A CASE OF OVERFISHING: DEPLETION OF SHRIMP RESOURCES ALONG NEENDAKARA COAST, KERALA*

Introduction

Mechanisation of the fishery along the Kerala coast has progressed considerably, resulting in an increase of the exploitation of ground fishes and prawns inside the 80 m depth contour to a significant level. Based on the facilities available for landing and disposal of catches, the operation of these mechanised boats is concentrated in certain centres along the coast, like Vizhinjam, Neendakara, Azhikode, Cochin, Beypore, etc. Prawns being the most important commodity in demand from the catches of the mechanised sector, a study of the trend in mechanised fishery in general and prawn production in particular from these centres would show that Neendakara is by far the most important centre. In fact, in some years the entire prawn catch of the mechanised fishery of Kerala during the monsoon months are landed at this centre. Hence a detailed study of the prawn fishery by mechanised boats based at Neendakara-Sakthikulangara complex has been attempted, with a view to determine whether there are any indications of overfishing either biological or economic.

Fishing operations and seasons

Prawn fishing in this region is mostly carried out by small mechanised boats of size upto 14 m length, operating two or four seam shrimp trawls in the coastal waters upto about 40 metres depth. These vessels carry out daily fishing cruises, starting from the base early in the morning and returning in the evening. The catches are landed at Sakthikulangara landing centre situated on the southern end of Neendakara bridge. There has been a steady increase in the number of boats operating from this base for the past few years as a result of the establishment of suitable infrastructure facilities and attractive catch returns of prawns from the inshore areas. The maximum number of boats/day operating from here during the peak season of 1970 was about 185, which by 1979 increased to about 1,200. The centre is perhaps the biggest landing centre of the country, having the maximum number of boats engaged in shrimp trawling (Fig. 1).

The trawling operations are carried out almost throughout the year, but a characteristic feature noticed in this area is that the peak fishing activities are restricted to a brief period of two or three months during the southwest monsoon period June to August, when normally the trawling operations remain weak or totally suspended in other parts of the west coast. During this period, hundreds of boats from other parts of the state and also from outside the state assemble here and temporally camp until the season is over.

Prawns constitute an average of about 38.4% of the total trawl catches of this area and support the commercial fishery throughout the year in varying proportions. The seasonal trend in production follows more or less the same pattern every year as could be seen from Table 1. While the catches remain to be of a low or moderate magnitude in most of the months, an average of about 83% of the landings of the year are recorded during the period June-August or in some years July–September. The total catch as well as the CPUE of prawns during this period are remarkably high as compared to the catch returns of the rest of the year, thereby indicating heavy concentration of fresh stock in these areas during the peak monsoon period. The success of the prawn fishery of the state in a particular year largely depends on the catch landed at this centre especially during the monsoon season. A comparison of the monthly catch statistics of the different years from 1973 to 1979 (Table 1) would indicate that the maximum catch as well as CPUE were registered in the month of August consecutively for the first four years, with a record catch of 31,722.2 tonnes in 1975 and catch rate of 298.6 kg/hr of trawling in 1973. In the subsequent years, however, a slight deviation from this occurred, September having been the highest productive month in 1977 and July in 1978 and 1979.

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Fig. 1. *Mechanised boats at landing jetty at Neendakara*

Species composition and biological aspects

The composition and biological characteristics of important species in the fishery were studied during the period May 1979 to April 1980 (Fig. 2). As in other regions of Kerala coast the prawn fishery of this area is supported by penaeid prawns only. *Parapenaeopsis stylifera, Metapenaeus dobsoni, Penaeus indicus, Metapenaeus affinis, Penaeus semisulcatus* and *Metapenaeus monoceros* contributed to the fishery in the order of their abundance. The dominant species in the month of January was *P. indicus,* amounting to about 41% of the total catch, followed by *M. dobsoni* and *P. stylifera* in almost equal quantities (25%). During the next month the trend changed suddenly, making *P. stylifera* the most important constituent species (41%) followed by *M. dobsoni* (31%) while *P. indicus* was reduced to about 6% of the month's catch. In March, *M. dobsoni* became the dominant species (40%), relegating *P. stylifera* (15%) and *P. indicus* (10%) to second and fourth places. *P. semisulcatus* appeared in large quantities (12%) occupying third place. In the next month *P. stylifera* showed considerable increase (70%) while *M. dobsoni* and *P. indicus* were second and third in importance, respectively. This increasing trend in the landings of *P. stylifera* continued in the succeeding months of May to October although the proportion between *P. stylifera* and *M. dobsoni* varied in different months. In July, the peak landing month in the monsoon period, the catch of *M. dobsoni* (6%) was negligible in comparison to that of *P. stylifera* (75%), while the quantity of *P. indicus* was 15%. The

Table 1. *Monthly catch trends of prawns at Sakthikulangara-Neendakara during* 1973–1979.

Months	Prawn landings in tonnes and CPUE in kg (in parenthesis)						
	1973	1974	1975	1976	1977	1978	1979
January	253.2 (7.9)	130.6 (5.7)	429.1 (7.6)	132.4 (4.9)	197.6 (6.1)	440.0 (2.3)	73.0 (3.7)
February	329.5 (11.2)	235.2 (9.2)	241.0 (5.3)	327.1 (10.3)	172.2 (4.2)	178.0 (0.9)	96.0 (4.0)
March	222.3 (7.5)	163.8 (5.5)	388.9 (5.3)	157.8 (8.6)	242.6 (1.7)	410.0 (2.6)	405.0 (15.5)
April	483.9 (16.3)	745.7 (12.8)	868.9 (10.1)	379.0 (14.2)	117.7 (2.9)	457.0 (1.9)	186.0 (4.8)
May	2,697.6 (34.9)	920.4 (12.0)	4,661.2 (22.5)	1,271.6 (12.2)	128.2 (2.7)	3,196.0 (8.8)	564.0 (6.5)
June	3,202.8 (73.0)	1,283.0 (16.1)	2,109.5 (13.1)	665.0 (18.9)	241.9 (6.8)	4,850.0 (8.0)	900.0 (22.3)
July	12,652.2 (197.1)	235.2 (7.2)	13,806.7 (50.0)	685.1 (50.3)	3,334.3 (25.7)	16,068.0 (80.2)	9,313.0 (71.8)
August	22,987.1 (298.6)	10,140.7 (111.4)	31,722.2 (148.8)	9,768.2 (104.1)	7,949.8 (42.6)	6,856.0 (37.1)	2,064.0 (15.7)
September	703.8 (15.7)	7,038.9 (52.2)	312.7 (7.8)	419.8 (8.1)	9,763.8 (45.5)	244.0 (1.9)	507.0 (5.9)
October	88.5 (3.2)	5,800.1 (49.5)	1,934.0 (28.1)	433.3 (9.6)	505.1 (3.1)	24.1 (0.5)	152.0 (2.5)
November	934.9 (26.4)	365.7 (4.7)	42.0 (0.7)	472.1 (8.1)	580.2 (5.4)	244.0 (4.8)	180.0 (3.6)
December	921.5 (15.4)	705.3 (9.0)	233.9 (5.1)	281.6 (8.9)	887.8 (4.4)	176.0 (3.3)	142.0 (4.6)
TOTAL (Average)	45,477.3 (82.6)	27,764.6 (33.7)	56,750.1 (42.6)	14,993.0 (27.9)	24,121.3 (18.0)	33,143.0 (13.7)	14,582.0 (20.1)

quantity of *M. dobsoni* landed in November was about 10% more (41%) than *P. stylifera* (30%) and *P. indicus* also showed increased catch in comparison to previous month. In December, the quantity of *P. indicus* further increased to 30%, although, the difference between the catches of *M. dobsoni* and *P. stylifera* remained more or less the same as in November. On an average *P. stylifera* formed 73%, *M. dobsoni* 19%, *P. indicus* 4% and other species 4% (Table 2).

A comparison of the species composition in the catches of the inshore prawn fishery of the neighbouring areas during the monsoon months when the fishery

Table 2. *Estimated catch and percentages of different species of prawns landed at Sakthikulangara-Neendakara during* 1979.

Species	Catch in tonnes	Percentage
P. stylifera	10,584	72.7
M. dobsoni	2,752	18.9
P. indicus	562	3.9
Others	684	4.5
TOTAL	14,582	100.0

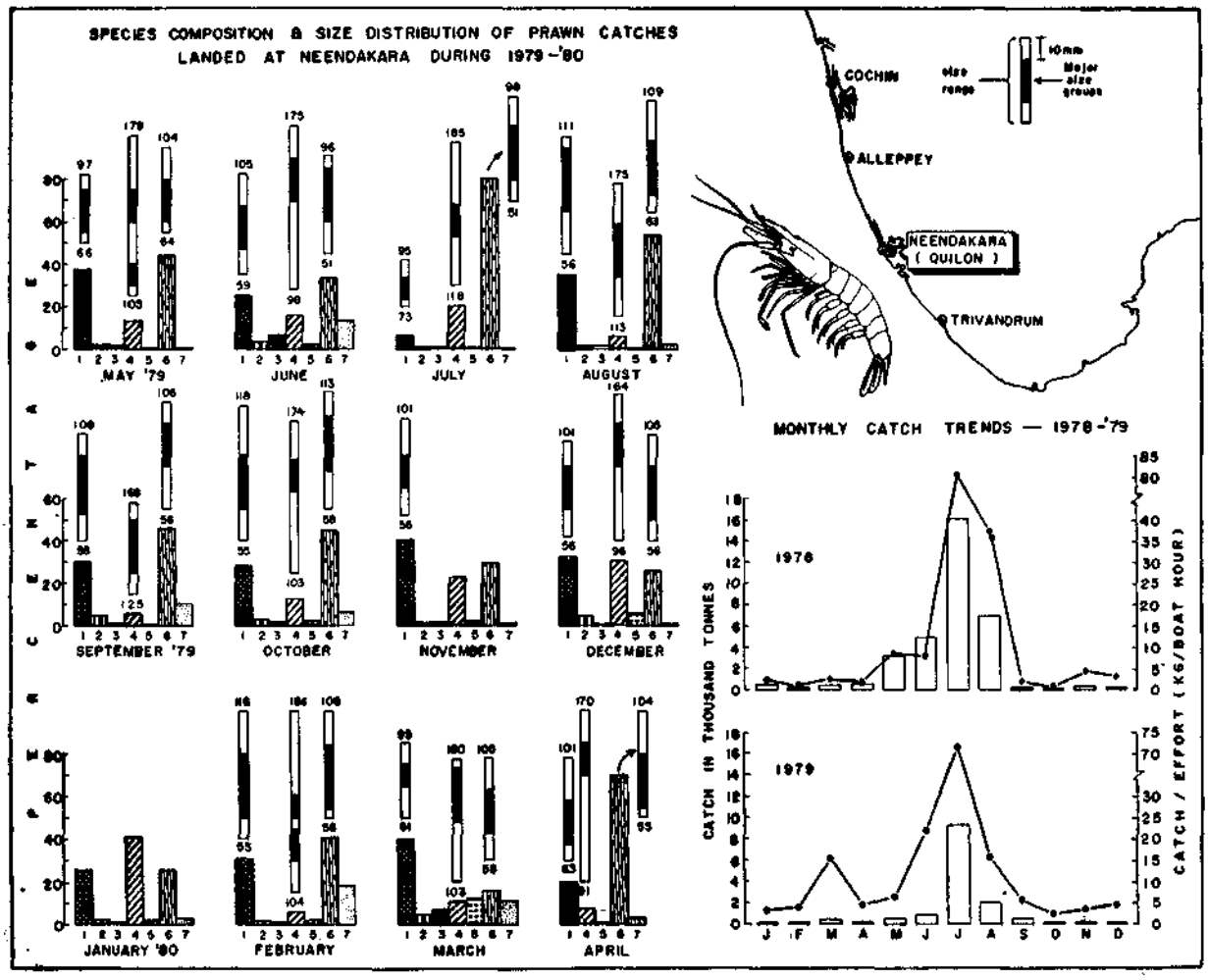


Fig. 2. *Monthly catch trends, species composition and size distribution of important species of prawns at Neendakara.* 1. *M. dobsoni,* 2. *M. monoceros,* 3. *M. affinis,* 4. *P. indicus,* 5. *P. semisulcatus,* 6. *P. stylifera,* 7. *Other species.*

is at its peak at Neendakara shows some differences between these nearby areas. The trawl fishery prawn catches at Cochin during the monsoon months is composed of 41.2% of *P. stylifera* and 40.6% of *M. dobsoni* while at Neendakara *P. stylifera* is quite dominant (76%) and only 18.6% *M. dobsoni* (Fig. 3). At the same time the indigenous fishery is dominated by *M. dobsoni* at both Cochin and Thottapilly area near Alleppey, the percentage contribution of the species being 65.2 and 84.3 respectively. If the area south of Neendakara is taken, the bottom-set gill-net catches at Colachel is quite different from all the other places in that it is almost exclusively supported by *P. indicus.* Thus it is quite evident that the peak fishery of Neendakara area is unique in that it is predominated by *P. stylifera* locally called 'Karikkadi chemmeen'. In fact, the fishermen and the industry has named the fishery as 'Karikkadi fishery'.

The size range in *P. stylifera* during the different months was from 51–109 mm in total length with large sized prawns in the range of 61–100 mm dominating in the catches. Although the general trend did not show much variation between the various months of the year, during the months of June and July the sizes showed a shorter range of 51–98 mm. In *M. dobsoni,* the sizes varied from 55 to 118 mm with the large sized prawns in the range of 66–105 mm more abundant. The months of March–May showed a decrease in the size range. *P. indicus* exhibited a range in total length between 91 mm and 186 mm. The larger sizes occurring in this species during the different months were within the size range of 131–160 mm.

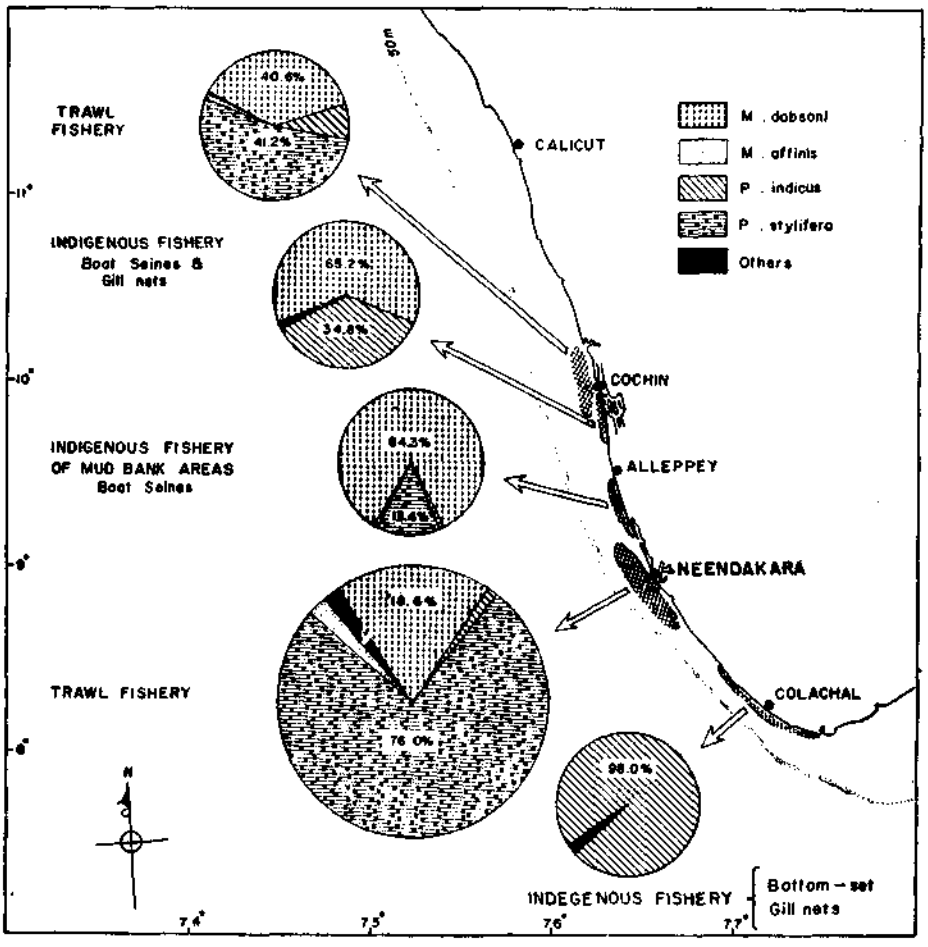


Fig. 3. Catch composition of the prawn fishery of Neendakara in comparison with that of the neighbouring centres during the monsoon period June — August. (Based on average for 3 years).

Studies on maturity distribution in females of the most important species have revealed that *P. stylifera* has a peak breeding season in March, May, October and December (Table 3). More females of *M. dobsoni* were observed with the ovaries in late stages of maturity during May–July, although higher percentages of mature females were also occurring during September, October and March. The percentage of mature females in *P. indicus* was more in comparison to the other two species, the probable peak breeding season being April, June–September and December, showing thereby that the breeding population of *P. indicus* may be moving into this area during this period.

Annual trend in production

The annual trend in prawn landings by shrimp trawlers at this centre in relation to the total fish catch

Table 3. *Monthly distribution of the spawning population of major species of prawns during May* 1979–*April* 1980.

Months		Percentage of mature females		
		M. dobsoni	*P. indicus*	*P. stylifera*
May	1979	36.4	19.2	33.3
June	,,	42.9	40.4	6.4
July	,,	39.0	43.1	13.9
August	,,	21.4	31.7	25.4
September	,,	30.3	48.1	18.5
October	,,	31.7	22.5	27.1
November	,,	—	—	—
December	,,	24.6	39.5	30.3
January	1980	—	—	—
February	,,	29.8	14.1	11.9
March	,,	32.7	21.6	29.1
April	,,	13.7	32.9	20.5

Table 4. *Annual trend in prawn landings by mechanised boats at Sakthikulangara-Neendakara in relation to total catch and fishing effort during* 1970–1979

Year	Total catch in tonnes	Total effort in hours	Prawn catch in tonnes	CPUE for prawns in kg/hr	Percentage of prawn in total catch
1970	26,704	1,46,185	1,845	12.6	6.9
1971	51,493	2,76,476	11,004	39.8	21.4
1972	23,622	3,83,227	11,267	29.4	47.7
1973	66,064	5,50,370	45,477	82.6	68.8
1974	77,748	8,23,719	27,764	33.7	35.7
1975	1,51,095	13,31,728	56,750	42.6	37.6
1976	29,836	5,36,897	14,993	27.9	50.2
1977	45,828	13,36,732	24,121	18.0	52.6
1978	89,892	24,13,475	33,143	13.7	36.8
1979	56,016	7,23,730	14,582	20.1	26.0

and effort expended during the ten-year period 1970–79 is shown in Table 4. It is seen that there is a steady increase in the fishing input from 1970 to 1975 and after a reduction in the subsequent year it picked up again to reach the maximum in 1978. The effort went down again in 1979. The prawn production also showed an increasing trend upto 1973, when an estimated catch of 45,477 tonnes (24 times more than in 1970) was landed at the highest catch rate of 82.6 kg/hr of trawling on an average. During this year the percentage contribution of prawns in the total catch (68.8) was also the highest ever recorded for this centre. In 1974, however, the fishery declined to the tune of about 40% over that of the previous year and the CPUE reduced to 33.7 kg/hr, inspite of the increased fishing effort put in for the exploitation. The year 1975 witnessed tremendous revival in the fishery and registered an all-time record catch of 56,750 tonnes along with the increase in fishing effort. The CPUE also showed improvement over that of the previous year. It is also of interest to note that in this year the prawn landings of this centre alone accounted for 72.8% of the total prawn catches of Kerala state and 40.0% of the penaeid prawn landings of the country. This situation did not last for long

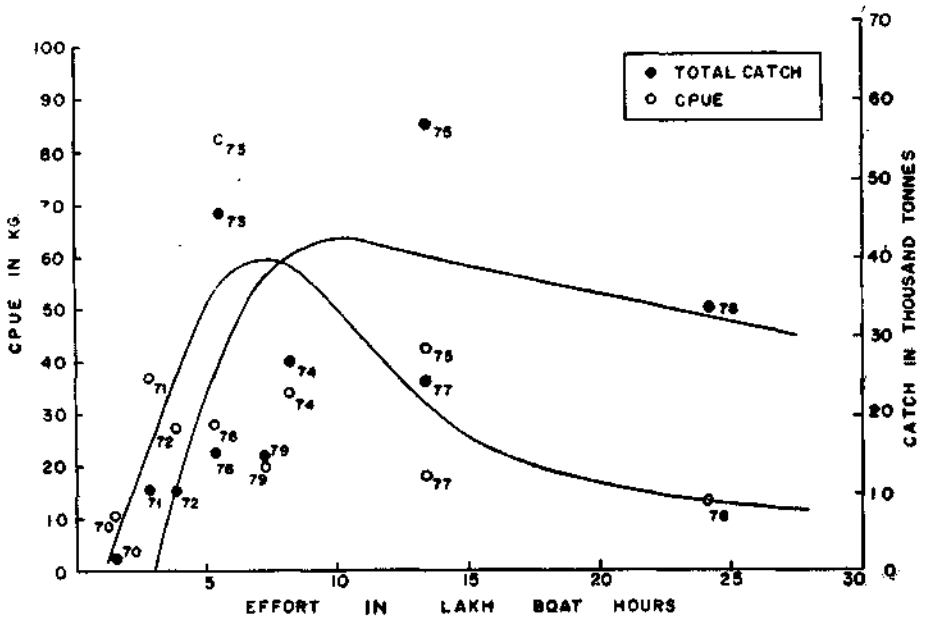
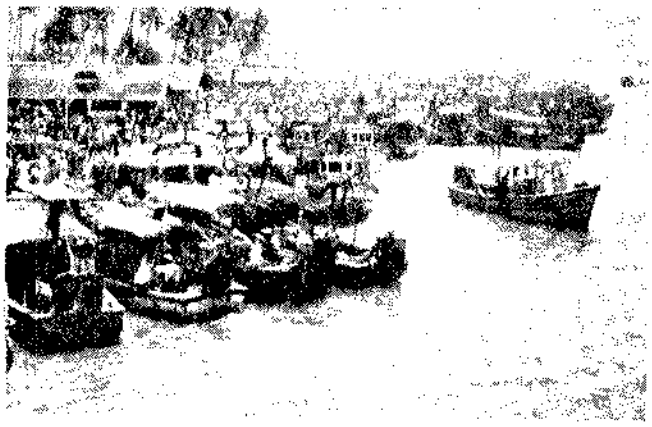
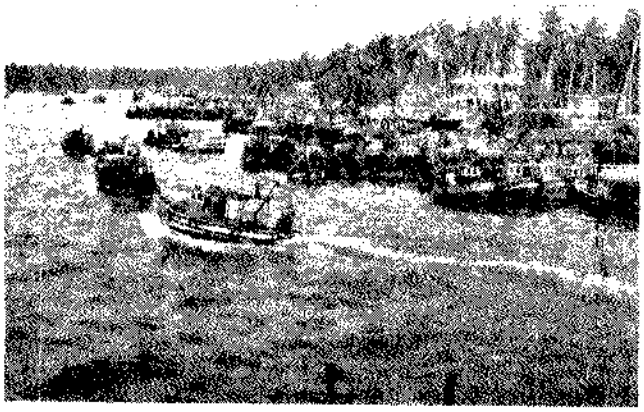


Fig. 4. Relation between effort and catch and catch per unit effort.

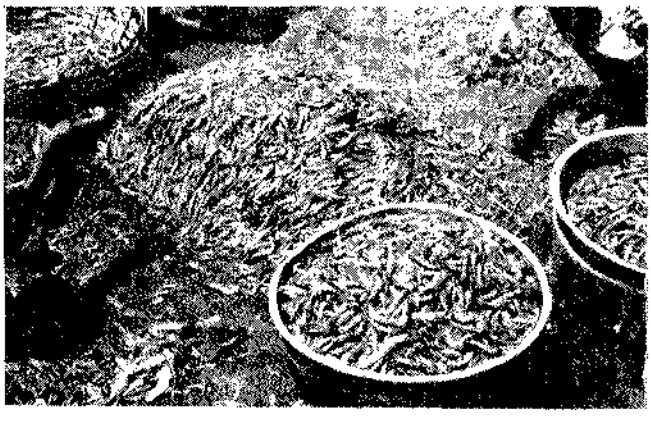




Mechanised boats landing at Neendakara jetty








Shrimp catches being sorted at the jetty

and followed a sudden decline in 1976 when the effort also reduced to almost the level of what was expended in 1973. But a remarkable difference noticed in the fisheries of these two years with more or less same input of effort is that when the highest CPUE was recorded in 1973 the catch rate was just one-third of it only in 1976. This declining trend in catch rate continued in the succeeding years. The total prawn production showed slight improvement, but not proportionate to the increase in trawling effort. In 1979 the prawn catch again declined to a very low level of 14,582 tonnes along with a decrease in trawling effort. However, the catch per unit effort showed improvement from that of 1978, brought about by the increased catch rate in the months outside the peak fishing season of July-August.

In general, from the peak fishing in 1973 and 1975, there has been considerable decrease in the total catch as well as catch per unit of effort in the subsequent years. This declining trend is quite evident in the yield curve (Fig. 4) drawn for the relationship of total effort and the catch per unit effort as well as total catch. Indications are that this is a case of economic overfishing. Prawns being an annual stock with high natural mortality, heavy fishing of prawn stock in one year may not very much affect the catch in the following year. However, when continuous declining trend in the catches with increasing input of effort over successive years is noticed it is possible that maximum sustainable yield in that restricted area has been reached and that further increase in effort input will result in only lesser economic return. Therefore conservation measures should be adopted for ensuring maximum economic return from the area. From the yield curve it would appear that the maximum sustainable yield would be about 35 to 40 thousand tonnes with an optimum input of effort of about 8 lakhs trawling hours. The catch per unit of effort could be controlled at the maximum economic level by restricting the effort at the desired level.

Discussion

In the light of this, having established that there is economic, if not biological, overfishing taking place in this area, it is high time that proper management of the fishery with implementation of conservation measures is thought of as pointed out by George (Fisherman 1 (2); 1980). Management of coastal prawn fishery is rendered difficult by the inherent problems associated with a multispecies fishery. There are several conservation measures which could be adopted for the management of a fishery, like control of the fishery in the estuarine phase, mesh regulation, closed season, licence limitation or restricting the effort and such others. Most of these methods are not only difficult to be implemented but also not very effective in a multispecies system.

Controlling the fishery in the adjoining estuarine water which is found to be helpful in enhancing the production of the inshore fishery in most areas may not be of use in this place. The major species contributing to the fishery here is *Parapenaeopsis stylifera* as seen earlier. It was also seen that in comparison to other neighbouring areas the fishery of this region is contributed to a large extent by this particular species. It is well known that this is one of the species which do not use the estuarine brackishwater areas to any great extent as its nursery ground for the juveniles as in the case of species like *Metapenaeus dobsoni* and *Penaeus indicus*. So the major portion of the catches come from the species which is distributed only in the inshore area of this region where the fishery is in operation. It is thus evident that the fishery is mostly contributed by a stock produced annually in these waters only and not moving in from any other areas apart from probably a slight offshore-inshore movement. Therefore any conservation measure for management of the fishery at the optimum level of exploitation will have to be necessarily concerned with the fishing operation of this particular region alone. In other words, control of the fishing in the estuarine region adjoining to this area may not help in improving the fishery here excepting in the case of species like *P. indicus* and *M. dobsoni* which also partly contribute to the fishery and may be using the adjoining estuarine area as their nursery grounds.

Mesh regulation will not be useful in a multispecies fishery constituted by species growing to different sizes. A catch of small or medium sized prawns would include smaller sized but adult specimens of the species growing to smaller sizes like *P. stylifera* and *M. dobsoni* as well as the smaller size groups of species growing to medium or larger sizes like *P. indicus*, *M. affinis* or *M. monoceros*. Hence, limitations of mesh size at a higher level with a view to catch only the larger sizes would lead to prevention of capturing the adults of the smaller growing varieties, which would thus be lost to the fishery.

So, restricting the input of effort in some way or other seems to be the only possible approach to management

of the fishery of this particular area. This is indirectly proved by the natural course of events also as evident from the effort and catch data for 1979 (Table 4). What has happened in this particular year is that due to lack of catches the number of boats operated from this centre was less, thus reducing the effort expended in this area. With the result, while there was considerable decrease in the total catch to less than half of that of 1978, the catch per trawling hour increased from 13.7 kg to 20.1 kg. So the natural reduction in effort has brought about an increase in catch rate. With the motivation of management the reduction in effort may be achieved either by enforcing a closed season for the fishery in the area or by limiting the number of boats in operation, the latter of which appearing more suitable due to the fact that during the peak season of the fishery several boats from even other states join the fishing fleet in these waters and enforcing a restriction to this entry to the fishing fleet may be easier. In both cases socio-economic considerations would render the implementation difficult. In view of the fast deteriorating situation in the catch rate obtained per boat at present the industry itself may be prepared at the moment for some restriction to be effected in the input of effort in order to get improved catch rate. It is up to the State Government and authorities concerned to take stock of the situation and evolve suitable method to restrict the effort expended for catching the prawns from this region.