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Length-Weight Relationship and Condition Factor of *Penaeus monodon* Fabricius, 1798 in Northern Odisha, India

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Abstract: ***Post larvae of Penaeus monodon were collected from cultured ponds in the coastal areas of northern Odisha in 2009.Length and weight measurements were taken every 30 days interval for the study of growth and length-weight relationship. The regression coefficient (r^2) was calculated to be 0.980, 0.982 and 0.979 for males, females and pooled samples. From regression equation 'b' values were traced for males (2.340), females (2.573) and pooled samples (2.454).The result demonstrated that lesser 'b' values in all cases correspond to slender growth of the samples indicating allometric growth.***

Keywords: Shrimp, Length, weight, Condition factor, Morphometry, regression

1. Introduction

The giant tiger shrimp, *Penaeus monodon* is the major species cultured and constitutes about 95-99% of total farmed shrimp production in the country [1]. It has the fasted growth rate among a number of penaeid species reared in captivity [2]. *P.monodon* is euryhaline and tolerates wide variations in salinity. The culture of shrimp has received maximum importance due to its high nutritive value, unique taste and high market value.

Length-weight relationships are important for a wide range of studies, such as estimating growth rates, age structure and shrimp population dynamics [3].Variations of length-weight relationship is an indicator in fishes and crustaceans that reflects fluctuations of uptake and allocation of energy. Further variations are affected by many factors such as food, stress due to overcrowding or reproductive cycle. The ratio also varied among sexes, species and seasons in both wild and cultured populations of *P.monodon* [4], [5]. Length-weight relationship between the two variables [6] is studied to determine the growth and possible differences among different stocks of the same species [7], [8].

The condition factor (K) is an index reflecting interactions between biotic and abiotic factors in the physiological condition of the fishes. Though condition factor indicates the general body condition not the biochemical characteristics [9] but the body condition could be a useful complement in invitro proximate composition analysis [10, 9, and 25]. However, the report on morphometric analysis on the basis of length-weight parameters and conditional factor (K) of *P.monodon* of coastal waters of Bay of Bengal along north east coast of Bhadrak, Balasore district of Odisha is limited. Although the water body of Bay of Bengal was studied by authors like [11] and [12] on various aspects including fish availability but the marine shrimps like *P.monodon* was not studied in wild condition or in captive condition. Hence an attempt has been made to study the penaeid shrimp (*P.monodon*) in cultured ponds along the coastal belts of northern Odisha.

2. Materials and Methods

2.1 Study site

The shrimp samples were collected from the ponds of S.R. Aquafarm pvt. Ltd. present at Kasaphala, Balasore in the district of Balasore and Albatross Aquafarm Pvt.Ltd.at Karanpali, Baincha in the district of Bhadrak for quantitative and qualitative analysis. The farms are situated along coastal belts of Bay of Bengal, Odisha. Balasore is situated between 20^0 48' -21^0 29' N(Latitudes) to 86^0 16' -87^0 29' E (Longitudes). Bhadrak is situated between 20^0 43' -22^0 11' N (Latitudes) to 82^0 39' -85^0 13'E (Longitudes).The coastal area along Bay of Bengal has high productivity [11] which support a large diversity of fishes and crustaceans.

2.2 Data Collection

The samples of shrimp were studied from the cultured ponds at different stations at an interval of 30 days during 2009-2010.The samples were identified and males and females were sorted by observing thelycum and petasma features [13,14].The length-weight was measured and conditional factor (K) was calculated from this. The total length (L) of each shrimp was measured from the tip of the rostrum to the end of the telson to the nearest 1mm. with a measuring board. Weight (W) was measured to the nearest 0.01 gm. by an electronic balance (Wensar model no PGB 600 India) after wiping the moisture on the body of the shrimp. Regression analysis and Analysis of variance (ANOVA) was calculated using software SPSS version 16.0.The length-weight relationship was calculated by the equation $W = aL^b$ where W is the total body weight (mg),L is the total length (cm), 'a' is a coefficient related to the body form and 'b' is exponent indicating isometric growth when equal to 3 [15].Parameters 'a' and 'b' were estimated by linear

regression on the transformed equation: Log_{10} (W) = Log_{10} a + Log_{10} (L).

3. Result

The length of *P. monodon* of 30 days ranged from 2.15 ±0.15cm to 3.85 ±0.85cm in females whereas the males ranged from 2.17 ±0.25 to 3.00 ±0.17cm.The average length of *P. monodon* 60 days was found to be 6.55 ±0.35cm in females and 5.71 ±0.28cm in males. The mean length of 90 days female *P. monodon* was found to be 10.70 ±0.37cm in females to 8.15 ±0.35cm in males and the length of 120 days females was found to be 15.85 ±0.25cm whereas the mean length of males was found to be 14.35 ±0.35cm.

The average weight of 30 days male and female *P. monodon* (PL) was found to be 2.89 ±0.13 gm and 3.00 ±0.15 gm but in infected ponds the 30 days *P. monodon* weighed about 2.15 ±0.13gm and 2.26 ±0.16gm.The average weight of healthy 60 days, 90days and 120 days old PL was found to be 5.76 ±0.34gm, 18.70 ±0.15gm and 34.15 ±0.35gm.But the average weight of infected *P..monodon* of 60 days, 90 days and 120 days were found to be 4.34 ±0.15gm, 16.24 ±0.17gm and 25.00 ±0.39gm.

Analysis of variance with two factors (ANOVA) was calculated among stations (ponds) of both the districts between station and age (30 days to 120 days) and the result showed that the length-weight relationship did not show any significance among stations (F =1.496 and F =1.268 where P =0.234 and 0.302).But the length-weight as well as condition factor (K) showed highly significant value among different age groups like 30 days,60 days,90 days and 120 days (F=6184.25 and 5197.64 and). No significant value was found among stations and age groups (Table 1).

Table 1: Two way analysis of variance of length, weight and condition factor in *P.monodon*

Analysis of variance with two factors (pooled)						
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Station	Length	.536	3	.179	.510^{NS}	.676
	Weight	4.554	3	1.518	.697^{NS}	.557
	CF	14.571	3	4.857	1.129^{NS}	.343
Age	Length	1998.498	3	666.166	1900.08**	.000
	Weight	12303.71	3	4101.238	1883.15**	.000
	CF	981.474	3	327.158	76.019**	.000
Station * age	Length	2.583	9	.287	.819^{NS}	.601
	Weight	9.027	9	1.003	.461^{NS}	.897
	CF	42.596	9	4.733	1.100^{NS}	.373
Error	Length	28.048	80	.351		
	Weight	174.229	80	2.178		
	CF	344.293	80	4.304		
Total	Length	8676.181	96			
	Weight	30781.49	96			
	CF	2716.842	96			
Corrected total	Length	2029.666	95			
	Weight	12491.52	95			
	CF	1382.934	95			
a. R Squared = .986 (Adjusted R Squared = .984)						
b. R Squared = .986 (Adjusted R Squared = .983)						
c. R Squared = .751 (Adjusted R Squared = .704)						

For the length-weight relationship, the estimates of the regression parameters for males and females and pooled value were obtained by regression analysis are shown in table 2. The equation of length-weight relationship and their logarithmic transformation was represented in table 1. The degree of association between the length and weight was computed from the linear regression analysis by the coefficient of determination of (r^2). Correlation coefficient (r) values were obtained by calculating the regression parameters as r= 0.980 for males, r=0.982 for females and r=0.979 for pooled value and were found to be significant at $p \leq 0.05$, indicating good correlation between length and weight of *P. monodon* (Table 2).

Table 2: Length-weight relationship parameters and condition factor (K) of *P.monodon*

Source	n	Length		Weight		Regression parameters			CF (K)
		Min	Max	Min	Max	a	b	r^2	
Male	48	2.00	15.50	1.50	31.05	-5.571	2.340	0.980	4.551±0.690
Female	48	3.05	15.93	1.80	34.00	-7.806	2.573	0.982	2.903±0.328
Pooled	96	2.00	15.93	1.50	34.00	-6.623	2.454	0.979	3.727±0.389

From the regression equation obtained in the present study, it is clear that the 'b' values traced for males (2.340) and females (2.573) and for pooled sample (2.454) which was lower than 3. The condition factor obtained in the present

study ranged from 2.903±0.328 in females to 4.551±0.690 in males (Table 2). Thus males exhibit higher K value than females.

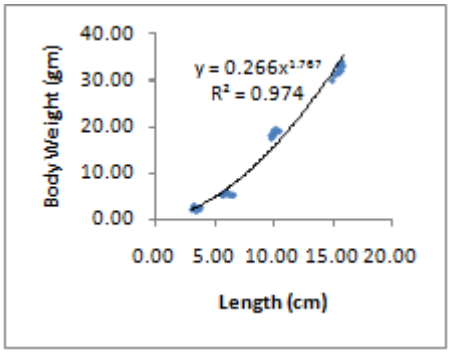

Figure 1: Parabolic relationship between Length and weight of female *P.monodon*.

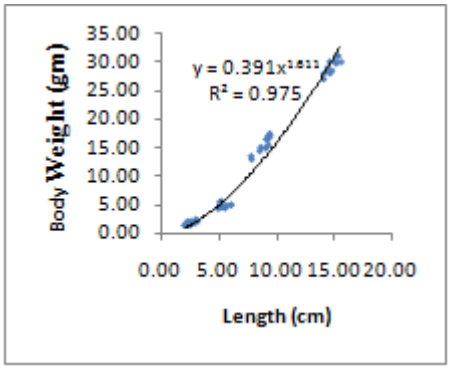

Figure 2: Parabolic relationship between length and weight of male *P.monodon*.

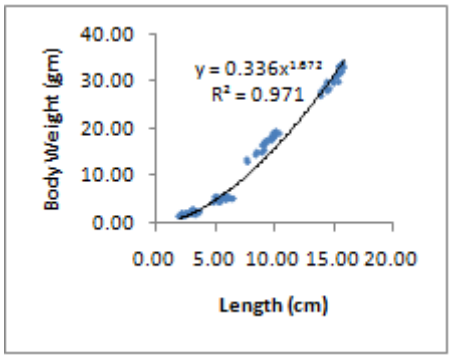

Figure 3: Parabolic relationship between Length and weight of pooled *P.monodon*.

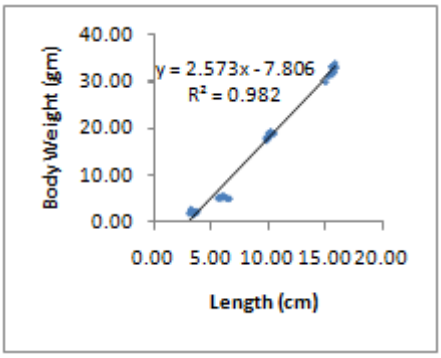

Figure 4: Linear relationships between length and weight in female *P.monodon*.

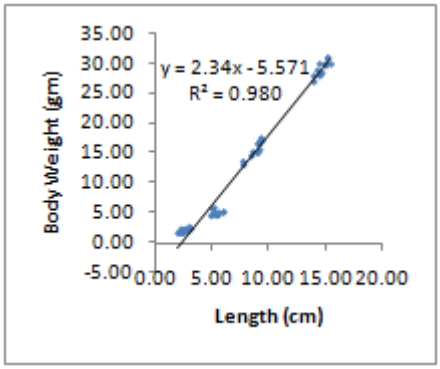

Figure 5: Linear relationship between length and weight in male *P.monodon*.

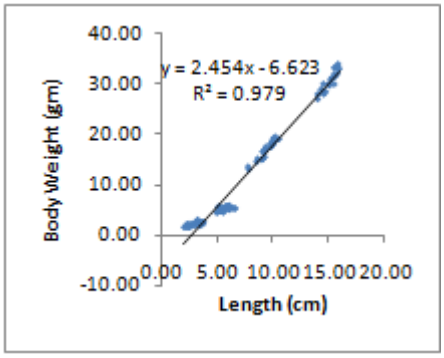

Figure 6: Linear relationship between length and weight in pooled *P.monodon*.

4. Discussion

Generally shellfishes and crustaceans maintain dimensional equality and the length-weight slope value less than 3 which indicate that the animal becomes slender as it increases in length where as the slope having value greater than 3 represents stoutness indicating allometric growth [16],[9]. The parameters of length-weight relationships estimated in the present study were within the ranges and also demonstrated by several workers as [17],[9] and [18]. The parabolic relationship between length and weight of females, males and pooled *P. monodon* is plotted in Figs.1, 2 and 3 respectively. Similarly the logarithmic values of observed length and corresponding weights of males, females and pooled *P. monodon* are plotted in Figs. 4, 5 and 6 respectively. The use of total length to determine length weight morphometric relationships has been widely applied for penaeids [19, 20, 21, and 5]. The growth rate of animals varied widely which depend upon developmental stages [5].In case of females the parabolic relationship between length-weights (Fig.1) showed isometric growth pattern. The higher slope of grow out may be due to developmental pathway of male prawn [16].In contrast, the females did not show any significant differences although showed higher slope. Bigger female sizes might be due to greater weight, increase per molt cycle leading to faster growth rate [22].But separation of morphometric relationships according to sexes may not be important for penaeids at certain life stages [19,23,21]. Further [5] had reported that morphometric dimorphism due to sex was observed only after the brood stock stage in captivity when females showed greater body weight per unit length in *P. monodon*.

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 [24].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. Further [16] has demonstrated that a condition factor (K) and relative condition factor (K_n) as 1.09 and 1.00 in *Macrobrachium rosenbergii*, suggesting good condition of the prawn .

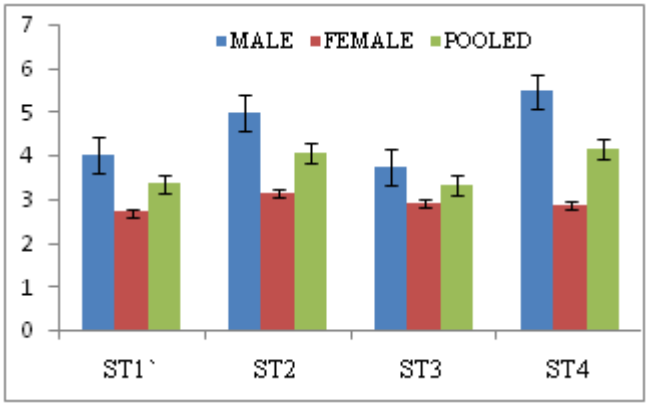

Figure 7: Condition factor (K) for male, female and pooled *P.monodon* in four stations.

In the present study the significantly higher K value in (Fig.7) growing animals (males and females) may be attained due to maturity of shrimps [9].The present results revealed that condition factor of shrimp may also be considered as an indicator of management efforts in a culture system.

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References

[1] M Sailendra,Ch. Sureshbabu, B.Srikanth,B.Kishore,D.Silambarasan,P.Jayagopal.Sustainable Culture method of giant black tiger shrimp,Penaeus monodon (Fabricius) in Andhra Pradesh, India.IOSR Jour.of Agri.and Veterinary Sc.Vol 1,issue 3:pp 12-16,2012.

[2] L.R.N.Foster and T.W.Beard.Experiments to assess the suitability of nine species of prawns for intensive cultivation.Aquaculture (3):584-586,1974.

[3] M.Tsoumani, R. Liasko, P. Moutsaki, I.Kagalou and I.Leonardos. Length-weight relationship of an invasive cyprinid fish (*Carassius gibelio*) from 12 Greek lakes in relation to their trophic states. Journal of Applied Ichthyology. *22*, 281-284,2006.

[4] C.T.Fontaine and R.A.Neal.Lenth weight relations for three commercially impotant penaeid shrimp of the Gulf of Mexico.Transactions of the American fisheries society,3:584-586.1971.

[5] J.H. Primavera,F.D.Parado-Estepa and J.L.Lebata. Morphometric relationship of length and weight of giant tiger prawn *Penaeus monodon* according to life stage, sex and source. Aquaculture, 164: 67–75.1998.

[6] E.D Le Cren. The length-weight relationships and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). J. Ani. Ecol., 20: 201-219.1951.

[7] G.Petrakis and K.I. Stergiou. Weight-length relationships for 33 fish species in Greek waters. Fish. Res., 21: 465-469. 1995.

[8] M.King. Fisheries biology, assessment and management. Second Edition. Blackwell Scientific Publications, Oxford, 1-381.2007.

[9] P.L. Lalrinsanga, B.R.Pillai, K.D.Mahapatra, L.Sahoo, R.W.Ponzoni,N.H. Nguyen, S.Mohanty, S.Sahu, V.Kumar, G.Patra, and S.Patnaik. 2012. 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.

[10] S.G.Sutton, T.P Bult and R.L.Haedrich. Relationships among fat weight, body weight, water weight, and condition factors in wild Atlantic salmon parr. Tran. American Fish. Soc., 129: 527–538.2000.

[11] S.S. Mohanty,D.S. Pramanik,B.P. Dash. Primary Productivity of Bay of Bengal at Chandipur in Odisha,India.Int Jour of Sci and Res Publ 4(10).2014.

[12] S.S.Mohanty ,D.S. Pramanik , B.P.Dash Fish Species Abundance and Diversity in Chandipur, Bay of Bengal, India. International Journal of Science and Research Volume 4 Issue 2; 1801-1805.2015.

[13] H.P.George, and B.C.Russell. FAO species identification field guide for fishery purposes. The marine fishery resources of Sri Lanka. FAO. Rome, Italy,19-37.1994.

[14] K.E.Carpenter andV.H. Niem . FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Cephalopods, crustaceans, holothurians and sharks. Rome, FAO**.** Volume 2**,** 687-1396.1998.

[15] K.I.Stergiou and D.K.Moutopoulos.A review of length weight relationship of fishes from Geeek marine waters.NAGA,ICLARM Q.24:182.2001.

[16] B.M.Kurup,M.Harikrishnan and S.Sureshkumar. Length-weight relationship of male morphotypes of *Macrobrachium rosenbergii* (de Man) as a valid index for differentiating their developmental pathway and growth phases. Indian J. Fish., 47(4): 283-290.2000.

[17] Reza Nahavandi, S.M.Nurul Amin, Md. Shater Zakarina and Mariana Nor Shamsudin. Growth and length weight relationship of *Penaeus monodon* (Fabricius) cultured in artificial sea water. Research Journal of fisheries and Hydrobiology, 5(1), 52-55.2010.

[18] S.Piratheepa,K.ChitravadiveluandU.Edrisinghe.Updates on the species of the shrimps in Kakkaithivu Coastal waters, Jaffna, Sri Lanka.Tropical Agricultural Research. *24(1),* 82-90.2012

[19] C.S.Cheng and L.Chen. Growth characteristics and relationships among body length, body weight and tail

weight of *Penaeus monodon* from a culture environment in Taiwan. Aquaculture, 91: 253–263.1990.
[20] S.Chow and P.A.Sandifer. Differences in growth, morphometric traits, and male sexual maturity among Pacific white shrimp, *Penaeus vannamei*, from different commercial hatcheries. Aquaculture 92: 165–178.1991.
[21] K.H.Chu,Q.C.Chen,L.M.Huang, and C.K.Wong. Morphometric analysis of commercially important penaeid shrimps from the Zhujiang estuary, China. Fish. Res., 23: 83-93.1995.
[22] M.Christine, Saldanha and A.Chatterji . Length weight relationship of laboratory reared penaeid prawn *Penaeus monodon* (Fabricius) (Crustacea: Penaeidae). Indian Journal of Marine Science. *26*, 389-391.1997.
[23] W.Dall, B.J. Hill, P.C. Rothlisberg and D.J. Sharples. The biology of the Penaeidae.-Advances in marine biology, Academic Press, London, 27: 1-489. 1990.
[24] M.Araneda, E.P.Pérez and E.Gasca-Leyva. White shrimp *Penaeus vannamei* culture in freshwater at three densities: Condition state based on length and weight. Aquaculture, 283: 13–18.2008.
[25] S.S.Mohanty, D.S.Pramanik , B.P.Dash . Proximate composition of three marine fishes of Chandipur, Bay of Bengal, India. Inter Jou of fish and aqu stud Vol.2 (4).2015

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