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Length-weight relationship and condition factor of white leg shrimp *Litopenaeus vannamei* (Boone, 1931) in culture systems of Choebdeh, West-South of Iran

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Abstract
In present study, 634 individual was investigated. The samples were selected from a cultural farm in Choebdeh fisheries site, close to Abadan city in the west-south of Iran. Weight and length of each sample were measured. The average weight and length of *Litopenaeus vannamei* were 8.96± 0.15(gr) and 11.82±0.07 (cm), respectively. The specific growth rate per days and condition factor (K) average were measured as 4.90% and 0.56. Length–weight equation was $Y = 0.0108\ X^{2.6935}$ with b parameter value of 2.6935 and $R^2 = 0.8895$. Therefore, a negative allometry was observed. It seems that, the ecological indices in cultured shrimps provide useful information from cultural condition to the farmers and aquaculture experts. In such a way, even minor fluctuation in feeding amounts, quality or quantity of inflow water and other parameters appear in these indices. The managers could use these indices to assess individual health and habitat conditions and decrease handling.

Keywords: Length-weight relationship, condition factor, white leg shrimp, *Litopenaeus vannamei,* culture systems, cultural condition

1. Introduction

Shrimps are highly priced seafood harvested from coastal tropical and warm-temperature waters throughout the world. Shrimps support commercially valuable fisheries in many areas of the world [1]. In recent decades, because of the high demand for shrimps, shrimp aquaculture has expanded rapidly in all around the world [2]. After worldwide spreading of with spot and other viral disease, disaster mortality and sever damages and economic losses occurred in shrimp culture systems, particularly in Asia. It is now evident that *L. vannamei* is farmed and established in several countries in East, Southeast and South Asia and is playing a major role in shrimp aquaculture production [3].

In Iran, *Penaeus indicus* was the main and major cultivating shrimp species infected by continues outbreaks of with spot syndrome virus since 2002. White spot disease has spread all around countries farms and caused large scale mortalities and severe damage to shrimp culture, leading to massive economic losses. Recently, non-native species *Litopenaeus vannamei* is cultured in aquaculture sites because of worldwide facing of the disease outbreaks [4]. Choebdeh is one of the biggest shrimp culture site in Iran and situated in 50 km from Abadan city. The *L. vannamei* has been introduced and farmed in south coasts of Iran since 2005 on a commercial scale, because of the availability of Specific Pathogen Free and Specific Pathogen Resistant brood stock. The last year, 32 farms were activated there and produced 1360 tons of *L. vanname* [5].

L. vannamei is native of pacific coast of Mexico and Central and South America as far south as Peru. It is mainly found on mud bottoms, down to a depth of 75 m. It is commonly known as white legged shrimp or Mexican white shrimp. It is greyish-white in color. The maximum weight of the females in the wild is about 120 g. The males are smaller at 60-80g. It lives in the column and prefers clayey loam soil. For *L. vannamei* the growth at 30 °C is much higher than at 25 °C. The optimal range of temperature for the species is between 30 and 34 °C. It can tolerate salinity levels of 0 to 50 ppt. Growth is uniform within 10-40 ppt. They can grow in fresh water also but the growth is slower below 10 ppt. pH range of 7 to 9 is tolerated with optimal growth at pH 8.0. Dissolved oxygen levels above 4.5 ppm are required for optimal growth [6].

Nowadays, the white leg shrimp *L. vannamei* is the most important penaeid shrimp species farmed worldwide [7].

Length-weight relationship and condition factor are extremely useful tools for understanding the biological changes in aquatics [8]. The length-weight relationship is a very useful tool in fisheries assessment. It is usually easier to measure the length of a specimen than the weight, and weight can be predicted later on using the length-weight relationship. Furthermore, standing crop biomass can be estimated [9] and seasonal variations in aquatic growth can be tracked in this way. The length-weight relationship also helps in predicting the condition, reproductive history and life history of aquatic species [10] and in morphological comparison of species and populations [11]. The condition factor is often associated with fitness, that is, a poor condition can manifest as several negative fitness consequences for the individual and fish populations. Somatic growth potential of aquatics can be reduced. Reproductive success can be reduced through a number of factors like lower fecundity, poor quality eggs and sperms. Additionally, poor condition may also lower the chances of survival.

In addition, to many applications in fishing and fish stocks assessment, Length- weight relationship could be an useful help for reducing human manipulations in cultured farms. With the knowledge of the Length- weight relation in the culture systems, we could measure the weights just by measuring the length of a sample of the population. Also, it is possible to determine biomass and growth fluctuations in culture period [9]. Furthermore, because of close relation between diet and growth fluctuations, it could be use this index for farm feeding management.

Length-weight and condition factor analysis can be used as a tool to assess the current and previous health and condition of aquatics. The condition factor provides a general indicator of the overall health of an individual that detect and assess potential changes in the length-weight relationship among years and locations. In cultural farms, condition factor and length-weight regression analysis have been used to assess individual health and habitat conditions such as food accessibility [12].

There are some studies on ecological indices of shrimp species in natural ecosystems [6]. In addition, some investigation studied these indices for cultured aquatic species in marine, brackish and freshwaters [13, 14]. Individual length and weight of wild shrimp species were recorded over a period of several years during the south coasts of Iran Bottom Trawl conducted annually by the Iranian fisheries science research institute, and usually, the resulting length-weight relationship has been used for the calculation of spawning stock biomass from female numbers by length. In cultural systems, there are some studies on *L. vannamei*, but most of them were in the fields of natural or formulated diets and the effects on growth, hematology indices or histopathology factors. A review of the literature reveals a fairly large amount of information on various aspects of the biology and culture of the common penaeid shrimps of Iran. However information on the length-weight relationships of shrimp in culture conditions is very limited. A study was therefore conducted to investigate the length-weight relationships of *L. vannamei* in culture farming systems.

2. Materials and Methods

The shrimp 9 days old post larvae *L. vannamei* at beginning the study were transferred from hatchery. The water takes from Bahmanshir River pumped to the farms by PVC pipe. Bahmanshir has brackish water and affected by tidal cycle of Persian Gulf. The pH, temperature, salinity and DO ranges were measured twice daily. The formulated diet was given made by local manufacture. On the 38th day of stocking and thereafter every week, specimens were collected randomly from each pond and their average± standard error length and weight were determined. The specimens were belonging to nine ponds in a farm. Length-weight relationships of shrimps were worked out by simple linear regression analysis using the equation $\log W = \log a + b \log L$ [15] for 634 individuals. The average allometric growth is usually described by the nonlinear power function $Y = a X^b$ [16]. In the present study, Y is the dependent variable, representing the measurements of the body parts or the total body weight; X is the independent variable (Carapace Length); a is the intercept on the y-axis; and b is the allometric growth coefficient. Regarding to the b value, the following three types of growth were showed: when b=3, the type of growth is described as isometric; when $b > 3$, the growth type is positively allometric; and whenb < 3, the growth type is negatively allometric. The condition factor (k) of the shrimps was estimated from the relationship. Where K = Condition factor, W = Weight of shrimps (g), L = Total Length of shrimps (cm).

$$K = \frac{1000w}{CL^3}$$

Specific growth rate was calculated as below:

$$SGR = \frac{\ln(final\ weight) - \ln(initial\ weight)}{Time\ period} \times 100$$

3. Results

The most water quality parameters were measured twice daily, in the morning and evening in all nine ponds. The average pH recorded during the culture period was from 8.54 to 8.61 in the morning and 8.66 to 9.39 in the evening. Dissolved oxygen measuring three times daily at 5 Pm, 00 Am and 5 Am. The average dissolved oxygen was ranging between 6.72 to 7.25 in the evening, 4.97 to 5.62 in midnight and 3.92 to 4.86 ppm recorded in the morning. Maximum dissolved oxygen level observed in the evening. The temperature was ranged between 24.6 to 34.4 ˚C in all culture ponds. The salinity level maximum was 35 and minimum 26 ppt was noticed in all culture ponds. All environmental parameters were similar in different ponds except of salinity. Due to river distance the salinity showed some fluctuation in different ponds. However, there were not any significant differences in shrimp length, weight or other growth indices. Thus, the whole shrimp farms were considered as a unit population.

Totally, weight and length of 634 individual was measured. The average weight and length of *Litopenaeus vannamei* 8.96±0.15(gr) and 11.82±0.07 (cm), respectively. The specific growth rate was 4.90% per days during study period. The length and weight fluctuation was measured weekly and the results shown in the Figure 1. The condition factor (K) which shows the state of overall well-being of shrimps in this study is given in figure 2 and its average was 0.56. The weekly value showed some fluctuations but there were no significant differences in condition factor amounts.

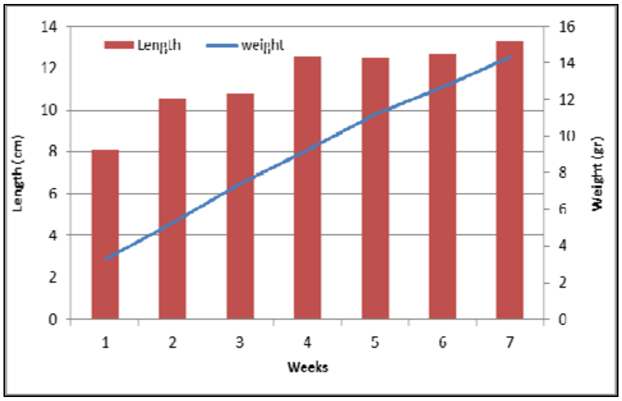

Fig 1: the fluctuation of length and weight parameter in cultured *L. vannamei* during study period

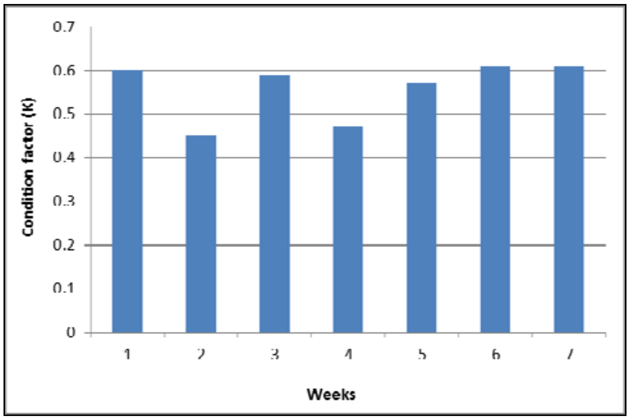

Fig 2: weekly value of condition factor (K) in cultured *L. vannamei* during study period

For growth pattern investigation in cultured *L. vannamei*, length –weight regression was measured for all sampling specimens. The equation was Y = 0.0108X2.6935 with b parameter value of 2.6935 and R^2=0.8895 and a negative allometry (b < 3) was observed (Figure 3). For these shrimps, the increase in weight of the shrimps occurred at a slower rate than did the increase in carpace length.

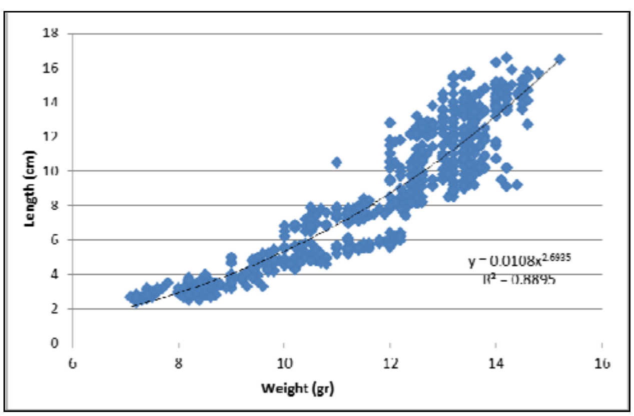

Fig 3: Length- weight relationship of cultured *L. vannamei* during study period

4. Discussion

Mathematical models of fish growth offer an objective and practical method for describing patterns of growth data and estimating fish weight at times between sampling intervals. Accurate estimations of standing biomass and therefore, of the amount of feed that must be provided, are vital to aquaculture management. An accurate length-weight relationship equation allows for the conversion of growth-in-length to growth-in-weight in stock assessment models, as well as the estimation of biomass from the length frequency distribution, condition and morphological characteristics of fish populations the relationship equation, thus, is an important aquaculture management tool [14].

Growth, which is defined as a change in magnitude, can be measured in size and tissue composition and represents one of the most significant parameters in aquaculture. The body composition of fish has recently received attention in studies on nutrition, genetics, and health because of the increasing interest in the quality and safety of fish products. Body composition is an important aspect of nutritional quality [17] and affects the nutritional value and consumption quality of fish. So, length- weight relationship recognition could be presented useful information for feeding strategy, culture system management and even aquaculture marketing.

Shrimp body weight is commonly recorded for culture management purposes to estimations of growth rate, feed conversion ratio, harvest weight, and productivity and 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 and culture condition. Therefore, the use of morphometric measurements and mathematical models in aquaculture is highly encouraged because that is the most precise and complete way of analyzing growth data with more less handling [6].

According to pervious study, extremely significant differences in the total length-weight ratio and condition factors were noticed in the *L. vannamei* broodstock collected from different hatcheries along coastal water [6]. Therefore, a length–weight relationship study is a useful index for measuring variation in the growth of an individual prawn or a group of prawns in natural and cultural conditions [18]. In the present study, high values of coefficients of determination (r^2=0.8895) suggested that body length is the best predictor of shrimp weight. This is agrees with the results of other reports such as Konan *et al*., 2014. Analysis of parameter b showed the negative allometry (b < 3) and it means, the increase in weight of the shrimps occurred at a slower rate than did the increase in carpace length. Fulton [19], who reported that even within species the length–weight ratio, varies slightly across different habitats. Because, the length–weight relationship can be affected by several factors, including habitat, area, seasonal effects, degree of stomach fullness, gonad maturity, sex, health, preservation techniques and differences in the observed length of specimens [20].

Environmental changes affected not only the growth but also the shape of *L. vannamei*. Under our culture conditions, differences in morphometrics among culture phases may also reflect variability in environmental parameters (e.g. temperature and salinity), feeding and rearing conditions (e.g. stocking densities) employed for each culture phase. While shrimp growth was commonly reported in terms of body weight, length measurements have been considered a less variable and easier means to record in the field. Although knowledge of the size structure at different culture stages is important for management decisions, instead of direct weighing, shrimp body weight can be inferred from body length that was more readily measured [6].

The condition factor shows a rather good condition for shrimp growth with a minor fluctuation in this cultural condition with daily specific growth rate of 4.90%. That is optimum weight gain. The condition factor fluctuation could be due to some changes in environmental parameter. Based on figure 2, there is some decreasing in week 2 and 4 in this index. Probably, increasing humidity degree and consequently oxygen depletion in pond water caused these changes. Because this problem solved by using extra aerator in ponds.

5. Conclusion

The results showed that, ecological indices in cultured shrimps provide useful information from cultural condition to the farmers and aquaculture experts. In such a way, even minor fluctuation in feeding amounts, quality or quantity of inflow water and other parameters appear in these indices. Length- weight relationship and condition factor in captive condition dependent on culture system quality and quantity and have lower operational costs than other specific aquaculture indices. Thus, it is suggested the information of these indices recorded by farmers for investigating cultural condition for more desirable management.

6. References

1. Ajani EG, Bello OB, Osowo O. Comparative condition factor of two Penaeid shrimps, *Penaeus notialis* (Pink shrimp) and *Penaeus monodon* (Tiger shrimp) in a coastal state, Lagos, South West Nigeria. Nature and Science. 2013; 11:1-3.
2. Lombardi JV, De Almeida MHL, Toledo LPR, Salee BOJ, De Paula EJ. Cage Polyculture of the Pacific white shrimp *Litopenaeus vannamei* and the Philippines Sea weed Kappaphycusalvarezii. Aquaculture. 2006; 258:412-415.
3. Balakrishnan G, Peyail S, Ramachandran K, Theivasigamani A, Savji KA Chokkaiah M, Nataraj P. Growth of Cultured White Leg Shrimp *Litopenaeus vannamei* (Boone 1931) In Different Stocking Density. Advances in Applied Science Research. 2011; 2:107-113.
4. Shyne Anand PS, Pillai SM, Kumar S, Panigrahi A, Ravichandran P, Ponniah AG, Ghoshal TK. Growth, survival and length weight relationship of *Fenneropenaeus merguiensis* at two different stocking densities in low saline zero water exchange brackish water ponds. Indian Journal of Geo-Marine Science. 2014; 43:1-12.
5. Iranian Fisheries Organization. Iranian Fisheries Organization Performance Report. 2016, 86 (In Persian).
6. Gautam K, Nazar AR, Anand Ganesh E, Mahendran S, Mahadevan G. Study of length and weight relationship of *Litopenaeus vannamei* (Boone 1931) from east coast of India. International Journal of Science Inventions Today. 2014; 3:365-376.
7. Alcivar–Warren AD, Meehan–Meola S, Won P, Xu Z, Delaney M, Zuniga G. Journal of Shellfish Research. 2007; 26:1259-1277.
8. Shah TH, Ul Hassan Balkhi M, Asimi OA, Khan I**.** Length weight relationship and ponderal index of rainbow trout (*Oncorhynchus mykiss* W., 1792) from Dachigam stream in Kashmir. African Journal of Agricultural Research. 2013; 8:1277-1279.
9. Morey G, Moranta J, Massuti E, Grau A, Linde M, Riere F *et al*. Weight-length relationship of littoral to lower slope fishes from the Western Mediterranean. Fisheries Research. 2003; 62:89-96.
10. Nikolsky GW. The ecology of Fishes. Academic Press: London and New York, 1963, 352.
11. King RP. Length-weight relationships of Nigerian freshwater fishes. Fish Byte. 1996; 19(4):53-58.
12. Hanson CH, Bajjaliya F. Analysis of the condition of rainbow collected form Kings river downstream of pine flat dam 1983-2005. Hanson Environmental, Inc., 2005, 14.
13. Biswas G, Sundaray JK, Thirunavukkarasu AR, Kailasam M. Length-weight relationship and variation in condition of *Chanos chanos* (Forsskal, 1775) from tide-fed brackish water ponds of the sunder bans- India. Indian Journal of Geo-Marine Sciences. 2011; 40:386-390.
14. Silva TSC, Santos LD, Silva LCR, Michelato M, Furuya VRB, Furuya WM. Length–weight relationship and prediction equations of body composition for growing-finishing cage-farmed Nile tilapia. Revista Brasileira de Zootecnia. 2015; 44:133-137.
15. Pauly D. Length-converted catch curves: A powerful tool for fisheries research in the tropics. Part 1-Fishbyte. 1983; 1:9-13.
16. Ricker WE, Linear regression in fisheries research. J Fish Res Board Canada. 1973; 30:409-434.
17. Breck JE. Body composition in fishes: body size matters. Aquaculture. 2014; 433:40-49.
18. Froese R. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. Journal of Applied Ichthyology. 2006; 22:241-253.
19. Konan KM, Ouattara A, Da Costa KS, Ade´po-Goure`ne AB, Goure`ne G. Allometric growth and condition factor of West African shrimp, *Macrobrachium vollenhovenii* (Herklots, 1857), in the rivers of Coˆted'Ivoire. Marine and Freshwater Research. 2014; 65:849-856.
20. Fulton TW. The rate of growth of fishes. 22nd Annual Report of the. Fishery Board of Scotland, 1904; 3:141-241.