

SHORT COMMUNICATIONS

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FOUND BUT FORGOTTEN: ON THE RECORDS, MISIDENTIFICATION, AND POTENTIAL REDISCOVERY OF THE RARE BROMO TENGGER SEMERU MOUNTAIN ENDEMIC SNAKE (SERPENTES: COLUBRIDAE: *Tetralepis fruhstorferi*)

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Tetralepis fruhstorferi is a snake currently only known to be endemic to a single active volcano complex of Bromo Tengger Semeru National Park in East Java of Indonesia. Its taxonomic identity and natural history are poorly known, as the most recent collection was in 1978 and limited to only a few collection records. We investigated two recently published surveys that have misidentified this species. This may indicate that *T. fruhstorferi* is still present in its type locality and our future surveys would focus on finding this species to assess its taxonomy and population status.

Keywords: East Java; Indonesia; rediscovery; topotype.

INTRODUCTION

Java is home to many endemic and enigmatic snakes that are of particular interest to herpetologists since the early Dutch colonial era (Boulenger, 1890; de Rooij, 1917; Kopstein, 1930). Though over a hundred species of snakes have been reported from Java (Uetz et al., 2021), much of the natural history of these taxa, their phylogenetic placement, the taxonomic identity of many museum specimens, and population status, especially from their

type locality (Kurniawan et al., 2021), are largely unknown. East Java is considered as the area with underestimated herpetofaunal diversity (Hodges, 1993; Kurniawan et al., 2021; Kusriani et al., 2021), holding several hidden and poorly known species, such as *Tetralepis fruhstorferi* Boettger, 1892, known as the Bluebelly Java snake or Fruhstorfer's Mountain snake. It is a monotypic genus, and its phylogenetic placement amongst snake families remains uncertain; thus, it is treated as incertae sedis within Colubridae (de Lang, 2017). It is only

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known from the single active volcanic area complex of Bromo Tengger Semeru National Park (TNBTS) (de Rooij, 1917). The species is categorized as vulnerable by IUCN due to its locality, which is adjacent to volcanic areas (Iskandar et al., 2012). Only a small number of specimens have been collected to date (see Table 1), with the most recent collection dating back to 1978 (Iskandar et al., 2012).

Only a few herpetofauna surveys were conducted around TNBTS regions, beginning just recently (see Septiadi et al., 2018; Erfanda et al., 2019). Two other, recent surveys (Tamam, 2014; Arroyan et al., 2020) have also assessed the herpetofaunal diversity of this area, and the results include a variety of species. Included in those survey results are species that we believe have been misidentified, and may represent *T. fruhstorferi*, which has not been seen over the past four decades. The first one was reported in Tamam (2014: p. 10) in which the species was erroneously identified as *Macrocalamus lateralis* Günther, 1864 (only distributed in Thailand and Peninsular Malaysia). The second survey, by Arroyan et al. (2020: p. 265), identified a snake as *Elapoidis fusca* Boie, 1827 (comparison briefly discussed below), which is likely sympatric with *T. fruhstorferi*. We investigated the identity of the species based on these previous findings, with notes on its natural history and current potential threats to their populations.

MATERIAL AND METHODS

The corresponding author of the first study confirmed that the specimen was not collected, but voucher photos were taken in-situ (Tamam, 2014: p. 10). Unfortunately, further confirmation about the taxonomic identity of the specimen could not be provided. The corresponding author of the second study (Arroyan et al., 2020) gave very informative natural history and morphological data toward the species identity; the data from the second study will be used for this report.

The survey (Arroyan et al., 2020) was conducted from February to March 2019 under the project entitled, “Biodiversitas Odonata, Lepidoptera, Herpetofauna, dan serangga pollinator (Hymenoptera) di Kawasan Taman Nasional Bromo Tengger Semeru,” mainly to observe the biodiversity of three major lakes and one resort (i.e., Ranu Darungan, Ranu Pani, Ranu Regulo, and Senduro) in TNBTS. Semeru Mountain is the highest mountain in Java located in TNBTS of East Java (3676 m a.s.l.) and is dominated by sub-montane and montane forests with a temperature range of 3 – 20°C (could reach subzero in extreme conditions).

The reported species in Arroyan et al. (2020) was found in an enclaved zone (a special area of which small rural communities of residents have settled, prior to the formal establishment of the national park), particularly

TABLE 1. Records of the Available *Tetralepis fruhstorferi* Specimens in Natural History Collections

Specimen number	Sample number	Sex	Date	Collector	Locality
SMF 17891 (Lectotype)	1	Female	1892	H. Fruhstorfer	“Tengger-Gebirge” = Indonesia, East Java, Bromo Tengger Semeru Mountain; elevation = 1200 m a.s.l.
ZMA.RENA.17675	1	—	May 1916	Museum Leiden	Indonesia, Java
RMNH.RENA.18628	1	Male	Unknown (presumably around the end of 19 th century)	J. H. F. Kohlbrugge	Indonesia, Java, Tosari
RMNH.RENA.46700	1	Female	Unknown (presumably around the end of 19 th century)	Dr. J. H. F. Kohlbrugge	Indonesia, Java, Tosari
RMNH.RENA.8765	1	—	May 1935	F. Kopstein	“Nongkejajar, Tengger gebergte” = Indonesia, East Java, Bromo Tengger Semeru Mountain, Nongkojajar
RMNH.RENA.36277	1	—	May 1935	F. Kopstein	“Nongkejajar, Tengger gebergte” = Indonesia, East Java, Bromo Tengger Semeru Mountain, Nongkojajar
NHMUK.1988.122	1	—	1988	—	Indonesia, East Java, Mt. Bromo; elevation: 2600 m a.s.l.
MZB.1669	2	Female	May 15 – 17, 1977	Gregory G. Hambali	Indonesia, East Java, Bromo Tengger Semeru Mountain, Semain stream near Cemoro Lawang; elevation: 2250 m a.s.l.
MZB.1670	1	Female	May 14, 1977	Gregory G. Hambali	Indonesia, East Java, Bromo Tengger Semeru Mountain, Cemoro Lawang; elevation: 1400 m a.s.l.

Abbreviations. SMF, Senckenberg Forschungsinstitut und Naturmuseum, Germany; ZMA.RENA/RMNH.RENA, Naturalis Biodiversity Center — Nationaal Natuurhistorisch Museum, Leiden, Netherlands; NHMUK, Natural History Museum, London, United Kingdom; MZB, Museum Zoologicum Bogoriense — BRIN, Bogor, Indonesia.

around the Ranu Pani Lake. The species was photographed *ex situ* and immediately released back to their encountered habitats. To further confirm the species identity, we follow the original description (Boettger, 1892) and other literature (Boulenger, 1893; de Rooij, 1917; de Lang, 2017). The morphology of the head was only observed based on the right side. The approximate total length was estimated using the digital scaling function in ImageJ v. 1.4.7 software (Rueden et al., 2017). For further comparisons, we also obtained morphological data from specimens housed in the Museum Zoologicum Bogoriense (MZB) — BRIN, Cibinong, Indonesia, and provided the availability of specimens housed in other institutional museums (Table 1).

RESULTS AND DISCUSSION

External morphology (Fig. 1). We confirmed the identity of the species in Arroyan et al. (2020) as *Tetralapis fruhstorferi* based on the following characters (after Boettger, 1892; Boulenger, 1893; de Rooij, 1917; de Lang, 2017): head indistinct from neck; small eye, rounded pupil; rounded body covered with smooth scales; rounded ventrals; anal plate divided; and divided subcaudals (Fig. 1A, C, D). Head scalation showed large nasals, nasal shield undivided; one loreal; 2 preoculars (preocular absent in *Elapoidis fusca*); 2 postoculars; large supraocular, three times longer than wider, twice as large as its eye diameter (smaller supraoculars, two times longer than wider, similar length as its eye diameter in *E. fusca*); four upper labials (six upper labials in *E. fusca*), third contacting orbit, very long in fourth; five lower labials in contact with chin-shields; both anterior and posterior temporals fragmented into minute scales (Fig. 1B, C). Coloration on dorsum dark reddish-brown, with dark vertebral line; ventrum reddish-grey faded in the lower part, with longitudinal black spot prominent in lower part (yellow ventrum in *E. fusca*) (Fig. 1). Sex determination, morphometrical measurements, and scales count were not taken during the survey, but the total length was 37.63 cm.

We found that this individual has two smalls grooved preoculars (Fig. 1B) similar to three other *T. fruhstorferi* specimens: MZB.1669 (corresponds to two specimens; Field No. 5687) and MZB.1770 (Fig. 2). This contrasts to a single large preocular, as stated in the original description and previous literature (Boettger, 1892; Boulenger, 1893; de Rooij, 1917; de Lang, 2017). A brief description based on four available specimens (RMNH.RENA.18628, RMNH.RENA.46700, RMNH.RENA.8765, and RMNH.RENA.36277; Table 1) observed by de Lang (2017) showed a single large preocular, similar to the

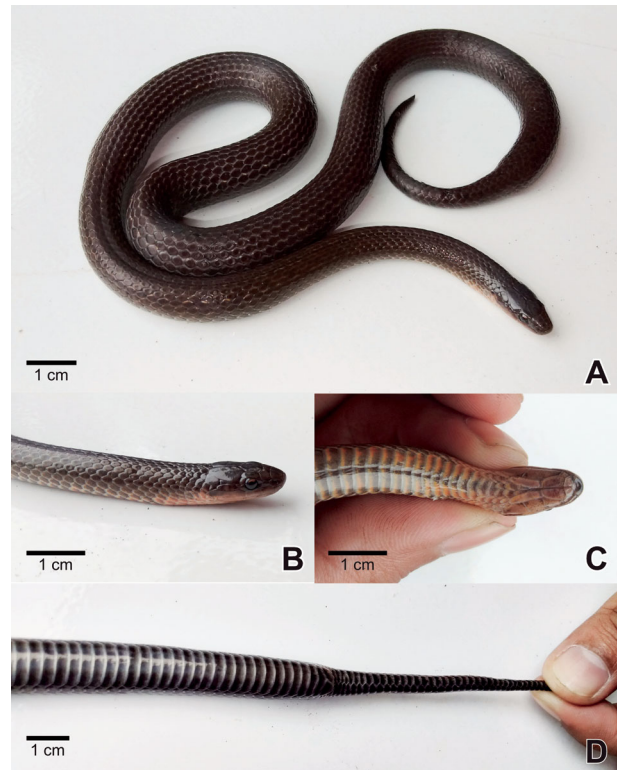


Fig. 1. *Tetralapis fruhstorferi* from Bromo Tengger Semeru mountain in life showing: A, dorsolateral view of whole body; B, dorsolateral view of anterior body part; C, ventral view of anterior body; D, ventral view of posterior body part. Photographs by M. R. Idrus.

original description and the previous literature aforementioned. More specimens need to be observed to confirm if this difference in scalation is a scale aberration in both Arroyan et al. (2014) individual and MZB specimens or if populations of *T. fruhstorferi* harbor intraspecific variation of the preocular scales.

Habitat and natural history. This individual was found in the slightly steep embankment of the Ranu Pani Lake (8°0'39.29" S 112°56'45" E; Fig. 3A), particularly coming from the shrubs, with a recorded elevation of 2114 m a.s.l. It fastly cruised across a pile of freshly mowed tall grass towards a nearby lake. The snake exhibited passive behavior and slow movement during handling and observations. The snake was encountered in the early morning at 7:00 a.m. It was found on 13 February 2020 during the late rainy season.

Previous records (Table 1) showed that most of the collected specimens were originated from the western side of the mountain (Tosari, Nongkojajar, Cemoro Lawang, Bromo mountain) near the adjacent streams. Arroyan et al. (2020) findings reveal that the species range is extended up to the central part of the mountain



Fig. 2. *Tetralepis fruhstorferi* housed in Museum Zoologicum Bogoriense (MZB) – BRIN, Bogor, Indonesia. Note that MZB.1669 with Field No. 5687 corresponds to two female specimens (left and middle). Photographs by L. Septiadi.

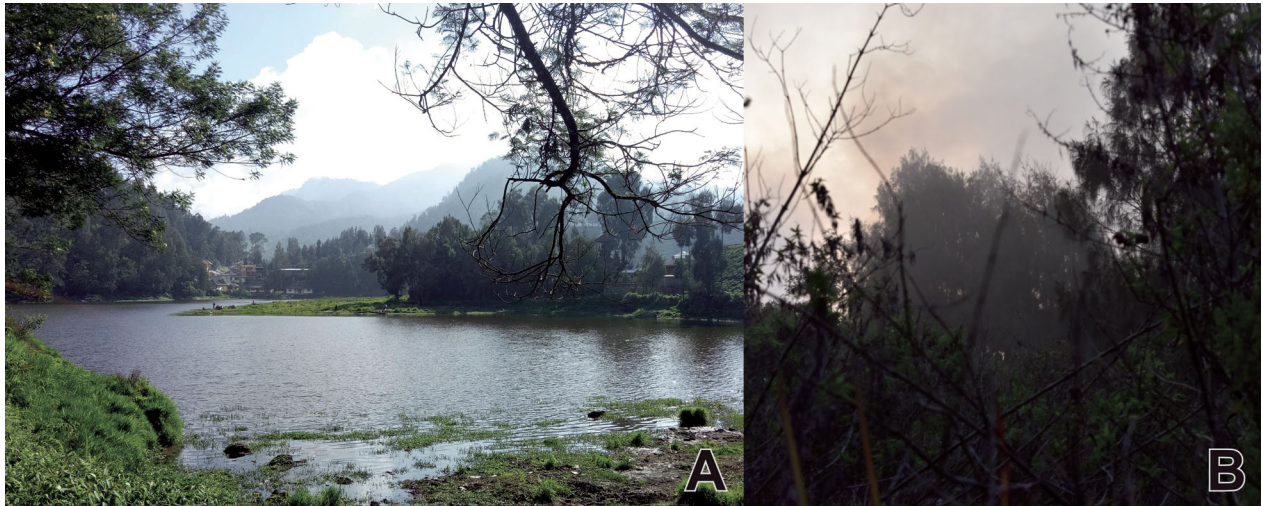


Fig. 3. View of habitat of *Tetralepis fruhstorferi* found in Ranu Pani (A), and forest fire near the lake recorded in 2018 (B). Photographs by N. Millah (A) and L. Septiadi (B).

(i.e., Ranu Pani, between Bromo and Semeru volcanoes). Based on these collection records, this species—while perhaps not semi-aquatic, may rely on bodies of water (lakes and streams). The records of this species are from high elevation (1200 – 2600 m a.s.l.; Table 1), but given the paucity of observed and collected specimens, this does

not rule out the possibility of the existence of populations up to the edge of montane forests of Semeru mountain (Kalimati, 2, 500 m a.s.l.), as allegedly seen by hikers and TNBTS park ranger. Although considered as rare species, reports from the locals reveal that it is not uncommon to be found within the area of Ranu Pani Lake,

as it has been found 3 times (by the same person) in 2013 – 2015 during rainy season (Fig. 4). The species may be terrestrial or semi-fossorial since no high trees or cliffs were observed around the lake, which is only dominated by the tall grass and shrub; Tamam (2014) found the individual perched on the shrub branches and Iskandar et al. (2012) reported that this species is semi-fossorial. The slow-moving behavior was in accord with the previous report (Hodges, 1993; de Lang, 2017), but our observations prove that it is capable of moving fast across harsh terrain. Hodges (1993) mentioned that the species was seen in the daylight, suggesting it has diurnal activity patterns. In contrast, Iskandar et al. (2012) stated that it was caught early at night, suggesting the species as crepuscular or nocturnal. In addition to Arroyan et al. (2020) findings, the species is mostly observed during twilight periods. In light of these reports, this species may also be cathemeral, being active at irregular patterns at any time of day or night. Since the individual was found in the late rainy season, it seems to prefer a cool and seasonal climate.

Threats and future recommendations. Though the conservation status of the species has been assessed (Iskandar et al., 2012), other threats in TNBTS, such as habitat degradation (Sawitri and Takandjandji, 2012; Roedjinandari, 2016), agriculture expansion, intensive tourist activity, and forest fires (Fig. 3B), could not be ruled out. Still, comprehensive information regarding their systematics, natural history, population status, and range distribution remains unknown, which must be a focus for future research. The participation of residents in Ranu Pani, TNBTS officers, and hikers/visitors is also critical to ensure the conservation of this rare endemic species. Perhaps, assigning this currently known endemic snake as the flagship species could draw the public's attention and serves as an initial step to further alleviate the research and conservation efforts in this area.

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Fig. 4. A resident displaying *Tetralepis fruhstorferi* caught from the area of Ranu Pani Lake, Bromo Tengger Semeru mountain, recorded in 2013 (rainy season). Photo courtesy of R. Ardiansyah.

to the synergistic effort of herpetologists from East Java and the herpetology-related study club from Malang which have kindly shared their precious data. Lastly, we would like to pay our gratitude and respect to Muhibbudin Abdillah (founder of “Kutrik” Study Club and “Varanus” Study Club of Universitas Islam Negeri Sunan Ampel-Surabaya, Indonesia), who, although no longer with us, continues to inspire by his spirit and persistence.

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