

PRESENT STATUS OF EXPLOITATION OF FISH AND SHELLFISH RESOURCES : FLATFISHES AND FLATHEADS

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ABSTRACT

The present paper deals with the fishery of flatfishes and flatheads along the west coast of India. Among flatfishes, the malabar sole *Cynoglossus macrostomus* contributes significantly to the catch; *Psettodes erumei* also forms a fishery along Maharashtra and Gujarat Coasts. Among flatheads *Platycephalus maculipinna* contributes to the fishery. These two resources are mainly exploited by trawl. It is found that both the species are continuous spawners, with peak spawning taking place during September - November period. In both the groups the one year old fish contributes to the fishery. The major peaks of fishing are either immediately after the onset of monsoon or postmonsoon months.

INTRODUCTION

Among the demersal fishes of India, flatfishes and flatheads occupy a significant place. The annual average catch of flatfishes in the country is estimated at 36,000 t which forms 4.5% of the total fish catch (CMFRI, 1989). Tholasilingam *et al.* (1973) stated that from shallow and intermediate depths along the southwest coast, flatfishes and flatheads formed important constituents. West coast contributes 80-90% of the total marine flatfishes landed in the country. Rao (1967) states that the region between Mulki in South Kanara and Quilon in Kerala is important for sole fishery. Seshappa (1973) comments that the sole fishery along the west coast has always been an inshore fishery. The fishing cruises of many vessels have not yielded catches of any mentionable magnitude from deeper waters. The flatfish fishery of the west coast is dealt with in the present paper; in the case of flatheads, the data from Cochin and Calicut only are considered, for want of data from other centres.

Though about 91 species of flatfishes are known from the Indian waters, only a few species contribute considerably to the fishery. Sehappa (1973) states that only *Cynoglossus macrostomus*, contributes to a regular fishery in Kerala and Karnataka Coasts, though a few others such as *C. dubius*, *Pseudorhombus* spp. and *Psettodes erumei* occur occasionally in the fishery.

Though a few species occur in stray numbers in the catches, *Platycephalus maculipinna* is the only

species that contributes to the flathead fishery of trawlers.

DATA BASE

Data collected during February 1984-August 1988, from small private trawlers are presented in this paper. Sampling was carried out every week. To estimate the monthly catch, the average weight of catch per unit, on observation days was multiplied by the number of units in operation on that day and the total for all observation days was raised to the total number of actual fishing days in that particular month. Data from artisanal gear were also made use of on certain occasions, whenever it was required to substantiate certain findings. For the present study, a year is divided into Monsoon (June-August), Postmonsoon (September-January) and Premonsoon (February- May) seasons.

OBSERVATIONS

General fishery characteristics

Craft and gear : Small mechanised trawlers of size less than 14 m are the main craft employed in the fishery in the 20-50 m depth along the west coast, although non-mechanised country crafts are also employed in certain parts. It is estimated that there are about 7684 commercial trawlers operating along the entire west coast. The trawl nets operated from these mechanised boats have a cod end mesh size of about 18-25 mm. Indigenous gears employed especially along the Kerala Coast are the different types of seine nets like boat seines and shore seines

and a few drag nets are also used seasonally. Along the Malabar Coast 57.4% of the total flatfish were landed by trawl nets and the rest by indigenous gears. Among indigenous gears, the bulk of the catch was by *Paithu vala* (boat seines) and the rest by *Nethal vala*, *Pattan kolli vala* and *Chooda vala*.

FLATFISH FISHERY

Of the total production of 42,651 t of flatfishes in the country during the year 1984 (CMFRI, 1989), 89% was contributed by the west coast. Rao (1967) states that on the west coast, the soles are next in importance only to oilsardine, mackerel and shrimp fisheries in the magnitude of catch. The production trend in recent years shows that the catches are higher along the southwest coast and lower towards the northwest coast (Table 1). Rao (1967) states that the region between Mulki in South Kanara and Quilon in Kerala is important for sole fishery. The present study shows that maximum production comes from the Kerala Coast, which accounts for 40% of the total sole catches from the west coast. Karnataka contributes on the average 25%, Goa 10.7%, Maharashtra 17% and Gujarat 8.9%.

Kerala : Kerala contributed forty percent of the total flatfish catches of the west coast of India. During 1983-84 period, an average quantity of 15,400 t of these fish were landed in Kerala (Jacob *et al.*, 1987) forming about 4% of the State's total fish landings. But in the subsequent years, there was a decline in the landings; in 1985, the catch was 11,203 t forming 3.5% of the total catch. During

1986 and 1987 also the fishery was still on a declining note, with catches of 9,226 t and 10,115 t. But during 1988, there was an overall improvement in the landings of all finfish resources including flatfish along the Kerala Coast.

The Malabar Coast in Kerala is well known for the flatfish fishery. It contributed on an average 7.08% of the total finfish catch at Calicut. The most predominant species contributing to the sole fishery is the malabar sole *Cynoglossus macrostomus*, locally known as *manthal*. Studies on this species from this area were initiated in 1952 by Bhimachar and Venkataraman and continued by Seshappa and Bhimachar (1955), George (1958), Rao (1967) and Seshappa (1964, 1973). The Sole landings at Calicut during 1984 were 641.4 t, which declined to 260.4 t and 115.1 t in 1985 and 1986 respectively. In 1987, the catches showed an improvement to 243.6 t. But again in 1988, the catch declined (Table 6). On the Malabar Coast there is no gear that catches the flatfish exclusively or throughout the year (Table 7). Trawl nets gave the maximum landings during postmonsoon. Two special features of this fishery along this region are that there are wide fluctuations in the annual yield and that the commercial landings occur mostly within two or three months, immediately after monsoon. At Puthiappa near Calicut, soles were landed by trawl nets. Peak landings occurred during postmonsoon. During 1984-88 soles formed 15.9% of the total finfish catch (Table 6).

At Cochin, the flatfishes form about 4% of the total fish production. They are landed throughout

TABLE 1. Statewise catch (tonnes) and percentage (in brackets) of flatfishes along the west coast during 1984-88

	Kerala			Karnataka			Goa		Maharashtra			Gujarat			
	Premon- soon	Monsoon	Post- monsoon	Premon- soon	Monsoon	Post- monsoon	Premon- soon	Monsoon	Post- monsoon	Premon- soon	Monsoon	Post- monsoon	Premon- soon	Monsoon	Post- monsoon
1984	-	-	-	-	-	-	-	-	-	1074	129	3697	5527	-	1656
	-	-	-	-	-	-	-	-	-	(1.3)	(0.89)	(1.69)	(6.0)	-	(1.14)
1985	3674	3442	4087	1177	27	2575	1662	7	913	1788	201	2740	2308	-	936
	(3.77)	(3.87)	(2.71)	(4.37)	(1.87)	(2.5)	(4.73)	(0.22)	(3.55)	91.74	(1.5)	(1.29)	(2.17)	-	(0.68)
1986	1774	1527	5925	2205	2147	2671	1736	103	606	2349	169	2588	793	-	1100
	(2.17)	(1.43)	(3.25)	(3.98)	(3.17)	(2.19)	(8.5)	(3.090)	91.9)	(1.83)	(0.95)	(1.52)	(0.7)	-	(0.94)
1987	4330	2409	3376	1058	157	3881	587	10	1782	2091	272	3477	181	5	1160
	(4.96)	(2.47)	(2.85)	(1.53)	(4.15)	(2.42)	(3.1)	(2.9)	(3.81)	(1.97)	(1.590)	(2.206)	91.8)	-	(1.08)
1988	4188	1598	6869	1923	35	2121	849	15	4989	1693	109	-	691	-	-
	(4.49)	(1.36)	(2.43)	(2.46)	(0.68)	(1.76)	(3.92)	(4.02)	(5.75)	(132)	(0.77)	-	(1.15)	-	-

the year by trawlers. During the period 1984-88, the landing of flatfishes was fairly good (Table 3). In 1984, the peak landings were in the month of February and a second one was noticed in June. Unlike the flatfish fishery on the Malabar Coast, landings were very much less during postmonsoon, but on the contrary, the fishery was fairly good during premonsoon and monsoon months. The peak landing was during the month of February and a second peak was noticed in June. In 1985 also, though the fishery of flatfishes showed a decline; a similar trend was observed with a major peak in March and another in June. In 1986, the flatfish fishery, especially the malabar sole fishery showed a two fold increase over the previous year. Fairly high catches of *C. macrostomus* were obtained during the period March-August; about 90% of the total flatfishes, were landed during this period. The peak landing was in the month of July. Again in 1987, the fishery showed an increasing trend; 89% of the total catch of flatfishes was landed during premonsoon and monsoon months. The catch was very poor during postmonsoon (Table 3). But by December the fishery was seen to have picked up again. In 1988 also, the flatfish fishery was fairly good. The major peak was during May and a minor peak was found during November.

Tholasilingam *et al.* (1968) stated that 3% of the ground fish catch off Cochin was comprised of soles; with a peak catch during December and another in April-May. According to Seshappa (1973), the commercial catches of Malabar sole at Calicut were obtained within two-three months immediately after the southwest monsoon, in large shoals at the surface and midwaters of the inshore sea. But this state of affairs was not observed in the Cochin area. The reason might be attributed to the changes in the method of fishing in the more recent times. Trawling became the more viable method for exploiting the ground fish resources. Before the introduction of trawlers, the shoaling behaviour of the fish was made use of for exploitation. The Malabar sole being a bottom dweller, feeds actively on amphipods, small polychaetes and lamelli-branches. During upwelling, the bottom mud is churned up and fish move to surface areas which are abundant in food, hence this shoaling behaviour could be attributed to be a feeding migration.

The flatfish fishery in relation to the intensity of rainfall was studied at Cochin. During 1985, 1986 and 1987, the catch rate had a direct correlation

with the intensity of rainfall; the catch rate was fairly high during monsoon months. The intensity of rainfall was quite high during this period in 1986 and 1987, but in 1988, on the contrary during premonsoon months when rainfall was minimum, the catch rate was highest (Table 5).

Another interesting observation in the flatfish fishery exploited by trawlers at Cochin, over the years 1984 to 1988 was that the peak catch occurred mostly during the month of June, although in some years, there seems to be a slight shift in this period of peak landing. During 1984 and 1985, the peak was in June, but in 1986, the maximum catch was in July, whereas in 1987 the peak landing was again in June. In 1988, the month of peak landing was slightly earlier in May. However the flatfish fishery seemed to attain a peak only after the monsoon had set in along this coast.

Karnataka : The average estimated annual landing of flatfishes in Karnataka was 2.7% of the total fish catch in the State. Trawl nets were the main gear employed in the sole fishery here; except during the monsoon months when trawling was very less. During the premonsoon of 1985, 1177 t of soles were landed in the State whereas during monsoon period, the catch was a very negligible quantity of 27 t. In the postmonsoon months of 1985, trawlers brought 2575 t of soles. During the premonsoon months of 1986, 2205 t of soles were landed, which was 3.99% of the total fish catch of the State. Unlike the previous year, during the monsoon months of 1986, fairly good catch of 2147 t was landed by non-mechanised gears which formed 31.8% of the total fish catch during the season. In the postmonsoon months the catch was 2671 t by trawlers forming only 2.2% of the total fish catch. During the months February-May 1987, the sole fishery was comparatively poor in Karnataka forming only 1.5% of the total fish catch. During the monsoon months also the fishery was rather poor, but in the postmonsoon months 3881 t of soles were landed from trawlers. The sole fishery in Karnataka showed a decline throughout 1988. In the premonsoon months only 1923 t of flatfishes were landed, followed by 2121 t during postmonsoon period. During monsoon period the catches were negligible.

Goa : In Goa the sole fishery was mainly a trawl exploited one. Fishing activities using trawlers were less during the monsoon months. Goa contributed roughly 3100 t of flatfishes annually.

During the premonsoon months of 1985, 1662 t of flatfishes were landed with CPUE of 0.024 kg. The sole fishery was practically nil during monsoon period; in the postmonsoon again only 913 t of flatfishes were landed. In the succeeding year also the premonsoon months yielded better catch than other periods of the year. During 1987, the fishery was comparatively good only during the postmonsoon. The flatfish fishery was poor during monsoon months along the Goa Coast in the 1984-88 period. It was fairly good during premonsoon period of 1985 and 1986. But in 1984 and 1985 the season of higher catch and catch rate was postmonsoon.

premonsoon and postmonsoon, *Psettodes erumei* contributed 10-15% of the total flatfish catch.

Gujarat : Along the Gujarat Coast, flatfish fishery during the monsoon months was practically nil. During the period 1984-88 the flatfish production during premonsoon months was more than that of the postmonsoon. During monsoon months trawling operations were less than 5% of those of premonsoon period. During 1984, 5527 t of flatfishes were landed in the premonsoon and 1956 t in the postmonsoon. There was no catch in the monsoon. In the following year, 2308 t and 926 t of flatfishes were landed during premonsoon and

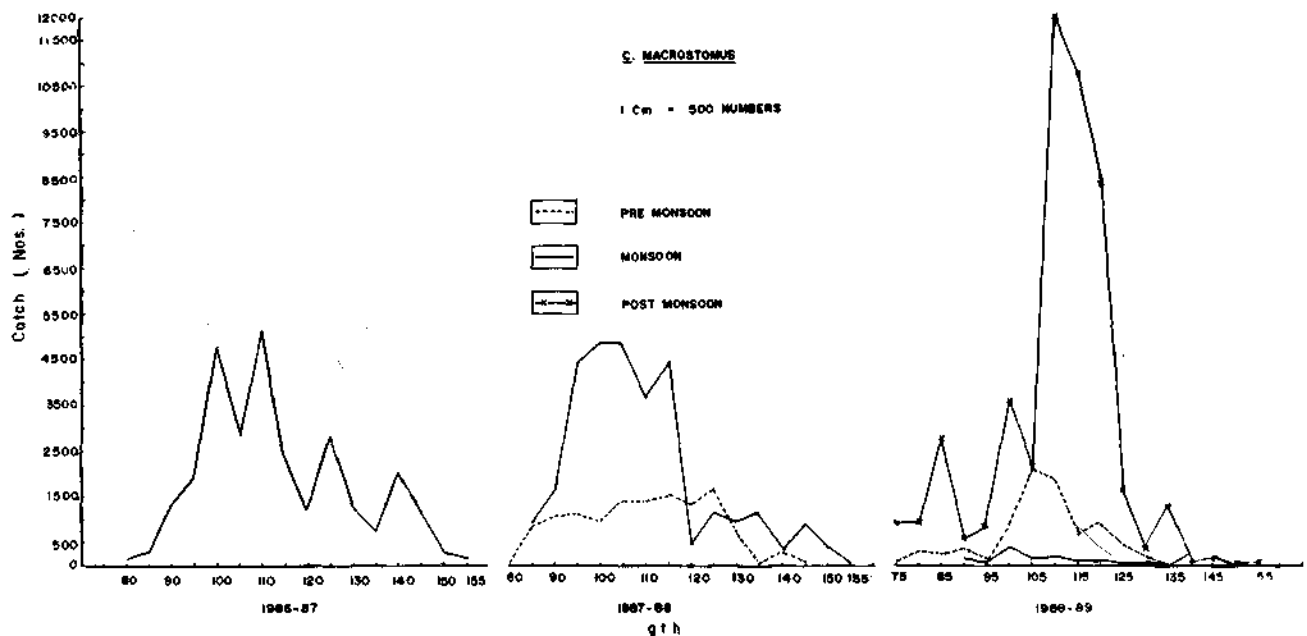


Fig. 1. Size distribution of *C. macrostomus* during premonsoon, monsoon and postmonsoon in the five year period 1984-88.

Maharashtra : Along the Maharashtra Coast also, fishing operations during monsoon period were much less, almost one-fourth that of the other months. Flatfish catch during monsoon for 1984-88 was very poor compared to the postmonsoon and premonsoon catches. During the postmonsoon months 3243 t of flatfishes were landed. In the premonsoon period of 1985 the flatfish landings were 1728 t; in the monsoon months it was only 198 t, but during postmonsoon the flatfish catch was about 2414 t. On an average the flatfish catch was only 1.3% of the total fish catch in the State. During 1986, the catch during premonsoon was slightly more than that of postmonsoon season. While it was the reverse in the succeeding years of 1987 and 1988. On the Maharashtra Coast, during

postmonsoon respectively. In 1986, 793 t were landed during premonsoon and 1100 t in the postmonsoon. In 1987 also there was not much increase in the catch, being 1381 t and 1160 t during premonsoon and postmonsoon respectively. On an average the flatfishes contributed to 0.9 to 1.5% of total fish catch in the State. *Psettodes erumei* contributed to 10-15% of the total flatfish catch in the Gujarat Coast.

Species composition

Although Norman (1927, 1928) described 91 species of flatfishes from Indian waters, only a few species contribute to the fishery. The bulk of the catch (about 90%) was constituted by *Cynoglossus macrostomus*, particularly in Kerala and Karnataka

Coasts. A few other species such as *C. dubius*, *C. macrolepidotus*, *C. lingua*, *Pseudorhombus* spp. and *Psettodes erumei* also occurred occasionally in the fishery.

Length composition

Along Cochin area, during premonsoon months *C. macrostomus* fishery was constituted by fishes in the size range 75-152 mm (Fig. 1). Fishes of smaller size were more in the fishery during February and March, but they were not predominant during monsoon period. During 1984-88, the mode in this season varied from 115 mm to 120 mm. Again in December-January, smaller fishes occurred in plenty in the fishery, their size ranged from 41 to 129 mm. In December, 75% of them were juveniles, with a mode of 65 mm. During November-December these were caught in fairly good quantity, the catch rate being upto 5 kg in the boat seines operating very near the shore upto a depth of 10 m.

The size frequency data of *C. macrostomus* at Cochin show that females have a higher upper size limit than males. Also females tend to grow at a faster rate than males. This is in conformity with the observation on *C. macrostomus* at Calicut (Seshappa and Bhimachar, 1955). At Puthiappa on the Calicut Coast *C. macrostomus* ranged in size from 55 to 154 mm.

Maturity and spawning

According to Seshappa (1955) spawning of Malabar sole starts by about October at Calicut and extends upto the premonsoon months. However, at Cochin gravid and spent adults were encountered in appreciable quantities in September. Some spawning activity was also observed in April-May. Young ones were (65 mm modal group) generally observed during November-January, very close to shore and exploited by cast net.

FISHERY OF FLATHEADS

The flatheads are also a nearshore demersal resource occurring along the west coast. Tholasingam *et al.* (1968) reported that these contributed to about 10% by weight of the miscellaneous fish component of the trawl catches at Cochin. The flathead fishery on the west coast has not been studied much except the work of Kuthalingam (1972) from off Mangalore. During 1984 a total of

208.5 t of flatheads landed at Cochin. The maximum landings (147 t) were in the premonsoon months. The lean period for the flathead fishery was the postmonsoon months with the catch as low as 9.9 t. The flathead fishery was on a decline in the succeeding years of 1985, 1986 and 1987. During 1985, the premonsoon catch was 15.0 t and in the monsoon it was 9.7 t and a total of 5.1 t of flatheads were landed in the postmonsoon months. In 1986 also, the flathead fishery showed a declining trend, with the total catch at 71 t. The bulk of the catch came during premonsoon and monsoon months. The maximum landing of 26.9 t was in August this year (Table 2). During 1987, a total of 81.5 t of flatheads only were landed at Cochin. Of this 27.8 t were landed during the monsoon period and 38.4 t in the premonsoon months. In the postmonsoon season, the flathead fishery was found to be rather poor as was seen in the previous years. But in 1988, the situation changed and a total of 322.1 t of flatheads were landed at Cochin. The catch during premonsoon months was 239 t and during monsoon season 63.4 t were caught. As observed in the previous years, the fishery declined as the monsoon advanced. The maximum catch (106.4 t) was observed in May.

TABLE 2. Monthly catch (Kg) of flatheads at Cochin during 1985-88

Month	1985	1986	1987	1988
January	-	-	1892	1174
February	-	8000	16596	24177
March	-	7000	18928	36543
April	-	-	-	71867
May	-	30067	3376	106428
June	-	6939	25635	51078
July	546	6683	406	3308
August	9210	26983	1812	9027
September	-	352	227	5575
October	-	-	-	10921
November	2932	-	5853	803
December	3225	-	6861	1204
Total	15913	86024	81586	322105

At Cochin, over the period of five years, the major peaks in the flathead fishery were observed during the monsoon and premonsoon months; the fishery was poor during the postmonsoon period (Table 4). Tholasingam *et al.* (1973) stated that off

Cochin *Platycephalus* sp., *Nemipterus japonicus* and *Otolithus* sp. were abundant in the shallow and intermediate depths during January - March.

TABLE 3. Estimated catch (Kg) of *Cynoglossus macrostomus* during premonsoon, monsoon and postmonsoon, during 1984-88 at Cochin

	1984	1985	1986	1987	1988
Premonsoon	147,457.49	65,247.71	548.63	152,373.1	224,213.77
Monsoon	60,176.8	40,718	255,437.2	245,294.4	39,827.4
Postmonsoon	876.64	6,875.7	56,049.9	15,213.69	133,400.77

At Calicut the flathead fishery constituted on an average of 0.11% of total landings during 1984-88 period with the maximum landings in 1986. A maximum of 73.9% of the flathead landings occurred during premonsoon period with catch per effort at 1.28 kg. The entire catch consisted of

TABLE 4. Estimated catch (Kg) of *Platycephalus maculipinna* at Cochin during premonsoon, monsoon and postmonsoon, during 1985-88

	1985	1986	1987	1988
Premonsoon	15,000	30,067	38,900	238,950
Monsoon	9,756	40,605	27,853	63,413
Postmonsoon	5,157	2,244	14,114	18,503

Platycephalus scaber. Out of the 85 t of flatheads landed at Puthiappa at Calicut, 77.5% were landed during premonsoon with a CPUE of 7.6 kg and the rest of the catch landed in the postmonsoon. Here the peak catch was in the month of March. A single species *viz.*, *P. scaber* constituted the catch (Table 6).

TABLE 5. Catch rate (%) of Malabar sole with intensity of rainfall in brackets at Cochin during premonsoon, monsoon and postmonsoon months

	1984	1985	1986	1987	1988
Premonsoon	59.33 (17.29)	31.61 (23.81)	13.69 (22.85)	33.79 (8.09)	50.20 (6.89)
Monsoon	20.54 (53.33)	61.36 (29.54)	75.03 (51.44)	60.61 (60.76)	13.96 (59.34)
Postmonsoon	20.05 (23.83)	7.02 (16.55)	11.83 (25.71)	5.60 (31.05)	35.84 (33.27)

During 1985 and 1986, the fishery at Cochin was good during monsoon months, when the quantum of rainfall was also quite good. But during the succeeding years, the fishery did not show positive correlation with the rainfall.

TABLE 6. Flatfish and flathead landings at Calicut during 1984 to 1988

Year	Total catch (t)	flat fishes (t)	%	flatheads (t)	%
1984	7417.8	641.4	8.7	6.7	0.09
1985	3750.4	260.4	6.9	1.5	0.04
1986	2288.4	115.1	5.0	0.4	0.10
1987	3147.6	243.6	7.7	4.1	0.13
1988 (upto Aug.)	248.4	78.0	31.4	Nil	Nil

Sex ratio and maturity

At Cochin, females of *P. maculipinna* predominated in the fishery in all the months except in June 1988, when the male : female ratio was 3:2. During premonsoon months, the predominant maturity stages were III and IV, more than 50% were mature fish. The presence of fishes in stage VII, in the fishery at least in stray numbers in all the months indicated prolonged or continuous spawning in this species. During the monsoon months, stages VII as well as stages II and III predominated in the fishery. However, in August, the most frequently occurring stages were V and VI in females, the ova were fully ripe and the ovaries

TABLE 7. Percentage of flatfish landings in different gears at Calicut during 1984-88

Gear	Premonsoon	Monsoon	Postmonsoon
Trawl net	85.26	-	70.99
Paithu vala	14.73	-	10.19
Chooda vala	0.01	71.22	0.27
Mathichala vala	-	20.86	0.06
Ailachala vala	-	-	3.26
Nethal vala	-	7.91	-
Patten Kolli vala	-	-	15.23

in oozing stage. Males were also in advanced stages of maturity of IV and V. Again in October also, the same condition prevailed and stages V, VI and VII predominated. 70% of specimens in the samples were either in oozing stage or partly spent condition. Quite a good number of juveniles and immature fish occur in the fishery during October-December. In January, though spawning takes place to a less extent, spent fish as well as fishes in stages II and III occurred in the fishery.

Length composition

The principal modes in the length frequency distribution of *P. maculipinna* in different months during 1985-88 ranged from 170 mm to 250 mm. During monsoon season, the modes were at 180-230 mm in different years; in the premonsoon at 190-250 mm and in postmonsoon at 195-230 mm (Fig. 2).

only when the fishes were shoaling in the surface and subsurface waters, but inefficient to capture them when they were at the bottom. In recent years, trawling was made possible almost throughout the year, except during monsoon, when mechanised trawling was suspended for sometime.

Although the spawning in the Malabar sole was throughout the year, the months of peak spawning were found to be postmonsoon months extending upto the premonsoon. During February-March small fishes and juveniles were more in the fishery. But in the monsoon period the size ranged from 98 to 146 mm and the predominant modes were at 115 and 120 mm. Again in the succeeding December - January also, smaller fishes occurred in plenty in the fishery; their size ranging from 41 to 129 mm with the mode at 65 mm.

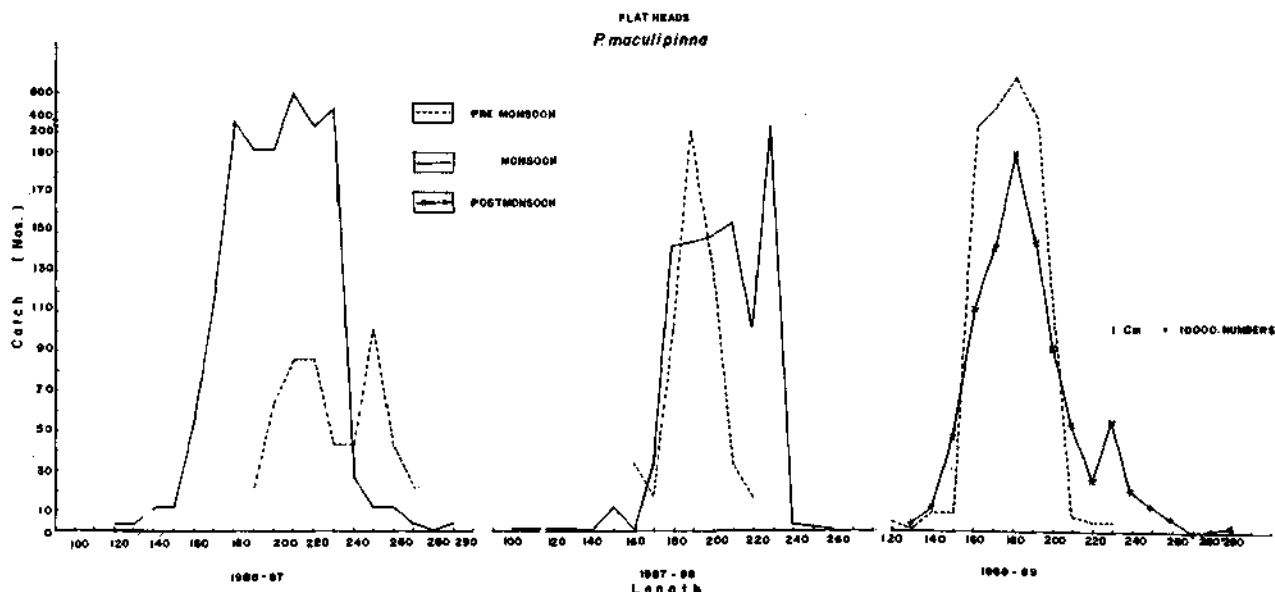


Fig. 2. Size distribution of *P. maculipinna* during premonsoon, monsoon and postmonsoon in the five year period 1984-88.

DISCUSSION

According to Seshappa (1973) the Malabar sole fishery in the Calicut Coast was a postmonsoon fishery with the maximum landings in September, though the landings gradually declined. He also reported a very high catch of soles in the premonsoon months with the juveniles dominating. With the introduction of mechanisation in the early sixties, the pattern of the fishery underwent a change, earlier, the gears employed were effective

The flatheads also spawn mostly during the postmonsoon months of August - October. During monsoon months, they are predominantly in stages II and III. In the case of soles and flatheads along the west coast, the fishes belonging to the one year old constitute the fishery. Juveniles and young ones of flatfishes are mainly caught during December-January and those of flatheads during premonsoon months. *It is found that during premonsoon and monsoon, these two resources are available in the inshore grounds in fairly good concentrations and the monsoon fishing does not affect the stocks.*

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