BIOLOGY OF *HILSA ILISHA* (HAMILTON) FROM THE CHILKA LAKE WITH AN ACCOUNT ON ITS RACIAL STATUS

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ABSTRACT

Biology of *Hilsa ilisha* (Hamilton) of Chilka Lake was studied during the period 1964-'65. The length-weight relationship of the species was found to be $W = 0.000004468\ L^{3.125}$. The size at first maturity was 187 mm for both males and females. The species was observed to spawn once a year during July to October. Females below 300 mm in length do not participate in spawning. Sex ratio between males and females was found to be 1:1.87. Fecundity of the species in the size range 353-515 mm varied from 390 to 1,120 thousands. Age and growth studies by Petersen's method showed that zero, one-year and two-year old fish attain 162, 237 and 387 mm size respectively in Chilka Lake. The average monthly rate of growth of the species was 20 and 13 mm during first and second years respectively. Juveniles (50-150 mm) subsisted mainly on organic detritus and the adults on zooplankton. Two waves of migration, one during monsoon consisting of large size-groups and the other in winter/spring, consisting predominantly of smaller sizes were observed, the former for breeding and the latter for feeding. The early brood was found to migrate to foreshore areas while the late brood remains in the lake. Meristic studies indicated the homogeneity of monsoon and winter/spring stocks. Chilka hilsa differed significantly from Hooghly hilsa with reference to certain meristic characters.

INTRODUCTION

Hilsa ilisha, known locally as 'ilish', forms an important commercial fishery in the Chilka lake. Chaudhuri (1916) observed the occurrence of the fish in the lake throughout the year, Jones and Sujansingani (1951) tentatively concluded from their study of hilsa fishery of the lake that inflow of water from the Daya river influences the fishery; greater flow of flood water inducing large number of spawning fish to migrate. They also reported that Chilka hilsa breeds in the lower reaches of Daya river. Mitra and Devasundaram (1954) studied the trends in fishery and presumed that the fish is a permanent inhabitant of

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the lake. Pillay (1957) compared certain meristic and non-meristic characters of Chilka hilsa with that of river Hooghly and indicated that the former belong to a stock separate from that of Hooghly. Jhingran *et al.* (1963) have given an account on age and growth of the fish. The purpose of this contribution is to examine the aspects of biology not covered in detail earlier and to re-examine those covered by earlier workers in the light of present observations.

Material and Methods

Samples for the studies were obtained from fish assembly centres of Balugaon, Kuhuri and Kaluparaghat all through the year. Balugaon is situated in the central sector and Kuhuri and Kaluparaghat in the northern sector of the lake. As the fish occurs very rarely in southern sector, samples from this sector were not collected. Length measurements of the fish were recorded at the landing centres and samples were brought to the laboratory for detailed examination. Total lengths were recorded to the nearest millimeter and total weights in a double pan balance with a sensitivity of 0.5 g. Meristic characters such as lateral line scale numbers, scute counts and vertebral counts were analysed statistically, to compare monsoon and winter waves of the Chilka stock with a view to find their racial position and for purpose of comparison with Hooghly stock.

Sex and stage of maturity were determined by macroscopic and microscopic examination of the gonad. Scale of maturity followed was that of Wood (1930). Fecundity was determined from the sample counts of mature eggs.

The gut contents of 125 juveniles (50-150 mm) and 245 adults were studied. The food was analysed both qualitatively and quantitatively, the latter by volumetric method. Both 'volume' and 'occurrence' indices were used to construct index of preponderence (Natarajan and Jhingran, 1961) to grade the gut contents and to understand the food preference of hilsa. Gastrosomatic index was studied for different months to assess the intensity of feeding.

Length-Weight Relationship

To study length-weight relationship 214 specimens (125-509 mm) were utilised. The relation between fish length and weight (Fig. 1) was derived by using the formula $W = cL^n$ or $\text{Log } W = \log C + n \log L$, Where W = weight, L = length, C = initial growth index and n = Equilibrium constant.

The length-weight equation for hilsa was found to be $\text{Log } W = 5.35 + 3.125 \log L$, $W = 0.000004468\ L^{3.125}$

The exponent 3.125 nearly conforms to the cube formula.

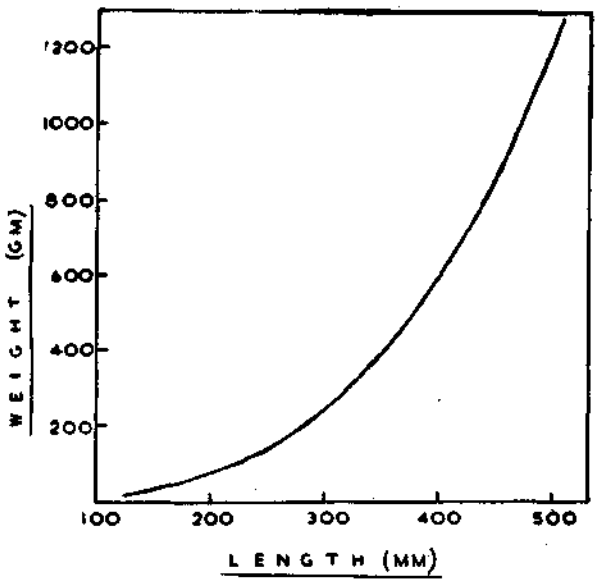

Fig. 1. Length-weight relationship of hilsa showing parabolic curve.

Relative Condition

The relative condition 'Kn' (Le Cren, 1951) of hilsa was calculated by employing the formula $Kn = \frac{w}{\hat{w}}$; where, w is the observed weight and $\hat{w}$ is the calculated weight (from length-weight relationship equation). The mean Kn values for different length groups are plotted (Fig. 2).

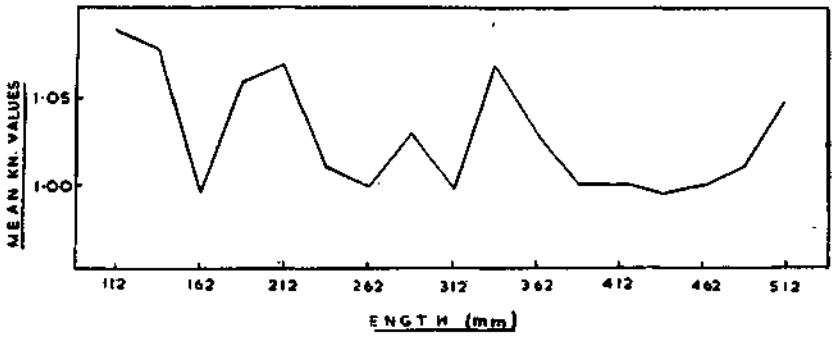

Fig. 2. Mean Kn values of hilsa at different lengths.

The condition was very high in smaller size groups. There was a gradual decline in the condition as the fish grew to a size of 162 mm and thereafter a sudden increase was noted at 187 mm. Subsequently two peaks were obser-

ved at 287 and 337 mm. The sudden increase at 187 mm may be due to the attainment of first maturity. Studies on the gonadial cycle also revealed that the species attains first maturity when it reaches the above size. Subsequent peaks may indicate the maturation of males and females though the observed values are little higher.

Maturation and Spawning

Maturation

Fig. 3 shows the progression in the maturation of hilsa through various months.

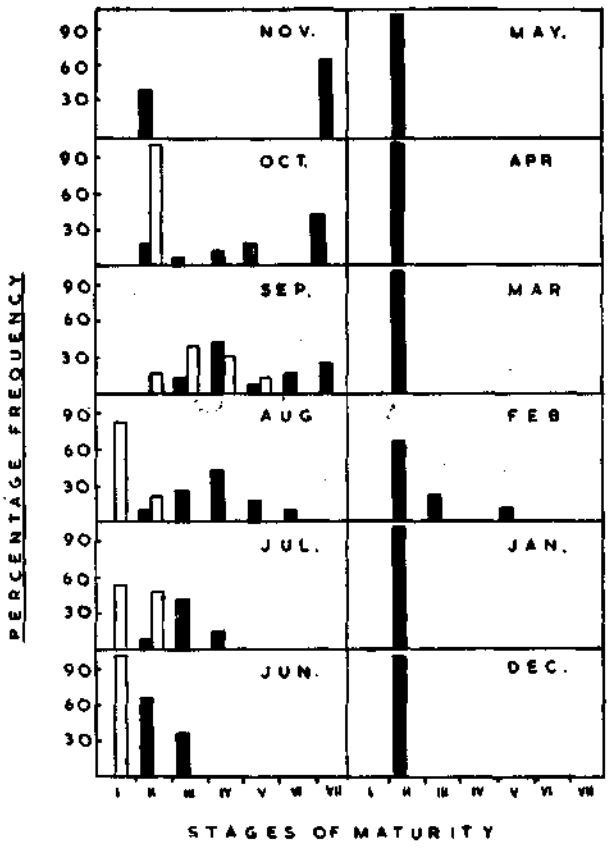

Fig. 3. Percentages of hilsa in different stages of maturity through months.

Larger size groups (above 300 mm) which were in early stages of maturity (III stage) in June progressed to stages V and VI by August. Mature specimens in this size group were encountered upto October. Spent fish began appearing in the catches from September and beyond October all specimens encountered were in spent condition. Smallar size groups (0-year group) in

the range (170-300 mm) were immature during the period June to August, but started maturing by early September and attained stage IV by middle of September. Female specimens beyond stage IV were never encountered in this size group either in Septmber or in subsequent months. But milting males were encountered in September. The maximum size of the intra-ovarian egg was 0.40 mm whereas in larger size groups, maturing early in the season, *i.e.*, during July to August, the maximum size of the intra-ovarian egg noted was 0.76 mm.

A few specimens 400 mm and above in length were found in early stages (stage III) of maturity in February. Only one specimen with V stage gonad was encountered during this month. The first year group which dominate the fishery during this period was immature.

Gonadosomatic Index

A study of gonadosomatic index of hilsa during different months (Fig. 4) revealed that there is a slight rise in the index in June (0.6422) denoting the

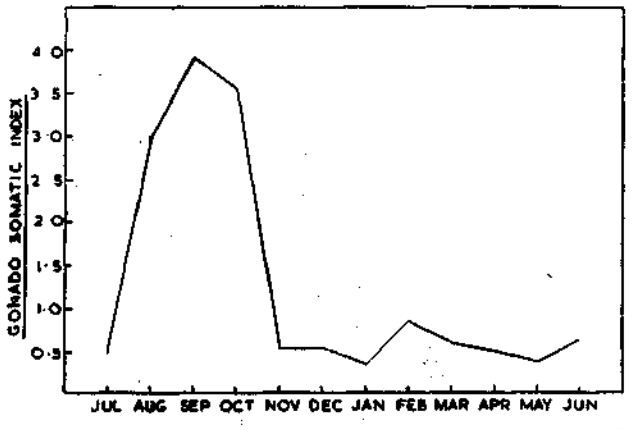

Fig. 4. Gonadosomatic index of hilsa for different months.

beginning of the maturation cycle. It was during this period that the larger size groups began maturing. Two peaks of index were observed, one in July (3.8440) and another in September (3.9050.) A sharp decline in index in November (0.5449) indicated the end of the maturation cycle. A small spurt was again noted in February (0.8659) with a fall in March (0.5950). The low magnitude of the spurt in February is due to the fact that only a few specimens attain the early stages of maturity in this month.

Size at first Maturity

Pillay (1958) mentioned that the approximate minimum size at first maturity for male and female hilsa in river Hooghly is 169 and 199 mm respectively. In Ganga the minimum size at first maturity is 350 mm (Mathur, 1964).

Pillay and Rao (1962) have recorded that the minimum maturity size of the fish in river Godavari is 355 mm. In the present study the smallest mature male and female measured 172 and 186 mm respectively. The sex-wise length frequency histograms of maturing and mature males and females pooled for the period July-October of 1964 and 1965 (Fig. 5) showed a mode at 187 mm for both males and females. This mode seems to represent the average size at first maturity for Chilka hilsa. The relative condition curve (Fig. 3) also confirms the above inference.

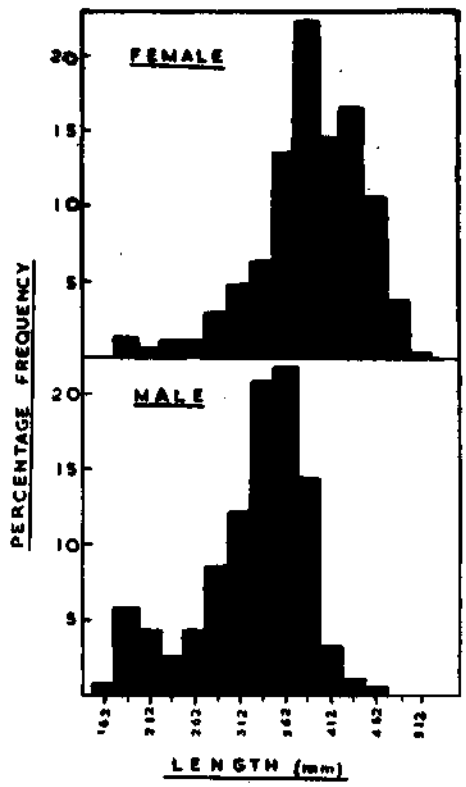

Fig. 5. Sex-wise length frequency of maturing and mature males and females of hilsa.

Spawning

Studies on the occurrence of larvae and spent fish indicated that the species spawns by about July/August when flood water entres the lake. August-September appears to be the peak spawning period. Beyond October no spawning activity was noticed and specimens observed during this period were either spent or immature. Larvae (4.5-9.00 mm) occurred from August to October and post-larvae (9.0-32.0 mm) upto December in plankton collections.

The present study thus confirms the findings of Jones and Sujansingani (1951) that hilsa breeds in the Chilka lake during monsoon months.

It is reported that hilsa of Hooghly (Pillay, 1958) and Ganga (Swaroop, 1959; Mathur, 1964) spawn several times during breeding season. The occurrence of fully spent specimens during the breeding season, presence of two distinct groups of ova, mature and immature in fully mature ovary (Fig. 6) and

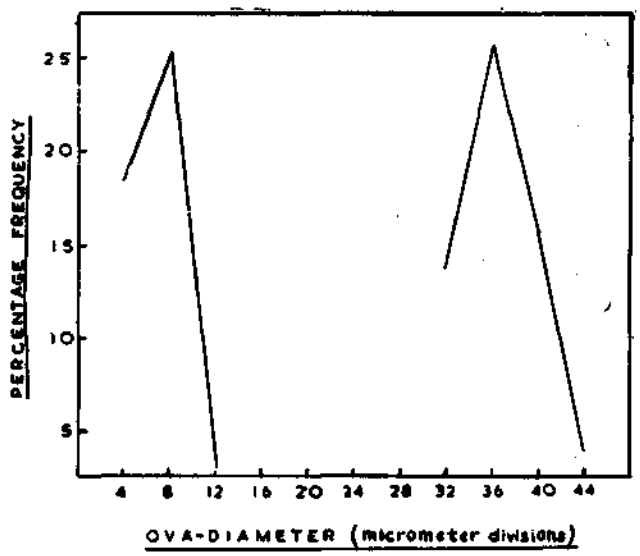

Fig. 6. Size frequency distribution of ova-diameter in a fully mature ovary of hilsa.

the non-occurrence of partially spent specimens, probably suggests that Chilka hilsa spawns only once in the season.

Jones and Sujansingani (1951) basing their observations on the collection of eggs and post-larvae at Garasaguda (lower reaches of river Daya) reported the possibility of the fish breeding in Daya river and its associated branches. Kowtal collected eggs and larvae from Daya river mouth area on the eastern shore of the northern sector, which suggests that the fish may also be breeding in the fresh water zone of northern sector of the lake near about the mouth of Daya river.

Two breeding periods, one in monsoon and another during spring season, have been reported for hilsa of river Hooghly (Jones and Menon, 1951; Pillay, 1958) and Ganga (Mathur, 1964), while according to Ravishchandra (1962) the species breeds only once in Hooghly during monsoon. In river Godavari also the fish breeds only once in a year, *i.e.*, during the monsoon (Chacko and Ganapati, 1949; Pillay and Rao, 1962). In Chilka lake though a small spurt of maturation was recorded in February, in a few larger specimens, these did not attain advanced stages of maturity, suggesting that they do not spawn.

This is further confirmed by the fact that no larvae or juveniles were encountered in plankton collections and commercial gear during this period. It is of interest to note in this connection the observations of Nair (1958) on the basis of morphological and histological features of the gonads of hilsa, that during gonadial activity from January-March the ova undergo atresia and resorption.

Similarly the smaller size-groups maturing late in the monsoon, never attained beyond IV stage maturity and no spent specimens were encountered in this size group. This suggests that these fish may not be spawning. Similar observations are available in hake (Hickling, 1930) and Norway pout (Gokhale, 1957). These are gadids and no such observations were reported in cluepids. Hence, the present observations have an added interest.

Thus it is concluded that even though the species attains maturity towards the end of first year of its life it spawns only in the second year.

Sex Ratio

Several opinions have been expressed on the sex ratio of hilsa populations. Pillay (1958) found that the total ratio of males to females is 1: 1.87 in river Hooghly, while in Ganga it was found to be 1: 1 (Mathur, 1964). In Godavari the ratio between males and females was 1:9 according to Chacko and Ganapati (1949) whereas according to Pillay and Rao (1962) it is 1:1.53. In the present instance females dominated almost throughout the year except in October when the ratio was 1:1. The total male to female ratio was found to be 1:1.6 Chi square test (Table 1) indicated that the observed ratio differs significantly from the expected ratio of 1.1.

TABLE 1. *Sex ratio of hilsa*

Months	Males	Females
January	—	10
February	1	5
March	3	6
April	3	10
May	—	—
June	5	12
July	229	346
August	109	149
September	1	13
October	45	45
November	3	10
December	2	20
	401	626

Chi square = 56.08 $P < 0.001$

FECUNDITY

Fecundity of thirteen specimens ranging from 353 to 515 mm was studied. The total number of eggs was found to range from 3.9 lakhs to 11.20 lakhs (Table 2).

TABLE 2. *Fecundity of* Hilsa ilisha

Total length mm	Weight g	Wt. of the ovary g	Fecundity
353	458	27.13	390,379
395	685	114.39	819,600
403	632	40.15	505,890
408	700	53.32	615,379
413	810	62.09	657,054
430	1060	134.56	1,120,304
431	1000	120.62	892,588
456	1040	141.28	1,017,216
458	964	49.15	580,543
464	1041	54.05	681,840
473	960	54.13	863,914
509	1293	49.25	1,071,500
515	1261	67.32	925,648

AGE AND GROWTH

Since the fish has a single restricted breeding season, Petersen's method of length frequency analysis was employed to determine the age of hilsa. Total lengths of 15,892 fishes were examined for this purpose. Length frequency for different months has been presented in polygons (Fig. 7).

In September, which is the peak breeding period, there is a single mode at 387 mm. This size group belongs to the second year which is participating in the spawning for the first time. The strength of this mode became feeble from November. A new mode at 237 mm appeared in the month of October. This size group has just completed one year of its life and hence represents first year group. In December a small mode at 62 mm appeared which represents the progeny of monsoon breed. This mode representing 0-year-group progressed to 137 mm in May and 162 mm in August. These are the progeny of late monsoon breeders which remained in the lake.

The fish is estimated to grow at an average monthly rate of 20 mm in the first year and 13 mm in the second year.

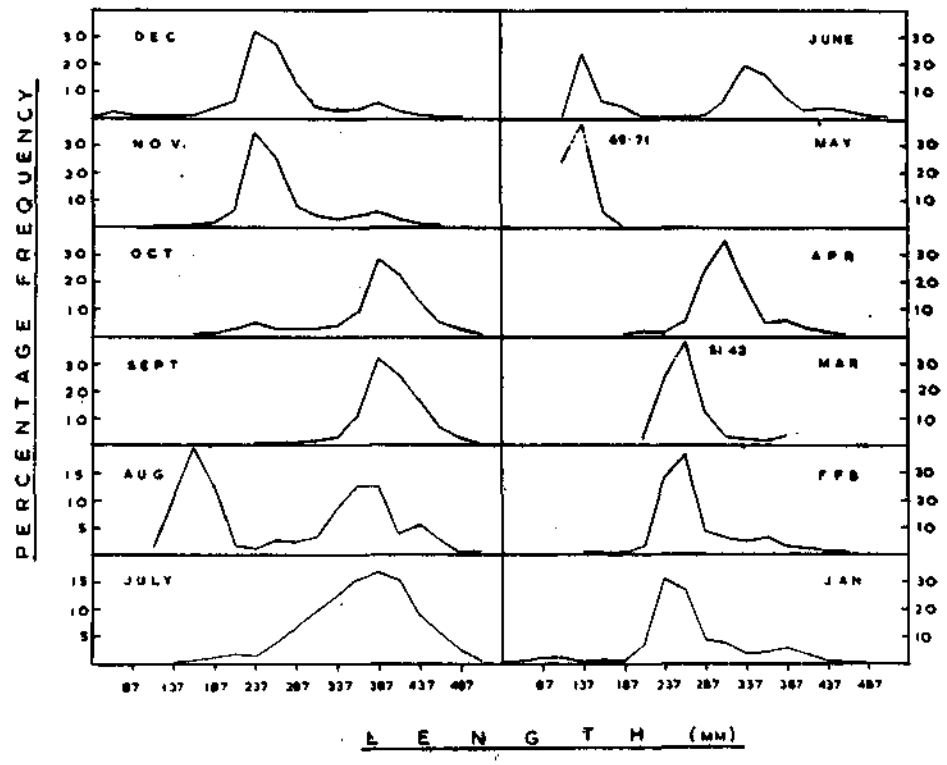

Fig. 7. Length frequency distribution of hilsa for different months.

Food and Feeding Habits

The food of young hilsa (50-150 mm) consisted chiefly of organic detritus (48.56%), copepods (25.82%), algae (10.32%), molluscan larvae (7.85%), mysids (5.34%), and diatoms (2.10%). In the size range 50-100 mm decayed organic detritus formed the dominant item (51.58%) followed by algae (15.57%) and copepods (14.57%) in the gut contents. In the size range 110-150 mm, however, there was an increase in the zooplankton content in the food (copepods 46.87%, molluscan larvae 8.55%).

The index of preponderance of food (Table 3) showed that organic detritus occupied the first place of preference in juveniles followed by copepods, molluscan larvae and algae.

Thus the studies reveal that juvenile hilsa of Chilka is predominantly a bottom feeder as observed by Hora and Nair (1940 a, b) and Halder (1968) in Bengal waters.

TABLE 3. *Index of preponderance of food items in young (figures in parenthesis) and adult hilsa*

Food items	Percentage of occurrence Oi	Percentage of volume Vi	Vi Oi	$\frac{Vi \cdot Oi}{\Sigma Vi \cdot Oi} \times 100$	Grading
Organic detritus	32.0 (39.03)	39.4 (48.56)	1260.80 (1895.30)	45.96 (70.31)	1 (1)
Copepods	32.8 (17.07)	38.2 (25.82)	1252.96 (440.75)	45.67 (16.47)	2 (2)
Mysids	9.1 (4.88)	12.2 (5.34)	111.02 (26.06)	4.04 (0.97)	3 (5)
Molluscan larvae	17.5 (19.51)	5.7 (7.85)	99.75 (153.15)	3.64 (5.72)	4 (3)
Diatoms	1.2 (4.88)	0.6 (2.10)	0.72 (10.27)	0.03 (0.38)	5 (6)
Rotifers	1.2 —	0.2 —	0.24 —	0.01 —	8 —
Algae	0.8 (14.63)	0.5 (10.32)	0.40 (150.98)	0.02 (5.64)	7 (4)
Sand and mud	5.4 —	3.2 —	17.28 —	0.63 —	6 —

TABLE 4. *Percentage composition of food items in adult hilsa through months*

Items Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Copepods	20	28	—	76	10	34	72	57	48.5	33	14	23
Mysids	35	—	—	2	—	—	—	—	2.5	18	36	44
Molluscan larvae	8	5	—	3	5	6	—	—	2	3	10	6
Rotifers	—	—	—	—	—	—	—	—	1.5	—	1	—
Diatoms	—	—	—	—	—	8	—	—	—	—	—	1
Organic detritus	36	67	—	18	77	50	21	36	38	46	30	26
Sand and mud	1	—	—	0.5	8	—	7	7	7.5	—	9	—
Algae	—	—	—	0.5	—	2	—	—	—	—	—	—
Percentage of empty stomachs	30	40	100	24	—	75	75	73	33	18	26	70

The principal groups of food items of adult hilsa, according to 'occurrence method, were organic detritus (32.0%), copepods (31.7%), molluscan larvae 17.5%) and mysids (4.2%). In addition, rotifers (1.2%), crustacean larvae (1.1%) and algae (0.8%) occurred on few occasions and in small quantities.

Copepods occurred throughout the year in varying quantities, being dominant in April, July, August and September (Table 4). Organic detritus also occurred almost throughout the year and was more during summer and monsoon months. Mysids were fairly represented in post-monsoon and winter months, and were dominant during the period November to January. In a few specimens the stomachs were gorged almost exclusively with mysids. Molluscan larvae (prosobranchs and lamellibranchs) were frequent in summer and winter months. Sand and mud were present in small quantities during monsoon months.

A study of index of preponderance (Table 3) showed the food items, in the order of preference, were organic detritus, copepods, mysids, molluscan larvae, diatoms and rotifers. Plankters (copepods, mysids, molluscan larvae diatoms and rotifers) accounted for 54% of the diet followed by organic detritus which indicates that the adult fish is predominantly a surface and column feeder. It is of interest to note that food of hilsa (both young and adult) of river Godavari consisted mainly of organic debris along with sand (Pillay and Rao, 1962), probably suggesting that in this habitat it is mainly a bottom feeder, at all stages.

Gastrosomatic index for different months (Fig. 8) indicated variability in feeding intensity. The low index in June, July and August was due to the

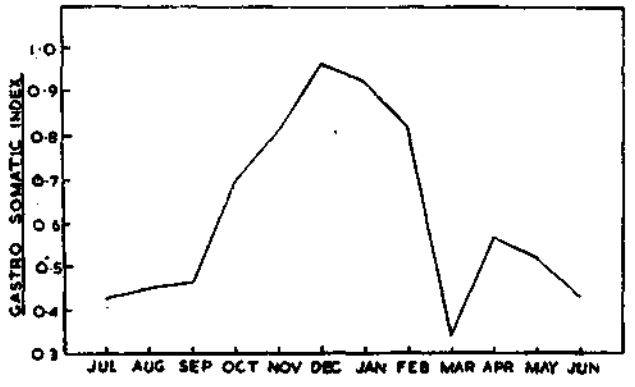

Fig. 8. Gastrosomatic index of hilsa for different months.

presence of large number of empty stomachs (Table 5). There was a slight rise in the index in September and the peak values were in November and

December. A slight decline was noticed from January and minimum value was in March. The high index in post-monsoon months indicated high feeding intensity and the low index in monsoon, poor feeding.

Subdued feeding activity in fishes during breeding season has been observed by several workers. Southwell and Prasad (1918) reported that hilsa migrating to the river Hooghly for spawning do not feed. Pillay and Rao (1962) did not find any change in the feeding activity of hilsa in Godavari and the presence of large number of empty stomachs during spawning season was attributed by them to the lack of food material in the river in that season. The present studies revealed low feeding activity in Chilka hilsa during breeding season. The feeding intensity was more in spent specimens as evidenced by the presence of large amounts of food in the guts and the high gastrosomatic index observed during post-monsoon months. Bhimachar (1955) reported that the intensity of feeding increases in spent hilsa in the river Hooghly whilst Swaroop (1959) found that the feeding of spent hilsa decreases immediately after spawning in Ganga at Allahabad.

Migratory Trends

According to Jones and Sujansingani (1951) there are two waves of hilsa migration in Chilka lake, one at the close of winter and the other at the commencement of monsoon. Jhingran *et al* (1963) reported that January to August is the main hilsa season. The present study confirms broadly the observations of Jones and Sujansingani (1951) and Jhingran *et al* (1963), with two peak season in hilsa catches, one during monsoon and the other in winter/spring. The monsoon catches consisted of mature fish which migrated to the lake for breeding consisting predominantly of larger size groups. The winter catches consisted of smaller size groups and were all immature. Larger size groups during this period remain in the outer channel and foreshore areas (Jhingran *et al.*, 1963).

Two waves of migration of hilsa have been observed in the river Hooghly also (Jones and Sujansingani, 1951; Pillay, 1958) which, according to Pillay (1958), correspond to two breeding seasons of the species. In chilka lake there is only a single breeding season, *i.e.*, during monsoon and the winter/spring migrants appear to have entered the lake for feeding. This view is corroborated by the availability of good zooplankton crop during this period (Jhingran *et al.*, 1963) and the high gastrosomatic index observed.

A test of significance (Table 6) showed that monsoon and winter hilsa belong to the same population, the only difference being in their sizes. Pillay (1958) observed similar difference in sizes of the two runs in Hooghly which he attributed to the fishing in winter by clap net, operating in surface waters and takes only smaller size groups, as they tend to move in surface waters,

whereas bigger size-groups prefer deeper waters. In Chilka lake, however, there is no such differential fishing and the lake is too shallow to expect any differential distribution.

Juveniles (31-90 mm) occurred in *Patuajal* catches along with other clupeids from November to January. It is likely that larger juveniles move down into the foreshore areas. Probably the sizes 31 to 90 mm represent the progeny of late breeders and these appear to remain in the lake with the rise in salinity during winter. The catches of inshore waters off Chilka mouth in December consisted of few specimens of hilsa juveniles measuring 70 to 78 mm indicating the movement of juveniles along coastal waters.

Based on the presence of juveniles in the catches of winter months Mitra and Devasundaram (1954) assumed that the fish is a permanent inhabitant of the lake. The sudden influx of larger size groups in breeding season and another influx of smaller ones in winter and the meagre catches in the deeper and more saline southern sector of the lake, all show that the species is a migrant into the lake. The juveniles, these authors have reported in the lake, could only be the progeny of late breeders.

Jones and Sujansingani (1951) indicated a direct correlation between flood water and hilsa landings. Table 5 gives river discharge for Mahanadi for monsoon months and total yield of the fish for different years. Mahanadi discharge could be taken as an index of discharge of river Daya into the lake as the latter is one of the deltaic branches of Mahanadi.

TABLE 5. *River discharge and hilsa landings for years 1961–65*

Year	River discharge (million acre feet)	Landings (tonnes)
1961	107.20	64.17
1962	32.32	172.34
1963	54.80	292.72
1964	53.50	65.28
1965	11.04	29.68

From Table 5 no trend is discernible between water flow and fishery.

RACIATION

The runs in the chilka lake

Since there are two distinct runs of hilsa in Chilka lake, one in monsoon and the other in winter, the possibility of these being representatives of two different stocks has been examined. The following meristic characters were chosen to study the difference between them as suggested by Pillay (1957), preventral scutes, post-ventral scutes, total scutes, lateral line scales, total number

TABLE 6. *Comparison of meristic characters of monsoon and winter stocks of hilsa of Chilka lake*

Character	MONSOON			WINTER						Probability	Significance
	N	$\bar{X}$	$\Sigma(X-\bar{X})^2$	N	$\bar{X}$	$\Sigma(X-\bar{X})^2$	D. F	σ d	t	(p)	
Pre-pelvic scutes	80	16.96	19.8040	51	16.96	1.9193	129	.0735	.0435	> .50	Not significant
Post-pelvic scutes	80	14.00	29.00	51	13.96	24.6410	129	.1132	.3533	> .50	"
Total scutes	80	30.92	48.3932	51	30.86	30.0046	129	.1584	.3786	> .50	"
Lateral line scales	78	46.39	64.7938	59	46.44	23.4864	135	.1406	.3050	> .50	"
Total vertebrae	23	44.87	6.3173	23	45.17	3.3047	44	.1371	1.4620	> .10	"
Trunk vertebrae	23	11.95	40.6900	23	11.91	52.8512	44	.4227	.7328	> .10	"
Caudal vertebrae without heaemal spines	23	11.30	59.4100	23	11.04	29.8016	44	.4174	.6229	> .50	"
Caudal vertebrae with haemal spines	23	21.56	53.4348	23	21.87	41.0529	44	.4296	7216	> .10	"
Vertebrae with duplicate neural spines	23	20.17	47.8275	23	20.60	66.5200	44	.4726	.9098	> .10	"
Vertebrae with single neural spine	23	24.70	48.8700	23	24.52	62.4528	44	.4665	.3858	> .50	"
Vertebrae with enlarged haemal canal	23	22.65	57.7475	23	22.82	21.8460	44	.3814	.4614	> .50	"

TABLE 7. *Comparison of meristic characters of Chilka hilsa with that of Hooghly*

Character	CHILKA			HOOGHLY						Probability	Significance
	N	$\bar{X}$	$\Sigma(X-\bar{X})^2$	N	$\bar{X}$	$\Sigma(X-\bar{X})^2$	D. F	σ d	t	(p)	
Pre-pelvic scutes	131	16.95	21.7455	530	16.8981	532.5000	659	.0894	.5805	$>.50$	Not significant
Post-pelvic scutes	131	13.99	42.9934	530	13.0509	671.6300	659	.1020	9.2060	$<.01$	Not significant
Total scutes	131	30.87	80.9110	530	29.9490	599.7000	659	.0958	9.7020	$<.01$	Significant
Lateral line scales	137	46.40	95.3200	403	46.3349	441.8000	538	.0988	.6578	$>.50$	Not significant
Total vertebrae	46	44.78	12.2264	74	45.1030	59.1459	118	.1460	2.2123	$<.05$	Significant
Trunk vertebrae	46	12.13	17.2174	74	12.3380	19.0014	118	.1040	2.0000	$<.05$	Significant
Caudal vertebrae without haemal spines	46	11.10	18.4600	74	11.4460	36.9965	118	.1240	2.6830	$<.01$	Significant
Caudal vertebrae with haemal spines	46	21.69	14.3340	74	21.3370	38.9966	118	.1261	2.7900	$<.01$	Significant
Vertebrae with duplicate neural spines	46	20.39	32.9566	74	20.5130	62.9993	118	.1691	.7273	$>.50$	Not significant
Vertebrae with single neural spine	46	24.61	22.9360	74	24.6210	69.9991	118	.1664	.0781	$>.50$	Not significant
Vertebrae with enlarged haemal canal	46	22.74	10.8696	73	22.9040	16.9991	117	.0778	2.1090	$<.05$	Significant

of vertebrae (excluding urostylar segment), trunk vertebrae, caudal vertebrae without haemal spines, caudal vertebrae with haemal spines, vertebrae with two neural spines, vertebrae with single neural spine and vertebra in which there is a sudden increase in the size of the haemal canal.

The significance in the mean values of the compared populations was tested statistically by 't' test and the results (Table 6) indicated that there is no significant difference between monsoon and winter migrants. Hence it is concluded that they belong to the same population .

Comparision of the Hilsa populations of Chilka and Hooghly

According to Pillay *et al.*, (1962) the hilsa populations of Chilka lake can be distinguished from those of Hooghly by certain meristic and non-meristic characters. The present studies revealed, biologically there is a disparity in the hilsa of Chilka and Hooghly in maturation and breeding. An attempt has been made to strengthen this view with reference to certain meristic characters. The same characters chosen for comparing monsoon and winter samples were considered for this purpose.

The data given by Pillay *et al.* (1962) for Hooghly hilsa has been utilised for comparison with Chilka hilsa by 't' test and the results are presented in the Table 7.

Pillay *et al.* (1962) have shown that the populations of Chilka and Hooghly differ significantly with reference to the following meristic characters.

1. Post pelvic scutes at 0.1% level ($P < 0.001$).
2. Total scutes at 0.1% level ($P < 0.001$).
3. Total vertebrae at 1% level ($P > 0.01$).
4. Vertebrae with enlarged haemal canal at 5% level ($P < 0.05$).

The present study revealed that the two populations are significantly different with reference to the following additional characters besides those already reported by Pillay *et al.* (1962)

1. Trunk vertebrae at 5% level ($P < 0.05$).
2. Caudal vertebrae without haemal spines at 1% level ($P < 0.01$).
3. Caudal vertebrae with haemal spines at 1% level ($P < 0.01$).

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