

THE PURSE-SEINE FISHERY FOR OIL SARDINE IN THE SOUTH KARNATAKA COAST AND ITS EFFECTS ON THE INDIGENOUS FISHERY

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ABSTRACT

With the introduction of purse seines in the midseventies the catches of oil sardine steeply rose from 6,129 t in 1976-77 to 32,629 t in 1979-80. However, in the subsequent year the landings declined by 6,800 t and with increase in effort the catch rate only showed a downward trend, obviously because of the large-scale removal of gravid fish during 1978-79 and 1979-80. The total instantaneous rate of mortality was found to be high indicating the high rate of mortality caused by the gear. The adverse effect of purse seiners on traditional fishery, with special reference to the shore-seine *Rampan*, is discussed.

INTRODUCTION

Following Goa, purse-seiners were introduced in the midseventies in the Dakshin Kannada district of Karnataka on commercial basis for exploitation of the pelagic fish resources, mainly from areas beyond the operational limit of traditional gears. The new fishery soon attained a phenomenal growth and, within a period of two years, the marine catch of the state had doubled—increasing over 0.76 lakh tonnes in 1976. Over 40% of the catch was oil sardine.

In this paper an appraisal is made of this purse-seine fishery, as at Mangalore, Malpe and Gangolli, from 1976-77 through 1980-81, on the basis of observations on rate of growth, year-class strength and total fishing mortality.

MATERIAL AND METHODS

Visits to the purse-seine-landing centre at Mangalore were made on every alternate day, during 1976 to 1978. Thereafter, the observations on catch and effort were made practically on all working days, in view of the increase in catches due to the addition of purse seiners. Biweekly samples were collected for biological studies. The samples were randomly drawn from various purse-seine units on sampling days and examined separately; on many occasions the sample size exceeded 300 numbers. For the estimation of the number of fish in different length groups on different sampling days and in the

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different months as well as for the catch per unit effort in numbers the method described by Sekharan and Dhulkhed (1963) was followed. Fortnightly and monthly visits were respectively made to Malpe and Gangulli to observe the trend of oil sardine landings by purse seiners in these places.

THE FISHERY

Fleet Strength

The number of purse-seiners added in Dakshina Kannada (information provided by the Dept. of Fisheries, Karnataka) during the different years were:

1977-78	..	69
1978-79	..	138
1979-80	..	21
1980-81	..	23

In 1976-77 about 12 purse seiners, mostly private-owned, had been in operation covering all the three centres. Attracted by the returns of these it was that the additional seiners were hustled into the fishery, deleteriously more for the limited area in 1977-78 and 78-79.

Catch Statistics

Since authentic data on fishing effort for 1976-77 for the centres were not available, estimate was made by the following method:

$$\sum_{j=1}^4 C_j = \text{cumulative total number of purse seines from 1977-78 to 1980-81 (251)}$$

where C_j = the number of purse seines reported to be available in the j th year

$$\sum_{j=1}^4 E_j = \text{total effort from 1977-78 to 1980-81 (Table 1, i.e., for Mangalore, Malpe and Gangolli respectively)}$$

where E_j = estimated effort in the j th year.

Total number of units operated during 1976-77 was

$$\frac{\sum E_j}{\sum C_j} \cdot C_1 = E_1$$

The estimates of E_1 for 1976-77 for Mangalore, Malpe and Gangulli were 1,372 and 837, respectively.

The landing data (Table 1) for 1976-77 and 1977-78 were provided by the Department of Fisheries, Karnataka, and, for the rest of the seasons, by the Fisheries Resources Assessment Division of the Central Marine Fisheries Research Institute.

TABLE 1. *Purse-seine landings (in tonnes) of oil sardine at Mangalore, Malpe and Gangulli.*

	1976-77		1977-78		1978-79		1979-80		1980-81	
	C	C/E	C	C/E	C	C/E	C	C/E	C	C/E
1. Centre: Mangalore										
Sept	—	—	450	1.04	4458	2.70	766	0.41	3583	1.53
Oct	1505	—	1347	2.32	9858	5.97	3855	1.60	767	2.87
Nov	480	—	463	0.72	440	0.33	4621	2.28	2857	1.56
Dec	973	—	494	0.78	674	0.39	2876	2.16	4021	2.17
Jan	637	—	1356	2.20	487	0.36	1285	1.00	1133	0.51
Feb	321	—	335	0.59	1211	1.18	2646	2.94	1237	1.17
Mar	83	—	204	1.04	1058	1.00	376	0.74	223	0.13
Apr	8	—	—	—	1319	1.23	15	0.02	588	0.28
May	—	—	—	—	51	0.09	673	0.90	17	0.01
Jun	—	—	—	—	353	0.97	—	—	55	0.04
Total	4007	2.92	4650	1.21	19909	1.68	17113	1.45	14481	0.89
	*(1373)		(3850)		(11828)		(11785)		(16180)	
2. Centre: Malpe										
Sep	—	—	46	0.36	2579	2.39	716	0.88	942	0.77
Oct	—	—	26	0.13	1809	1.68	433	0.30	779	0.57
Nov	—	—	547	2.24	60	0.06	49	0.07	826	0.79
Dec	130	—	568	2.19	—	—	978	1.37	371	0.55
Jan	383	—	1598	4.60	—	—	460	0.79	341	0.19
Feb	233	—	416	1.30	114	0.42	22	0.23	265	0.19
Mar	71	—	106	0.36	—	—	301	0.89	70	0.06
Apr	215	—	120	0.39	9	0.02	275	0.67	520	0.56
May	85	—	—	—	—	—	27	0.43	472	0.53
Jun	—	—	—	—	—	—	—	—	—	—
Total	1117	1.48	3427	1.55	4571	0.77	3291	0.64	4586	0.42
	(757)		(2208)		(5945)		(5152)		(10981)	

3. Centre: Gangulli

Sep	—	—	4	0.03	1957	3.62	179	4.84	1182	1.16
Oct	—	—	189	1.23	6192	6.88	2455	1.10	2269	1.39
Nov	51	—	1191	6.08	—	—	650	0.88	1531	1.59
Dec	234	—	588	3.00	—	—	295	0.31	543	0.63
Jan	309	—	728	3.71	—	—	1335	1.33	889	0.61
Feb	231	—	1164	4.16	—	—	281	0.86	161	0.13
Mar	156	—	1948	9.96	—	—	852	0.15	111	0.08
Apr	—	—	1434	4.66	—	—	135	0.20	2	0.002
May	2	—	190	2.71	—	—	—	—	74	0.06
Total	984	1.18	7436	4.09	8149	1.23	6182	0.88	6762	0.61
	(837)		(1820)		(6613)		(7032)		(11007)	

C = Catch in tonnes

C/E = Catch per unit effort

* Annual effort in terms of boats in parentheses

It is seen from this Table that, during 1976-77, the oil sardine landings at Mangalore amounted to 4,006 t, the CPUE (based on total effort only) being 2.92 t. In the ensuing season, there was a three-fold increase in effort, but the catches improved only by 16% over the previous year. During 1978-79 there was an all-time high landings of oil sardine of about 19,909 t and an appreciable increase in the number of purse seiners. However, this tempo was not kept up during 1979-80, when the catches dropped by 2,796 t (14.0%), though there was no decline in effort. The 1980-81 season witnessed a further decline in the catches by another 15.4%, notwithstanding the 37% increase in effort over the previous year. In all the seasons, more than half the annual total landings were during the October-December period, with the exception of 1976-77.

At Malpe, during 1977-78, with a three-fold increase in the total effort over 1976-77, the catch increased likewise to 3,427 t. During the next season, though the effort increased by 160%, the landings improved by 33.4% only. September recorded 2,579 t or 56.4% of the total annual catch. There were no catch during December and January, which are normally the productive months for oil sardine. Nevertheless, during 1980-81 the oil sardine catches regained the level of 1978-79 consequent on the higher input of effort, which was 113% over the preceding year.

At Gangulli, during 1977-78 the oil sardine catches amounted to 7,436 t, indicating a six-fold increase for slightly more than twice the effort expended in 1976-77. In 1978-79, oil sardine catches were recorded only during September and October which amounted to 8,149 t. The CPUE of 4.0 t was the highest for all the years and for all the centres considered.

Pooled catch data of the above centres showed that, during 1978-79, the catches of oil sardine in Dakshina Kannada amounted to 32,624 t, which was almost twice that of the previous year. During 1979-80 and 1980-81 the catches showed a successive decline of 6,843 t and 1,557 t. In Fig. 1 the catch and CPUE for Dakshina Kannada are plotted against the total effort in terms of units. It is seen that with the increase in effort, the catch rate of oil sardine showed a downward trend.

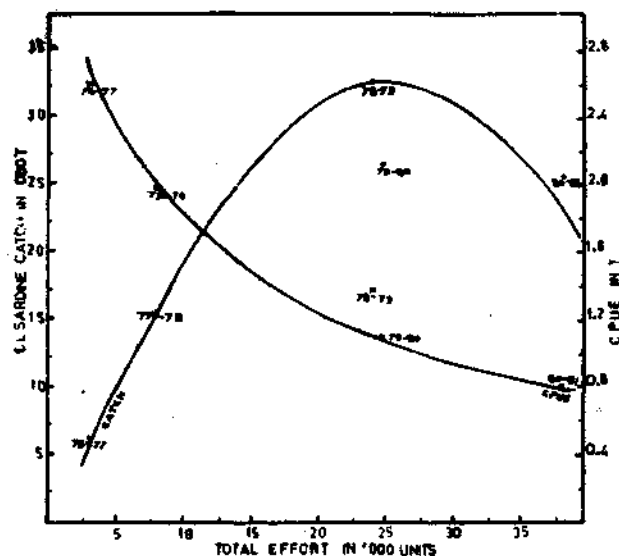


FIG. 1. Catch and CPUE of oil sardine plotted against total effort.

Effect of Purse Seining on Indigenous Landings of Oil Sardine

With the sudden increase in the number of purse seines, the adverse effect on the oil sardine catches of traditional gears was manifest (see also Jacob et al 1982). A fishing village, Baikampady, situated 10 km north of Mangalore, which was a famous fishlanding centre for the shore-seine, *Rampan*, is an example. During 1976-77 oil sardine landings at this place amounted to about 226 t, but showed a gradual decline in the subsequent seasons. In 1980-81 just 11.4 t were landed, of which 4 t were accounted by *Rampan*. It may be pointed out that, prior to the introduction of purse seines, i.e., during 1973-74, 1974-75 and 1975-76, the oil sardine catches landed by the indigenous gears at this centre were 220, 481 and 398 t, respectively (see Dhulkhed and Uma Kumari 1979). From 77-78 onwards the activities of the traditional gear, increasingly affected by diminishing returns, have slowly declined. If it was operated it was only for very short periods, not accounting for any significant landing. For the

cessation of this once highly remunerative traditional fishery there is no apparent cause other than the progressive encroachment of the purse seiners in their operational areas.

BIOLOGY

Growth Studies

For purpose of this study, oil sardine samples from purse seines at Mangalore alone have been taken into consideration. The length-frequency distributions were based on catch per unit in numbers, expressed in percentages, for five seasons.

The oil sardine in advanced stages of maturity occur normally from May to September. Hence, the fishing season begins by exploiting spawners and spent fish. The new recruits measuring from 55 mm onwards, comprising the 0-year-class, enter the fishery during September and October. It is obvious that the new recruits belong to several broods, generated from protracted spawning (Dhulkhed 1968).

The modes do not necessarily follow the same pattern of progression from year to year due to factors such as variations in the duration of spawning, temperature, availability of food, etc. Nevertheless, the progression of some important modes can be traced as given below:

Brood	Modal progression
A1 187 mm in October '76	197 mm in February '77
A2 172 mm in October '76	182 mm in February '77
B 142 mm in November '76	197 mm in April '77
C1 132 mm in December '76	177 mm in September '77-192 mm May '78
C2 147 mm in September '77	177 mm in May '78
D1 132 mm in October '77	172 mm in April '78
D2 117 mm in October '77	187 mm in Sept. '78-205 mm Jan. '79
D3 72 mm in October '77	162 mm in September '78-192 mm June '79
E 122 mm in September '78	172 mm in September '79-182 mm May '80
F 127 mm in October '79	167 mm in September '80-187 mm April '81
G1 112 mm in September '80	157 mm in May '81
G2 97 mm in September '80	147 mm in May '81
G3 82 mm in September '80	127 mm in May '81

It is seen from the progression of modes that the fish attains a length of 140-149 mm at the end of first year and 170-179 mm on completion of two years, which is in agreement with the findings of earlier workers. Based on this estimate, the oil sardine measuring less than 149 mm, 150-179 mm and

180 mm and above are treated as belonging to 0-, 1- and 2-year-classes, respectively. Based on the yearly computed numbers for the catches of these centres, the catch in weight of various age groups in respect of purse seine for Dakshina Kannada is estimated by the following method.

$$M \\ \sum_{j=1}^m X_{ij} = X_i$$

is the total annual estimated weight of the i th age group and

x_{ij} is the estimated weight of the i th age group in the j th month.

Thus estimated, in 1976-77 the fishery is mainly supported by the higher age groups. The catch of 1-year group amounts to about 1,650 t, whereas the 2-year-olds form slightly more than twice as much. On the other hand, during the next season, there is an influx of new recruits and, as a result, the catch of 0-year-class surpasses those of one- and two-year-olds put together. Further, it is seen that the recruitment of 0-year-class is consistently strong from 1978-79 onwards, and comprises the bulk of catches during 1979-80 and 1980-81 also. Among the seasons considered here, the strength of the 2-year classes of 1980-81 is the poorest.

Incidence of Spawners

During 1978-79 purse seines landed considerable quantities of oil sardine in spawning condition from April to June (Table 2), causing an adverse effect on the fishery in the ensuing season. Additionally, this gear again netted gravid oil sardine in May 1980.

TOTAL MORTALITY RATE

The total rate of mortality for the one- and two-year-olds based on the CPUE in numbers for Dakshina Kannada is estimated by adopting the method

TABLE 2. *Oil sardine in various maturity stages caught by purse seiners during 1978-79 (*) and 1979-80 (**).*

	Immature		Maturity stages (in %)								Sample		
	I	II	III	IV	V	VIIa	VIIb	nos.)					
Mar	80.8	99.5	19.2	0.5	—	—	—	—	—	—	—	240	220
Apr	56.5	60.0	22.0	21.3	20.5	10.7	1.0	8.0	—	—	—	200	150
May	—	4.3	6.4	3.0	34.5	14.7	56.6	53.0	5.5	2.5	—	110	300
Jun	—	—	—	—	23.6	—	65.0	—	10.0	—	1.4	220	—

(VIIa = partially spent, VIIb = fully spent).

described by Sekharan and Dhulkhed (1963). For the obvious reason, the data for 1976-77 are considered here. Estimates of one- and two-year-classes (CPUE in nos.) are:

Year	I	II
1977-78	653,875	185,822
1978-79	443,655	45,592
1979-80	339,395	50,273
1980-81	332,388	39,267

The rate of decrease for the years is:

	1977-78 78-79	1978-79 79-80	1979-80 80-81
Rate of decrease	0.07	0.11	0.12

The average annual rate of survival is 0.10. The instantaneous rate of mortality (Z) is 2.3. It is to be pointed out that when traditional gears were operating the Z values for Mangalore had been varying between 1.66 (Sekharan and Dhulkhed 1963) and 1.2 (Prabhu and Dhulkhed 1970). Balan et al (1979) felt that there was enough scope for increasing the effort of indigenous gears in Kerala, in view of the total instantaneous mortality values derived by the methods of Beverton and Holt and by Probability Paper were 0.62 and 1.84, respectively. Their corresponding F values were 0.16 and 0.46. The present value of Z is on the higher side, indicating the higher rate of fishing mortality due to the operation of purse seine. Sekharan (1974) had estimated, based on the value of Z as 1.66 (Sekharan and Dhulkhed 1963), that the annual instantaneous natural mortality (M), the fishing mortality (F) and annual exploitation rate (U) were 1.12, 0.54 and 0.26, respectively, for the oil sardine fishery for the west coast.

It may be pointed here that more than 200 purse seiners had operated from Mangalore, Malpe and Gangulli, a narrow belt of coastline. Hence the pressure on the oil sardine resource appears to be more than it could withstand, as could be gauged from the resultant decline in oil sardine catches from 1979-80 onwards, in spite of the increased effort. What is needed now is a strict control and regulation on the operation of purse seiners, as has been already suggested by Silas et al (1980) to conserve this resource urgently from further decline. It is also felt that indiscriminate removal of gravid fish if continued would eventually have a deleterious effect on this resource also in neighbouring Kerala state, where it forms the major fishery.

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