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Reproductive Biology and Feeding Habit of Gold Spot Mullet, *Liza parsia*

Joyanta Bir[1], B.M. Shahinur Rahman[2], Md. Sarower-E-Mahfuj[3,*], M. Aminur Rahman[4], M.S. Shah[1]

[1]Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna-9208, Bangladesh
[2]Bangladesh Fisheries Research Institute, Shrimp Research Station, Bagerhat-9300, Bangladesh
[3]Former MS student, Laboratory of Aquaculture and Artemia Reference Center, Ghent University, Belgium
[4]Laboratory of Marine Biotechnology, Institute of Biosceince, Universiti Putra Malaysia, Serdang, Selangor, 43400, Malaysia
*Corresponding author: sa.mahfuz@gmail.com

Abstract The gold spot mullet, *Liza parsia* (Hamilton, 1822), locally referred to as "Parsie", is a marine teleost fish suitable for culture in brackish water ecosystem. To date, very few reports on artificial propagation of gold spot mullet has ever been recorded and still seed stocking relies on wild recruitment. In order to determine the fecundity, reproductive biology and feeding habit of *L. parsia*, 75 gravid females were collected at the Pasur River and different shrimp farms in Khulna district, Bangladesh, from November 2010 to January 2011. The condition factor was ranged from 10.12 to 15.05 with a mean value of 12.35±1.08. Fecundity of *L. parsia* ranged from 56541 to 188860 and the mean fecundity was calculated as $122{,}999 \pm 30{,}035$. Total weight of the gonad was varied from 5.41 to 18.41 g, wherein the left lobe of the ovary varied from 2.78 to 9.57 g and the right lobe from 2.63 to 9.25 g. The mean weight of the right lobe gonad was 5.94 ± 1.41 g where as that for left lobe was 5.59 ± 1.38 g and the mean weight of gonad was 11.53 ± 2.77 g. The regression equation for fecundity with total length, standard length, body weight and gonad weight was estimated as $F = -176359 + 16034.5 \times TL$ ($r^2 = 0.60$), F= − 132956+16059.9xSL (r^2=0.57), $F = -5595.3 + 1588.79 \times BW$ ($r^2 = 0.63$) , $F = 9048.16 + 9881.27 \times GW$ ($r^2 = 0.83$), respectively. The regression equation for total length, standard length and body weight with the gonad weight was estimated as $GW = -19.154 + 1.64 \times TL$ ($r^2 = 0.74$), $GW = -15.41 + 1.69 \times SL$ ($r^2 = 0.74$) and $GW = -1.78 + 0.16 \times BW$ ($r^2 = 0.80$), respectively. The GSI values obtained in the present study were varied between 7.90 to 17.61 with a mean value of 14.20±1.65. The stomach contents were composed of a wide variety of algae, diatoms, desmids, plant materials, annelids, crustacean, bivalves, fishes, detritus and sand grains, indicating that the fish is omnivorous in its feeding habits. The findings obtained from this preliminary study would be helpful towards the understanding of the feeding habits, breeding season, gamete maturation and spawning activities, which will ultimately facilitate the mass seed production, aquaculture development and biodiversity conservation of this important fishery.

Keywords: *Liza parsia, Fecundity, condition factor, gonadosomatic index, feeding habits*

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1. Introduction

Fish and fisheries play a significant role in food and nutrition, employment and foreign exchange earnings in Bangladesh. Fish contributes 60% of the animal protein in the diet of the people of the country, 4.39% to the total GDP, 22.76% to the agricultural GDP and earns about 2.46% foreign exchange annually. The total amount contributed by fishery to GNP currently stands at BDTk. 2.70 million. The sector provides livelihood of 300 million as fishermen and fish farmers in the country. Fishery of Bangladesh is broadly divided into closed water culture and open water capture. The present total fish production in the country is 3.62 million MT in which 47% comes from open water capture and 53% from closed water culture fishery [1]. Presently a total of about 18 different indigenous and exotic fish species including two shell fish species namely fresh water prawn (*Macrobrachium rosenbergii*) and Black tiger shrimp (*Penaeus monodon*) are being cultured in Bangladesh. As for increasing the production from aquaculture which is though a possible option for meeting the demand of protein supplement in the diet of the people, there are expert opinions that more novel species have to be brought under culture system in the country. On the basis of this perspective, *Liza parsia* (Hamilton) locally known as "Parsie", is considered to be one of the most suitable species for aquaculture due to having high nutritive value, high flesh quality, high market demand as well as capability to tolerate a wide range of temperature and salinity, which are considered to be important for culture in coastal areas. It belongs to the family Mugillidae, commonly referred to as gold spot mullet, is a catadromous fish and widely distributed in the coastal

waters of tropical and sub-tropical regions [2]. This fish can tolerate wide ranges of environmental fluctuations and inhabits in freshwater, brackish and marine water at a depth range of 10-15 m [3].

For the domestication of this valuable species through aquaculture, it is very necessary to know the reproductive behaviour as well as food and feeding habits of *L. parsia*. Several studies have been carried out on mullet biology with a very brief account on fecundity, GSI, reproductive characteristics and spawning [4]. But so far, very few works have been done on the fecundity and GSI of *L. parsia* because of the difficulties to assess reproductive potential and induced breeding in captivity. The knowledge on the fecundity of fish is also essential for evaluating the commercial potentialities, life history study, practical culture and actual management of the fishery [5,6]. Fecundity of fishes varies from species to species and also within the same species due to associated with different factors *viz.*, age, gonad weight, ecological condition of the water body etc. [7]. Gonadosomatic index (GSI) is an indicator of gonadal development and maturity. GSI is also calculated to understand the exact maturity states and time of spawning, which is essential for providing better knowledge of breeding.

The condition factor of fish is influenced by several factors including age, sex, season, stage of maturation, fullness of gut, type of food consumed, amount of fat reserved and degree of muscular development. The food availability, composition of diets and the physico-chemical characteristics of water are strongly influenced the condition factor of fish [8,9]. The importance of studying the food and feeding habits of fishes lies in the fact that one can decide as to what programme should be taken up for the development of the water bodies to get more fish. There is a close relationship between the food ingested by the fishes and items of food available in the reservoir [10]. In estuarine waters, grey mullets feed on detritus, diatoms, algae and microscopic invertebrates, which they filter from mud and sand through their mouth and gills [11]. Length-weight relationship and condition factor are very important for aquaculture management as well as for ascertaining the environmental suitability of a specific fish [12]. Knowledge of Length-weight relationship is essential to establish growth equation in production computation [13]. It also provides data about seasonal variations in multiple spawning, degrees of mortality, robustness and variation of food consumption [14]. In view of this fact the present study was undertaken to determine fecundity, food and feeding habit, gonadosomatic index, condition factor and length weight relationship of gold spot mullet, *L. parsia*.

2. Materials and Methods

2.1. Sample Collection and Sites

In total, 75mature female of *L. parsia* was collected randomly from wild sources at the Pasur River and different shrimp farms in Khulna district, Bangladesh from November 2010 to January 2011. For feeding habit analysis, 30 live fish specimen was collected from the same location and farm in the month of January 2011. All the samples were immediately transported to the laboratory of Fisheries and Marine Resource Technology Discipline at Khulna University, and were used for the detailed studies on their reproductive biology and feeding habits.

2.2. Measurement Procedures

Total length (TL) and standard length (SL) from each individual *L. parsia* was measured by a scale, and body weight (BW) and ovaries weight were taken by electronic balance. Both left and right lobe weight of ovaries ware taken using the same way. Then sample weight was taken from all parts of ovaries from each lobe. Finally the number of eggs was directly counted with a fine needle.

2.3. Fecundity Estimation

Standard gravimetric method was used to determine the fecundity of *L. parsia*. Fecundity was estimated using the formula as follows:

$$F = \frac{\text{NxGonad Weight}(g)}{\text{Sample Gonad Weight}(g)}$$

Where, F is the fecundity and N is the number of eggs in the sample.

2.4. Gonadosomatic Index

Gonadosomatic Index (GSI) was calculated according to the formula used by [15] as follows:

$$GSI = \frac{W_1(g)}{W_2(g)} \times 100$$

Where, W_1= wet weight of gonad and W_2= total wet weight of gonad

2.5. Condition Factor

Condition factor (K) was calculated using the following formula:

$$K = \frac{W \times 10^3}{L^3}$$ [16]

Where, W= weight in gram, L= length in cm and K = condition factor, 10^3= the factors bringing the potential index.

2.6. Food and Feeding Habits

Fishes under study were dissected and the stomach was carefully cut from the rest of the digestive tract. The condition of feed was assessed by the degree of distension of the stomach and expressed as full, 3/4 full, 1/2 full, 1/4 full, tress and empty. These are known to as index of stomach fullness. The volume of stomach content estimated by observation was recorded on absolute scale. The largest volume found in preliminary study was allocated 100 points, and each of the stomachs as examined was then rated in one of the following categories 0, 3, 6, 12, 25, 50 and100 points, according to the volume of food present. The stomach contents were emptied into a Petri dish and examined under a binocular microscope with the help of Sedgewick Rafter Counting Cell Slide. Occurrence method was used for the qualitative analysis of food contents.

3. Results

3.1. Status of Ovary

Total gonad weight of *L. parsia* was varied from 5.41 to 18.82 g, where the left lobe of the ovary varied from 2.63 to 9.25 g and the right lobe from 2.78 to 9.57g. The mean total weight of the gonad was 11.53±2.77g wherein the mean weight of the left lobe was 5.59±1.38 g and the right lobe was 5.94 ± 1.41g.

3.2. Fecundity of Fish

The estimated fecundity of *L. parsia* was varied from 56,541 to 188,860 and the mean fecundity was calculated as 122,999 ± 30,035. Fecundity was varied depending on weight and length of fish. In this study, lowest fecundity was found in fish having total length of 18.10 cm, body weight of 68.50 g and gonad weight of 5.41 g, while the highest fecundity was found in fish having total length, body weight and gonad weight of 20.80 cm, 104.54 g and 18.41 g, respectively. Fecundity of *L. parsia* according to different length and weight classes is presented in Figure 1a and Figure 1b, respectively.

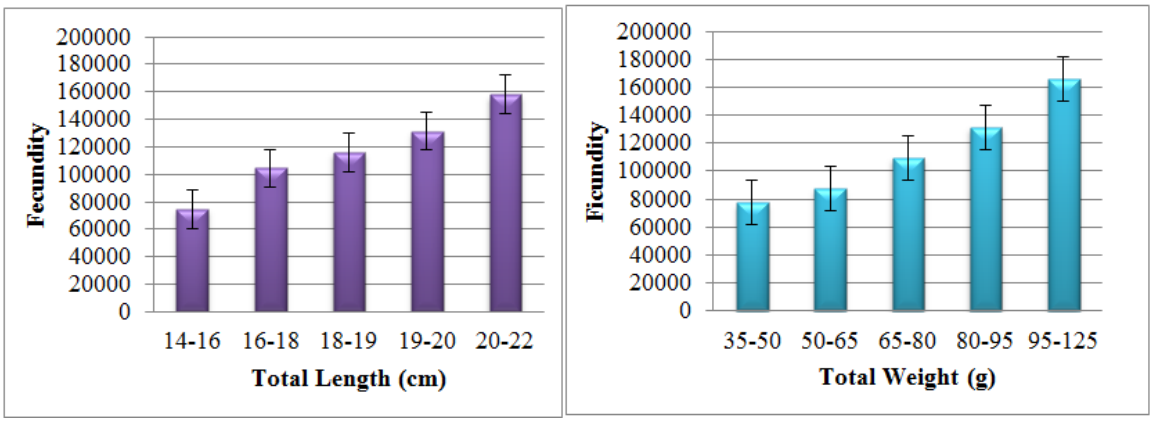

Figure 1. Fecundity of *L. parsia* under various size groups, which were categorized according to different length (1a) and weight (1b) classes

3.3. Relationships of Fecundity with Body Weight and Gonad Weight

The relationship between fecundity and body weight (Figure 2a) and between fecundity and gonad weight (Figure 2b) of *L. parsia* was found to be linear and positive, and the established equation were $F = -5595.3 + 1588.79 \times BW$ ($r^2 = 0.63$), (Figure 2a) and $F = 9048.16 + 9881.27 \times GW$ ($r^2 = 0.83$), Figure 2b.

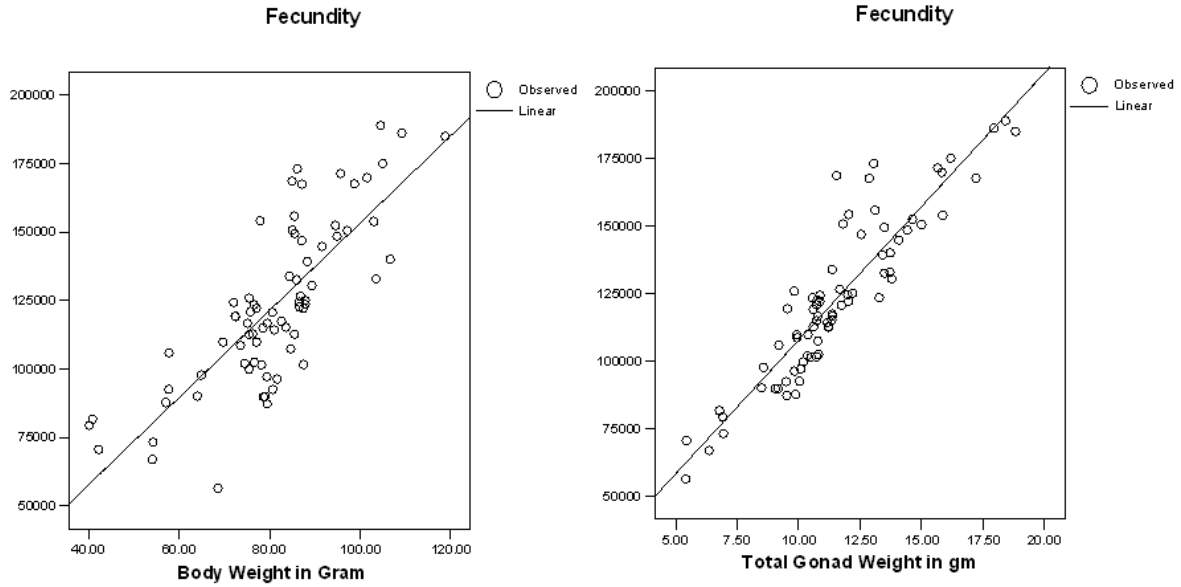

Figure 2. Relationships of fecundity with body weight (2a) and fecundity with gonad weight (2b) of *L. parsia*

3.4. Relationshipsof Gonad Weight with Total Length and standard Length

The relationship between gonad weightand total length (Figure 3a) and between gonad weight and standard length (Figure 3b) of *L. parsia* was observed to be linear and positive,and the established equationsin exponentialform were $GW = -19.154 + 1.64 \times TL$ ($r^2 = 0.74$) and $GW = -15.41 + 1.69 \times SL$ ($r^2 = 0.74$) and in logarithmic forms were $LogGW = -1.88 + 1.47 \times LogTL$ ($r^2 = 0.72$). and $LogGW = -1.78 + 1.41 \times LogSL$ ($r^2 = 0.72$), respectively.

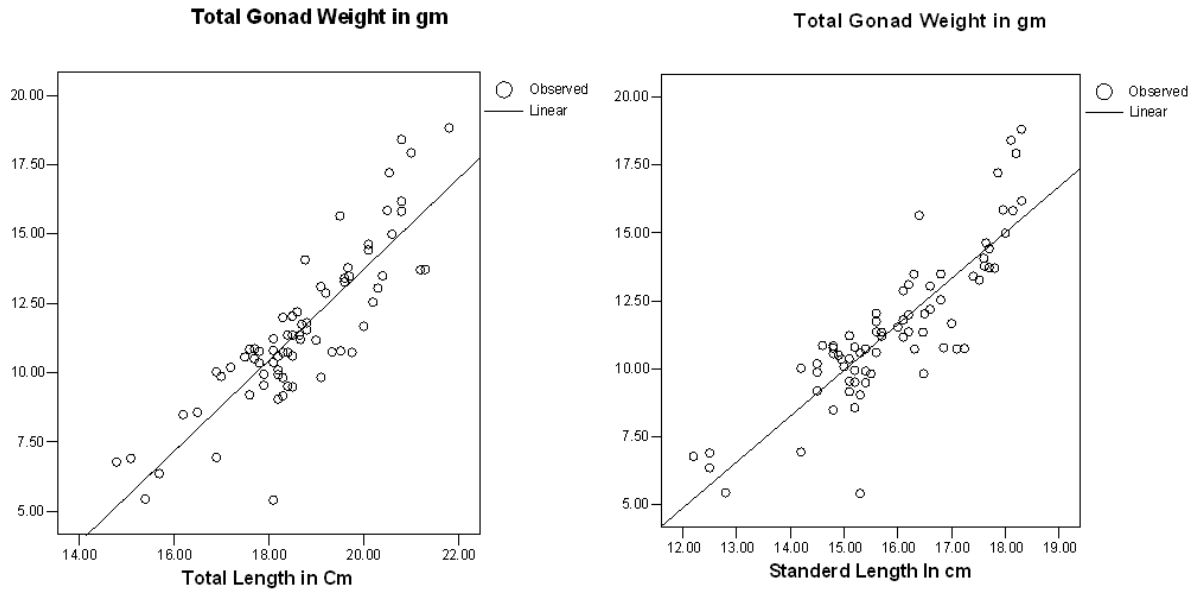

Figure 3. Relationship of total length with gonad weight (3a) and standard length with gonad weight (3b) of *L. parsia*

3.5. Relationship between Body Weight and Gonad Weight

The relationship between gonad weight and body weight of *L. parsia* (Figure 4) was found to be linear and positive, and the established equations were $GW = -1.78 + 0.16 \times BW$ ($r^2 = 0.80$).

3.6. Relationship between Condition Factor and Fecundity

The condition factor obtained in the present study was ranged between 10.12 and 15.05, with a mean value of 12.35±1.08.There was no significant relationship found between fecundity and condition factor of *L. parsia* (Figure 5) and the established equation were $F = 219798 - 7834.1 \times CF$ ($r^2 = 0.079$) and $LogF = 5.56 - 4.99 \times LogCF$ ($r^2 = 0.079$).

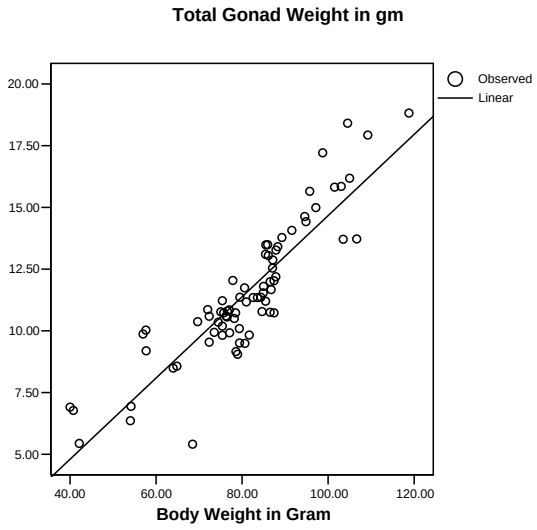

Figure 4. Relationship between body weight (BW) and gonad weight (GW) of *L. parsia*

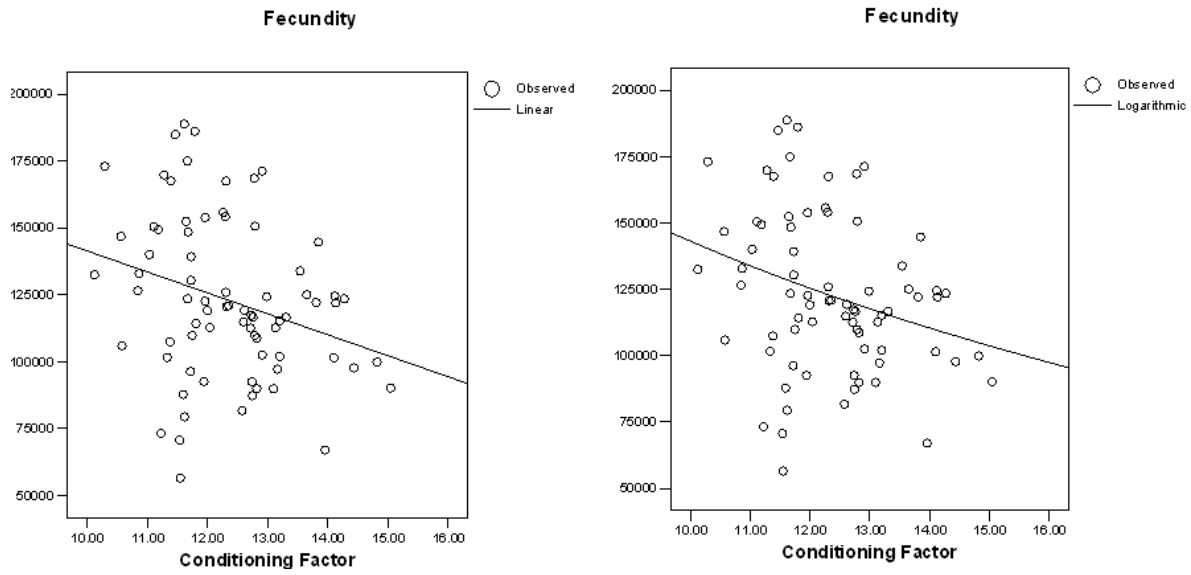

Figure 5. Relationship between condition factor and fecundity *of L. parsia*

3.7. Gonadosomatic Index (GSI)

The GSI values obtained in the present study were varied from 7.90 (for a female fish with a total length of 18.10 cm, body weight of 68.50 g and gonad weightof 5.41 g) to 17.61 (for a female fish with a total length of 20.80 cm, body weight of 104.54 g and gonad weight of 18.41 g). The mean value of the GSI was 14.21 with a standard deviation of 1.65.

3.8. Food Items in the Stomach of *L. parsia*

Different types of food items found in the stomach of *L. parsia* are summarized in Table 1. The stomach contents comprised of a wide variety of algae, diatoms, crustaceans, desmids, bivalves, zooplanktons etc.

Table 1. Different food items found in the stomach of *L. parsia*

Food categories	Species
Algae	*Spirogyra sp., Nostoc, Anabaena, Cosmarium sp., Thalassionema sp., Spirulina sp., Protococcus sp., Oscillatoria sp., Lyngbya sp., Enteromorpha sp., Polysiphonia sp., Cladophora sp. and Chaetophora sp.*
Diatoms	*Cyclotella sp., Fragillaria sp., Nitzschia sp., Synedra sp., Gyrosigma sp., Navicula sp.*, and *Epithemia sp.*
Crustacean	*Cyclops sp., Daphnia sp., Cyprissp., Eucypris sp., Paracyclops sp., Diaptomus sp.* *Moyna sp.*, Shrimp parts and prawn larvae.
Desmids	*Closterium sp.*
Bivalves	*Iphigenia sp.*
Zooplankton	Rotifer, copepods, copepods larval valves, cladoceran, moults of polychaete worms, nauplius and zoea larvae and mysids, microscopic organisms andpolychaetemoults,
Other food items	Plant materials, annelids, nematode, detritus, sand grains, pisces (fish bones, eyes, scales) and decayed organic matter

4. Discussion

In the present study, fecundity of *L. parsia* was found to be varied from 56541 (for a female having total length of 18.10 cm, body weight of 68.50 g and gonad weight of 5.41 g) to 188,860 (for a female with total length of 20.80 cm, body weight of 104.54 g and gonad weight of l8.41g). The mean fecundity was calculated as 122,999 ± 30,035. Fecundity may be varied with length, weight and other environmental factors. [17] observed the fecundity of *L. parsia* varying between 19,343 and 301,700. We observed here that the specimen having a total length of 20.80 cm and body weight of 104.54 g was carrying the highest number of eggs (188,860). However, variation was found in the fecundity of fish with equal lengths. A fish having total length of 18.20 cm, 86.10 g in body weight and 13.05 g in gonad weight produces 173,120 eggs, whereas another three fish of the same total length and body weight of 69.67, 72.01 and 87.88 g and gonad weight of 10.37, 10.86 and 13.27 g produced 109,872, 124,356 and 123,546 eggs, respectively. Even another two fish having total length of 20.80 cm and body weight of 105.00 and 101.51 g and gonad weight of 16.18 and 15.82g produced 175,046 and 169,816 eggs. Similar variations in fecundity were also observed among the length classes of Hilsa (*Hilsa ilisha*) in the River Padma, Bangladesh [6].

In the present study the condition factor was ranged from 10.12 to 15.05. The scattered plot of fecundity and condition factor showed no significant relationship and the correlation coefficient, r^2=0.079 also indicated that no relationship existed between condition factor and fecundity.

The GSI value indicates the development of gonad and maturity of fish. It increases with the maturation of fish and then declines abruptly thereafter [15]. The GSI value indicates the spawning season of a fish species and the higher GSI value indicates the spawning period. The GSI value was found to vary from 7.90 (for a female fish with a total length of 18.10 cm, body weight of 68.50 g and gonad weight of 5.41 g) to 17.61 (for a female fish with a total length of 20.80 cm, body weight of 104.54 g and gonad weight 18.41 g).

In this study, we found that the stomach contents were comprised of ten major categories (Table 1). These were algae, diatoms, desmids, plant materials, annelids, crustacean, bivalves, fishes, detritus and sand grains, indicating that the fish is omnivorous in its feeding habits. Similar result was also observed in *Mugil cephalus* [18].

5. Conclusion

The fish production of Bangladesh is increasing day by day because of the increasing production of inland culture fisheries but the amount of capture from our natural water bodies is declining due to the overharvesting and lack of proper biological knowledge on different fish stocks. *Liza parsia* is abundant in natural waster bodies and its culture is fully dependent on the natural source of fry, so the findings emerged from the study of its reproductive biology would provide some basic information on the breeding and seed production of this species. The major limitation of the present study was small sample size as well as data were collected for only three months, therefore, the differences in the GSI values during different months were not observed precisely. Some of the fish in the present investigation was not fully matured and the fecundity also varied within species of the same length and same body weight. Therefore, further year round study is needed to be done in order to understand the exact precision on feeding habits, breeding season, gamete maturation and spawning activities, which would immensely be helpful towards the mass seed production, aquaculture management and biodiversity conservation and as well as protect from endangered situation.

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