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Length-weight relationship and relative condition factor of *Polynemus paradiseus* (Linnaeus, 1758) from Hooghly-Matlah estuary, West Bengal

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Abstract The length-weight relationships (LWRs) and relative condition factor of *Polynemus paradiseus* (Linnaeus, 1758) were studied for 8 months (December to next July) at selected stretches of Hooghly-Matlah estuary, West Bengal. A total of 260 specimens of *P. paradiseus* in the length range of 145 to 265 mm total length (TL) collected at fortnight intervals by traditional gears, viz., gillnets and stationary bag nets for the present study. The length-weight relationship (LWR) was expressed as $W = 0.00000392\ L^{3.115}$ and $W = 0.00000237\ L^{3.182}$ for juveniles and adult groups, respectively which showed an isometric growth pattern. The correlation coefficient (r) for the LWRs was estimated at 0.92 and 0.96 for juveniles and adult groups, indicating a high degree of correlation between the two parameters for both groups. Isometric growth pattern (b~3.0) was observed in *P. paradiseus* with size at first mature at 145.0 mm total length. The 'a' values were observed as 0.00000392 and 0.00000237 and 'b' values as 3.115 and 3.182 for the juveniles and adult groups, respectively. The monthly mean relative condition factor (Kn) values varied from 1.002 to 1.177 and 0.986 to 1.239 for male and female specimens, respectively. The findings of the present study will provide baseline information for the conservation and management, and as the basis for further studies of this fish species in Hooghly-Matlah estuarine waters of India.

Key words *Polynemus paradiseus*, isometric growth, Hooghly-Matlah estuary, India

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Introduction

Polynemus paradiseus (Linnaeus, 1758), commonly known as 'Paradise threadfin' and locally called 'Topse', belongs to the family Polynemidae and forms a lucrative fishery in the Hooghly-Matlah estuarine system. This fish is considered important in terms of commercial value next to the *Tenualosa ilisha* fishery (Talwar and Jhingran, 1991; Borah *et al*., 2020). The species forms an important food fish among the fish-eating population of West Bengal. The study of length-weight relationship (LWR) and condition factor (K) are two important parameters in the management of fishery resources as they provide information on the conditions in which organisms are growing and their respective life history (Araneda *et al.*, 2008; Froese *et al*., 2011; Hossain *et al*., 2013; Froese and Pauly, 2017; Chakraborty *et al*., 2017; Sarkar *et al*., 2017a; Vahneichong *et al*., 2018; Bhakta *et al*., 2019a). Condition factor is a quantitative parameter estimated based on length-weight data, which indicates the state of wellbeing of the fish (Hossain *et al.*, 2006; Chakraborty *et al*., 2018). Determination of proper sizes of the fish to harvest for the maximum sustainable yield is directly related to the fish weight, and fish weight is considered to follow the hypothetical cube law (Bhattacharya and Banik, 2012).

There are ample literature on biological parameters like length-weight relationships, condition factors, food and feeding habits, etc. of the species under the family Polynemidae (Karekar and Bal, 1958; Hida, 1967; Kagwade, 1969; Qasim, 1972; Nabi *et al.*, 2007; Chaklader *et al*., 2015; 16; Hossen *et al.*, 2017). But information on LWRs and condition factors of *P. paradiseus* are very limited both from India and neighboring countries (Mandal *et al.*, 1998; Nabi *et al.*, 1999). In this context, the present study was attempted estimation of LWRs and Kn of *P. paradiseus* at selected stretches of Hooghly-Matlah estuary, India to know present status of this fishery in the environments. Studies on the LWRs and condition factor of *P. paradiseus* will be useful to understand the population dynamics of the species and for management of the fishery.

Materials and methods

The present study was conducted in the Hooghly-Matlah estuary, the largest brackish water delta in India. A total of 260 specimens of *P. paradiseus* in the length range of 145 to 265 mm (TL) were collected at fortnight intervals from December to next July, from Kakdweep, Sagar Island, Bokkali, and 8-Jetighat under Hooghly-Matlah estuarine system of West Bengal. The fish samples were mainly captured by gill net and stationary bag net locally called Beenjal, Behundijal which are multi-species non-selective small meshed gears. The collected samples were brought to the laboratory of the Department of Fisheries Resource Management, Faculty of Fishery Sciences, Chakgaria, Kolkata. The collected specimens included both the juveniles and adult fish. The TL of each sample was measured to the nearest 1.0 mm with a standard scale and the individual body weight (BW) was measured to the nearest 0.1 g using a digital analytical balance.

Le Cren (1951) proposed a non-linear equation in the form of $W = aL^b$, which explains the relationship between length (L) and weight (W) of fish, where 'a' and 'b' are constant. The 't' test was applied to test significant differences of 'b' value from a cube or isometric value of 3 for LWRs. Relative condition factor was calculated sex-wise for both males and females. In mature specimens sexes were differentiated easily, female specimens were usually larger with heavy bellies as compared to males. The sexes of the unidentified young specimens were determined by dissecting the gonads. The 'Kn' was calculated by using the formula $Kn = W_0 / W$, where W_0 is observed weight and W is calculated weight. The Kn value was recorded for males and females, separately in different months. The data used for the LWRs were used for the calculation of monthly mean values of Kn for each sample. All the statistical analyses were considered significant at 1% level ($p<0.01$).

Results and discussion

Length-weight relationship

The length at first maturity of *P. paradiseus* was observed to be 145 mm in the present study, henceforth samples were divided into two groups viz., group-I (≤145 mm) or juveniles group and Group-II (>145 mm) or adult groups. The non-linear equation on the LWRs was recorded as $W = 0.00000392\ L^{3.115}$ and $W = 0.00000237\ L^{3.182}$ for juveniles and adult groups, respectively. The coefficient of correlation (r) between length and weight of juveniles and adult groups was found highly significant ($p\leq0.01$), indicating a strong relationship. Isometric growth was observed in *P. paradiseus*, which seems 'b' values did not significantly differ from 3 and the values were more in adult stages compare to juveniles. This might be due to the feeding intensity of the species, and which was found in carnivorous in feeding habits and mainly feeds on shrimps, fishes, insects, crustaceans, etc. (Borah *et al*., 2019). Hossen *et al.* (2017) observed 121.0 mm as the size of *Polynemus paradiseus* at first maturity from the Tetulia river in southern Bangladesh which was a little smaller than the present estimated size at first maturity of 145.0 mm.

Mohammed (1955) found 'b' value of 2.883 of *Polydactylus indicus* for 404 samples with length ranged from 253.0-1072.0 mm from Bombay and Saurashtra waters. Kagwade (1971) studied the length-weight relationship of *Polydactylus heptadactylus* and expressed the equation as $W = 0.00001089\ L^{3.083}$ and $W = 0.00001147\ L^{3.075}$ for males and females species, respectively. Mandal *et al.* (1998) reported isometric growth of *P. paradiseus* from the Hooghly-Matalh estuarine system with 'b' value as 3.120. Nabi *et al.* (1999) found the positive allometric growth of *P. paradiseus* with 'b' values was 3.389 and 3.512 for male and female species, respectively from the Bay of Bengal of Bangladesh. Nath *et al.* (2004) studied the length-weight

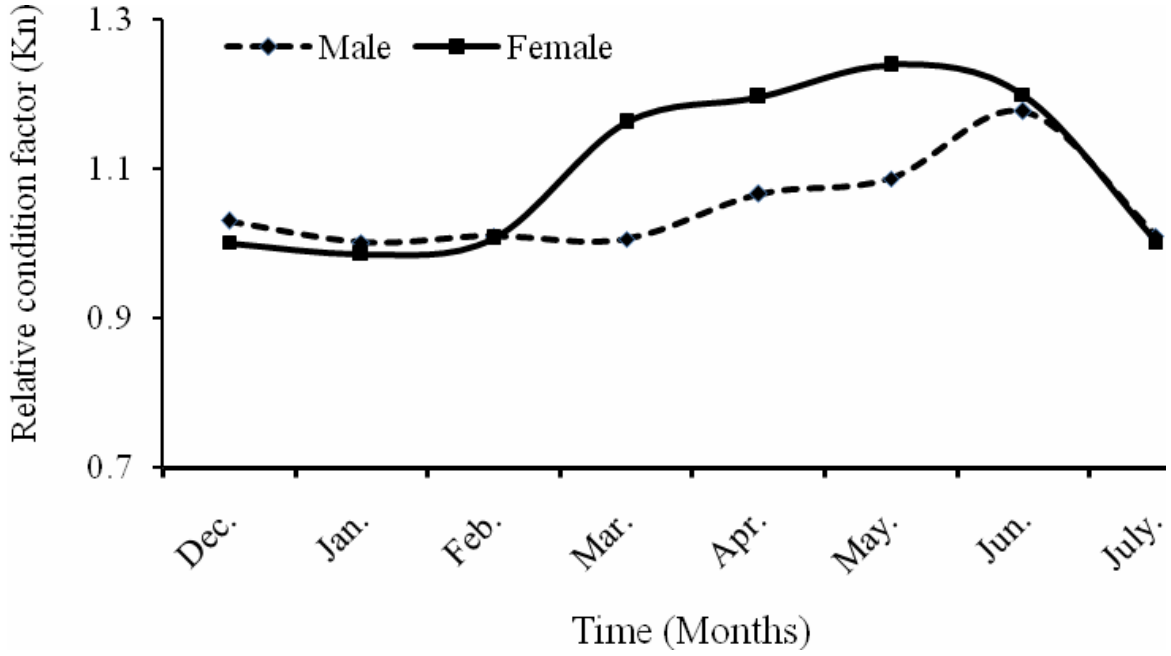

Fig. 1 Monthly mean variations of relative condition factor (Kn) of *P. paradiseus* from Hooghly-Matlah estuary

relationship of *P. paradiseus* and *Eleutheronema tetradactylum* from the Hooghly-Matlah estuarine system and 'b' values were reported as 3.120 and 3.214, respectively. Nabi *et al.* (2007) studied population dynamics of *Polynemus paradiseus* from the estuarine set bag net fishery of Bangladesh and found 'b' value as 2.740 with negative allometric growth. Hossain *et al.* (2015) found 'b' value of 3.23 with r^2 value of 0.954 in the length ranged from 9.1 to 17.1 cm of *P. paradiseus* from the Tetulia river, southern Bangladesh. Hossen *et al.* (2017) studied growth patterns and condition factors of *P. paradiseus* from the Tetulia river in southern Bangladesh and observed isometric growth in pre-monsoon and post-monsoon (b=3) but negative allometric growth was found in the monsoon period (b<3).

Hile (1936) proposed that the value of 'b' for an ideal fish range between 2.5 and 4.0. Differences in the growth patterns for the same species may be occurred due to several factors like sex, maturity, seasonal effects, food and feeding habits, habitat areas, preservation techniques and observed lengths (Bagenal, 1978 and Hossain *et al*., 2012; Das *et al*., 2016; Dey *et al*., 2016; Khongngain *et al*., 2017; Sarkar *et al*., 2017b; Bhakta *et al*., 2019b; Alam *et al*., 2020; Das *et al*., 2020). However, the 'b' value in the present study bears similarity with most of the workers and differs with few studies which might be due to local ecological conditions. The smaller size groups have a higher 'b' value compared to the larger fishes resembling the works of Hossen *et al.* (2017) in *P. paradiseus* and Pramanick *et al.* (2017) in *Chelon planiceps* fish species.

Relative condition factor (Kn value)

The monthly mean Kn values varied from 1.002 to 1.177 and 0.986 to 1.239 for male and female specimens, respectively (Figure 1). In males, the mean 'Kn' value was minimum (1.002) during January and maximum (1.177) during June. Whereas, in the case of females the mean 'Kn' value was minimum (0.986) during January and maximum (1.239) during May. The condition factor indicates an important aspect of feeding, spawning, and other aspects related to the well-being of the fish. A significant difference ($p \leq 0.05$) in mean 'Kn' values for both the sexes was observed in different months which was attributed to the feeding and gonadal development. For both the sexes, the low 'Kn' values were observed during January which may be due to less feeding tendency, and high during May and June which may be due to higher gonado-somatic index.

Ambily and Nandan (2010) found mean 'Kn' values ranging from 0.75 to 1.07 for males, 0.944 to 1.407 for females, and 0.96 to 1.196 for combined sexes of shovelnose catfish, *Arius subrostratus* (Valenciennes, 1840) from Champakkara backwater, Kerala. Hossen *et al.* (2017) reported 'Kn' values of 1.102, 1.314, and 1.221 of *P. paradiseus* during pre-monsoon, monsoon, and post-monsoon respectively from Tetulia river in southern Bangladesh. In present study the mean 'Kn' value of females (1.10) was higher than males (1.05), which indicates that the females were in better condition than males in Hooghly-Matlah estuary. Higher relative condition factor in female compare to male in others catfishes was also reported by in *Arius tenuispinis* (Das *et al.*, 1997), *Mystus vittatus* (Hossain *et al.,* 2006), *Gagata cenia* (Chaki *et al.,* 2013), *Chrysichythys nigrodigitatus* and *Schilbe mystus* (Kareem *et al.*, 2015) and in *Osteogeneiosus militaris* (Parida *et al.*, 2015). Le Cren (1951) suggested that 'Kn' values >1 indicate good general condition of the fish and <1 denotes the opposite condition. The 'Kn' values were also found to be high in smaller size fishes which are in agreement with the earlier workers like Das (2004), Hossen *et al.* (2017) and Pramanick *et al.* (2017). Bhattacharya and Banik (2012) mentioned a high condition factor (1.66) in smaller size groups (70-80 mm) compare to a low value (0.42) in higher size groups (201-210 mm) of *Ompok pabo* from Tripura, India. In the present study for *P. paradiseus* 'Kn' values exhibiting around unity indicates the very excellent condition of fish in the selected Hooghly-Matlah estuarine waters.

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References

Alam, A., Jha, D. N., Verma, S. K., Verma, H. O., Mishra, S. K., Das, S. C. S., Kumar, J., Thakur, V. R., Gupta, M. and Das, B. K. 2020. Length–weight relationships of four small indigenous freshwater fishes from the subtropical Ganga River, India. *Lakes & Reservoirs: Research & Management*, DOI: 10.1111/lre.12337.

Ambily, V. and Nandan, S. B. 2010. Length-weight relationship, relative condition factor (Kn) and morphometry of *Arius subrostratus* (Valenciennes, 1840) from a coastal wetland in Kerala. *Indian Journal of Fisheries,* **57** (4): 39-44.

Araneda, M., Perez, P. E. and Gasca-Leyva, E. 2008. White shrimp *Penaeus vannamei* culture in freshwater at three densities: condition state based on length and weight. *Aquaculture*, 283: 13-18.

Bagenal, T. B. and Tesch, F. W. 1978. Age and growth. In: Bagenal, T.B. (Ed.), *Methods for the assessment of fish production in freshwaters*. Oxford, Blackwell Scientific Publication, pp.101-136.

Bhakta, D., Das, S. K., Das, B. K., Nagesh, T. S., Behera, S. and Das, S. C. S. 2019a. Length-weight relationship and condition factor of *Otolithoides pama* (Hamilton, 1822) from Hooghly-Matlah estuarine system of West Bengal, India. *Indian Journal of Fisheries*, 66(4), 51-59.

Bhakta, D., Meetei, W. A., Vaishak, G., Kamble, S. P, Solanki, J. K. and Das, S. K. 2019b. Season-wise length-weight relationship and relative condition factor of *Tenualosa ilisha* (Hamilton, 1822) at Narmada estuary, Gujarat, India. *Indian Journal of Geo Marine Sciences*, 48(05): 635-638.

Bhattacharya, P. and Banik, S. 2012. Length-weight relationship and condition factor of *Ompok pabo* (Hamilton, 1822) from Tripura, India. *Indian Journal of Fisheries,* 59(4): 141-146.

Borah, N., Das, S. K. and Bhakta, D. 2020. Temporal changes in feeding and bio-indices of *Polynemus paradiseus* Linnaeus, 1758 occurring in Hooghly-Matlah estuary, West Bengal. *Indian Journal of Geo Marine Sciences*, **49**(01): 118-123.

Chaki, N., Joadder, M. A. R. and Fahad, M. Y. H. 2013. Lengths, length-length relationships and condition factor of Indian catfish *Gagata cenia* (Hamilton, 1822) in the Padma River, Bangladesh. *Journal of Fisheries*, **1**(1): DOI: dx.doi.org/10.17017/jfish.v1i1.2013.6.

Chaklader, M. R., Siddik, M. A. B. and Nahar, A. 2015. Taxonomic diversity of Paradise threadfin *Polynemus paradiseus* (Linnaeus, 1758) inhabiting southern coastal rivers in Bangladesh. *Sains Malaysiana*, 44 (9): 1241-1248.

Chaklader, M. R., Siddik, M. A. B., Nahar, A., Hanif, M. A., Alam, M. J. and Mahmud, S. 2016. Morphometric parameters and allometric growth in Paradise threadfin *Polynemus paradiseus* (Linnaeus, 1758) from a coastal river of Bangladesh. *Journal of Aquaculture Research Development*, 7: 417. doi:10.4172/2155-9546.1000417.

Chakraborty, R., Das, S. K. and Bhakta, D. 2017. Length-weight relationship, relative condition factor and food and feeding habits of *Channa striata* from wetlands of Nadia district, West Bengal. *Journal of the Inland Fisheries Society of India*, 49(2): 22-26.

Chakraborty, R., Das, S. K. and Bhakta, D. 2018. Length-weight relation, relative condition and GSI of *Channa punctata* (Bloch, 1793) in wetlands of Nadia district, West Bengal. *Journal of Aquaculture in Tropics,* 33(1-2): 11-18.

Das, N. G., Majumder, A. A. and Sarwar, S. M. M. 1997. Length-weight relationship and condition factor of catfish *Arius tenuispinis* Day, 1877. *Indian Journal of Fisheries*, 44 (1): 81-85.

Das, S. C. S., Khan, A., Alam, A., Dubey, V. K and Joshi. K. D. 2020. Piscine diversity, community structure and distributional patterns of the west Ramganag river: a mid Himalayan tributary of river Ganga. *Indian Journal of Animal Sciences*, 90(1): 109–115.

Das, S. C. S., Pathak, R. K., Khan, A. and Joshi, K. D. 2016. Assessment of fecundity and gonado-somatic index of pond reared *Cirrhinus mrigala* (Ham. 1822). *Journal of the Inland Fisheries Society of India,* 48(1): 32-36.

Das, S. K. 2004. Biology of length weight and condition in a brackish water fish *Liza tade* (Forskal). *Indian Journal of Environment and Ecoplanning*, 8(1): 209-211.

Dey, A., Das, S. K. and Bhakta, D. 2016. A comparative study on biological parameters of juvenile and adults of *Anabas testudineus* (Bloch, 1792) in wetlands of selected districts of West Bengal. *Indian Journal of Veterinary and Animal Sciences Research*, 45(5): 793-798.

Froese, R. and Pauly, D. (Eds) 2017: FishBase 2017: World Wide Web electronic publication. Available at: http://www.fishbase.org (accessed on 22 August 2017).

Froese, R., Tsikliras, A. C. and Stergiou, K. I. 2011: Editorial note on weight-length relations of fishes. *Acta Ichthyologica et Piscatoria*, 41: 261–263.

Hida, T. S. 1967. The distribution and biology of polynemids caught by bottom trawling in Indian Seas by the R/V 'Anton Brunn', 1963. M*arine Biological Association of India,* 9(2): 281-299.

Hile, R. 1936. Age and growth of *Sisco Leucichthys artedi* (Lesueur) in the lake of three Northern Highlands, Wisconsin. *Bulletin of the Bureau of Fisheries,* 48: 209 – 317.

Hossain, M. Y., Ahmed, Z. F., Leunda, P. M., Jasmine, S., Oscoz, J., Miranda, R. and Ohtomi, J. 2006. Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, south-western Bangladesh. *Journal of Applied Ichthyology*, 22: 304-307.

Hossain, M. Y., Rahman, M. M., Fulanda, B., Jewel, M. A. S., Ahamed, F. and Ohtomi, J. 2012. Length-weight and length-length relationships of five threatened fishes from the Jamuna (Brahmaputra River distributary) River, northern Bangladesh. *Journal of Applied Ichthyology*, 28: 275-277.

Hossain, M. Y., Rahman, M. M., Jewel, M. A. S., Hossain, M. A., Ahamed, F., Tumpa, A. S., Abdallah, E. M. and Ohtomi, J. 2013. Life-history traits of the critically endangered catfish *Eutropiichthys vacha* (Hamilton, 1822) in the Jamuna (Brahmaputra River distributary) River, northern Bangladesh. *Sains Malaysiana*, 42: 265–277.

Hossain, M. Y., Sayed, S. R. M., Rahman, M. M., Ali, M. M., Hossen, M. A., Elgorban, A. M., Ahmed, Z. F. and Ohtomi J. 2015. Length-weight relationships of nine fish species from the Tetulia River, southern Bangladesh. *Journal of Applied Ichthyology*, 31: 967-969.

Hossen, M. A., Hossain, M. Y., Ali, M. M., Pramanick, M. N. U., Nawer, F., Islam, M. A., Hossain, M. A., Bahkali, A. H. and Elgorban, A. M. 2017. Seasonal variations of growth pattern and condition of Paradise threadfin *Polynemus paradiseus* (Polynemidae) from Tetulia river in southern Bangladesh. *Indian Journal of Geo Marine Sciences*, 46(3): 582-590.

Kagwade, P. V. 1969. Food and feeding habits of *Polynemus heptadactylus* Cuv. and Val. *Indian Journal of Fisheries*, 16(1&2): 188-197.

Kareem, O. K., Olanrewaju, A. N. and Orisasona, O. 2015. Length-weight relationship and condition factor of *Chrysichythys nigrodigitatus* and *Schilbe mystus* in Erelu Lake, Oyo State, Nigeria. *Journal of Fisheries Livestock Production*, 3:150. doi:10.4172/2332-2608.1000150.

Karekar, P. S. and Bal, D. V. 1958. The food and feeding habits *of Polynemus indicus* (Shaw). *Indian Journal of Fisheries,* 5: 77-94.

Khongngain, O., Das, S. K. and Bhakta, D. 2017. Study on Food and feeding biology of *Trichogaster fasciata* Bloch and Schneider, 1801 from a wetland of Nadia district of West Bengal. *Journal of the Inland Fisheries Society of India*, 49(2): 03-09.

Le Cren, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology*, 20: 2-19.

Mandal, S. K., Mitra, P. M. and Gupta, R. A. 1998. Population dynamics and stock assessment of *Polynemus paradiseus* of the Hooghly-Matlah estuarine system. *Journal of the Inland Fisheries Society of India*, **30**(2): 19-23.

Mohamed, K. H. 1955. Preliminary observations on the biology and fisheries of the thread-fin, *Polydactylus indicus* Shaw in the Bombay and Saurashtra waters. *Journal of Fisheries*, 2(1): 164-179.

Nabi, M. R., Hoque, M. A., Rahman, R. A., Mustafa, S. and Kader, M. A. 2007. Population dynamics of *Polynemus paradiseus* from estuarine wet bag net fishery of Bangladesh. *Chiang Mai Journal of Science*, 34(3): 355-365.

Nabi, M. R., Kader, M. A. and Hakim, M. A. 1999. Length-weight relationship and condition factor in the fish *Polynemus paradiseus* from the Bay of Bengal. *The Chittagong University Journal of Sciences*, 23: 87-91.

Nath, D., Misra, R. N. and Karmakar, H. C. 2004. The Hooghly estuarine system: Ecological flux, fishery resources and production potential. ICAR-Central Inland Fisheries Research Institute Bull. No. 130, 79p.

Parida, P. K., Khuntia, B. K., Pati, B. K. and Sahu, B. 2015. Morphometry, length-weight relationship and relative condition factor of marine catfish, *Osteogeneiosus militaris* (Linn., 1758) of Mumbai waters. *The Asian Journal of Animal Science*, 10(2): 198-2005.

Pramanick, S., Das, S. K., Bhakta, D. and Johnson, C. 2017. Length-weight relationship and condition factor of Tade gray mullet, *Chelon planiceps* (Valenciennes, 1836) from Hooghly-Matlah Estuary, West Bengal, India. *Journal of Fisheries*, 5(1): 469–472.

Qasim, S. Z. 1972. The dyanamics of food and feeding habits of some marine fishes. *Indian Journal of Fisheries,* 19(1&2): 11-28.

Sarkar, M., Das, S. K., Mondal, A. and Bhakta, D. 2017a. Length-weight relationship and relative condition factor of carps *Labeo bata* and *Labeo rohita* from Kulia beel (wetland) of Nadia district of West Bengal. *Journal of Entomology and Zoology Studies*, 5(5): 1033-1036.

Sarkar, S., Das, S. K. and Bhakta, D. 2017b. Length weight relationship and relative condition factor of Indian shad, *Tenualosa ilisha* from Hooghly estuary system, West Bengal. *Journal of Inland Fisheries Society of India*, 49(1): 22-26

Talwar, P. K. and Jhingran, A. G. 1991. Inland fishes of India and adjacent countries. Vol. 2, CRC Press, New York, USA, 1158 p.

Vahneichong, E., Das, S. K., Mondal, A. and Bhakta, D. 2018. Length-weight relationship, condition factor and gonado-somatic index of *Labeo calbasu* (Hamilton, 1822). *Journal of Fisheries*, 6(3): 645-649.