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Studies on length-weight relationship and condition factor of *Hilsa ilisha* from Chilika Lake, Odisha

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Abstract

The present study describes the length-weight relationship and relative condition factor of *Hilsa ilisha* based on the length and weight data collected from Chilika Lake during January, 2014 to December, 2014. The specimens were collected using the gill net from the Chilika Lake. The work was carried out on 497 fishes ranging from 17.5 to 50.2 cm in length and weight of fishes ranging from 120 to 1370gm. The value of correlation coefficient was calculated to be 0.9684 indicating a high degree of correlation between the length and the weight. The parabolic and regression equations were found to be $W = 0.0174L^{2.99}$ and $\log W = -1.75945 + 2.99 \log L$, respectively. The exponent value 2.99 nearly confirms to the cube law, and the condition factor showed continuous decrease with increase in length indicating a physiological response of the fishes to different environmental conditions of the Lake waters.

Keywords: *Hilsa ilisha*, length, weight, condition factor, Chilika Lake

Introduction

Tenualoasa ilisha popularly known as hilsa, the Indian shad, is one of the most commercially important fish of Chilika Lake. Hilsa belongs to the sub family alosinae of family clupeidae. It is the tropical shad lives in the coastal waters, estuaries and rivers of Indo-Pacific region, which is mostly found from north Sumatra of Indonesia in the east to Kuwait in the west and important fisheries in Bangladesh, India, Myanmar, Pakistan and Kuwait [1]. It is basically a migratory fish shows anadromy in migration, which lives in coastal water of sea but migrates to river for breeding. The fish is a permanent inhabitant of the Lake, but moves to the lower reaches of Daya river for breeding [2].

Chilika Lake is the largest brackish water Lake of Asia. It is divided into four sectors depending on its water quality, distribution of biotic components and fishery yield, such as Northern Sector, Central Sector, Southern Sector and Outer Channel. Northern Sector receives most of the branches of Mahanadi out of which Daya river is the most important one. Fisheries constitute the most important economic activity of the Chilika Lake, which supports livelihood of 0.2 million local fisher folk [3]. There are about 268 species of fishes, 28 species of prawns and 34 species of crabs have been identified as inhabitants of Lake after post-hydrological intervention [3]. Before hydrological intervention, the average productivity of Chilika Lake was 11.3 t km^{-2} and Catch Per Unit Effort (CPUE) was 6.2 kg boat per day during post-intervention year [4]. Analysis of commercial catches showed that the migratory species contributed to the bulk of catches that is 75% by species and 68% by catch weight [4]. Presently, hilsa catch has drastically deteriorated in almost all river system of India. In 2010-11, the Hilsa catch from Chilika Lake was 68.65 MT which has drastically reduced to 7.79 MT in 2013-14 [5].

Length-Weight relationships in fish provides important tools in aquaculture management by helping in estimation of biomass from length frequency distribution, estimation of fish condition and assessment of morphological character of fish population and maturity of individuals. Length-Weight data are used in fish programmes to estimate growth rate [6]. Length-Weight relationship is very useful in fisheries to estimate the weight of individual fish [7]. It provides a mathematical means of determining the weight from known length and vice-versa. The knowledge helps to determine the growth pattern of the particular species, whether it is isometric (growth with unchanged body proportions and specific gravity) or allometric. Earlier studies on biology of *Hilsa ilisha* has been carried out by Ramakrishnaiah in 1972 [8], when there was no free flow of water between the Chilika Lake and the Bay of Bengal due to

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siltation of Magarmukha near Arakhakuda. The Chilika Development Authority (CDA) cut open a new mouth near Sipakuda during September 2000 for the free flow of the water between Chilika Lake and the sea. Meanwhile a great change has occurred in Lakes ecological characteristic, biological diversity and productivity. About 77 new species like *Tenualosa toli*, *Sardinella fimbriata*, *Sardinella longiceps* are appear in the Chilika Lake [9]. The annual fish landing of the Lake during 1995-96 was 1274 MT which has increased to 11,989 MT during 2001-02 and 12,466 MT during 2012-13[10]. It showed a steady increase in fish, prawn and crab landing due to improvement in overall ecology of the Lake ecosystem. Despite the fish harvest from the Lake has increased after hydrological intervention the landing of *Hilsa ilisha* has decreased. Annual landing of *Hilsa* during 2002 to 2013 fluctuated between 185.47 MT (2002-03) and 170.75 MT (2007-08) with an exhibiting declining trend from 2009 onwards having 4.13 MT during 2012-13 [5]. The present study aimed to analyze length weight relationship and condition factor of *Hilsa ilisha* from Chilika Lake which is a highly priced enigmatic fish and its catches drastically deceased after post hydrological intervention. These data helps in to understand the population characteristic and sustainable conservation of *Hilsa ilisha* in the Chilika Lake.

2. Materials and Methods

In this study, 497 individuals of *Hilsa* were caught from Chilika Lake using gill net during the period from January 2014 to December 2014 used for length-weight analysis and determination of condition factor. Chilika Lake is an important coastal wetland ecosystem in Indian subcontinent present in the state of Odisha, which is also one of the biological diversity hotspots of the country situated between latitudes 19°28' & 19°54' N and longitudes 85°05' & 85°38' E (figure 1). The total length of fish (i.e., from snout to end of the caudal fin) to the nearest mm with a ruler and wet weight was determined to the nearest gm using an electronic balance. The length-weight relationship was estimated by using the formula, $W=aL^b$ developed by Le Crean [11], Where L is the total length (cm), W is the body wet weight (gm), a is the intercept of the regression and b is the regression coefficient. The equation $W=aL^b$ can be linearly represented as $\log W = \log a + b \log L$. The values of 'b' and 'Log a' in the equation are estimated using least square regression method. The relative condition factor (K_n) is the ratio between observed weight (W_o) and calculated weight (W_c) i.e., W_o/W_c was estimated as formulated by Le-Cren [11].

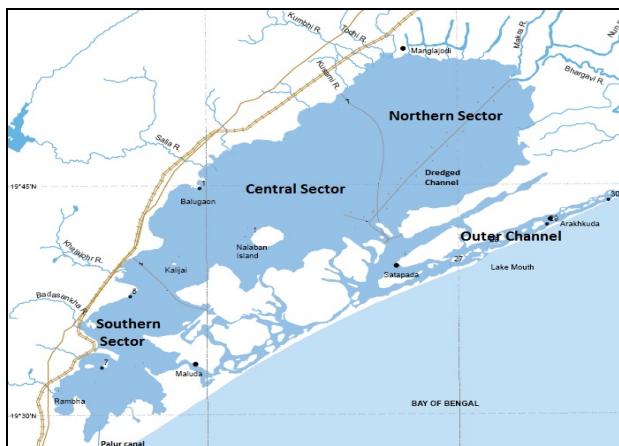


Fig. 1: Map of Chilika Lake showing four sectors of fish landing

3. Results

3.1 Length-Weight relationships

The most widely used equation for study of length-weight relationship of fish is $W=aL^b$. The length ranging from 17.5 cm to 50.2 cm and weight ranging from 120gm to 1370gm were taken into account during the study period. The length-weight relationship curve of *Hilsa ilisha* in Chilika Lake is shown in figure 2. The equation for the length-weight relationship of *Hilsa ilisha* was worked out and expressed as: The exponential form of equation obtained for length-weight relationship was

$$W = 0.0174L^{2.99}$$

The logarithmic form of length-weight relationship of *H. ilisha* was

$$\log W = -1.75945 + 2.99 \log L$$

The value of co-efficient of correlation (r) estimated for the species was 0.968401($P<0.01$) which indicate that the relationship between length and weight of the fish is significant. The exponential value 2.99 nearly confirms to the cube formula.

3.1.2 Condition factor 'Kn'

In the present study, the length wise relative condition factor of *Hilsa ilisha* (Fig.3) were estimated as 1.1717, 0.9183, 0.7828, 0.9112, 1.1619, 1.1460, 0.9097, 0.7484 and 0.6480 at the length group of 175 mm-215 mm, 215 mm-255 mm, 255 mm-295 mm, 295 mm-335 mm, 335 mm-375 mm, 375 mm-415 mm, 415 mm-455 mm, 455 mm-495 mm and 495 mm-535 mm respectively indicating fluctuation of condition factor within the size group, which implies the physiological change of the fish in different environmental regimes of the Lake water.

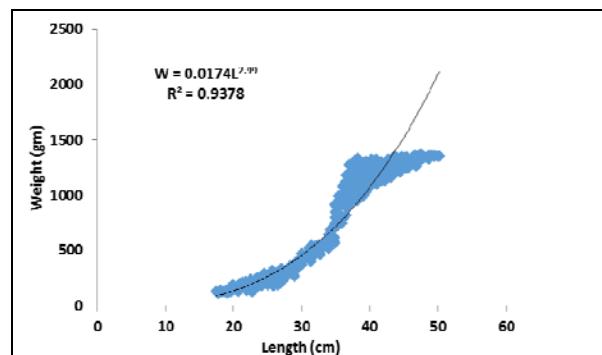


Fig. 2: Length-Weight relationship of *Hilsa ilisha* collected from Chilika Lake during January, 2014 to December, 2014

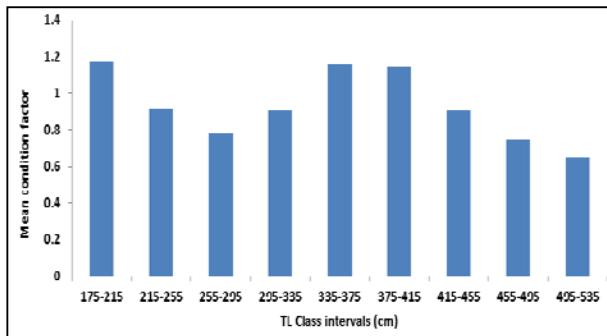


Fig 3: Relative condition factor (K_n) of *Hilsa ilisha* collected from Chilika Lake during January, 2014 to December, 2014

4. Discussion

Length-Weight relationship provides the information about estimation of fishery yield and general well being of the fishes [12]. Generally the weight increases as the cube of length called cube law [13]. This law is not strictly followed because the fish of same species normally do not retain the specific gravity of their tissue system throughout their life span [14]. For this reason, the relationship may depart from cube law depending on sex, season, feeding intensity and state of maturity. Martin [15] opined that b value lies between 2.5 to 4.0. The exponent value b provides information on fish growth, when $b = 3$ length-weight relationship is isometric, when b is other than 3 i.e., $b < 3$ fish shows negative allometric growth (fish become less rotund as length increases), whereas when $b > 3$ fish shows positive allometric growth (fish become more rotund as length increases). In the present study b value of *Hilsa ilisha* was 2.99 which is close to 3 shows isometric growth. Ramakrishnaiah [8] has studied on the same species had a length range 125 mm to 509 mm and b value 3.125 concluded nearly conforms to the cube formula indicating isometric growth, coincides the finding of the present study.

Condition factor of a fish reflects the information and variation in the physiological state of the fish in relation to its welfare and indicate the sustainability of the fish to the environment [16]. It is an indicator of general physiological conditions of fishes, such as, first maturity, spawning season, environmental conditions availability of food [13]. In the present study the Kn value is higher in lower length groups of fishes due to high feeding intensity. Gradually it decreases as fishes are going to attain the maturity stage. Parida *et al* [17] have concluded that the lowest Kn values during the more developed gonadal stages might mean resources transfer to the gonads during reproductive period. So, the observed peaks and values in the relative condition factor for length range of 175mm to 502mm might be associated with cyclic physiological processes by showing repeated development of gonads as well as increase in feeding intensity and shading of mature ova (spawning) respectively during life of the fish.

5. Conclusion and Recommendation

The present study provides the basic information about the length-weight relationship and condition factor of *Hilsa ilisha* from Chilika Lake. The length-Weight relationship indicated that the growth ratio of *H. ilisha* holds good. The growth of *Hilsa ilisha* in Chilika Lake obeyed the cube law and showed isometric growth. *Hilsa ilisha* is important from commercial point of view but the catches are decreasing in the last few years. In such situation, the conservation and fishery management became the need of the hour. Therefore, Government of India as well as the state Government should take necessary measures for enhancement of the *Hilsa ilisha* production in the country in general and Chilika Lake in particular. Use of fishing gears possessing mesh size of 80-85 mm or even less exploit undersized Hilsa of less than 500 g in proximity from Chilika Lake denies the fish to breed. Therefore Odisha Government should develop conservation strategy to stabilize the declining population of Hilsa by strictly banning this fishing during their breeding season.

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