

## Rediscovery of *Phalotris concolor* (Serpentes: Dipsadidae: Elapomorhini)

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ABSTRACT. *Phalotris concolor* Ferrarezzi, 1994 is a poorly known species described on the basis of a single female from municipality of Cristália, state of Minas Gerais, Brazil. Based on two recently collected specimens, we expand the knowledge of *P. concolor* with new morphological data, including the description of its hemipenis and color in life. A summary of comparative data between species of the *P. nasutus* group is present to aid the identification of new specimens. The new findings are important for a better understanding of the taxonomy of *Phalotris*.

KEY WORDS. Cerrado; geographic distribution; hemipenis; *Phalotris nasutus* group.

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*Phalotris* Cope, 1862 comprises 13 species of small to medium-sized fossorial snakes, which are widely distributed in open areas from Central Brazil to Argentina (PUERTO & FERRAREZZI 1994, LEMA 2002, JANSEN & KÖHLER 2008). *Phalotris* is distinguished from other Elapomorhini genera (*Apostolepis* Cope, 1862, *Coronelaps* Lema, 2010, and *Elapomorphus* Wiegman, 1843) by having fused prefrontals, which are separated from internasals. This genus is currently divided into three species groups: *P. tricolor*, *P. bilineatus*, and *P. nasutus* (FERRAREZZI 1994). The *Phalotris nasutus* group is diagnosed by two synapomorphies: a pointed snout with prominent rostral shield and fusion between the second and third series of temporal plates (sometimes on only one side of the head) (FERRAREZZI 1994). This group includes five valid species: *P. concolor* Ferrarezzi, 1994, *P. labiomaculatus* Lema, 2002, *P. lativittatus* Ferrarezzi, 1994, *P. nasutus* (Gomes, 1915) and *P. nigrilatus* Ferrarezzi, 1994 (FERRAREZZI 1994, LEMA 2002).

FERRAREZZI (1994) described *P. concolor* on the basis of a single female. Up to now, this species was known only from the holotype and diagnosed by characters such as the presence of an anterior temporal shield, lower and upper postoculars similar in size, 224 ventrals, and uniform dorsal coloration (FERRAREZZI 1994). In this study, we provide new data on morphological variation (meristic, morphometric, color pattern, hemipenial morphology) of *P. concolor* based on two additional specimens.

### MATERIAL AND METHODS

We collected two specimens of *Phalotris concolor* during fieldwork carried out in the municipalities of Brasilândia de Minas and Urucuia, northwestern Minas Gerais State, Brazil (Figs

1-8). The snakes were captured in pitfall traps (60 L) with drift fences set in a riparian zone (habitat details in Discussion). Specimens were euthanized using an intra-peritoneal injection of 2% Xylocaine, fixed in 10% formalin, preserved in 70% ethanol and deposited in the herpetological collection of the Museu de Zoologia João Moojen, Universidade Federal de Viçosa (MZUFV), Viçosa, Minas Gerais (numbers MZUFV1870 and MZUFV1890).

Terminology follows PETERS (1964) for scale counts and cephalic shields, except for temporal shields, which follows FERRAREZZI (1994). We obtained the following measurements in millimeters: snout-vent length (SVL); tail length (TL); head length (HL, from tip of the snout to the retroarticular process of the mandible); greatest head width (HW); internasal distance (ID, head width between the nares); horizontal eye diameter (ED); eye-nostril distance (END, from the anterior edge of the eye).

Measurements (length/width) of the cephalic shields follow CACCIALI *et al.* (2007). The “anterior gulars” and “posterior gulars” of CACCIALI *et al.* (2007) here are named “anterior chinshields” and “posterior chinshields”, following PETERS (1964). The “temporal” measurement of CACCIALI *et al.* (2007) was expanded to “anterior temporal” and “posterior temporal”, since the species studied by them (*P. nigrilatus*) exhibits only one series of temporal shield. The SVL and TL were measured with a flexible ruler to the nearest 1.0 mm and HW was measured with a digital caliper to the nearest 0.1 mm, whereas all other measurements were obtained under a stereomicroscope with millimetric ocular to the nearest 0.1 mm.

The right hemipenis of MZUFV 1890 was prepared following methods proposed by PESANTES (1994) and ZAHER & PRUDENTE (2003). Hemipenial terminology follows DOWLING & SAVAGE (1960) and ZAHER (1999).

## TAXONOMY

*Phalotris concolor* Ferrarezzi, 1994

*Phalotris concolor* Ferrarezzi, 1994. Memórias do Instituto Butantan, vol. 55 supl. 1, p. 26. Holotype: IB 55018, adult female.

Type locality. Brazil: Minas Gerais: Cristália municipality (17°S, 43°W, near Grão Mogol), on the bank of the Tacambiruçu River, tributary of the right bank of the Jequitinhonha River. (see Discussion for corrections).

Description of two new specimens. MZUFV 1870, adult female, collected on January 06, 2011 at Brasilândia de Minas (16°52'31"S, 46°10'24"W, 519 m above sea level, ca. 370 km W of the type locality); and MZUFV 1890, adult male, collected on February 02, 2011 at Urucuaia (16°06'36"S, 45°42'32"W, 536 m above sea level, ca. 330 km W of the type locality), both in the state of Minas Gerais, Brazil, M.R. Moura, R.M. Pirani & C. Coelho-Augusto leg.

Emended diagnosis. *Phalotris concolor* can be diagnosed by the following combination of characters: 15-15-15 smooth dorsal scale rows, without apical pits; temporal formula 1+1 (1+1+1 in one side of the head of the holotype); pointed snout with prominent rostral shield; internasal suture absent (n=1) or present (n=2); lower postocular reduced in size; six supralabials, the second and third contacting the eye; seven infralabials, the first four contacting the first pair of chinshields; 212 ventrals in the known male, 220-224 in females; 34 divided subcaudals in the male, 28-29 in females; cloacal shield divided; head dark brown above and ventrally cream; body red, reddish orange or light brown on the dorsum, and uniform cream ventrally; light nuchal collar three scales wide, and dark neck collar 2-3 scales wide. Hemipenis deeply bilobed. Table I shows a summary of morphometric and meristic data of *P. concolor*.

Comparisons with other species of the *nasutus* group. *Phalotris concolor* can be distinguished from *P. lativittatus*, *P. nasustus* and *P. nigrilatus* by having more than 200 ventrals in males and more than 210 ventrals in females. It can be distinguished from *P. labiomaculatus* (characters inside brackets) by having seven infralabials (eight) and supralabials mainly creamish (cream with black blotches). Table II shows a summary of comparative data between species of *P. nasutus* group.

Color in life. Dorsum of head dark brown, supralabials cream; a black spot (faint in MZUFV1890) on the lower margin of first supralabial; upper margins of second to fourth supralabials dark brown, and upper half or more of the fifth and sixth supralabials dark brown. A pale orange or cream nuchal collar, three dorsal scales wide, behind parietals, followed by a black, brownish gray or brown nuchal collar two dorsal scales wide beginning at the fourth dorsal scale row (Figs 5 and 6). Head ventrally cream, except for dark brown marks on rostral, mental, inner margins of first and fourth infralabials and first pair of chinshields. In MZUFV 1870, dark markings also present in center of fifth infralabial (Figs 7 and 8). Dorsal

scale rows 1-3 pale orange (MZUFV 1870) or cream (MZUFV 1890); above fourth scale row dorsum becomes reddish orange (MZUFV 1870) or light brown (MZUFV 1890). Faint (almost invisible) dark lateral line present on posterior portion of body of MZUFV 1870, between third and fourth scale rows; dark lateral line (faint in MZUFV 1890) present along second scale row of tail. Venter cream. In preservative, dorsal body color and nuchal collar become cream or whitish.

Hemipenis (MZUFV 1890). Description based on the fully everted and expanded right organ, extracted from the preserved specimen. Hemipenis deeply bilobed, semicalyculate, semicapitate. Total length 15.6 mm, lobe length 7.2 mm. Lobes with papillate calyces; larger calyces present on asulcate and medial surface of lobes, and also on distal region of asulcate side of hemipenial body. Hemipenial body with spinules on sulcate side. Asulcate side almost naked, except for some large spinules below lobes, converging into narrow median longitudinal row proximally. Lateral sides with two longitudinal rows of spines, one closer to asulcate and another closer to sulcate side. Row closer to asulcate side composed by three large spines decreasing in size proximally (the most distal spines are slightly curved distally). Row closer to sulcate side with four or five smaller spines, decreasing in size proximally. Four additional small spines present on both lateral sides, between the two rows of larger spines (Figs 9-11).

Distribution. *Phalotris concolor* is known from three localities associated with the Tropical and Subtropical Savannas ecoregion (OLSON *et al.* 2001), in areas represented by the Cerrado morphoclimatical domain in the northern part of Minas Gerais (Fig. 13).

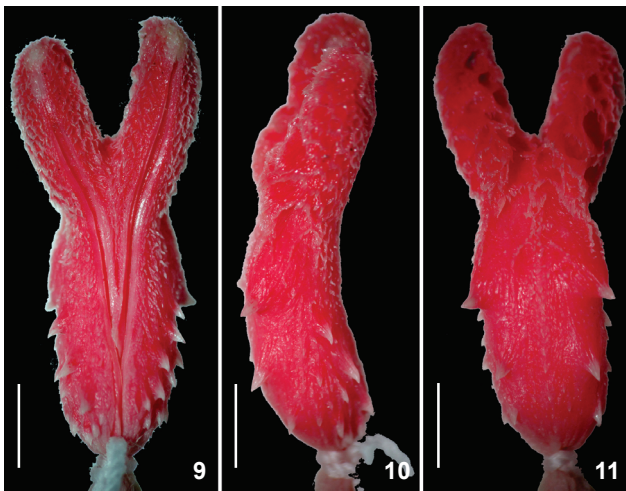
## DISCUSSION

In most specimens of the *Phalotris nasutus* group, the second and third temporals are fused into a large shield (FERRAREZZI 1994). In the holotype of *P. concolor*, the second and third temporal on the left side are not fused (FERRAREZZI 1994). Regardless of this asymmetry, it is worth noting that *P. concolor* has a temporal formula of 1+1, in contrast with the 0+1 pattern in the remaining species of the *nasutus* group with the exception of *P. labiomaculatus* (see Table II).

While the holotype (FERRAREZZI 1994) and MZUFV 1890 have an anterior temporal plate separating the fifth supralabial from the parietal, MZUFV 1870 has reduced anterior temporals on both sides of the head (Table I). Because of this reduced anterior temporal, the lower postoculars of MZUFV 1870 contact the third, fourth and fifth supralabials, instead of only the third and fourth, and its anterior and posterior temporals are separated by the fifth supralabial. Polymorphism related to temporal shields has been reported for other Elapomorphini such as *Apostolepis cearensis* Gomes, 1915 (FERRAREZZI *et al.* 2005), *Apostolepis nigrolineata* (Peters, 1869), and *Apostolepis quinquelineata* Boulenger, 1896 (CURCIO *et al.* 2011), *Coronelaps lepidus*



Figures 1-8. *Phalotris concolor*: (1-2) coloration of in life of the specimens collected in the municipalities of (1) Uruçuia (male, MZUFV 1890) and (2) Brasilândia de Minas (female, MZUFV 1870); (3-4) lateral, (4-6) dorsal, and (7-8) ventral views of the head. (3, 5, 7) female (MZUFV 1870); (4, 6, 8) male (MZUFV 1890). Scale bars: 4 mm.



Figures 9-11. Sulcate (9), lateral (10), and asulcate (11) sides of *Phalotris concolor* right hemipenis (MZUFV 1890). Scale bar: 3 mm.

(Reinhardt, 1861) (LEMA & DEIQUES 1995), *P. nigrilatus* (CACCIALI *et al.* 2007), *Phalotris sansebastiani* Jansen & Köhler, 2008 (JANSEN & KÖHLER 2008), and *P. nasutus* and *P. lativittatus* (FERRAREZZI 1994).

When alive, the dorsal color of the two known females of *P. concolor* (IBSP 55018 and MZUFV 1870) is uniformly red (FERRAREZZI 1994) or reddish orange, while the male (MZUFV 1890)

is light brown, and the dark lateral line on the tail is almost invisible. These differences could be due to sexual dichromatism (e.g., SHINE 1993, PIZZATTO *et al.* 2007) or simply a polymorphism.

Secondary sexual dimorphism is also found in scale counts, with females having more ventrals (220 and 224), fewer subcaudal pairs (28 and 29) and shorter tails in proportion to their body length (ratios: 0.071 and 0.078), when compared with the only known male (212 ventrals, 34 subcaudals and tail/body length ratio 0.103). These are common features in snakes (GREENE 1997), already reported for the *Phalotris nasutus* group (FERRAREZZI 1994).

Although *P. concolor* is considered the most basal lineage within *P. nasutus* species group on the basis of meristic characters (FERRAREZZI 1994), hemipenial morphology may offer contradictory evidence. The deeply bilobed hemipenis of *P. concolor* is more similar to the hemipenis of *P. labiomaculatus* (LEMA 2002) and *P. nigrilatus* (CACCIALI *et al.* 2007) than of *P. nasutus* and *P. lativittatus* (FERRAREZZI 1994, ZAHER 1999). Hemipenial spines of *P. concolor* seem to be the smallest of all within *nasutus* group. The curvature in the largest spines of *P. nigrilatus* was considered an autapomorphy (CACCIALI *et al.* 2007), but this character is also present in *P. concolor*, although only in the largest lateral spines closer to the asulcate side.

Three corrections on the type locality of *P. concolor* must be made: I) the spelling of the river on whose bank the holo-



Table I. Summary of morphometric and meristic data of known specimens of *Phalotris concolor*. Holotype data are based on the text and illustrations provided by FERRAREZZI (1994). All measures are in millimeters. A slash (/) is used to indicate the left and right sides, respectively, when they differ in some feature. Shield sizes are represented as width x length.

Sex	IB 55018 (Holotype)	MZUFV 1870	MZUFV 1890
	Female	Female	Male
Body measurements			
Snout-vent length	507	299	522
Tail length	43	23	60
Head length	15	8.8	14.2
Greatest head width	8.0	5.2	7.3
Internasal distance	–	2.3	3.1
Eye diameter	–	1.1	1.1
Eye-nostril distance	–	1.6	2.5
Shield measurements			
Rostral	–	1.2 x 2.3	1.5 x 3.3
Internasals	–	0.6 x 1.3/0.6 x 1.3	1.0 x 2.0/1.1 x 2.1
Nasals	–	1.6 x 0.8/1.6 x 0.8	2.2 x 1.4/1.8 x 1.3
Prefrontal	–	1.3 x 3.6	2.0 x 4.9
Frontal	–	2.5 x 2.1	(3.2 x 3.0)
Supraoculars	–	1.6 x 0.8/1.6 x 0.8	1.9 x 1.1/1.9 x 1.1
Parietals	–	4.8 x 2.4/4.9 x 2.3	5.7 x 3.0/5.5 x 2.8
Preoculars	–	1.0 x 0.8/0.9 x 0.8	1.3 x 1.0/1.2 x 1.0
Upper postoculars	–	0.6 x 0.6/0.6 x 0.6	1.1 x 1.0/0.9 x 1.0
Lower postoculars	–	0.5 x 0.7/0.6 x 0.7	0.6 x 0.6/0.7 x 0.5
Anterior temporals	–	1.2 x 0.5/0.8 x 0.4	2.7 x 0.9/2.4 x 1.2
Posterior temporals	–	3.2 x 1.5/2.8. x 1.5	4.1 x 2.0/4.0. x 2.0
First pair of chinshields	–	2.3/2.3	3.3/3.1
Second pair of chinshields	–	2.2./2.2	3.3/3.3
Meristic characters			
Dorsal scale rows	15-15-15	15-15-15	15-15-15
Pre-ventrals	1	3	3
Ventrals	224	220	212
Anal plate	divided	divided	divided
Subcaudals pairs	29	28/28	34/34
Internasal suture	Present	Absent	Absent
Temporal formula	1+1+1/1+1	1+1	1+1
Reduced anterior temporal	Absent	Present	Absent
Supralabials	6	6	6
Supralabials contacting the eye orbit	2nd and 3rd	2nd and 3rd	2nd and 3rd
Fifth supralabial contacting the parietal	Absent	Present	Absent
Infralabials	7	7	7
Infralabials contacting the first pair of chinshields	1st to 4th	1st to 4th	1st to 4th
Infralabials contacting the second pair of chinshields	–	4th and 5th	4th and 5th
Infralabials contacting the gulars	–	6th and 7th	6th and 7th

type was collected is Itacambiruçu, not Tacambiruçu; II) the Itacambiruçu River is a tributary of the left (instead of right) margin of the Jequitinhonha River; III) a point located at 17°S, 43°W would be outside Cristália Municipality, about 45 Km southwest of the Itacambiruçu River. The coordinates 16°40'S, 42°44'W, although approximate, would indicate the type locality better than the coordinates from the original description.

FERRAREZZI (1994) considered *P. concolor* to be restricted to the eastern part of the Espinhaço mountain range, separated from the geographically closest species (*P. nasutus*) by an extensive area occupied by the São Francisco River basin. The collection of two new specimens from the São Francisco River basin suggests that the distribution range of *P. concolor* is greater than previously thought. A fourth, unconfirmed record of *P.*



Table II. Comparative data of species from *Phalotris nasutus* group, based on the present work, FERRAREZZI (1994), ZAHER (1999), LEMA (2002)\*†, CACCIALI *et al.* (2007), VASCONCELOS & SANTOS (2009) and HANDAM *et al.* (2013).

	<i>P. concolor</i>	<i>P. labiomaclulatus</i>	<i>P. lativittatus</i>	<i>P. nasutus</i>	<i>P. nigrilatus</i>
Geographic distribution	Cerrado domain in central Brazil (northern Minas Gerais)	Cerrado domain in northern Brazil (Maranhão and Piauí)	Cerrado domain in southeastern Brazil (São Paulo) with a southern unconfirmed record in Santa Catarina	Cerrado domain in central Brazil; An isolated record in southern Amazon (Mato Grosso)	Transitional area between Wet Chaco and Atlantic Forest in eastern Paraguay
Maximum size (total length)	582 mm	754 mm	800 mm	950 mm	991 mm
Dorsal scale rows	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15; 17-15-15
Ventrals	212 ♂ 220-224 ♀	198-211 ♂ 220-234 ♀	182-199 ♂ 196-208 ♀	175-179 ♂ 189-198 ♀	184-186 ♂ 205 ♀
Subcaudal pairs	34 ♂ 28-29 ♀	34-42 ♂ 25-31 ♀	30-39 ♂ 23-31 ♀	34-36 ♂ 25-29 ♀	33-35 ♂ 27 ♀
Internasal suture	Absent/Present	Present	Absent/Present	Absent/Present	Absent
Frontal plate shape	Longer than wide	Longer than wide	Longer than wide/Wider than long	Longer than wide	Wider than long
Lower postocular reduced in size	Absent	Present	Absent/Present	Present	Present
Temporal formula	1+1+1; 1+1	0+1; 1+1	0+1; 0+1+1	0+1; 0+1+1	0+1; 0+1+1
Anterior temporal reduced in size	Absent/Present	Absent	–	–	–
Supralabials	6	6	6	6	6-7
Supralabials contacting the eye orbit	2nd-3rd	2nd-3rd	2nd-3rd	2nd-3rd	2nd-3rd; 2nd-4th
Fifth supralabial contacting the parietal	Absent/Present	Absent	Present	Present	Absent/Present
Number of infralabials	7	8	7	7	7-8
Dorsal ground coloration	Uniform red, reddish orange or light brown	Uniform red, with a linear series of black dots on each side	Uniform yellowish-brown	Uniform reddish	Blackish pink
Lateral stripe	Vestigial (Tail/Body and tail)	Vestigial (Body and tail)	3-5 scales wide	Vestigial (Body and tail)	–
Vertebral stripe	Absent	Absent	Absent/Present (thin)	Absent	Present, six scales wide. A thin middorsal stripe can be present on vertebral scales
Ventral coloration	Uniform cream	Uniform cream	Uniform cream	Uniform cream	Cream with dark blotches
Supralabial coloration	Mainly creamish	White and black blotched	Cream	Mainly cream	Dark brown with dark gray spots
Infralabial coloration	Cream with some dark blotches	Cream with outer margins black blotched	Cream with some dark blotches	Cream with some dark blotches	Dark brown with dark gray spots
Light nuchal collar width	3 scales	3-4 scales	2-3 scales	2 scales	Absent
Dark neck collar width	2-3 scales	1-2 scales	1 scale	1-2 scales	Absent
Hemipenial lobes	Deeply bilobed	Deeply bilobed	Bilobed	Bilobed	Deeply bilobed
Hemipenial body ornamentation	Spinulate on the sulcate side; a thin central longitudinal row of spinules along the asulcate side	Spinulate	Spinulate	Spinulate	Scattered spinulate

\* In the table I of LEMA (2002), data of *P. nasutus*, data of *P. lativittatus*, and data of *P. concolor*.

† The upper occipital shield used by LEMA (2002) is here considered as the third temporal shield, following FERRAREZZI (1994).

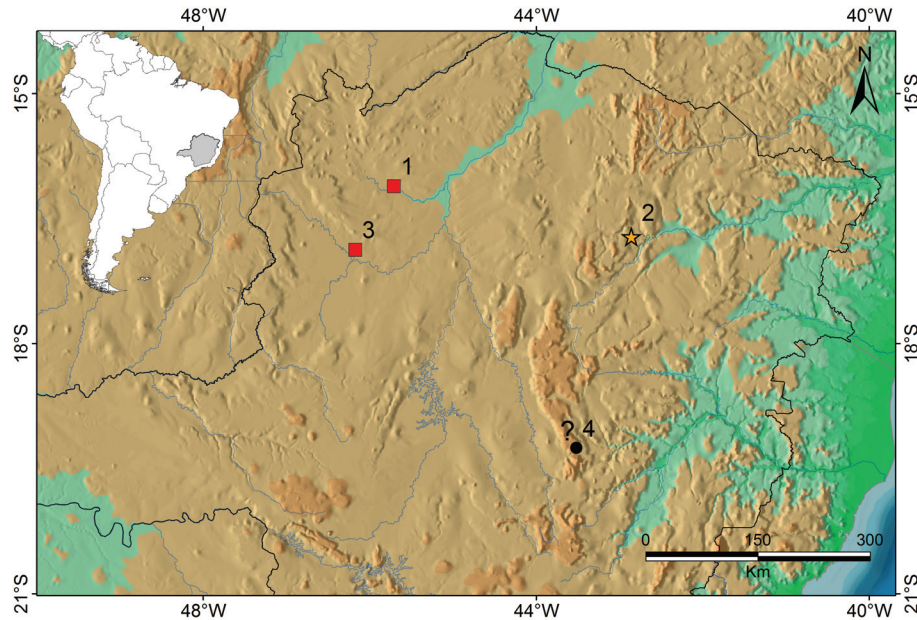


Figure 13. Geographic distribution of *Phalotris concolor*. Inset map: South America, with the state of Minas Gerais highlighted in grey. Main map: star = type locality, squares = new records, (?) unconfirmed record by SAWAYA & SAZIMA (2003). Municipalities: 1) Urucuia; 2) Cristália; 3) Brasilândia de Minas; 4) Jaboticatubas.

*concolor* is that of SAWAYA & SAZIMA (2003) from Serra do Cipó, southern Espinhaço mountain range.

There are no confirmed records of *P. concolor* in legally protected areas, and the type locality is within a priority region (Espinhaço Norte) for herpetofauna conservation in Minas Gerais (DRUMMOND *et al.* 2005). The lack of information about this species has led to its classification as Data Deficient (MARTINS *et al.* 2008). Studies have shown that the upland areas around aquatic environments are important for wildlife conservation (SEMLITSCH & BODIE 2003, FRAGA *et al.* 2011). The two specimens of *P. concolor* reported herein were captured in riparian vegetation. The holotype also seems to have been collected in a riparian zone, on the bank of Itacambiruçu River. Therefore, it is possible that *P. concolor* prefers riparian habitats, which emphasizes the importance of these areas for the conservation of the species.

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