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Records of bats predated by *Leopardus pardalis* (Carnivora: Felidae) in eastern Ecuador

Registro de murciélagos depredados por *Leopardus pardalis* (Carnivora: Felidae) en el oriente ecuatoriano

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Abstract

Despite its wide distribution, the natural history of the ocelot, *Leopardus pardalis*, is poorly known. Studies of diet and hunting strategies have determined that ocelots walk in search of prey, which include mostly small terrestrial and nocturnal mammals, especially rodents. The objective of this short article is report an event of predation on bats by an ocelot in a tropical rainforest in eastern Ecuador. **Methodology:** We analyzed stomach contents of an adult male ocelot that was hunted by members of a Huaorani community in Pastaza Province, Ecuador. After macroscopic analysis, four bat carcasses were retrieved (including incomplete skulls pieces). Once in the laboratory, skeletons were cleaned by dermestid beetles, which allowed the taxonomic identification of the skulls using morphological characteristics. **Results:** Morphological examination, mainly from cranial characters, of the bat skeletons recovered from the ocelot's stomach contents confirmed the presence of two species: three individuals of *Saccopteryx bilineata* and one individual of *Micronycteris megalotis*. **Conclusion:** The stomach contents from this ocelot demonstrate that bats are items in the diet of this predator. We suggest that the ocelot may search for bats in their roosts and use these species in a higher frequency than previously reported.

Keywords: Diet, *Micronycteris megalotis,* Ocelot, Predation, *Saccopteryx bilineata*.

Resumen

A pesar de su amplia distribución, la historia natural del ocelote, *Leopardus pardalis*, es poco conocida. Los estudios de dieta y estrategias de caza han determinado que los ocelotes buscan presas que incluyen mamíferos pequeños, terrestres y nocturnos, sobre todo roedores. El objetivo de este artí-culo es reportar un evento de depredación sobre murciélagos por un ocelote en una selva tropical en el este de Ecuador. **Metodología:** Se analizaron los contenidos estomacales de un ocelote macho adulto cazado por miembros de una comunidad Huaorani en la provincia de Pastaza, Ecuador. Después de un análisis macroscópico, se recuperaron cuatro cuerpos de murciélagos (incluyendo cráneos incompletos). Una vez en el laboratorio, los esqueletos se limpiaron por escarabajos derméstidos, lo que permitió la identificación taxonómica de los cráneos utilizando caracteres morfológicos. **Resultados:** El examen morfológico, sobre todo de los caracteres craneales de los esqueletos de los murciélagos recuperados de los contenidos del estómago del ocelote confirmó la presencia de dos especies: tres individuos de *Saccopteryx bilineata* y uno de *Micronycteris megalotis*. **Conclusión:** Los contenidos estomacales de este ocelote demuestran que los murciélagos son elementos de la dieta de este depredador. Se sugiere que el ocelote puede buscar murciélagos en sus dormideros y utilizar estas especies en una frecuencia más alta que la previamente reportada.

Palabras clave: Depredación, Dieta, *Micronycteris megalotis,* Ocelote, *Saccopteryx bilineata*.

Introduction

Members of the family Felidae face several difficulties when foraging, these challenges are mainly related to the availability of prey and the high demand of energy involved in acquiring it (Gittleman and Harvey 1982, de Villa Meza *et al.* 2002). The ocelot, *Leopardus pardalis* Linnaeus 1758, is distributed

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from southern United States (populations are known to exist in Texas and Arizona) to northern Argentina and Uruguay, except Chile (Emmons 1987, Sunquist and Sunquist 2002, Wozencraft 2005, Caso *et al.* 2008). In Ecuador, this species occurs in western and eastern tropical and subtropical forests extending into the Andean foothills between 0 and 1,500 m (Tirira 2007). The ocelot is listed as a Near Threatened species in Ecuador where it is endangered by habitat loss and mortality associated with poaching and conflicts with people (Espinosa *et al.* 2011).

Ocelots are nocturnal, starting to move around sunset, with peaks of activity in late evening hours and before sunrise (Konecny 1989, Sunquist and Sunquist 2002, Sunquist and Sunquist 2009). They usually rest between dawn and late afternoon in brush piles, in depressions on the ground, at the base of large trees, under fallen trees, or over branches (Sunquist and Sunquist 2002); however, daytime activity is not uncommon and is probably related to the diurnal activity of some prey species (Konecny 1989, Sunquist and Sunquist 2009). They do most of their hunting on the ground but they have also been reported as agile climbers and strong swimmers (Sunquist and Sunquist 2009). Mainly opportunistic, these medium-sized cats use strategies such as slow walks while seeking and listening, or sit-and-wait until a prey is encountered (Bisbal 1986, Emmons 1987).

Studies of the species food habits are scarce and do not cover continuous areas of its distribution (de Villa Meza *et al.* 2002). Ocelot's diet consists mainly of small terrestrial nocturnal mammals, specially rodents (Moreno *et al.* 2006), but they also prey on opossums, squirrels, cavies, rabbits, primates, iguanas, frogs, birds, fishes, insects and land crabs (de Villa Meza *et al.* 2002, Sunquist and Sunquist 2002, Wang 2002, Bianchi and Mendes 2007; Abreu 2008, Caso *et al.* 2008, Sánchez *et al.* 2008, Sunquist and Sunquist 2009). They also take occasionally larger prey (Konecny 1989, Aliaga-Rossel 2006). Bats have being rarely recorded in *Leopardus* diet studies and have not being an important food item compared with other prey found in stomach contents (Bisbal 1986, Emmons 1987, Chinchilla 1997, Moreno *et al.* 2006, Rocha-Mendes and Biaconi 2009). Herein, we report one event of predation on bats by an ocelot in a tropical rainforest in eastern Ecuador.

Methodology

We analyzed the stomach contents of an adult male ocelot that was hunted by members of a Huaorani community known as Tarangaro, Arajuno County, Pastaza Province (01°24'2.23''S; 77°23'0.76''W; 320 m). The Huaorani o Waorani is a Native American tribe that inhabits the northeastern Amazon of Ecuador (Napo, Orellana, and Pastaza Provinces). The rest of the specimen was collected, catalogued with a field number, measured, sexed and tissue sampled. The stomach contents were spread out in a container for macroscopic analysis. Green matter (plants, mosses, leaves) and unidentifiable items were separated from vertebrate and invertebrate remains. Four vertebrate carcasses from bats and two body parts from reptiles were sorted as individual samples. No other carcasses were found and the ones from bats were easily sorted because they were not sectioned in multiple pieces (Figure 1). Tissue samples from the ocelot and from the bat carcasses were preserved in 95% ethanol. Carcasses were fixed in formalin and individually bagged prior transportation.

The ocelot specimen and the four bat carcasses extracted from its stomach contents were formally accessed to the Mammal Collection at Museo de Zoología, Pontificia Universidad Católica del Ecuador (QCAZ 14797-QCAZ 147801). In the laboratory, bat carcasses were cleaned by dermestid beetles. Much of the skeletons were recovered (including semi-complete skulls pieces) that allowed taxonomic identification using morphological characteristics and the reference collection from QCAZ (Alonso-Mejía and Medellín 1991, Yancey *et al.* 1998, Williams and Genoways 2008).

Results and discussion

Analysis results from morphological examination confirmed the presence of four bats of two species: three individuals of *Saccopteryx bilineata* (QCAZ 14798-14800) and one individual of *Micronycteris megalotis* (QCAZ 14801).

Specimens QCAZ14798-14800 were identified based only on cranial characters. These specimens are emballonurids due to incomplete premaxillae, represented only by nasal branches (not palatal) which

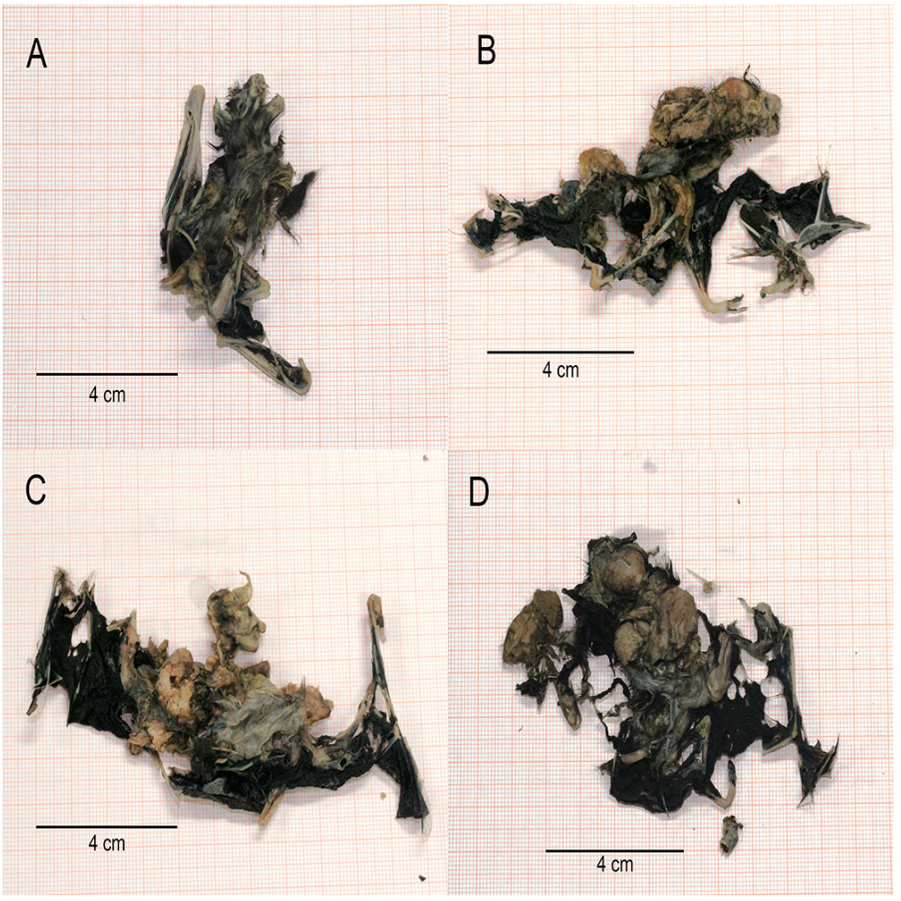

Figure 1. Bat carcasses extracted from stomach contents of *Leopardus pardalis*. *Saccopteryx bilineata* (A, B, C), and *Micronycteris megalotis* (D).

are not fused to each other at the midline neither to the adjacent maxillae (Figure 2A; Hood and Gardner 2007). In all cases, the muzzles are short and broad with the presence of a developed postorbital process (Figure 2B). Out of the emballonurid genera distributed in Ecuador and following the criteria of Hood and Gardner (2007), these specimens where identified as *Saccopteryx* for their lack of a rimmed depression at the dorsal surface of the rostra and absence of white fur (which excludes *Diclidurus*); posterior margin of basisphenoid pit separated from basioccipital by a transverse rim (unlike *Rhynchonycteris*); an upper anterior premolar shaped as a small spicule (Figure 2C; unlike *Centronycteris* and *Cormura*); flat rostra with supraorbital ridge continuous with the postorbital process, developed sagittal crests; large basisphenoid pits separated by a median septum (Figure 2D; unlike *Balantiopteryx* and *Peropteryx*).

Only two species of *Saccopteryx* occur in Ecuador: *S. bilineata* and *S. leptura*, both externally distinguishable by the fur color (chocolate brown in *S. bilineata* and slightly burnished brown in *S. leptura*) and forearm length (more than 43 mm in *S. bilineata* and less than 43 mm in *S. leptura*; Yancey *et al.* 1998). Unable to distinguish the mentioned external characters in the stomach remains, the identification was carried out at skull level, where both species differ in the maxillary toothrow length, usually more than 7 mm (6.4-7.4 mm) in *S. bilineata* and less than 6 mm (5.1-5.5 mm) in *S. leptura*; and also by the width across molars (M3-M3) more than 7 mm (7.2-7.6 mm) in *S. bilineata* and less than 7 mm (5.9-6.3) in *S. leptura* (Hood and Gardner 2007). The retrieved specimens (QCAZ 14798, QCAZ14799, and QCAZ 14800) showed maxillary toothrow lengths of 7.18 mm, 7.09 mm, and 7.05 mm, respectively. As for the width across molars, specimens showed 7.10 for QCAZ 14798 and 7.58 for QCAZ 14799 (QCAZ

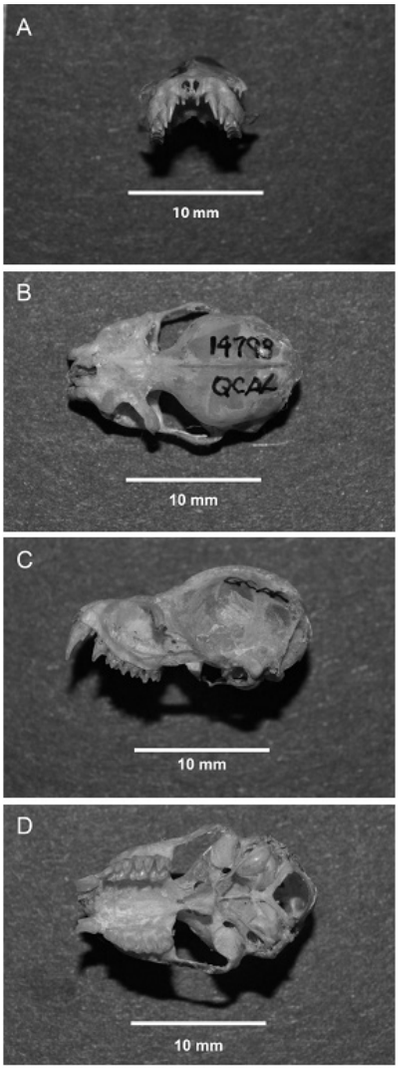

Figure 2. *Saccopteryx bilineata* skulls retrieved from stomach contents. A) QCAZ14799 premaxillae with only nasal branches; B) QCAZ14798, dorsal view of the cranium with developed postorbital process; C) QCAZ14798, lateral view of the cranium. The upper anterior premolar is a small spicule; D) QCAZ14798, ventral view of the cranium, showing large basisphenoid pits separated by a median septum.

14800 couldn't be measured across the molars).

Before the remains were cleaned in a dermestid colony, specimen QCAZ 14801 was identified as a phyllostomid due to a well-defined noseleaf. With the clean skeleton we identified molars with cusps and commissures in a W-pattern, diagnostic characteristic of the subfamily Phyllostominae (Williams and Genoways 2007). Despite of the incomplete skull, the remains were identified as *Micronycteris* because of the height of the upper canine (2.24 mm) which is twice the height of inner upper incisor (1.05 mm) noted as a diagnostic character (Simmons and Voss 1998). Also, we found a non molariform P3, and a lingual cingulum in P4 with a concave outline and no lingual cusp, in accordance to Simmons and Voss (1998).

Three species of *Micronycteris* are known to occur in Ecuador (*M. megalotis, M. hirsuta,* and *M. minuta*); as noted by Simmons (1996), cranial morphology is similar within all species of this genus. However, certain cranio-dental characteristics such as length of maxilar toothrow, as well as incisors and premolars size and shape resulted in the recognition of the specimens as *M. megalotis*. QCAZ14801 has large upper inner incisors, chisel-shaped small outer incisors, upper canines slightly divergent, premolars equal in size with one cusp each, four bifid lower incisors, and lower premolars aligned on the mandibule (Figure 3A, B; Alonso-Mejía and Medellín 1991, Simmons 1996, Simmons and Voss 1998). Length of maxilar toothrow of the specimen is 7.72 mm, well within *M. megalotis* measure range (6.4-7.8 mm, Alonso-Mejía and Medellín 1991). The specimen was not considered *M. hirsuta* following the criteria of Simmons and Voss (1998) for which *M. hirsuta* is, overall, a larger species than *M. megalotis*. Also, Simmons (1996) reports a larger toothrow for *M. hirsuta* (8.97-9.52 mm). Alternatively, *M. minuta* is a smaller species than *M. megalotis*, for which maxilar toothrow has been reported between 6.20 and 6.94 (Simmons 1996, López-González 1998, Simmons and Voss 1998).

Both species of bats found in the stomach content of the ocelot may use hollow trees, logs, caverns, and crevices as roosts (Alonso-Mejía and Medellín 1991, Yancey *et al.* 1998). It is also known that these two species roost together (Yancey *et al.* 1998).

Finally, morphological examination of the Squamata remains allowed the identification of two species of iguanas: *Enyalioides* sp. and *Plica umbra.* Plant material and invertebrate remains could not be identified.

Conclusions

It has been reported that the main hunting strategy of the ocelot and other medium to large size felids is mainly walking until prey is encountered (Emmons

1987); however, it has been also registered that ocelots kill prey by attacking them in their shelters (Sunquist and Sunquist 2009). Local hunters from the Huaorani Tarangaro community anecdotally described that they have observed, for several occasions, these cats searching for prey in tree cavities and then going inside them if prey are found. The stomach contents of this individual proves that bats are within the diet range of the predator and that they may actively search for bats in their roosts and use these species in a higher frequency than previously reported (Bisbal 1986, Mondolfi 1986, Emmons 1987, Konecny 1989), since these bat species are known to roost in tree cavities.

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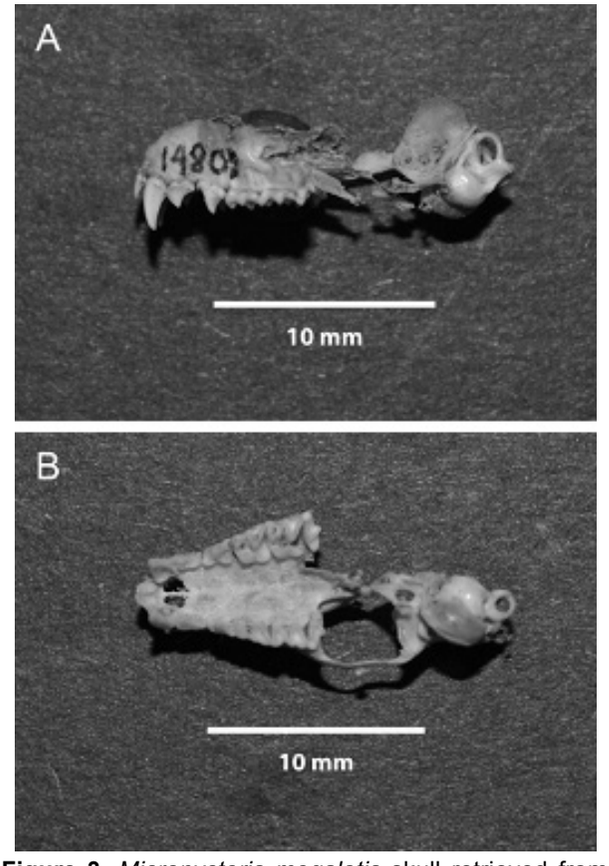

Figure 3. *Micronycteris megalotis* skull retrieved from stomach contents (QCAZ14801). A) lateral view of the partial cranium; B) ventral view of the partial cranium.

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