ISBN : 978-602-72574-5-0
Aplikasi Teknologi Sebagai Solusi Di Bidang Perikanan Secara Berkelanjutan
Seminar Nasional Perikanan Indonesia 19-20 November 2015, STP JAKARTA

MORPHOLOGICAL VARIATION OF MAHSEER (*Tor tambroides,* Bleeker, 1854*)* ALONG BATANG TARUSAN RIVER (West Sumatera): IMPLICATIONS FOR STOCK IDENTIFICATION[1]

Arif Wibowo [2]dan Marson[2]

ABSTRACT

Mahseer (*Tor tambroides,* Bleeker, 1854*)* is a cultural species and economic importance fish species in the Batang Tarusan River, West Sumatera. In this study morphological data was used to investigate stock identification within and among populations of mahseer. A total of 47 individuals were collected for morphology analysis in the Batang Tarusan River. Morphology analysis revealed although morphometric characteristics showed considerably greater discriminatory power to distinguish individuals from different areas than did the meristic characters, however all morphometrical and meristic showed existence analyses of mixed population among population samples. Corroborated result by meristic and morphometric analysis; there is a strong argument suggesting that the populations could be treated as a single stock unit.

Keywords: *Tor tambroides, morphological, stock, Batang Tarusan River*

INTRODUCTION

Tor tambroides, locally famous as “semah” is one of the Mahseer used for food. *Tor tambroides* inhabits the upper reaches of clean unpolluted river systems with rocky beds through hilly terrain (Singh and Menon 1994). They can morphologically be identified based on the presence of a long median lobe character (Kottelat et al. 1993, Kottelat and Whitten 1996, Rainboth 1996). Environmental degradation (i.e., river pollution, deforestation, watershed erosion, etc.) of headland areas and upper streams has led to the rapid destruction of natural habitats of *T. tambroides*. In addition, excessive demand for the highly priced *T. tambroides* flesh has led to uncontrolled fish harvesting and destructive fishing practices by locals and illegal fish poachers (Esa et al. 2008).

The need to have a proper management of this species is imminent. The proper management of fishery resources can be greatly enhanced by understanding the stock structure of wild populations. Recent success in the captive breeding of *T. tambroides* (Ingram et al. 2005) has created an opportunity for mass-producing this highly valued Mahseer for aquaculture and commercialization as well as for restocking natural water bodies for conservation purposes (Nguyen et al. 2006).

Morphological characters (morphometric and meristic) were used to identify the stock structure of mahseer. The analysis of morphometric and meristic characters is one of the most commonly used (e.g. Hurlbut and Clay, 1998; Melvin et al., 1992; Taylor and McPhail, 1985). Although these characters may be influenced by environmental conditions, they can be as valuable in indicating stock discreteness as other, more genetically related, features (Casselman et al., 1981; Kinsey et al., 1994; Lear and Wells, 1984). The goal of the study was to investigate stock identification within and among populations of mahseer.

MATERIALS AND METHODS

Sample description and collection locations

Mahseer were sampled during 2012. A total of 47 individuals from the Batang Tarusan River were sampled (Table 1 and Fig. 1). Samples were collected by cast net, during surveys. All fish were preserved first by formalin solution 10% for 7 days, rinsed by

[1] Makalah dipresentasikan pada Seminar Nasional Perikanan Indonesia Sekolah Tinggi Perikanan, Jakarta, 19-20 November 2015

[2] Research Institute for Inland Fisheries, Mariana, Palembang 30763, Indonesia

flowing water and finally kept in 70% ethanol solution just before being measured in the laboratory.

Table 1. Summary of *Tor tambroides (*Bleeker, 1854*)*, morphology samples, sampling localities and georeferences for mahseer collected from Batang Tarusan River

No	Morphology samples (ind)	Locality	Latitude	Longitude
1	11	Sungai Lundang	01^0 07.447'S	100^0 29.351'E
2	13	Kuto Tarusan	01^0 08.111'S	100^0 29.371'E
3	23	Ps. Minggu	01^0 06.8116'S	100^0 29.081'E
Total	47			

Measurements were taken, always by the same person, with 0.1mm precision. Eleven morphometric and seven meristic characters were used: morphometric—total length (TL,1), fork length (FL,2), standard length (SL,3), head length (HL,4), dorsal width (DW,5), pre-anal (PA,6), pre-pelvic (PC,7), pre-pectoral (PP,8), eye diameter (ED,9), pelvic length (PL,10), height tail (HT,11), dorsal length (DL,12); meristic-number of ray in dorsal (ND,13), number of ray in pectoral (NP,14), number of ray in pelvic (NC,15), number of ray in anal fin (NAF,16), number of ray in anal (NA,17), Figure 2.

Figure. 1. Map showing the relative locations of sampling sites of the Batang Tarusan River.

ISBN : 978-602-72574-5-0

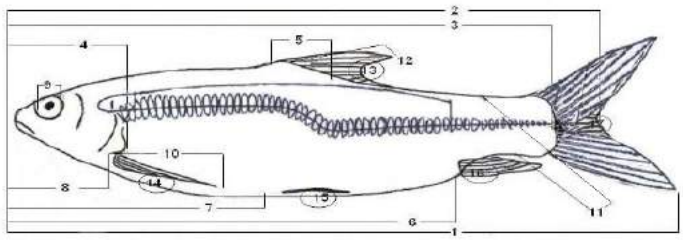

Figure 2. Morphometric and meristic characters measured of mahseer on the left side of each fish:

Morphometric characters were standardized to the overall mean standard length to correct for correlation with body size, the standardized measure being given by,

$$Mc = Mx\left(\frac{\overline{SL}}{SL}\right)^{b}$$

(modified from Hurlbut and Clay, 1998) where SL is the standard length, *M*x the measurement, SL the overall mean standard length and *b* is the slope, within areas, of the geometric mean regression (Ricker, 1973) on the logarithms of *M*x and SL. This regression model was chosen, because none of the variables could be considered either independent or dependent.

Pearson correlation coefficients between each pair of characters were calculated to evaluate the effectiveness of data transformation in reducing the influence of size in the measurements. Variables highly correlated, after the size effect removal, were considered redundant and eliminated from the analysis. For each variable, differences between males and females were evaluated by *t*-tests (morphometric variables) or Mann–Whitney tests (meristic variables). A standard multivariate discriminant analysis was performed separately for morphometric and meristic data. The resultant discriminant functions were used to classify the individuals into locations, and this classification classification success ratewas evaluated based on the percentage of individuals correctly classified in the original sample. All calculations were performed in STATISTICA 6.0 software (STATSOFT Inc.).

Results and Discussion

No statistical differences were found between males and females ($p > 0.05$, for all variables), so sexes were pooled in further analysis. The *Partial Wilks' Lambda* indicates that variable pre-pectoral contributes most in morphometrics character and variable number of ray in dorsal contributes most to the meristic character, Table 1.

Table 1. *Partial Wilks' lambda* of mahseer populations

Variabel	Morphology		Variabel
	Morphometric	Meristic	
DL	0.868	0.936	ND
PP	0.751	0.949	NAF
HL	0.769		
PC	0.874		
PA	0.838		
FL	0.927		

The plots of the individuals' coordinates in the first two functions show a high overlap between samples, both, in the morphometric and meristic overlap on the diagram (Figure. 3). The discrimination is not clear discriminate among three populations. The morphometric discriminant analysis correctly classified, on average, 45.19% of the individuals (Table 2).

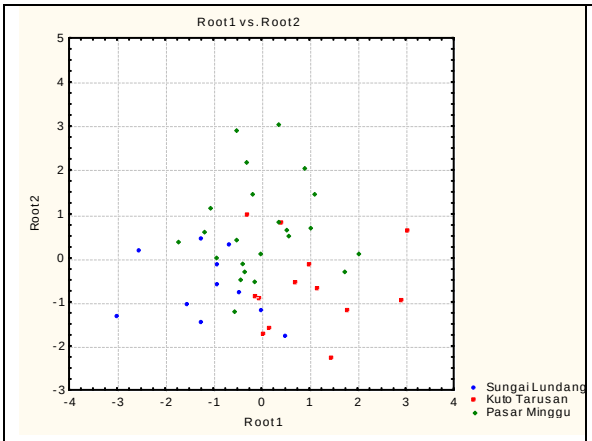

Figure. 3a. Plots of the coordinates of individuals of mahseer populations according to the first two discriminant functions obtained in the morphometric data analysis.

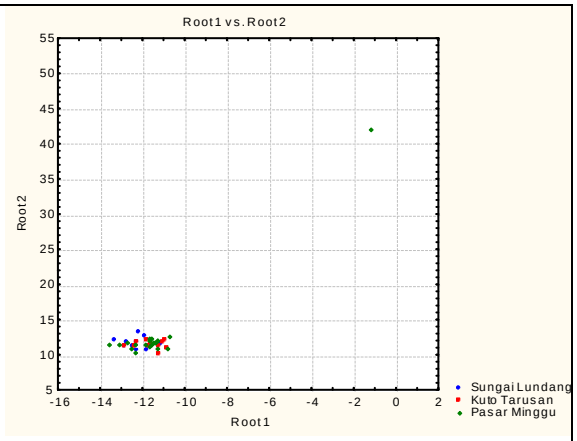

Figure. 3b. Plots of the coordinates of individuals of mahseer populations according to the first two discriminant functions obtained in the meristic data analysis.

The highest classification success rates were obtained for Pasar Minggu (78.26%), but the Sungai Lundang groups had less than 50% of the individuals correctly classified. Meristic analysis classification results were poorer with 41.7% of the individuals correctly classified (Table 6). Again, Pasar Minggu obtained the highest classification success rate (82.61%). The values of correctly classified individuals obtained for the other samples were lower than 50%.

Table 2. Percentage of individuals reclassified in each group in the validation of the discriminant analyses for the morphometric and meristic

		Sungai Lundang	Kuto Tarusan	Pasar Minggu
Morphometric	Sungai Lundang	36.36	27.27	36.37
	Kuto Tarusan	0.77	53.84	45.39
	Pasar Minggu	0.87	20.87	78.26
Meristic	Sungai Lundang	27.27	18.18	54.55
	Kuto Tarusan	23.08	15.38	61.54
	Pasar Minggu	13.04	4.35	82.61

The overlap between samples in the diagrams and the low classification success rates reflect the morphological similarity between *Tor tambroides* individuals collected along the Batang Tarusan River. Morphologic results revealed a high within samples variability and a low differentiation between population samples. It has been suggested that the morphological characteristics of fish are determined by an interaction between genetic and environmental factors. The environmental characteristics prevailing during the early development stages, when individuals are

more phenotipically influenced by the environment, are of particular importance (e.g. Ihssen et al., 1981; Junquera and Perez-G´andaras, 1993; Tudela, 1999). The morphological similarity of individuals collected along Batang tarusan River seems to indicate that the environmental conditions experienced by the plancktonic stages and young *T. tambroides* are similar or not different enough as to induce different morphologies in individuals of different localities.

Morphologic data from this study showed a little variability, corroborating the previous idea, did not gave support to the hypothesis of existence of discrete groups of *Tor tambroides* along the Batang tarusan River, suggesting that the populations could be treated as a single stock. Regarding fishery management, the *Tor tambroides* in the Batang tarusan River needs to be managed as a integrated unit.

CONCLUSION

Morphology analysis revealed although morphometric characteristics showed considerably greater discriminatory power to distinguish individuals from different areas than did the meristic characters, however all morphometrical and meristic showed existence analyses of mixed population among population samples. Corroborated result by meristic and morphometric analysis; there is a strong argument suggesting that the populations could be treated as a single stock unit.

REFERENCES

Casselman, J. M., J.J. Collins, E.J., Crossman, P.E. Ihssen and G.R. Spangler. 1981. Lake whitefish (*Coregonus clupeaformis*) stocks of the Ontario waters of Lake Huron. *Canadian Journal of Fisheries and Aquatic Sciences.* 38: 1772–1789.

Esa, Y.B., S.S. Siraj, S.K. Daud, K.A.A. Rahim, J.R.R. Japning and S.G. Tan. 2008. Mitochondrial DNA Diversity of *Tor tambroides* Valenciennes (Cyprinidae) from Five Natural Populations in Malaysia. *Zoological Studies.* 47(3): 360-367.

Hurlbut, T. and D. Clay. 1998. Morphometric and meristic differences between shallow- and deep-water populations of white hake (*Urophycis tenuis*) in the southern Gulf of St. Lawrence. *Can. J. Fish Aquat. Sci*. 55: 2274–2282.

Ihssen, P.E., H.E. Booke, J.M. Casselman, J.M. McGlade, N.R. Payne and F.M. Utter. 1981. Stock identification: material and methods. *Can. J. Fish Aquat*. *Sci.* 38: 1838–1855.

Ingram, B.A., S. Sungan, G.J.Gooley, Y.S. Sim, D. Tinggi, S.S. De Silva. 2005. Induced spawning, larval development and rearing of two indigenous Malaysian Mahseer, *Tor tambroides* dan *Tor duoronensis.* Aquat. Res. 36: 1001-1014.

Junquera, S. and G. Perez-G´andaras. 1993. Population diversity in Bay of Biscay anchovy (*Engraulis encrasicolus* L 1758) as revealed by multivariate analysis of morphometric and meristic characters. *ICES J. Mar. Sci.* 50: 383–391.

Kinsey, S. T., T. Orsoy, T.M. Bert, and B. Mahmoudi. 1994. Population structure of the Spanish sardine *Sardinella aurita*: natural morphological variation in a genetically homogenous population. *Marine Biology*. 118: 309–317.

Kottelat M, A.J. Whitten, S.N. Kartikasari and S. Wirjoatmodjo. 1993. *Freshwater fishes of Western Indonesia and Sulawesi*. Singapore: Periplus Edition.

Kottelat M and A.J. Whitten. 1996. *Freshwater fishes of Western Indonesia and Sulawesi: additions and corrections.* Hong Kong: Periplus Edition

Lear, W. H. and R. Wells. 1984. Vertebral averages of juvenile cod, *Gadus morhua*, from coastal waters of eastern Newfoundland and Labrador as indicators of stock origin. *Journal of the Northwest Atlantic Fishery Science*. 5: 23–31.

Melvin, G.D., M.J. Dadswell and J.A. McKenzie. 1992. Usefulness of meristic and morphometric characters in discriminating populations of American shad (*Alosa sapidissima*) (Osteichtyes: Clupeidae) inhabiting a marine environment. *Canadian Journal of Fisheries and Aquatic Sciences.* 49: 266–280.

Nguyen, T.T.T, B. Ingram, S. Sungan, G. Gooley, S.Y. Sim, D. Tinggi, S.S. DeSilva. 2006. Mitochondrial DNA diversity of broodstock of two indigenous Mahseer species, *Tor tambroides* and *Tor dourenensis* (Cyprinidae) cultured in Sarawak. *Aquaculture.* 253:259-269.

Rainboth W.J. 1996. Fishes of the Cambodian Mekong. *FAO species identification field guide for fishery purposes.* Rome: Food and Agriculture Organization Publication.

Ricker, W.E. 1973. Linear regressions in fishery research. *J. Fish. Res. Bd Can.* 30: 409–434.

Singh H.R and A.G.K. Menon. 1994. Evolution and taxonomic relationships of the kelah fishes of India. *In* P. Nautiyal, ed. Kelah of India and Nepal. New Delhi: Jagdamaba Prakashan, pp. 1-8.

Taylor, E. B. and J.D. McPhail. 1985. Variation in body morphology among British Columbia populations of coho salmon, *Oncorhynchus kisutch*. *Canadian Journal of Fisheries and Aquatic Sciences.* 42: 2020–2028.

Tudela, 1999. Morphological variability in a Mediterranean, genetically homogeneous population of the European anchovy, *Engraulis encrasicolus*. *Fish. Res*. 42: 229–243.

PERTANYAAN

1. Pernyataan anda tadi bahwa produksi ikan semah menurun secara drastis. Upaya- upaya atau langkah apa yang dilakukan agar dapat mempertahankan keberadaan ikan semah ?