LENGTH-WEIGHT RELATIONSHIPS AND CONDITION FACTORS OF BOMBAY DUCK, *HARPODON NEHEREUS* FROM ESTUARINE REGION OF KAKDWIP, WEST BENGAL

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ABSTRACT

This study describes the length-weight relationships and condition factors of Bombay duck, *Harpodonnehereus*from estuarine region of Kakdwip, West Bengal. A total of 550 specimens were caught by using various mesh size of gill nets from January 2011 to August 2011. The exponent 'b' values for both the forms were significantly different from 3 (P > 0.05; t = 10.6363 for Total Length and t = 8.1007 for Standard Length) indicating the allometric growth i.e., deviation from the hypothetical cube law. The monthly mean relative condition factor (Kn) was maximum in the month of February (Kn = 1.5537) and minimum in the month of April (Kn = 1.2202). The Kn values also express healthy condition showing good compatibility with the nature or environment.

Keywords: *Harpodonnehereus, length-weight relationship, Condition factor, allometric growth*

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INTRODUCTION

India as the second largest aquaculture producer in the world has the major contribution from freshwater aquaculture whose share in inland fisheries has gone up from 46% in the 1980s to over 85% in 2009-10. The existence of varied topography and different agro-climatic conditions in the state of West Bengal has bestowed upon a productive fishery resources. The state is endowed with rich diversity of water resources such as hill streams, reservoirs, irrigation canals, ponds, lakes, beels, bheries and other water bodies. In addition to it 158 km coastal line is available in West Bengal. It is a unique state being gifted with diverse which have diversified aquatic resources viz. freshwater, coldwater, brackish water and marine water.West Bengal has been able to secure the leading position in fish production for seven successive years and have been rewarded accordingly by Central Government as best productivity aware. West Bengal occupies first position in the field of inland fish and fish seed production. The total fish production of the state in 2010-11 was 16.15 lakh tons (Annual Report, DAHD, 2011-12). Starting from 2001 till 2006, every year the production of inland fishes had been increased. In 2001-2002 the total inland production was 9.153 lakh tones and in 2005-2006 the production was increased upto 10.90 lakh tones. Despite the production from marine sector were reduced to some extent during this period, the total production including inland and marine became 14.71 lakh tones during 2007-2008. Along with the fish, the productions of fish seeds were also increased during 2001-2010. When the production of seed in 2001-2002 was 9000 million units, this was increased to 34,993 million units during 2010-2011. Though the fish production is increasing steadily, there remains an annual deficit of 6-7% in this state. Since more than 90% of the population in West Bengal consumes fishes, the difference between the demand and supply always remains persistent. Fish biodiversity of India is vast and varied. Bombay duck inhibit 50-70 meters isobaths. It is a single species with a contribution of 5% of total landing and of 105087 tones by traditional and mechanized trawlers. North West contribution is 88% and North East is only 12% at of total annual production of 0.116 million tones. West Bengal shares it's of 27936tonnes annually (Ayyappan, 2011)

The fishery of Bombay duck is of considerable importance in the maritime state of Gujarat and Maharashtra, which together contributed nearly 88% of the total landing of this species in India. Hence the success of this fishery determines to large extent for the wellbeing of the fishery community in the Maharashtra and Gujarat state. The annual landing of Bombay duck does not show large fluctuation, especially after 1960. Bombay duck is one of the commercially important food fishes in the Hooghly estuarine system and ranks first in abundance in the commercial catches. Due to advent of mechanization of fishing crafts, the fishing activity off the West Bengal coast has considerably increased in recent years. Consequently the area of exploitation of fishery has increased and presently Bombay duck fishery is considered as a major fishery of West Bengal. The abundance of Bombay duck along the coast is gradually increasing. Bombay duck fishery is under constant pressure due to various stresses like habitat destruction due to pollution, over-exploitation, indiscriminate killing of juveniles etc, which in turn helps for the shrinkage of this fish population. Hence, there is a great need to manage the fisheries more carefully to ensure sustainable fish production in the future. In this regard fish stock assessment plays an important role in the rational management and conservation of this fishery resource. The population Dynamics and stock assessment both help to know, how the fish grow, their mortality rate, spawning time, where they go at spawning time, how much fishermen catch the fish, how much money maker of the fish, where maximum fishing is occurred, how fast the fish is grown etc. Ultimately main objective of stock assessment is to maintain the maximum sustainable yield of the fishes (Larkin, 1977). The mesh size regulation, close netting at the breeding season and quota system are the results of the stock assessment of the fishes.

MATERIALS AND METHODS

Collection of data

The length frequency data of unsexes fresh samples of *Horpodonnehereus* were collected at regular intervals from Nagendra Bazar Fish Markets, Diamond Harbour, 24 Parganas, West Bengal, India from January 2011 to August 2011. These samples were collected from different commercial gill-netters (locally known as behundi) were pooled and subsequently grouped into classes of three (3) centimeters interval of total length for estimation of growth parameters. The total length (from the tip of the snout to the tip of the caudal fin) and standard length (from the tip of the snout to the mid-point of caudal peduncle) of 550 fish were measured using a meter scale (1±mm) and weighed to the nearest 'g' using a mono pan balance. Total and standard length varied in the size range of 7.3 cm to 32.1 cm and 6.0 cm to 26.9 cm, respectively, and the weight ranged from 2 g to 250 g.

Analysis of Data

Length-weight relationship: The length-weight relationship of *Horpodonnehereus* estimated using the formula $W= aL^b$ (Lecren, 1951) where, W= total weight (g) of the fish, L= total length (cm) or standard length (cm) of fish and 'a' and 'b' are the constants or this equation can be linearly represented as Log W = Log a + b Log L. The constants 'a' and 'b' in the above equation were estimated using the methods of least square. The non-linear and linear equations were fitted separately for total length (TL) and standard length (SL). The co-efficient of determination (R^2) and standard error of 'b' (S_b) were calculated following standard statistical procedures. Analysis of co-variance was employed to test whether the 'b' values of two equations significantly differed at 5 % level (Snedecor and Cochran, 1967). The't' test was used (by dividing the differences between 'b' and '3' by standard error of 'b' to the whether the regression co- efficient significantly deviated from the expected cubic value (Snedecor and Cochran, 1967).

Relative condition factor (Kn): The relative condition factor (Kn) of *Harpodonnehereus* was calculated using the formula Kn= W/ Ŵ (Lecren, 1951) based on total- weight relationship, where Kn= relative condition factor; W= observed body weight; Ŵ= calculated body weight. W= relative condition factor amongst length groups were also calculated condition factor; the monthly fluctuations of mean relative condition factor and variations of mean relative condition factor amongst length group were also calculated.

RESULT AND DISCUSSION

Length weight relationship of *Harpodonnehereus*: The summary of total length-weight and the standard length-weight relationships of *Harpodonnehereus* based on 550 individuals ranging from the total length of 7.3 cm to 32.1 cm, standard length of 6.0 cm to 26.9 cm and weighing from 2 g to 250 g were given in the Table 1. The log transformation of linear regression of total length-weight relationship of *Harpodonnehereus* and its corresponding exponential form are represented in table1. The log transformation of linear regression and its corresponding exponential form of standard length-weight relationship of *Harpodo-nnehereus* are depicted in table 2. The total length - weight relationship of non-linear and linear forms were W=0.0000004 TL3.4262 and ln W= - 14.636 + 3.4262 ln TL, respectively with the correlation co-efficient (R2) of 0.9301. The standard length weight relationship of non-linear and linear forms were found to be W=0.000001 SL3.3408 (R2=0.9204) and ln W = - 13.529 + 3.3408 ln SL, respectively. The analysis of co-variance between the 'b' values estimated for total length-weight and standard length-weight were in significant (Table 2). It was also revealed from the't' test that the exponent 'b' values for both the forms were significantly different from hypothetical cube value 3 (Table 2) (P > 0.05; t=10.6363 for TL and t= 8.1007 for SL). The present findings are in accordance with the earlier reports of Krishnayya (1968) Bapat (1970) and Kurian (1992) who have also reported allometric growth pattern in *Harpodonnehereus* from the Bay of Bengal (b=3.2657) water, Arabian Sea (3.4444 in female and 3.7169 in males) and north west coast (2.0279) respectively. Contrary to the above results Nurul Amin (2001) and bapat et al. (1951) have recorded the isometric growth pattrn of *Harpodonnehereus* with 'b' values 3.051 and 2.889, respectively from Bay of Bengal and Arabian Sea. According to Le Cren (1951) the equation $W=a*L^b$ is a better fit to express the relation between length and weight than the hypothetical cube law $W=a*L^3$. Hence, the former equation was applied for the present study. The 'b' values are known to range between 2.5 to 4 in fishes (Hile, 1936 and Martin, 1949) and in majority of cases the value deviated from 3. According to Mitra (2001) the 'b' values indifferent species of Hooghly estuary ranged from 2.9615 to 2.3686. In general, adult fishes follow as isometric growth (Beverton and Holt, 1957). The variation in 'b' values could be attributed to environmental factors, food availability and physiological factors including sex and life stage (LeCren, 1951; Ricker, 1975).

Relative condition factor (Kn) of *Harpodonnehereus:* The mean relative condition factor (Kn) of *Harpodonnehere-us*during different month is represented in Table 3 and 4. The mean Kn value of *Harpod-onnehereus* calculated during January to August months was found to be 1.1196. The monthly fluctuation of the relative condition factor (Kn) showed the lowest condition (1.2202) in the month of April and the highest of condition (1.5537) in the month of February. The Ponderal Index or condition factor (K) and the relative condition factor (Kn) are the measures to study the condition of fish during different stages of growth and different seasons. They indicate the physiological state and general well-being of fish (Brown, 1957). The monthly fluctuations of the mean relative condition factor (Kn) of *Harpodonnehereus* showed the lowest condition (1.2202) in the month of April and the highest condition (1.5537) in the month of February (Table; 4).The Kn mean values exhibited an increased trend from April to July with a slight fall in August and reached the maximum in the month of February. Krishnayya (1968) recorded the lowest condition (1.7392 to 1.849) of *Harpodonnehereus* in the period between April to June. Further, he also noticed the Kn values of more than 2 from the month of October through march. However, Bapat (1970) an increased condition factor value of *Harpodonnehereus*in the month of April and low condition factor values during December to March. Nurul Amin (2001) observed the Kn values of *Harpodonnehereus* in the range of 0.908 to 1.22. The lowest mean Kn value in the month of April as noticed in present study, might be due to the metabolic strain of spawning of the species as the main spawning season of the species reported to be is during December to march (Bapat, 1970). The highest mean Kn value observed in the month of February might be due to the fact the fishes were in the peak spawning period and the gonads were fully fecund. The increased Kn value after May could also attributed to be the peak feeding period for the species, as observed by Bapat (1951). Such relations of high Kn values during peak spawning periods and low Kn values after spawning periods has also been reported in other fishes like *Tenualosailisha* (Khan *et al.*, 2001), *Osteobramabelangiri* (Singh, 2003) and *Punctiussophore* (Mitra*et al.,* 2005).Amongst the individuals of different length groups of *Harpodonnehereus*the mean Kn value was lowest in the length group of 15-18 cm. The mean Kn value decreased gradually up to 15-18 cm and showed an increased trend from 24.0 to 27.0 cm onwards. Bapat (1970) recorded a consistent increment in the condition factor (K) value from 27 cm onwards. He also noticed downwards trend for females and upward trend in the males often 21.0 cm. Krishnayya (1968) observed a gradual increase in the Kn values after the fish reaches 19.5 cm. The highest Kn value of *Harpodonnehereus* was recorded for the length of 28.5 cm by him, which he attributed to the peak spawning size. Generally the low Kn values of *Harpodonnehereus* were observed in the length group of 9-15 cm (Krishnayya, 1968). Fluctuations in the Kn values are common in fishes due to differential feeding intensity, size of the fish and most importantly the textual cycle (Lecren, 1951; Thakur, 1975).

Table 1: *Length weight relationship of Harpodonnehereus*

Length type	No. of individuals studied	Range of Length (cm)	Range of Weight (g)	Sex	Regression coefficient (b)	Exponential / non-linear form of equation	Linear / logarithmic equation	Correlation determination co-efficient (R^2)
Total length	550	7.3 - 32.1	2– 250	Unsexed	3.4262	$W=0.0000004\ T.L^{3.4262}$	ln W= -14.636+3.4262 ln TL	0.9301
Standard Length	550	6.0 – 26.9	2 -250	Unsexed	3.3408	$W=0.000001S.L^{3.3408}$	ln W= -13.529+3.3408 ln SL	0.9204

Table 2: *Statistical analysis to test deviation from cube law*

Length type	Degrees of Freedom (n-2)	Regression coefficient (b)	Deviation from regression (S^2)	Standard deviation (S_b^2)	Standard error (S_b)	t	Probability at 5% level of significance
Total length	550	3.4262	0.035	0.001606	0.04007	10.6363	Significant
Standard length	550	3.3408	0.04016	0.00176	0.04207	8.1007	Significant

Table3: *The mean relative Condition factor (Kn) of Harpodonnehereus during different months*

Sample month	Mean relative condition factor (Kn)
January	1.3688
February	1.5537
March	1.4483
April	1.2202
May	1.2751
June	1.4409
July	1.4224
August	1.3439

Table 4: *Length group wise mean relative condition factor (Kn) of Harpodonnehereus*

Length group (cm)	Mean relative condition factor (Kn)
6.0- 9.0	1.8299
9.0-12.0	1.4616
12.0-15.0	1.1788
15.0-18.0	1.0022
18.0-21.0	1.1003
21.0-24.0	1.0643
24.0-27.0	1.1655
27.0-30.0	1.2527
30.0-33.0	1.5644

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