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A NEW SPECIES OF *ATRACTUS* (SERPENTES: COLUBRIDAE: DIPSADINAE) FROM THE ATLANTIC FOREST OF ALTO PARANÁ, PARAGUAY

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ABSTRACT: We here describe a new species of *Atractus* from the Atlantic Forest of Alto Paraná Paraguay. The new species differs from other *Atractus* by the combination of the following characters: 17 dorsal scale rows without reduction, six supralabial and infralabial scales, only one post-ocular, a uniformly gray dorsum and a whitish belly with iridescent tonalities. The new species of *Atractus* is known only by the holotype which is a female specimen, and two paratypes. This is the third species of the genus recorded in Paraguay. Given the current status of the Atlantic Forest in Paraguay and in South America, the present species might be classified as highly threatened.

KEYWORDS: *Atractus kangueryensis* new species, Paraguay, San Rafael National Park, Taxonomy, Dipsadinae.

INTRODUCTION

Atractus is a fossorial genus of snakes (Fernandes and Puerto, 1993) characterized by the presence of only one pair of chinshields (Giraudo, 2001) and with poorly resolved phylogenetic affinities (Peters, 1960; Cadle, 1984; Lema, 1994; Zaher, 1999). The genus is widely distributed in South America (Giraudo and Scrocchi, 2000; Passos *et al.*, 2005), and including several species that are still known only from one specimen (Giraudo, 2001; da Silva *et al.*, 2005), or from only the type locality (e.g., *A. andinus*, *A. balzani*, *A. boettgeri*, *A. emigdioi*, *A. manizalensis*, among several others; see Tipton, 2005). Possibly the most extreme exception is *A. reticulatus* that is abundant in herpetological collections (Zaher *et al.*, 2005), and has a wide distributional range in southern Brazil, northern Argentina, Paraguay (Giraudo, 2001; Tipton, 2005), and Uruguay (Carreira *et al.*, 2004).

The first reference to a species of *Atractus* in Paraguay was made by Serié (1915), who cited a specimen of *A. reticulatus*, without any specific locality data. Later, Werner (1924) described *A. reticulatus paraguayensis* upon a second specimen from Paraguay. *Atractus reticulatus* was subsequently included in the Paraguayan herpetofaunal lists (Bertoni, 1939; Talbot, 1979; Böckeler, 1988). Álvarez *et al.* (1992) further described *A. r. scrocchi* from Corrientes (Argentina), Rio Grande do Sul (Brazil) and Alto Paraná (Paraguay), and recognizing two distinct subspecies of *A. reticulatus* in Paraguay. Posteriorly, Fernandes

(1995a) raised *A. r. paraguayensis* to the specific level, mainly due to its differences in coloration and lepidosis with the nominal form, and invalidated the subspecies *A. r. scrocchi*.

Vanzolini (2000) considers *A. paraguayensis* as synonym of *A. reticulatus*. Posteriorly, Giraudo and Scrocchi (2000) reported three new specimens of *A. paraguayensis*, confirming the specific status of the taxon based on records of Giraudo and Contreras (1994), which provided information on intraspecific variation. They also found overlapping values in the ventral scale counts among females of *A. reticulatus* and *A. paraguayensis*. Until presently, only these two species of *Atractus* were recorded in Paraguay.

Here we describe a new species of *Atractus* from San Rafael National Park, located in the Alto Paraná Atlantic Forest of Paraguay. The Paraguayan Atlantic forest is highly threatened since only 7% of the original coverage remains intact. San Rafael is the last large forest remnant in Paraguay and the new species might be already highly threatened due to habitat loss.

MATERIAL AND METHODS

Cephalic scales terminology follows Savage (1960). Ventral scale counts were made using Dowling's methods (Dowling 1951). The apical spine was not included in the countings of subcaudals. Measurements of cephalic scales as well as length and width of the head were done using a slide-caliper (0.01 mm).

The rest of the body measurements were recorded using a metric scale (1 mm). Paired structures are given in left/right form.

The holotype was weighted *in situ* with a bascule of 5 g (0.1 g of precision). Total length was taken from the tip of the snout to the tip of the tail, and body length from the tip of the snout to the base of the cloacal plate. Head length was recorded from the tip of the snout to the posterior edge of the jaws, and head width at the widest point. Sexual determination was made by a subcaudal incision. Acronyms are TTL: Total length, SVL: Snout-Vent length (body length), TL: Tail length, HL: Head length, HW: Head width. All measurements are in mm. Specimens are hosted in the Museo Nacional de Historia Natural del Paraguay (MNHNP). The new taxon is compared with other species of *Atractus* inhabiting the southern region of South America. Comparative data for other species were taken from Giraudo and Scrocchi (2000); Giraudo (2001); Passos *et al.* (2005) and Zaher *et al.* (2005). The holotype was found on the floor of a grassland area, potentially killed by working tools.

RESULTS

Atractus kangueryensis n. sp.

Holotype – MNHNP 11117, female from Kangüery, privately-owned reserve by Guyra Paraguay within the area delimited for the implantation of the San Rafael National Park, district of Alto Vera, Itapúa Department (26°30'42"S, 55°47'20"W) (Fig. 1). Collected on 23 March 2006 by Ramón Villalba.

Paratypes – MNHNP 9670, female from Estancia San Isidro (26°31'S, 55°52'W), 50 km NO from Pirapó, and 7.5 km E from the type locality. Collected on 11 January 2000 by Aida Luz Aquino, Norman Scott, Ismael Mora and C. Romero. MNHNP 11159, female from the same locality than the holotype. Collected on 23 January 2007 by Reinaldo Sánchez.

Diagnosis – *Atractus kangueryensis* differs from *A. albuquerquei*, *A. canedi*, *A. paraguayensis*, *A. reticulatus*, and *A. taeniatus* by a higher number of dorsal scale rows (17 instead of 15); from *A. reticulatus*, *A. serranus*, *A. trihedrurus*, and *A. snethlageae* by a greater number of ventral scales (130-166 instead of 165-169); and from *A. albuquerquei* by a lower number of ventral scales (170-200 instead of 165-169). Additionally, it can be distinguished from *A. albu-*

querquei and *A. canedi* by a lower number of subcaudal scales (27-50 instead of 22-25); from *A. paraguayensis*, *A. serranus*, *A. taeniatus*, *A. trihedrurus* and *A. snethlageae* by a lower number of supralabials (7-8 instead of 6); and from *A. canedi*, *A. pantostictus*, *A. paraguayensis*, *A. serranus*, *A. snethlageae* and *A. zebrinus* by a lower number of infralabials (7-8 instead of 6). Finally, the color pattern of the new species is distinct from that of *Atractus kangueryensis* from *A. canedi*, *A. paraguayensis*, *A. reticulatus*, *A. serranus*, *A. taeniatus*, *A. thalesdelemai*, *A. snethlageae* and *A. zebrinus*.

Description of the Holotype – A female weighting 4 gr., with a TTL of 185 mm, SVL of 173 mm, TL of 12 mm (6.49% of total length), HW of 5.6 mm, HL of 7.9 mm (4.27% of total length). Dorsal scale rows 17-17-17, smooth, without apical pits. 166 ventral scales, anal entire, 26 paired subcaudals. Rostral broader than high (0.18 x 0.11). Nasal divided, with nares opening between the two shields. Loreal almost twice longer than high (0.11 x 0.06/0.12 x 0.07), contacting second and third supralabials below, and prefrontal above. Prefrontal as long as broad (0.18 x 0.17/0.18 x 0.19), reaching nasals anteriorly, and frontal

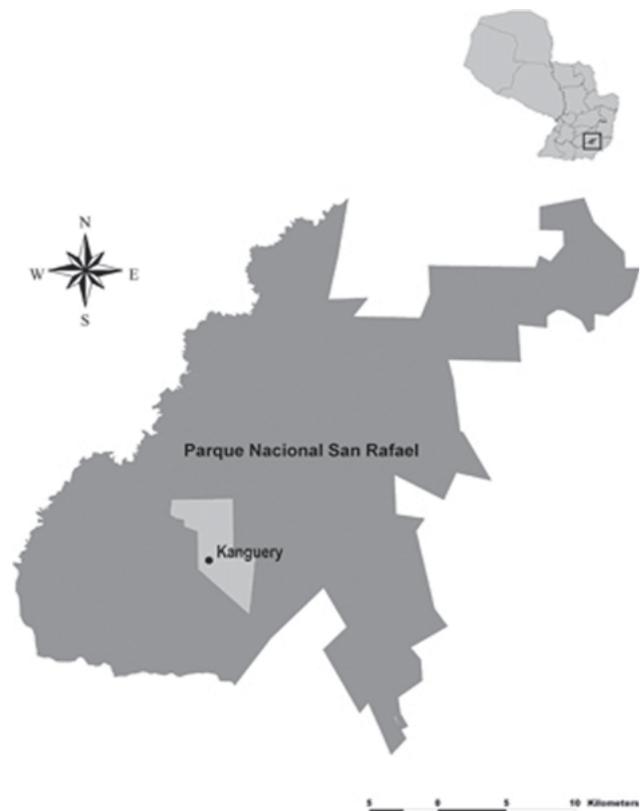


FIGURE 1. Location of San Rafael National Park in Paraguay, showing the type locality (Kanguery) of *Atractus kangueryensis*.

and supraocular posteriorly. Supraocular with trapezoid shape (damaged/0.10 x 0.16 x 0.05) contacting parietals, frontal and prefrontals. Prefrontal almost as long as broad (0.18 x 0.17/0.118 x 0.19). Only one pair of tiny postoculars, slightly square (0.05 x 0.05/0.06 x 0.05). Temporal formula 1+2. Anterior temporal longer than high (0.14 x 0.10/0.16 x 0.07). Upper posterior temporal more than twice as longer than high (0.27 x 0.11/0.26 x 0.09), and lower posterior temporal slightly irregular in size on both sides (large: 0.12/0.17; high: 0.09/0.07). Eye diameter 0.12 mm. Six supralabials on each side, second and third entering the orbit. Six infralabials, first, second, and third contacting the only pair of chinshields.

Variation with paratypes – Both hatchling females. The MNHNP 9670 has a TTL of 138 mm, SVL of 125 mm, TL of 13 mm (9.42% of total length), HW of 4.5 mm and HL of 8.7 mm (6.30% of the total length). MNHNP 11159 has a TTL of 129 mm, SVL of 118 mm, TL of 11 mm (8.53% of total length), HW of 3.9 mm and HL of 7.8 mm (6.04% of the total length). Dorsal scales without variation. Ventrals 165 to 169, with the last ventral double in the left side in MNHNP 11159. Both with 22 paired subcaudals. Cephalic pholidose follows the same pattern of the holotype. Infralabials of MNHNP 11159 are damaged.

Coloration in preservative – The adult coloration, based on the holotype, shows the upper surface of the head and dorsum pale gray. This color continues toward the dorsum of the body. In the nuchal region, this color is extending slightly downward. Supralabials, infralabials and the rest of the throat, whitish cream. The border of the scales in contact with the orbit, and all the postocular slightly darker gray (Fig. 2). Lateral scales with the hind edge of each scale dark brown. Center of each dorsal scale turn darker upward.

Belly and the first row of dorsal scales whitish cream. Anterior half of the second dorsal scale row gray, and posterior half white cream forming a reticulate pattern. In the tail, the first row of dorsal scales in contact with the subcaudals are gray. Subcaudals whitish cream.

Paratypes with different coloration. Specimen MNHNP 9670 has a reticulated pattern in the dorsum that starts in the second row. MNHNP 11159 has the dorsum uniformly grey, to the second dorsal row. First row is rose pink. Both specimens have an immaculate whitish belly. The head is similar, although MNHNP 9670 has a clear coloration behind the sides of the head. Both with the eye ring extremely marked.

Coloration in life – Holotype was found dead a few minutes (less than five) after killed, and then coloration was seen with the fresh specimen. Additionally specimen MNHNP 11159 was found alive. In life, the species shows coloration similar to that observed in preservative, but with an iridescent tonality. The dorsal color that in preservative is pale grey, in life is iridescent grey. The ventral color appears to be more whitish than when preserved. Due to the darker coloration in life, the ring around the eye is less visible. The rose pink line present in the first dorsal scale row of hatchling (MNHNP 11159) was more intense, and in preservative this color is losing.

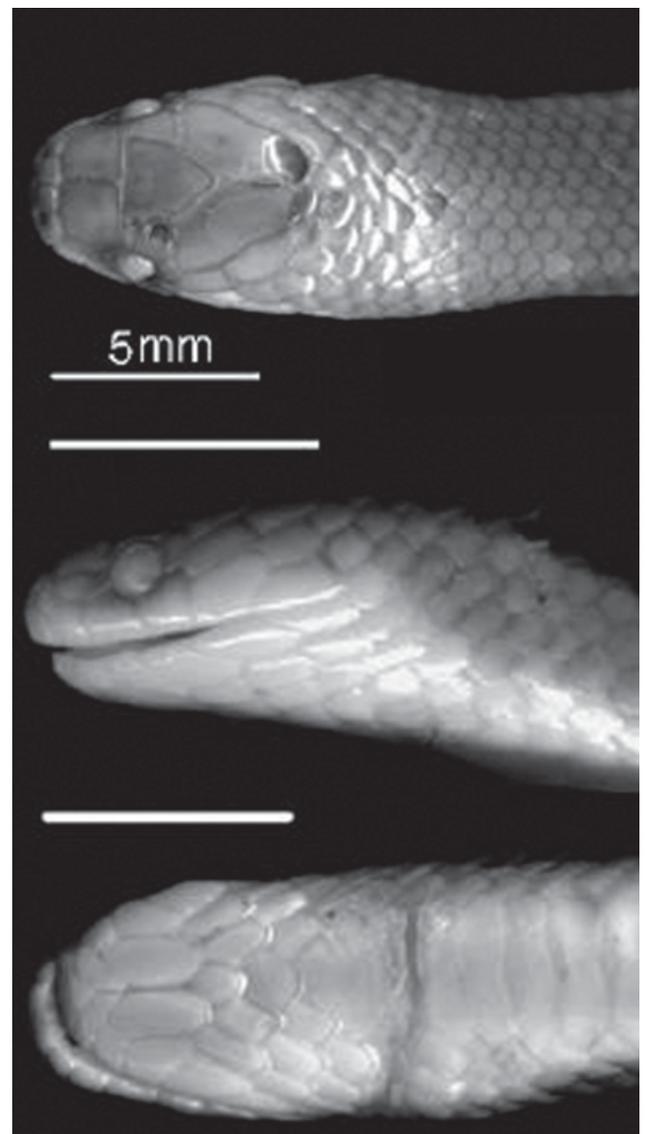


FIGURE 2. Detail of the head of the holotype of *A. kangueryensis*. Upper: Dorsal region; Middle: Lateral side; Lower: ventral surface.

Habitat and Distribution – *Atractus kangueryensis* is known only from the type locality, located in the San Rafael National Park, between the Departments of Itapúa and Caazapá. The park encompasses an area of 78.000 hectares of Atlantic Forest interspersed with southern grassland. The habitat in which the species was found is a natural grassland with several patches of Atlantic forest surrounding it (Fig. 3). The forest is high and dense, with several rivers and waterflows. The closer highway is located 50 km far away in straight line. The holotype was found dead around 07h30 and 08h00, in a rainy day with 23°C temperature.

Specimen MNHNP 9670 was found yet in the egg under a log, and born some hours later. Specimen MNHNP 11159 was found at the morning, in the grass close to a human dwelling. All specimens were found in grassland habitats, allied to Alto Paraná Atlantic Forest.

Ethimology – The specific epithet “*kangueryensis*” is a proper noun from the type-locality. It comes from the Guarani language and means “water coming from the bones” (*Kangue*: bone; *ry*: liquid, water), in reference to a place where the tribe Mbya Guarani buried their members. It is also the name of a stream that flows 2000 m far from the location where the holotype was collected.

DISCUSSION

A. kangueryensis is the only species of the genus, from Paraguay, with 17 dorsal scales rows. Although there is a broad chromatic variation in *A. reticulatus* (Fernandes, 1995a; Giraudo, 2001), *A. kangueryensis*



FIGURE 3. Habitat type where the specimen was collected.

differs from it by the color of the body, with *A. reticulatus* being reticulated while *A. kangueryensis* shows a uniform gray color pattern in the dorsum turning reticulated in the sides. *Atractus albuquerquei* closely approaches the color pattern present in *A. kangueryensis*. The former is characterized by a uniform dark brown dorsum with only the first row of dorsal scales that contact the ventrals being bicolor (brown on the upper half and light cream on the lower half) (Zaher *et al.*, 2005). In *A. kangueryensis* the light cream pattern of the belly extends to lower half of the second row of dorsal scales. These two species also differ notably in their number of dorsal, ventral and subcaudal scales (Table 1).

However, a strange trait of the scutellation is the presence of only one postocular. This character is shared only (among the compared species) with the holotype of *A. paraguayensis* and *A. thalesdelemai*. The former is very different not only in color, but

TABLE 1. Values of scutellation of the southernmost species of *Atractus*. DSR: Dorsal scales rows; Vent: Ventrals; SC: Subcaudals; SL: Supralabials; IL: Infralabials; PoO: Postoculars and Temp: Temporal formula. Data are taken from Giraudo and Scrocchi (2000); Giraudo (2001); Passos *et al.* (2005) and Zaher *et al.* (2005).

Species	DSR	Vent	SC	SL	IL	PoO	Temp
<i>Atractus kangueryensis</i> sp. nov.	17	165-169	22-26	6	6	1	1+2
<i>A. albuquerquei</i>	15	170-200	27-44	6	6	2	1+2
<i>A. canedi</i>	15	167	50	6	7	2	1+2
<i>A. pantostictus</i>	17	142-176	21-34	6-7	7-8	2	1+2
<i>A. paraguayensis</i>	15	157-166	22-30	7	7	1-2	1+2
<i>A. reticulatus</i>	15	130-163	19-34	6-8	6-7	2	1+2
<i>A. serranus</i>	17	146-163	14-31	7-8	7	2	1+2
<i>A. snethlageae</i>	17	137-163	22-35	7	8	2	1+2-2+1
<i>A. taeniatus</i>	15	141-165	21-31	7	6-8	2	1+2
<i>A. thalesdelemai</i>	17	151-167	22-29	6	6-7	1	1+2
<i>A. trihedrurus</i>	17	132-160	17-29	7-8	6-7	2	1+2
<i>A. zebrinus</i>	17	136-170	15-32	6-8	7	2	1+2

also in some meristic characters as dorsal, supralabial and infralabial scales. Nevertheless, the scutellation data of *A. kangueryensis* falls between the intraspecific variation range of *A. thalesdelemai* (except ventrals). In this case, coloration may differentiate both species. *A. thalesdelemai* has lateral sides of the neck cream white as well as first and second rows (Passos *et al.*, 2005), while *A. kangueryensis* has the neck gray in the sides; and only the first row of dorsal scales white cream, with only the second row gray anteriorly and white cream posteriorly. Also, dorsum of *A. kangueryensis* is grey uniform (just completely reticulated in MNHNP 9670), being reticulated only in the sides, and even without reticulation as MNHNP 11159. This contrasts with color of *A. thalesdelemai* that has all the dorsum and sides with the same pattern (Passos *et al.*, 2005). *A. thalesdelemai* never have the second dorsal scale rows colored. In addition, Passos *et al.* (2005) described *A. thalesdelemai* with any variation between adults and hatchlings. On the contrary, hatchlings of *A. kangueryensis* differ from adults because the former shows the first dorsal scale row of a pink color very evident. Finally, *A. thalesdelemai* is known from the type locality and surroundings (Passos *et al.*, 2005) as well as *A. kangueryensis*, and both locations are separated by a distance of 400 km. Is possible that these two species had to been, ancestrally, a unique species with a continuous distributional range.

The herpetofaunal diversity in Paraguay is poorly known yet, mainly in some regions of the dry Chaco, Cerrado and Alto Paraná Atlantic Forest. These two last are considered as megadiverse ecosystems (Myers *et al.*, 2000). *A. paraguayensis* and *A. reticulatus* were recorded in Paraguay, the former inhabiting a small area in the wet Chaco (Giraud and Scrocchi, 2000; Giraud, 2001), while the latter is restricted to the Atlantic Forest biome (Giraud, 2001). *Atractus kangueryensis* is only known from the type locality in the Alto Paraná Atlantic Forest. In this case, *A. reticulatus* and *A. kangueryensis* would be endopatric in this ecoregion. The ecoregion is severely threatened in its range in South America (Argentina, Brazil and Paraguay), with less than 7% remaining in Paraguay (Cartes, 2005). Given the fragility of the ecosystem in which *A. kangueryensis* was found and, it is of utmost importance to develop conservational strategy actions to conserve this biome in Paraguay. More studies are needed to know the intraspecific variation (mainly with respect to males) of *A. kangueryensis*, as well as his natural history, to provide detailed information

for conservation actions in its natural distributional range.

RESUMEN

En este trabajo se describe una nueva especie de *Atractus* proveniente del Bosque Atlántico del Alto Paraná de Paraguay. La nueva especie difiere de otras especies de *Atractus* por la combinación de los siguientes caracteres: 17 hileras dorsales sin reducción, seis escamas supralabiales e infralabiales, solo una postocular, un dorso de color gris uniforme y el vientre claro con tonalidades iridiscentes. La nueva especie de *Atractus* es conocida únicamente por el holotipo el cual es una hembra, y dos paratipos. Esta es la tercera especie del género registrada en Paraguay. Dado el presente estado del Bosque Atlántico en Paraguay y en Sudamérica en general, la presente especie puede ser clasificada como altamente amenazada.

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