Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 16 (5): 1337–1341
https://doi.org/10.15560/16.5.1337

PENSOFT

First records of Peruvian Toro, *Toromys rhipidurus* Thomas, 1928 (Rodentia, Echimyidae), in Colombia

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Abstract
Although taxonomy, ecology, and natural history information of the arboreal spiny rats is available, many gaps in some species distribution still exist. We report here the first records of the Peruvian Toro, *Toromys rhipidurus* (Thomas, 1928), in southern Colombia. This arboreal spiny rat was only known from the Peruvian Amazonia. These new records extend the known geographical distribution of the species by about 61 km northward from its nearest known locality, at Río Yavarí, Peru. In addition, we provide some notes on the natural history of the species.

Keywords
Arboreal rodents, Amazonia, Puerto Nariño, Tarapoto Lake.

Academic editor: Diego Astúa | Received 4 March 2020 | Accepted 13 September 2020 | Published 12 October 2020

Citation: Lozano-Flórez J, Cifuentes-Acevedo S (2020) First records of Peruvian Toro, *Toromys rhipidurus* Thomas, 1928 (Rodentia, Echimyidae), in Colombia. Check List 16 (5): 1337–1341. https://doi.org/10.15560/16.5.1337

Introduction

Neotropical spiny rodents are the group with the greatest diversity in shapes and habits of current hystricomorphic rodents due to their rapid radiation in America (Carvalho and Salles 2004; Emmons 2005). The greatest cladogenesis that gave rise to the current genera probably occurred approximately between 14 and 8 Ma in the Miocene (Leite and Patton 2002; Courcelle et al. 2019). The family Echimyidae is divided into four monophyletic subfamilies (Courcelle et al. 2019), but arboreal rats are considered a paraphyletic group (Loss et al. 2014; Upham and Patterson 2015). Arboreal Echimyidae rodents are poorly known in many aspects, such as their biology, ecology, and natural history; in addition, they are poorly sampled and under-represented in biological collections (Patterson and Velazco 2008).

The genus *Toromys* Iack-Ximenes, de Vivo & Percequillo, 2005 (Echimyidae, Echimyinae) has a restricted distribution in riverine forests along the line of the Central Amazonian region and the lower reaches of its tributaries in Brazil and Peru (Emmons et al. 2015; Emmons and Fabre 2018). This genus includes three species: *T. grandis* Wagner, 1845, distributed in the Brazilian Amazonia with 16 known localities along both sides of the lower Rio Amazonas, from near its confluence with the Rio Negro to Ilha Caviana at its mouth (Emmons et al. 2015); *T. albiventris* Emmons & Fabre, 2018, which has been recently described and is known from two localities in Peru, "Yarinacocha" and "Suaya" (Emmons and Fabre 2018); and *T. rhipidurus* Thomas, 1928 known only from northern Peru in the western Amazon Basin (Emmons et al. 2015).

Despite the distribution of *T. rhipidurus* at the north-

ern Peruvian Amazon, it has never been recorded in Colombia (Fig. 1). Here we present the first record of *T. rhipidurus* in Colombia including some notes on its natural history.

Methods

In January 2014, the researcher Andrés Acosta-Galvis observed three arboreal rats, identified as "Kono-Kono" by the community, during an expedition around the Tarapoto Lake, Colombia (Fig. 1). He took geographic coordinates using a GPSMap® 62sc Garmin. Also, he shared a photograph in the citizen science application iNaturalist (https://www.inaturalist.org/observations/6311838) and shared other photos and information with us. Arboreal rats were clung over the branches of trees apparently from the Polygonaceae family, around two meters over the boat. The habitat was a flooded *Várzea* forest into Tarapoto Lake near the Amazon River. To identify the species, we compared external traits of the rats observed in the pictures with the other species of the Echimyidae family, based on Emmons and Fabre (2018) and Emmons et al. (2015). To show the distribution of this species, we plotted the localities provided by Emmons and Fabre (2018), for specimens from Peru, and the new records for Colombia (Table 1; Fig. 1) using QGIS 3.6 (QGIS 2020).

Results

Family Echimyidae
Subfamily Echimyinae

***Toromys rhipidurus* (Thomas, 1928)**
Peruvian Toro

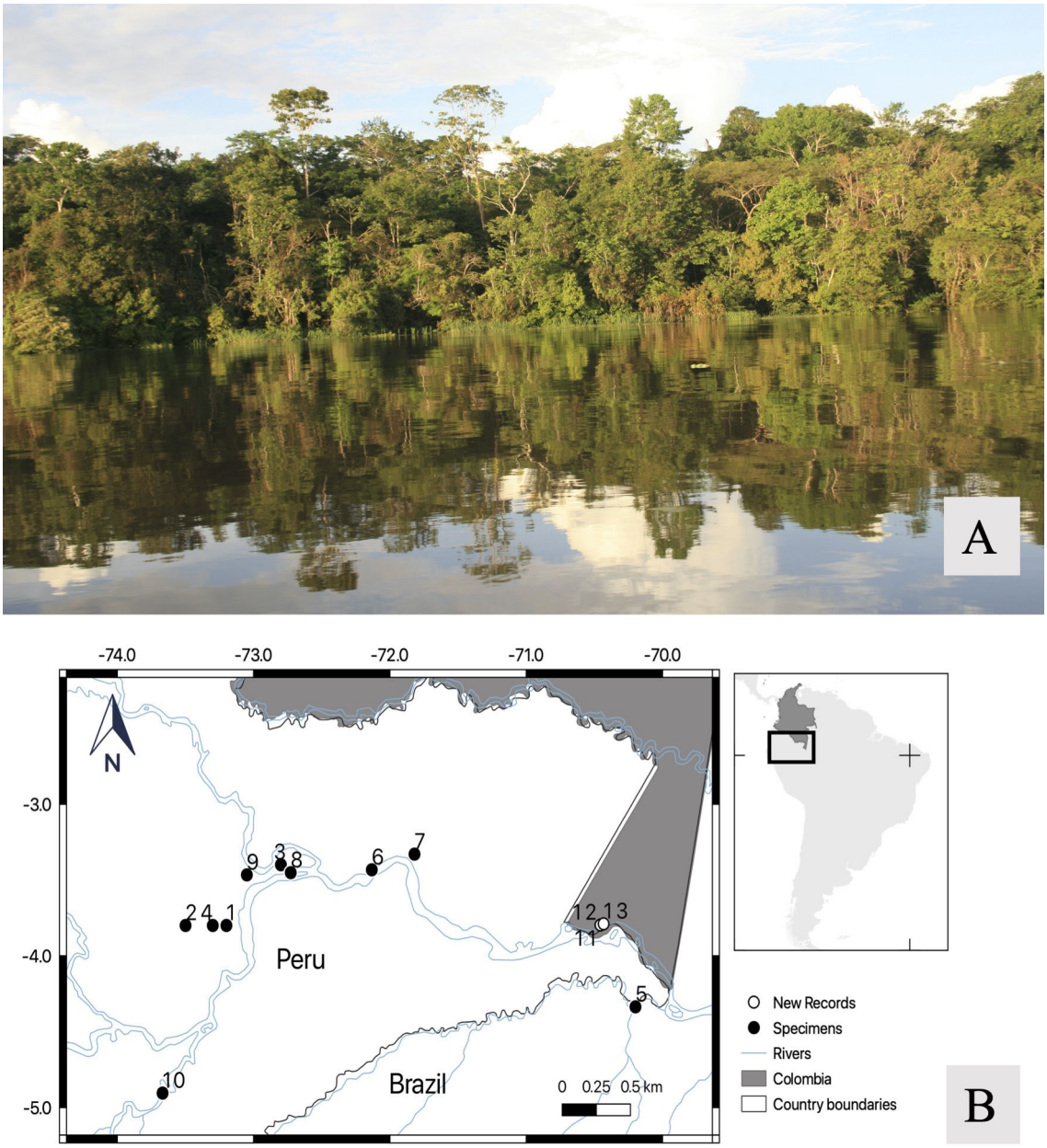

Figure 1. Habitat and records of *Toromys rhipidurus* in Peru and Colombia. **A.** Cochalarga, Tarapoto Lake, Puerto Nariño, Colombia. **B.** Historical records of Peruvian Toro in Peru (1–10) and new records in Colombia (11–13). Photograph: Andrés Acosta-Galvis.

Table 1. Historical localities of *Toromys rhipidurus*, Peruvian Toro, specimens in Peru (1–10) from Emmons and Fabre (2018) and three new records from Colombia (11–13).

	Locality	Latitude	Longitude
1	Loreto: Iquitos, Pampa Chica	−03.8	−073.2
2	Loreto: Río Nanay, Santa Rita	−03.8	−073.5
3	Loreto: Río Manití, Santa Cecilia	−03.4	−072.8
4	Loreto: Quistococha	−03.8	−073.3
5	Amazonas: Nazareth, Río Yavary (opposite Remate de Males, Brazil)	−04.3366	−070.1983
6	Loreto: Orosa	−03.433	−072.133
7	Loreto: Pebas	−03.33	−071.82
8	Loreto: Boca Mazán	−03.4520	−072.7279
9	Loreto: Puerto Indiana	−03.4667	−073.0500
10	Loreto: Jenaro Herrera	−04.9056	−073.6686
11	Amazonas: Puerto Nariño, Lago Tarapoto	−03.7975	−070.4557
12	Amazonas: Puerto Nariño, Lago Tarapoto	−03.7970	−070.4551
13	Amazonas: Puerto Nariño, Lago Tarapoto	−03.7893	−070.4321

New records. COLOMBIA • 1; Amazonas Department, Puerto Nariño, Tarapoto Lake, area of the lake locally known as "Cochalarga"; −03.7975, −070.4557; 76 m a.s.l.; 21 January 2014, 20:10 h; Andrés Acosta-Galvis (photographic evidence). • 1, same locality; −03.7970, −070.4551; 76 m a.s.l.; same date, 20:43 h; same observer (photographic evidence). • 1 juvenile; same locality; −03.7893, −070.4321; 76 m a.s.l.; same date, 22:16 h; same observer (photographic evidence).

Identification. The three arboreal rats in the photos are two adults and one juvenile. They have a dorsal pelage yellow-brown agouti with fine black bristles. The sides are more yellowish-grizzly than the dorsum. Underparts are whitish–gray with some parts in yellow, and contrast with the dorsal pelage (Fig. 2). Dark and long vibrissae and rust color on the rostrum. The ears are dark with a yellow-cream postauricular patches. The tail is furry, black with a rusty base (lightly sighted in the juvenile individual). Feet are grayish above, and the plantar foot is dark brown. The traits and color pattern of the spiny rats in the photos match the description and photographs of the Peruvian Toro, *T. rhipidurus*, in Emmons and Fabre (2018).

Toromys rhipidurus can be differentiated from its Amazonian congeners by the size and pelage color, *T. grandis* is bigger and has dark, soft pelage on the whole body, including the feet (Iack-Ximenes et al. 2005). Also, *T. albiventris* has pronounced white underparts, the dorsum is brown–agouti with rusty behind the shoulders to rump, and the feet are grayish-brown above; this species is only known from two localities, "Yarinacocha" and "Suaya", on the Ucayali River in Perú (Emmons and Fabre 2018). Similarly, *T. rhipidurus* differs from other genera within Echimyidae, including *Makalata* Husson, 1978 and *Dactylomys* I. Geoffroy Saint-Hilaire, 1838, which have their tail with short and black hairs exposing the skin. *Dactylomys dactylinus* Desmarest, 1817 is an arboreal larger rodent with soft pelage and a dorsal coloration grayish and orange on the posterior legs (Emmons et al. 2015). Also, the rust color on the rostrum does not extended above or posterior to the eyes like in *Makalata* (Emmons and Fabre 2018). On the other hand, *Leiuromys occasius* Thomas, 1921 is similar in size but has a rusty pelage on the dorsum, with strong spines, and a bright buff ventral coloration. Other arboreal echimyids, like *Mesomys* Wagner, 1845, have a brown-yellow pelage with hard spines and a tail with rusty hairs and a tuft at the tip (Iack-Ximenes et al. 2005; Emmons et al. 2015). Species of *Isothrix* Wagner, 1845 are larger and have a long, hairy tail. *Isothrix bistriata* Wagner, 1845 and *I. negrensis* Thomas, 1920 have facial stripes and a bicolored tail. *Echimys saturnus* Thomas, 1928 has black

Figure 2. Specimens of *Toromys rhipidurus*, Peruvian Toro, from Colombia. **A, B.** Adult individuals. **C.** Juvenile individual. Photographs by Andrés Acosta-Galvis.

pelage with spines and a long, bicolored tail (Emmons et al. 2015). Finally, some common and not arboreal echimyid species in the Amazonia belong to *Proechimys* J.A. Allen, 1899. They have a larger rostrum, and the tail is not black and without longer pelage (Tirira 2007; Emmons et al. 2015).

Discussion

The new record of *Toromys rhipidurus* in Colombia extend the species distribution more than 61 km from the northernmost nearest locality from Peru (Amazonas, Nazareth, Río Yavarí). All localities for the species are flooded forests near rivers, as is the locality of this new report. In Colombia, Tarapoto Lake covers a wide area of *Várzea* and *Igapó* forests, with the influence of the white waters of the Amazon River and the black waters of the Loretoyacu and Atacuari rivers (Moreno-Aroncha 2014).

Toromys rhipidurus is considered by the International Union for Conservation of Nature (IUCN) as Data Deficient (Vivar and Patterson 2016), and its natural history is poorly known. As other arboreal echimyid rodents, *T. rhipidurus* is a nocturnal species that uses the canopy and hollow trees as refugees in water streams and flooded forests (Emmons and Feer 1997; Tirira 2007). Although no evidence (i.e., no voice recordings available yet), the local name "Kono-Kono" is probably an onomatopoeic sound of its calls. If *Toromys* has that kind of vocalization, it could be confused with the calls of Amazon Bamboo Rats, *Dactylomys dactylinus* (Desmarest, 1817), a species also recorded in the region by a specimen deposited in the Natural History Museum of the Universidad Distrital Francisco José de Caldas (MHN-UD-1462; Appendix).

Citizen science platforms, like iNaturalist, have been an important tool to record species. For example, the first live record of the Colombian Weasel, *Mustela felipei* Izor & de la Torre, 1978, which was recorded in a rural house's bathroom, allowed for an updated hypothesis of this species' distribution and suggested its potential presence in protected areas (De Roux et al. 2019). Despite the importance of the citizen science apps to record the distribution and natural history of the species, it is still necessary and important to continue the collection of voucher specimens. Specimens of this elusive species of arboreal rat can fill gaps of its known distribution, used to resolve phylogenetic relationships of echimyid rodents, and help answer other ecological questions. Complementary, passive monitoring such acoustic and camera trap surveys in the canopy will contribute to the better understanding of the ecology of these charismatic rodents. Thus, in addition of reporting this species in the list of the Colombian mammals (Ramírez-Chaves et al. 2019), this paper is an invitation to conduct surveys of mammals in the canopy. Combining all possible techniques aimed at collecting and documenting specimens, such additional surveys will contribute validated specimens, tissue samples, and a better understanding of the ecology of these rodents in the Colombian Amazon and Orinoco regions where the presence of echimyid rodents is poorly understood.

Acknowledgements

We thank Andrés Acosta-Galvis for providing and sharing the photographs and his information about the records, José Aguilar Cano for the identification of trees in photographs, and Carolina Gómez-Posada, Orlando Acevedo-Charry, and Zuania Colón for commenting on a previous version of the manuscript. We also thank all the reviewers that contributed to improving this manuscript. The Instituto de Investigación en Recursos Biológicos Alexander von Humboldt gave us the time and financial support to prepare and submit this manuscript.

Authors' Contributions

LFJ and CAS wrote the manuscript, and LFJ made the maps and figures.

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Appendix

Record of *Dactylomys dactylinus* (Desmarest, 1817), a species also recorded in Amazonas Department, Colombia. COLOMBIA • 1 male; Amazonas Department, Puerto Nariño, Valencia; −03.4817, −070.1856; 76 m a.s.l.; 17 November 2016; Abelardo Rodríguez Bolaños leg., ARB-462; MHN-UD-1462