The Chittagong Univ. J. B. Sci.,Vol. 3(1 &2): pp. 139-148 , 2008.

REPRODUCTIVE BIOLOGY OF THE CLUPEID, *GONIALOSA MANMINA* (HAMILTON, 1822) FROM THE KAPTAI LAKE, BANGLADESH.

M. A. AZADI* AND A.S.M. SHARIFUR RAHMAN
Department of Zoology, University of Chittagong, Chittagong-4331, Bangladesh.

ABSTRACT

Gonialosa manmina was found to spawn once in a year from February to July in the Kaptai Lake. The fish was found to attain sexual maturity at 80 mm total length. Sex ratio of male and female was 1:2.39 (χ^2 = 26.25, df = 1, P<0.01). Female dominated significantly over male throughout the year. Seven stages of maturity were determined on the basis of morphological characteristics of gonads and diameter of ova. Fecundity of 24 fishes ranged from 13460 eggs to 56980 eggs with a mean of 32003±12612 eggs. Fecundity factor was 1882 eggs g^{-1} body weight. Fecundity (F) was highly correlated (P<0.001) with total length (TL), body weight (BW), ovary length (OL) and ovary weight (OW) and the relationships were as follows:
$F = 1.0080\ TL^{2.1648}$ or Log F = 0.0035 + 2.1648 Log TL (r = 0.977, t = 21.49)
$F = 2.8807\ SL^{2.0420}$ or Log F = 0.4595 + 2.0420 Log SL (r = 0.958, t = 15.66)
$F = 5477.722\ BW^{0.6332}$ or Log F = 3.7386 + 0.6332 Log BW (r = 0.990, t = 32.91)
$F = 12.516\ OL^{2.2057}$ or Log F = 1.0975 + 2.2057 Log OL (r = 0.987, t = 28.80)
$F = 934.544\ OW^{0.5062}$ or Log F = 2.9706 + 0.5062 Log OW (r = 0.996, t = 52.28)

Key words: Clupeid, Reproductive Biology, Fecundity, Sex-ratio, *G. manmina,* Kaptai Lake.

INTRODUCTION

Gonialosa manmina locally known as 'Chapila' is a commercially important naturally occurring auto-stocked clupeid fish in Kaptai Lake. The fish is also found in the rivers of the country and distributed in adjacent countries of Bangladesh (Day 1878, Munro 1955, Shafi and Quddus 1982, Rahman 1989). The Lake Kaptai is the biggest (68,800 ha) man-made reservoir in the South-East Asia from which a significant amount of different freshwater fishes are landed,

* Corresponding author Email: maazadi@yahoo.com

which annually varied from about 2000 mt (during 1976) to 8000 mt (during 2007) (Azadi *et al*. 1992, DoF 2008). Clupeids contributed more than 70% of the total catch consisting of small sized 'Kachki', *Corica soborna*, and 'Chapila', *Gudusia chapra* and *Gaonialosa manmina*. Now-a-days over fishing as well as habitat destruction in the water bodies lead the small fish population to decline. Awareness is growing among the fish biologists to conserve and enhance the production of the country's small indigenous fishes (Felts *et al.* 1996). To manage and increase the production of small indigenous fish species, a sound knowledge on reproductive biology dealing with maturity and fecundity of fish is very essential.

Some important works on the reproductive biology of different fish species of then Kaptai Lake have been done (Azadi *et al.* 1990, 1992, 1995, Shahzalal *et al*. 2003, Mamun and Azadi 2003, Azadi and Mamun 2004) but no work was found on the reproductive biology of *G. manmina* from the lake or elsewhere from the country. So, an investigation was undertaken to study the reproductive biology of an important clupeid, *Gonialosa manmina*, from the Kaptai Lake, Bangladesh.

MATERIALS AND METHODS

For the study of reproductive biology a total of 156 specimens of *G. manmina* were collected monthly from September 1995 to August 1996 from the fishermen catch at Rangamati area of Kaptai Lake. For maturity studies the specimens were given a median longitudinal incision ventrally after recording their length (mm) and weight (g). After dissection the sexes were determined on the basis of gonad. The gonads were taken out carefully and their lengths and weights were measured by millimeter scale and semiautomatic table balance (Ogawa Seiki Co. Ltd. Japan) of accuracy up to 0.01g respectively. Maturity stages were determined on the basis of scale adopted by the International Council for the Exploration of the Sea (Wood 1930). Chi-square (χ^2) test was carried out to evaluate the probability of equal abundance of sexes in each length group for each month. Reproductive maturity and breeding periods were determined by the Gonadosomatic Index (GSI) and Gonadal Length Index (GLI) following Schreck and Moyle (1990). Gravimetric method (Lagler 1956, Bagenal 1978) was used for the estimation of fecundity. Relationship between fecundity (F) and total length (TL), standard length (SL), body weight (BW), ovary length (OL) and ovary weight (OW) were determined by the regression equation $y = a + bx$. Fecundity factor was calculated by dividing fecundity (F) by body weight (BW).

RESULTS AND DISCUSSION

Sex-ratio

The monthly ratio between male and female sexes ranged from 1.00:1.50 to 1.00: 4.50, the average being 1.00:2.39 (χ^2 = 26.25, P<0.01, N = 156, df = 1) (Table 1). The sex-ratio fluctuated throughout the year though there was a distinct trend among females to be more abundant than males. Females significantly (P<0.01) dominated over males throughout the year. Dominance of females over males was also reported in *E. vacha* from the Kaptai Reservoir (Azadi *et al.* 1990).

TABLE1. MONTHLY DISTRIBUTION OF SEX RATIO AND CHI-SQUARE (X2) VALUES OF *G. MANMINA.*

Months	No. of fish examined	Male (M)		Female (F)		Ratio M : F	χ^2	Level of significance
		No.	%	No.	%			
Sep'95	10	4	40.00	6	60.00	1 : 1.5	0.4	P<0.05
Oct.	11	6	54.55	5	45.45	1.2 : 1	0.09	P<0.05
Nov.	13	4	30.77	9	69.23	1 : 2.25	1.92	P<0.05
Dec.	13	3	23.08	10	76.92	1 : 3.35	3.76	P<0.05
Jan.'96	11	2	18.18	9	81.82	1 : 4.5	4.45	P<0.05
Feb.	15	4	26.67	11	73.33	1 : 2.75	3.26	P<0.05
Mar.	13	4	30.77	9	69.23	1 : 2.25	1.92	P<0.05
Apr.	11	3	27.27	8	72.73	1 : 2.67	2.27	P<0.05
May	14	5	35.71	9	64.29	1 : 1.8	1.66	P<0.05
Jun.	12	3	25.00	9	75.00	1 : 3	3.76	P<0.05
Jul.	15	3	20.00	12	80.00	1 : 4	5.4	P<0.05
Aug.	18	5	27.78	13	72.22	1 : 2.6	3.55	P<0.05
Total	156	46	29.49	110	70.51	1 : 2.39	26.25	P<0.01

Description of the ovaries

The ripe ovaries are paired elongated organs occupying nearly the whole of the cavity. They are orange-yellow in colour (during February-July) and round in cross section. The left ovary was found to be slightly larger than the right ovary. The ovaries were suspended from the dorsal wall of the body cavity by a mesentery. Posteriorly the two lobes of the ovary were united to form a short and wide oviduct opening to the exterior through a pore. The fully ripe ovaries were found with distinct blood vessels during the spawning season.

Maturity stages

On the basis of microscopic and macroscopic study seven maturity stages of gonads were recognized. Stage 1. Immature (ova transparent): Ovaries elongated pinkish about ⅓ of the length of body cavity. Ova were invisible to the naked eye, only a single group of transparent ova with mode at 0.08 mm was encountered. Stage 2. Intermediate (ova semi opaque): This stage was found during the months of October to January. The ovaries were small, slender, almost globular and about half of the length of body cavity. Ova diameter mode shifted to 0.14 mm. Stage 3. Maturing (ova opaque): These ovaries were observed during December to March. Ovaries distinctly granular in appearance, ova creamy-white, distinct to the naked eye, ovary occupied more than half of the length of body cavity. Highest mode of the ova-diameter frequency was found between 0.20 mm to 0.35 mm. Stage 4. Maturing: Maturation continuing, ovaries extending to ⅔ of body cavity, ova bigger size and plainly visible. Ova-diameter mode shifted to 0.35 mm to 0.40 mm. Stage 5**.** Maturing (ova semi-transparent): This stage was available from February to August. Ripe ova not yet released. Ovaries occupied almost the entire body cavity and swollen, a few ova transparent. Largest mode in the ova-diameter frequency was between 0.40 mm to 0.48 mm. Stage 6. Mature (ova transparent): Fully mature stage was observed during the months from April to July. The first maturing group of ova has become fully mature and ready to be shed. Ova transparent and can be extruded easily by slight pressure on the belly, increased in length and weight, eggs were round and large. The highest mode in the ova-diameter frequency was between 0.48 mm to 0.51 mm. Stage 7**.** Spent: Ovaries were shrunken, ovarian membrane very vascular; a few dead detached mature ova remained in the lumen.

Gonadosomatic Index (GSI)

GSI of 106 females *G. manmina* is shown in the Fig.1. Minimum index values were recorded from October to January indicating non-spawning time of the fish. Sharp uprising tendency of GSI was observed in February and high GSI values maintained up to July and sharp fall occurred in August and there after gradually decreased indicating that February to July was the spawning season of the fish in the Kaptai Lake.

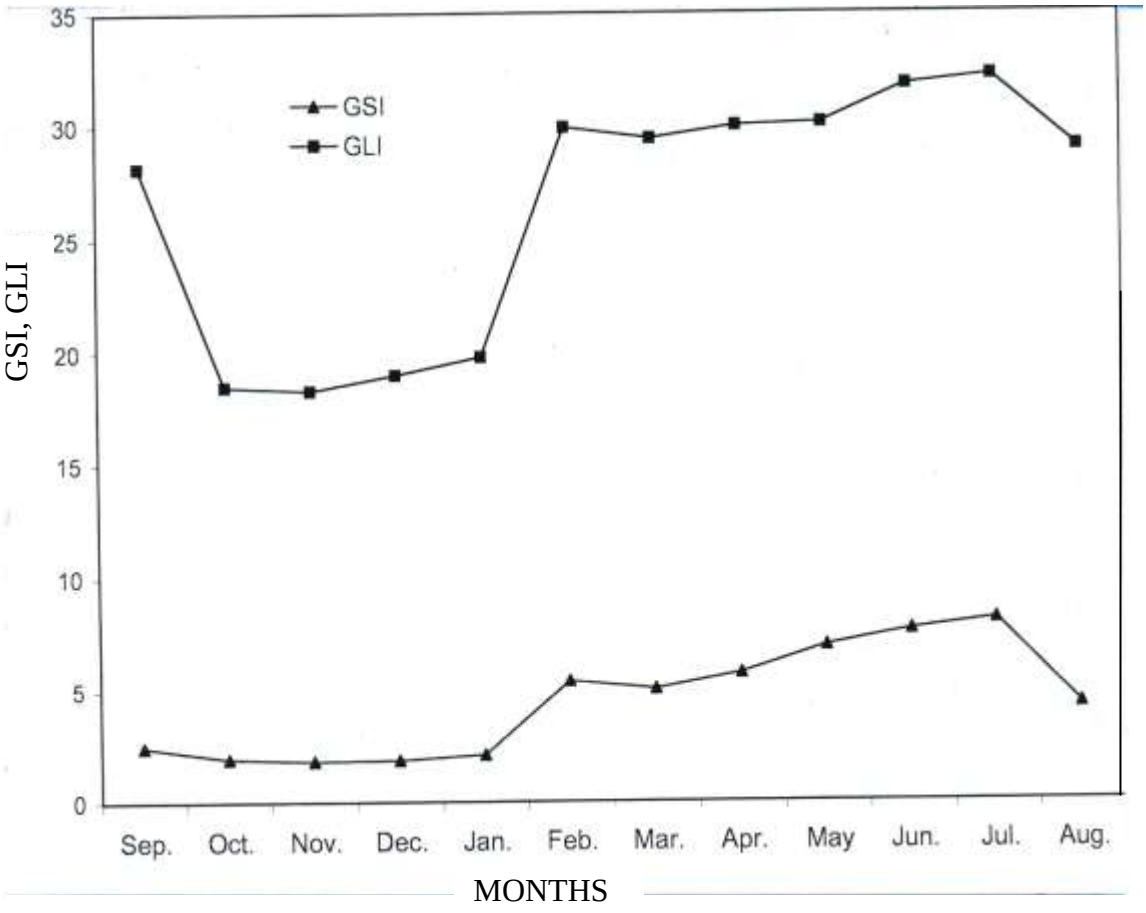

FIG.1. MONTHLY FLUCTUATIONS IN GONADOSOMATIC INDEX (GSI) AND GONADAL LENGTH INDEX (GLI) OF *G. MANMINA.*

Gonadal length Index (GLI)

Reproductive periodicity may be determined by the GLI (Hossain 1976, Hossain *et al.* 1991). The maximum and minimum values of GLI were found in July (32.2) and November (18.30) respectively (Fig.1). High values of GLI during the months of February to July indicated the breeding period of the fish in the Kaptai Lake (Fig.1). From the records of GSI and GLI it might be said that the fish spawned once in a year during February to July.

Fecundity

Fecundity of 24 *G. mamina* varied from 13460 eggs (for a fish of total length 80 mm, body weight 4.5g and ovary weight 220 mg) to 56,980 eggs (for a fish of total length 147 mm, body weight 30g and ovary weight 330mg) (Table 2) with a mean of 32,003±12612 eggs. Fecundity factor was 1882 eggs g^{-1} body weight. The mature ova diameter ranged from 0.43 mm to 0.53 mm. The fecundity (F) was highly correlated (P<0.001) with total length (TL), standard length (SL), body weight (BW), ovary length (OL) and ovary weight (OW). The relationships were as follows:

$F = 1.0080\ TL^{2.1648}$ or Log F = 0.0035 + 2.1648 Log TL (r = 0.977, t = 21.49)

$F = 2.8807\ SL^{2.0420}$ or Log F = 0.4595 + 2.0420 Log SL (r = 0.958, t = 15.66)

$F = 5477.722\ BW^{0.6332}$ or Log F = 3.7386 + 0.6332 Log BW (r = 0.990, t = 32.91)

$F = 12.516\ OL^{2.2057}$ or Log F = 1.0975 + 2.2057 Log OL (r = 0.987, t = 28.80)

$F = 934.544\ OW^{0.5062}$ or Log F = 2.9706 + 0.5062 Log OW (r = 0.996, t = 52.28)

All the relationships were found to be highly significant (P<0.001) and non linear and linear in arithmetic and logarithmic scales respectively. Fecundity increased more than square of total length and ovary length but less than one exponent of body weight and ovary weight. Similar significant relationships between fecundity and total length, body weight, ovary length and ovary weight were also found in other fishes from the Kaptai Lake and other water bodies (Dewan and Doha 1978, Azadi *et al*. 1990, Azadi *et al*. 1992, Azadi *et al*. 1995, Mamun and Azadi 2003, Shahzalal *et al*. 2003, Azadi and Mamun 2004, Bhuiyan and Rahman 1982, Bhuiyan and Islam 1990, Bhuiyan *et al*. 1993, Shafi and Quddus 1973). The relationship between fecundity and total length of the fish is normally non-linear in nature (Simpson 1951, Bagenal 1978 and Babiker and Ibrahim 1979). Mitchell (1913) assumed that the egg production is proportional to the length cube. Simpson (1951) and Pitt (1964) also hold this view and expressed that the fecundity is related to the cube of the length for plaice but Clark (1934) observed as square of the length.

TABLE 2. TOTAL BODY LENGTH, STANDARD LENGTH, BODY WEIGHT, OVARY LENGTH, OVARY WEIGHT AND FECUNDITY OF 24 FEMALE *G. MANMINA.*

SL. No.	Total body length (mm)	Standard length (mm)	Body weight (g)	Ovary length (mm)	Ovary weight (mg)	Fecundity
1	80	63	4.5	25	220	13460
2	85	66	5.2	26	290	16800
3	90	70	6.4	27	350	17906
4	93	71	6.5	27	370	18395
5	96	74	6.8	28	420	19880
6	100	80	8.2	28	480	20979
7	105	83	8.9	29	490	22007
8	110	86	9.9	30	540	23094
9	115	90	11	32	620	25100
10	117	91	12.3	33	680	26912
11	119	93	14	33	720	27081
12	121	95	15.6	34	880	29008
13	124	101	16	35	980	31010
14	125	102	16.3	36	1010	32654
15	128	105	18.5	37	1190	34607
16	130	106	19.9	38	1249	35101
17	131	106	22.2	39	1560	37090
18	135	107	25	40	1730	39008
19	136	107	28	41	1880	41010
20	140	108	29	41	2000	45000
21	142	109	30	42	2500	49000
22	145	111	31	42	2900	51000
23	145	112	32	43	3100	55000
24	147	112	34	43	3300	56980

REFERENCES

AZADI, M.A. AND NASIRUDDIN, M. 1990. Some aspects of biology of *Oreochromis niloticus* (Linn.) from Kaptai lake. *Bangladesh J. Sci. Res*. Special issue. 59-68.

AZADI, M.A., ISLAM, M.A. AND SOLAIMAN, S. 1990. Some aspects of reproductive biology of *Eutropiichthys vacha* (Ham.) in Kaptai lake, Bangladesh, *Chittagong Univ. stud. part II Sci.* **14**(2):43 – 48.

AZADI, M.A., ISLAM, M.A. AND PAUL, J.G. 1992. Biology and fishery of the catfish, *Mystus aor* in Kaptai lake, Bangladesh, In *Reservoir Fisheries of Asia* (Ed. De Silva, S.S.), International Development Research Center, Ottawa, Canada, 125 –140.

AZADI, M.A., ISLAM, M.A., NASIRUDDIN, M. AND QUADER, M.F. 1995. Reproductive biology of *Notopterus notopterus* in Kaptai lake, Bangladesh. *Bangladesh J. Zool.* **23**(2)**:** 215–220.

AZADI, M.A. AND MAMUN, A. 2004. Reproductive biology of the Cyprinid, *Amblypharyngodon mola* (Hamilton) from the Kaptai Reservoir, Bangladesh. *Pak. J. Biol. Sci*. **7**(10): 1727-1729.

BABIKER, M.M. AND IBRAHIM, H.1979. Studies on the biology of reproduction in the cichlid, *Tilapia nilotica* (Gonadal maturation and fecundity). *J. Fish. Biol*. **14**:437-448.

BAGENAL, T.B. 1978. Aspect of fecundity, P. 75 – 101. *In* Gerking S.D. (ed.) *Ecology of Freshwater Fish Production.* Blackwell Scientific Publications, Oxford.

BHUIYAN, A. S., ISLAM M. N. AND SULTANA, N. 1993. The fecundity and sex ratio of *Aspidoparia morar* (Hamilton) (Cyprinidae: Cypriniformes) and from the River Padma. *Univ. J. Zool. Rajshahi. Univ.* **12**: 59-63.

BHUIYAN, A. S. AND ISLAM, M. N. 1990. Fecundity of *Xenentodon cancila* (Belonidae : Beloniformes). *Environment and Ecology* **8**(3):1004-1007.

BHUIYAN, A. S. AND RAHMAN, K. 1982**.** On the fecundity of snake headed fish *Channa gachua* (Him.) (Channidae, Channiformes) *Bangladesh J. Zool.* **10**(2):101-110.

CLARK, F.N. 1934. Maturity of California Sardine, *Sardina cocrullea*, determined by ova-diameter measurements. *Calif. Fishgame Bull.* **42**:1–51.

DAY, F. 1878. *The Fishes of India: being a Natural History of the Fishes known to inhabit the Seas and Freshwaters of India, Burma and Ceylon*. Reproduced in 1958 by William Dowson and Sons, London 778 pp.

DoF- 2008. *Sankhalan,-Fisheries Resources Development Programme* (in Bengali) Directorate of Fisheries, Ministry of Fisheries and Livestock, Bangladesh, 81p.

FELTS, R.A., DHABIR, A. AND AKHTERUZZAMAN 1996. Small indigenous fish species (SIS) culture in Bangladesh. Integrated Food Assisted Development Project Sub Project-2 (IFADEPSP-2), Dhaka, Bangladesh.

HICKLING, C.F. 1940. The fecundity of the herring of the Southern North Sea. *J. Mar. Biol. Ass. UK.* **24** : 619-632.

HOSSAIN, M.A. 1976. Length-weight relationship and condition in freshwater prawn, *Macrobrachium malcolmsonii* H. Milne Eds. Third all India Cong. Zool. Abstract, 133: 20 pp.

HOSSAIN, M.A., RAHMAN, M.A. AND PARWEEN, S. 1991. A study on the sex ratio and reproductive cycle of *Nandus nandus* (Ham.). *J. Asiat. Soc. Bangladesh. Sci.* **17**(2): 41–144.

LAGLER, K.F. 1956. Enumeration of fish eggs. In *Freshwater Fishery Biology*, 2nd ed. W.M.C. Brown Co. Dubuque. 106–110 pp.

MAMUN, A. AND AZADI, M.A. 2003. Reproductive biology of a freshwater small fish *Salmostoma bacaila* (Hamilton) inhabiting Kaptai reservoir, Bangladesh. *Bangladesh J. Fish.* **26**(1-2):1-9.

MITCHELL, A.M. 1913. The eggs production of certain fishes. *Rep. N. Sea Fish. Invest. Comm. L. 5 th Rep*. (Northern Area):191–204.

MUNRO, I.S. 1955. *The Marine and Freshwater Fishes of Ceylon*. Dept. External Affairs, Canbarra Publications. XVI+349 pp, 56 plates.

PITT, T.K. 1964. Fecundity of the American plaice, *Hippoglossoides platessoides* (Fabr.) from Grand Bank and Newfoundland areas. *J. Fish. Res. Bd. Canada.* **21:**597– 612.

RAHMAN, A.K.A. 1989. *Freshwater Fishes of Bangladesh*. The Zoological Society of Bangladesh, Department of Zoology, University of Dhaka. 364 pp.

SCHRECK, C.B. AND MOYLE, P.B. (editors) 1990. *Methods of Fish Biology*, American Fisheries Society, Bethesda, Maryland, USA. 684 pp.

SHAFI, M. AND QUDDUS, M. M. A. 1973. The fecundity of the common punti, *Puntius stigma* (Cuvier and Valenciennes) (Cypriniformes). *Bangladesh J. Zool.* **2**(2):34-37.

SHAFI, M. AND QUDDUS, M. M. A. 1982. Bangladesher Matsya Sampad (in Bengali). Bangla Acad., Dhaka; 444 pp.

SHAHZALAL, M., MAMUN, A. AND AZADI, M.A. 2003. Reproductive biology of a small Clupeid, *Corica soborna* (Hamilton) from Kaptai reservoir, Bangladesh. *Bangladesh J.Fish.* **26**(1-2):11-15.

SIMPSON, A.C. 1951. The fecundity of the plaice. *Fish. Invest. London* **17**:180–230.

SOVERTSOV, S.A. 1941. *Population dynamics and the adaptive evolution of animals*, USSR. Academy of Science Press.

WOOD, H. 1930. Scottish herring shoals, Pre–spawning and spawning movements. *Scotland Fish Bd. Sci. Invest.* **1**:1–71.

Manuscript received on 2.11.08; Accepted on 12.4. 09
The Chittagong University Journal of Biological Sciences, Vol. 3(1 & 2): *pp.*139-148, 2008.