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CARNIVORES FROM THE MEXICAN STATE OF PUEBLA: DISTRIBUTION, TAXONOMY, AND CONSERVATION

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ABSTRACT: We examined 96 museum specimens belonging to 14 species of Carnivora from the Mexican State of Puebla. In addition, four species were documented based on literature records and by indirect evidence. The carnivorous mammals of Puebla belong to 5 families, 18 genera, 18 species and 23 subspecies. Eight of these 23 taxa are reported herein for the first time from the state of Puebla. Of the 18 species, *Herpailurus yagouaroundi*, *Lontra longicaudis*, *Taxidea taxus*, and *Galictis vittata* are considered by Norma Oficial Mexicana as threatened species, *Leopardus wiedii* and *Eira barbara* in danger of extinction, and *Potos flavus* is under special protection. We found *Lynx rufus*, *Canis latrans*, *Taxidea taxus*, and *Bassariscus astutus* were found only in the Nearctic region of the State, whereas *Herpailurus yagouaroundi*, *Leopardus wiedii*, *Lontra longicaudis*, *Galictis vittata*, *Eira barbara*, *Potos flavus*, and *Nasua narica* were found only in the Neotropical region of the State. The remaining seven species (*Puma concolor*, *Urocyon cinereoargenteus*, *Mustela frenata*, *Mephitis macroura*, *Spilogale putorius*, *Conepatus leuconotus*, and *Procyon lotor*) have been taken in both the Nearctic and Neotropical regions. Localities in the Sierra Norte de Puebla had the greatest species richness and abundance of individuals. The carnivores confront serious conservation problems in the state because they are hunted indiscriminately as trophies and by the local residents as harmful species. Moreover they are hunted for economic benefit by the sale of their skins or as living pets. The carnivores in some areas are used as food items and for therapeutic proprieties of their fat, skin, or bones. Unfortunately at this time we can't assess the full impact of these activities on the local populations.

Key words. Carnivores. Conservation. Distribution. México. Puebla. Taxonomy.

INTRODUCTION

Faunal studies for the state of Puebla are still rare and it is one of the states in Mexico which has received the least attention by mammalogists. This is paradoxical because Puebla has one of the richest faunas of the Mexican states. This richness is the result of two non-mutually exclusive factors. First is the confluence of the Nearctic and Neotropical regions as in most states in the central part of Mexico. Second is the varied topography of the state. Puebla has

a wide range of climates based on elevation, which varies from 200 m in the tropical regions of the state to 5,700 m at the top of the Pico de Orizaba. These conditions make a complex of habitats for its diverse mammalian fauna, presenting Nearctic elements in the Sierra Nevada Mountain Range (Popocatepetl and Iztaccíhuatl volcanoes), La Malinche Mountain, and Pico de Orizaba, and Neotropical elements on the Pacific and Atlantic slopes of the state. The vegetation varies from tropical deciduous forest in the southwestern part of

the state to tropical rain forest in the east, semi-desert with columnar cacti and arid grassland in regions of the Valle de Tehuacán and Cuenca de Oriental (Oriental Basin), and the coniferous forest in the Trans-volcanic Belt.

There are few papers with a primary focus on a particular region of Puebla or the review of a group of mammals (Warner and Beer, 1957; Heaney and Birney, 1977; Ramírez-Pulido et al., 1999; Rojas-Martínez and Valiente-Banuet, 1996). The majority of publications presented new records for the state (Villa-Ramírez, 1942; Ramírez-Pulido and Sánchez-Hernández, 1971; Laval, 1972; Urbano-Vidales et al., 1987; Castillo-Meza et al., 1997). More than 40 years have elapsed since Van Gelder (1960) provided seven new records of carnivores for the state, four of which were based upon collected specimens and three were visual records. Other papers since then have mentioned the presence of a few species of mammals in Puebla (Davis, 1944; Hall, 1951; Ingles, 1959; Baker and Petersen, 1969; Hall, 1981). Warner and Beer (1957) in their paper on vertebrates on Mesa San Diego recorded two carnivores and Hoffmann et al. (1972) and Bassols (1981) focused on some ectoparasites of *Mustela* sp. Recently, Gallo Reynoso (1997) provided new records of the river otter and, most recently, Álvarez and Ocaña (1999) reported carnivores in zooarcheological remains. In spite of these, papers on carnivores that inhabit Puebla are still rare. Our objective is to carry on a full review of the basic aspects of the distribution, taxonomy, and natural history of the order Carnivora of Puebla. As a result of the fieldwork we conducted in the state of Puebla, as well as from examining the specimens housed in mammal collections of Mexico and the USA, we are able to report here specimens of 8 taxa of carnivores, which represent new records from Puebla.

MATERIALS AND METHODS

We examined 96 specimens of carnivores deposited in the mammal collections of the Metropolitan Autonomous University, Iztapalapa Campus (UAMI), the National School of Biological Sciences (ENCB), Institute of Biology of the National Au-

tonomous University of Mexico (CNMA), University of Illinois Museum of Natural History (UIMNH), Texas Cooperative Wildlife Collection, Texas A&M University (TCWC), and the Museum of Michigan State University (MSU). For each subspecies, the specimens examined, additional records, measurements, and comments about their biology and habitat are presented. The weight is given in grams (g), and the measurements are given in millimeters (mm); cranial measurements were taken with electronic calipers with an accuracy of 0.01 mm, following Hall's (1981) criteria, and only measurements of the adult specimens (presphenoid-basisphenoid suture and basisphenoid-basioccipital completely fused together) are given. External measurements, weight, the collecting date, and reproductive data were taken directly from specimen tags. In the specimens examined, after the coordinates we provide the number of locality, which is showed in **Figure 1**. Ramírez-Pulido et al. (2005) were followed for nomenclature and species sequence. Taxa identified only from zooarcheological remains (*Lynx rufus*) or by scats (*Puma concolor*) are identified simply to the specific level because more than one subspecies could be present in Puebla, whereas in the case of the visual record of *Eira barbara senex* a subspecies name is given because there is only one subspecies in México.

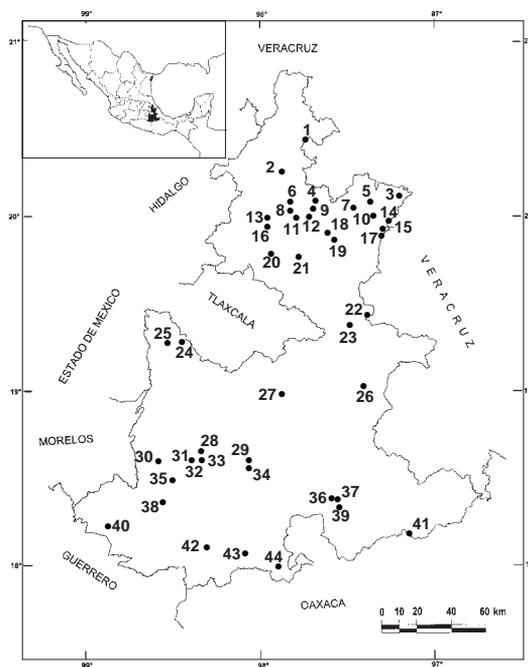


Fig. 1. Index and regional map of the Mexican state of Puebla. Numbers and closed circles correspond to localities of the specimens examined (see text).

SPECIES ACCOUNT

Family Felidae

Lynx rufus (Schreber, 1777).

Lince, Gato montés, Bobcat

Specimens examined — None.**Additional records** — Texcal; Tepeyolo (Álvarez and Ocaña, 1999 as zooarcheological remains); Tstatchihualt S[an]. Martín Texmelucan (Ferrari-Pérez, 1886).

This species is known from the state by zooarcheological remains (Álvarez and Ocaña, 1999) and from an old record by Ferrari-Pérez (1886). However, the residents of San José Alchichica report that the bobcat still can be found in the hills and ravines of the region and that it is often caught there. In fact, there is a record of a bobcat at 3 km W Limón in Veracruz (Hall and Dalquest, 1963), a locality very close to San José Alchichica.

Puma concolor (Linnaeus, 1771)

Puma, Mountain Lion

A scat, which according to Aranda (2000) and based upon comments by resident of the region, belongs to *Puma concolor*, was collected in a cornfield at 4.5 km S, 9.5 km W San José Alchichica [19° 23' 25"N, 97° 28' 59" W; Loc. 23]. Native vegetation in the general area was xeric scrub. The scat contained a large amount of rabbit hair (*Sylvilagus* sp.); it also had the front part of a mouse skull (*Peromyscus maniculatus*). Because of the location where the scat was found, the subspecies assigned was *P. c. mayensis*. However, it is likely that in the region of southwestern Puebla, in the Balsas Basin, mountain lions of the subspecies *P. c. azteca* can be found because a member of this taxon has been found north of Yautepec, Morelos (Hall, 1981; Álvarez-Castañeda, 1996), a locality that is not very far from Puebla.

Herpailurus yagouaroundi cacomitli

(Berlandier, 1859)

Yaguarundi

Specimens examined (2) — Ocotal [20° 4' 33"N, 97° 49' 42" W; Loc. 6], 1230 m (1 UAMI); 2 km N Hueytamalco [19° 56' 21"N, 97° 17' 21" W;

Loc. 15], Municipally. Hueytamalco (1 CNMA).

Additional record — 6 km N Hueytamalco (Urbano-Vidales et al., 1987).

The Ocotal specimen is a female because it was presented by local residents. The specimen from 2 km N Hueytamalco was mounted for exhibit, but the sex and age were not recorded. The specimen recorded by Urbano-Vidales et al. (1987) was "found dead on a road among coffee groves near a small human settlement."

Leopardus wiedii oaxacensis

(Nelson and Goldman, 1931)

Margay

Specimens examined (2) — Olintla [20° 6' 5"N, 97° 40' 59" W; Loc. 4], 790 m (1 UAMI); Ocotal [20° 4' 33"N, 97° 49' 42" W; Loc. 6], 1230 m (1 UAMI).

Two specimens, represented by skulls only, were donated by a local resident from Ocotal and Olintla. The margay appears to be uncommon in the region; this is probably due to the fact that it is hunted actively for its meat and skin, which is highly prized by local residents. The localities of the specimens examined are in the northeastern region of Puebla in the rain forest and tropical perennial forest. These specimens represent the first records for the state of Puebla and extend the known distribution of the species 90 kilometers southeastward from Alvarado, Veracruz (Hall and Dalquest, 1963).

The cranial measurements of the two adult, unsexed specimens were as follows: greatest length of skull, 89.9, 87.9; condyloincisive length, 82.9, 83.1; condylocanine length, 77.9, 78.4; palatal length, 33.4, 33.1; length of rostrum, 22.7, 21.5; breadth across upper carnassial tooth, 5.5, 5.6; interorbital constriction, 15.9, 17.3; postorbital constriction, 32.1, 32.0; zygomatic breadth, 58.9, 56.6; breadth of braincase, 45.0, 42.4; mastoid breadth, 40.5, 37.5; length of maxillary toothrow, 27.0, 26.4.

Family Canidae

Urocyon cinereoargenteus (Schreber, 1775)

Zorra gris, Gray fox

Three subspecies of this species potentially could be found in Puebla, including *Urocyon*

cinereoargenteus nigrirostris, *U. c. orinomus*, and *U. c. scottii*. Unfortunately, only a few specimens of this species are available for study, and some of these are only partial skulls or skins without the corresponding skulls. These specimens could not be compared morphologically; thus, the subspecies are assigned on the basis of geographic distribution. However, *U. c. nigrirostris* can be characterized by color pattern in which the side coloration is ochraceous, the venter is cream, and exhibits a white line throughout the hind leg from the posterior part of the venter to close to the metatarsal region, the dark dorsal stripe is evident, and can be distinguished from *U. c. scottii* in which the side and venter regions are ochraceous and the white line that runs throughout the hind leg and the dark dorsal stripe are less evident. Unfortunately we were not able to compare the characteristics of *U. c. orinomus* with the other subspecies because no skin was available for study.

Urocyon cinereoargenteus nigrirostris
(Lichtenstein, 1850)

Specimen examined (1) — 2 km N Zacapala [18° 36' 42"N, 98° 3' 52" W; Loc. 29], 1230 m. (1 UAMI).

Additional records — near Izúcar de Matamoros (Van Gelder, 1960, only as *Urocyon cinereoargenteus*); Piaxtla (Goldman, 1938, Hall, 1981).

Based on these localities, *U. c. nigrirostris* occurs only in the Balsas Basin region in the southwestern portion of the state, and is associated with tropical deciduous forest. The specimen examined is an adult of undetermined sex with a partially broken skull.

Urocyon cinereoargenteus orinomus
(Goldman, 1938)

Specimen examined (1) — 8 km W Zapotitlán de las Salinas [18° 19' 41"N, 97° 33' 16" W; Loc. 39], 1550 m (1 UAMI).

This specimen is a subadult male and represents the first record of the subspecies for Puebla. *U. c. orinomus* appears to be associated with xeric shrub and coniferous forest.

We examined the stomach of this specimen and found a small rabbit (*Sylvilagus* sp.).

Urocyon cinereoargenteus scottii
(Mearns, 1891)

Specimens examined (2) — Ocotlán [20° 4' 33"N, 97° 49' 42" W; Loc. 6], 1230 m (1 UAMI); Santiago Yancuictlalpan [20° 3' 37"N, 97° 28' 18" W; Loc. 7], 500 m (1 UAMI).

The two skulls examined were donated by the local residents because they occasionally consume fox. This record represents the first of the subspecies for Puebla. *U. c. scottii* exclusively occurs in the northeastern region of the state in association with tropical forest.

The cranial measurements of the one adult, unsexed specimen were as follows: greatest length of skull, 121; condyloincisive length, 119; condylocanine length, 109.4; palatal length, 58.1; length of rostrum, 44.3; breadth across upper carnassial tooth, 5.9; interorbital constriction, 24.8; postorbital constriction, 29.6; zygomatic breadth, 65.3; breadth of braincase, 44.6; mastoid breadth, 45.9; length of maxillary tooththrow, 50.1.

Canis latrans cagottis
(Hamilton-Smith, 1839)

Coyote

Specimen examined (1) — 5 km N Zacatlán de las Manzanas [19° 59' 33"N, 97° 57' 34" W; Loc. 13] (1 UAMI).

Additional records — Acatlán (Ingles, 1959); 6 mi SSW Izúcar de Matamoros (Van Gelder, 1960); Atlixco (Jackson, 1951); Río Frío, between City of Mexico and Puebla (Merriam, 1897 type locality of *Canis latrans cagottis*).

In addition to the specimen examined, field parties observed an adult individual at 4.5 km S, 9.5 km W San José Alchichica (19° 23' 25"N, 97° 28' 59" W). The coyote should be expected throughout the state and in association with all types of vegetation. It is one of the carnivores with the greatest habitat plasticity; in addition, it is commonly found in association with humans. The people of the area surrounding San José Alchichica enjoy hunting coyotes and accuse it of eating their cattle

and chickens. Ingles (1959) found a dead specimen in Acatlán hanging from the branches of a tree not far from a road, and Van Gelder's record (1960) refers to a coyote, which he saw crossing a road.

The measurements of our adult female were as follows: greatest length of the skull, 169.0; condyloincisive length, 166.0; condylocanine length, 149.0; palatal length, 87.0; length of rostrum, 74.0; breadth across upper carnassial tooth, 9.4; interorbital constriction, 25.8; postorbital constriction, 34.8; zygomatic breadth, 82.7; breadth of braincase, 55.1; mastoid breadth, 54.1; length of maxillary toothrow, 77.1.

Family Mustelidae

Lontra longicaudis annectens (Major, 1897)
Nutria, Perro de agua, Southern River Otter

Specimens examined — None.

Additional records (Gallo Reynoso, 1997) — Salto del Arroyo Tepezala, Rancho La Esperanza, 20 km E Venustino Carranza; Arroyo Ojo de Agua, Santa Cruz Tejalpan; Río Atoyac, Jolalpan; Río Mixteco, 2 km E Axutla.

Because no specimens of this species have been collected in Puebla, it is only known through indirect evidence (Gallo Reynoso, 1997) as scats and footprints. However, we observed a specimen, which a local resident had as a pet near Piedras Negras [20° 26' 28"N, 97° 45' 41" W]. The records for this species to date, are in tropical regions of northeastern and southwestern Puebla.

Mustela frenata Lichtenstein, 1831
Comadreja, Long-tailed Weasel

There are two subspecies of long-tailed weasel that occur in Puebla—*M. f. perotae*, which occurs in the northwestern and central part of the state, although it also may be found in the semiarid areas and coniferous forest of the Cuenca de Oriental (Oriental Basin) and Valle de Tehuacán (Tehuacán Valley), and *M. f. tropicalis*, which is only found in tropical forests in the northern part of the state. It is likely that *M. f. leucoparia* may be found in the southwestern region of the state of Puebla because it has been recorded in the north and east in

the state of Morelos (Ramírez-Pulido, 1969; Álvarez-Castañeda 1996).

Mustela frenata perotae Hall, 1936

Specimens examined (8) — Aquixtla [19° 47' 40"N, 97° 56' 3" W; Loc. 20], 2700 m (1 UAMI); 5 km S San José Alchichica [19° 26' 02"N, 97° 23' 19" W; Loc. 22] (1 ENCB); Río Otlati, 15 km NW San Martín [Texmelucan] [19° 17' 38"N, 98° 26' 38" W; Loc. 24], 8700 ft. (1 TCWC); 5 km S San José Alchichica [19° 26' 02"N, 98° 31' 59" W; Loc. 25], 3300 m (5 CNMA).

Additional records — Zacatlán (Hoffmann et al., 1972; Bassols, 1981); Huexotitla (Ferrari-Pérez, 1886).

This subspecies has only been found in the central part of Puebla in coniferous forest and xeric shrub, although it is probably present in the Cuenca de Oriental and Valle de Tehuacán region. The specimen examined from the vicinity of San José Alchichica was found killed on the road at a site surrounded by alfalfa fields.

The color pattern of the male (TCWC 2840) from Río Otlati is fairly typical of this subspecies. The top of the head of this specimen is black as are the areas around the eyes and extending onto the nose. There are areas in front of the ears that are white and there is a small white patch between the eyes. The nape of the neck and the area over the shoulders are a dark mahogany brown fading to lighter mahogany over the remainder of the body, sides, and proximal three quarters of the tail. The tail is tipped in black. The underparts are an ochraceous buff.

A male taken on July 21 had scrotal testes. Hoffmann et al. (1972) found a mesostigmata mite of the species *Hirdtionyssus staffordi* in a Zacatlán specimen. The specimens from Río Otlati were those recorded by Davis (1944) and Hall (1951).

The specimens from Aquixtla and Río Otlati were adult males with cranial measurements as follows: greatest length of the skull, 55.8, 50.3; condyloincisive length, 55.7, 50.1; condylocanine length, 54.8, 48.3; palatal length, 23.2, 20.8; length of rostrum, 13.3, 11.6; breadth across upper carnassial tooth, 2.9, 5.0; interorbital constriction, 12.4, 10.4; postorbital constriction, 10.1, 11.1; zygomatic breadth,

32.2, 28.5; braincase breadth, 21.5, 23.4; mastoid breadth, 27.2, 24.5; length of maxillary toothrow, 16.3, 13.7. External measurements of these specimens are as follows: total length, 510, 435; length of tail vertebrae, 205, 183; length of hind foot, 55, 46; length of ear, 20, 22; weight, 487.5, 245 g.

Mustela frenata tropicalis (Merriam, 1896)

Specimens examined (3) — Santiago Yancuictlalpan [20° 3' 37"N, 97° 28' 18" W; Loc. 7], 500 m (1 UAMI); Zacatlán [19° 56' 33"N, 97° 57' 34" W; Loc. 16] (1 CNMA); 20 km NE Tezuiltán [19° 56' 55"N, 97° 16' 18" W; Loc. 17] (1 CNMA).

This subspecies had not been previously reported in the state; therefore, the specimens examined represent the first record of the subspecies for Puebla. The nearest known locality for the subspecies is Jico, Veracruz, which is located 40 km SSE of Santiago Yancuictlalpan. This subspecies occurs in the tropical region of Veracruz (Hall, 1951), which coincides with the specimens examined because they were captured in the tropical forests in the north-eastern part of Puebla.

The specimens of this subspecies were slightly smaller than specimens of *M. f. perotae* of Tlaxcala and elsewhere in Puebla. It had a dark-brown dorsal coloration with a median dorsal stripe darker than the side regions, as compared to *M. f. perotae*, in which the dorsal and side color was a uniform yellowish brown. The middle ventral stripe was a deep ocher, besides the fact that this stripe is generally narrower. Except for the postorbital constriction, which was rather more similar to *M. f. perotae*, these specimens coincided more with the characteristics of *M. f. tropicalis* (Hall, 1951). The measurements of the Puebla specimens were slightly larger than those given by Hall (1951) for this subspecies, and much smaller than those for *M. f. perotae*. We believe there is likely to be intergradation between *M. f. perotae* and *M. f. tropicalis* (Hall, 1981; Hall and Dalquest, 1963).

The specimen from Santiago Yancuictlalpan was an adult female, with no sign of gross reproductive activity. The cranial measurements

of this specimen were as follows: greatest length of skull, 48.9; condyloincisive length, 48.8; condylocanine length, 47.0; palatal length, 19.5; length of rostrum, 11.5; breadth across upper carnassial tooth, 2.6; interorbital constriction, 10.3; postorbital constriction, 9.4; zygomatic breadth, 25.2; braincase breadth, 20.8; mastoid breadth, 22.2; length of maxillary toothrow, 14.3. External measurements of the specimen were total length, 410; length of tail vertebrae, 160; length of hind foot, 40; length of ear, 21; and weight, 250 g.

Taxidea taxus berlandieri Baird, 1858
Tlalcoyote, Badger

Specimen examined (1) — 10 km W Acatzingo [18° 58' 47"N, 97° 46' 55" W; Loc. 27], 2105 m, 1 (MSU).

Additional records — Texcal (Álvarez and Ocaña, 1999, as zooarcheological remain); 20 mi W Chalchicomula [Ciudad Serdán] near the Puebla-Veracruz boundary, 7500 ft. (Long, 1972).

The specimen examined was first reported by Baker and Petersen (1969). It was a female found freshly killed on the Orizaba-Puebla toll road on the morning of 4 August 1969. The location was on a plain dominated by Pico de Orizaba to the east and Malinche to the west. Grazed pastures and cornfields lined the highway at this point. The record from Long (1972) near Chalchicomula is based on a sight record. This species is known in Puebla only from the above records; however, the inhabitants of the area surrounding San Salvador El Seco say they often observed badgers in this region. Van Gelder (1960) mentioned seeing a badger in the zoo in the city of Puebla, but he could not learn the origin of the individual. These records are the southernmost for the species. All badgers from Mexico are assigned to the subspecies *T. t. berlandieri* (Long, 1972).

The skull of the specimen examined was destroyed when it was killed on the highway. The overall impression of the pelage is that this is a relatively pale badger. Black is confined to the top of the head, sides of the face, and behind the ears. The feet are also black. The white dorsal stripe extends from the head to the base of the tail; it is distinct on the top

of the head, and front shoulders, and on the rump, but it is faint in the mid-dorsal area. The tip of the tail is dark brown and not black.

Galictis vittata canaster Nelson, 1901
Grisón

Specimen examined (1) — 2 km N Zihuatentla [Zihuateutla] [20° 16' 13"N, 97° 53' 12" W; Loc. 2] (1 CNMA).

This record is the first for the grisón from Puebla, increasing the distribution of the species to 156 km southeast from Xilitla, San Luis Potosí (Hall, 1981), and 162 km northwest from Orizaba, Veracruz (Hall, 1981). This specimen is an adult male, captured in February 1949 in the tropical rain forest in the northeast region of Puebla.

Cranial measurements of the individual were as follows: greatest length of skull, 89.2; condyloincisive length, 89.2; condylocanine length, 84.2; palatal length, 44.6; length of rostrum, 21.5; breadth across upper carnassial tooth, 9.7; interorbital constriction, 20.0; postorbital constriction, 19.7; zygomatic breadth, 50.0; braincase breadth, 40.7; mastoid breadth, 49.9; length of maxillary toothrow, 26.6. External measures of the specimen were total length, 665; length of tail vertebrae, 145; length of hind foot, 80; and length of ear, 43.

Eira barbara senex (Thomas, 1900)
Tayra, Cabeza de Viejo

The "tayra" or "cabeza de viejo" has not been collected in Puebla; however, an individual of this species was observed crossing the road 8 km S Coxcatlán de Osorio, 1150 m [18° 11' 8"N, 97° 8' 48" W] in the southeastern part of the state. The locality was surrounded by tropical deciduous forest.

Family Mephitidae
Mephitis macroura macroura
Lichtenstein, 1832
Zorrillo, Hooded skunk

Specimens examined (7) — 1.5 km E Zacapoaxtla [19° 52' 19"N, 97° 34' 22" W; Loc. 19], 1370 m (1 UAMI); 10 km W San Martín Texmelucán [19° 16' 59"N, 98° 31' 59" W; Loc. 25], 3300 m (2 CNMA); 6 km NE San Andrés [Ciudad Serdán]

[19° 1' 45"N, 97° 24' 14" W; Loc. 26], SW slope of Mt. Orizaba, 9000 ft. (2 TCWC); 6 mi SSW Izúcar de Matamoros [18° 29' 21"N, 98° 30' 45" W; Loc. 35] (1 UIMNH); 3 km S Santa Ana Telostoc [18° 22' 15"N, 97° 34' 14" W; Loc. 36] (1 UAMI). **Additional records** — Santa Catarina, Cholula; Texcal (Álvarez and Ocaña, 1999, as zooarcheological remains); Tehuacán (Hall and Dalquest, 1950; Hall, 1981).

A female from Zacapoaxtla was obtained in some banana and avocado orchards in January and showed no signs of gross reproductive activity. A male with scrotal testes was obtained in April from Santa Ana Telostoc. The two specimens from San Martín Texmelucán are represented by unsexed skins alone. Van Gelder (1960) described in detail the conditions under which he captured the specimen from 6 mi SSW Izúcar de Matamoros. The two hooded skunks from the slopes of Mt. Orizaba were taken on August 11 in traps set at the opening of a burrow in a cornfield (Davis, 1944). The specimens are both subadult males with testes measurements of 5 by 3 and 4 by 2.5. Davis (1944) believed that the individuals were probably litter mates.

The two males from the slopes of Mt. Orizaba demonstrate the range of variation in color pattern in this species. One of the specimens (TCWC 2843) has a white hood on the back of the head and nape of the neck. The back and top of the tail are covered with long white hairs underlain visibly with black hairs. On the left side of the body there is a narrow white stripe from the shoulder to the hind leg. This stripe is absent on the right side of the body. There is a white spot on the center of the chest and a faint anteroposterior white line between the eyes. The other individual (TCWC 2844) has no hood and from the top of the head to the mid-back to the tip of the tail is black. There are lateral white stripes on both sides extending from the base of the ears onto the side of the rump. There is no white on the chest of this individual, but the white stripe between the eyes is present.

The cranial measurements of an adult female and an adult male, respectively, were as follows: greatest length of the skull, 60.6, 69.0; condyloincisive length, 56.9, 63.4;

condylocanine length, 51.9, 57.6; palatal length, 23.3, 25.2; length of rostrum, 20.3, 21.8; breadth across upper carnassial tooth, 4.8, 5.6; interorbital constriction, 16.8, 19.3; postorbital constriction, 17.4, 19.1; zygomatic breadth, 36.0, 41.7; braincase breadth, 26.8, 28.0; mastoid breadth, 31.6, 33.9; length of maxillary tooththrow, 20.6, 21.0. External measurements of the same specimens were as follows: total length, 510, 550; length of tail vertebrae, 290, 270; length of hind foot, 60, 64; length of ear, 25, 33; weight, 518, 856 g.

Spilogale putorius tropicalis Howell, 1902
Zorrillo, Spotted skunk

Specimens examined (5) — 8 mi W Izúcar de Matamoros [18° 36' 11"N, 98° 35' 34" W; Loc. 30] (1 UIMNH); 5 mi E Izúcar de Matamoros [18° 36' 11"N, 98° 23' 06" W; Loc. 31] (1 UIMNH); 4.5 mi E Izúcar de Matamoros [18° 36' 11"N, 98° 23' 34" W; Loc. 32] (1 UIMNH); 16 km SSW Izúcar de Matamoros [18° 21' 56"N, 98° 33' 48" W; Loc. 38] (2 UIMNH).

Additional record — Tepeyolo (Álvarez and Ocaña, 1999 as zooarcheological remains).

The specimens examined were briefly reported previously by Van Gelder (1960). He found spotted skunks to be among the commonest carnivores in the area of Izúcar de Matamoros. The 5 specimens examined were obtained between 30 December 1953, and 9 January 1954. Among the specimens are a male and female from 16 km SSW Izúcar de Matamoros, an unsexed individual from 8 km west of the town, and single males from the other two locations.

Van Gelder (1959, 1960) assigned these specimens to *S. p. tropicalis*. The color patterns of the specimens match closely with Figure 19 in Van Gelder (1959). The specimens clearly show more of the white color typical of *S. p. tropicalis* as opposed to *S. p. angustifrons* to the north. The white stripes are broadest in the specimen from 5 mi E Izúcar de Matamoros (UIMNH 15457), making it the lightest of the specimens examined.

Cranial measurements for 3 males and a female, respectively, were as follows: greatest length of skull, 51.6, 47.8, 51.4, 46.5;

condyloincisive length, 50.0, 46.7, 49.7, 44.7; condylocanine length, 47.1, 43.8, 46.8, 41.9; palatal length, 19.4, 17.4, 18.6, 16.9; length of rostrum, 14.8, 13.3, 14.2, 12.7; breadth across upper carnassial tooth, 4.8, 4.8, 4.5, 4.3; interorbital constriction, 14.0, 12.7, 13.9, 13.0; postorbital constriction, 13.8, 13.7, 14.6, 13.8; zygomatic breadth, 31.3, 29.1, 31.2, 27.5; breadth of braincase, 21.8, 21.9, 22.7, 22.1; mastoid breadth, 28.7, 26.2, 28.1, 25.6; length of maxillary tooththrow, 16.5, 15.2, 15.1, 14.9. External measurements of these specimens in the same order were as follows: total length, 352, 325, 346, 292; length of tail vertebrae, 111, 109, 101, 99; length of hind foot, 40, 35, 39, 36; length of ear, 25, 25, 27, 26.

The male from 16 km SSW Izúcar de Matamoros had two openings in the right frontal sinus in the postorbital region. These almost certainly were caused by a nematode parasite.

Conepatus leuconotus leuconotus
(Lichtenstein, 1832)
Zorrillo, Hog-nosed skunk

Specimens examined (6) — 4 km E Ayotoxco [20° 5' 47"N, 97° 22' 14" W; Loc. 5], 420 m (1 UAMI); Rancho Las Margaritas, 9 km NW Hueytamalco [20° 0' 10"N, 97° 21' 10" W; Loc. 10], 600 m (1 UAMI); 5 km W Guadalupe [19° 46' 0"N, 97° 46' 54" W; Loc. 21], 390 m (1 UAMI); Río Olati, 15 km NW San Martín [Texmelucan] [19° 17' 38"N, 98° 26' 38" W; Loc. 24], 8700 ft. (1 TCWC); 4.5 mi E Izúcar de Matamoros [18° 36' 11"N, 98° 23' 34" W; Loc. 32] (1 UIMNH); 7 mi E Izúcar de Matamoros [18° 36' 11"N, 98° 21' 7" W; Loc. 33] (1 UIMNH).

Additional records — Tepeyolo; Texcal (Álvarez and Ocaña, 1999, as zooarcheological remains); Rancho El Ajenjibre (Hall, 1981; Warner and Beer, 1957).

Dragoo et al. (2003) concluded on the basis of molecular, morphological, and morphometric data that *C. mesoleucus* and *C. leuconotus* are the same species; thus, according to these authors, for Mexico there is only *C. leuconotus leuconotus*. The two specimens from Ayotoxco and Rancho Las Margaritas (2477 and 1453 UAMI) were initially identified as *C.*

leuconotus and the specimens from Guadalupe (1844 UAMI) and Izúcar de Matamoros (UIMNH 15462-63) evinced all of the features of a *C. mesoleucus*. The specimen from Río Otlati (TCWC 2845) had a broad white stripe that extended from between the ears to base of the tail and the tail was all white. However, despite the morphological and size differences (see measurements) all specimens were assigned tentatively to *C. leuconotus*, following Drago et al. (2003).

The specimen from Rancho Las Margaritas was captured near stands of coffee and banana crops. According to Davis (1944) the female from Río Otlati was taken in a trap set at the entrance to a crevice in a rock ledge near a stream. Four of the specimens examined were females collected in late July and November and three showed no gross signs of reproductive activity. A female taken on 28 July was described on the specimen tag as "just finished lactating." Van Gelder (1960) described the conditions under which the two male specimens from the vicinity of Izúcar de Matamoros were captured on December 29 and 31.

The cranial measurements of two males (UIMNH 15462-63) and three adult females (UAMI 2477 and 1844, TCWC 2845) were, respectively, as follows: greatest length of the skull, 74.8, 69.7, 66.6, 79.8, 74.7; condyloincisive length, 70.8, 65.3, 62.5, 76.9, 70.6; condylocanine length, 64.2, 59.9, 58.1, 69.6, 65.3; palatal length, 30.1, 28.4, 24.3, 32.8, 30.3; length of rostrum, 25.0, 22.4, 21.3, 28.9, 25.2; breadth across upper carnassial tooth, 5.2, 5.5, 4.6, 5.6, 6.5; interorbital constriction, 22.0, 20.8, 19.2, 23.6, 23.1; postorbital constriction, 19.6, 20.0, 19.5, 21.8, 21.7; zygomatic breadth, 48.9, 42.5, 42.4, 45.5, 46.5; braincase breadth, 33.7, 32.9, 27.3, 35.0, 36.3; mastoid breadth, 39.5, 35.8, 33.3, 42.0, 42.0; length of maxillary toothrow, 21.6, 20.6, 21.1, 23.7, 22.3. External measurements of these specimens were as follows: total length, 620, 555, 575, 600, 690; length of tail vertebrae, 250, 202, 250, 250, 245; length of hind foot, 73, 70, 80, 70, 74; length of ear, 32, 28, 20, 30, 18. The three females weighed 1139, 2000, and 1700 g.

Family Procyonidae

Bassariscus astutus (Lichtenstein, 1830)

Cacomistle, Ringtail

There are two subspecies of this species in the state—*B. a. astutus* in which the distribution is primarily related to coniferous forest and xeric shrub, in the central and southeastern parts of Puebla, although it possibly may be found in most of the state, and *B. a. bolei* in which the distribution is confined to the southwestern part of the state in the Cuenca del Balsas (Balsas Basin) and is associated with tropical deciduous forest.

Bassariscus astutus astutus

(Lichtenstein, 1830)

Specimens examined (9) — Río Otlati, 15 km NW San Martín [Texmelucan] [19° 17' 38"N, 98° 26' 38" W; Loc. 24], 8700 ft. (3 TCWC); Mina de San Cristóbal, San Martín Totoltepec, Izúcar de Matamoros [18° 38' 54"N, 98° 20' 45" W; Loc. 28] (1 CNMA); 3 km SW Santa Ana Telostoc [18° 22' 15"N, 97° 34' 14" W; Loc. 37] (1 UAMI); 8 km W Zapotitlán de las Salinas [18° 11' 8"N, 97° 7' 36" W; Loc. 39], 1550 m (2 UAMI); 8 km S Coxcatlán [18° 11' 8"N, 97° 8' 48" W; Loc. 41], 830 m (1 UAMI); Las Sidras, 3 km NW Chila de las Flores [17° 59' 52"N, 97° 53' 42" W; Loc. 44], 1550 m (1 UAMI).

Additional records — Pan American Hwy. between Tepenene and Los Amates, SE Izúcar de Matamoros (Van Gelder, 1960; Hall, 1981); Puebla (Ferrari-Pérez, 1886).

At every locality where the specimens were collected except Río Otlati, the vegetation was xeric shrub. The cacomistle from Coxcatlán was captured in a trap with sugar cane as bait, which was placed near a hole on a river bank. The gastric content of this specimen was examined and it contained a water bird and a scorpion. The specimen from Las Sidras was obtained near a corn crop in a trap with prunes and corn as bait. The two specimens from Zapotitlán de las Salinas were hunted with a shotgun inside shrub vegetation. The specimens from Río Otlati were taken along the pine-bordered stream where their tracks were observed on a daily basis (Davis, 1944). The specimen recorded by Van Gelder (1960) was

observed along the Pan-American Highway in the hills southeast of Izúcar de Matamoros.

A single male was collected in August with scrotal testes. Three females captured in late August showed no signs of reproductive activity. Another female obtained in August and two taken on July 24 and 27 were lactating.

The cranial measurements of four adult females and two adult males were, respectively: greatest length of skull, 86.5 (86.1-87.0), 91.4, 90.3; condyloincisive length, 84.0 (82.5-85.3), 89.9, 87.0; condylocanine length, 79.5 (78.1-81.1), 84.6, 82.6; palatal length, 37.8 (37.4-38.3), 38.8, 40.6; length of rostrum, 27.1 (26.8-27.5), 29.1, 28.2; breadth across upper carnassial tooth, 8.2 (7.6-8.9), 8.4, 7.8; interorbital constriction 17.7 (16.8-18.5), 18.3, 17.0; postorbital constriction 18.2 (17.7-19.0), 17.7, 19.7; zygomatic breadth 53.2 (51.9-54.4), 54.9, 59.0; braincase breadth 34.8 (34.1-35.1), 35.5, 36.0; mastoid breadth 36.9 (36.1-38.2), 39.8, 41.8; length of maxillary tooththrow 33.1 (32.1-33.7), 34.9, 33.6. External measurements of the four females and one male were as follows: total length, 785 (780-791), 870; length of tail vertebrae, 383 (380-386), 440; length of hind foot, 77 (72-81), 83; length of ear, 51 (45-55), 57; weight, 1522 (1322-1638), 1698.5 g.

Bassariscus astutus bolei Goldman, 1945

Specimens examined (4) — Jolalpan [19° 54' 33"N, 97° 36' 28" W; Loc. 18], 900 m (1 UAMI); 3 km S Zacapala [18° 33' 42"N, 98° 3' 52" W; Loc. 34], 2370 m (1 UAMI); Xochiltepec [18° 13' 37"N, 98° 52' 33" W; Loc. 40], 1390 m (1 UAMI); San Juan Llano Grande, Municipality of Acatlán [18° 4' 1"N, 98° 5' 16" W; Loc. 43] (1 CNMA).

These specimens represent the first records of the subspecies for Puebla. The closest previous record is at Chilpancingo, Guerrero, which is the type locality of the subspecies; therefore, the Puebla localities extend the distribution of the subspecies by 110 km to the west. The specimens were collected in close association with tropical deciduous forest vegetation. A female captured in August was lactating. Sex of the other specimens is not available because only the skins were preserved.

The smaller size of *B. a. bolei* distinguishes it from *B. a. astutus* (Goldman, 1945). The only skull of this subspecies examined is that of an adult female and it is smaller than those of the *B. a. astutus* females listed above. The specimen has its upper premolar teeth in contact with each other, as opposed to specimens of *B. a. astutus* in which the teeth are separated by a small diastema. Furthermore, the upper carnassial of this female is wider than those of female *B. a. astutus* despite the fact that its skull is smaller. The general coloration of the body shows no differences between the subspecies.

The cranial measurements of the adult female were as follows: greatest length of skull, 81.8; condyloincisive length, 79.8; condylocanine length, 75.7; palatal length, 36.7; length of rostrum, 24.0; breadth across upper carnassial tooth, 9.0; interorbital constriction, 17.3; postorbital constriction, 18.0; zygomatic breadth, 51.9; braincase breadth, 33.5; mastoid breadth, 35.7; length of maxillary tooththrow, 32.1. External measurements of this specimen were total length, 765; length of tail vertebrae, 390; length of hind foot, 75; length of ear, 50; weight, 1210 g.

Potos flavus prehensilis (Kerr, 1792)
Kinkajou

Specimens examined (8) — Ocotal [20° 04' 33"N, 97° 49' 42" W; Loc. 6], 1230 m (3 UAMI); 3 km S Ocotal [20° 02' 44"N, 97° 49' 42" W; Loc. 8], 1230 m (3 UAMI); Rancho Las Margaritas, 9 km NW Hueytamalco [20° 00' 10"N, 97° 21' 10" W; Loc. 10], 600 m (2 UAMI).

Although the eight specimens examined do not increase the known distribution of the species because it has been reported from several tropical localities in northern Veracruz (Hall and Dalquest, 1963; Kortlucke, 1972), they do represent the first known records of kinkajou from Puebla. The species was found only in the cloud forest in northern Puebla. The specimens from Rancho Las Margaritas were donated by a local hunter; both were adult females collected in March and July. Neither of the females showed signs of reproductive activity. The specimens of kinkajou from 3 km

S Ocotal were donated by local residents but only one of the skulls was complete while for two of them only the mandible was provided. People in this area hunt the kinkajou for food and the hides are kept as trophies or for sale.

The cranial measurements of three adult females and one adult male were, respectively, as follows: greatest length of skull, 95.9, 96.2, 94.3, 95.8; condyloincisive length, 87.5, 89.4, 89.1, 90.3; condylocanine length, 81.3, 83.0, 83.6, 83.6; palatal length, 41.7, 38.9, 40.5, 41.4; length of rostrum, 27.0, 27.7, 23.8, 26.0; breadth across upper carnassial tooth, 5.7, 5.8, 5.8, 5.5; interorbital constriction, 21.3, 24.9, 21.5, 22.0; postorbital constriction, 25.2, 24.0, 22.3, 22.2; zygomatic breadth, 63.5, 63.4, 64.8, 59.3; braincase breadth, 41.0, 39.4, 41.3, 38.5; mastoid breadth, 44.3, 44.6, 45.9, 44.9; length of maxillary tooththrow, 27.3, 27.6, 27.1, 28.2. The external measurements of two adult females were as follows: total length, 1012, 1060; length of tail vertebrae, 492, 490; length of hind foot, 102, 95; length of ear, 41, 41; weight 2814.5, 3270 g.

Nasua narica (Linnaeus, 1766)

Coatí

Two subspecies of the coatí were found in the state. *N. n. molaris*, was found in shrub land and low deciduous forest in the southwestern part of the state, and probably occurs only in the Balsas Basin (Cuenca del Balsas), and *N. n. narica* was only found in the northern region of the state in tropical forest and tropical rain forest.

Nasua narica narica (Linnaeus, 1766)

Specimens examined (24) — 7 km NE Bienvenido de Galeana [20° 8' 9"N, 97° 12' 33" W; Loc. 3] (1 UAMI); Olintla [20° 06' 05"N, 97° 40' 59" W; Loc. 4], 790 m (2 UAMI); Ocotal [20° 04' 33"N, 97° 49' 42" W; Loc. 6], 1230 m (8 UAMI); Amixtlán [20° 02' 55"N, 97° 47' 54" W], 1230 m (4 UAMI); Hueytlalpan [20° 01' 36"N, 97° 41' 47" W; Loc. 9] (1 UAMI); Rancho Las Margaritas, 9 km NW Hueytlalpan [20° 00' 10"N, 97° 21' 10" W; Loc. 10], 600 m (1 UAMI); Zapotitlán de Méndez [20° 00' 3"N, 97° 42' 54" W; Loc. 12], 960 m (7 UAMI).

Additional record — Mesa San Diego (Warner and Beer, 1957, cited as *Nasua narica*).

Twenty-three of the specimens we examined were collected by local residents, who gave us only the skulls, but based on our instructions they provided us with the sex for each one. However, the specimen from Hueytlalpan, was captured in a cloud forest, and we have the skin and skull. The localities where the remainder of the specimens was captured were in tropical rain forest. The coatí is one of the most abundant carnivores mammals in the tropical region of northern Puebla; however, it is also the most hunted by the local residents. Generally, the residents hunt lone males, but, occasionally, they kill a whole family group in a single day. The main purpose for hunting is for use as food, but they also sell the hides.

Although a sufficient sample was not available to undertake a full statistical analysis, the males were on the average larger than females, particularly in the greatest length of skull ($t = 2.00$, $g. l. = 9$, $P < 0.05$), zygomatic breadth ($t = 3.19$, $g. l. = 9$, $P < 0.01$), mastoid breadth ($t = 2.87$, $g. l. = 7$, $P < 0.05$), and the sagittal crest was more developed in males. On the contrary, females were larger than males just in postorbital breadth ($t = 3.78$, $g. l. = 11$, $P < 0.01$). The cranial measurements (mean and range) of six adult females and eight adult males were, respectively, as follows: greatest length of skull, 120.6 (113.4-127.6), 125.1 (119.2-129.8); palatal length, 74.9 (71.9-79.7), 77.4 (75.3-80.8); length of rostrum, 52.3 (49.0-55.6), 53.0 (49.6-55.2); breadth across upper carnassial tooth, 7.8 (6.9-10.1), 7.6 (7.1-8.0); interorbital constriction, 26.0 (23.4-27.4), 27.2 (24.8-29.0); postorbital constriction, 30.4 (28.7-31.6), 27.8 (25.9-30.3); zygomatic breadth, 60.5 (56.1-63.7), 69.2 (61.1-76.9); braincase breadth, 44.6 (43.9-46.0), 45.0 (43.0-46.7); mastoid breadth, 43.5 (40.8-46.0), 46.6 (44.4-48.1); length of maxillary tooththrow, 46.1 (44.4-47.9), 47.1 (46.1-48.1). The external measurements of the female from Hueytlalpan were as follows: total length, 940; length of tail vertebrae, 467; length of hind foot, 94; length of ear, 40; weight, 3500 g.

Nasua narica molaris Merriam, 1902

Specimen examined (1) —Tochiname, Tecomatlán [18° 6' 33"N, 98° 18' 52" W; Loc. 42] (1 CNMA).

The specimen examined was a skull only collected in January. It was a female and shows no signs of reproductive activity. A specimen of this subspecies was reported by Van Gelder (1960) based on a skeleton found in a cave 5 mi E Izúcar de Matamoros. Re-examination of the specimen (UIMNH 15456) reveals that it is in fact a raccoon *Procyon lotor hernandezii*.

Procyon lotor hernandezii Wagler, 1831
Mapache, Raccoon

Specimens examined (10) — María Andrea [20° 27' 15"N, 97° 44' 08" W; Loc. 1], 110 m (1 UAMI); Ocotal [20° 4' 33"N, 97° 49' 42" W; Loc. 6], 1230 m (3 UAMI); Tepango de Rodríguez [20° 0' 10"N, 97° 47' 54" W; Loc. 11] (3 UAMI); María Andrea [20° 27' 15"N, 97° 44' 08" W; Loc. 14], 700 m (1 UAMI); 4.5 km S, 9.5 km W San José Alchichica [19° 23' 25"N, 97° 28' 59" W; Loc. 23] (1 ENCB); 5 mi E Izúcar de Matamoros [18° 36' 11"N, 98° 23' 06" W; Loc. 31] (1 UIMNH).

The raccoon has been reported in states surrounding Puebla, including Veracruz (Hall and Dalquest, 1963), Oaxaca (Goodwin, 1969), and Morelos (Álvarez-Castañeda, 1996), but has not been previously reported from Puebla. Ten specimens have been obtained in the state and are reported here. These specimens were from the north and central parts of the state, but it probably occurs throughout the state and is associated with all types of vegetation.

Only the specimens from near Hueytamalco and María Andrea were collected during our field studies; both were females captured on 10 February and 6 November, respectively, and neither showed breeding signs. All other specimens except the one from Izúcar de Matamoros were donated by local residents who hunt the raccoon for food and sell the skins. Van Gelder (1960) reported the specimen from Izúcar de Matamoros as a coatí, but it is clearly a raccoon. It is a skeleton that was found in a small cave.

The cranial measurements of two adult females, one adult male, and one unsexed adult,

were, respectively, as follows: greatest length of skull, 116.1, 117.8, 127.2, 123.9; condyloincisive length, 110.4, 111.8, 121.1, 120.1; condylocanine length, 102.4, 102.0, 112.9, 109.8; palatal length, 68.6, 69.3, 76.3, 73.6; length of rostrum, 38.8, 40.9, 42.9, 40.6; breadth across upper carnassial tooth, 8.9, 8.4, 9.5, 8.7; interorbital constriction, 22.3, 23.0, 26.8, 22.5; postorbital constriction, 24.9, 24.2, 25.8, 25.3; zygomatic breadth, 74.5, 73.6, 88.8, 75.5; braincase breadth, 50.3, 50.3, 54.8, 49.6; mastoid breadth, 60.5, 62.2, 69.6, 60.7; length of maxillary toothrow, 44.7, 44.0, 45.7, 45.8. The external measurements of an adult female were total length, 895; length of tail vertebrae, 272; length of hind foot, 120; length of ear, 61; weight, 6120 g

DISCUSSION

We document 14 species of Carnivora in the state of Puebla from a review of specimens in six collections in Mexico and the United States. In addition, four species were documented based on literature records and by indirect evidence (*Puma concolor*, *Lynx rufus*, *Lontra longicaudis*, and *Eira barbara*). The carnivorous mammals of Puebla belong to 5 families, 18 genera, 18 species and 23 subspecies (**Table 1**). Eight taxa represent new records for this state. It is also quite likely that *Bassariscus sumichrasti*, *Leopardus pardalis*, and *Panthera onca* inhabited the tropical region of the northeast of Puebla because they have been recorded in adjacent areas of the state of Veracruz (Hall and Dalquest, 1963; Hall, 1981).

By the geographic position of the State of Puebla, it has been influenced by the Nearctic and Neotropical faunas. Furthermore, due primarily to the topography of the region, it possesses wide variety of climates and types of vegetation; hence the state would be expected to have a great number of species with different biogeographic affinities. In Mexico there are 33 species of carnivores (Cervantes et al., 1994; Ramírez-Pulido et al., 1996) and Puebla has more than half of the species (54.5 %) and 78.3 % of the genera of carnivores in Mexico are present. Puebla also possesses five of the

Table 1

Taxonomic list of the carnivores from the Mexican State of Puebla. The acronyms correspond to: DIST (distribution), Nea (Nearctic Region), Neo (Neotropical Region), Nea-Neo (Nearctic plus Neotropical). SEMARNAT (conservation status, according to Norma Oficial Mexicana, SEMARNAT, 2002): A (threatened), P (endangered species), Pr (special protection). CITES (1984): Appendix I (species that are the most endangered), Appendix II (species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled), Appendix III (species included at the request of a party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation). IUCN (Baillie and Groombridge, 1996): EN, endangered; DD, data deficient; VU, vulnerable; NT near threatened.

TAXON	DIST	SEMARNAT	CITES	IUCN
FAMILY FELIDAE				
<i>Lynx rufus</i> (Schreber, 1777)	Nea		II	
<i>Puma concolor</i> (Linnaeus, 1771)	Nea-Neo		II	NT
<i>Herpailurus yagouaroundi</i> (Lacépède, 1809)	Neo	A	I	EN
<i>Herpailurus yagouaroundi cacomilti</i> (Berlandier, 1859)				
<i>Leopardus wiedii</i> (Schinz, 1821)	Neo	P	I	EN
<i>Leopardus wiedii oaxacensis</i> (Nelson and Goldman, 1931)				
FAMILY CANIDAE				
<i>Urocyon cinereoargenteus</i> (Schreber, 1775)	Nea-Neo			
<i>Urocyon cinereoargenteus nigrirostris</i> (Lichtenstein, 1850)				
<i>Urocyon cinereoargenteus orinomus</i> Goldman, 1938				
<i>Urocyon cinereoargenteus scottii</i> Mearns, 1891				
<i>Canis latrans</i> Say, 1823	Nea			
<i>Canis latrans cagottis</i> (Hamilton-Smith, 1839)				
FAMILY MUSTELIDAE				
<i>Lontra longicaudis</i> (Olfers, 1818)	Neo	A	I	DD
<i>Lontra longicaudis annectens</i> (Major, 1897)				
<i>Mustela frenata</i> Lichtenstein, 1831	Nea-Neo			
<i>Mustela frenata perotae</i> Hall, 1936				
<i>Mustela frenata tropicalis</i> (Merriam, 1896)				
<i>Taxidea taxus</i> (Schreber, 1778)	Nea	A		
<i>Taxidea taxus berlandieri</i> Baird, 1858				
<i>Galictis vittata</i> (Schreber, 1776)	Neo	A	III	
<i>Galictis vittata canaster</i> Nelson, 1901				
<i>Eira barbara</i> (Linnaeus, 1758)	Neo	P	III	VU
<i>Eira barbara senex</i> (Thomas, 1900)				
FAMILY MEPHITIDAE				
<i>Spilogale putorius</i> (Linnaeus, 1758)	Nea-Neo			
<i>Spilogale putorius tropicalis</i> Howell, 1902				
<i>Mephitis macroura</i> Lichtenstein, 1832	Nea-Neo			
<i>Mephitis macroura macroura</i> Lichtenstein, 1832				
<i>Conepatus leuconotus</i> (Lichtenstein, 1832)	Nea-Neo			
<i>Conepatus leuconotus leuconotus</i> (Lichtenstein, 1832)				
FAMILY PROCYONIDAE				
<i>Bassariscus astutus</i> (Lichtenstein, 1830)	Nea			
<i>Bassariscus astutus astutus</i> (Lichtenstein, 1830)				
<i>Bassariscus astutus bolei</i> Goldman, 1945				
<i>Potos flavus</i> (Schreber, 1774)	Neo	Pr	III	
<i>Potos flavus prehensilis</i> (Kerr, 1792)				
<i>Nasua narica</i> (Linnaeus, 1766)	Neo		III	
<i>Nasua narica narica</i> (Linnaeus, 1766)				
<i>Nasua narica molaris</i> Merriam, 1902				
<i>Procyon lotor</i> (Linnaeus, 1758)	Nea-Neo			
<i>Procyon lotor hernandezii</i> Wagler, 1831				

six families of terrestrial carnivores in Mexico, missing only the Ursidae.

Puebla has a mixture of Nearctic and Neotropical species. Four species of carnivores show a primarily Nearctic affinity: *Lynx rufus*, *Canis latrans*, *Taxidea taxus*, and *Bassariscus astutus*. All of these inhabit areas surrounding Sierra Nevada, La Malinche, Cofre de Perote, Pico de Orizaba, Cuenca de Oriental, and the Valle de Tehuacán. There are seven species whose distribution is primarily in the Neotropical region: *Herpailurus yagouaroundi*, *Leopardus wiedii*, *Lontra longicaudis*, *Galictis vittata*, *Eira barbara*, *Potos flavus*, and *Nasua narica*. All of these species are concentrated in a small tropical region of northeastern Puebla, although a few of them are in the southwestern part in the Balsas Basin (Cuenca del Balsas). Finally, seven species are widespread and in both regions: *Puma concolor*, *Urocyon cinereoargenteus*, *Mustela frenata*, *Spilogale putorius*, *Mephitis macroura*, *Conepatus leuconotus*, and *Procyon lotor*.

Currently, there is no updated and reliable information on the state of conservation of Puebla's carnivorous mammals; however, there is enough information, which indicates that a considerable number of species are endangered species at a state level, for more than one third (38.9 %, n = 7 species, **Table 1**) are in some category of risk (SEMARNAT, 2002). In this context, the Mexican wolf (*Canis lupus baileyi*) was not taken into account in our study because of the lack of information showing its presence in the state; nevertheless, it is possible that this species was extirpated from Puebla toward the end of the 19th century or the beginning of the 20th century (Sumichrast, 1881; Leopold, 1965).

Of the species considered by the Norma Oficial Mexicana (SEMARNAT, 2002), two are endangered (*Leopardus wiedii* and *Eira barbara*), one has special protection (*Potos flavus*), and four are classified as threatened (*Herpailurus yagouaroundi*, *Lontra longicaudis*, *Taxidea taxus*, and *Galictis vittata*). CITES (1984) covers nine species in different levels of risk (**Table 1**)—I: *Herpailurus yagouaroundi*, *Leopardus wiedii*, *Lontra longicaudis*; II: *Lynx rufus*, *Puma*

concolor; III: *Galictis vittata*, *Eira barbara*, *Potos flavus*, *Nasua narica*. IUCN list five species with different level of risk: *Herpailurus yagouaroundi* (EN), *Leopardus wiedii* (EN), *Puma concolor* (NT), *Lontra longicaudis* (DD), and *Eira barbara* (VU) (**Table 1**).

Herpailurus yagouaroundi, *Leopardus wiedii*, *Lontra longicaudis*, and *Eira barbara* are represented on all three lists (CITES, 1984; Baillie and Groombridge, 1996; SEMARNAT, 2002), which shows both a national and international concern for the preservation of these four species. All of the species considered in some category, except for bobcat (*Lynx rufus*) and badger (*Taxidea taxus*), are primarily of Neotropical origin; therefore, if there is interest in preserving endangered species, strategies must focus on the tropical zones of Puebla.

In spite of this species-level diversity of carnivores present in Puebla, every species is undergoing excessive hunting by local residents of many communities of the state. Hunting of these carnivores (especially *Nasua narica*, *Procyon lotor*, and *Potos flavus*) is an additional source of food for these people who are generally farmers. These residents make a particular diagonal cut in the skull of these animals on the higher part of the occipital to the front part of the basioccipital in order to extract the brain. Hunting these carnivores also represents an additional financial resource because they trade the hides (primarily *Urocyon cinereoargenteus*, *Potos flavus*, and *Leopardus wiedii*).

A hide may bring a price ranging from \$20.00 pesos (for example, raw skin of *Procyon lotor*) to \$2 000.00 pesos (for example, tanned hide of *Leopardus wiedii*). They also engage in the trade of live animals, and their prices can range from \$1 000.00 pesos for one coyote pup to \$4 000 pesos for an adult specimen a river otter (*Lontra longicaudis*). These dietary and financial benefits for the peasants seem to be historical and widespread in Mexico and Central America (March 1987; Aranda, 1991; Redford and Robinson, 1991; Álvarez and Ocaña, 1999). However, together with the destruction of the habitat as a result of agriculture and cattle farming (Gallo Reynoso, 1997), the hunting of carnivores is dramatically re-

ducing their populations. In spite of the impact caused by the exploitation of this resource, hunting has not been studied well yet; therefore, new studies must focus on understanding the impact of the human communities on the density of the carnivores.

A conservation strategy involving every carnivore species would seem to be too complex because each carnivore species respond to human pressure in a different way (Hernández Huerta, 1992); therefore, an adequate and important strategy would be the creation of protected areas (Glanz, 1991). In this regard, northern Puebla where rain forest, cloud forest, and tropical forest are located in close proximity, would be an ideal choice. This region is where we found the greatest diversity of carnivores including some in the endangered category. The area should not include fragmented habitats and must contemplate programs of environmental education and sustained management.

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LITERATURE CITED

- ÁLVAREZ T and A OCAÑA. 1999. Sinopsis de restos arqueozoológicos de vertebrados terrestres. Basada en informes del Laboratorio de Paleozoología del INAH. Instituto de Antropología e Historia, Colección Científica 386:1-108.
- ÁLVAREZ-CASTAÑEDA ST 1996. Los Mamíferos del Estado de Morelos. Centro de Investigaciones Biológicas del Noroeste, S. C., 211 pp.
- ARANDA M 1991. Wild mammal skin trade in Chiapas, México. Pp. 174-177, *in*: Neotropical wildlife use and conservation (JG Robinson and KH Redford, eds.). University of Chicago Press, Chicago, 520 pp.
- ARANDA M 2000. Huellas y otros rastros de los mamíferos grandes y medianos de México. CONABIO, Instituto de Ecología, A. C., 212 pp.
- BAILLIE J and B GROOMBRIDGE. 1996. IUCN red list of threatened animals. International Union for Conservation of Nature and Natural Resources. Gland, Switzerland, 368 pp.
- BAKER RH and MK PETERSEN. 1969. Records of the badger from Mexico. *Southwestern Naturalist* 14:251-252.
- BASSOLS BI. 1981. Catálogo de los ácaros Mesostigmata de mamíferos de México. *Anales de la Escuela Nacional de Ciencias Biológicas, México*, 24:9-49.
- CASTILLO-MEZA L, S GAONA and J GARCÍA-CHÁVEZ. 1997. La ardilla voladora *Glaucomys volans goldmani* (Nelson, 1904) en Puebla, México. *Revista Mexicana de Mastozoología* 2:119-121.
- CERVANTES FA, A CASTRO-CAMPILLO and J RAMÍREZ-PULIDO. 1994. Mamíferos terrestres nativos de México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología* 65:177-190.
- CITES. 1984. Protected species: Appendices I, II and III.
- CITES. U. S. Fish Wildlife Service Report 50 CFR 23. Washington, DC.
- DAVIS WB. 1944. Notes on Mexican mammals. *Journal of Mammalogy* 25:370-403.
- DRAGOO JW, RL HONEYCUTT, and DJ SCHMIDLY. 2003. Taxonomic status of white-backed hog-nosed skunks, genus *Conepatus* (Carnivora: Mephitidae). *Journal of Mammalogy* 84:159-176.
- FERRARI-PÉREZ F 1886. Catalogue of animals collected by the Geographical and Exploring Commission of the Republic of Mexico. *Proceedings of the U. S. National Museum* 9:125-199.
- GALLO REYNOSO JP. 1997. Situación y distribución de las nutrias en México, con énfasis en *Lontra longicaudis annectens* Major, 1897. *Revista Mexicana de Mastozoología* 2:10-32.
- GLANZ WE. 1991. Mammalian densities at protected versus hunted sites in Central Panama. Pp. 163-173, *in*: Neotropical wildlife use and conservation (JG Robinson and KH Redford, eds.). University of Chicago Press, Chicago, 520 pp.
- GOLDMAN EA. 1938. List of the gray foxes of Mexico. *Journal of the Washington Academy of Sciences* 28:494-498.
- GOLDMAN EA. 1945. A new cacomistle from Guerrero. *Proceedings of the Biological Society of Washington*, 58:105-106.
- GOODWIN GG. 1969. Mammals from the state of Oaxaca, Mexico, in the American Museum of Natural History. *Bulletin of the American Museum of Natural History*, 141:1-270.
- HALL ER. 1951. American weasels. University of Kansas Publications, Museum of Natural History, 4:1-466.
- HALL ER. 1981. The mammals of North America. John Wiley and Sons, 2:vi+601-1181 +90.

- HALLER and WW DALQUEST. 1950. Geographic range of the hooded skunk, *Mephitis macroura*, with description of a new subspecies from Mexico. University of Kansas Publications, Museum of Natural History 1:575-580.
- HALLER and WW DALQUEST. 1963. The mammals of Veracruz. University of Kansas Publications, Museum of Natural History 14:165-362.
- HEANEY LR and EC BIRNEY. 1977. Distribution and natural history notes on some mammals from Puebla, Mexico. Southwestern Naturalist 21:543-545.
- HERNÁNDEZ HUERTA A. 1992. Los carnívoros y sus perspectivas de conservación en las áreas protegidas de México. Acta Zoológica Mexicana, nueva serie 54:1-23.
- HOFFMANN A, I BASSOLS, and C MÉNDEZ. 1972. Nuevos hallazgos de ácaros en México. Revista de la Sociedad Mexicana de Historia Natural 33:151-159.
- INGLES LG. 1959. Notas acerca de los mamíferos mexicanos. Anales del Instituto de Biología, Universidad Nacional Autónoma de México 29:379-408.
- JACKSON HHT. 1951. Classification of the races of the coyote. Pp. 227-341, in: The clever coyote (SP Young and HHT Jackson, eds.). The Stackpole Co., Harrisburg, Pennsylvania and Wildlife Management Institute, Washington, DC, XV + 411 pp.
- KORTLUCKE SM. 1972. Morphological variation in the kinkajou, *Potos flavus* (Mammalia: Procyonidae), in Middle America. Occasional Papers of The Museum of Natural History, University of Kansas 17:1-36.
- LAVAL RK 1972. Distributional records and band recoveries of bats from Puebla, Mexico. Southwestern Naturalist 16:449-451.
- LEOPOLD AS 1965. Fauna Silvestre de México. Instituto Mexicano de Recursos Naturales Renovables, México, DF.
- LONG CA. 1972. Taxonomic revision of the North American badger, *Taxidea taxus*. Journal of Mammalogy 53:725-759.
- MARCH MIJ 1987. Los lacandones de México y su relación con los mamíferos silvestres: un estudio etnozoológico. Biotica 12:43-56.
- MERRIAM CH. 1897. Revision of the coyotes or prairie wolves, with descriptions of new forms. Proceedings of the Biological Society of Washington 11:19-33.
- RAMÍREZ-PULIDO J. 1969. Contribución al estudio de los mamíferos del Parque Nacional "Lagunas de Zempoala", Morelos, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoológica 40:253-290.
- RAMÍREZ-PULIDO J, J ARROYO-CABRALES y A CASTRO-CAMPILLO. 2005. Estado actual y relación nomenclatural de los mamíferos terrestres de México. Acta Zoológica Mexicana. Nueva serie 21:21-82.
- RAMÍREZ-PULIDO J, A CASTRO-CAMPILLO, J ARROYO-CABRALES y FA CERVANTES. 1996. Lista taxonómica de los mamíferos terrestres de México: A taxonomic list of the terrestrial mammals of Mexico. Occasional Papers, Museum of Texas Tech University 158:1-62.
- RAMÍREZ-PULIDO J, A CASTRO-CAMPILLO, A SALAME-MÉNDEZ, and HH GENOWAYS. 1999. The heteromyid rodents from the Mexican State of Puebla. Mastozoología Neotropical 6:113-127.
- RAMÍREZ-PULIDO J and C SÁNCHEZ-HERNÁNDEZ. 1971. *Tylomys nudicaudus* from the Mexican states of Puebla and Guerrero. Journal of Mammalogy 52:481.
- REDFORD KH and JG ROBINSON. 1991. Subsistence and commercial uses of wildlife in Latin America. Pp. 6-23, in: Neotropical wildlife use and conservation (JG Robinson and KH Redford, eds.). University of Chicago Press, Chicago, 520 pp.
- ROJAS-MARTÍNEZ AE and A VALIENTE-BANUET. 1996. Análisis comparativo de la quiropterofauna del Valle de Tehuacán-Cuicatlán, Puebla-Oaxaca. Acta Zoológica Mexicana, nueva serie 67:1-23.
- SEMARNAT. 2002. Norma oficial Mexicana NOM-059-ECOL-2001, Protección ambiental-Especies nativas de México de flora y fauna silvestres -Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio- Lista de especies en riesgo. Diario Oficial de la Nación, Marzo 6, 2002, pp. 56-85.
- SUMICHRAST F. 1881. Enumeración de las especies de mamíferos, aves, reptiles y batracios observados en la parte central y meridional de la República Mexicana. La Naturaleza, 5:199-214, 322-328.
- URBANO-VG, O SÁNCHEZ-H, G TÉLLEZ-G, and RA MEDELLÍN-L. 1987. Additional records of Mexican mammals. Southwestern Naturalist 32:134-137.
- VAN GELDER RG. 1959. A taxonomic revision of the spotted skunks (genus *Spilogale*). Bulletin of the American Museum of Natural History 117:229-392.
- VAN GELDER RG. 1960. Carnívoros in Puebla, Mexico. Journal of Mammalogy 41:519.
- VILLA-RAMÍREZ B. 1942. *Citellus variegatus rupestris* Allen, de Izúcar de Matamoros, Puebla. Anales del Instituto de Biología, Universidad Nacional Autónoma de México 13:555-569.
- WARNER DW and JR BEER. 1957. Birds and mammals of the Mesa de San Diego, Puebla, Mexico. Acta Zoológica Mexicana 2:1-21.