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# Distribution, Habitat Association, and Activity Patterns of Medium and Large-Sized Mammals of Sonora, Mexico

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**ABSTRACT:** Despite the proximity of Sonora, Mexico, to the United States, the mammalian fauna of Sonora has been poorly investigated, and many of the biological and ecological characteristics of these animals remain unknown. From July 1999 to August 2001, we carried out a mammalian inventory using camera traps surveys in order to provide information on the occurrence, distribution, habitat association, and activity patterns of medium and large-sized terrestrial mammals in the three major habitat types of the Sierra Madre Occidental foothills in east-central Sonora: (1) Sinaloan thornscrub (ST), (2) Oak woodland (OW), and (3) thornscrub-woodland ecotones (TW). Over 2348 trap-nights, we obtained 897 photographic records, documenting 18 species of wild mammals. White-tailed deer (*Odocoileus virginianus*), gray fox (*Urocyon cinereoargenteus*), mountain lion (*Puma concolor*), and coyote (*Canis latrans*) were the most frequently recorded and widely distributed species. In addition, we documented the presence of two endangered species, the jaguar (*Panthera onca*) and ocelot (*Leopardus pardalis*), as well as a threatened species, the badger (*Taxidea taxus*).

*Index terms:* activity patterns, distribution, habitat association, mammals, Sonora, Mexico

## INTRODUCTION

The remote and rugged mountains of east-central Sonora in northwestern Mexico have served, in combination with its low human population density, to retain many of its ecosystems in an almost pristine condition. The region serves as a biological corridor for several species of mammals and appears to act as a reservoir for ecosystem diversity. Sonora harbors seven of 10 orders of Mexican terrestrial mammals, encompassing 128 species. However, the Sonoran mammalian fauna has been poorly studied, and many of the biological and ecological characteristics of most of these species are unknown. This lack of data has limited the implementation of effective conservation and management programs.

We conducted an inventory of medium and large-sized mammals that focused on their distribution, habitat association, and activity patterns in Sonora's mountainous region. The region is of high biological value because it contains the largest unfragmented landscape in northwestern Mexico, and it encompasses three high-priority conservation areas (Sahuaripa; Bavispe-El Tigre; Yaqui River-Basaseachic waterfall) as proposed by CONABIO (2001) and documented by Arriaga et al. (2000a) and Arriaga et al. (2000b). Additionally, the region supports the northernmost jaguar (*Panthera onca*) population (López-González and Brown 2002, López-González and Lorenzana-Piña 2001).

## STUDY AREA

The study was conducted in east-central Sonora in the foothills of the Sierra Madre Occidental Mountain Range. Elevation ranges from 400 to 1400 m and the area contains a complex topography dominated by highly escarped mountains, intermountain valleys, and steep canyons. The climate is dry with an annual temperature and precipitation of 201 C and 500 mm, respectively. Nearly 70% of the annual precipitation falls between July and September.

The main vegetation types are sinaloan thornscrub (ST) and oak woodland (OW) (Brown 1994).

ST is a deciduous plant community during the dry season in April and May occupying a transitional moisture gradient between desert scrubs and temperate forests. It is characterized by an irregularly stratified canopy varying between 2-8 m in height, with thorny plants, microphytes, and succulents (such as *Acacia* spp.). This habitat is located between 400-900 m elevation, on low hills, mountain valleys, plateaus, and slopes. The oak woodlands are open communities of perennial trees, primarily oaks (*Quercus* spp.) that range between 6-15 m in height and are located in small hills, ravines, slopes, and mountaintops. This type occurs primarily between 800-900 m elevation. In some places, the separation between both communities is clearly defined. However, there is a wide overlap in the ecotones (Brown 1994). For that reason, we considered the thornscrub-woodland ecotone (TW) as a third distinct

plant community (Morrison et al. 1998). These ecotones mainly occur in gorges and canyons located between 800-1000 m.

## METHODS

We distinguished medium and large-sized mammals according to the definition of Ceballos and Navarro (1991): medium (between 1 and 10 kg) and large (> 10 kg). We, therefore, excluded species of the orders Insectivora, Chiroptera, and most of Rodentia. We recorded species using 35 mm Camtrakker camera traps connected to a passive infrared sensor that detects heat and movement (Lynam 2002). Sampling was carried out between July 1999 and August 2001. We conducted 16 separate sampling sessions encompassing 2348 trap-nights at 88 sampling sites distributed as follows: 51 in ST, 28 in OW and 9 in TW. Sampling intensity was distributed in approximate proportion to the area of the

given vegetation type. In each sampling session, we placed three to nine camera traps, separating them 1 to 5 km in order to reduce captures of the same individual at different sites (Diefenbach et al. 1994). The traps were placed at sites with prior presence of signs (tracks, scats) of the target species and little human or cattle presence. Most of the sites were located along cattle or wildlife trails (i.e., white-tailed deer (*Odocoileus virginianus*)), at trail intersections or dry riverbeds. Each trap was tied to a tree trunk 30-45 cm above the ground and cameras were left operating in the field for periods between 7-30 days.

## RESULTS

In total, 897 photographic records were obtained, of which 49% (n=437) were of wild mammals. The remainder was of cattle and horses (35%), birds (9%), or undetermined

(7%). We eliminated 87 mammal records because they were sequential. We documented 18 wild mammal species (Table 1). Widely distributed species such as gray fox (*Urocyon cinereoargenteus*) and white-tailed deer were the most common captures. Mountain lions (*Puma concolor*), coyotes (*Canis latrans*), and jaguars were recorded less frequently but also were detected throughout the study area. Lagomorphs (*Lepus alleni* and *Sylvilagus floridanus*) and bobcats (*Lynx rufus*) presented a more dispersed distribution, locally patchy. The rest of the species were recorded infrequently. Most species (n = 16) were associated with the ST vegetation type. Thirteen species were associated with the OW vegetation type with two, cacomistle (*Bassariscus astutus*) and spotted skunk (*Spilogale putorius*), recorded only in this habitat. Ten species were associated with the ecotone (TW) type.

**Table 1. Terrestrial mammals recorded in east-central Sonora during July 1999 - August 2001.**

Order <sup>a</sup>	Family	Species	Common name	Records (n)	Habitat <sup>b</sup>
Didelphimorphia	Didelphidae	<i>Didelphis virginiana</i>	Opossum	4	ST, OW
Carnivora	Canidae	<i>Canis latrans</i>	Coyote	37	ST, OW, TW
Carnivora	Canidae	<i>Urocyon cinereoargenteus</i>	Gray fox	88	ST, OW, TW
Carnivora	Felidae	<i>Leopardus pardalis</i> <sup>c</sup>	Ocelot	3	ST, OW
Carnivora	Felidae	<i>Lynx rufus</i>	Bobcat	13	ST, OW, TW
Carnivora	Felidae	<i>Puma concolor</i>	Mountain lion	26	ST, OW, TW
Carnivora	Felidae	<i>Panthera onca</i> <sup>c</sup>	Jaguar	20	ST, OW
Carnivora	Mustelidae	<i>Conepatus mesoleucus</i>	Hog-nosed skunk	1	ST
Carnivora	Mustelidae	<i>Spilogale putorius</i>	Spotted skunk	2	OW
Carnivora	Mustelidae	<i>Taxidea taxus</i> <sup>t</sup>	Badger	1	ST
Carnivora	Procyonidae	<i>Bassariscus astutus</i>	Ringtail	4	OW
Carnivora	Procyonidae	<i>Nasua narica</i>	Coatimundi	6	ST, TW
Carnivora	Procyonidae	<i>Procyon lotor</i>	Raccoon	1	ST
Artiodactyla	Tayassuidae	<i>Pecari tajacu</i>	Collared peccary	4	ST, TW
Artiodactyla	Cervidae	<i>Odocoileus virginianus</i>	White-tailed deer	81	ST, OW, TW
Rodentia	Sciuridae	<i>Spermophilus variegatus</i>	Rock squirrel	5	ST, OW, TW
Lagomorpha	Leporidae	<i>Lepus alleni</i>	Antelope jackrabbit	25	ST, OW, TW
Lagomorpha	Leporidae	<i>Sylvilagus floridanus</i>	Eastern cottontail	29	ST, OW, TW

<sup>a</sup> According to Wilson and Reeder (1993)

<sup>b</sup> ST: Sinaloan thornscrub, OW: Oak woodland, TW: Thornscrub-Woodland ecotone

<sup>c</sup> endangered, <sup>t</sup> threatened (NOM-059-ECOL-1994)

## DISCUSSION

The species documented in this study represent approximately 20% of the non-flying mammals reported for Sonora and 80% of the medium and big-sized mammals that potentially occur in the study area (Caire 1978, Hall 1981, Arita and Leon-Paniagua 1993).

In general, the number of records obtained for each species was influenced by size and mobility of species (Sargeant et al. 1998, Beauvais and Buskirk 1999). Thus, the smaller species, with smaller activity areas, were generally difficult to detect (RIC 1998). Likewise, the more frequently recorded, more widely distributed species were larger in size, such as white-tailed deer, mountain lion, jaguar, and coyote with the exception of the gray fox which is medium-sized; but, apparently, it is the most common carnivore in the study area.

Species most frequently recorded were those that: (1) are predominantly cursorial, such as the coyote and gray fox (Bekoff 1977, Fritzell and Haroldson 1982); (2) have extensive home ranges, such as the mountain lion and jaguar (Currier 1983, Seymour 1989, Nowell and Jackson 1996); and (3) use existing trails to move about. Detection of some species was undoubtedly influenced by its habitat and microhabitat utilization. For example, lagomorphs showed a dispersed distribution in a regional scale, but an aggregated one in certain localities, mainly in areas of low relief with herbaceous vegetation and shrubs.

There was an inverse relationship between the number of sampling sites and the number of different kinds of mammals captured in each of the habitats. The ecotones yielded the highest return in the number of different kinds of species per sampling effort. This may be a function of the higher overall plant species diversity in these areas; however, in general we feel that most of the species were not limited to a specific habitat.

Sonora's mountainous region serves as an important corridor for northwestward expansion for several species, includ-

ing the collared peccary, coatis (*Pecari tajacu*), and jaguars (Brown and Davis 1995, Felger and Wilson 1995). Although it is on the periphery of the distribution for some endangered species such as the jaguar and ocelot (*Leopardus pardalis*), the area may, in fact, be making an important contribution to their persistence as they are being extirpated in the center of their range as theorized by Channell and Lomolino (2000).

This study is but a first small step in documenting the faunal resources in an area considered being a high-priority region for conservation (Arriaga et al. 2000a). A complete inventory of biological resources and socioeconomic studies is recommended to aid in the evaluation of potential reserves and to improve the quality of life of local residents while reducing their negative impacts on the environment.

## ACKNOWLEDGMENTS

We would like to thank the following organizations for their economic and logistic support: Calder Trust, Denver Zoological Foundation, Naturalia, A. C., Lyn Chase Wildlife Foundation, National Fish and Wildlife Foundation, Oregon Zoo Foundation, Sky Island Alliance, The Columbus Zoo, The Lincoln Park Zoo, The Phoenix Zoo, Universidad Autonoma de Queretaro, Wallace Research Foundation, Wilburforce Foundation, and many individuals.

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