Hamadryad Vol. 36, No. 2, pp. 38 – x, 2013.

Nesting ecology of the King Cobra (*Ophiophagus hannah*) in India

Nikhil Whitaker[1], P. Gowri Shankar[2*] and Romulus Whitaker[1]

[1]Madras Crocodile Bank Trust/Centre for Herpetology, P.O. Box 4, Mamallapuram, Tamil Nadu, 603 104, India

[2]No. 14/60, Shakthinagar, Behind TTK, Dooravaninagar Post, Bangalore, 560 016, India.

*Corresponding author, E-mail: gowrishankar.pogiri@gmail.com

ABSTRACT.– Here we present the results of a nest survey of the King Cobra in the states of Karnataka, Mizoram, and Uttarakhand, with data collected between the 2004 and2010 nesting seasons. We collected data on thermal and hydric conditions in addition to the impact of rainfall, clutch survival, hatchling size, and incubation periods. Of 15 nests located, eight had temperature profiles recorded. Thirteen of 15 nests had a female King Cobra present upon location. The majority of nests (13) recorded were from the Shivamogga district of Karnataka, with a single nest each from Mizoram and Uttarakhand. Clutch size averaged 25 ± 0.5 (7–43) eggs with an average of 23 ± 8.7 (6–38) eggs surviving to term. We used a previously published regression equation to relate clutch size to female size. We also report on the lowest nest temperatures known in this species, the Uttarakhand nest, which averaged 23.0ºC. All nests were located between April and June, with eggs at various stages of development.

KEYWORDS.– King Cobra, *Ophiophagus hannah*, nesting ecology, nest temperatures

Introduction

The reproductive biology of the King Cobra, *Ophiophagus hannah*, apart from an in depth study by Leakey (1969) in Thailand, is little known. Other related subjects that have been reported on for this species include nest desertion by a female (Kannan 1993), captive breeding and husbandry (Burchfield 1977; Dattatri 1987), and sporadic reports on nests observed in the wild (Mustill 1936; Whitaker 1977). This is the only species within the Class Reptilia, apart from the Crocodylia, that actively constructs a nest (Evans 1902).

Material and Methods

King cobra nests were located 2004–2010 using information given by residents living in and around King Cobra nesting habitat. Local residents (areca nut plantation owners, shop-owners, local wildlife enthusiasts) were also encouraged to provide information on location of nests.

Temperature profiles of nests were recorded with automatic temperature loggers (Onset Instruments CORP, Pocasset, MA 02550, USA) that were pre-launched at 1h intervals, and placed within the nest chamber. Temperatures for other nests were recorded with manual mercury thermometers inserted in 2.5 cm diameter PVC tubes that were further pushed through a basket and carefully placed within the nest. During the period 2004–2010 nests were located between mid-April and the beginning of June — the onset of the south-west monsoon in Karnataka, but a relatively dry season in the North East, Mizoram, and North India at the foot-hills of the Himalayas, Uttarakhand. Each nest is presented on a case-by-case basis, due to the large variation in availability of temperature loggers, rain gauges and hygrometers, which limited the degree of information collected from each particular nest. The initial two years of nest data, 2004–2005, have detailed information on temperature/hydric conditions, whereas the remain-

der had nest chamber temperature recorded. Rainfall was measured with two 10 mm rain gauges in one nest, N1-2004, with one placed over the nest, and one in an open area adjacent to the nest. Nest width, length, and height were measured to the closest 3 cm, and flora associated with the nest and immediate surroundings were noted. Incubation period used here is measured from the date of location of the nest until hatching. We examined a total of 15 nests for predicted female total length (FTL), using an equation from Whitaker *et al*. (2005): FTL= 126.457 + 5.244 x CS (r^2 = 0.79; N = 23; SEE = 21.8), with a 95% confidence limit (Student's T-test, t = 2.080; df = 21).

Abbreviations used in the text are KA (Shivamogga district of Karnataka), TL (total length), SVL (Snout-vent length), in centimeters (cm) and wt (weight). Rainfall, where recorded, is given in millimeters (mm). Relative humidity (RH) is given as a percentage. Paired sample T-tests were used when identical numbers of observations were available for comparison, and ANOVA was used when two variables had different numbers of observations. Standard deviations are presented following the mean of temperature, humidity, and hatchling lengths and weights, followed by the range of values, and number of samples. All analyses were carried out using SPSS v.10 on a Windows Platform.

Results

2004, Nest One. Yedagaaru Hamlet, KA: The nest, comprised of dry leave litter, was found on 25 April 2004, at the base of a tree. Environmental variables at this nest were recorded from 15 May to8 August 2004, when the first eggs hatched. Temperature within the nest chamber (X = 24.3 ± 0.72ºC) differed significantly from temperature at 5 cm above the forest floor (X = 22.6 ± 1.06ºC, t = 30.80, df = 199, P > 0.0001) and 1 m above the forest floor (X = 22.7 ± 1.14ºC, t = 30.39, df = 207, P > 0.001). Nest temperature was observed to peak between 12h30 and 17h30. RH was observed to differ significantly between the nest chamber (X = 94.56% ± 5) and outside of the nest (X = 93.57% ± 5.52, t = 4.823, df = 165, P > 0.0001). Rainfall over the nest (X = 5.01 mm) was lower than rainfall in an adjacent open area (X = 5.72 mm), although the two did not differ significantly. The female was observed on the date of discovery of this nest only, after which she was not seen.

Eggs in this nest hatched after an observed incubation period of approximately 105 days, resulting in 16 hatchlings from 17 eggs, a hatching success of 94%. The average TL was 47.8 ± 2.1 cm (range 43.2–50.1 cm), and wt averaged 21.6 ± 2.8 gms (range 17–26 gms).

2005, Nest One. Agsarskone Hamlet, KA: This nest was constructed on 22 April 2005, as the owner of the hamlet had not seen the nest the day before. Ambient temperature outside the nest was measured manually from 1 May to16 June, and temperature within the nest chamber was measured manually from 12 May to16 June. The logger measured temperature from 10 June to21 July, when the eggs hatched. Nest chamber temperature (X = 24.6 ± 1.4ºC) differed significantly from ambient temperatures recorded near the nest (X=28.1 ± 2.6ºC; ANOVA, F = 46338.73, df = 70, P < 0.0001). This nest exhibited the greatest difference between nest chamber and outside temperature. Both nest chamber and outside ambient temperatures peaked at 10h30. Nest construction was observed first hand up until 4 May, after which the female was not seen again. Eggs in this nest hatched on 21 June at 13h00, with 23 of 24 eggs hatching for a hatching success of 96%, after an observed incubation period of 90 days. The TL of the hatchlings averaged 56.1 ± 1 cm (range 54–58 cm), while wt averaged 24.4 ± 1.3 gms (range 21–26 gms).

2005, Nest Two. Kamar Kodige, KA: This nest was first observed on 14 May 2005. Disturbed forest and plantation surrounded the nest, and a stream flowed nearby. Nest chamber and nearby ambient temperatures were recorded 20 June–28 July. Temperature within the nest chamber averaged 23.48 ± 1.28ºC, and was significantly different from outside ambient temperature, which averaged 24.77 ± 1.6ºC (t = -7.98, df = 114, P < 0.0001). Temperatures within the nest chamber peaked at 17h30 and at 08h30 for outside ambient temperature. The female was observed until 4 June, a period of twenty-two days, and disappeared with the onset of the south-west monsoon in mid-June.

Hatching occurred on 28 July, all 39 eggs following an incubation period of 76 days. The TL of the hatchlings averaged 54.9 ± 1.2 cm (range

52–57 cm), and wt averaged 20.5 ± 2 gms (range 16–23 gms).

2005, Nest Three. Koradi Village, KA: The site was visited on 26 June 2005, and it was found through local informants that the nest was seen in the last week of March, and an *O. hannah* was seen until sometime in April after which she abandoned the nest. No temperatures were measured in this nest. A visit on 11 July revealed that the eggs had hatched. The nest chamber was dry with hatchlings within, although the presence of shed skins indicated that snakes may have hatched 3–4 days earlier. Clutch size was seven eggs, with one egg apparently infertile. The TL of the six hatchlings averaged 55.8 ± 1.2 cm (range 55–58 cm).

2006, Nest One. Souli, Kalmane, KA: This nest was first observed on 4 May 2006. A data logger was placed in the nest cavity on 10 May. Temperature averaged 27.0 ± 0.7ºC (24.6–30.5ºC). The female was observed on the nest for a period of three days in early May. Out of 28 eggs counted, 25 (89%) hatched on the 19 July after an observed incubation period of 77 days. Three eggs were rotten.

2006, Nest Two. Magundi, KA: This nest was first observed on the 13 May 2006. A logger was placed in the nest on 17 June, and remained in place until hatching on 29 July. Mean nest temperature was 26.6 ± 1.5ºC (22.1–30.9ºC). The female was observed on the nest 10 May–13 May. Clutch size was 25 eggs, of which 24 (96%) hatched on the 29 July, after an observed incubation period of 77 days.

2008, Nest One. Kerebailu, Hallibidargodu, KA: This nest was first observed on 21 May 2008. A data logger was inserted within the nest chamber on 24 May. Another logger measured ambient temperature (at 1 m above the nest) from 24 May–14 August, the date of hatching. Temperature within the nest averaged 24.1 ± 2.8ºC (13.4–34ºC), whereas temperature outside the nest averaged 25.4 ± 5.7ºC (3.3–43.6ºC). Out of 20 eggs, 13 (65%) hatched following an 85 day observed incubation period.

2008, Nest Two. Kokodu, near Nallur, KA: The nest was first observed on 24 May. The nest hatched on 13 August, with a total of 28 eggs hatching out of 29, for a 97% hatch success, and an incubation period of 81 days. The TL of the 27 hatchlings averaged 55.6 ± 2 cm (range 49.5–58.5 cm), SVL averaged 45.5 ± 1.6 cm (range 45.5–47.5 cm), and wt averaged 34.3 ± 2.6 gms (range 26–38 gms).

2009, Nest One. Thaluve, Thirthahalli, KA: Thanks to information from the Karnataka Forest Department, this nest was first visited on 26 April 2009. The nest was located in a small patch of forest on a slope, close to a path frequented by people and cattle. It was surrounded by acacia plantation, areca and paddy fields. A data logger was put in the nest from 28 May to 3 August. Nest chamber temperature averaged 27.1 ± 2.2ºC (22.1–37.4ºC). The female on this nest was observed from 26 April to11 May. The observed incubation period was 107 days. Clutch size in this nest was 34, of which 32 (94%) hatched on 9 August. Two eggs were found to be rotten upon opening the nest.

2009, Nest Two. Billgadde, Hulugaru, KA: First observed on 28 April 2009. The nest was located next to a path used regularly by people and surrounded by a disturbed community forest with dense forest ca. 100 m from the nest. The female was observed from 28 April to11 May on the nest, during which period active nest construction was observed. Clutch size was 30 eggs, of which 28 (93%) hatched on 18 August, after an observed incubation period of 113 days. A sample of hatchlings measured comprised eight females and ten males. The TL averaged 50.2 ± 2.7 cm (range 41.2–53.2 cm), SVL 41.5 ± 1.4 cm (range 37.5–44 cm), and wt averaged 25.1 ± 2.3 gms (range 19–28 gms), with no observed gender differences in morphology. Two eggs deemed rotten were found within the nest

2009, Nest Three. Thanikodu, Kudremukh, KA: The nest was observed by a plantation worker in the last week of May. It was found under a tree close to a pedestrian mud path, surrounded by banana, areca and acacia plantations. A perennial river with thick forest stands was ~150 m from the nest. No female was observed in the vicinity of the nest. Eggs in the nest hatched on 13 August, and the nest was excavated on 15 August to determine clutch size. Of 43 eggs, 38 (88%) hatched successfully, 3 were rotten and 2 hatchlings were fully formed but found dead within their eggs. The TL of 37 hatchlings averaged 51.57 ± 2.1 cm (range 45.4–56.5 cm), SVL averaged 42.2 ± 1.8 cm (range 37.2–46.5 cm),

and wt averaged 22.8 ± 2.5 gms (range 13–26 gms).

2009, Nest Four. Mundagaru village, Matholli, Kudremukh, KA: This nest was located in thick forest, ~10 m from a pedestrian mud road on a slope with a perennial stream ~50 m from the nest, in May 2009. A local resident observed the female add leaf litter to the nest. The nest was visited on 3 June, by which time the female had left. A second visit on 13 August revealed that hatching had already taken place. Clutch size was 29 eggs, of which all hatched successfully based on egg-shell counts.

2009, Nest Five. Nainital Forest Division, Uttarakhand: this nest was found on 30 June 2009, and was located in an oak dominated forest, at 1980 m a.s.l. It was beside a path that residents frequented to collect fodder for their livestock. On 16 July, 15 days after the nest was found, a data logger was placed within the nest chamber, until the eggs hatched. Nest temperature averaged 23 ± 1.95ºC (18.3–31.1ºC). At this nest, 8–10 % of nest temperature readings were in the 23–24ºC range (Fig. 1). The female was observed on the nest from 30 June to12 July. Of 32 eggs, 28 hatched on 7 October, after an observed incubation period of 99 days. The TL of the 28 hatchlings averaged 50 ± 3.8 cm (range 37.5–55.9 cm), and wt averaged 21.79 ± 3.7 gms (range 9–25 gms).

2010, Nest One. Aizwal, Mizoram: The nest was located on 28 May 2010, in a bamboo thicket between a jhum ("slash and burn") cultivation area and coffee plantation, about 30 m on the upper side of slope of a footpath linking these two plantations. The female was observed with the nest from 28 May to 3 August. Of a clutch of 16 eggs, 4 hatched on 2 August, for an observed incubation period of 95 days. Seven eggs had been destroyed by local miscreants. A number of empty egg sacs were visible on the nest, and 5 hatchlings were given to the local Forest Department for release.

2010, Nest Two. Hasirumane, Ilimane, KA: This nest was located on 2 June 2010. The nest was situated adjacent to an areca plantation, 50 m from a perennial stream encompassed by secondary forest. A data logger was placed inside the nest on 20 June and removed from the nest on 18 July 2010 when the eggs hatched. The female was not observed on the nest. Mean temperature was 25.6 ± 0.8ºC (range 23–33ºC). This nest contained 34 eggs, of which 24 (71%) hatched.

Discussion

Predicted FTL averaged 268.7 ± 49 cm (range 163–352 cm; Fig. 2). The CS averaged 25 ± 0.5 eggs (range 7–43), with an average of 23 ± 8.7 eggs (range 6–38) surviving to term. Early and late embryonic deaths and/or infertile eggs (eggs not surviving to term) averaged 11 ± 0.8 (range 1–10). A report on captive breeding of *Ophiophagus hannah* at Brownsville Zoo yielded the largest clutch size known to date, 53 eggs, of which 39 hatchlings were produced (Burchfield 1977). Incubation period in this study averaged 86 ± 12.76 days (range 66–105 days, N = 9). This is similar to a report of captive bred *Ophiophagus hannah* at the Madras Crocodile Bank hatching in 57–63 days (Whitaker *et al.* 2005), a shorter incubation period than reported in other instances of captive breeding (70–75 days) (Oliver 1956; Burchfield 1977; Dattatri 1987). Wall (1925) reported clutch sizes ranging from 21–33 eggs from six nests. Wasey (1892) observed a clutch size of 33 eggs, although it is unclear if Wall in his report included Wasey's clutch size as his maximum number of eggs.

Interestingly, the smallest clutch size (2005, Nest Three) produced seven eggs yielding six hatchings, perhaps by a female nesting for the first time. A six year old captive bred female (MCBT ID K-7) nesting for the first time (measured 13 February 2001, TL = 184 cm, wt = 700 gms), laid a clutch of 4 viable eggs (2 eggs were normal and 2 very small) at the Madras Crocodile Bank Trust on 10 May 2001 (pers. obs.).

Mean temperatures experienced by the eggs differed among nests (23–27.1ºC), as did mean maxima (27.8–37.4ºC), and mean minima (13.5–24.6ºC) (Fig. 3). The volume of eight nests averaged 2.25 ± 1.4 m^3 (range 0.4–4.6 m^3) (Fig. 4), however compaction of the nest by rain and the addition of leaf litter by the female may have affected nest volume. The period that a female *Ophiophagus hannah* was observed in the vicinity of the nest averaged 29 days (range 2–77 days). We did not consider fluctuation in nest temperature related to the presence/absence of the female, unlike within the family Pythonidae wherein rhythmic contractions of the fe-

male's musculature generate heat to increase egg temperatures (Charles *et al.* 1985; Slip & Shine 1988). However, the presence of females on nests during rainfall may have reduced the amount of free water from rain reaching the eggs.

It would presumably be a challenge for King Cobra nests to maintain temperatures suitable for incubation at high elevation. The highest nest observed was 1980 m a.s.l. at the Nainital nest site (2009, Nest Five), where temperatures ranged from 18.3 to 31.1ºC. This may reflect that *Ophiophagus hannah* eggs have adapted to develop at low temperatures. Other high altitude nests have been observed at Talla Ramgarh, 1500 m a.s.l., and at Jeolikote, at around 1300 m a.s.l. (Wild Himalayas 2011), both also within the Nainital Forest Division, Uttarakhand. Sangha *et al.* (2011) reported finding a juvenile *Ophiophagus hannah* at an altitude of 2005 m. Perhaps a colony of *Ophiophagus hannah* in captivity could be bred and nests manipulated, i.e. with the female and without, at different times of incubation, different number of eggs (to gauge metabolic heat production) and different ambient temperatures (hence nest temperatures), similar to the work of Aubert *et al.* (2003) on *Python regius*. The highest altitudinal record for a King Cobra was reported by Waltner (1975) who mentioned a specimen he obtained from a site located at an altitude of 2181 m at Mussoorie in 1967.

One hundred eighty-nine hatchlings were measured following emergence from the nest. Hatchling TL, not taking nest site into factor, averaged 53.1 ± 3.5 cm (range 37.5–58.5 cm, N = 176). Hatchling SVL averaged 43.6 ± 2.4 cm (range 37.2–47.5 cm, N = 64), and wt averaged 25 ± 5.3 gms (range 9–38 gms, N = 170). This is similar to other published values, including those reported in a study by Chanhome *et al.* (2001), who recorded an average TLof 47.8 cm and wt of 12 gms in captive bred Thai King Cobras. Similarly, Chanhome (2007) reported a length of 48–65 cm and wt of 12.2–24 gms. Burchfield (1977) reported a ca. 4 m long female producing 19 hatchlings, averaging 47.9 ± 3.5 cm (range 40–55 cm) TL, and 25.8 ± 3.3 gms (14.7–29.8 gms) wt.

Previously thought to be a semi-evergreen specialist, *Ophiophagus hannah* is now known to occupy a wide variety of niches. The forests in the Shivamogga District of Karnataka are classified as West Coast Tropical Evergreen forest (1/A-C/4) by Champion & Seth (1968). Dominant plant types are *Dipterocarpus indicus*, *Diospyros candolleana; Humboldtia brunonis, Artocarpus hirsutus* (Pascal 1988). The landscape also contains an irregular mosaic of *Acacia auriculiformis*, *Areca catechu*, Banana *Ensete superbum* plantations and paddy fields. The forests of Mizoram are classified as 'Cachar Tropical Evergreen (IB/C3)' and 'Cachar Semi Evergreen (2B/C2)' (Champion & Seth 1968). In Uttarakhand's Temperate Zone, where one King Cobra nest was observed, the flora is typically dominated by oak species, (*Quercus leucotrichophora*, *Q. semecarpifolia*, & *Q. dilatata*). Coniferous forests also occur on slopes here. A summary of flora found around five nests from Shivamogga is presented in Table 1. Further studies on the reproductive biology

Table 1. Flora associated with five King Cobra nests.

Nest ID	Location/State	Flora around the nest site
2008, Nest One	Kerebailu, Hallibidargodu, Karnataka	Strychnos wallichaiana, Syzygium gardaneri, Nothopigia beddomii, Diospyros malabarica, Sarcanthus pauciflorus
2008, Nest Two	Kokodu, Nallur, Karnataka	Dichapetalon gelonioides, Myristica dactyloides, Amoora cararana, Humboltia brunonis, Lansium anamallayanum
2009, Nest Three	Mundagaru village, Matholli, Kudremukh, Karnataka	*Litsea ghatica, Syzygium zeylanicum, Memesylom ubmellatum, Symlex zeylanica, Gymnacranthera* sp.
2010, Nest One	Hasirumane, Ilimane, Karnataka	Madhuca longifolia(Neriifolia), Garcinia gummigutta, Zanthoxylum ovalifolium, Allophylus cobbe, Nilgirianthus heyneaunus, Justicia symplex
2010, Nest Two	Mualpui (Soth East Aizawl), Mizoram	Bambusa vulgaris, Bambusa nutans

across the range of the King Cobra within India would prove fruitful, especially with detailed environmental records from nests located at high elevations.

Acknowledgements

We thank our respective organizations for their support. We thank B.K. Singh, Principal Chief Conservator of Forests and Chief Wildlife Warden (Wildlife), N. B. Manjunath, Assistant Conservator of Forests, Brijesh Kumar, Conservator of Forests, N. H. Jaganath and H. S. Suresha, Range Forest Officers of the Karnataka State Forest Department for permission to undertake the study and cooperation in the field. We are thankful to P. Prashanth, Sharmila Rajasegaran and all other staff of Agumbe Rainforest Research Station for their assistance. We are grateful to all the student volunteers: Anju Devanur, Neeti Mahesh, Vipul Ramanuj, Ashwin, Gautham Ramachandra, Amruth of this project, who worked in the field. Were it not for their efforts this work would not have been possible and thus they are in effect the unnamed co-authors of this paper. Jignasu Dolia and Manish Rai helped with providing information on the Uttaranchal nest, and V. L. Hrima and H. T. Lalremsanga helped with information on the Mizoram nest. Thanks to J. Jagadeesh, Sandesh Kadur, Dilan Mandanna and Ramnath Chandrashekar for their timely help in the field, logistics and photography respectively. Thanks are also due to Madras Crocodile Bank/Centre for Herpetology for help in library reference and literature collection. We thank the following organizations for their generous financial support of the Agumbe Rainforest Research Station, the National Geographic Society (King Cobra Telemetry Project), National Geographic Television (A.R.R.S.) and the Whitley Fund for Nature (A.R.R.S.).

Literature Cited

AUBERT, F., X. BONNET, R. SHINE & S. MAUMELAT. 2003. Clutch size manipulation, hatching success, and offspring phenotype in the ball python (*Python regius*). *Biological Journal of the Linnean Society* 78: 263–272

BURCHFIELD, P. M. 1977. Breeding the king cobra *Ophiophagus hannah* at Brownsville Zoo. *International Zoo Yearbook* 17: 136–140.

CHAMPION, H. G. & S. K. SETH. 1968. A Revised Survey of the Forest Types in India. Natraj Publishers, New Delhi. 404 pp.

CHANHOME, L. 2007. Venomous snake husbandry [in Thai]. Pp. 89–107 *in* Queen Saovabha Memorial Institute, The Thai Red Cross Society. Dokbier Publishing, Bangkok.

CHANHOME, L., P. JINTAKUNE, H. WILDE & M. J. COX. 2001. Venomous snake husbandry in Thailand. *Wilderness and Environmental Medicine* 12: 17–23.

CHARLES, N., R. FIELD & R. SHINE. 1985. Notes on the reproductive biology of Australian pythons, genera *Aspidites, Liasis* and *Morelia*. *Herpetological Review* 16: 45–47.

DATTATRI, S. 1987. Breeding the king cobra (*Ophiophagus hannah*) in captivity. *Journal of the Bombay Natural History Society* 84: 222–227.

EVANS, G. H. 1902. The king-cobra, or hamadryad — *Naia bungaris* (Boulenger), *Ophiophagus elaps* (Günther). *Journal of the Bombay Natural History Society* 14: 409-418.

KANNAN, R. 1993. Nest-desertion by a king cobra (*Ophiophagus hannah*). *Journal of the Bombay Natural History Society* 90: 519–520.

LEAKEY, J. H. E. 1969. Observations made on King Cobras in Thailand during May 1966. *Journal of the National Research Council of Thailand* 5: 1–10.

OLIVER, J. A. 1956. Reproduction in the king cobra, *Ophiophagus hannah* Cantor. Zoologica, New York 41: 145–152.

MUSTILL, F. J. 1936. A hamadryad's nest and eggs. *Journal of the Bombay Natural History Society* 39: 186–187.

PASCAL, J. P. 1988. Wet Evergreen Forests of the Western Ghats: Ecology, Structure, Floristic Composition and Structure. French Institute, Pondicherry. 365 pp.

SANGHA, H. S., R. NAOROJI & M. SHARMA. 2011. Sighting of king cobra *Ophiophagus hannah* in Arunachal Pradesh, India: a new altitude record for northeastern India. *Reptile Rap* 11: 19.

SLIP, D. J. & R. SHINE. 1988. Reptilian endothermy: a field study of thermoregulation by brooding diamond pythons. *Journal of Zoology, London* 216: 367–378.

WALL, F. 1925. A hand-list of the snakes of the Indian Empire. *Journal of the Bombay Natural*

History Society 30: 242–252.

WALTNER, R. G. 1975. Geographical and altitudinal distribution of amphibians and reptiles in the Himalayas. Part IV. *Cheetal* 16: 12–17.

WASEY, G. K. 1892. A nest of king cobra's eggs. *Journal of the Bombay Natural History Society* 7: 257.

WILD HIMALYAS. 2011. http://wildhimalayas.blogspot.in/2011/07/king-cobra-nests-again-in-nainital.html. Accessed on 10 September 2012.

WHITAKER, R. 1977. Two reptile nests. *Hornbill*, April–June, 1977.

WHITAKER, R., N. WHITAKER & G. MARTIN. 2005. Notes on the captive husbandry of the king cobra (*Ophiophagus hannah*) at the Centre for Herpetology, Madras Crocodile Bank, India. *Herpetological Review* 36: 47–49.

Received: 25 April 2011.
Accepted: 23 October 2011.