

# One-year growth and development of a recaptured juvenile king cobra *Ophiophagus hannah* in the foothills of the Western Himalayas

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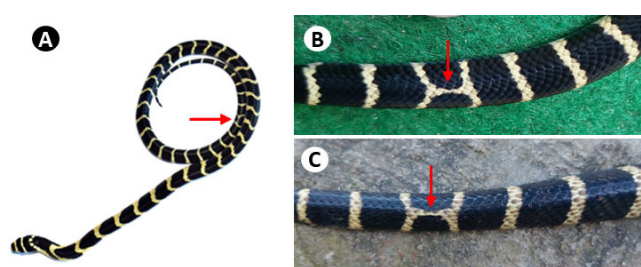
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The king cobra, *Ophiophagus hannah* (Cantor, 1836), the world's longest venomous snake, has naturally varying ventral hood markings that are known to vary sufficiently among individuals for them to be used for individual identification (Jones et al., 2020). We are aware of multiple recaptures of an adult male king cobra in our study area during previous years, which was easily recognisable due to its large size and an unmistakable, unique band pattern on its dorsal hood. Apart from dorsal and ventral hood pattern variations, king cobras also possess unusual combinations of subcaudal scale arrangement, which can provide additional information in support of individual identification (Jones et al., 2020). The subcaudal scales in these snakes are usually undivided near the cloaca but divided further down the tail and the transition from undivided scales to divided scales may occur more than once in the same individual. Jones et al. (2020) published a protocol that combined subcaudal scale arrangement/count and ventral hood markings to potentially differentiate between individual king cobras in Thailand. We present here, for the first time, evidence on the survival and growth-rate in the wild of a king cobra during the first year of life. The cobra was examined at the time of hatching, released into the wild and then recaptured one year later when it was identified by the following external features - total band count, unique band number/pattern, undivided subcaudal scale number and ventral hood pattern. The combination of these features, recorded at the time of birth, made its subsequent identification robust.

During July–September 2021, we monitored and protected a king cobra's nest in the Nainital Forest Division of Uttarakhand, India. The nest, located close to human habitation at an elevation of 1,511 m a.s.l., consisted of a mix of Chir Pine *Pinus roxburghii* and Baanj Oak *Quercus leucotrichophora* leaves. It contained 24 eggs from which 24 young cobras emerged in late September. As part of a long-term research and conservation study on this species, hatchlings were taken from the nest for morphometric measurement and photographs (Dolia et al., 2023 for detailed methods), prior to their safe release in the nearest suitable forest away from human habitation.

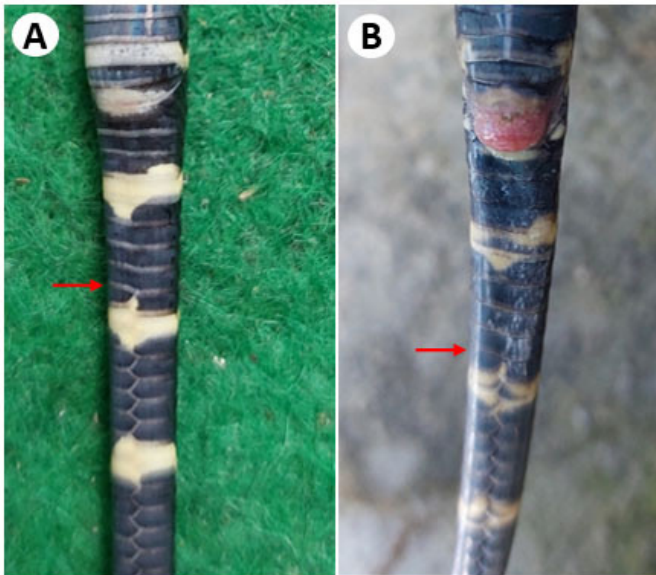
We collected a range of morphometric data for each hatchling (see Table 1). When counting the bands on the



**Figure 1.** Hatchling king cobra and the same individual about one year later to show the unique band mark (red arrows) - **A.** King cobra hatchling N27\_16 in 2021, **B.** Close-up of the unique band mark in 2021, and **C.** The same unique band a year later in 2022

dorsal surface we excluded the three bands on the head of a hatchling and began at the first chevron on the forebody and included the last band/dot usually present on the tail tip. We used a non-elastic string and tape measure to take length and girth measurements. In addition to these data, we also noted the band number that intersected (or was closest) to the cloaca of each individual. For example, for this particular recaptured hatchling/juvenile king cobra, the 41st band passed through the cloaca on the ventral side (the range for this feature varied from a minimum of 37 to a maximum of 47 for the 24 siblings of this nest). We took descriptive notes in case any unique band patterns were observed for any individual. We also took multiple photographs of each hatchling (including ventral hood, dorsal hood, whole-body and unique band pattern, if any) to build a photographic database of individual king cobra hatchlings to aid individual identification in the case of recapture.

One of the 24 hatchlings from this nest had a unique band pattern, thanks to which it was easily recognisable. In this individual (with the unique Identification Code, N27\_16), bands # 38 & 39 were joined by a perpendicular white line along the dorsum to form an unmistakable, clearly visible white 'H' shaped mark (Fig. 1). In general, the bands, or cross-bands, in king cobras are distinct and are usually not connected to one another. This detectable feature, combined with the total band count, total number of undivided subcaudal scales (Fig. 2) and matching ventral hood markings (Fig. 3) enabled us to confidently identify the juvenile snake



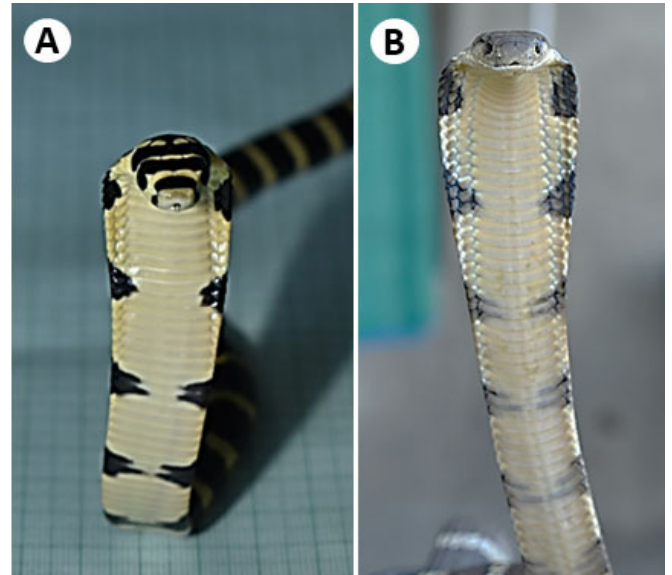
**Figure 2.** Ventral, cloacal, and subcaudal scales in king cobra N27\_16 - **A.** As a hatchling, and **B.** As a juvenile, approximately a year after it was born. Red arrows indicate the transition from undivided to divided subcaudal scales

**Table 1.** Morphometrics and scalation for the young king cobra N27\_16 in Nainital District, Uttarakhand, a day after emergence from its nest (29 September 2021) and when it was recaptured approximately a year later (15 October 2022)

Morphometric variable/ ID feature	29 September 2021	15 October 2022
Total length (mm)	565	1,160
Tail length (mm)	95	190
Mass (g)	23	75
Mid-body girth (mm)	31	60
Total no. of bands	54	54
Band passing through cloaca	41st	41st
Total no. of undivided subcaudal scales	8	8
Total no. of subcaudal scales	-	85
Total no. of ventral scales	-	251

as individual N27\_16, when it was recaptured on 14 October 2022. This was a little over a year after its initial release. We also noticed that the three yellowish-white bands (bars) on the head of the hatchling snake (which all king cobra neonates are born with) were now absent from the yearling juvenile (compare Figs. 3A and 3B). The disappearance of these head-bands with age from juvenile king cobras is a well-known fact, but we have not found any earlier published information with regard to the time-frame within which this occurs.

To our knowledge, this is the first report of the growth and development of a juvenile king cobra in the wild. In a period of just over one year, this young king cobra had more than doubled in length from 565 mm to 1,160 mm and tripled in weight from 23 g to 75 g (Table 1). For comparison, in captivity, well-fed juvenile king cobras can attain lengths of



**Figure 3.** Ventral hood markings of king cobra N27\_16 - **A.** As a hatchling in September 2021, and **B.** As a juvenile in October 2022



**Figure 4.** The juvenile king cobra N27\_16 regurgitating a northern white-lipped pit viper

2000 mm in 18 months (Pfaff, 2008). The distance between the release and recapture sites (as measured using the ruler tool in Google Earth Pro) was ~ 2.3 km, and there was a gain in altitude as the snake was first released at 1,615 m and recaptured at 1,751 m a.s.l., an increase of 136 m. The release site was an oak-forest patch beside a stream and the recapture site was a grassy habitat, close to human habitation. The recapture site was north of the release site and to reach this location it is possible that the juvenile king cobra had navigated a small stream, moderately steep slopes, tarred roads, and a few settlements/villages with bare land and cultivations around the houses.

On recapture, the juvenile king cobra was found to have consumed an adult *Trimeresurus septentrionalis* (northern white-lipped pit viper), one of the most common venomous snakes in the mid-elevation hills of Kumaon (pers. obs., JD). The king cobra regurgitated its prey (Fig. 4), probably as a result of capture/handling-related stress. The approximate total length of the dead pit viper was 600 mm, and it weighed 105 g, i.e. shorter but heavier than the king cobra. In all likelihood, the juvenile king cobra must have hunted the pit viper the previous day (i.e. 14 October 2022), as the former was found lying among grass in a sunny patch, for over an

hour before it was rescued by KK at around 15:00 h. The king cobra may have been basking to accelerate digestion, which had already proceeded as the head of the regurgitated pit viper was partly digested. After necessary data collection, the king cobra was safely released on 15 October, close to its original capture site, but away from human habitation.

This is the first time that we have seen or rescued a juvenile king cobra in over 15 years of research on this species in this subtropical, montane Himalayan landscape. The current observation adds valuable data for this rather elusive snake and corroborates findings by Jones et al. (2020) that ventral hood markings and subcaudal pholidosis can indeed be used to identify individual king cobras. It also shows that ventral hood markings, body band patterns and other natural features of hatchling king cobras appear to remain temporally consistent and can be used for accurate identification up to at least a year later, and possibly much longer.

### ACKNOWLEDGEMENTS

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