

Revision of *Philodryas mato Grossoensis* with the revalidation of *P. erlandi* (Reptilia: Squamata: Dipsadidae)

PIER CACCIALI^{1,2,3}, HUGO CABRAL^{3,4}, VANDA L. FERREIRA⁴ & GUNTHER KÖHLER¹

¹⁾ Senckenberg Forschungsinstitut und Naturmuseum, Senckenberganlage 25, 60325 Frankfurt a.M., Germany

²⁾ Johann Wolfgang Goethe-University, Institute for Ecology, Evolution & Diversity, Biologicum, Building C, Max-von-Laue-Str. 13, 60438 Frankfurt am Main, Germany

³⁾ Instituto de Investigación Biológica del Paraguay, Del Escudo 1607, Asunción, Paraguay

⁴⁾ Asociación Guyra Paraguay, Av. Cnel. Carlos Bóveda, Parque Asunción Verde, Viñas Cué, Paraguay

⁵⁾ Universidade Federal do Mato Grosso do Sul, CCBS, Zoologia, Cx.Postal 549, Campo Grande, Mato Grosso do Sul, Brazil

Corresponding author: PIER CACCIALI, e-mail: pcacciali@senckenberg.de

Manuscript received: 27 August 2014

Accepted: 19 August 2015 by ARNE SCHULZE

Abstract. Examination of the geographical variation of selected morphological characters in *Philodryas mato Grossoensis* resulted in evidence to support the recognition of two species and we therefore resurrect *P. erlandi* from the synonymy of *P. mato Grossoensis*. *Philodryas mato Grossoensis* inhabits Cerrado with some records in Atlantic Forest biomes in eastern Paraguay and southern Brazil, whereas *P. erlandi* is distributed in dry and arid environments of the Chaco in northern and western Paraguay, southeastern Bolivia, and northern Argentina. We designate SMF 49990 as neotype for *Philodryas mato Grossoensis*.

Key words. South America, Cerrado, Chaco, snakes, taxonomy.

Introduction

The genus *Philodryas* WAGLER, 1830 comprises a group of large diurnal snakes distributed widely across South America. According to the most recent systematic works, *Philodryas* belongs to the tribe Philodryadini with 21 species (VIDAL et al. 2000, 2010, ZAHER et al. 2009, 2014, PYRON et al. 2011, GRAZZIOTIN et al. 2012). This tribe is characterized by its hemipenial morphology consisting of a long organ with the truncus being much longer than the lobes, and two parallel rows of enlarged calyces covering the asulcate side of the truncus (ZAHER et al. 2009).

The genus *Philodryas* consolidates snakes usually called “racers” due to their slender body and fast movements. These snakes have terrestrial or arboreal habits and feed mainly on frogs and lizards (CEI 1993, NORMAN 1994). Some members of the genus have a spotted body pattern, others exhibit longitudinal stripes, but several of them are green or brown without pattern, and only one species exhibits a bicoloured coloration with the anterior portion of the body being greenish and the rest of the body reddish brown: *P. mato Grossoensis* KOSLOWSKY, 1898 (CEI 1993, NORMAN 1994, GIRAUDO 2001).

Philodryas mato Grossoensis was described by KOSLOWSKY (1898) from “Miranda” in Mato Grosso [do Sul] State (Brazil). The type specimen was deposited in the Museo de La Plata, Argentina (without specification of catalogue number) and is now lost (FERRARO & WILLIAMS 2006). SCHENKEL (1901) described *P. ternetzii* based on a specimen (NMB 1939) from “Bemalcue” in Paraguay. This locality is actually “Bernal Cué” and an old name for Colonia Nueva Colombia (Departamento Cordillera, Paraguay) (CACCIALI & WUEST 2009). Only one year later, LÖNNBERG (1902) described *P. erlandi*, probably on the basis of two specimens (not specified in the original description) from Tarija, Bolivia. These two specimens are now in different collections (i.e., NRM 5097 and BMNH 1946.1.8.43), recognized as syntypes by THOMAS (1976). Finally, WERNER (1909) described *P. boulengeri* based on a specimen without specific locality data, but probably from “Indien” (India) according to THOMAS (1976).

MÜLLER (1928) recognized *Philodryas mato Grossoensis*, *P. erlandi*, and *P. boulengeri* as subspecies of *P. ternetzii*, without justification, but AMARAL (1929a) placed these taxa in the synonymy of *P. mato Grossoensis*. This taxonomy remained without modification until the present and was

adopted by PETERS & OREJAS MIRANDA (1970) in their influential work and by subsequent authors.

Currently, *Philodryas mattogrossensis* is considered a species with a wide distribution in open formations (FOWLER & SALOMÃO 1994, HARTMANN & MÁRQUES 2005) in the Chaco and Cerrado (CEI 1993, LEYNAUD & BUCHER 1999, GIRAUDO & SCROCCHI 2002, BÉRNILS et al. 2007, VAZ-SILVA et al. 2007). Notwithstanding, BÉRNILS et al. (2007) and MARQUES et al. (2009) recorded the species in the Atlantic Forest.

An examination of specimens from several scientific collections produced evidence for the recognition of two taxa, both currently assigned to *Philodryas mattogrossensis*, that can be easily distinguished from each other by their coloration. In this work, we review the name-bearing types of the synonyms of *P. mattogrossensis*, and resurrect the name *P. erlandi*. Also, we designate SMF 49990, a specimen from “Taubaté, Mato Grosso do Sul (-20.2858° S, -56.0847° W), Brazil” as the neotype for *P. mattogrossensis*.

Materials and methods

We reviewed the original descriptions of *Philodryas mattogrossensis* and its synonyms, and also examined the type material and additional specimens assigned to this taxon (Appendix). Institutional acronyms used in the text are CEPB (Coleção de Herpetologia do Centro de Estudos e Pesquisas Biológicas da Universidade Católica de Goiás, Brazil), CEUCH (Coleção Zoológica de Referência, seção Herpetologia, Campus de Corumbá, Universidade Federal do Mato Grosso do Sul, Brazil), CZPLT (Colección Zoológica Para La Tierra, San Pedro, Paraguay), MCTPUCRS (Museu de Ciências e Tecnologia da Pontifícia Universidade Católica de Porto Alegre, Brazil), ZMH (Zoologisches Museum, Hamburg, Germany) (referred to as ZIMH by THOMAS 1976), and ZUFMS-REP (Coleção Zoológica de Referência, seção Répteis, Universidade Federal do Mato Grosso do Sul, Brazil). Other acronyms follow SABAJ PÉREZ (2013).

We compiled a distribution map using ArcGIS 10 based on specimens we examined and supplemented with data from the literature (i.e., KOSLOWSKY 1898, MÜLLER 1928, THOMAS 1976, YUKI 1992, LOBO & SCROCCHI 1994, CARVALHO & NOGUEIRA 1998, MORO 1999, ARZAMENDIA & GIRAUDO 2002, KACOLIRIS et al. 2006, MANÇO et al. 2006, VAZ-SILVA et al. 2007, MARQUES et al. 2009, SILVA-Jr et al. 2009, SCHALK 2010, ZAHER et al. 2011, and ARAUJO & ALMEIDA-SANTOS 2011). The ecoregional layer of our map is based on DINERSTEIN et al. (1995). Georeferences are in the WGS 1984 datum format and given in decimal degrees.

We used a Mann-Whitney U test to assess differences between ventral and subcaudal scalation ranges of females, males and both sexes together, using Past 2.01 (HAMMER et al. 2001).

We scored the available specimens for the following morphological characters: number of ventrals (following DOWLING 1951), subcaudals, dorsal scale rows (one head-

length posterior to head, at midbody, and one head length anterior to cloaca), preoculars, postoculars, temporals, supralabials (indicating scales contacting the orbit), and infralabials (indicating scales touching genials). Paired structures are presented in right/left sequence. Colour descriptions follow KÖHLER (2012).

Hemipenes were prepared following the techniques of PESANTES (1994) and MANZANI & ABE (1988). The left hemipenis of CEUCH 3017 (*Philodryas mattogrossensis*) was prepared for description. To assess possible ontogenetic variation (JADIN & KING 2012), we made comparisons based on the partially everted left hemipenes of specimens MNHNP 3501 and ZUFMS-REP 2507. The hemipenis of *P. erlandi* was described by THOMAS (1976) based on ZSM 9/1928 and ZAHER (1999) based on AMNH 141663, both under the name *P. mattogrossensis*. The terminology for hemipenes morphology follows DOWLING & SAVAGE (1960), ZAHER (1999), and MYERS & CADLE (2003). In cases where the organ showed a concave curvature on the sulcate surface, a thin needle was inserted to keep the shape more or less in same plane for photography.

The list of synonyms and chresonyms was derived by including only literature that cited specimens with specific locality data (even if without vouchers). Due to problems with the inventory of the Instituto Butantan (IBSP), it was not possible to access data on specimen IB 75182 (See GenBank GQ457880) used by ZAHER et al. (2009), VIDAL et al. (2010), PYRON et al. (2011, 2013), and GRAZZIOTIN et al. (2012); thus, these works are not included in the chresonymy.

Results

Our results show the presence of two groups that can be easily differentiated from one another by coloration and are strongly correlated geographically. We did not find any intermediate specimens (see “Variation” for respective species) and, therefore, consider the two colour morphs to represent distinct species. Additionally, we found some scalation characters (presented below) that confirm the existence of two distinct taxa.

Species 1: presence of a well-marked dark green or brown dorsal stripe that gradually changes to reddish brown in the posterior half of the body (Fig. 1). Lateral portion of neck and anterior half of the body cream or yellowish with more intense coloration that changes to reddish brown anteroposteriorly. Dorsal scale rows usually 21–19–15. First temporal short. Widely distributed in the Cerrado with some records in the Atlantic Forest.

Species 2: gradual transition from dark or light green to reddish brown from the head to the tail (Fig. 2). Lateral to dorsal coloration changes gradually. Dorsal scale rows usually 19–19–15. First temporal elongated. Widely distributed in the Chaco.

In scalation, aside from the distinctive shape of the first temporal scale and different counts of dorsal scale rows one head-length posterior to head, no additional characters could be identified that would be useful for differenti-

ating between the two taxa. Although our Species 2 tends to have a higher number of subcaudal scales ($U = 17$, $z = -2.607$, $p = 0.006$; Supplementary fig. 1), there is overlap between the ranges in the two species. Our sample shows no significant differences in the number of ventral scales ($U = 50$, $z = -0.249$, $p = 0.793$ in males; $U = 136.5$, $z = -0.66$, $p = 0.511$ combined) between Species 1 and 2 (Supplementary fig. 1). The sample size of females of Species 1 was too small for a meaningful comparison with females of Species 2.

Based on the consistent differences in coloration and supported by the subtle but obvious differentiation of the first temporal scale, we recognize two species of snakes formerly referred to *Philodryas mottogrossensis* and provide standardized species accounts for them.

In the original description of *P. mottogrossensis*, KOSLOWSKY (1898) wrote: “El color es por encima: sobre la

cabeza y la primera parte de la región dorsal del cuerpo (8 á 10 escamas) de un olivo oscuro que poco á poco pasa en un color quemado claro en el medio del cuerpo y que se vuelve en un rojizo sobre la parte posterior del cuerpo y cola.” [Translation: “The colour above is: on the head and the first part of the dorsal region of the body (8 to 10 scales) of dark olive that changes gradually to a reddish brown on the anterior half of the body, turning reddish toward the posterior part of the body and tail”] (Fig. 3).

With respect to coloration, SCHENKEL (1901) wrote in the description of *P. ternetzii* (considered a synonym of *P. mottogrossensis* by MÜLLER 1928): “... durch einen schwärzlichen Strich scharf vom Graubraun der Kopfoberfläche abgegrenzt; letztere Färbung setzt sich als breite Binde auf den Hals fort, wird erst schmaler und dunkler – an der engsten Stelle, 8–10 cm ...” [Translation: “demarcated sharply from the grey-brown head surface by a blackish line; this coloration continues as a broad band on the neck, first becoming narrower and darker – being 8–10 cm at the narrowest section ...”] (Fig. 4).

In both cases, reference is made to a dorsal stripe 7 to 10 scales wide. Nevertheless, in his description of *P. erlandi*, the next species in the synonymy list of *P. mottogrossensis* (also invalidated by MÜLLER 1928), LÖNNBERG (1902) states that the coloration of the species is: “Bluish green anteriorly (in spirit), becoming light greyish brown towards the posterior half of the body ...”, thus making no reference to a dark dorsal stripe.

The last species in the synonymy list of *P. mottogrossensis* is *P. boulengeri* described by WERNER (1909), who wrote: “... diese braune Färbung geht in einem allmählich auf 7 mediane Schuppenreihen sich verschmälern-den, allmählich schwarzbraun werdenden Längsband auf den vordersten Teil des Rumpfes über und ist hier von der sehr hellen, etwa grünlichweissen Färbung der Seiten scharf abgesetzt.” [Translation: “... this brown coloration [upper head surface] gradually narrows posteriorly into a longitudinal band, narrowing to 7 median dorsal scales in width, and gradually changing to dark brown on the foremost part of the body and being sharply offset from the very bright, greenish white colour of the sides.”] (Fig. 5). The holotype of *P. boulengeri* used to be in the ZMH, but is currently lost (THOMAS 1976). This coloration is consistent with that described for *P. mottogrossensis* and *P. ternetzii*.

For this reason, we consider the type specimens of *P. erlandi* to belong to a different taxon (referred to as Species 2 in Results); therefore this nominal taxon should be revalidated and extracted from the synonymy of *P. mottogrossensis* (referred to as Species 1 in Results). To avoid further confusion between these species, it is necessary to designate a neotype for *P. mottogrossensis* since the name-bearing type is lost (FERRARO & WILLIAMS 2006) (ICZN, Article 75.3.4) and provide detailed characterizations of both taxa (both morphological and geographical) to clarify the taxonomic status of the species involved (ICZN, Articles 75.3.1, and 75.3.3).



Figure 1. General aspect of Species 1, distributed in the Cerrado and Atlantic Forest. Photo: OTAVIO A. V. MARQUES.



Figure 2. General aspect of Species 2, present in the Chaco. Photo: PAUL FREED.

Philodryas erlandi LÖNNBERG, 1902

Philodryas Erlandi LÖNNBERG 1902: 460 (lectotype, NRM 5097 [by present designation] (Figs 6–7); type locality: Fortín Crevaux Nuero, Provincia de Tarija, Bolivia (-21.9° S, -62.9° W) by lectotype selection; paralectotype, BMNH 1946.1.8.43; from: Tatarenda, Provincia de Santa Cruz, Bolivia (-19.1105° S, -63.5141° W)).

Philodryas ternetzii erlandi: MÜLLER 1928.

Philodryas mattogrossensis: THOMAS 1976 (part.), CEI 1993 (part.), LOBO & SCROCCHI 1994, MORO 1999, ZAHER 1999, ARZAMENDIA & GIRAUDO 2002, KACOLIRIS et al. 2006, SCHALK 2010.

Diagnosis: *Philodryas erlandi* differs from all congeners except *P. mattogrossensis* by a dorsal colour that shifts from green on the anterior half of the body to brown on the posterior part. *Philodryas erlandi* is distinguished from *P. mattogrossensis* by the absence of a well-marked dark

green or brown dorsal stripe restricted to the anterior one-third of the body (vs present in *P. mattogrossensis*), presence of a dark line on the supralabials (vs absent or less evi-

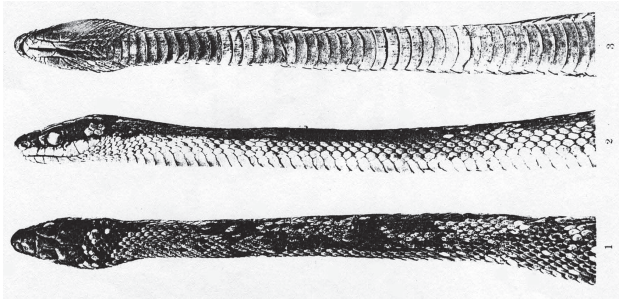


Figure 3. Original plate of KOSŁOWSKY's description of *Philodryas mattogrossensis*.



Figure 4. Type specimen of *Philodryas ternetzi* described by SCHENKEL (1901). Photo: EDUARD STÖCKLI.

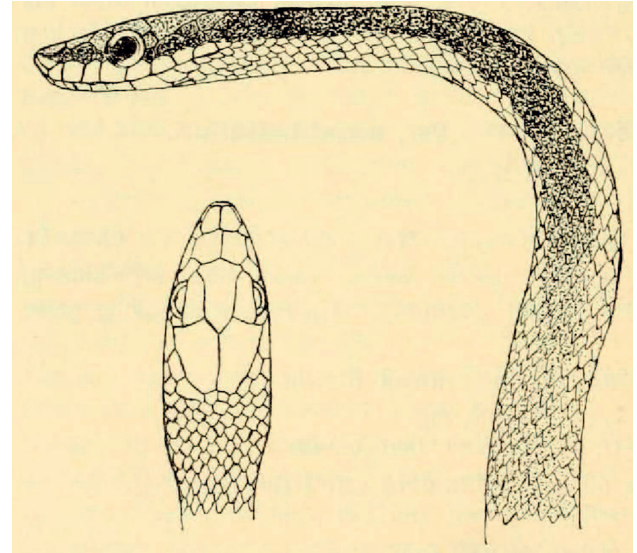


Figure 5. Original plate of *Philodryas boulengeri* described by WERNER (1909).



Figure 6. Dorsal (above) and ventral (below) views of the lectotype of *Philodryas erlandi* (NRM 5097); scale bar = 5 cm.

dent in *P. mottogrossensis*), dorsal formula usually 19–19–15 (vs usually 21–19–15 in *P. mottogrossensis*), and first temporal elongated (vs. as wide as high in *P. mottogrossensis*).



Figure 7. Details of the head (dorsal, lateral, and ventral views) of the lectotype of *Philodryas erlandi* (NRM 5097); scale bar = 1 cm.



Figure 8. Details of facial (above) and lingual (below) views of the left maxillary bone of *Philodryas erlandi* (NRM 5097); scale bar = 5 mm.

Description of the lectotype (NRM 5097): Male; SVL 471 mm; TL 221 mm (32% of total length), with pointed tail tip (Fig. 6); head long and narrow, wider than the neck; head length 20.1 mm; head width 12.8 mm; snout acuminate; nostril in posterior part of nasal scale; nostril–eye distance 3.9 mm; eye diameter 3.8 mm; mouth length 15.3 mm (Fig. 7); the three anterior maxillary teeth are widely spaced and only slightly recurved, whereas the nine teeth in the posterior portion of the maxilla are longer, more strongly recurved and narrowly spaced; a posterior diastema of 0.9 mm; (Fig. 8).

Rostral wider than high (4.0×2.9 mm), visible from above; internasals triangular; prefrontals as wide as long, $1.5 \times$ the size of the internasals; frontal almost twice as long as wide (5.9×3.4 mm), with a slight constriction near the middle; parietals twice as long as wide (4.8×2.3 mm), in contact with frontal, supraoculars, upper postoculars anteriorly, and temporals and occipitals laterally and posteriorly; supraoculars elongated, contacting prefrontals and preocular anteriorly, frontal at the inner lateral edge, and parietals posteriorly; prenasal triangular, in contact with internasal above, rostral anteriorly, and first supralabial below; postnasal higher than wide, contacting prefrontal and internasal above, loreal at the posterior edge, and the first and second supralabials below; loreals $1/1$, rectangular (1.7×1.4 mm); preoculars $1/1$, visible in dorsal view, in contact with supraocular and prefrontal above; postoculars $2/2$; upper postocular larger than the lower one; temporals $1+2/1+2$; first temporal rectangular and elongated (1.7×2.5 mm) (Fig. 9); second row of temporals poorly differentiated from nuchal scalation; supralabials $8(4-5)/8(4-5)$; 6^{th} and 7^{th} supralabials larger than the rest, followed by 5^{th} ; infralabials $10(1-6)/10(1-6)$; dorsal scales 19–19–15, each with a single apical pit; ventrals 223; anal plate divided; subcaudals 150, divided.

Coloration after 112 years of preservation in 70°GL ethanol: head Smoke Grey (264); scales behind parietals edged with Dark Greyish Brown (284); supralabials Pale Lime Green (112) with a thin Sepia (279) line along the upper border; infralabials immaculate Pearl Grey (262); dorsum Medium Plumbeous (294), grading into Drab (19) on the posterior body, portions without epidermal layer Dark Pearl Grey (290); dorsal and lateral faces of tail Smoke Grey (266); chin shields and gular region Pratt's Payne's Grey (293); ventral scales in anterior portion of body Dark Blue Grey (194) with a Pearl Grey (262) longitudinal stripe of one dorsal scale in width along its edges, and grading into Olive-Grey (265) at midbody, and into Cream White (52) under the tail.

Description of the paralectotype (BMNH 1946.1.8.43): Male (Fig. 10); SVL 26 + 367 mm (head clipped at neck level); TL 172 mm. Cephalic scalation follows same pattern as lectotype. Rostral wider (2.9×1.5 mm) than in the lectotype, and slightly visible from above; prefrontals and internasals almost same size. Infralabials $10(1-5)/9(1-5)$; dorsal scales 18–19–15; ventrals ca 227; subcaudals 136. Darker colour limited to the anterior third of the body.

Coloration in life (SMF 96720, a male from Friedensheim Colonia Menno, Boquerón, Paraguay): Dorsum of head Dark Drab (45) edged below by Sepia (286); supralabi-

als Sulfur Yellow (91) with a suggestion of Pistachio (102); ventral surface of head Light Sky Blue (191); dorsal face of body Olive-Grey (265) in its anterior portion, grading into

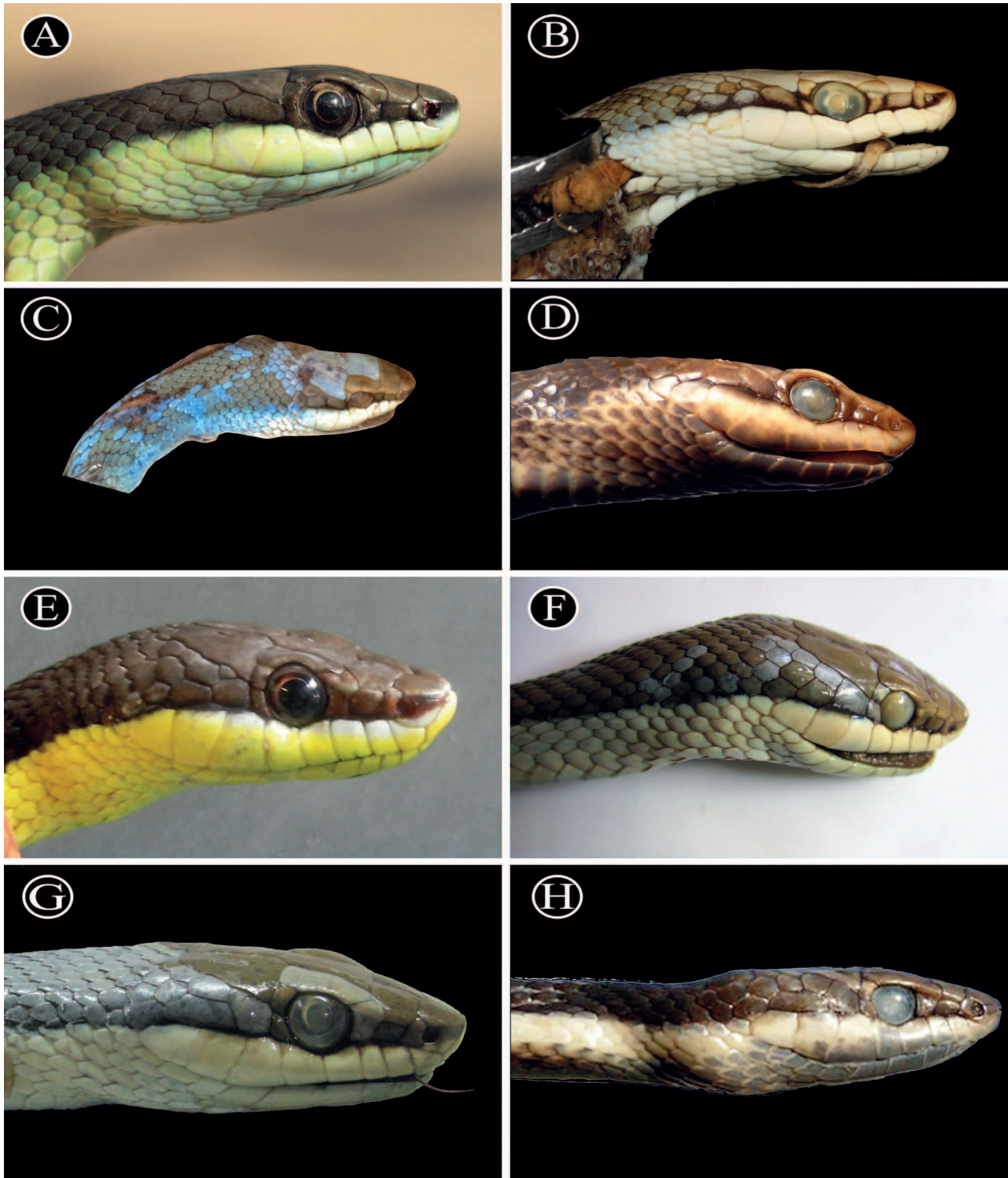


Figure 9. Details of the head of *Philodryas erlandi* (A–D) and *P. mattogrossensis* (E–H), showing differences in coloration, temporal shape, and muzzle. A) SMF 96720; B) BMNH 1946.1.8.43; C) AMNH-R 141663; D) MNHNP 6528; E) live specimen kept at the Universidade Federal de Mato Grosso do Sul; F) NMB 1939; G) MNHNP 6525; H) MNHNP 11713.

Army Brown (46) on posterior body, and into Cinnamon-Drab (50) on tail; ventral face of body Opaline Green (106), grading into Beige (254) on posterior body and tail; a dirty white longitudinal stripe along ventrals; iris Warm Sepia (40) with Clay Colour (20) in the upper portion.

Variation: The shapes of the cephalic scales of 24 additional specimens examined were similar to that observed in the lectotype and paralectotype. Variation in temporals was 1 + 1 (n = 2) and 1 + 2 (n = 22). Dorsals with reduction: 18–19–15 (n = 1), 19–19–15 (n = 20), and 21–19–15 (n = 2). Counts



Figure 10. Dorsal (left) and ventral (right) views of the paralectotype of *Philodryas erlandi* (BMNH 1946.1.8.43); scale bar = 5 cm.

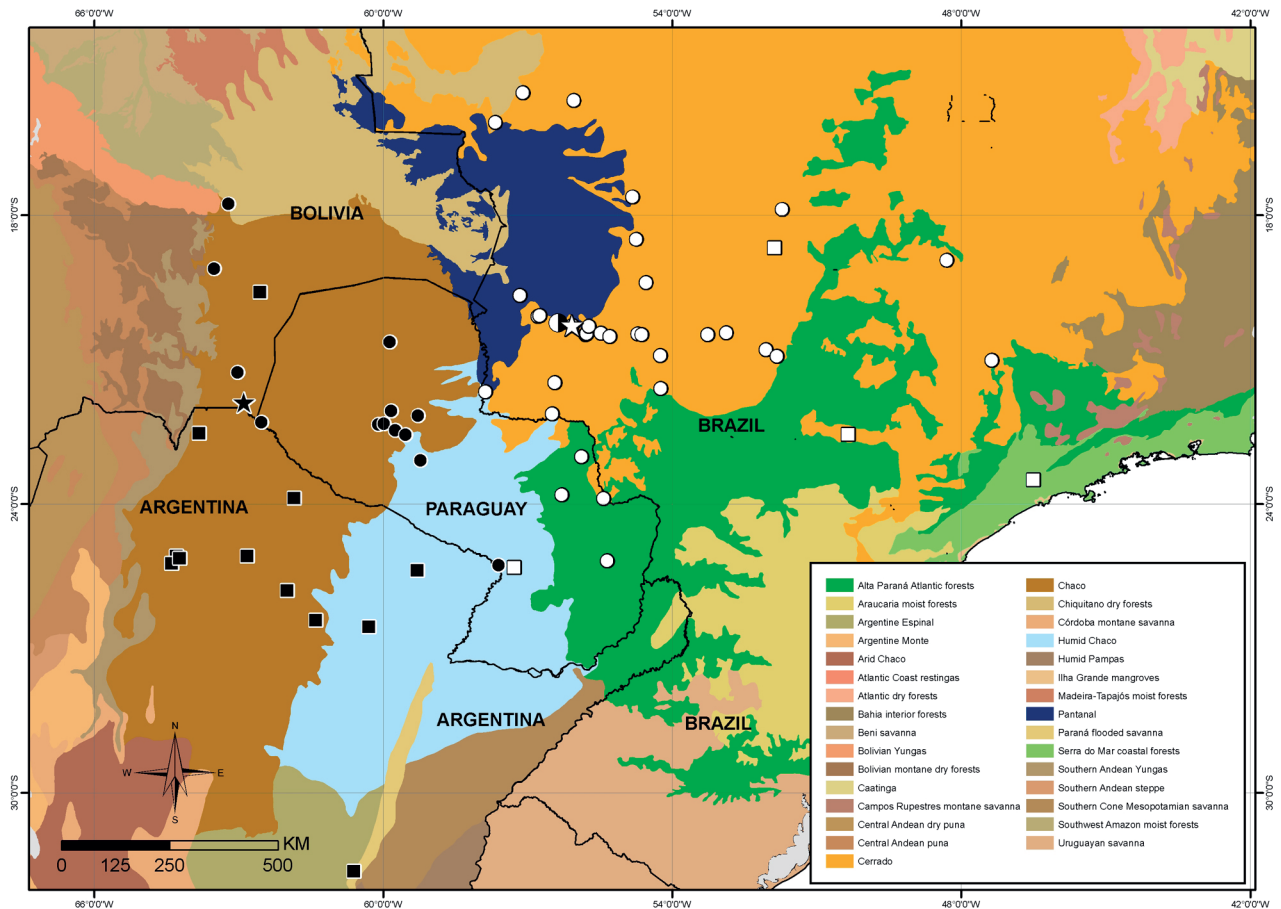


Figure 11. Distribution map of *Philodryas erlandi* (black symbols) and *P. mottogrossensis* (white symbols). Stars represent type localities (the black and white circle refers to Miranda, the previous type locality of *P. mottogrossensis*), circles represent specimens examined (see Appendix) and squares literature data (see Methodology for details).

Table 1. Scalation ranges of ventrals (Vent) and subcaudals (SC) of *Philodryas erlandi* and *P. mattogrossensis* discriminated by gender. The number of specimens examined is given in parentheses.

	<i>P. erlandi</i>	<i>P. mattogrossensis</i>
Vent F	215–237 (16)	215–231 (3)
Vent M	217–231 (12)	210–234 (17)
SC F	118–138 (13)	123–128 (4)
SC M	130–156 (10)	120–137 (12)

of ventrals and subcaudals are provided in Table 1. The coloration shows no significant differences. Based on the preserved specimens examined, the head colour varies in the spectrum from greyish brown to brownish red, and that of the body ranges from greyish to light brown or pinkish.

Distribution: *Philodryas erlandi* is distributed primarily in the Chaco, with some records in the Humid Chaco, and extending northward to near the Chiquitano Dry Forest in Bolivia, and westward to near the Arid Chaco in Bolivia and Southern Andean Yungas in Argentina (Fig. 11).

Philodryas mattogrossensis KOSLOWSKY, 1898

Philodryas mattogrossensis KOSLOWSKY 1898: 29 (neotype, SMF 49990 [by present designation] (Figs 12–13); type locality: Taunay, Mato Grosso do Sul (–20.28608° S, –56.0847° W), Brazil by neotype selection).

Philodryas ternetzii SCHENKEL 1901: 170; type locality: “Bemal-cue”. Holotype: NMB 1939.

Philodryas boulengeri WERNER 1909: 232; type locality: “Indien”. Type lost fide THOMAS (1976).

Philodryas ternetzii ternetzi: MÜLLER 1928.

Chlorosoma mattogrossense: AMARAL 1929a.

Philodryas mattogrossensis: THOMAS 1976 (part.), AMARAL 1977, COLLI et al. 2002, VAZ-SILVA et al. 2007, MARQUES et al. 2009, ZAHER et al. 2011, ARAUJO & ALMEIDA-SANTOS 2011.

Remarks: there are some specimens in the IBSP from Miranda (type locality after KOSLOWSKY 1898), but due to the tragic fire that impacted on most of the collections (AHE 2010, SANT’ANNA 2010, FRANCO 2012), many specimens were lost (Giuseppe Puerto, 2014, pers. comm.).

Diagnosis: *Philodryas mattogrossensis* can be distinguished from all congeners except *P. erlandi* by its coloration, shifting from green on the anterior half of the body to brown on the posterior part. *Philodryas mattogrossensis* is distinguished from *P. erlandi* by the presence of a dorsal stripe on the anterior third of the body (vs absent in *P. erlandi*), absence of a dark line between supralabials and the rest of the cephalic scalation (vs present in *P. erlandi*), dorsal formula usually 21–19–15 (vs 19–19–15 in *P. erlandi*), and the first temporal as wide as high (vs rectangular in *P. erlandi*).

Description of the neotype: Male; SVL 809 mm; TL 279+ mm, tip of the tail lost; head long and narrow, slightly differentiated from the neck; head length 32.7 mm; head width 16.5 mm; snout acuminate with rounded tip of snout; nostril–eye distance 5.5 mm; eye diameter 5.3 mm; mouth length 24.8 mm.

Rostral almost as wide as high (4.7 × 3.8 mm), barely visible from above; internasals triangular; prefrontals square; frontal longer than wide (7.5 × 5.3 mm); parietals broad (9.1 × 6.3 mm), in contact with frontal, supraoculars and superior postoculars anteriorly, and temporals and occipitals laterally; supraoculars elongated, contacting frontal at the inner edge, prefrontals and preocular anteriorly, and parietals posteriorly; prenasal rhomboidal, contacting internasal above, rostral anteriorly, and first supralabial below; postnasal high with a broad base, contacting prefrontal and internasal above, loreal posteriorly, and first and second supralabials below; loreals 1/1, rectangular (2.1 × 1.5 mm); preoculars 1/1, visible from above, contacting supraocular and prefrontal; postoculars 2/2, of equal size; temporals 1+2/1+2; first temporal different on each side (4.5 × 2.0 mm/3.6 × 2.2 mm), but always smaller than second lower temporal (Fig. 9); upper second temporals smaller than lower ones; supralabials 8(4–5)/8(4–5); 6th and 7th supralabials larger than the others; infralabials 10(1–6)/10(1–6); dorsal scales 19–19–15, with single apical pits; ventrals 217; anal plate divided; subcaudals 80+, divided.

Coloration after 60 years of preservation in 70°GL ethanol: dorsal and lateral faces of head Ground Cinnamon (270); supralabials Light Sulphur Yellow (93) grading into Light Greenish White (98) below; infralabials Light Greenish White (98) with a suffusion of Light Sulphur Yellow



Figure 12. Dorsal (above) and ventral (below) views of the neotype of *Philodryas mattogrossensis* (SMF 49990); scale bar = 10 cm.

(93); gulars and throat Light Greenish White (98); dorsum with a Mikado Brown (42) stripe of 11 scales in width on the neck (Dark Blue Grey (194) suffused with Light Sky Blue (191) on scales without epidermal layer), narrowing to seven scales in width in the first third of the body, and being wider posteriorly and suffused with Tawny Olive (17); laterals (from the first dorsal scale row) Tawny Olive (17) in the first half of the body, becoming Clay Colour (18) posteriorly to the tail; venter Pratt's Payne's Grey (293) with a Pale Sulphur Yellow (92) longitudinal stripe along the edges, and grading into Chamois (84) posteriorly to the tail.

Coloration in life (MNHP 11713, a female from Laguna Blanca, San Pedro, Paraguay): Dorsum of head suffused by Burnt Umber (48) and Hazel (26); supralabials Cream White (52) with a suffusion of Plumbeous (295), with the 3rd to 5th supralabials being almost entirely Plumbeous (295); ventral face of head Plumbeous (295), with the free edge of the scales being Cream White (52); dorsally a Warm Sepia (40) stripe of five scales in width, grading into a nine-scale wide stripe of Prout's Brown (47), followed by Tawny (60)/Dark Salmon Colour (59) at midbody; lateral sides of the third anterior part of the body Cream White (52) with Plumbeous (295) dashes in the centres of the scales; tail Tawny (60) dorsally and Plumbeous (295) ventrally.

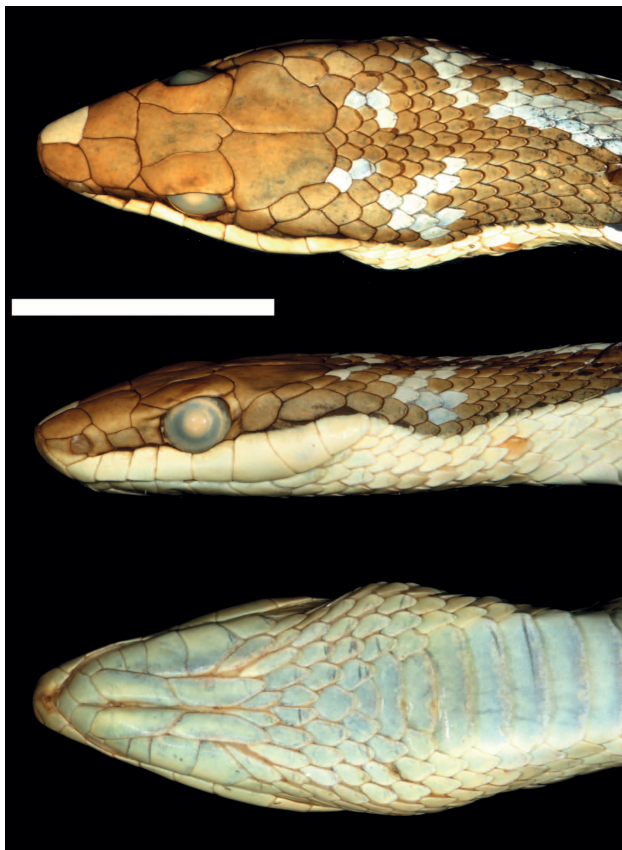


Figure 13. Details of the head (dorsal, lateral, and ventral views) of the neotype of *Philodryas mattogrossensis* (SMF 49990); scale bar = 2 cm.

Hemipenes morphology: Based on specimen CEUCH 3017 (Fig. 14): hemipenis long, deeply bilobate, and semicapitated, extending (inverted) to the 19th (left side) and 18th (right) subcaudal scales. The proximal region of the lobes extends to the 14th and 13th subcaudal, respectively. Sulcus spermaticus centrolineal, bifurcating in the proximal portion of the truncus with the branches continuing to the tip of the lobes. Ornamented with papillae calyces, spinules, and a twin series of enlarged spines (restricted to the lateral side) on the truncus, and with papillate calyces on the lobes.

Variation: We observed only little variation in head scalation. One specimen (SMF 58427) with temporals 1+2/1+3. Dorsals with reductions of 17–19–15 ($n = 1$) and 21–19–15 ($n = 16$). Variation of ventral and subcaudal ranges are given in Table 1. There is no major variation in coloration. MCZ-R 27681 shows some grey pigmentation on the lateral scales, below the dorsal stripe. The dorsal stripe is more reddish in this specimen (MCZ-R 27681) than in other specimens examined. With respect to the hemipenes, ZUFMS-REP 2507 shows more distinctly developed spinules on the peduncle than CEUCH 3017.

Distribution: The species is distributed mainly in the Cerado (with records from near the border with the Pantan-



Figure 14. Details of the left hemipenis of *Philodryas mattogrossensis* (CEUCH 3017); scale bar = 1 cm.

al) and the Alto Paraná Atlantic Forest of Brazil (Fig. 11). BERNILS et al. (2007) stated that its presence in the Alto Paraná Atlantic Forest is not confirmed but probable. These authors indicate the Paraná River as the southern limit for the species. MARQUES et al. (2009) provided a record from the Serra do Mar costal forest, although the specimen actually came from “Pico do Jaraguá”, which is an area of the Cerrado with influence of Atlantic Forest. MÜLLER (1928) provided one Paraguayan record from the locality of San Bernardino (Central Department) in the Humid Chaco.

Discussion

Philodryas contains some species with a long and confusing taxonomic history (e.g., *P. chamissonis* (WIEGMANN, 1835), *P. olfersii* (LICHTENSTEIN, 1823), *P. patagoniensis* (GIRARD, 1858), *P. psammophidea* GÜNTHER, 1872, and *P. viridissima* (LINNAEUS, 1758)). In the case of *P. mattogrossensis*, the taxonomy is rather simple because it is almost the only species with a gradual transition in dorsal and ventral colorations. A gradual ventral coloration change is also observed in *P. laticeps* (ZAHER et al. 2008). Nevertheless, *P. mattogrossensis* and *P. erlandi* are the only species of *Philodryas* with a dorsal coloration shift occurring gradually along the body.

The head scalation shows some differences between *P. erlandi* and *P. mattogrossensis*. All specimens examined exhibit one preocular and two postoculars in both species; temporals are 1 + 2 in both species, with few exceptions. Two of our examined specimens of *P. erlandi* had only one posterior temporal, whereas one specimen of *P. mattogrossensis* (SMF 58427) had three posterior temporals. The anterior temporals of *P. erlandi* are elongated whereas they are short in *P. mattogrossensis* (Fig. 9). Supralabials (always 8[4–5]) and infralabials (9–11) show no differences in both taxa. The dorsal scale rows show some differences, usually counting 19–19–15 in *P. erlandi*, and 21–19–15 in *P. mattogrossensis*. Ventral and subcaudal ranges overlap in both taxa, and neither of them exhibits sexual differences (Table 1). Subcaudal counts appear to be higher in males of *P. erlandi* than in males of *P. mattogrossensis* (Supplementary fig. 1). We could not detect sexual dimorphism in the LT/SVL ratio between males and females of both species (Table 2). In Table 3, we present a summary of differences between the two taxa.

Even when the hemipenes of *Philodryas mattogrossensis* exhibit the features typical of the genus, and in particular in the “*chamissonis*” group, which includes species with “very long” hemipenis patterns (DOWLING 1969, THOMAS 1976, ZAHER 1999), we found some differences to the description of the hemipenes of *P. erlandi* provided by ZAHER (1999: 141, AMNH 141663). The number of lateral spines was potentially slightly higher in *P. mattogrossensis* (6–7) compared to *P. erlandi* (6). The asymmetry in the lobes seems to be more pronounced in *P. mattogrossensis*. We found more distinctly developed spinules in the peduncle

Table 2. Snout–vent length (SVL), tail length (TL), and ratio between them of females (F) and males (M) of *Philodryas erlandi* and *P. mattogrossensis*. Length given in mm.

	<i>P. erlandi</i>		<i>P. mattogrossensis</i>	
	F	M	F	M
SVL	364–1133	471–1039	254–923	268–1080
TL	140–430	221–483	94–370	101–421
Ratio	0.36–0.50	0.46–0.50	0.37–0.43	0.31–0.49

Table 3. Brief overview of differences between *Philodryas erlandi* and *P. mattogrossensis*. SL – supralabials; M – males.

	<i>P. erlandi</i>	<i>P. mattogrossensis</i>
Dorsal stripe	Absent	Present
SL Black line	Marked	Slightly visible
Muzzle	Rounded	Sharpened
Temporal (1 st)	Elongated	Short
Dorsals	19–19–15	21–19–15
Subcaudals (M)	130–156	120–137
Distribution	Chaco	Cerrado

of ZUFMS REP 2507 than in a smaller specimen (CEUCH 3017), which could be an effect of ontogeny (JADIN & KING 2012).

When MÜLLER (1928) synonymised *P. ternetzii*, *P. erlandi*, and *P. boulengeri*, he apparently had no knowledge about the description of *P. mattogrossensis* (KOSLOWSKY 1898) and recognized two taxa, *Philodryas ternetzii ternetzii* and *P. t. erlandi*. This action was based on head scale proportions and ventral colour patterns. AMARAL (1929a) stated that there was no reason to accept the subspecies proposed by MÜLLER (1928) as different races, and included all of them in the synonymy of *P. mattogrossensis* (under the name *Chlorosoma mattogrossensis*) (see AMARAL 1929a, b).

Clearly, *Philodryas erlandi* demonstrates a predilection for dry or arid environments, whereas *P. mattogrossensis* more commonly inhabits humid habitats in the Cerrado grasslands between the Pantanal and the Atlantic Forest (Fig. 11). LEYNAUD & BUCHER (1999) recorded *P. erlandi* (referred as *P. mattogrossensis*) as a species typical of xerophytic forests, and COLLI et al. (2002) and VAZ-SILVA et al. (2007) indicated that *P. mattogrossensis* belonged to the Cerrado as well as also being present in the Atlantic Forest (Fig. 11; BERNILS et al. 2007). This information is congruent with what we have observed about the distribution of *P. erlandi* and *P. mattogrossensis*. Although both the Chaco and Cerrado are parts of the “dry diagonal” (PRADO 2000, WERNECK et al. 2012), they differ significantly in their ecological and biological traits. Cerrado habitats consist of savannas of variable structure, with gallery forests, and sandy and well-drained grounds (RATTER et al. 1997, MERELES 2013), whereas the Chaco sensu lato has clayish soils, thorny forests (with an abundance of cacti and bromeliads), and almost no herbaceous stratum (MERELES et al. 2013).

These two species, however, are parapatric in areas of the Humid Chaco (Fig. 11), whose physiognomic traits are more different from the Chaco sensu stricto (MERLES et al. 2013), and both are considered Pleistocenic Arc Seasonal Forests by some authors (PRADO & GIBBS 1993, PRADO 2000). Records of the two species are scarce in this ecoregion, and it is important to note that the closest range approximation between the two species lies in Paraguay: Asunción (*P. erlandi*) and San Bernardino (*P. mattogrossensis*). These records stem from old collections (made before 1930) and the environment has since experienced massive anthropogenic modifications associated with the growth of cities. Nowadays, these taxa are very likely no longer present in the surroundings of Asunción (the capital city of Paraguay).

Given the wide distribution of *Philodryas mattogrossensis* (previously recognized as a single taxon), the species was never classified as threatened and its conservation status seems to be “Least Concern” in all countries (RODRIGUES 2005, MOTTE et al. 2009, GIRAUDO et al. 2012). Probably this rating will apply to both *P. erlandi* and *P. mattogrossensis*. Nevertheless, due to the rapidly advancing deforestation in the Chaco ecoregion (CABALLERO et al. 2014), the conservation status of *P. erlandi* likely will require re-evaluation.

Acknowledgements

BODIL KAJRUP, EDUARD STÖCKLI (NRM), JOSÉ ROSADO (MCZ) and JONATHAN WOODWARD (AMNH) provided photographic records. We thank SVEN O. KULLANDER (NRM) and PATRICK CAMPBELL (BMNH) for loans of type material. MARTHA MOTTE (MNHNP), DAVID KIZIRIAN (AMNH), KARINA ATKINSON (CZ-PLT), ANDREA WEILER (CZCEN), and HELDER LÚCIO RODRIGUES SILVA (CEPB) allowed us to examine specimens in their care. GUSTAVO GRACIOLLI (ZUFMS-REP) provided specimens on loan; PAULA HELENA SANTA RITA (UNIDERP-ANHANGUERA) and VERA LÚCIA DE CAMPOS BRITES (UFU) are thanked for permitting the photography and examination of live specimens and LINDA ACKER (SMF) for specimens and data acquisition. FERNANDO PAIVA provided photographs of the hemipenis of *Philodryas mattogrossensis* (CEUCH 2017). PAUL FREED and OTAVIO A. V. MARQUES provided photographic records of *P. erlandi* and *P. mattogrossensis*, respectively. We were able to use the Ernst Mayr Library and the Biodiversity Heritage Library to search for literature, and ESTEBAN LAVILLA from the Fundación Miguel Lillo provided the original plate of *P. mattogrossensis* as published in KOSLOWSKY (1898). We thank the anonymous reviewers who helped to improve the present work. PC thanks the Collection Study Grant Program of the Richard Gilder Graduate School (AMNH) for facilitating the examination of specimens in its collection. PC received financial support from the Deutscher Akademischer Austauschdienst (DAAD, Germany), and PC and HC from Consejo Nacional de Ciencia y Tecnología, through the program PRONII (Paraguay).

References

AHE (2010): Algo más que unas colecciones de serpientes y arácnidos. – Boletín de la Asociación Herpetológica Española, **21**: 138.

- AMARAL, A. (1929a): Estudos sobre ophidios neotropicos: XVII. Valor systematico de varias formas de ophidios neotropicos. – Memorias do Instituto Butantan, **4**: 1–68.
- AMARAL, A. (1929b): Estudos sobre ophidios neotropicos: XVIII. Lista remissiva dos ophidios da região neotropica. – Memorias do Instituto Butantan, **4**: 126–271.
- AMARAL, A. (1977): Serpentes do Brasil. Iconografia colorida. – Univiversidade de São Paulo, São Paulo, p. 248.
- ARAUJO, C.O. & S. M. DE ALMEIDA-SANTOS (2011): Herpetofauna de um remanescente de cerrado no estado de São Paulo, sudeste do Brasil. – Biota Neotropica, **11**: 47–62.
- ARZAMENDIA, V. & A. R. GIRAUDO (2002): Lista y distribución de los ofidios (Reptilia: Serpentes) de Santa Fe, Argentina. – Cuadernos de Herpetología, **16**: 15–32.
- BÉRNILS, R., A. GIRAUDO, S. CARREIRA & S. CECHEIN (2007): Répteis das porções subtropical e temperada da Região Neotropical. – Ciência & Ambiente, **35**: 101–136.
- CABALLERO, J., F. PALACIOS, F. ARÉVALOS, O. RODAS & A. YANOSKY (2014): Cambio de uso de la tierra en el Gran Chaco Americano en el año 2013. – Paraquaria Natural, **2**: 21–28.
- CACCIALI, P. & U. WUEST (2009): Reptilia, Squamata, Colubridae, *Lygophis meridionalis*: Type locality. – Check List, **5**: 383–385.
- CARVALHO, M. A. & F. NOGUEIRA (1998): Serpentes da área urbana de Cuiabá, Mato Grosso: aspectos ecológicos e acidentes ofídicos associados. – Cadernos de Saúde Pública de Rio de Janeiro, **14**: 753–763.
- CEI, J. M. (1993): Reptiles del noroeste, nordeste y este de la Argentina. – Museo Regionale di Scienze Naturale di Torino, **14**: 1–949.
- COLLI, G. R., P. BASTOS & A. F. B. ARAUJO (2002): The Character and Dynamics of the Cerrado Herpetofauna. – pp. 223–241 in: OLIVEIRA, P. S. & R. J. MARQUIS (eds): The Cerrados of Brazil: Ecology and Natural History of a Neotropical Savanna. – Columbia University Press, New York.
- DINERSTEIN, E., D. OLSON, D. GRAHAM, A. WEBSTER, S. PRIMM, M. BOOKBINDER & G. LEDEC (1995): Una evaluación del estado de conservación de las ecorregiones terrestres de América Latina y el Caribe. – WWF & Banco Mundial, Washington, D.C., p. 176.
- DOWLING, H. G. (1951): A proposed standard system of counting ventrals in snakes. – British Journal of Herpetology, **1**: 97–99.
- DOWLING, H. G. & J. M. SAVAGE (1960): A guide to the snake hemipenis: a survey of basic structure and systematic characteristics. – Zoologica, **45**: 17–28.
- FERRARO, D. P. & J. WILLIAMS (2006): Material tipo de la colección de herpetología del Museo de La Plata, Buenos Aires, Argentina. – Cuadernos de Herpetología, **19**: 19–36.
- FOWLER, I. R. & M. G. SALOMÃO (1994): Activity patterns in the colubrid snake genus *Philodryas* and their relationship to reproduction and snakebite. – Bulletin of the Chicago Herpetological Society, **29**: 229–232.
- FRANCO, F. L. (2012): A Coleção Herpetológica do Instituto Butantan: da sua origem ao incêndio ocorrido em 15 de maio de 2010. – Herpetologia Brasileira, **1**: 22–31.
- GIRAUDO, A. R. (2001): Serpientes de la Selva Paranaense y del Chaco Húmedo. – Literature of Latin America, Buenos Aires, p. 285.
- GIRAUDO, A. R. & G. J. SCROCCHI (2002): Argentinian Snakes: An Annotated Checklist. – Smithsonian Herpetological Information Service, **132**: 1–53.

- GIRAUDO, A. R., V. ARZAMENDIA, G. P. BELLINI, C. A. BESSA, C. C. CALAMANTE, G. CARDOZO, M. CHIARAVIGLIO, M. B. CONSTANZO, E. G. ETCHEPARE, V. DI COLA, D. O. DI PIETRO, S. KRETZCHMAR, S. PALOMAS, S. J. NENDA, P. C. RIVERA, M. E. RODRÍGUEZ, G. J. SCROCCHI & J. D. WILLIAMS (2012): Categorización del estado de conservación de las serpientes de la República Argentina. – Cuadernos de Herpetología, **26**: 303–326.
- GRAZZIOTIN, F., H. ZAHER, R. W. MURPHY, G. SCROCCHI, M. A. BENAVIDES, Y. P. ZHANG & S. L. BONATTO (2012): Molecular phylogeny of the New World Dipsadidae (Serpentes: Colubroidea): a reappraisal. – Cladistics, **28**: 437–459.
- HAMMER, Ø., D. A. T. HARPER & P. D. RYAN (2001): PAST: Paleontological Statistics software package for education and data analysis. – Paleontologica Electronica, **4**: 9.
- HARTMANN, P. A. & O. A. MÁRQUES (2005): Diet and habitat use of two sympatric species of *Philodryas* (Colubridae), in south Brazil. – Amphibia-Reptilia, **26**: 25–31.
- JADIN, R. C. & R. B. KING (2012): Ontogenetic Effects on Snake Hemipenial Morphology. – Journal of Herpetology, **46**: 393–395.
- KACOLIRIS, F. P., I. BERKUNSKY & J. WILLIAMS (2006): Herpetofauna of the Argentinean impenetrable Great Chaco. – Phylomedusa, **5**: 149–157.
- KÖHLER, G. (2012): Color Catalogue for Field Biologists. – Herpeton, Offenbach, p. 49.
- KOSLOWSKY, J. (1898): Ofidios de Matto-Grosso (Brazil). – Revista del Museo de La Plata, **8**: 25–34.
- LEYNAUD, G. C. & E. H. BUCHER (1999): La fauna de serpientes del Chaco Sudamericano: diversidad, distribución geográfica y estado de conservación. – Academia Nacional de Ciencias Miscelanea, **98**: 1–46.
- LOBO, F. & G. SCROCCHI (1994): Osteología craneal del género *Philodryas* (Serpentes: Colubridae). – Cuadernos de Herpetología, **8**: 104–111.
- LÖNNBERG, E. (1902): On a collection of snakes from north-western Argentine and Bolivia containing new species. – Annals and Magazine of Natural History, **7**: 457–462.
- MANÇO, D. D. G., M. A. C. PIVATTO, V. R. B. MARIA, S. DULEBA, M. Z. MILANO, J. C. MAINCHEIN, J. SABINO & L. P. ANDRADE (2006): Diagnóstico e Plano de Manejo da Reserva Particular do Patrimônio Natural Cabeceira do Prata, Jardim, MS. Conservação Internacional do Brasil. – Associação dos Proprietários das RPPNs de MS, Mato Grosso do Sul, p. 350.
- MANZANI, P. R. & A. S. ABE (1988): Sobre dois novos metodos de preparo do hemipenis de serpentes. – Memórias do Instituto Butantan, **50**: 15–20.
- MARQUES, O. A. V., D. N. PEREIRA, F. E. BARBO, V. J. GERMANO & R. J. SAWAYA (2009): Os Répteis do Município de São Paulo: diversidade e ecologia da fauna pretérita e atual. – Biota Neotropical, **9**: 1–12.
- MERELES, F. (2013): Acerca de las extenciones de Cerrados y Cerradones en el Paraguay. – Paraquaria Natural, **1**: 35–38.
- MERELES, F., J. L. CARTES, R. P. CLAY, P. CACCIALI, C. PARADEDA, O. RODAS & A. YANOSKY (2013): Análisis cualitativo para la definición de las ecorregiones de Paraguay occidental. – Paraquaria Natural, **1**: 12–20.
- MORO, S. (1999): Relaciones filogenéticas de Xenodontinae (Serpentes) neotropicales basadas en musculatura craneal. – Cuadernos de Herpetología, **13**: 19–35.
- MOTTE, M., K. NÚÑEZ, P. CACCIALI, F. BRUSQUETTI, N. SCOTT & A. L. AQUINO (2009): Categorización del estado de conservación de los anfibios y reptiles de Paraguay. – Cuadernos de Herpetología, **23**: 5–18.
- MÜLLER, L. (1928): Herpetologische Mitteilungen. – Zoologischer Anzeiger, **77**: 61–84.
- MYERS, C. W. & J. E. CADLE (2003): On the snake hemipenis, with notes on *Psomophis* and techniques of eversion: A response to Dowling. – Herpetological Review, **34**: 295–302.
- NORMAN, D. (1994): Anfibios y reptiles del Chaco Paraguayo, Tomo I. – San José de Costa Rica, p. 309.
- PESANTES, O. S. (1994): A method for preparing the hemipenis of preserved snakes. – Journal of Herpetology, **28**: 93–95.
- PETERS, J. A. & B. OREJAS MIRANDA (1970): Catalogue of the Neotropical Squamata. Part I. Snakes. – Bulletin of United States National Museum, **297**: 1–347.
- PRADO, D. E. (2000): Seasonally dry forests of tropical South America: from forgotten ecosystems to a new phytogeographic unit. – Edinburg Journal of Botany, **54**: 437–461.
- PRADO, D. E. & P. E. GIBBS (1993): Patterns of species distributions in the dry seasonal forest of South America. – Annals of the Missouri Botanical Garden, **80**: 902–927.
- PYRON, R. A., F. T. BURBRINK, G. R. COLLI, A. N. MONTES DE OCA, L. J. VITT, C. A. KUCZYNSKI & J. J. WIENS (2011): The phylogeny of advanced snakes (Colubroidea), with discovery of a new subfamily and comparison of support methods for likelihood trees. – Molecular Phylogenetics and Evolution, **58**: 329–342.
- PYRON, R. A., F. T. BURBRINK & J. J. WIENS (2013): A phylogeny and revised classification of Squamata, including 4161 species of lizards and snakes. – BMC Evolutionary Biology, **13**: 93.
- RATTER, J. A., J. F. RIBEIRO & S. BRIDGEWATER (1997): The Brazilian Cerrado vegetation and threats to its biodiversity. – Annals of Botany, **80**: 223–230.
- RODRIGUES, M. T. (2005): Conservação dos répteis brasileiros: os desafios para um país megadiverso. – Megadiversidade, **1**: 87–94.
- SABAJ PÉREZ, M. H. (2013): Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an online reference. Version 4.0 (28 June 2013). – American Society of Ichthyologists and Herpetologists, Washington, DC. Available at <http://www.asih.org/>.
- SANT'ANNA, O. A. (2010): The fire consumed ... a treasure. – The Journal of Venomous Animals and Toxins including Tropical Diseases, **16**: 398–399.
- SCHALK, C. M. (2010): *Philodryas mottogrossensis* (Two-colored Racer). Diet. – Herpetological Review, **41**: 372.
- SCHENKEL, E. (1901): Achter Nachtrag zum Katalog der herpetologischen Sammlung des Basler Museums. – Verhandlungen der Naturforschenden Gesellschaft in Basel, **13**: 142–199.
- SILVA-JR, N. J., C. E. D. CINTRA, H. L. R. SILVA, M. C. COSTA, C. A. SOUZA, A. A. PACHÊCO-JR & F. A. GONÇALVES (2009): Herpetofauna, Ponte de Pedra Hydroelectric Power Plant, states of Mato Grosso and Mato Grosso do Sul, Brazil. – Check List, **5**: 518–525.
- THOMAS, R. A. (1976): A revision of the South American colubrid snake genus *Philodryas* Wagler, 1830. PhD Thesis, Texas A&M University, 324 p.

- VAZ-SILVA, W., A. GUIMARÃES GUEDES, P. DE AZEVEDO-SILVA, F. GONTIJO, R. SILVA, G. RIBEIRO & F. GOMES DE OLIVEIRA (2007): Herpetofauna, Espora Hydroelectric Power Plant, state of Goiás, Brazil. – *Check List*, **3**: 338–345.
- VIDAL, N., S. KINDL, A. WONG & B. HEDGES (2000): Phylogenetic relationships of Xenodontine snakes inferred from 12S and 16S ribosomal RNA sequences. – *Molecular Phylogenetics and Evolution*, **14**: 389–402.
- VIDAL, N., M. DEWYNTER & D. GOWER (2010): Dissecting the major American snake radiation: A molecular phylogeny of the Dipsadidae Bonaparte (Serpentes, Caenophidia). – *Competes Rendus Biologies*, **333**: 48–55.
- WERNECK, F. P., T. GAMBLE, G. R. COLLI, M. T. RODRIGUES & J. SITES (2012): Deep diversification and long-term persistence in the South American “Dry Diagonal”: integrating continent-wide phylogeography and distribution modeling of geckos. – *Evolution*, **66**: 3014–3034.
- WERNER, F. (1909): Über neue oder seltene Reptilien des Naturhistorischen Museums in Hamburg. – *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, **26**: 205–247.
- YUKI, R. N. (1992): Sobre a ocorrência de *Philodryas mottogrossensis* Koslowsky 1898 em Uberlândia, Minas Gerais, Brasil (Serpentes, Colubridae). – *Acta Biologica Leopoldensia*, **14**: 123–126.
- ZAHER, H. (1999): Hemipenial morphology of the South American xenodontine snakes: with a proposal for a monophyletic Xenodontinae and a reappraisal of colubroid hemipenes. – *Bulletin of the American Museum of Natural History*, **240**: 1–168.
- ZAHER, H., G. SCROCCHI & R. MASIERO (2008): Rediscovery and redescription of the type of *Philodryas laticeps* Werner, 1900 and the taxonomic status of *P. oligolepis* Gomes, 1921 (Serpentes, Colubridae). – *Zootaxa*, **1940**: 25–40.
- ZAHER, H., F. GRAZZIOTIN, J. CADLE, R. MURPHY, J. C. DE MOURA-LEITE & S. BONATTO (2009): Molecular phylogeny of advanced snakes (Serpentes, Caenophidia) with an emphasis on South American Xenodontines: a revised classification and descriptions of new taxa. – *Papéis Avulsos de Zoologia*, **49**: 115–153.
- ZAHER, H., F. E. BARBO, P. SANCHEZ MARTÍNEZ, C. NOGUEIRA, M. T. RODRIGUES & R. J. SAWAYA (2011): Répteis do Estado de São Paulo: conhecimento atual e perspectivas. – *Biota Neotropica*, **11**: 67–81.
- ZAHER, H., J. C. ARREDONDO, J. H. VALENCIA, E. ARBELÁEZ, M. T. RODRIGUES & M. ALTAMIRANO-BENAVIDES. (2014): A new Andean species of *Philodryas* (Dipsadidae, Xenodontinae) from Ecuador. – *Zootaxa*, **3785**: 469–480.
- Philodryas mottogrossensis*: Brazil: Goiás: Jataí (CEPB 1462); Mato Grosso do Sul: Aquidauana (ZUFMS-REP 1517, 1556, 1592, 1664, 2507); Campo Grande (ZUFMS-REP 269, 1588); Dois Irmãos do Buriti (CEUCH 3017); Guaycurus (MCZ-R 27681); São Gabriel do Oeste (CEUCH 3782); Sonora (CEPB 5457); Taunay (SMF 49990- neotype, 49991); Três Lagoas (ZUFMS-REP 998); Minas Gerais: Uberlândia (MCTPUCRS 4619); São Paulo: Altinópolis (SMF 58427). Paraguay: (MNHNP 3501, 9248) Amambay: Bella Vista (MNHNP 2501); Estancia Paicuará (MNHNP 6525); Cordillera: Colonia Nueva Colombia (NMB 1939- holotype of *Philodryas ternetzii*); San Pedro: Laguna Blanca (CZPLT 101, MNHNP 11713).

Supplementary material

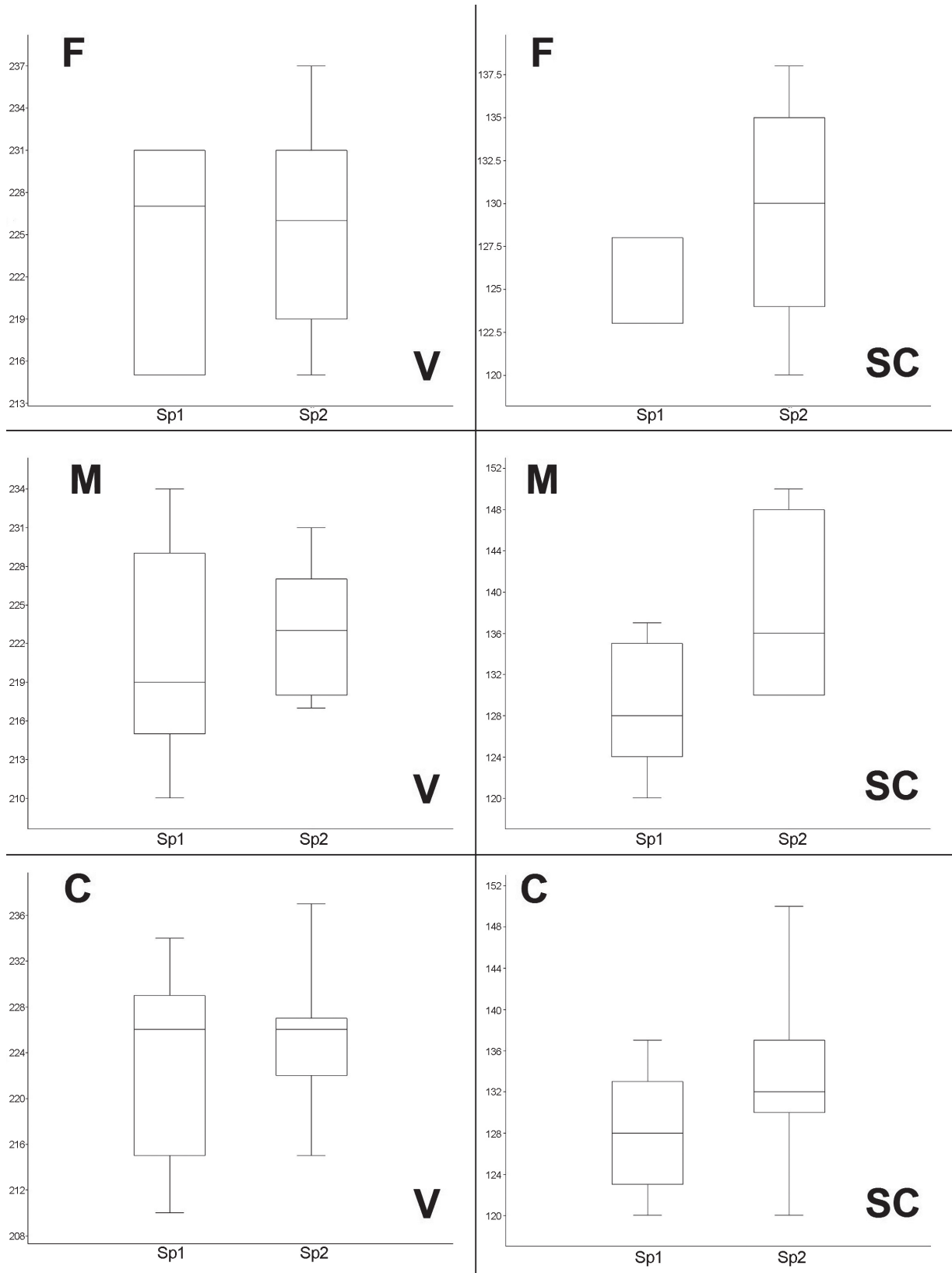
Additional information is available in the online version of this article at <http://www.salamandra-journal.com>

1 Supplementary figure. Box plots showing ranges of ventrals and subcaudals for Species 1 and 2.

Appendix

Specimens examined

Philodryas erlandi: Bolivia: (AMNH-R 141663); Santa Cruz: (AMNH-R 141370) Tatarendá (BMNH 1946.1.8.43- paralectotype); Tarija: Fortín Crevaux Nuero (NRM 5097- lectotype). Paraguay: (MNHNP 2653, 9244, 9515, 9567, SMF-no label); Alto Paraguay: Madrejón (MNHNP 2573–5, 7228); Boquerón: Campo Loro (MNHNP 10658); Filadelfia (CZCEN 0419, MNHNP 2576, 10030); Friedensheim (SMF 96720); Pozo Hondo (MNHNP 2654, 6528); Central: Asunción (SMF 70937); Presidente Hayes (AMNH-R 143302); Campo León (SMF-GK 3792); Estancia Palo Santo (MNHNP 4196, 10454); Route IX, Km 335 (MNHNP 3502).



Supplementary figure 1. Box plots showing ranges of ventrals (V) and subcaudals (SC) between females (F) males (M), and both sexes combined (C) for Species 1 and 2.