

Chapter 8

Black Bear (*Ursus americanus*)

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I. INTRODUCTION –

- A. Management – Numerous changes have taken place throughout the history of black bear management in Wyoming. Black bears were considered a predator prior to 1911, and then classified as big game (1911-1977), and ultimately as trophy game (1978-present). Hunt areas were established in 1981, the annual bag limit was reduced from 2 to 1 in 1988, and the bear tag was removed from the resident elk license 1988.

A black bear management plan was written in 1994 (Wyoming Game and Fish Department 1994) and revised in 2007 (Wyoming Game and Fish Department 2007). Management scale was expanded from the hunt area level, to broader Bear Management Units (BMUs) (Fig. 1). Harvest is regulated through a mortality quota applied to the female segment of the population. Presently, separate female harvest quotas are applied to the spring and fall hunting seasons in each BMU. Seasons close when quotas are reached. The spring hunting season is typically from 1 May to 15 June. The fall season is typically 1 September to 31 October. Dogs cannot be used to hunt bears in Wyoming, but baiting is allowed. Baits must be registered and the number and density are subject to standards set forth by regulation. Hunters are responsible for inquiring about the status of harvest quotas prior to hunting. A toll free, 24-hour “hotline” is operated for this purpose. Bears must be checked at a Game and Fish Office within 3 days of harvest. Sale of edible bear parts is prohibited, but skulls, hides, claws, and gall bladders may be sold.

Approximately 200 black bears are harvested annually in Wyoming. Sixty percent are harvested in the spring season. Eighty percent of spring-harvested bears are killed over bait. Only 24% of bears harvested during fall seasons are taken over bait. Hunter success is also higher in spring.

Under Wyoming statute, a landowner or lessee, or the employee of a landowner can kill any black bear causing damage to private property. Depredations are most common in high elevation areas where domestic livestock, particularly sheep, graze seasonally. The Department reimburses livestock owners for losses that are confirmed depredations by bears. Owners of beehives are also reimbursed for damage caused by bears. In some parts of the state, bear damage can be a problem in residential areas and campgrounds as well. Statewide, an average of 9.5 black bears are removed annually to resolve conflicts. The Department does not limit the number of bears that can be removed to alleviate damage problems, nor are those mortalities applied against annual hunting quotas.

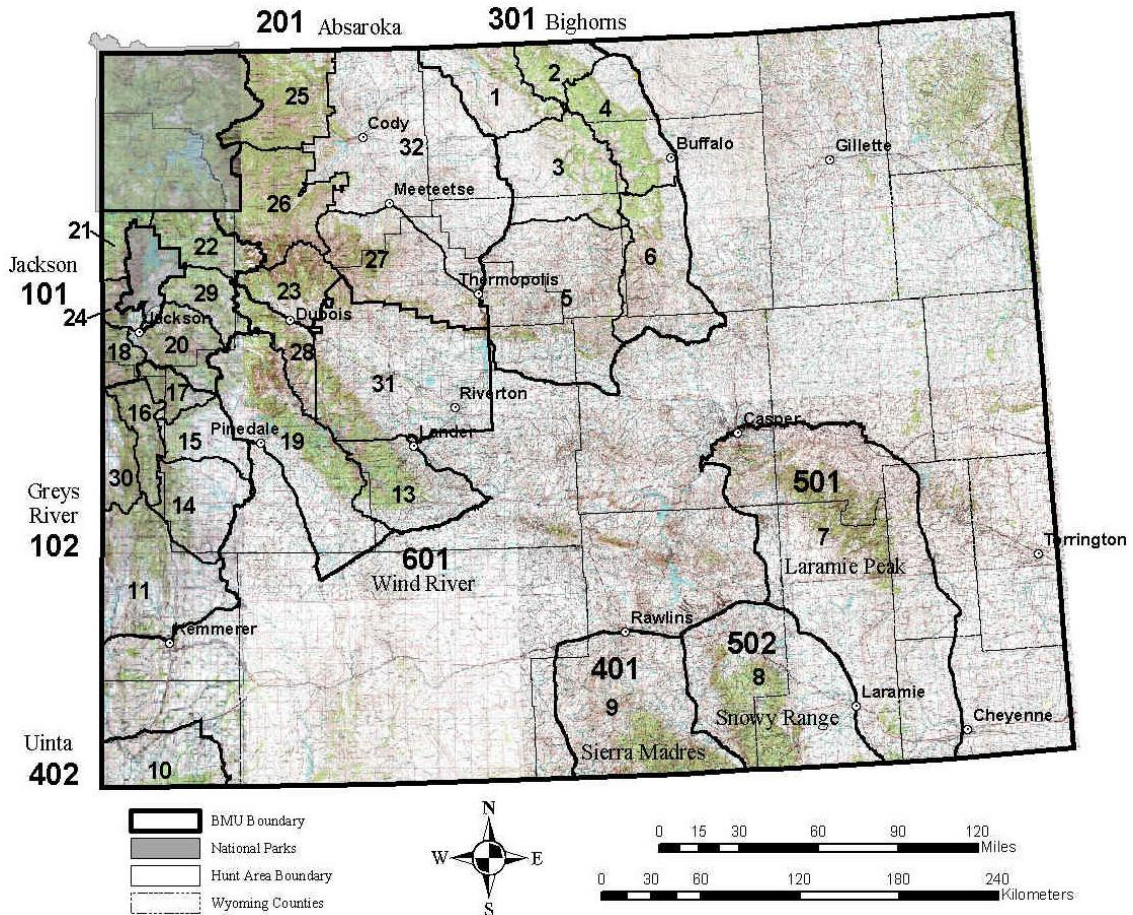


Fig. 1. Black bear hunt areas and Bear Management Units. Boundaries were delineated in 1994 to correspond with known black bear distributions and population centers.

II. LIFE HISTORY –

Black bears inhabit forested areas of all major mountain ranges in Wyoming. Populations are presumed highest in northwestern Wyoming, where higher seasonal moisture creates more abundant forage. The Bighorn Mountains in northern Wyoming also contain a robust black bear population. Lower densities of black bears inhabit the Snowy, Sierra Madre, Laramie Peak, and Uinta mountain ranges of southern.

Black bears vary from blond to black in Wyoming. Light brown, chocolate brown and cinnamon are common. Combinations of color phases, such as light brown body with darker brown legs, are also present. Weights of 57 adult males captured during Department research and damage operations between 1988 and 2005 ranged from 120 to 440 pounds (average 248 pounds). Weights of 39 adult females captured during the same period ranged from 85 to 250 pounds (average 160).

Black bears can be aged, and the reproductive efforts of females assessed from cementum annular rings deposited on roots of teeth (McLaughlin et al. 1990, Coy and Garshelis

1992, Harshyne et al. 1998, Costello et al. 2004). Based on samples from 384 female black bears harvested in Wyoming from 1988 – 2005, the average age of first reproduction is 5.2 (Table 1). These data indicate 70% of female black bears have produced a litter by their 5th summer. The average birth interval was 2.2 years (n=632). Although female black bears may have up to 5 cubs per litter in more productive habitats, typical litters in Wyoming are between 1 and 3 cubs. Mean litter size of 16 female black bears handled in winter dens from 1995 – 2005 was 1.9 cubs. The young remain with the female until spring/summer of their second year when they disperse and the female will again breed.

Female black bears usually enter dens in October. Males enter dens later, and all but a few adult males are denned by late November. Adult males are first to leave dens in spring, usually in late March to early April. Females with newborn cubs are last to leave, usually in late April or early May (Beecham and Rohlman 1994, Grogan 1997, Costello et al. 2001).

Food habits of black bears vary widely depending on season and location. In the Rocky Mountain West, black bears emerging from dens consume new growing grasses and forbs. As temperatures rise, they follow snowmelt to higher elevations focusing on the newly greening vegetation (Beecham and Rohlman 1994). When more nutritious mast crops (berries and nuts) ripen in late summer and fall, black bears focus intently on these foods (Beecham and Rohlman 1994, Costello et al. 2001). Ants, bees, and insect larvae comprise the majority the black bear's diet other than vegetation (Beecham and Rohlman 1994). However, during early summer, newborn ungulates such as elk calves can become a key food source in the West (Smith and Anderson 1996, Zager et al. 2005, Zager and Beecham 2006). Irwin and Hammond (1985) determined 83–94% of the volume of black bear diets in the Grey's River area of western Wyoming was vegetable matter, depending on annual and seasonal variation. The bulk of remaining animal matter consisted of carrion in spring and insects in summer and fall.

Black bear populations are very susceptible to changing environmental conditions. Significant declines in reproductive success have been documented after preferred black bear food crops failed (Beecham and Rohlman 1994). Costello et al. (2001) also documented the number of bears and proportion of females harvested by hunters were higher in years when oak mast crops failed in New Mexico. In Wyoming, the numbers of black bear incidents and black bears killed during the hunting season increase during very dry years and when production of critical bear foods, especially fall mast crops, is poor. During such years, bears move greater distances in search of food, making them more vulnerable to harvest and more likely to be involved in conflicts. Sometimes, they enter areas inhabited by humans.

We have few reliable estimates of bear densities in Wyoming, but based on harvest indices all populations are believed stable or increasing. The total area of suitable habitat in Wyoming is approximately 74,000 ha.

III. DESCRIPTION OF TECHNIQUES –

A. Census –

1. Mark-Recapture –

- a. Rationale – Mark-recapture studies are done to estimate the actual population of bears. Procedures involve marking a random sample of animals and resampling to estimate the proportion of marked animals in the population. The total number of animals originally marked is extrapolated based on the proportion of marked animals in the sample to estimate the population size. Although mark-recapture procedures are widely used and generally considered the most accurate method to estimate bear populations, some problems can be encountered. Two key assumptions are difficult to rigidly meet. These include, equal probability of capture, and no ingress or egress of animals in the study area (geographic closure). In addition, mark-recapture studies tend to be costly and labor intensive, which limits their practicality to small geographic areas. Total population estimates are geographically extrapolated from representative areas. Despite these problems, 16 of 27 states (59%) report using some form of mark-recapture technique to help assess their black bear populations (Garshelis 1990).
- b. Application – A mark-recapture study must be designed properly to be successful. Catch rates are balanced through trap spacing (to ensure all animals have access to traps), timing and duration of trapping (to account for seasonal movements), and trap types, sets and baits (to enhance capture of trap-wise animals). Radio-transmitters may be used to detect movements across study area boundaries. The study areas should be large enough to represent a population, and its attributes (habitat, hunting pressure, harvest structure) should be representative of other areas to which the estimate may be applied.

Several mark-recapture or resight methods are currently used to estimate bear abundance. The most common approach is to capture, mark, and release bears, then recapture a random sample of bears from within the population. Trapping and handling techniques are described in Erickson (1957), Johnson and Pelton (1980), and Jonkel (1993). Ear-tags and radio-collars can serve as marks. Sampling to obtain recapture/resight data can be accomplished with trapping (Lindzey and Meslow 1977, LeCount 1982, Beecham 1980), aerial observations (Miller et.al. 1997), photographs (Mace et al. 1994, Beck 1997, Grogan and Lindzey 1999), or by tallying marks in the harvest (Garshelis 1990). Methods that do not involve handling bears include distributing baits laced with chemical markers that are detectable in scats (radio-isotopes; Eager 1977, Pelton and Marcum 1977) or bones/teeth of harvested bears (tetracycline; Garshelis 1990), or typing (profiling) DNA from hair collected at bait sites (Paetkau and Strobeck 1994, Proctor 1995, Grogan and Lindzey 1999).

- c. Analysis of data – Various population ecology textbooks (i.e., Begon 1979, Krebs 1989) describe methods used to analyze mark-recapture data. Analytical methods have also been devised to address unique issues, such as unequal catch rates or lack of demographic closure (see Otis et al. 1978, Pollock 1982, White et al. 1982, White 1996). If radio-location data are available, the estimate can be improved by calculating the number of marked animals present during recapture efforts (Miller et al. 1987, Miller et al. 1997) or by weighting the marked proportion based upon the time each animal spends in the trapping area (Garshelis 1992). In general, lack of demographic closure (caused by births, deaths, immigration, emigration) can be addressed with the proper analysis (i.e., Jolly-Seber), however, populations will tend to be overestimated unless the assumptions of equal susceptibility to capture and geographic closure are met or accounted for in the analysis.
 - d. Disposition of data – The results of any mark-recapture study should be reported and distributed to Regional Wildlife Coordinators and the Trophy Game Section. This information is useful for evaluating hunting season frameworks and harvest quotas.
2. Bait-station Surveys –
- a. Rationale – Bait-station surveys can provide an index to assess local abundance of bears. Baits are placed along predetermined routes. Bears attracted to the baits leave signs such as claw marks on a tree, tracks in sifted dirt or sand, hair on trees or shrubs, or tooth punctures in sardine cans. Bait-station surveys are easy to conduct (i.e., bear sign is easy to identify and capture/handling of bears is not needed) and relatively inexpensive. However, there are three potential drawbacks. First, bears visiting more than one bait may inflate abundance estimates. The likelihood of this occurring is relatively high since baits are typically placed close together (0.5 mi intervals). Second, baits are typically distributed along roads, therefore visitation rates may indicate use of these routes by bears rather than the number of bears living in the vicinity. If bears avoid the selected road, abundance would be underestimated, as documented by LeCount (1982). Conversely, selecting a route used as a major travel lane by bears would lead to an overestimate. Third, bait visitation rates can be affected by availability of natural foods. Visitation decreases during periods of high natural food abundance. This effect can occur between years, or more importantly, between sampling periods within the same year. Surveys should be scheduled to provide consistent results.
 - b. Application – Numerous studies describe how to conduct bait-station surveys (Carlock 1986, Fendley et al. 1989, Johnson 1989, Clark 1991). Surveys typically involve multiple routes of 50 baits each. Baits are separated by 0.5 miles and placed on alternate sides of the road. Ideally, several routes should be established in each major habitat type. The area surveyed should be representative of other areas to which the results will be extrapolated. Baits should be set out the same

timeframe and for the same duration each year. Weather conditions, natural food abundance, and plant phenology should be noted to help explain fluctuations in visitation rates. Baits are generally checked after 2 to 3 weeks, and evidence of bear visitation is recorded. Missing baits may be replaced. Baits may or may not be moved between consecutive surveys.

- c. Analysis of data – The percent of baits visited is an index of bear abundance that can be compared among years, provided sources of bias are recognized. Visitation rates may also be compared among areas if all other factors (i.e., natural food abundance, age/sex structure of the population) are similar. Bait-station surveys are, for the most part, used only as supporting information and not as the primary means of assessing bear populations (Garshelis 1990). At present, Wyoming does not use bait-station surveys.
 - d. Disposition of data – The results of bait-station surveys should be reported and distributed to Regional Wildlife Coordinators and the Trophy Game Section. This information can be useful for evaluating hunting season frameworks and harvest quotas.
3. Incidental Observations –
- a. Rationale – Black bears are secretive, nocturnal, and live in forested habitats. Consequently, incidental sightings are rare and thus a poor index of bear abundance. However, bear sign can corroborate presence. Some states, including Wyoming, record numbers of bear sightings reported by hunters, but these data should be viewed cautiously. For example, persons hunting over bait may report several observations of the same animal.
 - b. Application – Department personnel should record bear sign they encounter and submit records for inclusion in the Wildlife Observation System (WOS). The number of bears observed by successful hunters should be recorded on the Black Bear Mortality Form when harvested bears are checked.
 - c. Analysis of data – Records of incidental observations can be consulted to corroborate other trend indicators, but should not constitute a primary measure of abundance. Incidental observations can be tallied for each hunt area or BMU. Data can be graphically displayed by Geographic Information System (GIS) software. Observations may also be useful for reviewing environmental effects of proposed projects, particularly if the presence of bears must be documented.
 - d. Disposition of data – Wildlife Observation records should be forwarded monthly to regional Wildlife Coordinators. Biological Services performs data searches upon request. The system has recently been reprogrammed enabling field personnel to search and sort records from remote personal computer stations. Black Bear Mortality Forms should be forwarded to Regional Wildlife Coordinators, and then to the Trophy Game Section where they are entered into a

statewide Black Bear database. Bear sightings by hunters are not tallied in the Annual Black Bear Mortality Summary, but they can be requested from the Trophy Game Section if needed.

B. Harvest Data –

1. Harvest Survey –

- a. Rationale – A harvest survey is mailed annually to each licensed black bear hunter in Wyoming. The survey is designed to measure hunter effort and success. The total harvest is not estimated because it can be more accurately determined from mandatory inspection data. In Wyoming, hunter surveys are done by a contracted service, and results are published in the Department’s Annual Report and the Report of Big Game Harvest. The harvest survey is discussed in Appendix III.

2. Bait Registration

- a. Rationale – In Wyoming, the density of bear baits cannot exceed 1 per section of federal land. Hunters are required to register locations of baits prior to placing them in the field. This prevents crowding of baits (and hunters), improves hunter satisfaction, and enables the Department to evaluate baiting.
- b. Application – Each regional office maintains a database of bait registration records. As hunters register bait locations, the information is entered in the database and plotted on a map. Office managers typically do this. Copies of the regional databases are forwarded to the Trophy Game Section at the end of each hunting season (i.e., each spring and fall), and the information is compiled into a statewide database.
- c. Analysis of data – Bait locations can be tallied several ways. For example, bait densities (i.e., baits/mi²) can be calculated within a drainages or hunt area. Success of hunters using baits can also be contrasted against success of hunters who do not.
- d. Disposition of data – Copies of regional bait registration databases should be forwarded to the Trophy Game Section at the end of each spring and fall hunting season.

3. Sex/Age Determination –

- a. Rationale – Many states, including Wyoming, use sex and age composition of harvested bears as a primary tool to evaluate and recommend management actions (Garshelis, 1990). In Wyoming, the desired harvest of female bears for a stable population is 30 – 40% of the total harvest in each BMU. Further information

regarding sex and age criteria is provided in the Wyoming Black Bear Management Plan (Wyoming Game & Fish Department 2007).

- b. Application – The skull and pelt from each harvested bear must be presented to a Department employee for inspection within 3 days after harvest. Harvested bears are the only source of data presently used to monitor black bear populations in Wyoming. The mandatory reporting system has been in place since 1975. Two teeth are extracted from each bear skull and used for aging. Department personnel also record location of kill, sex, number of days hunted, and method of take. Skulls must be presented in an unfrozen condition to allow successful removal of teeth. Teeth are sent to the Veterinary Lab at the University of Wyoming. Aging is based on the cementum annuli technique (Willey 1974, Stoneberg and Jonkel 1966). Proof of sex must remain naturally attached to the pelt for accurate identification. A survey conducted in 1992 indicated 96% of licensed bear hunters comply with these regulations (University of Wyoming, 1992).

Game and Fish personnel identify the sex of each bear by examining genitalia. Teats of female bears are inspected to determine if the bear has previously lactated. If a bear has not previously lactated, its teats are pinkish in color and lack pigmentation. A bear that has lactated will have darker, pigmented teats. Teats are generally swollen and milk is present if the bear is currently lactating.

Although age is most accurately determined based on the cementum annuli technique, each bear's age is also estimated at the time it is checked. Tooth eruption and wear patterns are examined for this purpose. Juveniles can usually be identified by body size. Estimating age in this manner is very subjective and tooth wear patterns vary depending on diet. Consequently, bear ages are assigned to the following, broader categories: Juvenile (≤ 1), subadult (2-4), adult (5 and over). Juvenile teeth show little wear and no staining. Cubs-of-the-year have milk teeth and usually weigh < 40 lbs. Yearlings retain some milk teeth, however permanent incisors and canines have erupted, yearlings usually weigh < 80 lbs. Body weights can be highly variable and should only be considered along with other factors when estimating age. Bears acquire a full set of permanent teeth by age 2. Subadult bears (2-4 yrs) typically have little to no tooth wear and some staining. Canines are usually sharp and incisors are slightly worn. Adult bears between 5 and 10 years of age generally have considerable wear on incisors, canines are rounded with slight wear patterns where lower and upper canines contact, and staining is prominent. Bears > 10 years old almost always have considerable wear on incisors, and as age progresses, incisors become worn even with gum line. Canines are usually very rounded, chipped or broken, and wear patterns are pronounced where upper and lower canines contact. Staining is extensive, and older bears have commonly lost one or more abscessed molars.

- c. Analysis of data – Sex and age data are used to evaluate harvest in each BMU. Desired harvest composition is 30 – 40% females. Adult females should

comprise 45 – 55% of the female harvest (Wyoming Game & Fish Department 2007).

- d. Disposition of data – Tooth samples and copies of Black Bear Mortality forms are sent to Regional Wildlife Coordinators. Coordinators forward these to the Trophy Game Section. The information from each form is entered into a statewide database. Tooth samples are sent to the Game and Fish Laboratory for age determination. Harvest composition (sex and age) is reported in the Annual Black Bear Mortality Summary prepared by the Trophy Game Section.
4. Body Condition –
- a. Rationale – Body condition is an indication of health and fitness, and can be useful in assessing habitat quality and general condition of the population (Bailey 1984, Smith 1990). The Department does not use a quantitative method to evaluate body condition. The condition of each harvested bear is qualitatively assessed when it is inspected through the mandatory check process. The conditions of all captured bears are also noted.
 - b. Application – Presence and quantity of fat are the basis for assessing excellent, good, fair, or poor condition when each bear is checked or captured. The condition is recorded on each mortality form or capture form.
 - c. Analysis of data – The Department does not currently analyze body condition data. However, biologists may refer to this data when evaluating environmental conditions or population status in specific areas.
 - d. Disposition of data – Information about body condition is recorded on Black Bear Mortality and Capture forms. Copies of the forms are sent to Regional Wildlife Coordinators. After proofing, Coordinators forward them to the Trophy Game Section. The information from each form is entered in a statewide database.
5. Laboratory Aging by Tooth Cross-Sectioning –
- a. Rationale – The most reliable method of aging bears is based on counting annular layers of cementum in tooth cross-sections (Marks and Erickson 1966, Stoneberg and Jonkel 1966, Willey 1974, Kolensky and Strathearn 1987). A layer of cementum is deposited each year around the dental roots of mammals. These layers indicate age in years (Dimmick and Pelton 1994). Older bears can be difficult to accurately age because outer annuli are deposited in thinner layers (Willey 1974). False and double annuli are also present in some bears (Morris et al. 1978). However, estimates derived from tooth annuli provide the most accurate age information for managing bear populations.
 - b. Application – The cementum annuli technique involves both field and laboratory procedures. A tooth must first be extracted from captured or harvested bears. To

ensure consistency, we recommend using the first premolar (pm1) to age black bears (Dimmick and Pelton 1994). This tooth is located directly behind the upper or lower canine.

Teeth can be removed with various dental elevators or tooth extraction devices available through veterinary supply companies. Waddell (1975) describes the technique and tools used to remove black bear teeth. Exercise care to maintain the integrity of the tooth. In most cases, it is imperative to keep the root of the collected tooth intact (Dimmick and Pelton 1994). If the root is broken, remove another tooth (there are generally 4 vestigial premolars). In addition, you should take into consideration the well being of live animals and preservation of trophy skulls. However, these teeth are very small, sometimes barely breaking the gum line. Removing more than one should not impair the appearance of trophy skulls, nor should it affect the function of live bears. After teeth are removed, they should be kept clean and placed in a small, properly labeled envelope.

Reproductive histories of female black bears can also be reconstructed from cementum annuli (Coy and Garshelis 1992). It is possible to obtain such information as age at first reproduction, interval between reproductive efforts, and number of reproductive efforts. These reproductive histories can help biologists estimate reproductive rates, construct population age structures, and set harvest quotas.

- c. Analysis of data – The Game and Fish Laboratory determines ages and reproductive histories. The lab returns this data to the Trophy Game Section where it is assessed based on criteria in the Wyoming Black Bear Management Plan (Wyoming Game & Fish Department 2007).
- d. Disposition of data – Bear teeth and accompanying data forms are sent to Regional Wildlife Coordinators. After proofing forms, Coordinators forward these to the Trophy Game Section where they are cataloged and forwarded to the lab. Data are summarized in an annual report of black bear mortality. These reports are available through the Trophy Game Section.

C. Capture and Handling –

1. Trapping and Marking –

- a. Rationale – Bears are captured and marked for various reasons including research to estimate sex and age structure of a population, population size and density, home ranges, and habitat use patterns (Lindzey and Meslow 1977, Beecham 1983, Garshelis 1992, Beck 1997, and Grogan 1997). Trapping may also be necessary to manage nuisance bears (Wyoming Game & Fish Dept. 1994). Personnel should be thoroughly familiar with capture and handling techniques to assure safety and proper care of the bear.

- b. Application – Several effective techniques are available to trap bears. The Department generally uses trailer-mounted culvert traps or foot snares, depending on accessibility of the site and public safety concerns. Culvert traps are used near areas of concentrated human activity such as housing developments or campgrounds. Foot snares are used when many traps are needed during research efforts, or when accessibility by motorized vehicle is limited. Trapping techniques are discussed by Jonkel (1993). Baits such as commercial scent lures, animal parts or other food items are used to attract bears into trap sites.

Once captured, bears are immobilized with Telazol (a combination of tiletamine hydrochloride (HCL) and zolazepam HCL). Dosage is 7 mg/kg (Kreeger 1996). Bears can tolerate imprecise dosages of Telazol. It is rapid acting and allows a gradual recovery in bears (Gibeau and Paquet 1991). Telazol is generally delivered by a CO₂-powered pistol, dart rifle, or jab stick. Bears >1 year of age are sometimes fitted with a radio transmitter collar. Cotton spacers are used in the collars to increase the likelihood the collar will be shed after 2-3 years (Jonkel 1993).

Each bear is fitted with ear-tags and marked with an identification tattoo when possible. Round, hog-button style ear tags are used. Each tag has a unique number on one side and the letters WGFD on the other signifying the bear was captured by the Wyoming Game & Fish Department. Tattoo pliers are used to place a tattoo on the inside upper lip. The tattooed number generally corresponds with the ear tag number.

Several morphometric measurements are recorded during capture, including weight, total length, contour length, girth, height, neck circumference, head length and width, and pad length and width. Mammary nipple length, width and pigmentation, and vulva condition are recorded to assess reproductive status of females (Jonkel and Cowen 1971, LeCount 1986, Beck 1991). Depending on the purpose of trapping, bears are either released on site or relocated.

- c. Analysis of data – The Department does not formally analyze bear capture data. However, the Trophy Game Section maintains a statewide database of capture information, and data are available upon request.
- d. Disposition of data – Any time a bear is anesthetized, a Large Predator Capture Form must be completed. When bears are not anesthetized (only trapped and moved), the sections of the capture form pertaining to date and location of capture, date and location of release, and a physical description of the bear must be completed. Capture forms are sent to Regional Wildlife Coordinators. After Coordinators have proofed the forms, they are forwarded to the Trophy Game Section and the information is entered in a statewide database.

2. Relocation –

- a. Rationale – Relocation of offending animals is often necessary to resolve conflicts between bears and humans. In each case, the decision to move a bear is made by regional enforcement personnel. Bears are usually moved to prevent further conflicts such as garbage raiding, livestock depredations, or property damage. Relocation gives the bear an opportunity to stay out of trouble. Once relocated, young bears often remain in the general vicinity of the release site, however older bears frequently return to the location where the conflict happened, especially when a food reward has been obtained. In most cases, the preferred management action is to move a nuisance bear at least once before lethal measures are considered.
- b. Application – The safest way to transport bears is in a culvert-type trap mounted on a trailer. Bears should be fully conscious when being transported. If the bear has been anesthetized, it should be allowed to recover before transporting commences. Keep the trap/trailer out of direct sunlight when it is parked. If the bear will be moved a long distance, keep the animal hydrated. To do this, run water from a common garden hose into the trap. Bears will drink heavily when ambient temperatures are high.
- c. Analysis of data – The Department does not currently analyze data collected during relocation actions. However, the data can be acquired from the statewide database maintained by the Trophy Game Section.
- d. Disposition of data – If the bear is anesthetized, a Large Predator Capture Form must be completed. When bears are not anesthetized, the sections of the capture form pertaining to date and location of capture, date and location of release, and a physical description of the bear must be completed. Capture forms are sent to Regional Wildlife Coordinators. After proofing the forms, Coordinators forward them to the Trophy Game Section, and the information is entered in a statewide database.

IV. LITERATURE CITED –

- Anderson, C.R., M.A. Ternent, D.S. Moody, M.T. Bruscano, and D.F. Miller. 1997. Grizzly bear-cattle interactions on two cattle allotments in northwest Wyoming. Final Rep. Wyo. Game and Fish Department, Lander. 78pp.
- Bailey, J.A. 1984. Principles of Wildlife Management. John Wiley & Sons, New York. 373pp.
- Beecham, J.L. 1983. Population characteristics of black bears in west-central Idaho. *J. Wildl. Manage.* 47(2):405-412.

- Beck, T.D.I. 1991. Black Bears of West-Central Colorado. Colorado Div. Wildl. Tech. Pub. 39, 86pp.
- Beck, T.D. 1997. Development of black bear inventory techniques. Colorado Division of Wildlife Federal Aid Progress Report W-153-R-10, WP5A, J2. Fort Collins, CO.
- Begon, M. 1979. Investigating animal abundance. Edward Arnold Publishers. London, 97pp.
- Carlock, D.M. 1986. Preliminary results of three years of bait-station surveys for black bears in north Georgia. East. Workshop Black Bear Res. And Manage. 8:118-124.
- Clark, J.D. 1991. Arkansas status report. East. Workshop Black Bear Res. And Manage. 9.
- Coy, P.L. and D.L. Garshelis. 1992. Reconstructing reproductive histories of black bears from the incremental layering in dental cementum. Canadian Journal of Zoology 70:2150-2160.
- Dimmick, R.W. and M.R. Pelton. 1994. Criteria of sex and age. Pages 169-214 in T.A. Bookhout, ed. Research and management techniques for wildlife and habitats. Fifth ed. The Wildlife Society, Bethesda, Maryland.
- Eager, D.C. 1977. Radioisotope feces tagging as a population estimator of black bear (*Ursus americanus*) density in the Great Smoky Mountains National Park. M.S. Thesis, University of Tennessee, Knoxville, TN. 89pp.
- Erickson, A.W. 1957. Techniques for live-trapping and handling black bears. Transactions of the North American Wildlife Conference 22:520-543.
- Fendley, T.T., L. Abercrombie, and M. Crocker. 1989. Relative abundance and distribution of black bear in the mountains of South Carolina. Clemson, SC, Clemson Univ. 46pp.
- Garshelis, D.L. 1990. Monitoring effects of harvest on black bear populations in North America: a review and evaluation of techniques. Eastern Workshop Black Bear Research and Management 10:120-144.
- Garshelis, D.L. 1992. Mark-recapture density estimation for animals with large home ranges. Pages 1098-1111 in D.R. McCullough and R.H. Barrett, editors. Wildlife 2001: Population. Elsevier Applied Science, London.
- Grogan, R.G. 1997. Black bear ecology in southeast Wyoming: The Snowy Range. M.S. Thesis, University of Wyoming, Laramie, WY. 84pp.
- Grogan, R.G., and F.G. Lindzey. 1999. Estimating size of black bear populations using DNA-based capture-recapture sampling: progress report. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, WY. 16pp.

- Grogan, R.G., and F.G. Lindzey. 1999a. Estimating population size of a low-density black bear population using capture-resight. *Ursus* 11:117-122.
- Holm, G.W. 1997. Habitat use, spatial distribution, activity patterns, and food habits of sympatric black and grizzly bears in northwestern Wyoming. M.S. Thesis, University of Wyoming, Laramie, WY.
- Johnson, K.C., and M.R. Pelton. 1980. Prebaiting and snaring techniques for black bears. *Wildlife Society Bulletin* 8:46-54.
- Johnson, K.G. 1989. Bait-station surveys to monitor relative density, distribution, and activities of black bears in the southern Appalachian region. Univ. Tenn., Knoxville, unpubl. Rep. 53pp.
- Jonkel, C.J., and I.M. Cowan. 1971. The black bear in the spruce-fir forest. *Wildlife Monographs*. Number 27.
- Jonkel, J.J. 1993. A manual for handling bears for managers and researchers. U.S. Fish and Wildlife Service, Office of Grizzly Bear Recovery, Missoula, MT. 175pp.
- Kolensky, G.B. and S.M. Strathearn. 1987. Black Bear. Pages 442-454 in M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch, eds. *Wild furbearer management and conservation in North America*. Ontario Ministry of Natural Resources and Ontario Trappers Association, Toronto, Canada. 1150 pp.
- Krebs, C.J. 1989. *Ecological methodology*. Harper and Row Publishers, New York, NY. 654pp.
- Kreeger, T.J. 1996. *Handbook of wildlife chemical immobilization*. Wildlife Pharmaceuticals, Inc., Fort Collins, Colorado. 342pp.
- LeCount, A.L. 1982. Scent-station locations affect on estimating black bear abundance. *Proc. West. Assoc. Fish and Wildl. Agencies* 62:408-422.
- Lindzey, F.G., and E.C. Meslow. 1977. Population characteristics of black bears on an island in Washington. *J. Wildl. Manage.* 41(3):408-412.
- Mace, R.D., S.C. Minta, T.L. Manley, and K.E. Aune. 1994. Estimating grizzly bear population size using camera sightings. *Wildlife Society Bulletin* 22:74-83.
- Marks, S.A. and A.W. Erickson. 1966. Age determination in the black bear. *Journal of Wildlife Management* 30:389-410.

- Miller, S.D., E.F. Becker, and W.B. Ballard. 1987. Black and brown bear density estimates using modified capture-recapture techniques in Alaska. *International Conference on Bear Research and Management* 7:23-35.
- Miller, S.D., G.C. White, R.A. Sellers, H.V. Reynolds, J.W. Schoen, K. Titus, V.G. Barnes, R.B. Smith, R.R. Nelson, W.B. Ballard, and C.C. Schwartz. 1997. Brown and black bear density estimation in Alaska using radiotelemetry and replicated mark-resight techniques. *Wildlife Monographs*. 133. 55pp.
- Morris, K., T. Eagle, B. Zytaruk, and A. Manville. 1978. A case for standardizing the interpretation of tooth sections for aging black bears. Pages 354-361 *in* R.D. Hugie ed. *Proceedings of the 4th Eastern Black Bear Workshop*, Greenville, Maine.
- Otis, D.L., K.P. Burnham, G.C. White, and D.R. Anderson. 1978. Statistical inference from capture data on closed animal populations. *Wildlife Monograph* 62. 135pp.
- Paetkau, D., and C. Strobeck. 1994. Microsatellite analysis of genetic variation in black bear populations. *Molecular Ecology* 3:498-495.
- Pelton, M.R., and L.C. Marcum. 1977. The potential use of radioisotopes for determining densities of black bears and other carnivores. Pages 221-236 *in* R.L. Phillips and C. Jonkel, editors. *Proceedings 1975 Predator Symposium*, Montana Forest Conservation Experimental Station, University of Montana, Missoula.
- Pollock, K.H. 1982. A capture-recapture design robust to unequal probability of capture. *Journal Wildlife Management* 46:752-757.
- Proctor, M. 1995. DNA fingerprinting from black bear hair as a basis for a mark-recapture population estimate. M.S. Thesis, University of Alberta, Canada.
- Smith, R.L. 1990. *Ecology and Field Biology*. 4th ed. Harper & Row, New York. 922pp.
- Stoneberg, R.P. and C. Jonkel. 1966. Age determination of black bears by cementum layers. *Journal of Wildlife Management*. 30(2):411-414.
- University of Wyoming. 1992. Bear hunter survey. Unpublished Report. Survey Research Center, Univ. of Wyo., Laramie. 10pp.
- University of Wyoming. 1994. Public attitude survey on black bear management in Wyoming. Unpublished Report. Survey Research Center, Univ. of Wyo., Laramie. 8pp.
- Unsworth, J.W., J.J. Beecham, and L.R. Irby. 1989. Female black bear habitat use in west central Idaho. *Journal Wildlife Management* 53:668-673.
- Waddell, T.E. 1975. A technique for extracting a bear's first premolar. *Wildlife Digest*, Arizona Game and Fish Department, 3pp.

- White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, Los Alamos, NM. 235pp.
- Willey, C.H. 1974. Aging black bears from first premolar tooth sections. *Journal of Wildlife Management*. 38(1):97-100.
- Wyoming Game and Fish Department. 1994. Black bear management plan. Lander, Wyoming, USA. 40 pp.
- Wyoming Game and Fish Department. 2007. Wyoming black bear management plan. Lander, Wyoming, USA. 58 pp.
- White, G.C. 1996. NOREMARK: population estimation from mark-resighting surveys. *Wildlife Society Bulletin* 24:50-52.
- Young, D.D., and J.J. Beecham. 1986. Black bear habitat use at Priest Lake, Idaho. *International Conference on Bear Research and Management* 6:73-80.