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Length-Weight Relationship (LWR) and Condition Factor of Black Tiger Shrimp (*Penaeus monodon* Fabricius, 1798) Culture in Earthen Pond during the Summer Season

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Abstract: Penaeid shrimps played crucial role to uplift the aquaculture production in recent years not only in India but across the world. Its fast growth rate, market price and meat quality make it most acceptable cultured species among fish farmers. Andhra Pradesh, Tamil Nadu, West Bengal and Gujarat are the leading states in shrimp-production. South Gujarat has made significant strides in the shrimp production from 300 metric tonne in 2009 to 45000 metric tonne per annum in 2019 with generating annual turnover of Rs 2000 crore (Government of India, 2020). The present study was conducted in the earthen pond of Maruti Aqua farm Navsari, South Gujarat to evaluate the growth, production and profitability of *Penaeus monodon* farming during summer season May 2023 to October 2023. The mean length and weight of shrimp was observed as 20.38 cm and 20.32 cm; and 69.524 g and 67.264 g for pond 1 and 2, respectively. Stocking density was 0.125 million in both the pond with survival rate 67% and 72% for pond 1 and 2, respectively. The production was recorded as 5864 kg and 6648 kg after six months from stocking for pond 1 and 2, respectively. It is advised that scientific management practices not only decline the investment cost but also incline the overall production that ultimately enhances the profit of farmers.

Keywords: Shrimp, Length-weight relationship, Condition factor, Stocking, Production

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Introduction

The black tiger shrimp, *Penaeus monodon* is the main species cultured in south Gujarat contributing about 95-99% of total farmed shrimp production in the country (Sailendra, 2012). It has the fastest growth rate among a number of penaeid species reared in captivity (Foster and Beared, 1974). *P. monodon* is euryhaline and tolerates wide variations in salinity. The black shrimp received maximum importance due to its high nutritive value, unique taste and high market

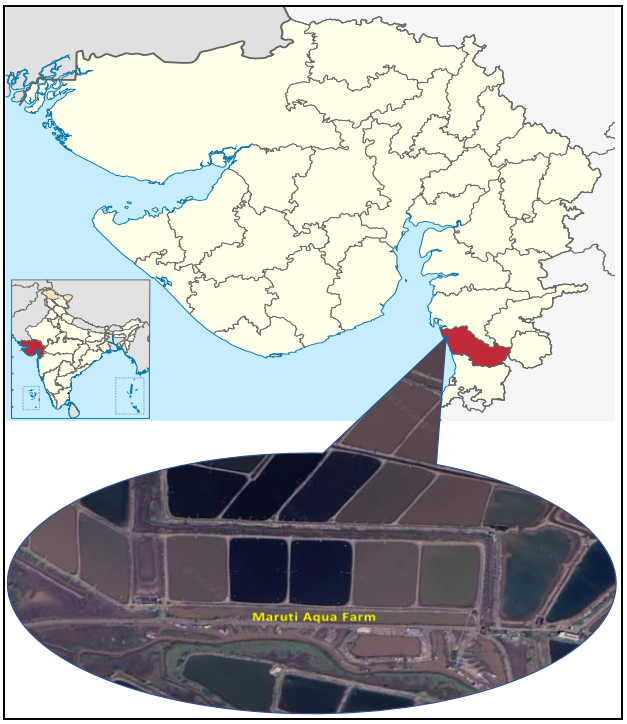

Fig. 1: Map of study area (Maruti Aqua Farm).

value across the world (Ling, 1969; New, 2002).

Length-weight relationships is mathematical tool for estimating growth rates, age structure and shrimp population dynamics (Tsoumani *et al*., 2006). Discrepancies in length-weight relationship indicate that fishes and crustaceans are under stress due to environmental condition, pollution, overcrowding, disease outbreak and management practices (Ujjania *et al*., 2021). The length weight relationship ratio also varied among sexes, species and seasons in both wild and cultured populations of *P. monodon* (Fontaine and Neal, 1971). Length weight relationship between the two variables is studied to determine the growth and possible differences among different stocks of the same species (LeCren, 1951; Petrakis and Stergiou; 1995; King, 2007).

Condition factor indicate the general well-being of aquatic animal in its aquatic environment. Condition factor (K) is an index which reflect the interaction between biotic and abiotic component of habitat. It indicates body condition which is important morphometric parameter to analyze the *in vitro* proximate composition analysis (Sutton *et al*., 2000).

The present study provides some important information about the morphometric relationship, condition factor and length-weight relationship of *Penaeus monodon* in Maruti Aqua farm, Navsari district of Gujarat during summer season. This study will be helpful to manage biomass and regulate the farm operations to increase the profit margin of farmers.

Materials and Methods

Experimental site

The present study was conducted to find the growth of black tiger shrimp, *Penaeus monodon* in earthen ponds during summer seasons at Maruti Aqua farm, Navsari District, Gujarat, India. The ponds P1 and P2 are approximately 1.0 hector of area and in square shaped (Fig. 1).

Stocking and culture Period

Healthy post larvae (PL) of uniform size generally PL11/12 were stocked in the pond during summer

season (May 2023) with stocking density 0.125 million/ hac. Specific pathogen free post larvae were counted and kept in hapa for acclimatization before release into the pond.

Morphometric measurement

For the measurement of length and weight 500 specimens from pond 1 and pond 2 were sampled during harvesting period using drag net. Shrimp specimens were used to measure the total length in centimeter (distance from tip of rostrum to the tip of telson) by measuring scale. The weight of each specimen was measured by electronic weighing scale.

Growth analysis of shrimp

The length weight relationship of the shrimp was estimated using linear regression equation (Pauly, 1983):

$$W = aL^b$$

Where W is weight of shrimps (g), L is length of shrimps (cm), a is Intercept and b is slope.

The values of "a" and "b" was given a logarithmic transformation according to the following formula (Pauly, 1983):

$$\text{Log } W = a + b \log L$$

Where Y is log W and X is log L of shrimps.

The condition factor (CF) of shrimp species was calculated from the formula prescribed by Hile (1936):

$$K=W/L^3\times100$$

Results and Discussion

The detail of pond type, size, date of shrimp stocking, date of harvesting, total seed stocked, total shrimp production, shrimp counts and survival rate are mentioned in Table 1, while total length-weight Relationships, condition factors and growth pattern of *P. monodon* was mentioned in Table 2.

During the present study, length of *P. monodon* was minimum (16.0 and 17.0 cm), maximum (25.0 and 24.5 cm) and mean (20.38 and 20.32 cm) in Pond 1 and 2, respectively Minimum, maximum and mean values of the condition factor from both the ponds were recorded as: for P1 0.600, 1.440 and 0.813; and for P2 0.629, 1.046 and 0.792. Logarithmic transformation of length-weight relationship was done to estimates the regression parameters for pond 1 and 2 which is represented in Figure 2 A and B. The degree of association between the length and weight was computed from the linear regression analysis. The slope or regression coefficient (b) was 2.513 and 2.675 for Pond 1 and 2 while correlation coefficient r^2 value was reported as 0.836 and 0.867 for pond 1 and 2, respectively (Fig. 2 A, B).

Linear relationship between length and weight was observed in tiger shrimp from both the studied pond and similar observation was reported by Solanki *et al*. (2020) from Government Shrimp Farm, Navsari district, Gujarat, India. Mostly shellfishes and crustaceans maintain dimensional equality and in the present study length-weight slope value less than 3 indicates that the animal becomes slender as it increases in length and low weight gain resulting into the negative allometric growth. The growth rate of the black tiger shrimp (*P. monodon*) in earthen shrimp cultured pond likely be influenced by competition and Pond management challenges. Similar low weight gain was reported by Lalrinsanga *et al*. (2015) and Mohanty *et al.* (2015) from different agro-ecological region of India and from Odisha, respectively. Although, Udoinyang *et al*. (2016) reported isometric growth of seven shrimp species from Iko river estuary, Nigeria and Mane *et al*. (2019) reported both positive and negative allometric growth of commercially important penaeid shrimp from Maharashtra, India.

The condition factor (K) played significant role in management of culture system as it provides certain information of definite conditions in which the organisms are growing Araneda *et al*. (2008). Further, it is an indicator of changes in food reserves and therefore an indicator of the general shrimp condition. The low condition factor of the

Table 1: Grow out information of studied pond during the summer season

Details	**Pond$_1$**	**Pond$_2$**
Pond nature	Earthen pond	Earthen pond
Pond size (in hac)	1.0	1.0
Date of stocking	20/05/2023	20/05/2023
Date of harvest	05/10/2023	05/10/2023
Days of culture	139	139
Total seed stocked (million)	0.125	0.125
Production (Kg)	5,864	6,648
Counts	14.000	15.000
Survival rate (%)	67	72

Table 2: Morphometric observations and condition factor of shrimp

Parameters		**Pond$_1$**	**Pond$_2$**
Total length (cm)	Minimum	16.0	17.0
	Maximum	25.0	24.5
	Mean	20.38	20.32
	Standard error	0.078	0.068
Weight (gm)	Minimum	36.000	40.000
	Maximum	113.000	111.000
	Mean	69.524	67.264
	Standard error	0.713	0.643
Condition factor (K)	Minimum	0.600	0.629
	Maximum	1.440	1.046
	Mean	0.813	0.792
	Standard error	0.004	0.003

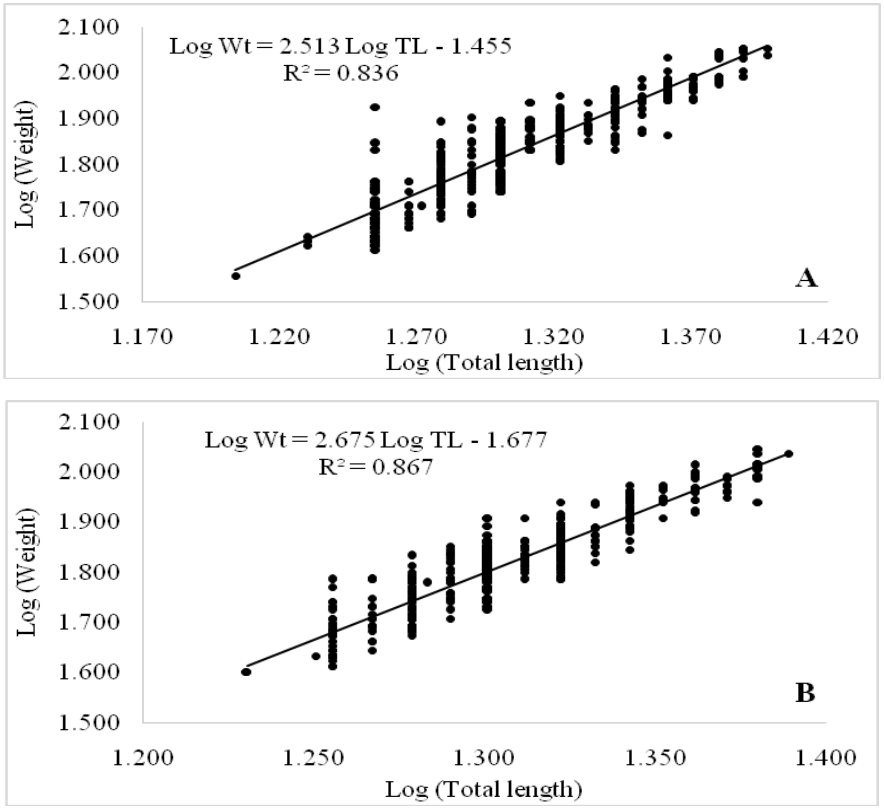

Fig. 2: Length weight relationship of tiger shrimp during summer season in (A) Pond$_1$ and (B) Pond$_2$.

black tiger shrimp in present study can be attributed to competition, physico-chemical parameters and management practices in cultured pond. Similar result was reported by Komi *et al*. (2017) from Andoni River System, Niger Delta, Nigeria. Solanki *et al*. (2020) also reported the low condition factor of *Penaeus monodon* from Navsari district, Gujarat, India.

Conclusion

The results of present study confirmed the linear regression and significant correlation between length and weight of *Penaeus monodon*. Regression coefficient values in present study was below the isometric value which suggest for correction in farm management and culture practices. The outcome of present study will help the farmers to manage their culture pond by adopting better farm management practices.

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