

A REDESCRIPTION OF *GEGENEOPHIS CARNOSUS* (BEDDOME, 1870) (AMPHIBIA: GYMNOPHIONA)

G.M. Malathesh, K.R. Gundappa, S. Ravichandra Reddy and Katre Shakuntala

Department of Zoology, Bangalore University, Jnana Bharathi, Bangalore, Karnataka 560056, India.

Abstract

Eight specimens of the lesser known *Gegeneophis carnosus* (Beddome) sighted and collected during June-September 1996 from the General Cariappa Biodiversity Park at Madikeri, Karnataka State, India are redescribed with details of their morphology, morphometry and comparative taxonomic analysis. The species appears to be an altitudinal one, restricted in its distribution to the wet semi-evergreen forest range of the Western Ghat belt of Kerala and Karnataka and inhabits a unique cryptic subterranean habitat.

Keywords

Amphibia, *Gegeneophis carnosus*, *redescription*, *Biodiversity Park*, *Madikeri*

Introduction

Gegeneophis carnosus was first discovered at Peria Peak in Wyanad, Malabar, (Beddome, 1870) and subsequently recorded at the foot of Ponmudi Hill ranges, Kallar, Kerala (Ferguson, 1904; Inger *et al.*, 1984), by the side of small water courses on the hillside in Tenmalai, Travancore (Seshachar, 1942), at Kotagehar, in the Kodagu region of Karnataka, (Ramaswami, 1943; Seshachar & Ramaswami, 1943), at Bonnakad Estate, Kerala and at Palode, near Thiruvananthapuram (Pillai & Ravichandran, 1999). However, observations on ecology and morphology of the species remain incomplete. The present paper redescribes the species from specimens collected from General Cariappa Biodiversity Park, Madikeri, Kodagu District, Karnataka. These specimens are deposited in the Museum of Aqua Laboratory, Department of Zoology (MALZ 9601 to 9608), Bangalore University, Jnana Bharathi, Bangalore.

Materials and Methods

Specimens of *Gegeneophis carnosus* were collected during June, August and September 1996 from the clayey regions under thick vegetation found along small streams in the Cariappa Biodiversity Park, Madikeri (1143.3m). By carefully digging the clay around the root system of shrubs, individuals were located and hand picked. These microhabitats had porous soil with continuous gradient seepage of water. The soil was rich in humus

and the pH ranged from 5.5. to 6.0. Specimens of medium-sized earthworms (*Pheretima* sp.) and on one occasion, an unidentified species of an adult caecilian (*Ichthyophis* sp.) were also encountered in the same habitat. Extensive soil excavations by wild boar were a frequent sight during the search for this caecilian. Soon after collection, the specimens were transferred to polyethylene containers along with small amount of soil. Upon return to the laboratory, the animals were anaesthetized and preserved in 70% alcohol and each tagged with a separate number. Using slide calipers morphometric measurements of the specimens were made.

Results and Observations

Morphology

Colouration: Live specimens are generally pinkish-red, slightly darker on the dorsum than on the venter. The head and collars are distinctly lighter, yellowish-pink. The snout and jaws are characteristically light yellow being lighter than the rest of the body. Such a body colouration of *G. carnosus* has also been reported by Daniel (1963) and Taylor (1968). On preservation in 70% alcohol however, the above colouration was lost and the body was rendered mottled with light olive dorsally and light greyish-cream ventrally. Two distinct dark patches are present on dorsal region of head, one each on either side of the median line. Eyes are hardly visible as spots, embedded in the bone of skull.

Description

Head oval, slender, snout projecting beyond mouth (Fig. 1), eyes hardly visible, buried under skull bone. Tentacular area distinctly swollen (Fig. 2), foramen not visible from above. Nostrils nearly terminal, not visible from directly above the head. Tentacular foramen situated below and behind nostril. Two collars delineated by first and second and third nuchal grooves, a small incomplete dorsal groove apparent in anterior, smaller collar especially in preserved specimens; posterior collar larger, complete above, partially divided by a transverse groove, which courses laterally and fuses with first primary annulus ventrolaterally. Posterior to collars, are distinct primary annuli followed by secondary annuli. All primary annuli are complete above and below and grooves are apparent only on microscopic observation and/or on preservation in alcohol. In preserved specimens, body surface, especially dorsal surface of primaries exhibits pigmentation, suggesting a faint, warty glandular surface. Posterior to primaries are, seven secondaries of which anterior four are complete. The posterior terminus of body is covered with an unsegmented shield. On the ventral side of shield is the transverse vent (Fig. 3). Area of vent is markedly translucent, whitish in colour and vent is bordered by denticles all around; the shield narrows terminally; no tail.

Morphometry

Data on the morphometry of the eight specimens collected are given in Table 1. The longest specimen measures 226mm with a body width of <6mm indicating that it is a slender species

compared to other caecilians recorded from southern India (Taylor, 1968; Balakrishna *et al.*, 1982a, 1982b). The width in length ranged between 35-41 and head-length surpasses head-width.

Of the eight specimens collected, only one (MALZ 1906M) is a male, showing an everted phallodeum (Fig. 4). As this specimen measures 205mm in total length, it is presumed that, of the other seven specimens collected, at least two (MALZ 9607 and 9608) which measure >205mm but do not exhibit phallogedeal eversion could be considered as females, while the remaining five, measuring <205mm are either immature males or females. The study of Taylor (1961, 1968) on this species was based on individuals measuring only 162-172mm and he was also doubtful of their maturity.

Table 2 presents data on the details of body folds and morphometric measurements of individuals collected. The total number of body folds in each of the eight specimens ranged from 109 to 118. While the primaries ranged from 101 to 110, the secondaries were always seven, with a single terminal shield. Width of the second collar always surpasses that of the first. Tentacle is located closer to the nostril.

Dentition

Details of teeth rows and measurement of teeth are in Table 3. There are four dental series, all teeth recurved posteriorly. In the upper jaw, the outer premaxillary - maxillaries are 11-1-11 of

Table 1. Gross morphometric measurements (in mm) of *Gegeneophis carnosus*

Parameters	9601 (IM)	9602 (IM)	9603 (IM)	9604 (F)	9605 (F)	9606 (M)	9607 (F)	9608 (F)
Total length	133.00	138.00	155.00	186.00	197.00	205.00	210.00	226.00
Body width at the widest region	3.88	3.96	4.22	5.04	5.04	5.06	5.84	5.58
Width in length (times)	35.00	35.38	36.91	36.91	39.01	36.48	35.91	40.68
Head length	4.00	4.47	4.47	4.70	4.86	4.23	4.47	4.23
Head Width	3.06	3.43	3.43	3.53	3.76	4.01	4.04	3.76
Posterior terminal width	3.24	3.36	3.74	4.56	3.72	4.08	5.10	4.50
Snout length	0.94	0.94	0.94	0.94	1.04	1.18	0.94	1.18
Terminal shield length	1.88	2.12	2.35	2.12	1.88	3.01	2.35	3.06
Terminal shield width	1.41	1.88	1.88	1.41	1.41	2.35	1.88	2.35
Length of throat	3.06	3.29	3.29	4.23	4.00	4.00	4.00	3.76
Length of cloacal area	0.94	1.18	1.18	1.41	1.64	N.R.	1.80	1.52
Width of cloacal area	0.94	1.18	1.18	1.60	1.41	N.R.	1.80	1.41

Malz: Museum of the Aqua Lab, Department of Zoology, Bangalore University.

IM - Immature individual. F - Female, M - Male, N.R. - Not recorded due to everted cloaca.



Figure 1. Lateral view of *Gegeneophis carnosus* showing the anterior part



Figure 2. Ventral view of *Gegeneophis carnosus* showing swollen tentacular area

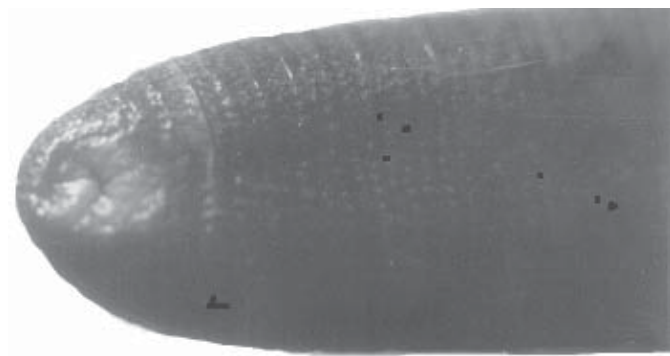


Figure 3. Ventral view of female *Gegeneophis carnosus* showing the vent



Figure 4. Lateral view of male *Gegeneophis carnosus* showing everted phallosodium

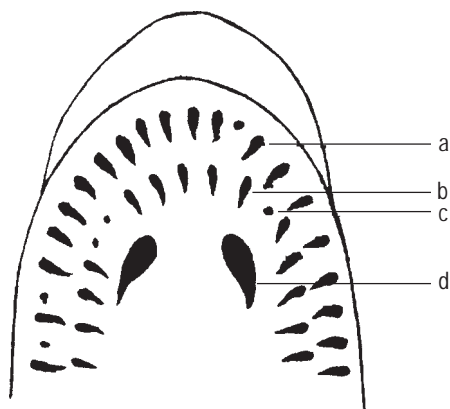


Figure 5. Details of dentition in the upper jaw.
 a. outer row of premaxillary-maxillary teeth (11-1-1);
 b. Inner row of prevomeropalatine teeth (8-1-8);
 c. Vacant space to indicate loss of tooth; d. Choanae.

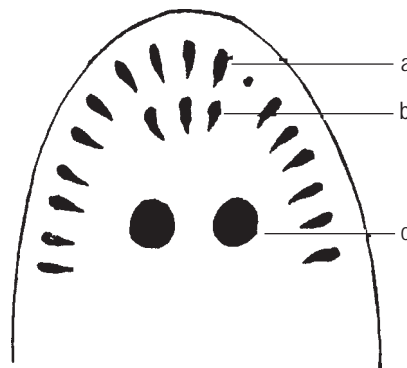


Figure 6. Details of dentition in the lower jaw.
 a. Outer row of dentary teeth (8-1-8); b. Inner row of splenial teeth (1-1-1); c. Narial plug on the tongue.

Table 2. Details of annuli and morphometric measurements (linear: μm) of *Gegeneophis carnosus*.

Parameters	9601 (IM)	9602 (IM)	9603 (IM)	9604 (F)	9605 (F)	9606 (M)	9607 (F)	9608 (F)
Total number of folds	110	114	118	109	114	114	115	116
Number of primary annuli	102	106	110	101	106	106	107	108
Number of secondary annuli	7	7	7	7	7	7	7	7
Terminal shield	1	1	1	1	1	1	1	1
Tip of snout to I nuchal groove	3995	4465	4465	4700	4860	4230	4950	4230
Tip of snout to II nuchal groove	5170	5875	5875	6110	6390	6510	6830	6510
Tip of snout of I primary annual groove	8050	7755	8225	8460	8640	9095	9180	9095
Width of I collar	1175	1410	1416	1410	1530	2280	1880	2280
Width of II collar	1880	1880	2350	2350	2250	2585	2350	2585
Average width of each primary	940	1410	1551	1551	1551	1551	2040	1645
Average width of each secondary annulus	705	940	940	1410	940	940	960	658
Distance between eye and tentacle	940	940	1880	1410	1880	1880	1880	1645
Distance between tentacle and nostril	470	658	940	893	705	846	940	705

Table 3. Details of dentition and choanae of *Gegeneophis carnosus*.

Jaws	Teeth rows	Distance between the two teeth rows (μm)	Average number of teeth	Distance between two successive teeth (μm)	Avg. length / width of each tooth (μm)	Distance between two choanae (μm)
Upper	Outer Premaxillary maxillary	600	11-1-11	144	240/72	600
	Inner Prevomeropalatine	600	8-1-8	144	240/72	
Lower	Outer Dentary	360	8-1-8	120	Anterior larger 360/96 Posterior smaller 144/72	-
	Inner Splenial	360	1-1-1	120	144/72	-

which 4-1-4 are premaxillaries and 7-7 are maxillaries. The inner prevomeropalatines are 8-1-8 of which 4-1-4 are prevomerines and 4-4 are palatines. The distance between these two rows of teeth is about 600 μm and the distance between two successive teeth is about 144 μm . The average length/width of each tooth in both rows is about 240/72 μm respectively. In the lower jaw, the anterior (except 1-1-1) teeth in the outer dentary are the largest, with tooth size diminishing posteriorly. The premaxillary and maxillary teeth are the second largest, and even among these, the premaxillary ones are more exposed than the maxillary ones. There is no size difference between the anterior and posterior teeth of these rows. The prevomeropalatine teeth are of the same size as the premaxillary and maxillary. The splenial teeth are similar to prevomeropalatine, both being distinctly smaller than the dentary. On closure of the two jaws, the upper jaw

projects over the lower with the premaxillary-maxillary teeth overlying the dentary. In all eight specimens, in the four series of teeth, tooth loss is evident from their loci (Figs. 5-6).

Tongue

The fleshy tongue bears two globular narial plugs. The narial plugs are located in deep cavities, their upper surfaces are on level with the surface of the tongue. The diameter of one narial plug in the distance between them is >3 times. The choanae are directed outwards and forwards (Fig. 5).

Phallodeum

The everted phallodeum is pear-shaped, pale in colour, with distinct vertical ridges (about 5-6 rows on each side). The diameter is around 1786 μm and length 2397 μm . The terminal

Table 4. Comparison of characteristics of *Gegeneophis fulleri*, *G. ramaswamii*, *G. krishni* and *G. carnosus*

Parameters	<i>G. fulleri</i>	<i>G. ramaswamii</i>	<i>G. krishni</i>	<i>G. carnosus</i>
Girth of the body	The body gradually increases in girth from head to a stump-like terminus at which place the body has its greatest width	A large species with the terminus of the body wider than elsewhere	Body thin worm-like	Body slender, nearly of uniform width throughout its length
Width in length	21 to 25 times	21 to 25 times	39 to 55 times	35 to 41 times
Greatest known length	220mm	340mm	195mm	226mm
Primary folds	90	98-104	125	105-112
Secondary folds	13	8-14	15	7
Eyes	Covered by bone	If present under skull bones, not visible	Not visible	Buried under skull bone
Tentacles	Situated half way between eye and nostril	Lie below and behind nostril	Lie below and a little behind nostril	Closer to the nostril than eye
Dentition				
Premaxillary-maxillary	17-1-17	12-12	11-1-11	
Prevomero-palatine	11-1-11	17-1-19	11-11	8-1-8
Dentary	10-10	14-14	6-6	8-1-8
Splental	4-4	3-3	2-2	1-1-1
Known localities, elevation and references	Kuttal, 9km southwest of Silchar, Assam, India (76.3m) (Alcock, 1904).	13 places at Thiruvananthapuram, Kerala (32-593m) (Ferguson, 1904; Daniel, 1963; Seshachar & Ramaswami, 1943; Taylor, 1964; Bhatta, 1997; Oommen et al., 2000); 4 places at Kollam, Kerala (70-550m) (Seshachar, 1942; Seshachar & Ramaswami, 1943; Taylor, 1964; Oommen et al., 2000); Kanyakumari (600m), Tamil Nadu (Oommen et al., 2000)	Gurpur, Karnataka (150m) (Pillai & Ravichandran, 1999)	Peria Peak (1524.4m), Wynaad, Malabar (Beddome, 1870); Foot of Ponnudi Hills, Kallar (132m), Kerala (Ferguson, 1904); Hills of Tenmalai, Travancore, Kerala (Seshachar, 1942); Kotagehar (945.1m), Mahnad, Karnataka (Seshachar & Ramaswami, 1943); Ponnudi Hills (350m), Kerala (Inger et al., 1984); Palode, Trivandrum (160m), Bommakad Estate, Kerala (593m) (Pillai & Ravichandran, 1999); Madikeri (1143.3m), Karnataka (Malathesh et al., present observation)

aperture width is about 864µm (Fig. 4).

Diagnosis and distribution of the species

The specimens collected at Madikeri and as described above have been diagnosed as *Gegeneophis carnosus* (Beddome), after comparison with specific characters of other species of the genus *Gegeneophis* (Table 4). The redescription of *G. carnosus* as detailed in this paper clearly distinguishes it from other species of *Gegeneophis*, especially in the pattern of dentition and few other morphometric characters. The distribution of *G. carnosus* appears to have an altitudinal range extending from 150m (Seshachar, 1942) to 1524.4m (Beddome, 1870) and is restricted to the wet semi-evergreen forests of the Western Ghats of Kerala and Karnataka, southern India. This distribution is perhaps influenced by climatic conditions (see also Daniel, 1963).

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