

First records of the endangered Atacama *Myotis atacamensis* (Chiroptera, Vespertilionidae), at high altitude in the Parinacota Province, northern Chile

Primer registro a gran altitud de Myotis atacamensis (Chiroptera, Vespertilionidae), un murciélago amenazado en la Provincia de Parinacota, norte de Chile

Gonzalo Ossa^{1*}, Karol Vilches² and Pablo Valladares Faúndez³

ABSTRACT

Myotis atacamensis is a bat species with severely fragmented populations along the coast of Peru and Chile, recently considered as Endangered by the IUCN because of habitat fragmentation. Here we report for the first time records of the species via echolocation call analysis at localities above 3000 m elevation, increasing the distribution of the species by more than 1000 m altitude.

Keywords: Arica y Parinacota Region; endangered species; desert ecosystem; echolocation; high altitude.

RESUMEN

Myotis atacamensis presenta poblaciones severamente fragmentadas a lo largo de la costa de Perú y Chile. Actualmente se encuentra considerada como especie amenazada por la IUCN, debido a la fragmentación de su hábitat. En el presente trabajo reportamos el primer registro de esta especie utilizando registros de sus llamadas de ecolocación a una altitud superior a 3.000 msnm, incrementando su distribución en más de 1.000 metros de altitud.

Palabras Clave: Región de Arica y Parinacota; especies amenazadas; ecosistema desértico; ecolocación; altitud geográfica.

Myotis atacamensis is a widely distributed bat species from southern Peru to northern Chile (Aragón & Aguirre, 2014; Rodríguez-San Pedro *et al.*, 2014; Simmons, 2005). Its type locality is San Pedro de Atacama, Antofagasta Region, Northern Chile, at an altitude of 2.400 m (Lataste, 1892; LaVal, 1973). The habitat of this species includes only semiarid and arid environments, which produces a fragmented population scheme (Iriarte, 2008; Mann, 1978; Ossa *et al.*, 2015). Because of the dependence on its habitat and increasing fragmentation during the last years, the Atacama *Myotis* was recently declared an endangered species by the IUCN (Vargas-Rodríguez *et al.*, 2016).

The Atacama *Myotis* is an insectivorous bat, with short periods of activity from dusk to midnight (Galaz *et al.*, 2009). It is one of the smallest bats

in Chile and South America, along with *Myotis chiloensis* (Canals *et al.*, 2005; Mann, 1978). The distribution ranges of these species overlap in the Coquimbo and Valparaíso regions (Iriarte, 2008; Rodríguez-San Pedro *et al.*, 2015, 2014), however they are easily recognizable in hand because of the lighter fur color and shorter forearm of *M. atacamensis* (Ossa *et al.*, 2010b, 2015).

Recent studies of the echolocation calls of the *Myotis* species in Chile differentiate the species easily because of the higher frequency range of *M. atacamensis* with respect to *M. chiloensis* (Ossa *et al.*, 2010a; b, 2015; Rodríguez-San Pedro & Simonetti, 2013; Rodríguez-San Pedro *et al.*, 2015). We present here the highest records of *M. atacamensis*, exceeding by 1075 and 1056 meters the previous records of the species.

¹ ConserBat EIRL. San Fabián, Chile.

² Programa para la Conservación de los murciélagos de Chile (PCMCh), Departamento de Ecología y Medio Ambiente, Instituto de Filosofía y Ciencias de la Complejidad. Ñuñoa, Santiago, Chile.

³ Laboratorio de Zoología Integrativa, Departamento de Biología, Facultad de Ciencias, Universidad de Tarapacá. Arica, Chile.

* Autor por correspondencia: chalofoh@gmail.com

We used a Song Meter SM3Bat (Wildlife Acoustics Inc. USA) to record bat echolocation calls in 2 villages in the Parinacota Province, Arica and Parinacota Region, northern Chile (Figure 1). The recorder was installed during 1 night at each village (Table 1), and was set to record bats from dusk to sunrise at a sampling rate of 256 kHz, recording bats that echolocate up to 120 kHz (Obrist *et al.*, 2010). Files obtained in the field were analysed using the software Avisoft SAS Lab Pro (Avisoft Bioacoustics, Germany); we measured the frequency at the start, end and maximum amplitude of each pulse (kHz) and the duration of the pulses (ms) in searching phase.

We obtained 35 calls of *M. atacamensis* (Table 1), from which we measured 1171 pulses in the search phase (Table 2). Measurements were as follows: start frequency: 67.0 ± 10.2 kHz; end

frequency: 47.7 ± 2.9 kHz; peak frequency: 52.0 ± 3.2 kHz; duration of the pulses: 3.3 ± 3.3 ms and interval between pulses: 134.9 ± 65.8 ms. Those values are coincident with values obtained in other recent studies in the Tarapacá Region (Ossa *et al.*, 2015) and Valparaíso Region (Rodríguez-San Pedro *et al.*, 2015). Very few bat surveys have been done in the Arica and Parinacota Region, which results in a lack of information about this group of mammals in the area (Sierra-Cisternas & Rodríguez-Serrano, 2015). The presence of *M. atacamensis* at higher altitudes could be a result of seasonal migration, searching for food and avoiding the high temperatures at lower altitude as other *Myotis* species in the Northern Hemisphere (Norquay *et al.*, 2013; Ruedi & Castella, 2002).

The localities reported here for *Myotis atacamensis* increase its altitudinal distribution

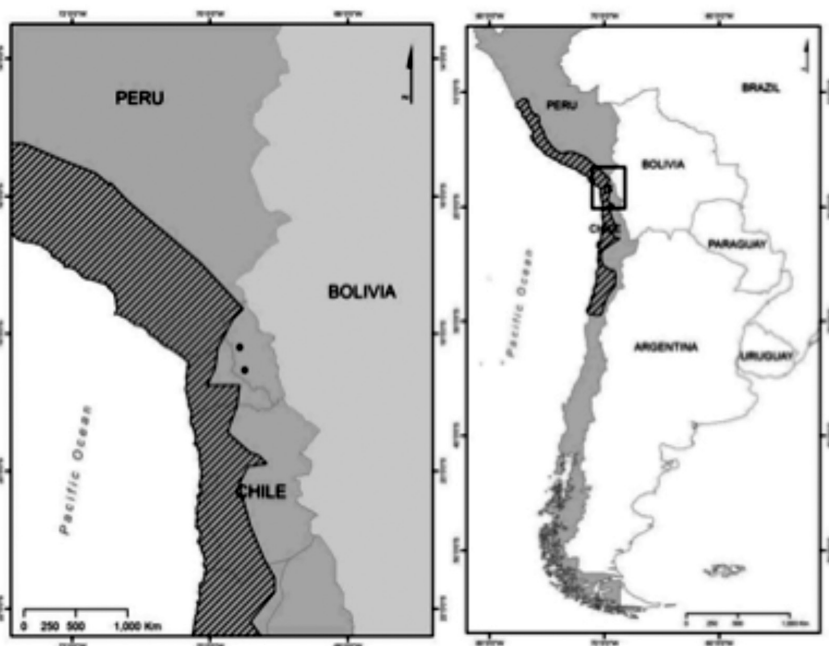


Figure 1. Distribution map of extant localities of *Myotis atacamensis* in southern Peru and northern Chile (Vargas-Rodríguez *et al.* 2016). Black circles represent the new records.

Table 1. Study sites, date, altitude, coordinates and number of files of *Myotis atacamensis* obtained in one night of sampling.

Site	Date	Altitude (masl)	Coordinates	Number of files
Putre	Oct 28th 2014	3475	18°31'S - 69°29'O	18
Lupica	Oct 30th 2014	3456	18°11'S - 69°34'O	17

Table 2. Echolocation parameter measurements for files obtained in the field (this study) and comparison with other datasets obtained in the field.

Reference	Location	Start Frequency (kHz)	End Frequency (kHz)	Peak Frequency (kHz)	Duration (ms)	Interval (ms)
This study	Parinacota province	67.0 ± 10.2	47.7 ± 2.9	52.0 ± 3.2	3.3 ± 3.3	134.9 ± 65.8
Ossa <i>et al.</i> (2015)	El Tamarugal province	79.3 ± 16.4	50.4 ± 5.6	56.5 ± 6.9	2.7 ± 0.7	73.6 ± 17.2
Rodríguez-San Pedro <i>et al.</i> (2015)	Marga Marga province	67.4 ± 1.8	42.6 ± 0.5	50.3 ± 0.7	4.6 ± 0.0	124.9 ± 16.3

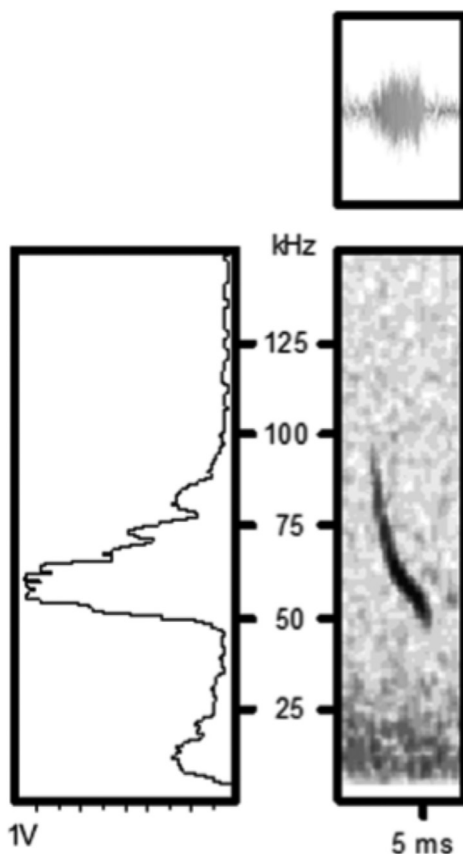


Figure 2. Sonogram of a characteristic pulse of *Myotis atacamensis*. Y-axis represents frequencies (kHz) and X-axis represents time (ms) Spectrogram was created using Avisoft SAS Lab Pro V5.2.07 (Avisoft Bioacoustics, Germany). Parameters were: Fast Fourier Transform length: 512; frame size 100%; Overlap 75%.

by more than 1000 meters of altitude, proving that this species is not restricted to coastal habitats and lowlands as previously thought (Galaz & Yáñez, 2006; Wilson, 1997). *Myotis atacamensis* use high altitude valleys to obtain refuge and to feed; the presence of old mines and villages allow this species to hibernate during the cold season (Mann, 1945). The Atacama *Myotis* have been recently classified as Endangered (Vargas-Rodríguez *et al.*, 2016) because of its highly fragmented populations in the coastal desert of northern Chile and southern Peru, but valleys are closer to each other in the highlands and are not separated by desert pampas, so the populations probably are less fragmented.

During the same field work we searched for bat echolocation calls at the Caquena village (18°03'S - 69°12'O; 4402 m) with no results, certainly because of the cold temperature and strong winds in the area. This kind of field work is crucial to determine the distribution ranges of endangered bat species in Chile, in environments where probably no bat studies have been done in the past.

Acknowledgements

This study was supported by the fund for research for undergraduate students UTA 4713-15, obtained through the research department of the University of Tarapacá. We want to thank Rodrigo Silva and Daniel Terán for their valuable help during the fieldwork and Catalina Zumaeta for the occurrences map.

Literature Cited

- Aragón, G. & Aguirre, M.
2014. Distribución de murciélagos (Chiroptera) de la Región Tacna, Perú. *Idesia (Arica)*, 32: 119-127.
- Canals, M.; Grossi, B.; Iriarte-Díaz, J. & Veloso, C.
2005. Biomechanical and ecological relationships of wing morphology of eight Chilean bats. *Revista Chilena de Historia Natural*, 78: 215-227.
- Galaz, J.L. & Yáñez, J.
2006. *Los murciélagos de Chile: Guía para su reconocimiento*, Centro de Ecología Aplicada. Santiago, Chile. 79 pp.
- Galaz, J.L.; Yáñez, J.; Gantz, A. & Martínez, D.R.
2009. Orden Chiroptera. In A. Muñoz-Pederos & J. Yáñez, (Eds.), *Mamíferos de Chile*, (pp. 67-89). CEA Ediciones. Valdivia, Chile. 570 pp.

- Iriarte, A.
2008. *Los Mamíferos de Chile*. Lynx Ediciones. Barcelona, España. 420 pp.
- Lataste, F.
1892. Etudes sur la faune chilienne II. Note sur les chauves-souris (Ordre des Chiropteres). *Actas de la Sociedad Científica de Chile*, 1: 70-91.
- LaVal, R.K.
1973. A revision of the Neotropical bats of the genus *Myotis*. *Natural History Museum of Los Angeles County, Science Bulletin*, 15: 1-54.
- Mann, G.
1945. Mamíferos de Tarapacá. Observaciones realizadas durante una expedición al alto norte de Chile. *Biológica*, 2: 23-98.
- Mann, G.
1978. Los pequeños mamíferos de Chile. *Gayana Concepción*, 40: 1-342.
- Norquay, K.J.O.; Martínez-Núñez, F.; Dubois, J.E.; Monson, K.M. & Willis, C.K.R.
2013. Long-distance movements of little brown bats (*Myotis lucifugus*). *Journal of Mammalogy*, 94: 506-515.
- Obrist, M.K.; Pavan, G.; Sueur, J.; Riede, K.; Llusia, D. & Marquez, R.
2010. Bioacoustics approaches in biodiversity inventories. In J. Eymann, J. Degreef, C. Häuser, J.C. Monje, Y. Samyn & D. VandenSpiegel (Eds.), *Manual on Field Recording Techniques and Protocols for All Taxa Biodiversity Inventories*. pp. 68-99.
- Ossa, G.; Díaz, F.; O'hrens, O.; Laker, J. & Bonacic, C.
2010a. Conociendo los murciélagos a través de sus ultrasonidos. *La Chiricoca*, 11: 26-31.
- Ossa, G.; Forero, L.; Novoa, F. & Bonacic, C.
2015. Caracterización morfológica y bioacústica de los murciélagos (Chiroptera) de la Reserva Nacional Pampa de Tamarugal. *Biodiversidadata*, 4: 21-29.
- Ossa, G.; Ibarra, J.T.; Barboza-Marquez, K.; Hernández, F.; Gálvez, N.; Laker, J. & Bonacic, C.
2010b. Analysis of the echolocation calls and morphometry of a population of *Myotis chiloensis* (Waterhouse, 1838) from the southern Chilean temperate forest. *Ciencia e Investigación Agraria*, 37: 131-139.
- Rodríguez-San Pedro, A.; Allendes, J.L.; Castillo, M.; Peñaranda, D. & Peña-Gómez, F.
2014. Distribution extension and new record of *Myotis atacamensis* (Lataste, 1892) (Chiroptera: Vespertilionidae) in Chile. *Check List*, 10: 1164-1166.
- Rodríguez-San Pedro, A.; Peñaranda, D.; Allendes, J. & Castillo, M.
2015. Update on the distribution of *Myotis atacamensis* (Chiroptera: Vespertilionidae): southernmost record and description of its echolocation calls. *Chiroptera Neotropical*, 21: 1342-1346.
- Rodríguez-San Pedro, A. & Simonetti, J.A.
2013. Acoustic identification of four species of bats (Order Chiroptera) in central Chile. *Bioacoustics*, 22: 165-172.
- Ruedi, M. & Castella, V.
2002. Evolution of migration and geneflow in *Myotis myotis*: a molecular perspective. *Bat Research News*, 43: 106.
- Sierra-Cisternas, C. & Rodríguez-Serrano, E.
2015. Los quirópteros de Chile: avances en el conocimiento, aportes para la conservación y proyecciones futuras. *Gayana (Concepción)*, 79: 57-67.
- Simmons, N.B.
2005. Order Chiroptera. In D.E. Wilson and D.M. Reeder (Eds.), *Mammal Species of the World*. (pp. 312-529). John Hopkins University Press, Baltimore. 2 pp.
- Vargas-Rodríguez, R.; Peñaranda, D.; Ugarte-Núñez, J.; Rodríguez-San Pedro, A.; Ossa, G. & Gatica Castro, A.
2016. *Myotis atacamensis*. The IUCN Red List of Threatened Species. e.T14143A22050638. Available: <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T14143A22050638>.
- Wilson, D.E.
1997. Genus *Myotis*. In A.L. Gardner (Ed.), *Mammals of South America - Marsupials, Xenarthrans, Shrews and Bats*. The University of Chicago Press. Chicago and London. pp. 468-480.