



# First record and distribution extension of *Agalychnis terranova* in the Montes de María, Colombia

Primer registro y extensión de distribución de *Agalychnis terranova* en los Montes de María, Colombia

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## Resumen

Presentamos un nuevo registro de la distribución de la rana arborícola de ojos rojos *Agalychnis terranova* para los Montes de María, en el departamento de Sucre, Colombia, ampliando su distribución 187,9 km en línea recta en dirección suroeste, desde su registro de distribución más al norte en la Sierra Nevada de Santa Marta en el departamento del Cesar y, 474,6 km al norte desde su localidad de ocurrencia más al occidente en el departamento de Chocó. Finalmente, proveemos comentarios del ámbito biogeográfico y perspectivas de investigación a partir de este nuevo reporte.

**Palabras clave:** Caribe; Cinturón árido pericaribeño; rana de ojos rojos, Sucre.

## Abstract

We report a new locality of occurrence of the red-eyed treefrog *Agalychnis terranova* in the Montes de María, in the department of Sucre, Colombia, which extends its distribution by 187.9 km southwest from its northernmost record in the Sierra Nevada de Santa Marta in the department of Cesar, and 474.6 km to the north from the westernmost locality in the department of Chocó. Finally, we make comments on the biogeography and research perspectives following this new record.

**Keywords:** Caribbean; Pericaribbean arid belt, red-eyed tree frogs; Sucre.

## 1. Introduction

*Agalychnis* Cope 1864, is primarily a Central American genus of tree frogs belonging to the monophyletic subfamily Phyllomedusinae [1,2]; it is distributed from México, south through Guatemala, Belize, El Salvador, Nicaragua, Costa Rica, Panamá and western Colombia and Ecuador. The first largest systematic analysis of this subfamily, performed by Faivovich et al. [2], grouped fourteen species within the genus *Agalychnis*, without morphological synapomorphies and only recognizable by means of molecular data; however, this hypothesis was revised by [1] based on a wider phylogenetic analysis of amphibians that suggested little support for the species content of the genus sensu Faivovich et al. [2]; therefore, [1] did not recognize the synonyms suggested by [2]; however, the hypothesis of [1] seems to have received little attention by the herpetological community in the further recognition of species within *Agalychnis*, and several of the species placed into the genus by [2] are still accepted. The most recent addition to the genus was through the discovery of *Agalychnis terranova* in Colombia, assigned to the mainly Central American *Agalychnis callidryas* group [3]. Later on McCranie et al. [4] resurrected the species *Agalychnis taylori*. We therefore follow [5], who presents the most updated content, based on all the available

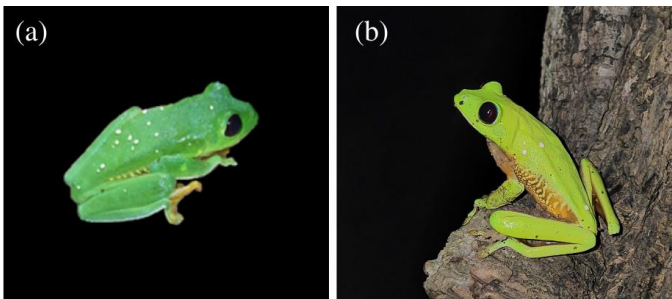
literature to date, and recognizes fourteen species within the genus.

*Agalychnis terranova* [3] is the only red-eyed tree frog yet recorded in the Magdalena river valley in Colombia; the two main synapomorphies that confirm it as an *Agalychnis* frog are the palpebral membrane reticulated with gold and the red iris [2], and the external morphological particularity that distinguishes it from any other species in the *A. callidryas* group is the orange colour of its flanks with small white warts (Fig. 1b) [3]. Furthermore, this is a nocturnal medium size slender frog, with green dorsum and whitish vent, and was first described from specimens collected in the Middle Magdalena river valley, in the departments of Antioquia (Sonsón) and Cundinamarca (Yapotí), occurring at localities characterized by tropical humid forest [3]. Later, *A. terranova* was reported inhabiting the humid tropical forest of the eastern cordillera in the department of Santander (San Vicente de Chucurí) [6], and the lowland rainforest of the Pacific coast, in the department of Chocó (Unión Panamericana - Salero) [7]. The most recent record of the species was in the Sierra Nevada de Santa Marta [8], inhabiting a disturbed dry forest in the department of Cesar (Valledupar - Villa Germania). The present communication documents a new occurrence of *A. terranova* and extends its

distribution to the west in the Caribbean hills of the Montes de María, department of Sucre, Colombia, and into a new biogeographical region, the Pericaribbean arid belt [9].

## 2. Methodology, results, and discussion

On the 29<sup>th</sup> of December 2021 between 19:00 hours and 20:00 hours researchers of the Grupo de Investigación Biología Evolutiva from the Universidad de Sucre, including JJD, observed an individual of *Agalychnis terranova* in the municipality of Chalán, department of Sucre (9.5886°N - 75.3425°W, at approximately 430 meters of elevation). The male frog was perched on the surface of a bitter palm leaf (*Sabal mauritiiformis*) near an artificial pond; the specimen was photographed but not collected (Fig. 1a). It is worth mentioning that, back in 2015, former members of the research group had mentioned about the presence of frogs matching the description of *A. terranova*, in the Estación Primatológica de CARSUCRE, municipality of Colosó, department of Sucre; however, they did not preserve specimens, nor did they photographed individuals to corroborate the taxonomic identification, therefore making it difficult to do a formal and verifiable report.



**Figure 1:** *Agalychnis terranova* in life in Montes de María, municipality of Chalán, Sucre, Colombia. Photographs: (a) Jhesteiner Julio-Dávila, specimen not collected and (b) Dilan Vergara-Comas, specimen collected (MZUSU-H00150).

After obtaining the permissions from the Environmental authorities (Agencia Nacional de Licencias Ambientales - ANLA and the Corporación Autónoma Regional de Sucre - CARSUCRE), we started searching for the species aiming to collect a specimen to finally corroborate its identification. In our most recent expedition to the Montes de María we visited the exact spot in the municipality of Chalán, Sucre (9.5886°N - 75.3425°W), where the specimen in Fig. 1a was observed, and this time we observed another individual of *A. terranova* at 20:30 hours on the 5<sup>th</sup> of May 2022, perched on a tree branch at approximately 3 meters from the ground. The specimen was photographed in situ (Fig. 1b) and collected by hand to confirm the morphological diagnostic characteristics of the *A. terranova* (see Tab. 1).

In the laboratory of the Grupo de Investigación Biología Evolutiva at the Universidad de Sucre, the specimen was euthanized by applying a solution of 1% Roxicaine cutaneously

in the dorsum. Hepatic tissue was extracted and stored in 95% ethanol for further studies and, finally, the specimen was fixed in a solution of 10% formaldehyde for 48 hours to be then preserved in 75% ethanol. In order to confirm the taxonomic identity according to the original description of the species [3] the following morphometric measurements (in millimetres to the nearest 0,1 unit) were taken using a digital calliper UBERMAN (error 0.001): SVL (snout–vent length), HW (head width), HL (head length), END (eye to nostril distance), ED (eye diameter), NSD (nostril to tip of snout distance), IND (internarial distance), AMD (distance between the anterior margins of eyes), TD (tympanum diameter), FAL (forearm length), FAB (forearm breadth), HAL (hand length), THL (thigh length), TBL (tibia length), TAL (tarsal length), FL (foot length), TFD (third finger disk diameter) and FFD (fourth toe disk diameter) Tab. 1.

**Table 1:** Diagnostic morphometric measurements (in mm) of *Agalychnis terranova* to compare our specimen MZUSU-H00150 with the male holotype [3]. Abbreviations are explained in the text. For the diagnostic values we present the min and max values from Rivera-Correa et al. [3].

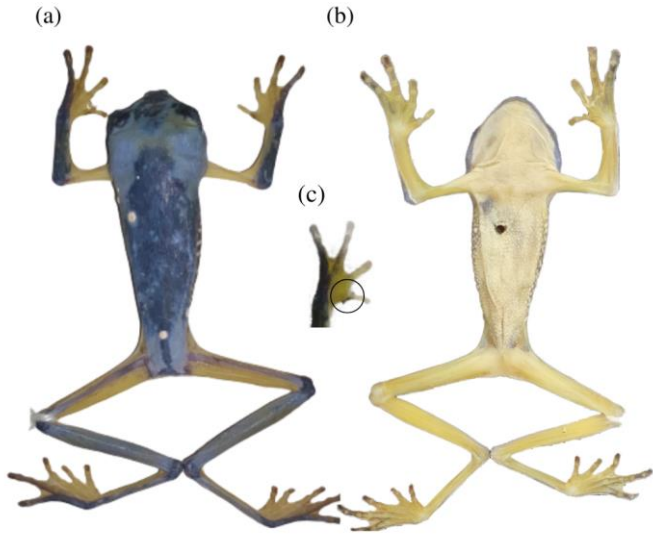
Measurement	Range for males	Holotype	MZUSU-H-00150
SVL	42.50 - 50.80	47.90	49.27
HL	13.90 - 18.90	15.20	14.41
HW	13.40 - 17.60	17.30	16.31
ED	4.60 - 5.90	5.20	5.04
END	4.20 - 5.10	4.60	4.68
NSD	1.80 - 2.70	2.30	2.19
IND	3.30 - 4.10	3.00	3.68
AMD	9.40 - 11.70	12.20	9.91
TD	2.30 - 3.40	3.90	2.29
FAL	9.80 - 13.00	*	12.59
FAB	3.10 - 4.50	*	3.47
HAL	12.00 - 13.90	*	13.04
THL	22.60 - 27.10	27.10	23.79
TBL	22.80 - 26.10	26.10	25.38
TAL	13.10 - 15.80	15.50	14.93
FL	15.20 - 18.90	17.80	16.45

\* These measurements were not available in Rivera-Correa et al. [3].

Additionally, the webbing formulae was checked and also followed [3]: fingers I ( $2^{1/2}-2^{2/3}$ ) -  $2^{1/2}$  II ( $2-2^+$ ) - ( $2^{2/3}-3$ ) III ( $3-3$ ) - ( $2^{1/2}$ ) IV and toes I ( $2-2^+$ ) - ( $2^{1/3}-2^{1/2}$ ) II ( $2-2^+$ ) - ( $3^+-3^{1/3}$ ) III ( $2-2^+$ ) - ( $3-3^+$ ) IV ( $3^{2/3}-3^+$ ) - ( $2-2$ ) V. The specimen and the liver tissue were deposited in the Museo Zoológico de la Universidad de Sucre (MZUSU) under collection number H00150.

We confirmed the identity of our specimen as being from the species *Agalychnis terranova* based on the morphometric measurements (Tab. 1, MZUSU-H-00150), and the webbing

formulae that was observed as follows: fingers: I  $2^{1/2}$ – $2^{2/3}$  II  $2$ – $2^+$  III  $2^{1/2}$ – $2^{2/3}$  IV and toes: I  $2^{1/3}$ – $2^{1/2}$  II  $2$ – $2^+$  III  $2$ – $2^+$  IV  $3^{2/3}$ – $3^+$  V; both sources of information are within the range for males of the species according to [3]. Furthermore, we suspected it was a male frog in the field based on calls we heard and followed to locate it (we ephemerally observed the vocal sacs the first time we detected the frog), and concluded it was a male by the presence of nuptial pads once it was collected (Fig. 2c).

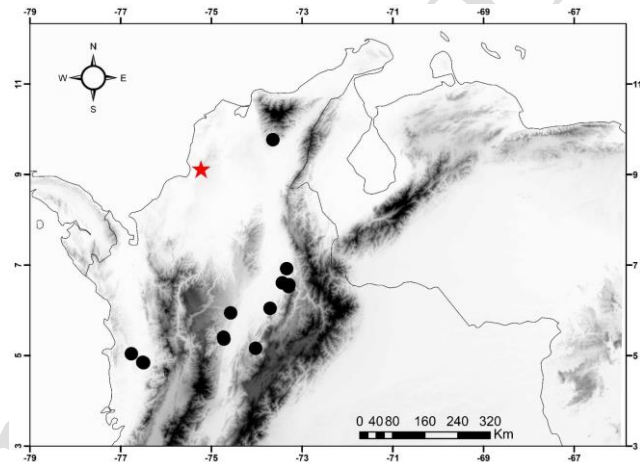


**Figure 2:** Specimen of *Agalychnis terranova* collected, preserved, and deposited in the Museo Zoológico de la Universidad de Sucre under catalogue number MZUSU–H00150: (a) dorsal view, (b) ventral view, and (c) zoom to the nuptial pad.

*Agalychnis terranova* was described from the holotype and paratypes collected in the departments of Antioquia and Cundinamarca [3], where it inhabits humid tropical forests along the middle Magdalena River valley, an inter Andean zone included in the Chocó–Magdalena biogeographic province [9]; additionally, it was recorded in the humid tropical forests of the department of Santander [6], yet again within the same biogeographic region. Later, the distribution of the species was extended to the department of Chocó [7], allowing to further support the hypothesis of a historical biogeographical relationship between the present-day regions comprising the Pacific lowlands of Chocó, and the middle and low Magdalena River valley [9]. The known distribution up until 2016 would suggest the species had close ecological affinity with the conditions particularly offered by humid tropical forests, and the humid climatic regime in general, as observed in the sister species *A. callidryas* in Mesoamerica [10,11].

However, the most recent distribution extension of the species in the department of Cesar, evidenced the capacity of the species to occur in dry forests [8], particularly those of the Sierra Nevada de Santa Marta, which represents another biogeographic region, the Macizo de la Sierra Nevada de Santa Marta [9], suggesting that *A. terranova* has a wider

environmental spectrum than previously thought; moreover, it is worth mentioning that very little has been studied on the ecology and reproduction of the species, to conclude on its specific requirements. Also, the latter record indicated the population occurs in a disturbed area, similar to what has been observed for the sister species *A. callidryas* in many localities of Mesoamerica [11], where this species is widely distributed and does not seem to be very demanding on the conservation status of the habitat for it to occur; although the size of its populations and their reproductive success could have a direct relationship with the type and structure of the forests [10,11].



**Figure 3:** Geographic distribution of *Agalychnis terranova* in Colombia: literature reports (circles) new record (red star).

Herein we present the first record of *A. terranova* in Montes de María, extending its known geographic distribution by 187.9 km straight-line to the southwest from its previous record in the department of Cesar [8], and 474.6 km to the north from the westernmost locality for the species in the department of Chocó [7] (Fig. 3). This new record is located within a new biogeographic region for the species, known as the Pericaribbean arid belt [9], specifically in the azonal enclave called Montes de María and Piojó that presents very particular environmental conditions, favouring endemism due to the need for adaptations to survive in a climatic regime and soil conditions that are not common in other areas of the Caribbean [9]; indeed, we observed a difference in vegetation cover and hydrological and environmental dynamics in the place we found this frog, and the high hills of Montes de María in general, compared to the other fragments of dry forest in Sucre. As in other localities known for the species, the Montes de María are also strongly affected by human activities, such as livestock and agriculture. Therefore, we highlight the urgent need to carry out studies focused on assessing the conservation status and impact of different stressors, particularly of anthropic activities, on the populations of *A. terranova*.

On the other hand, for the Caribbean region of Colombia two species of the genus *Agalychnis* (*A. terranova* and *A. callidryas*) have been recorded [8,12,13,14]. We made an exhaustive

search in the literature, databases and metadata in this respect aiming to corroborate the information, and found two investigations that reported the occurrence of *A. callidryas* in the department of Bolívar [12,13]; however, no visual evidence is presented, and only Romero and Lynch [13] mentioned in its supplementary material about the ICN catalogue numbers 13729 and 13730, as the voucher specimens of *A. callidryas* collected in the rural area of Matute, Bolívar; but, there is no access to these catalogue numbers in the ICN database, nor in SiB Colombia or GBIF, or any other data base available online, and specifically no information can be accessed for the ICN catalogue numbers between 13725 and 13750. In addition, there is a photographic field guide to the amphibians and reptiles of the Jardín Botánico Guillermo Piñeres (JBGP), located in the department of Bolívar, where *A. callidryas* was recorded using a photograph of a specimen from Costa Rica (guide available in: <https://fieldguides.fieldmuseum.org/es/guías/guía/1087>). Therefore, with the available evidence, we consider the occurrence of the species *A. callidryas* to be uncertain in the department of Bolívar and the Caribbean region of Colombia, and suggest the necessity to check and corroborate, if the specimens catalogued as *A. callidryas* belong to such species or if they correspond to populations of *A. terranova*. The latter, also motivates us to point out the opportunities and needs that the genus *Agalychnis* represents for reasonably proposing and testing systematic hypotheses.

### 3. Conclusion

This work provides valuable information on the distribution of *A. terranova*, expanding the known distribution of the species in the Colombian Caribbean region. Due to its arboreal habits this is a species difficult to observe in the field unless it is in reproductive activity, when it occupies natural or artificial ponds, so it is extremely important to study different aspects of the natural history of the species, which are scarce in the whole country. It is suggested to carry out molecular studies that help to corroborate the identification made based on the diagnostic morphological characters of the species, and to test phylogeographical and systematic hypotheses for the genus *Agalychnis*, including its representatives in South and Central America.

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Corporación Autónoma Regional de Sucre - CARSUCRE to do fieldwork in the Reserva Forestal Protectora Serranía de Coraza y Montes de María - RFPSCMM; special thanks to Jhon Jairo Mercado Amaya of the Oficina de Fauna Silvestre at CARSUCRE for his administrative collaboration. We are thankful to Yarlenis Mercado Gómez for technical assistance and collaboration at the Museo Zoológico de la Universidad de Sucre (MZUSU). Thanks to our colleagues Javier Sunyer and Hugo Vides for fruitful discussions on this topic and to Rachael Antwis and two anonymous reviewers for comments on early versions of the manuscript.

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