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Trabajo

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The advertisement call of *Dendropsophus soaresi* (Amphibia, Anura, Hylidae) from the type locality and other sites in the State of Piauí, Northeastern Brazil

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ABSTRACT
Many species identification issues can be minimized by providing descriptions of the advertisement calls from specimens in the type locality. In this paper, we detail the advertisement call of *Dendropsophus soaresi* from six localities in the State of Piauí, Northeastern Brazil, including the type locality (Picos, PI), and expand the known distribution of the species within the state. The previous mating call description attributed to *D. soaresi* was based on specimens from Mambaí, State of Goiás, approximately 960 km from its type locality. We present a comparative analysis of the advertisement calls of species within the *Dendropsophus marmoratus* Group.

Key words: Dendropsophini; *Dendropsophus marmoratus* Group; Picos Treefrog; Bioacoustics.

Introduction

The genus *Dendropsophus* Fitzinger, 1843 is currently composed of 105 species (Frost, 2025), distributed in nine groups (Faivovich *et al.*, 2005; Orrico *et al.*, 2021). The *D. marmoratus* species group was first proposed by Bokermann (1964) (as *Hyla marmorata* group) and included the larger species *H. marmorata*, *H. senicula*, *H. melanargyrea*, and *H. nahdereri*; and the smaller *H. microps*, *H. parviceps* (now in the *D. parviceps* Group; Orrico *et al.*, 2021), *H. schubarti* (now in the *D. leucophyllatus* Group; Orrico *et al.*, 2021), and "*H. moraviensis* Taylor from Costa Rica" (*nomen nudum*).

Currently, the *Dendropsophus marmoratus* Group is composed of eight species: *D. acreanus* (Bokermann, 1964), *D. dutrai* (Gomes & Peixoto, 1996), *D. marmoratus* (Laurenti, 1768), *D. melanargyreus* (Cope, 1887), *D. nahdereri* (B. Lutz & Bokermann, 1963), *D. novaisi* (Bokermann, 1968), *D. seniculus* (Cope, 1868), and *D. soaresi* (Caramaschi & Jim, 1983) (Faivovich *et al.*, 2005; Orrico *et al.*, 2021). The species of the *D. marmoratus* Group are small to medium-sized (combined SVL 27.4–44.2 mm in males, 30.0–52.0 mm in females) and have bark-like colored dorsum (Orrico *et al.*, 2021). The advertisement calls of seven out of the eight species of the *D. marmoratus* Group have been described (Table 1). These calls are considered simple, with dominant frequency varying between the first and the second harmonics in the same note, cyclic amplitude modulation (especially towards the end of the note), and many pulses (combined range 22–84 pulses per note) (Orrico *et al.*, 2021)

Sounds production by animals primarily serve to announce the presence of an individual to others of the same species (Duellman & Trueb, 1994). To achieve this, the bioacoustic parameters generated must be species-specific (Ryan, 1991; Wells, 1977) and have evolved to reduce acoustic

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Table 1. Descriptions of the advertisement calls of species of the *Dendropsophus marmoratus* group and respective authors.

Species	Advertisement call description(s)
Dendropsophus acreanus	Márquez *et al.* (1993)
Dendropsophus dutrai	Not described
Dendropsophus marmoratus	Duellman (1978); Duellman and Pyles (1983); Zimmerman (1983); Zimmerman and Bogart (1984); Rodriguez and Duellman (1994)
Dendropsophus melanargyreus	Duellman and Pyles (1983); Márquez *et al.* (1993); Teixeira and Giaretta (2009)
Dendropsophus nahdereri	Orrico *et al.* (2009); Conte *et al.* (2010)
Dendropsophus novaisi	Protázio *et al.* (2017)
Dendropsophus seniculus	Bokermann (1967); Hepp *et al.* (2012)
Dendropsophus soaresi	Guimarães *et al.* (2001); this paper

interference with sympatric species (Ryan 1991, Gerhardt & Huber 2002, Martins & Jim 2003, 2004, Silva *et al.* 2008). Due to this specificity, bioacoustic studies have become increasingly used in integrative taxonomic studies (Köhler *et al.* 2017). Bioacoustics is an important taxonomic tool in anuran amphibians, as each acoustic signal has relatively invariant characteristics that can be as useful as morphological characters in identifying the species that produce it (Gerhardt & Huber 2002). Furthermore, when bioacoustics are an essential feature in species delimitation, it is particularly important to obtain type locality recordings of that species when describing the calls of previously described species (Köhler *et al.*, 2017).

Dendropsophus soaresi is one of the seven species whose vocalizations have been described, although the recordings are from a population distant from the type locality. In this paper, we describe the advertisement call of *D. soaresi* from six localities in the State of Piauí, Northeastern Brazil, including the type locality (Picos, PI), and expand the known distribution of the species in the state.

Materials y methods

Eight specimens from six different municipalities in the State of Piauí, Northeastern Brazil, including the type locality (Municipality of Picos; Caramaschi and Jim, 1983) of *Dendropsophus soaresi* (Fig. 1), were recorded using a Tascam DR05 digital recorder with a Yoga Super-unidirectional Electric Condenser HT81 microphone. The recordings were made at 24 bits and a sampling rate of 48 kHz. The parameters were analyzed in Raven Pro 1.6.5, employing a Hann window type, with an FFT (Fast Fourier Transform) at 512 samples and 50% overlap. The Hann window type is the preferred choice for biological sound analysis according to Beeman (1998). The parameters, following Köhler *et al.* (2017), include call duration (CD) in seconds, interval between calls (IbC) in seconds, calls per minute (calls/min), pulses per note (pulses/note), pulses per second (pulses/s), pulse duration (PD) in seconds, dominant frequency (DF) in kHz, fundamental frequency (FF) in kHz, frequency modulation (FM) in a qualitative manner, and the presence or absence of harmonics. Voucher specimens are deposited in the Natural History Collection of the Federal University of Piauí (CHNUFPI – Coleção de História Natural da Universidade Federal do Piauí, Floriano, PI), with all specimens obtained in the State of Piauí, Brazil. This includes one specimen from the Municipality of Picos (CHNUFPI 2248 – 7°05’00.1”S, 41°29’59.9”W), the type locality of the species; one from Currais (CHNUFPI 1776 – 9°1’50”S, 44°23’34.6”W); three from Floriano (CHNUFPI 1459, 1460, 2616 – 6°48’45.7”S, 43°3’31.2”W); one from Ribeiro Gonçalves (CHNUFPI 2250 – 7°35’40”S, 45°20’33.31”W); one from São Francisco do Piauí (CHNUFPI 1513 – 6°59’35.1”S, 42°34’33.4”W); and one from Uruçuí (CHNUFPI 2252 – 7°13’58.4”S, 44°33’58”W). Recordings of the vocalizations are deposited in the Museu Nacional do Rio de Janeiro (MNVOC folder 76, tracks 01-08).

Results

In total, the advertisement calls of eight specimens (n = 317 calls) of *Dendropsophus soaresi* were analyzed. The individualized data per specimen and the overall average are presented in Table 2.

Figure 1. *Dendropsophus soaresi* (Caramaschi and Jim, 1983), in life (unvouchered specimen). Picos (PI), type locality. Photo: Marco Antonio de Freitas.

The advertisement call of *D. soaresi* (Fig. 2) consists of a single multipulsed note, with a duration of 0.34±0.03 s (0.25–0.49) and 32.9±1.9 (25–42) pulses per note. The amplitude gradually increases until about two-thirds of the note and then sharply decreases at the end, creating a fan-shaped note. The final pulse exhibits no modification in amplitude modulation and displays no cyclic modulation in emission intensity. The interval between calls is 0.99±0.19 s (0.49±2.10); the repetition rate is 45.9±4.3 (20.2–62.3) calls per minute; the pulse rate is 102.7±3.3 (79±114) pulses per second; the pulse duration is 0.007±0.001 s (0.002–0.020); the dominant frequency is at 3.43±0.18 (1.89–4.13) kHz; and the fundamental frequency is 2.00±0.11 (1.46–2.41) kHz. Frequency modulation shows an upward sweep with a terminal drop in frequency (U-D: up-down shape). All calls exhibited harmonics, with the dominant frequency most often located in the second harmonic; however, in specimens CHNUFPI 2248 and CHNUFPI 2616, it was also found in the first harmonic.

Discussion

The type specimens of *Dendropsophus soaresi* were collected in open vegetation, typically of "caatinga", in altitudes between 200 to 400 m (Caramaschi and Jim 1983). During this study we observed that the call is harsh, emitted by specimens perched on branches at 1 to 3 m high, usually about 1 m, on the borders of small lentic water bodies formed by recent rains. Formerly, in the State of Piauí, the species was known to occur, besides its type locality, in the municipalities of Brejo do Piauí, Caxingó, Ribeiro Gonçalves, São Raimundo Nonato, and Cajueiro da Praia (Roberto *et al.*, 2013; Araújo *et al.*, 2020). The present study expands the species distribution to the municipalities of Currais, Floriano, São Francisco do Piauí, and Uruçuí.

The advertisement call of *D. soaresi* was first described by Guimarães *et al.* (2001) based on ten calls of two specimens from the Municipality of Mambaí (State of Goiás), about 960 km from the type locality (Caramaschi and Jim 1983). Guimarães *et al.* (2001) reported calls with a repetition rate of 17–20 calls per minute, while we described a repetition rate of 45.9±4.3 (20–62) calls per minute. This sharp divergence in the call repetition rate is expected because this parameter has a wide variability according to the environment (such as temperature and humidity) and social factors (such as density of the chorus) (Wells, 2007). All other temporal

Table 2. . Bioacoustic analyses of *Dendropsophus soaresi*. CHNUFPI = voucher specimen deposited in the Natural History Collection of the Federal University of Piauí (Coleção de História Natural da Universidade Federal do Piauí), N = analyzed calls, CD = call duration in seconds, IbC = interval between calls, PD = Pulse duration, DF (kHz) = Dominant Frequency in kilohertz, FF (kHz) = Fundamental Frequency, H = presence of harmonics, FM = Frequency Modulation, U-D= Up in the beginning, Down at the end of the call, SVL = Snout-Vent Length in millimeters, Locality = municipality where the calls were recorded. * type locality of the species.

CHNUFPI	N	CD (s)	IbC (s)	Calls/min	Pulses /note	Pulses/s	PD (s)	DF (kHz)	FF (kHz)	H	FM	SVL	Locality/air temperature
1459	37	0.32±0.02 (0.25-0.36)	0.93±0.16 (0.74-1.37)	46.9±4.74 (37.3-56.6)	30.5±2.0 (25-33)	101.8±1.8 (97-105)	0.009±0.001 (0.008-0.01)	3.48±0.09 (3.36-3.62)	1.90±0.02 (1.89-1.98)	yes	U-D	32.7	Floriano (23.5°C)
1460	40	0.33±0.02 (0.26-0.37)	0.92±0.18 (0.68-1.50)	46.9±3.33 (40.4-53.7)	31.0±2.0 (26-35)	100.5±2.7 (94-103)	0.009±0.001 (0.009-0.012)	3.49±0.09 (3.36-3.62)	1.90±0.02 (1.89-1.98)	yes	U-D	31.2	Floriano (25.0°C)
2616	89	0.35±0.02 (0.25-0.39)	0.79±0.27 (0.49-2.00)	54.3±5.34 (40.3-61.2)	35.1±2.0 (30-39)	107.6±2.7 (97-114)	0.009±0.002 (0.008-0.020)	3.31±0.04 (1.89-3.53)	2.18±0.01 (1.89-2.41)	yes	U-D	29.5	Floriano (23.5°C)
1776	44	0.39±0.03 (0.30-0.49)	1.21±0.26 (0.80-2.10)	38.3±5.68 (20.2-56.3)	37.7±2.8 (32-42)	96.8±1.7 (95-103)	0.009±0.001 (0.008-0.011)	3.79±0.13 (3.38-4.13)	2.11±0.05 (2.06-2.16)	yes	U-D	30.7	Currais (28.3°C)
2248	30	0.35±0.02 (0.31-0.38)	0.96±0.19 (0.75-1.55)	47.0±4.1 (35.5-54.5)	30.8±1.6 (26-32)	102.1±2.1 (100-107)	0.009±0.001 (0.008-0.012)	3.03±0.72 (1.89-3.62)	1.90±0.02 (1.89-1.98)	yes	U-D	30.8	Picos* (26.0°C)
1513	20	0.32±0.01 (0.28-0.34)	0.97±0.13 (0.75-1.10)	45.3±3.1 (40.5-48.8)	30.6±2.7 (27-33)	103.4±2.7 (100-107)	0.003±0.009 (0.002-0.006)	3.58±0.13 (3.45-3.79)	1.87±0.09 (1.46-2.07)	yes	U-D	29.0	São Francisco do Piauí (26.8°C)
2250	11	0.32±0.02 (0.27-0.35)	1.40±0.2 (1.20-1.80)	32.9±3.1 (27.8-37.6)	33.1±0.7 (32-34)	101.4±8.5 (79-111)	0.005±0.001 (0.004-0.006)	3.05±0.15 (2.84-3.87	2.10±0.03 (2.00-2.15)	yes	U-D	30.3	Ribeiro Gonçalves (30.2°C)
2252	46	0.35±0.09 (0.33-0.38)	0.71±0.11 (0.53-1.00)	56.2±3.9 (46.0-62.3)	34.6±2.1 (30-37)	108.3±2.3 (104-113)	0.005±0.001 (0.004-0.014)	3.78±0.07 (3.66-3.94)	2.04±0.04 (2.01-2.11)	yes	U-D	29.4	Uruçuí (27.0°C)
Mean	317	0.34±0.03 (0.25-0.49)	0.99±0.19 (0.49-2.10)	45,9±4,3 (20.2-62.3)	32.9±1.9 (25-42)	102.7±3.3 (79-114)	0.007±0.001 (0.002-0.020)	3.43±0.18 (1.89-4.13)	2.00±0.11 (1.46-2.41)	-	-	-	-
Guimaraes *et al.* (2001)	10	0.39 ±0.06 (0,31-0,46)	--	10.91±5.57 (17 – 20)	33 ±4 (28 – 38)	--	0,011±0,001 (0.007-0.014)	3.29±0.15 (2.71–3.47)	--	yes	--	--	Mambaí/GO

parameters analyzed by Guimarães *et al.* (2001) [call duration: 0.39±0.06 s (0.31–0.46); pulses per note: 33±4 (28–38); and pulse duration 0.012±000.1 s (0.007–0.014)] are consistent with those presented here [call duration: 0.34±0.03 s (0.25–0.49); pulses per note: 32.9±2.9 (25–42); and pulse duration: 0.007±0.001 s (0.002–0.020)].

All calls of *D. soaresi* presented harmonics, with the dominant frequency usually located in the second frequency band. However, in the specimens CHNUFPI 2248 and CHNUFPI 2616 it was also located in the first harmonic. The dominant frequency was 3.43±0.18 kHz (1.89–4.13), while, according to Guimarães *et al.* (2001), the dominant frequency is 3.29±0.15 kHz (2.71–3.47). The slight difference observed in this parameter could be related to the different sizes of the observed anurans, as this characteristic influences the dominant frequency of the vocalization of an animal (Wells, 2007). Notwithstanding, the specimens' SVL was not provided by Guimarães *et al.* (2001).

The advertisement calls of *D. seniculus*, *D. marmoratus*, *D. acreanus*, *D. novaisi* (Bokermann 1967), *D. melanargyreus* (Márquez *et al.* 1993; Teixeira & Giaretta 2009), *D. nahdereri* (Orrico *et al.* 2009), and *D. soaresi* (present work) are similar in having a single multipulsed note with harmonics. Guimarães *et al.* (2001) did not classify the call of *D. soaresi* as harmonic, but it is possible to observe two frequency bands in the figure provided by them (Teixeira and Giaretta, 2009; pers. obs.). Márquez *et al.* (1993) refer that the call of *D. acreanus* and *D. melanargyreus* is a trill (pulse train), with no frequency modulation in *D. acreanus* and downward frequency modulation in *D. melanargyreus*, with both of them with harmonic structure. In the figure of *D. melanargyreus* of the calls reported by Márquez *et al.* (1993), it is possible to observe a dominant frequency with a slight ascendant modulation at the beginning of the call and descendant at the end. In the call of *D. soaresi*, we observed the same modulation structure.

The advertisement call parameters of species of the *Dendropsophus marmoratus* Group are summarized in Table 3. The calls are similar in structure, presenting a single multipulsed note with two harmonics (generally with dominant frequencies at the second harmonic), which could be a possible synapomorphy for the group according to Orrico *et al.* (2009) and Hepp *et al.* (2012), but not tested in the phylogeny of the Dendropsophini of Orrico *et al.* (2021). Nevertheless, it is possible to observe the greater similarity in the advertisement calls of the species *D. soaresi* and *D. melanargyreus*, which is congruent with the phylogeny proposed by Orrico *et al.* (2021) in which these are sister clades. Further acoustic comparisons could be provided only with a standardization of the bioacoustic analysis. The remarkably high number of harmonics (n = 32), without pulses, described by Bokermann (1967) for the advertisement call of *D. seniculus*, was correctly interpreted as side-bands (*sensu* Vielliard, 1993) by Orrico *et al.* (2009), and this was corroborated by Hepp *et al.* (2012). Subsequently, Orrico *et al.* (2009) considered the supposed fundamental harmonics

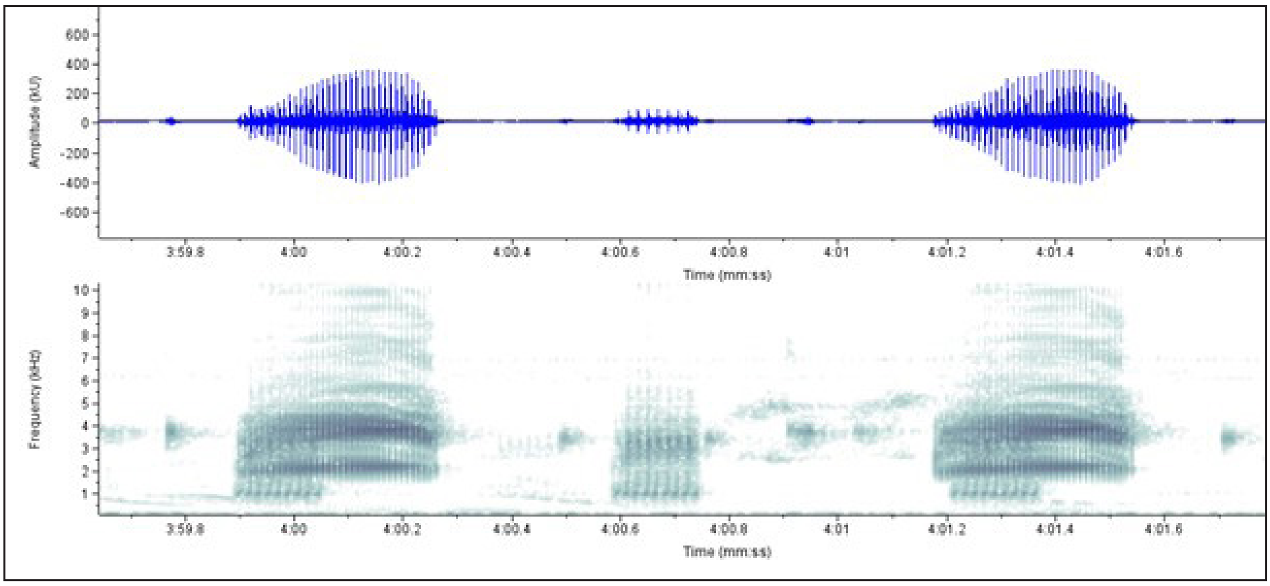

Figure 2. Oscillogram of two advertisement calls of *Dendropsophus soaresi*. Below, spectrogram of the same calls. Specimen CHNUFPI 2248, Municipality of Picos (PI), 30.8 mm SVL, air temperature 26.0°C.

Table 3. . Advertisement call parameters of the species of the *Dendropsophus marmoratus* Group presented as range (average ± standard deviation), when available. U – Up, D – Down Frequency modulation.

Species	No. of calls	Call duration (s)	Interval between calls (s)	Calls / minute	Notes / second	Pulses / note	Pulses / second	Pulse duration (s)	Dominant frequency (kHz)	Frequency modula-tion	Fundamental frequency (kHz)	Final pulse clusters	SVL (mm)	Author (s)
D. soaresi	317	0.25 - 0.49 (0.34 ± 0.03)	0.49 - 2.10 (0.99 ± 0.19)	20.2 - 62.3 (45.9 ± 4.3)	0.33 - 1.00 (0.76 ± 0.06)	25 - 42 (32.9 ± 1.9)	79 - 114 (102.7 ± 3.3)	0.02 - 0.20 (0.007 ± 0.001)	1.89 - 4.13 (3.43 ± 0.18)	U-D	1.46 - 2.16 (2.0 ± 0.11)	No	29.0 - 32.7 (30.45 ± 1.42)	Present work
D. soaresi	10	0.31 - 0.46		17 - 20		28 - 38		0.007 - 0.014	2.71 - 3.47	U-D		No		Guimarães *et al.* (2001)
D. acreanus	23	0.23 - 0.47 (0.33 ± 0.047)		17 - 53 (41.3 ± 10.5)		22 - 39 (30.4 ± 4.5)	67 - 125 (92.6 ± 14.9)		3.01 - 3.79 (3.46 ± 0.21)	No	1.61 - 1.85 (1.75 ± 0.74)	2	41.7	Márquez *et al.* (1993)
D. marmoratus	10	0.11 - 0.27 (0.21)		11.5 - 35.3 (20.2)			120 - 140 (130)		1.32 - 1.67 (1.51)	--	0.33 - 0.42 (0.37)	No	43	Duellman (1978)
D. marmoratus	27	0.17 - 0.26 (0.21)		11.5 - 35.3 (20.2)			120 - 140 (132)		1.32 - 1.69 (1.51)	--	0.33 - 0.42 (0.37)	No		Duellman & Pyles (1983)
D. marmoratus	3						156		2.10	No		No	43.0	Zimmerman (1983)
D. marmoratus	11	0.17 - 0.26 (0.22)	1.12 - 48.7 (6.25 ± 6.51)	9.61			138.9 - 194.3 (166.6)		3.36 - 3.49 (3.43)	--	1.29 - 1.78 (1.53)	No		Zimmerman & Bogart (1984)
D. marmoratus				20						--				Rodríguez & Duellman (1994)
D. melanargyreus	1	0.25 - 0.33 (0.28)		21.0 - 41.0 (30.5)			127 - 140 (136.3)		2.09 - 2.40 (2.24)	--	0.13 - 0.16 (0.14)	No	40 - 44	Duellman & Pyles (1983)
D. melanargyreus	16	0.37 - 0.46 (0.41 ± 0.19)		13 - 64 (35.1 ± 13.2)		34 - 39 (37.1 ± 1.5)	83 - 97 (91 ± 5.2)		3.04 - 3.66 (3.50 ± 0.18)	U-D	1.68 - 1.87 (1.82 ± 0.53)	No	36.2	Márquez *et al.* (1993)
D. melanargyreus	2	0.45 - 0.50		44		35-38(37)		0.012 - 0.014 (0.013)	2.88 - 3.51	D	1.46 - 1.92	No		Teixeira & Giaretta (2009)
D. nahdereri	60	0.44 - 0.98(0.70 ± 0.15)				31 - 66(48.1 ± 8.2)		0.01 - 0.02 (0.013 ± 0.002)	1.38 - 1.46 (1.39 ± 0.03)	No		1-3		Orrico *et al.* (2009)
D. nahdereri	11	0.60 - 0.91 (0.75 ± 0.10)			0.9 - 1.7 (1.29 ± 0.3)	47 - 76 (57 ± 10)			2.40 - 2.69 (2.59 ± 0.11)	No	1.69 - 1.83 (1.77 ± 0.06)	Yes	39.3 - 45.1 (42.9 ± 1.71)	Conte *et al.* (2010)

D. novaisi	12	0.75 - 0.97 (0.88 ± 0.06)	1.08 - 1.69 (1.38 ± 0.18)	20 - 25 (22.5 ± 3.33) 25 - 26 (25.5 ± 0.71)		60 - 84 (76.2 ± 5.7)		0.002 - 0.013 (0.004 ± 0.001)	2.22 - 4.093.19 - 3.56 (3.36 ± 0.17)	No	1.36 - 2.35 (1.87)	No	Protázio *et al.* (2017)
D. seniculus	1	0.30		16					2.0 – 3.0	U-D		Yes	Bokermann (1967)
D. seniculus	143	0.26 - 0.36 (0.31 ± 0.03)		56.6 - 66.3 (60.7 ± 2.88)	0.94 - 1.10 (1.01 ± 0.05)	35 - 55 (47.7 ± 3.7)	127.7 - 162.8 (151.8 ± 5.9)		1.87 - 4.50 (3.97 ± 0.69)	U-D	1.87 - 2.44 (2.08 ± 1.66)	Yes	Hepp *et al.* (2012)

of the advertisement calls of *D. marmoratus* and *D. melanargyreus* described by Duellman and Pyles (1983) — and consequently by Duellman (1978), since all were based on the same data — to be very low (0.12–0.14 kHz and 0.13–0.14 kHz, respectively) interpreting them as artifacts. Orrico *et al.* (2009) appear to have misinterpreted the data on pulse rate instead of the correct fundamental frequency column of the Table 2 in Duellman and Pyles (1983). Duellman (1978) and Duellman and Pyles (1983), using the same data, reported the fundamental frequency of 0.33–0.42 kHz for the advertisement call of *D. marmoratus* and 0.13–0.16 kHz for *D. melanargyreus*. Nevertheless, these values are considered unusually low, and we concur with Orrico *et al.* (2009) that they should be regarded as artifacts.

The call duration of *D. soaresi* [0.25–0.49 s (0.34±0.03)] is approximately the same as that of *D. acreanus* and *D. seniculus* (combined: 0.23–0.47 s), longer than that of *D. marmoratus* (0.11–0.27 s), and slightly shorter than the calls of *D. melanargyreus*, *D. nahdereri*, and *D. novaisi* (combined: 0.25–0.98 s). The call repetition rate of *D. soaresi* [20.2–62.3 (45.9±4.3) calls/minute; 17–20 in Guimarães *et al.* 2001; combined: 17–62.3] overlaps with that of *D. acreanus*, *D. marmoratus*, *D. melanargyreus*, and *D. novaisi* (combined: 11.5–64), and is slightly lower than that of *D. seniculus* (56.5–66.3); it is unknown in *D. nahdereri*. The number of pulses/note of *D. soaresi* [25–42 (32.9±1.9)] does not differ from that of *D. acreanus*, *D. melanargyreus*, *D. nahdereri*, and *D. seniculus* (combined: 22–76), and is smaller than in *D. novaisi* (60–84); it is unknown in *D. marmoratus*. The number of pulses/second in *D. soaresi* [79–114 (102.7±3.3)] does not differentiate from that of *D. acreanus* and *D. melanargyreus* (combined: 67–125) and is smaller than that in *D. marmoratus* and *D. seniculus* (120–192.3); it is unknown in *D. nahdereri* and *D. novaisi*. The dominant frequency in *D. soaresi* [1.89–4.13 (3.43±0.18) kHz] does not distinguish from that of *D. acreanus*, *D. marmoratus*, *D. melanargyreus*, *D. nahdereri*, *D. novaisi*, and *D. seniculus* (combined: 1.32–4.50). The fundamental frequency in *D. soaresi* [1.46–2.41 (2.0±0.11) kHz] does not differ from that of *D. acreanus*, *D. marmoratus*, *D. melanargyreus*, *D. nahdereri*, *D. novaisi*, and *D. seniculus* (combined: 1.29–2.44). All other species, except for *D. acreanus*, *D. marmoratus*, *D. novaisi*, and *D. nahdereri*, show frequency modulation in the calls. The modulation pattern is up-down (U-D) in the species *D. soaresi* and *D. seniculus*, while for the species *D. melanargyreus* the modulation was classified as descending (down) according to Márquez *et al.* (1993), confirmed by Teixeira and Giaretta (2009), but in the figure provided by Márquez *et al.* (1993) it is possible to observe an U-D modulation. The final pulses (*sensu* Hepp *et al.* 2012) are absent in *D. soaresi, D. marmoratus*, *D. melanargyreus*, and *D. novaisi*, while they are present in *D. acreanus*, *D. nahdereri*, and *D. seniculus*.

According to Gerhardt and Huber (2002), acoustic data are useful taxonomic characters in many anuran species groups. Although there is considerable overlap in the individual parameters of the advertisement calls within the *D. marmoratus* Group, the combination of these parameters usually form a unique profile for each species. For example, the vocalization of *D. soaresi* can be distinguished without parameter overlapping from those of *D. marmoratus* (pulse repetition rate), *D. novaisi* (call duration and number of pulses per note), and *D. seniculus* (pulse repetition rate) (see Table 2). This suggests that acoustic data could serve as a useful taxonomic tool for this group (Gerhardt and Huber, 2002) and the acoustic characters may also be informative in phylogenetic studies.

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Trabajo

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Nemátodos parásitos en reptiles de Argentina: una actualización tras 5 años de investigación

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ABSTRACT
The objective of this study was to update the state of knowledge on reptile nematodes in Argentina, five years after the last review. Following the 2020 review on parasitic nematodes in reptiles, we provide an updated taxonomic and systematic list of nematodes parasitizing reptiles in Argentina. A total of 40 nematode taxa, belonging to 2 orders, 5 suborders, 12 families and 19 genera, were found to parasitize 54 reptile species across 11 families. These included 44 species of lizards, 5 turtles and 5 snakes. Among the parasites, nematodes of the families Pharyngodonidae and Physalopteridae were the most prevalent with 13 and 7 recorded taxa, respectively. Regarding hosts, the family Liolaemidae had the highest number of examined species (n= 28), followed by Teiidae (n= 4). Compared to 2020 review, this study adds 16 new species of parasitic nematodes and 14 new host species, making a significant advancement in parasitological research in Argentina. This updated information will be valuable for developing plans and projects related to the ecology and conservation of reptiles in Argentina.

Key words: Amphisbena; Argentina; Herpetofauna; Lizards; Snakes; Turtles.

RESUMEN
El objetivo del presente estudio fue actualizar el estado del conocimiento sobre nemátodos parásitos de reptiles en Argentina, cinco años después de la última revisión. Tras la revisión publicada en 2020 sobre nemátodos parásitos en reptiles, en este trabajo proporcionamos una lista taxonómica y sistemática actualizada de los nemátodos que parasitan reptiles en Argentina. Un total de 40 taxones de nemátodos parásitos, pertenecientes a 2 ordenes, 5 subórdenes, 12 familias y 19 géneros, parasitan 54 especies de reptiles distribuidos en 11 familias con 44 especies de lagartijas, 5 tortugas y 5 serpientes. Con respecto a los parásitos, los nemátodos de la familia Pharyngodonidae y Physalopteridae presentaron el mayor número de taxones registrados (n= 13 y n= 7 respectivamente). En cuanto a los hospedadores, los reptiles de la familia Liolaemidae fueron los más examinadas (n= 28), seguido por los de la familia Teiidae (n= 4). Los resultados de esta revisión evidencian la incorporación de 16 especies de nemátodos parásitos y 14 especies de hospedadores adicionales en comparación con la revisión del 2020. Este avance representa un progreso significativo en los estudios parasitológicos en Argentina. La información actualizada será de utilidad para la elaboración de planes y proyectos relacionados con la ecología y conservación de los reptiles en el pais.

Palabras Claves: Anfisbena; Argentina; Herpetofauna; Lagartos; Serpientes; Tortugas.

Introducción

Argentina cuenta con un total 18 regiones naturales o ecorregiones, lo que la convirte en uno de los países con mayor diversidad biogeográfica del mundo (archivo general de la nación, 2024). Esta gran diversidad biogeográfica permite albergar una riqueza biológica significativa, con 1.109 especies

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de peces (539 de agua dulce y 570 marinos), 176 de anfibios, 1.102 de aves, 407 de mamíferos y un total de 446 especies de reptiles (Bauni *et al.*, 2021). A lo largo de los años, se han realizado numerosos estudios parasitológicos sobre esta amplia diversidad de especies de animales, cuya información es de vital importancia para la elaboración de planes de manejo y conservación (Castillo *et al.*, 2020a; Castillo, 2024). En este contexto, los inventarios o listas detalladas juegan un papel crucial, ya que permiten resumir la información generada por diversas investigaciones a lo largo de décadas (Castillo *et al.*, 2020a; Castillo, 2024). Entre los inventarios parasitológico desarrollados en Argentina, se encuentran listas de endo y ectoparásitos en peces, reptiles, anfibios y mamíferos (Lunaschi y Drago, 2007; González *et al.*, 2015; González-Rivas *et al.*, 2018; Castillo *et al.*, 2020a; Fugassa, 2020; Ramallo y Ailán-Choke, 2022; Carballo *et al.*, 2024; Castillo, 2024).

Con respecto a reptiles, según el último informe sobre nemátodos parásitos en Argentina, Castillo *et al.* (2020a) mencionan que en el 53% del territorio argentino no existen registros o estudios parasitológicos relacionados con nematodos en reptiles. De las 23 provincias que conforman el país, solo en 12 se han realizado algún tipo de estudios, análisis o registros. Esta falta de información probablemente esté relacionada con la escasez de grupos de investigación dedicados al tema (Castillo *et al.*, 2020a). Además, de las aproximadamente 408 especies de reptiles en Argentina, solo 40 especies se han registrado algún taxón de nemátodos, lo que representa apenas el 9,8% del total de especies analizadas (Castillo *et al.*, 2020a). Estos resultados resaltan la necesidad de incrementar las investigaciones sobre la relación parásito-hospedador en este grupo.

El objetivo de esta investigación es actualizar la lista de nemátodos parásitos en reptiles de Argentina presentada hace 5 años, incorporando en esta ocasión la nueva clasificación taxonómica de nemátodos y teniendo en cuenta los nuevos cambios.

Materiales y métodos

En este estudio, elaboramos un listado actualizado de nemátodos parásitos en reptiles de Argentina. Consideramos todos los estudios citados en Castillo *et al.* (2020a) y las publicaciones realizadas después de 2020. Los registros incluyen el hospedador, la ubicación geográfica y las referencias correspondientes.

Para elaborar el listado de nemátodos en reptiles de Argentina, seguimos la clasificación propuesta por Hodda (2022), teniendo en cuenta los taxones válidos. La metodología empleada fue la misma utilizada en Castillo *et al.* (2020a). La búsqueda bibliográfica abarcó publicaciones hasta diciembre del 2024 y se realizó en diferentes motores de búsqueda académicos como SciELO (Scientific Electronic Library Online), Dialnet, Google Scholar y WorldWideScience.org. Utilizamos palabras claves en español e inglés para la búsqueda: Argentina, helmintos, lagartijas, nematodes, parásitos, tortugas, reptiles, serpientes.

Además, se revisaron las revistas no indexadas en bases de datos académicas como la Revista Argentina de Parasitología y la Revista Latinoamericana de Parasitología. No se incluyeron resúmenes presentados en congresos, tesis doctorales ni trabajos de pregrado.

Resultados

Lista taxonómica de parásitos- hospedadores mencionados para Argentina. El asterisco (*) indica nuevos registros.

En sus estudios, Castillo *et al.* (2020a) recopilaron todos los registros de nematodos parásitos en reptiles de Argentina, totalizando 26 taxones. Concluyeron que, de las 408 especies válidas de reptiles en Argentina, solo en 40 se registraron nemátodos parásitos. Este trabajo representó la primera revisión y lista taxonómica de nemátodos parásitos en reptiles para el país.

Siguiendo la nueva clasificación de Hodda (2022), se identificó un total de 40 taxones de nemátodos parásitos, pertenecientes a 2 ordenes, 5 subórdenes, 8 superfamilias, 12 familias y 14 subfamilias, que parasitan a 54 especies de reptiles (44 especies de lagartijas, 5 tortugas y 5 serpientes) distribuidas en 11 familias (Tabla 1 y 2).

Phylum Nematoda Cobb, 1932
Clase Chromadorea Inglis, 198
Orden Spirurida Railliet, 1915
Suborden Spirurina Railliet & Henry, 1915
Superfamilia Camallanoidea Railliet & Henry, 1915
Familia Camallanidae Railliet & Henry, 1915
Subfamilia Camallaninae Railliet & Henry, 1915

Género *Camallanus* Railliet & Henry, 1915
***Camallanus* sp.** Railliet & Henry, 1915
Hosp.: *Hydrodynastes gigas* Duméril, Bibron & Duméril, 1854

Tabla 1. Lista de nemátodos parásitos mencionados para Argentina.

Familia/ especies de nemátodos	Castillo *et al.*, 2020	Nuevos registros	Hospedadores
Camallanidae			
Camallanus sp.	X		Serpientes
Camallanus emydidius		X	Tortuga acuática
Physalopteridae			
Thubunaea eleodori	X		Lagartijas
Thubunaea acostai		X	Lagartijas
Physaloptera sp.	X		Lagartijas
Physaloptera retusa	X		Lagartijas
Physaloptera lutzi	X		Lagartijas
Physaloptera tupinambae		X	Lagartijas
Physaloptera liophis	X		Serpientes
Hedruridae			
Hedruris dratini	X		Tortuga acuática
Hedruris orestiae	X		Tortuga acuática
Gnathostomatidae			
Spiroxys contortus	X		Tortuga acuática
Pharyngodonidae			
Pharyngodon travasossi		X	Lagartijas
Parapharyngodon sp.	X		Lagartijas
Parapharyngodon riojensis	X		Lagartijas
Parapharyngodon sanjuanensis	X		Lagartijas
Parapharyngodon sceleratus		X	Lagartijas
Parapharyngodon bainae		X	Lagartijas
Spauligodon sp.		X	Lagartijas
Spauligodon aff. lamothei		X	Lagartijas
Spauligodon maytacapaci	X		Lagartijas
Spauligodon loboi	X		Lagartijas
Skrjabinodon sp.		X	Lagartijas
Skrjabinodon castillensis		X	Lagartijas
Thelandros sp.	X		Lagartijas
Atractidae			
Labiduris argentinensis	X	X	Tortuga terrestre
Cosmocercidae			
Aplectana tucumanensis	X		Anfisbena
Aplectana travassosi	X		Anfisbena
Aplectana nananae		X	Anfisbena
Kathlaniidae			
Cruzia sanjuanensis		X	Tortuga terrestre
Cruzia toba		X	Lagartijas
Falcaustra sp.	X		Tortuga terrestre
Falcaustra affinis		X	Tortuga acuática
Heterakidae			
Strongyluris oscari	X		Lagartijas

Ascarididae			
Hexametra boddaertii	X		Serpientes
Ancylostomatidae			
Diaphanocephalus galeatus	X		Lagartijas
Kalicephalus sp.	X		Serpientes
Kalicephalus subulatus	X		Serpientes
Kalicephalus costatus	X		Serpientes
Molineidae			
Oswaldocruzia sp.		X	Lagartijas

Referencias: Ramallo, 1996; Castillo *et al.*, 2020a

Camallanus emydidius Mascarenhas & Müller, 2017*
Hosp.: *Trachemys dorbigni* (Duméril & Bibron, 1835)*
Referencias: Palumbo *et al.*, 2024

Familia Physalopteridae Railliet, 1893 (Leiper, 1908)
Subfamilia Thubunaeinae Sobolev, 1949

Género *Thubunaea* Seurat, 1914
Thubunaea eleodori Ramallo, Goldberg, Bursey, Castillo & Acosta, 2016
Hosp.: *Liolaemus eleodori* Cei, Etheridge & Videla, 1985
Referencias: Ramallo *et al.* 2016a; Castillo *et al.*, 2020a

Thubunaea acostai Castillo & González-Rivas, 2024*
Hosp.: *Liolaemus gracielae* Abdala, Acosta, Cabrera, Villavicencio & Marinero, 2009*
Referencias: Castillo y González-Rivas, 2024

Subfamilia Physalopterinae Railliet, 1893

Género *Physaloptera* Rudolphi, 1819
***Physaloptera* sp.** Rudolphi, 1819
Hosp.: *Liolaemus olongasta* Etheridge, 1993
Homonota underwoodi (Kluge, 1964)
Pristidactylus scapulatus (Burmeister, 1861)
Aurivela tergolaevigata (Cabrera, 2004)
Tropidurus etheridgei Cei, 1982
Liolaemus darwinii (Bell, 1843)*
Liolaemus riojanus Cei, 1979*
Philodryas trilineata (Burmeister, 1861)*
Leiosaurus belli Duméril & Bibron, 1837
Referencias: Cruz *et al.*, 1998; Castillo *et al.*, 2019a,b,d; Gallardo *et al.*, 2019; Castillo *et al.*, 2020a,b; Castillo *et al.*, 2022a; 2023a

Physaloptera retusa Rudolphi 1819
Hosp.: *Liolaemus neuquensis* Müller & Hellmich, 1939
Leiosaurus belli
Leiosaurus catamarcensis Koslowsky, 1898
Salvator rufescens (Günther, 1871)
Aurivela longicauda (Bell, 1843)*
*Pristidactylus scapulatus**
Referencias: Goldberg *et al.*, 2004; Castillo *et al.*, 2019a; Castillo *et al.*, 2020a,b; González-Rivas et al. 2022a; Castillo *et al.*, 2023a

Physaloptera lutzi Cristofaro, Guimarães & Rodrigues, 1976
Hosp.: *Liolaemus Quilmes* Etheridge, 1993
Liolaemus ornatus Koslowsky, 1898
Liolaemus puna (*L. alticolor*) Lobo & Espinoza, 2004
Referencias: Ramallo y Díaz, 1998

Physaloptera liophis Vicente & Santos, 1974
Hosp.: *Xenodon merremi* (Wagler 1824)
Referencias: Lamas *et al.*, 2016

Physaloptera tupinambae Pereira, Alves, Rocha, Souza Lima & Luque, 2012
Hosp.: *Tropidurus torquatus* Wied-Neuwied 1820*
Referencias: Colunga *et al.*, 2021

Superfamilia Habronematoidea Chitwood & Wehr, 1932
Familia Hedruridae Petter, 1971
Subfamilia Hedrurinae Petter, 1971

Género *Hedruris* Nitzsch, 1812
Hedruris dratini Palumbo, Servián, Sánchez & Díaz, 2019

Tabla 2. Lista de hospedadores reptiles parasitados por nemátodos mencionados para Argentina.

Familia/ especies de reptiles	Castillo et al., 2020	Nuevos registros	Orden (sub-orden de nemátodos)
Testudinidae			
Chelonoidis chilensis	X		Spirurida (Ascaridina)
Chelidae			
Hydromedusa tectifera	X		Spirurida (Spirurina, Gnathostomatina)
Phrynops hilarii	X		Spirurida (Spirurina, Gnathostomatina, Oxyurina)
Acanthochelys pallidipectoris		X	Spirurida (Oxyurina)
Emydidae			
Trachemys dorbigni		X	Spirurida (Spirurina, Gnathostomatina, Ascaridina)
Colubridae			
Hydrodynastes gigas	X		Spirurida (Spirurina)
Xenodon merremi	X		Spirurida (Ascaridina, Spirurina), Rhabditida (Rhabditina)
Oxyrhopus guibei	X		Spirurida (Ascaridina)
Dipsadidae			
Erythrolamprus miliaris (= *Liophis miliaris*)	X		Rhabditida (Rhabditina)
Philodryas trilineata		X	Spirurida (Spirurina)
Teiidae			
Teius teyou	X		Spirurida (Oxyurina, Ascaridina)
Aurivela longicauda		X	Spirurida (Spirurina, Oxyurina)
Aurivela tergolaevigata	X		Spirurida (Spirurina)
Salvator rufescens	X		Spirurida (Spirurina)/ Rhabditida (Rhabditina)
Ameiva ameiva		X	Spirurida (Ascaridina)
Phyllodactylidae			
Homonota horrida		X	Spirurida (Oxyurina)
Homonota darwinii		X	Spirurida (Oxyurina)
Homonota underwoodi	X		Spirurida (Spirurina)
Amphisbaenidae			
Amphisbaena bolivica	X		Spirurida (Ascaridina)
Amphisbaena darwinii		X	Spirurida (Ascaridina)
Tropiduridae			
Tropidurus torquatus	X		Spirurida (Spirurina, Oxyurina)/ Rhabditida (Rhabditina)
Tropidurus etheridgei	X		Spirurida (Spirurina, Oxyurina)
Tropidurus spinulosus	X		Spirurida (Ascaridina)
Leiosauridae			
Pristidactylus scapulatus	X		Spirurida (Spirurina, Oxyurina)
Leiosaurus belli			Spirurida (Spirurina)
Leiosaurus catamarcensis			Spirurida (Spirurina)
Liolaemidae			
Liolaemus gracielae		X	Spirurida (Spirurina, Oxyurina)
Liolaemus buergeri	X		Spirurida (Oxyurina)

Liolaemus terani		X	Spirurida (Oxyurina)
Liolaemus hauthali		X	Spirurida (Oxyurina)
Liolaemus darwinii		X	Spirurida (Spirurina)
Liolaemus riojanus		X	Spirurida (Spirurina)
Liolaemus ruibali	X		Spirurida (Oxyurina)
Liolaemus tenuis	X		Spirurida (Oxyurina)
Liolaemus ramirezae	X		Spirurida (Oxyurina)
Liolaemus parvus	X		Spirurida (Oxyurina)
Liolaemus andinus	X		Spirurida (Oxyurina)
Liolaemus huacahuasicus	X		Spirurida (Oxyurina)
Liolaemus puna (L. alticolor)			Spirurida (Spirurina)
Liolaemus eleodori	X		Spirurida (Spirurina)
Liolaemus olongasta	X		Spirurida (Spirurina)
Liolaemus neuquensis	X		Spirurida (Spirurina)
Liolaemus quilmes	X		Spirurida (Spirurina, Oxyurina)
Liolaemus ornatus	X		Spirurida (Spirurina, Oxyurina)
Liolaemus fitzgeraldi	X		Spirurida (Oxyurina)
Liolaemus chiliensis	X		Spirurida (Oxyurina)
Liolaemus elongatus	X		Spirurida (Oxyurina)
Liolaemus pictus	X		Spirurida (Oxyurina)
Liolaemus capillitas	X		Spirurida (Oxyurina)
Phymaturus williamsi	X		Spirurida (Oxyurina)
Phymaturus extrilidus			Spirurida (Oxyurina)
Phymaturus palluma	X		Spirurida (Oxyurina)
Phymaturus cf. *palluma*		X	Spirurida (Oxyurina)
Phymaturus punae	X		Spirurida (Oxyurina)

Hosp.: *Hydromedusa tectifera* Cope, 1870
Phrynops hilarii (Duméril & Bibron, 1835)
*Trachemys dorbigni**
Referencias: Palumbo *et al*., 2019; 2024
Hedruris orestiae Moniez, 1889
Hosp.: *Hydromedusa tectifera*
Referencias: Palumbo *et al*., 2016

Suborden Gnathostomatina Skryabin & Ivaschkin, 1973
Superfamilia Gnathostomatoidea Railliet, 1895
Familia Gnathostomatidae Railliet, 1895
Subfamilia Spiroxyinae Baylis & Lane, 1920

Género *Spiroxys* Schneider, 1866
Spiroxys contortus (Rudolphi, 1819)
Hosp.: *Phrynops hilarii*
Hydromedusa tectifera
*Trachemys dorbigni**
Referencias: Palumbo *et al*., 2016; Castillo *et al*., 2020a; Palumbo *et al*., 2024

Suborden Oxyurina Railliet, 1916
Superfamilia Oxyuroidea Cobbold, 1864
Familia Pharyngodonidae Travassos, 1920
Subfamilia Pharyngodoninae Travassos, 1920

Género *Pharyngodon* Diesing, 1861
Pharyngodon travassosi Pereira, 1935
Hosp.: *Teius teyou* (Daudin, 1802)
Referencias: Castillo *et al*., 2019a; Castillo *et al*., 2020b; Castillo *et al*., 2022b

Género *Parapharyngodon* Chatterji, 1933
***Parapharyngodon* sp.** Chatterji, 1933
Hosp.: *Liolaemus ruibali* Donoso-Barros, 1961
Liolaemus parvus Quinteros, Abdala, Gómez & Scrocchi 2008

Liolaemus fitzgeraldi Boulenger, 1899
Tropidurus torquatus
Tropidurus etheridgei
Referencias: Castillo *et al.*, 2019c, Castillo & Acosta, 2019; Lamas y Zaracho, 2006; Castillo *et al.*, 2020b

Parapharyngodon riojensis Ramallo, Bursey & Goldberg, 2002
Hosp.: *Phymaturus punae* Cei, Etheridge & Videla, 1985
Phymaturus extrilidus Lobo, Espinoza, Sanabria & Quiroga, 2012
Phymaturus palluma (Molina, 1782)
Liolaemus ruibali
Liolaemus parvus
Liolaemus buergeri Werner, 1907
*Aurivela longicauda**
Liolaemus terani Abdala, Díaz-Gómez & Langstroth, 2021*
Liolaemus hauthali Abdala, Díaz-Gómez & Langstroth 2021*
Referencias: Ramallo *et al.*, 2002a; Goldberg *et al.*, 2004; Ramallo *et al.*, 2017; Castillo *et al.*, 2017; 2018; 2019e; Castillo *et al.*, 2020a,b; Ramallo y Stazzonelli, 2023a,b

Parapharyngodon sanjuanensis Ramallo, Bursey, Castillo & Acosta, 2016
Hosp.: *Phymaturus punae*
Phymaturus williamsi Lobo, Laspiur & Acosta, 2013
Phymaturus extrilidus
Phymaturus cf. *palluma**
Referencias: Ramallo *et al.*, 2016b; Castillo *et al.*, 2020a; Ramallo *et al.*, 2020; Castillo y Acosta, 2022

Parapharyngodon sceleratus Freitas, 1957*
Hosp.: *Liolaemus parvus*
Referencias: Castillo *et al.*, 2022c

Parapharyngodon bainae Pereira, Sousa & Lima, 2011*
Hosp.: *Tropidurus torquatus*
Referencias: Colunga *et al.*, 2021

Género *Spauligodon* Skryabin, Schikhobalova & Lagodovskaja, 1960
***Spauligodon* sp.** Skryabin, Schikhobalova & Lagodovskaja, 1960*
Hosp.: *Liolaemus parvus*
Referencias: Castillo *et al.*, 2022c

Spauligodon* aff. *lamothei Monks, Escorcia- Ignacio & Pulido- Flores, 2008*
Hosp.: *Homonota horrida* (Burmeister, 1861)*
Referencias: Castillo *et al.*, 2024

Spauligodon maytacapaci Vicente & Ibanez, 1968
Hosp.: *Liolaemus chiliensis* Lesson, 1830
Liolaemus elongatus Koslowsky, 1896
Liolaemus pictus Duméril & Bibron, 1837
Liolaemus tenuis Duméril & Bibron, 1837
Liolaemus andinus Koslowsky, 1895
Referencias: Goldberg *et al.*, 2004; Castillo *et al.*, 2020a

Spauligodon loboi Ramallo, Bursey, & Goldberg 2002
Hosp.: *Liolaemus capillitas* Hulse, 1979
Liolaemus ornatus Koslowsky, 1898
Liolaemus quilmes Etheridge, 1993
Liolaemus ramirezae Lobo & Espinoza, 1999
Liolaemus huacahuasicus Laurent, 1985
Referencias: Ramallo *et al.*, 2002b; Castillo *et al.*, 2020a

Genus *Skrjabinodon* Inglis, 1968
***Skrjabinodon* sp.** Inglis, 1968*
Hosp.: *Pristidactylus scapulatus*
Referencias: Castillo *et al.*, 2023a

Skrjabinodon castillensis González-Rivas, Castillo & Acosta, 2022*
Hosp.: *Homonota horrida* *
Homonota darwinii Boulenger, 1885*
Liolaemus gracielae
Referencias: González-Rivas *et al.*, 2022b; Castillo *et al.*, 2023b

Genus Thelandros Wedl, 1862
Thelandros sp. Wedl, 1862
Hosp.: *Tropidurus etheridgei*
Acanthochelys pallidipectoris (Freiberg, 1945)*
Phrynops hilarii
Referencias: Cruz *et al.*, 1998; Palumbo *et al.*, 2024

Suborden Ascaridina Inglis, 1983
Superfamilia Cosmocercoidea Railiet, 1916
Familia Atractidae Railiet, 1917
Subfamilia Atractinae Railliet, 1917

Genus *Labiduris* Schneider, 1866
Labiduris argentinensis González-Rivas, Castillo & Simoncelli 2024*
Hosp.: *Chelonoidis chilensis* (Gray, 1870)

Referencias: González-Rivas *et al.*, 2024a; Castillo *et al.*, 2020a

Familia Cosmocercidae Railiet, 1916
Subfamilia Cosmocercinae Railiet, 1916

Género *Aplectana* Railliet & Henry, 1916
Aplectana tucumanensis Ramallo, Bursey & Goldberg, 2008
Hosp.: *Amphisbaena bolivica* Mertens, 1929
Referencias: Ramallo *et al.*, 2008

Aplectana travassosi (Rego & Ibañez, 1965)
Hosp.: *Xenodon merremi*
Referencias: Lamas *et al.*, 2016

Aplectana nananae Ramallo, Goldberg & Ruiz, 2023*
Hosp.: *Amphisbaena darwinii* Duméril & Bibron, 1839*
Referencias: Ramallo *et al.*, 2023

Familia Kathlaniidae Lane, 1914 (Travassos, 1918)
Subfamilia Cruziinae Travassos, 1917

Género *Cruzia* Travassos, 1917
Cruzia sanjuanensis González-Rivas, Castillo & Simoncelli, 2024*
Hosp.: *Chelonoidis chilensis*
Referencias: González-Rivas *et al.* 2024b

Cruzia toba Ailán-Choke, Rosa, González & Pereira, 2024*
Hosp.: *Ameiva ameiva* (Linnaeus, 1758)*
Teius teyou
Referencias: Ailán-Choke *et al.*, 2024

Subfamilia Kathlaniinae Lane, 1914

Género *Falcaustra* Lane, 1915
***Falcaustra* sp.** Lane, 1915
Hosp.: *Chelonoidis chilensis*
Referencias: González-Rivas *et al.*, 2019; Castillo *et al.*, 2020a

Falcaustra affinis (Leidy, 1856)*
Hosp.: *Trachemys dorbigni* *
Referencias: Palumbo *et al.*, 2024

Superfamilia Heterakoidea Railliet & Henry, 1912
Familia Heterakidae Railliet & Henry, 1912

Subfamilia Spinicaudinae Travassos, 1920

Género *Strongyluris* Mueller, 1894
Strongyluris oscari Travassos, 1923
Hosp.: *Tropidurus spinulosus* (Cope, 1862)
Referencias: Sutton *et al.*, 1998; Castillo *et al.*, 2020a

Superfamilia Ascaridoidea Baird, 1853
Familia Ascarididae Baird, 1853
Subfamilia Angusticaecinae Skryabin & Karokhin, 1945

Género *Hexametra* Travassos, 1919
Hexametra boddaertii (Baird, 1860)
Hosp.: *Oxyrhopus guibei* Hoge & Romano, 1977
Referencias: Peichoto *et al.*, 2016; Castillo *et al.*, 2020a

Orden Rhabditida Chitwood, 1933
Suborden Rhabditina Chitwood, 193
Superfamilia Strongyloidea Baird, 1853
Familia Ancylostomatidae Looss, 1905 (= Diaphanocephalidae)
Subfamilia Diaphanocephalinae Travassos, 1920

Género Diaphanocephalus Diesing, 1851
Diaphanocephalus galeatus (Rudolphi, 1819)
Hosp.: *Salvator rufescens*
Referencias: Spinelli *et al.*, 1992; Castillo *et al.*, 2020a

Género *Kalicephalus* Molin, 1861
***Kalicephalus* sp.** Molin, 1861
Hosp.: *Xenodon merremi*
Referencias: Lamas *et al.*, 2016; Castillo *et al.*, 2020a

Kalicephalus subulatus Molin, 1861
Hosp.: *Xenodon merremi*
Referencias: González *et al.*, 2018; Castillo *et al.*, 2020a

Kalicephalus costatus (Rudolphi, 1819)
Hosp.: *Erythrolamprus miliaris* (= *Liophis miliaris*) (Linnaeus, 1758)
Referencias: Ramallo, 2005; Castillo *et al.*, 2020a

Familia Trichostrongylidae Leiper, 1908 (Leiper, 1912)
Subfamilia Molineinae Skryabin & Shultz, 1937

Género *Oswaldocruzia* Travassos, 1917
***Oswaldocruzia* sp.** Travassos, 1917*
Hosp.: *Tropidurus torquatus*
Referencias: Colunga *et al.*, 2021

Discusión

Presentamos una actualización sobre los nemátodos parásitos en reptiles de Argentina, cinco años después de la última revisión. Hasta la fecha, se han registrado 54 especies de reptiles en el país asociadas con nemátodos en una relación parásito-hospedador. En la revisión previa realizada por Castillo et al. (2020a), se habían identificado 40 especies de reptiles en esta interacción. En la presente actualización, incorporamos 14 nuevas asociaciones entre parásitos y sus hospedadores. Las nuevas interacciones corresponden a registros en lagartijas de la familia Liolaemidae (*L. gracielae*, *L. terani*, *L. hauthali*, *L. darwinii*, *L. riojanus* y *P.* cf. *palluma*), Phyllodactylidae (*H. horrida* y *H. darwinii*), Teiidae (*A. longicauda* y *A. ameiva*), Amphisbaenidae (*A. darwinii*), Dipsadidae (*P. trilineata*), Chelidae (*A. pallidipectoris*) y Emydidae (*T. dorbigni*), lo que representa un avance significativo en los estudios endoparasitológicos enfocados en nemátodos parásitos. Cabe destacar que algunos de estos nuevos registros probablemente se deben a estudios con fines taxonómicos, como los realizados por Ramallo y Stazzonelli (2023a,b), Ramallo *et al.* (2023), Castillo *et al.* (2023b) y, Castillo y González- Rivas (2024), entre otros. Al igual que en Castillo *et al.* (2020a), en la presente lista los reptiles más estudiados corresponden a lagartijas de la familia Liolaemidae, probablemente debido a la amplia distribución de los *Liolaemus*.

En los últimos cinco años, se ha registrado un notable aumento en la diversidad de nemátodos que parasitan reptiles, con la descripción de nuevas especies. Entre ellas se encuentran *T. acostai* en *L. eleodori*, *S. aff. lamothei* en *H. horrida*, *S. castillensis* en *H. horrida* y *H. darwinii*, así como *L. argentinensis* y *C. sanjuanensis* en *C. chilensis*, todas reportadas en la provincia de San Juan (Castillo *et al.* 2023 b; 2024; Castillo y González-Rivas, 2024; González-Rivas et al., 2024 a, b).

Nuestra conclusión final es que el conocimiento sobre nemátodos parásitos en reptiles sigue siendo escaso, especialmente en lo que respecta a estudios ecológicos. Esto probablemente se deba a un esfuerzo reducido de muestreos con fines parasitológicos, como ocurre en otros tipos de parásitos en la herpetofauna (Castillo, 2024) y a un escaso número de grupos de investigación dedicados a la parasitología en reptiles y anfibios.

Es importante generar listas y actualizar el conocimiento parasitológico en herpetozoos, ya que esto permitirá comprender mejor la diversidad de parásitos que interactúan con la fauna de reptiles en Argentina (Castillo, 2024). Por lo tanto, esperamos que la presente lista sea de utilidad a investigadores ecólogos y herpetólogos en la elaboración de planes de manejo y conservación.

Conflicto de Intereses

Los autores declaran no tener conflicto de intereses.

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Nota

Cuad. herpetol. 39 (1): 27-31 (*2025*)

First report of the interaction between the toad *Melanophryniscus nigricans* and the leech *Helobdella cordobensis* in the Tandilia Mountains

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ABSTRACT
Melanophryniscus nigricans is an endangered endemic anuran species restricted to the Tandilia Mountains in Argentina. We report for the first time the interaction between this toad species and the leech *Helobdella cordobensis.* We observed the interaction in a temporary pond at the "Sierra del Tigre" Natural Reserve during a breeding event of *M. nigricans* on February 7th, 2024. A leech was found attached to the belly of a toad and removed manually with no evidence of injury in the amphibian, suggesting a case of phoresis instead of parasitism. This report is also the first documented phoretic interaction between *H. cordobensis* and anurans from Argentina.

Key Words: Anuran; Argentina; Endemic species; Phoresis; Temporary pond.

Melanophryniscus nigricans is a recently described anuran species endemic from the highland grasslands of the Tandilia Mountains, a conservation priority area within the Pampas ecoregion in Argentina (Bilenca & Miñarro, 2004; Martinez-Aguirre *et al.*, 2021). This species is considered as endangered due to its restricted distribution, habitat loss and fragmentation, modification of natural grasslands, climate change, and woody invasive species (Cairo & Zalba, 2007; Martinez-Aguirre *et al.*, 2021).

Under climate change and habitat fragmentation scenarios, infectious diseases and macroparasites could pose additional threats to *Melanophryniscus nigricans* populations, that would merit future monitoring due to its high conservation priority (Soler *et al.*, 2014; Agostini *et al.*, 2015). For example, the chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) has contributed to amphibian population declines worldwide and has also been found infecting some *M. nigricans* specimens in the Tandilia Mountains (Blaustein *et al.*, 2011; Agostini *et al.*, 2015). Macroparasites, such as leeches (Hirudinea), could affect amphibian survival and were reported to interact with a great variety of anuran species (Kutschera *et al.*, 2010; Stead & Pope, 2010; Canazas-Teran *et al.*, 2024). The ecological relationships of leeches with amphibians are complex, either being considered as predators or parasites for all life stages of the latter (Romano & Di Cerbo, 2007; Soler *et al.*, 2014).

Helobdella cordobensis (Ringuelet, 1942) is a freshwater leech endemic to the Neotropical region, with records in Argentina and Chile, generally associated with montane environments (Ringuelet, 1985; Siddall & Borda, 2004; Christoffersen, 2009). It was first reported in Argentina for the Province of Córdoba, and later for Buenos Aires (Gullo, 2014; Gullo, 2015; Cortelezzi *et al.*, 2018), Tucumán and Jujuy (Romero, 2023).

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Species in the genus *Helobdella* are small, dorsoventrally flattened, predators of aquatic invertebrates, derived from putatively blood-feeding ancestors (Siddall & Borda, 2003; Oceguera-Figueroa, 2007). However, some authors argued that species of *Helobdella* might be parasitic (Platt *et al.* 1993).

Leeches attach to other animal species to feed (Govedich *et al.*, 2010), and also move to different places at their expense (phoresis), which allows them to colonize new habitas (Govedich & Mosser, 2015). Predatory species are known to have several phoretic hosts, including birds and amphibians (Platt *et al.*, 1993, Khan & Frick, 1997; Maia-Carneiro *et al.*, 2012).

Only two interactions between *Helobdella* and South American anurans were reported, both from Perú (Canazas-Teran *et al.*, 2024). Recharte (1995) recorded *Helobdella* sp., parasitizing *Telmatobius jelskii* in Cusco, and Canazas-Teran *et al.* (2024), who conducted the most recent review of amphibian-leech associations, confirmed the occurrence of *Helobdella* sp. attached to *Telmatobius arequipensis* in Arequipa and Apurimac. The main goal of this work is to report for the first time the interaction between *Melanophryniscus nigricans* and the leech *H. cordobensis* in the Tandilia Mountains, Argentina.

As part of the "Darwin's Blackish Toad conservation project," we conducted field surveys in the "Sierra del Tigre" Natural Reserve within the Tandilia Mountains between August 2023 and March 2024. This Reserve protects 140 ha of natural grasslands with high conservation priority, and although being part of a suburban landscape it holds several breeding sites of *Melanophryniscus nigricans* (Fig. 1; Bilenca & Miñarro, 2004; Cortelezzi et al, 2015).

During an explosive breeding event of *Melanophryniscus nigricans* in temporary ponds on February 7th, we observed a male carrying a leech specimen (37°22'40.4" S 59°08'00.4" W). The leech was attached to the belly of the toad (Fig. 2), which was collected and transported to the laboratory. The leech was cleared in glycerine and preserved in 70% alcohol, measurements and observations were performed using a stereomicroscope, and identification was based on Ringuelet (1985), Siddall & Borda (2004) and Marchese *et al.* (2020).

The leech was removed manually, with no evidence of injury, or further bleeding in the toad;

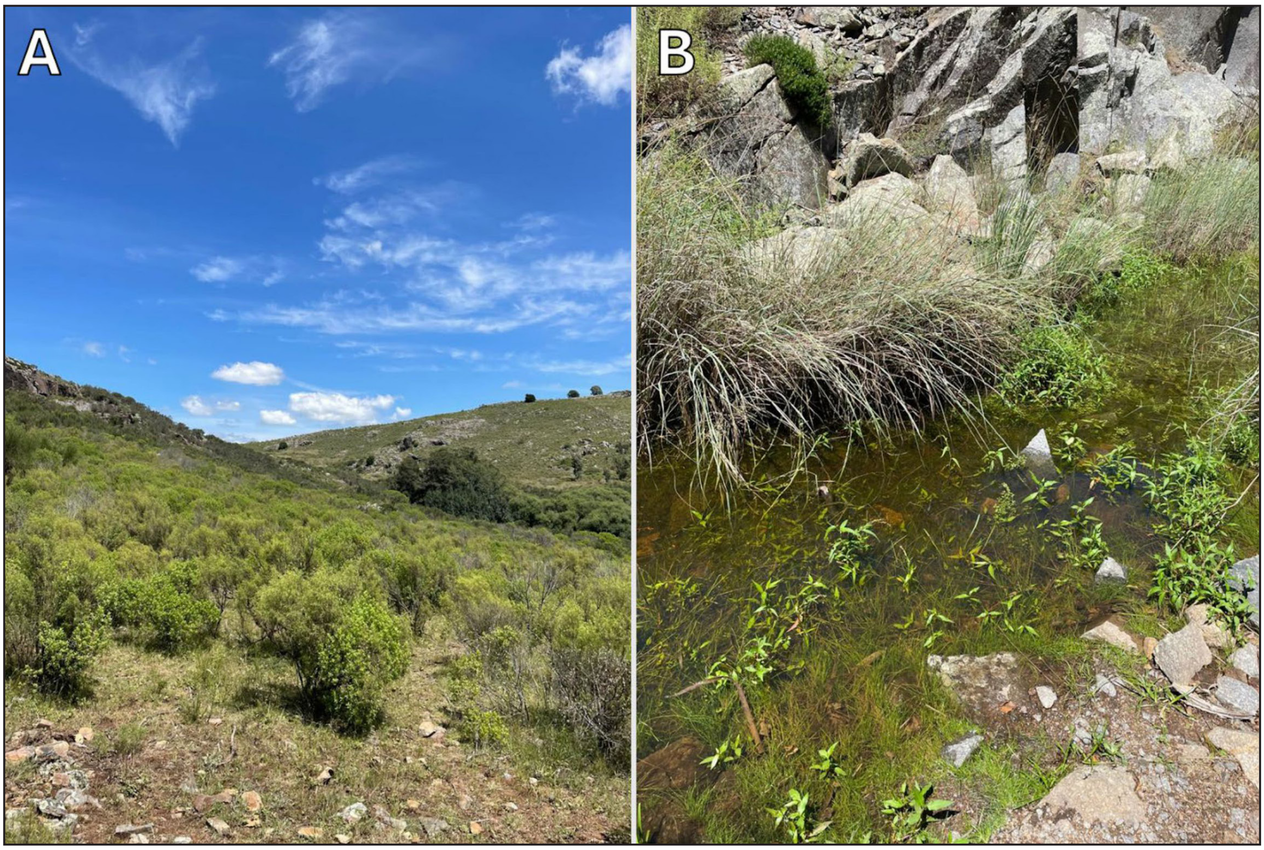

Figure 1. Highland Grasslands of Tandilia Mountains. Habitat of *Melanophryniscus nigricans* (A), and collection site at a breeding pond (B). Photo: Clara Trofino-Falasco.

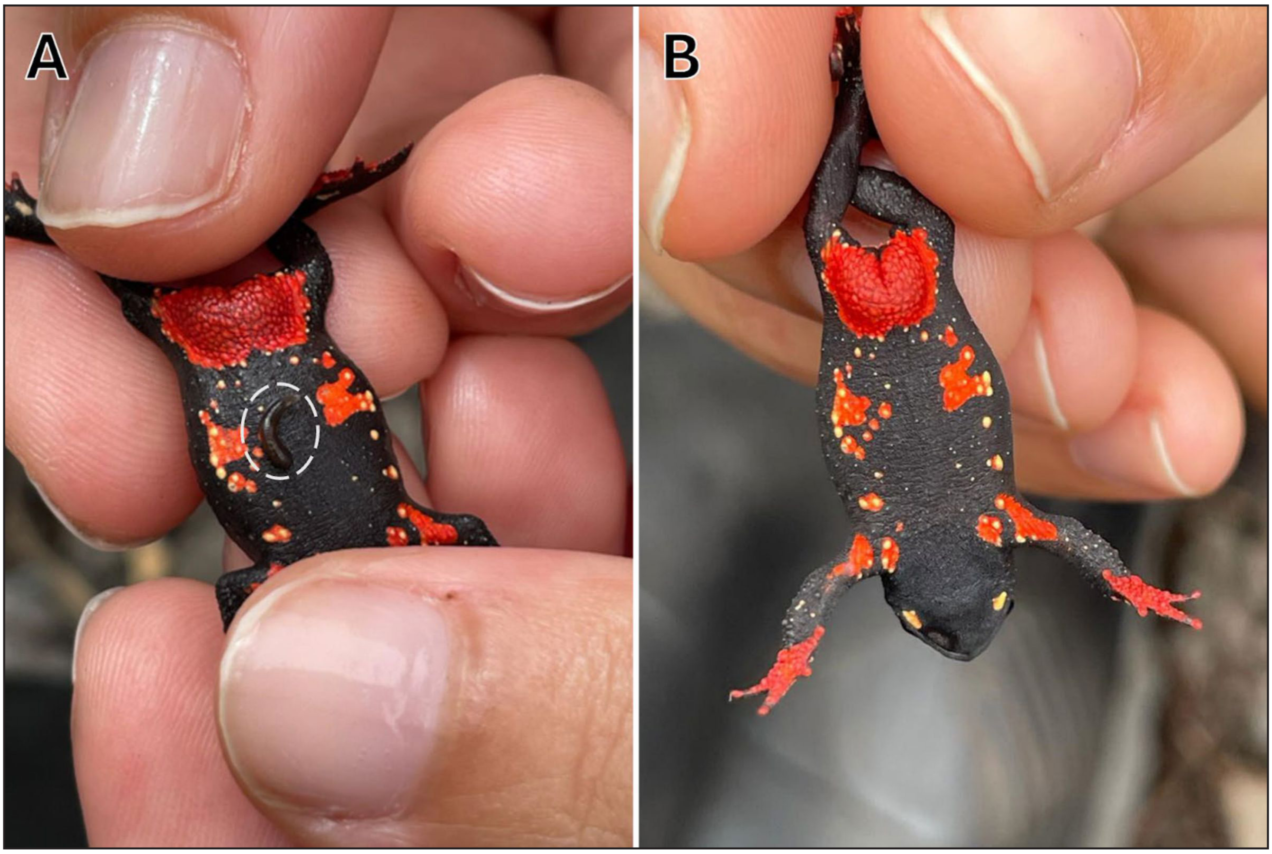

Figure 2. Phoresis of the leech *Helobdella cordobensis* by the toad *Melanophryniscus nigricans*, Tandilia, Argentina. Leech attached to the toad belly (A), ventral view of the skin once removed (B). Photo: Juan Boeris.

besides, we did not observe wounds or scars in satellite skin areas. We identified the leech specimen as *Helobdella cordobensis*. Adults of this species typically measure approximately 12 mm length and 6 mm width, with coloration that can vary from brown to light brown (Gullo, 2015). The specimen measured 4.5 mm in total length and 1.7 mm in maximum width. It had a pair of eyes located in somite IV, gonopores in XII separated by one annulus, simple annuli without gland or nuchal plate, with longitudinal lines of pigments on the dorsal surface. A straight pharynx extended to somite XIII with thick salivary ducts at its base and diffuse salivary glands, five pairs of gastric caeca of increasing size plus the pair of postcaeca in somite XIX with a descending path (Fig. 3). The reproductive system organs could not be observed since the specimen presented an immature state of development.

Our observations suggest that the relationship between *Melanophryniscus nigricans* and *Helobdella cordobensis* is a case of phoresis and not parasitism. Leech attachment to amphibian skin is favored in habitats where water level is low, as indicated for populations of *Rana iberica* in northern Spain (Ayres & Comesaña, 2010). Aquatic habitat reduction caused by usual hydrological cycles, droughts, or the pressure exerted by human activities could favor these interactions.

Species of the genus *Helobdella* are assumed to be predators, but some authors recognize the potential occurrence of ectoparasitism on amphibians, especially anurans. Tiberti & Gentilli (2010) reported parasitism of *Helobdella stagnalis* on *Rana temporaria*. On the other hand, Zimić (2015) and Gómez-Benitez *et al.* (2023) documented interactions between leeches and anurans, quoting both the possibility of parasitism and phoresy in their studies.

Our observation is the first case of phoresy between an anuran species and the genus *Helobdella* in Argentina. Little is known about other species of Glossiphoniidae leeches infesting anurans in South America (Christoffersen, 2009) and our work indicates that these ecological interactions may be more extended between *Helobdella* and Neotropical anurans. Further research may attend the possible impact of leeches on this endangered anuran, in the

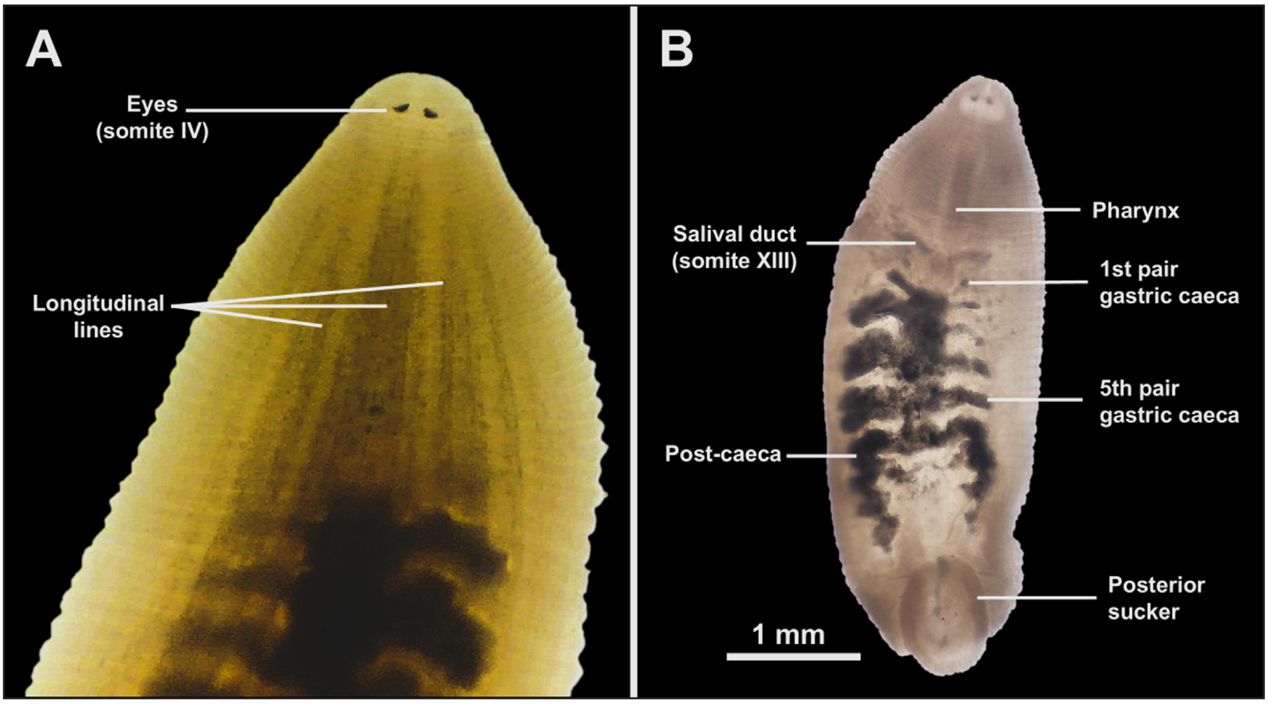

Figure 3. *Helobdella cordobensis* removed from *Melanophryniscus nigricans*. Dorsal view (A) and ventral view of clarified specimen (B). Photo: Facundo Tejedor.

context of current habitat loss and fragmentation of the natural grasslands it inhabits.

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Nota

Cuad. herpetol. 39 (1): 33-35 (*2025)*

Interacciones predador presa de *Phymaturus palluma* (Squamata: Liolaemidae) con *Agriornis montanus* (Aves: Tyrannidae) y *Upucerthia dumetaria* (Aves: Furnariidae)

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ABSTRACT
Predator-prey interactions are difficult to observe in nature, requiring time and systematic surveys to obtain results that can be documented. Photographic records are a tool that provides valuable information on species behavior in certain situations. This paper details the response of the lizard *Phymaturus palluma* to the presence of two birds from the genera *Agriornis* and *Upuchertia*, which suggest antipredatory behaviors by the reptile.

Key Words: High mountain lizard; Behavior; Black-billed Shrike-Tyrant; Scale-throated Earthcreeper; Mendoza.

RESUMEN
Las interacciones predador-presa son difíciles de observar en la naturaleza, las cuales requieren de tiempo y recorridas sistemáticas para obtener resultados que puedan documentarse. Los registros fotográficos son una herramienta que provee valiosa información del comportamiento de las especies en determinadas situaciones. En el presente trabajo se detallan respuestas conductuales del lagarto *Phymaturus palluma* ante la presencia de dos aves de los géneros *Agriornis* y *Upuchertia* las que sugieren comportamientos antipredatorios por parte del reptil.

Palabras Claves: Lagarto cola de piche; Comportamiento; Gaucho Serrano, Bandurrita Esteparia, Mendoza.

La conducta de predación en animales consiste en la capacidad de una especie para desarrollar estrategias que eviten su captura y posibiliten su escape ante potenciales amenazas o predadores. Si bien esto actúa como una fuerza selectiva que modela las poblaciones de las presas, estas interacciones predador-presa suelen ser poco observadas en el campo para determinadas especies (Fava *et al.*, 2018). Dentro del grupo de los lagartos escamosos y para el género *Phymaturus,* Fava y Acosta (2018) mediante recorridas y con la utilización de siluetas artificiales de aves, describieron para *P. williamsi* ocho tipos de conductas ante la presencia de posibles predadores: Cowering (modificación de la posición del cuerpo en respuesta a una amenaza, como agacharse o encogerse), Head bobbing (movimiento de oscilación de la cabeza), Forelimb waving (movimiento de miembros anteriores), Displacement (desplazamiento), Body turning (redirección o giro de la posición del cuerpo), Vigilance (exploración y movimiento de la cabeza hacia el predador), Jumping (salto) y por último, Hiding (ocultarse).

El género *Phymaturus* comprende lagartos Liolaemidos caracterizados por sus hábitos saxícolas, herbívoros y vivíparos (Lobo y Abdala, 2007), entre los que se incluye la especie *Phymaturus palluma* (Bell, 1843) comúnmente conocida como Lagarto cola de Piche. Tiene aspecto robusto, con coloración criptica pardo grisáceas en juveniles y hembras, mientras que en los machos adultos presentan partes verdosas, negras y amarillo ocre hacia la cola (Scolaro, 2006). Es un reptil generalmente manso, que permanece inmóvil sobre la superficie de las rocas en días soleados, pero que se vuelve activo y agresivo al defender su territorio, el cual establece en rocas y grietas donde el macho convive con crías y

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juveniles (Cei y Videla, 2002; Scolaro, 2006, Ferrer, *obs. pers.*). Su distribución abarca las provincias de San Juan y Mendoza, con su locación típica en "Uspallata-Paramillos" (Scolaro, 2010; Ávila *et al.*, 2013), encontrándose en todo el sector altoandino con preferencia en hábitats rocosos de basalto hendidos, ambientes de monte y roquedales de altura (Cei y Videla, 2002; Corbalán y Debandi, 2008). Actualmente es categorizada como una especie "Vulnerable" para la Argentina (Abdala *et al.*, 2012; Bauni *et al.*, 2021).

A continuación se detallan dos interacciones predador-presa registradas mediante fotografías y observación directa, las que involucran a este reptil y su respuesta ante la presencia de aves.

El primer evento se registró el 14 de noviembre de 2014, a las 9:50 horas, durante una de las recorridas habituales de monitoreo que se realizaban en la Quebrada de Punta de Vacas (32º50'49"S, 69º45'50"O; 2.400 m s.n.m.), Parque Provincial Aconcagua, provincia de Mendoza, cuando un individuo adulto de *P. palluma* se encontraba asoleándose sobre una roca. La repentina aparición de un ejemplar de *Agriornis montanus* (D'Orbigny y Lafresnaye, 1837), el cual sujetaba con el pico una lagartija (*Liolaemus sp.*) recientemente cazada, permitió observar la respuesta inmediata del *P. palluma* por alejarse hacia una zona opuesta para ocultarse (Fig. 1). Esta conducta coincide con las conductas de "desplazamiento" y "giro del cuerpo" mencionadas en Fava y Acosta (2018) como comportamiento antipredatorio para *P. williamsi*.

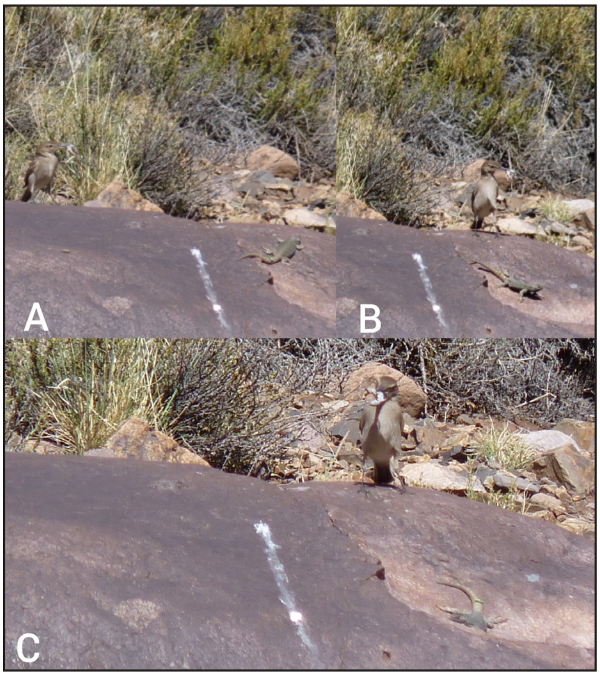

Figura 1. Interacción entre un ejemplar de *Phymaturus palluma* y un individuo de *Agriornis montanus,* el cual lleva una lagartija en el pico. (A) Aparición del ave sobre la roca, (B) aproximación del ave y desplazamiento del reptil y (C) rotación del cuerpo en dirección opuesta.

Tres días después, el 17 de noviembre de 2014, a las 9:58 horas, en el mismo sitio, se observó a un ejemplar de *Upucerthia dumetaria* (Geoffroy Saint-Hilaire, 1832) acercarse lentamente a un individuo de *P. palluma* desde el mismo sector de la roca que anteriormente lo había hecho *A. montanus*. En esta ocasión el reptil permaneció en el lugar, realizando un meneo de la cabeza, hasta que el furnárido voló a otro sector del roquedal (Fig. 2). Esto también coincidiría con las categorías de "vigilancia" y "oscilación/meneo de cabeza" señaladas en el trabajo de Fava y Acosta (2018).

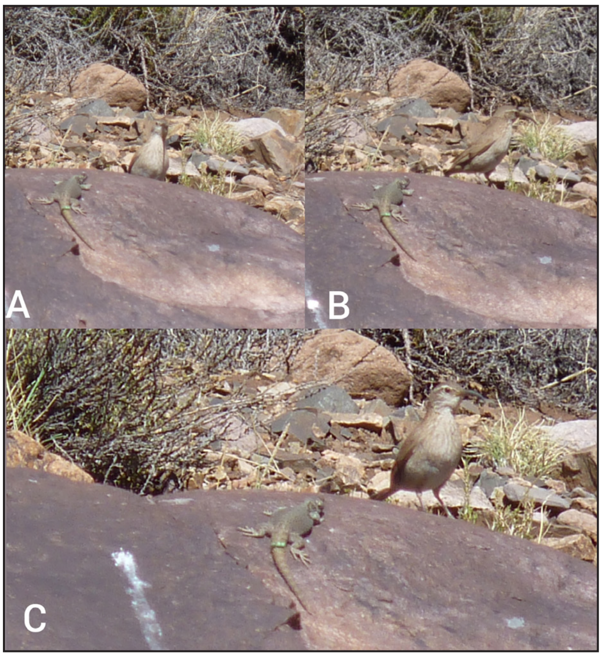

Figura 2. *Phymaturus palluma* ante la presencia de *Upucerthia dumetaria*. (A) La cercanía del ave provoca una conducta de vigilancia, (B) la cual se mantiene en conjunto con meneos de la cabeza y (C) que continuó hasta que el ave abandonó la roca.

El Gaucho Serrano, *A. montanus,* es un hábil y oportunista cazador que puede ingerir una gran variedad de presas (Ferrer, 2024), existiendo como ejemplo de lagartos escamosos antecedentes de la predación sobre *Pristidactylus achalensi* (Gallardo, 1964), *Phymaturus maulense* (Nuñez *et al.,* 2010) (De la Peña, 2023a; Ramirez-Alvarez y Cox, 2023) y especies de *Liolaemus* (Valdecantos *et al.*, 2024).

En el caso de la Bandurrita Esteparia, *U. dumetaria,* es un ave típica de la estepa arbustiva que se alimenta básicamente de insectos, renacuajos, peces, crustáceos, semillas y frutos, no existiendo hasta el momento datos sobre la inclusión de reptiles en su dieta (Martínez y González, 2017; De la Peña, 2023b).

Según Dos Anjos Rodrigues *et al.* (2024) los registros fotográficos y las observaciones de campo son herramientas que proveen importante información sobre la biodiversidad, desde aspectos poco conocidos de la dieta, comportamiento de alimentación, hasta las interacciones predador-presa. Los eventos aquí descriptos y registrados demostrarían a) una reacción y conducta antipredatoria de *P. palluma* respecto de *A. montanus* como un potencial predador, similar a lo que Fava y Acosta (2018) y Fava *et al.* (2018) mencionan para *P. williamsi* y Ramirez-Alvarez y Cox (2023) para *P. maulense* y b) la interacción con un ejemplar de *U. dumetaria*, la cual creemos que no representaría propiamente un predador para este reptil, por los antecedentes en la literatura respecto a la alimentación de este furnárido y debido a que *P. palluma* se mantuvo siempre a escasa distancia de la misma, en actitud de vigilancia, pero sin alejarse.

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A la Dirección de Recursos Naturales Renovables de Mendoza, al cuerpo de Guardaparques de la provincia de Mendoza, a la Dra. Nadia Vicenzi por los comentarios que enriquecieron el manuscrito y por autorizarme a utilizar fotos con ejemplares bajo su estudio en la zona, a los revisores por sus valiosos aportes.

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Nota

Cuad. herpetol. 39 (1): 37-40 (*2025*)

Thanatosis in the Gold-striped Frog *Lithodytes lineatus* (Anura: Leptodactylidae) in the tropical dry forest of northeastern Colombia

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ABSTRACT
Predation forces prey to develop multiple forms of evasion, including thanatosis, as a behavior that leads to the adoption of a posture where the animal appears to be dead. In this study we report for the first time thanatosis as a strategy present in the genus *Lithodytes* and the species *L. lineatus*, adding one more behavior to a list that includes Batesian mimicry, Müllerian mimicry, deimatic behavior and chemical mimicry.

Key Words: Predator-prey, North of Santander, Behavioral defenses, Antipredator behavior, Anurans.

RESUMEN
La depredación obliga a las presas a desarrollar múltiples formas de evasión, entre estas se incluye la tanatosis, como un comportamiento que conduce a la adopción de una postura donde el animal parece muerto. En este estudio se reporta por primera vez la tanatosis como una estrategia presente en el género *Lithodytes* y la especie *L. lineatus*. Por tanto, se suma un comportamiento más a la lista que incluye mimetismo Batesiano, mimetismo Mülleriano, conducta deimática y mimetismo químico.

Palabras Claves: Depredador-presa, Norte de Santander, Comportamiento defensivo, Comportamiento antipredatorio, Anuros.

Many amphibian species develop different behavioral strategies to avoid predation (Cloudsley-Thompson, 1999; Haynes and Sen, 1995; Humphreys and Ruxton, 2018; Toledo *et al.,* 2011). Anurans thwart predation with defensive adaptations such as immobility, crouching down, contracting, chin-tucking, phragmosis, puffing up the body, body-raising, cloacal discharge, defensive vocalisation, production of secretions, mimicry, thanatosis and many others. (Pedroso-Santos *et al.,* 2022; Santos *et al.,* 2016; Toledo *et al.,* 2011). Thanatosis, also known as "death feigning", is a response to predation events where individuals remain immobile, increasing the chances of survival by dissuading predators (Rogers and Simpson, 2014; Toledo *et al.*, 2010). Despite the fact that these strategies are well documented in anurans, there are no previous reports of this behavior in *Lithodytes lineatus* (Escobar-Lasso and González-Duran, 2012; Toledo *et al.,* 2010).

Lithodytes lineatus (Schneider, 1799) is a monotypical species of small frogs (SVL: 38.1-52 mm ♀; SVL: 34.9-47 mm ♂), distributed from

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northern Bolivia to northwestern Colombia (Frost, 2024). On 30 October 2024 at 11:00 pm, were recorded two individuals of *L. lineatus* (SVL: 45.3 mm ♀ and 37.5 mm ♂) in a tropical dry forest fragment, San Cayetano municipality, Cúcuta, North of Santander, Colombia (7.845193° N, 72.666591° W, datum WGS84, 783 m a.s.l.) (Fig. 1). The species was identified from the original descriptions of Duellman (2005) and the thanatosis was documented under the key criteria proposed by Rogers & Simpson (2014). The two individuals of *L. lineatus* were found at the edge of a nest (Nest area = 15m^2) of ants of the genus *Atta*. Both individuals were captured, measured, photographed and then released in the same area (Fig. 1. A). When released it was observed that both individuals remained motionless, with the abdomen

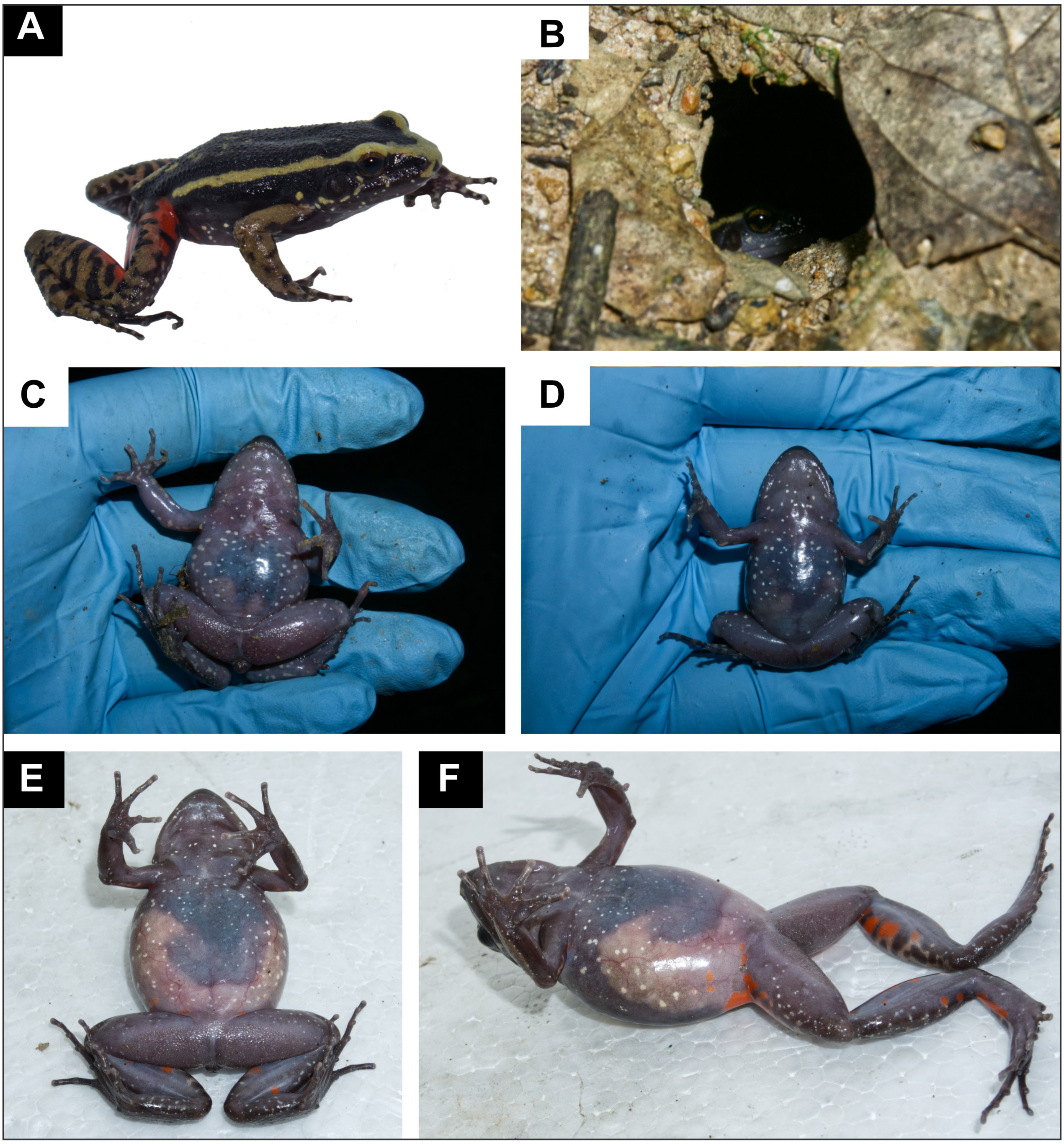

Figure 1. Photographic record of *Lithodytes lineatus* in a fragment of tropical dry forest, San Cayetano municipality, North of Santander, Colombia. A) Male in dorso-lateral view, B) Male hiding in the anthill after release, C) Female individual thanatosis when handled by the researcher and D) Male thanatosis when handled by the researcher. E and F) Female in a state of thanatosis or death feigning on a different substrate (styrofoam box).

turned upwards, widely separated fingers, partial or fully extended phalanges, eyes closed and forelimbs stretched away from the trunk (Fig. 1. C, D, E, F). Even when manipulated they did not exhibit any movements or escape attempts (Fig. 1. C, D). After manipulation, the frogs maintained this posture for approximately 2 minutes and 38 seconds (male), and 1 minute and 43 seconds (female) (Fig. 1. E, F), then recovered their normal posture rapidly, seeking refuge in the nearest entrance of the nest (Fig. 1.B). These observations suggest that the two individuals of *L. lineatus* display a typical thanatosis behavior.

Generally, this strategy is present in species that do not perform any other defensive response (Humphreys and Ruxton, 2018). However, *L. lineatus* presents a wide repertoire of strategies such as Batesian mimicry (similar to *Allobates femoralis;* Cintra *et al.,* 2014*)*, Mullerian mimicry (similar to *Ameerega picta*; Cintra *et al.,* 2014), chemical mimicry (similar to *Atta spp*; de Lima-Barros *et al.,* 2016) and deimatic behavior (Bernarde and Kokubum, 2009; Nelson and Miller, 1971; Prates *et al.,* 2011; Toledo *et al.,* 2010), to which this new record of death feigning or thanatosis is added. Other examples of thanatosis within the family Leptodactylidae are reported in *Leptodactylus macrosternum*, *L. vastus*, *L. cunicularius*, *L. labyrinthicus*, *L. fuscus*, *L. marambaiae*, *L. mystacinus*, *L. latrans* and *L. plaumanni* (de Oliveira-Santos et *al.,* 2023; Lourenço-de-Moraes *et al.,* 2014; Toledo *et al.,* 2010).

Thanatosis in *L. lineatus* is similar to that mentioned in other of the Leptodactylidae species, but with its own particularities such as the anterior and posterior extremities extended, and the slightly more extended fingers (Fig. 1. E, F). In addition, as with other strategies such as Batesian mimicry and deimatic behavior (Cintra *et al.* 2014), it would be worth considering a more in-depth evaluation of this behavior, including a wide range of individuals, populations and a precise experimental design. These observations constitute the first records of thanatosis for the monotypic genus *Lithodytes* and add one more defensive strategy for its repertoire.

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Nota

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Limbs interweaving for Neotropical anurans

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ABSTRACT
Anurans have developed a variety of antipredator behaviors, including aposematism, posturing, and leg interweaving, to enhance survival against predators. Leg interweaving, observed in species like *Dendropsophus branneri* and *D. oliverai*, involves crossing limbs and may serve as a displaced behavior rather than a true defense. Unlike species with bright aposematic colors, these frogs rely primarily on camouflage for protection. The variability and limited documentation of leg interweaving highlight the need for further experimental research to clarify its function and significance, contributing to a deeper understanding of the adaptive strategies employed by anurans under predation pressure.

Key Words: Legs interweaving; Anuran behavior; Displaced behavior; Defensive strategies.

Predation has been a crucial selective force driving the evolution of behavioral and life-history traits in amphibians (Wells, 2007). Anurans, in particular, exhibit a wide array of antipredator mechanisms that may act independently or synergistically to enhance survival (Marchisin & Anderson, 1978; Duellman & Trueb, 1994; Toledo *et al.* 2011). These mechanisms fall into 30 categories (Toledo *et al.* 2011) and are classified based on their roles in avoiding detection, preventing attacks, or countering predators. Prevention tactics include aposematism, charging, posturing, escape, and warning sounds (Ferreira *et al.* 2019). Legs interweaving is a postural defense mechanism that may serve to avoid identification, often accompanied by disruptive or aposematic coloration and potentially toxic secretions (Toledo *et al.* 2011). This behavior involves intertwining the limbs and may display bright colors, aid in skin secretion dispersion, or simulate injury, as observed in *Leptodactylus chaquensis* and *Hylomantis aspera* (Toledo *et al.* 2011; Ferreira *et al.* 2019). It was first documented in *Hylambates keithae*, a species endemic to Tanzania (Channing & Howell, 2003). Observations of leg interweaving in *Dendropsophus branneri* and *D. oliverai* suggest it may function as a defensive mechanism or a displaced behavior, warranting further investigation.

Behavioral observations were made alongside a temporary pond located within the campus of Universidade Federal de Pernambuco (UFPE) (8°2'47.84" S 34°57'9.70" O), in the city of Recife, state of Pernambuco, Brazil. The pond surface had an approximate area of 14 m² and was surrounded by herbaceous vegetation, mainly tall grass. On May 29, 2024, the authors visited the pond at night with the objective of collecting couples of *Dendropsophus branneri* for research, and defensive behaviors were recorded upon capture of adult specimens of *D. bran-*

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neri and *D. oliveirai*. To document the behavior, the specimens were captured by hand and restrained by one of their forelimbs. Other individuals of *D. branneri* were manually captured, always held by the left forelimb, to allow for free movement of hindlimbs. When the behavior of legs interweaving (the frog turns onto its back, throwing its limbs over its body and displaying aposematic or disturbing colors on its legs and belly), thanatosis (the individual adopts a posture that gives it the appearance of being dead, which can inhibit or deflect the attack of a potential predator), or kicking (the frog is grasped by the head it pushes the predator's face or hands with its hind legs and kicks) occurred, the duration of the behavior was recorded, and the number of kicks was counted. After the behavior ceased, the individuals were released at the original capture site. Handling procedures were conducted under authorization granted by the Sisbio/ICMBio license n°. 84573-1 and approved by the Animal Use Ethics Committee of the Federal University of Pernambuco (protocol n° 141/2022).

The observation of limb interweaving behavior occurred during handling of specimens. A gravid female of *D. branneri* was captured by hand and immediately interwove her hindlimbs (Fig. 1A). Upon collection, it immediately assumed this posture, which lasted approximately 1 minute and 13 seconds. The specimen crossed the right hindlimb over the left. Once she uncrossed her legs, she jumped back into the vegetation. Additional 13 specimens of *D. branneri* were manually captured using the same procedure. Seven exhibited thanatosis (limbs and curving their bodies and retracting their limbs) and maintained this posture for approximately 2 minutes and 35 seconds (minimum 2 minutes and maximum 3 minutes and 10 seconds). Once the posture ended, they jumped back into their natural habitat. The most frequently observed behavior among the *D. branneri* specimens was kicking, performed by eleven of the fourteen individuals. Of these, five were the same individuals that exhibited thanatosis. The kicks were predominantly delivered with the left hindlimb (ten out of eleven), with only one individual kicking with the right hindlimb. While collecting *D. branneri* we accidentally captured a female of *D. oliverai*, which displayed a similar behavior of legs interweaving (Fig. 1C), crossing her right leg over her left. After 1 minute and 15 seconds maintaining this posture, the female return to its resting position and was released into the vegetation.

The most recent report on antipredator mechanisms in anurans was made by Ferreira *et al.* (2019). Extensive research has highlighted interactions between anurans and their predators, encompassing arthropods, fishes, mammals and birds (Toledo 1995, Zug *et al.* 2001). Although many of these records are opportunistic in nature, they play a crucial role in ethological studies, as they provide fundamental insights into animal behavior and the complex interactions between species (Wells 2007), acting as a selective pressure driving the evolution of antipredator strategies in anurans. In this context, behavioral displacement often occurs during defensive actions, manifesting as deviations from typical behaviors or the engagement in seemingly unrelated

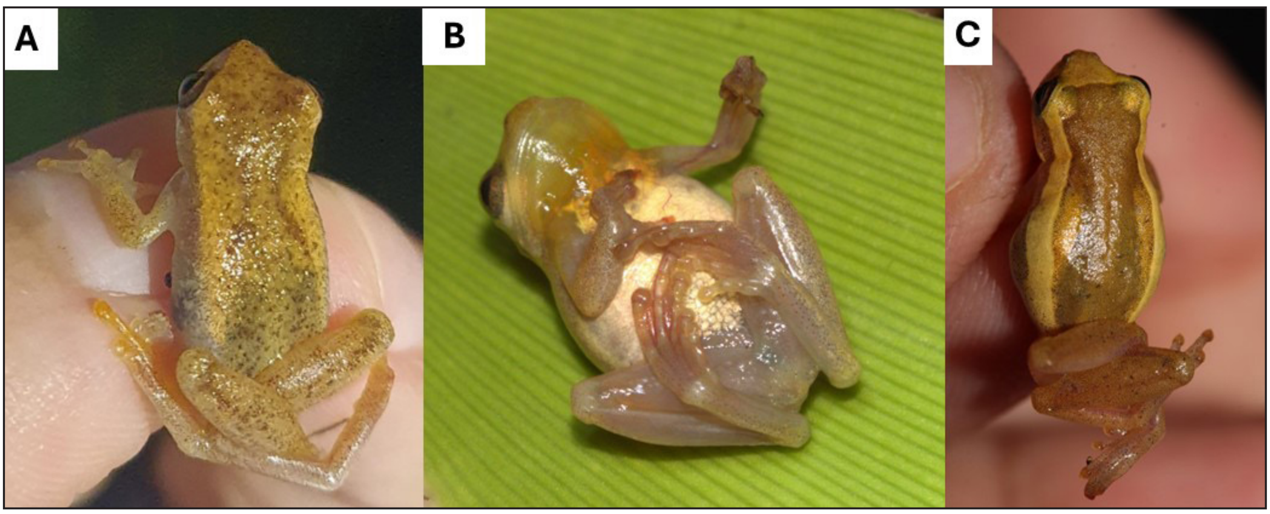

Figure 1. Defensive postures of some *Dendropsophus* specimens when handled by their forearm: (A) female *D. braneri* displaying legs interweaving; (B) male *D. branneri* displaying thanatosis; (C) female *D. oliveirai* displaying legs interweaving. All specimens recorded at the campus of Universidade Federal de Pernambuco, in Recife, northeastern Brazil.

activities. This phenomenon indicates that animals may adopt seemingly irrelevant behaviors as coping mechanisms in response to perceived threats or stressors (Lorenz 1966 , Moyer 1967). Understanding this interplay between defensive behavior and displacement can further elucidate the adaptive strategies employed by anurans and other animals under threat, highlighting the nuanced ways in which these species evolve their antipredator mechanisms.

In addition to the records described herein, legs interweaving was documented in ten species of anurans, distributed in five families (Table 1). Interweaving posture varies among different species and can be roughly classified based on limb position: Type 1: interweaving arms and legs over the body ventrally (*Hylambates keithae* – Fig.2A); Type 2: knees in touch and interweaving ankles (*Adenomera hylaedactyla* – Fig. 2H); Type 3: interweaving legs on the back and sides (*Hylomantis aspera* – Fig. 2E); Type 4: interweaving legs and overlap them (*Leptodactylus macrosternum, Leptodactylus latrans* – Fig. 2G and F, respectively); Type 5: interweaving legs over the back (*Physalaemus crombiei* – Fig. 2F); Type 6: interweaving legs in the inguinal region (*Frostius pernambucensis*, *Haddadus binotatus*, *Bokermannohyla oxente, Dendropsophus branneri, D. oliverai* and *Scinax tripui* – Fig. 2A and C, and Fig. 2B, C, D, respectively).

Table 1. Anuran species for which the behavior of "limb interweaving" has been documented.

Family	Species	Local	Reference
Bufonidae	*Frostius pernambucensis*	Alagoas (Brazil)	Ramos *et al.* (2021)
Craugastoridae	*Haddadus binotatus*	Bahia (Brazil)	Rojas-Padilla *et al.* (2019)
Hylidae	*Bokermannohyla oxente*	Bahia (Brazil)	Souza *et al.* (2020)
	Dendropsophus branneri	Perrnambuco (Brazil)	present
	Dendropsophus oliverai	Pernambuco (Brazil)	present
	Hylomantis aspera	Bahia (Brazil)	Gally *et al.* (2014)
	Scinax tripui	Minas Gerais (Brazil)	Vieira *et al.* (2022)
Hyperolidae	*Hylambates keithae*	Tanzania	Channing & Howell (2003)
Leptodactylidae	*Adenomera hylaedactyla*	Piauí (Brazil)	Eduardo *et al.* (2021)
	Leptodactylus macrosternum	São Paulo; Paraná; Pernambuco (Brazil)	Lourenço-de-Moraes *et al.* (2014); Santiago *et al.* (2021)
	Leptodactylus latrans	Espírito Santo (Brazil)	Mathielo *et al.* (2022)
	Physalaemus crombiei	Espírito Santo (Brazil)	Mathielo *et al.* (2022)

Given that in our study only one specimen out of 14 *Dendropsophus branneri* (ten males and four females) displayed legs interweaving behavior, we hypothesize that it may represent a case of displaced behavior, instead of a defensive mechanism. Displacement activities are behavioral patterns exhibited by an animal that are apparently irrelevant to its ongoing activity (Tinbergen 1952) and may be categorized as displaced when evaluated in terms of the expected norms compared to the actual behavior observed in other individuals. This behavior can occur, for example, in conflict situations (McFarland 1966). There are different hypotheses about the emergence of displacement activities. Some authors suggest that tension builds up during conflict and is released in some way through the performance of displacement activity (e.g., Tinbergen 1952). Others propose that conflicting tendencies inhibit each other, allowing a third and irrelevant tendency to manifest, thus giving rise to displacement activity (e.g., van Iersel & Bol 1958). In rhesus monkeys, displacement activities are anxiety signals (Maestripieri *et al.* 1992b). Other examples of atypical behavior in Anura include reproductive displacement in *Anaxyrus fowleri* and *Anaxyrus terrestris* during their release calls (Leary 2011), and in *Phyllomedusa bicolor*, where a male separates nearby pairs in amplexus (Venâncio & Melo-Sampaio 2010).

Some species exhibit defensive mechanisms to display their aposematic coloration, which is plesiomorphic in Anura and shows numerous apomorphies across families (Toledo & Haddad, 2009). This display involves bright colors (such as red, blue, orange, or yellow), hypertrophied glands,

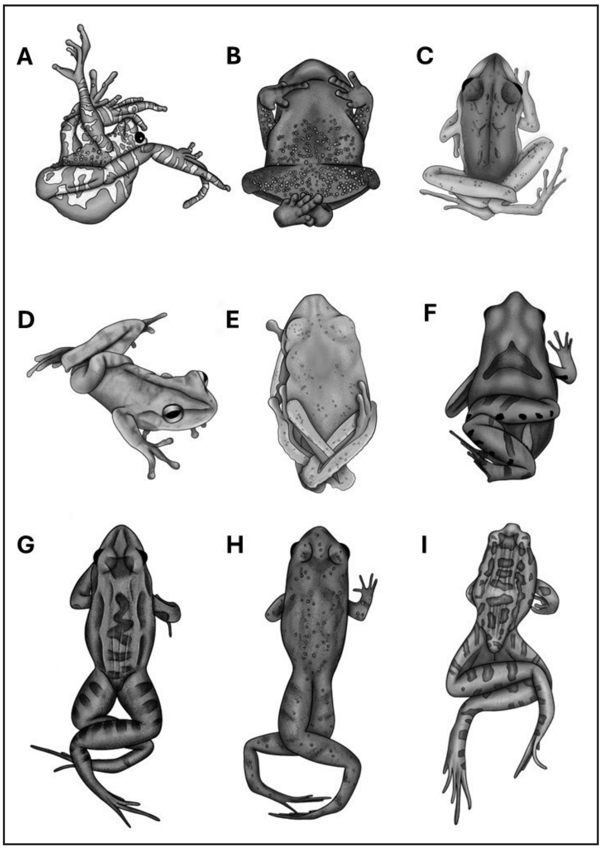

Figure 2. Anurans species showing legs interweaving when threatened by a potential predator: (A) *Hylambates keithae* (Channing & Howell 2003), (B) *Frostius pernambucensis* (Ramos *et al.* 2021), (C) *Haddadus binotatus* (Rojas-Padilla *et al.* 2019), (D) *Bokermannohyla oxente* (Souza *et al.* 2020), (E) *Hylomantis aspera* (Gally *et al.* 2014), (F and G) *Physalaemus crombiei* and *Leptodactylus latrans,* respectively (Mathielo *et al.* 2022), (H) *Adenomera hylaedactyla* (Eduardo *et al.* 2021) and I: *Leptodactylus macrosternum* (Lourenço-de-Moraes *et al.* 2014).

or eye-shaped spots located on the dorsum, axilla, underside of the body, thighs, or postfemoral region (Toledo & Haddad, 2009). These features act as deceptive signals to disorient and confuse attacking predators or to warn them of the presence of toxins or unpalatability (Siddiqi *et al.* 2004). Based on observations of defensive behaviors of *Adenomera hylaedactyla, Bokermannohyla oxente* and *Haddaus binotatus*, authors claim that legs interweaving is not related with aposematism because of the absence of bright coloration, hypertrophied glands, or eye-shaped spots on their bodies indicating the presence of toxins and unpalatability (Ferreira *et al.* 2019, Souza *et al.* 2020). We suggest that legs interweaving in *D. branneri* and *D. oliverai* are also not related with aposematism, due to the lack of warning colors. It is known that the skin of *Hyla* species (the former genus that included *H. branneri* and *H. oliverai*) produces a diverse array of bioactive peptides that act as a first line of defense against predators and pathogens. These peptides are stored in specialized glands and secreted onto the skin surface when the frog is threatened (Wu *et al.* 2011, Chai *et al.* 2021, Yin *et al.* 2023). For *Dendropsophus* species, there is a gap in knowledge regarding the composition of secretions produced and stored in their skin, and therefore it cannot be confirmed whether or not they possess any toxic substances that function as a defense against predators. It is well known that frogs in genus *Dendropsophus* employs camouflage with disruptive coloration as a defense mechanism to avoid detection. This involves the use of contrasting markings to make the detection of body edges and boundaries more challenging for predators. This coloration may manifest as light dorsal stripes (as seen in *D. oliverai*), irregular spots or patches, dark lines around the eyes, or ocular markings (as in *D. branneri*) (Wells 2007).

It is possible that legs interweaving is actually a type of displaced behavior and that, at least in *D. branneri*, individuals will generally count on alternative defensive strategies (kicking, feigning death) when threatened by a potential predator. Most records of legs interweaving to date were based on a small number of observations conducted in the field, and the resulting display is extremely variable (Fig. 2). Hence, the study of potential alternative defensive mechanisms in anurans would greatly benefit from experimental approaches, with an increased number of samples and well-defined experimental controls.

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Cuad. herpetol. 39 (1): 47-53 (*2025*)

A new addition to the frog fauna of Uruguay, *Physalaemus cristinae* Cardozo *et al.*, 2023 (Anura, Leptodactylidae)

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ABSTRACT

We present the first finding in Uruguay of the recently described frog *Physalaemus cristinae*. Adult specimens were collected in two localities of north-western Uruguay, on the east bank of the Uruguay River: near the city of Bella Unión associated to temporal ponds of an agricultural area; and in an urban area within the city of Salto. The advertisement call consisted of a single and non-pulsed note, characteristic of *P. cristinae*. In addition, partial sequences of the cytochrome b gene confirmed the species identity. We consider that the presence of *P. cristinae* in north-western Uruguay, previously unregistered in a well sampled area, is due to recent cross-river dispersal from populations in the Provinces of Entre Ríos and Corrientes, Argentina, on the west bank of the Uruguay River.

Key Words: Amphibian; Geographic distribution; Uruguayan savanna; *Physalaemus*.

Uruguay is situated within the Uruguayan savanna ecoregion of eastern South America, at the southern part of the Neotropical Region (Morrone, 2014). The north-west of this country constitutes a transitional zone with the Southern Cone Mesopotamian Savanna and Espinal ecoregions of Argentina. Consequently, the geographic distribution of some vertebrate species associated to these biomes reach north-western Uruguay as the boundaries of their distributions. There are well known examples of this among amphibians, like the species *Rhinella dypticha* (Cope, 1862) (Bufonidae; Klappenbach, 1969), *Pseudis limellum* (Cope, 1862) (Gudynas and Rudolf, 1983), *Dendropsophus nanus* (Boulenger, 1889) (Langone and Basso, 1987), *Scinax nasicus* (Cope, 1862), *Leptodactylus macrosternum* Miranda-Ribeiro, 1926, and *L. podicipinus* (Cope, 1862) (Vaz-Ferreira *et al*., 1984). A similar distribution pattern is exhibited by the recently described frog *Physalaemus cristinae* Cardozo *et al*. (2023) of the *P. cuvieri* Fitzinger, 1826 species group (Leptodactylidae), present in central-eastern Argentina and Paraguay. This species dwells from the Humid Chaco to the Espinal ecoregion more southwards, including some areas adjacent to north-western Uruguay but the species was still not recorded from this country. Herein, we present the first record of *P. cristinae* in Uruguay, based mainly on DNA sequences and acoustic analy-

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sis.Vouchers were accessioned at the herpetological collection of Museo Nacional de Historia Natural (MNHN), Montevideo, Uruguay. Four adult frogs were collected in the agricultural area of Alcoholes del Uruguay – ALUR (GRA; 30.1957ºS, 57.3637ºW), 7 km south from the city of Bella Unión, Departamento de Artigas: MNHN 9949 and MNHN 9950, 29 January 2024, males, snout-vent length (SVL) 22.1 mm and 21.7 mm respectively; MNHN 9951, 9 February 2024, female, SVL 25.0 mm; MNHN 9952, 3 March 2024, male, SVL 22.8 mm. An additional one was captured within the urban area of the city of Salto, Departamento de Salto (SGBS; 31.2408ºS, 57.5903ºW): MNHN 9999, 2 April 2025, male. The climate in this region is temperate wet with average annual temperature and precipitation of 19.8 ºC and 1600 mm respectively (Bidegain *et al.*, 2012). Land use in the surrounding landscape is dominated by intensive agriculture, mainly rice and sugar cane crops. At ALUR, frogs were detected at night during summer, around human habitations and temporary ponds of adjacent grasslands. Most captured specimens were males found calling hidden among herbaceous vegetation (Fig. 1). The specimen from Salto was captured in a temporary pond within an urban area, while calling along with *Odontophrynus asper* and *Leptodactylus latinasus*.

Genomic DNA from tissue samples of two specimens was extracted after Aljanabi and Martínez (1997), and fragments of the cytochrome b gene (*Cyt-b*) were amplified by standard polymerase chain reaction (PCR) using the primers MVZ15 (5'-GA-ACT AATGG CCCAC ACWWTA CGNAA-3'), and MVZ16 (5'-AA ATAGG AARTA TCAYT CTGGT TTRAT-3'), after Moritz *et al.* (1992). The purified amplicons were sequenced in both directions at Macrogen Inc. (Korea), and chromatograms processed using the software DNABaser v.3 (Heracle BioSoft, 2013). DNA sequences were accessioned in the GenBank database: PQ316074 (MNHN 9951), and PQ316075 (MNHN 9952). Alignments were done with Clustal W (Thompson *et al.*, 1994), executed in BioEdit (Hall, 1999) under default parameters.

The obtained sequences were studied in a phylogenetic analysis run along with a subset of the matrix data of the *Cyt-b* gene previously used by Cardozo *et al.* (2023), available from GenBank: *Engystomops freibergi* OR453824; *Physalaemus albifrons* OR453860; *P. albonotatus* OR453812-OR453816, OR453820, OR453829- OR453831, OR453842, OR453843, OR453845, OR453847, OR453854, OR453855, OR453861, OR453862; *P. barrioi* OR453825; *P. biligonigerus* OR453848; *P. cristinae* OR453826, OR453833, OR453838, OR453840, OR453849, OR453852, OR453856, OR453858: *P. cuvieri* OR453821; *P. lateristriga* OR453817; *P. lisei* OR453834; *P. nattereri* OR453863; *P. santafecinus* OR453853; *P. signifier* OR453823; *P. spiniger* OR453822. Sequence sampling mainly focused on *P. cristinae* given its known geographic proximity, and it sister taxon *P. albonotatus*. The most parsimonious trees were inferred through heuristic searches employing TNT software (Goloboff *et al.*, 2008), with 1000 addition sequences of the tree bisection-reconnection, retaining 100 trees per replication. Support values were estimated on strict consensus tree running of 1000 replicates under parsimony jackknife (Farris *et al.*, 1996) with default TNT settings, and 0.36 of removal probability.

At the site of collection of the studied specimens we could record the advertisement call of an unvouchered male with an iPhone 8 cell phone, on 28 February 2024, at 0:20 am, with 24º C environmental temperature. A single note was analysed with Sound Forge Pro 17 software, with the sonogram generated by Blackman-Harris, 2.048 FFT, 90% overlap FFT, and 10.000 resolution. Graphics were obtained with Raven Pro 1.6.5 (K. Lisa Yang Center for Conservation Bioacoustics, 2024).

The phylogenetic analysis indicated that the specimens collected in northern Uruguay are *P. cristinae*. Their partial sequences of the *Cyt-b* gene were recovered within a well-supported clade that grouped all analysed terminals of this species (Fig. 2). This clade was the sister of another one corresponding to *P. albonotatus*, a closely related taxon considered the sister species of *P. cristinae* by Cardozo *et al.* (2023). Both species are cryptic and similar to *P. cuvieri*, from which *P. cristinae* slightly differs due to the absence of reddish colouration in the inguinal region Cardozo *et al.* (2023). This feature was not present in our study specimens, whose major external morphological characters matched with those of *P. cristinae* as indicated by Cardozo *et al.* (2023) in the description of the species, for instance: medium size (SVL range 20.5-32.0 mm), slender body, smooth dorsal skin, head longer than wide, absence of V-shaped dorsal pattern, dorsal colouration with brown tones or entirely green, sacral region without dark ocelli, absence of a narrow white outline of the mandible or extending from the posterior corner of the eye, absence of a median

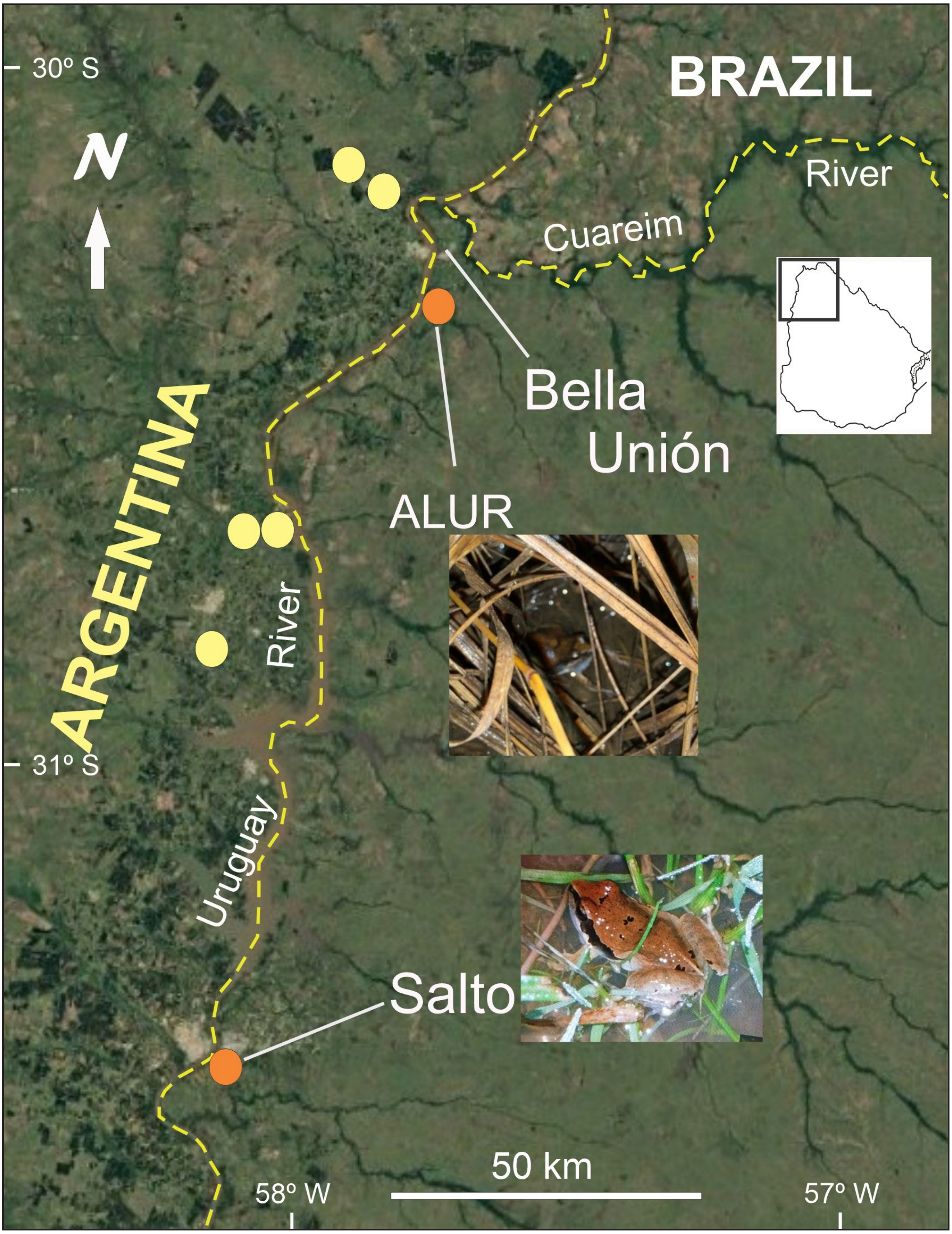

Figure 1. Location of ALUR - Alcoholes del Uruguay, and Salto, in northern Uruguay, sites of collection of *Physalaemus cristinae* (insets) in temporary ponds; orange dots. Closest known localities in Argentina, are indicated after Cardozo et al. (2023), yellow dots. Dashed lines correspond to country borders (image adapted from Google Earth Pro, 26 May 2025).

stripe on throat and chest (plus the abdomen), but sparse spotting.

Another relevant taxonomic character useful to distinguish *P. cristinae* from *P. albonotatus* is the advertisement call. In the case of *P. albonotatus* the call consists of a single and pulsed long note (1.1–1.5 s), whereas the call of *P. cristinae* is composed by a single but non-pulsed note (0.91–1.77 s). Additional characteristics of the latter are fundamental frequency between 517–696 Hz, starting at 519–865 Hz, ending at 484–634 Hz, and the dominant frequency mainly over the first, fourth, or fifth harmonics (Cardozo *et al.*, 2023).

The advertisement call characteristics of our recorded specimen (single note) are overall coincident with that described for *P. cristinae* (Fig. 3): a non-pulsed note of 0.78 s., with descendant modulation, fundamental frequency starting at 793 Hz and ending at 607 Hz, being the dominant frequency 3243 Hz–2352 Hz. The call is noticeably longer from that of *P. cuvieri* (0.25 – 0.33 s, see Braga *et al.*, 2023) also present in Uruguay.

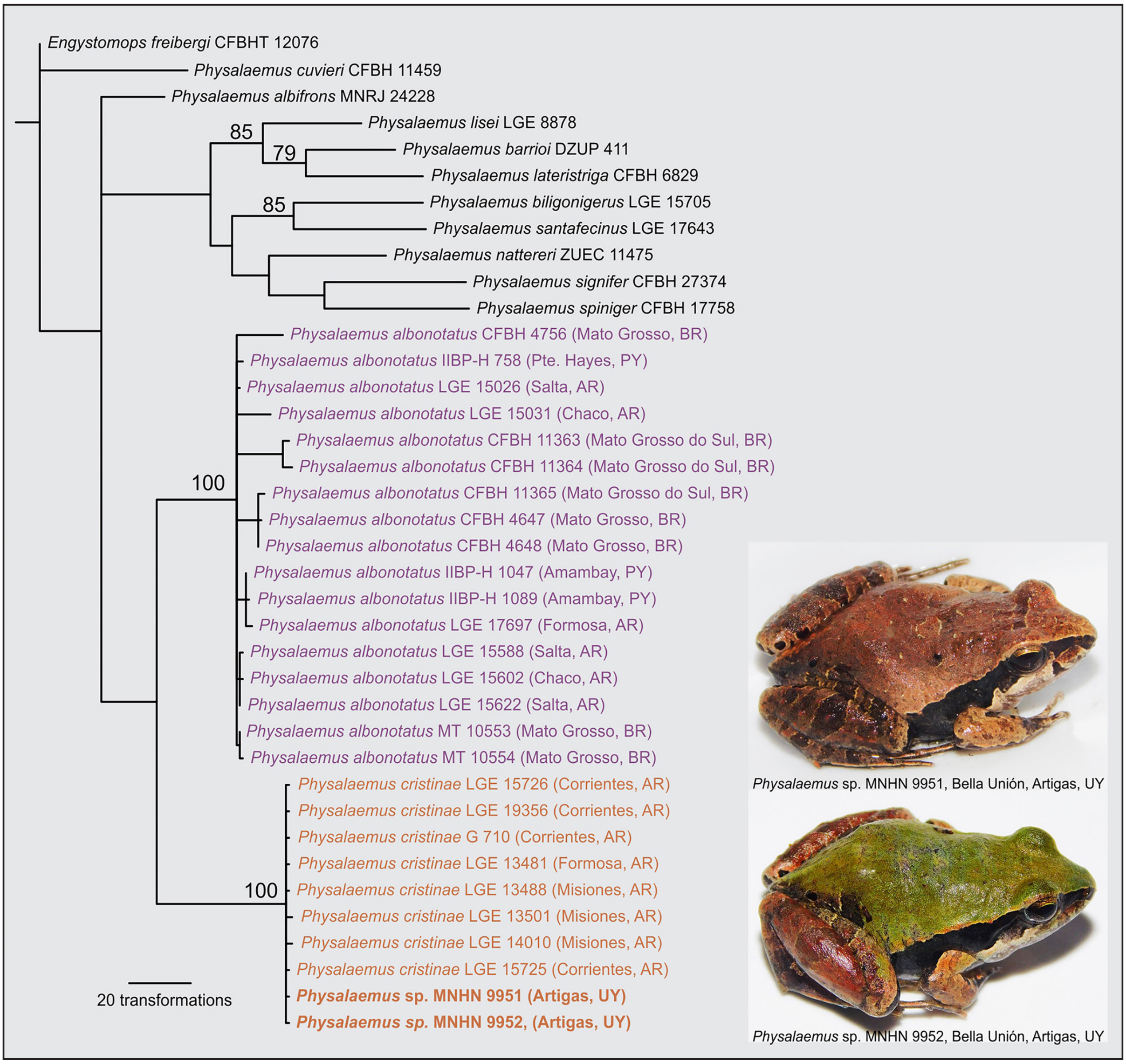

Figure 2. Phylogenetic relations of studied *Physalaemus* specimens from northern Uruguay (UY) based on partial sequences of the *Cyt-b* gene, studied against a subset of data used by Cardozo et al. (2023). The analysis targeted relationships with *P. albonotatus* and its sister taxon *P. cristinae* given their geographic proximity, including specimens from Argentina (AR), Brazil (BR), and Paraguay (PY). The figure shows the strict consensus of the 70 trees of 1032 steps obtained with TNT, branch lengths are proportional to the number of transformations, and node Parsimony Jackknife supports greater than 50 are indicated.

The presence of *P. cristinae* in north-western Uruguay is in agreement with the geographic distribution of the species depicted by Cardozo *et al.* (2023). Furthermore, according to these authors, the closest known populations of the cryptic species *P. albonotatus* are present approximately 600 km to the northwest, in Chaco Province, Argentina. Until the present work, only *P. biligonigerus* (Cope, 1861) and *P. riograndensis* Milstead, 1960, were recorded in much of our study area (Núñez *et al.*, 2004). These species are morphologically very different from *P. cristinae*, much smaller SVL in *P. riograndensis* (14-26 mm; Barrio, 1965), and more robust body and shovel-like metatarsal tubercles in *P. biligonigerus* (Barrio, 1965; Nascimento *et al.*, 2005; Lourenço *et al.*, 2015). It must be noted that the authors intensively surveyed a large geographic area of northern Uruguay in the surroundings of Bella Unión from 1999 to 2004 (Borteiro, 2005; Borteiro and Kolenc, 2007; Borteiro *et al.*, 2008), with additional sporadic surveys up to 2019 (Laufer *et al.*, 2021). *Physalaemus* species recorded during these surveys were only *P. biligonigerus*, and mainly *P. riograndensis*. At ALUR (formerly CALNU) and nearby areas, we knew of only the occurrence of the latter associated to flooded sugar cane crops (Borteiro and Kolenc, 2007). It is unlikely that *P. cristinae* would have passed unnoticed given its noticeable advertisement call and distinctive external morphology. The same could be said about the city of Salto, where *P. cristinae* was found within the urban area of the city. We consider that its presence in north-western Uruguay could be explained by recent cross-river dispersal. The new localities reported herein at ALUR and Salto are about 125 km distant from each other, but very close to the Uruguay River shore (2.0 and 0.8 km respectively), which leads to hypothesize that at least two different dispersal events of *P. cristinae* across this river may have occurred in recent years. This is congruent with the several close localities with confirmed presence of *P. cristinae* in the Province of Entre Ríos and Corrientes, Argentina, on the west bank of the Uruguay River (Cardozo *et al.*, 2023). It must be noticed that a severe drought affected the region between 2019 and 2022 (Besnier *et al.*, 2024; Rivera, 2024), and the extreme low water level of the Uruguay River may have favoured the dispersal of amphibians. The environments at both sides of this river are comparable, and also noticeable similarity among the diversity their anuran faunas was early pointed by Gudynas (1984). Our findings reinforce the hypothesis that the Uruguay River is not a barrier for the anuran fauna (Gudynas, 1984). The extent of the current distribution of *P. cristinae* in Uruguay,

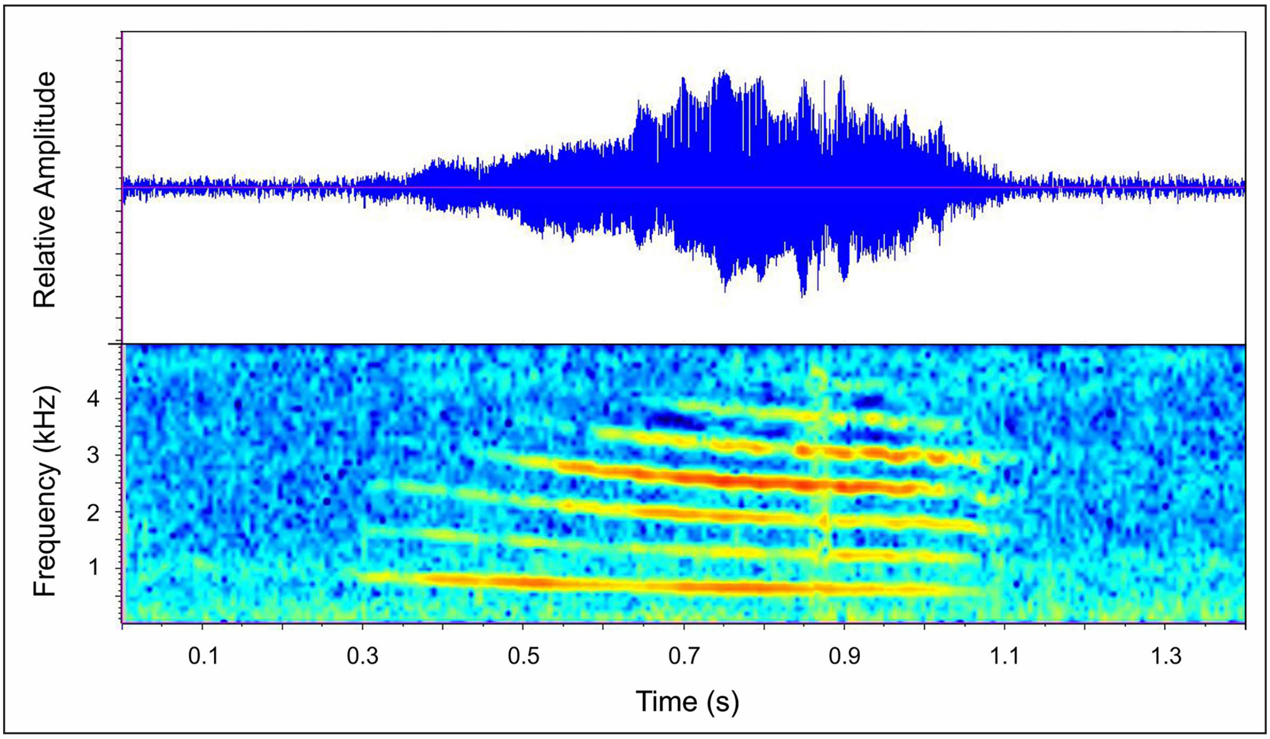

Figure 3. Advertisement call of *Physalaemus cristinae* from ALUR, Bella Unión, Uruguay: oscillogram (top) and spectrogram (bottom), 28 February 2024, 0:20 am, 24º C.

and the fate of these most likely recently established populations (including extinction or expansion) deserves future studies. A recent southwards population expansion was proposed for several frog species in Uruguay (Laufer et al., 2021), but baseline data is always difficult to ascertain. The starting point of the *P. cristinae* story in Uruguay is now being set.

Acknowledgments

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Nota

Cuad. herpetol. 39 (1): 55-58 (*2025*)

Stretched up in a tree a knot down in our hands: first record of climbing and defensive habits of *Trilepida salgueiroi* (Amaral, 1955) (Serpentes, Leptotyphlopidae)

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ABSTRACT

Threadsnakes are typical burrowers with specialised diet in social insects. Climbing behaviour has been observed for some of these species although there is no consensus about the nature of such behaviour for fossorial species. In this study we describe the first climbing behaviour for *Trilepida salgueiroi* in an occasional observation together with the description of the sequence of defensive behaviours displayed during its capture.

Key Words: Threadsnake; Fossorial snake; Natural history; Behaviour.

Describing defensive mechanisms may provide insights on evolutionary trends of predator/prey relationships and defensive character selection pressures (Greene, 1983). Squamates have diverse anti-predator mechanisms and many behavioural displays in order to avoid predators (Greene, 1973; Tozetti *et al.*, 2009; Pough *et al.*, 2016) and among them, snake tactics are apparently well documented (Greene, 1988). Nonetheless, some groups and species of snakes are underrepresented in such records, as is the case for 'scolecophidians', traditionally known as threadsnakes, blindsnakes and wormsnakes. Most representatives of this group are specialised burrowers and their diet is composed of larvae or adults of social insects (Greene, 1997; Cundall and Greene, 2000; Webb *et al.*, 2000). Due to these secretive habits and small size they are difficult to encounter and only few contributions on its ecology, systematic, morphology and natural history, including defensive behaviour, are available (Adalsteinsson *et al.*, 2009; Greene, 1997; Wallach, 2016). Threadsnakes` defensive mechanisms include cloacal sac discharge, silvery colouration, death-feigning and erratic movements, defecation, writhing, and vigorous semirigid serpentine behaviours (Richmond, 1955; Visser, 1966; Gehlbach *et al.*, 1968; Watkins *et al.*, 1969; Gehlbach, 1970, Martins *et al.* 2018). Particularly, individuals of the Leptotyphlopidae family have only few observations and information on its natural history and behaviour is considered incipient (Avila *et al.*, 2006). This is greatly exemplified by the fact that the first description of defensive repertoire of *Trilepida* spp. was for *Trilepida jani* recently described by Martins *et al.*, (2018).

Even though scolecophidians are known for their fossorial or ground-dwelling lifestyles, a few records of climbing behaviour have accumulated in the past decades for representatives of the group.

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For instance, climbing and arboreal behaviour in blindsnakes representatives have been previously reported for typhlopoids as *Anilios* (Chappman and Dell, 1975; Shine and Webb, 1990), *Antillothyphlops* (Tolson and Campbell, 1989), *Gerrhopilus* (Kraus, 2017) *Indotyphlops* (Das and Wallach, 1998; Bazzano, 2007), *Medatyphlops* (Glaw and Vences, 1994), *Ramphotyphlops* (Taylor, 1922; Gaulke, 1995), and *Typhlops* (Landestoy, 2023). For leptotyphlopids, fewer records have been provided for *Epictia* (Mole, 1924; Schmidt and Walker, 1943; Vanzolini, 1970; Fraga and Carvalho, 2020), *Myriopholis* (Minton, 1966), *Rena* (Gehelbach and Baldbridge, 1987; Repp, 2019), *Mitophis* (Landestoy, 2023) and *Trilepida* (Dunn, 1944).

The genus *Trilepida* currently contains 15 recognized species distributed throughout South America (Uetz *et al.*, 2024) that typically exhibit fossorial habits, as expected for the family (Pinto and Curcio, 2011). Within the genus, records of climbing activity have only been reported for an individual of *T. macrolepis* found in a vertical concrete wall at 0.6 m height in Colombia (Dunn, 1944). Herein we provide the first record of climbing behaviour for *Trilepida salgueiroi*. This species is endemic to Brazil, distributed in Atlantic Forest lowland in the states of Bahia, Espirito Santo, Minas Gerais and Rio de Janeiro (Nogueira *et al.*, 2020). In addition, we describe the defensive repertoire of the species during capture and manipulation.

We spotted a male specimen of *Trilepida salgueiroi* (MNRJ28050) measuring 320 mm of CRC on a tree trunk climbing a completely vertical surface through grooves in the bark at 20:10 pm on the 3th September 2023. The behaviour was observed in Niterói municipality, Rio de Janeiro, Brazil (-22.953, -43.019) inside lowland dense ombrophilous forest. The specimen was found about 1.8 meters above the ground and rose even higher while we were filming and photographing the specimen. The specimen was using the bark grooves to maintain the body in the tree (Fig. 1). At one point we captured the specimen that immediately displayed cloacal discharge and erratic movements as defensive behaviour. On a second manipulation for photography, the specimen tried to escape and when handled started prodding with the tail spine. The animal was then transferred to Setor de Herpetologia, Departamento de Vertebrados, Museu Nacional do Rio de Janeiro/UFRJ. When it was handled for another photo session the specimen exhibited the defensive behaviour known as coiling, where the individual wrapped itself around its own body forming a kind of "knotted ball" (Fig. 2). In addition, the specimen once again displayed cloacal discharge and prodding with its caudal spine.

Figure 1. *Trilepida salgueiroi* displaying climbing behaviour in tree, using the bark grooves to sustain its body in vertical surface.

Climbing and arboreal behaviour in threadsnakes raise the discussion about ecological and evolutionary history of climbing habits in the group. Authors have suggested that the behaviour could be related to foraging and feeding habits, expanding range, following pheromone trails of conspecifics of the opposite sex or broadening of ecological niche (Das and Wallach, 1998; Repp, 2019). Either way, the habit may be more common than believed to be among threadsnakes, and must be further explored and studied. In the case described above, no feeding was observed neither specific movement patterns was detected.

Figure 2. *Trilepida salgueiroi* showing the defensive behaviour of coiling when handled before the photo shoot.

The defensive behaviour reported here is known for many species of threadnsakes and blindsnakes. Balling is a common behaviour in Anomalepididae, Leptotyphlopidae and Typhlopidae (Tozetti *et al*., 2021; Martins *et al*., 2018) as well as prodding with tail and cloacal discharge (Martins *et al*., 2018). However, this is the first report of a defensive behaviour for *Trilepida salgueiroi*. The species is a secretive snake with little information on its natural history. This study contributes for the species biology knowledge, providing new data on its behaviour. We also emphasise that studies concerning habitat use of 'scelocophidians' is essential to better understand climbing events documented for individuals of this group.

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Competing interests

The authors declare that they have no conflict of interest

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Novedad zoogeográfica

Cuad. herpetol. 39 (1): 59-62 (*2025*)

Allobates brunneus (Cope, 1887) (Anura, Aromobatidae): significant distribution extension for a formerly critically endangered species from the Brazilian Cerrado

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Localities.— We recorded specimens of *A. brunneus* in at least 14 localities from four municipalities of Mato Grosso state (Brazil: Fig. 1).

(1) Santo Antônio do Leverger Municipality, Serra de São Vicente (Lat. -15.853663°, Long. -55.432219°), November 2013, one male adult (Fig. 2A) observed by VAC (see Acknowledgements);

(2) Campo Verde Municipality (Lat. -15.610240°, Long. -55.441949°), November 2019, one male adult observed by CS in the riparian forest of Casca river;

(3) Chapada dos Guimarães Municipality: I) Comunidade Peba/Cachoeira Rica (Lat. -15.268262°, Long. -55.561704°), October 2019, observed by BB, CS, TFD-R, and MVA. Three male adults recorded in the leaf litter of a swamp forest, locally called *buritizal* (monodominant stand of the buriti palm—*Mauritia flexuosa* L.f.), at 09:56 a.m. (Fig. 2B); II) Comunidade Peba/Cachoeira Rica (Lat. -15.2725532°, Long. -55.5323062°), October 2019, observed by CS and MVA. Eight male adults recorded in the leaf litter of a *buritizal* between 06:05 - 07:05 a.m; III) Comunidade Peba/Cachoeira Rica (Lat. -15.265925°, Long. -55.606554°), November 2019, two male adults observed by CS; IV) Água Fria (Lat. -15.164834°, Long. -55.805071°), January 2020, observed by BB, CS, and MVA. Ten unsexed adults recorded in the leaf litter of a *buritizal* at 05:50 a.m.; V) Água Fria (Lat. -15.229135°, Long. -55.741601), February 2020, observed by CS and MVA. Three male adults recorded in the leaf litter of a *buritizal* at 08:50 a.m.; VI) Cachoeira do Pingador (Lat. -15.090651°, Long. -55.860354°), January 2020, observed by CS and BB. Three male adults recorded calling at 18:05 p.m.; VII) Parque Nacional da Chapada dos Guimarães (Chapada dos Guimarães National Park), headwaters of the Coxipó-Açu river (Lat. -15.212625°, Long. -55.930245°, 350 m elev.), December 2020. One specimen collected by BB and CS and deposited in the Herpetological collection of Universidade Federal de Mato Grosso (UFMT 19648). The individual was recorded in the leaf litter of a riparian forest established on hydromorphic soil, at 09:03 a.m. (Fig. 2C); VIII) Camping da Deusa (Lat. -15.615011°, Long. -55.442168°), December 2020, collected by BB, CS, and VDSA (see Acknowledgements) and deposited in the Herpetological collection of Universidade Federal de Mato Grosso (UFMT 19649–19654). Six male adults recorded between 06:02 – 06:20 a.m. and 16:46 – 16:50 p.m. in the riparian forest of Casca river (Fig. 2D);

(4) Cuiabá Municipality: I) Loteamento Ecoville da Chapada (Lat. -15.189814°, Long. -55.940870°), March 2020, observed by CS and TFD-R. Four male adults recorded in the leaf litter of a *buritizal* along the riparian forest of Coxipó-Açu river at 06:00 a.m.; II) Loteamento Ecoville da Chapada (Lat. -15.189308°, Long. -55.938889°), December 2020, collected by BB and CS and deposited in the Herpetological collection of Universidade Federal de Mato Grosso (UFMT 19646–19647). Two male adults were recorded at 06:23 and 06:36 a.m.

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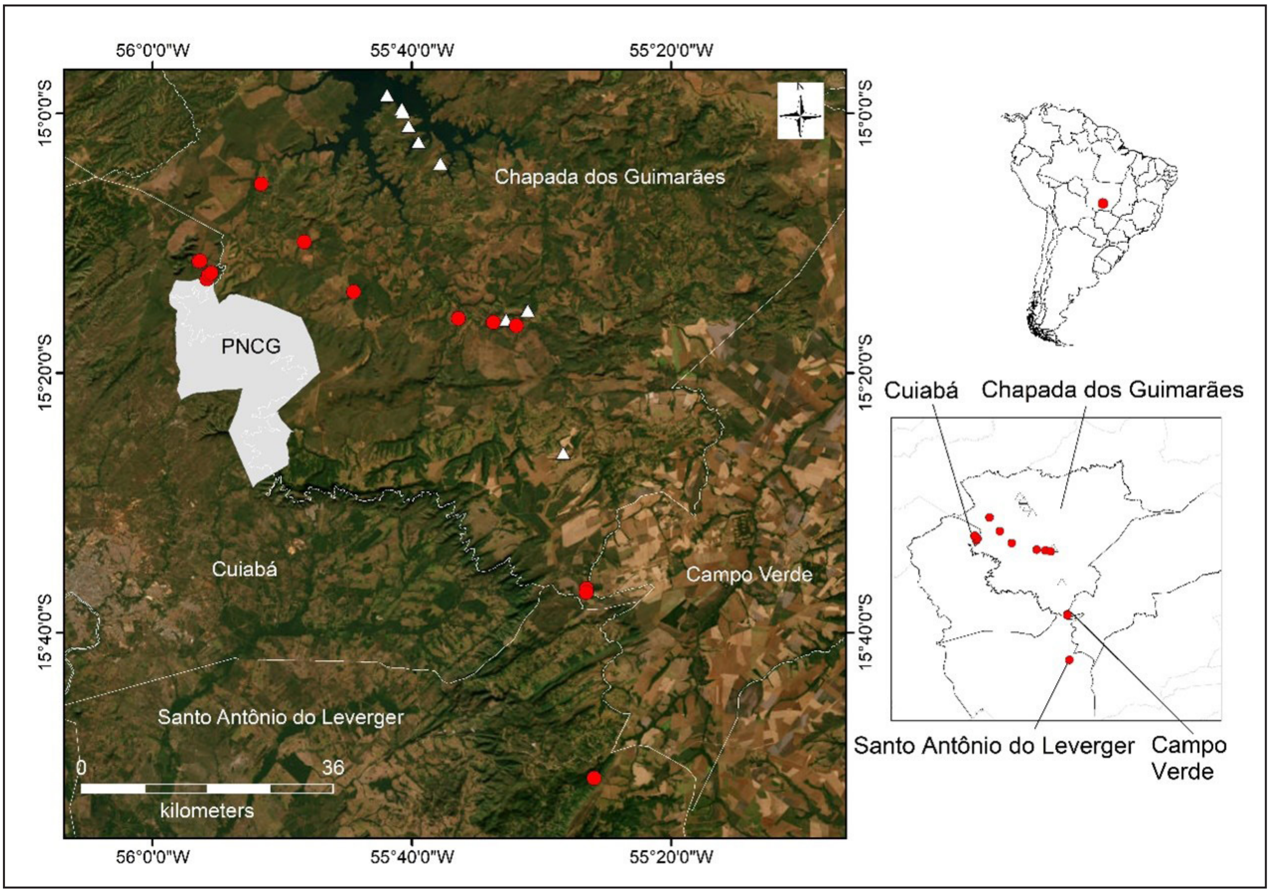

Figure 1. Distribution of *Allobates brunneus* in South America. Red dots = new records reported in this study; white triangles = previously known records. PNCG = Parque Nacional de Chapada dos Guimarães.

Comments.— The genus *Allobates* Zimmerman and Zimmerman, 1988 (Aromobatidae) comprises 63 species (Frost, 2024) of cryptically colored leaf-litter anurans (Grant *et al.*, 2006), commonly known as nurse-frogs. They are distributed throughout Central and South America (in the Pacific lowlands of Colombia and Ecuador; north and west in Central America to Nicaragua; Martinique, and Amazonian drainages in Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Surinam, and French Guiana; Frost, 2024). Most of the 32 species already recorded in Brazil (Segalla *et al.*, 2021) have Amazonian distributions (Grant *et al.*, 2006), and only two species are distributed in localities along the Cerrado ecorregion: *Allobates goianus* (Bokermann, 1975) and *A. brunneus* (Cope, 1887) (Valdujo *et al.*, 2012).

Allobates brunneus was described after specimens collected in Chapada dos Guimarães (state of Mato Grosso, midwestern Brazil), in the western Cerrado. Nearly a century after its description, the species was rediscovered in riparian habitats of affluents of the Manso river, one of the main tributaries to the Cuiabá river, belonging to the upper Paraguay river basin (Strüssmann, 2000). At that time, large populations of *A. brunneus* were recorded in *buritizais* occurring along the Casca and Quilombo rivers. Most of these habitats were subsequently flooded during the filling of the reservoir of the Manso hydroelectric power plant, leading to severe population reduction of *A. brunneus*. Some small subpopulations of *Allobates brunneus* remained in the headwaters of the Casca river, in private properties situated outside the limits of the neighboring Chapada dos Guimarães National Park (Lima *et al.*, 2009). With its extent of occurrence (EOO) previously estimated to be lower than 5 km², *A. brunneus* was initially listed as Critically Endangered–CR and presently as Near Threatened–NT, in the Brazilian Red List (see Bastos *et al.*, 2023). In the IUCN Red List (IUCN SSC Amphibian Specialist Group, 2023), the species is listed as Endangered–EN.

Figure 2. Adult males of *Allobates brunneus* recorded in Santo Antônio do Leverger (A) and Chapada dos Guimarães (B -D), Mato Grosso State, Brazil.

Our records of *Allobates brunneus*—all of them in the Mato Grosso state and in the Cerrado ecoregion—include the first occurrence of the species for the municipalities of Santo Antônio do Leverger, Campo Verde, and Cuiabá, and increase from one to four the number of municipalities where the species is currently known. They extend the known geographic distribution of the species approximately 43 km westward and 67 km southeastward. Besides, one population was located within a protected area (the Chapada dos Guimarães National Park) for the first time.

Even though our data still reveal a somewhat restricted distribution, the EOO of *A. brunneus* is herein estimated to be 1,992 km² and the AOO, 56 km². The EOO estimate excludes the historical records for the Manso hydroelectric power plant (Chapada dos Guimarães), where there has been significant habitat loss by flooding. We also recorded cattle trampling and/or drainage of *buritizais* in part of the species' AOO, which promote a continuing decline in habitat quality. However, we found neither evidence of severe fragmentation nor of a continuing decline in the number of mature individuals or the number of subpopulations. Extensive *buritizais* do occur to the north of the EOO of *A. brunneus*, where the occurrence of this or of related species (see Lima *et al.*, 2009) should be investigated. Therefore, investment is needed to better delineate the boundaries of the geographic distribution of *A. brunneus*. In addition, investments are also needed for habitat-focused conservation initiatives.

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Novedad zoogeográfica

Cuad. herpetol. 39 (1): 63-67 (*2025*)

Novo registro de *Copeoglossum nigropunctatum* (Spix, 1825) (Squamata, Scincidae) em Brejo de Altitude no Domínio Morfoclimático da Caatinga, nordeste do Brasil

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Localidade.— Brasil, estado de Pernambuco, município de Floresta, Reserva Biológica de Serra Negra – REBio de Serra Negra (08º39'25"S e 38°01'35"O; 1.050 m a.s.l.). Dois espécimes coletados entre 2 e 7 de fevereiro de 2014 por Leonardo Barros Ribeiro. Os espécimes foram depositados na Coleção Herpetológica do Museu de Fauna da Caatinga (MFCH 3457 e 3462) no Centro de Conservação e Manejo de Fauna da Caatinga (CEMAFAUNA-CAATINGA), localizado na Universidade Federal do Vale do São Francisco em Petrolina, Pernambuco, Brasil.

Comentários.— *Copeoglossum nigropunctatum* (Spix, 1825) (anteriormente *Mabuya nigropunctata*) (Fig. 1A-C) é uma das 15 espécies pertencentes à família Scincidae (Guedes *et al.*, 2023). Apresenta como principais caracteres diagnósticos a presença de cinco escamas supraciliares subiguais, um par de escamas frontoparietais (com uma longa sutura mediana), cada uma delas em contato com a frontal, dorsais lisas a tricarenadas. De cada lado do corpo, a partir da região loreal, exibe uma larga faixa escura e bem definida, até a cauda, margeada ou não, por claras listras dorsal e ventral (Rebouças-Spieker, 1981; Ávila-Pires, 1995). *Copeoglossum nigropunctatum* ocorre no Brasil, Guiana Francesa, Suriname, Guiana, Colômbia, Equador, Peru e Bolívia (Ribeiro-Júnior e Amaral, 2016), e, na verdade, é um complexo de espécies dividido em três clados, segundo Miralles e Carranza (2010), sendo eles: (1) clado ocidental, composto por amostras da Amazônia Ocidental, abrangendo desde a costa Venezuelana e ilha de Trinidad até o estado do Acre, no Brasil; (2) clado oriental, composto por amostras Guiano-amazônicas orientais amplamente distribuídas desde o escudo Guianense até o escudo Brasileiro; e (3) clado meridional, restrito à periferia sul do estado do Amazonas, desde o estado de Rondônia até o estado de Goiás no Brasil. Portanto, de acordo com a subdivisão sugerida, os exemplares coletados no presente estudo pertencem ao clado oriental. Apresenta hábito diurno e atividade heliófila. Nestas condições, os indivíduos são frequentemente vistos forrageando na serrapilheira, ou aquecendo-se sob galhos e troncos de árvores caídas (Avila-Pires, 1995).

No Brasil, *C. nigropunctatum* tem ampla ocorrência (Guedes *et al.*, 2023), sendo encontrada na Amazônia, Floresta Atlântica, Cerrado e na Caatinga. No nordeste brasileiro, apresenta registros nos estados do Maranhão, Piauí, Ceará, Paraíba, Pernambuco, Alagoas, Sergipe e Bahia, distribuídos em áreas de baixa a alta altitude (80-1.114 m a.s.l.), com temperatura média anual de 21 a 27°C e precipitação média anual entre 447 e 1.467 mm (Vanzolini, 1981; Ávila-Pires, 1995; Borges-Nojosa e Caramaschi, 2003; Franzini *et al.*, 2019; Uchôa *et al.*, 2022).

No Domínio Morfoclimático da Caatinga, *C. copeoglossum* pode ser encontrada, de forma disjunta, em áreas de vegetação densa e arbórea, com

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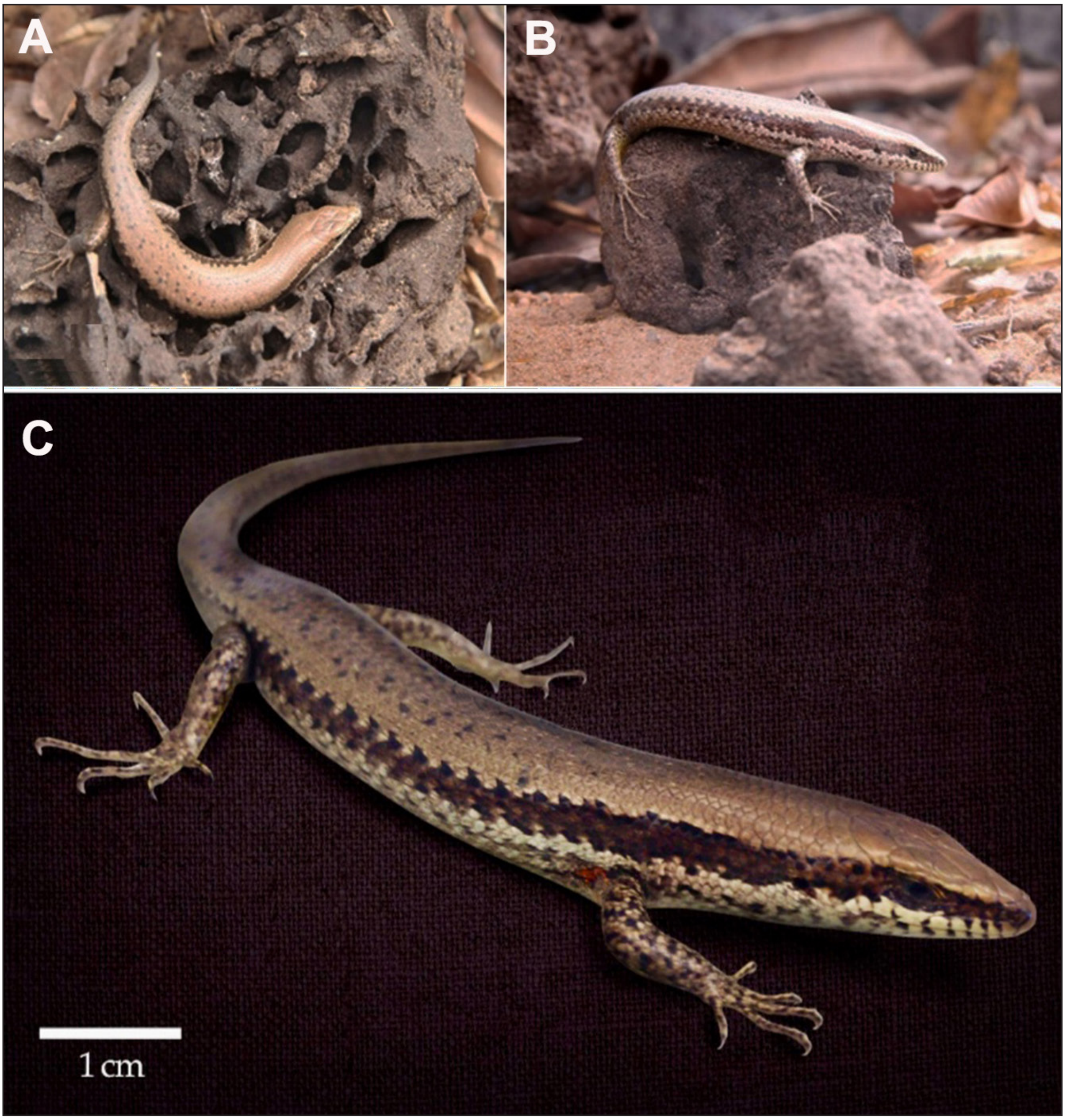

Figura 1. *Copeoglossum nigropunctatum*: vista dorsal (A), lateral (B) e aproximada em fundo preto (C) de um dos espécimes (70 mm de comprimento rostro-cloacal, MFCH 3462), coletado na área de floresta da Reserva Biológica de Serra Negra, Pernambuco. Fotos por Leonardo B. Ribeiro.

alguns elementos arbustivos, em solo arenoso. Tem ocorrência considerável em enclaves de floresta úmida, com elementos atlânticos (planaltos conhecidos como Brejos de Altitude) e amazônicos (Duellman, 1978; Cunha *et al.*, 1991; Nascimento *et al.*, 1988; Silva e Leal, 2017). Sua ocorrência foi registrada em alguns Brejos de Altitude nos estados do Ceará (Borges-Nojosa e Caramaschi, 2003; Loebmann e Haddad, 2010) e de Pernambuco (Freitas *et al.*, 2023), e em áreas florestadas dentro da Caatinga no estado do Piauí (Cavalcanti *et al.*, 2014; Dal Vechio *et al.*, 2016).

A composição de Floresta Atlântica Pluvial Submontana (ou Floresta Subperenifólia) (Freire *et al.*, 2018), na REBio de Serra Negra (Fig. 2A-B), a torna única, em comparação ao seu entorno (Caatinga *stricto sensu*), e a faz um refúgio para *C. nigropunctatum*. Dentre as áreas conhecidas

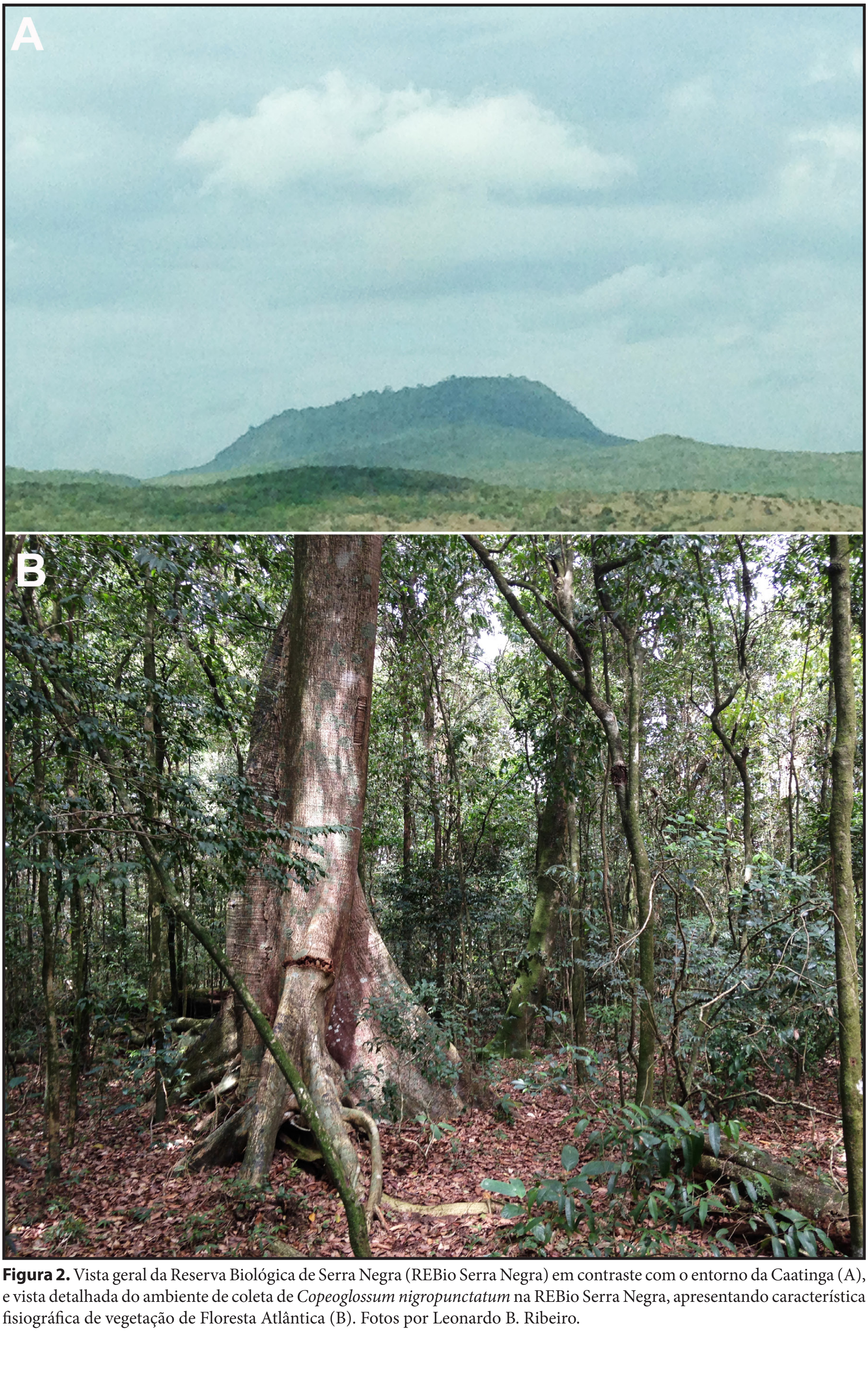

Figura 2. Vista geral da Reserva Biológica de Serra Negra (REBio Serra Negra) em contraste com o entorno da Caatinga (A), e vista detalhada do ambiente de coleta de *Copeoglossum nigropunctatum* na REBio Serra Negra, apresentando característica fisiográfica de vegetação de Floresta Atlântica (B). Fotos por Leonardo B. Ribeiro.

de ocorrência de *C. nigropunctatum* no Domínio Morfoclimático da Caatinga (Fig. 3A), o novo registro da espécie, ocorre em solo classificado como Neossolo (Fig. 3B) em altitude entre 901 e 1.200 m (Fig. 3C), dentro da ecorregião do Raso da Catarina (Fig. 3D), e estende a distribuição conhecida em aproximadamente 200 km oeste do registro mais próximo no município de Caruaru, Pernambuco (Brejo dos Cavalos).

A ocorrência de *C. nigropunctatum* no Brejo de Altitude da REBio de Serra Negra mostra a estreita relação envolvendo Floresta Atlântica e Floresta Amazônica em meio à Caatinga, como vestígios do que ocorreu no processo evolutivo de diversos táxons, como resultado do isolamento destes ambientes. Em específico, o novo registro além ampliar o conhecimento sobre a história de vida de *C. nigropunctatum*, desperta para uma janela de investigação integrando estudos taxonômico, morfológico e molecular entre populações dessa espécie.

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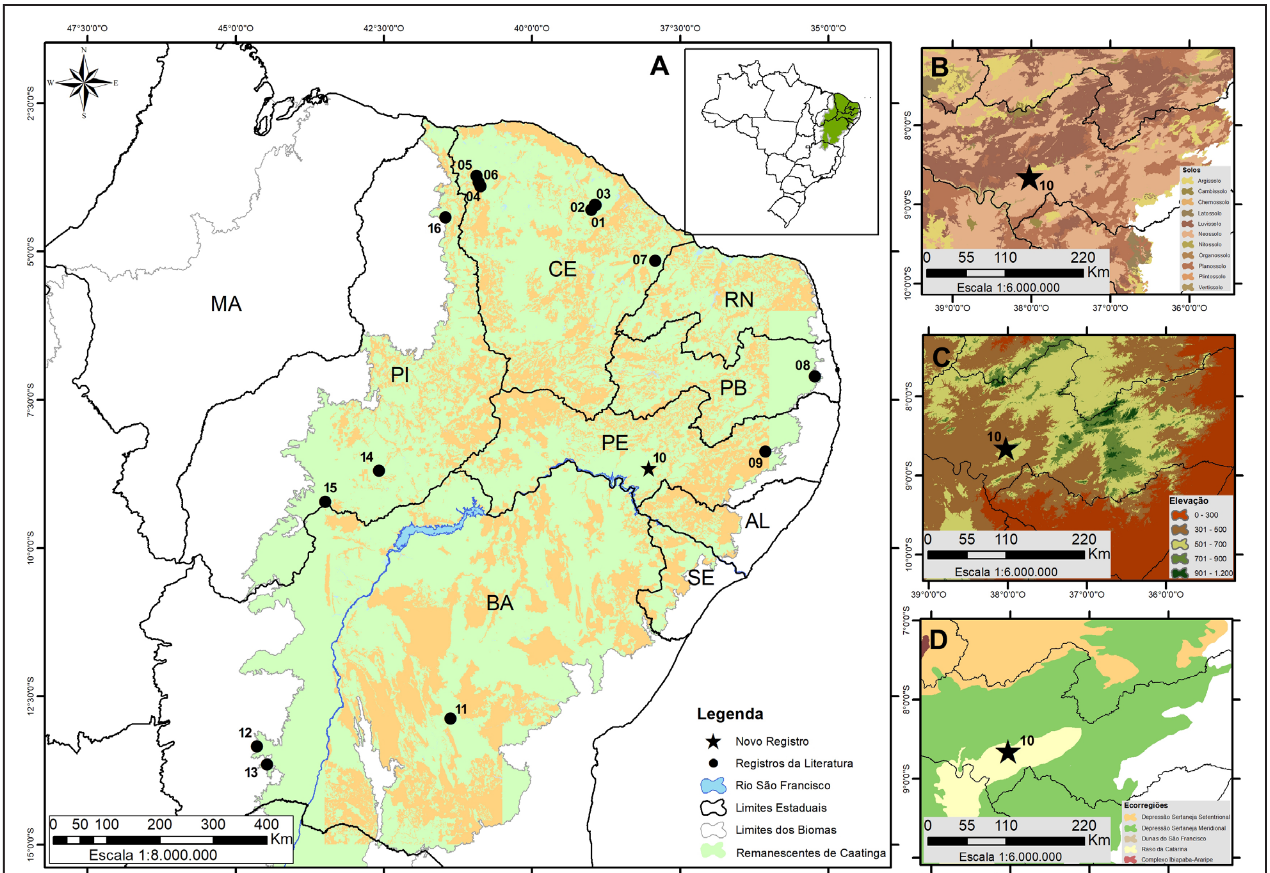

Figura 3. Distribuição geográfica de *Copeoglossum nigropunctatum* no Domínio Morfoclimático da Caatinga, nordeste do Brasil. (A) Os círculos representam dados da literatura e a estrela o novo registro deste estudo. Localidades: Ceará (CE): 1. Mulungu (4°18'05"S, 38°59'47"O), 2. Guaramiranga (4°14'00"S, 38°53'59"O), 3. Pacoti (Área de Proteção Ambiental Serra de Baturité: 4°13'15.60"S, 38°55'35.98"O), 4. Ibiapina (3°54'8.47"S, 40°52'9.23"O), 5. Ubajara (3°50'23"S, 40°53'49"O), 6. Tianguá (3°43'37.16"S, 40°56'12.14"O), 7. Quixeré (5°04'18.2"S, 37°59'23.2"O); Paraíba (PB): 8. Sapé (7°06'24"S, 35°13'41"O); Pernambuco (PE): 9. Caruaru (Brejo dos Cavalos: 8°22'36.84"S, 36°3'32.76"O), 10. Floresta (Reserva Biológica de Serra Negra, Novo Registro: 08°39'25"S, 38°01'35"O); Bahia (BA): 11. Chapada Diamantina (12°52'48.48"S, 41°22'20.73"O), 12. Correntina, 13. Jaborandi; Piauí (PI): 14. Serra da Capivara (8°41'45"S, 42°34'52"O), 15. Serra das Confusões (9°13'22"S, 43°29'23"O), 16. Pedro II. Fonte: Ávila-Pires (1995), Borges-Nojosa e Caramaschi (2003), Loebmann e Haddad (2010), Dubeux *et al.* (2022), Uchôa *et al.* (2022), Freitas *et al.* (2023), Arruda *et al.* (2024). (B) Mapa parcial de classificação dos solos (IBGE, 2015). (C) Mapa de elevação. (D) Mapa parcial de classificação das ecorregiões da Caatinga (Silva *et al.*, 2017).

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Novedad zoogeográfica

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Un nuevo registro de *Oxyrhopus petolarius* (Linnaeus, 1758) en el Chaco Paraguayo

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Localidad.— Paraguay, Departamento Presidente Hayes, Distrito Pozo Colorado (-23.414519°; -57.478558°, Fig. 1). El 2 de julio de 2024 fue colectado un ejemplar de *Oxyrhopus petolarius* en una sabana de palmares próximos al Rio Paraguay. El ejemplar se encuentra depositado en la colección del Museo Nacional de Historia Natural del Paraguay (MNHNP 12963).

Comentarios.—El género *Oxyrhopus*, perteneciente a la familia Dipsadidae, agrupa a un conjunto de serpientes neotropicales caracterizadas por su notable diversidad de colores y patrones. Este género se distribuye ampliamente a lo largo de América del Sur y Centroamérica, abarcando una variedad de hábitats que van desde selvas tropicales hasta sabanas y bosques secos (Zaher *et al.*, 2009).

Muchas de las especies de este género exhiben mimetismo batesiano, imitando los patrones aposemáticos de las serpientes coral verdaderas del género *Micrurus*. Este fenómeno mimético ha sido ampliamente documentado y se considera una adaptación evolutiva clave que les permite evitar la depredación al aprovechar la reputación peligrosa de las serpientes coral (Greene & McDiarmid, 1981).

Dentro del género *Oxyrhopus* se incluyen especies como *O. petolarius* y *O. guibei*, las cuales han sido registradas en diversos ecosistemas, evidenciando la plasticidad ecológica del género. Las especies de este género son predominantemente nocturnas y terrestres, aunque ciertas especies pueden exhibir comportamientos arbóreos en situaciones específicas, lo que sugiere una flexibilidad comportamental adaptativa (Gibbs *et al.*, 2006).

Oxyrhopus petolarius (Linnaeus, 1758) es una serpiente ovípara, de hábitos terrestres y ocupa las ecorregiones Amazonia, Bosque Atlántico y Pantanal principalmente (Giraudo, 2002; Torre-Loranca *et al.*, 2006; Cabral & Scott, 2014; Nogueira *et al.*, 2016). En Paraguay existen cuatro registros de esta especie, dos de ellos provienen del Bosque Atlántico (Cabral & Scott, 2014; Cacciali *et al.*, 2016), una del pantanal (Cacciali *et al.* 2021) y una en el extremo sur del pantanal en transición con la ecorregión Chaco Húmedo (Bueno & Cantero, 2022).

En este trabajo presentamos un nuevo registro de *O. petolarius* en la ecorregión Chaco Húmedo, ampliando el área de distribución en aproximadamente 200km al sur del registro conocido más cercano, y ampliando el rango conocido de hábitats utilizados por la especie.

El registro tuvo lugar en una formación alterada de sabanas inundables con influencia directa de los pulsos del río Paraguay, a aproximadamente

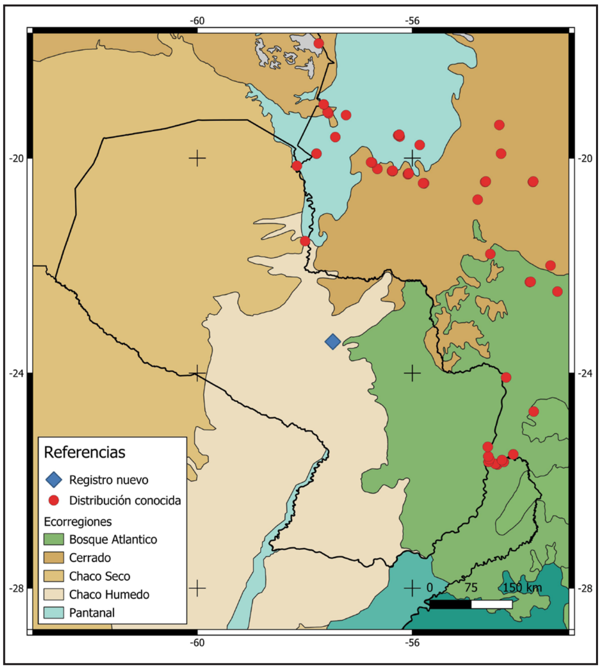

Figura 1. Mapa comparativo de distribución conocida y nuevo registro para *Oxyrhopus petolarius*.

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100 m del mencionado curso hídrico. La cobertura es mayoritariamente herbácea, siendo las gramíneas las más abundantes, con presencia variable pero generalmente dispersa de karanda'y (*Copernicia alba*) y algunos ejemplares aislados de algarrobos (*Neltuma fiebrigii* y *N. nigra*). El ejemplar colectado (Fig. 2) presenta preocular 2/1, posoculares 2/2, temporales 2+3/2+3, supralabiales 8/8, infralabiales 9/9.

Oxyrhopus petolarius ha sido categorizada como Vulnerable en Paraguay y Argentina, en gran parte como consecuencia de la creciente destrucción de su hábitat natural en ambos países (Giraudo *et al.*, 2012; Martínez *et al.*, 2020). Este registro de *O. petolarius* en la Ecorregión del Chaco Húmedo subraya la importancia de esta área como refugio para la especie. Esta ecorregión es de gran relevancia ecológica, pero ha sufrido una considerable pérdida de su cobertura forestal original, principalmente debido a actividades humanas intensivas como la expansión agrícola y la deforestación. La degradación continua de este hábitat crítico no solo amenaza a *O. petolarius*, sino también a la biodiversidad en general que depende de estos bosques para su supervivencia.

Figura 2. Ejemplar de *Oxyrhopus petolarius* colectado.

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Novedad zoogeográfica

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Primer registro de nidificación de *Caiman latirostris* (DAUDÍN, 1802) en Gualeguaychú – Provincia de Entre Ríos

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Localidad.— República Argentina. Provincia de Entre Ríos. Departamentos Uruguay y Gualeguaychú. Localidad Gualeguaychú. Estancia El Potrero de San Lorenzo, Reserva de Usos Múltiples (RUM) El Potrero (32°58'52.88"S; 58°15'53.74"O; Fig. 1). Colectores: Vega Gerardo Gabriel , Avalo Daniel y Guillermo Treboux.

El día 06 de octubre del 2022 se detectó la presencia de un ejemplar de *Caiman latirostris,* el cual fue registrado fotográficamente. A partir de ese momento se comenzaron a realizar búsquedas activas de individuos y nidos, por medio de observación directa y de drones.

El día 11 de enero de 2024 se produjo un nuevo avistamiento (Fig. 2A) en otro sector de la reserva. El 22 de abril de 2024, se pudo visualizar la presencia de

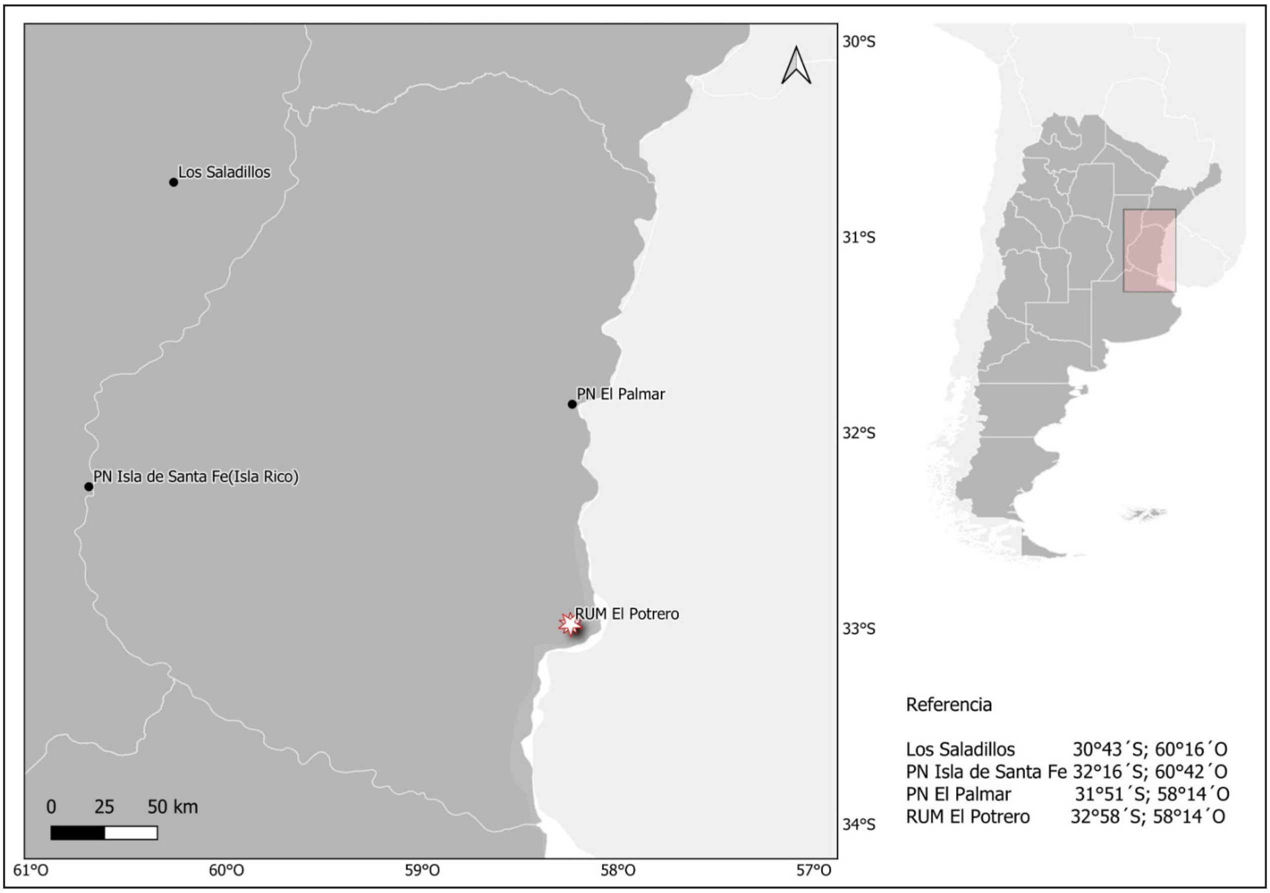

Figura 1. Registros de nidificación de *Caiman latirostris* más próximos (en círculos negros; Río Arapey; Los Saladillos: Simoncini *et al.*, 2009; PN Islas de Santa Fé: Larriera., com. pers.; PN El Palmar: Vega., 2022), al nuevo registro (estrella blanca y roja) hallado en la reserva de usos múltiples El Potrero, localidad de Gualeguaychú de la Provincia de Entre Ríos.

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un gran número de neonatos de *C. latirostris* junto a un individuo adulto (Fig. 2B, 2C), presumiblemente la hembra progenitora y a pocos metros un nido eclosionado (32°58'42.82"S; 58°14'35.92"O) (Fig. 2D). Se realizó el conteo diurno de los neonatos avistados al fin de poder estimar el número de ejemplares presentes en el sitio, registrando un número máximo de 11 individuos en un único conteo. En la RUM El Potrero se encuentran representadas las provincias Esteros del Iberá, distrito Delta del Paraná y Pampeana, distrito Uruguayense (Arana *et al*. 2021).

Comentarios.— *Caiman latirostris* (Daudín, 1802) es un reptil de hábitos anfibios con amplia distribución geográfica en las cuencas de los ríos Paraná, Paraguay, Uruguay y São Francisco; desde el nordeste de Argentina, el extremo noreste de Brasil, el sudeste de Bolivia, Paraguay y el norte de Uruguay (Siroski *et al*., 2020).

Según Borteiro *et al*. (2006) y Simoncini *et al*. (2009), en la República Argentina, *C. latirostris* se distribuye desde los 5° S, en la provincia de Formosa, hasta los 32° S., en la provincia de Santa Fe.

La localidad aquí citada extiende 124 km al sur, la zona de nidificación de la especie en base a la información previamente reportada (Giménez *et al*. 2008; Vega, 2022).

Figura 2. Primer ejemplar avistado (A), individuo adulto junto a un ejemplar recién nacido (B), tres individuos recién nacidos (C) y nido de caimán eclosionado en cercanías de los individuos avistados (D).

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Registro y primer voucher fotográfico de un lagarto enigmático: *Urostrophus longicauda* (Boulenger, 1891) en el Parque Nacional Iberá, Corrientes, Argentina

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Localidad.— Parque Nacional Iberá sobre la Ruta Nacional 118 (27°54'58.7"S 57°27'20.0"W) en la localidad de San Antonio, Corrientes, Argentina (Fig. 1). El individuo fue hallado y fotografiado el 25/01/2025 a las 22:45 por Alfredo Sabaliauskas. Las fotografías (Fig. 2) fueron depositadas como voucher en el catálogo fotográfico del Instituto Nacional de Limnología (INALI 579).

Comentarios.— *Urostrophus longicauda* (Boulenger, 1891) es un lagarto que habita en arbustos y pastos altos (Etheridge y Williams, 1991) con escasas observaciones en Argentina, Paraguay y Brasil (Fig. 1). Los primeros registros en Argentina se obtuvieron en localidades del este de la provincia de Chaco y "localidades no especificadas" de Santa Fé y Misiones (Etheridge y Williams, 1991). Posteriormente, durante el llenado de la Represa Yacyretá, su distribución se extendió al noreste de Corrientes y Paraguay, (Álvarez *et al.*, 1995). Luego se colectaron ejemplares en la provincia de Corrientes, en la Estancia San Juan Poriahú, San Miguel (Waller, 2009) y en la Reserva Natural Provincial Isla Apipé Grande, Ituzaingó (Zaracho *et al.*, 2014). Los mismos se encuentran depositados en la Colección Herpetológica de la Universidad Nacional del Nordeste, Corrientes (UNNEC). En Paraguay hasta el momento, esta especie se encuentra restringida a la localidad de Itapúa, una región de pastizales mesopotámicos, y a San Pedro, región de Chaco Húmedo (Etheridge y Williams, 1991; Lions y Álvarez, 1996; Cacciali *et al.*, 2016). El registro más reciente fue realizado en el Complejo de Reservas Gouyra Reta (Sforza y Cacciali, 2020). Adicionalmente, se colectó un ejemplar en la Usina Hidroeléctrica Porto Primavera, Presidente Epitácio, en el estado de São Paulo, Brasil y fue depositado en el Museo de Zoología de la Universidad de São Paulo [MTR (LG 1370)] (Rodrigues *et al.*, 2014). Registros adicionales han sido reportados durante la revisión de puntos geográficos de colecciones herpetológicas (GBIF, 2025).

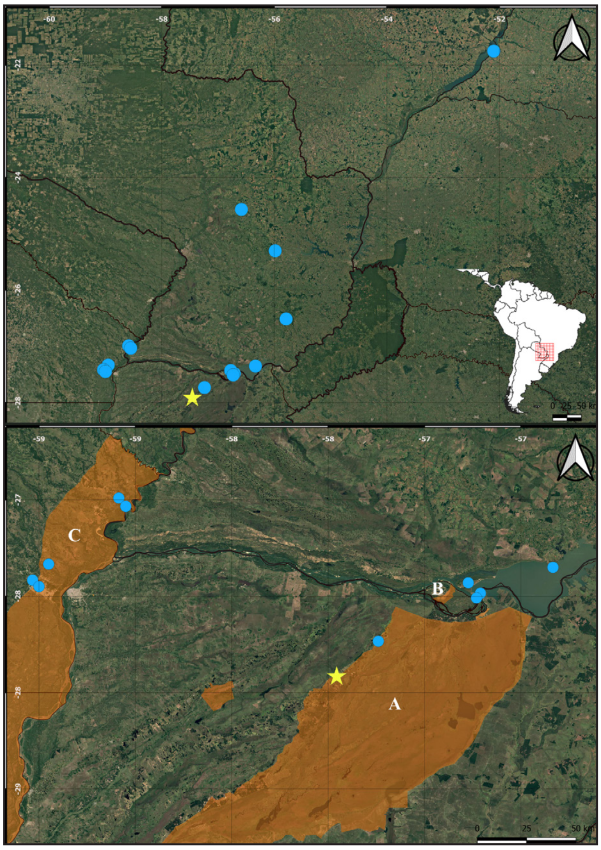

Figura 1. Mapa de registros de *Urostrophus longicauda* en Sudamérica (arriba) y específicamente en Argentina (abajo). Círculos celestes: registros históricos (Etheridge y Williams, 1991; Lions y Álvarez, 1996; Waller, 2009; Rodrigues *et al.*, 2014; Zaracho *et al.*, 2014; Cacciali *et al.*, 2016; Sforza y Cacciali, 2020; GBIF, 2025). Estrella amarilla: nuevo registro. Áreas protegidas de Argentina: A) Parque Nacional Iberá, B) Reserva Natural Isla Apipé Grande y C) Sitio RAMSAR Humedales Chaco.

El individuo fue encontrado inmovil sobre el asfalto de la Ruta 118. Se tomaron fotografías sobre la ruta, luego fue recogido y depositado en la vege-

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tación circundante, donde fue fotografiado y posteriormente liberado. El especimen fue catalogado como adulto, comparando el largo total aproximado con estudios previos (Boulegner, 1891; Etheridge y Williams, 1991), aunque no fue posible determinar el sexo. Este nuevo registro se encuentra a 30 km (al suroeste) del punto más austral conocido para la especie en nuestro país, es la segunda observación en el Parque Nacional Iberá, 16 años posterior a la primera, y aporta una nueva observación para la provincia de Corrientes.

Urostrophus longicauda se encuentra categorizada como Amenazada a nivel nacional (Abdala *et al.*,2012) y Vulnerable a nivel internacional (Arzamendia *et al.,* 2017). Estas clasificaciones se justifican debido a una distribución restringida y pérdida de hábitat. Su biología es poco conocida, siendo asociado a pastizales inundables del Chaco Húmedo (Etheridge y Williams, 1991).

La obtención de registros fotográficos puede contribuir a la conservación de *Urostrophus longicauda* al facilitar la transmisión de conocimiento sobre su identidad y características físicas a la comunidad. Las fotografías constituyen una vía eficaz para divulgar sobre la existencia de este lagarto y concientizar sobre las problemáticas que sufren sus poblaciones.

Figura 2. Fotografías de *U. longicauda* depositadas en el catálogo fotográfico del Instituto Nacional de Limnología (INALI 579)

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A Alejandro Giraudo, Henrique C. Costa, Pier Cacciali y Víctor Zaracho por su ayuda con la recopilación de información sobre registros históricos de la especie. A José Manuel Sánchez, Paola A. Carrasco y Paula Rivera por sus consejos y correcciones sobre la redacción del manuscrito.

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Novedad zoogeográfica

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A second record of *Acanthochelys pallidipectoris* (Freiberg, 1945) in the Humid Chaco of Paraguay

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Locality.— Paraguay, Central, Villa Elisa (Fig. 1). Exact coordinates can be provided upon request to the corresponding author. In March 6th 2025, a male of the species (Fig. 2) was found in a house garden.

Comments.— The site where the turtle was found is highly urbanized, at least 1.8 km away from the Paraguay river on a straight-line measurement, around 150 and 170 km respectively from the nearest localities (El Bagual Natural Reserve, Formosa, Argentina: Scrocchi and Giraudo, 2005; and Pilar, Ñeembucu department, Paraguay: Giraudo and Contreras, 1994). The site of the find has a perimeter fence that is not fixed to the ground. The specimen was collected by local residents and later transferred to the Departamento de Recursos Faunísticos y Medio Natural (Facultad de Ciencias Veterinarias, Universidad Nacional de Asunción), where we made routine medical assessments following all the required permits issued by the Ministerio del Ambiente y Desarrollo Sostenible. The specimen is currently kept in captivity at the Facultad de Ciencias Veterinarias, under the care of veterinary staff.

The specimen weighed 458 g with straight carapace length of 164 mm, maximum carapace width 120 mm, plastron length 147 mm, plastron width 96 mm, and carapace height 50 mm. These measurements closely match those reported by Vinke *et al.* (2011) and Cassano (2022), also suggesting the specimen is an adult. The single physical damage we perceived was a chronic injury on the left eyeball.

Regarding weather conditions, the days leading up to March 6th, 2025, Villa Elisa experienced the lingering humidity and warmth characteristic of late summer in Paraguay's Central Department. The beginning of the month showed partly cloudy skies with occasional bursts of sunshine, and the air remained heavy with moisture. On March 3rd and 4th, brief showers were recorded in the afternoon, accompanied by mild easterly winds that stirred the dense clouds. By March 5th, cloud cover had thickened slightly, leading to a warm, overcast morning and light rainfall during the evening hours. On March 6th, the weather was notably humid and warm, with early morning temperatures hovering around 23°C and reaching up to 31°C by mid-afternoon. The sky remained mostly cloudy throughout the day, although no major rainfall was recorded. A light breeze from the southeast moved slowly across the urban landscape.

Villa Elisa is part of the Metropolitan Area of Asunción, a region where urban growth has outpaced planning efforts, resulting in flood-prone neighborhoods, and increasing pressure on natural ecosystems. The landscape is gently undulating, sloping toward the Paraguay River. While many roads in the city center are paved, a significant portion of Villa Elisa still features cobblestone streets. In the surrounding areas, dirt roads predominate, interspersed with green spaces that include industrial lots, sports fields, vacant land, and waste disposal sites. *Acanthochelys pallidipectoris* inhabits a wide range of water bodies from ditches along roads and

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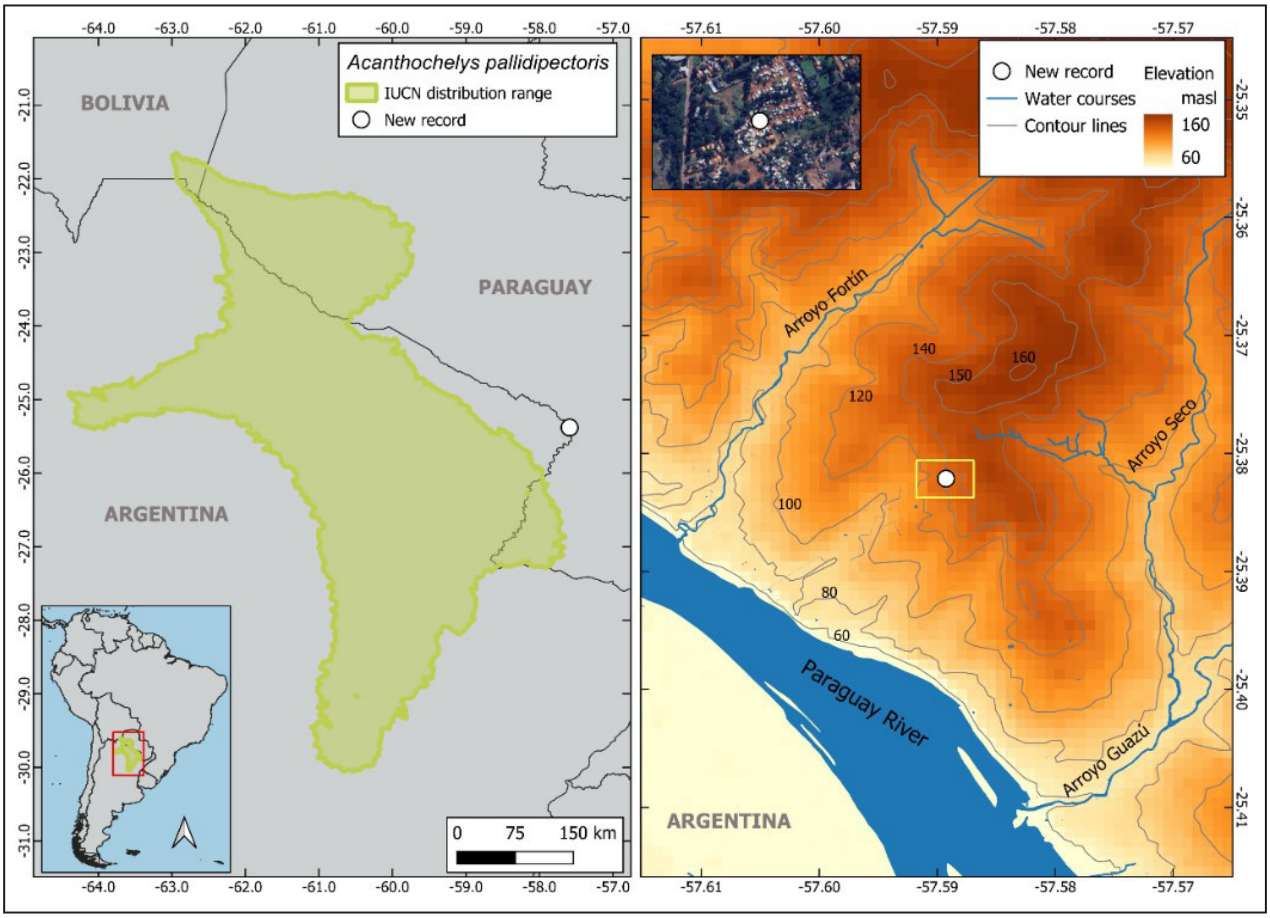

Figure 1. Distribution map of *A. pallidipectoris* (left), and the location of the new record (right). White dot indicates the new record in Villa Elisa (Central Department, Paraguay).

artificial ponds and flooding grasslands, usually in shallow waters (Cabrera, 2022). No ditches were found that could facilitate the animals access from the river to the site of the find, and the only water bodies in the surroundings of the area where this new record was found are some deeply urbanized streams, referred in Figure 1.

In this area the only freshwater turtle recorded was *Mesoclemmys vanderhaegei* (Cacciali and Buongermini, 2022). Reports of *A. pallidipectoris* in Paraguay are comparatively scarce and associated to the western portion of the Chaco (Fritz and Pauler, 1992; Cacciali *et al.*, 2016; Sanchez *et al.* 2019; Villalba *et al.*, 2022) but with a single record for natural areas near Pilar (Ñeembucu department: Giraudo and Contreras, 1994). *Acanthochelys pallidipectoris* is a species categorized as Endangered according to the IUCN Red List (Vinke and Vinke, 2022), although at national level its status varies between the different countries. Being categorized from as Critically Endangered (in Paraguay: Martínez *et al.*, 2020) and Threatened in Argentina (Prado *et al.*, 2012). In Bolivia, the last categorization classified it as Nearly Threatened (González and Montaño, 2009), although newer studies identify it as a high priority species, based on the analysis of conservation priorities (Domic-Rivadeneira *et al.*, 2021).

This record represents a range extension for *A. pallidipectoris*, highlighting the importance of urban biodiversity monitoring in areas traditionally considered outside the species' range. Although the presence of the individual in such an atypical environment may suggest anthropogenic introduction, either accidental or intentional, it also underlines the need to investigate overlooked or novel dispersal mechanisms. Data reported by Vetter and Clay (2024) show a clear preference toward tortoises (*Chelonoidis carbonaria* and *C. chilensis*) for the illegal pet trade in Paraguay with freshwater turtles in a much smaller scale. Given the species' threatened conservation status and the increasing transformation of its natural habitat, further efforts

Figure 2. Dorsal (A), ventral (B) and frontal (C) views of the male of *A. pallidipectoris*.

are warranted to assess potential movements, both natural and human-mediated, and to evaluate the role of urban environments in shaping species distribution patterns. This finding reinforces the value of continued surveillance and citizen engagement in biodiversity reporting, particularly in densely populated and rapidly changing regions such as the Metropolitan Area of Asunción.

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