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Biology of *Amblypharyngodon mola* (Hamilton) from a floodplain wetland, West Bengal

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ABSTRACT

Biology of *Amblypharyngodon mola* from a floodplain wetland was studied during May 2003 to April 2004. The length-weight relationship of the fish suggested isometric growth. The regression models obtained was log W = 2.9819 X - 4.9826 log L, R^2 = 0.7278 for male and log W = 3.0579 X -5.0873 log L, R^2 = 0.9213 for female. The fish is a herbivore, feeding mainly on species belonging to the orders Myxophyceae, Bacillariophyceae, Chlorophyceae and Euglenophyceae. November-February was the most active feeding period. The sex ratio was 1:7.7. The fecundity ranged from 21 to 16867, while the relative fecundity ranged from 7 to 2122. The length at first maturity was 51-56 mm for males and 39-44 mm for females. The ova diameter ranged from 0.05 to 0.7 mm. The fish breed once for a definite period during April-October in the wetland.

Introduction

West Bengal has more than 150 floodplain wetlands, locally called *beels*. These wetlands, spread over an estimated area of 42,000 ha, harbour a large number of small native fish species. In recent years, under fisheries enhancement programme, culture based fisheries has been intensified in most of these *beels* and are regularly being stocked with Indian major carps. In this process, small native fish species are being removed as 'eradication of unwanted fishes'. As a result, a drastic shift in the species composition and diversity in favour of major carps, at the cost of some of the prized native fish species has been noticed in these wetlands (Sugunan *et al.*, 2000). Although most of these small species are considered as low value and referred as 'weed fishes', have high nutritional value (Ghosh *et al.*, 2004). *Amblypharyngodon mola*, distributed in India, Bangladesh and Myanmar belonging to the family Cyprinidae, is among the badly affected small indigenous species (Jayaram, 1999). Once forming a major component of the fishery of indigenous fishes of these wetlands and playing a major role in the nutritional requirements of the natives, its availability has now been drastically reduced. Few attempts have been made to study its biology and conservation in floodplain wetlands.

The studies carried out on *A. mola* were that of Zafri and Ahmed (1981), Ravi Shankar and Sarala (1986; 1989). Various aspects of the culture and farming of the species were investigated by Kohinoor *et al.* (2001). Nevertheless, comprehensive information on the biology of the species in the wetlands, which is a prerequisite in the stock rehabilitation programmes is lacking. Therefore, the present study was undertaken.

Materials and methods

Monthly samples of *A. mola* collected during May 2003 to April 2004 from 'Saguna' floodplain wetland, situated at North 24 Parganas district of West Bengal were used for studying their biology. Fish samples were collected through local fishers in the size range of 25-90 mm in length and 0.21-8.98 g in weight. The relationship between length and weight of the fish was established following the formula of Le Cren (1951) by transforming into a straight-line equation, Log W = log a + b log L. To see whether the species followed cube law, the values of the exponent 'b' was tested against '3' applying 't' test. A total of 297 specimens were examined for establishing the relationship. Gut contents of 200 specimens were analysed for studying food habits. The food items were identified up to major taxonomic groups. The period of intense feeding of the fish was arrived at by following the monthly gastro-somatic index expressed as the ratio of the weight of gut to body weight using the following formula.

Gastro somatic index = Weight of gut / Weight of fish x 100

Sex ratio was studied using Chi-square test (X^2), following the equation of Fisher (1970).

Fecundity was estimated by counting the number of mature ova from a known weight of sub samples collected from the anterior, posterior and middle portions of both the ovaries and calculating the total number of mature ova in the ovary following Grimes and Huntsman (1980).

The length at first maturity was worked out for males and females by plotting the condition factor K of male and female against their length groups according to Hart (1946). The condition factor K was calculated using the formula, $K = W \times 10^5 / L^3$, where K is condition factor, W is weight of fish, L is the total length of fish and the number 10^5 is introduced to bring the value near unity.

The length at first maturity for females was also determined directly by plotting the percentage of mature fish against their length. The length at which 50% of the females were mature was considered as the length at first maturity. The breeding periodicity was studied by observing the growth of ova following the progression of their diameter (Hickling and Rutenberg, 1936). Eggs were sampled from the anterior, middle and posterior regions of both the ovaries. An ocular micrometer was used for the measurement of diameter. The gonado-somatic index (GSI) for females was estimated following June (1953) and expressed as the ratio of the weight of gonad to body weight.

Results and discussion

Length weight relationship

Establishing the relationship between length and weight is useful in fishery management by helping prediction of potential yield and determination of size at capture for obtaining MSY, as these management parameters are directly related to weight

of the fish. The relationship is also useful in differentiating small taxonomic units, as variations occur within populations of different localities (Le Cren, 1951; Chonder, 1972). The length-weight equation models established for both the sexes of *A. mola* separately and in combination are given in Table 1. The regression model fitted for length and weight of male, female and sexes combined yielded significant results (Table 1). Values of the exponent 'b' for male and female did not vary significantly from '3' (t lest, t = 0.30605, d.f. =27 for male, t = 0.1217, d.f = 246 for female) following cube law, while that of the sexes combined showed slight variation (t test, t = 2.30892, d.f - 295, p>0.05). For a fish, which maintains its shape throughout its life, the value of regression coefficient will be '3' (Varghese, 1961; Talwar, 1962). Other than '3', the value indicates allometric growth. Babu *et al.* (1981) reported difference in growth pattern between male and female of a related species, *A. chakaiensis* from Kerala, where males did not show departure from isometric growth, while the females did. In *A. mola* the difference was not significant. This value may change with locality, sex, and maturity of a fish (Le Cren, 1951) besides environmental conditions. Hence it can be considered that *A. mola* followed isometric growth.

Food habits

The length of the gut ranged from 105 to 320mm. The weight of gut contents ranged from 0.01 to 0.1g; 99% of which was constituted by phytoplankton and the rest was zooplankton. The percentage composition of phytoplankton in the gut content of the fish showed that Myxophyceae (45%) followed by Bacillariophyceae (27%) were the dominent items. Chlorophyceae formed 20% of the gut contents and the rest (8%) was Euglenophyceae. The dominant Myxophyceans were *Melosira, Cyclotella, Navicula, Synedra, Asterionella, Fragilaria* and *Pinnularia,* in their order of dominance. The major zooplankton groups were Rotifera and Rhizopoda. *Brachionus* and *Lecane* were the two genera in rotifers, whereas *Euglypha* was the only genus in Rhizopoda.

The values of gastro-somatic index were high during November-February (1.84-2.53) with the peak being in November (2.5) indicating the period of intense feeding activity. The period of low

TABLE 1: *Regression models and coefficients obtained for different variables of* A. mola

Variable	Model	Dependent variable range	df	SE	R^2	P >
Length-Weight (male)	Log W = 2.9819X -4.9826 log L	0.99-2.58	27	0.05914	0.7278	0.01
length-Weight (female)	Log W = 3.0579X -5.0873 Log L	1.08-8.98	246	0.47550	0.9213	0.01
Length-Weight (combined)	Log W = 3.1154X -5.1948 Log L	0.39-8.98	295	0.04998	0.9236	0.01
Length-Fecundity	Log F = 6.5578X -8.7976 Log L	21-16867	155	1.22308	0.2460	0.01
Weight-Fecundity	Log F = 2.372X +1.956 Log W	21-16867	155	1.15616	0.3504	0.01

SE = Standard error, df = Degrees of freedom

intense feeding was April-October.

Reproductive biology

Significant variation (Chi-square, $p>0.01$) in sex ratio of the fish in different months from the expected ratio of 1:1 was observed. The ratio varied between 1:1 to 1:12. The sex ratio for the pooled monthly observations was also significant (Chi-square, $p>0.01$) with 7.7 females for every male. Babu and Nair (1983) and Ravi Shankar and Sarala (1986) also observed predominance of females in the population of *A. chakaiensis* and *A. mola* respectively. Babu and Nair (1983) reported a sex ratio of 1 : 1.96 for *A. chakaiensis* and monthly fluctuations in the preponderance of females. Qasim (1966) attributed the preponderance of one sex in the population to the sexual difference in the growth rate. Number of males were very low to nil during April-May and September, the spawning season; December to March, the period of post spawning. This may be due to the spawning and post spawning mortality of males. Similar observations were reported by Babu and Nair (1983) for *A. chakaiensis*. The absence of spent males in the samples also indicated mortality of males during and after spawning. The females of *A. mola* were bigger in size (average length 68.4mm, average weight 3.5g) than males (average length 56.9mm, average weight 1.8g). Similar size difference was reported in *A. chakaiensis* (Babu and Nair, 1983).

The fecundity ranged from 21 (64 mm and 2.65g) to 16867 (90 mm and 8.98g), while the relative fecundity (fecundity per gram body weight) ranged from 7 to 2122. Fecundity was high during July to October. The monthly fluctuation of absolute and relative fecundity showed similar trend. The regression model of the relationship of fecundity with total length and weight of the fish was Log F = 6.5578X -8.7976 Log L, R^2= 0.2460 and Log F= 2.372X +1.956 Log W, R^2= 0.3504 respectively (Table 1).

The condition factor K for males and females of the fish in relation to different length groups is shown in Fig. 1. Hart (1946) observed a point of inflexion on a curve showing the diminution of K with increase in length, which indicated the length at which sexual maturity is

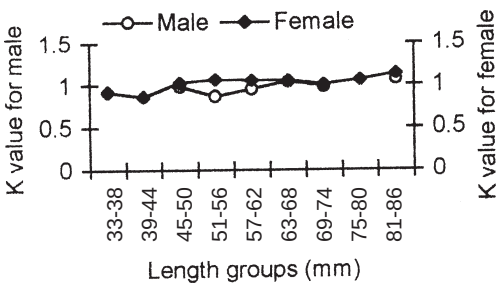

Fig. 1. Condition factor in relation to different length group of male and female *A. mola*

attained. This feature has successfully been applied in many fishes (Menon, 1950; Qayyum and Qasim, 1964; Kagwade, 1968). Using this method, Babu and Nair (1983) worked out the total length at first maturity of *A. chakaiensis* as 49 to 61 mm and 57.9 to 65.7 mm for males and females respectively. There are inflexions on the curve showing K of *A. mola* against the length group 51-56 mm for males and 39-44 mm for females at which the K values were lowest (Fig. 1) indicating the length at first maturity according to Hart (1946). The maturity curve plotted for the females by direct observation of ovaries also showed that 50% of the females mature at length group 39-44 mm. No specimens below 44 mm length were found to be mature.

The diameter of ova ranged from 0.05 to 0.7 mm. The frequency of occurrence of ova of different diameter plotted against months showed that immature ova (0.05-0 25 mm, were present in all the months along with other stages of ova. The percentage occurrence of immature ova was highest in November (64%). The percentage occurrence of maturing ova (0.3-0.45 mm) was higher from April to September. April to October was the period when the percentage occurrence of ripe ova (0.5-0.7 mm) was at its peak indicating breeding period. November to March was the period when maturing and mature ova were absent. The breeding season for *A. mola* from Himayathsagar, Andhra Pradesh was February to July (Ravi Shankar and Sarala 1986). However, in the present study, April to October was the period when the percentage of occurrence of ripe ova was at its peak, indicating breeding period. During November to March, the percentage of maturing and mature ova was low, an indication of shedding of ova in these months. The intensity of feeding reduced during April-October, the breeding period, as inferred from the low gastro-somatic index. After breeding, the fish feed intensively to recover from the breeding loss, as indicated by the high gastro-somatic index during November-February, the post-spawning period.

The monthly variations in the gonad weight and gonado-somatic index (GSI) of the fish is shown in Fig. 2. Ravi Shankar and Sarala (1986) reported higher GSI for *A. mola* in June. In this study, however the monthly variations in the gonad weight and gonado-somatic index (GSI) of the fish showed higher values during April-May and September-October. After October, the values gradually decreased in the following months indicating shedding of eggs,

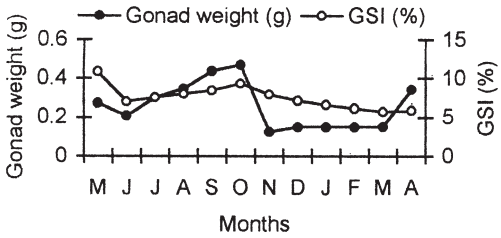

Fig. 2. Monthly variations in the gonad weight and gonado-somatic index (GSI) of *A. mola*

which could also be inferred from the ova diameter progression.

The mean of the percentage frequency of ova of different size plotted against different length groups are shown in Fig. 3. The percentage frequency distribution of ova of different diameter showed that in addition to the mode 'a' formed by immature ova (between 0.05 and 0.25 mm) there was another mode 'b' at 0.5 to 0.65mm, which were clearly separated from each other. The spawning period of a fish will be for

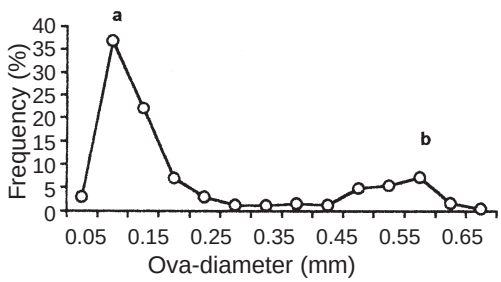

Fig.3. Frequency of occurrence of eggs of different diameter in ovaries

a definite duration if the mature ova are sharply separated from the stock of immature ova (Hickling and Rutenberg, 1936). It is likely that the ova ranging in size from 0.5 to 0.65mm were the stock of eggs to be shed during the ensuing spawning. The mode 'a' indicated the recruitment stock, which was present in the ovaries throughout the year. These indicated that the fish spawn once for a definite duration in a year.

A. mola feed predominantly on phytoplankton. November-February was the period of intense feeding activity. The fish followed isometric growth. Females were larger than males and the sex ratio was in favour of females. Males attained first maturity at 51-56 mm and females at 39-44 mm length. The fecundity ranged from 21 to 16867. The fish breed once for a definite period during April-October.

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References

Babu, N. and B. N. Nair 1983. Sex ratio in *Amblypharyngodon chakaiensis*. *Proc. Natl. Acad. Sci. India,* **53B**(2): 129-132.

Babu, N., B. N. Nair and N. K. Balasubramanian 1981. Length-weight relationship of *Amblypharyngodon chakaiensis* (Babu and Nair). *Intl. J. Acad. Ichthyol.,* **2**(2): 43-46.

Chonder, S. L. 1972. Length-weight relationship of mature female *Labeo gonius* (Hamilton) from the Keetham reservoir. *J. Inland Fish. Soc. India,* **4**: 216-217.

Fisher, R. A. 1970. *Statistical Methods for Research Workers*, 362pp, 14th edition. Oliver and Boyd, Edinburg.

Ghosh Devjani, Rahul Chakraborty and Sudip Dey 2004. Nutritive value of some small fishes available in the markets of a northeast Indian city, Shillong, with reference to certain essential elements. *J. Inland Fish. Soc. India,* **36**(1): 36-40.

Grimes, B and Huntsman 1980. Reproductive biology of the Vermilion Snapper, *Rhomboplites aurorubens* from North Carolina and South Carolina. *Fish. Bull.,* **78**: 137-146.

Hart, T. J. 1946. Report on the trawling surveys in the Patagonian continental shelf. *Discovery Rep.,* **33**: 233-408.

Hickling, C. F. and E. Rutenberg 1936. The ovary as an indicator of spawning period in fishes. *J.Mar. Biol. Ass. UK.,* **21**: 311-317.

Hile. R. 1936. Age and growth of the cisci, *Leucichthys artedi* (Le Sucer) in the lakes of the north eastern highlands, Wisconsin. *Bull. US Bur. Fish.,* **48:** 311-317.

Jayaram, K. C. 1999. *The freshwater Fishes of the Indian Region*, 551 pp, Narendra Publishing House, New Delhi (India).

June, F. C. 1953. Spawning of yellow fin tuna in Hawaiian waters. *US Fish Wild Serv. Fish Bull.,* **45**: 47-64.

Kagwade, V. N. 1968. Maturation and spawning of the horse mackerel *Caranx kalla* (Cuv. and Val.). *Indian J. Fish.,* **15**: 207-220.

Kohinoor, A. H. M., M. M. Wahab, M. L. Islam and S. H. Thilsted 2001. Culture potential of mola *(Amblypharyngodon mola),* chela *(Chela cachiux)* and punti *(Puntius sophore)* under monoculture system. *Bangladesh J. Fish. Res.,* **5**(2): 123-134.

Le Cren, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition of perch (*Perca fluviatilis*). *J. Anim. Ecol.,* **21:** 210-219.

Menon, M. D. 1950. Bionomics of the poor cod *Gadus minutus* L. in the Plymouth area. *J. Mar. Bio. Ass. U.K.,* **29**: 185-239.

Qasim, S. Z. 1966. Sex ratio in fish populations as a function of sexual differences in growth rate. *Curr. Sci.,* **35**(6): 140-142.

Qayyum, A. and S. Z. Qasim 1964. Studies on the biology of some fresh water fishes, Part II, *Barbus stigma* (Cuv. and Val.). *J. Bombay Nat. Hist. Soc.,* **61**: 330-347.

Ravi Shankar Piska and Sarala Waghray 1986. Some aspects of reproductive

biology of *Amblypharyngodon mola* (Hamilton). *Geobios,* **13**(5): 204-207.

Ravi Shankar Piska and Sarala Waghray 1989. Biochemical variations of reproductive tissues of *Amblypharyngodon mola* (Ham.) with reference to spawning cycle. *Indian J. Fish.,* **36**(4): 335-336.

Sugunan, V. V., G. K. Vinci, B. K. Bhattacharjya and M.A. Hassan 2000. Ecology and fisheries of *beels* in West Bengal. *Central Inland Fisheries Research Institute, Barrackpore,* Bull. No. **103**: 1-53.

Talwar, P. K. 1962. A contribution to the biology of the halfbeak, *Hyporhamphus georgii* (Cuv. and Val.) (Hemirhamphidae). *Indian.J. Fish.,* **9**(1): 168-196.

Varghese, T. J. 1961. Observations on the biology of *Raconda russelliana* (Gray). *Indian J. Fish.,* **8**(1): 96-106.

Zafri, A. and K. Ahmed 1981. Studies on the vitamin-A content of freshwater fishes, content and distribution of vitamin-A in mola *(Amblypharyngodon mola)* and dhela *(Rohtee codo). Bangladesh. J. Biol. Sci.,* **10:** 47-53.

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