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Length-weight Relationship and Relative Condition Factor inThenus Orientalis (Lund, 1793) along East Coast of India

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Abstract: In order to focus sand lobsters T. orientalis from the eastern coast of India, study on their length-weight relationships and relative condition factor was carried out for a period of one year. A total of 824 specimens of T. orientalis ranging from 58mm to 252 mm were collected from the Mudasal odai landing center. The Total Length (TL) and weight was measured. Comprising of 543 males and 281 females were used for this study. The length-weight relationships shows the b values obtained for males and females are 2.9161 and 2.9758. The b value for females was slightly higher than males because of their faster growth rate in the younger size groups. During the present study, in the length-weight relationship of T. orientalis the weight increased proportionately to an increase in length in males and females. It is clear from the above that the difference in all the morphological relationships between the two sexes of T. orientalis is very narrow. Thus it is clear that these fishes maintain its body shape throughout its life with slow growth rate. The peak minimum value of Kn based on length wise for males and females were recorded at 93 and 97mm (TL) respectively. The Kn value for males and females was higher during March and April Lower values of 'Kn' for males and females were recorded during the length at first maturity.

Key Words: lobsters, T. orientalis, eastern coast, India, length-weight, condition factor

INTRODUCTION

Experience worldwide has shown that there is unrestricted use of marine resources and the consequent decline in the stocks. This is attributed to the following factors, Population growth, rise in the international demand for fish, improvements in the internal market infrastructure, modern technologies, environmental conditions, high price for certain species and poor fisheries management. It is the responsibility of the scientists and the fisheries research institutes to provide scientific data and the management plans. In India such a plan is urgently and very badly needed for the lobster fishery.

The length-weight relationships study assumes an important prerequisite in fishery biological investigations. It is mainly dealt with to know the variations in expected weight from the known length groups, which are, in turn, the indications of fatness, breeding and feeding state and their suitability to the environment. The study is also perceived to establish precise mathematical equations between the length and weight. So that if one is measured the other could be computed. There have been many investigations on length-weight relationship of finfishes. In our country lobster are distributed along the east and west coast, but they were found abundant in the west coast of India. Exploitation of lobsters has increased tremendously because of their high price and as a valued sea food item. Initially dead lobsters were collected from the landing centers by the agents from the processing centers, where it was cooked and exported to foreign countries especially Japan. Nowadays the lobsters are exported in live conditions because live organisms fetch more money than dead ones.

Length measurement of crustaceans especially of lobsters was carried out by few workers. Templeman (1935) studied the relationship between carapace length and width of the second abdominal segment in Homarus americanus to determine maturity. Later on, morphological relationships have been described in Jasus lalandii by Fielder (1964), in Panulirus homarus and lalandii by Heydorn (1969) and in P.homarus by Berry (1971). Conversion factors have been worked out for the first time for the various sets of morphological characters in an Indian rock lobster Panulirus polyphagus by Kagwade (1987). Kabli and Kagwade (1996) studied the morphometry and conversion of the sand lobster, Thenus orientalis (Lund) from Bombay waters.

Along the eastern coasts of Indian waters no such relationship was drawn for Orientalis. Whereas in the western part some of the notes worthy studies available are as follows, morphometry age and growth, and reproductive biology of this species are available. The aim of this study is to compare the difference between the previous reports with the present findings.

MATERIAL AND METHODS

A total of 824 specimens of T. orientalis ranging from 58 to 252 mm were collected from the Mudasalodai landing center during January 2008 to December 2008.

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The Total Length (TL) was measured between the notch in the carapace in front and the posterior margin of the telson behind. Comprising of 543 males and 281 females were used for this study. The whole body weight of individual sand lobster ranging from 5 to 315 gm was recorded by using an electronic balance. Lobsters in the inter moult stage with all appendages intact were only considered for the study since lobsters in pre moult and post moult stages showed variations in weight. All materials were analyzed in the fresh condition.

The average log values of the observed weight and length in each group varying by 5mm were plotted for males and females. When plotted in millimeter graph paper for males and females showed a linear correlation. Since, it has been found to adequately describe length-weight relationship of most species, the formula is:

$W = CL^3$

Where, W- weight

L-Length
C-a constant

The above formula was applicable to calculate either the weight of the lobster of known length or the length of lobster of known weight, if the forms and specific gravity remain constant.

LeCren, (1951) used the parabolic equation of the form

$W = aL^b$

To express the relation between length and weight, Where,

W-weight
L-Length
a- a constant equivalent to c
b- a constant to be determined empirically

Individual variations from length-weight relationships have been studied under the general condition (LeCren, 1951). Such changes in "condition" have usually been analyzed by means of condition factor or k-factor or ponderal index that has been calculated by using different formula by various workers.

The condition of a lobster is influenced by the seasonal changes of gonads and also by the feeding intensity. This is why, instead of total body weight, nominal body weight is considered to calculate the condition of the lobster, since it is not influenced by the weight of the gonad and stomach contents (Papageorgious, 1979).

The condition factor most typically used by fishery researchers is computed by the formula.

$$K = \frac{W \times 10^5}{L^3}$$

This equation is based on the ideal form of a lobster where in the length-weight formula is $W=aL^b$, b=3, and the cube law is obeyed when b=3, as it frequently the case, K computed by the formula changes with length (Le Cren, 1951). Computing the relative condition factor based on empirical length-weight relationship and is calculated by the formula, however, can eliminate the effect of length on K.

$$Kn = \frac{W}{W}$$

Where, W represents the observed weight and the calculated weight. The difference between k and kn is that the former is measuring then deviation of an individual from a hypothetical ideal lobster while the later is measuring the deviation of an individual from average weight for length. As there is significant difference in the length-weight relationship between males and females the kn values were computed separately for the sexes.

RESULTS AND DISCUSSION

The regression parameters of the length-weight relationship of T. orientalis for a period of one year (Jan and Dec, 2008) were analyzed and the details of sum of the squares and products of length-weight data for males and females are presented in Tables 1-3.

The length-weight relationships of males and females during the study period were analyzed using ordinary least square regression with 95% confidence. The linear relationship between length and weight is shown in Figure 1 and 2. The monthly-obtained data for one year was pooled and obtained the following regression equation.

$\text{LogW} = -4.4826 + 2.9161 \log L$.

The correlation co-efficient (r) value for male is 0.9931 ($p < 0.001$).

$\text{LogW} = -4.6322 + 2.9758 \log L$.

The correlation co-efficient (r) value for female is 0.9918 ($p < 0.001$).

Analysis of co-variance for the regression of log weight on log length, between males and females for one year are presented in Tables1-3. Significant difference could be noticed in the F test at 5% level while comparing the males and females. Length as well as month wise condition factor for males and females of T. orientalis are presented in Figure 3 and 4. The peak minimum value of Kn based on length wise for males and females were recorded at 93 and 97mm (TL), respectively. The Kn value for males and females was higher during March and April.

The fishes continue to grow throughout their life. Rapid growth indicates abundant food supply and other

Table 1: Sum of squares and products of the length-weight data of males and females of *T. orientalis*.

Category	No. of fish	x	y	x^2	y^2	xy
Males	543	1189.595	1034.882	2613.747	2037.887	2289.371
Females	281	623.0522	552.4276	1385.545	1122.687	1236.995

x, y = Sum of x and y, x^2, y^2, xy = Sum of squares and products

Table 2: Corrected sum of squares and products of length-weight data of males and females of *T. orientalis*, regression co-efficient and deviation from the regression.

		Sum of squares and products					
Category	df	x^2	xy	y^2	b value	df	s.s
Males	542	7.6029	22.1695	65.5468	2.9160	541	0.9022
Females	280	4.0716	12.1152	36.6506	2.9757	279	0.6014
Total	822	11.6745	34.2847	102.1974		820	1.5036

df = degrees of freedom, x^2, xy, y^2 = corrected sum of squares and products, b = regression co-efficient, ss = sum of squares.

Table 3: Analysis of covariance for males and females of *T. orientalis*.

Source of variation	df	Sum of squares	Mean square	Observed F	5% F
Deviation from individual regression	820	1.5036	.001	9.4*	3.00
Difference between regression	1	.0094	.0094		
Deviation from average individual regression	821	1.513			

*significant

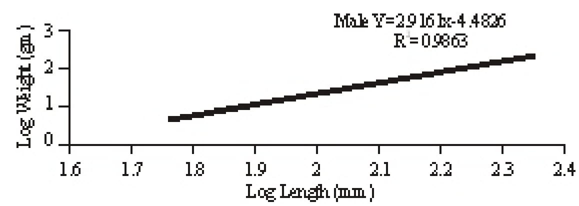

Fig.1: T. orientalis length-weight relationship in males

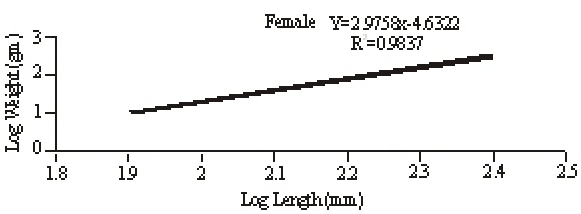

Fig.2: T. orientalis length-weight relationship in females

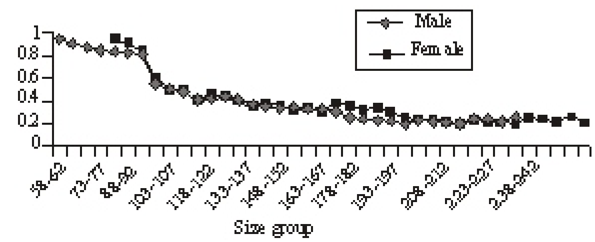

Fig.3: Size-wise relative condition factor (Kn) for T. orientalis

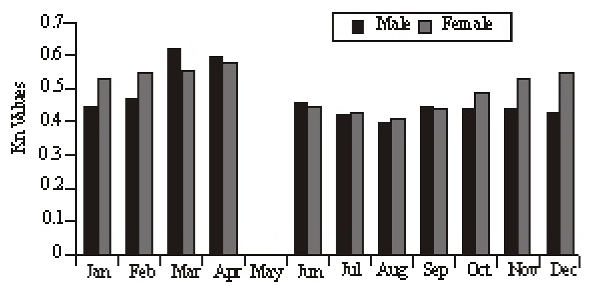

Fig.4:Month-wise relative condition factor (Kn) for T. orientalis

favorable conditions, whereas slow growth is likely to indicate non-availability of food. The weight of the fish increased logarithmically with an increase in length, with the value lying between 2.5 and 3.5 but usually close to 3.0 (Carlander, 1969). The b value was calculated to find out whether the fish is growing allometrically or isometrically. If the b value is 3.0 the growth is isometric, and it holds good only when the density and form of the fish are constant. If it is allometric, the fish grows with weight increasing at slower (b < 3.0) or faster (> 3.0) relative to the increase in length.

Qasim (1973a) and Bal and Rao (1984) indicated that the values of a and b differed not only between different species but also within the same species depending on sex, stage of maturity and food habits. Beverton and Holt (1957) reported that cubic relationship between length and weight had the b value near to 3.0. Ricker (1958) observed that a fair number of species seem to approach this ideal. Hile (1936) proposed that the b value for an ideal fish might range between 2.5 to 4.0. In the present study, the b values obtained for males and females are 2.9161 and 2.9758. The b value for females was slightly higher than males because of their faster growth rate in the younger size groups. These findings are similar to the results found out by Kabli and Kagwade (1996) along the Bombay waters. In that b value was 2.7013 for males and 2.7938 for females. The results shows slightly higher value of the previous study but it was below the values of 3 (allometric).

In the present study the regression line indicated a close relationship between males and females. The exponent values for males and females were around the allometric value (b < 3.0) 2.9161 and 2.9758, a value was 4.4826 and 4.6321 and the correlation co-efficient (r) was greater than 0.9. During the present study, in the length-weight relationship of T. orientalis the weight increased proportionately to an increase in length in males and females. Lower values of Kn for males and females were recorded during the length at first maturity. During the months of October to February females Kn values are higher than males this may be due to spawning season or stress. Similar results were obtained by several authors;

fluctuation in Kn value might be either related to other parameters like breeding cycle (LeCren, 1951; Pantulu, 1962; Reuben et al., 1995), feeding rhythms (Hile, 1948; Bal and Jones, 1960) and environment (Wahabeb, 1992 b). It is clear from the above that the difference in all the morphological relationships between the two sexes of T. orientalis is very narrow. Thus it is clear that these fishes maintain its body shape throughout its life with slow growth rate.

CONCLUSION

As in case of certain specific fishes, the lobster stocks also seem to deplete in the natural habitat because of over fishing. In many areas, peak fishing coincides with peak breeding season and during this period active breeders constitute 60-70% of the catch. These breeders are expected to maintain the population by spawning several times before they are caught at large size. The indiscriminate exploitation of these breeding populations will have strong repercussions on the fishery on the long run. This is reflected on the reduced catch per unit effort. To improve the declining catch from natural habitats and also to produce lobsters by culture techniques, something must be done before it is late instead of facing a critical phase in lobster resources and its fishery.

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