Systematic studies on Ilisha kampeni (Weber & De Beaufort, 1913) (Pisces, Clupeidae) and a biometric comparison of stocks from two localities

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Abstract

Ilisha kampeni (Pisces Clupeidae) is described based on new material from Bombay and Kakinada. The species was originally described as *Pellona kampeni* from Java and Borneo. Samples of *I. kampeni* from Bombay (west coast) and Kakinada (east coast) are compared, using 't' test and Chi-square test for meristic characters and multivariate analysis for body measurements. Significant differences observed in 6 of the 12 meristic characters and all the 6 body measurements indicate that the samples from Bombay and Kakinada belong to different stocks.

Introduction

Ilisha kampeni (Weber & de Beaufort, 1913) was originally described as *Pellona kampeni* from Java and Borneo. The species has evaded the attention of Indian ichthyologists for a long time and has recently been recorded from the Bay of Bengal as well as the Arabian Sea (Seshagiri Rao, 1975a, b.). The species can be identified following the key given by Seshagiri Rao (1974). In this paper *I. kampeni* is described based on new material from Kakinada and Bombay and a biometric comparison of samples from two localities is presented using statistical methods.

Material

A random sample of 35 specimens of *I. kampeni* (85.0–109.0 mm S.L.) was collected at Sasoon Docks landing centre, Bombay on 14-1-1975. Similarly a sample of 33 specimens (103.0–123.0 mm S.L.) was collected at Kakinada on 15-11-1976. Counts and measurements recorded follow Whitehead *et al.* (1966). All the 68 specimens were used in the studies on systematics and biometric comparison of samples.

Systematics

Order Clupeiformes
Suborder Clupeoidei
Family Clupeidae
Subfamily Pristigasterinae

Ilisha kampeni (Weber & de Beaufort, 1913).

Pellona kampeni Weber & de Beaufort, 1913, Fish. Indo-Austr. Arch., 2:87.

Ilisha whiteheadi Seshagiri Rao., 1974, Copeia, 1974: 861–864.

Description

Br. St. 6, D 16–18, P 14–16, V 7, A 39–46, gillrakers 9–11 + 20–24, scutes 17–21 + 7–10 (total 25–30), vertebrae 11–14 + 28–31 (total 41–43).

As percentages of standard length: body depth 25.8–31.8, head length 23.2–29.4, snout length 6.3–9.0, eye diameter 6.7–9.0, post-orbital 9.1–11.7, length of upper jaw 12.0–14.6, length of lower jaw 12.9–15.3; pectoral fin length 13.3–17.3, pelvic fin length 4.6–7.2, anal fin base 33.0–39.8; pre-dorsal distance 40.0–51.6, prepelvic distance 37.6–48.7, pre-anal distance 49.1–60.9.

Body compressed, its width 3½ times in its depth,

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deepest under dorsal origin. Belly keeled, scutes beginning at isthmus, not as trenchant and prominent as in *I. megaloptera* in the post-pelvic region. Maxilla reaching to below middle of eye, lower edge with fine serrae. No hypomaxilla. Two supramaxillae, the first (anterior) slender, the second expanded posteriorly and tapering to a slender shaft anteriorly. Operculum indented at the level of eye. Teeth present in single series in both jaws, those of lower jaw curved back, of premaxilla prominent, but median portion of upper jaw without teeth.

Frontals with prominent ridges of *megaloptera* pattern. A pair of ridges arising on median line before anterior border of eye, passing posteriorly, gradually diverging from each other; another pair of ridges parallel to and in close association with the former, the two ridges of each side may join at hind end of the skull (Seshagiri Rao, 1972). In addition to the above, a short median ridge extends from anterior end to a level above middle of eye, and each pair of ridges is widely separated when compared with *megaloptera*. The ridge pattern described here is a modified *megaloptera* type.

Dorsal origin a little nearer to snout tip than to caudal base. Pectorals almost reaching pelvic base or failing to reach palvic base by ½ eye diameter. Auxillary scale present, about ¾ length of fin. Pelvic fins small, base usually nearer to anal origin than to pectoral base by ⅙ to ½ eye diameter. Pelvic axillary scale present. Distance between pelvic tip and anal origin 1–1½ diameters of eye. Anal origin below 8–10th branched dorsal ray.

Swimbladder with paired postcoelomic prolongation extending to 19th anal pterygiophore.

Scales with single unbroken striation on exposed portion; none to about 6 interrupted striations on unexposed portion.

Colour: dorsal profile greenish to dark grey, extending on upper ⅓ of flanks; rest of flanks silvery white. Dorsal fin hyaline, dark towards tip; pectorals, pelvics and anal hyaline. Caudal yellowish, margin black.

Note: *Ilisha kampeni* is a delicate slender bodied fish and apparently does not grow beyond 175 mm in total length. The swimbladder has a paired posteoelomic prolongation and the operculum is

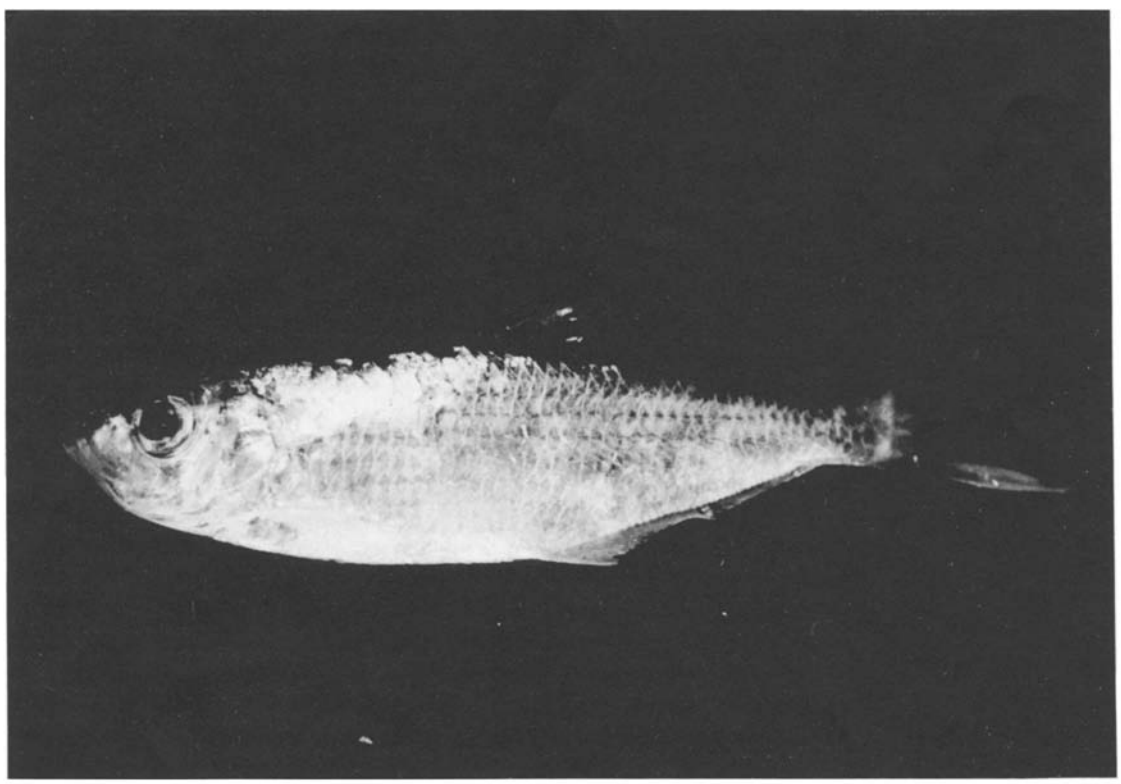

Fig. 1. Ilisha kampeni 134.0 mm S.L.

indented at the level of the eye, both characters being shared by the closely related but, deeper bodied *I. melastoma* (depth; 36.3–38.2 in % of S.L.). In *I. kampeni* the pseudobranch is covered by a thin membrane on its basal half, but exposed in all other Indian species of *Ilisha*.

Comparison of stocks

The study of geographic variation, racial differentiation and population systematics is of considerable importance to evolutionary theory and systematics (Thorpe, 1976). In the absence of migratory investigations on fish stocks in tropical waters, biometric methods to analyse the differences between stocks from different localities assumes significance. Earlier investigations on comparison of fish stocks in Indian waters were those of Devanesen & Chidambaram (1943), Devanesen (1943), Prabhu & Dhulkhed (1972) on *Sardinella longiceps* Val; Pillay (1952, 1954, 1957) on *Hilsa ilisha* (Ham. Buch) and Rao (1967a, b) on *Stolephorus insularis* Hardenberg.

In the present investigation samples of *Ilisha kampeni* from two localities are compared. Student's 't' test and Chi-square test (Bailey, 1959) were applied to test the significance of differences between the means of meristic characters. Body measurements of samples from the two localities were subjected to D^2 analysis (Rao, 1952) using a HONEYWELL 400 computer.

The following body measurements were selected for the present study, as they were found to be variable.

(1) standard length, (2) body depth, (3) head length, (4) pre-dorsal distance, (5) pre-pelvic distance and (6) pre-anal distance.

The variance-covariance matrix, correlation matrix, D^2 and F values were computed. The D^2 between two groups is computed following Rao (1952).

To test the significance of differences between the two samples in each of the 6 body measurements 't' is calculated using the following equation:

$$t = C\,|\,\bar{x}_i - \bar{y}_i\,|\,/\,\sqrt{V_{ii}}$$

where

$$C = \frac{\sqrt{N_1 N_2}}{\sqrt{N_1 + N_2}}$$

$\bar{x}_i$ = mean of the i th character for locality 1.
$\bar{y}_i$ = mean of the i th character for locality 2.
v_{ii} = pooled variance for the i th character.

Since the degree of freedom is high, the 't' value as calculated above is assumed to follow a standard normal distribution under the null hypothesis.

Meristic characters

The frequency distribution, mean values ($\bar{X}$), standard deviation (S.D.) and standard error (S.E.) of the 12 characters are given in Table 1, a-l.

The 't' test reveals significant differences between the samples from the two localities in the following 6 of the 12 characters for which the samples are compared:

i. pectoral fin rays
ii. anal fin rays
iii. gillrakers on lower arm
iv. total number of gillrakers
v. post-pelvic scutes
vi. total number of scutes

The characters in which the two samples do not differ significantly are:

i. dorsal fin rays
ii. gillrakers on upper arm
iii. pre-pelvic scutes
iv. pre-haemal vertebrae
v. haemal vertebrae
vi. total number of vertebrae

The Chi-square test gave similar results as the 't' test (Tables 2 and 3).

Table 1.

a. Dorsal fin rays

Locality	16	17	18	n	$\bar{X}$	S.D.	S.E.
Bombay	6	22	7	35	17.028	± 0.617	± 0.104
Kakinada	2	28	3	33	17.030	± 0.394	± 0.068

b. Pectoral fin rays

Locality	14	15	16	n	$\bar{X}$	S.D.	S.E.
Bombay	–	10	25	35	15.714	± 0.458	± 0.077
Kakinada	5	24	4	33	14.969	± 0.529	± 0.092

Table 1 *(continued)*

c. Anal fin rays

Locality	39	40	41	42	43	44	45	46	n	$\bar{X}$	S.D.	S.E.
Bombay	–	–	1	4	9	13	5	3	35	43.742	± 1.196	± 0.202
Kakinada	1	1	4	9	6	6	5	1	33	42.848	± 1.622	± 0.282

d. Gillrakers – upper arm

Locality	9	10	11	n	$\bar{X}$	S.D.	S.E.
Bombay	–	26	9	35	10.257	± 0.443	± 0.074
Kakinada	3	25	5	33	10.060	± 0.496	± 0.086

e. Gillrakers – lower arm

Locality	20	21	22	23	24	n	$\bar{X}$	S.D.	S.E.
Bombay	–	–	12	12	11	35	22.971	± 0.822	± 0.139
Kakinada	4	12	12	4	1	33	21.575	± 0.969	± 0.168

f. Total number of gillrakers

Locality	29	30	31	32	33	34	35	36	n	$\bar{X}$	S.D.	S.E.
Bombay	–	–	–	–	11	12	6	6	35	34.317	± 1.035	± 0.175
Kakinada	1	4	10	12	4	1	1	–	33	31.636	± 1.220	± 0.212

g. Pre-pelvic scutes

Locality	17	18	19	20	21	n	$\bar{X}$	S.D.	S.E.
Bombay	1	–	17	16	1	35	19.457	± 0.700	± 0.118
Kakinada	–	2	9	15	7	33	19.818	± 0.846	± 0.147

h. Post-pelvic scutes

Locality	7	8	9	10	n	$\bar{X}$	S.D.	S.E.
Bombay	1	30	4	–	35	8.085	± 0.073	± 0.063
Kakinada	2	17	13	1	33	8.393	± 0.658	± 0.114

i. Total number of scutes

Locality	25	26	27	28	29	30	n	$\bar{X}$	S.D.	S.E.
Bombay	1	1	16	15	1	1	35	27.485	± 0.853	± 0.144
Kakinada	–	3	2	15	11	2	33	28.212	± 0.992	± 0.172

Table 1 *(continued)*

j. Pre-haemal vertebrae

Locality	11	12	13	14	n	$\bar{X}$	S.D.	S.E.
Bombay	–	12	23	–	35	12.657	± 0.481	± 0.089
Kakinada	1	11	16	5	33	12.757	± 0.751	± 0.130

k. Haemal vertebrae

Locality	28	29	30	31	n	$\bar{X}$	S.D.	S.E.
Bombay	–	24	11	–	35	29.314	± 0.471	± 0.079
Kakinada	5	15	12	1	33	29.272	± 0.761	± 0.132

l. Total number of vertebrae

Locality	41	42	43	n	$\bar{X}$	S.D.	S.E.
Bombay	1	34	–	35	41.971	± 0.169	± 0.028
Kakinada	2	28	3	33	42.030	± 0.394	± 0.068

Table 2. *I. kampeni.* Significance of the difference in the means of meristic characters in samples from Bombay and Kakinada determined by applying 't' test.

Character	't' value	Significance at 5% level
Dorsal fin rays	0.011	Not significant
Pectoral fin rays	6.218	Significant
Anal fin rays	2.598	Significant
Gillrakers upper arm	1.728	Not significant
Gillrakers lower arm	6.421	Significant
Total number of gillrakers	9.795	Significant
Pre-pelvic scutes	1.930	Not significant
Post-pelvic scutes	2.406	Significant
Total number of scutes	3.260	Significant
Pre-haemal vertebrae	0.675	Not significant
Haemal vertebrae	0.276	Not significant
Total number of vertebrae	0.819	Not significant

Comparison of means

When compared with sample from Kakinada, the sample from Bombay has: a) higher number of pectoral and anal fin rays b) slightly higher number of gillrakers on upper and lower arms of the gillarch, c) lower number of scutes and d) lower number of vertebrae.

Body measurements

The means ($\bar{X}$) of the 6 body measurements and the standard deviation (S.D.) for the samples from Bombay and Kakinada are given in Table 4.

The values of D^2 and 'F', computed to test the significance of the differences between the two samples from Bombay and Kakinada are given in Table 5, and the values of the 't', to test the significance of differences in each of the 6 body measurements between the samples from the two localities are given in Table 6.

The differences are significant between the pooled data of samples from the two localities (Table 5). The results of the 't' test indicate significant differences between the two samples in all the 6 body measurements used in the present analysis (Table 6).

Summary

Ilisha kampeni is described, based on new material, from Indian waters. Samples of *I. kampeni* from two localities, Bombay and Kakinada, are compared by applying Student's 't' test and Chi-square test for 12 meristic characters and D^2

Table 3. *I. kampeni*. Significance of the differences in the meristic characters of samples from Bombay and Kakinada by applying the Chi-square test.

Character	D.f.	χ^2	Significance at 5% level
Dorsal fin rays	2	4.264	Not significant
Pectoral fin rays	2	25.951	Significant
Anal fin rays	5	8.408	Significant
Gillrakers upper arm	1	4.105	Not significant*
Gillrakers lower arm	3	28.492	Significant
Total number of gillrakers	4	49.350	Significant
Pre-pelvic scutes	2	4.126	Not significant
Post-pelvic scutes	2	9.454	Significant
Total number of scutes	3	19.113	Significant
Pre-haemal vertebrae	1	0.179	Not significant*
Haemal vertebrae	1	0.187	Not significant*
Total number of vertebrae	1	1.520	Not significant*

*Yates correction applied following Bailey (1959:59).

Table 4. Mean values ($\bar{X}$) and Standard deviation (S.D.) of 6 body measurements from Bombay and Kakinada (numbers 1–6 represent the six morphometric characters. *vide*. text)

		1		*2*		*3*		*4*		*5*		*6*	
Locality	Range	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Bombay	85.0–109.0	95.885	6.466	29.171	1.688	25.657	1.862	47.142	2.724	38.914	3.303	55.057	3.701
Kakinada	103.0–123.0	113.272	5.450	32.000	1.658	29.697	1.590	54.121	3.028	46.787	2.446	63.484	3.510

Table 5. Significance of the differences in the six body measurements between the samples from Bombay and Kakinada

Species	Bombay (N_1)	Kakinada (N_2)	D^2	F	Degrees of freedom		Value of 'F'at		Significance
					$\nu_1 = P$	$\nu_2 = N_1 + N_2 - P - 1$	5% level	1% level	
I. kampeni	35	33	12.654	33.109	6	61	2.24	3.11	Significant

analysis for 6 body measurements. The two samples differ significantly from each other in 6 of the 12 meristic characters and in all the 6 body measurements used in the present study. Based on these observations it is concluded that the samples of fishes from Bombay and Kakinada belong to different stocks.

Table 6. Values of 't' for the 6 body measurements computed to test the significance of differences between the stocks in each character from the two localities.

Character	't' value	Standard normal		Significance
		at 5% level	at 1% level	
1	11.953	1.96	2.58	Significant
2	6.970	1.96	2.58	Significant
3	9.593	1.96	2.58	Significant
4	10.003	1.96	2.58	Significant
5	11.118	1.96	2.58	Significant
6	9.662	1.96	2.58	Significant

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