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The Length - Weight Relationship Factor and Sex-Ratio of Mantis Shrimp (*Harpiosquilla* spp) in Andaman Sea of Satun Province, Thailand

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Abstract This study estimated the length-weight relationship, sex ratio and population parameters of mantis shrimp, *Harpiosquilla* spp. from the coastal waters of Andaman Sea, Satun Province, Thailand between February 2015 and March 2016. The length- weight relationship factor of Mantis Shrimp in Andaman Sea of Satun Province, Thailand was conducted for 12 consecutive months (February, 2015 – March, 2016). Data were collected from 437 individuals. The research method was surveyed, descriptive analyzed and interviewed. The most frequently catch fish was shown between 190-335 mm. They was positive allometric pattern. Length - weight relationship had equation (all samples) $W = 0.0341L^{2.6564}$ ($R^2 = 0.8129$) and (males) $W = 0257.0 \times {}^{7425.2}R8377.0 = {}^{2}$ and (females) $W = 0.061x^{2.481}$ ($R^2 = 0.7239$). Mantis Shrimp sexual dimorphism with sex ratio of 1.54 : 1.0 which was significantly biased in favour of males. The catch mantis shrimp still had a chance to mature and spawn. However, the fishery aspects become important in this case and may need to investigate. The study provided a basic and valuable information for the Mantis Shrimp fisheries management and population monitoring.

Keywords: length- weight, Sex-ratio, Mantis Shrimp

Introduction

Mantis shrimps, or stomatopods, are marine crustaceans of the order Stomatopoda. They branched from other members of the class Malacostraca around 400 Mya. The mantis shrimps typically grow to around 10 centimetres in length. A few can reach up to 38 cm. The largest mantis shrimp ever caught had a length of 46 cmand was caught in the Indian River near Fort Pierce, Florida, in the United States. A mantis shrimp's carapace (the bony, thick shell that covers crustaceans and some other species) covers only the rear part of the head and the first four segments of the thorax. Varieties range from shades of brown to vivid colours, as there are more than 450 species of mantis shrimp.

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They are among the most important predators in many shallow, tropical, and sub-tropical marine habitats. However, despite being common, they are poorly understood as many species spend most of their life tucked away in burrows and holes. Ecologically, mantis shrimps are one of the most conspicuous members of the littoral and sublittoral large-sized benthic animals living in soft sediments worldwide. These organisms reside in their burrows for shelter, reproduction and feeding. The spearer mantis shrimp, *Harpiosquilla* spp. lives on muddy bottoms in coastal waters around Thailand. The shrimp is mostly exported to Hong Kong and Taiwan, and demand continues to increase over the years. To avoid the extinction of the shrimp due to exploitation, domestication of wild population is an alternative. For this, information on the biology of the shrimp is needed.

The length weight relationships of fish are important for converting length observations, obtained for example from underwater visual census methods, into weight estimates for, for example, biomass estimates. Such relationships, while easily obtained, are still unavailable for many fish species. Length-weightrelationship (LWR) and its parameters 'a' and 'b' are of great importance in fishery biology and practical assessment of stocks of aquatic species (Gulland, 1983; Enin, 1994; Stergiou and Moutopoulos, 2001). Pauly D. (1993) suggested the following situations when length-weight relationship may be needed. The conversion of length of individual fish to weight. Estimating the mean weight of fish of a given length. Conversion of growth equation for length into a growth equation for weight, and Morphological comparisons between populations of the same species or between species. Population dynamics of stomatopod has been studied in other countries such as in Mekong Delta of South Vietnam by Dinh *et al*. (2010), in Kuala Tungkal of Jambi Province Sumatera Island, Indonesia by Wardiatno and Mashar (2011). However, study regarding population biology of stomatopods. Therefore, the present study was undertaken on the population dynamics to know the stock status of *Harpiosquilla* spp. in the coastal waters of the Andaman Sea of Satun Province, Thailand.

Objectives: In this study, therefore, some biological aspects of the of the Mantis shrimp, including data on Total Length (TL)-Body Weight (W) and Sex-ratio, male and female individual samples taken from the Andaman Sea were studied.

Materials and methods

Mantis Shrimp were collected by gill net in Andaman Sea, Satun, Thailand. All sampling was conducted for 12 consecutive months (February, 2015 – March, 2016). All meshes of the gill net were 4.5 inch length square

mesh. The gill net, used in a maximum depth of 2 m, was trawled manually along the shallow areas of the Andaman Sea. The Total Length, female and male Mantis Shrimps were measured nearest 1 mm and Weight (W) was balanced nearest 0.1 g. Totally 437 individuals were analyzed.

The length-weight relationships of all collected samples were determined by the expression $W= a*L^b$, where W is the derived weight (g), L is TL (cm) and a is the intercept of the regression curve and b (slope) are most easily estimated by linear regression based on logarithms; log (W) = log (a)+b log (L) (Lagler, 1968). The significance of regression was assessed by analysis of variance (ANOVA). Equations expressing the width/length-weight relationships of Mantis Shrimps were calculated in relation to sex.

Sex ratio was determined for all fish pooled and for each month. Comparisons if sex ratio depared from the expected 1:1 rate were determined by Chi-square test at 95% significance level. Size structure was assessed by length frequency distribution in 12 size classes, with numerical fish abundance also compared by Chi-square test for each class. Principal component analysis and one-way analysis of variance ANOVA followed by an a posteriori Tukey test (Zar, 1984) were used for spatial and temporal assessing of fish distribution by size class.

Figure 1. Research location Red box indicates the mudflat where the mantis shrimps were collected.

Results and Discussion

Size composition

In this study we collected and measured TL total of 437 individuals Mantis Shrimp, ranging from 19.0 to 33.5 cm (Fig 2)and Mean TL, female and male individuals of Mantis Shrimp's were 28.44 cm. (1.80 SE) and 27.39 cm. (2.17 SE) respectively. Analysis of Kolmogorov-Smirnov test detected no significant differences ($p>0.05$) in morphometry between females and males (Table 1). Weight, female and male individuals of Mantis Shrimp's were 250.01 g. (43.03 SE) and 229.75 g. (51.14 SE) respectively. Analysis of Kolmogorov-Smirnov test detected no significant differences ($p>0.05$) in morphometric between females and males.

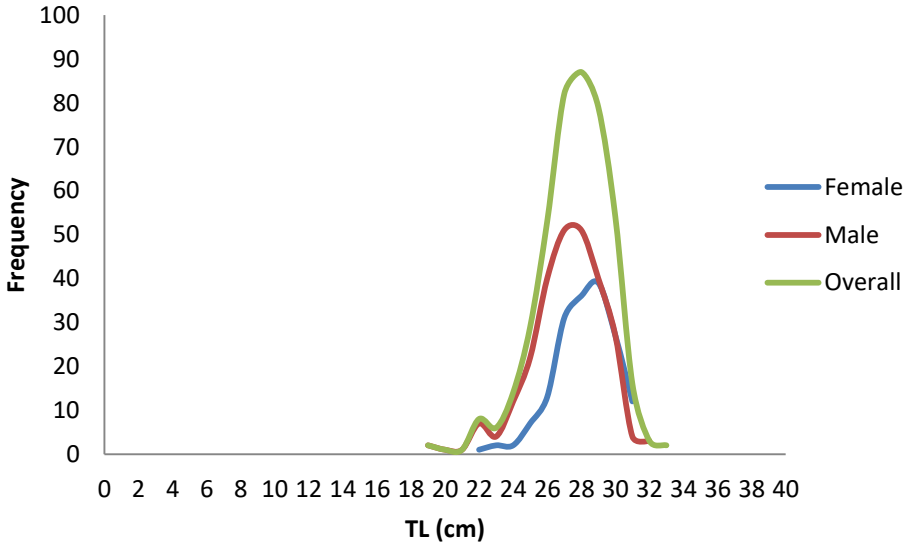

Figure 2. Size frequency distribution by size groups of Mantis Shrimp for each sex and overall individuals

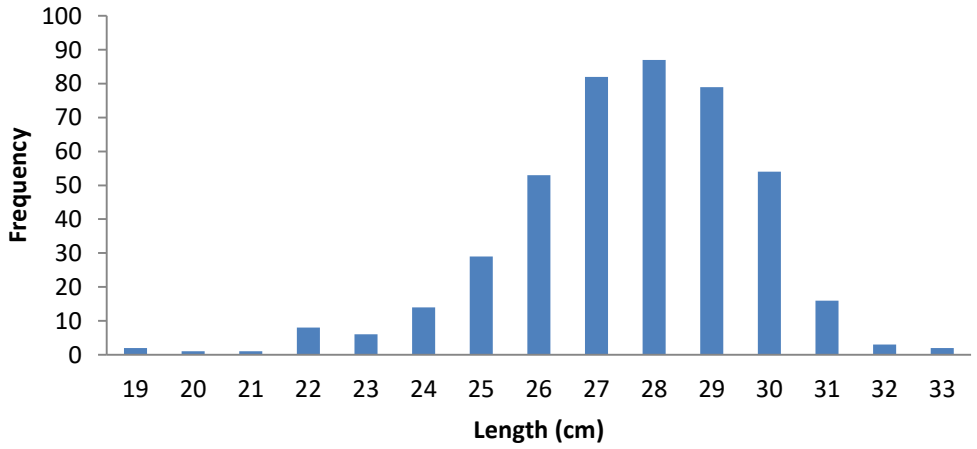

Figure 3. Size frequency distribution by size groups of Mantis Shrimps for each sex and overall individuals

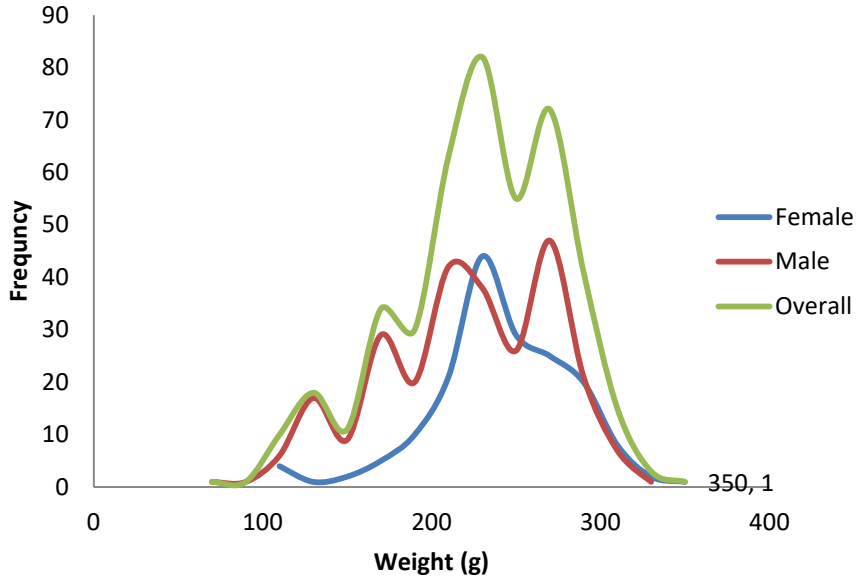

Figure 4. Size frequency distribution by weight groups of Mantis Shrimp for each sex and overall individuals

Table 1. Length and weight of Mantis Shrimp

Sex	Length (TL) cm.					Weight (W) g.					
	Min	**Max**	**Mean**	**±**	**S.E**	**Min**	**Max**	**Mean**	**±**	**S.E**	**N**
F	22	33.5	28.44	±	1.80	122	391	250.01	±	43.03	172
M	19	32	27.39	±	2.17	74	332	229.75	±	51.14	265
Total	19	33.5	27.80	±	2.10	74	391	237.72	±	49.07	437

Length-weight relationship

Relationships between TL and W were expressed by equations: $W = 0.0341L^{2.6564}$ ($R^2 = 0.8129$) and (males) W =0257.0 x $^{7425.2}$R8377.0 = ² and (females) $W = 0.061x^{2.481}$ ($R^2 = 0.7239$).Mantis Shrimp sexual dimorphism with sex ratio of 1.54 : 1.0 which was significantly biased in favour of males. (Fig. 5-6) ANOVA test detected highly significant differences in regression coefficients between the regression of W and CW for all sexes (Table 3). The carapace width/length-weight relationships show isometric growth except that of juvenile crabs (positive allometry).

The width-length regressions were also highly significant ($p<0.01$). Width-length relationships of blue crab were given in the Fig. 4.

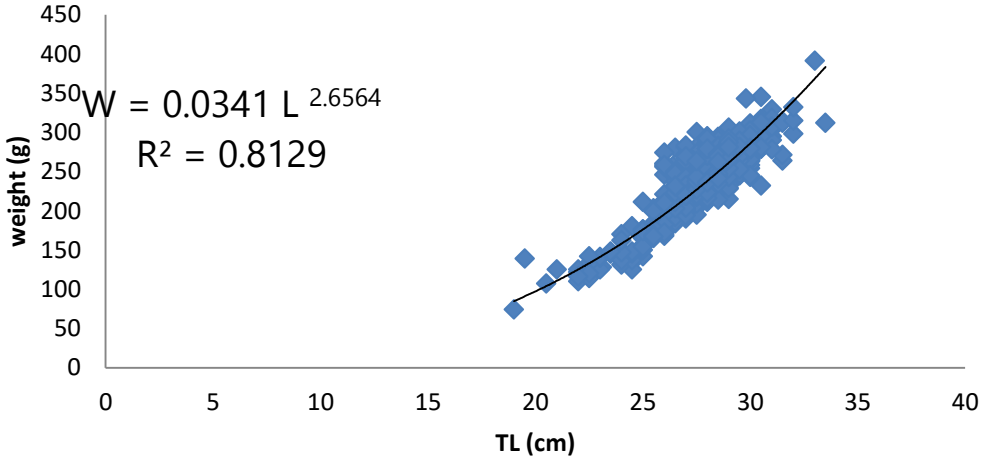

Figure 5. Relationships between total length (TL) and weight (W) groups of Mantis Shrimp overall individuals

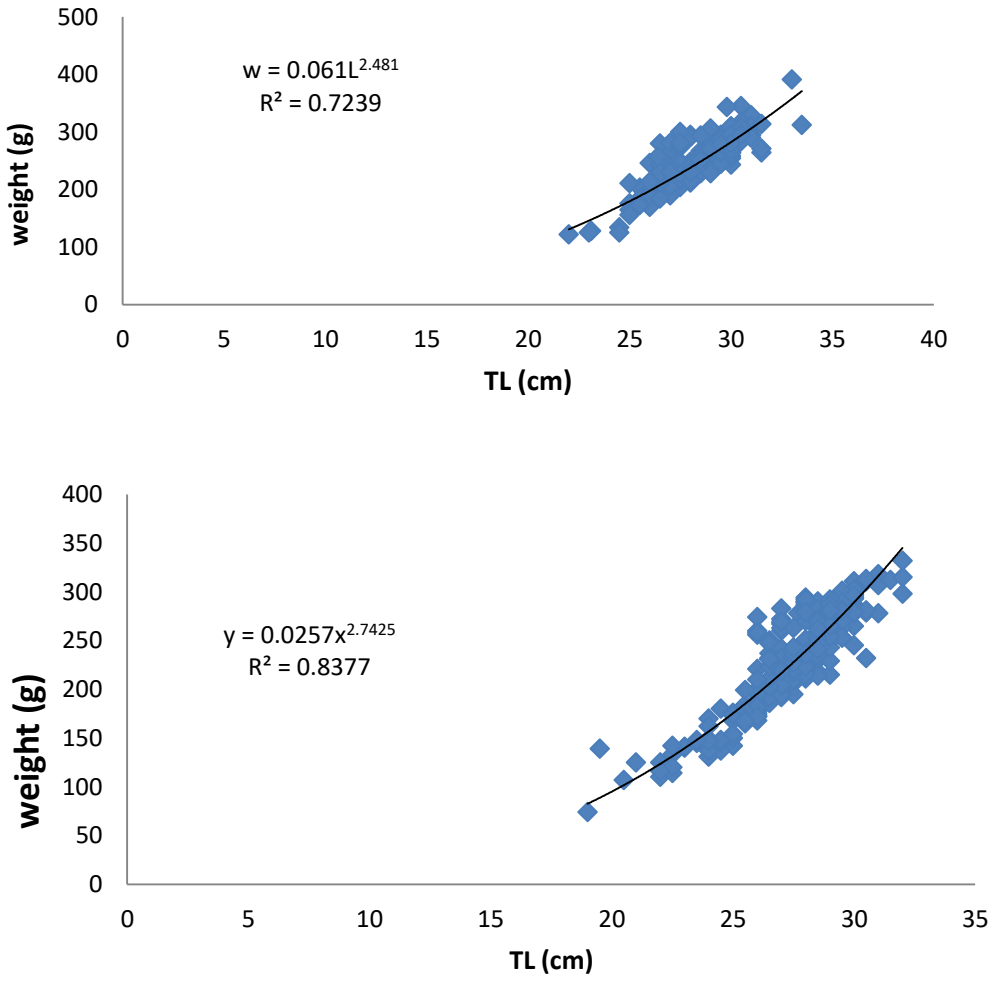

Figure 6. Relationships between total length (TL) and weight (W) groups of Mantis Shrimp overall individuals (Male)

Table 2. Regression parameters of the relationship between W and TL

Sex	**W = aTL^b**			
	a	**b**	**N**	**R2**
Female	061.0	481.2	172	R7239.0 = ²
male	0257.0	7425.2	265	R8377.0 = ²
Total	0341.0	6564.2	437	R8129.0 = ²

Sex ratio and size structure constitute basic information in assessing reproductive potential and estimating stock size in fish populations. The sex ratio (male: female) for population distribution in the whole bay area was 1 : 1.54 and did not depart from the expected 1:1 rate (Table 3) A similar 1:1 sex ratio was found for February 2015, September 2015, October 2015, November 20151, December 2015 and January 2016 and but on the March 2015, April 2015, May 2015, June 2015, July 2015 and August 2015 significantly according to X^2 test Overall, there was no significant departure from the expected 1:1 sex ratio during the study months, but males were significantly ($p < 0.05$) more numerous than females on March 2015, April 2015, May 2015, June 2015, July 2015 and August 2015, males also outnumbered females but the examined fishes were numerically insufficient to permit a reliable conclusion (Table 3)

The target species of the present study is *Harpiosquilla* spp, one of the two common mantis shrimps of the same genus inhabiting mudfats at the mouth of the Tungkal River, Jambi Province. The other species living in the research location is Harpiosquilla harpax. Only few, if any, research has discussed sex ratio among mantis shrimps. Like most decapods crustaceans, the sex ratio for the entire population of Harpiosquilla raphidea was female-biased. However, variations in the ratios by size classes were detected. Unusual male-biased ratios for the whole population was found in some callianassid shrimp, such as Callianassa kraussi (Forbes, 1973). In callianassid shrimp population, records of female-biased sex ratio as an artifact of collecting methods were hypothesized by Rowden & Jones (1994). However, Pezzuto (1998) in his review wrote that female-biased. In the present study, females dominated the larger size. This would probably be related to the behaviour of the males. After becoming mature, the males have to fight for mating partners. So, the number of males after maturation decreases gradually, yielding female-biased ratios in some larger classes. However, a reduced number of sexually mature males through fights and/or due to predation when they leave the burrow to rummage around for females, could have compensation for the decapods population.

Table 3. Sex- Ratio for population distribution in Andaman Sea, Satun Thailand

Month	Number	Male	Female	Expected value		Sex ratio		x^2	H_0
				Male	Female	Male	Female		
Feb-15	39	16	23	19.50	19.50	1	0.70	1.26	accept
Mar-15	32	23	9	16.00	16.00	1	2.56	6.13	non-accept
Apr-15	45	35	10	22.50	22.50	1	3.50	13.89	non-accept
May-15	33	26	7	16.50	16.50	1	3.71	10.94	non-accept
Jun-15	37	26	11	18.50	18.50	1	2.36	6.08	non-accept
Jul-15	30	23	7	15.00	15.00	1	3.29	8.53	non-accept
Aug-15	31	21	10	15.50	15.50	1	2.10	3.90	non-accept
Sep-15	34	20	14	17.00	17.00	1	1.43	1.06	accept
Oct-15	30	20	10	15.00	15.00	1	2.00	3.33	accept
Nov-15	51	25	26	25.50	25.50	1	0.96	0.02	accept
Dec-15	44	23	21	22.00	22.00	1	1.10	0.09	accept
Jan-16	31	7	24	15.50	15.50	1	0.29	9.32	non-accept
Total	437	265	172	218.50	218.50	1	1.54	19.79	non-accept

Note: Chi-square table (x2) at degree of freedom (2-1), x [(2-1) x (12 -1)] = 1, 11 of confidential value = 3.84 and 19.68

Conclusion

Mantis Shrimp were collected by gill net in Andaman Sea, Satun, Thailand. All sampling was conducted for 12 consecutive months (February, 2015 – March, 2016). All meshes of the gill net were 4.5 inch length square mesh. The gill net, used in a maximum depth of 2 m, was trawled manually along the shallow areas of the Andaman Sea.

Length - weight relationship had equation (all samples) $W = 0.0341L^{2.6564}$ ($R^2 = 0.8129$) and (males) W =0257.0 x $^{7425.2}$R8377.0 = ^{2} and (females) $W = 0.061x^{2.481}$ ($R^2 = 0.7239$). Mantis Shrimp sexual dimorphism with sex ratio of 1.54 : 1.0 which was significantly biased in favour of males. The relative growth pattern was positive allometric for both males and females of *Harpiosquilla* spp. which indicated as multi-spanner behaviour of this species. The population of males were predominant over females. The rate of exploitation for *Harpiosquilla* spp. was slightly below the optimum level of Exploitation (E=0.50) and thus precautions or stock assessment regarding this species in the coastal waters of Andaman sea, must be taken so that the species might not undergo over exploitation. The catch mantis shrimp still had a chance to mature and spawn. Investigation, however, on fisheries aspects become important in this case. The present study provides a basic and valuable information for the Mantis Shrimp fisheries management and population monitoring. The catch mantis shrimp still had a chance to mature and spawn. Investigation, however, on fisheries aspects become important in this case. The present study provides a basic and valuable information for the Mantis Shrimp fisheries management and population monitoring. The result from this study is the important information for identifying the population dynamics and biology of mantis shrimp in Andaman Sea, Satun, Thailand.

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