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PROCEEDINGS ONLY

SPATIAL ECOLOGY AND POPULATION STRUCTURE OF ENDANGERED BLACK BEARS (*Ursus americanus*) IN NORTHWESTERN MEXICO

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Abstract: Black bears (*Ursus americanus*) are considered an endangered species by Mexican authorities, where most of the of the recovery and management efforts have been carried out in eastern Mexico, a lack of ecological information along the Sierra Madre Occidental makes it a priority for research. The aim of this study was to provide baseline information about black bears in the Mexican State of Sonora. Throughout 2005 we used radio-telemetry, spoor (tracks and scats), and camera-trap records to determine home range, habitat use and activity patterns, and population structure during dry and wet seasons in two ranches with ecologically distinct environments. Home range estimates are 380 km^2, we recorded Black bears using seven habitat types, most importantly juniper-oak forest (32.5%), pine forest (31.2%) and pine-oak (22.8%); we found significant difference between ranches and seasons. Through camera traps we estimated a density of 18.6 ind/100km^2. The population is structured of 30% adults, 16.7% cubs and 53.3% subadults. These conditions reflect a growing population favored by food abundance in the last two years.

INTRODUCTION.
Large terrestrial mammals are among the most affected species that constitute an important component of biological diversity (Arita and León, 1993), those of large size are more susceptible to anthropogenic processes as they low population density, low reproductive rates, and extensive home

ranges, additionally dispersal distances for sub-adults are quite remarkable (Gittleman and Harvey 1982). Among these group of susceptible species, we can include the black bear (*Ursus americanus*), one of the biggest terrestrial mammals that exist in Mexico, weighting up to 270 kg. (Beecham and Rohlman 1994). Currently, black bear populations in Mexico have being severely affected by over harvest, and is classified as endangered of extinction by Mexican Laws (SEMARNAT 2002).

Habitat association --The presence of black bears has being reported in different vegetation types, representing a broad variation in the use and selection of the different components of the habitat. The majority of this variability is attributed to the productivity and availability of food, followed by characteristics present in each type of vegetation as cover, slope, elevation, availability of water and environmental humidity. Habitat use studies are important to comprehend the role that organisms play in ecosystem function, enriching the processes within habitats through their activities (Bueno 1996; Silva 2002). Black bear ecological knowledge inn Mexico is restricted to Sierra Madre Oriental (Doan-Crider 1995; McKinney & Delgadillo 2004), with only a published study in the Sierra Madre Occidental (Sierra *et al* 2005), therefore ecological research studies remain a priority for this region of Mexico.

Our objective was to describe the spatial ecology, food habits and population structure of black bears *(Ursus americanus)* in the Sierra of San Luis, Sonora.

Study area – Field work was carried our in the mountains of the Sierra de San Luis, located in the Agua Prieta municipality, in the State of Sonora. The area includes two ranches, ranch "Los Ojos" (approximately 6,500 ha) and "El Pinito" (approximately 6,300 ha), located between the 108° 56' of N longitude, and 31° 11' of W latitude. The area includes a mosaic of vegetation types, and it's dominated by a forest of juniper-oak woodlands, pine forest, pine-oak forest, open low forest, grasslands and chaparral (Palacio-Prieto *et al*. 2000).

Methods
Field work - We used a suite of techniques during 2005 to achieve our objectives. We carried out two trapping periods for a total effort of 370 trapping nights using leg-hold snares and barrel traps. We placed a radio-collar on the captured animals to assess their location, movement patterns and home range size (Bissonete et al 1994). Aerial telemetry was performed with the support of Environmental Flying Services, flights were made approximately every two weeks to locate the radio-collared animals.

Black bear records were obtained using camera-tramps, a total of 22 were distributed in both ranches. Each camera-trap consists of a camera inside a water proof case, in which the camera-tramp is fastened to the trunk of a tree with elastic cords to a predetermined height and angle between 30 and 50 cm of the ground to get photographs of the whole body. The shooter of the camera is activated by an infrared movement sensor. Each photographic event had the day and hour printed (Kucera and Barret,1993). The camera-traps were placed in sites where signs of activity of the species were previously found, and were located mainly in trail crossings by bears or other wildlife, as well as in dry river beds.

Black bear tracks were identified using size and form, stamping five fingers in each paw are observed, the front paw is approximately equal in width and length, while the rear paw is longer (McKinney and Delgadillo 2004; Costello *et al* 2001).

In order to have a permanent record of the footprint, the trace was transferred to an acrylic of 20 x 25 cm with a water marker and later this stamping was transferred to a plastic bag (Ziploc ©) with an indelible marker. The measures of length and width of each footprint were taken with a ruler and were assigned to different categories following the criteria proposed by Costello et al (2001).

Black bear scat were identified by having a cylindrical form, segmented and deposited in pile, with a 3 to 5 cm diameter, coloration was variable depending of the consumed food.

All records were captured in a data base created in Microsoft Excel 2000 (v.9.0) assigning the following fields: identification number (ID), genera, species, date, type of record (footprint, scat, observation, resting sites, photographic event), location, surrounding vegetation, UTM-X and UTM-Y. Using Arcview 3.2 program (ESRI 1999) we elaborated a geographic information system of the area of study, in which the geo-references of all the obtained records were used, placing them in a space-map using the forest national inventory (Palacio-Prieto et al 2000) to locate the registers inside the existing vegetation patches in the zone of study obtaining the area, the use of each vegetal community, as well as the available area present in the zone of study and other important parameters such as the elevation, slope and the aspect that bears are using.

A chi-square test was applied and the 95% Bonferroni confidence intervals were developed to determine whether significant differences existed between availability and use in each one of the vegetal communities (Milton 2001; Theodore, 1994).

Home range was estimated through the Adaptive Kernel method, which calculates the probability of an animal using a determined area, this estimation was made with the Animal Movement extension for ArcView (Powell *et al* 1997).

To determine population structure, the records of the camera-tramps were used; for all the animals that were well appreciated in the photographs the following categories were assigned: Adult, Sub-adult, Female and Bear Cubs. The differentiation was based in their morphological characteristics (McKinney and Delgadillo 2004). A parallel analysis using footprints to obtain estimates of population structure through certain standard measures, we assigned all the footprints to certain age, this was made by measuring the width of the front paw and the length of the rear paw (Costello *et al* 2001).

Food habits were determined by dissecting scats, separating manually the articles present in each one, placing them in different categories for their later identification. The determination of articles present in the scats was made with the help of a stereoscopic microscope, an optic microscope, the use of plants guides (MacMahon, 1994; Orth, 1995), as well as hair identification keys (Arita and Aranda, 1987).

For this study it was decided to express the results in three forms: Percentage of Occurrence, Relative Frequency and

Consumed Biomass. Being used on independent manner, the percentage of occurrence shows in what quantity of samples an alimentary article in particular appeared, but it does not reflect the proportion in relation with the rest of the articles, nor the ingested quantities. Though, when the three of them are used in a joined manner they give reliable information about the articles of major importance in the alimentation, besides this data representation is the more widely used and allows to make comparisons with other studies (Korschgen 1980; Sierra *et al* 2005;Silva 2002).

RESULTS

During 2005 a total of 450 records were obtained within the area of study, including: Two captured males with radiocollars, 141 photographic events of camera-tramps, 179 scats, 105 footprints, one lying site, two sightings and 22 aerial telemetry locations.

Home range – Average area utilized by male black bears in the study area was of 344.7 ± 186.3 km², being of 213.0 km² for male #1, and 476.4 km² for male #2 (Figure 1).

Habitat use.

During the course of the year 2005 and its different seasons it was identified that black bears used six habitat types.

Open Low Forest (BBA) was the most used habitat in both ranches, with a 34.80% at "El Pinito", both in spring and autumn diminishing in summer; and with a 56.32 % in the ranch "Los Ojos" in which it was used in summer as well as in autumn (Figure 2). Another habitat that was frequently used by bears was the chaparral (CH), it was used with 29.20%, it's the second habitat more

used in the ranch "El Pinito" and the bears used it mainly during spring and summer, diminishing in the autumn. Besides the pine-ever green oak forest (BPE) was used with a 27.13 % in the ranch "El Pinito" during spring and summer, also diminishing in autumn. And at last the induced grassland (PI) obtained a high percentage (43.67) of usage in the ranch "Los Ojos" using it in summer but more in autumn (Figure 3).

The results of the Chi-square indicate us that the black bear is using the different habitats present in the are of study in a disproportionate way to their availability in the area ($X^2 = 244.05$, gl=5, P>0.05).

When we applied the Bonferroni intervals, we found that in the ranch "El Pinito" the bears were selecting the habitats of open low forest and the chaparral and that they were avoiding the pine-ever green oak forest ant the grasslands (Table 1). While in the ranch "Los Ojos", we found that the bears were using the open low forest according with its availability in the area and that they were selecting the induced grassland and avoiding chaparral, bush and natural grassland (Table 2). When analyzing the use of the habitat taking in consideration the parameters of elevation, aspect and slope in the two sites, in the ranch "El Pinito", black bears use elevations between 1500 and 1900 m, being the majority of the records oriented to the southeast, and finally use slopes between the 5º and the 15º. In the ranch "Los Ojos" they are using heights between the 1300 and 1500 meters above sea level, though the orientation and slopes are very similar. A significant difference between the two was not found.

Population Structure.

When comparing the ages obtained between the width and the length of the paws it was found that no significant differences exist between the population structure obtained for each size ($X^2=1.368$, gl=4, P<0.85).

The population structure that was obtained was conformed mainly by adult individuals, the adult males of more than tour years of age conformed in average of 35.91%, and the adult females a 25.63%, while the males of 2 to 3 years around 7.6%, and the females of the same age an 8.1%, while the cubs conformed a 22.64% of the population (Figure 4). And gathering adults with sub-adults to obtain a better proportion of genders, it was obtained that the males conformed the 43% of the population, while the females a 33.78% and finally the cubs of both genders are a 22.64% (Figure 4).

Activity Patterns.
The black bear was found active at the end of spring, during summer and at the beginning of autumn, being the months of major activity July and October diminishing considerable in November and December.

 The black bear was found active through all day. During spring only seven events were registered, five of which are active between the 16:00 and the 20:00 hrs, that's why that difference is marked. However in summer and autumn were registered 134 registers, all of which give a better estimate of the activity periods. Two long periods of activity are present in summer, which are from 6:00 to 10:00 in the morning and in the afternoon from 14:00 to 16:00, also between 18:00 and 20:00 hrs. During autumn a major activity was registered between 16:00 and 24:00 hrs.

While active the black bear passed its time associated to different types of habitats. In Figure 5 we observe to what tour schedule they use more each type of vegetal community. Having that the most used habitat is the low open forest which they use it during all the day evenly, after comes the pine-ever green oak forest in which also they show actives during all the day but having their major activity peaks in two periods which are from 6:00 to 10:00 hrs. In the morning and in the afternoon from 16:00 to 20:00hrs.

On the other hand, we observed that the chaparral is used preferentially by night or at dawn, finding major activity after the 20:00hrs and before the 8:00 hrs, being the more active hours between 22:00 and till 24:00 and from the 4:00 till the 6:00hr. Also is the pine forest in which we don't observe much activity, but the one registered is by night since the 22:00 till the 10:00 in the morning. And at last the induced grassland is used evenly during almost all the day, not finding activity but in the mornings before the 8:00 hrs (Figure 5).

Food habits.
Black bear food habits were determined by means of the analysis of 179 scats. The main feeding categories for black bears are vegetal material being more consume the fruits of the manzanitas (*Arctostaphylus pungens),* junipers (*Juniperus deppeana*) and sotol (*Dasylirion wheeleri*). Regarding animal material the more consumed items were insects, mainly ants (Formicidae) and coleopterans; mammals most consumed were the cottontail rabbit (*Sylvilagus floridanus)* and young peccaries (*Tayassu tajacu*).

In terms of percentage of occurrence the prey articles of major importance that appear in a major number of times in the scats of vegetal material, the manzanitas (*Arctostaphylos pungens*) with a 94.44%, followed by junipers (*Juniperus deppeana*) with an occurrence of 47.22%, and in third place the sotol (*Dasylirion wheeleri)* in a 44.44%. Regarding the animal material, the insects were the principals, the ants (Formicidae) with a 14.44%.

In relation with the relative frequency, the vegetal material was the most frequent with an 81.71% and the animal material an 18.29% (invertebrates 13.67%, vertebrates 3.76% and birds an 0.68%), of the vegetal material the manzanita (*Arctostaphylos pungens*) was the most frequent with a 29.25%, followed by the juniper (*Juníperus deppeana*) with a 14.62% and the sotol (*Dasylirion wheeleri)* with a 13.76% of frequency. Of the animal material the ones that present the major frequency were the insects, the ants (Formicidae) with a 4.47%, the scribble (Coleoptera) with a 3.78%, and of the vertebrates the cottontail rabbit (*Sylvilagus floridanus*) with a 1.54% and the peccary (*Tayassu tajacu*) with 1.37%.

Regarding the consumed biomass, the vegetal material still is dominant in the black bear's diet with a 59.86% and the animal material with a 40.14% (vertebrates 27.11%, invertebrates 10.94% and birds 1.98%). In vegetal material, the manzanita (*Arctostaphylos pungens*), still is constituting the main component in the black bear's diet with a 19.86%, followed by the juniper (*Juníperus deppeana)* with a 16.04% and the sotol (*Dasylirion wheeleri)* with a 9.33% of biomasa; and of the animal material the most important is the collar peccary (*Tayassu tajacu*) with a 15%,

followed by the white tail deer (*Odocoileus virginianus*) with a 5.58% and the rabbit (*Sylvilagus floridanus*) with a 4.49%; of the arthropods the more important were the ants (Formicidae) with a 3.58% and the scribble (Coleoptera) with a 3.03% (Figure 6).

DISCUSSION.

These data help us to comprehend the use of the habitat that black bear presented in the area of study during 2005, which may be influenced by all these factors, because what the black bear seeks is a quality habitat which be capable to satisfy all its basic needs.

The bears showed a marked tendency in both ranches toward habitats with shrubby associations like the ones present in the open low forest (BBA) which are associations of pine-ever green oak-juniper and grassland, which have a high nourishment productivity (acorns and berries), a good coverage which suits them as protection against predators and high temperatures, because this type of habitat gives them more fresh places to rest (Rzedowski 1981), in addition of having the advantage of being near the dams which constitute the main water source of the ranch, amongst in the dry season. All these characteristics influence in the activity patterns of the bears, because in this type of habitat the bears are active constantly and through all the day.

The black bears also selects the chaparral (CH), which provides them the fruit that constitute the major part of their feeding, the little apple (*Arctostaphylos pungens*), and it's suitable to mention that in this habitat the activity of the bears is limited to certain periods of the day when the temperature is not so high, because the chaparral does not offers protection against the high

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temperatures that in summer surpass the 45ºC.

The use of the arboreal stratum is frequent due to the foliar coverage, but when it's used in a major way is during the trees fructification season. It's reported in studies that the acorns (*Quercus sp* fruit) and the juniper are important components in the black bear's diet (Doan-Crider, 1995; Hellgren 1993).

In the use of the induced grassland (PI) in the ranch "Los Ojos" is slightly common to find the bears in the open areas, but is suitable to mention that this ranch is not as heterogeneous as the ranch "El Pinito" and that the bigger vegetal parchments that are present in it are the ones of open low forest and the induced grassland. This could be an explanation to why they are selecting this habitat, another could be that in the grasslands they have a major visibility and this favors them when hunting, because they can better detect their preys which do often are peccary offspring and rabbits, which are frequently found in the grasslands.

Authors mention that generally the selection of a component of the habitat is strongly related with an availability of food inside the vegetal communities, and that the bears even appear in more open places and with less foliar coverage, but where the food is more abundant (Beecham y Rohlman, 1994).

It's suitable to mention that in studies of use of habitat that were made in prior years in the zone of study, during 2002 in a study made only in the ranch "El Pinito", the bears selected, as same that in 2005, the open low forest and the chaparral (Sayago 2004), while in 2003 in a study made also in both ranches, the bears selected the pine-ever

green oak forest, the pine forest and the grasslands (Sierra *et al* 2005).

The size of the home range varies depending in the food concentration; also, this does not constitute one unique big area, but it's composed of various small areas of nourishment, connected between them by paths and corridors (SEMARNAP 1999).

Regarding the home range, the obtained results show that we are within normal ranks, showing an average size of 344.7 km², being the biggest (476.4 km²) for the male 2 which is a young male, and generally they always traverse more distances seeking good nourishment sources and seeking an opportunity for reproduction (SEMARNAP 1999; Doan-Crider, 1995), to the contrary of the male adults which already have their home range well delimited, which is the case of the male 1 which home range is smaller (212.9 km²).

These hame ranges have a medium size compared with the ones of other populations closers to the area of study, like the one in New Mexico which the bears have registered home ranges of an average from 150 up to 870 km^2 (Costello *et al* 2001). Comparing it with the study made with the bears in Idaho, in which are reported home range go from 19.30 km^2 for females, and 901.0 km^2 for males. (Beecham y Rohlman, 1994). In the Arizona´s chaparral reported home ranges are small, with a size for male adults of 29 Km^2, for sub-adult males of 42 Km^2 and for female adults of 17.8 Km^2 (Le Count 1984). The black bears of the Burro Mountains in Coahuila have home ranges from 73.8 and 119.6 Km^2 for males, and 12 to 27.2 Km^2 for females (Doan-Crider, 1995).

Regarding the activity patterns, they show us that the black bears are animals that are active during the day, maybe resting in the hours of the day when the temperatures very high, being possible then to consider them as diurnal animals, twilight and nocturnal in occasions.

In general they are of diurnal and twilight habits, with pikes of activity at down and at sunset, when the temperature diminishes. Nevertheless, these patterns of activity can vary; seasonally the nocturnal activity is more common during the rain season or upon human presence, in which case they may turn nocturnal (LeCount, 1982; Lariviere *et al* 1994Doan-Crider 1995; SEMARNAP 1999).

Black bear population structure, reflect a growing population that is favorably responding to the conditions that the habitat offers. This is seen when observing the high percentage of cubs and sub-adults, besides of having a high percentage of female adults that are of reproduction age, which means that this population is even more likely to continue growing. These results also suggest that the year 2004 was a good year with a lot of precipitations, which was reflected in the year 2005 with a high productivity in the habitats and with a good percentage of surviving cubs.

Regarding the method to assign the photographs to an age category, this resulted more complicated because it is not easy to distinguish between females and sub-adults; in the other hand the males and the cubs are easy to identify, but even so the results were similar to the ones obtained with the footprints.

When we compare them with a near zone we have that the population structure that was obtained in Arizona in 1982, this resulted a little similar with the obtained in this study regarding percentages of adults, though it varies in sub-adults, being conformed as follows: a 36.36% of male adults, a 34.54% of female adults, a 23.63% of male sub-adults and a 5.45% of female sub-adults, and cubs are not mentioned (Le Count 1982).

The nourishing habits of the black bear in the zone of study were dominated mainly by vegetal material and in less quantity by animal material, which accords with what several authors reported. It's said that it is an opportunistic animal and that it feeds with what is in hand (Doan-Crider, 1995), but all of them agree that the bear's diet is mainly constituted by vegetal material and in less quantity of animal material, as it occurred in the zone of study (Hellgren 1993; Stubblefield, 1993 Doan-Crider, 1995).

Of the vegetal material, the articles that stand out were the little apple (*Arctostaphylos pungens*), the juniper (*Juniperus deppeana*) and the sotol (*Dasylirion wheeleri*) and presented high frequencies of consumption' and according with the contribution of biomass, the little apple (*Arctostaphylos pungens*) and the juniper (*Juniperus deppeana*) continue to be the most important components used during their fructification seasons.

In the case of the sotol (*Dasylirion wheeleri*) it obtained a high frequency of consumption, being associated to the fact that the water resource is limited in the zone of study, causing that the bear seeks food that give it this resource, and the sotol holds considerable amounts of water inside and agreeing with that reported by Hellgren

(1993) and Doan Crider (1995), who report the importance of the sotol in the black bear's diet and attribute it to the fact that the sotol is a succulent and nutritious species. It's suitable to mention that in studies of nourishing habits made in prior years in the zone of study, the little apple also came out to be the main component in the black bear's diet (Sierra *et al.* 2005, Silva 2002).

Of the animal material, in the group of the mammals in particular, it was found the rabbit *(Sylvilagus floridanus)* as the one with major frequency, but the one that come out really important regarding the contribution to the consumed biomass was the collar peccary (*Tayassu tajacu*) which according with the remains it's known they were offspring, which are easier to capture for the black bear. The fact that in this area the bears are consuming the peccary is new, because in the studies of the prior years the consumption of this specie was not reported (Sierra et al. 2005, Silva 2002).

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Table 1.- Habitat use and Bonferroni intervals at the ranch "El Pinito". Selected (+), avoided (-), used according to availability (=).

Habitat	Bonferroni Interval	Result
Open Low Forest	$0.2782 \leq 0.348 \leq 0.4178$	0.2109 (+)
Chaparral	$0.2273 \leq 0.292 \leq 0.3567$	0.0944 (+)
Pine-Oak Woodland	$0.2063 \leq 0.271 \leq 0.3357$	0.3378 (-)
Pine Forest	$0.0337 \leq 0.071 \leq 0.1083$	0.1686 (-)
Natural Grassland	$-0.0084 \leq 0.018 \leq 0.0444$	0.1810 (-)

Table 2.- Habitat use and Bonferroni intervals in the ranch "Los Ojos". Selected (+), avoided (-), used according to availability (=).

Habitat	Bonferroni Interval	Result
Open Low Forest	$0.4267 \leq 0.5632 \leq 0.6997$	0.6504 (=)
Chaparral	$0 \leq 0 \leq 0$	0.0012 (-)
Induced Grassland	$0.3003 \leq 0.4368 \leq 0.5733$	0.2408 (+)
Natural Grassland	$0 \leq 0 \leq 0$	0.0839 (-)
Bush	$0 \leq 0 \leq 0$	0.0234 (-)

Figure 1.- Graphic representation of home range shape and size for two male black bears.

Figure 2.- Comparison of the use of the habitat by the black bear between ranches.
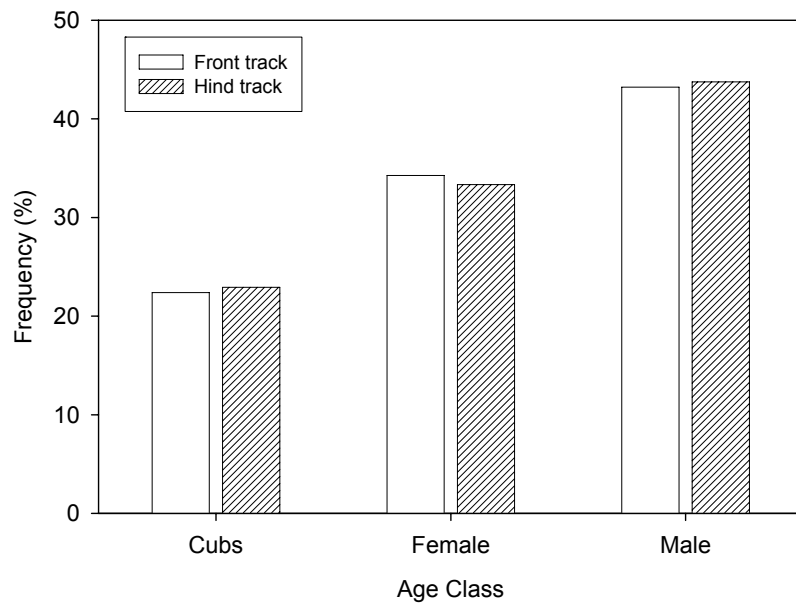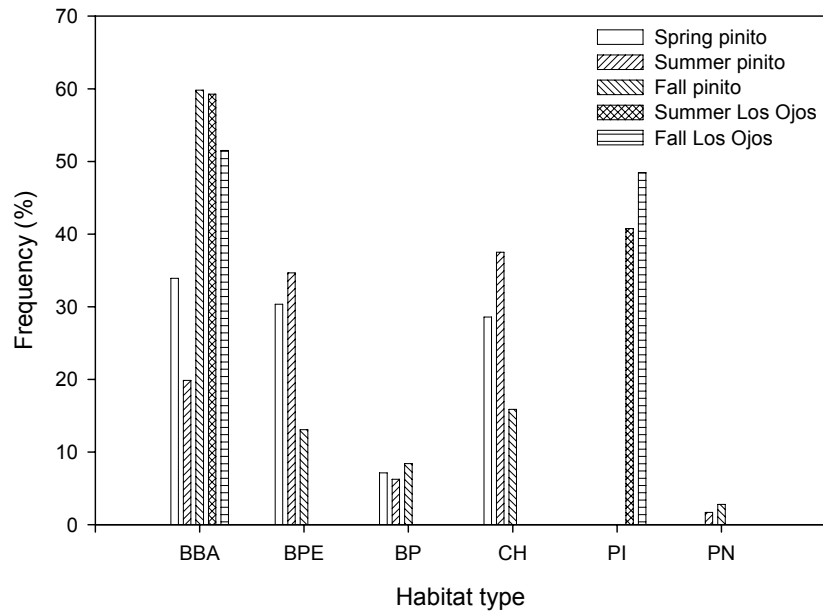
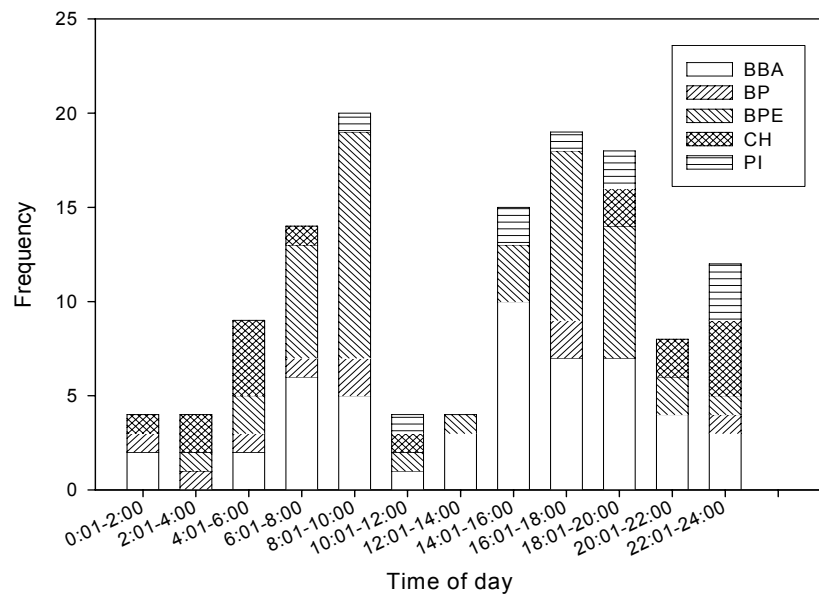Figure 3.- Use of the habitat by the black bear between seasons and ranches.

Figure 4. - Population structure of the black bear in the Sierra of San Luis using two sizes of footprints.

Figure 5.- Pattern of activity of the black bear in relation with the vegetal communities in the area of study.

Figure 6.- Food items utilized by black bears at Sierra San Luis.
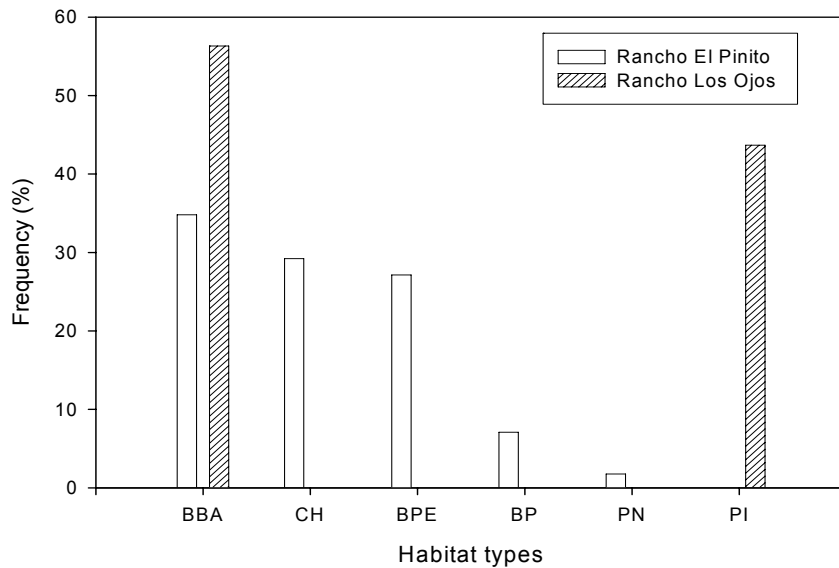
POPULATION DYNAMICS AND MOVEMENT OF BLACK BEARS IN NORTHERN COAHUILA, MÉXICO

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Abstract: The American black bear (*Ursus americanus*) is listed as an endangered species in México. Black bear populations rapidly declined in the 1940's and 1950's resulting in the extirpation of this species in many states. Remnant populations remained in several isolated mountain ranges in northern Coahuila, particularly in the Maderas del Carmen and Serranías del Burro. Through these remnant populations natural recovery of black bear populations has occurred, evidenced by range expansion into adjacent mountain ranges in Coahuila and across the Rio Grande into western Texas. During dispersal these small reestablishing populations are subject to poaching, illegal take of cubs, and indiscriminate killing by ejido residents and ranching entities. Educational materials are nonexistent and natural resource agency personnel have no experience working with black bears. Our study is located in the Maderas del Carmen, a sky island in the Chihuahuan Desert that lies some 60 km south of the Big Bend Region of western Texas and 165 km nw of Muzquiz, Coahuila. Our study is long term with our major objectives being the identification of major dispersal corridors from the Maderas del Carmen, determination of mortality factors during dispersal and within the resident population, reproductive rates, sex rations of resident bears, seasonal movement in relation to food availability, habitat use, diet, home range and population density. A high priority of our study is working cooperatively with landowners to develop safe travel corridors and provide management techniques to avoid problem bears. We have developed educational materials and provide technical support to Mexican agency personnel for handling black bears. We developed the first field guide to black bears for México. Currently we are monitoring 30 radio collared black bears in a mosaic of habitats from low Chihuahuan Desert scrub to high elevation montane forest. Habitat suitability indexes are being developed for use in other areas of México where bears may eventually reoccupy historic habitat. Results of our study will provide needed knowledge on black bear ecology and management in a slowly expanding population in the borderlands of northern México. The identification of the ecological corridors and their protection may be a major factor in the continued expansion and reestablishment of black bear populations in the borderlands of northern México and western Texas.

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PRELIMINARY REPORT ON MADERAS DEL CARMEN BLACK BEAR STUDY, COAHUILA, MÉXICO

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ABSTRACT— Black bears (*Ursus americanus*) declined in México during the 1940's and 1950's resulting in a moratorium on hunting. Remnant populations remained in a few isolated mountain ranges in Coahuila. México listed the black bear as endangered in 1986; slowly black bear populations began recovering and expanding in Coahuila. Our study site is located in the Maderas del Carmen and our objectives are the determination of home range, population density, survival, mortality, diet, habitat use, and dispersal. Our top priority is the identification of ecological corridors used by dispersing bears and the protection of these corridors. Currently 13 radio collared bears are being tracked.

RESUMEN—El oso negro (*Ursus americanus*) declino en México durante los años 1940's y 1950's, trayendo como resultado una moratoria en la cacería. Poblaciones remanentes permanecieron en montañas aisladas de Coahuila. En 1986, México listo al oso negro como una especien en peligro de extinción. La población de oso negro se esta recuperando, particularmente en Coahuila. Nuestro sitio de studio es en Maderas del Carmen, y los objetivos son la determinación del ámbito hogareño, densidad poblacional, sobrevivencia, mortalidad, dieta, uso de habitat y dispersió. Nuestra prioridad es la identificación y la protección de estos corredores.

A lack of qualitative and quantitative data regarding black bears (*Ursus americanus*) in México, and recent range expansion of this species into former historic range in northern México and western Texas has produced a need for research and development of management strategies for this umbrella and keystone species in the border region.

In the 1940's and 1950's black bear numbers began declining in México with a few remnant populations remaining in the northern mountains of Coahuila, particularly in the Maderas del Carmen and Serranías del Burro (Baker 1956). Baker (1956) also stated that "*The bear population is slowly being reduced because the animal is shot at every opportunity.*" Leopold (1959) reported, *"It is a matter of some astonishment that the black bears of México have maintained themselves so well in the face of ceaseless hunting and persecution."* From these accounts and others we can surmise that the decline of the bear population was attributed mainly to uncontrolled hunting and indiscriminate killing. The eradication program for the lobo (*Canis lupus baileyi)* in México probably took a significant toll on bear numbers also. Poisons and traps were used to eradicate the lobo and black bears probably were victim to the poison laced in carcasses and by being caught in baited steel traps. Both of these methods often kill non-targeted wildlife since they are not species specific. During

the 1950's the President of México placed a moratorium on all bear hunting, and in 1986 listed it as endangered (SEMARNAP 1999). With some protection, black bears began recovering in northern Coahuila and currently the population is expanding into former historical range in Coahuila and adjacent states. The Secretaria de Medio Ambiente Recursos Naturales Y Pesca (SEMARNAP), formed a subcomittee ;"Proyecto Para La Conservación y Manejo Del Oso Negro En México (SEMARNAP 1999). The black bear is also currently listed under Appendix II of the Convention for International Trade on Endangered Species (CITES).

Hall (1981) described 16 subspecies of black bears for North American, the original subspecies described as ranging in Coahuila was *U. a. eremicus*, currently only 2 subspecies are taxonomically recognized; the Louisiana black bear (*U. a. luteolus*), and the Mexican black bear that ranges in Chihuahua and Durango (*U. a. amblyceps*), all other black bears in North America are referred to as *Ursus americanus*.

Recent studies in the Serranías del Burro (Doan-Crider and Hellgren 1996) indicate an increasing population of black bear. Later studies in the same area focused on livestock depredation and cub survival (Doan-Crider and Hewitt 2001). In 1998, two studies began in western Texas on the recently recolonizing black bear populations. The study conducted at the Texas Parks and Wildlife, Black Gap Wildlife Management Area (Black Gap WMA) focused on black bear ecology in a lower elevation Chihuahuan Desert habitat (McKinney and Pittman 1999). The second study focused on the ecology of the black bear in Big Bend National Park (Big Bend NP) (Onorato and Hellgren 2001, Onorato et al 2001). The importance of these two

studies in relation to northern México was the documentation of 3 radio-collared black bears from the Black Gap WMA crossing the Rio Grande (Rio Bravo del Norte) during dispersal to the Maderas del Carmen via the northeast side known as the El Jardín; subsequently, one radio-collared adult male was killed near LaLinda, Coahuila. Bears from Big Bend NP dispersed from park lands due to unavailability of fall food sources; they likewise dispersed to Coahuila and Chihuahua, except dispersal was on the southwest side of the Maderas del Carmen in the area known as the Boquillas del Carmen. Five mortalities occurred on radio-collared bears from Big Bend NP on private ranches and communal lands (ejidos) in Coahuila and Chihuahua (Onorato pers. comm.). Reports to McKinney in April 2002 by Procuraduría Federal de Protección al Ambiente (PROFEPA) and Secretaria de Medio Ambiente Recursos Naturales (SEMARNAT) personnel confirmed that all 5 of the black bears from Big Bend NP that were located by aerial telemetry mortality signals were killed.

The Maderas del Carmen range crosses the Rio Grande and enters Texas at the boundary between the Black Gap WMA and Big Bend NP. The possibility exists there may be two main travel/dispersal corridors for black bears moving within the greater Maderas del Carmen ecosystem. Dispersal corridors that black bears use moving from the Maderas del Carmen and Serranías del Burro into adjacent mountains in Coahuila have not been documented. The potential also exists that the Maderas del Carmen is a sanctuary for black bears and the importance and protection of these travel corridors may be a contributing factor to black bear survival, as well as allowing continued expansion of the population in

northern México and western Texas. Information on black bear survival during dispersal periods is nonexistent in México.

In the state of Coahuila, information is needed on life history parameters including reproduction, density, survival, home range, diet, habitat use, dispersal patterns and avenues, seasonal movement in relation to food availability, emigration into adjacent areas and egress from Texas and surrounding Mexican mountains. Black bear predation on domestic livestock has become a major issue for a number of ranchers and ejidatarios (communal property owners) in several adjacent areas, and pressure to hunt the black bear to alleviate the problem is currently an issue. However, all black bears do not kill livestock, and hunting bears in a slowly recovering and expanding population is not the solution. Several bears may be killed without taking the problem bear; it is virtually impossible to determine exactly which bear killed livestock unless the bear is actually seen making the kill, or the bear has an identifiable marker of some type.

We reviewed historical information, and current literature, interviewed ranchers and collected information from local ejidatarios on black bears in northern Coahuila. From this information we concluded problems facing black bears are: (1) lack of research to gain the necessary knowledge to manage black bear populations, (2) illegal take of bear cubs, (3) loss of habitat, (4) indiscriminate killing, (5) agencies lacking personnel trained to handle black bears, (6) lack of management recommendations based on sound biological data from a broad area of the state of Coahuila, (7) lack of educational materials, (8) public attitude toward black bears, (9) incomplete black bear ecology information, and (10) political issues. Our research project is a 5 year study with options for extension. Objectives are; (1) the identification of major dispersal corridors from the Maderas del Carmen, and determination of mortality factors during dispersal and within the resident population, (2) reproductive rates, (3) sex ratios of resident bears, (4) seasonal movement in relation to food availability, (5) cub survival, (6) habitat use, (7) genetic variability in mitochondrial DNA, (9) diet, (10) cooperative work with ranchers and ejidos to develop safe travel corridors during dispersal, (11) develop educational materials and work with landowners to avoid problem bears, and (12) provide technical support and training to Mexican agency personnel.

STUDY AREA— The study area is located principally in the Maderas del Carmen in northern Coahuila, located 60 km south of the Big Bend Region of western Texas and 165 km northwest of Muzquiz, Coahuila, México (29° 04' 06" N 102° 37' 17" W). This mountain chain has been called various names; La Fronterizas, Carmens, El Jardín, Maderas and Sierra el Carmen; to clarify the names the Maderas del Carmen is a contiguous range running from south in Coahuila at the Cuesta Malena north to the Rio Grande, and extending into western Texas where it reaches its northern limit at the Santiago Range. The Maderas del Carmen is a sky island surrounded by lower Chihuahuan Desert with range in elevations from ≥ 1,000 m to ≥ 2,700 m. The area can basically be divided into two parts; a limestone portion in the north and an igneous portion in the south. The Maderas del Carmen is characterized by 5 major vegetation associations: desert shrub, chaparral (matorral), grasslands, forest (oak-pine) (*Quercus- Pinus)* and conifer forest (INE-SEMARNAP 1997). The lower desert elevations are characterized by creosotebush

(*Larrea tridentata),* mesquite (*Prosopis glandulosa*), prickly pear (*Opuntia*), lechuguilla (*Agave lechuguilla*), and candelilla (*Euphorbia antisyphilitica*). The transition zone is dominated by beaked yucca (*Yucca rostrata*), giant white dagger (*Y. carnerosana*), sotol (*Dasylirion leiophyllum*), beargrass (*Nolina erumpens*) and native grasses (*Bouteloua* and *Aristida*). The canyons and higher elevations are dominated by oaks, junipers (*Juniperus*), and several species of pine. The highest elevations are dominated by Douglas fir (*Pseudotsuga menzziesii*) and Coahuila fir (*Abies coahuilenses*). The highest escarpments of the Maderas del Carmen serve as a break against coastal winds, which results in the majority of the rainfall for the area (Muller 1947). The heaviest rainfall occurs in mid to late summer and early fall. The lower slopes may average 0 to 20 cm of annual rainfall, while the high mountain areas may receive three times that amount. Climate is temperate with monthly temperatures ranging from 10° C in the winter months to 32° in the summer months.

METHODS—We began trapping black bears in mid November 2003 under permit #SGPA/DGVS/08756. Standard black bear barrel traps were used for capture (McKinney and Pittman 2001). Telazol (A.H. Robbins Company, Richmond, Virginia) is not available in México, but is distributed under the trade name of Zoletil (Vibrac Corporation, Guadalajara, México). A combination of tiletamine hydrochloride and zolazepam hydrochloride was used to immobilize black bears at the rate of 1 cc/45 kg, allowing roughly 1 to 1.75 hours handling time, depending on body condition and individual metabolism of bears. Drugs were administered by jabstick (Wildlife Pharmaceuticals, 512 Webster Court, Fort

Collins, Colorado) into heavy muscle in the hindquarters. Body mass is estimated for the initial immobilization, and then measured to the nearest kg on a spring scale (Cabela's, Cabela Drive, Sidney, Nebraska). Morphological measurements were taken to the nearest cm using a flexible measuring tape for chest, head, neck circumference, zoological length, width and length of hind and front feet, and shoulder height. Canines, claws, baculum length, testes width and length and nipple length were measured to the nearest mm using vernier calipers. Nipple color was noted, as well as presence/absence of vulval swelling and lactation status for all females. Fat levels were estimated and assigned a category of 1 to 5, with 5 being the heaviest level of fat. Pelage color was classified as black, brown or brown-black, and presence of any white chest markings are noted. One upper premolar (UPM1) was extracted from all adult bears. Tooth age is being estimated by cementum annuli analysis (Willey 1974). A topical spray was applied to any existing wounds. Ophthalmic ointment containing chloramphenicol (Bemacol 1%, West Chester, Pennsylvania) was administered to the eyes to prevent dryness and the eyes were covered during immobilization. Tissue and hair samples were collected from the ear with a sterile biopsy punch and placed in lysis buffer for further mtDNA analysis. Adult males, females, subadults and yearlings (>1 yr.) bears were fitted with MOD-500 black bear radio collars equipped with S6A mortality sensors (Telonics Inc., 932 Impala Avenue, Mesa, Arizona 85204). All collars were equipped with breakaway cotton spacers to prevent injury to growing bears (Hellgren et al 1988). All bears had microchips (AVID, 3179 Hammer Avenue, Norco, California 92860)

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placed subcutaneously between the shoulder blades. We remain at the capture site with each bear until they are fully recovered.

Radio tracking by ground telemetry is used to locate radio collared bears. Ground locations were obtained using hand-held antennas with TR4 and TR5 receivers (Telonics Inc., 932 East Impala Avenue, Mesa, Arizona 85204). We homed in on radio signals until the bear was observed, or we could walk within 300 m of the individual bear. Supplemental aerial telemetry is being provided by Big Bend NP. Triangulation is used for remote inaccessible locations. Locations are recorded using global positioning system (GPS) to determine Universal Transverse Mercator (UTM) coordinates which are marked on topographical maps published by Instituto Nacional de Estadista Geographiae Informática (INEGI). ARCVIEW (ESRI, Redlands, California) will be used to analyze final data for home range and dispersal movements.

Bears dispersing from the study area to western Texas will be located through coordination with Texas Parks and Wildlife and Big Bend NP. Bears dispersing into adjacent Mexican mountains will be located using ground telemetry with permission from landowners to monitor bears on private properties.

Females are being checked in dens when possible. Entry and exit dates into dens are estimated for radio-collared females. Den work is conducted in March. Females are immobilized in the den and cubs, when present will be counted, sexed, weighed and a microchip implanted subcutaneously for future identification. Family groups will be monitored after den exit to determine survival rate of cubs (Trent and Rongstad 1974, Heisey and Fuller 1985).

Population estimates will be made using mark-recapture estimation techniques for mammals with large home ranges (Garshelis 1992). Age structure is calculated using tooth samples from adult bears, estimating age by cementum annuli analysis. Bears ≥ 1 year old are classified as yearlings, 2 to 3 year olds subadults, and ≥ 3 years old adults.

Vegetation associations were visually sampled and situated in areas that were used regularly by bears. Oaks, fruit trees and shrubs were randomly selected and marked to document mast production over a period of years. Grasses were sampled for availability on a year-round basis by recording dormancy, green seeds, seeds scattering and browning of stems. Horizontal ground cover analysis was used to determine cover availability (LeCount et al 1984). We estimated horizontal ground cover in 4 major habitats. Horizontal ground cover for sotol-lechuguilla-grassland habitat averaged 54.4 m, oak-chaparral (matorral) 30 m, oak-juniper-pine 18.5 m and oak-pine-fir 41.5 m.

Plant phenology plots were established randomly and checked on a regular basis to determine ripening dates of various fruits, nuts, and seeds. This method allows us to predict what areas bears will be feeding in at a given time of the year. Acorns are an important fall food source when bears are build fat reserves for winter hibernation. Twenty oaks of several species (*Q. gravesi, Q. laceyi, Q. grisea, Q. mohriana, Q. arizonica, Q. rugosa*) were randomly selected and marked to document acorn production over a 5 year period. Oaks were assigned a numerical score of 0 to 3 for mast production, 0 being no production, (1) light production $< \frac{1}{4}$ tree produced acorns, (2) medium production $\geq \frac{1}{2}$ tree produced acorns, (3) heavy production $\geq \frac{3}{4}$ tree

produced acorns. Diet is being determined by scat collection. Scats are collected and placed in Ziploc bags and labeled with date, location and condition (wet/dry). Each scat is air dried on a screen frame and examined macrohistically using point frame analyses method (Chamrad and Box 1964). Seasonal diets are categorized as winter (December-February), spring (March-May), summer (June-August) and fall (September-November). Delgadillo (2001) identified 23 species of plants/animals in bear diets in the higher elevations of Maderas del Carmen.

PRELIMINARY RESULTS—
Trapping began November 8, 2003 and 3 bears were captured that month. All bears hibernated by mid-December. Trapping operations began for the year 2004 in April when bears began spring movement. Ten bears, 4 adult males, 7 yearlings (5 males, 2 females) and 2 adult females were captured from April to September 2004. Preliminary sex ratio for the 2003-2004 trapping seasons for captured bears is 31% adult males, 15% adult females and 54% yearlings. Two yearling males dispersed from the study area with 1 yearling returning and the other yearling moving northward toward the Texas border, where radio signal contact was lost in June. Subsequent ground and aerial telemetry checks have failed to locate this yearling. Two adult males (#01, #04) dropped their collars when the cotton spacers broke after 6 and 10 months respectively. One female was in estrus when captured and showed signs of recent breeding; the second female was not lactating and cubs were not observed. No recaptures occurred and no mortalities or problems with immobilization occurred.

Bear sign was found in all 5 major vegetation associations. Major vegetation associations normally occur within certain zones of elevation, but because of overlap in vegetative communities, describing a certain zone can be misleading. In addition, mountainous terrain causes slopes to vary considerably. These patterns result in a rich mosaic of Chihuahuan Desert plants available to bears from the lower desert to the fir forest, rather than distinct bands of vegetation at particular elevations. Trapping was concentrated in areas where most bear activity occurred and where seasonal foods were available. Bears were captured in 5 major habitats; 15% were captured in pine-oak, 15% chaparral (matorral), 47% oak-juniper, 15% sotol-grassland and 8% oak-pine-fir.

Preliminary analysis of scats indicates major food items in the spring black bear diet are yucca and sotol hearts, juniper berries, Mexican squawroot (*Conopholis mexicana*), and Wright's tickclover (*Desmodium psilophyllum*). Summer diet included mesquite beans, prickly pear cactus tunas, agrito (*Mahonia trifoliolata*) berries, grasses, point-leaf manzanita (*Astostaphylos pungens*) berries, yucca hearts and Wright's tickclover. Fall food items included acorns, Mexican persimmons (*Diospyros texana*), prickly pear cactus tunas, Tracey hawthorne (*Crataegus tracyi*) apples, and madroño (*Arbutus xalapensis*) fruits. The single animal identified in the diet was Carmen Mountain white-tailed deer found in a summer scat. Preliminary analysis indicates diet of black bears in Maderas del Carmen is 98% plant based.

As part of this project we developed the first black bear field guide for México which is available to Mexican agencies and landowners dealing with black bears. The field guide covers ecology, depredation, coexisting with black bears, management techniques and handling and transporting

black bears safely. We also developed a brochure on coexisting with black bears, and have a rehabilitation facility located at Rancho Pilares which we have successfully rehabilitated and released 4 cubs in 2 years.

DISCUSSION—This is a five year black bear study with options for extension. Results presented here are for one trapping season and are preliminary. Further field work with a larger sample size will provide necessary information on population dynamics of black bears in the Maderas del Carmen ecosystem. This information will allow us to develop habitat suitability indexes for adjacent areas and states. This information will also be incorporated into management plans for black bears in our project area and can also be used by Mexican agencies in other areas of Coahuila. Furthermore, this study will fill in a void on genetics of this population and provide information on dispersal avenues bears are using crossing the international border as well as into adjacent areas in México.

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DIFFERENTIAL FITNESS IN FEMALE AMERICAN BLACK BEARS: MANAGEMENT IMPLICATIONS

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Abstract: Management regimes for American black bears often assume that females reproduce on a schedule suggested by their natural history, that is, reproductive maturity at a mean age of five years, mean litter size of 2, mean birth intervals of 2 years, and high cub survival due to prolonged maternal care. But how close to reality are the mean values we generate for life history parameters? Does wide individual variation among females make calculation of means an exercise that leads to misunderstanding about a hunted population's potential to persist? We address these questions with analysis of a long-term (14-year) dataset of individual reproductive performances of female black bears on the East Tavaputs Plateau, Utah. In this study, cub mortality was 54%; on 46 occasions (out of 112) females that were expected to have cubs did not; and 24 females missed at least 1 reproductive bout. Additionally, in 4 years out of 14, no offspring were found in any dens visited. The female segment of this population and semi-isolated populations in Utah could be conserved by several management strategies, such as returning to a spring hunt, which results in fewer females harvested, marking females with easily identifiable eartags, prohibiting harvest of females, and permitting hunting over bait with any legal weapon. Management of this population should be sensitive to a high degree of individual and annual variation in reproductive output.

RELATIONSHIP BETWEEN WHITEBARK PINE CONE PRODUCTION AND ROADSIDE BEAR VIEWING OPPORTUNITIES IN YELLOWSTONE NATIONAL PARK, 1990-2004

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Abstract: Opportunities for viewing grizzly bears (*Ursus arctos)* and American black bears (*U. americanus*) from roadways in Yellowstone National Park (YNP) have increased in recent years. Unlike the past, bear viewing from roadsides now involves bears feeding on natural foods not human food handouts and garbage. We examine the relationship between bear viewing opportunities during the fall and abundance of whitebark pine *(Pinus albicaulis)* seed production using recorded observations of grizzly and black bears from YNP roads and comparing the numbers of sightings to an index of whitebark pine cone production. Bear viewing opportunities during the fall season are inversely related to the abundance of whitebark pine seed production. When whitebark pine seed production is high during fall, bears move to high elevation whitebark pine stands where bear viewing opportunities are limited. When whitebark pine seed production is low, bears forage in nonforested meadows at lower elevations where they provide good bear viewing opportunities. We suggest that native foods found in road corridors are an important resource and maybe be especially important to some individual bears during years that produce poor whitebark pine seed crops. The frequency of bears foraging along roadsides will likely increase if whitebark pine stands are reduced by mountain pine beetle (*Dendroctonus ponderosae*) and whitepine blister rust (*Cronartium ribicola*).

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DENNING CHRONOLOGY AND HUNTER HARVEST OF BLACK BEARS IN NEW MEXICO

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Abstract: Knowledge of black bear (*Ursus americanus*) denning chronology has implications for influencing demographic composition of hunter-kill and interpreting harvest data. We used telemetry data collected during 1993-2000 in 2 regions of New Mexico to estimate den-entry date (102 bears on 174 occasions), den-emergence date (86 bears on 177 occasions), and test for differences between regions, sexes, and among years of varying fall mast production. We also used New Mexico Department of Game and Fish (NMDGF) harvest data (1985-2000) to test for effects of differential patterns of denning chronology on the proportion of females harvested. On average, bears of northern New Mexico entered dens 11 days earlier than bears of southern New Mexico and emerged from dens 10 days later. Bears from northern New Mexico exhibited distinct demographic patterns of denning chronology whereas this pattern was absent or at least less discernable in southern New Mexico. Bears appeared to delay den entry or hasten den emergence to take advantage of increased food availability. Proportion of females harvested was higher during the pre-den-entrance period than the den-entrance period in the north ($P < 0.001$), but not in the south ($P = 0.231$). Proportion of females harvested was lower during the den-emergence period than the post den-emergence period in the north ($P = 0.058$) and south ($P = 0.097$). Late fall seasons (1998-2000) resulted in a lower proportion of females harvested in the north ($P = 0.006$) but not in the south ($P = 0.492$). Differences in denning chronology and harvest composition between northern and southern New Mexico suggest that regional management strategies may be beneficial. These data have implications for selecting hunting season dates in New Mexico and interpreting harvest data.

Key words: American black bear, demographic composition, den, denning chronology, harvest data, hibernation, hunting seasons, mast, New Mexico, *Ursus americanus*.

JUDGMENTS OF RESPONSIBILITY IN HUMAN-BEAR CONFLICT

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Abstract: Understanding linkages between judgments of responsibility and acceptability of
wildlife management actions can enhance agency efforts to abate human-wildlife conflict. This
presentation examines this attribution process in human-bear conflicts. Data were obtained from
a survey of registered voters in Anchorage, Alaska (n = 971). Respondents evaluated 3 non-fatal
(e.g., nuisance bear in garbage) and 3 fatal (e.g., aggressive bear kills hiker) human-bear
interaction scenarios. For each scenario, respondents were asked to: (a) assign a judgment of
responsibility to each of 3 potential causal agents (person involved, bear, or Alaska Department
of Fish & Game [ADF&G]), and (b) evaluate the acceptability of destroying the bear. Between
22% and 48% of respondents judged the human to be solely responsible in 5 of the 6 scenarios;
the exception was when an aggressive bear kills a hiker where only 7% judged the human solely
responsible. Between 13% and 35% considered the bear to be responsible. Less than 7% believed
ADF&G was solely responsible in all scenarios except for the scenario involving an aggressive
bear (25%). Across all scenarios, humans and bears were judged equally responsible, on average,
by 12% of respondents. Approximately 11% of respondents judged all 3 agents (human, bear,
ADF&G) to be equally responsible. Judgments of responsibility influenced acceptability ratings
for destroying the bear. For example, killing the bear was unacceptable if the human (either
solely or in combination with the bear and/or ADF&G) was judged responsible. Implications of
these findings for managing human-wildlife conflicts are discussed.

Key words: acceptability, Alaska, black bear (*Ursus americanus)*, human dimensions, human-
wildlife conflict, responsibility, wildlife management

INTRODUCTION

When humans occupy wildlife
habitat, the potential for human-wildlife
conflict increases (Beckman and Berger
2003, Zack et al. 2003). Decker and Chase
(1997) define human-wildlife conflict as any
situation where human behavior negatively
impacts wildlife or wildlife creates a
negative impact on humans. When a
particular human-wildlife conflict creates
public concern, human dimensions research
can facilitate understanding public
preferences for management alternatives.

Public preferences for wildlife
management actions, however, are complex.
Simply asking people how they feel about a
management action such as destroying
problem wildlife in urban areas, for
example, does not address situational
differences that influence public approval
(Manfredo et al. 1998, Wittmann et al.
1998). Taking the life of a wild animal, for
example, is often conditional on situation
specifics such as the extent of damage
incurred by the person involved (e.g., human
injury, property loss or death). Situation
specifics also influence who individuals
believe is responsible for a given outcome
(e.g., the person, the animal involved or the
management agency) (Weiner 1995).
Layden et al. (2003), for example, showed
that most respondents placed responsibility

on individuals rather than the wildlife agency for a series of hypothetical human-wildlife conflict situations. These findings illustrate the importance of understanding stakeholder beliefs when approaching wildlife management problem solving.

The present paper explored the relationship between judgments of responsibility and the acceptability of a lethal management action (i.e., destroying a bear involved in a human-wildlife conflict situation). Responsibility judgments were examined for 3 potential causal agents (i.e., the person involved, the bear, Alaska Department of Fish and Game [ADF&G]). Acceptability evaluations were examined for two types of encounter situations (i.e., fatal, and non-fatal). The fatal encounter scenarios resulted in the death of a human. The non-fatal situations ranged from nuisance problems to the loss of a pet.

METHODS

Data for this analysis were obtained from a mailed survey sent to a random sample of registered voters in Anchorage, Alaska (Whittaker et al. 1997). Anchorage is home to more than 260,000 people, 250 black bears (*Ursus americanus*), and around 50 brown bears (*Ursus arctos*) (ADF&G 2000). Residential development continues in areas where bears are common, and reported conflicts have increased sharply in recent years (ADF&G 2000).

In total, 971 completed surveys were returned for an overall response rate of 59%. A follow-up telephone non-response survey (n = 108) indicated that non-respondents did not differ statistically from respondents and thus, the data were not weighted.

Variables Measured

Six scenarios involving negative human-bear encounter situations were examined. Three scenarios concerned bear encounters that resulted in human death: 1) a bear charges, mauls and kills a person, 2) a person inadvertently gets between a mother bear and her cubs, 3) a person encounters a bear with a history of aggression toward humans. The 3 scenarios depicting non-fatal bear encounters were described as: 1) a nuisance bear eating pet food and getting into garbage, 2) a bear charging and knocking down a hiker, causing minor injuries, and 3) a bear killing a pet.

For each of these 6 scenarios respondents were asked to assign a judgment of responsibility to each of 3 potential causal agents: 1) the person involved, 2) the bear, or 3) ADF&G. Levels of responsibility were initially coded "none," "some," "most," and "all." To allow for shared responsibility, these variables were recoded into new variables with the following categories: no one responsible, human responsible, human and bear equally responsible, human and ADF&G equally responsible, bear responsible, ADF&G responsible, bear and ADF&G equally responsible, and all three equally responsible.

Measures of the acceptability for destroying the bear asked respondents to rate the management action for each scenario as "highly acceptable" (+3), "moderately acceptable" (+2), "slightly acceptable" (+1), "no opinion" (0), "slightly unacceptable" (-1), "moderately unacceptable" (-2), or "highly unacceptable" (-3).

RESULTS

Percentages for the responsibility judgments for each scenario (Table 1) indicated the humans and the bears accounted for 65-77% of the responsibility judgments across all but one scenario. The pattern was not evident for the scenario where a bear with a history of aggression toward humans killed a hiker. In this case, the ADF&G was judged solely or partially responsible by 56% of the respondents, while humans were judged solely or partially responsible by 27%. In all but the case of the aggressive bear killing a hiker, the ADF&G was generally judged to have little responsibility when compared with humans and bears.

A statistically significant relationship ($F \geq 12.21$, $P < 0.001$) was observed between judgments of responsibility and the acceptability of destroying the bear involved for each of the 6 scenarios. Effect sizes ranged from $Eta = .295$ (nuisance bear in garbage) to $Eta = .408$ (bear kills hiker). To facilitate understanding these relationships, we used the potential for conflict index (PCI) (see Manfredo et al. 2003 and Vaske et al. 2006 for a detailed explanation of the statistic). PCI graphically displays acceptability ratings in relation to an independent variable (i.e., judgments of responsibility). The PCI statistic ranges from 0 (no conflict) to 1 (conflict). The larger the PCI bubble, the greater the variation around the mean response or potential for conflict.

Respondents who believed that no one was responsible or that humans (either solely or in combination with the bear and the agency) evaluated destroying the bear as unacceptable for both non-fatal and fatal scenarios (with the exception of an aggressive bear killing a hiker). The strength of this conviction varied by scenario and was evident in both the means on the 7-point scale and the PCI values (Figure 1). For example, in the scenario where a bear bluff charges a hiker and causes minor injuries, the means for destroying the bear consistently approached "highly unacceptable." The PCI values for this scenario and for no one responsible or humans responsible ranged from .05 to .09. The small associated bubbles suggest considerable consensus that killing the bear was unacceptable.

When the bear or the agency was held responsible, the bubbles were generally larger indicating less agreement about killing the bear. Relatively large bubbles that straddle the neutral line highlight the greatest potential for conflict. In these situations some respondents support the management action, while others did not. For example, for the scenario where a sow with cubs kills a hiker and the bear or the agency was believed to be responsible, the mean response was "no opinion" and the PCI values ranged from .44 to .83.

In the scenario where an aggressive bear kills a hiker and a human was judged to be responsible (either entirely or partially), the means hovered around the 0 point on the scale and the PCI values ranged from .63 to 82. In this same scenario, if the bear or the agency were considered responsible, killing the bear was evaluated as "moderately acceptable" and the PCI values were in the .1 to .24 range

DISCUSSION / IMPLICATIONS

Respondents who judged humans responsible for human-bear conflicts may have viewed the situation as controllable and were generally not supportive of destroying the bear. Conversely, when respondents judged the bear and/or ADF&G responsible, support for lethal control increased. This pattern of response varied in intensity across the different scenarios, suggesting that situation specifics influence both responsibility judgments and the acceptability of management actions. The large PCI bubbles associated with some sub-groups indicated a large amount of variation in individual responses. This suggests that even when destroying the bear is rated as acceptable, this action may be controversial with the public.

These findings highlight the complexity of dealing with human-bear conflict in urban areas. "Pre-emptive" actions against a bear involved in relatively benign conflicts with humans may face public opposition. However, if a bear becomes aggressive toward humans, the agency will likely be judged responsible for failing to react sooner. Finding middle ground solutions in these situations are likely to involve the development of new education campaigns that reinforce a sense of personal responsibility. Ultimately, achieving long-term reductions in the face of increasing human-bear conflict potential will likely require interdisciplinary approaches that combine traditional methods of animal

control with strategies aimed at encouraging human behaviors that result in fewer and

less severe conflicts.

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Table 1. Percentage of respondents judging respo[nsibility]

	Non-fatal		
Judgment of Responsibility	Bear Kills Pets	Bear Bluff Charges Hiker	Nuisa[nce] Bear Garba[ge]
Human Responsible	30	22	45
Bear Responsible	35	27	21
ADF&G Responsible	4	4	6
Human & Bear Equal	11	18	11
Human & ADF&G Equal	3	6	4
Bear & ADF&G Equal	4	3	2
All three	11	12	9
No One Responsible	2	8	

Figure 1. Judgments of responsibility and acceptability of lethal response for six human-bear conflicts in Anchorage, Alaska.

The center of each bubble represents the mean acceptability rating. The bubbles are the Potential for Conflict Index (PCI).

PCI values range from 0 (no conflict) to 1 (conflict). The larger the bubble the greater the potential for conflict.

Fatal – Bear Kills a Hiker (no details)
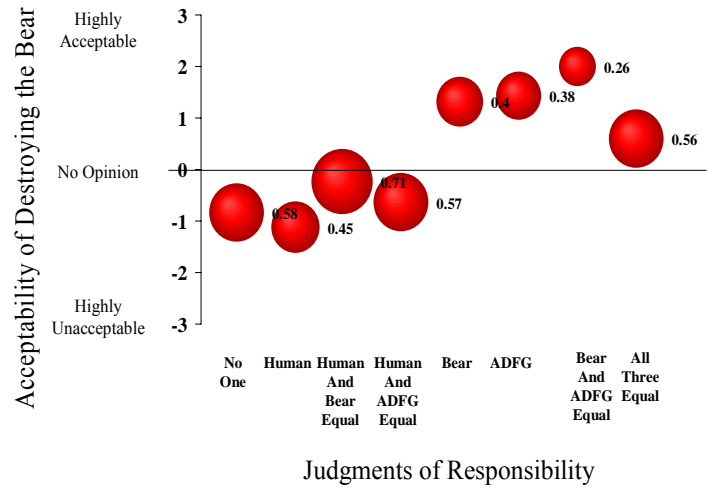
Fatal – Sow with Cubs Kills a Hiker
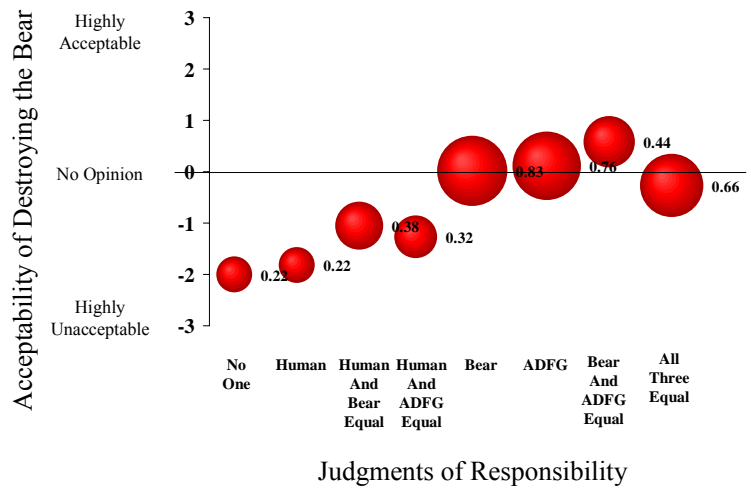
Non-Fatal – Bear Kills Pets in Neighborhood
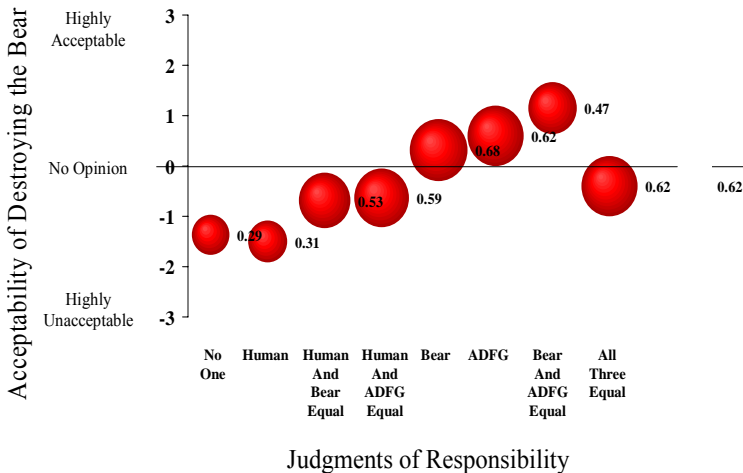
Fatal – Aggressive Bear Kills a Hiker
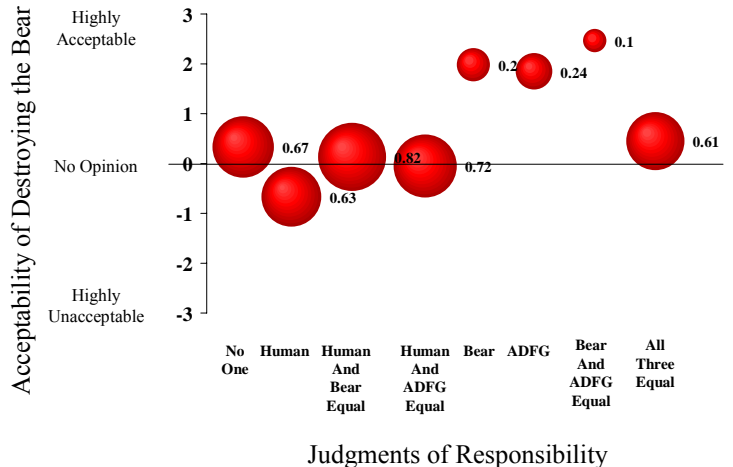
MODELING PREDICTORS OF BLACK BEAR-HUMAN CONFLICTS IN COLORADO

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Abstract: Black bear and human interactions have been increasing throughout bear range in North America. In Colorado, bear-human conflicts increased rapidly in the 1970s and caused up to a third of all black bear mortality in the early 2000s. As people continue to live, recreate, and develop in black bear habitat, bear-human conflicts will demand greater attention from wildlife professionals. Consequently, a greater understanding of current spatiotemporal trends in bear-human conflicts and their predictors is warranted in order to efficiently allocate management resources and more effectively manage black bears. We defined conflicts as any bear-human interactions prompting action from the Colorado Division of Wildlife (CDOW), USDA-WS, or landowners to either trap or kill the bears involved. The CDOW maintains a non-harvest database of black bear mortalities due to conflicts, which we augmented with trapping events. The combined database includes conflicts relating to agricultural operations, human development, and road kills, with each record including a township-range or UTM coordinate at the location of the conflict. Using GIS, we mapped all conflict occurrences and used general linear modeling to identify variables (e.g., human housing density, habitat, and weather parameters) that best explained patterns of conflicts across the landscape. Modeling results, management implications, and improvements in data collection associated with bear-human conflicts will be discussed.

FOOD FOR THOUGHT: ARE BACKPACKERS IN THE YOSEMITE WILDERNESS COMPLYING WITH FOOD STORAGE REGULATIONS?

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Abstract: In 2004, Yosemite National Park instituted a black bear protection law requiring backpackers to store their food in approved bear-resistant food storage canisters within seven air miles of a road and anywhere above 9600 feet; this constitutes a large majority of the park's wilderness. In 2005 we administered a trailhead survey to evaluate backpackers' willingness and ability to comply with this new requirement. We determined that 85 percent of Yosemite backpackers intended to use bear-resistant food canisters during their trips in 2005 but only72 percent of canister users were sure that all their food, trash and toiletries would fit into the canisters they were carrying. We found backpackers who took measures to pack their canisters efficiently were significantly more likely to be food storage compliant during their trip.

key words: bear-resistant food storage canisters, human-bear conflict, wilderness food storage

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Conflict between backpackers and black bears in the Sierra Nevada Mountains of central California is cited as a serious threat to visitors and a serious problem for managers seeking to protect naturally-functioning wilderness ecosystems (Graber 1981). Given the region's widespread popularity as a seasonal recreation site for wilderness enthusiasts bear-human risks must be mitigated. Past studies in popular wilderness areas indicate that as visitor densities increase, reported bear incidents increase linearly (Merrill 1978, Singer and Bratton 1980, Keay and van Wagtendonk 1983). In 2003, overnight use of the Yosemite Wilderness was approximately 80,000 people for a total of 145,000 user nights (National Park Service 2004). An average of 100 wilderness bear incidents are reported in Yosemite annually, although the actual number of incidents is thought to be much higher (Graber 1981, McCurdy 2006).

Forty percent of the state's black bear population inhabits the Sierra Nevada Mountains, with an estimated population density of between 0.5 and 1.0 bears per square mile (Grenfell and Brody 1986, Koch 1983, Sitton 1982). Over two-thirds of the land that comprises the Sierra Nevada Mountains is administered by the National Park Service (NPS) and U.S. Forest Service (USFS). The NPS has exclusive jurisdiction to manage wildlife living within park boundaries. Wildlife residing on USFS land is managed by the California Fish and Game Department (CDF&G), but land use and wilderness policies that govern national forests are the responsibility of the USFS.

To coordinate regional bear protection efforts, a coalition of wildlife biologists and recreation and wilderness managers from the Parks and Forests of the Sierra Nevada established the Sierra Interagency Black Bear Group (SIBBG) in 2000. A primary function of the SIBBG is to apply uniform testing standards and approval protocols for bear-resistant food storage containers intended for commercial use on Sierra Nevada public lands (standards

are available at http://www.sierrawildbear.gov/). In an effort to preserve a healthy black bear population on a regional-scale, SIBBG members also share information, techniques and ideas, and coordinate policies and information pertaining to bear conservation.

While studying the interactions of bears and humans in the Yosemite wilderness, Graber (1985) and Dalle-Molle et al. (1985) offered an innovative strategy to alleviate bear-human conflict: a bear-resistant food canister that could be carried by backpackers. Although canisters were a novel idea in the 1980's, canisters have gradually supplanted the use of metal lockers, food hanging poles and tree cables to become the preferred method of food storage for Sierra backpackers (Koy and Anaya 2002). However, even with widespread and voluntary use of canisters, a low enough level of food availability to discourage food seeking behavior in bears has not been realized and incidents continue in the region (National Park Service 2004a). van Wagtendonk (2003a) suggested that the establishment of a canister requirement in Yosemite National Park may be needed to increase compliance to a level that adequately reduces the prevalence and severity of bear-human encounters.

In other regions of North America where black and grizzly bears exist, park and forest managers have enacted bear-resistant canister regulations to minimize backcountry human-bear conflict. As of September 2006, canister-required public lands include portions of the Inyo National Forest and Sequoia-Kings National Parks in Southeastern California, Denali, Glacier Bay and Gates of the Arctic National Parks in Alaska, Olympic National Park in Washington, the Lost Coast Wilderness in Northern California, and the Eastern High Peaks Wilderness in upstate New York. Other parks and forests in the western United States where bears are present encourage the use of canisters but do not require them.

In 2004, Yosemite National Park officials also enacted a canister use requirement (National Park Service, 2004b). Starting in April 2004, canister use was made mandatory in all wilderness areas within 11 km (seven air miles) of park roadways and anywhere above 2900 m (based on the average tree line elevation in the Sierra Nevada Mountains). This regulatory action also removed the technique of suspending food from tree limbs as a legal means of food storage where canisters are required. During the summer of 2005, we evaluated the effectiveness of this new regulatory action in part by asking backpackers to assess how prepared they were to manage their food on their wilderness trips.

Study area

Yosemite National Park encompasses 302,000 ha on the western slope of the Sierra Nevada Mountains in central California. Elevations vary from 600 m on the western boundary to 4000 m along the Sierra crest. The climate is Mediterranean with hot, dry summers and cool, moist winters. Plant distribution in Yosemite is strongly influenced by elevation and topography, with five major vegetation types largely dictating the seasonal distribution of black bears in the park (Graber 1985).

Ninety-four percent of Yosemite National Park was officially designated as wilderness in 1984 and encompasses 281,855 ha of the park. There are 55 trailheads, with 1118 km of trail that provide access to 375 camping destinations in the Yosemite Wilderness (van Wagtendonk 2003b). An additional 46 trailheads feed 668 km of trail on Forest Service wilderness areas adjacent to the park. The Yosemite Wilderness is bordered by the Emigrant Wilderness to the north, the Hoover Wilderness to the east, and the Ansel Adams Wilderness to the south. Two of the

west's most popular hiking trails traverse the Yosemite Wilderness: the John Muir Trail, which originates in Yosemite and goes 340 km south to Mount Whitney, and 80 km of the Pacific Crest Trail, a 4265 km route that connects the Mexican and Canadian borders.

Wilderness users are required to use bear-resistant canisters in roughly 90% of the park's wilderness (Figure 1). Metal food storage lockers are located at six of the park's most heavily visited backcountry destinations and can be used as an alternative to carrying a canister. Use in the Yosemite Wilderness in 2005 was 90,011 visitor-nights (National Park Service 2006).

Methods

A random sample of 501 backpacking groups were drawn from the population of adult wilderness users who took overnight trips in the Yosemite Wilderness in 2005. Surveys were given out at randomly selected wilderness trailheads and two backpacker campgrounds ranging from 1100 m to 3000 m in elevation in Yosemite National Park between May and October, 2005. The survey was administered under permit conditions outlined in Humboldt State University Human Subjects in Research approval # 04-96: OMB Expedited Approval for NPS-sponsored public surveys permit # 1024-0224-NPS#05-06 and NPS scientific research and collecting permit # YOSE-2005-SCI-0049.

Participants were asked to complete a brief written survey designed to measure their bear-related preparedness in wilderness. The questionnaire posed nineteen questions pertaining to compliance with food storage regulations before the outcome of the wilderness users' intentions and behavior was known. Basic demographic information such as the number of people in each party, what method(s) of food storage they planned to

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use, and how much pre-trip planning and preparation backpackers expended prior to entering the park was requested. Additional questions asked where and when park visitors found out about the new food storage regulation, and whether they altered their travel plans as a result.

Four hundred eight-five questionnaires were completed by backpackers at trailheads prior to their embarking on a wilderness trip. The overall response rate for the survey was 97 percent.

Results

Surveys collected on site were screened for completeness and those filled out at least half way were entered into a database managed by PsychData (PsychData, LLC, State College, PA). Analysis was done using SPSS statistical software (SPSS Inc. Chicago, Illinois). The median age of the sample population was 36 years with a range of 18 to 79 (minors were excluded from the survey). Groups of four or fewer people represented a significantly greater proportion of the survey sample (96%) than larger groups. Average trip length was 6 nights, with a range of 1 to 100+ nights in the backcountry. Three hundred twenty-eight respondents (63%) were California residents, while 153 (29%) were from other U.S. states and 52 (9%) were visitors from foreign countries. Fifty-nine percent had been on at least one previous wilderness trip in Yosemite National Park. Forty-nine percent planned their trip more than 6 months in advance, with only five percent of respondents reporting that the new canister requirement caused them to alter the schedule or destination of their trip.

Central to the study is the extent that backpackers knew about or had considered food storage requirements prior to embarking on their wilderness trip. Eighty-five percent of respondents (n=409) reported that they had been aware of the canister

regulation changes for a year or more. Eleven percent of respondents (n=51) found out when picking up their permit in the park. Four percent of respondents (n=19) said they were unaware of a canister requirement. One hundred and thirty-five respondents (30%) learned about the park's wilderness food storage regulations using the internet. The same number (30%) relied on past experience in Yosemite, while only 84 backpacking groups (19%) obtained their information from rangers or other park employees after arriving at Yosemite National Park.

Of the 485 groups who completed the survey, 428 reported taking one or more canisters on their trip (88%) while 57 said they did not (12%). Of canister users, 308 groups (72%) reported that they knew they would be able to achieve full compliance by fitting all their food, trash and toiletries into their canisters on the first night of their trip. Seventy-nine groups (19%) were unsure and the remaining 42 groups (8%) knew that they would have excess. Table 1 summarizes the open-ended question *"if needed, what do you plan to do with overflow items?"*
Seventy respondents answered the question *"if you don't have a canister, how do you plan to store your food, toiletries, trash or other scented items"* Sixty-three percent (n=44) of those who answered were planning to use metal food lockers, which provide a legal alternative to canisters at seven backcountry locations in Yosemite. Of the remaining groups, six (7%) admitted that they intended to store their food illegally by hiding, guarding or leaving it out, and 21 (30%) were planning to hang their food in a tree. This last respondent group would be compliant only if they counterbalanced their food according to park guidelines and were beyond the seven air mile canister-only boundary and under 9600 feet in elevation.

The most common type of canister being used in Yosemite in 2005 was the Backpacker's Cache (Garcia Machine, Visalia, CA) with 69% of the use. Figure 2

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illustrates the distribution of canister brands used in Yosemite in 2005. Two hundred twenty-eight (47%) of the canisters used in Yosemite in 2005 were rented from the park (Garcia Backpacker Cache canisters). Two hundred (42%) were personally-owned while the remaining 53 canisters (11%) were borrowed or rented outside of Yosemite National Park.

The final five questions of the survey pertained to the food backpackers packed into their canisters in 2005. Four hundred and eighty-two respondent groups provided information about how long before their trip they had purchased and packed their food. Seventy-seven groups (16%) bought their food within a day of their trip, while 268 groups (55%) bought their food within a week of their trip; 137 groups (28%) bought their food a month or more prior to their trip. On average, backpacking groups bought their food seven days prior to their trip and packed their food within 2.5 days of their trip. Only 71 groups (15%) packed their food into their canister the same day of their trip. Two hundred and thirty-two groups (54%) reported purchasing all or most of their food (80% or more) with canister capacity in mind. One hundred seventy-two groups (40%) reported repackaging some or all (70% or more) of their food to reduce bulk. Three hundred eighty-two groups (79%) carried meals that consisted primarily of dried or dehydrated food. Logistic regression was used to determine that backpackers who took measures to maximize the space in their canisters were more likely to fit all their food, trash and toiletries in their canisters on every night of their trip ($R^2 = 0.133$, $F_{(2,424)} = 3.8$, $p<.05$). Significant correlations were found between the number of canisters carried and two demographic measures (group size and trip length) (Table 2) but not between the number of canisters carried and three measures of canister packing effort (percentage of dried or freeze dried meals, percentage of items that were repackaged to reduce bulk, and percentage of food that was readily packable, e.g. dried instead of fresh apples).

Discussion

Our survey revealed a wide range of variability in backpacker preparedness levels in Yosemite National Park. Clearly Yosemite backpackers are making an effort to comply with the new canister use regulation. Most (88%) wilderness users are carrying canisters, even to places where their use remains optional (e.g., backcountry camps where lockers exist and remote wilderness areas where food hanging is still permitted). A large percentage of backpackers are buying dried or dehydrated food to reduced bulk and repackaging their food to reduce the space that wrappers and cartons take in a canister. However, we found that 12% to 35% of the groups surveyed still brought more food than could fit in their canisters and consequently intended to use ineffective (and often illegal) methods to store their excess. Bear conflict is likely to continue as long as ineffective food storage practices of hanging, hiding or guarding food continue, especially in highly visited backcountry sites. Over one hundred bear incidents were reported to Yosemite park rangers in 2005, indicating that bear conflict is continuing despite the introduction of more effective food storage strategies and widespread canister use in the park wilderness.

In light of our findings, the National Park Service may want to make several improvements to its canister program in an effort to increase backpacker's canister packing efficiency. Those who have never seen or used a canister before would benefit from specific facts about canister packing and their holding capacity. We encourage the NPS to disseminate food storage and canister information to potential wilderness users long before they arrive in the park. The value of repackaging cannot be overemphasized, as removing bulky product packaging can free up as much as 50% more

space in a canister. Offering inexpensive zip-lock baggies to permit holders may provide necessary encouragement for backpackers to repackage. Backpackers should similarly be encouraged to choose dehydrated and/or freeze-dried food, as these items are easier and more efficient to pack. Finally, increased enforcement of the park's new canister requirement may be warranted. Although it would be an extreme measure, compliance with canister laws may be best achieved if rangers withhold wilderness permits until backpackers can display fully packed canisters.

Acknowledgments

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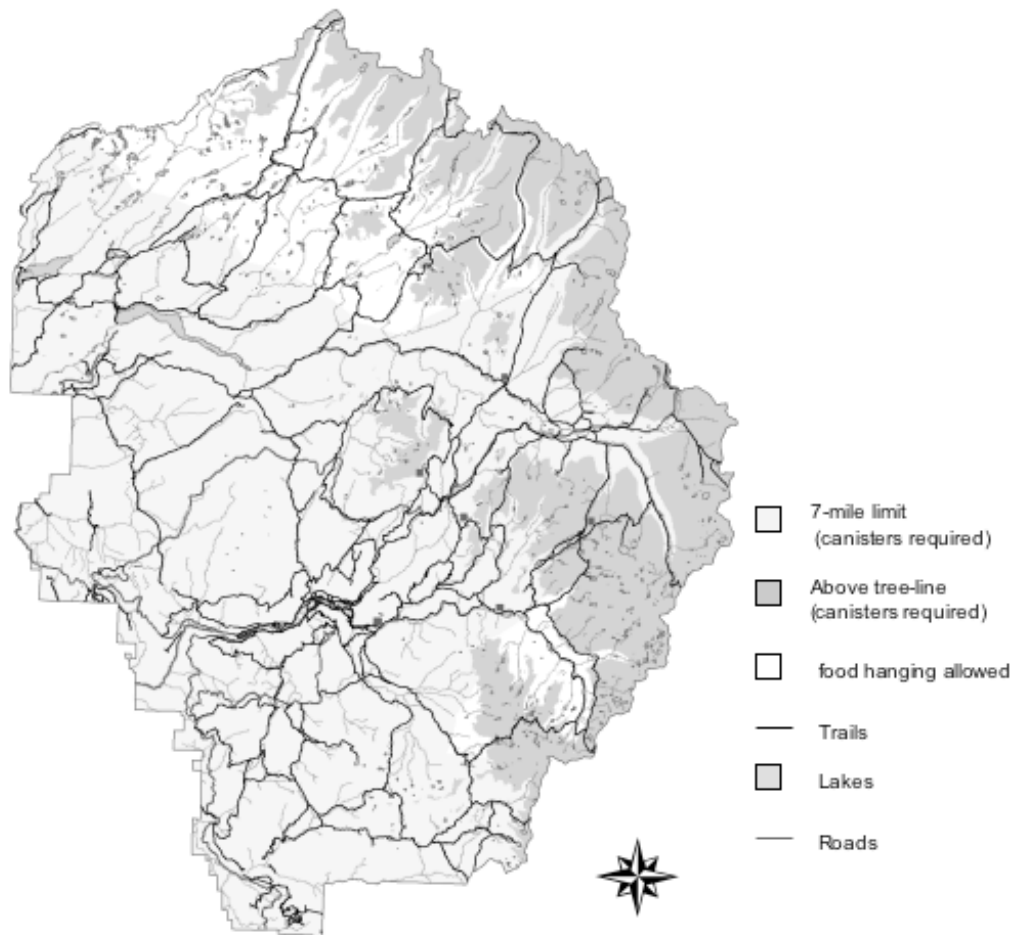
Figure 1. Yosemite National Park wilderness zones. Canisters are required within 11 km (seven air miles) from park roads and elevations above 2900 m.

Wild Ideas
Bearikade
3%

Unspecified
10%

Bear Keg
1%

Bear Vault
17%

Garcia
BackpackerÕs
Cache
69%
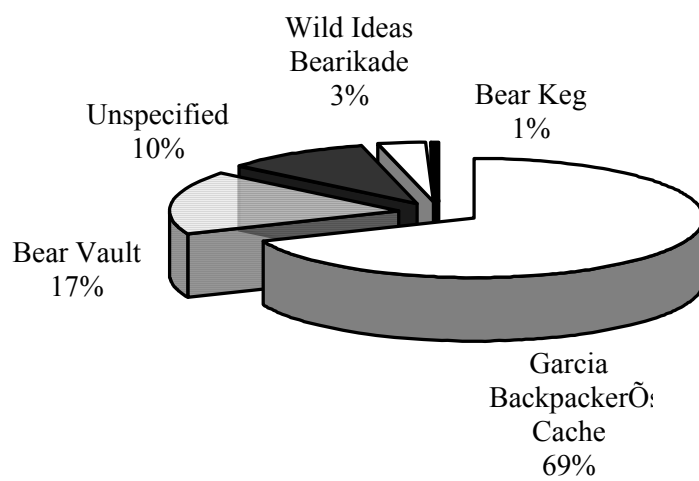
Figure 2. Over two-thirds of the canisters being used in Yosemite National Park are made by Garcia Machine of Visalia, CA. Forty-seven percent of all canisters used in 2005 were rented from the park and 42% were personally-owned.

Table 1. Four hundred and fifteen backpackers provided a range of options they intended to use to store food items that exceeded canister space. Only 64% were confident their plan was legal in the Yosemite Wilderness**.**

Would be fully compliant with their canister excess (n=264) 64%

- "will use a food storage locker" • "will give excess food away"

- "will put overflow in a trailhead locker or trash can before leaving"

- "will eat anything that wouldn't fit in canister"

Might be able to comply with their canister excess (n=101) 23%

- "will hang it in a tree" • "will throw excess away"

- "will rent additional canister" • "will carry excess back out"

- "will borrow space in someone else's canister"

- "will make excess fit in canister"

Would not be compliant with their canister excess (n=50) 12%

- "will hide stuff sacks of food" • "have no plan"

- "will keep excess in tent " • "will guard excess food"

- "will pack in an Ursack"[1] • "will leave toiletries sitting out"

- "will leave trash sitting out" • "will store in backpack"

- "will sleep with it in pillow or sleeping bag"

- "will use a locker on 1st night & hide food on following nights"

- "will use a locker on 1st night & hang food on following nights"

[1] Ursack food sacks were not sanctioned for use in Yosemite until 2006

Table 2. Correlations between group size, trip length, number of canisters and the amount of dried or dehydrated food that backpackers packed in their bear-resistant food canisters in Yosemite National Park.

Pearson Correlations	Number of canisters carried	Size of group	Number of trip nights	Percentage of freeze dried or dehydrated food	Percentage of food purchased w/ canister capacity in mind
Size of group	.786***				
Number of trip nights	.109*	-.083*			
Percentage of freeze dried or dehydrated food	.074	.004	.009		
Percentage of food purchased w/ canister capacity in mind	.011	-.004	.019	.085*	
Percentage of canister items repackaged to reduce bulk	.024	.053	-.042	-.008	.129**

∗ significant at p <.05, ∗∗ significant at p <.01, ∗∗∗ significant at p <.0001

COST EFFECTIVENESS OF THE BLACK BEAR SUPPLEMENTAL FEEDING PROGRAM IN WESTERN WASHINGTON

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Abstract: In 2004 I concluded that the black bear (*Ursus americanus)* supplemental feeding program was an effective, non-lethal damage control tool to protect conifers during the spring in western Washington, USA (Ziegltrum 2004). Consequently, I analyzed the costs of the supplemental feeding program which is used for about 10 years from stand age 15 to 25 and the costs of accepting bear tree damage. One Douglas-fir *(Pseudotsuga menziesii)* stand with known yield data served as a model. I assumed 15, 25, and 35% bear tree damage in this stand at age 15 and allowed the stand to grow to 35, 40, and 45 year rotations. Present value calculations (PV) were performed for the costs of the feeding program to determine if it was the best expenditure for the Animal Damage Control Program (ADCP) in comparison. For the sensitivity analysis I used 5, 6, and 7% interest rates. I found that the costs of feeding bears for 2.5 months annually were always lower than the costs of the bears' tree damage. Therefore, I concluded that the supplemental feeding program was a cost effective damage control tool.

A SPATIAL ANALYSIS OF POTENTIAL AND REALIZED BLACK BEAR-HUMAN CONFLICT IN NEW MEXICO

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Abstract: Using geographic information systems (GIS) and data from black bears ear-tagged and radio-marked during 1992–2000, we documented patterns of black bear-human conflict in two regions of New Mexico. The Northern Study Area (NSA), in the Sangre de Cristo Mountains, was adjacent to 3 towns and included part of Philmont Scout Ranch (a recreation property hosting ~20,000 visitors/year). The remote Southern Study Area (SSA), located in the Mogollon Mountains, was entirely within the Gila National Forest. We estimated areas of concentrated use by bears >1 year old, and examined overlap with areas of potential conflict, including towns, campgrounds, and other known sources of garbage or food. Most bears on the NSA had one or several sources of anthropogenic food within their home ranges, but few bears on the SSA did. Despite the potential for conflict on the NSA, most bears did not engage in nuisance or depredation activities. On the SSA, ranges of only 7% of females and 11% of males overlapped areas of potential conflict, and none were involved in nuisance or depredation activities ($n = 77$). Among all ear-tagged bears, only 2% of females and 1% of males were known or suspected of conflict ($n = 154$). On the NSA, ranges of 82% of females and 89% of males overlapped areas of potential conflict, but only 16% and 38% were known or suspected of nuisance or depredation activity ($n = 86$). Among all ear-tagged bears on the NSA, only 16% of females and 20% of males were known or suspected of conflict ($n = 158$). Two thirds of offending NSA bears were attracted to towns or campgrounds with unsecured garbage, pet food, deer food, or bird feeders. In contrast, only one quarter were attracted to Philmont Scout Ranch camps, despite overlap by 74% of radio-marked bears. This indicates the comprehensive bear-human management system

employed by Philmont discouraged most bears from obtaining food and causing conflict. In a statewide analysis, we predicted 17% of bear habitat lies within 5 km of human-populated areas. Among 10 distinct regions of bear habitat, this area ranged from <1% to >50%. Efforts to reduce the availability of anthropogenic food to bears can be quite effective at reducing potential conflicts, and these efforts are needed in New Mexico and wherever bear habitat exists.

MEXICO BLACK BEAR STATUS REPORT

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Abstract: Black bears (*Ursus americanus)* began declining in México in the 1940's and 1950's with remnant populations remaining in a few isolated mountain ranges in northern México. In the mid-1950's a moratorium was placed on all bear hunting in México by presidential decree. Black bears were officially listed as endangered in 1986 Instituto Nacional de Ecología (INE) and Secretaria de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP). Historically the black bear was distributed in the Mexican states of Coahuila, Chihuahua, Durango, Jalisco, Nayarit, Nuevo León, Sinaloa, San Luis Potosí, Sonora, Tamaulipas and Zacatecas. Current populations are unevenly distributed in the states of Coahuila, Chihuahua, Tamaulipas, Nuevo León, Sonora and Durango with the largest populations being located in the northern portion of Coahuila in the Maderas del Carmen and Serranías del Burro and several adjacent mountain ranges. Currently there are no population estimates for México. However, populations are expanding in northern Coahuila documented by reestablishment of small populations in western Texas and adjacent mountains. In 1999, INE and SEMARNAP formed, "*Proyecto Para La Conservación y Manejo Del Oso Negro En México,* with objectives focused on the recuperation of black bear populations, management and conservation. Currently four research projects are being conducted in México; Population dynamics and movements of black bears in northern Coahuila, México (McKinney and Delgadillo), Black bear pilot study in Nuevo León using GPS collars (Carvajal and Pronatura), Mexican black bear management and conservation of an endangered species in the Sierra San Luis, Sonora (López) and Preliminary study of black bear populations in the Sierra de Gomas and Sierra de Milpillas in Nuevo León (Guadarrama et al). Continued threats to black bears are illegal hunting and indiscriminate killing. Depredation on domestic livestock is a problem in some areas.

Key Words: black bear, status, distribution, research.

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Historically the black bear was distributed in 9 Mexican states, currently the black bear is unevenly distributed in 7 Mexican states (Coahuila, Chihuahua, Sonora, Tamaulipas, Durango, Zacatecas, and Nuevo León) with the largest populations being concentrated in the northern portion of Coahuila, particularly in the Maderas del Carmen and Serranías del Burro, (McKinney and Delgadillo 2005, Doan-Crider and Hellgren 1996). The population in México began a sharp decline in the 1940's and 1950's, this correlates to the decline in western Texas (McKinney and

Pittman 1999). Substantial information in historical documents and reports from older residents attribute the decline to uncontrolled hunting, indiscriminate killing and loss of habitat (Marsh unpublished 1938, Baker 1956 and Leopold 1959). One other factor that may be considered in the decline was the efforts to eradicate the Mexican lobo (Canis lupus baileyi). Poison laced carcasses and steel traps may have contributed to the demise of many black bears. In the mid 1950's President Aleman declared a moratorium on all bear hunting in México, this was probably the first conservation effort for this species (e. Sellers pers. comm.). However, population numbers continued to decline with remnant populations remaining in isolated mountain ranges in northern Coahuila, particularly the Maderas del Carmen and Serranías del Burro, and possibly the adjacent northern states in Chihuahua and Durango (Baker 1956, Leopold 1959). Through these remnant populations, natural recovery began in northern Coahuila in the aforementioned mountain ranges. This process was aided by a group of ranchers in the Serranías del Burro that began a conservation program to protect and enhance habitats and native wildlife (G. Osuna and E. Sellers pers. comm.). In 1986, México officially listed the black bear as endangered (Norma Oficial Mexicana 2001). The Secretaria de Medio Ambiente Recursos Naturales y Pesca (SEMARNAP) and Instituto Nacional Ecología (INE) formed a subcommittee for conservation and management of the black bear in México (SEMARNAP y INE 1999).

Currently the black bear is listed as endangered in all of their range in México with the exception of the population in the Serranías del Burro in northern Coahuila (Norma Oficial Mexicana 2001). This population was delisted from endangered to special protection status several years ago in response to studies which reported a high density of black bears (Doan-Crider and Hewitt 2001). Additionally, ranches and ejidos (communal lands) under "Unidades Para la Conservación Manejo y Aprovechamiento Sustentable de la Vida Silvestre (UMA's) reported very high numbers of black bears through direct observation, and pressure from landowners for legal permits to sell hunts to alleviate depredation problems were probably also considered in the delisting process. The Serranías del Burro is located some 60 km southeast of the west Texas border and < 20 km across a broad valley from the Maderas del Carmen.

CURRENT THREATS

Threats to the slowly expanding black bear population in México continue to be a problem. We identified current threats as: (1) continued illegal hunting and indiscriminate killing, (2) fragmentation of habitats resulting in non-contiguous lands, (3) illegal take of cubs, (4) lack of information on true population size and distribution of bears, (5) unverified depredation reports and inflated depredation numbers from UMA's , (6) lack of law enforcement in remote areas, (7) lack of educational materials, and (8) lack of implemented management plans.

RESEARCH

To our knowledge there are currently 4 research projects in 3 states in México. (1)Coahuila- Population Dynamics and Movements of Black Bear in Northern, Coahuila, (McKinney and Delgadillo); (2) Sonora-Spatial Ecology and Population Structure of Endangered Black Bear in Northwestern, México, (Lopez); (3) Nuevo León-Population Studies of Black Bear in

the Northern Region of the State of Nuevo León, México, (Carvajal, Pronatura, Maehr and Caso); and (4) Nuevo León- Preliminary Study of Black Bear Populations in the Sierra de Gomas and Sierra de Milpillas in Nuevo León, México, (Guadarrama, Salgado, Gonzales, Moreno and Gabriel).

Previously three research projects were conducted in Coahuila; (1) Ecología Nutricional del Oso Negro en la Sierra Maderas del Carmen, (Delgadillo 2001 thesis); (2) Population Characteristics and Home Range Dynamics of the Black Bear in Northern Coahuila, Mexico, (Doan-Crider 1996 thesis); and (3) Movements and Spaciotemporal Variation in Relation to Food Productivity and Distribution, and Population Dynamics of the Mexican black bear in the Serranias del Burro, Coahuila, Mexico (Doan-Crider 2003dissertation).

CONCLUSIONS

The black bear population is naturally recovering and expanding slowly into areas of historic range in México. The continued expansion and conservation of this species will depend greatly on the landowner's willingness to coexist with black bears. Public education about black bears should continue and expand. Research needs to be conducted in other areas and states to obtain more knowledge on true population size and distribution. Currently there is no population estimate.

Involvement of non-governmental organizations (NGO's), corporations, and private landowner's are imperative and may be a major factor in research, conservation and continued expansion of black bear populations in Mexico. Two projects in Mexico that are important in black bear conservation are both owned by NGO's and are preserving large tracks of contiguous lands; both have black bear populations and current research projects. These two projects can serve as models both locally and globally of what can be accomplished with NGO's backing conservation projects. In Coahuila, the Proyecto El Carmen, Naturaleza Sin Fronteras A.C., owned and funded solely by CEMEX, the second largest cement company in the world has made a long term commitment of resources and the purchase of 300,000 acres of contiguous lands for habitat and native wildlife restoration in the Maderas del Carmen ecosystem. The second project is located in Sonora, Cuenca Los Ojos Foundation is privately owned by Josiah and Valer Austin, and their purchase of > 200,000 acres of land in the Sierra San Luis and Cajon Bonito dedicated to the restoration of habitat and native wildlife is a large conservation step in the state of Sonora.

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WASHINGTON BLACK BEAR STATUS REPORT - 2006

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DISTRIBUTION AND ABUNDANCE

Although population surveys are not being conducted on a statewide basis, all indications are that Washington State has an abundant and healthy black bear (Ursus americanus) population. Based on population reconstruction and computer modeling, the Department estimates the statewide black bear population at approximately 25,000-30,000 animals.

Table 1. General black bear harvest guidelines used in Washington (Game Management Plan 2002).

Parameter	Harvest		
	Liberalize	Acceptable	Restrict
% Females in harvest	< 35%	35-39%	> 39%
Median age of harvested females	> 6 years	5-6 years	< 5 years
Median age of harvested males	> 4 years	2-4 years	< 2 years

In Washington, black bears inhabit 31 of 37 counties, occupying all forested habitats in Washington including the Olympic, Cascade, Okanogan, Selkirk and Blue Mountains ranges. The shrub-steppe habitat of the Columbia Basin and 2 island counties within the north Puget Sound area do not support resident black bear populations.

MANAGEMENT GUIDELINES AND POPULATION OBJECTIVES

The goals for black bear management in Washington are to: 1) preserve, protect, perpetuate, and manage black bear and their habitats to ensure healthy, productive populations; 2) minimize threats to public safety from black bears, while at the same time maintaining a sustainable and viable bear population; 3) manage black bear for a variety of recreational, educational and aesthetic purposes including hunting, scientific study, cultural and ceremonial uses by Native Americans, wildlife viewing and photography; and 4) manage populations statewide for a sustained yield (Washington Department of Fish and Wildlife, 2002).

For management purposes, the state is divided into 9 black bear management
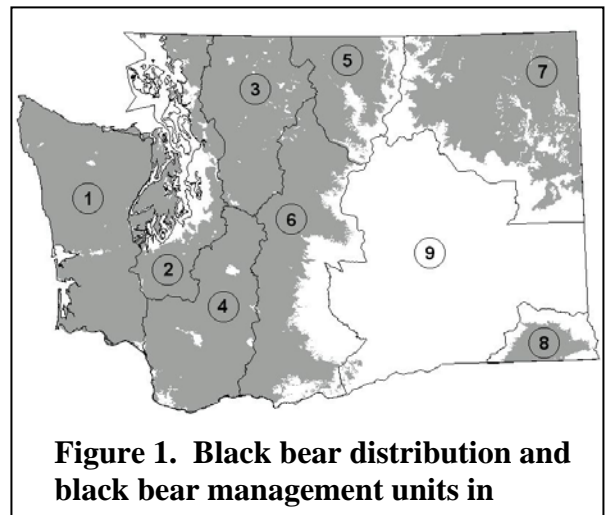
Figure 1. Black bear distribution and black bear management units in

units (BBMU's)(Figure 1). Harvest levels vary between BBMU depending on local population dynamics and environmental conditions. To maintain stable bear populations, modifications to harvest levels are made on a three-year rotation through the Wildlife Commission process.

The percentage of females in the total harvest and median ages of males and females can be used as indicators of exploitation

(Beecham and Rohlman 1994) and Washington utilizes this technique (Table 1).

However, while managers often use sex and age structure data of harvested bears as an index to population growth (Pelton 2000), examining those data alone may provide misleading interpretations (Caughley 1974, Bunnell and Tait 1981, Garshelis 1991, Clark 1999). For example, the age structure of a declining bear population can be the same as the age structure in an increasing population. In addition to this shortcoming, there is often a time lag between when a population begins to decline and when that decline is evident in sex and age structure data (Harris 1984). In some cases, by the time a decline is detected,

to recover the population. However, detecting a decline early can enable managers to make a quicker recovery or retain stability.

Sensitivity analyses of bear populations indicate that adult female and cub survival are the most influential parameters to population growth rates (Clark 1999). As such, Washington Department of Fish and Wildlife (WDFW or Department) has begun to develop survey efforts that aim to improve the estimates of these parameters, while at the same time evaluating harvest data to assess long-term trends; sex and age ratio's of harvested bears can then be used as a secondary indicator of population change.

Table 2. Statewide black bear harvest, hunter effort, and median age information, 1996 - 2006, Washington Department of Fish and Wildlife.

| | | | | | % | | | Median Age | | |
Year	Male	Female	Total Harvest	# of Hunters	Success	# Hunter Days	# Days per kill	Males	Females	% Females
1996	951	359	1,310	12,868	10%	104,431	80	4.5	5.5	27%
1997	546	298	844	11,060	8%	97,426	115	4.5	5.5	35%
1998	1,157	645	1,802	20,891	9%	216,456	120	4.5	5.5	36%
1999	757	349	1,106	37,033	3%	481,319	435	4.5	5.5	32%
2000	777	371	1,148	37,401	3%	296,849	259	3.5	5.5	32%
2001	919	512	1,431	25,141	6%	230,431	161	3.5	4.5	36%
2002	800	427	1,227	24,844	7%	219,428	127	3.5	5.5	35%
2003	989	583	1,556	22,510	7%	192,544	123	3.5	4.5	37%
2004	1,093	561	1,654	21,573	8%	186,626	113	3.5	5.5	34%
2005	940	333	1,333	20,724	6%	172,527	129	3.0[1]	5.0[1]	25%

[1]Iincomplete data set, analysis is ongoing

bear numbers may have been reduced to a point where it could take longer than a decade

HUNTING SEASONS AND HARVEST TRENDS

The use of bait and hounds for hunting black bear has been illegal in

Washington since the 1997 season. Since that time, bear seasons were lengthened, bag limits increased from 1 to 2 in some areas, and spring seasons have been expanded to 9 of Washington's 136 Game Management Units (GMU's). Legislation also passed that provided authority to the Fish and Wildlife Commission to reduce costs for black bear transport tags. In the following years, 1998-2000, the result was an increased number of bear hunters, and therefore, bear harvest. Since 2001, the number of bear hunters has decreased but harvest has not, averaging 1,440 bears per year (Table 2).

Depending on location, black bear hunting season begins either August 1st or September 6th and continue through November 15th. In GMU's where a spring hunt occurs, the dates are April 15 through May 31. While there is no physical mandatory sealing requirements for bear, successful hunters must provide kill statistics and the first upper premolar of their kill for ageing via a tooth envelope provided by WDFW.

BLACK BEAR RESEARCH
Formal population estimation studies have not been as high a priority for WDFW as other species, such as cougar (Puma concolor). However, the Department has conducted some important scientific research with regards to black bears. From 1963 to 1969, the Department studied black bear damage to coniferous forests and gathered basic demographic information that was used to establish management guidelines (Poelker and Hartwell 1973). The next study occurred from 1994-1999 and documented habitat use, home range size, and survival in three ecoregions in Washington (Koehler and Pierce 2003).

Finally, from 1996-1997, WDFW conducted bait station surveys as a measure of bear abundance. However, an analysis of statistical power indicated that at the level of survey intensity, the Department would not be able to detect a change in bear abundance using bait stations (Rice et al. 2001). For that reason, the survey technique was discontinued.

Beginning in 2003, capture efforts have been initiated in eastern Washington to monitor adult female and cub survival in selected areas to better assess bear population status and impacts of hunting. In 2005, in response to spring bear seasons being implemented to reduce bark-peeling damage on public lands, the Department launched a population estimation / survival-monitoring project in Capitol Forest in western Washington. In the spring of 2006, 160 trap nights of effort resulted in no visits and thus no captures. Two more trapping sessions are planned for later this year. In conjunction with this project, the Tumwater School district has initiated several natural resource related student programs that will give high school students the opportunity to side-by-side with professional biologists and foresters: involvement in black bear research is part of this program. To date, over a dozen teachers have accompanied WDFW personnel in the field while

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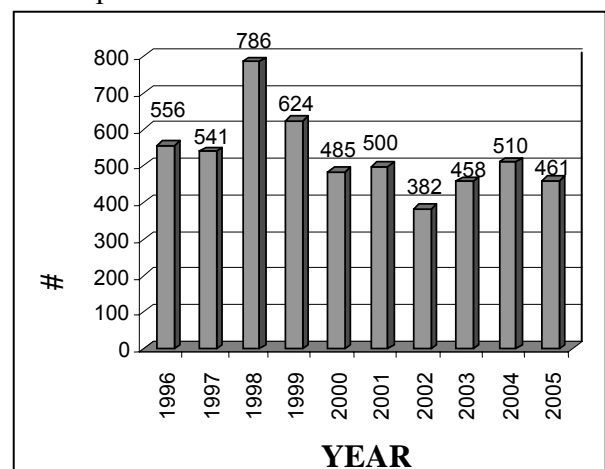
Figure 3. Confirmed human-black bear interactions in Washington, 1996-2005, Washington Department of Fish and

conducting bear research and to gather information for curriculum planning. While there is still a long way to go, the goal is that students will eventually be able to accompany WDFW biologists on bear captures.

HUMAN / BLACK BEAR CONFLICT

The total number of black bear-human interactions over the past decade decreased from a high in 1998 of 786 complaints to a low in 2002 with 382 complaints (Figure 3). Since then, complaints have averaged 476 per year. In Washington, negative black bear/ human conflict overwhelmingly involves garbage issues (i.e. poor storage), but tree peeling, livestock, orchard and apiary depredations are also experienced. Human population growth and development has only compounded these issues. The Department recently completed a statewide policy for handling black bear/human conflicts by field personnel. The policy specifies circumstances in which animals will be monitored, captured and relocated, or captured and destroyed. The Department has also worked proactively to prevent these conflicts by conducting "Living with Wildlife" workshops annually to schools and local communities, distributing educational materials to stakeholders and in key locations, purchasing and installing bear-proof containers, and supplying regional WDFW offices with bear education materials.

MANAGING BLACK BEAR CONFLICT MANUAL

Department personnel have recently completed a 2nd draft of a field manual to assist agency personnel (wildlife and enforcement programs) responding to black bear conflict situations (Figure 3). The manual was created to: (1) get an accurate and consistent message about bears to the public; and, (2) increase WDFW's consistency and professionalism when addressing bear conflict issues in the field.   The manual has 2 sections: *Section 1: Bear Behavior and Avoiding Conflict*; and *Section 2: Trapping Bears and Trap Safety*. Section 1 includes chapters titled *Understanding Bears*, *Types of Bear Encounters*, *What To Do if You Encounter a Bear*, and *Tips To Avoid Negative Bear Interactions*. Section 2 has 3 chapters titled *Trapping and Immobilizing Bears*, *Culvert Trap Safety* (for bears and people), and *What To Do With Captured Bears*. The manual is mostly in a bulleted format for quick and easy retrieval of information.   Along with first-hand professional experiences, many other informational sources were used when developing this manual including the video *Staying Safe in Bear Country, A Behavioral Approach to*

Figure 3. Graphic illustration of the recently developed field manual for managing bear conflict, Washington Department of Fish and Wildlife,

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*Reducing Risk (*Magic Lantern Communications, Toronto, Canada) and *Bear Shepherding Guidelines For Safe and Effective Treatment of Human/Bear Conflicts* (Wind River Bear Institute, Missoula, Montana). The manual reviews animal immobilizations but does not discuss drug types and dosages as all WDFW personnel using immobilizing drugs are required to attend a yearly course taught by Department veterinarians. The manual also covers topics such as: (1) possible actions for resolving black bear-human conflicts based on the level of risk; (2) bear behavior and public safety risks to consider when trapping and relocating black bears; and, (3) Site factors to consider when capturing black bears for on-site release, relocation, or aversive conditioning.

WILDLIFE ATTACK INVESTIGATION MANUAL

The Procedure for Investigation of Wildlife Attacks on Humans manual (Figure 4) was developed to assist WDFW officers and biologists with the investigation of a wildlife attack on a human being. We hope we will never need to use the manual, but feel it is necessary to have it in place considering the potential litigious ramifications. In the event of a wildlife attack and a human fatality, it is imperative to remain focused and be mindful of the investigative process to insure an effective and complete investigation. Numerous people from many agencies may be responding to this type of scene, potentially followed by the media with cameras and video recorders; these dynamics can affect the overall process. The purpose of this manual is to guarantee the integrity of all the evidence. The manual was designed to be a step-by-step guide that can guide wildlife WDFW personnel and others with their investigation. The intent is that all WDFW personnel that may use this manual would review it and be familiar with it prior to its need. Personnel from British Columbia Ministry of Environment, Lands and Parks provided the template for this manual after a fatal human attack and subsequent lawsuit several years ago. We drew on their experience, then elaborated upon the template and customized the manual for use in Washington. We also added track ID plates and travel patterns to help identify carnivores (black bear, grizzly bear, cougar, bobcat, wolf, coyote, dog) that could be involved in a human attack in Washington. After several revisions, the manual is in the process of becoming part of a formal regulation and is being incorporated into statewide wildlife officer training programs. Upon completion of those tasks, the manual will become part of the list of required field equipment carried by all wildlife
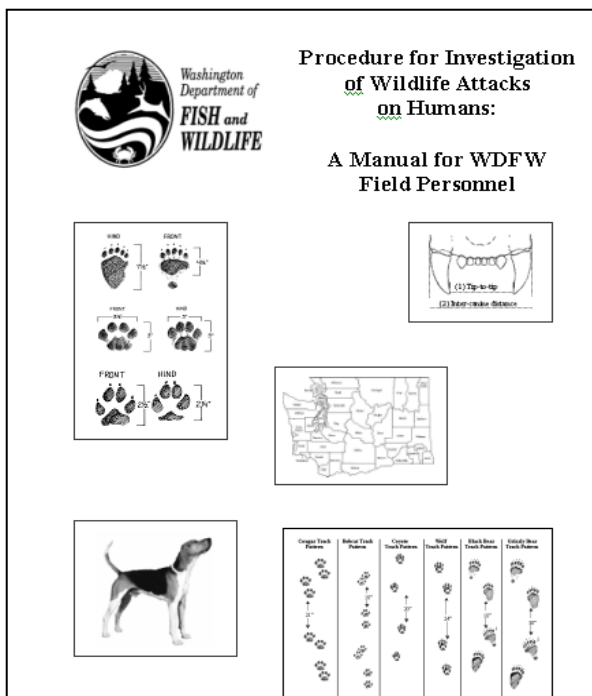
Figure 4. Graphic illustration of the recently developed wildlife attack investigation manual, Washington Department of Fish and Wildlife, 2006.

officers and biologists that may respond to a wildlife attack.

Black Bear License Plate

Wildlife-themed license plates are now available to Washington residents and feature some of the state's premier wildlife species (Figure 5). Adopted by the 2005 Washington State Legislature and signed into law by Governor Christine Gregoire, these special license plates feature a black bear, bald eagle, killer whale, elk, or mule deer image. Plates are available for passenger vehicles, light duty pickups, trailers, motorcycles, motorhomes, RVs, 5th wheels and campers. Wildlife-themed backgrounds are available for an additional cost ($40 new, $30 subsequent renewal) plus fees. Revenue generated from the sale of "Washington's Wildlife" license plates will be spent to improve management of Washington's game animals. Activities include, but are not limited to: habitat improvements, improved population monitoring, population restoration and expansion, improved public access opportunities, and improved educational materials. This additional revenue will be an invaluable source of funding to many game and non-game management programs.

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Figure 5. One of 5 wildlife-themed license plates featuring a black bear, Washington Department of Fish and

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IDAHO BLACK BEAR STATUS REPORT

Steve Nadeau, Large Carnivore Manager, Idaho Department of Fish and Game, Boise,
ID 83707

Abstract: Black bears in Idaho were classified as a big game animal in 1943, with
intensity of harvest and regulations varying annually. Bears are distributed widely
throughout the coniferous forests of northern and eastern Idaho. Harvest of bears in 2004
was the highest every recorded in Idaho when 2,462 bears were reported harvested, and
33,163 bear tags were sold. Harvest for 2005 was similar at 2,370 bears reported and
33,670 tags sold.   A 2004 survey of bear tag holders indicated only 13,252 (40%) of the
tag holders actually hunted bears, of those there was a 20% success rate. Bear harvest
increased over the last 4 years as a result of reduced bear tag prices and 2 bear bag limits
in some big game units, longer seasons statewide, and the ability to use a nonresident
deer tag for a bear or lion.   Bears were monitored using a combination of harvest data,
trend surveys, and using mark-recapture techniques.   The latest (1998) Bear
Management Plan called for testing age structure changes resulting from various
intensities of harvest, developing new monitoring techniques, and using adaptive
management to address concerns. Populations appeared to be stable.

UTAH BLACK BEAR STATUS REPORT

Kevin D. Bunnell, Mammals Program Coordinator, Utah Division of Wildlife Resources

Abstract: The Utah Division of Wildlife Resources conducted and experimental spring bear hunt from 2001-2005. The study consisted of 3 sets of paired units comparing spring and fall hunting strategies. The objectives of the study were to determine if spring hunting results in reduced female harvest and /or reduce livestock depredation. Results indicate a significant reduction in female harvest with a spring hunting strategy, but no difference in livestock depredation was detected. The results of this experiment were used to justify reinstating spring bear hunting statewide beginning in 2006.

NEW MEXICO BLACK BEAR STATUS REPORT

Rick Winslow, Large Carnivore and Furbearer Biologist, New Mexico Department of Game and Fish, PO Box 25112 or #1 Wildlife Way, Santa Fe, NM 87504

Abstract: New Mexico switched to a Zone Management system with harvest limits on the total number of bears that could be harvested and the total number of female bears that could be harvested in 2004. After two seasons of this new management paradigm we investigate the results.

WYOMING BLACK BEAR STATUS REPORT

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DAN BJORNLIE, Trophy Game Biologist
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CHARLES R. ANDERSON, Trophy Game Biologist
    260 Buena Vista, Lander, WY 82520

Black Bear Classification

Prior to 1911, black bears (*Ursus americanus)* and grizzly bears (*Ursus arctos*) were classified as predators throughout Wyoming, meaning they could be taken at any time, anywhere, and by any means. From 1911 to 1938, both species were classified as game animals on most of the national forests within the state, including the Black Hills, and were classified as predators throughout the remainder of the state. During this time, the majority of bear hunting seasons statewide coincided with those of big game species. In 1938, the first spring seasons were set for most of the state and, the following year, bears were classified as game animals statewide. Game animal classification allowed for the protection of cubs and females with cubs at side, additionally, bears could not be trapped or hunted with dogs without the approval of the local game warden. This lasted until 1957, when bears were once again given predator status in some parts of the state and game animal status in the remainder of the state. In 1967, bears were reclassified as big game animals statewide. In 1968, black bears and grizzly bears were separated and managed as distinct species in order to protect the declining grizzly bear population. Then, in 1976, black bears were given their current status of trophy game animals, which committed the Wyoming Game and Fish Department (WGFD) to reimburse landowners for livestock losses.

Distribution and Abundance

Black bears occupy most of the major mountain ranges within Wyoming, including the Absaroka, Teton, Wyoming, Wind River, Bighorn, Laramie, Sierra Madre, Snowy, and Uinta ranges. They do not inhabit the Black Hills of northeast Wyoming, although their historic range included this area. The 9 occupied mountain ranges comprise approximately 112,000 km^2 of suitable black bear habitat and are composed of 4 distinct black bear populations that are geographically isolated from each other by high elevation grasslands and sagebrush dominated deserts. The largest population occurs in the northwest corner of the state, including Yellowstone National Park, and is contiguous with bear populations in Idaho and Montana. The second largest population occurs in the Bighorn Mountains of north central Wyoming. This population primarily resides within the state and only extends into Montana for a short distance. The third population, extending northeast from the south central region of the state, is contiguous to large tracts of black bear

habitat in Colorado. Nonetheless, studies conducted in the Snowy Range Mountains indicate that this area exhibits relatively low bear densities compared to densities observed in other portions of the western United States (Grogan 1997). The fourth population exists in the southwest corner of the state and has the smallest distribution and lowest densities of bears found in Wyoming. This region is a small extension of the Uinta Mountains that originates in Utah. Currently, there are few reliable estimates of bear abundance in Wyoming, but all populations are believed to be stable.

Population Monitoring

In 1979, Wyoming was divided into 31 black bear hunt areas that closely corresponded with elk hunt areas, but, in 1993, this system was reorganized into 29 hunt areas that more closely resembled known bear distribution. With the completion of Wyoming's black bear management plan in the spring of 1994, the 29 hunt areas were grouped together into 9 bear management units (BMU). Each BMU contains hunt areas with distinct bear populations that are specific to the 9 mountain ranges that occur in the state (Figure 1). Management of black bears is based on harvest within each BMU, not individual hunt areas.

Figure 1. Wyoming black bear hunt areas and bear management units, 2006.

201 Absaroka   301 Big Horns

25
32
26
21
Jackson
101
22
29
23
24
28
27
18
20
31
17
19
16
15
30
14
13
11
Grey's
River
102

1
2
4
3
5
6

Wind River
601

501 Laramie Peak

7

Snowy Range
502

Sierra Madre
401

9
8

Uintas
402
10
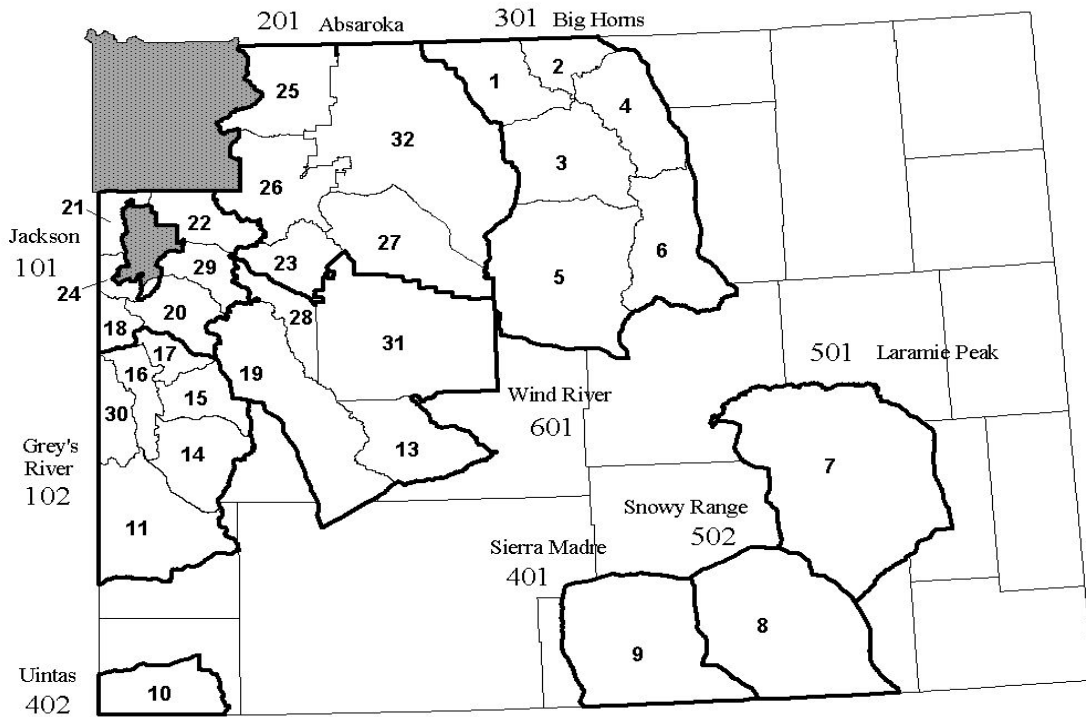
BMU Boundary
National Parks
Black Bear Hunt Areas
Wyoming Counties

N
W   E
S

100   0   100   Kilometers

Relatively few changes have occurred with the BMU system of management since 1994 other than a few minor hunt area boundary changes, the addition of 2 new hunt areas, and the opening of 1 BMU that had previously been closed. BMU 402 (Uintas) was opened to the hunting of black bears beginning in 2001, however, only a spring season exists, the fall season remains closed at this time. In 2002, hunt area 31 was added to the Wind River BMU, which includes all non-Indian owned fee title lands within the exterior boundaries of the Wind River Indian Reservation. Hunt area 32 was created in 2003. This unit includes primarily privately owned lands in the basin between the Bighorn and the Absaroka Mountains. It allows for limited public take in an attempt to reduce the number of damage situations and human/bear conflicts.

Information collected from harvested bears is the only source of data presently used to monitor black bear populations in Wyoming. A mandatory reporting system was instituted in 1979 that requires all successful hunters to present the skull and pelt of harvested bears to a WGFD employee, who collects 2 teeth for aging and records location of kill, sex, number of days hunted, method of take, and a general description of overall body condition. Skulls and pelts must be presented in an unfrozen condition and proof of sex must remain naturally attached to the pelt for accurate identification.

Desired harvest criteria and indicators of overharvest were established in 1994 to better monitor trends in black bear populations statewide and within each BMU (Table 1). Currently, the desired harvest of female bears is ≤35% of the total harvest, whereas overharvest is indicated by a female harvest of ≥40% of the total harvest or a sub-adult female harvest of ≥35% of the total female harvest. Desired harvest of

male black bears is ≥60% of the total harvest. Median ages of ≥4, ≥6, and ≥5 are recommended for males, females, and total harvest, respectively.

Table 1. Wyoming black bear harvest criteria and harvest characteristics.

Criteria	Desired	Overharvest	1996 – 2005
% Female Harvest	≤ 35%	≥ 40%	33%
% Male Harvest	≥ 60%		67%
% Sub-adult[a] Female to Total Female Harvest		≥ 35%	53%
Median Age			
Female	≥ 6 Yrs.	≤ 4 Yrs.	4 Yrs.
Male	≥ 4 Yrs.	≤ 2 Yrs.	4 Yrs.
Total	≥ 5 Yrs.	≤ 3 Yrs.	4 Yrs.

[a] Sub-adult bears are ≤ 4 years of age as determined by cementum annuli aging techniques.

Annual female quotas are evaluated each winter by comparing the sex and age structure of the harvest for the last 5 years with the indicators of potential overharvest. If the 5-year trend suggests that overharvest may be occurring, reduced quotas may be recommended for the following year, and conversely, increased quotas may be recommended if the 5-year trend is below the desired level.

Management Plan

In 1993, the WGFD formed a committee to develop a statewide management plan for black bears. This plan was finalized in 1994

and, soon after, new regulations for the management of black bears were in place. Three main objectives were set forth to guide bear management in the state of Wyoming: 1) strive to keep harvest within the desired criteria; 2) provide a harvest of 200 – 275 bears annually; and 3) provide maximum hunting opportunity while maintaining stable bear populations. These objectives have not changed since 1994; however, it is becoming increasingly difficult to maintain our third objective due to early season closures as female quotas fill. It is difficult to determine if these early season closures are the result of an increase in bear populations statewide, if current environmental conditions (i.e., drought) are affecting the bears' susceptibility to hunting, or if hunter selectivity has been altered due to the female mortality quota system (hunters taking the first bear they see).

Currently, the WGFD is attempting to limit quota increases to better evaluate this situation. Additionally, the annual female quotas are being set for three-year cycles in an attempt to better evaluate hunter effort and variation in closing dates due to filling the quota because of environmental conditions such as early snow melt or drought conditions.

The WGFD is in the process of rewriting the statewide management plan. The process began in 2005 and will be completed in the fall of 2006. Current criteria are being evaluated to determine if they are adequate. If not, new harvest criteria will be formulated. We will attempt to provide criteria for objectives of population increases, decreases, or stabilization. Management recommendations will also be made to provide additional data to determine if the criteria are adequate and what impact current management emphasis is having on specific black bear populations.

Hunting Laws and Regulations

New regulations governing black bear female mortality quotas were enacted in the fall of 1994. Hunt areas with distinct bear populations were combined to form BMUs and assigned annual female mortality quotas, so that once a quota was filled the hunting season in that BMU automatically closed (Table 2). Initially, harvest from the 1994 fall and 1995 spring seasons were regulated as one annual quota, but this was changed in the spring of 1995 to include separate spring and fall quotas for each calendar year. This assured that a fall season would occur regardless of spring harvest levels. If female mortality quotas for the spring hunting season are exceeded, the excess is subtracted from the fall mortality quotas. Conversely, if female mortality quotas in the spring have not been reached, the portion of the quota remaining will be added to the fall mortality quota.

Table 2. Black bear management units, hunt areas, season types, season dates, and quotas for hunt year 2006.

Black Bear Management Unit	Hunt Area	Season Type Archery General		Annual Female Mortality Quota
Bighorns	1 – 5	May 1-4 Sept. 1-14	May 15-June 15 Sept. 15-Oct. 31	10 Spring 5 Fall
	6	Archery Closed Archery Closed	May 1-June 15 Sept. 1-Oct. 31	1 Spring 1 Fall
Laramie Peak	7	April 15-30 Aug. 15-31	May 1-June 7 Sept.	3 Spring 2 Fall

			1-Oct. 31	
Snowy Range	8	April 15-30 Sept. 1-30	May 1-June 7 Oct. 1-31	4 Spring 2 Fall
Sierra Madre	9	April 15-30 Sept. 1-30	May 1-June 15 Oct. 1-31	3 Spring 2 Fall
Uinta	10	April 15-30 Fall Closed	May 1-June 15 Fall Closed	1 Spring Fall Closed
Greys River	11	April 1-30 Aug. 15-31	May 1-June 15 Sept. 1-Oct. 31	3 Spring 3 Fall
Greys River	14, 15, 16, 17, 30	April 15-30 Aug. 15-31	May 1-June 15 Sept. 1-Nov. 15	14 Spring 10 Fall
Wind River	13	April 15-30 Aug. 15-31	May 1-June 15 Aug. 1-31[a] Sept. 1-Oct. 31	3 Spring 2 Fall
Wind River	19	April 15-30 Aug. 15-31	May 1-June 15 Sept. 1-Nov. 15	6 Spring 4 Fall
Wind River	28	April 15-30 Aug. 1-14	May 1-June 15 Aug. 15-Oct. 31	3 Spring 3 Fall

	31	April 15-30 Aug. 1-14	May 1-June 15 Aug. 15-Oct. 31	2 Spring 2 Fall
Jackson	18, 20, 21, 22, 24, 29	April 15-30 Aug. 15-31	May 1-June 15 Sept. 1-Nov. 15	11 Spring 9 Fall
Absaroka	23	April 15-30 Aug. 1-14	May 1-June 15 Aug. 15-Oct. 31	8 Spring[b] 10 Fall[b]
Absaroka	25, 26, 27	April 15-30 Aug. 15-31	May 1-June 15 Sept. 1-Oct. 31	
Absaroka	32	April 15-30 Archery Closed	May 1-June 15 Aug. 1-Oct. 31	2 Spring 3 Fall

[a] Valid only in that portion of Area 13 within the Popo Agie Wilderness.
[b] Inclusive to areas 23, 25, 26, and 27.

Presently, only legal and illegal female black bear mortalities are counted against the quotas. Female bears that died as a result of vehicle collisions were counted toward the quota through the 2000 hunting season, but this was changed prior to the 2001-hunting season. Bears removed because of nuisance activity do not count towards annual female quotas and there are no limits on the number of damage bears that can be removed annually. The separation of damage mortality from bear harvest management is intended to prevent a high nuisance year from influencing annual harvest quotas.

Season dates are generally from 15 April to 15 June during the spring and 1 August to 15 November in the fall. Typically, the first 2 weeks of the spring and fall seasons are special archery only seasons with opening and closing dates specific to each hunt area or BMU. However, beginning in 2003, hunt area 6 in the Bighorn BMU no longer offers archery only seasons. A general hunting season starts the day after archery season ends and remains open until the female quota for the hunt area or BMU is filled or the season closure date is reached.

Successful black bear hunters must present the skull and pelt from each bear taken to a WGFD employee for inspection within 3 days after the harvest. Legal shooting hours are from one-half hour before sunrise to one-half hour after sunset. The annual bag and possession limit is 1 bear per hunter per calendar year. Cubs and females with cubs at side are protected from harvest and dogs may not be used to hunt, run, or harass bears. Non-resident hunters are not allowed to hunt black bears in any federal or state designated wilderness areas without a professional or resident guide. Hunters are responsible for inquiring about season closures by calling a toll free telephone number prior to going into the field. For the upcoming 2003 black bear hunting season, resident and non-resident bear licenses cost $30.00 and $250.00, respectively.

During the fall of 1993, the U.S. Forest Service (USFS) prohibited bear baiting on national forest lands within Wyoming because an environmental assessment of the activity was not yet complete. In the spring of 1994, baiting on these lands was reinstated after the final environmental assessment concluded that regulations of bear baiting in Wyoming would be the sole responsibility of the WGFD, regardless of land ownership. In addition to recommendations made in the Black Bear Management Plan, this temporary ban on baiting further increased public awareness of the issue. As a result, current baiting regulations include:

- Baiting is permitted in all hunt areas except those within the federal grizzly bear recovery area.

- Bait is defined as a nontoxic biodegradable substance, not to exceed 200 lbs, enclosed in a rigid container no larger than 8 cubic feet.

- The use of game animals, birds, fish, or protected species is prohibited.

- Baits cannot be placed more than 7 days prior to the season opening and it must be removed no later than 7 days after the season closes.

- Baits cannot be placed within 200 yards of a water source, road, or pack trail; or within one-half mile of a developed campground, picnic ground, or building.

- Bait density cannot exceed more than 1 per square mile, and 1 hunter cannot maintain more than 2 baits at once.

- Prior to placing a bait on any federal or state public land, a written description of the proposed location must be registered at any WGFD regional office.

- The hunter's name, address, and phone number must be permanently affixed to the outside of the bait container.

- If a grizzly bear shows up at a bait site, the hunter shall report it immediately to the WGFD. The bait site will be closed and the bait removed as soon as possible by WGFD personnel. No person will be allowed to use that bait site for the remainder of the calendar year.

Harvest Summary

Since 1979, total black bear harvest has increased 274% in Wyoming. From 1979 to 1982, harvest averaged 175 bears per year compared to 233 bears per year from the most recent ten year period, 1996-2005 (Table 3). With the implementation of the female mortality quota system in the fall of 1994, a sharp decline in harvest was observed, dropping from 237 in 1993 to 136 in 1996, which was the lowest harvest recorded since 1979. Since then, harvest has steadily increased, reaching a high of 323 bears in 2002. During this same time period the removal of black bears involved in conflicts also increased dramatically, from 4 in 1998 to 40 in 2001 (Table 3). Bears taken because of conflicts are not counted against the female quota. During the last ten years 157 bears have been removed which have not counted against the quota. They are not included in the analysis that attempts to address the impacts of hunting seasons on black bear populations. These bears account for approximately 6% of the total annual mortality.

In 1992, spring seasons were shortened to protect late-emerging females with cubs. Since then, spring female harvest has stailized from an average of 43 from 1992 to 45 for the last 10 years. Additionally, fall female harvest has increased slightly from an average of 29 in 1979 – 1992 to 32 for 1996-2005. From

1996 – 2005, statewide female harvest has accounted for 33% of all harvested bears while 53% of these have been sub-adult females (Table 1). In this same time frame, median ages of female, male, and total harvest have all equaled 4 years of age.

Almost 58% of the annual bear harvest recorded for the period of 1993 – 2002 occurred during the spring season even though the number of spring hunter days accounted for only 35% of the total annual hunter days (Table 3). These values increased during the last ten years, 1996-2005. Approximately 62% of the total harvest occurred in the spring season and spring hunter days increased to 43%. Hunter days per harvested bear is also markedly lower during the spring season (spring = 49 days/bear; fall = 103 days/bear). This is likely due to the influence of baiting since 81% of all bears harvested in the spring since 1996 were killed over bait, compared to 16% in the fall when most successful hunters incidentally take a bear while pursuing deer and elk.

Table 3. Wyoming black bear harvest and damage statistics, 1996-2005.

Year	No. Bears Harvested					No. Hunter Days[a]			No. Damage Bears:	
	Spring		Fall							
	M	F	M	F	Total	Spring	Fall	Total	Translocated	Remov
1996	74	34	16	12	136	6633	11854	18487	11	14
1997	84	40	36	17	177	4291	9558	13489	1	8
1998	96	25	44	32	197	6987	7713	14700	11	4
1999	83	40	45	26	194	11944	6635	18579	12	4
2000	99	45	40	19	203	6267	8650	17917	24	9
2001	96	50	82	32	260	6933	9073	16006	18	40

02	106	45	116	56	323	9079	12886	21965	24	
03	103	61	57	41	262	8719	12713	21432	3	
04	135	47	64	50	296	9592	12879	22471	16	
05	119	59	66	37	281	b	b	b	5	
tal	995	446	566	322	2329	70445	91961	162406	125	
ean	96	45	57	32	233	7827	10218	18045	13	16

[a] One hunter day is equal to 1 day hunted/hunter.
[b] Data not yet available

In the northwest and north-central portion of the state, female mortality quotas have increased from 57 in 1995 to 115 in 2006 although only 35% (19 of 54) of the quotas have been filled. The female quota increase is partly due to concerns related to increased nuisance bear activity, even though there is no data to support that moderate increases in harvest from sport hunting will reduce nuisance activity. In fact, the number of bears taken in nuisance actions increased dramatically since 2000 despite increased harvest from hunting in the last 5 years. The combination of increased take due to sport hunting and nuisance control has undoubtedly reduced bear populations in the western portion of the state. As a result, we have documented a decrease in female median age and an increase in percent sub-adult female harvest in this area.

Depredation Trends, Policies, and Programs

Currently, Wyoming uses a statewide protocol for managing trophy game depredations and interactions with humans. Each incident is handled on a case-by-case basis and is dealt with accordingly based on the location of the incident, the threat to human safety, the severity of the incident, and the number of incidents the animal has been involved in. Every effort is made to prevent unnecessary escalation of incidents through an ascending order of options and responsibilities:

1. No Management Action Taken (combined with educational efforts)
   a) Educational pamphlets and discussion on how to live safely in bear country are provided

2. Deterrent Methods (combined with educational efforts)
   a) Removal or securing of attractant by the landowner, leasee, or WGFD
   b) Removal of depredated carcass by landowner or leasee
   c) Use of guard dogs (landowner responsibility)
   d) Educational pamphlets and discussion on how to live safely in bear country are provided

3. Aversive Conditioning (combined with educational efforts)
   a) Use of rubber bullets by the WGFD or designated person/agency
   b) Use of pepper spray by the landowner or WGFD
   c) Noise making devices (e.g., explosives) or flashing lights by the landowner, leasee, or WGFD
   d) Educational pamphlets and discussion on how to live

4. Trapping and Relocation (combined with educational efforts)
   a) If the above efforts do not deter the bear from the area, if public safety is compromised, if it is a first offense, or if it has been a lengthy span of time between offenses
   b) Educational pamphlets and discussion on how to live safely in bear country are provided

5. Lethal Removal of the Animal by the WGFD (combined with educational efforts)
   a) If the above methods do not deter the bear, if public safety is compromised, or if the offending bear has been involved in multiple incidents in a short span of time
   b) Wyoming statute also allows for any black bear damaging property to be killed by the owner, employee, or leasee of the property
   c) Bears that have been removed from the population will be used for educational purposes
   d) Educational pamphlets and discussion on how to live safely in bear country are provided

The WGFD works closely with hunters, outfitters, recreationalists, livestock operators, and homeowners in an attempt to minimize conflicts with black bears. Every spring, the WGFD hosts bear and lion workshops throughout the state to educate people about bear and lion biology, front and backcountry food storage techniques, what to do in the event of an encounter with a bear or lion, and the morphological characteristics that differentiate a black bear from a grizzly bear. In addition, numerous presentations are given throughout the year to civic, private, and school groups to educate them about bear biology and how to coexist safely with bears. Media outlets are also used to inform and educate members of the general public about bear safety issues. The WGFD has developed a bear identification test that can be taken on line by the public. The test aids in differentiating black bears from grizzly bears in an attempt to reduce the take of grizzly bears because of mistaken identification.

On the national forest lands within the federally allocated grizzly bear recovery area, developed campgrounds are required to have bear proof dumpsters and bear proof food storage containers. The area covered by food storage regulations is being expanded as grizzly bear distribution expands. If traveling or hunting in the backcountry, food must be stored in bear proof containers or hung on game poles or trees out of the reach of bears. However, homeowners and businesses within this area are not required by state law to store food or waste in bear proof containers. Recently, bear management officers have begun supplying homeowners who continually have conflicts with bears, or upon request of the homeowner, 55-gallon barrels to use as bear proof storage containers for attractants that must be stored outdoors. These barrels were donated by the Wyoming Department of Transportation free of charge.

Even with all the preventive measures taken by the WGFD, conflicts with black bears do occur. The number of black bear conflicts have ranged from a low of 35 reported incidents in 1996 to a high of 230 reported incidents in 2002. The WGFD is fiscally responsible for confirmed livestock losses and apiary damage caused by black bears, as well as mountain lions (*Puma concolor*) and grizzly bears. The number of black bear damage claims for the last 10 years range from 13 to 24, and payments made to claimants range from $8,922 to $35,397 (Figure 2). Sheep accounted for 70% of the total damage payments made in 2005, while apiaries accounted for 30% (Figure 3). An average of 16 nuisance bears were removed annually and 13 were translocated annually during the last 10 years with peak removals taking place in 2001, 2002, and 2005. The number of translocations peaked at 24 in 2000 and 2002 (Table 3).

Figure 2. Black bear damage claims and payments, 1996 – 2005.

Figure 3. Percent black bear damage payments by type, 2005.

SHEEP
70%
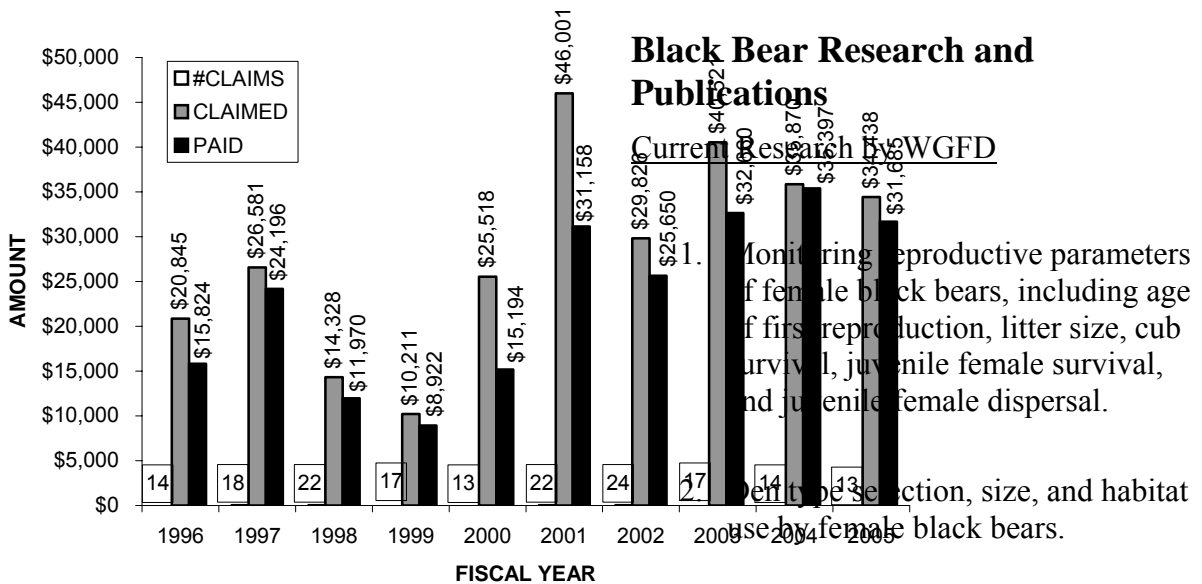
Black Bear Research and Publications

Current Research by WGFD

1. Monitoring reproductive parameters of female black bears, including age of first reproduction, litter size, cub survival, juvenile female survival, and juvenile female dispersal.

2. Den type selection, size, and habitat use by female black bears.

Recent Publications

Grogan, R. 1997. Black bear ecology in southeast Wyoming: the Snowy Range. M.S. Thesis, University of Wyoming, Laramie, WY. 84pp.

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Holm, G. 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.

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Gasson, W., R. Grogan, and L. Kruckenberg. 2003. Black bear management in Wyoming. Wyoming Game and Fish Department. Cheyenne, WY. 95pp.

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University of Wyoming. 1992. Bear hunter survey. Unpublished Report. Survey Research Center, University of Wyoming, Laramie, WY. 10pp.

University of Wyoming. 1994. Public attitude survey on black bear management in Wyoming. Unpublished Report. Survey Research Center, University of Wyoming, Laramie, WY. 8pp.

Wyoming Game and Fish Department. 1994. Black bear management plan. Trophy Game Section, Lander, WY. 40pp.

Wyoming Game and Fish Department. 2002. Annual black bear mortality summary. Trophy Game Section, Lander, WY. 54pp.

Public Attitudes Towards Black Bear Hunting and Management

There has been no public attitude surveys conducted in Wyoming concerning black bear hunting and management since 1993. In that year, the USFS prohibited baiting on national forest lands during the fall hunting season. Baiting was allowed on these lands the following spring; however, the temporary restriction heightened awareness and controversy of the baiting issue, and a public attitude survey was conducted in the winter of 1993. The 3 key findings of this survey were 1) approximately half of the

respondents had little or no knowledge of black bear management in Wyoming or the controversy surrounding bear baiting and spring hunting; 2) 16% and 32%, respectively, felt that baiting and spring hunting should continue; and 3) 52% agreed that some form of bear hunting should continue. A similar survey only involving licensed bear hunters was also conducted in 1992, in which, unsurprisingly, only 20%

Conclusions

The greatest bear management challenge that the state of Wyoming will face in the future is maximizing hunter opportunity while maintaining stable bear populations. Already, based on the harvest criteria set forth in the black bear management plan, it appears as if black bear populations are showing the effects of increased harvest. It is very difficult to determine, strictly from harvest data, if this increased harvest is the direct result of an increase in black bear populations since 1999, if environmental factors have played a larger role in the susceptibility of bears to hunting, or if hunter selectivity has changed since the implementation of the female mortality

favored elimination of bear baiting. However, a somewhat surprising result of the 1992 survey was that 52% of the respondents (licensed bear hunters) favored shortening spring seasons to reduce female harvest. Presently, no referendums or state legislation banning baiting or spring bear hunting have been proposed in Wyoming, although it is apparent that nationwide approval of these activities is declining.

quota system. If money and manpower were not issues, research projects that would better estimate black bear densities and population demographics statewide would be initiated. This information could be used to better formulate harvest criteria based on data from bear populations in Wyoming. It could also be used to assist in setting appropriate female mortality quotas within each BMU in the state.

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Grogan, R.G. 1997. Black bear ecology in southeast Wyoming: the Snowy Range. M.S. Thesis, University of Wyoming, Laramie, WY. 84pp.

UNDERSTANDING THE NUTRITIONAL ECOLOGY OF FREE-RANGING UTAH BLACK BEARS (*Ursus americanus*) USING STABLE ISOTOPE TECHNIQUES

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Abstract: Although observational studies and fecal analyses have been used to quantify diets for various bear species, this technique is limited by the differential disappearance of foods during digestion and passage, thereby changing the ratios between the foods consumed and the residues excreted in feces (scat). Stable isotope analysis of hair and other tissues has recently been shown to give a more accurate estimate between animal matter and vegetation in the diet of free-ranging bears. The stable isotope ratios of carbon ($^{13}C/^{12}C$ or $\delta^{13}C$) and nitrogen ($^{15}N/^{14}N$ or $\delta^{15}N$) can be used to elucidate diet since the isotopic values of body tissues reflect the isotopic signatures of the foods and liquids consumed. Trophic level can be inferred by tissue $\delta^{15}N$ as related to fractionation of stable nitrogen isotope ratios ($^{15}N/^{14}N$) during the preferential excretion of ^{14}N, usually enriching consumer tissues on the order of $\approx$ 3-4‰ with each trophic level shift. However, bear $\delta^{15}N$ values may be influenced by their nitrogen balance, such that anabolic states may cause a decreased $\delta^{15}N$ and catabolic states and high protein diets an increased $\delta^{15}N$. Hair $\delta^{13}C$ may or may not display patterns indicative of nutritional stress. To better understand the relationship between gender, dietary history and ratio of foodstuffs ingested, $^{13}C/^{12}C$ and $^{15}N/^{14}N$ were determined in hair samples from harvested free-ranging, male and female Utah black bears to infer temporal and spatial relationships to assimilated diets and habitat utilization.

UTAH BLACK BEAR (*Ursus americanus*) POPULATION ESTIMATES USING NONINVASIVE GENETIC TECHNIQUES

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In 2004, a black bear density study began on the Western portion of the Kamas Ranger District, Wasatch-Cache National Forest, Utah. This is a pilot study to determine if noninvasive hair collection DNA techniques will provide reliable population density estimates on the relative low density black bear population in Northern Utah. Other study objectives are to determine: cell size, bait selection, optimal starting and ending dates, collection interval and movement patterns between cells. The study area is 15 km X 15 km square, 260 km² (25,900 ha). In 2004, field work began on 12 June. A 5X5 grid was used making a total of 25 cells. Each cell was 1,036 ha. Hair was collected at 14 day intervals and each cell was rebaited with a new liquid scent. One hundred-eighty samples were collected and 43 (24%) were assigned to individual black bear by DNA analysis. Thirteen individuals were identified. There were 5 males (38%) and 8 females (62%). A population estimate was obtained using program MARK at the 95% CI. One model's estimate was 13-13 and another was 13-17. The 2005 field season began two weeks later on 25 June, due to deep snow on the high elevation's of the study area. This year a 4X4 grid was used (16 cells) on the same study area. Each cell was 1,620 ha. The same four scents and same distribution sequence was duplicated. One hundred forty-four samples were collected. Of these, 47 (33%) were assigned to individuals. Seven were recaptures of bears identified in 2004 (2 males and 5 females). Eight new bears were sampled (4 males and 4 females) making a total of 15 individuals identified in 2005 (6 males and 9 females). Program MARK was used to obtain a population estimate of 15-21 individuals at the 95% CI. During the two year study, 21 individuals have had DNA material collected on the west Kamas study area (9 males, 12 females). This study will continue in 2006 in the same area with possible modification in cell size, scents used, session length and starting date.

SURVEY OF NORTH AMERICAN AGENCY PROTOCOLS REGARDING BLACK BEAR MANAGEMENT AND HUMAN INTERACTIONS

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Managing black bear-human interactions has evolved from public feeding and viewing of garbage-habituated bears to nationwide bear education campaigns focused removing food attractants. We conducted a survey to assess various elements of bear-human conflict protocols and to identify techniques currently used by wildlife agencies to manage bear conflicts throughout United States, Canada, and Mexico. Forty-eight agencies responded to the survey and provided answers about current bear populations, levels of complaints, and types of interactions. In this manuscript, we compile and compare management strategies across North America and discuss strengths and weaknesses of those programs so that management agencies could learn from the experiences of other states, provinces, and countries and update their own bear management protocols.

SAFETY IN BEAR COUNTRY: IS THE MESSAGE GETTING THROUGH?

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Abstract: Encounters between people and black bears (*Ursus americana*) can be costly.   People may be injured, property damage may be significant, and resolving nuisance complaints may require a substantial commitment of money and staff of wildlife agencies that could be used for other management activities.   An interagency task force was formed in 2000 to determine ways to reduce human-bear encounters in Arizona and New Mexico. During the summers of 2001 and 2002, we distributed safety brochures, posters and campground table stickers in areas of New Mexico that had experienced chronic problems from nuisance bears. We wanted to determine if our efforts were effective in informing the public. Using identical survey instruments, we polled individuals who live in or visited regions where safety information was distributed (treatment areas) and compared them with responses from individuals in regions where information was not distributed (reference areas).   We hypothesized that people in areas provided with information about safety in bear country would be better informed than those in areas not provided with such information and residents in bear country would be better informed about bear safety issues than visitors.   Survey scores in treatment areas were higher than in reference areas for residents ($P = 0.028$) and to a lesser extent for campers ($P = 0.1$).   Residents in treatment areas also scored highest of all sample groups. Respondents generally understood the critical role anthropogenic food plays in creating nuisance behavior. However, room for improvement in knowledge of safety in bear country remains.

Key words: anthropogenic, black bears, campers, food, garbage, nuisance, residents, safety, *Ursus americana.*

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HABITUATION, FOOD CONDITIONING, AND OTHER TERMS USED AND MISUSED BY BEAR MANAGERS

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Abstract: Bear biologists and managers frequently discuss habituation and food conditioning alternately and without understanding the differences between the terms, sometimes coining new terms such as food habituation. Other terms frequently misused or created are aversive and adversive conditioning, classical conditioning, positive and negative conditioning and others. Along with the terms come management implications and perception by publics and other professionals. This presentation will define the terms and their common use as described in ethological literature, what they mean for bear management, and implications for the public.

INVESTIGATING THE ROLE OF SOCIAL LEARNING IN PROBLEM BLACK BEARS USING GENETIC RELATEDNESS ANALYSES

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Abstract: How and what animals learn can be impacted by the learning opportunities presented in their environment, including from conspecifics. Solitary animals have less opportunity for social learning than gregarious species. However certain life history characteristics, such as lengthy periods spent in association with mothers prior to independence, may be one avenue for social learning in solitary species. Black bears (*Ursus americanus*) at the interface of wildlands and human-altered landscapes may learn behaviors that help them exploit anthropogenic resources which can cause them to be labeled nuisance bears. A high degree of relatedness among problem individuals could indicate a strong parent-offspring link in the transfer of problematic behaviors (i.e., social learning). Conversely, a weak parent-offspring link may suggest that problem individuals learn from random processes which are not a vital component for the development of such behaviors. We combined genetic data with behavioral data for 116 American black bears (*Ursus americanus*) from the Lake Tahoe Basin and Yosemite National Park, USA, to test the hypothesis that related bears share behavioral patterns. Based on their behavior, we categorized bears as food-conditioned (FC) or non food-conditioned (NFC). We compared levels of relatedness, based on microsatellite DNA genotyping, within and between these groups. The presence of at least one FC relative did not impact whether a bear was FC or NFC and groups of related bears displayed both behaviors. Additionally, we compared behavior between 9 mother-offspring pairs determined through genetic analysis of maternity. In five pairs, cubs did not fall into the same behavioral category as their mother. These data provided evidence that behavior in black bears does not always partition along related lineages. Specifically, maternal behavior did not predict offspring behavior in these populations.

Key Words: behavior, black bear, relatedness, social learning, *Ursus americanus*

SANDIA MOUNTAIN BEARWATCH, A NEW MEXICO BEAR CONSERVATION GROUP

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Abstract: Sandia Mountain BearWatch (SMBW) formed eleven years ago with the express purpose of ensuring a stable population in the state of New Mexico. There are three focus areas:

- <u>public education</u> on living in bear country entails direct mailings, handouts, bear fairs, presentations and other means to keep the issue in the public eye.
- <u>hunt policy</u> entails employing scientifically vetted recommendations presented to policy makers combined with a vast public awareness program made possible by the cooperation of the local press and TV.
- municipal responsibilities on <u>refuse handling</u> has led to formation of a separate 501 (c) 3 corporation that uses grants and private gifts that can assist communities in acquiring bear-resistant dumpsters and to educate their citizens.

SMBW strictly adheres to a number of principals including not opposing bear hunting but vehemently opposing bad policy, not having a creeping agenda, always using science and developing cooperative relationships with all the parties who have a vested interest in the outcome. We have assisted local and state officially as well as Game & fish staff and Commission members discharge their duties and have strived to develop a trustful relationship with all parties.

During the past decade we have assisted Game & Fish in transforming New Mexico's bear hunt policy from reactive and *ad hoc* to a very progressive managed plan that is respectful of both hunter's needs and good conservation. Public awareness is high and progress is being made to bear proof New Mexico municipalities.
http://SandiaMountainBearWatch.org

DIET COMPARISON OF TWO CHIHUAHUAN DESERT BLACK BEAR POPULATIONS

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Abstract: The American black bear (*Ursus americanus)* is a resident species in areas of the Chihuahuan Desert in northern México and adjacent western Texas. We compared the diet of two distinct populations within one Chihuahuan Desert Ecosystem for similarities as well as differences in diet with regard to seasonal movement, dispersal and reestablishing populations in historic habitat in both countries. The Maderas del Carmen is a vast sky island located in northern Coahuila, México directly south of the Big Bend Region of western Texas. The Maderas del Carmen ranges in elevation from > 1000 m to over 2700 m and is characterized by 5 major vegetation types; desert shrub, matorral, sotol-yucca grasslands (*Dasylirion-Yucca-Bouteloua sp.)*, oak-pine (*Quercus-Pinus sp.)* forest, and fir (*Abies sp.)*forest. The Black Gap Wildlife Management Area is located in south Brewster County, Texas and shares a border with the state of Coahuila, México along the Rio Grande. The Black Gap Wildlife Management Area is characterized by 3 major vegetation associations; desert shrub, prickly pear-lecheguilla (*Opuntia sp.-Agave lecheguilla)*, sotol-yucca and oak chaparral with elevations ranging from 484 m above sea level 1403 m. Food items in black bear diets were sampled by scat collection and analysis using point frame analysis (Chamrad et al 1964). Scats (n=290) were analyzed from June 1998 to June 1999 in the Maderas del Carmen of Coahuila, México, and scats (n=452) were analyzed from September 1998 to August 2000 in Black Gap. A total of 28 food items in diet of black bears from the Maderas del Carmen, and 24 items in the diet of black bears from Black Gap Wildlife Management Area were documented. We separated scats into seasonal diet categories for analysis. Results indicated that black bears from both populations had many similarities in diet but certain differences were apparent. Bears in the Maderas del Carmen have a mosaic of habitats that produce a wide diversity; whereas the Black Gap population were restricted to a very xeric habitat with 2 plants being important year round sources; sotol *(D. leiophyllum*) and beaked yucca (*Y. rostrata)*. Elevation differences in the two populations played an important part in food availability; however bear movement was typical in both areas and directly correlated to the ripening and availability of seasonal food sources. The diet in both populations consisted mainly of vegetation, 98% in the Maderas del Carmen and 96% in the Black Gap Wildlife Management Area.

Key words: black bear, Chihuahuan Desert sky island, reestablishing populations, diet, northern México, west Texas, plant diversity. *Ursus americanus*

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BACKPACKER USE OF BEAR-RESISTANT CANISTERS AND LOCKERS AT SEQUOIA AND KINGS CANYON NATIONAL PARKS

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Abstract: When bears enter backcountry campsites to obtain human food, undesirable and potentially dangerous incidents occur. This problem is minimized if backpackers carry their food in bear-resistant canisters or use metal storage lockers. A representative survey of 242 backpacking groups in Sequoia and Kings Canyon National Parks (SEKI), during summer 2003, revealed high (91%) voluntary use of canisters or storage lockers. Voluntary canister users most frequently explained their usage as protecting their food, protecting themselves, keeping the bears wild, or for convenience. Survey results suggest that losing food to a bear also encourages the subsequent use of a canister.

Availability of rental canisters at the trailhead importantly facilitates this storage option. An important minority of backpacking parties (9%) persist in using food hanging, a method easily overcome by SEKI bears, saying that they have always stored food that way, or that canisters are too small and heavy. This user group is sufficiently large that bears continue to obtain human food, and nuisance behaviors persist. To ensure that backpackers universally store food in a way that it is unavailable to bears (i.e. canisters or lockers), regulations may be desirable.

"FOOD STORAGE REGULATION IN THE YOSEMITE WILDERNESS: IMPLICATION FOR BEARS AND BACKPACKERS"

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Abstract: Despite extensive efforts to mitigate conflicts between humans and bears in Yosemite's backcountry, backpackers continue to lose food to bears at a relatively high level, averaging over 100 reported incidents per year for the last five years. Conflicts between backpackers and black bears in the Sierra Nevada are cited as a serious threat to both visitors and managers seeking naturally functioning wilderness systems. In 1998, a low-cost rental program was established in Yosemite National Park that increased voluntary use of bear-resistant food storage canisters and earned canisters widespread acceptance by Yosemite backpackers. Beginning in 2004, Yosemite National Park required backpackers to store their food in approved bear-resistant food storage canisters anywhere within seven miles of a park road and anywhere above 9600 feet; this constitutes a large majority of the park area. Visitor surveys in Yosemite National Park were initiated in 2005 to evaluate the effectiveness of visitors' use of bear-proof food storage canisters in the Yosemite Wilderness.

DEVELOPING AN EDUCATION AND AWARENESS PROGRAM TO REDUCE BEAR AND HUMAN CONFLICT IN YOUR COMMUNITY

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Abstract: Many communities in the west, which are dealing with bear and human conflicts, struggle to get the right messages out to their residents about bears. An effective Bear Education and Awareness Program, whether coordinated by a government agency or NGO, should attempt both to increase public understanding of bears and demonstrate to residents how to coexist with bears through proper management of attractants. This program should involve the entire community to insure that the target audience is getting the right, consistent message at the right time, through the most effective medium.

The primary components of an effective program involve: establishing a means to measure the success of your efforts, coordinating with multiple agencies to track and analyze complaint call data, targeting bear and human conflict "hot spots", development of school education programs, educational media campaigns, including local newspaper, radio and television; and media kits for presentations, signage, display booths, brochures, etc. and making funding for the program self-sustainable.

EVALUATION OF A NEW AVERSIVE CONDITIONING TREATMENT TO MANAGE BLACK BEARS IN YOSEMITE NATIONAL PARK

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Abstract: As a pilot project, we evaluated behavioral responses of food-conditioned black bears (*Ursus americanus*) in Yosemite National Park to a new high level aversive conditioning technique. The new technique consisted of following a single bear for 168 consecutive hours, during which negative stimuli was applied when a target bear came within 50 yards of a developed area. We compared this new technique to the sporadic negative conditioning currently in practice, by using a modified BACI (Before-After/Control-Impact) design in which bears targeted for treatment had pre- and post-treatment data gathered, and non-treatment bears acted as controls for comparison to treatment bears. We measured 3 variables on all bears that entered developed areas in Yosemite Valley: (1) the amount of time bears spent in developed areas, (2) the amount of anthropogenic food attained by bears, and (3) the number of reported human-bear conflicts. We applied aversive conditioning treatments to 3 highly food-conditioned bears and applied sporadic negative conditioning to 8 bears in Yosemite Valley from 18 May to 31 September 2005. During treatment periods, target bears (1) had fewer human-bear conflicts; (2) obtained less anthropogenic food; and (3) spent less time in developed areas compared to pre- and post-treatment data. These results indicate the new techniques may be very effective for short-term management compared to sporadic negative conditioning. However, post-treatment bears quickly returned to developed areas within 1-8 days, and resumed behavior and activity patterns similar to pretreatment periods and control bears. Further research is necessary to boost sample sizes before conclusive statements can be made about the efficacy of this technique.

Key words: Aversive conditioning, black bear, Yosemite National Park, negative stimuli, habituated, food-conditioned

HIGH BLACK BEAR HARVESTS IN A TEMPERATE RAINFOREST

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Abstract: Game Management Unit (GMU) 2, located in southern southeast Alaska, contains some of the highest black bear densities in North America. Recent mark recapture estimates from an adjacent area with similar habitat characteristics suggested bear densities of 2-4 bears per square mile. GMU 2 includes Prince of Wales Island, the 3rd largest island in North America, and a series of surrounding islands. Located in temperate rain forest habitat dominated by Sitka Spruce and Hemlock forest this area has experienced extensive habitat alterations from over 50 years of large scale commercial logging. Along with the abundance of bears, GMU 2 annually produces trophy bears including regular entries into the Boone and Crocket and Pope and Young record books. That combined with over 3,000 miles of drivable roads and extensive beach access along many remote shoreline areas make this an increasingly popular hunting area. Recent hunting magazine articles, cable channel video exposure, and limited black bear hunting opportunities elsewhere have all contributed to the rapidly increasing hunter effort and harvest. Hunter reported harvest has increased 47% during the past 10 years and game managers worry that total mortality may be exceeding sustainable levels especially in some popular hunting areas. Spring harvests are skewed toward large male bears while fall harvests are close to a 50:50 sex ratio.

Key words: Black bear harvest, Southeast Alaska, temperate rain forest, *Ursus americanus*.

FECAL ANALYSIS OF BLACK BEARS IN YOSEMITE VALLEY, YOSEMITE NATIONAL PARK, CALIFORNIA, 2001-2002.

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Abstract: In the absence of hunting pressure, food has long served as the primary link between humans and black bears (*Ursus americanus*) in Yosemite National Park. This relationship is at the heart of bear management in Yosemite National Park, and has only grown more complex over the last 80 years with increasing numbers of visitors and human-bear conflicts (Thompson and McCurdy 1995). Despite intensive efforts to reduce the amount of human food obtained by bears, human-bear conflict numbers have remained high. We estimated annual and seasonal black bear food habits through analysis of feces collected in Yosemite Valley during 2001 and 2002 to determine the extent to which bears are obtaining human-intended food and garbage. We found a 79% reduction in the amount of human food and garbage present in bear scat, indicating that park efforts have been effective. We also found heavy use of non-native apples by bears throughout Yosemite Valley, indicating widespread use of several historic apple orchards. We recommend removal of these orchards, as they appear to be an attractant to bears and may contribute to habituation and eventual food-conditioned behavior.

In the United States, humans and black bears are interacting with increasing frequency as population growth brings people into more remote areas and bears develop a taste for human food items (Thompson and McCurdy 1995, Beckmann and Berger 2003). Indeed, human food has long served as a common denominator between humans and bears, and often resulting in conflict (Beeman and Pelton 1980, Graber 1981, Tate and Pelton 1983, Hastings et al. 1989, Mattson 1990, Wright 1992, Peine 2001). As bears exhibit increasingly sophisticated food-conditioned behaviors, unique challenges are posed for wildlife managers, entrusted with protecting human safety, personal property, and healthy wildlife populations.

Yosemite National Park (YNP) provides a unique opportunity for examining the problems that can arise between humans and black bears where bear populations are protected. It has long been recognized that human presence in YNP, as in other areas of high human use, significantly alters the behavior and ecology of black bears (Rogers et al. 1976, Hastings et al. 1981, Tate and Pelton 1983, Mattson 1990, Keay 1990, Keay 1995, Thompson and McCurdy 1995). Human-black bear conflicts are especially pronounced at the interface of wild and developed areas (Beckmann and Berger 2003), such as the Yosemite Valley (YV) region of YNP. These areas offer the greatest lessons for developing management strategies of both bears and humans.

The National Park Service initiated the Human-Bear Management Program in Yosemite in 1975 to address negative human and black bear interactions (National Park Service 1975, Thompson and McCurdy 1995, National Park Service 2003). Goals of the program included restoring and maintaining the natural distribution, abundance, and behavior of the black bear population; providing for the safety of

visitors and their property; and providing opportunities for visitors to understand, observe, and appreciate black bears in their natural habitat. One element of the plan included research on Yosemite's bears to determine population-level impacts of habituation and food conditioning. A quantification of bear food habits was completed in 1981 (Graber 1981, Graber and White 1983), providing a metric by which to compare this current effort to evaluate the success of the Human-Bear Management Program since 1975 in reducing the amount of human food and garbage available to bears. The goal of our research was to estimate current food habits of bears in Yosemite Valley, and provide Park managers with a means to evaluate their success in reducing the availability of human food and garbage to bears.

A current food habits assessment was also meant to highlight the issue of non-native vegetation in YV and its contribution to human-bear conflict. Several non-native apple orchards and blackberry thickets have become established in close proximity to developed areas throughout the valley, creating potential hotspots for human-bear conflict. Managers have become increasingly concerned that bears may be attracted to the abundance of apples and berries in these areas of high human density, and over time become habituated to the presence of people. Habituation, in turn, may lead to food conditioned behavior, a loss of fear of humans, and aggressive displays, which threaten visitor safety (McArthur Jope 1983). Habituated bears are more likely to be involved in human-bear incidents, may exhibit aggressive behavior toward people, and stand a greater chance of being killed to protect human safety and property (Gilbert 1989, Mattson et al. 1992).

Study Area

Yosemite National Park encompasses approximately 308,000 ha on the west slope of the Sierra Nevada range in central California (Figure 1).

This research was conducted in the approximately 1,800 ha of Yosemite Valley, on the western slope of the park. Average temperatures in Yosemite Valley (1,200 m) range from 12 to 32 C in the summer to -3 C to 8C in the winter; average precipitation is 92 cm/year, 87% of which falls between the months of November and April. The vegetation of the valley is composed primarily of mixed conifer, with prevalent species being ponderosa pine (*Pinus ponderosa*), incense cedar (*Calocedrus decurrens*), and California black oak (*Quercus kelloggii*) (Barbour and Major 1977). The riparian communities of the Merced River and several smaller stream systems that flow into the valley are interspersed with these woodland and forest communities to create a varied valley ecosystem of seasonal wetlands, a fen, steep talus slopes and expansive meadows.

The valley floor ecosystem matrix is heavily impacted by human development. Although the valley comprises only 3% of the Park's area, it receives 90% of the nearly 3.5 million people who visit the Park annually (Keay and Webb 1989, National Park Service Public Use Statistics Office www.aqd.nps.gov/stats). Approximately 45% of the Park's nearly 2,000 campsites and most of the 1,600 lodging units for Park visitors and employees are located in the valley. Accommodations include two major hotels, four restaurants, two swimming pools, tennis courts, horse stables, grocery stores, a bus system and a clinic. Additionally, 62% of human-bear conflicts documented in the Park between 1989 and 2002 occurred in Yosemite Valley (Matthews et al. 2003).

METHODS

Bear scat was collected in YV 20 July - 1 November 2001 and 29 March - 4 November 2002 both opportunistically and on designated transects. Transect areas encompassed representative vegetation types and areas with and without concentrated human use. Each transect was flagged and walked at least twice a month 20 July - 1 November 2001. Scat was also collected

opportunistically while radio-tracking and in areas known to be used by bears. Several Park employees assisted in scat collection in areas where they regularly patrolled, such as in campgrounds and picnic areas.

Designated transects were primarily used in 2001. The purpose of this systematic collection was to more accurately assign scat into seasonal categories. However, this method was found to be inefficient, and often times transects were completely void of scat. In 2002, therefore, we focused on opportunistic collection methods in an effort to increase the collection efficiency. In order to age and thus classify scat into seasonal categories, we observed the drying process of fresh scat samples placed in locales of varying degrees of exposure. Fresh samples were obtained from trapped bears and placed in either direct sun or shade on a variety of substrates, such as grass, rock, and forest floor. Moisture due to rain was not a concern due to a lack of precipitation. Samples were observed once a day and changes to the appearance and texture of samples both exteriorly and interiorly was noted. We were able to age samples confidently by describing the moisture content at the time of collection and efforts were directed at collecting samples less than two weeks old.

This refinement in collection methods facilitated the collection of a greater number of samples because effort was concentrated on areas known to be used by bears. Collection efforts were conducted throughout the Valley every two weeks. Efforts were made to ensure that samples were collected from areas representative of the entire Valley and not only from a few high use areas. This was accomplished through bi-weekly systematic collection efforts and record-keeping of collection results. Telemetry locations of radio-collared bears assisted in the location of day beds and other areas frequented by bears.

Scat for which age could not be determined was also collected from representative areas of YV. Although the data from these samples was not used for the

seasonal analysis of diet, they offered important information for an annual compositional analysis of bear food habits.

We employed the same scat analysis methods used by Graber (1981) to facilitate a comparison of findings between the two studies. Each sample was either oven-dried (2001) or sun-dried (2002), re-hydrated in water with a surfactant, and then passed through a series of sieves (1mm and 0.4mm) to separate out equal-sized particles for identification. Food items were identified macroscopically and with the use of a dissecting microscope. Food items were keyed out to species, when possible. Each item was categorized into one of the following classes: herbage (including roots, stems and leaves); reproductive plant parts (including flowers, fruit, or seeds); human foods (including garbage and human-intended food); animal matter; debris (including items inadvertently consumed, such as wood, bark, stones, and pine needles).

Black bear food habits were quantified by determining the average proportional contribution of herbage, reproductive plant parts, human-provided foods, animal matter, and debris in collected scat samples within two-week intervals and annually. Seasonal analysis was completed by grouping scat samples of known-age into two-week intervals. The proportion of samples within each period containing major forage class items was graphed and seasonal patterns analyzed. The traditional seasonal divisions of spring, summer and fall were used following Graber (1981).

Percent volume of each food item class was measured by water displacement to the nearest 1%. Volumetric analysis alone tends to overestimate the proportion of herbage eaten and underestimate more easily digested reproductive plant parts and animal foods (Hatler 1972, Poelker and Hartwell 1973, Mealey 1980, Graber 1981, Graber and White 1983). To provide a more accurate assessment of food habits, the percent frequency of food items was also calculated. Percent frequency of occurrence was calculated as the percent of total scat

samples in which an item comprised at least 1% of the volume of a sample (Graber 1981, Graber and White 1983). Percent frequency of occurrence and percent composition by volume were reported separately and compared to Graber (1981) and Graber and White (1983) where possible.

Graber and White (1983) quantified black bear food habits within three elevation classes throughout YNP: below 1,800 m; 1,800 to 2,400 m; and above 2,400 m. Although they did not quantify bear food habits in YV independent of other areas below 1,800 m, this elevation class included the Valley, much of the region surrounding Hetch Hetchy Reservoir, and Wawona. Graber (1981) did quantify food habits for YV specifically, but only as the proportion of major forage classes in bears' diets by percent volume. For this single expression of data, we were able to make direct comparisons between studies.

RESULTS

A total of 500 scat samples were collected and analyzed from YV during 2001 and 2002. Seventy-nine of the 162 samples collected in 2001 and 198 of the 338 samples collected in 2002 were aged to within two weeks and used for seasonal diet analysis. The rest of the samples fell into annual categories and were analyzed to complement the analysis of overall diet composition.

Annual Diet Composition

Vegetative and animal matter composed 80% and 3% of fecal remains by volume of bears in YV, respectively. Human food and garbage and debris (including unidentified matter) made up the remaining 6% and 10%, respectively (Table 1).

Reproductive plant parts were the most prevalent items in fecal remains of black bears in YV, comprising an average 51% of fecal volume and present in 83% of all scats annually (Table 1). Reproductive plant parts primarily included apple (*Malus* spp.), Western raspberry (*Rubus leucodermis*), Himalayan blackberry (*Rubus himalaya*), manzanita (*Arctostaphylos* spp.) and acorn (*Quercus* spp.). Apples, non-native to the Park, were prevalent in the fecal remains of YV bears (Figure 2), comprising an average of 30% fecal volume, and were represented in 57% of all samples. Other food items used in this forage class were blue elderberry (*Sambucus mexicana*), western chokecherries (*Prunus demissa*), coffeeberry (*Rhamnus* spp.), dogwoods (*Cornus* spp.), gooseberries and currents (*Ribes* spp.), thimbleberries (*Rubus* spp.), and Sierra plum (*Prunus subcordata*).

Herbage was the second most prevalent forage class, comprising 29% of fecal volume and present in 44% of all samples (Table 1). Herbage included graminoids and graminoid-like plants such as sedges and rushes, leaves and stems, and forbs. The most common food items in this forage class were graminoids, comprising 25% of total scat volume and present in 38% of all samples (Table 1). Frequently consumed graminoids included *Poa* spp., *Avena* spp., and *Agrostis* spp. species. Frequently consumed forb species during our study included *Trifolium* spp., *Montia* spp., and *Lupinus* spp. Horsetail (*Equisetum* spp.) was present in 2.2% of all samples. Yampah (*Perideridia* sp.) and an unidentified mushroom were found in at least one sample each, and club moss (*Isoetes* spp.) was present in trace amounts during the spring.

Human-provided food and garbage comprised an average 6% of the fecal volume and was present in 22% of all samples (Table 1). Animal matter comprised 3% of total scat volume and was found in 35% of all scat samples collected (Table 1). Debris and other non-food items comprised an average of 10% of fecal volume. These items were primarily wood, bark, pine needles, and rocks.

Insects were the most common animal matter detected in scat samples, making up 1.1% of the total volume and present in 28% of all samples (Table 1). Insects of the families *Vespidae* (wasps), *Apiae* (bees), *Isoptera* (termites) and *Formicidae* (ants), especially carpenter ants

(*Campanotus* spp.), were the most represented animal food items. Other identifiable animal remains found in scat samples were rodent hair and bones (including one specimen from the *Muridae* family), mule deer (*Odocoileus hemionus*) hair and bones, raccoon (*Procyon lotor*) hair, bird feathers, and fish bones. A Park employee in wildlife management witnessed a male bear chase, kill and feed on a mule deer buck in YV in the early fall of 2002. Findings from this study indicate that the composition and prevalence of herbage in bears' diets has changed little since Graber's work in the late 1970's (Tables 2 and 3) (Graber 1981, Graber and White 1983). Results from this study also indicate comparable use of animal matter to the findings of Graber and White (1983) (Tables 2 and 3). In YV, Graber (1981) reported that human foods comprised an average of 21% of scat volume in comparison to our finding of 6% (Figure 2).

Seasonal Diet Composition

Bears in YV varied their diets seasonally (Figures 3 and 4). Herbage was the most prevalent forage class in the spring, giving way to reproductive plant parts in the summer and fall (Figures 3 and 4). Apples comprised the majority of reproductive plant parts detected from mid-June through the end of September. In the summer months of late June to September, apples occurred in 79% of scat samples, and averaged 60% of dietary volume. Use of human food peaked from late June to early September, reflecting human visitation numbers to YV (Figures 3, 4, and 6). Acorns, which comprised the hard mast forage class, became a prevalent food source for bears around the middle of September (Figures 3 and 5), and comprised an average 41% of fecal remains during the month of October.

Animal matter comprised 0.6%, 2.0%, and 4.7% of total scat volume during spring, summer and fall, respectively. During these periods, animal matter was present in 26.7%, 28.8%, and 54.1% of scat samples, respectively (Table 1). This seasonal pattern can be largely attributed to fluctuations in the use of insects by bears, as the frequency of occurrence of other animal matter remained relatively consistent throughout the year. Use of other animal matter by percent volume was comparatively low during the spring season, averaging less than 1% of scat volume. Insects were found relatively consistently throughout the spring and summer, present in 17.8% and 19.9% of samples and comprising 0.5% and 0.8% of total scat volume, respectively. However, the apparent use of insects by bears nearly doubled in the fall. This finding was due to a high number of insects used in the fall of 2001. In 2002, for comparison, use of insects was relatively consistent throughout the summer and early fall.

DISCUSSION

Fecal analysis provides insight into the diet of animals, but is far from being an accurate measure of food habits. Differential digestibility of diet items has the effect of deemphasizing foods that are well-digested in the analysis of feces. Hewitt and Robbins (1996) reported figures illustrating the differences between actual food habits, fecal volume, and assimilated diets of grizzly bears and developed correction factors to address the diet-feces discrepancy. These were not employed for two reasons. Firstly, they were developed for grizzly bears with a greater dietary dependence on animal matter; secondly, they were not developed to include consumption of human foods and garbage. Since Graber (1981) estimated food habits of bears through analysis of feces, it is appropriate that we use the same measure to compare results of the two studies. Therefore, the conclusions based on these findings provide a measure of fecal habits, rather than food habits.

Results from this study indicate that reproductive plant parts, mainly from non-native flora such as apples, are the most consumed forage class of bears in YV, and that consumption of human food and garbage by black bears has decreased by more than 70% since the late 1970's. The

current seasonal diet of black bears in YV is very similar to the findings reported for Yosemite (Graber 1981, Graber and White 1983) and other regions of North America (Beeman and Pelton 1980, Grenfell and Brody 1983, Hellgren and Vaughn 1989, Stubblefield 1993, Boileau et al. 1994).

Annual Diet Composition

The finding that reproductive plant parts comprise the forage class most consumed by bears in YV is consistent with those of Graber and White (1983), who reported reproductive plant parts as the greatest contribution to bears' diets (41%) in regions below 1,800 m in YNP (Table 3). Graber (1981) reported similar results for YV specifically, where reproductive plant parts comprised 54% of bears' diets (Table 3).

Similar to current results, Graber and White (1983) reported use of manzanita berries, acorns, apples, and pears (*Pyrus* spp.) in YV, and pine nuts (*Pinus* spp.) and bitter cherries (*Prunus emarginata*) at higher elevations. Dogwoods, gooseberries, currants, blackberries, raspberries, thimbleberries, coffeeberries, western chokecherries, serviceberries (*Amelanchier* spp.), snowberries (*Symphoricarpos* sp.) and huckleberries and bilberries (*Vaccinum* spp.) were also reportedly found, but each comprised less than 1% of scat volume. The list of fruits represented in these samples were similar to those found by Graber and White (1983), with the exception of pine nuts, bitter cherries, serviceberries, snowberries, huckleberries, and bilberries. Graber and White (1983) similarly reported use of yampah at elevations between 1,800 and 2,400 m in YNP and noted that the roots were an important source of starch for Native Americans inhabiting Yosemite. Mealey (1980) also reported the use of yampah by bears in Yellowstone National Park. In agreement with current findings, Holcroft and Herrero (1991) report use of moss, but considered it to have been ingested incidentally.

Intensive use of fruits, nuts, and seeds as they became available has also been reported in black bear food habits studies in Pennsylvania (Bennett et al. 1943), Tennessee (Beeman and Pelton 1980), California (Grenfell and Brody 1983; Stubblefield 1993), Idaho (Beecham and Rohlman 1994), and Québec (Boileau et al. 1994). Considerable use of berries, especially *Rubus* species, was also reported in Alberta, Canada (Holcroft and Herrero 1991), and North Carolina (Hellgren and Vaughn 1989). Bears' use of herbage in YV is also consistent with food habits studies throughout North America, varying in species composition and depending on geographical location (Landers et al. 1979, Maehr and Brady 1984, Hellgren 1993).

The apple orchards provide consistent food for bears in close proximity to the developed areas of YV during peak human visitation. Not surprisingly, bears have frequented the orchards of YV for decades (Beatty 1943, Thompson and McCurdy 1995). Similar to the open-pit dumps of the nineteenth and twentieth centuries, the apple orchards may be serving as sites for habituation of YNP's black bears, by providing a unique opportunity for Park visitors and employees to view bears foraging (Beatty 1943, Graber and White 1983). Other researchers have documented bears making consistent use of "wild" trees, abandoned, and maintained orchards, more often during years when native bear foods are in short supply (Bennett et al. 1943, Mattson 1990).

It is important to note that these data reflect bears' use of apples only while bears are present in YV. Since scat samples were only collected from areas within the Valley, these results do not depict the overall diets of bears that also forage outside of YV. Furthermore, these results may, in part, reflect researcher bias in collection efforts. Although collection efforts remained constant throughout all areas of YV, the orchards yielded high numbers of samples during the period when apples were ripe. Many bears frequented the orchards during this time, and fresh samples were easy to locate.

Himalayan blackberries, another non-native food source, were consumed in great quantities while seasonally available. Despite efforts to distinguish their seeds from those of the native raspberry with the use of a seed reference collection, we were not able enough to draw conclusions on the use of this contentious non-native species. However, radio telemetry relocations of bears in YV suggested heavy use of blackberries while the fruits were available in mid-summer.

Results from this research indicate that bears are consuming about one-third the amount of anthropogenic foods as they were 25 years ago. Such a decrease in the amount of human food in bears' diets suggests that Park Service efforts to reduce the availability of human food to bears have been effective. Indeed, the Park has taken extensive measures to ensure that campers' food is stored in ways that prevent bears' access to it, and addressed issues of garbage handling and management.

Another gauge by which to measure the success of the YNP Human-Bear Management Plan is an analysis of the number of human-bear incidents in YV over time. Concurrent with a reduction in the amount of human food and garbage consumed, one would expect a decline in the number of human-bear incidents. Harms (1980) and Keay and Webb (1989) assessed incident numbers for the entire Park between 1974 and 1978, the period during which Graber (1981) and Graber and White (1983) collected their food habits data. Over these 5 years, human-bear incidents averaged 683 per year parkwide. Matthews et al. (2003) assessed human-bear incident numbers for the entire park and YV during 2001-02. For these two years, incident numbers averaged 395 for the entire park and 263 per year in YV.

Such a decrease in human-bear incident numbers may be the result of greater funding directed at the bear program since 1999. In that year, Congress appropriated $500,000 annually to the YNP Bear-Management Plan with which to address much-needed staffing and equipment demands. Funds were used to staff additional bear-related positions, purchase and install food storage lockers, improve public information, and conduct research. An organization with representatives from each park division and park cooperators was also formed to coordinate the Human-Bear Management Program.

Longer-term monitoring is necessary to determine the continued success of the Human-Bear Management Plan. However, the reduction in the amount of human food and garbage consumed by bears and in the number of human-bear incidents recorded in 2001-2002 suggests that the plan has achieved some levels of success. Measures such as bear-proof trash cans, dumpsters, recycling cans, and food storage containers, as well as an intensive educational campaign may have contributed to this (Lackey In Press). Additionally, YNP employs interpretive rangers to patrol campgrounds each night, law enforcement rangers to enforce food storage regulations, and 24-hour bear management patrols during the busiest summer months to respond to incidents and use aversive conditioning practices on bears in developed areas.

Human food and garbage has been documented as a large proportion of the diet of black bears in other locales, especially in areas of high human recreational use. Garbage made up 33% of the diet and was found in 55% of the scats of black bears in the San Gabriel Mountains of southern California (Stubblefield 1993). Beeman and Pelton (1980) and Grenfell and Brody (1983) found garbage and other anthropogenic foods made up as much as 6 and 4% of the annual diet of black bears in the Great Smoky National Park and in the Tahoe National Forest, California, respectively.

Garbage consumption by bears was reported to be insignificant on study sites in Trinity and Placer counties in California (Sitton 1982) and in Florida (Maehr and Brady 1984), but made up 5-10% of the diet of bears on a site in Tulare County, California (Sitton 1982). No human food or

garbage was reported in bear scat collected in northern California (Piekielek and Burton 1975), Big Bend National Park (McClinton et al. 1992, Hellgren 1993), southeastern North Carolina (Landers et al. 1979), northern or west-central New Mexico (Costello et al. 2001), northwestern Wyoming (Irwin and Hammond 1985), and Gaspésie Park in eastern Québec (Boileau et al. 1994). In comparison to YNP, these areas typically had smaller black bear populations and/or less human recreational pressure.

Consistent with the results of Graber and White (1983), we found the volume of insects almost equal to the volume of all other animal matter consumed. However, both studies found that insects were present in nearly three times as many samples as other animals. Overall, wasps, ants, and termites made up the largest contribution of insect matter to fecal remains of bears in YV. Many food habits studies have reported colonial insects as the most common animal matter used by of black bears throughout North America (Hatler 1972, Landers et al. 1979, Grenfell and Brody 1983, Maehr and Brady 1984, Hellgren 1993, Beecham and Rohlman 1994, and Boileau et al. 1994). Ants, specifically, have been reported as the most common insect species eaten by bears in Texas (Hellgren 1993), North Carolina (Landers et al. 1979, Hellgren and Vaughn 1989), Virginia (Kasbohm et al. 1995), Minnesota (Noyce et al. 1997), Quebec (Boileau et al 1994), Yukon (MacHutchon 1989), Alberta (Holcroft and Herrero 1991), and California (Grenfell and Brody 1983). Graber and White (1983) also reported ants, especially carpenter ants, to be the most heavily used insect in YNP. In contrast, we found wasps (*Vespula* spp.) to be more common in bear scat in YV, in part due to high numbers consumed in fall 2001. Wasps have been known to show strong annual variation in population numbers (Graber and White 1983), and it is possible that 2001 was characterized by high numbers of wasps in YV. Beeman and Pelton (1980) also found greater numbers of wasps than any other insects in bears' diets in the Great Smoky Mountains of Tennessee.

Bull et al. (2001) hypothesized that bears in Oregon consumed more insects to compensate for a shortage in fruit during one year of their study, and suggested that insects provided a compensatory food source when other resources were scarce. Likewise, Beecham and Rohlman (1994) found insects to be most important to bears during drought years. The relatively lower number of ants in my samples may be due to the abundance of other food sources in YV. YV is known to provide excellent bear habitat and was characterized by an abundance of herbaceous matter, soft mast, and acorns during the two years of this study.

Seasonal Diet Composition

Results from this study on seasonal diet composition were consistent with the general food habits of black bears previously described in Yosemite (Graber 1981, Graber and White 1983), California (Stubblefield 1993), Arizona (LeCount et al. 1984), the Great Smoky Mountains National Park (Beeman and Pelton 1980, Eagle and Pelton 1983), the Adirondacks of New York (Costello 1992), North Carolina (Landers et al 1979, Hellgren and Vaughan 1989, Hellgren 1993), Idaho (Beecham and Rohlman 1994), Virginia (Kasbohm et al. 1995), Florida (Roof 1997), and Québec (Boileau et al. 1994).

In general, the scat of black bears in YV was dominated by graminoids and other herbaceous matter in the spring, soft mast in the summer, hard mast in the fall, and animal matter and anthropogenic foods throughout the foraging season. These results were consistent with the seasonal food habits of black bears throughout North America. Other researchers found that herbaceous matter made up the majority of bears' diets in spring (Grenfell and Brody 1983, Hellgren and Vaughan 1989, Costello 1992, Boileau et al. 1994). Soft mast including reproductive plant parts, such as berries and fruits, dominated summer diets (Grenfell and Brody 1983, Boileau et al.

1994). Hard mast, including acorns, beechnuts (*Fagus grandofolia*), saw palmetto (*Serenoa repens*), black gum (*Nyssa sylvatica*), and hickory (*Carya* spp.) comprised the majority of foods eaten during the fall (Landers et al. 1979, Beeman and Pelton 1980, Grenfell and Brody 1983, Maehr and Brady 1984, Hellgren and Vaughn 1989).

In YV, the predominance of apples in bears' scats during the late summer and early fall periods is of interest, reflecting the abundance of this non-native species. Coinciding with bears' hyperphagia period, the ripening of apples in YV appeared to offer bears a reliable and concentrated food source obtained without a major investment in foraging time. We also found manzanita to be a prevalent fruit detected in the late summer, similar to the findings of several other California studies (Graber and White 1983, Grenfell and Brody 1983, Stubblefield 1993). Manzanita appeared to be eaten in all stages of its phenology, as seeds appeared in scat in the early spring before berries were ripe. Bears may either have eaten unripe berries early in the season, fed on dried berries from the previous year (Grenfell and Brody 1983), or been targeting the leaves of the plants. This study indicated that bears in YV used coffeeberry exclusively in the fall, as did Stubblefield (1993) in southern California.

The percent frequency of occurrence of human food and garbage was highest in the feces of bears in the summer months and lowest in the spring after den emergence. These results were consistent with visitation numbers to YNP and the number of overnight visitors to YV (Figure 6) (National Park Service Public Use Statistics Office www.aqd.nps.gov/stats). Results from this study were consistent with those of Grenfell and Brody (1983) who reported garbage consumption to be high during summer months in the Sierras, coinciding with frequent bear disturbances in campgrounds. Beeman and Pelton (1980) also reported anthropogenic food consumption by bears was correlated with

visitor use of Great Smoky Mountains National Park.

Animal matter, other than insects, was used fairly consistently, albeit in apparently low quantities, throughout the year. These findings were consistent with the seasonal use of animals in Tennessee (Eagle and Pelton 1983), Oregon (Bull et al. 2001), Wyoming (Irwin and Hammond 1985), North Carolina (Landers et al. 1979), and the Yukon (MacHutchon 1989). Results from this study indicate that insects, specifically, were consumed least in the spring and with increasing frequency and in greater volumes in the summer and fall. These findings were not consistent with those of Graber and White (1983), who reported a steady use of insects throughout the year (Tables 1.1 and 1.2).

Analysis of the use of insects by bears in YV was influenced by data from a single year. Bears made greater use of wasps in the fall of 2001 compared to 2002. As a result, findings for 2002 indicate more consistent use of insects across seasons than for the two years combined. Wasp population numbers may have been cycling high in 2001 making them abundant for consumption by bears during that year (S. Thompson, National Park Service, personal communication). Wasps were reportedly used most intensively during the late summer and fall seasons in Florida (Maehr and Brady 1984), Tennessee (Beeman and Pelton 1980), Virginia (Kasbohm et al. 1995), North Carolina (Landers et al. 1979), Alaska (Hatler 1972), Alberta (Holcroft and Herrero 1991), Wyoming (Irwin and Hammond 1985), and California (Grenfell and Brody 1983).

MANAGEMENT RECOMMENDATIONS

Based on this study of black bear food habits in YV, we offer the following recommendations in support of YNP efforts to reduce the number of human-bear conflicts in YV and ensure the long-term survival of wild bear populations in YNP.

Apples from the three historic orchards and other trees located throughout YV were an important food source for bears from mid-June until the end of September. YNP receives approximately 58% of its annual human visitation during this period (National Park Service Public Use Statistics Office www.aqd.nps.gov/stats). The apple orchards provide a food source for bears in close proximity to the developed areas of YV and serve as potential sites for habituation. If the goals of YNP are to continue to reduce human-bear interactions, we recommend that YNP proceed with the management goals of the Yosemite Valley Plan to remove the historic Curry Orchard (National Park Service 2000). Similarly, trees should be incrementally removed from the Lamons and Hutchings Orchards. The current Yosemite Valley Plan calls for the retention and management of Lamons Orchard in order to preserve it as an historic and cultural resource. Hutchings Orchard is also slated to be retained, but not managed. Of the three orchards mentioned in the Yosemite Valley Plan, Curry Orchard is the most egregious because it also serves as a parking lot. Therefore, its removal should be of highest priority. Although Lamons and Hutchings Orchards are not developed, their proximity to developed areas and high levels of human use could be attracting bears to YV and contributing to habituation and human-bear conflicts.

Historically, immediate and complete removals of non-native food sources have been followed by increases in the number of human-bear conflicts in Yosemite (Beatty 1943) and Yellowstone (Craighead et al. 1974, Knight and Eberhardt 1985, Mattson et al. 1990) National Parks. Thus, a gradual reduction in the availability of apples through the immediate removal of the Curry Orchard and the incremental removal of trees from Lamons and Hutchings Orchards would allow for a more gradual transition for bears from apples to alternate, natural food sources. Enforcement of food storage regulations and aversive conditioning will be critical, following the removal of Curry Orchard, as bears accustomed to foraging on apples seek out alternate food sources.

If the goal to reduce human-bear conflict cannot be achieved through gradual reduction of all orchards, our recommendations include continued proactive management of the orchards. Current orchard management practices include the mechanical removal of mature fruit from trees using aerial trucks, ladders, and rakes. The fruit is collected off the ground and disposed of in bear-proof dumpsters. These efforts should continue in order to minimize the impacts of the orchards on bear activity and foraging behavior, as called for in the Yosemite Valley Plan (National Park Service 2000). In addition, the management of the orchards should include efforts to minimize bears' exposure to human presence by regulating access to the orchards and providing interpretive opportunities.

Finally, we recommend continued vigilance in implementing management strategies, in conjunction with research and monitoring to measure the success of YNP efforts. Results from this study indicate that current practices are effective in reducing the amount of human food and garbage available to bears in YV. YNP managers should continue to adapt and improve their management tools to address changing circumstances. Management efforts should focus on constantly upgrading proactive educational campaigns aimed at visitors and employees alike (Lackey and Ham 2003, Lackey In Press), strict enforcement of food storage regulations, waste management practices, and continued investigation of bear food habits in YV. Continued assessments of the diets and foraging behavior of bears will assure the best management practices aimed at reducing human-black bear conflicts and ensuring wild bear populations in YNP.

ACKNOWLEDGEMENTS

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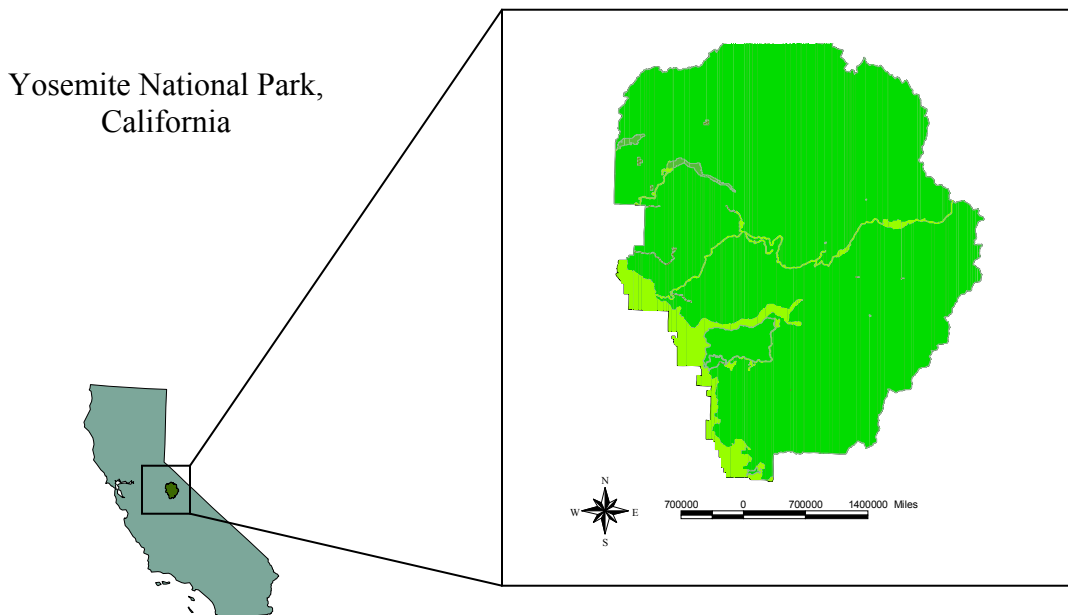
Figure 1. Yosemite National Park, California, USA.

Yosemite National Park, California

Figure 2. Percent volume of black bear food items in Yosemite Valley, Yosemite National Park, California, 1974-78 and 2001-02.
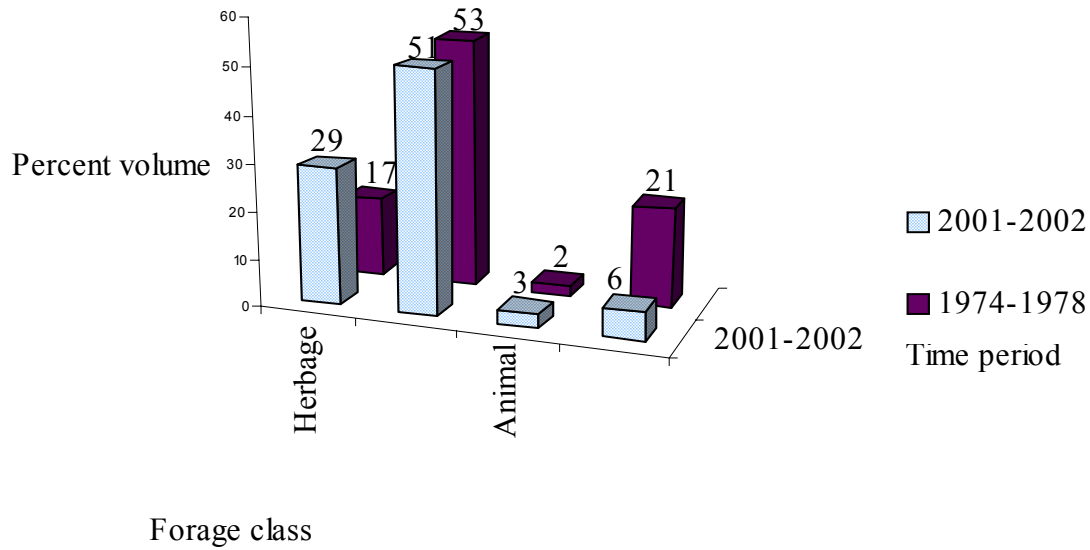

Figure 3. The spring (n=44), summer (n=137), and fall (n=96) percent frequency of occurrence of major forage classes used by black bears based on scat analysis in Yosemite Valley, Yosemite National Park, California, 2001 and 2002.
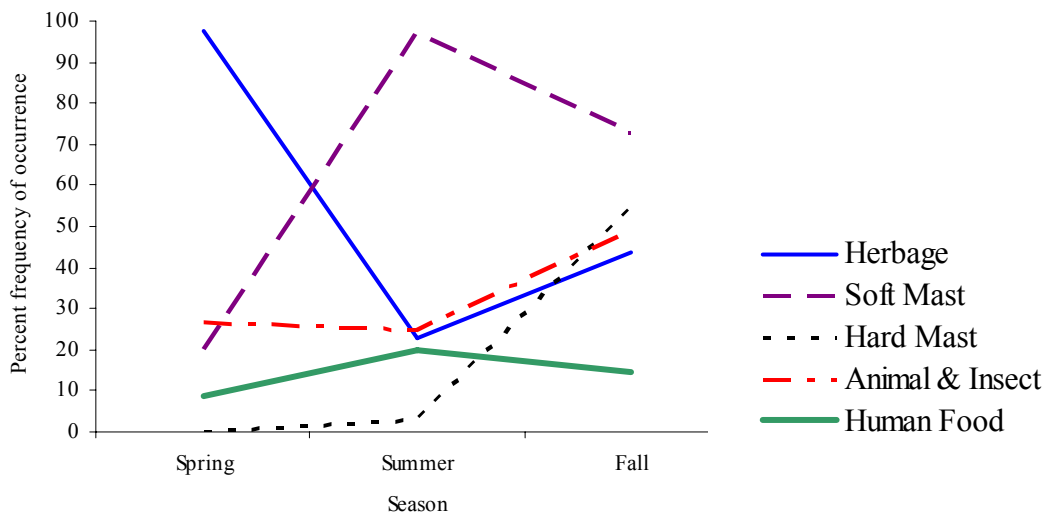
Figure 4. Percent volume of major food classes used by black bears by two week intervals 15 March - 4 November in Yosemite Valley, Yosemite National Park, California, 2001 and 2002.
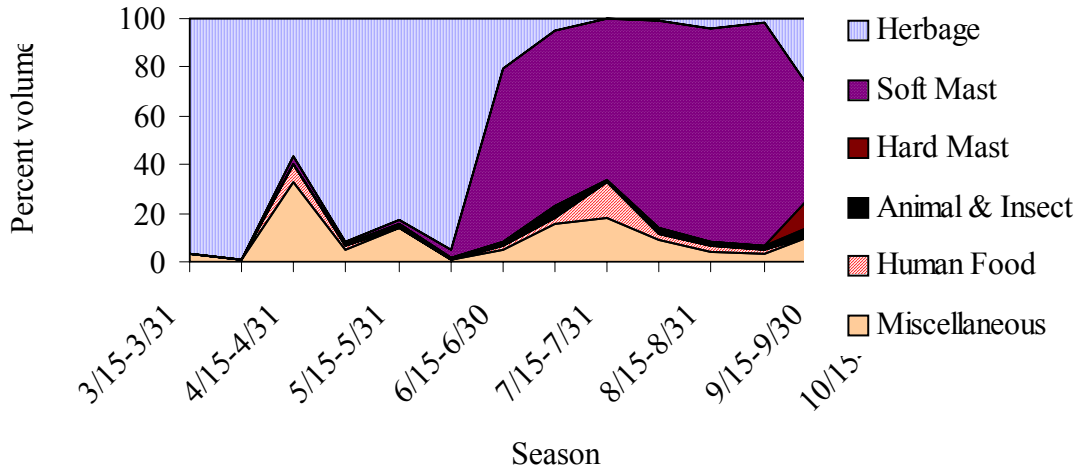

Figure 5. Average percent composition of food items in black bear diets in Yosemite Valley, Yosemite National Park, California, 2001-2002.
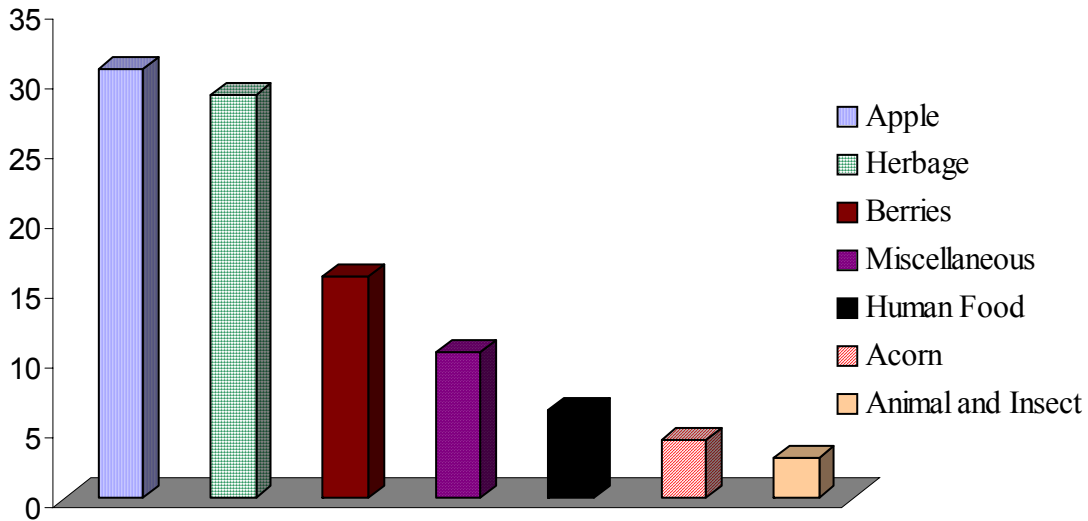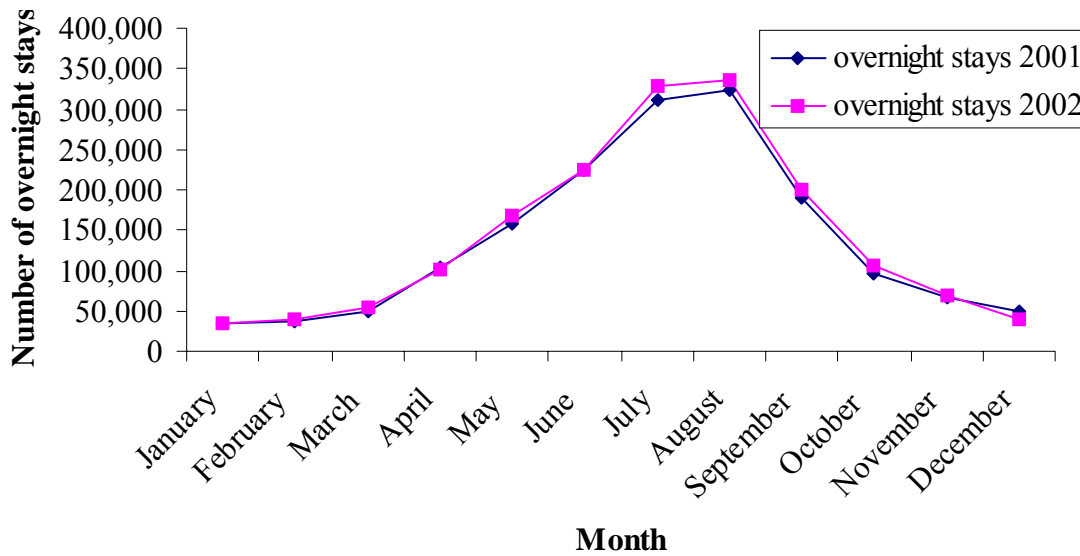
Figure 6. Overnight visitation to Yosemite National Park by month, 2001 and 2002.

Item	Spring (n=45)		Summer (n=136)		Fall (n=96)		Annually (n=500)	
	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.
Reproductive plant parts	2.4	20.0	81.1	97.8	75.7	97.9	51.1	82.8
Acorns	0.0	0.0	0.7	2.8	30.5	54.2	4.3	13.8
Apples	1.6	11.1	59.5	79.1	38.5	57.3	30.8	57.2
Berries and other fruit	<0.1	8.9	20.9	39.7	6.7	27.1	16.0	38.0
Herbage	89.3	97.8	4.3	22.8	6.1	43.8	29.0	44.0
Grasses, sedges, rushes	86.3	95.6	3.6	16.9	4.0	35.4	25.2	37.6
Forbs	3.0	17.8	0.7	9.6	2.1	24.0	3.7	15.2
Animal matter	0.6	26.7	2.0	28.8	4.7	54.1	3.0	35.4
Insects	0.5	17.8	0.8	19.9	2.7	40.6	1.1	28.0
Other animals	<0.1	8.9	1.2	8.9	2.0	13.5	1.8	11.8
Human-provided foods	0.7	8.9	3.1	19.9	1.5	14.6	6.4	22.4
Debris	4.8	73.3	6.5	52.2	7.1	52.1	7.7	58.0
Unidentified matter	2.2		2.3		3.7		2.9	

Table 1. The percent volume and percent frequency of occurrence of food items found in black bear scats (n=500) collected in Yosemite Valley, Yosemite National Park, California, 2001 and 2002. Listed items within each category comprised at least 1% of total scat volume.

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Item	Spring (n=420)		Summer (n=897)		Fall (n=81)		Annually (n=1,404)	
	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.
Reproductive plant parts	15	46	21	47	64	89	22	49
Arctostaphylos spp.	5	17	9	22	11	25	7	18
Acorns	9	13	4	7	11	17	6	9
Apples and Pears	<1	1	3	4	25	30	3	5
Pinus spp.	<1	1	1	2	7	17	1	3
Prunus emaringata	<1	1	2	4	5	14	1	4
Herbage	65	85	51	68	12	33	53	71
Grasses, sedges, rushes	43	70	35	58	10	30	36	60
Forbs	11	25	12	26	2	7	11	25
Animal matter	4	43	5	46	5	43	5	44
Insects	2	32	3	35	1	25	2	33
Other animals	2	9	2	9	3	18	2	10
Human-provided foods	11	29	17	31	9	21	15	30
Debris	3	30	5	29	9	27	5	29
Unidentified matter	1	2	1	2	3	5	1	2

Table 2. The percent volume and percent frequency of occurrence of food items found in black bear scats (n=1,404) collected in Yosemite National Park, California, 1974 to 1978 (Graber 1981). Listed items within each category comprised at least 1% of total scat volume.

Item	Areas below 1,800m in elevation	Yosemite Valley
Herbage	35	17
Reproductive plant parts	41	53
Animal and Insect	3	2
Human Food	16	21

Table 3. The percent volume of food items in black bear scat samples collected in areas below 1,800m in elevation and in Yosemite Valley, Yosemite National Park, California, 1974 to 1978 (Graber 1981). Listed items within each category comprised at least 1% of total scat volume.

REPRODUCTIVE RATES OF HUMAN-HABITUATED FEMALE BLACK BEARS AT WHISTLER SKI RESORT IN SOUTHWEST BRITISH COLUMBIA, 1996-2005

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Abstract: Reproductive rates were compared for 22 human-habituated female black bears (*Ursus americanus*) utilizing different clumped-food sources (Whistler Municipal Landfill and Whistler-Blackcomb Mountains alpine ski area) with dissimilar levels of human food and huckleberry (*Vaccinium* spp.) availability from 1996 to 2005 at Whistler Ski Resort in southwest British Columbia. Methodology were based on high resolution photo-identification during systematic counts, focal monitoring of reproductive behaviors, non-evasive collection of live weights, surveys of maternal dens, DNA-sampling of known animals, bear behavior ranking index for human-habituation, and huckleberry phenology. Reproductive rates differed between the two areas, with a rate of 1.30 for landfill females and 0.70 for ski area females. Landfill females consumed more human foods annually, than ski area females. Ski area females accessed human foods from commercial and residential garbage bins in Whistler Village and valley bottom during fall, in response to shortages in the berry crop. Landfill females had seasonal access to human foods from within a semi-operating electric enclosure, open construction dump, and garbage bins stored on the outside of the electric fence at the Whistler Landfill. Average spring litter size for landfill females was 2.3 and remained stable despite efforts to bear-proof the landfill. Average spring litter size for ski area females was 1.7 which fluctuated depending on reproductive cycle and availability of the fall berry crop. Ski area females had access to higher concentrations of berries but at lower berry days (number of days ripe berries available) and landfill females had access to lower concentrations of berries but for higher berry days. Despite a short distance of 5-10 km between the ski area and the landfill, resident females remained independent of each clumped-food source area. Correlations of weight gain, berry days, and human-food consumption with female bear behavior and reproductive rate is analyzed and discussed.

Key words: *Ursus americanus*, black bear, reproduction, weight gain, behavior, habituation, *Vaccinium* spp., landfill, ski area, Whistler, southwest British Columbia.

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