



Journal of  
**Fisheries and  
Aquatic Science**

ISSN 1816-4927



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## Diet Composition of Sergestid Shrimp *Acetes serrulatus* from the Coastal Waters of Kukup, Johor, Malaysia

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### ABSTRACT

Shrimps of the genus *Acetes* Milne-Edwards, 1980 are ecologically and commercially important. The diet composition of *A. serrulatus* were examined based on 370 specimens collected in the coastal waters of Johor, Peninsular Malaysia from April 2008 to April 2009. The food items in the gut of *A. serrulatus* were comprised of phytoplankton, zooplankton, plant matter, appendages of decapods, debris and unidentified fragments. Majority of the stomach sacs examined (88.72%) were filled up with food while only 11.28% were found empty. Based on the Simple Resultant Index (% Rs), appendages of decapod (31.87%) was found to be the primary food items, followed by plant matter (16.48%) and zooplankton (14.18%). Thus, it could be concluded that *A. serrulatus* is omnivorous and feed on phytoplankton, zooplankton and microcrustacean.

**Key words:** Diet composition, *acetes serrulatus*, peninsular malaysia

### INTRODUCTION

Locally known as 'udang geragau' or 'udang baring', shrimps of the genus *Acetes* are commercially important in Malaysia with an annual landing of 13,797 metric tons in 2007 (DOF, 2009). *Acetes serrulatus* that ranged from 15-28 mm in total length is abundantly found in the coastal waters of Kukup in the state of Johor, Peninsular Malaysia. The *Acetes* resource is solely caught using bag net throughout the year (Oh *et al.*, 2010). A small proportion of the catch is marketed as fresh shrimps while the greater proportion of it is sun-dried, salted or fermented in various form of local products such as 'belacan' and 'cincalok' (Amin *et al.*, 2009; Arshad *et al.*, 2008; Pathansali, 1966). Besides local consumption, some of the products are packed and exported to Singapore, Indonesia, Philippines, Netherland, Vietnam and Thailand (DOF, 2009).

*Acetes* plays an important role in the productivity of the ocean. It links with zooplankton and large animals of the higher trophic levels in the food chains and transports organic matter produced in the upper layer to the lower layer through vertical migration (Xiao and Greenwood, 1993). *Acetes* shrimps are widely used as a cheaper alternative crustacean meal in hatchery operations and culture pond due to the increasing price of brine shrimp cyst production. It has also been used to feed fish, larvae and adult of penaeid shrimps both in laboratory and aquaculture industry.

In comparison with our knowledge on the population biology (Amin *et al.*, 2010a, b) little is known about the feeding habits of *Acetes* species. The analysis of stomach contents has been used

in studies of other species of *Acetes* such as *A. intermedius* (Chiou *et al.*, 2005), *A. sibogae* (Coman *et al.*, 2006), *A. paraguayensis* (Collins and Williner, 2003) and *A. indicus* (Deshmukh, 2002). However, to date no studies on the diet composition of *A. serrulatus* in Johor waters have ever been reported.

## MATERIALS AND METHODS

**Sample collection:** *Acetes serrulatus* were collected from commercial set bag net fishery in the coastal waters of Johor (Lat. 0°16.13'N and Long. 103°28.34'E), Peninsular Malaysia from April 2008 to April 2009 (Fig. 1). The length of the net is approximately 21 m with 0.5 cm mesh sizes at the cod end. Samples were preserved with 10% buffered formalin in seawater in the field before transported back to the laboratory for further analysis.

**Stomach examination:** The guts of 30 *A. serrulatus* (15 males and 15 females) were examined monthly except October (5 males and 5 females) during the study period. Stomach contents were



Fig. 1: Geographical location of the study area (\*) in the coastal waters of Johor, Peninsular Malaysia

identified to the lowest possible taxonomic level. The degree of stomach fullness was estimated according to the empirical scale adapted from Chrisfi *et al.* (2007).

**Stomach content analysis:** The percentage frequency of occurrence ( $(F_{pi})$ ) and percentage numerical abundance ( $(C_i)$ ) for each type of prey was calculated using the formulae by Chrisfi *et al.* (2007):

$$\text{Percentage frequency of occurrence } (F_{pi}) = (N_{1i}/N_p) \times 100 \quad (1)$$

where,  $N_{1i}$  is the number of the stomachs in which food item  $i$  was found while  $N_p$  is the number of non-empty stomachs.

$$\text{Percentage numerical abundance } (C_i) = ni / \sum_{i=1}^m ni \times 100 \quad (2)$$

where  $n_i$  is the number of  $i$ th food item and  $m$  is the number of food items.

The relative importance of food item on the diet of *A. serrulatus* was assessed by Simple Resultant Index (%Rs) according to Mohan and Sankaran (1988):

$$\text{Simple Resultant Index } (\%Rs) = \frac{\sqrt{C_i^2 + F_{pi}^2}}{\sum_{i=1}^m \sqrt{C_i^2 + F_{pi}^2}} \times 100 \quad (3)$$

## RESULTS

**Diet composition:** The food items in the gut of *A. serrulatus* were comprised of the phytoplankton, zooplankton, plant matter, appendages of decapods, debris and unidentified fragments. Figure 2 showed some of the food items found in the gut of *A. serrulatus*. Based on the Simple Resultant Index (%Rs), appendages of decapods (31.87%) was found to be the primary food items, followed by plant matter (16.48%) and zooplankton (14.18%) (Table 1).

Table 1: Overall diet composition of *Acetes serrulatus* ranked by Simple Resultant Index (%RS) in the coastal waters of Johor

Food items	Ci	Fpi	% Rs
Phytoplankton	50.95	90.35	70.78
Chlorophyta	10.91	30.41	20.75
Diatoms	20.09	30.41	20.81
Other spp.	10.95	20.53	20.24
Zooplankton	15.14	18.85	16.98
Copepod	20.24	30.27	20.78
Mollusc	12.19	14.52	13.32
Other spp.	00.71	10.05	00.89
Plant matter	20.26	20.88	20.43
Appendages of decapods	47.40	37.47	42.44
Debris	90.57	10.56	10.01
Unidentified fragments	10.69	20.89	20.35

C<sub>i</sub>: Percentage numerical abundance; F<sub>pi</sub>: Percentage frequency of occurrence; % Rs: Simple resultant index

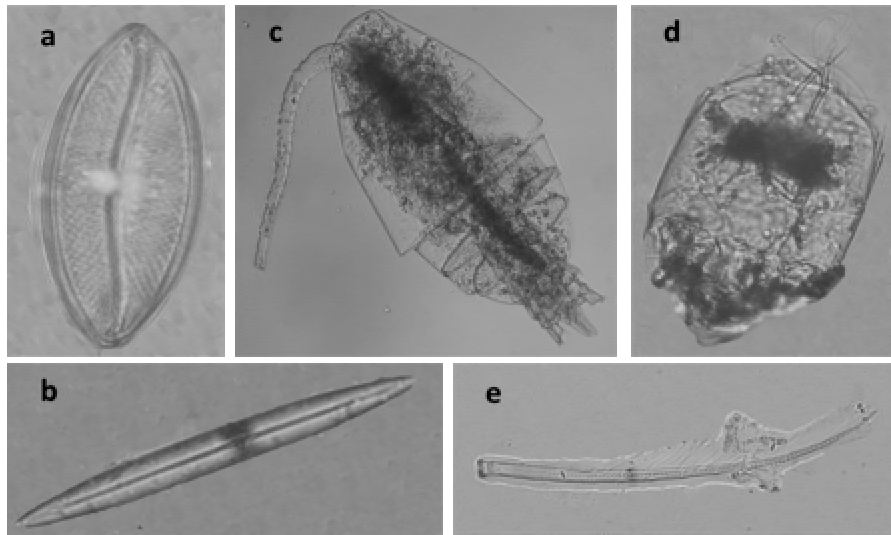


Fig. 2: Food items found in the gut of *Acetes serrulatus*. a, b: Phytoplankton (X40); c, d: Zooplankton (X40); e: Parts of decapods (X40)

Table 2: Percentage of fullness of guts of *Acetes serrulatus* in the coastal waters of Johor

Year	Month	N	Full (1)	3/4 Full	1/2 Full	1/4 Full	Empty (0)	
2008	Apr	30	23.33	10.00	36.67	30.00	0.00	
	May	30	16.67	26.67	23.33	26.67	6.67	
	Jun	30	30.33	20.00	16.67	26.67	33.33	
	Jul	30	13.33	10.00	30.00	20.00	26.67	
	Aug	30	10.00	23.33	26.67	23.33	16.67	
	Sep	30	60.67	26.67	33.33	30.00	3.33	
	Oct	10	0.00	10.00	30.00	20.00	40.00	
	Nov	30	13.33	20.00	36.67	30.00	0.00	
	Dec	30	16.67	26.67	33.33	23.33	0.00	
	2009	Jan	30	30.33	30.00	33.33	33.33	0.00
		Feb	30	0.00	16.67	43.33	33.33	6.67
		Mar	30	60.67	33.33	30.00	26.67	3.33
Apr		30	13.33	30.00	40.00	6.67	10.00	
% Occurrence		370	90.74	21.80	31.11	25.38	11.28	

**Feeding intensity:** Of the 370 stomachs examined, majority of the stomachs (88.72%) were filled up with food item while only 11.28% were empty sac. The highest percentage of full gut was found in April 2008 (23.33%), 3/4 full gut in March 2009 (33.33%), 1/2 full gut in February 2009 (43.33%), 1/4 full gut in January and February 2009 (33.33%) and empty stomach in June 2008 (33.33%) (Table 2).

**Monthly variation of diet:** The monthly percentage frequency of occurrence ( $F_{pi}$ ) of food items in the guts of *A. serrulatus* varied with season (Table 3). Appendage of decapod was the most important food group for all months, amounting to 44.44% in September 2008. Phytoplankton was

Table 3: Percentage frequency of occurrence ( $F_{pi}$ ) of food items in guts of *Acetes serrulatus* in the coastal waters of Johor

Food items	Frequency of occurrence (%)												
	2008									2009			
	A	M	J	J	A	S	O	N	D	J	F	M	A
Phytoplankton	13.0	18.0	10.0	11.0	40.3	20.2	00.0	10.0	10.0	12.0	60.9	90.8	10.0
Chlorophyta	40.5	60.0	30.5	50.8	20.1	00.0	00.0	40.0	10.7	30.5	40.6	10.9	60.2
Diatoms	20.2	90.0	00.0	20.9	00.0	20.2	00.0	60.0	50.3	30.5	20.3	50.8	40.6
Other spp.	60.8	30.0	70.1	20.9	20.1	00.0	00.0	00.0	30.5	50.2	00.0	10.9	00.0
Zooplankton	22.0	21.0	14.0	14.0	26.0	17.0	10.0	18.0	80.9	14.0	25.0	31.0	20.0
Copepod	60.8	60.0	30.5	50.8	00.0	20.2	00.0	20.0	00.0	00.0	20.3	50.8	70.8
Mollusc	13.0	15.0	70.1	80.8	21.0	15.0	10.0	16.0	80.9	10.0	23.0	25.0	12.0
Other spp.	20.2	00.0	30.5	00.0	40.3	00.0	00.0	00.0	00.0	30.5	00.0	00.0	00.0
Plant matter	15.0	18.0	17.0	17.0	21.0	24.0	30.0	20.0	19.0	26.0	18.0	17.0	23.0
Appendages of	31.0	33.0	35.0	35.0	36.0	44.0	40.0	38.0	41.0	38.0	39.0	33.0	39.0
Debris	11.0	60.0	14.0	8.8	80.7	11.0	20.0	12.0	16.0	70.0	90.3	70.8	40.6
Unidentified	4.50	30.0	70.1	11.0	20.1	00.0	00.0	20.0	30.5	10.7	00.0	00.0	10.5

recorded in all months except during October 2008. Chlorophyta highest in July 2008 and April 2009 while diatom was common in May 2008 and March 2009. Throughout the study period, zooplankton was commonly found in the diet, with relatively higher occurrence in August 2008 and February to April 2009. Copepod was found in a high proportion of stomachs in April 2009. Mollusca were present in all months, with a peak in March 2009. Plant matter was encountered throughout the year, with high occurrence in August to November 2008, January and March 2009. Small quantity of debris was noticed in most months. Unidentified fragments were especially abundant during June and July 2008.

## DISCUSSION

*Acetes* has long been recognized as an omnivore species feeding on a wide range of food items. The food items in the gut of *Acetes serrulatus* comprised of the phytoplankton, zooplankton, plant matter, appendage of decapod, debris and unidentified fragment. This finding is supported by several other reports on *Acetes* feeding habit (Metillo, 2011; Chiou *et al.*, 2005; Xiao and Greenwood, 1993).

In the present study, based on the Simple Resultant Index, appendages of decapod (42.44%) were found to be the primary food items, followed by plant matter (20.43%) and zooplankton (16.98%). Contribution of phytoplankton and debris to the diet of *A. serrulatus* was small. This is in agreement with Flock and Hopkins (1992) who reported that sergestids are zooplanktivores with crustaceans as the predominant food. The 11 sergestid species examined in the eastern Gulf of Mexico predate on copepods, ostracods, euphausiids, coelenterates, chaetognaths and olive-colored debris (spectrum of phytoplankton and protozoans).

The diet of *A. intermedius* sampled from the coastal waters of Southwestern Taiwan generally agreed with the present findings. Chiou *et al.* (2005) found three food groups including phytoplankton, zooplankton and amorphous materials of which dinoflagellates constituted the major components in the gut contents of *A. intermedius*. Copepods were reported to be the primary zooplankton food items in the stomach of *A. paraguayensis* (Collins and Williner, 2003) *A. indicus* (Deshmukh, 2002), *A. japonicus* (Ikematsu, 1953) and *A. erythraeus* (Le Reste, 1970). However, in the present study mollusc was found to be the primary zooplankton food item of *A. serrulatus*.

The differences of predominant food ingested by *Acetes* spp. may be attributed to the availability of food in different environments. Seasonal diet shift in response to change in food availability have also been observed in other marine organisms (Oueda *et al.*, 2008). Additionally, variations in food preference may help reduce feeding competition. As demonstrated by Chiou *et al.* (2005), *A. intermedius* feed more on dinoflagellates than diatom in order to avoid prey competition with anchovy larvae that shared the same habitat. Further detailed investigations on the composition of plankton are needed to clarify the causes of food selectivity of *A. serrulatus* in the study area.

In term of stomach fullness, majority of the stomach examined contain food (88.72%) while only 11.28% were empty. Similar results were found for *A. indicus* in the coastal waters of Bombay (Deshmukh, 2002). In his analysis of foreguts, 12.96% specimens showed empty foreguts while 23.61% were full with 15.74% half (1/2) full, 15.74% quarter (1/4) full and remaining 17.13% with traces of food. Coman *et al.* (2006) and Deshmukh (2002) found majority of the material in the gut of *Acetes* shrimps was unidentifiable. They pointed out that the macerated effect of the gastric mill makes food items difficult to identify under microscope. In addition, the recognizable remains in gut may be affected by digestive rate of particular species, feeding after capture as well as the time of day or night when shrimps were collected.

## CONCLUSION

In summary, stomach contents of *A. serrulatus* indicate that it is omnivorous as this species feeds on a variety of items including phytoplankton, zooplankton and microcrustaceans. Based on the Simple Resultant Index (% Rs), appendages of decapods (31.87%) was found to be the primary food items, followed by plant matter (16.48%) and zooplankton (14.18%).

## ACKNOWLEDGMENTS

This study was supported by research grant provided by the Ministry of Science, Technology and Innovation (MOSTI) with grant number 05-01-04-SF0613. The authors would like to thank Universiti Putra Malaysia (UPM) for the provision of research facilities and technical assistance.

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