

**A study to analyze reproductive potency of
butter catfish, *Ompok bimaculatus* (Bloch 1794)
and its induced breeding**

THESIS

**SUBMITTED FOR THE AWARD OF THE DEGREE IN
FULFILLMENT OF**

Doctor of Philosophy
IN
APPLIED ANIMAL SCIENCES

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प्रजा शील करुणा
ESTABLISHED 1996

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Enrollment No. 137/08

Year 2017

Fish considered as a fifth largest agricultural resource. Fish are the keystone species used as an indicator of good water quality and health of the aquatic environment. They control the distribution as well as the richness of other organisms in the aquatic ecosystems. India is sanctified with different natural water resources in the form of rivers, streams, reservoirs, wetlands, lakes and ponds, etc. that all are natural habitats for fish species.

In Indian riverine system, the most important river is Ganga River which is the fifth largest river in the world. It supports rich biodiversity, though out of 30 river interlinks have been identified. It has many tributaries such as Ramganga, Gomati, Ghaghara, Gandak, Kosi, Yamuna, Tons, Sharda, Hooghly, Sone, Punpun, Kiul, Ajay, Damodar, Rupnarayan and Haldi. The total length of the Ganges from Gaumukh to its mouth at Sagar Island in the Bay of Bengal is 2715 km. Brahmaputra, Cauvery, Krishna, Mahanadi, Narmada and Subernrekha rivers are major rivers of India. There are several studies of fish biodiversity in Indian rivers.

Now freshwater ecosystem is facing serious threats. There is a loss of aquatic ecosystems and therefore fish biodiversity. Freshwater fish is one of the threatened taxonomic groups. The important reason for their extinction is human interference and environmental constraints. The freshwater catfish, *Ompok bimaculatus* (Bloch, 1794) locally known as pabda, is an indigenous species. It is popularly known as butter catfish because of its flexible bony structure. It has extensive geographical distribution. Over the last few decades, its population is drastically reduced due to industrial pollution, pesticide, extensive habitat destruction and defragmentation, riverine siltation, disease, pollution, poisoning, destructive fishing in breeding season, proliferation of exotic fish species and high exploitation. As a result, *O. bimaculatus* has been listed as a near threatened species as per IUCN.

Therefore, to conserve and sustainable management of this near threatened catfish, the study of its reproductive biology is needed. This also helps in increasing the technological efficiencies of aqua-culturist. The method of studying the reproductive

biology or cycle is to follow the seasonal changes in gonadal characteristics. The annual gonadal cycle of any fish depends on the external signals received from the environment. The present study provides an effective knowledge for spawning pattern of freshwater butter catfish, *Ompok bimaculatus* (Bloch, 1794). This research dealt with the study of morpho-metric and reproductive parameters, and its induced breeding performance.

Chapter I

Exploration of morpho-metric and reproductive parameters of freshwater butter catfish, *Ompok bimaculatus* (Bloch, 1794) in different Indian rivers

The present work was focused to explore the freshwater butter catfish *Ompok bimaculatus* (Bloch, 1794) from wild population of different Indian rivers (Betwa, Brahmaputra, Cauvery, Chambal, Ganga, Ghaghara, Gomati, Hooghly, Krishna, Mahanadi, Narmada, Ramganga, Sharda, Sone, Subarnarekha, and Tapti). The exploration was performed in relation to morpho-metric and reproductive parameters assessment viz., body weight and depth, total length, fork length, standard length, gonadal weight, gonadosomatic index, ovarian protein, fecundity, oocyte weight and oocyte diameter. There was significant correlation between different studied parameters of explored Indian rivers ($p < 0.05$). The result found that River Narmada has best sample of *Ompok bimaculatus* in respect to body weight (95.8 ± 18.8 gm) and depth (59.1 ± 5.4 mm), total length (283.1 ± 38.8 mm), fork length (256.4 ± 35.1 mm), standard length (239.0 ± 33.4 mm), gonadal weight (14.08 ± 0.95), gonadosomatic index (14.79 ± 0.004), ovarian protein (7.98 ± 0.0003) and fecundity (21512.57 ± 5606.06). However, oocyte weight was higher in Krishna River sample and oocyte diameter was higher in Cauvery River sample. Changes in gonadosomatic index (GSI), ovarian protein and ovarian histology were also observed in preparatory, pre-spawning and spawning phase of reproductive cycle. GSI and ovarian protein concentration distributions were correlated significantly ($p < 0.05$) by linear regression analysis. The histological assessment showed that ovaries exhibited seven stages of oocyte development, which were oogonia,

chromatin nucleolar, early perinucleolar, yolk granules, late perinucleolar, vitellogenesis and vitellogenic oocyte stages in all the three phases of reproduction. The observation of fish sampled from different Indian rivers showed that Narmada River has better adaptive condition for growth and breeding of *O. bimaculatus* in comparison of others rivers.

Chapter II

Annual reproductive cycle of freshwater butter catfish, *Ompok bimaculatus* (Bloch, 1794) in Lucknow region

The aim of the present study was to examine the annual changes in gonadosomatic index (GSI), gonadal macro- and micro-scopic changes and oocyte diameter (OD) of freshwater butter catfish, *Ompok bimaculatus* sampled from Gomati River. The obtained result showed that GSI was increased with the progressively gonadal maturation. It was increased significantly in July (4.32 ± 0.047 in female and 0.83 ± 0.017 in male) and it reached its peak point in the month of August (5.37 ± 0.037 in female and 0.98 ± 0.06 in male) and lowest value was recorded in October month (0.64 ± 0.019 in female) and November month (0.11 ± 0.004 in male) ($p < 0.001$). The GSI data also get support from macro-scopic monthly detail of gonads. The GSI was significantly correlated with the physico-chemical characteristics of Gomati River water. The OD was varied from 0.052 ± 0.005 to 0.84 ± 0.024 . The maximum OD was observed in August month and lowest in September month. It showed a significant relationship with GSI. Histological studies of gonads (ovary and testis) had given a clear picture of annual reproductive cycle of freshwater butter catfish, *Ompok bimaculatus* as; resting phase (November-January month), preparatory phase (February-March month), pre-spawning phase (April-July month), spawning phase (August month) and post-spawning phase (September-October month). The histological studies of ovary of *O. bimaculatus* reported an eight stages of oocyte development (oogonia, chromatin nucleolus, early perinucleolus, late perinucleolus, yolk vesicle, vitellogenesis, vitellogenic and post ovulatory follicles), and five types of spermatogenic cells in testis viz, spermatogonia, primary spermatocytes, secondary spermatocytes, spermatids and spermatozoa in the

seminiferous tubules during different reproductive phases. These observations are important for a better understanding of reproductive biology of this fish in northern region to adopt breeding practices of freshwater butter catfish, *Ompok bimaculatus*.

Chapter III

Induced breeding performance of freshwater butter catfish, *Ompok bimaculatus* (Bloch, 1794) with different hormones

The present study was aimed to provide information about induced breeding and embryonic development of near threatened freshwater butter catfish, *Ompok bimaculatus* (Bloch, 1794). Induced breeding of *O. bimaculatus* was performed by three different commercially available hormones viz., Ovidac, Gonopro-FH and Ovaprim. During the experiment, dosage of selected hormones was scanned for successful breeding to get most effective concentrations. Both male and female brooders were injected with a range of hormones in a single dose. The result showed that 15:5 IU/g body weight dose of Ovidac, 0.9:0.2 ml/kg body weight dose of Gonopro-FH and 1.2:0.4 ml/kg body weight dose of Ovaprim in female/male were significantly effective dosage which has given best response regarding number of eggs ovulated (Ovidac: $F=255.5$, Gonopro-FH: $F=370.29$, Ovaprim: $F=112.54$; $p < 0.05$), fertilization rate (Ovidac: $F=47.45$, Gonopro-FH: $F=62.74$, Ovaprim: $F=64.59$; $p < 0.05$) and hatching rate (Ovidac: $F=15.3$, Gonopro-FH: $F=31.21$, Ovaprim: $F=39.07$; $p < 0.05$). In Ovaprim induced group of fish, the Latency period was less (11 hr) as compared to other exogenous hormones viz., Gonopro-FH (12 hr) and Ovidac (14 hr). The highest significant fertilization rate ($92.73 \pm 0.64\%$) and hatching rate ($89 \pm 0.29\%$) was noticed in effective dose of Ovaprim injected group of fish as compared to Gonopro-FH ($76.41 \pm 0.87\%$ fertilization rate; $70.76 \pm 0.35\%$ hatching rate) and Ovidac ($68.38 \pm 0.51\%$ fertilization rate; $62.24 \pm 0.41\%$ hatching rate) ($F=269.79$, $F=99.15$; $p < 0.05$). The embryonic development was same in all tested induced hormones. By research output It may stated that near threatened freshwater butter catfish, *Ompok bimaculatus* might be breed in captivity like other catfish with Ovaprim which act as a most potent exogenous hormone.