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Population Characteristics, Length-Weight and Length-Length Relationships of *Acetes vulgaris* (Decapoda: Sergestidae) in the Coastal Waters of Pontian, Johor, Peninsular Malaysia

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Abstract: The population structure, length-weight and length-length relationships of *Acetes vulgaris* were examined based on 1141 specimens collected in the months of June and July 2006 from Pontian, Johor Bahru. The morphological characteristics of *A. vulgaris* were examined and the result was found to be similar when compared with the previous research. Mean length of males was 23.18±2.95 mm while for females was 23.91±3.53 mm. The range of total length for the males and females was 14.00-33.00 and 13.00-32.00 mm, respectively. The relationship between the total length and body weight of *A. vulgaris* was $W = 0.0178L^{2.6368}$ ($r^2 = 0.829$) for males and $W = 0.0082L^{2.9144}$ ($r^2 = 0.902$) for females. The carapace length and total length, relationship for males and females were $CL = 4.1844TL + 2.3983$ ($r^2 = 0.732$) and $CL = 4.0872TL + 1.8879$ ($r^2 = 0.732$), respectively. The sex ratio of female to male was found to be at 1: 3.27 with the number of males exceeded that of the females.

Key words: Population structure, sex ratio, *Acetes vulgaris*

INTRODUCTION

Acetes are small pelagic shrimps of which the body length ranges approximately between 10 and 40 mm (Omori, 1975). It is known as *udang geragau* in Malacca while in Terengganu it is well known as *udang baring* and *bubok* in Sabah and Sarawak. *Acetes* play an important role in the productivity of the ocean where it provides an important link between plant material, phytoplankton, zooplankton and large animals of the higher trophic levels. It is also important in the diet of a range of marine predators including ctenophores, cephalopods, crustacean, fish and juvenile crocodiles (Xiao and Greenwood, 1993). The shrimp of the genus *Acetes*, is mainly used in subsistence fisheries and is, therefore, commercially important in the Peninsular Malaysia. The annual landing of *Acetes* in Malaysia was 7,528 tons during 2004, only a small proportion of the catch is marketed as fresh shrimps; the greater proportion is dried, salted or fermented in various form of food (Arshad *et al.*, 2007). Thus, they form a major source of protein in Malaysia.

Length-weight relationships have been extensively used for: (i) estimation of weight from length due to

technical difficulties and the amount of time required to record weight in the field; (ii) conversion of growth in length equations to growth in weight for use in stock assessment models; (iii) estimation of the biomass from length observations; and (iv) estimation of the condition factors of the aquatic species. In addition to the above, length-weight relationships are useful for between region comparisons of life histories of a certain species. There have been no published reports available on *Acetes vulgaris* in Malaysia except some reports on other species of *Acetes* (Amin *et al.*, 2007, 2008a, b; Arshad *et al.*, 2007). Therefore, the present study was undertaken to estimate the size frequency distribution for age structure and length weight relationships to know the growth pattern of *Acetes vulgaris* from the coastal waters of Pontian, Johor, Peninsular Malaysia.

MATERIALS AND METHODS

Samples collection and identification: Samples were collected using bagnet in the months of June and July 2006 from fishermen operating in the coastal waters of Pontian, Johor, Peninsular Malaysia (Fig. 1). Specimens were preserved in 10% formalin in the field and

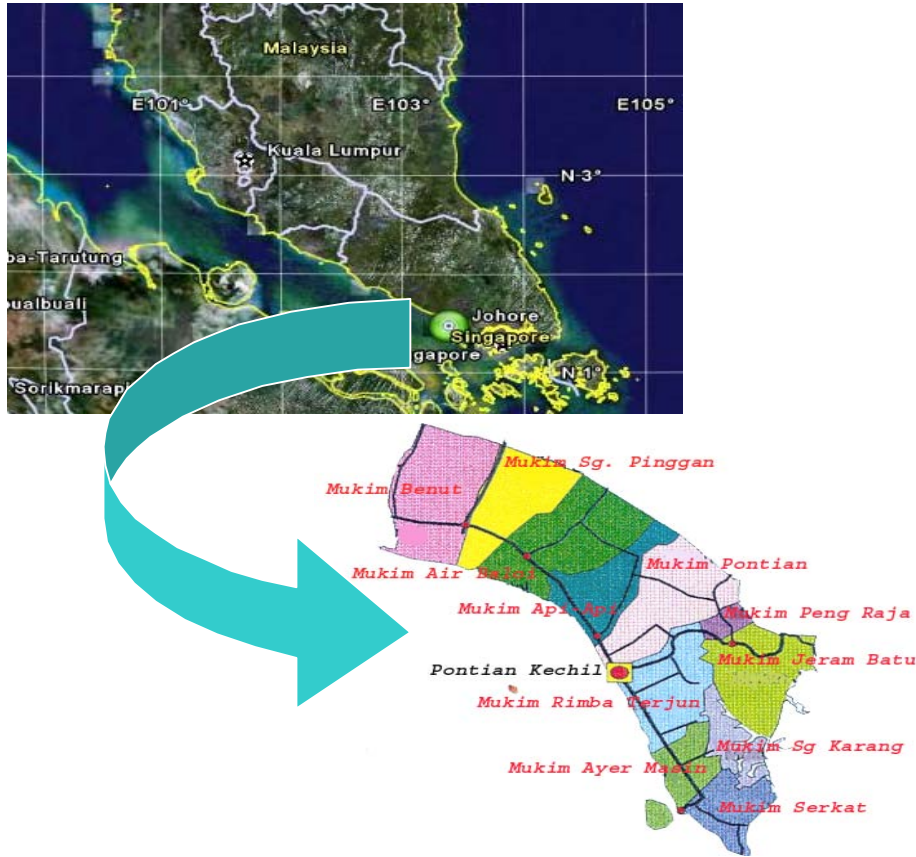


Fig. 1: Geographical location of the sampling station (●) in the coastal waters of Pontian, Johor, Peninsular Malaysia

transported to the laboratory for further analysis. In the laboratory, 20 g sub samples were taken and *Acetes vulgaris* were identified and sorted out on the basis of morphometric characteristics such as shape of the telson, presence or absence of procurved tooth between the bases of first pleopods and others characteristics mentioned by Omori (1975).

Length weight relationships: Total length (TL) and body weight (BW) of 1141 individuals (874 males and 267 females) were measured. Total length was measured from tip of the rostrum to the tip of the telson to the nearest 0.1 mm accuracy and body weight was measured by using an electronic balance of 0.01 mg accuracy. To establish the length-weight relationship, the commonly used relationship was applied by Quinn and Deriso (1999) was applied:

$$W = aL^b$$

where, W is the total weight (mg), L is the total length (mm), a is intercept (condition factor) and b is the exponent. The parameters a and b were estimated by least squares linear regression on log-log transformed data:

$$\text{Log}_{10}W = \text{Log}_{10}a + b \text{Log}_{10}L$$

The coefficient of determination (r^2) was used as an indicator of the quality of the linear regression (Scherrer, 1984). In addition, 95% confidence limits of the parameter b and the statistical significance level of r^2 were estimated.

Length-length relationships: To establish the length relationships a total of 436 samples of *A. vulgaris* were analyzed. Total length (TL, from the tip of the rostrum to the tip of telson) and carapace length (CL, from the first denticle of the rostrum to the starting point of the first abdominal segment) were measured to the nearest 0.01 mm. For establishing the total length and carapace length relationship, the least square method was followed. The 95% confidence limits of the parameter b and the statistical significance level of r^2 were estimated for the relationship.

Size frequency analysis: Length frequency data of *A. vulgaris* was analyzed by using MINITAB Version 14 and SPSS Version 11.5.

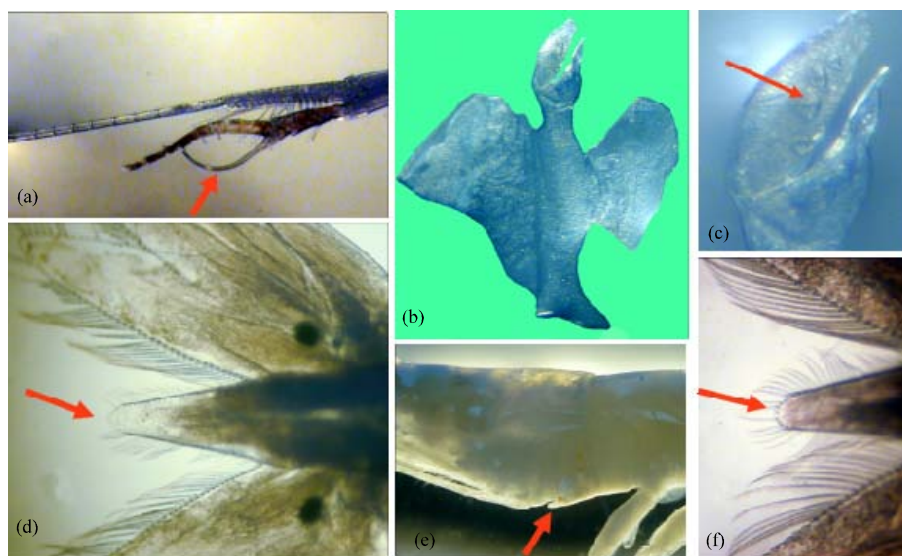


Fig. 2: *Acetes vulgaris* (a) Claspingspines (x 40); (b) Petasma (x40); (c) Capitulum of petasma (x40); (d) Apex of the telson triangular (male, x40); (e) Genital coxa (x40) and (f) Apex of the telson triangular (female, x40)

Sex ratio: The sexes were determined by the presence or absence of petasma on the first pleopod as well as the claspingspines of the lower antennular flagellum (Omori, 1975).

RESULTS

Taxonomic account:

Family : Sergestidae
 Subfamily : Sergestinae
 Genus : *Acetes* H. Milne Edwards
 Species : *Acetes vulgaris* Omori 1975: 69, Fig. 3

Descriptive remarks: The antennule consisted of three basal segments, the peduncle and a pair of multi-jointed flagella. In females the lower antennular flagellum is 20- 24 segmented. While in males the lower antennular flagellum is 17-21 segmented and there is only one claspingspine on the lower antennular flagellum (Fig. 2a). The first segment of the main branch is with small swelling which bears 4-6 basal spinules with the segment opposite the tip of the claspingspine bears 4-5 spinules. The petasma is with pars astrigen (Fig. 2b). The capitulum of the petasma is thick, twice as long as broad and bared 3 large falcate hooks on the outer margin (Fig. 2c). The distal part of the capitulum is broadly obtuse with 7-8 small hooks. The main external characteristics of *A. vulgaris* included the triangular shape of the apex of telson in male (Fig. 2d). The genital area of the females is having a pair or large round protuberances on the anterior part of the third

Table 1: Length-weight relationship parameters of *A. vulgaris* in the coastal waters of Pontian, Johor, Peninsular Malaysia

Sex	N	TL range	a	b	r ²
Female	267	13.00 – 32.00	0.0082	2.6368	0.834
Male	874	14.00 – 33.00	0.0178	2.9144	0.902

N: Sample size; TL: Total Length; a and b: Parameters of the length-weight relationship; r²: Coefficient of determination

thoracic sternite. Behind the protuberances a deep procurved furrow runs transversally across the body. In males, the anterior margin of the genital coxa is pointed (Fig. 2e). However, the apex of telson is rounded in females (Fig. 2f).

Length-weight relationships: The length-weight relationship parameters of males and females of *A. vulgaris* are presented in Table 1. In both sexes, it is observed that weight bears curvilinear relationships (Fig. 3) with the length which becomes linear after logarithmic transformation (Fig. 4). The calculated equations for the length-weight relationship for males and females were $W = 0.0178L^{2.6368}$ or $\log W = 2.6368 \log L - 1.7507$ ($r^2 = 0.8343$) and $W = 0.0082L^{2.9144}$ or $\log W = 2.9144 \log L - 2.132$ ($r^2 = 0.902$), respectively.

Length-length relationships: The mean carapace lengths of *A. vulgaris* were plotted against the mean total lengths (Fig. 5). Estimated length-length relationship parameters are presented in Table 2. The relationships were highly significant ($p < 0.01$) with coefficient of determination, $r^2 > 0.732$.

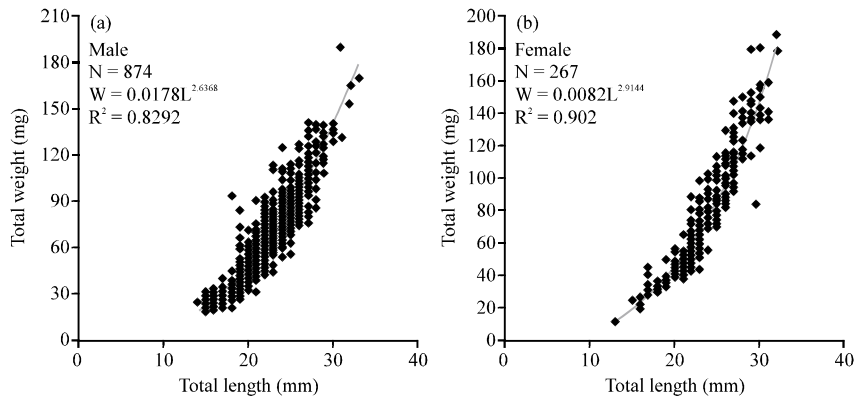


Fig. 3: Relationship between total length (mm) and total weight (mg) in (a) males and (b) females *A. vulgaris* (arithmetic)

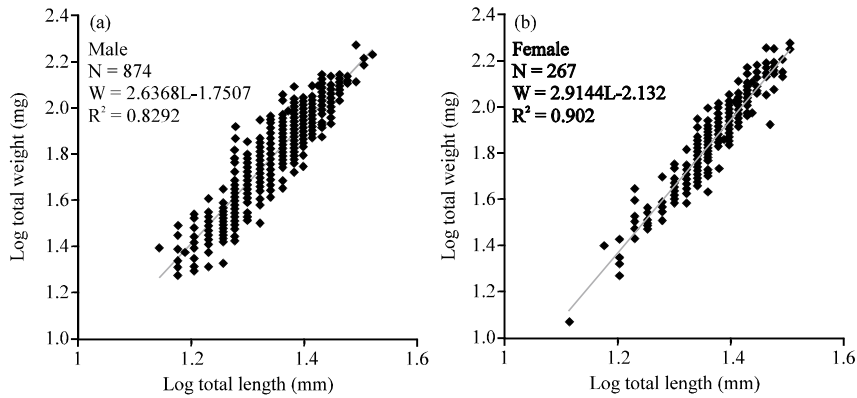


Fig. 4: Relationship between log total length (mm) and log total weight (mg) in (a) males and (b) females *A. vulgaris* (logarithmic)

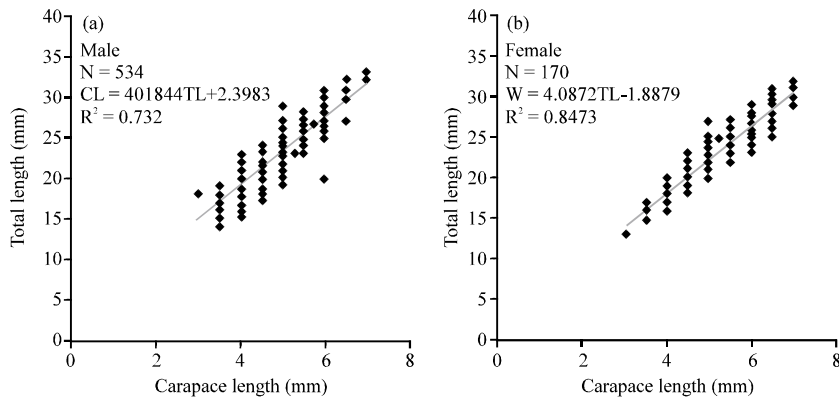


Fig. 5: Scatter diagram showing the relationship between carapace length and total length of (a) males and (b) females *A. vulgaris*

Table 2: Morphometric relationship between total length and carapace length of *A. vulgaris* in the coastal waters of Pontian, Johor, Peninsular Malaysia

Sex	Length-length relationship	N	r ²
Male	CL = 4.1844 TL + 2.3983	534	0.732
Female	CL = 4.0872 TL + 1.8879	170	0.847

Population structure: Total No. of individuals collected for this study was 874 (76.6%) males and 267 (23.4%) females, respectively. The mean total length (TL) was 23.18 (± 2.95) and 23.91 (± 3.53) mm for males and females, respectively. The minimum and maximum total length for

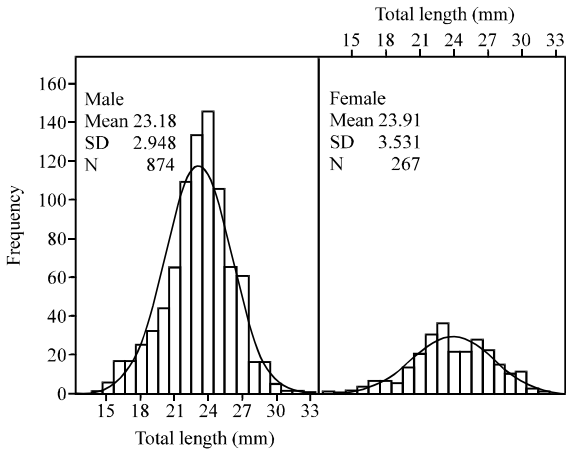


Fig. 6: Length frequency histogram of males and females of *A. vulgaris* from the coastal waters of Pontian, Johor, Peninsular Malaysia

Table 3: Variations of *A. vulgaris* sex ratio in relation to size (TL) in the coastal waters of Pontian, Johor, Peninsular Malaysia.

Total length (mm)	Male	Female
13.50	1	1
15.50	23	5
17.50	42	14
19.50	76	20
21.50	175	52
23.50	283	60
25.50	172	49
27.50	75	38
29.50	22	23
31.50	4	5

males was 14.00 and 33.00 mm while 13.00 and 32.00 mm for females. Figure 6 shows the length-frequency histograms of males and females of *A. vulgaris*. The mean total length of females was slightly higher than males but not significant (t-test, $p > 0.001$).

Sex ratio: The result indicated that the sex ratio of female to male was found to be 1:3.27 with the number of males approximately 3 times more than the females. The sex ratio by size class (TL) showed a clear predominance of males in the lower sizes (< 29.5 mm). On the other hand, the number of females increased after 29.5 mm of body size (Table 3).

DISCUSSION

The morphological characteristic of *A. vulgaris* from Pontian, Johor is fully agreed with Omori (1975). The main external characteristics of *A. vulgaris* include the triangular shape of the apex of telson in males, no procurved spine but a small conical projection between the bases of the first pleopods in both females and males. While in males, there is only one clasping spine on the lower antennular flagellum. The capitulum is thick and

there are three large hooks on the outer margin while the distal part of the capitulum obtuse with 7-8 small hooks. The size of the adult females was slightly bigger than males with mean length of 23.18 ± 2.95 mm in males and 23.91 ± 3.53 mm in females.

The value of the growth coefficient *b* obtained for males and females of *A. vulgaris* was 2.6368 and 2.9144 respectively. In both cases, the value of *b* lies between the expected value of 2.50-3.50 reported for most aquatic organisms (Ecoutin *et al.*, 2005). However, the estimated *b* value for males (2.6368) and females (2.9144) is significantly lower than isometric value (3) at 5% level. This indicated the negative allometric nature of growth for both sexes of *A. vulgaris*.

The sex ratio of *Acetes* usually deviates from 1:1, there frequently being more females than males (Xiao and Greenwood, 1993). However, in the present study the sex ratio between the females and males was 1 : 3.27 with the number of male's proportion higher than the females. Sex ratio may be related to the growth, mortality and behavior of the shrimp populations (Oh and Jeong, 2003). Skewed sex ratio can be caused by different mortality between sexes and different behavioral characteristics such as migration (Kim, 2005).

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