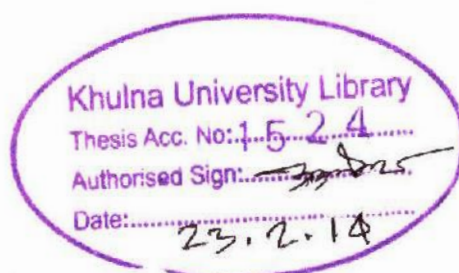


**A Preliminary Study on Brood Management and Breeding Technique
of Commercially Important Brackish Water Fish, *Liza parsia***



SUDIP BISWAS



**Fisheries and Marine Resource Technology Discipline
Khulna University
Khulna, Bangladesh**

December, 2011

**A Preliminary Study on Brood Management and Breeding Technique
of Commercially Important Brackish Water Fish, *Liza parsia***

A Thesis

By

Sudip Biswas

Examination Roll No: MS-110616

Session: 2010-2011



**A project thesis submitted to Fisheries and Marine Resource Technology
Discipline in partial fulfillment of the requirements for the Degree**

of

Masters of Science in Aquaculture

December, 2011

**A Preliminary Study on Brood Management and Breeding Technique
of Commercially Important Brackish Water Fish, *Liza parsia***

Approved as to style and content

By



A handwritten signature in black ink, appearing to read "Nazmul Ahsan", written over a horizontal line.

Dr. Md. Nazmul Ahsan

Professor and Head

Fisheries and Marine Resource Technology Discipline

Khulna University

Khulna-9208

Declaration

A Preliminary Study on Brood Management and Breeding Technique of Commercially Important Brackish Water Fish, *Liza parsia*

The results presented in the thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.

Sudip Biswas

(Signature of the candidate)

Sudip Biswas

Examination Roll No: MS-110616

Session: 2010-11



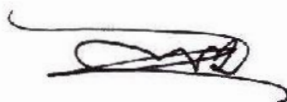
(Signature of the co-supervisor)

Abul Farah Md. Hasanuzzaman

Assistant Professor

Fisheries and Marine Resource Technology Discipline

Khulna University Khulna, Bangladesh



(Signature of the supervisor)

Dr. Khandaker Anisul Huq

Professor

Fisheries and Marine Resource Technology Discipline

Khulna University, Khulna, Bangladesh



December, 2011

***DEDICATED
TO
MY BELOVED PARENTS***



Acknowledgement

At first all my admiration goes to the Supreme Creator of the universe God for his grate mercy to create and keep me alive to complete this project work for the degree of M.Sc. in Aquaculture from Khulna University under Fisheries and Marine Resource Technology Discipline.

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Sudip Biswas

Khulna University

December, 2011

Abstract

The study was conducted on broodstock management and artificial breeding of *Liza parsia* from June 2010 to June 2011 at Marine Biological Research Station of FMRT Discipline, Dacope, Khulna, Gollamary Fish seed Multiplication Farm and Fish Biology Laboratory Khulna University, Bangladesh. The relationship between the total length and body weight of the species was found to be a linear ($r^2 = 0.88$) which indicates that weight of fish increased with the increase in total length. The condition factor ranged from 10.12 to 15.05. The fecundity of *Liza parsia* varied from 56541 to 188860, and the mean fecundity was calculated as 122999 ± 30035 . The GSI values obtained in the present study varied between 7.90 to 17.61. The female broods were 18 to 21 cm in total length and 70 to 110 g in weight while the males were 12 to 15 cm and 60 to 80 g. A brood stocking rate of *Liza parsia* was 800-1000 kg/ha in broodstock pond. Water quality parameters of the broodstock pond were recorded as temperature 28-32°C, salinity 7ppt, pH 6.5-8.5 and dissolved oxygen 5-7 ppm. The captured brood fishes were kept in a concrete cistern (2 m dia x 1 m depth), filled with filtered underground water and salinity was gradually increased up to 10-12ppt by adding 150ppt brine in 72 hrs and water temperature of the breeding cistern was maintained between 22 and 23°C using electric thermostats. Fishes with female: male (1:1) sex ratio was kept in a similar cistern and artificial breeding of *Liza parsia* was done by a single dose of hormone (Ovaprim) injection at 3ml/kg body weight. The injection was pushed in deep muscle at the base of the dorsal fin and injected fishes responded to the hormone within 50 hours for spawning. The fertilization rate was $56 \pm 7\%$ of the spawned eggs. About 30% of the fertilized eggs were hatched out 42-43 hours after spawning but the embryos were dead within 2 hours. Further research should be carried out for better brood stock management and to develop seed production technique of this species in Bangladesh.

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List of abbreviations

B W	Body weight
cm	Centimeter
DoF	Department of Fisheries
F	Fecundity
FMRT	Fisheries and Marine Resource Technology Discipline
g	Gram
GDP	Gross Domestic Products
GSI	Gonadosomatic index
GW	Gonad weight
K	Condition factor
T L	Total length

Chapter 1

Introduction

Bangladesh is the largest deltaic country in the world. As a deltaic country it is enriched with water resources. Fish has a great significance in the life of mankind, being an important natural source of protein and provider of certain other useful products as well as economic value to many nations. It has great nutritious value and is an important alternative to other protein sources. Fisheries play an important role in the socio-economic development of the agro-base economy of Bangladesh. Fisheries sector contributes around 3.74% to the GDP and 3.00% to foreign exchange earnings through export. Fish is the principal source of food, supplying some 58% of animal protein in the diet of our population. Fisheries provide livelihood of about 12.8 million people of the country directly or indirectly (DoF, 2010).

Liza parsia (Hamilton.) locally known as “Parse” is one of the most popular and commercially important fish due to having high nutritive and market value. The fish *Liza parsia* (Ham.) belongs to the family Mugilidae commonly known as gold spot mullet is a catadromous fish. It is found in coastal region of the Bay of Bengal in Bangladesh, especially in the Sibsa river, Kapotakkha river, estuaries and polder areas (Joadder and Hossain, 2008). This fish is also distributed in many countries, like Southeast Asia, Taiwan, the Mediterranean and Eastern European countries and in many parts of central and South America and its products also contribute to valuable fishery economics in Japan and Australia (Nash and Shehadesh, 1980). It can tolerate wide ranges of environmental fluctuation and found in freshwater, brackish and marine water at a depth range of 10 - 15m (Riede, 2004).

It is being cultured in many developing countries, as a brackish water fish commonly available in shallow coastal waters, estuary and mangrove swamps of Bangladesh. The adult and juvenile are hardy, euryhaline, eurythermal and not competitor of food (Rheman *et al.*, 2002). Juveniles often occur in shrimp culture farms and mangrove swamps. It is one of the most favorite, tasty and commercially important fish in Bangladesh as well as in Southeast Asia and many parts of central and South America.

The popularity of this species in aquaculture is due to high quality of its flesh, its extreme tolerance of a wide range of temperature and salinity, which is important for culture in intertidal ponds (Nlewadim and Deekae, 1997).

According to Natural resources institute of Goa India, the body shape of *Liza parsia* is slender. The head is moderately wide and dorsally flattened. Adipose tissue covers most of iris posteriorly and part of it anteriorly. First dorsal fin inserted nearer to snout tip than of caudal fin base; second dorsal fin origin on vertical between anterior-third of half of anal fin base. Color in life is greenish-brown above, white to silvery below- A golden spot on the operculum is present. It grows 15-19cm in one year and maximum length may attain 40cm in natural waters and 25cm in ponds (Talwar and Jhingran, 1991).

Scientific classification of *Liza parsia*:

Kingdom: Animalia

Phylum: Chordata

Subphylum: Vertebrata

Superclass: Osteichthyes

Class: Actinopterygii

Order: Perciformes

Suborder: Mugiloidei

Family: Mugilidae

Genus: *Liza*

Species: *Liza parsia* (Hamilton, 1822)

English name: Gold spot mullet

Liza parsia is an herbivorous, feeding mainly on algae, higher plant parts, protozoans, crustaceans, debris, sand and mud and unidentified food materials (Joadder and Hossain, 2008).

In Bangladesh much emphasis has been given to induce breeding of the *Liza parsia* and other marine fish. Fish can be induced to spawn either by hormonal treatment or by environmental manipulation. Major carp pituitary hormone, mullet pituitary glands and human chorionic gonadotropin were effectively used in the induced breeding experiments of *Liza parsia* and other marine fishes. *Liza parsia* do not breed in saline or brackish water ponds or lakes and estuaries although they attain maturity there. They migrate to the sea for breeding during monsoon months. The available information shows that the gonads reach full maturity at 30ppt and above (Nash and Shehadeh, 1980).

Induced breeding of these fish species can be thought of from two major points of views. Firstly the brood stock development and management of these fishes; and second is its artificial propagation to produce fry. The attempt and effort made to brood management and induced breeding in captivity through the proposed study is thought to have positive implications in the long run for the starting and development of marine/brackish water finfish culture industry in Bangladesh.

It will not only solve a constraint in seed supply, but also reduce impact on wild stock. The work will be carried out in brackish water areas close to the Sundarbans, where there are facilities for breeding and nursery rearing of the fish; the local shrimp ghers have the potential for supply of wild caught broods for use in the hatchery.



1.1 Objective of the study

Broad objective

- ❖ To manage broodstock at captive condition.
- ❖ To develop artificial breeding protocol for *Liza parsia*.

Specific objective

- ❖ Estimation of fecundity of *Liza parsia*.
- ❖ Determination of gonadosomatic index and conditioning factor of *Liza parsia*.
- ❖ Determination of the relationship between length-fecundity and weight-fecundity.

Chapter 2

Review of literature

It is essential to know about the related information about the work. So the following information is reviewed in favor of the present study.

Joadder and Hossain (2008) reported *Liza parsia* is a brackish water mullets and locally known as Parse, Phaissa, Phasa etc. It is found in coastal region of the Bay of Bengal in Bangladesh, especially in the Sibsa River, Kapotakkha River, estuaries and polder areas. It is an herbivorous species, feeding mainly on algae, higher plant parts, protozoans, crustaceans, debris, sand and mud and unidentified food materials.

Das *et al.* (2008) reported *Liza parsia* is available in the estuary during their breeding season from October to December, where salinity may range from 0 to 35ppt.

Breder and Rosen (1966) reported the mode of reproduction of *Liza parsia* is dioecism and the fertilization is external. There is a linear relationship between fecundity and the body weight of *Liza parsia* and the relationship between fecundity and length was curvilinear (Pillay, 1958). However, there are also reports having a linear relationship between the length and the fecundity (Mathur, 1964; Shafi *et al.* 1977).

Published information about the fecundity and the relationship between fecundity and total length, body weight and gonad weight of the fishes of Bangladesh are studied by a number of authors. Saifullah *et al.* (2004) studied the fecundity of *Hitsa ilisha* from 20 matured female from the Bay of Bengal. The fecundity was found to range from 1030951 to 1940620 with a mean of 1377884 ± 290145 . The regression line for total length, standard length, body weight and fecundity were found linear when they were plotted against their fecundity on the logarithmic scale.

Rheman *et al.* (2002) reported the fecundity of *Liza parsia* ranged from 19343 to 301700 with an average value of 26812.6. The relationship between fecundity and total length, body weight and gonad weight showed linear relationship and the equation were $\text{LogF} = 0.0024 + 4.0761 \text{ LogTL}$, $\text{LogF} = 3.3177 + 1.0778 \text{ LogBW}$ and $\text{LogF} = 3.7550 + 1.5161 \text{ LogGW}$. The fish was found to spawn for several months with two spawning peaks one in December and the other in February as is indicated by the peaks of gonadosomatic index. Cadwallader (1976) suggested that a straight line could be fitted to length against fecundity dots.

Rheman *et al.* (2002) reported that females *L. parsia* has maximum GSI values 16.7 in December and this species spawned for several months with two spawning peaks in the months of December and February. The peak reproduction period was in February and the egg diameter was 0.59mm, but in December it was 0.49mm. GSI values and egg diameter changes were harmonious with each other. These results showed that the reproduction period had two peaks, one in February and another in December. These results are similar to the results obtained by Das (1992) in *L. subviridis*, Ergene (2000) in *L. ramada* and Rheman *et al.* (2002) in *L. parsia*.

The feeding frequency acceptable to a fish is directly related to the stomach capacity of the fish (Kong and Nose, 1971). Reports of Shelbourn *et al.* (1973) and Jobling (1982) indicate better growth in fish fed frequently than in those fed periodically.

Roy and Hossain (2006) studied the fecundity and sex ratio of *Mystus cavasius*. The fecundity ranged from 4026 to 25960 with an average of 12432.38 ± 13401 . The male and female sex ratio was 1: 1.38.

The reproductive biology of *Amblypharyngodon mola* from the Kaptai Reservoir was studied by Azadi and Mamun (2004). It was found that the female dominated significantly over male throughout the year and overall sex ratio of male and female was 1.00:2.078. Fecundity varied from 1280 to 13679 with an average of 5182 ± 3731 . Fecundity was found highly correlated with body length, ovary weight and ovary length. Sarker *et al.* (2002) reported the fecundity and gonadosomatic index of *Mystus gulio*. Fecundity was determined at different length, weight, and ovary ranges of different individual fish. At different length ranges from 10-20cm of fish showed different fecundity and significantly highest mean fecundity was found 21589 (19394-23481) from 20-22cm length ranges of fish.

Kurup and Samuel (1938) studied the maturity and spawning of *Liza parsia* and found that breeding season extends from October to May with peak spawning from December to April. According to Cherif *et al.* (2007) the male of *Liza parsia* spawn from April to July, whereas the reproductive of the females occurs in the late spring and summer (May to June).

Ergene (2000) recorded the male and female sex ratio 1:1.24 of *Liza parsia* in Akgol-Paradeniz Lagoon. Hsu *et al.* (2007) found that the suitable temperature for mullet breeding is 22~23°C and is a winter breeder.

Karmakar and Ghosh (1984) attempted to determine the optimum rates of feeding in *Liza parsia* using rice polish as the lone feed source. This feed was especially inadequate because of its low protein content. Like many other fishes, this fish also changed its food with the change of season (Joadder and Hossain, 2008).

Khan *et al.* (2002) studied the fecundity and GSI of brackish water catfish *Plotosus canius* (Hamilton-Buchanan) and found that the linear relationship between weight and fecundity was more valid than that of length and fecundity. The results of correlation regression equation of total length-fecundity, body weight-fecundity and gonad weight-fecundity were ($r^2 = 0.832619$), ($r^2 = 0.933599$) and ($r^2 = 0.96116$) respectively.

Narejo *et al.* (2002) studied the reproductive biology of spiny eel reared in the cemented cisterns of Bangladesh Agricultural University. Fecundity of eel ranged from 580 to 10980 eggs. The fecundity increased with the increase in length and weight of the fish and linear relationship was obtained when the fecundity data were plotted against the total length, body weight and gonad weight.

Pervin and Mortuza (2008) have shown that the condition factor is varying with the sex, which may be due to feeding intensity and gravid condition of female or due to some other factors. In a study of condition factor of culturable species, Saxena and Saksena (2009) have revealed that *Catla catla* has shown an irregular pattern of condition in different months and different length groups, whereas, *Labeo rohita*, *Cirrhinus mrigala* and *Cyprinus carpio* have shown a decreasing pattern of K value in successive months and all length groups in a culture system.

Banu *et al.* (1985) reported the fecundity of *Anabus testudineus* varies from 12355 eggs (a fish with total length 12.3cm and weight 30.24g) to 41820 eggs (a fish with total length 15.5cm and weight 66-62g). The correlation co-efficient was highest in case of relationship between fecundity and ovary weight, which indicated that fecundity bears strong relationship with ovary weight. The fecundity was found to have linear relationship with total length, somatic and ovary weight.

Thompson (1966) cited by Wells (1984) agreed that sand grains were found throughout the alimentary canal of mullets, and those helped in the trituration of food in the gizzard-like pyloric stomach. The proportion of sand and detritus in the gut of juveniles increased with length, indicating that they tend to take more food from the bottom as they grow older. Adult striped mullet have been described as herbivorous, detritivorous and "interface" feeders. The diet and feeding behaviour of mullet may vary by location, but their major foods are epiphytic and benthic microalgae, macrophyte detritus, or inorganic sediment particles (Collins, 1985).

Alam *et al.*, (2008) used ovaprim (2 ml both male and female, a single dose per kg body weight) hormone in induced breeding of *Liza parsia*.

Das (1992) reported the spawning activity appeared to continue first after 48-52 hours post injection and incubation period is 32~36 hours at 22~25°C and 38~42 hours at 20~21.5°C and reported a hatching rates (%) were 82±12, 76±8 and 56±16 for November, December and January trials respectively of *Liza parsia*.

The condition factor 'K' is to basically assess the condition of fish which is influenced by several factors including age of fish, sex, season, stage of maturation, fullness of gut, type of food consumed, amount of fat reserve and degree of muscular development. The condition factor is not constant and found to vary in an individual, species or a population having relationship between seasonal changes in the environment and with the changes of physiological conditions of the fishes (Doha and Dewan, 1967).

Chapter 3

Materials and Methods

3.1 Brood stock management

The site was selected in the areas which have easy access of saline water; Dacope Upazilla, near Sundarbans and adjacent to Pashur river.

3.1.1 Selection of pond

A fish pond is the living house of fish. So its condition has direct influence on all the physiological features of the fish that live in. Therefore a brood rearing pond should be so selected that it fulfills all the major important requirement of brood fish.

Site selection

The site was selected in the area having availability of brood fish, demand of fry and fingerling, well communication and transportation system, availability of raw materials and public utility, proper sun light throughout the year for convenient of producing natural food, soil of the pond was clay-loamy chosen for high water retention capacity and pH of soil was 6.5-7.5. The dike of the pond was high enough to protect the pond from flooding during high tide or normal flood level and the site was chosen in the areas adjacent to a dairy farm for easy accessibility of organic fertilizer.

Pond Description

Table -01. Characteristics of pond for broodstock development

Parameters	Range
Size of the pond	30 decimal
Shape of the pond	Rectangular for easy management & netting
Water depth	1.2-1.5m
Drainage system	Gentle slope towards outlet
Slope of the dike	1:2



Figure 1. Brood development pond for *Liza parsia*

3.1.2 Pond preparation

Flow chart of the works of pond preparation

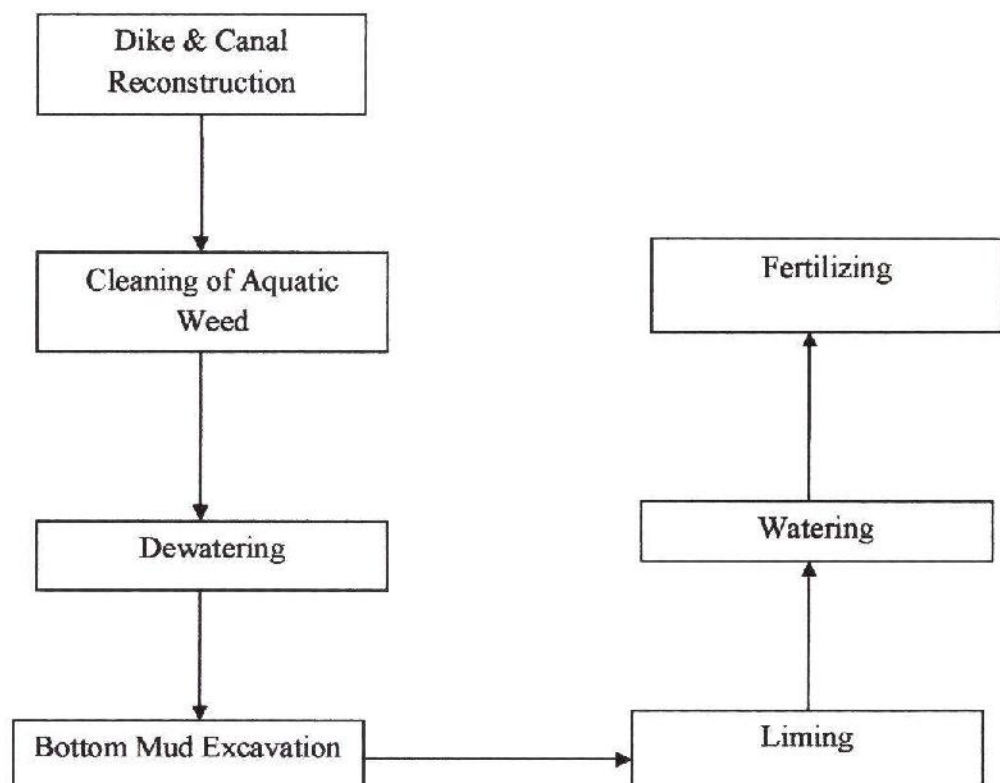


Figure 2. Flow chart of pond preparation

Dike and canal reconstruction was the most vital part of the pond preparation it helps to avoiding entry undesirable species into the stocking pond, prevent danger of flood, erosion and water leakage. Aquatic weeds utilized pond nutrients, decrease productivity, shelter harmful insects and decrease living space. So these were cleared by manual labour.

For better preparation the pond was de-watered by pumping and sun dried before 1-2 months prior to stocking for killing the unwanted fishes, germs of diseases and parasites, and for liming and fertilization.

Application of lime in a pond serves some important purposes. In a pond it will act a disinfectant, as fertilizer and as a buffering substance. It kills all the germs of the diseases and parasites, improves quality of the bottom soil increasing the calcium concentration and acts a buffering substance to maintain soil and water pH. Liming was done after completely dewatering the pond.

The range of soil pH was 6.5-7.5 and for this range lime stone (CaCO_3) was applied at the rate of 1kg/decimal. River water was introduced through pumping and depth of the pond was 1.5-2m. After 15-20 days of liming, the pond was fertilized with organic and inorganic fertilizer.

Table -02. Dose of fertilizer for brood pond preparation

Organic fertilizer

As first dose,

Organic materials	Dose
De-composed cowdung	5kg/decimal

Source: (Matsha Pakha, 2005)

Inorganic fertilizer

First dose,

Fertilizer	Dose
Urea	100g/decimal
TSP	50g/decimal
MoP	20g/decimal

Source: (Matsha Pakha, 2005)

To maintain the food level, organic & inorganic fertilizer should be used at a suitable rate after stocking according to the requirement.

Water quality

Table -03. Water quality parameter for *Liza parsia*

Parameters	Range
Temperature	20-25°C
Salinity	Ranged from 10-20 ppt on the basis of river water salinity
Dissolve oxygen	4-8ppm
pH	6.5-7.5
Sechi disk depth	25-40cm

Source: (Jhingran & Pullin, 1988)



3.1.3 Sources of brood

Adult fish of those species were collected from estuarine water bodies, viz, the shrimp ghers of the southwestern Bangladesh and was managed in brood ponds of experimental site. Fry/juveniles of those species were collected and raised at experimental ponds. This practice will be continued for up to maturation.

3.1.4 Stocking

Initially the collected brood is raised in hyposaline pond water under semi-controlled conditions and wild-caught adults were first acclimatized under pond conditions before stocking. Brood stocking rates of *Liza parsia* was 800-1000kg/ha of brood stocking pond and weigh of fish varies from 40-60g during the period of stocking.

3.1.5 Post stocking management

Feeding

The species is mainly diurnal and feeds on zooplankton, benthic organisms and detritus. Adult fish tend to feed mainly on algae while inhabiting freshwater. Enhancing natural food production in the ponds through artificial fertilization is important as this reduces considerably the requirements for manufactured feed.

Supplementary food was given to the breeders with well balanced food at a fixed schedule until the water blooms appeared, when the feeding is stopped.

Composition of Feeds

Table -04. Composition of fish ingredients (Dry basis)

Name of ingredients	Feed %
The semi-composite mixture of half-cooked rice and pulses (1:1)	50
Fish Meal (Saudi Bangla Feed)	30
Mustard oil cakes	20

Source: (Alam and Mollah, 1988)

Supplementary foods with vegetative matter such as Hydrilla, Najas, Utricularia, and soft young leaves of other plants were given some times as food for better results. Growth is checked by sampling, and if growth rates are not as expected, rice and/or wheat bran is added daily as a supplement to the natural feed in ponds.

Feeding Rate

Fish were feed daily at the rate of 2-3% of their body weight using 40% protein in feed formulation.

Table -05. Composition of fish feed and their protein level

Name of ingredients	Feed (40%) protein level	
	Weight in gm of feeds	Total protein in feed (gm)
Fish Meal (Saudi Bangla Feed)	24	33.08
Mustard oil cakes	14	3.78
Rice bran	54	3.18

Source: (Alam and Mollah, 1988)

Feeding Frequency

Feeding was done two times a day. First 9.00 am at morning and 5.00 pm at evening.

Average water quality during broodstock management

All fishes require a pond of good water quality. Usually mullet requires highly fertile water due to their planktonic feeding habit. Water quality of the pond was considered good having the following physical, chemical and biological characteristics of water.

Table-06. Water quality parameter maintaining during broodstock management of *Liza parsia*

Water temperature	28-32°C
pH	6.5-8.5
Dissoved oxygen	5-7ppm
Carbondioxide	1-2ppm
Total hardness and total alkalinity	200-300ppm
Available phosphorus	0.5-1ppm
Available potassium	0.5-1ppm
Tranparency	35-40cm

Source: (Jhingran & Pullin, 1988)

3.2 Study of biology

Sample collection

The experiment was conducted in The Biological laboratory of Fisheries and Marine Resources Technology Discipline Khulna University, Khulna. The study period was three months from November 2010 to January 2011. Twenty five mature fish were collected randomly during monthly sampling to determine the total length and weight. A total 75 female of *Liza parsia* were examined to determine the gonadosomatic index, fecundity and Length-Weight relationship. Sample was collected from the study area.

Measurement of total length and body weight

The collected specimens were brought to the laboratory and total length (TL) and body weight (BW) were measured. Initially the fish were washed thoroughly with tap water. Then the excessive water of fish body was wiped off by tissue paper. Total length of fish was recorded in centimeter from tip of snout to the end of the tail and. Body weight was recorded by electric balance of 0.001g accuracy.

Measurement of weight of ovaries and fecundity estimation

Ovary of fish was removed from the body by dissecting out the abdomen. Then ovary was cleaned and washed by distilled water. Excess moisture from the surface of ovary was removed using tissue paper. Then ovaries weight was taken by electric balance. Both left and right lobe weight of ovaries were taken in 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.

Fecundity was estimated by using following formula:

$$F = \frac{N \times \text{Gonad Weight}}{\text{Sample Gonad Weight}}$$

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

Gonadosomatic index (GSI)

Finally Gonadosomatic Index was estimated by Parameswarn *et al.*, (1974) equation as follows

$$GSI = \frac{W_1}{W_2} \times 100$$

Where, W_1 = Wet weight of gonad
 W_2 = Wet weight of fish

Conditioning factor

Conditioning factor (K) was calculated by following formula:

$$K = \frac{W \times 10^3}{L^3} \quad (\text{King, 1997})$$

Where, W = body weight in gram,

L = total length in cm

K = conditioning factor

10^3 = the factors bringing the potential index

3.3 Induced breeding

Induced breeding technique of Liza parsia

It was done in January 2011 in Gollamary hatchery in Khulna. This process include...

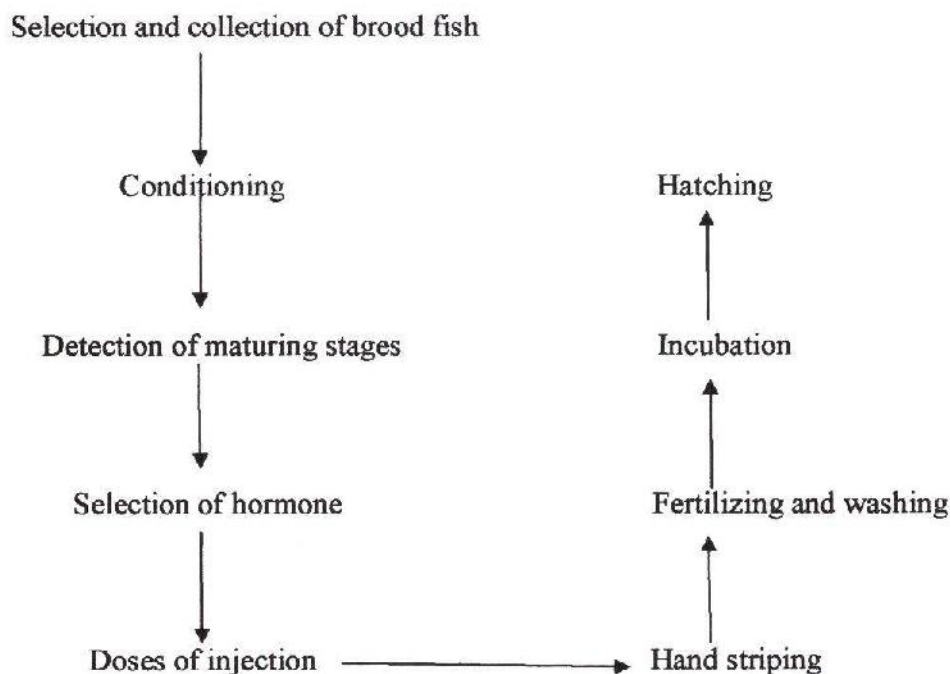


Figure 3. Flow chart of induced breeding technique of *Liza parsia*

Collection of Brood Fishes

Sixteen live gravid females and twelve live ripe males of *Liza parsia* were collected from the experimental ponds in Dacope Upazilla, near Sundarbans and adjacent to Pashur river in January 2011. The matured males and females were selected on the basis of their morphological criteria. The gravid females has swollen belly with round and reddish genital papillae, while ripe males secrets milky white milt on gentle pressure in its anal region. The female broods were 18 to 21cm in total length and 70 to 110g in weight while the males were 12 to 15cm and 60 to 80g. The fishes were kept in a concrete cistern (2 m dia x 1 m depth), filled with filtered underground water, which were gradually increased up to 12ppt by adding 150ppt brine in 72 hrs. It was done in 23 January 2011. Pelleted feed was given which was cleaned up time to time.

Fishes with female: male (1:1) sex ratio was kept in a similar cistern containing 12ppt water after hormone injection. There were no water shower but aeration was provided with portable electric aerator. Water temperature of the breeding cistern was maintained between 22-23°C using electric thermostats.

Hormone dose and injection

After 72hrs of conditioning fishes of both the sexes were injected with hormone at a dose of 3ml/kg body weight in deep muscle at the base of the dorsal fin. A synthetic gonadotropin releasing hormone analogue (SGnRH) commercially known as "Ovaprim" was used in this study.

Hand striping, fertilizing and washing

At the first trial, female of *Liza parsia* was showing active reproductive behavior for courtship and maintaining a position slightly behind the male and latter took parallel position but male were too weak to show any sign of reproductive behavior. For this reason hand striping was done after 52 hours of post injection in 28 January 2011. Eggs from ripe females were stripped into dry bowls and milt from male fish were then added to the eggs and mixed for 30 seconds by soft feather.

The second trial was done in 1 February 2011. In this trial, courtship was happened and female released their eggs into the water.

Incubation and hatching

The fertilized eggs were introduced into the incubation cisterns. Incubation is that period during which the fish develops inside the egg. This period of incubation temperature was 22-23°C and continuous aeration was provided with portable electric aerator.



Chapter 04

Results

4.1 Length-Weight relationship

The length-weight relationship was determined using the formula $W = aL^b$ which in logarithmic form was $\text{LogBW} = \text{Log}a + b\text{Log}L$. The relationship between body weight and total length gave the following equation:

$$\text{BW} = -101.46 + 9.77 \times \text{TL} \quad (r^2 = 0.88)$$

$$\text{LogBW} = -2.65 + 2.25 \times \text{LogTL} \quad (r^2 = 0.89)$$

The relationship between body weight on total length (Fig. 4) was linear and positive. When the body weight and length were converted to logarithmic form linear and positive relationship was also obtained between log body weight and log total length (Fig. 5)

4.2 Description of the ovary

Ovaries of the specimen were full of mature eggs. Colors of the ovaries were golden yellow in the ripe adults. The total weight of the gonad varied from 5.41 to 18.82g where the left lobe of the ovary varied from 2.63 to 9.25g and the right lobe varied from 2.78 to 9.57g. The mean weight of the gonad was $11.532 \pm 2.773\text{g}$ where the mean weight of the left lobe was $5.589 \pm 1.381\text{g}$ and the right lobe was $5.942 \pm 1.409\text{g}$.

4.3 Estimation of fecundity

The fecundity of *Liza parsia* varied from 56541 to 188860 and the mean fecundity was calculated as 122999 ± 30035 . Fecundity varied depending on weight and length. In this study minimum fecundity was found in fish having total length of 18.1 cm, body weight 68.5g and gonad weight 5.41g while the maximum fecundity was found in a fish having total length of 20.8 cm, body weight 104.54g and gonad weight 18.41g. Fecundity of *Liza parsia* according to different length and weight classes is presented in Fig. 6. and Fig. 7, respectively.

4.4 Gonadosomatic index

Gonadosomatic index (GSI) indicates the breeding season of fish. The GSI values obtained in the present study varied between 7.90 (for a female fish with a total length of 18.1cm, body weight of 68.5g and gonad weight of 5.41g) to 17.61 (for a female fish with a total length of 20.8cm, body weight of 104.54g and gonad weight 18.41g). The mean value of GSI was 14.2045 with a standard deviation of 1.65155.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Gonadosomatic Index	75	9.71	7.90	17.61	14.2045	1.65155
Valid N (list wise)	75					

4.5 Condition factor

The condition factor obtained in the present study ranged from 10.12-15.05. The mean value of the condition factor was 12.3560 with a standard deviation of 1.0822.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Conditioning Factor	75	4.92	10.12	15.05	12.3560	1.08022
Valid N (listwise)	75					

4.6 Sex ratio and reproductive period

The sex ratio of the fish (Male:Female) for spawning and fertilization was 1:1. The peak reproductive period of *Liza parsia* is November to January. But we are too late because of shortage of brood and lack of male breeders.

4.7 Induced breeding

At the first trial, the fertilized eggs did not hatch out but the second trial spawning activity appeared to continue first 36 hours post injection. *Liza parsia* started pairing just before spawning. The females were more active during the time of mating. Twelve hours since the first spawning, all fishes were removed from the spawning cistern. The eggs were floating and drifting in nature. To determine the fertilization rate a random 100 egg samples were studied and classified as fertilized and unfertilized under a electric microscope. The fertilization rate was calculated by the total sampled number (n=100) of eggs. The fertilization rate was found as $56 \pm 7\%$. The incubation period was about 42-43 hours. Hatching percentage could not be calculated correctly. Because all the embryos were died just after hatching.

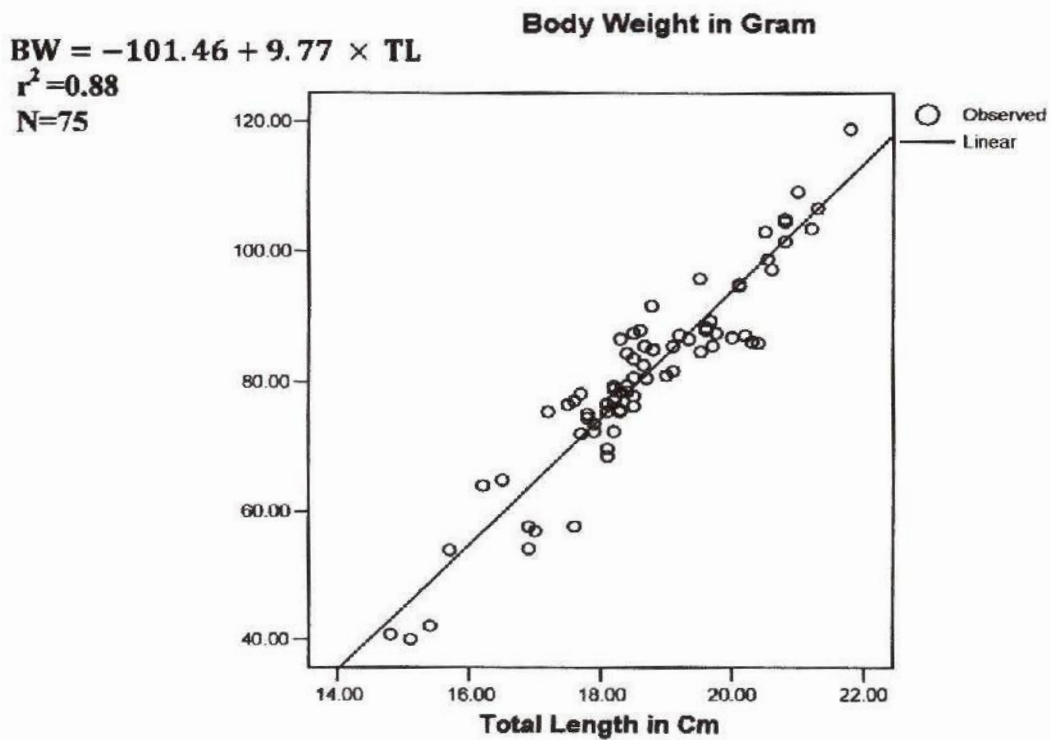


Fig.4: Relationship between total length (TL) and body weight (BW) of *Liza parsia*.

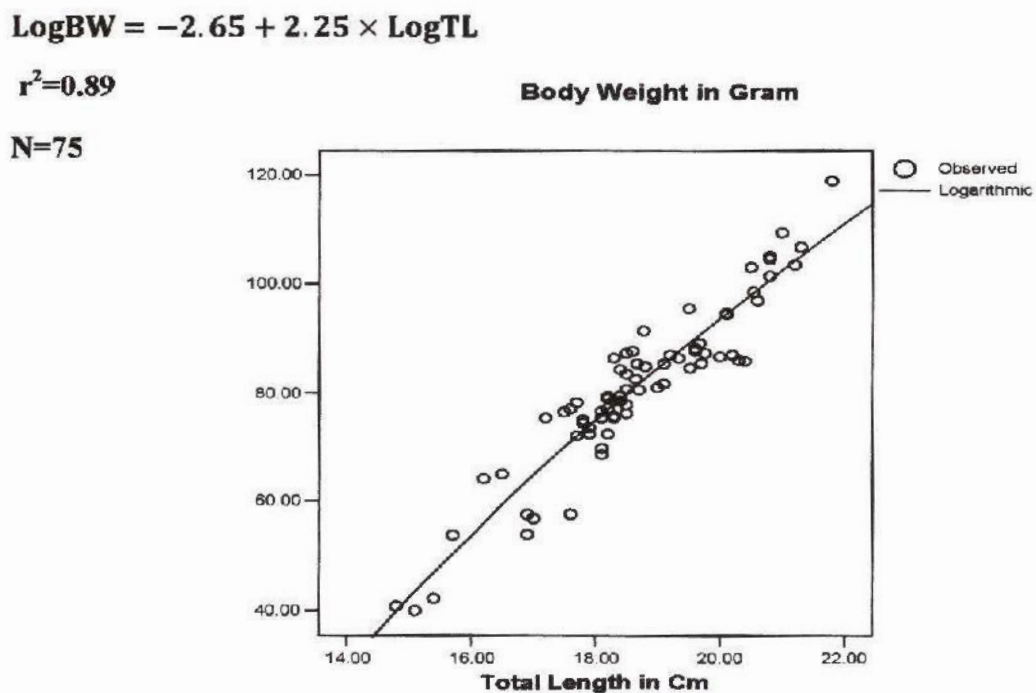


Fig.5: Relationship between log total length (LogTL) and log body weight (LogBW) of *Liza parsia*.

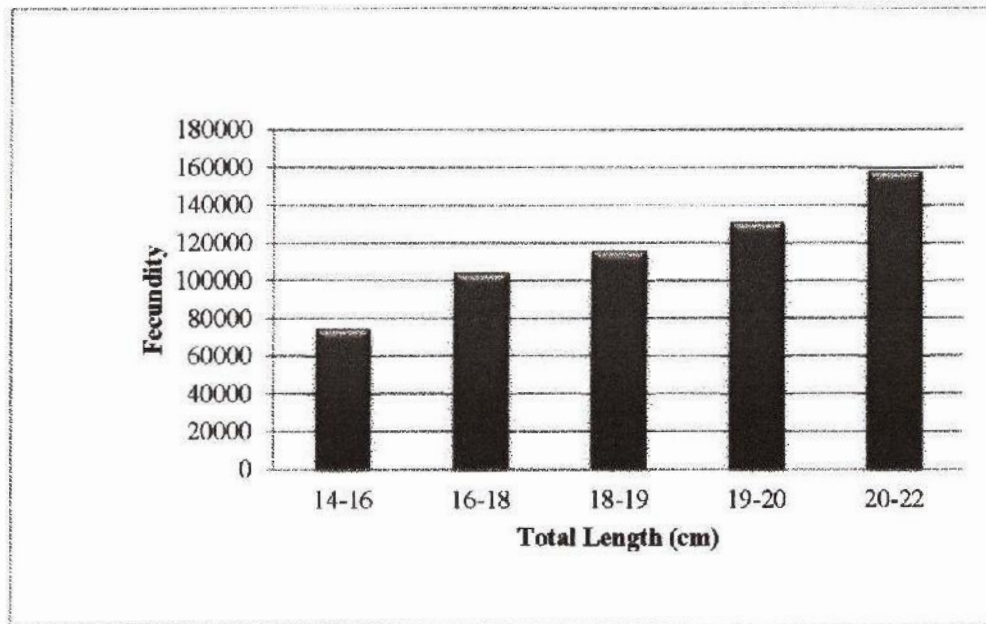


Fig. 6: Fecundity of *Liza parsia* according to different length groups.

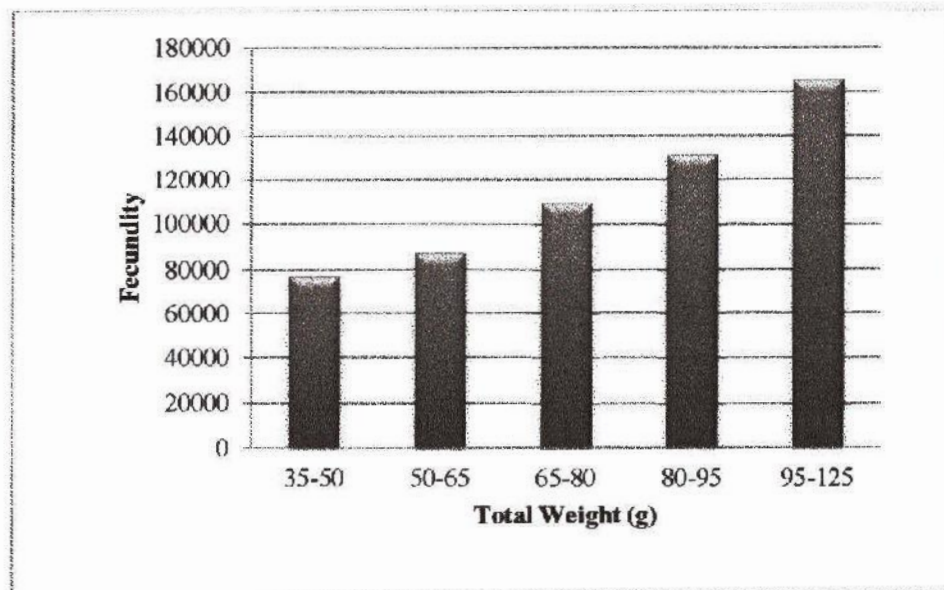


Fig. 7: Fecundity of *Liza parsia* according to different weight groups.

CHAPTER 5

DISCUSSION

The value of the regression coefficient “b” usually lies between 2.5 and 4.0 and an ideal fish maintain the shape $b=3$ (Hile, 1936). A value significantly larger or smaller than 3.0 indicates allometric growth. A value less than 3.0 shows that the fish becomes lighter (negative allometric) or greater than 3.0 indicates that the fish becomes heavier (positive allometric) for a particular length as it increases in size (Wootton, 1998).

The present study observed that, the values of the total length when plotted against the corresponding weight of fishes and the regression line drawn showed a linear relationship. The relationships indicate that weight of fish increases with the increase in total length. The values of the coefficient of correlation between total length and body weight ($r^2= 0.88$) was also significant. The relationship between total length and body weight of *Liza parsia* in the present study agreed well with the results reported for *Catla catla* (Zafar *et al.* 2003) and *Temualosa ilisha* (Halder and Amin, 2005).

Fecundity may be varied with length, weight and other environment factors. In this study fecundity of *Liza parsia* was found to vary from 56541 (total length of 18.1cm, body weight 68.5g and gonad weight 5.41g) to 188860 (total length of 20.8cm, body weight 104.54g and gonad weight 18.41g). The mean fecundity was calculated as 122999 ± 30035 . Rheman *et al.* (2002) observed the fecundity of *Liza parsia* varying between 19343 to 301700. Numerous factors like nutritional status, racial characteristics, time of sampling and maturity stage, environmental factors etc have so far known to exhibit variation in fecundity both within and between fish population.

In the present study, the specimen having total length of 20.8cm and body weight 104.54g was found to carry the highest number of eggs 188860. However, variation was found in the fecundity of fish of equal length. A fish having total length of 18.2cm, 86.1g in body weight and 13.05g in gonad weight produces 173120 eggs whereas three other fishes of the same total length

and body weight of 69.67, 72.01 and 87.88g and gonad weight 10.37, 10.86 and 13.27g produced 109872, 124356 and 123546 eggs respectively. Even two more fishes having total length of 20.8cm and body weight of 105 and 101.51g and gonad weight of 16.18 and 15.82g produced 175046 and 169816 eggs. Similar variation was also observed in the other length classes. This type of variation was also reported by several workers (Hamilton, 1822; Pillay and Rao, 1961; Islam *et al.* 1987).

The condition factor is not constant and found to vary in an individual, species or a population having relationship between seasonal changes in the environment and with the changes of physiological conditions of the fishes (Doha and Dewan, 1967).

In the present study, the condition factor obtained ranged from 10.12 to 15.05. The scatter 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 gonadal development and maturity of fish. It increases with the maturation of fish and declines abruptly thereafter (Parameswam *et al.* 1974). The GSI value also 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 18.1cm, body weight 68.5g and gonad weight 5.41g) to 17.61 (for a female fish with a total length of 20.8cm, body weight 104.54g and gonad weight 18.41g). But the study was conducted for only three months so the variation in the GSI value in different months was not observed and the peak spawning period was also not determined.

From the present study, the spawning activity was signed out after 36 hours post spawning in the second trial. This period was reported as 34-35 hours for *Mugil parsia* (Radhakrishnan *et al.* 1976), 48-52 hours for *Liza subviridis* (Das, 1992) and 0-50 hours for *Mugil cephalus* (Liao, 1975). The eggs took 42-43 hours after spawning to hatch out. Das (1992) reported that the incubation period of *Liza subviridis* is 32-36 hours at 22-25°C and 38-42 hours at 20-21.5°C of temperatures.

The hatching rates could not be calculated due to massive death of the embryos just after hatch out. Das (1992) found the hatching rate 62.5% for *Liza subviridis* bred artificially in winter.

The physiochemical parameters of the breeding cistern were measured periodically following standard methods (APHA, 1995) and the mean values are given in table 7. The salinity of water in the present study was bit lower (20‰) while other parameters were close to that has been reported by Das (1992) for *Liza subviridis*.

Table -07. Values of different water quality parameters of breeding cisterns of *Liza parsia*

Water quality parameters	Mean values±SE
Water salinity (‰)	20±1
Water temperature (°C)	22.5±0.5
pH	8.0±0.5
Dissolve oxygen (mg/l)	9±1

Chapter 06

Recommendation

- ✦ During increasing salinity of water of the breeding cistern, various types of problem may occur in brood stocks. These are loosing of scale and mucus, dehydration of body fluid, reddening of body and sometimes death of fish. Hence, salinity of water in breeding cistern should be increased very carefully and slowly.
- ✦ Use improved quality supplement feed for better gonadal development of brood fish.
- ✦ Good transport facilities in the time of brood transportation have to be developed.
- ✦ A national policy is needed for the development and utilization of Gold spot mullet culture in the coastal water body because it was very difficult to find matured brood from the nature and different farms as the species is nearly extinct in the coastal and Sundarbans region.

Chapter 07

Conclusion

There is a vast scope of brackish water aquaculture with numerous species in Bangladesh especially mullet species. *Liza parsia* is good candidate species for aquaculture due capable of tolerating high fluctuation of salinity but the culture of this species has not yet been developed in our country. This species have a good market demand and consumer acceptance. As day by day the natural stock of the fisheries resource is getting reduced because of overexploitation or excessive catch. Thus the practice of artificial breeding has become a very popular way to conserve stock and to make good profit with regard to commercial and nutritional purpose. Though artificial breeding of *Liza parsia* has not well practiced yet in Bangladesh, it is a good source of protein and can help to earn currency if artificial breeding and culture is introduced. In terms of artificial breeding, selection of good and healthy brood is a major concern. For good production, breeding selection is a vital part. So we can get maximum production if proper brood fish management and breeding techniques are practiced. One of the options to protect and conserve the declining natural fish stock of this species in inter-tidal zones of Bangladesh is to domesticate the species and produce fish seeds in captive condition. Preliminary success of brood management and breeding technology of *Liza parsia* has been developed through this research. The major limitation of the present study was limited number of broods and season failure. GSI value during different months was not observed. So, further study is needed for the breeding technique for several years.



Chapter 08

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Appendix

Table-08. Total weight (T.W), Total length (TL), Total gonad weight (TGW), Estimated fecundity (TE), Conditioning factor (C.F) and GSI value of 75 female of *Liza parsia*

Serial	TW(gm)	TL(cm)	TGW(gm)	TE	CF	GSI
1	69.67	18.1	33.2	109872	11.75	14.88
2	40.77	14.8	27	81771	12.58	16.62
3	42.15	15.4	28.2	70744	11.54	12.91
4	40.01	15.1	27.6	79471	11.62	17.27
5	54.18	16.9	31.1	73278	11.22	12.81
6	64.84	16.5	31.7	97771	14.43	13.22
7	77.85	18.5	34.1	154212	12.3	15.47
8	79.36	18.2	33.2	97287	13.16	12.71
9	54.02	15.7	28.2	67048	13.96	11.77
10	63.98	16.2	31	90205	15.05	13.27
11	75.42	18.3	33.8	125984	12.31	13.02
12	72.35	17.9	33	119350	12.61	13.19
13	84.92	18.8	34.8	168616	12.78	13.59
14	95.73	19.5	35.9	171376	12.91	16.35
15	85.44	19.1	35.3	155826	12.26	15.33
16	77.1	18.2	33.6	109857	12.79	12.87
17	106.65	21.3	39	140092	11.04	12.86
18	87.08	20.2	37	146883	10.56	14.4
19	85.52	19.7	36	149484	11.19	15.76
20	84.37	18.4	34	133905	13.54	13.46
21	57.69	17.6	32.1	105975	10.58	15.93
22	85	18.8	34.9	150736	12.79	13.88
23	87.13	19.2	35.3	167598	12.31	14.77
24	86.1	20.3	36.9	173120	10.29	15.16
25	86.76	20	37	126609	10.85	13.45
26	56.97	17	31.5	87829	11.6	17.32
27	57.64	16.9	31.1	92653	11.94	17.4
28	68.5	18.1	33.4	56541	11.55	7.9
29	72.35	18.2	33.5	119195	12	14.64
30	72.01	17.7	32.3	124356	12.99	15.08
31	76.25	18.5	34.1	112818	12.04	13.9
32	75.72	18.3	33.7	120975	12.36	14.17
33	75.05	17.8	32.6	116697	13.31	14.35
34	103.52	21.2	39	132932	10.86	13.24
35	77.05	17.6	32.4	122114	14.13	14.08
36	76.5	17.5	32.3	123538	14.27	13.8

Appendix

37	80.57	18.7	34.3	120698	12.32	14.57
38	78.19	17.7	32.6	101546	14.1	13.43
39	73.53	17.9	33.1	108707	12.82	13.52
40	80.66	18.5	33.9	92564	12.74	11.77
41	78.57	18.3	33.4	89895	12.82	11.66
42	75.41	17.2	31.7	99942	14.82	13.51
43	79.4	18.4	33.6	87343	12.75	11.98
44	84.64	19.52	36.37	107489	11.38	12.74
45	87.44	19.76	36.86	101636	11.33	12.27
46	81.67	19.1	35.58	96401	11.72	12.04
47	86.52	19.34	36.58	122707	11.96	12.42
48	85.95	20.4	37.2	132587	10.12	15.7
49	80.99	19	35.1	114332	11.81	13.79
50	78.96	18.2	33.5	89968	13.1	11.46
51	82.58	18.65	35.12	117464	12.73	13.74
52	78.49	18.4	34.71	114996	12.6	13.67
53	104.54	20.8	38.9	188860	11.62	17.61
54	109.23	21	39.2	186146	11.79	16.41
55	98.74	20.54	38.4	167632	11.39	17.43
56	118.8	21.8	40.1	184978	11.47	15.84
57	75.41	18.1	33.2	112627	12.72	14.88
58	85.47	18.67	34.37	112759	13.13	13.1
59	87.84	18.6	35.2	125110	13.65	13.88
60	87.42	18.5	35	122210	13.81	13.76
61	86.52	18.3	34.5	124523	14.12	13.86
62	79.48	18.4	34.6	116750	12.76	14.29
63	74.45	17.8	32.75	102053	13.2	13.9
64	76.58	18.1	33.3	102540	12.91	14.1
65	83.57	18.5	34.2	115328	13.2	13.58
66	94.57	20.1	37.74	152488	11.65	15.47
67	94.86	20.1	37.8	148542	11.68	15.2
68	97.14	20.6	38.6	150531	11.11	15.43
69	101.51	20.8	38.94	169816	11.28	15.58
70	89.27	19.67	37.28	130480	11.73	15.44
71	88.29	19.6	37	139305	11.73	15.19
72	87.88	19.6	37.11	123546	11.67	15.1
73	103.05	20.5	38.46	153917	11.96	15.38
74	105	20.8	39.1	175046	11.67	15.41
75	91.57	18.77	36.37	144807	13.85	15.37

Photo Gallery



Figure 01. A ripe *Liza parsia* ready for artificial breeding.

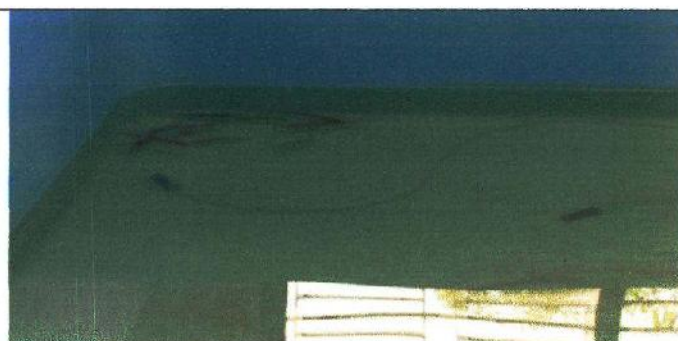


Figure 02. Matured males and females *Liza parsia*



Figure 03. Females showing active reproductive behavior for courtship and maintaining a position slightly behind the male



Figure04. Brood capture by net



Figure 05. Length measurement of brood fish



Figure 06. Injecting hormone in deep muscle at the base of the dorsal fin in male *Liza parsia*

Photo Gallery



Figure 07. Injecting hormone in deep muscle at the base of the dorsal fin in female *Liza parsia*



Figure 08. Identify mature brood for hand striping



Figure 09. Hand striping of brood fish

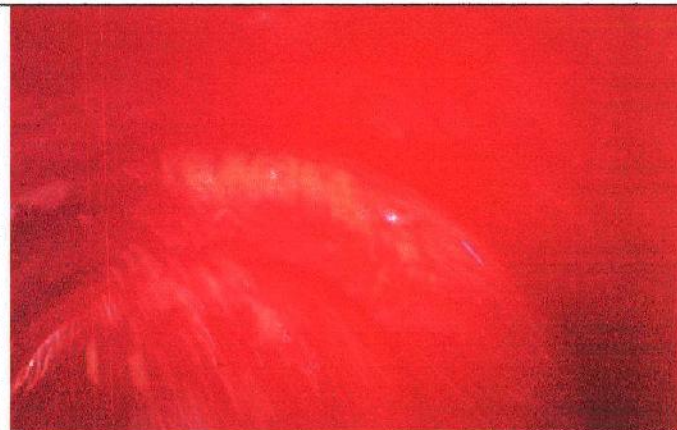


Figure 10. Fertilized eggs



Figure 11. Keep fertilized eggs into the cistern for incubation



Figure 12. Eggs before hatching

Photo Gallery

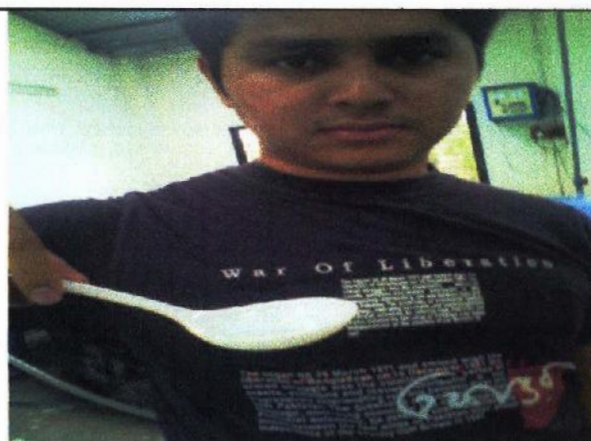


Figure 13. Embryos sample in a spoon



Figure 14. Embryos after hatching in a spoon



Figure 15. Sample of *Liza parsia*

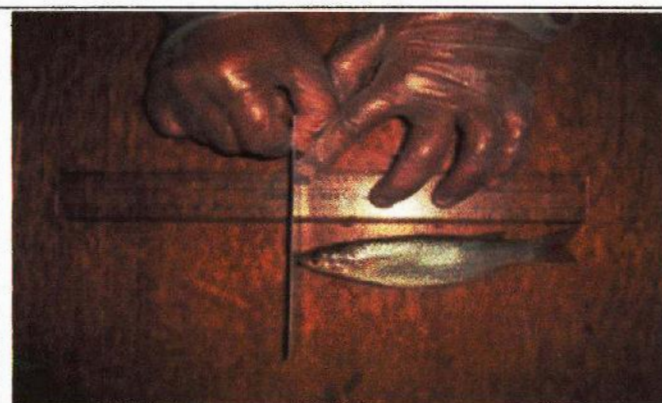


Figure 16. Total length measurement of *Liza parsia*



Figure 17. Total weight measurement of *Liza parsia*



Figure 18. Measurement of sample gonad weight

Photo Gallery

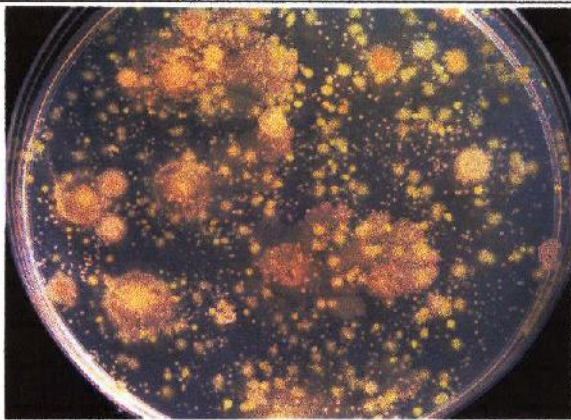


Figure 19. Eggs sample in dilute solution



Figure 20. Observed egg fertilization by Electric Microscope