Range and elevation extension for the Yunnan Water Snake, *Trimerodytes yunnanensis* (Rao & Yang, 1998) (Serpentes, Colubridae), from Thailand and some notes on its natural history

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Abstract

*Trimerodytes yunnanensis* (Rao & Yang, 1998), Mountain Water Snake, mainly occurs at elevations of more than 1,000 m above sea level (a.s.l.). We provide both a range extension to Lampang, Thailand, and the lowest known elevation record for this species at 400 m a.s.l. This record is also the southernmost known occurrence of *T. yunnanensis* and the genus as a whole. In addition, a morphological description of the juvenile, ecological notes in the field, and feeding habits in captivity are provided.

Keywords

Ecological notes, Lampang, lowland habitat, reptiles

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Introduction

The snake genus *Trimerodytes* Cope, 1895 belongs to the family Colubridae and consists of six species (Uetz 2021), *T. aequifasciatus* (Barbour, 1908), *T. annularis* (Hallowell, 1856), *T. balleatus* Cope, 1895, *T. percarnatus* (Boulenger, 1899), *T. yapingi* (Gou, Zhu & Liu, 2019), and *T. yunnanensis* (Rao & Yang, 1998). *Trimerodytes* are aquatic snakes, commonly found near streams, ponds, and lakes, and generally feed on fish (Pauwels et al. 2009; Das 2010; Chan-ard et al. 2015; Das 2018). *Trimerodytes* is endemic to East and Southeast Asia and is generally recognized as a mountain species because they occur at higher altitudes (Rao and Yang 1998; Pauwels et al. 2009; Le et al. 2015).

*Trimerodytes yunnanensis* was originally described from southern China by Rao and Yang (1998) in the genus *Sinonatrix* Rossman & Eberle, 1977. However, after re-examining morphological characters and its phylogenetic relationships, Ren et al. (2019) placed this species in the genus *Trimerodytes*. The distribution of *T. yunnanensis* is fragmented, and it has been reported from southern China, Thailand (Chiang Rai Province) (Pauwels et al. 2009), Vietnam (Son La Province) (Le et al. 2015), and northern Myanmar (Kachin state) (Wogan et al. 2008). *Trimerodytes yunnanensis* strictly inhabits the vicinity of aquatic habitats in montane forests ranging from 900 to 2000 m a.s.l. (Rao and Yang, 1998; Pauwels et al. 2009; Le et al. 2015).

During a field survey in August 2019 in Lampang Province, northern Thailand, a juvenile specimen of *T. yunnanensis* was found, which provides the first sighting...
of this species in a lowland habitat. Here, we provide a morphological description and compare this specimen to others from Thailand and with reports in the literature. We also provide ecological notes in the field and feeding habits in captivity.

Methods

The specimen was found in a pond near a village in Mueang Pan District, Lampang Province, Thailand. A photograph of the snake was captured in the field. We caught the specimen using a dip net and carefully transferred it to a plastic box. In the laboratory, the snake was kept at room temperature (25 °C). As a semiaquatic habitat, a 20-inch glass tank was set up where rocks and gravel separated the wet and dry areas (70/30 wet and dry parts, respectively). The snake was kept in the laboratory for a year to study its feeding patterns before the snake died naturally. The voucher specimen was preserved in 70% ethanol and deposited in the collection of the Zoological Museum Kasetsart University (ZMKU), Bangkok, Thailand. The meristics and scalations were examined for identification following Chan-ard et al. (2015). The scalations were recorded including the number of dorsal and ventral scales, number of subcaudal scales (pairs), the number of supralabial and infralabial scales. Furthermore, the number of maxillary teeth and the number of X-markings on the trunk and tail were noted. External morphology of the snake was compared to the specimens recorded in Thailand, collection numbers QSMI 544 and QSMI 1326 which were deposited at herpetological collections of the Queen Saovabha Memorial Institute, Thai Red Cross, Bangkok. Coordinates were taken using a handheld Garmin GPSMAP 60CSx. Animal care and use protocol approval number U1-07249-2560 permits to PD. Geographic distributions were plotted using the online mapping application SimpleMappr (Shorthouse 2022).

Results

*Trimerodytes yunnanensis* (Rao & Yang, 1998)

Figure 1

**New record.** THAILAND – Lampang • Mueang Pan District, Chae Son Subdistrict; 18.8308°N, 099.4850°E; 400 m a.s.l.; 14. IIX. 2019; Wu Taksintum leg.; dipnet; 1 ♀ (juvenile), ZMKU_PD_0027.

**Identification.** Morphology-based identification was compared to the original description (Rao and Yang 1998). The specimen measured 33.9 cm in snout–vent length and 43.4 cm in total length (measurements made after the snake was deceased) and was determined to be a female by using probing technique (Laszlo 1975) when the specimen was first collected.

Body stout, cylindrical; head elongate but not distinct from neck; muchal groove distinct; internasal narrower than prefrontal; head scalation on the left side with 1 loreal; 1 preocular; 4 postoculators; 9 supralabials with the fourth and fifth contacting orbit, the seventh largest; 10 infralabials; 31 maxillary teeth; dorsal scale rows 19-19-17 with keeled except for the lowest three rows; 158 ventral scales; divided cloacal scale; 76 pairs of subcaudal scales. The dorsal reddish-brown with 42 transverse bands, having 43 X-marks on lateral sides along the body and tail. Ventral cream; lower branch of X-markings appearing along the lateral edges of the ventral part, gradually linked medially along the venter and producing a checkered pattern towards the tail.

Based on the scalation, our specimen falls within the range of variation and coloration pattern reported for the species by Rao & Yang (1998). We compared our specimen to the specimens recorded in Thailand (Pauwels et al. 2009) and the original description (Rao and Yang 1998) (Table 1). The distinctive X-mark pattern in *Trimerodytes* species is shared between *T. aequifasciata* and *T. yunnanensis*. However, our specimen clearly differs from *T. aequifasciata* in having 31–35 maxillary teeth (vs. 23–28 maxillary teeth in *T. aequifasciata*) and 156–165 ventral scales (vs. 142–154 ventral scales).

**Distribution.** The holotype and paratypes of this species were collected from Yunnan Province, southern China during 1960–1991 (holotype KIZ 75I0191, adult male). All specimens were collected from high-altitude habitats between approximately 900 and 2,000 m a.s.l. from Jingdong, Menglian, Jinggu, Yongde, Lufeng, and Yunnan (Rao and Yang 1998).

Records from Myanmar were first mentioned by Wogan et al. (2008) from Kachin State, and the second report was from Putao District, Kachin State (Ren et al. 2019). However, these two records from Myanmar lacked details about the habitat or morphology of the specimens.

In Vietnam, *T. yunnanensis* were recorded for the first time by Le et al. (2015) who found three specimens in secondary forests in northwestern Vietnam. One adult male and one adult female were collected near Ta Lo San village, Sen Thuong Commune, in a buffer zone of the Muong Nature Reserve at an elevation of 1,097 m a.s.l. In addition, one adult female was collected in Sop Cop Nature Reserve, Son La Province, at an elevation of 990 m a.s.l.

In Thailand, Pauwels et al. (2009) reported the first record of *T. yunnanensis* was from a bamboo forest at approximately 1,200 m a.s.l. in Wiang Pa Pao District, Chiang Rai Province. A second specimen was discovered at the same location in April 2010, but the information about its habitat was not recorded (Tawan T, per. comm. January, 2022). Both specimens were deposited at Queen Saovabha Memorial Institute (QSMI). Moreover, photographic records from Chiang Mai and Nan Province were taken at the elevation approximately 800–1,200 m a.s.l (iNaturalist 2022).

Our specimen, the third found in Thailand, was found on 14 August 2019 at 8.30 pm. The snake was encountered in a pond surrounded by shrubs and aquatic plants near the road in Mueang Pan District, Lampang.
Figure 1. Trimerodytes yunnanensis from Mueang Pan District, Lampang province (ZMKU_PD_0027). A. specimen in life. B. dorsal and ventral views of the preserved specimen. C. side of the head. D. dorsal and ventral views of the head.

Table 1. Comparison of characters between Trimerodytes yunnanensis in this study and previously recorded specimens.

| Recorded specimens from Thailand | The original description of species |
|----------------------------------|------------------------------------|
| Reference                        | Present study | Pauwels et al. 2009 | Unpublished data | Rao and Yang 1998 |
| Number of observed specimens     | 1            | 1                   | 1               | 15              | 13              | 6               |
| Sex                              | Female       | Female              | Male            | Male            | Female          | Male and female |
| Stage                            | Juvenile     | Adult               | Adult           | Adult           | Adult           | Juvenile        |
| SVL (cm)                         | 33.9         | 75.0                | 62.1            | 4.40–4.98× as that of tail | 4.42–4.83× as that of tail | Not provided |
| Total length (cm)                | 43.4         | 98.5                | 83.7            | Not provided    | Not provided    | Not provided    |
| Dorsal scales                    | 19–19–17     | 19–19–17            | 19–19–17        | 19–19–17        | 19–19–17        | 19–19–17        |
| Ventral scales                   | 158          | 155                 | 159             | 159–165         | 157–161         | 156–165         |
| Subcaudal (pairs)                | 76           | 72                  | 73              | 68–75           | 61–71           | 66–77           |
| Supralabial scales               | 9/9          | 9/8                 | 9/9             | 9–10            | 9–10            | 9–10            |
| Infralabial scales               | 10           | 12                  | 10              | 10              | 10              | 10              |
| Maxillary teeth                  | 31           | Not provided        | Not provided    | 31–35           | 31–35           | 31–35           |
| X-Marking body + tail            | 29 + 13      | 38 in total         | 27 + 21         | 21–28 + 11–17   | 21–28 + 11–17   | 21–28 + 11–17   |
Province, and this record extends the geographic range by 47 km south of the previously known record and by 400 km south of the type locality in China (Fig. 2). The pond where we collected our specimen was at 400 m a.s.l. Our new record is from the lowest known elevation for this species. The vegetation around the pond was predominantly covered by grassland and mixed deciduous forest.

**Feeding habits in captivity.** The snake spent most of its time in the water and only went onto the rock for sunbathing. It was fed *ad libitum* with aquarium fish (small white carp, molly, and small goldfish) and tadpoles of *Microhyla mukhlesuri* Yaakob & Sukumaran, 2007. The snake aggressively foraged, and it commonly fed on prey underwater, except for the large prey, which was moved up to the rock before consumption. Sometimes, the snake held large prey above the water level for a while before eating it. Interestingly, the snake preferred small goldfish to other prey provided.

**Discussion**

Our morphological examination of the juvenile specimen does not show significant differences from the original

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**Figure 2.** Geographic distribution of Trimerodotes yunnanensis. A red star indicates the new record of *T. yunnanensis* from Mueang Pan District, Lampang province, Thailand, and black circles indicate previous records of *T. yunnanensis* from (1) China (Rao and Yang 1998), (2) Myanmar (Wogan et al. 2008; Ren et al. 2019), (3) Vietnam (Le et al. 2015) and (4) Thailand (Pauwels et al. 2009).
description. However, the specimen QSMI 544 from Chiang Rai exhibits a more infralabial scales (12) than our specimen (10) and the original description (10 or 11). Variation in sculation may occur among juveniles and adults (Thorpe 1975; Dohm and Garland 1993; Lindell et al. 1993).

There was a difference in the color pattern of the venter between our specimen and QSMI 544. Pauwels et al. (2009) described X-markings that present on left and right sides of specimen QSMI 544 as contacting each other on the ventrum and the subcaudal part. This pattern can also be found in recent specimens. However, the ventral band of recent specimen is wider than in QSMI 544, implying that our specimen was juvenile. The color pattern of our specimen is similar to the original description by Rao and Yang (1998) and to the Vietnamese specimens described by Le et al. (2015) in which the lower branches of X-markings terminate at lateral edges of the ventral scales and start contacting each other at one-third of the body length to the tail. The ventral blotches become denser posteriorly, toward the tail and make the subcaudals black in color.

*Trimerodutes yunnanensis* appears to be restricted to low-temperature water, especially in montane/submontane forests (Chan-ard et al. 2015; Das 2018). However, the altitude and characteristics of the habitat of this specimen were slightly different from the previous records. The pond where we found our specimen was only at 400 m elevation a.s.l., which is the lowest altitudinal record for this species. The holotype from China and the QSMI 544 specimen were from high altitudes, 2,000 m and 1,200 m a.s.l., respectively (Rao and Yang 1998; Pauwels et al. 2009).

In terms of habitat utilization, the first recorded specimen of *T. yunnanensis* in Thailand (QSMI 544) was found in a fast-flowing rocky stream in bamboo forest (Pauwels et al. 2009). However, our specimen was encountered in standing water with muddy substrates. Interestingly, Vietnamese specimens were found in trees near rocky streams in secondary forest (Le et al. 2015). Given the present observations, lower temperatures may not be a limiting factor for the distribution of *T. yunnanensis*, and the snakes may occupy a broader range of habitat types than previously known. Unfortunately, the habitat of the holotype was not recorded.

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Authors’ Contributions

Conceptualization: PD. Data curation: PD. Formal analysis: PD. Investigation: PD. Methodology: PD. Resources: WT. Visualization: PD. Writing – original draft: PD. Writing – review and editing: PD, WT.

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