females during the breeding season may be more widespread than formerly thought. During spring 1992, I observed movements outside of traditional home ranges for some adult females who should have been in breeding condition. These movements were observed for bear numbers 461 (age 11 with 1 two-year-old), 460 (age 13 with 2-three-year-olds), 335 (age 14 with 2 four-year-olds), and 337 (a 24 year-old female who weaned her last litter in 1987). Such movements were not observed for bears not in breeding condition. These movements could represent estrous female bears having to search a wider range to find scarce males.

Increasing age of radio-marked bears makes interpretation of these data difficult (Table 21). Failure to consistently locate all bears during spring flights since ending the Susitna Hydroelectric studies in 1985 adds to the difficulty of interpreting data. Since the Susitna dam studies ended, the objective of monitoring has been to determine reproductive status; once this status was determined (e.g., the bear was without cubs), it was frequently not relocated during subsequent flights. Definitive data on these relationships requires consistent monitoring, marking of a new sample of younger females to compare with historical data, and documenting changes in density and proportion of males in the population.

Age of first reproduction. No data from radio-marked individuals are available to evaluate potential changes in age of first reproduction because subadult bears have not been radio-marked since 1987. Data on the sex ratio of harvested animals by age class suggest that age of first reproduction has gotten older during the period of heavy harvests (Fig. 8).

Future Bear Management Direction in GMU 13

While this report was in preparation, the Alaska Board of Game decided to consider brown bear regulation changes for GMU 13 during its spring 1993 meeting, a year ahead of the normal schedule. This was done after the Board adopted a plan to implement wolf population regulation in portions of GMU 13. This plan listed objectives for wolf, moose, caribou, and grizzly bears. For grizzly bears, the population objective established by the Board was to "reduce significantly" and the harvest objective was ">125" (ADF&G 1992:1). One reason listed for these objectives was that public testimony prevailed favoring strong support for intensive management of GMU 13 wildlife populations to provide high yields of moose and caribou for humans.

Management goals listed for GMU 13 were: "to conserve all populations of wildlife; to produce high yields of moose and caribou for humans and to provide the maximum opportunity to participate in hunting for these species; to maintain all populations of wildlife, including predators, at significant and visible levels to provide for a broad spectrum of uses. The appropriate management emphasis for GMU 13 is on high yields of moose and caribou; wolves and grizzly bears are important wildlife resources and must be managed on a sustained yield basis and maintained at viable levels (ADF&G 1992: 1-2)." This plan suggests that the Board is likely to adopt regulations to reduce bear populations in GMU 13 at a faster rate than is occurring.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Although bear populations were reduced in Subunit 13E by an estimated 43% during the 1980s, evidence does not demonstrate that this increased moose calf survivorship. There was no evidence of a compensatory increase in productivity or cub survivorship by the bear population. There may have been a compensatory decline in bear productivity caused by an increased cub dependency period and delayed maturing, but data are inadequate to conclusively identify increased hunting as the cause of these changes.

If bear populations respond to increased hunting by declines in productivity, then this would contradict the compensatory response model most frequently hypothesized. Because bear populations in this study area appear to have been significantly reduced and because there is good baseline data on population composition, productivity, and movements from Su-hydro project investigations (1980-1985), northern GMU 13 would be an ideal place to investigate population responses to heavy hunting. This combination of circumstances is unlikely to occur elsewhere and answers to questions about population responses to heavy hunting pressure are important to managers of exploited bear populations.

My analyses suggest that if it is decided to avoid further reductions in bear populations, harvests should be reduced to half the existing level throughout GMU 13 except in Subunit 13D. Though no direct information on the status of bear populations in Subunit 13D is unavailable, analyses based on extrapolations from northern GMU 13, suggest that the bear population was little affected by liberal hunting regulations during the 1980s. Failure to reverse the suspected decline in bear numbers in the rest of GMU 13 will result in decreased opportunities to hunt bears in this area. As a matter of public policy, there is little reason to continue bear reductions because data indicate that continued reductions would not create corresponding benefits to hunters of ungulate populations.

My analysis indicating significant declines in GMU 13 brown bear populations is based on direct measurements only in the Denali Highway (Count Area 3) study area. Elsewhere, this conclusion is based on indirect evidence, inference from harvest data, and by models of sustainable harvest that require making assumptions about density-dependent and other relationships that may be misunderstood. A systematic density estimate in the MIDSU (Su-hydro) study area needs to be continued. This estimate, which could be conducted in 1994 at the earliest, would be used to compare population density and composition with values obtained from the same area in 1985. This work would also provide information on density-dependent relationships. Without direct evidence to support the existence of higher population and/or sustainable harvest levels than has been developed during this project, my analyses suggest that bear populations in GMU 13 (except Subunit 13D) will continue to decline under existing harvest levels.

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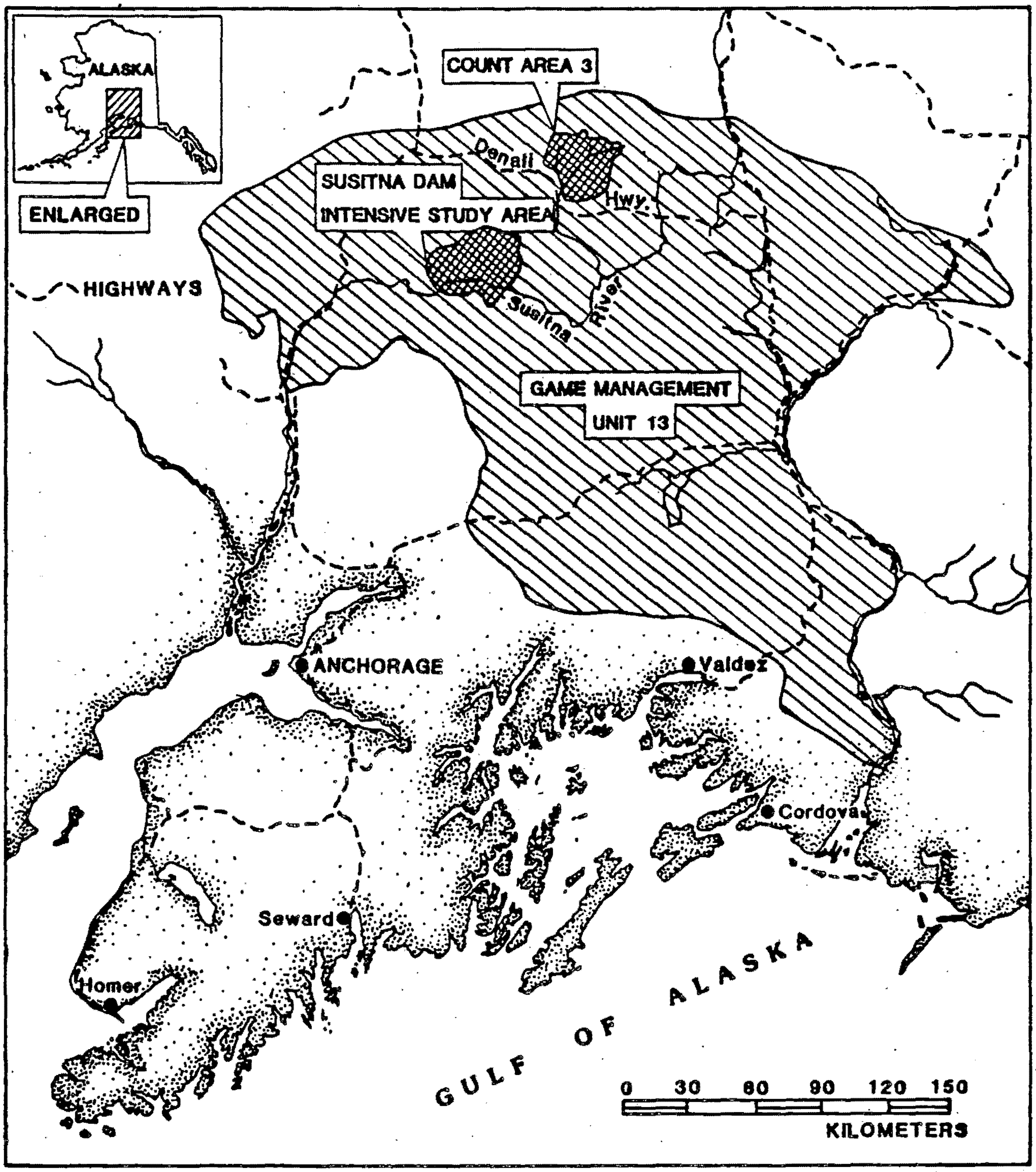

Figure 1. Map of GMU 13 and locations of intensive study.

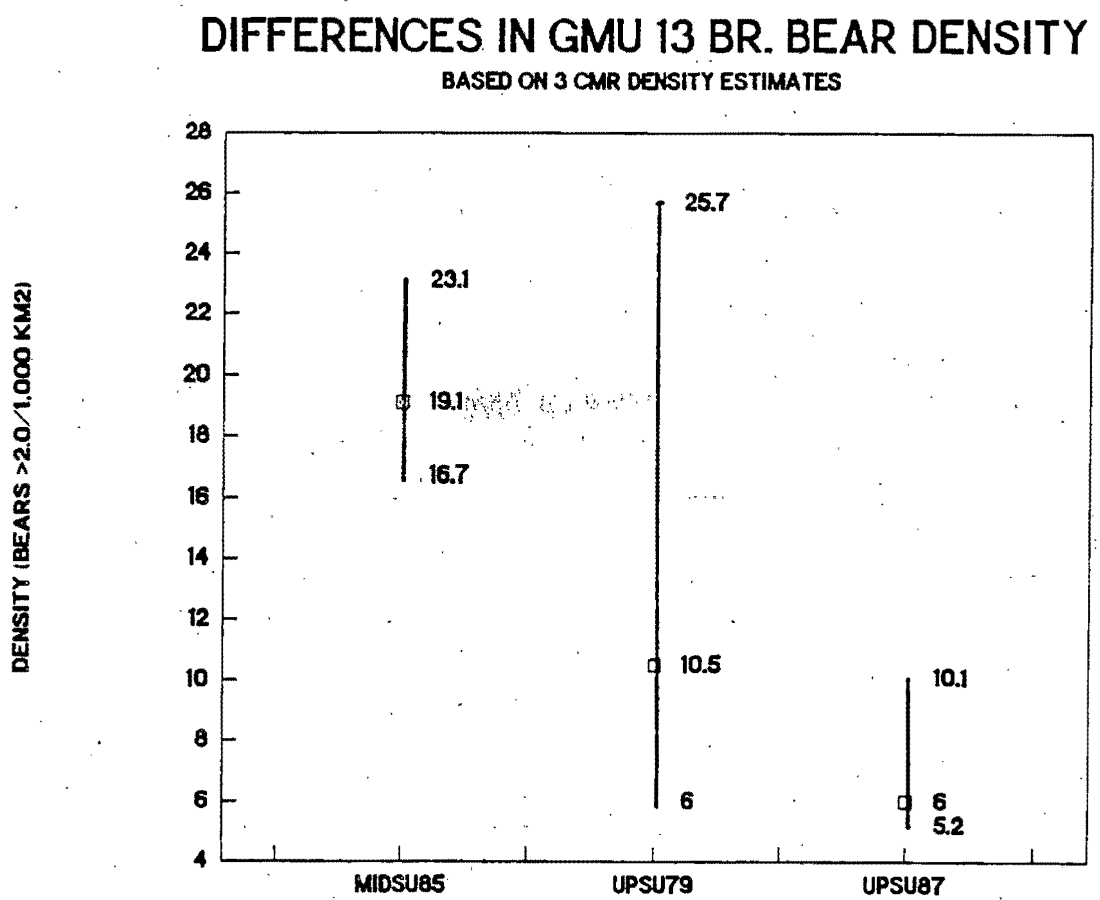

Figure 2. Measured brown bear densities (bears >2.0) using CMR techniques in the Upper Susitna Study Area (UPSU) in 1979 and 1987 and in the Susitna Dam Study Area (MIDSU) in 1985 (95% CIs are illustrated).

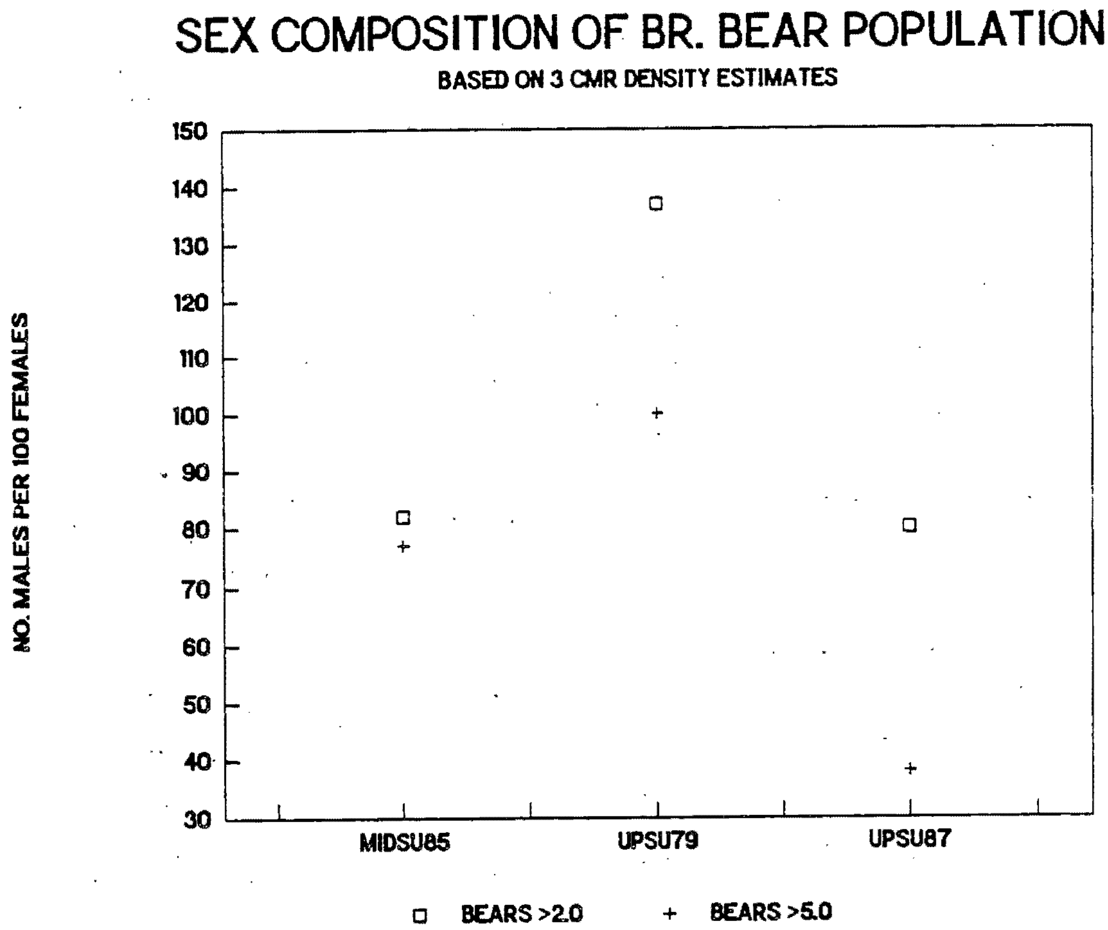

Figure 3. Sex composition of brown bear populations in 3 GMU 13 study areas based on bears present at least once in the study area during density estimation procedures.

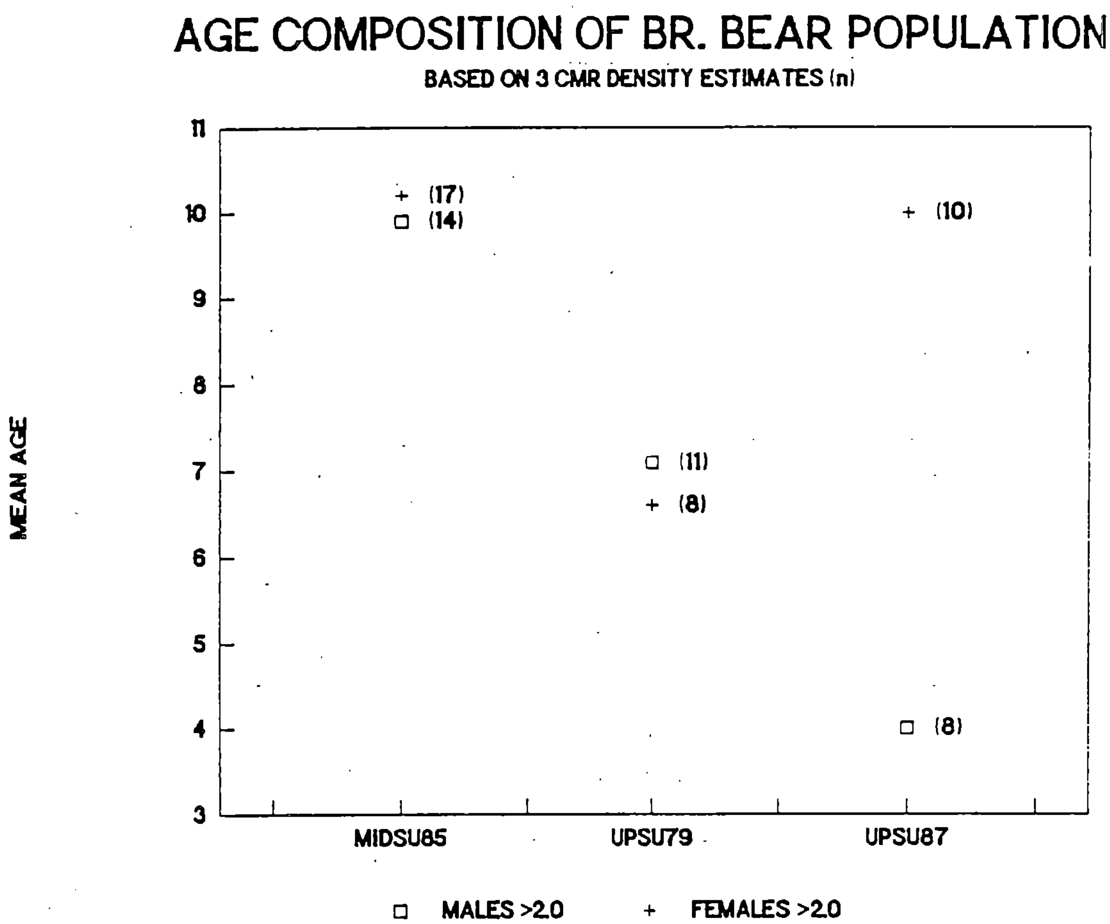

Figure 4. Age composition of brown bear populations in three GMU 13 study areas based on bears present at least once in the study area during density estimation procedures. Includes bears >2.0 years-old.

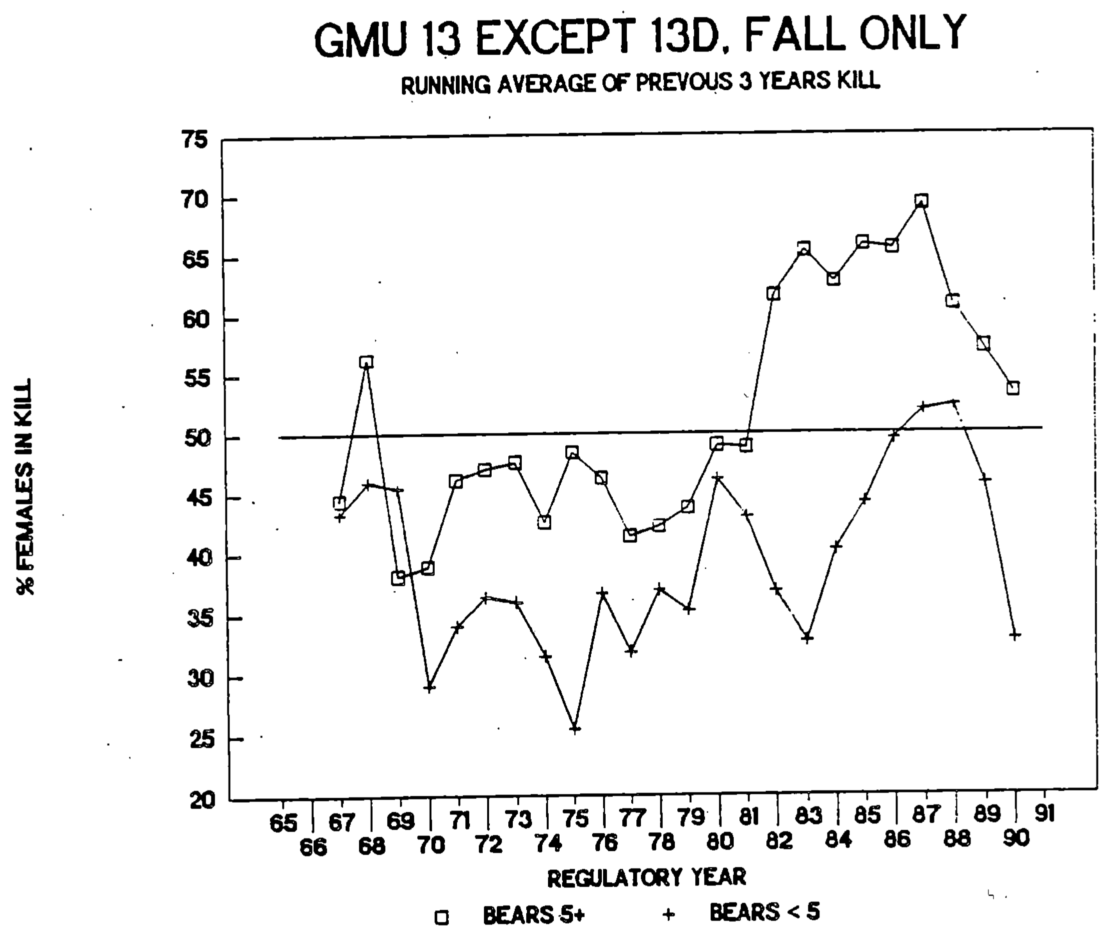

Figure 5. Trend in sex ratio of bears harvested in fall seasons in GMU 13, excluding 13D. [sexratio.wk1, oldvyng.pic].

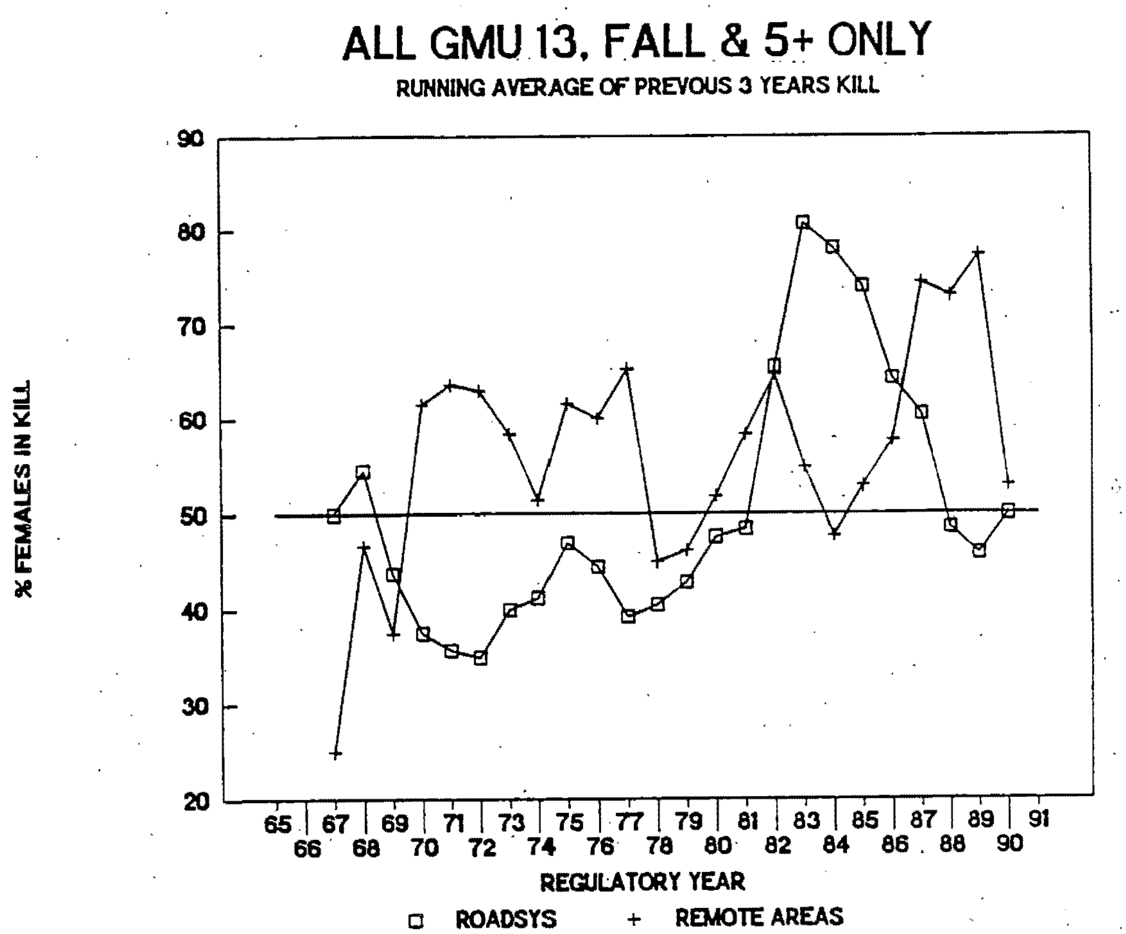

Figure 6. Trend in sex ratio of bears harvested in fall seasons in road accessible and remote portions of GMU 13, excluding Subunit 13D. [sexratio.wk1, 5pl.pic].

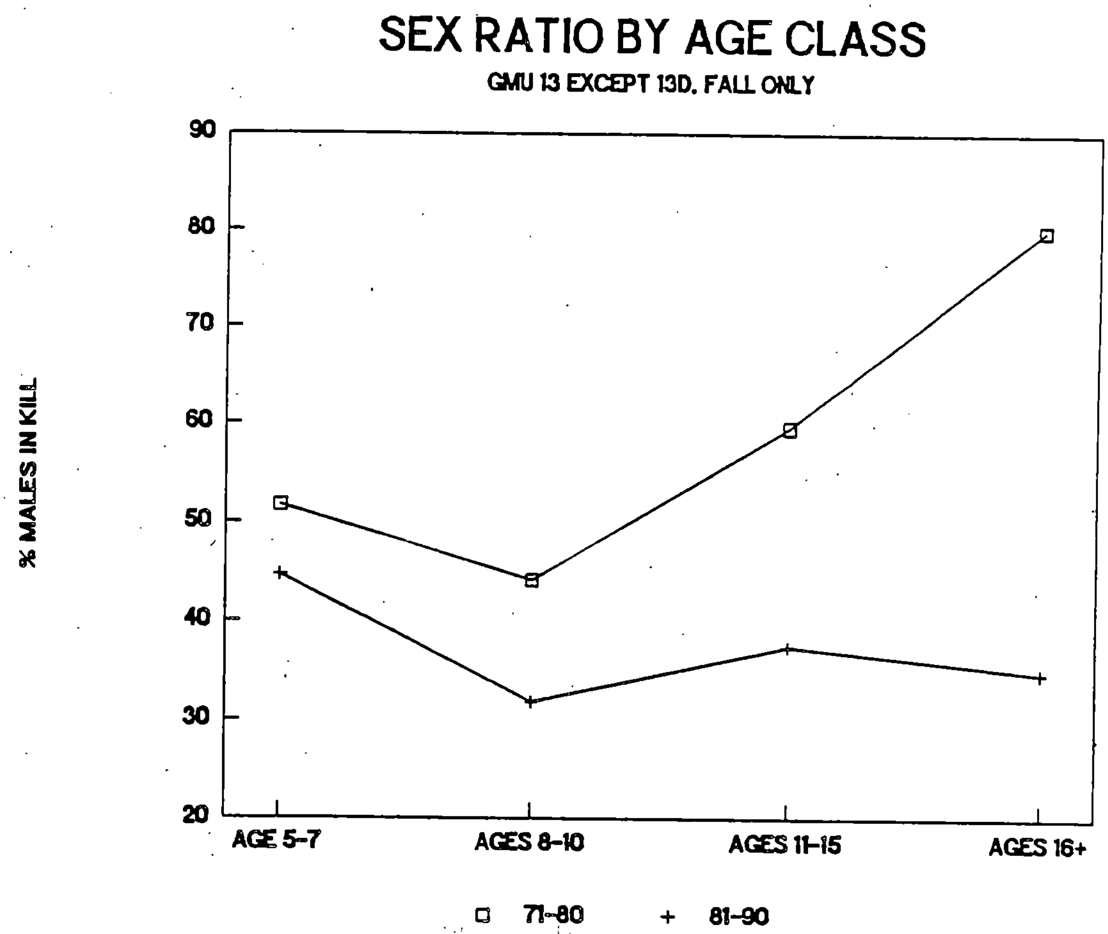

Figure 7. Comparison between 1971-80 and 1981-90 of sex ratio of harvested bears by age class for bears >5. [Fraser2.wk1, Fraser.pic].

Figure 8. Comparison between 1971-80 and 1981-90 of sex ratio of harvested bears by age class for bears <=5. [Fraser.wk1, Fraser.pic].

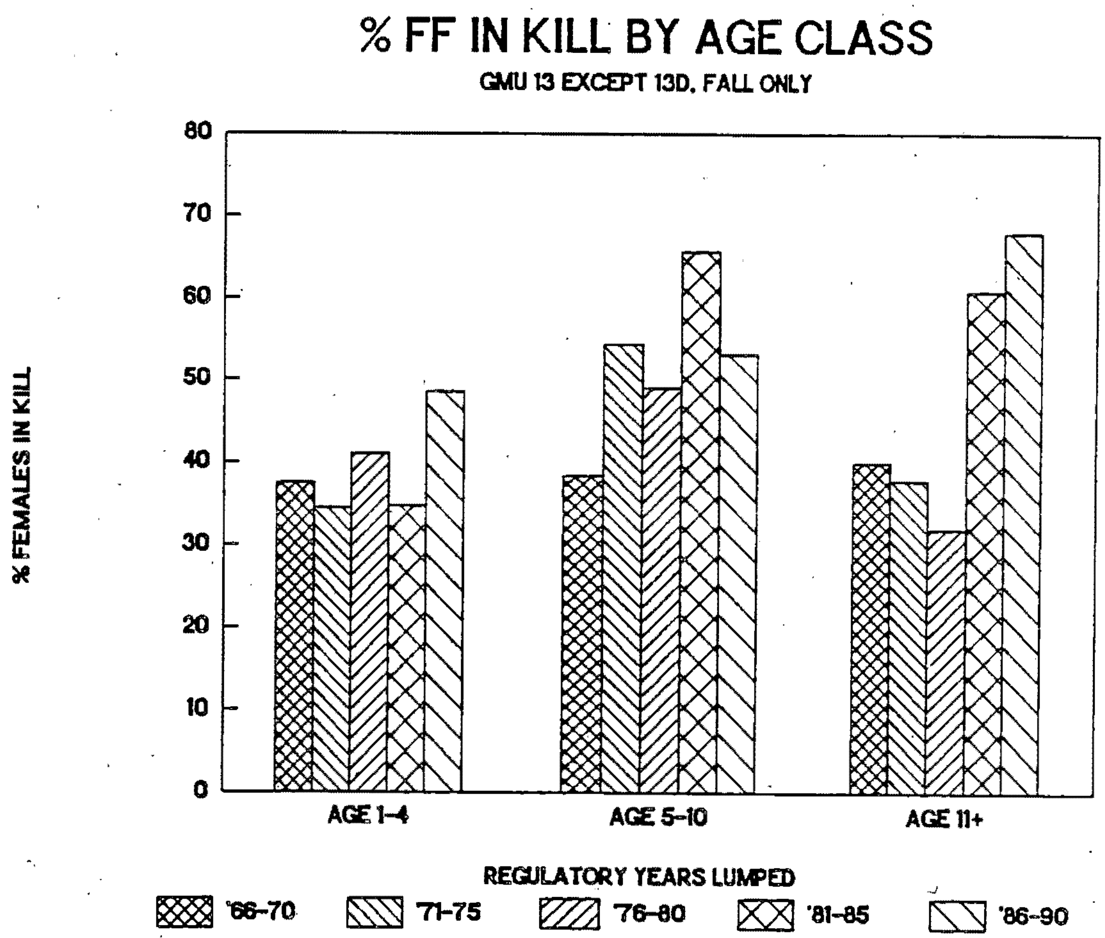

Figure 9. Trend in percent females in harvest of subadult, young adult, and old adult brown bears. [Sex_age.wk1, %fftwo.pic].

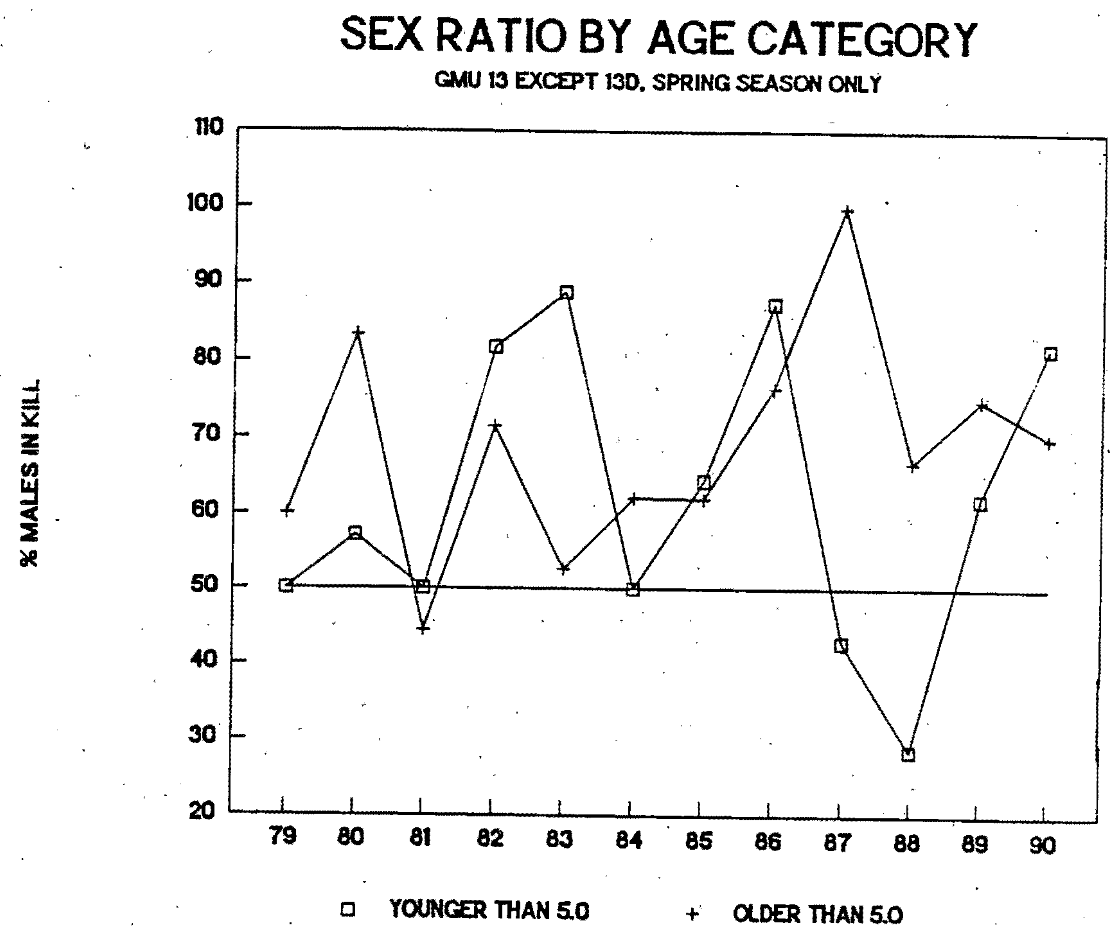

Figure 10. Trends in sex ratio of harvests during spring seasons for subadult and adult bears. [Spring.wk1, spring.pic].

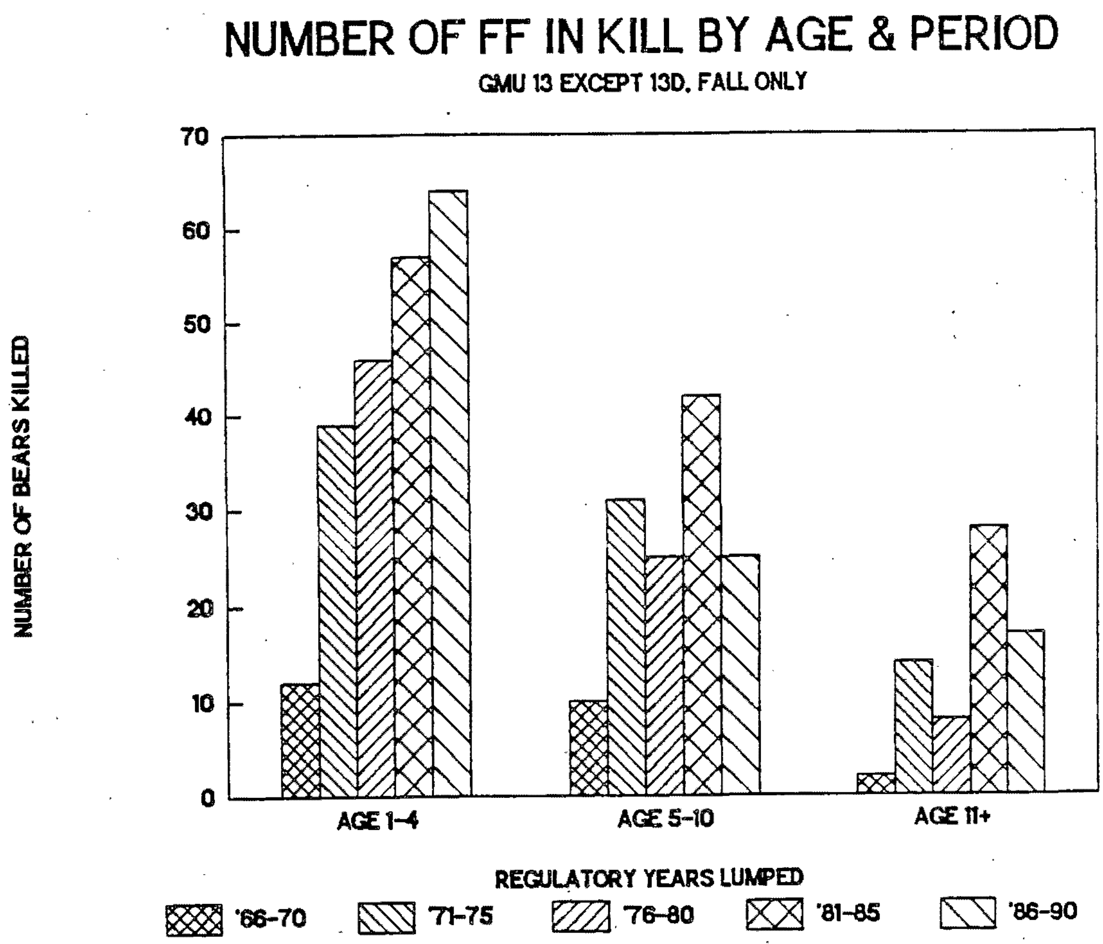

Figure 11. Trends in number of female brown bears harvested in fall seasons by age class and period. [Sex_age.wk1, females.pic].

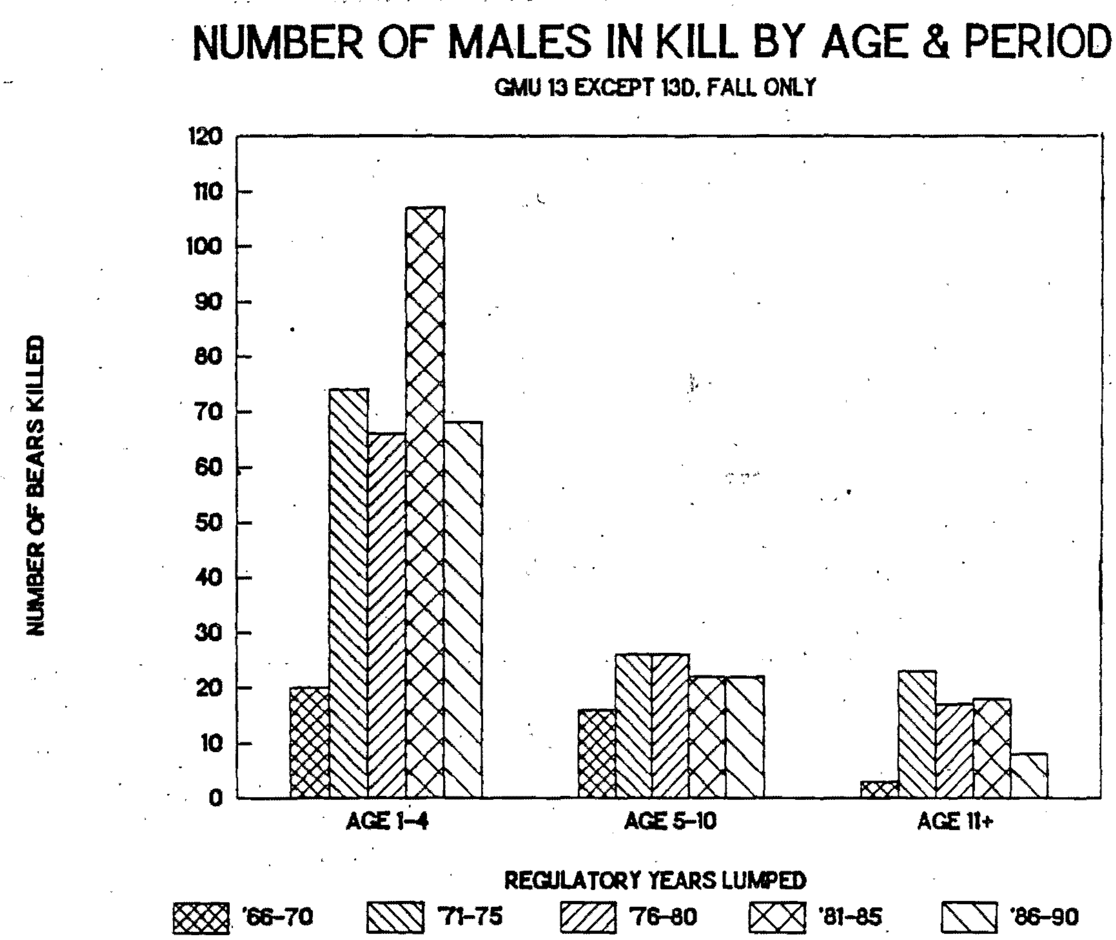

Figure 12. Trends in number of male brown bears harvested in fall seasons by age class. [Sex_age.wk1, males.pic].

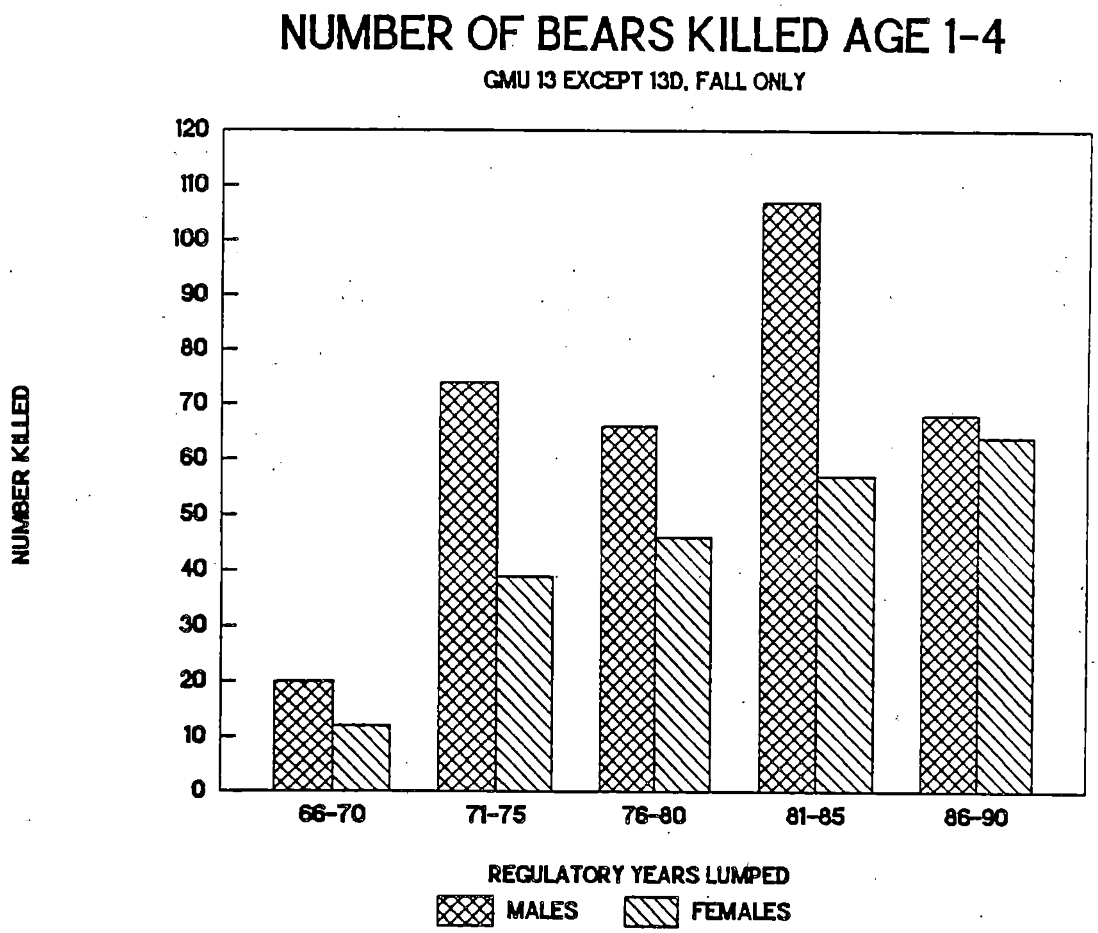

Figure 13. Trends in number of subadult bears killed by sex class. [Sex_age.wk1, 1to4.pic].

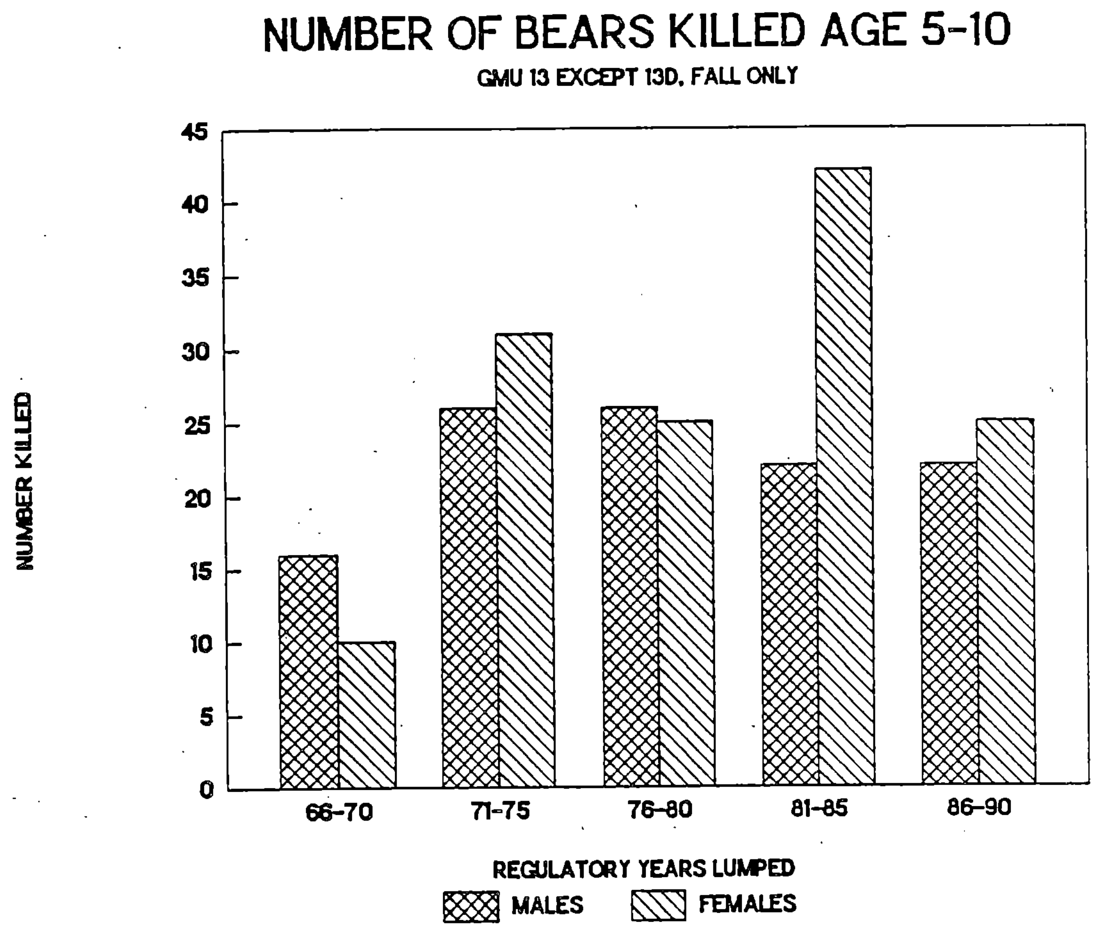

Figure 14. Trends in number of young adult bears killed by sex class. [Sex_age.wk1, 5to10.pic].

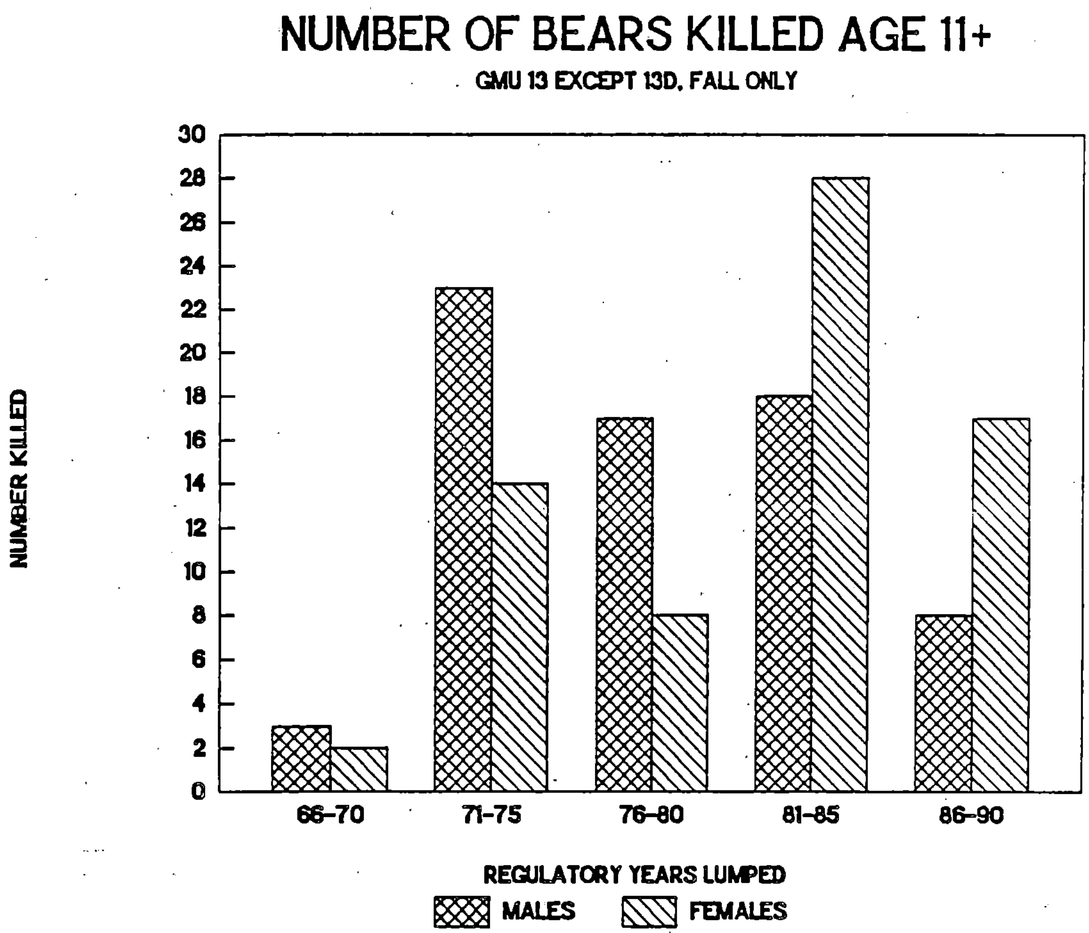

Figure 15. Trends in number of older adult bears killed by sex class. [Sex_age.wk1, 11plus.pic].

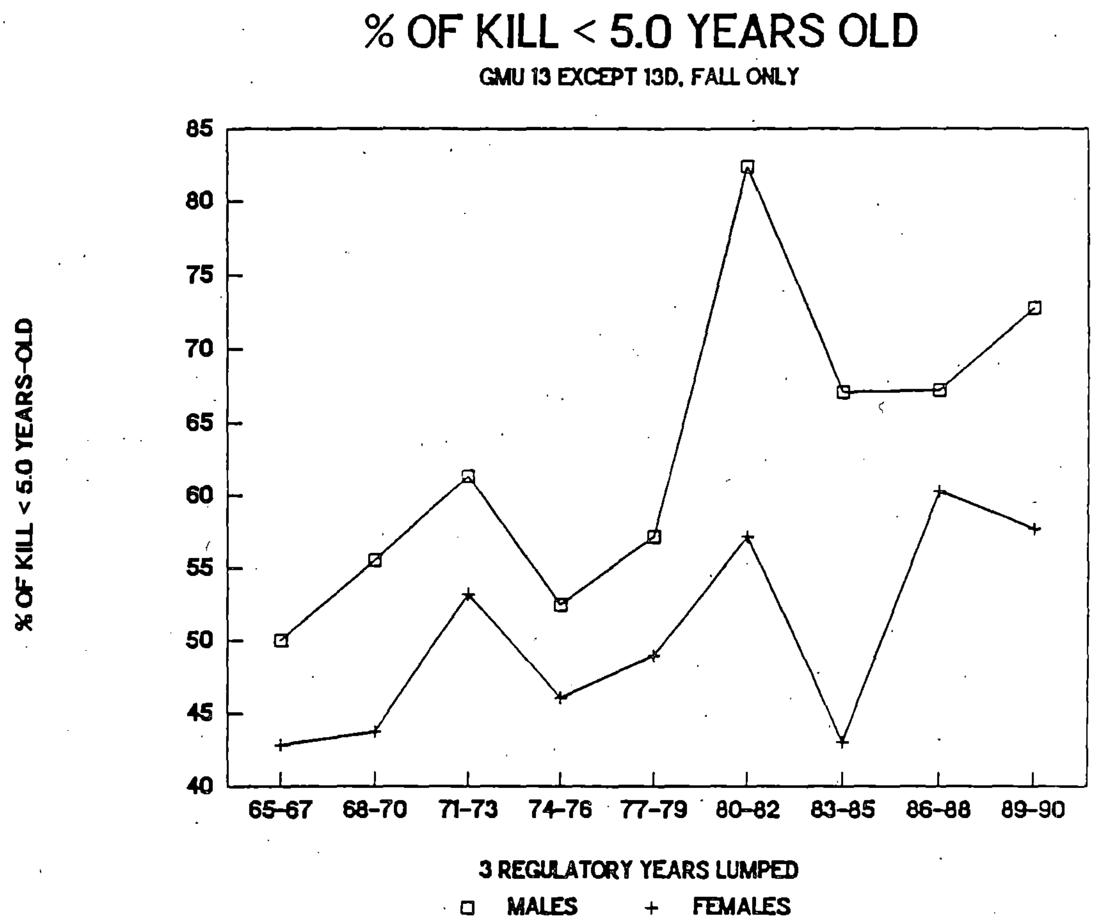

Figure 16. Trends in proportion of fall harvests of GMU 13 brown bears that are <5.0 years-old. [%young.wk1, %young.pic].

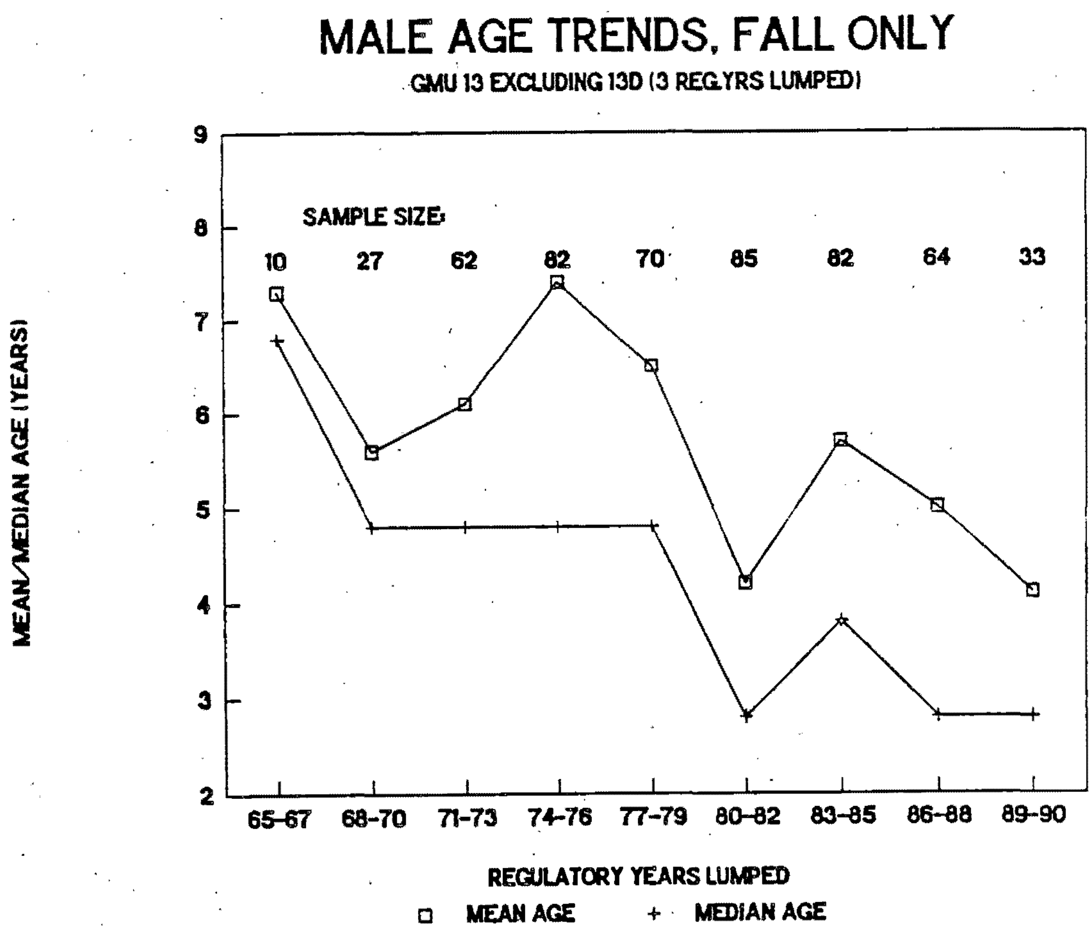

Figure 17. Trends in mean and median age of male brown bears taken in fall seasons in GMU 13. [Age.wk1, Mlump.pic].

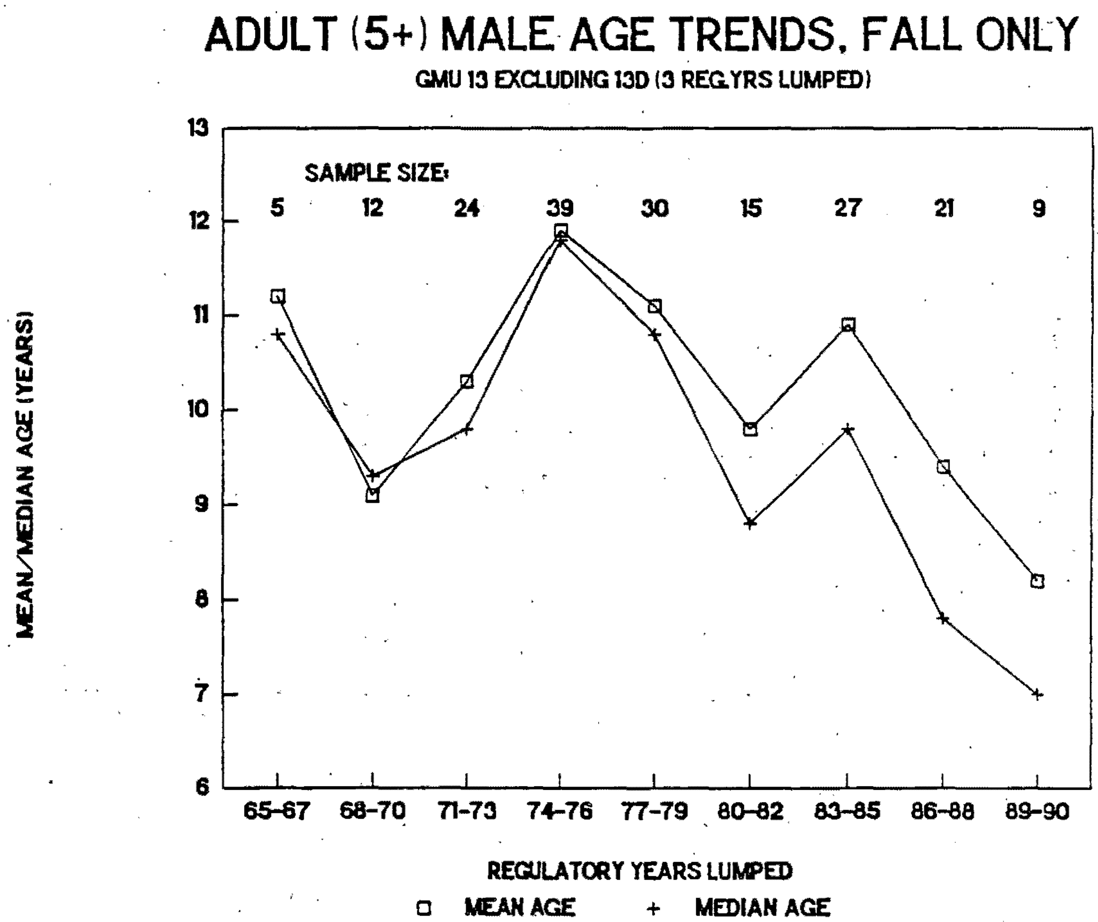

Figure 18. Trends in mean and median age of male brown bears older than 5.0 taken in fall seasons in GMU 13. [Age.wk1, Mlump5pl.pic].

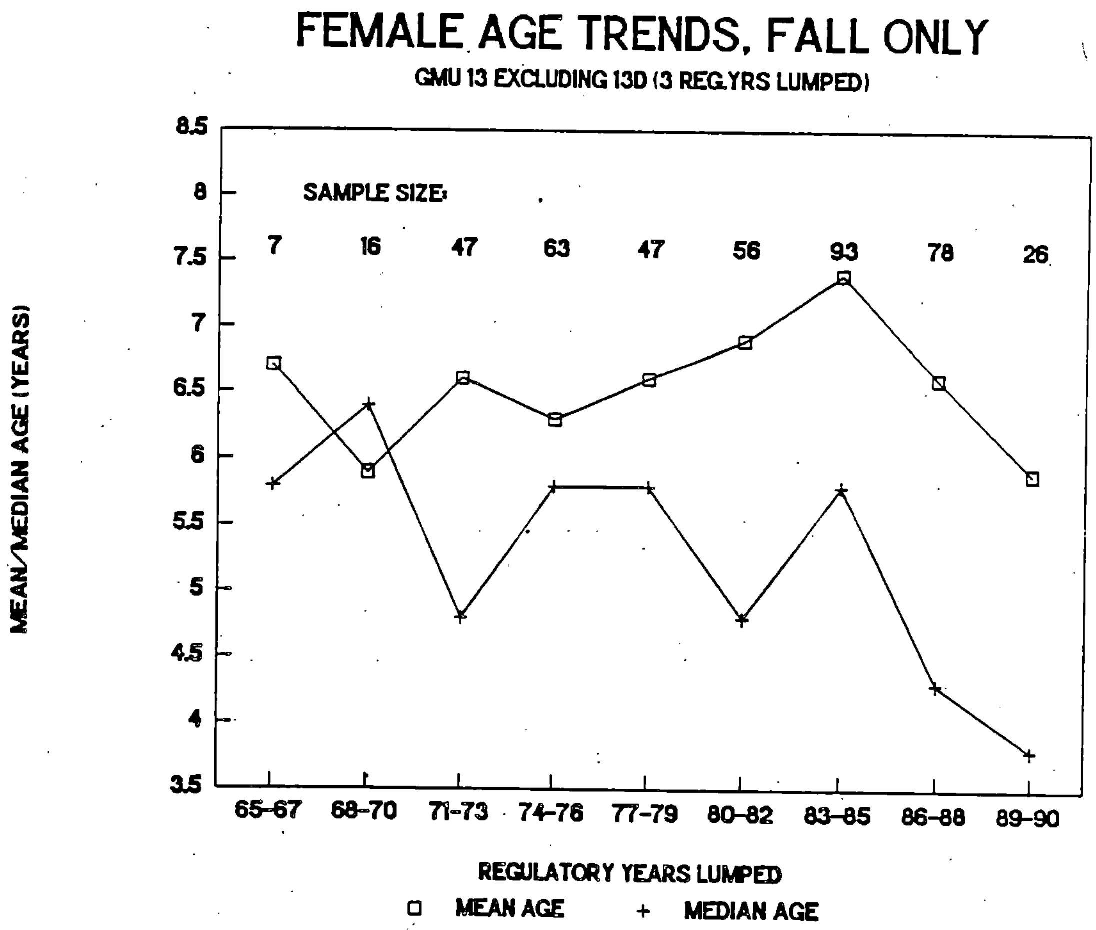

Figure 19. Trends in mean and median age of female brown bears taken in fall seasons in GMU 13. [Age.wk1, Flump.pic].

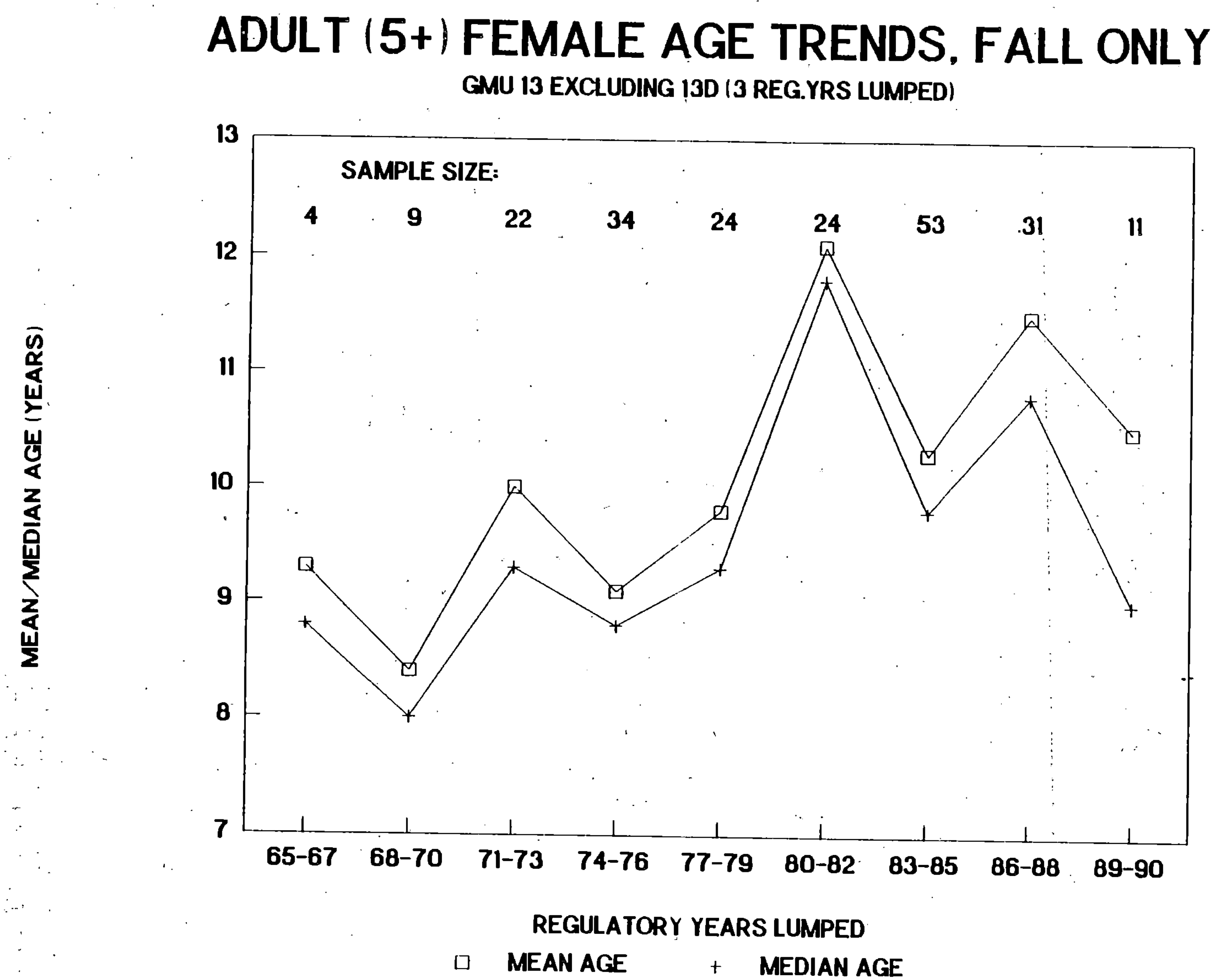

Figure 20. Trends in mean and median age of female brown bears older than 5.0 taken in fall seasons in GMU 13. [Age.wk1, Flump5pl.pic].

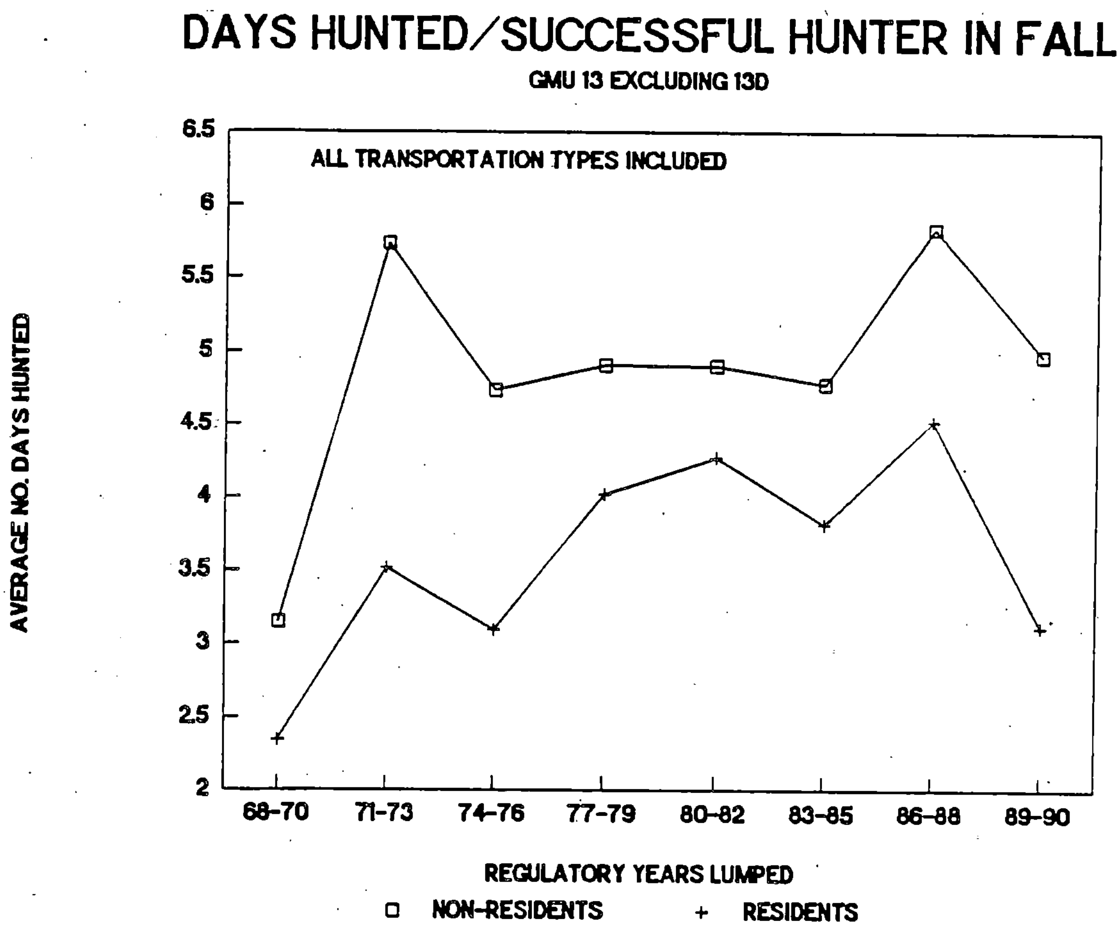

Figure 21. Trends in number of days hunted per successful resident and non-resident brown bear hunter during fall seasons in GMU 13. [Effort.wk1, effort.pic].

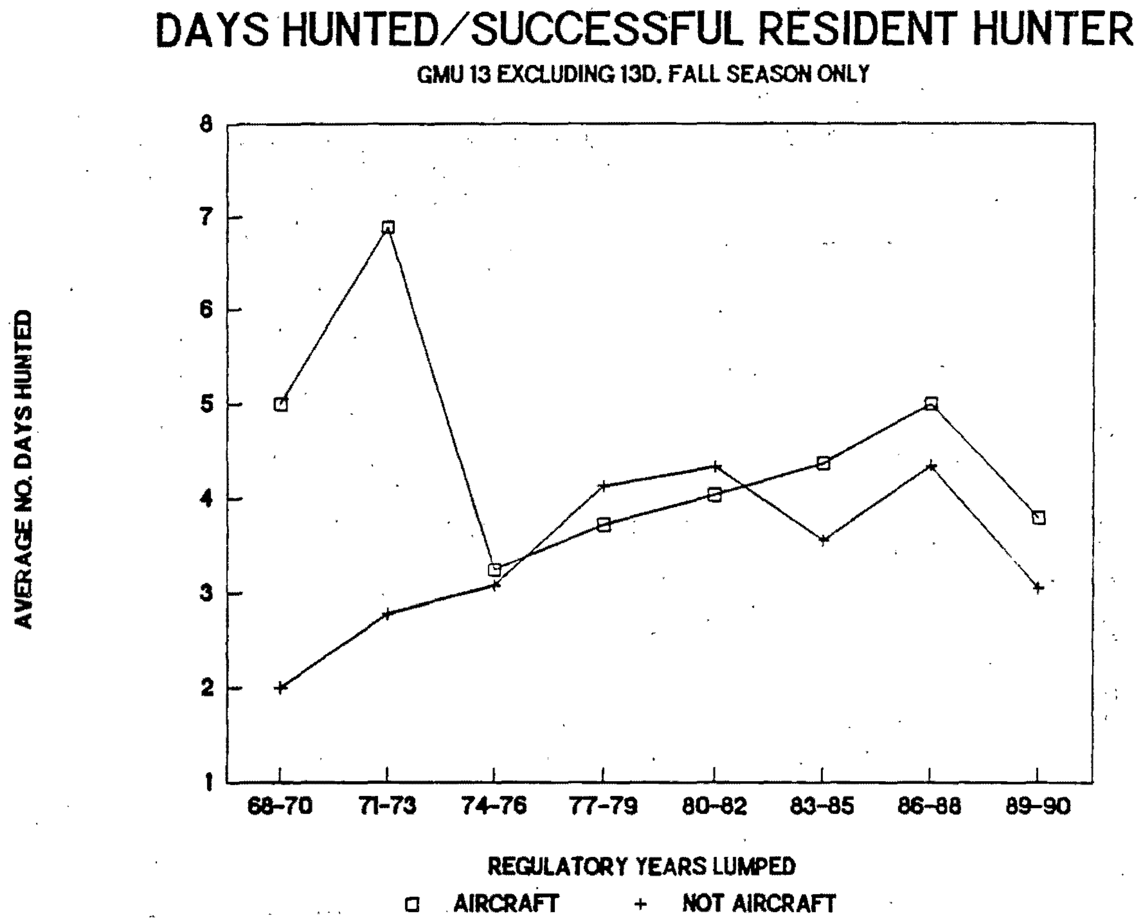

Figure 22. Trends in number of days hunted per successful resident and non-resident brown bear hunter during fall seasons in GMU 13. [Effort.wk1, effort.pic].

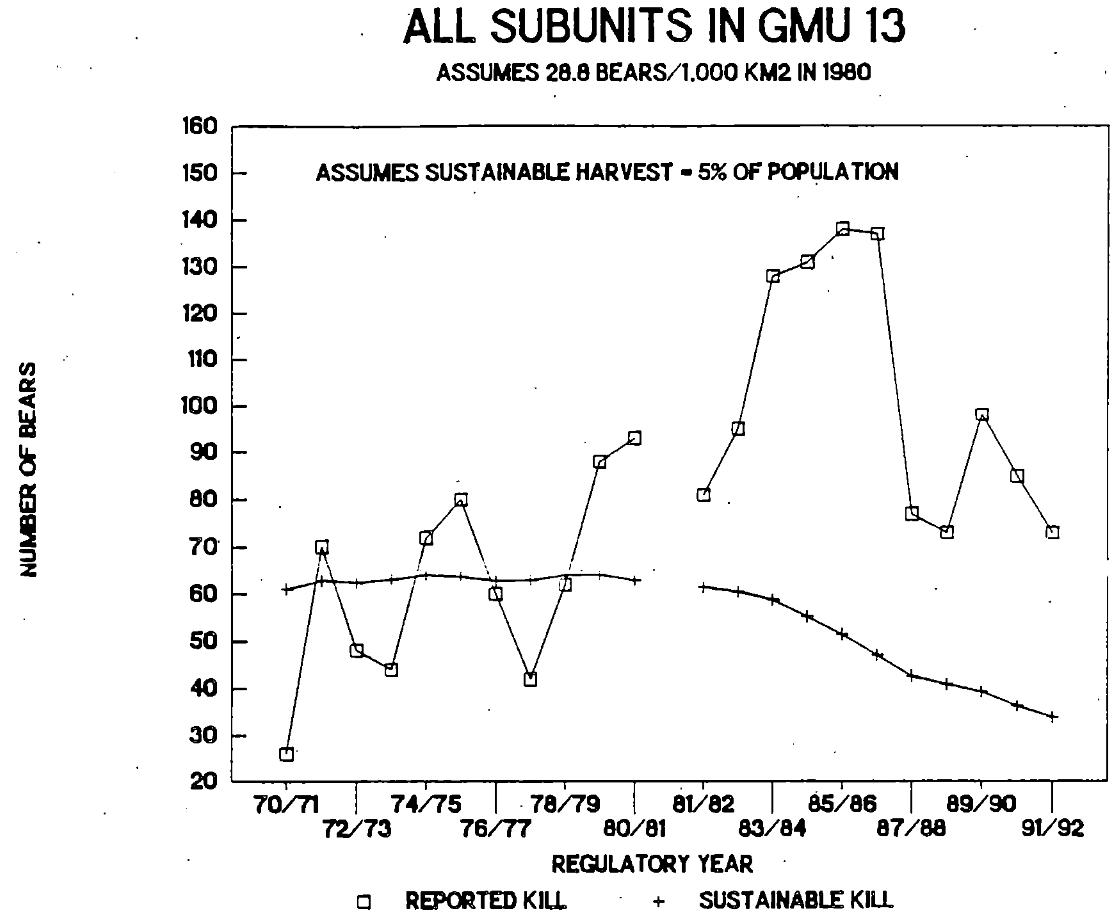

Figure 23. Comparison of harvests with calculated sustainable harvests in GMU 13 based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13all.pic].

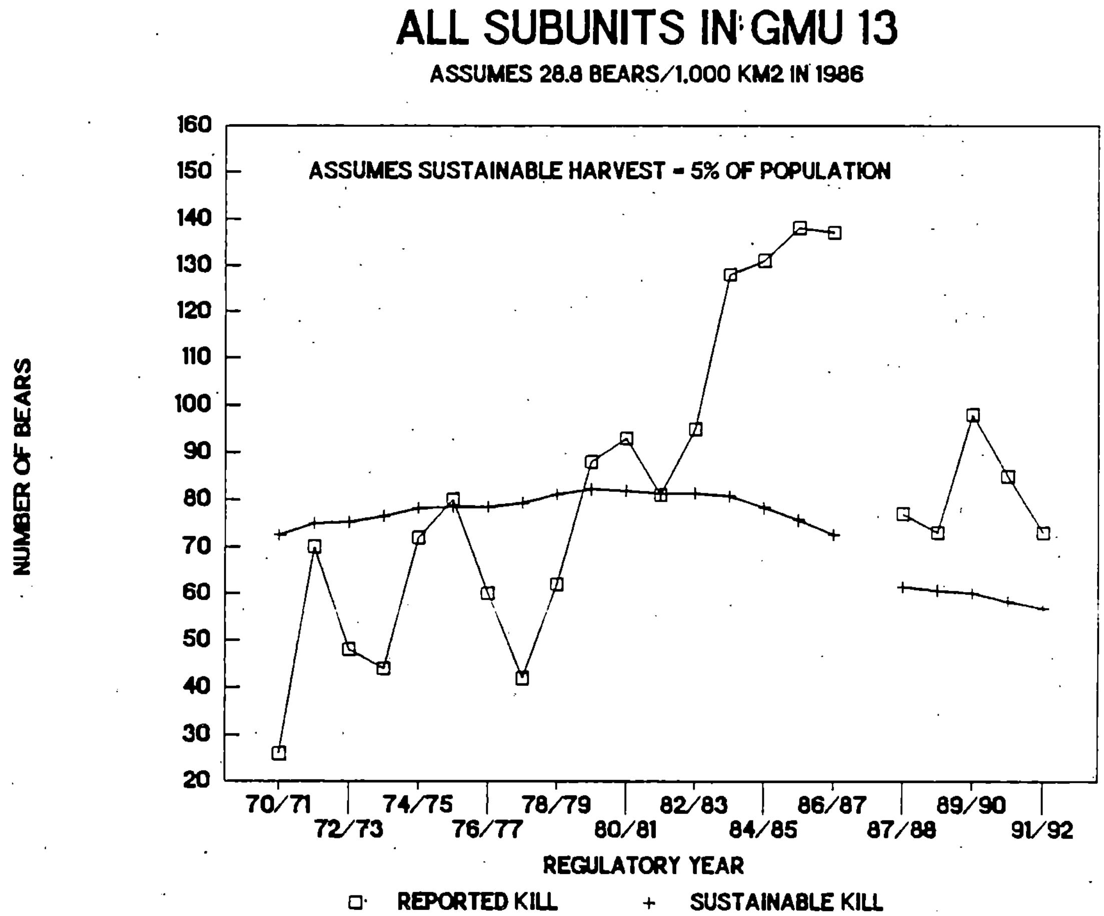

Figure 24. Comparison of harvests with calculated sustainable harvests in GMU 13 based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, su13al2.pic].

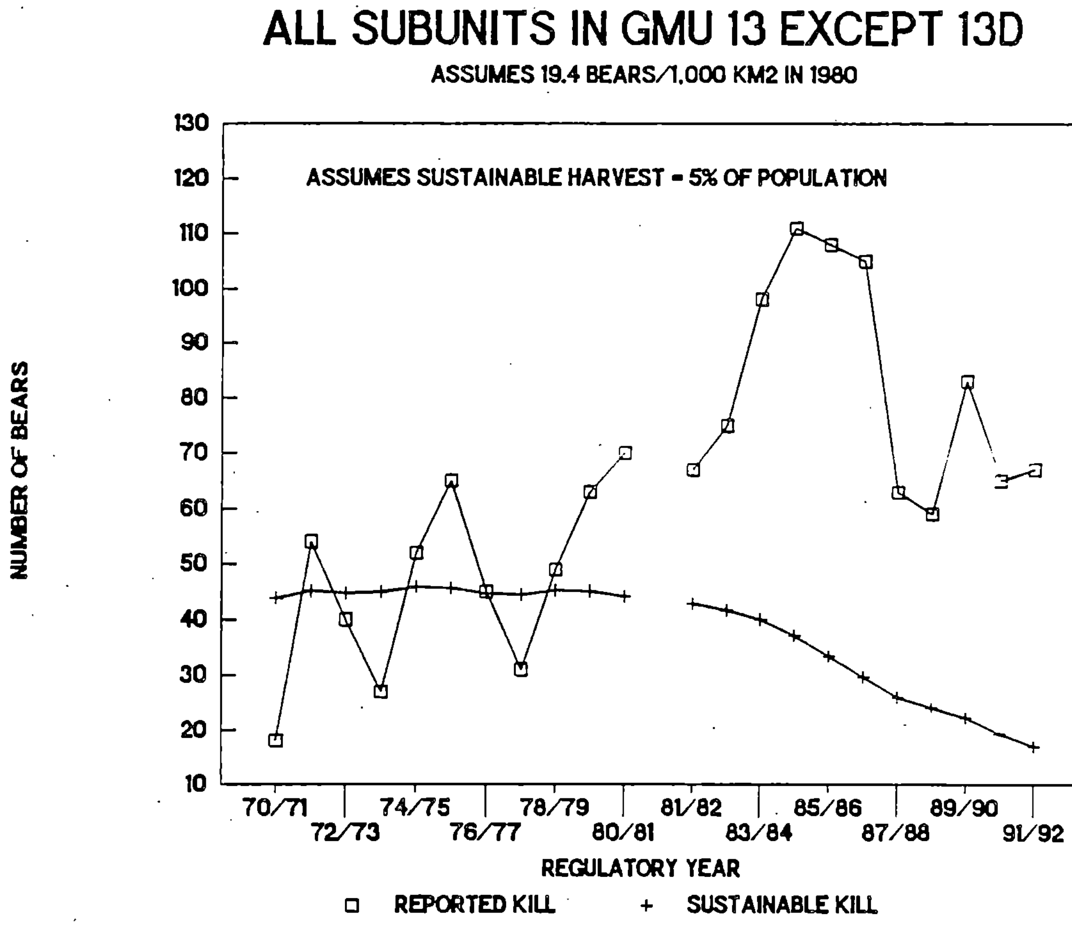

Figure 25. Comparison of harvests with calculated sustainable harvests in GMU 13, excluding Subunit 13D, based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13xd.pic].

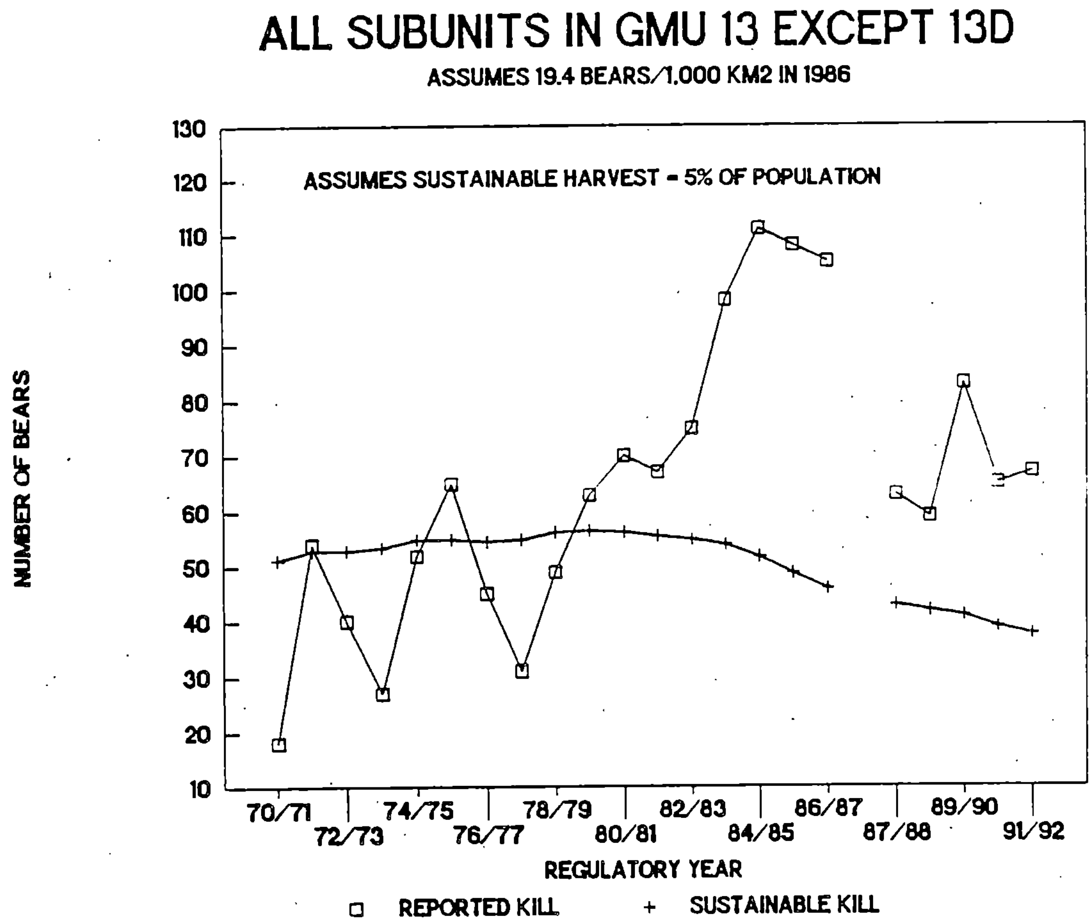

Figure 26. Comparison of harvests with calculated sustainable harvests in GMU 13, excluding Subunit 13D, based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, sus13xd2.pic].

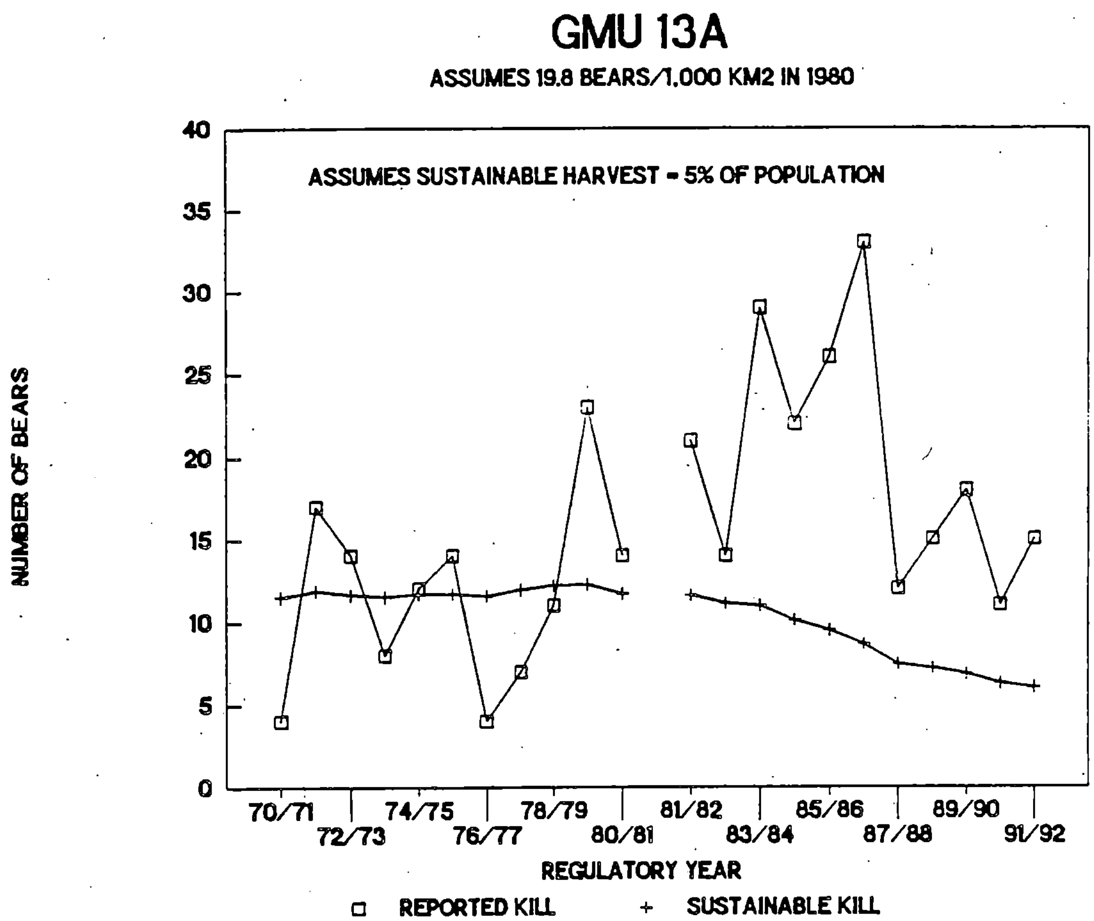

Figure 27. Comparison of harvests with calculated sustainable harvests in GMU 13A based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13a.pic].

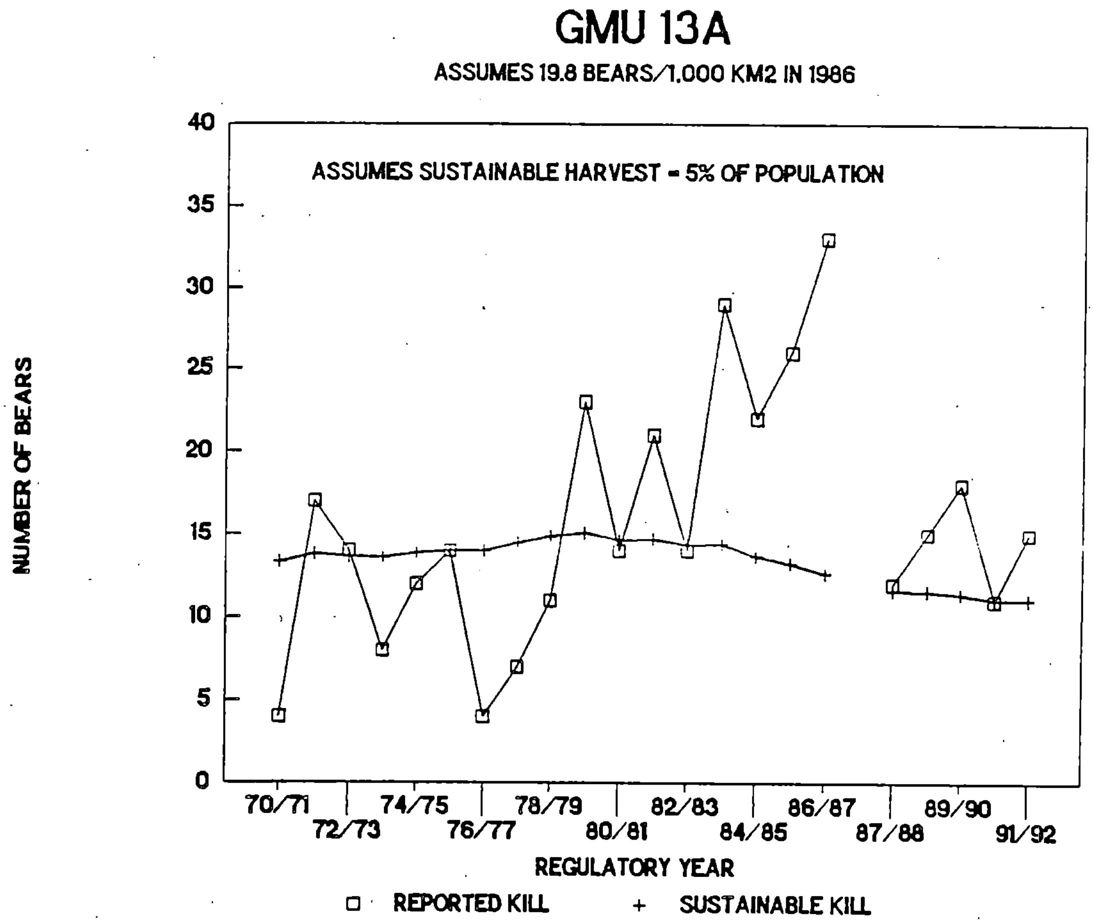

Figure 28. Comparison of harvests with calculated sustainable harvests in GMU 13A based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, su13a2.pic].

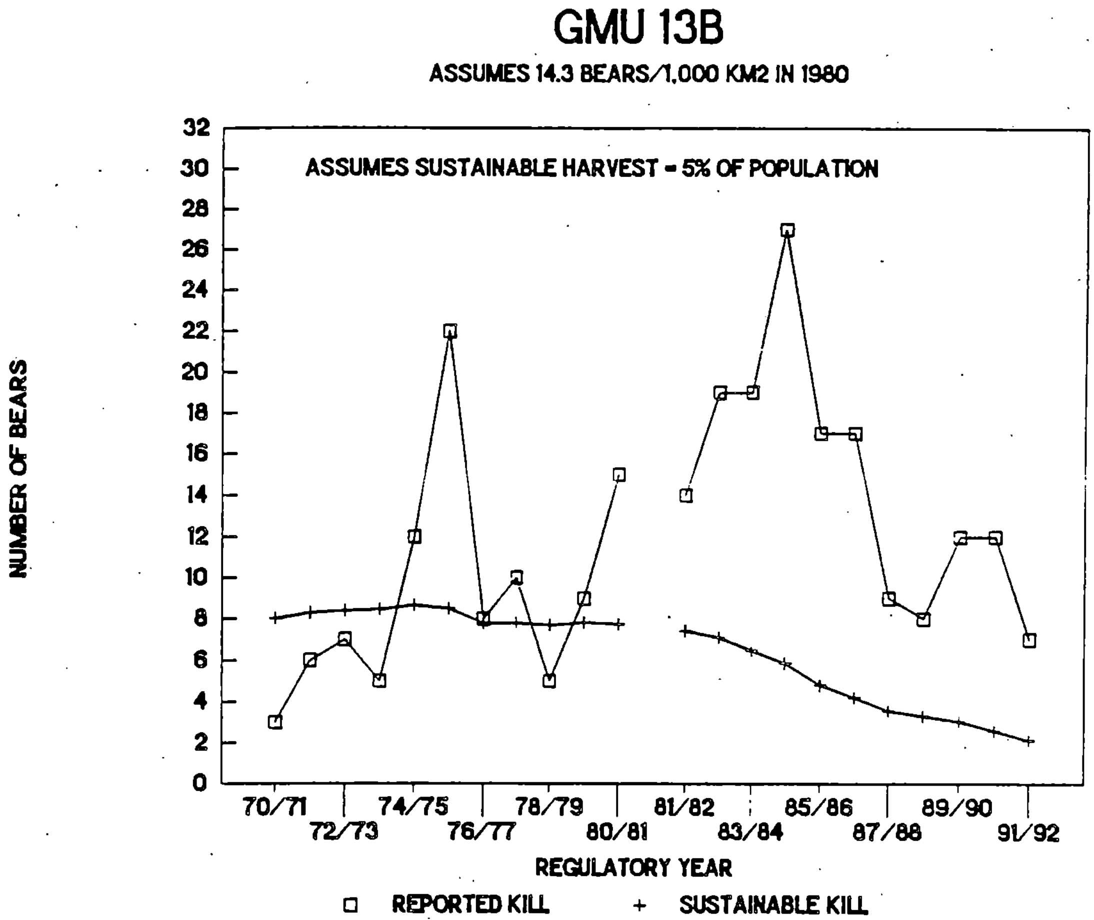

Figure 29. Comparison of harvests with calculated sustainable harvests in GMU 13B based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13b.pic].

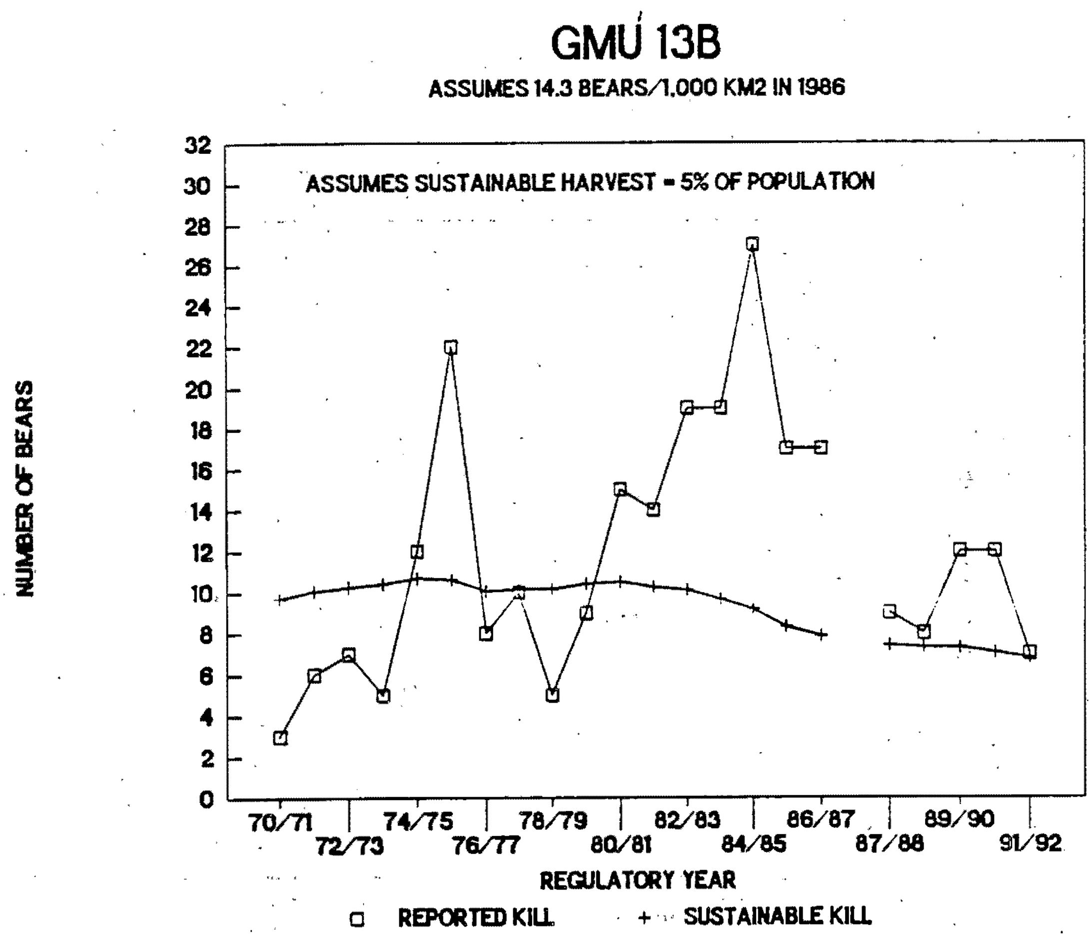

Figure 30. Comparison of harvests with calculated sustainable harvests in GMU 13B based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, su13b2.pic].

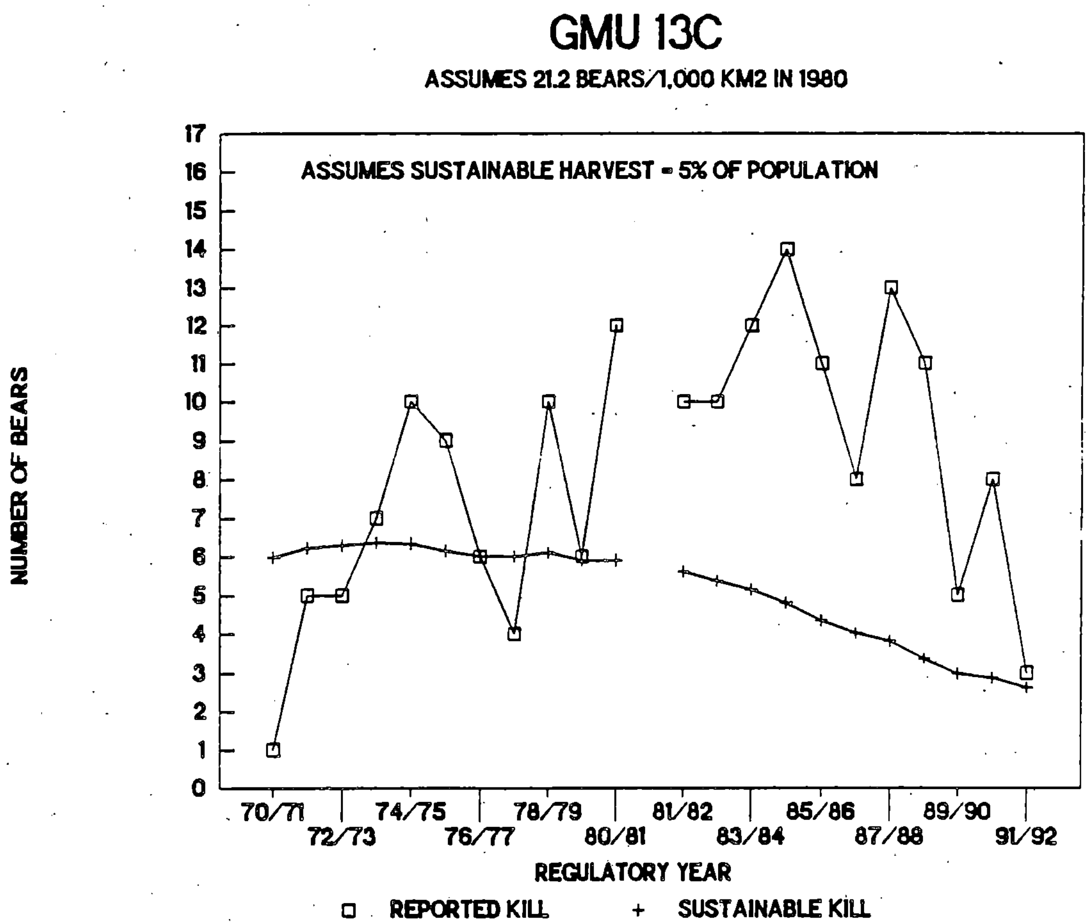

Figure 31. Comparison of harvests with calculated sustainable harvests in GMU 13C based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13c.pic].

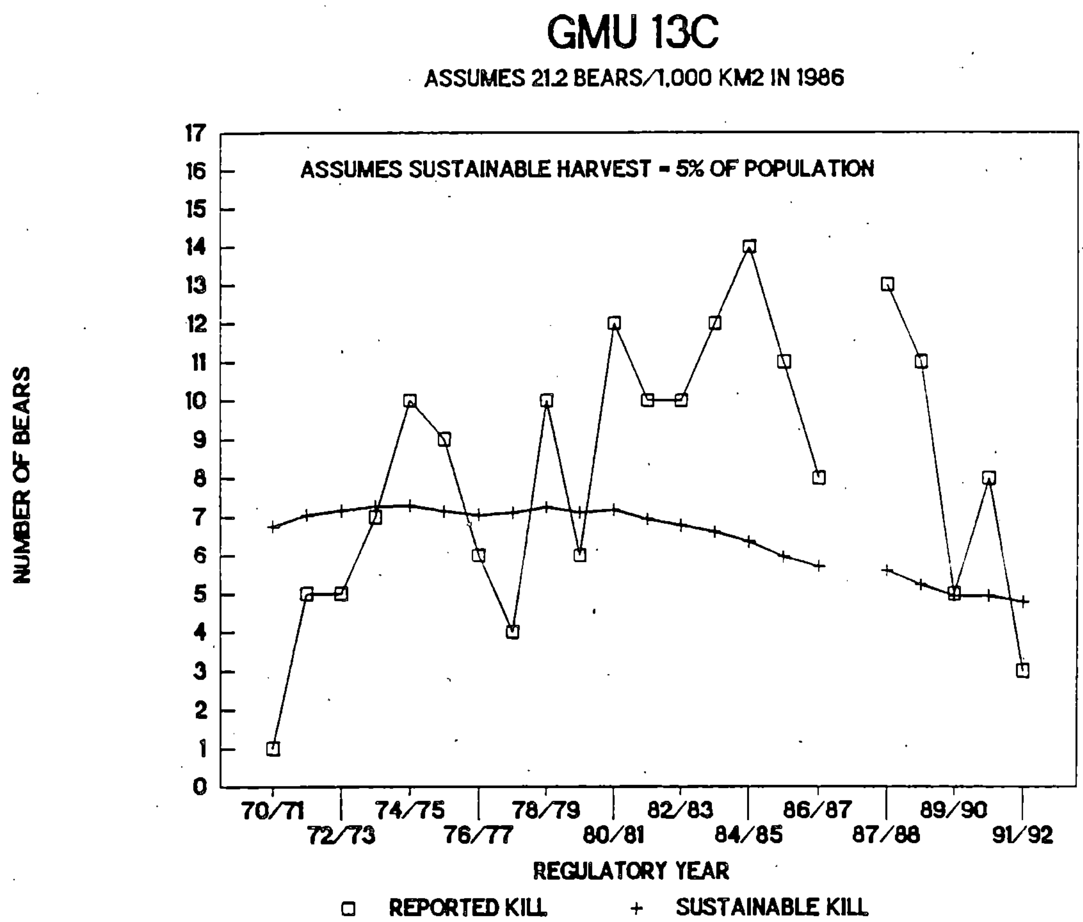

Figure 32. Comparison of harvests with calculated sustainable harvests in GMU 13C based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, su13c2.pic].

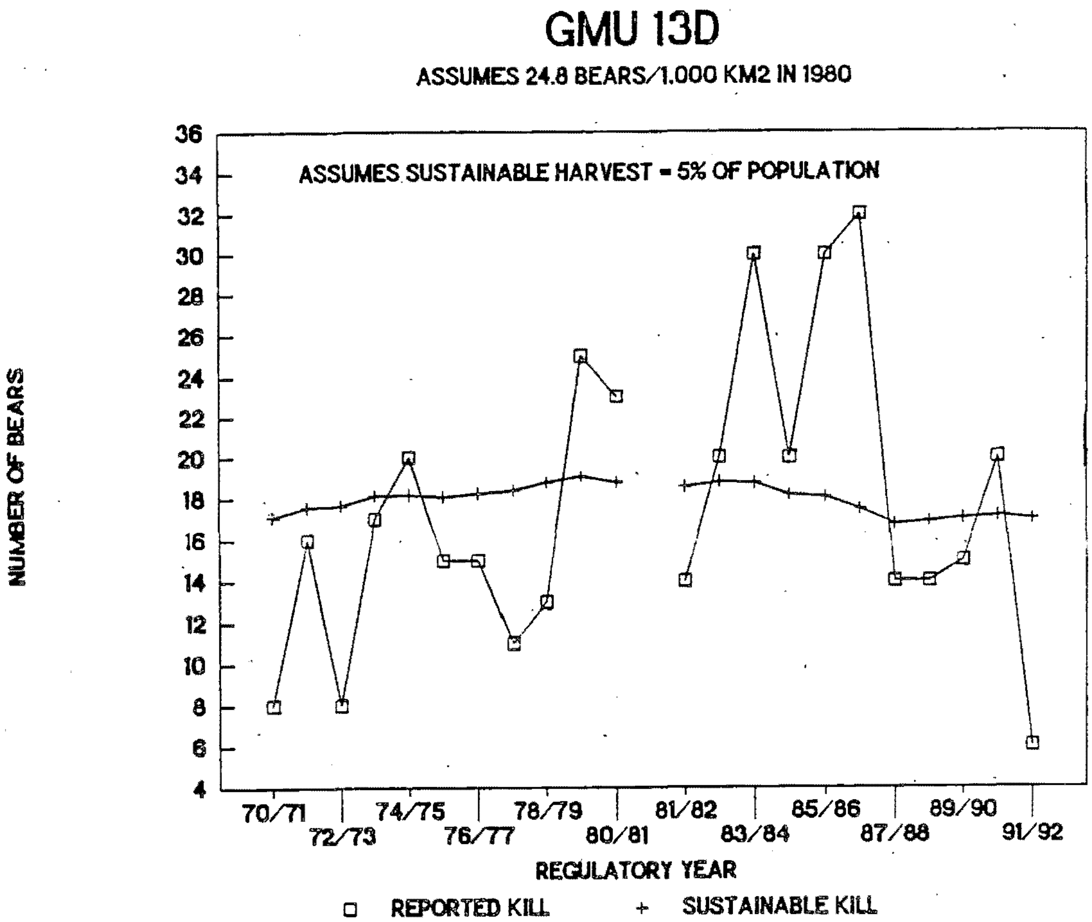

Figure 33. Comparison of harvests with calculated sustainable harvests in GMU 13D based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13d.pic].

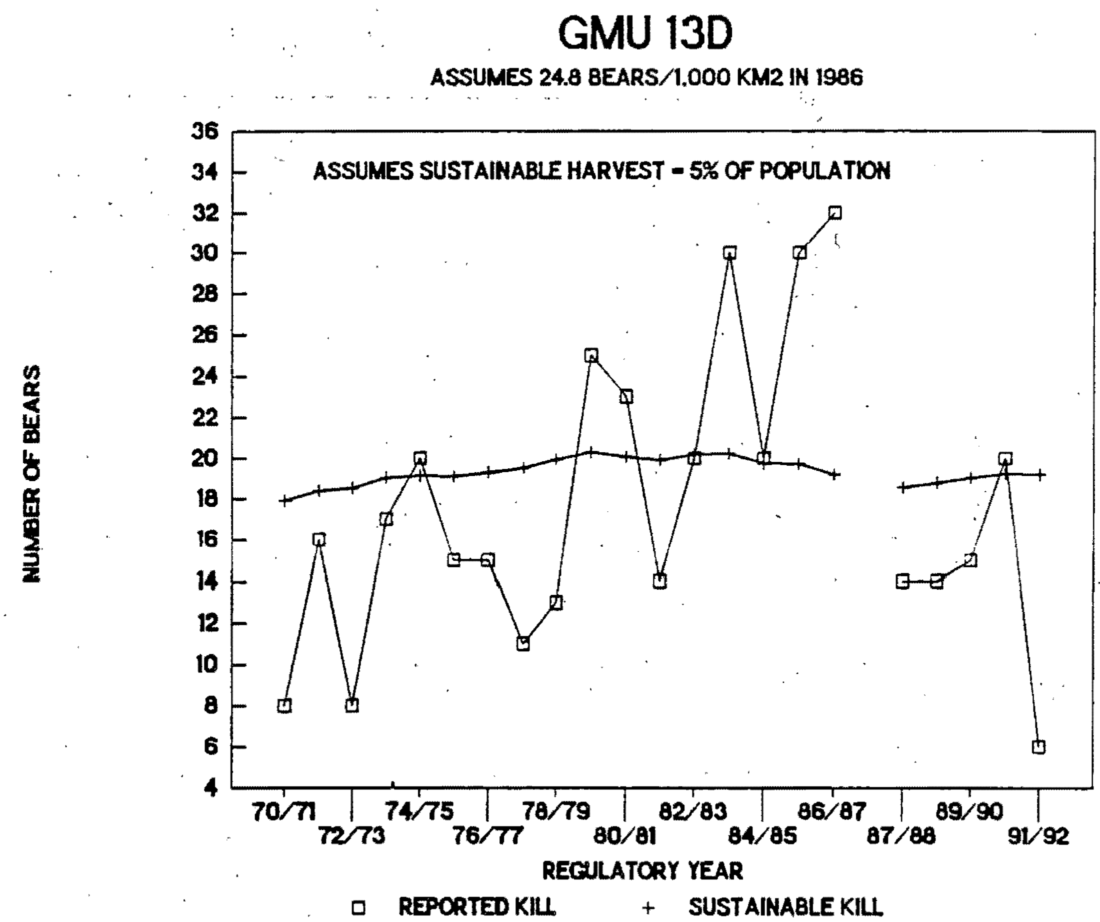

Figure 34. Comparison of harvests with calculated sustainable harvests in GMU 13D based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, su13d2.pic].

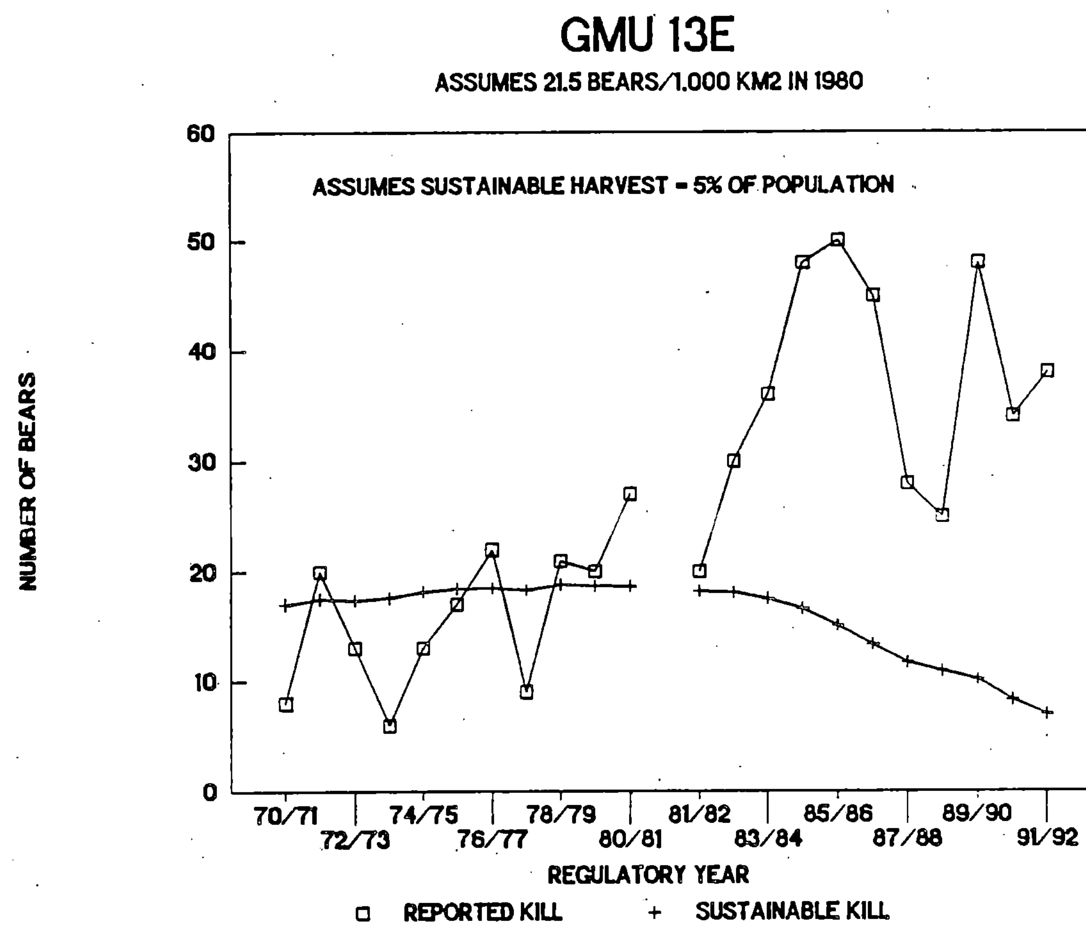

Figure 35. Comparison of harvests with calculated sustainable harvests in GMU 13E based on assumption that estimated density of bears existed in 1980. [d:\GMU13\subunits.wk1, sus13e.pic].

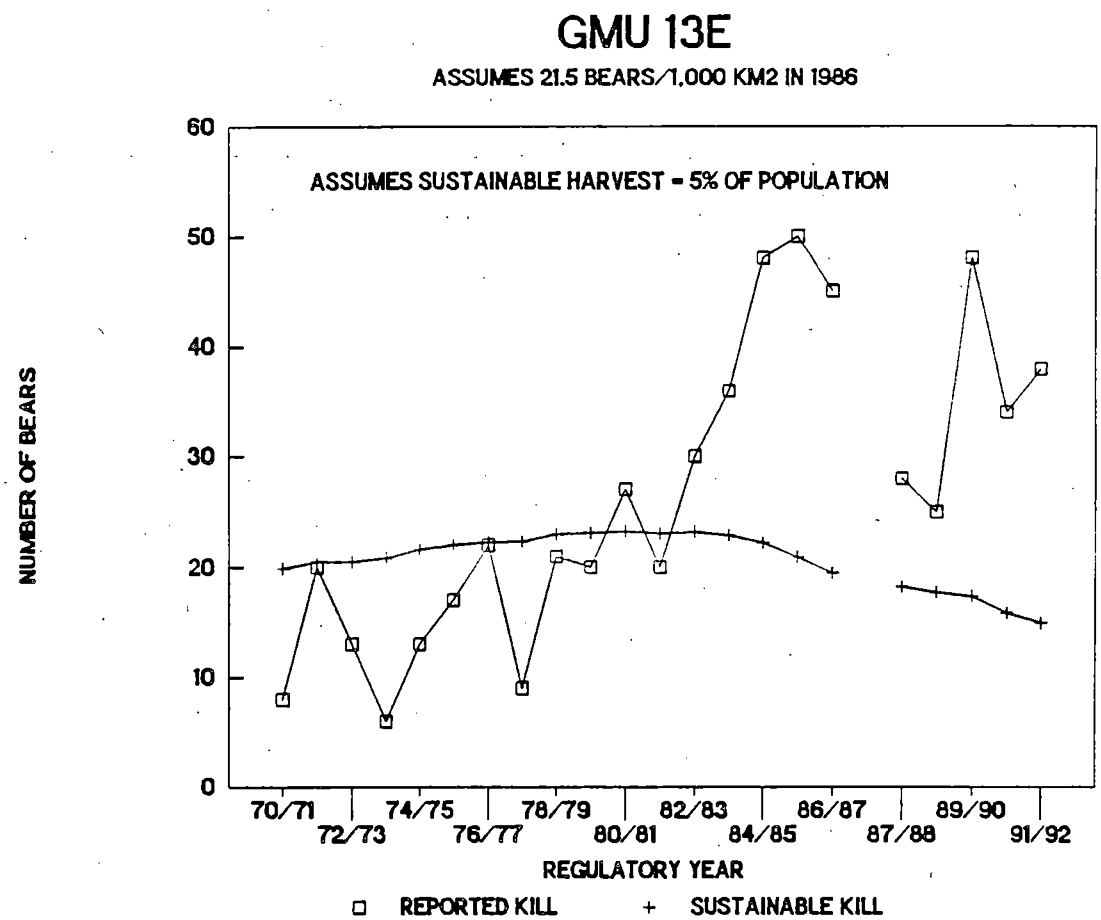

Figure 36. Comparison of harvests with calculated sustainable harvests in GMU 13E based on assumption that estimated density of bears existed in 1986. [d:\GMU13\subunits.wk1, su13e2.pic].

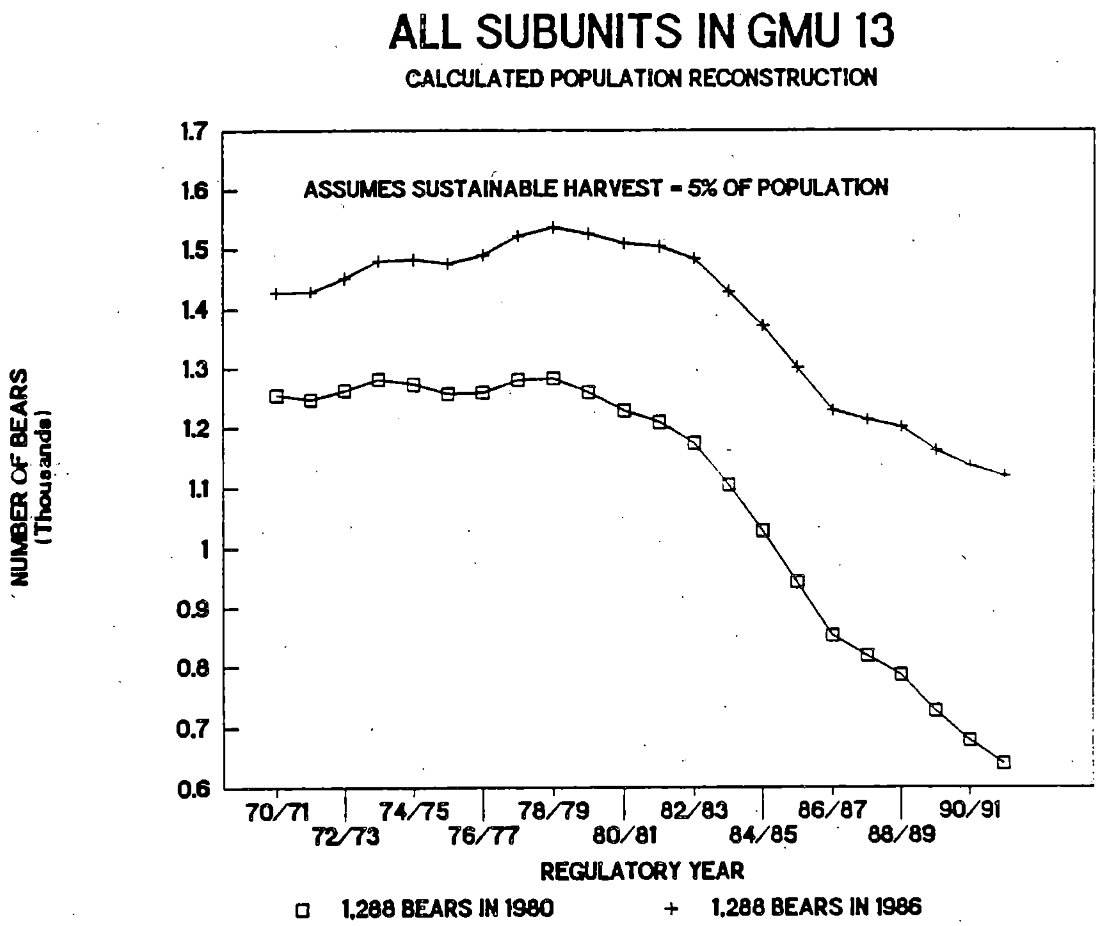

Figure 37. Calculated reconstructed population trends based on reported harvests in GMU 13; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13all.pic].

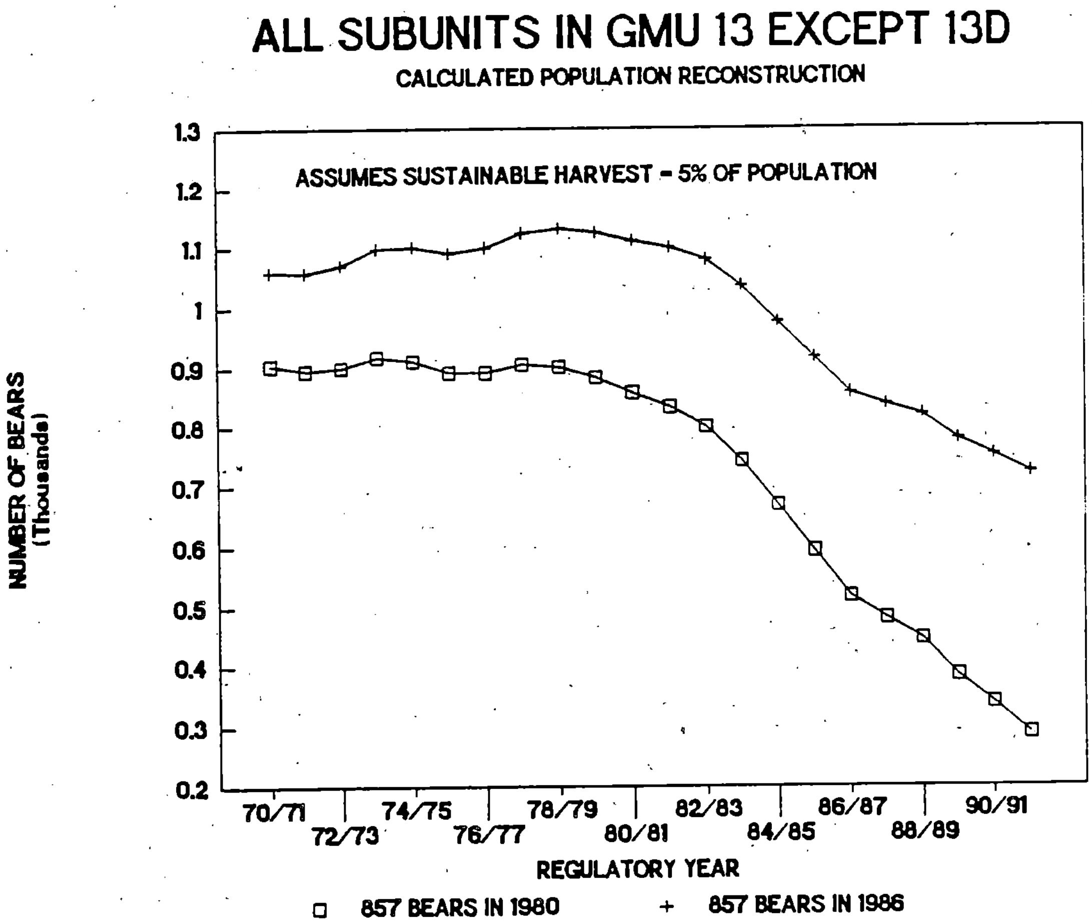

Figure 38. Calculated reconstructed population trends based on reported harvests in GMU 13, excluding Subunit 13D; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13xd.pic].

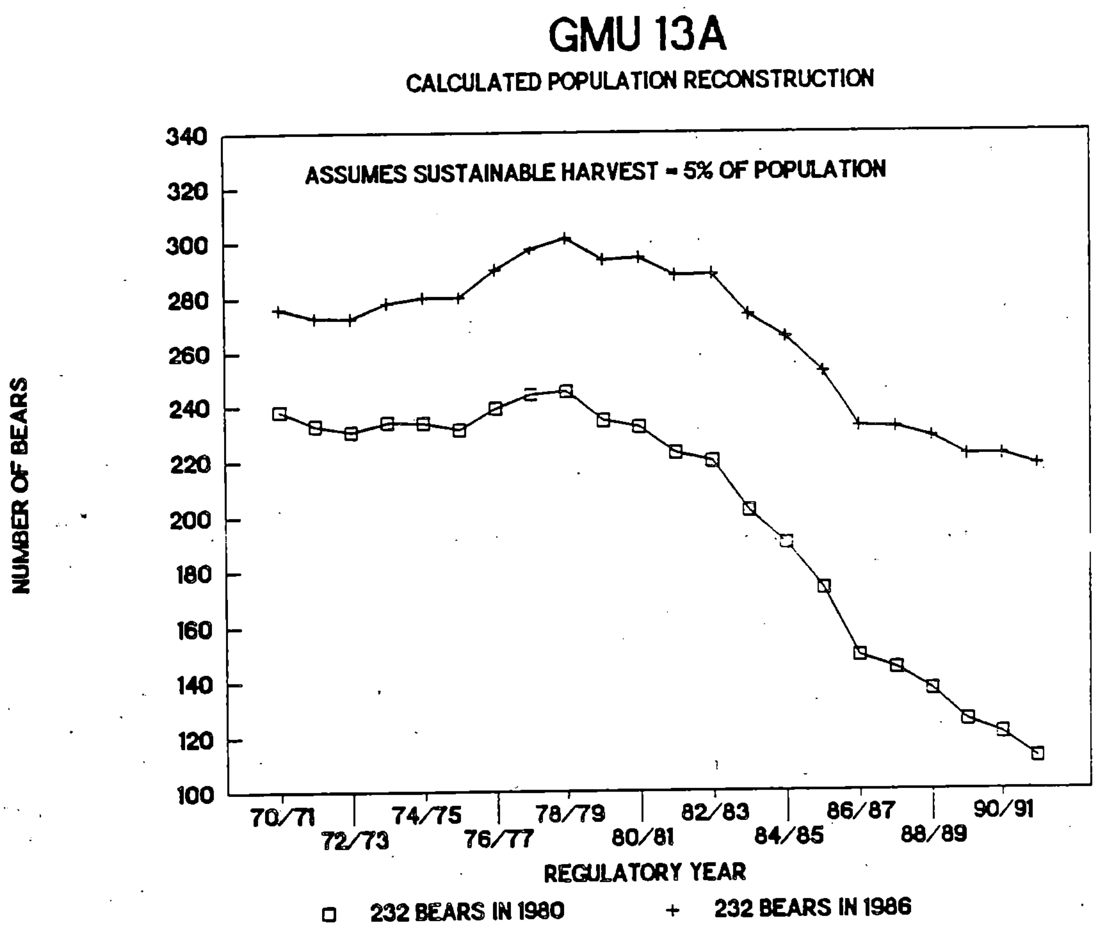

Figure 39. Calculated reconstructed population trends based on reported harvests in Subunit 13A; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13a.pic].

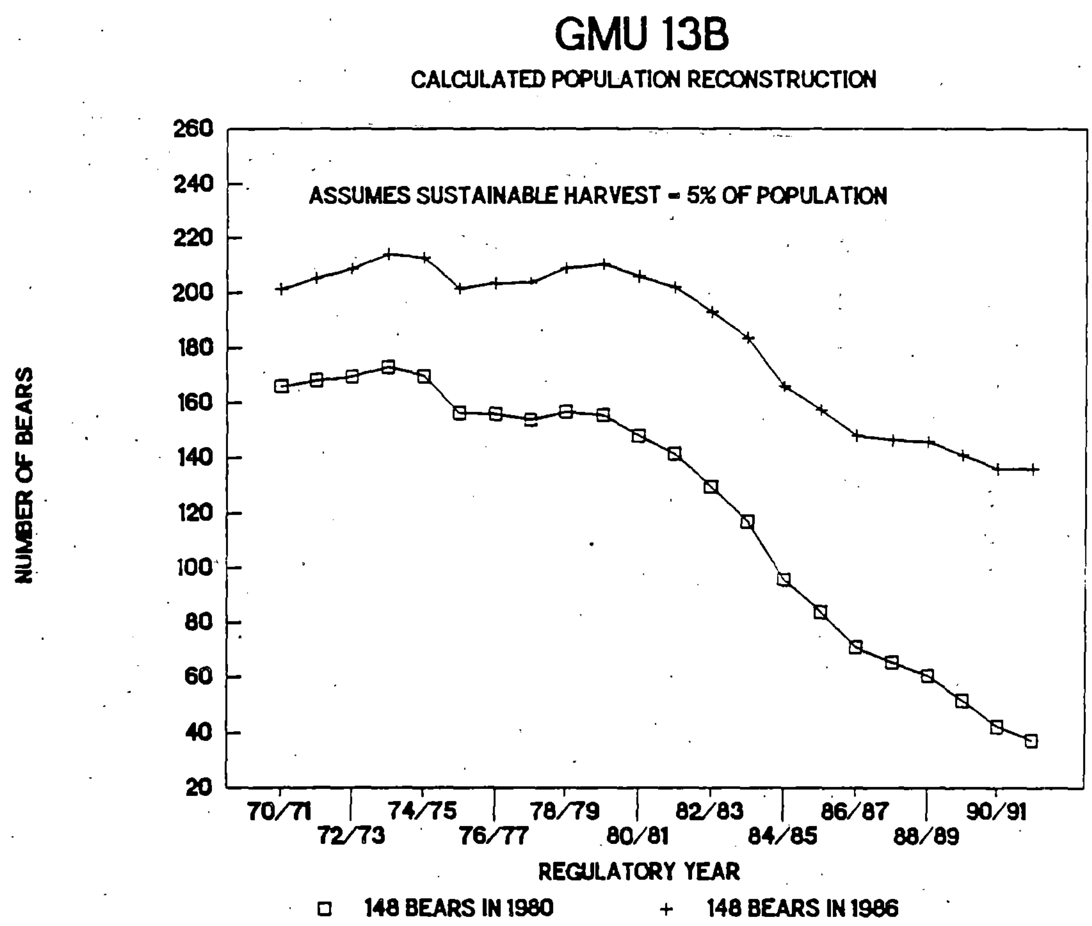

Figure 40. Calculated reconstructed population trends based on reported harvests in Subunit 13B; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13b.pic].

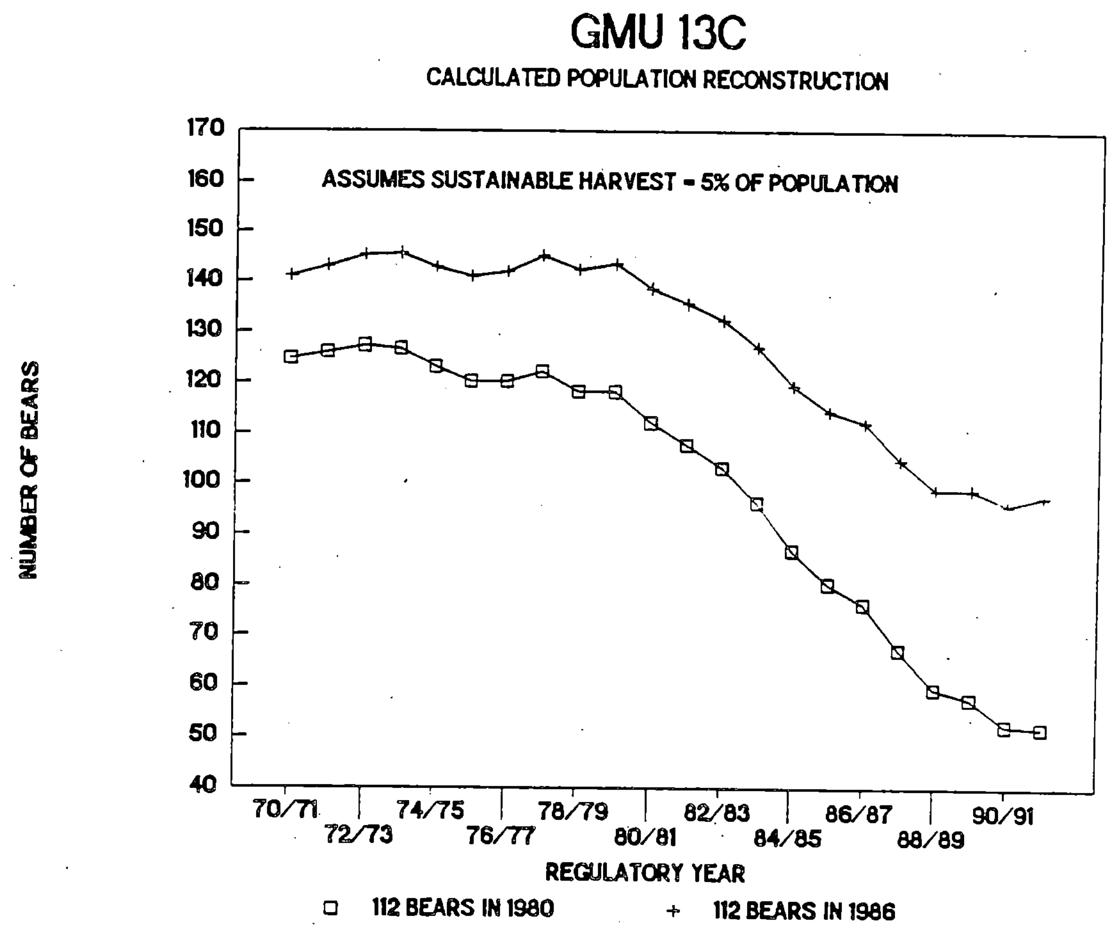

Figure 41. Calculated reconstructed population trends based on reported harvests in Subunit 13C; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13c.pic].

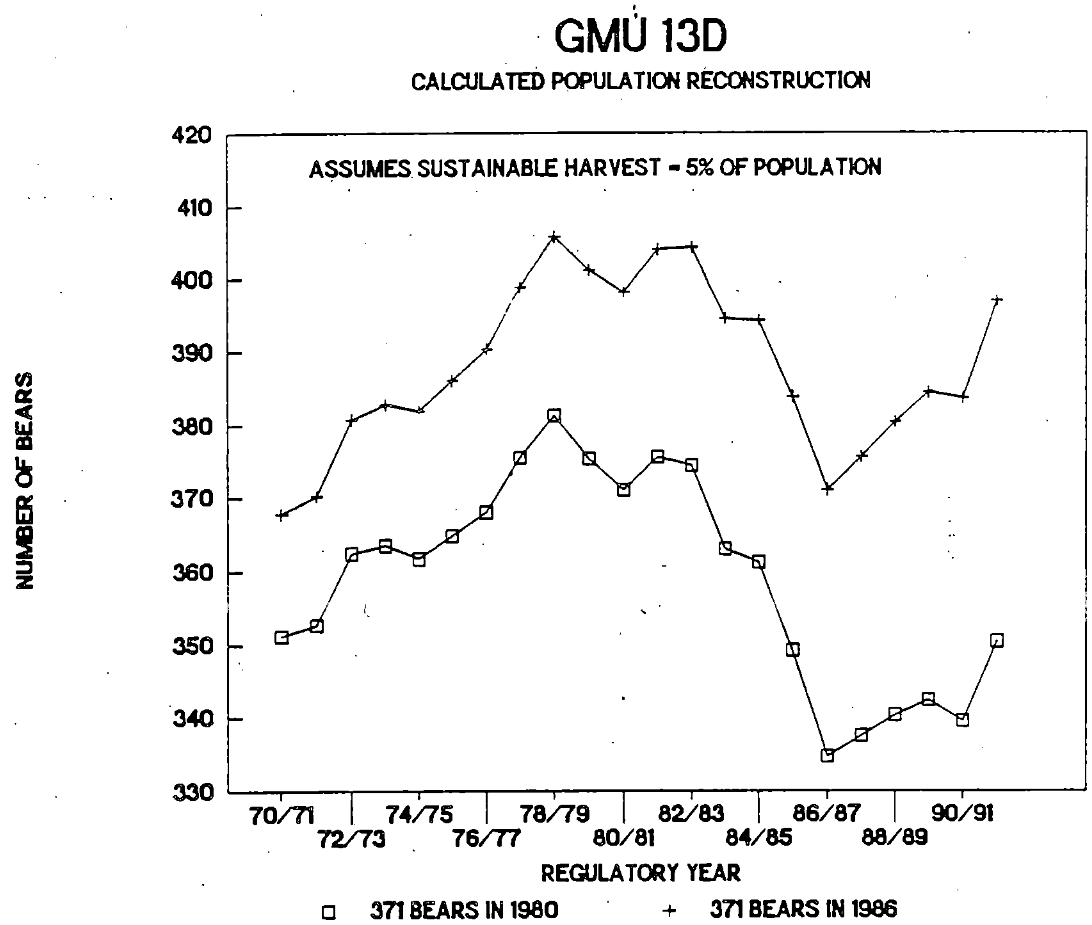

Figure 42. Calculated reconstructed population trends based on reported harvests in Subunit 13D; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13d.pic].

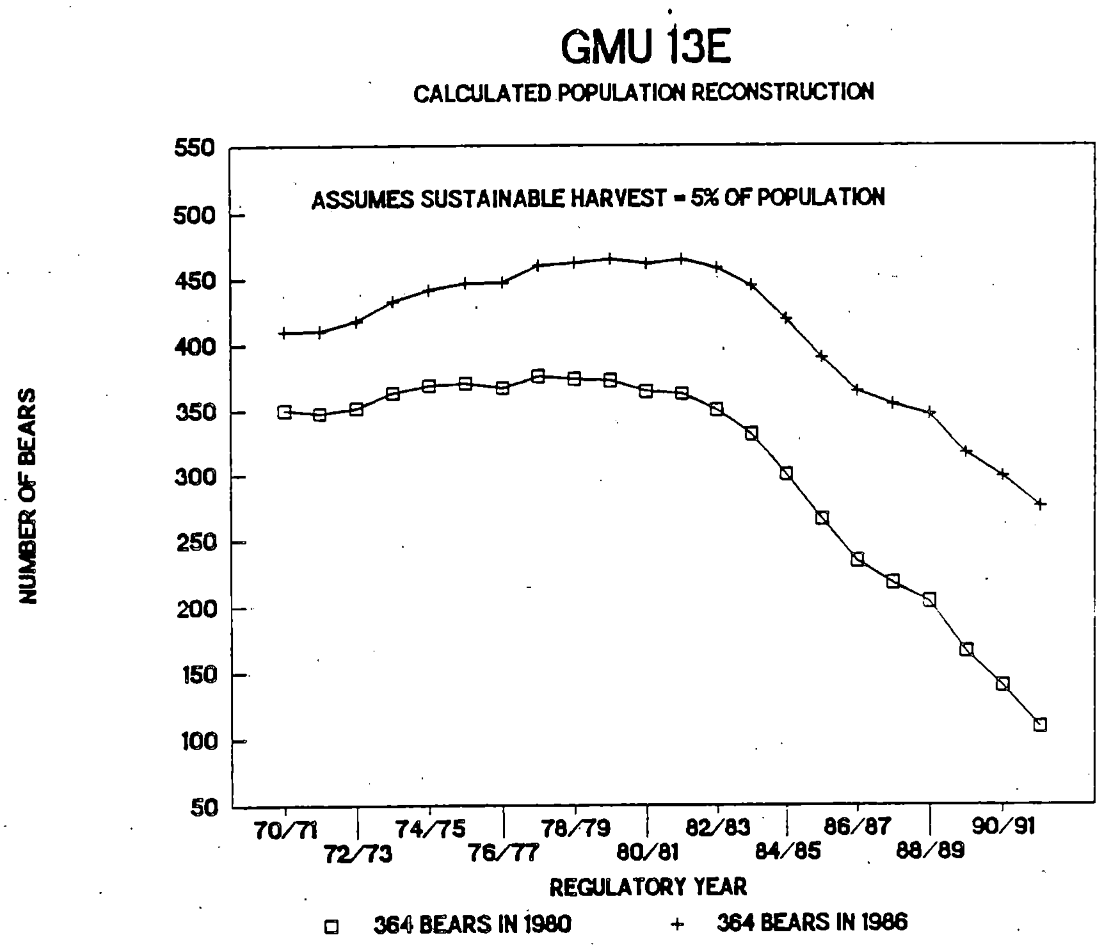

Figure 43. Calculated reconstructed population trends based on reported harvests in Subunit 13E; reconstructions are based on scenarios that the estimated population of bears existed in 1980 and in 1986. [d:\GMU13\popcomp.wk1, pop13e.pic].

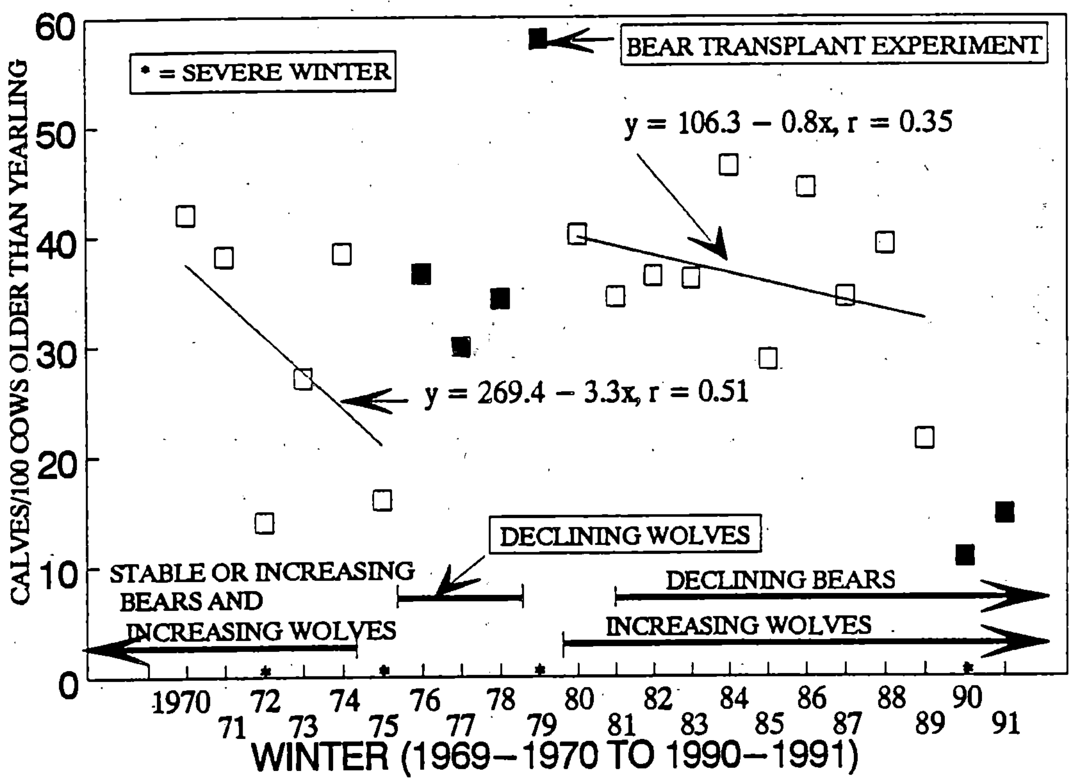

Figure 44. Trends in moose calf:cow ratios during and before the period of increased bear hunting (from Miller and Ballard 1992). Filled in squares were not utilized in regression analyses.

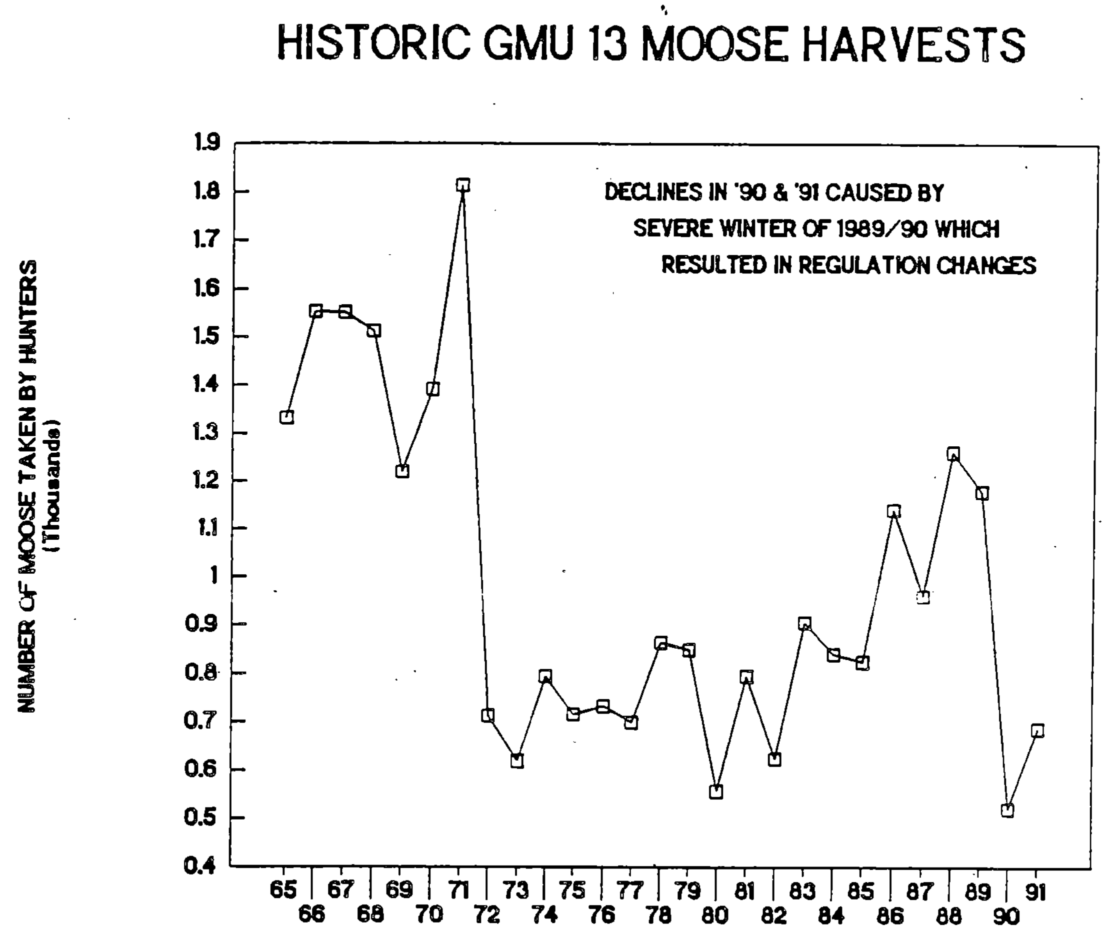

Figure 45. Number of moose harvested in GMU 13, 1965-1991. [Mkill.wk1, Moosekill.pic].

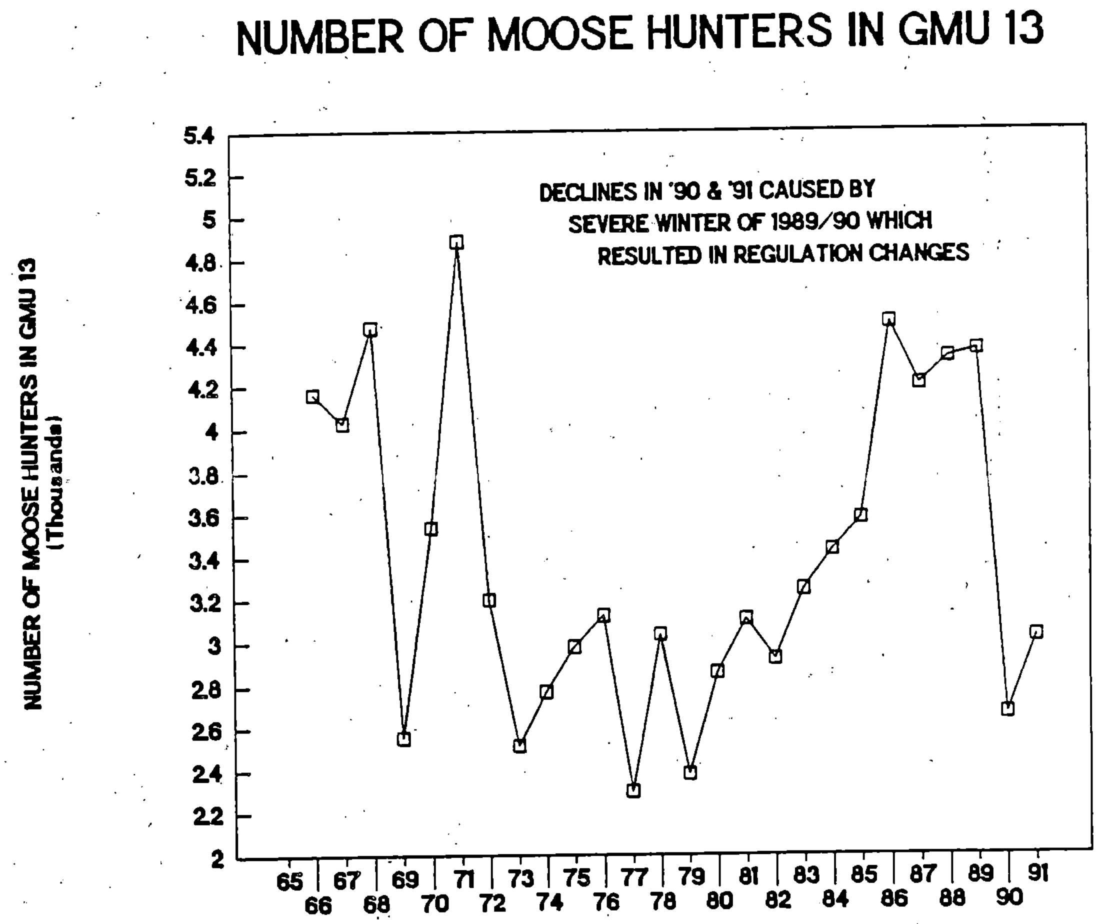

Figure 46. Number of moose hunters in GMU 13, 1965-1991. [Mkill.wk1, Mhunters.pic].

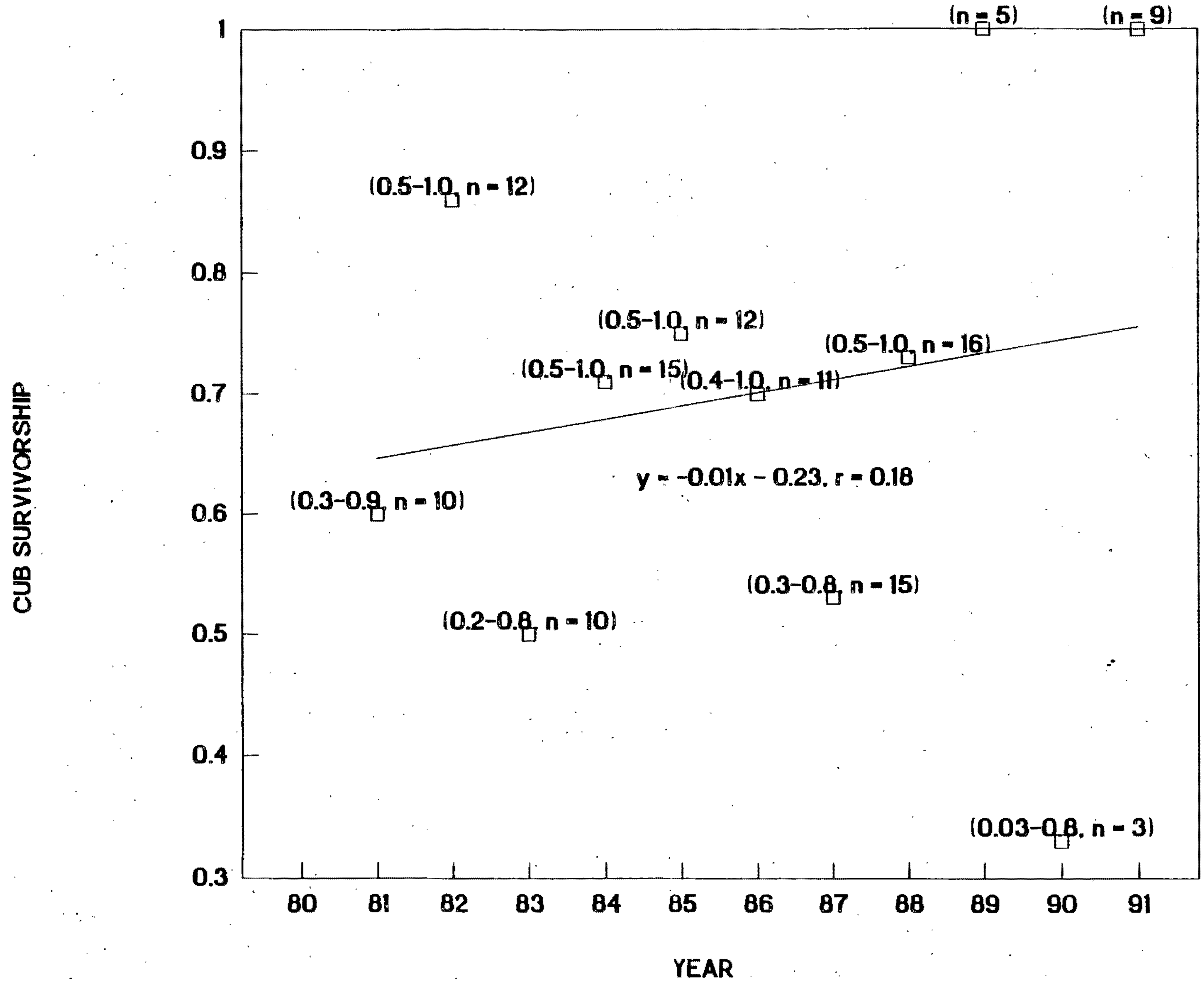

Figure 47. Trend in cub survivorship during the period of bear reduction. Slope of line is not significant ($\underline{P} = 0.42$).

Table 1. Brown bears captured in GMU 13 studies, 1980-1990.

	Capture							
Tattoo	Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
(277)	F	10.5	225*	4/10/80			1065/1066	w/2 ylgs, not marked, collar shed 80/81 den
(278)	M	9.5	375*	4/19/80			-- --	capture mortality
(279)	M	9.5	400*	4/20/80			1100/1099	collar shed by 6/12/80, recaptured 5/18/83, shot 9/84
280	M	5.5	300*	4/20/80			1097/1098	recollar next spring
(214)	M	4.5	300*	4/22/80			1072/1071	collar shed 9/9/80, recaptured 6/85, shot Fall 91
281	F	3.5	250*	4/22/80			16175/15950	not turgid, see 5/81 recapture
(282)	M	4.5	325*	4/22/80			1079/1080	see 6/82 recapture, shot Spring 92
283	F	12.5	280*	4/22/80			690/689	w2 @2.5: 284 and 285
(284)	M	2.5	180*	4/22/80			1074/1073	w/283 see 5/5/81 recapture
285	M	2.5	180*	4/22/80			687/688	w/283
286	M	3.5	264	5/1/80			1081/1082	
(292)	F	3.5	174	5/2/80			1322/1321	Turgid, shot 5/89
(293)	M	(3.5)	277	5/2/80			1116/1115	recaptured 8/81, 5/83, shot spring '85
(294)	M	10.5	607	5/2/80			-- --	died on 8/6/81 recapture
(295)	M	12.5	589	5/3/80			1303/1304	collar shed by 5/4/80
299	F	13.5	285	5/4/80			1109/1110	w/2 ylgs, turgid, recaptured 5/7/81
(297)	M	1.5	65	5/4/80			(1301/1302)	w/299, shot by hunter on 9/18/81
298	M	1.5	65	5/4/80			1318/1317	w/299
306	F	3.5	163	5/4/80			1319/1320	turgid
(308A)	M	6.5	480	5/6/80			(1126/1125)	shot 9/83
(308B)	F	5.5	240	5/6/80			1096/1095	turgid(?) - died on 8/6/81 recapture
(309)	M	12.5	600	5/6/80			(1117/1118)	collar shed by 5/14/80, recaptured 6/85, shot spring '90
(312)	F	10.5	319	5/7/80			1312/1311	w/311
(311)	M	2.5	227	5/7/80			-- --	w/312, shot on 9/16/80
313	F	9.5	286	5/7/80			1119/1120	w/314 @2.5 --
314	F	2.5	154	5/7/80			(1049/1050)	w/313, recaptured 6/1/85, 6/87
315	F	2.5	90*	5/7/80			1127/1128	alone, recaptured 5/18/83
(284#2)	M	3.5	125	5/5/81			(1074/1073)	near 283 w/2c, shot by hunter of 5/18/81
(331)	F	6.5	172	5/5/81			(1296/1295)	w/332 and 333, died August 1982
(332)	M	2.5	79	5/5/81			(1215/1216)	w/331 and 333, shot by hunter on 9/5/82
(333)	M	2.5	67	5/5/81			(1240/1239)	w/331 and 332, shot by hunter on 9/3/81
334	F	10.5	325	5/5/81			1292/1291	estrus, missing in 1982
335	F	3.5	194	5/5/81			1220/1219	recaptured 5/14/83 and 6/86, age changed + 1 '83 tooth
281#2	F	4.5	--	5/6/81			1201/1202	estrus? recaptured 5/15/83
283#2	F	13.5	261	5/6/81			1089/1090	w/338 and 339 @ 0, recaptured 5/14/83
338	F	0.5	12	5/6/81			1224/1223	w/283, sex switched to female

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Table 1. Continued

Tattoo	Capture				Frequency	Serial #	Ear Tags	Comments
	Sex	Age	Wt.	Date				
(339)	M	(0.5)	13	5/6/81			1222/1221	w/283, recaptured 6/85, sex switched to male; shot 9/85
312#2	F	11.5	280	5/6/81			1300/1299	w/2c @0.5 (not captured), recaptured 5/14/83
313#2	F	10.5	284	5/6/81			1120/1119	w/336, recaptured 5/14/83
336	F	0.5	--	5/6/81			1237/1238	w/313, not drugged (abandoned)
337	F	13.5	321	5/6/81			1294/1293	w/3c reunited on 5/9/81, recaptured 5/14/83
340	F	3.5	190	5/6/81			1225/1218	not estrus, recaptured 5/15/83, Rt. eartag replaced 5/90
280#2	M	6.5	394	5/7/81			1097/1267	w/F 341, recaptured 5/16/83
(341)	F	6.5	224	5/7/81			(1208/1207)	w/M 280, collar failed, recaptured 6/82; died in 88/89 den
299#2	F	14.5	291	5/7/81			1109/1110	w/2 @2.5 (297 and 298 - not recaptured), not estrus, recaptured 8/6/81
(342A)	M	2.5	220	5/7/81			1228/1227	alone, see 5/25/82 recapture, died 7/84
344	F	5.5	--	5/8/81			1204/1203	w/2 cubs subsequently, recaptured 5/14/83
(345)	M	7.5	495	5/8/81			-- --	capture mortality
(308B)#2	F	6.8	--	8/6/81			-- --	recapture mortality
299#3	F	14.8	--	8/6/81			1109/1110	collar replaced, recaptured 5/18/81
(293#2)	M	(4.8)	--	8/6/81			1115/1116	collar replaced, recaptured 5/18/83, shot spring '85
(294#2)	M	11.8	--	8/6/81			-- --	recapture mortality
347	M	14.8	500*	8/6/81			(1234/1233)	collar shed 9/81, recaptured 6/9/85
(342A#2)	M	3.5	250*	5/25/82			1228/1227	collar replaced, died 7/84
(373)	M	9.5	450*	6/11/82			-- --	no tattoo, w/G283 (F), collar shed 6/83
(282#2)	M	6.5	350*	6/11/82			(529/1643)	recapture of marked bear, shed collar, recaptured 5/84 & 6/86, shot Spring 92
(379)	F	(5.5)	300*	6/11/82			(1595/1585)	w/2@c, Downstream study, shot 9/85
(380)	F	15.5	275*	6/12/82			(1588/532)	w/2@1, not captured, shot 9/83
(381)	F	(3.50	200*	6/12/82			(533/1592)	alone, recaptured 5/18/84 & 6/86, shot 9/89
313#3	F	12.5	300*	5/15/83		6259	same	w/2@1
382	M	1.5	66	5/14/83		12546	2135/2134	w/313 and 383, recaptured 5/18/84, implant
(383)	F	1.5	53	5/14/83		12542	(2490/2491)	w/313/ and 382, died unknown causes, implant
283#3	F	15.5	--	5/14/83		(6340)	same	w/cub #3, recaptured 6/86
(003)	F	0.5	--	5/14/83		1024	(1360/1359)	w/283, special cub collar, no tattoo, cub eaten
337#2	F	15.5	--	5/14/83		6309	same	w/385@2
385	F	2.5	60	5/14/83		(15210-12548)	(1695/1694)	w/337, breakaway & implant, recaptured 6/85, tags replaced
(312#2)	F	13.5	350*	5/14/83		(6342)	(1299/1300)	w/386@2, died 5/16/84
386	M	2.5	200*	5/14/83		15212-12545(Imp)	2146/2141	w/312, breakway 5B collar, dispersed, implant
344#2	F	7.5	325*	5/14/83		10445	same	w/2@0, not captured
335#2	F	5.5	--	5/14/83		--	same	no radio in chopper

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Table 1. Continued

Tattoo	Capture Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
335#3	F	5.5	236	5/16/83		(15276)	same	alone, one year added to '81 age based on '83 tooth
388	F	14.5	450*	5/14/83		(6988)	(2478/2477)	w/388 and 289@2, recaptured 5/16/84 & 6/86, ear tags gone 5/90
(389)	M	(2.5)	135	5/14/83		(15214-12544)	2170/2171	w/388 and 390, breakaway 5B collar, died 10/83, implant
390	M	2.5	125*	5/14/83		15211-12543	2148/2147	w/38 and 389, breakaway 5B collar-shed, implant
340#2	F	5.5	250*	5/15/83		(15285)	same	recaptured 5/17/84, collar replaced 6/85
384	F	12.5	300*	5/15/83		15279	2499/2500	w/391, 392, 393@2
(391)	M	2.5	140*	5/15/83		(15213)	(2078/2079)	w/384 et al., breakaway 5B collar, shot 9/84
(392)	M	2.5	140*	5/15/83		(15246)	(2111/2110)	w/384 et al., breakaway 4B collar, shot 5.84
393	F	2.5	105	5/15/83		15247	1589/1598	w/384 et al., breakaway 4B collar
(293#3)	M	(6.5)	439	5/15/83		15291	same	--, shot spring '85
(394)	F	6.5	250*	5/15/83		(15277)	(1693/1692)	w/cub #4, shot 9/84
(004)	F	0.5	10	5/15/83		--	(1358/1357)	w/394-chewed on, no tattoo, died later
(395)	F	3.5	175*	5/15/83		(15289)	(2415/2416)	alone, regular 6B collar, shot 9/4/83
281#3	F	6.5	325*	5/15/83		(15284)	same	w/2@0 (#5 and #6), recollared 5/17/84
(005)	M	0.5	8.5	5/15/83		(1023)	(1350/134)	w/281, expandable cub collar, no tattoo, eaten
(006)	F	0.5	8.3	5/15/83		(1026)	(1346/1345)	w/281, expandable cub collar, no tattoo, eaten
280#3	M	8.5	482	5/16/83		(15290)	same	recaptured 6/85
396	F	13.5	274	5/16/83		(14885)	1685/1684	w/2@2, (397, 398), recaptured 6/86
(397)	F	(2.5)	132	5/16/83		--	(2493/2492)	w/396, recaptured 6/4/85, shot 9/85
(398)	F	(2.5)	135*	5/16/83		--	2105/2104	w/396, shot 6/86
(399)	M	(9.5)	600*	5/17/83		(15278)	2087/2108	recaptured 5/15/84, shot 5/87
400	M	20.5	542	5/17/83		(15281)	2132/2133	recaptured 5/18/84
299#4	F	16.5	275*	5/18/83		15283	same	w/3@0, darted in den, recaptured 5/15/84
418	M	0.5	13*	5/18/83		1024	1347/1348	w/G299, special cub collar, shed 10/83, old #7
419	M	0.5	13*	5/18/83		1025	1342/1343	w/G299, special cub collar, old #8
(417)	M	0.5	13*	5/18/83		1022	(536/535)	w/G299, special cub collar, shed 7/83, old #9
(279#2)	M	12.5	700*	5/18/83		(10339)	1653/1100	recapture, previous shed collar, recaptured 5/16/84
315#2	F	5.5	203	5/18/83		15288	same	estrus, alone, just marked previously
403	F	6.5	275*	5/18/83		15275	1564/1565	w/2@0, not captured, Downstream
407	F	4.5	220*	5/19/83		2905	2401/1543	alone, downstream, recaptured 6.85
299#5	F	17.5	308	5/15/84		same	w/3@1,	417-419
(417#2)	M	1.5	94	5/15/84		12080	same	w/G299 & siblings, small implant, shot 5/86
418#2	M	1.5	86	5/15/84		12081	same	w/G299 & siblings, large implant
419#2	M	1.5	84	5/15/84		12076	same	w/G299 & siblings, small implant
(399)#2	M	(10.5)	662	5/15/84		(6405)	same	alone, shot 5/87

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Table 1. Continued

Tattoo	Capture Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
388#2	F	15.5	400*	5/16/84		same	same	w/2c. replaced 6/86
(16)	M	0.5	--	5/16/84		(1389)	(1389/1390)	w/G388, capture-induced separation, died/shed 6/84
(17)	F	0.5	00	5/16/84		(1623)	(40/50)	w/G388, capture induced separation, died 5/84
312#3	F	14.5	300*	5/16/84		(6332)	same	w/3c, old and new radio failures, capture mortality on 5/17/84
(279#3)	M	13.5	800*	5/16/84		(6339/18884)	same	large implant, shot 9/84
281#4	F	(7.5)	350*	5/17/84		(6407)	same	w/2c, recaptured 6/87
(21)	M	0.5	14	5/17/84		(1703)	1386/1383	w/G281, drowned?
(22)	M	0.5	14	5/17/84		(1710)	(1385/1384)	w/ G281, killed by BrB
337#3	F	16.5	325	5/17/84		same	same	w/2c, recaptured 6/85
(08)	F	0.5	12	5/17/84		1708	(1338/1337)	w/337, shot spring '90
09	F	0.5	12	5/17/84		1711	1340/1339	w/337
340#3	F	6.5	375*	5/17/84		same	same	w/2c, recaptured 6/85, 6/87
(23)	F	0.5	17	5/17/84		1713	45/28	w/340, shot 4/89, sex determined @ sealing
(24)	M	0.5	14	5/17/84		1706	44/27	w/340, shot, Clearwater Mts. 9/91, sex determined at
420	F	19.5	350*	5/17/84		6335	2447/2057	w/2@1, one is 421
(421)	M	1.5	78	5/17/84		3984/1886	1644/2086	w/420 & uncaptured sibling. Large implant, female sibling, 437, captured 6/85, shot 9/88
422	M	4.5	205	5/18/84		18716	2136/2137	alone near camp
381#2	F	(5.5)	263	(5/18/84)		(6341)	same	alone, collar replaced on 6/86, shot 9/89
400#2	M	21.5	600*	5/18/84		6325	same	alone
382#2	M	2.5	148	5/18/84		(15289)	same	w/G313, old implant = 8.110, breakaway, picked up 6/86
423	F	21.5	300*	5/18/84		(6306)	none	w/4c, drug problem, recaptured 6/86
25	M	0.5	7	5/18/84		1712	39/32	smallest cub w/G423
--	F	0.5	--	5/18/84		--	49/48	other sibling w/G423 not marked or sexed
425	F	14.5	--	6/01/84		(6344)	2486/2413	w/282 M, recaptured 6/86, 3 teeth misplaced
(282#3)	M	8.5	--	6/01/84		(--)	same	w/425, recapture of shed collar, recaptured 6.86
342#3	M	5.6	--	7/28/84		--	--	capture mortality
(427)	M	(3.5)	195	6/01/85		(6322)	(1697/2113)	rot-away canvas spacer used, shot Spring 92
(398#2)	F	(4.5)	200*	6/01/85		(6315)	same	396's offspring @2 in 1983, shot 6/86
314#2	F	7.5	285*	6/01/85		(6352)	same/2498	w/1@1, @2w/G313 on 5/80; litter at age 6, replaced 6/87
(429)	F	(1.5*)	104	6/01/85		--	(1514/1518)	w/G314 breakaway collar, shot 9/86
(341#2)	F	10.5	--	6/03/85		(6287)	2174/1372	old collar failed, added new tags to old, replaced 6/87
(214#2)	M	9.5	600*	6/03/85		(xx46)	(1071/1649)	previously shed collar, recaptured 5/86, shot Fall 91
437	F	2.5	175*	6/03/85		1036	2082/2083	w/G421, probably sibling, rot-away collar
								sealing

continued on next page

Table 1. Continued

Tattoo	Sex	Capture Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
(309/440#2)	M	17.5	700*	6/04/85		(6298)	(2193/1523)	old collar shed, tattoo 440 in upper left, breakaway, shot spring '90
(442)	M	(13.5)	750*	6/04/85		--	(1627/2117)	"Harley" yellow flag in rt. ear, shot 9/86, ear tag gone
443	M	8.0*	400*	6/04/85		--	2172/--	red flat in right, blond
(397#2)	F	(4.5)	300*	6/04/85		6449	(1534/1597)	estrus w/443, was w/G396 in 1983@2, shot 9/85
447	F	7.5	400*	6/05/85		10337	2430/2429	--, breakaway
347#2	M	18.5	650*	6/09/85		--	2184/2181	orange flags in ears, old eartags gone
(339/ 450#2)	M	(4.5)	150*	6/09/85		--	(1221/2130)	originally captured in 1981 @Ow/G283, sexed as F, switched w/sex of sibling? tattoos = 450, shot 9/85
385#2	F	4.5	130*	6/09/85		--	1507/1592	green flag on visual drop-off, old ear tags replaced
407#2	F	6.5	200*	6/09/85		same	same	alone drop-off feature added to collar
337#4	F	17.5	200*	6/09/85		6440	same	w/2@1 - these have no collars
273#2	F	9.5	200*	6/09/85		(6342)	same	age=3 in 1979, transported, returned, collar replaced, see 6/87
340#3	F	17.5	250*	6/10/85		(6333)	same	replaced collar, w/2@1, recaptured 6/87
280#4	M	10.5	400*	6/10/85		--	same	collar removed
388#3	F	17.5	425*	6/05/86		(6348)	same	w/2@1, not captured, collar replaced
335#4	F	8.5	300*	6/05/86		(6288)	same/2481	w/1@2=G466, collar replaced
466	F	2.5	150*	6/05/86		--	2097/2056	w/mom-335
396#2	F	16.5	300*	6/06/86		(6343)	same	estrus, collar replaced
(381#3)	F	(7.5)	225*	6/06/86		(15285)	--/same	w/2@1, not captured, collar replaced, shot 9/89
(214#3)	M	10.5	600*	6/06/86		--	none/2062	collar removed, shot Fall 91
283#4	F	18.5	300*	6/06/86		(6340)	same	w/2@1, not captured, collar replaced
423#2	F	22.5	275*	6/06/86		(6306)	1540/1541	w/3@2, not captured, collar replaced
425#2	F	16.5	250*	6/06/86		6449	same	w2@1, not captured, last tooth pulled, collar replaced, lost 9/89
(282#4)	M	10.5	550*	6/06/86		--	(2129/same)	alone, collar removed, neck bad, shot Spring 92
340#4	F	19.5	342	6/05/87		(6293)	same	alone, replaced collar
337#5	F	19.5	288	6/05/87		(27816)	same	estrus, replaced collar
281#5	F	10.5	300*	6/05/87		(27814)	same	estrus, replaced collar
314#3	F	9.5	320*	6/05/87		(6295)	2498/3071	w/3@0, left ear tag and collar replaced
273#3	F	11.5	300*	6/05/87		(27821)	676/3082	w/3@0, replaced left ear tag, replaced collar
(001)	F	0.5	16	6/05/87		--	581/584	w/273 & uncaptured sibling, shot 4/92
(002)	M	0.5	18	6/05/87		--	585/578	w/273 & uncaptured sibling, shot 4/92
341#3	F	12.5	313	6/05/87		(6324)	same	w/1@1, replaced collar; died in 88/89 den
340#5	F	22.5	---	5/27/90		6350	215/214(R)	replaced collar and rt. eartag

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Table 1. Continued

Tattoo	Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
	Capture							
388#4	F	21.5	---	5/27/90		6440	181/183(R)	replaced collar and 2 missing eartags
335#5	F	12.5	---	5/27/90		15286	same	w/2@1, not captured; replaced radio
281#6	F	13.5	---	5/27/90		19048	same	Estrus, replaced collar
273#4	F	14.5	---	5/27/90		19049	same/320(Y)	Estrus, replaced collar & rt. eartag
314#4	F	12.5	---	5/27/90		19045	same	w/1 coy capt.-induced separation, replaced collar
423#3	F	26.5	---	5/27/90		6353	same/212(W)	estrus, replaced collar & rt. eartag
337#6	F	22.5	---	5/27/90		6346	304/213(W/R)	alone, replaced collar & both eartags
283#5	F	22.5	---	5/27/90		19020	same/193(R)	w/2@1, replaced collar & rt. eartag
396#3	F	20.5	---	5/27/90		19046	same	w/3@1, replaced collar
460#2	F	15.5	---	5/27/90		6322	same	w/2@1, replaced collar

Brown bears captured in upper Susitna River studies, 1986 and 1987

Tattoo	Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
	Capture							
453	F	4	250*	6/3/86		6345	2443/2363	w/2@0, lost 1c but successfully reintroduced next day
(468)	F	0.5	15	6/3/86		--	562/561	w/G453, shot Spring 91
--	F	0.5	17	6/3/86		--	558/559	w/G453
454	F	4	175*	6/3/86		6278	2358/2353	alone, no tattoo
(455)	M	8	525	6/3/86		6351	(2058/1700)	alone, drop-off collar, removed all tags 6/87, shot 9/89
(456)	F	6	250*	6/4/86		(15290)	(2441/2352)	w/2@0, one captured, shot 5/87
--	M	0.5	33	6/4/86		--	551/552	w/uncaptured sibling & 456
457	M	7	525	6/4/86		15291	(2129/2066)	w/458, drop-off collar, removed all tags 6/87
(458)	F	17	200*	6/4/86		6443	2421/2446	w/457, drop-off collar, shed, shot spring 1990
459	F	3	100*	6/4/86		--	2435/2407	alone, recaptured 6/87
460	F	7	300*	6/4/86		6349	560/564	w/2@0, no ear flags, roto tags
--	M	0.5	30	6/4/86		--	--	capture mortality
(--)	F	0.5	30	6/4/86		--	553/554	w/460 & sibling, shot 9/88
461	F	5	275*	6/5/86		15284	1529/2427	w/1@0
--	M	0.5	26	6/5/86		--	567/555	w/461
462	F	7	275*	6/5/86		6298	2412/2487	w/1@1, magnet left on? in '86, okay in '87
463	M	1.5	90*	6/5/86		--	2193/2198	w/G462
464	M	2	150*	6/5/86		--	2185/2177	alone
465	F	3	250*	6/5/86		(6309)	1525/2442	alone, collar removed 6/87

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Table 1. Continued

Tattoo	Capture Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
(466)	F	2	150*	6/5/86		--	2097/2056	offspring w/G335 (Su-Hydro), shot Spring 91
467	M	3	190	6/5/86		--	2144/2138	alone
468	F	1	70	5/30/87		27826	558/559	w/mom 453 & sibling, glue-on transmitter
459#2	F	4	198	5/30/87		6344	(same)	alone, rot-away collar, shed summer '88
						27827		glue-on radio (mod. 300)
469	F	6	275*	5/30/87		19053	2364/2424	w/2@1, '85 radio
						1023		glue-on transmitter (mod. 200), 19-50ppm
(470)	M	2	185	5/30/87		(3.930**)	2176/2179	alone, glue-on transmitter
(470#2)	M	2	--	6/8/87		--	--	removed transmitters, shot 9/87
471	M	5	450*	5/30/87		--	2099/1699	w/girlfriend 472
471#2	M	5	--	6/8/87		--	--	removed radio
472	F	12	375*	5/30/87		--	3076/3045	estrus, w/boyfriend (471) and 1@1 (475)
472#2	F	12	--	6/8/87		--	--	removed radio
473	F	6	295	5/30/87		--	3075/3045	alone
(473#2)	F	6	--	6/8/87		--	--	removed radio, shot 9/88
474	M	3	335	5/31/87		6302	2512/2658	alone, '85 radio
						27828	--	glue-on radio (mod. 300)
475	M	1	70*	5/31/87		1022	2637/2504	w/472 and stepdad, glue-on radio
475#2	M	1	--	6/8/87		--	--	removed transmitter, checked teeth
476	M	2	150*	5/31/87		19048	2067/2065	w/477 (sibling?)
						27852	--	
476#2	M	2	--	6/8/87		--	--	removed transmitters
477	F	2	125*	5/31/87		--	2654/2699	w/476 (sibling?)
(477#2)	F	2	--	6/8/87		--	--	removed radio, shot 9/87
478	F	9	340*	6/1/87		X988	3026/3046	w/2@1
						1700	--	glue-on radio (mod. 300)
479	M	2	224*	6/4/87		--	2503/2681	alone
479#2	M	2	--	6/8/87		--	--	removed collar
480	M	2	205	6/4/87		--	2649/2635	alone
480#2	M	2	--	6/8/87		--	--	removed collar
481	F	14	282	6/5/87		6287	3016/3064	w/3@1, old '85 radio
482	F	7	300*	6/6/87		--	3093/3080	w/3@1

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Table 1. Continued

	Capture							
Tattoo	Sex	Age	Wt.	Date	Frequency	Serial #	Ear Tags	Comments
482#2	F	7	--	6/8/87		--	--	removed radio
457#2	M	8	600*	6/7/87		--	--	removed collar & ear tags, both badly infected
455#2	M	9	550*	6/8/87		--	--	removed collar & ear tags, both badly infected
465	F	4	310*	6/8/87		--	(same)	alone, removed collar

* Weight estimated, ( ) indicates shed, or removed collar or dead bear, # recapture, - collar or mark replaced subsequently, last tattoo = 425, last cub = #25.
* estimated
** glue-on transmitter

Table 2. Brown bear regulations and harvests in Alaska's GMU 13, 1961-1992.

Calendar Year	Bag limit	Spring season	Autumn season	Total No. days	Spring kill	Autumn kill	Total kill
1961	1/year	none	9/1-9/30	30	0	42	42
1962	1/year	none	9/1-9/30	30	0	32	32
1963	1/year	none	9/1-9/30	30	0	43	43
1964	1/year	none	9/1-9/30	30	0	38	38
1965	1/year	none	9/1-10/15	30	1	47	48
1966	1/year	none	9/1-9/30	30	0	63	63
1967	1/year	none	9/1-9/30	30	0	32	32
1968	1/4years[1]	none	9/15-10/15	21	0	39	39
1969	1/4years	none	9/20-10/20	31	0	17	17
1970	1/4years	none	9/15-10/5	21	0	26	26
1971	1/4years	none	9/1-10/5	35	0	70	70
1972	1/4years	none	9/10-10/10	31	0	48	48
1973	1/4years	none	9/10-10/10	31	0	45	45
1974	1/4years	none	9/1-10/10	40	0	72	72
1975	1/4years	none	9/1-10/10	40	0	80	80
1976	1/4years	none	9/1-10/10	40	0	59	59
1977	1/4years	none	9/1-10/10	40	1	40	41
1978	1/4years	none	9/1-10/10	40	2	62	64
1979	1/4years	none	9/1-10/10	40	0	73	73
1980	1/4years	5/10-5/25	9/1-10/10	56	15	69	84
1981	1/4years	5/10-5/25	9/1-10/31	77	24	58	82
1982	1/year[1]	4/25-5/25	9/1-12/31	153	23	59	82
1983	1/year	1/1-5/31	9/1-12/31	273	36	81	117
1984	1/year	1/1-5/31	9/1-12/31	273	47	77	124
1985	1/year	1/1-5/31	9/1-12/31	273	54	91	145
1986	1/year	1/1-5/31	9/1-12/31	273	45	91	136
1987	1/4years[1]	1/1-5/31	9/1-12/31	273	46	58	104
1988	1/4years	1/1-5/31	9/1-12/31	273	19	48	67
1989	1/4year	1/1-5/31	9/1-12/31	273	25	52	77
1990	1/4year	1/1-5/31	9/10-12/31[3]	263	46	37[2]	83
1991	1/4year	1/1-5/31	9/10-12/31[3]	263	48	33	81
1992	1/4year	1/1-5/31	9/10-12/31[3]	263	45	64	109

[1] Starting July 1 of year.
[2] Temporary ungulate season changes caused no overlap with autumn bear seasons for first time.
[3] Except for 13D which remained 9/1-12/31.

Table 3. Estimation of bear population in GMU 13 based on Harley McMahan's extrapolation from the 1985 Su-hydro estimate (7.0 all ages/100 mi^2 or 4.9 >2.0/100 mi^2).

	sq. in.	sq. mi.	Harley's Stratification Factor	Substitute Stratification Factor*	Estimated Number of Bears ALL	>2.0
Subunit 13A						
a3	96.16	1497.0	0.775		81.2	56.8
a2	83.51	1300.1	0.95		86.5	60.5
a1	55.12	858.1	0.875		52.6	36.8
A?	49.62	772.5	unk	1.25(upsu)	17.8	16.1
13A TOTAL		4428			238	170
ACTUAL AREA		4528				
% diff. in area		2.2				
Tobey, Ballard & Miller 1987 estimate =					232	157
% difference in Harley's estimate =					2.5	7.8
Subunit 13B						
b4	22.25	346.4	0.55		13.3	9.3
b5	11.48	178.7	unk	'87 Clearwater	3.4	2.0
b3	42.67	664.3	0.6		27.9	19.5
b1	94.84	1476.5	0.95		98.2	68.7
b2/87	65.49	1019.5	0.55		39.3	27.5
b6	9.35	145.6	unk	'87 Clearwater	2.8	1.6
13B TOTAL		3831			185	129
ACTUAL AREA		3987				
% diff. in area		3.9				
Tobey, Ballard & Miller 1987 estimate =					148	96
% difference in Harley's estimate =					19.9	25.4
Subunit 13C						
c2	55.64	866.2	0.8		48.5	34.0
c1	77.32	1203.7	0.85		71.6	50.1
13C TOTAL		2070			120	84
ACTUAL AREA		2044				
% diff. in area		-1.3				
Tobey, Ballard & Miller 1987 estimate =					112	75
% difference in Harley's estimate =					6.8	10.8

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Table 3. Continued.

	sq. in.	sq. mi.	Harley's Stratification Factor	Substitute Stratification Factor*	Estimated Number of Bears All	>2.0
Subunit 13D						
d1	93.86	1461.2	0.85	86.9	60.9	
d2	70.49	1097.4	0.8	61.5	43.0	
d3	43.71	680.5	0.6	28.6	20.0	
d?1	63.95	995.6	unk	1.5(upsu)	41.4	24.8
d?2	19.64	305.8	unk	1.5(upsu)	12.7	7.6
d?3	18.93	294.7	unk	1.5(upsu)	12.3	7.3
d?4	58.07	904.0	unk	1.5(upsu)	37.6	22.5
13D TOTAL		5739	281	186		
ACTUAL AREA		5771				
% diff. in area		0.6				
% "unfamiliar"		43.6				
Tobey, Ballard & Miller 1987 estimate =					371	251
% difference in Harley's estimate =					-32.0	-34.8
Subunit 13E						
e1	48.93	761.7	1.1		58.7	41.1
e2	31.16	485.1	1.05		35.7	25.0
e3	39.58	616.2	0.8		34.5	24.2
e4	26.43	411.5	0.9		25.9	18.1
e5	41.78	650.4	0.95		43.3	30.3
e?1	204.58	3184.9	unk	0.75(midsu)	167.8	116.2
e85	37.39	582.1		known	35.7	24.7
e87	18.18	283.0		Mon. known	9.2	6.1
13D TOTAL		6975			411	286
ACTUAL AREA		6530				
% diff. in area		-6.8				
Tobey, Ballard & Miller 1987 estimate =					364	243
% difference in Harley's estimate =					11.4	14.9
All GMU 13		23043			1235	855
ACTUAL AREA		22857				
% diff. in area		-0.8				
Tobey, Ballard & Miller 1987 estimate =					1228	823
% difference in Harley's estimate =					0.5	3.7

* In areas where Harley McMahan did not estimate a stratification factor, the factor used by Tobey, Miller and Ballard was substituted or the estimated value for the study area was used ("known").

Other reference densities:

Clearwater est. = 1.9/100 mi^2 (all) or 1.1/100 mi^2 (>2.0)
Monihan est. = 3.24/100 mi^2 (all) or 2.16/100 mi^2 (>2.0)
UPSU est. = 2.77/100 mi^2 (all) or 1.66/100 mi^2 (>2.0)

Table 4. Brown bear population reconstruction for GMU 13 based on assumption that sustainable harvest level is 5% of the population in year (i +1).

All GMU 13, estimated population (N) = 1,228, area = 59,154 km²

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km²	Resultant Population if (N) was Iin1986	Cumulative Percent Change from Base	Density #/1000km²
		1219.50			1452.6		
70/71	26	1254.48	2.87	21.21	1426.60	-1.79	24.12
71/72	70	1247.20	2.27	21.08	1427.93	-1.70	24.14
72/73	48	1261.56	3.45	21.33	1451.33	-0.09	24.53
73/74	44	1280.64	5.01	21.65	1479.89	1.88	25.02
74/75	72	1272.67	4.36	21.51	1481.89	2.02	25.05
75/76	80	1256.30	3.02	21.24	1475.98	1.61	24.95
76/77	60	1259.12	3.25	21.29	1489.78	2.56	25.18
77/78	42	1280.07	4.97	21.64	1522.27	4.80	25.73
78/79	62	1282.08	5.13	21.67	1536.38	5.77	25.97
79/80	88	1258.18	3.17	21.27	1525.20	5.00	25.78
80/81	93	1228.09	0.70	20.76	1508.46	3.85	25.50
81/82	81	1208.40	-1.60	20.43	1502.89	3.46	25.41
82/83	95	1173.82	-4.41	19.84	1483.03	2.09	25.07
83/84	128	1104.51	-10.06	18.67	1429.18	-1.61	24.16
84/85	131	1028.74	-16.23	17.39	1369.64	-5.71	23.15
85/86	138	942.17	-23.28	15.93	1300.12	-10.50	21.98
86/87	137	852.28	-30.60	14.41	1228.13	-15.45	20.76
87/88	77	817.90	-33.40	13.83	1212.40	-16.54	20.50
88/89	73	785.79	-36.01	13.28	1200.02	-17.39	20.29
89/90	98	727.08	-40.79	12.29	1162.02	-20.00	19.64
90/91	85	678.43	-44.75	11.47	1135.12	-21.86	19.19
91/92	73	639.36	-47.94	10.81	1118.88	-22.97	18.91

Table 4. Continued.

All GMU 13 except 13D, estimated population (N) = 857, area = 44,219 km²

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km²	Resultant Population if (N) was in 1986	Cumulative Percent Change from Base	Density #/1000km²
		877.4			1025.46		
70/71	18	903.27	2.95	20.43	1058.73	3.24	23.94
71/72	54	894.43	1.94	20.23	1057.67	3.14	23.92
72/73	40	899.16	2.48	20.33	1070.55	4.40	24.21
73/74	27	917.11	4.53	20.74	1097.08	6.98	24.81
74/75	52	910.97	3.83	20.60	1099.93	7.26	24.87
75/76	65	891.52	1.61	20.16	1089.93	6.29	24.65
76/77	45	891.09	1.56	20.15	1099.43	7.21	24.86
77/78	31	904.65	3.11	20.46	1123.40	9.55	25.41
78/79	49	900.88	2.68	20.37	1130.57	10.25	25.57
79/80	63	882.92	0.63	19.97	1124.10	9.62	25.42
80/81	70	857.07	-2.32	19.38	1110.30	8.27	25.11
81/82	67	832.85	-2.82	18.83	1098.82	7.15	24.85
82/83	75	799.49	-6.71	18.08	1078.76	5.20	24.40
83/84	98	741.47	-13.48	16.77	1034.70	0.90	23.40
84/85	111	667.54	-22.11	15.10	975.43	-4.88	22.06
85/86	108	592.92	-30.81	13.41	916.20	-10.65	20.72
86/87	105	517.56	-39.61	11.70	857.01	-16.43	19.38
87/88	63	480.44	-43.94	10.87	836.85	-2.35	18.93
88/89	59	445.46	-48.02	10.07	819.69	-4.35	18.54
89/90	83	384.74	-55.11	8.70	777.68	-9.26	17.59
90/91	65	338.97	-60.45	7.67	751.56	-12.30	17.00
91/92	67	288.92	-66.29	6.53	722.14	-15.74	16.33

Continued on next page

Table 4. Continued.

GMU 13A, estimated population (N) = 232, area = 11,719 km^2.

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km	Resultant Population if (N) was in 1986	Cumulative Percent Change from Base	Density #/1000km^2
		230.4			266.64		
70/71	4	237.92	3.26	20.30	275.97	3.50	23.55
71/72	17	232.82	1.05	19.87	272.77	2.30	23.28
72/73	14	230.46	0.02	19.67	272.41	2.16	23.25
73/74	8	233.98	1.55	19.97	278.03	4.27	23.72
74/75	12	233.68	1.42	19.94	279.93	4.98	23.89
75/76	14	231.36	0.42	19.74	279.93	4.98	23.89
76/77	4	238.93	3.70	20.39	289.92	8.73	24.74
77/78	7	243.88	5.85	20.81	297.42	11.54	25.38
78/79	11	245.07	6.37	20.91	301.29	13.00	25.71
79/80	23	234.32	1.70	20.00	293.36	10.02	25.03
80/81	14	232.04	0.71	19.80	294.02	10.27	25.09
81/82	21	222.60	-4.05	18.99	287.72	7.91	24.55
82/83	14	219.73	-5.29	18.75	288.11	8.05	24.58
83/84	29	201.72	-13.05	17.21	273.52	2.58	23.34
84/85	22	189.80	-18.19	16.20	265.19	-0.54	22.63
85/86	26	173.29	-25.30	14.79	252.45	-5.32	21.54
86/87	33	148.96	-35.79	12.71	232.07	-36.24	19.80
87/88	12	144.40	-37.76	12.32	231.60	-0.17	19.76
88/89	15	136.63	-41.11	11.66	228.18	-1.65	19.47
89/90	18	125.46	-45.92	10.71	221.59	-4.49	18.91
90/91	11	120.73	-47.96	10.30	221.67	-4.45	18.92
91/92	15	111.77	-51.83	9.54	217.75	-6.14	18.58

Continued on next page

Table 4. Continued.

GMU 13B, estimated population (N) = 148, area = 10,318 km²

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km²	Resultant Population if (N) was in 1986	Cumulative Percent Change from Base	Density #/1000km²
		160.80			194.50		
70/71	3	165.84	3.13	16.07	201.23	3.46	17.17
71/72	6	168.13	4.56	16.30	205.29	5.55	17.52
72/73	7	169.54	5.43	16.43	208.55	7.22	17.80
73/74	5	173.02	7.60	16.77	213.98	10.01	18.26
74/75	12	169.67	5.51	16.44	212.68	9.35	18.15
75/76	22	156.15	-2.89	15.13	201.31	3.50	17.18
76/77	8	155.96	-3.01	15.12	203.38	4.56	17.35
77/78	10	153.75	-4.38	14.90	203.55	4.65	17.37
78/79	5	156.44	-2.71	15.16	208.72	7.31	17.81
79/80	9	155.26	-3.44	15.05	210.16	8.05	17.93
80/81	15	<u>148.03</u>	-7.94	14.35	205.67	5.74	17.55
81/82	14	141.40	-4.46	13.70	201.95	3.83	17.23
82/83	19	129.47	-12.52	12.55	193.05	-0.75	16.47
83/84	19	116.94	-20.98	11.33	183.70	-5.55	15.68
84/85	27	95.79	-35.28	9.28	165.88	-14.71	14.16
85/86	17	83.58	-43.53	8.10	157.18	-19.19	13.41
86/87	17	70.76	-52.19	6.86	<u>148.04</u>	-23.89	12.63
87/88	9	65.30	-55.88	6.33	146.40	-1.08	14.19
88/89	8	60.56	-59.08	5.87	145.72	-1.54	14.12
89/90	12	51.59	-65.14	5.00	141.01	-4.73	13.67
90/91	12	42.17	-71.51	4.09	136.06	-8.07	13.19
91/92	7	37.28	-74.81	3.61	135.86	-8.20	13.17

Continued on next page

Table 4. Continued.

GMU 13C, estimated population (N) = 112, area = 5,290 km²

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km²	Resultant Population if (N) was in 1986	Cumulative Percent Change from Base	Density #/1000km²
		119.70			135.30		
70/71	1	124.69	4.16	23.57	141.07	4.26	26.67
71/72	5	125.92	5.20	23.80	143.12	5.78	27.05
72/73	5	127.22	6.28	24.05	145.27	7.37	27.46
73/74	7	126.58	5.74	23.93	145.54	7.57	27.51
74/75	10	122.90	2.68	23.23	142.81	5.55	27.00
75/76	9	120.05	0.29	22.69	140.96	4.18	26.65
76/77	6	120.05	0.29	22.69	142.00	4.95	26.84
77/78	4	122.06	1.97	23.07	145.10	7.25	27.43
78/79	10	118.16	-1.29	22.34	142.36	5.22	26.91
79/80	6	118.07	-1.37	22.32	143.48	6.04	27.12
80/81	12	111.97	-6.46	21.17	138.65	2.48	26.21
81/82	10	107.60	-3.93	20.34	135.58	0.21	25.63
82/83	10	102.98	-8.05	19.47	132.36	-2.17	25.02
83/84	12	96.13	-14.17	18.17	126.98	-6.15	24.00
84/85	14	86.94	-22.38	16.43	119.33	-11.80	22.56
85/86	11	80.28	-28.32	15.18	114.30	-15.52	21.61
86/87	8	76.30	-31.88	14.42	112.01	-17.21	21.17
87/88	13	67.11	-40.08	12.69	104.60	-6.61	19.77
88/89	11	59.47	-46.90	11.24	98.83	-11.76	18.68
89/90	5	57.44	-48.71	10.86	98.77	-11.81	18.67
90/91	8	52.31	-53.29	9.89	95.71	-14.54	18.09
91/92	3	51.93	-53.64	9.82	97.50	-12.95	18.43

Continued on next page

Table 4. Continued.

GMU 13D, estimated population (N) = 371, area = 14,935 km²

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km²	Resultant Population if (N) was in 1986	Cumulative Percent Change from Base	Density #/1000km²
		342.10			357.92		
70/71	8	351.21	2.66	23.52	367.82	2.76	24.63
71/72	16	352.77	3.12	23.62	370.21	3.43	24.79
72/73	8	362.40	5.93	24.27	380.72	6.37	25.49
73/74	17	363.52	6.26	24.34	382.75	6.94	25.63
74/75	20	361.70	5.73	24.22	381.89	6.70	25.57
75/76	15	364.78	6.63	24.42	385.99	7.84	25.84
76/77	15	368.02	7.58	24.64	390.28	9.04	26.13
77/78	11	375.43	9.74	25.14	398.80	11.42	26.70
78/79	13	381.20	11.43	25.52	405.74	13.36	27.17
79/80	25	375.26	9.69	25.13	401.03	12.04	26.85
80/81	23	<u>371.02</u>	8.45	24.84	398.08	11.22	26.65
81/82	14	375.55	1.23	25.15	403.98	12.87	27.05
82/83	20	374.33	0.90	25.06	404.18	12.92	27.06
83/84	30	363.04	-2.14	24.31	394.39	10.19	26.41
84/85	20	361.20	-2.64	24.18	394.11	10.11	26.39
85/86	30	349.26	-5.86	23.39	383.81	7.23	25.70
86/87	32	334.72	-9.78	22.41	<u>371.00</u>	3.66	24.84
87/88	14	337.45	-9.04	22.59	375.55	1.23	25.15
88/89	14	340.33	-8.27	22.79	380.33	2.51	25.47
89/90	15	342.34	-7.72	22.92	384.34	3.60	25.73
90/91	20	339.46	-8.50	22.73	383.56	3.39	25.68
91/92	6	350.43	-5.54	23.46	396.74	6.94	26.56

Continued next page

Table 4. Continued.

GMU 13E, estimated population (N) = 364, area = 16,900 km²

Year	Reported Kill	Resultant Population if (N) was in 1980	Cumulative Percent Change from Base	Density #/1000km²	Resultant Population if (N) was in 1986	Cumulative Percent Change from Base	Density #/1000km²
		341.00			397.80		
70/71	8	350.05	2.65	20.71	409.69	2.99	24.24
71/72	20	347.55	1.92	20.57	410.17	3.11	24.27
72/73	13	351.93	3.21	20.82	417.68	5.00	24.71
73/74	6	363.53	6.61	21.51	432.57	8.74	25.60
74/75	13	368.70	8.12	21.82	441.20	10.91	26.11
75/76	17	370.14	8.54	21.90	446.26	12.18	26.41
76/77	22	366.65	7.52	21.69	446.57	12.26	26.42
77/78	9	375.98	10.26	22.25	459.90	15.61	27.21
78/79	21	373.78	9.61	22.12	461.89	16.11	27.33
79/80	20	372.46	9.23	22.04	464.99	16.89	27.51
80/81	27	364.09	6.77	21.54	461.24	15.95	27.29
81/82	20	362.20	-0.49	21.43	464.30	16.72	27.47
82/83	30	350.31	-3.76	20.73	457.51	15.01	27.07
83/84	36	331.83	-8.84	19.63	444.39	11.71	26.30
84/85	48	300.42	-17.47	17.78	418.61	5.23	24.77
85/86	50	265.44	-27.08	15.71	389.54	-2.08	23.05
86/87	45	233.71	-35.79	13.83	364.01	0.00	21.54
87/88	28	217.39	-40.28	12.86	354.20	-2.69	20.96
88/89	25	203.26	-44.16	12.03	346.91	-4.70	20.53
89/90	48	165.43	-54.55	9.79	316.26	-13.12	18.71
90/91	34	139.70	-61.62	8.27	298.07	-18.11	17.64
91/92	38	108.68	-70.14	6.43	274.97	-24.46	16.27

Table 5. Mean brown bear harvest density in GMU 13 by subunit and calculated density that would be required to sustain these harvests assuming a 5% sustainable harvest level. Estimated sustainable harvest rate that would be required to avoid declines given harvest density and estimated subunit density is also calculated based on subunit density estimates obtained in 1987.

Area	1983-1986 mean harvest density (range) (#/1,000 km^2)	Bear density (#/1,000 km^2) required to sustain reported mean harvest density @5% (range)	Estimated density (1987)	Required sustainable harvest rate
13A	2.19 (1.54-2.99)	43.9 (30.8-58.0)	21.3	10.3 (7.2-14)%
13B	1.90 (1.74-2.42)	38.0 (34.8-48.4)	14.3	13.3 (12.3-16.0)%
13C	1.97 (1.51-2.46)	39.4 (30.2-49.2)	21.2	9.3 (7.1-11.6)%
13D	1.70 (1.34-2.34)	34.0 (26.8-46.8)	24.8	6.9 (5.4-9.4)%
13E	2.33 (1.66-3.14)	46.6 (33.2-62.8)	26.5	8.8 (6.3-11.8)%
all 13	2.23 (1.98-2.45)	44.6 (39.6-2.45)	20.8	10.7 (9.4-11.8)%
all 13 but 13D	2.23 (1.76-2.64)	44.6 (35.2-52.8)	19.4	11.5 (8.8-13.6)%

Table 6. Status of brown bears first marked during GMU 13 studies, 1980-1992. (A=alive, ND=no data available, F=shot in fall, SP=shot in spring). ND in year of capture indicates bear was not collared or soon shed its collar and no subsequent data were collected.

Bear ID	Sex/Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992(sp.)
1980 captures														
277	F/10 in '80	A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
279	M/9 in '80	A	A	A	A	Shot-F	--	--	--	--	--	--	--	--
280	M/5 in '80	A	A	A	A	A	A	ND	ND	ND	ND	ND	ND	ND
281	F/3 in '80	A	A	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A	A(COY)
282	M/4 in '80	A	A	A	A	A	A	A	A	A	A	A	A	Shot-SP
283	F/12 in '80	A	A	A	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A(COY)
284	M/2 in '80	A	Shot-SP	--	--	--	--	--	--	--	--	--	--	--
286	M/3 in '80	A	A	A	A	Shot-F	--	--	--	--	--	--	--	--
292	F/3 in '80	A	A	A	A	A	A	A	A	A	Shot-SP	--	--	--
293	M/3 in '80	A	A	A	A	ND	Shot-SP	--	--	--	--	--	--	--
294	M/10 in '80	A	Died-Aug.	--	--	--	--	--	--	--	--	--	--	--
295	M/12 in '80	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
299	F/13 in '80	A	A	A	A	A	ND	ND	ND	ND	ND	ND	ND	ND
297	M/1 in '80	A	Shot-F	--	--	--	--	--	--	--	--	--	--	--
306	F/3 in '80	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
308a	M/6 in '80	A	A	A	Shot-F	--	--	--	--	--	--	--	--	--
308b	F/5 in '80	A	Died-Aug.	--	--	--	--	--	--	--	--	--	--	--
309	M/12 in '80	A	A	A	A	A	A	A	A	A	A	Shot-SP	--	--
311	M/2 in '80	Shot-F	--	--	--	--	--	--	--	--	--	--	--	--
312	F/10 in '80	A	A	A	A	Died-NS	--	--	--	--	--	--	--	--
313	F/9 in '80	A	A	A	A	A	Shot-F	--	--	--	--	--	--	--
314	F/2 in '80	A	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A(COY)	A(COY)	A(YLG)
315	F/2 in '80	A	A	A	A	A	A	Shot-SP	--	--	--	--	--	--
1981 captures														
331	F/6 in '81	--	A	Died-Aug.	--	--	--	--	--	--	--	--	--	--
332	M/2 in '81	--	A	Shot-F	--	--	--	--	--	--	--	--	--	--
333	M/2 in '81	--	Shot-F	--	--	--	--	--	--	--	--	--	--	--
334	F/10 in '81	--	Lost-Sept shot?	--	--	--	--	--	--	--	--	--	--	--
335	F/2 in '81	--	A	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A(@3)	A(@4)
337	F/13 in '81	--	A	A	A	A	A	A	A	A	A	A	A	A
339	M/0 in '81	--	Cub	Ylg	A	A	Shot-F	--	--	--	--	--	--	--
340	F/3 in '81	--	A	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A(COY)	A(YLG)
341	F/6 in '81	--	A	A	A	A	A	A	A	A (Den death)	--	--	--	--

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Table 6. Continued.

Bear ID	Sex/Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992(sp.)
342a	M/2 in '81	--	A	A	A	Died-NS	--	--	--	--	--	--	--	--
344	F/5 in '81	--	A	A	A	Lost Sept shot?	ND	ND	ND	ND	ND	ND	ND	ND
347	M/14 in '81	--	A	A	A	A	A	ND	ND	ND	ND	ND	ND	ND
214***	M/2 in '78	A	A	A	A	A	A	A	A	A	A	A	Shot-F	--
273***	F/3 in '79	A	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A	A(COY)	A(YLG)
1982 captures														
379**	F/5 in ;82	__	__	A	A	A	Shot-F	--	--	--	--	--	--	--
380	F/15 in '82	--	--	A	Shot-F	--	--	--	--	--	--	--	--	--
381	F/3 in '82	--	--	A	A	A	A	A	A	A	Shot-F	--	--	--
1983 captures														
385	F/2 in '83	--	--	--	A	A	A	ND	ND	ND	ND	ND	ND	ND
386	M/2 in '83	--	--	--	A	Shot-SP	--	--	--	--	--	--	--	--
388	F/14 in '83	--	--	--	A	A	A	A	A(@2)	A(COY)	A(@1)	A(@2)	A	A
389	M/2 in '83	--	--	--	A, Died Oct.	--	--	--	--	--	--	--	--	--
390	M/2 in '83	--	--	--	A	ND	ND	ND	ND	ND	ND	ND	ND	ND
384	F/12 in '83	--	--	--	A	Lost in Sept.-shot?	ND	ND	ND	ND	ND	ND	ND	ND
391	M/2 in '83	--	--	--	A	Shot-F	--	--	--	--	--	--	--	--
392	M/2 in '83	--	--	--	A	Shot-SP	--	--	--	--	--	--	--	--
393	F/2 in '83	--	--	--	A	ND	ND	ND	ND	ND	ND	ND	ND	ND
394	F/6 in '83	--	--	--	A	Shot-F	--	--	--	--	--	--	--	--
395	F/3 in '83	--	--	--	Shot-F	--	--	--	--	--	--	--	--	--
396	F/13 in '83	--	--	--	A	A	A	A	A	A	A(COY)	A(YLG)	A(@2)	A(@3)
397	F/2 in '83	--	--	--	A	A	Shot-F	--	--	--	--	--	--	--
398	F/2 in '83	--	--	--	A	A	A	Shot-SP	--	--	--	--	--	--
399	M/9 in '83	--	--	--	A	A	A	A	Shot-SP	--	--	--	--	--
400	M/20 in '83	--	--	--	A	A	A	ND	ND	ND	ND	ND	ND	ND
403**	F/6 in '83	--	--	--	A	A	A	A	A	ND	ND	ND	ND	ND
407**	F/4 in '83	--	--	--	A	A	A	A	A	ND	ND	ND	Shot-F	--
1984 captures														
420	F/19 in '84	--	--	--	--	A	A	A	ND	ND	ND	ND	ND	ND
421	M/1 in '84	--	--	--	--	--	--	A	A	Shot-F	--	--	--	--
422	M/4 in '84	--	--	--	--	A	Died-SP	--	--	--	--	--	--	--

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Table 6. Continued.

Bear ID	Sex/Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992(sp.)
423	F/21 in '84	--	--	--	--	A	A	A	A	A	A	A	A	A
425	F/14 in '84	--	--	--	--	A	A	A	A	A	A Shot?	--	--	--
382	F/2 in '84	--	--	--	--	A	A	ND	ND	ND	ND	ND	ND	ND
417	M/1 in '84	--	--	--	--	--	A	Shot-SP	--	--	--	--	--	--
023	F/0 in '84	--	--	--	--	Coy	Ylg	A	A	A	Shot-SP	--	--	--
008	F/0 in '84	--	--	--	--	Coy	Ylg	A	A	A	A	Shot-SP		----
024	M/0 in '84	--	--	--	--	COY	YLG	A	A	A	A	A	Shot-F	--
1985 captures														
427	M/3 in '85	--	--	--	--	--	A	Shot-SP	--	--	--	--	--	--
429	F/1 in '85	--	--	--	--	--	A	Shot-SP	--	--	--	--	--	--
437	F/2 in '85	--	--	--	--	--	A	A	ND	ND	ND	ND	ND	ND
442	M/13 in '85	--	--	--	--	--	A	Shot-SP	--	--	--	--	--	--
443	M/A in '85	--	--	--	--	--	A	ND	ND	ND	ND	ND	ND	ND
447	F/7 in '85	--	--	--	--	--	A	Shed collar	ND	ND	ND	ND	ND	ND
1986 captures														
453	F/1 in '86	--	--	--	--	--	--	(COY)	(YLG)	(@2)	Shot-SP	--	--	--
454	F/4 in '86	--	--	--	--	--	--	A	A(coy)	ND	ND	ND	ND	ND
455	M/8 in '86	--	--	--	--	--	--	A	A	ND	Shot-F	--	--	--
456	F/6 in '86	--	--	--	--	--	--	A	Shot-SP	--	--	--	--	--
457	M/7 in '86	--	--	--	--	--	--	A	A	A	Shot-F	--	--	--
458	F/18 in '86	--	--	--	--	--	--	A	A(coy)	A(coy)	ND	Shot-SP		----
459	F/3 in '86	--	--	--	--	--	--	A	A	A	ND	ND	ND	ND
460	F/7 in '86	--	--	--	--	--	--	A(coy)	A(ylg)	A	A(coy)	A(YLG)	A(@2)	A(@3)
460a	F/0 in '86	--	--	--	--	--	--	A(w/460)	A(w/460)	Shot-F	--	--	--	--
461	F/5 in '86	--	--	--	--	--	--	A	A(coy)	A(ylg)	A	ND	ND	ND
462	F/10 in '86	--	--	--	--	--	--	A(ylg)	A(coy)	A(ylg)	A	ND	ND	ND
465	F/3 in '86	--	--	--	--	--	--	A	A	ND	ND	ND	ND	ND
467	M/3 in '86	--	--	--	--	--	--	A	ND	ND	ND	ND	ND	ND
1987 captures														
466	F/2 in '87	--	--	--	--	--	--	--	A	A	A	A	Shot-SP	--
468	F/2 in '87	--	--	--	--	--	--	--	(YLG)	A	A	A	Shot-SP	--
469	M/6 in '87	--	--	--	--	--	--	--	A(ylg)	ND	ND	ND	ND	--
470	M/2 in '87	--	--	--	--	--	--	--	Shot-F	--	--	--	--	--

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Table 6. Continued.

Bear ID	Sex/Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992(sp.)
001	F/0 in '87	--	--	--	--	--	--	--	COY	COY	A	A	A	Shot-SP
002	M/0 in '87	--	--	--	--	--	--	--	YLG	YLG	A	A	A	Shot-SP
471	M/1 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
472	F/12 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
473	F/6 in '87	--	--	--	--	--	--	--	A	Shot-F	--	--	--	--
474	M/3 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
476	M/2 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
477	F/2 in '87	--	--	--	--	--	--	--	Shot-F	--	--	--	--	--
478	F/9 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
479	M/2 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
480	F/2 in '87	--	--	--	--	--	--	--	A	ND	ND	ND	ND	ND
481	F/14 in '87	--	--	--	--	--	--	--	A(ylg)	A	ND	ND	ND	ND
482	F/7 in '87	--	--	--	--	--	--	--	A(ylg)	ND	ND	ND	ND	ND
A. Max. no. marked bears potentially alive in year, includes ND. Excludes tagging and natural mortalities and ND for coy or ylgs when originally marked except if shot later. (M:F)		25(14:11)	32(15:18)	30(11:19)	46(19:27)	48(17:31)	48(18:30)	52(14:38)	62(17:45)	58(15:43)	54(14:40)	48(12:36)	45(11:34)	40(9:31)
		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992(sp.)
B. No KNOWN shot in year (M:F)			1(1:0)	3(3:0)	1(1:0)	3(1:2)	6(5:1)	5(2:3)	6(3:3)	4(2:2)	3(1:2)	6(2:4)	3(1:2)5(2:3)--	
Min. % known shot (B/A)		4%	9%	3%	7%	13%	10%	12%	6%	5%	11%	6%	11%--	
males		18%	20%	9%	5%	29%	11%	20%	12%	7%	14%	8%	18%--	
females		0	0	0	7%	3%	10%	8%	4%	5%	10%	6%	9%--	
C. No. known shot plus suspected (unreported) shot in year (M:F).		1(1:0)	4(3:1)	1(1:0)	3(1:2)	8(5:3)	5(2:3)	6(3:3)	4(2:2)	3(1:2)	7(2:5)	3(1:2)	5(2:3)--	
Probable min. % shot (C/(A-suspects)		4%	13%	3%	7%	17%	11%	11%	7%	6%	15%	6%	11%--	
D. o. bears known alive (excludes ND, died, lost, cubs, or ylgs).		23	29	28	43	39	40	43%	37%	31	26	21	19--	

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Table 6. Continued.

Bear ID	Sex/Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992(sp:)
Probable min. % shot (C/(A-suspects)		4%	13%	3%	7%	17%	11%	11%	7%	6%	15%	6%	11%	--
D. -- (excludes ND, died, lost, cubs, or ylgs).		No. bears known alive			23	29	28	43	39	40	43%	37%	31	262119
Probable % shot (C/D)		4%	14%	4%	7%	21%	13%	14%	11%	10%	27%	14%	26%	--
Cumulative % shot (based on bear-years available, from row A and C).		4%	9%	7%	7%	9%	10%	10%	9%	9%	9%	9%	8%	--

Not Included:

Subadults @2 in 1980: 285;
1983: 397 & 398 both recaptured in 1985
1986: 464, 466
Subadults @1 in 1980: 298;
1983: 383;
1984: 418, 419
1986: 463
1987: 468, 475

* G373 (M@9 in 1982) not included as it shed its collar and had no ear tags or tattoo, so was not recognizable as a marked bear subsequently.

** Downstream study area

*** Captured earlier as part of studies outside of Su-Hydro area.

Not all were available during whole year as tagging was done after the spring hunting season.

Table 7. Summary of Nelchina Basin brown bear litter size data for cub-of-the-year (based on spring observations of radio-collared bears), 1978-92 (spring).

Bear ID (year-age)	Litter Size (COY) (year)	Comments	Usable Summary
206 (1978, 13)	3 (1979)	Lactating female with male in 1978, during last observation prior to shedding collar the cubs were not seen but undergrowth was thick (6/17/79).	none
207 (1978, 11)	3 (1978)	When last seen on 10/7/78 had all three cubs on 5/31/79, had only 1 ylg. which stayed with her until last observation on 9/12/79.	2 of 3 lost
213 (1978, 10)	2 (1979)	Lost apparent ylg. due to 1978 capture, had newborns when transplanted in 1979, lost these 8-16 days after release, bear apparently died in study area after return.	none-transplant bias
231 (1979, 13)	3 (1979)	Turgid in 1978, bred, lost 2 of 3 cubs by 6/11/79, survivor lived at least until lat observation on 8/3/79 (no exit data in 1980).	2 of 3 lost
273 (1987, 11)	3 (1987)	Survived to exit	0 of 3 lost
273 (1991, 15)	3 (1991)	Survived	0 of 3 lost
281 (1983, 6)	2 (1983)	Both killed by brown bear by 6/1/83, cubs collared.	2 of 2 lost

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Table 7. Continued.

Bear ID (year-age)	Litter Size (COY) (year)	Comments	Usable Summary
281 (1984, 7)	2 (1984)	Lost both in May, 1 suspected killed by brown bear, other unknown (accidental drowning?), collared cubs.	2 of 2 lost
281 (1985,8)	2 (1985)	Lost 1 in June, other survived	1 of 2 lost
281 (1988, 11)	2 (1988)	Both survived	0 of 2 lost
281 (1992, 15)	2 (1992)	----	----
283 (1981, 13)	2 (1981)	Weaned 2@2 in 1980, lost 1 cub by 9/1 other lost as ylg.	1 of 2 lost
283 (1983, 15)	1 (1983)	Killed by brown bear by 5/17/83, cub was collared	1 of 1 lost
283 (1985, 17)	2 (1985)	Both survived to den exit	0 of 2 lost
283 (1989,21)	2 (1989)	Both survived to den exit	0 of 2 lost
283 (1992, 24)	1 (1992)	----	----
299 (1982, 15)	1 (1982)	Bear weaned 2@2 in 1981, cub lost by 6/9/62.	1 of 1 lost
299 (1983, 16)	3 (1983)	All cubs collared, alive to den exist.	0 of 3 lost
312 (1981,11)	2 (1981)	Had a 2-year-old in 1980, lost 1 cub by 6/18, other weaned in 1983.	1 of 2 lost
312 (1984, 14)	3 (1984)	Capture-related losses (collared)	none

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Table 7. Continued.

Bear ID (year-age)	Litter Size (COY) (year)	Comments	Usable Summary
313 (1981, 10)	1 (1981)	Bear had a 2-year-old offspring in 1980, lost cub (possible capture-related)	1 of 1 lost (capture related?)
313 (1982, 11)	2 (1982)	Both survived	0 of 2 lost
314 (1987, 9)	3 (1987)	Lost 1 in late summer, other survived	1 of 3 lost
314 (1990, 12)	2 (1990)	Lost 1 in May naturally, other capture loss	1 of 1 lost
314 (1991, 13)	3 (1991)	Survived to den exit	0 of 3 lost
335 (1984, 6)	2 (1984)	Both survived to den exit	0 of 2 lost
335 (1988, 10)	2 (1988)	Survived	0 of 2 lost
337 (1981, 13)	3 (1981)	Cubs and female reunited, 1 cub lost in 81/82 den, other 2 survived to exit (1 weaned in 1983, other lost as ylg).	1 of 3 lost
337 (1984, 16)	2 (1984)	Both survived to den exit, collared cubs	0 of 2 lost
340 (1984, 6)	2 (1984)	Both survived to den exit, collared cubs.	0 of 2 lost
340 (1987, 9)	3 (1987)	Lost all in early summer, bred	3 of 3 lost
340 (1988, 10)	2 (1988)	Lost 1 in summer	1 of 2 lost
340 (1991, 13)	3 (1991)	Survived to den exit	0 of 3 lost
341 (1982, 7)	2 (1982)	Survived until 7/15/82 when bear was lost	none
341 (1986, 11)	1 (1986)	Survived	0 of 1 lost

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Table 7. Continued.

Bear ID (year-age)	Litter Size (COY) (year)	Comments	Usable Summary
344 (1981, 5)	2 (1981)	Both lost in '82 as yearlings	0 of 2 lost
344 (1983, 7)	2 (1983)	Lost 1 in early July - other survived to den exit.	1 of 2 lost
379 (1982, 5)	2 (1982)	Both survived	0 of 2 lost
381 (1985, 6)	2 (1985)	Survived to exit	0 of 2 lost
381 (1988, 9)	3 (1988)	Survived to exit	0 of 3 lost
384 (1984, 13)	2 (1984)	Survived to September at least	0 of 2 lost
388 (1984, 15)	2 (1984)	Capture-related losses (collared)	none
388 (1985, 16)	2 (1985)	Survived to den exit	0 of 2 lost
388 (1988, 19)	2 (1988)	Survived to exit	0 of 2 lost
394 (1983, 6)	1 (1983)	Lost (capture related?) by 5/16, bred	1 of 1 lost (capture related?)
396 (1984, 14)	1 (1984)	Lost in May	1 of 1 lost
396 (1985, 15)	2 (1985)	Lost both in June, bred	2 of 2 lost
396 (1989, 19)	3 (1989)	All survived to exit, very large	0 of 3 lost
403 (1983, 6)	2 (1983)	Lost 1 in Sept., other ok to den exit	1 of 2 lost
403 (1986, 9)	3 (1986)	2 survived to exit	1 of 3 lost

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Table 7. Continued.

Bear ID (year-age)	Litter Size (COY) (year)	Comments	Usable Summary
420 (1986, 21)	2 (1986)	Both lost in mid-summer	2 of 2 lost
423 (1984, 21)	4 (1984)	One died in July (collared), others ok to den exit.	1 of 4 lost
423 (1987, 24)	1 (1987)	Lost in early summer	1 of 1 lost
425 (1985, 14)	2 (1985)	Survived	0 of 2 lost
425 (1988, 17)	1 (1988)	Lost in June	1 of 1 lost
425 (1989, 18)	2 (1989)	Suspect shot in fall	none
447 (1986, 8)	2 (1986)	Lost contact (shed collar)	none
453 (1986, 4)	2 (1986)	Both survived to exit	0 of 2 lost
454 (1987, 5)	2 (1987)	Unknown survival (shed collar)	none
456 (1986, 6)	2 (1986)	Cubs lost in den?	2 of 2 lost
458 (1987, 18)	1 (1987)	Lost in mid-summer	1 of 1 lost
458 (1988, 19)	3 (1988)	Survived thru Sept., shed in spring	0 of 3 lost ?
460 (1986, 7)	2 (1986)	1 lost due to capture	none
460 (1989, 10)	2 (1989)	Survived to exit	0 of 2 lost

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Table 7. Continued.

Bear ID (year-age)	Litter Size (COY) (year)	Comments	Usable Summary
461 (1986, 5)	1 (1986)	Lost due to capture	none
461 (1987, 6)	2 (1987)	1 lost in mid-summer, other survived	1 of 2 lost
461 (1990, 9)	2 (1990)	1 lost June - October	1 of 2 lost
462 (1987, 8)	2 (1987)	Survived	0 of 2 lost

<u>Summary</u>

No. of cubs	No. of litters	mean litter size (range)	
144	68	2.1 (1-4)	40 of 120 cubs lost in first year of life = 33.3% (2 of these possibly capture-related).

Table 8. Summary of Nelchina Basin brown bear litter size data for litters of yearlings (based on spring observation of radio-collared bears), 1978-1992 (spring).

Bear ID (year-age)	Litter Size (ylgs.) (year)	Comments	Summary
207 (1978, 11)	1 (1979)	Survived until 9/12/79	0 of 1 lost
213 (1978, 10)	1 (1978)	Apparent ylg. was not captured, had cubs following year	1 of 1 lost (capture related?)
220 (1978, 5)	1 (1978)	Ylg. entered den and was weaned in 1979, bred	0 of 1 lost
221 (1978, 8)	2 (1978)	Survived, weaned in 1979	0 of 2 lost
231 (1978, 12)	1 (1979)	Survived until 8/79	none
234 (1978, 5)	2 (1978)	Paxson dump bear, lost apparent ylgs. between 6/23/78 and 8/4/78, reportedly had cubs in August 1979, radio failed	none
240 (1979, 5)	2 (1979)	Bear transplanted with ylgs., not known if ylgs., survived to return to study area, bear was alone on 7/18/80	none
244 (1979, 6)	1 (1979)	Thin female transplanted with ylg., ylg. survived at least 21 days, female bred, but alone in July and August 1980	none-transplant bias
251 (1979, 10)	2 (1979)	Very large ylgs. lost 10-17 days after transplant, bear had no cubs in 1980 (August)	none-transplant bias
254 (1979, 9)	2 (1979)	Female died after transplant (ylgs.??)	none
261 (1979, 7)	2 (1979)	Lost 1 ylg. between 1 and 7 days after transplant, other survived at least until Sept., didn't return to study area.	none-transplant bias

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Table 8. Continued.

Bear ID (year-age)	Litter Size (ylgs.) (year)	Comments	Summary
269 (1979, 16)	2 (1979)	Transplanted, returned to study area with female, no cubs on 9/29/80, shot in fall 1981 reportedly without cubs	none-transplant bias
273 (1988, 12)	3 (1988)	Survived	0 of 3 lost
273 (1992, 16)	3 (1992)	--	--
274 (1979, 11)	1 (1979)	Transplanted, no radio	none
277 (1980, 10)	2 (1980)	Ylgs. visually aged, not captured, survived to enter den, no exit data as bear shed collar in den	0 of 2 lost
281 (1986, 9)	1 (1986)	Survived, weaned next year	0 of 1 lost
281 (1989, 12)	2 (1989)	Survived	0 of 2 lost
283 (1982, 140	1 (1982)	Lost by 5/18/82	1 of 1 lost
283 (1986, 18)	2 (1986)	Survived, weaned next year	0 of 2 lost
283 (1990, 22)	2 (1990)	Survived, weaned next year	0 of 2 lost
299 (1980, 13)	2 (1980)	Both survived, weaned next year	0 of 2 lost
299 (1984, 17)	2 (1984)	Survived with internals to exit from den	0 of 3 lost
312 (1982, 12)	1 (1982)	Survived, weaned next year	0 of 1 lost
313 (1983, 120	2 (1983)	Lost 1 (surgery related?) by 6/2/83, other survived through October	0 of 1 lost

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Table 8. Continued.

Bear ID (year-age)	Litter Size (ylgs.) (year)	Comments	Summary
314 (1988, 10)	2 (1988)	Survived to exit	0 of 2 lost
314 (1985, 7)	1 (1985)	Survived to den exit	0 of 1 lost
314 (1992, 14)	3 (1992)	----	----
335 (1985, 7)	2 (1985)	1 lost in June, other survived to exit	1 of 2 lost
335 (1989, 11)	2 (1989)	Survived	?
337 (1982, 14)	2 (1982)	Lost 1 by 6/17/82, other survived	1 of 2 lost
337 (1985, 17)	2 (1985)	Survived to den exit	0 of 2 lost
340 (1985, 7)	2 (1985)	Survived to October at least	0 of 2 lost (?)
340 (1989, 11)	1 (1989)	Survived through October at least	0 of 1 lost (?)
340 (1992, 14)	3 (1992)	--	--
341 (1987, 12)	1 (1987)	Survived	0 of 1 lost
344 (1982, 6)	2 (1982)	Lost 1 by 6/17, other by 7/26/82	2 of 2 lost
344 (1984, 8)	1 (1984)	Lost 1 in May, sibling lost year before	1 of 1 lost
379 (1983, 6)	2 (1983)	Lost 1 in June-September period	1 of 2 lost
380 (1982, 15)	2 (1982)	Both survived to den entrance, at least 1 exited den and was weaned	0 of 2 lost
381 (1986, 7)	2 (1986)	Survived, weaned next year	0 of 2 lost

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Table 8. Continued.

Bear ID (year-age)	Litter Size (ylgs.) (year)	Comments	Summary
381 (1989, 10)	3 (1989)	Mother shot in fall	0 of 2 lost
388 (1986, 17)	2 (1986)	Survived, weaned next year	0 of 2 lost
388 (1989, 20)	2 (1989)	Survived to exit	0 of 2 lost
396 (1990, 22)	3 (1990)	Survived	0 of 3 lost
403 (1984, 7)	1 (1984)	Survived through November at least	0 of 1 lost
403 (1987, 10)	2 (1987)	--	--
420 (1984, 19)	2 (1984)	Survived to den exit	0 of 2 lost
423 (1985, 22)	3 (1985)	All survived to den exit	0 of 3 lost
425 (1986, 15)	2 (1986(	Both lost in mid-summer - possibly capture related. Not seen until 6 weeks following capture. Bred in 1987.	none
453 (1987, 5)	2 (1987)	Survived to exit	0 of 2 lost
460 (1987, 8)	1 (1987)	Survived until September, assume weaned at 2 as was shot the next fall	0 of 1 lost
460 (1990, 11)	2 (1990)	Survived to den exit	0 of 2 lost
460 (1991, 10)	1 (1991)	Survived to den exit	0 of 1 lost
461 (1988, 8)	1 (1988)	?	?
462 (1988, 9)	2 (1988)	Survived	0 of 2 lost

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Table 8. Continued.

Bear ID (year-age)	Litter Size (ylgs.) (year)	Comments	Summary
469 (1987, 6)	2 (1987)	Survived until mid-summer	--
472 (1987, 12)	1 (1987)	Collar removed, lost control	none
478 (1987, 9)	2 (1987)	--	--
481 (1987, 14)	3 (1987)	At least 2 survived to exit	0 of 2 lost (?)
482 (1987, 7)	3 (1987)	Collar removed, lost contact	none

Summary

No. of yearlings	No. litters	mean litter size (range)	
114	61	1.87 (1-3)	8 of 72 lost = 11.1% (1 loss possibly capture-related)

Table 9. Summary of Nelchina Basin bear litter size date for litters of 2-year-olds (based on observations of radio-collared bears).

Bear ID (year-age)	2-year-old Litter Size (year)	Comments
204 (1978,7)	2 (1978)	weaned by 6/19/78, bred
273 (1989, 13)	2 (1989)	--
281 (1987, 10)	1 (1987)	weaned by 6/5
281 (1990, 13)	2 (1990)	weaned, bred
283 (1980, 12)	2 (1980)	weaned in mid-June, bred, new litter next year
283 (1987, 19)	2 (1987)	2(+?) still with mother in '88, weaned next year
283 (1991, 22)	2 (1991)	weaned in spring
312 (1980, 10)	1 (1980)	weaned right after capture in May, new litter in 1981
312 (1983, 13)	1 (1983)	weaned by 6/13, bred
313 (1980, 9)	1 (1980)	weaned by May, bred, new litter in 1981
313 (1984, 13)	1 (1984)	weaned in May, bred
220 (1978, 5)	1 (1979)	weaned by 6/17, bred
221 (1978, 8)	2 (1979)	--
269 (1979, 16)	2? (1980)	--
299 (1980, 13)	2 (1981)	weaned in 5/81, new litter in 1982
337 (1983, 15)	1 (1983)	weaned by 5/15, bred
337 (1986, 18)	2 (1986)	still with mother in 86/87 den, weaned next year
381 (1987, 8)	2 (1987)	weaned in spring
384 (1983, 12)	3 (1983)	weaned by 6/13, one of these 3 may not have been part of this litter, bred

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Table 9. Continued

Bear Id (year-age)	2-year-old Litter Size (year)	Comments
388 (1983, 14)	2 (1983)	weaned by 6/13, bred
388 (1987, 18)	2 (1987)	weaned by 6/23
388 (1990, 21)	2 (1990)	weaned, bred
396 (1983, 13)	2 (1983)	weaned by 6/1, bred
396 (1991, 21)	2 (1991)	Survived, not weaned
331 (1981, 6)	2 (1981)	weaned by 6/15, bred, no cubs in 1982, died in 1982 (reason?)
379 (1984, 7)	1 (1984)	apparently weaned cub (time?), bred
314 (1986, 8)	1 (1986)	weaned
314 (1989, 11)	2 (1989)	weaned
420 (1985, 20)	2 (1985)	weaned in May
423 (1986, 23)	3 (1986)	weaned
335 (1990, 12)	2 (1990)	not weaned
341 (1988, 13)	1 (1989)	--
453 (1988, 6)	2 (1988)	shot in fall
460 (1991, 12)	2 (1991)	survived, not weaned
461 (1989, 10)	2 (1989)	weaned, no more data
461 (1992, 12)	1 (1992)	still w/mom on 6/18/92
481 (1988, 15)	2 (1988)	??

Summary

No. of 2-year-olds	No. of litters	Mean litter size (range)
65	37	1.76 (1-3)

Table 10. Summary of Nelchina Basin bear litter sizes for litters of 3- and 4-year-old offspring.

Bear Id (year-age)	3-year-old Litter Size (year)	Comments
337 (1987, 19)	2 (1987)	weaned
283 (1988, 21)	2(1988)	weaned
273 (1990, 14)	2 (1990)	weaned > 10/91, < 5/12/92, bred
335 (1991, 13)	2 (1991)	not weaned until next year
396 (1992, 22)	3 (1992)	weaned in June
460 (1992, 13)	2 (1992)	--

Bear ID (year-age)	4-year-old Litter Size (year)	Comments
335 (1992, 14)	2 (1992)	weaned in June

Table 11. Morphometrics of brown bear cubs-of-the-year handled in GMU 13, 1978-92.

Cub ID	Mother's ID	Date Handled	Sex	Wt(lbs)	Comments
001	G213	22 May 1979	M	10.0	transplanted see Spraker
002	G213	22 May 1979	M	10.0	et al. (1981)
--	G207	27 May 1978	M	12.0	see Spraker, et al. (1981)
--	G207	27 May 1978	F	12.0	
G338	G283	6 May 1981	M	12.0	ear tagged
G339	G283	6 May 1981	F	13.0	ear tagged
G336	G313	6 May 1981	F	--	cub abandoned?, ear tagged
003	G283	14 May 1983	F	--	collared
004	394	15 May 1983	F	10.0	neck=230mm, ear tagged
005	G281	15 May 1983	M	8.5	collared
006	G281	15 May 1983	F	8.3	collared
418	G299	18 May 1983 (den)		M	over 10.0neck=225mm, collared
419	G299	18 May 1983 (den)		M	over 10.0neck=245mm. collared
417	G299	18 May 1983 (den)		M	over 10.0neck=225mm, collared
016	G388	16 May 1984	M	13.5	collared, 13.5 lbs (5/29/84
017	G388	16 May 1984	F	-	collared
021	G281	17 May 1984	M	14.0	collared, neck=250mm
022	G281	17 May 1984	M	13.5	collared
008	G337	17 May 1984	F	12.3	collared, neck=220mm
009	G337	17 May 1984	F	11.5	collared, neck=230mm
023	G340	17 May 1984	?	16.5	collared
024	G340	17 May 1984	?	14.0	collared
025	G423	18 May 1984	M	7.0	collared, smallest of 4 in litter
---	G423	18 May 1984	F	-	not collared
018	G312	16 May 1984	F	17.0	collared
019	G312	16 May 1984	M	16.0	collared
020	G312	16 May 1984	M	17.0	collared

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Table 11. Continued.

Cub ID	Mother's ID	Date Handled	Sex	Wt(lbs)	Comments
---	G453	3 June 1986	F	15.0	ear tagged
---	G453	3 June 1986	F	17.0	ear tagged
---	G456	4 June 1986	M	33.0	ear tagged
---	G460	4 June 1986	M	30.0	capture mortality
---	G460	4 June 1986	F	30.0	ear tagged
---	G461	5 June 1986	M	26.0	ear tagged
---	G273	5 June 1987	F	16.0	ear tagged
---	G273	5 June 1987	M	18.0	ear tagged

Totals: 18 males and 15 females: $X^2 = 0.27$, 1.2.d.f., $\underline{P} = 0.60$

Table 12. Morphometrics of brown bears first handled as yearlings in GMU 13, 1978-1992.

Ylg ID	Mother's ID	Date Handled	Sex	Wt(lbs)	Comments
G232	G234	23 June 1978	F	100(est.)	Spraker, et al (1981)
G235	G234	23 June 1978	F	100(est.)	
G238	G240	23 May 1979	M	95	transplanted, see
G239	G240	23 May 1989	F	65	Ballard et al. 1980
G245	G244	24 May 1979	F	46	transplanted, op. cit.
G252	G251	27 May 1979	M	134	transplanted, op cit.
G253	G251	27 May 1979	M	139	
G256	G254	27 May 1979	M	47	transplanted, op cit.
G257	G254	27 May 1979	M	47	
G262	G261	2 June 1979	M	90	transplanted, op cit.
G263	G261	2 June 1979	M	87	
G270	G269	6 June 1979	F	100	transplanted, op cit.
G271	G269	6 June 1979	F	95	
G275	G274	7 June 1979	M	68	transplanted, op cit.
G297	G399	4 May 1980	M	65	tagged
G298	G399	4 May 1980	M	65	tagged
G382	G313	14 May 1983	M	66	implant transmitter
G383	G313	14 May 1983	F	53	implant transmitter, died
G417	G299	15 May 1984	M	94	implant transmitter, (small)
G418	G299	15 May 1984	M	86	implant transmitter, (large)
G419	G299	15 May 1984	M	84	implant transmitter, (small)
G421	G420	17 May 1984	M	78	sibling not captured, large implant and breakaway.
G429	G314	1 June 1985	F	104	breakaway collar, shot 9/86.
G463	G462	5 June 1986	M	90(est.)	ear tagged
G468	G453	30 May 1987	F	70(est.)	glue on radio
G475	G472	31 May 1987	M	75(est.)	glue on radio

Totals: 17 males and 9 females: $X^2 = 2.46$, 1d.f., $\underline{P} = 0.12$.

Table 13. Age at first reproduction for GMU 13 brown bears.

ID No.	Age 3	4	5	6	7	8	9
202	?	?	?	?	?	adult	adult
204	?	?	cubs	adult	adult	adult	adult
209	?	open	open[c]	open	?	?	?
215	open	open	?	?	?	?	?
219	?	open	?	?	?	?	?
220	?	cubs	adult	adult	adult	adult	adult
221	?	?	?	?	adult	adult	adult
234	?	cubs	adult	adult	adult	adult	adult
240	?	cubs	adult	adult	adult	adult	adult
244	?	?	cubs	adult	adult	adult	adult
248	?	open	?	?	?	?	?
261	?	?	?	adult	adult	adult	adult
264	?	open	?	?	?	?	?
267	?	open	?	?	?	?	?
273	open	?	?	?	?	?	?
277	?	?	?	?	?	?	adult
281	open	open	open	adult	adult	adult	adult
306	open	?	?	?	?	?	?
312	?	?	?	?	?	adult	adult
313	?	?	?	?	adult	adult	adult
314	?	?	?	adult	adult	adult	adult
315	open	?	open	open	?	?	?
331	?	cubs	adult	adult	adult	adult	adult
334	?	?	?	?	?	adult	adult
335	open	open	open	cubs	adult	adult	adult
340	open	open	open	cubs	adult	adult	adult
341	?	?	?	open[c]	adult	adult	adult
344	?	?	cubs	adult	adult	adult	adult
379	?	?	cubs	adult	adult	adult	adult
381	open	open	open	adult	adult	adult	adult
385	open	open	?	?	?	?	?
394	?	?	?	adult	adult	adult	adult
395	open	?	?	?	?	?	?
397	?	open	?	?	?	?	?
398	?	open	open	?	?	?	?
403	?	?	?	adult	adult	adult	adult
407	?	open	open	open	open	open	cubs?
447	?	?	?	?	open[c]	adult	adult
453	?	cubs	adult	adult	adult	adult	adult
454	?	?	cubs	adult	adult	adult	adult
456	?	?	?	cubs	adult	adult	adult
459	open	open	open	?	?	?	?

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Table 13. Age at first reproduction for GMU 13 brown bears.

ID No.	Age 3	4	5	6	7	8	9
460	?	?	?	?	cubs	adult	adult
461	?	?	cubs	adult	adult	adult	adult
462	?	?	?	cubs	adult	adult	adult
465	open	open	open	?	?	?	?
469	?	?	cubs	adult	adult	adult	adult
478	?	?	?	?	?	adult	adult
482	?	?	?	cubs	adult	adult	adult

[a] The following calculations exclude all question marks.

Age	3	4	5	6	7	8	9
# sub-adults	12	15	10	3	1	1	0
# 1st litters	0	5	7	6	1	0	1
# >1st litters	0	0	5	17	26	32	33
% adults	0.0	25.0	54.5	88.5	96.4	97.0	100.0

Mean age of first litter = 5.35 years.

The following calculations correct for missing data by assuming litters were produced the following year for bears that died prematurely (when >5.4).

Age	3	4	5	6	7	8	9
# sub-adults	11	15	8	3	1	1	0
# 1st litters	0	5	6	9	3	0	1
# >1st litters	0	0	5	17	26	32	33
% adult	0.0	25.0	57.9	89.7	96.7	97.0	100.0

Mean age of first litter = 5.58 years

[b] adult means first litter was at indicated age or younger.

[c] open means had no litter but not considered a subadult as could have had a previous, unobserved litter.

Table 14. Summary of reproductive intervals for brown bears by bear ID. Based on data in Table 11, this report. Year litter was born and reason for intervals >3 years are indicated in parentheses; "lost" means lost complete litter at age coy unless otherwise indicated. Interval is defined as weaning of 1 litter to weaning of next litter or as from production of first litter to first weaning.

ID of Bears with Complete Intervals of:					
2 Years	3 Years		4 Years	5 Years	8 Years
472*(85)	220(77)*	335(84)	313(82, 1 lost)	281(85, 2 lost)	283(85, 1 lost @ age 1;
221(77)*	340(84)	299(83, 1 lost)		1 lost @ age 0;	314(84)*312(81)337(84, weaned
@age=3)	1 skipped				
	314(87)	337(81)	340(88, lost 1)		
	380(81)*	337b(84)			
	420(83)*	388(85)			
	379(82)	388(88)			
	423(84)	381(85)			
	299(79)*	281(88)			
	388(88)	403(83)			
	460(86)	453(86)			
	462(87)	461(87)			
		481**(86)			
		283(89)			
		273(87)			

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Table 14. Continued

Incomplete Intervals That Will Be at Least the Indicated Length: 3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years
283(92) 340(91) 461(90)	420(87, (lost 1)	403(1 lost @ age 1)	335(87, skipped 1, didn't wean until age 4	344(85, lost 2 @ age 1)	337(93, skipped 5)	423(93, lost 1, skipped 5)
	460(89, didn't wean @2)	458(88, lost 1 skipped 1)		425(89, lost 1 @ age 1 and 1 @ 0, skipped 1)		396(93), lost 2, skipped 2, didn't wean until age 3
	331(83, skipped 1)	388(93, skipped 2)				
	281(92, skipped 1)					
	341(86, skipped 1)					
	314(91, lost 1)					
	273(91, skipped 1)					

* Litter was first observed when composed of 1-year-olds

Summary:

Average Reproductive Interval

Complete Intervals Only (n = 34)	3.3 years
Incomplete Intervals Only (n = 18)	5.6 years
Complete and Incomplete (n = 52)	4.19 years

Table 15. Brown bear offspring survivorship and weaning, GMU 13 studies, (excludes bears transplanted in 1979).

	Mother's ID (age in year when first captured)				
Year	G207 (11 in 1978)	G220 (5 in 1978)	G221 (8 in 1978)	G204 (7 in 1978)	G321 (12 in 1978)
1978	3 cubs, April-Oct.	1 ylg., May-Oct.	2 ylgs., May-Oct.	2 @ 2 in May, weaned	bred
1979	1 ylg., May-Sept. 2 yrlgs., lost in 78/79 den?	1 @ 2, weaned in June	2 @ 2 weaned	no data in May, radio failure	2 of 3 cubs lost in June, 1 survived April-Sept.
1980	no data	no data	no data	no data	no data

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Table 15. Continued.

Year	Mother's ID (age in year when first captured) G312 (10 in 1980)	G299 (13 in 1980)	G313 (9 in 1980)	G283 (13 in 1980)	G281 (3 in 1980)
1980	weaned 1 @ 2 in May, breeding not observed	2 of 2 ylgs. survived May-Oct.	weaned 1 @ 2 in May, bred	weaned 2 @ 2 in June, bred	not estrous
1981	1 of 2 cubs lost in June, other survived May-Oct.	weaned 2 @ 2 in May and bred	1 @ 0 lost in May (capture related?)	1 of 2 cubs lost in Aug., other survived	estrous, bred
1982	yearling survived	lost 1 of 1 @ 0 in June	2 @ 0 survived	lost 1 @ 1 in May, bred	alone, bred
1983	weaned 1 @ 2 in June, bred, off-spring = G385, transmitted	3 @ 0 survived (w/collars)	1 @ 1 lost in June (transmitted internally), sibling survived	lost 1 @ 0 in May, bred, lost cub had transmitter	2 @ 0 lost in May (bear predation), not seen breeding
1984	w/2 @ 0-bear killed in May	3 @ 1 survived (w/internals)	1 @ 2 weaned in May, shot	alone, bred	2 @ 0 lost in May, bred
1985	--	weaned 2-year-olds, collar failed?	--	2 @ 0, survived	2 @ 0, 1 lost in June, other survived
1986	--	ND	--	2 @ 1, survived	1 @ 1, survived
1987				2 @ 2 survived into den	1 @ 2 weaned
1988	--	ND	--	2 @ 3 weaned	2 @ 0, survived

same bears continued on next page

Table 15. Continued.

Year	G312 (10 in 1980)	G299 (13 in 1980)	G313 (9 in 1980)	G283 (13 in 1980)	G281 (3 in 1980)
	Mother's ID (age in year when first captured)				
1989	--	ND	--	2 @ 0	2 @ 1
1990	--	ND	--	2 @ 1, survived	2 @ 2 weaned in May, bred
1991	--	ND	--	2@2, weaned	alone
1992 (thru June)	--	ND	--	1@0	w/2@0

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Table 15. Continued

	Mother's ID (age in year when first captured)					
Year	G331 (6 in 1981)	G341 (6 in 1981)	G337 (13 in 1981)	G344 (5 in 1981)	G335 (3 in 1981)	G340 (3 in 1981)
1981	2 @ 2 weaned in May, bred	alone, bred in May	lost 1 @ 0 in winter den, 2 survived	2 @ 0 survived	weaned from mother	alone
1982	no cubs, bred, died in July (reason?)	had 2 @ 0 thru July, bear missing subsequently	lost 1 @ 1 in June, other survived	lost 1 @ 1 in May, lost other in early July	alone, bred	alone
1983	--	no data	weaned 1 @ 2 in May, bred	2 @ 0, lost 1 by late June, other survived	alone, bred	alone
1984	--	no data	w/2 @ 0, collared, both survived	1 @ 1 lost in May, bear lost in July	w/2 @ 0 thru Oct.	w/2 @ 0, survived
1985	--	alone	w/2 @ 1, survived	ND	2 @ 1, 1 lost in June	2 @ 1 survived to den entrance
1986	--	w/1 @ 0	w/2 @ 2	ND	1 @ 2 weaned	alone, assume weaned young
1987	--	w/1 @ 1	2 @ 3, weaned	ND	alone, bred	3 @ 0, all lost early in summer bred

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Table 15. Continued

	Mother's ID (age in year when first captured)					
Year	G331 (6 in 1981)	G341 (6 in 1981)	G337 (13 in 1981)	G344 (5 in 1981)	G335 (3 in 1981)	G340 (3 in 1981)
1988		w/1 @ 2 in May, mom	alone	ND	w/2 @ 0	w/2 @ 0, 1 lost in died in
88/89				summer		
		den				
1989	ND	--	alone	ND	w/2 @ 1	w/1 @ 1 thru October, lost in den? mom skinny
1990	ND	--	alone, not lactating	ND	w/2 @ 2, not weaned	alone; as same weaned 5/12
breeding on						
1991	ND	--	alone	ND	w/2@3	w/3@0
1992 (thru June)	ND	--	alone	ND in June	w/2@4, weaned	w/3@1

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Table 15. Continued.

Year	Mother's ID (age in year when first captured) G380 (15 in 1982)	G394 (6 in 1983)	G384 (12 in 1983)	G379 (5 in 1982)	G388 (14 in 1983)	G381 (3 in 1982)
1982	2 @ 1 survived until denning, one may have died in den	no data	no data	2 @ 0 survived	no data	alone
1983	at least 1 @ 2 weaned in May, possibly both shot in Sept.	lost 1 @ 0 in May (?capture-related possible?),bred	weaned 2 or 3 @ 2 in June, bred	1 of 2 survived lost 1 (June - Sept.)	weaned 2 @ 2	alone, bred
1984	--	alone, shot	w/2 @ 0 thru Sept., missing	probably weaned 1 @ 2 after May 23	w/2 @ 0, capture-related cub loss, bred	alone, bred
1985	--	--	ND	alone, shot	w/2 @ 0, survived	w/2 c, survived
1986	--	--	ND	--	w/2 @ 1, survived	w/2 @ 1, survived
1987					w/2 @ 2 weaned	w/2 @ 2, weaned
1988	--	--	ND	--	w/2 @ 0	w/3 @ 0
1989	--	--	ND	--	w/2 @ 1	W/3 @ 1, mom shot in fall

same bears continued on next page

Table 15. Continued.

Year	G380 (15 in 1982)	G394 (6 in 1983)	G384 (12 in 1983)	G379 (5 in 1982)	G388 (14 in 1983)	G381 (3 in 1982)
	Mother's ID (age in year when first captured)					
1990	--	--	ND	--	2 @ 2 weaned bred	--
1991	--	--	ND	--	ND, alone?	--
1992	--	--	ND	--	alone, bred	--

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Table 15. Continued.

Year	Mother's ID (age in year when first captured) G396 (13 in 1983)	G403 (6 in 1983)	G420 (19 in 1984)	G423 (20 in 1984)	G425 (14 in 1984)	273 (3 in 1979)	314 (7 in 1985)
1983	weaned 2 @ 2 in May, bred	2 @ 0 thru Aug. lost 1 in Sept.	no data	no data	no data	--	--
1984	lost litter of 1 @ 0 in May, breeding?	w/1 @1, lost after Apr.	w/2 @ 1, survived	4 @0, one lost in July, others survived to Oct.	alone, bred	--	--
1985	2 @ 0 lost in June	?	weaned 2 in May	3 @ 1 survived	w/2 cubs, survived	alone	1 @ 1 survived
1986	alone, bred	w/3 @ 0	w/2 @ 0, both lost in June	3 @ 2 weaned in May	w/2 @ 1, lost in June-July	alone	1 @ 2 weaned in May-June
1987	alone, bred	w/2 @ 1	no data	w/1 @ 0, lost in early summer	alone, bred	w/3 @ 0	3 @ 0, 1 lost in mid-summer
1988	alone, bred	ND	ND	alone	w/1 @ 0, lost in May	3 @ 1	2 @ 1
1989	w/3 @ 0	ND	ND	alone	w/2 @ 0 thru July suspect mom shot in fall	2-3 @ 2 thru Oct.	2 @ 2 weaned in May

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Table 15. Continued.

Year	Mother's ID (age in year when first captured) G396 (13 in 1983)	G403 (6 in 1983)	G420 (19 in 1984)	G423 (20 in 1984)	G425 (14 in 1984)	273 (3 in 1979)	314 (7 in 1985)
1990	w/3 @ 1, survived	ND	ND	alone	ND	assume weaned 2@3, breeding	2 @ 0, lost, mid-May, lost other because of capture in late May
1991	w/3@2	ND	ND	alone	ND	w/3@0	3@0
1992 (thru June)	w/3@3, weaned in May	ND	ND	alone (fat)	ND	w/3@1	3@1

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Table 15. Continued.

Year	Mother's ID (age in year when first captured) 453 (4 in 1986)	458 (17 in 1986)	460 (7 in 1986)
1985	--	--	--
1986	w/2 @ 0	alone, bred	w/2 @ 0, 1 lost
1987	w/2 @ 1	w/1 @ 0, lost in June, bred	w/1 @ 1 thru Sept.
1988	w/2 @ 2 in May, later?	w/3 @ 0, shed	alone assumed weaned 1 @ 2 in May (the 2-yr-old shot in Sept.)
1989	shot 4/17	ND	w/2 @ 0
1990	--	shot 5/90	w/2 @ 1, survived
1991	--	--	w/2@2, not weaned
1992 (thru June)	--	--	w/2@3

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Table 15. Continued.

Year	Mother's ID (age in year when first captured)		
	461 (5 in 1985)	462 (7 in 1986)	481 (13 in 1986)
1986	w/1 @ 0, lost, capture related?	w/1 @ 1, weaned in June?, bred	--
1987	w/2 @ 0, 1 lost in mid-summer	w/2 @ 0	w/3 @ 1 in June
1988	w/1 @ 1 thru Sept.	2 @ 1	w/2 @ 2 in May, failed
1989	assume weaned, 1 @ 2 - ND	w/2 @ 2 - weaned, bred	ND
1990	w/2 @ 0, 1 lost in May	missing 5/90	ND
1991	w/1@1, survived	--	ND
1992 (thru June)	w/1@2, not weaned in spring	--	ND

Table 16. Age at which brown bear offspring were weaned before and after 1987. Data compiled from Table 15.

Age at Weaning

Age at Weaning	Bear ID (year of weaning <1987)	Bear ID (year of weaning ≥1987)
2	220(79), 221(79), 204(78), 312(80), 312(83), 299(81), 299(85), 313(80), 313(84) 283(80), 331(81), 337(83), 335(86), 340(86), 380(83) 384(83), 379(84), 388(83) 396(83), 420(85), 423(86) 314(86)	283(91), 281(87), 281(90), 340(90), 341(88), 388(87), 388(90), 314(89), 460(88), 461(89), 461(92*), 462(89)
Total	22	12
3	0	283(88), 337(87), 396(92), 273(90), 460(92*),
Total	0	5
4	0	335(92)
Total	0	1
% weaning at >2	= 0% (n=22)	33.3% (n=18)

* Still incomplete, could be 1 year longer.

Table 17. Status of individual radio-marked adult (≥5.0 yr. old) female brown bears in GMU 13 that were "expected" to have litters of newborn cubs (COY) from 1979 to 1992. Females were classified as "expected" to have a litter of COY if they had a litter of 2-year-olds the preceding year, lost a litter during spring of the preceding year, or were at least 5 years-old and expecting their first litter.

Expected but no COY			Expected & w/COY	
Bear ID	Age	Comments	Bear ID	Age
Year = 1979				
321	13			
Year = 1980				
No Data				
Year = 1981				
331	7	died in July	312	11
			313	10
			283	14
Year = 1982				
281	5	bred in 1981	299	15
			313	11
Year = 1983				
335	5		299	16
340	5		283	16
			281	6
			344	5
			403	6
Year = 1984				
283	17		312	14
394	7		281	7
381	5		337	13
425	14		335	6
			340	6
			384	13
			388	15
			396	14
			423	21

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Table 17. Continued.

Expected but no COY Bear ID	Age	Comments	Expected & w/COY Bear ID	Age
Year = 1985				
379	8		283	18
273	9		281	8
			388	16
			381	6
			396	15
			425	15
Year = 1986				
396	16		341	11
273	10		403	9
458	17		420	21
			460	7
			461	6
Year = 1987				
337	19	w/@3	340	9
335	9		423	24
396	17		273	11
			314	9
			458	18
			461	7
			462	8
Year = 1988				
283	21	w/@3	281	11
337	20		335	10
396	18		388	19
423	25		381	9
			425	18
			458	19
Year = 1989				
337	21		283	22
423	26		396	19
			425	19
			460	10
Year = 1990				
337	22		314	12
423	26		461	10
273	14	didn't wean @ 2 in 1989		

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Table 17. Continued.

Expected but no COY			Expected & w/COY	
Bear ID	Age	Comments	Bear ID	Age
Year = 1991				
337	23		340	13
423	27		314	13
281	14		273	15
335	13	w/@3		
288	22	[Based on 1992 status]		
Year = 1992				
337	24		283	25
423	28		281	15
460	13	w/@3		
396	22	w/@3		
335	14	w/@4		
388	23			

Table 18. Summary of frequency with which adult (>=5) female brown bears were without COY offspring in a year when they were "expected" to have COY. Bears were "expected" to have COY if they weaned or lost a litter in the preceding year, if they had 2-year-old offspring the preceding year, or if they were at least 5 years old and "expecting" their first litter.

Year	No. "Expected" to have COY but did not	Mean Age	No. "Expected" to have COY and did	Mean Age	Total Females	Percent "Expectation" Wrong	Cumulative Percent "Expectation" Wrong
1979	1	23	--	--	1		
1980	--	--	--	--	0		
1981	1	7	3	11.7	4	25.0	40.0
1982	1	5	2	13	3	33.3	37.5
1983	2	5	5	9.8	7	28.6	33.3
1984	4	10.8	9	12.1	13	30.8	32.1
1985	2	8.5	6	13	8	25.0	30.6
1986	3	14.3	5	10.8	8	37.5	31.8
1987	3	15	7	12.3	10	30.0	31.5
1988	4	21	6	14.3	10	40.0	32.8
1989	2	23.5	4	17.5	6	33.3	32.9
1990	3	20.7	2	11	5	60.0	34.7
1991	5	19.8	3	13.7	8	62.5	37.3
1992	6	20.7	2	20	8	75.0	40.7

Table 19. Frequency with which adult (≥6 radio-marked) brown bear females were with and without offspring. Data compiled from Table 15.

Year	ID of bears with offspring	Total	ID of bears without offspring	% without offspring
1978	207, 220, 221, 204	4	0	
1979	207, 220, 221, 321	4	0	
1980	312, 299, 313, 283	4	0	
1981	312, 299, 313, 283, 331, 337, 344	7	341 12.5	
1982	312, 299, 313, 283, 341, 337, 344, 380, 379,	9	331 (died),	10.0
1983	312, 299, 313, 283, 281, 337, 334, 380, 394, 384, 379, 388, 396, 403	14	-- 0	
1984	312, 299, 313, 281, 337, 344, 335, 340, 384, 379, 388, 396, 403, 420, 423	15	283, 394, 425	16.7
1985	299, 283, 281, 337, 335, 340, 388, 381, 396, 420, 423, 425, 314, 481	14	379 6.7	
1986	283, 281, 337, 335, 340?, 338, 381, 403, 420, 423, 425, 314, 453, 460, 461, 462, 481	17	396 5.6	

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Table 19. Continued.

Year	ID of bears with offspring	Total	ID of bears without offspring	% without offspring
1987	283, 281, 337(@3), 340, 388, 381, 403, 423, 273, 314, 453, 458, 460, 461, 462	15	335, 396, 425	16.7
1988	283(@3), 281, 335, 340, 388, 381, 425, 273, 314, 453, 458, 460, 461, 462	14	337, 396, 423	17.6
1989	283, 281, 335, 340, 388, 381, 396, 425, 273, 314, 460, 461, 462	13	337, 423	13.3
1990	283, 281, 335, 340(?), 388, 396, 273(@3), 314, 460, 461	10	337, 423	16.7
1991	283, 335(@3), 340, 396, 273, 314, 460, 461	8	281, 337, 388, 423	33.3
1992	283, 281, 335(@4), 340, 396(@3), 273 314, 460(@3), 461	9	337, 388, 423	25.0
Summary		Total No.	Total No.	
1976-1986		88	7	7.4
1987-1992		69	17	19.8
1987-1992*		62*	17	21.5

*Excludes 7 bears with 3 or 4 year old offspring.

Table 20. Observations of potentially breeding (≥5.0 yr. old and not with COY or yearling), radio marked, brown bear females observed with another bear during 1 May to 20 June, 1978-1992.

Year = 1978

Bear ID	Age	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
202	8	25	6	
204	7	19	4	7
206	13	30	23	0
208	12	31	0	0
209	5	17	7	0
212	10	15	5	0
213	10	10	2	0
231	12	9	8	0
Total = 8	77	156	55	7
Mean	9.6	19.5		

% of all observations with male = 35%
% of observations excluding observations w/weaning offspring w/ a male = 37%

Year = 1979

Bear ID	Age	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
220	6	3	1	2
221	9	2	0	2
Total = 2	15	5	1	4
Mean	7.5			

% of all observations with male = 20%
% of observations excluding observations w/weaning offspring w/a male = 100%

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Table 20. Continued.

Year = 1980

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
283	12	3	0	3
309	12	2	0	0
312	10	3	0	1
308	5	5	1	0
Total = 4	39	13	1	4
Mean	9.8	2.6		

% of all observations with male = 8%
% of observations excluding observations w/weaning offspring w/ a male = 11%

Year = 1981

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
299	14	7	4	1
313	11	4	1	0
331	6	9	1	5
334	10	19	18	1
341	6	14	13	0
308	6	5	1	0
Total = 6	56	58	38	7
Mean	8.8	9.7		

% of all observations with male = 66%
% of observations excluding observations w/weaning offspring w/ a male = 75%

Year = 1982

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
281	5	5	2	0
283	14	3	2	0
331	6	6	1	0
Total = 3	25	14	5	0
Mean	8.3	4.7		

% of all observations with male = 36%
% of observations excluding observations w/weaning offspring w/ a male = 36%

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Table 20. Continued.

Year = 1983

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
283	15	4	3	0
312	13	7	1	5
315	5	6	2	0
335	5	8	2	0
337	15	7	1	3
340	5	6	0	0
380	16	3	1	0
384	12	6	1	4
388	14	7	1	5
394	6	6	2	0
396	13	5	2	3
Total = 11	119	65	16	20
Mean	10.8	5.9		

% of all observations with male = 25%
% of observations excluding observations w/weaning offspring w/ a male = 36%

Year = 1984

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
281	7	16	4	0
283	16	32	20	0
313	13	32	16	3
315	6	4	0	0
344	8	2	2	0
379	7	2	1	1
381	5	21	2	0
388	15	22	10	0
394	7	8	0	0
396	15	4	0	0
407	6	2	0	0
425	8	15	4	0
Total = 12	113	160	59	4
Mean	9.4	13.3		

% of all observations with male = 37%
% of observations excluding observations w/weaning offspring w/ a male = 38%

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Table 20. Continued.

Year = 1985

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
214	9	3	2	0
273	9	2	2	0
280	9	3	0	0
282	9	2	1	0
309	17	2	0	0
341	10	4	2	0
379	8	1	0	0
398	6	2	0	0
399	11	5	0	0
400	21	2	0	0
403	8	1	0	0
407	7	2	0	0
420	20	4	2	2
422	7	1	0	0
447	7	2	0	0
Total = 15	158	36	9	2
Mean	10.5	2.4		

% of all observations with male = 25%
% of observations excluding observations w/weaning offspring w/ a male = 27%

Year = 1986

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
273	10	2	0	0
314	8	1	0	1
335	8	3	0	2
337	18	1	0	1
340	8	1	0	0
396	17	2	2	0
407	8	2	0	0
423	22	2	0	2
461	5	1	0	0
458	17	1	1	0
Total = 10	121	16	3	6
Mean	12.1	1.6		

% of all observations with male = 19%
% of observations excluding observations w/weaning offspring w/ a male = 30%

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Table 20. Continued.

Year = 1987

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
281	10	3	0	1
283	19	2	0	2
335	9	3	1	0
337	19	3	1	1(@3)
340	9	2	0	0
381	8	1	0	1
388	19	1	0	1
396	18	2	1	0
407	9	2	1	0
425	17	1	1	0
456	7	1	0	0
472	12	7	7	0
473	6	2	1	0
Total = 13	162	30	13	6
Mean	12.5	2.3		

% of all observations with male = 43%
% of observations excluding observations w/weaning offspring w/ a male = 54%

Year = 1988

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
283	20	1	0	1(@3)
337	20	2	0	0
341	13	1	0	1
396	19	2	1	0
423	24	1	0	0
425	18	1	0	0
460	9	1	0	0
453	6	2	0	2
459	5	1	0	1
Total = 9	134	12	1	5
Mean	14.9	1.3		

% of all observations with male = 8%
% of observations excluding observations w/weaning offspring w/ a male = 14%

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Table 20. Continued.

Year = 1989

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
273	13	1	0	1
337	21	1	0	0
423	25	1	0	0
462	10	1	0	1
Total = 4	69	4	0	2
Mean	17.3	1.0		

% of all observations with male = 0%
% of observations excluding observations w/weaning offspring w/ a male = 0%

Year = 1990

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
337	22	2	0	0
340	12	3	1	0
423	26	3	0	0
314	12	1	0	0
281	13	3	2	1
273	14	3	2	0
335	12	3	0	3
388	21	3	2	1
Total = 8	132	21	7	5
Mean	16.5	2.6		

% of all observations with male = 33%
% of observations excluding observations w/weaning offspring w/ a male = 44%

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Table 20. Continued.

Year = 1991

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
283	23	1	0	1
337	23	1	0	0
423	27	1	0	0
460	12	1	0	1
396	21	1	0	1
281	14	1	0	0
335	13	1	0	1(@3)
Total = 7	133	7	0	4
Mean	19.0	1.0		

% of all observations with male = 0%
% of observations excluding observations w/weaning offspring w/ a male = 0%

Year = 1992

Bear ID	AGE	No. of observations	No. observations w/ another adult	No. observations w/weaning offspring
461	11	2	0	0
337	24	2	0	0
423	28	2	0	0
460	13	2	0	2(@3)
396	22	2	0	1(@3)
335	14	3	0	2(@4)
338	23	2	1	0
Total = 7	135	15	1	5
Mean	19.3	2.1		

% of all observations with male = 7%
% of observations excluding observations w/weaning offspring w/ a male = 10%

Table 21. Proportion of observations during May 1-June 20 of radio-marked adult females (excludes those with COY, yearlings, and offspring-weaned-that-year) that were with another adult bear (known or presumed to be male).

Year	No. Bears	Mean Age	Range in Age	No. Observ.	Observ. w/male	% w/male
1978	8	9.6	5-13	149	55	36.9
1979	2	7.5	6-9	1	1	100.0
1980	4	9.8	5-12	13	9	69.2
1981	6	8.8	6-14	51	38	74.5
1982	3	8.3	5-14	14	5	35.7
1983	11	10.8	5-16	45	16	35.6
1984	12	9.4	5-16	156	59	37.8
1985	15	10.5	6-21	34	9	26.5
1986	10	12.1	5-22	10	3	30.0
1987	13	12.5	6-19	24	13	54.2
1988	9	14.9	5-24	7	1	14.3
1989	4	17.3	13-25	2	0	0.0
1990	8	16.5	12-26	16	7	43.8
1991	7	19.0	12-27	3	0	0.0
1992	7	19.3	11-28	10	1	10.0
1978-1987 Total=				497	208	41.9
1988-1992 Observed Total=				38	9	23.7

1-tailed Chi square (1 d.f.) = 5.15, P = 0.02.

Table 22.Proportion of observations during May 1-June 20 of radio-marked adult females (excludes those with COY, yearlings, and offspring-weaned-that-year) that are with another adult bear (known or presumed to be male).

Year	No. Bears	Mean Age	Range in Age	No. Observ.	Observ. w/male	% w/male
1978	8	9.6	5-13	149	55	36.9
1979	2	7.5	6-9	1	1	100.0
1980	4	9.8	5-12	13	9	69.2
1981	6	8.8	6-14	51	38	74.5
1982	3	8.3	5-14	14	5	35.7
1983	11	10.8	5-16	45	16	35.6
1984	12	9.4	5-16	156	59	37.8
1985	15	10.5	6-21	34	9	26.5
1986	10	12.1	5-22	10	3	30.0
1987	13	12.5	6-19	24	13	54.2
1988	9	14.9	5-24	7	1	14.3
1989	4	17.3	13-25	2	0	0.0
1990	8	16.5	12-26	16	7	43.8
1991	7	19.0	12-27	3	0	0.0
1992	7	19.3	11-28	10	1	10.0
1978-1987 Total=				497	208	41.9
1988-1992 Observed Total=				38	9	23.7

1-tailed Chi square (1 d.f.) = 5.15, _P_ = 0.02.

Table 23. Reported kill and recommended harvest levels in GMU 13 by subunits. Sustainable kill is estimated as 5% of estimated reconstructed population using 2 scenarios for when the estimated base population occurred (see Table 4).

	Reported Kill*	Calculated Sustainable Kill Scenario 1**	Scenario 2	Midpoint
GMU 13	79(73-85)	32	56	44
GMU 13, except 13D	66(65-67)	15	36	25
13A	13(11-15)	6	11	8
13B	10(7-12)	2	7	4
13C	6(3-8)	3	5	4
13D	13(6-20)	18	19	19
13E	36(34-38)	5	14	10

*Average of last 2 years (90/91 and 91/92)
**Estimated population base in 1980
***Estimated population base in 1986

APPENDICES

Appendix A. Excerpts from annual management reports for brown bear in GMU 13.

1979: "Large, older males continue to appear in the harvest, indicating that the opportunity for hunters to take trophy bears still exists. The brown bear population appears to be altered little by existing harvest levels [73 bears]... Predator-prey studies in Unit 13 have identified brown bears as significant predators on moose populations. The public response to this research has been to demand more liberal brown bear hunting regulations. In response to this public input, the first spring brown bear season ever conducted in Unit 13 will be held in 1980. The spring season will be 15 days long and will begin on 10 May" (1980:73-74).

1980: "Density estimates and reproductive data indicated that the Unit 13 bear population is capable of withstanding the current level of harvest [84 bears]... The age structure of future harvests should be monitored closely to detect unfavorable trends in age structure" (1981:70-72).

1981: "The relative abundance of brown bears in Unit 13 is supported by frequent observations of bears made by Department personnel and the general public. Additionally, the public reported to the Department more incidents with problem bears in 1981 than in previous years" (1982: 65-66).

1982: "Frequent observations of brown bears by Department staff and the public support the hypothesis of relative abundance throughout much of Unit 13 ... Since the spring season was opened in 1980, the mean harvest (82 bears) represents a 41% increase over the mean harvest (58 bears) from 1970-79, when no spring season occurred ... Increases in mean age and skull size for both males and females support the contention that the brown bear population is capable of withstanding current levels of harvest ... Some concern over a long-term decrease in mean age of males warrants closely monitoring the age structure of future harvests" (1984:33-34).

1983: "Available data suggest little change in population status ... The reported kill of 117 brown bears during 1983 was appreciably higher than the average of 80 for the period 1980-82" (1984:32-33).

1984: "Continued frequent observations of grizzly bears throughout much of Unit 13 suggest little change in their relative abundance over the past year ... Although the reported kill of 124 grizzlies during 1984 was the highest ever recorded for Unit 13, harvest data analyses shows little if any reason for concern. Mean age and skull size for both males and females support the contention that the grizzly bear population is capable of withstanding current levels of harvest. (1984:30-31).

1985: "The grizzly bear harvest in Unit 13 has been increasing since hunting regulations were liberalized in 1980. The recent harvest of 146 grizzlies is the highest on record ... Current harvest data do not indicate the increased harvest has resulted in a decline in mean age or size of bears taken during 1985 [although these data are subject to bias caused by bootlegging] ... Harvest rates of marked bears in Unit 13 suggest the current take may exceed the sustained yield...Areas where marked bears are located, however, are popular hunting areas, and harvest rates observed there may not apply to other areas within the unit ... Bear hunting in Unit 13 has been increasing in popularity for a number of reasons ... A substantial increase in the number of bears killed in Unit 13 has occurred and requires that the bear population be monitored carefully ... Until more population data are collected, no changes in seasons or bag limits are recommended" (1986:26-27).

1986: "Frequent sightings suggest that bears are numerous ... A decline in the percentage of males taken in the fall harvests suggests fewer males are present. Current harvest data do not indicate that the increased harvest has resulted in a decline in mean age or size of bears taken in 1986 [however, these data may be biased by bootlegging] ... A census will be completed in 1987, its goal will be to derive a brown bear population estimate for the upper Susitna River. To determine if any changes in bear numbers have occurred in this area, this population estimate will be compared with the estimate obtained in 1979. Until additional information on the population trend in Unit 13 is obtained, no changes in seasons or bag limits are recommended"(1987: 28-30).

1987: "The brown bear harvest in Unit 13 has increased substantially over the years...The growth of the brown bear population in Unit 13 was halted after 1980, when harvest rates began increasing. Since then bear numbers have been declining in the more accessible, heavily hunted portions of the unit. As a result, the overall population is lower than it had been before liberalization of harvests had begun ... [the density estimated conducted in 1987 near the Denali Highway] suggests current bear densities in this upper Susitna are roughly half of those previously observed in this area ... Mean age of males in the fall [harvest] has been generally lower ... Interpretation of age and size data is difficult; younger animals in the harvest could mean a higher reproductive and juvenile survival rate or, conversely, a higher harvest rate and little recruitment into the older age classes. Although it is reasonable to assume most of the decline in densities observed in the upper Susitna River study area [was] caused [by] increased sport harvests, additional factors must be considered; e.g. no bears were observed in the vicinity of the [Valdez Ck. gold] mine ... gold mining development ... [and this mine] may have [caused] displacement or increased unreported killing ... from that area. This supposition is additionally supported by increased observation of moose calf twins in the vicinity of the mine during fall composition counts. Also, overall densities could be lower in this area because of the residual effect of the 1979 transplant ... Research results suggest that harvests must be reduced if the bear population is to be stabilized at its current level ... The population objective for Unit 13 also calls for maintaining a harvest composed of a minimum of 50% males. The current average harvest of 56% males means that the overall goal has been met [because of the increasing popularity of spring hunting which selects for males]" (1989:73-81).

1988: "After the bag limit was reduced in 1987, both hunter interest and harvests declined ... [declines in mean age and skull sizes for both sexes] reflects fewer older bears in the population ... Although it is reasonable to assume most of the decline in densities observed in the upper Susitna Study Area is attributed to increased sport harvest, additional factors may have had a role [such as gold mine development] ... if the bear population is to be stabilized, harvests will have to be reduced ... Harvest composition figures for 1988 showed that males composed 68% of the harvest, well above the management guideline of a minimum of 50% ... [however more females than males were taken during fall harvests which are more reflective of the population] ... If the total harvest or the harvest of females exceeds estimated sustainable harvest rates, additional hunting restrictions will be needed...no changes...are currently recommended." (1990: 76-83).

1989: Only cursory performance reports were written this year.

1990/91. "Since 1980, evidence suggests bear numbers have declined in more accessible, heavily hunted portions of Unit 13 ... At the spring 1990 meeting, the Board of Game passed the first reduction in season length for most of Unit 13 since 1983 when the current season was established [a 10 day delay in fall opening in order to] ... reduce the incidental take of brown bears, especially females, by hunters primarily after moose and caribou ... Additional studies will be necessary to determine changes in status or trend... Although the current harvest of 98 brown bears is well below those reported in the mid-1980s, it still exceeds the estimated maximum sustainable harvest level of 70 bears in Unit 13 by 40% ... Because of the increased popularity of bear hunting, the harvest decline observed following the reduction in bag limit was not maintained. ... males comprised 61% of the harvest, well above the management guideline of 50% minimum ... I recommend that the [management] objective be changed to 60% males in the harvest ... the increased brown bear kill this year occurred during the spring season [attributed, in part, to record deep snows and easier snowmachine access] ... Bear overharvesting is often associated with heavy moose and caribou hunting pressure ... Reducing [bear] harvests in areas with high visibility and good access may require additional regulatory restrictions ... season closures in April may be appropriate [if continue to have high April harvests by snowmachine hunters] ..." 1991:111-123).

1991/92: Only cursory performance reports written this year.

Appendix B. Public Proposals to Alaska Board of Game meeting conducted during Spring, 1990.

PROPOSAL 28 - 5 AAC 85.020. HUNTING SEASONS AND BAG LIMITS FOR BROWN BEAR. Amend Units 11 and 13 brown bear bag limit as follows:

Allow the taking of one brown bear (grizzly), every regulatory year in Units 11 and 13.

PURPOSE: Minimize and reduce bear populations to reasonable and safe levels throughout the Copper Basin area.

JUSTIFICATION: With the closing of all but subsistence hunting in the Wrangell-St. Elias National Park in GMU 11, a large build up of Brown-grizzly bears has resulted. These bears now appear to be overflowing across the Copper River into GMU 13 and breeding up there as well. Moose numbers are down significantly in the lower sections of GMU 13. Black bear numbers are decreasing rapidly and brown/grizzly cub ratios seem to be very low, apparently being cannibalized by the larger bears. The people/bear confrontations have increased tremendously. Rumors of people shooting and dumping "problem bears" abound. How often this happens is pure speculation, but it is apparently happening some. Most people in our area are used to living with a few grizzly bears around, but the large numbers of bears we "now enjoy" is a bit too much. We ask, "Must we wait until people are mauled before we get some relief?" Many people have expressed concern that a year of poor fish runs or poor berry crops will result in a real war with the bears. It has definitely become a safety issue with many residents of our area.

WHAT WILL HAPPEN IF NOTHING IS DONE?

WHO IS LIKELY TO BENEFIT?

WHO IS LIKELY TO SUFFER

OTHER SOLUTIONS CONSIDERED?

PROPOSED BY: Concerned Citizen Committee for Safe Communities (SC-095)

PROPOSAL: 28 - 5 ACC 85.020. HUNTING SEASONS AND BAG LIMITS FOR BROWN BEAR.

Allow the taking of one grizzly bear per regulatory year for residents of Unit 11 and 13.

Justification: The incidence of grizzly bears in villages and in fish camps has been steadily increasing over the last few years. The regulation change to 1 grizzly every 4 regulatory years was instituted as an added enforcement tool against taking bears in other units and registering them as taking in Units 11 and 13; not because of a depletion in actual numbers of bears.

PROBLEM:

WHAT WILL HAPPEN IF NOTHING IS DONE?

WHO IS LIKELY TO BENEFIT?

WHO IS LIKELY TO SUFFER?

OTHER SOLUTIONS CONSIDERED?

PROPOSED BY: Copper River Native Association (SC-111)

PROPOSAL 29 - 5 AAC 85.020. HUNTING SEASONS AND BAG LIMITS FOR BROWN BEAR. CHANGE THE OPENING OF BROWN BEAR SEASON IN UNIT 13 TO SEPTEMBER 10.

UNITS AND BAG LIMITS	RESIDENT OPEN SEASON	NONRESIDENT OPEN SEASON
Unit 13		
1 bear every four regulatory years	Sept. 10[1]-May 31	Sept. 10[1]-May 31

PROBLEM: Unit 13 brown bear seasons and bag limits were liberalized in the early 1980s, resulting in a doubling of the bear harvest and a reduction in bear numbers over large portions of GMU 13. Since 1987 when a bag limit restriction was imposed, the management objective for brown bears in Unit 13 has been to maintain a stable bear population. Total Unit 13 brown bear harvest has been 104, 64 and 74+ for 1987, 1988 and 1989, respectively. Bear harvests still exceed the sustainable harvest rate for the bear population over much of Unit 13. In Subunits 13A, B, C, and E, harvest in 1988 and 1989 were 52 and 57 bears, respectively, of which 40% were females. With this sex ratio in the harvest, the estimated population in these units can sustain a harvest of only 32-47 bears. Harvests could be larger if the proportion of females in the harvest is reduced. For example, with 30% females in the harvest the population could provide a harvest of 43-63 bears. Staff recommends a reduction in harvest, especially of females, to sustainable levels. This can best be accomplished by eliminating the early part of the fall hunting season, as the largest number of females are shot during this period. We do not anticipate a significant increase in defense of life and property bear kills.

WHAT WILL HAPPEN IF NOTHING IS DONE?: Brown bear populations over much of the more open, heavily hunted portions of GMU 13 will continue to decline. If this happens, drastic reductions in brown bear hunting opportunities may soon be required to stabilize bear numbers at these lower densities.

WHO IS LIKELY TO BENEFIT? Bear hunters and guide/outfitters who wish to prevent further declines in bear numbers which may result in closure or severe restriction of bear hunting in this area. Other members of the public who wish to retain the current brown bear population in GMU 13.

WHO IS LIKELY TO SUFFER? Those hunters and guide/outfitters specifically hunting brown bears early in the fall season. Some hunters and guides who conduct multiple species hunts early in the fall season will lose some of this hunting opportunity sooner than they would if restrictions are not adopted until bear numbers are more reduced. Hunters not specifically after brown bears but who would take one if the opportunity occurred.

OTHER SOLUTIONS CONSIDERED? Elimination of the last 2 weeks of the spring season may be necessary but is not proposed at this time because fewer females are harvested then. Also, the spring season is popular with individuals specifically hunting for brown bear.

PROPOSED BY: Alaska Dept. of Fish and Game

PROPOSAL: 216 - 5 AAC 92.014. BROWN BEAR TAG FEE EXEMPTION. Eliminate the $25 fee of brown/grizzly tags within Unit 11 and 13.

Purpose: Minimize and reduce bear populations to reasonable and safe levels throughout the Copper Basin area. Also to encourage hunter participation.

JUSTIFICATION: With the closing of all but subsistence hunting in the Wrangell St. Elias National Park in GMU 11, a large build up of Brown-grizzly bears has resulted. These bears now appear to be overflowing across the Copper River into GMU 13 and breeding up there as well. Moose numbers are down significantly in the lower sections of GMU 13. Black bear numbers are decreasing rapidly and Brown/Grizzly cub ratios seem to be very low, apparently being cannibalized by the larger bears. The people/bear confrontations have increased tremendously. Rumors of people shooting and dumping "problem bears" abound. How often this happens is pure speculation, but it is apparently happening some. Most people in our area are used to living with a few Grizzly bears around, but the large numbers of bears we "now enjoy" is a bit too much. We ask, "Must we wait until people are mauled before we get some relief?" Many people have expressed concern that a year of poor fish runs or poor berry crops will result in a real war with the bears. It has definitely become a safety issue with many residents of our area.

WHAT WILL HAPPEN IF NOTHING IS DONE?

WHO IS LIKELY TO BENEFIT?

WHO IS LIKELY TO SUFFER?

OTHER SOLUTIONS CONSIDERED?

PROPOSED BY: Concerned Citizen Committee for Safe Communities

Appendix C. Public Proposals to Alaska Board of Game meeting conducted during Spring, 1992.

PROPOSAL 33 - 5 AAC 85.020. HUNTING SEASONS AND BAG LIMITS FOR BROWN BEAR. Amend brown bear hunting regulation for Unit 13 as follows:

One bear every regulatory year. Bear season Aug. 15 through May 31. (To reduce bears to historical level of approx 500.)

PROBLEM: Mismanagement of GMU 13. Though caribou have increased from about 12,000 to 40,000 the Department has not allowed increased human harvest. Also moose seasons have been cut back to four days. The reason is that increased prey has resulted in abnormally high predator populations (bears and wolves) and biologist Toby has mismanaged this GMU for predator harvest before allowing for human harvest. The increase in grizzly bears from 500/600 to 1500 has resulted in Mr. Tobey requiring 5000 to 7000 more moose before human harvest is allowed.

WHAT WILL HAPPEN IF NOTHING IS DONE? The public will soon realize that the Dept. of Fish and Game is effectively managing Alaska's wildlife on a "sustained yield" for predators basis and not for human consumptive uses. The bears and wolves will continue to increase faster than prey populations so Mr. Tobey will continue to restrict hunting.

WHO IS LIKELY TO BENEFIT? All human consumptive uses of Unit 13 wildlife.

WHO IS LIKELY TO SUFFER? Non-human consumptive users.

OTHER SOLUTIONS CONSIDERED? Legislation to require ADF&G to manage AK's wildlife for maximum sustained human yield.

PROPOSED BY: Lynn Levengood

PROPOSAL 34 - 5 AAC 85.020. HUNTING SEASONS AND BAG LIMITS FOR BROWN BEAR.

Realign all of Unit 13 with an opening date for hunting brown bear, in the whole unit as follows:

Unit 13 brown/grizzly bear September 1 through May 31

One bear every four regulatory years.

PROBLEM: Realign all of Unit 13 with an opening date for hunting brown bear, in the whole unit.

WHAT WILL HAPPEN IF NOTHING IS DONE? Statistics for brown bear in the unit show that the population is increasing. Hunters sightings of bear seem to be at an all time high. This could be because of one bear every four years regulation has been in effect long enough to cause an increase in bears in this unit.

WHO IS LIKELY TO BENEFIT? Hunters, protection officers, by possibly reducing bear populations by a few more bears being taken. It could have an impact on our declining moose population.

WHO IS LIKELY TO SUFFER?

OTHER SOLUTIONS CONSIDERED?

PROPOSED BY: Copper Basin Advisory Committee

PROPOSAL 35 - 5 AAC 85.020. HUNTING SEASONS AND BAG LIMITS FOR BROWN BEAR.

Extend Units 13A, B, C & D brown bear season and change bag limit as follows:

1. Return bear season opening to September 1st - May 31st and change bag limit to one bear every regulatory year - subject to return to one bear every four years when ADF&G deems necessary.

PROBLEM: Excessive grizzly bear predation and the continued decline of human harvestable moose, sheep and caribou because of grizzly bear predation, Re-1980 Ballard moose calf mortality study - study concluded 79% of collared calves and 72% of collared cows were killed by 13 grizzly during spring study period. Also Denali A/C committee members conducted a 4-hour aerial survey September 22, 1991 which revealed a summer survival of only 8 calves per 188 cows, which is prior to winter exposure. There are over 1,200 bears in Unit 13!!

WHAT WILL HAPPEN IF NOTHING IS DONE? A continuing decline of human harvestable moose, sheep and caribou in Unit 13, further creating a shortage of harvestable protein needed for human consumption statewide. Ungulate seasons have been drastically reduced in past years due to excessive predation and increased human needs.

WHO IS LIKELY TO BENEFIT? All human food harvesters - statewide increased calf and cow moose as well as caribou and sheep survival rate.

WHO IS LIKELY TO SUFFER? No one.

OTHER SOLUTIONS CONSIDERED? There is no substitute solution for the sustained yield human harvest principle.

PROPOSED BY: Denali Advisory Committee

PROPOSAL 36 - 5 AAC 85.020. BAG LIMIT FOR BROWN BEARS. & 5 AAC 91.132. HUNTING SEASON AND BAG LIMIT FOR BROWN BEAR. Add 9 days to Units 13, A, B, C, and E brown bear season and change bag limits as follows:

1. One bear every regulatory year.
2. Bear season to start Sept. 1 and end May 31.

PROBLEM: Excessive bear (grizzly) predation. The continuing decline of human harvestable moose, sheep and caribou in Unit 13. The cause, grizzly bear predation - re: Ballard - moose calf mortality study. The study concluded 79% of the collared calves and 72% of the collared cows were killed by 13 grizzly bears during the spring study periods.

WHAT WILL HAPPEN IF NOTHING IS DONE? A continuing decline of human harvestable moose, sheep, and caribou in Unit 13 further creating a shortage of harvestable protein needed for human consumption - statewide.

WHO IS LIKELY TO BENEFIT? All human food harvesters - statewide - cow and moose calf survival.

WHO IS LIKELY TO SUFFER? No one.

OTHER SOLUTIONS CONSIDERED? There is no substitute solution for the sustained yield human harvest principle.

PROPOSED BY: Bill Hagar

Appendix D. Analysis of Predator-Prey relationship presented by a Fairbanks resident and GMU 13E guide.

February 1, 1992

To:
The 2 Enclosures are as follows:

1. Game Shortage Statement - for your information.
This statement is the culmination of 11 months worth of research to determine why there is such a shortage of Game for Human Harvest (consumption)

2. The Alaska Game Board meeting in Anchorage, March 9 thru April 10, addresses many of the problems we are presently experiencing. There are 207 Proposals. Enclosed - 2 pages of the most critical proposals (Statewide) to let you know what the consensus is in Fairbanks. It is very important that your community submit Oral or Written Positions on Proposals. Collectively we can bring about change and alleviate the shortage of Human Harvestable Game.

For further information and questions contact:

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CC to:

Butch Loper-Chair-Cantwell Advisory
Don Horrell-Chair-Copper Basin Advisory
Will Luebke-Chair-Paxson Advisory
Charlie Akers-Chair-Wasilla-Mat Su Advisory
Bill Ellis-Chair-Tok Advisory
Bud Burris-Chair-Alaska Outdoor Council
Mike Tinker-Chair-Fairbanks Advisory
Lynn Levengood-Chair-Fairbanks Hunting Club
Ted & Ruth McHenry-Chair Copper Center
Sam Snyder-Fairbanks
All Game Board Members
Fairbanks Trappers Association
Stan McGorty-Kenai
Art Saaloos-Delta Junction
Dave Kelleyhouse-Director ADF&G
Wayne Regelin-Deputy Director ADF&G
Chris Smith-Region Director ADF&G
David Johnson-Region Director ADF&G

BALANCE SHEET GAME HARVEST/ALLOCATION

-PROBLEM-

1.Restricted low Human Prey (moose, caribou, sheep) Harvest Annually!

2.Human Harvest is less than 10% of the harvestable moose, caribou & sheep statewide.

3.Why so low? - Why so many problems? - Why subsistence priority? (Shortage of Game)

-QUESTION-

What happens to the other 90% of the harvestable moose, caribou and sheep?

-STATEMENT-

ADF&G's Estimated Predator/Prey Statewide Game Populations

40,000 Brown/Grizzly Bears	200,000 Black Bears	2,100 Musk Ox
25,000 Wolves/Wolverines	155,000 Moose	1,500 Elk
14,000 Mountain Goat	375,000 Sitka Deer	850 Bison
70,000 Dall Sheep	835,000 Caribou	

-EXAMPLE-

1988-1989 - Statewide Prey Harvest Totals

1. Human Harvest Moose	7,695	Predator Harvest-Bear/Wolf-Moose	69,255
2. Human Harvest Caribou	25,351	Predator Harvest-Bear/Wolf-Caribou	228,159
3. Human Harvest Sheep	1,452	Predator Harvest-Bear/wolf-Sheep	13,068
	34,498		310,482

-ANSWER-

1. ADF&G's Prey Harvest/Allocation - Annually - (Moose, sheep & caribou)
   A. 34,498-Prey-Human Harvest/Allocation 10%
   B. 310,482-Prey-Wolf, Bear Predator Harvest/Allocation 90%

-CONCLUSION-

1. Excessive Predation - 90/10 ratio
2. ADF&G's Current Management Philosophy - SUSTAINED YIELD ECO SYSTEM
3. SURPRISE

-SOLUTION-

1. ADF&G's return to a SUSTAINED YIELD HUMAN HARVEST PHILOSOPHY/SYSTEM
2. 70% Prey per predator 30% Prey per Human 70/30 ratio
3. Human Prey Harvest would change from 34,498 to 98,566 - an increase of 64,068 - (NO SHORTAGE)-

-FACT-

1. 850 Prey Animals per Day (every day) are allocated to PREDATORS
2. 94 Prey Animals per Day (every day) are allocated to HUMAN HARVESTERS

-ENLIGHTENMENT-

1. Now we Know Where the other 90% of Prey Goes!
2. Now we Know Why there is a shortage of Human Harvestable Prey!
3. Now we Know Why Subsistence priority (shortage of game) Exists!
4. Now we Know Why Our Problem is ADF&G's Management Philosophy/system!

Appendix E. GMU 13 Uniform Coding Areas (UCUs) combined for evaluating brown bear harvest data based on ease of hunter access to study area. Allocations were based on consultations with GMU 13 Area Biologist Bob Tobey, the coding areas combined are the same as those evaluated by Miller (1988, Appendix A, p. 113) except that the western and southern portions of GMU 13C, west of the Chistochina River, were included as part of the western and eastern road system rather than as remote regions. Includes records through fall 1991. Excludes 31 harvest records from unspecified locations in GMU 13.

Code 1. Remote peripheral portions of GMU 13 including western 13E, northeastern 13C, and most of 13D away from the highway (596 records in database).

```
REPLACE ALL AREA WITH '1' FOR GMU+MINOR > '13E0299' .AND.
    GMU+MINOR < '13E0800'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13C501'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13C502'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13C503'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13C303'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13C304'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR > '13D0099' .AND.
    GMU+MINOR < '13D0700'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D10'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D12'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D08'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D16'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D17'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D19'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D20'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D21'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D22'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D13'
REPLACE ALL AREA WITH '1' FOR GMU+MINOR = '13D14'
REPLACE ALL AREA WITH '1' FOR GMU+MAJOR+MINOR = '13DZOO00'
```

Code 2. Remote central portions of GMU 13 away from the road system (514 records in database).

```
REPLACE ALL AREA WITH '2' FOR GMU+MINOR > '13E1199' .AND.
    GMU+MINOR < '13E1500'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR > '13E1599' .AND.
    GMU+MINOR < '13E2500'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13ES0000'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13ES0200'
```

```
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13ES0300'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR > '13A1399' .AND.
GMU+MINOR < '13A20'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR = '13A21'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR = '13A08'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR = '13A09'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13AS0000'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13AS0200'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13AS0300'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13AS0400'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13AS0700'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR > '13B0099' .AND.
     GMU+MINOR < '13B0300'
REPLACE ALL AREA WITH '2' FOR GMU+MINOR = '13B15'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13BS0400'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13BS0700'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13ZS0300'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13ZS0400'
REPLACE ALL AREA WITH '2' FOR GMU+MAJOR+MINOR = '13ZS0200'
```

Code 3. Heavily hunted areas in northern GMU 13 including the Denali Highway (429 records in database).

```
REPLACE ALL AREA WITH '3' FOR GMU+MINOR > '13E2499' .AND.
     GMU+MINOR < '13E3000'
REPLACE ALL AREA WITH '3' FOR GMU+MINOR = '13E31'
REPLACE ALL AREA WITH '3' FOR GMU+MINOR = '13E32'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ET0100'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13EZ0000'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ES0100'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ES0000'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ES0500'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ES0600'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ET0100'
REPLACE ALL AREA WITH '3' FOR GMU+MINOR > '13B0499' .AND.
     GMU+MINOR < '13B09'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13BS0000'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13BS0500'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13BS0600'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ZS0500'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ZS0600'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13ZS0700'
REPLACE ALL AREA WITH '3' FOR GMU+MAJOR+MINOR = '13EZ000000'
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```
REPLACE ALL AREA WITH ’3’ FOR GMU+MAJOR+MINOR = ’13EZ000076’
REPLACE ALL AREA WITH ’3’ FOR GMU+MAJOR+MINOR = ’13EZ000082’
REPLACE ALL AREA WITH ’3’ FOR GMU+MAJOR+MINOR = ’13EZ000085’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B03’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B04’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B09’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B10’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B11’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B12’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B13’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B16’
REPLACE ALL AREA WITH ’3’ FOR GMU+MINOR = ’13B17’
REPLACE ALL AREA WITH ’3’ FOR GMU+MAJOR+MINOR = ’13Z000076’
```

Code 4. Heavily hunted easy access areas along the Glenn and Richardson Highways (649 records in database).

```
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C010’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C020’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C0301’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C0302’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C0073’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C0373’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C0473’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13C0573’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC000300’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC000303’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC000304’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC000401’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC010500’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC010501’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC010502’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13CC010503’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13E01’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13E02’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR > ’13E0799’ .AND.
    GMU+MINOR < ’13E1200’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13E30’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13E15’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13ES0100’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13B14’
REPLACE ALL AREA WITH ’4’ FOR GMU+MINOR = ’13B18’
REPLACE ALL AREA WITH ’4’ FOR GMU+MAJOR+MINOR = ’13BC0300’
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REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13BT0200'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13BZ00076'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13BZ00084'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13BC931784'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13BC0200'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR > '13A0099' .AND. GMU+MINOR < '13A0800'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR > '13A0999' .AND. GMU+MINOR < '13A1400'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13A20'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AC0300'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AC0400'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AM0000'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AM0200'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AZ000072'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AZ000073'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13AZ000084'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13D18'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13D23'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13D09'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13D11'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13D15'
REPLACE ALL AREA WITH '4' FOR GMU+MINOR = '13D07'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13DC0000'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13DC00070'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13DC00084'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13DC0400'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13DM0000'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13CC00073'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZC0000'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZC0200'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZC0300'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZC0400'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZM0000'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZZ0000'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZZ00076'
REPLACE ALL AREA WITH '4' FOR GMU+MAJOR+MINOR = '13ZZ00084'

Appendix F. Abstract of black bear reproductive paper and tables of reproductive data for black bears in the Susitna Dam study area, 1980-1990.

Draft date: February 1992

PRODUCTIVITY AND CUB SURVIVORSHIP IN A LOW-DENSITY BLACK BEAR POPULATION IN SOUTH-CENTRAL ALASKA

Sterling D. Miller. Alaska Dep. Fish and Game, 333 Raspberry Rd., Anchorage, AK. 99518-1599.

Abstract: Low reproductive and high cub mortality rates were documented in a low-density black bear population (90 bears/1,000 km^2) studied during 1980-1991. Mean litter size was 2.1 for newborn cubs (range = 1-4), 1.9 for yearlings, and sex ratio for cubs or yearlings were not different from 50:50 ($P > 0.10$). Mean age of first reproduction was 5.9 years (range = 5-7), reproductive interval was 2.7 years (range = 2-5), and 59% of newborn cubs survived for 1 year (survivorship = 0.54, 95% CI = 0.42-0.66). Productivity of bears and calculated consumption rates of moose calves were similar to findings in a more southern Alaskan black bear population on the Kenai Peninsula studied by Schwartz and Franzmann (1991). This supported their hypothesis that productivity was dependent on calf consumption rates during spring. First year survivorship, however, was lower than in the 2 Kenai populations studied by Schwartz and Franzmann (1991) (P = 0.06 and <0.01)). A large proportion of adult females were without cubs following an apparent berry crop failure and again 5 years later, this generated pulses of cubs produced 2-3 years and 6-7 years after the berry crop failure. In order of probable significance to population growth potential, the parameters in these 3 populations that were responsive to changes in environmental conditions were first year survivorship, recruitment interval, and age at first reproduction; litter size was not responsive. Simulation studies demonstrated that reproductive rate parameters (interval and age of first litter) can be estimated more accurately and rapidly by including parameters projected from incomplete data and criteria for when to do this are offered.

Table F1. Summary of black bear litter size data based on observations of bears with litters of newborn cubs.

Mother's ID (age-year)	Litter Size	Comments
B289 (10 in spring '81)	3	lost 1 in August, 2 survived
B289 (12 in spring '83)	2	lost 1 cub in September, other survived to den exit
B289 (14 in spring '85)	2 (in den) [2 at exit]	both survived to yearling age
B289 (16 in spring '87)	1	survived to August at least
B289 (18 in spring '88)	X	had 1 @ COY in October (earlier?)
B301 (8 in spring '81)	2	both survived to yearling age
B301 (10 in spring '83)	2 (in den) [2 at exit]	survivorship undetermined female shed collar
B317 (7 in summer of '80)	2 (summer)	initial capture in summer, both survived to fall, cubs not seen with bear at initial capture
B317 (10 in '83)	2 (in den) [2 at exit]	lost 1 in June, other survived to den exit
B317 (12 in spring '85)	2 (in den) [2 at exit]	1 survived to den entrance, 1 lost in July
B317 (13 in spring '87)	2	survived to August, at least
B318 (5 in summer '80)	1 (summer)	survived
B318 (8 in '83)	2 (den) [2 at exit]	both lost by 6/6/83 apparently, shed collar
B328 (7 in summer '81)	2 (summer)	bred in 1980. Lost 1 by 7/29/81, shed collar in den (not sure if survived until exit)
B328 (11 in spring '85)	3 (in den) [3 at exit]	lost 6/6 - 7/24
B328 (13 in spring '87)	3	survived to den entrance
B326 (5 in summer '80)	2 (summer)	bear shot in 1980, cubs may have been adopted by B317

continued on next page

Table F1. Continued.

Mother's ID (age-year)	Litter Size	Comments
B321 (11 in spring '81)	2	no cubs in summer 1980, both cubs lost by 8/24/81, no litter in '82, no litter verified in 1983 but may have lost a litter early in 1983, bred in 1983
B321 (14 in '84)	2	lost 1 of 2 by 6/29, other survived to den entrance
B327 (5 in summer '80)	2 (summer)	both survived to yearling age
B327 (8 in '83)	2 (den)	cubs survived into June, female
B349 (6 in spring '83)	2 (den) [0 at exit?]	first litter, no cubs in summer '81 or spring '82, cubs apparently lost in May '83, collar shed in July -- no ylgs on 5/84
B349 (8 in spring '85)	2 (in den) [2 at exit]	one survived to den entrance, 1 lost in August
B349 (9 in '87)	2	survived to den entrance
B349 (12 in 1990)	2	survival (?)
B354 (5 in '82)	2	both survived to den entrance, at least 1 ylg at exit in '83
B354 (7 in '84)	2	may have lost 1 by den entrance
B354 (9 in '86)	2	lost 1 in Sept., other ok to exit
B354 (11 in '88)	3	all survived
B354 (13 in '90)	2	1 lost by 6/30
B361 (8 in '83)	4 (in den) [3 at exit]	lost 1 in den prior to exit, others survived to den exit in '84
B361 (12 in '87)	2	survived to den entrance, 1 lost in den
B363 (6 in '84)	2 (in den) [2 at exit]	bear missing after 5/23/83, cubs alive at that time
B363 (8 in '87)	2	survived to den exit
B363 (10 in '89)	2	2 lost

(continued on next page)

Table F1. Continued.

Mother's ID (age-year)	Litter Size	Comments
B364 (10 in '86)	2	both survived to den exit
B364 (13 in '89)	2	both survived to den entry (next year?)
B369* (6 in '84)	2 (in den) [2 at exit]	none lost to den entrance
B369* (9 in '87)	2	survived
B369* (12 in '90)	X	with at least 1 COY, survival unk.
B370* (8 in '83)	2 (in den) [2 at exit]	bear missing after 5/23/83, cubs alive at that time
B372* (10 in '83)	3 (in den) [3 at exit]	lost 1 in early July, others survived to 7/20, female lost in September '83
B374* (7 in '83)	3	think lost 2 in July, bear shot in September '83
B375* (6 in '83)	2	both survived to exit in '84
B376* (5 in '83)	3 (in den) [3 at exit]	all survived to exit in '84
B376* (10 in '88)	2	survival unknown
B377* (5 in '83)	[1-2??] NOT COUNTED	cubs may have been lost prior to or during capture, cubs not seen during capture but saw at least 1 cub 9 days earlier on 5/10/83
B377* (6 in '84)	some(in den) [0 at exit]	heard at least 1 cub in den, none seen at exit
B377* (7 in '85)	2 (in den) [2 at exit]	lost 1 in June, other in August-September
B377* (9 in '87)	3	at least 2 survived
B377* (11 in '89)	2	survival unknown
B378* (7 in '83)	2 (in den) [2 at exit]	both survived to '84 den exit
B378* (9 in '85)	1	survived to den entrance

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Table F1. Continued.

Mother's ID (age-year)	Litter Size	Comments
B378* (11 in '87)	2	survived to den entrance
B379 (9 in '83)	3 (den) [2 at exit]	lost all cubs by 5/23/83, bred again, died in July
B402* (12 in '85)	2 (in den) [2 at exit}	both survived to den entrance
B402* (15 in '88)	2	survival unknown
B404* (11 in '83)	1	survived thru 7/20/83 at least, not seen in '84
B405* (17 in '83)	2	both survived to den exit in '84
B406* (11 in '83)	2	both survived to den exit in '84
B409* (?)(6 in '84)	?	not observed in '84
B409* (7 in '85)	2	probable age = cub, survived
B409* (9 in '87)	2	survivorship?
B409* (17 in '89)	2	survival unknown
B410* (7 in '83)	2	both survived thru June, bear shot in July
B411* (9 in '84)	2	status at entrance into '84 den unknown
B438 (9 in '86)	3	B438 probably shot by 9/5/86, cub status unknown
B441 (11 in '87)	2	survived
B329 (7 in '87)	2	1 lost in June-Aug., other ok
B448 (8 in '87)	2	assumed lost when mother died

(continued on next page)

Table F1. Continued.

Total number of cubs	Number of litters	Mean litter size (range)	Comments (includes)
138	65	2.12(1-4)	all cub litters counted at earliest observation
123	58	2.12(1-3)	spring observations only (w/o den data or summer litters)
44	19	2.3(2-4)	observations in dens only

* Downstream study area

Table F2. Summary of black bear litter size data based on observations of bears with litters of yearlings (age at exit from den).

Mother's ID (age-year)	Litter Size	Comments
B288 (10 in 1980)	3	bred in 1980, ylgs with female into August, shed collar in 1980
B290 (8 in 1980)	2	weaned by 6/23/80, bred in 1981, collar removed on 8/5/81 (neck scarred)
B289 (9 in 1980)	2	weaned by 5/22/80, bred, 3 cubs in 1981
B289 (13 in 1984)	1	with mon to September bred in June
B289 (11 in 1982)	2 (in den)	weaned by 6/9/82, bred, had 2 cubs in 1983
B289 (15 in 1986)	2	weaned by 7/9/86
B289 (17 in 1988)	1	weaned
B301 (7 in 1980)	1	weaned by 6/12/80, bred, had 2 cubs in 1981
B301 (9 in 1982)	2	weaned by 6/17/82, bred, had 3 cubs in 1983
B317 (8 in 1981)	2	weaned by 6/18/81, bred, 1 ylg returned and was with female until 9/9/81, no cubs in 1982
B317 (11 in 1984)	1	weaned in June, bred
B317 (15 in 1988)	2	weaned
B318 (6 in 1981)	1 (den)	ylg (B330) weaned by 5/29/81, bred, ylg died by 8/24/81, no (reason?) cubs in 1982, bred again, 2 cubs in 1983
B318 (10 in 1985)	2	B318 not located after 6/11/85
B327 (5 in 1981)	2 (den)	ylg B329 and sibling, sibling weaned by 6/5/81, B329 by 6/21, bred, no cubs in 1982, bred again, cubs in 1983
B 329 (8 in 1988)	1	--

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Table F2. Continued.

Mother's ID (age-year)	Litter Size	Comments
B349 (9 in 1986)	1	--
B349 (11 in 1988)	2	--
B354 (6 in 1983)	1 (?)	at least 1 ylg exited den (perhaps) both?), weaned by 6/2/83
B354 (10 in 1987)	1	weaned after 6/7
B354 (12 in 1989)	3	weaned
B361 (13 in 1988)	1	weaned
B363 (8 in 1985)	2	weaned by 9/4/85
B363 (11 in 1988)	2	weaned
B364 (8 in 1984)	3	2 weaned early, bred, still with one in September
B364 (11 in 1987)	2	2 weaned in June
B369* (7 in 1985)	2 (in den) [2 at exit]	
B402* (10 in 1983)	3	weaned in early July
B402* (13 in 1986)	2	weaned by September
B409* (8 in 1986)	2	probably age = 1
B411* (8 in 1983)	2	weaned after 6/13
B321 (15 in 1986)	1	weaned by 6/27/85
B361 (9 in 1984)	3	entered den w/mom, weaned at age 2
B369 (10 in 1988)	2	weaned at age 2
B375* (11 in 1984)	2	weaned in June
B376* (8 in 1984)	3	weaned 2 in June, 1 with mom in October
B377* (10 in 1988)	2	weaned?
B378* (8 in 1984)	2	not seen after June

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Table F2. Continued.

Mother's ID (age-year)	Litter Size	Comments
B378* (14 in 1988)	3	weaned ?
B404* (12 in 1984)	[?]	'84 status not verified
B405* (18 in 1984)	2	with mon into August
B406* (12 in 1984)	2	weaned by September
B409* (16 in 1988)	2	weaned
B432 (6 in 1985)	1	weaned by 6/3/85
B441 (12 in 1988)	2	weaned

Total Number of ylgs. observed	Number of litters	mean litter size (range)	Comments
82	43	1.91 (1-3)	all litters with ylgs. counted

*Downstream study area

Table F3. Reproductive histories of radio-marked female black bears. ("Shed" refers to removal by bear of radio collar). Bears were in upstream study area unless otherwise indicated.

Year	289 (9 in '80)	290 (8 in '80)	301 (7 in '80)	317 (7 in '80)
1980	w/2@1 weaned in May-bred	w/2@1 weaned in June	w/1@1 weaned in June	w/2@0 in August
1981	w/3@0, 1 lost in Aug.	alone, bred, collar removed	w/2@0,	w/2@1, weaned in June, bred, reunited w/1@1 through September
1982	weaned 2@1, May-June, bred	--	w/2@1, weaned in June, bred	no newborns, possibly w/1@2 into June
1983	w/2@0, 1 lost in Sept.	--	w/2@0, shot in Sept.	w/2@0, 1 lost in June
1984	weaned 1@1 in May, bred, reunited June-Sept. weaned in Sept.	--	--	w/1@1, weaned, June, bred, reunited predenning
1985	w/2@0, survived	--	--	w/2@0, 1 lost in July, other OK through Sept. at least
1986	w/2@1, weaned (date?)	--	--	alone in June
1987	w/1@0, survived	--	--	w/2@0, survived
1988	w/1@1, weaned (?)	--	--	w/2@1, weaned
1989	w/1@0, ND	--	--	ND
1990	--	--	--	--

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Table F3. Continued.

Year	318 5 in '80	321 10 in '80	325 11 in '80	327 5 in '80	328 6 in '80	329 1 in '81	349 4 in '81	354 5 in '82	361 7 in '82	363 4 in '82
1980	w/1@0 in Aug.	alone in Aug.	alone in Aug.	w/2@0 in Aug.	alone in Aug.	with mother 327	--	--	--	--
1981	w/1@1, weaned in May, bred	w/2@0, lost both in Aug.	alone, shed in next den	w/2@1 in den, 1 weaned in May, other in June, bred	w/2@0, 1 lost in July, other okay thru Sept., collar shed	weaned from 327 in June	alone	--	--	--
1982	alone	alone	--	alone, bred	?	alone	alone	w/2@0, to den entrance	alone	alone, bred?
1983	w/2@0, suspect lost both June, shed	think lost litter very early, bred	--	w/2@0, mother died in July	?	alone, bred?	w/2@0, both lost in den	w/1@1 weaned in May, bred	w/4@0 in den, 1 lost in den	alone, bred
1984	[must have had at least 2@0 based on 1985]	w/1@0 (in July)	--	--	alone, bred	alone, bred?	alone	w/2@0, 1 lost in Sept.	w/3@1 not weaned-- seen in den	w/2@0 survived
1985	w/2@1 in June when reported	w/1@1 weaned in June	--	--	w/3@0, all lost in June-July	alone, bred?	w/2@0 in den, 1 lost in August	alone (June)	w/3@2, weaned in June	w/2@1 weaned, date?
1986	?	alone	--	--	alone	alone	w/1@1, weaned (date?)	w/2@0 (Sept.) 1 lost in Sept. 2	alone in June	alone, bred
1987	--	alone, died	--	--	w/3@0 survived	w/2c, 1 lost in June-Aug.	w/2c survived	w/1@1, weaned	w/2c, 1 lost in den	w/2c, survived
1988	--	--	--	--	ND, shed collar	w/1@1 (?) weaned	w/2@1 weaned	w/3@0, survived	w/1@1, weaned	w/2@1, weaned
1989	--	--	--	--	shed	ND	alone	w/3@1	ND	w/2 cubs 1 lost early, 1 in den
1990					--	--	w/2@0 collar failed	w/2@0, 1 lost, ND	--	alone?

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Table F3. Continued.

Year	364 6 in '82	Downstream 367 4 in '82	Downstream 369 4 in '82	Downstream 370 7 in '82	Downstream 372 9 in '82	Downstream 374 7 in '82	Downstream 375 9 in '82	Downstream 376 6 in '82	Downstream 377 4 in '82	Downstream 378 6 in '82	Downstream 402 10 in '83
1982	alone, bred, collar failed	alone	alone	alone	alone, bred	alone?	w/3@1?	alone?	alone	alone	--
1983	[must have had cubs based on 1984]	alone-shot	alone	w/2@0, failed collar	w/2@0, failed collar	w/3@0, 2 died in July, shot in fall	w/2@0, survived	w/3@0	alone?	w/2@0, survived	w/3@1, weaned in June
1984	w/3@1, weaned in June-July bred, reunited w/1 in Sept.	--	2@0 in den lost 1 in Sept.	--	--	--	w/2@1 weaned in July	w/3@1, weaned in May, reunited in July and Sept.	alone	w/2@1, weaned	alone
1985	w/1@2 in June	--	w/1@1 weaned in June-July	--	--	--	shot in spring	alone?	w/2@0, 1 lost in June, other in July-Aug.	w/1@0, survived	w/2@0
1986	w/2@0, survived thru Sept.	--	alone?	--	--	--	--	alone	alone	alone	w/2@1, survived
1987	w/2@1 weaned	--	w/2c, survived	--	--	--	--	alone, bred	w/3c, 2+ survived	w/3c, survived	alone
1988	alone	--	w/2@1	--	--	--	--	w/2@0 (survival?)	w/2@1	w/3@1	w/2@0 survival
1989	w/2c survived to den entry	--	w/2@2 weaned	--	--	--	--	failure	w/2@0 (survival?)	failure	failure
1990	ND	--	w/1+@0 (survival?)	--	--	--	--	--	failure	--	--

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Table F3. Continued.

Year	Downstream 404 11 in '83	Downstream 405 17 in '83	Downstream 406 11 in '83	Downstream 409 5 in '83	Downstream 410 7 in '83	Downstream 411 8 in '83	431 11 in '85	432 6 in '85	438 8 in '85	441 9 in '85	448 6 in '85
1982	--	--	--	--	--	--	--	--	--	--	
1983	w/1@0 thru July then ??	w/2@0, survived	w/2@0, survived	alone?	w/2@0 shot	w/2@1, weaned June-Aug.	--	--	--	--	
1984	alone in August	w/2@1, not weaned	w/2@1, weaned in June-Aug., collar failed	alone?	--	w/2c, survived	--	--	--	--	
1985	3@0 in den, shot in spring	w/2@2, weaned in June, shot	--	w/2@0 probable age	--	w/2@1,	alone, bred	w/1@1, weaned in June, bred	w/2@2?, age??	alone, bred	alone bred
1986	--	--	--	w/2@1 probable age	--	alone	alone in June	alone in June	w/3@0, shot	alone bred	alone
1987	--	--	--	w/2c, survived	--	ND	ND	alone, shot	--	w/2c, survived	w/2c, died in summer
1988	--	--	--	w/2@1	--	--	--	--	--	w/2@1	--
1989	--	--	--	w/2@0 (survival?)	--	--	--	--	--	not seen	--
1990	--	--	--	ND	--	--	--	--	--	--	--

Table F4. Summary of known losses of black bear cubs-of-the-year. Losses calculated during first season out of den (in dens or at emergence from dens as cubs to entrance into dens as cubs.

Year	Upstream study area	Downstream study area	Both areas
1980	no data	no data	--
1981	4 of 9 lost (289, 301, 321, 328	no data	4 of 9 lost
1982	0 of 2 lost (354)	no data	0 of 2 lost
1983 incomplete data*	13 of 18 lost (289, 317, 318 361, 349, 379	1 of 12 lost (375, 376, 377**, 378, 405, 406	9 of 25 lost
1984 complete data	1 of 4 lost (321, 354, 363)	0 of 2 lost (369)	1 of 6 lost
1985 complete data	7 of 11 lost (289, 317, 328, 349, 377)	0 of 3 lost (378, 402)	7 of 14 lost
1986 complete data***	0 of 4 lost (354, 364)	0 of 0 lost	0 of 4 lost
1987 complete data****	3 of 19 lost (289, 317, 328, 349, 361, 363, 377, 441, 329)	0 of 6 lost (369, 378, 409)	3 of 27 lost
1988	0 of 3 lost (354)	no data	0 of 3 lost
1989	2 of 4 lost (363, 364)	no data	2 of 4 lost
1990	1 of 2 lost (354)	no data	1 of 2 lost
1991	ND		
TOTALS (all years)	31 of 76 = 37% lost	1 of 23 = 4% lost	27 of 94=29% lost

* Incomplete data resulted from not observing the family status of the bear before it entered its winter den, shed collars, collar failures, or early hunter kills. Tabulated losses occurred prior to loss of the female to these causes.

** B377 may have lost 2 of 2 rather than the 1 of 1 tabulated in 1983, the initial litter size was not known with certainty.

*** B438 and B409 had inadequate data.

**** Not included is B448 (2 of 2 assumed lost when mom died or was killed).

Table F5. Age at first reproduction for GMU 13 Su-hydro area black bear females. "Adult" means first litter was at indicated age or younger, "open" means had no litter, data indicated with (*) were not included as bear could have had a previous unobserved, litter.

		Age					
Id	Area	3	4	5	6	7	8
289	u	?	?	?	?	?	adult
290	u	?	?	?	?	adult	adult
301	u	?	?	?	cubs	adult	adult
317	u	?	?	?	?	adult	adult
318	u	?	?	cubs	adult	adult	adult
326	u	?	?	cubs	adult	adult	adult
327	u	?	?	cubs	adult	adult	adult
328	u	?	?	?	open*	cubs*	adult
329	u	open	open	open	open	cubs	adult
349	u	?	open	open	cubs	adult	adult
354	u	?	?	cubs	adult	adult	adult
361	u	?	?	?	open*	cubs*	adult
363	u	?	open	open	cubs	adult	adult
364	u	?	?	?	open*	cubs*	adult
367	d	?	open	open	?	adult	adult
368	d	open	?	?	?	?	?
369	d	?	open	open	cubs	adult	adult
370	d	?	?	?	?	open*	cubs*
374	d	?	?	?	?	open*	cubs*
375	d	?	?	?	?	?	adult
376	d	?	?	?	open*	cubs*	adult
377	d	?	open	open	open	cubs	adult
378	d	?	?	?	open*	cubs	adult
409	d	?	?	open	open	cubs	adult
410	d	?	?	?	?	adult	adult
411	d	?	?	?	?	cubs*	adult
432	u	?	?	cubs	adult	adult	adult
438	u	?	?	?	?	adult	adult
446	u	?	?	open	?	?	?
448	u	?	?	?	open*	open*	cubs*
Both areas							
# Subadults		2	6	8	3	0	0
# 1st litters		0	0	5	4	4	0
#>1st litter		0	0	0	5	14	25
% "adult" =		0.0	0.0	38.5	75.0	100.0	100.0

Mean age of first reproduction = 5.92 years

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Table F5. Continued.

	Age 3	4	5	6	7	8
Upstream only						
# Subadults	1	4	5	1	0	0
# 1st litter 0	0	5	3	1	0	
#>1st litter	0	0	0	5	11	16
% "adult" =	0.0	0.0	50.0	72.7	100.0	100.0
Mean age of first reproduction = 5.56 years						
Downstream only						
# Subadults	1	2	3	2	0	0
# 1st litter 0	0	0	1	3	0	
#>1st litter	0	0	0	0	3	9
% "adult" =	0.0	0.0	0.0	66.7	100.0	100.0
Mean age of first reproduction = 6.75 years						

Table F6. Summary of reproductive intervals for black bears in the Susitna hydroelectric project study area. Year of litter and reasons for intervals >2 years are indicated in parenthesis; "lost" means lost complete litter.

Complete Intervals of:

2 Years		3 Years	4 Years	5 Years
289 (81)	363 (84)	317 (83, skipped 1)	318 (84, skipped 1, lost 1)	321 (84, lost 1, skipped or lost 2)
289 (83)	364 (86)	361 (83, weaned @ 2)	349 (85, skipped 1 lost 1)	
289 (85)	369*(84)	361 (87, skipped 1)	369*(87, skipped 1, weaned @2)	
289 (87)	375*(83)	363 (87, skipped 1)		
301 (81)	376*(83)	364 (83, weaned @ 2)**		
317 (80)	378*(83)			
317 (85)	378*(85)			
317 (87)	378*(87)			
318 (80)	406*(83)			
327 (80)	409*(85)			
329 (87)	409*(87)			
349 (87)	410*(84)			
354 (82)				
354 (84)				
354 (86)				
354 (88)				

Incomplete Intervals of:

3 YEARS	4 YEARS	5 YEARS
327 (83. skipped 1)	377*(87, lost 1, skipped 1)	376*(88 skipped 3)
349 (90, skipped 1)	328 (85, lost 1, skipped 1)	
364 (89, skipped 1)	363 (91, lost 1, skipped 1)	
402*(88, skipped 1)	432*(88, skipped 2)	
431 (87, skipped 1)		
441 (87, skipped 1)		
448 (87, skipped 1)		
411*(87, skipped 1)		

* Downstream study area

** Female separated from 3 @ 1 but reunited and apparently denned with 1 of these.

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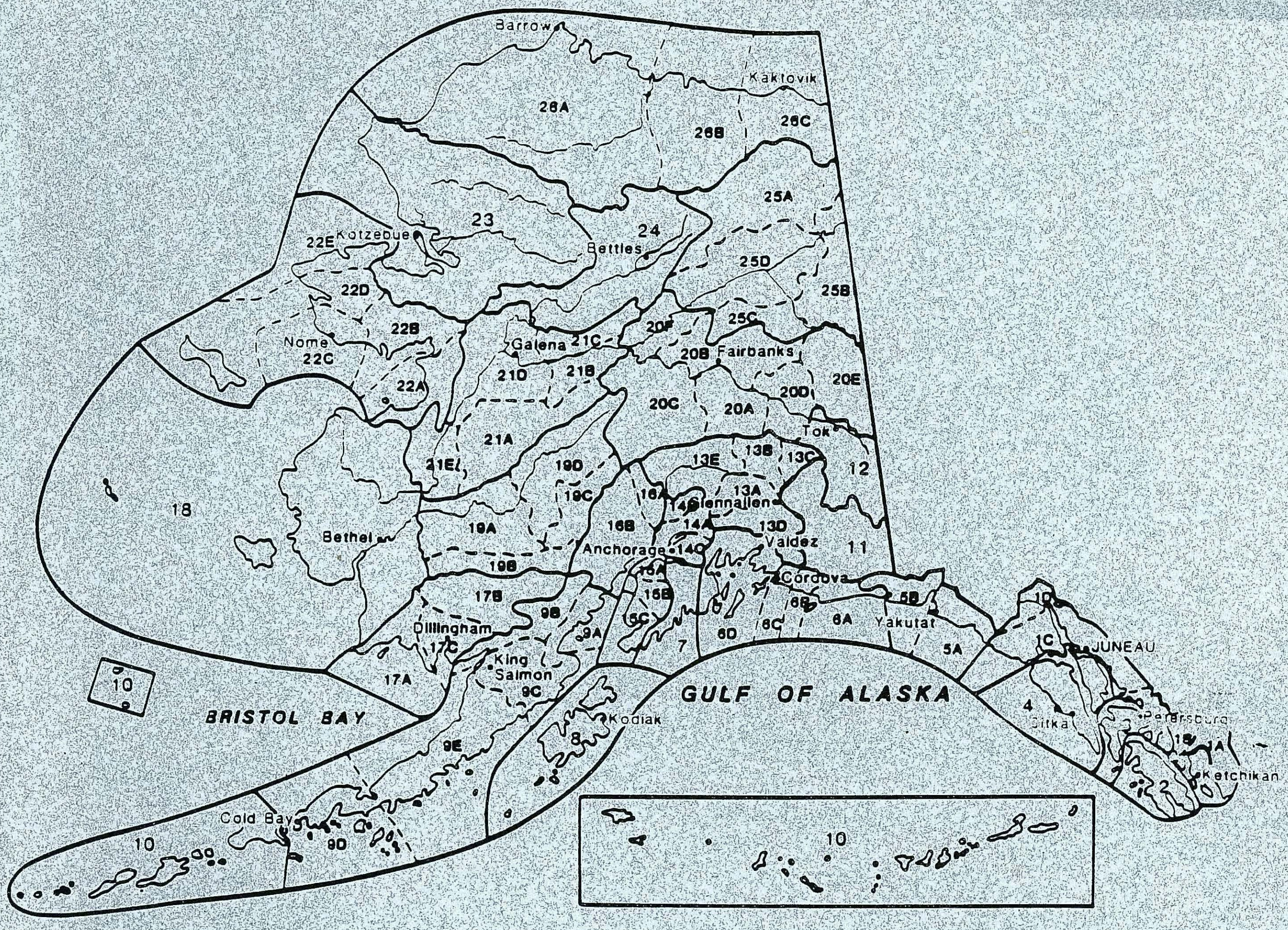
Table F6. Continued.

	Interval
Mean Recruitment Interval, Upstream Area Only	
Complete intervals (n = 26)	2.46
Incomplete intervals only (n = 8)	3.25
Complete and incomplete intervals (n = 34)	2.65
Mean Recruitment Interval, Downstream Area Only	
Complete intervals (n = 11)	2.18
Incomplete intervals only (n = 5)	3.8
Complete and incomplete intervals (n = 16)	2.69
Mean Recruitment Interval, Both Areas	
Complete intervals (n = 37)	2.37
Incomplete intervals only (n = 13)	3.46
Complete and incomplete intervals (n = 50)	2.66

Alaska's Game Management Units



Federal Aid in Wildlife Restoration

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. Alaska receives 5% of the revenues collected each year, the maximum allowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.