



Research Paper

Seasonal variations in the Ovaries of some teleosts in respect to their gono-somatic index and fecundity

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Abstract: Observations on seasonal variations and oocyte development in the teleost species (*Labeo rohita*, *Anabas testudineus* and *Mastacembelus armatus*) were done for a complete year from January 2019 to December 2019. In all the species six stages via immature, developing, early maturing, ripening, mature-gravid and spent were identified on the basis of oocyte development. Protocol for the preparation of paraffin blocks were followed during the observation. Histological slides were prepared and histological observations were carried out. Simultaneously attempt has been made to study their gono-somatic index and fecundity. Results showed that all the selected species are unisexual and with paired ovaries joined by a short oviduct opening outside with a minute aperture. Ovaries were seen under fully developed in between June to August, empty in between September to December and active in between January to May. Their gono-somatic index were maximum in the month of June to August confirming their spawning stage. Absolute fecundity also determined in June to August was maximum in all the species indicating its direct correlation with gono-somatic index. Environmental parameters

including temperature appear to affect the growth and development of ovary.

Keywords: Annual cycle, gonadosomatic index, oogenesis, Absolute fecundity.

Introduction:

Labeo rohita (rohu) is a major carp and an annual breeder. Based on observations of wild fish, it attains maturity in the end of second year of life (Alikunhi, 1957; Jhingran and Pullin, 1985). However, under pond culture conditions, some fish may mature at the end of first year of life in Indian sub-tropical environment (Orissa, India). In Bangladesh, it matures at an age of 3-4 years (Jhingran and Pullin, 1985). Khan (1972), reported females maturity at the age of 18 month while male attains maturity before the maturation of female in Aligarh (North India).

The *Anabas testudineus* (Bloch, 1792), climbing perch is an air breathing; freshwater food fish species belongs to the family Anabantidae and order Perciformes. This species naturally distributed in Bangladesh, India, Pakistan, Ceylon, Burma, Sri Lanka, Thailand, Cochin-China, Tongking, southern China, Philippines, Polynesia, and Malaysia (Jayaram, 1981; Talwar and Jhingran,

1991, Tay *et al.*, 2006). It occurs mainly in low lying water bodies like swamps, marsh lands, lakes, canals, ponds, paddy fields, pools, small pits, and estuaries (Jayaram, 1981; Talwar and Jhingran, 1991). They are well known for their ability to migrate between ponds over land (Liem, 1987). During the larval and juvenile stages they prefer plankton and in adult stages are omnivorous feeding nature and mainly feed on insects, invertebrates, fish and plants (Riehl and Baensch, 1991). This species also been reported as one of the successful biological control organisms in controlling mosquitoes like *Aedes sp.*, *Culex sp.* and *Anopheles sp.* in sewage waters (Chandra *et al.* 2008).

Data presented in this paper for GSI of *Anabas testudineus* well agree with evidence cited in other papers. In particular Marimuthu *et al.* (2009), Choudhury *et al.* (1991).

Mastacembelus armatus is a species of ray-finned, spiny eels belonging to the genus *Mastacembelus* (Scopoli, 1777) of the family Mastacembelidae, and is native of India, Pakistan, Sumatra, Sri Lanka, Thailand, Viet Nam, Indonesia and other parts of South East Asia. This species is not only a popular aquarium fish but also as a food fish. The caloric value of eel flesh is high (Nasar, 1997). The freshwater spiny eel belongs to a family Mastacembelidae of order Synbranchiformes and also known as *Bam* or *Baim*. It commonly occurs in the freshwater of this sub-continent (Talwar and Jhingran, 1991). *Mastacembelus armatus* is a very popular fish with high market demand, having about doubled the market value compared to the carp fishes in the country.

Knowledge on reproductive biology of fish is essential for evaluating the commercial potentialities of its stock, life history, culture practice and management of its fishery (Islam *et al.*, 2012). Reproductive potential of a population is

one of the basic demands to designate the individuals of that population in respect to their gonadal conditions (Akter *et al.*, 2012). In order to achieve success in fish culture, it is important to assess the breeding cycle with fecundity of cultivable fishes. Knowledge on the fecundity of a fish species is important for determining: spawning potential and its success (Karim and Hossain, 1992); fluctuations in the egg production potential of individual stock related to life processes such as age and growth (Shaheena, 2012); effects of environmental factors (Bromage *et al.*, 1992); and formulating the commercial management of fishery (Lagler, 1956). Reddy (1979) mentioned that determination of breeding season is an essential part of biological investigations of fishes.

Factors influencing development and spawning time in female fish are temperature, photoperiod, longitude, latitude, lunar or tidal cycles, rainfall, run-off water, size, age, pollutants, and stress etc. No single factor can be said to be responsible for spawning. The act involves fulfillment of a chain of interrelated conditions as prerequisite to spawning (Berois *et al.*, 2004; Juchno *et al.*, 2007). For carps, optimum temperature of 22-31⁰C, long-days, proper spawning ground, monsoon rains and cloudy atmosphere have been reported to be important factors (Jhingran, 1986).

Materials and Methods:

Fish Collection and Measurements: Experimental fishes *Labeo rohita*, *Anabas testudineus*, *Mastacembelus armatus* were collected from Son River at Anuppur located about 48 km far from Shahdol. Sampling started from January 2019 to December 2019. The samples were carefully transported to the laboratory. Water temperature also was measured in situ at the time of sampling by water analyzer ALFA, Naina Solaris limited.

In laboratory before dissection and removal of gonads Total body weight in gram (g) and Length of fishes in centimeter (cm) were recorded. After measurement an incision was made on ventral side of the abdomen and gonads were separated carefully. Immediately the weight and length of gonads also were measured.

Gonosomatic Index: After that GSI were calculated according to the formula of Lane and Matty (1980).

$$GSI = g / G \times 100$$

Where, g = Weight of gonad
 G = Weight of Fish

Absolute Fecundity

Absolute fecundity was estimated by simple gravimetric method. A small piece of ovary was taken. After cleaning and drying, the sub-sample (5g) was weighed. Total numbers of eggs were then counted. Absolute fecundity was then calculated by using the formula:-

$$F = n G/g$$

Where,
 F = Absolute Fecundity
 G = Weight of ovary in gram
 g = given part of ovary for counting.
 n = Number of eggs in sub sample.

Results and Discussion:

Environmental parameters

Table-I shows monthly changes in the water temperature during the period of study. The minimum water temperature of the year is recorded in the month of January (14.5), whereas the maximum temperature (28.5⁰c) of the year was in the month of May.

Total Body weight

At the start of the experiment in January the mean body weight of *Labeo rohita* was 1430.50g probably because of lower temperature and photoperiod, After February, the body weight started

increasing gradually and reached 2100.10g in August, the ovaries were fully developed when water temperature and photoperiod was maximum. After August, it decreased in September (1690.60g) due to spawning. The mean body weight of *Anabas testudineus* was 33.56 in January; the body weight started increasing gradually and reached 41.55 in August, when the ovaries were fully developed. the mean body weight of *Mastacembelus armatus* was 129.06g in January, after February, the body weight started increasing gradually and reached 278.49g in June, the ovaries were fully developed when water temperature and photoperiod was maximum.

Total body length

Minimum total length was recorded in January as 46.6cm (*Labeo rohita*), 13.4 cm (*Anabas testudineus*) and 40.53cm (*Mastacembelus armatus*) and the length started increasing and in December it was 53.5 cm (*Labeo rohita*), 15.2 cm (*Anabas testudineus*) and 47.10 cm (*Mastacembelus armatus*). (Table I)

Gonad weight and length

The weight of Ovary 14.80g (*Labeo rohita*), 0.48g (*Anabas testudineus*), and 2.14g (*Mastacembelus armatus*) was the lowest in December, while the highest values 561.95 g (*Labeo rohita*), 3.64g (*Anabas testudineus*) were encountered in August but the weight of ovary 32.34 g (*Mastacembelus armatus*) were encountered in June. Although the highest value for gonad length was also seen in August in case of *Labeo rohita* and *Anabas testudineus* and for *Mastacembelus armatus* it was in June. The minimum values for gonad length was observed in January. (Table I).

Gonad somatic index (GSI)

The GSI values were lowest during the month of January 1.1352 (*Labeo rohita*) and 1.379 (*Mastacembelus armatus*) but

1.324 (*Anabas testudineus*) in December while the maximum were seen in August in 26.7582 (*Labeo rohita*) and 8.760 (*Anabas testudineus*) but for *Mastacembelus armatus* it was in June (11.612). The monthly distribution of gonad somatic index (GSI) of female fishes is given in Table I.

Fecundity

Absolute fecundity was calculated by simple gravimetric method. In present observation absolute fecundity in *Labeo rohita* (A total number of 1,382.6 eggs per gram of ovary weight and 369.97 per gram of body weight) and *Anabas testudineus* (A total number of 484.83 eggs per gram of ovary weight and 42.47 per gram of body weight) were measured in the month of August while Absolute fecundity of *Mastacembelus armatus* (Total number of 286.98 eggs per gram of ovary weight and 33.32 per gram of body weight) was measured in the month of June.

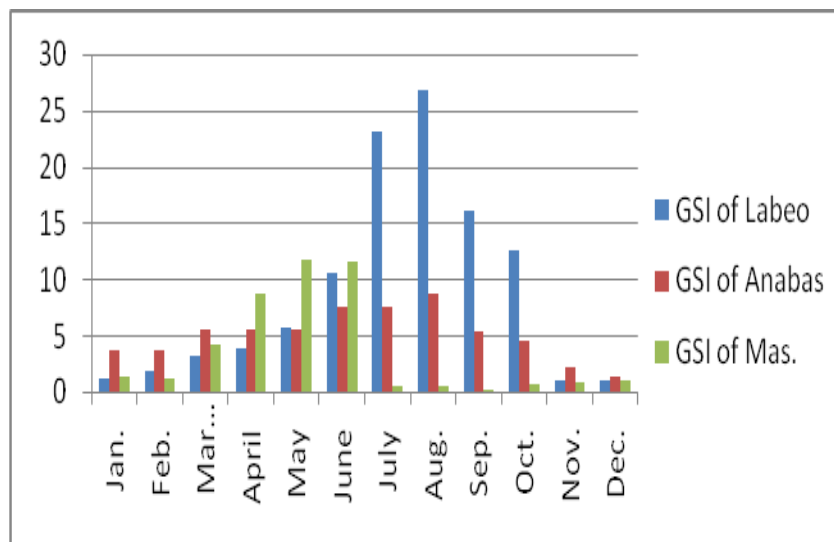
Finally, it can be concluded that the annual reproductive cycle of experimental fishes was studied on the basis of gross appearance, and weight of ovaries. Histologically, this was based on oogenesis and the GSI values of the ovaries. It is clear from the Tables -01, that ovaries during the months of December to February were small in size and contained mainly peri-nucleolar oocytes. The weight of ovaries started increasing in March and peaked in August (*Labeo rohita*, *Anabas testudineus*) and June (*Mastacembelus armatus*). The GSI was also highest in same manner with ovaries having vitellogenic oocytes in a group synchronous mode. From September to October, the weight of ovaries and GSI declined and the ovaries were already regressed by November.

Changes in (water) temperature and photoperiod have been shown to correlate well with gonadal weights and therefore with gonado-somatic index (Mylonas and Zohar, 2007). In the present study also, it seems that both photoperiod and temperature play an important role in gonadal recrudescence and maturation. In our study, the ovaries of experimental fishes started developing in March when the photoperiod increased from the minimum in December and when the water temperatures started increasing from the minimum in January and ultimately showed a peak in June, July and August although the water temperature was still higher (maximum encountered in the present study, i.e. 28.5⁰c). Thus, we can conclude that ovarian development and maturation in fishes is initiated by lengthening photoperiods and increasing temperatures.

Fecundity is a measure of fertility, such as sperm count or egg count or the number of live offspring produced by an organism. We measured the absolute fecundity with ovaries collected from fishes at mature-gravid stage in June (*Mastacembelus armatus*) and August (*Labeo rohita*, *Anabas testudineus*).

In case of *Anabas testudineus* fecundity was much less than the estimate given by Kasi Marimuthu (2009) and in case of *Mastacembelus armatus* the estimate of fecundity was about similar than the estimate given by Narejo (2003). The difference in the fecundity estimation could be due to different environmental conditions in which the populations live. The fecundity also varied with the seasons, climatic conditions and environmental habitat, nutritional status and genetic potential (Bromage *et al.*, 1992). Table: 01, 1- *Labeo rohita*, 2- *Anabas testudineus*, 3- *Mastacembelus armatus*.

Month	Average Weight of fish (gram)			Average Length of fish (cm)			Average weight of ovary (gram)			Average GSI			Average Water Temperature °C
	1	2	3	1	2	3	1	2	3	1	2	3	
Jan.	1430.50	33.56	129.06	46.6	13.4	40.53	16.24	1.23	1.78	1.1352	3.665	1.379	14.5
Feb.	1410.50	33.90	151.95	46.8	13.5	41.32	25.40	1.26	1.89	1.8007	3.716	1.243	19.0
March	1434.82	35.44	159.33	47.5	13.7	42.33	45.00	1.98	6.61	3.1380	5.586	4.148	22.5
April	1439.50	35.89	166.39	47.8	14.6	42.78	55.75	2.00	14.56	3.8728	5.572	8.750	24.0
May	1638.86	36.42	208.25	47.9	15.0	43.67	94.35	2.01	24.50	5.7570	5.518	11.764	24.5
June	1834.74	38.33	278.49	49.5	15.1	44.22	194.75	2.89	32.34	10.6145	7.539	11.612	25.5
July	1885.20	40.73	236.13	50.6	15.3	44.89	434.70	3.07	1.37	23.0585	7.537	0.580	27.5
Aug.	2100.10	41.55	220.66	52.5	15.2	44.99	561.95	3.64	1.25	26.7582	8.760	0.566	28.5
Sep.	1690.60	37.67	220.09	51.8	15.1	45.12	271.71	1.99	0.36	16.0718	5.282	0.163	20.5
Oct.	1582.10	37.09	216.10	52.9	14.9	45.14	198.95	1.67	1.29	12.5750	4.502	0.596	19.5
Nov.	1450.80	36.87	218.09	53.5	15.3	46.15	15.00	0.80	1.79	1.0339	2.169	0.820	19.0
Dec.	1480.12	36.23	210.07	53.5	15.2	47.10	14.80	0.48	2.14	0.9999	1.324	1.018	15.0



HISTOGRAM SHOWING GSI OF EXPERIMENTAL FISHES IN DIFFERENT MONTHS OF YEAR



IMAGES SHOWING EXPERIMENTAL FISHES AND THEIR MATURE OVARIES

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