First record of *Chrysopelea taprobanica* Smith, 1943 (Squamata: Colubridae) from India

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Abstract: *Chrysopelea taprobanica* Smith, 1943 was previously considered to be endemic to the dry and intermediate zones of Sri Lanka. However, an adult specimen of *C. taprobanica* was collected from Seshachalam Biosphere Reserve of Andhra Pradesh, India, being the first record of this snake species from India, significantly extending the known range of distribution of the species. The dry zones of peninsular India were connected with Sri Lanka as recently as ca. 17,000 years ago, which probably allowed movement of species between these two regions.

Key words: Andhra Pradesh, *Chrysopelea*, India, new record

The flying snakes (*Chrysopelea*) are arboreal members of the family Colubridae, consisting of five nominal species distributed across South and Southeast Asia (Uetz and Hošek 2013). Two species of the genus occur in India: *Chrysopelea ornata* (Shaw, 1802) in the mainland (and several other south Asian countries) and *C. paradisi* Boie, 1827 in the Andaman group of islands (and several other south-east Asian countries) (Whitaker and Captain 2004).

*Chrysopelea taprobanica* Smith, 1943 was described based on a type series from Kanthali (=Kantalai) and Kurunegala in Ceylon (now Sri Lanka) (Smith 1943). It is considered endemic to Sri Lanka widespread in the dry and intermediate zones of the island, and is sympatric with *C. ornata* in part of its range (Derniyagala 1955; Somaweera 2004). The habitat in which *C. taprobanica* occurs in Sri Lanka is a dry-mixed evergreen forest (Sameera Karunarathna pers. comm.). *Chrysopelea taprobanica* differs from *C. ornata* and *C. paradisi* by the last ventral shield not being divided (*vs.* last ventral divided in *C. ornata* and *C. paradisi*), and an olive dorsal colour with black cross-bars (*vs.* red rosettes along the back green above, each scale with a black median line in *C. ornata* and in case of *C. paradisi* the colour is black above, each scale with a central yellow spot) (Smith 1943; Derniyagala 1955).

In 2000, an unidentified specimen suspected to be *Chrysopelea taprobanica* was photographed by Dr. Santharam in a deciduous forest patch in Rishi Valley, Andhra Pradesh, India (V. Santharam pers. comm.) but the specimen was not collected. On 28 November 2013, we collected a specimen of *Chrysopelea taprobanica* in the dry deciduous forest of Chamala, Seshachalam Biosphere Reserve (13°35′24″ N, 079°15′28″ E), Andhra Pradesh, India. The specimen (voucher BLT 076, collection permit: RC/11/2012/BLT issued by Andhra Pradesh Forest Department) is deposited in Bio-Lab of Seshachalam Hills, Tirupathi, India, and it represents the first-ever confirmed record of *C. taprobanica* from India and anywhere outside Sri Lanka (Figure 1).

Muscle tissues from the abdomen region were stored in 100% ethanol for genetic analysis and the specimen was fixed in 10 % formaldehyde and store in 70 % ethanol. DNA was extracted using a Qiagen DNeasy Blood and Tissue kit. Two mitochondrial genes were amplified using the polymerase chain reaction and sequenced for BLT 076: 16s rRNA (~ 493 bp) and NADH4 (~ 680 bp) following PCR conditions and primer combinations of Pyron et al. (2013). Eight other sequences of closely related species of snakes from Sri Lanka...
were downloaded from Genbank (Chrysopelea spp.: KC347508, KC347496; Dendrelaphis spp.: KC347497, KC347518, KC347509, KC347493; Ahaetulla spp.: KC347526, KC347512) and compared with the new record (BLT 076). The sequences were aligned in software MEGA 5.1 and uncorrected P-distances were calculated and compared (Tamura et al. 2011). The model of sequence evolution was determined using the program JModelTest 2.1.2 (Darriba et al. 2012). GTR+I+G model was chosen by hierarchical likelihood ratio test (hLRT) and support was assessed with 1,000 rapid bootstraps. The NADH4 mitochondrial sequences were used to build maximum likelihood tree using the software RaXML GUI (Silvestro and Michalak 2012).

Colour descriptions and images are discussed based on the live specimen, BLT 076. Ventral scales were counted following Dowling (1951), however the tip of the terminal scute was excluded from the number of subcaudals. Dorsal scales were counted at approximately one head length posterior to the head, at mid-body (corresponding to half the number of ventral scales) and at approximately one head length anterior to the vent, respectively.

Based on the colour pattern, morphometric comparisons, and genetic analysis, the identity of the specimen BLT 076 was confirmed as Chrysopelea taprobanica. It was clearly separated from C. ornata (the only other member of the genus present in mainland India) based on the presence of an undivided pre-anal scale; and olive dorsal colour with black cross-bars. The specimen is a long, slender snake measuring 812 mm total length (589 mm snout-vent length and 223 mm tail length). It has 201 ventral scales; 106 subcaudal scales; and 17:17:15 dorsal scales. Snout broad and rostrum wide (5.0 mm). Internasals longer (3.5 mm) than broad (2.6 mm); prefrontals almost as long (4.3 mm) as wide (4.4 mm); frontal longer (8.8 mm) than wide (6.0 mm); supraocular single; a relatively large pair of parietals which are longer (9.3 mm) than wide (6.1 mm). The diameter of the eye (3.5 mm) is more than half its distance from the nostril (4.7 mm). Head length (23.7 mm), head width (9.0 mm), head height (7.9 mm), and body width (12.5 mm).

Eye in contact with the 4th, 5th and 6th supralabials; one preocular touching the third and fourth supralabials; preoculars are in contact with loreal and prefrontal in front; loreal in contact with the 2nd and 3rd supralabials; nasal divided. Two postocular scales, first in contact with the parietal and the second in contact with two pairs of temporals (Figure 2). The head and neck are with six horizontal black and yellow cross bars with the horizontal stripes continuing to the lateral side of the head. In total of 57 black bands are present along the body and 14 on the tail (Figure 3). Comparison of BLT 076 DNA sequences (Genbank accession number KM673289 and KM673290) from India with sequences of Chrysopelea taprobanica and C. ornata from Sri Lanka showed a 100% match between samples of C. taprobanica. The relationship of C. taprobanica from Sri Lanka and India is well-supported in the maximum likelihood tree (Figure 4).
Derniyagala (1955) noted that the dorsal scale counts (17:15:13) of the specimens of *Chrysopelea taprobanica* he collected (unknown vouchers) were different to those of the type series housed at the British Museum of Natural History ([17:19:15 in BMNH 1906.7.21.1 (1946.1.9.75), BMNH 1915.5.3.19-11 (1946.1.9.65-66)]. Our specimen (BLT 076) has a count of 17:17:15 dorsals, indicating variations in these counts. Our recorded number of subcaudals (106) falls lightly below previous records of 107-123 but the number of ventral scales (201) falls within the known range (198–214) (Smith 1943; Derniyagala 1955). The identical genetic sequences of *C. taprobanica* sample found in India and Sri Lanka suggest that they probably dispersed to India from Sri Lanka or vice versa in the recent past.

Five other species of dry zone arboreal snakes of Sri Lanka have also been reported from southern India in the past, viz. *Ahaetulla nasuta, Ahaetulla pulverulenta, Boiga trigonata, Dendrelaphis tristis,* and *Dryocalamus nympha*. The Seshachalam hill range where we found *Chrysopelea taprobanica* is part of the Eastern Ghats in southern Andhra Pradesh. The Eastern Ghats are a chain of broken hills in Peninsular India and compared to the Western Ghats they are less explored for their biodiversity (Das 2003). Given that the dry zones in southern peninsular India and Sri Lanka had land connections in the recent past (ca. 17,000 years ago) (Voris 2000), it is not surprising that a species thought to be endemic to the dry and intermediate zones of Sri Lanka was found in the Indian dry deciduous forests.

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Authors’ contribution statement: BG collected the specimen from field. BG and VD collected data from the specimen. SM collected data from museum specimens. VD, SM, BG and NVSP wrote the text and VD did the analysis.

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