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Research Article

Stocks delineation of bull's eye fish (*Priacanthus hamrur)* in Indian water using morphometric measurements and meristic counts

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ABSTRACT
The Moontail bull's eye (*Priacanthus hamrur)* is one of the commonly available fish species found in the deep sea and under ledges or hovering next to coral heads during the day. In the present study, around 300 specimens were collected from different location in east and west coast of India including Kakinada, Kolkata, Cochin and Mumbai to investigate the stock differentiation among the populations. A total of 14 morphometric traits and 10 meristic counts were studied. The descriptive statistics of morphometric traits indicated the much larger growth in populations of west coast compares to the east coast. The meristic traits were not much efficient in identifying the stocks. Pre pelvic fin length, post anal fin length, post dorsal length, pre dorsal fin length, head length, eye diameter, body depth, caudal peduncle depth and dorsal fin base helped in the separation of stocks. All the four stocks have separate morphometric features. The present study will provide the baseline information on the stock characteristics of *P. hamrur* from Indian water and management measures of the resources for sustainable utilization.
Keywords: *Stock, Morphometric, Meristic and Resource.*

INTRODUCTION

Priacanthus hamrur is one of the most important emerging species among the commercial catches of Indian coast, but there is lack of information on its population structure, biology and population dynamics. Stock identification is the basic requirement of studying the different population parameter of the species. Stock identification of species is essential for fishery management because most applied population models assume that the group of individuals has homogeneous vital rates (e.g., growth, maturity, mortality). Stock deleneation is a central theme in fisheries science that involves the recognition of self-sustaining components within natural populations (Crandall *et al.*, 2000; Thorpe *et al.*, 1996). Patterns of morphometric variation in fishes may indicate differences in growth and maturation rates because body form is a product of ontogeny. The present study has been made to identify stocks of *Priacanthus hamrur* using meristics and traditional morphology which give a good insight into the stock relationships of this species. Better management practices can be attempted based on findings of the present study.

MATERIALS AND METHODS

During the study, samples of *P. hamrur* was collected from landing centres of Versova (Maharashtra) & Cochin (Kerala) on the west coast and Kakinada (Andhra Pradesh) & Digha (West Bebengal) during October 2017 to January 2018 (Table 1 and Figure 1). *P. hamrur* was identified by following the description given by FAO species identification sheets (Russell, 1990). A total of 279 fish samples of *P. hamrur* were collected during the present study were studied for stock identification. The collected specimens were placed in the insulated fish boxes lined ice and taken to the laboratory for further study. The Samples were cleaned thoroughly in running water to remove the slime or dirt and kept in a freezer at -20^0C. The frozen samples were thawed adequately for before studies.

A total of eleven meristic characters were taken into account for the present study (Table 2). The meristic characters counted following the widely accepted method provided by Hubbs and Lagler (1958). The operculum of the left side of fish removed by cutting the gill cover and first gill arch was removed to count the gill rakers on upper and lower gill arch. All counts and measurements are taken from the left lateral aspect of the fish. 14 morphometric measurements have been taken for a total of 279 specimens (Table 3 and figure 2).Google Earth used for marking fish landing center location. Data entry, editing, transformation and other

statistical analysis was done in MS-Excel 2010, IBM SPSS and Statistica (Ver 12.).

Table 1: Details of sampling

Coast	East Coast		West coast	
Stock	Andhra Pradesh	West Bengal	Maharas htra	Kerala
Landing Centre	Kakinada	Digha	Versova	Cochin
Location	16.57^{O}N 82.15^{O}E	21^{O} 41 N 87^{O} 33 E	19.12^{O} N 72.82 ^{O} E	9.97^{O}N 76.28^{O}E
Date of sampling	20 Oct. 2017	10 Dec. 2017	13 Jan. 2017	25 Dec. 2017
Sample sizes (n)	88	64	63	64
Total	279			

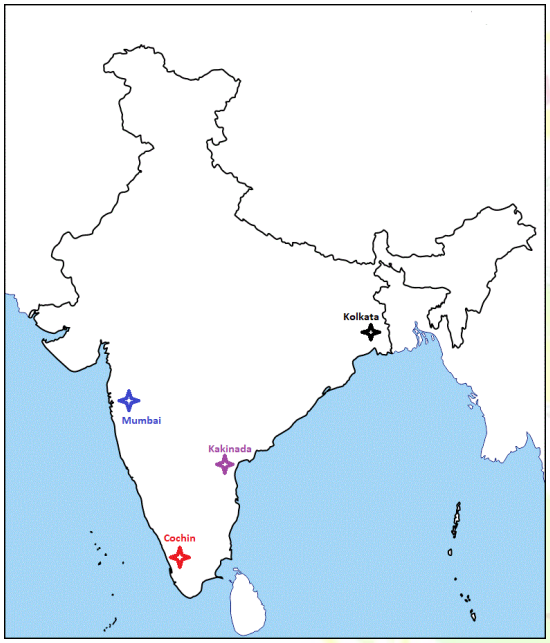

Figure 1: Location selected for sampling of Bull's eye, *Priacanthus hamrur*

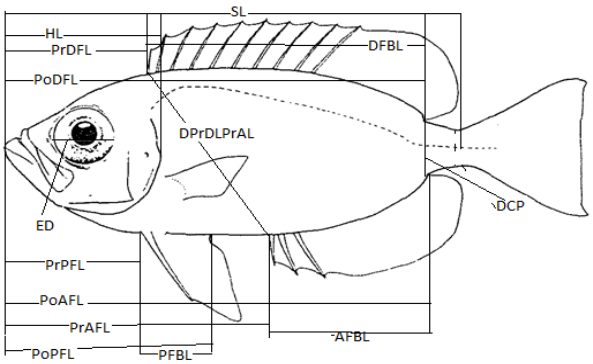

Figure 2: Diagrammatic representation of morphometric measurements of the body of *P. hamrur*

Table 2: Meristic traits of *P. hamrur*

S. No.	Meristic traits	Acronyms
1	Number of the dorsal fin spines	DFS
2	Number of the dorsal fin soft rays	DFR
3	Number of the pectoral fin rays	PFR
4	Number of the pelvic fin spines	PEFS
5	Number of the pelvic fin rays	PEFR
6	Number of the anal fin spines	AFS
7	Number of anal rays	AFR
8	Number of caudal fin rays	CFR
9	Number of total gillrakers on the first gill arch	GR
10	Number of branchiostegal rays	BGR
11	Number of scales on the lateral line	SAL

Table 3: Morphometric traits of the body of *P. hamrur*

Sl. No	Morphometric traits	Acronyms	Description
1	Standard length	SL	Distance between the tip of the snout and the base of the caudal fin rays
2	Head length	HL	Distance from the tip of the snout to the posterior margin of the operculum
3	Eye diameter	ED	Diameter of the eye along the body axis
4	Pre dorsal length	PrDL	Distance from the tip of the snout to the origin of the dorsal fin
5	Post dorsal length	PoDL	Distance from the tip of the snout to the end of the dorsal fin
6	Dorsal fin base length	DFBL	Distance between the origin and end of the dorsal fin
7	Pre pelvic fin length	PrPL	Distance from the tip of the snout to origin of the pelvic fin
8	Post pelvic fin length	PoPL	Distance from the tip of the snout to end of the pelvic fin
9	Pelvic fin base length	PFBL	Distance between the origin and end of the pelvic fin
10	Pre anal fin length	PrAL	Distance from the tip of the snout to origin of the anal fin
11	Post anal fin length	PoAL	Distance from the tip of the snout to end of the anal fin
12	Anal fin base length	AFBL	Distance between the origin and end of the dorsal fin
13	Depth of insertion of anal and dorsal fin	DPC	Distance between insertion of the dorsal fin and the insertion of the anal fin.
14	Distance between dorsal fin origin and anal fin origin	DPrDL PrAL	Distance between dorsal fin origin and anal fin origin

RESULTS AND DISCUSSION

Meristic Counts

The descriptive statistics of the meristic traits *viz.* minimum, maximum, mode and range is presented in table 4. In the present study ten meristic traits were considered, to characterize the stock of *Priacanthus hamrur*. Out of ten meristic traits four traits, such as dorsal fin spines, pelvic fin spines, anal fin spines and branchiostegal rays showed no variation. The range value was higher for the number of pectoral fin rays, dorsal fin rays, gillrakers and the lateral line scale. The total gillrakers count on the on the first gill arch, has minimum and maximum values of 20 and 25, respectively, in all the stocks. The number of dorsal and pectoral fin rays also shows a little variation in range values with fish stocks. The Kolkata and Mumbai stocks possess less number of scales on the lateral line when compare to the Kakinada and Cochin stocks. The mode value of all the meristic traits except the dorsal fin spines, anal fin spines, pelvic fin spines and the branchiostegal rays varied between the four stocks (Table 5). The mode values clearly indicate the variation of different meristic traits between the four stocks of *P. hamrur* along the Indian coast. The minimum and maximum values of the meristic traits did not show much variation between sexes, however the range of dorsal fin rays, anal fin rays and branchiostegal rays showed variation (Table 5)

Morphometric characters

Descriptive statistics viz. minimum, maximum, mean, standard deviation and coefficient of variance estimated for morphometric traits of *P. hamrur* are presented in table 5. The standard length of fish, ranged from 11.91 to 27.54 cm for all the stocks. The standard length ranged from 11.91 to 27.54 cm for the males and 12.01 to 26.95 cm for females. The standard length of the collected samples ranged from 11.91 to 27.54 cm with value coefficient of variance as 22.43% (Table 6).The mean standard length observes was 19.56 cm. The head length of the sample ranged from 3.01 to 9.58 cm with a coefficient of variance of 22.94% (Table 5).

Table 4: Overall descriptive statistics of meristic traits

TRAITS	MIN	MAX	RANGE	MODE	CV (%)
Dorsal fin spines	10	10	0	10	0.00
Dorsal fin rays	12	15	3	14	3.95
Pelvic fin spines	1	1	0	1	0.00
Pelvic fin rays	4	5	1	5	10.65
Anal fin spines	3	3	0	3	0.00
Anal fin rays	11	15	4	14	5.29
Pectoral fin rays	14	18	4	17	3.14
Gill rakers on the lower limb	20	25	5	24	3.49
Scales on the lateral line	100	110	10	110	2.26
Branchiostegal rays	8	8	0	8	0.00

Table 5: Overall descriptive statistics of morphometric traits of the body of *P. hamrur*

TRAITS	Mean	MIN	MAX	SD	CV (%)
SL	19.56	11.91	27.54	4.39	22.43
PrPL	6.11	3.88	8.80	1.38	22.61
PoPL	8.89	5.00	13.19	2.14	24.13
PrAL	11.03	6.01	15.71	2.52	22.82
PoAL	16.74	1.06	23.60	4.07	24.34
PoDL	16.80	10.01	23.50	3.84	22.87
PrDL	6.28	3.90	10.25	1.46	23.18
HL	5.97	3.01	9.58	1.37	22.94
ED	2.46	1.03	3.92	0.58	23.67
DPrDLPrAL	7.58	4.03	10.96	1.81	23.84
DCP	1.92	1.00	3.06	0.54	28.25
DFBL	10.93	6.04	15.63	2.59	23.74
PFBL	2.95	1.00	5.03	0.91	30.90
AFBL	6.44	2.97	9.42	1.57	24.41

Table 7: Comparison of morphometric characters of *P. hamrur*

Characters (cm)	Philip (1994)	Saker (2009)	Vidya (2010)	Present Study (2018)
Standard length	10.2-29.5	10.7 – 27.4	10 – 24.4	11.91-27.54
Head length	2.79-3.37	-	-	3.01-9.58
Eye diameter	1.13-1.6	-	-	1.03-3.92
Anal fin length	4.7-5.9	-	-	2.97-9.42
Pelvic fin length	2.6-3.22	-	-	1.00-5.03

Table 8: Comparison of fin formula of *P. hamrur*

Authors name	Fin formula
Koteswaramma (1982)	D, X+14; A, III+14; P, 18; V, I+5
Starnes (1988)	D, X +13-15; A, III+13-16; P, 17-20, GR, 24-26
Philip (1994)	D, X+13-15; A, III+14-15; P, 18-19, GR, 24-26
Present study (2018)	D, X+12-15; A, III+11-15; P, 14-18; V, I+4-5; GR, 20-25

The eye diameter varied from 1.03 cm to 3.92 cm with a coefficient of variance of 23.67%. The maximum eye diameter was observed in Mumbai stock and minimum in Kakinada stock (Table 6). The caudal peduncle depth of the collected sample varied from 1.00 to 3.06 cm (Table 5). In the present study, the head length was found to be smaller in Kakinada stock (Table 6).

Meristic traits:

Meristic characters are the numbers of discrete, and serially repeated countable characters. Koteswaramma (1982) has recorded number of meristic characters dorsal fin spine (10), dorsal fin ray (12-15), anal fin spine (3), anal fin ray (11-15), pelvic fin spine (1),

Table 6: Stock wise descriptive statistics of morphometric traits of the body of *P. hamrur*

TRAITS	EAST COAST							WEST COAST												
	KAKINADA					KOLKATA		COCHIN								MUMBAI				
	Mean	MIN	MAX	SD	CV (%)	Mean	MIN	MAX	SD	CV (%)	Mean	MIN	MAX	SD	CV (%)	Mean	MIN	MAX	SD	CV (%)
SL	13.87	11.91	17.47	1.14	8.25	23.97	19.03	27.54	1.64	6.85	20.84	19.02	23.34	0.90	4.31	22.14	15.05	25.00	1.95	8.81
PrPL	4.43	3.88	5.71	0.42	9.57	7.67	6.06	8.80	0.59	7.67	6.38	5.05	7.18	0.43	6.74	6.73	4.08	8.02	0.74	10.94
PoPL	6.25	5.00	7.92	0.73	11.71	11.27	9.05	13.19	0.94	8.38	9.51	8.03	10.98	0.65	6.79	9.70	6.07	11.86	1.09	11.20
PrAL	7.81	6.01	9.64	0.66	8.40	13.74	11.04	15.71	1.02	7.40	11.86	10.01	13.56	0.68	5.71	12.17	8.00	13.98	1.09	8.96
PoAL	11.86	10.00	15.02	1.06	8.95	20.73	16.07	23.60	1.40	6.77	17.52	1.06	20.08	3.23	18.43	19.04	13.07	21.65	1.66	8.73
PoDL	11.82	10.01	15.06	1.06	8.93	20.71	16.02	23.50	1.44	6.97	18.02	16.00	20.07	0.80	4.46	18.90	13.01	21.54	1.67	8.85
PrDL	4.58	3.90	6.27	0.52	11.47	7.96	6.08	10.25	0.82	10.30	6.50	6.00	7.57	0.44	6.84	6.83	4.09	8.16	0.75	10.96
HL	4.39	3.01	5.37	0.45	10.22	7.73	6.05	9.58	0.62	8.07	6.11	5.01	7.07	0.41	6.70	6.36	4.01	7.52	0.67	10.52
ED	1.96	1.03	2.67	0.26	13.31	3.22	2.04	3.92	0.30	9.26	2.34	2.00	2.91	0.32	13.50	2.53	1.03	3.30	0.48	19.02
DPrDLPrAL	5.24	4.03	6.67	0.54	10.27	9.15	7.01	10.96	0.76	8.27	8.24	7.06	9.42	0.45	5.44	8.76	6.03	10.76	0.88	10.09
DCP	1.26	1.00	1.92	0.25	19.77	2.30	1.08	3.06	0.36	15.58	2.19	2.01	2.55	0.17	7.88	2.24	1.08	2.92	0.31	13.88
DFBL	7.54	6.04	9.67	0.71	9.48	13.25	10.01	15.63	1.05	7.94	11.86	11.00	13.28	0.58	4.90	12.60	8.07	14.32	1.20	9.54
PFBL	2.05	1.00	3.27	0.59	28.52	3.72	3.00	5.03	0.64	17.10	3.20	2.01	4.48	0.58	18.18	3.21	2.03	4.82	0.72	22.43
AFBL	4.42	2.97	5.91	0.58	13.22	7.70	6.03	9.24	0.70	9.04	7.05	6.00	7.77	0.44	6.19	7.50	5.07	9.42	0.80	10.72

Pelvic fin ray (4-5), pectoral fin ray (14-18), lateral line scale (100-110), Total number of gillrakers (20-25) and branchiostegal rays (8) for *P. hamrur*. Whereas Starnes (1988) reported some variations i.e. dorsal fin spines (10), dorsal fin rays (13-14), anal fin spines (3), anal fin rays (14-15), pectoral fin rays (17-20), Lateral-line scales (70-90) and total gillrakers (22-26). The overall mode value of meristic traits found in the present study is almost similar to the above reports. In the present study, variations in meristic characters were less compared to morphometric characters. The variations between stocks were attributed to the gillrakers and scales on the lateral line. The variations in gillrakers of fishes and scale count due to isolation caused by differences in salinity gradients were also reported (Ikusemiju, 1975; Omoniyi and Agbon, 2007).

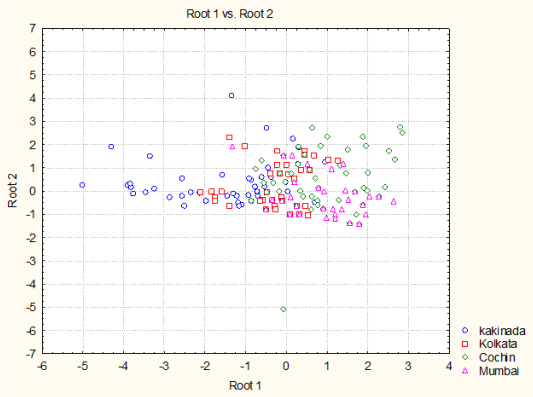

Figure 3: Scatter plot of four stocks based on different meristic counts

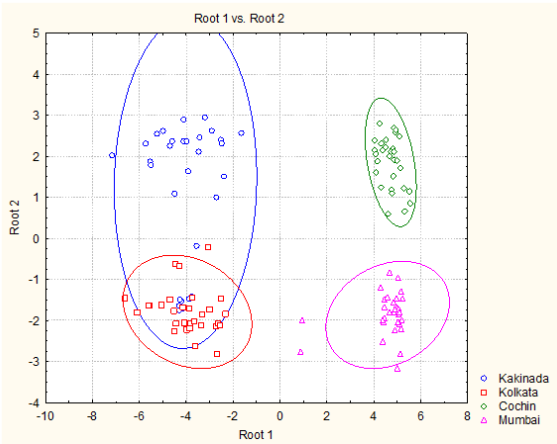

Figure 4: Scatter plot of four stocks based on morphometric variables

Morphometric traits:

Ecological and evolutionary process is the main reason for change in morphological structures of fishes. Polymorphism includes variation in behavior, change in morphology or life history traits in populations and is most commonly seen in vertebrate populations (Robinson and Wilson, 1994; Wimberger, 1994, Smith and Skulason, 1996). Environmental changes are susceptible to different morphometric traits of fish thus exhibit high plasticity of phenotypic characters in overall body shape where phenotypic plasticity is the ability of a genotype to respond to an alternative environmental condition producing an array of phenotypes (Thompson, 1991). The relationships between standard length and rest variables were analysed by using linear regression analysis. The minimum and maximum standard lengths observed in the present study were 11.91 cm and 27.54, respectively. These values are lower than those reported by Saker (2009). The minimum and maximum standard lengths observed by Saker (2009) were 10.7 cm and 27.4 cm, respectively. The average standard length of the fish collected from Kolkata was 23.97 cm which is comparatively higher than other stocks, whereas, the average standard length of the fish collected from Kakinada was 13.87 cm and it was the least among all the stocks. There is no significant difference ($P<0.05$) in average standard length between Cochin and Mumbai stocks.

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