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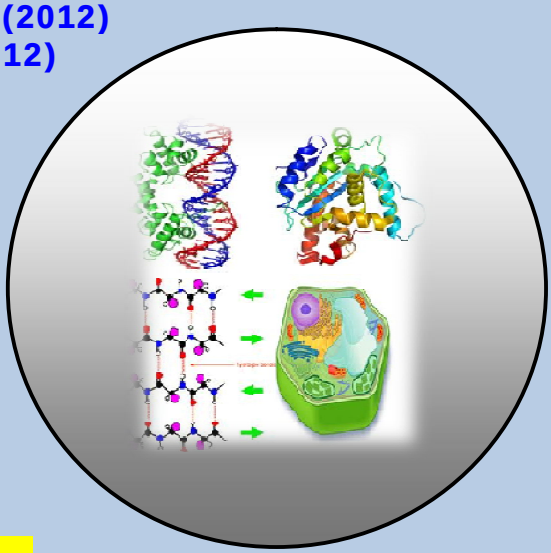

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RESEARCH PAPER

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Ovarian Development, Reproductive Cycle and Fecundity Indices in *Mystus tengara* (Hamilton, 1822)

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ABSTRACT

Mystus tengara is a commercially important small indigenous fish species of Bangladesh. The ovary of the species passes four major maturation stages viz. Immature (mean ova diameter 0.30±0.01 mm), Maturing (mean ova diameter 0.48±0.03 mm), Mature (mean ova diameter 0.76±.02 mm) and Ripe stage (mean ova diameter 1.15±0.02 mm) up to maturity. The gravid females are only observed from April to July. The ranges of GLI and GSI values are found highest (GLI, 23.60 to 30.90 and GSI, 14.16 to 22.69) from April to July. All three methods used to determine the reproductive cycle of M. tengara focused that the fish breeds in April to July and during this single spawning time the fish spawns for more than once, as mature, ripe and immature ovaries were found in the same size group of females. The fish is moderately fecund having reproductive potentiality as 11995.18±480.21 eggs in average. The relationship among fecundity and five important variables viz. total length, standard length; total weight, ovary length and ovary weight were found positively correlated. The results of the study will play a vital role for the proper management and conservation of the species.
Key words: GLI, GSI, Ovary, Reproduction, Fecundity and Mystus tengara.

INTRODUCTION

Mystus tengara is one of the preferred small indigenous freshwater fish species of Bangladesh. Proper management and conservation of the species can play vital role in the country economy.

Research on different biological aspects of the species is therefore important to find out the best ways of better management. The reproductive biology of a population of any fish species is essential for assessing commercial potentialities of its stock, life history, culture practice and actual management of its fishery (Doha and Hye, 1970). Among different parameters reproductive biology ovarian development, reproductive periodicity and fecundity are the three most indispensable aspects to assess the reproductive biology of a species. Research on the ovarian development provides information about maturation stages of ovary indicating reproductive periodicity that helps us to know about the spawning season, breeding period as well as the active breeding period of that species. In addition, fecundity is also a crucial aspect to know about the number of population given by any species. There are several number of studies have been operated on the biology of *Mystus* species *viz.* Pandian (1966), Rao and Sharma (1984), Khan *et al*. (1992), Hoque and Hossain (1993), Dasgupta (2002), Sarker *et al.* (2002), Musa and Bhuiyan (2007), Bhatt *et al.* (1977) and Islam *et al.* (2011). But research on *Mystus tengara* is scanty than our actual need. In Bangladesh, such investigations on this species are rare and superficial. To date, there have not been any complete investigation and research work on the ovarian development, reproductive cycle and fecundity indices of this species. The research work is aimed to find out a complete feature on the reproductive biology of *M. tengara* for different contributors of the fisheries sector of Bangladesh as well as the world.

MATERIAL AND METHODS

Random sampling was done to collect adult *M. tengara* at a regular interval of one week from different fish landing centres of Rajshahi, Bangladesh since January 2011 to December 2011. A total of 870 specimens were collected during day time and precautions were taken to save from spoilage or any damage. After collection, the specimens were washed well, confirmed to the species level and then tagged and preserve by date in plastic jars with 5% formalin. The total length, standard length and total weight of the specimens were measured. The specimens were sexed and the numbers of gravid females were recorded.

The gonads of fishes were removed intact and placed in 5% formalin which not only preserved the ovary but made it much easier to separate the eggs from the ovarian wall (Shafi and Quddus, 1974). The length of the ovary was measured with the help of a fine point divider. The weight of gonads was taken with the help of an Electronic balance Model: KD-300KC to an accuracy of 0.01g. Excess moisture of the ovaries was removed by using blotting papers before weighing. The changes of color of the ovary were noted depending on the degree of maturation. The mean ova diameter, Gonadosomatic index (GSI) and Gonadal length index (GLI) was calculated for each month to find out the spawning season. Gonadosomatic index (GSI) and Gonadal length index (GLI) were calculated according to the formula described by Welcomme (1985) and Wootton (1990) as follows:

$$GSI = \frac{weight\ \ of\ \ the\ \ gonad}{weight\ \ of\ \ the\ \ fish} \times 100\ ,\quad GLI = \frac{Length\ \ of\ \ the\ \ gonad}{Length\ \ of\ \ the\ \ fish} \times 100$$

Ten to fifteen ova were collected at random from the anterior, central and posterior regions of each ovarian lobe by separating them out from the tissue by a fine needle and a brush. These were arranged in several rows on a glass slide and the diameter of individual ova was measured with the help of an ocular micrometer fitted on a compound microscope. The ova diameter was recorded twice in every month. A total of 84 gravid females were studied for the estimation of fecundity. The gravimetric method was followed to determine the fecundity according to Lagler, (1966), Hossain *et al* (1997) and Latifa *et al*. (2002). The relationship of fecundity with total length (TL), standard length (SL), total weight (TW), ovary length (OL), and ovary weight (OW) were estimated by the least square method.

RESULTS AND DISCUSSION

There are several aspects to study reproductive biology of any fish species. Among these, ovarian development, reproductive cycle and fecundity have been used to study reproductive biology of *M. tengara* in the present work.

Ovarian Development

Female fishes have a pair of ovaries that pass through different developmental stages to be matured. And the maturation of oocytes in the ovaries of *M. tengara* undergoes four major stages and can be detected by size and colours of the ovary. The stages repeat in cyclic order in which ovarian development continues and the fish get ready to breed again. During the study period following stages of oocytes are observed including spent and resting stages in the ovaries of *M. tengara* (Table 1).

Stage-I Immature: The ovaries were small, thread like and the ova were difficult to clearly define without a microscope. The ovary was irregular in shape and transparent ova are nearly round shaped with central nucleus. Ova diameter was ranged from 0.10 to 0.45 mm with the mean of 0.30±0.01 mm (Table 1).

Stage-II Maturing: The ovary became slight opaque due to the deposition of yolk and the ovary wall was still irregular. Immature ova were found with frequent maturing ova. The nucleus was not clearly visible. Diameter of the ova ranged from 0.41to 0.57 mm with the mean of 0.48±0.03 mm (Table 1).

Stage-III Mature: The ovary became enlarged and spherical. Ovarian wall was slightly thin. The nucleus was invisible due to heavy deposition of yolk and the colour of the ovary became light yellow. Ova diameter ranged from 0.62 to 0.89 mm with the mean of 0.76±.02 mm (Table 1).

Stage-IV Ripe: The ovary became deep yellow and grew in size. Ova were seen with open eyes. Ovarian wall was transparent and full of blood vessels. The colour of the ovary became deep yellow. The mean diameter of ova was found 1.15±0.02 mm ranged from 0.78 to 1.27 mm (Table 1).

Stage-V Spent: Ovaries were flaccid, reduced in volume and size with brownish colour. The ova were of different size, few maturing ova were still being seen through the ovary wall with a few ripe ones. The mean diameter of ova was found 0.56±0.01 mm (Table 1).

Stage-V Resting: Ovaries become constrictive and reduced in volume. Several growing up ova were observed with a mean diameter of 0.12±0.02 mm (Table 1).

Reproductive Cycle

Breeding season of a species repeats in cyclic order, in which the organism undergoes maturation changes and thereby gets ready to breed again. This repeated phenomenon is known as reproductive cycle (Milton and Arthington, 1983). The reproductive act in some fishes occurs only once in a very short lifetime, while in other fishes, it occurs once in a moderately long life span. Several other species spawn more than once in a year more or less continually (Lagler *et al*., 1977).

Table 1. Variation in ova diameter in different stages of maturity with distinguishing color.

Developmental Stages of ova	Ova diameter (mm)			Colour of ovary
	Minimum	Maximum	Mean±SE	
Immature	0.10	0.45	0.30±0.01	Whitish
Maturing	0.41	0.57	0.48±0.03	Whitish yellow
Mature	0.62	0.89	0.76±.02	Light yellow
Ripe	0.78	1.27	1.15±0.02	Deep yellow
Spent	0.44	0.81	0.56±0.01	Brownish
Resting	0.10	0.25	0.12±0.02	Whitish

Values are presented as mean **±** SE.

In the present investigation, the gravid females are only observed from April to July. The ranges of GLI and GSI values are found remarkably highest (GLI, 23.60 to 30.90 and GSI, 14.16 to 22.69) from April to July in comparison to other months (GLI, 12.98 to 19.74 and GSI, 1.28 to 7.40) presented in Figure 1. All the three methods used to determine the reproductive cycle of *M. tengara* focused that the fish breeds in April to July. During this single spawning time the fish spawns for more than once, as mature, ripe and immature ovaries were found in the same size group of females. Most of the freshwater fishes of Bangladesh breed during the monsoon and post-monsoon. Similar results have been observed by Hossain *et al*. (1992) in *O. pabda*; Nargis and Hossain (1992) in *A. testudineus*; Parween *et al*. (1993) in *E. danricus*; Fatema *et al.* (1997) in *O. bacaila*; Islam *et al*., (2001) in *S. phasa*; Koc *et al*. (2007) in *L. cephalus*; and Dadzie *et al.* (2008) in *P. niger* Alam *et al.* (2012) in *S. gora* while working on the reproductive cycle of fishes.

Several dissimilarities were also reported by Hossain *et al*. 2002 in *G. manminna* (January to June); Lorenzo *et al*., 2002 in *L. mormyrus* (June to December); Fazli *et al*., 2008 in *L. aurata* (October to December); and Mazlan and Rohaya, 2008 in *P. schlosseri* (June to October) both in marine and freshwater fishes of the world.

Fecundity

Fecundity is one of the important factors of the biology and population dynamics of fish (Alam *et al.* 2012). The fecundity of a species is not a constant number, it fluctuates within a certain range and species specific (Shafi *et al.*, 1978; Afroze and Hossain, 1983; Hossain *et al.,* 1992; Rahman *et al.,* 2002). In the present investigation the fecundity of *M. tengara* varied from 7287 to 19123 with a mean of 11995.18±480.21. Several researches worked on the other species of *Mystus* and found variation in fecundity.

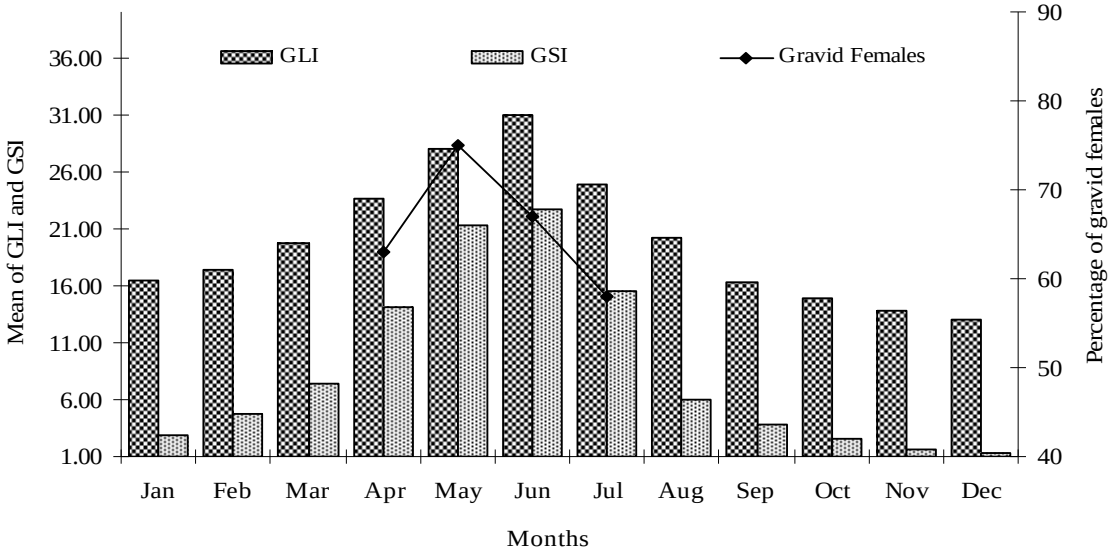

Figure 1. Variation in GLI, GSI and percentage of gravid females of *M. tengara* in different months showing reproductive cycle.

Khan *et al*. (1992) reported that the fecundity of *M. tengara* ranged from 720 to 5223. Rao and Sharma (1984), Hoque and Hossain (1993) and Islam *et al.* (2011) reported the fecundity of *M. vittatus* ranged from 3500 to 18800; 2534 to 60746 and 18210 to 44620 respectively. Sarker *et al.* (2002) and Dasgupta (2002) reported the fecundity of *M. gulio* ranged from 11436 to 23481 and 425 to 18199 respectively; Musa and Bhuiyan (2007) reported that fecundity range of 4,652-57,932 in *M. bleekeri*. Bhatt *et al.* (1977) reported fecundity of 20064 to 46443 and 3314 to 63135 for *M. seenghala* and *M. cavasius* respectively. Though the result of the present study varied with the result of Khan *et al.* (1992) but the result of the present study is more acceptable considering the fecundity of other species of *Mystus*; and according to Lagler *et al.* 1977 who stated that variation in fecundity is very common among the same species of fish depending on their size, age and environmental conditions.

Table 2. Relationships with fecundity (F) among total length (TL), standard length (SL), total weight (TW), ovary length (OL) and ovary weight (OW) of *Mystus tengara* (N=84).

Relationships		Values of 'a'	Values of 'b'	Values of 'r'
Ordinate (Mean±SE)	**Abscissa (Mean±SE)**			
F = (11995.18±480.21)	TL (10.6±0.53) cm	7769.5	99.428	0.889
	SL (8.92±0.31) cm	-9895.1	2453.3	0.883
	TW (15.43±0.42) g	-1787.9	893.32	0.910
	OL (2.76±0.27) cm	2886.2	3299.2	0.790
	OW (5.18±0.35) g	1844.7	1959.4	0.749

*Correlation is significant at the 0.01 level.

The relationships with fecundity among five important variables *viz.* total length, standard length, total weight, gonad length and gonad weight were established and descriptive statistics of these variables are presented in Table 2. The relationships were found significant and determined to be positively correlated as described by Bagenal, 1978.

CONCLUSION

Study on the reproductive biology of *M. tengara* is found to be essential in the sense that it may provide information and clues for a tactful and skilful nature of ovarian development, reproductive cycle and fecundity of the species. The outcome of the present study has provided some new and updated information that will play an important role in proper management and conservation of this species.

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REFERENCES

Afroze, S. and Hossain, M. A. 1983. The fecundity and sex-ratio of *Amblypharyngodon mola* (Hamilton) (Cyprinifromes:Cyprinidae). *Univ. j. zool. Rajshahi Univ.* **2**: 29-32.

Alam, M. M., Ahsan, M. K. and Parween, S. 2012. Ovarian development, fecundity and reproductive cycle in *Securicula gora* (Hamilton, 1822). *DAV International Journal of Science.* **1**(2):96-66.

Bagenal, T. B. 1978. Aspects of fish fecundity. In: *Ecology of freshwater fish production* (ed.S. D. Gerking). Willey Int., New York. pp. 75-101.

Bhatt, V.S., Dalal, S.G. and Abidi, S.A.H. 1977. Fecundity of the freshwater catfishes *Mystus seenghala* (Sykes), *Mystus cavasius* (Ham.), Wallagonia attu (Bloch) and Heteropneustes fossilis (Bloch) from the plains of northern India. *Hydrobiologia.* **54** (3): 219-224.

Dadzie, S. and Abou-Seedo, F. 2008. Reproductive guilds (maturation, spawning frequency and fecundity) in the black pomfret, *Parastromateus niger* (Carangidae) in the Kuwaiti waters of the Arabian Gulf. *J. Appl. Ichthyol.* **24**: 562–568

Dasgupta, M. 2002. Fecundity of Mystus gulio (Hamilton) from West Bengal. *Indian J. Fish.*, 49 (4), 457-459.

Doha S. and Hye M. A. 1970. Fecundity of the Padma river *Hilsa ilisha* (Hamilton). *Pakistan. J. Sci*. 22: 176-183.

Fatema, N., Mortuza, M. G., Parween, S. and Hossain, M. A. 1997. On the breeding periodicity of *Oxygaster bacaila* (Hamilton) (Cypriniformes: Cyprinidae). *Univ. j. zool. Rajshahi Univ.,* **16**: 101-102.

Fazli, H., Janbaz, A. A., Taleshian, H. and Bagherzadeh, F. 2008. Maturity and fecundity of golden grey mullet (*Liza aurata* Risso, 1810) in Iranian waters of the Caspian Sea. *J. Appl. Ichthyol.* **24**: 610-613.

Hoque, M.A. and Hossain, M.A. 1993. Sexual maturity and fecundity of the freshwater catfish *Mystus vittatus* (Bloch). *Univ. J. Zool. Rajshahi Univ*., 12, 9-13.

Hossain, M. A., Islam, M. N., Ahsan, M. K. and Sultana, N. 2002. Reproductive periodicity of *Gonialosa manminna* (Ham.) (Clupeiformes: Clupeidae). *Univ. j. zool. Rajshahi Univ.,* **21**: 91-92.

Hossain, M. A., Parween, S and Rahman, M. A. 1997. Fecundity of *Nandus nandus* (Hamilton-Buchanan) (Nandidae: Perciformes). *J. bio-sci.*, **5**: 305-307.

Hossain, M. A., Taleb, A. and Rahman, M. H. 1992. Reproduction and fecundity of *Ompok pabda* (Ham.). *Bangladesh J. Sci. Res*., **10**(1): 49-52.

Islam, M. N., Flowra, F. A. Khatun, S. and Hossain, M. A. 2001. Reproduction and reproductive periodicity of *Setipinna phasa* (Hamilton) (Clueiformes: Engraulidae). *Univ. j. zool. Rajshahi Univ*., **20**: 92-94.

Islam, S.S., Shah, M.S. and Rahi, M.L. 2011. Study of fecundity and induced breeding of *Mystus vittatus*. Bangladesh J. Zool., 39 (2), 205-212.

Khan, S., Banu, N. and Isabella, B. 1992. Studies on some aspect of the biology and fecundity of *Mystus tengara* (Hamilton-Buchanan, 1822). *Bangladesh J. Zool*., 20, 151-160.

Koc, H. T., Erdogan, Z., Tinkci, M. and Treer, T. 2007. Age, growth and reproductive characteristics of chub, *Leuciscus cephalus* (L., 1758) in the Ikizcetepeler dam lake (Balikesir), Turkey. *J. Appl. Ichthyol.,* **23**: 19-24.

Lagler, K. F. 1966. *Freshwater Fishery Biology* (second edn). WM. C. Brown Company. Dubuque. Iowa. 421p.

Lagler, K. F. Bardach, J. E. and Miller, R. R. and Passino, D. R. M. 1977. *Ichthyology* (second edn.). John Willey and Sons. Inc. New York. London. Sydney. 506p.

Latifa, G. A., Rahman, M. M. and Parvin, S. 2002. Fecundity and maturation of gonad of snakehead fish *Channa striatus* (Bloch, 1793) (Channiformes: Channidae). *Univ. j. zool. Rajshahi Univ.,* **21**: 65-67.

Lorenzo, M., Pajuelo, J. G., Me´ndez-Villamil, M., Coca, J. and Ramos, A. G. 2002. Age, growth, reproduction and mortality of the striped seabream, *Lithognathus mormyrus* (Pisces, Sparidae), off the Canary Islands (Central-east Atlantic). *J. Appl. Ichthyol.,* **18**: 204–209.

Mazlan, A. G. and Rohaya, M. 2008. Size, growth and reproductive biology of the giant mudskipper, *Periophthalmodon schlosseri* (Pallas, 1770), in Malaysian waters. *J. Appl. Ichthyol.* **24**: 290-296.

Milton, D. A. and Arthington, A. H. 1983. Reproductive biology of *Gambusia affinis halbrooki* (Baird and Girard), *Xiphophorus helleri* (Gunther) and *X. maculatus* (Heckel) (Pisces: Poeciliidae) in Queensland. *Australian J. Fish. Biol*., **23**: 230-41.

Musa, A.S.M. and Bhuiyan, A.S. 2007. Fecundity of Mystus bleekeri (Day, 1877) from the River Padma near Rajshahi city. Turk. J. Fish. Aquat. Sci., 7, 161-162.

Nargis, A. and Hossain, M. A. 1992. Reproductive periodicity of climbing perch *Anabas testudineus* (Bloch) (Anabantidae: Perciformes). *Bangladesh. J. Sci. Ind. Res*., **27**(1 & 2): 87-93.

Pandian T. J. 1966. Feeding and reproductive cycle of the fish *Mystus gulio* in the Covum backwaters, Madras. *Indian J. Fish*. **13**(1-2): 322-333.

Parween, S., Begum, N., Rahman, M. H. and Hossain, M. A. 1993. On the breeding periodicity of *Esomus danricus* (Hamilton). *Univ. j. zool. Rajshahi Univ.,* **12**: 31-34.

Rahman, M. H., Parween, S., Mortuza, M. G. and Ahsan, M. K. 2002. Reproductive periodicity and spawning potentiality of *Rhinomugil corsula* (Ham.) (Mugiliformes: Mugilidae). *Univ. j. zool. Rajshahi Univ.,* **21**: 99-100.

Rao, T.A. and Sharma, S.V. 1984. Reproductive biology of *Mystus vittatus* (Bloch) (Bagridae: Siluriformes) from Guntur, Andhra Pradesh. Hydrobiologia, 119, 21-26.

Sarker P. K., Pal H. K., Rahman M. M. and Rahman M. M. 2002. Observation on the fecundity and gonado-somatic index of Mystus gulio in brackishwater in Bangladesh. Online J. Biol. Sci. 2(4): 235-237.

Shafi, M. A. and Quddus, M. M. A. 1974. The fecundity of the common punti, *Puntius stigma* (Cuvier and Vallenciennes) Cyrpinidae : Cypriniformes. *Bangladesh J. Zool*., **2**(2): 133-145.

Shafi, M., Quddus, M. M. A. and Islam, N. 1978. Maturation and Spawning of *Hilsa ilisha* (Hamilton-Buchanan) of the River Meghna. *Dhaka university studies* Part-B, **XXVI**(2): 63-71.

Welcomme, R. L. 1985. River Fisheries. FAO Fish. *Tech. Pap*. 262. 330 pp.

Wootton, R. J. 1990. *Ecology of teleost fishes*, (first edn). Chapman and Hall, London.

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