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## Identity and Description of *Garra maclellandi* (Jerdon, 1849) from the Type Locality, and a Neotype Designation from Cauvery River Basin, Southern India.

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### Research Article

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#### ABSTRACT

*Gonorrhynchus maclellandi* was described from Bhavani River at the foothills of Nilgiris in Tamil Nadu and Manantawady River in Wayanad (Kerala), of Western Ghats (Jerdon, 1849). As there are no types available for all the species described by Jerdon from southern India, *Gonorrhynchus maclellandi* was redescribed by Silas (1958) and placed in the genus *Garra*. However, the species description and figure provided for *G. maclellandi* seems to be doubtful as per the original description of this species. We collected one specimen from the type locality and upon close examination we found that the specimen was consistent in features as outlined in the description by Jerdon. *Garra maclellandi* is part of the group of species of *Garra* in India having 16 circumpeduncular scales. This species is distinguishable from closely related species, *Garra platycephala* and *Garra jerdoni*, and diagnosed from all other species of *Garra* reported from Peninsular India. With the findings reported herein and the absence of any types for *Garra maclellandi* (Jerdon) we designate a neotype for the species.

#### INTRODUCTION

*Gonorrhynchus maclellandi* was described from Bhavani River at the foothills of Nilgiris in the Tamil Nadu and Manantawady River in Wayanad (Kerala) part of Western Ghats [4]. The species is characterized (as per Jerdon) by having 36 scales along the body (lateral line) in 9 rows (lateral transverse) and a dorsal profile rising from occiput to dorsal-fin origin. Since its description the identity of this species has been largely controversial. Since no types are available for almost all the species described by Jerdon and revisionary studies are underway for the genus *Garra* it is now essential to designate a neotype for this species after a period of 163 years. Silas [8] tried to identify *Gonorrhynchus gotyla* (Jerdon) and *Gonorrhynchus maclellandi* as *Garra stenorrhynchus* and *Garra maclellandi*, but the figure provided for *G. maclellandi* appears untenable. Furthermore, a recent collection from Manantawady River in Wayanad contains a single specimen almost identical to *G. maclellandi* as described by Jerdon. Here we redescribe *G. maclellandi* based on the topotype and designate the specimen as neotype. We compared All recognized and valid species of *Garra* thus far reported from the Western Ghats, peninsular India, were examined and are compared to the species.

#### MATERIALS AND METHODS

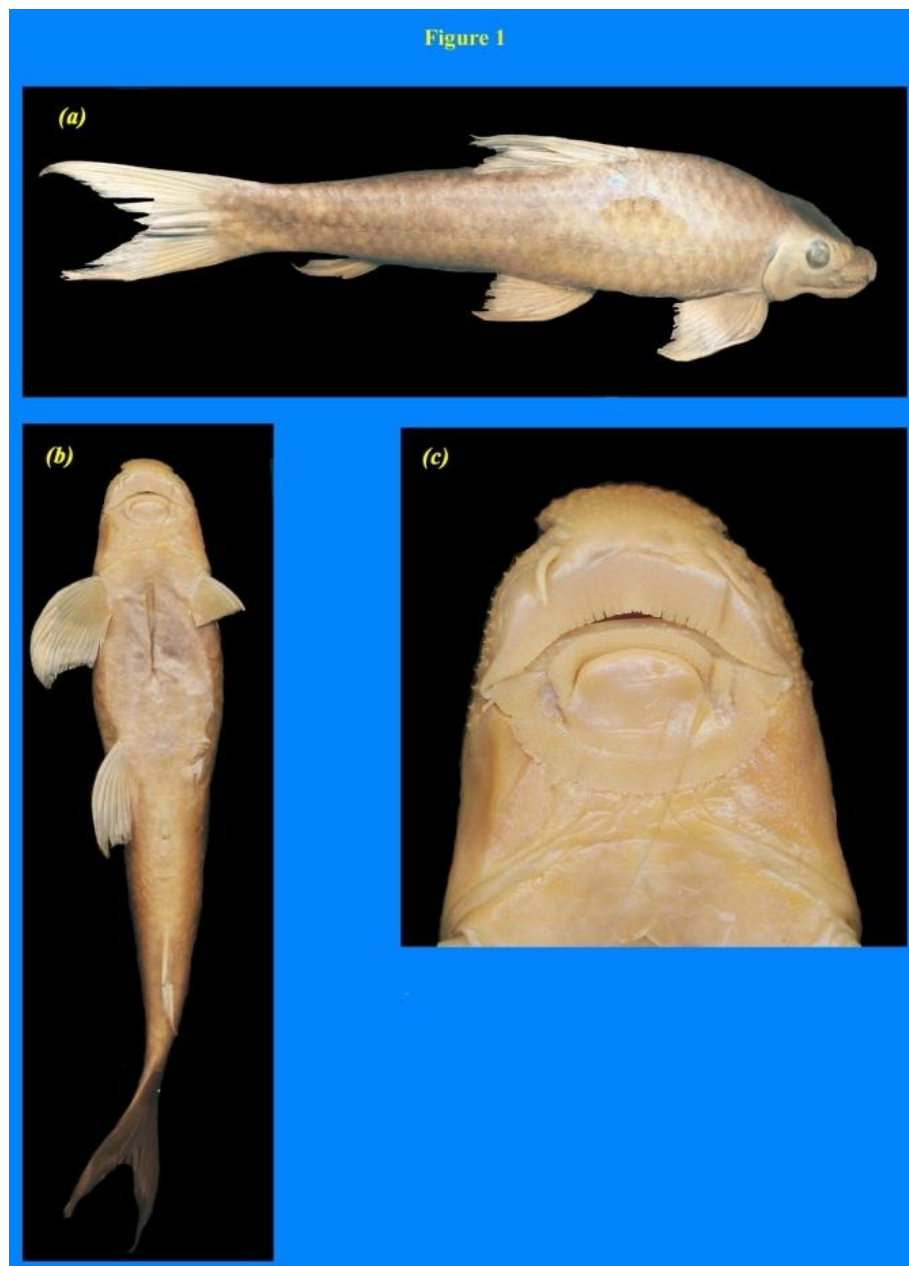
Abbreviations used herein include SL = Standard Length, HL = Head Length, ZSI/SRS/SRC = Zoological Survey of India/Southern Regional Station/Southern Regional Centre, F = Fish, FF = Freshwater

Fish, MSUMNH = Manonmaniam Sundaranar University Museum of Natural History, (MSUMNH) in Alwarkurichi, India, CMA = Collection of M. Arunachalam. Methods for measurements and counts follow those of Hubbs and Lagler [3]. Measurements were taken to the nearest 0.1 mm using digital calipers. Body measurements are expressed as percentage of Standard Length (%SL); head measurements are expressed as percentage of Head Length (%HL). Distance between pectoral-fin origin and vent and distance between pelvic-fin origin and vent are also taken for the present study.

Meristic and morphometric characters such as disc length, disc width, central-pad length, central-pad width, post-dorsal length and body depth follow methods outlined by Kullander and Fang [5]. As noted by the latter authors, lip structures serve as important characters for the diagnosis and identification of most species of *Garra* and are also important in resolving phylogenetic relationships.

#### DESCRIPTION OF THE NEOTYPE

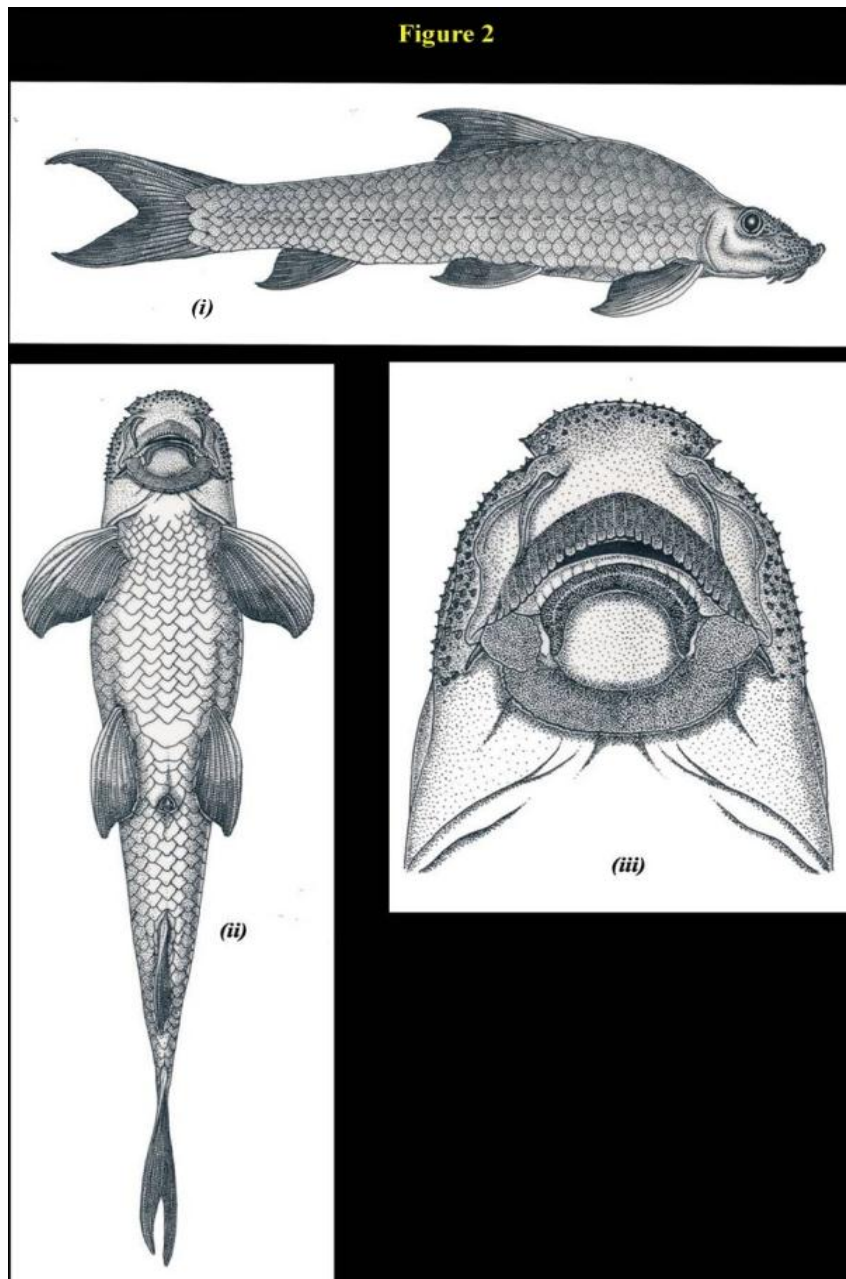
##### *Garra maclellandi*



(a) Lateral view of *Garra maclellandi*

(b) Ventral view of *Garra maclellandi*

(c) Oral view of *Garra maclellandi* in caudoventral aspect to show papillose upper lip



Line drawings of lateral (i), ventral (ii) oral views of *Garra maclellandi* collected from Nulpuzha, Wayanad Wildlife Sanctuary, Kabini Drainage, Tirunelli, and Kerala.

MSUMNH C-7, 1 ex. Male. 157.57 mm SL, Mananthavadi, Wayanad Wildlife Sanctuary, Kabini River, Kerala, India (N 12° 13' 0" E 76° 54' 39"), Collectors: M. Arunachalam, P. Kumar and A. Johnson. 13 September 1998.

#### Diagnosis

*Garra maclellandi* is differentiated from *G. jerdoni* (Fig. 3) by a shorter caudal peduncle (7.6 in SL vs. 7.3 in SL); shorter distance between dorsal-fin origin to pelvic-fin insertion (4.5 vs. 4.9 in SL); shorter height of anal-fin (5.9 vs. 6.2 times in SL); deeper caudal peduncle (10 vs. 8.4 in SL); greater distance between occiput and dorsal-fin origin (4.3 vs. 3.5 times in SL); greater distance between occiput and pectoral-fin insertion (6.7 vs. 6.3 times in SL); shorter distance between dorsal-fin insertion and pelvic-fin insertion (5.7 vs. 6.5 times in SL); shorter distance between dorsal-fin origin and pectoral-fin insertion (3.8 vs. 4.4 times in SL); greater distance between pectoral-fin and pelvic-fin insertions (4.0 vs. 3.3 times in SL); shorter distance between pelvic-fin origin and vent (6.0 vs. 7.3 times in SL); greater orbit width (4.7 vs. 3.5

times in HL); greater length of central pad (4.6 vs. 4.0 times in HL); and greater width of central pad (4.4 vs. 2.7 times in HL). (Table 1)

*Garra mccllelandi* can be distinguished from *G. platycephala* (Fig. 3) by a greater caudal peduncle length (7.6 vs. 6.9 times in SL); shorter distance between dorsal-fin origin and pelvic-fin insertion (4.5 vs. 5.0 times in SL); greater height of anal-fin (5.9 vs. 5.5 times in SL); shorter distance between occiput and dorsal-fin origin (4.3 vs. 4.7 times in SL); greater distance between occiput and insertion of pectoral-fin (6.7 vs. 4.5 times in SL); shorter distance between dorsal-fin origin and pelvic-fin insertion (5.7 vs. 6.7 times in SL); shorter distance between dorsal-fin origin and pectoral-fin insertion (3.8 vs. 4.4 times in SL); greater distance between pectoral-fin insertion and pelvic-fin insertion (4.0 vs. 3.3 times in SL); shorter distance between pelvic fin origin and vent (6.0 vs. 6.5 times in SL); shorter snout (1.7 vs. 3.4 times in HL); greater orbital width (4.7 vs. 3.5 times in HL); shorter length of central pad (4.6 vs. 4.0 times in HL); and greater width of central pad (4.4 vs. 2.7 times in HL).

*Garra mccllelandi* (Jerdon) is distinguished from topotypes of *G. mullya* from Maharashtra, South India by more lateral-line scales (35 vs. 32-34); more anal scale rows (7 vs. 3-4.5); and raised dorsal profile of body (vs. stright). (Table 2)

*Garra mccllelandi* (Jerdon) is distinguished from *G. gotyla stenorhynchus* in having greater number of lateral-line scale rows (35 vs. 33-34); greater number of anal scale rows (7 vs. 3-5); and no proboscis (vs. single median proboscis).

*Garra mccllelandi* (Jerdon) is distinguished from *G. bicornuta* in having more lateral-line scale rows (35 vs. 32); more circumpeduncular scale rows (15 vs. 12); more anal scale rows (7 vs. 3-4); and no proboscis (vs. well developed bi-lobed proboscis).

*Garra mccllelandi* (Jerdon) can be differentiated from *Garra kalakadensis* by fewer caudal-fin rays (9+8 vs. 10+9); more number of lateral-line scales (35 vs. 32-33); more number of circumpeduncular scales (15 vs. 12-14) and more number of anal scale rows (7 vs. 2-2.5).

It shows distinction with *Garra surendranathanii* by more number of branched pectoral-fin rays (15 vs. 12); less number of lateral-line scales (35 vs. 36); more number of pre anal scales (20 vs. 11-14) and presence of deep transverse groove on snout (vs. absent).

*Garra mccllelandi* (Jerdon) is distinguished from *Garra periyarensis* by less lateral-line scales (35 vs. 38-39); more circumpeduncular scales (15-16 vs. 12); more circumferential scales (22 vs. 18) and presence of scales in chest and belly (vs. absent).

*Garra mccllelandi* (Jerdon) showed differences with *Garra menoni* by presence of scales on chest and belly (vs. absent).

*Garra mccllelandi* (Jerdon) is distinguished from *Garra hughi* by presence of pre dorsal scales (vs. absent); less number of lateral-line scales (35 vs. 36-37); presence of scales in chest and belly (vs. absent) and more number of scales between lateral-line to pelvic-fin origin (3.5 vs. 2.5).

It shows difference with *Garra mlapparaensis* by more branched pelvic-fin rays (8 vs. 7); more number of unbranched anal-fin rays (3 vs. 1); more branched pectoral-fin rays (15 vs. 12); less number of caudal-fin rays (9+8 vs. 10+9); less pre-dorsal scales (10 vs. 12); and more number of circumpeduncular scales (16 vs. 12).

*Garra mccllelandi* (Jerdon) is distinguished from *Garra emarginata* by more unbranched anal-fin rays (3 vs. 1); more branched pelvic-fin rays (8 vs. 7); less number of caudal-fin rays (9+8 vs. 10+9); less pre-dorsal scales (10 vs. 11-12); more number of circumpeduncular scales (16 vs. 12) and less pre anal scales (20 vs. 26).

## Description

Body elongate and sub-cylindrical; body depth 5.0 times in SL. Head flat or slightly concave in the single largest specimen; its length 4.7 times in SL. Snout conical and smooth; its tip marked off by a transverse groove, and large number of prominent areas of tubercles; its length is 1.7 times in HL. Mouth

wide; length of upper jaw 2.8 times in HL. Two pairs of barbels, rostral barbels shorter than eye-diameter; maxillary barbels rather rudimentary and placed in labial groove.

Dorsal-fin inserted distinctly nearer tip of snout than to base of caudal-fin; pre-dorsal-fin length 2.3 times in SL; post-dorsal-fin length 1.7 times in SL. Pectoral-fin length is about equal to head length; its length is 4.8 times in SL; pelvic-fin length 5.1 times in SL. Dorsal-fin origin is anterior to the pelvic-fin origin. Its upper edge concave and is moderately high 3.9 times in SL. Distance between pectoral-fin to vent is 2.3 times in SL; distance between pelvic-fin to vent is 6.0 times in SL; distance between pectoral-fin insertion to pelvic-fin insertion is 4.0 times in SL; distance between pectoral-fin insertion to anal-fin origin is 1.9 times in SL; distance between pelvic-fin insertion to anal-fin origin is 4.0 times in SL.

Caudal-fin deeply forked; upper lobe longer than lower lobe. Length of caudal peduncle 3.3 times in SL; depth of caudal peduncle 10 times in SL. Distance from vent to anal fin origin is 2.1 times to the distance between pelvic-fin insertion and anal-fin origin.

Mental disc well-developed; disc length 2.9 times in HL; disc width 2.0 times in HL; central-pad length 4.6 times in HL; central-pad width 4.4 times in HL.

Scales moderate-sized; lateral-line scale rows 35 (1); predorsal scale rows 10 (1); upper transverse scale rows 4.5 (1); scale rows from lateral-line to pelvic-fin insertion 3.5 (1); lower transverse scale rows 4.5 (1); circumpeduncular scale rows 16 (1); circumferential scale rows 22 (1); scale between vent and anal-fin, 7 (1); chest and belly scaled. Fins long; dorsal-fin rays ii, 8 (1); anal- fin rays iii, 5 (1); pelvic- fin rays i, 8 (1); pectoral- fin rays i, 15 (1).

#### Colour (as per original description)

In life, olivaceous, fading to yellowish on flanks and belly; black spot behind upper angle of gill-opening. Dorsal, anal and caudal-fins yellowish with grey markings; paired fins yellowish, with outer edges dark grey and margins orange.

In alcohol, dark grey above, paler beneath; black spot behind the upper angle of gill-openings; sides of young specimens with distinct dark mid-lateral stripe from opercle to base of caudal fin in; in larger specimens stripe merges with the dark grey of the upper half of body.

#### Geographic Distribution

India: Cauvery drainage, Nilgiri District, Tamil Nadu and tributaries of Cauvery River in Kerala.

#### DISCUSSION

While reviewing the systematic position of *Garra mccllellandi* (Jerdon) based on his fresh collections from Cauvery River Silas <sup>[8]</sup> discussed *G. mccllellandi* as being characterized as having 35-37 lateral-line scales, 10-11 predorsal scales, 15-16 scales around caudal peduncle (circumpeduncular scales), 6.5-8.0 scales between vent and origin of anal-fin (anal scale rows), 4-4.5 scales between lateral-line and origin of dorsal-fin (upper transverse rows), and 2.5-3.5 scales between lateral-line and insertion of pelvic-fin (lateral-line to pelvic scale rows). The single specimen recently sampled from the Mananthavadi River in Wayanad possessed 35 lateral-line scales, 10 predorsal scales, 15 circumpeduncular scales, 4.5 upper transverse scale rows, 3.5 scales between lateral-line and insertion of pelvic-fin and 7 anal scale rows. All of these traits are within the ranges identified by Silas. However, Jerdon <sup>[4]</sup> described the dorsal profile as rising, slightly convex from occiput to caudal peduncle. The recently captured species that we argue to be *G. mccllellandi* has a raised dorsal profile. The figure by Silas of the specimen he thought to be *G. mccllellandi* (1958; p.529; figure. d) showed a flat and straight dorsal profile; however, the specimen from which this illustration is based could not be traced to the specimens collected by him in either the Zoological Survey of India or in any other institutes where he would have deposited specimens. In addition, Silas mentioned that his specimens of *G. mccllellandi* differed from *G. platycephala* Rao <sup>[6]</sup> in having 37-39 lateral line scales, but the holotype of the specimen in ZSI (F 9816/1) had 37 lateral-line scales as figured in the specimen; thus, the illustrated specimen in Silas is more consistent with descriptive information for *G. platycephala* and may actually belong to this species. The diagnostic characters of *G. platycephala* and *G. mccllellandi* are 3 unbranched dorsal-fin rays in *G. platycephala* whereas 2 unbranched dorsal-fin rays *G. mccllellandi*; similarly in comparisons as above number of unbranched anal-fin rays are 2 vs. 3; lower transverse scales 3.5 vs. 4.5 (are counted on a

backward diagonal from the lateral-line to and includes the midline scale row between the anus and anal-fin. Hubbs and Lagler [3] and Silas [8] also mentioned that Hora [2] considered *G. jerdoni* Day and *D. elegans* Annandale as conspecific with *G. maclellandi*.

*G. maclellandi* differs from *G. jerdoni* Day in having fewer unbranched dorsal-fin rays (2 vs. 3), greater number of unbranched anal-fin rays (3 vs. 2), more rows of lower transverse scales (4.5 v. 3.5) and a greater orbit width. However, Hora [2] and Silas [8] synonymised *G. jerdoni* with *G. platycephala*. Based on our examination of types of both *G. jerdoni* and *G. platycephala* we conclude that both are distinct species.

In the original description of *G. platycephala* Rao, head length is almost 5 times in SL and in the collection from ZSI HL/SL was 4.9, and the width of the orbit is close to that presented in the original description. In *G. platycephala* the snout and the dorsum are flattened while in *G. maclellandi* the dorsum is raised; *G. jerdoni* is already distinguished from these species based on meristic and morphometric characters above.

Shaji *et al.* [7], in describing *Garra surendranathani* from the Chalakudi River mentioned that *G. surendranathani* possesses spiny tubercles and that in *G. maclellandi* the tubercles are in a rosette shaped. While tubercles in the present specimen are rosette shaped the dorsal profile of the head of the specimen of *G. maclellandi* illustrated by Shaji *et al.* [7] is different from that of the present type designated herein. Moreover, there are no data on the collection of *G. maclellandi* in the paper by Shaji *et al.* [7] and also the voucher specimens are not tracable either in ZSI, Chennai or in ZSI, Western Region, Kozhicode, Kerala.

### Comparative Materials Examined

***Garra mullya*** (Sykes): MSUMNH – C2, Alwarkurichi, 4ex. 36.08-50.59mm SL; (Location: Bheema River, Krishnar River basin, Maharashtra, India, putative topotypes). Collected by: Dr. M. Arunachalam and Team. Date of collection: 26.11.1998.

***Garra gotyla stenorhynchus*** (Jerdon): MSUMNH – C3, Alwarkurichi, 15ex. 87.23-126.16 mm SL; (Location: Nellithurai, Bhavani River, Tamil Nadu, India, topotypes). Collected by: Dr. M. Arunachalam and Team. Date of collection: 02.02.2001.

***Garra bicornuta*** Rao: MSUMNH – C4, Alwarkurichi, 19ex. 59.6-138.5 mm SL; (Location: Thunga river at Thirthahalli, Karnataka, India, topotypes). Collected by: Dr. M. Arunachalam and Team. Date of collection: 19.01.2004.

***Garra kalakadensis*** Rema Devi: MSUMNH – C5, Alwarkurichi, 10ex. 54.4-74.0 mm SL; (Location: Kalakad, Tamiraparani River Basin, Tamil Nadu, India). Collected by: Dr. M. Arunachalam and Team. Date of collection: 10.02.2001.

***Garra hughi*** Silas: MSUMNH – C6, Alwarkurichi, 10ex. 47.0-62.6mm SL; (Location: Perumalmalai Stream, Kodaikanal, Tamil Nadu, India, topotypes). Collected by: Dr. M. Arunachalam and Team. Date of collection: 07.05.1996.

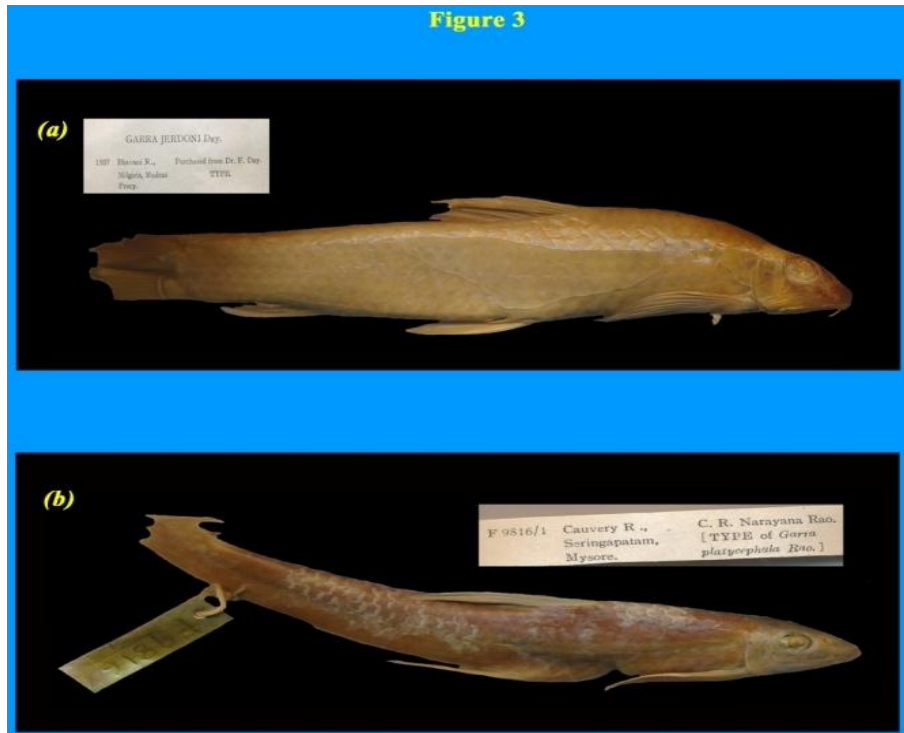
***Garra menoni*** Rema Devi and T.J. Indra: Holotype: ZSI/SRS, Chennai, F 553, 69.00 mm SL; (Location: Kunthi River, Silent Valley, Kerala, India). Collected by: R.S. Pillai. Date of collection: 19.01.1979.

***Garra periyarensis*** K.C. Gopi: Holotype: ZSI, CLT, No V/F 9426, 156.00 mm SL; Periyar River, Thanikkudy, Periyar Tiger Reserve, Kerala, India. Collected by: P.M. Sureshan. Date of collection: 07.11.1996. MSUMNH – C8, Alwarkurichi, 4ex. 142.5-160.1mm SL; (Location: Thuraiyar, Peachiparai range, Parambikulam Periyar Tiger Reserve, Kerala, India, topotypes). Collected by: Dr. M. Arunachalam and Team. Date of collection: 29.06.2009.

***Garra surendranathani*** Shaji, Arun and Easa: Holotype: ZSI/WGRS/9390, 147 mm SL; Orukomban, tributary of Chalakkudy river, Kerala, India. Collected by: Shaji, Arun and Easa. Date of collection: 12.03.1996. MSUMNH – C9, Alwarkurichi, 3ex. 111.35-122.09mm SL; (Location: Orukomban, Kerala, India, topotypes). Collected by: Dr. M. Arunachalam and Team. Date of collection: 20.12.2003.

**Garra emarginata** Madhusoodana Kurup and Radhakrishnan: Holotype: ZSI/WGRC/F2472, 85.72 mm SL; Pooyemkutti, Periyar River, Kerala, India. Collected by: K.V. Radhakrishnan. Date of collection: 11.06.2003. **Garra mlapparaensis** Madhusoodana Kurup and Radhakrishnan: Holotype: ZSI/WGRC/F2473, 74.53 mm SL; Mlappara, Periyar River, Kerala, India. Collected by: K.V. Radhakrishnan. Date of collection: 12.04.2002. **G. jerdoni** Day ZSI, Calcutta, F 1507, 160.56 mm SL; (Location: Bhavani River, Nilgiris, Tamil Nadu, India). Type Specimen purchased from Dr. Francis Day. (As per label in ZSI)

**Garra platycephala** Rao ZSI, Calcutta, F 9816/1, 104.29 mm SL; (Location: Cauvery River, Srirangapatnam, Mysore, Karnataka, India).



(a) *Garra jerdoni* – Type specimen F 1507 from ZSI, Kolkatta, West Bengal, India.  
 (b) *Garra platycephala* – Type specimen F 9816/1 from ZSI, Kolkatta, West Bengal, India.



Map showing collection site of *Garra maclellandi*.

Table 1: Comparative morphometric characters of species of *Garra* from peninsular India.

No.	Morphometric characters	MSUMNH-C7	MSUMNH-C2		MSUMNH-C3		MSUMNH-C4		MSUMNH-C5		Holotype	MSUMNH-C8	
		<i>Garra maclellandi</i> (Neotype)	<i>G. mullya</i>		<i>G. gotyla</i> <i>stenorhynchus</i>		<i>G. bicornuta</i>		<i>G. kalakadensis</i>		ZSI/SRS <i>G. menoni</i> F 553	<i>G. periyarensis</i>	
		Min	Min	Max	Min	Max	Min	Max	Min	Max	Min	Min	Max
	<b>Standard length</b>	<b>157.57</b>	<b>36.08</b>	<b>50.59</b>	<b>87.23</b>	<b>126.16</b>	<b>59.63</b>	<b>138.47</b>	<b>54.37</b>	<b>70.98</b>	<b>69.00</b>	<b>142.47</b>	<b>160.06</b>
2	Snout to urocentrum	94.42	94.76	96.18	92.47	96.04	79.55	95.43	91.95	93.88	93.22	92.85	94.01
3	Pre anal length	74.20	73.48	77.56	71.95	77.54	59.99	78.73	72.29	76.93	71.28	70.78	72.05
4	Pre dorsal length	42.34	45.09	50.52	25.29	45.26	34.82	46.77	45.06	48.21	49.35	39.10	40.33
5	Pre pelvic length	44.73	50.63	54.35	48.63	53.06	41.08	53.28	48.87	52.84	48.14	46.12	47.83
6	Pre pectoral length	18.79	21.96	23.78	19.32	22.50	15.81	23.11	21.00	23.03	20.61	19.09	40.12
18	Peduncle length	13.14	8.82	12.75	11.05	14.67	8.23	16.35	10.27	13.63	14.30	15.48	16.69
19	Dorsal origin / pelvic insert	22.03	22.17	27.25	22.54	26.09	22.04	27.91	17.34	22.22	15.32	17.27	19.50
21	Anal fin height	16.93	10.56	20.37	19.68	21.65	16.38	23.15	8.53	21.15	16.64	15.31	17.48
25	Peduncle depth	9.92	9.92	12.86	13.85	15.49	9.08	14.51	9.50	11.26	10.36	9.55	10.31
26	Caudal fin length	29.50	24.20	30.98	23.93	30.18	23.15	33.35	26.15	31.10	25.71	23.07	24.12
27	Dorsal fin height	25.33	23.44	28.29	21.27	28.31	23.78	33.67	22.69	24.60	18.96	22.26	24.00
28	Pectoral fin length	20.46	22.03	25.85	22.33	24.41	17.39	25.64	24.23	26.16	24.25	17.82	18.68
29	Pelvic fin length	19.34	13.05	23.01	19.51	21.25	16.52	25.22	19.96	21.68	18.23	16.33	18.06
33	Occiput to dorsal origin	22.86	23.80	26.40	21.76	26.36	17.89	25.85	22.66	26.64	31.51	18.57	19.95
34	Occiput to Pectoral insert	14.88	16.93	20.20	16.85	19.75	14.90	19.00	15.02	17.20	14.07	11.73	13.99
35	Occiput to Pelvic insertion	34.53	37.58	43.49	38.79	42.32	33.05	41.32	34.58	41.12	37.84	32.37	34.74
36	Dorsal insert to Pelvic insert	17.40	12.33	19.33	17.83	27.76	17.04	23.33	12.82	15.92	12.67	12.33	12.78
37	Dorsal origin \ Pectoral insert	26.07	21.59	26.56	24.48	28.20	22.29	29.45	20.63	24.85	23.96	19.98	21.60
38	Dorsal origin to anal org	40.41	37.47	39.86	36.45	41.30	31.93	42.00	31.83	36.48	30.57	34.44	36.25
39	Dorsal insertion / Caudal	40.86	31.23	33.04	31.89	36.91	29.14	37.81	32.16	38.24	36.36	40.70	42.68
40	Dorsal insertion / anal org	26.37	21.59	25.29	21.76	25.08	19.46	25.86	20.16	22.56	19.43	20.76	21.38
41	Dorsal insert \ anal insert	31.62	26.66	29.06	25.54	28.90	23.42	30.15	24.50	28.52	24.07	27.14	28.50
42	Dorsal fin base length	15.13	16.13	17.15	15.43	18.73	13.61	21.38	12.30	18.05	11.10	14.09	15.41
43	Anal fin base length	6.86	4.85	6.07	5.89	8.96	5.19	9.65	5.61	9.31	6.04	6.87	7.71
44	Pectoral insert / Pelvic insert	24.80	23.25	27.67	27.01	34.40	26.36	34.46	25.39	30.71	26.33	25.30	29.08
45	Pectoral insert \ anal origin	50.34	42.77	47.43	46.30	52.66	41.15	56.60	43.89	47.33	46.49	45.15	49.63
46	Pelvic insert to anal origin	24.67	16.96	21.12	17.22	45.88	16.57	21.83	15.29	19.63	18.42	19.51	20.89
49	Post-dorsal length	56.34	48.81	53.09	49.06	54.38	44.87	57.17	45.47	51.60	45.06	56.86	58.33
50	Body depth	19.93	20.01	25.53	20.77	25.45	20.18	26.47	16.21	19.51	13.81	13.36	13.83
51	Distance b/w pect fin / vent	42.29	43.07	47.35	45.68	51.85	39.46	52.55	45.31	51.22	46.33	40.58	44.08
52	Distance b/w pelvic fin / vent	16.53	14.86	19.93	15.21	19.75	14.73	20.67	16.36	21.39	17.41	13.51	15.28



No.	Morphometric characters	MSUMNH-C7 <i>Garra maclellandi</i> (Neotype)		MSUMNH-C2 <i>G. mulya</i>		MSUMNH-C3 <i>G. gotyla stenorrhynchus</i>		MSUMNH-C4 <i>G. bicornuta</i>		MSUMNH-C5 <i>G. kalakadensis</i>		Holotype ZSI/SRS <i>G. menoni</i> F 553	MSUMNH-C8 <i>G. periyarensis</i>	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
	<b>Head length</b>	<b>33.13</b>	<b>13.82</b>	<b>8.92</b>	<b>13.82</b>	<b>19.81</b>	<b>27.79</b>	<b>14.65</b>	<b>29.89</b>	<b>14.59</b>	<b>19.74</b>	<b>14.95</b>	<b>30.45</b>	<b>33.98</b>
7	Pre occipital length	82.55	99.83	91.24	99.83	81.81	96.44	85.95	99.53	79.71	89.68	89.70	82.55	91.18
8	Snout to opercle	94.14	97.53	93.15	97.53	90.95	96.27	92.01	98.64	87.25	95.20	96.12	91.87	94.66
9	Upper jaw length	34.98	35.76	29.26	35.76	33.62	42.04	27.65	38.06	30.09	45.51	40.20	25.75	28.58
10	Snout length	58.92	46.24	40.13	46.24	52.74	65.00	50.31	61.36	46.25	53.55	56.32	52.58	53.59
11	Pre nasal length	44.01	34.35	29.20	34.35	35.52	47.50	25.69	39.16	33.35	40.37	41.27	35.18	38.08
12	Orbit width	20.86	28.70	23.52	28.70	21.20	24.91	20.44	32.13	20.36	25.23	20.87	21.32	25.28
13	Inter orbital width	45.73	46.33	39.44	46.33	41.82	49.12	35.85	46.78	35.48	43.63	45.02	34.17	35.81
14	Inter nasal width	36.67	30.47	27.42	30.47	29.65	37.71	16.49	29.69	24.62	47.50	26.56	25.98	27.58
15	Head width	72.26	73.77	61.43	73.77	72.70	88.66	64.00	78.19	68.19	80.42	78.06	64.83	67.48
22	Head depth at nostril	34.35	41.12	31.84	41.12	42.61	53.54	29.34	49.87	36.44	43.68	38.19	30.26	34.35
23	Head depth at pupil	51.68	61.21	48.26	61.21	57.64	64.41	57.17	66.24	46.81	56.11	47.02	47.12	52.12
24	Head depth at occiput	59.58	74.44	57.96	74.44	67.65	83.62	64.84	82.47	53.90	66.49	56.92	53.56	58.12
53	Disc length	33.84	26.48	18.95	26.48	37.13	40.94	30.62	39.78	33.51	41.06	40.87	34.83	37.31
54	Disc width	49.26	18.31	10.99	18.31	44.51	57.72	40.00	52.38	49.42	59.51	64.95	39.76	43.64
55	Central pad length	21.46	29.15	26.12	29.15	23.01	28.77	19.29	25.28	18.65	26.61	19.53	21.05	24.75
56	Central pad width	22.49	45.83	33.05	45.83	27.79	37.37	85.95	99.53	30.48	37.38	34.65	22.63	26.99

Table 1 (Contd.)

No.	Morphometric characters	MSUMNH-C9 <i>G. surendranathanii</i>		MSUMNH-C6 <i>G. hughi</i>		Holotype ZSI - Calcutta <i>Garra platycephala</i> F 9816/1	Holotype ZSI - Calcutta <i>Garra jerdoni</i> F 1507	Holotype ZSI/WGRC - Calicut <i>Garra emarginata</i> F 2472	Holotype ZSI/WGRC - Calicut <i>Garra mlapparaensis</i> F 2473
		Min	Max	Min	Max	Min	Min	Min	Min
	<b>Standard length</b>	<b>111.35</b>	<b>122.09</b>	<b>46.99</b>	<b>62.57</b>	<b>104.29</b>	<b>160.56</b>	<b>85.72</b>	<b>74.53</b>
2	Snout to urocentrum	93.66	94.74	93.86	96.87	94.39	95.99	79.41	70.05
3	Pre anal length	73.48	75.72	72.00	77.98	78.73	76.44	64.74	53.93
4	Pre dorsal length	41.19	43.21	48.45	51.35	39.64	42.71	37.7	32.77
5	Pre pelvic length	45.70	46.48	46.50	52.47	46.53	45.68	41.32	37.24
6	Pre pectoral length	18.75	20.36	20.15	23.96	18.00	18.07	16.02	15.09
18	Peduncle length	12.79	15.28	8.70	12.32	14.44	13.61	9.73	10.17
19	Dorsal origin / pelvic insert	19.18	20.21	14.14	16.77	19.57	20.30	13.83	14.61
21	Anal fin height	16.39	18.52	14.26	16.50	18.14	15.96	13.93	14.09
25	Peduncle depth	9.56	9.90	8.37	9.70	9.98	11.84	9.53	8.55
26	Caudal fin length	22.74	26.28	24.96	32.00	0.00	0.00	20.47	20.48
27	Dorsal fin height	21.39	22.91	17.92	21.27	27.54	19.22	15.28	18.16
28	Pectoral fin length	21.13	22.64	21.88	24.71	21.12	21.95	21.63	16.98
29	Pelvic fin length	18.44	18.66	17.76	20.60	19.86	20.20	18.21	15.03
33	Occiput to dorsal origin	21.80	23.95	26.86	31.66	21.21	28.10	20.78	18.93
34	Occiput to Pectoral insert	13.73	14.49	11.63	16.88	22.24	15.69	11.38	9.75
35	Occiput to Pelvic insertion	36.02	38.53	34.89	41.56	37.88	43.74	31.02	28.26
36	Dorsal insert to Pelvic insert	12.61	13.01	10.41	13.33	14.92	15.33	10.72	10.04
37	Dorsal origin \ Pectoral insert	21.31	21.77	22.47	26.14	22.33	22.32	20.65	17.21
38	Dorsal origin to anal org	37.38	40.15	29.05	34.76	41.41	40.85	29.81	26.28
39	Dorsal insertion / Caudal	40.08	44.73	33.41	39.01	36.83	45.15	33.91	32.01
40	Dorsal insertion / anal org	23.97	25.65	16.84	22.48	29.20	28.18	19.17	15.81
41	Dorsal insert \ anal insert	30.76	31.77	23.81	27.79	0.00	31.54	25.33	19.61
42	Dorsal fin base length	13.05	14.29	9.74	13.55	16.22	15.47	10.18	10.41

43	Anal fin base length	5.99	7.91	5.93	8.38	6.19	6.79	4.74	5.05
44	Pectoral insert / Pelvic insert	25.10	27.43	23.38	27.44	29.78	29.63	23.82	22.77
45	Pectoral insert \ anal origin	48.87	49.54	44.61	49.85	57.76	54.38	44.62	37.94
46	Pelvic insert to anal origin	21.85	23.12	18.03	22.00	28.78	24.50	18.95	14.57
49	Post-dorsal length	54.14	58.10	46.44	53.79	53.48	61.01	40.06	38.79
50	Body depth	15.82	17.26	12.86	15.70	19.19	18.05	11.39	11.95
51	Distance b/w pect fin / vent	42.98	45.60	46.80	49.54	45.42	44.51	42.25	35.64
52	Distance b/w pelc fin / vent	15.65	16.36	17.43	21.64	15.29	13.66	15.62	12.57

Table 1 (Contd.)

No.	Morphometric characters	MSUMNH-C9 <i>G. surendranathanii</i>		MSUMNH-C6 <i>G. hughi</i>		Holotype ZSI - Calcutta <i>Garra platycephala</i> F 9816/1	Holotype ZSI - Calcutta <i>Garra jerdoni</i> F 1507	Holotype ZSI/WGRC - Calicut <i>Garra emarginata</i> F 2472	Holotype ZSI/WGRC - Calicut <i>Garra mlapparaensis</i> F 2473
		Min	Max	Min	Max	Min	Min	Min	Min
	<b>Head length</b>	<b>24.74</b>	<b>26.78</b>	<b>12.52</b>	<b>15.27</b>	<b>21.16</b>	<b>29.48</b>	<b>18.59</b>	<b>16.18</b>
7	Pre occipital length	86.86	91.81	88.50	98.10	88.09	93.72	16.59	14.29
8	Snout to opercle	89.96	93.95	77.72	98.98	90.45	92.91	16.34	14.07
9	Upper jaw length	33.87	34.80	28.99	39.56	99.20	29.72	-	-
10	Snout length	48.99	53.73	45.77	54.94	28.88	60.65	8.62	8.28
11	Pre nasal length	37.27	38.08	32.18	40.47	36.81	39.31	5.67	4.91
12	Orbit width	23.82	25.42	15.91	21.49	28.17	27.85	3.91	4.02
13	Inter orbital width	37.43	38.09	38.26	52.02	45.18	49.63	8.19	7.21
14	Inter nasal width	26.36	37.67	20.67	29.32	33.65	39.96	6.43	4.45
15	Head width	68.69	74.57	71.01	78.16	71.22	80.90	14.39	11.14
22	Head depth at nostril	39.99	42.36	33.04	43.09	32.42	33.04	6.06	5.86
23	Head depth at pupil	48.96	49.44	41.85	46.96	54.25	55.39	8.78	8.24
24	Head depth at occiput	58.29	60.02	45.40	55.60	63.71	62.79	10.78	9.78
53	Disc length	35.25	36.31	39.15	48.23	32.89	30.77	6.04	4.92
54	Disc width	46.86	49.64	21.25	28.21	46.03	48.58	8.83	7.74
55	Central pad length	22.76	23.19	52.16	65.75	20.04	24.53	3.71	3.17
56	Central pad width	30.84	33.79	32.67	40.12	30.10	35.79	5.85	5.71

Table 2 Comparative meristic characters for species of *Garra* from peninsular India.

No.	Meristic counts	MSUMNH-C7 <i>Garra maclellandi</i> (Neotype)	MSUMNH-C2 <i>G. mulya</i>	MSUMNH-C3 <i>G. gotyla</i> <i>stenorhynchus</i>	MSUMNH-C4 <i>G. bicornuta</i>	MSUMNH-C5 <i>G. kalakadensis</i>	Holotype ZSI/SRS <i>G. menoni</i> F 553
1	Unbranched dorsal fin rays	2	3	3	2	2	3
2	Branched dorsal fin rays	8	7-8	8	8	8	7
3	Unbranched anal fin rays	3	2	2	2	2	3
4	Branched anal fin rays	5	5	5	5	5	5
5	Unbranched pelvic fin rays	1	1	1	1	1	1
6	Branched pelvic fin rays	8	7-8	7-8	8	8	8
7	Unbranched pectoral fin rays	1	1	1	1	1	1
8	Branched pectoral fin rays	15	12-14	13-15	13-14	13-15	14
9	Caudal fin upper lobe	9	9	9	9	10	9
10	Caudal fin lower lobe	8	8	8	8	9	8
11	Lateral line scales	35	32-35	33-34	31-32	32-33	35
12	Predorsal scales	10	9-11	9-10	8-9	10-11	NK
13	Upper transverse rows	4.5	4.5	3.5-4.5	3.5-4.5	4.5	4.5

14	Lateral line to pelvic scale rows		3.5	3.5	2.5-3.5	2.5	3.5
15	Lower transverse rows (anus)	4.5	4.5	4.5	3.5-4.5	3.5	NK
16	Circumpeduncular scales	16	15-16	15-16	12	12-14	12
17	Circumferential scales	22	21-22	20-22	18-20	20	18
18	Anal scale rows	7	3-4.5	3-5	3-4	2-3.5	NK
19	Pre anal scales	20	19-23	20-23	18-20	17-20	NK
20	Proboscis & transverse groove on snout	Snout conical, its tip marked off by a transverse groove with Rosette shaped tubercles	Snout round and smooth, with the tip marked off by a deep transverse groove	Snout with a well developed median proboscis	Snout with a well-marked bilobed proboscis	Snout obtusely rounded without proboscis, but a deep transverse groove and conspicuous tuberculated transverse lobe at tip.	Snout round and smooth
21	Scales on chest and belly	Well developed scales on chest and belly region	Chest and belly scaled	Chest and belly scaled	Chest and belly scaled	Chest and belly scaled	Chest and belly naked

No.	Meristic counts	MSUMNH-C8 <i>G. perlyarensis</i>	MSUMNH-C9 <i>G. surendranathanii</i>	MSUMNH-C6 <i>G. hughi</i>	Holotype ZSI - Calcutta <i>Garra platycephala</i> F 9816/1	Holotype ZSI - Calcutta <i>Garra jerdoni</i> F 1507	Holotype ZSI/WGRC - Calicut <i>Garra mlapparaensis</i> F 2473	Holotype ZSI/WGRC - Calicut <i>Garra emarginata</i> F 2472
1	Unbranched dorsal fin rays	2	2	2	3	3	1	2
2	Branched dorsal fin rays	8	8	7	8	8	7	8
3	Unbranched anal fin rays	2	2	2	2	2	1	1
4	Branched anal fin rays	5	5	5	5	5	5	5
5	Unbranched pelvic fin rays	1	1	1	1	1	1	1
6	Branched pelvic fin rays	7-8	7	7-8	8	7	7	7
7	Unbranched pectoral fin rays	1	1	1	1	1	1	1
8	Branched pectoral fin rays	13-14	12	13-14	14	14	12	13
9	Caudal fin upper lobe	9	8	9	Damaged	9	10	10
10	Caudal fin lower lobe	8	8	8	Damaged	8	9	9
11	Lateral line scales	38-39	36	36-37	37	36	35	35
12	Predorsal scales	10-11	11	Absent	9	9	12	11
13	Upper transverse rows	4.5	4.5	4.5	4.5	4.5	4.5	4.5
14	Lateral line to pelvic scale rows	3.5	3.0	2.5	3.5	3.5	3.5	2.5
15	Lower transverse rows (anus)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
16	Circumpeduncular scales	12	16	14-15	16	16	12	12
17	Circumferential scales	18	21-22	Absent	NAC	NAC	16	16
18	Anal scale rows	Absent	5.5-6.5	2.0-3.0	NAC	NAC	3	4
19	Pre anal scales	5.5-6.5	11-14	Absent	NAC	7	24	26
20	Proboscis & transverse groove on snout	Snout with a prominent tuberculated, knob like protuberance	No proboscis and deep transverse groove	Snout is broadly rounded and indistinguishable groove is present across the snout	No proboscis and deep transverse groove	No proboscis and deep transverse groove	Snout rounded with fine tubercles	Snout round and smooth
21	Scales on chest and belly	Chest and belly naked	Chest naked & belly with subcutaneous scales	Chest and belly naked	Well developed scales on chest and belly region	Well developed scales on chest and belly region	Well developed scales on chest and belly region	Well developed scales on chest and belly region

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