Black bear hunting in northwest Montana has shown a dramatic increase in popularity since the early 1970s. In 1971, the Montana Department of Fish, Wildlife, and Parks (MDFWP) recorded about 19,000 black bear hunter-days and approximately 650 bears killed in Region 1 of northwest Montana (28,600 km²). By 1979, hunter-days had increased to 55,000 with almost 1,000 bears harvested during spring and autumn seasons totaling 18 weeks (Brown et al. 1991). With this increase in harvest and hunting pressure, MDFWP biologists became concerned about trends in overall bear numbers. Interviews with hunters and residents indicated a general decline in bear sightings and nuisance bear complaints.

In an effort to reduce the overall harvest and afford greater protection to reproductively active females, MDFWP biologists shortened the spring season in a portion of the region beginning in 1981. Since 1984, the black bear hunting season has remained constant with a 15 April to 15 May spring season and a 12-week autumn season that extends from early September to late November. Annual harvest and effort in Region 1 decreased to about 630 bears harvested and 43,000 hunter-days by 1990 (Brown et al. 1991). Fifty-two percent of the regional harvest from 1986 to 1990 occurred during the spring hunting season, with most during May.

Under Montana law only 1 bear may be harvested per hunter per year, and the use of dogs and baiting is prohibited. Female bears with young and individual cubs may not be harvested. Successful hunters are required to present the skull for removal of a tooth for aging.

This paper seeks to examine reproduction and survival rates of adult black bears under the annual 2-season hunting regime. Data are presented and examined from the Cabinet Mountains and the Yaak River study areas in northwest Montana.

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STUDY AREA

Habitat use and population characteristics of black and grizzly bears were studied from 1983 to 1992 in the Cabinet Mountains and the Yaak River of northwest Montana (48°N, 116°W). The study areas encompassed approximately 2,000 km² in the Yaak River and 2,200 km² in the Cabinet Mountains. Study areas were estimated from the distribution of trap sites and home ranges of collared bears. The study areas were bisected by the Kootenai River, with the Cabinet Mountains to the south and the Yaak River area to the north. Approximately 90% of the study area was on public land administered by the Kootenai and Panhandle National Forests. The Cabinet Mountains Wilderness Area encompassed 381 km² of the study area at higher elevations of the Cabinet Mountains. Open road densities on the study area varied from 0 km per km² within the wilderness area to as high as 3 km per km² on corporate timberlands.

Elevations on the study area ranged from 664 m along the Kootenai River to 2,664 m at Snowshoe Peak. Weather was dominated by a Pacific maritime climate characterized by short, warm summers and heavy, wet
winter snowfalls. South and west slopes at lower elevations supported stands of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). Grand fir (*Abies grandis*), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) dominated the lower elevation moist sites. Mixed stands of subalpine fir (*Abies lasiocarpa*), spruce (*Picea engelmannii*), and mountain hemlock (*Tsuga mertensiana*) were predominant above 1,500 m. Lodgepole pine (*Pinus contorta*) dominated large areas at mid and upper elevations, especially north of the Kootenai River. Mixed stands of coniferous and deciduous trees were interspersed with riparian shrubfields and wet meadows along the major rivers. Huckleberry (*Vaccinium spp.*), an important food for black and grizzly bears (*Ursus arctos horribilis*), was a common component in the understory. The occurrence of huckleberry and other berry-producing shrubs were largely a result of wildfires that occurred between 1910 and 1929, and also from timber harvesting. Effective fire suppression since then has virtually eliminated wildfire as a natural force in creating and maintaining berry-producing shrubfields.

The southern portion of the study area was characterized by high, precipitous peaks with steep slopes. The northern portion was characterized by mountains that were lower in elevation, had gentler slopes, and were forest-covered. Contemporary resource use included mineral exploration and extraction, timber harvest, and recreation.

**METHODS**

**Capture and Marking**

Bears were captured with leg-hold snares following the techniques described by Johnson and Pelton (1980). All bears were immobilized with a drug mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine hydrochloride; the use of trade names does not imply endorsement of such products by the U.S. Fish and Wildlife Service). Drugs were administered intramuscularly with either a syringe mounted on a pole or a Palmer Cap-Chur gun. Immobilized bears were measured, weighed, tattooed, and a first premolar tooth extracted for age determination (Stoneberg and Jonkel 1966).

Each captured bear was marked with an individually numbered ear tag in each ear. A subsample of the bears captured were fitted with motion-sensitive radio transmitters. To prevent permanent attachment, a canvas spacer was used in the collars that was designed to separate in 2-3 years (Hellgren et al. 1988).

Trapping efforts were conducted primarily during the spring (May and June) and autumn (September) months from 1983 to 1992. Trap sites were usually located within 200 m of a road to allow vehicle access. Many trap sites were accessed from closed roads. One or two 2-person crews checked the snares daily. Bait consisted primarily of road-killed deer, with lesser amounts of beaver carcasses, elk, moose, and meat scraps from processing plants.

Captured females were closely examined by study personnel and information relating to reproductive status was collected. Mammals were examined for evidence of lactation, and nipple length, width, and color were recorded. During the spring and early summer months the vulva was examined for swelling, an indication of estrous. Adult females were often removed from their dens in winter in order to replace aging radio collars, and the number, sex, and weight of any young present was recorded.

**Radio Monitoring**

Instrumented black bears were aerially located each week (weather permitting) during the 7-8 month period in which they were active. In addition, efforts were made to obtain as many ground locations as possible, usually by triangulating from a vehicle. Bear activity was assessed each time a location was obtained. Collars that were inactive for unusual periods of time were approached from the ground and a determination made of the fate of the bear. All specific locations were plotted on U.S. Geological Survey topographic maps (1:24,000) and recorded by Universal Transverse Mercator Coordinates. Distance from radio locations to the nearest open road and trail were measured on maps to 30 m accuracy on the Cabinet Mountains Study Area (Kasworm and Manley 1990). Roads closed to motorized vehicles were considered trails in the analysis.

**Survival Estimation**

A computer software program that incorporates a staggered entry design was used to calculate survival and cause-specific mortality rates from the radiotelemetry information (Pollock et al. 1989). This method assumed that marked individuals were representative of the population, individuals had independent probabilities of survival, capture and radiocollar did not affect future survival, censoring mechanisms were random, a time origin could be defined, and newly collared animals had the same survival function as previously collared animals.
Censoring was defined as radio-collared animals being lost due to radio failure, radio loss, or emigration of the animal from the study area. One female black bear died as a result of anesthetization in the den, but was censored from the data rather than treating her as a mortality.

Our time origin began at capture or on the first of February, which was assumed as the birthdate of all bears. Some bears <5 years old were collared, but telemetry from these animals was not used in the analysis until they reached 5 years of age. Animals were intermittently added to the sample over the 10 years of the study. Whether or not a captured bear was fitted with a radio collar was based on desire for better geographical spacing and also a desire to collar more adult females than males. Collared bears were assumed to be representative of the male and female segments of the population ≥5 years old. Survival times for individual black bears were assumed to be independent.

Mortality dates were established from hunter harvest information and estimates of dates based on radio telemetry, collar retrieval, and mortality site inspection. Radio failure dates were estimated using the date of the last radio location when the animal was known to be alive.

### Estimating Maximum Sustainable Mortality

A population model which estimates maximum sustainable mortality was developed by Bunnell and Tait (1980). This model incorporates average natality rates and the average age of first reproduction. The model assumes that the mortality rate is constant for all age classes, and that cubs die only if the mother dies. To produce a nondeclining population, the mortality rate was balanced against the natality rate. In our use of the model, cub mortality was not included. Only adult bears with similar survival rates were considered.

### RESULTS

#### Black Bear Captures and Monitoring

Three hundred and nineteen individual black bears were captured from 1983 to 1992 on the study areas, of which 68% were males and 32% were females. One hundred and seventy-seven of the bears were adults (≥5 years old) and 142 of the bears were subadults (≤4 years old).

Forty-eight black bears aged 5 to 21 years old were radio collared. Twenty-one of these individuals were males that carried functional collars for 4-68 months. Monitoring time included portions of 55 bear-years for males and 86 bear-years for females.

Age distribution of the collared sample was limited to bears ≥5 years old, but was also skewed toward older age bears. Seventy-three percent of the male bear-years used in the sample were from bears ≥8 years of age. Eighty-four percent of the female bear-years were from bears ≥8 years of age.

#### Reproduction

Records from 111 female black bears captured during spring were analyzed to determine age of first reproduction. Incidence of estrous, lactation, cub presence, and nipple length were used in the analysis (Table 1). Lactation was noted in only 1 of 30 bears aged 3-5 years old. The 4-year-old bear that showed evidence of lactation was radio-collared and was never subsequently seen with cubs. Signs of estrous (swelling of the vulva) were noted in 13% (n = 30) of the black bears aged 3-5 years old. Six of nine 6-year-olds showed signs of estrous, were lactating, or had cubs present at capture. Fifty-seven percent (n = 61) of the captured black bears >6 years old were in a similar reproductive state. No female bears first captured as 4- or 5-year-olds (n = 4) produced cubs prior to the age of 6.

Mammary gland nipple length appeared to be greater for bears that had produced cubs than for bears that had not (Kasworm and Manley 1988). Nipple length measurements were recorded from female black bears captured since 1984 (n = 85). Only 1 of 28 captured black bears <6 years old had nipple lengths >12 mm.

### Table 1. Reproductive state of female black bears captured during spring trapping in northwest Montana, 1983-92.

<table>
<thead>
<tr>
<th>Age class</th>
<th>n</th>
<th>Estrous</th>
<th>Lactation or</th>
<th>Nipple length ≥ 12 mm (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cub-2.0</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0 (7)</td>
</tr>
<tr>
<td>3.0</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>0 (8)</td>
</tr>
<tr>
<td>4.0</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>0 (6)</td>
</tr>
<tr>
<td>5.0</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>1 (7)</td>
</tr>
<tr>
<td>6.0</td>
<td>9</td>
<td>2</td>
<td>4</td>
<td>4 (5)</td>
</tr>
<tr>
<td>7.0</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>7 (9)</td>
</tr>
<tr>
<td>8.0</td>
<td>12</td>
<td>2</td>
<td>5</td>
<td>10 (11)</td>
</tr>
<tr>
<td>9.0</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>5 (6)</td>
</tr>
<tr>
<td>10.0-24.0</td>
<td>29</td>
<td>11</td>
<td>6</td>
<td>25 (26)</td>
</tr>
</tbody>
</table>

*Sample size for nipple length measurement.*
Eighty-nine percent of captured bears ≥6 years old (n = 57) had nipple lengths ≥12 mm. While this information does not demonstrate a cause and effect relationship, it is unlikely the correlation of increased nipple length and first reproduction was completely coincidental. This information supports our contention that little successful reproduction occurred on our study area among females prior to the age of 6.

Portions of 86 bear-years were available for analysis, but only 68 bear-years from 25 female black bears ≥6 years old had complete reproductive information (Table 2). During this time 22 litters were produced. In 1 instance a female lost her 2 cubs in June of 1987, came back into estrous, then produced cubs again the following year. In 2 other instances female bears were killed before the sex and number of cubs produced could be determined.

Twenty known litters were comprised of 35 cubs, for a mean litter size of 1.75. Mean interval between litters was 3.2 years, excluding the litter that was lost in 1987. An annual reproductive rate of 0.51 cubs/adult female ≥5 years old was calculated assuming 33 cubs were successfully produced during 65 bear-years. If the 2 dead females had each produced 2 cubs and the number of bear-years was increased to 67, the reproductive rate would have been 0.55.

Ten litters containing 21 cubs or yearlings were captured and examined at dens or shortly after den emergence. Fifteen of the individuals were males and 6 were females. The sex ratio from this sample was highly skewed but not significantly different from 50:50 (χ² = 3.05, 1 df, P = 0.08).

Maximum Sustainable Mortality

Using an average litter size of 1.7, an interbirth interval of 3.2 years, and a first age of reproduction of 6, a maximum sustainable mortality rate of 12% from all causes was derived using Bunnell and Tait's (1980) model. Survival rates less than 0.88 would theoretically cause this population to decline.

Survival of Radio-Collared Black Bears

The 2 study areas encompassed portions of 3 hunting districts in which season lengths have differed slightly in the past. The annual survival rates and survival functions of all adult bears within each district was compared by Z-tests and the log-rank test described by Pollock et al. (1989). No significant difference was detected among the comparisons of the 3 survival rates (survival = 0.73-0.84, Z < 1.16, P > 0.25) or among any of the pair-wise comparisons of survival functions (P > 0.47). Data from the study areas were pooled for further analysis.

Annual survival rates of all adult bears during the 10 years of study varied from 0.60 to 1.00 (Table 3). Annual survival displayed no clear trend during the study period (r² = 0.06, P = 0.49).

Survival rates of adult males during 1983-92 (0.73 ± 0.13, estimate ± 95% CI) were not different (Z < 1.16, P = 0.46) from adult females (0.79 ± 0.09) during the same time frame. Similarly, survival functions of adult males and females were not significantly different (P = 0.75).

Twenty-four censors of collared animals were made from survival calculations over the course of the study. The censoring mechanism was examined through a check of the fates of censored animals if they were killed after the radio collar quit and through the development of alternate survival rates. Fates of 13 censored bears were not known. Seven animals lost their radio collars, which were later recovered. Three bears wearing nonfunctioning collars were subsequently harvested by hunters. One bear died as a result of handling procedures. This death was treated as a censor.

Four black bears (1 M and 3 F) disappeared with less than 2.0 years time on their transmitters. Had these suspected deaths been counted as mortalities, survival rates would have been 0.71 ± 0.13 for males and 0.74 ± 0.10 for females.

Table 2. Cub production of radio-collared female black bears ≥6 years old in northwest Montana, 1983-92.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cubs</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Litters</td>
<td>1</td>
<td>1</td>
<td>7a</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>22a</td>
</tr>
<tr>
<td>Females monitored</td>
<td>5</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>68</td>
</tr>
</tbody>
</table>

a Includes 2 litters in which adult females were killed before counts of cubs were obtained.

<table>
<thead>
<tr>
<th>Period</th>
<th>No. at risk</th>
<th>No. of deaths</th>
<th>No. censored</th>
<th>No. added</th>
<th>Survival estimate</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.00</td>
<td>1.00-1.00</td>
</tr>
<tr>
<td>1984</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>0.80</td>
<td>0.58-1.00</td>
</tr>
<tr>
<td>1985</td>
<td>10</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>0.88</td>
<td>0.72-1.00</td>
</tr>
<tr>
<td>1986</td>
<td>15</td>
<td>6</td>
<td>3</td>
<td>15</td>
<td>0.65</td>
<td>0.49-0.82</td>
</tr>
<tr>
<td>1987</td>
<td>21</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>0.65</td>
<td>0.44-0.86</td>
</tr>
<tr>
<td>1988</td>
<td>13</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1.00</td>
<td>1.00-1.00</td>
</tr>
<tr>
<td>1989</td>
<td>12</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>0.67</td>
<td>0.28-1.00</td>
</tr>
<tr>
<td>1990</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0.60</td>
<td>0.30-0.90</td>
</tr>
<tr>
<td>1991</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1.00</td>
<td>1.00-1.00</td>
</tr>
<tr>
<td>1992</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0.71</td>
<td>0.38-1.00</td>
</tr>
</tbody>
</table>

Causes of Mortality

Twenty-one instances of known mortality were recorded during the 10 years of study among the 48 collared animals. Of 9 mortalities among males, 1 occurred during April and 8 occurred during May. Female mortality was more evenly distributed with 3 deaths occurring in April, 5 in May, 1 in July, 2 in October, and 1 in November.

Thirteen mortalities were reported hunter kills consisting of 9 males and 4 females. Four mortalities were illegal kills that all involved females. Two were females with cubs that were shot outside of legal season and 2 were females accompanied by yearlings killed during open season. One mortality involving a female was classified as a natural mortality. This bear was 24 years old when found dead during early July. Three female mortalities were classified as unknown, but may have been related to hunting (e.g., wounding loss or failure to report a kill). These included 1 cut-off radio collar found hidden under a rock and 2 collars found within 200 m of open roads where the cause of death could not be determined from the animal parts found. All of the unknown mortality occurred during the hunting season.

Sixty-two percent of known mortality was reported by hunters. Hunting was the only source of mortality for males and produced a mortality rate of 0.27 (Table 4). Hunting and illegal kills produced identical mortality rates of 0.08 for females. The unknown cause of death category for females had a mortality rate of 0.05. The natural mortality rate for females was 0.02.

Four radio-collared black bears disappeared with less than 2.0 years of elapsed time on their transmitters and were classified as suspect mortalities. These included 1 female that disappeared in May, 1 male in June, 1 female in July, and 1 female in August. All were adults and major shifts in home range were not expected. Extensive aerial searches were conducted for these animals after signal loss. Mortality rates associated with the suspect category were 0.03 for males and 0.06 for females (Table 4).

Comparisons of Radio Returns and Ear Tag Returns

Twenty-seven percent of the 48 radio collars placed on bears were returned by hunters. Of 21 collared males, 9 were returned by hunters and of 27 collared females, 4 were returned. Hunter return rates for males and females were 43% and 15% respectively. All hunter kills occurred during the spring hunting season.

Two hundred and thirty-four black bears >5 years old were captured and ear-tagged in addition to those radiocollared during 1983-92. Twenty-five percent of these were returned by hunters. Ninety-two of the ear-tagged bears were males of which 28 were returned by hunters during the study period. Forty-two were females of which 6 were returned. Hunter-return rates were 30% and 14% respectively. Hunter-return rates of radio collars and ear-tagged bears were not different for males, females, or total bears ($\chi^2 < 0.57$, $P > 0.45$). Seventy-four percent of returned ear tags occurred during the spring hunting season and 26% were returned during autumn. Seasonal distribution of returns was different between radio collars and ear tags ($\chi^2 = 4.26$, $P = 0.04$).

Table 4. Mortality rates and number of deaths by source for radio-collared black bears from northwest Montana, 1983-92.

<table>
<thead>
<tr>
<th>Sex</th>
<th>n</th>
<th>Hunting</th>
<th>Illegal</th>
<th>Natural</th>
<th>Unknown</th>
<th>Total</th>
<th>Suspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>21</td>
<td>0.27 (9)</td>
<td>0.00 (0)</td>
<td>0.00 (0)</td>
<td>0.00 (0)</td>
<td>0.27 (9)</td>
<td>0.03 (1)</td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>0.08 (4)</td>
<td>0.08 (4)</td>
<td>0.02 (1)</td>
<td>0.05 (3)</td>
<td>0.21 (12)</td>
<td>0.06 (3)</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>0.16 (13)</td>
<td>0.05 (4)</td>
<td>0.01 (1)</td>
<td>0.03 (3)</td>
<td>0.24 (21)</td>
<td>0.05 (4)</td>
</tr>
</tbody>
</table>
Relations of Human Access to Mortality

Road and trail influences on black bears in the Cabinet Mountains study area were described by Kasworm and Manley (1990). This analysis involved distances from radio locations to the nearest open road or trail (trails include closed roads). This data set was further analyzed to determine the relations between mortality and black bear use of habitat near roads or trails. Only diurnal aerial locations were analyzed.

Mean distance to the nearest open road from 393 radio locations of bears killed during this study (\(\bar{x} = 1,338\) m) was less (\(t = 9.18, P < 0.001\)) than the mean distance for 826 locations of bears still alive at the end of the study (\(\bar{x} = 2,014\) m). Mean distance to the nearest trail from locations of bears killed during the study (\(\bar{x} = 565\) m) was less (\(t = 2.72, P = 0.007\)) than the mean distance for bears still alive at the end of the study (\(\bar{x} = 657\) m). Bears that survived during the course of this study had movement patterns that kept them farther from roads and trails than bears that did not survive.

DISCUSSION

We calculated a natality rate of 0.51 and an age of first reproduction of 6 years old for our study area. These values are similar to the natality rate of 0.57 and 6 years old as first age of reproduction for the Whitefish Range in northwest Montana (Jonkel and Cowan 1971). In northern Idaho, a natality rate of 0.46 and a first age of reproduction of 5 years old were recorded (Beecham 1980). These values contrast sharply from central and eastern United States black bear populations, which have reported litter sizes of 0.46 and a first age of reproduction of 5 years old were reported (Beecham 1980). These values are similar to the natality rate of 0.57 and 6 years old as first age of reproduction for the Whitefish Range in northwest Montana (Jonkel and Cowan 1971). In northern Idaho, a natality rate of 0.46 and a first age of reproduction of 5 years old were recorded (Beecham 1980).

When reproductive rates of black bears and grizzly bears are compared, the values are often similar or lower for black bears. A study of grizzly bears on the Montana Rocky Mountain East Front (Aune and Kasworm 1989) indicated a natality rate of 0.85 and a mean age of first reproduction of 7 years old. McLellan (1988) reported a natality rate of 0.86 and a mean age of first reproduction of 6 years old for grizzly bears in the North Fork of the Flathead drainage in northwest Montana and southeast British Columbia. Considerable attention is currently given to reducing the mortality of grizzly bears, because of their low reproductive rates. Similar concerns may be warranted for black bears if current population levels are to be maintained.

Hunters were asked to return ear tags or radio collars to us after killing a bear. Several successful hunters indicated that they did not see the radio collar until they approached the dead animal. A few hunters indicated that they saw the collar and decided not to shoot. This potential bias could cause our estimates of survival to be liberal. The evidence presented indicates survival rates lower than the minimum sustainable, given the reproductive parameters of the population. At least one potential bias in our data involves the proximity of radio-collared bears to roads. Black bears that used habitat closer to roads appear to have a higher mortality rate than bears that used less densely roaded habitat. Because the majority of trapping occurred within 200 m of roads (both open and closed roads), captured bears may be more prone to being killed. In a survey of spring black bear hunters in the Yaak study area, only 8 of 61 successful hunters stated they shot their bear more than 1 km from an open road. Sixty-six percent of the bears that were killed were first observed from an open road (Thier 1990). However, the home ranges of bears collared in this study contained much of the least roaded habitat within these study areas. In the Cabinet Mountains study area, all collared bears had large portions of their home ranges in either designated wilderness or in USDA Forest Service designated nonmotorized recreation areas. In the Yaak study area, the majority of bears had portions of their home ranges within roadless areas designated by the USFS Roadless Area Review Evaluation (RARE II). Black bears using more heavily roaded areas in northwest Montana than our study area could be expected to experience heavier mortality associated with hunting. Additional road closures during hunting seasons could reduce hunting mortality.

All hunter kills of radio-collared bears occurred during the spring hunting season. Hunter-killed black bear age data from tooth returns has been collected since 1985 (MDFWP unpubl. data). Seven hundred fifty-seven bears ≥5 years old were killed within the hunting districts that corresponded to our study areas. Fifty-eight percent of hunter harvest occurred in spring and 42% in autumn during 1985-92. Forty-one percent of adult harvest occurred among males during a 4-week spring season and 17% during a 12-week autumn season. Seventeen percent of adult harvest occurred among females in spring and 25% during autumn. This data indicates adult males are 3 times more vulnerable and adult females twice as vulnerable during spring versus autumn. Given our sample size of collared
bears, few collared bears would be expected to be harvested during autumn. Though the 4 known hunter kills of radio-collared females occurred in spring, 3 additional mortalities occurred in autumn that may have been related to hunting.

Radio-collared bears were located further from open roads during autumn than spring (Kasworm and Manley 1990). Some of the difference in seasonal mortality may be explained by this fact.

Only adult bears were collared and survival rates determined by telemetry represent that age group. Lower survival of subadult than adult black bears has been extensively reported (Jonkel and Cowan 1971, Bunnell and Tait 1985, Kolenosky 1986, Schwartz and Franzmann 1991). Overall black bear survival rates on our study area may be lower than reported here.

Hunter harvest of black bears and associated unreported mortality appears to be the largest source of mortality. The illegal kill of black bears documented by this study occurred exclusively in females. However, some of the unknown or suspect mortality in both sexes may have also been illegal kills. At least one of the illegal kills involved a hunter who unknowingly shot a female that was accompanied by young. This mortality was at least partially a product of hunting. Two of the illegal kills in this study represented not only the loss of the adult female, but also the loss of their newborn cubs. The loss of older adult females is of particular importance because older females have been shown to produce larger litters with greater rates of survival than younger females (Alt 1982, Elowe and Dodge 1989, Kolenosky 1990). Similarly, the presence of older age males may improve cub survival. Increased cub mortality through cannibalization by younger males replacing home ranges formerly used by older adult males has been reported (Young and Ruff 1982, Lecount 1987).

Given the magnitude of mortality, the low reproductive rates of the population, and the degree of access currently available, we believe a more conservative approach to black bear management is warranted in northwest Montana.

LITERATURE CITED


