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Original Article

Morphometric, Meristic and Comparative Studies of *Mystus* Three Species (Family: Bagridae) from Two Different Habitats of Andhra Pradesh, India

Satyanarayana Murthy CH.V.*, T. Baby Ratnakumari**

Abstract

The present study concerned with three Mystus species, Mystusvittatus, Mystusgulio, Mystuscavasius. Mystus species are small indigenous fresh water fishes with high nutritional value. Morphology of fishes has been the primary source of information for taxonomic and evolutionary studies. In the present study total 16 morphometric external characters were analysed and the correlation of body parts with total length and head length were analysed. The differences in morphometric characters is due to geographical and environmental variations are also observed. The mean value of the meristic counts are also studied in three species

Keywords: Mystusvittatus; Mystusgulio; Mystuscavasius; Morphometric Characters; Meristic Counts.

Introduction

Historically the morphology of fishes has been the primary source of information for taxonomic and evolutionary studies. Despite the value and availability of genetic, physiological, behavioural and ecological data for such studies, systematic ichthyologists continue to depend heavily on morphology for taxonomic characters. Species have characteristic shapes, sizes, pigmentation patterns, disposition of fins and other external features that aid in recognition, identification and classification.

Moreover, morphometric analyses can be a tool in assessing habitat – specific differentiation of populations, such as differentiation related to predation pressures, salinity, temperature, food availability etc. Differences in morphometric and meristic characters among populations of a species are thought to be the result of genetic differences or environmental factors or their interactions.

Morphometric analyses have been very useful for separating species, populations and races in the past and have been widely used for the identification of different fish stocks (Turan et al., 2004,2005). Such morphometric studies of fish populations are very important for understanding the interactive effect of environment, selection and heredity on the body shapes and sizes within a species (Cadrin 2000). Several studies on the comparative morphometrics of different fish populations have been conducted Nakamura 2003; Turan et al., 2005; Ibanez Aguirre et al., 2006, Negi Ramakrishna and NegiTaran 2010, Muhammadzafari et al., 2002. Morphometrics is very important in biology because it allows quantitative descriptions of organisms. Quantitative approach allowed scientists to compare the shapes of different organisms much better.

The objectives of the present study are to assess and describe geographic variation in morphological and meristic characters of three Mystus species. *Mystusvittatus, M. gulio and M. cavasus*from two different places Visakhapatnam and Srikakulam is to identity the best set of characters for group separation and relate the observed variations with the specific ecological constraints of each population.

Author's Affiliation: *Research Scholar **Professor, Department of Zoology, Andhra University, Visakhapatnam, Andhra Pradesh 530003, India.

Reprint's Request: Satyanarayana Murthy CH.V., Research Scholar, Department of Zoology, Andhra University, Visakhapatnam, Andhra Pradesh 530003, India.
E-mail: Satyam097@gmail.com

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Material and Methods

Very limited information is available on the morphometric measurements and meristic counts of Mystus species from the freshwater bodies of Andhra Pradesh. Further recognition or identification of a species is necessary and must be done in all types of biological studies, where morphological systematics is used for quick identification and conformation. Therefore the present study is designed to generate data on morphometry and geographical variations in three Mystus species, *Mystusvittatus, M. gulio, M. cavasius.*

The materials for the present study were collected from two different aquatic habitats namely Nagavali river at Srikakulam, Meghadrigeddain Visakhapatnam of Andhra Pradesh.

Nagavaliriver is one of the major rivers in Srikakulam. The river rises on the eastern slopes of the eastern ghats near Lakhbahai in the Kalahandi district of Odisha. Geographically the river located between 18^0 10″to 19^0 44″ north latitudes and 82^0 53″ to 84^0 05″ east longitudes.

The total length of the river is about 256km, of which 161km are in Odessa and the rest in Andhra Pradesh. The catchment area of the basin is 9,510 square km. Nagavali is an interstate river with 5048km^2 river basin area in Andhra Pradesh.

Mehadrigedda is a major drinking water source of Visakhapatnam city, a perennial freshwater stream stretching between latitude $17^0$44"N and longitudes $83^0$1′54"E and located 15 km South of Visakhapatnam. The reservoir has a maximum water spread area of 360 Sq. km.

The samples collected during the period from January 2010 to December 2010. Total 150 species were used for the study of morphometric and meristic counts in each species. Different types of fishing methods were employed for the collection of specimens. Gill nets, Drag nets and other traditional traps were used for the collection of fishes, with the help of local fishermen.

The fish samples were collected and preserved in 10% formalin in the field itself and brought to the laboratory for further systematic studies. Details of the coloration were recorded in the fresh specimens itself.

The fishes were identified up to the species level with the help of authentic keys such as Day (1878), Talwar and Jhingran (1991). Morphometric and meristic counts were done by following Standard measure ments of jayaram.

Morphometric measurements were recorded with a dial-reading caliper with an accuracy of 0.02 mm. In the present study the data of maximum and minimum values presented in Centimetres and the ratios of body parts in percentages. Analysis of variance (ANOVA) was carried out to test the significance of morphological differences.

Table 1: Definitions and Acronyms of morphometric measurements and meristic counts of Mystus species used in this study

Character	Description	Acronym
Total length	Distance from the tip of the snout to the longest caudal fin ray	TL
Standard length	Distance from the tip of the snout to the tail base	SL
Body Weight,gm	Weight of the fis in grams	BWT
Body Width	The greatest width just posterior to the gill opening	BW
Body Height or depth	Maximum depth measured from the base of the dorsal spine	BH
Head length	Distance from the tip of the snout to the posterior margin of the opercula	HL
Head length excluding snout	from the anteror edge of the orbit to the posterior margin of the opercula	HLExS
Widh of head	It was a straight measurement of the distance between the two eyes	WH
Snout length	The front of the upper lip to the fleshy anterior edge of the orbit	SNL
Eye diameter	The greatest bony diameter of the orbit	ED
Caudal peduncale length	From base of the last anal fin ray to middle of caudal fin fold	CPL
Anal fin length	Base length, greatest distance measured in a straight line between the anterior most and posterior point of junction with the body	AFL
Pelvic fin length	Base length, greatest distance measured in a straight line between the anterior most and posterior point of junction with the body	PVFL
Pectoral fin length	Base length, greatest distance measured in a straight line between the anterior most and posterior point of junction with the body	PFL
Caudal peduncle height	The depth of the tail base	CPH
Dorsalfin length	Base length, greatest distance measured in a straight line between the anterior most and posterior point of junction with the body	DFL
Caudal fin length	From tail base to tip of the caudal fin	CFL

Results

Mystus Vittatus

The morphometric measurements of M. vittatus from two different places were shown in the Table no 2. Total length varies between 11.09 to 16.05cm with a mean value of 13.87±1.53 and Standard length 8.52 to 12.33cm with a mean value of 10.65±1.17 in Visakhapatnam. T.L and S.L in Srikakulam varies 9.36 – 14.53 and 7.39 – 11.48cm with a mean value of 12.18±1.74, 9.62±1.37 respectively. Comparison of the mean of morphometric ratios was shown in the Table 10.

In the present study coefficient correlation between the morphometric characters were analyzed to determine the relationship. Correlation between the various body parts with a total length of *Mystusvittatus* were shown in Table 8, SL, HL, BH, PFL, PVFL, AFL, CFL shows high correlation with TL. Correlation analysis of various body parts with head length are shown in Table 9, SL, SNL, ED, BW shows high correlation (r>0.9) with head length (HL).

Linear regression is used to analyze the relationship between two individual variables. In the present study by using Linear regression method the relationship between the morphometric characters of *M. vittatus* from two different places Visakhapatnam and Srikakulam were studied.

The morphometric characters *M. vittatus*shows that the R^2 value is 0.222. It shows that the model explains 22% of variations between Visakhapatnam and Srikakulam. Durbin- Watson static informs us whether the assumption of independent error is tenable. The value 0.883 is better when it is closed to 1.

The coefficients and Collinearity statistics when linear regression is applied. The two Collinearity statistics are T-test. The standardized coefficient value of Beta is 0.271 and unstandardised coefficient of B and std.error is 0.202 and 0.066. The statistic t-value is 3.058.Hence there is no problem of Collinearity among the variables used in the model and linear regression is appropriate.

The ANOVA tests the acceptability of the model from a statistical perspective. The Regression row displays information about the variation accounted for by the model. The Residual row displays information about the variation that has not been accounted by the model. The regression much is less

Table 2: Morphometric measurements of*Mystusvittatus*from two different placesVisakhapatnam and Srikakulam

Measurements (cm)	Visakhapatnam					Srikakulam				
	Minimum	Maximum	Mean ± SD		TL(%)/ Mean	Minimum	Maximum	Mean ± SD		TL (%) Mean
Total length (TL)	11.09	16.05	13.87	±1.53		9.36	14.53	12.18	±1.74	
Standard length (SL)	8.52	12.33	10.65	±1.17	76.79	7.39	11.48	9.62	±1.37	78.99
Body Weight,gm (BWT)	29.13	42.16	36.43	±4.02	262.67	17.14	26.60	22.30	±3.18	183.08
Body Width (BW)	1.64	2.38	2.05	±0.23	14.80	1.22	1.89	1.58	±0.23	13.00
Body depth (BD)	2.22	3.21	2.77	±0.31	20.00	1.71	2.66	2.23	±0.32	18.30
Head length (HL)	1.76	2.55	2.21	±0.24	15.90	1.53	2.37	1.99	±0.28	16.30
Head length excluding snout (HLExS)	1.30	1.88	1.62	±0.18	11.70	0.98	1.53	1.28	±0.18	10.50
Widh of head (WH)	1.47	2.13	1.84	±0.20	13.30	1.16	1.80	1.51	±0.22	12.40
Snout length (SNL)	0.47	0.67	0.58	±0.06	4.20	0.54	0.84	0.71	±0.10	5.80
Eye diameter (ED)	0.53	0.77	0.67	±0.07	4.80	0.37	0.57	0.47	±0.07	3.90
Caudal peduncale length (CPL)	1.64	2.38	2.05	±0.23	14.80	1.22	1.89	1.58	±0.23	13.00
Anal fin length (AFL)	1.42	2.05	1.78	±0.20	12.80	0.92	1.42	1.19	±0.17	9.80
Pelvic fin length (PVFL)	1.42	2.05	1.78	±0.26	12.80	1.22	1.89	1.58	±0.23	13.00
Pectoral fin length (PFL)	1.47	2.13	1.84	±0.19	13.30	1.10	1.71	1.44	±0.21	11.80
Caudal peduncle height (CPH)	1.12	1.62	1.40	±0.15	10.10	0.67	1.04	0.88	±0.13	7.19
Dorsalfin length (DL)	1.34	1.94	1.68	±0.18	12.10	1.13	1.76	1.47	±0.21	12.10
Caudal fin length (CFL)	1.51	2.18	1.89	±0.21	13.60	1.26	1.96	1.64	±0.23	13.50

Table 3: Meristic counts of the Mystusvittatus captured from Visakhapatnam and Srikakulam

Meristic data	Number			
	Visakhapatnam		Srikakulam	
	Range	Mean	Range	Mean
Dorsal fin rays	I, 6-7	I, 7	I, 5-7	I, 7
Pectoral fin rays	I, 8-10	I,9	I, 8-11	I,9
pelvic fin rays	5-7	5	5-7	5
Anal fin rays	9-13	12	9-14	12
Caudal fin rays	14 -18	17	14-19	17
No. of barbels	4 pairs	4 pairs	4 pairs	4 pairs

than residual sums of squares, which indicates that around 9% of the variation in *Mystusvittatus* at Visakhapatnam and Srikakulam is explained by the model. However, F statistic is found significant, since the p value (0.003) less than 0.05.

In the present study, meristic counts of all samples Table 4 ranged 6-7 fin rays and a single spine of the dorsal fin, 8-11 fin rays and a single spine for pectoral fin, 5-7 fin rays for pelvic fin, 9-14 fin rays for the anal fin, 14-19 fin rays of caudal fin. The mean numbers of above meristic characters are not significantly different. Generally the rayed dorsal fin equal to head in young specimens or less than head in adult specimens and the spine is serrated internally. Pectoral fin not reaching pelvic fin with a spine. Caudal fin forked with upper lobe longer. Barbells are 4 pairs, maxillary pair reaching pelvic fin base, outer mandibular pair extends to middle of pectoral fin, inner mandibular pair extends to pectoral fin base or to gill opening and nasal pair extends to the hind border of orbit.

Mystus Gulio

The morphometric measurements of *Mystusgulio* from two different places Visakhapatnam and Srikakulam were shown in the Table no 4. TL varies between 13.02-18.12cm with a mean value of 15.91±1.60 and 12.04-17.50 with a mean value of 11.77±1.45 from Visakhapatnam and Srikakulam. SL varies between 10.00–13.92cm (12.22±1.23) and 9.51–13.83cm (11.77±1.45) in two different stations. Comparison of the mean of morphometric ratios was shown in the Table 10.

Correlation between the morphometric characters with total length were analyzed and shown in Table 8. Almost all body parts show correlation with total length. SL, HL, DFL, PFL, PVFL, AFL, CFL shows high correlation (r>0.95) with total length. The correlation between head length and other body parts are shown in Table 9. SL, SNL, ED shows high correlation (r>0.95) with head length.

Linear regression is used to analyze the relationship between two individual variables. In the present study by using Linear regression method the relationship between the morphometric characters of *M. gulio* from two different places Visakhapatnam and Srikakulam were studied.

The model summary of *M. gulio* shows that the R^2 value is 0.075. It shows that the model explains 7% of variations between Visakhapatnam and Srikakulam. Durbin- Watson static informs us whether the assumption of independent error is tenable. The closer to 1 the value is the better and for the data it was 0.075.

The coefficients and Collinearity statistics when linear regression is applied. The two Collinearity

Table 4: Morphometric measurements of*Mystusgulio*from two different places Visakhapatnam and Srikakulam

Measurements (cm)	Visakhapatnam					Srikakulam				
	Minimum	Maximum	Mean ± SD		TL(%)/ Mean	Minimum	Maximum	Mean ± SD		TL(%)/ Mean
Total length (TL)	13.02	18.12	15.91	±1.60		12.04	17.50	14.90	±1.83	
Standard length (SL)	10.00	13.92	12.22	±1.23	76.79	9.51	13.83	11.77	±1.45	78.99
Body Weight,gm (BWT)	34.20	47.60	41.79	±4.19	262.67	22.05	32.04	27.28	±3.35	183.09
Body Width (BW)	1.93	2.68	2.35	±0.24	14.80	1.57	2.28	1.94	±0.24	13.00
Body depth (BD)	2.60	3.62	3.18	±0.32	20.00	2.20	3.20	2.73	±0.33	18.30
Head length (HL)	2.07	2.88	2.53	±0.25	15.90	1.96	2.85	2.43	±0.30	16.30
Head length excluding snout (HLExS)	1.52	2.12	1.86	±0.19	11.70	1.26	1.84	1.56	±0.19	10.50
Widh of head (WH)	1.73	2.41	2.12	±0.21	13.30	1.49	2.17	1.85	±0.23	12.40
Snout length (SNL)	0.55	0.76	0.67	±0.07	4.20	0.70	1.02	0.86	±0.11	5.80
Eye diameter (ED)	0.62	0.87	0.76	±0.09	4.80	0.47	0.68	0.58	±0.07	3.90
Caudal peduncale length (CPL)	1.93	2.68	2.35	±0.24	14.80	1.57	2.28	1.94	±0.24	13.00
Anal fin length (AFL)	1.67	2.32	2.04	±0.20	12.80	1.18	1.72	1.46	±0.18	9.80
Pelvic fin length (PVFL)	1.67	2.32	2.14	±0.23	13.45	1.57	2.28	1.94	±0.24	13.00
Pectoral fin length (PFL)	1.73	2.41	2.12	±0.21	13.30	1.42	2.07	1.76	±0.22	11.80
Caudal peduncle height (CPH)	1.32	1.83	1.61	±16	10.10	0.87	1.26	1.07	±0.13	7.19
Dorsalfin length (DFL)	1.58	2.19	1.92	±0.19	12.10	1.46	2.12	1.80	±0.22	12.10
Caudal fin length (CFL)	1.77	2.46	2.16	±0.22	13.60	1.61	2.35	2.00	±0.25	13.40

Table 5: Meristic counts of the Mystusgulio captured from Visakhapatnam and Srikakulam

Meristic data	Number			
	Visakhapatnam		Srikakulam	
	Range	Mean	Range	Mean
Dorsal fin rays	I, 6-7	I,7	I, 6-7	I,7
Pectoral fin rays	I, 8-10	I, 9	I,8-9	I, 9
pelvic fin rays	5-7	6	5-8	6
Anal fin rays	9 - 15	14	11 - 16	15
Caudal fin rays	15 - 18	16	15 -18	16
No. of barbels	4 pairs	4 pairs	4 pairs	4 pairs

Table 6: Morphometric measurements of*Mystuscavasius*from two different places Visakhapatnam and Srikakulam

Measurements (cm)	Visakhapatnam					Srikakulam				
	Minimum	Maximum	Mean ± SD		TL(%) Mean	Minimum	Maximum	Mean ± SD		TL(%) Mean
Total length (TL)	9.50	15.20	12.64	±1.83		10.50	16.40	13.62	±1.92	
Standard length (SL)	7.30	11.67	9.71	±1.41	76.81	8.30	12.96	10.76	±1.52	79.02
Body Weight,gm (BWT)	24.96	39.93	33.21	±4.81	262.73	19.23	30.03	24.94	±3.51	183.14
Body Width (BW)	1.41	2.25	1.87	±0.27	14.80	1.37	2.13	1.77	±0.25	13.00
Body depth (BD)	1.90	3.04	2.53	±0.37	20.00	1.92	3.00	2.49	±0.35	18.30
Head length (HL)	1.51	2.42	2.01	±0.29	15.90	1.71	2.67	2.22	±0.31	16.30
Head length excluding snout (HLExS)	1.11	1.78	1.48	±0.21	11.70	1.10	1.72	1.43	±0.20	10.50
Widh of head (WH)	1.26	2.02	1.68	±0.24	13.30	1.30	2.03	1.69	±0.24	12.40
Snout length (SNL)	0.40	0.64	0.53	±0.08	4.20	0.61	0.95	0.79	±0.11	5.80
Eye diameter (ED)	0.46	0.73	0.61	±0.09	4.80	0.41	0.64	0.53	±0.07	3.90
Caudal peduncale length (CPL)	1.41	2.25	1.87	±0.27	14.80	1.37	2.13	1.77	±0.25	13.00
Anal fin length (AFL)	1.22	1.95	1.56	±0.23	12.34	1.03	1.61	1.34	±0.19	9.80
Pelvic fin length (PVFL)	1.22	1.95	1.62	±0.23	12.80	1.37	2.13	1.67	±0.25	12.27
Pectoral fin length (PFL)	1.26	2.02	1.68	±0.25	13.30	1.24	1.94	1.61	±0.23	11.80
Caudal peduncle height (CPH)	0.96	1.54	1.28	±0.18	10.10	0.75	1.18	0.98	±0.14	7.19
Dorsalfin length (DFL)	1.15	1.84	1.53	±0.22	12.10	1.26	1.97	1.63	±0.23	12.00
Caudal fin length (CFL)	1.29	2.07	1.72	±0.25	13.60	1.41	2.20	1.83	±0.26	13.40

statistics are T-test. The standardized coefficient value of Beta is 0.276 and unstandardised coefficient of B and std-error is 0.061 and 0.019.The statistic t-value is 3.116.Hence there is no problem of Collinearity among the variables used in the model and linear regression is appropriate.

The ANOVA tests the acceptability of the model from a statistical perspective. The Regression row displays information about the variation accounted for by the model. The Residual row displays information about the variation that has not been accounted by the model. The regression much is less than residual sums of squares, which indicates that around 6% of the variation in MystusGulio is explained by the model. However, F statistic is found significant, since the p value (0.002) less than 0.05.

The range and the mean values of meristic counts of *Mystusgulio* from Visakhapatnam and Srikakulam are shown in Table 5. Meristic counts of all samples from two stations are ranged 6-7 (mean, 7) and a single spine of dorsal fin, 8-10 (m, 9) fin rays and a single spine for pectoral fin, 5-8 (m, 6) fin rays for pelvic fin, 9-16 (m, 14) fin rays for anal fin and 15-18 (m, 16) fin rays of caudal fin. Meristic counts from two different stations were compared; mean number of the meristic counts did not show significant variations. 4 pairs of barbels are observed, maxillary pair reaching the middle or end of the pelvic fin. Dorsal spine half as long as head, strong, serrated, pectoral spine strong, serrated as long as head without snout. Caudal fin forked, upper lobe longer.

Mystuscavasius

Maximum, minimum and mean values of morphometric measurements of *Mystuscavasius* are given in Table 6. TL in two different stations Visakhapatnam and Srikakulam varies between 9.50-15.20, 10.50-16.40 with mean values of 12.64±1.83, 13.62±1.92. SL varies between 7.30-11.67 (m 9.71±1.41), 10.50-16.40 (m 13.62±1.92). Mouth terminal, transverse, upper jaw longer.The median groove rather wide, extending to the base of occipital process. Occipital process narrow, 3 or 4 times as

Table 7: Meristic counts of the Mystuscavasius captured from Visakhapatnam and Srikakulam

Meristic data	Number			
	Visakhapatnam		Srikakulam	
	Range	Mean	Range	Mean
Dorsal fin rays	I, 6- 7	I,7	I, 6-7	I,7
Pectoral fin rays	I, 8-9	I,8	I,7-9	I,8
pelvic fin rays	5-7	6	6-8	6
Anal fin rays	10-12	11	9-12	11
Caudal fin rays	15-18	16	15-17	16
No. of barbels	4 pairs	4 pairs	4 pairs	4 pairs

long as wide at its base and reaching basal bone of dorsal fin.

The correlation of various morphometric measurements with total length are shown in Table 8. SL, HL, BW, DFL, PFL, PVFL, AFL, CFL shows high correlation (r>0.94) with total length. Correlation of various body parts with head length is shown in Table 9. SL, ED, SNL, BH, BW shows high correlation (r>0.9) with head length.

By using Linear regression method the relationship between the morphometric characters of *M. cavasius*from two different places Visakhapatnam and Srikakulam were studied.

The model summary of *M.cavasius* shows that the R^2 value is 0.396. It shows that the model explains 39% of variations between Visakhapatnam and Srikakulam. Durbin-Watson static informs us whether the assumption of independent error is tenable. The closer to 1 the value is the better and for the data it was 0.057.

The coefficients and Collinearity statistics when linear regression is applied. The two Collinearity statistics are T-test. The standardized coefficient value of Beta is 0.635 and unstandardised coefficient of B and std.error is 0.027 and 0.017.The statistic t-value is 2.517. Hence there is no problem of Collinearity among the variables used in the model and linear regression is appropriate.

The ANOVA tests the acceptability of the model from a statistical perspective. The Regression row displays information about the variation accounted for by the model. The Residual row displays information about the variation that has not been accounted by the model. The regression much is less than residual sums of squares, which indicates that around 6% of the variation in *Mystuscavasius* is explained by the model. However, F statistic is found significant, since the p value (0.004) less than 0.05.

Meristic counts of all samples from Visakhapatnam and Srikakulam (Table 7) ranged from 6-8 (mean 7) fin rays and a single spine for dorsal fin, 7-9 (m 8) fin rays and a single spine for pectoral fin, 5-8 (m 6) fin rays for pelvic fin , 9-12 (m 11) for anal fin rays, 15-18 (m 16) for caudal fin rays.

Meristic counts from two different places (Visakhapatnam and Srikakulam) were compared, the mean numbers of above meristic counts did not show significant differences. 4 pairs of barbels are observed, maxillary pair reaching beyond base of caudal fin. Dorsal fin with a weak finely serrated

Table 8: Correlation Analysis of various body parts with Total length in three Mystus species from two different places

Parameters	Coefficient of Correlation (r) values					
	Mystusvittatus		Mystusgulio		Mystuscavasius	
	Visakhapatnam	Srikakulam	Visakhapatnam	Srikakulam	Visakhapatnam	Srikakulam
SL	0.9765	0.9658	0.9768	0.9614	0.9721	0.9698
SNL	0.9497	0.9576	0.9452	0.9493	0.9521	0.9612
HL	0.9748	0.9872	0.9736	0.9859	0.9266	0.9595
ED	0.9654	0.9714	0.9597	0.9628	0.9711	0.9599
BW	0.9467	0.9582	0.9641	0.9218	0.9438	0.9507
BH	0.9727	0.9624	0.9708	0.8996	0.9463	0.9731
PFL	0.9687	0.9378	0.9724	0.9969	0.9711	0.9648
PVFL	0.9812	0.9769	0.9819	0.9788	0.9808	0.9795
AFL	0.9813	0.9844	0.9614	0.9782	0.9837	0.9195
DFL	0.9275	0.9138	0.9513	0.908	0.9431	0.9211
CFL	0.9912	0.9834	0.9729	0.9811	0.9799	0.9738
CPL	0.9599	0.8504	0.9604	0.8498	0.9421	0.8821

Table 9: Correlation Analysis of various body parts with head length in three Mystus species from two different places

Parameters	Coefficient of Correlation (r) values					
	Mystusvittatus		Mystusgulio		Mystuscavasius	
	Visakhapatnam	Srikakulam	Visakhapatnam	Srikakulam	Visakhapatnam	Srikakulam
TL	0.9748	0.9872	0.9736	0.9859	0.9266	0.9595
SL	0.9781	0.9737	0.9695	0.9865	0.9466	0.9354
SNL	0.9489	0.9289	0.9253	0.9824	0.9521	0.9359
ED	0.9156	0.9469	0.9043	0.9576	0.9635	0.9522
BW	0.9318	0.9599	0.9638	0.9408	0.9021	0.9282
BH	0.8175	0.9762	0.9623	0.9643	0.9775	0.9488
PFL	0.8511	0.8863	0.8835	0.9111	0.9017	0.8431
PVFL	0.8931	0.8573	0.8723	0.8169	0.8214	0.8181
AFL	0.9539	0.8726	0.9011	0.8627	0.7895	0.7989
DFL	0.8835	0.8664	0.8641	0.7965	0.8127	0.8081
CFL	0.8423	0.8391	0.9004	0.8571	0.8011	0.7916
CPL	0.8327	0.8469	0.8594	0.7821	0.7692	0.8279

Table 10: Comparison of mean of of morphometric ratios among three Mystus species from two different places with the mean of the mean values

% Ratio	Mystusvittatus				Mystusgulio				Mystuscavasius			
	Visakhapatnam	Srikakulam	M.M	±SD	Visakhapatnam	Srikakulam	M.M	±SD	Visakhapatnam	Srikakulam	M.M	±SD
HL/TL	15.93	16.34	16.14	0.29	15.90	16.31	16.11	0.29	15.90	16.30	16.10	0.28
HL/SL	20.75	20.69	20.72	0.05	20.70	20.65	20.67	0.04	20.70	20.63	20.67	0.05
WH/HL	83.26	75.88	79.57	5.22	83.79	76.13	79.96	5.42	83.58	76.13	79.85	5.27
ED/TL	4.83	3.86	4.34	0.69	4.78	3.89	4.33	0.63	4.83	3.89	4.36	0.66
ED/SL	6.29	4.89	5.59	0.99	6.22	4.93	5.57	0.91	6.28	4.93	5.60	0.96
ED/HL	30.32	23.62	26.97	4.74	30.04	23.87	26.95	4.36	30.35	23.87	27.11	4.58
BW/TL	14.78	12.97	13.88	1.28	14.77	13.02	13.90	1.24	14.79	13.00	13.89	1.27
BW/SL	19.25	16.42	17.84	2.00	19.23	16.48	17.86	1.94	19.26	16.45	17.85	1.99
BW/HL	92.76	79.40	86.08	9.45	92.89	79.84	86.36	9.23	93.03	79.73	86.38	9.41
BH/TL	19.97	18.31	19.14	1.18	19.99	18.32	19.15	1.18	20.02	18.28	19.15	1.23
BH/SL	26.01	23.18	24.60	2.00	26.02	23.19	24.61	2.00	26.06	23.14	24.60	2.06
BH/HL	125.34	112.06	118.70	9.39	125.69	112.35	119.02	9.44	125.87	112.16	119.02	9.69
BW/BH	74.01	70.85	72.43	2.23	73.90	71.06	72.48	2.01	73.91	71.08	72.50	2.00
DFL/TL	12.11	12.07	12.09	0.03	12.07	12.08	12.07	0.01	12.10	11.97	12.04	0.10
DFL/SL	15.77	15.28	15.53	0.35	15.71	15.29	15.50	0.30	15.76	15.15	15.45	0.43
DFL/HL	76.02	73.87	74.94	1.52	75.89	74.07	74.98	1.28	76.12	73.42	74.77	1.91
PFL/TL	13.27	11.82	12.54	1.02	13.32	11.81	12.57	1.07	13.29	11.82	12.56	1.04
PFL/SL	17.28	14.97	16.12	1.63	17.35	14.95	16.15	1.69	17.30	14.96	16.13	1.65
PFL/HL	83.26	72.36	77.81	7.70	83.79	72.43	78.11	8.04	83.58	72.52	78.05	7.82
PVFL/TL	12.83	12.97	12.90	0.10	13.45	13.02	13.24	0.30	12.82	12.26	12.54	0.39
PVFL/SL	16.71	16.42	16.57	0.20	17.51	16.48	17.00	0.73	16.68	15.52	16.10	0.82
VFL/HL	80.54	79.40	79.97	0.81	84.58	79.84	82.21	3.36	80.60	75.23	77.91	3.80
AFL/TL	12.83	9.77	11.30	2.17	12.82	9.80	11.31	2.14	12.34	9.84	11.09	1.77
AFL/SL	16.71	12.37	14.54	3.07	16.69	12.40	14.55	3.03	16.07	12.45	14.26	2.55
AFL/HL	80.54	59.80	70.17	14.67	80.63	60.08	70.36	14.53	77.61	60.36	68.99	12.20
CFL/TL	13.63	13.46	13.55	0.11	13.58	13.42	13.50	0.11	13.61	13.44	13.52	0.12
CFL/SL	17.75	17.05	17.40	0.49	17.68	16.99	17.33	0.48	17.71	17.01	17.36	0.50
CFL/HL	85.52	82.41	83.97	2.20	85.38	82.30	83.84	2.17	85.57	82.43	84.00	2.22
CPL/SL	19.25	16.42	17.84	2.00	19.23	16.48	17.86	1.94	19.26	16.45	17.85	1.99

spine, almost equal to head excluding snout. Adipose dorsal fin originates just behind the rayed dorsal fin. Caudal fin forked, pointed, upper lobe longer.

Discussion

The relative marphometric studies conducted in sixteen external characters were analyzed and significant differences were observed and the correlation of body parts with total length and head

length were analyzed. Almost all body parts shows high correlation with total length, eye diameter width of the head, snout length shows high correlation with Head length. The differences in morphometric characters is due to the geographically variations and environmental variations such as food abundance and temperature).

The mean values of the meristic counts studies in three Mystus species shows constant values but shows small differences among individuals this probably indicated identity in their parental stock.

We revealed significant differences in morphometrics between two populations of *Mystus* species populations from Srikakulam and Visakhapatnam. There is a clear morphological distinction between certain characters in both populations. It is often difficult to explain the causes of morphological differences between populations (Cadrin 2000). These differences may be genetically related differences (or) they might be associated with phenotypic plasticity in response to different environmental factors in each area (Murta 2000). Thus morphological variation can reflect genetic differences between stock and/or environmental differences between localities.

Morphometric comparisons of African catfish, *Clariasgariepinus* in different river systems in Turkey revealed a significant divergence (Turan et al., 2005). Similarly, both morphological and genetic methods have been used to characterize different populations of *Clariasgariepinus* and *Clariasanguillaris* (Agnese et al., 1997). Thus the possibility exists that the observed morphological variations in the present study might be because of genetic differences among the populations. Correlations between genetic variations and morphological variations has been confirmed in natural populations (Poulet et al., 2004) and both have been widely used to make assessments of population differentiation (Buth& Crabtree 1982; Agnese et al., 1997; Ibanez et al., 2006).

Genetic differentiations were observed among different populations of yellow catfish *Mystusnemurus* from Thailand (Leesa-Nga et al., 2000). Significant genetic diversity was observed among two different populations of Korean catfish, *Silurusasatus* (Yoon & Kim 2001). In Malaysian river catfish, (*Mystusnemurus*) genetic variations were observed among different rivers and tributaries of Malaysia (Chong et al., 2000). In the present study, the genetic basis of morphometric differences is not studied but the application of molecular markers would be a very useful method (Agnese et al., 1997; Delling et al., 2000; poulet et al., 2004) for confirming the observed phenotypic differences among different geographical regions and for facilitating the development management strategies. The information on morphometric measurements of fishes and statistical relationship between them are essential for taxonomic work (Narejo, 2008). To know the origin of stock; separation of stock or identification of fish species morphometric characters are frequently used (Lashari et al., 2004; Narejo et al., 2008).

The results of the present study Table 8, 9 shown that high co-efficient of correlation (r) values in all most all cases. From the co-efficient of correlation values it is evident that dorsal fin length, pectoral fin length, pelvic fin length, caudal fin length, standard length and head length are highly correlated with the total length (TL). Eye diameter, snout length, width of head is highly correlated with the head length (HL). The above relationship indicated that the body measurements are linear. The similar linear relationship was also obtained by Ganguly et al., (1959) in *Latescalcarifer*, Mehta and Bapat (1977) in *Ophiocephalusgachua*, Hoque and Rahman (1985) in *Gudusiachapra,* and Lashari et al., (2004) in *Cirrhinusreba.*

Morphometric differences among stocks are expected because they are geographically separated and may have originated from different ancestors. In the present study Meghadrigedda and the river Nagavali are two different habitats with wide environmental variations. Fishes are very sensitive to environmental changes and quickly adapt themselves by changing necessary morphometrics. Morphological characters can show high plasticity in response to differences in environmental conditions, such as food abundance and temperature (Allendorf and Phelps 1988; Swain et al., 1991; Wimberger 1992).

The phenotypic plasticity of fish is very high. Then adapt quickly by modifying their physiology and behavior to environmental changes. These modifications ultimately change their morphology (Stearns 1983).

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