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## Original Article

# Feeding and reproductive biology of *Amblypharyngodon mola* (Cypriniformes: Cyprinidae) from two floodplain lakes of India

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**Abstract:** Pattern of feeding and reproduction of *Amblypharyngodon mola* (Hamilton, 1822) was studied in two floodplain lakes of North 24 Parganas districts of West Bengal in India during 2011. Results indicated that the fish exhibited a predominantly herbivorous diet with algae as the main content of gut. A long, thin walled, coiled gut and closely packed filamentous gill racker suited this feeding habit. Feeding intensity of the fish fluctuated throughout the year, males showing maximum intensity in June and females showing maximum intensity in February and November. Females outnumbered males (1.9:1) and were found as highly fecund with a calculated fecundity factor of 1445 ova g<sup>-1</sup> of body weight. From the peak of gonado-somatic index and ova diameter it was revealed that *A. mola* apparently spawned only once during July in these floodplain lakes. It was concluded that improvement of ecosystem health of these two lakes were necessary to ensure spawning of the fish.

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## Introduction

*Amblypharyngodon mola* (Hamilton, 1822) is a conspicuous member of the small indigenous freshwater fish (SIFF) species that inhabit ponds, rivers, floodplain lakes, canals, paddy fields and many other small water bodies in the Indian sub-continent. SIFF species are defined as fish which grow to the size of 25-30 cm at mature or adult stage of their life cycle (Sarkar and Lakra, 2010).

*Amblypharyngodon mola* has drawn special interest among more than 200 SIFF available from north east India because of its high nutritional value (Alam et al., 2004) and demand in the markets of Indian sub-continent (Azadi and Mamun, 2004).

Although various aspects of culture and farming of the species are known (Kohinoor, 2000; Kohinoor et al., 2001; Roy et al., 2002), most farmers of the sub-continent do not include this species in freshwater aquacultures, because it is an auto-breeder in

confined water and compete with major carps for space, natural food as well as supplementary feed (Data, 2010). However, Roos et al. (1999) observed that *A. mola* could be cultured successfully in small seasonal ponds in polyculture with carps subject to availability of good seeds and minor modification of the culture techniques. The floodplain lakes, particularly those which are opened and maintain a connection with the river, remained as the unique habitat for a large number of small freshwater self-recruiting riverine species of fish like *A. mola*. In a recent study on two floodplain lakes of Ichchamati river basin *A. mola* has been found as one of the most abundant species in spite of a general trend of decline of finfish species in these two floodplain lakes (Mondal and Kaviraj, 2009) and many other floodplain lakes of India (Panigrahi et al., 2003; Kar et al., 2006). Suresh et al. (2007) observed that *A. mola* once formed a major component of the

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fisheries from floodplain lakes of West Bengal, but its availability had been drastically reduced during the last few years. The floodplain lakes in West Bengal and other north eastern states of India are gradually shrinking due to several allocthonous and autocthonous factors (Das, 2002; Deka et al., 2005; Mondal and Kaviraj, 2008).

Therefore, it has become very pertinent to study the biology of *A. mola* inhabiting these water bodies for a sustainable supply of the fish. Comprehensive information on the biology of a species is an essential prerequisite to plan its stock rehabilitation programme in a water body. Reproduction of the freshwater fish particularly the SIFF is greatly influenced by the environmental condition of the habitat occupied by them. At present, only limited information is available on the reproduction capacity of *A. mola* in floodplain lakes (Piska et al., 1991). The objectives of the present study were to make a detailed study on the biology of *A. mola* with emphasis on its reproduction capacity to protect the natural population of the species in the floodplain lakes of North 24 Parganas district of West Bengal in India.

## Materials and Methods

**Study sites and sampling:** Studies were made in two floodplain lakes, Gopalnagar and Dumar, situated on Ichhamati river basin in the Bongaon sub-division (23.07° N; 88.82° E) of West Bengal in India. A detailed account of these two lakes, locally called as baur, has been described previously (Mondal and Kaviraj, 2009). The study period covered from January to December 2011. Random samples of *A. mola* were collected in the morning from different sites of each baur using fine mesh cast net and gill net and pooled together to make a composite sample for study at every month.

**Feeding habit:** Detailed feeding habit was studied every month on random samples of 15 specimens captured from these two lakes. The sampled fish were dissected out by a clean scissor and the viscera were cut open. Length of the gut and length of the body cavity were recorded. Structure of gut, gill and

gill racker of five sampled fish were recorded. The gut was cut open and emptiness or fullness of the gut was recorded in all the sampled specimens. The period of intense feeding was determined as monthly feeding index (FI) using the following formula  $FI = (NF/N) \times 100$ , where NF is the number of fishes with food in stomach and N is the number of fish examined.

Gut contents of the sampled fish were taken out from the anterior portion of the gut in a watch glass. Necessary dilution of the gut content was made with normal saline and it was observed under light microscope using a Sedgwick-rafter cell. Food items were identified up to major taxonomic group.

**Determination of reproductive pattern:** The numbers of male and female fish in a sample of fifty specimens was recorded and reproductive pattern was studied separately for each sex. However, length and weight of only ovary could be recorded, because testis of this species was too small to be weighed. The selected mature ovaries were preserved in 5% formalin, which helped in separating the eggs from the ovarian wall (Shafi and Quddus, 1974) and make further studies. Following parameters of reproductive behaviors were determined:

**Sex ratio:** The sex ratio was analyzed on total samples of fish by Chi-square test following the equation of Fisher (1970), assuming that the ratio of male and female in the population to be 1:1.

**Gonado-Somatic Index (GSI):** The gonado-somatic Index (GSI) was determined using the formula  $GSI = (GW / BW) \times 100$ , where GW = gonad weight, BW = body weight of fish.

**Fecundity, maturity and ova diameter:** Fecundity was measured on random samples of 50 mature female fishes (length 4.70 to 7.7 cm and weight 2.50 to 7.0 g). Samples taken from the anterior, middle and posterior region of both ovaries were weighed separately and number of mature ova present within each sample was counted. Absolute fecundity was estimated on the basis of total weight of the ovaries using the following formula  $F = (WO \times N) / W$ , where F is fecundity, WO is total weight of ovary, W is the weight of the sub-samples of ovary and N is

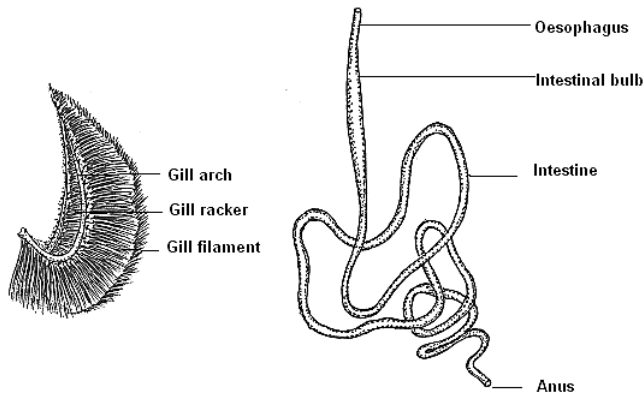


Figure 1. Structure of gill and alimentary canal of *Amblypharyngodon mola*.

the number of mature ova counted in the sub sample. Ova diameter was calculated every month on ovaries collected at random from 10 mature fishes with the help of ocular and stage micrometer. Diameters of 10 ova were measured at random from anterior, middle and posterior region of each ovary and then the mean diameter was calculated.

## Results

**Anatomical features related with feeding:** Specimens of *A. mola* collected from these two baurs showed terminal mouth. Gills were found with long filaments and minute but closely packed filamentous gill rackers (Fig. 1). Alimentary canal was characterized by a long, thin walled and highly coiled gut. There was practically no stomach.

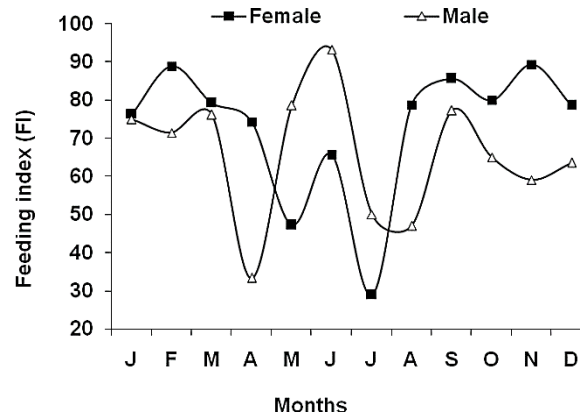


Figure 2. Monthly variation of feeding index of *Amblypharyngodon mola*.

Instead, the anterior part of the intestine was slightly swollen forming an intestinal bulb behind the oesophagus.

**Feeding behavior and gut contents:** Feeding intensity fluctuated throughout the year showing three peaks both in male and female. Maximum feeding activity, as revealed from the feeding index, was recorded in June in case of male and February and November in case of female. Females showed less feeding activity for the months of May to July than rest of the months, while males showed less feeding activity for the months of April, July and August than the rest of the months (Fig. 2).

The fish showed a preference of herbivorous diet (Fig. 3). Algae were the main component of the gut

Table 1. Monthly variation in sex ratio of *Amblypharyngodon mola*.

Months	Total samples	Male	Female	Sex ratio	Chi-square
J	50	16	34	1:2.1	6.48*
F	50	14	36	1:2.6	9.68**
M	50	21	29	1:1.4	1.28
A	50	15	35	1:2.3	8.00**
M	50	14	36	1:2.6	9.68**
J	50	15	35	1:2.3	8.00**
J	50	12	38	1:3.2	13.52**
A	50	17	33	1:1.9	5.12**
S	50	22	28	1:1.3	0.72
O	50	20	30	1:1.5	2.00
N	50	22	28	1:1.3	0.72
D	50	22	28	1:1.3	0.72
Overall	600	210	390	1:1.9	54.00**

Significant at \* $P < 0.05$  and \*\* $P < 0.01$

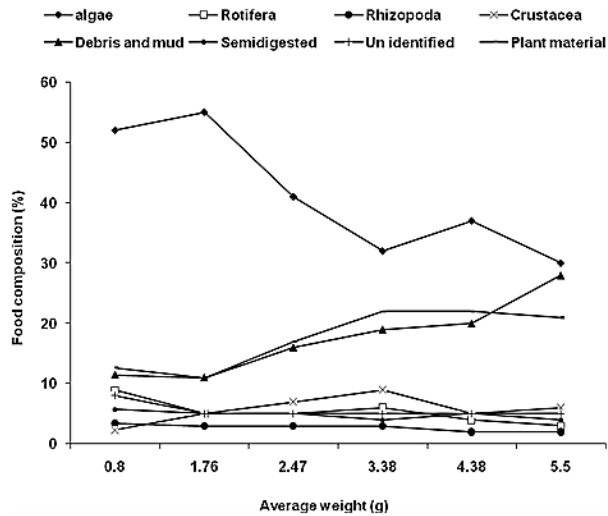


Figure 3. Food preference of different weight class of *Amblypharyngodon mola*.

content followed by plant materials, debris and mud, crustacean, rotifera and rhizopoda. Among different groups of algae observed in the gut Chlorophyceae was the dominant group followed by Mixophyceae and Bacillariophyceae. The rests included Cyanophyceae and Euglenophyceae. There was a slight variation in food preference among different weight class. Lower weight class preferred more algae than higher weight class. The higher weight class though preferred algae consumed high amount of other plant materials and debris and mud than the lower weight class. The ratio of total length to gut length was 1: 3.56.

**Reproductive pattern:** The ratio of male and female varied between 1:1.3 to 1:3.2, which has been mentioned in Table 1. The ratio significantly departed from the expected 1:1 ratio in the months of January ( $P<0.05$ ), February, April, May, June, July, August, October ( $P<0.01$ ). During these months the females significantly outnumbered the males. The overall sex ratio for the whole sample over a period of twelve months also varied significantly from the expected ratio ( $P<0.01$ ) with 1.9 female for every male.

The GSI of the female ranged from a minimum value of  $1.39 \pm 0.45$  in December to a maximum value of  $12.75 \pm 3.75$  in July. The diameter of ova ranged from 0.05 to 0.62 mm. It showed a single peak,

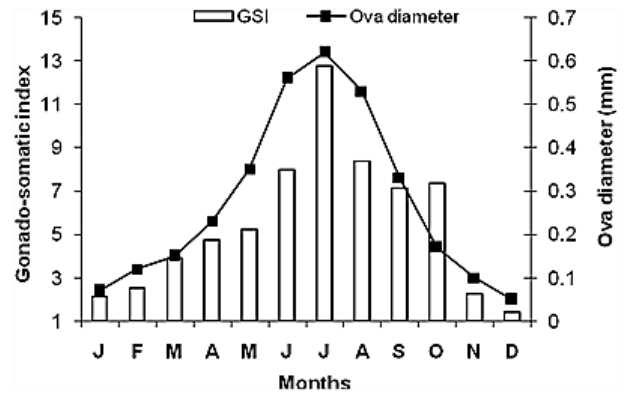


Figure 4. Gonado-somatic index and ova diameter of female *Amblypharyngodon mola*.

which coincided, with the peak of GSI (Fig. 4). The fecundity of mature female *A. mola* ranged from 3785 (fish with body length 4.90 cm, body weight 2.70 g and ovary weight 0.2 g) to 12590 (fish with body length 7.20 cm, body weight 6.50 g and ovary weight 0.92 g) and the calculated fecundity factor was  $1445 \text{ ova g}^{-1}$  of body weight.

## Discussion

**Feeding habit:** Gut content analysis of *A. mola* shows that fish is predominantly herbivorous in feeding habit. Algae are the main food item of this fish. Very little amount of zooplankton in the gut content indicates that *A. mola* feeds zooplankton occasionally. This is also supported from the observations of gut content of *A. mola* captured from reservoir of Andhra Pradesh (Piska et al., 1991), of Bangladesh (Mamun et al., 2004) and floodplain lakes of West Bengal (Suresh et al., 2007). However, Piska et al. (1991) found higher aquatic plants as the second most important food items next to algae in the gut content and found no animal food contents in the gut. In the present study, Chlorophyceae was recorded as the most dominant group in the gut content of mola. Mamun et al. (2004) also found Chlorophyceae as the dominant group of algae in the gut content of *A. mola*. But Suresh et al. (2007) observed Myxophyceae as the dominant group of algae in the gut content of *A. mola*. Gut length more than three times longer than the body length strongly support the herbivorous nature of the fish (Mamun et

al., 2004). Present data indicate that the feeding habit of *A. mola* changes with the increase in body weight. Piska et al., (1991) also showed that feeding habit of *A. mola* changed with the increase in length of the fish. The present study indicates that intensity of feeding of mola in the two floodplain lakes is high (less number of empty stomach and high feeding index) during September to February. Piska et al. (1991) observed September to January as the period of intense feeding for this fish. The lowest feeding intensity (High number of empty stomach and low feeding index) of mola in these two floodplain lakes during July coincided with the active spawning month. Piska and Waghray (1986) also reported that high incidence of empty guts coincided with the spawning season.

**Reproductive pattern:** Sex ratio of *A. mola* showed a predominance of females over males (1 male: 1.9 female) in the floodplain lakes under study. This is also supported by the observation of Piska and Waghray (1986), Afroze et al. (1991), Azadi and Mamun (2004), Suresh et al. (2007). The single peak of GSI and ova diameter indicate that *A. mola* breeds once in a year (July) in the studied floodplain lakes. However, breeding time varies with habitat. Suresh et al. (2007) observed April to October as the breeding season for this species in another floodplain lake of West Bengal. Piska and Waghray (1986) observed that the breeding season of *A. mola* from Himayatsagar, Andhra Pradesh extended from February to July. But in Kaptai reservoir of Bangladesh *A. mola* was found as a multiple breeder and spawned during July, August, October and March (Azadi and Mamun, 2004). Kohinoor et al. (2003) obtained highest value of GSI during July and concluded that *A. mola* breeds twice in a year once during May-July and again during September-October from samples collected from the pond of Bangladesh agricultural university. Hoque and Rahaman (2008) also concluded that *A. mola* breeds twice in a year once in May and another in September in ponds and beels of Bangladesh. Result of the present study indicates that *A. mola* is a highly fecund fish and capable of breeding twice. Fecundity

of *A. mola* in the floodplain lakes under study increased with length and weight of the fish and weight of the gonad. Similar observation had been recorded by Azadi and Mamun (2004) in a reservoir of Bangladesh.

It is concluded from the present study that *A. mola* is predominantly planktophagus and predominantly herbivorous in feeding habit. It is necessary to maintain ecosystem health of the two floodplains so that there is adequate supply of plankton in the lakes as food for the fish. The fish breeds only once i.e. during July in the floodplain lakes under study and it is also necessary to keep the environment of the lakes free of any stress during this period.

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