

## First record of *Anoura aequatoris* (Lömberg, 1921) (Chiroptera: Phyllostomidae) from Bolivia

## Primer registro de *Anoura aequatoris* (Lömberg, 1921) (Chiroptera: Phyllostomidae) para Bolivia

Hugo Mantilla-Meluk<sup>1,3</sup>, Luis F. Aguirre<sup>2</sup>, Alex Mauricio Jiménez-Ortega<sup>3</sup>

### Abstract

Herein we introduce the first Bolivian record of the phyllostomid nectar feeding bat *Anoura aequatoris* collected at Chijchijpa, La Paz, Bolivia. The new record represents a substantial latitudinal extension in the distribution of the species of 04°25' with respect to the southernmost known record from Pasco, Oxapampa, Perú. The phenetic variation of the herein presented new record of *A. aequatoris* is investigated through a principal components analysis performed on nine craniodental variables including all recognized species in the *A. caudifer* complex. Finally, comments on the taxonomy of the group are also presented.

**Keywords:** Nectar feeding bat; Distribution; Taxonomy; Latitudinal extension.

### Resumen

Se da a conocer el primer registro boliviano del murciélago nectarívoro filostómido *Anoura aequatoris* colectado en Chijchijpa, La Paz. El nuevo registro representa una extensión latitudinal considerable en la distribución de esta especie de 04° 25' con respecto al registro más austral conocido proveniente de Pasco, Oxapampa, Perú. Al tiempo, la variación fenética de los registros de la especie incluidos en este trabajo se investiga a través de un análisis de componentes principales realizado con nueve variables craneodentales incluyendo todas las especies reconocidas en el complejo *A. caudifer*. Finalmente, se adicionan comentarios sobre la taxonomía del grupo.

**Palabras clave:** Murciélago nectarívoro; Distribución; Taxonomía; Extensión latitudinal.

### Introduction

Until 1960 (Handley 1960), the genus *Anoura* (Phyllostomidae: Choeronycterini) comprised three relatively wide distributed species: *A. caudifer*, *A. cultrata*, and *A. geoffroyi*. Cabrera (1957) recognized two geographic variants within *A. caudifer*, the smallest representative of the genus: *A. c. caudifer* (Geoffroy St. Hilaire 1818), type locality in Rio de Janeiro, Brazil (22° 53'60" S, 03°13'60" W) distributed from Colombia to Brazil and *A. c. aequatoris* (*Lonchoglossa wedii aequatoris*, Lömberg 1921), described from Ilambo (=Illambo) Gualea, western

Ecuador (00°7'00"N, 78°44'00"W) at 1,512 m, distributed across Colombia, Ecuador, and Perú.

Although Tamsitt and Valdivieso (1966) suggested that small representatives of the genus from throughout South America belonged to a single species with no geographic variants, recent taxonomic revisions of museum voucher specimens of small representatives of the genus *Anoura* revealed a greater taxonomic diversity, partially associated with geographic and ecological structure (Mantilla-Meluk and Baker 2006, 2010). As a result, the genus *Anoura* currently consists of ten species (Mantilla-Meluk and Baker 2010) three of them previously

<sup>1</sup> Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia. e-mail: hugo.mantilla@gmail.com  
<sup>2</sup> Universidad Mayor de San Simón, Centro de Biodiversidad y Genética, Cochabamba, Bolivia. e-mail: laguirre@fcyt.umss.edu.bo  
<sup>3</sup> Grupo de Investigación en Manejo de Fauna Silvestre Chocoana, Programa de Biología con Énfasis en Recursos Naturales, Universidad Tecnológica del Chocó «Diego Luis Córdoba», Quibdó, Colombia. e-mail: alexmauriciojimenez@gmail.com  
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**Figure 1.** Skull and mandible of *Anoura aequatoris* male specimen MSB 68350 collected at Chijchijpa, La Paz, Bolivia and *A. caudifer* male specimen MSB 70292 from Cochabamba, 12 km SW of Villa Tunari, Bolivia reported by Anderson (1997).

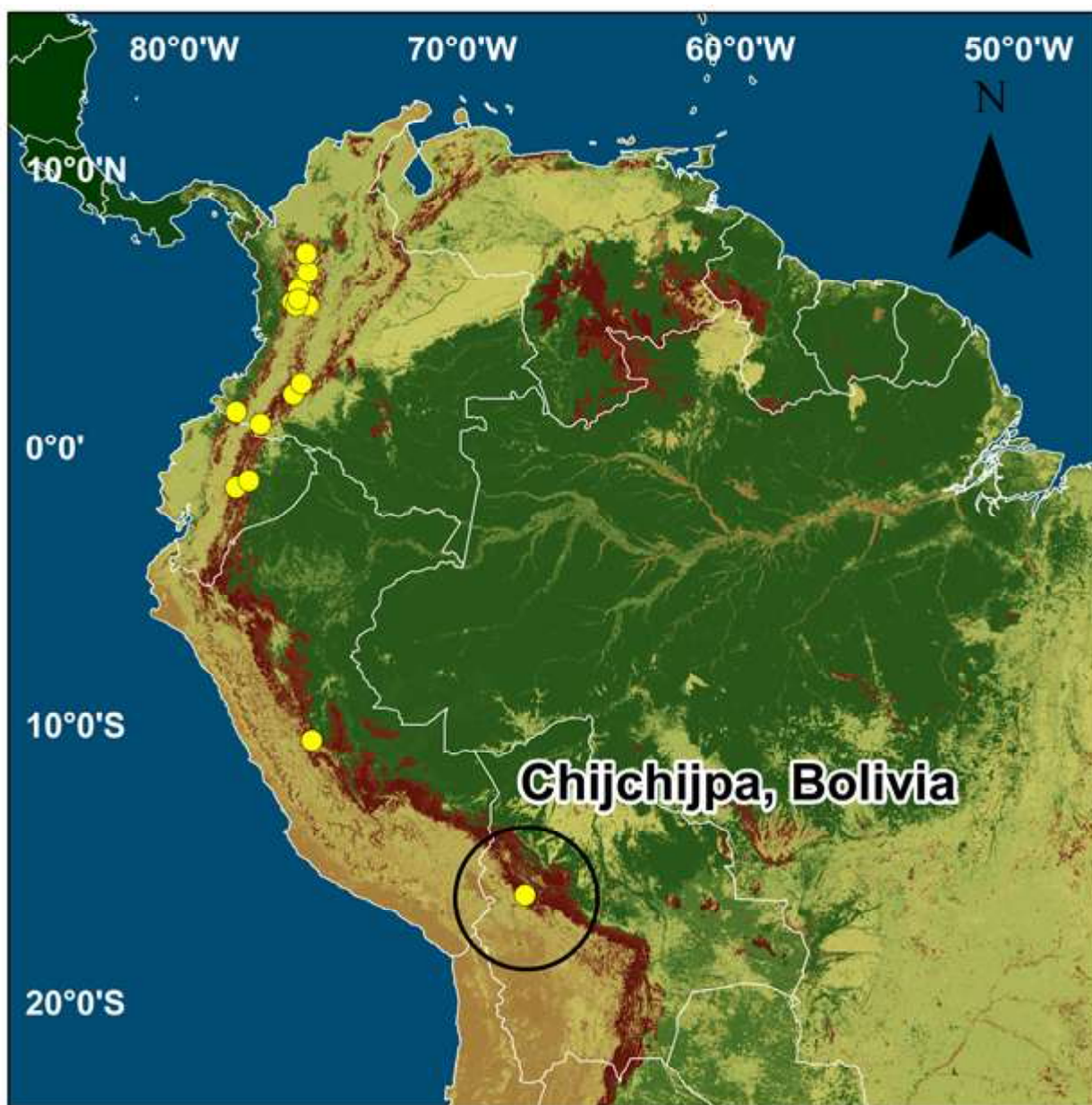
contained within *A. caudifer*: *A. cadenai* Mantilla-Meluk and Baker 2006, *A. fistulata* Muchhala *et al.* 2005, and *A. luismanueli* Molinari 1994. In addition, Mantilla-Meluk and Baker (2006), elevated *A. c. aequatoris* to the specific level and extended the distribution of this taxon across the Central and Western Cordilleras of the Colombian Andes, with the northernmost limit of the species represented by a specimen collected in Cocorná, department of Antioquia, Colombia (06°57'00"N, 75°35'00"W), deposited at the Instituto de Ciencias Naturales of the Universidad Nacional de Colombia (ICN) (ICN 9763). Pacheco *et al.* (2009) agreed with Mantilla-Meluk and Baker (2006) and reported *A. aequatoris* from the Peruvian yungas from a specimen collected at Pasco, Oxapampa, San Alberto, Parque Nacional Yanachaga Chemillén and deposited at the Museo de la Universidad de San Marcos (MUSM 14915-16) which constitutes the southernmost known record of the species. Species richness in *Anoura* has

been historically associated with the mountainous system of the northern Andes in Colombia where all recognized species in the genus have been documented (Mantilla-Meluk *et al.* 2009). Species diversity in *Anoura* gradually decreases southward, being the Andes of Bolivia the southernmost range of highland representatives of the genus (Mantilla-Meluk and Baker 2010). Currently, four species of *Anoura* have been documented for Bolivia *A. caudifer*, *A. cultrata*, *A. geoffoyi* (Aguirre 2007), and *A. peruana* (Mantilla-Meluk and Baker 2010).

As product of a recent revision of *Anoura* specimens deposited at the Southwestern Biology Collection of the University of New Mexico (MSB) we found a specimen misidentified as *A. caudifer* matching the cranial characters described for *A. aequatoris* (Lönnberg 1921) constituting the first documented record of this taxon for Bolivia.

**First Bolivian record of *Anoura aequatoris* (Lönnberg 1921).** Male specimen MSB 68350, collected at Chijchijpa, 1224 m; 16°09'00" S, 67°44'00" W (Figure 1), on July 6, 1992 by the Bolivian Expedition party 1992; preserved as skin, partially broken skull, and postcranial skeleton in good conditions, with frozen heart and kidney tissues associated and identified with catalogue number NK 25254.

To characterized the phenetic variation of the herein presented Bolivian *A. aequatoris* record, two Principal Components Analysis (PCA) were performed for nine craniodental variables recorded as follows: PCA 1: performed on 21 male specimens of *A. aequatoris* including representatives of this taxon from: Bolivia (n=1), Colombia (n=12), and Ecuador (n=8); PCA 2: performed on a selected group of 54 male specimens representing all small recognized species in the *A. caudifer* complex (*A. aequatoris*, n=21; *A. cadenai*, n=4; *A. caudifer*, n=18; *A. fistulata*, n=1; *A. luismanueli*, n=10). Analyzed variables include: palatal length (PAL); rostral width (RW); postorbital constriction (PO); mastoid breadth (MB); distance across upper canines (C-C); distance across third upper molars (M-M); tooth row length (TR); length of the mandible (ML), and length of the mandibular tooth row (ManTR). All variables were log-transformed and statistical analyses were performed in the statistical package PAST, available at <http://folk.uio.no/ohammer/past/index.html>. Since



**Figure 2.** Collecting localities of *Anoura aequatoris* analyzed specimens, including the herein presented first record of this taxon for Bolivia represented by specimen MSB 68350, collected at Chijchijpa, La Paz, Bolivia at 1,224 m (16°7'00" S, 67°44'00" W).

skull of specimen MSB 68350 from Bolivia is partially damaged (Figure 2), greatest length of skull (GLS) and condylo-basal length (CB) were not included in the PCA. However, averages of GSL and CB are reported for the rest of analyzed *Anoura* species in Mantilla-Meluk and Baker (Table 4, p. 13 2006); for description of the measurements see Mantilla-Meluk and Baker (2010, p.3). Craniodental measurements were taken in millimeters to the

nearest 0.1 mm with a dial caliper Mitutyo Absolute Snap series 573.

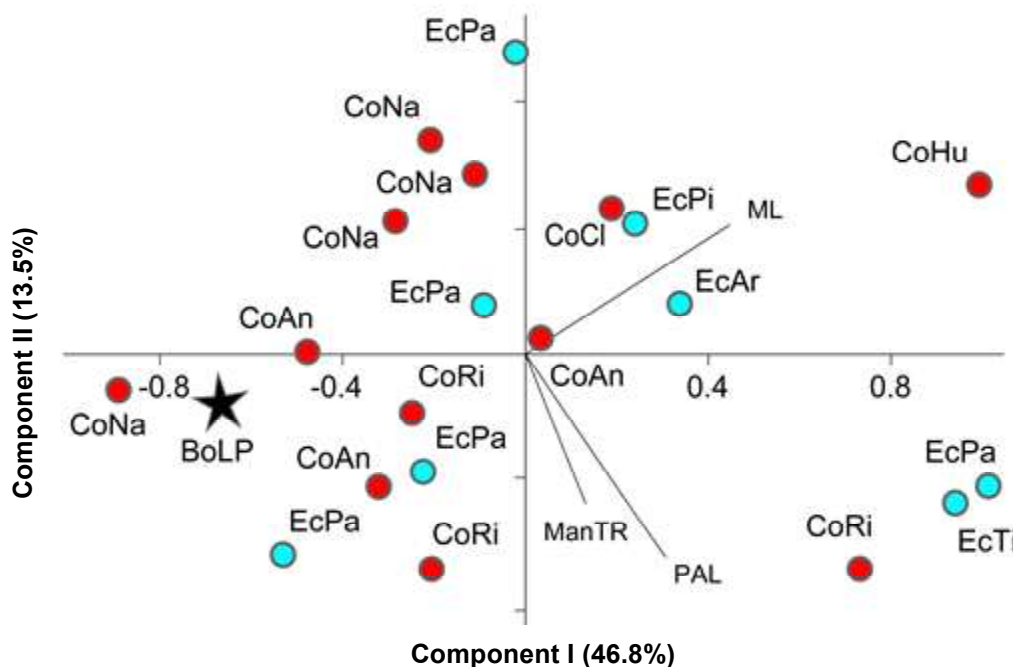
**Skull comparisons.** *Anoura aequatoris* specimen MSB 68350 has the typical enlarged anteroexternal cusp and a reduced associated cristid on the first upper molar, characters identified as synapomorphies of the *A. caudifer* complex (Griffiths and Gardner 2008; Mantilla-Meluk and Baker 2010, Figure 8, p. 15). This character differentiates *A. aequatoris* from

*A. carishina*, *A. geoffroyi*, and *A. peruana* (Mantilla-Meluk and Baker 2010). Additionally, as different from *A. peruana* and *A. latidens*, *A. aequatoris* has complete zygomata (Figure 2). In *A. aequatoris* specimen MSB 68350, the upper canines have a smooth anterior face with no sulci and the first lower premolar is not enlarged and bladelike shape as in *A. cultrata* (Handley 1960). Skull measurements of the specimen are smaller than that in typical *A. caudifer* and falls within the morphometric ranges reported for *A. aequatoris* and *A. lusimanueli*, (Lömmberg 1921, Mantilla-Meluk and Baker 2006). The dentary is robust and curved contrasting the straight and slender dentary of *A. cadenai*, *A. caudifer* from Brazil and *A. fistulata*. Finally, the mandible lacks the characteristic protrusion at the mandibular suture (mandibular keel) present in *A. fistulata* (Mantilla-Meluk and Baker 2006, Figure 6, p. 12).

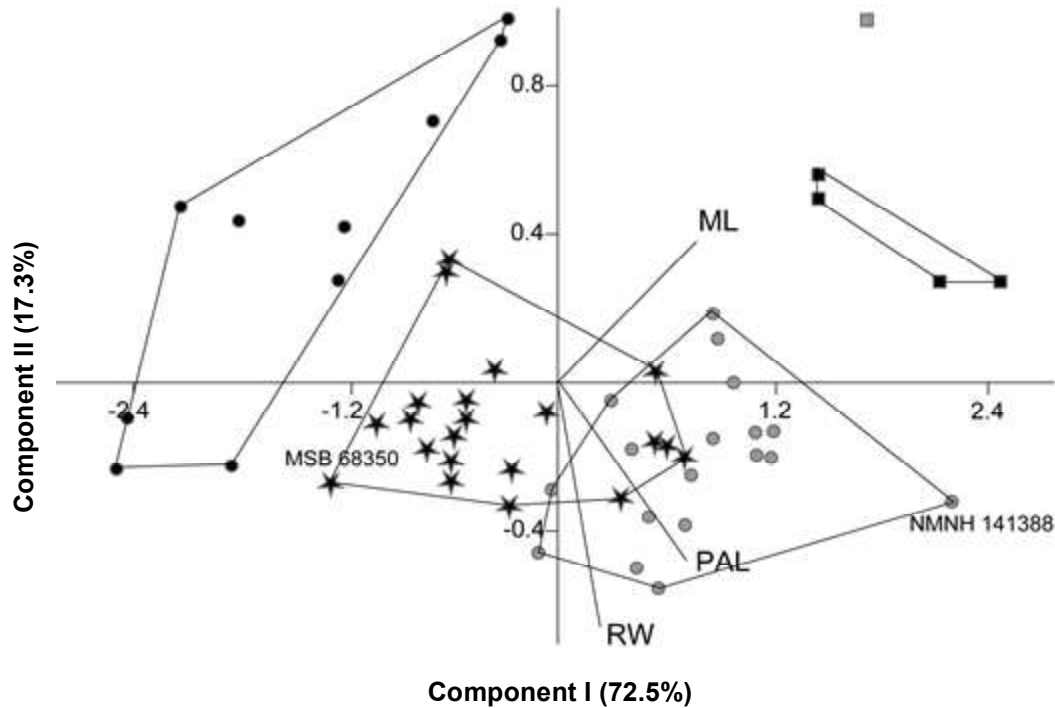
**Morphometric analyses.** In our PCA 1, the first two components accounted for most of the observed skull variation among analyzed specimens of *A. aequatoris* (Component I 46.8%; Component II 13.7%) with all variables showing positive loading in the first component indicating differences in size.

Specimen MSB 68350 from Chijchijpa, Bolivia presented similar loadings of those associated with *A. aequatoris* specimens from the Colombian department of Antioquia at the northernmost extreme of the distribution of the species (Figure 3).

In our PCA 2, including all recognized taxa within the *A. caudifer* complex (*sensu* Mantilla-Meluk and Baker 2010), the first two components accounted for most of the variation (Component I 72.5%; Component II 7.3%) with all variables associated with positive loadings in the first component, indicating differences in size among analyzed specimens. In PCA2, the largest species *A. cadenai* and *A. fistulata* were clearly discriminated in the morphospace, while *A. caudifer* and *A. aequatoris* showed some degree of overlap in skull size. The smallest representatives of the genus *A. aequatoris* and *A. lusimanueli* did not overlap in the morphospace of our PCA 2 (Figure 4). The documented overlap between *A. caudifer* and *A. aequatoris* can be associated with the no inclusion of GSL and CB in the analysis due to skull damages in specimen MSB 68350, as well as the use of fewer variables in comparison with other analyses that have



**Figure 3.** Principal components analysis performed for nine craniodental variables of 21 *Anoura aequatoris* specimens from localities in Bolivia (black star): La Paz (BoLP); Colombia (red circles): Antioquia (CoAn); Caldas (CoCl); Huila (CoHu); Nariño (CoNa); Risaralda (CoRi); and Ecuador (blue circles): Arajuno (EcAr); Pastaza (EcPa); Pchincha (EcPi); Tiguino (EcTi). Vectors with the greatest loadings: palatal length (PAL); mandibular length (ML); and mandibular tooth row (ManTR).



**Figure 4.** Principal components analysis performed for nine craniodental variables of 54 selected specimens representing all recognized species within the *A. caudifer* complex: *A. aequatoris* (stars, including specimen MSB 68350 from Chijchijpa, Bolivia); *A. cadenai* (black squares); *A. caudifer* (grey dots, including specimen NMNH 14388 collected at Minas Gerais, Brazil); *A. fistulata* (grey square); and *A. luismanueli* (black dots). Abbreviations of vectors contributing to the observed variation in skull measurements: mandible length (ML); distance across upper third molar (M-M); palatal length (PAL); and rostral width (RW).

shown greater resolution between these two taxa (Mantilla-Meluk and Baker 2006, 2010; Mantilla-Meluk *et al.* 2009). As a remarkable result, *A. caudifer* specimen NMNH 141388 (PAL = 13.0 mm), from Minas Gerais, Brazil, appeared to be closely related in size with *A. cadenai*. Specimen NMNH 141388 has the typical enlarged anteroexternal cusp and a reduced associated cristid on the first upper molar, characters identified as synapomorphies of the *A. caudifer* complex (Griffiths and Gardner 2008; Mantilla-Meluk and Baker 2010 Figure 8, p. 15), separating *Anoura* specimen NMNH 141388 from *A. carishina*, *A. geoffroyi*, and *A. peruana* (Mantilla-Meluk and Baker 2010). Additionally, as different from *A. peruana* and *A. latidens*, *Anoura* specimen NMNH 141388 has complete zygomata, and a well-developed uropatagium with a fringe of hairs on its edge. Further analyses are necessary to determine the taxonomic affinities of small *Anoura* specimens from Brazil.

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## Appendix I

**Analyzed specimens.** Analyzed specimens not included in our PCA analysis are marked by an asterisk (\*). The acronyms of institutions: Field Museum of Natural History (FMNH); Instituto de Ciencias Naturales (ICN); Southwestern Biology Collection of the University of New Mexico (MSB); and National Museum of Natural History, of the Smithsonian Institution (NMNH).

*Anoura aequatoris*: BOLIVIA: La Paz, Chijchijpa, MSB 68350 ♂; COLOMBIA: Antioquia; Andes, Vereda Soledad, Finca Reina ICN 16501 ♂; Medellín, Parque Regional Aruí, La Aguada, ICN 18045 ♂; Jericó, Parque Regional Las Nubes, Bosque La Cascada, ICN 18050 ♂; Caldas; Manizales, Quebrada Guayabala, Jardín de Mariposas, Recinto Pensamiento, Maltería, ICN 16729 ♂; Huila, Belén, Hacienda Meremberg, ICN 7615 ♂, Pitalito, ICN 7616 ♂\*; Nariño; Barbacoas, Altaquer, ICN 13636 ♂, La Victoria, FMNH 113502-04 ♂; Llorente, El Carmen, Oleoducto, FMNH 113610 ♂\*, FMNH 113613 ♂\*, FMNH 113616 ♂\*, FMNH 113511 ♂\*; Risaralda; Mistrató, Quebrada San Antonio, ICN 12296 ♂, Vereda Empalado km 12 Carretera Mistrató-San Antonio del Chamí, ICN 12536 ♂; Pueblo Rico, Camino a la Bocatoma, ICN 11460 ♂, ICN 11462 ♂\*; Santuario, Vereda El Campamento, ICN 11832 ♂\*; ECUADOR: Arajuno, NMNH 548074 ♂, Pastaza, Mera NMNH 548070 -72 ♂, NMNH 548078-80 ♂; Pichincha, Zapadores, Rio Saloya, NMNH 513436 ♂, Tiguino 1, NMNH 574512 ♂. *Anoura cadenai*: COLOMBIA: Valle del Cauca, Calima (ICN 9152 -54 ♂); Pance, ICN 8893 ♂. *Anoura caudifer*: BOLIVIA: Cochabamba, 12.5 KM SW Villa Tunari, Cavernas de Repechón, Parque Nacional Carrasco, MSB 70292 ♂; Santa Cruz, 1 km NE Estancia Cuevas, MSB 67062 ♂\*; BRAZIL: Amazonas, Camanãos, Rio Negro, NMNH 256290 ♂; Minas Gerais, Sete Lagoas, 3 Mi ESE, NMNH 391044 ♂, Para, Altamira, NMNH 549370 ♂; Rio de Janeiro, FMNH 34064 ♀, Terezopolis, 20 Km E, NMNH 282162 ♂; São Paulo, FMNH 14596 ♂, FMNH 92990 ♂, FMNH 92994 ♂, FMNH 94694-96 ♂, FMNH 94701 ♂, FMNH 141597 ♂; São Sebastião, NMNH 141388 ♂; VENEZUELA: Barinas, Altamira, NMNH 419452 ♂, NMNH 419454-55 ♂, NMNH 419461 ♂. *Anoura fistulata*: COLOMBIA: Cauca, Génova, Municipio de Colón, ICN 19653 ♂. *Anoura luismanueli*: COLOMBIA: Cundinamarca; Tena, Pedro Palo, 2000 m, ICN 5493 ♂; Santander; Charalá, Virolín, left margin Oibita River, ICN 6603 ♂, ICN 6605-06 ♂, ICN 6608 ♂, ICN 8123 ♂, ICN 8981 ♂, ICN 15295 ♂\*; El Encino, ICN 17522\* ♂, ICN 17524\* ♂; VENEZUELA: Mérida, Cueva Del Salado, Bailadores, 4 Km E, NMNH 581898-99 ♂.