REPTILES & AMPHIBIANS

Notes on Günther's Oriental Slender Snake (*Trachischium guentheri*) from the Himalayan Realm of North Sikkim, India

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Abstract.—The Indian Himalayan Region (IHR) is known for its biodiversity, yet it faces substantial threats from anthropogenic activities and climate change. Despite the ecological importance of the IHR, herpetofaunal studies, especially in the eastern Himalayan State of Sikkim, remain limited. We herein address aspects of natural history of a fossorial snake, Günther's Oriental Slender Snake (*Trachischium guentheri*) in North Sikkim. We encountered 25 snakes during field surveys from 30 September to 12 October 2023 in the Lachen region at elevations of 2,549–2,918 m asl. Responses of snakes to unusually high rainfall led to increased road mortality during the peak tourist season. In response, we propose two specialized structures, featuring elevated barriers and elaborate hollow, trapezoidal concrete slabs, to mitigate roadkills. We also emphasize the importance of monitoring to identify areas with high traffic where measures to mitigate road mortality should be employed.

The Indian Himalayan Region (IHR) is one of the planet's most biodiverse areas (Mittermeier et al. 1999). Despite its considerable ecological, hydrological, and biological significance, the mountain ecosystems in the IHR face severe threats from increasing global temperatures and anthropogenic activities (Acharya et al. 2012). The impact of climate change is highly visible in the Himalayan Region, where the biophysical environment is defined by a complex network of snow-covered mountains and severe drainage, temperature, and precipitation cycles (Sharma et al. 2009). Poikilothermic animals are particularly susceptible to climate change in the IHR (Harikrishnan et al. 2022). At present, 280 herpetofaunal species have been reported from the IHR (Deuti 2018; Varadaraju and Deepak 2018). However, information on the herpetofauna from the eastern Himalayan hill state of Sikkim is largely limited to a relatively few general faunal accounts (Boulenger 1890; Smith 1931, 1935, 1943; Ganguli-Lachungpa 1998; Jha and Thapa 2002; Chettri et al. 2011).

Three of the 71 species of snakes that have been reported in Sikkim are in the fossorial snake genus *Trachischium*: *T. fuscum*, *T. tenuiceps,* and *T. guentheri* (Chettri et al. 2011). *Trachischium guentheri* Boulenger 1890, which is listed as Vulnerable on the IUCN Red List (Ghosh 2021), is distributed in India, Nepal, Bhutan, and Tibet (Smith 1943; Bauer and Günther 1992; Wallach 1988; Shah and Tiwari 2004; Wang et al. 2019; Uetz et al. 2024). In India, it has been recorded from Sikkim and West Bengal at elevations of 900–2,100 m (Smith 1943). In Sikkim the species was reported from the Lachen and Lachung Valleys by Chettri et al. (2009), who reported frequent encounters with this species in North Sikkim, where investigations of this species have been limited due to factors that include its secretive behavior, short activity period, and its occurrence in remote riverine habitats (Chettri et al. 2009). Herein we provide updated insights into the current status of this high-elevation snake.

Methods

The eastern Himalayas, encompassing Sikkim and the northeastern Indian states, stands as one of the world's biodiversity hotspots (Mittermeier et al. 1999). It is situated at the convergence of multiple biogeographic realms (Palearctic, Oriental) and regions (Indo-Malayan, Indochinese). Sikkim, positioned within the Himalayan Biogeographic Zone of India (Rodgers and Panwar 1988), boasts unparalleled biodiversity that can be attributed to its strategic geographical placement, wide elevational range (300–8,580 m asl), and diverse climatic conditions. The area, which is in the Himalayan Biogeographic Zone and the Central Himalayan Biotic Province, has about nine forest types (Champion and Seth 1968; Rodgers and Panwar 1988). The study area near Lachen in North Sikkim extends from 27.727031, 27.721247 to 88.549369, 88.556778. The vegetation of the area is predominantly broadleaf alpine forest and coniferous forest (Champion and Seth 1968; Chettri et al. 2009). The region experiences

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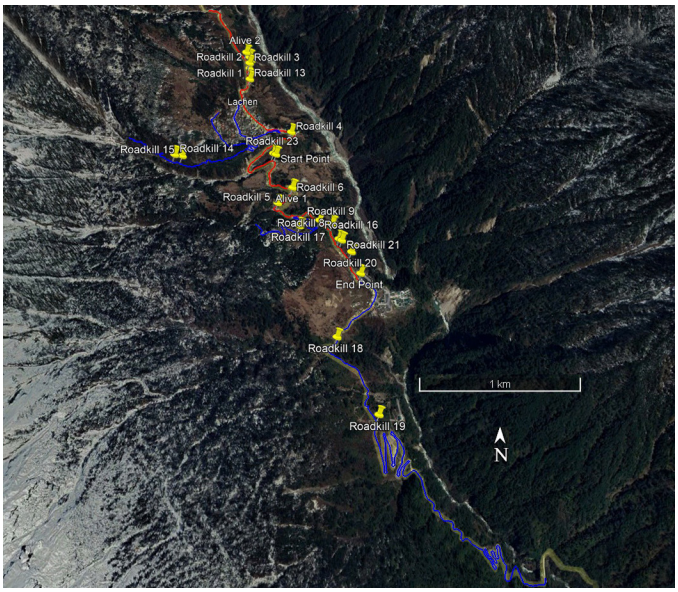

Figure 1. The study area, primary (red) and opportunistic (purple) survey paths, and encounter locations (yellow symbols) in and around Lachen, North Sikkim, India.

a temperate climate, characterized by average monthly temperatures ranging from 3.7–13.6 °C, annual rainfall fluctuates between 1,300–1,500 mm, reaching its peak in July, and relative humidity typically hovers around 70–80% (Chettri et al. 2009).

We conducted visual encounter surveys for reptiles from 30 September to 12 October 2023, surveying a 4.25-km stretch of the same road from the northernmost bridge of Lachen to Chaten Town every day at 1900–2100 h, during which we noted the number of roadkilled *T. guntheri*. In addition, we opportunistically collected data along 10.69 km of treks and roads (Fig. 1). All individuals, whether roadkilled or alive, were photographed in the field, GPS coordinates were collected for each encounter using a handheld GPS device (Garmin Etrex-30), and each locality and immediate habitat from each roadkill were recorded. Roadkills were removed from the road to avoid recounting.

Results and Discussion

The 25 snakes that were recorded during the survey (Figs. 2–4; Table 1) matched the description in Smith (1943). The live juvenile (Fig. 3), however, was not photographed during the survey but was captured in 2019 in Lava, in northern West Bengal.

Elevations of encounters ranged from 2,549 to 2,918 m asl, temperature from 8 to 20 °C during the survey period, and all snakes were found on the road and trails either during or immediately after rain. Vegetation along both sides of the road was predominantly comprised of broadleaf temperate forest, featuring patches of *Rhododendron* and bamboo, with highland shrubs and coniferous forest on the slopes (Fig. 5).

The first live individual encountered on 1 October 2023 and the second on 2 October 2023 were observed for over an hour. On the night of 1 October, the snake travelled nearly 8 m parallel to the road and, on several occasions, attempted to enter the moist, loose humus-rich soil along the road, pushing its snout into the soil while using the conical tip of its tail as an anchor. Despite multiple attempts, the snake quickly emerged each time, as the soil was saturated with water. During a similar episode in the early morning of 2 October 2023, we initially assumed that the snake's activity was related to foraging. However, after continuous observation, we determined that the incessant rainfall had saturated the soil, prompting the snakes to emerge and seek drier areas.

Chettri et al. (2009) recorded peak encounter rates during June–July, when three persons found 26 snakes in half an hour (17 snakes/hour) in Lachen Valley. They observed a decline in sightings during October–November and February–March, with none observed in December–January. In the current study, the high numbers in October could be associated with the unusually heavy rainfall. October is the onset of the peak tourist season in North Sikkim, and Lachen serves as a crucial stopover for accessing renowned tourist destinations such as Gurudongmar Lake and Thangu. Consequently, a notable increase in nocturnal and early-morning vehicular activity led to the high road mortality. Ghosh (2021) indicated that this species is locally common in both Sikkim and Darjeeling and suggested that the population in Sikkim was stable, although at present the area of occupancy is less than 20,000 km^2 and the population seems to be severely fragmented.

Snakes in the genus *Trachischium* are poorly studied, presumably attributable in large part to their fossorial habits. Because fossorial environments are largely considered more stable and less prone to above-ground environmental fluctuations, studies have demonstrated that snake lineages inhabiting these environments evolve into new species at a slower pace and face higher extinction rates when compared to their above-ground counterparts (Bars-Closel et al. 2017; Cyriac and Kodandaramaiah 2018). Hence, this fossorial snake inhabiting high elevations could serve as an ideal model for investigating effects of climate change. This phenomenon is widespread in the Himalayas, where temperatures are increasing at an annual rate typically surpassing 0.01 °C and are exhibiting unusual periodic variations (Sharma et al. 2009).

Previous records (Chettri et al. 2009, 2010, 2011) and our observations indicate that this semi-fossorial species occurs predominantly in temperate montane forests on rocky slopes. Ghosh (2021) noted that the species also is found in disrupted environments such as crop fields and dung heaps. Although thorough studies are required to understand the behavior and natural history of this elusive snake, based on current information regarding its status and the frequency of roadkills, mitigation measures are in order. Once the high

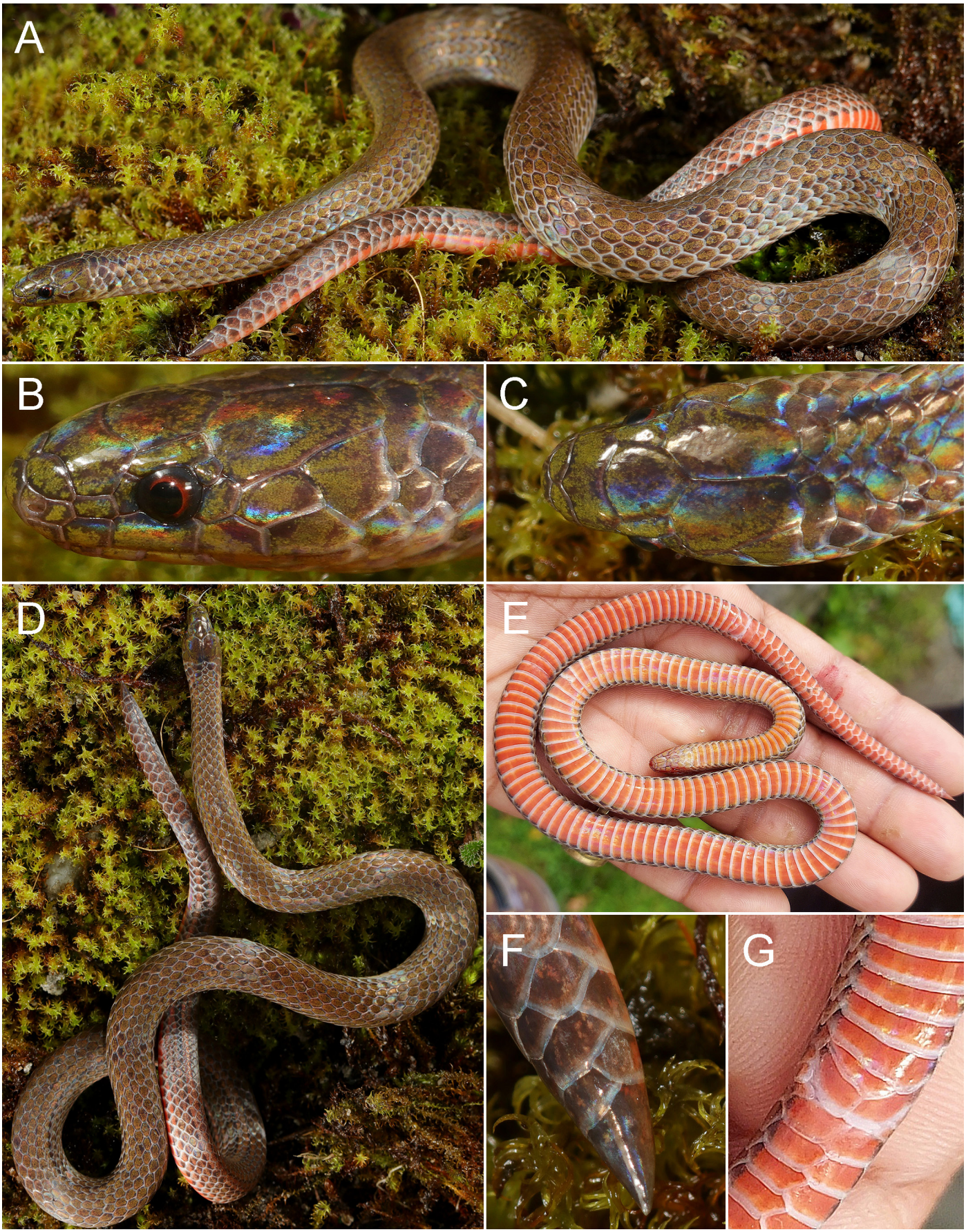

Figure 2. An adult Günther's Oriental Slender Snake (*Trachischium guentheri*): Lateral view of the body (A); lateral (B) and dorsal (C) views of the head; dorsal (D) and ventral (E) views of the body; conical tip of the tail (F); and divided cloacal plate (G). Photographs by Vivek Sarkar.

Figure 3. A juvenile Günther's Oriental Slender Snake (*Trachischium guentheri*): Lateral and dorsal views of the head and body. Photographs by Vivek Sarkar.

traffic-related mortality areas are identified via long-term monitoring, we propose using specialized structures in those stretches of roads. One option could be laying barriers alongside paved roads with underpasses to permit movements of snakes (Fig. 6). An obvious limitation of this model is that debris accumulating along these barriers could render them ineffective unless periodically cleared. A second, more elaborate option (Fig. 7) involves placing hollow, trapezoidal concrete slabs in a manner that allows water to pass through the gaps between the slabs while snakes use the hollow channels in the slabs to cross the road. The slabs would need to be reinforced with steel bars a to support the weight of vehicles.

Figure 4. Roadkilled Günther's Oriental Slender Snakes (*Trachischium guentheri*). Photographs by Vivek Sarkar.

Table 1. Günther's Oriental Slender Snakes (*Trachischium guentheri*) encountered in the study site in and around Lachen, North Sikkim, India. Numbers correspond to sites marked in Fig. 1.

No.	Location (elevation) (m)	Date (time)	Conditions
1 (Roadkill 1)	27.733292, 88.549444 (2,240)	30 Sep 2023 (1908)	Light rain
2 (Roadkill 2)	27.734611, 88.549383 (2,742)	30 Sep 2023 (1920)	Light rain
3 (Roadkill 3)	27.734592, 88.549403 (2,740)	30 Sep 2023 (1920)	Light rain
4 (Roadkill 4)	27.728972, 88.553061 (2,697)	30 Sep 2023 (2025)	Light rain
5 (Roadkill 5)	27.723208, 88.551919 (2,675)	1 Oct 2023 (1930)	Light rain
6 (Roadkill 6)	27.724414, 88.553108 (2,686)	1 Oct 2023 (1913)	Light rain
7 (Roadkill 7)	27.721708, 88.556461 (2,648)	1 Oct 2023 (1913)	Light rain
8 (Roadkill 8)	27.721692, 88.556494 (2,649)	1 Oct 2023 (2020)	Light rain
9 (Roadkill 9)	27.721692, 88.556494 (2,646)	1 Oct 2023 (2021)	Heavy rain
10 (Roadkill 10)	27.721692, 88.556494 (2,646)	1 Oct 2023 (2022)	Heavy rain
11 (Roadkill 11)	27.721692, 88.556494 (2,653)	1 Oct 2023 (2025)	Heavy rain
12 (Live 1)	27.724467, 88.553186 (2,683)	1 Oct 2023 (2055)	Heavy rain
13 (Live 2)	27.735503, 88.549108 (2,742)	2 Oct 2023 (0750)	Morning sun after all-night rain
14 (Roadkill 12)	27.735142, 88.549369 (2,735)	2 Oct 2023 (0823)	Morning sun after all-night rain
15 (Roadkill 13)	27.734131, 88.549411 (2,741)	2 Oct 2023 (0830)	Morning sun after all-night rain
16 (Roadkill 14)	27.726117, 88.543422 (2,918)	2 Oct 2023 (1717)	Heavy rain
17 (Roadkill 15)	27.726083, 88.544028 (2,902)	2 Oct 2023 (1720)	Heavy rain
18 (Roadkill 16)	27.721817, 88.555425 (2,687)	4 Oct 2023 (1015)	Heavy rain
19 (Roadkill 17)	27.721247, 88.553744 (2,719)	4 Oct 2023 (1040)	Heavy rain
20 (Roadkill 18)	27.713131, 88.556778 (2,615)	7 Oct 2023 (0940)	Light rain
21 (Roadkill 19)	27.707639, 88.560078 (2,549)	7 Oct 2023 (1000)	Light rain
22 (Roadkill 20)	27.719586, 88.558092 (2,607)	11 Oct 2023 (1730)	Heavy rain
23 (Roadkill 21)	27.720392, 88.557267 (2,644)	11 Oct 2023 (1700)	Heavy rain
24 (Roadkill 22)	27.720467, 88.557036 (2,653)	11 Oct 2023 (1702)	Heavy rain
25 (Roadkill 23)	27.727114, 88.551533 (2,705)	12 Oct 2023 (0558)	Morning sun after all-night rain

Figure 5. Vegetation along the path where Günther's Oriental Slender Snakes (*Trachischium guentheri*) were encountered: *Rhododendron* forest (top); coniferous forest (center); bamboo forest (bottom). Photographs by Vivek Sarkar.

Figure 6. A suggested mitigation measure to reduce the number of road-killed Günther's Oriental Slender Snakes (*Trachischium guentheri*): An elevated barrier with a protrusion along the upper side edge; note also the underpass (arrow) that allows snakes to reach the other side of the road without exposure to vehicular traffic.

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Figure 7. A second suggested mitigation measure to reduce the number of roadkilled Günther's Oriental Slender Snakes (*Trachischium guentheri*) is comprised of 60 cm-high hollow, trapezoidal concrete slabs laid in an alternate manner to allow for the passage of water and providing channels for snakes to pass.

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