

Season-wise length-weight relationship and relative condition factor of *Tenualosa ilisha* (Hamilton, 1822) at Narmada estuary, Gujarat, India

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Length-weight relationship and relative condition factor of *T. ilisha* was conducted for one year (2014-15) at Narmada estuary, Gujarat, India. Fish samples were collected from Bharuch, Bhadbhut, Mehgam and Ambetha landing sites covering 72 km of estuarine stretch. Two distinct fishing seasons were observed at Narmada estuary, viz., June-October and January-March, though the bulk of the harvest comes from monsoon season. A total of 312 fish samples were collected, 270 during monsoon and 42 during the winter season. The mean length and weight were recorded 35.37 ± 11.36 cm and 625.83 ± 39.81 g during monsoon and 36.84 ± 3.82 cm and 537.44 ± 17.45 g during the winter season. The 'b' value was found to be 3.07 and 2.76 and relative condition factor was 1.02 and 1.01 during monsoon and winter seasons, respectively.

[Keywords: Length-weight relationship; relative condition factor; *Tenualosa ilisha*; Narmada estuary]

Introduction

The Indian shad *Tenualosa ilisha* (Hamilton, 1822) commonly known as 'Palva' belongs to the sub-family Alosinae of family Clupeidae, an anadromous species. Study of length-weight relationship generally used for the conversion of growth-in-length equations to growth-in-weight equations for use in stock assessment models to estimate the stock assessment biomass from a limited sample size as indicators of fish condition (Dubey¹). Length-weight relationship is an important tool in fish biology, physiology, ecology, fisheries assessment and fish conservation. In the present study, length-weight relationships and

ilisha from estuarine regions (Khan³, Bhaumik⁴ and Flura⁵), but no work has been reported from Narmada estuary, Gujarat, India. In this context, the present findings will be important to know the condition and status of the fishery in the Narmada estuarine region and accordingly suitable management plans may be worked out.

Materials and Methods

A total of 312 *T. ilisha* fish samples were collected month-wise from June 2014 to May 2015 from four landing sites under Narmada estuary, Gujarat, India. Fish samples were collected from Bharuch, Bhadbhut,

estuaries, Gujarat, India, which could be helpful for management of the fishery. Catches of hilsa from Narmada estuary were reported to be declining rapidly year after year, and declines have also been reported from other parts of the country. Declines of hilsa catch may be the result of over-fishing and industrial pollution (which causes large-scale mortality of fish eggs and larvae) and construction of dams (which impacts the species spawning migrations²). Several studies have been carried out in aspects of the length-weight relationship of *Tenualosa*

sites covering 72 km fish specimens were mainly caught by gill nets, bag nets and stake nets. Total length (TL) was taken from the tip of the snout to the extended tip of the caudal fin nearest 0.1 mm by a standard scale and weight to the nearest 0.01 g by digital weighing balance. Out of 312 specimens, 270 were collected during monsoon months and rest 42 during winter months. The mean length and weight was 35.37 ± 11.36 cm and 625.83 ± 39.81 g for monsoon season and 36.84 ± 3.82 cm and 537.44 ± 17.45 g for the winter season, respectively. The non-linear equation in the form of $W = aL^b$ (Le Cren⁶),

which explains the length and weight relationship of fishes, was followed in the present study. The significance of the exponent (b) was tested with fisher't' test. The relative condition factor is given by the formula, $Kn = W_0 / \hat{W}$, where W_0 is observed weight and \hat{W} is calculated weight.

Results and Discussion

Season-wise length-weight relationship and relative condition factor of 312 specimens of *T. ilisha* collected from Narmada estuary for one year are presented in Table 1. Statistical parameters like, sample size, length and weight of the specimen, maximum reported length⁷, regression parameters of a and b for length-weight relationship, correlation of determination (r^2) and relative condition factors are provided for better understanding. The minimum and maximum total length and weight were 6.5 cm (3.0 g) and 52.0 cm (1690 g) during monsoon season and 34.5 cm (31.0 g) and 45.5 cm (950 g) during the winter season, respectively. The 'b' value was recorded 3.07 during monsoon and 2.76 during winter season, which indicates that during monsoon growth was positive allometric ($b > 3$) and during the winter growth was negative allometric ($b < 3$). The coefficient of determination (r^2) value was recorded 0.99 during monsoon and 0.87 during winter months (Figure 1 & 2). The relative condition factors for both the seasons were found to be more than 1 (1.02 during monsoon and 1.01 during winter), which indicates that for both the seasons fish inhabits good conditions.

The length-weight relationship of *T. ilisha* at Narmada estuary was highly significant ($p < 0.01$) with r^2 values close to 1 for both the seasons. The 'b' value for both the seasons was close to 3 which indicated isometric growth of the fish. The value of exponent 'b' in equation $W = aL^b$ usually lies between 2.5 to 3.5⁸. The 'b' value recorded during the monsoon season in the present work shows almost similar trend with the other studies like Sujansingani⁹ found 'b' value of *Hilsa ilisha* in the tidal stretch of Hooghly as 3.04 to 3.13 in different seasons of the years 1949-

1952; Ramakrishnaiah¹⁰ reported 'b' value of 3.125 in combined sexes of Hilsa in Chilka Lake. Rahman¹¹ reported 'b' value was 3.18 for *Tenulosa ilisha* in Bangladesh. Dutta¹² found 'b' value of hilsa was 3.109 with r^2 value of 0.9898 from Northern Bay of Bengal in West Bengal. The 'b' values of 3.211, 3.229 and 3.161 for the juveniles, female and male of *Tenulosa ilisha* was recorded by Boblame¹³. Flura⁵ reported 'b' value as 3.04 from Meghna river, Bangladesh. Mohanty and Nayak¹⁴ reported isometric growth of *Hilsa ilisha* with 'b' value of 2.99 in the size group of 17.5 to 50.2 cm in length and 120 to 1370 gm in weight from Chilika Lake, Odisha. Sarker¹⁵ could found 'b' value of 3.0382 and 3.0239 of *Tenulosa ilisha* (Hamilton, 1822) for male and female respectively from Tentulia river of Bangladesh.

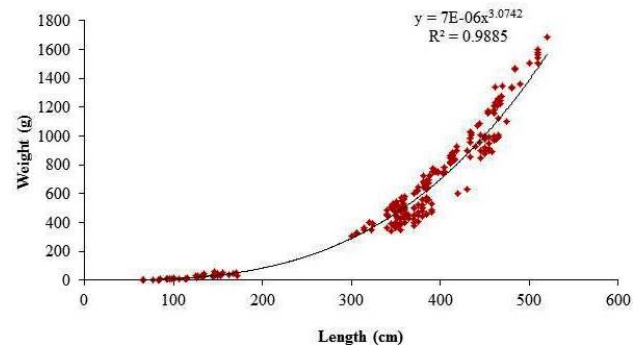


Fig. 1 — Length-weight relationship of *T. ilisha* during monsoon months

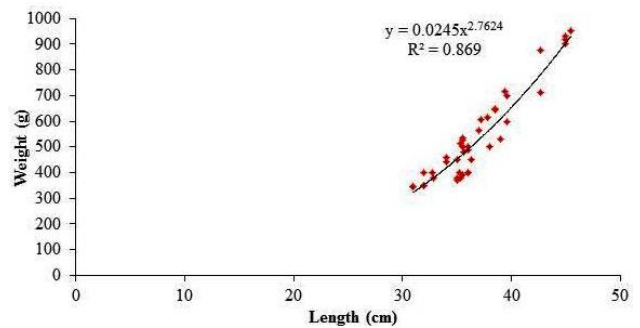


Fig. 2 — Length-weight relationship of *T. ilisha* during winter months

Table 1 — Descriptive statistics and length-weight distribution of *T. ilisha* in different seasons of Narmada estuary, Gujarat, India

Season	n	TL (cm)		BW (g)		Max.* (cm)	Regression parameters		95% CL of a	95% CL of b	r^2	Kn value
		Min	Max	Min	Max		a	b				
Monsoon	270	6.5	52.0	3.0	1690	60.0	0.0000006	3.07	0.0000005-0.0000008	3.03-3.11	0.99	1.02
Winter	42	34.5	45.5	31.0	950	60.0	0.024	2.76	0.0071-0.0844	2.42-3.11	0.93	1.01

n, sample size; TL, total length; BW, body weight; a, intercept; b, slope; CL, confidence limit; r, coefficient of determination; Min, minimum; Max, maximum.

*Maximum standard length recorded from FishBase (Froese and Pauly, 2017).

Rajyalakshmi¹⁶ found 'b' value as 3.26 in the length group of 370-587 mm and 2.81 in the length group of 60-189 mm of the river Godavari hilsa. The little low 'b' value recorded during winter in the present work is also supported by the works of Reuben¹⁷, Amin¹⁸ and Roomiani¹⁹. Reuben¹⁷ reported the isometric growth of hilsa with 'b' value as 2.805 in Northeast coast of India. Amin¹⁸ reported 'b' value of 2.878 for Hilsa from the coastal region of Chittagong and 'b' value in female and male Hilsa of Hooghly estuary was 2.8474 and 3.2278, respectively. Dar²⁰ reported 'b' values of *Ilisha melastoma* and *Tenualosa toil* as 2.62 and 2.82 respectively from Mumbai Coast, India. Roomiani¹⁹ reported 'b' value of 2.687 with isometric growth of Hilsa in coastal water of the north-west Persian Gulf.

A relatively higher relative condition factor was recorded during monsoon (1.02) as compared to winter (1.01) season. The value of K_n of more than 1 indicates good health and less than 1 indicate the poor condition of the fish⁶. Khan¹⁷ reported high relative condition factor (K_n) value during peak spawning period and feeding periods of *Tenualosa ilisha*. De and Datta²¹ reported the highest K_n value for the youngest size groups of *T. ilisha* at Hooghly estuarine system with the maximum value for female during the month of June and the lowest from September to October. Higher condition factor of *Hilsa ilisha* was reported in smaller size groups compared to larger size groups at Chilka lake¹⁰. Reuben¹⁷ found K_n value of Hilsa shad low during September and February and high in July and December. Dutta¹² observed condition factor of *T. ilisha* as 1.141 ± 0.004 of Northern Bay of Bengal, West Bengal, India.

Conclusion

The *Tenualosa ilisha* is found to be overfished from Narmada estuary. The use of small-size mesh nets, trawling and environment degradation are responsible for diminishing Hilsa. Knowing of stock assessment of certain species is a prerequisite for sustainable management of the fishery in a region. The data generated through the study of length-weight relationship and condition of hilsa from Narmada estuary will be useful to manage the fishery in the estuarine system.

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