

Observations on the exploitation of penaeid prawn resources in the Palk Bay off Mandapam during 1986 - '93

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ABSTRACT

The penaeid prawns contributed to 16.70% of the total trawl landings at Mandapam during 1986-'93. Out of the ten species represented in the catch, four species namely *Penaeus semisulcatus*, *Metapenaeopsis stridulans*, *Trachypenaeus pescadoreensis* and *Metapenaeus burkenroadi* supported the fishery throughout the year. Contributing to over 50%, *P. semisulcatus* was the dominant species, followed by *M. stridulans*. Over the years a gradual decline of *P. semisulcatus* in the species percentage composition and a steady increase of that of *M. stridulans* was observed. The change in the species composition during 1986-'93 has been discussed. May to August was the peak season for the fishery. Two peak seasons, one during May-August and the other during November-December were observed for *P. semisulcatus*. The annual fishing effort fluctuated between 3,54,055 and 6,48,513 hours with an average of 4,90,361 hours. The annual prawn catch ranged from 561 to 1,065.8 t, the average annual catch being 703.5 t. The annual catch per hour ranged from 0.8 to 2 kg. The MSY and corresponding optimum fishing effort was 726.2 t and 5,61,415 hours respectively.

Introduction

The efforts to develop trawl fishing in the Palk Bay along the southeast coast of India commenced as early as the beginning of the twentieth century (Herdman, 1903; Hornell, 1916). However, it was only from the early sixties that concerted attempts were made to assess the fishing potentials of these fishing grounds, particularly by the erstwhile Indo-Norwegian project and

the results were reported (Rao, 1968; Rao and Dorairaj, 1969; James and Adolph, 1969). More recently, the trends and species composition of the prawn fishery of this area during the seventies were reported by Nandakumar (1981, 1983). Since the eighties, the exploitation of penaeid prawn resources from Palk Bay increased considerably and Mandapam emerged as one of the important prawn landing centres in this region. This paper deals with the

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exploitation of penaeid prawn resources in the Palk Bay based on the data collected at Mandapam during 1986-'93.

Fishing operations

Maheswarudu *et al.* (in press) gave information about the trawl operations and fishing ground in the Palk Bay off Mandapam. Small mechanised trawlers of 9.15 - 9.76 m OAL fitted with 41-88 HP engines, based at Mandapam on the northern side are employed for the exploitation of penaeid prawns throughout the year. Shrimp trawl net having cod end mesh size of 26 mm is generally operated by these vessels. Single day trips from 1500 to 0900 hours on the

next day are performed, and during certain season, stay over - a-day fishing is also carried out. These vessels cover fishing grounds as far as off Thondi on the northwestern side of Mandapam and up to the EEZ border between India and Sri Lanka on the eastern side (Fig.1). Following local regulations, the trawlers go for fishing to the north western and northeastern regions on alternate days. The depth in the fishing ground varies from 7 to 13 m. Bottom of the fishing ground is flat and muddy favouring bottom trawling. Besides being shallow, the nearshore zone of this region is characterised by luxuriant growth of seagrasses upto about 4 m

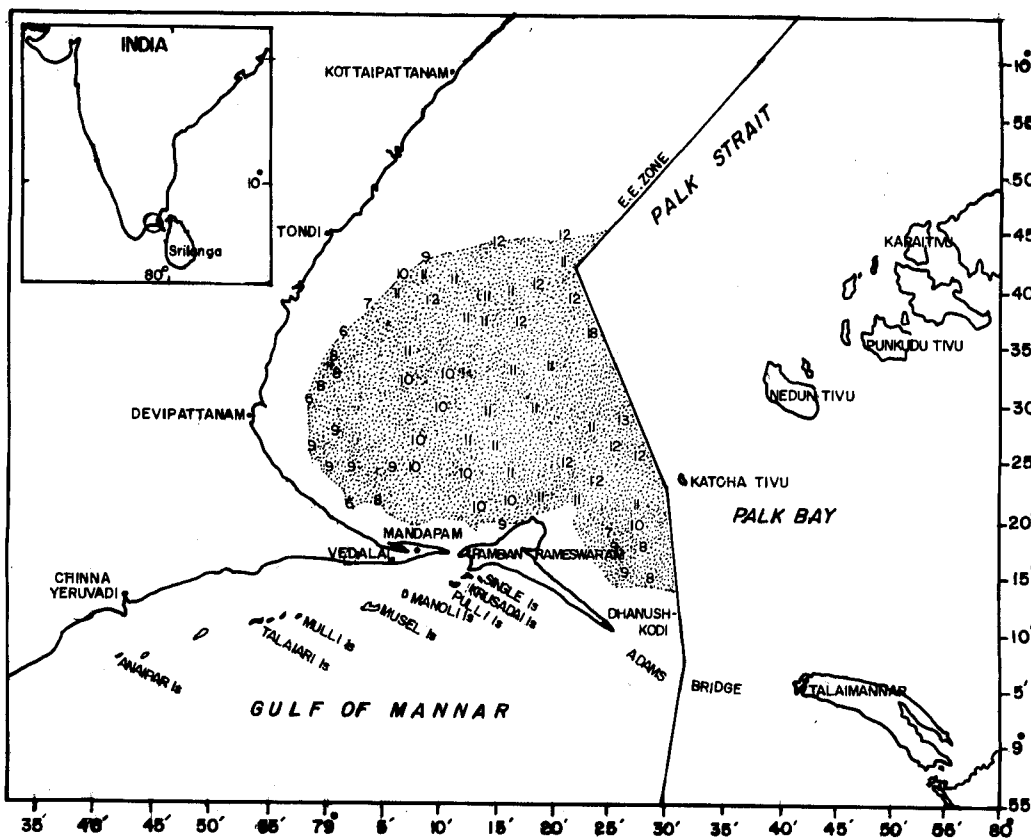


Fig. 1. Trawl fishing ground in the Palk Bay off Mandapan.

depth and serves as nursery ground for juveniles of *Penaeus semisulcatus* (Sampson *et al.*, 1989).

Material and methods

Data on catch and effort of shrimp trawlers at Mandapam were collected regularly once a week from April 1986 to March 1993. Data on effort and catch collected on each observation day were raised to total number of units landed on that day to obtain total effort and catch of each observation day. The pooled totals of all observation days in a month were raised to total number of actual fishing days in that month to arrive at monthly estimates. Prawn samples were analysed in the laboratory for species composition. Stock assessment was carried out by following the surplus yield model of Schaefer (1954) as revised by Ricker (1975).

Results

Trends in landings

Estimated fishing effort, penaeid prawn catch, catch per hour and percentage of prawns in total trawl land-

ings during 1986-'93 are presented in Table 1. The annual fishing effort varied from 3,54,055 (1987-'88) to 6,48,513 hours (1988-'89) with an annual average of 4,90,361 hours. An alternating declining and increasing trend in the annual fishing effort was observed during the period.

The annual penaeid prawn catch fluctuated between 547.5 t in 1988-'89 and 1,065.7 t in 1992-'93 with the average annual catch at 703.4 t. The catch declined from 719.5 t in 1986 - '87 to 547.5 t in 1988-'89 and then increased to 1,065.7 t in 1992-'93. The penaeid prawns formed 16.69% of the total trawl landings during 1986-'93. Forming 23.6% in 1986-'87, the percentage contribution of prawn decreased to 13.0% in 1991-'92 and then increased to 20.0% in 1992-'93.

The catch per hour was low, 0.84 kg in 1988-'89 and the maximum 2.01 kg in 1992-'93. The average annual catch per hour was 1.43 kg for the whole period.

Monthly fishing effort, catch per hour (CPH) and total penaeid prawn

TABLE 1 : Estimated effort, penaeid prawn catch, catch per hour and percentage of prawn catch of trawlers operated in the Palk Bay off Mandapam during 1986 - '93

Year	Fishing effort (hours)	Prawn catch (tonnes)	Catch per hour of prawn (kg)	Prawn catch in total trawl landings (%)
1986-'87	4,38,260	719.5	1.6	23.6
1987-'88	3,54,055	561.0	1.6	22.6
1988-'89	6,48,513	547.5	0.8	13.5
1989-'90	4,79,241	669.2	1.4	15.1
1990-'91	5,00,517	661.2	1.3	13.6
1991-'92	4,82,440	700.1	1.5	13.0
1992-'93	5,29,500	1,065.7	2.0	20.0
Average	4,90,361	703.4	1.4	16.6

catch during 1986-'93 showed that total penaeid prawn catch varied from 7.6 t (January 1989) to 280.2 t (July 1992) (Fig. 2). The fishing effort ranged from 6,200 hours (January 1989) to 85,500 hours (June 1989). The lowest CPH was observed in September 1992 (0.473 kg) and the highest in July 1992 (4.35 kg).

The peak season for prawn fishery was from May to August (Fig. 2) when about 50% of the annual fishing effort, more than half of the annual prawn catch and higher CPH were recorded. The lean period for prawn fishery in the Palk Bay was during September-October and January-April.

Species composition

The penaeid prawn fishery of this region was supported by ten species belonging to the family Penaeidae. Of these, *Penaeus semisulcatus*, *Metapenaeopsis stridulans*, *Trachypenaeus pescadorensis* and *Metapenaeus burkenroadi* were the major components and supported the fishery continuously. The other species such as *Penaeus merguensis*, *P. latisulcatus*, *Metapenaeus affinis*, *Parapenaeopsis maxillipedo*, *Metapenaeopsis hilarula* and *Parapenaeopsis uncta* occurred in the catches irregularly.

Penaeus semisulcatus was the principal species contributing about 50% of the total catch in all the years except in 1991-'92 and 1992-'93 when it formed only 25.63 and 32.78% respectively (Table 2). The catch declined from 452.0 t in 1986-'87 to 306.2 t in 1987-'88 and gradually increased upto 453.4 t in 1989-'90 and again declined to 349.3 t in 1992-'93. The average annual catch was 390.3 t. The monthly catch varied from 4.4 t in January 1989 to 94.2 t in June 1989. Two peak seasons,

one during May-August and the other during November-December were observed (Fig. 2).

Metapenaeopsis stridulans was the second major species, its contribution varying from 23.44 in 1988-'89 to 49.79% in 1992-'93. The annual catch varied between 128.3 t (1988-'89) and 530.6 t (1992-'93) and the annual average catch was 226.1 t. The monthly catch ranged from 0.2 t in January 1989 to 175.0 t in July 1992. May-August was the productive period (Fig. 2).

Trachypenaeus pescadorensis occupied the third position in the order of abundance and its percentage contribution varied from 4.5 in 1988-'89 to 9.92 in 1992-'93. The annual catch declined from 47.8 t in 1986-'87 to 24.6 t in 1988-'89 and then steadily increased to 105.7 t in 1992-'93. The average annual catch was 50 t. Monthly catch ranged from 0.06 t in March, 1990 to 28.4 t in August 1992. May-August was the productive period.

Metapenaeus burkenroadi was the fourth important constituent species, contributing to 2.3% of total prawn catch in 1988-'89 and 7.29% in 1991-'92. The annual catch fluctuated from 12.6 t in 1988-'89 to 68.6 t in 1992-'93, the average catch being 29.6 t. The monthly catch varied from 0.02 t in September 1989 to 40.4 t in July 1992. May to August was the peak season.

The annual catch of other constituent species varied from 0.5 t (0.08%) in 1989-'90 to 17.2 t (2.39%) in 1986-'87. *Penaeus merguensis* landed only during five years (1987-'88, 1988-'89 and 1990-'91 to 1992-'93). The annual catch ranged from 0.6 t (0.09%) in 1991-'92 to 8.9 t (0.84%) in 1992-'93 and the average catch was 2.7 t. *Parapenaeopsis*

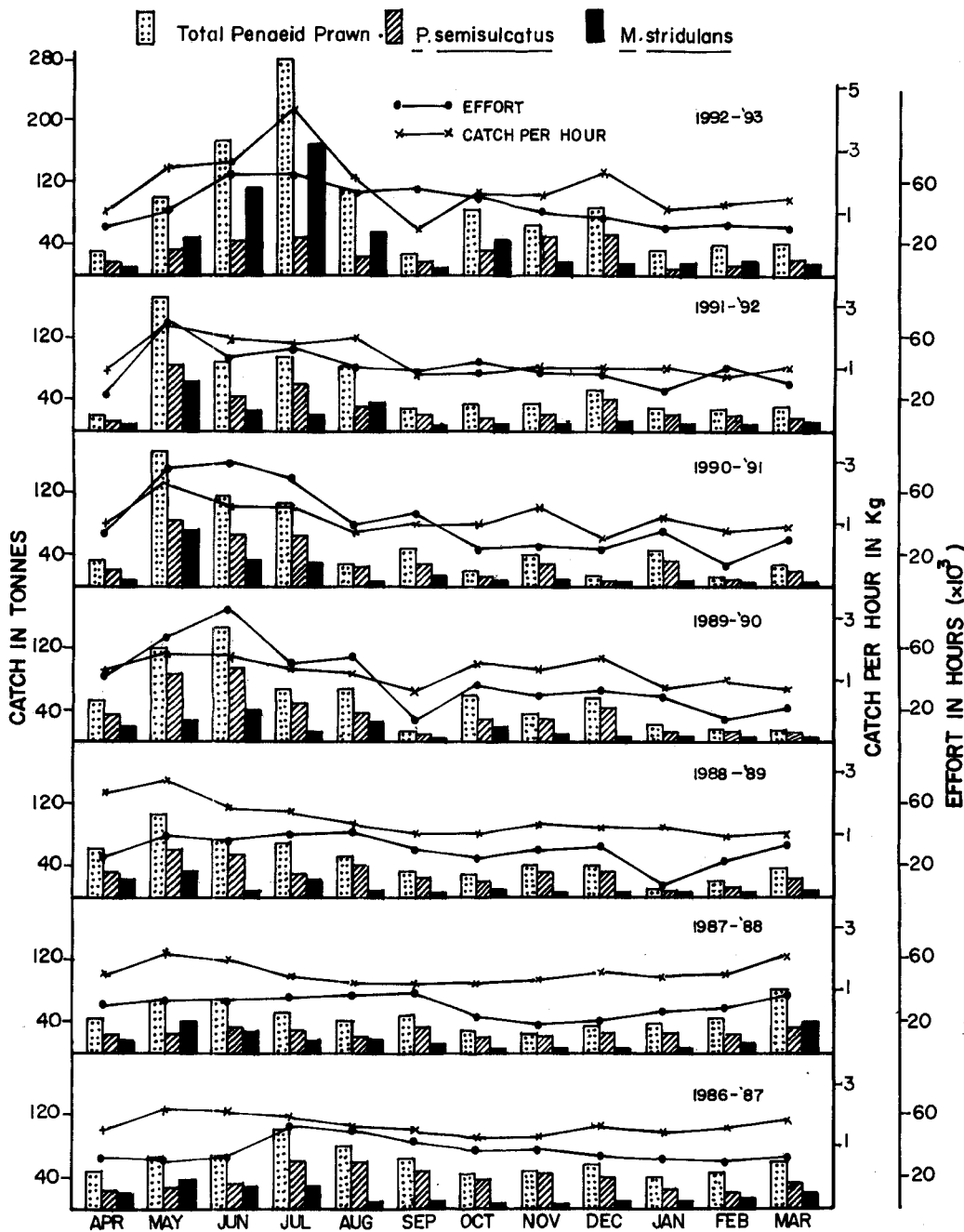


Fig. 2 Month wise total penaeid prawn catch, *P. semisulcatus* catch, *M. stridulans* catch, effort and catch per hour at Mandapam during the years 1986-93.

TABLE 2. Species composition of penaeid prawn catch by weight (t), landed at Mandapam from Palk Bay during 1986 - '93 (Percentage is given in parenthesis)

Year	Species	<i>P. semi-sulcatus</i>	<i>M. stri-dulans</i>	<i>T. pesca-dorensis</i>	<i>M. burken-roadsi</i>	<i>P. Mergui-ensis</i>	<i>P. maxi-llipedo</i>	<i>P. lati-sulcatus</i>	<i>M. affinis-rula</i>	<i>M. hila-rula</i>	<i>P. uncta</i>	Total prawn catch (t)
1986-'87		452.086 (62.8)	182.902 (25.41)	47.880 (6.7)	19.462 (2.7)	-	15.402 (2.14)	1.437 (0.2)	0.35 (0.005)	0.327 (0.045)	-	719.531
1987-'88		306.268 (54.6)	185.833 (33.11)	42.204 (7.52)	19.082 (3.4)	1.952 (0.35)	4.591 (0.82)	-	-	1.246 (0.2)	-	561.126
1988-'89		373.004 (68.12)	128.343 (23.44)	24.669 (4.51)	12.604 (2.3)	3.617 (0.66)	4.439 (0.81)	-	-	0.026 (0.005)	0.859 (0.155)	547.561
1989-'90		453.481 (67.76)	158.601 (23.70)	39.483 (5.9)	17.121 (2.56)	-	0.543 (0.08)	-	-	-	-	669.229
1990-'91		408.831 (61.82)	181.817 (27.50)	46.826 (7.08)	19.605 (2.97)	3.944 (0.6)	0.203 (0.03)	-	-	-	-	661.226
1991-'92		389.518 (25.63)	214.795 (30.68)	43.938 (6.28)	51.055 (7.29)	0.621 (0.09)	-	-	-	0.179 (0.03)	-	700.106
1992-'93		349.389 (32.78)	530.618 (49.79)	105.775 (9.92)	68.582 (6.44)	8.954 (0.84)	-	2.448 (0.23)	-	-	-	1,065.766
Average		390.368 (55.489)	226.130 (32.143)	50.111 (7.123)	29.637 (4.21)	2.727 (0.39)	3.596 (0.511)	0.555 (0.08)	0.005 (0.0007)	0.254 (0.036)	0.123 (0.0173)	703.506

maxillipedo appeared in the fishery for five years (1986-'87 to 1990-'91). The annual catch gradually declined from 15.4 t (2.14%) in 1986-'87 to 0.2 t (0.03%) in 1990-'91. *Penaeus latisulcatus* was recorded only during two years (1987-'88 and 1992-'93). *Metapenaeus affinis* was recorded only in 1986-'87 (0.03 t) and thereafter it did not occur in the fishery. During the first five years *Metapenaeopsis hilarula* contributed to fishery in small quantities (0.02 t in 1988-'89 and 1.2 t in 1987-'88). *Parapenaeopsis uncta* was recorded only during 1988-'89 (0.8 t).

During 1986-'92 *Penaeus semisulcatus* was the dominant species. However, in 1992-'93, this species was replaced by *M. stridulans* which became dominant. Monthwise catch (Fig. 2) also had shown that *P. semisulcatus* was the dominant species in all the months during 1986-'92 except in May of 1986 and 1987 when *M. stridulans* was the dominant species. During May-September 1992 *M. stridulans* was the major contributory species in prawn fishery of this region.

Stock assessment

Annual catch per hour values of all seven years were plotted against their corresponding values of effort and straight line relation was found. The estimated value of r was -0.5661. The estimated values of a and b were 2.587 and 0.000002304 respectively. Maximum sustainable yield (MSY) and optimum effort were calculated as 726.2 t and 5,61,415 hours respectively. This estimation thus reveals that the exploitation of penaeid prawns in this area has reached the optimum level.

Discussion

The results of surveys carried out

during 1964 under the erstwhile Indo-Norwegian project (60.0 - 334.6 kg catch per hour, James and Adolph, 1969) encouraged private entrepreneurs to initiate trawl fishing for exploiting prawns and fishes in the Palk Bay on commercial scale in the beginning of the seventies. During 1973-'75 the average annual fishing effort and annual prawn catch was 1,13,980 hours and 309.12 t respectively (Nandakumar, 1981). With the gradual increase of intensity of exploitation, the average annual fishing effort and catch reached the level of 4,90,361 hours and 703.4 t respectively during 1986-'93, as against optimum level of 5,61,415 hours and 726.2 t (Fig 3) and this suggests restriction of effort to maintain sustainable yield.

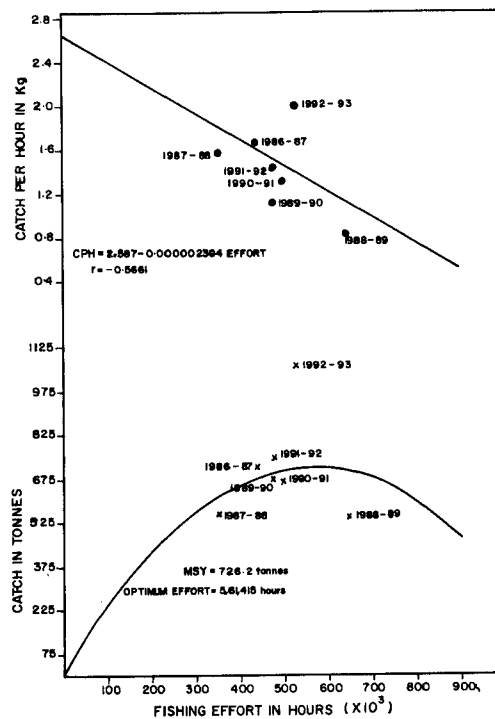


Fig. 3. Application of Schaefer model to penaeid prawn stock in the Palk Bay off Mandapam.

James and Adolph (1969) reported that *M. affinis* was the dominant species followed by *P. semisulcatus* in the prawn catch in the Palk Bay. Nandakumar (1983) observed that the prawn fishery during 1973 was supported mainly by *P. semisulcatus* followed by *M. affinis*. He also reported that species like *P. merguensis*, *M. stridulans* and *T. pescadorensis* were the new entrants into fishery in 1979. Table 2 shows that *M. affinis* formed less than 1% in 1986-'87 and thereafter disappeared from the fishery. In 1986-'93 *P. semisulcatus* was the major species contributing to more than half of the total catch and *M. stridulans* became the second major species, replacing *M. affinis*. *T. pescadorensis* and *M. burkenroadi* occupied the third and fourth places in the species composition in prawn fishery. *P. merguensis* did not appear in all the years of study. It is also seen from Table 2 that percentage contribution of *P. semisulcatus* showed a declining trend, whereas that of *M. stridulans* registered an increasing trend. If *M. stridulans* replaces *P. semisulcatus* in future as the dominant species, it would be a setback to trawler operations in the Palk Bay because of less economic value of the former. The change in species composition of prawn fishery during 1965 - '93 may be in accordance with the principles of ecology that when a particular species decreases in its population the related species increases (Odum, 1971).

The peak season for penaeid prawn fishery during May-August (Fig. 2) referred in the present study is in conformity with the observation of Nandakumar (1981). The two peak seasons, one during April-August and the other during November-December

observed for *P. semisulcatus* (Fig. 2) coincide with the two peak recruitment periods of the same species in this region (Maheswarudu et al., in press).

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References

- Herdman, W.A. 1903. Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Mannar *Royal Society*, Part I : 29-30.
- Hornell, J. 1916. Notes upon two exploring cruises in search of trawl grounds off the Indian and Ceylon coasts. *Madras Fish. Bull.*, No.8 : 23-41.
- James, P.S.B.R. and Clement Adolph, 1969. Observations on trawl fishing in the Palk Bay and Gulf of Mannar in the vicinity of Mandapam. *Indian J. Fish.*, 12 (2): 530-545.
- Maheswarudu, G., P.E. Sampson Manickam, P. Vedavyasa Rao, M.R. Arputharaj and K. Muniyandi. Some aspects of biology and exploitation of the green tiger prawn, *Penaeus (Penaeus) semisulcatus* De Haan from Mandapam (Palk Bay) and Pamban (Gulf of Mannar) southeast coast of India. *Indian J. Fish.* (in press).
- Nandakumar, G. 1981. Observations on the prawn fishery of the Mandapam area. *Indian J. Fish.*, 27 (1&2) : 257-260.
- Nandakumar, G. 1983. Change in species composition of prawns in the trawl fishery at Mandapam. *J. mar. biol. Ass. India*, 20 (1&2) : 181-183.

- Odum, E.P. 1971. Principles and concepts pertaining to organization of the population level. In: *Fundamentals of Ecology*, W.B. Saunders Company, USA., 161-228.
- Rao, K. Virabhadra 1968. Distribution pattern of the major exploited marine fishery resources of India. *Bull. Cent. Mar. Fish. Res. Inst.*, No. 6: 1-69.
- Rao, K. Virabhadra and K. Dorairaj 1969. Prawn grounds on the continental shelf fished by trawlers. *Bull. Cent. Mar. Fish. Res. Inst.*, No. 14: 217-234.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. *Bull. Fish. Res. Bd. Canada*, 191:382 pp.
- Sampson, M.P.E., M.R. Arputharaj and P. Vedavyasa Rao 1989. Exploitation of juveniles of green tiger prawn, *Penaeus (Penaeus) semisulcatus*, along Palk Bay and its impact on the prawn fishery of the region. National Symposium on Research and Development in Marine Fisheries. *CMFRI Bulletin*, No. 44: 137-145.
- Schaefer, M.B. 1954. Some aspects of the dynamics of population important to the management of the commercial fisheries. *Bull. I-ATTC.*, 1(12): 27-55.