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Overview of El Carmen Project, Maderas del Carmen, Coahuila, México

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ABSTRACT—Maderas del Carmen is 165 km northwest of Muzquiz, Coahuila and south of the Big Bend region of western Texas. This sky island has long been recognized for its diversity in fauna, flora, rare and endemic species. However, it is an ecosystem that was exploited for many years by mining, logging, overgrazing, and unregulated hunting. CEMEX has purchased, or has under conservation agreement more than 87,000 ha with the objective of habitat and native wildlife restoration. Current projects include baseline inventories, restoration of habitats, supplementing and reintroduction of native wildlife populations, and specific research on key wildlife species.

RESUMEN—Maderas del Carmen se encuentra a 165 km al noroeste de Muzquiz, Coahuila y al sur de la región del Big Bend al oeste de Texas. Es una isla famosa por su riqueza de flora, fauna y especies raras y endémicas. Sin embargo, es un ecosistema que fue explotado por muchos años por la minería, extracción de madera, sobrepastoreo y cacería. CEMEX tiene en propiedad o bajo acuerdo de conservación arriba de 87,000 ha con el objetivo de restaurar el hábitat y fauna nativa. Los proyectos actuales incluyen el inventario biológico, restauración de hábitat, suplemento y reintroducción de fauna nativa, además de estudios específicos de especies clave.

Maderas del Carmen is located 165 km northwest of Muzquiz, Coahuila. Locally and internationally, this mountain chain has been called various names; La Fronterizas, Carmens, El Jardín, Maderas and Sierra el Carmen. For the purpose of this paper, the Maderas del Carmen is the contiguous range running from south in Coahuila at the Cuesta Malena north to the Rio Grande border with west Texas. This rugged mountain range fits the Chihuahuan Desert “sky island” concept with lower Chihuahuan Desert landscape surrounding deciduous woodlands and conifer forest at elevations exceeding 2,700 m.

The Maderas del Carmen is a land rich in biodiversity, culture, and history. Historical accounts for the region date back to 1747 (J. Santos Landois, pers.

comm.), when the governor of Coahuila, Pedro de Rabago, led an expedition into the mountains. In the 18th and 19th centuries; Comanches raided the regional ranches, smugglers brought illegal liquor made from sotol (*Dasylirion leiophyllum*) into Texas, and the remote canyons were hideaways for bandits. Since the mid-1900s, people on both sides of the international border have schemed and dreamed of ways to conserve the biodiversity of this ecosystem. Plans were made for an international park, scientists sporadically visited the area, new and endemic species were discovered; however, capital, political commitment, revolutions, and inaccessibility prevented these plans from becoming reality.

Meanwhile the natural resources of the Maderas del Carmen continued to be exploited. Overgrazing by domestic livestock took a tremendous toll on native grasslands to the extent that seed banks were seriously depleted in many areas. Mining for lead, silver, and fluorspar scarred the landscape. Removal of native trees from riparian areas for mining supports depleted gallery forests, nesting sites for raptors were lost, and the destruction opened avenues for erosion. Commercial hunting to supply food for thousands of miners, and unregulated subsistence hunting depleted populations of native wildlife. Candelilla (*Euphorbia antisiphilitica*) was harvested by the ton for the wax industry. Logging operations in the high forests began in the 1920s and continued on a large scale until the late 1960s. Thousands of trees were cut and left lying on the forest floor.

Among native wildlife, three species were extirpated—the Mexican lobo (*Canis lupus baileyi*), desert bighorn sheep (*Ovis canadensis mexicana*), and pronghorn (*Antilocarpa americana*). Remnant black bear (*Ursus americana*) populations remained in several isolated Coahuilan mountain ranges, including the Maderas del Carmen, Serraníos del Burro, and Sierra Santa Rosa (Baker 1956; E. Sellers de Spence, pers. comm.). Elk (*Cervus elaphus*), grizzly bear (*U. arctos*), and American bison (*Bos bison*) may also have been present in northern Coahuila in Spanish times, likewise these species would also have been highly vulnerable in the southeastern limits of their ranges (R. Baker, pers. comm.). Despite the exploitation of resources, Maderas del Carmen retained much of its biodiversity at the close of the 20th century.

In 1994, the Mexican government officially designated the Maderas del Carmen as a protected area with a management plan following three years later (SEMARNAP 1997). However, management continues to be severely hampered because all lands are private ranches or communal ejidos with locked gates, and traditional land use practices continue.

CEMEX—a global cement company and one of the three largest companies in the world—recognized the ecological value of the Maderas del Carmen and in 2000 launched the El Carmen Project to resolve the conservation predicament. The main objectives of the El Carmen Project are to: (1) purchase outright or negotiate conservation agreements on lands within the boundaries of the protected area; (2) purchase lands in adjacent mountains that are important ecological links; (3) assess the lands ecological condition and biodiversity; (4) develop and implement conservations plans for the restoration and protection of the ecological integrity and unique biodiversity; and (5) define and develop plans for protection of vital ecological corridors spanning the international border and into adjacent mountain ranges in México.

METHODS—*Baseline Inventories*—The first step toward ecosystem management is knowing what species are found in the area. This objective is best accomplished by formal baseline inventories. We began this effort by compiling historical data on the flora and fauna and building preliminary checklists. Formal baseline inventorying began in October 2001 and is an ongoing project as more lands are purchased. We spent approximately 21 days per month for two years on the initial baseline work. Field methods were the same used to inventory Texas Parks and Wildlife management areas and state parks (Simpson et al. 1996). Results of final baseline inventory work will be published separately.

HABITAT RESTORATION—One of the major priorities of the El Carmen Project is habitat restoration. Our first steps were to remove all domestic livestock, including more than 3,000 goats, over 1,000 cattle and approximately 100 horses. All interior fences were then removed (> 200 km) to allow wildlife to move freely. Grasslands and canyon complexes are being rested and allowed to regenerate naturally. Some areas have been identified that will require mechanical manipulation and reseedling of native grasses (*Bouteloua* and *Aristida*) and test plots have been established outside the boundaries of the protected area in Rancho Los Pilares. Existing earthen tanks were cleaned and watering spots were developed in areas with pipeline and wildlife friendly water troughs. Existing water troughs were altered with cement, rock, or wooden ramps to allow all wildlife to water safely. Springs were mapped and cleaned. No hunting is allowed on project lands. Restoration of riparian corridors that once supported galley forests of native cottonwoods (*Populus fremontii*) evidenced by a few remaining cottonwoods will begin in 2005, using saplings from an adjacent private ranch.

Before any management techniques are applied, a thorough assessment of the lands are conducted to determine if these techniques will be detrimental to rare, endangered, endemic, or small populations of flora and fauna. We follow the species ranking listed in the Norma Oficial Mexicana NOM-059-ECOL (SEMARNAT 2002).

In the high mountains, exhaustive manual labor to clean up the ecosystem has resulted in the disposal of tons of sawdust—this remnant of logging operations has polluted streams for many years. For three years, cans, bottles, and other debris littering the mountain landscape in numerous locations has been hauled off by the dump truck load. All buildings that are not historical have been removed; this included all mining and logging shacks and corrals from ranching activities.

A fire management school was hosted by El Carmen to train staff, crews from area ejidos, and ranchers in safe fire fighting techniques. Current laws (SEMARNAT) do not approve prescribed burning in protected areas.

WILDLIFE RESTORATION—Northern México has suffered from unregulated hunting and depletion of native wildlife species in many areas for untold years. The Maderas del Carmen was no exception; desert mule deer (*Odocoileus hemionus*) populations were practically nonexistent; however the Carmen Mountain white-tail (*O. virginianus carminis*) population numbers were somewhat higher because they tend to inhabit higher forest country in inaccessible terrain. Both species of deer are being supplemented with stock from adjacent ranches that have surplus levels. The species and subspecies are the same, no new subspecies of deer have been reintroduced into the existing deer populations. Not only will these supplemental releases increase the herd numbers but will also provide genetic diversity in a sky island population.

Desert bighorn sheep were native to this area but were considered extinct in all of their range in Coahuila by 1950 (unpublished reports). Reports by older residents, hunters, and reports to Dr. Rollin Baker (1956) support this conclusion. E.G. Marsh (1937, unpublished report, Department of Botany, University of Texas, Austin, TX) reported desert bighorn in this area; as well as J.O. Langford having in his possession a set of horns taken some 64 km into Coahuila, south of Hot Springs (Big Bend) (E.G. Marsh in litt.). In 2000, CEMEX, in collaboration with Texas Parks and Wildlife Department, began an intensive desert bighorn restoration project with the objective of building numbers sufficient to maintain a brood herd in a facility at Rancho Pilares. Surplus from this facility will be released into the wild to establish free-ranging herds in the Maderas del Carmen as well as supply adjacent historic habitats in Coahuila with desert bighorns. Desert bighorns were captured in Sonora, México from several

locations including Tiburon Island. Captured bighorns were verified as *O.c. mexicana*, required by Secretaría De Medio Ambiente Recursos Naturales (SEMARNAT). Currently over 100 desert bighorns are in the brood facility which is 5,000 ha of typical bighorn habitat surrounded by an 2.4 m high electric wired fence to discourage predators. Recently, we made the first wild release of desert bighorns back into historic habitat from bighorns captured in Sonora, México from the Yaqui Reserve at Hermosillo. These bighorns were originally from Isla Tiburon, Sonora and were also certified as *O.c. mexicana*.

Wild turkeys (*Meleagris gallopavo*), were once abundant (R. Baker pers. comm.) although they are rarely seen now. Area ejidos capture wild turkeys and pen them with domestic white turkeys, the result is a mixture of white plumages varying from all white to mottled brown and white. Apparently many escaped captivity and made their way back into the mountains. It is not an uncommon sight on adjacent ejidos to see wild turkeys penned with domestic white turkeys. Javelina (*Pecari tajacu*) numbers were low, however, without hunting pressure the javelina population is increasing rapidly. Small-sized and medium-sized mammal populations appear very stable, supported by our data from live trapping, observations, and night cruise lines. Mountain lion populations appear very healthy evidenced by the many scats, scrapes and tracks, and remote camera photography.

In 2003 we began an introduction program of Rocky Mountain elk (*Cervus elaphus*). The initial release consisted of 41 elk (35 cows, 6 bulls), and in 2004 we supplemented the original release with an additional 19 elk (14 cows, 5 bulls). There is some doubt as to whether elk ever ranged in this area of Coahuila, however, fossil evidence south in the Cuatro Ciénegas area (Gilmore 1947), and recent discoveries of Indian paintings and pictographs depicting elk just south of the Maderas del Carmen suggest that elk were in the area (Ing. R. Rodriguez Garza, pers. comm.). The small herd of elk that have been introduced to the project site are providing a needed management tool for brush control in several canyons by browsing on the ever-encroaching brush species; a direct result of over 100 years of overgrazing. They are also an alternate prey item for mountain lions, and in the future may be the main prey item if the Mexican lobo is reintroduced into historic habitat.

Elk were obtained from established herds belonging to David Garza Laguera in the adjacent Serranías del Burro (48.3 km east), which has been an established herd for over 30 years. All elk were tested, vaccinated, and ear tagged as well as radio collared and placed in a soft release facility at El Carmen before release into the wild. The herd has grown slowly, reproduction is adequate for the herd to grow; but

predation by mountain lions is a controlling factor in calf survival. Habitat surveys as well as consultations with elk experts in the United States were conducted before elk were released. In addition, four exclosures were built to monitor vegetation in areas elk used regularly. No significant impact has been observed. If impacts to habitats, or competition with other native species occurs in the future, the plan is to remove the elk; however, currently they are serving a very good purpose in brush management, especially since prescribed burning is illegal in protected areas in México.

PRELIMINARY RESULTS AND PROJECT ADVANCES—Our baseline inventories have provided much needed information of species richness in the project area. Currently we have documented 79 species of reptiles and amphibians, 74 species of mammals, 259 species of birds, and over 400 species of plants. We expect to add more species as baseline inventories continue on newly acquired lands. Baseline results will be published in a final document at completion of field work. Several new species have been documented, and historical records verified again for the first time in many years; these include the endemic Coahuila mole (*Scalopus aquaticus montanus*), which was first documented at El Club on the east side of the Maderas del Carmen by Dr. Rollin Baker (1951, 1956), we obtained the second specimen in the same area at El Club. Other important little-known species include the cliff chipmunk (*Eutamias dorsalis carminis*), and the endemic Miller's shrew (*Sorex milleri*). We documented adults, young and six nests of Miller's shrews. Several new species of bats have been documented including southern yellow bat (*Lasiurus ega*), eastern red bat (*L. borealis*), and Mexican long-nosed bat (*Leptonycteris nivalis*). The white-nosed coati (*Nasua narica*) and eastern fox squirrel (*Sciurus niger*) are permanent residents and represent range expansion into areas not formerly occupied by these species.

Eighty-five permanent vegetation transects using the line intercept method with 100 m transects were established to monitor vegetation over a period of years to denote changes in plant composition and diversity (Canfield 1941; Chambers and Brown 1983). In addition, scent stake surveys (Linhart and Knowlton 1975) were employed to survey for nocturnal and large species that could not be successfully live trapped in smaller conventional traps. All scientific collections are maintained at El Carmen under permits from Secretaría De Medio Ambiente Y Recursos Naturales (SEMARNAT).

Along with continued baseline inventories long-term research projects were implemented to monitor populations. These projects are being conducted by El Carmen biological staff and include:

- Population Ecology of Reintroduced Desert Bighorn Sheep,
- Herd Ecology of Desert Bighorn Sheep In the Rancho Pilares Brood Facility in Coahuila, México,
- Population Dynamics and Movement of Black Bears in Northern Coahuila, México, and
- Habitat Use of an Introduced Herd of Rocky Mountain Elk in the Maderas del Carmen.

Mexican and American universities use the area to conduct research on specific species, and El Carmen works closely with a host of conservation and wildlife agencies in both countries. These include: Instituto Nacional de Antropología e Historia (INAH), Comisión Nacional de Áreas Naturales Protegidas (CONANP), Universidad Autónoma Agraria Antonio Narro, Agrupación Sierra Madre, Conservadores de Ecosistemas Del Puerto Del Pino (CONECO), Cuenca Los Ojos Foundation, Fondo Mexicano Para la Conservación De La Naturaleza, Museo Maderas del Carmen, Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT), Comisión Nacional Para el Conocimiento y Uso de la Biodiversidad de México (CONABIO), El Instituto Nacional De Ecología (INE), Procaduria Federal de Protección al Ambiente (PROFEPA), Pronatura, Unidos Para La Conservación, Facultad Ciencias y Forestales, Nuevo León, México, Conservation International (CI), Birdlife International, National Parks and Conservation Association, Big Bend National Park, The Wild Foundation, Texas Parks and Wildlife, Yale University, University of Texas at Austin, Sul Ross State University and Bear Trust International. El Carmen Project also has an advisory board comprised of scientists from México and the United States. Major projects and management actions are reviewed by this advisory board and approved before they are implemented at El Carmen.

We also participate locally and internationally in specific conferences and workshops. Each year we sponsor and teach an international workshop at El Carmen; one university from Texas and one from México send ten students and their professors to El Carmen for a week of learning baseline inventory methods and selected wildlife management techniques.

Employment opportunities for area ejidos have provided steady paying jobs. Many of our employees who formerly hunted or ran domestic livestock on the area are now protecting the flora and fauna, working daily to conserve and enhance the resources. El Carmen employs 25 full-time workers from the ejidos and Muzquiz area, a full time biological staff, and, depending on the scope of the current projects, up to 50 workers.

FUTURE PLANS—Continued land acquisition in the Maderas del Carmen and adjacent mountain ranges is a major goal at El Carmen. Protection of this ecologically important area in northern Coahuila will only be accomplished through direct purchase or long-term conservation agreements. As lands are acquired, baseline inventories, habitat and wildlife restoration will continue on newly acquired properties. Research on a species-oriented level will continue. In the near future, there will be a research facility constructed at Rancho Los Pilares which will house the scientific collections, a museum, formal library, work areas, offices, conference room, laboratory, native gardens, and dormitories for workers and students.

El Carmen project will serve as a model not only locally but globally to demonstrate what can be accomplished with commitment from non-governmental organizations and private entities to conserve and protect the vast biodiversity of México's natural heritage.

We gratefully acknowledge the long-term commitment and resources provided by CEMEX to restore the lands in the Maderas del Carmen. We also acknowledge the many people that have contributed in so many ways to the El Carmen Project, each contribution is appreciated and the list of supporters is very long. Dr. Rollin Baker and Dr. Clyde Jones, David Riskind and Patricio Robles Gil deserve special thanks for support and guidance at El Carmen.

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