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LENGTH-WEIGHT RELATIONSHIP OF SPINY LOBSTER, *PANULIRUS HOMARUS* POPULATION INHABITING SOUTHERN COASTAL REGION OF SRI LANKA

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Abstract: Scalloped spiny lobster, *Panulirus homarus* is one of the most commercially important lobster species out of six spiny lobsters recorded from southern coastal region of Sri Lanak. A total of two hundred and fifty specimens were subjected to the study along southern coastal waters during the time period from January 2012 to January 2013. Growth pattern and relationships of total-length with body weight and carapace- length with body-weight of *Panulirus homarus* were studied for male, female and total population separately. Regression equations for total-length and body weight for male, female and total *P. homarus* population were $W = 0.000016TL^{3.04}$, $W = 0.066\ TL^{1.41}$, $W = 0.001318\ TL^{2.17}$ respectively. Carapace length-body weight relationships for males was $W = 0.02455\ CL^{2.57}$ and $W = 1.3580\ CL^{1.33}$ for females. For the total population it was $W = 0.0912\ CL^{2.15}$. For female and the total *P. homarus* populations growth coefficient values (b) were significantly different from 03 (1.41, 2.17 respectively ($p<0.05$)), thus those populations exhibit negative allometric growth pattern. Since the growth coefficient value for males was not significantly different from 03 (3.04 ($p>0.05$)), it shows isometric growth pattern. Results of the current study were compared with the data derived from a past study of this species collected from the same geographic region and revealed a significant difference in the growth patterns of males and females of the populations. The change of temporal and environmental conditions could be responsible for these differentiations. Monitoring of growth pattern of *P. homarus* population in the southern coastal belt is important for the construction of effective management plans for the lobster fishery industry in Sri Lanka.

Keywords: *Panulirus homarus*, Spiny lobster, Length -weight relationship, Southern Coastal belt, Sri Lanka, Growth pattern.

Introduction

Spiny lobsters distribute along the continental coast and islands in tropical to warm-temperate regions of the world. Six spiny lobster species have been recorded in Sri Lanka (Jayawickrama, 1991), but currently only five species except *P. polyphagus* could be found in the southern coastal belt of Sri Lanka. *Panulirus homarus* is the most common, easily found,

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highly abundant species and commercially most important species in the region. They usually (*P. homarus*) inhabit shallow water areas.

Various studies of *P. homarus* have been undertaken on their distribution, biology, ecology and genetics (George, 1997; De Bruin, 1969; Jayawickrema, 1991; Jayakody, 1989, 1993; Thuy, 2000; Senevirathna and Munasinghe, 2012). The length-weight relationships (LWR) of spiny lobster are important in fisheries management practices and comparative population dynamic studies. Species-specific growth parameters have been recorded in past studies for scalloped spiny lobsters in various parts in the world (Jayakody, 1991, 1993; Mohamed and George, 1971; Kulmiye 2004; Sahar et al, 2012).

In this paper, we discussed the length-weight relationship of spiny lobster *P. homarus* in Southern coastal belt of Sri Lanka and compared the estimated population growth pattern with the previously published data for this species in the same geographical region. Continuous records of population structure are required to construct effective management plans of the lobster fishery industry.

Materials and Methods

Two hundred and fifty *P. homarus* specimens were collected from four locations of the Southern coastal region of Sri Lanka (Figure 01) during January 2012 to January 2013. Lobsters were collected with the help of SCUBA divers and gill net fishermen. Sample analysis was conducted in the Zoology laboratory of Department of Zoology, University of Ruhuna, Matara, Sri Lanka. After transporting samples to the laboratory, individuals were cleaned using pure water and mopped to remove the plant debris and other impurities, adhere into the body of lobsters.

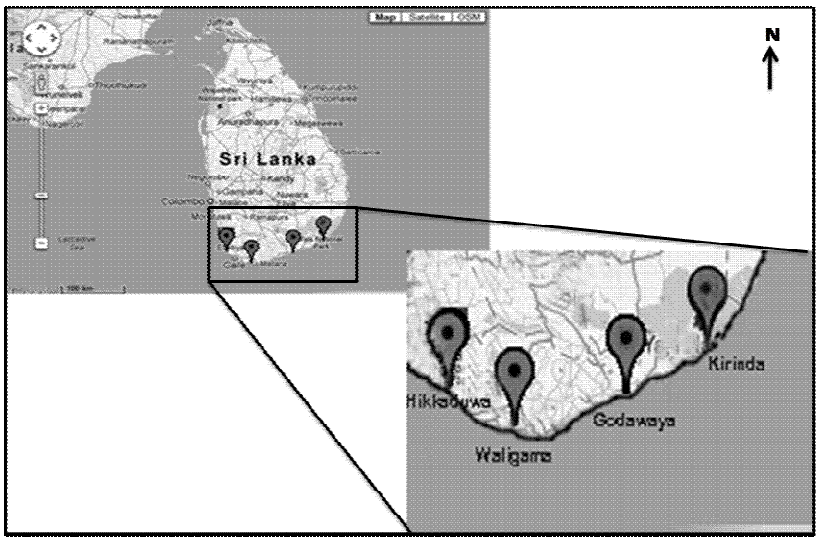

Figure 01: Lobster sampling localities along the southern coastal belt of Sri Lanka

Lobsters collected from four locations were pooled and considered as one population. Male and females were separated using external morphological characters. The total length and carapace length (+ 0.01mm) and total weight (+ 0.01 g) were recorded separately. The total length was measured from tip of posterior margin of the orbit to the tip of the telson, to the nearest millimeter, keeping the abdomen fully stretched using a ruler. Carapace length was measured with Vernier calipers from orbital notch to the hind edge of the carapace along the mid dorsal line (Farmer, 1975) (Figure 2).

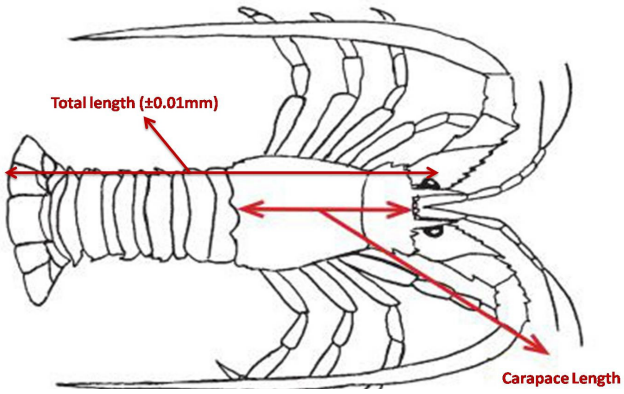

Figure 2. Schematic presentation of length measurements collected for the current study.

The relationship between the length and weight (LWR), of a fish/shell fish is usually expressed by the equation $W = aL^b$ (Ricker, 1973). Logarithm transformation of length-weight relationship was calculated using the formula: W = log a + b log L where, (W) is the total weight (g), (L) is the total length (mm), (a) the intercept and (b) the slope or allometric growth coefficient. Linear relationships between (1) total-length and body weight, (2) carapace- length and body-weight were assessed for males, females and total *P. homarus* population by the computer based linear regression analysis. The Pearson correlation coefficient was determined to estimate the strength and pattern of relationship between the two variables (Ivanov and Krylov, 1980). Significance of the regressions was evaluated by General Linear Model Analysis of Covariance (GLMANCOVA). The "b" values obtained for three populations were tested using Student's t-test to see whether the 'b' values differ significantly from the numerical value 3 (Zar, 1999). Student t test was performed to compare results of the current study and the previous study conducted for *P. homarus* from the same geographic location. All statistical analyses were conducted using MINITAB (Version 14) statistical software and the significance level was tested at 95% confidence interval.

Results and Discussion

Descriptive Statistics for population analysis of *P. homarus* are given in theTable 01.Weight range of the whole sample was recorded as 31.00 g - 167.19 g. Highest mean weight (105.47 g), highest total mean length (184.85 mm) and highest carapace length (26.27 mm) were recorded for females compared to males.

Table 01: Results of descriptive Statistics for male, female and total population of *P. homarus*

Parameter	Mean			Maximum			Minimum		
	Total Population	Male	Female	Total Population	Male	Female	Total Population	Male	Female
W / g	87.81	82.93	105.47	167.19	154.00	167.19	31.00	31.00	59.09
TL/ mm	164.18	158.46	184.85	278.00	193.00	278.00	111.00	111.00	152.00
CL / mm	23.99	23.37	26.27	40.20	30.75	40.20	16.20	16.20	21.30

W - Weight, TL - Total Length, CL - Carapace length

According to Pearson correlation coefficients, there were strong relationships for (1) total-length and body weight, (2) carapace- length and body-weight of male, female and total *P. homarus* population at significantly different level (0.05) (Table 02). According to Linear regression models all 'F' values found to be significant at 5% level. Allometric coefficient (b) was recorded as 3.04, 1.41 and 2.17 for male, female and total population respectively. According to Bagenal and Tesch, (1978), when allometric coefficient (b) larger or smaller than 3.0 it shows an allometric growth pattern ($b > 3$ - positive allometric growth and $b<3$ - negative allometric growth) and isometric growth pattern can be observed when b equal to 3.0.

According to our results, 'b' values of female and total population are inferior than 3.0. Also student t-test showed that the 'b' values obtained for female and total population were significantly different from 3.0 ($p<0.05$) indicating negative allometric growth. For males, 'b' value (3.04) did not deviate significantly from 3 ($p>0.05$), thus males exhibit isometric growth pattern. The 'b' value depends on several factors such as age, body shape and amount of fat present, sex, maturity stage, season, temperature, salinity and available nutrient in food (Moutopoulos and Stergiou, 2002). Therefore, for a single population, the differences of the growth pattern between male and female cause due to sex differences. Growth coefficient

could be different according to different geographical locations even for the same species. Taskavak and Bilecenoglu (2001) and Ozaydin and Taskavak (2006) has revealed that the parameter 'b' in the length-weight relationship could be vary seasonally, even daily and between habitats. The results of present and the past studies conducted on length-weight relationship for *Panulirus* species from southern coastal belt of Sri Lanka are given in the Table 03. Results of the t test indicated that the growth coefficients of males and females of the current study were significantly different from the previous study conducted by Sanders and Liyanage (2009) using sample from the same geographic locations.

Table 02: Results of the Linear regression models of *P. homarus* population

Population	Relationship	Regression Equations	F value of regression	P value of regression	Correlation Coefficient
Total Population	TL - W	LogW = - 2.88 + 2.17 LogTL [a]	145.27	0.000	0.845*
		W = 0.00132 TL $^{2.17}$			
	CL - W	LogW = - 1.04 + 2.15 LogCL [b]	126.64	0.000	0.828*
		W = 0.0912 CL $^{2.15}$			
Male	TL - W	LogW= - 4.78 + 3.04 LogTL [c]	199.74	0.000	0.903*
		W = 0.000016TL $^{3.04}$			
	CL - W	LogW = - 1.61 + 2.57 LogCL [d]	146.60	0.000	0.875*
		W = 0.02455CL $^{2.57}$			
Female	TL - W	LogW = - 1.18 + 1.41 LogTL [e]	81.57	0.000	0.803*
		W = 0.066 TL $^{1.41}$			
	CL - W	LogW= 0.133 + 1.33 LogCL[f]	37.22	0.000	0.673*
		W = 1.3580 CL $^{1.33}$			

[a,b,c,d,e,f] *- Significantly different at 5% level. W - Weight, TL - Total Length, CL - Carapace length

This variation could be due to temporal and environmental changes occurred during the past period. According to the results, (Table 02) carapace length and total weight of the male, female and unsexed lobsters were also subjected to linear relationship. This linear regression is also significantly different for male and female populations. The estimated 'b' value could be used to compare growth pattern among species as well as geographical locations. Thus, study of biometric relationships is of vital importance in fishery biology investigations and in stock assessment process (Dineshbabu, 2008).

Table 03: Derived growth coefficients of regression lines between total length and body weight for different lobster species in southern coastal belt of Sri Lanka.

Recorded Species	Study Period	"b" Value of regression line		Study
		Male	Female	
P. versicolor		2.6800	2.7400	
P. penicillatus		3.3200	2.6200	
P. ornatus	2007	2.6900	2.8600	Sanders and
P. longipes		3.0500	2.9800	Liyanage (2009)
P. homarus		2.6300	2.6700	
P. homarus	2013	3.0400	1.4100	Present Study

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References

[1] De Bruin, G. H. P. 1969: The ecology of spiny lobsters *Panulirus* spp. of Ceylon waters. Bulletin of Fishery research station. Ceylon. 20(2): 171-189.

[2] Dineshbabu, A.P. 2008. Morphometric relationship and fishery of Indian Ocean lobsterette, *Nephropsis stewarti* Wood-Mason 1873 along the southwest coast of India. Journal of Marine Biology Assesment India, 50(1): 113 - 116.

[3] Farmer, A.S.D. 1975. Synopsis of biological data on the Norway lobster *Nephrops norvegicus* (Linneus, 1758). FAO Fish. Synopsis, 112: 97 pp.

[4] George, W. 1997: Tectonic plate movements and the evolution of *Jasus* and *Panulirus* spiny lobsters (Palinuridae). Marine and Freshwater Research 48: 1121-1130.

[5] Ivanov, B. G. and Krylov. V. V. 1980. Length-weight relationship in some common prawns and lobsters (Macrura, Natantia and Reptantia) from Western Indian Ocean. Crustaceana, 38: 279-289.

[6] Jayakody, D. S. 1989. Size at onset of sexual maturation and onset of spawning in female *Panulirus homarus* (Crustacea: Decapoda: Palinuridae) in Sri Lanka. Marine Ecology progressive series 57: 83-87.

[7] Jayakody, D.S., 1991. Fishery Population Dynamics and Breeding Biology of *Panulirus homarus* on the South Coast of Sri Lanka. Unpublished PhD Thesis. Department of Biological and Molecular Sciences, University of Stirling, United Kingdom.

[8] Jayakody, D.S., 1993. On the growth, mortality and recruitment of the spiny lobster (*Panulirus homarus*) in Sri Lanka waters. Naga, the Iclarm quarterly. 38-42 pp.

[9] Jayawickrema, S. J. C. 1991: Fishery and population dynamics of *Panulirus homarus* (Linnaeus) from Mutwal, Sri-Lanka. Journal National Science Council Sri-Lanka 19(1): 52-61.

[10] Kulmiye A.J. (2004) Growth and reproduction of the spiny lobster, *Panulirus homarus homarus* (Linnaeus, 1758) in Kenya. PhD Thesis, University of Nairobi, Kenya, 175pp

[11] Mohamed, K.H. and George M. J., 1971. Results of the tagging experiments on the Indian spiny lobster, *Panulirus homarus* (Linnaeus) - movement and growth. Indian Journal of Fisheries, 15:15-26.

[12] Moutopoulos, D.K. and Stergiou, K.I. 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). Journal of Applied Ichthyology, 18: 200-203.

[13] Ozaydin, O. and Taskavak, E. 2006. Length-weight relationhips for 47 fish species from Izmir Bay (Eastern Agean Sea, Turkey). Acta Adriat., 47: 211-216.

[14] Ricker, W.E., 1973. Linear regressions in fishery research. Journal of Fish. Research Board Canada, 30: 409-434.

[15] Sahar Mehanna, Said Al-Shijibi, Juma Al-Jafary, Rashid Al-Senaidi, 2012. Population dynamics and management of scalloped spiny lobster *Panulirus homarus* in Oman coastal waters. Journal of Biology, Agriculture and Healthcare www.iiste.org ISSN 2224-3208 (Paper) ISSN 2225-093X (Online) Vol 2, No.10.

[16] Senevirathna, J.D.M. and Munasinghe, D.H.N., 2012. Phylogenetic status of four spiny lobster species in Southern coastal region of Sri Lanka. Proceedings of NARA Scientific Session, 29pp.

[17] Sanders, M. and Liyanage U., 2009. Preliminary assessment for the spiny lobster fishery of the south coast (Sri Lanka). The project report of National Aquatic Resources Research and Development Agency (NARA), Sri Lanka.

[18] Taskavak, E. and Bilecenoglu, M., 2001. Length-weight relationships for 18 lessepsian (Red Sea) immigrant fish species from the Eastern Mediterranean coast of Turkey. Journal of Marine Biology Association UK., 81: 895-896.

[19] Thuy, N.T.B., 2000. Distribution and growth of spiny lobster *P. homarus* (Linnaeus) in the central waters of Vietnam. Collection of Marine Research Works 10: 228-232.

[20] Zar, J.H., 1999. Biostatistical Analysis. 4th Edn., Prentice-Hall, New Jersy, USA., Pages: 469.