International Journal of Fisheries and Aquatic Studies 2016; 4(1): 335-340

International Journal of Fisheries and Aquatic Studies

ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2016; 4(1): 335-340

www.fisheriesjournal.com
Received: 12-11-2015
Accepted: 15-12-2015

Debansu Sekhar Pramanik
Department of Zoology,
D.R. Nayapalli College,
Bhubaneswar-751012, Odisha.

Swati Sucharita Mohanty
Department of Bioscience and
Biotechnology, F.M. University,
Balasore.

Correspondence
Debansu Sekhar Pramanik
Sr.Lecturer, Department of
Zoology, D.R. Nayapalli College,
Bhubaneswar-751012, India.

Length-weight relationship and biology of some common edible fish species at Chandipur, Bay of Bengal, Odisha

Debansu Sekhar Pramanik, Swati Sucharita Mohanty

Abstract
Length-weight relationship (LWR), condition factor and biology of six edible fish species were estimated seasonally from July 2011 to March 2012 at Bay of Bengal, Chandipur-on-Sea. A total of 720 specimens were measured and gut contents were also identified during the study period. The result showed that ʽbʼ and r^2 values of LWR of *Hilsa ilisha, Johnius carutta, Liza parsia, Mugil cephalus, Polydactylus paradisus* and *Sillago sihama* as 0.115, 0.117, 0.09, 0.026, 0.228, 0.151, 0.106, 0.044, 0.263, 0.285, 0.069, 0.062 respectively and r = 0.97. The decreased K factor % was observed in monsoon only (2.68, 2.08, 1.32, 2.73, 1.49 and 1.48 respectively) indicating a strong association between length - weight and six specimen specified allometric growth pattern. Analysis of food items in different seasons showed that the diatoms were the major portion of food item in *Hilsa hilsa, Mugil cephalus and Sillago sihama.*

Keywords: Length-weight, condition factor, gastrosomatic index, hepatosomatic index, Bay of Bengal.

1. Introduction

Fishes have great significance in the life of mankind being an important natural source of protein and providing certain other useful products as well as economics sustenance to many nations. The gradual erosion of commercial stock due to over exploitation and alternation of the habitat is one reason why the science "Fish biology" came to existence [1]. It is well known fact that the knowledge on fish biology particularly on morphometry, length – weight relationship, condition factor, reproduction, food and feeding habits are of utmost importance for pisciculture management. In fact the size and shape are the fundamental to the analysis of variation in the living organism. Further, fish occupy very significant position in the aquatic detritus and grazing food chains as they take food organisms ranging from semi digested detritus particle to planktonic organisms [2, 3]. Expressed that there is not a single fish in nature which is exclusively carnivorous or herbivorous. All fishes are basically omnivorous and it is only on the basis of percentage of animals and plants in their food, they are categorized into one group or other. Length weight relationship (LWR) of fishes is important in fisheries and fish biology as they establish a mathematical relation [4, 5] between them. Like other morphological characters, the LWR can be used as a parameter with various developmental stages in life such as growth, maturity [6]. Morphological characters have been commonly used in fishery biology to measure discreteness and relationships among taxonomic categories. There are many well documented morphometric studies, which provide evidence for stock discreteness [7, 8]. In case of fishes, differences in the length-weight relationship among sexes, species, seasons and sites have been reported for both wild and cultured populations [9, 10]. Seasonal changes in the length-weight relationship of fish populations have been related to seasonal variations in reproductive biology where mature fishes have higher weight at length than immature ones [11]. The relationship between the biological changes and growth, mortality and longevity has been studied [6, 8]. Besides this it is also important to study the reproductive cycle for better understanding of the role of individual in that ecosystem. Age with growth parameters of fishes provides essential data to control the dynamics of the fish population and also management of the fishery resource. Fish biology has been observed to display the morphological and anatomical peculiarities of the fish body with internal organs (alimentary canal). Food and feeding habits of fishes is essential for a better understanding their life history. Variation of feeding habits resulted in variation in biochemical composition.

The LWR relationship is used to measure the condition of the fish and also determines its growth pattern (isometric or allometric). In addition the LWR and K factor analysis provide important clues on environmental changes. Hence the present attempt has been made to study the length-weight relationship, biology of fishes and respective growth pattern in Bay of Bengal, Chandipur habitat which is useful in understanding and management of this sustainable resource.

2. Materials and Methods

2.1 Fish and sampling site

Fish samples were collected from Chandipur (Balaramgadi), Bay of Bengal during July 2011 to March 2012 through pre informed fishermen which were caught by trawl net and gill net. A total of 720 specimens of six species as *Hilsa ilisha, Johnius carutta, Liza parsia, Mugil cephalus, Polydactylus paradisus*, *Sillago sihama* belonging to different families were measured by a metric scale and a digital weighing machine (Model-Afcosoft electronic balance, Bombay-Burma Trading Co. Ltd.).

2.2 Methodology

Total length was measured from the lower jaw to the tip of the tail, spread normally. In less than 100 watt illuminations the internal organ (Stomach) was exposed, detached from the main body and their specific weights were determined (Fig.1 and 2). The stomach was preserved in 5% formaldehyde and subsequently analyzed both qualitatively and quantitatively. The food items were subjected to higher degree of mutilation due to the action of digestive juice. Therefore, the gut contents could be identified up to higher taxonomic group. The volume index was evaluated from the total points of the entire item recorded over the period of study. In order to get a clear picture of frequency of occurrence as well as volume of various items the "index of preponderance" method was used [12]. The index of preponderance (I) was worked out using the formula;

$$I = \frac{\text{Vi Oi}}{\sum \text{Vi Oi}} x\ 100$$

I = Index of preponderance
V_I = Volume percent
O_i = Occurrence percent

The length-weight relationship was established by the equation $W = aL^b$ [13-14]

Where W= Weight of fish (gm)
L= Length of fish (cm)
a = Intercept, b = Slope

The value of ʿaʾ and ʿbʾ was given a logarithm transformation according to the following formula:

Log W = log a + b log L [13]

The coefficient of condition has usually been represented by the letter K and is expressed by relating the standard length of the fish to its weight. It is calculated by the formula;

$K = W/L^3 \text{ X } 100$

K is the coefficient of condition, W is the weight of fish (in gram) L is the standard length of fish (in cm.)

Fig 1: Anatomical display of *M. cephalus*

Fig 2: Anatomical display of *L.parsia*

3. Result and discussion

3.1. Fish biology

Fish samples were analyzed seasonally and their biological parameters; conditional factors (K), gastrosomatic index (GSI), hepatosomatic index (HSI) were determined (fig. 3, 4 and 5). In this study conditional factor (K) of six fish species (*H. ilisha, M. cephalus, S. sihama, P. paradisus*, *L. parsia, and J. carutta*) were studied seasonally. The seasonal variation of conditional factor ranged between 1.314±0.218 in *S. sihama* during winter to 3.346±0.674 in *P. paradisus* in winter (Fig.3). In *M. cephalus* the K percent ranged among summer (1.541), winter (1.696), monsoon (1.488) and post monsoon (1.495). Higher % was observed in *P. paradisus* in summer, winter, monsoon and post monsoon as 2.533, 3.346, 2.732, and 2.879 respectively. The decreased K factor % was found in monsoon having 1.488 in *M. cephalus*,1.493 in *S. sihama*, 2.732 in *P. paradisus*, 1.327 in *L. parsia* and 2.089 in *J. carutta* with higher value of 2.685 in case of *H. ilisha* (Fig.3). The seasonal variations in the gastrosomatic index (GSI) values were observed in six species. The ranges of variation were 3.677% in *H. ilisha* during monsoon to 13.706% in *L. parsia* during monsoon (Fig.4). GSI% in *M. cephalus* was observed to be 5.904 in summer, 4.957 in winter 6.600 in monsoon and 6.526 in post monsoon. Thus in winter lower value was observed. But in *H. ilisha* the higher values were observed as 5.804 in summer and 5.216 in winter whereas monsoon and post monsoon showed lower values (3.677 and 3.848). The GSI index was higher in fishes like *P. paradiseus, L. parsia and J. carutta*. The increased value was found in all during pre-spawning period. The seasonal variation of hepatosomatic index was calculated which ranged between 0.923 in *M. cephalus* during winter to 2.443 in *P. paradiseus* during monsoon (Fig.5). In *H. ilisha* the lowest value (0.677) was found in monsoon to highest (1.173) during summer. In *S. sihama* lowest (0.631) during post monsoon to highest in summer (1.205).

Correlation coefficient value (Table1) among seasons was calculated and for conditional factor correlation between summer and winter was found to be 0.587 whereas between winter and monsoon it was calculated to be (r = 0.729). Post monsoon showed the positive and strong value (r =0.707, 0.743, 0.837) with summer, winter and monsoon season. Conditional factor have positive correlation with gastrosomatic and hepatosomatic index. Gastrosomatic index showed positive correlation within seasons (r = 0.865, 0.913 and 0.943 at $P \leq 0.01$) (Table 2). Similarly hepatosomatic index showed positive values among themselves (r = 0.886, 0.966, 0.826 at $P \leq 0.01$) (Table 3).

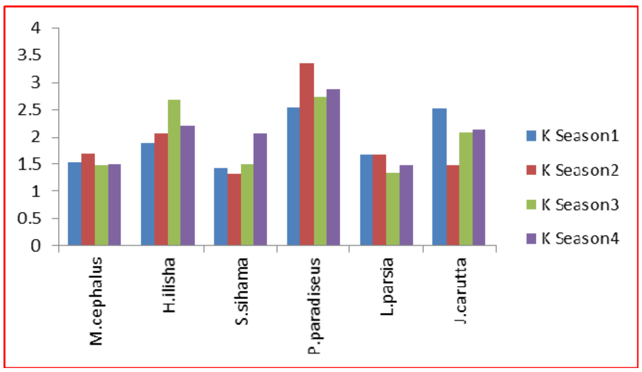

Fig 3: Seasonal variation of conditional factor (Season1 = summer, 2 = winte r, 3 = monsoon, 4 = post monsoon)

Table 1: Seasonal correlation coefficient of conditional factor

	Season1	Season2	Season3	Season4
Season1	1.000			
Season2	0.587	1.000		
Season3	0.714	0.729	1.000	
Season4	0.707	0.743	0.837	1.000

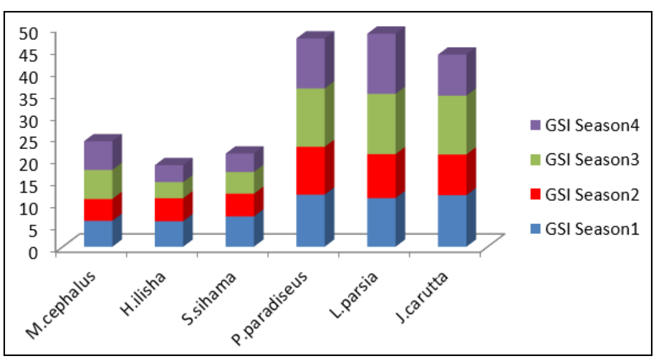

Fig 4: Seasonal variation of gastrosomatic index

Table 2: Seasonal correlation coefficient of GSI

	Season1	Season2	Season3	Season4
Season1	1.000			
Season2	0.975	1.000		
Season3	0.965	0.954	1.000	
Season4	0.865	0.913	0.943	1.000

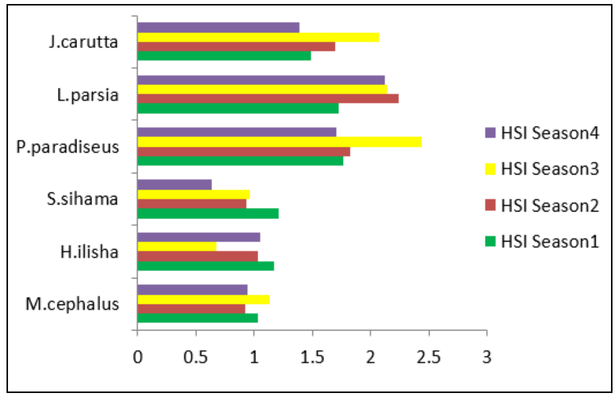

Fig 5: Seasonal variation of hepatosomatic index

Table 3: Seasonal correlation coefficient of HSI

	Season1	Season2	Season3	Season4
Season1	1.000			
Season2	0.944	1.000		
Season3	0.915	0.893	1.000	
Season4	0.886	0.966	0.826	1.000

The average weight of *H. ilisha* was varied from 223.46gm to 454.46gm, in *J. carutta* varied from 58.09gm to 89.78gm, in *L. parsia* it was between 56.59gm to 77.99gm. The average weight of *M. cephalus* was varied from 243.19gm to 357.98gm, in *P. paradiseaus* it was between 50.83gm to 88.83gm. and in *S. sihama* the weight varied from 145.66 to 275.66 gm.

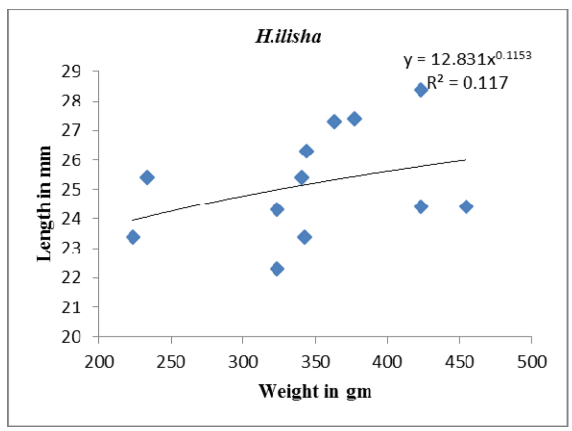

Fig 6: Linear relationship of length and weight of H. ilisha

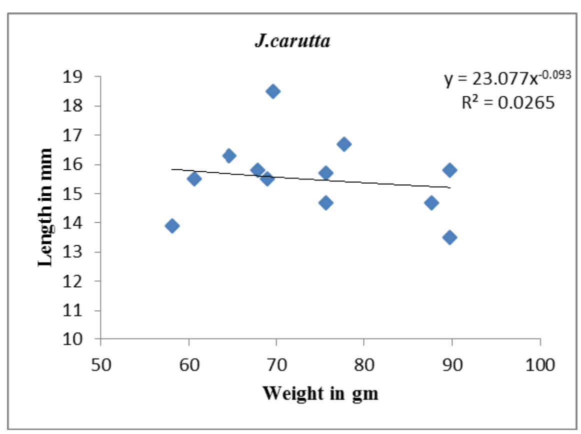

Fig 7: Linear relationship of length and weight of J. carutta

Similarly the average length of *H. ilisha* was between 220.30mm to 280.4mm, in *J. carutta* it was varied from 130.50mm to185.00mm, in *L. parsia* it was between 150.00mm to 180.00mm.
In *M.cephalus* the length was between 235.00mm to 287.00mm, in *P. paradiseaus* it was ranged between 113.00mm to 163.00mm and in *S. sihama* 205.00mm to 255.00mm. One way analysis of variance showed significant differences between the weights (F=125.74, $p \leq 0.01$) and also showed differences in lengths (F= 171.06, $p \leq 0.01$).
The regression parameters for six species were calculated to be 12.83(Fig.6), 23.07(Fig.7), 6.32(Fig.8), 14.39(Fig.9), 4.43(Fig.10) and 16.14 (Fig.11) for a values of *H. ilisha, J. carutta, L. parsia, M. cephalus, P. paradiseaus* and *S. sihama*. Further the b and r^2 values of above were found to be 0.115 and 0.117 in *H. ilisha,* 0.09 and 0.026 for *J. carutta,* 0.228 and 0.151 for *L. parsia*, 0.106 and 0.044 in *M. cephalus,* 0.263 and 0.285 for *P. paradiseaus* and 0.069 and 0.062 in *S. sihama*.

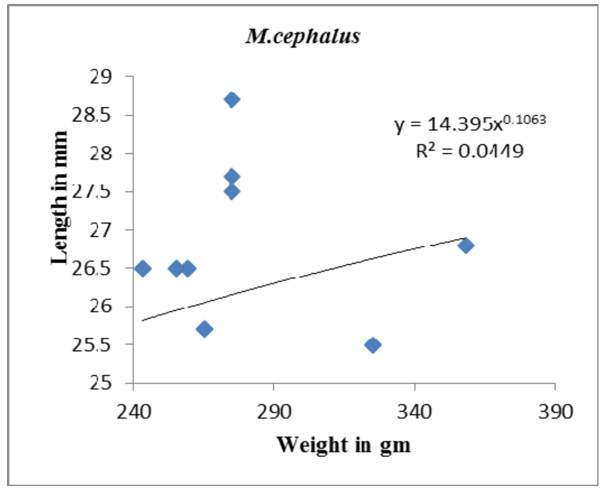

Fig 9: Linear relationship of length and weight of *M. cephalus*

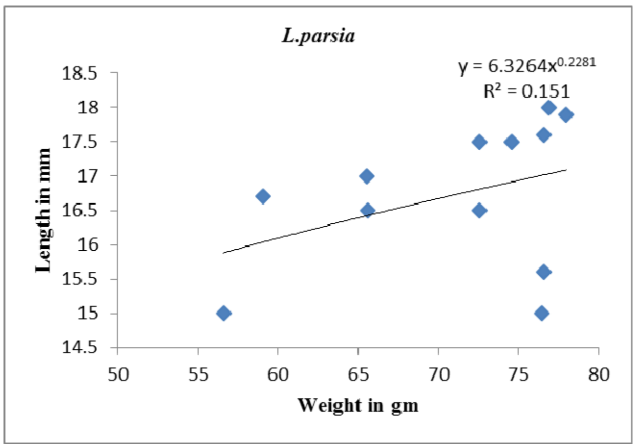

Fig 8: Linear relationship of length and weight of *L. parsia*

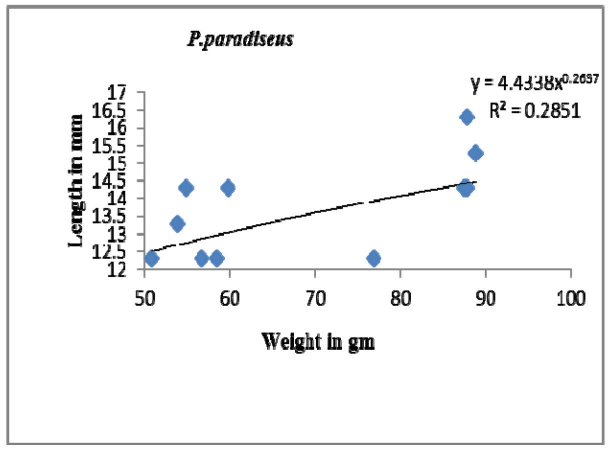

Fig 10: Linear relationship of length and weight of *P. paradiseaus*

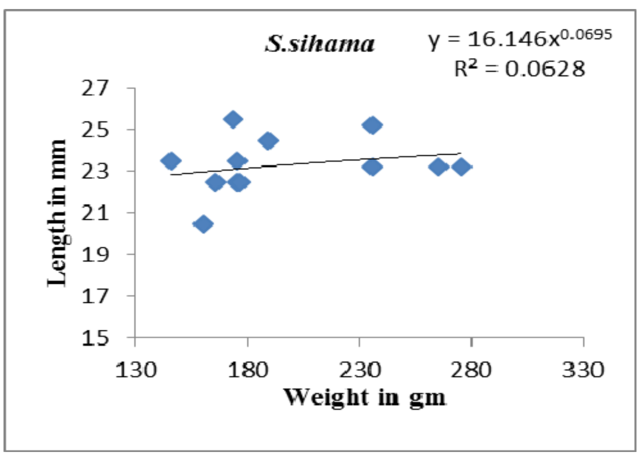

Fig 11: Linear relationship of length and weight of *S. sihama*

3.2. Analysis of gut content

Analysis of gut content of *Hilsa ilisha* were revealed that the food items of this fish comprised of the members of diatoms, copepods, algae, digested plant materials and sand particles. The diatoms were formed the main food item of gut contents of the species.
Analysis of food items in different seasons showed that the diatoms were the major portion of food item whose value ranged from 51.496 in winter to 59.560 percent in post monsoon. The volume % was found to be 31.98% in summer to37.51% in post monsoon and occurrence % was calculated to be 41.39 in summer to 42.71 in post monsoon. The preference of food items in descending order were diatoms (59.56%) to copepod (27.11%) to algae (5.81%). The preference of food items in winter was calculated to be diatoms (51.60%) copepod (34.20%) to digested food (7.63%) to algae (4.86%) and sand particles (1.67%). During summer, the most preferred food was diatom (51.49%), copepod (31.12%), digested food

(9.15%) to algae (5.82%) and sand particle (2.40%).
Tabulated values indicated that the food items of the fish *M. cephalus* comprised of dead and decaying organic matter, sand and mud, diatoms, algae and copepods. The major genera of diatoms were skeleton ma, Thalassionema, Chae toceros, coscinodiscus, Rhizosolenia and micro algae followed by the cladophora (green algae). A major portion of gut content in adult *Mugil cephalus* was sand and detritus (45.15%) by Volume and (39.15%) by occurrence. The gut content also consisted of encrusted algal matter including myxophyceae, dinoflagellates and copepods. Seasonal variation indicated that preferred food items showed variation in relation to season. In post monsoon season, the percentage composition of food items on their preference basis were dead and decaying matter (65.32%), sand and mud (25.51%) followed by algae (5.84%), diatoms (1.90%) and copepods (1.41%). In winter season, the preference level of food were dead and decaying (60.65%) sand and mud (23.68%), algae(7.04%), diatoms (6.86%) and copepods (1.74%). The percentage composition of the food items in their index in winter season were dead and decaying matter (64.81%) followed by sand and mud (21.75%) diatoms (6.01%), algae (4.62%) and copepod (2.78%). The different food items identified in the stomach of *Sillago sihama* were diatoms (Bacillariophyceae), cyanophyceae (dinoflagellata) constitute main food of plant origin. Copepods, nematodes, foraminifera, bivalves were also formed the part of the food. In occurrence method, diatoms were found to be the most preferable food of plant origin. The relative importance of food items was also studied seasonally. In the post monsoon season, the index of preponderance for food items were diatoms (88.47%), dinoflagellata (1.36%), copepod (1.11%), nematode (3.05%), animal derivative (5.13%) and foraminifera (0.84%). The volume % of diatom was highest in post monsoon (76.2%) and occurrence % of 13.36. In winter the diatoms constitute the major portion of food with volume % (59.03) and occurrence percentage (31.00). The preponderance index was calculated to be 84.17 in winter for diatoms followed by copepods (11.39%), dinoflagellates (3.89%). The other parts as nematodes, foraminifera and animal derivatives were negligible during winter (0.09, 0.18 and 0.25%). But during summer the food preference was changed with high percentage (82.81) of animal derivatives including crabs and shrimps, eggs, insects, scales and crustaceans. The major portion of this was found to be crabs and shrimps. The decreasing order of food preferences were nematodes (15.05%), foraminifera (1.19%), copepods (0.34), diatoms (0.29%) and dinoflagellates (0.28%). Thus from three seasonal results, it was observed that copepods, diatoms and dinoflagellates were present in stomach content of *S. sihama* in all the seasons. It was however, observed that diatoms were the most consumed food item in *S. sihama* accounting for (80–90)%. In all the species, the relative condition factor remained high during July to November, with peak in November. It plummeted in December, showing further decline till March. *S. sihama* has a prolonged breeding season from July to February with peak spawning in November in coastal waters [15]. The rise in K value from July corresponded to the period of gonadal maturation. The abrupt fall in condition in December, in all maybe attributed to increased spawning activity. Higher condition factor values observed during July-February in all species from Chandipur-on-sea, were attributed to full maturity of gonads [16]. Low K values in January and August in *L. parsia* were ascribed to spawning [2]. Variation in K values in *M. cephalus* and *H. ilisha* during monsoon and post monsoon attributed to spawning period but other species showed the relative condition at its spawning during winter. In the length-weight relationship, the point of inflexion is indicative of the length at which sexual maturity starts. The present results support this observation since in all the cases the higher values were observed at their spawning period only [15]. The parameters of length-weight relationships estimated in the present study were within the ranges and also demonstrated by several workers as [17, 18, 19]. Similarly the logarithmic values of observed length and corresponding weights of pooled samples are determined. The use of total length to determine length weight morphometric relationships has been widely applied for penaeid [20, 21, 11, 10]. The growth rate of animals varied widely which depend upon developmental stages [10]. The condition factor (K) played an important role in management of culture system as it provides certain information of specific conditions in which the organisms are growing [22, 23]. Further it is an indicator of changes in food reserves and therefore an indicator of the general shrimp condition. Our study also reflected good condition of shrimp.

4. Conclusion

A characteristic of the length weight relationship in fishes and invertebrates is that the value of the exponent ‛b’ is 3 when growth in weight is isometric (without changing shape). If ‘b’ value differs from 3, growth is said to be allometric (fish changes shape as it grows larger). Allometric growth may be negative (b<3) or positive (b>3). The present estimated exponent (b=2.25–2.57) is close to isometric growth. The high correlation coefficient r of 0.97 obtained in this study showed that there is a strong association between length and weight. The present findings also specified allometric growth of fishes in Chandipur habitat.

5. Acknowledgements

Authors are extremely grateful to the Head of Bioscience and Biotechnology Department, F.M University, Balasore, India for the facilities provided. The authors are also thankful to the fishermen of Bay of Bengal at Chandipur coast for their help in collection of data during study period. The authors humbly acknowledge the officials of Fishery department (Marine), Balasore district, Odisha for their cooperation during the study.

6. References

1. Jones R. The use of length composition data in fish stock assessments (with notes on VPA and cohort analyses). FAO fisheries circular. 1984; 634:55.
2. Rao LM, Rao PS. Food Feeding Habits. Of *Glossogobius giuris* from Gosthani Estuary; Indian. J Fish. 2002; 49:35-40.
3. Jhingran VG, Natarajan AV, Banerjee SM, David A. Bulletin of the Central Inland Fisheries research Institute, India, 1969; 12:26-48.
4. Sarkar UK, Deepak PK, Nagi RS. Length weight relationship of Clown knife fish *Chitala chital* (Ham.1822) from Ganga basin, India, J Appl. Ichtyol. 2008; 25:232-233.
5. Mir JI, Sarkar UK, Dwivedy AK, Pal A, Jena JK. Pattern of intrabasin variation of condition factor, relative condition factor and form factor of an Indian major carp, *Labeo rohita* (Ham-Buc 1822) in the Ganga basin, India, Europ. J Biol. Sc. 2012; 4:126-135.
6. Thomas J, Venu S, Kurup BM. Length-weight

relationship of some deep-sea fish inhabiting the continental slope beyond 250m depth along the West Coast of India. Naga, Iclarm, 2003; 26 2:17-21.

7. Enin UI. Length - weight parameters and condition factor of two West African Prawns. Rev. Hydrobiol. Trop, 1994; 272:121-127.
8. Hart AI, Abowei JFN. A study of the length-weight, condition factor and age of ten fish species from the lower Nun River, Niger Delta. Afr. J Appl. Zool. Environ. Biol. 2007; 9:13-19.
9. Fontaine CT, Neal RA. Length weight relations for three commercially important penaeid shrimp of the Gulf of Mexico. Transactions of the American fisheries society, 1971; 3:584-586.
10. Primavera JH, Estepa P, Lebata FD. Morphometric relationship of length and weight of giant tiger prawn *Penaeus monodon* according to life stage, sex and source. Aquaculture, 1998; 164:67-75.
11. Chu KH, Chen QC, Huang LM, Wong CK. Morphometric analysis of commercially important penaeid shrimps from the Zhujiang estuary, China. Fish. Res. 1995; 23:83-93.
12. Natarajan AV, Jhingran VG. Index of preponderance: a method of grading the food elements in the stomach analyses of fishes. Indian. Journal of Fisheries. 1961; 8:54-59.
13. Pauly D. Some simple methods for the assessment of tropical fish stocks. FAO Fish. Tech. Pap, 1983, 234-52.
14. Sparre P, Ursin E, Venema SC. Introduction to tropical fish stock assessment, Part 1. Manual FAO Fisheries Technical Paper No. FAO Rome. 1989; 1:337-306,
15. Jayasankar P. Length weight relationship and relative condition factor in *Sillago sihama* (Forskal) from Mamdapam region. Indian. J Mar. Sci. 1991; 38:183-186.
16. Reddy CR, Neelakantaan B. Relative Condition Factor and Gonado Somatic Index in *Sillago sihama* (Forskal); Indian J. Fish. 1991; 40(3):171-174.
17. Nahavandi R, Nurul Amin SM, Md. Shater Zakarina, Mariana nor Shamsudin. Growth and length weight relationship of *Penaeus monodon* (Fabricius) cultured in artificial sea water. Research. Journal of fisheries and Hydrobiology. 2010; 5(1):52-55.
18. Lalrinsanga PL, Pillai PL, Mahapatra KD, Sahoo L, Ponzoni RW *et al*. Nguyen NH, Mohanty S, Sahu S, Kumar V, Patra G, and Patnaik S. Length–weight relationship and condition factor of nine possible crosses of three stocks of giant freshwater prawn, *Macrobrachium rosenbergii* from different agro-ecological regions of India. Aquacult. Int, 2012.
19. Piratheepa S, Chitravadivelu K, Edrisinghe U. Updates on the species of the shrimps in Kakkaithivu Coastal waters, Jaffna, Sri Lanka. Tropical Agricultural Research. 2012; 24(1):82-90.
20. Cheng CS, Chen L. Growth characteristics and relationships among body length, body weight and tail weight of *Penaeus monodon* from a culture environment in Taiwan. Aquaculture, 1990; (91):253-263.
21. Chow SN, Sandifer PA. Differences in growth, morphometric traits and male sexual maturity among pacific white shrimp, *Penaeus vannamei* from different commercial hatcheries. Aquaculture. 1991; 92:165-178.
22. Araneda M, Pérez EP, Gasca-Leyva E. White shrimp *Penaeus vannamei* culture in freshwater at three densities: Condition state based on length and weight. Aquaculture.2008; 283:13-18.
23. King RP. Length-weight relationships of Nigerian coastal water fishes. Fiesbyte.1996; 19:53-58.