

Research Article

**NEW SPECIES OF *HYPSELOBARBUS* (CYPRINIDAE: CYPRINIFORMES)
FROM CAUVERY RIVER BASIN, SOUTH INDIA**

***¹Arunachalam, M., ²Chinnaraja, S. and ³R.L. Mayden**

¹Manonmaniam Sundaranar University, Sri Paramakalyani Centre for Environmental Sciences,
Manonmaniam Sundaranar University, Alwarkurichi-627 412, Tamil Nadu, India

²Research Department of Zoology, Poompuhar College (Autonomous), Melaiyur-609 107,
Sirkali, Nagapattinam dist., Tamil Nadu, India

³Department of Biology, Saint Louis University, Saint Louis, Missouri 63103, USA

Article History: Received on 16th November 2015; Accepted 16th December 2015

ABSTRACT

Hypselobarbus currently includes three valid species that possess a strong, osseous dorsal fin spine (modified ray). These include *H. dubius*, *H. micropogon* and *H. periyarensis*. *Hypselobarbus dubius* (Day, 1867) from Bhavani River, Tamilnadu and Noolpuzha from Wynaad, Kerala is found to exhibit morphological variation. Upon closer examination, these populations represent a new species distinct from *H. dubius*. The new species, *Hypselobarbus nilgiriensis*, is diagnosed from its *H. dubius* by having more circumferential scale rows (34-35 vs. 30-33), more transverse breast scale rows (14-15 vs. 9-11) and more preanal scale rows (41-45 vs. 34-38).

Key words: Cyprinidae, *H. dubius*, *H. micropogon*, *H. nilgiriensis* sp. nov., *Hypselobarbus* and Taxonomy.

INTRODUCTION

Day (1867) described *Puntius* (= *Hypselobarbus*) *dubius* from Bhavani River (Cauvery River basin) as having a strong hardened dorsal fin spine and the maxillary and rostral barbels being of equal length. Raja (2010) noted that the topotypic populations of *H. dubius* exhibited variation in numbers of transverse breast scale rows. Given this reported variation the species was examined for morphological variation. In this study, based on the above diagnosis by Day (1867), we examined all available samples of *Hypselobarbus dubius* from the Bhavani River. Through this examination a species was discovered masquerading under the name *H. dubius* that is clearly distinct from its congener and is herein described as a new.

METHODS

Fish collections were made between 1996-2005 at river sites by earlier workers led by M. Arunachalam and from local fishermen. Measurements were made point to point using digital calipers. Methods used for the meristic and morphometric characters are based Hubbs and Lagler (1964). Morphometric characters from landmarks 9, 18-26,

29-31 and 34-35 (Table 2) were the additional truss measurements (Strauss and Bookstein 1982). Preanal scales (Jayaram, 1991) are the scales from the anus to the isthmus. The meristic character of Lateral transverse scale (Ltr.) rows described by Day (1889) in his comparisons within *Hypselobarbus* is "number of longitudinal rows of scales between the back and abdomen, usually counted, unless some other part of the side is specified, from the anterior end of the dorsal fin to the ventral". Body measurements are expressed as percentage of Standard Length (%SL); head measurements are expressed as percentage of Head Length (%HL). Total length (TL) was also used for comparison.

Abbreviations used

MSUMNH (Manonmaniam Sundaranar University, Museum of Natural History) and also from CMA (collections of M. Arunachalam).

RESULTS

Hypselobarbus dubius Day 1867

*Corresponding author e-mail: arunacm@gmail.com

(Figure 1 and Tables 1-2).

Diagnosis: *Hypselobarbus dubius* is distinguished from *H. curmuca* in having two pairs of barbels (vs. single pair), fewer upper transverse scale rows (8-8.5 vs. 9.5-10), and fewer circumferential scale rows (30-33 vs. 39-40). The species is distinguished from *H. kolus* in having two pair of barbels (vs. single pair), fewer upper transverse scale rows (8-8.5 vs. 9.5-10) and fewer transverse breast scale rows (9-11 vs. 12-14), and is distinguished from *H. mussullah* in having more predorsal scale rows (14 vs. 12-13) and fewer preanal scale rows (34-38 vs. 40-44). It is distinguished from *H. kurali* in having fewer transverse breast scale rows (9-11 vs. 21-23), fewer preanal scale rows (34-38 vs. 43-

46), and dorsal fin height (25.67-36.28 vs. 17.86-23.93 %SL). It is distinguished from *H. micropogon* having more lateral line scale rows (42-45 vs. 36-41), more predorsal scale rows (14 vs. 12-13) and more circumferential scale rows (30-33 vs. 26-29). This species is distinguished from *H. periyarensis* in having fewer predorsal scale rows (14 vs. 17-18) and shorter occiput to dorsal fin origin (22.88-28.99 vs. 30.12-34.75 %SL) and pectoral fin insertion to anal fin origin (42.77-51.07 vs. 53.12-57.68 %SL). This species is distinguished from *H. lithopidos* in having more lateral line scale rows (42-45 vs. 37-40), more upper transverse scale rows (8-8.5 vs. 6.5) and more circumferential scale rows (30-33 vs. 25-27).



Figure 1. *Hypselobarbus dubius* MSUMNH 243. 1ex, 168.32 mm SL. Bhavani River at Athikadavu, collected by Dr. M. Arunachalam and team 03 February 2001.

Description: Body moderately deep, its depth 25.70-33.02 %SL; dorsal fin origin anterior to pelvic fin insertion by 1.5 to 2 scale rows. Predorsal length 42.60-50.40 %SL; prepelvic length 44.99-52.09 %SL; preanal length 69.78-76.83 %SL; pre-pectoral length 23.02-28.65 %SL, and pelvic fin insertion to anal origin 18.41-27.31 %SL. Nape slightly convex behind a concavity posterior to occiput. Caudal peduncle moderately deep, depth at narrowest region 9.30-11.18 % SL; caudal peduncle length 11.47-17.74 %SL.

Head long, 23.52-30.86 % SL, with long cranium (19.47-25.92 %SL). Head depth at nostril 30.97-44.19, at pupil 48.29-59.98 and at occiput 64.83-77.11 %HL. Preopercle straight and 70.37-76.87 %HL, interorbital concave, interorbital distance 31.64-39.66 %HL. Eyes large, 20.63-33.36 %HL. Snout long, length 34.46-46.36 %HL; mouth subterminal. Upper jaw length 26.89-40.86 %HL; gape width 17.32-29.13 %HL; lower jaw keratinous but not sharp. Two pairs of barbels; maxillary barbel length 21.23-34.94 %HL and rostral barbel length 16.21-31.73 %HL.

Dorsal-fin rays iv-8(7) or 9(14), anal-fin rays iii-5(21), pelvic-fin rays ii-8(6) or 9(15), and pectoral-fin rays i-14(7) or 15(14). Dorsal fin moderately high, 25.67-36.28 %SL, and dorsal spinous ray is strong, its length 23.02-33.97 %SL. Anal fin, when depressed extending beyond caudal fin base; length 16.23-28.12 %SL. Distal margin of anal fin is convex; first, second and the third unbranched rays not equal in length. Length of anal fin base 13.76-19.46 %SL. Pelvic fin long, 16.47-21.29 %SL. Pectoral fin long, 19.08-

23.39 %SL; fin moderately falcate, extending to 1.5 scale rows anterior to pelvic fin origin. Caudal fin deeply forked 26.46-37.19 %SL, upper and lower lobes are 4.5 times longer than middle rays.

Scales small, lateral-line scale rows 42(11), 43(5), 44(3) or 45(2), predorsal scale rows 14(21), upper transverse scale rows 8(7) or 8.5(14), lateral line to pelvic scale rows 4.5(10), 5(6) or 5.5(5), lower transverse scale rows 7(8), 7.5(12) or 8(1), circumpeduncular scale rows 18(16) or 19(5), circumferential scale rows 30(5), 31(3), 32(6) or 33(7), transverse breast scale rows 9(7), 10(10) or 11(4), and preanal scale rows 34(8), 35(4), 36(4), 37(1) or 38(4).

Hypselobarbus micropogon (Valenciennes)

(Figure 2 and Tables 1-2)

Diagnosis: Distinguished from *H. curmuca* in having two pairs of barbels (vs. single pair), fewer lateral line scale rows (36-41 vs. 42-43), fewer upper transverse scale rows (6.5-7.5 vs. 9.5-10) fewer circumferential scale rows (26-29 vs. 39-40) and longer dorsal spine height (28.42-36.68 vs. 21.77-25.23 %SL) The species is distinguished from *H. kolus* in having two pairs of barbels (vs. single pair), fewer upper transverse scale rows (6.5-7.5 vs. 9.5-10), fewer circumpeduncular scale rows (16-18 vs. 20-21), fewer circumferential scale rows (26-29 vs. 35-37) and higher dorsal fin (30.39-39.71 vs. 20.75-27.17 %SL). The species is further distinguished from *H. mussullah* in having fewer circumferential scale rows (26-29 vs. 30-31), fewer preanal scale rows (31-34 vs. 40-44), taller dorsal spine (28.42-

36.68 vs. 14.90-24.17 %SL) and taller dorsal fin (30.39-39.71 vs. 23.18-24.84 %SL). It is distinguished from *H. kurali* in having fewer circumferential scale rows (26-29 vs. 32-33), fewer transverse breast scale rows (8-12 vs. 21-23), fewer preanal scale rows (31-34 vs. 43-46) and taller dorsal fin (30.39-39.71 vs. 17.86-23.93 %SL). This species is distinguished from *H. periyarensis* in having fewer lateral line scale rows (36-41 vs. 43-44), fewer predorsal scale rows (12-13 vs. 17-18), fewer circumferential scale

rows (26-29 vs. 32-34), and a shorter distance between occiput and dorsal fin origin (24.50-29.44 vs. 30.12-34.75 %SL) and dorsal fin origin to pectoral insertion (27.21-31.82 vs. 33.25-37.45 %SL). This species is distinguished from *H. lithopidos* in having strong dorsal fin spine (vs. weak dorsal fin spine), and taller dorsal spine (28.42-36.68 vs. 21.07-26.32 %SL), longer maxillary barbels (25.39-36.76 vs. 20.76-24.08 %HL), and longer rostral barbels (17.96-28.83 vs. 7.13-13.37 %HL).



Figure 2. *Hypselobarbus micropogon* MSUMNH 244. 1ex, 136.95 mm SL, Pillur Dam, Bhavani River collected by Dr. M. Arunachalam and team 10 March 2001.

Description: Body moderately deep, depth 25.11-30.77 %SL. Dorsal fin origin anterior to pelvic fin insertion by 1 to 1.5 scale row. Predorsal length 44.69-50.08 %SL; prepelvic length 45.62-50.45 %SL; preanal length 70.18-76.15 %SL. Pre-pectoral length 21.92-26.81 %SL, pelvic fin insertion to anal origin 20.25-26.66 %SL. Nape slightly convex behind a concavity posterior to occiput. Caudal peduncle moderately deep, depth at narrowest region 9.00-10.93 %SL; caudal peduncle length 10.20-17.62 %SL.

Head long 22.66-26.51 %SL, and with long cranium of 18.24-22.43 %SL. Head depth at nostril 32.26-41.32, at pupil 53.97-62.29 and at occiput 68.94-79.76 %HL. Preopercle straight and 35.49-42.09 %HL, interorbital concave, interorbital distance 34.70-41.76 %HL. Eyes large, 31.28-36.54 %HL. Snout long, length 35.49-42.09 %HL; mouth subterminal. Upper jaw length 30.14-36.46 %HL; gape width 21.01-32.01 %HL; lower jaw keratinous but not sharp. Two pairs of barbels; maxillary barbel length 26.92-41.40 %HL; rostral barbel length 17.96-28.83 %HL.

Dorsal-fin rays iv-8(3) or 9(15), anal-fin rays ii(3) or iii-5(15), pelvic-fin rays ii-8(7) or 9(11), and pectoral-fin rays i-13(1), 14(8) or 15(9). Dorsal fin moderately high, 30.39-39.71 %SL, and spinous ray of dorsal fin strong, it is length 28.42-36.68 %SL. Anal fin length 16.94-24.40 %SL. Distal margin of anal fin convex; first, second and the third unbranched rays not equal in length. Length of anal fin base 5.71-10.00 %SL. Pelvic fin long, 18.16-22.56 %SL. Pectoral fin long, 17.53-23.74 %SL, fin moderately falcate, extending to 3 scale rows anterior to pelvic fin origin. Caudal fin deeply forked 29.26-34.58 %SL, upper and lower lobes are 4.5 times longer than middle rays.

Scales small, lateral-line scale rows 36(1), 37(2), 38(2), 39(4), 40(8) or 41(1), predorsal scale rows 12(4) or 13(14), upper transverse scale rows 6.5(4), 7(12) or 7.5(2), lateral line to pelvic scale rows 3.5(3), 4(8) or 4.5(7), lower transverse scale rows 5.5(2), 6(2) or 6.5(14), circumpeduncular scale rows 16(7), 17(5), or 18(6), circumferential scale rows 26(3), 27(4), 28(9) or 29(2), transverse breast scale rows 8(2), 9(2), 10(7), 11(6) or 12(1), and preanal scale rows 31(6), 32(6), 33(3) or 34(3).

***Hypselobarbus nilgiriensis* sp. nov.**

(Figure 3 and Tables 1-2)

Holotype: MSUMNH 245. 1ex, 202.29 mm SL, Bhavani River at Nellithurai collected by Dr. M. Arunachalam and team, 11 October 2001 (Fig. 3).

Paratypes: CMA260. 2ex, 191.09-219.43 mm SL, Bhavani River at Nellithurai collected by Dr. M. Arunachalam and team, 11 October 2001. CMA261. 1ex, 323.25 mm SL, Bhavani River at Nellithurai collected by Dr. M. Arunachalam and team, 10 March 2002. CMA262. 2ex, 176.11-178.34 mm SL, Pillur Dam, Bhavani River collected by Dr. M. Arunachalam and team, 08 March 2002. CMA263. 1ex, 408.71 mm SL, Noolpuzha from Wynaad, Kerala collected by Dr. M. Arunachalam and team, 17 September 2001.

Diagnosis: *Hypselobarbus nilgiriensis* sp. nov. is distinguished from *H. dubius* in having more circumferential scale rows (34-35 vs. 30-33), more transverse breast scale rows (14-15 vs. 9-11), more preanal scale rows (41-45 vs. 34-38), shorter maxillary barbel

length (16.46-20.19 vs. 21.23-34.94 %HL) and shorter rostral barbel length (7.31-13.31 vs. 16.21-31.73 %HL). This species is distinguished from *H. micropogon* in having more predorsal scale rows (15 vs. 12-13), more circumferential scale rows (34-35 vs. 26-29), more transverse breast scale rows (14-15 vs. 8-12), more preanal scale rows (41-45 vs. 31-34), shorter dorsal fin spine (21.88-25.71 vs. 28.42-36.68 %SL) and shorter dorsal fin height (22.99-27.07 vs. 30.39-39.71 %SL).

It is distinguished from *H. curmuca* in having two pairs of barbels (vs. single pair), fewer circumferential scale rows (34-35 vs. 39-40) and fewer transverse breast scale rows (14-15 vs. 10-11). It is distinguished from *H. kolus* in having two pairs of barbels (vs. single pair), fewer predorsal scale rows (15 vs. 13), more preanal scale rows (41-45 vs. 34-37) and a longer snout (43.45-50.41 vs. 34.3-42.76 %HL). It is distinguished from *H. mussullah* in

having more predorsal scale rows (15 vs. 12-13), fewer circumferential scale rows (34-35 vs. 30-31), more transverse breast scale rows (14-15 vs. 11-12) and slightly shorter preanal length (70.87-73.73 vs. 74.94-77.16 %SL). It is distinguished from *H. kurali* in having more predorsal scale rows (15 vs. 13.14), more circumferential scale rows (34-35 vs. 32-33), and more transverse breast scale rows (14-15 vs. 21-23). This species is further distinguished from *H. periyarensis* in having fewer predorsal scale rows (15 vs. 17-18), more transverse breast scale rows (14-15 vs. 10-13), and length between dorsal fin origin and pectoral insertion (26.21-30.92 vs. 33.25-37.45 %SL). This species is distinguished from *H. lithopidos* in having a strong dorsal spine (vs. weak), more lateral line scale rows (41-45 vs. 37-40), more predorsal scale rows (15 vs. 11-13), more circumferential scale rows (34-35 vs. 25-27), a longer prenasal length (31.56-37.48 vs. 18.44-24.79 %HL) and smaller gape width (19.51-24.63 vs. 26.31-34.06 %HL).



Figure 3. *Hypselobarbus nilgiriensis* sp. nov. MSUMNH 245. (Holotype) 1ex, 202.29 mm SL, Bhavani River at Nellithurai collected by Dr. M. Arunachalam and team, 11 October 2001.

Description: Body moderately deep, depth 25.34-31.06 %SL. Dorsal fin origin anterior to pelvic fin insertion by 1.5 to 2 scale rows; predorsal length 43.02-48.64 %SL; prepelvic length 44.39-50.21 %SL, and preanal length 70.87-73.73 %SL. Prepectoral length 21.84-26.17 %SL, pelvic fin insertion to anal origin 19.14-23.98 %SL. Nape slightly convex behind a concavity posterior to occiput. Caudal peduncle moderately deep, depth at narrowest region 9.69-11.90 % SL; caudal peduncle length is 12.44-17.34 %SL.

Head long 23.49-27.18 %SL, with long cranium of 18.86-22.70 %SL. Head depth at nostril 38.98-44.54, at pupil 52.53-60.84 and at occiput 64.12-76.66 %HL. Preopercle straight and 73.05-76.77 %HL, interorbital concave, interorbital distance 35.67-44.67 %HL. Eyes large 16.59-26.14 %HL. Snout long 43.45-50.41 %HL; mouth subterminal. Upper jaw length 28.70-33.75 %HL; gape width 19.51-24.63 %HL; lower jaw keratinous. Two pairs of barbels; maxillary barbel length 16.46-20.19 %HL and rostral barbel length 7.31-13.31 %HL.

Dorsal-fin rays iv-8(1) or 9(6), anal-fin rays iii-5(7), pelvic-fin rays ii-7(7), and pectoral-fin rays i-14(1), 15(5) or 16(1), dorsal fin moderately high, 22.99-27.99 %SL, and spinous dorsal ray strong, its length 21.88-25.71 %SL. Anal

fin when depressed extending beyond caudal fin base, its length 18.13-23.47 %SL. Distal margin of anal fin is convex, first, second and the third unbranched rays not equal in length. Length of anal fin base 7.82-9.64 %SL. Pelvic fin long 15.91-18.08%SL. Pectoral fin long 17.95-20.70 %SL, fin moderately falcate, extending to 3 scale rows anterior to pelvic fin origin. Caudal fin deeply forked 23.66-30.93 %SL, upper and lower lobes 5 times longer than middle rays.

Scales small, lateral-line scale rows 41(1), 43(1), 44(3) or 45(2), predorsal scale rows 15(7), upper transverse scale rows 8.5(1) or 9(6), lateral line to pelvic scale rows 5.5(7), lower transverse scale rows 7(3) or 7.5(4), circumpeduncular scale rows 18(4) or 19(3), circumferential scale rows 34(4) or 35(3), transverse breast scale rows 14(2) or 15(5), and preanal scale rows 41(2), 42(1), 43(3) or 45(1).

Etymology: The species name *nilgiriensis* is a noun in apposition named after the Nilgiri Biosphere Reserve where both the Bhavani and Noolpuzha rivers are the two major catchments in Tamil Nadu and Kerala, respectively.

Distribution: This species is currently endemic to the Bhavani River in Tamil Nadu and Noolpuzha in Wynaad, Kerala.

Table 1. Meristic characters of *Hypselobarbus dubius*, *Hypselobarbus micropogon*, and *Hypselobarbus nilgiriensis* sp. nov.

Meristic characters	<i>H. dubius</i>	<i>H. micropogon</i>	<i>H. nilgiriensis</i> sp. nov.	
	MSUMNH243. CMA246,247,248, 250,251,252, n=21	MSUMNH244. CMA253,254,255, 256, 257,258,259. n=18	Holotype MSUMNH H 245, n=1	Paratype CMA260,26 1,262,263. n=6
1. Dorsal fin rays	iv,8-9	iv,8-9	iv,8	iv,9
2. Anal fin rays	iii,5	ii-iii,5	iii,5	iii,5
3. Pelvic fin rays	ii,8-9	ii,8-9	ii,9	ii,9
4. Pectoral fin rays	i,14-15	i,13-15	i,15	i,14-16
5. Caudal fin rays	10+9	10+9	10+9	10+9
6. Upper transverse rows	8-8.5	6.5-7.5	9	8.5-9
7. Lower transverse scale rows	7-8	5.5-6.5	7.5	7-7.5
8. Lateral line to pelvic scale rows	4.5-5.5	3.5-4.5	5.5	5.5
9. Lateral line scale rows	42-45	36-41	43	41-45
10. Predorsal scale rows	14	12-13	15	15
11. Circumpeduncular scale rows	18-19	16-18	18	18-19
12. Circumferential scale rows	30-33	26-29	35	34-35
13. Transverse breast scale rows	9-11	8-12	15	14-15
14. Pre anal scale rows	34-38	31-34	43	41-45

Table 2. Morphometric characters of *Hypselobarbus dubius*, *Hypselobarbus micropogon*, and *Hypselobarbus nilgiriensis* sp. nov. Body character measurements are represented as % standard length and head character measurements are represented as % head length.

Measurements from point to point (identified by numbers and names)	<i>H. dubius</i>	<i>H. micropogon</i>	<i>H. nilgiriensis</i> sp. nov.	
	MSUMNH243. CMA246,247,24 8,250, 251,252, n=21	MSUMNH244. CMA253,254,255, 256,257, 258,259. n=18	Holotype MSUMNH 245, n=1	Paratype CMA260,261, 262,263. n=6
1. Standard length	105.09-264.09	105.69-146.08	202.29	176.11-408.71
	% of Standard Length			
2. Snout to urocentrum	91.64-95.69	91.18-95.67	93.65	92.19-95.05
3. Pre anal length	69.78-76.83	70.18-76.15	72.47	70.87-73.73
4. Pre dorsal length	42.60-50.40	44.69-50.08	48.60	43.02-48.64
5. Pre pelvic length	44.99-52.09	45.62-50.45	50.14	44.39-50.31
6. Pre pectoral length	23.02-28.65	21.92-26.81	24.83	21.84-26.17
7. Pre occipital length	19.47-25.92	18.24-22.43	21.65	18.86-22.70
8. Caudal peduncle length	11.47-17.74	10.20-17.62	15.29	12.44-17.34
9. Dorsal origin to pelvic insertion	24.64-37.84	24.94-30.31	28.51	26.14-30.51
10. Dorsal spinous height	23.02-33.97	28.42-36.68	23.68	21.88-25.71
11. Anal fin height	16.23-28.12	16.94-24.40	18.79	18.13-23.47
12. Depth of caudal peduncle	9.30-11.18	9.00-10.93	11.14	9.69-11.90
13. Caudal fin length	26.46-37.19	29.26-34.58	30.13	23.66-30.93
14. Dorsal fin height	25.67-36.28	30.39-39.71	27.01	22.99-27.07
15. Pectoral fin length	19.08-23.39	17.53-23.74	17.98	17.95-20.70
16. Pelvic fin length	16.47-21.29	18.16-22.56	17.54	15.91-18.08

17. Pelvic auxiliary scale length	4.80-9.87	5.09-9.03	6.00	4.42-7.44
18. Occiput to dorsal fin origin	22.88-28.99	24.50-29.44	28.23	22.82-29.27
19. Occiput to pectoral fin insertion	17.46-20.75	16.56-20.49	21.12	17.91-21.80
20. Occiput to pelvic fin insertion	37.41-41.76	37.50-41.58	40.12	37.33-40.83
21. Dorsal insertion to pelvic fin insertion	20.23-25.59	21.54-26.42	23.24	20.10-25.26
22. Dorsal origin to pectoral fin insertion	26.75-32.73	27.21-31.82	29.40	26.21-30.92
23. Dorsal origin to anal fin origin	36.12-42.10	36.05-39.18	38.47	35.14-40.23
24. Dorsal fin insertion to caudal	30.89-37.69	30.00-34.35	37.18	34.88-37.78
25. Dorsal insertion to anal fin origin	22.25-36.00	18.93-25.16	25.22	23.23-27.47
26. Dorsal insertion anal fin insertion	22.95-28.72	22.74-27.75	26.85	26.64-30.17
27. Dorsal fin base length	13.76-19.49	15.80-18.91	15.28	14.77-15.76
28. Anal fin base length	6.82-9.41	5.71-10.00	8.91	7.82-9.64
29. Pectoral insertion pelvic fin insertion	21.64-29.14	23.21-27.50	25.23	22.67-26.16
30. Pectoral insertion anal fin origin	42.77-51.07	40.97-49.72	45.40	42.22-48.18
31. Pelvic insertion to anal fin origin	18.41-27.31	20.25-26.66	20.03	19.14-23.98
32. Post-dorsal length	46.51-56.33	46.99-53.93	51.82	50.23-55.62
33. Body depth	25.70-33.02	25.11-30.77	28.84	25.34-31.06
34. Distance b/w pectoral fin to vent	43.43-53.96	46.28-53.65	48.04	45.47-51.81
35. Distance b/w pelvic fin to vent	20.67-29.97	21.56-27.00	22.46	22.01-27.21
36. Head length	23.52-30.86	22.66-26.51	25.67	23.49-27.18
	% of Head Length			
37. Snout to opercle	70.37-76.87	72.23-79.00	76.66	73.05-76.77
38. Snout length	34.46-46.36	35.49-42.09	46.06	43.45-50.41
39. Upper jaw length	26.89-40.86	30.14-36.46	30.73	28.70-33.75
40. Pre nasal length	21.62-34.62	24.13-28.37	32.20	31.56-37.48
41. Orbit width	20.63-33.36	31.28-36.54	21.32	16.56-26.14
42. Inter orbital width	31.64-39.66	34.70-41.76	40.40	35.67-44.69
43. Inter nasal width	20.81-31.58	23.22-29.34	26.84	22.42-27.97
44. Head width	49.11-60.68	53.44-65.07	57.87	52.37-59.52
45. Gape width	17.32-29.13	21.01-32.01	24.12	19.51-24.63
46. Lower jaw to isthmus	56.28-72.66	54.28-65.86	70.01	63.51-70.06
47. Head depth at nostril	30.97-44.19	32.26-41.32	42.56	38.98-44.54
48. Head depth at pupil	48.29-59.98	53.97-62.29	57.64	52.53-60.84
49. Head depth at occiput	64.83-77.11	68.94-79.76	74.62	64.12-76.66
50. Maxillary barbel length	21.23-34.94	25.39-36.76	16.81	16.46-20.19
51. Rostral barbel length	16.21-31.73	17.96-28.83	8.28	7.31-13.31

DISCUSSION

Day (1867) described *Puntius* (= *Hypselobarbus*) *dubius* with the following measurements relative to total length: head length 1/5, caudal fin length 1/4, anal fin base length 1/16, body depth 1/4, and dorsal fin height 1/5, and the maxillary and rostral barbels of equal length. All specimens (n=21) collected from Bhavani River and Noolpuzha showed characters exactly similar to that of Day (1867). Also the maxillary barbel length varied from 8.20-16.23mm and the rostral barbel length ranged from 7.03-13.23mm, ranges that matched the original description of Day (1867). Additionally Day described both the barbels together equalled the width of orbit and all specimens examined had a range of 8.04-16.35mm, within range of orbit width. When examining the features outlined by Day, *Hypselobarbus nilgiriensis* is distinguished from *H. dubius*

in caudal fin length (4.00-4.15 vs. 4.55-5.05 TL), anal fin base length (15.02-16.25 vs. 12.43-13.06 TL), dorsal fin height (4.00-4.15 vs. 4.60-5.47 TL), maxillary barbel length (16.46-20.19 vs. 21.23-34.94 %HL), and rostral barbel length (7.31-13.31 vs. 16.21-31.73 % HL). The new species is clearly distinct from *H. dubius* in the lateral transverse scale rows (10/8-9 vs. 9/7-8) and showed the variation in circumferential scale rows. Additional diagnostic characters between these two species include transverse breast scale rows and preanal scale rows. This species, along with *H. dubius* and *H. micropogon*, showed similarity in having a strong dorsal fin spine while the strength of the dorsal spine in other congeners is weak to moderately weak. It is now evident that the enigmatic genus *Hypselobarbus* has greater diversity than current taxonomy for the group outlines, with more undescribed species in

rivers of the Western Ghats, one of the hotspots of diversity for these and other fish species (Arunachalam *et al.*, 2012).

Comparative materials: *Hypselobarbus curmuca*: ZSI/SRC F. 8749/1, 94 mm SL, Thunga River, Holehoddu, collected by Aswin Rai, 16 May 2013. MSUMNH 83, 1ex, 219.52 mm SL, Sholaiyar Dam, Chalakudi River, collected by M. Arunachalam, 23 March 2001. CMA 32, 5ex, 118.15-199.79 mm SL, Sholaiyar Dam, Chalakudi River, collected by M. Arunachalam, 23 March 2001. CMA 33, 1ex, 144.37 mm SL. Upper Kanneri, tributary of Kali River, Karnataka, collected by M. Arunachalam, 10 May 2002.

***Hypselobarbus kolus*:** (labeled as *H. curmuca* (neotype)), ZSI/SRC F. 8748/1, 141.20 mm SL, Thunga River, Holehoddu, collected by Aswin Rai. 16 May 2013. ZSI/SRC F 8057/1, 120 mm SL, Holebagilu, Sharavathi River, Karnataka, collected by Sreekantha, 15 September 2002. ZSI/SRC F 8751/1, 145.00 mm SL, Mutha River, Pune, Maharashtra, collected by Hemant Ghate. June 2002. MSUMNH 84, 1ex, 186.51 mm SL, Sholaiyar dam, Chalakudi River, collected by M. Arunachalam, 23 March 2001. CMA 34, 3ex, 121.44-158.27 mm SL, Sholaiyar dam, Chalakudi River, collected by M. Arunachalam, 23 March 2001. MSUMNH 85, 1ex, 116.46 mm SL, Sharavathi River, Karnataka, collected by M. Arunachalam, 30 May 2003. CMA 35, 2 ex, 101.86-105.9 mm SL, Sharavathi River, Karnataka, collected by M. Arunachalam, 30 May 2003. MSUMNH 86, 1ex, 190.83 mm SL, Krishna River at Sakthi Nagar, collected by M. Arunachalam, 16 October 2004. CMA 36, 2ex, 177.71-180.94 mm SL, Krishna River at Sakthi Nagar, collected by M. Arunachalam, 16 October 2004. MSUMNH 87, 1ex, 139.16 mm SL, Thunga River at Shimoga, collected by M. Arunachalam, 20 November 2004. CMA 37, 3ex, 112.16-131.85 mm SL, Thunga River at Shimoga, collected by M. Arunachalam, 20 November 2004. CMA 38, 5ex, 121.75-144.05 mm SL. Mula Muta River (Pune), collected by M. Arunachalam, 12 June 1998. CMA 47, 1ex, 186.40 mm SL, Cauvery River at Basavanahalli village, Karnataka, collected by M. Arunachalam, 11 May 2001.

Hypselobarbus kurali ZSI/SRC F4003/1, Holotype, 270.00 mm SL, Kumaradhara River, near Nettana, Dakshin Kannada, collected by A.G.K. Menon, 7 January 1992. ZSI/SRC F4003/1, 258.66 mm SL, Kumaradhara River, near Nettana, Dakshin Kannada, collected by A.G.K. Menon, 7 January 1992. MSUMNH 88, 1ex, 166.83 mm SL, Kallada River at Rosemala village, Kerala, collected by M. Arunachalam, 23 January 2003. CMA 39, 7ex, 144.55-160.55 mm SL, Data same as above.

H. periyarensis MSUMNH 103. 1 ex, 264.56 mm SL, Periyar River, Bharathapuzha River basin, Kerala, collected by M. Arunachalam and team, 13 September 2002. CMA 117, 9 ex, 219.86-260.45 mm SL, Periyar River, Bharathapuzha River basin, Kerala collected by M. Arunachalam and team, 13 September 2002.

Hypselobarbus mussullah ZSI SRC F. 8750, 2 ex, 169-185 mm SL, Uppinangudi Nethravathi River, collected by Aswin Rai, 07 April 2013. ZSI/SRC F. 8759, 1ex, 240.57

mm SL, Bhira Dam at Koland, Maharashtra, India, collected by J.D. Marcus Knight, 2014.

***Hypselobarbus lithopidos*:** ZSISRC F8663/2, 104.02-135.76 mm SL, Phalguni River Karnataka collected by Aswin Rai, 14 October 2012. CMA 184. 1ex, 118.33 mm SL, Thunga River, collected by M. Arunachalam and team 22 November 2004. CMA 185, 1ex, 68.35 mm SL, Thunga River at Mandeggodde, collected by M. Arunachalam and team, 20 November 2004. CMA 186. 1ex, 139.46 mm SL, Khal River (Maharashtra), collected by M. Arunachalam and team.

***Hypselobarbus dubius*:** MSUMNH 243, 1ex, 168.32 mm SL, Bhavani River at Athikadavu, collected by Dr. M. Arunachalam and team, 03 February 2001. CMA 246, 6ex, 105.09-135.10 mm SL, Pillur Dam, Bhavani River collected by Dr. M. Arunachalam and team, 30 March 2002. CMA247, 1ex, 115.08 mm SL, Bhavani River at Nellithurai collected by Dr. M. Arunachalam and team 30 March 2002. CMA248, 3ex, 215.92-264.09 mm SL, Bhavani River at Athikadavu, collected by Dr. M. Arunachalam and team, 03 March 2001. CMA 250, 2ex, 195.62-215.02 mm SL, Bhavani River at Athikadavu collected by Dr. M. Arunachalam and team, 28 January 2002. CMA 251, 3ex, 166.03-197.66 mm SL, Pillur Dam, Bhavani River collected by Dr. M. Arunachalam and team, 18 April 2002. CMA 252, 5ex, 128.44-153.49 mm SL, Pillur Dam, Bhavani River collected by Dr. M. Arunachalam and team, 20 September 2002.

***Hypselobarbus micropogon*:** MSUMNH 244, 1ex, 136.95 mm SL, Pillur Dam, Bhavani River, collected by Dr. M. Arunachalam and team, 10 March 2001. CMA253, 2ex, 130.78-171.35 mm SL, Pillur Dam collected by Dr. M. Arunachalam and team, 10 March 2001. CMA254, 2ex, 138-139.88 mm SL, Bhavani River at Athikadavu collected by Dr. M. Arunachalam and team, 03 February 2001. CMA255, 2ex, 106.77-130.61 mm SL, Bhavani River at Athikadavu, collected by Dr. M. Arunachalam and team, 27 March 2001. CMA256, 2ex, 104.84-138.17 mm SL, Bhavani River at Chengal, collected by Dr. M. Arunachalam and team, 21 November 2001. CMA257, 3ex, 105.69-146.08 mm SL, Bhavani River at Nellithurai, collected by Dr. M. Arunachalam and team, 08 March 2002. CMA258, 2ex, 113.39-117.45 mm SL, Bhavani River at Nellithurai, collected by Dr. M. Arunachalam and team, 11 October 2001. CMA259, 4ex, 111.94-122.15 mm SL, Pillur Dam, Bhavani River, collected by Dr. M. Arunachalam and team, 16 March 2003.

ACKNOWLEDGMENTS

Senior author thanks Dr. K. Ilango, Officer-in-charge, Zoological Survey of India, Southern Regional Centre, Chennai for providing permission to examine the specimens of *Hypselobarbus*. Also we thank Dr. Jayashree Tilak, who is in charge of the freshwater fishes in ZSI/SRC, Chennai, Tamilnadu. The senior author (M.A.) was supported by Manonmaniam Sundaranar University under National Agricultural Technology Project under Mission Mode Programme of "Germplasm Inventory and Gene

Banking of Freshwater fishes” (sanction letter No. 27281/98/NATP/MA-III/dt 23.12.1999). This research was also possible with grants to RLM under Saint Louis University and the USA National Science Foundation Grants EF-0431326, DEB-1021840 and DBI-0956370 for the taxonomy and systematics of Cypriniformes fishes. The two initiatives Cypriniformes Tree of Life and All Cypriniformes Global Biodiversity Initiative (www.cypriniformes.org) have aided in this mission.

REFERENCES

- Arunachalam, M., Raja, M., Muralidharan, M. and Mayden, R.L. 2012. Phylogenetic relationships of species of *Hypselobarbus* (Cypriniformes: Cyprinidae): an enigmatic clade endemic to aquatic systems of India. *Zootaxa* 3499: 63-73.
- Day, F., 1867. On the fishes of the Neilgherry hills and rivers around their bases. *Proc. Zool. Soc. London*, 19: 281-302.
- Day, F., 1889. *The Fauna of British India including Ceylon and Burma. Fishes*, Taylor & Francis, London, vols. I and II: pp. 548 and 509.
- Hubbs, C.L. and Lagler, K.F., 1964. *Fishes of the Great Lakes region*. University of Michigan Press, Ann Arbor, USA, pp. 213.
- Jayaram, K.C., 1991. Revision of the genus *Puntius* Hamilton from the Indian region (Pisces: Cypriniformes, Cyprinidae, Cyprininae). *Rec. Zool. Surv. India, Occasional Paper*, 135, 1-178.
- Raja M., 2010. Molecular phylogenetic analysis and morphometric characterization of the big sized barbs of the endemic genus *Hypselobarbus* (Cypriniformes: Cyprinidae) of the Western Ghats. Ph.D. Thesis, Manonmaniam Sundaranar University, Tamil Nadu, India, pp. 251.
- Strauss, R.E. and Bookstein, F.L., 1982. The truss: Body form reconstructions in morphometrics. *Systematic Zool.*, 31 (2): 113-135.