Int. Res. J. of Science & Engineering, 2019; Vol. 7 (1): 35-40 http://www.irjse.in
ISSN: 2322-0015

ORIGINAL ARTICLE

Length weight relationship of commercially important penaeid prawns of Maharashtra, India

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Manuscript Details
Received : 23.01.2019
Accepted: 26.02.2019
Published: 28.02.2019

ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Sushant Mane, Sujit Sundaram, Abhay Hule, Milind Sawant and Deshmukh VD. Length weight relationship of commercially important penaeid prawns of Maharashtra, India. *Int. Res. Journal of Science & Engineering,* 2019, 7 (1): 35-40.

ABSTRACT

Length weight relationships (LWR) of seven species of commercially important penaeid prawns were established from Maharashtra waters. The coefficient of correlation (r^2) for various parameters ranged from 0.80 to 0.99, indicating high degree of relationship. The present studies indicated that the LWR between the sexes were significantly different and therefore, it was necessary to use separate expressions for males and females. The slope of LWR of males and females ranged from 2.6515 to 3.5602. Peak values for condition factor (Kn) of *Penaeus merguiensis* was observed during February, *Metapenaeus monoceros* during June, *M. affinis* during February, *M. brevicornis* during December, *Parapeneopsis strylifera* in August, *P. sculptilis* during July and *Solenocerra crassicornis* during September.

Key words: Length-weight relationship, condition factor, penaeid prawns, Mumbai

1. INTRODUCTION

Study of length-weight relationship (LWR) is very important in biology and stock assessment studies. In stock assessment model, yield is estimated in terms of weight. The LWR data can be used for estimating the biomass of a population. LWR is usually to obtain the knowledge of the growth. A study of LWR helps in obtaining the yield estimates by analytical models [1].

Some of the studies on the length-weight relationship of penaeid prawns from Indian waters are by George [2], Rajaylakshmi [3,4] Kunju [5], Rao [6], Thomas [7], Ramamurthy [8], Sukumaran and Rajan [9, 10], Achuthankutty [11], Patel [12], Lalithadevi [13,14], Sukumaran *et al*. [15], Nandakumar [16], Pillai *et al.* [17], Bhadra and Biradar [18] and Chakravarty and Ganesh [19].

There is a possibility that same species in different areas may differ with their morphometry and to find out these differences LWR is a very important tool. The diffrence may be possibly due to different food, temperature, pollution stress etc. Using condition factor analysis one can detect the seasonal variation in the condition of fish, which may vary with food abundance and the average reproductive stages of the stock [20]. Individual variations in LWR which has been considered as the general condition of the organism will be analysed by means of condition factor or k-factor or ponderal index [21].

Maharashtra is a major marine fish production state in India with penaeid prawns contributing 9.9 % in the total fish catch of the state [22]. The penaeid prawn catch in Maharashtra mainly consists of seven commercially important species such as *Penaeus merguiensis*, *Metapenaeus affinis*, *M. monoceros*, *M. brevicornis*, *Parapeneopsis stylifera*, *P. sculptilis* and *Solonocerra crassicornis*. LWR of these species would be very helpful for parameteriziation of the yield equations, stock size estimation and management.

From the rewiew of litrature it seems that there is not much studies on the LWR of commercially important penaeid prawns from Maharashtra waters. Mumbai accounts for nearly 60% of Maharashtra's fish landings [23], hence the species from these centres can be considered as representative of Maharashtra state. Thus an attempt was made to study the LWR of commercially important penaeid prawns.

2. EXPERIMENTAL DETAILS

Samples of seven commercially important penaeid prawn species were collected over the years by making weekly trips to the landing centres for the study of LWR. The specimens were collected randomly from different gears viz. *dol* net, trawl net and barrier net in Mumbai waters, which are operated in 1-4 m, 5-15 m and 15-60 m depths respectively. The number of specimens collected - *Penaeus merguiensis* (M-467 & F-679), *Metapenaeus affinis* (M-517 & F-618), *M. monoceros* (M-330 & F-394), *M. brevicornis* (M-983 & F-1598), *Parapeneopsis stylifera* (M-573 & F-884), *P. sculptilis* (M-301 & F-445) and *S. crassicornis* (M-387 & F-884). The specimens of each species were sorted sex-wise, measured from tip of the rostrum to tip of telson to the nearest millimetre for total length with a fine pair of dividers. The specimens were properly blotted witrh tissue paper and weighed on electronic balance up to 0.001 g accuracy for their total weight.

For expressing the length and weight relationship $W = aL^b$ was used, where W= weight in grams, L= total length in millimetre, a & b are the allometric growth constants. Length and weight are not linearly correlated with each other hence by taking log values they were linearised for the regression equation Log W = a + b log L.

The relationships between the sexes of the same species were tested by ANACOVA of Snedecor and Cochran [24] for both slopes and elevations and found to be significantly different ($p<0.05$). Therefore, for all the estimates related to weight, separate relationships were used for the male and female prawns.

Males of same species were generally observed to be slender and smaller in size than females, therefore LWR were calculated separately for males and females. The differences between the relationships were tested by student's 't' test for the slope and elevation at 5% and 1% significance level. Difference between 'b' values of the sexes was tested by 't' test.

Month wise condition factor (Kn) for females were determined by using the expression: $Kn=W/W_1$, Where W is monthly average of actual weights and W_1 is average of monthly calculated weights.

3. RESULTS AND DISCUSSION

Total length, total weight and their ranges for males and females of the seven species of penaeid prawns and their estimated linear regression parameters for the two sexes and presented in Table 1. Comparison of regression coefficient 'b' showed that *M. monoceros*, *M. brevicornis*, *P. stylifera* and *P. sculptilis* were highly significant ($p<0.01$) and for *M. affinis* significantly different ($p<0.05$) confidence level but for *M. affinis*, it showed significant difference ($p<0.01$). Only *S. crassicornis* was not significantly different at ($p< 0.01$) level.

It was noticed that the exponent 'b' was higher in female prawns, excepting for *P. stylifera* and *P. sculptilis* wherein males exhibited higher 'b'. Since female prawns were

larger and bulkier than males of the same cohort, higher 'b' in females is reasonable. However, in case of *P. stylifera* and *P. sculptilis* despite the males being smaller, 'b' was higher than females. In these males rostrum is relatively much shorter and increase in size of rostrum is not proportionate to the body length. On the other hand females of these two species are bulkier but their rostrum grew relatively much longer, as a result they did not gain weight proportionately with their length increments, therefore their 'b' value was smaller than in males.

The results of students 't' test is given in Table 1. The 't' test indicated that *M. brevicornis* male and *S. crassicornis* male followed the cube law while, males and females of the other species shows significant difference at ($p<0.05$) confidence level.

Rajyalakshmi [3] gave two different relationships for *M. brevicornis*; one for 0-year group and another for older groups but in each case the two sexes were combined and a common relationship was given. Hall [25] calculated the carapace length-weight relationship for a number of Indo-Pacific penaeid prawns and he also gave a common equation for the two sexes together. Ramamurthy and Manickaraja [8] found sex-wise difference between the total length and carapace length relationship of *P. stylifera, M. dobsoni* and *M. affinis* and hence gave different regression equation for each sex. Rao [1] gave sex-wise relationships for both juveniles and adults of *M. monoceros*. Nandakumar [16] also gave separate relationships for the two sexes of *M. monoceros*. George [2] juveniles of *M. monoceros* in the size range of 25-105 mm and obtained a common equation, $W = 0.01989\ L^{2.7603}$ for the two sexes together. Ramaseshaiah and Murthy [26] quoted that at higher length females weigh more than males and observed that the regression lines of males and females were significantly different for *Metapenaeopsis barbata* (De Haan) from the Visakhapatnam coast. Dinesh Babu [27] and Dinesh Babu and Manissery [28] observed a significant difference in length weight relationship between sexes in *M. Monoceros* and *S. choprai* respectively. Sarada [29] has observed significant relationship between males and females in *Penaeus semisulcatus* with the slope values as 3.01 in males and 2.98 in females.

Table 1. Length weight relationships of seven species of commercially important penaied prawns from Maharashtra waters

Species	sex	Size range (mm)	Weight range in g	No. of Specimens	Regression coefficients		Corrected A	r^2	Difference between sexes	
									Slopes	Elevation
					a	b	a'		't' value	
P. merguiensis	M	48-171	0.559-38.934	467	-6.0859	3.4251	0.00000082	0.9897	1.765*	2.449*
	F	54-237	0.739-107.998	579	-6.1538	3.4600	0.00000070	0.9940		
M. monoceros	M	45-162	0.600-26.610	330	-5.0203	2.9064	0.0000095	0.9770	5.934**	-
	F	45-209	0.686-66.515	394	-5.3239	3.0730	0.0000048	0.9910		
M. affinis	M	48-141	0.568-17.123	517	-5.3692	3.0723	0.0000043	0.9200	2.107*	3.680**
	F	48-176	0.530-37.451	678	-5.5540	3.1713	0.0000028	0.9600		
M. brevicornis	M	43-109	0.731-9.300	983	-4.5274	2.6715	0.0000298	0.9470	7.278**	-
	F	36-152	0.501-20.197	1598	-4.8321	2.8456	0.0000148	0.9760		
P. stylifera	M	46-103	0.331-6.668	573	-6.3570	3.5602	0.00000044	0.8900	3.7292**	-
	F	47-139	0.444-13.912	884	-5.9716	3.3308	0.0000011	0.9240		
P. sculptilis	M	37-113	0.257-11.352	301	-5.8939	3.4120	0.0000013	0.8060	2.577**	-
	F	37-154	0.150-26.207	445	-5.4424	3.1418	0.0000036	0.9150		
S. crassicornis	M	38-92	0.318-7.910	387	-5.3579	3.1499	0.0000044	0.8200	0.554	0.756
	F	32-114	0.324-13.354	884	-5.4341	3.1953	0.0000037	0.9140		

* Significantly different ($P<0.05$), ** Significantly different ($P<0.01$)

Table 2. Monthly Condition factor values (Kn) of seven species of commercially important penaied prawns from Maharashtra waters

Months	*P. merguiensis*	*M. monoceros*	*M. affinis*	*M. brevicornis*	*P. stylifera*	*P. sculptilis*	*S. crassicornis*
January	1.03	1.03	1.08	1.03	1.03	0.98	0.83
February	**1.07**	1.03	**1.10**	1.04	0.96	0.94	1.06
March	1.04	0.96	1.04	1.03	0.98	0.94	0.94
April	1.01	1.00	0.99	0.99	0.95	1.10	1.01
May	1.00	1.02	1.06	0.99	0.92	1.07	0.92
June	1.00	**1.09**	1.05	0.97	0.99	0.95	0.89
July	0.00	0.00	0.00	0.94		**1.13**	0.00
August	1.06	0.98	0.80	0.97	**1.11**	1.07	0.98
September	1.02	1.02	0.97	0.95	1.01	1.02	**1.11**
October	1.01	0.99	0.90	1.03	1.02	1.11	0.93
November	1.01	0.92	0.98	1.01	1.09	0.98	0.80
December	1.04	0.98	1.01	**1.09**	1.01	1.02	1.03

Note: Figures indicated in bold are peak values

The present work also showed that for males and females different equations should be used, as both the relationships are significantly different at 1 % and 5 % significance levels stressing the need of separate equations. The values of correlation coefficient calculated for males and females showed high degree of correlation for all species (Table 1), between the two variables length and weight. Slightly higher values of regression coefficient in both the sexes than the isometric value indicated that the prawns grows at higher rate than cube of its length.

Rao [1] gave LWR and other dimensional relationships for *M. monoceros* collected from trawl catch from Kakinada and observed that males were heavier than females up to 77 mm, after which females became heavier. This he explained on the basis that after 77 mm length, juveniles from estuaries move to inshore waters and the maturation process starts. The gonads in females being heavier than those in the males the females become heavier than males. Similarly, Nandakumar [16] while studying *M. monoceros* also concluded that females in general become heavier than males from 80 mm onwards due to gonad development. The same was tried in *M. brevicornis* and it was observed that up to 55 mm size, the weight of males was slightly higher than that of females and thereafter the weight of females increased.

There are two different school of thought as far as disproportionate sizes of males and females in prawns are concerned. One set of authors opine that when the juveniles migrate from estuaries to the offshore waters, the females, on account of their faster growth rate, start gaining weight much rapidly than the males and the other set of authors are of the opinion that the disproportionate rise in weights of females cannot be attributed to the maturation process of females alone. It is likely that in males most of their energy is diverted to sexual behavior such as chasing the mates, rather than for the somatic body growth, as a result they remain thin and slender. Furthermore, the gonads of males in the case of prawns never grow remarkably large unlike in the case of females. Further the feeding intensity of males was also found lesser than the females in general.

Monthly condition factor (Kn) analysis for females is provided in Table 2. It is observed that higher condition factor (Kn) for females of *P. merguiensis* was during February, *M. monoceros* during June, *M. affinis* during February, *M. brevicornis* during December, *P. strylifera* in August, *P. sculptilis* during July and *S. crassicornis* during September.

Condition factor (Kn) is a measurement of the general health conditions of an organism as calculated by the ratio of body weight to body length. It is often used to quantify an animal's physical wellbeing, and considered to be a useful complement for growth estimate in crustaceans [30]. Condition factor reflects the physical and biological circumstances and fluctuations by

interaction among feeding conditions, parasitic infection and physiological factors [21]. Condition factor is an important parameter for the management of culture systems [31] and it is also used to monitor the population response to environmental change over time and to assess the overall health productivity [32].

In present study, the seasonal changes were observed in the condition factor in the females of all the species. This may be related to the seasonal fluctuations in the spawning seasons. Le Cren [21] has correlated the condition factor with the seasonality in feeding condition and gonadal maturity and spawning season. However, generally in prawns the food mass in the gut is very megre and it cannot be considered as an influential factor for condition index. The fluctuations observed in the condition factor in the present study is due to abundance of matured females in the population during the spawning season. Simmilar observations were made by Patel *et al.* [12] in *P. penicillatus* and Joseph and Soni [33] observed the change in 'Kn' value in different months in case of *M. kutchensis*, reaching the peak stage in spawning month *i.e.* December for larger female. Similarly, Chakravarthy and Ganesh [19] observed in case of *Solenosera melantho,* that for females the condition factor is more in October due to spawning season.

The current finding of LWR and the condition index of commercially important penaeid prawns from Maharashtra waters may help in the evaluation of spawning season with respect to stock management studies.

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