

Length-weight relationship and relative condition factor of pond-reared mahseer, *Tor putitora* (Ham.)

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Abstract

The study deals with the length-weight relationship and relative condition factor (K_n) of mahseer, *Tor putitora* reared for 150 days in ponds. The logarithmic form of equation for the relationship was found to be $\log W = -1.727 + 2.875 \log L$ or $W = 0.01875L^{2.875}$. The graphical presentation of the parabolic and logarithmic forms showed respectively the curvilinear and linear relationships between length and weight of the fish. The mean value (\pm sd) of relative condition factor was found to be 0.95 ± 0.12 . The exponential value 'b' was found to be 2.96 and the coefficient of correlation 'r' was 0.965, which showed strong and highly correlated relationships between length and weight of the fish.

Key words: Length-weight relationship, *Tor putitora*

Introduction

Mahseer (*Tor putitora*) is an important cyprinid fish famous for its lucrative appearance and delicious taste and is highly popular among people of the Southeast Asian countries, particularly in the Indian subcontinent, including Nepal (Mirza 1993 and 1994a&b, Nath *et al.* 1994, Shrestha 1994). There are seven species of mahseer in Southeast Asia but only two species, namely, *Tor tor* and *Tor putitora* are reported in Bangladesh. They are distributed in the hill streams of Sylhet, Mymensingh, Dinajpur Districts and the Kaptai reservoir of Rangamati (Rahman 1989). Although reported to occur in some areas of Bangladesh (Ahmed 1969, Chandra and Haque 1982a&b, Rahman 1989, Azadi *et al.* 1990) it has not yet been possible either to develop a commercial fishery of mahseer in its natural habitat or to introduce the fish into commercial aquaculture of Bangladesh. Recently, the fish is gaining special attention because of its rapid disappearance from natural environment. To establish the fish in its natural habitat, scientists are becoming increasingly concerned with the biology and management of the fish.

Length-weight relationship is a very important aspect of the biology of any fish, particularly when the fish is to be reared commercially. Due to variations in season, food

composition and multiple spawning, growth fluctuations are more common in fishes of tropical and subtropical waters (Lagler 1956). However, in most fishes, length and weight bear a specific relationship from which the physical well being of a fish can be ascertained for a given body at a given time (Doha and Dewan 1967). The study of length-weight relationship in fishes helps to determine the mathematical relationship between the two variables and to calculate the variation from the expected weight for length of individual or groups of fishes (Le Cren 1951).

Many works have so far been undertaken on the length-weight relationships of different species of fishes. However, very few reports are available on the length-weight relationship of fishes under the genus *Tor*. Dasgupta (1991) studied the length-weight relationship of *Tor putitora* from Meghalaya, India and Javaid *et al.* (1992) from Islamabad, Pakistan. Study on the length-weight relationship of *Tor* fishes in Bangladesh is also of considerable importance. In the present study, attempt has been made to establish the length-weight relationship of pond-reared *Tor putitora*.

Materials and methods

Hatchery produced fingerlings of mahseer with average total length of 11.80 cm and body weight of 12.50 g were reared with supplementary feeding under fertilized condition for a period of 150 days in earthen ponds of Bangladesh Fisheries Research Institute, Mymensingh. At harvest, average total length and weight were 20.25 cm and 85.60g, respectively. Fish were sampled fortnightly and total length and weight of individual fish were recorded. Therefore, large volume of data on length and weight of fish at different ages and sizes were obtained.

Total length (from snout to the end of the tail) of each individual fish was measured to the nearest centimeter (cm) on a scale. Weight was taken to nearest gram (g) on a sensitive digital electronic balance. For calculation, the data were divided into 12 class intervals and the frequency for each class interval was found out. The regression line of length-weight relationship was drawn by plotting the body weight data against the total length data. Again, all the mid-values (cm) of the class intervals and the corresponding average weight (g) were converted to base \log_{10} to obtain straight-line relationship between length and weight. The non-linear equation $W=aL^b$ representing the length-weight relationship in fishes as proposed by Le Cren (1951) was used, which is the linear equation of the type $Y = a + bX$, where $Y = \log W$, 'a' and 'b' are constants and $X = \log L$. The constants 'a' and 'b' were estimated by least square method. The regression coefficient (b) and correlation coefficient (r) were determined by a programme scientific calculator.

The relative condition factors were also calculated separately for each class interval by the following formula (Le Cren 1951):

$$K_n = \frac{W}{\hat{W}}$$

Where, K_n = relative condition factor

W = observed body weight (g)

\hat{W} = calculated body weight (g)

\hat{W} was calculated by using the following formula:

$$\hat{W} = \text{antilog}(\log a + n \log L)$$

Results and discussion

The results of the length-weight relationships are shown in Table 1. The logarithmic form of equation obtained for the length-weight relationship of *Tor putitora* was represented by $\log W = -1.727 + 2.875 \log L$, or, $W = 0.01875 L^{2.875}$. The parabolic and logarithmic relationships between the length and weight are given in Figs. 1 and 2. The length-weight relationship in parabolic equation usually lies between 2.5 and 4.0 (Hile 1936). In a typical fish that maintains constant shape, 'b' will be 3.0, i.e., growth is isometric (Andrade and Campos 2002). However, the condition of fish is subject to variations with a number of factors including reproductive cycles and availability of foods (Thompson 1943, Rounsefell and Everhart 1953, Lagler 1956, Morato *et al.* 2001). Such variations may also be related to the environmental factors and the age and the physiological state of the fish (Brown 1957). Dasgupta (1991) reported that the length-weight relationship of mahseer, *Tor putitora* follows the cube law, indicating an isometric pattern of growth. He also stated that the condition factor 'K' and the relative condition factor (K_n) vary with season, age of the fish and feeding intensity. Javaid *et al.* (1992) determined the value of regression slope to be $b = 2.93$ in case of *Tor putitora*. The variations in results obtained in the present study might be due to the factors mentioned above.

The value of the correlation coefficient 'r' recorded in the present study was 0.965 (Table 1), which indicates strong and highly correlated relationship between length and weight of the fish. Roy (1987) also observed strong and highly correlated relationship between length and weight in three species of carps.

Table 1. Length-weight relationship and relative condition factor of *T. punitora*

Class intervals	Mid value (TL) (cm)	Frequency (f)	Av. Wt. (W) (g)	logL	logW	Calculated wt. (\hat{W})	K_n	Av K_n	r
12-13	12.5	10	25.58	1.097	1.408	33.46	0.76		
13-14	13.5	12	29.84	1.130	1.475	37.23	0.80		
14-15	14.5	16	33.90	1.161	1.530	41.17	0.82		
15-16	15.5	21	35.75	1.190	1.553	45.22	0.87		
16-17	16.5	23	54.90	1.217	1.739	47.93	1.15		
17-18	17.5	27	62.76	1.243	1.798	56.66	1.11		
18-19	18.5	29	69.65	1.267	1.843	66.16	1.05		
19-20	19.5	35	76.38	1.290	1.883	76.74	0.99		
20-21	20.5	30	85.82	1.312	1.934	88.43	0.97		
21-22	21.5	12	97.03	1.332	1.987	100.60	0.96		
22-23	22.5	7	109.56	1.352	2.039	114.45	0.95	0.95±0.12	
23-24	23.5	3	121.80	1.371	2.086	129.36	0.94		0.96

The graphical representation of regression lines for length-weight relationships of the fish indicated that the weight of fish has curvilinear relationships with total length. The regression lines obtained by plotting the log data (log length against log weight) were straight, which indicate that the log length of the fish has linear relationship with log weight. These findings agree with that reported by Shrivastava and Pandey (1981), who observed straight-line relationship in carps. The relative condition factor (K_n) ranged between 0.76 and 1.15 with a mean (\pm sd) value of 0.95 ± 0.12 . The K_n values recorded for the fish indicate good condition of the fish. K_n values were found to show an increasing trend with higher age groups but a decreasing trend was observed with further increase in age (Fig. 3). Le Cren (1951), Shafi and Mustafa (1976) and Azadi *et al.* (1991) also reported variations in K_n values with different age and size groups of fishes.

Tor fishes are poorly studied group among the carps. Little is known about the different aspects of biology and culture potential of this fish. The present study indicates an isometric pattern of growth and a strong and highly correlated relationship between length and weight of the fish. However, it is recommended that the length-weight relationship and condition of the fish should be studied further both for cultured and wild populations.

References

- Ahmed, N., 1969. Study on the spawning habits and early development of copper mahseer, *Barbus (Lissochilus) hexagonolepis*. McDonald Proc. Natl. Inst. Sci. India., 14 (1): 21-28.
- Andrade, H.A. and B.O. Campos, 2002. Allometry coefficient variations of the length-weight relationship of skipjack tuna (*Katsuwonus pelamis*) caught in the southwest South Atlantic. *Fish. Res.*, 55: 307-312.
- Azadi, M. A., M. Shafi and M. A. Islam. 1991. Studies on the age and growth of mahseer, *Tor tor* (Ham.) from the Kaptai Lake, Bangladesh. *Bangladesh J. Zool.*, 19 (1): 47-54.

- Azadi, M.A., M.A. Islam and J.G. Paul, 1990. Reservoir Fisheries of Asia. *In*: S.S. Proceeding of the 2nd Asian Reservoir Fisheries Workshop held in Hangzhou, Peoples' Republic of China (ed. De Silva), 15-19 October 1990. pp. 125-140.
- Brown, M.E., 1957. The Physiology of Fishes I. Academic Press Inc., New York, 371 pp.
- Chandra, K.J. and A.K.M. Aminul Haque, 1982a. Studies on the biology of *Tor* spp. in natural and artificial waters of Bangladesh I: Distribution, abundance, fishery. *Bangladesh J. Fish.*, 2-5 (1-2): 51-58.
- Chandra, K.J. and A.K.M. Aminul Haque, 1982b. Studies on the biology of *Tor* spp. in natural and artificial waters of Bangladesh. II: Taxonomy. *Bangladesh J. Fish.*, 2-5 (1-2): 59-64.
- Dasgupta, M., 1991. Food and feeding habits of the mahseer, *Tor putitora* (Hamilton). *Indian J. Fish.*, 38 (4): 212-217.
- Doha, S. and S. Dewan, 1967. Studies on the biology of tilapia (*Oreochromis mossambicus* Peters). Length-weight relationship and condition factor. *Pak. J. Sci.*, 19 (1 & 2): 23-28.
- Hile, R., 1936. Age and growth of the cisco, *Leucichthys artedi* (Lesueur) in the lakes of three northern highlands, Wisconsin. Bull. *U.S. Bur. Fish.*, 48: 211-317.
- Javid, M.Y., A. Salam, M.N. Khan and M. Naeem, 1992. Weight-length and condition factor relationship of a freshwater wild mahseer, *Tor putitora* from Islamabad, Pakistan. *In*: Proceedings of Pakistan Congress of Zoology (eds. M. Ahmed and A.R. Shakoori). Zoological Society of Pakistan. Vol. 12. pp. 335-340.
- Lagler, K.F., 1956. Length-weight relationship and condition. *In*: Freshwater Fishery Biology. W.M.C. Brown Co., Dubuque, Iowa, 421 pp.
- LeCren, E.D., 1951. The length-weight relationship and seasonal cycle in gonadal weight and condition in the perch, *Perca fluviatilis*. *J. Animal Ecol.*, 20 (2): 201-219.
- Mirza, M.R., I. Ali and M.N. Javed, 1993. A contribution to the fishes of the Kurram Agency, Pakistan. *Punjab J. Zool.*, 8: 37-40.
- Mirza, M.R., M.N. Javed and M. Tariq, 1994a. A note on the fish fauna of the river Zhob, Pakistan. *Pak. J. Biol.*, 26 (2): 189 pp.
- Mirza, M.R. and M.S. Khan, 1994b. A note on the fishes of the Badri Stream near Swabi, Northeast Frontier Province, Pakistan. *Pak. J. Zool.*, 26 (4): 361 pp.
- Morato, T., P. Afonso, P. Lourinho, J.P. Barreiros, R.S. Santos, and R.D.M. Nash, 2001. Length-weight relationships for 21 coastal fish species of the Azores, north-eastern Atlantic. *Fish. Res.*, 50: 297-302.
- Nath, M. M., R.K. Jabir-Singh and M.M. Chopra, 1994. A report on the decline of sport fish in the rivers and streams of the hills of Uttar Pradesh with particular reference to the Doon Valley region. *In*: Threatened fish of India (eds. P.V. Dehadrai, P. Das and S.R. Verma). Proc. of the National Seminar on Endangered Fishes of India, held at National Bureau of Fish Genetic Resources, Allahabad, India. *Nature Conservators*. pp. 219-227.
- Rahman, A.K.A., 1989. Freshwater Fishes of Bangladesh. The Zoological Society of Bangladesh.
- Rounsefell, G.A. and W.H. Everhart, 1953. Age and Growth. *In*: Fisheries Sciences. John Willey and Sons, New York. pp. 297-327.
- Roy, P.K., 1987. Length-weight relationship of a major carp *Cirrhinus mrigala* (Hamilton). *Matsya*. 12-13: 39-44.
- Shafi, M. and G. Mustafa, 1976. Observations on some aspects of biology of the climbing perch, *Anabas testudineus* (Block) (Anabantidae: Perciformes). *Bangladesh j. Zool.*, 4 (1): 21-28.
- Shrestha, T. K., 1994. Migration and spawning of golden mahseer in Himalayan waters of Nepal. *J. Freshwat. Biol.*, 6 (1): 71-77.
- Shrivastava, S. and A. K. Pandey, 1981. Length-weight relationship and condition factor of three Indian major carps in composite fish farming. *Matsya*, 7: 70-74.

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Thompson, D.A.W., 1943. *On Growth and Form*. 2nd Ed., Univ. Press, Cambridge. 282 pp.

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