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Study of some Morphometric and Meristic Characters of a Parassi mullet, *Mugil incilis* (Mugilidae: Mugiliformes) from the Indus River at Sukkur District of province Sindh, Pakistan

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ABSTRACT: A study was conducted to analyze morphological characteristics of a mugilid species, *Mugil incilis* collected from the landing sites on Indus River of district Sukkur, province Sindh during the period from August 2014 to December 2014. These fishes are commonly known as "parassi mullet". A total of 80 samples of this species were collected which includes 42 male and 38 female fishes respectively. About twelve morphometric and two meristic characteristics were selected for this study. No significant variations (t-test p>0.05) were observed among the male and female members of the populations of this species except the first dorsal (DF1) and pelvic fin (PelFH) that shows significant (t-test; p<0.05) variation in their heights. As morphometric and meristic characters have key importance in the systematic classification of fishes, hence, these two characters had been found to helpful in observing the phenotypic variation among the male and female populations of this species.

Keywords: Mugilidae, Parassi mullet (*Mugil incilis*), morphometric and meristic characters.

INTRODUCTION

Fishes which belong to the Mugilidae family are commonly called as "mullets" or "grey mullets". They are actinopterygian fishes and occupy temperate and tropical seas along with brackish and coastal marine ecosystems (Thomson 1997, Nelson 2006). As they can tolerate a broad range of salinities, therefore, they are found in all types of aquatic environments. They migrate from fresh water to marine water, the adolescent life prior to adulthood remain chiefly in lakes and rivers (Lee and Tamaru, 1988; El-Deeb *et al.,* 1996). Due to the economic importance of mullets, vast studies were carried out on different aspects of these mullet fishes by the several workers throughout the world, such as, Ibáñez and Gallardo-Cabello (1996), Ibáñez *et al.* (1999), González-Castro *et al.* (2009) and Kendall *et al.* (2009).

Mugil incilis belongs to the family Mugilidae is most commonly named as "parassi mullet". Species like *Mugil incilis, Cathorops spixii* and *Eugerresplumier* had been considered as the most important fish species from commercial point of view in Colombia, Cienaga Grande de Santa Marta (CGSM), because during the years from 1993 to 1994,it was estimated that they were caught in percentage of about 81% during annual fishing as reported by Santos-Martínez & Viloria (1998).

Even, in Pakistan, about half of the total finfish landings at Pakistan coast are including sardines and mullets (Munshi *et al*., 2005). Talwar and Jhingran (1992) reported that morphometric can be described as external measurements of organism, whereas meristic calculations signify the successive counts of organism's body elements. Lindsey (1988) studied that meristic counts, morphological characteristics and body size commonly differ clinically according to the geographic gradient. Ihssen *et al.* (1981), Allendorf (1988), Swaine *et al.* (1991) and Turan (1999) also stated that the adaptations in phenotype always do not results in heritable genetic alteration, therefore, the phenotypic dissimilarity between populations are not generally used as proof of genetic demarcation. Information regarding to the variations in morphological characters will be consequently valuable to reveal patterns experiential in genetic character and phenotypic dissimilarity among the different populations of same fish species (Beheregaray and Levy, 2000). Lately, Zubia *et al.* (2015) describes the systematic importance of thirty-one morphometric and four meristic studies for the correct identification of morphologically identical four mugilid species of family Mugilidae from the Karachi coast.

Hence, in systematic classification of fish, morphometric characteristics are commonly applied and help in the classification of population as well as species living in different type of water bodies in diverse geographical areas. Therefore, several researchers including Hoque (1984), Gosh *et al.* (1988), Narejo *et al.* (2000), Lashari, *et al.* (2004), Narejo (2010) performed their work on some aspects of morphometric classification of various fish species from different water bodies of Asian countries including Pakistan, India and Bangladesh. Senou (1988) Ghasemzadeh (1998) and Ghasemzadeh & Ivantsoff (2004) pointed out the fact that variation in exterior morphology and meristic characters have recurrently been primary way of creating taxonomic discrimination between the members of family Mugilidae, so due to this reason and new morphometric as well and meristic diagnostic techniques, classification and taxonomy of the mugilid species are unstable, because all these new methods can reveal clear knowledge related to their systematic classification, therefore, sum of genuine taxa is expected to change.

MATERIAL AND METHODS

A. Samples collection

A total of 80 samples including 38 females and 42 males of *Mugil incilus* were collected monthly from the landings at sites on Indus River during the period from August to December 2014. Fish were transported to the laboratory, where they were measured, weighed, and macroscopically sexed. Each specimen was identified to species level. Then fishes were immediately preserved in 10% formaldehyde solution for detail examination.

B. Morphometric and meristic data

Studies of morphometric and meristic characters followed the methods given by Dars *et al.* (2012), Zubia *et al.* (2015) with some modifications. Morphometric measurements were made using dial or digital callipers. In Laboratory, about 12 morphometric and 2 meristic characters of each fish sample were made in the present study as shown in Tables 1 & 2. Total length (TL) and all other measurements were taken in millimetres.

Table 1: Shows acronyms of morphometric measurements and meristic counts of *Mugil incilus.*

Characters	Acronyms
Morphometric characters	
Total length	TL
Forked length	FL
Standard length	SL
Head length	HL
Body depth	D
First dorsal-fin height	D1H
First dorsal-fin base length	D1L
Pectoral-fin length	PFL
Pelvic-fin height	Pel FH
Pelvic-fin length	Pel FL
Anal-fin height	AFH
Anal-fin length	AFL
Meristic counts	
Transverse row scales counted in transverse series from the origin of first dorsal fin to the origin of pelvic fin.	TRS1
Transverse row scales were counted in transverse series between the second dorsal fin and anal fin.	TRS2

C. Statistical analysis of data

All statistical analysis of data was performed by using Minitab software version 17.0. For the analysis of phenotypic variation between male and female sexes of *Mugil incilus*, 2 sample t-test at 95%. Confidence interval (CI) was calculated (Table 2) in order to find out the significance (t-test, $p<0.05$) of variations between the means of each character among the male and female populations of the same species.

Table 2: Means and standard deviation of phenotype traits based on morphometric characters and meristic counts used for differentiation analysis between male and female sexes of *Mugil incilus*. All measurements were in millimeters (mm).

Morphometric characteristics	Combined sexes N = 80			female N = 38			male N = 42			Two samples t-test and CI				Sig.
	Mean+S.D	Range		Mean+S.D	Range		Mean+S.D	Range		95% CI		t-test	p	
		Min.	Min.		Min.	Min.		Min.	Min.					
TL	134.2+5.0	125.0	145.0	134.5+5.3	125.0	145.0	134.0+4.7	125.0	145.0	-2.80	1.07	-0.5	0.62	NS
FL	124.2+4.84	113.0	135.0	124.1+5.26	113.0	134.0	124.4+4.52	115.0	135.0	-1.87	2.52	0.3	0.76	NS
SL	114.6+4.52	104.0	125.0	114.9+4.72	108.0	125.0	114.4+4.38	104.0	125.0	-2.51	1.56	-0.5	0.64	NS
HL	30.4+ 2.5	24.0	34.0	30.5+2.71	24.0	34.0	30.4+2.44	24.0	34.0	-1.27	1.03	-0.2	0.83	NS
D	32.4+2.69	25.0	40.0	32.7+2.59	26.0	40.0	32.3+2.77	25.0	39.0	-1.62	0.77	-0.7	0.47	NS
D1L	15.1+1.28	13.0	18.0	14.9+1.08	13.0	18.0	15.3+1.44	13.0	18.0	-0.15	0.92	1.5	0.15	NS
D1H	10.1+1.79	6.0	14.0	9.73+1.67	6.0	12.0	10.5+1.83	6.0	14.0	0.01	1.56	2.0	0.04	c
PFL	19.8+1.42	18.0	24.0	19.6+1.12	18.0	22.0	20.1+1.60	18.0	24.0	-0.13	1.09	1.6	0.11	NS
Pel FH	15.9+0.89	14.0	18.0	15.6+0.84	14.0	18.0	16.1+0.90	14.0	18.0	0.02	0.80	2.1	0.03	c
Pel FL	6.65+1.85	4.0	10.0	6.3+1.52	4.0	10.0	6.9+2.05	4.0	10.0	-0.24	1.36	1.4	0.16	NS
AFH	15.5+1.45	12.0	18.0	15.3+1.35	12.0	18.0	15.5+1.55	13.0	18.0	-0.44	0.85	0.6	0.52	NS
AFL	8.1+1.34	5.0	10.0	7.86+1.35	5.0	10.0	8.2+ 1.32	5.0	10.0	-0.30	0.89	1.0	0.32	NS
Meristic counts														
TRS1	5.48+0.63	4.0	7.0	5.42+0.72	4.0	7.0	5.52+0.55	4.0	6.0	-0.18	0.39	0.7	0.48	NS
TRS2	6.58+0.65	4.0	7.0	6.63+0.58	5.0	7.0	6.57+0.70	4.0	7.0	-0.35	0.23	-0.4	0.67	NS

Note: NS: not significant (when $p>0.05$); c : Significant at 5% level (t-test; $p<0.05$); 95% CI = Confidence interval.

RESULT AND DISCUSSION

All specimens of *Mugil incilus* were ranging from 125 to 145 mm in total length (TL) were used for the studies of the morphometric and scales were used for studies of meristic characteristics. During this study, total length (TL) of male was ranged from 125 to 143 mm, while female ranged from 130 to 145 mm, respectively. The results of the present study revealed that among the fourteen morphological characteristics, the variation between the means of only two morphometric characters such as, first dorsal fin height (D1H) and pelvic fin height (PelFH) of male and female individuals of *Mugil incilus* were found to be significant (t-test; $p<0.05$), thence these two characters could be useful for observing phenotypic variation between male and female sexes of *Mugil incilus*, as shown in Table 2. Meristic calculations were easier to estimate in addition to this it is beneficial as the majority counts can be calculated from the live fish. Though, meristic data only can't provide the feature necessary to distinguish the dissimilarities among the two different populations (North et al., 2002).Besides, Akyol and Kinacigil (2001) establish that discriminate examination of seven morphometric characteristics in mature specimens of grey mullets demonstrated the fact that *Liza aurata* and *Lizasaliens* were alike in forms, whereas, *Chelonlabrosus* and *Mugil cephalus* were slightly dissimilar from each other. Particular research works were performed regarding meristic and morphometric characteristics of male and female of different species of fish such as, Lashari, *et al.* (2004), Narejo *et al.*, (2000), Narejo (2010) and Dars *et al.* (2012) work done morphological characteristics of *Cirrhinus reba*, *Gudusia chapra*, *Channa punctatus* and observed the similar result which was in agreement with our present findings. Furthermore, In *Cirrhininus reba*, it was observed that the mean values of meristic count illustrated no significance differences (t-test, $p>0.05$) which was in agreement with our present study. But when male and female of the same species of *Cirrhininus reba* that were inhabitants of Manchar Lake of Jamshoro district were studied, they illustrated significant (t-test, $p<0.05$) differences in a variety of meristic count that was in contrasting with the results of our present study. According to the Narejo (2010), the knowledge of morphometric dimensions of fishes along with statistical affiliation between them are most important for authentic taxonomic research work. Therefore, in our present investigation, both morphometric and meristic measurements were used to evaluate the morphological variations between male and female fishes of *Mugil incilis*. Ample facts were shown to accept the statement that morphometry can distinguish between different species of fish and different populations (Minos *et al.*, 1995; Cavalcanti *et al.*, 1999; Sabadin *et al.*, 2010; Díaz-de-Astarloa *et al.*, 2011; Zhan and Wagn, 2012). According to our consequences, the most chief measures to take notice for differentiation purpose among male and female *Mugil incilis* were morphometric and meristic characters and it had been concluded that only two morphometric characters that were D1H (First dorsal-fin height)and PelFH (Pelvic-fin height) were found to be significant (t-test; $p<0.05$), hence these characters could be used in future for observing phenotypic variation between male and female sexes of *Mugil incilus*.These measurements and facts should be mentioned in mullet identification keys so that it could be helpful for future researchers.

Though, to put forward a few indicative characteristics that allow the simple field identification between species, taxonomists must merge diverse paraphernalia (meristic and morphometric characters, osteology, pattern coloration) for achieving the maximum identification rate. In regard to the family Mugilidae, Corti and Crosetti (1996) and in recent times, Heras *et al.* (2006) and González-Castro *et al.* (2008) presented a vital study based on taxonomy applying the body shape to distinguish the mullets belonging to the same genus. For detail knowledge of the environmental factors that influence morphometric and meristic characteristics, ample of detail analysis will be required to formulate an appropriate prediction regarding the use of suitable methods (Anyanwu 1993).

CONCLUSIONS

The lack of similarity in the morphologic outcome of mullet species suggests us to analyze the present status of mugilid species by inclusive an alysisvia molecular genetics and morphologic markers together. Hence, from the results of our present study, it was concluded that we had not noticed any obvious amount of morphologic demarcation among morphometric and meristic differences among the male and female populations of *Mugil incilus* in river Indus of district Sukkar, Pakistan.

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