The Bioscan 8(4): 1265-1269, 2013
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

SEXUAL DIMORPHISM AND GONADAL DEVELOPMENT OF A RARE MURREL SPECIES *CHANNA BLEHERI* (BLEHER) IN ASSAM

RINKU GOGOI[1]*, S. BEHERA[2], BIBHA CHETIA BORAH[3] AND SONMOINA BHUYAN[3]
[1]AICRP on Integrated Farming System, Assam Agricultural University, Jorhat - 785 013, Assam
[2]Department of Fisheries Resource Management, Faculty of Fishery Sciences,
WBUAFS, Budherhat Road, Panchasayar - 700 094, Kolkata
[3]Fisheries Research Centre, Assam Agricultural University, Jorhat-785013
e-mail: rinkuz1986@rediffmail.com

KEYWORDS
Channa bleheri
Dark blotch
Beel
maturity stage

Received on :
24.05.2013

Accepted on :
08.10.2013

***Corresponding author**

ABSTRACT
The reproductive biology of a rare murrel species *Channa bleheri* (Bleher) commonly known as 'rainbow snakehead' was studied during 2010-2011 in the laboratory of Faculty of Fishery Science, WBUAFS, Kolkota, West Bengal. The study revealed that the sexual dimorphism in *C. bleheri* exists in the form of a prominent dark blotch in the dorsal fin of the male fish which becomes distinct with the advancement of the maturity stage. Round or oval vent in female and elongated genital in male is another distinctive characteristic for identification of sexes in this species particularly during the breeding season. The Gonado somatic index (GnSI) in male was found to ranges between 0.127- 0.161% while in female it ranges from 0.810 - 3.519%. The peak GnSI value of male was during April to June (0.159-0.161%) while in female the highest value of GnSI were recorded during April to July (2.938- 3.519%). The presence of only one batch of maturing/mature ova indicates that the species breeds only once in a year which is supported by GnSI values exhibiting a single annual peak in both male and female.

INTRODUCTION

Channa bleheri (Bleher), also known as the 'rainbow snakehead' is a commercially important murrel species, having distinction as both ornamental and food fish. The species first described by Virke in 1991, has very limited geographical distribution. The species was named after the famous German fish collector Heiko Bleher who discovered it in 1987. It is reported to be native to the Upper Assam zone of Brahmaputra in India (Vierke, 1991, Vishwanath 2009). The species have specific characteristics of hibernating inside mud holes during winter and coming out to the freshly filled open waters or flood during rainy season (Goswami *et al.,* 2006). Due to its bright and unique coloration on the body, attractive pattern on the fins as well as peculiar dramatic body movement the species is considered as one of the most potential indigenous ornamental fish species of Assam in context to the ornamental trade. To meet its demand in ornamental fish market, the species is often collected from natural water of the state like beels and swamps of the state and exported to different countries through an unorganized trade link. As a result, the population of this rare species is reported to be decreasing to a great extent (Musikosithern, 2000), enlisting it as one of the endangered species of India (Lakra et.al 2010), which needs immediate steps for conservation. Culture and propagation of a species under controlled condition is one of the effective steps for off situ conservation of a fish species. However, for culture of a wild species under controlled condition, several factors are needed to be considered. The primary need for selecting a wild fish for culture is the availability of knowledge on different aspects of bionomics of the species that are of major significance for successful culture and breeding operation. Although the reproductive biology of certain murrel species were studied by Rath (1980), Rath and Mahanty-Hejmadi (1984), Sanwal and Khanna (1971), Ali (1999), Gaikwad *et al.,* (2009); reports on systematic study on reproductive biology of *C. bleheri* is not available.

The knowledge on reproductive cycle of the species will help in formulating breeding and culture technology of the commercially important species for mass propagation as well as conservation. In view of the above, the present study was undertaken to study some aspects of reproductive biology of *Channa bleheri* (Bleher) which will include sexual dimorphism and gonadal maturity cycle, gonadosomatic index. The breeding season of the species will be determined on the basis of the findings.

MATERIALS AND METHODS

The study was conducted during 2010-2011 in the Department of Fishery Resource Management, West Bengal University of Animal and Fishery Science, Kolkota, West Bengal. Live samples of *Channa bleheri* were collected from natural environment (Beels and swamps) of Tinsukia and Dibrugarh districts of Assam during September 2010 to August 2011, where the species was available in wild and brought to the laboratory for study. Monthly random sampling was done with a sample size of 15 mature fish and the collection was

done by traditional method of catching. The weight (w/w) and length (total length, standard length and girth) of fishes were measured by standard procedure. The external features of live fishes were observed thoroughly viz., the body colour pattern, characteristic of vent as well as the structure of the belly and any peculiarity in external morphology or body shape was studied. On the basis of the keen observation on the external morphology and through trial and error, the sexes of the fishes were assumed and on the basis of assumption these were segregated sex wise. The fishes were dissected to take out the gonads. For confirmation of the sex and then these results were correlated back with the external morphological characteristics recorded through eye estimation.

For gonadal development study, the live fishes were dissected and the gonads (testes/ovary) were taken out and put into physiological saline solution. The gonads were washed properly to remove the blood, adhering tissues and fats. The colour, size, length and weight of the gonads were recorded for each sample. By using the parameters mentioned above, the Gonadosomatic index (GnSI), testicular index (TI) and ovarian index (OI) were determined. The following formulas were employed in the calculation of the GnSI (Lagler, 1956), TI and OI.

$$GnSI = \frac{\text{Gonad mass (g)}}{\text{Body mass (g)}} \times 100$$

$$TI\left(\frac{g}{cm}\right) = \frac{\text{Total testis mass/2 (g)}}{\text{Total testis length/2 (cm)}}$$

$$OI\left(\frac{g}{cm}\right) = \frac{\text{Total ovary mass/2 (g)}}{\text{Total ovary length/2 (cm)}}$$

RESULTS AND DISCUSSION

The GnSI was recorded sex wise and month wise throughout the period of study. The maturity cycle and the peak breeding seasons were determined by studying the trend of GnSI during the study. It was found that the total length of male *Channa bleheri* was 152.000 ± 3.361 to 159.333 ± 4.476 mm and female was 151.800 ± 3.658 to 157.833 ± 2.940 mm. The weight of male fish ranged between 30.250 ± 3.543 to 34.908 ± 5.426 g and that of female was 25.866 ± 5.845 to 35.683 ± 3.166 g (Table1). The external morphology of the species did not show distinct characteristics in male and female. Some fish species were found to exhibit distinct sexual dimorphism (Lehri, 1967), from which they can be identified sex wise easily at any time of their life. In case of *C. bleheri,* the absence of such distinct secondary morphological characteristics makes it difficult to identify the sex instantly. However, some of the characteristic during peak breeding period were found to be distinct and were useful for identification of sex in this species.

Sexual dichromatism is often common in several species of fish. In general males are more brightly coloured than their female counterparts. Dehadri *et al.,* (1973) reported that the murrels in India are sexually dichromic and dimorphic exhibiting variation in pigmentation particularly during breeding season. Similar remarkable sexual dichromatism are also recorded in some other species like *Anabas testudineas, Ailia coilia* etc (Bardach *et al.,* 1972, Dehadri *et al.,* 1973). The body colours of *Channa bleheri* in both the sexes were found to be bright. Presence of one distinct round black spot at the end of the dorsal fin during breeding season in male fish is a prominent secondary sexual character for this species (Fig 1). Presence of the round black spot in the dorsal fin can be taken as an identification mark for male during breeding season. In case of female as such there is no such spot (Fig.2). During July to February, no remarkable difference of vent was observed in both the sexes. However, as the breeding season (from April onwards) approaches, the female exhibits a round shaped vent. In case of male the genital organ becomes pointed. Similar type of genital characteristics i.e.; females having round and males having elongated genital opening was observed by Dehadri *et al.*,,1973, in case of *C punctata* (Bloch). As such this characteristic is found to be common with other murrel species.

Testicular morphology and morphometry

The testes of *Channa bleheri* were found to be paired and elongated. During July to March, it was noticed that the structure of testis of *Channa bleheri* was thin and delicate whereas during April to June, the testes become thick, fattened and lobulated. It was found that the colour of the testes was changing according to the maturation of testes and with the rhythm of

Figure 1: Photograph showing a male *Channa bleheri* with a round black spot at the end of dorsal fin

Figure 2. Photograph showing a female *Channa bleheri* with no black spot at the end of dorsal fin

seasonal testicular cycle. During the month August to March the colour of the testes became pinkish white. With progressing from the month of April to July, the colour of testes turns pinkish white to pinkish yellow indicating the progress in development of testes as well.

Length and weight of testes ranged between 17.600 ± 1.837 to 22.922 ± 1.481 mm (0.031 ± 0.010 g to 0.063 ± 0.015 g) in the sample studied and observed to be the maximum during May to June. This indicates that the peak breeding period for the species is May- June. During July to August, it showed decreasing trend and again an increasing trend from November onwards. Throughout May-June, milt could be oozed out by pressing on belly of the male fish which supports the full maturity of the fish during that period. The Gonado somatic index (GnSI) in male was found to range between 0.127 ± 0.015 to 0.161 ± 0.033. The highest value of GnSI in male fishes was found during May and June (0.160 ± 0.014 to 0.0161 ± 0.033) which supports that the peak breeding period lies during these months.

Ovarian morphology and morphometry

The ovaries of *Channa bleheri* were paired and elongated in structure. They were lying dorsally but at the posterior side in the body cavity. Both the ovaries were found free at the anterior end but their posterior ends were united together into one. The colour of ovary varied much during different period of breeding cycle. The ovaries were delicate and opaque structure with less lobulated surface during July to December whereas it became deep yellow and translucent with more lobulations during February to June.

During July to December, the ovaries were pale, pinkish white in colour or opaque and light yellow in colour. During March, the ovary became bright yellow. During July-August, the ovaries became sac like and reduced in volume with dull appearance. During January-February, the length, weight of ovary was comparatively less than the March-April. The length, weight and volume of ovary were observed maximum in May-June. Mature ova were seen to come out with a gentle pressure on abdomen.

The value of the GnSI (Table1) in female *C. bleheri* was observed to range from 0.810% to 3.519% during the period of study. From September onwards, it exhibit a steady increase till the month of June after which there was a declining trend. The highest value of GnSI were recorded during April to July (2.938-3.519%) with peak during May-June which indicated that the breeding season for the species lies between April to July with peak during May- June. This coincides with its male counterpart, which is again in agreement with the law of nature for successful breeding and production of progeny of any species. Majority of fish species of the temperate region are recorded to breed during the period April to July with the advent of Monsoon**.** The increasing environmental temperature, fresh rain water with high dissolve Oxygen content, longer photoperiod and plenty of natural food during that period act as triggering factors for commencing breeding in majority of fish species in this region.

The value of GnSI in both male and female has revealed a distinct relationship with the body weight and length of fish.

Table 1: Morphometry of body and ovary/testes of female/male *Channa bleheri*

Month	Female					Male				
	Weight of fish (g)	Length of fish (mm)	Weight of ovary (g)	Length of ovary (mm)	GnSI (%)	Weight of fish (g)	Length of fish (g)	Weight of testis (g)	Length of testis (mm)	GnSI (%)
September 2010	26.200 ± 3.633	151.800 ± 3.658	0.186 ± 0.035	18.600 ± 1.816	0.810 ± 0.047	30.500 ± 3.543	154.200 ± 3.784	0.031 ± .010	17.600 ± 1.837	0.127 ± 0.015
October 2010	26.857 ± 1.546	152.714 ± 2.058	0.238 ± 0.008	20.714 ± 4.423	0.864 ± 0.026	30.850 ± 1.388	155.000 ± 3.858	0.033 ± 0.003	18.750 ± 1.281	0.130 ± 0.008
November 2010	28.166 ± 2.065	153.500 ± 2.073	0.339 ± 0.011	24.666 ± 0.516	0.995 ± 0.059	32.311 ± 1.709	156.222 ± 1.641	0.037 ± 0.002	19.111 ± 0.833	0.135 ± 0.005
December 2010	29.685 ± 0.987	153.800 ± 1.632	0.423 ± 0.007	26.000 ± 1.154	1.186 ± 0.036	32.562 ± 1.116	156.750 ± 2.549	0.041 ± 0.001	20.500 ± 0.925	0.139 ± 0.003
January 2011	30.966 ± 1.432	154.666 ± 3.464	0.619 ± 0.066	27.653 ± 2.179	1.917 ± 0.133	32.816 ± 3.256	156.833 ± 5.036	0.045 ± 0.003	21.666 ± 1.632	0.144 ± 0.004
February 2011	32.200 ± 2.659	154.900 ± 3.271	0.858 ± 0.032	29.200 ± 2.167	2.313 ± 0.085	33.930 ± 1.918	157.400 ± 3.204	0.050 ± 0.004	22.300 ± 1.429	0.148 ± 0.010
March 2011	32.600 ± 3.507	155.200 ± 2.588	0.965 ± 0.024	30.200 ± 1.303	2.674 ± 0.221	34.150 ± 2.915	157.600 ± 3.977	0.055 ± 0.006	22.727 ± 1.159	0.150 ± 0.008
April 2011	34.250 ± 5.123	155.700 ± 2.602	1.028 ± 0.136	30.400 ± 4.320	2.964 ± 0.181	34.500 ± 5.752	158.090 ± 3.155	0.060 ± 0.008	22.818 ± 2.101	0.159 ± 0.016
May 2011	34.666 ± 5.316	155.966 ± 3.232	1.068 ± 0.051	30.666 ± 3.076	3.322 ± 0.385	34.888 ± 5.566	158.333 ± 3.617	0.061 ± 0.011	22.888 ± 2.147	0.160 ± 0.014
June 2011	35.683 ± 3.166	157.833 ± 2.940	1.140 ± 0.155	31.500 ± 0.836	3.519 ± 0.917	34.908 ± 5.426	159.333 ± 4.476	0.063 ± 0.015	22.922 ± 1.481	0.161 ± 0.033
July 2011	30.312 ± 2.737	155.125 ± 2.587	0.888 ± 0.005	25.250 ± 1.388	2.938 ± 0.034	33.600 ± 5.190	156.571 ± 2.322	0.058 ± 0.004	18.985 ± 1.112	0.145 ± .007
August 2011	25.866 ± 5.845	154.666 ± 2.055	0.315 ± 0.026	18.666 ± 1.211	0.957 ± 0.050	30.777 ± 3.153	152.000 ± 3.361	0.040 ± 0.007	17.777 ± 2.438	0.134 ± 0.020

Table 2: Morphological changes and testicular/ovarian cycle of *Channa bleheri*

Testicular/ovarian cycle	Months	Morphological changes of male	Morphological changes of female
Resting phase	August-September, 2010	Testes is thin, slender translucent and pale in colour. Both the gonad invisible to naked eye.	Ovaries very small, thin, thread like, pale in colour, occupying a small part of the body cavity.
Early maturing phase	October-December, 2010	Testes become enlarge, flat, increase in length and weight, and creamy white in colour. Both the gonads are readily seen without any aid.	Ovaries become slightly larger and increase in length and weight with minute opaque whitish eggs occupied about half of the body cavity.
Developing phase	January-February, 2011	Testes enlarge, increase in length and weight, light pinkish and thicker in size and look more vascular. Blood capillaries become conspicuous.	Ovaries distended occupied, about 2/3 of abdominal cavity with large pale yellow eggs.
Developed or pre-spawning phase	March-April, 2011	Testes become soft turgid pinkish red and increase in length and weight. Blood capillaries prominent.	Ovary becomes more enlarged occupying almost entire body cavity, with large number of big, turgid, spherical, translucent, deep yellow ripe ova.
Spawning phase	May-June, 2011	Testes weight is highest, turgid and pink in colour.	Ovary walls become thin almost transparent. Ripe eggs are visible through the ovarian wall and some ripe eggs are present in the oviduct.
Spent phase	July, 2011	Testes become flaccid, thin and dull white in colour.	Gonad shrunken having loose walls. Ovaries are flaccid, shrinked and sac like, reduced in volume. Ovary contains ripped unspawned darkened eggs and a large number of small ova.

The growth of gonads in female however, much more higher than that of its male counterpart.

During the peak period, the ripe ovary was observed to fill almost the entire body cavity. The presence of only one batch of maturing/mature ova indicates that the species breeds only once in a year. Good numbers of fish species from temperate region often have multiple spawning bouts within a season (Turner 1993). Several species are reported to breed a multiple of times within a season (Chetia Borah *et al.,* 2010). The species under study is however a single spawner which is indicated by GnSI values exhibiting a single annual peak. The morphological changes of both ovary and testes recorded in *C. bleheri* (Table 2) also support this observation. The cycle of maturation and depletion of gonads synchronizes in both male and female exhibiting a regular seasonal rhythm throughout the population. Most fish species exhibits periodic or cyclic reproductive behavior. The maturing phenomenon in fish is indicated by successive development of gonads which can be observed by studying the changing pattern of structure and condition of gonads in different month of the year. In the present study, the gonads of the *C. bleheri* was found to develop from thin, flat and tiny structure during August- October to soft, flabby elongated pinkish yellow testis and (0.050-0.063gm weight) and deep yellow elongated ovaries with translucent ova (0.965-1.140 gm) during March-June. Availability of maturing specimen from October onwards indicated that the maturity cycle commenced from the post monsoon months. Whereas appearance of fish with fully developed gonads from the last part of April to last part of June indicated that the breeding season of this species is restricted from April to June. The spent fishes with shrinking testes and flaccid ovaries were found to appear from June onwards. All these consequences indicate that the maturity cycle of the species extends from October to July. August-September may be considered resting stage for the species.

These findings are in concurrence with breeding cycle of majority of the species of the region. This may be due to the prevailing environmental factors of the area, as certain environmental factors like ambient, temperature, photo period, rainfall etc. are known to play a significant role in gonadotrophic activity of pituitary gland which have a triggering effort on the development of gonads (Lin and Peter, 1996).

REFERENCES

Ali, A. B. 1999. Aspects of reproductive biology of female snakehead (*Channa strita* Bloch) obtained from irrigated rice agro ecosystem, Malaysia. Hydrobiologia 411. 1999 Kluwer Academic Publisher, Printed in Netherlands. pp. 71-77.

Bardach, J. E.; Ryther. J. H. and Melarney, W. O. 1972. Aquaculture, the Farming and Husbandry of Freshwater and Marine organism. John Wiley & Sons. New York. pp. 225-226.

Chetia Borah B, Rimzhim Gogoi, Bipul. K. Kakati (2010). Breeding of *Amblypharyngodon mola* (Ham) in small homestead ponds. *J. Inland Fish Soc. India*. **42(2):** 42-47.

Dehadrai, P. V., Banerjee, S. R., Thakur, N.K. and Das, N.K. 1973. Sexual dimorphism in certain air breathing teleosts *J. Inland Fish. Soc. India*. **5:** 71-78.

Goswami, M. M., Borthakur, A. and Pathak, J. 2006. Comparative biometry, habitat structure and distribution of four endemic snakehead (Teleostei : Channidae) species of Assam, India. *J. Inland Fish. Soc. India*. **38(1):** 1-8.

Gaikwad, M. V., More,V. R., Shingare, S. M., Hiwarale, D. K and Khillare, Y. K. 2009. Study on Gonadosomatic and Fecundity Relationship in Air Breathing Fish *Channa gachua* (Ham) From Godavari near Aurangabad. *African Journal of Basic and Applied Sciences*. **1(5-6):** 93-95.

Khanna, S. S., Sanwal, R. 1971. Cyclic changes in the ovary of a freshwater teleost, *Channa gachua*. *Zool Beitr*. **18**: 71-78.

Lagler, K. F. 1956. Freshwater Fishery Biology W.M.C. Brown co.,

Dubuque, Iowa, U.S.A., pp. 110.

Lakra W. S., Sarkar U. K., Gopalakrishnan A. and A. Kathirvelpandian 2010. Threatened freshwater fishes of India; NBFGR Publication, Lucknow. pp. 16.

Lehri, G. K. 1967. The annual cycle in the testis of the catfish *Clarias batrachus* (L.). *Acta. Anat.* **67:** 135-154

Lin, H. R. and R. E. Peter 1996. Hormones and spawning in Fish. *Asian Fisheries science.* **9:** 21-33.

Musikasinthorn, P. 2000. *Channa aurantimaculata,* a new Channid fish from Assam (Brahmaputra River Basin), India, with designation of a neotype for *C. amphilebus* (McClelland, 1845). *Icthyological Research.* **47(1):** 27-37.

Rath, R. 1980. Biology, reproduction and effect of hormones on the female gonad of freshwater oesteichthys, *Channa punctata* (Bloch). Ph. D. Thesis. Utkal University, India.

Rath, R.; Mohanty-Hejmadi, R. 1984. Morphological staging of ovary in freshwater snake head murrel *Channa punctata* (Bloch). *Pranikee.* **5:** 22-30.

Sanwal, R. and Khanna, S. S. 1972a. Seasonal changes in the testes of a freshwater fish *Channa gachua. J. Acta. Anat.* **83**: 139-148.

Turner G. F. 1993. Teleost mating behavior; In the behavior of Teleost Fishes. (Pitcher T. J. ed.) London: Chapman and Hall. pp. 307-332.

Virke, J. 1991. Fin farbenforther neuer Schlangenkopffisch aus Assam *Channa bleheri* spec. nov. *Das Aquariam.* **259:** 20-24.

Vishwanath, W. and Geetakumari, K. 2009. Diagnosis and interrelationship of fishes of the genus *Channa* Scopoli (Teleostei : Channidae) of northeastern India. *Journal of Threatened Taxa.* **1(2):** 97-105.