

New locality records of the Mizo rain snake *Smithophis atemporalis* with meristic and morphometric data based on specimen collection and a citizen science initiative

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INTRODUCTION

Knowledge of the geographical distribution of a species is an important aspect in biodiversity conservation and management (van Maes et al., 2015), and it is among the parameters used to assess conservation threat status (IUCN Standards and Petitions Committee, 2019). Global scale issues such as land-use change and climate change have increased the need to map and predict the distribution of a species. However, species distribution modelling requires many years of field work in gathering information and has proved to be very expensive (Feldman et al., 2021). Citizen science, the cooperation between scientific experts and non-experts, is a rapidly expanding tool in the field of biodiversity documentation (Dickinson et al., 2012). Though the credibility and quality of data from citizen science poses a challenge (Tulloch et al., 2013; Cooper et al., 2014), citizen science programmes have been implemented on a wide range of taxa (van Strien et al., 2013). Social media, especially Facebook can be a useful platform for citizen science due to the high number of users and ease of interaction (Liberatore et al., 2018).

Snakes of the genus *Smithophis* Giri et al. (2019) are semi-aquatic, natricine colubrids distributed from north-east India through north-east Myanmar to south-west China (Giri et al., 2019; Vogel et al., 2020; Das et al., 2020). Giri et al. (2019) erected the genus to accommodate *Smithophis bicolor* (Blyth, 1854) (previously *Rhabdops bicolor*) and a new species *Smithophis atemporalis* Giri et al. (2019). Recently, two more species viz. *S. linearis* Vogel et al. (2020) (from south-western China and north-east Myanmar) and *Smithophis arunachalensis* Das et al. (2020) (from Arunachal

state, north-east India) were added to the genus (Vogel et al., 2020; Das et al., 2020). The genus is characterised by having single prefrontal and internasal scales (Giri et al., 2019; Vogel et al., 2020). Little information is available on the distribution and natural history of these species (Giri et al., 2019; Vogel et al., 2020; Das et al., 2020). *Smithophis atemporalis* differs markedly from its congeners in lacking temporal scales. It is most similar to *S. arunachalensis* – both have a distinct lateral zigzag pattern with inverted 'V' shapes of the ventral colour extending dorsolaterally. However, *S. atemporalis* can be distinguished from *S. arunachalensis* in having a yellow to off-white venter in life (vs. bright yellow in *S. arunachalensis*). As of now, *S. atemporalis* is known with certainty only from Mizoram University campus (type locality) and its adjoining areas in Aizawl and Durtlang, and Bawngva village in Mamit district of Mizoram (Giri et al., 2019; Remruatpuui et al., 2020); an area of about 144 km² within the state of Mizoram. Herein, we map the distribution of *S. atemporalis* based on previous records, new voucher specimens and a citizen science initiative.

METHODS & MATERIALS

Specimen collection, preservation and morphological data

Specimens of *S. atemporalis* were collected from Mizoram state, India under a research and collection permit issued by the Department of Environment, Forest and Climate Change, Government of Mizoram. Specimens were preserved in 10 % formalin and later transferred to 70 % ethanol for longer preservation. Specimens were deposited at the Herpetological collections of the Systematics and Toxicology Laboratory (MZUHC), Department of Zoology, Mizoram

University, Mizoram, India. The following measurements and counts were taken following Giri et al. (2019): Tail length (TaL), Snout-vent length (SVL), Total length (TL), Ventral scales (VEN), Subcaudal scale (SC), Midbody scale rows (MSR), Supralabials (SL), Supralabials touching eye (SLTe), infralabials (IL), Temporals (T), Preocular (PreOc), Supraocular (SOc), Postocular (PosOc), Dark 'V's on body, Dark bands on tail. Bilateral scale counts (except subcaudal scales, which was counted only on the left side) separated by a comma are given in left, right order.

Citizen Science

For this purpose, we used the Facebook group "Zoram Rul Chanchin" as a platform. The group was created in October 2011, and at the time of writing there are about 2,950 members. Most of the authors of this study are administrators or moderators of this group. The activity in the group mainly involves users posting snake photos to obtain identifications. The unique colour pattern of *S. atemporalis* makes it a suitable candidate for mapping species distribution through citizen science as it can be easily identified from photographs. Members of the Facebook group who posted images of *S. atemporalis* were asked to provide locations for their sightings. The approximate geocoordinates of the specimens were recorded from Google Earth.

Determination of range

Geospatial data from the *S. atemporalis* records of previous studies and the current investigation were analysed using the QGIS open-source program. The extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites (IUCN, 2001). Range was determined using the minimum convex polygon method (Mohr, 1947; IUCN, 2001), defined as the smallest polygon in which none of the internal angles exceed 180 degrees and containing all the species records (IUCN, 2001). The area of this polygon was calculated by the QGIS software. This minimum convex polygon method is usually used to determine the home range size (Hayne, 1949; Harris et al., 1990) but more recently has been adapted to determine the extent of occurrence of a species (IUCN, 2001; Klemann & Vieira, 2013).

RESULTS & DISCUSSION

In this study, we collected six specimens of *S. atemporalis* from different localities within the state of Mizoram, India. These specimens generally agreed with the original descriptions of *S. atemporalis* (see details of measurements and counts in Table 1) except for the presence of two postocular scales on the left side of one individual (MZUHC 779, Fig. 1B). However, the second postocular is very small and seems to be an anomaly. Two of the voucher specimens were collected from within the known distribution of the species, whereas four specimens were collected from outside the known locality of the species.

Although several photos of *S. atemporalis* were posted in the Facebook group (even before the species was described), upon enquiry only twenty-three users replied mentioning

Table 1. Meristic and morphometric data for examined specimens of *Smithophis atemporalis* (N=5)

Voucher number	MZUHC 1145	MZUHC 22	MZUHC 779	MZUHC 36	MZUHC 776	MZUHC 786
Sex	M	M	F	M	M	M
TaL (mm)	137*	136	64*	138	139	101
SVL (mm)	422	393	392	386	421	320
TL (mm)	559*	529	456*	524	560	421
VEN	198	200	198	200	200	191
SC	70*	77	70*	85	76	77
MSR	17	17	17	17	17	17
SL	5,5	5,5	5,5	5,5	5,5	5,5
SLTe	3rd,3rd	3rd,3rd	3rd,3rd	3rd,3rd	3rd,3rd	3rd,3rd
IL	6,7	5,5	6,6	5,5	7,7	6,6
T	0,0	0,0	0,0	0,0	0,0	0,0
PreOc	1,1	1,1	1,1	1,1	1,1	1,1
SOc	1,1	1,1	1,1	1,1	1,1	1,1
PosOc	1,1	1,1	2,1	1,1	1,1	1,1
Dark 'V's on body	34,35	35,34	35,35	39,38	35,37	33,32
Dark bands on tail	15,15*	18,16	15,15*	20,19	18,18	13,14

*indicates measure/count incomplete because end of tail missing

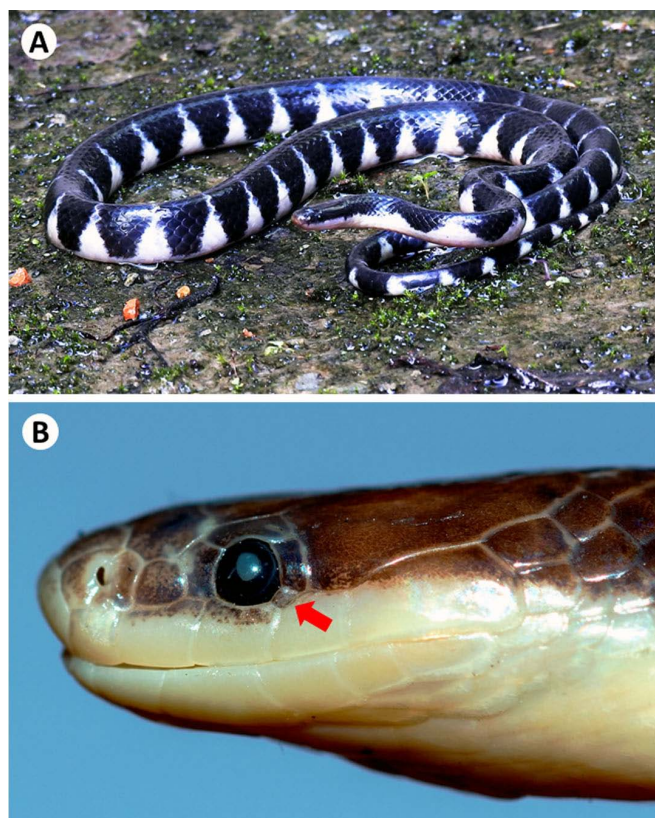


Figure 1. *Smithophis atemporalis* - **A.** Live photo of from Aizawl, Mizoram (unvouchered specimen), **B.** Lateral aspect of the left side of head in MZUHC 779 showing an anomalous second postocular scale (arrow)

actual localities where the photographs were taken. Images with locality data were posted between March 2012 to September 2020. Most of these were from outside the known distribution of the species.

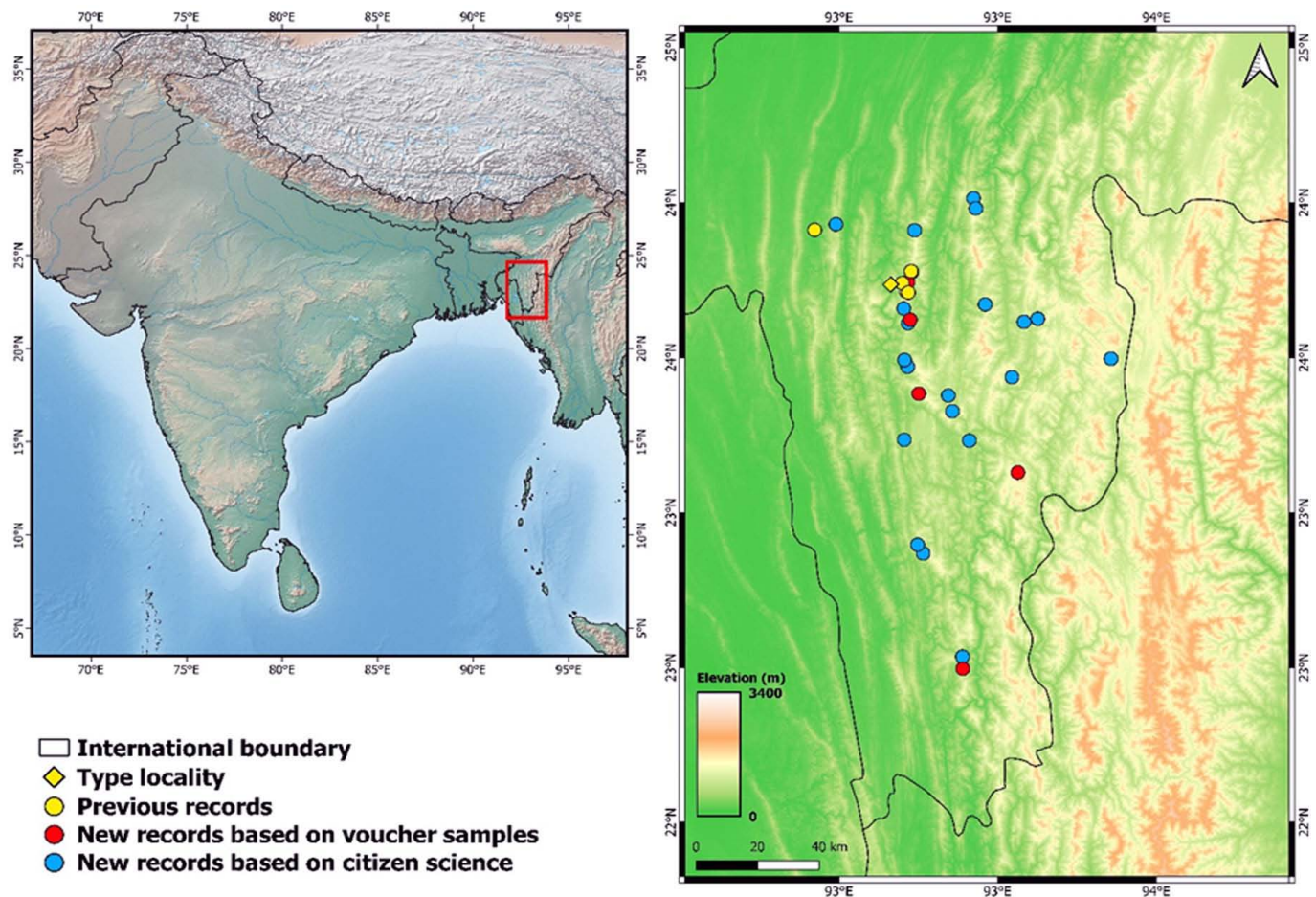


Figure 2. Known localities of *Smithophis atemporalis* based on previous records and present study

The present study adds valuable information to our knowledge of this little-known species and significantly increases its known range by approximately 34 km in a north-easterly direction, 68 km towards the east, 70 km in a south-easterly direction, 126 km towards the south and 80 km towards the west (Fig. 2). This increases the known area of this species from 144 km² to 8,196 km². From the present known records of the species, its distribution possibly extends to Tripura and Manipur states in India as it had been recorded from Bawngva village (ca. 9 km from Mizoram-Tripura border) and Darlawn village (ca. 11 km from Mizoram-Manipur border). Since photos and voucher specimens of *S. atemporalis* are available from near the Indo-Myanmar border (Champhai town and North Vanlaiphai village), the species is likely to be found in the adjacent Chin hills of Myanmar.

Although the species is not rare within Mizoram, little information is available on its distribution and natural history and the species is likely to qualify as Data Deficient based on criteria for the Red List of Threatened Species (IUCN Standards and Petitions Committee 2019).

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