

# Notes on the distribution and natural history of the King Cobra (*Ophiophagus hannah* Cantor, 1836) from the Kumaon Hills of Uttarakhand, India

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## Introduction

Native to South and Southeast Asia, the King Cobra (*Ophiophagus hannah* Cantor, 1836) is the world's longest venomous snake, capable of growing up to 5.49–5.79 m (Aagard, 1924; Mehrtens, 1987; Daniel, 2002). Its established global distribution includes the following 15 countries: Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China (mainland as well as Hong Kong Special Administrative Region), India, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, Philippines, Singapore, Thailand and Vietnam (Stuart et al., 2012). Although widely distributed, this snake is considered rare in most parts of its range, except in forested parts of Thailand where it is relatively common (Stuart et al., 2012).

In southern India, the King Cobra is found along the Western Ghats of Tamil Nadu, Kerala, Karnataka, Goa (Whitaker and Captain, 2004) and up to southern Maharashtra (Yadav and Yankanchi, 2015). In northern India the species occurs in the Terai region of Uttar Pradesh (Whitaker and Captain, 2004) and in the mountainous state of Uttarakhand (Waltner, 1975; Rasaily et al., 2008; Theophilus et al., 2008; Singh and Joshi, 2016). In the east, it occurs in the states of Bihar, Jharkhand, Orissa, West Bengal (Stuart et al., 2012) and extending southwards to northern coastal Andhra Pradesh (Murthy and Murthy, 2012). In northeast India, it has been recorded from all states including Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura (Das et al., 2008; Stuart et al., 2012; Hrima et al., 2014). The King Cobra is also found on the Andaman Islands in the Bay of Bengal (Smith, 1943; Whitaker and Captain, 2004). Some

herpetologists believe that the King Cobra may be part of a larger species complex (Das, 2002). However, further phylogenetic studies based on molecular data between the different populations are needed to shed light on its true taxonomy.

The King Cobra's known altitudinal distribution ranges from 150 m to 1530 m in Nepal (Schleich and Kästle, 2002) and from sea level to 1800 m in Sumatra (David and Vogel, 1996). In India, the species has been sighted at 1840 m in Sikkim (Bashir et al., 2010), and King Cobra nests have been found between 161 m and 1170 m in Mizoram (Hrima et al., 2014). The King Cobra has also been recorded up to c. 1830 m in the Nilgiris and in the Western Himalayas (Smith, 1943). The highest altitude recorded and published for an adult King Cobra was 2181 m in the Mussoorie hills of Uttarakhand (Waltner, 1975), and the highest known altitude recorded for a King Cobra hatchling (dead specimen) was 2005 m in the West Kameng district of Arunachal Pradesh (Sangha et al., 2011).

Most published literature on the ecology of this species in the wild comes from the tropical rainforests of southern India, mainly from the Malnad region of Shivamogga District, Karnataka (see Bhaisare et al., 2010; Whitaker et al., 2013). Recent observations from north and northeastern India regarding the distribution (Das et al., 2008; Bashir et al., 2010; Sangha et al., 2011) and nesting ecology (Rasaily et al., 2008; Hrima et al., 2014; Singh and Joshi, 2016) of the species suggest that the King Cobra may not be uncommon in the sub-tropical/temperate forests of India.

I present here four separate observations regarding the altitudinal distribution, nesting ecology and diet of King Cobras from Nainital district in Uttarakhand State of northern India.

*Altitudinal distribution.*—Between 2006–2017, 18 King Cobra nests and numerous (>40) sightings of adult King Cobras were recorded by my colleagues and me in

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**Figure 1.** A King Cobra's nest composed of pine leaves in Kumaon, Uttarakhand. Note the female cobra lying on top of the nest (Picture courtesy: K.S. Sajwan)

the Nainital district of Uttarakhand. Most sightings of the snake were near human habitation, and nests often occurred in disturbed/degraded forests, some even in private fruit orchards (Dolia, unpublished data). These distribution and nest occurrence records show that the world's longest venomous snake inhabits and breeds in the Kumaon hills, at elevations ranging from 900 m to 2000 m, where winter temperatures are often close to freezing, resulting in snowfall in some areas (Gupta et al., 2016).

In October 2012, a King Cobra hatchling was found at 2303 m (29.4725° N; 79.6494° E) in the Indian Veterinary Research Institute's (IVRI) campus at Mukteshwar, Nainital. I recorded the location of the sighting using a Global Positioning System (GPS) unit (Model: Garmin GPSMAP 76CSx, Garmin Ltd., Kansas, U.S.A). Although I did not directly see the hatchling snake, a staff member of IVRI provided me with video clips of the hatchling taken with his mobile phone. The movements of the hatchling King Cobra indicate that it may have been born just a few days prior to when the video was recorded, as is evident from the hatchling's

lack of proper balance (especially of the hood part) and rather slow reactions to somebody prodding it with a stick. Its somewhat lethargic behaviour may have been induced by the cold weather. I became aware of this sighting on 3 May 2013, while conducting an interview survey as part of my study on the distribution and nesting ecology of King Cobras in the Kumaon hills.

This sighting marks the highest recorded altitude for the King Cobra in its worldwide range. This, coupled with distribution records from northeastern India (Das et al., 2008), suggests that the species may be well adapted to survive in the sub-tropical/temperate forests of India. Given that the average minimum temperature during December-February (from the years 1953–1979) was below 5°C (<http://www.imd.gov.in/section/climate/climateimp.pdf>; (<https://www.euttaranchal.com/tourism/nainital-weather.php>), and snow and frost are common during winters ([http://www.nainitaltourism.com/About\\_Kumaon.html](http://www.nainitaltourism.com/About_Kumaon.html)), it would be interesting to study the thermal biology of these large poikilotherms during that period. The locals usually do not encounter snakes during winter (Nov–Feb), probably because



most snakes go into hibernation (M. Rai pers. comm.). However, there is anecdotal evidence of an adult King Cobra that was seen basking at regular intervals during December–January, at an altitude of above 2000 m near Gagar, Kumaon (M. Rai pers. comm.).

**Nesting and hatching ecology.**—On 28 June 2009, a King Cobra nest was discovered in the Ramgarh Block of Nainital, at an altitude of 1615 m (please note that Whitaker et al., 2014 have inaccurately mentioned an altitude of 1980 m, for this same nest). The coordinates of the nest were: 29.4438° N and 79.5722° E (Model: Garmin GPSMAP 76CSx, Garmin Ltd., Kansas, U.S.A.). This was the second King Cobra nest found in the Kumaon region (see Rasaily et al., 2008 for an account of the 1<sup>st</sup> nest). The nest was primarily composed of Baanj oak (*Quercus leucotrichophora*) leaves, and the female was seen guarding the nest for 2–3 weeks, after which she abandoned it. On 7 October 2009, after approximately 100 days since the first observation, I

was able to spot the first King Cobra hatchling of this nest, and subsequently monitored and measured all the emerging hatchlings during the following days. On 10 October 2009, I carefully opened up the nest to count the number of eggs it contained. In all, there were 32 eggs, 28 of which had hatched successfully. However, the interesting fact was that 29 living hatchling King Cobras had emerged from only 28 eggs. After double-checking my count of hatchlings as well as of the empty eggshells, I concluded that the most likely explanation for this anomaly was that two snakes had hatched from a single egg; in other words, a case of ‘twinning’ had occurred. To corroborate this finding, I noticed that two hatchlings were unusually smaller and lighter in weight than their siblings. These two individuals, in all likelihood the single-egg twins, weighed 12 g (total length=40 cm) and 9 g (total length=37.5 cm) respectively, whereas the mean weight of their siblings was 22.7 g (standard deviation or SD=1.9 g, range=17.0–25.0 g, n=26 as one individual was not weighed), little more than the combined weight of both. The mean total length of their siblings was 50.8 cm (SD=2.1 cm, range= 46.7–55.9 cm, n=27). Singh and Thapliyal (1973) also reported a reduced weight in twin embryos of *Natrix piscator* (current name: *Xenochrophis piscator*). Among the four unsuccessful eggs from this nest, two were found to be rotten; one hatchling died soon after birth, and one hatchling was stillborn.

To the best of my knowledge, this is the first reported case of twinning in *Ophiophagus hannah*. Instances of twinning, whether monozygotic or dizygotic, have been documented in other snakes, such as Checkered Keelback (*Xenochrophis piscator*) (Singh and Thapliyal, 1973), Corn Snake (*Pantherophis guttatus*) (Marion, 1980), Japanese Ratsnake (*Elaphe climacophora*) (Fukada, 1978) and the Indochinese Ratsnake (*Ptyas korros*) (Dieckmann et al., 2014). It would be interesting to know whether twinning occurs in other populations of *Ophiophagus hannah*. Also, monitoring the ecology and fate of these often-smaller individuals (i.e. whether they are able to survive to adulthood or not) may be worthwhile.

A second observation that I would like to report concerns a female cobra with her nest of pine leaves. In June 2011, a King Cobra’s nest was found (29.3671° N, 79.4729° E; elevation 1481 m) near Jeolikote, Nainital, Uttarakhand. The nest was mainly composed of Chir pine (*Pinus roxburghii*) leaves and the female was present on the nest when first seen (Fig. 1). This is the first published record of a King Cobra nest being



**Figure 2.** The segregated unviable (i.e. spoilt) eggs (indicated by arrow) are visible at the base of this nest (Picture courtesy: K.S. Sajwan)



**Figure 3.** A King Cobra seen in Kohinoor Ground, Sattal, Uttarakhand (Picture courtesy: Mohammed Younus)

composed entirely of pine leaves; prior to this record, only anecdotal evidence existed about such nests.

On 22 July 2011, approximately one month later, seven rotten/unfertilized (i.e. unviable) eggs were found separated from the main clutch of healthy eggs (S. Ramachandran pers. comm.), and were visible at the base of this nest (Fig. 2). Prior to abandoning the nest for good, the female cobra was observed moving in the bottom section of the nest, close to where the eggs are usually located (S. Ramachandran pers. comm.). While the female cobra was not actually observed separating the seven unviable eggs, it is likely to have been a deliberate action on her part for the following reasons: (1) Nest sanitation or ‘nest cleaning’ has been observed in several species of invertebrate and vertebrate animals (e.g., Rothenbuhler, 1964; Lang et al., 2002; Guigueno and Sealy, 2012; Diez et al., 2014), and separation of unviable eggs from viable eggs could be an evolutionary adaptation for animals such as King Cobras with large brood sizes and/or long incubation periods, and (2) there was no evidence of this nest having been disturbed or invaded by any other human or animal during the entire time that it was observed.

This is the first report of potentially hygienic behaviour or ‘nest sanitation’ from a nesting female King Cobra. This nest contained 22 eggs in all, 11 of which hatched on 21 September 2011, two months after the discovery of the separated unviable eggs. Out of the 15 eggs remaining in the nest chamber (i.e. excluding the seven unviable eggs that were removed), four eggs were found to be rotten. The mean total length of the 11 hatchlings was 52.7 cm (SD=3.3 cm, range= 45.5–58.0 cm) and the mean weight was 18.3 g (SD=2.2 g, range= 15.0–22.0 g).

**Diet.**—In the afternoon of 12 October 2012, Mr. Mohammed Younus (a local snake rescuer) found an adult King Cobra (c. 9–10 ft. long; Fig. 3) in Kohinoor Ground (behind YMCA Camp), Sattal, Uttarakhand. After the locals had disturbed the snake by throwing stones at it, it regurgitated two dead snakes (Fig. 4). The first was an Indian Rat Snake (*Ptyas mucosa* Linnaeus, 1758), and the second was a Himalayan White-lipped Pit Viper (*Trimeresurus septentrionalis* Kramer, 1977). Mr. Younus used his Samsung mobile phone (Model: GT-S5263) to take pictures of the event, which he later shared with me. He did not capture the King Cobra as it was already stressed due to the disturbance caused by the locals (M. Younus pers. comm.). This is the first report of a King Cobra having fed on a *Trimeresurus septentrionalis*, the latter being a common snake in the Kumaon region and probably responsible for the majority of snake-bite cases in these hills (Theophilus et al., 2008). A study on King Cobras in Agumbe (Shimoga district, Karnataka) revealed that one radio-tagged male King Cobra had consumed 26 pit vipers during a six-month period. Two of these were *Hypnale hypnale* and the remaining 24 were *Trimeresurus malabaricus* (Bhaisare et al., 2010).

## Discussion

These observations provide novel information on the natural history and distribution of King Cobras from a lesser-known population in India. To summarize, the observations reported here extend the known altitudinal limit of the species by at least 200 m, provide



**Figure 4.** Regurgitated meal of the adult King Cobra seen in Sattal, Uttarakhand, showing the Indian Ratsnake (white arrow) and Himalayan White-lipped Pit Viper (yellow arrow) that were previously ingested. (Picture courtesy: Mohammed Younus)

information on the diet of the species, describe the first known *in situ* case of twinning in the species, and provide evidence that a nesting female King Cobra may be able to differentiate, and segregate, viable eggs from unviable ones.

The relatively large number of sightings of King Cobras and their nests in the Kumaon region raises the optimistic possibility that adult King Cobras and their nests may occur in similar densities in the surrounding districts of Uttarakhand as well. Further studies covering additional areas of the Himalayas are required to help determine the true distribution and population of King Cobras in the sub-tropical and temperate regions of India.

Additional studies, especially in colder areas of the range (e.g. other parts of the Western and Eastern Himalayas), are needed to better understand the natural history and ecology of this poorly studied apex predator in relation to extreme climatic conditions. It is urgently required to understand whether future global warming, especially in a mountainous state like Uttarakhand where mean annual temperature has increased by 0.46 °C within the last century (Mishra, 2017), would reduce or improve the King Cobra's chances of survival at high altitudes. Radio telemetric studies, similar to the one carried out in Agumbe (see Barve et al., 2013), in the high-altitude range of this species would potentially help elucidate movement patterns, home-range, diet, seasonal shifts (if any) in its local distribution, which could help design a sound long-term conservation plan for this globally declining species.

**Acknowledgements.** I thank the Uttarakhand Forest Department for granting me permission to carry out fieldwork. I am grateful to the then director of IVRI (Mukteshwar) for allowing me to enter the campus for GPS-marking a sighting location, as well as to the staff member who provided me with the video clips of the hatchling. I thank Mohammed Younus, Sidharth Ramachandran and K.S. Sajwan for providing me with valuable information and pictures to validate these field notes, and to the latter two for great help and support during fieldwork. I am indebted to Manish Rai for his constant help during fieldwork, and for his valuable role as my mentor. I also thank Tapogiri (a unit of Sri Aurobindo Ashram, Pondicherry) and its staff for excellent logistical support during fieldwork. I thank Dr. Cheryl Nath for her critical, valuable and timely inputs to improve this manuscript. The Mohamed Bin Zayed Species Conservation Fund (U.A.E.) and Idea Wild (U.S.A) funded parts of this research, for which I am very grateful.

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