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Study of reproductive biology of female Channa punctatus from the wetland of Begusarai district North Bihar, India

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Abstract
The spotted snakehead, *Channa punctatus* (Bloch) belonging to the family Channidae. India has 9 species of *Channa* in different part of India. Channa species are common fish available in the wetland of Begusarai. In the present study *Channa puntatus* has been selected for the study of reproductive biology of female fish. The samples were collected and preserved in 10% formalin for anatomical study. The body cavity of fish specimen was cut open and the gonads were exposed for clear view. The ovary was measured for morphometry and was fixed in 10% neutral buffered formaldehyde and Buins fluid, embedded in wax 5 m section cut in microtome and dewaxed sections were stained with haemotoxyline and eosine and microphotographs were captured in Olympus. The gonads of *Channa punctatus* are elongated organs lying in the body cavity and are held in position by the mesenteries. The six (6) different maturity stages were identified depending on their structure, position occupied by gonads in the abdominal cavity and the diameter of unspawned eggs. It is observed that all stages of maturity occurred in most of the months of a year. The immature (stage-1) and maturing (stage II) specimens were encountered from October-February onwards, while developing (stage III), mature (stage IV) and gravid fish (stage V) were collected in February-March and spent fishes (stage VI) were recorded in between April and September. Some resting adult specimens were encountered throughout the year. In the present study the average fecundity of *C. punctatus* varied between 2110 and 34,980 for a corresponding length and weight 12cm - 26.2 cm and 30.5 - 95.5 g respectively which is comparatively higher than the reports for this species by Rath and Hejmadi (1976) fecundity of *C. punctatus* ranged from 733 - 9225 for the length ranging from 8.5-16.0 cm. saikia *et al*. (2013).

Keywords: Reproductive biology, wetland (chaur), *Channa puntatus*, gonad, ovary, spawning morphology, ovum, fecundity, sexual maturity, breeding cycle

Introduction
Reproduction in fishes is a seasonal phenomenon in which gonadial activity is regulated through the interaction of endogenous and environmental factors. As the fishes inhabit varied ecological environments and regions, differences in their spawning pattern is expected. The knowledge of habitat ecology, spawning morphology, physiology and reproductive biology has become indispensible for the development of pisciculture. Study on reproductive biology of any fish species is essential for assessing commercial potentialities of its stock, life history, culture practice and actual management of its fishery.

Earlier different aspects of reproductive biology has been studied by different workers Among many, Craig Bennett, (1930), Hickling, (1936); Dixit,(1956); Belsare's,(1962); Khanna and Pant,(1967); Rai, (1967); Lehri, (1968); Khanna and Sanwal, (1971); Afroze and Hossain, (1990) [1]; Adamassu, (1996) [2]; Ali and Kadir, (1996) [3]; Alam and Pathak, (2010) [4]; Bagenal, (1978); Brown-Peterson, Overdtreet, Lotz, Franks and Burns, (2001) [5]; Clark, (1934); Doha and Hye' (1970) [6]; Ezenwaji, (1998); Emmanuil, (2011) [7]; Fagade, Adebisi and Atanda, (1984) [8]; Gupta, and Shrivastava, (2001) [9]; Hails and Abdullah, (1982) [10]; Hina, (2010) [11].

Many workers at home and abroad have been studied the cyclic changes in the primary reproductive organs of different fishes. Jones, (1950); Khan, (1986) [12]; Mishra, (1991) [13]; Mwandya AW, Gullstrom, Andersson, Ohman, Mgaya and Bryceson, (2010) [14]; Parween, Mortuza, and Hossain, (2000) [15]; Rutaisire, Booth, (2005) [16]; Sunita Kapil, Kulkarni, Gijare and Tantarpale, (2011) [17]; Tracey, Lyle and Haddon, (2007) [18]; West, (1990) [19] etc.

It is very interesting that the Channa species are common and abundant in the wetland (chaurs). These can withstand distress very easily.

These fishes are omnivorous in nature. They voraciously eat away about all types of available food of the water body hence one of the survivors are Puntius species of the chaur.

Material and Methods

The sample for the present study was collected from the wetlands Begusarai North Bihar India by using gill nets from the month of research period. Fishing took place twice a week at the edges and middle of the water body. Specimens collected were transported in an ice-chest to the laboratory where they were later examined.

For anatomical and histological study: The samples were collected and preserved in 10% formalin for anatomical study. The body cavity of fish specimen was cut open and the gonads were exposed for clear view. The ovary was measured for morphometry and was fixed in 10% neutral buffered formaldehyde and Buins fluid, embedded in wax 5 m section cut in microtome and dewaxed sections were stained with haemotoxyline and eosine and microphotographs were captured in Olympus.

Observation

The ovary of *Channa punctatus* is a bilobed organ lying just ventral to the air bladder and is attached to the coelom by a thin mesovarium. The spindle shaped ovary on the left side is generally greater in length than that of the right side and they remain separated from one another throughout their length. At about two third of their length both the ovaries fuse to form a thin walled oviduct which opens outside through the genital aperture. The last one-third part of the ovary of each side behind the oviduct remains as a posteriorly extended sac. The matured ovary is orange yellow in colour with distinct granular appearance. (Plate-1, A) Ova are visible through the ovarian wall, to naked eyes.

Morphological changes of ovary

Resting phase: Ovaries very small, thin, thread like, pale in colour, occupying a small part of the body cavity. Ova not visible to naked eye. Early maturing phase: Ovaries become slightly larger and increase in length and weight with minute opaque whitish eggs occupied about1/4th of the body cavity. Ova of stage I and II visible.

Developing phase: Ovaries distended occupied, about1/3 of abdominal cavity with large pale yellow eggs. Ova of stage I, II, and III present. Developed or pre-spawning phase: Ovary becomes more enlarged occupying almost 2/3rd body cavity, with large number of big, turgid, spherical, translucent, deep yellow ripe ova. Large number ova of II, few of group III and IV. Spawning phase: Ovary walls become thin almost transparent. Ovarian blood vessels prominent, occupies almost entire length of body cavity. Ripe eggs are visible through the ovarian wall and some ripe eggs are present in the oviduct. Ova of stage IV are dominant.

Spent phase: 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 immature stage I ova.

Histology of ovary

Histological features of the ovaries, the diameter of the largest oocytes, the number of ovulating females with over ripe eggs, and the number of mature oocytes were examined during the annual cycle in female *Channa punctatus*. The following stages of ovarian development were distinguished during oogenesis in the populations:

Stage I: There is previtellogenesis and initial differentiation of the oogonia. Follicles proliferate from the germinal epithelium. They are round, very small and macroscopically undistinguished. The nucleus is large and occupies most of the oogonium. The nucleoli are located along the peripheral part of the nucleus. The follicular epithelium of the oogonium is visible (Plate 2, A&B)

Stage II: The numbers of nucleoli increase they are visible on the surface of the whole nucleus. The follicular and thecal layers are well defined around the oocytes. The oolemma (stained red) is formed between the cytoplasm and the follicular epithelium (Plate-2, C)

StageIII: Vitellogenesis is just beginning. There is initial (light) vacuolization of the cytoplasm. Single small vacuoles (primary yolk) appear peripherally in the cytoplasm. The vitellogenic oocytes are opaque and are enlarging by the addition of cytoplasm (Plate-2, D).

Dissected ovary of *C. punctatus.* Ovary of C. punctatus (plate 1a & 1b)

Stage IV: Vacuolisation of the cytoplasm has reached an intermediate stage. Vacuoles are gradually increasing in size and number in the peripheral and central zones of the oocyte (Plate-2,E)

Stage V: Vacuolisation of the cytoplasm is complete (heavy). The whole cytoplasm is densely filled with vacuoles. Oolemma and theca are conspicuous (Plate 2,F).

Stage VI: Secondary yolk is beginning to form. Yolk vesicles are initially accumulated in the periphery of the oocyte. Deposited yolk inclusions are stained pink/red by eosin. Maturing oocytes are enlarging (Plate 2,F).

Stage VII: Most of the cytoplasm is filled with secondary yolk. Yolk is visible as densely packed globules or a homogeneous red mass in the cytoplasm (Plate 2E)

Stage VIII: The ovulating oocytes, full of yolk, are spent during ovulation. Mature (fully transparent) and immature (opaque) oocytes are arranged in layers. Mature ova are immersed in bathing fluid and form an upper layer in the ovarian cavity near the oviduct. Postovulatory follicles consisting of follicular and thecal layers are present (Plate 2, F). Regression stage (R): The whole ovary is in an advanced stage of regression, with granulation and disintegration of the cytoplasm and the surrounding layers of all oocytes. Folded and ruptured remains of oocytes in different stages are visible.

Plate 1: Dissected ovary of *C.punctatus.*

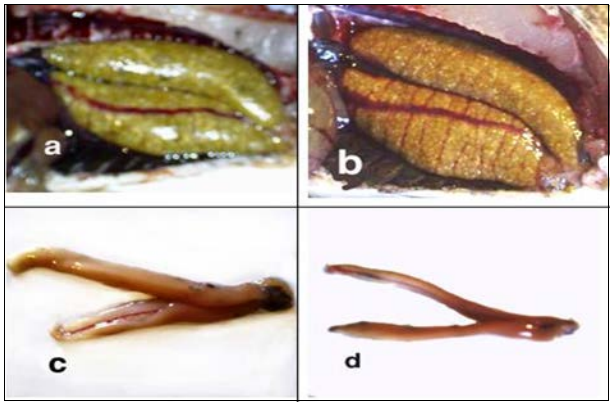

Plate 1ab: Ovary of *C. punctatus* (plate 1a & 1b)

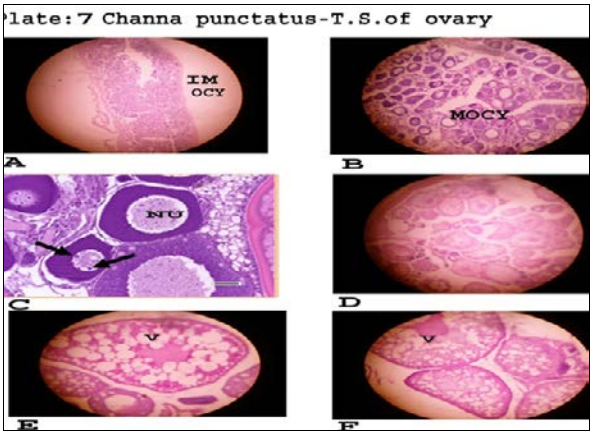

Plate 2: Channa punctatus –T.S. of overy

Discussion and Conclusion

The gonads of *Channa punctatus* are elongated organs lying in the body cavity and are held in position by the mesenteries. The six (6) different maturity stages were identified depending on their structure, position occupied by gonads in the abdominal cavity and the diameter of unspawned eggs. It is observed that all stages of maturity occurred in most of the months of a year. The immature (stage-1) and maturing (stage II) specimens were encountered from October-February onwards, while developing (stage III), mature (stage IV) and gravid fish (stage V) were collected in February-March and spent fishes (stage VI) were recorded in between April and September. Some resting adult specimens were encountered throughout the year.

In the present study the average fecundity of *C. punctatus* varied between 2110 and 34,980 for a corresponding length and weight 12cm -26.2 cm and 30.5-95.5 g respectively which is comparatively higher than the reports for this species by Rath and Hejmadi (1976) fecundity of *C. punctatus* ranged from 733-9225 for the length ranging from 8.5-16.0 cm. saikia *et al*. (2013). Absolute fecundity was ranged from 2423 to 6466 and the number of eggs increases as the fishes gain in weight and length. Bhuiyan (1984) reported the fecundity range in *C. punctatus* 1690-12784 for the corresponding length and weight ranging from 116 to 197 mm and 16.2-60 g which is comparable to this present observation. Great disparity was reported with regard to fecundity in different locality in the same species. This could be due to the availability of food in the natural and captive conditions. The variation in fish fecundity is believed to be not only due to fish length and weight but also due to nutritional diet, running water and influence of vitamins (Dube, 1993). Fecundity is proportional to fish size when length and weight considered. The present observations on fecundity reveal that, *C. punctatus* is a less fecund fish when compared to carps, catfish and other air breathing fishes. Rath and Hejmadi (1976) reported the similar observations. It is possible to suggest that the lower number of eggs is also correlated with shorter development time and mortality rate of fingerlings, which means higher survival rate. Thus less number of eggs does not prove to be a disadvantage in reproductive potential. However, low fecund fishes can be attributed to exhibit parental care towards their progeny in order to compensate ova paucity.

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