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Short Communication: Second record of *Eumops chiribaya* (Chiroptera, Molossidae) in Peru

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Abstract. *Medina CE, Díaz DR, Malaga BA, Medina YK, López E. 2018. Short Communication: Second record of* Eumops chiribaya *(Chiroptera, Molossidae) in Peru. Biodiversitas 19: 1979-1984.* The bat *Eumops chiribaya* was recently described from southwestern Peru, based on unique specimen collected in the coastal desert of Moquegua Department. Herein, we document the second record for the country based on a specimen collected in Arequipa Department. This specimen is described in detail and compared with the holotype of *E. chiribaya*. This record represents a significant extension of the geographic range for this species, both in latitude and elevation, and it show the high diversity of bats living in the coastal valleys of southwestern Peru. Our record adds one genus and species to the Arequipa Department, totaling 17 bat species in the Department.

Keywords: Arequipa, Bonneted Bat, Chiribaya, geographic range extension

INTRODUCTION

Peru is one of the five countries in the world with the greatest diversity of mammals, it being estimated that at least 566 species of mammals are distributed throughout Peru (Velazco 2013; Moras et al. 2015, Pacheco et al. 2009; Medina et al. 2016; Uturunco and Pacheco 2016; Sanchez and Pacheco 2016; Miranda et al. 2017; Nascimento et al. 2017; Hurtado and Pacheco 2017; Rocha et al. 2017; Ruedas et al. 2017; Suárez-Villota et al. 2017; Velazco et al. 2017; Do Prado and Percequillo 2018; Emmons and Fabre 2018; Voss et al. 2018; Zeballos et al. 2018). Rodents and bats represent two thirds of the total diversity (64%) for Peru (Pacheco et al. 2009), due to evolutionary and adaptive exclusiveness that they have developed over time. Fourteen per cent of rodents and bats are endemic species from Peru and are distributed along the coast and western slope of Andes (Pacheco et al. 2009).

The bats of genus *Eumops* Miller belongs to the nearly cosmopolitan bat family Molossidae (Eger 2008), ranging from southern United States to Patagonia in Argentina (Eger 1977), and can be easily recognized by the following characters: upper lip smooth or rarely with a very small facial grooves but never deeply wrinkled, ears joined on the forehead, longer antitragus not detached from lower border of the ear, and upper border of nostrils surrounded by pointed and very small warts and small hairs (Gregorin 2009). Currently *Eumops* includes 16 species recognized as valid (Gregorin et al. 2016). The majority of species were described between 1800's to 1940's (Sanborn 1932; Eger 1977). However, after seven decades three new species were recently described: *Eumops wilsoni* Baker et al. from the lowlands of western Ecuador and Peru, *Eumops chiribaya* Medina et al. from the coastal desert and western slopes of southwestern Peru, and *Eumops chimaera* Gregorin et al. from lowlands of eastern Bolivia and Brazil.

Ten species of *Eumops* occur in Peru, namely *E. auripendulus* (Shaw), *E. chiribaya*, *E. delticus* Thomas, *E. hansae* Sanborn, *E. maurus* (Thomas), *E. nanus* (Miller), *E. patagonicus* Thomas, *E. perotis* Schinz, *E. trumbulli* (Thomas), and *E. wilsoni* (Pacheco et al. 2009; Medina et al. 2016). They are widely distributed throughout the country, including northwestern dry forest, coastal desert, mountain forest, Amazonian forest and savannah portions (Eger 1977; Eger 2008; Baker et al. 2009; Pacheco et al. 2009; Díaz 2011; Medina et al. 2012). *E. chiribaya* is endemic to Peru, known by one specimen collected in the coastal desert of Moquegua Department (Medina et al. 2014).

Despite the peculiar fauna from coast and western slope of southern Peru, very few studies have been conducted to record the mammalian diversity in this region (Escomel 1929; Jiménez et al. 1982; Dávila et al. 1987; Zeballos et al. 2001; Pari et al. 2015). However, after seven years of field works, we report the second specimen *E. chiribaya* from Peru, based on one specimen caught in the Ocoña Valley, Arequipa department, southwestern Peru.

MATERIALS AND METHODS

Study area

The specimen of *Eumops* was captured in the Ocoña Valley, which is on the western slope of the Andes in southern Peru (Figure 1). Ocoña Valley is an unusual region as it connects with the deepest canyon in the World, the Cotahuasi Canyon, which have a depth of 3535 m (Jimenez et al. 2003).

The climate in the basin of Ocoña River changes with the altitude. Up to 2000 m, the annual mean temperature is 16°C and the annual precipitation is 300 mm, considerably higher in summer (ANA 2015). The native vegetation along the river is dominated by trees (*Prosopis pallida* Kunth) and shrubs (*Tessaria integrifolia* Ruiz and Pav.), that are used sometimes as firewood by local populations (Jimenez et al. 2003). The native fauna is composed mainly of frogs (*Rhinella limensis* [Werner]), lizards (*Microlophus* spp. Duméril and Bibron), snakes (*Bothrops pictus* [Tschudi]), birds (*Merganetta armata* Gould, *Xenospingus concolor* [D'Orbigny and Lafresnaye]), foxes (*Lycalopex griseus* Gray), otters (*Lontra felina* [Molina]), bats (*Amorphochillus schnablii* Peters, *Platalina genovensium* Thomas, *Tomopeas ravus* Miller) and rodents (*Oligoryzomys arenalis* Thomas) (Zeballos et al. 2001; Jimenez et al. 2003). Some of these vertebrates are considered threatened in national and international legislation or are endemic to Peru (Pacheco et al. 2009; Schulenberg et al. 2010; MINAGRI 2014; IUCN 2018).

Historically, agriculture was the principal economic activity in Ocoña Valley. However currently, the informal mining and urban expansion have the most negative impact on to the native flora and fauna in the region.

Methods

The specimen is housed in the Museo de Historia Natural de la Universidad Nacional de San Agustín (MUSA). External measurements were recorded from the original field tags, which included: total length, distance from the tip of the nose to the tip of the tail; tail length, length of tail vertebrae; Ear length, distance from the base of the notch to the uppermost margin of the pinna; hindfoot length, distance from the heel to the tips of the claws; forearm length (FA), distance from the wrist to the elbow, including the skin; and weight, corporal masa. Wing measurements were taken following the definitions and illustration of Freeman (1981) and Bernardi et al. (2009). Measurements were taken with digital calipers to the nearest 0.1 mm as follows: fourth digit metacarpal length (LIV), distance from the wrist, including the skin, to the metacarpal-phalangeal joint; first phalanx of fourth digit length (fal1-IV), distance from the metacarpal-phalangeal joint to the distal end of the first phalanx of the third digit; greatest length of skull (GLS), distance from one condyle to the anterior face of the incisors; braincase breadth (BB), maximum width measured dorsal to the auditory bullae with the blades of the calipers resting on the zygoma; condyle-incisive length (CIL), distance from the occipital condyles to the anterior face of the incisors; zygomatic breadth (ZB), distance between the zygomatic arches measured on the squamosal bones; postorbital breadth (PB), minimum interorbital distance measured across the frontals; palate length (PL), distance from the anterior face of the incisors to the posterior margin of the palate lateral to the posteromedial projection; maxillary toothrow length (MTRL), distance from the anterior face of the canine to the posterior edge of the third molar; breadth across upper molars (M–M), distance across the crowns of the third molars; width across upper canines (C-C), width across the canines including cingula; mandible length (DENL), distance from one condyle to the anterior face of the incisors; and mandibular toothrow length (MANDL), distance from the canine to the third molar.

The specimen was identified with taxonomic keys (Anderson, 1997, Eger 2008, Diaz et al. 2016), specialized literature (Eger 1977, Freeman 1981, Gregorin 2009, Medina et al. 2014, Gregorin et al. 2016) and by comparison with housed specimen in MUSA. Taxonomy follows Wilson & Reeder (2005).

RESULTS AND DISCUSSION

Order Chiroptera Blumenbach, 1779

Family Molossidae Gervais, 1856

Eumops chiribaya Medina, Gregorin, Zeballos, Zamora and Moras, 2014

Chiribaya's Bonneted Bat

Specimen examined

MUSA 20972, adult male preserved in fluid and skull removed, collected at San Antonio-Ocoña Valley, Ocoña District, La Unión Province, Arequipa Department, Peru (15°42'57" S, 073°05'11" W WGS84, elevation 740 m), on 5 June 2017.

MUSA 8493, Holotype, adult female preserved as skin, skull, and partial skeleton, collected at El Algarrobal, Ilo Province, Moquegua Department, Peru (17º37'22" S, 071º16'07" W WGS84, elevation 110 m), on 1 June 2010.

Description

The specimen MUSA 20972 was identified as *Eumops chiribaya* by following combinations of characters: medium body size (Table 1); dorsal coloration light olive-brown to griseous, with slightly lighter belly (Figure 1); pelage is soft, long (6-7 mm taken at the level of the shoulder region); dorsal hairs bicolored, with white base that conspicuously contrast with the tip. Face naked; upper lip smooth to weakly wrinkled on distal edge of snout. Nose blackish; upper border of narial region surrounded by small and pointed warts, internarial ribs covered by small, spoon-like and blackish hairs. Ears large (25.7-28 mm), round, blackish and joined on the forehead; upper border smooth, but the inner face with brown hairs distributed from the dermal keel to the top of the ear. Tragus square-shaped. Antitragus semicircular, wider than higher. Dorsal surface of propatagium and plagiopatagium near to forearm and dactilopatagium at basal middle of fifth metacarpal covered with short light olive-brown to griseous hairs. Feet blackish; external edges and ventral surface of the first and

fifth toes of the feet covered by short hairs, silver in color, with claws covered by longer hairs of the same color. Calcar longer than feet. Uropatagium dull brown with free portion of the tail blackish.

Skull with elongated and narrow rostrum in dorsal view, and straight in profile (Figure 2). Braincase rounded, tending to be angular anteriorly; opisthocranion curved dorsally and anteriorly. Nasal process of the premaxilla well-developed. Postorbital constriction narrow. Medial sagittal crest poorly developed. Palate long and slightly wide. Medial process of posterior margin of palate bridge absent. Incisive foramina tiny, with two concentric cusps longitudinally. Mesopterygoid fossa broad and rectangular. Foramen ovale well-developed. Sphenorbital fissure narrow. Basisphenoid pits large, deep, rectangle-shaped, and separated from each other by a narrow septum. Mastoid foramen present. Premetacrista equal to half the length of postparacrista on M3. Mandible gracile with well-developed keel.

The main differences between the specimen MUSA 20972 and the *Eumops chiribaya* Holotype are the morphometric measures (Table 1), which could be associated with sexual dimorphism reported within the family Molossidae (Freeman 1981). The specimen MUSA 20972 help to describe the range of variation for *E. chiribaya* (Medina et al. 2014).

Natural history

MUSA 20972 was captured with a mist net of standard size installed at water level over backwater, following protocols presented by Jones et al. (1996). The river backwaters are apparently a "hotspot" of feeding, because four bat species were recorded along with MUSA 20972 during field work in the Ocoña Valley. *Amorphochilus schnablii* and *Myotis atacamensis* (Lataste) were the most abundant species, both with a value of 1.61 individuals per 10 mist nets-night (Calhoum and Casby 1958); meanwhile *Promops davisoni* Thomas, *Tadarida brasiliensis* I. Geoffroy St.-Hilaire and *Eumops chiribaya* were less abundant species (values of 1.29, 0.65 and 0.32, respectively).

Table 1. External and cranial measurements (mm) and weight (g) of known specimens of *Eumops chiribaya* (Medina et al. 2014). Abbreviations are defined in text.

Measures	Moquegua	Arequipa
	Holotype MUSA 8493 Female	Present study MUSA 20972 Male
Total length	134	135
Tail length	52	53
Hindfoot length	13.5	11.0
Ear length	25.7	28.0
Weight	20.3	30.0
FA	61.1	62.1
LIV	58.02	62.36
fal1-IV	20.66	20.27
GLS	23.36	23.66
CIL	22.51	22.76
PL	9.38	9.61
ZB	13.23	13.85
PB	4.55	4.69
BB	11.59	11.22
C-C	4.93	5.18
MTRL	8.55	8.72
M-M	8.40	9.13
DENL	15.92	16.82
MANDL	9.41	9.20

Figure 1. External morphology of the living individual of Eumops chiribaya (MUSA 20972) collected in Ocoña Valley, Arequipa, Peru (Photograph by B.A. Malaga)

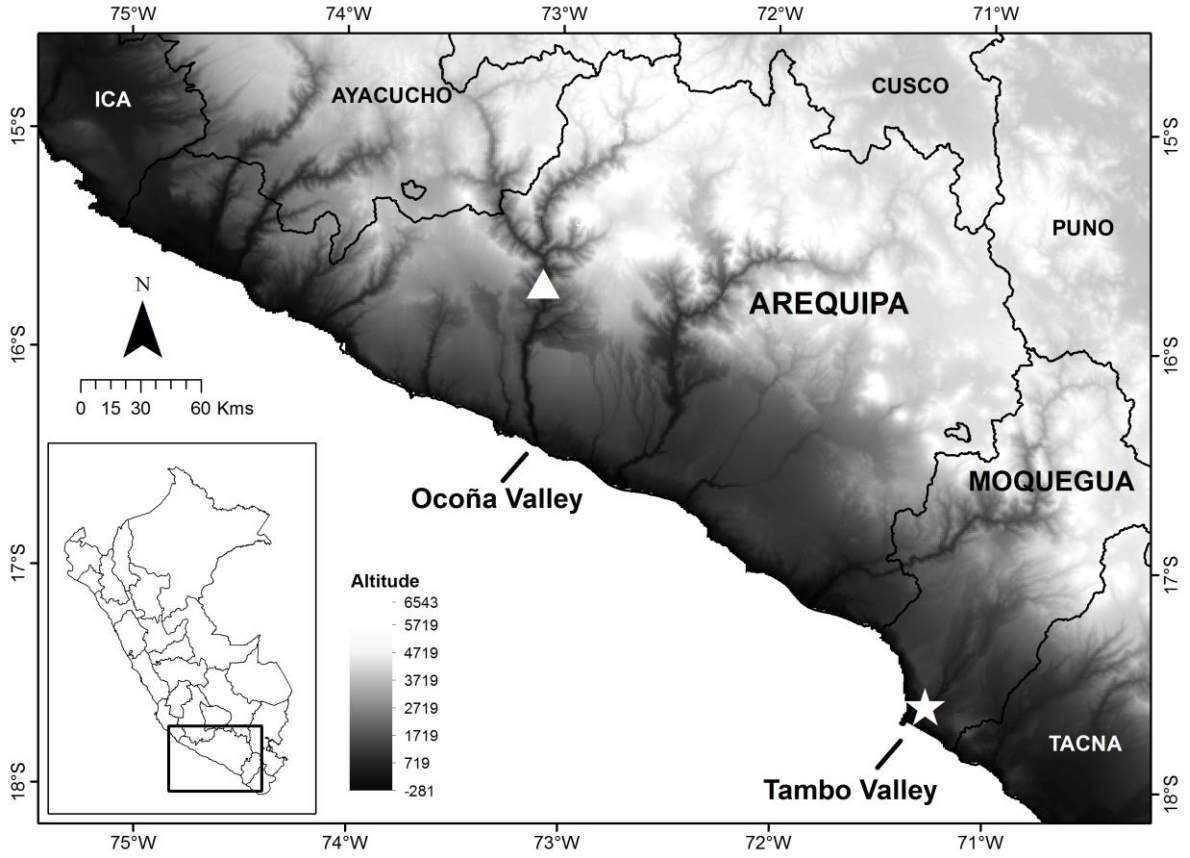

Figure 3. Distribution map of *Eumops chiribaya*. The new record is denoted with a triangle and type locality with a star (Medina et al. 2014)

Figure 2. Dorsal, ventral and lateral views of cranium and mandible of *Eumops chiribaya* from Peru. Left, holotype (MUSA 8493); and right, specimen collected in Ocoña Valley (MUSA 20972). Scale bar equal to 10 mm.

Mormopterus kalinowskii (Thomas) is another bat species that are sympatric with *E. chiribaya* (Medina et al. 2014). These records shown complex trophic relationships in the bat community that allow the coexistent of many insectivorous bat species (Pari et al. 2015), a fact that has been discussed by some authors in relation to bat sizes and its preys (Freeman 1981). So, if follow the statement of Muñoz and Molinari (2000) it is probable that the diet of *E. chiribaya* is mainly composed by big insects, like Coleoptera and Lepidoptera species.

The known localities for *Eumops chiribaya* suggest like preference by inhabit valley surrounded by steep hills (slope > 60°). None data is available about its dens, however it's probable that use cracks at steep hills.

Distribution

MUSA 20972 increases the upper distribution limit of *Eumops chiribaya* to 743 m of elevation, and it extends the distribution range of the species in 286.57 km northeast from type locality, El Algarrobal, Ilo, Moquegua, Peru (Medina et al. 2014) (Figure 3). It's very probable that distribution potential models might infer a high suitability of *E. chiribaya* in the valleys of Camana, Chili and Tambo, meanwhile the upper distribution limit of *E. chiribaya* might be from sea level to 2,000 m of elevation, considering that others *Eumops* species of medium body

size inhabit along this range altitudinal distribution (Eger 2008; Medina et al. 2014).

Final considerations

Pari et al. (2015) report 10 species of bats in the Ocoña Valley and show information about the high diversity of bats living in the coastal valleys of Arequipa Department, as well as the kinds of refuges used and its reproduction patterns. The record of *Eumops chiribaya* is an evidence of this diversity and it reinforce the nomination of the Ocoña–Cotahuasi Basin as Area Importance for the Conservation of Bats (AICOM) from Arequipa (Aguirre and Barquez 2013; Pari et al. 2015). This strategy would help to stop the main threats that bats currently face in Ocoña Valley, such as: habitat degradation, informal mining, extensive pesticide use, beliefs or superstitions of local people, new infrastructure projects, between others (Pari et al. 2015).

Eumops chiribaya adds one genus and species to the Arequipa Department reaching to 17 bat species in the region (Zeballos et al. 2001; Zeballos and Lopez 2002; Pari et al. 2015). Besides the record here presented, other bat species has been registered with acoustic sampling by the authors, but none capture has been made of these in mist nets. In the future, more field exploration almost certainly will reveal new records from Arequipa, or even new species for science. Consequently, *E. chiribaya* can easily be separated of others living species bats from Arequipa using the following key (modified from Pari et al. 2015):

1a. Noseleaf present 2
1b. Noseleaf absent 5

2a. Noseleaf reduced to a pair of dermal outgrowths above rhinarium; thumb longer than 10 mm ..... *Desmodus rotundus* Geoffroy St.-Hilaire
2b. Noseleaf well-developed; thumb shorter than 8 mm 3

3a. Rostrum wide and short; rudimentary uropatagium; tail absent ..... *Sturnira bogotensis* Shamel
3b. Rostrum narrow and elongate; uropatagium well-developed; tail present 4

4a. Forearm longer than 45 mm; tongue with deep lateral grooves ..... *Platalina genovensium*
4b. Forearm shorter than 40 mm; tip of the tongue with filiform papillae ..... *Glossophaga valens* Miller

5a. Tail enclosed in uropatagium 6
5b. Tail extends well beyond the posterior border of the uropatagium (free section > 5 mm) 9

6a. Thumb tiny enclosed in propatagium; tail extend until middle of uropatagium ..... *Amorphochilus schnablii*
6b. Thumb develop not enclosed in propatagium; tail extend until border of uropatagium 7

7a. Ears longer than 26 mm ..... *Histiotus montanus* Philippi and Landbeck
7b. Ears shorter than 25 mm 8

8a. Forearm longer than 36 mm; face pelage blackish ..... *Myotis oxyotus* (Peters)
8b. Forearm shorter than 35 mm; face pelage cream color ..... *Myotis atacamensis*

9a. Small antitragus and tragus developed; ear with a basal lobe ..... *Tomopeas ravus*
9b. Large antitragus and tragus reduced; ear lacks a basal lobe 10

10a. Ears separated on the forehead 11
10b. Ears united in a point on the forehead or by a nasal keel on the rostrum 12

11a. Forearm longer than 40 mm ..... *Tadarida brasiliensis*
11b. Forearm shorter than 40 mm ..... *Mormopterus kalinowskii*

12a. Upper lip deeply wrinkled resulting in vertical grooves 13
12b. Upper lip smooth or slightly wrinkled 15

13a. Forearm longer than 55 mm ..... *Nyctinomops macrotis* Gray
13b. Forearm shorter than 55 mm 14

14a. Forearm longer than 47 mm; greatest length of skull more than 19 mm ..... *Nyctinomops aurispinosus* (Peale)
14b. Forearm shorter than 47 mm; greatest length of skull less than 19 mm ..... *Nyctinomops laticaudatus* (Geoffroy St.-Hilaire)

15a. Ears longer than 20 mm, extending to tip of nose when laid forward ..... ***Eumops chiribaya***
15b. Ears shorter than 20 mm, do not reach the tip of the nose when laid forward 16

16a. Forearm longer than 45 mm; four incisors lower ..... *Promops davisoni*
16b. Forearm shorter than 45 mm; two incisors lower ..... *Molossus molossus* (Pallas)

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