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BIOMETRIC ANALYSES TO IDENTIFY POPULATIONS OF *ILISHA MELASTOMA* (SCHNEIDER, 1801) FROM COASTAL WATERS OF SOUTH INDIA*

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ABSTRACT

The present investigation deals with the analyses of deliminating populations of Indian shad *Ilisha melastoma* based on morphometric characters. A total number of 828 specimens obtained during 1982 to 1983 from commercial catches from Madras, Porto Novo, Point Calimere, Mandapam, Tuticorin, Cape Comorin, Vizhinjam, Calicut, Mangalore and Karwar, were considered for this analysis employing 17 body measurements. The allometric equations were tested and the fitness was analysed by plotting a sample (male and female separately) and by calculating the correlation coefficient for all combinations of characters. Besides, 95% confidence zones were calculated taking the standard length as an independent variable and other characters as dependent variables. Though there were no significant differences between sexes at 95% confidence zones, statistical calculations of regression coefficients of all combinations of characters from nine stations showed significance at 5% level in certain combinations which were eliminated from further intersample analyses. Based on the sum of the statistical differences between 17 parameters (in combinations) the samples were judged by the method of rejective limits of 25% probability level. These results suggest that although *I. melastoma* is found distributed all along the east and west coasts of S. India, it tends to form localized stocks.

INTRODUCTION

STUDIES on the temporal and spatial distribution of marine fishes are considered to be indispensable for better exploitation. Biometric analysis of fish helps to identify populations and to indicate whether a population is homogenous or heterogenous.

Several workers have attempted to identify populations on stocks of various species of tropical seas for successful management. Devanesan and Chidambaram (1943) observed differences in *Sardinella longiceps* collected from the eastern parts of Arabian Sea. Devanesan (1943) made an observation in head length of oil sardines from Malabar and Bombay-Karachi regions. Pillay and Ghosh (1962) also made comparative study of the populations of *Hilsa ilisha*. Dutt (1962, 1972) made significant contributions to population and racial investigations on Indian fishes. Dwivedi (1964) reviewed the methods for identification of populations of pelagic fishes. He (1969) also recorded the occurrence of races in *S. insularis* from the west coast of India. Radhakrishnan (1964) attempted racial studies on long finned herring *Opisthopterus tardoore* along the Kanara Coast. Rao (1967 a) differentiated stocks of *Anchoviella* (*Stolephorus*) *commersonii* obtained from Waltair and Godavari Estuary on the basis of meristic characters and body measurements. He (1967 b) also distinguished two 'groups' of *Stolephorus insularis* at Waltair. Rao and

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Joglekar (1968) separated populations of *Setipinna godavariensis* on the basis of morphometric measurements, meristic characters and length-weight and fecundity relationships. Prabhu and Dhulkhed (1972) observed three varieties of oilsardine from the catches of Mangalore. Dutt and Seshagiri Rao (1981) identified different populations among *Escualosa thoracata* collected from Bombay and Waltair Coasts. Seshagiri Rao (1981) compared the populations of *Ilisha kampeni* of Bombay and Kakinada Coasts. Rao and Rao (1983) attempted a biometric comparison of *Nemipterus japonicus* populations along the east coast of India.

A number of statistical methods employed in the investigations of fish populations were reviewed by many workers (Marr, 1955; Royce, 1964; Sokal, 1965).

Efforts have been made to identify different stocks of clupeid fishes in Indian waters, based on biometric characters. The present investigation was made to determine whether the stocks of Indian shad *Ilisha melastoma* found along the east and west coasts of India belong to a single homogenous population, or to a number of indipendent and distinct stocks. In the absence of tagging experiments, which give positive evidence for the existence of populations, the morphometric characters were employed presently to assess populations of *Ilisha melastoma*.

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Materials and Methods

Specimens of *Ilisha melastoma* were collected during 1982-'83 from commercial catches at different localities along the east and west coasts of India *viz.* Madras (1), Porto Novo (2), Point Calimere (3), Mandapam (4), Tuticorin (5), and Cape Comorin (6) on east coast, Vizhinjam (7), Calicut (8), Mangalore (9) and Karwar (10) on west coast (Fig. 1). The data on morphometric measurements were recorded from these specimens preserved in 10% neutral formalin.

The following body measurements were considered for the present study :

SL	:	standard length
SNL	:	snout length
EYD	:	eye diameter
DEY	:	interorbital width
POL	:	postorbital length
LJL	:	lower jaw length
HL	:	head length
PPD	:	prepectoral distance
PDD	:	predorsal distance
PVD	:	prepelvic distance
PAD	:	preanal distance
DFB	:	dorsal fin base
AFB	:	anal fin base
FL	:	fork length
BD	:	body depth
PVI	:	pectoral-pelvic interspace
PAI	:	pelvic-anal interspace

The statistical analysis were performed using FORTRAN programme. However males and females were combined together as no significant difference was evident after preliminary examinations.

1. Each value was transformed into common logarithms, and allometry equations of log $y = a + b \log x$ were calculated by the method of least squares. Confidence intervals of 5% level of correlation coefficients (r) and regression-coefficients (b) were computed :

$$b - t\,(0.05)\,sb \leq \beta \leq b + t\,(0.05)\,sb$$

where 'b' is regression coefficient, t (0.05) the probability at the 5% significance level,

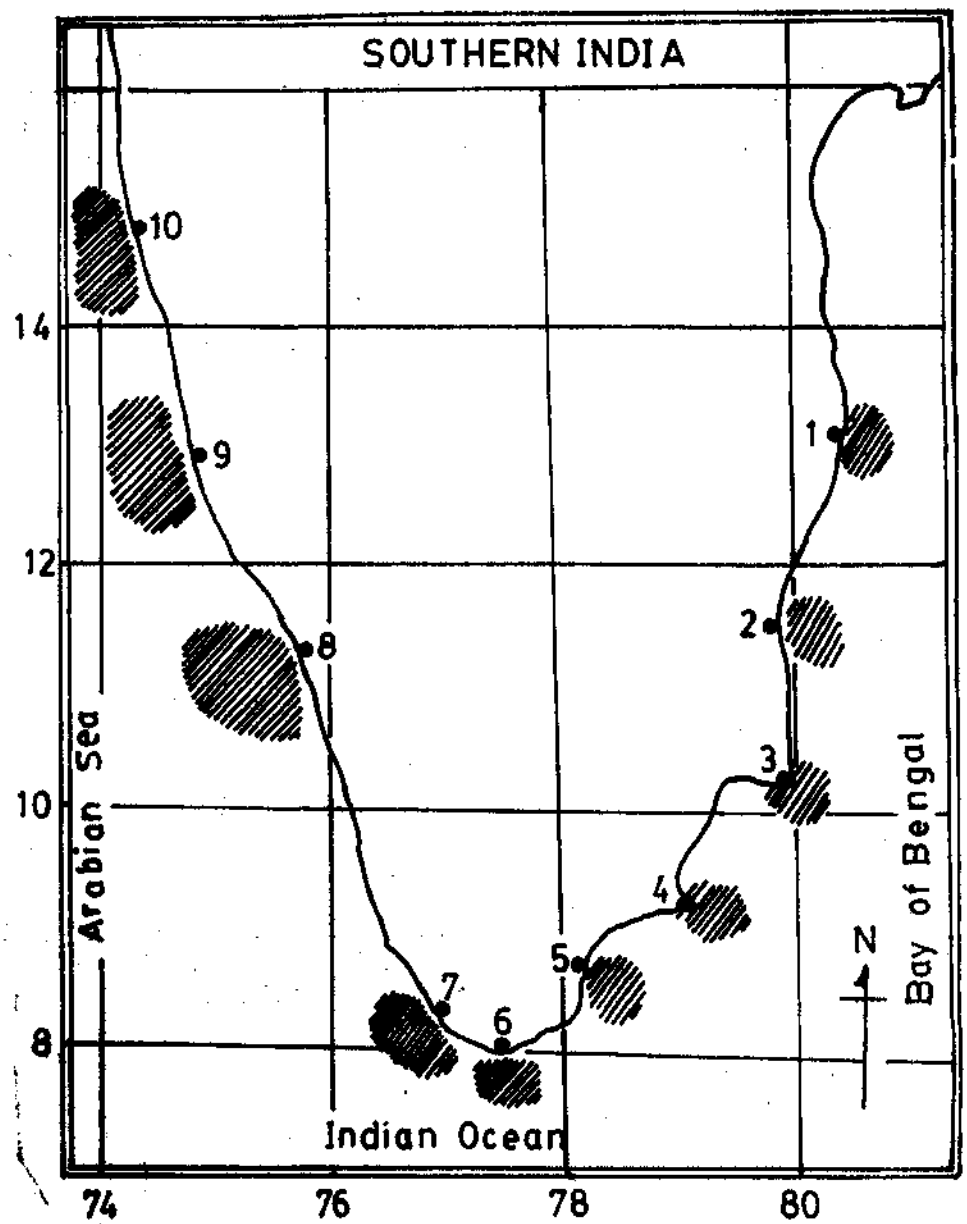

Fig. 1. Schematic map showing the collection areas and pile of estimated distributions of populations of *Ilisha melastoma* classified by morphometric analysis. (Numbers given in parenthesis denotes the number of specimens collected from that area): 1. Madras (95), 2. Porto Novo (104), 3. Point Calimere (45), 4. Mandapam (97), 5. Tuticorin (88), 6. Cape Comorin (90), 7. Vizhinjam (90), 8. Calicut (81), 9. Mangalore (85) and 10. Karwar (53).

and '*sb*' the standard deviation of regression coefficients :

$$sb = sy.\,x/\sqrt{\Sigma x^2}$$

where '*sy.x*' is simple standard deviation from regression. The null hypothesis at 5% significance level was tested in cases where the population regression coefficient was zero or one after the following equation :

$$t = \frac{b - \beta}{sb}$$

2. Allometry equations were computed for 136 growth combinations that each factor could be compared with all other 16 factors. The test for significance of regression coefficients were performed by the method of covariance analysis, adopted by Snedecor and Cochran (1967).

Results

Primary investigations

Applications of allometry equations : This equation can be expressed as

$$y = a + b\,x$$

where, $y = \log Y$, $x = \log X$. This equation is a simple one, where X is considered as a standard measurement of body part and Y is a comparable variable. A sample from Porto Novo (2) was analysed by plotting the log values (male and female separately) in an ordinary graph paper in order to know whether the forms of *Ilisha melastoma* fit into this equation.

The comparable combinations of body length (SL) with 16 measurements were considered presently. The rejection curves of all combinations were much narrow characterised by close scattering of data. *Ilisha melastoma* was found to mature at 125-134 mm in total length and the point of inflection could not be recognised in any combination. Correlation coefficients (r) are seen around 0.9 between two optional factors in most of the 136 combinations. Null hypothesis of Ho : $p = 0$ were rejected at 1% probability level. The application of allometric equation to relative growth of all seventeen factors of *Ilisha melastoma* was found to be preferable for further analysis.

Comparison between males and females : No morphological difference could be observed between the males and females of *I. melastoma*. The scatter diagrams also showed that no differential growth was evident in all the seventeen characters. The '*r*' values for combination of characters of male and female of *I. melastoma* obtained for five stations were found to be around 0.9 indicating no difference between sexes. The figures drawn with 95% confidence zones of males and females of sample (Porto Novo) also did not show any significant deviation between sexes in all the seventeen characters studied.

Analysis of covariance for 17 characters of fishes (males and females) obtained from nine stations were computed. Karwar sample was not included in the above analysis because of its smaller size. Significant difference were recorded between the sexes in certain combination of characters of each sample. It could be observed that the sexes often differed in certain combinations of characters among 1,2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 16 and 17 in different samples. The above facts clearly indicate that significant differences were detectable while comparing the paired lots of male and female. Combinations which showed significance at 5% level were noted and counted from nine stations. If the number for any combination exceeded 25% level of probability, (three and more out of nine) then that combination was excluded from further analysis Subsequently 42 out of 136 combinations of such characters, which showed significance at 5% level were excluded.

Comparison between samples

After excluding certain combinations of characters which showed significance between male and female, analysis of regression coefficients for other pairs of combinations were performed to compare the morphological characters of samples. The test of significance of difference between regression coefficients was computed by analysis of covariance. 'F' values were calculated for regression coefficients for selected pairs of 94 combinations of characters between samples drawn from various localities. Combinations which showed significance at 5% level were counted in each intersample analysis, and they were converted into percentages, which were then normalized, with arcsine transformation, to standard distribution. The rejection limit was taken at 25% probability to judge the relationships between the samples because these percentages of differences accounted for approximately 25% in sexual comparisons in all the sample.

From the relationships observed between different samples, all samples were found to be independent stocks (Fig. 1). However, the Karwar sample (10) showed its affinity with Porto Novo (2), Mandapam (4), Tuticorin (5) and Cape Comorin (6) samples.

Discussion

Allometry equations were fitted for five samples. The combinations were based not only on length of the fish, but also on all the measurements with permutations and combinations. Allometry equations for both sexes were tested separately for five samples. The fitness was also analysed by calculating the correlation coefficient for all combinations.

Morphometric differences between sexes were examined for 17 characters, with permutations and combinations, besides calculating the 95% confidence zones, taking the standard length as an independent variable and other characters as dependent variables. Though there was no significant difference between sexes at 95% confidence zones, statistical calculations of regression coefficients of all combinations from nine stations showed significance at 5% level, in several combinations, which were eliminated from further intersample analysis. Based on the sum of the statistical differences between 17 parameters (in combinations), the samples were judged by the method of rejective limits at 25% probability level. All samples were found to be independent stocks.

According to Ahlstrom (1957), the races of a fish species may be formed under conditions of partial or complete isolation of groups of fishes, with a slight difference in body proportions of meristic characters preserved in each group. The small differences need not necessarily be apparent in individual specimens, but may be revealed in large number of specimens. The significance of differences could be appraised by means of statistical differences which could be due to environmental or hereditary factors. It is extremely difficult to determine whether differences are phenotypic or genotypic; yet knowledge of the causes of the difference is essential to an understanding of their significance. Accoring to Hjort (1930) some regard the formation of races as a result of a fortuitous hereditary combination characteristics while others as due to an interplay of adaptations shown by the animals concerned and physico-chemical conditions predominating in particular areas of the sea. But Schmidt (1930) is of the view that some extrinsic factors may influence the average characters by which the different races of fishes are distinguished. However, it may be wrong to ignore the fact that the differences in average characters could also be helpful to distinguish races which are determined by hereditary factors.

Mayr (1942) discussed the classification of isoatilng mechanisms, and according to him

if some individuals have little or no opportunity to interbreed, these reproductive groups get more isolated biologically, eventhough they may be in contact geographically. The indentification of different groups is a gradual process and it cannot be completed unless enough information on the biology of various species is made available. Thus the population refers to unit stocks, races, etc. although it means only the biological units (Dutt, 1962). In many cases, each area may support two races based on biometric characters and they may differ in spawning seasons too (spring and autumn spawners) (Parson and Hodder, 1971). Iwata (1975) stated that the identification of population of a species of fish is the first useful step towards a better understanding of the harmony which may exist in the maintenance of stocks of that species for rational exploitation.

The results of the present study on morphometric comparisons of samples of *I. melastoma* collected from ten localities indicate the existence of separate populations based on the variations of morphomerics. Such morphological heterogeneity may be due to careful genetic selection of characters that can best suit them to the environment.

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