

Rediscovery of *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003 at the type locality (Amphibia: Gymnophiona: Caeciliidae)

Wiederentdeckung von *Gegeneophis seshachari*
RAVICHANDRAN, GOWER & WILKINSON, 2003 an der Typuslokalität
(Amphibia: Gymnophiona: Caeciliidae)

DAVID J. GOWER & VARAD GIRI & MARK WILKINSON

KURZFASSUNG

Wir berichten über die Wiederentdeckung von *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003, einer Blindwühlenart die bisher nur vom Holotypus bekannt war. Ein weiteres Exemplar wurde im Boden einer Plantage bei der Typuslokalität Dorle, Maharashtra, Indien 36 Jahre nach der Aufsammlung des Holotypus gefunden. Das neue Exemplar unterscheidet sich vom Holotypus in mehreren Details, insbesondere im Vorhandensein eines schwachen terminalen Kieles (stärker ausgeprägt beim lebenden Tier), ein bisher unbekanntes Merkmal bei indischen Caeciliiden. Dennoch charakterisieren morphologische Merkmale dieses Exemplar eindeutig als *G. seshachari*, und diese Art zur endemischen indischen Gattung *Gegeneophis* zugehörig. Dieses zweite Exemplar wurde während der bisher anscheinend einzigen gezielten Suche nach Blindwühlen in der Umgebung der Typuslokalität gefunden. Dies bestätigt Befunde jüngerer Zeit wonach unterirdisch lebende Wirbeltiere in der Lage sind, in anthropogen veränderten Habitaten zu überleben. Fehlende Bestätigungen älterer Nachweise lassen daher vermuten, daß es sich hierbei vielmehr um einen Mangel an adäquater Sammeltätigkeit handelt.

ABSTRACT

We report the rediscovery of the caecilian amphibian *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003, a species previously known only from the holotype. An additional specimen was collected from soil in a mixed plantation during brief fieldwork at the type locality, Dorle, Maharashtra, India, 36 years after collection of the holotype. The new specimen differs from the holotype in several details, most notably in having a faint terminal keel (more pronounced in life), a feature previously unknown in any Indian caeciliid. However, morphology supports referral of the specimen to *G. seshachari*, and of this species to the endemic Indian caeciliid genus *Gegeneophis*. The collection of the second specimen occurred during what appears to be the only dedicated search for caecilians in the vicinity of the type locality. This adds to recent evidence that subterranean vertebrates can survive in intimately synanthropic habitats, and that elapse of many years since last reported sightings can simply reflect a lack of appropriate field effort.

KEY WORDS

Amphibia: Gymnophiona: Caeciliidae: *Gegeneophis seshachari*, Caecilian, taxonomy, systematics, morphology, conservation, Maharashtra, Western Ghats, India

INTRODUCTION

The caeciliid caecilian amphibian *Gegeneophis seshachari* was described recently by RAVICHANDRAN et al. (2003) on the basis of a single specimen in the collections of the Zoological Survey of India, Kolkata (ZSIC). The holotype (ZSIC A3384) was collected on August 12th 1967 by P. W. SOMAN from Dorle Village, Ratnagiri District, Maharashtra, India. SOMAN (1975) reported collecting three specimens in total and retaining two in his personal collection, but these latter specimens were never described

and are presumed lost. The holotype previously had been mistakenly identified as *Indotyphlus battersbyi* TAYLOR, 1960 (SOMAN 1975; PILLAI & RAVICHANDRAN 1999) the only caeciliid species known from Maharashtra at that time. At the time of its description 36 years later, no further specimens were known and nothing was known of the animal in life. Here we report the rediscovery of *G. seshachari*, provide a comparison of the new specimen with the holotype, and discuss the implications of our findings.

MATERIALS AND METHODS

On October 18th and 19th 2003, a visit was made to the village of Dorle (16°46.35' N, 73°20.8' E) which, contra GRANDISON & SOMAN (1963), lies within the Taluka (administrative region) of Ratnagiri rather than Rajapura. Dorle receives annual rainfall of 2800 mm (SOMAN 1975) and ranges from just above sea level to about 75 m. It lies close to the coast, with the lower margins of the village including brackish water habitats. Dorle village is largely shady, with plantations including coconut, areca nut and banana occurring around and among housing (SOMAN 1975; Fig. 1a). Inland, the village is surrounded by a raised (c. 75 m a.s.l.) plateau that at the time of the visit was covered in a mosaic of rice paddy and other crops, scrub, grassland, and bare rock dotted with scattered boulders, rocks and small pools that were drying out. This mostly open

plateau area (Fig. 1b, see also GRANDISON & SOMAN 1963: plate 1; SOMAN 1975) is a very different habitat to that in and immediately surrounding the village, and in October 2003 was notably hotter and drier.

Early in the night of October 18th, approximately 20 person hours were carried out in searching for amphibians and reptiles by visual encounter, including turning over rocks. Most of this time was spent on the plateau, but some searching also took place within the lowest levels of the village. On the morning of October 19th, approximately three person hours of digging was conducted in mixed plantations and gardens within the village, and a further three person hours of searching on the surrounding plateau, in and around small pools, but mostly under rocks.

RESULTS

On the morning of October 19th, a single caecilian was found, by digging, in the top 10 cm of firm soil in a mixed plantation within the lower part of the village. This was accessioned into the collection of the Bombay Natural History Society, Mumbai (BNHS 4231) and identified as *Gegeneophis seshachari*. Comparative morphometric and meristic data for BNHS 4231 and the holotype are presented in Table 1. Whereas no gonads could be found in the holotype, tiny ova were visible through an incision into the body cavity of BNHS 4231 which is about 10% smaller than the holotype but has a disproportionately shorter head and narrower body at the level of the vent. Sexual dimorphism in the relative sizes of the head (NUSSBAUM 1985; NUSSBAUM & PFRENDER 1998; JONES et al. 2006) and body terminus (GUDYNAS et al. 1988) in some other caecilians suggest that the holotype may be an immature male.

There are several differences between BNHS 4231 (Fig. 2) and the holotype of *G. seshachari* as described by RAVICHANDRAN et al. (2003). In the new specimen, the tentacular regions are not strongly bulging in

dorsal view. The margin of the upper lip in lateral view is not straight but slightly concave. In ventral view, the anterior margin of the lower jaw is not much more broadly rounded than the corresponding margin of the snout tip. The eye is more clearly visible, through clearer skin, both in preservative and in life, but no lens can be discerned. Viewed laterally, the eye lies slightly closer to the margin of the upper lip (equidistant from the lip and dorsal margin of the head in the holotype). The nuchal region is discernibly thicker than the back of the head and marginally thicker than the anterior of the rest of the body. The first nuchal groove is broadly incomplete midventrally. The faint second nuchal groove is possibly incomplete middorsally. The middorsal sinusoidal curve of the first nuchal groove is barely discernible, and the second nuchal groove does not appear to be curved. The transverse dorsal groove on the second collar is slightly closer to the second nuchal groove instead of to the third. Some annular grooves are complete midventrally as far anterior as the 32nd primary annulus. The seven annular grooves anterior to the vent

Table 1. Data for the holotype (ZSIC A3384) and a second specimen (BNHS 4231) of *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003. Morphometric data are given in mm. L - left; R - right. * - count made by doubling the number of teeth and empty sockets detected on one side.

Tab. 1: Daten zum Holotypus (ZSIC A3384) und einem zweiten Exemplar (BNHS 4231) von *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003. Längenangaben in mm. A. - Abstand. L - links; R - rechts; * - Zählwert erhalten durch Verdoppelung der Zahl von Zähnen und unbesetzten Zahnbefestigungsstellen einer Seite.

	ZSIC A3384	BNHS 4231
Maturity and sex / Reife und Geschlecht	immature / unreif	immature female / unreifes Weibchen
Total length / Gesamtlänge	116	103
Distance between external nares / A. zwischen den äußeren Nasenöffnungen	0.9	0.8
Distance between tentacles / A. zwischen den Tentakeln	1.8	1.4
Distance between eyes / A. zwischen den Augen	1.8	1.4
Distance between eye and naris / A. Auge - Nasenöffnung	1.4	1.3
Distance between snout tip and eye / A. Schnauzenspitze - Auge	1.9	1.6
Distance between snout tip and tentacle / A. Schnauzenspitze - Tentakel	1.3	1.0
Distance between snout tip and jaw angle / A. Schnauzenspitze - Mundwinkel	3.0	2.4
Distance from snout tip to midpoint between front of eyes / A. Schnauzenspitze - Mitte der Verbindungslinie der Augenvorderränder	1.7	1.5
Distance between jaw angle and tip of lower jaw / A. Mundwinkel - Vorderes Ende des Unterkiefers	2.4	2.0
Distance between jaw angle and tentacle / A. Mundwinkel - Tentakel	1.7	1.3
Snout tip to lateral part of first nuchal collar groove / A. zwischen Schnauzenspitze und erster Nackenfurche	4.0	3.4
Head width at level of jaw angles / Kopfbreite auf Höhe der Mundwinkel	2.2	2
Head width at level of first nuchal collar groove / Kopfbreite auf Höhe der ersten Nackenfurche	2.3	2.2
Width of body at level of vent / Rumpfbreite auf Kloakenhöhe	2.4	1.8
Circumference at midbody / Körperumfang in Rumpfmittle	11	10
Length of terminal shield / Länge des Terminalschildes	3.7	1.9
Width of disc surrounding vent / Breite der Kloakalscheibe	0.9	0.9
Distance between vent and body terminus / A. Kloakalöffnung - Schwanzende	0.7	0.8
Primary annuli / Primäre Annuli	122	126 (L), 127 (R)
Premaxillary-maxillary teeth / Prämaxillar-Maxillar-Zähne	21	23
Vomeropalatine teeth / Vomero-Palatinal-Zähne	20*	22
Dentary teeth / Zähne auf dem Dentale	18	16
Splennial teeth / Zähne auf dem Spleniale	3	2

are not complete midventrally. Middorsally, the annular grooves are intermittently complete, most clearly anteriorly. The terminal shield is not bulbous and has a faint terminal keel, expressed as a vertical, posterodorsal dark stripe lacking the pronounced whitish glands of adjacent skin. In life, the keel appeared slightly raised but it is very poorly indicated in the preserved specimen. The disc surrounding the vent is not elevated and bears five (not six), more regular anterior and six (not seven) posterior denticulations. The choanae are separated by about the width, rather than almost twice the width, of one choana – further emphasising the relatively larger head of the holotype. The dorsal surface of the tongue bears no obvious grooves. As reported for the holotype, examination of the mouth was difficult

without damaging the specimen. A concerted effort failed to detect multiple cusps (a faint indication of a second cusp on some vomeropalatine teeth was reported for the type) but we are not confident that all teeth are monocuspid. There is possibly a single tooth position diastema between the vomerine and palatine series, in which case the combined vomeropalatine count for tooth positions given in Table 1 is an overestimate by two.

In preservative, BNHS 4231 only approaches a clear bicoloured pattern on the right side, and the transition from dark dorsum to paler venter is generally more gradual than in the type. The dorsum is a lilac-grey brown (rather than grey). The lateral region between the jaw angle and collar region is notably pale. The body terminus is

a little greyer dorsally but not notably paler than the adjacent body. The dorsal surface of the head is browner (not olive) than the adjacent body. The lateral surfaces of the lower jaws are not so notably pale, and the pale area on the chin extends back onto the underside of the first collar. The paler, whitish disc surrounding the vent has a few dark flecks. The tip of the lower jaw is paler than the top of the head.

Some of the differences between ZSIC A3384 and BNHS 4231 might be attributed to differences in mode and duration of preservation. Thus, the relatively shorter terminal shield and greater number of primary annuli counted for BNHS 4231 might be due to faint, incomplete posterior annular grooves being more visible in this newer specimen, the relatively wider disc surrounding the vent and relatively greater distance between vent and body terminus in the new specimen might be related to less shrinkage in BNHS 4231, and colour differences are largely attributable to greater fading of the older holotype. Meristics (annular and tooth counts) are similar, there are no obvious differences in body proportions, and, with the exception of the terminal keel, differences do not exceed those expected for conspecifics. Importantly, both specimens lack secondary annuli and have an unsegmented terminal shield, features that are unique to *G. seshachari* among Indian (and Asian) caecilians.

RAVICHANDRAN et al. (2003) compared *G. seshachari* with various genera of caeciliids that lack secondary annuli and scales, and noted that it differed from the East African *Boulengerula* in having eyes that are visible externally, and in lacking a terminal keel. The terminal keel of BNHS 4231 is poorly developed, and detailed similarity to the more pronounced keels of *Boulengerula* would need to be demonstrated to seriously challenge RAVICHANDRAN et al.'s (2003) assignment to *Gegeneophis*, which we follow here with the implication that the keels are convergent. Furthermore, *G. seshachari* resembles other *Gegeneophis* and differs from all species of *Boulengerula* in having narial plugs. GIRI et al. (2003) presented a key to the species of *Gegeneophis* that is unaffected by the findings presented here.

In life, the body of BNHS 4231 was a dark purple-pink becoming paler ventrally, and greyer posteriorly. The head was a paler shade of pink-grey with some whitish areas, most noticeably the eye-tentacle stripe and around the nares. The eye was clearly visible. The ventral surface of the snout, chin, and throat were white, except for the pinkish (blood infused) mentum. RAVICHANDRAN et al. (2003) described the annular grooves of the holotype as slightly whitish, but in the second specimen they were marked by a dark crease bordered posteriorly by a line of tiny whitish spots betraying underlying dermal glands. The

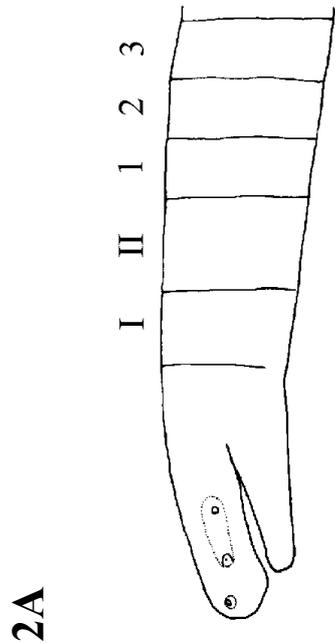
Figs. 1 and 2 (opposite page). / Abb. 1 und 2 (gegenüberliegende Seite).

Fig. 1. Habitats in the vicinity of Dorle, Maharashtra, the type locality of *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003. A – Area at the lowest levels of the village just above sea level, with mixed plantations bordering brackish water environments. B – Drier, higher (c. 75 m a.s.l.) plateau above most of the village, with scrub, grassland, and scattered boulders.

Abb. 1. Lebensraum nahe dem Dorf Dorle, Maharashtra, der Typuslokalität von *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003. A – Gebiet an der tiefsten Stelle der Dorfes unmittelbar über Meeressniveau, mit gemischten Pflanzungen am Rande brackischer Gebiete. B – Trockeneres, höher gelegenes (ca. 75 m ü. M.) Plateau oberhalb des Großteils des Dorfes, mit Busch, Grasland und verstreuten Felsblöcken.

Fig. 2: Morphology of the second known specimen of *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003 (BNHS 4231). A – Drawing (from a photograph) of the head and anterior of the body in lateral view. Collars labelled with Roman numerals; annuli labelled with Arabic numerals. The areas demarcated with dotted lines around the nostril and tentacle + eye are lacking pigment in life. B – Photograph in life of the posterior end of the body in lateral view, showing the unsegmented terminal shield. See Table 1 for dimensions.

Abb. 2: Morphologie des zweiten bekannt gewordenen Exemplars von *Gegeneophis seshachari* RAVICHANDRAN, GOWER & WILKINSON, 2003 (BNHS 4231). A – Kopf und Vorderrumpf von lateral (nach einer Photographie). Halsbänder mit römischen, Annuli mit arabischen Ziffern bezeichnet. Die von punktierten Linien begrenzten Areale um die Nasenöffnung und um Tentakel + Auge sind beim lebenden Tier unpigmentiert. B – Körperhinterende (Foto des lebenden Tieres) von lateral mit dem unsegmentierten terminalen Schild. Abmessungen siehe Tab. 1.



terminal shield was not immediately obvious to the naked eye because the posterior-most annular grooves are not the most clearly marked. The shield was grey with small

whitish glands becoming more abundant towards the posterior end of the body. The dark grey terminal keel was obvious to the naked eye.

DISCUSSION

SOMAN (1975) reported that he came across the holotype while collecting the viper *Echis carinatus* (SCHNEIDER, 1801) from under stones. It is unclear if this was in the shady village (where BNHS 4231 was found) or on the surrounding plateau. We found *E. carinatus* but no caecilians under rocks on the plateau, and one caecilian but no *E. carinatus* in the village. At the time of our visit, the plateau seemed to us to be too dry and hot to be hospitable to caecilians. However, SOMAN collected the holotype in August, during the monsoon, at which time conditions on the plateau may be more favourable to caecilians. The caeciliid *Indotyphlus maharashtraensis* GIRI, GOWER & WILKINSON, 2004 is known from not too dissimilar (though higher altitude) open plateau habitats elsewhere in Maharashtra (GIRI et al. 2004).

We are unaware of any attempts to find caecilians in the vicinity of Dorle in the 36 years between the discovery of the holotype and our recent rediscovery. The holotype was a bycatch of a search for snakes rather than the result of an effort to locate caecilians, so that our brief dig in agricultural soil close to housing is almost certainly the first dedicated attempt to find caecilians at Dorle.

Our successful search confirms that *G. seshachari* is extant and further demonstrates that, for subterranean vertebrates, a long period since the last verified report is, in the absence of appropriate sampling, not necessarily cause for concern (GOWER et al. 2004; MALONZA & MÜLLER 2004; GOWER & WILKINSON 2005). It also provides another example of a caecilian species that can survive in intimately synanthropic habitats (e.g. MEASEY et al. 2003; GOWER et al. 2004; GOWER & WILKINSON 2005). The small amount of digging conducted on October 19th was restricted to shady, mixed plantations and gardens, so that future effort might make comparable searches for *G. seshachari* and other caecilians among other crops (e.g. paddy fields) and scrub in the immediate vicinity of Dorle, and on the raised plateaus surrounding the village.

Although now known to be extant, *G. seshachari* is still of 'data deficient' conservation status. Lowland coastal Maharashtra contains large areas of habitat that appear to be similar to that in which the second specimen of *G. seshachari* was collected. Future fieldwork is required to make a preliminary assessment of abundance and distribution of this species.

ACKNOWLEDGEMENTS

We thank the very hospitable people of Dorle (especially Mr Uday KORGAONKAR) for their enthusiastic and invaluable assistance. Ishan AGARWAL and Sameer KEHIMKAR helped with fieldwork. Hendrik MÜLLER provided useful comments on an earlier draft of this paper and translated the abstract. Our caecilian research

has been made possible with the support of N. CHATURVEDI and A. R. RAHMANI of the Bombay Natural History Society. DJG and MW were able to visit Maharashtra thanks to a ZRF award from the Natural History Museum. VG was supported in part by a seed grant from the Declining Amphibian Population Task Force.

REFERENCES

- GIRI, V. & WILKINSON, M. & GOWER, D. J. (2003): A new species of *Gegeneophis* PETERS (Amphibia: Gymnophiona: Caeciliidae) from the Western Ghats of southern Maharashtra, India, with a key to the species of the genus.- *Zootaxa*, Auckland; 351: 1-10.
- GIRI, V. & GOWER, D. J. & WILKINSON, M. (2004): A new species of *Indotyphlus* TAYLOR (Amphibia: Gymnophiona: Caeciliidae) from the Western Ghats, India.- *Zootaxa*, Auckland; 739: 1-19.
- GOWER, D. J. & LOADER, S. P. & WILKINSON, M. (2004): Conservation assessments of soil-

- dwelling vertebrates: insights from the rediscovery of *Typhlops uluguruensis* (Reptilia: Serpentes: Typhlopidae).- Systematics and Biodiversity, Cambridge; 2: 79-82.
- GOWER, D. J. & WILKINSON, M. (2005): Conservation biology of caecilian amphibians (Gymnophiona).- Conservation Biology, Boston; 19: 45-55.
- GRANDISON, A. C. & SOMAN, P. W. (1963): Description of a new geckonid lizard from Maharashtra, India.- Journal of the Bombay Natural History Society, Mumbai; 60: 322-325.
- GUDYNAS, E. & JORGE, D. W. & AZPÉLICUETA, M. (1988): Morphology, ecology and biogeography of the South American caecilian *Chthonerpeton indistinctum* (Amphibia: Gymnophiona: Typhlonectidae).- Zoologische Mededelingen, Leiden; 62: 5-28.
- JONES, D. T. & LOADER, S. P. & GOWER, D. J. (2006): Trophic ecology of East African caecilians (Amphibia: Gymnophiona), and their impact on forest soil invertebrates.- Journal of Zoology, London; 269: 117-126.
- MALONZA, P. K. & MÜLLER, H. (2004): A rediscovery after two decades: the Changamwe lowland caecilian *Boulengerula changamwensis* LOVERIDGE, 1932 (Amphibia: Gymnophiona: Caeciliidae).- Journal of East African Natural History, Nairobi; 93:57-61.
- MEASEY, G. J. & GOWER, D. J. & OOMMEN, O. V. & WILKINSON, M. (2003): Quantitative surveying of limbless endogeic vertebrates – a case study of *Gegeneophis ramaswamii* (Amphibia: Gymnophiona) in southern India.- Applied Soil Ecology, Amsterdam; 23: 43-53.
- NUSSBAUM, R. A. (1985): Systematics of caecilians (Amphibia: Gymnophiona) of the family Scolecophoridae.- Occasional Papers, Museum of Zoology, University of Michigan, Ann Arbor; 713: 1-49.
- NUSSBAUM, R. A. & HINKEL, H. (1994): Revision of East African caecilians of the genera *Afrocaecilia* TAYLOR and *Boulengerula* TORNIER (Amphibia: Gymnophiona: Caeciliidae).- Copeia, New York; 1994: 750-760.
- NUSSBAUM, R. A. & PFRENDER, M. E. (1998): Revision of the African caecilian genus *Schistometopum* PARKER (Amphibia: Gymnophiona: Caeciliidae).- Miscellaneous Publications, Museum of Zoology, University of Michigan, Ann Arbor; 187: 1-32.
- PILLAI, R. S. & RAVICHANDRAN, M. S. (1999): Gymnophiona (Amphibia) of India. A taxonomic study.- Records of the Zoological Survey of India, Occasional Papers, Kolkata; 72: 1-117.
- RAVICHANDRAN, M. S. & GOWER, D. J. & WILKINSON, M. (2003): A new species of *Gegeneophis* PETERS (Amphibia: Gymnophiona: Caeciliidae) from Maharashtra, India.- Zootaxa, Auckland; 350: 1-8.
- SOMAN, P. W. (1975): Occurrence of the caecilian *Indotyphlus battersbyi* TAYLOR in RATNAGIRI.- Journal of the Zoological Society of India, Kolkata; 27: 176-177.
- WILKINSON, M. & LOADER, S. P. & MÜLLER, H. & GOWER, D. J. (2004): Taxonomic status and phylogenetic relationships of *Boulengerula denhardtii* NIEDEN, 1912 (Amphibia, Gymnophiona, Caeciliidae).- Mitteilungen aus dem Museum für Naturkunde Berlin, Zoologische Reihe, Berlin; 80: 41-51.

DATE OF SUBMISSION: September 17, 2005

Corresponding editor: Heinz Grillitsch

David J. GOWER, Department of Zoology, The Natural History Museum, London SW7 5BD, UK < d.gower@nhm.ac.uk >; Varad GIRI, Bombay Natural History Society, Hornbill House, Dr Sálím Ali Chowk, S. B. S. Road, Mumbai 400 023, India, Mark WILKINSON, Department of Zoology, The Natural History Museum, London SW7 5BD, UK