



Research Article

Investigations on the Feeding and Spawning in *Bagarius bagarius* from Manchar Lake District Jamshoro, Pakistan

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Abstract | An investigation on the feeding and breeding in *Bagarius bagarius* was examined from Manchar Lake District Jamshoro, Sindh, Pakistan. Total 62 samples were accessed at different length groups during April-September 2022. The range of samples was between (10.0 to 70.0 cm) and from (28-3500 g) in total length and weight respectively. For food determination the experimental fish was divided into three length groups *viz.*, small (10.0-15.0 cm) medium (15.1-30.0 cm) and large (40.0-70.0cm) for the determination of feed preference. The results of the investigations revealed that the food fondness of *B. bagarius* was detected as highly carnivorous (Piscivorous) displayed higher preferences for fish (46.6 %) seconded by insect larvae (20 %) and 3rd preferred was debris (15.4 %). For breeding analysis values of ova diameter were found to be ranged between 0.55-1.0 mm, the gonadosomatic index (GSI) values were also from to be increasing from 0.71-6.5% and from 0.82-10.28% for both the sexes. These values remained high during April to August. It indicated that the fish spawned once in a year in July. Outcomes of egg estimation during the examination depended on 10 matured *B. bagarius* from Manchar Lake. Fecundity ranged between 260-554 eggs. Least egg estimation 260 was detected from fish of 41.8cm and 88.0 g in length and weight. The highest egg was 554 from 59.0 cm and 155 g in both length and weight. Total body length exhibits better relationship with fecundity of experimental fish *B. bagarius* from Manchar Lake than the other parameters.

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Keywords | Food preference, Gut content, Spawning periodicity, Fecundity GSI, *Bagarius bagarius*, Manchar Lake



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Introduction

Manchar is a beautiful picturesque Lake Man means Jewel while Char means an expanse of water. Positioned at the west of River Indus River,

District Jamshoro, Sindh, Pakistan and around 18 km away from Shawn Sharif (Narejo, 2006). There are several islands in the lake the main islands are Lal chatto and Mashak and also famous for fishes and fowls. The massive normal depression surrounded by

Khirthar mountain range in its west side and Lakhi hills on its south and River Indus in its east side (Jafri *et al.*, 2006). It delivers surroundings to the variety of life with substantial for fish population, travelling birds, macrophytes, invertebrates and various kinds of plankton which used as food/forage to the number of animals and humans. It cares hundreds and thousands of fisher folk communities, that rest on freshwater fish from this lake (Wadhar *et al.*, 2013).

The catfish belongs to the order siluriformes which is the largest orders of teleost's fish possessing around 4100 kinds (species) and representing 12% of all teleost's and 6.3% of the entire vertebrate fauna. These are low in calories, extracted oil livers are excellent bases for vitamin D and B2 (Riboflavin) with omega-3. Catfish are important because they serve several dissimilar ways such as including food, medicinal, sports and ornamental values (Hossain, 2010). *Bagarius bagarius* also known as freshwater shark of the genus *Bagarius* and family Siluriformes these are indigenous species in Pakistan, Thailand, Indonesia, India, Sri Lanka, and Viet Nam. *Bagarius bagarius* is known with different vernacular names in different countries. Catfish is commercially valuable fish found in inland waters with palatable size nutritious and delicious (Mawa *et al.*, 2022; Narejo *et al.*, 2002).

Exploring feed preferences and spawning periodicity in fish is critical for assessing the potential of their culture in open waters rearing with natural and supplementary feed stuffs (Lashari *et al.*, 2010). No existing data is available on the targeted fish so, that the current investigation was initiated to furnish primary data on *Bagarius bagarius* from Manchar Lake. The purpose to know feeding habit and breeding biology in fish are significant biological factors which would help to select a group of fish in polyculture or mono-culture system in raceways, cisterns and ponds to evade the rivalry with in the system which will enable them to live with harmony, association and to exploit available food in the environment (Narejo *et al.*, 2005).

This study is new of its kinds and no body from Pakistan have reported this type of investigation on this fish (*Bagarius bagarius*) and from Manchar lake.

Materials and Methods

Collection of experimental fish

To look over the food and feeding likings and spawning periodicity breeding biology of *Bagarius bagarius* 62 specimens were inspected which were gathered from Manchar Lake, District Jamshoro, Sindh, Pakistan during April to September 2022. The fish were collected by different nets with the help of fisherman. After collection, samples were study in terms their length and weight with the use measuring board (cm) and weight by numerical balance then keep in container for later analysis. The samples of gut and gonads were fixed with 5% formaldehyde then transferred to the vessels for the determination of food feeding and breeding analysis.

Transportation and preservation of fish

Collected fish were preserved in 5% formalin and in polythene bag and transported to Laboratory Department of Fresh Water Biology and Fisheries, for further analysis.

Laboratory analysis

- The preserved fish was taken out from polythene bag washed with tap water and length measured in cm on measuring board and weight was recorded in grams on electronic balance.
- The food items were identified with the help of different books and keys.
- For breeding biology analysis, the determination of sex and the gonad condition documented on the individual basis, after that the gonads were kept in tube with 10% formaldehyde solution for further analysis and investigations.

Contents of gut

The gut of experimental fish was removed and preserved in 5% formalin guts were washed, uncoiled and unnecessary tissues were removed dissected carefully and their contents washed into petri dish after that detected under a light microscope (Olympus, model B-2000) by using Sedgwick-rafter counting cell. The electivity index (E) or Ivlev's index was computed rendering to given formulae:

$$E = \frac{r_1 - P_1}{r_1 + P_1}$$

Whereas, relative contents of items represented as r_1 , items present in the environment donated (+1)

positive value (-1) negative value resulted as avoidance of substance.

Ova size measurements

For the ova size measurements 100 ova were used as per standard from both ovaries of experimental fish through ocular micrometer fitted in binocular microscope (Olympus) as endorsed Narejo *et al.* (2002) and their association was determined through least-squares analysis as given LeCren (1951).

Determination of (GSI)

Determination of gonadosomatic index (GSI) was undertaken separately for both the sexes for entire period of investigations through the formulae given below.

$$GSI = \frac{\text{weight of testis/ovary}}{\text{weight of fish}} \times 100$$

Estimation of egg production capacity

Estimation of egg production capacity (fecundity) of *Bagarius bagarius* the study was relied upon 10 mature fish. The sub-sample of 1g was taken from anterior, middle and posterior regions of the both ovaries weighed on automated balance and the eggs found in 1 g sample were totaled. Egg production capacity was determined on the base of weight of both ovaries.

The egg production of the experimental fish was calculated with the help of formula given below.

$$F = N \times \text{weight of ovary/weight of sub - sample}$$

Where; F= egg production ability (fecundity); N= ova in sub-sample.

Numerous fish body factors such as weight of fish, ova weight and of fish were contrived with egg production (fecundity) and the association of the several body factors was premeditated through least square procedures as recommended LeCren (1951).

Results and Discussion

Food and feeding of *Bagarius bagarius* was studied in terms of quantity and quality of food taken by fish in relation to body weight and stomach weight from Manchar Lake district Jamshoro, Sindh Pakistan during April to September 2022. In total 62 samples varied between 10.0-70.00 cm were specified. Table 1 showed categories of food items percentage (%) observed from gut of *Bagarius bagarius* combined (small, medium and large groups). The results of food and feeding experiment indicated that *B. bagarius* was carnivorous in food selection with higher proclivity fish as dominant (46.6%-50%) followed by insect larvae (20%) in each group and 3rd preferred food was debris (13.4%-15.4%). In small size group 12 fish sample were assessed the higher preferences was fish (40.6%) followed by insect larvae (20%) and 3rd was debris (13.4%). In medium size group 23 samples were examined and also found that the higher preferred food was fish (49.4%) followed by insect larvae (20%) and 3rd was debris (16%). In large size group 27 fish sample were observed the higher preferences was again fish (50%) followed by insect larvae (20%) and third was debris (15.4%).

Breeding biology

Measurement of egg size: The measurement of egg size of *B. bagarius* from Manchar Lake district Jamshoro displayed (Table 2). The data of experimental months during April-August 2022, measurements of egg size as seemed in the ovaries of *B. bagarius*. Size of egg deviated from 0.55-1.00 mm, found to be increasing in width through April-August with topmost during July through entire duration of investigations. Size of eggs was noted as unchanged and rounded shaped, it inferred that all matured eggs were released simultaneously topmost period of spawning (July). There were almost empty follicles without eggs was seen during August, which reflects that all matured eggs were released at once during topmost spawning period (Table 2).

Table 1: Categories of food item percentage (%) observed from gut of *Bagarius bagarius* from Manchar Lake, District Jamshoro, Sindh Pakistan (small, medium and large group).

Length group	No. of fish	Fish	Insect larvae	Worms	Debris	Miscell-aneous	Plants matter	Total
Small 10.0-15.00 cm	12	40.6%	20%	6%	13.4%	15%	5%	100%
Medium 15.1-30.00 cm	23	49.4%	20%	-	16%	14.6%	-	100%
Large 40.0-70.00 cm	27	50%	20%	-	15.4%	14.6	-	100%

Table 2: Month wise changes in ova diameter of *Bagarius bagarius* from Manchar Lake Jamshoro, Sindh Pakistan.

S.No.	Months	Number of female	Ova diameter (mm)
1	April	05	0.55
2	May	05	0.71
3	June	05	0.93
4	July	05	1.0
5	August	05	No eggs

Determination of gonadosomatic index

The % of gonadosomatic index in the investigation was seen deviated from 0.71 6.5 in male 0.82-10.28 in female. %GSI noted to be increases from month of April-July displayed one greatest/topmost in July (Table 3). During current research work the high values of GSI were observed during month of April- July, it ranged 0.71 to 6.5% and from 0.82 to 10.28% for both the sexes. It can be inferred from (Table 3) that there were almost empty follicles without eggs was seen during August, which reflects that all matured eggs were released at once during topmost spawning period in August and the% GSI after breeding at the minimum scale 0.71 in male and 0.82 in female. Lastly, it is inferred that experimental fish *Bagarius bagarius* spawns in July once in year as indicating high values of both parameters such as % of GSI and measurements of egg size achieving maximum during July.

Table 3: Month wise changes in Gonadosomatic index of *Bagarius bagarius* from Manchar Lake Jamshoro, Sindh Pakistan.

S.No.	Months	No. of male	% GSI male	No. of female	% GSI female
1	April	05	3.40	05	5.32
2	May	05	4.80	05	6.43
3	June	05	5.50	05	8.0
4	July	05	6.5	05	10.28
5	August	05	0.71	05	0.82

Fecundity

Egg estimation in the studies were rely on 10 ripe specimens *Bagarius bagarius* displayed in (Table 4). It seems that the estimation of egg in *B. bagarius* deviated from 260-554. Small quantity of egg 260 obtained from fish of 41.8 cm length and 88.0g in weight and maximum count was 554 eggs from 59.0 cm length and 155 g in weight (Table 4). Average egg in 1g weight of fish and ovary was 5.87 and 809

correspondingly. Relationship of numerous body factors like weight of fish and ovary and fish length of *B. bagarius* with fecundity was contrived with their respective variables exhibited perfect association with weight of ovary (X) and fecundity (Y). Body length and fecundity in *B. bagarius* were observed and positive correlation ($r = 0.98$). The upward tendency in fecundity increases in relation to body length. The equation between fish length with fecundity was enumerated as follows:

$$\log F = -1.4 + 0.7 \log l (r = 0.98)$$

It was observed from the above formula of regression analysis that the body length exhibits better relationship with fecundity of experimental fish *B. bagarius* from Manchar Lake. Values of numerous body factors contrived with fecundity resulted as linear/better association of fecundity with weight of ovary ($r = 0.99$). Correlation of coefficient between fecundity and body weight enumerated as $\log F = 0.32 + 2.54 \log Bw (r = 0.99)$.

Table 4: Length, weight gonad weight and fecundity of experimental fish, *Bagarius bagarius* from Manchar Lake Jamshoro.

S.No	Length of fish	Weight of fish	Gonad weight	Fecundity
01	41.8	88.0	6.8	260
02	48.0	98.0	8.9	360
03	52.5	143.0	8.6	489
04	55.0	120.0	9.2	485
05	58.9	145	6.8	260
06	59.0	155	10.2	554
07	46.1	90.0	7.0	280
08	49.3	100	7.3	300
09	51.1	110	7.2	295
10	43.8	95.5	7.4	310
11	47.3	97.0	7.9	350
12	50.0	130.5	8.0	390

The present analysis on food preference and spawning periodicity of *Bagarius bagarius* was collected from Manchar Lake District Jamshoro, Sindh, Pakistan was enumerated from 62 specimen during April to September 2022 ranging in size from 10.0 to 70.0 cm in length and 28.0-3500g in weight respectively. For food analysis the experimental fish was divided into three length groups viz., small ranges from (10.0-15.0 cm), medium ranges from (15.1-30.0 cm) and large

ranges from (40.0-70.0 cm) for the determination of food preference. In small size group 12 fish sample were assessed the higher preferences was fish (40.6%) followed by insect larvae (20%) and 3rd was debris (13.4%) In medium size group 23 samples were examined and also found that the higher preferred food was fish (49.4%) followed by insect larvae (20%) and 3rd was debris (16%) In large size group 27 fish sample were observed the higher preferences was again fish (50%) followed by insect larvae (20%) and third was debris (15.4%), the results revealed that *Bagarius bagarius* is mainly carnivorous in nature. Unlike many observations based upon feeding habit of several kinds of fish agreed by diverse researchers such as [Thebo et al. \(2019\)](#) in small *Ompok pabda* gut shows preference to zooplanktons, plant debris and protozoa, medium size disclosed to choose worms, detritus and insect larvae and large revealed with zooplankton, insect larvae, debris and detritus. [Narejo et al. \(2016\)](#) in *H. fossilis* are planktivorous mainly feed on crustaceans besides plant matter and worms, [Noor et al. \(2013\)](#) termed *R. rita* as carnivorous chiefly fed upon small fish, insects and crustaceans. [Haque et al. \(2020\)](#) reported alike food items from the analyses of gut in *R. rita*. Lastly, their examination verified that crustaceans (zooplankton) and insects were detected to be the important food stuffs. [Ramesh and Kiran \(2016\)](#) *Clarias batrachus* food analysis discovered that food items with fish larvae, insect larvae, zooplankton, organic debris and small shrimps. [Laghari et al. \(2015\)](#) commented on *Labeo calbasu* that the fish is bottom feeder principally fed which containing decayed organic matter. [Rao \(2017\)](#) studied feeding behavior of *Rita rita* and *Bagarius bagarius* he found continuous presence of arthropods in both species' mollusks were secondary food in *R. rita* and plants in *B. bagarius*. [Elias \(2009\)](#) enumerated stomach content analysis of *Clarias gariepinus* feed on zooplanktons, [Iqbal and Waseem \(2008\)](#) observed that *R. rita* had first preference of crustaceans followed by mollusks shells, fish cycloid scales and rotten vegetation. [Chaturvedi and Saksena \(2014\)](#) concluded that *Mystus caviasus* feeding on wide range of phytoplankton, zooplankton, insects their larvae and mollusks. [Hashim et al. \(2014\)](#) in *Labeo gonius*, [Wirat and Tippayadara \(2009\)](#) observed the gut of *Helicophagus wandersii* frequency of occurrence of bivalves was 100% and nematodes. [Nishad et al. \(2021\)](#) indicated from present study that fish *R. rita* are rely frequently upon insects, mollusks and plant matter. [Gupta \(2015\)](#) indicates that feeding habit of *Channa punctatus* is carnivorous including

zooplanktons, insects, crustaceans, fishes, plant matter and miscellaneous. [Narejo et al. \(2016\)](#) studied feeding biology of *Cyprinus carpio* is omnivorous in habit. Our investigation on food preference more or less similar to those reported by [Rao \(2017\)](#).

The studies on breeding biology of catfish *Bagarius bagarius* from Manchar Lake Jamshoro have been initiated with a view to contributing basic knowledge towards their profitable commercial production. The investigation was based on reproductive biology, in terms of ova size, GSI and fecundity analysis. The diameter of ova in the present research was observed as 0.55 to 1.0 mm. Similar observation was also recorded by [Narejo et al. \(2003\)](#) in *Monopterusuchia* from Bangladesh. They recorded range between 0.100-1.00 in diameter. [Mastoi et al. \(2008\)](#) in *Labeo calbasu*, maximum ova diameter was from 1.30. [Narejo et al. \(2015\)](#) in *Channa striatus*. They recode ova size 0.70-1.30mm. [Jalbani et al. \(2015\)](#) observed ova diameter of *Heteropneustes fossilis* size of ova diameter was 0.90-1.10. [Jalbani et al. \(2016\)](#) recorded size of ova 0.24-1.40 in catfish *Rita rita*. [Chandio et al. \(2016\)](#) recorded size of ova from 1.0-2.82 mm in *Notopterus notopterus* from Indus River. Findings of these all researchers are in accordance of the present work. In the present study values of Gonadosomatic index was noticed from 0.71-6.5 for male and 0.82-10.28 for male respectively. Numerous works recorded alike values from the eels. Like, [Narejo et al. \(2002\)](#) recorded values of GSI 8.40 and 10.58 for male and female, respectively. [Afroz \(2000\)](#) noticed GSI values 0.31 to 1.85 in *Monopterusuchia*. [Rahman and Mollah \(2013\)](#) determined 1.3 for male and 12.0 for female *Macrogathus aral*. [Ali et al. \(2013\)](#) dogged GSI values 14.40. [Miah et al. \(2015\)](#) calculated GSI values 2.14 in male and 5.1 in female in *Monopterusuchia*. These all values are alike or similar with current research. Many workers also determined GSI value in other fish species also like [Narejo et al. \(2006\)](#) in *G. chapra*, [Lashari et al. \(2007\)](#) for *Cirrhinus reba*, [Jalbani et al. \(2015\)](#) in *Heteropneustes fossilis* and [Chandio et al. \(2016\)](#) in *Notopterus notopterus*. Diameter of ova showed inverse relationship with fecundity (ova diameter increases and decreases fecundity). Numerous researchers reported low ova diameter values with high fecundity in number of fish species as ([Narejo et al., 2015, 2018; Bakht et al., 2020; Thebo et al., 2022; Parveen et al., 2022](#)). Finally, it was concluded that the experimental fish *Bagarius bagarius* from Manchar Lake prefers fish as most suitable diet and breeds once

in a year in the month of July.

Conclusions and Recommendations

The fish under examination was ranked as highly carnivorous and most preferred food item (Piscivorous) in nature. The spawning season of the fish was April to August. The fecundity values were found to be high during July. It indicated that the fish spawned once in a year during July. Outcomes of egg estimation during the examination rely on 10 matured *B. bagarius* from Manchar Lake. Fecundity was ranged between 260-554 eggs. We recommend that the environment of the lake is favourable for spawning in the month of July.

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Novelty Statement

This study is new of its kinds in Pakistan and no one have reported this type of investigation on this fish (*Bagarius bagarius*) and from Manchar lake.

Author's Contribution

Bushra Shaikh: Performed the experiment and analysis, write-up of the manuscript.

Naeem Tariq Narejo: Designed and conceived the idea of this experiment.

Faheem Saddar and Athar Mustafa Laghari: Collected fish and eggs samples for the research.

Muhammad Hanif Chandio: Assisted in literature, helped in proofread and gathering data.

Majida Parveen Narejo: Helped in checking of data.

Urooj Imtiaz and Ghulam Abbas: Helped in relevant literature, read the manuscript, and wrote the document while gathering data.

Shahnaz Rashid: Assisted in format setting and bibliography up to-date.

Conflict of interest

The authors have declared no conflict of interest.

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