Papéis Avulsos de Zoologia

Museu de Zoologia da Universidade de São Paulo

Volume 56(2):9-26, 2016 **www.mz.usp.br/publicacoes** **ISSN impresso: 0031-1049**
www.revistas.usp.br/paz **ISSN *on-line:* 1807-0205**

Mammalian diversity in the Savanna from Peru, with three new addictions from country

César E. Medina[1,4]
Kateryn Pino[1]
Alexander Pari[1]
Gabriel Llerena[1]
Horacio Zeballos[2]
Evaristo López[1,3]

ABSTRACT

*Bahuaja Sonene National Park protects the unique sample of subtropical humid savannas in Peru, which are known as "Pampas del Heath" with 6,136 hectares of area. Many endangered species and/or endemic from savannas occur there, however studies about the diversity of mammals in Pampas del Heath are limited and only three assessments there have been carried out since mid-1970s. Therefore we surveyed mammals in three habitat types of the Pampas del Heath (savanna, ecotonal area and forest) during late 2011. We used several methods of record for the different mammal groups including 1) capture techniques with mist nets, snap traps, Sherman traps, Tomahawk traps and pitfall traps, 2) and detection techniques direct by means of camera traps, visualization of mammals during long walk, observation of tracks and interviews to local people. Total capture efforts totalized 6,033 trap/nights, 136 mist-net/nights and 108 cameras/nights. Sixty-nine species of mammals were recorded: 33 in savanna, 33 in ecotonal area and 38 in forest. Sixteen species are new records for the Pampas del Heath and three are new records from Peru (*Cryptonanus unduaviensis, Rhogeessa hussoni *and* Rhogeessa io*). Analyses on the sampling effort, relative density, diversity and community structure of small mammals were made for the three habitats types. Moreover eight species are Threatened and 24 are listed in CITES. The new records here presented elevated the previous known mammal species richness in Peru from 538 to 541, and show the importance to conduct inventories to describe the biodiversity in remote areas, like the Pampas del Heath.*

Key-Words: Distribution; Mammals; Pampas del Heath; Richness.

[1.] Colección Científica – Museo de Historia Natural de la Universidad Nacional de San Agustín de Arequipa (MUSA). Av. Alcides Carrión s/n. Arequipa, Perú.
[2.] Instituto de Ciencias de la Naturaleza, Territorio y Energías Renovables, Pontificia Universidad Católica del Perú. Av. Universitaria 1801, San Miguel, Lima 32, Perú.
[3.] Facultad de Ciencias Biológicas y Agropecuarias de la Universidad Nacional de San Agustín de Arequipa.
[4.] Corresponding author. E-mail: cmedinap1234@yahoo.com

http://dx.doi.org/10.11606/0031-1049.2016.56.02

INTRODUCTION

The Cerrado Biome includes an array of forests and savannas that border the southern edge of the Amazon rain forest, located mainly in central Brazil, eastern Bolivia and some parts of Paraguay. These habitats have tropical climates with strong temperature, rainfall seasonality, nutrient-poor, poorly drained areas subject to annual flooding and desiccation support edaphic, fire- and flood-maintained grasslands, and savanna woodlands (Gottsberger & Silberbauer-Gottsberger, 2006).

The Bahuaja Sonene National Park (PNBS) protect the Pampas del Heath since 1996. These are the unique sample of savanna within Peruvian territorial limits, and home to many species known nowhere else in the country, such as the Maned Wolf *Chrysocyon brachyurus* and the Marsh Deer *Blastocerus dichotomus* (Hofmann *et al.,* 1976; Luna *et al.,* 2002). Studies about the diversity of mammals in Pampas del Heath are sparse and only three assessments there are since the mid-1970s to nowadays (Hofmann *et al.,* 1976; Emmons *et al.,* 1994; Luna *et al.,* 2002), which reduced the successful management of this protected area.

Under this premise the "Asociación para la Investigación y el Desarrollo Integral" (AIDER), the "Museo de Historia Natural de la Universidad Nacional San Agustín de Arequipa" (MUSA) and "Servicio Nacional de Áreas Naturales Protegidas por el Estado" (SERNANP) together made possible carry out an important expedition to the Pampas del Heath in 2011 in order to fill this information gaps. This paper documented the diversity of mammals of three localities placed in Pampas del Heath, according to three habitats types (savanna, ecotonal area and forest).

MATERIALS AND METHODS

Study area

The Pampas del Heath is located in the Madre de Dios Department, southeastern Peru, near border between Peru and Bolivia (Figure 1). It has an area of 6,136 hectares (MINAM, 2012), and it is an extension of Cerrado Paceño (Ibisch *et al.,* 2003) with a warm, humid and tropical climate (Hanagarth & Beck, 1996). Precipitation annual is approximately 2,000 mm and average temperature is between 24 and 26°C (Luna *et al.,* 2002).

The savanna in this region is characterized by herbaceous vegetation composed mainly of Poaceae and Ciperaceae, occurring together with termite mounds surrounded by clayey poorly drained soils. Palms (*Mauritia flexuosa*) may also occur in the area either dispersed or concentrated along of marshes and forming Gallery forests (Figure 2). There are also patch forests like small islands of 100 m^2 composed by shrubs such plant of the family Melastomataceae (*Macairea thyrsiflora, Graffenrieda limbata,* between others) and small tree (*Matayba guianensis, Virola sebifera,* between others) (MINAM, 2012).

This mosaic of savannas is surrounded by seasonal evergreen Amazonian forests, with a canopy that reaches 30-35 m and emergent of up to 40 m, and the frequent presence of *Bertholletia excelsa.* The forest develops on well-drained soils of the lateritic rolling pen plain of the southwestern Amazon, where it represents the extensive matrix of vegetation cover in areas with humid pluviseasonal bioclimate of southern Peru, northern Bolivia and western Brazil (Josse *et al.,* 2007).

The ecotonal area between the savanna and forest has a variable size that could be of a few meters in burned areas, until 80 m in unburned area.

We surveyed mammals in three localities of the Pampas del Heath at the beginning of wet season,

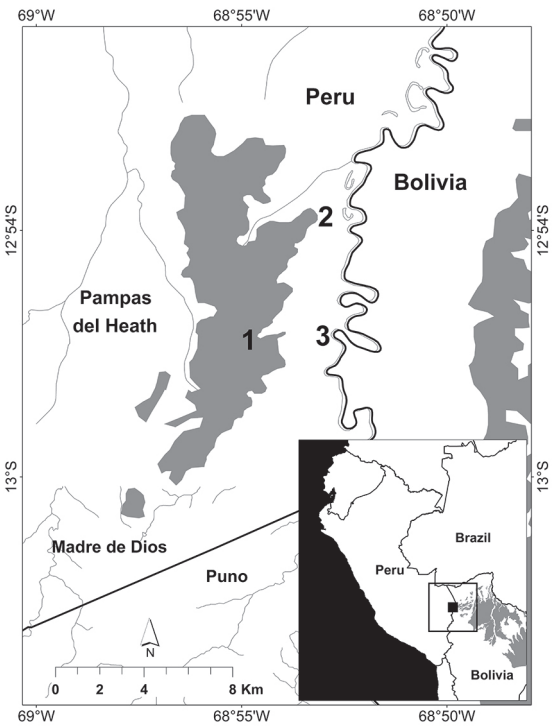

FIGURE 1: Location of Pampas del Heath from Peru: **(1)** Aguas Claras Camp; **(2)** Cocha Paujil; and **(3)** Refugio Juliaca. The gray area represents the Savanna (from Josse *et al.,* 2007).

FIGURE 2: Panoramic views of the Pampas del Heath from Peru (top) with patches of forests (middle) and palms (bottom).

since 30 November to 14 December 2011, which are following:

a) Aguas Claras Camp (-12°57'20"S, -68°54'46"W, 216 m), located in a patch of forest inserted in the savanna (Figure 1). The surveys were carried out during 14 continuous days installing traps in two habitats (savanna and ecotonal area).
b) Cocha Paujil (-12°53'33"S, -68°53'12"W, 218 m), located to approximately 7 km northeast Aguas Claras Camp. The surveys were carried out the last four days of the expedition installing traps in the ecotonal area habitat.
c) Refugio Juliaca (-12°57'19"S, -68°53'08"W, 211 m), located next to Heath River. The surveys were carried out during 10 continuous days installing traps in the forest habitats.

Field methods

Marsupials and rodents were caught in Pitfall traps, Victor traps, Sherman traps and Tomahawk traps (Aplin *et al.,* 2003). Pitfall traps were installed in two transects of 60 m with 10 buckets of five gallons each one and with drift fences (Voss & Emmons, 1996; Patton *et al.,* 2000) which were checked every 12 hours. Other traps were placed in two transects of one km in length each one and that were used a bait composed of oat, vanilla and canned fish. In the forest, Victor traps were installed both on ground as to 1.5 m of height, meanwhile Tomahawk traps were installed at different heights (cero, two, eight and 15 m) following to Graipel (2001) but with some modifications, and these used as bait banana essence.

Bats were registered with mist nets standard, 12 m long by 2.5 m high, which were installed in different places of frequent passage by bats and to different heights, from level ground to 30 m, between palms. The mist nets were open from 18:00 until 6:00 hours and were checked regularly during the night. Additionally, we searched for bats in their shelters, such as hollow trees, under leaves, among others (Jones *et al.,* 1996).

Cuddeback camera traps with motion detection sensors were used in savanna following a trapping opportunistic methodology regarding the location and number of cameras. Cameras were separated by one to three km from each other, arranged on possible paths of the animals and programmed to take all day with a minimum interval of one minute between photos. Walks were made for observation and traces search of large mammals (feces, burrows, tracks, bones, etc.) which were performed at a speed of about one km/hour. Moreover interviews were conducted at park rangers following to Dietrich (1995) and with the support of color plates of species potentially present in the study area (Emmons & Feer, 1999; Eisenberg & Redford, 1999; Leite *et al.,* 2009).

Specimens were collected as material reference being preserved as skins or fluid following to López *et al.* (1998) and these were deposited in the Scientific Collection of Museo de Historia Natural de la Universidad Nacional de San Agustin (MUSA).

Data analyses

Captured or photographed specimens and different tracks founded in field were identified with taxonomic keys (Anderson, 1997; Emmons & Feer, 1999; Gardner, 2007a; Voss & Jansa, 2009; Weksler

& Percequillo, 2011), specialized literature (Patton *et al.,* 2000; Rossi, 2005; Percequillo *et al.,* 2008; Leite, 2009) and by comparison with housed specimen in MUSA. Taxonomy follows Pacheco *et al.* (2009).

Specimens representing new records for Peru were analyzed and compared with diagnostic characters and measurements available in the literature (Goodwin, 1958; LaVal, 1973; Ruedas & Bickham, 1992; Voss *et al.,* 2005; Bickman & Ruedas, 2007; Gardner, 2007b; Aires *et al.,* 2011; Baird *et al.,* 2012). Measurements obtained for each specimen include external measurements from tags or field notes: total length (TL), length of tail (LT), length of hind foot (HF), length of ear (Ear), length forearm only for bats (FA) and weight (W); head-and-body length was computed (HBL) by subtracting LT from TL. All measurements are in millimeter (mm) and weights are in gram (g). Cranial and mandibular measures were taken with help of a digital caliper to the nearest 0.01 mm. Marsupials were measured following definitions and illustrations of Voss *et al.* (2001, 2005). Vespertilionidae family bats were measured following LaVal (1973), and Ruedas & Bickham (1992) with some modifications by Baird *et al.* (2012).

Species accumulation curves for small mammals based on Clench model were calculated to determine if the sampling effort was adequate (Soberón & Llorente, 1993; Moreno, 2001). The randomization of the data was performed with Primer v.6 program (Clarke & Gorley, 2006), while the curves were drawn in Statistica v.7 program (StatSoft, 1998) with the adjustment method Simplex & Quasi-Newton (Jiménez-Valverde & Hortal, 2005).

Relative density of small mammals was estimated by Trap-Day Index which relates the number of individuals caught with the capture effort employed (Calhoum & Casby, 1958). For bats, the Index expresses the number of individuals captured (including those released) per 10 mist-net/nights, while for marsupials and rodents the number of individuals caught per 100 trap/nights.

The diversity of small mammals was analyzed with the Margalef (D_{Mg}) and the Menhinick (D_{Mn}) index based on data submitted previously to rarefaction (Magurran, 1988) while the community structure based on range-abundance curves (Feinsinger, 2001; Moreno, 2001). Trophic groups were assigned following Emmons & Feer (1999), Hice *et al.* (2004), do Nascimento (2007), Percequillo *et al.* (2008) and Guichón & Cassini (2009).

The conservation status of each species recorded was evaluated according to the criteria adopted by national and international institutions (MINAGRI, 2014; IUCN, 2012; CITES, 2013). Endemic species were assigned following Pacheco *et al.* (2009).

RESULTS AND DISCUSSION

During 15 days of survey, we used 136 mist-nets (59 in savanna, 47 in ecotonal area and 30 in Forest), 6,033 traps-nights (2,925 in savanna, 2,287 in ecotonal area and 1,599 in forest) and 108 camera-nights (all in savanna) in sampling for a total of 331 small mammals caught and two large mammals photographed. The capture effort was larger than previous assessments in the Pampas del Heath (Emmons *et al.,* 1994; Luna *et al.,* 2002).

Richness

We reported 69 species of mammals, which belong to nine orders, 24 families and 55 genera (Table 1). The families Phyllostomidae (15 species) and Cricetidae (10 species) were the best represented following of Didelphidae (nine species), Molossidae (six species) and Vespertilionidae (six species).

The forest had the highest raw species richness, followed by ecotonal area and savanna (38, 33 and 33 species, respectively). Likewise, 18 species were recorded only in the savanna while nine were in the ecotonal area and 20 in the forest. In contrast, ten species were common in all three vegetation forms (Table 1).

Sixteen species represented new records for the Pampas del Heath (*Cryptonanus unduaviensis, Marmosa lepida, Marmosops bishopi, Marmosops* sp., *Euryoryzomys nitidus, Neacomys minutus, Neacomys spinosus, Oligoryzomys* sp., *Micronycteris minuta, Platyrrhinus incarum, Cynomops abrasus, Eumops patagonicus, Molossus coibensis, Rhogeessa hussoni, Rhogeessa io,* and *Bassaricyon alleni*) (Figure 3).

The outstanding records were three species unknown to the list of mammals from Peru, which are:

ORDER DIDELPHIMORPHIA Gill 1872
Family Didelphidae Gray 1821
***Cryptonanus unduaviensis* (Tate 1931)**
Unduave Mouse Opossum

Specimen examined: adult female (MUSA 12695), collected at Aguas Claras Camp, Pampas del Heath, Madre de Dios (12°57'20"S, 68°54'46"W, 216 m). Measures see Table 2.

TABLE 1: Mammals registered in Pampas del Heath (Bahuaja Sonene National Park). New records from the Area is denoted with triangles, meanwhile new records from Peru is with squares. Numbers in brackets include the relative densities of small mammal species. *Previous records:* α, Emmons *et al.* (1996); and β, Luna *et al.* (2002). *Trophic Group:* Fu, Fungivorous; In, Insectivorous; Fr, Frugivorous; Gr, Granivorous; He, Herbivorous; Cr, Carnivorous; Om, Omnivorous; Ne, Nectarivorous.

Code	Species Accounts	Common names	Vegetation forms			Previous records	Trophic Group
			Savanna	Ecotone	Forest		
	DIDELPHIMORPHIA						
	Didelphidae						
	Caluromys lanatus	Brown-eared Woolly Opossum				α, β	Fr, In
A	*Cryptonanus unduaviensis* ▲■	Unduave Mouse Opossum		X (0.04)			In, Fr
	Didelphis marsupialis	Common Opossum			X	α, β	Om
B	*Lutreolina crassicaudata*	Lutrine Opossum	X (0.03)			β	Cr
C	*Marmosa lepida* ▲	Rufous Mouse Opossum		X (0.04)			In, Fr
	Marmosa murina	Murine Opossum				β	In, Fr
D	*Marmosa (Micoureus) regina*	Bare-tailed Woolly Mouse Opossum		X (0.04)		α, β	Om
E	*Monodelphis peruviana*	Peruvian Short-tailed Opossum		X (0.17)	X (0.19)	β	In
F	*Marmosops bishopi* ▲	Bishop's Slender Opossum		X (0.09)	X (0.31)		In, Fr
G	*Marmosops* sp. ▲	Slender Opossum	X (0.03)	X (0.13)	X (0.13)		In, Fr
	Marmosops impavidus	Tschudi's Slender Opossum				β	In, Fr
H	*Marmosops noctivagus*	White-bellied Slender Opossum			X (0.06)	α	In, Fr
	Philander opossum	Gray Four-eyed Opossum				α, β	In, Cr
	CINGULATA						
	Dasypodidae						
	Dasypus novemcinctus	Nine-banded Armadillo	X			β	In, Cr
	Dasypus cf. *septemcinctus*	Brazilian Lesser Long-nosed Armadillo				α	In
	Priodontes maximus	Giant Armadillo			X	α	In
	PILOSA						
	Myrmecophagidae						
	Myrmecophaga tridactyla	Giant Anteater				α	In
	Tamandua tetradactyla	Southern Tamandua				β	In
	PRIMATES						
	Cevidae						
	Cebus albifrons	White-fronted Capuchin		X		β	Fr, In
	Saguinus fuscicollis	Brown-mantled Tamarin				α, β	Fr, Ne, In
	Saguinus imperator	Emperor Tamarin				β	Fr, Ne, In
	Aotus azarae	Azara's Night Monkey			X	α, β	Fr, In, Ne
	Saimiri sciureus	Tufted Capuchin				α, β	In, Fr, Ne
	Sapajus apella	Guianan/margarita Island Brown Capuchin				α, β	Om
	Pitheciidae						
	Callicebus sp.	Titi		X		α, β	He, Fr
	Atelidae						
	Alouatta sara	Bolivian Red Howler			X	α, β	Fr, He
	Ateles chamek	Peruvian Spider Monkey				α	Fr, He
	RODENTIA						
	Sciuridae						
	Sciurus ignitus	Bolivian Squirrel				α	Gr, Fr, Fu
	Sciurus sanborni	Sanborn's Squirrel				α	Gr
	Sciurus spadiceus	Southern Amazon Red Squirrel		X		α, β	Gr, Fr
	Cricetidae						
I	*Cerradomys maracajuensis*	Maracaju's Rice rat	X (0.21)	X (0.26)		α, β	He, In
J	*Euryoryzomys nitidus* ▲	Elegant Oryzomys	X (0.03)	X (0.31)	X (0.50)		Fr, In, Gr
K	*Hylaeamys perenensis*	Western Amazonian's Rice Rat	X (0.07)	X (0.39)	X (0.50)	α, β	Fr, In, Gr
L	*Pseudoryzomys simplex*	Brazilian False Rice Rat	X (0.79)	X (0.04)		β	¿?

Code	Species Accounts	Common names	Vegetation forms			Previous records	Trophic Group
			Savanna	Ecotone	Forest		
M	*Neacomys minutus* ▲	Tiny Bristly Mouse		X (0.04)	X (0.06)		In, Fr
N	*Neacomys spinosus* ▲	Bristly Mouse		X (0.04)	X (0.13)		In, Fr
O	*Necromys lenguarum*	Bolo Mouse	X (2.70)	X (0.22)		α, β	In, Om
P	*Oecomys bicolor*	White-bellied Oecomys		X (0.13)	X (0.19)	α, β	Fr, Gr
Q	*Oligoryzomys microtis*	Small-eared Pygmy Rice Rat		X (0.04)		β	Gr, In
R	*Oligoryzomys* sp. ▲	Pygmy Rice Rat	X (0.03)				Gr, In
	Dinomyidae						
	Dinomys branickii	Pacarana				α	He
	Caviidae						
S	*Cavia aperea*	Brazilian Guinea Pig	X (0.21)			α, β	He
	Hydrochoerus hydrochaeris	Capybara			X	α, β	He
	Dasyproctidae						
	Dasyprocta variegata	Brown Agouti				α	Fr, In
	Echimyidae						
	Mesomys hispidus	Ferreira's Spiny Tree Rat				α	Fr, In
T	*Proechimys simonsi*	Simons' Spiny-Rat		X (0.31)	X (0.25)	α, β	Gr, Fr, Fu
	CHIRÓPTERA						
	Emballonuridae						
	Rhynchonycteris naso	Proboscis Bat			X	α, β	In
	Saccopteryx bilineata	Greater Sac-winged Bat				β	In
	Peropteryx macrotis	Lesser Dog-like Bat				β	In
	Phyllostomidae						
U	*Glossophaga soricina*	Pallas's Long-tongued Bat	X (0.17)	X (1.06)	X (0.33)	α	Ne, In, Fr
	Lonchophylla thomasi	Thomas's Nectar Bat				α	Ne, In
	Lophostoma silvicolum	White-throated Round-eared Bat				α, β	In, Fr
	Chrotopterus auritus	Woolly False Vampire Bat				α	Cr, In
	Micronycteris megalotis	Little Big-eared Bat				α	In, Fr
V	*Micronycteris minuta* ▲	Tiny Big-eared Bat			X (0.33)		In, Fr
	Phyllostomus elongatus	Lesser Spear-nosed Bat				α, β	Fr, In, Ne
	Phyllostomus hastatus	Greater Spear-nosed Bat				α, β	Fr, In, Ne
	Tonatia saurophila	Stripe-headed Round-eared Bat				β	In, Fr
W	*Trachops cirrhosus*	Fringe-lipped Bat		X (0.21)		α	Cr, In
	Carollia benkeithi	Southern Chesnut Short-tailed Bat				α, β	Fr, In, Ne
X	*Carollia brevicauda*	Silky Short-tailed Bat		X (0.21)	X (0.67)	α, β	Fr, In, Ne
Y	*Carollia perspicillata*	Seba's Short-tailed Bat	X (0.34)	X (0.85)	X (0.33)	α, β	Fr, In, Ne
Z	*Rhinophylla pumilio*	Dwarf Little Fruit Bat			X (0.33)	α, β	Fr, In, Ne
AA	*Artibeus gnomus*	Dwarf Fruit-eating Bat	X (0.17)	X (0.21)	X (1.33)	α, β	Fr
AB	*Artibeus lituratus*	Great Fruit-eating Bat	X (2.20)	X (0.64)	X (1.33)	α	Fr, In, Ne
AC	*Artibeus obscurus*	Dark Fruit-eating Bat		X (0.21)	X (1.33)	α, β	Fr, In, Ne
AD	*Artibeus planirostris*	Flat-faced Fruit-eating Bat	X (0.34)	X (0.21)	X (1.33)	α	Fr, In, Ne
	Chiroderma trinitatum	Little Big-eyed Bat				β	Fr, In, Ne
	Chiroderma villosum	Hairy Big-eyed Bat				α	Fr, In, Ne
	Mesophylla macconnelli	MacConnell's Bat				α	Fr, In, Ne
AE	*Platyrrhinus incarum* ▲	Inca Broad-nosed Bat	X (0.17)				Fr, In, Ne
	Sturnira lilium	Little Yellow-shouldered Bat				α, β	Fr, In, Ne
	Sturnira magna	Greater Yellow-shouldered Bat				α	Fr, In, Ne
AF	*Sturnira tildae*	Tilda's Yellow-shouldered Bat			X (0.33)	α, β	Fr, In, Ne
AG	*Uroderma bilobatum*	Common Tent-making Bat	X (0.85)	X (0.21)	X (0.33)	α, β	Fr, In, Ne
AH	*Uroderma magnirostrum*	Brown Tent-making Bat	X (0.34)	X (0.64)		α	Fr, In, Ne
AI	*Vampyriscus bidens*	Bidentate Yellow-eared Bat		X (0.21)	X (0.67)	α	Fr, In, Ne

Code	Species Accounts	Common names	Vegetation forms			Previous records	Trophic Group
			Savanna	Ecotone	Forest		
	Vampyrodes caraccioli	Great Stripe-faced Bat				α	Fr, In, Ne
	Noctilionidae						
AJ	*Noctilio albiventris*	Lesser Bulldog Bat	X (0.34)			α, β	In
	Molossidae						
AK	*Cynomops abrasus* ▲	Cinnamon Dog-faced Bat	X (0.34)				In
AL	*Eumops maurus*	Guianan Bonneted Bat	X (0.51)			β	In
AM	*Eumops patagonicus* ▲	Patagonian Bonneted Bat	X (1.02)				In
AN	*Molossus coibensis* ▲	Coiban Mastiff Bat	X (0.51)				In
AO	*Molossus molossus*	Pallas's Mastiff Bat	X (0.17)		X (1.33)	α, β	In
AP	*Promops centralis*	Crested Mastiff Bat	X (0.51)			β	In
	Vespertilionidae						
	Eptesicus brasiliensis	Brazilian Brown Bat				α, β	
AQ	*Eptesicus furinalis*	Argentinian Brown Bat	X (0.51)			β	In
AR	*Myotis albescens*	Silver-tipped Myotis			X (0.33)	β	In
AS	*Myotis nigricans*	Black Myotis	X (1.86)			α	In
AT	*Myotis riparius*	Riparian Myotis	X (0.17)			α, β	In
	Lasiurus cinereus	Hoary Bat				β	
AU	*Rhogeessa hussoni* ▲■	Eastern Little Yellow Bat	X (0.17)				In
AV	*Rhogeessa io* ▲■	Southern Little Yellow Bat		X (0.21)			In
	CARNIVORA						
	Felidae						
	Leopardus pardalis	Ocelot				β	Cr
	Leopardus wiedii	Margay				α	Cr, In
	Panthera onca	Jaguar			X	α, β	Cr
	Puma concolor	Cougar				β	Cr
	Canidae						
	Atelocynus microtis	Short-eared Dog			X	α, β	Cr
	Chrysocyon brachyurus	Maned Wolf	X			α, β	Cr, Fr
	Mustelidae						
	Eira barbara	Tayra				α, β	Cr, In, Fr
	Lontra longicaudis	Neotropical Otter			X	β	Cr, In
	Pteronura brasiliensis	Giant Otter			X	α, β	Cr
	Procyonidae						
	Bassaricyon alleni ▲	Allen's Olingo			X		Fr, In
	Nasua nasua	South American Coati				α, β	Om
	Potos flavus	Kinkajou			X	α, β	Fr, In
	PERISSODACTYLA						
	Tapiridae						
	Tapirus terrestres	South American Tapir	X	X	X	α, β	He, Fr
	ARTIODACTYLA						
	Tayassuidae						
	Pecari tajacu	Collared Peccary	X	X		α, β	Fr, In, Cr
	Tayassu pecari	White-lipped Peccary				α, β	Fr, In
	Cervidae						
	Blastocerus dichotomus	Marsh Deer	X			α, β	He
	Mazama americana	South American Red Brocket			X	α, β	Fr, Fu
	Mazama nemorivaga	South American Brown Brocket				α, β	Fr
	Total orders		7	6	8		
	Total families		12	10	17		
	Total genera		27	25	32		
	Total species		33	33	38		

Remarks: The genus *Cryptonanus* contains five species distributed in Bolivia, Brazil, Paraguay, Argentina and Uruguay (Tate, 1931; Voss *et al.,* 2005); here we present the first report of this genus for Peru based in a specimen caught in a pitfall trap (Figure 3).

Our specimen was identified as *Cryptonanus* by the following combination of characters: small size, prehensile tail longer than head-and-body (Table 2), dorsal surface of tail covered by tiny sows, plantar surface of manus with distinct plantar pads, manual digits III and IV subequal in length (Voss *et al.,* 2005). Nasals distinctly wider posteriorly than anteriorly, secondary foramen ovale absent, petrosal exposed on poster lateral surface of braincase through fenestra in parietal-squamosal suture, P3 taller than P2, unworn C1 with small accessory worn-out cusps (Figure 4).

TABLE 2: Measurements (mm) and weights (g) of the specimen of *Cryptonanus unduaviensis* from Peru and referred material to *C. unduaviensis* (data from Voss *et al.* 2005).

	Bolivia								Peru
	Santa Cruz		La Paz	Beni				Pando	Madre de Dios
	IGP 157	MSB 58508	AMNH 72563[1]	AMNH 209156	MSB 70752	AMNH 209154	FMNH 114658	MSB 57000	MUSA 12695
Sex	m	m	m	f	f	m	m	m	f
Head-body length	121[2]	86	102	97	111	106	110	105	96
Total length	135	120	120	112	112	132	115	133	119
Length of hind foot	18	17	17	17	16	17	15	19	17.2
Length of ear	18	14	—		14	16	17	17	17
Condylobasal length	30	25.9	—	25.6	26.9	28.2	—	28.3	26.3
Nasal breadth	4.4	3.3	3.3	3.5	3.7	4.2	3.5	4.2	3.7
Least interorbital breadth	5.3	4.8	—	4.7	4.6	5.2	4.9	5	4.8
Zygomatic breadth	17.6	14.7	—	14.2	15.3	15	—	16.3	14.8
Palatal length	16.2	14.2	—	14.1	14.6	15.7	14.8	15.5	14.5
Palatal breadth	9.6	8.4	—	8.2	8.3	8.1	8.6	8.3	8.6
Maxillary toothrow length	11	10.5	10.9	10.3	10.5	10.9	10.7	10.7	10.5
Length of molars	5.7	5.7	5.7	5.6	5.6	5.7	5.8	5.6	5.7
Length of M1-M3	4.9	4.9	4.9	4.8	4.8	5	5.1	4.8	4.9
Weight	40	15	—	18	21	24	28	26	22

[1] holotype; [2] atipical measure.

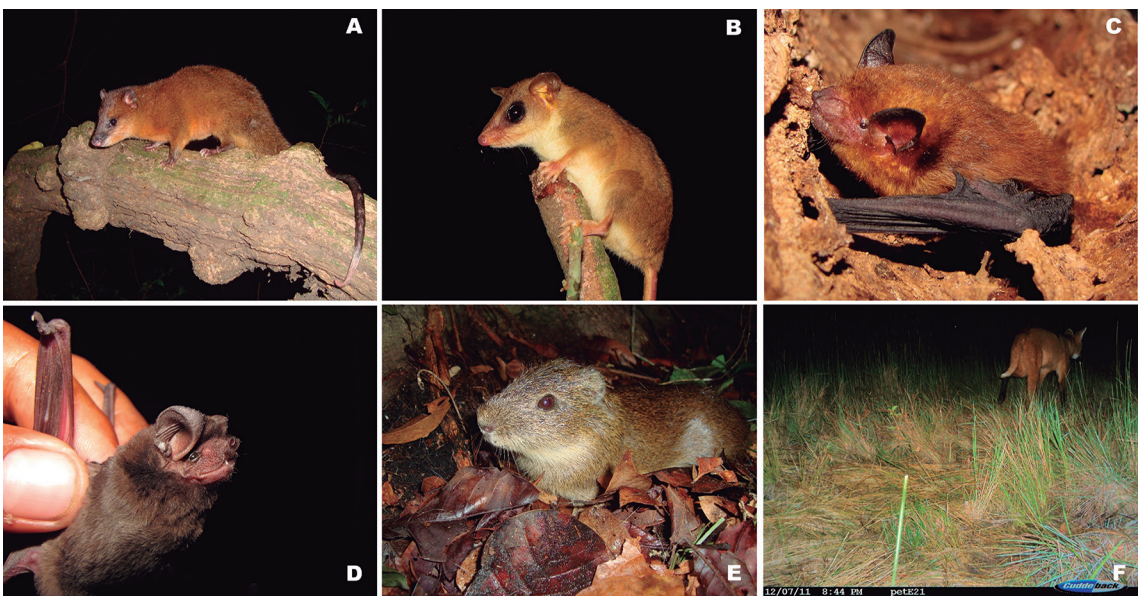

FIGURE 3: Some species registered in Pampas del Heath from Peru: **(A)** *Lutreolina crassicaudata*ᵛ; **(B)** *Cryptonanus unduaviensis**; **(C)** *Rhogeessa hussoni**; **(D)** *Eumops patagonicus**; **(E)** *Cavia aperea**; and **(F)** *Chrysocyon brachyurus** (Photos by K. Pinoᵛ and A. Pari*).

All this characters agreed with the description of this genus (Voss *et al.,* 2005; Voss *com. pers.*). Furthermore, our specimen can be identified as *C. unduaviensis* by the following combination of characters: tail length more than 111 mm (Table 2), condylobasal length more than 25.5 mm, maxillary too throw more than 10.0 mm, length of upper molar series (M1-M4) more than 5.5 mm; venter self-colored light yellowish buff. The characters and measurements of our specimen fell within the range of variation described for *C. unduaviensis* in the literature (Voss *et al.,* 2005; Gardner, 2007b; Voss & Jansa, 2009; Voss, *com. pers.*).

Habitat: Voss *et al.* (2005) reported that one individual of *C. unduaviensis* was collected on a tree island surrounded by seasonally flooded grassland and another was in grass at the edge of a marshy stream. Our specimen was caught in the ecotone of the Aguas Claras Camp, on the sixth day that the pitfall traps line was working. Others small mammals caught in the same trap lines are *Marmosops bishop, Neacomys minutus,* and *Necromys lenguarum.*

Distribution: The specimen MUSA 12695 extends the distribution range of *C. unduaviensis* southwest from Independence, Pando (Bolivia) by 223 km (Anderson, 1997).

ORDER CHIROPTERA Blumenbach 1779
Family Vespertilionidae Gray 1821
***Rhogeessa hussoni* Genoways & Baker 1996**
Husson's Yellow Bat

Specimen examined: adult male (MUSA 12902), collected at Aguas Claras Camp, Pampas del Heath, Madre de Dios (12°57'20"S, 68°54'46"W, 216 m). Measurements see Table 3.

Remarks: The genus *Rhogeessa* is endemic to the Neotropical region and one group in that genus exhibits high species diversity despite a lack of morphological differentiation. The previously known complex of species named as *R. tumida* consists of five species (*R. aeneus, R. genowaysi, R. io, R. velilla,* and

FIGURE 4: Left to right, dorsal, ventral and lateral views of cranium and mandible. **(A)** *Cryptonanus unduaviensis* MUSA 12695; **(B)** *Rhogeessa hussoni* MUSA 12902; and **(C)** and *Rhogeessa io* MUSA 12903. Scale bar equal to 10 mm.

TABLE 3: Measurements (mm) and weights (g) of the specimens of *Rhogeessa hussoni* and *R. io* from Peru compare with referred material of the genus *Rhogeessa* in South America (data from Goodwin, 1958; Ruedas & Bickman, 1992; Genoways & Baker, 1996; Aires *et al.,* 2011). Holotype is denoted with asterisk and numbers in brackets include ranges.

Measures	*Rhogeessa hussoni*			*Rhogeessa io*		
	Suriname	Brasil	Peru	Venezuela		Peru
	*	n = 4	MUSA 12902	*	n = 10	MUSA 12903
Total length	—	—	81	—	—	70
Tail length	—	—	31	—	—	30
Hind foot length	—	(5.02 – 6.43)	6.1	—	—	6.3
Ear length	—	(8.07 – 11.84)	12.5	—	—	11.6
Forearm	30.2	(28.8 – 30.91)	28.6	28	—	28.8
3rd digit metacarpal	29	(26.3 – 28.2)	28.5	—	(26.2 – 28.4)	26.8
4th digit metacarpal	27.8	—	28.1	—	(25.9 – 27.4)	26.4
Greatest length of the skull	13.2	(12.6 – 13.2)	13.2	12.1	(11.7 – 12.6)	12.5
Condylobasal length	10	—	11.1	s/m	(8.5 – 9.1)	10.6
Mastoid width	7.1	—	7.3	7+	—	s/m
Breadth of braincase	5.7	—	6.2	6	—	6.1
Zygomatic width	8.9	—	8.9	8.1	—	8.3
Postorbital width	3.2	(3.41 – 3.80)	3.4	—	—	3.2
Width across upper canines	3.8	(3.78 – 4.09)	3.9	—	(3.4 – 3.6)	3.6
Width across second upper molars	5.6	—	5.7	5.5	(5.0 – 5.4)	5.6
Maxillary toothrow	4.7	(4.56 – 4.89)	4.9	4.6	—	4.8
Postpalatal length	4.7	—	4.9	—	(4.0 – 4.4)	4.8
Mandibular toothrow	5.2	(5.06 – 5.34)	5.6	—	(5.4 – 5.7)	5.4
Width across lower canines	—	(2.56 – 2.78)	2.8	—	—	2.6

R. hussoni), which are distributed in Middle America and north of South America (Audet *et al.,* 1993; Baird *et al.,* 2008; 2012).

Genoways & Baker (1996) described *R. hussoni* based on one specimen from Sipaliwini Airstrip, District of Nickerie (Suriname), and included other report from Maranhão (Brazil). Years afterwards, Aires *et al.* (2011) presented new locality records extending the west distribution extension in Brazil (Nova Lacerda, Mato Grosso). Here we present the first report of this species for Peru based on a specimen caught in a mist net installed at ground level in open savanna (Figure 3).

Our specimen is identified as *Rhogeessa hussoni* due to following combination of characters: one upper and three lower incisors on each side; space between upper incisors narrow; one upper premolar on each side; upper surface of uropatagium not densely furred; dorsal and ventral coloration golden brown with brown tips; pads inflated above the muzzle (Figure 3). Forearm greater than 27.1 mm. Parietals not inflated at juncture of the sagittal crest with the lambdoidal crests (helmet lacking) (Figure 4); greatest length of skull more than 12.6 mm; width across first upper canines more than 3.7 mm (Table 3). All this characters agreed with the description of *R. hussoni* (Genoways & Baker, 1996; Bickham & Ruedas, 2007; Aires *et al.,* 2011), however it necessary carry out citogenetic and molecular studies to confirm that (Backer, *com. pers.*).

Habitat: Rhogeessa hussoni has been found in mixed savanna, gallery forest, lowland evergreen rainforest and Atlantic Forest (Genoways & Baker, 1996; Aires *et al.,* 2011). Our specimen was caught in the open savanna of Refugio Juliaca, the first night that the mist net was set. Others bats species caught in the same net were *Artibeus lituratus, Carollia perspicillata* and *Noctilio albiventris.*

Distribution: Our specimen MUSA 12902 extends the distribution range of *R. hussoni* in 1,031 km westwards from Córrego Areia Branca, Nova Lacerda, Brazil (Aires *et al.,* 2011).

Rhogeessa io Thomas 1903
Thomas's Yellow Bat

Specimen examined: sub-adult male (MUSA 12903), collected at Aguas Claras Camp, Pampas del Heath, Madre de Dios (12°57'20"S, 68°54'46"W, 216 m). Measures see Table 3.

Remarks: Pacheco *et al.* (2007) were the first to report *Rhogeessa* in Peru, the species *R. io,* based in specimens

from northwest Peru (Zarumilla, Tumbes), however Pacheco *et al.* (2009), following Baird *et al.* (2008, 2009), tentatively assign that samples as *R. velilla* and therefore *R. io* was not considered in the last list of mammals of Peru. Nevertheless, here we present the first report of *R. io* for Peru based on a specimen caught in a mist net installed 2 m above level ground in the ecotone.

MUSA 12903 was identified as *Rhogeessa io* by the following character combinations: one upper and three lower incisors on each side; space between upper incisors narrow; one upper premolar on each side; upper surface of uropatagium not densely furred; dorsal coloration light brown and ventral coloration pale yellow; pads inconspicuous above the muzzle. Forearm greater than 27.1 mm. Parietals not inflated at juncture of the sagittal crest with the lambdoidal crests (helmet lacking) (Figure 4); greatest length of skull less than 12.6 mm; width across first upper canines less than 3.7 mm (Table 3). All this characters agreed with the description of *R. io* (Thomas, 1903; Bickham & Ruedas, 2007; Aires *et al.,* 2011), however it necessary carry out citogenetic and molecular studies for confirm that (Backer, *com. pers.*).

Habitat: Rhogeessa io is the most widely distributed *Rhogeessa* in South America and it inhabits a variety of habitats, including evergreen and deciduous forest, thorn shrub, open areas, and villages (Bickham & Ruedas, 2007; Soriano & Tavares, 2008). Our specimen was caught in the ecotone of Refugio Juliaca, in the second night that the mist net was set. Others bats species caught in the same net were *Artibeus lituratus, Artibeus obscurus, Carollia brevicauda, Carollia perspicillata, Uroderma bilobatum,* and *Vampyriscus bidens.*

Distribution: The specimen MUSA 12903 extends the distribution range of *R. io* 444 km westward from Caravana, Beni, Bolivia (Bickham & Ruedas, 2007).

Our results suggest the existence of at least 111 species of mammals in Pampas del Heath and surrounding habitats, resulting number of the 69 species recorded here, 74 documented by Emmons *et al.* (1994) and 72 listed by Luna *et al.* (2002). However, due to isolated location of Pampas del Heath from rest of Cerrado, it possible that several forms of small mammals reported here (*e.g., Lutreolina crassicaudata, Cerradomys maracajuensis* or *Pseudoryzomys simplex*) could be different afterward taxonomic studies more detailed (molecular analyzes).

Others small mammals species that could be potentially registered in the Pampas del Heath and surrounding are *Kunsia tomentosus, Caluromysiops irrupta, Marmosa rubra, Marmosa (Micoureus) demerarae, Metachirus nudicaudatus, Holochilus sciureus, Juscelinomys* sp., *Diclidurus albus, Peropteryx kappleri, Saccopteryx leptura, S. canescens, Desmodus rotundus, Diphylla ecaudata, Micronycteris minuta, Phylloderma stenops, Artibeus anderseni, Vampyrum spectrum, Sphaeronycteris toxophyllum, Noctilio leporinus, Pteronotus parnelli,* and *Myotis simus.* Because of they have been recorded Protected Areas near to Pampas del Heath, or are commonly caught in the Bolivian's savanna (Emmons *et al.,* 2002; Emmons *et al.,* 2006a; 2006b; Solari *et al.,* 2006; Terán *et al.,* 2008; Emmons & Patton, 2012).

Our new records for Peru add one more genus and three species to the country reaching to 541 mammal species in Peru (Pacheco *et al.,* 2009; Lim *et al.,* 2010; Velazco *et al.,* 2010a, 2010b; Gregorin & Almeida, 2010; Gutiérrez *et al.,* 2010; Mantilla-Meluk & Baker, 2010; Díaz, 2011; Velazco & Cadenillas, 2011; Hice & Velazco, 2012; Larsen *et al.,* 2012; Medina *et al.,* 2012; Jiménez *et al.,* 2013; Marsh, 2014; Medina *et al.,* 2014; Pacheco *et al.,* 2014; Rengifo *et al.,* 2014; Velazco *et al.,* 2014; Zeballos *et al.,* 2014; Patton *et al.,* 2015; Hurtado & Pacheco, 2015; Vermeer & Tello-Alvarado, 2015). That show the importance of conduced Flora and Fauna Monitoring Programs for knowing better the diversity of Peruvian mammals in Peru as a whole and in Pampas del Heath in particular.

Sampling effort

Graphs of the species accumulation of small mammals built with the observed data show a trend of increasing richness species if it rises the sampling effort in each of the vegetation forms studied (Figure 5), suggesting that not overall species richness was registered.

Clench models obtained for the savanna, ecotonal area and forest had a good adjust with R2 values of 0.9992, 0.9993 and 0.9997, respectively. The model estimated a total of 45 species for the savanna, 53 for the ecotonal area and 49 for the forest (Figure 4), but in neither case is the asymptote reached (pending 1.52 in savanna, 1.65 in ecotonal area and 1.52 in forest). Moreover, the model indicates that 61% of total species have been registered during our assessment in the Savanna, while in the ecotone and forest have been 53% and 51%, respectively. The model estimated that 17, 28.9 and 29.8 days (sampling events) of assessment would be capable of recording the 80% of predicted species in the savanna, ecotonal area and forest (respectively), while Aguirre (2002) estimated

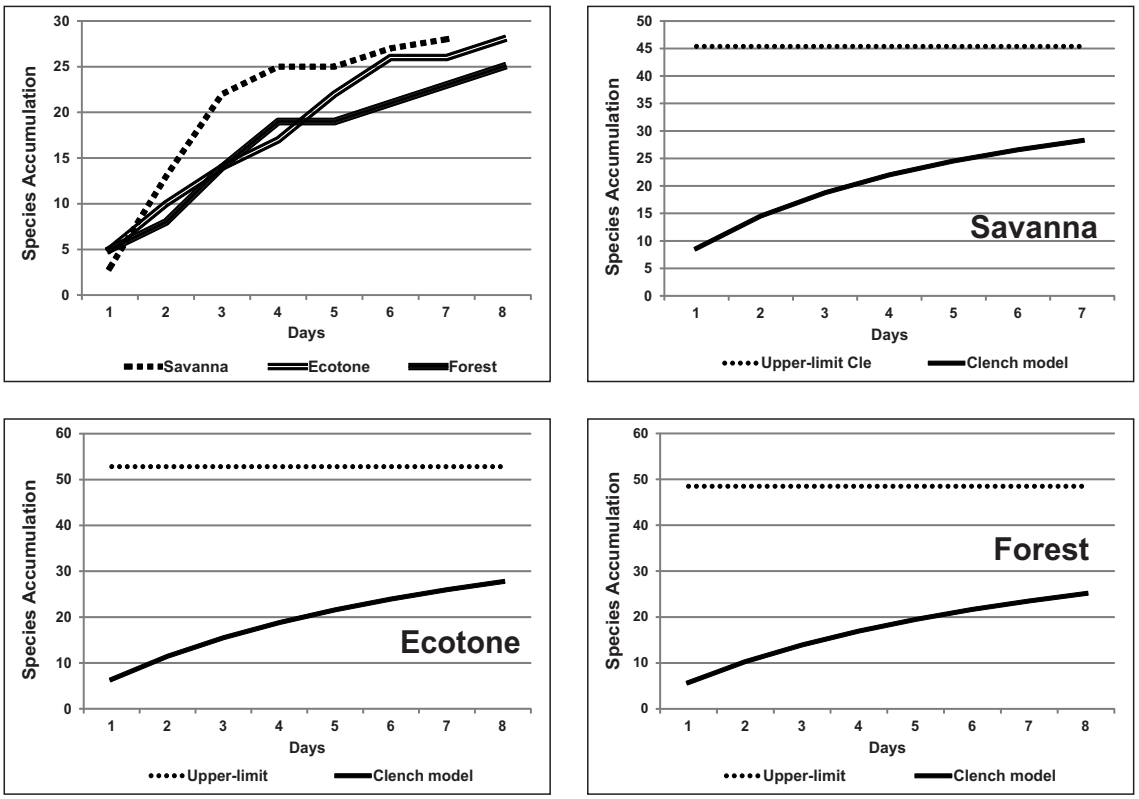

FIGURE 5: Species accumulation curves for each vegetation types evaluated. Empirical curves (upper left) and Clench models (the rest).

30 nigths of sampling effort for to register the 88% of bats species in Bolivian's savanna.

Relative density

The marsupial *Marmosops bishopi,* the rodent *Necromys lenguarum,* and the bats *Artibeus lituratus* and *A. planirostris* were the most abundant during the survey. Less abundant species were usually represented by a single individual: the marsupials *Cryptonanus unduavensis, Lutreolina crassicaudata, Marmosa lepida, M. (Micoureus) regina* and *Marmosops noctivagus;* the rodents *Oligoryzomys microtis, Oligoryzomys* sp.; and the bats *Myotis riparius, Platyrrhinus incarum, Rhogeessa hussoni, R. io,* and *Trachops cirrhosus* (Table 1).

In the savanna, only two species of marsupials were reported and this were equally abundant (*Marmosops* sp. and *Lutreolina crassicaudata*). The most abundant rodents were *Necromys lenguarum* and *Pseudoryzomys simplex,* meanwhile in the bats were *Artibeus lituratus* and *Myotis nigricans* (Table 1). Respect to the bats, our relative densities in the savanna are similar to the surveys in Noel Kempff Mercado National Park and Espiritu's savanna, when frugivores bats (*Carollia* spp. and *Artibeus lituratus*) and slow-flying insectivores bats (*Myotis nigricans* and *Noctilio albiventris*) were the most commons, respectively (Aguirre, 2002; Emmons *et al.,* 2006b).

In the ecotonal area, the marsupial *Monodelphis peruviana,* the rodents *Euryoryzomys nitidus* and *Hylaeamys perenensis,* and the bats *Glossophaga soricina* and *Carollia perspicillata* were the most abundant species, meanwhile in the forest were the marsupial *M. bishopi,* the rodents *H. perenensis* and *E. nitidus,* and the bats *Artibeus gnomus, A. lituratus, Artibeus obscurus* and *A. planirostris* (Table 1).

There were species occupying the three vegetation forms but these have fluctuation in their densities surely as response to the environments resources in each vegetation form (Mohammadi, 2010). Thus, we found some species more abundant in forest environments (*e.g., Marmosops* sp., *E. nitidus, H. perenensis* and *A. gnomus*) than in open environments (*e.g., Uroderma bilobatum* and *A. lituratus*), and vice versa (Table 1).

Diversity

The diversity of marsupial and rodents in the ecotonal area (D_{Mg} = 3.53 and D_{Mn} = 2.26) and forest (2.49 and 1.64) were upper than savanna (1.26

and 0.91), however the diversity of bats was similar between the Savanna (3.52 and 2.51), Ecotonal area (3.51 and 2.50) and Forest (3.53 and 2.52).

These fluctuations could be explained since several approaches (resource foods, refuges, temperature, between others) nevertheless we suspect of the influence of moonlight on behavior of the marsupials and rodents, due to during the survey in the savanna the moon was in waxing crescent (November 31), likewise in the ecotonal area and forest that was full (December 10) to waning gibbous (December 14) (US Naval Oceanography, 2012). Effect of moonlight has been well documented for several nocturnal mammals by reducing their use of open space, or restricting their activity to darker periods of the night (Morrison, 1978; Gilbert & Boutin, 1991; Wolfe & Summerlin, 1989; Upham, 2008).

Community structure

Savanna's range-abundance curves showed bats assemblages dominated by two species, one frugivorous and other insectivorous, being remarkable the presence

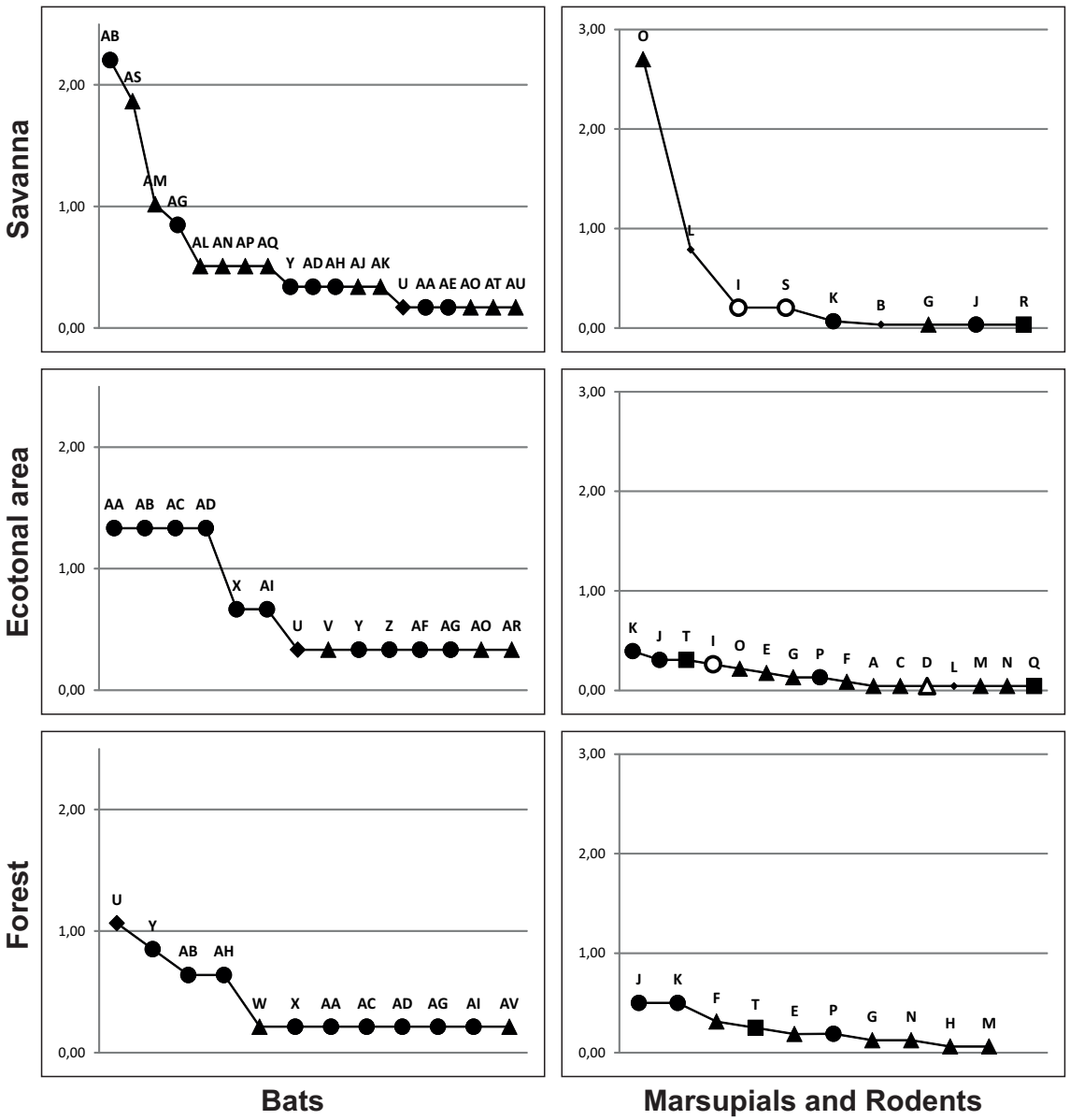

FIGURE 6: Range-abundance curves (pi) for small mammals from Pampas del Heath. Codes of each species are denoted in Table 1. Trophic group: Insectivorous (full triangles), Frugivorous (circles), Herbivorous (empty circles), Carnivorous (stars), Omnivorous (empty triangles), Nectarivorous (diamonds) and Granivorous species (squares).

of a greater number of insectivores species (1 sp.) compared with the rest of trophic groups (eight sp., frugivorous and nectarivorous). On the other hand the marsupials and rodents assemblages showed a wide variety of trophic groups, which were greatly dominated by insectivorous species (Figure 6). Both curves resemble the Fishers's logarithmic series model (Fisher *et al.,* 1943), which describes a community dominated by one or two species very abundant followed by many with lower abundances. This model generally applies to small communities under stress or pioneers, where one or a few factors dominate the ecology of the community (Moreno, 2001; Magurran, 1988).

Ecotone's range-abundance curves showed a bats assemblages dominated by frugivorous species, followed by some insectivorous and nectarivorous species. Whereas for the marsupials and rodents community showed a wide variety of trophic groups, whose species had similar abundances (Figure 6).

Forest's range-abundance curves showed a bats assemblages dominated by two species, one nectarivorous and other frugivorous, with the presence of a greater number of frugivorous species (nine sp.) compare with the rest of trophic groups. Whereas the marsupials and rodents assemblages showed a slight dominance by frugivorous species and there was a greater richness of insectivorous species (six species) compared with the other trophic groups (four species, frugivorous and granivorous) (Figure 6).

Curves constructed for the ecotonal area and forest seem fit to a Log normal distribution model (Sugihara, 1980), which describe communities with light equilibria between number of the most abundant species and least abundant species. This model generally characterize samples of large, mature and diverse communities due to there is a hierarchical segregation of niche used by the organisms (Moreno, 2001; Magurran, 1988).

Emmons *et al.* (1994) and Luna *et al.* (2002) reported a high richness of insectivorous bat species in Pampas del Heath, however it is notable replacement of organisms between the savanna, ecotonal area and forest. Our data showed a great dominance of insectivorous species in open habitats, like savanna, which are gradually replaced by frugivorous species conform the vegetation change forward arboreal habitats, like ecotonal area and forest (Figure 6).

Conservation status

Thirteen species are categorize as threatened according to Peruvian and international law, which two are in Data insufficient (IUCN, 2012; MINAGRI, 2014). Additionally 24 suffer pressure of International Trade (CITES, 2013), which seven are categorized on Appendice I, 15 on Appendice II and two on Appendice III (Table 4).

Eight species corresponding to endemic mammals from Neotropical savannas (Table 4) (Emmons *et al.,* 1994; Luna *et al.,* 2002; Voss *et al.,* 2005; Emmons *et al.,* 2002; 2006a; 2006b; Percequillo *et al.,* 2008).

TABLE 4: Conservation status of mammals registered during the study.

Species Accounts	Conservation status			Endemic from Savanna
	DS 04-2014	IUCN	CITES	
DIDELPHIMORPHIA				
Cryptonanus unduaviensis				X
Lutreolina crassicaudata				X
CINGULATA				
Priodontes maximus	VU	VU	I	
PILOSA				
Myrmecophaga tridactyla	VU		II	
PRIMATES				
Cebus albifrons			II	
Saguinus fuscicollis			II	
Saguinus imperator			II	
Aotus azarae			II	
Saimiri sciureus			II	
Sapajus apella			II	
Callicebus sp.			II	
Alouatta sara			II	
Ateles chamek	EN	EN	II	
RODENTIA				
Cerradomys maracajuensis				X
Pseudoryzomys simplex				X
Oligoryzomys sp.				X
Dinomys branickii	VU	VU		
Cavia aperea				X
CARNIVORA				
Leopardus pardalis			I	
Leopardus wiedii	DD		I	
Panthera onca	NT		I	
Puma concolor	NT		II	
Atelocynus microtis	VU			
Chrysocyon brachyurus			II	X
Eira barbara			III	
Lontra longicaudis			I	
Pteronura brasiliensis	EN	EN	I	
Potos flavus			III	
PERISSODACTYLA				
Tapirus terrestris	NT	VU	II	
ARTIODACTYLA				
Pecari tajacu			II	
Tayassu pecari	NT	VU	II	
Blastocerus dichotomus	VU	VU	I	X
Mazama americana	DD			
Total species	13	7	24	8

Future studies that may be interesting to Pampas del Heath are the dynamic between particular vegetation of the savanna and mammal with the skilled of modifying that such as *Cavia aperea* and *Blastocerus dichotomus* (herbivorous species), or studies about population status of carnivorous species (*Lutreolina crassicaudata* and *Chrysocyon brachyurus*).

RESUMEN

*El Parque Nacional Bahuaja Sonene (PNBS) alberga la única muestra de la sabana húmeda tropical sudamericana en Perú la cual es conocida como "Pampas del Heath", con sólo 6,136 hectáreas de superficie. En su ámbito ocurren muchas especies en peligro de extinción y/o endémicas de sabana, sin embargo estudios que dan a conocer la diversidad de mamíferos en las Pampas del Heath son escasos contándose con sólo tres evaluaciones desde 1977 hasta el presente. Por tanto, desarrollamos relevamientos de mamíferos en tres tipos de hábitats de las Pampas del Heath (sabana, área ecotonal y bosque) a fines del año 2011. Utilizamos varios métodos de registro para los diferentes grupos de mamíferos muestreados, incluyendo 1) técnicas de captura con redes de niebla, trampas de golpe, trampas Sherman, trampas Tomahawk y trampas de Caída, y 2) técnicas de detección directa por medio de cámaras trampa, avistamiento de mamíferos en senderos, búsqueda de rastros y entrevistas a pobladores locales. El esfuerzo de captura fue de 6,033 trampas/noche, 136 redes/noche y 108 cámaras/noche. Registramos un total de 69 especies de mamíferos: 33 en la sabana, 33 en el área ecotonal y 38 en el bosque. Dieciséis especies son nuevos reportes para las Pampas del Heath y tres son nuevos registros para el Perú (*Cryptonanus unduaviensis, Rhogeessa hussoni *and* Rhogeessa io*). Se realizó análisis del esfuerzo de muestreo, densidad relativa, diversidad y estructura comunitaria de los mamíferos pequeños para los tres tipos de hábitats. Además siete especies se encuentran Amenazadas y 24 están en CITES. Los nuevos registros aquí presentados incrementan el listado de mamíferos del Perú de 538 a 541 y ponen en evidencia la importancia de conducir inventarios biológicos para describir la biodiversidad de áreas remotas, como las Pampas del Heath.*

Palabras-Clave: Distribución; Mamíferos; Pampas del Heath; Riqueza.

ACKNOWLEDGEMENTS

We are grateful to U.F. Pardiñas (Centro Nacional Patagónico), B.D. Patterson (Field Museum of Natural History) and J. Salazar-Bravo (Museum of Natural History, Texas Tech University) for suggestions that improved an earlier version of the manuscript. Finally R. Gutiérrez and D. Huamán for fieldwork support. This study was supported by Asociación para la Investigación y Desarrollo (AIDER), Museo de Historia Natural de la Universidad Nacional de San Agustín de Arequipa (MUSA) and Bahuaja Sonene National Park, which it had the help of Wildlife Conservation Society (WCS). We also thanks the Ministerio de Ambiente and SERNANP for the permits to capture and collect specimens (RJ 007-2011).

REFERENCES

Aguirre, L.F. 2002. Structure of a neotropical savanna bat community. *Journal of Mammalogy,* 83:775-784.

Aires, C.C.; do Nascimento, F.O. & Césari, A. 2011. Mammalia, Chiroptera, Vespertilionidae, *Rhogeessa hussoni* Genoways & Baker, 1996: Distribution extension and taxonomic notes. *Checklist,* 7:117-119.

Anderson, S. 1997. Mammals of Bolivia, taxonomy and distribution. *Bulletin of the American Museum of Natural History,* 231:1-652.

Aplin, K.P.; Brown, P.R.; Jacob, J.; Krebs, C.J. & Singleton, G.R. 2003. *Field methods for rodent studies in Asia and the Indo-Pacific.* Canberra, CSIRO. 223p. (ACIAR Monograph, n. 100)

Audet, D.; Engstrom, M.D. & Fenton, M.B. 1993. Morphology, karyology, and echolocation calls of *Rhogeessa* (Chiroptera: Vespertilionidae) from the Yucatan Peninsula. *Journal of Mammalogy,* 74:498-502.

Baird, A.B.; Hillis, D.M.; Patton, J.C. & Bickham, J.W. 2008. Evolutionary history of the genus *Rhogeessa* (Chiroptera: Vespertilionidae) as revealed by mitochondrial DNA sequences. *Journal of Mammalogy,* 89:744-754.

Baird, A.B.; Hillis, D.M.; Patton, J.C. & Bickham, J.W. 2009. Speciation by monobrachial centric fusions: A test of the model using nuclear DNA sequences from the bat genus *Rhogeessa. Molecular Phylogenetics and Evolution,* 50:256-267.

Baird, A.B.; Marchán-Rivadeneira, M.R.; Pérez, S.G. & Baker, R.J. 2012. Morphological analysis and description of two new species of *Rhogeessa* (Chiroptera: Vespertilionidae) from the Neotropics. *Occasional Papers of the Museum of Texas Tech University,* 281:1-25.

Bickham, J.W. & Ruedas, L.A. 2007. Genus *Rhogeessa* H. Allen, 1866. *In:* Gardner, A.L. (Ed.). *Mammals of South America: Marsupials, Xenarthrans, Shrews and Bats.* Chicago, University of Chicago Press. v. 1, p. 483-484.

Calhoum, J.B. & Casby, J.U. 1958. *Calculation of home range and density of small mammals.* Washington, U.S. Department of Health Education and Welfare. 24p. (Public Health Monograph, 55).

CITES. 2013. *Convention on International Trade in Endangered Species of Wild Fauna and Flora. Appendices I, II y III.* Available in: www.iucnredlist.org. Access: 06 jul. 2013.

Clarke, K.R. & Gorley, R.N. 2006. *PRIMER v6. User Manual/ Tutorial.* Plymouth, UK. Primer-E Ltd.

Díaz, M.M. 2011. New records of bats from the northern region of the Peruvian Amazon. *Zoological Research,* 32:168-178.

Dietrich, J.R. 1995. El Uso de Entrevistas para averiguar la distribución de Vertebrados. *Revista de Ecología Latinoamericana,* 2:1-4.

Eisenberg, J.F. & Redford, K.H. 1999. *Mammals of the Neotropics, the central Neotropics Vol. 3: Ecuador, Peru, Bolivia, Brazil.* Chicago, The University of Chicago Press.

Emmons, L.H. & Feer, F. 1999. *Mamíferos de los Bosques Húmedos de América Tropical: una guía de campo.* Santa Cruz de la Sierra, Editorial F.A.N.

Emmons, L.H. & Patton, J.L. 2012. Taxonomic revision of Bolivian *Juscelinomys* (Rodentia, Cricetidae) with notes on morphology and ecology. *Mammalia,* 76:285-294.

Emmons, L.H.; Ascorra, C. & Romo, M. 1994. Mammals of the río Heath and Peruvian pampas. *In:* Foster, R.; Carr, J. & Forsyth, A. (Eds.). *The Tambopata-Candamo Reserved Zone of southeastern Perú: A biological assessment.* Washington, Conservation International. p. 146-149. (RAP Working Papers 6).

Emmons, L.H.; Chávez, V.; Rocha, N.; Phillips, B.; Phillips, I.; Del Aguila L.F. & Swarner, M.J. 2006a. The non-flying mammals of Noel Kempff Mercado National Park (Bolivia). *Revista Boliviana de Ecología,* 19:23-46.

Emmons, L.H.; Romo, M.; Luna, L.; Cornejo A. & Kopper, C. 2002. Comparación de ocurrencia de especies de mamíferos del SNPH (RAP 1992 y 1996) con otras localidades de Madre de Dios. *In:* Montambault, J.R. (Ed.). *Informes de las evaluaciones biológicas de Pampas del Heath, Perú, Alto Madidi, Bolivia, y Pando, Bolivia.* Washington, Conservation International. p. 106-110. (RAP Working Papers 24).

Emmons, L.H.; Swarner, M.J.; Vargas-Esppinosa, A.; Tschapka, M.; Azurduy H. & Kalko, E.K.V. 2006b. The forest and savanna bat communities of Noel Kempff Mercado National Park (Bolivia). *Revista Boliviana de Ecología,* 19:47-57.

Feinsinger, P. 2001. *Designing field studies for biodiversity conservation.* Washington, Island Press.

Fisher, R.A.; Corbet, A.S. & Williams, C.B. 1943. The relation between the number of species and the number of individuals in a random sample of animal population. *Journal of Animal Ecology,* 12:42-58.

Gardner, A.L. 2007a. *Mammals of South America Volume 1. Marsupials, Xenarthrans, Shrews, and Bats.* University of Chicago, Chicago Press.

Gardner, A.L. 2007b. Genus *Cryptonanus* Voss, Lunde, and Jansa, 2005. *In:* Gardner, A.L. (Ed.). *Mammals of South America Volume 1. Marsupials, Xenarthrans, Shrews, and Bats.* University of Chicago, Chicago Press. p. 40-43.

Genoways, H.H. & Baker, R.J. 1996. A new species of the genus *Rhogeessa,* with comments on geographic distribution and speciation in the genus. *In:* Genoways Jr., H.H. & Baker, R.J. (Eds.). *Contributions to Mammalogy: A Memorial Volume Honoring Dr. J. Knox Jones.* Lubbock, Museum of Texas Tech University. v. 1, p. 83-87.

Gilbert, B. & Boutin, S. 1991. Effect of moonlight on winter activity of snowshoe hares. *Arctic and Alpine Research,* 23:61-65.

Goodwin, G.G. 1958. Bats of the genus *Rhogeessa. American Museum Novitates,* 1923:1-17.

Gottsberger, G. & Silberbauer-Gottsberger, I. 2006. *Life in the Cerrado: A South American tropical seasonal ecosystem.* Ulm, Reta Verlag. v. 1.

Graipel, M.E. 2001. A simple ground-based method for trapping small mammals in the forest canopy. *Mastozoología Neotropical,* 10:177-181.

Gregorin, R. & Almeida, E. 2010. Revalidation of *Promops davisoni* Thomas (Molossidae). *Chiroptera Neotropical,* 16:648-659.

Guichón, M.L. & Cassini, M.H. 2009. Role of diet selection in the use of habitat by pampas cavies *Cavia aperea pamparum* (Mammalia, Rodentia). *Mammalia,* 62(1):23-36.

Gutiérrez, E.E.; Jansa, S.A. & Voss, R.S. 2010. Molecular systematics of mouse opossums (Didelphidae: *Marmosa*): assessing species limits using mitochondrial DNA sequences, with comments on phylogenetic relationships and biogeography. *American Museum Novitates,* 3692:1-22.

Hanagarth, W. & Beck, S. 1996. Biogeographie der Beni-savannen (Bolivien). *Geographische Rundschau,* 48:662-668.

Hice, C.L. & Velazco, P.M. 2012. The Non-volant Mammals of the Reserva Nacional Allpahuayo-Mishana, Loreto, Peru. *Special Publications, Museum of Texas University,* 60:1-135.

Hice, C.L.; Velazco, P.M. & Willig, M.R. 2004. Bats of the Reserva Nacional Allpahuayo-Mishana, northeastern Peru, with notes on community structure. *Acta Chiropterologica,* 6:319-334.

Hofmann, R.K.; Ponce del Prado, C.F. & Otte, K.C. 1976. Registro de dos nuevos mamíferos para el Perú, *Odocoileus dichotomus* (Illiger-1811) y *Chrysocyon brachyurus* (Illiger-1811) con notas sobre su hábitat. *Revista Forestal del Perú,* 6:61-81.

Hurtado, C.M. & Pacheco, V. 2015. New mammalian records in the Parque Nacional Cerros de Amotape, northwestern Peru. *Revista Peruana de Biología,* 22(1):77-86.

Ibisch, P.L.; Beck, S.G.; Gerkmann, B. & Carretero, A. 2003. Ecorregiones y ecosistemas. *In:* Ibisch, P.L. & Mérida, G. (Eds.). *Biodiversidad: La Riqueza de Bolivia.* Santa Cruz de la Sierra, Editorial FAN. v. 1, p. 47-88.

IUCN. 2012. *IUCN Red List of Threatened Species. Version 2012.1.* Available in: www.iucnredlist.org. Access: 20 jan. 2014.

Jiménez, C.F.; Pacheco, V. & Vivas, D. 2013. An introduction to the systematics of *Akodon orophilus* Osgood, 1913 (Rodentia: Cricetidae) with the description of a new species. *Zootaxa,* 3669:223-242.

Jiménez-Valverde, A. & Hortal, J. 2005. Las curvas de acumulación de especies y la necesidad de evaluar la calidad de los inventarios biológicos. *Revista Ibérica de Aracnología,* 8:151-161.

Jones, C.; McShea, W.J.; Conroy, M.J. & Kunz, T.H. 1996. Capturing mammals. *In:* Wilson, D.E.; Cole, F.R.; Nichols, J.D.; Rudran, R. & Foster, M.S. (Eds.). *Measuring and monitoring biological diversity: standard methods for mammals.* Washington, Smithsonian Institution Press. v. 1, p. 115-155.

Josse, C.; Navarro, G.; Encarnación, F.; Tovar, A.; Comer, P.; Ferreira, W.; Rodríguez, F.; Saito, J.; Sanjurjo, J.; Dyson, J.; Rubin de Celis, E.; Zárate, R.; Chang, J.; Ahuite, M.; Vargas, C.; Paredes, F.; Castro, W.; Maco, J. & Reátegui, F. 2007. *Ecological systems of the Amazon Basin of Peru and Bolivia. Classification and Mapping.* Arlington, NatureServe.

Larsen, R.J.; Knapp, M.C.; Genoways, H.H.; Khan, F.A.A.; Larsen, P.A.; Wilson, D.E. & Baker, R.J. 2012. Genetic diversity of neotropical *Myotis* (Chiroptera: Vespertilionidae) with an Emphasis on South American Species. *PLoS ONE,* 7:e46578.

LaVal, R. 1973. Systematics of the genus *Rhogeessa* (Chiroptera: Vespertilionidae). *Occasional Papers of the Museum of Natural History the University of Kansas,* 19:1-47.

Leite, R.L.; Foster, R.B. & Wachter, T.S. 2009. *Mamíferos Grandes del Sudeste de la Amazonía Peruana: Parque Nacional del Manu, Concesión para Conservación Los Amigos y Parque Nacional Alto Purús.* Asociación para la Conservación de la Cuenca amazónica (ACCA) y Environmental & Conservation Programs, The Field Museum. Chicago.

Lim, B.K.; Engstrom, M.D.; Reid, F.A.; Simmons, N.B.; Voss, R.S. & Fleck, D.W. 2010. A New Species of *Peropteryx* (Chiroptera: Emballonuridae) from Western Amazonia with

Comments on Phylogenetic Relationships within the Genus. *American Museum Novitates,* 3686:1-20.

López, E.; Morales, A.; Ponce, E. & Rivera, S. 1998. *Preparación de taxidermias de vertebrados para estudio e investigación.* Arequipa, Universidad Nacional de San Agustín.

Luna, L.; Emmons, L.; Romo, M. & Cornejo-Farfán, A. 2002. Mamíferos encontrados en el Santuario Nacional Pampas del Heath durante la expedición del RAP de 1996. *In:* Montambault, J.R. (Ed.). *Informes de las evaluaciones biológicas Pampas del Heath, Perú; Alto Madidi, Bolivia; y Pando, Bolivia.* Washington, Conservation International. v. 1, p. 66-70. (Bulletin of Biological Assessment 24).

Magurran, A.E. 1988. *Ecological diversity and its measurements.* New Jersey, Princeton University Press.

Mantilla-Meluk, H. & Baker, R.J. 2010. New species of *Anoura* (Chiroptera: Phyllostomidae) from Colombia, with systematic remarks and notes on the distribution of the *A. geoffroyi* complex. *Occasional Papers of the Museum of Texas Tech University,* 292:1-18.

Marsh, L. 2014. A taxonomic revision of the Saki Monkeys, *Pithecia* Desmarest, 1804. *Neotropical Primates,* 21:1-163.

Medina, C.E.; Gregorin, R.; Zeballos, H.; Zamora, H.T. & Moras, L.M. 2014. A new species of Eumops (Chiroptera: Molossidae) from southwestern Peru. *Zootaxa,* 3878:19-36.

Medina, C.E.; Zamora, H.T.; Zeballos, H.; Pari, A.; Pino, K. & Delgado, W. 2012. Primer registro de *Eumops patagonicus* y ampliación del rango de distribución geográfica de *E. hansae,* en el sur de Perú. *Mastozoología Neotropical,* 19:345-351.

MINAGRI, 2014. Actualización de la lista de Clasificación y Categorización de Especies Amenazadas de Fauna Silvestre legalmente protegidas por el Estado. *In:* Ministerio de Agricultura y Riego del Perú (Ed.). *El Peruano: Decreto Supremo Nº 004-2014.* Lima. v. 1, p. 520497-520504.

MINAM. 2012. *Memoria descriptiva del Mapa de Cobertura Vegetal del Perú.* Lima, Editorial Super Gráfica EIRL.

Mohammadi, S. 2010. Microhabitat Selection by Small Mammals. *Advances in Biological Research,* 4:283-287.

Moreno, C.E. 2001. *Métodos para medir la biodiversidad.* – Zaragoza, M&T. (Manuales y Tesis SEA, vol. 1).

Morrison, D. 1978. Lunar phobia in a neotropical fruit bat, *Artibeus jamaicensis* (Chiroptera, Phyllostomidae). *Animal Behaviour,* 26:852-855.

do Nascimento, V. 2007. *Ecologia alimentar de pequenos mamíferos de áreas de Cerrado no Sudeste do Brasil.* Universidade Federal de Uberlandia. Dissertação de Mestrado.

Pacheco, V.; Cadenillas, R. & Velazco, S. 2007. Noteworthy bat records from the Pacific Tropical rainforest region and adjacent dry forest in northwestern Peru. *Acta Chiropterologica,* 9(2):409-422.

Pacheco, V.; Cadenillas, R.; Salas, E.; Tello C. & Zeballos, H. 2009. Diversidad y endemismo de los Mamíferos del Perú. *Revista Peruana de Biología,* 16:5-32.

Pacheco, V.; Rengifo, E.M. & Vivas D. 2014. Una nueva especie de ratón orejón del género Phyllotis Waterhouse, 1837 (Rodentia: Cricetidae) del norte del Perú. *Therya,* 5(2):481-508.

Patton, J.L.; da Silva, M.N.F. & Malcolm, J.R. 2000. Mammals of the Rio Juruá and the evolutionary and ecological diversification of Amazonia. *Bulletin of the American Museum of Natural History,* 244:1-306.

Patton, J.L.; Pardiñas, U.F.J. & D'Elia, G. 2015. *Mammals of South America.* Vol. 2: *Rodents.* Chicago, The University of Chicago Press.

Percequillo, A.R.; Hingst-Zaher, E. & Bonvicino, C.R. 2008. Systematic review of genus *Cerradomys* Weksler, Percequillo and Voss, 2006 (Rodentia: Cricetidae: Sigmodontinae: Oryzomyini), with description of two new species from Eastern Brazil. *American Museum Novitates,* 3622:1-46.

Rengifo, E.M. & Pacheco, V.M. 2014. Taxonomic revision of the Andean leaf-eared mouse, Phyllotis andium Thomas 1912 (Rodentia: Cricetidae), with the description of a new species. *Zootaxa,* 4018(3):349-380.

Ruedas, L.A. & Bickham, J.W. 1992. Morphological differentiation between *Rhogeessa minutilla* and *R. tumida* (Mammalia: Chiroptera: Vespertilionidae). *Proceedings of the Biological Society of Washington,* 105:403409.

Soberón, J.M. & Llorente, J. 1993. The use of species accumulation functions for the prediction of species richness. *Conservation Biology,* 7:480-488.

Solari, S.; Pacheco, V.; Luna, L.; Velazco, P.M. & Patterson, B.D. 2006. Mammals of the Manu Biosphere Reserve. *In:* Fieldiana: Zoology N.S., 110:13-23. (B.D Patterson.; D.F. Stotz & S. Solari, (Eds.). Mammals and Birds of the Manu Biosphere Reserve, Peru.)

Soriano, P. & Tavares, V. 2008. *Rhogeessa io. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1.* Available in: www.iucnredlist.org. Access: 14 VII 2012.

StatSoft. 1998. *STATISTICA (data analysis software system and computer program manual).* Versión 6. StatSoft, Inc., Tulsa, OK.

Sugihara, G. 1980. Minimal community structure: an explanation of species abundance patterns. *The American Naturalist,* 116:770-787.

Tate, G.H.H. 1931. Brief diagnoses of twenty-six apparently new forms of *Marmosa* (Marsupialia) from South America. *American Museum Novitates,* 493:1-14.

Terán, M.F.; Ayala, J. & Hurtado, J.C. 2008. Primer registro de *Kunsia tomentosus* (Rodentia: Cricetidae: Sigmodontinae) en el norte del departamento de La Paz, Bolivia. *Mastozoología Neotropical,* 15:129-133.

Thomas, O. 1903. Two South American forms of *Rhogeessa. Annals and Magazine of Natural History,* 7:382-383.

Upham, N.S. 2008. *Rodent activity in relation to moonlight in sandy and open habitats of the great basin desert.* Los Angeles Occidental College. Ms Thesis.

US Naval Oceanography. 2012. *Phases of the Moon and Percent of the Moon Illuminated.* Available in: www.usno.navy.mil/USNO/astronomical-applications/data-services. Access: 13 V 2012.

Velazco, P.M. & Cadenillas, R. 2011. On the identity of *Lophostoma silvicolum occidentalis* (Davis & Carter, 1978) (Chiroptera: Phyllostomidae). *Zootaxa,* 2962:1-20.

Velazco, P.M.; Gardner, A.L. & Patterson, B.D. 2010. Systematics of the *Platyrrhinus helleri* species complex (Chiroptera: Phyllostomidae), with descriptions of two new species. *Zoological Journal of the Linnean Society,* 159:785-812.

Velazco, P.M.; Gregorin, R.; Voss, R.S. & Simmons, N.B. 2014. Extraordinary Local Diversity of Disk-Winged Bats (Thyropteridae: *Thyroptera*) in Northeastern Peru, with the Description of a New Species and Comments on Roosting Behavior. *American Museum Novitates,* 3795:1-28.

Velazco, S.; Pacheco, V. & Meschedec, A. 2010. First occurrence of the rare emballonurid bat *Cyttarops alecto* (Thomas, 1913) in Peru – Only hard to find or truly rare? *Mammalian Biology,* 76:373-376.

Vermeer, J. & Tello-Alvarado, J.C. 2015. The Distribution and Taxonomy of Titi Monkeys (Callicebus) in Central and Southern Peru, with the Description of a New Species. *Primate Conservation,* 29:9-29.

Voss, R.S. & Emmons, L.H. 1996. Mammalian diversity in neotropical lowland rainforests: a preliminary assessment. *Bulletin of the American Museum of Natural History,* 230:1-115.

Voss, R.S. & Jansa, S.A. 2009. Phylogenetic relationships and classification of Didelphidae marsupials, an extant radiation

of New World metatherian mammals. *Bulletin of the American Museum of Natural History,* 322:1-177.

Voss, R.S.; Lunde, D.P. & Jansa, S.A. 2005. On the contents of *Gracilinanus* Gardner & Creighton, 1989, with the description of a previously unrecognized clade of small didelphid marsupials. *American Museum Novitates,* 3482:1-34.

Voss, R.S.; Lunde, D.P. & Simmons, N.B. 2001. The Mammals of Paracou, French Guiana: A Neotropical lowland rainforest fauna. Part 2. Nonvolant species. *Bulletin of the American Museum of Natural History,* 263:1-236.

Weksler, M. & Percequillo, A.R. 2011. Key to the genera of the tribe Oryzomyini (Rodentia: Cricetidae: Sigmodontinae). *Mastozoología Neotropical,* 18:281-292.

Wolfe, J. & Summerlin, C. 1989. The influence of lunar light on nocturnal activity of the old field mouse. *Animal Behavior,* 37:410-414.

Zeballos, H.; Palma, E.; Marquet, P.A. & Ceballos, G. 2014. Phylogenetic relationships of *Calomys sorellus* complex (Rodentia: Cricetidae), with the description of two new species. *Revista Mexicana de Mastozoología Nueva Época,* 4:1-23.

Aceito por Mario de Vivo em: 02/12/2015
Impresso em: 01/09/2016

Publicado com o apoio financeiro do Programa de Apoio às Publicações Científicas Periódicas da USP

Seção de Publicações do MZUSP