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Dr. Rani Dhanze

Professor & Head,

Department of Fisheries

Resource Management, College

of Fisheries, Central Agricultural

University (I), Lembucherra,

Agartala, Tripura, India

Prabir Debbarma

Junior Research Fellow,

Centre of Excellence on Fishery

and Aquaculture Biotechnology

for North-eastern India, COF,

CAU, Lembucherra, Agartala,

Tripura, India

Dr. JR Dhanze

Consultant & Farmer Dean

Centre of Excellence on Fishery

and Aquaculture Biotechnology

College of Fisheries, Central

Agricultural University (I),

Lembucherra, Agartala, Tripura,

India

Correspondence

Dr. Rani Dhanze

Professor & Head,

Department of Fisheries

Resource Management, College

of Fisheries, Central Agricultural

University (I), Lembucherra,

Agartala, Tripura, India

New record of a little known species *Mastacembelus oatesii* Boulenger, 1893 (Synbranchiformes: Mastacembelidae) from Nagaland and Mizoram States of Northeast India, with redescription

Dr. Rani Dhanze, Prabir Debbarma and Dr. JR Dhanze

Abstract

The species *Mastacembelus oatesii* Boulenger, has so far been recorded from Myanmar and other South East Asian countries. However, while confirming the specific identity of some fish species collected from Northeastern states of India, authors came across a lot of *Mastacembelus* specimens identified as *M. armatus* (Lacepede). However, on meticulous examination of series of specimens based on morphometric and meristic data it was observed that some of the specimens belong to *Mastacembelus oatesii* Boulenger, reported as the first record from North eastern states of India, which is in contiguity to the type locality of this species in Myanmar by the ramification of different tributaries of Chindwin-Irrawaddy Basin. Hence, the detailed systematic identity based on diagnostic traits and the distributional pattern of *M. oatesii* is discussed in this paper.

Keywords: *Mastacembelus oatesii*, evaluation of taxonomic traits, distributional pattern, new record

Introduction

Northeastern region of India is endowed with rich diversity of natural resources including abundant water resources and biodiversity. One-third of India's runoff flows from the Northeast through the Brahmaputra and Barak rivers drainage system into the Bay of Bengal, traversing plain of Bangladesh. However, the drainage of a small area of Eastern Manipur, Nagaland and Mizoram, finds its way into Chindwin, a tributary of Irrawaddy, which flows through Yangon (Rangoon) traversing its delta and falls into the Gulf of Martaban, a part of Andaman Sea. Based on the physiographic and topographic features, Northeastern Region can be divided into the eastern Himalayas, the northeastern hills, and the Brahmaputra and Barak valley plains. At the confluence of the Indo-Malayan and Eastern Palaeartic biogeographic realms, the region encompasses a profusion of habitats characterized by diverse biota with a high level of endemism. The World Wide Fund for Nature (WWF) has identified the entire eastern Himalaya as a priority Global 2000 Eco region; and Conservation International has subsumed its eastern Himalaya "hotspot" into a wider Indo-Burma hotspot, which now includes all the eight states of the Northeast (Gurumyum, & Choudhury, 2009) [6]. The river of Manipur, Mizoram and Nagaland originating from the Nagahills and Northwestern hills of Manipur are distinctly of two types some flowing southeastwards augmenting water of Chindwin-Irrawaddy Basin while others such as Barak and its tributaries flowing southwestwards forming the Barak-Meghna basin drainage system. The fish fauna of these two drainage system are distinctly different in view of the geographical barrier constituted by the hill ranges such as Naga hills, Manipur hills and Longtharai. During the systematic study of the fishes collected from entire Northeast Region of India under the Centre of Excellence for fishery and Aquaculture for Northeast, we observed some distinct features in respect of distributional pattern as well as bio systematic attributes, some of which are discussed in the present communication in respect of newly recorded species of the genus *Mastacembelus*.

The genus *Mastacembelus* Scopoli, 1777, is uniformly distributed in Indian waters and Southeast Asian region, characterised by spiny eel-like fishes, cylindrical and compressed body without pelvic fin and tapering anteriorly. The non-protractible pre-maxilla present as distinct bones and gills are poorly developed, confluent across the breast, and restricted to the

lower half of the body. Many species of this genus are known from adjacent Southeast Asian countries (Roberts, 1986) [10], however, from Indian aquatic habitats only one species *Mastacembelus armatus* (Lacepede) has been invariably recorded as per the perusal of the pertinent published literature (Jayaram, 2013; Yazdani, 1990; Talwar and Jhingran, 1991; Barman, 1994; Vishwanath *et al.*, 2007; Kar and Sen, 2007; Goswami *et al.*, 2012) [8, 15, 12, 2, 14, 9, 5]. Perhaps, because of the overlapping nature of taxonomic traits, morphological characters and colour patterns of different species of this genus, the earlier workers could not pinpoint the range of specific variation, which resulted erroneous identification of the species from Indian waters. However, Roberts (1986) [10] published a comprehensive systematic review of the Mastacembelidae or spiny eels of Burma and Thailand, based on the evaluation of different taxonomic traits and established the threshold of inter-specific variation, which is considered as one of the standard work for identification of the species of genus *Mastacembelus*. Hence the present study has been carried out to ascertain the specific identity of fishes of the genus *Mastacembelus* and its distributional range in the region for final cataloguing in Natural History referral Museum, College of Fisheries, CAU, Lembucherra, Agartala.

Materials and methods

More than 218 specimens of the family Mastacembelidae have been collected during the extensive surveys conducted to inventories the fish faunal resources from different river system and their tributaries of Northeastern Region with the aim to establish a Referral Museum of fish species in the region, under the project “Centre of Excellence on Fishery and Aquaculture Biotechnology for Northeastern India”. The study was carried out during the last four years (March, 2013 to June, 2017). While confirming the tentatively identified material having temporary registration number, we came across 11 specimens collected from the river Tuphaleri and Laney in Nagaland and Sihhimui in Mizoram, erroneously identified as *Macrognathus* or *Mastacembelus* sp. as detailed under the material examined.

For confirmation of the specific identification, different morphometric measurements were mensurated with the help of Dial caliper (up to 0.1 mm) and meristic counts with the help of binocular microscope. Out of total 43 morphometric characters, 38 proportions as percentage of different attributes for each specimen were calculated and subjected to statistical analysis (to determine the range of variation, mean, SD and SE) as tabulated in Tab. 1. The Microsoft Excel version 2007 (12.0.4518.1014) service pack was used to analyze the data statistically.

Material examined and deposited in the referral museum COF, CAU, Lembucherra:

Mastacembelus oatesii Boulenger, 1893

COF-CAU-0266, 4 ex. (SL 178-244mm), Lanye river, N25° 36.745' E 094° 30.125', Alt.674m, Nagaland, 13. 05. 2014, Coll. Himadri Saha & Party.

COF-CAU-0267, 1 ex. (SL 223mm), Tuphaleri river, Losataphe, N25° 35.423' E 094° 231', Alt. 843m, Nagaland, 08. 04. 2017, Coll. Himadri Saha & Party.

COF-CAU-0268, 1ex. (SL.207mm), Tuphaleri river, Tacholerul, N25° 30.287' E 094° 25.571', Alt. 927m Nagaland, 06.04.2017, Coll. Himadri Saha & Party.

COF-CAU- 0265, 5ex. (SL. 153-160mm), Sihhimui river, Talwang Mizoram, 21.11.2013, Coll. Samar Jama.

Results

Out of the total 218 specimens of Mastacembeloids examined, which include probably three species (*Mastacembelus armatus*, *M. dayi*, *M. oatesii*) we came across 11 specimens tentatively identified as *Mastacembelus armatus* but apparently different from the rest of other 207 specimens in respect of morphological and colour patterns which is quite variable in most of the Mastacembeloids depending upon the size, age and habitat. On meticulous reexamination and analysis of the morphometric and meristic data mensurated from these 11 specimens of different age and size group as tabulated in (Tab.1), it is inferred that these 11 specimens are of *Mastacembelus oatesii* and not of *M. armatus*. These two species can easily be distinguished based on combination of 16 morphometric and meristic characters (Tab.1, Pl. I, fig. 5). The most distinguishing characters that we evaluated includes the shape of caudal fin, which has round margin and with a distinct constriction at the confluence of dorsal and anal fin in *M. oatesii* vs. truncate without constriction uniformly confluent in *M. armatus*; dorsal fin counts XXXII–XXXVI,48–56 dotted with longitudinal bands vs. XXXVI–XXXVIII,70–82; anal fin III,43-57 dotted with 10–15 dark conical bars vs. III,70–80 without bars and their coloration pattern which is conspicuous and tally with the elaborate description of the species by Roberts (1986) [10]. Besides meristic counts, different body proportions as evaluated during the present study, the range of various morphometric proportion are consistently differentiating the two species in respect of 11 characters with a minimum standard deviation such as HL, HD, BD, PFL, CFL, PSDL, PrSDL, PPL as % of SL and PrOL, PtOL, UJL, LJL as% of HL (Tab.1, fig.5), however, the morphometric range given by earlier worker are overlapping in most of the species of this genus (Yazdani, 1990; Talwar and Jhingran, 1991) [15, 12]. Further, the reporting of 11 specimens as catalogued from the rivers of Nagaland and Mizoram is the first record from India, which is the extension of its distributional range from its type locality (Inle lake, Myanmar) to India.

Table 1: Frequency distribution of different Morphometric proportions and meristic counts

Morphometric proportion	1	2	3	4	5	6	7	8	9	Average	SD	Range
Total length	186.32	167.85	163.12	244.11	220.07	209.11	178.66	231.57	214.34	201.68	28.82	163.12–244.11
Standrad length% TL	92.26	95.57	93.92	95.81	95.32	94.65	93.46	96.61	94.67	94.70	1.33	92.26–96.61
Head length %TL	17.30	18.27	19.51	17.89	17.59	17.34	17.04	16.60	16.88	17.60	0.88	16.60–19.51
Head length %SL	18.76	19.12	20.77	18.67	18.45	18.32	18.23	17.17	17.83	18.59	0.99	17.17–20.77
]Head width% HL	26.86	23.87	23.29	31.72	31.13	29.09	33.18	33.43	31.95	29.39	3.87	23.29–33.43
Eye diameter% HL	14.83	13.82	17.19	10.10	9.74	9.87	9.86	11.50	13.57	12.28	2.70	9.74–17.19
Eye diameter% POL	48.09	37.29	48.67	26.82	25.89	29.68	26.36	30.55	40.44	34.87	9.12	25.89–48.67
Eye diameter% PtOL	26.73	24.13	32.83	17.34	17.54	17.01	17.88	21.15	22.31	21.88	5.34	17.01–32.83

Pre-orbital length% HL	30.83	37.07	35.32	37.65	37.61	33.25	37.39	37.65	33.55	35.59	2.51	30.83–37.65
Pre-orbital length% PtOL	55.59	64.71	67.47	64.65	67.75	57.29	67.82	69.23	55.16	63.30	5.68	55.16–69.23
Post-orbital length% HL	55.46	57.29	52.36	58.25	55.52	58.04	55.12	54.38	60.83	56.36	2.51	52.36–60.83
Inter orbital width% POL	30.08	27.88	21.98	22.45	29.05	24.21	25.83	20.73	24.71	25.21	3.27	20.73–30.08
Upper jaw length% HL	35.45	33.03	32.24	36.05	34.41	33.61	31.64	37.34	33.50	34.14	1.85	31.64–37.34
Lower jaw length% HL	24.13	20.43	25.14	25.72	25.42	26.25	25.10	29.07	24.82	25.12	2.25	20.43–29.07
Lower jaw length% POL	61.49	56.90	71.17	68.31	67.58	71.36	67.14	77.19	73.97	68.35	6.20	56.90–77.19
Head depth% HL	28.23	34.07	30.26	38.07	35.49	33.86	31.73	35.68	34.77	33.57	3.02	28.23–38.07
Head depth% BD	65.70	77.24	65.60	77.09	61.48	69.30	64.88	80.98	70.63	70.32	6.71	28.23–38.07
Body depth% TL	7.43	8.06	9.00	8.83	10.16	8.47	8.33	7.31	8.31	8.43	0.86	61.48–80.98
Body depth% SL	8.06	8.43	9.58	9.22	10.65	8.95	8.92	7.57	8.78	8.91	0.89	7.57–10.65
Dorsal fin base length% SL	79.62	78.21	78.81	81.27	73.36	77.85	82.54	80.12	73.39	78.35	3.18	73.36–82.54
Soft dorsal fin base length% SL	37.22	46.20	34.48	39.09	38.53	37.74	40.47	36.69	45.12	39.50	3.87	34.48–46.20
Pectoral fin length% SL	5.05	6.25	6.32	5.40	5.19	4.94	5.86	5.42	4.19	5.40	0.67	4.19–6.32
Pectoral fin length% HL	26.92	32.67	30.45	28.95	28.11	26.96	32.16	31.56	23.49	29.03	2.99	23.49–32.67
Pectoral fin base length% PFL	56.34	37.03	34.06	49.29	55.61	59.10	53.63	48.23	52.00	49.47	8.63	34.06–59.10
Anal fin base length% SL	40.87	42.03	39.37	40.28	41.04	43.76	43.83	41.67	40.40	41.47	1.53	40.28–43.83
Soft anal fin base length% SL	38.67	36.37	35.63	36.89	36.26	39.77	40.21	36.41	37.57	37.53	1.65	35.63–40.21
Caudal fin length% SL	5.50	5.35	4.09	5.44	5.08	4.89	4.01	4.37	4.32	4.78	0.59	4.01–5.50
Caudal fin base length% CFL	12.82	9.71	11.12	15.12	14.93	12.82	15.95	13.87	14.31	13.41	2.01	9.71–15.95
Pre spinous dorsal length% SL	21.58	24.08	24.18	19.62	20.81	20.14	20.98	21.40	20.55	21.48	1.61	19.62–24.18
Pre spinous dorsal length % Pre spinous Anal length	34.15	38.48	36.93	30.28	33.17	33.04	34.32	34.29	31.97	34.07	2.46	30.28–36.93
Pre soft dorsal length% SL	62.78	59.88	66.20	60.84	63.81	64.99	62.58	64.05	65.76	63.43	2.14	59.88–66.20
Pre soft dorsal length% Pre soft Anal length	99.35	95.68	101.13	93.89	101.70	106.59	102.36	102.63	102.29	100.62	3.84	93.89–106.59
Pre pectoral length% SL	18.69	19.00	19.89	18.01	18.98	18.14	18.62	17.86	18.15	18.59	0.64	17.86–19.89
Pre spinous anal length% SL	57.28	58.10	61.76	59.39	59.06	57.09	54.34	58.03	57.81	58.10	2.00	54.34–61.76
Pre soft anal length% SL	63.19	62.59	65.47	64.80	62.74	60.97	61.14	62.41	64.29	63.07	1.55	60.97–65.47
Pre pectoral to anal spine dist.% SL	40.79	39.01	42.20	41.79	43.11	40.06	38.42	38.21	37.55	40.13	1.96	38.21–43.11
Pre pectoral to soft anal dist.% SL	44.35	43.19	43.78	47.16	44.68	44.65	43.62	42.63	44.48	44.28	1.29	42.63–47.16

Meristic counts

Dorsal fin	XXXVI, 56	XXXIV, 49	XXXII, 52	XXXV, 48	XXXIV, 52	XXXIV, 53	XXXIV, 49	XXXIV, 53	XXXVI, 50			XXXII–XXXVI, 48–56
Pectoral fin	i,20	i,20	i,20	i,24	i,22	i, 23	i,23	i,21	i,21			I, 20–24
Anal fin	III,57	III,50	III,52	III,43	III,48	III,51,	III,45,	III,43	III,55			III, 43–57
Caudal fin	20	18	18	22	22	23	22	22	23			18–23



Fig 1: *Mastacembelus oatesii*, Reg. No. COF CAU-268



Fig 3: *M. armatus*, caudal fin shape and colour pattern



Fig 2: *M. oatesii*, caudal fin shape and colour pattern (magnified)



Fig 4: *M. dayi*, caudal fin shape and colour pattern

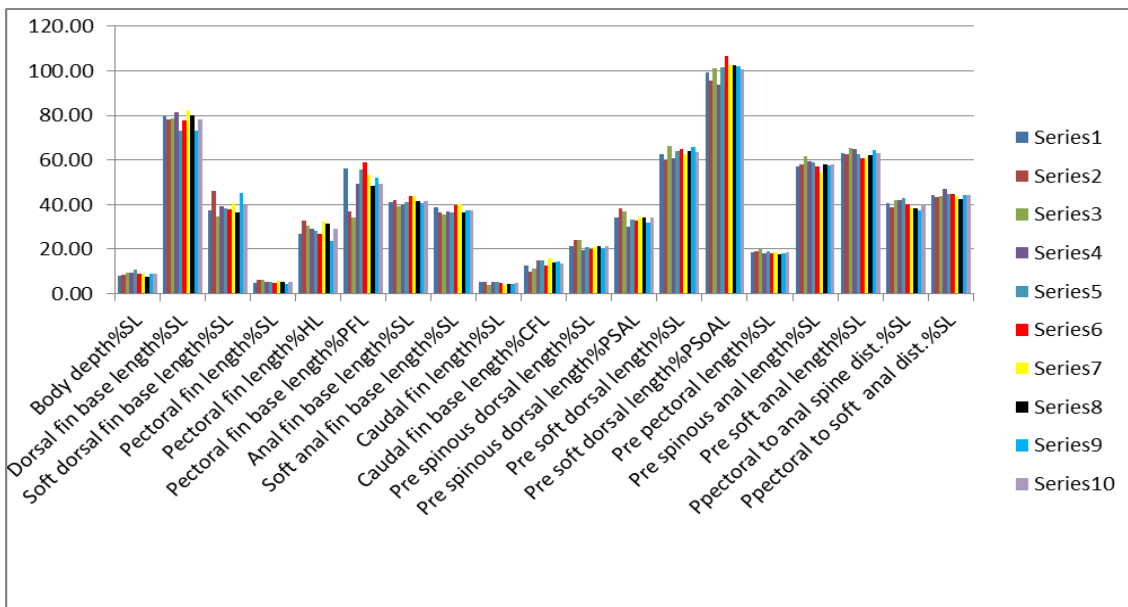


Fig 5.1: Morphometric data frequency distribution

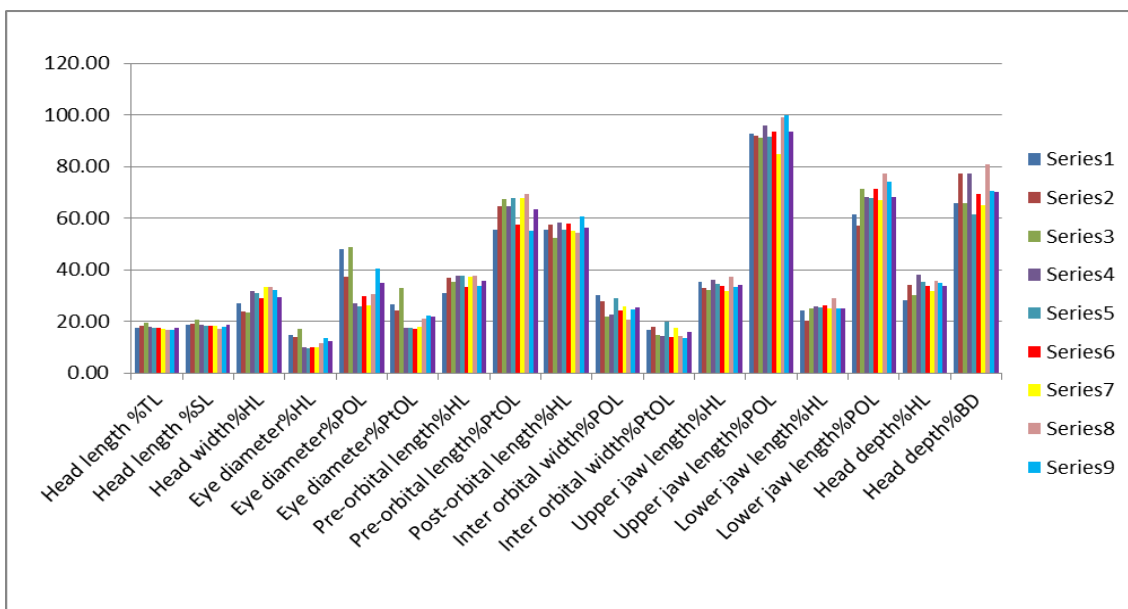


Fig 5.2: Morphometric data frequency distribution

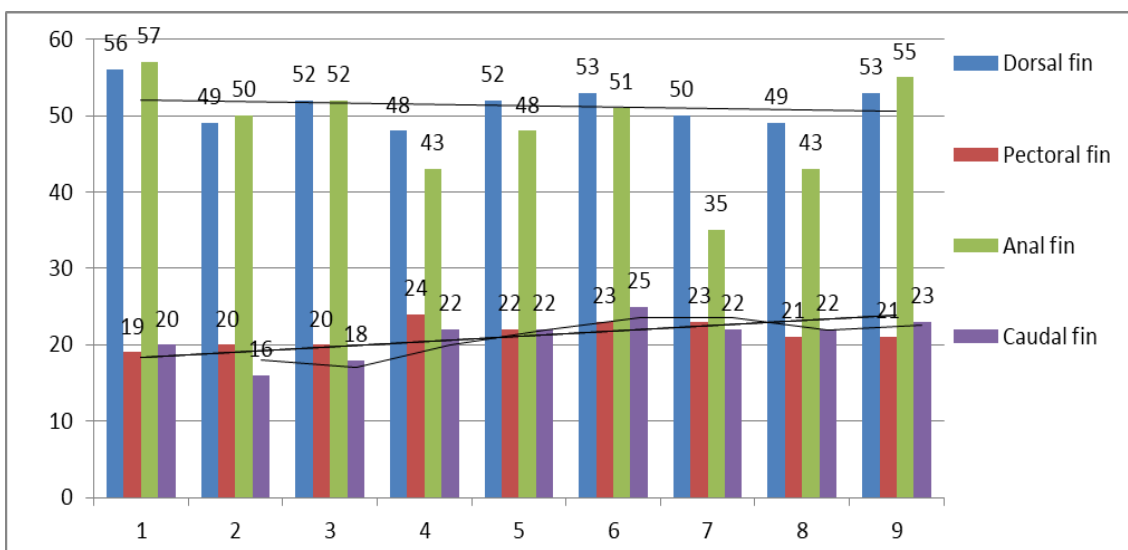


Fig 5.3: Meristic data frequency distribution

Discussion

Boulenger (1893)^[3] described a new species *Mastacembelus oatesii* from Fort Stedman, Inle lake, Myanmar, erstwhile (Burma). Subsequently, the species was recorded by many researchers but confined to Chindwin-Irrawaddy drainage system in southeast Asian countries (Boulenger, 1912; Annandale, 1918; Hora, 1923; Sufi, 1956; Travers, 1984; Roberts, 1986; Yazdani, 1990)^[4, 1, 7, 11, 13, 10, 15]. The only comprehensive systematic account of the Mastacembeloid from India and adjacent countries was published by Yazdani (op.cit.)^[15], but recognized only one species i.e. *M. armatus* from Indian waters and other 3 species (*M. caudicellatus*, *M. pancalus*, *M. zebrinus*), which otherwise belong to the genus *Macrogathus* (Roberts, 1986)^[10] and placed all the spiny eel under the order Mastacembeliformes. The specific identification of Mastacembeloids was considered difficult in view of variable colour pattern and overlapping nature of different taxonomic traits but Roberts (op.cit.)^[10] resolved the specific ambiguity and clearly distinguished between *M. armatus* vs. *M. oatesii* and some other species which he relegated to the genus *Macrogathus*. Perhaps, Roberts^[10] and Yazdani^[15], were not aware of the work of Travers (1984)^[13], who based on the phylogenetic analysis of all the Mastacembeloidei, relegated them to the order Synbranchiformes. We evaluated total 43 morphometric and meristic characters mensurated from 218 specimens of different size and age group collected from different states of Northeast India. As a result we could identify 11 specimens as *M. oatesii*, which tally with the diagnosis of Roberts (1986)^[10] in respect of 16 morphometric and meristic characters (Tab.1, fig. 5). The most distinguishing characters, which, we evaluated includes the shape of caudal fin with round margin and a distinct constriction at the confluence of dorsal and anal fin in *M. oatesii* vs. truncate without constriction uniformly confluent in *M. armatus*; dorsal fin counts XXXII–XXXVI, 48–56 dotted with longitudinal bands vs. XXXVI–XXXVIII, 70–82 without any distinct bands; anal fin III, 43–57 dotted with 10–15 dark conical bars vs. III, 70–80 without bars and their colour pattern. These traits are more or less in conformity with the original description of the species by Boulenger (1912)^[4]. There is another closely related species *M. dayi* Boulenger, which can easily be distinguished from *M. oatesii* based on caudal fin shape and colour pattern which is very distinct from other closely related species as depicted in the (Pl. I, fig.1–4). But since there are only three specimens of *M. dayi* in the collection of 218 specimens so could not ascertain the diagnosis based on the analysis of morphometric and meristic counts; however efforts are being made to collect more specimens and pin point the occurrence of this species in the region. Based on the analysis of above mentioned data and scrutiny of the pertinent published literature, it is deduced that this is the first record of *M. oatesii* from Northeastern states particularly (Nagaland and Mizoram) of India. This elucidate the extension of its distributional range from Myanmar to India, perhaps may be due to the ramification and contiguity of Chindwin-Irrawaddy drainage system in the Northeastern states of Manipur, Nagaland and Mizoram. Since the description of this species in the published Indian literature is very skeptical (Yazdani, 1990; Talwar and Jhingran, 1991)^[15, 12]; so we endeavored to provide a precise redescription of *M. oatesii*, based on the evaluation of various taxonomic traits so as to resolve the future confusion of misidentification and distribution status. All the specimens studied has been deposited in the referral Museum of college

of Fisheries, Lembucherra under specific registration Nos. as mentioned in the material examined, for easy accessibility of future researchers in the region.

Conclusion

While concluding, we feel that the available taxonomic description of *M. oatesii* needs to be revised based on the evaluation of various morphometric and meristic characters as described below:

Mastacembelus oatesii Boulenger, 1893

Mastacembelus oatesii Boulenger, 1893, Ann. Mag. Nat. Hist., (6) 12: 199 (type locality: Fort Stedman, Inle lake, Burma); Roberts, 1986, Jap. J. Ichthyol., 33(2): 95–109 (diagnosis); Yazdani, 1990. Rec. Zool. Surv. India, Occ. Paper No. 124. 36pp; Talwar, & Jhingran, 1991. *Inland Fishes of India and Adjacent Countries*. 2: 132.

Diagnostic characters

General body contour cylindrical, tapering gently from occipital region to the tip of snout; dorsal and anal fin hyaline with longitudinal bands and conical bars respectively and both the fins joined with caudal fin with a slight constriction at confluence; two–third of the posterior body marked with two rows of round, rhomboidal or hexagonal blotches with dark edge on either side of a dark streak from tip of snout to caudal fin base, overall colour greenish dark brown above and pale below (Pl. I, fig. 1, 2).

Description

D XXXII–XXXVI, 48–56; P i, 20–i, 24; A III, 43–57; C 18–23

General body contour cylindrical, tapering from occipital to tip of snout, but posterior one third from the origin of soft dorsal fin to caudal peduncle laterally compressed. The most consistence body proportions which we evaluated include; HL 18.59 (17.17–20.77), BD 8.91 (7.57–10.65), PFL 5.40 (4.19–6.32), SAFL 37.53 (35.63–40.21), CFL 4.78 (4.01–5.50), PSDL 21.48 (19.62–24.18), PPL 18.59 (17.86–19.89), PAL 63.07 (60.97–65.47), P–AD 44.28 (42.63–47.15) all as % of Standard length. Gill openings small, confluent across the breast, and restricted to the lower half of the body. Pre-opercular spine embedded in the skin, lower jaw short, POL 35.59 (30.83–37.65), PtOL 56.36 (52.36–60.83), L JL 25.12 (20.43–29.07) all as % of Head length. Both soft dorsal and anal fins originate at the same vertical line and united with the caudal fin with a small constriction at the confluence. Overall body colour dark brown with greenish ting above lateral line and pale below in live, in preserved specimens no greenish sheen. Posterior two-third body spackled with two rows of dark brown blotches on either side of dark streak along the lateral line, all fins hyaline, dorsal fin dotted with longitudinal bands and anal with conical or peg like bars. Caudal fin with three to five light zigzag bands, outer margin more or less rounded (Pl. I, fig. 1, 2).

Geographical Distribution: India: Nagaland, Mizoram, Chindwin-Irrawaddy drainage (new record); Myanmar, Inle lake basin.

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