New record and updated geographic distribution of *Anolis phyllorhinus* Myers & Carvalho, 1945

The genus *Anolis* (sensu lato) comprises a highly diverse group of arboreal lizards from tropical and subtropical America (Ávila-Pires 1995; Nicholson 2002), with more than 400 known species (Uetz & Hosek 2018), including several recently described (e.g., Velasco & Hurtado-Gomes 2014; Poe & Ryan 2017). Inside the South American clade *Anolis* (*Dactyloa*), a group of species is characterized by the presence of a large rostral proboscis in males (Williams 1979). The overall understanding on causes and functions of such structure is still incipient (Rodrigues et al. 2002), but recent studies indicate its use in social courtship, mating and agonistic interactions (Poe et al. 2012; Quirola et al. 2017), as is known for other lizards, e.g., the Madagascan *Furcifer rhinoceratus* (Gray, 1843) or the Sri Lankan *Ceratophora tennentii* Günther, 1861. Three anole species share the possession of a rostral proboscis: *Anolis laevis* Cope, 1876, *A. phyllorhinus* Myers & Carvalho, 1945 and *A. proboscis*, Peters & Orcés, 1956, however, they do not form a monophyletic group, as recent phylogenetic frameworks evidenced that this character evolved independently in these lineages (Prates et al. 2015).

Anolis phyllorhinus, the only proboscid anole endemic to Brazil, inhabits forested areas of central Amazonia at the southern Amazonas River (Ávila-Pires 1995; Ribeiro-Júnior 2015a), distributed from the right bank of the Madeira River to the left bank of the Tapajós River. This species differs from the sympatric and morphologically similar *A. punctatus* Daudin, 1802, besides the presence of the rostral proboscis in males, by some meristic and morphometric characters and different size and color pattern of the gular dewlap of males (Rodrigues et al. 2002). Despite the lengthy elapsed time since its description, there remains scarce information on the natural history, ecology and overall distribution range of this rarely observed lizard (Rodrigues et al. 2002; Prates et al. 2015), reasons that left the conservation status of the species unevaluated by the IUCN Red List of Threatened Species (IUCN 2018). Primary knowledge on the geographic range of *A. phyllorhinus* is based on one specimen from the type locality, in the lower Madeira River, Amazonas State (Myers & Carvalho 1945), and one specimen for Jacareacanga, in the left bank of the upper Tapajós River (Williams 1965). Almost 40 years later, eight specimens, including the first known female, were recorded in Aripuanã, Mato Grosso State (Rodrigues et al. 2002). In this same state, another four specimens of this lizard were recorded during a faunal rescue in the left bank of the Teles Pires River, a tributary of the Tapajós River (São-Pedro et al. 2009; R. N. Feio, pers. comm.). Aiming to improve this knowledge, here the authors present a new record for this lizard, representing the 15th known vouchered specimen after 68 years of its description, being the easternmost known locality of occurrence and first located in the right bank of the Tapajós River, Pará State, Brazil.

On 04 November 2013, one adult male (snout-vent length 81 mm) of *A. phyllorhinus* was recorded inside a pitfall trap (04°52’ S, 56°26’ W; municipality of Trairão; Fig. 1) as part of a long-term survey for amphibians and reptiles in the middle Tapajós River region, Pará State, Brazil (Moraes et al. 2016). This pitfall trap was located ca. 1.5 kilometers in a straight line to the Jamanxim River, one of the main trib-

Fig. 1: Adult male specimen of *Anolis phyllorhinus* MYERS & CARVALHO, 1945, recorded in the right bank of the middle Tapajós River, Pará State, Brazil (SVL 81.0 mm; INPA-H 39769), showing the characteristic rostral proboscis and reddish dewlap coloration.

utaries of the Tapajós River. The habitat is dominated by primary Terra Firme forest (never flooded by large river annual pulses), with high trees, open understory and low anthropogenic influence (Fig. 2). The individual of *A. phyllorhinus* was found dead inside the pitfall trap, collected under permits #066/2012 provided by Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), and deposited in the Collection of Amphibians and Reptiles of the Instituto Nacional de Pesquisas da Amazônia (INPA-H) under the accession number INPA-H 39769.

The specimen was identified as *A. phyllorhinus* through examination of its external morphology (WILLIAMS 1979; ÁVILA-PIRES 1995; RODRIGUES et al. 2002), since no other Brazilian lizard has this unique combination of characters (comparisons with

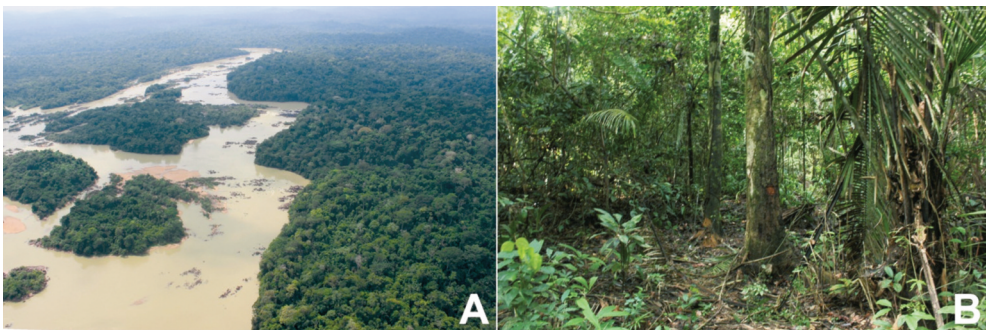

Fig. 2: Photographs from vicinities of the new locality of occurrence for *Anolis phyllorhynus* MYERS & CARVALHO, 1945. A – Aerial view of the Jamanxim River and its forested banks; B – Primary Terra Firme forest.

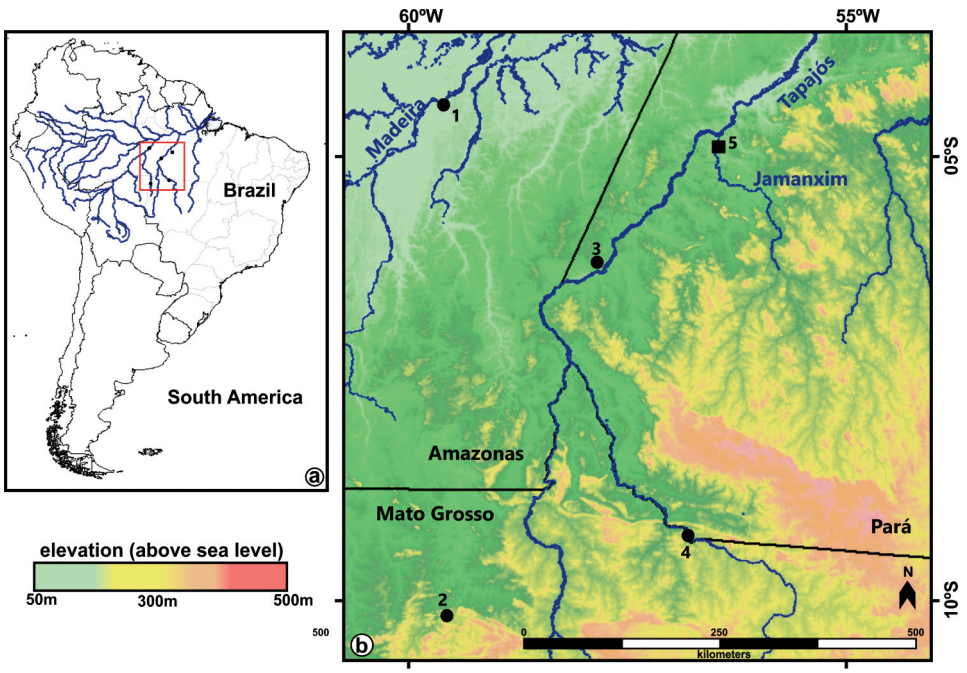

Fig. 3: Updated geographic distribution map of *Anolis phyllorhinus* MYERS & CARVALHO, 1945, in South America (a) and Southern Amazonia (b), with an elevational background. Dots: literature records. 1 - Lower Madeira River, Amazonas State (type locality: MYERS & CARVALHO 1945); 2 - Aripuanã, Mato Grosso State (RODRIGUES et al. 2002); 3 - Jacareacanga, Pará State (WILLIAMS, 1965); 4 - Left bank of the Teles Pires River, Mato Grosso State (SÃO-PEDRO et al. 2009). Square: new record. 5 - Right bank of the Jamanxim River, Pará State.

the sympatric and morphologically similar *A. punctatus* are shown in parentheses): rostral proboscis in males present (absent), gular dewlap of males small, bright red, with bluish-gray scales (large, color varying from orange, yellow or white, with green-yellowish or gray scales), anterior sublabial scales smooth and small (keeled and large), and number of post-rostral scales high [11] (low [5-9]). Also, *A. punctatus* was observed during the ca. 940 days of sampling on both banks of the middle Tapajós River, with 600 pitfall traps in operation for 600 days, and ca. 340 days of active surveys, being more commonly registered (14 records) than the rare *A. phyllorhinus* (only a single record, on the last sampling day). All vouchered females of green-colored *Anolis* were reviewed carefully through external morphology analyses, but none corresponded to *A. phyllorhinus*.

This new record extends the known geographic range of *A. phyllorhinus* to the east, being the first locality of occurrence on the right bank of the Tapajós River (Fig. 3), ca. 353 km southeast of the type locality in the lower Madeira River, Amazonas State (04°23'16" S, 59°35'38" W) (MYERS & CARVALHO 1945), 685 km northeast from the Aripuanã locality, Mato Grosso State (10° 15'03" S, 59°32'57" W) (RODRIGUES et al. 2002), 211 km northeast from the Jacareacanga locality, in the left bank of the Tapajós River, Pará State (06°12'24" S, 57° 49'28" W) (WILLIAMS 1965) and 493 km northeast from the second record in Mato Grosso State (09°20' S, 56°46' W) (SÃO-PEDRO et al. 2009).

With the new record and updated geographic distribution presented here, central southern Amazonia is emphasized as a relevant endemism region for *A. phyllorhinus*. Other species seem to share this distribution pattern and are mainly distributed throughout this region, including: *Tupinambis longi-*

lineus Ávila-Pires, 1995 (Ribeiro-Júnior & Amaral 2016), which was also recently recorded on the right bank of the Tapajós River (Moraes et al. 2017), *Loxopholis osvaldoi* (Ávila-Pires, 1995) (Ribeiro-Júnior & Amaral 2017), *Cercosaura anordosquama* Sturaro, Rodrigues, Colli, Knowles & Ávila-Pires, 2018 and one undescribed taxon of this genus (Ribeiro-Júnior & Amaral 2017), *Rondonops xanthomystax* Colli, Hoogmoed, Cannatella, Cassimiro, Gomes, Ghellere, Sales-Nunes, Pellegrino, Salerno, Marques De Souza & Rodrigues, 2015, and *Gonatodes tapajonicus* Rodrigues, 1980 (Ávila-Pires 1995; Ribeiro-Júnior 2015b). This region is characterized by the transition of two main geomorphological compartments, the western sedimentary basin of the Solimões-Amazonas River and the eastern Brazilian Cratonic Shield, which seems to affect the geographic distribution of Amazonian biota (Moraes et al. 2016) and may also have played a relevant role in the diversification of these lizards. Future biogeographic studies focusing on this issue can benefit by the choice of these target taxa.

Anoles are among the most prominent lizard groups known for restricted geographic distributions (Meiri et al. 2018), a characteristic that makes the taxa particularly sensitive to environmental changes and local extinctions (Purvis et al. 2000). The deficiency of herpetological surveys in the Amazon (Azevedo-Ramos & Galatti 2002; Oliveira et al. 2016), high morphological similarity of females with *A. punctatus* (Rodrigues et al. 2002), possible preference for canopy strata, or natural low abundances throughout the restricted range (Meiri et al. 2018), may be among the causes of the scarcity of data on the overall geographic distribution range of *A. phyllorhinus*. However, the continuously intensification of inventories in Amazonian remote areas may provide new localities of occurrence, helping to clarify its entire range and conservation status.

ACKNOWLEDGMENTS: The authors thank L. F. Storti, J. Cassimiro, J. O. Gomes, M. Hoffman, T. F. D. Rodrigues, J. M. B. Ghelere, A. B. Barros and E. S. Brito for help in sampling and CNEC Worley Parsons Engenharia S. A. (São Paulo), for financial and logistical support. The Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil) provided a scholarship to L. J. C. L. Moraes. Fernanda P. Werneck thanks financial support from CNPq (475559/2013-4), Fundação de Amparo à Pesquisa do Estado do Amazonas (FAPEAM-062.00665/ 2015), Partnerships for Enhanced Engagement in Research from the U.S. National Academy of Sciences and U.S. Agency of International Development (PEER NAS/ USAID PGA-2000005316), and L'Oréal-Unesco For Women in Science Program.

REFERENCES: Ávila-Pires, T. C. S. (1995) Lizards of Brazilian Amazonia (Reptilia: Squamata).- Zoologische Verhandelingen, Leiden; 299: 1-706. Azevedo-Ramos, C. & Galatti, U. (2002): Patterns of amphibian diversity in Brazilian Amazonia: conservation implications.- Biological Conservation, Barking; 103 (1): 103-111. IUCN - International Union for Conservation of Nature and Natural Resources (2018): The IUCN Red List of Threatened Species. WWW database available at < http://www.iucnredlist.org/ > [last accessed: August 10, 2018]. Meiri. S. & Bauer, A. M. & Allison, A. & Castro-Herrera, F. & Chirio, L. & Colli, G. R. & Das, I. & Doan, T. M. & Glaw, F. & Grismer, L. L. & Hoogmoed, M. & Kraus, F. & LeBreton, M. & Meirte, D. & Nagy, Z. T. & Nogueira, C. C. & Oliver, P. & Pauwels, O. S. G. & Pincheira-Donoso, D. & Shea, G. & Sindaco, R. & Tallowin, O. J. S. & Torres-Carvajal, O. & Trape, J-F. & Uetz, P. & Wagner, P. & Wang, Y. & Ziegler, T. & Roll, U. (2018): Extinct, obscure or imaginary: The lizard species with the smallest ranges.-Diversity and Distributions, Oxford, etc.; 24 (2): 262-273. Moraes, L. J. C. L. & Pavan, D. & Barros, M. C. & Ribas, C. C. (2016): The combined influence of riverine barriers and flooding gradients on biogeographical patterns for amphibians and squamates in south-eastern Amazonia.- Journal of Biogeography, Oxford; 43 (11): 2113-2124. Moraes, L. J. C. L. & Ribeiro-Júnior, M. A. & Pavan, D. (2017): *Tupinambis longilineus* Ávila-Pires, 1995 (Squamata, Teiidae): revised distribution of a rare Amazonian species.- North-Western Journal of Zoology, Oradea; 13 (2): 364-368. Myers, G. S. & Carvalho, A. L. (1945): A strange new leaf-nosed lizard of the genus *Anolis* from Amazonia.- Boletim do Museu Nacional-Zoologia, Rio de Janeiro; 43: 1-14. Nicholson, K. E. (2002): Phylogenetic analysis and a test of the current infrageneric classification of *Norops* (beta *Anolis*).- Herpetological Monographs, Lawrence; 16: 93-120. Oliveira, U. & Paglia, A. P. & Brescovit, A. D. & Carvalho, C. J. B. & Silva, D. P. & Rezende, D. T. & Leite, F. S. F. & Batista, J. A. N. & Barbosa, J. P. P. P. & Stehmann, J. R. & Ascher, J. S. & Vasconcelos, M. F. & Marco Jr., P. & Neto, P. L. & Dias, P. G. & Ferro, V. G. & Santos, A. J. (2016): The strong influence of collection bias on biodiversity knowledge shortfalls of Brazilian terrestrial biodiversity.- Diversity and Distributions, Oxford, etc.; 22 (12): 1232-1244. Poe, S. & Ayala, F. & Latella, I. M. & Kennedy, T. L. & Christensen, J. A. & Gray, L. N. & Blea, N. J. & Armijo, B. M. & Schaad, E. W. (2012): Morphology, phylogeny, and behavior of *Anolis proboscis*.- Breviora, Cambridge; 530, 1-11. Poe, S. & Ryan M. J. (2017): Description of two new species similar to *Anolis insignis* (Squamata: Iguanidae) and resurrection of *Anolis* (*Diaphoranolis*) *brooksi*.- Amphibian & Reptile Conservation, Berkeley; 11 (2): 1-16. Prates, I. & Rodrigues, M. T. & Melo-Sampaio, P. R. & Carnaval, A. C. (2015): Phylogenetic relationships of Amazonian anole

lizards (*Dactyloa*): Taxonomic implications, new insights about phenotypic evolution and the timing of diversification.- Molecular Phylogenetics and Evolution, Barking; 82: 258-268. Purvis, A. & Gittleman, G. L. & Cowlinshaw, G. & Mace, G. M. (2000): Predicting extinction risk in declining species.- Proceedings of the Royal Society of London, London; (Ser. B) 267 (1456): 1947-1952. Quirola, D. R. & Mármol, A. & Torres-Carvajal, O. & Narvaez, A. E. & Ayala-Varela, F. & Moore, I. T. (2017): Use of a rostral appendage during social interactions in the Ecuadorian *Anolis proboscis*.- Journal of Natural History, London; 51 (27-28): 1625-1638. Ribeiro-Júnior, M. A. (2015a): Catalogue of distribution of lizards (Reptilia: Squamata) from the Brazilian Amazonia. I. Dactyloidae, Hoplocercidae, Iguanidae, Leiosauridae, Polychrotidae, Tropiduridae.- Zootaxa, Auckland; 3983: 1-110. Ribeiro-Júnior, M. A. (2015b): Catalogue of distribution of lizards (Reptilia: Squamata) from the Brazilian Amazonia. II. Gekkonidae, Phyllodactylidae, Sphaerodactylidae.- Zootaxa, Auckland; 3981: 1-55. Ribeiro-Júnior, M. A. & Amaral, S. (2016): Catalogue of distribution of lizards (Reptilia: Squamata) from the Brazilian Amazonia. III. Anguidae, Scincidae, Teiidae.- Zootaxa, Auckland; 4205: 401-430. Ribeiro-Júnior, M. A. & Amaral, S. (2017): Catalogue of distribution of lizards (Reptilia: Squamata) from the Brazilian Amazonia. IV. Alopoglossidae, Gymnophthalmidae.- Zootaxa, Auckland; 4269: 151-196. Rodrigues, M. T. & Xavier, V. & Skuk, G. & Pavan, D. (2002): New specimens of *Anolis phyllorhinus* (Squamata, Polychrotidae): the first female of the species and of proboscid anoles.- Papéis Avulsos de Zoologia, São Paulo; 42 (16), 363-380. São-Pedro, V. A. & Costa, H. C. & Feio, R. N. (2009): A herpetofauna do AHE Dardanelos, Aripuanã, Mato Grosso. Viçosa (UFV - Universidade Federal de Viçosa), pp. 40. Uetz P. & Hošek J. (2017): The Reptile Database. WWW online database available at < http://www.reptile-database.org > [last accessed: July 10, 2018]. Velasco, J. A. & Hurtado-Gómez, J. P. (2014): A new green anole lizard of the "*Dactyloa*" clade (Squamata: Dactyloidae) from the Magdalena river valley of Colombia.- Zootaxa, Auckland; 3785 (2): 201-216. Williams, E. E. (1965): South American *Anolis* (Sauria, Iguanidae): two new species of the *punctatus* group.- Breviora, Cambridge; 233: 1-15. Williams, E. E. (1979): South American anoles: the species groups. 2. The proboscis anoles (*Anolis laevis* group).- Breviora, Cambridge; 449: 1-19.

KEY WORDS: Reptilia: Squamata: Dactyloidae: *Anolis phyllorhinus*, proboscid anoles, new record locality, Amazonia, Tapajós River, Pará State, Brazil

SUBMITTED: February 30, 2018

AUTHORS: Leandro J. C. L. Moraes (Corresponding author < leandro.jclm@gmail.com >) [1, 2], Fernanda P. Werneck [3] & Dante Pavan [2]

[1] Programa de Capacitação Institucional, Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil.

[2] Ecosfera Consultoria e Pesquisa em Meio Ambiente Ltda., São Paulo, SP, Brazil.

[3] Programa de Coleções Científicas Biológicas, Coordenação de Biodiversidade, Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil.