REPTILES & AMPHIBIANS

Neonatal Morphology of the Common Krait (*Bungarus caeruleus*), Russel's Viper (*Daboia russelii*), and Common Bamboo Pitviper (*Craspedocephalus gramineus*)

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India is home to 354 species and subspecies of snakes (Mohapatra et al. 2024). Gujarat, in western India's semi-arid zone, is home to over 60 of these species. Gujarat is one of India's most biogeographically diverse states, with habitats ranging from moist deciduous forest to deserts, supporting a wide range of floral and faunal species (Patel and Vyas 2019). Gujarat is home to the "Big Four" venomous snakes, the Indian or Spectacled Cobra (*Naja naja*), Common Krait (*Bungarus caeruleus*), Russel's Viper (*Daboia russelii*), and Saw-scaled Viper (*Echis carinatus*), which are responsible for the majority of snakebites in the country (Suraweera et al. 2020). Other venomous species documented in the state include the Common Bamboo Pitviper (*Craspedocephalus gramineus*) and the Sind Krait (*Bungarus sindanus*) (Patel and Vyas 2019).

Figure 1. Eggs of a Common Krait (*Bungarus caeruleus*) stored in a plastic container filled with vermiculite (upper left), freshly emerged hatchlings after the successful incubation period (right), and one stillborn hatchling with a visible malformation (bottom left). Photographs by Priyank Kapadi.

Reptiles & Amphibians ISSN 2332-4961
https://doi.org/10.17161/randa.v31i1.21683

The Snake Research Institute (SRI) was founded to prepare a pool of medically significant venoms from western India for the development of region-specific antivenoms. The Institute has an in-house serpentarium. SRI-trained technicians collected snakes after obtaining necessary authorization from the appropriate authorities. A Russel's Viper was collected on 6 January 2023 from Valsad District (20.5184, 73.1783), a Common Krait on 20 January 2023 from Surat District (21.2246, 72.7793), and a Common Bamboo Pitviper on 19 February 2023 from The Dangs District (20.7293, 73.8063). After physical examinations by the veterinarian at SRI, the snakes were kept in captivity, overseen by the curator, consultants, and senior scientific officer. A digital vernier calliper was used to measure the length and width of eggs six hours after being laid. Neonates were carefully restrained by hand and a thread and ruler were used to measure snout-vent and tail lengths to the nearest centimeter. Weights of eggs and neonates were measured with a scientific-grade Igene Labserve electronic weighing system accurate to four decimal places. Sexes of neonates were determined by cloacal popping 15–20 days post-hatching.

On 21 March 2023, the Common Krait laid six white, leathery eggs at about 1430 h. Eggs were separated, candled, marked, and stored in a plastic container filled with vermiculite (1 cup vermiculite and 1/2 cup water). Eggs and substrate were sprinkled with antifungal powder to prevent infections (Fig. 1). The container was kept in a dark room at 27–28 °C and 70–80% relative humidity. Mean length and width were 2.133 ± 0.071 cm and 0.837 ± 0.018 cm, respectively (Table 1). The female's initial weight of 149 g on 17 March 2023 was reduced to 102 g after laying eggs. The eggs hatched during the night of 19 May 2023 (Fig. 1). One of the six hatchlings died due to malformation (Fig. 1) but the other five were healthy. Neonates were glossy black (blue iridescence) with some brown, had completely black eyes with large pupils, heads somewhat broader than necks, little white spots on forebodies, and white bands from midbody to the tip of the tail. Three neonates finished their first shed in five days, the other two took an additional 1–2 days. Mean weight and total length were 5.991 ± 0.666 g and 27.3 ± 0.8 cm, respectively (Table 2).

Table 1. Measurements of Common Krait (*Bungarus caeruleus*) eggs taken six hours after laying.

	Egg Measurements		
No.	Weight (g)	Length (cm)	Width (cm)
1	9	2.156	0.838
2	8	2.037	0.807
3	7	2.151	0.845
4	8	2.067	0.833
5	7	2.235	0.838
6	8	2.151	0.863

Table 2. Measurements of Common Krait (*Bungarus caeruleus*) hatchlings recorded within six hours of hatching. SVL = snout-vent length, TL = tail length.

No.	Sex	Weight (g)	SVL (cm)	TL (cm)
1	F	6.311	23.3	3.5
2	F	6.201	23.0	3.6
3	M	6.187	24.1	3.9
4	M	6.449	24.4	3.9
5	M	6.147	23.7	4.0
6	M	4.649	22.4	4.0

Figure 2. Neonatal Common Bamboo Pitvipers (*Craspedocephalus gramineus*) separated from their mother for physical examination. Photograph by Aadit Patel.

Figure 3. Neonatal Russel's Vipers (*Daboia russelii*) separated from their mother for physical examination; inset: stillborn neonate without any visible physical injury or malformation. Photographs by Aadit Patel and Priyank Kapadi.

Table 3. Measurements of Common Bamboo Pitviper (*Craspedocephalus gramineus*) neonates recorded within six hours of parturition. SVL = snout-vent length, TL = tail length.

No.	Sex	Weight (g)	SVL (cm)	TL (cm)
1	M	3.860	19.1	4.9
2	M	3.867	18.7	4.8
3	F	4.515	19.5	4.1
4	F	3.758	18.6	4.0
5	M	3.752	18.5	4.7
6	F	3.656	18.5	3.5
7	M	3.912	19.5	4.9
8	M	4.407	19.6	5.1
9	M	3.950	18.5	4.7
10	F	4.119	18.5	4.0
11	M	3.935	19.1	4.4
12	F	4.190	19.2	4.2

On 29 May 2023, the Common Bamboo Pitviper gave birth to 12 neonates (Fig. 2). The neonates were olive green, with greenish-yellow eyes with vertical pupils, triangular heads larger than necks, and blackish-green markings on their upper bodies that extended to the tip of the tail. Mean weight and total length were 3.993 ± 0.265 g and 23.383 ± 0.774 cm, respectively (Table 3). On 2 June 2023, the Russel's Viper gave birth to 16 neonates (Fig. 3a), one of which was stillborn (Fig. 3b). They were yellowish-brown with vertical pupils, triangular heads wider than necks, black rings on upper bodies to tails, and yellowish tail tips. Mean weight and total length were 8.761 ± 0.335 g and 25.600 ± 0.678 cm, respectively (Table 4).

Reports on neonatal biology of snakes are limited. The Common Krait and Russel's Viper are distributed throughout India and the Indian Subcontinent (Whitaker and Captain 2004), but knowledge of their ecology, dietary variations, and venomics is limited. The scientific literature on their reproductive biology is almost non-existent. To the best of our knowledge, this is the first report on the neonates of these two species. Common Bamboo Pitvipers are endemic to India, where they occur primarily in the Western and Eastern Ghats (Whitaker and Captain 2004). Although some information is available on adult morphology and natural history, information on reproductive biology is lacking. This report presents the first account of neonatal Common Bamboo Pitvipers.

Table 4. Measurements of Russel's Viper (*Daboia russelii*) neonates recorded within six hours of parturition. SVL = snout-vent length, TL = tail length.

No.	Sex	Weight (g)	SVL (cm)	TL (cm)
1	M	8.548	21.1	3.7
2	F	8.660	22.5	4.1
3	F	8.493	22.0	3.3
4	M	9.050	21.6	3.9
5	F	8.219	21.7	3.1
6	F	8.486	22.2	2.9
7	F	8.400	21.6	3.4
8	F	8.967	22.5	3.4
9	M	8.690	21.7	3.8
10	F	8.478	23.5	3.2
11	F	9.063	22.3	3.4
12	F	8.519	22.4	3.2
13	M	9.380	23.3	3.8
14	M	9.090	22.1	3.5
15	F	8.955	21.9	3.4
16	F	9.170	21.8	3.3

Acknowledgements

We thank the Chief Wildlife Warden of Gujarat State and the Director of Gujarat Forestry Research Foundation, Gandhinagar, Gujarat, for providing the necessary approvals and facilities at the Institute, respectively. We also thank Vishal Santra for his input and experience in both this study and in editing the manuscript and Ankur Patel, Veterinary doctor at SRI, for his assistance.

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