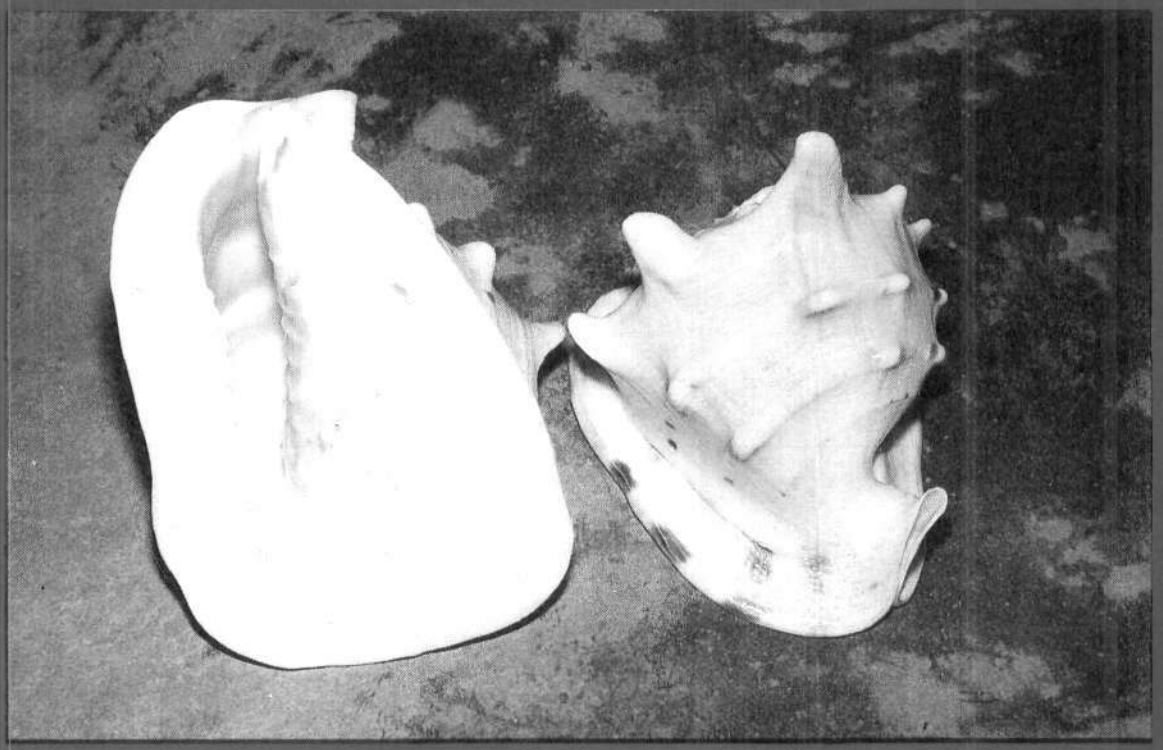
ISSN 0254-380 X

समुद्री मात्स्यिकी सूचना सेवा
MARINE FISHERIES INFORMATION SERVICE

No. 160 April, May, June 1999



तकनीकी एवं विस्तार अंकावली
TECHNICAL AND EXTENSION SERIES

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान कोचिन, भारत
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE COCHIN, INDIA

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

903 MARINE FISHERIES IN KERALA

T. M. Yohannan, P. N. Radhakrishnan Nair, N. G. K. Pillai and P. L. Ammini

Central Marine Fisheries Research Institute, Cochin — 682 014, India

Introduction

The 1980s was an important period in the development of marine fisheries in Kerala. In the first half of this period rapid motorisation of the indigenous crafts with outboard engines made the traditional sector more efficient. Outboard engines became an integral part of the indigenous fisheries and the fishers could extend their activities to more distant and deeper waters. Slowly they started discarding their old dugouts and going for plank-built boats with transformed stern to fix their outboard engines conveniently. In the latter half of the 1980 s a new gear called ringseine became very popular in exploiting the pelagic resources and replaced the boatseines to a very great extent. Huge size of the new net (450 to 900 m long) and large number of crew (30 to 40) needed for its operation necessitated larger boats and more outboard engines. . Thus the large plank-built 'kettuvallam' became the common craft to which 3 outboard engines were fitted. The smaller plank-built boats used in the operation of boatseines and gillnets, were coated with fiberglass. During the peak ringseine fishing period these boats are being used as carrier boats to land the catch from ringseines so that the fishing can continue for a longer duration. Now even the 'kettuvallam' is being made of marine plywood coated with fiberglass. Thus a new sector called motorised sector was added to the existing mechanised sector and the remaining being non-mechanised indigenous sector. The motorised sector grew rapidly and in 1988 it became the most important sector yielding the maximum catch.

In 1988 a partial ban on trawling during the monsoon was introduced along the coast of Kerala through a Government Order. Thereafter, the ban was enforced every year at varying intervals during the southwest monsoon period. This was based on the recommendations of the expert committee appointed by the Government of Kerala to study the fisheries of the state and to suggest resource management measures for reviving the marine fisheries which was suffering a set back during the 1968-80 period. The ban was recommended for the southwest monsoon in order to protect the sprawners and the new recruits, on the ground that most of the commercially important fish species have their peak spawning and recruitment along the Kerala coast during this period. It was also aimed to protect the interests of the traditional fishermen.

In the meantime, infrastructural facilities like the fisheries harbour helped the fishers to land their catches safely even during the rough monsoon season. This resulted in an increased fishing activity during the monsoon which greatly improved the catches of pelagic resources. With the increased export market for cephalopods, in addition to prawns, there was an intensification of trawling by increasing the size of the crafts, extending the fishing area and the fishing time. These developments resulted in an increase in the annual average catch.

Data base

Data collected by the Fisheries Resources Assessment Division of the Central Marine Fisheries Research Institute (CMFRI), Cochin on the fisheries of Kerala during the period from 1980 to 1996 form the basis of this study. By 1988 the ringseines got established in exploiting the pelagic resources. Partial ban on trawling during the monsoon was initiated and an upward trend in the marine fish catch was also observed in the same year. Hence, 1988 is taken as an year of transition in the marine fisheries of Kerala and the fishery for the years before 1988 was compared to that during the years therafter to study the changing characteristics of the fishery.

Characteristics of the growth of marine fisheries in Kerala

Fig. 1 representing the annual marine fish catch in Kerala from 1980-'96, shows two distinct periods. The first period is from 1980- '87 with annual average catch of 3,33,577 tonnes and the second from 1989-'96 with an annual average catch of 5,85,224 tonnes. With a catch of 4,70,000 tonnes, 1988 stands as a year of transition. The increase from the former period was 2,51,648 tonnes which is 75.40 % of growth.

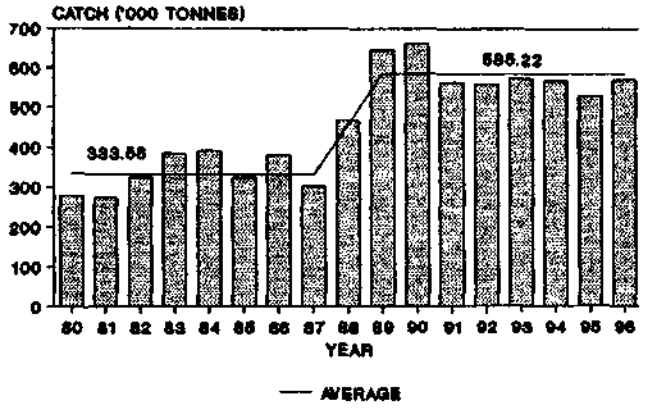


Fig. 1. Total marine fish catch in Kerala (1980-'96).

Fig. 2 gives the changing prominence of the different sectors of the fishery. The traditional sector dominated the fishery till 1983 and thereafter it declined with the fast development of the motorised sector. In 1985 , the traditional sector contributed only 24 % of the fish catch in the state when the contribution by the motorised sector was 43 % and the mechanised sector 33 %. In 1989 the contribution by the motorised sector increased to 63 % and the traditional sector declined to 5 %, but the mechanised sector maintained its contribution at 32 %. In 1994 the contribution by the mechanised sector increased to 57 %., pushing down the contribution by the motorised sector to the second place at 39 %. The traditional sector suffered further decline. In 1996 the motorised, mechanised and the traditional sectors contributed 51, 44 and 5 %, respectively.

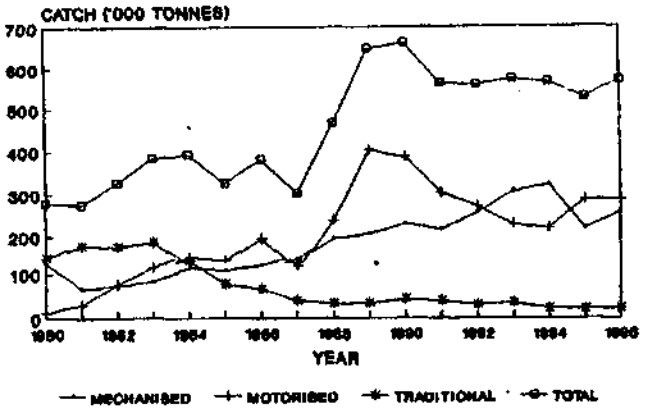


Fig. 2. Catch in different fisheries sectors.

The effort, catch and the catch per unit effort of the individual gear in the different sectors during 1993 - '96 are given in Table 1. It can be seen that the mechanised sector was dominated by trawl nets which contributed 97.40 % of the catch in this sector. The peak catch per unit effort was realised by purseseines. Purseseines are operated only at Cochin whereas trawl nets are operated all along the coast except in the Trivandrum District. With 71.10 % of the total catch in the motorised sector, ringseine is the most important gear with the maximum catch per unit effort in the motorised sector.

TABLE 1. *Effort, catch and catch per effort in different fisheries sectors in Kerala (average for 1993 - '96)*

Gear	Effort (nos)	%	Catch (tonnes)	%	C/E (kg)
MECHANISED SECTOR					
Trawl net	6,13,085	97.88	2,77,291	97.36	452.29
Gill net	6,776	1.08	876	0.31	129.28
Purse seine	3,124	0.50	5744	2.02	1,828.86
Hooks & line	3,349	0.53	898	0.32	268.27
Total	6,26,333	100.00	2,84,809	100.00	
MOTORISED SECTOR					
Ringseine	2,28,607	18.92	1,75,964	71.10	769.72
Gillnet	5,67,381	46.96	34,713	14.03	61.18
Trawl					
(Minitrawl)	1,40,188	11.63	10,164	4.11	72.35
Boatseine	39,669	3.28	13,590	5.49	342.59
Hooks & line	1,76,114	14.58	11,325	4.58	64.31
Disco net	55,975	4.63	1,734	0.70	30.97
Total	12,08,34	100.00	2,47,490	100.00	
TRADITIONAL SECTOR					
Gillnet	5,17,674	56.33	10,054	39.66	19.00
Shoreseine	55,529	6.04	7,725	30.47	139.00

Hooks & line	3,02,449	32.91	3,515	13.87	12.00
Boat-seine	27,821	3.03	3,256	12.84	117.00
Others	15,420	1.68	800	3.16	51.88
Total	9,18,893	100.00	25,350	100.00	

Table 2 gives the growth of the marine fisheries in Kerala rom 1985 - 87 period to 1993-'96 period. The average annual increase in catch was 2,20,024 tonnes. 74.9 % of this increase was made by ringseines, 64.5 % by trawls. 5.9 % by motorised gillnets and 0.2 % by purse seines when the catches of motorised boatseines registered a decline of 31.2 %, the mechanised gillnet 3.5 % and the other gear 10.8 %. Only ringseines and trawls had an improved catch per unit effort whereas all other gear suffered a decline in catch per effort.

TABLE 2. *Increase in the total average annual catch from 1985-'87 period to* 1993-'96 period and *the percentage contribution by the important gear*

Gear	Increase no. of operations	Increase in catch (t)	Percentage contribution to total increase	Increase in catch per effort (kg)
Ring seine	1,78,483	1,64,832	74.92	356.78
Trawl	1,16,174	1,41,936	64.51	195.82
OB gilnet	2,70,303	12879	5.85	-9.05
Purse seine	398	4,95	0.22	-96.71
Mech. gillnet	-56,584	-7,708	-3.50	-3.18
OB boatseine	-1,77,565	-68,695	-31.22	-59.70
Others	--	-23,716	-10.78	--
Total		2,20,024	100.00	

Fig. 3 gives the growth of trawl fisheries during 1986-'96. A steady increase in catch was observed from 1986 to 1994 followed by a minor decline. The peak effort was in 1988 with the lowest catch per effort. Subsequently there was a decline in effort and an increase in catch per effort. The second peak in effort was in 1994 with a decline in catch per effort. The relation between the relative growth in effort and catch per effort from 1986 to 1996 is shown in Fig.4. There is a clear trend of decrease in relative growth in catch per effort with the relative growth of effort.

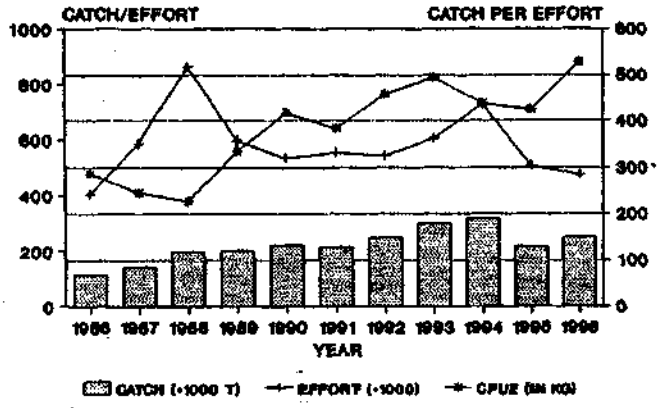


Fig. 3. Trawl; fishery in Kerala export, catch and cpue.

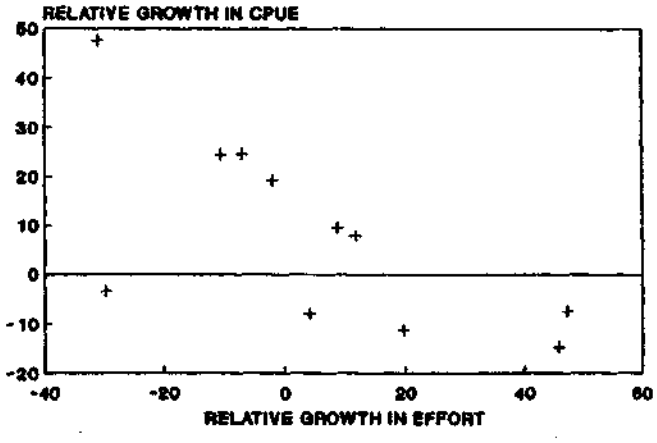


Fig. 4. Relation between effort and cpue trawl (Kerala 1986-'96).

Similar analysis of the ringseine fishery is shown in Fig. 5. A sharp increase in effort and catch of ringseines after 1998 is evident. But the fishery could not maintain the catch level. It steadily declined till 1994 followed by a minor improvement. This fishery attained its

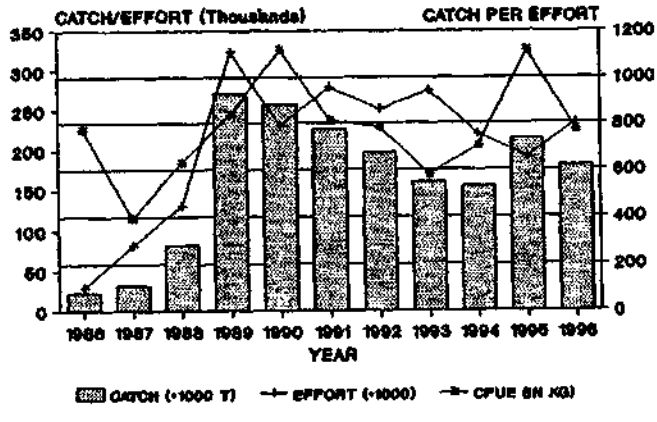


Fig. 5. Ring seine fishery in Kerala effort, catch and cpue.

full strength and efficiency by 1989. Hence, the relation between the relative growth of effort and catch per effort was studied only for the period from 1989 to 1996. Fig. 6 shows the inverse relation between these two characteristics more clearly than in the trawl fishery.

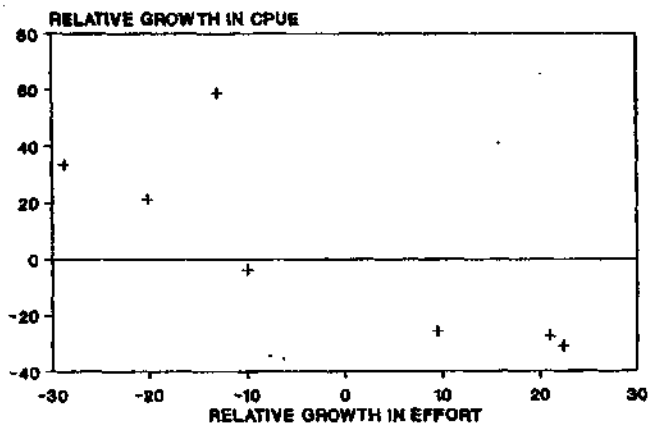


Fig. 6. Relation between export and cpue ringseine (Kerala 1989-'96).

The annual catch trends in the marine fisheries of Kerala are set by these two gear. The growth of the average catch after 1988 is influenced by the ringseines and trawl. The increase in effort by both these gear was found to result in a reduction in their catch per effort.

Table 1 shows that the trawl fishery is the most important in terms of effort and catch, followed by ringseine. Though the effort in gill net fishery is much higher than in the ringseine fishery the catch and catch per effort are not comparable to the trawl and ringseine fishery. Fig. 7 shows the relative growth in catch, effort and catch per effort of major gear from 1985-'88 period to 1993-96 period. Maximum increase in effort and catch is observed in ringseine fishery. But its increase in cpue is second to that of trawl fishery in which the growth in effort was the least. The growth was poor in the purse seine and motorised gillnet fishery with a decline in catch per effort. Mechanised gillnet and motorised boatseine fisheries declined. The boatseine fishery declined on the onslaught of ringseine fishery because they were competing for the same resources.

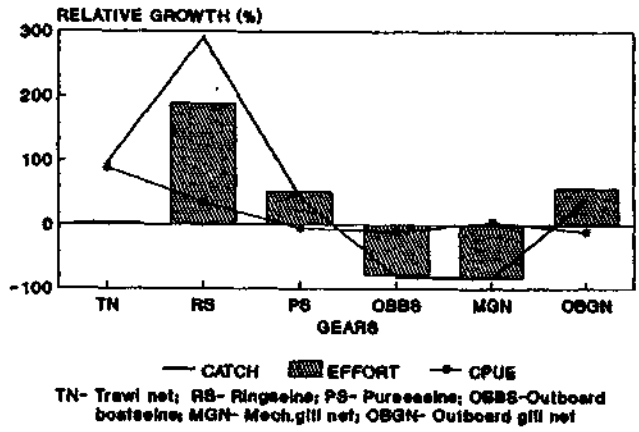


Fig. 7. Variations in effort, catch and cpue Kerala (1985-'88 to 1993-'96).

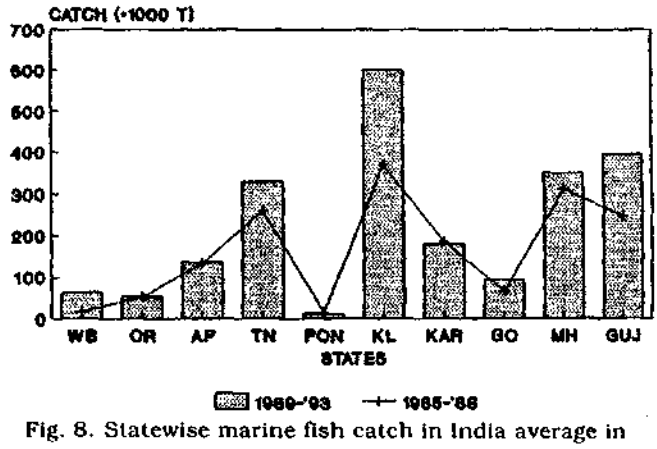


Fig. 8. Statewise marine fish catch in India average in tonnes.

Comparison with all India marine fish catch

During 1989-'93 the annual average marine fish catch in Kerala was 6,02,012 tonnes which was 25.34 % of the total marine fish catch in India (Fig. 8). The increase in the annual average catch from 1985-'88 to 1989-

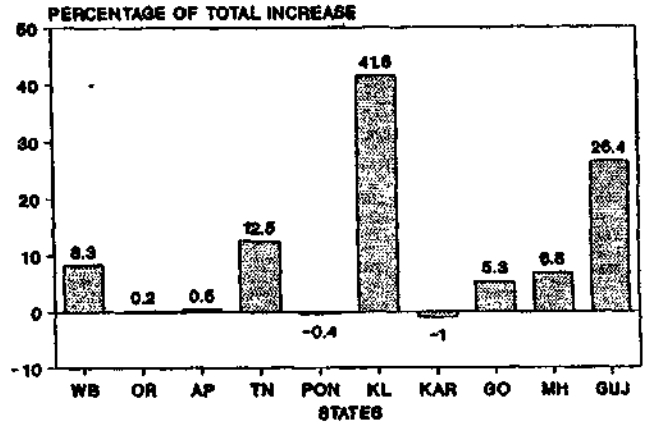


Fig. 9. Statewise increase in total catch 1985 '88 to 1989-'93

'93 period is shown in Fig. 9. Kerala contributed 41.6 % of the increase followed by Gujarat (26.4 %), Tamil Nadu (12.5 %), West Bengal (8.3%), Maharashtra (6.8 %), Goa (5.3 %), Andhra Pradesh (0.5 %) and Orissa (0.2 %). The catches from Karnataka and Pondicherry showed a minor decline. Kerala tops in the average fish catch per kilometer of coastline (Fig. 10) and per area of the continental self (Fig. 11). Thus the coastal waters of Kerala are the most productive around the Indian coast and intensively exploited, and the increase in exploitation with time is much faster. The decline in the catch of Karnataka the nearby state along the same coastline, has to be considered against this background. Such increase in the intensity of exploitation can destroy the natural refuges of the fish stocks in space and time resulting in damaging their renewability. As Kerala leads the development of marine fisheries in India the state has the responsibility to initiate conservation and management of the resources seriously.

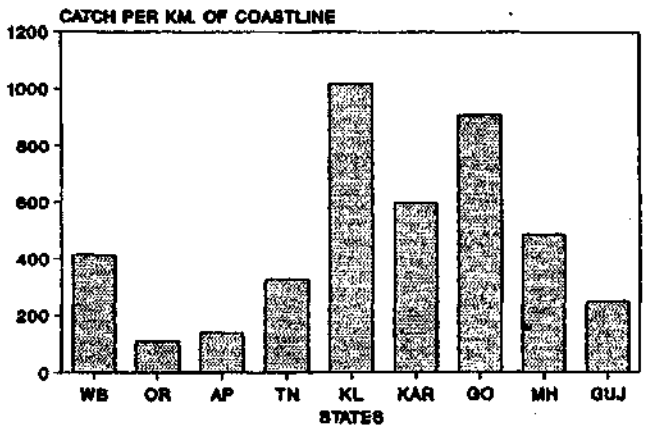


Fig. 10. Catch per km. of coastline in tonnes trawl (Kerala 1986-'96).

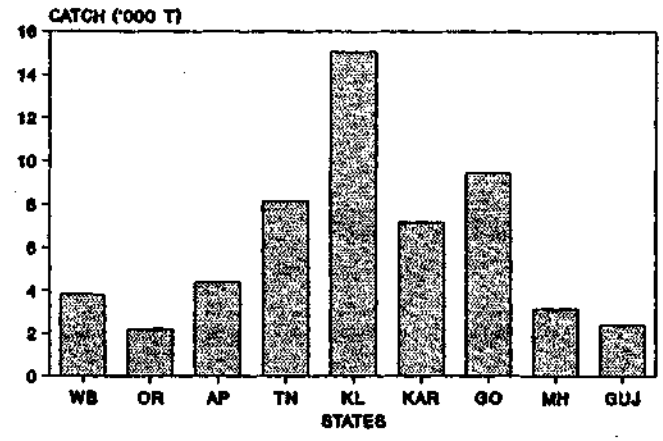


Fig. 11. Catch per 1000 sq.km continental shelf average in tonnes (1986-'93).

Changing fishery resources

Table 3a to 3e give the annual average catch of different varieties of fish during 1985-'88 and 1993-'96. The relative growth in the total fish catch from the former period was 50.8 %. 51.7 % of the total increase was contributed by pelagic fishes, 17.8 % by demersal finfishes, 13.5 % by molluscs, 9.4 % by crustaceans and 7.5 % by miscellaneous groups. The catch variations are depicted in Fig. 12. The maximum increase and decline

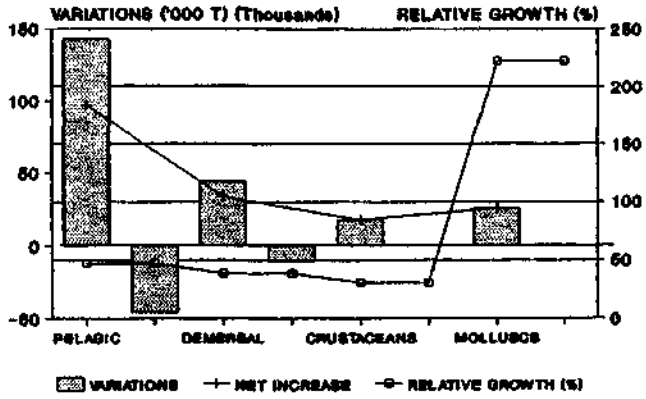


Fig. 12. Groupwise catch change Kerala (1985-'88 & 1993-'96).

in catch of different varieties of fishes were experienced by the pelagic fishery with maximum net increase, followed by demersal finfishes. Catches of molluscs did not show any decline. Among crustaceans there was a minor decline only in the catch of non-penaeid prawns. The maximum relative growth was registered in the molluscan fisheries due to sharp increase in the catch of cephalopods with the increased export demand. The minimum relative growth was registered in the crustacean fisheries in spite of the export demand.

TABLE 3a. *Growth in the average landing (tonnes)*

PELAGIC FISHES

Name of fish	1993-'96	1985-'88	Difference	Rel. growth %	% of total growth
Indian mackerel	83,189	23,495	59,694	254.1	31.7
Scads	56,120	16,492	39,628	240.3	21.1
Lesser sardines	28,477	8,201	20,276	247.2	10.8
Stolephorus	39,290	31,495	7,795	24.7	4.1
Other clupeids	11,988	6,991	4,997	71.5	2.7
Horse mackerel	5,203	1,816	3,387	186.5	1.8
Thryssa	5,655	3,364	2,291	68.1	1.2
Barracudas	3,510	1,257	2,253	179.2	1.2
Auxis spp.	4,565	3,791	774	20.4	0.4
Half beaks & full beaks	1,476	810	666	82.2	0.4
Wolf herring	1,370	716	654	91.3	0.3
S. commerson	5,879	5,340	539	10.1	0.3
E. affinis	7,388	7,212	176	2.4	0.1
Other shads	130	17	113	664.7	0.1
other tunnies	806	747	59	7.9	0.0
Mullets	520	486	34	7.0	0.0
Hilsa shads	38	15	23	153.3	0.0
Flying fishes	7	2	5	250.0	0.0
Thrissina	0	1	0	1	0.0
Billfishes	167	167	0	0.0	0.0
Acanthocybium spp.	0	0	0	0	0.0
Leather jackets	342	344	-2	-0.6	0.00
Coilia	0	3	-3	-100.0	0.0
T. tonggol	117	200	-83	-41.5	0.00
K. pelamis	1	92	-91	-98.9	0.0
S. gutiatus	186	1,824	-1,638	-89.8	-0.9
Other carangids	6,545	19,914	-3,369	-16.9	-1.8
Ribbon fishes	9,122	15,317	-6,195	-40.4	-3.3
Oil sardine	1,519	56,266	-34,747	-61.8	-18.5
Total	3,03,610	2,06,369	97,237	47.1	51.7

Table 3a further indicates that the resource that contribute maximum (31.75 %) to the growth of fish catch from 1985-'88 period to 1993- 96 period was the Indian mackerel. Fig.13 shows the annual catch of Indian mackerel in Kerala

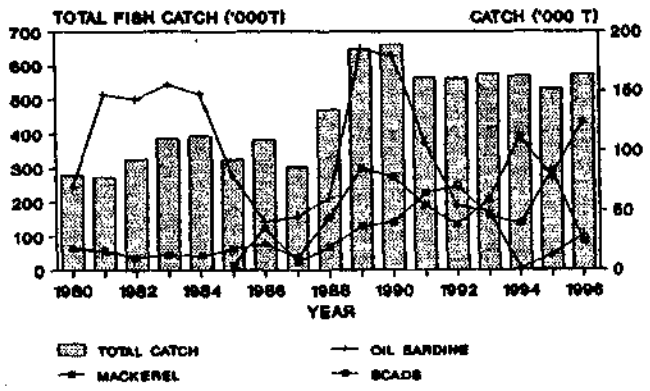


Fig. 13. Total fish of Kerala against the catch of come species.

from 1980-'96. The increase in the catch of mackerel is almost concomitant with the increase in the total fish catch, but at a higher rate and with sharper fluctuations. 73 % of the mackerel catch in Kerala is contributed by the ringseine fishery which has been maintaining the prominence since 1989.

In contrast, the oil sardine fishery which was the mainstay of the pelagic fisheries of Kerala sharply declined after 1990. Its decline from the annual average catch during 1985-'88 to 1993-'96 was 61.8 % (Fig. 13). The earliest success of the ringseine fishery was in netting this resource abundantly in 1989 and '90 along with mackerel. In 1989 this resource gave a record catch of 1.9 lakh tonnes which decline to 1,554 tonnes in 1994 (a decline of 99.2 %). The collapse of this very important resource after 1990 put a break in the fast growth of ringseine fishery. Fig. 5 shows almost a steady decline in the catch and effort in the ring seine fishery.

Another important resource which contributed substantially (21.1 %) to the increase in the pelagic fisheries is the scads (Table 3a). This resource showed its pontential in 1986. After poor catches in 1987 the yield increased steadily till 1992 and started to fluctuate thereafter (Fig.13).

In the demersal fisheries (Table 3b) the catch variations were not as strong as in the pelagic fisheries. The maximum increase was in the catch of threadfin breams accouting for 8.06 % of the increase in total fish catch. This was

followed by perches, soles, lizard fishes and croakers. The maximum relative increase was observed in the catch of Chinese pomfret and eel.

TABLE 3b. *Growth in the average landings (tonnes)*

DEMERSAL FINFISHES

Name of fish	1993-'96	1985-'88	Difference	Rel. growth %	% of total growth
Threadfin breams	42,854	27,702	15,152	54.7	8.1
Other perches	13,640	5,776	7,864	136.1	4.2
Soles	17,653	10,835	6,818	62.9	3.6
Lizard fishes	12,826	7,820	5,006	64.0	2.7
Croakers	13,790	9,506	4,284	45.1	2.3
Rock cods	3,833	665	3,168	476.4	1.7
Silver pomfret	913	453	460	101.5	0.2
Chinese pomfret	405	22	383	740.9	0.2
Rays	1,546	1,329	217	16.3	0.1
Halibut	235	95	140	147.4	0.1
Eels	141	9	132	466.7	0.1
Black pomfret	1,256	1,145	111	9.7	0.1
Pigface breams	342	244	98	40.2	0.1
Skates	102	18	84	466.7	0.0
Flounders	112	52	60	115.4	0.0
Threadfins	71	80	-9	-11.4	0.0
Big jawed jumper	868	980	-112	-11.4	-0.1
Snappers	202	387	-185	-47.8	-0.1
Silverbellies	4,900	5,486	-586	-10.7	-0.3
Sharks	3,162	4,464	-1,302	-29.2	-0.7
Goatfishes	1,015	2,708	-1,693	-62.5	-0.9
Catfishes	468	7,096	-6,628	-93.4	-3.5
Total	20,333	86,868	33,462	38.5	17.8

TABLE 3c. *Growth in the average landings (tonnes)*

MOLLUSCS

Name of fish	1993-'96	1985-'88	Difference	Rel. growth %	% of total growth
Cephalopods	36,295	11,490	24,805	215.9	13.2
Gastropods	746	0	746	-	0.4
Total	37,041	11,490	25,551	222.4	13.6

Conspicuous decline was observed in the catch of catfishes. The rate of decline is estimated as 93.4 %.

The cephalopod fishery (Table 3c) experience a major intensification with relative growth of 215.8 % in the catch of 1993-'96 period from 1985-'88 period. As in the case of scads this resource also exhibited its potential in 1986, declined in 1987 and started its steady and fast development (Fig. 14).

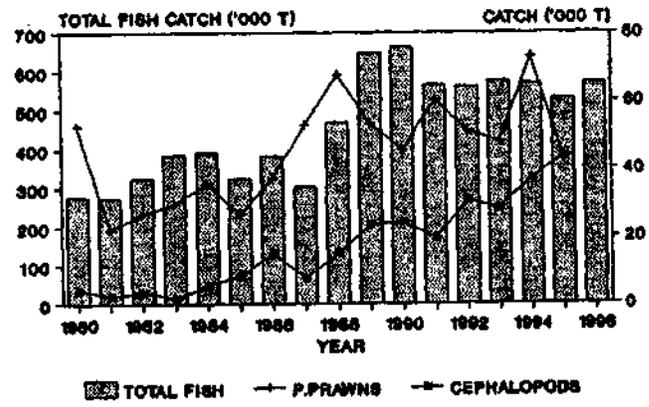


Fig. 14. Total fish catch of Kerala against the catch of some species.

The crustaceans showed a relative growth of 30.5 % from 1985-'88 to 1993-'96 (Table 3d). The penaeid prawn catch increased by 18% during the period.

TABLE 3d. *Growth in the average landings (tonnes)*

CRUSTACEANS

Name of fish	1993-'96	1985-'88	Difference	Rel. gowth %	% of total growth
Penaeid prawns	54,361	46,059	8,302	18.0	4.4
Stomatopods	16,916	9,923	6,993	70.5	3.7
Crabs	4,140	1,771	2,369	133.8	1.3
Lobsters	193	99	94	94.9	0.0
Non-penaeid prawns	139	182	-43	-23.6	0.0
Total	75,749	58,034	17,715	30.5	9.4

TABLE 3e *Growth in the average landings (tonnes)*

MISCELLANEOUS AND TOTAL CATCH OF FISH

Name of fish	1993-'96	1985-'88	Difference	Rel. growth %	% of total growth
Dolphin & porpoise	6	0	6	-	0.0
Seacow	0	0	0	-	0.0
Miscellaneous	21,400	7,345	14,055	191.4	7.5
Total	21,400	7,345	14,061	191.4	7.5
All varieties	5,58,133	3,70,105	1,88,026	50.8	100.0

The crab also showed maximum relative growth. Only the nonpenaeid prawn landings registered a relative decline by 23. 8 %. The prawn fishery though improved steadily from 1985 to1988 fluctuated afterwards. But the general trend is that of improvement. The difference in the average catch of certain important groups during 1986-'88 and 1993-'96 along with percentage growth is given in Fig. 15.

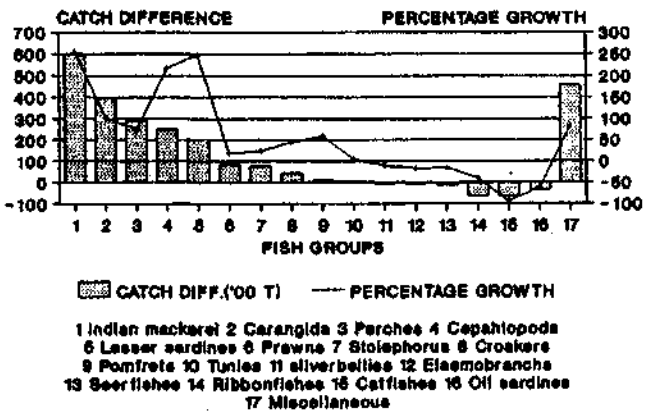


Fig. 15. Kerala-difference in average catch 1985'88 to 1993-'96.

Causes of growth

As stated earlier the average annual catch of the marine fish from Kerala in 1980-'87 increased by 75.4 % during 1989-'96 period. The transitional period was 1988. Two important events of this transitional period are worth mentioning.

1. Growth of ringseine fishery and
2. Commencement of ban on trawling for varying periods during the monsoon to protect the resources and the interests of the traditional fishermen.

Table 2 gives an indication of the growth of the fisheries by different gear. A comparison is made between the average annual situation in 1985-'87 (being the pre-ringseine and pre-ban period) and 1993-'96 (being the ringseine. ban period). The increase in the total fish catch from former period to the latter was 2,20,024 tonnes. The ringseine with an increase of 1,78,483 operations, 1,64,832 tonnes of catch and 356.8 kg of catch per effort contributed 74.9 % of this increase. Ringseine is a surface gear. This increase in the catch is offset by the decline of catch in other surface gear reducing the effective total increase in catch by surface gear to 78,087 which is only 35.5 % of the total increase. But the increase in the catch by trawl amounts 64.5 % of the total increase in the fish catch. Hence a major share of the average increase in catch was made by trawls. Similarly the increase in the catch per unit effort of trawls also can be considered as the maximum. But the relative increase in effort was less in the trawl when compared to all the other gear together. The effort of motorised gillnets increased most with a decline in the catch per effort. The question is whether monsoon ban on trawling was the reason for such an improvement in trawl catches. There is no method of verifying this as the fishery underwent a series of changes during this period apart from introduction of trawl ban-increase in the efficiency of trawlers, duration of fishing and range of exploited area. However, when the trawl fishery alone is considered the low relative increase in effort and significant increase in its catch and C/E (Fig.7) indicates that the introduction of trawl ban during monsoon has also played a key role in the enhancement of production. Moreover the penaeid prawn catches have improved and started fluctuating sharply and the cephalopod fishery has expanded. However, an uncontrolled

development of a fishery is always dangerous because continuous exploitation of the resources would violate their natural refuges in space and time and refuse them the opportunity to multiply and grow. On that ground the present duration of ban on trawling during the monsoon has to be considered as insufficient.

Analysis given in Figs. 4 and 6 indicates that the further growth of the ringseine and trawl operations will result in a reduction of catch per effort. These fisheries are the backbones of the marine fisheries in Kerala. We have perhaps reached a state of supersaturation of fishing effort in these sectors.

Gearwise variations

Table 4 gives the changes in the catch of different fish varieties in the major gear. In the trawl catches there was an average increase of 1,58,455 tonnes of fish in 1993-'95 when compared to 1985-'87 indicating a relative growth of 1,334 %. The increase in effort was only 35.3 %. Major varieties that contributed to this growth were cephalopods, scads, threadfin breams and penaeid prawns. A decline in the catch of catfishes, mullets and nonpenaeid prawns was observed. Table 5 shows the changes in catch per effort of these fishes. The cpue of penaeid prawns showed a slight decline, so also the cpue of silverbellies, non-penaeid prawns, threadfins, mullets, catfishes, etc. But cpue of most of the other species showed an increase with a total average relative increase of 72.5 %.

The average catch in the ringseine fishery increased by 1,30,650 tonnes which is 288.3 % of relative growth with 186.5 % increase in effort. (Table 4). Catch of Indian mackerel, scads, whitebaits and lesser sardines contributed to the bulk of the increase. Major decline was in the catch of other carangids, catfishes and oil sardine. The catch per unit effort of oil sardine and other carangids showed a decline. However, the total cpue showed a relative growth of 35.6 %.

It was the motorised boatseine fishery which declined considerably. The relative growth in catch was -84.3 % with a decline of 83.1 % in effort. All varieties of fishes except Indian mackerel, mullets, non-penaeid prawns and hilsa shad showed decline. Similarly there was a general decline in catch per effort. Considerable increase was observed in the catch of Indian mackerel and to a certain extent the mullets. The relative decline in the total catch per effort was -6.8 %.

Biological basis of fisheries management

A critical perusal of the fisheries in Kerala reveals that the single species resources are prone to sharper fluctuations than the multispecies fisheries. The fluctuations get more smoothened when we consider the total annual catches. The total fish catch is a product of the total productivity of the area fished. Variations in the total productivity are less pronounced and beyond our control. The decline in one species may help another species to increase due to their ecosystem interactions. But due to selective exploitation, the valuable species generally decrease and worthless species increase.

Most of the fish species that we exploit are short lived. They grow fast, reproduce at the age of one year and do not contribute to the fishery for more than two years. Table 6 gives the most successful spawning periods of some of the fishes we exploit. It can be noticed that a lot of spawning activity takes place in our waters during or immediately prior to monsoon. The spawning activity starts by around February and prolongs upto July.

TABLE 4., *Change in the fishery of major gear in Kerala between periods 1985-'87 and 1993-'95 (Average catch in tonnes)*

I. Trawl fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Cephalopods	6,169	33,521	27,352	443.38
Scads	1,277	20,672	19,395	1,518.79
Threadfin breams	27,833	42,695	14,862	53.40
Penaeid prawns	31,972	42,787	10,815	33.83
Other perches	2,605	9,807	7,202	276.47
Lizard fishes	5,827	12,772	6,945	119.19
Stolephorus	2,402	9,219	6,817	283.81
Stomatopods	9,156	15,527	6,371	69.58

Ribbon fishes	2,238	8,570	6,332	282.93
Soles	7,073	13,040	5,967	84.36
Other carangids	3,156	8,035	4,879	154.59
Croakers	4,846	8,783	3,937	81.24
Indian mackerel	215	4,151	3,936	1,830.70
Rockcods	53	3,250	3,197	6,032.08
Barracudas	389	2,819	2,430	624.68
Crabs	1,406	3,805	2,399	170.63
Thryssa sp.	768	2,922	2,154	280.47
Horse mackerel	9	1,878	1,869	20,766.67
Sharks	405	2,113	1,708	421.73
Other clupeids	298	1,594	1,296	434.90
Half beaks & Full beaks	2	890	888	44,400.00
Wolf herring	143	927	784	548.25
Gastropods	0	744	744	-
Goat fishes	284	982	698	245.77
Rays	743	1351	608	81.83
S.commersoni	15	619	604	4,026.67
Silver pomfret	127	592	465	366.14
Chinese pomfret	2	273	271	13,550.00
Black pomfret	62	331	269	433.87
Halibut	35	225	190	542.86
Silverbellies	2,792	2,944	152	5.44
Lobsters	35	150	115	328.57
Leather-jackets	0	109	109	-
S. guttatus	3	92	89	2,966.67
Skates	3	91	88	2,933.33
Other sardines	31	106	75	241.94
Eels	5	68	63	1,260.00
Flounders	65	109	44	67.69
Snappers	0	36	36	-
E.affinis	1	7	6	600.00
Pig-face breams	0	6	6	-
Flying fishes	1	7	6	600.00
Hilsa shad	1	4	3	300.00
Other tunnies	1	4	3	300.00
Auxis spp.	1	4	3	300.00
Other shads	12	3	-9	-75.00
Non-penaeid prawns	13	2	-11	-84.62
Threadfins	53	32	-21	-39.62
Big-jawed jumper	445	401	-44	-9.89
Oil sardine	92	11	-81	-88.04
Mullets	188	25	-163	-86.70
Catfishes	1,113	202	-911	-81.85
Miscellaneous	4,454	17,361	12,907	289.78
All Fish	1,18,819	2,77,274	1,58,455	133.36
Effort (units)	4,53,085	6,13,085	1,60,000	35.31

II. Outboard boatseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	2,564	3,148	584	22.78
Mullets	58	310	252	434.48
Non-penaeid prawns	43	67	24	55.81
Hilsa shad	0	6	6	-
Halibut	0	0	0	-
Auxis spp.	1	0	-1	-100.00
Lizard fishes	3	3	0	0.00
Goatfishes	3	0	-3	-100.00
S.guttatus	4	0	-4	-100.00
Rays	13	8	-5	-38.46
Wolf herring	5	0	-5	-100.00
Crabs	7	1	-6	-85.71
Bill fishes	7	0	-7	-100.00
S.commersoni	11	3	-8	-72.73
Threadfin breams	8	0	-8	-100.00
Catfishes	12	3	-9	-75.00
Black pomfrets	76	59	-17	-22.37
Sharks	22	1	-21	-95.45
Barracudas	65	44	-21	-32.31
Stomatopods	44	0	-44	-100.00
Silver pomfrets	70	26	-44	-62.86
Unicorn cod	46	0	-46	-100.00
Half beaks & Full beaks	98	45	-53	-54.08
Big-jawed jumper	272	63	-209	-76.84
Horse mackerel	317	0	-317	-100.00
Other sardines	1,788	1408	-380	-21.25
Cephalopods	453	29	-424	-93.60
E.affinis	474	0	-474	-100.00
Thryssa sp.	931	414	-517	-55.53
Leather-jackets	600	43	-557	-92.83
Soles	567	7	-560	-98.77

Other perches	1601	540	-1061	-66.27
Silverbellies	1,413	151	-1262	-89.31
Other clupeids	2,897	1,572	-1325	-45.74
Ribbon fishes	2,156	128	-2028	-94.06
Croakers	3,593	1,142	-2451	68.22
Penaeid prawns	4,162	145	-4017	-96.52
Scads	7,790	980	-6810	-87.42
Other carangids	8,343	358	-7985	-95.71
Stolephorus	13,263	1,592	-11671	-88.00
Oil sardine	32,191	1,144	-31047	-96.45
Miscellaneous	312	107	-205	-65.71
All Fish	86,284	13,590	-72694	-84.25
Effort (units)	2,34,678	39,669	-195009	-83.10

III. Ringseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	8,194	60,712	52,518	640.93
Scads	3,549	30,807	27,258	768.05
Stolephorus	3,250	22,409	19,159	589.51
Other sardines	2,702	20,480	17,778	657.96
Penaeid prawns	1,263	5,971	4,708	372.76
Other clupeids	1,610	5,777	4,167	258.82
Croakers	246	2,047	1,801	732.11
Other perches	695	2,397	1,702	244.89
Auxis spp.	0	1,404	1,404	-
Thryssa sp.	298	1,265	967	324.50
Silverbellies	75	797	722	962.67
Black pomfrets	174	579	405	232.76
E. affinis	168	417	249	148.21
Soles	27	220	193	714.81
Chinese pomfret	0	120	120	-1
S. commersoni	76	145	69	90.79
Mullets	70	138	68	97.14
Big-jawed jumper	11	77	66	600.00
Ribbon fishes	2	52	50	2,500.00
Barracudas	6	45	39	650.00
Cephalopods	2	38	36	1,800.00
Rays	1	27	26	2,600.00
Elasmobranchs	0	21	21	-
Sharks	1	15	14	1,400.00
Bill fishes	0	14	14	-
Wolf herring	3	12	9	300.00
Clupeids	0	7	7	-
Rockcods	0	5	5	-
S. guttatus	8	10	2	25.00
Threadfin breams	0	2	2	-
Threadfins	0	2	2	-
Skates	0	1	1	-
Seer fishes	0	1	1	-
Other shads	11	11	0	0.00
Silver pomfrets	89	65	-24	-26.97
Oil sardine	16,228	16,151	-77	-0.47
Leather-jackets	169	63	-106	-62.72
Half beaks & Full beaks	267	124	-143	-53.56
Catfishes	574	9	-565	-98.43
Horse mackerel	1,558	430	-1128	-72.40
Other carangids	3,768	2,477	-1291	-34.26
Miscellaneous	220	619	399	181.36
All Fish	45,314	1,75,964	1,30,650	288.32
Effort (units)	79,800	2,28,607	1,48,807	186.47

TABLE 5. *Change in catch per effort (kg) of major gear in Kerala between the periods 1985-'87 and 1993-'95*

I. Trawl fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Cephalopods	13.61	54.68	41.07	301.76
Scads	2.82	33.72	30.90	1,095.74
Threadfin breams	61.43	69.64	8.21	13.36
Penaeid prawns	70.57	69.79	-0.78	-1.11
Other perches	5.75	16.00	10.25	178.26
Lizard fishes	12.86	20.83	7.97	61.98
Stolephorus	5.30	15.04	9.74	183.00
Stomatopods	20.21	25.33	5.12	25.33
Ribbon fishes	4.94	13.98	9.04	183.00
Soles	15.61	21.27	5.66	36.26

Other carangids	6.96	13.11	6.15	88.36
Croakers	10.70	14.33	3.63	33.93
Indian Mackerel	0.47	6.77	6.30	1,340.43
Rockcods	0.12	5.30	5.18	4,316.67
Barracudas	0.86	4.60	3.74	434.88
Crabs	3.10	6.21	3.11	100.32
Thryssa sp.	1.70	4.77	3.07	180.59
Horse mackerel	0.02	3.06	3.04	15,200.00
Sharks	0.89	3.45	2.56	287.64
Other clupeids	0.66	2.60	1.94	293.94
Half beaks & full beaks	0.00	1.45	1.45	-
Wolf herring	0.32	1.51	1.19	371.88
Gastropods	0.00	1.21	1.21	-
Goat fishes	0.63	1.60	0.97	153.97
Rays	1.64	2.20	0.56	34.15
S.commersoni	0.03	1.01	0.98	3,266.67
Silver pomfret	0.28	0.97	0.69	246.43
Chinese pomfret	0.01	0.45	0.44	4,400.00
Black pomfret	0.14	0.54	0.40	285.71
Halibut	0.08	0.37	0.29	362.50
Silverbellies	6.16	4.80	-1.36	-22.08
Lobsters	0.08	0.25	0.17	212.50
Leather-jackets	0.00	0.18	0.18	-
S. guttatus	0.01	0.15	0.14	1,400.00
Skates	0.01	0.15	0.14	1,400.00
Other sardines	0.07	0.17	0.10	142.86
Eels	0.01	0.11	0.10	1,000.00
Flounders	0.14	0.18	0.04	28.57
Snappers	0.00	0.06	0.06	-
E.affinis	0.00	0.01	0.01	-
Pig-face breams	0.00	0.01	0.01	-
Flying fishes	0.00	0.01	0.01	-
Hilsa shad	0.00	0.01	0.01	-
Other tunnies	0.00	0.01	0.01	-
Auxis spp.	0.00	0.01	0.01	-1
Other shads	0.03	0.00	-0.03	-100.00
Non-penaeid prawns	0.03	0.00	-0.03	-100.00
Thredfins	0.12	0.05	-0.07	-58.33
Big-jawed jumper	0.98	0.65	-0.33	-33.67
Oil sardine	0.20	0.02	-0.18	-90.00
Mullets	0.41	0.04	-0.37	-90.24
Catfishes	2.46	0.33	-2.13	-86.59
Miscellaneous	9.83	28.32	18.49	188.10
All Fish	262.24	452.26	190.02	72.46
Effort (units)	4,53,085	6,13,085	1,60,000	35.31

II Outboard boatseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	10.92	79.35	68.43	626.65
Mullets	0.25	7.81	7.56	3,024.00
Non-penaeid prawns	0.18	1.68	1.50	833.33
Hilsa shad	0.00	0.14	0.14	-
Halibut	0.00	0.00	0.00	-
Auxis spp.	0.00	0.00	0.00	-
Lizard fishes	0.01	0.07	0.06	600.00
Goatfishes	0.01	0.00	-0.01	-100.00
S.guttatus	0.02	0.00	-0.02	-100.00
Rays	0.05	0.20	0.15	300.00
Wolf herring	0.02	0.00	-0.02	-100.00
Crabs	0.03	0.03	0.00	0.00
Bill fishes	0.03	0.00	-0.03	-100.00
S.commersoni	0.05	0.08	0.03	60.00
Threadfin breams	0.03	0.00	-0.03	-100.00
Catfishes	0.05	0.08	0.03	60.00
Black pomfrets	0.32	1.50	1.18	368.75
Sharks	0.09	0.02	-0.07	-77.78
Barracudas	0.28	1.10	0.82	292.86
Stomatopods	0.19	0.00	-0.19	-100.00
Silver pomfrets	0.30	0.66	0.36	120.00
Unicorn cod	0.19	0.00	-0.19	-100.00
Half beak & full beaks	0. 42	1.13	0.71	169.05
Big-jawed jumper	1.16	1.59	0.43	37.07
Horse mackerel	1.35	0.00	-1.35	-100.00
Other sardines	7.62	35.50	27.88	365.88
Cephalopods	1.93	0.73	-1.20	-62.18
E.affinis	2.02	0.00	-2.02	-100.00

Thryssa sp	3.97	10.44	6.47	162.97
Leather-jackets	2.56	1.09	-1.47	-57.42
Soles	2.41	0.18	-2.23	-92.53
Other perches	6.82	13.62	27.28	22.28
Silverbellies	12.34	3.80	-2.22	-36.88
Other clupeids	12.34	13.62	27.28	221.07
Ribbon fishes	9.19	3.22	-5.97	-64.96
Croakers	15.31	28.80	13.49	88.11
Penaeid prawns	17.74	3.65	-14.09	-79.43
Scads	33.19	24.71	-8.48	-25.55
Other carangids	35.55	9.02	-26.53	-74.63
Stolephorus	56.51	40.12	-16.39	-29.00
Oil sardine	137.17	28.83	-108.34	-78.98
Miscellaneous	1.33	2.71	1.38	103.76
All Fish	367.67	342.59	-25.08	-6.82
Effort (units)	23,468	39,669	-195009	-83.10

III. Ringseine fishery

Name of species	1985-'87	1993-'95	Relative growth in catch	Relative growth in %
Indian mackerel	103	266	163	158.25
Scads	44	135	91	206.82
Stolephorus	41	98	57	139.02
Other sardines	34	90	56	164.71
Penaeid prawns	16	26	10	62.50
Other clupeids	20	25	5	25.00
Croakers	3	9	6	200.00
Other perches	9	10	1	11.11
Auxis spp.	0	6	6	-
Thryssa spp	4	6	2	50.00
Silverbellies	1	3	2	200.00
Black pomfrets	2	3	1	50.00
E. affinis	2	2	0	0.00
Soles	0	1	1	-
Chinese pomfret	0	1	1	-
S. commersoni	1	1	0	0.00
Mullets	1	1	0	0.00
Big-jawed jumper	0	0	0	-
Ribbon fishes	0	0	0	-
Barracudas	0	0	0	-
Cephalopods	0	0	0	-
Rays	0	0	0	-
Elasmobranchs	0	0	0	-
Sharks	0	0	0	-
Bill fishes	0	0	0	-
Wolf herring	0	0	0	-
Clupeids	0	0	0	-
Rockcods	0	0	0	-
S. guttatus	0	0	0	-
Threadfin breams	0	0	0	-
Threadfins	0	0	0	-
Skates	0	0	0	-
Seer fishes	0	0	0	-
Other shads	0	0	0	-
Silver pomfrets	0	0	0	-1
Oil sardine	203	71	-132	-65.02
Leather-jackets	2	0	-2	-100.00
Half beaks & full beaks	3	1	-2	-66.67
Catfishes	7	0	-7	-100.00
Horse mackerel	20	2	-18	-90.00
Other carangids	47	11	-36	-76.60
Miscellaneous	3	3	0	0.00
All Fish	567.84	769.72	201.88	35.55
Effort (units)	79,800	2,28,607	1,48,807	186.47

TABLE 6. *Intensive spawning period of major pelagic fishes along the Kerala coast*

	Fishes	Spawning period
1.	*Sardinella longiceps*	May to July
2.	*S. gibbosa*	March to May
3.	*S. albella*	April to June
4.	*S. fimbriata*	May to June
5.	*Dussumieria* spp.	April to July
6.	*Stolephorus devisi*	January to March
7.	*S. bataviensis*	January to March
8.	*Euthynnus affinis*	May to July
9.	*Auxis thazard*	May to july
10.	*Rastrelliger kanagurta*	May to July
11.	*Trichiurus lepturus*	April to June
12.	*Decapterus russelli*	April to June
13.	*Megalaspis cordyla*	May to August

There is a phenomenon termed as "bet-hedging" by Lambert and Ware. Some fishes release batches of eggs over an extensive area during a protracted spawning period which is adaptive in situation where prey availability is unpredictable and the risk of total recruitment failure is avoided by many independent spawning bouts. This phenomenon is prevalent in Indian waters. Indian mackerel starts spawning by February and reaches a peak by May-July. Spawning is observed even in November but peak recruitment is confined to the products of spawning in May-July. This is due to the repetitive phenomenon called "upwelling" in our coastal waters. The process of upwelling starts by around March, reaches a peak by August/September and starts sinking by October/November. The upwelled water rich in nutrients causes plankton bloom in the coastal waters. The nutrients brought in by the river inflow during the monsoon also intensify the bloom. This plankton bloom is favourable to the successful survival of the planktonic larvae of the fishes reducing their death due to starvation especially during their critical stage in development and helps better recruitment. Hence, the spawning activity during the upwelling period becomes most successful. The spawning during May-July is very crucial to recruitment. During the pre-outboard and pre-ringseine period the fishing activity using the traditional units was very little in the monsoon period because of the unfavourable weather conditions and lack of safe landing facilities. With the introduction of powerful outboard engines and better landing facilities like fishing harbours, the fishing activity during the monsoon has become easier resulting in increased exploitation of spawners and early juveniles of many fish species. The length frequency distribution of mackerel and oil sardine in Kerala along with their mean length during 1993-'94 in respect of mackerel and during 1985-'88 and 1993-'96 in respect of oil sardine are given in Figs. 16 and 17. Figs. 18 and 19 give the mean length and mean weight of mackerel and oil sardine. Juveniles of Indian mackerel of size below 155 mm and weight below 35 g are exploited abundantly during the period from July to September. In

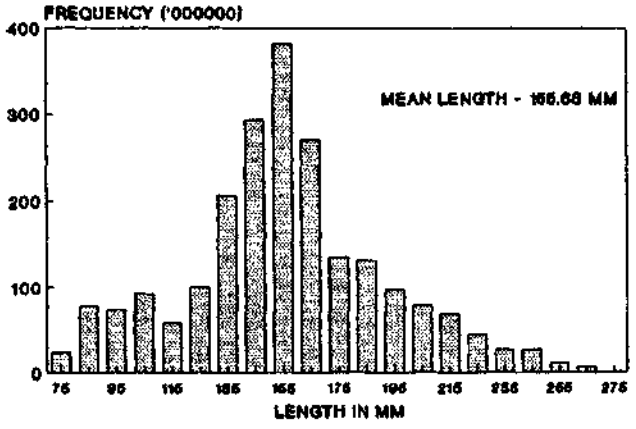


Fig. 16. Indian Mackerel - Kerala (1993-'94) length frequency distribution.

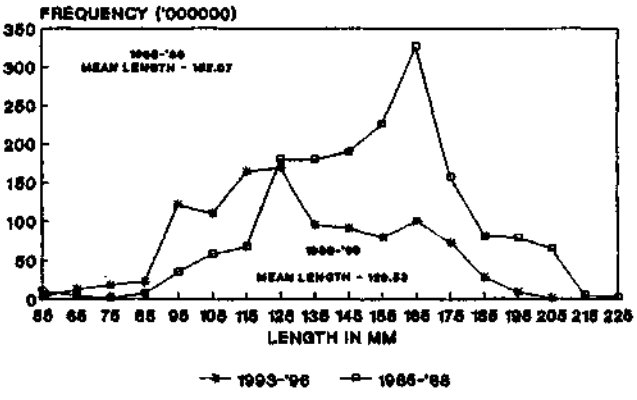


Fig. 17. Oil sardine - Kerala length frequency distribution (1986 - '88 & 1993-'96).

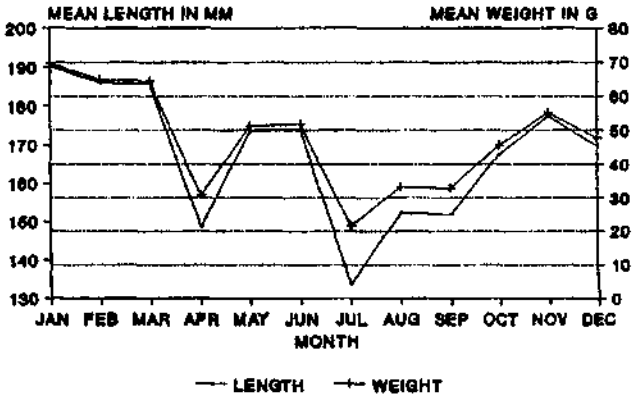


Fig. 18. Monthly mean length and weight Indian mackerel (1993-'96).

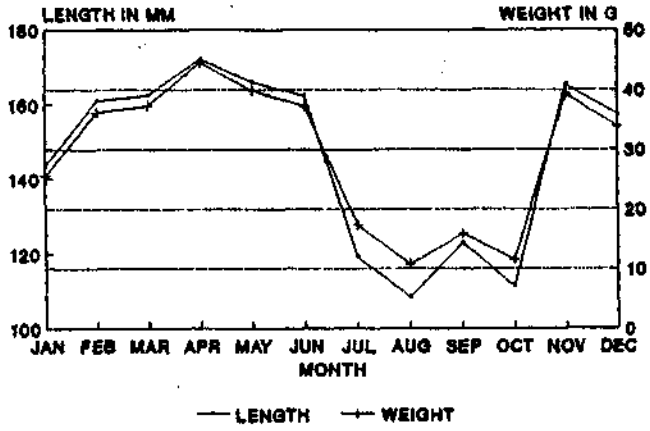


Fig. 19. Monthly mean length and weight oil sardine (1993-'96).

the case of oil sardine juveniles of length below 120 mm and weight below 15g are exploited during the period from July to October. Table 7 gives the monthly catch details of oil sardine and mackerel in different districts of the state. On an average, from 1993 to 1996 almost 50.3 % of the catch of mackerel was landed during July-September. Oil sardine catch during the period of low mean length (July-October) comes to 50 %. These are the rates at which early juveniles of most of the pelagic fishes are being exploited. As a result the fish stocks decline very fast. This growth overfishing is the result of uncontrolled development in the fishery due to intensified ringseine operations during monsoon season.

If growth overfishing is the problem caused by monsoon fisheries, the exploitation during the premonsoon period is on the spawning stocks. As the peak spawning is in May-July, exploitation during April-July is on the spawning stocks. The intensity of this kind of fishery is more towards the southern districts of Kerala (Trivandrum to Alleppey). From Table 7 it can be assumed that the new recruits of mackerel enter the fishery in full strength in September and that of oil sardine in October when they are of age less than 4 months and 5 months respectively.

TABLE 7. *Month-wise and district-wise mackerel catch (t) in Kerala (Average for 1993-'96)*

Months	TVM	QLN	ALP	EKM	TCR	MAL	CLT	KNR	KSD	Total	Percentage Numbers
Jan.	215.75	329.25	136.75	287.00	37.00	687.00	758.75	59.50	3.75	2,514.75	1.36
Feb.	187,25	310.00	68.50	128.00	23.25	64.25	108.50	97.00	5.50	992.25	0.58
Mar.	803.25	268.50	89.50	197.25	46.50	123.25	302.00	171.25	13.50	2,015.00	1.18
Apr.	446.50	827.25	199.50	469.75	7.75	330.25	272.00	203.50	65.25	2,821.75	3.47
May.	1,561.25	1,444.50	448.00	1,154.25	388.00	67.50	213.50	29.00	147.75	5,453.75	4.01
Jun.	50.25	211.00	1,088.00	813.50	1,150.00	228.75	2,005.50	468.5	1,630.25	7,645.7	5.56
Jul.	148.00	72.50	2,078.25	311.75	1,690.00	172.25	6,124.50	515.00	865.00	11,977.25	21.07
Aug.	126.50	672.00	4,530.00	1,223.00	348.50	855.2	3,524.2	844.00	235.25	5,491.75	17.62
Sep.	244.00	820.00	7,300.00	4,761.25	2,269.25	223.25	3,196.25	1,452.50	710.25	20,976.75	24.08
Oct.	240.50	636.50	5,029.25	3,385.75	1,753.50	1,754.75	1,900.75	936.25	1,591.00	17,228.25	14.23
Nov.	791.75	362.75	777.50	808.00	634.75	714.50	370.75	244.00	42.75	4,746.75	3.24
Dec.	281.00	375.75	1,146.50	658.25	29.00	423.00	1,419.50	183.00	28.50	4,544.50	3.59
Total	5,096.00	6,330.00	22,891.75	14,197.75	11,510.50	5,644.00	20,196.25	5,203.50	5,338.75	96,408.50	100.00
%	5.29	6.57	23.74	14.73	11.94	5.85	20.95	5.40	5.54	100.00	

TVM : Trivandrum, QLN : Quilon, ALP : Alleppey, EKM : Ernakulam, TCR : Trichur, Mal : Malappuram, CLT : Calicut, KNR : Kannur, KSD : Kasaragod

TABLE 8. *Month-wise and district-wise oil sardine catch (t) in Kerala (average for 1993-'96)*

Months	TVM	QLN	ALP	EKM	TCR	MAL	CLT	KNR	KSD	Total	Percentage Numbers
Jan.	1.50	123.25	424.00	80.25	449.25	0.00	122.50	21.50	7.50	1,229.75	4.02
Feb.	0.25	384.25	201.25	88.00	25.25	0.00	383.25	104.25	0.00	1,186.50	2.74
Mar.	26.00	426.75	0.00	90.00	32.75	0.00	50.25	19.75	0.50	646.00	1.44
Apr.	10.50	2,837.75	285.50	5.50	0.00	0.00	0.00	0.00	0.00	3,139.25	5.88
May.	33.00	7.75	0.00	9.25	0.00	0.00	0.00	0.00	0.00	50.00	0.10
Jun.	4.25	30.75	55.25	11.50	0.00	0.00	0.00	47.50	0.00	149.25	0.33
Jul.	0.00	4.50	335.25	333.50	744.00	0.00	453.00	0.00	0.00	1,870.25	10.88
Aug.	3.50	8.75	62.00	17.75	361.00	0.00	59.75	182.00	0.25	695.00	5.41
Sep.	49.25	257.25	201.25	830.75	340.75	19.75	2,791.50	556.50	224.25	5,271.25	27.72
Oct.	25.75	325.00	961.50	118.25	800.25	692.50	1,014.00	55.25	44.00	4,036.50	29.02
Nov.	134.50	699.25	648.50	160.25	409.00	284.75	109.00	543.25	4.75	2,993.25	6.36
Dec.	3.75	1,430.50	210.75	101.25	40.50	0.00	358.75	228.75	98.50	2,472.75	6.09
Total	292.25	6,535.75	3,385.25	1,846.25	3,202.75	997.00	5,342.00	1,758.75	379.75	23,739.75	100.00
%	1.23	27.53	14.26	7.78	13.49	4.20	22.50	7.41	1.60	100.00	

Present scenario

During 1993-'96 out of an average catch of 5.5 lakh tonnes of fish landed in Kerala, 48.4 % was contributed by mechanised trawls, 30.8 % by large seines (purseseine and ringseine), 4.1 % by boatseines, 9.2 % by gill nets, 3.8 % by hooks & line and the remaining 1.9 % by other gear (Table 9). Trawl fishery dominates in Kollam, Ernakulam and Kozhikode districts. In other districts the motorised crafts land maximum catch (Table 10). The minitrawl landing is maximum in Alleppey. The contribution by the non-mechanised fishery is of importance only in Thiruvanantha- puram district where neither the trawls nor the ringseines are operated. Even here, the non-mechanised fishery is on the decline with the spreading of motorisation. Fig. 20 shows the monthly average total catch along with the catches of ringseines and trawls. Peak catches are made in August. This is mainly due to the increase in the catches of trawl and ring seines. The poor catch during June is perhaps due to the non-operation of trawls during banperiod.

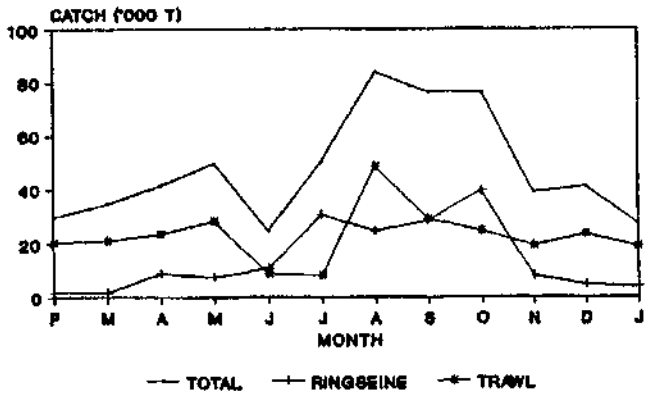


Fig. 20. Monthly catch in *Kerala* average 1993-'96.

Subsequently the ringseine catch increased to a first peak in July. Fig. 21 shows that the peak catches of ringseine are made during monsoon and subsequently there

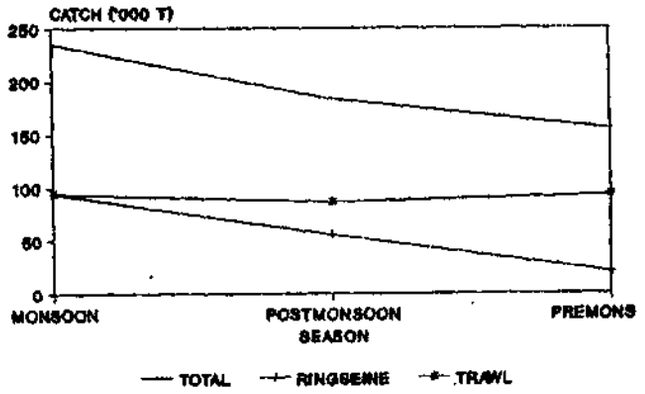


Fig. 21. Seasonwise catch in Kerala average 1993-'96.

was a steep decline in its catches. Due to lifting of the thermocline with upwelling the surface mixed layer during monsoon is v very narrow where the new recruits of the pelagic fishes get locked and become highly vulnerable to the pelagic ear. Besides the incursion of the poorly oxygenated bottom water of the entire shelf during this period push most of the demersal fish stocks to the surface (Banse, 1959). Hence, intensive exploitation by ringseines during monsoon is on the new recruits resulting in early stocks decline. However, in the trawl fishery this trend of fast decline in catches after monsoon is not observed.

TABLE 9. *Average gearwise catch (1993 -'96) in tonnes in coastal districts of Kerala*

Gear	TVM	QLN	ALP	EKM	TCR	MAL	CLT	KSD	Total	Percentage
MTN	0	1,00,899	1,831	58,993	3,124	12.38	82,717	7,032	2,66,632	48.4
OBRN	0	15,367	4,90,35	18,250	22,168	10,975	38,401	7,766	1,61,959	29.4
OBDGN	13,265	15,083	994	279	2,085	664	3,470	607	36,444	6.6
OBBS	4,135	0	0	9,331	4,835	7	25	0	18,332	3.3
OBHL	8,673	5,970	341	123	74	2	538	48	15,766	2.9
NBDGN	6,264	2,573	80	731	655	265	440	27	11,033	2.0
OBTN	0	3	6,036	28	679	133	3,196	13	10085	1.8
NMSS	6,096	1,631	23	4	0	18	1	25	7,797	1.4
PS	0	0	0	7488	0	0	0	0	7,488	1.4
NMBS	4,002	0	117	11	88	6	82	0	4,305	0.8
NMHL	3,140	648	0	49	0	0	174	0	4,010	0.7
OBDN	510	0	0	0	0	1,167	0	0	1,677	0.3
OBDIS	345	62	2	0	3	832	380	0	1,623	0.3
MDGN	0	1	0	1,535	30	6	16	0	1,587	0.3
MHL	0	10	0	891	0	0	14	0	914	0.2
NMSN	893	0	0	0	0	0	0	0	893	0.2
NMOTRS	28	0	0	36	0	0	5	0	69	0.0
OBOTRS	61	0	0	0	0	0	0	0	61	0.0
NMCN	0	0	0	36	0	0	3	0	39	0.0
NMRN	0	0	0	0	0	0	0	0	0	0.0
NMGN	0	0	0	0	0	0	0	0	0	0.0
	47,410	1,42,244	58,457	97,780	33,738	26,112	1,29457	15,518	5,50714	100.00

TABLE 10. *Districtwise total catch in average*

	Catch (t)		Effort (N)	
Trivandrum				
Mechanised	0.0	0.00	0	0.00
Motorised	26,477.5	56.46	6,56,510	52.13
Non-mechanised	20,422.0	43.54	6,02,864	47.87
Total	46,899.5	100.00	12,59,374	100.00
Quilon				
Mechanised	1,00,909.0	70.94	1,71,849	25.24
Motorised	36,482.5	25.65	3,55,422	52.20
Non-mechanised	4,852.0	3.41	1,53,613	22.56
Total	1,42,243.5	100.00	6,80,883	100.00
Alleppey				
Mechanised	1,831.0	3.13	6,324	2.85
Motorised	56,407.0	96.49	2,08513	93.94
Non-mechanised	219.0	0.37	7,137	3.22
Total	58,457	100.00	2,21973	100.00
Ernakulam				
Mechanised	68,905.5	70.47	1,43,085	50.35
Motorised	28,009.0	28.64	69,517	24.46
Non-mechanised	865	0.89	71,556	25.18
Total	97,780.0	100.00	2,84,158	100.00
Trichur				
Mechanised	3,153.5	9.35	14,829	17.32
Motorised	29,841.0	88.45	55,492	64.82
Non-mechanised	743.0	2.20	15,290	17.86
Total	33,737.5	100.00	85,610	100.00
Malappuram				
Mechanised	12,044.0	46.13	39,729	30.04
Motorised	13,779.0	52.77	77,393	58.51
Non-mechanised	288.5	1.10	15,149	11.45
Total	26,111.5	100.00	1,32,270	100.00
Kozhikode				
Mechanised	82,746.0	63.92	88,938	37.36
Motorised	46,007.5	35.54	1,19,919	50.37
Non-mechanised	703.5	0.54	29,215	12.27
Total	1,29,457.0	100.00	2,38072	100.00
Kannur				
Mechanised	10,014.5	41.42	60,200	44.96
Motorised	13,921.0	57.58	56,865	42.47
Non-mechanised	240.5	0.99	16,843	12.58
Total	24,176.0	100.00	13,3907	100.00
Kasaragod				
Mechanised	5,101.0	34.48	36,354	36.25
Motorised	9,620.5	65.03	57,583	57.41
Non-mechanised	73.0	0.49	6,359	6.34
Total	14,794.5	100.00	1,00,296	100.00

Discussion

The marine fisheries of Kerala is dominated by trawls. Trawl landings are concentrated at Calicut, Ernakulam and Quilon districts due to the availability of harbour facilities. Trawl is contributing to 488.4 to % of the the marine fish catch in Kerala and the catch is composed of more fish varieties than any other gear. The increase in fish catch after 1988 was largely due to the increase in the catch of this gear. There was an increase in the intensity and the area of fishing operation. The ban on trawling during varying periods of monsoon since 1988 also might have had a beneficial effect on the fishery as this provided favourable conditions for spawning and recruitment of fish species during the peak period of these activities.

The ringseine fishery which started in the second half of 1980s intensified in 1988 and the gear contributed substantially to the increase in catch. But the progress in ringseine fishery was partly at the cost of other surface gear like boat seine and gillnets. As the development of this fishery was uncontrolled, the exploitation was more during monsoon season on the early juveniles of pelagic fishes of age less than 5 months; as the intensive spawning and recruitment of major pelagic resources are observed during monsoon. This caused an early decline of the stocks of these species.

The major changes that took place in the fisheries of Kerala during the 1980s are the increased efficiency of exploitation and extended area of operation. Larger trawlers are going to deeper waters and were engaged in stay over fishing. The ringseine units fitted with powerful outboard engines were also exploiting deeper waters. The situation can be detrimental to the fish stocks unless they are provided with certain amount of protection in space and time for rebuilding. The ban on trawling enforced during a limited period in monsoon can be considered as a right step in this direction for the benefit of the demersal fish stocks. But the pelagic fish is still left in an unprotected condition. It is high time certain refuges are provided for the species supporting ringseine fishery also.

In an open access exploitation system as ours, conservation of stocks is beset with a lot of problems. The exploitation cannot be expected to be prudent. The gear are used according to their effectiveness without considering the biological implications or sustainability of fish stocks. The United Nations Convention of the Law of the Sea in 1982 entrusted the responsibility of protecting the fish resources of the Exclusive Economic Zone to the corresponding coastal states by judicious exploitation. Many of the coastal states signatory to this convention have not yet taken up this responsibility earnestly. In India, the Government of Kerala state has issued some orders in this direction but many are with poor enforcement record.

It is difficult to suggest methods of managing the multispecies and multigear fisheries of Kerala. A method of successional fishing can be initiated on an experimental basis. By this method, varieties of gear are used in space and time according to the biological characteristics of the fishes with an aim of protecting their spawning stock and early juveniles. As the successful spawning period of most of the fishes is during May-July, the fishing during this period has to be regulated to protect the spawning stock. During this period all gear other than large meshed (above 80 mm) drift gill nets and hooks and line that exploit larger fishes like seerfishes, tunas, sharks, perches, etc. should be strictly controlled. After July operation of gill nets of mesh size above 40 mm may be ecouraged to catch the post-spawners. This will avoid the exploitation of new recruits from the May-July spawning. If the fishermen prefer seines or purse seines the mesh size has to be regulated to 40 mm. All kinds of gear that are presently used may be allowed to operate during October-March under strict vigil. Trawling (including minitrawling) in the inshore waters should be controlled from May to September to protect spawners, spawning activity and the juveniles of fishes.

Under the present condition of the marine fisheries in Kerala with a long history of uncontrolled development these measures may seem to be extremely rigorous. But the fishery will get adapted to the controls. Reduction in the juvenile fishery can cause a surge in the drift net and hooks and line fishery due to predator-prey relationship. By allowing optimum growth of the new recruits the quality and quantity of the yield can be improved many fold and can sustain the production. Besides this will facilitate the maximum use of the productivity of our waters by taking full advantage of the plankton bloom with upwelling. The food chain of plankton/detritus, plankton feeders/detritus feeders and the carnivores will not get interrupted. Bottom trawling ia a destructive way of fishing. Many countries have banned trawling in their coastal waters. It affects the benthos and the production of meroplankton. However, the amount of yield from trawl fisheries and its economic importance cannot be overlooked. Its operation has to be restricted to areas with a depth more than 35 metres.

Management of the fisheries can be made more effective if the actual fishermen are involved in the decision making. Fishermen cooperatives can be formed which can be vested with the responsibility of protecting the fish-

eries resources they exploit. They can be made aware of the biological and environmental basis for sustainability of fish stocks by constant interactions with the scientific community. Such interactions will be beneficial to the fishermen, fisheries, the fishery scientists and the policy makers. Besides it will make the implementation of the management options smooth and effective.

Fishery management policies are seldom final. We are dealing with a highly dynamic biosphere where upheavals can take place without our knowledge. Hence, any management strategy should be reviewed and corrected from time to time.

Acknowledgment

The authors are thankful to Dr. M. Devaraj, Director, Central Marine Fisheries Research Institute, Cochin for suggesting this study. We are also grateful to Mr. K.N. Kurup, Head, Fisheries Resources Assessment Division, CMFRI for making available the marine fish landing data used in this analysis, also for critically going through the manuscript and making valuable comments.

Table 5. *Change in the fishery of major gear in Kerala between periods 1985-'87 and 1993-'95. (average catch in tonnes).*

I. Trawl fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Cephalopods	6,169	33,521	27,352	443.38
Scads	1,277	20,672	19,395	1,518.79
Thread fin breams	27,833	42,695	14,862	53.40
Penaeid prawns	31,972	42,787	10,815	33.83
Other perches	2,605	9,807	7,202	276.47
Lizard fishes	5,827	12,772	6,954	119.19
Stolephorus	2,402	9,219	6,817	283.81
Stomatopods	9,156	15,527	6,371	69.58
Ribbon fishes	2,238	8,570	6,332	282.93
Soles	7,073	13,040	5,967	84.36
Other carangids	3,156	8,035	4,879	154.59
Croakers	4,846	8,783	3,937	81.24
Indian mackerel	215	4,151	3,936	1,830.70
Rock cods	53	3,250	3,197	60,32.08
Barracudas	389	2,819	2,430	624.68
Crabs	1,406	3,805	2,399	170.63
Thryssa sp.	768	2922	2154	280.47
Horse mackerel	9	1,878	1,869	20,766.67
Sharks	405	2,113	1,708	421.73
Other clupeids	298	1,594	1,296	434.90
Half beaks & full beaks	2	890	888	44,400.00
Wolf herring	143	927	784	548.25
Gastropods	0	744	744	-1.00
Goat fishes	284	982	698	245.77
Rays	743	13,51	608	81.83
S. commersoni	15	619	604	4,026.67
Silver pomfret	127	592	465	366.14
Chinese pomfret	2	273	271	13,550.00
Black pomfret	62	331	269	433.87
Halibut	35	225	190	542.86
Silverbellies	2,792	2,944	152	5.44
Lobsters	35	150	115	328.57
Leather-jackets	0	109	109	-1.00
S. guttatus	3	92	89	2966.67
Skates	3	91	88	2,933.33
Other sardines	31	106	75	241.94
Eels	5	68	63	1,260.00
Flounders	65	109	44	67.69
Snappers	0	36	36	-1.00
E. affinis	1	7	6	600.00
Pig-face breams	0	6	6	-1.00
Flying fishes	1	7	6	600.00
Hilsa shad	1	4	3	300.00
Other tunnies	1	4	3	300.00
Auxis spp.	1	4	3	300.00
Other shads	12	3	-9	-75.00
Non-penaeid prawns	13	2	-11	-84.62
Threadfins fishes	53	32	-21	-39.62
Big-jawed jumper	445	401	-44	-9.89
Oil sardine	92	11	-81	-88.04
Mullets	188	25	-163	-86.70
Catfishes	1,113	202	-911	-81.85
Miscellaneous	4,454	17,361	12,907	289.78
All fish	1,18819	2,77,274	1,58,455	133.36
Effort (units)	4,53,085	6,13,085	1,60,000	35.31

II. Outboard boatseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	2,564	3,148	584	22.78
Mullets	58	310	252	434.48
Non-penaeid prawns	43	67	24	55.81
Hilsa shad	0	6	6	-1.00
Halibut	0	0	0	
Auxis spp.	1	0	-1	-100.00
Lizard Fishes	3	3	0	0.00
Goat Fishes	3	0	-3	-100.00
S. guttatus	4	0	-4	-100.00
Rays	13	8	-5	-38.46
Wolf herring	5	0	-5	-100.00
Crabs	7	1	-6	-85.71
Bill fishes	7	0	-7	-100.00
S. commersoni	11	3	-8	-72.73
Threadfin breams	8	0	-8	-100
Catfishes	12	3	-9	-75.00
Black pomfrets	76	59	-17	-22.37
Sharks	22	1	-21	-95.45
Barracudas	65	44	-21	-32.31
Stomatopods	44	0	-44	-100.00
Silver pomfrets	70	26	-44	-62.86
Unicorn cod	46	0	-46	-100.00
Half beaks & full beaks	98	45	-53	-54.08
Big-jawed jumper	272	63	-209	-76.84
Horse mackerel	317	0	-317	-100.00
Other sardines	1,788	1,408	-380	-21.25
Cephalopods	453	29	-424	-93.60
E. affinis	474	0	-474	-100.00
Thryssa	931	414	-517	-55.53
Leather-jackets	600	43	-557	-92.83
Soles	567	7	-560	-98.77
Other perches	1,601	540	-1,061	-66.27
Silverbellies	1,413	151	-1,262	-89.31
Other clupeids	2,897	1,572	-1,325	-45.74
Ribbon fishes	2156	128	-2,028	-94.06
Croakers	3,593	1,142	-2,451	-68.22
Penaeid prawns	4,162	145	-4,017	-96.52
Scads	7,790	980	-6,810	87.42
Other carangids	8,343	358	-7,985	95.71
Stolephorus	13,263	1,592	-11,671	-88.00
Oil sardine	32,191	1,144	-3,10471-	-96.45
Miscellaneous	312	107	-205	-65.71
All fish	86,284	13,590	-72,694	-84.25
Effort (Units)	2,34,678	39,669	-1,95,009	-83.10

III. Ringseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	8,194	60,712	52,518	640.93
Scads	3,549	30,807	27,258	768.05
Stolephorus	3,250	22,409	19,159	589.51
Other sardines	2,702	20,480	17,778	65.96
Penaeid prawns	1,263	5,971	4,708	372.76
Other clupeids	1,610	577	41,67	258.82
Coakers	246	2,047	1,801	732.11
Other perches	695	2,397	1,702	244.89
Auxis spp.	0	1,404	1,404	-
Thryssa	298	1,265	967	324.50
Silver bellies	75	797	722	962.67
Black pomfrets	174	579	405	232.76
E. affinis	168	417	249	148.21
Soles	27	220	193	714.81
Chinese pomfret	0	120	120	-
S. commersoni	76	145	69	90.79
Mullets	70	138	68	97.14
Big-jawed jumper	11	77	66	600.00
Ribbon fishes	2	52	50	2,500.00
Barracudas	6	45	39	650.00
Cephalopods	2	38	36	1,800.00
Rays	1	27	26	2,600.00
Elasmobranchs	0	21	21	-
Sharks	1	15	14	1,400.00
Bill Fishes	0	14	14	-
Wolf herring	3	12	9	300.00
clupeids	0	7	7	-
Rock cods	0	5	5	-
S. guttatus	8	10	2	25.00
Threadfin breams	0	2	2	-
Threadfin fishes	0	2	2	-
Skates	0	1	1	-

Seer fishes	0	1	1	-
Other shads	11	11	0	0.00
Silver pomfrets	89	65	-24	-26.97
Oil sardine	16,228	16,151	-77	-0.47
Leather jackets	169	63	-106	-62.72
Half beaks & full beaks	267	124	-143	-53.56
Catfishes	574	9	-565	-98.43
Horse mackerel	1,558	430	-1,128	-72.40
Other caerangids	3,768	2,477	-1,291	-34.26
Miscellaneous	220	619	399	181.36
All fish	45314	1,75,964	1,30,650	288.32
Effort (units)	79,800	2,28,607	148,807	186.47

TABLE 5. *Change in catch per effort (kg) of major gear in Kerala between the periods 1985-'87 and 1993-'95*

I. Trawl fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Cephalopods	13.61	54.68	41.07	301.76
Scads	2.82	33.72	30.90	1,095.74
Thread fin breams	61.43	69.64	8.21	13.36
Penaeid prawns	70.57	69.79	-0.78	-1.11
Other perches	5.75	16.00	10.25	178.26
Lizard Fishes	12.86	20.83	7.97	61.98
Stolephorus	5.30	15.04	9.74	183.77
Stomatopods	20.21	25.33	5.12	25.33
Ribbon fishes	4.94	13.98	9.04	183.00
Soles	15.61	21.27	5.66	36.26
Other carangids	6.96	13.11	6.15	88.36
Croakers	10.70	14.33	3.63	33.93
Indian mackerel	0.47	6.77	6.30	1,340.43
Rock cods	0.12	5.30	5.18	4,316.67
Brracudas	0.86	4.60	3.74	434.88
Crabs	3.10	6.21	3.11	100.32
Thryssa	1.70	4.77	3.07	180.59
Horse mackerel	0.02	3.06	3.04	1,52,00.00
Sharks	0.89	3.45	2.56	287.64
Other clupeids	0.66	2.60	1.94	293.94
Half beaks & full beaks	0.00	1.45	1.45	287.64
Wolf herring	0.32	1.51	1.19	371.88
Gastropods	0.00	1.21	1.21	-1.00
Goat fishes	0.63	1.60	0.97	153.97
Rays	1.64	2.20	0.56	34.15
S. commersoni	0.03	1.01	0.98	3,266.67
Silver pomfret	0.28	0.97	0.69	246.43
Chinese pomfret	0.01	0.45	0.44	4,400.00
Black pomfret	0.14	0.54	0.40	285.71
Halibut	0.08	0.37	0.29	362.50
Silver bellies	6.16	4.80	-1.36	-22.08
Lobsters	0.08	0.25	0.17	212.50
Leather-jackets	0.00	0.18	0.18	-1.00
S. guttatus	0.01	0.15	0.14	1,400.00
Skates	0.01	0.15	0.14	1,400.00
Other sardines	0.07	0.17	0.10	142.86
Eels	0.01	0.11	0.10	1,000.00
Flounders	0.14	0.18	0.04	28.57
Snappers	0.00	0.06	0.06	-1.00
E. affinis	0.00	0.01	0.01	-1.00
Pig-face breams	0.00	0.01	0.01	-1.00
Flying fishes	0.00	0.01	0.01	-1.00
Hilsa shad	0.00	0.01	0.01	-1.00
Other tunnies	0.00	0.01	0.01	-1.00
Auxis spp.	0.00	0.01	0.01	-1.00
Other shads	0.03	0.00	-0.03	-100.00
Non-penaeid prawns	0.03	0.00	-0.03	-100.00
Threadfin fishes	0.12	0.05	-0.07	-58.33
Big-jawed jumper	0.98	0.65	-0.33	-33.67
Oil sardine	0.20	0.02	-0.18	-90.00
Mullets	0.41	0.04	-0.37	-90.24
Catfishes	2.46	0.33	-2.13	-86.59
Miscellaneous	9.83	28.32	18.49	188.10
All fish	262.24	452.26	190.02	72.46
Effort (units)	4,53,085	6,13,085	1,60,000	3,31

II. Outboard boatseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	10.92	79.35	68.43	626.65
Mullets	0.25	7.81	7.56	3,024.00
Non-penaeid prawns	0.18	1.68	1.50	833.33
Hilsa shad	0.00	0.14	0.14	-1.00
Halibut	0.00	0.00	0.00	-1.00
Auxis spp.	0.00	0.00	0.00	-1.00
Lizard fishes	0.01	0.07	0.06	600.00
Goat fishes	0.01	0.00	-0.01	-100.00

S.guttatus	0.02	0.00	-0.02	-100.00
Rays	0.05	0.20	0.15	300.00
Wolf herring	0.02	0.00	-0.02	-100.00
Crabs	0.03	0.03	0.00	0.00
Bill fishes	0.03	0.00	-3.03	-100.00
S. commersoni	0.05	0.08	0.03	60.00
Threadfin breams	0.03	0.00	-0.03	-100.00
Catfishes	0.05	0.08	0.03	60.00
Black pomfrets	0.32	1.50	1.18	368.75
Sharks	0.09	0.02	-0.07	-77.78
Barracudas	0.28	1.10	0.82	292.86
Stomatopods	0.19	0.00	-0.19	-100.00
Silver pomfrets	0.30	0.66	0.36	120.00
Unicorn cod	0.19	0.00	-0.19	-100.00
Half beaks & full beaks	0.42	1.13	0.71	169.05
Big-jawed jumper	1.16	1.59	0.43	37.07
Horse mackerel	1.35	0.00	-1.35	-100.00
Other sardines	7.62	35.50	27.88	365.88
Cephalopods	1.93	0.73	-1.20	-62.18
E. affinis	2.02	0.00	-2.02	-100.00
Thryssa	3.97	10.44	6.47	162.97
Leather-jackets	2.56	1.09	-1.47	-57.42
Soles	2.41	0.18	-2.23	-92.53
Other perches	6.82	13.61	6.79	99.56
Silverbellies	6.02	3.80	-2.22	-36.88
Other clupeids	12.34	39.62	27.28	221.07
Ribbon fishes	9.19	3.22	-5.97	-64.96
Croakers	15.31	28.80	13.49	88.11
Penaeid prawns	17.74	3.65	-14.09	-79.43
Scads	33.19	24.71	-8.48	-25.55
Other carangids	35.55	9.02	-26.53	-74.63
Stolephorus	56.51	40.12	-16.39	-29.00
Oil sardine	137.17	28.83	-108.34	-78.98
Miscellaneous	1.33	2.71	1.38	103.76
All fish	367.67	342.59	-25.08	-6.82
Effort (units)	2,34,678	39,669	-195,001	-83.10

III. Ringseine fishery

Name of species	1985-'87	1993-'95	Relative growth	
			In catch	In %
Indian mackerel	103	266	163	158.25
Scads	44	135	91	206.82
Stolephorus	41	98	57	139.02
Other sardines	34	90	56	164.71
Penaeid prawns	16	26	10	62.50
Other clupeids	20	25	5	25.00
Croakers	3	9	6	200.00
Other perches	9	10	1	11.11
Auxis spp.	0	6	6	-1
Thryssa	4	6	2	50.00
Silverbellies	1	3	2	200.00
Black pomfrets	2	3	1	50.00
E. affinis	2	2	0	0.00
Soles	0	1	1	-1
Chinese pomfret	0	1	1	-1
S. commersoni	1	1	0	0.00
Mullets	1	1	0	0.00
Big-jawed jumper	0	0	0	-1
Ribbon fishes	0	0	0	-1
Barracudas	0	0	0	-1
Cephalopods	0	0	0	-1
Rays	0	0	0	-1
Elasmobranhs	0	0	0	-1
Sharks	0	0	0	-1
Bill fishes	0	0	0	-1
Wolf herring	0	0	0	-1
Clupeids	0	0	0	-1
Rock cods	0	0	0	-1
S. guttatus	0	0	0	-1
Threadfin breams	0	0	0	-1
Thread	0	0	0	-1
Skates	0	0	0	-1
Seer fishes	0	0	0	-1
Other shads	0	0	0	-1
Silver pomfrets	0	0	0	-1
Oil sardine	203	71	-132	-65.02
Leather-jackets	2	0	-2	-100.00
Half beaks & full beaks	3	1	-2	-66.67
Catfishes	7	0	-7	-100.00
Horse mackerel	20	2	-18	-90.00
Other cearangids	47	11	-36	-76.60
Miscellaneous	3	3	0	0.00
All fish	567.84	769.72	201.88	35.55
Effort (units)	79,800	2,28,607	1,48,807	186.47