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Redescription of *Bagrichthys macropterus* and Comparing it with *B. macracanthus*, *B. majusculus* and *B. obscurus*

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Abstract

Descriptive morphological and morphometric characters for 45 parameters and weight-length relationship of 30 tropical freshwater bagrid catfish, *Bagrichthys macropterus* (Bleeker, 1853), from the Mun river in northeastern Thailand were investigated. The aim of this study was to quantify morphological differences between *Bagrichthys macropterus* and *B. obscurus* Ng, 1999. The results revealed that fin spines for the anal, caudal, dorsal, pectoral, and ventral fins were ii-iv/11-13; 8/7; I,7; I,7-8; and I,5, respectively. And gill rakers were 7-10. Serrations of the dorsal and pectoral spines were 13-15, 22-25, respectively, on posterior margin. Mandibulary teeth were not found on all tooth-bearing surfaces. All four pairs of barbel were longer in males than in females ($P<0.05$). Morphologically, this species is very similar to *B. obscurus*, but can be differentiated by caudal peduncle depth, nasal barbel length and serrations of the dorsal and pectoral spines.

Keywords: bagrid catfish, *Bagrichthys macropterus*, *B. macracanthus*, *B. majusculus*, *B. obscurus*, tropical freshwater fish, morphometry.

Introduction

The Bagridae is a tropical freshwater fish family with 27 genera containing 205 species reported globally (Nelson, 1994). One highly specialized genus is *Bagrichthys*, which is reported distributed in large, muddy rivers throughout South-East Asia including Indonesia, Malaysia, Cambodia and Thailand (Roberts, 1989; Rainboth, 1996). This genus is typically characterised by an elongate body and laterally compressed caudal peduncle. Its dorsal fin is spiny with dorsally-directed serrations on the posterior edge and a long adipose fin without a free posterior margin, the gill membranes united at its isthmus (Roberts, 1989; Mo, 1991). Seven species are currently recognised in South-East Asia including: *Bagrichthys hypselopterus* (Bleeker, 1852), *B. macropterus* (Bleeker, 1853), *B. macracanthus* (Bleeker, 1854), *B. vaillantii* (Popta, 1906), *B. micranodus* (Roberts, 1989), *B. obscurus* (Ng, 1999) and *B. majusculus* (Ng, 2002).

Taxonomy of *Bagrichthys* had been confused as different fish taxonomists had applied their own ideas. Recently, Ng (1999, 2002) classified two new species in this genus: *B. obscurus* (Ng, 1999) and *B. majusculus* (Ng, 2002). For *B. obscurus*, he investigated 9 preserved specimens at the University of Singapore National Museum (USNM) that were collected in Thailand from 1923 to 1975 for the first species, reporting that *B. obscurus* was morphologically very similar to *B. macropterus* in general, but differentiated in having a uniformly brown body without a pale midlateral stripe and no pale blotches on the body sides, a more slender body, a shorter adipose-fin base, and the genital papilla in males meeting the base of the first anal fin ray. Besides, Ng (2002) diagnosed 4 specimens of *B. majusculus* from Thailand that had been accumulated from 1970 to 1975 preserved in USNM. He reported that *B. majusculus* was very similar to *B. macracanthus* and *B. vaillantii*. These species differ from other congeners in having a unique combination of a relatively large and broad mouth, moderately long dorsal spine with 15–27 serrations, inner, chin and mandibular barbel with straight margins, the dorsal-spine length was 24.4–32.5% of the standard length (SL), maximum adipose height was 9.9–10.5% SL, and caudal peduncle depth was 7.1–7.5% SL.

The genus *Bagrichthys* is uncommon in Thailand, particularly the 2 new species reported by Ng. It may be reasonable to presume by lacking of records indicate that these two species have disappeared from Thai freshwater fauna. Previous occurrences of *B. macracanthus* have been reported in the Mun River (Doungsawat and Choekachorn, 1991; Saenjundaeng, 2001), and the Bangprakong River (Saenjundaeng, 2001). *B. macropterus* was also reportedly found in the Chaophraya River (Smith, 1945) and in lower part of Mun River (Doungsawat and Choekachorn, 1991; Dumrongtripob *et al*., 1998; Chaengkij *et al*., 2004; Pilasamorn, 2004). Occurrence in other rivers in Thailand has never been reported.

B. macropterus is a tasty species after cooking. It is also well known as a popular aquarium fish since it has a unique, beautiful colour and is suitably sized to be raised in small indoor aquaria, as well as being a highly tolerant species. Bleeker was a pioneer working on the identification of *B. macropterus*

Bleeker, 1853 (type locality: Muara Kompeh, Sumatra). He originally classified it as *Pseudobagrichthys macropterus* Bleeker, 1862. Later Günther (1864) accepted it as *Bagroides macropterus* Günther, 1864 with which Smith (1945) concurred for fish studied in Thailand. Finally, in working on bagrid fish in Japan, China, Malaysia and Indonesia, Jayaram (1968) classified this species as *B. macropterus*. However, Roberts (1989) suggested for western Borneo Indonesia the separation of *B. macropterus* into a genus by the characteristics of mouth opening being relatively small and narrow, oral dentition extremely reduced, jaws and palate with a few scattered teeth (sometimes apparently absent) deeply buried in soft tissue, dorsal fin spine relatively short with 15 or fewer serrations, chin and mandibular barbel strongly crenulated, colour in life pale brownish or tan with whitish or cream-colored light areas.

This study aimed to record detailed characteristics for this species under field conditions and to provide the first analysis of its morphometric study. The knowledge obtained from this study is expected to facilitate the proper classification of *B. macropterus* in Thailand and to aid in its conservation.

Materials and Methods

A total of 30 *B. macropterus* specimens were collected from January to May, 2007 from the Mun River. Samples came from three districts in Ubonratchathani province, North-East of Thailand: Khongjiam, Phiboonmongsaharn and Varinchaumrarb (Figure 1). A pulsed - DC 220 V 650 W electro fishing unit with a ring anode was used. The unit was applied from a fibreglass boat. Each fish specimen was sexed, weighted and measured fresh in the field. Sexing was made by observing the appearance of the genital papillae in males (Figure 2). Weight and length were recorded in g and cm, respectively. Measurements were made on the left side of specimen (Figure 3a). A morphometric study was performed for each sex. The mean data measured were compared.

Fin ray and gill raker counts were obtained under a binocular dissecting microscope using transmitted light. The subunits of the head are presented as a proportion of head length (HL); head length and measurements of body parts were given as proportion of the standard length (SL). Morphometric details follow Anseeuw *et al*. (2005) and Eschmeyer (1998). T-tests (Sokal and Rohlf, 1995) were used to compare sexes. Morphological descriptions and measurements were grouped into 8 categories as follows:

1. Body length composed of a total length (TL; 1) measured from the tip of the snout to the end of the caudal fin, Fork length (FL; 2) measured from the tip of the snout to the origin of the caudal fin fork and standard length (SL; 3) taken from the tip of the snout to the base of the caudal fin (Figure 3a).

2. Body distance: point to point lengthwise from

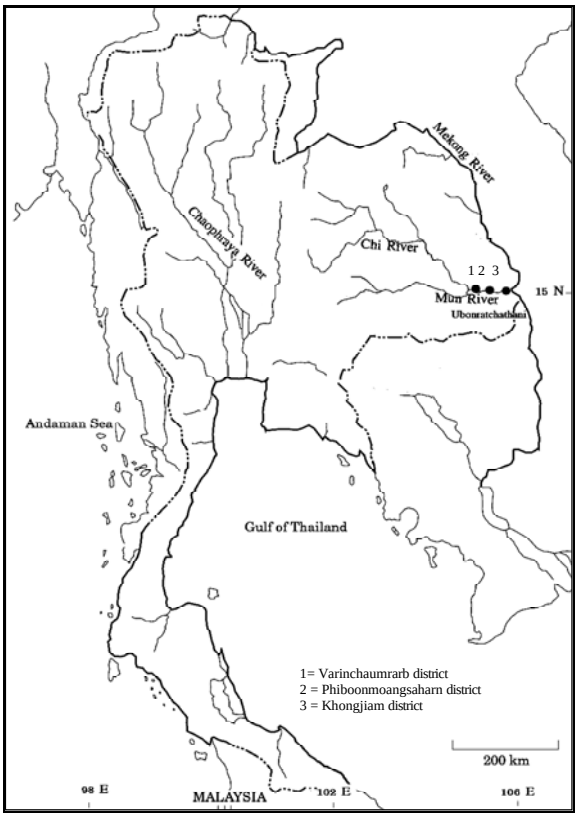

Figure 1. A map of Thailand showing sampling sites.

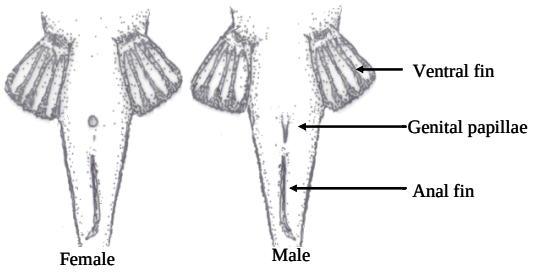

Figure 2. The ventral view of caudal flexure of a *Bagrichthys macropterus* showing the genital papillae (in males).

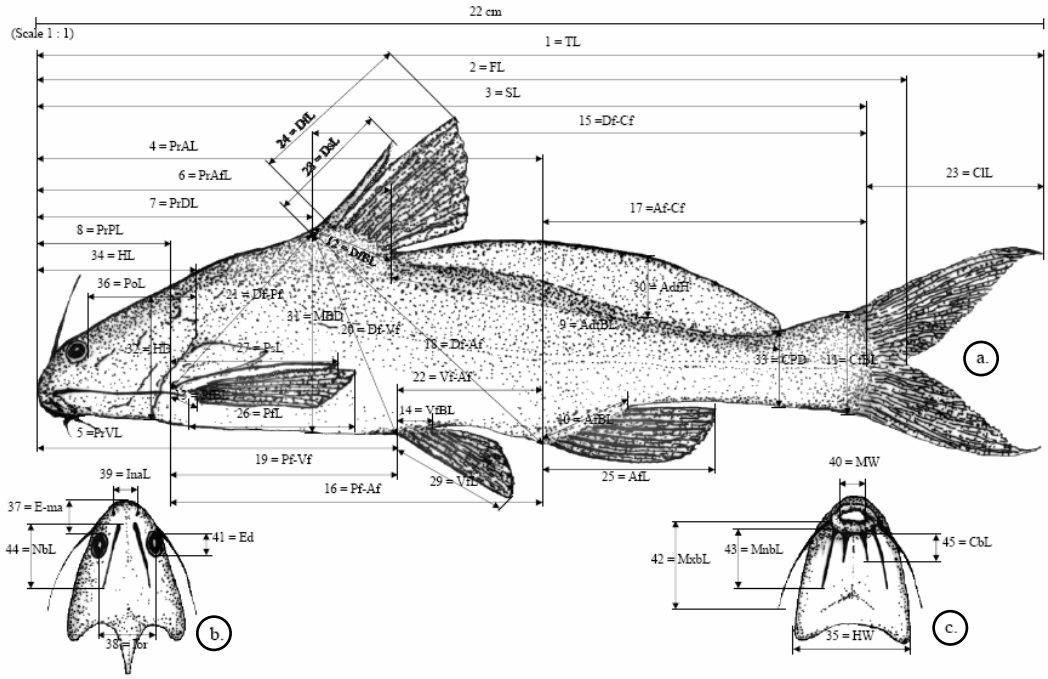

Figure 3. The left side body of *Bagrichthys macropterus* showing measurement of body lengthwise (a), the head dorsal view (b), and the head ventral view (c).

the tip of the snout to the origin of the fin including preanal length (PrAL; 4) measured from the tip of the snout to origin of the anal fin, preventral length (PrVL; 5) measured from the tip of the snout to origin of the ventral fin, preadipose length (PrAfL; 6) measured from the tip of the snout to origin of the adipose fin, predorsal length (PrDL; 7) measured from the tip of the snout to origin of the dorsal fin and prepectoral length (PrPL; 8) measured from the tip of the snout to origin of the pectoral fin (Figure 3a).

3. Body distance point to point lengthwise from the origin to the end of the fin base including adipose fin base length (AdfBL; 9) measured from the origin to the end of the adipose fin base, anal fin base length (AfBL; 10) measured from the origin to the end of anal fin base, caudal fin base length (CfBL; 11) measured from the upper to the lower of caudal fin base, dorsal fin base length (DfBL; 12) measured from the origin to the end of the dorsal fin base, pectoral fin base length (PfBL; 13) measured from the origin to the end of pectoral fin base and ventral fin base length (VfBL; 14) measured from the origin to the end of ventral fin base (Fig 3a).

4. Body distance point to point lengthwise as a fin to fin distance including dorsal fin to caudal fin distance (Df-Cf; 15) measured from origin of the dorsal fin to base of the caudal fin, pectoral fin to anal fin distance (Pf-Af; 16) measured from origin point of the pectoral fin to origin of the anal fin, anal fin to caudal fin distance (Af-Cf; 17) measured from origin of the anal fin to base of the caudal fin, dorsal fin to anal fin distance (Df-Af; 18) measured from origin of the dorsal fin to origin of the anal fin, pectoral fin to ventral fin distance (Pf-Vf; 19) measured from origin of the pectoral fin to origin of the ventral fin, dorsal fin to ventral fin distance (Df-Vf; 20) measured from origin of the dorsal fin to origin of the pectoral fin, (Df-Pf; 21) measured from origin of the dorsal fin to origin of the pectoral fin and ventral fin to anal fin distance (Vf-Af; 22) measured from origin of the ventral fin to origin of the anal fin (Figure 3a).

5. Fin slope or spine length including caudal lope length (ClL; 23) measured from the base to the tip of

caudal fin, dorsal fin length (DfL; 24) measured from the origin to the tip of dorsal fin, anal fin length (AfL; 25) measured from the insertion of anal fin to its tip, pectoral fin length (PfL; 26) measured from the insertion of pectoral fin to its tip, pectoral spine length (PsL; 27) measured from insertion of the pectoral spine to its tip, dorsal spine length (DsL; 28) measured from insertion of the dorsal spine to its tip, ventral fin length (VfL; 29) measured from the insertion of ventral fin to its tip and adipose fin height (AdfH; 30) measured from the highest of adipose fin (Figure 3a).

6. Body depth length including maximum body depth (MBD; 31) measured from origin of dorsal fin to origin of the ventral fin, head depth (HD; 32) measured at the maximum vertical height at gill membranes united at the isthmus and caudal peduncle depth (CPD; 33) measured at upper caudal origin (Figure 3a).

7. Head length and its components including head length (HL; 34) measured from the snout tip to rear border of gill membranes cover, Head width (HW; 35) measured at the maximum width across operculum, postorbital to operculum length (PoL; 36) measured from the posterior end of the eye to the posterior end of opercular membrane, eye and mouth angle distance (E-Ma; 37) measured from the tip of snout to anterior end of the eye, interorbital space (Ior; 38) measured between the centre of the eyes, intranasal length (InaL; 39) measured between the two nasals, mouth width (MW; 40) measured from across mouth corners and eye diameter (Ed; 41) measured from horizontal eye diameter (Figure 3a, 3b, 3c).

8. Barbel length includes maxillary barbel length (MxbL; 42) measured from the origin of the maxillary barbell to its tip, mandibular barbel length (MnbL; 43) measured from the origin of the mandibular barbell to its tip, nasal barbel length (NbL; 44) measured from the origin of the nasal barbell to its tip and chin barbel length (CbL; 45) measured from the origin of the chin barbell to its tip (Figure 3b, 3c).

Results

Following results were obtained from this study. The fin ray and gill rakers counts were: dorsal I,7; pectoral I,7-8; anal ii-iv/11-13; caudal 8/7; ventral i,5; gill rakers 7-10. Dorsal spine straight and robust, counts were 13 (9 specimens), 14 (11 specimens) and 15 (10 specimens), with serrations on the posterior margin, dorsal branch fin ray count was 7 (30 specimens). Pectoral spine margin with 22 (3 specimens), 23 (9 specimens), 24 (8 specimens) and 25 (10 specimens) serrations along entire length on the posterior margin, pectoral branch fin ray counts were 7 (9 specimens) and 8 (21 specimens). Anal fin ray counts were 2 (15 specimens), 3 (15 specimens), 4 (10 specimens) and branch fin ray counts 11 (9 specimens), 12 (16 specimens) and 13 (5 specimens). Caudal fin counts were: upper caudal fin ray 8 and lower caudal fin ray 7 (both 30 specimens). Ventral fin ray counts were 1 and branch fin ray 5 (both 30 specimens) (Figure 2). Gill rakers counts were 7 (9 specimens), 8 (9 specimens) and 10 (12 specimens). Mandibulary teeth were not found on all tooth-bearing surfaces (Figure 4).

Different morphometric parameters among sexes of *B. macropterus* revealed that the male fish was longer than the female in total length, whereas the female was longer in term of fork length and standard length, however, at equal length the female was heavier (Table 1).

In body distance point to point lengthwise from the tip of the snout to the origin of the fin group as a percentage of the standard length (%SL) revealed that the male fish was longer than female in preadipose length, predorsal length and prepectoral length, but the female was longer in term of preanal length and preventral length (Table 1).

Body distance point to point lengthwise from the origin to the end of the fin base group revealed that the male fish was longer than the female in adipose fin base length, anal fin base length, caudal fin base length and ventral fin base length, whereas the female was longer in term of dorsal fin base length and pectoral fin base length (Table 1).

Body distance point to point lengthwise in the fin to fin distance group revealed that the male fish was longer than the female in dorsal fin to caudal fin distance, anal fin to caudal fin distance, dorsal fin to pectoral fin distance and ventral fin to anal fin distance, whereas the female was longer in term of pectoral fin to anal fin distance, dorsal fin to anal fin distance, pectoral fin to ventral fin distance and dorsal fin to ventral fin distance (Table 1).

The fin slope and spine length group revealed that the male fish was longer than the female in caudal lope length, anal fin length, pectoral spine length, dorsal spine length and ventral fin length, whereas the female was longer in term of dorsal fin length, pectoral fin length and adipose fin height (Table 1).

The body depth length group revealed that the male fish was longer than the female in maximum body depth and caudal peduncle depth, but the female was longer in term of head depth.

Mean of head lengths (HL) was 3.44±0.30 in males and 3.43±0.32 in females. Lengths of head component in percentage of the head length (in %HL) revealed that the male fish has longer than the female in eye and mouth angle distance, interorbital space, internasal length, mouth width and eye diameter, whereas the female was longer in term of head width and postorbital to operculum length (Table 1).

Barbels were in four pairs with mean of maxillary barbel length (MxbL), mandibular barbel length (MnbL), nasal barbel length (NbL) and chin barbel length (CbL) being 91.17±16.10, 48.82±11.83, 55.17±10.64 and 23.77±5.64 in % HL, respectively, There were significant differences (P<0.05) between males and females (in % HL, maxillary barbel length 106.12±11.66 in males vs. 76.83±6.91 in females, mandibular barbel length 58.75±5.89 in males vs. 33.88±6.59 in females, nasal barbel length 63.75±6.68 in males vs. 46.59±5.69 in females, and chin barbel length 28.60±3.54 in males vs. 18.94±1.78 in female).

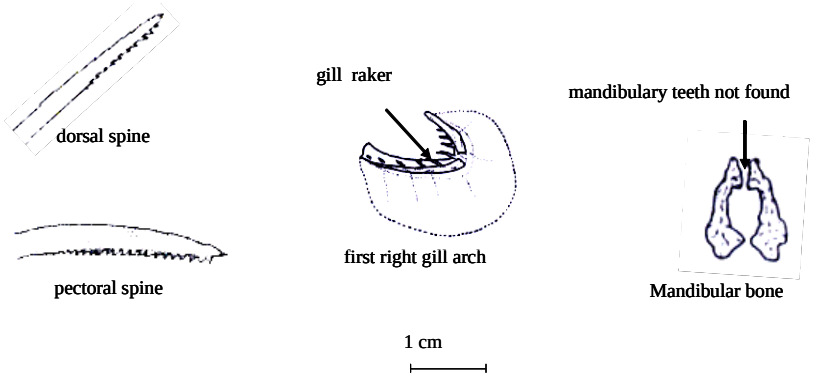

Figure 4. The spines, first right gill arch and mandibulary teeth of a *Bagrichthys macropterus*.

Table 1. Morphometric characters of *Bagrichthys macropterus*

Character	Males fish (n=15)			Females fish (n=15)			Total (n=30)		
	Mean±Std	Min	Max	Mean±Std	Min	Max	Mean±Std	Min	Max
1. TL (cm)	23.17±2.27	18.50	26.50	22.99±1.39	20.50	25.50	23.08±1.85	18.50	26.50
2. FL (cm)	19.95±2.02	15.70	22.50	20.40±1.59	18.00	24.00	20.17±1.80	15.70	24.00
3. SL (cm)	19.07±1.96	15.20	22.00	19.33±1.29	17.00	21.50	19.20±1.64	15.20	22.00
in %SL									
4. PrAL	60.02±4.47	44.74	64.10	62.00±1.90	59.02	66.11	61.01±3.53	44.74	66.11
5. PrVL	45.05±1.15	43.18	47.70	45.40±1.28	43.78	47.78	45.22±1.21	43.18	47.78
6. PrAfL	43.16±1.02	40.91	44.50	42.86±1.21	40.00	44.44	43.01±1.11	40.00	44.50
7. PrDL	35.34±1.18	33.33	37.10	34.78±1.57	30.73	36.47	35.06±1.39	30.73	37.06
8. PrPL	19.92±1.17	17.50	22.10	19.60±0.83	18.05	21.14	19.76±1.01	17.50	22.05
9. AdfBL	48.81±2.28	45.00	53.70	47.42±1.33	44.39	49.74	48.12±1.97	44.39	53.68
10 .AfBL	11.76±0.70	10.53	13.00	11.62±0.64	10.24	12.78	11.69±0.66	10.24	13.00
11. CfBL	11.19±0.87	10.00	13.12	10.83±0.92	9.76	13.50	11.01±0.90	9.76	13.49
12. DfBL	9.38±0.79	7.65	10.50	9.62±0.41	9.05	10.27	9.50±0.63	7.65	10.53
13. PfBL	5.22±0.83	2.73	6.30	5.33±0.31	4.65	5.90	5.27±0.62	2.73	6.32
14. VfBL	3.41±0.31	3.00	3.90	3.25±0.22	2.86	3.60	3.34±0.28	2.86	3.95
15. Df-Cf	67.78±3.60	58.42	71.70	67.46±3.77	55.61	71.79	67.62±3.63	55.61	71.79
16. Pf-Af	46.30±1.69	43.16	50.30	47.35±1.63	44.21	50.30	46.82±1.72	43.16	50.33
17. Af-Cf	39.42±2.52	35.95	46.80	38.00±1.90	33.89	40.00	38.71±2.31	33.89	46.84
18. Df-Af	36.81±1.47	34.21	39.00	37.12±0.90	35.79	38.89	36.96±1.21	34.21	38.97
19. Pf-Vf	30.43±2.02	26.32	32.70	30.69±1.32	28.57	33.50	30.56±2.82	26.32	33.50
20. Df-Vf	26.29±1.22	24.55	28.20	26.33±0.91	23.90	28.00	26.31±1.05	23.90	28.21
21. Df-Pf	25.84±1.09	23.64	28.10	25.74±0.99	23.90	27.20	25.79±1.02	23.64	28.10
22. Vf-AF	22.71±1.77	19.00	24.70	22.44±1.05	20.49	24.50	22.30±1.44	19.00	24.74
23. ClL	21.24±2.72	16.67	27.50	19.54±1.00	17.56	21.00	20.39±2.19	16.67	27.45
24. DfL	18.86±1.65	16.00	22.10	19.84±1.17	18.05	21.54	19.35±1.49	16.00	22.05
25. AfL	17.75±2.50	11.05	21.00	17.73±1.40	15.35	20.00	17.74±1.99	11.05	21.00
26. PfL	17.65±1.60	14.50	20.30	17.71±0.86	15.61	19.43	17.68±1.27	14.50	20.26
27. PsL	16.08±1.50	14.00	19.60	15.95±0.78	14.63	17.95	16.02±1.18	14.00	19.61
28. DsL	15.36±1.41	13.00	17.50	15.08±1.05	13.17	16.74	15.22±1.23	13.00	17.50
29. VfL	13.35±0.92	11.50	14.50	13.25±1.60	10.77	18.00	13.30±1.29	10.77	18.00
30. AdfH	8.02±0.63	6.82	9.20	8.25±0.38	7.62	8.82	8.13±0.52	6.82	9.15
31. MBD	24.28±1.37	21.40	26.80	23.12±1.21	21.05	26.00	23.70±1.40	21.05	26.80
32. HD	14.48±1.17	12.00	15.80	15.45±0.58	14.21	16.50	14.96±1.03	12.00	16.50
33. CPD	9.32±0.61	8.32	10.50	9.28±0.38	8.57	9.77	9.30±0.50	8.32	10.46
34. HL (cm)	3.44±0.30	3.00	4.00	3.43±0.32	2.70	4.00	3.44±0.31	2.70	4.00
in %HL									
35. HW	79.67±5.72	70.00	93.30	81.20±7.64	75.68	107.41	80.43±6.68	70.00	107.41
36. PoL	59.79±5.34	53.33	73.30	59.85±7.57	52.78	81.48	59.82±6.44	52.78	81.48
37. E-Ma	36.32±5.37	21.05	43.30	36.12±4.00	33.33	48.15	36.22±4.66	21.05	48.15
38. Ior	31.35±4.49	18.42	37.10	31.05±2.91	27.78	40.74	31.20±3.72	18.42	40.74
39. InaL	20.27±4.04	13.89	26.70	17.39±3.46	13.16	25.93	18.83±3.98	13.16	26.67
40. MW	18.61±1.47	16.67	21.10	17.57±2.62	15.15	25.93	18.09±2.16	15.15	25.93
41. Ed	13.61±1.79	11.11	16.70	12.87±1.90	10.81	18.52	13.24±1.85	10.81	18.52
42. MxbL	106.12±11.66	87.50	133.37	76.83±6.91	67.50	92.60	91.17±16.10	67.50	133.37
43. MnbL	58.75±5.89	50.00	70.00	33.88±6.59	27.03	55.60	48.82±11.83	27.03	70.00
44. NbL	63.75±6.68	55.56	76.70	46.59±5.69	39.47	63.00	55.17±10.64	39.47	76.67
45. CbL	28.60±3.54	21.76	36.70	18.94±1.78	15.79	22.22	23.77±5.64	15.79	36.67

Morphological feature of *B. macropterus* is similar to that of *B. obscurus* in general but discriminated in having a uniformly light brown body with a pale creamy midlateral stripe running along entire body length and pale silver blotches of the body sides. Adipose fin blade is long curving from the end of dorsal fin base to its caudal. Small black stripe along the outer edge fin blade is recognized. Fin rays of all fins are cleared with grayish fin tips. Sexual dimorphism is distinguished in male fish by appearance of a pair of pale white genital papillae at anterior to the anal fin but, in female fish, by a round shape of female sex organ located at the same position.

Distribution of *B. macropterus* was found consistently within the downstream of the Mun River from the ending into Mekong River Basin at Khongjiam district (15°18'49" N; 105°09'42" E) up to the reach where the Chi River joins with the Mun River at Muang Ubonratchathani district (15°10'09" N; 104°42'83" E) and the lower reach of the Chi River up to Mahachanachai district of Yasothorn province (15°31'46" N; 104°14'96" E), approximately 100 km surface distance western from the Chi River end.

It was reported that this bagrid catfish species habitat in large muddy rivers, fed on small fish, benthic invertebrates and plant detritus. Spawning was at the beginning of the rainy season and young fish raised up in the flooded riparian forest areas along the river. Juveniles appear in August. (Rainboth, 1996).

Discussion

Descriptive morphological features which distinguish *B. macropterus* from other fish include unscaled, smooth skin, complete lateral line with long tubular epidermal extensions of the sensory pores mid-laterally. The body is long and compressed, dorsal profile rising evenly and steeply from the tip of the snout to the origin of the dorsal fin. The ventral profile is flat to the anal fin base, then slopes dorsally toward the end of caudal peduncle. Anus and urogenital opening are located vertically mid-way between the anal and ventral fins. The anal fin base is located ventrally to the posterior half of the adipose fin. The fin margin is curved or straight. There is no posterior membranous connection to the body at the last anal fin ray. The dorsal fin is located at the middle of the body with the origin nearer the tip of the snout than the caudal flexure. The dorsal fin margin is convex, usually with an anterior branch of fin rays. The last dorsal fin ray has no posterior membranous connection to the body. The dorsal spine is straight and robust and there were 13-15 serrations on its posterior margin. The ventral fin originates vertically through the posterior end of the dorsal fin base.

The ventral fin margin is slightly convex, the tip of adipose fin does not reach the anal fin origin. The caudal fin is deeply forked, the upper and lower lobes pointed, with the outermost principal fin rays prolonged into filaments. Procurrent rays are symmetrical and extend only slightly anterior to the fin base. The pectoral fin possesses a stout spine which is sharply pointed at the tip. The anterior spine margin is smooth but the posterior spine margin is serrated with 22-25 serrations along its entire length. The pectoral fin margin is interiorly straight. The adipose fin has a convex margin for its entire length and is deeply incisived posterior.

The dorsal surface of the head and body are uniformly dark brown, with a cream-coloured midlateral streak running along the entire length of the body. The ventral surfaces of the head and body are white to cream, the adipose fin and fin rays of all fins are brown, and the inter-radial membranes of all fins have scattered melanophores. The head is somewhat compressed and narrow with the anterior part produced into a prominent, protruding snout with a somewhat truncate margin when viewed laterally. The gill openings are wide, extending from the exposed surface post-temporally to beyond the isthmus. The gill membranes are free from and not attached across isthmus. The eyes are ovoid with the horizontal axis longest. They are located entirely in dorsal half of head with the orbit margin free. The small teeth are arranged in irregular rows on all tooth-bearing surfaces.

The maxillary barbel is moderately long, extending to the opercular flap. The mandibular barbel originates close to the midline; this barbel is thicker and longer than the nasal barbel and extends to the level of the anterior margin of the orbit. The nasal barbel is slender, extending to the posterior margin of orbit (females) or to midway between the posterior margin and the base of the supraoccipital (males). The chin barbel originates posterior-laterally to the inner mandibular barbel, extending to the level of the centre of the orbit. All four pairs of barbel are longer in males than in females ($P<0.05$).

B. macropterus can be differentiated from *B. macracanthus* in having a shorter dorsal spine (*B. macropterus* 15.22±1.23 vs. *B. macracanthus* 24.62±2.18% SL) (Saenjundaeng, 2001). In addition, in *B. macropterus* mandibulary teeth are not found on mandibular bone, the mouth is inferior and relatively small with papillate lips, and the gill rakers counts are *B. macropterus* 7-10 vs. *B. macracanthus* 10-12.

B. macropterus can be differentiated form *B. majusculus* with *B. majusculus* having a larger and broad mouth, well-developed oral dentition with homodont teeth, a gill rakers count of *B. macropterus* 7-10 vs. *B. majusculus* 10-13, a moderately long dorsal spine with 15-27 serrations and a dorsal spine length *B. macropterus* 13.0-17.5 vs. *B. majusculus* 24.4-32.5% SL) (Ng, 2002).

Morphologically, *B. macropterus* was similar to *B. obscurus*. A comparison of the 18 morphometric categories of *B. macropterus* from this report with *B. obscurus* studied by Ng (1999) revealed that 16 characters had similar ranges: preanal length, preventral length, predorsal length, prepectoral length, adipose fin base

length, anal fin base length, dorsal fin base length, caudal slope length, pectoral fin length, pectoral spine length, dorsal spine length, adipose fin height, eye diameter, maxillary barbel length, mandibular barbel length and chin barbel length. The only two characters which showed differences were caudal peduncle depth and nasal barbel length. In addition, serrations of the dorsal and pectoral spines were different (Table 2).

It should be noted that the results of morphological and morphometric identification of *B. macropterus* revealed a high percentage of similarity with *B. obscurus* and these species may be closely related. It would be worthwhile investigating this group using molecular techniques to evaluate details in genetic differences.

Table 2. Comparison of the morphometric characters of *B. macropterus* (this report), *B. obscurus* (by Ng, 1999), *B. majusculus* (by Ng, 2002) and *B. macracanthus* (by Saenjundaeng, 2001).

Character	*B. macropterus*	*B. obscurus*	*B. majusculus*	*B. macracanthus*
Gill rakers count	7-10	8	10-13	10-12
Preanal length (in % SL)	44.74 -66.11	59.3-65.9	58.7-62.9	53.7-62.1
Preventral length (in % SL)	43.18 - 47.78	44.2-48.3	40.2-45.4	38.5-43.7
Predorsal length (in % SL)	30.73-37.06	33.6-37.7	35.4-38.6	29.6-33.8
Prepectoral length (in % SL)	17.50-22.05	17.2-21.9	18.0-20.3	14.6-19.9
Adipose fin base length (in % SL)	44.39-53.68	43.3-48.9	46.0-50.7	44.9-56.5
Anal fin base length (in % SL)	10.24-13.00	9.7-14.0	11.0-12.6	10.3-14.9
Dorsal fin base length (in % SL)	7.65-10.53	8.3-12.0	11.3-12.8	11.4-17.8
Caudal lope length (in % SL)	16.67-27.45	21.3-28.2	25.5-35.2	-
Pectoral fin length (in % SL)	14.50-20.26	18.2-22.2	17.2-19.4	-
Pectoral spine length (in % SL)	14.50-20.26	18.2-22.2	15.8-20.7	14.3-18.4
Serrations of pectoral spine	22-25	18-22	12-21	21-23
Dorsal spine length (in % SL)	13.00-17.50	15.3-17.8	24.4-32.5	15.3-17.8
Serrations of dorsal spine	13-15	11-12	15-27	26-29
Adipose fin height (in % SL)	6.82-9.15	6.3-8.3	9.9-10.5	-
Eye diameter (in % HL)	10.8-118.5	10.9-14.1	14.1-17.2	15.7-23.7
Caudal peduncle depth (in % SL)	8.32-10.46	6.7-8.3	7.1-7.5	-

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