# ON THE FISHERY OF *PENAEUS SIMISULCATUS* AND ITS DISTRIBUTION IN RELATION TO DEPTH ALONG TINNEVELLY COAST, SOUTHERN INDIA

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## ABSTRACT

Studies on the total landings in relation to the effort expended in the fishery indicate that off Tinnevelly coast the resource of *Penaeus semisulcatus*, the mainstay of the local prawn fishery, is underexploited. Breeding and recruitment into the fishery though take place more or less round the year, the breeding is more intense during July-October, December and February and the recruitment during November and February. *P. semisulcatus* is fished from three grounds along this coast, namely off Pattanamarudur-Tuticorin, Punnaikkayal and Manappad, ranging respectively in depth from 0 to 2 m, 8 to 20 m and 15 to 30 m. From the size distribution, the juveniles appear to prefer shallow waters whereas the adults to prefer deeper areas. The mean sizes of males and females in the shallow-water fishery are found to be 89.1 mm and 90.5 mm, respectively. But the dominant modes of males and females in the fishery at Punnaikkayal varied respectively between 110 mm and 150 mm and 120 mm and 180 mm and at Manappad between 140 mm and 160 mm and 160 mm and 210 mm. That the prawns in maturing stages are found thus always in the deeper fishing grounds, and never in the shallow-water fisheries, indicate that the species move to the deeper waters for breeding.

## INTRODUCTION

*Penaeus semisulcatus* de Hann contributes to a fishery of considerable significance along the southeast coast of India. Manisseri (1982) has reported in detail the characters of the fishery of the juveniles along this coast. Even though stray occurrence of this species has been reported from the southwest coast of India (Mohamed 1969), it does not contribute to any considerable fishery in this region. A minor fishery of the species has, however, been reported from the "Bheris" of West Bengal by Pillay (1954). There is also a seasonal fishery for the species, of not much consequence, in the Veraval area of Gujarat. According to Suseelan (1979), juveniles of the species occur in large numbers in the Ashtamudi lake, in Kerala, however, without contributing to a fishery of commercial significance. On the other hand, *P. semisulcatus* is the mainstay of the rich prawn fishery along the Tinnevelly coast. In the present study an attempt is made to assess the magnitude of exploitation of the resource and to know its

biological characteristics influencing the fishery. An attempt is also made to study the movement of the species in relation to depth, as has been done by George et al (1971) on penaeid prawns in the fishing grounds off Cochin.

## The Fishing Grounds

The major fishing ground for *P. semisulcatus* along the Tinnevelly coast is "Punnaikkayal madai", which is 8-20 m in depth (Fig. 1). On an average, 104 trawlers operated per day in this ground during 1978-80. A seasonal fishery of large-size *P. semisulcatus* is exploited from another fishing ground, "Manappad madai", south of Tuticorin, where fishing is usually done in the depths of 15-25 m, occasionally extending up to 30-32 m. Trawlers are operated during day time and catches landed by evening. Prawn catches from Punnaikkayal are landed at the Tuticorin fisheries harbour and those from Manappad at Virapandiyanpattanam and Tiruchendur. Whereas the fishery at Punnaikkayal is round the year, it is only seasonal (from June to October) at Manappad. On an average, 195 trawlers operated per day during the season at Manappad in 1978, landing large-size *P. indicus* and *P. semisulcatus*.

As has been reported earlier (Manisseri 1982), a rich fishery for juveniles of *P semisulcatus* is also in existence in the shallow-water area off the coast from Pattanamarudur to Tuticorin. Fishing is done here in very shallow waters, within 2 m depth, catching only juveniles, in considerably large numbers. The bottom here, which is sandy with intermittent corals and rocky patches, slopes gently, and is covered with a thick growth of sea weeds. This is in sharp contrast with the bottoms at Punnaikkayal and Manappad, both of which are muddy. A difference, to suit the bottom terrain, is observed in the types of fishing gear used as well; whereas only trawlers operate in the muddy grounds, "Olva valai", a kind of traditional drag-net, is used for fishing juveniles in the shallow ground covered with marine plants.

## Material and Methods

Weekly samples of about 50 prawns were collected from the catches of each fishing ground from January 1978 to October 1980. However, data on the seasonal fishery of Manappad could not be had completely during 1979-80, as the fishing here was disrupted owing to some clashes among fishermen. Biological parametres such as total length (from the tip of rostrum to the tip of telson), sex, maturity stages, etc. of *P. semisulcatus* were recorded simultaneously with the collection of data on the effort expended, the total catch and the species composition of the catch for the period.

## Observations

Estimated total landings of *P. semisulcatus* from Punnaikkayal during the years 1978, 1979 and 1980 (January to October) were about 156.5 t,

257.1 t and 396.2 t, respectively, showing a trend of increase from 1978 through 1980. A similar trend of increase was noticed in the case of total penaeid prawns, too, landed from Punnaikkayal madai, rising from 244.7 t in 1978 to 404 t in 1979. The increase was more phenomenal in the year 1980, when an estimated total of 1014.1 t of prawns were landed at this centre, this increase being partly

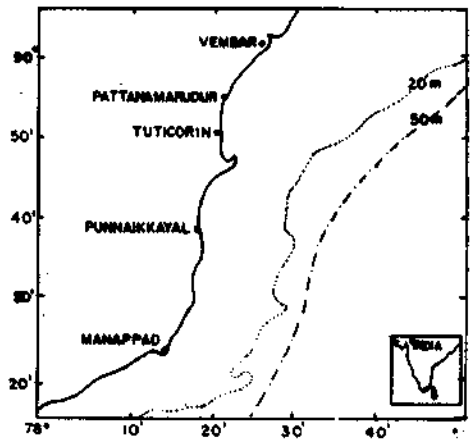


FIG. 1. Map of Tinnevelly coast, S. India.

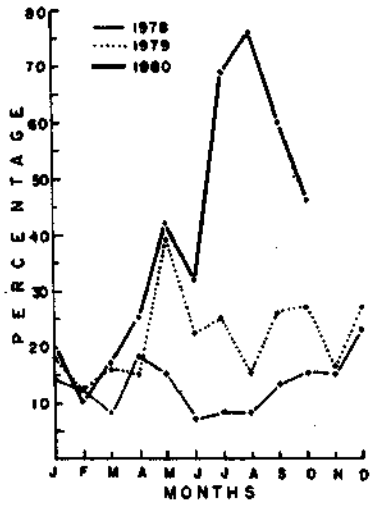


FIG. 2. Seasonal abundance of *P. semisulcatus* landed at Tuticorin fishing harbour during 1978-80.

due to some trawlers landing their catches also from the Manappad madai. The data on monthly landings of the species during the period under study are presented in Table 1. A comparison of the total landings during the three years 1978 to 1980 shows that the peak landings of *P. semisulcatus* were during July-December and May (Fig. 2). The catches of the species per unit hour during these successive years were 0.9 kg, 1.2 kg and 1.3 kg. (Fig. 3). An interesting observation is that there was a steady increase in the effort expended in this region, the average number of boats operated per day increasing from 72 in 1978 to 96 in 1979 and 143 in 1980. This increase in effort was accompanied by a corresponding increase in both the catch per unit hour and the total landings of *P. semisulcatus* as mentioned earlier. Both *P. semisulcatus* and *P. indicus*, which were almost equally dominant in the prawn fishery of Punnaikkayal, were in good demand and were sold at the same price.

Of the *P. semisulcatus* from the Punnaikkayal ground landed at the Tuticorin fisheries harbour, the males ranged in length from 90 mm to 180 mm and the females from 90 mm to 230 mm. The dominant modes for males varied between 110 mm and 150 mm in 1978, 110 mm and 140 mm in 1979 and 120 mm and 150 mm in 1980. For females the dominant modes varied between

TABLE 1. *Estimated total landings of* P. semisulcatus *by trawlers at the Tuticorin fishing harbour (wt in kg).*

| Year | 1978 | | 1979 | | 1980 | |
|---|---|---|---|---|---|---|
| Month | *P. semi-sulcatus* | Total prawn landing | *P. semi-sulcatus* | Total prawn landing | *P. semi-sulcatus* | Total prawn landing |
| January | 13,680 | 15,972 | 18,000 | 22,500 | 20,148 | 41,976 |
| February | 12,162 | 18,870 | 11,550 | 16,500 | 9,644 | 25,380 |
| March | 7,938 | 15,876 | 15,880 | 26,460 | 17,000 | 42,500 |
| April | 17,676 | 39,300 | 14,569 | 32,375 | 24,624 | 55,963 |
| May | 15,204 | 22,026 | 39,045 | 52,060 | 42,434 | 70,723 |
| June | 7,446 | 11,034 | 21,577 | 39,230 | 32,127 | 1,07,090 |
| July | 8,255 | 13,670 | 24,692 | 35,275 | 69,058 | 2,30,194 |
| August | 8,359 | 15,911 | 15,112 | 24,375 | 75,514 | 1,88,784 |
| September | 12,608 | 20,187 | 26,237 | 40,365 | 59,981 | 1,49,952 |
| October | 15,314 | 23,560 | 27,305 | 45,508 | 45,700 | 1,01,556 |
| November | 15,316 | 22,395 | 16,146 | 24,840 | — | — |
| December | 22,550 | 25,920 | 26,949 | 44,544 | — | — |
| Total | 1,56,508 | 2,44,721 | 2,57,062 | 4,04,032 | 3,96,230 | 10,14,118 |

120 mm and 180 mm in 1978, 130 mm and 180 mm in 1979 and 140 mm and 180 mm in 1980. This multimodal nature, shown in Fig. 4, suggests recruitment of smaller size groups into the fishery throughout the year. However, the entry of smaller sizes was more conspicuous during February-April, this period seemingly representing the peak recruitment season. There was considerably good recruitment of smaller sizes also in November.

The *P. semisulcatus* landed from the shallow-water fishery at Pattanamarudur-Tuticorin were all juveniles, measuring from 56 mm to 110 mm, with the mean sizes of males and females respectively at 89.1 mm and 90.5 mm during October 1978 to September 1979. On the other hand, the catches from the deep Manappad fishing ground were constituted by large-size adults only, the males ranging in length from 120 mm to 180 mm and females from 120 mm to 220 mm in 1978. Dominant modes of males varied between 140 mm and 160 mm and those of females between 160 mm and 210 mm (Fig. 5).

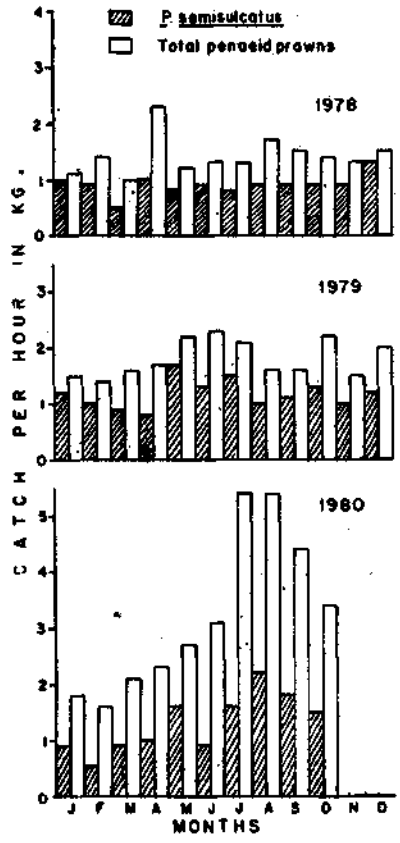


FIG .3. Rate of catch of penaeid prawns landed at Tuticorin fishing harbour during 1978-80.

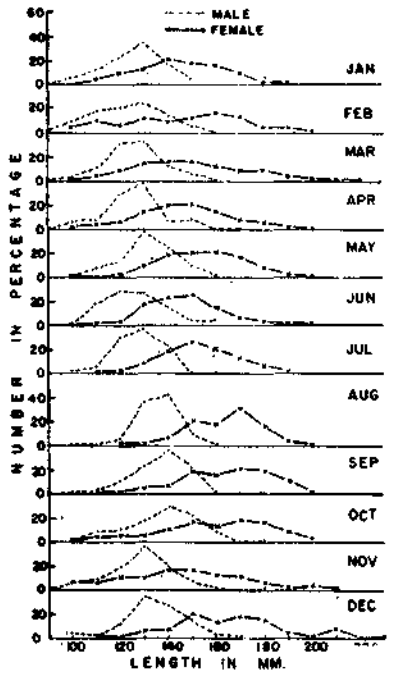


FIG. 4. Size-frequency distribution of *P. semisulcatus* from Punnaikkayal for the years 1978-80.

The proportion of females to males was nearly same in all the three fishing grounds, the females always predominating. In Punnaikkayal the females were in an average 62.6% in 1978, 56.9% in 1979 and 60.6% in 1980. In the juveniles exclusively thriving in the shallow-water area at Pattanamarudur-Tuticorin also there was likewise predominance of females (56.5%) in 1978-79. Similarly, at Manappad females accounted for 56.5% in the fishery in 1978. This female predominance, in the fishery for *P. semisulcatus,* is, however, not new, as similar cases of female predominance have been reported to exist in several commercially important penaeid prawns (George et al 1963). Nevertheless, as females were equally predominant both in the juvenile and in the adult fishery of *P. semisulcatus,* it may be inferred that off the coast of Tinnevelly there was no segregation of sexes in relation to depth or breeding.

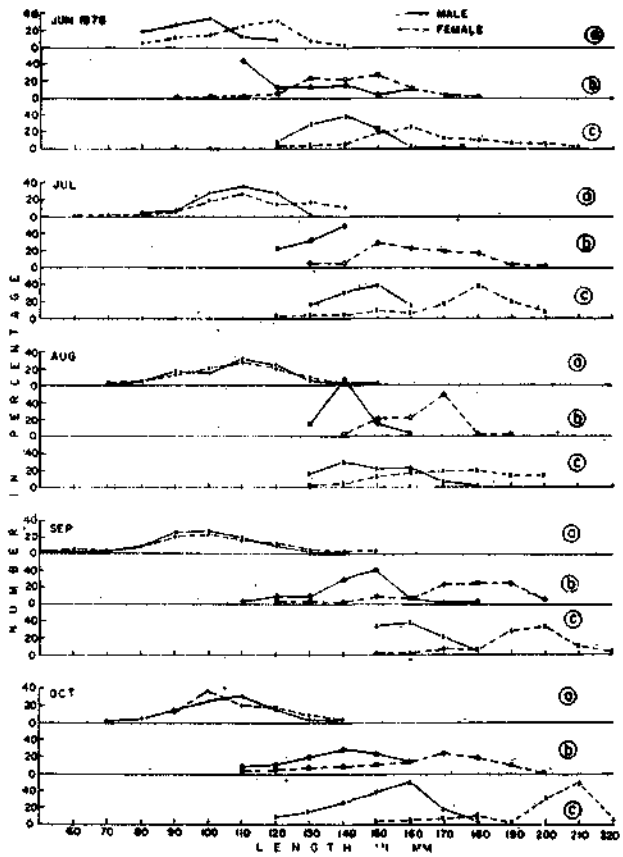


FIG. 5. Size-frequency distribution of *P. semisulcatus* along Tinnevelly coast, in relation to depth. Fishery from: (a) shallow water (b) Punnaikkayal and (c) Manappad.

The females of *P. semisulcatus* were classified, according to the stage of maturity, into immature, early maturing, late-maturing, mature, spent-recovering and impregnated, following Rao (1968). The frequency distribution of these different stages in the samples collected from the Tuticorin fisheries harbour during 1978-80 shows that at Punnaikkayal madai 21.1% of the females were immature, 19.4% early maturing, 37.5% late-maturing and mature and 21.2% spent-recovering (Fig. 6). The occurrence of maturing stages throughout the year indicates the breeding of the species being continuous. However, the abandance of late-maturing and mature specimens during the months of July to October suggests that the peak breeding activity was during this period. On an average, during 1978-80, about 46.7%, 54.7%, 47.4% and 49.4% of females were in late-maturing and mature stages in July, August, September and October, respectively. Minor peaks could be noticed in February and December.

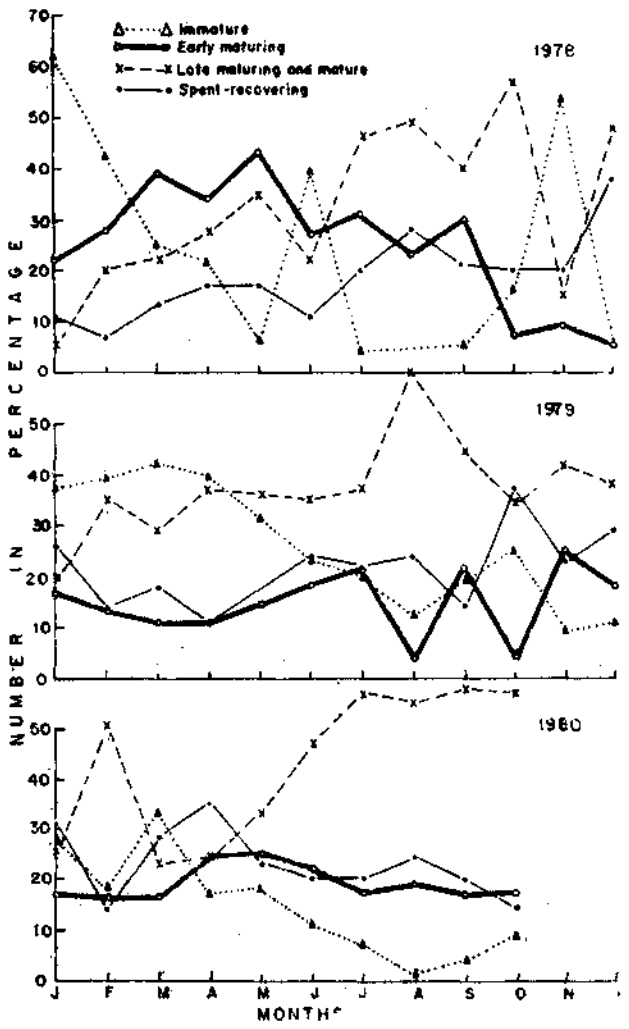


FIG. 6. Maturity stages of *P. semisulcatus* (female) from Punnaikkayal for the years 1978-80.

Prawns in maturing stages were never encountered in the shallow-water fishery of *P. semisulcatus* at Pattanamarudur-Tuticorin. On the other hand, in the fishery at Manappad, where the ground is deeper, about 54.0, 44.1, 72.4 and 65.8% of females were in late-maturing and mature stages in July, August, September and October, respectively (Fig. 7). A corresponding decrease is noticed in the case of immature females, the percentage decreasng from 14.3 in June to 2.7 in July and 3.9 in August. Immature stages were not present during September and October. A trend of decrease is noticed in the percentage of

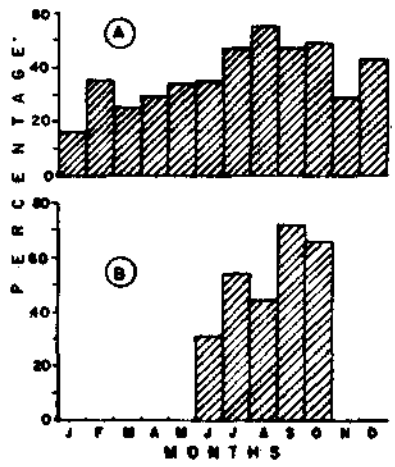


FIG. 7. Late maturing and mature females of *P. semisulcatus* from: (A) Punnaikkayal (1978-80) and (B) Manappad (1978).

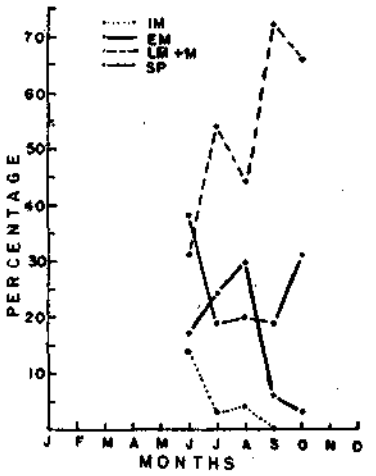


FIG. 8. Maturity stages of *P. semisulcatus* (female) from Manappad seasonal fishery in 1978 (IM = immatue, EM = early maturing, LM + M = late maturing and mature and SP = spent-recovering).

early maturing stage also (Fig. 8). The trend of decrease in the immature and early-maturing prawns of comparatively smaller sizes seen toward the advance of the season may suggest that entry of such indviduals into the fishery had taken place toward the beginning of the season only.

## Discussion

Though the major fishery for *P. semisulcatus* is at Punnaikkayal, the importance of the other two fishing grounds cannot be overlooked as one of them contributes to a round-the-year fishery of juveniles and the other to an economically important seasonal fishery of big-size prawns. Besides, a comparison of the size-frequency distributions shows that the three grounds are interdependent, with a much-probable, size-dependent movement of *P. semisulcatus* among them (see Fig. 5). Dominant modes of male *P. semisulcatus* were at 100, 110 and 140 mm and that of females at 120, 150 and 160 mm in Pattanamarudur-Tuticorin, Punnaikkal and Manappad, respectively, in June 1978. The modes for males were likewise at 110, 140 and 150 mm and for females at 110, 150 and 180 mm in the three fishing grounds in July. This increase in modal size with increasing depth was consistent throughout the period under study. The increase was more conspicuous in Manappad towards the end of the season, the modal sizes in October being 110, 140 and 160 mm in the case of male and 100, 170 and 210 mm in the case of female respectively at Pattanamarudur-Tuticorin, Punnaikkayal and Manappad. It may therefore be inferred that the

species prefer to be in shallow waters in the juvenile phase, and, from there, move to deeper waters as it grows. In the commercially important penaeid prawns of the southwest coast of India, too, George et al (1971) have reported similar cases of size-dependent movement.

The multimodal nature of *P. semisulcatus* from Punnaikkayal madai suggests the recruitment of younger size-groups into the fishery here to be throughout the year, resulting from year-round breeding. However, the peak recruitment is in February-April and November as indicated by the higher percentage of immature prawns of smaller size-groups, probably resulting from the peak breeding in July-October, December and February. Juveniles of the species landed from the shallow-water fishery also show multimodal length frequency, indicating recruitment throughout the year. But, in the seasonal fishery at Manappad, unlike in the other two centres, the modes are at the smaller size-groups, in the months of June to August, which form the beginning of the season here, suggesting that recruitment here is at this time. The absence of immature females towards the latter half of the season supports this inference of recruitment taking place at Manappad about the beginning of the season only.

The study also shows that *P. semisulcatus* changes its preference to the kind of substratum as it grows. The juvenile thrives in a sandy and rocky bottom that is fully covered with aquatic vegetation, whereas the adult prefers a muddy substratum. Yasuda (1956) too had observed that juveniles of *P. semisulcatus* measuring 3.2 mm to 17.0 mm in carapace length spend their life from late August to middle of October in certain areas of the Seto Inland Sea of Japan, where *Zostera marina* are growing. After middle of October the species seems to be fished only from the offshore areas where the bottom is muddy. This habit of *P. semisulcatus* is in contrast with the habit of most other penaeid prawns, which are found in muddy substratum throughout their life. It is, incidentally, this difference in the choice of substratum in the case of *P. semisulcatus* that makes it necessary to employ different types of gear in the different prawn fishing grounds off Tinnevelly coast.

In Punnaikkayal, late-maturing and mature females were between 47% and 55% of the total females during July-October, the peak breeding season. In Manappad, the female prawns belonging to these stages of maturity were even more, contributing up to 72.4% in September 1978. This increasing occurrence of maturing stages in deeper waters together with their total absence in the shallow waters of the coastal area is a clear indication of *P. semisulcatus* moving out to deeper waters for breeding. Viewed in this context, the seasonal fishery for *P. semisulcatus* at Manappad becomes significant, Manappad is the deepest fishing ground in this region, and the fishery here is during June-October, which is more or less the peak breeding period of the species, because in this period the maximum percentage of late-maturing and mature stages, constituting perhaps the breeding stock, has been recorded.

The juveniles of most of the commercially important penaeid prawns are extensively fished from brackish waters and estuaries, which provide them with nurseries all along the coast of India. According to George (1973), the penaeid prawns are closely associated with the shallow brackishwater environments. *P. semisulcatus* too, like the other penaeid prawns, prefer a shallow-water habitat in its juvenile phase. But, unlike the other penaeids, *P. semisulcatus* spends its juvenile phase in a purely marine environment, though also in shallow depths. Stray occurrence of juveniles of *P. semisulcatus* has, however, been reported from estuaries in certain other areas, where they do not contribute to fisheries of any considerable magnitude.

The total estimated landings of *P. semisulcatus* from the Punnaikkayal madai increased steadily from 1978 to 1980 along with the effort expended and accompanied by an increase in the catch per unit hour. This trend of increasing production with increasing effort might indicate the presence of a rich prawn fishery resource available in this region for further exploitation. (Stock assessment of the fishery of *P. semisulcatus* in this region and its maximum sustainable yield are being dealt with separately). But, it is essential to monitor the trend of the fishery and evolve a proper management policy to prevent indiscriminate fishing, particularly at Manappad.

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## REFERENCES

GEORGE, M. J. 1972. Zoogeographic distribution of Indian Penaeidae. *Indian J. Mar. Sci.*, 1 (1): 89-92.

GEORGE, M. J. 1973. The influence of backwaters and estuaries on marine prawn resources. *Proc. Symposium on Living Resources of the Seas around India;* 563-569.

GEORGE, M. J., S. K. BANERJI AND K. H. MOHAMED. 1971. Size distribution and movement of the commercial prawns of the southwest coast of India. *Seafood Export J.*, 3 (1): 143-149.

GEORGE, M. J., K. RAMAN AND P. KARUNAKARAN NAIR. 1963. Observations on the offshore prawn fishery of Cochin. *Indian J. Fish.*, 10 (2)A: 460-499.

MANISSERI, MARY, K. 1982. On the fishery of juveniles of *Penaeus semisulcatus* along the Tinnevelly coast, Tamil Nadu. *Indian J. Fish.*, 29 (1 & 2): 20-28.

MANISSERI, MARY K. AND C. MANIMARAN. 1981. On the fishery of the Indian white prawn *Penaeus indicus* H. Milne Edwards along the Tinnevelly coast, Tamil Nadu. *Indian J. Fish.*, 28 (1 & 2): 208-216.

MOHAMED, K. H. 1969. *Genus Penaeus* Fabricius 1978. *Bull. cent. mar. Fish. Res. Inst.*, 14: 49-75.

PILLAY, T. V. R. 1954. The ecology of a brackishwater 'bheri' with special reference to fish culture practices and biotic interactions. *Proc. nat. Inst. Sci. India*, 20: 399-427.

RAO, P. VEDAVYASA. 1968. Maturation and spawning of the penaeid prawns of the southwest coast of India. *FAO. Fish. Rep.*, 57(2): 285-302.

SUSEELAN, C. AND M. KATHIRVEL. 1979. A good nursery ground for tiger prawns located in Kerala. *Mar. Fish. Infor. Serv. T & E Ser.*, No. 12: 8-9.

YASUDA, I. 1956. Shrimps of Seto Inland Sea of Japan. *Proc. Indo-Pacific Fish. Counc.*, 6th Session, Sections I and III: 378-386.