

**BLACK BEAR DATA ANALYSIS UNIT  
MANAGEMENT PLAN**

*Dolores/Hermosa*

DAU B-06

GAME MANAGEMENT UNITS

71, 72, 73, 74, 711, & 741

Southwest Region

Prepared for:

Colorado Parks and Wildlife

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Date: January, 2013



*Approved by the Colorado Parks and Wildlife Commission January, 2013*

**DATA ANALYSIS UNIT PLAN FOR B-06**  
**EXECUTIVE SUMMARY**

**GMUs: 71, 72, 73, 74, 711, & 741** ((Montezuma, most of Dolores, and portions of La Plata, San Juan, and San Miguel Counties)

**Land Ownership:** 32% USFS, 31% Private, 20% Tribal, 13% BLM, 2% NPS, 1% State

**Previous Management Objective:** Stable, no population objective for B-06

**2012 Mortality Objectives:**

Harvest objective - 95, Total mortality objective - 110

**Strategic Goal and Objectives (adopted January 2013):**

A stable population following a moderate reduction in the population

Total annual mortality objective:  $\leq 210$  for up to five years (to 2018), then 90-135

Total annual harvest objective:  $\leq 179$  for up to five years (to 2018), then 77-115

Black bear Data Analysis Unit (DAU) B-06 is located in the Southwest corner of Colorado. The DAU includes all of Montezuma County, the majority of Dolores County, and portions of La Plata, San Juan, and San Miguel Counties. The Game Management Units (GMUs) in B-06 are 71, 72, 73, 74, 711, and 741. The main communities within B-06 include the cities of Cortez, Dolores, Mancos, and a portion of Durango. Over half of the DAU which is 2.49 million acre (10,080 square kilometers) is public land. Eighty-three percent of the DAU, or just over 2 million acres, is considered overall black bear range. Comparatively, B-06 has high quality bear habitat.

*BACKGROUND*

In general, overall annual bear mortality has increased over the last 10 years in B-06. Since 2002, total bear mortality in B-06 has ranged from a low of 32 in 2005 to a high of 126 in 2002, with an average of 71 bears annually. The 3-year and 10-year annual hunting mortality averages are 72 and 57 bears respectively. The 30 day September high-powered rifle season has the highest average 3-year success rate (~17%) among methods of take, and is responsible for approximately 40% of the annual bear harvest in B-06 (average 26 bears per year). Archery hunters take on average 11 bears annually with a 15% success rate. Muzzleloader hunters take an average of 3 bears each year with an 11% success rate. Harvest for hunters in the 4 concurrent rifle seasons averages 17 bears per year. The majority of harvest occurs in GMUs 711 and 74 where there is a high percent of public land allowing for easy hunting access and quality bear habitat.

The percent of adult males in harvest is at 20% indicating a decreasing population and percent females in the harvest 39% indicating a stable population. The percent adult female in total female harvest is 44% and represents an increasing population.

Game damage claims have averaged 8 per year in B-06 for the last 10 years. Predation to sheep and cattle, then damage to beehives are the most common claim types and the average payment is \$532. Conflicts between bears and humans are not uncommon in B-06. Often these are the result of bears using developed habitats and food sources that are associated with people.

A suite of habitat and population models have been developed as part of the revision of the B-06 DAU plan to help provide estimates of the projected bear population in the unit. These include a general vegetation/bear density extrapolation, a use/occupancy surface extrapolation based on habitat classifications, and two model simulations with varying constraints (liberal and conservative).

In 2012 CPW reanalyzed bear populations throughout the state using the most current data available. At that time it was realized that the B-06 population was larger than previously believed. The habitat and population models used in this plan use the most current data.

## SIGNIFICANT ISSUES

The most significant issue regarding bear management in the Dolores/Hermosa DAU relates to managing conflicts between bears and people. As rural development continues to increase it will cause a decline in bear habitat and place more people in occupied bear range. As a result it can be expected that the amount of human-bear interactions and human-bear conflicts will increase. These conflicts can take a number of forms including game damage to agriculture producers, property damage to homeowners and direct contact between bears and humans across all landscape types. This management issue and what tools should be used to address it are complex and multifaceted. The structure of a DAU plan focuses on one specific tool, primarily hunting, out of a suite of tools including education, enforcement, and habitat modification that can also be used to manage conflicts. Unfortunately, the types of conflicts that occur with bears and the landscapes they occur in often preclude simple changes in licensing or hunting structure from completely resolving the problem. This DAU plan provides harvest related monitoring structures along with strategic goal alternatives that will be directing bear population size in B-06.

## MANAGEMENT ALTERNATIVES

The B-06 was managed for a stable bear population prior to 2013. This plan revision outlines three strategic goal alternatives for bear management in B-06.

*Maintain a stable population:* Total mortality, or off-take, as a proportion of the population should fall in the 7-13% range. Proportion of adult males in the harvest should be within 25-35%, with all females making up 30-40% of harvest. Additionally, adult females should comprise approximately 45-55% of the female harvest. Not every management index must be in complete agreement, but should point toward a stable trend.

*A stable population following a moderate reduction in the population:* Total mortality as a proportion of the population would incrementally be increased over a three year period to 15% and then be maintained at that level for up to two years. Proportion of adult males in the harvest could be low, even below 25%, with total female harvest rates going over 40%. Additionally, adult female proportions in the female harvest could comprise over 55% of the female harvest.

Not every management index must be in complete agreement, but most should point toward a population being held below biotic thresholds. After this period of increased harvest, management would shift to maintain a stable population as outlined above but at the new, lower population size.

*A stable population following an aggressive reduction in the population:* Total mortality as a proportion of the population would incrementally be increased over a three year period to 20% and then be maintained at that level for up to two years. Proportion of adult males in the harvest could be low, even below 25%, with total female harvest rates going over 40%. Additionally, adult female proportions in the female harvest could comprise over 55% of the female harvest. Not every management index must be in complete agreement, but most should point toward a population being held below biotic thresholds. After this period of increased harvest, management would shift to maintain a stable population as outlined above but at the new, lower population size.

Based on the input of an internet survey, a 30-day comment period, and CPW personnel, the Colorado Parks and Wildlife Commission adopted a strategic goal of managing for a **stable population following a moderate reduction in the population**. Under this management regime, off-take can be incrementally increased over a three year period to 15% and then be maintained at that level for up to two years. After that, off-take will decrease to 10% to achieve a stable population. Throughout this time age and gender proportions in the harvest will be monitored to assess whether the population is increasing, stable, or decreasing and if management goals are being met. It is also recommended by CPW staff that flexibility remains within management prescription of this plan to allow for the most current and applicable data be used as it becomes available so long as the “spirit” of the adopted management objectives are respected.

**BEAR DATA ANALYSIS UNIT PLAN for B-06 (Hermosa/Dolores)**

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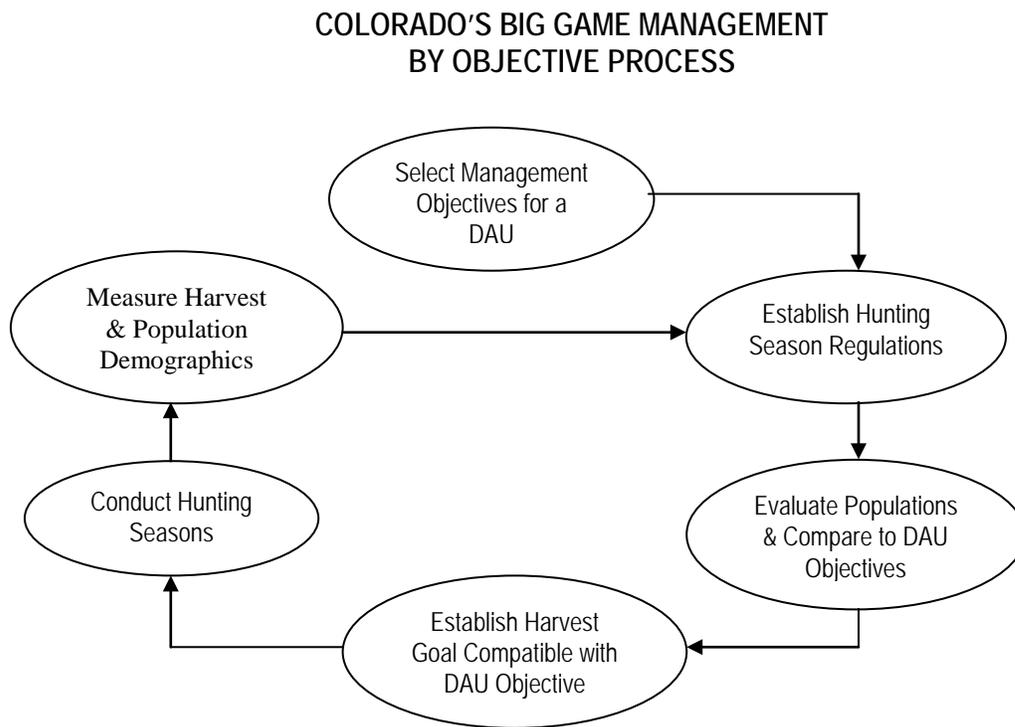
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## INTRODUCTION

The Colorado Division Parks and Wildlife (CPW) manages wildlife for the use, benefit and enjoyment of the people of the state in accordance with the CPW's Strategic Plan and mandates from the Colorado Parks and Wildlife Commission and the Colorado Legislature. Colorado's wildlife resources require careful and increasingly intensive management to accommodate the many and varied public demands and growing impacts from people. CPW is responsible for the maintenance of Colorado's big game at population levels that are established through a public review process and approved by the Colorado Parks and Wildlife Commission.

## DAU PLANS AND WILDLIFE MANAGEMENT BY OBJECTIVES

To manage the state's big game populations, the CPW uses a management by objective approach (Figure 1). Big game populations are managed to achieve objectives established for Data Analysis Unit (DAUs).



**Figure 1. Management by objectives process used by the CPW to manage big game populations on a DAU basis.**

DAUs are geographic areas that typically contain an individual big game population. For large mobile carnivores like black bears DAUs are primarily administrative constructs with generally similar habitats and/or human social considerations. DAUs are composed of smaller areas designated as game management units (GMUs), which provide a more practical framework where the management goals can be refined and applied on a finer scale, typically through hunting regulations.

The DAU plan process is designed to balance public demands, habitat and big game populations into a management scheme for the individual DAU. The public, hunters, federal and local land use agencies, landowners and agricultural interests are involved in the determination of the plan objectives through input given during public meetings, the opportunity to comment on draft plans and when final review is undertaken by the Colorado Parks and Wildlife Commission.

The strategic goals and specific mortality objectives defined in the plan guide a long term cycle of annual information collection, information analysis and decision making. The end product of this process is a recommendation for numbers of hunting licenses for the DAU (Figure 1). The plan also specifically outlines the management techniques that will be used to reach desired objectives. CPW intends to update these plans as new information and data become available, at least once every ten years.

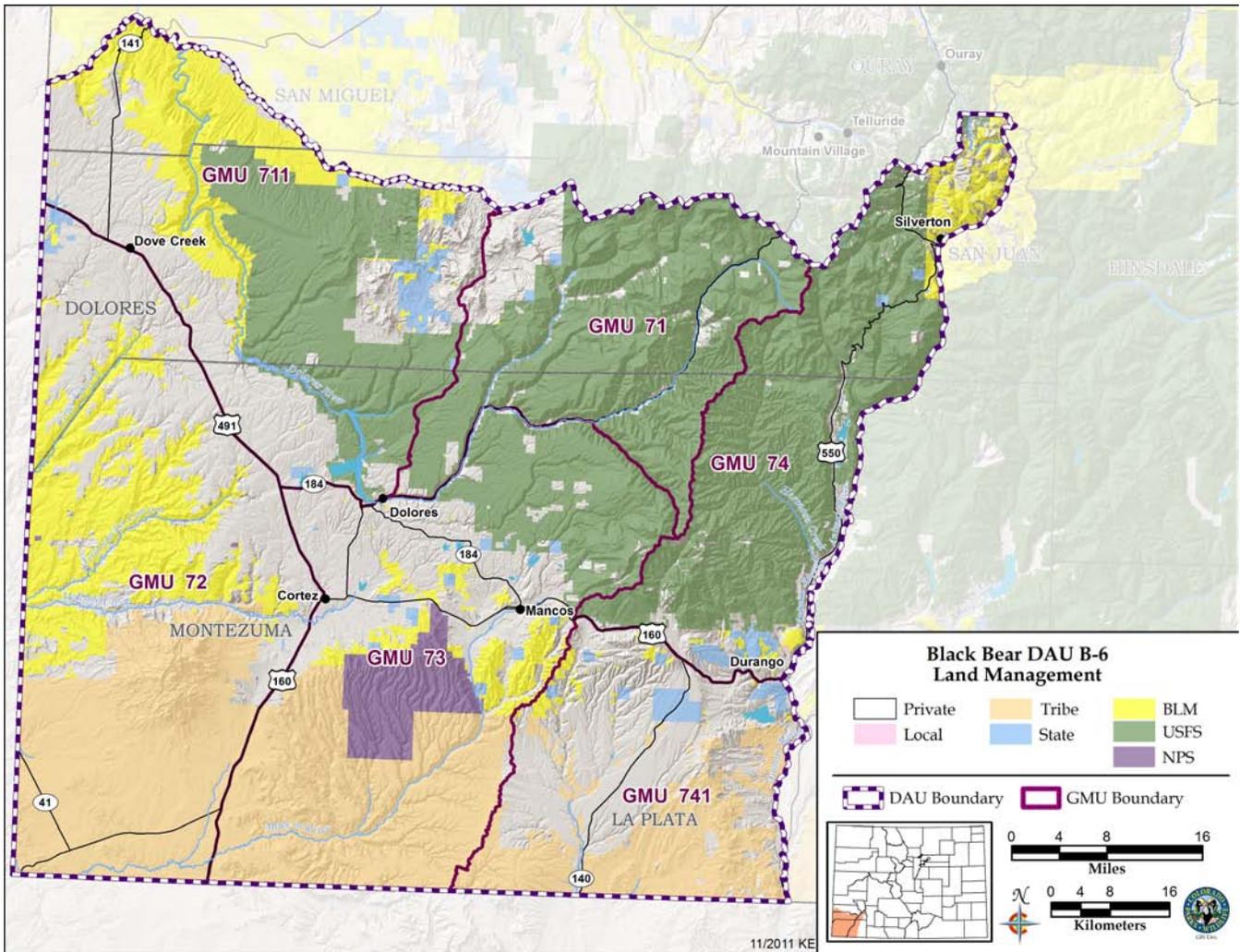
## **DATA ANALYSIS UNIT DESCRIPTION**

### ***Location***

DAU B-06 for black bear (*Ursus americanus*) is located in the extreme southwest corner of Colorado. It is bounded on the south by the New Mexico state line, on the west by the Utah state line, on the north by Summit Canyon Creek, Dolores River, Disappointment Creek Dolores-San Miguel County line, and the Ouray-San Juan County line, and on the east by the San Juan-Hinsdale County line and the Animas River. The DAU includes all of Montezuma County, most of Dolores County and portions of La Plata, San Juan and San Miguel Counties. The Game Management Units (GMUs) in B-06 are 71, 72, 73, 74, 711, and 741. Population centers within B-06 include the west portion of Durango, Mancos, Dolores, Cortez, Dove Creek, and Silverton.

The DAU encompasses 4,291 square miles (11,115 square kilometers) with the U.S. Forest Service (USFS) and private ownership accounting for most of the land management within (Figure 2). The US Forest Service (USFS) manages 32% of the land, private ownership accounts for 31%, tribal land held by either the Ute Mountain Ute Tribe or the Southern Ute Indian Tribe 20%, Bureau of Land Management (BLM) manages 13%, the National Park Service (NPS) with Mesa Verde National Park controls 2%, and CPW manages just over 1%. Less than 1% is State Land Board and Municipalities.

The entire DUA is considered as overall black bear range. Approximately 29% of the DAU is mapped as summer concentration habitat for black bears and 24% as fall concentration areas (Figure 3).

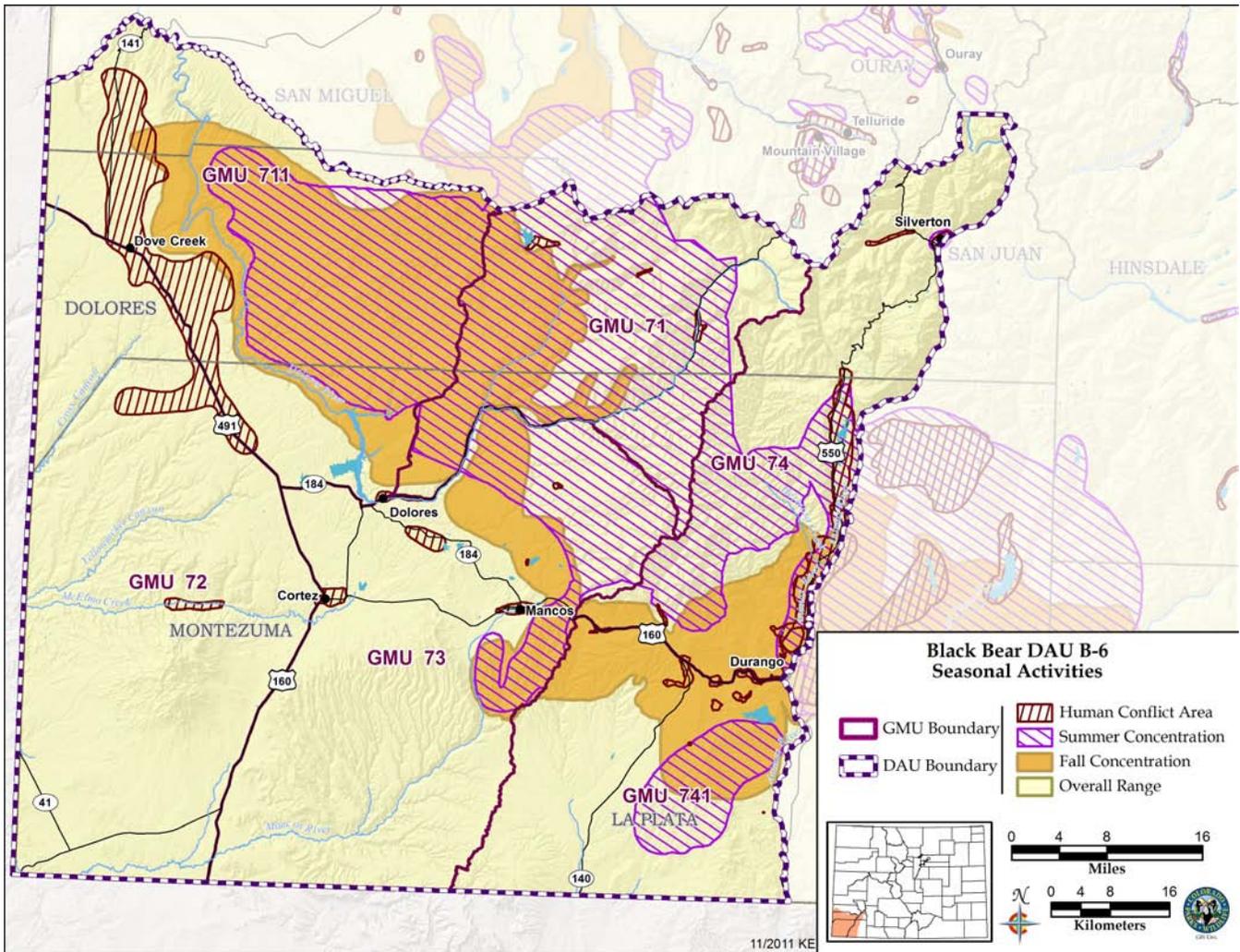


**Figure 2. Location and land management status of B-06.**

***Land Use and Land Status***

Durango, Dolores, and Cortez are the major human population centers in B-06. Cortez is relatively distant from primary bear habitat and human/bear interactions are few. Durango on the other hand is nestled within prime bear habitat and bears are common within and around the city. As would be expected human/bear conflicts are common and are related to food sources with garbage being the main attractant. The remainder of the human population is scattered throughout rural communities including large farms and ranches, subdivisions, and small towns. Human-bear issues are common wherever there is overlap in bear habitat and human occupation.

Human population growth rate in the western portion of B-06 is at almost half of Colorado’s growth rate (7.2% in Montezuma County and 11.9% for Dolores County compared to 16.9% in Colorado). The eastern portion containing La Plata County has a 16.8% growth rate and is at the state average (<http://quickfacts.census.gov/qfd/states/>). As human expansion encroaches into bear habitat, human-bear conflicts can be expected to increase.



**Figure 3. Black bear activity layers in B-06**

***Topography & Climate***

The elevation in the DAU ranges from a low of 4,700 feet near the Four Corners to a high of nearly 14,000 feet at several places between Dolores and Telluride.

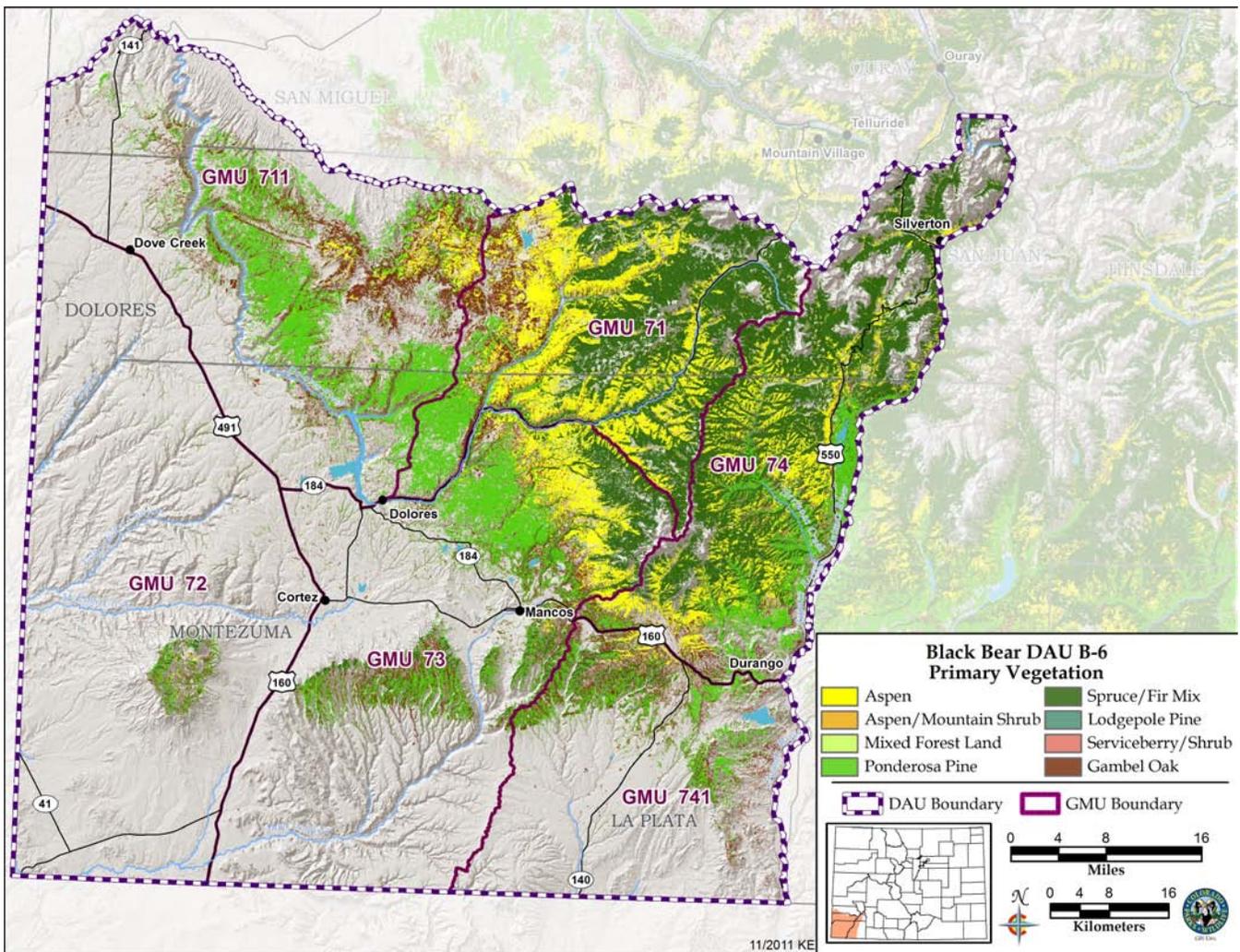
The climate is termed highland mountain, with cool summers at high elevations but very warm at the lowest, and with very cold winters throughout. Snowfall is very heavy throughout the mountainous areas, but is variable at lower elevations. The low elevations receive 8 inches or less of precipitation annually, but some areas in the mountains receive over 30 inches of precipitation. Snowfall can be 250-300 inches per winter at higher elevations in northeastern portions of the DAU.

***Vegetation***

The lower elevations along the Dolores, McElmo Creek, and Disappointment Creek are high desert vegetation types and have dominant canyon-mesa geographic features, with some agricultural areas in the river flood-plain areas. As elevations increase, the vegetation changes to grassland/shrub,

pinyon-juniper, and ponderosa pine often with an oak understory, mountain shrub, aspen, and Douglas-fir. At the highest elevations above 12,000 feet, sub-alpine spruce fir and Engleman spruce lead into alpine areas of willow or grass/sedge/forbs communities (Figure 4).

Agricultural areas and cultivated croplands occur primarily in the western portion of the DAU along the Highway 491 corridor. Types of crops include hay, beans, wheat, grass seed, and sunflower seed. Fruit trees are popular among homeowners, but scarce for commercial production.



**Figure 4. Vegetation classes in B-06.**

Natural bear habitat could be considered excellent in much of B-06 relative to other parts of Colorado. There is abundant mountain shrub communities for mast and berry forage along with plentiful aspen communities and pinyon-juniper communities. B-06 is a productive bear population.

## **MANAGEMENT HISTORY**

### ***Administrative***

The DAU was created in 1995 and the boundary of B-06 has remained unchanged since.

### ***Hunting Seasons***

Prior to 1935, black bears were not considered a game animal, which afforded them no protection from being shot on sight if they were encountered or preyed on livestock. In 1935, they were awarded some protection by being classified by the state legislature as a game animal. This established limits on the annual harvest and on the number of licenses that an individual could possess. From 1935 to 1963, bears were hunted in the fall usually concurrently with the annual deer and elk seasons. In 1964, a spring hunting season was established with unlimited licenses. This continued until 1986, when licenses for the spring season were limited (Beck 1991). The fall hunting seasons occurred concurrently with the established deer and elk seasons and licenses were unlimited until the limited September rifle seasons were established in 1989. Hunters wishing to hunt bears during the established deer and elk season still had access to unlimited licenses until 2005 when license caps were established for these licenses.

In 1992, a constitutional amendment was passed and changed bear hunting within the state by preventing bear hunting prior to September 1<sup>st</sup> and outlawed the use of bait and dogs as aids for hunting black bears. Since 1992, the annual hunting seasons have begun on September 2<sup>nd</sup>. Black bear hunting is currently the most restricted since European settlement in the area. This is reflected in the thriving bear populations.

Since 2000, hunting seasons have started with an early, limited, rifle season that runs from September 2<sup>nd</sup> through September 30<sup>th</sup> each year, along with concurrent archery, muzzleloader, 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> rifle season licenses. Under the current season structure, the 4 concurrent seasons are 5 days, 9 days, 9 days and 5 days in length. In addition to the limited September rifle licenses, Private Land Only (PLO) limited September licenses were added to the DAU in 2009. Harvest is concentrated in the limited September rifle season as it is concurrent with the initial phases of the bear hyperphagia period. Harvest and success rates decline as hunting seasons progress through the fall months (October-November) due to bears entering the initial stages of winter dormancy.

### ***License Allocation history***

License allocations in B-06 have had some changes in the last 13 years. From 1999-2004 concurrent rifle (first, second, third and fourth big game rifle seasons) licenses were specified in B-06, but unlimited in number. Archery and muzzleloader bear licenses were unlimited in 1999 to 2002 and then limited in 2003. Beginning in the fall of 2005, all these licenses became over-the-counter (OTC) with caps and only the September rifle license remained limited. OTC licenses are limited (capped number) for each hunt code but licenses could be purchased without going through the limited draw (bought first-come, first-served) However, this had no functional impact on concurrent rifle season bear hunter opportunity, as the license cap was rarely reached. Archery and muzzleloader licenses often sell out the first day they go on sale for archery and within a few days of going on sale for muzzleloader. The September rifle licenses available in B-06 have been limited and specified since 1999. In 2008 a

PLO season that ran concurrent with the September rifle season was added. These licenses were limited and remain that way (Figure 5).

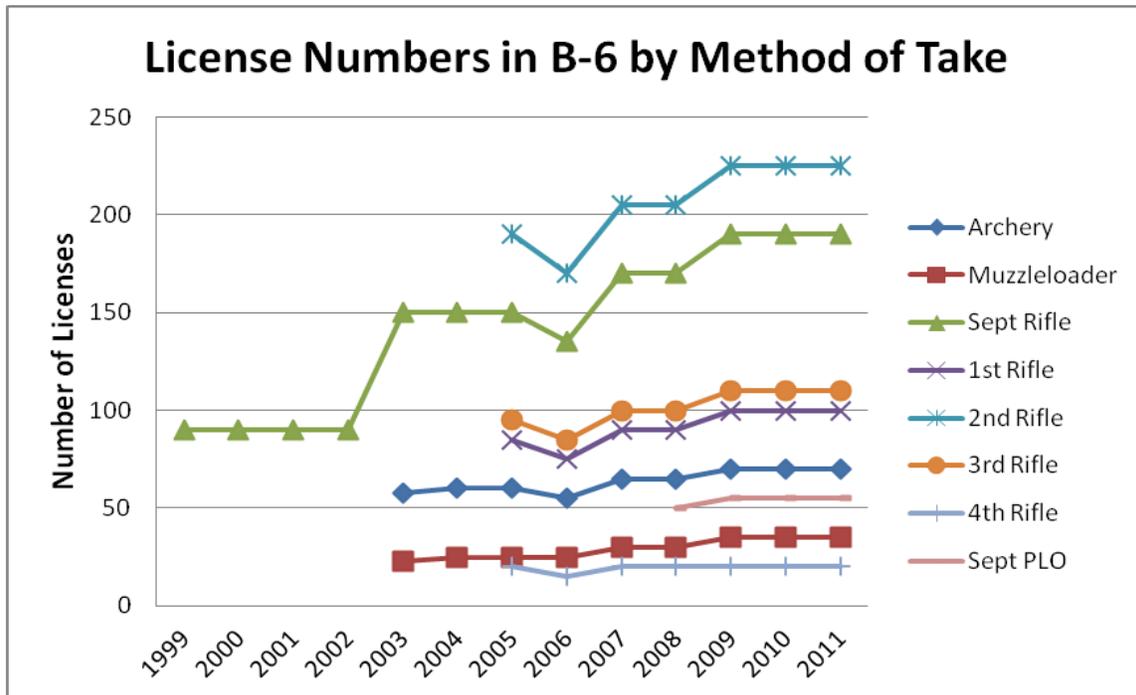


Figure 5. Thirteen-year license history in B-06

**Mortality: Harvest and Non-Harvest**

In general, overall annual bear mortality increased over the last 10 years in B-06 (Figure 6). Since 2002, total bear mortality in B-06 ranged from a low of 32 in 2005 to a high of 126 in 2002. While the 10-year average of annual bear mortality was 71, the 3-year average was slightly higher at 85 bears. Mortality from hunter harvest also increased over the past 10 years. The 10-year average of hunting mortality was 57 bears per year, and 3-year average was 72 bears. Part of the reason for the increasing trend in harvest was due to increasing number of licenses over the same time period. A record number of bears were killed in 2002. This was due to extreme drought conditions when bears were attempting to obtain food from any sources available, many which were anthropomorphic creating human conflicts. Bears were also more susceptible to harvest and accidental kill (such as caused by vehicle collisions) during this same time period because of their increased activity while searching for food.

Harvest mortality and total mortality vary significantly by GMU, but are proportionally consistent the last 10 years. Game Management Unit 74 and 711 had the highest levels of harvest and total mortality in the DAU, followed by GMUs 71, 73 and 741 respectively. The least amount of mortality occurred in GMU 72 which only had an occasional bear killed (Figure 7). Harvest and total mortality levels appear to be roughly proportional to the amount of fall bear habitat, GMU size and hunting access. GMU 74 and 711 have similar total mortality averages but hunter harvest accounts for most of the mortality in GMU 711 while mortality in GMU 74 is a mix of hunter harvest and other types.

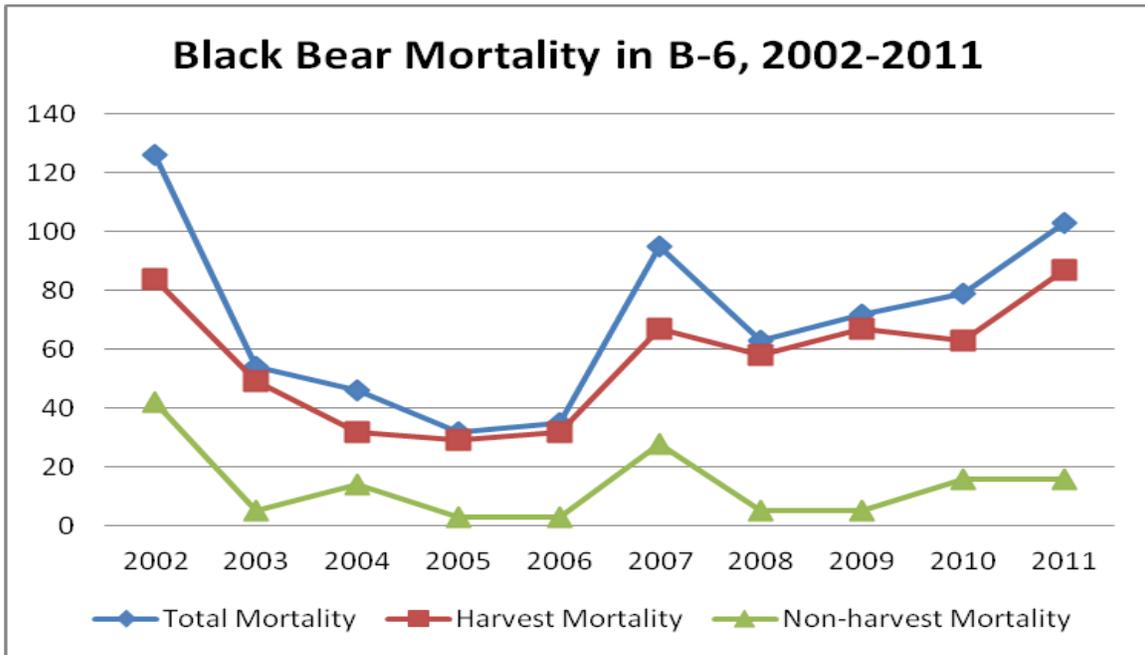


Figure 6. Total black bear mortality in B-06

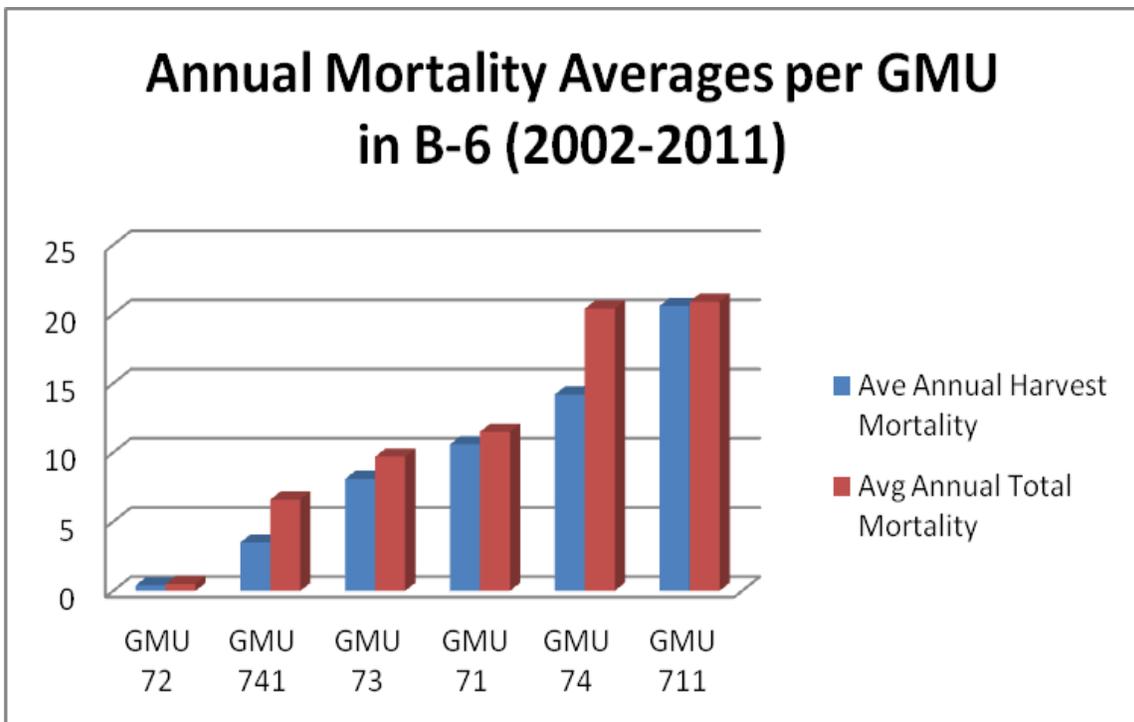
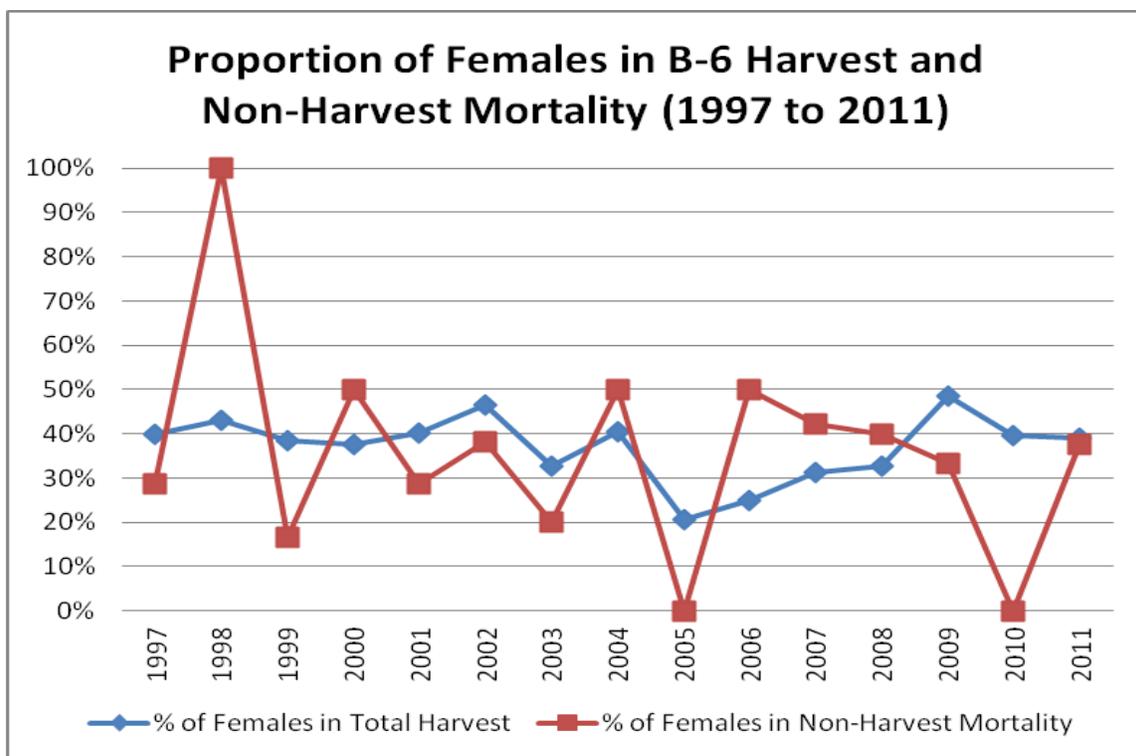


Figure 7. Annual average hunting and total mortality by GMU (2002-2011)

This is due to GMU 711 being a popular hunting area with good access and ideal bear habitat. GMU 74 provides excellent bear habitat and access for hunters but it also contains the west half of Durango where bear/human conflicts are common. Because of this, a higher proportion of bears are killed by means other than harvest, such as road mortalities and CPW removal of human conflict bears.

The proportion of females in the B-06 harvest has fluctuated over the last 15 years (Figure 8). The lowest proportion of females harvested occurred from 2005 to 2008. During this time frame the percent of females harvested was in the lower 20's with the lowest point at 20% in 2005. Prior to and after that time period the proportion of female harvest had been around 40%. The 3-year average proportion of females in the harvest was 42%, while the 10-year average was 36%. The 3-year and 10-year average proportions of females in non-harvest mortality were 24% and 31% respectively.



**Figure 8. Proportion of females in B-06 harvest and non-harvest mortality**

***Mortality: Method of Take***

Among methods of take, the 30 day September rifle season takes the most bears, approximately 45% of the annual bear harvest in B-06, and had a three year average success rate of 17% (Table 1). Archery hunters contributed an average of 11 bears per year to the harvest and had a 3-year average success rate of 15%. Muzzleloaders harvested an average of 3.1 bears per year in B-06 with an 11% success rate. The total harvest of all the combined rifle seasons is 17 bears per year. While always low, harvest success rates varied from 3-11% in the first, second and third rifle seasons to nearly 0% in the fourth when many bears are unavailable for harvest due to the onset of winter dormancy.

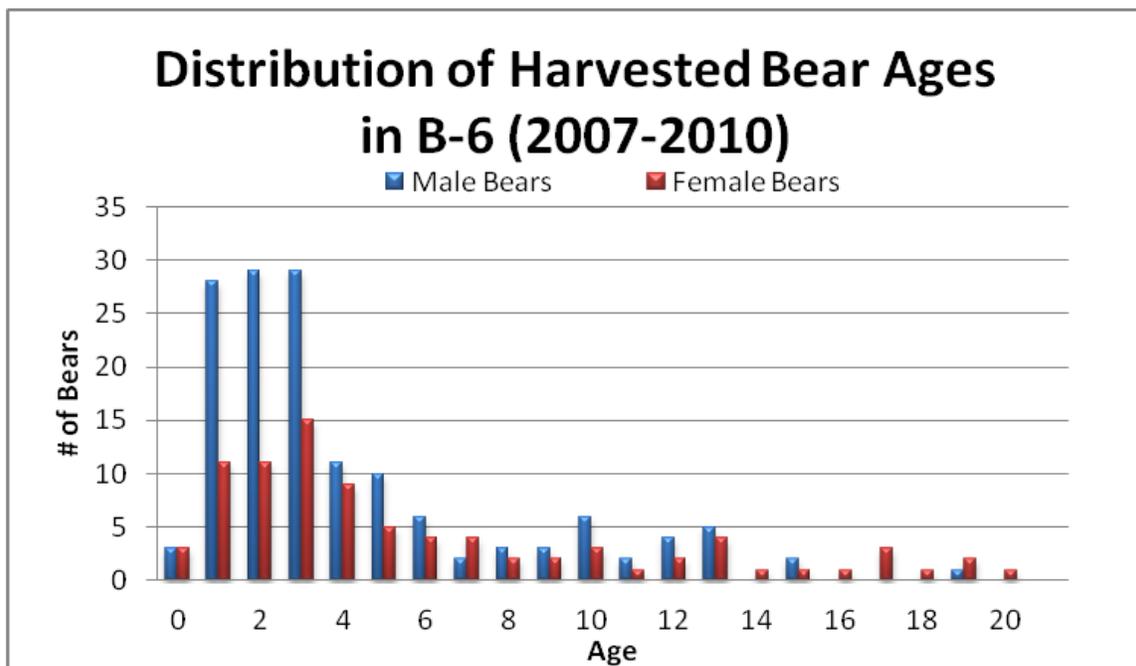
**Table 1. Black bear harvest history, by method of take, in B-06 (2002-2011)**

YEAR	Archery Harvest	Muzzleloader Harvest	September Rifle Harvest	1st-4th Rifle Season Harvest	September PLO Rifle
2002	44	8	16	16	--
2003	8	2	20	19	--
2004	3	1	15	13	--
2005	5	1	10	13	--
2006	4	0	16	12	--
2007	12	7	33	15	--
2008	8	1	27	22	5
2009	7	3	38	19	6
2010	16	2	34	11	10
2011	7	6	46	26	8
Average	11.4	3.1	25.5	16.6	7.3

***Mortality: Age and Gender***

Beginning in 2007, a premolar was extracted from harvested bears and other deceased bears handled by CPW. These teeth were collected and submitted annually for aging via cementum annuli sectioning. Bear age data have been collected for 4 years, with a total sample in B-06 of 258 bears.

The technique of counting annual rings in cementum of bear teeth is a reliable method for determining ages of black bears (Harshyne et al. 1998, Costello et al. 2004). This is especially true for bears less than five years of age. For bears five years of age or older, errors increased with the age of the bear (McLaughlin et al. 1990, Harshyne et al. 1998, Costello et al. 2004). Since most female black bears in Colorado do not reproduce until their fifth year, classification of females into sub-adult (non-



**Figure 9. Age distribution of harvested bears in B-06 (2007-2010)**

reproducing) and adult (reproducing) age classes using cementum annuli is quite reliable. Therefore, all female black bears age five and over are considered adults for the purposes of harvest data analyses. Cementum analysis of female black bears in B-06 indicated that the mean age of primiparity is five years and the mean birth interval is two years.

Included are figures showing the frequency of each bear year-class, by gender from the 2007-2010 dataset (Figure 9 & 10). Both harvest and non-harvest mortality sample sizes are greatly skewed towards the sub-adult age classes. In the case of males, the majority of black bear mortalities were in the 1.5-3.5-year old classes. Analysis of gender and age from harvested bears can give an indication as to the population performance. B-06 data averaged over the past three years (2008-2010, 2011 data was not available) does not give a clear view. The proportion of adult males in harvest is at 20% indicating a decreasing population. The proportion of females in the harvest is 39% indicating a stable population. The proportion of adult females in total female harvest is 44% and represents an increasing population. For more on these indices refer to the further discussion in Management Considerations section.

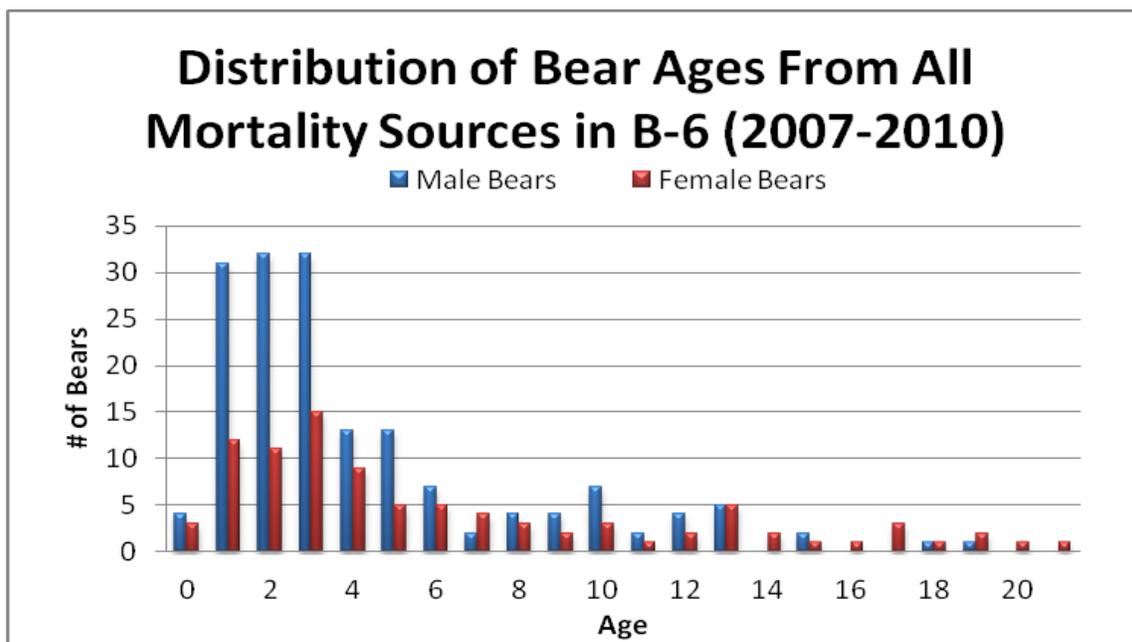


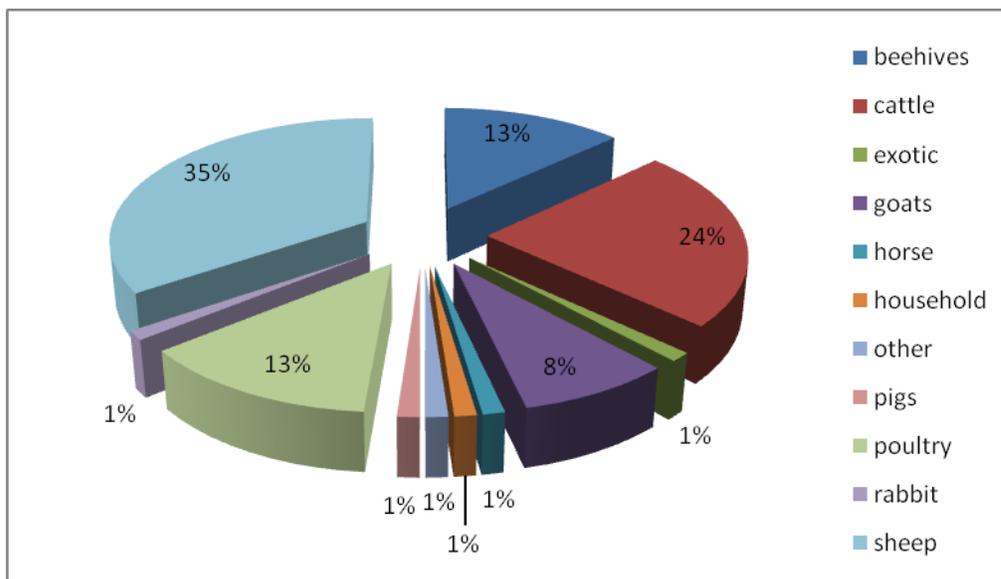
Figure 10. Age distribution of bears from all mortality sources in B-06 (2007-2010)

***Game Damage and Human Conflict Management***

The state of Colorado is liable for damage to livestock and personal property used in the production of an agricultural product caused by black bears. Prior to 2001 the State also paid damage to any personal property incurring damage. In the past 10 years (2002-2011) there have been 84 black bear claims paid out totaling \$44,713 in B-06. Cattle, sheep, and beehives were the most common types of claim (Figure 11). The mean claim payment since 2002 was \$532, with a range from \$15- \$5,277. The majority of the claims have been in GMU 73 (41%), followed by GMU 741 (19%) and 74 (17%). GMUs 711 and 71 had 11% and 10% respectively, and finally GMU 72 with 2%. This is not surprising being that GMUs 73, 74, and 741 are where a large portion of the bear habitat is shared with human

development.

Human conflicts with black bears in B-06 are common occurrences. In many cases, human interactions with bears are reported to the CPW call centers or field staff. This subset of conflicts is documented in written form by CPW staff and range from a second hand report of a bear being seen in a town or suburb to a physical incident between a bear and a person. While these conflict reports provide a snapshot of individual incidents, lumping reports into categories or evaluating summary statistics can be misleading. There are a number of issues related to capturing the location of the incident versus the location the report was filed from, the reliability of some reports and the bias in reporting associated with increased media coverage on an event or location that can all significantly increase or decrease the number of conflict reports. The CPW continues to document reported human conflicts with bears, and will continue to improve and refine the system and methods used for collecting and synthesizing those reports. Bears involved in conflicts will be handled per CPW policy at the discretion of the field officer or supervisor.



**Figure 11. The proportion of game damage claimed in DAU B-06 by type of claim from 2002-2011**

A considerable proportion of human development occurs in bear habitat. Development causes the loss and fragmentation of habitat, restricting the number of bears that can live on the landscape. It also puts more people into bear territory which increases human-bear contacts. This results in more human-bear conflicts. As humans continue to encroach into the bears' domain, it can be expected that the bear population will decrease. It is unfair to both humans and to bears to attempt to manage the bear population at the same level as pre-development. However it is also irresponsible to remove or attempt to remove all black bears from the landscape. The two must be balanced.

***Current harvest and total mortality objectives***

The current bear harvest objective identified in the 2000 B-06 Black Bear DAU plan (Wait 2000) was to harvest a maximum of 50 bears per year as a three year average. No non-harvest mortality objective was identified in the 2000 DAU plan; however the harvest objective and the total mortality

objective were used synonymously in setting annual license numbers. Beginning in 2009 the harvest objective and total mortality objective were incrementally increased to address a presumed increasing bear population as well as growing concerns of the bear population surpassing the social tolerance level. This was based partially on the number of bear complaints and human/bear conflicts. In 2012 the harvest mortality and total mortality objective for the DAU was 95 bears and 110 bears, respectively.

## **MANAGEMENT CONSIDERATIONS**

Black bears have been classified as big game in Colorado since 1944. Yet the first black bear management plan was not developed until 1990, following seminal research in the Black Mesa area in western Colorado. Most of the fundamental aspects of black bear demographics, survival and reproductive strategies, physical characteristics, and behaviors described by Beck (1991) and by Gill and Beck (1990) hold true today.

Black bears live at relatively low densities compared to other big game species. They are relatively late maturing and slow reproducers. At high mortality levels, especially if the mortality is driven by poor natural forage conditions, the proportion of females in total mortality increases. When combined with poor reproduction and recruitment the high mortality levels may result in a population decline if a large area is affected or if there are no source areas nearby to produce dispersing sub-adult black bears. In source areas, black bear populations are limited by the capacity of the habitat to support black bears and their social structure. Some species compensate for excessive adult mortality by producing more offspring. However, black bears do not respond in this manner. High adult mortality tends to result in a younger age population and lower productivity (average number of young per litter). Young male black bears disperse from their mother's home range when they are 1.5 to 2.5 years old and often travel long distances to occupy vacant habitat. However, young female black bears rarely disperse far. As a result, black bear populations far from source areas are slow to recover from over-harvest.

Colorado has elected to adopt a form of source-sink management wherein DAUs will be managed with different overall management strategies. Sink areas will be geographically dispersed and should be allied with corresponding stable/increasing management areas in order to provide proximity to source areas. Other States and Provinces have followed a similar construct under varying names, including light, moderate, or heavy harvest regimes; population increase, stable, or reduction strategies; and population growth, maintenance, or suppressed strategies. Each term is relative because managers can't know with absolute certainty how many bears there are or what the precise population trajectory may be at the moment. Thus, by necessity harvest or population management strategies must choose a relative approach.

Bears are primarily solitary and their survival strategies do not lend themselves to easy or inexpensive inventory methods. Consequently, managers must rely upon indirect information and indices to population status and trajectory. Although many States and Provinces have adopted similar gender and age class indices, in few circumstances have these indices been directly tested experimentally. Rather, they have resulted from relatively few observational studies within the then existing management frameworks. From these certain conclusions were arrived at based on the observed data and inferences made about the relative vulnerability of age classes and gender cohorts.

Certain age class and gender cohort indices have been shown to have the same values in both increasing and declining populations (Costello et al. 2001), and so caution is always advised to observe them over time rather than instantaneously. If total harvest or mortality in relation to the actual population size (absolute harvest or mortality rate) is quite small, then the relative proportions used by certain indices could have no real relationship to a population effect. Therefore, rather than relying on a few indices, it may be more appropriate to describe and use a suite of indices to inform management decisions. The following indices will be evaluated in relation to black bears in DAU B-06: Habitat models and forage condition monitoring, mortality density, population modeling, hunter success rates, age class and gender composition in harvest, human-bear conflicts, and game damage.

### *CPW Bear Study*

In 2011 CPW began research on human-bear conflicts and the ecology of urban and wildland bears in the Durango area. There are three main objectives of this study. The first objective aims to test management strategies to reduce bear-human conflicts through the reduction of the availability of anthropogenic food to bears, the development of a plan for translocation of nuisance black bears, and the use of a spatially-targeted harvest program to reduce the number of nuisance bears. The second objective is to determine the influence of urban environments on regional bear population dynamics. For this portion of the project, the research team will evaluate the availability of natural and anthropogenic food resources on bear movement and habitat use, estimate vital rates of bears relative to their use of natural and anthropogenic foods, and quantify the relative effects of resource use, conflict bear management (lethal removals and translocations) and harvest on bear demography. The last objective of the study is to develop population and habitat models to support the sustainable management of black bears. Components of this objective include using multiple data sources (harvest, DNA mark-recapture, and telemetry data) to develop improved bear population models to guide annual harvest regulations and inform statewide estimates of population size and trend. Additionally, project personnel will build regional habitat models to better predict bear density, direct the location of future monitoring efforts, and identify key seasonal resource areas. These objectives address significant questions in bear management and the results will be invaluable for future black bear management.

### ***Habitat Models***

Habitat use by black bears primarily depends on the season and available forage. Most black bears in B-06 appear to use the lower elevation pinyon-juniper habitats throughout the year. There are higher concentrations of bears in this habitat in early spring and late fall as they are free of snow and have juniper berry or pinyon nut crops. Black bears in the DAU use higher elevation mountain shrub and aspen communities throughout the summer and fall as they have high abundance and quality forage. In B-06 there is a high black bear use of low elevation riparian areas when berries are plentiful.

Two different habitat models have been developed to relate bear use, occupancy and forage value to project possible populations by extrapolating bear densities. The population projections use densities derived from relevant Colorado data and from literature. Managers applied densities representative of similar habitats and vegetation types in Colorado to develop population projections and then select population ranges which best represent current conditions in the DAU.

General Vegetation/Bear Density Extrapolation

The first model was developed by Gill and Beck (1991) in an unpublished report to the Colorado Parks and Wildlife Commission and was modified by Apker (2003) in an internal CPW report. This model applies subjective probable black bear densities for different vegetation types to the amount of land area of those vegetation types in the various GMUs. The vegetation type amounts for this model were derived from landsat GAP project coarse vegetation types. This vegetation/density model provides a snapshot extrapolation of possible bear population size in Colorado based on current vegetation classes and both measured and projected bear densities in those vegetation classes from the 1990s. This model and its subsequent extrapolation yields a projected bear population in B-06 of 850 black bears (Table 2). This estimate appears to be low based on harvest projections and other analysis.

**Table 2. B-06 bear numbers based on vegetation extrapolation**

Common Name	Square Miles of Veg. Class in DAU	Acres of Veg. Class in DAU	Percent of DAU that is Veg. Class	Bear Density as 1 bear/X mi <sup>2</sup>	Bear Numbers
Aspen	294.86	188713	6.87%	1	295
Douglas fir	0.70	450	0.02%	8	0
Forest dominated wetland/riparian	0.22	141	0.01%	10	0
Gambel oak	256.23	163988	5.97%	1	256
Juniper woodland	31.45	20127	0.73%	20	2
Mesic upland shrub	4.57	2923	0.11%	6	1
Mixed conifer	17.61	11268	0.41%	10	2
Mixed forest	8.05	5150	0.19%	6	1
Pinyon Juniper	1238.40	792578	28.86%	8	155
Ponderosa Pine	524.37	268879	12.22%	6	87
Shrub dominated wetland/riparian	8.73	5584	0.20%	10	1
Spruce fir	458.74	293593	10.69%	10	46
Spruce-fir clearcut	12.23	7828	0.29%	10	1
Subalpine meadow	29.75	19037	0.69%	10	3
<b>TOTAL</b>	<b>2885.90</b>	<b>1780259</b>	<b>67.24%</b>		<b>850</b>
Square miles in DAU		4285.48			

Use/occupancy Density Extrapolation

The second habitat model was developed in 2008 using the CPW Basinwide GIS Vegetation Classification project data (Figure 4) and CPW wildlife managers were asked to rank each vegetation type for its relative forage value. This results in a two tiered habitat ranking system. Use/occupancy was defined at 4 levels; primary, secondary, edge, and out. Relative forage value was rated for primary, secondary, and edge habitat based upon the perceived potential of those habitats to provide forage for black bears. Use/occupancy terms are defined as follows:

Primary – cover types that bears typically and normally are found at various times of year.  
 Secondary – cover types that bears occasionally use but is not preferred.  
 Edge – cover types infrequently used, but bears may be found in when adjacent to Primary cover types.  
 Out – cover types that are not black bear habitat or those in which bears would only travel through.

The result of this use/occupancy analysis provides tables of bear habitat in terms of its relative use and state of occupancy and their potential relative forage value. This resulted in a matrix for assigning habitat quality and subsequently for assigning bear densities to different habitat quality to extrapolate a potential population. Table 3 provides the results of the surface area analysis for B-06 and utilizes density values that will be discussed below. The population results for B-06 can be incorporated into modeling efforts or used as comparison to independent population model runs.

**Table 3. Results of habitat surface area analysis for use/occupancy population estimate in B-06**

BEAR DAU	GMU	Out km <sup>2</sup>	Bear Habitat Categories				Bear Density			Projected Bear Population			
			Area in km2				Bear/km2			Primary	Secondary	Edge	Total
			Primary	Secondary	Edge	Total	Primary	Secondary	Edge				
B-06	71	67	1,047	88	147	1,348	0.36	0.23	0.04	377	20	5	402
	72	1,988	48	48	452	2,536	0.19	0.13	0.02	9	6	9	24
	73	928	667	125	591	2,312	0.25	0.19	0.03	167	24	15	205
	74	202	1,007	105	228	1,542	0.36	0.23	0.04	363	24	8	395
	711	768	638	445	273	2,125	0.30	0.23	0.03	192	102	8	302
	741	570	235	109	339	1,254	0.19	0.13	0.02	45	14	6	65
<b>B-06 Total</b>		<b>4,523</b>	<b>3,643</b>	<b>920</b>	<b>2,031</b>	<b>11,117</b>				<b>1,152</b>	<b>191</b>	<b>52</b>	<b>1,394</b>

Two 2009 Colorado mark-recapture surveys indicate higher densities than those found by most studies, analyses, or management reports in the western US (Table 4). Although density estimates are influenced by the size of the study area and the methods by which density estimates were derived (see Apker et al. 2010); overall habitat quality in the two 2009 study areas in Colorado is probably better than that found in most other study areas. It should also be noted that both the Colorado 2009 survey areas were selected in large part because they were considered among the highest overall quality habitat in Colorado and the exact survey grid areas were structured to include mostly the highest quality cover and forage value habitat for the survey season.

In addition to the two recent studies in Colorado, CPW also studied the black bear population on the nearby Uncompahgre Plateau, GMUs 61 and 62 (Beck 1995). Beck (1995) determined the Uncompahgre Plateau had a density of 36/100 km<sup>2</sup> (1 bear /mi<sup>2</sup>), which was considered to be very high. However, in recent years, based on increasing harvest success and more available anthropogenic food sources, it is plausible that densities in Primary quality bear habitat could be similar to that in the NWSA (North West Study Area near Glenwood Springs) or SESA (South East Study Area near Trinidad) management areas.

Several other correlates of bear habitat use/occupancy are also available to managers in B-06 including harvest density/locations, roadkill/highway crossings, and conflict hotspots. An evaluation of

B-06 harvest locations superimposed on the basic categories of bear habitat use and occupancy indicates that most harvest, and presumably most of the bears, are being found (in the fall) in primary habitat or within edge habitat that very closely adjoins primary habitat (Figure 12). The significant exception to this would be the presence of bears, as documented through roadkill, harvest and conflicts, in high densities in some localized areas of edge habitat (those associated with human food sources).

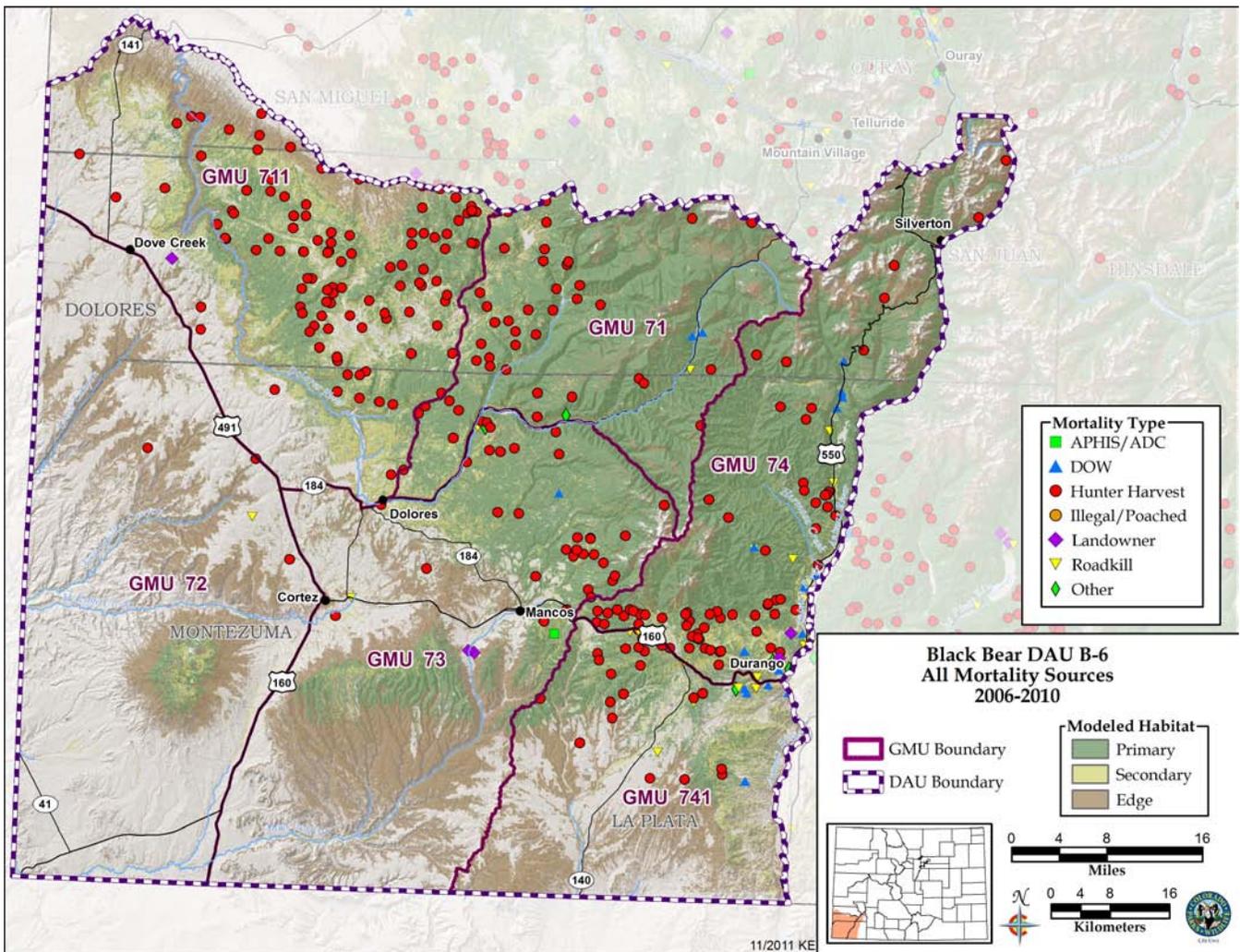
**Table 4. Reported black bear densities from research, analysis, or management reports in diverse locations and habitat types.**

<b>Location</b>	<b>Source</b>	<b>Per 100 km<sup>2</sup></b>
<b>Washington</b>	Linzey 1977	112 – 149
<b>Nevada – Tahoe Basin (urban)</b>	Beckmann and Berger 2003	120
<b>•Colorado – SESA</b>	Apker et al. 2010 unpublished	47 – 52
<b>Wisconsin</b>	Belant et al. 2005	50 – 64
<b>Idaho</b>	Beecham and Rohlman 1994	31 – 77
<b>•Colorado – NWSA</b>	Apker et al. 2010 unpublished	45 – 50
<b>Idaho</b>	Beecham 1980	43 – 47
<b>Alberta</b>	Kemp 1976	38
<b>Montana</b>	Jonkel and Cowan 1971	38
<b>Colorado – Uncompahgre</b>	Beck 1995 Fed Aid Rpt	36
<b>Idaho</b>	Rohlman 1989	34
<b>Arizona</b>	LeCount 1982	33
<b>Nevada – Sierra Range</b>	Goodrich 1990	20 – 40
<b>Arizona</b>	Waddel and Brown 1984	27.8
<b>Colorado – BMSA</b>	Beck 1991	17.9
<b>New Mexico</b>	Costello et al. 2001	9.4 – 17
<b>Colorado – Middle Park</b>	Beck 1997 Fed Aid Rpt	8.1
<b>Utah</b>	Utah Division of Wildlife Resources 2000	7.7
<b>Arizona</b>	LeCount 1987	6
<b>Wyoming</b>	Grogan and Linzey 1999	2.1 – 3.0
<b>Colorado - RMNP</b>	Baldwin and Bender 2007	1.35

### ***Mortality Density and Rates***

The amount of human-caused mortality in relation to the amount of suitable habitat available is another method to gauge the impacts of human-caused mortality on black bear populations. This can be useful in illustrating impacts on a more local scale and standardizing mortality between DAUs with varying habitat suitability. The number of human-caused mortalities can be divided by the area of primary and secondary habitat.

Thus B-06 with 4,563 km<sup>2</sup> of primary and secondary habitat and an average of about 71 bears killed per year over the past 10 years = a mortality density of 1.6 bears/100km<sup>2</sup>. Then assuming that the bear population is about 1,500 bears, which is roughly the mid-point between the various habitat and population model projections (discussed later), then the median bear population density in the DAU is about 32.9 bears/100km<sup>2</sup>. Using these figures to calculate a mortality rate yields 1.6/32.9 = 5%. It is likely that some human-caused non-harvest bear mortality occurs in B-06 that is undetected, but it is unlikely that the average ten-year total mortality exceeds the 13% threshold to push the population into suppression.



**Figure 12. Location of bear mortalities in B-06 (2006-2010)**

While there are few reference values for human-caused mortality density in the literature, these values may be used to assess relative trends of harvest in each hunt area through time. Evaluating mortality density in relation to estimated population densities for black bears give some context with which to interpret these data. Miller (1990) demonstrated that under optimal conditions of reproduction and survival, maximum sustainable total mortality for black bears could be as high as 14.2%. Beck and White (1996 unpublished) conducted black bear population simulation analyses which, given their assumptions, produced stable bear populations with annual mortality at up to 15%.

It is unlikely that bears annually experience optimum reproduction and survival conditions due to environmental variation affecting forage conditions and black bear vulnerability to mortality factors. Therefore, we have formulated mortality rate thresholds associated with different management strategies which are somewhat lower than the foregoing:

<u>Management Strategy</u>	<u>Mortality Rate Threshold</u>
Increasing	< 7%
Stable	7% - 13%
Decreasing	> 13%

### ***Forage Condition - Mast Production Surveys***

Forage conditions influence bear reproductive success and certain gender and age specific survival rates due to changes in vulnerability to mortality (Beck 1991, Costello et al. 2001). Therefore, managers consider forage conditions when formulating annual management recommendations. In the fall of 2008, CPW began inventory of mast production conditions. Following survey protocols developed by Costello et al. (2001), we made only slight modifications to provide a basic 5 point matrix of fall mast fruit productions for gamble oak, juniper spp., chokecherry, and serviceberry. Forage condition results within DAUs can then be represented numerically to reflect annual forage conditions. These results can provide managers objective information about relative forage conditions over time and use that with their professional judgment to influence management recommendations. Taking it a step further, the results can be used as one of the many population model inputs as a factor influencing birth rates and cub survival in the population models.

### ***Population Models***

Another tool to estimate black bear populations is the development of deterministic population models utilizing annual harvest data and density data, where available, along with biological data from the literature. The starting population estimate for the models was derived from the vegetation/density model (Apker 2003) that estimated 850 bears in B-06 (Table 2). We used plausible values from the literature for age-specific survival (Costello et al. 2001, Beck 1991, Beck 1997), number of cubs per litter, and estimated forage condition index values to account for changes in reproduction and mortality rates due to poor forage years. For 2008 and 2009, we used actual forage condition index values derived from CPW assessing vegetation. For years prior to 2008-2009, non-hunt mortality was used to determine an index of forage conditions based on the assumption that if non-hunt mortality is higher than average, then forage conditions must have been poor and if non-hunt mortality was lower than average, then forage conditions were probably good. The models used mortality data with harvest as a direct model input and non-hunt mortality adjusted upward since we know records do not document all non-hunt mortality.

While the models do yield population estimates, these estimates are predicated on many plausible, yet assumed input values. The results do appear to conform to population extrapolations derived by the habitat models. Nonetheless, the value of the models is most worthwhile as an assessment of trends in population trajectories and responses to mortality and forage condition variability rather than the absolute population estimate produced.

Two models were developed for B-06, one model with liberal, but plausible model parameters, and another model with more conservative, but plausible parameter values.

Assumptions common to both Liberal and Conservative Models

The initial population size of 900 bears and the starting age distributions for both models was derived from extrapolations of habitat quantity and known bear densities from the literature. Sex ratio at birth was assumed to be 50:50, with an average litter size of 2. Based on 2007-2009 tooth data, there were 30 adult female bear samples in B-06 that allowed for evaluation of primaparty and birth interval. This sample supports using five years as the age of female primaparty in B-06 and using a birth interval of 2 years between litters. Both models employ a non-harvest multiplier of 1.5 that increases the value of the reported non-harvest mortality.

Subadult and adult survival rates were largely midpoints of published ranges in New Mexico and Colorado (Costello et al. 2001, Beck 1991, Beck 1997), while cub survival fell within published ranges but was modulated by a mast index that is intended to reflect documented forage conditions on a yearly basis. Predicted population and age structure levels beyond the current year (2011) relied upon the continuation of assumptions used in the preceding years, as well as projected future mortality levels at levels necessary to stabilize the population.

Liberal Model

The differences in assumptions between the liberal and conservative models are related to survival rates. Club survival rates were variable according to forage conditions and the model utilized the following rates: 37% for poor food years, 65% for average food years, and 80% for good food years. In addition to survival rates, the liberal model utilized the following survival rates for the other age and sex classes of bears: Yearling female was 90%, sub-adult female was 92%, adult female 93%, yearling males was 91%, sub-adult males was 90%, and adult males was 89%. Modeling results from using the liberal inputs and assumptions were:

<i>2011 Post-hunt population estimate</i>	<i>2,410</i>
<i>Total adult bears (male/female)</i>	<i>909 (319/590)</i>

Conservative Model

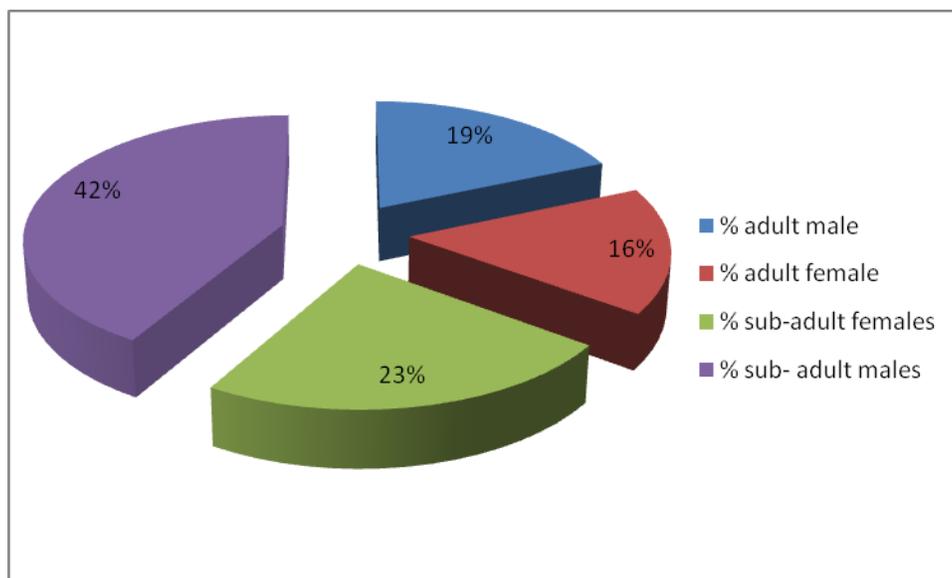
The conservative model used lower survival rates than the liberal model. Again cub survival rates were variable according to forage conditions and the model utilized the following rates: 37% for poor food years, 65% for average food years, and 80% for good food years. In addition to survival rates, the conservative model utilized the following survival rates for the other age and sex classes of bears: Yearling female was 89%, sub-adult female was 92%, adult female 93%, yearling males was 90%, sub-adult males was 89%, and adult males was 89%. Modeling results from using the liberal inputs and assumptions were:

<i>2011 Post-hunt population estimate</i>	<i>1,640</i>
<i>Total adult bears (male/female)</i>	<i>683 (208/475)</i>

***Mortality Composition and Management Criteria***

Black bear vulnerability to harvest and other mortality factors varies depending upon differences in habitat, hunter effort or pressure, access, and forage conditions. Bears are less vulnerable where cover is dense over large geographic areas. They are more vulnerable where vehicle access is good. The greatest influence in annual variation in bear vulnerability is forage conditions. When natural forage

quality or availability is poor bears must become much more mobile in search of food, especially during fall hyperphagic periods. Increased mobility tends to result in bears being more visible to hunters, more likely to encounter human food sources, more frequently found along or crossing roads, and more concentrated in areas where there may be relatively more forage available. All of these tendencies can result in increased hunter harvest, increase human conflict mortality, more roadkills and other forms of mortality. Not all segments of bear populations are equally vulnerable however, regardless of other influences. Hunting pressure affects harvest rate, which affects age structure, sex ratios, and densities of black bear populations. Adult males are typically most vulnerable because they are bold (often use open areas) and have larger home ranges. Sub-adult males are slightly less vulnerable. Consequently, the adult male segment of a population is the first to be reduced under hunter pressure. As harvest rates increase, the proportion of sub-adult black bears (those less than 5 years old) in the harvest typically increases, whereas the proportion of adult males declines. **A low percentage of adult males ( $\geq 5$  years old) in the harvest may be an indication of over-harvest.** This criterion is a more sensitive indicator of black bear population levels than median age (Idaho Dept. of Fish and Game 1998). The mean percent of adult males in the harvest in relatively stable populations in Idaho (Beecham and Rohlman 1994) and New Mexico (Costello et al. 2001) under moderate to high harvest levels was 30% and 28%, respectively. Studies of black bear populations in Alaska, Virginia, and Arizona showed similar relationships between lightly and heavily hunted populations. **Therefore, 25% to 35% adult males in the harvest could indicate a stable black bear population.** Levels lower than 25% may indicate a higher level of harvest, which has reduced the adult male segment of the population; whereas levels higher than 35% may indicate a much lighter harvest level. Based on the four years of available data in B-06 (2007-2010), it appears that current harvest levels could be high, as adult males only comprise 19% of the total harvest (Figure 13).



**Figure 13. Bear harvest in B-06 by proportion of age class and gender (2007-2010)**

As harvest levels increase and additional adult and sub-adult males are removed from an area, the proportion of females in the harvest begins to increase (Fraser et al. 1982, Kolenosky 1986, Beecham and Rohlman 1994), because female are least vulnerable, especially if accompanied by cubs. The

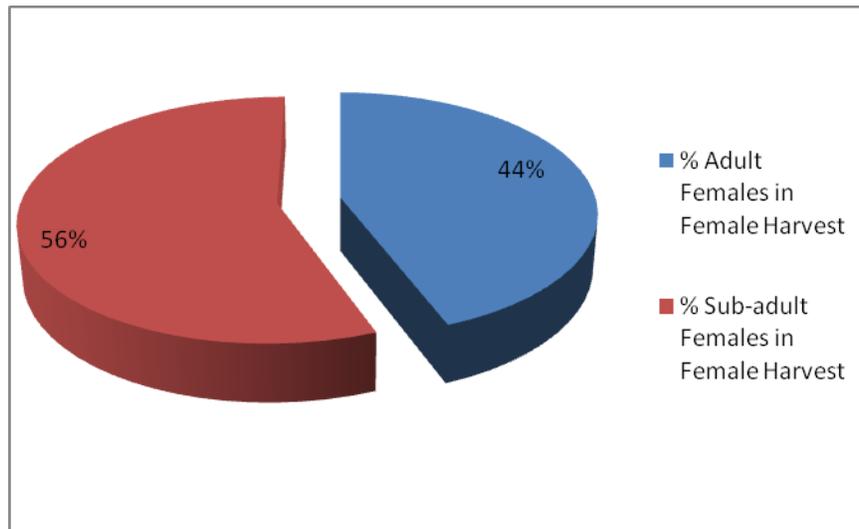
average percent females in the harvest of black bear populations under moderate and high hunting pressure in Idaho (Beecham and Rohlman 1994) and New Mexico (Costello et al. 2001) was 35% and 40%, respectively. Beecham and Rohlman (1994) suggest a desired proportion of female harvest of 35% to maintain a stable population, whereas Beck (1991) suggested maintaining <40% females in harvest. **Therefore, a range of 30% to 40% females in the total harvest could indicate a stable black bear population.** Data Analysis Unit B-06 appears to be at the top end of the stable range using this indicator, with a 39% female harvest rate over the last four years (2007-2010) (Figure 13). Proportions higher than 40% may suggest reduction of the number of females in the population. Monitoring this criterion helps ensure a stable reproductive portion of the population and the ability of the population to rebound in the event of a decline.

With increasing harvest of a black bear population, younger females are removed and older females become more common in the harvest. **Thus, the proportion of adults in the female harvest would rise with increasing harvest rates, increasing mean age of females in the harvest** (Kolenosky 1986, Beecham and Rohlman 1994). This phenomenon is especially important with late-reproducing species like bears, since removing adult females has the enhanced effect of not only reducing the number of bears in the population, but also decreasing reproductive potential of the population and, thus, its ability to respond to declines. The delayed response of slow reproducing populations to reductions was noted by Harris (1984) and was demonstrated in modeling efforts by Miller (1990), who predicted black bear populations reduced by 50% would take an average of 17 years to recover if hunting pressure was reduced by 25%.

The percent of adults in the female harvest, rather than mean or median age of the females in the harvest, can also be used to gauge the presumed population trajectory. Averaged over a three-year period, this criterion provides a more meaningful measurement of female harvest age structure, especially in areas with small sample sizes. The mean percent of adult females in the harvest of two New Mexico black bear populations under moderate and high harvest pressure was 55% and 70%, respectively (Costello et al. 2001). The mean percent adult females in the Wyoming statewide female black bear harvest from 1994-2005 was 47%, with a range of 32% – 57%, **suggesting that 45 – 55% adult female harvest provides a stable proportion of adult females** (Wyoming Game and Fish Dept. 2007). In B-06, adult females comprised 44% of the female harvest from 2008-2010, indicative of a stable population under this criteria (Figure 14).

Looking at criterion independently could give very different results than when considering them together. For instance, as a hypothetical looking only at a reduced percentage of adult males in the harvest may indicate a population is moving from light to moderate harvest. However, evaluating the other criteria may show an increased proportion of females and higher proportion of adult females in the harvest, indicating a much higher level of harvest than looking at males alone. Alternatively, a high percentage of adults in the female harvest, assessed independently, would indicate population reduction. However, when the percent adult males and percent females in the harvest are both in the population increase or stable range, the population might actually be thriving. This situation might occur when the DAU is adjacent to or has an area providing a source of immigrating black bears. Source areas can be defined as areas of suitable habitat with little to no human-caused mortality that may provide dispersing bears to surrounding areas (Beecham and Rohlman 1994, Powell et al. 1996). Areas adjacent to sources

may have a lower proportion of adults in the harvest due to sub-adults dispersing to occupy vacant home ranges of harvested bears. These areas may also be able to rebound more quickly from overharvest (Beecham and Rohlman 1994). Dispersing sub-adult males may also supplement surrounding populations and absorb much of the harvest to the point where female harvest remains low and adult females comprise a higher proportion of the population.



**Figure 14. Proportion of female harvest, by age class in B-06 (2007-2010).**

To better evaluate harvest data, black bear seasons are set for a five year period as with most other big game species in Colorado. We recommend that harvest objectives and attendant license allocations be set for three-year periods. This would allow for a more complete analysis of the effects of harvest by holding dates and quotas the same for each three-year season cycle. In order to increase the sample size of the harvest data and to reduce the influence of high or low annual harvest rates due to environmental or other factors, three-year running averages will be used in harvest data analyses rather than analyzing annual data independently. While the evaluation of harvest criteria will be analyzed using a three-year average, data from the previous 10 years (two black bear generations) or longer should be analyzed to illustrate longer-term trends in harvest and related population trends.

### ***Social Factors***

The social factors that influence management of black bears in B-06 include game damage, human conflicts, and hunting opportunity. As mentioned in the previous section on game damage, the highest number of claims was bear depredation on sheep and cattle followed by damage to beehives. The average number of game damage claims over the last 10 years was 8.5 per year. During the years of natural forage failures, damage claims increase. Monitoring trends in game damage may be another index to monitor bear management. If game damage claims appear to be increasing over the 8.5/year average, outside of poor natural forage years, then that may mean the population is increasing and searching for alternative food sources. In addition to domestic livestock depredation and beehives, human conflicts occur when bears are utilizing garbage containers, bird feeders, and potentially entering cars or houses when access is easy and attractants are present. Increasing human conflicts can be an indicator of increasing bear populations, but locally is believed to be more a factor of increasing human

population and development in prime bear habitat. Increasing human conflicts usually generate more outreach to address minimizing bear attractants.

Direct, significant human conflicts with black bears in B-06 typically involve a bear entering or attempting to enter a home, cabin, trailer or car. These conflicts are dealt with by CPW field staff differently depending on severity of the incident, other site-specific qualities and whether the bear in question had been previously handled by the CPW. There is a CPW policy on handling bears that have already received a first “strike”, as well as procedures to follow if a bear makes physical contact with a person.

In addition to managing game damage and human conflicts, we are also interested in maintaining hunting opportunity. Bear hunting in B-06 is popular with competition for limited September rifle licenses taking preference points to draw, as well as archery and muzzleloader licenses selling out shortly after being available to purchase.

## **STRATEGIC GOALS AND MANAGEMENT OBJECTIVES**

### ***Process for Developing Strategic Goals and Management Objectives***

#### *Public Process*

Through the DAU planning process, ample opportunity was given for the general public to provide input on bear populations and management in B-06. A survey was made available on the internet from May 18 to June 22, 2012. Information about the survey was given through a press release and on the CDOW website. Those who did not have internet access were sent a hard copy of the survey at their request. Additionally postcards were mailed to individuals who had hunted bears in B-06 within the previous two years and to 2,000 random residents with the DAU. Letters requesting comments were also sent to local counties, land management and natural resource agencies, local and statewide special interest groups, and local Native American tribes.

There were 227 people who participated in the survey (221 on-line, 6 hard copies). The demographics of respondents were: 81% were residents of Colorado, 73% lived in the DAU, and 66% were bear hunters or applied for a bear license. Human/bear conflicts were important to 80% of respondents. Of the three management alternatives outlined within this plan;

- 60% supported alternative 1 of maintaining a stable population,
- 18% favored alternative 2 of a three year decrease using 15% off-take rate, and
- 13% chose alternative 3 of a three year decrease using a 20% off-take rate.

Written comments were numerous and each was reviewed. A significant proportion of comments involved management change outside the realm of this plan such as initiating a spring season, allowing baiting and the use of dogs, and preventing human development in bear habitat. Most people who wrote comments wanted the CPW to manage for a viable bear population. How they viewed this was varied from drastically decreasing the number of bears to the other extreme of not hunting bears. A large percent commented that people need to be more responsible to avoid human/bear conflicts. There

were two main thoughts on how to deal with human/bear problems; 1) was to educate people so that people learned how to live with bears, and 2) was to increase hunter harvest on bears. Interestingly was the number of comments from residents who had lived in the same area for 20, 30 or more years and had never seen a bear on or around their property until the past 5-10 years. Now several of these people are having numerous bears on their property and are experiencing multiple problems with bears. A copy of the survey and survey results are on file at the Durango CPW service center and are available upon request.

Additionally Montezuma County Board of County Commissioners and the Southwestern Colorado Livestock Association provided comment. Both of these entities favored alternative 3, or an aggressive reduction in the bear population. In part this was based on the belief that bear populations were exceeding the carrying capacity and that conflicts with bears were increasing.

The Southern Ute Indian Tribe (SUIT) also provided comment. The SUIT recommended that CPW delay the work on the DAU plan until after more information on local bear populations and ecology was gleaned from the CPW bear research which started last year in Durango. This information could be used to provide better management directive in the new DAU plan.

After the initial public outreach a draft of the B-06 plan was developed and posted on the CPW website ([www.wildlife.state.co.us](http://www.wildlife.state.co.us)) from July 2 to August 2, 2012 for further public review and comment. A letter that stated the draft plan was available for review and requested comments was sent to local counties, land management and natural resource agencies, local and statewide special interest groups, and local Native American tribes.

La Plata County provided comments during this time period. The county acknowledged that human/bear conflicts were an important component of managing bears and that CPW had invested a large amount of resources to minimize these conflicts. La Plata County deferred management recommendations to CPW, but suggested a more cautious approach be used initially if decreasing the population was prescribed.

Bear Smart Durango also commented on the draft plan. Recommendations were that available anthropomorphic food sources be removed in bear habitat prior to using any bear population management strategy.

District Wildlife Managers (DWMs) working within B-06 as well as the local Area Wildlife Manager (AWM), Patt Dorsey, and myself reviewed the comments and survey results. On August 13, 2012 we met and discussed recommended management alternatives for this plan. There was agreement that the B-06 bear population was higher than ever recorded and human/bear conflicts reflected this. Within the past five to ten years human/bear conflicts had grown significantly and bears were becoming more aggressive searching for anthropomorphic food sources. This had been documented in the number of bear/human conflict report forms over the years. Bears entering houses and other structures in search of food had become a common occurrence where before it was rare. A tireless effort had been made by CPW personnel to teach people how to live with bears and avoid conflict. This will remain an important strategy regardless of bear population management objectives. DWMs also had observed more bears in

areas away from urban development. Based on all this, there was general consensus that the bear population was thriving and that the social tolerance of bears had been exceeded. A lower bear population was desirable. It was felt that this could be done while still providing a healthy, viable population and a quality experience for bear hunters and others wishing to view bears in natural habitat, away from human development.

### ***Strategic Goals***

Subsequent total mortality and harvest objectives are presented as a range of probable amounts necessary to achieve the strategic goal of the DAU. Annual monitoring of mortality amounts, gender and age structure, Colorado black bear density study, and annual forage condition survey results are all incorporated into determining annual mortality objectives. However, the models and their results have not been validated with demographic data from Colorado bear populations. Moreover, the data that has been collected and used for model inputs result from relatively new efforts. We anticipate that the models will change and be improved over time and thus should be viewed as **presumptive** estimates. Therefore, although the plan identifies mortality and age and gender objectives, these are initial values. Modeling will be conducted every other to every third year, while other mortality data and demographics are collected and analyzed annually. Population extrapolations based on predicted densities, range-wide or within vegetation associations, will be re-evaluated as new data is gathered via research and mark-recapture surveys. While unlikely, objectives may be periodically adjusted in order to achieve the DAU strategic goals based on changes in the information sources above. Specific objectives will be documented in annual objective sheets approved by the Parks and Wildlife Commission. These objective sheets will also govern annual license levels to achieve the DAU strategic goals.

#### **Three Alternative Strategic Goals in B-06 were considered:**

***Stable population trend:*** To achieve a strategic goal of maintaining a stable bear population in B-06, management criteria applied to determine harvest and total mortality rates should fall in an intermediate range. Total mortality, or off-take, as a proportion of the population should fall between 7-13% of the estimated population. Based on current population projections the total mortality would be approximately 97-181 black bears annually. Proportion of adult males in the harvest should be within 25-35%, with all females making up 30-40% of harvest. Additionally, adult females should comprise approximately 45-55% of the female harvest. Within the framework of an overall stable population, game damage and human/bear conflicts in localized areas of concern would fall under current CPW policies. Not every management index must be in complete agreement, but most should point toward a stable population. The current three year average total bear mortality in B-06 is 85 of which 40% is female, 20% adult male, and the proportion of adult females in the female harvest is 44%.

***A stable population following a moderate reduction in the population:*** Applied management criteria determining harvest and total mortality rates would be in the liberal range. This would achieve a strategic goal of decreasing the bear population in B-06. It would then be re-evaluated after five years and management would continue to decrease the population or change to maintain the bear population at the new, lower size.

Total mortality, or off-take, as a proportion of the population would incrementally be increased

over a three year period to 15% and then be maintained at that level for up to two years. Based on current population projections, the total mortality objective would be 210 black bears annually. The proportion of adult males in the harvest could be low, even below 25%, with total female harvest rates going over 40%. Additionally, adult female proportions in the female harvest can account for rates over 55%. During these five years of decreasing the population, the sex and age composition of mortality and harvest would be evaluated annually to determine if the indices were indicating a downward trend. Also, analysis of damage and nuisance complaints would be used to determine if a higher harvest was meeting management goals. Not every management index must be in complete agreement, but most should point initially toward a decreasing trend. After this period of increased harvest, management would shift to maintain a stable population but at the new, lower population size (parameters outlined in Stable Population Trend above).

*A stable population following an aggressive reduction in the population:* Applied management criteria determining harvest and total mortality rates would be in the liberal range. This would achieve a strategic goal of decreasing the bear population in B-06. It would then be re-evaluated after five years and management would continue to decrease the population or change to maintain the bear population at the new, lower population size.

Total mortality, or off-take, as a proportion of the population would incrementally be increased to 20% over three years and then held there for up to two years. Based on current population projections the total mortality objective would be approximately 280 black bears. Proportion of adult males in the harvest can be low, even below 25%, with total female harvest rates going over 40%. Additionally, adult female proportions in the female harvest can account for rates over 55%. After three years of decreasing the population, the sex and age composition of mortality and harvest would be re-examined to determine if the indices were indicating a downward trend. This information, combined with analysis of damage and nuisance complaints, would inform decisions on whether to continue with higher harvests for the next few years, or whether the population was within an acceptable range and overall harvest and mortality could be decreased to stabilize the population (parameters outlined in Stable Population Trend above). Not every management index must be in complete agreement, but most should point initially toward a decreasing trend, followed by a stable trend.

### ***Monitored Data to Inform Management***

All known dead black bear, from both harvest and non-harvest sources, are checked by CPW staff to obtain biological information. The proportion in total mortality of each gender will continue to be closely monitored on an annual basis to assure that female mortality rates are not contrary to the DAU strategic goals. Age structure in total mortality and reproductive history are derived from extraction of a premolar tooth from bears when bear harvest and non-hunt mortality is reported through the mandatory check.

In 2009 and 2010, hair snag surveys were conducted in two locations in Colorado. A third survey was added in 2011 which included a portion of this DAU. Additional hair snag survey areas may be established in the future during the term of this DAU plan. Results about bear density, gender, and possibly age structure from these surveys may be incorporated into the habitat model/density extrapolations.

Because of low reproductive rates, black bear populations cannot sustain high harvest levels over prolonged periods. Research has shown that high harvest levels can quickly reduce black bear populations to levels where severe reductions in harvest quotas and season lengths may be necessary for greater than 10 years for full recovery of a population (Miller 1990, Beecham and Rohlman 1994). Therefore, the following harvest criteria will be assessed at the DAU level, with each DAU strategic goal set to achieve the criteria for reduced, stable, or increasing black bear numbers.

Total mortality

Monitoring harvest and overall mortality totals in relation to projected population size will be important in interpreting mean age and relative proportions of age/gender classes as indices. Based upon the recommended strategic goal of a **stable population following a moderate reduction in the population**, the total mortality off-take range that would allow managers to reach that goal is up to **15%** for as many as five years, then **7-13%** for the remainder of the life of this plan.

Proportion of mortality by age and gender

The following 3 harvest criteria will be monitored annually, using a 3-year average in B-06.

	Population Trend		
	Decreasing	Stable	Increasing
% of Adult Males in Total Harvest	< 25%	25 - 35%	> 35%
% of All Females in Total Harvest	> 40%	30 - 40%	< 30%
% of Adult Females in Total Female Harvest	> 55%	45 - 55%	< 45%

Forage condition monitoring

Collected annually this data can be used when projecting reproductive rates, cub survival, vulnerability to harvest and other factors related to modeling and predicting population trends for the upcoming year. Annual forage condition/mast production surveys are conducted in representative GMUs in DAU B-06. Results of these surveys are incorporated into population modeling efforts, as are mortality, age and gender structure data.

Game Damage & Human Conflict

Numbers and types of game damage claims associated with bears will be monitored annually. In addition, documented human conflicts will be monitored annually. The general trend in damage claims and conflicts will be evaluated to determine if they are increasing or decreasing, but no specific trigger or action is being identified. In most cases, management efforts will be taken to address an individual bear causing conflict through CPW policy. Management efforts may include public outreach to trap and transplant or even harvest conflict bears, following protocols identified in CPW Administrative Directive W-2.

**Management Objectives**

The specific total mortality and harvest objectives are based on present information and assumptions about population status and trajectory. These represent starting points in an ongoing process. Annual changes to mortality and harvest objectives are anticipated based on new information

and evaluation of monitored data. Annual quantitative objectives will be documented in DAU objective sheets approved by the Parks and Wildlife Commission during annual regulation cycles.

Using the 4 different models/techniques to project plausible bear population sizes in B-06 yields the following:

Vegetation/ Bear Density extrapolation = 850 independent bears

Use/occupancy density model population extrapolation = 1,394 independent bears

Liberal Population Model for 2011 = 2,410 bears (1,748 independent)

Conservative Population Model for 2011 = 1,640 bears (1,204 independent)

For purposes of calculating mortality objectives to correspond with the strategic goal in the DAU a 2009 presumptive post-hunt population of **1,400 independent bears** will be used. This is based on the use/occupancy density model and the conservative population model. It is also supported by current black bear mortality demographics. Harvest and total mortality objectives are based on the population of independent bears since cubs are not legal for harvest in Colorado. Population estimates will be revised and utilized as new data becomes available from hair snare surveys in B-06 and the CPW bear study in Durango.

### **Mortality Objectives – 3 year running average**

#### **Total Mortality Objective**

In order to achieve a DAU strategic goal of stable population following a moderate reduction in population in B-06, it is estimated that the average total mortality should be ≤ 210 up to five years at a 15% off-take then decreased to a 10% off-take which may be 90-135.

#### **Hunter Harvest Objective**

Annual hunter harvest objectives are determined by deducting the 3-year running average amount of non-hunter mortality from the total mortality objective. If the strategic goal is a stable population following a moderate reduction in the population, then hunter harvest objectives could be adjusted up or down to (presumably) increase or decrease the rate population growth or decline. Based on a total mortality objective of ≤ 210 up to five years at a 15% off-take then decreased to a 10% off-take which may be 90-135, the hunter harvest objective will be ≤ 179 up to five years, then decreased to around 77-115.

#### **Age & Gender Structure (harvest composition) in Hunter Harvest Objective**

It is estimated that the 3-year running average proportion of age and gender structure in hunter harvest should meet the following criteria:

Harvest Criteria	Strategic Goal	
	Decreasing	Stable
% of Adult Males in Total Harvest	< 25%	25 - 35%
% of All Females in Total Harvest	> 40%	30 - 40%
% of Adult Females in Total Female Harvest	> 55%	45 - 55%

**Game Damage and Human Conflict Objectives**

Standard CDOW management techniques will be employed in B-06 to reduce game damage and human conflicts with bears. While management techniques used may be similar in both management zones, the application of lethal control to remove conflict individuals in bear management zones may be used more consistently. Other methods of non-lethal intervention will be used when the conditions and individual situation warrant it.

***Conclusion and preferred DAU strategic goal (with mortality objectives)***

CPW Commission adopted a **stable population following a moderate reduction in the population** in DAU B-06. This is based on the current population size and flourishing performance, habitat availability, human and agricultural conflict potential, human development and growth rate in bear habitat, and input from the public survey and 30-day comment period. In 2012 the B-06 population reached a historic high and has pushed the social tolerance of these animals coexisting with people. This has occurred during the same time period that there has been significant urban development in bear habitat, resulting in a loss of habitat. These issues can be partially addressed by decreasing the population over five years at a 15% off-take. A stable, healthy, and viable population of bears will be managed thereafter which was the wish of a large proportion of the public that provided comments on this management plan.

The **total mortality objective** will be incrementally increased over three years up to 210 (15% off-take), held there for up to two more years, then decreased to 10% of the population level which may be 90-135 bears annually. **Hunter harvest objective** will be incrementally increased up to 179 over three years then held at that level for up to two more years. It would then be decreased to 77-115, depending on the new population size, per year for the remainder of the life of this plan. Age and gender proportions will be monitored to assess whether the population is increasing, stable, or decreasing. Total mortality, or off-take, as a proportion of the population should fall in the 13-18% range for the first three years, and then decrease to 7-13% for the remaining years of this plan. Proportion of adult males in the annual harvest can be less than 25% during the 15% off-take, but should be 25-35% thereafter. All females in the harvest can be greater than 40% for the three year of 15% off-take and 30-40% for the remaining years. Proportion of adult females in the total female harvest can be greater than 55% during the three year decreasing phase, but should fall between 45-55% after that time period. Not every management index must be in complete agreement, but most should point toward the management goal.

The specific total mortality and harvest objectives were based on present information and assumptions about population status and trajectory. These represent starting points in an ongoing

process. Flexibility needs to remain within management prescription of this plan to allow for the most current and applicable data to be used as it becomes available so long as the “spirit” of the adopted management objectives are respected. Specifically is the increased knowledge of black bear ecology, population dynamics, and behavior that is expected to be gleaned from the black bear study which just began in Durango (part of this DAU) in 2011 and is scheduled to conclude in 2016. Annual changes to mortality and harvest objectives are anticipated based on new information and evaluation of monitored data. Annual quantitative objectives will be documented in DAU objective sheets by the Parks and Wildlife Commission during annual regulation cycles.

## REFERENCES

- Apker, J. A., P. Lukacs, J. Broderick, B. Dreher, J. Mao, A. Vitt 2010. Non-Invasive DNA-Based Black Bear Density Estimates in Colorado – 2009. Internal Colorado Division of Wildlife Memo.
- Baldwin, R. A. and L. C. Bender. 2007. Population demographics, habitat utilization, critical habitats, and condition of black bears in Rocky Mountain National Park. Rocky Mountain National Park, Estes Park, Colorado. 244pp.
- Beck and White (1996 unpublished)
- Beck, T.D. 1991. Black bears of west-central Colorado. Colorado Division of Wildlife Report Number 39. 86pp.
- Beck, T. D. 1995. Development of black bear inventory techniques. Colorado Division of Wildlife. Wildlife Research Report. Federal Aid Project W-153-R-8, Job Progress Report. 11pp.
- Beck, T. D. 1997. Development of black bear inventory techniques. Colorado Division of Wildlife. Wildlife Research Report. Federal Aid Project W-153-R-10, Final Report. 11pp.
- Beecham, J.J. and J. Rohlman. 1994. A shadow in the forest: Idaho's black bear. The University of Idaho Press, Idaho, 245pp.
- Costello, C.M., D.E. Jones, K.A. Green Hammond, R.M. Inman, K.H. Inman, B.C. Thompson, R.A. Deitner, H.B. Quigley. 2001. A study of black bear ecology in New Mexico with models for population dynamics and habitat suitability. Final Report Federal Aid in Wildlife Restoration Project W-131-R. 197 pp.
- Costello, C.M., K.H. Inman, D.E. Jones, R.M. Inman, B.C. Thompson, H.B. Quigley. 2004. Reliability of the cementum annuli technique for estimating age of black bears in New Mexico. Wildlife Society Bulletin 32:169 – 176.
- Fraser, D.G., J.F. Gardner, G.B. Kolenosky, and S. Strathearn. 1982. Estimation of harvest rate of black bears from age and sex data. Wildlife Society Bulletin 10:53 – 57.
- Gill, R. B. and T. D. Beck. 1990. Black bear management plan. Colorado Division of Wildlife Report Number 15. 44pp.
- Grogan, R.G. 1997. Black bear ecology in Southeast Wyoming: The Snowy Range. M.S. Thesis, University of Wyoming, 84pp.
- Harris, R.B. 1984. Harvest age structure as an indicator of grizzly bear population status. M.S. thesis, University of Montana, Missoula. 204pp.

Harshyne, W.A., D.R. Diefenbach, G.L. Alt, G.M. Matson. 1998. Analysis of error from cementum-annuli age estimates of known-age Pennsylvania black bears. *Journal of Wildlife Management* 62:1281 – 1291.

Idaho Dept. of Fish and Game. 1998. Idaho black bear management plan, 1999 – 2010: Status and objectives of Idaho's black bear resource. 77pp.

Kolenosky, G.B. 1986. The effects of hunting on an Ontario black bear population. *International Conference on Bear Research and Management* 6:45 – 55. Page **38** of **39**

McLaughlin, C.R., G.J. Matula, Jr., R.A. Cross, W.H. Halteman, M.A. Caron, AND K.I. Morris. 1990. Precision and accuracy of estimating age of Maine black bears by cementum annuli. *International Conference on Bear Research and Management* 8:415–419.

Miller, S.D. 1990. Population management of bears in North America. *International Conference on Bear Research and Management* 8:357 – 373.

Powell, R.A., J.W. Zimmerman, and D.E. Seaman. 1996. Demographic analyses of a hunted black bear population with access to a refuge. *Conservation Biology* 10:224 – 234.

Wait, S. 2000. Black bear management guidelines for bear DAU B-06. Colorado Division of Wildlife. Unpublished.

Wyoming Game and Fish Department. 2007. Wyoming black bear management plan. 59pp.