

# Collection of vulnerable nests with eggs for the captive incubation of king cobra *Ophiophagus hannah* as a conservation strategy in Mizoram north-east India

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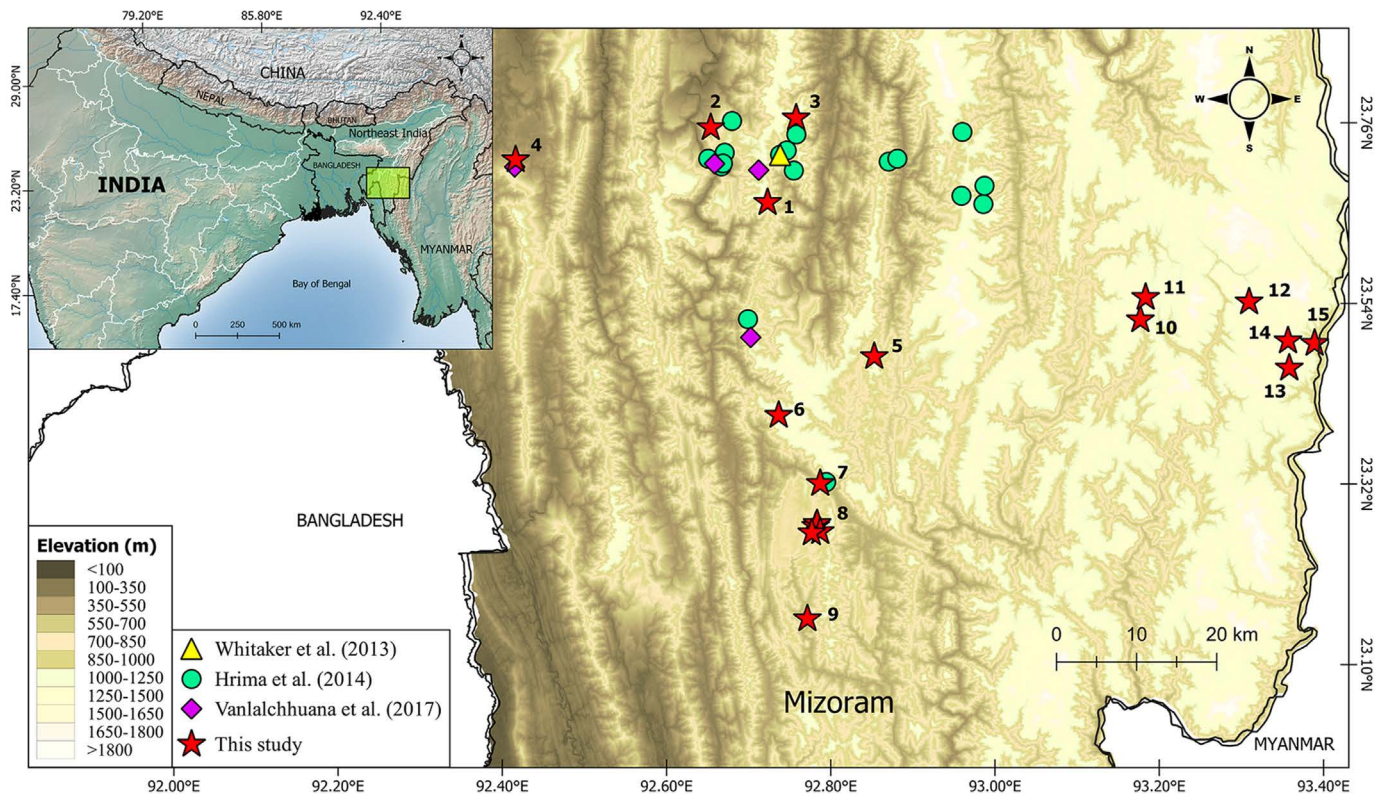
The king cobra *Ophiophagus hannah* (Cantor, 1936) is the world's largest venomous snake inhabiting a wide variety of niches such as grassland, forests, shrubland, wetlands, mangrove swamps, agricultural areas and may occur in the vicinity of rural villages (Whitaker & Captain, 2008; Stuart et al., 2012). It is widely distributed across south Asia, south-east Asia, and east Asia at altitudes up to at least 2,000 m a.s.l. (Waltner, 1975; Das et al., 2008). It is the only snake species where females actively construct a nest from leaf litter or other plant material (Loveridge, 1946; Schmidt & Inger, 1957; Whitaker et al., 2013; Hrima et al., 2014; Dolia, 2018). Nests have been seen between April and July (Daniel, 1983; Whitaker et al., 2013). The females are known to guard the nest, sometimes residing in the nest's upper chamber or coiling on top of the nest (Loveridge, 1946; Whitaker et al., 2013; Vanlalchhuana et al., 2017), and subsequently deserting the nest when the neonates hatch (Kannan, 1993). Females can lay up to 14–53 eggs in a single clutch (Das, 2012; Hrima et al., 2014; Burchfield, 1977). On one occasion, twin nests at a distance of only 6.6 m apart were reported from the northern India (Dolia & Das, 2020).

Destruction of habitats, illegal trade, and persecution by humans are the primary conservation threats to the king cobra (Stuart et al., 2012; Shankar et al., 2013; Marshall et al., 2018). Consequently, the species is considered to be declining throughout its range and is currently listed as “vulnerable” (VU) on the IUCN Red List (Stuart et al., 2012); placed in Appendix II by CITES; and is in Schedule II of the Indian Wildlife Protection Act (1972). In north-eastern India, Das et al. (2008) speculate that king cobra numbers are declining rapidly due to large scale habitat destruction. Sightings of freshly killed king cobra in Mizoram are not uncommon especially in agricultural or plantation areas. Herein, we report the cases of king cobra nests threatened with destruction by local villagers, which we relocated as a preliminary approach for ex-situ conservation of king cobra populations in Mizoram, north-east India.

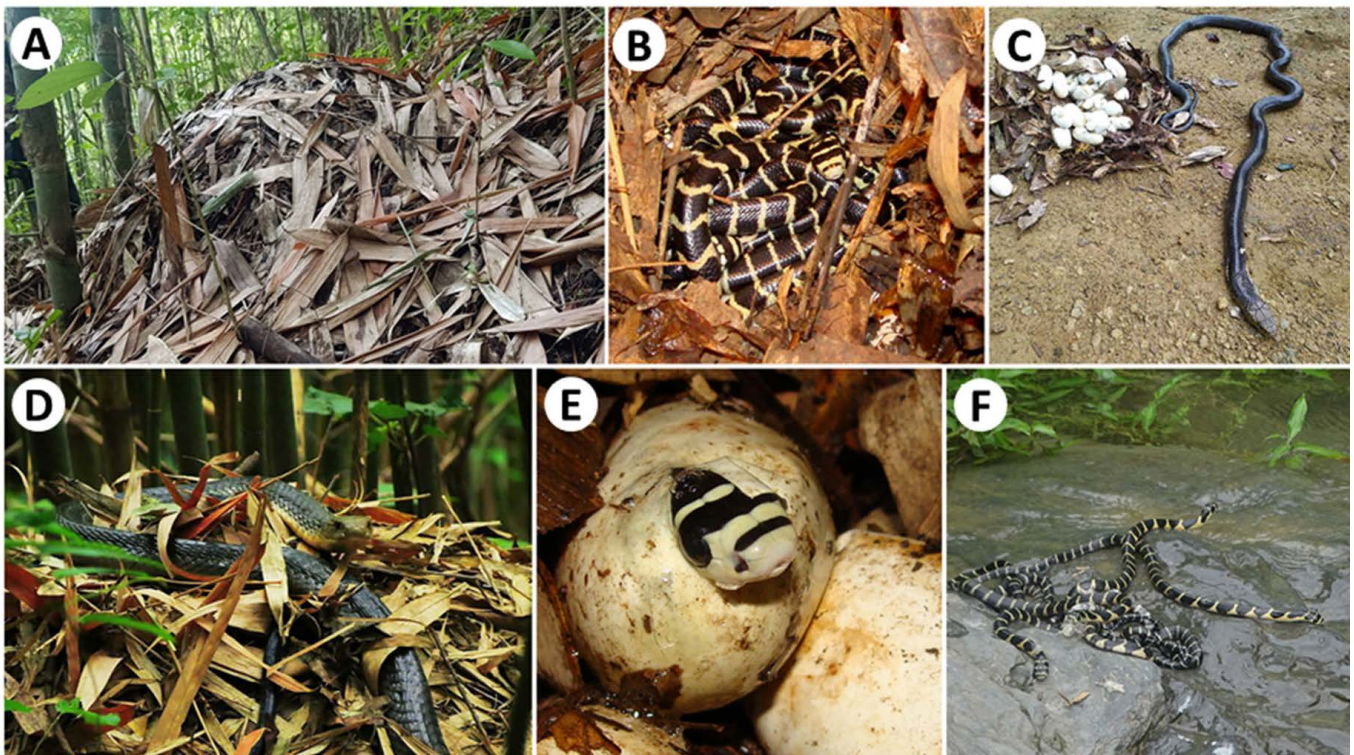
During the study period (2017–2021), we documented 18 new king cobra nesting sites at elevations ranging from 400 m to 1,450 m a.s.l. plotted using QGIS v3.16.2 in Figure 1

together with 23 previously documented sites from Mizoram. For details of the newly reported nesting sites refer to Table 1S in Supplementary Material. The nests from Chhingchhip (Serchhip District) and Thenzawl IV (Serchhip District) had already been deserted by the female (Fig. 2A) and hatchlings were found inside the nest (Fig. 2B). Unfortunately, while visiting the nest at Muthi (Aizawl District), the female snake was found lying rotten nearby its nest; also, the nest at Tlangsam (Champhai District) was completely destroyed along with the eggs, and the female was found shot dead (Fig. 2C). However, the nest encountered in Dampa Tiger Reserve (Mamit District) had no potential threat at the time of our visit, so it was left in the natural breeding site after photographing the snake (Fig. 2D). Nesting materials from those recorded in Champhai District comprised various leaves of plants such as *Pinus kesiyae*, *Quercus griffithii*, *Q. serrata*, *Heteropanax fragrans*, *Lithocarpus pachyphyllus* etc., which are mainly found in the Assam Subtropical Pine Forest (9/C2) (see Fig. 2C), while the remainder of documented nests were constructed of bamboo leaves such as *Melocanna baccifera*, *Dendrocalamus hamiltonii*, *Bambusa tulda* etc., which are found in Secondary Moist Bamboo Brakes (2/2S1) (Figs. 2A, 2B & 2D) (Champion & Seth, 1968).

In total we relocated 13 nests, along with 12 females, that were threatened by local villagers and were close to either human habitations or agricultural land. The eggs and nests were translocated intact, and the eggs successfully incubated using the original mound inside an enclosure (created using a 1.5 m high tarpaulin ‘wall’) under semi-natural condition in the backyard of the Departmental Building of Zoology (23.736734 °N, 92.663347 °E; 796 m a.s.l.), Mizoram University campus. During the incubation period (June to August), the temperature and humidity within the mounds were recorded using a digital hygrometer, ThermoHygroMeter-Temptec (Mextech™) and were observed to fluctuate between 26–30 °C and 80–90 %, respectively. The females and the hatchlings were released back in the nearest reserved forests to within an average distance of 3.8 km (1.1–5.6 km) of the original nesting sites (Fig. 2F, Table 1S).



**Figure 1.** Map showing king cobra nesting sites in Mizoram, north-east India from both previous studies and the current conservation programme (red stars, some red stars refer to more than one nesting site) **1.** Hualngo, **2.** Tanhril, **3.** Muthi, **4.** Dampa Tiger Reserve, **5.** Chhingchhip, **6.** Samlukhai, **7.** Sailam, **8.** Thenzawl I–IV, **9.** Chhipphir, **10.** Khawzawl I, **11.** Khawzawl II, **12.** N. Khawbung, **13.** Tlangsam, **14.** Zote I, **15.** Zote II.



**Figure 2.** *Ophiophagus hannah* in Mizoram, north-east India: **A.** Deserted nest at Thenzawl IV, **B.** Deserted hatchlings uncovered inside the nest at Chhingchhip, **C.** Completely destroyed nest and eggs with the freshly killed female from Tlangsam, **D.** Female coiling above its nest in Dampa Tiger Reserve, **E.** Hatching from incubated eggs, **F.** Releasing hatchlings at Zongaw Reserved Forests

The local community (Mizo) has a deep-rooted fear of snakes and all are treated as deadly animals, so they are killed without hesitation. Currently, nest translocation is the only available conservation option for the region. We suggest that a more effective long-term conservation management strategy is required that includes an intensive awareness campaign directed at local communities.

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