International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

ISSN 2347-2677
www.faunajournal.com
IJFBS 2020; 7(4): 191-195
Received: 22-04-2020
Accepted: 24-05-2020

HG Solanki
Department of Aquaculture (COF, NAU) Navsari, Gujarat, India

NC Ujjania
Department of Aquatic Biology (VNSGU), Surat, Gujarat, India

C Gopal
Central Institute of Brackishwater Aquaculture, Chennai, Tamil Nadu, India

SM Pillai
Central Institute of Brackishwater Aquaculture, Chennai, Tamil Nadu, India

Corresponding Author:
NC Ujjania
Department of Aquatic Biology (VNSGU), Surat, Gujarat, India

Length-weight relationship, condition factor and length-frequency analysis of tiger shrimp (*Penaeus monodon* fabricius, 1798)

HG Solanki, NC Ujjania, C Gopal and SM Pillai

Abstract
The tiger shrimp *Penaeus monodon* (Fabricius, 1798) were collected from the Government shrimp farm, Coastal Salt salinity Research Station (CSSRS), Navsari Agricultural University, Navsari, Gujarat, India during the year 2009-2010. The morphometric measurements including length and weight of 321 male, 317 female and 638 pooled population that shows 8.0-19.4 (15.257±0.070) cm, 8.0-18.5 (15.019±0.098) cm and 9.0-19.4 (15.426±0.100) cm range of length with 8.0-52.0 (30.546±.0498), 8.0-58.0 (32.760±0.541) and 8.0-58.0 (31.663±0.369) gm range of weight respectively. The regression coefficient (r^2) 0.788, 0.772 & 0.780, intercept (a) -1.451, -1.620 & -1.536 and slope or regression coefficient (b) 2.478, 2.624 & 2.552 was observed for male, female and pooled population samples. The value of regression coefficient (b) was < 3.0 that shows negative allometric growth of studied population. The values of condition factor (K) was 0.537 - 1.646 (0.875±0.009) for male, 0.455 - 1.646 (0.875±0.009) for female and 0.455 - 1.646 (0.876±0.007) for pooled population which revealed that condition of studied shrimp population was almost uniform during the study period.

Keywords: Shrimp, length, weight, condition factor, regression and length frequency distribution

Introduction
The tiger shrimp *Penaeus monodon* (Fabricius, 1798) [13], is one of the most important commercially cultivable crustacean species of the world due to its high nutritive value, unique taste and high market value (Ling, 1969 and New, 2002) [20, 25]. It constitutes about 95-99% of the total farmed shrimp production in the country (Sailendra, 2012) [32]. Tiger shrimp is euryhaline and is the fastest growth rate among the penaeid species reared in captivity (Foster and Beared, 1974) [9]. The growth, population condition and population distributions are important for the cultural management and can be estimated by the application of length-weight relationship (LWR), condition factor and length frequency (Peixoto *et al*., 2004; Gautam *et al*., 2014; Mohanti *et al*., 2015; Udoinyang *et al*., 2016) [28, 10, 23, 37].

The length-weight relationship between the two variables (length and weight) which determine the possible differences among different stocks of the same species (Petrakis and Stergiou, 1995; King, 2007) [29, 16]. These biological aspects are also important for a wide range of studies, such as estimating growth rates, age structure and population dynamics of shrimp and fishes (Abohweyere and Williams, 2008; Deekae and Abowee, 2010; Fatima, 2001; Tsoumani, 2006) [1, 6, 8, 36].

The condition factor (K) is an index value which reflects the interactions between biotic and abiotic factors in the physiological condition of the aquatic organisms. It also indicates the general body condition of the organism which could be a useful complement in *in vitro* proximate composition analysis (Sutton *et al*., 2000, Lalrinsanga *et al*., 2012, and Mohanty *et al*., 2015) [35, 18, 23]. In Indian waters, George (1959) [11], Rajyalakshmi (1981) [30], Sukumaran *et al*. (1993) [34], Nandakumar (1998) [24], Bhadra and Biradar (2000) [3] and Chakravarty and Ganesh (2014) [5] conducted some of the important studies on the morphometric aspects of the penaeid shrimps. The present study provides some important information about the morphometric relationship, condition factor and length-frequency distributions of *P. monodon* in the Government shrimp farm, CSSRS, Navsari Agricultural University (NAU), Navsari, Gujarat which will be helpful to manage biomass and regulate the farm operations.

Materials and Methods

The total of 638 samples of shrimp specimens were collected from the Government shrimp farm, Coastal Salt Salinity Research Station, Navsari Agricultural University, Navsari, Gujarat, India during 2009-2010. The samples were identified as male and female by observing the thelycum and petasma features (George and Russell, 1994; Carpenter and Neil, 1998) [12, 4]. For the morphometric study (LWR, CF and LFD), length and weight were measured. The total length (L) of each specimen were measured from the tip of the rostrum to the end of the telson and weight (W) was measured by measuring board and electronic balance, respectively.

The length-weight relationship was calculated separately for each category based on the following methodology:

$Y = a+b X$ (Ramasesaiah and Murty, 1997) [31].

$W = aL^b$ (LeCren, 1951) [19].

Its logarithmic transformation is

$Log W = Log a + bLog L$

The condition factor (CF) of shrimp species was calculated as the bodyweight expressed as a percentage of the cube of the total length. It was calculated following the following formula:

$K=W/L^3\times100$ (Hile, 1936) [15].

Where 'W' represents weight (gm), 'L' is the total length (cm) and 'a' and 'b' the constants.

For the length-frequency distribution analysis the collected morphometric data (length) of specimens were categorized in different categories according to length *i.e*. 8.0-10.0, 10.0-12.0, 12.0-14.0, 14.0-16.0, 16.0-18.0 and 18.0-20.0 cm designated as A, B, C, D, E and F.

Data analysis was completed with the help of MS Excel 2003.

Result and Discussion

The tiger shrimp specimens ranged in length from 8.0-19.4 (15.257±0.070) cm, which included 317 males ranging in length from 8.0-18.5 (15.019±0.098) cm and 321 females ranging in length from 9.0-19.4 (15.426±0.100) cm. The male, female and pooled population measured from 8.0-52.0 (30.546±.0498), 8.0-58.0 (32.760±0.541) and 8.0-58.0 (31.663±0.369) g, respectively to study the length-weight relationship, condition factor and length frequency distribution (Table 1).

Length-weight relationship (LWR)

A straight-line relationship was observed between length and weight of tiger shrimp (Fig. 1 a, b & c). The variables (length and weight) shows the correlation coefficient (R^2) 0.788, 0.772 & 0.780, intercept (a) -1.451, -1.620 & -1.536 and slope or regression coefficient (b) 2.478, 2.624 & 2.552 for male, female and pooled population (Fig. 1 a, b & c).

The value of regression coefficient (b) is less than 3, which depicts that the growth is negative allometric in male, female and pooled population of tiger shrimp. Hall (1966) [14] calculated the carapace length-weight relationship for Indo-Pacific penaeid prawns and prescribed the common equation for the two sexes together. Sarada (2010) [33] has observed a significant relationship between males and females in *Penaeus semisulcatus* with the slope values as 3.01 in males and 2.98 in females. Gopalakrishna (2013) [13] conducted a similar study and reported negative allometric growth for male (2.4) and females, (2.6) between wild and cultured shrimp. Mohanty *et al*. (2015) [23] also reported negative allometric growth (2.340 to 2.573) in *Penaeus monodo*n from Odisha. Although, Udoinyang *et al*. (2016) [37] reported isometric growth and Mane *et al*. (2019) [21] reported both positive and negative allometric growth.

Condition factor (K)

The condition factor (K) is an indicator of changes in food reserves and played an important role in culture system management. It provides certain information about the specific growing conditions of general shrimp. The values of K was 0.537 - 1.646 (0.875±0.009) for male, 0.455 - 1.646 (0.875±0.009) for female and 0.455 - 1.646 (0.876±0.007) for pooled population of tiger shrimps (Table 1). The observed value of K revealed that the condition of studied shrimp population was almost uniform during the study period. The K-value ranged between 0.748-1.319, 0.783-1.236 and 0.785-1.285 for different length groups of male, female and pooled population. The K-values shows decline trend for the length groups, which revealed that the condition of the tiger shrimp population was good at the early stage of life compared to the later stage (Fig. 2). The study for condition factor was (mean values of K 0.875) for male and female indicated the stable condition of both the sexes of tiger shrimp (Fig. 2).

In present study results reflected that tiger shrimp was in good condition and no sex-based differences in studied species. Similar results of *K* were observed by were made by Patel *et al.* (1986) [27] in *P. penicillatus*, Kunda *et al*. (2008) [17] and Ming *et al*. (2016) [22] in *M. rosenbergii* whereas, Olawusi-Peters *et al*., (2014) [26] reported K = 0.49 (*N. hastatus*), *K* = 0.82 (*P. atlantica*), *K* = 0.74 (*M. rosenbergi*i) from coastal waters of Ondo state. Mane *et al*. (2019) [21] were also reported a similar range of condition factor (0.92-1.09) in *P.monodon* from Maharashtra while Mohanty *et al*. (2015) [23] reported K-value >1.0 in *P.monodon* from Odisha. In contradict to present study, K-values for female shrimps is generally higher than that of the male (Udoinyang *et al*., 2016) [37] while Mohanty *et al*. (2015) [23] reported that K-values were high for male than that of the female.

Length-frequency distribution

Length-frequency distribution of *P. monodon* was described in figure 3. The results show the maximum dominance (157, 136 and 295) of length group D (14-16 cm) and minimum dominance (3, 5 and 8) of length group F (18-20 cm) in male, female and pooled population of shrimp. In length-frequency distributions occurrence of the larger sized animal is the indication of satisfactory growth of shrimp in the grow-out system. Previous research work of Ayub and Ahmed (1992) [2]; Fatima (2000) [7] also supports this opinion, while young shrimps dominated the elder penaeid shrimp population in other studies (Fatima, 2001) [8].

Table 1: Length and weight parameters of tiger shrimp

Population	n	Length (cm) Min. - Max. (Mean±SE)	Weight (gm) Min. - Max. (Mean±SE)	Condition Factor (K) Min. - Max. (Mean±SE)
Male	317	8.0 - 18.5	8.0 - 52.0	0.537 - 1.646
		(15.019±0.098)	(30.546±.0498)	0.875±0.009
Female	321	9.0 - 19.4	8.0 - 58.0	0.455 - 1.646
		(15.426±0.100)	(32.760±0.541)	0.875±0.009
Pooled	638	8.0 - 19.4	8.0 - 58.0	0.455 - 1.646
		(15.257±0.070)	(31.663±0.369)	0.876±0.007

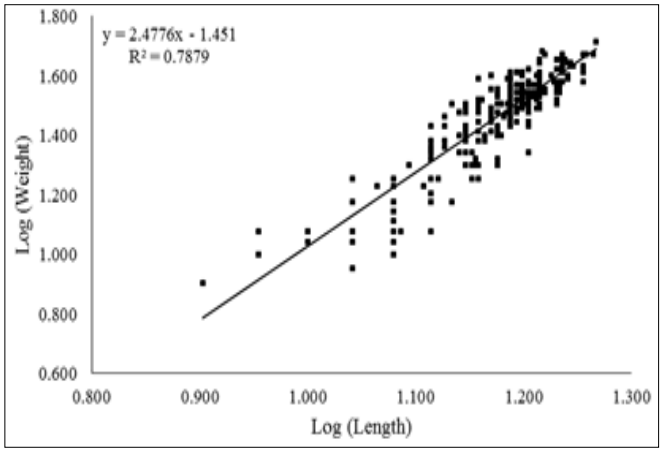

Fig 1(a): Length-weight relationship of the male population of tiger shrimp

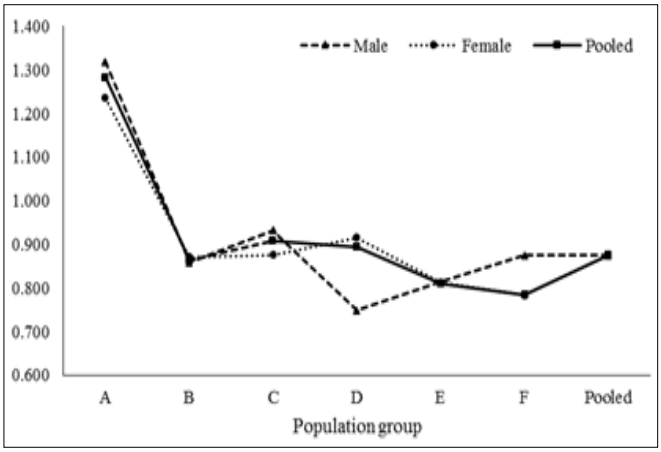

Fig 2: Condition factor (K) of different groups and pooled population of tiger shrimp

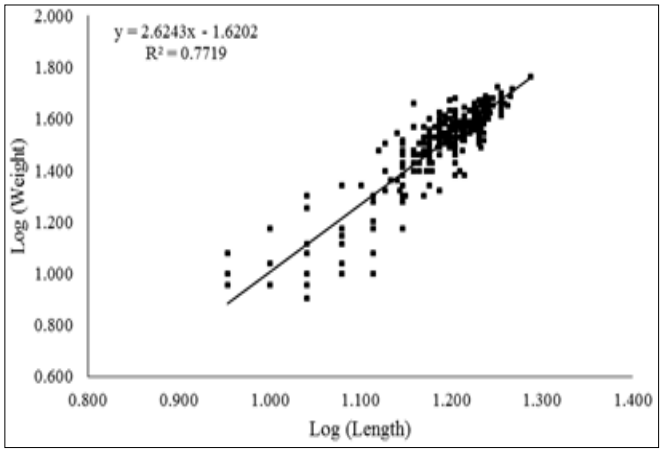

Fig 1(b): Length-weight relationship of the female population of tiger shrimp

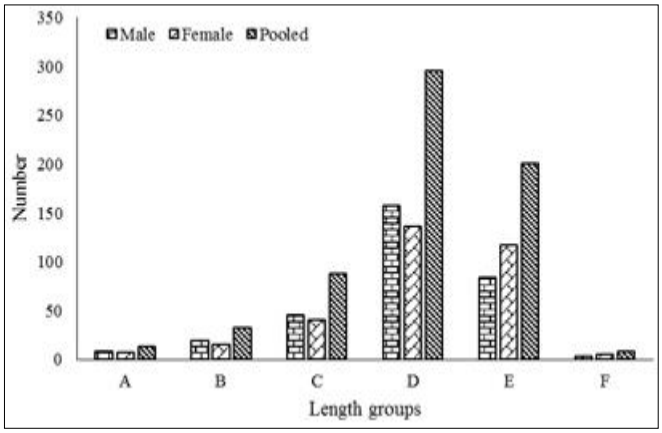

Fig 3: Length frequency distribution of tiger shrimp

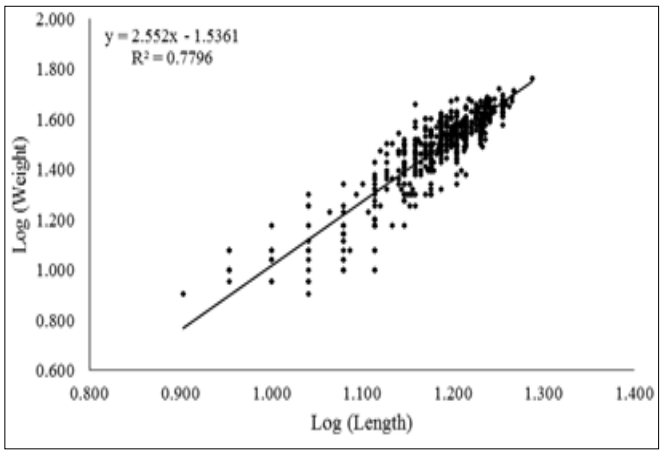

Fig 1(c): Length-weight relationship of the pooled population of tiger shrimp

Reference

1. Abohweyere PO, Williams AB. Length-weight relationship and condition factor of *Macrobrachium macrobrachion* in the Lagos-Lekki Lagoon system. Nigeria. Res. J Biol. Sci. 2008; 3(11):13331336.
2. Ayub Z, Ahmed M. Population structure of the penaeid shrimp *Penaeus pencillatus*, *P. merguiensis* and *Metapenaeus affinis* from Pakistan waters (Arabian Sea). Mar. Res. 1992; 1:15-27.
3. Bhadra S, Biradar RS. Population dynamics of Penaeid prawn *Penaeus merguiensis* off Mumbai coast. J Indian Fish. Ass. 2000; 27:65-77.
4. Carpenter KE, Niem VH. FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Cephalopods, crustaceans, holothurians and sharks. Rome, FAO. 1998; 2:687-1396.
5. Chakravarty M, Ganesh PC. Relationship between length-weight, total length-carapace length and total length- abdominal length and relative condition factor in

the deepwater mud shrimp *Solenocera melantho* (de Man, 1907) off Visakhapatnam coast. Int. J Adv. Res. 2014; 2(12):657-668.
6. Deekae SN, Abowei JFN. The Fecundity of *Macrobrachium macrobrachion* (Herklots, 1851) from Luubara Creek, Ogoni Land, Niger Delta, Nigeria. Int. J Ani. Vet. Adv. 2010; 2(4):148-154.
7. Fatima M. Length-weight relationship of some penaeid shrimps from Karachi. Pak. J Zool. 2000; 32:185-186.
8. Fatima M. Study on Length-frequency and Length-weight Relationship of *Penaeus japonicus* and *Parapenaeopsis sculptilus.* J Biol. Sci. 2001; 1(3):171-172.
9. Foster LRN, Beard TW. Experiments to assess the suitability of nine species of prawns for intensive cultivation. Aquacult. 1974; (3):584-586.
10. Gautam K, Nazar AR, Anand Ganesh E, Mahendran S, Mahadevan G. Study of length and weight relationship of *Litopenaeus vannamei* (Boone, 1931) from the east coast of India. Int. J Sci. Inven. Today. 2014; 3(4):365-376.
11. George MJ. Notes on bionomics of the prawn *Metapenaeus monoceros* (Fabricius). Ind. J Fish. 1959; 6(2):268-277.
12. George HP, Russell BC. FAO species identification field guide for fishery purposes. The marine fishery resources of Sri Lanka. FAO. Rome, Italy, 1994, 19-37.
13. Gopalakrishna IA, Rajkumar M, Rahman MM, Sun J, Anthony PJ, Venmathimaran BA. Length-weight relationship and condition factor of wild, Grow-out and Loose-shell affected giant tiger shrimp, *Peneaus monodon* (Fabricius 1798) (Decapoda: Penacidae. J Appl. Ichth. 2013; 30:251-253.
14. Hall DNF. Observation on the Taxonomy and Biology of some Indo-pacific Penaeidae (Crustacean, Decapoda) Fish. Publication Colonial off London. 1966; 17:1-229.
15. Hile R. Age and growth of the Cisco, *Leucichthys ardeti* (Le Sueur), in the lakes of the North-Eastern highlands, Wisconsin. Bulletin of United States Beuro of Fisheries. 1936; 48:311-317.
16. King M. Fisheries biology, assessment and management. Second Edition. Blackwell Scientific Publications, Oxford, 2007, 1-381.
17. Kunda M, Dewan S, Uddin MJ, Karim M, Kabir S, Uddin MS. Length-weight relationship, condition factor and relative condition factor of *Macrobrachium rosenbergii* in rice fields. Asian Fisheries Science. 2008; 21:451-456.
18. Lalrinsanga PL, Pillai BR, Patra G, Mohanty S, Naik NK, Sahu S. Length-weight relationship and condition factor of giant freshwater prawn *Macrobrachium rosenbergii* (De Man, 1879) based on developmental stages, culture stages and sex. Turkish J Fish. Aquatic Sci. 2012; 12:917-924.
19. LeCren ED. The length-weight relationships and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). J Ani. Ecol. 1951; 20:201-219.
20. Ling SW. The general biology and development of *Macrobrachium rosenbergii* (De Man). FAO Fisheries Report. 1969; 57:589-606.
21. Mane Sushant, Sundaram Sujit, Hule Abhay, Sawant Milind, Deshmukh VD. Length-weight relationship of commercially important penaeid prawns of Maharashtra, India. Int. Res. J Sci. Engg. 2019; 7(1):35-40.
22. Ming Yang, Fujiang Ding, Xilin Dai. Length-length, Length-weight Relationships and Condition Factor of the Giant Freshwater Prawn *Macrobrachium rosenbergii* (de Man 1879) Cultured in Earthen Pond at High Density. Asian Fish. Sci. 2016; 29:164-177.
23. Mohanty Sabita Kumari, Mohanty Swati Sucharita, Dash Bisnu Prasad, Pramanik Debansu Sekhar. Length-Weight Relationship and Condition Factor of *Penaeus monodon* Fabricius, 1798 in Northern Odisha, India. Int. J Sci. Res. 2015; 4(4):1300-1304.
24. Nandakumar G. Length-weight relationship and other dimensional relationships of *Metapenaeus monoceros* (Fabricius). J Mar. Biol. Ass. India. 1998; 40(1&2):30-40.
25. New MB. Farming freshwater prawns: A manual for the culture of the giant freshwater prawn (*Macrobrachium rosenbergii*). FAO Fisheries Technical Paper No. 428, Rome, 2002, 212.
26. Olawusi-Peters OO, Ajibare AO, Bello-Olusoji OA. Length-weight relationship and condition factor of shrimps in coastal waters of Ondo State, Southwest, Nigeria. Int. J Fish. Aquat. Studies. 2014; 1(3):16-32.
27. Patel RI, Prasad MN, Mansuri AP. Length-weight relationship and relative condition factor of prawn, *Metapenaeus kutchensis* (George, George & Rao), from Okha (Gujarat). Indian J Fish. 1986; 33(1):127-128.
28. Peixoto S, Soares R, Wasielesky W, Cavalli RO, Jensen L. Morphometric relationship of weight and length of cultured *Farfantepenaeus paulensis* during nursery, grow out, and brood stock production phases. Aquacult. 2004; 241:291-299.
29. Petrakis G, Stergiou KI. Weight-length relationships for 33 fish species in Greek waters. Fish. Res. 1995; 21:465-469.
30. Rajyalakshmi T. Further studies on maturity, breeding, age and growth of the estuarine prawn, *Metapenaeus brevicornis* (H. Milne Edwards). J Inland Fish. Soc. India. 1981; 13(1):57-72.
31. Ramaseshaiah M, Murthy BVSR. Length-weight and total length carapace length relationship of *Metapenaeopsis barbata* (De Haan) from the Visakhapatnam coast. Indian. J Fish. 1997; 44(1):91-95.
32. Sailendra M, Sureshbabu Ch, Srikanth B, Kishore B, Silambarasan D, Jayagopal P. Sustainable Culture method of giant black tiger shrimp, *Penaeus monodon* (Fabricius) in Andhra Pradesh, India. IOSR J Agri. Vet. Sci. 2012; 1(3):12-16.
33. Sarada PT. Fishery and Biology of green water shrimp *Penaeus semisulcatus* (De Haan, 1844) landed at Puthiappa, Kozhikode, Kerala Coast. J Mar. Biol. Ass. India. 2010; 52(1):24-28.
34. Sukumaran KK, Alagaraja K, Suseelan C, Rajan KN, James DB, Subramanian T *et al*. Stock assessment of the penaeid prawn. *Metapenaeus dobsoni* (Miers) along the Indian coast. Indian J Fish. 1993; 40(1 & 2):35-49.
35. Sutton SG, Bult TP, Haedrich RL. Relationships among fat weight, body weight, water weight, and condition factors in wild Atlantic salmon parr. Tran. American Fish. Soc. 2000; 129:527-538.
36. Tsoumani M, Liasko R, Moutsaki P, Kagalou I, Leonardos I. Length-weight relationship of an invasive cyprinid fish (*Carassius gibelio*) from 12 Greek lakes in relation to their trophic states. J Appl. Ichth. 2006;

22:281-284.
37. Udoinyang EP, Amali O, Iheukwumere CC, Ukpatu JE. Length-weight relationship and condition factor of seven shrimp species in the artisanal shrimp fishery of Iko river estuary, southeastern Nigeria. Int. J Fish. Aqua. Stud. 2016; 4(2):109-114.