

New Rain-Forest Species of *Pseudoxyrhopus* Günther (Squamata: Colubridae) from Northern Madagascar

RONALD A. NUSSBAUM, FRANCO ANDREONE, AND CHRISTOPHER J. RAXWORTHY

The colubrid snake genus *Pseudoxyrhopus* includes nine species endemic to Madagascar. A 10th species, *P. analabe*, is described from a single specimen collected in primary rain forest at 1050-m elevation on the western slopes of Anjanaharibe-Sud Mountain in northern Madagascar. *Pseudoxyrhopus analabe* differs from all other *Pseudoxyrhopus* in having all undivided subcaudal scales; it also has an undivided cloacal plate, a condition known for only one other species within the genus, *P. tritaeniatus*.

THE colubrid snake genus *Pseudoxyrhopus* (nine species) and two apparently related genera, *Heteroliodon* (one species) and *Pararhadinaea* (two species), are restricted to Madagascar. Although these three genera are probably monophyletic, the relationships among them and their relationships to colubrids outside of Madagascar are unknown (Raxworthy and Nussbaum, 1994). The nine currently recognized species of *Pseudoxyrhopus* are secretive, nocturnal, ground-dwelling, surface active to semiburrowing snakes which are rarely encountered. Most species are represented in museums by only a few specimens and usually by only one specimen per locality. For these reasons, the genus is very poorly known taxonomically, and virtually nothing is understood about the life history and ecology of the various species.

Pseudoxyrhopus was most recently reviewed by Raxworthy and Nussbaum (1994). These authors relegated *P. dubius* to the synonymy of *P. tritaeniatus*, transferred *P. occipitalis* to *Heteroliodon*, placed *H. torquatus* in synonymy of *H. occipitalis*, and described three new species leaving a total of nine species in the genus. Raxworthy and Nussbaum (1994) recognized four phenetic groups of *Pseudoxyrhopus* based on morphometric characters and behavior. Group A includes *P. ambrensis* Mocquard and *P. kely* Raxworthy and Nussbaum. These two species are characterized by small size (< 238 mm SVL), low numbers of scales rows (19 or 21), low numbers of ventral (< 154) and subcaudal (< 54) scales, fewer than 12 dentary teeth posterior to the largest dentary tooth, a single enlarged posterior maxillary tooth, and a pale nuchal band. Group B includes *P. heterurus* (Jan) and *P. sokosoko* Raxworthy and Nussbaum. Snakes of group B are similar to group A snakes in their small size (< 510 mm SVL), few scale rows (21), and fewer than 12 posterior dentary teeth; but they have more than one enlarged posterior maxillary tooth and lack a nuchal band. Group C includes

P. ankafinaensis Raxworthy and Nussbaum, *P. microps* Günther, and *P. tritaeniatus* Mocquard. This group is characterized by large size (up to 1195 mm SVL), high number of scale rows (25), and a higher number of ventral (> 190) and subcaudal (> 70) scales than the other three groups. Group D includes *P. quinquelineatus* (Günther) and *P. imerinae* (Günther). These two species have a strongly overhanging rostral scale and 12 or more posterior dentary teeth. Raxworthy and Nussbaum (1994) pointed out that the species within these four phenetic groups have largely allopatric distributions, being isolated either by elevation or latitude.

Recently, a 10th, undescribed species of *Pseudoxyrhopus* was collected by pitfall trapping in the rain forests of northern Madagascar. This new species is clearly referable to phenetic group A and is geographically isolated from the other two species (*ambrensis*, *kely*) of this group. We describe this new form herein.

MATERIALS AND METHODS

Pitfall trapping consisted of three, 50-m lines with plastic buckets (29.0 cm diameter, 27.5 cm deep) placed in the ground at 5-m intervals along alternate sides of a plastic drift fence (0.5 m high), for a total of 11 pitfalls per line, or 33 pitfalls per site. The three lines were placed in primary rain forest and maintained for eight days, from 27 January until 3 February 1996. The specimen was euthanized by injection with chlorobutanol, fixed in 10% buffered formalin, soaked in water to remove the formalin, and stored in a final solution of 75% ethanol. The terminology of characters is largely that of Raxworthy and Nussbaum (1994). Snout-vent length (SVL) and tail length were measured with a ruler to the nearest 1.0 mm. MRSN refers to the Museo Regionale di Scienze Naturali (Torino). Comparative material is documented in Raxworthy and Nussbaum (1994).

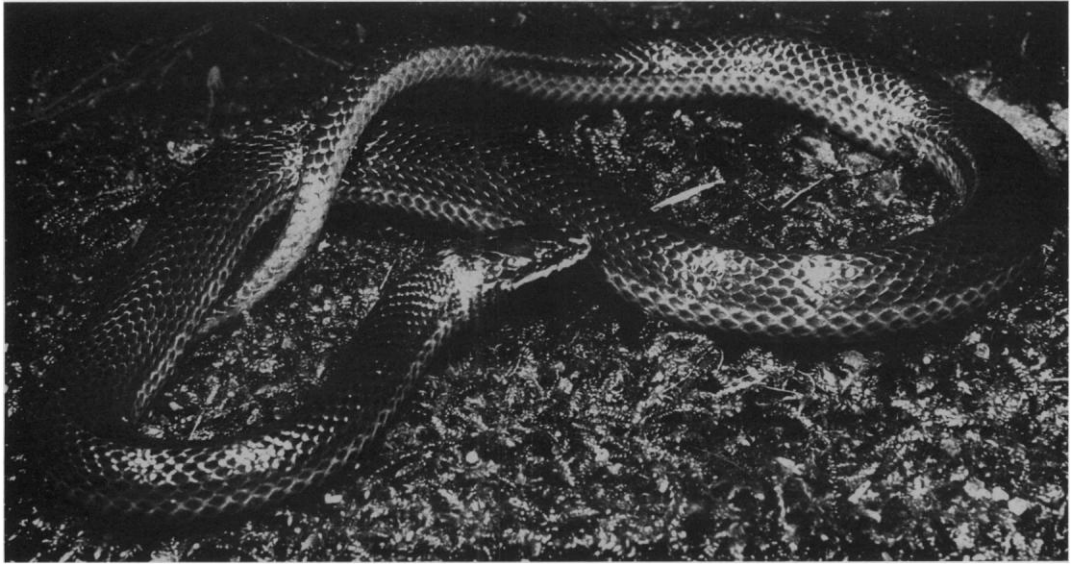


Fig. 1. Holotype (MRSN R1591) of *Pseudoxyrhopus analabe* in life.

Pseudoxyrhopus analabe n. sp.
 Figures 1–2

Holotype.—MRSN R1591; a mature female collected 2 February 1996, western slope of Anjanaharibe-Sud Mountain, Valley of Analabe River, 49°26.60'E, 14°46.62'S, 1050-m elevation, Be-

fandriana Fivondronana, Mahajunga Province, Madagascar by Franco Andreone, Herilala Randriamahazo, and Jasmin Emile Randrianirina.

Paratypes and other specimens.—None.

Identification.—A *Pseudoxyrhopus* with 21 scale rows, 8 supralabials, 146 ventrals, entire cloacal plate, 38 entire subcaudals, dark venter, and light nuchal band.

Description of holotype.—Excellent condition; short posteroventral slit in body; tail complete; mature or maturing female; 3 eggs in left ovary, decreasing in size anteriorly (3.1 × 2.2 mm, 2.2 × 1.9, 1.3 × 1.3); right ovary 13 mm anterior of left ovary, with 3 eggs decreasing in size posteriorly (2.2 × 1.7, 1.2 × 1.2, 0.9 × 0.9).

SVL 260 mm; tail 51 mm; 21 rows of smooth dorsal scales at midbody; body round in cross-section; 146 ventrals; 38 undivided subcaudals; cloacal plate undivided; 8 supralabials, fourth and fifth contacting eye; 9 infralabials, 5 in contact with anterior genial, fifth much larger than others and in contact with both anterior and posterior genials; anterior genials longer than posterior genials; rostral wider than high, visible from above; internasals pentagonal, wider than long, barely shorter than prefrontals, combined width same as rostral width; prefrontals much wider than long, extending lateroventrally to line between midorbit and nostril, contacting loreal; frontal pentagonal, as wide as long, shorter than parietals; loreal about as high as

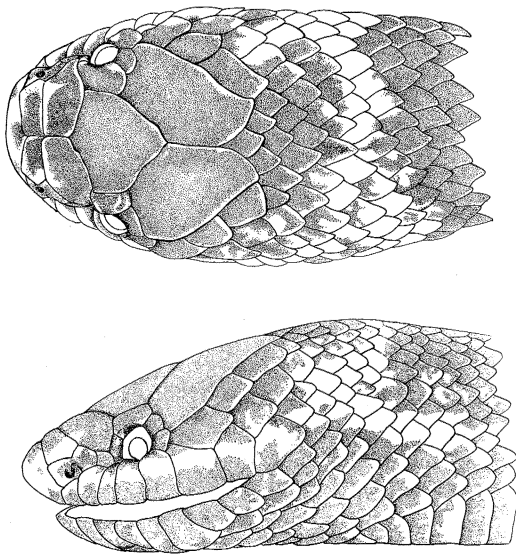


Fig. 2. Dorsal and left lateral views of the head of the holotype (MRSN R1591) of *Pseudoxyrhopus analabe*. Scale = 5 mm.

long, lower than preocular, contacting second and third supralabials; nasal semidivided by inferior suture; one preocular, two postoculars; temporals 1 + 2 + 3; snout bluntly rounded; eye small, vertical diameter 1.5 mm, diameter slightly less than height of bordering supralabials; pupil round; head barely distinct from neck; maxillary teeth, 12 + 1 (left and right), diastema present between anterior teeth and posteriormost tooth, posteriormost tooth fanglike, directed posteriorly; dentary teeth 14 (left and right), increasing in size to the sixth, which is the largest (fanglike) dentary tooth, seventh to 14th dentary teeth much smaller and decreasing in size posteriorly.

Color in life.—Dorsum of head, body, and tail dark lavender or purple-brown, interrupted by pinkish orange nuchal band with irregular borders; chin, throat, and venter of body colored like dorsum, increasingly darker anteriorly, chin nearly black with light mottling on ventral edges of infralabials 4 and 5; body with ventrolateral pink stripe with brown spots (usually one brown spot per scale) from ventral margin of nuchal band to base of tail, stripe covers lateral edges of ventrals and dorsal scale rows 1–2.5; second, upper, much thinner, pink, lateral stripe extending from midbody to tail, bolder posteriorly where it is confined to dorsal scale rows 4–5, fainter anteriorly where it occurs on scale rows 5–6; tail dark dorsally, pink with scattered brown spots ventrolaterally, becoming darker midventrally with a nearly continuous dark midventral line; bright pinkish orange labial stripe on upper edges of supralabials, continuous and widening around rostral where it is brightest, with pair of short posteriorly directed branches across lateral edges of internasals and anterior edges of nasals ending on anterior edges of prefrontals; rostral with pair of dark spots facing anteriorly; iris pinkish orange. After six weeks in alcohol, the pink and pinkish orange coloration have faded to light pinkish white, but the pattern remains distinctive.

Etymology.—The specific name “*analabe*” is a compound Malagasy word pronounced “an-ah-bay,” meaning “at the big forest” and is used here as a noun in apposition (“the one at the big forest”). Analabe is also the name of the river and valley where the holotype was found.

Habitat.—The holotype was collected in a pitfall trap 30 m from the nearest stream in a patch of primary, valley rain forest. The habitat in Analabe Valley is a patchwork of pristine and altered forest, with most of the unaltered forest occur-

ring on the ridges and steepest slopes. In the degraded patches, the original vegetation has been replaced by ferns and grasses. During the period that Analabe Valley was surveyed, the weather was cloudy and rainy, with rainfall occurring almost daily. The snake, the only one caught in pitfalls during the 264 trap days, was captured at night and retrieved from the pitfall at 0800 h. The air minimum temperature the night of capture was 18 C. Mean maximum daily air temperatures during the survey period ranged from 20–22 C.

Remarks.—*Pseudoxyrhopus analabe* is the only species of the genus in which all subcaudal scales are undivided; and, with the exception of a few individuals of *P. tritaeniatus*, it is the only species with an undivided cloacal plate. The latter species, however, has 25 midbody scale rows (21 in *P. analabe*), far more ventral and subcaudal scales (Table 1), a bold pattern of two or three dorsolateral reddish stripes, and is probably much larger. There are four other *Pseudoxyrhopus* species with 21 midbody scale rows (Table 1). In addition to the scalation features described above, these four species can also be distinguished from *P. analabe* as follows: *P. quinquelineatus* is least similar to *P. analabe*, differing in coloration (no pink stripes and a uniform, light-colored venter) and in having a strongly overhanging rostral scale. *Pseudoxyrhopus analabe* is most similar in dorsal and head coloration to *P. ambreensis*, but the latter has 7 (rather than 8) supralabials, at least 52 subcaudals in the undamaged tail (38 in *P. analabe*), and a light-colored venter (dark in *P. analabe*). *Pseudoxyrhopus analabe* shares some characteristics with *P. heterurus* and *P. sokosoko*, but *P. heterurus* has at least 52 subcaudals, and both *P. heterurus* and *P. sokosoko* lack a pale nuchal band and have lighter colored venters.

Pseudoxyrhopus analabe apparently is a relatively small- to medium-sized species, as is indicated by the mature or nearly mature condition of the ovaries of the holotype. It is larger than *P. kely*, probably in the size range of *P. ambreensis*, *P. imerinae*, and *P. sokosoko* and probably smaller than the remaining species of the genus.

DISCUSSION

Phenetically similar species of *Pseudoxyrhopus* have an interesting pattern of distribution (Raxworthy and Nussbaum, 1994). For example, *P. heterurus* is distributed throughout much of the northeastern rain-forest belt as far south as Manombo Reserve, Farafangana. Its apparent sister-species, *P. sokosoko*, occurs 180 km south of

TABLE 1. CHARACTERISTICS OF *Pseudoxyrhopus* SPECIES. Subcaudal scale counts given only for those with complete tails except where noted; div = divided; ent = entire; het = heterogeneous. Specimens documented in Raxworthy and Nussbaum (1994).

	N	SVL	Scale rows	Ventrals	Subcaudals	Anal plate	Supra-labials
<i>ambreensis</i>							
males	1	333	21	146	54 (div)	div	7
females	2	227–238	21	152–154	52–54 (div)	div	7
<i>ankafinaensis</i>							
males	1	945	25	206	46 ^a (div)	div	8
<i>analabe</i>							
females	1	260	21	146	38 (ent)	ent	8
<i>heterurus</i>							
females	3	347–510	21	159–161	52–56 (het)	div	8
<i>imerinae</i>							
females	2	360–362	19	146–147	41–43 (div)	div	8
<i>kely</i>							
males	1	180	19	134	37 (div)	div	8
females	1	130	19	139	38 (div)	div	8
<i>microps</i>							
males	6	288–1,195	25	208–232	76–84 (div)	div	8
females	7	440–805	25	212–232	76–89 (div)	div	8
<i>quinquelineatus</i>							
males	8	265–460	21	139–144	48–59 (div)	div	8
females	3	195–450	21	148–152	48–52 (div)	div	8
<i>sokosoko</i>							
males	2	153–285	21	142–145	45–46 (div)	div	8
females	2	295–320	21	142–144	46–51 (div)	div	8
<i>tritaeniatus</i>							
males	6	437–850	25	203–217	65–66 (div)	het	8
females	1	765	25	216	76 (div)	div	8

^a tip missing.

the distributional area of *P. heterurus* in low- to mid-elevation rain forest (see maps in Raxworthy and Nussbaum, 1994).

This pattern is also evident in the distribution of *P. analabe* and the two species most similar to it, *P. ambreensis* and *P. kely*. *Pseudoxyrhopus ambreensis*, which is restricted to the rain forests of Montagne d'Ambre, has the northernmost distribution. *Pseudoxyrhopus ambreensis* and *P. analabe* occur in similar habitats at similar elevations but are geographically isolated by 250 km. The extensive lowland area, centered around Ambilobe, which separates the two species is characterized by degraded, arid vegetation largely devoid of forest. The third species, *P. kely*, is restricted to extreme southern Madagascar where it occurs in coastal littoral and low riverine forests near Tôlanaro (Fort Dauphin).

The 10 *Pseudoxyrhopus* species are secretive

ground dwellers and include nocturnal, surface-active and semiburrowing forms. Behavioral observations indicate that some species, *P. ambreensis*, *P. kely*, and *P. quinquelineatus*, have a stronger tendency to burrow than others, using their snouts to dig through the substratum. The rarity of specimens of *Pseudoxyrhopus* and the widely scattered localities of most species are probably due to a combination of their secretive habits and the disrupted condition of the native forests of Madagascar. Unlike some groups of the Madagascan herpetofauna, snakes of this genus are rarely found in highly degraded forests and never in anthropogenic habitats such as fields and villages. The continuing fragmentation of Madagascar's forests is, therefore, likely to have a more dramatic effect on species of *Pseudoxyrhopus* than on some other snake groups that seem to survive, and even thrive, in human-

formed habitats, for example, some species of *Dromicodryas*, *Leioheterodon*, *Liophidium*, and *Madagascarchophis*.

Known from a single specimen, *P. analabe* must be considered one of the rarest snakes in Madagascar. However, the secretive nature of *Pseudoxyrhopus* species and the limited amount of herpetological fieldwork completed to date in Madagascar give hope that the species is more widespread and common than current data suggest.

The type locality of *P. analabe* lies on the western slope of Anjanaharibe-Sud, apparently outside of Anjanaharibe Reserve (the boundaries are not yet clearly defined), which is limited to the southeastern region of the chain (Nicoll and Langrand, 1989). The herpetofauna of Anjanaharibe-Sud is generally similar to that of nearby rain-forest sites (Masoala, Marojejy, Tsaratana, Manongarivo) surveyed by Raxworthy and Nussbaum (unpubl.) but includes a few species of particular interest. In addition to *P. analabe*, another undescribed snake species of the genus *Liophidium* is recorded so far only from Anjanaharibe-Sud, and a few new microhylid frogs have been found there. Rare but not endemic species recorded at Anjanaharibe-Sud include the burrowing snake *Typhlops mucronatus* and the burrowing skink *Androngo crenni*. A more detailed list with ecological considerations will be published elsewhere (Raxworthy et al., in press). Recently it has been proposed to extend the boundaries of Anjanaharibe-Sud Reserve. The discovery of *Pseudoxyrhopus analabe* as well as many other rare species of amphibians and reptiles in the region, some as yet undescribed, stresses the importance of expanding the boundaries of the reserve for maximal protection of these species.

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- (RAN) DIVISION OF REPTILES AND AMPHIBIANS, MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN 48109-1079; (FA) MUSEO REGIONALE DI SCIENZE NATURALI, SEZIONE DI ZOOLOGIA, VIA G. GIOLITTI, 36, 10123, TORINO, ITALY; AND (CJR) CENTER FOR ENVIRONMENTAL RESEARCH AND CONSERVATION, COLUMBIA UNIVERSITY, MAIL CODE 5557, 1200 AMSTERDAM AVENUE, NEW YORK, NEW YORK 10027-5557. E-mail: (RAN) nuss@umich.edu; (FA) frand@mbox.vol.it; (CJR) cr147@columbia.edu. Send reprint requests to RAN. Submitted: 17 May 1996. Accepted: 22 Aug. 1997. Section editors: D. Cundall and R. Irish.