Ecology

Richness of insectivorous bats in a chaparral area in the municipality of Tecate, Baja California, Mexico

Riqueza de murciélagos insectívoros en una zona de chaparral en el municipio de Tecate, Baja California, México

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Abstract

Twenty species of bats have been reported in the state of Baja California, however, there is not much information available for this group due to the lack of local studies. Therefore, the objective of this study was to increase the knowledge about the actual existing chiropteran fauna in Tecate, Baja California. For this purpose, a combined sampling was performed by capturing specimens using mist nets and an ultrasonic bat detector. The sampling took place from September to November 2013 and from May to June 2014. Five species of the Vespertillionidae family were registered with mist nets, and the ultrasonic records detected 12 species of the Vespertilionidae, Molossidae and Phyllostomidae families. The fact that 4 scantly documented species were detected in the area (*Eumops perotis*, *Lasiurus xanthinus*, *Lasiurus blossevillii* and *Myotis melanorhinus*) is noteworthy. The results obtained provide the first data about echolocation sounds of bats in this locality. Thus, the information obtained in this research is relevant to the implementation of strategies for the conservation of bats in this area.

Keywords: Anabat; Bioacoustics; Echolocation; Northwestern Mexico; Ultrasonic detection

Resumen

En el estado de Baja California se han registrado 20 especies de murciélagos, desafortunadamente para esta región la información disponible sobre este grupo es escasa debido a la falta de estudios locales. De esta manera, el objetivo del presente estudio fue incrementar el conocimiento sobre la quiropterofauna presente en Tecate, Baja California. Para esto, se realizó un muestreo combinado mediante la captura de ejemplares con redes de niebla y un detector ultrasónico. Los muestreos fueron realizados durante los meses de septiembre a noviembre de 2013 y de mayo a junio de 2014. Mediante las redes de niebla se registraron 5 especies de la familia Vespertillionidae y con los registros ultrasónicos se detectaron 12 especies de las familias Vespertilionidae, Molossidae y Phyllostomidae. Destaca la presencia de 4 especies (*Eumops perotis*, *Lasiurus xanthinus*, *Lasiurus blossevillii* y *Myotis melanorhinus*) que cuentan con pocos registros para la zona. Los resultados obtenidos aportan los primeros datos sobre los sonidos de ecolocalización de los murciélagos para esta localidad. Por tanto, la información obtenida en este trabajo es de importancia para la implementación de estrategias para la conservación de los murciélagos de esta área.

Palabras clave: Anabat; Bioacústica; Ecolocalización; Noroeste de México; Detección ultrasónica

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Introduction

In Mexico, we can find 140 bat species, 20 of which are distributed in the state of Baja California, mainly in arid and semi-arid areas and represent the second most diverse order within the state (Martínez-Gallardo, 2011; Ramírez-Pulido, González-Ruiz, Gardner, & Arroyo-Cabrales, 2014). The Baja California Peninsula is an unique environmental region as a result of its geological history; it belongs to the biogeographical province of California (Álvarez-Castañeda, Ríos, Cortés-Calva, González-Ruiz, & Suárez-Gracida, 2008). In this region, several species of bats have adapted, and therefore each of them results particularly interesting in contrast with those of other areas of the country.

At a local level, limited information is available for this group, mainly in the northern part of the state (Guevara-Carrizales, Zamora-Gutiérrez, Gonzáles-Gómez, & Martínez-Gallardo, 2013). Estimating species richness recorded in an area at a given time region is essential for the biological conservation of biodiversity (Boulinier, Nichols, Sauer, Hines, & Pollock, 1998), and is also relevant when dealing with the design of strategies, use and protection of Mexican biological resources especially in regions with limited information (Martínez-Gallardo, 2007). In the northern part of Baja California several of the bat species that have been registered are insectivorous species of the Emballonuridae, Molossidae and some Vespertilionidae families that are difficult to register through conventional trapping methods such as mist nets, harp traps, entomological nets or birdshot shotguns, since they fly at high altitudes. As a consequence, only certain groups may be registered and biological inventories remain far from being complete (Briones-Salas, Peralta-Pérez, & García-Luis, 2013; Rydell, Arita, Santos, & Granados, 2002).

Because most of the bat species emit high-frequency ultrasonic sounds when foraging, these ultrasonic waves has been used for diagnostic purposes in many species, since each of them are subject to interspecific variations enabling their identification (O'Farrell & Gannon, 1999; O'Farrell & Miller, 1999; O'Farrell, Miller, & Gannon, 1999; Neuweiler, 2000; Rydell et al., 2002). With this technique and mist nets, bat species have been registered in a few zones of the northern region of Baja California, within the protected areas "Parque Nacional Constitución de 1857, Parque Nacional Sierra de San Pedro Mártir" where 15 and 14 species respectively (Martínez-Gallardo, 2007) have been recorded, whereas in "Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado" 7 species were detected (Guevara-Carrizales et al., 2013). The scarce information on bat richness also emphasizes the need for supplementing the bat sound libraries of the region.

The use of a combination of mist nets and ultrasonic detectors represents a good strategy to calculate the number of bat species in a specific locality, since the ultrasonic detectors record those species that fly at low and high altitudes (Briones-Salas et al., 2013). In addition, the use of ultrasonic detectors improves the information of the species sound libraries and records their variations in different geographical locations (Barclay & Brigham, 2004; Guevara-Carrizales et al., 2013; Neuweiler, 2000; Rydell et al., 2002). The combination of both methods increases the chances of detecting bats in a given area. Therefore, the objective of this research was to study the richness of existing insectivorous bats using these methods in the Ejido Jacumé, municipality of Tecate in the State of Baja California, Mexico.

Materials and methods

The study was conducted in the Ejido Jacumé, located 10.8 km NE of village Luis Echeverría Álvarez "El Hongo", in the municipality of Tecate, in the state of Baja California, with geographical coordinates at 32°33′0.6″ N, 116°15′20″ W (Fig. 1). The area belongs to the biogeographical region known as Province of California (Arriaga, Aguilar, Espinosa-Organista, & Jiménez, 1997; Espinosa & Ocegueda, 2008; Morrone, 2005; Rzedowski, 2006) and part of this area is within the Priority Terrestrial Region "Sierra of Juarez" (RTP-12) considered as an important environmental area by the Mexican governmental institution Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (Arriaga-Cabrera et al., 2000).

Geologically, the terrain presents a landscape formed by plateaus and plains resulting in depressions that form bogs that are delimited by extended rolling hills and numerous steep rock formations (Johnson, 2003). The average of annual temperature is 18–22 °C with rainfall between summer and winter. The predominate vegetation is composed of chaparral plant communities with small areas of microphyll desert shrubs and a few individuals of *Pinus* and *Quercus* (Arriaga-Cabrera et al., 2000; Rzedowski, 2006). Since it is a cattle production area, artificial bodies of water may be found.

Field work and data analysis

Due to the complexity of performing field work at night in the region, principally because of the activities related to the border with United States of America such as a continuing influx of migrants and difficult access by road, the collection of the specimens was done during months suggested by local authorities in September, October and November 2013, as well as in May and June 2014. Six mist nets (6 × 2.5 m and 12 × 2.5 m) were used and placed in areas where an increased activity of bats was observed resulting in different sample effort in these areas, such as in water bodies, swamps, small natural creeks, cattle drinking troughs, wells and dams distributed in the 3 different types of vegetation identified in the polygon (Fig. 1). This sampling method has advantages and disadvantages, but is relevant for many ecological studies such as the detection of rare species (Hedgren & Weslien, 2007). Mist nets were placed in 10 different sites during 176 hours for 26 days using a total of 2,670 m of nets with an average sampling effort of 102.7 m of nets per night, every night comprised 1.5 hour before the end of evening astronomical twilight. Each of the captured specimens were handled in accordance with the American Society of Mammalogists guidelines (Sikes, Gannon, & The Animal Care and Use of the American Society of Mammalogists, 2011) and were identified using specialized field keys (Álvarez, Álvarez-Castañeda, & López-Vidal, 1994; Medellín, Arita, & Sánchez, 2008). Data such as age, sex and reproductive status