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Study on length weight relationship and condition factor of whiteleg shrimp *Litopenaeus vannamei* (Boone, 1931) cultured in earthen pond, Khambhat (Gujarat)

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Abstract
The length-weight relationship and condition factor of whiteleg shrimp *Litopenaeus vannamei* were described in present paper. For proposed research work the length and weight of the shrimp was measured from earthen pond of Moriraj Aqua Firm, Rohini, Khambhat taluka of Gujarat state during October 2020. The result shows that mean length, weight and condition factor were signify 11.644±0.040 cm, 18.355±0.249 gm, 1.165±0.009 for length group A, 13.466±0.025 cm, 30.510±0.233 gm, 1.246±0.006 for length group B and 14.480±0.035 cm, 38.550±0.246 gm, 1.268±0.005 for length group C while it was 13.741±0.051 cm, 32.829±0.388 gm and 1.249±0.004 for pooled population. The squire value correlation coefficient (r) depicted a strong linier relationship between the variables, it was ranged 0.674 and 0.828 for different length groups and 0.941 for pooled data. The regression coefficient or growth constant (b) was noted 3.536, 3.462, 3.239 and 3.322 for respective length groups and pooled population which is > 3.0 that indicating positive allometry growth of studied shrimp in earthen ponds.

Keywords: whiteleg shrimp, length and weight relationship, growth and condition factor

Introduction
Aquaculture is rearing of aquatic organisms under controlled or semi-controlled conditions that includes underwater agriculture of aquatic plants and culture of aquatic animals including fish, lobster, shrimp, oyster, crabs, mussels, sea-weeds and clams etc. (Landau, 1992). As of the high demands for shrimp in Europe, Japan, the United states, shrimp aquaculture has extended quickly in entirely the world, especially in humid areas, such as Southeast Asia and Latin America (Lombardi *et al.*, 2006) [17] and *L. vannamei* is the important penaeid shrimp variety cultured globally (Alcivar-Warren *et al.*, 2007; Suriya *et al*., 2016; Khademzadeh and Haghi, 2017) [1, 27, 20] because of its fast growth rate, short cultured period and high export value it's expanded rapidly cross the country (Darvin *et al.*, 2017; Jaganmohan and Leelakumari, 2018) [3, 10]. In a Gujarat state since 1995 culture of *Penaeus monodon* was affected by various infectious diseases and during 2001-2002 onwards most of farmers faced huge economic losses due to disease and sifted to culture of exotic species whiteleg shrimp (*Litopenaeus vannamei*) because this species is specific pathogen free (SPF), specific pathogen resistance (SPR), fast growing at early life stage, easier to culture in very high stocking densities and it is less aggressive in nature. Still, the successful production of shrimp is rest on physico-chemical and biological parameters including length-weight relationship and condition factor are extremely useful tools for understanding the biological changes in aquatics (Shah *et al.*, 2013) [24]. The length-weight relationship has dynamic status in fisheries science to determine possible variances between diverse stocks of the same species (King, 2007) [11], explain the stocks and comparative growth studies (Peixoto *et al*, 2004) [22]. Although shrimp body weight is commonly recorded for culture management purposes including estimations of growth rate, feed conversion ratio, harvest weight and productivity, the application of morphometric relationships could be a simple alternative to estimate body weight from length measurements that are less variable and more easily measured in the field (Gautam *et al*., 2014) [7]. The value of condition factor is an index which is calculated from the weight and length and indicate the interaction among living and non-living factors in the biological condition of the aquatic organisms (Lizama *et al*., 2000; Solanki *et al*., 2020) [16].

It can be used to estimate changes in nutritional condition (Lizama *et al*., 2000; Sutton *et al*., 2000, Lalrinsanga *et al*., 2012, and Mohanty *et al*., 2015; Solanki *et al*., 2020) [26, 28, 14, 19]. In cultured farms, it helps to assess health and habitat conditions such as food accessibility (Hanson and Bajjaliya, 2005; Khademzadeh and Haghi, 2017) [8, 20]. Such kind of study on length-weight relationship and condition factor are important to understand the life cycle of shrimp and contributing adequate management for farming. Therefore, an effort has been made to analyse the length and weight relationship and condition factor (K) of cultured *Litopenaeus vannamei* (Boone, 1931) [2] from earthen-pond which is located at Khambhat (Gujarat).

Materials and Methods

Morphometric data included length and weight of 252 specimens of whiteleg shrimp *L.vannamei* were random measured from earthen pond of Moriraj Aqua Firm located at Rohini village of Khambhat taluka, Gujarat during October 2020. The length of specimen was measured from the posterior margin of the orbit to the tip of endopod of uropod with the help of digital Vernier calliper with accuracy of ±0.02 mm and weight were taken by using an electronic balance to the nearest 0.01 gm. These length data were categorised in three groups at the distances of 2.00 cm e.g., 10.000 - 12.000 cm, 12.001- 14.000 cm and 14.001 -16.000 cm which were nominated as A, B and C respectively.

The length-weight relationship was calculated by nonlinear power function $Y= a X^{b}$ (Ricker, 1973) and simple linear regression analysis using the equation Log (W) = log (a) + b log (L) (Pauly, 1983) [21]. The condition factor (K) was determined from the equation $K=W/L^3\times100$ (Htun-Han, 1978) [9], where K is condition factor, W is weight in gram, L is total length in cm.

Result and Discussion

In present study, length 11.365-15.325 (13.741±0.051) cm and weight 16.850-46.040 (32.829±0.388) gm were observed for the pooled population whereas, length and weight were noted 11.365-11.890 (11.644±0.040) cm and 16.850-20.590 (18.355±0.249) gm for length group A, 12.685-13.989 (13.466±0.025) cm and 23.980-37.300 (30.510±0.233) gm for length group B and 14.085-15.325 (14.480±0.035) cm and 34.700-46.040 (38.550±0.246) gm for length group C (Table 1). The result table 2 depicted that length group B was dominated containing 136 (54%) of the population followed by length group C 99 (39%) and length group A 17 (7%). The findings of Fatima, (2000) [4] for penaeid shrimps (Tandel, 2020) [29] for whiteleg shrimp supports the current results, while dominancy of younger shrimp and dominancy of elder shrimp in the population was reported by Fatima, (2001) [21] and Solanki *et al*., (2020) [26] respectively.

The length-weight relationship allows for conversion of growth-in-length to growth-in-weight in standard valuation models (Silva *et al.,* 2015) [25]. The variables (length and weight) show the straight-line graph and correlation coefficient (r^2) was noted 0.828, 0.674, 0.772 and 0.941 for length group A, B, C and pooled data respectively which indicate the positive and strong linear relation between the variables (Table 2 and Fig. 1A to 1D). The growth constant or regression coefficient (b) was observed 3.536 for length group A, 3.462 for length group B, 3.239 for length group C and 3.322 for pooled population (Table 2). In present study the value of (b) was noted >3.0 which indicated that growth of the studied shrimp is positive allometric which express that growth of shrimp was abnormal and increase in weight was more with respect to length. Udoinyang *et al*., (2016) [30] reported isometric growth while Mane *et al*., (2019) [18] reported positive allometric growth. The similar finding on this aspect were also reported by Konan *et al*., (2014) [14] and Khademzadeh and Hanghi, (2017) [20]. Consequently, length weight relationship is convenient guide or tool to compute the variation in growth of specific prawn or group of prawns in natural and cultural environments (Froese, 2006) [6].

The factor of condition reflects, through its variations, information on the physiological state of the fish in relation to its welfare. In present study, the condition factor (K) was observed 1.128-1.257 (1.165±0.009) for length group A, 1.144-1.404 (1.246±0.006) for length group B, and 1.151-1.369 (1.268±0.005) for length group C and 1.228-1.404 (1.249±0.004) for pooled population (Table 2). The resulted value of K was more than one which indicated that the condition of studied shrimp population was uniform, good and length group-based condition differences were not observed in the studied species. Similar findings for K value in *P.monodon* were reported by Mohanty *et al*., (2015) [19] from Odisha and Mane *et al.* (2019) [18] from Maharashtra. In contradicting the present findings less than 1.0 value of K was reported in *P.penicillatus* (Kunda *et al*., 2008) in *L.vannamei* (Tandel, 2020) [29] and in *P. monodon fabricius* (Solanki *et al*., 2020) [26].

Table 1: Length weight observation in earthen pond

Length group	TL (cm)	Weight (gm)	Condition factor (k)
A	11.365-11.890 11.644±0.040	16.850-20.590 18.355±0.249	1.128-1.257 1.165±0.009
B	12.685-13.989 13.466±0.025	23.980-37.300 30.510±0.233	1.144-1.404 1.246±0.006
C	14.085-15.325 14.480±0.035	34.700-46.040 38.550±0.246	1.151-1.369 1.268±0.005
Pooled	11.365-15.325 13.741±0.051	16.850-46.040 32.829±0.388	1.228-1.404 1.249±0.004

Table 2: Statistical values of intercept, slope and co-efficient of correlation and regression.

Length group	n	a	b	r^2
A	17	-2.507	3.536	0.828
B	136	-2.427	3.462	0.674
C	99	-1.014	3.239	0.772
Pooled	252	-2.270	3.322	0.941

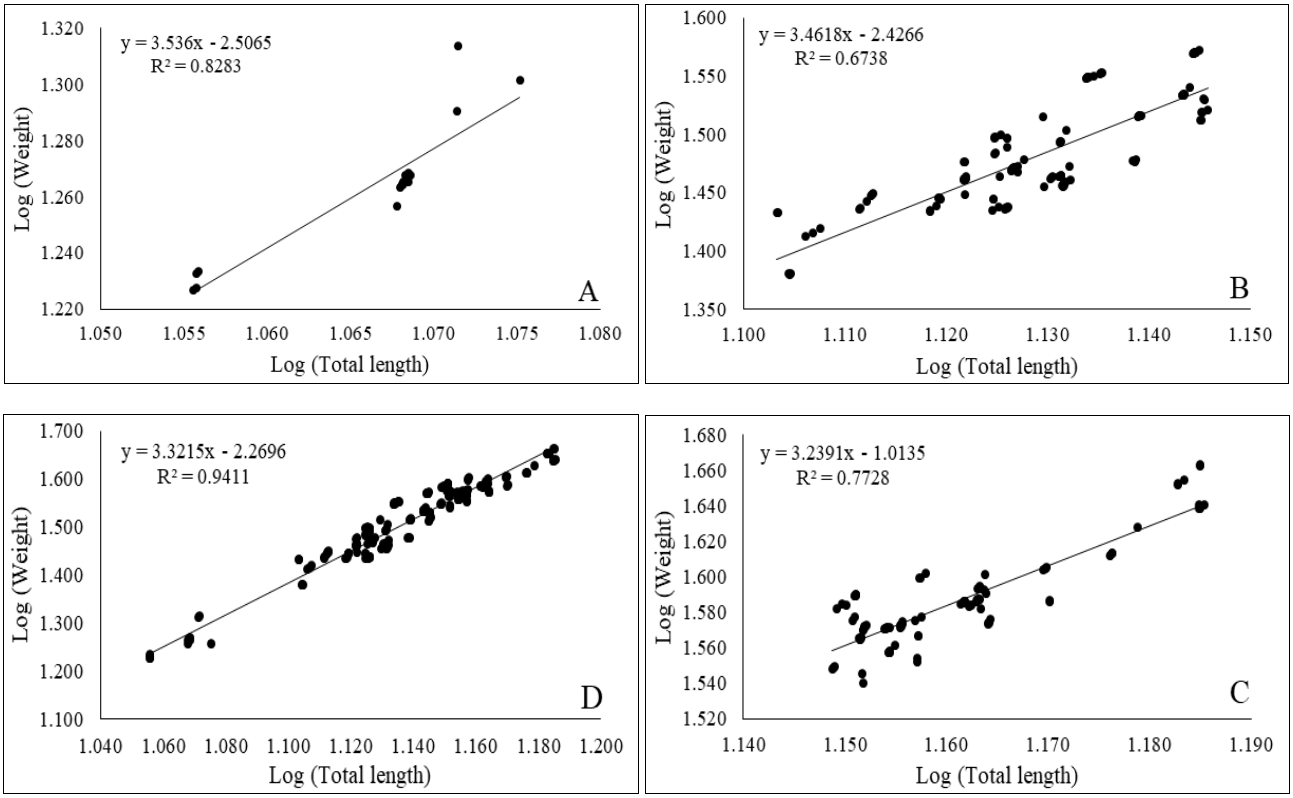

Fig 1: Length - weight relationship of *L. Vannamei* cultured in earthen pond (A is for length group A, B is for length group B, C is for length group C and D is for pooled population)

Conclusion

On the basis of the length weight relationship and condition factor findings it can concluded that the growth of studied shrimp was positive allometric because growth constant of studied shrimp was >3.0 which indicated that growth of shrimp was abnormal and increase in weight was more with respect to length. Similarly, the value of condition factor was > 1.0 which is also indicate that condition of the shrimp was more than good. Although environment of cultured pond was conducive for the shrimp but to achieve optimum and economic growth there is need to alter the farm operation practices.

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