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# PRAWN FISHERY OF THE KAKINADA BACKWATERS

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## ABSTRACT

The Kakinada backwaters of Andhra Pradesh, with an area of 330 square km, support an active prawn fishery throughout the year. Stake nets and drag nets account for over 90% of the total prawn landings of the backwaters. Annual prawn landings at Boddu Venkataya Palem, a place 18 km away from Kakinada, ranged from 240 - 713 tonnes in the six year period 1968 to 1973. Peak landings of prawns are observed in April-May and October-December periods. About 25 species of penaeids and 20 species of non-penaeids are observed in the prawn landings. While *Metapenaeus monoceros* dominate the prawn fishery in almost all the months of the year forming over 50% of the prawn landings, *Metapenaeus dobsoni*, *Metapenaeus brevicornis*, *Penaeus indicus* and *Penaeus monodon* also contribute substantially to the backwater fishery. *Metapenaeus affinis* which is very common in the marine prawn landings is found to contribute very little to the backwater fishery.

## INTRODUCTION

Prawns form an important component of the marine fisheries of India. Andhra Pradesh, with its 1000 km of coastline and extensive estuaries and backwaters, support a lucrative prawn fishery. The information relating to the prawn fishery of Andhra Pradesh is very scanty. Recent investigations by Sekharan *et al* (1968) off Visakhapatnam and Muthu *et al* (MS) off Kakinada indicate that prawns form an important component of the demersal fisheries of the region. It is well known that the backwaters and estuaries form the nurseries for the juveniles of most of the commercially important penaeid prawns. Ganapati and Subramanyam (1966) and Subramanyam (1964, 1965, 1967 and 1973) carried out preliminary survey of the prawn fishery of the Goutami Godavary estuarine system and found that the prawn fishery of the area is of considerable magnitude. An attempt is made here to make a qualitative and quantitative appraisal of the prawn fishery of the Kakinada backwaters.

## Extent of Backwaters

The Kakinada backwaters extend from latitude 16° 45-55′ N and longitude 82° 15-21′ E. The backwaters extend from Kakinada town on the North to the Goutami branch of the Godavary river on the South, bordering the Kakinada Bay on the East, encompassing an area of 330 square km. The entire area is full of mangroove mudflats traversed by a net-work of tidal creeks. All these creeks are connected to the Kakinada Bay either directly or indirectly. Some of these creeks have direct connection to the Godavary river or to the adjacent Bay of Bengal. Of these, the Coringa and Gaderu rivers which are about 21 and 11 km long respectively are the most prominent channels through which freshwater is drained into the Kakinada Bay from the Godavary river during the South West monsoon period (Rama Sarma and Ganapati, 1972). The depth of many of these creeks does not exceed 3 metres. However at some points of Gaderu and Coringa rivers depths upto 6 metres were recorded. Gaderu branches from Godavary at Bhairavapalem and runs north to end up in the Kakinada Bay. The Coringa, Gaderu and the other creeks are characterised by the presence of several channels of freshwater inflows, low transparency of the water almost throughout the year, prolonged period of freshwater domination, influence of saltwater from the bay and sea beginning from November, markedly high gradients horizontal and vertical in salinity and temperature, high nutrient content of the water, and the inward flow of water from the two ends of the creeks during flood phase and the outward flow during the ebb (Rama Sarma and Ganapati, 1972). The bottom of all these creeks and rivers is muddy and very rich in detritus and bottom fauna.

A number of fishing villages are located in these backwaters. The fishermen of these villages entirely depend on the fishery resources of these backwaters for their livelihood. To study the prawn fishery regular observations were made from Boddu Venkataya Palem, a village situated about 18 km from Kakinada in the backwaters region.

## Fishing Gear

Stake nets (*Toka vala* or *Vala kattu*), drag nets (*Pakkadevu vala*) push nets (*Dobbudu vala*) and dip nets (*Yethudu vala*) are the main gear used for the capture of prawns. Drag nets and stake nets account for over 90% of the total prawn landings. The description and operation of these gear are discussed in detail by Ramamurthy and Muthu (1969). The operation of stake nets is restricted to 16 to 20 days in a month. On some days of November and December boats remain in the fishing grounds continuously and fish at every low tide, the catch being sent to the landing centre by carrier boats.

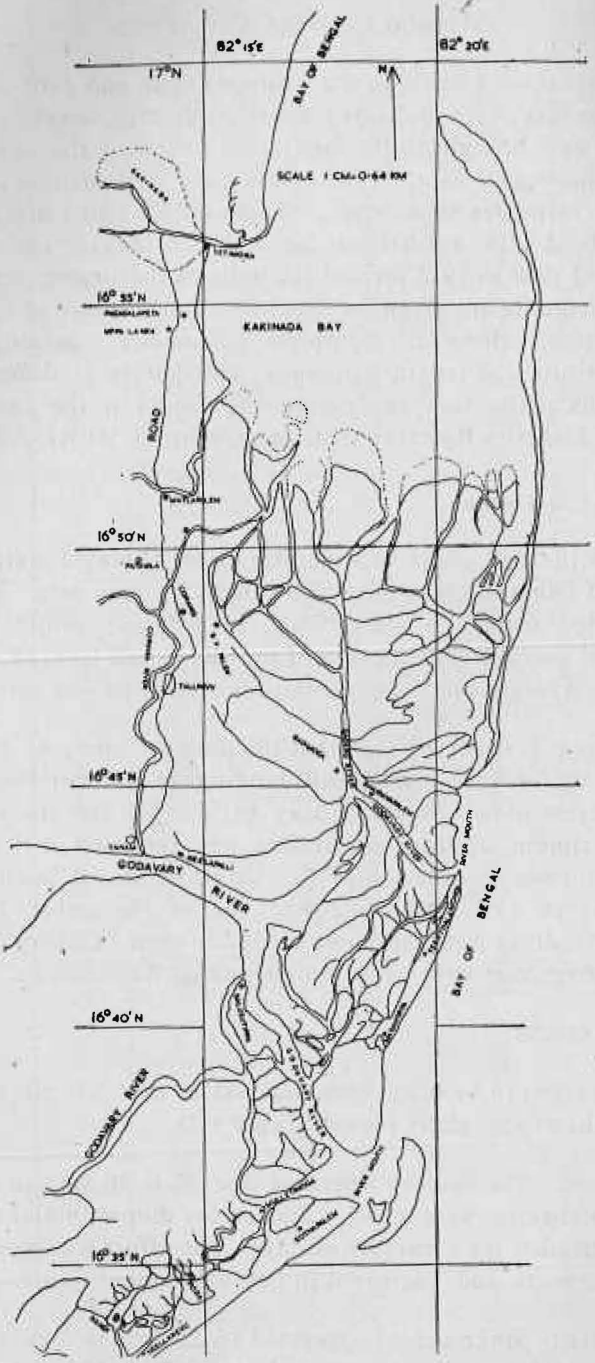


Fig. 1. Map showing Kakinada backwaters.

## Method of Data Collection

Weekly visits were made to the fishing centre and data on catch, effort and other particulars were collected from randomly selected fishing units. Prawn samples were brought to the laboratory to record the species composition and other biological data. From these data, collected on the observation days, monthly estimates were made. The unit of effort is taken as a day of operation of a boat with normal crew (catch/boat/day). The data collected during the period 1968 to 1973 formed the basis of the present report. To save space only pooled data are given for species composition and length composition of the samples. However, complete particulars regarding catch, effort, species composition and length frequency distribution of different species in different months of the six year period are found in the annual reports of Central Marine Fisheries Research Institute, Cochin (CMFRI, Annual Reports).

## MAGNITUDE OF THE FISHERY

Although the gear under consideration were operated mainly for prawns, some amount of fish and crabs were also caught by these nets. The proportion of prawns varied from 42.8 % to 95.6 % in different months of the study period. Annual average contribution of prawns varied from 68.6 % in 1972 to 82.2% in 1969. Average annual contribution of prawns was calculated to 76%.

From Table I it can be seen that the prawn fishery of the region was active throughout the year with peak landings in October-December period with a less significant peak in April-May period. In the six year period of observation maximum landings of prawns were recorded in 1973 (713 tonnes) and the minimum was recorded in 1968. Monthly prawn landings fluctuated from 7.3 tonnes in July 1969 to 249 tonnes in November 1973. Annual average prawn landings were estimated at 392 tonnes. Fishery was relatively good in alternative years with considerable annual fluctuations.

## EFFORT FLUCTUATIONS

The effort put in by drag nets and stake nets varied considerably in different months of the study period (Table III).

*Drag nets* : The net was operated for 27 to 28 days in a month when the weather conditions were good. During the monsoon and on festive days fishing was suspended for a number of days. The effort was more or less equal in the first three years and increased in the subsequent years.

*Stake nets* : Stake net was operated 16-20 days in a month. The effort put in by stake nets gradually increased from 1968 to 1973 as observed in the

Table I. *Prawn landings by drag nets and stake nets at Boddu Venkataya Palem during 1968 to 1973.*
(Weights in kg)

| Months | January | Feb. | March | April | May | June | July | August | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | 14580 | 14340 | 15630 | 32400 | 44905 | 19720 | 15120 | 10620 | 12240 | 14940 | 35100 | 11040 | 240635 |
| 1969 | 16280 | 14160 | 18172 | 32112 | 16646 | 12960 | 7300 | 18032 | 21880 | 205725 | 53600 | 20940 | 437807 |
| 1970 | 17490 | 20060 | 18639 | 18441 | 25090 | 12754 | 38160 | 17014 | 7965 | 29642 | 24130 | 19007 | 248393 |
| 1971 | 18164 | 15354 | 25515 | 20330 | 23250 | 30020 | 28605 | 37497 | 45864 | 43100 | 50705 | 63950 | 402354 |
| 1972 | 16830* | 21090 | 13860 | 12157 | 25029* | 11070 | 28594 | 29095 | 24048 | 30879 | 65186 | 32194 | 310032 |
| 1973 | 17635 | 7885 | 8480 | 14535 | 15255 | 13950 | 25110 | 17565 | 21780 | 152376 | 249410 | 169080 | 713061 |
| Average | 16830 | 15482 | 16716 | 21663 | 25029 | 16746 | 23815 | 21637 | 22296 | 79444 | 79689 | 52702 | 392047 |

* Average values inserted as no data were collected.

Table II. *Species composition of backwater prawn landings at Boddu Venkataya Palem*
( pooled for the years 1968 to 1973 )

| Months | Jan. | Feb. | March | Aprll | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total catch in kg. | 23467 | 23998 | 25447 | 29071 | 38298 | 26249 | 35596 | 33113 | 35191 | 88647 | 93308 | 63697 | 516082 |
| Prawn catch in kg. | 16830 | 15482 | 16716 | 21663 | 25029 | 16746 | 23815 | 21637 | 22296 | 79444 | 79689 | 52702 | 392047 |
| Percentage of prawns. | 71.7 | 64.5 | 65.7 | 74.5 | 65.4 | 63.8 | 66.9 | 65.3 | 63.4 | 89.6 | 85.4 | 82.7 | 76.0 |
| Species composition by weight in kg. | | | | | | | | | | | | | |
| *Metapenaeus monoceros* | 8767 | 7228 | 9512 | 11009 | 13226 | 8351 | 12423 | 11534 | 14119 | 60255 | 41875 | 27032 | 225331 |
| % | 52.1 | 46.7 | 56.9 | 50.8 | 52.8 | 49.9 | 52.2 | 53.3 | 63.3 | 75.8 | 52.5 | 51.3 | 57.5 |
| *M. affiais* | 230 | 434 | 785 | 257 | 441 | 359 | 655 | 1143 | 1164 | 543 | 498 | 587 | 7096 |
| % | 1.4 | 2.8 | 4.7 | 1.2 | 1.8 | 2.1 | 2.8 | 5.3 | 5.2 | 0.7 | 0.6 | 1.1 | 1.8 |
| *M. dobsoni* | 843 | 928 | 654 | 1882 | 2572 | 1316 | 2477 | 1552 | 1084 | 4002 | 10644 | 10136 | 38090 |
| % | 5.0 | 6.0 | 3.9 | 8.7 | 10.3 | 7.9 | 10.4 | 7.2 | 4.9 | 5.0 | 13.4 | 19.2 | 9.7 |
| *M. brevicornis* | 1039 | 703 | 1136 | 3819 | 1623 | 1181 | 1945 | 1716 | 883 | 1604 | 1996 | 3008 | 20653 |
| % | 6.2 | 4.5 | 6.8 | 17.6 | 6.5 | 7.1 | 8.2 | 7.9 | 4.0 | 2.0 | 2.5 | 5.7 | 5.3 |
| *Penaeus monodon* | 1264 | 1831 | 1171 | 574 | 741 | 798 | 1424 | 1732 | 1726 | 3449 | 3830 | 3297 | 21837 |
| % | 7.5 | 11.8 | 7.0 | 2.6 | 3.0 | 4.8 | 6.0 | 8.0 | 7.7 | 4.3 | 4.8 | 6.3 | 5.6 |
| *P. indicus* | 1502 | 1501 | 1454 | 2245 | 4314 | 2966 | 3011 | 2156 | 1869 | 5557 | 6344 | 4017 | 36936 |
| % | 8.9 | 9.7 | 8.7 | 10.4 | 17.2 | 17.7 | 12.6 | 10.0 | 8.4 | 7.0 | 8.0 | 7.6 | 9.4 |
| *P. merguiensis* | 279 | 290 | 175 | 100 | 357 | 360 | 275 | 231 | 174 | 298 | 617 | 555 | 3711 |
| % | 1.7 | 1.9 | 1.0 | 0.5 | 1.4 | 2.1 | 1.2 | 1.1 | 0.8 | 0.4 | 0.8 | 1.1 | 0.9 |
| *Other penaeids* | 353 | 784 | 741 | 651 | 581 | 581 | 450 | 627 | 338 | 537 | 567 | 894 | 7104 |
| % | 2.1 | 5.1 | 4.4 | 3.0 | 2.3 | 3.5 | 1.9 | 2.9 | 1.5 | 0.7 | 0.7 | 1.7 | 1.8 |
| *Non-penaeids* | 2553 | 1783 | 1088 | 1126 | 1174 | 834 | 1155 | 946 | 939 | 3199 | 13318 | 3176 | 31291 |
| % | 15.2 | 11.5 | 6.5 | 5.2 | 4.7 | 5.0 | 4.8 | 4.4 | 4.2 | 4.0 | 16.7 | 6.0 | 8.0 |

Table III. *Fishing units engaged in Prawn fishery at Boddu Venkataya Palem during 1968 - 1973.*

Stake nets (*Thoka vala*)

| Months | Jan. | Feb. | March | April | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | 225 | 600 | 300 | 315 | 828 | 480 | 240 | 270 | 200 | 200 | 630 | 90 | 4378 |
| 1969 | 480 | 480 | 376 | 450 | 539 | 630 | 250 | 292 | 200 | 954 | 522 | 216 | 5389 |
| 1970 | 320 | 280 | 240 | 153 | 378 | ... | 1020 | 423 | 120 | 783 | 504 | 450 | 4671 |
| 1971 | 400 | 375 | 450 | 416 | 477 | 378 | 390 | 710 | 756 | 950 | 1010 | 1070 | 7382 |
| 1972 | ... | 540 | 972 | 608 | ... | 531 | 654 | 780 | 612 | 513 | 1422 | 790 | 7422 |
| 1973 | 564 | 324 | 420 | 603 | 492 | 504 | 756 | 702 | 369 | 1308 | 1476 | 1472 | 8990 |

Drag nets (*pakkadevu vala*)

| Months | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | 900 | 1320 | 1170 | 1620 | 2660 | 1470 | 1665 | 1140 | 1280 | 1560 | 1680 | 840 | 17305 |
| 1969 | 1330 | 1400 | 1540 | 2133 | 1640 | 1440 | 675 | 1295 | 1280 | 1818 | 1330 | 1352 | 17233 |
| 1970 | 1304 | 1356 | 1521 | 1692 | 1778 | 1456 | 2058 | 1104 | 1035 | 1351 | 1475 | 1379 | 17510 |
| 1971 | 1456 | 1296 | 1800 | 1485 | 1855 | 1785 | 1869 | 2261 | 2436 | 1452 | 1521 | 1890 | 21106 |
| 1972 | ... | 1593 | 1890 | 1350 | ... | 1431 | 2240 | 2296 | 1729 | 2169 | 1638 | 1967 | 18303 |
| 1973 | 2129 | 1526 | 1666 | 2079 | 1953 | 1820 | 2115 | 1360 | 2007 | 1980 | 2156 | 2310 | 23101 |

Table IV. *Catch per unit of effort (Catch/boat/trip in kg) for prawns at Boddu Venkataya Palem in 1968 - 1973.*

| Months | Jan. | Feb. | March | April | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *Stake nets* | | | | | | | |
| 1968 | 20.0 | 7.0 | 24.8 | 51.43 | 18.3 | 12.5 | 15.8 | 10.0 | 10.0 | 27.0 | 32.9 | 20.0 | 20.5 |
| 1969 | 10.0 | 10.0 | 13.0 | 14.0 | 7.5 | 3.9 | 13.0 | 15.6 | 18.2 | 176.2 | 63.8 | 17.5 | 45.2 |
| 1970 | 12.0 | 14.4 | 12.0 | 9.2 | 19.0 | ... | 21.4 | 20.2 | 12.0 | 18.0 | 16.1 | 14.0 | 17.1 |
| 1971 | 13.8 | 14.0 | 19.0 | 12.3 | 11.3 | 20.7 | 19.2 | 19.4 | 22.0 | 28.0 | 32.4 | 35.2 | 23.4 |
| 1972 | ... | 6.2 | 4.0 | 4.5 | ... | 5.3 | 10.7 | 11.3 | 11.5 | 13.5 | 30.9 | 12.0 | 12.9 |
| 1973 | 8.2 | 6.9 | 4.5 | 6.3 | 7.8 | 8.1 | 10.0 | 10.1 | 11.2 | 82.8 | 128.1 | 82.7 | 51.0 |
| Average | 11.7 | 10.8 | 12.6 | 15.7 | 13.1 | 10.7 | 16.5 | 15.4 | 16.9 | 70.7 | 60.4 | 45.4 | 31.0 |
| | | | | | | *Drag nets* | | | | | | | |
| 1968 | 11.2 | 7.7 | 7.0 | 10.0 | 11.2 | 9.3 | 6.8 | 6.9 | 8.0 | 6.1 | 8.6 | 11.0 | 8.7 |
| 1969 | 8.6 | 6.7 | 8.6 | 12.1 | 7.7 | 7.3 | 6.0 | 10.4 | 14.3 | 20.7 | 15.3 | 12.7 | 11.3 |
| 1970 | 9.7 | 11.8 | 10.4 | 10.1 | 10.1 | 8.8 | 8.0 | 7.7 | 6.3 | 11.5 | 10.9 | 9.2 | 9.6 |
| 1971 | 8.7 | 7.8 | 9.4 | 10.2 | 9.6 | 12.4 | 11.3 | 10.5 | 12.0 | 11.4 | 11.8 | 13.9 | 10.9 |
| 1972 | ... | 11.1 | 5.3 | 7.0 | ... | 5.8 | 9.6 | 8.9 | 9.8 | 11.1 | 13.0 | 11.5 | 9.4 |
| 1973 | 5.9 | 3.7 | 4.0 | 5.2 | 5.9 | 5.4 | 8.3 | 7.7 | 8.8 | 22.3 | 27.7 | 20.5 | 11.0 |
| Average | 8.5 | 8.1 | 7.4 | 9.1 | 9.1 | 8.2 | 9.2 | 8.9 | 10.1 | 14.3 | 15.3 | 13.9 | 10.2 |

drag net fishery. Maximum effort by stake nets was observed during October-December of all the six years coinciding with heavy landings by this gear. Fluctuations in effort in the first three quarters of different years were found to be negligible. Higher figures for effort in the months May 1968, July 1970 and March 1972 were mainly due to migration of stake nets from Gadimoga, a nearby landing center, to the place of observation. The sharp decline in the effort during December of 1968 and 1969 was mainly because of the bad weather that prevailed in the area.

## CATCH PER UNIT OF EFFORT

Average monthly catch per unit of effort (catch/boat/trip) for drag nets showed little fluctuations from year to year (Table IV). It varied from 3.7 kg in February 1973 to 27.7 kg in November 1973. Comparatively higher values were recorded during September-December period in all the years.

The stake net fishery experienced wider fluctuations in C/E during the six year period, the peak being generally observed in October-December period (Table IV). In 1968 a deviation from the general trend was observed with high values being recorded during April–June and December periods. The fishery in 1969 was characterised by high values in the five months period of August-December. A completely different picture was found in 1970 in which year high C/E values were observed in January-May in addition to the usual peak of October-December. In 1971 the catch rate was uniform in all the months with an ill defined peak in October-December period. The second half of 1972 recorded high C/E values reaching a maximum in November (Table IV). Poor catch rates were observed during the first half of 1973 and then gradually increased to reach exceptionally high values in October-December period.

## SPECIES COMPOSITION

20 species of penaeids and 19 species of non-penaeids occurring in the Godavary estuary have been listed (Ganapati and Subramanyam 1966). Muthu (1969) described a new species of *Parapenaeopsis* from these backwaters and named it at *Parapenaeopsis indica*. All the species recorded by these workers were observed during the present investigation and in addition 3 more species of penaeids namely *Metapenaeus lysianassa*, *Parapenaeopsis cornuta* and *Metapenaeopsis stridulans* were recorded for the first time from these backwaters. Among these, only 7 species viz., *Metapenaeus monoceros*, *M. dobsoni*, *M. brevicornis*, *M. affinis*, *Penaeus monodon*, *P. indicus* and *P. merguiensis* contributed to the fishery in commercial quantities (Table II).

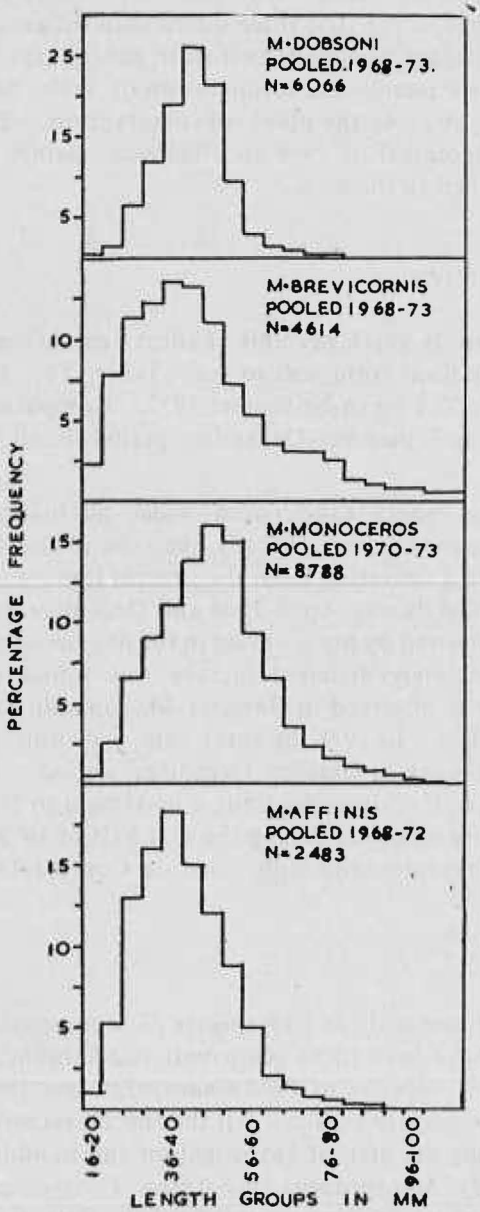


Fig. 2. Length frequency distribution of *M. affinis*, *M. monoceros*, *M. brevicornis* and *M. dobsoni*.

*Metapenaeus monoceros*

In all the years of observation *M. monoceros* formed the major constituent of the backwater prawn landings, and its average annual catch is estimated at 225 tonnes. The landings of this species varied from 138 to 368 tonnes in different years of the study period. This species formed about 57.5% of the backwater prawn fishery, with annual variations from 49% in 1972 to 70% in 1969.

Although *M. monoceros* of 16-105 mm in total length were observed in the backwater landings only juveniles of 35-70 mm in total length dominated the fishery (Fig. 2). Monthly variations in the size composition of the catches were not very significant in many of the years. There was no significant progression of the modes with time.

*Metapenaeus dobsoni*

With average annual landings upto 38 tonnes *M. dobsoni* formed the second important species of the backwater prawn fishery forming about 10% of the annual prawn catch. The landings of this species were good in alternate years fluctuating from 12 tonnes (1970) to 111 tonnes (1973). The species was landed throughout the year with two peaks of abundance usually during April - July and October - December.

The length frequency distribution for the years 1968 to 1973 (pooled) indicate that *M. dobsoni* of 16-80 mm were caught in the backwater fishery (Fig. 2). Although a wide range of size groups were observed only prawns of 31-55 mm dominate the fishery in all the months. Size composition in different months of the six year period showed marked variations without any indication of seasonal domination of size groups. The length frequency distribution was unimodal indicating a single age class contricuting to the fishery (Fig. 2). The recruitment of juveniles to the fishery did not appear to follow a definite trend in different years of the study period.

*Metapenaeus brevicornis*

This species with average annual landings of about 20 tonnes formed an important item of the fishery throughout the year, accounting for upto 5% of the annual prawn catch. Its occurrence was highly variable in the landings of different boats on the same day, the boats fishing in sandy areas bringing better catches of this species. When fishing in the creeks for the other species was not remunerative, boats resorted to fishing in the Kakinada Bay for this species. As the amount of effort put in varied greatly in the Kakinada Bay on different days of a month and in different months of a year the landings do

not give a periodic trend. The fishery for this species was more or less stable during the six year period.

A wide range of size groups contributing to the fishery are observed during the six year period (Fig. 2). Seasonal trend in the predominance of different size groups was lacking in different months. Although *M. brevicornis* of 16-100 mm in total length were represented in the landings only juveniles of 45-80 mm were the mainstay of the fishery. However in April 1969 and January 1970 good numbers of mature males and females were landed in considerable quantities from the Kakinada Bay.

*Metapenaeus affinis*

The occurrence of *M. affinis* in the backwater landings was sporadic and did nst follow a seasonal pattern. However in some months it formed an important component of the prawn landings. The average annual landings are estimated at 7 tonnes forming 1.8% of the prawn catches.

Juveniles of 16-95 mm were observed in the landings, 26-50 mm specimens dominating the fishery in many months. Length frequency distribution was more or less unimodal in many months with little progression of modes.

*Penaeus indicus*

This species with its annual landings of about 37 tonnes formed an important component of the backwater prawn fishery. *P. indicus* was observed in the landings throughout the year. This was generally more abundant during April-July and October-December. The contribution of this species to the prawn fishery varied from 6.7% to 13.9% in different years of the study period. Its average annul contribution to the prawn fishery is calculated to 9.4%.

The size frequency distribution of the species show that a wide range of size groups were represented in the landings. But only juveniles of 40-80 mm length range were the mainstay of the fishery (Fig. 3). No trend in the progression of the modes were noticed.

*Penaeus monodon*

*P. monodon* with its annual average landings of 21.8 tonnes formed an important species of the backwater prawn fishery, if not in the magnitude of the landings, at least by the value of the catches. The landings of the species gradually increased from 1968 to 1973 because of the aimed fishing for this species on account of its demand for the export market. The fishery for this species was active throughout the year with peak in October-December period.

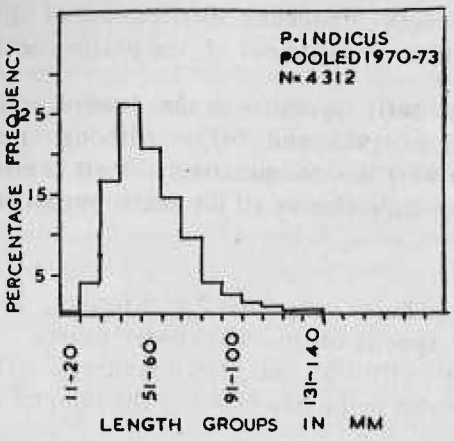


Fig. 3. Length frequency distribution of *P. indicus*.

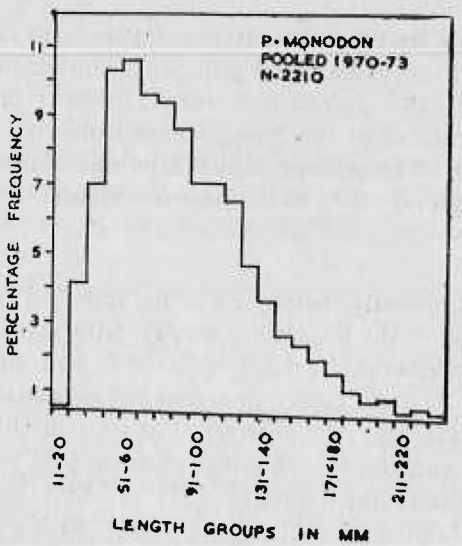


Fig. 4. Length frequency distribution of *P. monodon*.

Length frequency distribution of *P. monodon* for 1970-1973 (Fig. 4) shows that prawns of 20-260 mm were represented in the backwater landings. But specimens measuring more than 150 mm were few in numbers. Length frequency distribution indicates a multimodal distribution in different months of a year with little evidence of modal progression. However the

annual pooled length frequency distribution indicate a single mode. The multimodal modal length frequency distribution of different months may be due to the continuous recuritment of the postlarvae into the backwaters.

Recruitment of early juveniles to the fishery was found more in the post-monsoon period of 1972 and 1973. Although the number of bigger prawns in the fishery were less comparatively, their contribution to the fishery by weight was quite considerable in all the years, particularly in 1972 and 1973.

*Penaeus merguiensis*

Annual landings fluctuating from 2 to 5 tonnes, *P. merguiensis* formed only an insignificant species of the backwater fishery. On an average it was contributing only 0.9% of the annual prawn landings. The fishery was highly irregular, with the species being not found in the samples in many months.

Prawns upto 150 mm were represented in the backwater landings. However the mainstay of the fishery was only juveniles of 60-100 mm.

*Other penaeids*

Penaeids which are not encountered regularly in the landings and form only a negligible part individually are grouped as "other penaeids". They were *Parapenaeopsis sculptilis*, *Solenocera indica*, *Penaeus japonicus* and *Penaeus semisulcatus*. The catches of this group varied from 3 to 16 tonnes per annum in the six year period. The average annual landings of this group are estimated at 7 tonnes forming about 1.8 % of the prawn catches.

*Non-penaeids*

Non-penaeids, mostly belonging to the family Palaemonidae, form an important component of the backwater fishery with average annual landings of 31 tonnes. The species that are encountered in considerable quantities were *Palaemon tenuipes*, *P. styliferus*, *Leptocarpus potamiscus*, *Macrobrachium rude*, *M. malcomsonii* and *M. lamarrei*. Annual landings varied from 15 to 91 tonnes showing considerable fluctuation from year to year. Their contribution to the fishery was maximum in 1973 (12.8%) and minimum in 1969 (5%). They were landed throughout the year with a peak of abundance during October – December period.

## Discussion

The foregoing account shows that the prawn fishery of the Kakinada backwaters is of considerable magnitude. The average annual average catch is nearly 400 tonnes at the landings centre observed. Prawns are landed throughout the year with peak landings in October - December period. This peak is

observed early or late by one or to months in some years. Menon and Raman (1961) observed similar phenomenon.

The Kakinada backwaters are very rich in the variety of prawn fauna. The prawn fishery of the Kakinada backwaters is unique in *M. monoceros* contributing to well over 57% of the fishery. Further an observation of the data (CMFRI reports) shows that the fluctuations in the total backwater prawn landings are entirely dependent on the success of the *M. monoceros* fishery. The fishery for this species shows a prominent peak in October - December and a minor peak in April - May.

The size composition of the commercial catches of *M. monoceros* found in the present investigations are in close agreement with those of Subramanyam (1973) from Godavary estuary and George (1959) from Cochin backwaters. From the length frequency distribution (Fig. 2) it is evident that prawns of more than 80 mm in total length are rare in the catches indicating migration of the species after reaching this size to the inshore waters. Mohamed and Rao (1971) expressed that the species migrated to the inshore waters from Cochin backwaters at about a length of 85 mm. On the contrary, George (1959) was of the opinion that the emigration commences after it reaches a length of about 100 mm in Cochin backwaters; whereas Subramanyam (1973) found that the species migrated to sea at a length range of 46-50 mm. The present observations disagree with the work of the latter two workers. *M. monoceros* of about 100 mm are almost negligible in the fishery and juveniles of *M. monoceros* measuring more than 50 mm form as much as 60% of the fishery in many months of any particular year.

Subramanyam (1973) studying the growth rate of *M. monoceros* under laboratory conditions found that it grows at a rate of 13 mm per month. Further he believes that the growth rate in natural environment would be still higher than that observed in the rearing experiments. If these growth rates are taken into consideration the juveniles measuring 80 mm in total length are only 5 to 6 months old. From these it can be infered that this species spends about 6 months in the backwaters. Subramanyam (1973) was rather confused in stating that " it would appear from the present rearing studies, that the life span of the prawn in the estuary is about a year".

The occurrence of *M. dobsoni* in commercial quantities in the Kakinada backwaters is unique among east coast estuaries and backwaters. Although not of the same magnitude as that of Cochin backwaters, the fishery for this species is comparable to that in the continuous occurrence throughout the year. The present investigations fully agree with the observations of Menon and Raman (1961) on the size composition of the species in the backwaters.

Rajyalakshmi (1961) from the Hooghly estuary and Ramamurthy (1967) from inshore waters of Kutch found that the fishery for *M. brevicornis* is only seasonal. An examination of the Table II indicates that the fishery for this species is active throughout the year with ill-defined seasons from year to year in the Kakinada backwaters. Studying the biology of the species from the Hooghly, Rajalakshmi (1961) found two year groups representing the fishery whereas only one year group is represented in the Kakinada backwaters.

*M. affinis* forms an insignificant component of the backwater prawn fishery as in Cochin backwaters and elsewhere on both the coasts. The range and modal sizes found in the present study are in close conformity with those observed by Mohamed and Rao (1971) from Cochin backwaters.

The mainstay of the backwaters fishery for *P. indicus* are the juveniles 40-100 mm in total length as in the Godavary estuary (Subramanyam, 1965) and Cochin backwaters (Menon and Raman, 1961). The latter are of the opinion that this species migrates to sea at a length of 100 mm, but on the contrary, the former finds that the species may migrate to sea at a length of 31-120 mm. In the Kakinada backwaters *P. indicus* of more than 100 mm in total length are scarce in the commercial landings. The migrating population referred to by Subramanyam (1965) may not be migrating to sea, but representing movements of the population within the estuarine limits as observed by Tabb *et al* (1962) in the case of *Penaeus duorarum* in the Florida Bay. Rao (1967) infers that migration into the sea starts about 93 mm and completes at a length of 115 mm in Chilka Lake. From the above it is apparent that no two workers agree on the size and age at which the species migrates to sea.

*P. monodon* is found to be very scarce along the estuaries and backwaters of the west coast. On the east coast it forms an important component of the fishery in Chilka and Pulicat lakes and in the Godavary estuary. Subramanyam (1966) estimated the production of the species from the Goutami estuary as 500 tonnes in 1960-61. These figures are more or less in conformity with the present investigations. As is the case with other penaeids divergent opinions are expressed regarding the size and age at which the species migrates to sea. However in the Kakinada backwaters *P. monodon* upto 150 mm are represented in the landings throughout the year in good numbers.

From the above it is apparent that the entire backwater fishery is supported by juveniles belonging to the commercially exploited species in the offshore waters of the region. The occurrence of the juveniles in the backwaters throughout the year indicates that spawning activity of many of the commercial species is protracted. From the earlier discussion on length and age composition it would appear that the juveniles of the Kakinada

backwaters are not more than six months old. Further it is evident that size composition of the different species varied considerably.

Year to year fluctuations in the prawn landings are observed to be considerable during the six year period. The fluctuations in the prawn fishery are related to various factors by different workers. Gunter and Hildebrand (1954), Thompson (1955), Menon and Raman (1961) are of the opinion that the rainfall of the corresponding year influences the prawn fishery to a great extent, while Subramanyam (1966) found that the magnitude of *Palaemon tenuipes* fishery of the Godavary estuary is directly related to the annual river discharges into the estuary. Baxter (1962), George (1962) and Subramanyam (1966) are of the opinion that the fishery of penaeid species is influenced to a great extent by the recruitment into the estuary. Slack-Smith (1968) studying the prawn fishery of Shark Bay, Western Australia, states that the prawn fishery is usually on one year old stocks and conseqently violent fluctuations in recruitment are followed by similar fluctuations in the catch.

In the present study it is found that effort and catch have been on the increase from 1968 to 1973 as a result of the entry of new boats into the fishery. In spite of considerable increase in fishing effort in the latter years (1972 and 1973) the catch per unit of effort did not show any decline indicating the capacity of the backwater fishing grounds to withstand the increasing fishing pressure. Even the length composition of different species exploited does not show any reduction in the bigger size groups in the fishery. These are the signs of an expanding fishery and finally it can be stated that there is no problem of overfishing of the prawn stocks of these backwaters. However, as a precautionary measure, it is necessary to study the prawn fishery and the species exploited in relation to the factors mentioned earlier.

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