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## Bull's eye fish (*Priacanthus hamrur*) stock delineation in Indian water using meristic counts and morphometric data

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Research Article

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### ABSTRACT

During the day, the Moontail bull's eye (*Priacanthus hamrur*) is a fish species that is often seen in the deep water, behind ledges, or hovering around coral heads. About 300 specimens were gathered for the current research from various locations on India's east and west coasts, such as Kakinada, Kolkata, Cochin, and Mumbai, in order to look at population stock differentiation. Ten meristic counts and fourteen morphometric features were examined. The descriptive statistics of morphometric features showed that the west coast's population increase was much greater than that of the east coast. When it came to identifying the stocks, the meristic characteristics were not very effective. Stock separation was aided by pre-pelvic fin length, post-anal fin length, post-dorsal fin length, pre-dorsal fin length, head length, eye diameter, body depth, caudal peduncle depth, and dorsal fin base. Each of the four stocks has unique morphometric characteristics. The current research will provide baseline data on *P. hamrur* stock features from Indian water and resource management strategies for sustainable use.

**Keywords:** *Stock, resource, morphometric, and meristic.*

### INTRODUCTION

Although *Priacanthus hamrur* is one of the most significant new species among the commercial catches of the Indian coast, little is known about its biology, population dynamics, and population structure. The fundamental prerequisite for researching the various population parameters of the species is stock identification. Since most applied population models assume that the group of individuals has homogenous vital rates (e.g., growth, maturity, mortality), stock identification of species is crucial for fisheries management. A key concept in fisheries research is stock deleneation, which is the identification of self-sustaining elements in natural populations (Crandall et al., 2000; Thorpe et al., 1996). Because body shape is a result of ontogeny, patterns of morphometric variation in fish may reveal variations in growth and maturation rates. The goal of the current research is to identify *Priacanthus hamrur* stocks using conventional morphology and meristics, which provide valuable information about the species' stock connections. The results of this research may be used to try better management techniques.

### MATERIALS AND METHODS

From October 2017 to January 2018, samples of *P. hamrur* were gathered from landing centers in Versova, Maharashtra, and Cochin, Kerala, on the west coast, as well as Kakinada, Andhra Pradesh, and Digha, West Bengal (Table 1 and Figure 1). The FAO species identification sheets' descriptions were used to identify *P. hamrur* (Russell, 1990). During the current investigation, 279 fish samples of *P. hamrur* were gathered and examined for stock identification. The gathered specimens were transported to the lab for further analysis after being stored in insulated fish boxes packed with ice. The samples were stored in a freezer at -200C after being properly cleansed under running water to get rid of any debris or slime. Prior to the investigations, the frozen materials were sufficiently thawed. For the current investigation, eleven meristic traits in all were considered (Table 2). The meristic characteristics were tallied using Hubbs and Lagler's (1958) generally recognized approach. To count the gill rakers on the upper and lower gill arches, the fish's left operculum was removed by cutting off the gill cover and first gill arch. The fish's left lateral aspect is used for all counts and measurements. A total of 279 specimens have undergone 14 morphometric measurements (Table 3 and picture 2). The location of the fish landing facility is marked using Google Earth. Data input, modification, conversion, and more

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            | Maharashtra           | Kerala            |
| Landing Centre   | Kakinada           | Digha                  | Versova               | Cochin            |
| Location         | 16.57°N<br>82.15°E | 21° 41' N<br>87° 33' E | 19.12° N<br>72.82 ° E | 9.97°N<br>76.28°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                |                        |                       |                   |

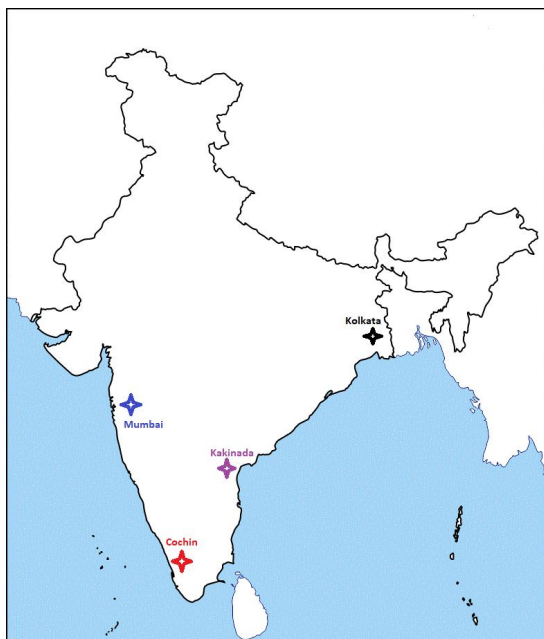


**Figure 1: Location selected for sampling of Bull's eye, *Priacanthus hamrur***

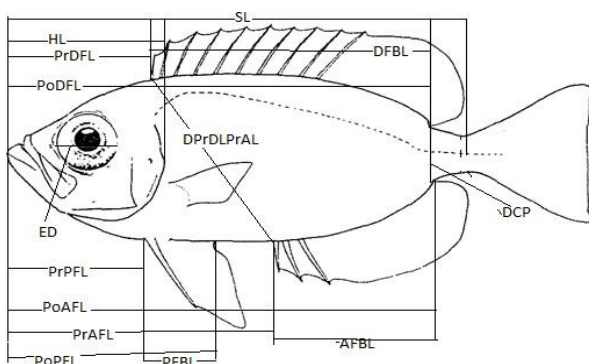


**Figure 2: Diagrammatic representation of morphometric measurements of the body of *P. hamrur***

**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 anal 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 Table 4 displays the descriptive statistics of the meristic features, including minimum, maximum, median, and range. Ten meristic characteristics were taken into account in the current investigation to describe the *Priacanthus hamrur* stock. Four of the 10 meristic traits—dorsal fin spines, pelvic fin spines, anal fin spines, and branchiostegal rays—showed no variation. Gillrakers, pectoral fin rays, dorsal fin rays, and the lateral line scale all had larger range values. In every stock, the total gillrakers count on the first gill arch has minimum and maximum values of 20 and 25, respectively. Fish populations also exhibit some variation in the range values of the number of dorsal and pectoral fin rays. Compared to the Kakinada and Cochin stocks, the Kolkata and Mumbai stocks have fewer scales on the lateral line. With the exception of the dorsal fin spines, anal fin spines, pelvic fin spines, and branchiostegal rays, the mode value of every meristic characteristic differed across the four stocks (Table 5). The median values make it evident how the four *P. hamrur* stocks around the Indian coast vary in a number of meristic characteristics. The range of dorsal fin rays, anal fin rays, and branchiostegal rays varied between the sexes, but the minimum and maximum values of the meristic features did not (Table 5). Morphometric characteristics Table 5 presents descriptive data for *P. hamrur* morphometric features, including minimum, maximum, mean, standard deviation, and coefficient of variation. For every stock, the average fish length varied from 11.91 to 27.54 cm. For boys and females, the standard length varied from 11.91 to 27.54 cm and 12.01 to 26.95 cm, respectively. The gathered samples had a standard length of 11.91 to 27.54 cm and a coefficient of variation of 22.43% (Table 6). The average standard length measured was 19.56 cm. With a coefficient of variation of 22.94%, the sample's head length varied from 3.01 to 9.58 cm (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 |

With a coefficient of variation of 23.67%, the eye diameter ranged from 1.03 cm to 3.92 cm. Mumbai stock had the largest eye diameter, whereas Kakinada stock had the smallest (Table 6). The obtained sample's caudal peduncle depth ranged from 1.00 to 3.06 cm (Table 5). According to the current investigation, Kakinada stock had shorter heads (Table 6). Meristic characteristics: Discrete, serially repeated countable characters make up meristic characters. Dorsal fin spine (10), dorsal fin ray (12–15), anal fin spine (3), anal fin ray (11–15), and pelvic fin spine (1) are among the meristic characteristics noted by Koteswaramma (1982).

**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  |

*P. hamrur*'s branchiostegal rays (8), total number of gillrakers (20–25), lateral line scale (100–110), pectoral fin ray (14–18), and pelvic fin ray (4–5). 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) are among the differences noted by Starnes (1988). The current study's overall meristic trait mode value is almost identical to the results mentioned above. Meristic character ariances were lower in the current investigation than morphometric character variations. The gillrakers and scales on the lateral line re blamed for the differences between stocks. There have also been reports of fluctuations in fish gillrakers and scale counts as a result of isolation brought on by variations in salinity gradients (Ikusemiju, 1975; Omoniyi and Agbon, 2007).

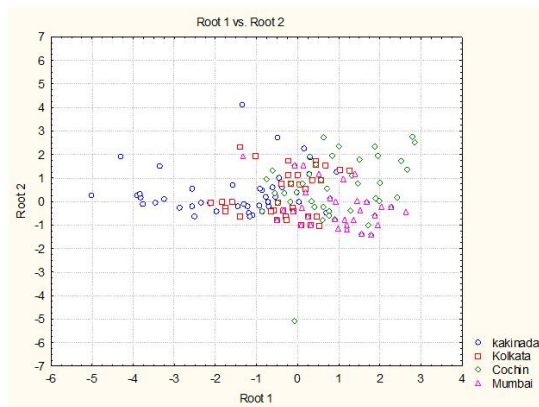


**Figure 3: Scatter plot of four stocks based on different meristic counts**

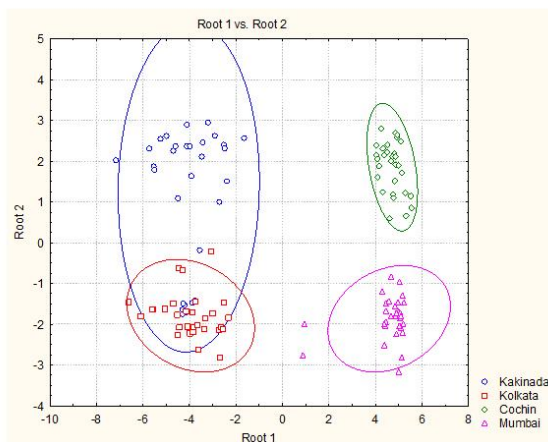


**Figure 4: Scatter plot of four stocks based on morphometric variables**

### Morphometric traits:

Fish morphological changes are primarily caused by ecological and evolutionary processes. Most often seen in vertebrate populations, polymorphism include behavioral variation, morphological changes, or life history features (Robinson and Wilson, 1994; Wimberger, 1994, Smith and Skulason, 1996). Fish exhibit high phenotypic character plasticity in overall body shape due to environmental changes that are susceptible to various morphometric traits. Phenotypic plasticity is the capacity of a genotype to react to a different environmental condition, resulting in a variety of phenotypes (Thompson, 1991). Linear regression analysis was used to examine the connections between rest and standard length factors. The current investigation found that the minimum and maximum standard lengths were 11.91 cm and 27.54 cm, respectively. These figures are less than what Saker (2009) reported. Saker (2009) found that the minimum and maximum standard lengths were 10.7 cm and 27.4 cm, respectively. In comparison to other stocks, the average standard length of fish obtained from Kolkata was 23.97 cm, while the average standard length of fish gathered from Kakinada was 13.87 cm, the lowest of all the stocks. The average standard length of Cochin and Mumbai stocks does not vary significantly ( $P < 0.05$ ).

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