



Fishery and biology of green tiger shrimp *Penaeus semisulcatus* (De Haan, 1844) landed at Puthiappa, Kozhikode, Kerala coast

P. T. Sarada

Calicut Research Centre of Central Marine Fisheries Research Institute, West Hill P. O., Kozhikode, Kerala 673005, India. E-mail: ptsarada @ yahoo.com

Abstract

The fishery and biology of *Penaeus semisulcatus* based on data collected from 2003 to 2007 from Puthiappa, Kozhikode, Kerala are described. The annual catch varied from 0.7 t to 12.4 t with an average of 5.8 t. The fishing season was from January to June and the landings peaked in May. The total length of male ranged from 76 to 190 mm and females from 96 to 220 mm. The sex-ratio did not deviate significantly from 1:1. Gut analysis showed that shrimps with empty stomach were dominant (60%); and the major food items were detritus (39%), molluscs (31.4%) and crustaceans (28.5%). The minimum size of mature female was 150 mm and the gonado-somatic Index was the highest in February. Fecundity varied from 2,83,650 to 7,51,200 mature eggs. Relationships between total length and weight, length and ovary weight, body weight and ovary weight, fecundity and ovary weight, fecundity and length and fecundity and body weight were determined.

Keywords: *Penaeus semisulcatus*, fecundity, gonado-somatic index

Introduction

The green tiger shrimp *Penaeus semisulcatus* is one of the commercially important penaeid shrimps in both capture fisheries and culture practices due to its large size and fast growth rate. In India, it is more common along the east coast than the west coast (Kurian and Sebastian, 1976). In earlier years, more than half of the shrimp landings of Gulf of Mannar and Palk Bay were contributed by *P. semisulcatus* but in later years, it showed a declining trend (Nandakumar, 1980; Sampson Manickam *et al.*, 1989). The fishery (Manisseri, 1982, 1986), biology (Thomas, 1975, 1981) and growth (Thomas, 1977) of *P. semisulcatus* were studied in detail along the east coast. Juvenile fishery of the species was reported from Cochin backwaters (Rao and Kathirvel, 1972) and Ashtamudi Lake (Suseelan and Kathirvel, 1979). However, there is no report on the fishery and biology of this species from the commercial catches of west coast. In earlier years the occurrence of the species was sporadic which comprised only of juveniles. The present study relates to seasonal fishery, size composition and

biology of *P. semisulcatus* landed at Puthiappa during 2003 - 2007.

Material and Methods

Catch, effort and species composition from trawlers were collected twice a week from Puthiappa landing centre. Random samples of *P. semisulcatus* were collected every month from the catches and analysed for sex-wise length-frequency, gut contents, maturity condition and length-weight relationship.

The length-weight relationship was calculated using the formula $\text{Log } W = \text{Log } a + b \text{ Log } L$, where W = weight in g and L = total length in mm. A total of 284 females and 332 males were used for this purpose.

The gonado-somatic index was calculated for females using the formula $\text{GSI} = \text{weight of ovary} \times 100 / \text{weight of shrimp}$. The relationships between ovary weight and total length, fecundity and total length, fecundity and body weight, fecundity and ovary weight were determined using the equation, $\text{Log } Y = \text{Log } a + b \text{ Log } X$ (weight

in g and length in mm). The relationship between ovary weight and body weight was calculated using the formula $Y = a + b X$. For this analysis 56 ripe females were used.

The sex ratio was tested using chi-square analysis (Snedecor and Cochran, 1967). For gut content analysis, 'points method' (Pillay, 1952) and 'Index of preponderance method' (Natarajan and Jhingran, 1961) were used based on 615 individuals.

Results and Discussion

Fishery: *P. semisulcatus* were caught by multi-day trawlers operating in 40 - 110 m depth by using cod end mesh size of 20 to 25 mm. A minor fishery of this species along the Puthiappa coast started in February 2003. Generally, the fishing season started in January and ended in June. In 2006, the species was caught in November and December also in small quantity. The monthly catch varied from 6 kg to 1854 kg which peaked in May. The effort varied from 11,835 units in 2003 to 24,227 units in 2005 with an average of 17089 units (Table 1). The CPUE was maximum in March (1.01 kg) followed by May (0.62 kg) (Fig.1). In Cochin backwaters the shrimp occurred from December to June (Rao and Kathirvel, 1972). In Ashtamudi Lake, it formed 67.2% of the total juveniles landed during postmonsoon period (Suseelan and Kathirvel, 1979). Along the Mandapam coast, *P. semisulcatus* supports a lucrative trawl fishery throughout the year with peak landings during October - January and April - June (Nandakumar, 1980). In Tinneveli coast the peak landing was observed from July to December and in May (Manisseri, 1986).

Table 1. Annual effort, catch and CPUE of *Penaeus semisulcatus* from trawlers at Puthiappa

Year	Effort (Units)	Catch (kg)	Catch/effort (kg)	Contribution to shrimp catch (%)
2003	11835	7793	0.7	1.13
2004	11904	719	0.1	0.13
2005	24227	12439	0.5	0.72
2006	20451	6145	0.3	0.41
2007	17028	1958	0.1	0.18
Average	17089	5811	0.3	0.53

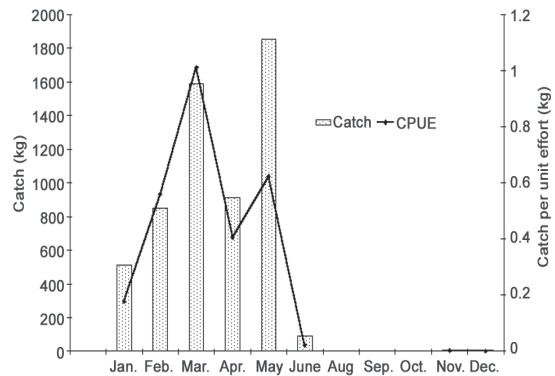


Fig. 1. Monthly trawl effort, catch, CPUE and percentage of *Penaeus semisulcatus* in total shrimp catch off Kozhikode

Biology

Length distribution: The length ranged from 76 to 190 mm in males and from 96 to 220 mm in females. The modal class in males shifted between 116 - 120 mm and 151-155 mm whereas in females it shifted between 141-145 mm and 161-165 mm. Juvenile recruitment was more in 2004 (Fig. 2). In Punnaikkayal madai, a major fishing ground along

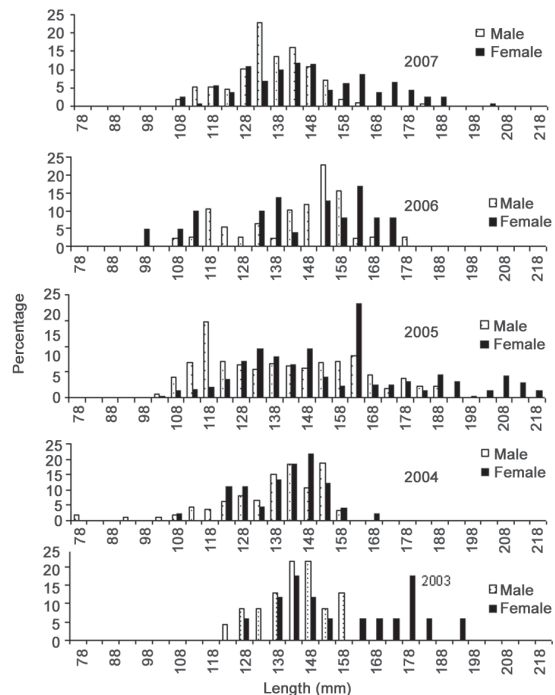


Fig. 2. Annual length distribution of *Penaeus semisulcatus*

Tinneveli coast, the length of males ranged from 90 to 180 mm and females from 90 to 230 mm (Manisseri, 1986). The maximum length recorded earlier for male was 180 mm (Fisher and Bianchi, 1984) whereas in the present study it is 190 mm.

Sex ratio: The annual sex ratio between male and female was 1.07:1 which did not deviate from 1:1 ratio significantly ($p>0.05$). The monthly variation in sex ratio was also not significant. Thomas (1975) also did not find significant variation in the abundance of males and females.

Food and feeding condition: Prawns with empty stomach were more prevalent (60%) in the catch followed by $\frac{1}{4}$ full (20%), $\frac{1}{2}$ full (10.5%), $\frac{3}{4}$ full (7.5%) and full (2%). The rare occurrence of actively fed shrimps in the catches might be due to the nocturnal feeding behaviour of the species. Along this coast fishing is mainly during day time. Thomas (1981) observed from the Palk Bay and Gulf of Mannar that the major catch consisted of poorly fed shrimps in the former sea area while a good percentage of the actively fed shrimps were found from the latter. In Palk Bay the fishing was during day and in Gulf of Mannar it was in the night. Kutty and Murugapoopathy (1969) and Wassenberg and Hill (1994) also reported nocturnal feeding behaviour in *P. semisulcatus*.

The dominant food items in the stomach were detritus (39.0%), molluscan (31.4%) and crustacean remains (28.5%). The molluscan remains mainly consisted of small bivalve and gastropod shells either in intact or broken condition. Among the crustaceans, copepod remains (flagella and setae) were the main components. Foraminiferans and fish remains (bones and scales) were also found in the stomach occasionally. The variation in food in different months and different sizes was not significant. Thomas (1981) opined that *P. semisulcatus* does not search for any particular food item, but feeds on those items which come across during feeding.

Maturity condition: Except in 2006, spent females were dominant followed by early maturing stage. The percentage of mature females was maximum in February followed by March (Fig. 3) indicating the spawning season along Malabar coast. The gonado-somatic index (GSI) fluctuated between

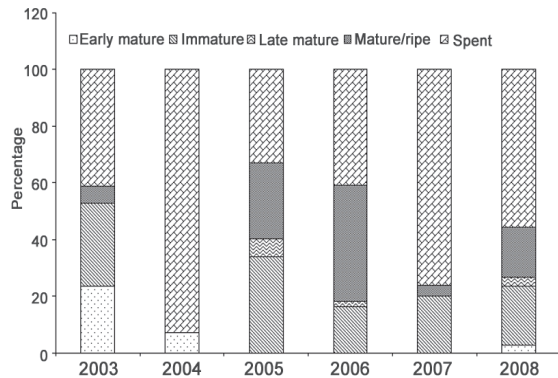


Fig. 3. Annual maturity condition of *Penaeus semisulcatus*

4.057 and 10.069 and the highest value was in February. The peak spawning season off Mandapam was from June to September and January to February (Thomas, 1975) and in Tinneveli coast, between July and October (Manisseri, 1986). These studies show that the peak spawning season changes from one geographic area to another. The minimum size of ripe female in the present study was 150 mm. However, as spent females were obtained at much smaller size (128 mm), it appears that the female attains maturity and spawns at length < 128 mm. According to Kumlu *et al.* (1999) *P. semisulcatus* attains first sexual maturity size at around 130 mm size. The minimum length of sexual maturity for males and female reported in Pilar and Capiz Bays were 123 and 145 mm respectively (Villarta and del Norte-Campos, 2004). Badawi (1975) reported that the species spawns five times in its life.

Fecundity: The weight of ovary varied from 1.5 to 5.008 g and fecundity from 2,83,650 to 7,51,200 mature eggs. The fecundity showed exponential correlation with total length (mm), body weight (g) and ovary weight (g). Ovary weight also showed significant positive correlation with total length, body weight and fecundity. These relationships are as follows:

$$\text{Log Y (ovary weight)} = -7.834925 + 3.7056 \text{ Log X (total length)} \quad (r = 0.965, n=56, p<0.01)$$

$$\text{Log Y (fecundity)} = 5.17609 + 1.000 \text{ Log X (ovary weight)} \quad (r = 0.619, n = 56, p<0.05)$$

$$\text{Log Y (fecundity)} = -2.65883 + 3.70564 \text{ Log X (total length)} \quad (r = 0.694, n = 56, p<0.05)$$

Log Y (fecundity) = 3.411029 + 1.34605 Log X (body weight) (r = 1.0000, n = 56, p<0.01)

Log Y (ovary weight) = 29.7912 + 5.4243 Log X (Body weight) (r = 0.619, n = 56, p<0.05)

The fecundity reported by Thomas (1975) varied from 51,891 to 6,60,904 eggs with an average of 2,68,430. However, he did not find any relationship between fecundity and length and weight of ovary. Aktas and Kumlu (1999) reported egg production as 1, 77,000 ± 1, 33,340 in ablated females.

Length-weight relationship: It was calculated for the sexes as

Males: Log W = -5.1404 + 3.0180 Log L (r = 0.956, n = 332)

Female: Log W = -5.0689 + 2.9867 Log L (r = 0.987, n = 284)

Analysis of covariance showed that the variation of length-weight relationship between males and females was significant at 0.05 level. The length-weight relationship showed that the weight of the shrimp at a given length is higher in the present study than that reported by Thomas (1977) from Mandapam area. The relationship obtained in the present study was similar to that obtained from Iskenderun Bay, North- Eastern Mediterranean (Kumlu *et al.*, 1999), Gulf of Suez, Egypt (Mehanna, 2000) and Bardawil lagoon, Egypt (Yassien, 2004).

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