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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 1940s and 1950s 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 1940s y 1950s, 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 especie en peligro de extinción. La población de oso negro se esta recuperando, particularmente en Coahuila. Nuestro sitio de estudio 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 1940s and 1950s 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 (1956:298) also stated that “The bear population is slowly being reduced because the animal is shot at every opportunity.” Leopold (1959:412) 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 1950s 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 subcommittee—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) listed 16 subspecies of black bears for North America, the original subspecies described as ranging in Coahuila was *U. a. eremicus*, currently only two 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 Texas Parks and Wildlife’s 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, Abstracts from the 13th International Conference on Bear Research and Management, Jackson Hole, Wyoming). The importance of these two studies in relation to northern México was the documentation of three 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 five 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 that there may be two main travel or 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 five-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 which ranges in elevation from $\geq 1,000$ m to $\geq 2,700$ 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 five major vegetation associations: desert shrub, chaparral (matorral), grasslands, forest (oak-pine) 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 antispybilitica*). The transition zone is dominated by beaked yucca (*Yucca rostrata*), giant white dagger (*Y. carnerosana*), sotol (*Dasyllirion leiophyllum*), beargrass (*Nolina erumpens*) and native grasses (*Bouteloua* and *Aristida*). The canyons and higher elevations are dominated by oaks, junipers, and several species of pine. The highest elevations are dominated by Douglas fir (*Pseudotsuga menziesii*) 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°C 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 or 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) placed subcutaneously between the shoulder blades. We remain at the capture site with each bear until it is 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 Estadística Geografía e 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 Department and Big Bend National Park. 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 four 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 on at a given time of the year. Acorns are an important fall food source when bears are building fat reserves for winter hibernation. Twenty oaks of several species (*Q. gravesi*, *Q. laceyi*, *Q. grisea*, *Q. mobriana*, *Q. arizonica*, *Q. rugosa*) were randomly selected and marked to document acorn production over a five-year period. Oaks were assigned a numerical score of 0 to 3 for mast production: 0 being no production, 1 being light production with $< 1/4$ of the tree producing acorns,

2 being medium production with $\geq \frac{1}{2}$ of the tree producing acorns, and 3 being heavy production with $\geq \frac{3}{4}$ of the tree producing 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 through February), spring (March through May), summer (June through August) and fall (September through November). Delgadillo (2001) identified 23 species of plants and animals in bear diets in the higher elevations of Maderas del Carmen.

PRELIMINARY RESULTS—Trapping began 8 November 2003 and three 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, four adult males, seven yearlings (five males, two females) and two adult females were captured from April to September 2004. Preliminary sex ratio for the 2003 to 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 one 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 five 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 five 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, agarito (*Berberis trifoliolata*) berries, grasses, point-leaf manzanita (*Arctostaphylos pungens*) berries, yucca hearts, and Wright's tickclover. Fall food items included acorns, Mexican persimmons (*Diospyros texana*), prickly pear cactus tunas, Tracy hawthorne (*Crataegus tracyi*) apples, and Texas madrone (*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 where we have successfully rehabilitated and released four cubs in two 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, will 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 to cross the international border as well as into adjacent areas in México.

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