MARINE FISHERIES INFORMATION SERVICE

TECHNICAL AND
EXTENSION SERIES

No.21
July 1980

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

IMPACT OF MESH SIZE REDUCTION OF TRAWL NETS ON THE PRAWN FISHERY OF KAKINADA IN ANDHRA PRADESH*

Introduction

Kakinada is one of the important fish landing centres of Andhra Pradesh. Fishery resources from the coastal waters off this centre has been traditionally exploited by indigenous crafts and gears. Commercial trawling to tap the ground fishes and crustaceans was initiated in 1964. Since then there has been a steady increase over the years in the number of trawlers operating along this coast resulting in considerable expansion of the fishing industry. With the development of an export market for prawns from Kakinada after 1970 the sole aim of the trawler operation has been to harvest more and more prawns. This has eventually resulted in certain changes in the gear and crafts and the area of operation. One such change was in the mesh size of the cod ends of the trawl nets. The Central Marine Fisheries Research Institute has been undertaking routine monitoring studies on the prawn fisheries of this centre since 1967 and, of late especially from 1977 onwards it was noticed that relatively smaller prawns of the conventional species as well as adults of the tiny shrimp *Acetes* started appearing regularly in the trawl catches in considerable quantities. This has prompted an analysis of the prawn catches of the area in relation to the mesh sizes of the nets operated and the results are reported here.

Prawn fishery by trawl nets

Prawn fishing at Kakinada by trawl nets is carried out by small mechanised boats of sizes upto 12 m belonging to three categories namely Pablos (9 m), Pomfrets (10 m) and Sorrahs (12 m) based at the fishing harbour. The trawling ground lies between 5 m and 80 m depth outside Kakinada bay and extends upto a distance of about 50 km off the shore (Fig. 1). According to Muthu *et al (Indian J. Fish.* 2, 1975) the mesh size of the cod ends of the nets operated during 1967–70 was 25 mm, and the prawn catch consisted mostly of big prawns (11.9%) consisting of species like *Penaeus indicus* and *P. monodon* and medium sized prawns represented by *Metapenaeus affinis, M. monoceros, Parapenaeopsis stylifera* and *P. hardwickii* (60.5%). The rest of the catch was contributed by small prawns such as *M. dobsoni, Hippolysmata ensirostris, Palaemon tenuipes* and several other small sized penaeid prawns in comparatively small quantities. A change in pattern of the species composition was noticed from early 1977 onwards, coinciding with a noticeable change in the mesh sizes of the gears operated for catching prawns.

Change in mesh sizes

The present study involves two surveys on the cod end mesh sizes of commercial trawls, one in November 1977 and the other in August 1978. The frequency of the cod end mesh sizes recorded on these two occasions of successive years is shown in Table 1. During the first survey in 1977 a total number of 28 nets representing all the gears operated from the three types of boats were examined. The mesh size ranged from 10 mm to 20 mm at the cod end as compared to 25 mm in earlier years recorded by Muthu *et al* and 82% of the nets belonged to less than 18 mm mesh. In the second survey made in 1978, 37 nets were sampled and it was observed that still smaller sizes of mesh were also introduced into the fishery by that time, the range of mesh size being 8-20 mm. Out of this, more than 85% had meshes below 17 mm thereby indicating a gradual reduction in the cod end mesh size. The increasing catch trend in these years would show that this decrease in cod end mesh size has been evidently introduced by the fishermen for getting improved catches.

Effect of mesh size reduction on prawn fishery

It is generally believed that reduction of mesh sizes in commercial gears may lead to harvesting of juvenile populations and consequent decrease in sizes of species caught coupled with probable depletion of the stocks of exploited species. In order to verify this, an analysis of the data collected during 1967–1979 on catch, effort, catch rate (catch per hour) and species composition has been made and the results are shown

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Table 1. *Frequency of cod end mesh size of trawl nets observed in November 1977 and August 1978 at Kakinada*

Cod end mesh size in mm	NOVEMBER 1977 No. of nets	Percentage	AUGUST 1978 No. of nets	Percentage
8	—	—	1	2.70
9	—	—	2	5.41
10	2	7.14	3	8.11
11	2	7.14	3	8.11
12	5	17.87	6	16.22
13	2	7.14	4	10.81
14	2	7.14	3	8.11
15	3	10.71	5	13.50
16	3	10.71	4	10.81
17	4	14.30	2	5.41
18	2	7.14	2	5.41
19	—	—	1	2.70
20	3	10.71	1	2.70
Total No. of nets examined	28	100.00	37	100.00

in Tables 2, 3 and 4. Besides catch and effort details an attempt is also made to analyse the length distribution of important species which determine the success of the trawl fishery of this coast.

Variations in prawn production

As could be seen from Table 2, the prawn catches showed more or less a steady increasing trend till 1977 and thereafter reduced, although remaining at high range when compared to years earlier to 1975. The catch per hour of trawling, however, exhibited many ups and downs over the years. The thirteen year period can be divided into 4 stages in the development of the prawn fishery along this coast. In the first stage, during the years 1967–69, there was not much emphasis on catching prawns as the price for prawns was very low when compared to the subsequent years. The boats covered only the nearby fishing grounds and the cod end mesh size was 25 mm as pointed out earlier. The catch per hour (C.P.H) was also more or less stable. The decline in effort and prawn catch during 1969 was mainly due to the migration of some trawlers to Visakhapatnam harbour.

In the second stage, during the years 1970–72, export trade gradually developed and the price of the

Table 2. *Prawn landings by trawlers at Kakinada during* 1967–1979, *with details on catch/hour and percentage composition of penaeids, non-penaeids and Acetes spp. (Landings in tonnes and C. P. H. in Kg)*

Years	Penaeids			Non-penaeids excluding *Acetes*			*Acetes* spp.			Total prawns		Effort of trawling (in hours)
	Catch	C.P.H.	%	Catch	C.P.H.	%	Catch	C.P.H.	%	Catch	C.P.H.	
1967	119	5.9	90.2	13	0.64	9.8	—	—	—	132	6.6	20183
1968	317	7.5	93.2	23	0.54	6.4	—	—	—	340	8.0	42454
1969	245	7.2	91.4	23	0.67	8.6	—	—	—	268	7.9	34155
1970	369	9.8	91.6	34	0.91	8.4	—	—	—	403	10.7	37701
1971	560	10.0	92.9	43	0.77	7.1	—	—	—	603	10.8	55854
1972	839	12.4	96.9	27	0.40	3.1	—	—	—	866	12.8	67628
1973	791	5.9	96.2	31	0.23	3.8	—	—	—	822	6.1	134119
1974	1380	7.8	96.4	51	0.29	3.6	—	—	—	1432	8.1	176929
1975	1455	7.8	89.5	170	0.91	10.5	—	—	—	1625	8.7	187065
1976	2308	9.7	95.1	120	0.51	4.9	—	—	—	2428	10.2	237333
1977	2771	6.7	44.8	1882	4.54	30.4	1538	3.71	24.8	6191	14.9	414697
1978	1326	3.7	64.5	409	1.13	19.9	321	0.89	15.6	2056	5.7	361470
1979	1651	4.7	68.9	406	1.16	16.9	339	0.97	14.1	2396	6.8	349738

Table 3. *Annual landings in tonnes of different species of prawns by trawlers at Kakinada during* 1967—1979

Species	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
M. monoceros	20	83	46	61	73	118	138	486	222	168	432	194	213
M. affinis	37	69	50	42	56	78	62	83	245	100	82	100	121
M. dobsoni	4	42	66	139	195	319	323	325	317	1257	1482	382	247
M. brevicornis	12	35	17	28	86	107	98	128	105	169	185	164	100
P. monodon	17	22	20	39	25	60	41	92	151	101	64	119	89
P. indicus	15	13	15	25	27	91	42	88	94	108	238	59	109
P. merguiensis	4	1	2	1	2	5	4	9	12	18	27	20	53
P. stylifera	2	15	9	9	35	21	19	52	69	78	30	47	143
P. hardwickii	2	5	5	9	17	—	7	23	30	52	12	28	80
S. crassicornis	3	21	7	8	26	12	29	36	38	65	92	59	85
Other penaeids	4	12	12	8	18	27	25	59	171	192	126	154	411
Non-penaeids excluding *Acetes*	13	23	23	34	43	27	31	51	170	120	1881	409	406
Acetes spp	—	—	—	—	—	—	—	—	—	—	1538	321	339

Table 4. *Annual percentage composition of different species in the trawler prawn landings at Kakinada during 1967—1979*

Species	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
M. monoceros	15.4	24.0	17.1	15.0	12.1	13.6	16.8	33.9	13.7	6.9	7.0	9.4	8.9
M. affinis	27.9	20.0	18.5	10.4	9.3	9.0	7.6	5.8	15.1	4.1	1.3	4.9	5.0
M. dobsoni	2.9	12.1	24.7	34.6	32.4	36.9	39.3	22.7	19.5	51.8	23.9	18.6	10.3
M. brevicornis	8.9	10.2	6.4	6.9	14.2	12.3	12.0	9.0	6.5	7.0	3.0	8.0	4.2
P. monodon	12.5	6.4	7.3	9.6	4.0	7.0	5.0	6.4	9.3	4.2	1.0	5.8	3.7
P. indicus	11.7	3.9	5.4	6.3	4.5	10.5	5.1	6.2	5.8	4.4	3.8	2.9	4.5
P. merguiensis	2.9	0.1	0.8	0.1	0.3	0.6	0.5	0.6	0.8	0.7	0.4	1.0	2.2
P. stylifera	1.5	4.3	3.2	2.4	5.8	2.5	2.4	3.6	4.3	3.2	0.5	2.3	6.0
P. hardwickii	1.5	1.5	1.9	2.3	2.8	—	0.9	1.6	1.9	2.1	0.2	1.4	3.3
S. crassicornis	2.5	6.1	2.6	2.0	4.4	1.4	3.5	2.5	2.3	2.7	1.5	2.9	3.6
Other penaeids	2.9	5.4	3.6	2.0	3.0	3.2	3.1	4.1	10.5	7.9	2.0	7.5	17.2
Non-penaeids excluding *Acetes*	9.4	6.0	8.5	8.4	7.1	3.1	3.8	3.6	10.4	4.9	30.4	20.0	17.0
Acetes spp.	—	—	—	—	—	—	—	—	—	—	24.8	15.6	14.1

prawns went up sharply. Simultaneously changes in the craft and gear also occurred to catch more and more prawns. As a result of these changes in the fishing implements and consequent increase in the efficiency of nets to harvest prawns, the prawn landings as well as C.P.H. increased during this period. The cod end mesh sizes of most of the nets were reduced to 20 mm by this time.

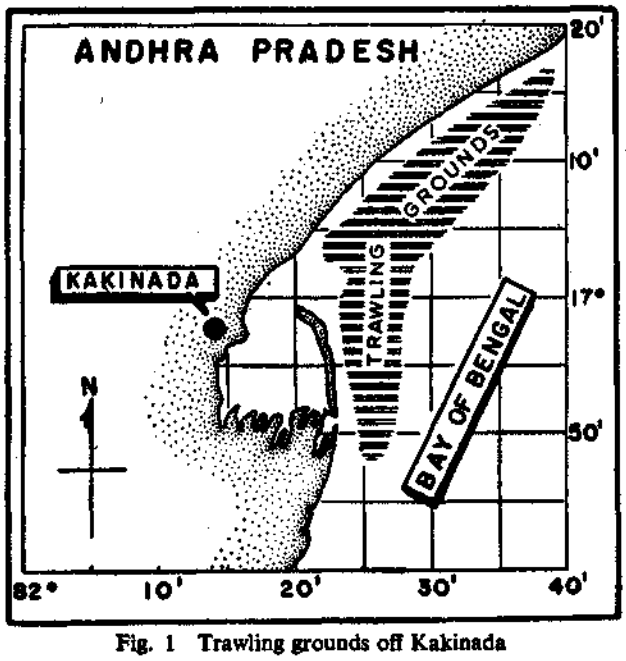

Fig. 1 Trawling grounds off Kakinada

In the third stage, during 1973–76, the effort has increased enormously with entry of new boats into the fishery. In 1973 a decrease in the prawn landings was observed inspite of the two-fold increase in the effort. Probably this was the first sign of depletion of the prawn stocks hitherto exploited by the trawlers. To overcome this situation many of the trawlers were forced to venture distant grounds. By 1976, the trawlers started combing along this coast covering about 100 km of the coast line upto 80 m depth. This dispersed effort over a wider area was responsible for the steady increase of prawn landings and C.P.H. during this period. Modification in the gear, however, was negligible as the main aim was to catch bigger sized prawns which fetch premium price.

In the fourth stage, during 1977–79, the effort has reached a saturation point. As the boats are small and cannot operate beyond a reasonable distance from the shore the only alternative for the fishermen to get better prawn catch was to reduce the mesh size of the cod end to less than 20 mm (Table 1). By this time the exporters started purchasing smaller species like *M. dobsoni* also for export purpose. As a result of this mesh size reduction and enormous increase in fishing effort the prawn landings touched a record level of 6,191 tonnes in 1977. This was mainly due to the heavy catches of non-penaeid prawns and the entry of *Acetes* into the fishery in large quantities. The increase in penaeid catch was only marginal (463 t). The C.P.H. for penaeids was low in 1977 when compared to the previous three years. In the following years, 1978 and 1979, the total production as well as catch rate of prawns were relatively low although the trawling effort expended was about 50% more than in 1976 and the nets with reduced cod end mesh sizes continued operations. This may indicate that the fishery has already crossed the level of optimum production and the decline after 1977 was probably the result of diminishing returns due to overfishing.

Change in species composition

Data on species composition for the different years (Tables 3 and 4) would indicate that penaeid prawns formed the bulk of the fishery contributing

more than 90% till 1976 and most of the major species have shown more or less a steady increasing trend of production. But in the subsequent years the non-penaeid prawns which are generally smaller in size than the penaeids, contributed to the catches in greater proportions in as much as relegating penaeid prawns into a secondary position in 1977. The important species are *Acetes* spp. *Palaemon tenuipes* and *Hippolysmata ensirostris*. The most significant change occurring during this period was the entry of the sergestid prawns *Acetes* spp. into the fishery to the extent of forming 14–30%. These tiny shrimps, although available in abundance in the sea as well as backwater areas of this centre and caught regularly in the indigenous gears, have never been encountered before in the trawl catches supporting a fishery. Their entry into the trawl fishery in large quantities along with other non-penaeid prawns of smaller sizes in 1977 coincides with the reduction in mesh sizes of the nets, indicating thereby that this change is brought about by the reduction in mesh size.

Change in sizes of prawns

Examination of the annual length frequency data indicates that in the penaeid prawns like *M. dobsoni* the major size group contributing to the fishery decreased from 81–100 mm in 1972 to 71–80 mm by 1978–79 period (Fig. 2). The mean size of the females of this species showed a decreasing trend from 1972 to 1978, while in males the decrease began from 1975 and continued till 1978 (Table 5). The percentage of prawns measuring less than 60 mm total length shown in the same table was also relatively high during 1977–78 than in the previous years.

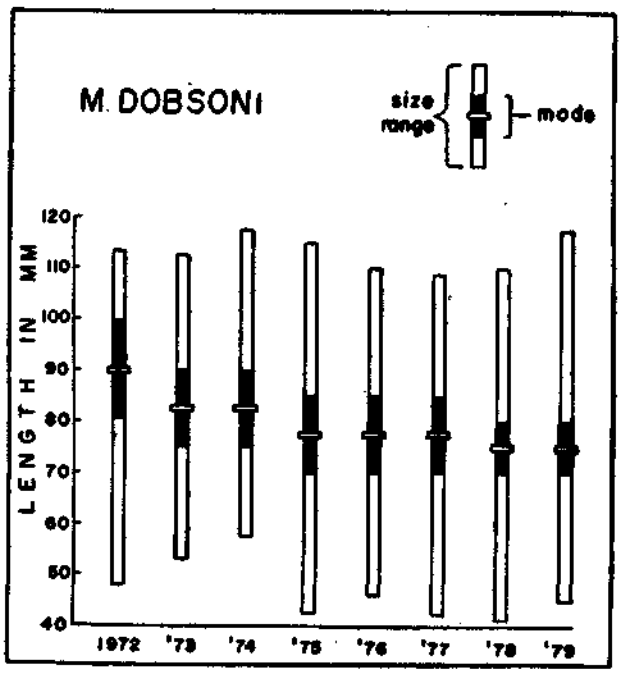

Fig. 2 Annual size distribution of *Metapenaeus dobsoni* in the trawl catches at Kakinada during 1972–79

Table 5. *Annual mean sizes and percentage composition of prawns below 60 mm total length of M. dobsoni during* 1972–78

Year	Females		Males	
	Mean size in mm	% of prawns below 60 mm total length	Mean size in mm	% of prawns below 60 mm total length
1972	88.49	2.82	79.14	3.19
1973	87.25	1.69	75.50	3.18
1974	84.94	—	80.08	1.47
1975	82.88	4.25	77.89	4.76
1976	82.36	1.74	73.71	3.71
1977	82.24	4.47	73.76	8.38
1978	78.41	10.93	69.28	17.98

In the case of another important penaeid species *M. monoceros* the major sizes in the trawl fishery were within 111–150 mm total length during 1972–76 with minor variations between years (Fig. 3). But, from 1977 onwards the size began to decline and reached 81–90 mm by 1978. A gradual decrease in the annual mean sizes was also noticed in recent years (Table 6).

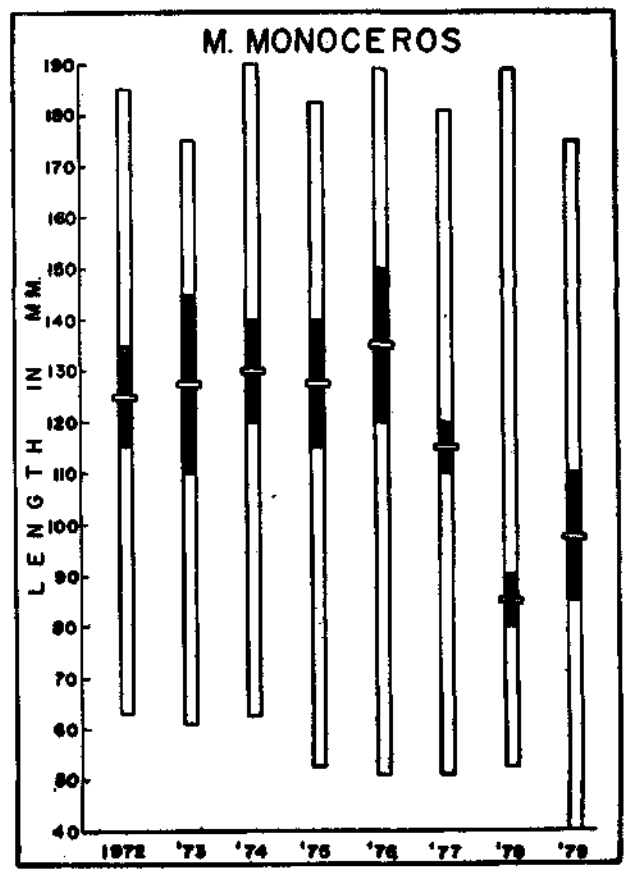

Fig. 3 Annual size distribution of *Metapenaeus monoceros* in the trawl catches at Kakinada during 1972–79

Table 6. *Annual mean sizes and percentage composition of prawns below 100 mm total length of M. monoceros during 1972–78*

Year	Females		Males	
	Mean size in mm	% of prawns below 100 mm total length	Mean size in mm	% of prawns below 100 mm total length
1972	118.77	25.63	105.29	38.71
1973	114.02	38.05	100.00	43.20
1974	122.23	25.18	111.69	25.64
1975	123.56	16.94	111.72	19.15
1976	122.30	25.88	107.44	37.24
1977	114.60	30.69	102.53	40.33
1978	114.96	40.85	102.07	50.55

All these are clear-cut evidences to suggest that a population consisting of smaller sizes of prawns are being exploited in recent years. Here it is necessary to know whether this situation has arisen due to mesh size reduction or not. In order to verify this, the length frequency distribution of *M. dobsoni* caught in cod ends of 20, 15 and 10 mm mesh sizes has been analysed and the results depicted in Fig. 4. It is seen that catchability of smaller prawns is more in trawl nets with 10 mm and 15 mm cod end meshes. This clearly proves that reduction of mesh size is responsible for catching more numbers of smaller prawns.

In addition the entry of smaller sized shrimps and non-penaeid prawns like *Acetes* spp. *P., tenuipes* and *H. ensirostris* at the time of mesh size reduction of the nets also points towards the fact that size reduction of prawns is brought about by mesh size decrease.

Conclusion

From the analysis it is clear that the prawn fishery from 1977 onwards shows a difference from that of the earlier years in respect of prawn production and catch rate, species composition and sizes of the constituent species. During these years no changes were observed in the depths or area of fishing operations, length of fishing trips or any other characteristic of the fishery in general, except for the conspicuous reduction in cod end mesh sizes of the nets used and noticeable increase in input of effort. Therefore it would appear that these two factors are responsible for the present state of the fishery in this area.

The decrease in total catch of prawns as well as catch rate is probably brought about by the increase in fishing effort. Although the decrease in size of important species of penaeid prawns might have been partly due to the increase in effort, the situation in this area involving reduction of cod end mesh sizes

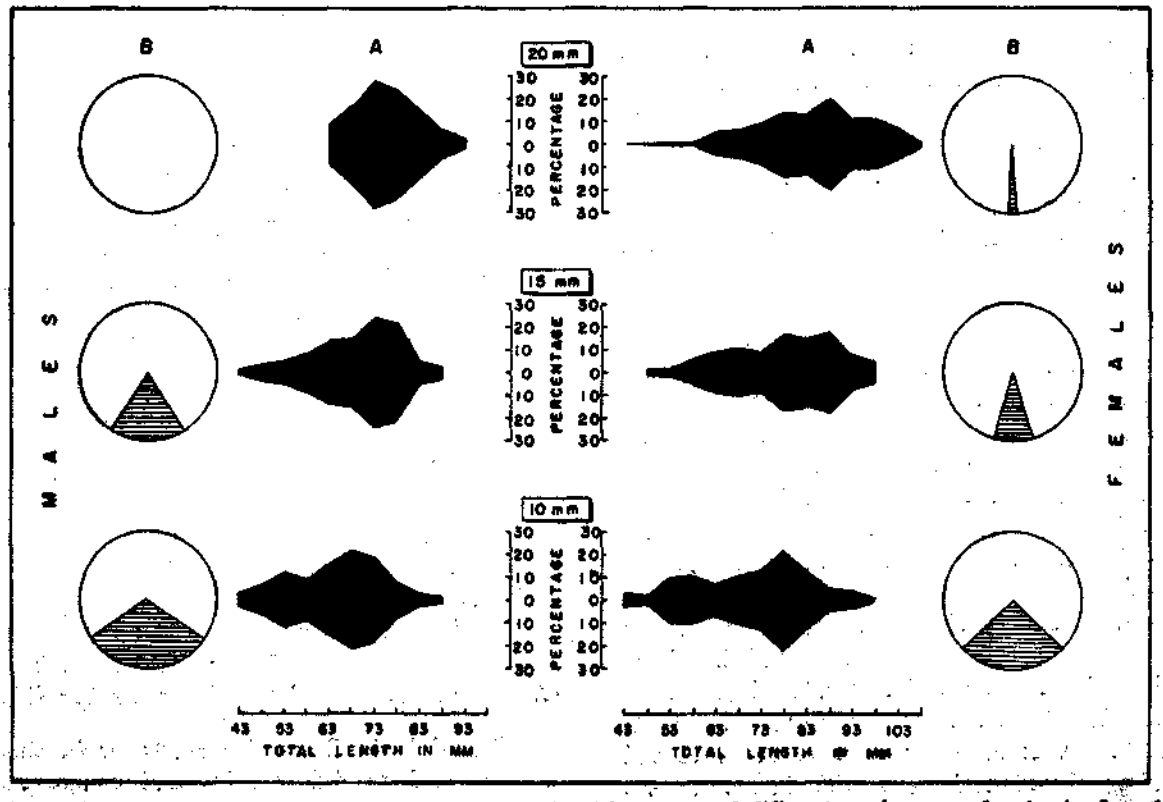

Fig. 4 Length frequency distribution of *Metapenaeus dobsoni* from nets of different mesh size cod ends. A – Length distribution, B – Percentage of prawns measuring less than 60 mm size.

of the trawl nets points to the fact that the latter may be the main reason for change in sizes. The occurrence of smaller sized prawns like *Acetes* spp. which are never found in trawl nets with bigger size cod end mesh would definitely establish this fact. However, the drastic reduction in the catch rate of prawns in recent years along with the phenomenal increase in effort and simultaneous deterioration of sizes of exportable varieties of prawns in this area would need careful watching of the situation from the point of view of conservation of the resources.

The important point which emerges from the present analysis is the entry of *Acetes* and other small non-penaeid prawns into the trawl fishery as a result of mesh size reduction. It is also clear that large quantities of these shrimps are caught by the trawl nets with smaller mesh sizes. From a management approach if a reversion of the cod end mesh sizes of the nets to the larger sizes prevalent prior to 1977 and a prohibition of the operation of smaller mesh nets is recommended in order to increase production of large sized prawns, probably the smaller sized species like *Acetes* which are now represented in huge quantities may be lost to the fishery. Taking into consideration the value of the tiny shrimps from the point of view of utilisation a decision may have to be taken about regulation in the mesh sizes in the trawl fishery.

Editor: In view of the fact that the new resources of the tiny shrimp *Acetes* spp. has come into the fishery as a result of the reduction in cod end mesh sizes of the trawl nets, with the restoration of the mesh to the pre-1977 sizes in order to prevent catching smaller sized prawns, an alternate method of exploitation of the resources of the smaller shrimps may have to be developed. As these shrimps mostly occupy the column, experimental fishing with midwater trawls of small mesh sizes will be useful in exploiting the resource.