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THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

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CONTENTS

Cover photo: Little tunas landed at the Fisheries Harbour, Cochin by the drift gill nets.

FOCUS ON SMALL SCALE FISHERIES: DRIFT GILLNET FISHERY OFF COCHIN, 1981 AND 1982

E. G. Silas, P. Parameswaran Pillai, A. A. Jayaprakash and M. Ayyappan Pillai

Introduction

The main emphasis in the marine fisheries development programme during the first three Five Year Plan periods and the following three Annual Plans was on the mechanisation of fishing crafts existing at that period and introduction of new mechanised fishing boats. With the advent of mechanisation in the fishery sector, development of diversified fishing methods in the artisanal fishery has gathered momentum. In recent years, the drift gillnet fishery has become one of the fast growing fishing methods in the coastal fishing sector because of its economic viability and selectivity for catching larger pelagics which find ready acceptance and consumer demand in the market. However, experience has shown that the fishermen engaged in this fishery by and large are not benefitted fully commensurate with the effort expended by them, mainly because of their financial constraints to acquire, own and operate the mechanised boats, and their dependence on 'middle men' for disposal of the catch. The present report embodies the result of the study carried out on the mechanised drift gillnet fishery off Cochin and the cost-benefits of the operation during the period 1981 and 1982.

The mechanised drift gillnet fishery, commenced in the inshore waters of Cochin in 1969, and in 1977 about 90 small mechanised *(pablo type)* boats were in operation using nylon drift gillnets, with base at Fort Cochin. The Cochin Fisheries Harbour, constructed at a cost of Rs. 4.0 crores and controlled by the Cochin Port Trust was commissioned in 1978. About 130 drift gillnetters were registered in 1979 in the harbour where facilities for handling, packing and transport of the catch are available. The berthing charges levied by the Harbour authorities for gillnet boats with catch till 1981 was Rs. 3 per day which was enhanced to Rs. 4 in 1982. Similarly, from 1982, charges for utilizing space for net repairs for gillnets at the rate of Rs. 5 per day was also introduced. Fishermen from Kanyakumari District constituted ninetyfive percent of the personnel engaged in the operation of the drift gillnets off Cochin. The agents, merchants and the labourers attached to them manage the disposal and marketing of the fishes landed at the Fisheries Harbour.

Fishing area

The area of operation of the drift gillnetters is generally in the 20–50 m depth zone off Cochin (Fig. 1). As the drift gillnet operations are confined to the surface and mid-depth zones at the fishing grounds, a brief review of the hydrographic features of the area during 1981 and 1982 is presented here *(C. P. Ramamritham,* Personal communication).

The overall intensity of upwelling during 1981 was less than that in 1980. During the monsoon season of 1981, a noticeable intermittent upwelling occurred during August in the inshore area off Cochin. By late October, the monsoon features disappeared and during November more or less uniform temperature conditions prevailed from surface to bottom. By December, there was an overall increase in temperature and salinity with inversion of the upper layers.

Summer of 1982 was associated with a noticeable decrease in the dissolved oxygen content in the whole vertical column of water. The summer temperature values in the region were of the order of 30–32°C. During the monsoon of 1982, the peak upwelling was noticed during mid-July. At the 20 m depth zone, thermocline could be observed at 5m depth with a temperature record of 22.5°C at 10m level. By mid-August, the inshore belt of this area was occupied by a single cold water mass of temperature between 23.0 and 24.5°C. During monsoon, the surface dilution was drastic and the surface bottom difference in the salinity was nearly 10‰. The changeover from monsoon was observed during September to October period. The waters have become warmer with a noticeable increase in dissolved oxygen content, and by December end a more or less isothermal water column was established in this area with oxygen values of nearly 80% of the saturation values at the said temperature and salinity.

Material and Methods

Weekly four trips amounting to 16 days in a month were made to the Fisheries Harbour, Cochin for the field sampling programme during 1981 and 1982 to estimate the daily, monthly and year-wise catch and effort. Regular catch and effort data were maintained by monitoring the catch and species composition by random sampling. To estimate the monthly species-wise composition and 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.

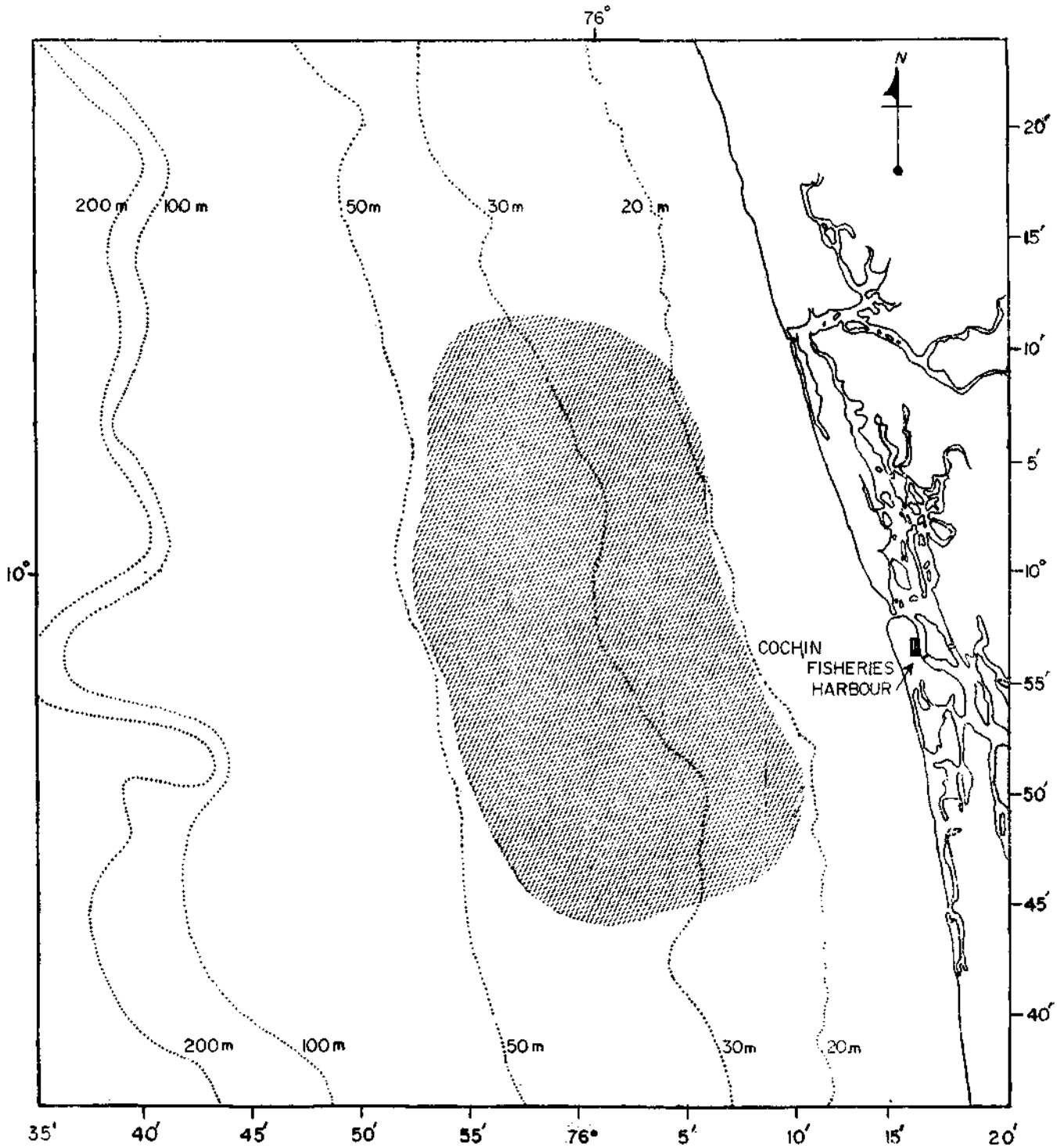


Fig. 1. Map showing the area of operation of drift gillnetters off Cochin

Regular price structure of each species were noted when the catch was unloaded are auctioned by the commission agents. Fishes such as tunas were auctioned at a price fixed per fish after separating the lot into large, medium and small specimens. By counting the number and price per fish in each lot in a boat the price per kilogram and the income for the boat was calculated. During the peak fishing season some of the larger fishes such as carangids *(Scomberoides commersonianus)* and catfishes were also auctioned by bidding the highest

price per fish. The date-wise variation in the price structure of various fishes were recorded for the monthly computation of the price structure of different species, and for the estimation of details of economics of operation.

Data regarding the cost of the boat, net and other accessories and operational expenditure were collected after interviewing 25 boat-owners and fishermen actually involved in the profession.

Fishing Fleet

Crafts

The size of the mechanised boats *(Pablo type)* operating off Cochin range from 7.62 to 9.14 m (Pl. I). Sixty percent of the boats are fitted with 'Ruston' two cylinder (24 Hp) or three cylinder (38 Hp) engines, and the rest use 'Bukh' two cylinder (30 Hp) or three cylinder (45 Hp) and 'Yanmar' two cylinder (30 Hp) engines. The mechanised boats are owned by local persons and the fishermen especially from Kanyakumari, Tamil Nadu.

Gear

Tamil Nadu fishermen own ninetyfive per cent of the gears being operated at this centre. The total length of the net varies from 800–1000 m and depth 4–8 m. During operation, usually 9–12 pieces are plied together and proper sinkers and floats are attached for maintaining buoyancy. The net is fabricated from No. 6 or 8 or 22 nylon monofilament and it is occassionally treated with indigenous concoctions made from various natural materials such as the husk of the tamarind or fruit of palm tree. Mesh size (stretched) of the net usually varies between 7 and 13 cm (Pl. I).

Operational details

The fishermen start from their base by 1600 Hrs and reach the fishing ground by 2000 Hrs. Setting and hauling time range from 1 to 2 Hrs depending on the size of the net and catch respectively. Soaking time usually range between 3 to 4 hrs. The fishermen get back to the Fisheries Harbour to unload the catch between 0600–0900 hrs.

Production

Effort distribution

An estimated total of 22,642 units were operated in 1981 but only 19,894 units were operated in 1982. Monthly distribution of the effort expended in the drift gillnet fishery during 1981 and 1982 are presented in Fig. 2. Maximum number of units were in operation during May to August which amount to 51% of the total annual effort at this centre. During the post-monsoon period, the effort expended was relatively low in both the years.

Catch

Total annual estimated landings by the drift gillnet fishery in 1981 and 1982 were 2,476 and 1,849 tonnes respectively which indicate that the annual landing sharply decreased by 25.3% in 1982 as compared to that in 1981. The annual catch per unit effort of 109.3 kg in 1981 also decreased to 93.2 kg in 1982. Monthly distribution of catch per unit effort during 1981 and 1982 is presented in Fig. 2. It is evident that relatively high values of c/f were realised in the months of April and July–October in 1981 whereas the productive months in 1982 were April, May and July–October.

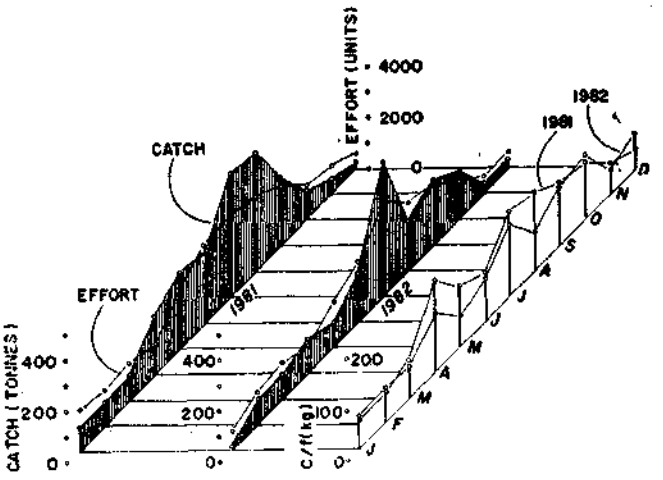


Fig. 2 Month-wise total catch and effort expended and CPUE in the gillnet fishery during 1981 & 1982

Species composition

Different species landed by the drift gillnets during 1981 and 1982 are presented in Table 1. Though the fishery has taken several species, the important groups among them were tunas and billfishes, seerfishes, catfishes, pelagic sharks, pomfrets and carangids. Cobia, dolphin fish, barracuda and wolfherring were quantitatively not significant, but were common in the drift gillnet fishery during certain months.

Annual percentage composition of major groups in the total landings during 1981 and 1982 is presented in Fig. 3. Tunas and billfishes constituted more than 45 per cent of the total landings in both the years, followed by catfishes (14%), elasmobranchs (13.5%), seerfishes (11%), carangids (6%), pomfrets (5%), mackerel (3.5%) and others (3%). The percentage composition of dolphins in the total drift net catch was not significant (1%).

Catch composition

Estimated monthly landing of different groups of fishes in 1981 and 1982 are presented in Table 2. In order to delineate the productive periods, the catch per effort of major groups during these years are presented in Figs. 4 and 5.

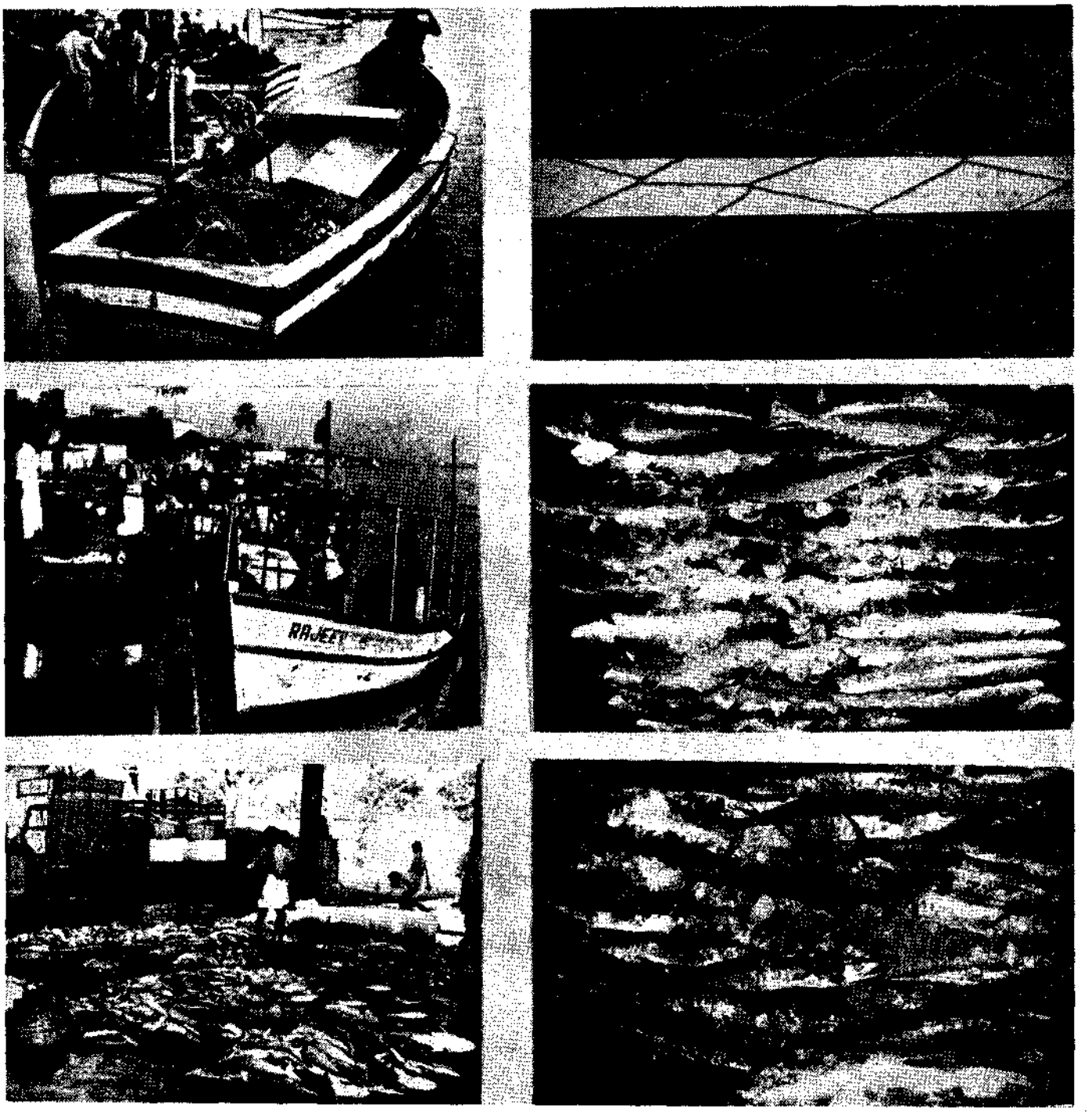


Plate I. Typical drift gillnetters, part of the net being used and different categories of fishes landed at the Cochin Fisheries Harbour.

Tunas and billfishes

The percentage contribution of tunas and billfishes to the total catch by the drift gillnet were 49.5% and 46.1% during 1981 and 1982 repectively. The estimated total landings of tunas and billfishes was 1,225 tonnes in 1981 which dwindled to 852 tonnes in 1982. Tuna catches comprised mainly of *E. affinis*, *A. thazard* and *T. tonggol* followed by *A. rochei*, *S. orientalis* and *T. albacares*. The former three species occurred in all the months in both the years whereas *A. rochei* and *S. orientalis* were present in stray numbers in the pre-monsoon period and *K. pelamis* was recorded sporadically during February to May in 1981. The percentage com-

position of *E. affinis* to the total tuna catch during 1981 was 62.6% which was reduced to 36.6% in 1982. The contribution of *A. thazard* to total tuna landings increased from 31.6% in 1981 to 57.1% in 1982. *T. tonggol* contributed to about 1.4% of the total tuna catch in both the years.

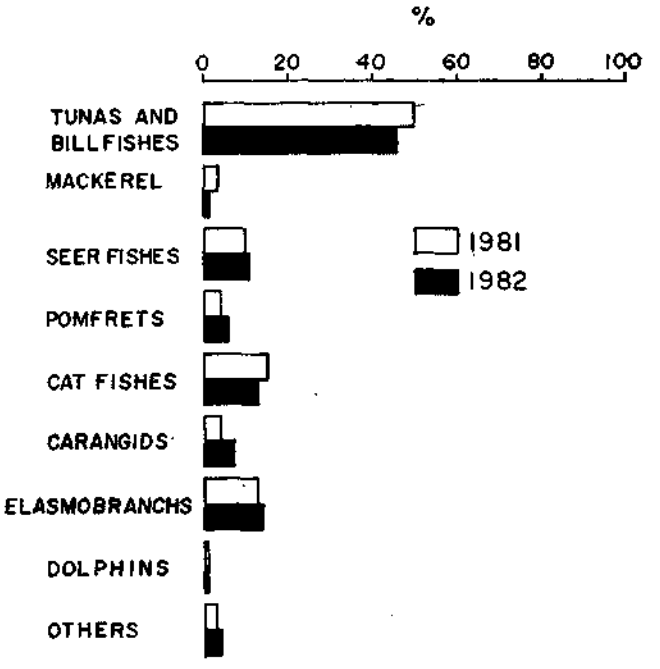


Fig. 3. Annual percentage composition of major groups of fishes landed by drift gillnet during 1981 and 1982.

Billfishes were mainly represented by the sailfish and occasionally the black marlin. The potentiality of this resource in the inshore waters remains under exploited. Total catch of billfishes accounted for about 16 tonnes in both the years. Monthly c/f of these groups indicate that April–September period was more productive in both the years.

Seerfishes

S. commerson and *S. guttatus* supported the seerfish fishery at Cochin. *S. lineolatus* was recorded only once in January 1982. *S. commerson* dominated in the catches from August to February. It constituted the major species in the catch accounting to 97.6% and 85.8% of the total seerfishes landings in 1981 and 1982 respectively, a decline of 14% from 1981 to 1982. *S. guttatus* occurred in good numbers during August–October and this species contributed to 2.4% of the total seerfish landings in 1981 which was increased to 14.1% in 1982. The c/f of seerfishes during different months indicate that the productive period of this group was during August to April in both the years.

Pomfrets

Pomfrets were represented by two species, *Formio niger* and *Pampus argenteus* and they contributed to 4.2% and 5.3% of the annual total landings of all fishes by the drift gillnets during 1981 and 1982 respectively. The total landing of pomfrets in 1982 was 98 tonnes as compared to that in 1981 (105 tonnes) *F. niger* contributed to 91% and 71% and *P. argenteus* 9% and 29% of the total pomfret landings in 1981 and 1982 respectively. Fluctuation in the c/f of these species indicate that August–November period accounted for bulk of the catches of pomfrets in the area.

Table 1. *A check list of species landed by drift gillnets during* 1981 *and* 1982 *at Cochin*

Family	Scientific name	Common name
	Fishes	
SCOMBRIDAE	*Rastrelliger kanagurta*	Indian mackerel
	* *Scomberomorus commerson*	Narrow barred seerfish
	* *S. guttatus*	Indo-Pacific seerfish
	S. lineolatus	Streaked seerfish
	Acanthocybium solandri	Wahoo
	* *Euthynnus affinis*	Little tuna
	* *Auxis thazard*	Frigate tuna
	A. rochei	Bullet tuna
	Sarda orientalis	Oriental is bonito
	* *Thunnus tonggol*	Longtail tuna
	T. albacares	Yellowfin tuna
	Katsuwonus pelamis	Skipjack tuna
ISTIOPHORIDAE	*Istiophorus platypterus*	Sailfish
	Makaira indica	Black marlin
FORMIONIDAE	* *Formio niger*	Black pomfret
STROMATEIDAE	* *Pampus argenteus*	Silver pomfret
	P. chinensis	Chinese pomfret
ARIIDAE	* *Arius serratus*	Common catfish
	* *A. dussumieri*	Dussumieri's catfish
	* *A. thalassinus*	Giant catfish
	A. tenuispinis	Slender spined catfish
CARANGIDAE	* *Alepes djeddaba*	Djeddaba crevelle
	Seriola nigrofasciata	Black banded kingfish

Table 1 (contd)

		Caranx melampygus	Black tipped travally
		C. stellatus	
		C. sexfasciatus	Dusky travelly
		C. ferdau	Ferdau's travelly
		Elagatis bipinnulatus	Rainbow runner
		Megalaspis cordyla	Hardtail scad
	*	*Scomberomorus commersonianus*	Talang queenfish
		S. tol	Slender queenfish
RACHYCENTRIDAE	*	*Rachycentron canadus*	Cobia
CORYPHAENIDAE	*	*Coryphaena hippurus*	Dolphin fish
POMADASYDAE		*Pomadasys hasta*	Grunts
SERRANIDAE		*Epinephelus* spp.	Groupers
LOBOTIDAE		*Lobotes surinamensis*	Brown tripple tail
MURAENOSOXIDAE		*Congresox talabonoides*	Indian pike conger
BELONIDAE		*Strongylura crocodilus*	Fork-tail Alligator gar
		Ablennes hians	Barred needlefish
MEGALOPIDAE		*Megalops cyprinoides*	Indo-Pacific tarpon
POLYNIMIDAE		*Polynemus sextarius*	Black-spot threadfin
CLUPEIDAE		*Sardinella longiceps*	Oil sardine
SPHYRAENIDAE	*	*Sphyraena jello*	Banded barracuda
CHIROCENTRIDAE	*	*Chirocentrus dorab*	Wolf herring
SYNODONTIDAE		*Saurida tumbil*	Greater lizard-fish
PSETTODIDAE		*Psettodes erumei*	Indian halibut
MENIDAE		*Mene maculata*	Moonfish
TRICHIURIDAE		*Trichiurus* spp	Ribbonfish
GALEIDAE	*	*Carcharinus melanopterus*	Black shark
	*	*C. limbatus*	Grey shark
		C. macloti	Hardnose shark
	*	*Rhizoprionodon acutes*	Grey dogshark
		R. oligolinx	Dogshark
	*	*Scoliodon sorrakowah*	Dogshark
	*	*S. walbeehmi*	—
	*	*Hemigaleus balfouri*	—
SPHYRNIDAE	*	Sphyrna zygaena	Round-headed hammer headed shark
MOBULIDAE	*	*Mobula diabolus*	Lesser devil ray
MYLIOBATIDAE		*Aetobatus narinari*	
	*	*Rhinoptera javanica*	Javanese cowray
PRISTIDAE		*Pristis microdon*	Small toothed sawfish

Marine Mammals

	Delphinus delphis	Common dolphin
	Tursiops aduncus	Spotted dolphin

* Species which occur commonly in the drift gillnet catches at Cochin.

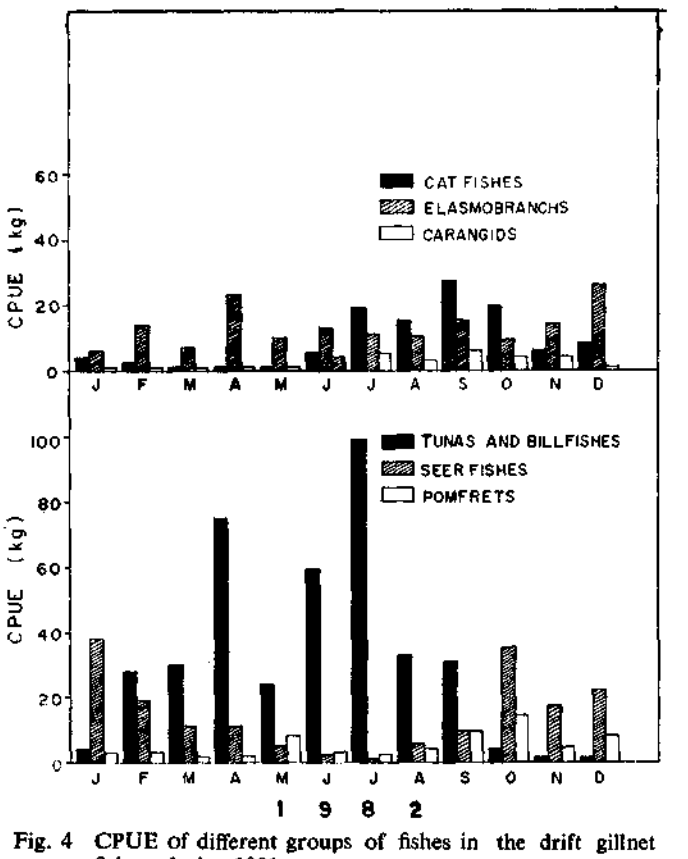


Fig. 4 CPUE of different groups of fishes in the drift gillnet fishery during 1981.

Elasmobranchs

The drift gillnet catches were invariably dominated by *Carcharinus melanoptera, C. limbatus, Scoliodon*

Table 2. *Estimated month-wise landings of major groups of fishes (in tonnes) and the effort expended by drift gillnets at Cochin Fisheries Harbour during* 1981 *and* 1982

Major groups of fishes	Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Tunas and billfishes	1981	0.66	2.56	3.09	171.99	219.18	296.57	339.05	159.87	110.50	13.81	5.63	2.08	1,224.99
	1982	2.50	34.33	43.27	74.83	43.86	131.44	352.45	84.67	77.65	6.34	0.59	0.14	852.07
Seerfishes	1981	23.20	16.50	10.15	8.84	12.26	1.25	15.16	89.25	8.02	17.60	22.81	10.99	236.03
	1982	23.03	22.67	15.90	10.76	9.59	3.36	3.25	12.49	22.28	55.32	12.48	13.73	204.88
Mackerel	1981	0.53	6.44	0.94	1.19	22.56	1.74	3.03	3.86	22.31	0.27	0.03	0.26	63.15
	1982	0.91	0.32	1.41	0.85	0.88	1.88	1.37	3.92	0.16	0.61	0.32	—	12.62
Pomfrets	1981	7.92	3.02	2.32	2.62	20.74	4.08	5.90	20.15	8.84	18.98	6.91	3.27	104.76
	1982	1.93	3.38	1.76	1.54	14.41	6.80	5.68	10.07	23.46	21.14	2.71	5.37	98.24
Catfishes	1981	12.51	20.57	35.14	10.18	2.62	29.21	44.70	100.52	64.90	28.05	11.84	6.81	367.06
	1982	2.12	2.12	1.57	6.52	1.31	10.88	68.25	37.64	67.22	29.96	4.04	5.33	231.08
Carangids	1981	1.47	2.46	0.12	2.26	0.48	4.21	27.85	19.99	21.44	20.31	1.37	5.24	107.21
	1982	0.64	0.71	1.42	0.90	0.80	8.72	19.82	6.90	14.10	64.52	3.03	0.39	121.95
Elasmo-branchs	1981	29.22	28.54	36.64	18.73	14.82	32.04	37.54	65.94	16.74	9.95	11.79	6.86	308.82
	1982	3.61	17.00	10.44	23.54	18.16	29.34	56.60	26.42	36.14	13.54	10.14	16.65	261.59
Others	1981	7.19	7.28	8.75	3.97	5.27	3.35	7.45	3.56	6.82	5.28	2.09	1.60	62.61
	1982	1.69	2.47	7.43	5.00	10.01	5.51	7.29	6.09	11.76	3.66	1.01	1.81	63.73
Dolphins	1981	—	—	0.08	0.11	0.54	—	0.50	—	—	—	0.14	—	1.37
	1982	0.15	—	1.21	—	—	0.13	0.15	0.15	—	0.69	—	—	2.48
Total	1981	82.70	87.37	97.24	219.91	298.45	272.45	481.19	463.14	259.36	114.25	62.62	37.11	2,476.01
	1982	36.57	82.99	84.41	118.07	99.02	198.07	514.86	188.35	252.78	195.78	34.32	43.42	1,848.63
Estimated effort (Units)	1981	1,566	1,301	1,482	1,195	2,463	3,045	3,109	3,081	2,371	1,092	1,137	800	22,642
	1982	605	1,207	1,461	1,004	1,843	2,245	3,559	2,559	2,483	1,572	737	639	19,894

sorrakkowah, Rhizopriondon acutes and *Sphyrna zygaena.* Their total catch in 1981 was 309 tonnes which dwindled to 262 tonnes in 1982. Monthly fluctuations in the catch per unit of effort of elasmobranchs in the drift gillnet fishery indicate that in both the years high catches were recorded during October to March.

Catfishes

Catfishes were represented by *Arius serratus, A. dussumieri, A. thalassinus* and *A. tenuispinis* of which *A. serratus* dominated in the drift gillnet catches in both the years. The total catfish catch of 367 tonnes in 1981 sharply decreased to 231 tonnes in 1982. They were present in the landings throughout the year. However, good landings have been recorded during August–March in 1981 and July–December in 1982. Month-wise c/f indicate that July–October is the productive period for catfishes in both the years.

Mackerel

Although the mesh size of the drift gillnet employed at Cochin (7–13 cm) is not meant for small species such as mackerel, an estimated total of 63 tonnes were landed by the drift gillnets in 1981. The catch of mackerel during 1982 recorded a decline of about 69% over 1981 catches. Relatively good landings were recorded during May–September.

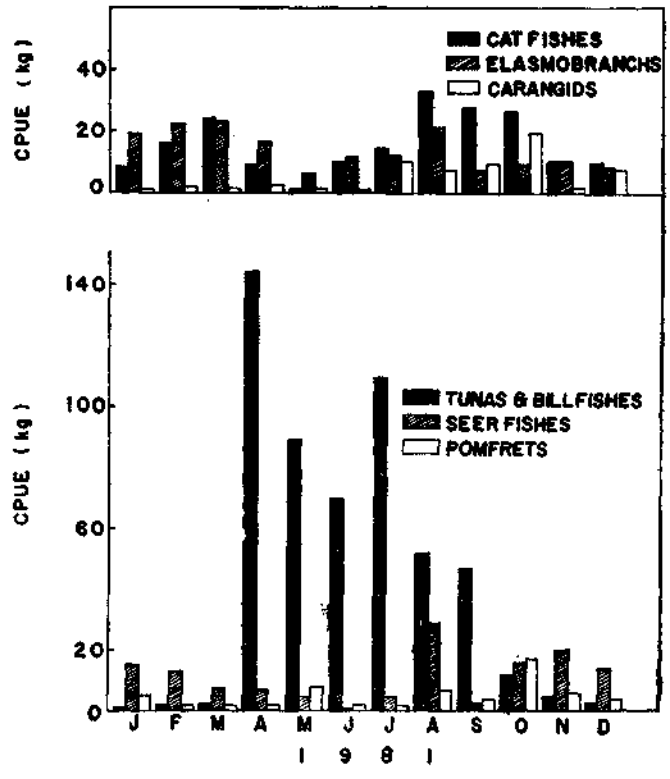


Fig. 5 CPUE of different groups of fishes in the drift gillnet fishery during 1982.

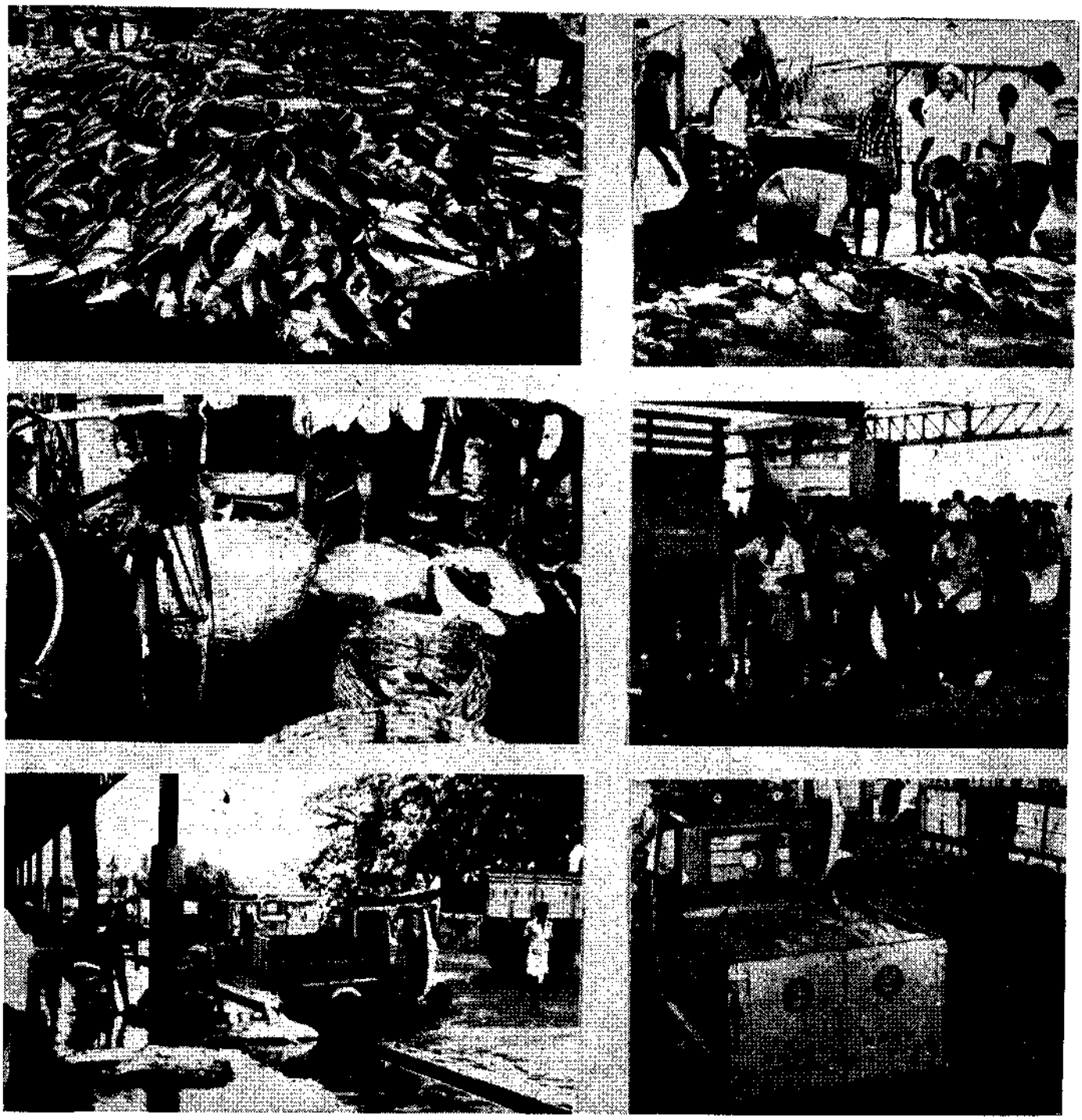


Plate II. Different categories of fishes landed are being transported from the Cochin Fisheries Harbour.

Carangids

The carangid catches comprised of commercially important species such as *Alepes djeddaba,Scomberoides commersonianus* and *S. tol.* Less common species were *Caranx melampygus, C. sexfasciatus, Carangoides gymnostethus, Elagates bipinnulatus, Megalaspis cordyla* and *Alectis ciliaris.* During June to October they were available in good numbers in the fishery in both the years. Their c/f indicate that the productive period for carangids in the drift gillnet fishery at Cochin was during July to October.

Other fishes

Among other groups of fishes which constituted quantitatively less significant were cobia, dolphin fish, barracuda and wolfherring which were represented in the fishery in scattered numbers more or less throughout the year. Other species such as *Pomadasys hasta, Lobotes surinamensis, Megalops cyprinoides, Saurida tumbil, Psettodes erumei* and *Trichiurus* sp. were present in the landings in scattered numbers during certain months of the year.

Incidental catch of dolphins

Dolphins belonging to the species *Delphinus delphis* and *Tursiops aduncus* were accidentally caught by drift gillnets and they were landed in stray numbers during certain months. They constituted about 1% of the total drift gillnet landings in both the years. No seasonal periodicity in the catch could be attributed to this group.

Disposal and Marketing

The fish catches are auctioned at the Fisheries Harbour. The commission agents fix up the prices for the quality fish and maintain all the accounts regarding the price realised, expenditure and bata paid to the fishermen and settle the accounts with the owners and fishermen once in a week, mostly on Saturdays. Major part of the quality fishes such as seerfish and pomfrets are distributed to the local markets, cold storages and hotels in and around Ernakulam, Alwaye and Muvatupuzha through bicycles, autocarrier and tempo vans. Major share of tunas are transported by lorries to the southern parts of Kerala especially to the markets at Quilon and Trivandrum districts. Catfishes and sharks are chiefly transported to the markets in the northern parts of Kerala such as Kunnamkulam, Patambi, Tellicherry and Cannannore. (Plate II) Fins of bigger sharks are removed first and the flesh lump salted and dried at Fort Cochin.

Economics of operation

The drift gillnet fishery is an enterprise, managed by fishermen who are actually involved in the fishing operations and the non-fishermen who are profited by investments, and which produce food for the society and a source of income for the participants. For the purpose of assessing the economics of operation of drift gillnetters and to evaluate the share of income for the participants in the fishery, information was gathered on the fluctuation in the price of major groups of fishes, operational expenditure and income from the fishery during the period 1981 and 1982 and the data analysed.

Yearly fluctuation in the total catch, price realised through the sales and price per tonne of major groups of fishes at Cochin Fisheries Harbour during 1981 and 1982 are presented in Fig. 6. During 1981, the price of 2,476 tonnes of fishes was 7.17 million rupees while in 1982 1,849 tonnes of fishes fetched 7.82 million rupees.

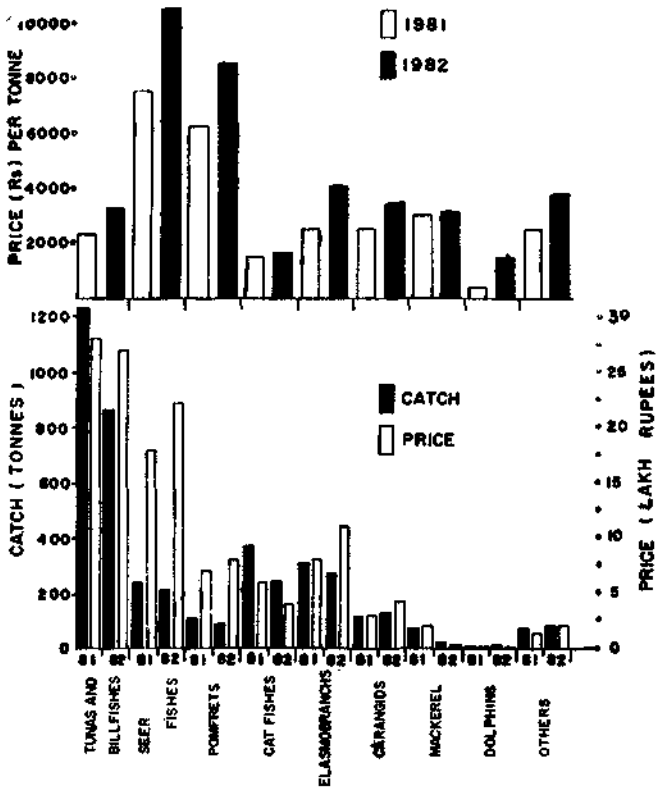


Fig. 6. Annual catch (tonnes), price (lakh rupees) *(lower panel)* and fluctuation in price per tonne *(upper panel)* of major groups of fishes landed by drift gillnetters during 1981 and 1982.

Annual fluctuation in the price per tonne of major groups indicate that except for mackerel and catfish the price of other fishes increased sharply in 1982 as compared to that in the previous year. Of these groups, distinct price difference was observed for tunas and billfishes, seerfishes and pomfrets.

In order to estimate the monthly fluctuation in the price of fishes at the Cochin Fisheries Harbour, information was also collected on these lines for major groups of fishes for 1981 and 1982 and the results presented in Tables 3 and 4. In both the years seerfishes, pomfrets, mackerel, catfishes and carangids evinced considerable fluctuation in the pattern of price during different months.

Often we are posed with the question about the economic viability of the operation of drift gillnetters. In this report, an attempt has been made to present the economics of this fishery based on the operation of private drift gillnetters at Cochin (Table 5).

Table 3. *Monthly fluctuation in the total catch, price realised and price per Kg. of fish at the Fisheries Harbour, Cochin during* 1981 *and* 1982.

Month	Year	Catch (tonnes)	Price realised (in 1000 Rs.)	Price per kg. (Rs.)
Jan.	1981	82.7	318.3	3.8
	1982	36.6	264.0	7.3
Feb.	1981	86.9	335.9	3.8
	1982	83.0	450.8	5.4
Mar.	1981	97.7	341.7	3.5
	1982	84.4	414.5	4.9
April	1981	219.3	607.8	2.8
	1982	118.1	579.6	4.9
May	1981	298.9	1,010.3	3.4
	1982	99.0	482.5	4.9
June	1981	272.5	509.0	1.9
	1982	198.1	858.7	4.3
July	1981	481.2	1,281.7	2.7
	1982	514.8	1,719.7	3.3
Aug.	1981	463.1	1,250.3	2.7
	1982	188.3	840.7	4.2
Sep.	1981	259.6	744.6	2.9
	1982	252.8	927.7	3.7
Oct.	1981	114.3	346.7	3.0
	1982	195.8	811.8	4.1
Nov.	1981	62.6	283.2	4.5
	1982	34.3	211.3	6.5
Dec.	1981	37.1	143.8	3.9
	1982	43.4	263.6	6.1
Total	1981	2,476.0	7,173.5	2.9
	1982	1,848.6	7,824.8	4.2

The inputs in the drift gillnet fishery are the (1) fixed capital which includes cost of vessel and gear, and (2) operational expenditure including fuel cost, maintenance, depreciation on capital and administrative expenses. The benefits are the value of the output in the form of income and the profit on income. In the present analysis, direct cost and direct benefit relating to the value of the catch only are taken into consideration.

Under direct costs, the fixed capital for the investment for the vessel and gear has been considered to be between Rs. 75,000–80,000 and Rs. 25,000–30,000 respectively. Under recurring operational expenditure, the price of fuel, maintenance of the craft and gear, depreciation on capital and port dues are included which amounts to 0.066 million rupees per boat per annum. The annual revenue has been calculated by estimating the landed value of the fish at about 0.963 million rupees (average for 1981 and 1982) per boat per annum and the profit by operation per boat operating for about 280 fishing days per annum at the Cochin Fisheries Harbour has been estimated as 0.031 million rupees. From this the profitability was found to be 32.4% per boat. However, keeping in mind the fluctuation in the fishing season and non-recurring expenditure such as unforeseen breakdown, loss of nets and fishing days, the annual net profit of drift gillnet can be rounded off to Rs. 31,222 and the net profit from the fishery less commission paid for agents has been estimated as Rs. 29,661 per annum which is shared by the boat owner, the crew and the net owner on a 33.3 percent basis.

Strategies for future development

While the gillnet fishery is showing profitability, we feel that there is need for critically examining some areas for improvements in production, quality and enhanced returns for the catches.

(i) Storage facility

When there is good catch (300 kg or more per boat), nearly 10–15% of the catch is landed in deteriorated condition which realises very low price. Species such as *Auxis rochei* and *Rastrelliger kanagurta* are easily damaged due to dumping of the catch on the deck space between the engine cabin and sides of the vessel. The boats do not carry any ice, nor has any special study been made whether this would be feasible. The problem merits serious consideration to advise the fishermen how the quality of the catch could be maintained and improve ways of storing the same. Carrying ice boxes may not be a solution. Perhaps, some structural modifications of the boat have to be considered without being detrimental to the stability of the boat.

Before advising the gillnet fishermen some trials to study the economics taking into consideration added inputs would be necessary.

(ii) Area of operation

Our study has clearly shown that these boats will not be able to increase their area of operation due to limitations mainly with regard to fuel intake capacity. Alternate use of energy saving device, namely use of sails has not been tried on these boats and this is an area which needs some attention.

(iii) Soaking time

Normally only one operation is carried out allowing for a soaking time of about 3–4 hrs and when good fishing is expected during the months of May–July, the soaking time is reduced to about 2 hours, so that atleast two operations are carried out. This method again

results in deterioration of the catch from the first operation and very low value realisation. Hauling is manually done and is time consuming, taking anywhere from one to two hours depending on the catch. The point is whether it is desirable to have longer soaking time by reducing hauling time. One way by which hauling time could perhaps be reduced would be by the installation of a suitable mechanical hauler.

(vi) Social aspects

Despite the good price that the gillnet catch fetches, some amount of indebtedness of the fishermen to the middlemen still exists. It is not uncommon for these fishermen to draw an advance at the time of settling of the accounts by the fishermen from boat owners and auctioneers (middlemen). Since majority of the fishermen are from Tamil Nadu, there is need for looking into the socio-economic problems faced by these category of fishermen.

Table 4. *Month-wise fluctuation in the price of major groups of fishes and dolphins (in thousand Rs. per tonne) landed by drift gillnets at Cochin Fisheries Harbour during* 1981 *and* 1982

Major groups of fishes	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Tunas and billfishes	1981	3.00	3.59	3.28	2.41	2.80	1.77	2.44	1.79	2.30	1.98	2.96	2.36
	1982	3.03	3.29	3.42	3.48	2.95	3.34	3.25	3.24	3.16	3.11	3.07	3.07
Seerfishes	1981	7.13	9.06	9.94	9.81	10.32	6.68	8.11	6.61	8.02	6.59	7.10	7.07
	1982	9.40	9.97	10.07	10.51	11.60	12.04	12.73	12.99	8.41	8.46	9.34	10.49
Mackerel	1981	3.00	3.16	3.20	2.90	2.71	4.80	3.16	2.28	2.85	2.90	3.00	2.99
	1982	3.05	3.14	3.02	3.12	3.01	3.63	3.57	3.06	2.01	3.02	3.00	—
Pomfrets	1981	6.20	7.33	7.27	6.51	6.57	5.80	7.38	5.27	7.04	5.65	6.62	5.94
	1982	6.14	7.82	6.94	10.72	8.48	9.28	10.63	10.23	9.06	7.07	7.55	8.32
Catfishes	1981	1.34	1.95	1.83	1.80	1.24	1.17	1.46	1.05	2.40	0.89	1.44	0.77
	1982	1.00	1.94	2.87	1.51	1.50	2.81	1.92	2.13	1.00	0.95	1.50	1.50
Carangids	1981	2.65	2.09	1.44	2.11	1.33	1.37	3.05	1.24	2.85	1.66	0.30	1.23
	1982	2.11	3.83	3.12	4.16	4.24	4.72	6.24	3.14	2.11	2.76	2.93	3.04
Elasmobranchs	1981	2.12	2.16	3.07	2.70	3.17	2.16	2.89	1.78	3.85	2.31	2.83	3.22
	1982	3.12	3.83	3.91	5.27	3.93	5.31	4.30	4.95	2.85	3.50	3.27	3.81
Others	1981	2.29	3.93	4.28	3.28	3.39	4.73	2.27	2.33	2.71	2.75	3.75	3.26
	1982	2.61	4.47	4.10	5.54	3.84	3.89	4.07	4.22	2.40	3.00	3.00	3.70
Dolphins	1981	—	—	0.90	0.90	0.80	—	1.04	—	—	—	0.79	—
	1982	1.38	—	1.42	—	—	2.17	1.55	1.26	—	1.22	—	—

(iv) Bottom set gillnet fishery

Although during the seerfish fishing season (September-November) the fishermen operate their nets using more number of sinkers to set the net in the sub-surface layer, no attempts have been made to develop bottom set gillnet fishery in this area. Trials are called for so that the resources which could be exploited thus could be identified and information made available.

(v) Diversification

We have been speaking of diversification, and effort to be reduced on shrimp trawling. The conversion of mechanised boats involved with shrimp trawling to efficient gillnetters with mechanised hauling system also needs consideration. Since these boats range in size from 9.6–13.0 m, the operational range, better storage facilities and longer stay away from port could be thought of.

From late December 1983 a few motorsied canoes with 5-6 persons have conducted drift gillnet fishing from closer inshore. There is need to see to what extent such diversification could be integrated in the existing fishery in the small scale sector.

Table 5. *Cost benefits in the operation of drift gillnetters at Cochin* 1981–1982 *(per boat per annum)*

A. *Fixed capital (Rs.)*

i)	Cost of the vessel including hull, engine and accessories	: 75,000–80,000
ii)	Cost of the gear including accessories	: 25,000–30,000

B. *Operational expenditure (Rs.)*

Recurring

i) *Fuel*

a)	Engine running hours (Av. 7 hrs/day for 280 fishing days)	: 1,960
b)	Fuel consumption at the rate of 4.75 litres/hour	: 9,310
c)	Total fuel cost (Rs.) (Av. Rs. 2.53/litre)	: 23,554.30

d)	Cost of lubrication oil (Rs.) (1.6 litres/week at the rate of Rs. 9.55 per litre)		445.60
e)	Bata for crew (3-4 men) (Rs.) (Consolidated amount of Rs. 30/- per day)		8,400.00
ii) Maintenance (Rs.)			
a)	Vessel @ 2% average for hull and accessories and @ 5% average for engine and accessories	:	5,425.00
b)	Gear @ 10% average for the net	:	2,750.00
iii) *Depreciation on capital* (Rs.)			
a)	Hull and engine (@ 20%)		15,500.00
b)	Net and accessories (@ 33.5%)	:	9,212.50
iv) *Administrative Expenses* (Rs.)			
	Port dues	:	1,050.00
	Total		66,337.40

C. Annual income (Rs.)			
	Total catch (kg.) (@ daily 95.5 kg. for 280 fishing days)	:	26,740.00
	Revenue (@ Rs. 3.60/kg.)	:	96,264.00
D. Profit (Rs.)			
	Profitability %	:	31.10
	Rate of return %	:	28.50
	Investment: Turnover ratio	:	1.0:0.92
E. Pay back period (years)		:	3.51
F. Profit allocation (Rs.)			
i)	Profit	:	29,926.60
ii)	Share of the commission agents (@ 5%)	:	1,496.30
iii)	Profit less the commission	:	28,430.30
iv)	Share of the boat owner (@ 33.3%)	:	9,476.77
v)	Share of the crew (@ 33.3%)	:	9,476.77
vi)	Share of the net (@33.3%)	:	9,476.77

LARVAL REARING AND SPAT SETTLEMENT OF BROWN MUSSEL *PERNA INDICA* IN THE LABORATORY*

Earlier work at the Central Marine Fisheries Research Institute has proved the great potential for mussel farming in the coastal waters of India. The brown mussel *Perna indica* is one of the two species occurring in India, but with a narrow distribution along the extreme south-west coast. The inadequacy of mussel seed in the wild is one of the constraints for taking up commercial mussel farming. Initial success has been achieved in the artificial breeding of the brown mussel and spat have been raised in the laboratory.

Spawning in this species commences from May and lasts till August, with a peak during June-July. Induced spawning in the laboratory in June was achieved by thermal stimulation by keeping mature animals at 31°–34°C. Sudden change in temperature induced spawning at 34°C. But the eggs developed only upto veliger stage and were not healthy. In July, the mussels spawned in the tanks naturally without any external stimuli. Males spawned first. The milt was expelled in a jet. The eggs were liberated usually in two or three spells, at intervals ranging from 30 minutes to 3 hours. The eggs were spherical and brick red in colour and measured 45-60 μ. The milt was mixed with the eggs kept in beakers with filtered sea water and fertilization took place immediately.

Trochophore larvae were noticed within 7 hours after fertilization. Within 20 hours early veliger stage was observed in the larval rearing tanks and the larvae were D-shaped within 24 hours (Fig. 1). The larvae measured 70-76 μ in the antero-posterior axis and 62 to 65 μ in dorso-ventral axis. Early umbo stage was observed from 7th day onwards (Fig. 2). Late umbo stages

*Prepared by K. K. Appukuttan, T. Prabhakaran Nair and K. T. Thomas

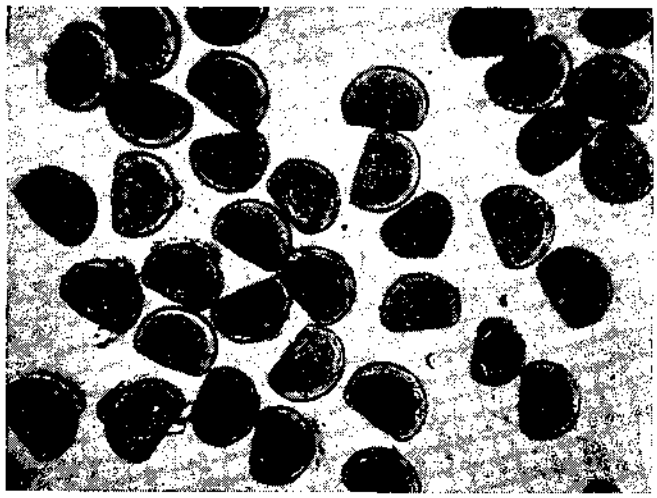


Fig. 1. D-shaped veliger larvae of *Perna indica*

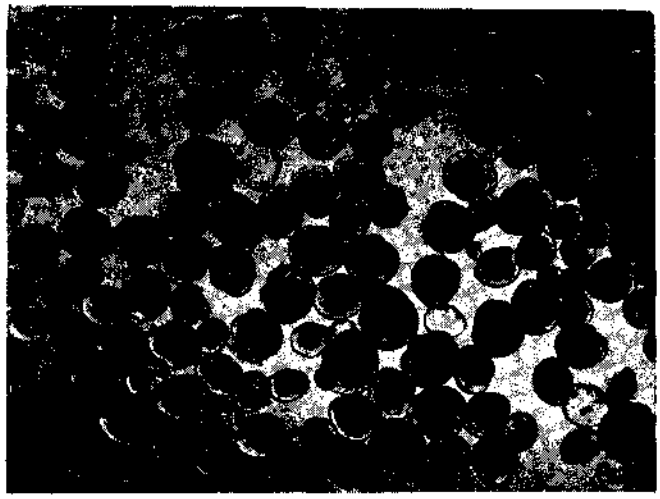


Fig. 2. Umbo larvae of *P. indica*

were noticed from 9th day and larvae measured 200 μ in the antero-posterior axis. The larvae showed a thick greenish yellow digestive gland in the antero-dorsal region visible through the transparent shell. Larvae reached eyed stage by 13th day with a characteristic dark pigmented eye spot ventral to the digestive gland. The valves were more convex with concentric striation and the antero-posterior axis measured 208 to 261 μ and dorso-ventral axis 200 to 260 μ. From 16th day onwards pediveliger stages were found in the rearing tanks. This stage was characterised by the slightly oblique valves, protruding foot and reduced velum. Shell became thick and brown colouration started appearing in the valves. On 17th day the largest pediveliger measured 489μ in the antero-posterior axis and 437μ in the dorso-ventral axis. The larvae crept at the bottom of the tanks with the help of foot and aggregated near the points of aeration. The velum had disappeared totally and the larvae started settling on clutches viz., nylon monofilament, plastic sheets, granite pebbles, mussel shells and glass plates by 21st day. The spat have attained characteristic shape and brown colour of the adult (Fig. 3). Good settlement of spat was observed in the bottom of the rearing tanks also. The maximum length of spat observed on 21st day was 780 μ. By 32nd day the maximum size of the spat in the rearing tanks was 2.7 mm.

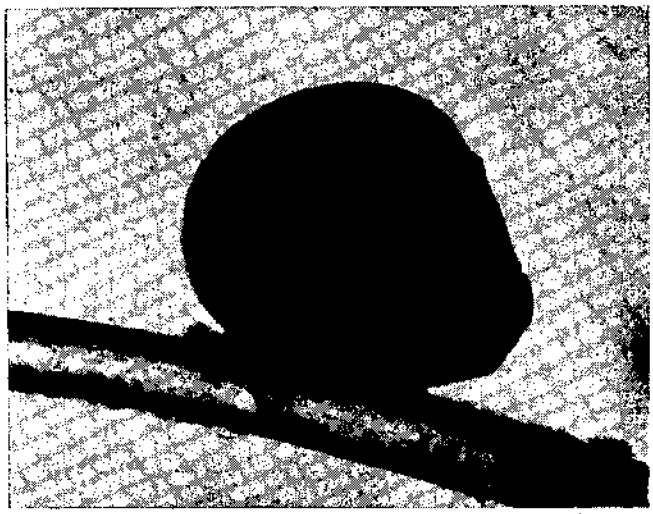


Fig. 3. Young spat of *P. indica* settled on monofilament.

For larval rearing sea water filtered through 40 μ bolting silk was used. Fibre glass tanks of 50 l capacity were used as rearing vessels and sea water was changed once daily and aerated well. The larval density was 10,000–15,000 per litre upto 5th day and became reduced to 5,000–6,000 per litre afterwards. Feeding of larvae with micro algae *Isochrysis galbana* and *Pavlova* sp. was started from the straight-hinge veliger stage. The total cell count per microlitre varied from 71 to 120 cells. The quantity of algae fed was increased gradually as the larvae grew to umbo, eye spot and pediveliger stages. Phytoplankton, with additional inoculation of *Isochrysis*, cultured in open tanks was given for the spat from 29th day onwards. Further research has been taken up to standardise water quality, larval density and food concentration to achieve maximum settlement and survival.

MARINE MAMMAL NEWS

Dear Reader,

During the last few years a number of strandings of whales, dolphins, and porpoises have been detected and same have been reported along our coasts. The accidental capture of dolphins and the dugong in fishing operations have also been reported. These marine mammals are protected under the Indian Wild Life (Protection) Act 1972, and trade in many of the marine mammals is also banned or controlled under the Convention of International Trade in Endangered Species of Fauna and Flora (CITES).

The Central Marine Fisheries Research Institute has the National Marine Living Resources Data Centre (NMLRDC) for the acquisition, storage and dissemination of information on living resources from our Exclusive Economic Zone (EEZ). The Institute has also a network of field centres all along the coast numbering over 40, which facilitates the acquisition of field data. With this facility supplemented by observations from various organisations interested in the marine sector, it is hoped to build up a National Data Centre for marine mammals and sea turtles at the Central Marine Fisheries Research Institute as part of the NMLRDC.

Under this programme on marine mammals it is proposed to have the following:

1. Monitoring of strandings of whales, dolphins, porpoises and the dugong.

2. Monitoring of incidental catches of dolphins, porpoises and the dugong in fishing operations.

3. Determining the effects of marine pollution on cetaceans and dugong. This will also involve biochemical analysis of body parts for assessing uptake of pollutants from carcasses.

4. Biology of cetaceans and dugong with emphasis on food and feeding, maturing, age, growth and reproduction.

5. Behaviour and social structure.

6. Acquisition of data from ship board observations.

7. Assessing the role of marine parks and reserves on cetaceans and the dugong in coastal waters.

8. Examining the legal frame work under which protection, conservation and management would be possible.

9. Benign research and ways and means of non-consumptive utilization of the resource.

10. Rapid dissemination of information on marine mammals.

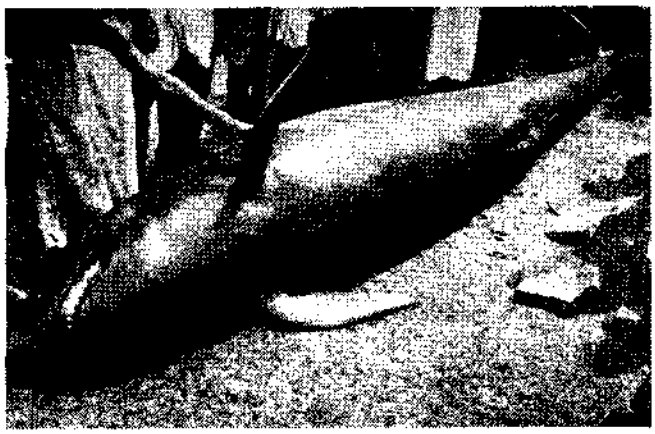
It is proposed to give full credit to those who send such observations. The accumulation of data from various sources on cetacean stranding and accidental capture could throw a considerable amount of light on their life habits and behaviour. We would also like to publish good photographs of the specimens which could also help in establishing the proper identity of the species. With this in view, I solicit your co-operation in sending us your observations on marine mammals which could enhance our knowledge about their life habits and behaviour.

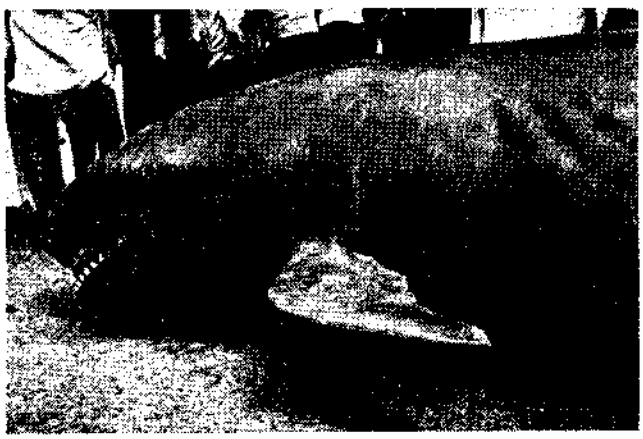
In this issue we are documenting a few strandings of lesser cetaceans (the false killer whale *Pseudorca crassidens)* from along our coast.

E. G. SILAS
Director

1. Stranding of *Pseudorca crassidens* at Calicut, Kerala

The fishermen of Puthiappa, a fishing village 5 km north of Calicut saw a whale stranded on 28–7–1975 at about 3.30 in the afternoon. It was dragged ashore and was left in a tidal pool of about $\frac{1}{2}$ x 50 x 20 m. After struggling in the pool for about two hours it died. It was identified as false killer whale *Pseudorca crassidens* (Owen) (Fig. 1 & 2). After taking its detailed morphometric measurements, the whale was burried for taking its skeleton.





	Measurements in cm	% of total length
Total length	423	
Tip of snout to origin of flippers	74	17.47
,, ,, dorsal	184	43.48
,, ,, eye	43	10.27
,, ,, blow-hole	50	11.90
,, ,, genital pore	243	57.48
,, ,, annus	275	64.99
Length of flippers		
anterior margin	63	14.97
posterior margin	41	9.82
width at base	20	4.84
vertical height	56	13.34
Dorsal fin		
anterior margin	52	12.32
posterior margin	21	5.07
width at base	44	10.43
vertical height	26	6.18
Caudal fin		
spread of caudal length	85	20.07
Girth of body		
at flippers	175	41.52
at anus	120	28.45
Eye diameter	3	0.80
Diameter of blow-hole	5	1.18
Cleft of mouth	38	9.09
Distance between eye to mouth	7	1.77
,, ,, eye to blow-hole	35	8.38
,, ,, genital slit and anus	32	7.74
Length of genital slit	30	7.22
Length of small intestine	1466	346.24
Length of large intestine	804	189.89

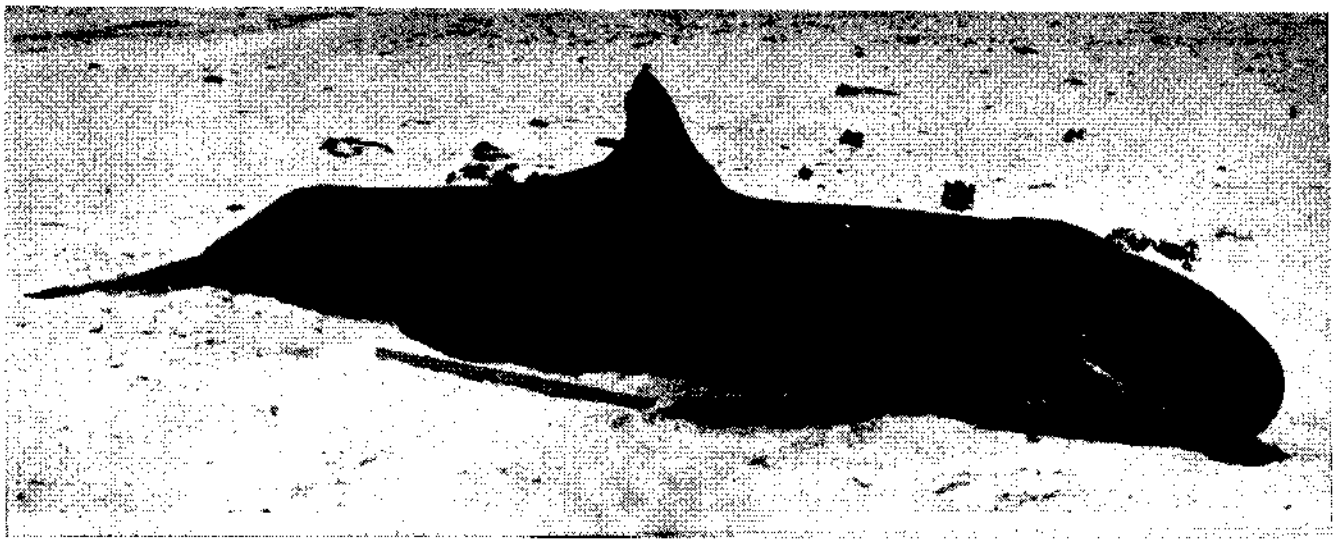
Dentition $\frac{9 + 9}{10 + 10}$

The stomach content was analysed and found to contain semidigested matter including remains of the catfish *Tachysurus* sp. A biochemical analysis of the muscle, liver and blood was attempted and the results are as follows:

	Fat	Protein	Ash	Acid insoluble
	(Moisture free base in %)			
Muscle	10.50	84.57	1.95	0.24
Liver	26.00	64.43	3.17	0.12
Blood	1.54	85.24	0.50	0.11

The authors are thankful to Dr. G. Seshappa for his help during the study.

Reported by R.S. Lal Mohan, K. V. Somasekharan Nair and P. Ramadoss.



2. Stranding of *Pseudorca crassidens* at Rameswaram, Gulf of Mannar

On 18th October, 1975 at 08.00 hrs a whale was seen struggling near Rameswaram in Gulf of Mannar and was towed to the shore (Fig. 3). By the time the whale was brought to the shore it died.

Occasional strandings of whales have been reported by several authors along the Indian coasts. The present specimen was identified as a male of the false killer whale *Pseudorca crassidens* (Owen). The diagnostic characters of the species are the head tapering anteriorly into a rounded snout, the teeth large, powerful, circular in cross section and 8 to 11 pairs in upper and lower jaws, the dorsal fin small, directed backwards and with a concave posterior border and dark black body colouration. In the specimen, eight pairs of teeth were present in the upper jaw. In the lower jaw there were ten teeth on right side and eleven teeth on left side. The front five pairs of teeth in each jaw were blunt.

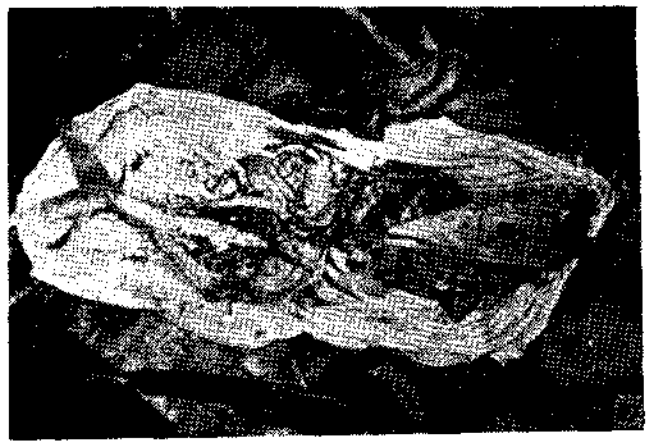
The morphometric measurements are given below:

	Measurements in cm
Total length (from tip of snout to fork of caudal flukes)	384
Snout to origin of dorsal	160
Snout to origin of flipper	70
Snout to front end of eye slit	45
Diameter of eye	4.5
Snout to anterior margin of blow-hole	50
Snout to penis	194
Snout to anus	247
Snout to origin of upper jaw	42
Snout to origin of lower jaw	39
Width of blow-hole	8
Base of dorsal	53
Anterior margin of dorsal	55
Height of dorsal	30
Base of flipper	19
Length of flipper from anterior insertion to tip	55
Breadth of the flipper at the middle	21
Horizontal length of flukes	89
Girth at the dorsal origin	165
Length from the lower base of the flipper to the tip	40
Length from the anus to caudal fork	129
Length from origin of dorsal to caudal fork	224
Length from origin of flipper to caudal fork	308
Girth at the genital slit	139
Girth at the caudal peduncle	44
Girth at the origin of the flipper	141
Penis length	44
Penis girth at the base	20
Penis tip narrow, penis girth at the tip	1

Reported by R. Thiagarajan,
P. Nammalwar and
K. M. S. Ameer Hamsa.

3. Capture of a false killer whale *Pseudorca crassidens* at Port Blair, Andamans

On 27–7–76, when one of the mechanised fishing vessels belonging to the Andaman and Nicobar Administration set gill nets off Maduban near Port Blair two false killer whales belonging to the species *Pseudorca crassidens* (Owen) were entangled. One of them, however, escaped when trying to bring them ashore.



False killer whale has a world wide distribution, It is a truely oceanic form and is gregarious in nature, moving in schools. The present record (Fig. 4) is the first of its occurrence from the Andaman Sea.

Some of the measurements (in cm) of the whale are given below:

Total length	396
Distance from the tip of the snout to the origin of dorsal	139
Distance from the tip of the snout to the eye	48
Distance from the tip of the snout to the angle of mouth	33
Distance from the tip of the snout to anterior insertion of the flipper	57
Breadth of flipper	20
Length of flipper	43
Width of the body	66
Breadth of the dorsal fin	43
Height of the dorsal fin	23
Distance between the posterior margin of the flipper and the anterior margin of the dorsal fin	71
Distance from the posterior margin of the dorsal fin to the notch of the caudal fluke	183
Width of the caudal fluke	23
Length of the largest tooth	10
Diameter of the blow-hole	5

When the stomach was cut open the head of a Barracuda and tail portion of a Carangid fish were found in semidigested condition (Fig. 5).

Reported by D. B. James

Compiled and prepared by M. J. George, G. Subbaraju & S. K. Dharmaraja
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