J. Appl. Environ. Biol. Sci., 2(2)52-58, 2012

ISSN: 2090-4215
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Length Weight Relationship of Four Commercially Important Marine Fishes of Northern Bay of Bengal, West Bengal, India

Sachinandan Dutta*, Sourav Maity, Abhra Chanda, Anirban Akhand and Sugata Hazra

School of Oceanographic Studies, Jadavpur University, Kolkata-700 032, West Bengal, India.

ABSTRACT

Length-weight relationship of four commercially important marine fish species of four genus from four different families were estimated between July 2010 and July 2011 at three different fish landing centers of West Bengal. A total of 1971 individual fishes of four species were measured. Length-weight relationship was established by the formulae: $W=aL^b$. The 'b' values and 'r^2' values of length-weight relationship of *Tenualosa ilisha*, *Pampus argenteus, Scomberomorus guttatus and Osteogeneiosus militaris* were observed to be 3.109, 2.841, 2.894, 2.945 and 0.989, 0.987, 0.991, 0.992 respectively. The condition factor of all these four species were 1.141 ± 0.004 in *T. ilisha*, 0.649 ± 0.003 in *S. guttatus*, 1.623 ± 0.008 in *P. argenteus* and 0.941 ± 0.004 in *O. militaris*. There was a significant positive correlation between length and weight which indicates that all the four species maintain their shape throughout their life.

Key words: Length weight relationship, fish landing center, condition factor, Bay of Bengal.

INTRODUCTION

The length-weight relationship (LWR) is a very important parameter to understand the growth dynamics of the fish population. Length and weight data are useful standard results of any fish sampling program [15]. LWR of fishes are important in fisheries biology because they allow the estimation of the average weight of fish of a given length group by establishing a mathematical relation between the two parameters [5]. The LWR is particularly important in parameterizing yield equations and in estimations of stock size [1]. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish [23]. The study of morphometric characters in fishes is important because they can be used for the differentiation of taxonomic units [3]. In fisheries science, the condition factor is used in order to compare the "condition", "fatness" or wellbeing of fish [2]. The condition factor usually increases with sexual maturation. Pati [18] estimated length weight relationship of *P. argenteus* from Bay of Bengal (BOB). Biswas et al. [6] calculated the LWR along with the variation of condition factor of *Chanos chanos* in brackish water pond of Indian Sundarbans, West Bengal (WB). Sawant and Raje [22] estimated the LWR of *Arius caelatus and A. thalassinus* from Mumbia and Vishakhapatanam coast. Similar studies were done by Haimovici and Velasco [11], Muto et al [16], Harission et al. [12], Volvich et al. [24], Rahman et al. [19], Ecoutin et al [8], Kalayci et al. [13], Cherif et al. [7], Gökçe et al. [10] in other areas.

In this present study the length weight relationship was calculated along with the mean length and weight of four different fish species from the three main marine fish landing centers of West Bengal. The condition factor was also estimated to understand their condition of growth.

MATERIALS AND METHODS

Length-weight relationship of four marine fish species viz. *Tenualosa ilisha*, *Pampus argenteus, Scomberomorus guttatus* and *Osteogeneiosus militaris* were measured by a metric scale and a digital weighing machine of Wensar (TTB-3), capacity 3 kilograms and accuracy 0.01 gram. A total of 1971 individual fishes were measured from July 2010 to July 2011 from Kakdwip Fishing Harbour (21°51'56.80"N and 88°10'25.65"E) and Frasuregunje Fishing Harbour (21°34'45.91"N and 88°15'5.38"E) of District South24-Parganas and Digha-Mohana fish market (21°37'47.78"N and 87°32'35.19"E) lying in the District Purba Midnapur (Figure 1). The fishes were caught by gill net and trawl net from Bay of Bengal Large Marine Ecosystem.

***Correspondence Author:** Sachinandan Dutta, School of Oceanographic Studies, Jadavpur University, Kolkata-700 032, West Bengal, India. Phone: +91-9143684917 Fax: +91-33-21426242 E-mail address: duttasachi@gmail.com

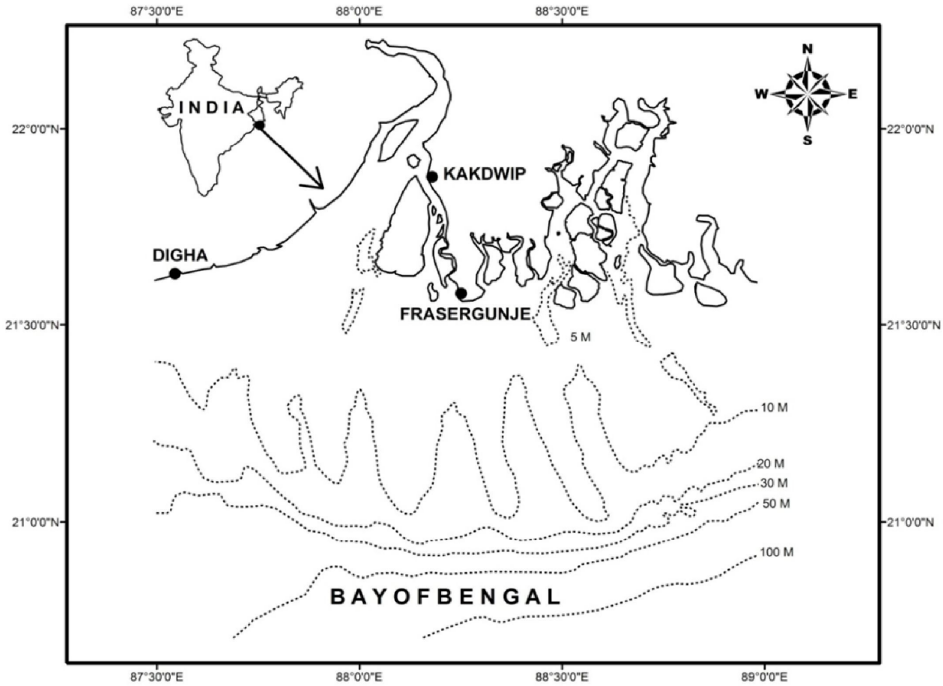

FIGURE 1. Figure shows the sites of the present study.

Length was measured in millimeters (mm) and weight was measured in grams (g). Total length was measured from the lower jaw to the tip of the tail; spread normally [24]. The minimum and maximum lengths and weights were also estimated. The length-weight relationship was established by the equation $W=a.L^b$ [14], where W is the weight of the fish, L is the total length of the fish, 'a' is the exponent describing of the rate of change of weight with respect to length and 'b' denotes the weight at unit length. The 'a' and 'b' were also calculated from the $W=a.L^b$ equation. When the parameter 'b' is equal to 3, the growth is called isometric but the growth is positive allometric when the 'b' value is more than 3 and negative allometric when the 'b' value is less than 3.
The coefficient of condition has usually been represented by the letter K when the fish is measured and weighed in the metric system. The formula most often used is: $K=W*100,000/L^3$, where: W = the weight of the fish in grams; L = the standard length of the fish in millimeters [25].
All the calculations were done by using Microsoft Office Excel 2010.

RESULTS AND DISCUSSION

The LWR of 1971 individual fishes of four different species of four different families have been detailed on Table 1.

A total of 550 individual of Hilsa Shad (*Tenualosa ilisha*) were measured during this study period and the mean length and mean weight of Hilsa Shad were 311.91 ± 2.58 mm and 387.71 ± 8.84 g simultaneously. The 'b' value of Hilsa Shad was 3.109 and the r^2 value was 0.9898. The length weight relationship of Hilsa Shad was found to be $W = 0.000006*L^{3.109}$ (Figure 2) where the 'b' value is 3.109, so the growth of Hilsa Shad is observed to be positive allometric in nature. Reuben et al. [21] established the LWR of Hilsa Shad from northeast coast of India and the relationship is $W=0.00003693321*L^{2.8053}$. The LWR of Hilsa Shad, $W = 0.00305*TL^{3.381}$ was calculated by Nurul Amin et al. [17] from Bangladesh water. In Hilsa Shad the condition factor was 1.141 ± 0.004, which indicate that the weight increases with the cube of length.

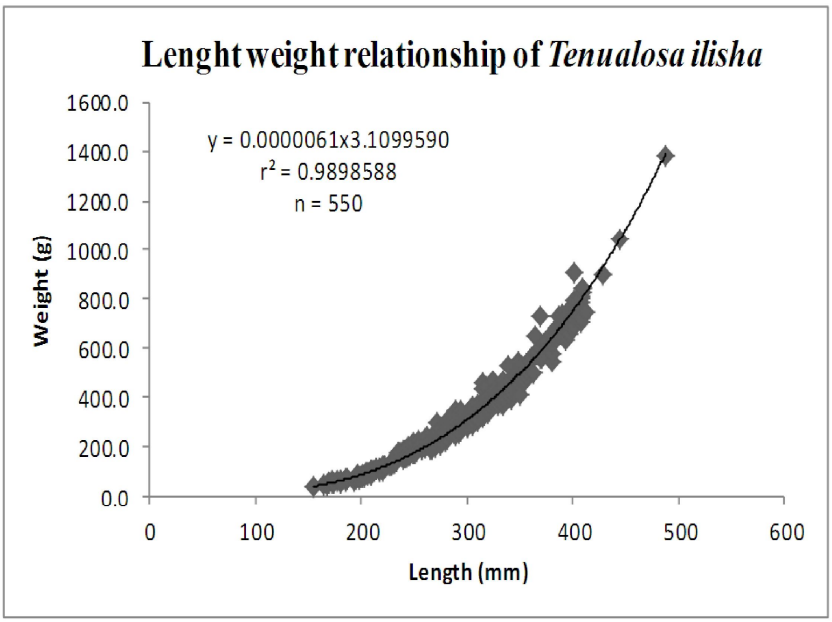

FIGURE 2. Length weight relationship of *Tenualosa ilisha.*

Indo-Pacific King Mackral, (*Scomberomorus guttatus*) which is elongated in shape; its mean length was observed to be 375.54 ± 4.80 mm and the mean weight was 418.2 ± 15.3 g. In this present study 480 individual of *S. guttatus* were measured. The LWR of *S. guttatus* was $W = 0.00001\ L^{2.894}$, where the r^2 value was 0.9915 (Figure 3), from this relationship it can be inferred that their growth is negative allometric in nature. According to Rashid et al. [20] the LWR of *S. guttatus* was $W = 0.0101\ L^{2.8622}$. The condition factor of *S. guttatus* was 0.649 ± 0.003, so its growth is poor, weight is not increasing with the length, that's why it elongated in shape.

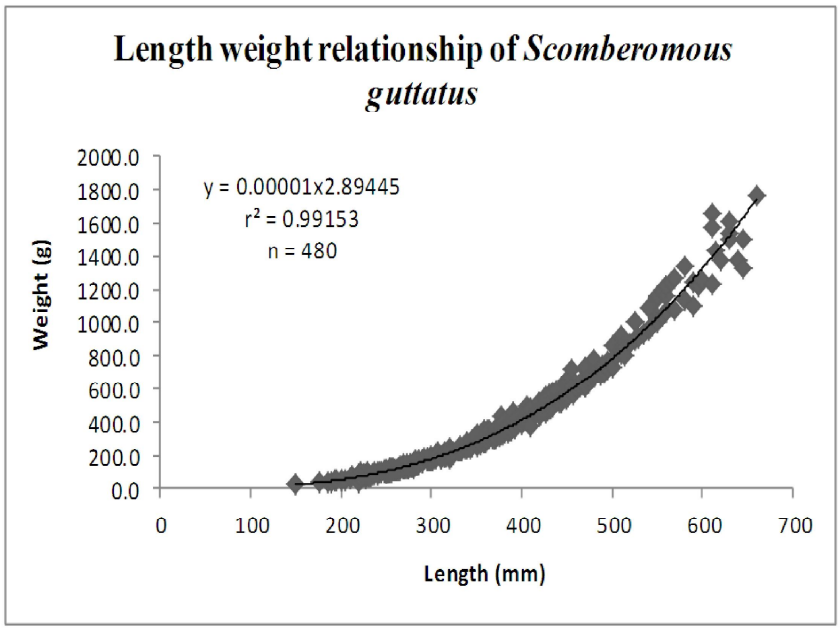

FIGURE 3. Length weight relationship of *Scomberomorus guttatus*.

A total of 467 Silver Pomfret were measured during this study period. The mean length and mean weight were 205.14 ± 2.62 mm and 168.84 ± 6.63 g respectively. The growth of *P. argenteus* is negative allometric as its 'b' value was found to be 2.841 and the LWR was $W = 0.00004*L^{2.841}$ (Figure 4). The r^2 value of length and weight was 0.9873. Pati [18] established the LWR for *P. argenteus* $W=0.01340*L^{2.5307}$ for male and $W=0.009523*L^{2.6920}$ for female. In 2009 Ghosh et al. [9] estimated the log transformation of LWR of *P. argenteus,* which is log W = -1.8052 + 3.050426 log L, where the 'b' value was 3.050426. Rahman et al. [19] estimated 'a' and 'b' values -1.1004 and 2.7931 respectively in *P. argenteus.* The growth of *P. argenteus* in Northern Bay of Bengal is quite good as its condition factor is 1.623 ± 0.008.

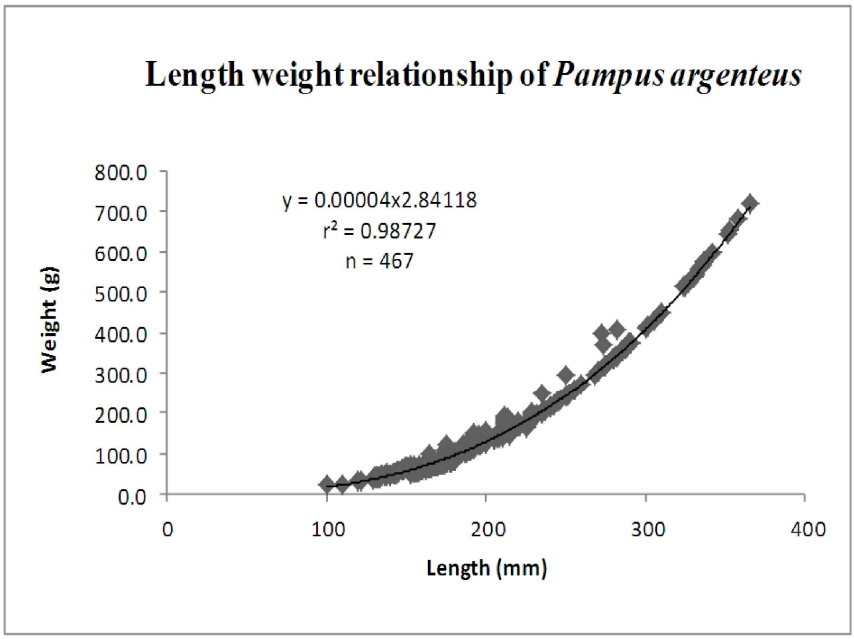

FIGURE 4. Length weight relationship of *Pampus argenteus*.

From the Bay of Bengal, Soldier Cat Fishes (*Osteogeneiosus militaris*) of various size groups were caught every year. Among 474 Soldier Cat Fishes, the mean length was 305.75 ± 4.04 mm and mean weight was 339.7 ± 16.1 g respectively. The LWR of *O. militaris* was $W = 0.000013*L^{2.945}$ (Figure 5) where the 'b' value was 2.945 and the r^2 value was 0.9923. Sawant and Raje [22] estimated the LWR of *Arius caelatus and A. thalassinus* from Mumbai and Vishakhapatanam coast. For *A. caelatus* it is log W= -5.42954 + 3.173407 log L (male); log W= -5.84139 + 3.335444 log L (female)., where the 'r' value is 0.979559 for male and 0.911744 for female. For *A. thalassinus* it is log W= -5.12893 + 3.029225 log L (male); log W= -5.10804 + 3.04644 log L (female). The condition factor in *O. militaris* was 0.941 ± 0.004, indicating that its growth has been more or less normal.

TABLE 1. Table shows the length weight relationship of four marine fishes.

Common name	Scientific name	Family	n	Mean Length (L) ± SE Mean	Mean Weight (W) ± SE Mean	r^2	b	a	K ± SE Mean
Hilsa Shad	*Tenualosa ilisha,* Hamilton, 1822	Clupeidae	550	311.91 ± 2.58	387.71 ± 8.84	0.9898	3.109	0.000006	1.141 ± 0.004
Indo-Pacific King Mackral	*Scomberomorus guttatus,* Bloch & Schneider, 1801	Scombridae	480	375.54 ± 4.80	418.2 ± 15.3	0.9915	2.894	0.00001	0.649 ± 0.003
Silver Pomfret	*Pampus argenteus,* Euphrasen, 1788	Stromateidae	467	205.14 ± 2.62	168.84 ± 6.63	0.9873	2.841	0.00004	1.623 ± 0.008
Soldier Cat Fish	*Osteogeneiosus militaris,* Linnaeus, 1758	Aridae	474	305.75 ± 4.04	339.7 ± 16.1	0.9923	2.945	0.000013	0.941 ± 0.004

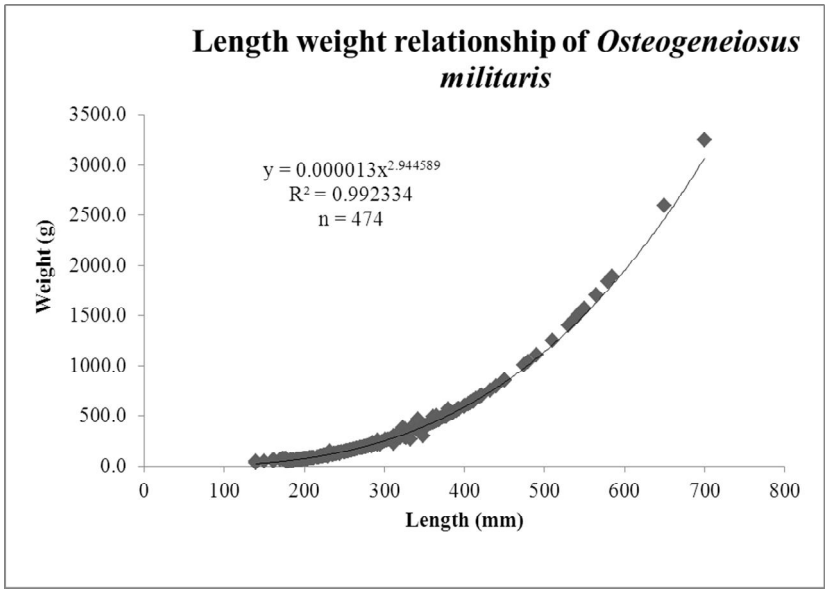

FIGURE 5. Length weight relationship of *Osteogeneiosus militaris*.

CONCLUSIONS

The length-weight relationship is very important for proper exploitation and management of the population of fish species [4]. The LWR of these commercially important marine fishes helps to manage their stock in the Northern Bay of Bengal. From the length weight relationship study it is clear that the growth of *T. ilisha* is positive allometric in nature and in case of *P. argenteus, S. guttatus and O. militaris* it is negative allometric in nature and the length and the weight of all the four species are significantly correlated. It indicates that the all the four species maintain their shape throughout their life. From the perspective of condition factor the growth of *P .argenteus* and *T. ilisha* is excellent whereas the growth of *O. militaris* is more or less stable but the weight of *S. guttatus* is not increasing with the length, probably because of environmental stress caused by the low salinity of the Hugli estuary.

ACKNOWLEDGEMENT

The authors are grateful to the Sribas Sashmal, Bidhan Chandra Das and Baburam Bhowmik and fishermen from West Bengal coast for their help during data collection. The authors also humbly acknowledge the Indian National Center for Ocean Information Services (INCOIS) for funding the Potential Fishing Zone (PFZ) validation project, for conducting the present study.

REFERENCES

1. Abdurahiman, K.P., T. Harishnayak, P.U Zacharia and K.S. Mohamed, 2004. Length-weight relationship of commercially important marine fishes and shellfishes of the southern coast of Karnataka, India. NAGA, World Fish Center Quarterly, Vol. 27 No. 1 and 2.
2. Ahmed, E. O., M. E. Ali and A. Aziz, 2011. Length-Weight Relationships and Condition Factors of Six Fish Species in Atbara River and Khashm El- Girba Reservoir, Sudan. International Journal of Agriculture Sciences, Vol. 3, Issue 1, PP-65-70.
3. Ambily, V. and S.B. Nandan, 2010. Length-weight relationship, relative condition factor (Kn) and morphometry of Arius subrostratus (Valenciennes, 1840) from a coastal wetland in Kerala. Indian J. Fish., 57(4): 39-44.
4. Anene, A., 2005. Condition factors of four cichlid species of a man-made lake in Imo state, Southeast, Nigeria. Turk. J. Fish. Aquat. Sci., 5: 43 - 47.

5. 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.

6. Biswas, G., J.K. Sundaray, A.R. Thirunavukkarasu and M. Kailasam, 2011. Length-weight relationship and variation in condition of *Chanoschanos* (Forsskal, 1775) from tide-fed brakishwater ponds of the Sundarbans-India. Indian Journal of Geo-Marine Science, Vol. 40(3), pp.386-390.

7. Cherif, M., R. Zarrad, H. Gharb, H. Missaoui and O. Jarboui, 2008. Length-weight relationships for 11 fish species from the Gulf of Tunis (SW Mediterranean Sea, Tunisia). Pan-American Journal of Aquatic Sciences, 3 (1): 1-5.

8. Ecoutin, J.M., J.J. Albaret and S. Trape, 2005. Length–weight relationships for fish populations of a relatively undisturbed tropical estuary: The Gambia, Fisheries Research, 72, 347–351.

9. Ghosh, S., G. Mohanraj, P.K. Asokan, H.K. Dhokia, M.S. Zala and H.M. Bhint, 2009. Fishery and stock estimates of the silver pomfret, *Pampus argenteus* (Euphrasen), landed by gill netters at Veraval. Indian J. Fish., 56(3): 177-182.

10. Gökçe, G., M. Çekiç and H. Filiz, 2010. Length-Weight Relationships of Marine Fishes of Yumurtalık Coast (İskenderun Bay), Turkey.Turk J Zool, 34,101-104.

11. Haimovici, M., and G. Velasco, 2000.Length-Weight Relationship of Marine Fishes from Southern Brazil. The ICLARM Quarterly, (Vol. 23, No. 1).

12. Harrison,T.D., 2001. Length-weight relationships of fishes from South African estuaries, J. Appl. Ichthyol. 17 (2001), 46-48.

13. Kalayci, F., N. Samsun, S. Bilgin and O. Samsun, 2007. Length-Weight Relationship of 10 Fish Species Caught by Bottom Trawl and Mid water Trawl from the Middle Black Sea, Turkey, Turkish Journal of Fisheries and Aquatic Sciences, 7: 33-36.

14. 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.

15. Morato, T., P. Afonso, P. Loirinho, J.P. Barreiros, R.S. Sanstos and R.D.M. Nash, 2001. Length-weight relationships for 21 costal fish species of the Azores, North-eastern Atlantic. Fisheries Research, 50: 297-302.

16. Muto, E.Y., L. S. H. Soares and C. L. D. B. Rossi-Wongtschowski, 2000. Length-Weight Relationship of Marine Fish Species off São Sebastião System, São Paulo, Southeastern Brazil, Naga, The ICLARM Quarterly, (Vol. 23, No. 4).

17. Nurul Amin, S.M., A. Arshad, G.C. Haldar, S Shohaimi and R. Ara, 2005. Estimation of Size Frequency Distribution, Sex Ratio and Length-Weight Relationship of Hilsa Shad (*Tenualosa ilisha*) in the Bangladesh Water. Research Journal of Agriculture and Biological Sciences, 1(1): 61-66.

18. Pati, S., 1981. Observations on the length-weight relationship of Pomfrets from the Bay of Bengal. *Mahasagar-Bulletin* of the National Institute of Oceanography, 14(1), 83-85.

19. Rahman, M.S., M.A. Rahaman, M.R. Rahaman and D. Kamal, 2004. Length-weight relationship , condition factor and harvesting records of Silver Pomfret (*Pampus argenteus*) in the Southwestern region of Bangladesh, Pakistan Journal of Biological Sciences, 7 (4): 452-456.

20. Rashid, H., M. G. Mustafa and S. Dewan, 2010. Population dynamics and the management of the Indo-Pacific king mackerel *Scomberomorus guttatus* from the upper Bay of Bengal off Bangladesh coast. The Bangladesh Veterinarian, 27(2) : 82 – 90

21. Reuben, S., S.S. Dan, M.V. Somaraju, V.Philipose and T.V. Sathianandan, 1992. The resources of Hilsa Shad shad, Hilsa Shad ilisha (Hamilton), along the northeast coast of India. Indian Journal of Fisheries, 39 (3.4): 169.181.

22. Sawant, P.B. and S.G. Raje, 2009. Morphometry and length weight relationship of the Catfishes Arius caelatus (Valenciennes, 1840) and Arius thalassinus (Ruppell, 1837) off Mumbai, Veraval and Vishakhapatanam coasts. Asian Fisheries Science, 22: 215-228.

23. Schneider, J.C., P.W. Laarman and H. Gowing, 2000. Chapter 17: Length-Weight Relationships. Manual of Fisheries Survey Methods II.
24. Volvich, L. and S. Appelbaum, 2001. Length to Weight Relationship of Sea Bass *Lates calcarifer* (Bloch) Reared in a Closed Recirculating System, The Israeli Journal of Aquaculture – Bamidgeh 53(3-4), 158-163.
25. Williams. J. E., 2000. The Coefficient of Condition of Fish. Chapter 13 in Schneider, James C. (ed.) 2000. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.