**Annexure 6**

**ANALYSIS OF SOME MORPHOMETRIC AND MERISTIC CHARACTERS OF** *HILSA ILISHA* **OF BANGLADESH WATERS**

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## 1. INTRODUCTION

The Hilsa Shad, Hilsa *ilisha* (Hamilton), is one of the most important species of food fish caught in Bangladesh and is a major source of protein in the people's diet and for providing employment. Over the past four decades or so, a number of reports have dealt with morphometric and meristic differences in *Hilsa ilisha* in the Indo-Bangladesh region. The important work on Bangladesh hilsa is that of Quddus et a/. (1984), besides brief studies of Quereshi (1968) and Shafi, Quddus and Hossain (1977). However, all these investigations had covered inland waters only — riverine and estuarine. From the review attempted by Raja (1985), it seems that these investigations have resulted in establishing individually different stocks in each of the major river systems in the Indo-Bangladesh region. In addition he had also drawn attention to the report of segregation of stocks into at least two varieties, a broad and slender one, in India, Bangladesh and Burma. It was also pointed out by him that no studies have been made on the composition, continuity, independence or interdependence of the stocks of the marine sector. Provisionally, based purely on the evidence of available literature, he suggested that there may be at least four stocks in the region, three anadromous and one marine. The three anadromous stocks may be distributed thus: one in the Indo-Bangladesh area, one in eastern Bangladesh and one in the central and southern regions of Burma. The marine stock may be contributing to the fishery of south-eastern Bangladesh coast contiguous with the Arakan coast of Burma. These are supposed to be in addition to the purely fluviatile stocks in the upper reaches of the five major river systems in India, Bangladesh and perhaps in Burma.

Because of the total lack of any racial studies on the hilsa of the marine environment, the investigations launched by the UNDP/FAO project "Marine Fishery Resources Management in the Bay of Bengal" included the aspect of racial studies in the programme to cover the hilsa from riverine, estuarine and marine environments,

All approaches were considered -biometric, biochemical, cytogenetic and tagging. It was also originally planned to subcontract the work to a university. Financial demands for undertaking biochemical/cytogenetic studies were too high to be accommodated within the project's budget. Tagging experiments are a still more expensive undertaking. Hence it was decided to limit the approach to the conventional one, biometrics. In its attempt at exploring the possibilities of subcontracting the studies to the university, the project lost considerable time. Hence the studies could be initiated only during the middle of the project period, September 1985, thus limiting the study period to about 6-7 months.

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## 2. MATERIALS AND METHODS

The samples were collected from September/October 1985 to March 1986 from the experimental and commercial catches from Cox's Bazar, Chittagong, Khepupara and Chandpur.

From Chandpur, an adequate sample size could not be obtained from experimental fishing; hence a part of the samples of Chandpur was procured either from the fishing ground or from the landing centre. For Khepupara, all the samples were procured from commercial catches since no experimental fishing could be conducted in that area. The number of fish examined from different stations by month and sex is shown in Table I.

Originally the plan was to examine the fish the same day they were procured in respect of Chandpur, Khepupara and Chittagong stations. Only with regard to Cox's Bazar would there be some delay in the arrival of iced samples at Chittagong, but they were to be examined immediately after. For this purpose the senior author was expected to be at Chittagong when the samples arrived but unfortunately he could not adhere to this plan. Consequently, the samples caught during experimental fishing were preserved in ice on board, and transferred to deep freeze after landing until they were taken up for examination. Except the Khepupara samples which were examined fresh, the other samples from the fishing grounds or from the landing centre were also kept in deep freeze for later examination. The period that elapsed between the time of procurement and the time of examination is shown in Table II.

The morphometric and meristic characters chosen ware those which had in the past been found to have exhibited significant differences. Such selected morphometric characters were the total length (TL), depth at dorsal origin (DP), head length (HL), thickness of body (TH), eye diameter (ED) and caudal peduncle length (CPL). The meristic characters selected are post-pelvic scutes (PS) and pectoral fin rays (PF).

Total length was measured with the help of a metre scale to the nearest millimeter, while body depth, caudal peduncle length, head length, thickness of body and eye diameter were measured with the help of a slide caliper. The accuracy of the slide caliper was 0.5 mm. All meristic counts and morphometric measurements were made following Pillay (1957).

The following definitions were applied to the characteristics measured or counted.

*Total length* (TL) is the distance from the tip of snout, when the mouth is closed, to the tip of the lower lobe of the caudal fin, when stretched out.

*Depth at dorsal origin* (DP) is the distance between the dorsal and ventral edges of the body as measured from the origin of dorsal fin.

*Head length* (HL) is the distance from the tip of snout, when mouth is closed, to the posterior-most point of the operculum.

*Thickness* of *body* (TH) is measured across the thickest part, usually at the 5th–6th lateral line scale of each side.

*Eye diameter* (ED) is measured longitudinally across the left eye.

*Caudal peduncle length* (CPL) is the distance from the posterior edge of the base of the anal fin to the base of caudal fin.

*Pectoral fin rays* (PF) is the number of the fin rays in the pectoral fin.

*Post-pelvic scutes* (PS) is the number of scutes posterior to the origin of the pelvic fin at the anal opening.

In addition, the individual weights of fish and stages of maturity were also recorded.

The data were subjected to regression analysis and analysis of covariance with the help of the Microstat Programme on an Apple IIe microcomputer.

The descriptive statistics of morphometric characters and those of meristic characters are shown in Table III and IV.

## 3. RESULTS

### (i) Morphometric characters

Among all the morphometric characters, the estimated regression statistics between TL vs DP, TL vs HL, TL vs TH, TL vs CPL and HL. vs ED between months and stations are shown in Table V to IX. It may be seen from these tables that only for the relationship between TL and HL (Table VI) was the $r^2$ value more or less uniformly high, at the level of 85 to 100% at all the stations, for the months of November to February. The data were therefore subjected to analysis of covariance. Since the $r^2$ values of other morphometric characters were very erratic and were not of a significant order, analysis of combinations of these variables, month-wise and station-wise, could not be justified. The erratic and/or low value of $r^2$ is attributed to the data being affected by a certain factor or factors. Hence no further treatment of data was taken up for other morphometric characters.

*Total length and head length*

The scatter diagrams for the variables is shown in Fig. 1, and the estimated parameters of the regression equation for the pooled data of each station in Table X. The analysis of covariance for the relationship between total length and head length showed that there were no significant differences in the slopes of the regression lines between stations, but the intercepts exhibited significant differences. The test for the intercepts indicated that those relating to Chittagong and Cox's Bazar were not different from each other and the same was the case between Chandpur and Khepupara. It was hence concluded that some factor could be responsible for this separation of Chittagong/Cox's Bazar fish on the one hand and Chandpur/Khepupara fish on the other.

It may be recalled that the frozen periods for different stations were different (Table II). In order to see whether differences in the frozen period could have affected the intercept, a dozen Hilsa from Chandpur were collected on 12-6-1986 and frozen till they were analysed on 1-7-1986.

Fig. 2 shows the relationship between the number of days of preservation and the values of intercept in the regression equation. It may be seen that the values of intercept increase as the days of preservation increased. After analysis it was found that while the value of the slope remained the same, i.e., 0.23, the value of intercept, 3.0278, falls on the line for the values obtained earlier on the basis of which Fig. 2 was drawn.

Since in the case of samples from Chittagong and Cox's Bazar the preservation days were more than double that of Chandpur, it is possible that the high values of intercept obtained for Chittagong and Cox's Bazar was due to the longer period of preservation. If this difference were to be rejected on the basis of this causal factor, the conclusion is that between TL and HL there is no significant difference between the samples of the four stations.

### (ii) Meristic characters

*Post-pelvic scutes:* Analysis of variance to test the significance of averages among four stations (Table XI) showed that there was no significant difference in the number of post-pelvic scutes among four stations, a conclusion which is completely different from earlier investigations on this character (Pillay, 1957 ; Rao, 1969 ; Quddus *et al., 1984).*

*Pectoral fin rays:* The results of analysis (Table XII) indicated the same conclusions as for the post-pelvic scutes, namely, no significant difference between the stations, which again is a departure from some of the earlier works (Rao, 1969, Quddus et *al., 1984).*

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In general, the results from these two characters did not indicate the existence of more than one race of **Hilsa ilisha** at the stations investigated, and there was no evidence or basis for an unbiased separation of samples for any comparative study.

## 4. SUMMARY

Nearly 500 specimens were measured from four stations representing marine, estuarine and riverine sectors. The morphometric characters selected for the study were total length, depth at dorsal origin, thickness of body, caudal peduncle length, head length and eye diameter; the meristic characters were post-pelvic scutes and pectoral fin rays.

Among the five different pairs of non-meristic characters, the correlation between four of them was found to be erratic and not significant. Although in the case of total length versus head length, the correlation was of high order and there were no significant differences in the regression coefficient, the differences in the values of intercept were traced to the differences in the period of storage under frozen conditions. Thus the results obtained on the morphometric data have to be totally rejected for reasons of defective methodology in preservation of fish.

Analysis of variance on the two meristic characters showed that there were no significant differences in the mean values between stations.

## 5. LITERATURE CITED

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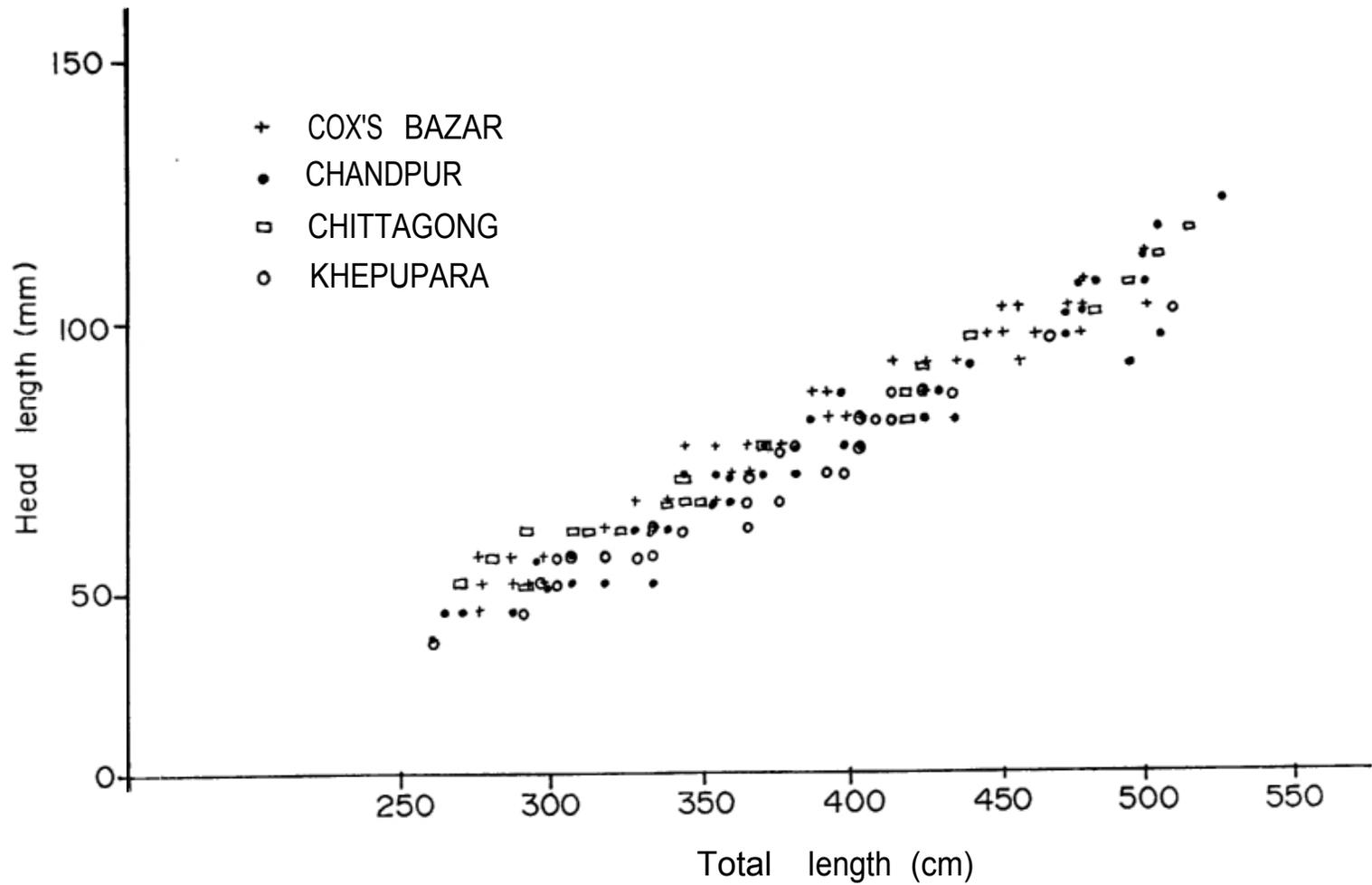
Fig. 1 Scatter diagram of Total Length (TL) versus Head Length (HL) of *Hilsa ilisha,* at Cox's Bazar Chittagong, Khepupara and Chandpur.
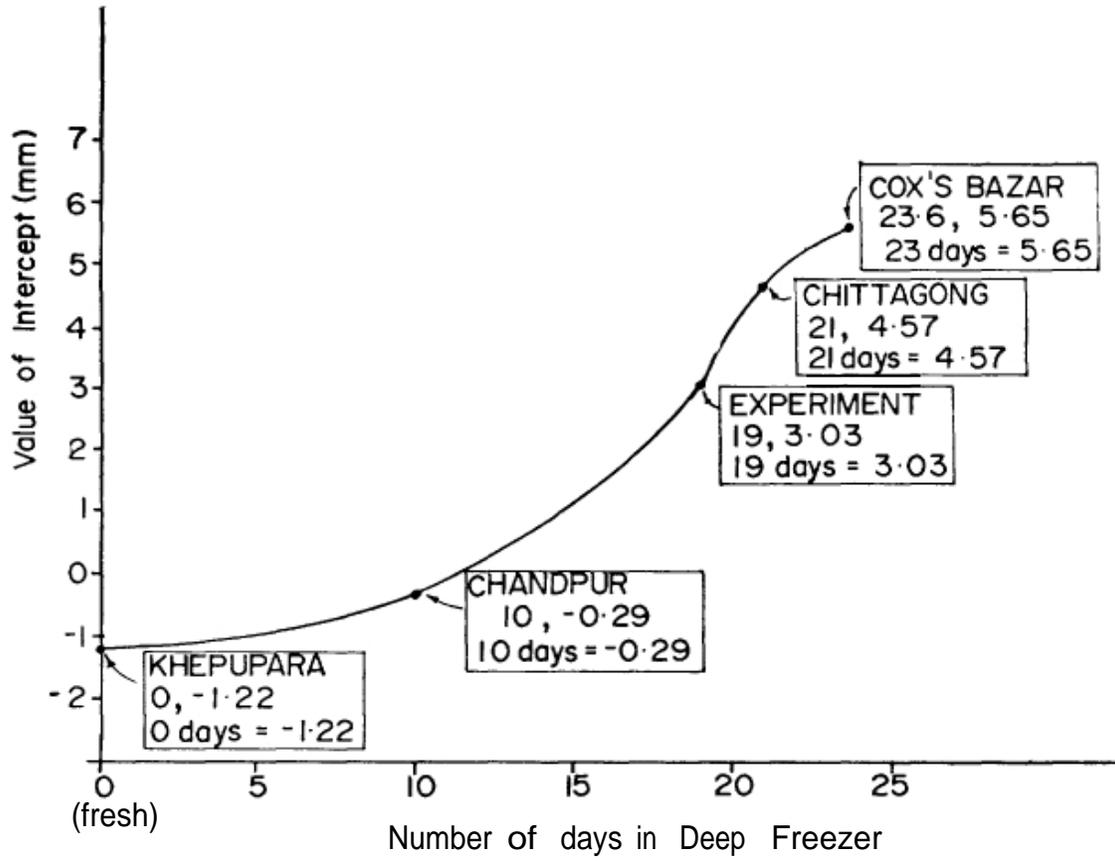
Fig. 2 Relationship between period of preservation of *Hilsa ilisha* in deep-freezer and intercept values obtained from regression analysis of "total length versus head length".

**Table I**

**Number of fish examined by month, sex and station**

| Month | Cox's Bazar | | | Chittagong | | | Chandpur | | | Khepupara | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female | Male | Total | Female | Male | Total | Female | Male | Total | Female | Male | Total |
| Sep. 1985 | — | — | — | — | — | — | 5 | 21 | 26 | — | — | — |
| Oct. 1985 | 14 | 7 | 21 | 18 | 5 | 23 | 10 | 10 | 20 | — | — | — |
| Nov. 1985 | 15 | 3 | 18 | 9 | 12 | 21 | 12 | 12 | 24 | 8 | 12 | 20 |
| Dec. 1985 | 14 | 10 | 24 | 11 | 12 | 23 | 4 | 15 | 19 | 2 | 18 | 20 |
| Jan. 1986 | 12 | 7 | 19 | — | — | — | 7 | 8 | 15 | 14 | 10 | 24 |
| Feb. 1986 | 3 | 15 | 18 | 7 | 11 | 18 | 7 | 8 | 15 | 10 | 14 | 24 |
| March 1986 | 13 | 10 | 23 | 15 | 10 | 25 | 10 | 14 | 24 | 6 | 18 | 24 |
| Total | 71 | 52 | 123 | 60 | 50 | 110 | 55 | 88 | 143 | 40 | 72 | 112 |

**Table II**

**Interval between collection of samples and their examination**

| Station | Date of collection | Date of examination | Period under frozen condition | Average period of preservation |
|---|---|---|---|---|
| Chittagong | Sept. 15 | Oct. 10 | 25 | |
| | Oct. 14 | Oct. 29 | 15 | |
| | Nov. 14 | Nov. 27 | 13 | 21 days |
| | Dec. 23 | Jan. 25 | 33 | |
| | Feb. 20 | Mar. 21 | 29 | |
| | Mar. 15 | Mar. 26 | 11 | |
| Chandpur | Sept. 25 | Oct. 7 | 12 | |
| | Oct. 28 | Nov. 12 | 15 | |
| | Nov. 28 | Dec. 1 | 4 | |
| | Dec. 26 | Dec. 27 | 1 | 10 days |
| | Jan. 26 | Jan. 28 | 2 | |
| | Feb. 27 | Mar. 23 | 24 | |
| | Mar. 25 | Apr. 5 | 12 | |
| Cox's Bazar | Sept. 7 | Oct. 2 | 25 | |
| | Oct. 7 | Oct. 30 | 23 | |
| | Nov. 7 | Nov. 28 | 21 | |
| | Dec. 27 | Jan. 25 | 29 | 23.6 days |
| | Jan. 7 | Jan. 26 | 19 | |
| | Feb. 20 | Mar. 21 | 29 | |
| | Mar. 7 | Mar. 26 | 19 | |
| Khepupara | Nov. 19 | Nov. 19 | 0 | |
| | Dec. 23 | Dec. 23 | 0 | |
| | Jan. 19 | Jan. 19 | 0 | 0 days |
| | Feb. 19 | Feb. 19 | 0 | |
| | Mar. 31 | Mar. 31 | 0 | |

## Table III

**Minimum and maximum values of morphometric characters and weight of fish at different sampling stations**

|  |  | Chittagong | Chandpur | Cox's Bazar | Khepupara |
|---|---|---|---|---|---|
| Total length (TL) | Min | 288 | 262 | 287 | 279 |
|  | Max | 488 | 529 | 488 | 488 |
| Depth at dorsal origin (DP) | Min | 72.3 | 44.4 | 58.5 | 75.8 |
|  | Max | 123.4 | 138.6 | 135.3 | 136.8 |
| Head length (HL) | Min | 69.85 | 40.6 | 68.2 | 63.4 |
|  | Max | 117.1 | 122.3 | 114.4 | 115.6 |
| ,Caudal peduncle length (CPL) | Min | 19.5 | 10.8 | 19.6 | 20.2 |
|  | Max | 39.1 | 51.2 | 35.45 | 35.2 |
| Eye diameter (ED) | Min | 9.8 | 10 | 10.4 | 10.08 |
|  | Max | 15.8 | 20.3 | 15.4 | 18.2 |
| Weight (WT) | Min | 190 | 140 | 220 | 260 |
|  | Max | 1330 | 1600 | 1420 | 1320 |

## Table IV

**Descriptive statistics for meristic character examined**

| Meristic character |  | Chittagong | Chandpur | Cox's Bazar | Khepupara |
|---|---|---|---|---|---|
|  |  | n=136 | n=121 | n=130 | n=113 |
|  | Min | 12 | 11 | 10 | 12 |
| Post-pelvic scutes (PS) | Max | 15 | 15 | 14 | 15 |
|  | Mean | 13.1324 | 13.1135 | 12.9813 | 13.1681 |
|  | Std. Dev. | 0.541723 | 0.631246 | 0.507452 | 0.532894 |
|  |  | n=142 | n = I I I | n=133 | n = I I I |
|  | Min | 14 | 13 | 14 | 13 |
| 'Pectoral fin rays (PF) | Max | 16 | 15 | 16 | 16 |
|  | Mean | 14.7817 | 14.5594 | 14.7929 | 14.5664 |
|  | Std. Dev. | 0.49273 | 0.51214 | 0.533137 | 0.564992 |

**Table V**

Regression statistics on the relationship between depth (DP) at dorsal origin and total length (TL) with sex combined and separated by station and by month

(CTG=-Chittagong;     CHA=Chandpur;   CB=Cox's     Bazar;   KHE=Khepupara)

| Month | Station | Sex Slope | Combined Intercept | n | $r^2$ | n | Male $r^2$ | Female $r^2$ | n |
|-------|---------|-----------|--------------------|---|-------|---|-----------|-------------|---|
| October | CTG | 0.27 | 0.97 | 23 | 0.42 | 5 | 0.8243 | 0.4049 | 18 |
| | CHA | 0.19 | 30.36 | 20 | 0.51 | 10 | 0.8029 | 0.2752 | 10 |
| | CB | 0.28 | -4.97 | 21 | 0.76 | 7 | 0.9111 | 0.4311 | 14 |
| | KHE | – | – | – | – | – | – | – | – |
| November | CTG | 0.21 | 17.90 | 21 | 0.91 | 12 | 0.9258 | 0.9696 | 9 |
| | CHA | 0.26 | 4.00 | 24 | 0.88 | 12 | 0.9604 | 0.5636 | 12 |
| | CB | 0.1 9 | 33.18 | 18 | 0.62 | 3 | 0.6955 | 0.7889 | 15 |
| | KHE | 0.21 | 21.89 | 20 | 0.76 | 12 | 0.7059 | 0.9643 | 8 |
| December | CTG | 0.27 | -4.66 | 23 | 0.91 | 12 | 0.9567 | 0.9228 | 11 |
| | CHA | 0.24 | 10.47 | 19 | 0.95 | 15 | 0.8684 | 0.9821 | 4 |
| | CB | 0.22 | 13.85 | 24 | 0.82 | 10 | 0.7764 | 0.8427 | 14 |
| | KHE | 0.18 | 30.64 | 20 | 0.70 | 18 | 0.7599 | – | 2 |
| January | CTG | – | – | – | – | – | – | – | – |
| | CHA | 0.27 | -1.05 | 15 | 0.92 | 8 | 0.6872 | 0.8966 | 7 |
| | CB | 0.25 | -3.55 | 19 | 0.90 | 7 | 0.9072 | 0.8847 | 12 |
| | KHE | 0.27 | 1.51 | 24 | 0.70 | 10 | 0.5584 | 0.5751 | 14 |
| February | CTG | 0.18 | 35.36 | 18 | 0.44 | 11 | 0.5728 | 0.0781 | 7 |
| | CHA | 0.32 | -19.52 | 15 | 0.96 | 8 | 0.9188 | 0.8325 | 7 |
| | CB | 0.22 | 10.94 | 18 | 0.30 | 15 | 0.2871 | 0.9996 | 3 |
| | KHE | 0.23 | 13.13 | 24 | 0.84 | 14 | 0.8327 | 0.6341 | 10 |
| March | CTG | 0.23 | 8.50 | 25 | 0.74 | 10 | 0.0317 | 0.7120 | 15 |
| | CHA | 0.17 | 31.41 | 24 | 0.57 | 14 | 0.4678 | 0.7294 | 10 |
| | CB | 0.26 | -4.36 | 23 | 0.80 | 10 | 0.8199 | 0.7670 | 13 |
| | KHE | 0.30 | -16.83 | 24 | 0.88 | 18 | 0.8567 | 0.8417 | 6 |

## Table VI

### Regression statistics on the relationship between head length (HL) and total length (TL) by month and station

| Month | Station | Slope | Intercept | $r^2$ | n |
|---|---|---|---|---|---|
| October | CTG | 0.23 | 5.28 | 0.86 | 23 |
| | CHA | 0.22 | 9.64 | 0.80 | 20 |
| | CB | 0.21 | 12.88 | 0.93 | 21 |
| | KHE | — | — | — | — |
| November | CTG | 0.23 | 2.56 | 1.00 | 21 |
| | CHA | 0.23 | 1.17 | 0.94 | 24 |
| | CB | 0.20 | 16.16 | 0.94 | 18 |
| | KHE | — | — | — | — |
| December | CTG | 0.22 | 6.01 | 0.97 | 23 |
| | CHA | 0.22 | 3.49 | 0.99 | 19 |
| | CB | 0.22 | 6.29 | 0.96 | 24 |
| | KHE | 0.25 | -7.28 | 0.97 | 20 |
| January | CTG | — | — | — | — |
| | CHA | 0.23 | 0.82 | 0.95 | 15 |
| | CB | 0.22 | 4.85 | 0.99 | 19 |
| | KHE | 0.23 | -0.68 | 0.93 | 24 |
| February | CTG | 0.26 | -9.67 | 0.75 | 18 |
| | CHA | 0.24 | -2.64 | 0.99 | 15 |
| | CB | 0.27 | -8.89 | 0.95 | 18 |
| | KHE | 0.22 | 6.81 | 0.92 | 24 |
| March | CTG | 0.25 | -7.59 | 0.85 | 25 |
| | CHA | 0.13 | 31.89 | 0.58 | 24 |
| | CB | 0.21 | 12.86 | 0.89 | 23 |
| | KHE | 0.24 | -2.92 | 0.92 | 24 |

Table VII

Regression statistics on the relationship **between** thickness of
body (TH) and total length (TL) by sex, month and station

| Month | Sex | Station | Slope | Intercept | $r^2$ | n |
|---|---|---|---|---|---|---|
| October | Female | CTG | 0.0769 | 13.6226 | 0.2989 | 18 |
| | | CHA | 0.0509 | 26.4186 | 0.4301 | 10 |
| | | CB | 0.0961 | 8.7043 | 0.5021 | 14 |
| | | KHE | — | — | — | — |
| October | Male | CTG | 0.2410 | -1.3907 | 0.9558 | 5 |
| | | CHA | 0.0646 | 18.0475 | 0.4192 | 10 |
| | | CB | 0.1362 | -9.0618 | 0.8224 | 7 |
| | | KHE | — | — | — | — |
| November | Female | CTG | 0.1019 | 3.8713 | 0.9598 | 9 |
| | | CHA | 0.0836 | 14.3803 | 0.4943 | 12 |
| | | CB | 0.0802 | 16.2136 | 0.3195 | 15 |
| | | KHE | 0.0867 | 11.0026 | 0.8268 | 8 |
| November | Male | CTG | 0.2140 | 7.8892 | 0.9917 | 12 |
| | | CHA | 0.1122 | 6.6294 | 0.7296 | 12 |
| | | CB | -0.1036 | 82.0281 | 0.2379 | 3 |
| | | KHE | 0.0727 | 13.7824 | 0.3010 | 12 |
| December | Female | CTG | 0.1385 | -7.5309 | 0.7289 | 11 |
| | | CHA | 0.0471 | 30.3289 | 0.6222 | 4 |
| | | CB | 0.1369 | -8.7068 | 0.9298 | 14 |
| | | KHE | — | — | — | — |
| December | Male | CTG | 0.1049 | 1.8133 | 0.7180 | 12 |
| | | CHA | 0.1063 | 7.3638 | 0.7477 | 15 |
| | | CB | 0.0869 | 9.5123 | 0.7121 | 10 |
| | | KHE | 0.0620 | 21.3347 | 0.6524 | 18 |
| January | Female | CTG | — | — | — | — |
| | | CHA | 0.0907 | 10.4579 | 0.8761 | 7 |
| | | CB | 0.1540 | -16.7977 | 0.8970 | 12 |
| | | KHE | 0.0727 | 17.7859 | 0.6830 | 14 |
| January | Male | CTG | — | — | — | — |
| | | CHA | 0.0014 | -8.1417 | 0.5233 | 8 |
| | | CB | 0.1131 | 0.3027 | 0.7894 | 7 |
| | | KHE | 0.0616 | 20.9932 | 0.4488 | 10 |
| February | Female | CTG | -0.0253 | 60.5406 | 0.0220 | 7 |
| | | CHA | 0.1789 | -31.3052 | 0.6197 | 7 |
| | | CB | 0.2275 | -35.4532 | 0.8620 | 3 |
| | | KHE | 0.0446 | 27.7230 | 0.4253 | 10 |
| February | Male | CTG | 0.0545 | 24.8258 | 0.1570 | 11 |
| | | CHA | 0.1378 | -8.5301 | 0.6512 | 8 |
| | | CB | 0.1279 | -4.4318 | 0.7527 | 15 |
| | | KHE | 0.0923 | 9.1503 | 0.6555 | 14 |
| March | Female | CTG | 0.0412 | 29.5690 | 0.2502 | 15 |
| | | CHA | 0.0699 | 21.4957 | 0.3496 | 10 |
| | | CB | 0.1070 | 0.3080 | 0.7781 | 13 |
| | | KHE | 0.0961 | 4.4403 | 0.7327 | 6 |
| March | Male | CTG | 0.1524 | -17.4828 | 0.3301 | 10 |
| | | CHA | 0.0492 | 17.3203 | 0.3831 | 14 |
| | | CB | 0.1138 | 0.7238 | 0.7183 | 10 |
| | | KHE | 0.1325 | -7.3213 | 0.6199 | 18 |

**Table VIII**

Regression statistics on the relationship between caudal peduncle length (CPL) and total length (TL) by month and station (sex combined)

| Month | Station | Slope | Intercept | $r^2$ | n |
|---|---|---|---|---|---|
| | CTG | 0.0930 | -8.5158 | 0.5074 | 23 |
| | CHA | 0.0704 | 0.7623 | 0.7683 | 20 |
| October | CB | 0.0625 | 4.1248 | 0.6015 | 21 |
| | KHE | — | — | — | — |
| | CTG | 0.0885 | -5.0843 | 0.9471 | 21 |
| | CHA | 0.1065 | -12.6249 | 0.7679 | 24 |
| November | CB | 0.0651 | 3.1477 | 0.6448 | 18 |
| | KHE | 0.0685 | 1.4547 | 0.6703 | 20 |
| | CTG | 0.0712 | 0.4181 | 0.8285 | 23 |
| | CHA | 0.0843 | -4.8500 | 0.8812 | 19 |
| December | CB | 0.0641 | 2.5350 | 0.8901 | 24 |
| | KHE | 0.0759 | -0.9208 | 0.8158 | 20 |
| | CTG | — | — | — | — |
| | CHA | 0.0493 | 6.8991 | 0.8750 | 15 |
| January | CB | 0.0499 | 8.1233 | 0.7994 | 19 |
| | KHE | 0.0551 | 5.6477 | 0.4954 | 24 |
| | CTG | 0.0510 | 8.3137 | 0.1712 | 18 |
| | CHA | 0.0503 | 9.4707 | 0.4312 | 15 |
| February | CB | 0.0607 | 4.6054 | 0.3470 | 18 |
| | KHE | 0.0601 | 3.4518 | 0.6703 | 24 |
| | CTG | 0.0669 | 1.3451 | 0.2788 | 25 |
| | CHA | 0.0426 | 9.4204 | 0.5868 | 24 |
| March | CB | 0.0410 | 13.9919 | 0.3975 | 23 |
| | KHE | 0.0263 | 16.8228 | 0.2331 | 24 |

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**Table IX**

**Regression statistics on the relationship between Head Length (HL) and Eye Diameter (ED) by month and by station (sex combined)**

| Month | Station | Slope | Intercept | $r^2$ | n |
|---|---|---|---|---|---|
| | CTG | 0.0738 | 6.0068 | 0.3623 | 23 |
| | CHA | 0.1439 | -1.1495 | 0.3835 | 20 |
| October | CB | 0.0749 | 5.7675 | 0.6068 | 21 |
| | KHE | — | — | — | — |
| | CTG | **0.0922** | 4.2445 | **0.9042** | 21 |
| | CHA | 0.0823 | 5.4694 | 0.8512 | 24 |
| November | CB | 0.1180 | 1.6617 | 0.7776 | 18 |
| | KHE | — | — | — | — |
| | CTG | **0.0936** | 4.0142 | 0.8201 | 23 |
| | CHA | 0.0787 | 5.5047 | 0.7247 | 19 |
| December | CB | 0.0782 | 5.8367 | 0.6687 | 24 |
| | KHE | 0.1119 | 3.3214 | 0.8114 | 20 |
| | CTG | — | — | — | — |
| | CHA | 0.0623 | **7.2982** | 0.4714 | 15 |
| January | CB | 0.0820 | 5.2841 | 0.7601 | 19 |
| | KHE | 0.0821 | 6.0749 | 0.2793 | 24 |
| | CTG | 0.0475 | 8.7574 | 0.1699 | 18 |
| | CHA | 0.0794 | 5.0583 | 0.8404 | 15 |
| February | CB | 0.0701 | 6.2683 | 0.4071 | 18 |
| | KHE | 0.0478 | 9.1752 | 0.3277 | 24 |
| | CTG | 0.0371 | **9.7882** | 0.0800 | 25 |
| | CHA | 0.0774 | 5.8876 | 0.8432 | 24 |
| March | CB | 0.0493 | 8.2810 | 0.0821 | 23 |
| | KHE | 0.0864 | 5.1045 | 0.6961 | 24 |

**Table X**

**Regression statistics of the posted data on the relationship between Head Length (HL) and Total Length (TL) by stations**

| Station | N | Pooled months | $r^2$ | Slope | Intercept | TL (Max; Min) in mm | Average number of days after freezing |
|---|---|---|---|---|---|---|---|
| Chittagong | 44 | Nov. to Feb. | 0.9890 | 0.2268 | 4.5702 | 487; 288 | 21.0 |
| Chandpur[1] | 99 | Nov. to Feb. | 0.9732 | 0.2351 | -0.2862 | 529; 278 | 10.0 |
| Cox's Bazar | 79 | Nov. to Feb. | 0.9688 | 0.2245 | 5.6538 | 473; 287 | 23.6 |
| Khepupara[2] | 68 | Nov. to Feb. | 0.9517 | 0.2365 | -1.2254 | 488; 279 | 0 |

[1]Sept. data included
[2]No data for November

## Table XI

### Analysis of variance on mean values of post-pelvic scutes for the four sampling stations

Analysis of variance
One-way anova

| Station | | | | Range | Mean | In |
|---|---|---|---|---|---|---|
| Chittagong | . . | . . | . . | 12-15 | 13.132 | 136 |
| Chandpur | . . | . . | . . | 11-15 | 13.116 | 121 |
| Cox's Bazar | . . | . . | . . | 10-14 | 12.992 | 130 |
| Khepupara | . . | . . | . . | 12-15 | 13.168 | 113 |
| Pooled | . . | . . | . . | 10-15 | 13.100 | 500 |

Analysis of variance

| Source | Sum of squares | D.F. | Mean square | F Ratio |
|---|---|---|---|---|
| Between | 2.205 | 3 | 0.735 | 2.267 |
| Within | 160.795 | 496 | 0.324 | |
| Total | 163.000 | 499 | | |

## Table XII

### Analysis of variance on mean values of pectoral fin rays for the four sampling stations

Analysis of variance
One-way anova

| Station | | | | Range | Mean | In |
|---|---|---|---|---|---|---|
| Chittagong | . . | . . | . . | 14-16 | 14.782 | 142 |
| Chandpur | . . | . . | . . | 13-15 | 14.613 | 111 |
| Cox's Bazar | . . | . . | . . | 14-16 | 14.722 | 1333 |
| Khepupara | . . | . . | . | 13-16 | 14.676 | 111 |
| Pooled | . . . . . . | | | 13-16 | 14.704 | 497 |

Analysis of variance

| Source | Sum of squares | D.F. | Mean square | F Ratio |
|---|---|---|---|---|
| Between | 1.915 | 3 | 0.638 | 2.321 |
| Within | 135.606 | 493 | 0.275 | |
| Total | 137.52 1 | 496 | | |