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# Morphological Study for Identification Improvement of Tambra Fish (*Tor* spp.: Cyprinidae) from Indonesia

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## ABSTRACT

The identification improvement among species of *Tor* was conducted based on fish specimens in Museum Zoology Bogor. Each species represented 8 specimens and measured 22 characters (in mm) used digital caliper. The Canonical variate analysis (discriminant function analysis) was used. The results showed these four species different in morphology, and *Tor soro* 100% grouping from its congeners. Five characters were selected to separate species. Commonly, population of tambra fish in the world was critical therefore needed conservation.


**Keywords**: fish, *Tor,* morphology, character, species, conservation.

## INTRODUCTION

Tambra fish or Mahseer also named Kings of the rivers was included to genera *Tor* and family Cyprinidae. Indonesia has four species of *Tor* viz., i.e: *Tor tambroides* Blkr*, T. tambra* (C.V.)*, T. douronensis* (C.V.) and *T. soro* (C.V). Kiat (2004) reported that currently, there are about 20 different species have been designated as species under the genus of *Tor* from all across Asia. Weber and Beaufort (1916) named its genera by *Labeobarbus*, and differentiated to species based on median fleshy lobe on lower lip; then Kottelat et al. (1993) stated that systematics of *Tor* are still chaotic. The while, mostly species of *Tor* are threatened especially by clearing and over-fishing. Rachmatika (2005) reported that *Tor* spp. no founded at logged stations in the Seturan river of Melinau, East Kalimantan. Furthermore, Primack (1993) stated that a species with a low population density will tend to have only small population if its range fragmented by human activities.

Tambra are the largest fishes found within the upper reaches of large rivers where they rule supreme. They grow to enormous sizes of more than a hundreds pounds therefore potential as fish consume. These fish are active swimmers usually preferring to move among the faster flowing waters or rapids. Feeding on variety of foodstuff, including smaller fishes, they occupy the topmost echelons of the complex riverine community (Kiat, 2004; Anonymus, 2003). Then, Sulastri et al. (1985) stated that the algae was main diet of this fish, followed by detritus and insects. In Malaysia, Kiat (2004) reported that these species has price 180 RM per kg, moreover up to 300 RM (RM: Ringgit Malaysia). In North Sumatera, *Tor soro* used as substitution of batak fish (*Neolissochilus thieenmanni*) for cultural ceremony. *Tor* spp. also potential for game fishing like as salmon fish because has strong power. Unfortunately, population of *Tor* in native habitats is rare and its systematic still problem, also not yet success to domesticate.

Museum Zoologicum Bogoriense (MZB) is accidently has all species of *Tor* from Indonesia (*Tor soro, T. douronensis, T. tambra,* and *T. tambroides*). This study will be compare these species based on morphology. The results hoped for accurate identification that supported for domestication success (conservation).

## MATERIALS AND METHODS

A total of 32 fish specimens in Museum Zoology Bogor (now Zoology Division, Research Center for Biology, Indonesian Institute of Sciences Bogor [LIPI] in Cibinong) were measured, each species represented by 8 specimens. Twenty-two measurements (in mm) of body characters were taken using digital caliper. These characters are TL: total length, HL: head length, HW: head width, HD: head depth, ED: eye diameter, SNL: snout length, IW: inter-orbital width, ML: mouth length, BD: body depth, BW: body width, CPL: caudal peduncle length, CPD: caudal peduncle depth, DBL: dorsal fin base length, DFH: dorsal fin height, PL: pectoral fin length, VBL: ventral fin base length, ABL: anal fin base length, PPL: pre pelvic length, PAL: pre anal length, PDL: pre dorsal length, SNBL: snout barbell length, MXBL: maxillary barbell length. This methods main refer to Hubbs and Lagler (1974).

The canonical variate analysis (discriminant function analysis) were used study the morphological differences between species (Kendall, 1975; Morrison, 1978). The characters were transformed to percent of standard length; and all analyses were performed using SPSS.

## RESULTS AND DISCUSSION

The sample size, mean and standard deviation of characters measurement are presented in Table 1. This table shows that *Tor tambroides* has larger average head

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length, head depth, mouth length, and pre pelvic length than others species. This result is important to compare among species of tambra fish.

Hitherto, among species of *Tor* separated based on median lobe on lower lip (Figure 1) that completed with compare between osseous of dorsal ray and head length, anal and dorsal fin (Weber and Beaufort, 1916; Kottelat et al., 1993; Inger and Chin, 1990; Kiat, 2004). Weber and Beaufort (1916) explained that *Tor soro* without lobe, anal less high than dorsal; *T. tambroides* with lobe that reaching a line connecting corners of mouth; *T. douronensis* with lobe but not reaching a line connecting corners of mouth, stiff portion of osseous dorsal ray about as long as head without snout; *T. tambra* with lobe as *T. douronensis* but stiff portion of osseous dorsal ray not quite half as long as the head.

**Figure 1.** The median lobe at lower lips of *Tor.*

**Table 1.** The results of characters measurement (mean and standard deviation)

| Characters | *T. tambra* SL:154.650±50.469 n: 8 | *T. douronensis* SL:120.338±7.859 n: 8 | *T. soro* SL:120.488±11.402 n: 8 | *T. tambroides* SL:125.088±19.809 n: 8 |
|---|---|---|---|---|
| TL | 133.398 ±2.467 | 133.175 ±2.488 | 132.247 ±2.841 | 129.118 ±3.391 |
| HL | 26.462 ±1.346 | 27.325 ±2.003 | 25.678 ±1.081 | 28.438 ±1.442 |
| HW | 16.269 ±0.721 | 16.173 ±0.706 | 15.311 ±1.096 | 15.657 ±0.593 |
| HD | 19.703 ±0.927 | 19.858 ±0.909 | 19.560 ±0.614 | 20.168 ±1.029 |
| ED | 6.014 ±0.654 | 6.733 ±0.660 | 6.132 ±0.255 | 6.931 ±1.009 |
| SNL | 10.204 ±0.750 | 9.772 ±0.835 | 9.331 ±0.666 | 9.548 ±0.379 |
| IW | 10.288 ±0.150 | 9.069 ±0.361 | 9.853 ±0.999 | 9.323 ±0.423 |
| ML | 9.796 ±0.531 | 9.747 ±1.088 | 9.149 ±1.147 | 10.539 ±0.469 |
| BD | 30.324 ±2.070 | 30.733 ±1.684 | 29.231 ±3.227 | 28.752 ±3.094 |
| BW | 16.235 ±1.622 | 14.466 ±1.889 | 15.516 ±1.098 | 13.864 ±0.517 |
| CPL | 15.255 ±1.231 | 17.163 ±0.959 | 16.392 ±1.896 | 16.792 ±1.573 |
| CPD | 12.345 ±0.737 | 12.771 ±0.672 | 13.177 ±0.944 | 11.981 ±0.963 |
| DBL | 14.891 ±0.727 | 15.674 ±1.021 | 15.733 ±1.772 | 15.281 ±0.696 |
| DFH | 26.108 ±2.238 | 25.814 ±1.785 | 24.951 ±1.880 | 24.371 ±3.423 |
| PL | 23.531 ±3.464 | 23.236 ±0.882 | 22.472 ±0.792 | 22.670 ±1.350 |
| VBL | 21.162 ±2.609 | 20.804 ±0.962 | 20.277 ±1.180 | 19.045 ±1.951 |
| ABL | 8.287 ±0.706 | 8.685 ±0.569 | 8.403 ±0.276 | 7.960 ±0.520 |
| PPL | 51.733 ±1.999 | 51.100 ±2.164 | 51.035 ±1.279 | 53.216 ±1.725 |
| PAL | 75.800 ±2.761 | 75.890 ±1.143 | 76.838 ±1.129 | 76.600 ±2.036 |
| PDL | 51.570 ±1.011 | 50.131 ±2.209 | 50.135 ±2.424 | 50.156 ±1.351 |
| SNBL | 9.018 ±1.556 | 9.207 ±2.690 | 6.904 ±0.362 | 8.640 ±1.357 |
| MXBL | 10.076 ±0.601 | 10.803 ±2.685 | 8.481 ±1.247 | 10.518 ±1.711 |

The generally description of *Tor* are body elongate, moderately compressed. Snout more or less prominent; mouth inferior or subinferior, horseshoe shaped; upper jaw strongly protractile. Lips more or less thick, continuous, the lower with an uninterrupted transverse fold, the median part of which may be developed into a lobe. Four barbels: an anterior rostral pair, the other pair behind corner of mouth. Suborbital bone narrow. Dorsal with 8-9 bones branched rays and scaly sheath at its base; its origin somewhat before or opposite to origin of ventrals; last osseous dorsal ray enlarged and smooth. Anal with 5 branched rays. Scales large, with fine, longitudinal or converging, more or less undulated lines. Lateral line running in the middle of the tail, complete with 21-28 scales.

Specifically *T. tambroides* has body size larger than the others, Haryono (2003) reported caught its species in Bukit Batikap (Muller mountain region, Central Kalimantan) that 20 kg weights; moreover, local people informed was caught 80 kg. Smith (1945) also reported that the size of *Tor* reached 100 cm and weight > 30 kg. The while, size of *T. douronensis* from Kayan Mentarang Nature Reserve, now National Park in East Kalimantan commonly 3-5 kg (Haryono, 2002). Similarly with *T. douronensis*, the size of *T. soro* < 10 kg weights. The last species protected by local people in Kuningan Regency West Java after hundreds years at swimming pool viz. Cibulan, Cigugur, Pasawahan and Darmaloka. The body color this species is different among swimming pool, therefore interesting for genetics study.

The morphometric data was examined by canonical discriminant analysis with two steps. First step was examined all characters, and second of them only examined selected characters (5 characters). The selection of characters following value of Wilk's Lambda, and the result of main characters viz. IW, CPL, CPD, HW, and BD. The box plot first character (IW) represent at Figure 2 that showed range its character of *Tor soro* is widest, whereas *Tor tambra* is smallest. Then plotting of selected characters by function 1, 2, and 3 explained variation each 63.6%, 31.3% and 5.1% (Table 2.), and a joined these function explained 87.5%.

Figure 3 showed that *Tor soro* different from its congeners by 100% grouping, 12.5% of *Tor tambra* grouping with *Tor tambroides*, 12.5% of *Tor douronensis* grouping with *Tor tambroides*; *Tor tambroides* grouping with *Tor tambra* and *Tor douronensis* eaches 12.5%. *Tor soro* strictly separated that assumed no median lobe at lower lip, while the others present but not similar.

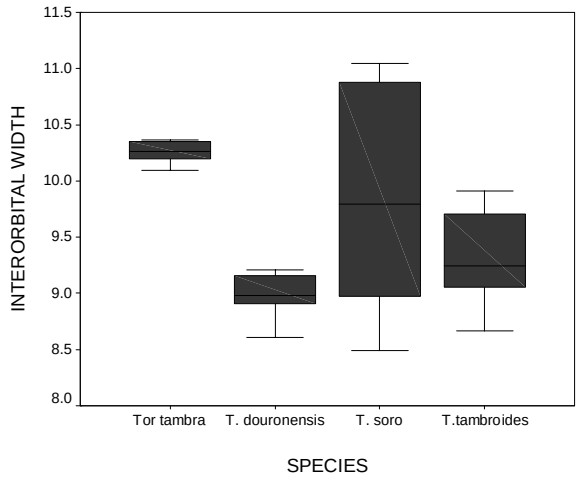


**Figure 2.** Box plot of inter-orbital width (IW) of four species of *Tor* from Indonesia.

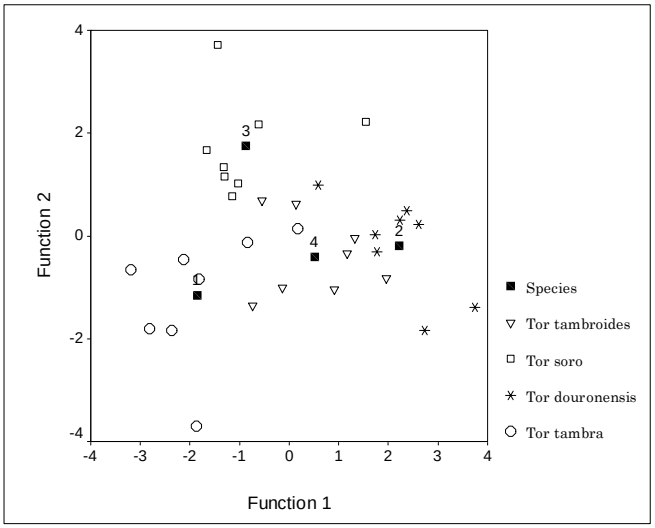


**Figure 3.** Plotting four species of *Tor* from Indonesia.

**Table 2.** Selected characters, canonical variate function coefficient for four species of *Tor* . Standard and standardized (in brackets).

| Characters | Functions | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| IW | -5.200 (-2.179) | -0.052 (0.147) | 0.407 (0.250) |
| CPL | 0.294 (0.709) | 0.149 (0.261) | -0.249 (0.084) |
| CPD | 0.004 (0.252) | 0.394 (1.823) | 0.747 (0.720) |
| HW | 0.043 (0.878) | -0.112 (-0.687) | 0.630 (0.706) |
| BD | 0.041 (0.122) | -0.381 (-0.464) | 0.584 (0.116 |
| Constanta | -11.355 | -3.934 | -27.481 |
| Eigenvalues (%) | 63.6 | 31.3 | 5.1 |

The description was explained by Kiat (2004), Roberts (1989, 1993; 1999), Tweedie (1956), Zhou and Cui (1996), and Kottelat (2001) that Tambra or Mahseer have large of head and mouth. The head is somewhat elongated allowing it to easily swim headlong against fast flowing waters with minimal resistance. The snout is obtusely rounded, and prominent. The inter-orbital space between the eyes is flat and the snout is pointed while the jaws are of equal length. They have two pairs barbells, one near the snout and the other at the maxilla. The nostrils are close together and nearer to the eye than to the snout. The mouth which is both protrusible and suctorial. The mouth is slightly inferior, making it well adapted for feeding off the sub-stratum of fast flowing streams and rivers. Generally mature female have a more rounded belly as compared to males, which usually have a firmer and more keeled ventral surface. The large scales are descriptive of this group of fishes. The number of scales on the lateral line range from 20 to 30 usually. The cycloid scales, though large, are quite fine and can be eaten as a snack when fried or steamed. The coloration of Mahseer is also sought after by hobbyists for its beautiful coloration. Pigmented completely across the body, the coloration of the Mahseer is a rich matrix of yellow, red and blue.

The completely description four species of *Tor* from Indonesia were described by Weber and Beaufort (1916) based on morphological characters, these are:

*Tor soro*

Dorsal fin with 3 spines and.8-9 rays; anal fin with 3 spines and 5 rays; Pectoral fin with 1 spine and 14-16 rays; ventral fin with 2 spines and 8 rays; linea leteralis with 24-28 scales. Height 3.4-3.8 in SL, 4.3-4.6 in length with caudal. Head about 4.3 in SL, 5.4 in length with caudal. Eye about 4, about 1 1/3 in somewhat prominent snout and nearly twice in interorbital space. Mouth inferior. Lips moderately thick, median part of lower lip without lobe, but fixed to the skin. Rostral barbels about as long as eye or longer, shorter than maxillary ones. Length of operculum 11/2-13/4 in its height. Origin of dorsal nearer to snout than to base of caudal, opposite 7$^{th}$ or 8$^{th}$ scale lateral line, somewhat before origin of ventrals, separated by 8 or 9 scales from occiput. Dorsal concave, its third spine ossified, strong, somewhat shorter than head, without its flexible part shorter than head without snout. Anal oblique, not reaching caudal when depressed, its longest ray somewhat less than dorsal spine. Ventrals conspicuously shorter than, pectorals and much shorter than height of dorsal, far distant from anus, separated by 2scales from lateral line. Pectorals somewhat shorter than height of dorsal, far distant from ventrals. Caudal deeply incised, the lobes pointed, much longer than head. Least height of caudal peduncle 1 ½ in its lenghth, surrounded by 12 scales. Silvery, back olivaceous. Scales on upper surface with a darkish base, fins hyaline.

*Tor tambroides*

Dorsal fin with 3 spines and.9-10 rays; anal fin with 3 spines and 5 rays; pectoral fin with 1 spine and 15-16 rays; ventral fin with 2 spines and 8 rays; linea leteralis with 23-24 scales Height 3 to more than 3.4 or somewhat more in length with caudal. Head about 3.6- 3.8, 4.6 – 5 in length with caudal. Eye 4 – 5, 1 ½ to 2 in interorbital space. Lips broad, swollen, thick, continuous, the upper one generally with an anterior lobe, the lower one with a long free median lobe, which reaches to aline connecting the corners of the mouth. Maxillary barbels somewhat longer than the rostral ones, slightly or much longer than eye. Origin of dorsal about in the middle between end of snout and root of caudal, separated by 8 or 9 scales from occiput, opposite to 7$^{th}$ scale of lateral line and slightly before origin of ventrals. Dorsal concave, third spine strong, osseous about 1 1/3 in head, its stiff portion as long as the head without snout. Anal truncate, depressed not reaching caudal, its height somewhat less than that of the dorsal. Ventral as long as height of anal, not reaching anus, separated by 2 scales from lateral line. Pectoral slightly shorter than height of dorsal. Caudal deeply forked, its lobe pointed, the lower one the longer, equal to or longer than head. Least height of

caudal peduncle about 1 ½ times in its length, surrounded by 12 scales, Silvery, back dark, as also the fins.

*Tor duoronensis*

Dorsal fin with 3 spines and.9 rays; anal fin with 3 spines and 5 rays; pectoral fin with 1 spine and 16 rays; ventral fin with 2 spines and 8 rays; linea leteralis with 21-24 scales Height 3.2-3.3, 4.1 in length with caudal. Head 4-4.2, 5-5.3 in length with caudal. Eye 4 ½ – 5, 1 ½ or more in snout, twice or somewhat more in interorbital space. Rostral barbels about 1 ½ times, maxillary barbels about twice in eye. Lips thick, continuous, the lower one with median, more or less developed square lobe, the hindborder of which does not reach the line connecting the corners of the mouth. The blunt snout somewhat prominent, mouth inferior. Origin of dorsal opposite to 6$^{th}$ or 7$^{th}$ scale of lateral line and slightly before that of ventrals, separated by 8 scales from occiput, somewhat nearer to end of snout than to base of caudal. Dorsal concave, its third spine osseous, rather strong, slightly shorter than head, its stiff part about equal to head without snout. Anal truncate, slightly less high than dorsal, depressed not reaching caudal. Ventrals separated by 2 scales from lateral line, their length about equal to height of anal, distant from anus. Pectoral slightly shorter than height of dorsal. Caudal deeply forked, its lobe pointed, about equal to head. Least height of caudal peduncle 1 ½ or more in its length, surrounded by 12 scales. Silvery, back darkish. Base of scales of back and sides darkish.

*Tor tambra*

Dorsal fin with 4 spines and.8-9 rays; anal fin with 3 spines and 5 rays; pectoral fin with 1 spine and 14-16 rays; ventral fin with 1 spines and 7-8 rays; linea leteralis with 22-24 scales. Height 3 ½-4, 4-4 1/5 in length with caudal. Head pointed, 3.3-4.2, 4.1-5.3 in length with caudal. Eye 5-6.6, 1 ¾ to more than twice in snout and about twice in slightly convex interorbital space. Maxillary barbels generally somewhat longer than the rostral ones and about equal to length of snout. Snout prominent, mouth inferior, lips thick, continuous, the lower one with a median well developed free lobe, the hindborder of which is convex or truncate, but does not reach the line connecting the corners of the mouth. Origin of dorsal opposite to 7 $^{th}$ scale of lateral line and slightly before that of ventral, separated by 8 or 9 scales from occiput, nearer to end of snout than to base of caudal. Dorsal concave, its fourth ossified spine rather feeble, with its flexible portion equal to head without snout, its stiff portion less than half length of head. Anal truncate, its height somewhat more than that of dorsal, depressed reaching base of caudal or not so far. Ventrals separated by 2 scales from lateral line, their length equal to height of anal or somewhat less, distant from anus. Pectorals much longer than height of dorsal, somewhat less than length of head. Caudal deeply forked, its lobe pointed, shorter than head. Less height of caudal peduncle 1 ½ in its length, more or less than twice in length of head, surrounded by 12 scales. Silvery, fins darkish.

Tambra fish are interesting both consume fish and ornamental fish, however this fish has low population that resulted by constant degradation of freshwater. This fish very sensitive to water quality changes and can thrive only in waters which are clean and undisturbed. In addition, un-controlled harvesting and distortion of the riverine ecosystem and its surrounding have contributed further to the general decline in number of tambra fish in the world. Therefore, conservation is needed such as by method of protection and rehabilitation of rivers.

## CONCLUSION

*Tor soro* strictly separated from its congeners. Five morphology characters (IW, CPL, CPD, HW, and BD) most important for differentiated four species of *Tor* from Indonesia, beside median lobe on lower lips. *Tor tambroides* has body size larger than the others and interesting for continued study (domestication); *Tor soro* is important for genetics study. All species of *Tor* have economically potential and critical population so needed conservation.

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