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Reproductive biology of three important Indigenous small fish viz., Mola (*Amblypharyngodon mola*), Chela (*Chela cachius*) and Punti (*Puntius sophore*)

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Abstracts: Reproductive biology of three important small indigenous fish species mola (*Amblypharyngodon mola*), punti (*Puntius sophore*) and chela (*Chela cachius*) was studied for 12 months from January to December, 1999 in the Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. Gonadosomatic index (GSI) and ova diameter were analysed to determine their reproductive cycle. Three hundreds sixty female and one hundred forty four male samples of each species of fish, mola (*Amblypharyngodon mola*), punti (*Puntius sophore*) and chela (*Chela cachius*) were examined in this study. The GSI values for female mola, punti and chela ranged from 1.78±0.88 to 17.06±2.66, 1.16±0.64 to 24.81±1.50 and 1.34±0.64 to 10.19±2.17, respectively. The highest values of the GSI in mola and punti were obtained during July while that of chela, during June. The results of monthly observations on the ova diameter indicated that mola, punti and chela spawned at least twice a year, once during May-July and again during September-October.

Keywords: Reproductive biology, Mola (*Amblypharyngodon mola*), Chela (*Chela cachius*), Punti (*Puntius sophore*), GSI, Ovadiamter, Bangladesh

Introduction

Indian major carps and Chinese carp have been cultured in Bangladesh for the last two decades as a mean of increasing fish production from aquaculture (Akand *et al.*, 1991). Small fish species have been regarded as competitor with carps, and, culture practices were directed at eradication of them from aquaculture systems (Kohinoor *et al.* 1998). They were also thought to have had a lower food conversion rate than carps. In the past, such species of fish had a lower market value, partly because of their abundance in the natural water bodies. For this reason, there was very little effort to raise and culture small fish commercially.

In recent years, the natural production of small indigenous fish species (SIS) has been declining. There have been major losses of their natural habitats as well as breeding grounds due to implementation of flood control, drainage and irrigation projects, which have considerably reduced the area and duration of flooding (Hussain *et al.* 1997). As a consequence, most of the perennial beels have become seasonal water bodies with no possibility for the brood small fish to survive for the next breeding season. Moreover, increased fishing pressure from an increased population, incidence of fish disease (especially epizootic ulcerative syndrome) and de-watering of natural water bodies for irrigation and fishing purposes have resulted in the depletion of natural stocks of such species.

Some small indigenous species have high nutritional value in terms of protein, fats, micro nutrients, vitamins and minerals, the micro nutrients that are not commonly available in other foods sources of Bangladeshi people. Since these species are normally cooked and eaten whole, their effects on the diet are further enhanced since the bones also provide rich source of calcium. Further more, mola (*Amblypharyngodon mola*), punti (*Puntius sophore*) and chela (*Cŝteobrama cotio cotio*) contain more available vitamin-A than any other edible freshwater fish of Bangladesh (Thilsted *et al.* 1997).

Study on reproductive biology of any given fish is essential for evaluating the commercial potentialities of its stock, life history, culture practice and actual management of its fishery (Doha & Hye, 1970). Reproductive potential of a population is one of the basic exigencies to designate the individuals of that population in respect to their gonadal conditions (Jhingran & Verma, 1972). Therefore, in order to be successful in fish culture, it is important to assess the yearly breeding cycle of culturable fish. Spawning of fish occurs during a particular phase of the reproductive cycle. Some fishes breed once a year, while some at regular intervals throughout the year. Knowledge of gonadal development and the spawning season of a species allow subsequent studies on spawning frequency of its population, which is important for its management. A thorough understanding of the early development of a fish species is also considered as an important step for the fish culturists. Very few works has been done in such direction in this country (Afroze & Hossain, 1990; Mustafa, 1991; Afroze, 1996 & Begum, 1997).

The aim of the present study was to determine the natural reproductive cycle of mola (*A. mola*), punti (*P. sophore*) and chela (*C.cachius*) based on their gonado-somatic index (GSI) and ova diameter.

Materials and Methods

Sample collection and preservation

Live samples comprised of 30 female and 12 male fish of each species of mola (*Amblypharyngodon mola*), chela (*Chela cachius*) and punti (*Puntius sophore*) were collected by seine net monthly throughout the research period during January to December 1999 from the ponds of Field Laboratory of Fisheries Faculty, Bangladesh Agricultural University. After collection, the live specimens were brought to the laboratory and the gonads of females and males were taken out through dissection and used for further studies.

Methods for determining the reproductive periodicity

Following methods were used to determine the reproductive periodicity of these fish:

(a) Gonado Somatic Index (GSI)

GSI is a well-known method, frequently applied to determine the spawning frequency of fish and crustaceans. The Gonadosomatic Index (GSI) was calculated according to the following formula (Lagler, 1956):

$$GSI = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100$$

(b) Diameter of ova

When an ovary of a fish was removed, small representative parts from anterior, posterior and middle portions of them were taken separately. The ova of the samples was separated in a physiological saline solution (0.65% NaCl) media contained with a petridish and spread on a glass slide to measure the diameter under a microscope with an ocular micrometer. The unit of the ocular micrometer, visible under the microscope, was standardized with a stage micrometer for measurement of ova diameter in micrometer (μm). At least 300 ova of a single sample of each species were measured and observed values for ova diameter was expressed in unit value of the ocular micrometer. Observed values of ova diameter are measured as 1 unit = 10 μm (using a microscope with 10X10 = 100 times magnification).

Statistical analysis

The software statistical packages viz., MICROSTAT and Excel for Windows'97 were used to determine the frequency distribution of ova diameter.

Results

Gonadosomatic Index (GSI)

Mola (*A. mola*)

The GSI values for female mola was found to range from 1.78±0.88 to 17.06 ±2.66. The maximum GSI value was found in July, which indicated the period of maximum gonadal growth. In May, a sharp increase in the mean of GSI value and further sharp drop in the GSI in August, might have been caused by spawning. Again, the GSI value increased in September and then further decreased gradually in successive months (Table 1). Monthly variations in GSI values of male mola are presented in Table 2, which showed the range of values from 0.46±0.17 to 1.79±0.94. It is evident, from the results, that the GSI values increased slowly from January to May, then sharply increased in June, again the values began to fall slowly from July up to December.

Table 1: Mean and standard deviation (±SD) of total body weight total length, gonad weight and GSI (%) at successive months in female mola

Month	o. of fish examined	Total length (cm)	Body weight (g)	Gonad weight (g)	GSI (%)
January	30	5.02±0.50	1.12±0.99	0.020±0.034	1.78±0.88
February	30	5.12±0.44	1.13±0.26	0.029±0.01	2.57±0.78
March	30	5.85±0.52	1.94±0.93	0.13±0.09	6.70±2.27
April	30	6.5±0.54	2.90±0.82	0.33±0.15	11.18±3.83
May	30	6.98±0.55	3.80±0.89	0.55±0.20	14.47±2.95
June	30	7.34±0.59	4.37±1.02	0.67±0.25	15.33±2.99
July	30	7.42±0.58	5.04±1.01	0.86±0.22	17.06±2.66
August	30	7.29±1.36	6.28±1.05	0.89±0.46	14.17±6.43
September	30	6.98±0.74	4.20±1.49	0.71±0.43	16.90±5.89
October	30	7.20±0.68	4.10±1.35	0.42±0.31	10.24±4.61
November	30	7.37±0.67	3.82±1.05	0.24±0.17	6.28±4.39
December	30	7.31±0.84	4.33±1.59	0.17±0.21	3.92±2.70

Table 2: Mean and standard deviation (±SD) of total body weight, total length, gonad weight and GSI (%) at successive months in male mola

Month	No. of fish examined	Total length (cm)	Body weight (g)	Gonad weight (g)	GSI (%)
January	12	5.46±0.36	1.15±0.29	0.008±0.001	0.69±0.21
February	12	5.5±0.32	1.19±0.26	0.010±0.002	0.84±0.26
March	12	5.28±0.34	1.20±0.21	0.013±0.003	1.08±0.29
April	12	5.36±0.24	1.40±0.15	0.016±0.009	1.14±0.35
May	12	5.5±0.26	1.58±0.28	0.021±0.006	1.32±0.31
June	12	5.75±0.27	1.78±0.28	0.032±0.003	1.79±0.94
July	12	5.68±0.23	1.69±0.15	0.029±0.0024	1.71±0.37
August	12	5.98±0.26	1.89±0.21	0.028±0.009	1.48±0.40
September	12	5.68±0.37	1.71±0.31	0.020±0.005	1.17±0.34
October	12	5.73±0.33	1.70±0.25	0.016±0.53	0.94±0.31
November	12	6.56±1.31	1.75±0.24	0.014±0.06	0.80±0.22
December	12	5.75±0.35	1.74±0.17	0.008±0.003	0.46±0.17

Chela (*C. cachius*)

The average monthly GSI values indicated that the gonads of female chela developed slowly from January to April, and rapidly developed from April to July. The GSI values recorded in June and July showed the peak of gonadal development. In August, the value began to decline suddenly and kept that trend during the followed months up to December. Range of GSI values for female of chela was found between 1.34±0.64 and 10.19±2.17 (Table 3). The GSI values obtained for male chela are presented in Table 4, which rang between 0.43±0.39 and 2.56±0.43. The testes developed slowly from January to March, after which the GSI value increased successively up to June indicating that the June is the peak of maturation period for male chela. After June, the GSI value decreased sharply in July and gradually decreasing up to December.

Table 3: Mean and standard deviation (±SD) of total body weight, total length, gonad weight and GSI (%) at successive months in female chela

Month	o. of fish examined	Total length (cm)	Body weight (g)	Gonad weigh (g)	GSI (%)
January	30	7.05±0.20	2.64±0.24	0.04±0.02	1.36±0.70
February	30	7.46±0.55	2.76±0.80	0.13±0.70	4.71±2.40
March	30	7.78±0.54	2.88±1.18	0.19±0.14	6.59±2.31
April	30	7.85±0.38	2.85±0.40	0.20±0.50	7.01±1.45
May	30	7.74±0.26	2.81±0.44	0.25±0.08	8.89±2.10
June	30	7.97±0.47	3.04±0.47	0.31±0.11	10.19±2.17
July	30	7.85±0.37	2.97±0.39	0.30±0.33	10.10±3.39
August	30	7.95±0.35	3.18±0.53	0.28±0.07	8.80±1.73
September	30	7.70±0.77	2.75±0.87	0.18±0.09	6.54±2.23
October	30	7.50±0.60	2.46±0.45	0.11±0.06	4.47±1.88
ovember	30	7.41±0.60	2.37±0.67	0.07±0.08	2.95±2.63
ecember	30	8.13±0.40	2.97±0.41	0.04±0.01	1.34±0.64

Table 4: Mean and standard deviation (±SD) of total body weight, total length, gonad weight and GSI (%) at successive months in male chela

Month	No. of fish examined	Total length (cm)	Body weight (g)	Gonad weight (g)	GSI (%)
January	12	8.32±0.69	2.51±0.61	0.020±0.001	0.80±0.16
February	12	7.26±0.37	2.53±0.27	0.037±0.01	1.46±0.39
March	12	7.57±0.31	2.55±0.35	0.039±0.014	1.53±0.45
April	12	7.82±0.52	2.68±0.36	0.047±0.028	1.75±0.28
May	12	7.71±0.31	2.67±0.41	0.059±0.049	2.20±0.46
June	12	8.01±0.46	3.12±0.45	0.080±0.01	2.56±0.43
July	12	8.21±0.24	3.46±0.53	0.064±0.02	1.85±0.38
August	12	8.18±0.35	3.60±0.46	0.065±0.030	1.81±0.78
September	12	8.27±0.35	3.61±0.43	0.059±0.02	1.63±0.49
October	12	7.99±0.30	3.21±0.51	0.043±0.01	1.33±0.23
November	12	7.92±0.64	3.11±0.70	0.031±0.01	0.99±0.44
December	12	9.13±0.45	3.0 4±0.91	0.013±0.26	0.43±0.39

Punti (*P. sophore*)

The GSI values for female of punti was found to range from 1.16±0.36 to 24.81±1.50 (Table 5). It has been found that the GSI values developed slowly from January to April. It increased rapidly in May and reaching to its maximum value in July and remained high until August where it was evident that the peak GSI values lied between July and August. The GSI values began to fall steeply from August to October showing the beginning of refractory period. The GSI developments of male gonad of punti are given in Table 6. The values ranged between 0.39±0.08 and 4.11±0.52. In the first few months, from January to May, GSI values indicate that the gonads developed slowly. From May to June, the gonad development of male punti was found to increase successively. After June, the values of GSI decreased gradually until December.

Table 5: Mean and standard deviation (±SD) of total body weight, total length, gonad weight and GSI (%) at successive months in female punti

Month	No. of fish examined	Total length (cm)	Body weight (g)	Gonad weight (g)	GSI (%)
January	30	8.84±0.94	8.96±1.56	0.10±0.14	1.16±0.36
February	30	8.25±1.38	7.79±3.79	0.31±0.22	3.85±0.41
March	30	8.14±0.78	6.88±2.16	0.53±0.32	7.70±2.66
April	30	8.38±0.96	8.65±2.2	0.98±0.49	11.32±5.05
May	30	8.32±0.92	8.32±2.39	1.57±0.47	18.94±0.47
June	30	9.81±0.75	14.30±3.58	3.04±0.88	21.26±2.36
July	30	9.0±1.10	12.16±4.75	3.01±1.50	24.81±1.50
August	30	9.0±0.99	9.56±3.30	2.34±1.02	24.51±1.13
September	30	8.15±0.64	8.30±2.03	1.57±0.83	18.92±2.23
October	30	8.66±0.60	9.60±2.60	1.08±0.55	11.26±1.07
November	30	8.51±1.27	9.90±2.99	0.95±0.89	9.67±1.48
December	30	8.77±1.13	9.59±3.25	0.26±0.32	2.69±1.92

Table 6: Mean and standard deviation (±SD) of total body weight, total length, gonad weight and GSI (%) at successive months in male punti

Month	No. of fish examined	Total length (cm)	Body weight (g)	Gonad weight (g)	GSI (%)
January	12	7.8±0.34	5.69±0.16	0.022±0.005	0.39±0.08
February	12	6.85±0.35	5.09±0.44	0.056±0.01	1.10±0.24
March	12	7.68±0.77	5.34±1.56	0.079±0.04	1.48±0.48
April	12	7.65±0.38	4.90±1.22	0.110±0.03	2.24±0.38
May	12	7.80±0.68	5.91±1.86	0.170±0.04	2.88±0.58
June	12	7.99±0.43	6.24±0.50	0.257±0.04	4.11±0.52
July	12	7.5±0.57	5.53±1.15	0.195±0.06	3.52±0.39
August	12	7.2±0.42	5.56±1.78	0.176±0.014	3.16±0.68
September	12	7.01±0.85	4.94±1.78	0.109±0.04	2.20±0.62
October	12	7.33±0.44	5.05±0.83	0.099±0.047	1.96±0.69
November	12	7.90±0.59	5.92±1.39	0.075±0.05	1.26±0.66
December	12	7.1±0.14	5.80±1.21	0.034±0.019	0.59±0.69

Progression in the size of ova during different months

The progression in monthly average diameter of ovarian eggs of mola, chela and punti show relationship with seasonal cycles of oocyte development. Observation on the mean size and specially of class-mean size of ova during different months of the year indicate that the females of all the three examined species remained mature from May till October. The monthly observations of the ova diameter are described below.

Mola (*A. mola*)

The different stages of oocyte in mola with a measurement of diameter are present at varied proportions in the ovary throughout the year (Fig. 1). The varied proportions of oocyte with a measurement of diameter in a class interval of 001-021 unit showed decreasing trend in frequency percentage from January to July (100-0.00%) and increasing trend from August to December (0.00-47.80%). The proportions of oocyte that measured with a class intervals of 021-051, 051-101 and

071-101 unit occupied by the ovary is varied with reverse trend to above as from January to July (0.00-38.09, 0.00-95.36 and 0.00-23.26, respectively) and from July to December (4.66-18.87, 95.36-33.34 and 23.26-0.00, respectively) but with a single drop in July. Here, it is evident that 051-101 (vitellogenic and mature) and 071-101 class interval groups (mature) show peaks in frequency percentage in July, whereas, the 021-051 (pre-vitellogenic) group shows two peaks, one in May and another in October, and a drop in July and these results indicate negative relationships between the groups, 021-051 vs. 051-101 and 071-101. Moreover, the proportion of oocytes measuring within the class interval of 001-021 were quite absent from July till August, after which they were observed to regenerate before September.

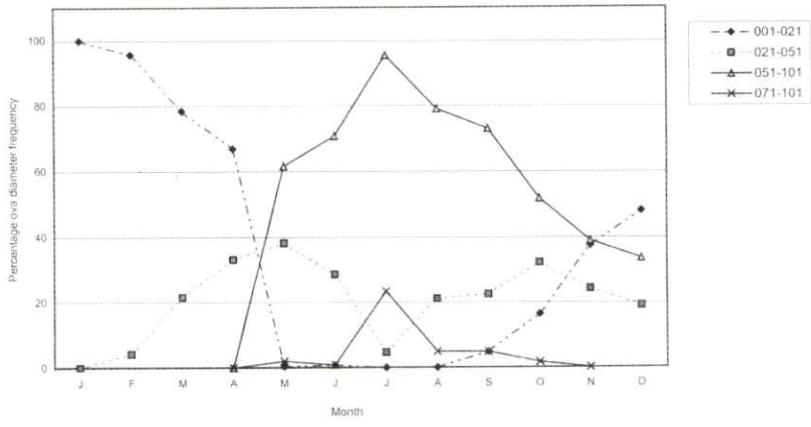

Figure 1: Month wise percent distribution of oocytes of different diameter in different stages of development in samples of ovarian cells of mola

Chela (*C. cachius*)

In chela, oocytes at different stages with a measurement in diameter are present at varied proportions in the ovary throughout the year (Fig. 2). The varied proportions of oocyte with a measurement of diameter in a class interval of 001-021 unit showed decreasing trend in frequency percentage from January to July (100-

0.00), and increasing trend from August to December (0.00-99.40 %). The proportion of oocyte that measured with a class intervals of 021 -041, 041-101 and 061-101 unit occupied by the ovary is varied with reverse trend to above as from January to July and August (0.00-26.26 & 25.98, 0.00 - 73.76 & 74.00 and 0.00 - 1.88 & 2.08, respectively) and from August to December (25.98-0.60, 74.00- 0.00 and 2.08 - 0.00, respectively), but with a single drop in July and August. Here, it is evident that 041-101 (vitellogenic and mature) and 061-101 (mature) class interval groups show peaks in July, August and September, respectively, whereas 021-041 group (previtellogenic) shows two peaks, one in May and another in October, and a drop in July and August in frequency percentage, which indicate negative relationships between the groups (021-041 vs. 041-101 and 061-101). The proportion of oocytes measuring the class interval of 001-021 were quite absent in May, and July to August, after which they were observed to be regenerated before September. The oocytes of the class interval of 021 - 041 were with increasing rate in frequency percentage after dropping in July and August.

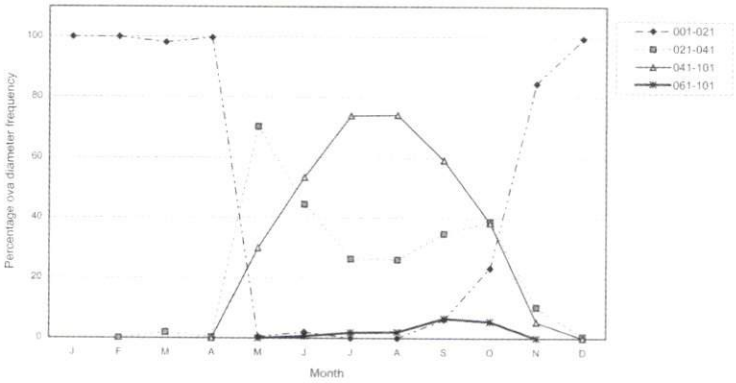

Figure 2: Month wise percent distribution of oocytes of different diameter in different stages of development in samples of ovarian cells of chela

Punti (*P. sophore*)

The different stages of oocyte with a measurement in diameter are present at varied proportions in the ovary of punti throughout the year (Fig. 3). The varied

proportions of oocyte with a measurement of diameter in a class interval of 001-021 unit showed decreasing trend in frequency percentage from January to June (100-0.00%), and increasing trend from August to December (0.00-70.41%). The proportions of oocyte that measured with a class intervals of 021-051, 051-111 and 081-111 unit occupied by the ovary is varied with reverse trend to above as from January to July (0.00-71.93, 0.00-99.33 and 0.00-11.92, respectively) and from July to December (0.66-12.87, 99.33-16.74 and 11.92-0.37, respectively), but with a single drop in July. Here, it is evident that 051-111 (vitellogenic and mature) and 081-111 (mature) class interval groups show peaks in frequency percentage in July and September, respectively, whereas the 021-051 (pre-vitellogenic) group shows two peaks, one in April and another in November and a drop in July. These results indicate negative relationships between the groups, 021-051 vs 051-111 and 081-101. Moreover, the proportion of oocytes measuring within the class interval of 001-021 were quite absents from June to August, after which they were observed to regenerate before September.

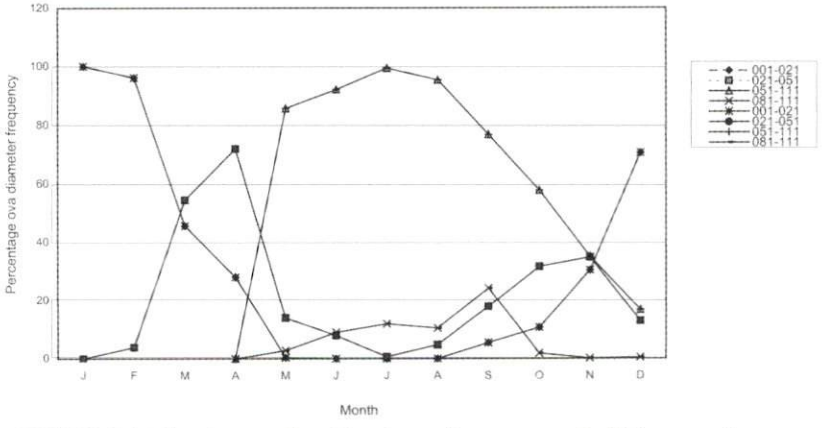

Figure 3: Month wise percent distribution of oocytes of different diameter in different stages of development in samples of ovarian cells of punti

Discussion

In the present study, gonadal development of the three small indigenous fish viz. mola, chela and punti, were studied in order to see the pattern and timing of maturation stages of germ cells in gonads. Therefore, the experiment was started after the end of one spawning season and carried out through the year from January to December.

Gonadosomatic Index (GSI)

The value of GSI increases with the maturation of fish and is being maximum during the period of peak of maturity and declining abruptly thereafter, when the fish become spent. The monthly changes in GSI reflect the ovarian activity of a fish. Afroze and Hossain (1990) observed that the GSI values of mola maxize in August and is minimum in November. Mustafa (1991) stated that the GSI values of male and female mola began to increase from January, with a peak in March followed by a steep fall in April. Again, the index values began to rise and there was a second peak in June and a third peak in September. Peaks of the GSI index values in March, June and September might have been due to the completion of maturity, the subsequent steep fall in the index values clearly indicated alternatively the spawning and spent condition of fish. The results of the present study with mola, punti and chela showed that, the GSI are maximum during July, when the majority of fish are found to be mature. Moreover, the highest values of the GSI are obtained during May to September in case of mola and punti, while April to August in case of chela. In the present study, the index values in both sexes increased gradually from January till June; there was a drop in August, again the values increased in September followed by a sharp decline in October. These results indicate that the spawning period of the fish lies between May to September. However, the present results are not fully agreed with that of Mustafa (1991) and more or less agreed with that of Afroze and Hossain (1990), with a few exceptions.

The exceptions are a portion of the spawning period, March, April and October that are not revealed in the fish, mola, in the present study.

While in case of punti, Mustafa (1991) found that index values in both sexes increased gradually from January to June, there was a drop in July, again the values increased in August and September following by a sharp decline in October. But, in the present study, the GSI values in both sexes increased gradually up to June, gradually decreasing up to December, showing no peak, after that. The GSI value is found to be in the peak during July and more or less same in August, when the majority of the fish are found to be mature and the highest values of the GSI are obtained during May to September. These results indicate that the spawning period of the fish is to be in between May to September. The monthly changes in GSI reflect the ovarian activities. The increasing GSI of punti suggests that the ovary had maximum percentage of yolk laden ripe eggs in June, July and August. However, in September, slightly decrease in GSI indicates that a batch of ripe eggs had been released. Therefore it can be assumed that the fish may spawn more than once a year. However, the present findings are partially in agreement with the previous observation of Mustafa (1991), who pointed out that spawning period of *Puntius sophore* might be two times in a year, during June and September.

In chela, the peak values of GSI of both sexes are found in June-July, then a sharp decline in August. This indicates that the fish might spawn in these months. The GSI values are found to be in continues decline from August to December. The pattern of the GSI value of the fish indicated that the spawning period might be in between May and August, and hardly in September. No related literature is available as to be compared with the results of the present work, but, Dewan (1973) observed similar results of the spawning period between June and September in his study of fecundity of chela (*C. phulo*).

Ova diameter index

The oocytes obtained in samples with measurements in diameter in class intervals of 01-21 unit (10-210μm) and 21-51/41/61 unit (210-510/410/610μm) are morphologically appeared to be of the stages of oogonia and early/late perinucleolus and, late perinucleolus and cortical alveoli (previtellogenic), in mola, chela and punti, respectively. These stages of oocyte, after January-March, once again started to generate before September and which indicates the second spawning of the fish. The vitellogenic oocyte is seemed to be occupied by the class interval of 51/41/61-101/101/111 unit (510/410/610-1010/1010/1110 μm). Again, the oocytes obtained in samples with measurements in a corresponding class interval of 71/61/81-101/101/111 unit (710/610/810-1010/1010/1110 μm) are full matured and these oocytes, when attained extreme diameter, undergoe ovulation/ spawning or in atretic stage. The occurrence of ova of different size gradations between immature and ripe, once in the mature ovary may be taken as an evidence of prolonged spawning period (Sathyanesan, 1962). Moreover, an increasing proportion of full-matured oocyte in an ovary might be indicative of a less frequent breeding tendency of the fish.

Mola (*A. mola*)

It is evident from results that the 051-101 unit (vitellogenic and mature) and 071-101 unit class interval groups (mature) show peaks in frequency percentage in July whereas the 021-051 unit (pre-vitellogenic) group shows two peaks, one in May and another in October and a drop in July, which indicate negative relationship, between the groups, 021-051 vs 051-101 unit and 071-101 unit, also indicating two spawning seasons. Moreover, the proportion of oocytes measuring within the class interval of 001-021unit was quite absents from July to August, after which they were observed to be regenerating before September. These observations indicate the initiations of the second spawning of the fish, i.e. mola spawn two

times a year. An opinion can be put from the results of ova diameter values. It may be said that mola, starts spawning from May and continuing this activity up to October, with a peak in July. These results reveal that most of the female individuals carried vitellogenic along with mature oocyte for spawning in that period. However, in mola, mature ova were commonly observed by Afroze and Hossain (1990). They found highest value of mean diameter and also highest reproductive activities in between August and October. These results are inconsistency with the present observation, which denote highest mean of the monthly ova diameter in July.

Chela (*C. cachius*)

The results clearly indicate that the 041-101 unit (vitellogenic and mature) and 061-101 unit (mature) class interval groups show peaks in frequency percentage in July and September, respectively, whereas the 021 - 041 unit (pre-vitellogenic) group shows two peaks, one in May and another in October with a drop in July. These results indicate negative relationship between the groups, 021-041 vs. 041-101 and 061-101 unit and also indicate the two spawning seasons. Moreover, the proportion of oocytes measuring within the class interval of 001 - 021 unit was quite absents from July to August, after which they were observed to be regenerate before September. These observations indicate the initiation of the second spawning of the fish, thus, chela spawns twice a year. An opinion can be put from the results of ova diameter values, chela starts spawning from May and continuing up to October with a peak in July. These results reveal that most of the female individuals carried vitellogenic-mature oocyte for spawning in that period.

Punti (*P. sophore*)

From results, it is evident that the 051-111 unit (vitellogenic & mature) and 081-111 unit (mature) class interval groups show peaks in frequency percentage in July

and September, respectively, whereas the 021-051 unit (pre-vitellogenic) group shows two peaks, one in April and another in November and a drop in July, indicaticating negative relationship between the groups, 021-051 vs 051-111 and 081-111 unit and also indicating present of the two spawning seasons Moreover, the proportion of oocytes measuring within the class interval of 001-021 unit was quite absents from June to August, after which they were observed to be regenerate before September. These observations indicate the initiation of the second spawning of the fish, thus, punti spawn twice a year. It may be concluded from the results of ova diameter values that punti starts spawning from May and continuing up to October with a peak in July. These results also reveal that most of the female individuals carried vitellogenic-mature oocyte for spawning in that period. Sathyanesan (1962) indicated the spawning duration of punti (*Puntius sophore*) through diameter frequency of the intra-ovarian eggs in the riverGanges. He opined that the species apparently breeds from late April-July, having the peak spawning period during the later half.

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