http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 15 (12): 595-599, 2012
ISSN 1028-8880 / DOI: 10.3923/pjbs.2012.595.599

Length-weight Relationship of *Mugil cephalus* (Linnaeus 1758) in Vellar Estuary, Southeast coast of India

[1]S. Murugan, [1]S. Ajmal Khan, [1]P.S. Lyla, [1]C. Prasanna Kumar, [2]K.C.A. Jalal,
[2]B.Y. Kamaruzzaman and [2]B. Akbar John
[1]Centre of Advanced Study in Marine Biology, Faculty of Marine Science,
Annamalai University, Parangipettai, Tamil Nadu, India
[2]Department of Biotechnology, Kulliyyah of Science, International Islamic University Malaysia,
Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia

Abstract: A detailed study on the length weight relationship of *Mugil cephalus* in Vellar estuary was conducted between January 2004 and December 2005. Statistical tests such as regression coefficient 'b' and 'a' tests were performed to compare the b values of males and females from the hypothetical value of 3. The b value of male (2.7658) differed significantly from the hypothetical value of 3 ($t = -2.8586 < 0.05$), the b value of female (2.8586) did not differ significantly from the hypothetical value ($t = -1.0158 > 0.05$). Values of both males and females were less than 3 which proved the negative allometry growth pattern.

Key words: Mullet, *Mugil cephalus*, length weight relationship, Vellar estuary, India

INTRODUCTION

Length-weight relationship is considered vital in fisheries as it correlates and reveals the mathematical relationship between the variables length and weight of the fishes (Lawson, 2011; Arshad *et al*., 2012; Thulasitha and Sivashanthini, 2012). Studies on length-weight relationship play a vital role in predicting the growth rate, feeding intensity, metamorphosis and general well being of the fish population (Sivashanthimi *et al*., 2009; Hazmadi *et al*., 2011). Besides comparing the life history of fishes of different localities (Petrakis and Stergiou, 1995), the length-weight relationship can also be used for estimating the number of fish landed and comparing the population in space and time (Cicek *et al*., 2008; Khan *et al*., 2011). Knowledge of the relationship between the weight of a fish and its length is also helpful to biologists in converting samples of length frequency data into weight data for calculation of catch in terms of weight or biomass. The length-weight relationships could also be used to (1) estimation of mean weight of the fish of a given length group (Beyer, 1987); (2) conversion of length-growth to weight-growth equivalents in yield- per- catch and related models, (3) interspecific and inter population morphometric comparison of fish species and (4) assessing the well-being of fish population (Bolger and Connolly, 1989; Kulbicki *et al*., 1993; King, 1996a; Hajjej *et al*., 2011). In tropical waters, the fish growth fluctuation is more frequent due to seasonal variations, more spawning and composition of food (Das *et al*., 1997; Amin, 2001). Venkataramanujam and Ramanathan (1994) were not having a different opinion pointed out that it is the direct way of transforming logarithmic growth rates into weight and the same shows major taxonomic variations and incidences in the life history like metamorphosis and the onset of maturity. Length-weight relationship is helpful in the evaluation of the condition or general well being of the animal through the study of condition factor (K) or relative condition factor (KN).

It is worth mentioning that virtually no information on the length-weight relationship of *Mugil cephalus* from Parangipettai waters are available. Therefore the present study was undertaken on the length-weight relationship and relative condition of *Mugil cephalus* occurring in Vellar estuary.

MATERIALS AND METHODS

Description of the study area: Parangipettai (lat. 11°30'N, long. 79°46'E) situated on the southeast coast of India in endowed with a variety of biotopes such as neritic, estuarine, backwater and mangrove swamps within easy reach of our biological station. The Vellar River has

Corresponding Author: B. Akbar John, Department of Biotechnology, Kulliyyah of Science, International Islamic University Malaysia, Jalan Sultan Ahmad Shah Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia

its origin in the Servarayan hills in Selam district, 240 km west of Parangipettai. It opens in to the Bay of Bengal at Parangipettai after flowing over a distance of about 480 km. This estuary is 600 m wide at its junction with the sea. This is a true estuary and is subjected to long term seasonal variations in salinity. During the northeast monsoon (October to December) the estuary drains more of fresh water.

Data collection: *Mugil cephalus* were collected from the commercial catches brought to the fish landing centers of Parangipettai for the period of two years from January 2004 to December 2005. A total of 840 specimens (390 males and 450 females) ranging in size from 10 to 49 cm for males and 10 to 54 cm for females were used for the present study . The Total Length (TL) of each fish was measured from the anterior most edge of the snout to the posterior most edge of caudal fin to the nearest mm with a measuring board. Weight (W) was measured to the nearest 0.1 g by an electronic balance (Roy Electronic balance) after draining the water from the buccal cavity and wiping the moisture content on the body of fish (King, 1996a).

The length-weight relationship was calculated separately for each category based on the methodology of Le Cren (1951). The hypothetical and parabolic equation used by him is $W = aLb$. Its logarithmic transformation is $\log_e W = \log_e a + b \log_e L$ i.e., $Y = a+bx$ according to Ramaseshaiah and Murthy (1997), where 'W' represents weight in g and 'a' and 'b' the constants, which were estimated by the method of least squares.

The linear equation was fitted separately for males and females of *Mugil cephalus*. Analysis of Covariance (ANCOVA) was employed to test the significance of difference between regression coefficients (b) at 5% level of both sexes (Snedecor, 1956; James, 1967; Snedecor and Cochran, 1967). The t-test (Snedecor and Cochran, 1967) was employed to test whether the regression coefficient (b) departed significantly from the expected hypothetical cubic value 3.

RESULTS

The estimated parameters of the length-weight relationship and other statistical details of *Mugil cephalus* are consolidated in Table 1 and 2. The logarithmic values of observed length and corresponding weights of males and females are plotted in Fig. 1 and 2, respectively. Similarly the parabolic relationship between length and weight of males and females of *M. cephalus* is plotted in Fig. 3 and 4. The regression plots of the data indicated a linear relationship between the two variables.

Table 1: Regression analysis of data for length-weight relationship in male and female *Mugil cephalus*

		Sum of squares and products				Errors of estimation	
Category	df	x^2	xy	y^2	b	df	SS
Males	197	5.7267	15.8387	44.1541	2.7658	196	0.3477
Females	241	10.9219	28.7017	78.5515	2.8586	240	3.1259
Total	438	16.6486	15.8387	122.7056		436	3.4736

b: regression coefficient

Table 2: Analysis of covariance showing difference between regressions of length-weight relationship in male and female *Mugil cephalus*

Sources of variation	df	SS	MS	F-value	p-value
Deviation from individual regression	436	3.4736	0.007967	13074.45	<0.005
Difference between regressions	1	104.163	104.1638		

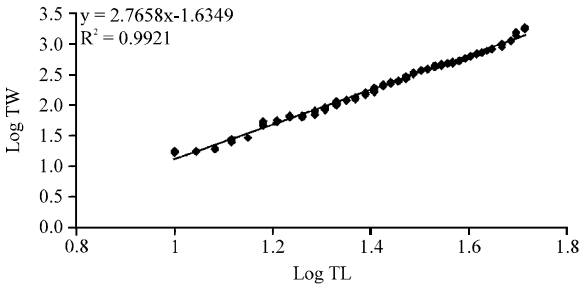

Fig. 1: Logarithmic relationship between length (TL) and weight (TW) in male *Mugil cephalus*

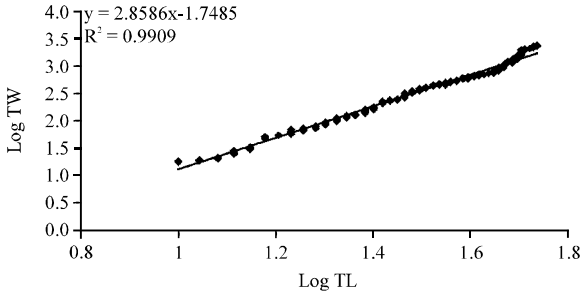

Fig. 2: Logarithmic relationship between length (TL) and weight (TW) in female *Mugil cephalus*

The logarithmic equations derived for males and females of the *Mugil cephalus* presently studied are given below:

- For males: $\log_e W = -1.6349+2.7658 \log_e L$
- For females: $\log_e W = -1.7485+2.8586 \log_e L$

The parabolic relations derived are:

- For males: $W = 0.0232 L^{2.7658}$
- For females: $W = 0.0178 L^{0.9909}$

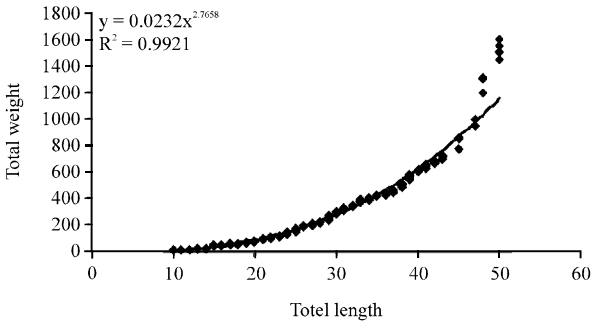

Fig. 3: Parabolic relationship between length and weight of male *Mugil cephalus*

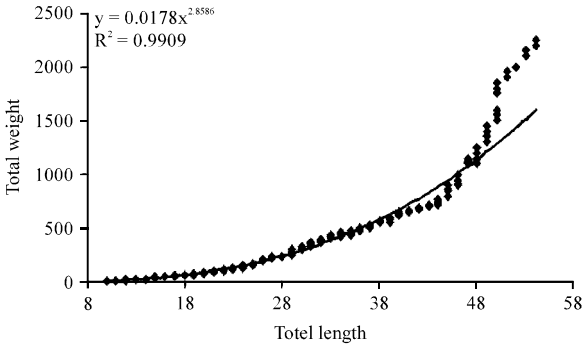

Fig. 4: Parabolic relationship between length and weight of female *Mugil cephalus*

Analysis of covariance used to test the difference in regression coefficients (b) between males and females revealed significant differences (F = 13074.45, p<0.005). The t-test revealed that the values of regression coefficient (2.7658) and (2.8586) obtained with 390 males and 450 females, respectively departed significantly from the cube value (3) at 5% level in the case of males (F = -2.3096; p<.05). However, it was not so in the case of females (F = -1.0158; p>0.05).

DISCUSSION

From the regression equation obtained in the present study it is clear that the 'b' values traced for males (2.7658) and females (2.8586) were less than 3, showing the negative allometric pattern of growth. King (1996a) pointed out that the exponent (b) in the length-weight relationship of fishes is usually 3. The 'b' value is very close to 3.0 but varies between 2.5 and 3.5. If the 'b' value for fish is 3, the fish grows isometrically; if it is greater than 3, the fish exhibits positive allometry and if it is lower than 3 the fish exhibits negative allometry (Tesch, 1968).

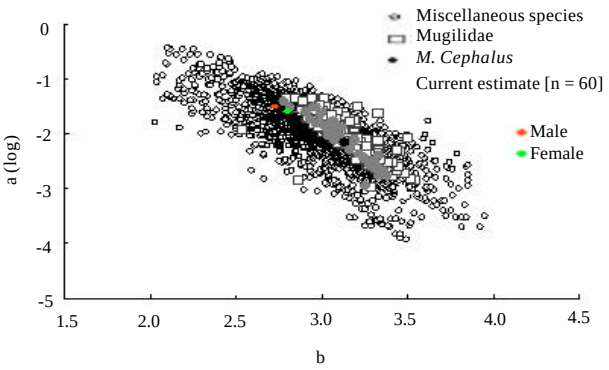

Fig. 5: Plot of log 'a' versus 'b' for male and female *Mugil cephalus*

Fishery biologists also stated that the 'a' and 'b' values not only differ in different species but differ in the same species depending on sex, stage of maturity, food habits and so on (Qasim, 1973; Bal and Rao, 1984).

The present study on length- weight relationship of *M. cephalus* showed that the b value of male (2.7658) differed significantly from the hypothetical value of 3 (t = -2.8586<0.05), the b value of female (2.8586) did not differ significantly from the hypothetical value of 3 (t = -1.0158>0.05).values of both males and females were less than 3. However, differences were found between the regressions of males and females and hence separate regression equations were derived for males and females. It can be concluded that the weight in both sexes of this mullet species increases in proportion 2.7658 for males and 2.8586 for females, if not exactly in proportion of 3. Several factors are responsible for the minor difference in b values of males and females, such as differential metabolic rates and growth rates, status of ovarian maturation, reproductive potential and fullness of stomach or intensity of feeding during analysis, food and feeding habits, biochemical make up, environmental conditions etc.

In general, the values of the relationship between length and weight obtained in the present study are very similar to those found by other investigators who carried out studies in coastal lagoons and marine areas. The results obtained for *M. cephalus* in the present study agree well with those of King (1996b), Garcia *et al.* (1998) and Haimovici and Velasco (2000). The 'a' and 'b' values obtained for *M. cephalus* were superimposed in the plot of log 'a' versus 'b' available for *M. cephalus* and 1700 miscellaneous species in Fish Base 2004 for comparison and is shown in Fig. 5. Estimated values in the present study fall well within the range of values reported earlier for *M. cephalus*.

ACKNOWLEDGMENT

Authors are thankful to the Dean and Director, T. Balasubramanian, CAS in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai for his encouragement and provided facilities.

REFERENCES

Amin, S.M.N., 2001. Studies on age and growth, VPA analysis and relative condition factor of *Harpodon nehereus* (Ham-Buch) from the neritic water of Bangladesh. J. Biol. Sci., 1: 192-194.

Arshad, A., S.M. Nurul Amin, Y.L.Z. Nuradiella, Z.C. Cob, R. Ara and D. Aziz, 2012. Population characteristics of *A. japonicas* from the Kedah coastal waters of peninsular Malaysia. J. Fisher. Aquat. Sci., 7: 162-172.

Bal, D.V. and K.V. Rao, 1984. Marine Fisheries. Tata McGraw Hill Publishing Company, New Delhi, India, pp: 470.

Beyer, J.E., 1987. On length-weight relationships. Part 1: Computing the mean weight of the fish of a given length class. Fishbyte, 5: 11-13.

Bolger, T. and P.L. Connolly, 1989. The selection of suitable indices for the measurement and analysis of fish condition. J. Fish. Biol., 34: 171-182.

Cicek, E., D. Avsar, C.E. Ozyurt, H. Yeldan and M. Manasirli, 2008. Age, growth, reproduction and mortality of tub gurnard (*Chelidonichthys lucernus* (Linnaeus, 1758)) inhabiting in babadillimani bight (Northeastern Mediterranean Coast of Turkey). J. Boil. Sci., 8: 155-160.

Das, N.G., A. Majumder and S.M.M. Sarwar, 1997. Length-weight relationship and condition factor of catfish, *Arius tenuispinis* Day, 1877. Indian J. Fish., 44: 81-85.

Garcia, C.B., J.O. Duarte, N. Sandoval, D. von Schiller, G. Melo and P. Navajas, 1998. Length-weight relationship of demarsal fishes from the gulf of Salamanca, Colombia. Naga, ICLARAM, Q., 21: 30-32.

Haimovici, M. and G. Velasco, 2000. Length-weight relationship of marine fishes from Southern Brazil. Naga, ICLARAM Q., 23: 19-23.

Hajjej, G., A. Hattour, A. Hajjej, H. Allaya, O. Jarboui and A. Bouain, 2011. Biometry, length-length and length-weight relationships of little tuna *Euthynnus alletteratus* in the Tunisian waters. J. Fish. Aquat. Sci., 6: 256-263.

Hazmadi, M.Z., S.M.N. Amin, A. Arshad, M. Aminur Rahman and S.M. Al-Barwani, 2011. Size frequency and length-weight relationships of spined anchovy, *Stolephorus tri* from the coastal waters of Besut, Terengganu, Malaysia. J. Fish. Aquatic Sci., 6: 857-861.

James, P.S.B.R., 1967. The Ribbon-Fishes of the Family Trichiuridae of India. Vol. 1, Marine Biological Association of India, India, Pages: 226.

Khan, S., M.A. Khan, K. Miyan and M. Mubark, 2011. Length-weight relationship of nine freshwater teleosts collected from river Ganga, India. Int. J. Zool. Res., 7: 401-405.

King, R.P., 1996a. Length-Weight relationships of Nigerian freshwater fishes. Naga, ICLARM. Q., 19: 45-52.

King, R.P., 1996b. Length-weight relationships of Nigerian coastal water fishes. Fiesbyte, 19: 53-58.

Kulbicki, M., G. Mou-Tham, P. Thollot and L. Wantiez, 1993. Length-weight relationships of fish from the lagoon of New Caledonia. NAGA, ICLARM Quarterly, 16: 26-30.

Lawson, E.O., 2011. Length-weight relationships and fecundity estimates in mudskipper, *Periophthalmus papilio* (Bloch and Schneider 1801) caught from the mangrove swamps of Lagos Lagoon, Nigeria. J. Fish. Aquat. Sci., 6: 264-271.

Le Cren, E.D., 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (*Perca fluviatilis*). J. Anim. Ecol., 20: 201-219.

Petrakis, G. and K.I. Stergiou, 1995. Weight-length relationships for 33 fish species in Greek waters. Fish. Res., 21: 465-469.

Qasim, S.Z., 1973. Some implications of the problem of age and growth in marine fishes from the Indian waters. Indian J. Fish., 20: 351-371.

Ramaseshaiah, M. and B.V.S.R. Murthy, 1997. Length-weight and total length-carapace length relationships of *Metapenaeopsis barbata* (De Haan) from the Visakhapatnam coast. Indian J. Fish., 44: 91-95.

Sivashanthini, K., G.A. Charles and W.S. Thulasitha, 2009. Length-weight relationship and growth pattern of *Sepioteuthis lessoniana* Lesson 1830 (Cephalopoda: Teuthida) from the Jaffna Lagoon, Sri Lanka. J. Biol. Sci., 9: 357-361.

Snedecor, G.W., 1956. Statistical Methods Applied to Experiments in Agriculture. 5th Edn., The Iowa State College Press, USA.

Snedecor, G.W. and W.G. Cochran, 1967. Statistical Methods. 6th Edn., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India, Pages: 593.

Tesch, F.W., 1968. Age and Growth. In: Methods for Assessment of Fish Production in Freshwaters, Ricker, W.E. (Ed.). Blackwell Scientific Publications, Oxford, UK., pp: 93-123.

Thulasitha, W.S and K. Sivashanthini, 2012. Growth pattern and length weight relationship of *Scomberoides lysan* (Pisces: Carangidae) from the Northern waters of Sri Lanka. J. Fish. Aquat. Sci., 7: 57-64.

Venkataramanujam, K. and N. Ramanathan, 1994. Manual of Finfish Biology. Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi, India, Pages: 110.