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Rediscovery of *Barilius rugosus* Day (Cypriniformes: Cyprinidae) Firstly after its Description in 1867

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Abstract

Barilius rugosus Day is a least known cyprinid fish described from south India. This name was not used by most of the researchers after its original description in 1867. Lack of specimens from its type locality is the main reason for the failure in confirming its identity. An examination of the specimens of *Barilius rugosus* collected recently from a stream of Bhavani River at Palakkad shows, however, that it exhibits many distinct differences from its congeners. *Barilius rugosus* can be distinguished from its congeners in having a slender body, 8-9 branched rays in dorsal fin, 39-40 lateral line scales, 17-19 predorsal scales, 15- 17 vertical greyish silvery bands on laterals, white tipped dorsal fin and anal fin and prominent tubercles on tip of snout and jaws. Morphometric characters and meristic counts of *Barilius rugosus* were analysed well based on the topotypic materials.

***B**arilius rugosus* was described by Francis Day[3] from the mountain streams of south India. Even though he described this species distinctly, himself and the later authors kept away from this name intentionally or inadvertently. Day himself, in his later volumes[2,6], was suspicious about the identity of this new species. In the original description, *B. rugosus* was compared with *B. bakeri* Day. But in his 'Fishes of India[5]…', Day treated *Barilius rugosus* as a synonym of *B. gatensis*[20]. Jerdon[12], who described three new species of this genus from south India, avoided *B. rugosus* from all his accounts. Gunther[7] treated *B. rugosus* as a distinct species. Beavan[1] not recognised the identity *B. rugosus* in his accounts. Talwar and Jhingran[19] did not recognise the identity of the Day's *Barilius*. Menon[14] catalogued it as a synonym of *Barilius gatensis* (Valenciennes[20]). Jayaram[11] eluded the *rugosus* from his all-taxonomic accounts including 'The freshwater fishes of the Indian region'. Knight *et al.*[13] avoided the name *B. rugosus* from their description of *B. ardens*. *B. rugosus* is currently a forgotten species even though it was described originally (Day[3]) in much detail. Researchers after Day[3] was oblivious about the identity of *B. rugosus,* mainly because of the neglect of this species by the original discoverer himself. Moreover,

Associate Professor & Head

it had not been procured by them from its type locality after its original description. Unfortunately, Bhavani and Siruvani, two perennial Rivers, are the least explored water bodies in south India for taxonomic studies: especially part of these Rivers at Palakkad Mountain ranges in Kerala-Tamil Nadu Border. Serious ichthyotaxonomic studies conducted on eastern parts of Bhavani River along the base of Nilgiris were also scarce. Adventurous and dangerous nature of this fast flowing and rocky bottom stream may be a hurdle for many researchers to conduct taxonomic studies on the fish fauna in it. Furthermore, most of the workers were confused between *B. rugosus* and *B. gatensis;* both of these species were described from south Indian mountain streams, *rugosus* from'the Bowany and Seegoor Rivers, (Now Bhavani and Siruvani Rivers) and the rapid streams along the lower slopes of the Neilgherries' (Now Nilgiris) and *gatensis* from 'fresh waters that descend from the mountains of the Gates' (now Western Ghats).

As per original descriptions, *B. rugosus* possess many distinct morphometric and meristic differences from *B. gatensis.* This inspirited this author to procure specimens of *Barilius* from Bhavani River at Palakkad Mountain ranges which resulted in collection of many original specimens of *Barilius rugosus*. Detailed meristic and morphometric analysis revealed that *Barilius rugosus* is a distinct species with many valid differences from its congeners.

Specimens of the selected fish were procured from the freshwater stream using gill net and fixed in 10 % formalin; congeners of the selected fish were also collected from their respective type localities and preserved; after proper preservation, fishes were taken out and taxonomically analysed. Measurements were taken point to point using dial calipers and data recorded to tenths of a millimeter. Parts of head are measured as percentage of head length (HL); remaining body parts were presented as percentage of standard length (SL). Methods used are those of Jayaram[10]. Comparison and discussion were based on topotypic specimens. Specimens of *Barilius rugosus* used for this study are now deposited in the museum of dept. of Zoology BJM Govt College Chavara. Relative species which were utilized as comparative specimens for this study, are now deposited in various ZSI museums of India.

Barilius rugosus Day :

Barilius rugosus, Day[3]. *Proceedings of Zoological Society of London.* P. 294.

Day[5], The Fishes of India; London.

Gunther[7]. *Catalogue of fishes in British museum,* 7: 291.

Menon[14],Check list-fresh water fishes of India. 175: 1-366.

Materials examined: DOZ/GCC 200, 7 specimens, 115.4 - 135.0, a small stream of Bhavani River at Agali, near the base of Nilgiri Hills, Coll. Mathews Plamoottil, 23.12.2020.

Diagnosis : *Barilius rugosus* (Fig. 1-3) can be distinguished from its congeners in having a slender body (24.3 – 27.1 % SL), 15- 17 vertical greyish silvery bands on laterals, whitedorsal and anal fin tip, 8-9 branched rays in dorsal fin, 39-40 lateral line scales, 17-19 predorsal scales, anterior part of anal fin

considerably elongated than its posterior part which forms a distinct indentation in the middle of the fin and prominent tubercles on tip of snout and upper and lower jaws.

Description: Body laterally compressed; both dorsal and ventral profiles moderately convex; pre dorsal region convex; post dorsal region nearly in a straight line; pre occipital region nearly straight; cleft of mouth large,oblique and extending posteriorly to beneath middle of orbit; lower jaw longer than upper jaw; lower jaw is received at its termination into a slight emargination formed by the junction of the intermaxillaries. Pharyngeal teeth in three rows, curved, slightly hooked and pointed at their extremities. Prominent tubercles on snout, sides

Fig. 1. *Barilius rugosus*, DOZ/GCC 200, after preservation in formalin.

Fig. 2. A formalin preserved adult specimen of *Barilius rugosus* (lateral vertical stripes were not focussed due to light reflection)

Fig. 3. Head of *Barilius rugosus* showing tubercles

of the intermaxillaries and inferior surface of lower jaw. Nares located nearer to orbit than to snout tip; anterior pair semitubular, posterior pair broad and prominent. Eyes large, located behind the angle of jaws, on dorso lateral region of head; its lower margin located considerably above angle of mouth, upper surface never reach to dorsal profile of head.

Dorsal fin commences above middle of ventral fin, nearly midway between snout and middle of caudal fin,extending posteriorly to above third anal ray; outer margin of dorsal fin straight; anterior extremities of dorsal fin the highest. Base of dorsal fin scaleless. Pectoral fin tip never reaches to ventral fin origin, reach 2-3 scales in front of it; outer margin of pectoral fin nearly straight; ventral fin tip reach or reach near to anal opening, extend to 1- 2 scales in front of anal fin; outer margin of ventral fin convex. One auxiliary scale present on either side of ventral fin base which is half length of the latter; anal fin commences behind and below middle of dorsal fin; its tip reaches 7-8 scales in front of caudal fin base. Anal fin with a convex and concave margin; anterior branched rays of it protrudes considerably from the outer margin and posterior rays considerably shorter. Base of anal slightly scaled. Caudal fin moderately emarginate; lower lobe considerably longer; base of caudal fin scaled. Lateral line is concave and distinct throughout; it passes downwards nearly parallel to abdominal profile. Scales moderate, distinct and with two to three raised lines on each.

Colour *:* Dorsal black; laterals grey; abdomen silvery white; 15-17 greyish silvery, long vertical stripes on back to a little above lateral line; 6-7 small round to oval black spots above tip of pectoral fin to tip of ventral fin. Mature adults have one to three rough spots on each scale on the posterior half of the body. Base of dorsal and anal fin deep black and its anterior extremity tipped with white, extreme tip of anal fin red.

Regional Names *:* Ozhukkan Paral (Malayalam), Aattukendai (Tamil).

Comparisons : *Barilius rugosus* differs from all its congeners (Fig. 4-10) in having greater number of lateral line scales (Day[3] wrote it as 40; Gunther[7] mentioned it as 41), in number of dorsal and anal fin rays and in the colour of body and fins. *Barilius gatensis* and *B. bendelisis* are the close congeners of *B. rugosus*;

Fig 4. *Barilius malabaricus*, collected from Kannur, ZSI/WRC/P/5562.

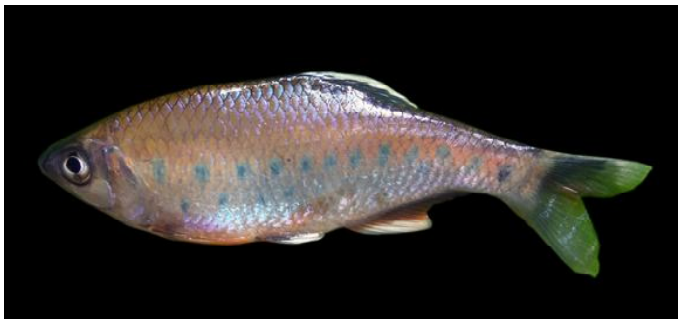

Fig. 5. *Barilius canarensis,* collected from Kannur,ZSI/ANRC-26829.

Fig. 6. *Barilius ardens* collected from Karnataka, V/F/NERC/ZSI/5329.

Fig. 7. *Barilius bendelisis* collected from KarnatakaGCC/DOZ 116.

Fig. 8. *Barilius bakeri* collected from Mundakkayam, ZSI/WRC/P/5561.

Fig. 9. *Barilius cyanochlorus,* Holotype, FBRC/ZSI/VS/02.

Fig. 10. A specimen of *Barilius* GCC/DOZ 120, collected from Karnataka showing similarity to *B. gatensis*

these are characterised by having elongated body with 7- 8 branched rays in dorsal fin and having some vertical colour bands or lines on lateral region. *B. rugosus* differs from *B. bendelisis* (Hamilton[8,9]) in having 8-9 (Vs. 7) branched rays in dorsal fin, 12-14 (vs. 8) branched anal fin rays and in having 2 (vs. 4) barbels. *B. rugosus* further differs from *B. bendelisis* in having 15-17 vertical black bands on lateral sides (vs. 9 thin vertical lines). *Barilius gatensis* (Valenciennes[20]) is a closely related species of *B. rugosus*. Owing to close taxonomical similarities, Day[5] and Menon[14] treated the latter as the synonym of the former. Both these south Indian species have a slender body with vertical bands or lines on lateral sides and in having 11- 12 dorsal fin rays and 15-17 anal fin rays. *Barilius rugosus* differs from *B. gatensis* in having long (vs. short) 15- 17 (vs. 9) vertical bands on laterals and 39- 40 (vs. 38) lateral line scales. Valenciennes[20], description of *B. gatensis* was very brief and of general in taxonomic characters. Valenciennes[20] did not mention about any special colour of fins of his fish. In *Barilius rugosus* base of dorsal and anal fin deep black and their extremities tipped with white; extreme tip of anal fin red. But Valenciennes not

recorded any of these characters in *B. gatensis*. 15- 17 large vertical bands on lateral sides of *B. rugosus* are prominent and distinct; in adult *B. rugosus,* below the middle part of the vertical stripes, 5-6 small oval spots are present. but no such bands and spots were noted in *B. gatensis.* Shape of dorsal and anal fin of *B. rugosus* is unique. *Barilius rugosus* is a distinct and different species showing marked taxonomic differences from its congeners.

Barilius gatensis is currently considered as a common species in northern parts of Kerala and Karnataka. But the specimens currently considered as *B. gatensis* are different from Valenciennes' *Barilius gatensis;* its taxonomic characters are not matching with the diagnostic features originally described by Valenciennes[20]. According to original description body of *B. gatensis* is '… compressed and quite wide… eye is large…thirty-eight rows of scales on each side…colours are browned on the back, silvery under the belly….crossed by small vertical greyish bands, which are seen by reflects, I count nine...'. It is difficult to find a fish with all these characters.

During this research work a single specimen of a *Barilius* species had been collected from Karnataka which showed similarity to Valenciennes' description of *gatensis*: Lateral line scales 37 and 10 vertical bands / stripes on laterals.

But DNA sequencing could not be done on this *Barilius* species; moreover, it do not fully match with Valenciennes' description in all respects. *Barilius gatensis* must yet to be procured, identified and DNA sequenced. Therefore, Valenciennes[20]'s original description is used here for comparison.

In the original description, Day[3] treated *B. bakeri* as a close congener of *B. rugosus* and compared both the species. Day[3] wrote: "…this species differs from the *Barilius bakeri,* being of a more slender shape, whilst the jaws are surrounded by large glands, and, instead of a few distinct oval or round spots along the lateral line, it has fifteen distinct stripes.." . But these two species differ from each other in many meristic and morphometric characters. Moreover *bakeri* was described from Mundakkayam of Kottayam district which is 275 km away from the type locality of *rugosus. Barilius rugosus* differs from *B. bakeri* in having39-40 (vs. 37-38) lateral line scales, 8- 9 (vs. 10) branched dorsal fin rays, 17-19 (vs. 14-16) pre dorsal scales and body depth at dorsal fin origin 24.3 – 27.1 (vs. 29.6-30.9). *Barilius rugosus* differs from *B. canarensis* Jerdon[12] in having more (39-40 vs. 35-36) lateral line scales, more predorsal scales (17- 19 vs. 14–15) and fewer (8 -9 vs. 10) branched dorsal fin rays. More over *B. rugosus* bears a single row of 15 -17 vertical bands on the mid lateral sides of the body (vs. double row of spots along the length of the body in *B. canarensis*). *Barilius rugosus* differs from *B. ardens* Knight *et al*.[13], in its colour pattern; the former is with a row of 15-17 black vertical bands on the lateral side (vs. 7–9 large, bluish-green, vertically elongate blotches). Furthermore, it differs from *ardens* in having more (39- 40 vs. 36- 37) lateral line scales, fewer (8-9 vs. 10) branched dorsal fin rays, greater (13-14 vs. 11-12) pectoral fin rays, shorter (body depth at dorsal fin origin 24.3 – 27.1 % SL. vs. 30.2–34.2) body and longer

(17.5-19.0 % SL vs. 14.5–16.9) caudal peduncle. *Barilius rugosus* differs from *B. malabaricus* Jerdon[12] in having shorter body (body depth at dorsal fin origin24.3 – 27.1 % SL. vs. 32.2–36.3) with a row of 15- 17 black vertical lateral bands (vs. a row of 9–13 round or oval bluish-green spots), 39- 40 (vs. 36–38) lateral line scales and 8-9 (vs. 11) branched dorsal fin rays.

B. rugosus differs from *B. cyanochlorus* Plamoottil & Vineeth[15] in having15-17 greyish silvery, long vertical lines pass from back and reach a little above lateral line. (vs. Eight vertical bands on mid lateral region, each with lower blue and upper green parts), 17-19 (vs. 14-16) dorsal scales, 8-9 (vs. 11) branched dorsal fin rays and in 2 (vs. 4) barbels.

Fig. 11. A stream of Bhavani River at Agali, Palakkad- the collection locality of *B. rugosus*

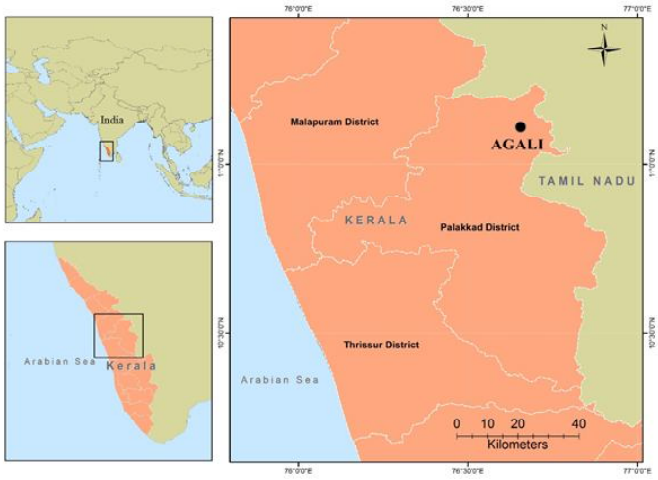

Fig. 12. Map showing Agali at Palakkad, the place of collection of *B. rugosus*

Table-1. Morphometric Characters of *Barilius rugosus*

Sl. No	Measurement	Range	mean	S.D
1	Total length (mm)	115.4 - 135.0	124.94	7.61
2	Standard Length (mm)	95.0 - 114.5	103.45	6.11
3	Head Length(mm)	28.0 – 34.4	30.03	1.75
4	Head length	27.6 – 30.4	28.88	0.86
5	Head depth	18.8 – 21.6	20.42	1.17
6	Head width	14.1 – 16.2	15.18	0.91
7	Body depth at dorsal origin		25.81	0.91
8	Body depth at anal origin	22.5 – 25.7	24.32	1.15
9	Body width at dorsal origin	11.4 – 13.1	12.08	0.58
10	Body width at anal origin	6.0 – 7.1	6.68	0.35
11	Pre-dorsal length	53.1 – 54.5	53.68	0.53
12	Post-dorsal length	46.7 – 49.0	47.92	0.81
13	Pre-pelvic length	46.6 – 49.0	48.2	0.77
14	Pre- anal length	61.9 – 64.6	63.71	0.86
15	Length of dorsal fin	15.3 – 17.5	16.8	0.83
16	Length of pectoral fin	17.1 – 18.7	17.8	0.68
17	Length of pelvic fin	12.8 – 13.9	13.35	0.40
18	Length of anal fin	16.2 – 18.2	17.25	0.77
19	Length of caudal fin	22.7 – 25.0	23.94	0.80
20	Length of base of dorsal fin	14.2 – 15.4	14.88	0.47
21	Length of base of anal fin	18.8 – 23.0	21.04	1.38
22	Length of caudal peduncle	16.6 – 20.0	17.92	1.26
23	Depth of caudal peduncle	10.2 – 11.2	10.71	0.34
24	Width of caudal peduncle	4.71 – 5.47	5.04	0.24
25	Distance between pectoral fin and pelvic fin	19.1 – 21.2	20.27	0.72
26	Distance between pelvic fin and anal fin	15.6 – 17.2	16.42	0.58
27	Distance between anal fin and caudal fin	33.0 – 35.8	34.7	0.98
28	Distance from ventral to vent	15.4 – 16.8	15.88	0.46
29	Distance from anal to vent	0.18 – 0.96	0.50	0.36
30	Head depth	67.4 – 75.2	70.72	3.15
31	Head width	50.0 – 56.8	52.68	2.53
32	Eye diameter	28.4 – 31.0	29.54	0.88
33	Pre-orbital distance	52.6 – 57.6	55.45	1.63
34	Post-orbital distance	42.6 – 48.4	45.97	1.89
35	Pre-occipital distance	62.5 – 69.6	66.14	2.65
36	Post-occipital distance	114.9 – 127.5	121.84	5.89
37	Inter orbital width	30.8 – 34.6	32.7	1.45
38	Inter narial width	16.6 – 18.6	17.74	0.65
39	Snout length	24.1 – 27.8	25.7	1.36
40	Width of gape of mouth	26.6 – 35.3	31.27	3.01
41	Length of maxillary barbels	0.68 – 1.39	1.15	0.30

Table-2. Meristic Countsof *Barilius rugosus*

Sl. No	Characters	Range
1	Lateral line scales	39-40+1
2	Pre-dorsal scales	17-19
3	Dorsal fin origin to lateral line	8.5
4	Ventral fin origin to lateral line	2.5
5	Anal fin origin to lateral line	3.5
6	Circumpeduncular scales	7-8
	Fin ray count	
7	Dorsal fin rays	ii.8-9
8	Pectoral fin rays	i.13-14
9	Pelvic fin rays	i.8
10	Anal fin rays	ii-iii,12-14
11	Caudal fin rays	iii.17.iii
12	Number of barbells	2

Habitat: The freshwater stream from which *Barilius rugosus* was collected is a small water stream at Agali in Palakkad Mountain ranges (Fig. 11 & 12). The attitude of the area is about 750 meters above sea level. The stream is floored by rocky substratum; patches of cobbles, boulders and sand occur at certain points. The width of the water channel varies between 18 m 20 m. This high-level region is characterized by intermittent occurrence of moderately dense riparian fauna. *Dalbergia latifolia, Sleichera oleosa, Terminalia bellerica, Anthocephalus cadamba, Mitragyna parviflora, Machilus macrantha, Stereospermum personatum, Grewia tilifolia etc* are the riparian vegetation at the locality of *Barilius rugosus*. *Amblypharyngodon melettinus, Anguilla bengalensis, Hemibagrus punctatus, Barbodes bovanicus, Barbodes carnaticus, Channa gachua, Channa marulius, Channa punctatus, Channa striatus* etc are the co occurring fish species.

Several synonymic fish species are residing in the water bodies of south India. Creation of the synonymy is mainly due to imperfect original description, unavailability of type specimens in the animal depositories and failure in procuring forgotten species from their type localities. Many fish species are being rediscovered and redescribed during last decade and have resurrected from their synonymy with others. *Pristolepis malabarica* (Plamoottil & Abraham[16]), *Gobius malabaricus* (Plamoottil[17]), *Mystus keletius* (Plamoottil[18]) are some examples. It is expected that more synonymic species will be resurrected from their synonymy in days to come.

Comparative materials examined :

Barilius cyanochlorus: Holotype: FBRC/ZSI/VS/02, 58.5 mm SL, water stream at Chully, Kasargod, coll. Mathews Plamoottil and Vineeth. K, 25/05/2020. Paratypes: FBRC/ ZSI/VS/03, 6, 52.2-70.00 mm SL, a water stream at Chully, Kasargod, coll. Mathews Plamoottil and Vineeth. K, 25/05/2020. *Barilius canarensis:* ZSI/ANRC-26829, 1, 67 mm SL, Uppinangadi, Karnataka, coll. Mathews Plamoottil & Vineeth, 30/01/2020; ZSI/ANRC-26830, 1, 103 mm SL, Kolichaal, coll. Mathews Plamoottil & Vineeth, 03/01/ 2020. *Barilius bakeri:* ZSI/WRC/P/ 5561, 3, 91-110 mm SL, Manimala River, 07.02.2012, coll. Mathews Plamoottil; *Barilius malabaricus:* ZSI/WRC/P/5562 113, 2, 81-90 mm SL, Malom, Kasargod, coll. Mathews Plamoottil & Vineeth, 21/06/2019: *Barilius ardens:* V/F/NERC/ZSI/5329, Kammaadam,

Kerala, coll. Mathews Plamoottil & Vineeth K, 05/01/2020: ZSI/WGRC/6866, 2, 94-100 mm SL, Coorg, coll. P.M Sureshan; *Barilius gatensis*, Valenciennes description (1844); ZSI/WGRC/4818, 75-79 mm SL, Noolpuzha, Rampur, Wayanad, coll. K.N Nair; GCC/DOZ 120, 1, 97 mm, Hunsur, Karnataka, coll. Mathews Plamoottil & Vineeth K 24/01/2020; *Barilius bendelisis,* GCC/DOZ 121, 2, 38.5-56 mm SL, Thirthahalli, Karnataka, coll. Mathews Plamoottil & Vineeth K 29/02/2020.

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