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FIRST CONFIRMED DISTRIBUTION RECORDS OF *Dendrelaphis bifrenalis* (BOULENGER, 1890) (REPTILIA: COLUBRIDAE) IN INDIA, WITH A REVISED KEY TO THE SOUTHERN INDIAN FORMS

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Abstract

We report for the first time an accurate record of *Dendrelaphis bifrenalis* (Boulenger, 1890), a colubrid snake thus far considered endemic to Sri Lanka, from southern India. Our data is based on a voucher specimen collected from Shenbagathoppu, Srivilliputhur, Tamil Nadu, India. We also refer a paratype of *D. girii* from Sirumalai and a voucher specimen previously identified as *D. girii* from Meghamalai (both from Tamil Nadu, India) to *D. bifrenalis*. Additionally, based on congruence of diagnostic features, observed but uncollected specimens reported from the Eastern Ghats in Jawadi, Bilgiri and the Tada (or Kambakkam) hills are herein referred to *D. bifrenalis*. The Indian records of *D. bifrenalis* available thus far indicate its occurrence in mixed deciduous forests of mid-hills. Our examination of the historical (in 1890s) specimen that formed the sole basis of the record of *D. bifrenalis* in India, from “Trevandrum, Travancore” in the wet zone of the Western Ghats reveals that it is in fact *D. girii*. We conclude by drawing parallels in distribution patterns between the Western Ghats-endemic *D. girii* and the corresponding Sri Lankan wet zone endemic species *D. wickrorum*, whose description enabled a proper identification of the Sri Lankan and Indian dry zone populations as *D. bifrenalis*.

Key words: deciduous forests, Eastern Ghats, forebody stripes, Shenbagathoppu, Sri Lanka

Introduction

Dendrelaphis bifrenalis (Boulenger, 1890) is a colubrid snake described from Ceylon (now Sri

Lanka) based on three syntypes, from which Danushka *et al.* (2020) designated NHMUK 1946.1.6.4 as the lectotype. In the original

description, the only distribution given was “Ceylon” (Boulenger 1890). Günther (1858) was the first author to recognize the originality of this form, when he regarded it as a variety of *Dendrophis picta* noting: “Var. C. Muzzle elongate; two long loreal shields. Adult, Ceylon” (see Boulenger 1890). Sclater (1891) reported a specimen of “*D. bifrenalis*” from Travancore, Trevandrum (see below). Abercromby (1911) stated that *D. bifrenalis* is a common species in Ceylon. Wall (1924), in a compilation on Indian snakes, stated its distribution as Western Ghats South of Palghat Gap, Travancore, Ceylon. Smith (1943) stated the distribution of *D. bifrenalis* as Ceylon, Southern India (Trivandrum, Travancore), again alluding to the Ferguson’s specimen exchanged with the Calcutta Museum (see Sclater 1891, Ferguson 1895). Much later, Whitaker (1976), in his book on Indian snakes, listed *D. bifrenalis* annotating its distribution as “Western India”.

Das & Whitaker (1990) reported a *D. bifrenalis* based on a 1,000 mm long female sighted in March that year in Vanjikadavu near Nadukani (10.1090°N, 76.6998°E; 50 m a.s.l.), Kerala. One year later, Malhotra & Davis (1991) reported *D. bifrenalis* based on a single specimen 495 mm long, at 1,150 m a.s.l. abutting scrub and a shola forest boundary in Srivilliputhur hills, Tamil Nadu. The uncanny resemblance in these two Indian records of *D. bifrenalis* was that in both instances, the snakes were seen chasing *Indirana* sp. frogs, possibly to feed on (Das & Whitaker 1990, Malhotra & Davis 1991). The whereabouts of these specimens remains unknown (Whitaker pers. comm. March 2018). Das (1994) in his compilation on the reptiles of South Asia, stated the distribution of *D. bifrenalis* as India (Western Ghats) and Sri Lanka. Clearly, there was no consensus about the identity of the Indian records assigned to *D. bifrenalis*. Hence, modern works did not regard *D. bifrenalis* as part of the Indian snake fauna (Daniel 2002; Das 2002; Das & DeSilva 2005; Whitaker & Captain 2004; Somaweera 2006; Wallach *et al.* 2014). Curiously Wallach *et al.* (2014) referenced Malhotra & Davis’ record from Srivilliputhur, India, but stated its distribution only as Sri Lanka. Das & de Silva (2005) unfortunately misidentified *D. bifrenalis* as *D. caudolineolatus* (Günther, 1869), a totally different species (Wall 1921, Smith 1943).

Recent surveys in dry forests of southern India revealed the presence of an unidentified

Dendrelaphis species having a long, black forebody stripe and bright red tongue. Such populations were recorded in the Jawadi hills (Ganesh & Arumugam 2016), the Bilgiri hills (Ganesh *et al.* 2018) and the Kambakkam hills (Ganesh & Guptha 2022) in the Eastern Ghats. Unfortunately, as no snake could be captured for a closer diagnosis, it was simply noted that it was similar to *D. ashoki* Vogel & van Rooijen, 2011. As is known, the recently described *D. ashoki* is the Western Ghats species previously confused with the Indochinese species *D. pictus* (Gmelin, 1789) (see Vogel & van Rooijen 2011a). *Dendrelaphis ashoki* also has a large black forebody stripe and a bright red tongue, though it is restricted to wet forests of the Western Ghats (Vogel & van Rooijen 2011a). These species differ in their loreal scales, with *D. ashoki* having a single loreal, whereas *D. bifrenalis* (and *D. girii*) have two loreals on each side of the head (Vogel & Van Rooijen 2011a,b).

Meanwhile, taxonomic studies on the genus *Dendrelaphis* in the Western Ghats-Sri Lanka biodiversity hotspot resulted in significant taxonomic revisions. A new species, *D. girii*, described from the Western Ghats of India (Vogel & van Rooijen 2011b) was likely earlier considered to be the Indian population of *D. bifrenalis*. Subsequently, in the most recent work pertaining to the *D. bifrenalis* group, a new species *D. wickrorum* was described from what were considered populations of *D. bifrenalis* in Sri Lanka (Danushka *et al.* 2020). The major diagnostic character separating both species is the eye streak: small and short (till jaw angle) in *D. wickrorum* but thick and very long (surpassing neck) in *D. bifrenalis* sensu stricto (see Danushka *et al.* 2020). It was also stated that while *D. wickrorum* was found in the wet zone, *D. bifrenalis* sensu stricto is restricted to the dry and intermediate zones in Sri Lanka (Danushka *et al.* 2020).

One of us (RA) collected a specimen of *Dendrelaphis* sp. resembling the Eastern Ghats populations (see figure 6C in Ganesh *et al.* 2018). By that time, *D. bifrenalis* sensu stricto was also better redefined by Danushka *et al.* (2020), as having two loreals [Note: in Latin, *bifrenalis* means “with two loreal scales”] and very long black stripes across the head on to the forebody. The collected specimen and a few photo vouchers, both by us (Ganesh & Arumugam 2016, Ganesh *et al.* 2018) and by colleagues (see Fig. 2A–D) revealed the

presence of these two diagnostic characters in the Indian specimens too. In this paper, we report a confirmed record of *D. bifrenalis* from India for the first time, describe that specimen and other specimens and summarize the information from the few, scattered, previous anecdotal Indian reports available to us.

Material and Methods

This study is based on an examination of 29 specimens of three species, viz. *Dendrelaphis bifrenalis* ($n=17$; 14 from Sri Lanka, 3 from India); *D. girii* ($n=7$) and *D. wickrorum* ($n=5$), including their name-bearing types. For each examined specimen, 21 characters including aspects of colour pattern, body proportions and scalation were recorded. Snout–vent length and tail length were measured by marking the length on a piece of string and subsequently measuring the position of the mark to the nearest millimetre. Other body measurements were scored using digital vernier calipers, to the nearest 0.1 mm. The number of ventrals was counted following Dowling (1951). Subcaudals were counted on the left side, the terminal scute was excluded. Symmetrical scalation characters when no precision is given refer to both sides being identical. Relative tail length was calculated by dividing the tail length by the total length. For detailed definition and terminologies of scalation, see Vogel & Van Rooijen (2011a) and Danushka *et al.* (2020). **Museum Abbreviations:** BNHS, Bombay Natural History Society Museum, India; NHMUK, Natural History Museum London, United Kingdom; SACON, Sálim Ali Centre for Ornithology & Natural History, India; SMNS, Staatliches Museum für Naturkunde Stuttgart, Germany; ZSIC, Zoological Survey of India, Kolkata, Head Office, India; ZSI/SRS, Zoological Survey of India, Southern Regional Station, Chennai, India.

Taxonomy

Dendrelaphis bifrenalis (Boulenger, 1890)

(Figs. 1–3; Table 1)

Dendrelaphis sp. — Ganesh & Arumugam 2016,

Ganesh *et al.* 2018, Ganesh & Guptha 2022

Dendrelaphis girii — Ganesh & Arumugam 2016

Dendrelaphis girii (in part) — Vogel & Van Rooijen 2011b, Ganesh *et al.* 2020

New material ($n=1$): ZSI/SRS/VRS-327 (Fig. 1A–C), collected by Dr. R. Aengals and party

from Chenbagathoppu Odai (9.5440°N, 77.5544°E; 200 m a.s.l.), Srivilliputhur, Virudhunagar district, Tamil Nadu, India on 21 September 2015. **Additional material ($n=2$):** BNHS 3273 (Fig. 1D), collected by S.P. Vijayakumar from Sirumalai Hills (10.1819°N, 77.9698°E; 990 m a.s.l.), Dindugal District, Tamil Nadu, India in 2001; a paratype of *Dendrelaphis girii* (see Vogel & Van Rooijen 2011a); SACON/VR-81, collected by S. Bhupathy from Meghamalai Hills (9.6958°N, 77.2319°E; 560 m a.s.l.), Theni District, Tamil Nadu, India in 2009 (Ganesh *et al.* 2020).

Description of ZSI/SRS/VRS-327. Well preserved adult male; body elongate; habitus slender; head distinct from neck; neck thin and delicate; eye large; tail long; relative tail length 0.67. **Measurements (in mm):** snout–vent length 535.0; tail length 360.0; head length 16.5; head width 7.5; head depth 5.3; eye diameter 4.2; inter-orbital distance 4.4; inter-narial distance 3.2; eye–nostril distance 3.2; eye–rostral distance 5.4. **Scalation:** Dorsal scales smooth, with two, anterior apical pits on each scale, arranged in oblique series; anterior scale rows 15 (at neck); midbody scale rows 15; posterior scale rows 9 (at vent); supralabials 9 (5 & 6 touching orbit); infralabials 10 (1–5 touching anterior genials); loreals 2 on each side of head; temporals 1+2+2; preocular 1; postoculars 2; preventrals 2; ventrals 167, angulate laterally; cloacal plate paired; subcaudals 155, paired. **Hemipenis:** examined in situ; organ rather short and thick, extending to 2–3 subcaudals, not forked at apex; length 4.2; width 2.1; pedicel narrower than lobed head, partly obscured by tiny, numerous flounces and spinules set on the lobe; organ centripetal, twisting anti-clockwise; sulcus groove not quite visible in sulcal view; asulcal view smooth, but for the anterior flounces. **Colouration:** Soon after preservation, dorsum fawn brown throughout the length of the body; laterally with a thick black stripe on forebody, extending from loreal region, across eye, neck and on to forebody; at about one head length posterior to neck the stripe disintegrates to form a discontinuous series of black bars; white ventrolateral stripe from neck to tail base, from where onwards it gets paler and obscures progressively near tail tip; labials, mental, gular regions and uniform unpatterned white; eye with black round pupil; iris golden brown; tongue bright red; inter-scalar skin copper blue to olivaceous; eye and tongue discolored in preservation.

Variation. Major morphometric characters summarized in Table 1 (in mm). Snout–vent length 510.0–570.0; tail length 298.0–310.0; head length 15.0–18.9; dorsal scale rows 15:15:9–11; ventrals 169–173; subcaudals 145–150; infralabials 9 or 10; temporals 1+2+2 or 1+2+3.

Distribution and natural history. In India (Fig. 3), *D. bifrenalis* is currently known to inhabit the drier eastern slopes of the Western Ghats and the wetter higher elevation forests of the Eastern Ghats, consistently occurring in deciduous forest belts. The specimen (ZSI/SRS/VRS-327) used in the above description was collected from a riparian hill forest dominated by *Mangifera indica* (Anacardiaceae) and *Terminalia arjuna* (Combretaceae) trees. The collection site, Shenbaga (= Chenbaga) thoppu, is situated in the foothills of the Srivilliputhur massif, located at the eastern offshoot of the Western Ghats. Srivilliputhur hills are covered by mixed deciduous forests, especially along the riverine stretches (Rajendran & Agarwal 2007). Similarly, SACON/VR-81 was collected from a nearby site in the Meghamalai hill slopes (Ganesh *et al.* 2020), also covered by mixed deciduous forest type (Karuppusamy & Ravichandran 2016). In the nearby hill range of Sirumalai, the extreme southern part of the Eastern Ghats, this species was recorded in Khandige or Namasthe Estate (Vanak *et al.*

2001, Vogel & van Rooijen 2011b, Ganesh & Arumugam 2016). This area is also covered with mixed deciduous forests (Jayakumar *et al.* 2008). Further north along the Eastern Ghats, *D. bifrenalis* was reported from Malai Thirupathur (12.3220°N, 78.6888°E; 1030 m a.s.l.) and Alangayam hills (12.6408°N, 78.7816°E; 580 m a.s.l.) in the Jawadi massif (Ganesh & Arumugam 2016). These areas are covered by moist and dry deciduous forests (Jayakumar *et al.* 2008). West of these areas, *D. bifrenalis* was also reported from Bilgiri hills, in Gundri (11.6854°N, 77.4126°E; 920 m a.s.l.) and Malliamman Durgam (11.5710°N, 77.3415°E; 1330 m a.s.l.) hill ranges in Erode District, Tamil Nadu (Ganesh *et al.* 2018). These snakes were sighted in April 2016. One adult was sighted at Gundri in dense thickets of *Prosopis* (Fabaceae) bushes during daytime and a juvenile was sighted on a tree trunk in Malliamman Durgam. Both areas are covered with mixed deciduous forests and a matrix of human-modified habitats including plantations (Sathya 2017). Ganesh & Guptha (2022) recorded this species based on an uncollected subadult from Ubbalamadugu Falls (13.6141°N, 79.8438°E; 120 m a.s.l.), Kambakkam hill, Chittoor District, Andhra Pradesh in December 2016. This site has riparian and moist deciduous forests (Prasad *et al.* 1986).

Table 1. Morphological characters of the Indian specimens of *Dendrelaphis bifrenalis* compared with literature data (*fide* Danushka *et al.* 2020) of Sri Lankan specimens; — = not examined

Characters	Indian specimens (<i>n</i> =3)			Sri Lankan specimens (<i>n</i> =14)
	ZSI/VRS-327 Shenbagathoppu	SACON/VR-81 Meghamalai	BNHS 3273 Sirumalai	
Sex	male	female	female	pooled
Snout–vent length	535	570	515	344–646
Tail length	360	310	298	201–395
Relative tail length	0.40	0.35	0.37	0.37–0.38
Head length	17.5	15	18.9	14.1–27.4
Head width	6.5	9	—	6.5–11.4
Dorsal scale rows	15:15:9	15:15:11	15:15:11	15:15:9–11
Ventrals	167	169	173	153–173
Subcaudals	155	150	145	139–166
Cloacal plate	2	2	2	2
Supralabials	9	9	9	9
Infralabials	10	10	9 or 10	10
Loreal	2	2	2	2
Preoculars	1	1	1	1
Postoculars	2	2	2	2
Temporals	1+2+2	1+2+3	1+2+2	1+2+2 or 3

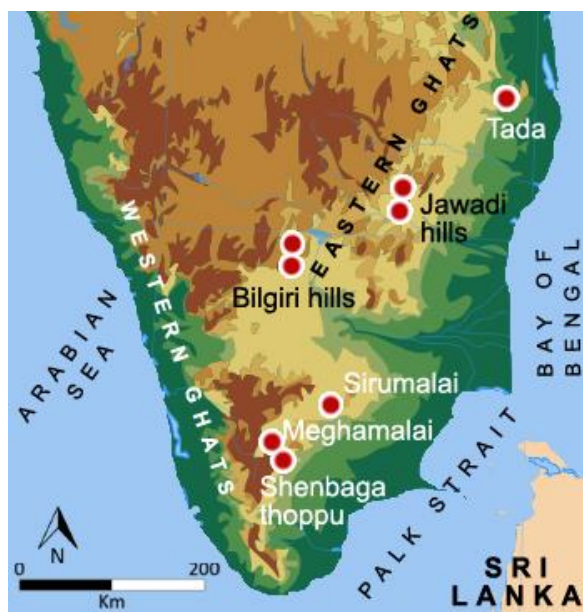


Figure 3. Current distribution of *Dendrelaphis bifrenalis* in India based on confirmed records

Remarks. Sclater (1891) reported on a specimen Reg. No.13504 from Trevandrum Museum, stating the distribution of *D. bifrenalis* as “Travancore and Ceylon”. Despite Sclater’s statement, Boulenger (1894) stated its distribution only as “Ceylon”. Ferguson (1895) explicitly remarked that “Boulenger only records this from Ceylon; it is, however, not uncommon in Trevandrum”. It was Ferguson’s specimen from Travancore that was deposited in the Trevandrum Museum; this specimen was in turn lodged with the Indian Museum, Calcutta (*vide* Sclater 1891). Wall (1921a) stated that “the only Indian specimen was sent to me from Trivandrum, Travancore” and that his Travancore specimen was gravid, having five large eggs. Wall (1921b) again referred to this same specimen. Our examination of ZSIC 13504 revealed it to be *Dendrelaphis girii* (Fig.4A). To further support this identification, we photographed a live uncollected specimen of the same species (Fig. 4B) near Arippa, 50 km northeast of Trivandrum. Thus, we once again uphold the view of Vogel & Van Rooijen (2011b) and also Palot (2015) that Ferguson’s specimen Reg. No. 13504 should be referred to as *D. girii*. However, one paratype BNHS 3273 from Sirumalai (Eastern Ghats) is instead referred to as *D. bifrenalis*.

Discussion

Recently, the *Dendrelaphis* species inhabiting North India, especially the Northeast, were well reviewed (Biakzuala *et al.* 2022), but the

southern Indian forms still remain to be as thoroughly studied. A total of five species of *Dendrelaphis* were thus far known to inhabit Peninsular India (see the key in Chandramouli & Ganesh 2012). Of these, only the commonest, *D. tristis* (Daudin, 1803), is widespread (Das 2002, Whitaker & Captain 2004). Four more species are endemic to the wet zones of southwestern India, in the Western Ghats, namely: *D. chairecacos* (Boie, 1827), *D. grandoculis* (Boulenger, 1890), *D. ashoki* and *D. girii* (see van Rooijen & Vogel, 2008, 2009; Vogel & van Rooijen, 2011a,b). While *D. tristis*, *D. schokari* (endemic to Sri Lanka) and *D. chairecacos* belong to the *D. tristis* group, *D. grandoculis* plus *D. caudolineolatus* and *D. effrenis* (both Sri Lankan) belong to one (phenetic) group (Wickramasinghe 2016, Danushka *et al.* 2020, SRG pers. obs.). The supposedly Sri Lankan endemic species *D. oliveri* (Taylor, 1950) and also *D. ashoki* of the Western Ghats, belong to the *D. pictus* group (Vogel & van Rooijen 2011a; Wickramasinghe 2016), while *D. bifrenalis*, *D. girii* and *D. wickrorum* belong to the *D. bifrenalis* group (Danushka *et al.* 2020). Through the present work, *D. bifrenalis* too is now added to the Indian snake fauna.

In the Western Ghats, only two species of *Dendrelaphis* having distinct black eye streaks occur – *D. ashoki* and *D. girii* (Vogel & van Rooijen 2011a,b). *Dendrelaphis grandoculis* lacks an eye streak (Whitaker & Captain 2004). The wet zone specialist *D. ashoki* is superficially similar to *D. bifrenalis*, in having a much wider, longer black facial streak that continues across the neck onto the forebody. However, *D. ashoki* can be easily distinguished from *D. bifrenalis* by having only one loreal scale on each side of the head (Chandramouli & Ganesh 2012). Another diagnostic feature separating the two is the ventrolateral stripe. In the original description (Vogel & van Rooijen 2011a) and the subsequent treatment (Danushka *et al.* 2020), *D. girii* was reported to either totally lack or possess only a faint white ventrolateral stripe. However, our perusal of both preserved and live specimens (see Figs. 4C–D) reveal that *D. girii* too has white ventrolateral stripes, similar to congeners discussed above. Thus, *D. girii* differs by having a smaller eye with eye diameter < snout length (*vs.* > in *D. wickrorum*)) (see Danushka *et al.* 2020).

Dendrelaphis bifrenalis is a species known from the dry and intermediate zones of Sri Lanka (Danushka *et al.* 2020). While the fauna

of the dry zones of Southern India and Sri Lanka share several species, the wet zones of both the regions have distinctly endemic species, peculiar to each region. Therefore, it is not surprising that this species also occurs on the Indian peninsula. A similar case of another closely related colubrid snake purported as a Sri Lankan endemic, reported authentically from India is *Chrysopelea taprobanica* Smith, 1943 (Guptha *et al.* 2015, Somaweera *et al.* 2015). We also acknowledge the fact that some populations thought to belong to the same species were also later shown to be different at species level between the Western Ghats and Sri Lanka, e.g. the *Boiga beddomei* group (Ganesh *et al.* 2020, 2021) and the *Ahaetulla pulverulenta* group (Mallik *et al.* 2020). We also point out here that the aforesaid species were actually morphologically different, as acknowledged by Smith (1943), for the *A. pulverulenta* group.

Also, judging by the location in the same hill range, we hypothesize that Malhotra & Davis' record will also most likely refer to *D. bifrenalis* and not *D. girii*. However, the Vanjikadavu record from Kerala by Das & Whitaker (1990) may most likely correspond to *D. girii*, as wet forests habitats are more characteristic of *D. girii* (SRG pers. obs.). Among other *Dendrelaphis* species, the dry zone dweller *D. tristis* is common to both countries, but there are two allopatric wet zone vicariants, *D. schokari* (Kuhl, 1820) in Sri Lanka and *D. chairecacos* (Boie, 1827) in the Western Ghats, India (van Rooijen & Vogel 2008, 2009). Similarly, we hypothesize that the dry zone inhabitant *D. bifrenalis* is common to both countries but there are two allopatric wet zone vicariants viz. *D. wickrorum* in Sri Lanka (Danushka *et al.* 2020) and *D. girii* in the Western Ghats, India (Vogel & Van Rooijen 2011a), respectively.

Revised key to Southern Indian *Dendrelaphis* (modified after Chandramouli & Ganesh 2012) intended for live specimens:

- | | |
|--|--|
| <p>1. (a) Tongue red in colour 2
 (b) Tongue black or blue 4</p> <p>2. (a) One loreal scale on each side of head
 <i>D. ashoki</i>
 (b) Two loreal scales on each side of head 3</p> <p>3. (a) Black temporal stripe covers forebody
 <i>D. bifrenalis</i>
 (b) Black temporal stripe only covers head and
 neck <i>D. girii</i></p> | <p>4. (a) tongue black, ocular streak absent
 <i>D. grandoculis</i>
 (b) tongue blue, black ocular streak present 5</p> <p>5. (a) dorsum with yellow vertebral stripe
 <i>D. tristis</i>
 (b) no vertebral stripe on dorsum
 <i>D. chairecacos</i></p> |
|--|--|

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