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Length-Weight relationship and sex ratio of fresh water fish *Amblypharyngodon mola* (HAM-BUCH) from Assam

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ABSTRACT
The length-weight relationship and sex ratio of the cyprinid *Amblypharyngodon mola* collected from the ponds of Jorhat district were studied during the period from July 2009 to June 2011. The length – weight equations and the correlation coefficients obtained for males, females and pooled or combined ones were:

Males	Log W= -4.759 + 2.846 Log L (r = 0.945, SE=0.0392, df=309)
Females	Log W= -5.536 + 3.286 Log L (r = 0.953, SE=0.0496, df=259)
Sexes combined	Log W= -4.965 + 2.966 Log L (r = 0.947, SE=0.0427, df=479)

The females of *A.mola* gained more weight with increase in length, indicating a better well-being than the males. The length-weight relationship of *A.mola* in both sexes combined, shows almost isometric pattern of growth in the studied habitat indicating that the existing hydro biological conditions of culture pond is conducive for the feeding and optimum growth of the fish. The study on sex ratio showed dominance of females over the males all throughout the year with an annual average sex ratio of 1: 1.953.

Keywords: *Amblypharyngodon mola*, Length-weight relation, sex ratio, Isometric growth.

1. Introduction
Amblypharyngodon mola (Ham-Buch), belonging to the family Cyprinidae and order Cypriniformes, is a small indigenous fish species (SIS) of high commercial importance. The fish is important because of its rich taste and high nutritional value. It is found to contain higher amount of vitamin-A than any other edible fish [1]. Considered as a delicacy by the common people of the region, the fish is favoured both in the fresh form as well as highly preferred for smoking and drying. It also has good demand as an ornamental fish in the international market. The conservation status of the species is categorized as 'lower risk least concern' (LR Lc) by the CAMP [2]. Commonly known as 'Mola carplet' or 'Pale carplet', *A.mola*, is widely distributed in fresh water habitats like rivers, streams, ponds, beels, canals, paddy fields etc. It is a self-recruiting species and its culture is being encouraged among the fish farmers in N.E. India to overcome the nutritional deficiency.

The study of the length –weight relationship of fishes forms an important base for fish biology. The statistical relationship between these two parameters has great significance with regard to their morphology, biology, nutrition, condition and growth rate. Further this relationship is useful in differentiating small taxonomic units, as variations may occur within populations of different localities [3].

Sex ratio on the other hand, is a comparison of the number of males and females in a population. According to Panthulu [4] sex ratio is an indicator of population behaviour and fecundity. An understanding of the sex ratio of a fish in different months and seasons is essential for obtaining information on seasonal segregation of the sexes and also their differential growth.
Because of the lack of information on these important biological aspects of *A.mola* from Assam, the present study on length-weight relationship and sex ratio was carried out in the climatic conditions of Assam.

2. Materials and methods

The samples for study were collected at monthly intervals during July 2009 to June 2011 from the ponds of Assam Agricultural University, situated in Jorhat district at $26^0 48'$; 296″N Longitude and $94^0 11'961''$ E Latitude. A total of 480 specimens were collected for the study. They were then categorized into three groups viz. males, females and combined. Soon after collection, the specimens were wiped with a blotting paper and weighted in an electric balance (Dhona). The total length (TL) in mm was measured from the tip of the pre- maxilla, with the jaws closed to the end of the longest caudal peduncle fin ray using a fish measuring board. The sexes were differentiated by surgical observation of the gonads. The length-weight relationship was calculated with the help of the formula of Le Cren [3].

$$W = a L^b$$

Where W= Weight of fish in grams, L= Total length of fish in mm, and 'a' and 'b' are constants. The formula can be converted into a linear equation.

$$\text{Log } W = \log a + b \log L$$

The values of the constant 'a' and the exponent 'b' were calculated by least square method.

For determination of sex ratio a total of 1660 fishes were used and ratio was analysed by Chi square (χ^2) test.

$$\chi^2 = \frac{\Sigma(O-E)^2}{E}$$

Where, O observed value and E= expected value

3. Results and Discussion:

The total length of the fishes ranged from 40.7mm to 94.2 mm and weight ranged from 0.5443 grams to 9.8604 grams. The length-weight equations derived separately for males, females and sexes combined were:

Males Log W= -4.759 + 2.846 Log L (r = 0.945, SE=0.0392, df=309)
Females Log W= -5.536 + 3.286 Log L (r = 0.953, SE=0.0496, df=259)
Sexes combined Log W= -4.965 + 2.966 Log L (r = 0.947, SE=0.0427, df=479)

High degree of correlation between length and weight has been indicated by correlation coefficient (r). The observed length and weight are delineated in scatter diagrams for female in Fig.1, male in Fig.2 and for combined in Fig.3. The values of regression coefficient computed are 3.286 (female), 2.846 (male), and 2.966 (sexes combined).

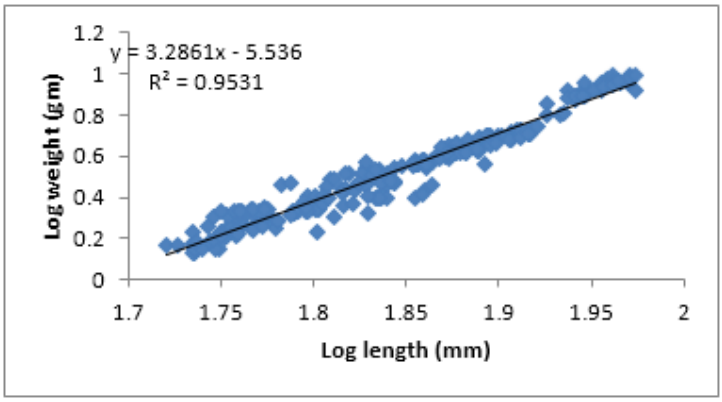

Fig 1: Length-weight relationship of female *A.mola*

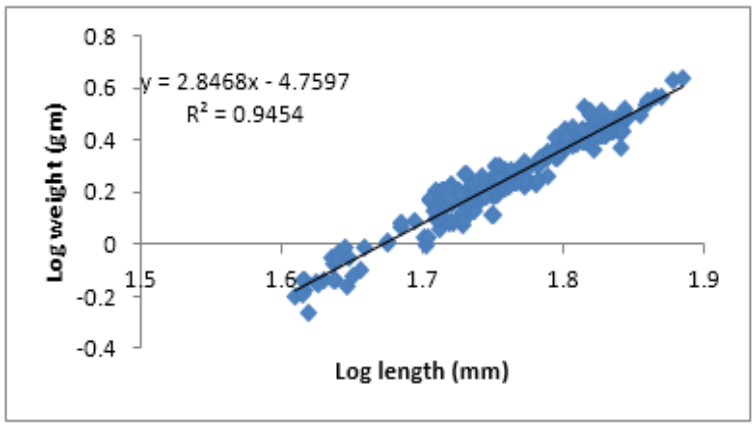

Fig 2: Length-weight relationship of male *A.mola*

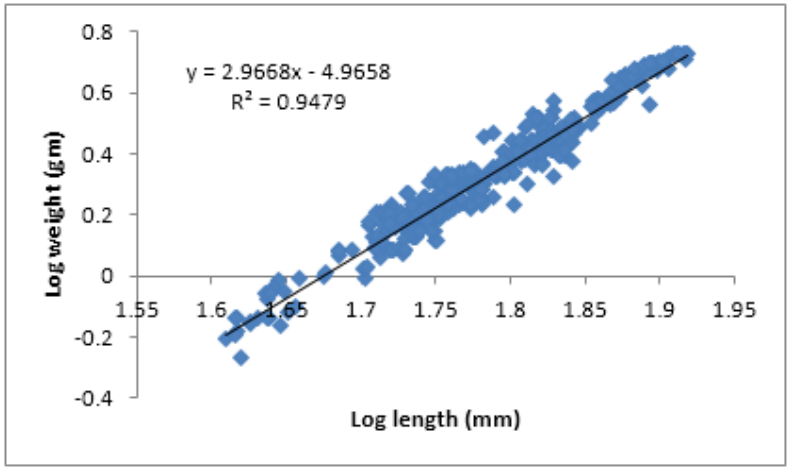

Fig 3: Length-weight relationship of sexes combined for *A.mola*

For a fish, which maintains its shape throughout its life, the value of regression coefficient will be 3 [5, 6]. Other than 3, the value indicates allometric growth. The present study indicated that the fish did not follow the cube law strictly. The regression co-efficient (b) of female was higher than that of the male. Similar observation of higher regression value for female than the males was obtained by many authors like Mitra *et.al.* [7] in case of *Puntius sophore* from flood plain wetland in West Bengal, Baishya *et.al.*[8] in *Amblypharyngodon mola* in Garjan beel of Assam, Prasad and Ali [9] in *Puntius filamentosus* from Chalakudy River, Kerala, Harish Kumar *et al.*[10] in *Rasbora daniconius* from Karnataka, Azadi and Naser [11] in *Labeo bata* from Bangladesh etc.

Hile [12] and Martin [13] reported that the value of exponent 'b' usually range between 2.5 and 4.0. Le Cren [3] pointed out that the variation in 'b' value is due to environmental factors, season, food availability, sex, life stage and other physiological factors. An overview of literature reveals that the length –weight relationship of fish differs from one species to another. Natarajan *et al.* [14] reported the difference in the length –weight relationship of intra- specific populations inhabiting the same water body. Several biological factors like sex (Reddy [15]), size of fish (Devaraj [16]), physiological condition and gonadal maturity (Le Cren [3]; Bashirullah [17]), feeding (Reddy [15]) and fatness have significant influence over length-weight relationship of fishes. In the present study the higher exponent value of female may be attributed to the general condition of appetite, gonadal contents of the fish and also environmental conditions.

From the study of sex ratio of *A.mola* it was found that the number of females was more than that of males. Monthly and yearly percentage of male and female showed that the females dominated the natural population all throughout the year (Table 1). Out of 1660 fishes, 562 were males and 1098 were females. The monthly ratio between males and females ranged from 1: 1.3636 to 1: 3.615, the average being 1: 1.953 (χ^2 = 173.0698, p< 0.05, N=1660).

Table 1: Monthly distribution of sex ratio and chi- square (χ^2) value of *A.mola*

Months	No. of fish	Male (Obs. value)		Female (Obs. value)		Ratio of male and female	χ^2 (male + female)	Level of significance
		No	%	No	%			
June	160	41	25.625	119	74.375	1 : 2.9	38.025	p<0.05
July	120	26	21.67	94	78.34	**1 : 3.615**	38.534	p<0.05
Aug	100	34	34	66	66	1 : 1.94	10.24	p<0.05
Sept	140	37	26.428	103	73.57	1 : 2.78	31.114	p<0.05
Oct	165	59	35.75	106	64.24	1 : 1.796	13.3878	p<0.05
Nov	120	47	39.167	73	60.834	1 : 1.553	5.6334	p<0.05
Dec	135	57	42.23	78	57.78	1 : 1.368	3.2667	p>0.05
Jan	130	55	42.3076	75	57.692	**1: 1.3636**	3.0769	p>0.05
Feb	150	58	38.67	92	61.34	1 : 1.586	7.7066	p<0.05
March	125	39	31.2	86	68.8	1 : 2.205	17.672	p<0.05
April	145	47	32.41	98	67.58	1 : 2.08	17.9379	p<0.05
May	170	62	36.47	108	63.529	1: 1.742	12.447	p<0.05
Total/ Avg	1660	562	33.855	1098	66.144	**1: 1.953**	173.0698	p<0.05

Dominance of females over the males in case of *A.mola* was also reported by Azadi and Mamun [18]. Analysis of size frequency distribution of *A.mola* by Afroze *et.al* [19] stated dominance of females over males all throughout the year (n=3.60). Dominance of females was also seen in other species of fishes like *E.vacha* [20]. Different populations inhabiting different regions show different sex ratios [21]. A higher sex ratio has been reported during the first breeding season and

lower sex ratio in second breeding season when the water parameters are at their peak according to Singh [22]. A rising temperature and moderate water velocity, vulnerability of females to their predators and other natural hazards, migratory phase in brooder population are some of the reasons for changes in sex ratio in fishes [23].

4. Conclusion

From the above findings it can be presumed that the females of *A.mola* gained more weight with increase in length, indicating a better well-being than the males. The length-weight relationship of *A.mola* in both sexes combined, indicate almost isometric pattern of growth in the studied habitat and therefore it can be concluded that the existing hydro biological conditions of culture pond is conducive for the feeding and optimum growth of the fish. From the study on sex ratio it was observed that during the breeding months, most of the fishes (in random sampling) were females, while during the non-breeding seasons, the number of males increase even though the number of males could not surpass the number of females.

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