

Inshore Demersal Fisheries off Orissa Coast

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Results of bottom trawling in inshore areas off Paradeep with reference to total catch composition and catch per unit effort during 1962-1978 are reported. With increase in fishing effort, benthic species recorded the highest catch in 1969-'70 and thereafter it fluctuated. Fluctuations till 1968-'69 may be due to seasonal migration of fishes. The decline after 1971-'72 can be attributed to overfishing. Off Mahanadi, Devi and Rushikulya river mouths, showed a north-south migration of fishes from October. Presently off Devi river mouth is a rich ground for demersal fishes.

Orissa has 480 km of coast line. The broad continental shelf in the northern region extends from 25 to 35 km and is a rich ground for pelagic fishes (Roy & Roy, 1972). The continental shelf narrows towards south (Borisov, 1962) and is a favourable trawling ground for pelagic and demersal fishes. Even though trawling started in 1962 at Paradeep (Biswas, 1978) attempts to evaluate demersal fishery resources have not been made so far. The present communication based on catch per unit effort (Banerji & Krishnan, 1973) attempts to evaluate the demersal fish stock off Paradeep.

Materials and Methods

Bottom trawlings were conducted at Paradeep (Lat. 20°15' N, Long. 86°45' E) off Astarang (Lat. 20°N, Long. 86°23' E) and off Damodarpur (Lat. 19°25' N, Long. 85°5' E) situated on Mahanadi, Devi and Rushikulya river mouths (Fig. 1). Wooden trawlers of 9.75 to 13.1 m OAL fitted with 55 to 90 B.H.P. engines were employed. Otter trawls with 18 to 23 m head rope and 2.5 cm stretched cod-end mesh were operated between Mahanadi and Jatadhar river mouths (Fig. 2) at 6 to 15 fathoms during October to March from 0700 h to 1600 h. Duration of each haul varied from 90 to 120 min. Monthly and yearly variations in catch and its composition were recorded for prawns, pomfrets,

clupeiform fishes, polynemids, sciaenids, ribbon fishes, silver bellies, glass fishes and cat fishes. The rest are grouped as miscellaneous. The meteorological conditions were similar to that reported by Biswas (1978). Since data pertaining to the efficiency of nets, fishing techniques and catch were available, the actual fishing performance of steel trawlers alone were evaluated. In wooden trawlers, the fishing efficiency varied with reference to design, size, material and ownership of nets and hence data collected by government trawlers were taken as the basis. In case of private trawlers, the efficiency was calculated by random sampling.

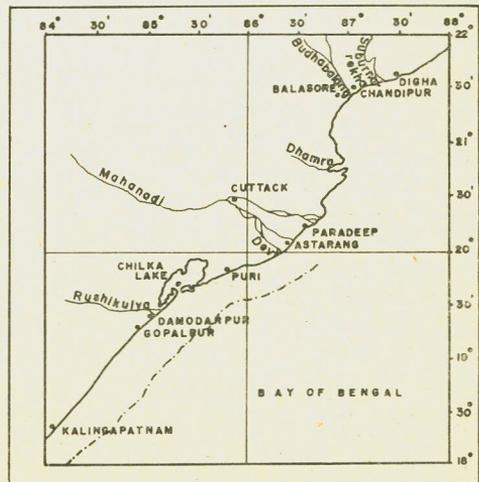


Fig. 1. Location of fishing base

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Results and Discussion

The total landings from 1962-'78 (Table 1) indicate a maximum of 3,088.92 tonnes during 1975-'76 employing 25 trawlers. As the effort varied with the size of the boat, engine horse power, size of nets, and period of the year, the catch per trawling hour was taken as the index. The total catch per trawling hour was 126.30 kg during 1962-'63 (Table 3). It fluctuated during subsequent years with the highest in 1969-'70 (221.88 kg/h). The catch/h was lowest in 1976-'77 (27.40 kg/h). In spite of fewer boats (4 to 19) operated during 1962-'63 to 1970-'71, the catch per unit

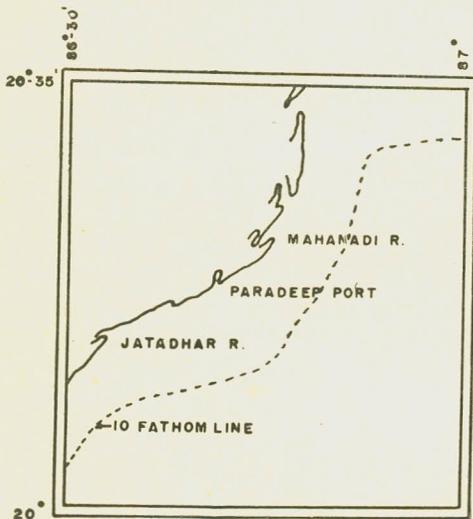


Fig. 2. Trawling ground between Mahanadi and Jatadhar

effort was nearly 2.5 to 8.0 times more than that of 1976-'77. But in 1977-'78, with 5 boats covering 4572 trawling hours (Table 2), the catch rate was only 43.89 kg. It was 126.3 kg/h in 1962-'63, 67.61 kg/h in 1964-'65 and 81.2 kg/h in 1967-'68 even though the fishing effort in those years never exceeded 3886 trawling hours. A substantial increase in fishing effort during 1971-'72 to 1976-'77 failed to increase the catch rate proportionately (Table 3).

From 1962-'63 to 1967-'68, only government trawlers were engaged in fishing. From 1968-'69 onwards, private trawlers started fishing, reaching a maximum of 25 boats in 1975-'76. Consequently, there was

a sudden increase in the fishing effort (37,396 trawling hours) and catch rate (82.60 kg/g) as shown in Fig. 3. With further increase in fishing effort (81,476 trawling hours) in 1976-'77, total catch rate lowered significantly (27.40 kg/h), indicating the attainment of maximum sustainable yield as observed by Gulland (1968). In 1977-'78, by reducing the fishing effort, the catch per hour increased only marginally (43.89 kg/h), suggesting that the increased fishing effort in 1976-'77 completely exploited the fishes in the area and the migration of fishes could not replenish the stock to the earlier level. According to Banerji & Krishnan (1973), when both the catch and catch per unit effort in a steady population shows a downward trend, it can be concluded that the increased fishing activities result in a reduction of the yield, and the fishing effort has to be reduced.

To obtain a measure of the activity of the fishing fleet, estimates for the total trawling hours with catch, percentage of total trawling hours without catch, trawling hours with catch per boat and total boat days availed in the season (Table 2) were made. The first estimate of total fishing effort of steel trawlers was obtained by adding trawling hours with catch and estimated trawling hours without catch per year. The second estimate was arrived at by multiplying boat days and average trawling hours per boat in each fishing season. Allowance was made for the increased efficiency of the vessels, such as higher horse power, use of large synthetic nets and length of towing hours at sea. Saetersdal *et al.* (1965) observed 3% annual increase in fishing efficiency of boats that employ

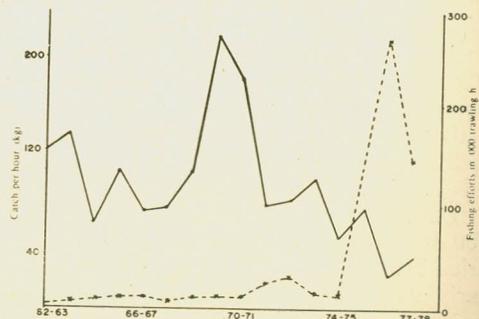


Fig. 3. Correlation between fishing effort and catch per hour

Table 1. Annual trawl landings of demersal fishes at Paradeep

Year	Government boats	Total boats in the region	Total catch of prawn and fish by government boats	Total annual landings tonnes	
			tonnes	Prawn & fish	Prawn
1692-'63	4	4	192.99	192.99	11.54
1963-'64	6	6	317.26	317.26	19.42
1964-'65	10	10	262.75	262.75	23.65
1965-'66	15	18	794.54	794.54	45.13
1966-'67	19	22	614.74	614.74	43.03
1967-'68	11	14	250.21	250.21	27.52
1968-'69	12	22	565.79	1541.49	83.67
1969-'70	13	23	1399.60	2954.65	278.11
1070-'71	10	20	911.87	1912.73	192.85
1971-'72	21	29	1708.39	3249.86	454.55
1972-'73	23	31	2468.74	4599.56	313.74
1973-'74	24	36	1110.59	2292.03	142.90
1974-'75	24	41	518.35	1089.92	235.42
1975-'76	25	208	3088.92	26681.14	3232.75
1976-'77	21	344	2232.22	16029.88	1336.97
1977-'78	5	242	200.67	14102.80	2368.24

Table 2. Total fishing effort and estimated fishing effort of all the boats at Paradeep

Year	Depth fathoms	Fishing effort of government boats in trawling hours	Trawling hours with catch '000 h	Trawling hours without catch %	First estimate '000 h	Total trawling hours × Average trawling hours '000h	Efficiency factor	Corrected estimate (2nd estimate) '000h
1962-'63	6-10	1528	1.764	4.69	1.847	1.568	0	1.568
1963-'64	6-10	2245	2.754	4.94	2.890	2.448	0.257	2.511
1964-'65	6-10	3886	4.500	7.63	4.843	4.000	0.443	4.177
1965-'66	6-10	7080	10.545	7.99	11.387	9.490	1.474	10.889
1966-'67	6-10	7676	11.350	9.37	12.413	10.215	1.666	11.917
1967-'68	6-10	3080	5.605	9.81	6.155	5.605	1.177	6.265
1968-'69	11-15	5064	15.930	11.45	17.754	11.947	1.884	14.198
1969-'70	11-15	6308	15.816	11.96	17.708	11.862	1.927	14.148
1970-'71	11-15	4864	12.948	13.00	14.631	10.790	2.326	13.300
1971-'72	11-15	20332	37.854	18.35	44.800	31.545	1.838	37.343
1972-'73	11-15	28032	48.930	21.56	59.479	40.775	1.829	48.232
1973-'74	11-15	10324	23.178	22.59	28.414	21.246	2.003	25.501
1974-'75	11-15	8824	19.302	25.03	24.133	19.302	2.183	23.515
1975-'76	20-25	37396	387.109	26.93	491.357	265.446	3.511	358.644
1976-'77	20-25	81476	674.739	28.01	863.733	501.234	3.556	679.472
1977-'78	20-25	4572	411.590	29.84	534.408	288.113	3.406	386.244

larger purse seines. Using data on horse power of boats, size, design and construction of nets, estimates of increase in efficiency as in Table 4 were obtained. A revision has been made of the estimate on the effect of increase in towing hours with no catch on the efficiency (Table 5).

The relative increase in effort was found

significant (Table 2). The total annual landings of demersal fish as a whole and prawn caught in bottom trawl (Table 1) divided by various estimates of fishing effort (Table 2) provided the estimates of catch per unit effort (Table 3). All the estimates of catch per unit effort declined in three stages, that is, from 1962-'63 to

Table 3. *Estimates of catch per unit effort at Paradeep*

Year	Catch/h of total demersal fish for all the boats operated in the margin			Catch/h of total prawn for all the boats operated in the margin	
	Government boats kg	As per first estimate kg	As per second estimate kg	As per first estimate kg	As per second estimate kg
1962-'63	126.30	104.46	123.05	6.25	7.36
1963-'64	141.32	109.78	126.35	6.72	7.73
1964-'65	67.61	54.25	62.90	4.88	5.66
1965-'66	112.22	69.78	72.97	3.96	4.14
1966-'67	80.08	49.52	51.58	3.47	3.61
1967-'68	81.24	40.65	39.94	4.47	4.39
1968-'69	113.73	86.82	108.57	4.71	5.89
1969-'70	221.88	166.85	208.84	15.70	19.66
1970-'71	187.47	130.73	143.81	13.18	14.50
1971-'72	84.02	72.54	87.03	10.15	12.17
1972-'73	88.07	72.03	95.36	5.27	6.50
1973-'74	107.57	80.66	89.88	5.03	5.60
1974-'75	58.74	45.16	46.35	9.75	10.01
1975-'76	82.60	54.30	74.39	6.58	9.01
1976-'77	27.40	18.56	23.59	1.55	1.97
1977-'78	43.89	26.39	36.51	4.43	6.13

1967-'68, 1969-'70 to 1974-'75 and 1975-'76 to 1977-'78 both in case of prawn and total stock in the area. The significant rise in catch (2 to 4 times) per unit effort in 1968-'69 to 1969-'70 was due to a three-fold increase in fishing effort, introduction of large sized light weight trawl net made of synthetic twine and trawling at 11-15 fathoms (Table 2). But during 1975-'76 an increase of 0.5 to 2 times of catch/h was noticed consequent to 20 times fishing effort compared to previous year. A further increase in effort (74.3%) in 1976-'77 failed to increase either the total catch or catch per unit effort and showed a sharp decline in both the cases. By reducing the effort to 39% in the next year (1977-'78), the catch rate increased to 42.19%, but not to the level of 1975-'76. Thus it may be concluded that the maximum equilibrium yield (Banerji & Krishnan, 1973) has already been achieved in 1975-'76 and further increase in fishing effort will only decrease the catch per unit effort.

The average catch per hour was 68.56 kg for the different groups, namely, miscellaneous fishes, sciaenids, prawns, pomfrets,

Table 4. *Estimate of increase in efficiency*

Year	Increase in efficiency
1962-'63	0
1963-'64	2.70
1964-'65	4.80
1965-'66	16.02
1966-'67	18.38
1967-'68	13.05
1968-'69	21.27
1969-'70	21.89
1970-'71	26.73
1971-'72	22.51
1972-'73	23.31
1973-'74	25.88
1974-'75	29.12
1975-'76	48.05
1976-'77	49.39
1977-'78	48.54

ribbon fishes, clupeids, polynemids, silver bellies, glass fishes and cat fishes in the order of abundance. The percentage composition of these groups to total catch also followed a similar trend (Table 6). The composition of catch according to Misra

Table 5. *Effect of increase in towing hours with no catch on the efficiency*

Year	Increase in efficiency
1962-'63	0
1963-'64	2.57
1964-'65	4.43
1965-'66	14.74
1966-'67	16.66
1967-'68	11.77
1968-'69	18.84
1969-'70	19.27
1970-'71	23.26
1971-'72	18.38
1972-'73	18.29
1973-'74	20.03
1974-'75	21.83
1975-'76	35.11
1976-'77	35.66
1977-'78	34.06

et al. (1972) based on landings of 1969-'70 to 1971-'72 does not agree with the average percentage composition calculated in this study.

The average monthly variation of catch increased from 16.92 to 40.91 kg/h (November to March). The catch rate of prawn, pomfret, ribbon fish and cat fish declined

from March, their peak landing was from December to February. In other groups the catch increased still further in March, but to a lesser degree, compared to the percentage of their increase in previous months (Table 7). The higher catch rate (more than 4 times) at Paradeep, than at Damodarapur, shows that the areas off Mahanadi river mouth as a better trawling ground than off Rushikulya river mouth. It is interesting to note that, the catch rate of total landings and the majority of fish groups were more in Astarang than at Damodarapur but slightly less when compared to Paradeep (Table 6). Miscellaneous fishes were significantly fewer and quality fishes dominated the catches at Astarang compared to Paradeep suggesting exploitable commercially important demersal fish stock in the area. The catch rate from October onwards increased progressively, reaching the maximum in December and gradually declined till March both at Paradeep and Damodarapur (Table 7). But the highest catch of prawns was in December at Paradeep followed by cat fish in January. Ribbon fish, clupeiform fishes, polynemids, sciaenids and silver bellies concentrated in the area during February and March respectively. The highest catch rate of miscellaneous group and total stock was noticed in March.

Table 6. *Regionwise average trawl catch*

Total fishing effort h	Paradeep 20719			Astarang 1995			Damodarapur 1165		
	Total catch	Compo- sition of catch	Catch/h	Total catch	Compo- sition of catch	Catch/h	Total catch	Compo- sition of catch	Catch/h
	kg	%	kg	kg	%	kg	kg	%	kg
Prawn	138111	9.72	6.66	20363	18.18	10.21	595	3.02	0.51
Pomfret	93815	6.60	4.53	9386	8.38	4.70	1819	9.22	1.56
Clupeiform fishes	65795	4.63	3.17	1660	1.48	0.83	608	3.08	0.52
Polynemids	16194	1.14	0.78	79	0.07	0.04	137	0.69	0.12
Sciaenids	439240	30.92	21.20	46764	41.76	23.44	5897	29.89	5.06
Ribbon fishes	77980	5.49	3.76	4423	3.96	2.22	1028	5.21	0.88
Silver bellies & glass fishes	15766	1.11	0.76	3192	2.85	1.60	389	1.97	0.33
Cat fishes	13828	0.97	0.67	7507	6.70	3.76	268	1.36	0.23
Eel	—	—	—	7928	7.08	3.97	—	—	—
Carangids	—	—	—	2479	2.21	1.24	—	—	—
Soles	—	—	—	1679	1.50	0.84	—	—	—
Elasmobranchs	—	—	—	1877	1.68	0.94	—	—	—
Miscellaneous	559781	39.42	27.02	4647	4.15	2.33	8988	45.56	7.71
Total	1420510	100.00	68.56	111984	100.00	56.13	19729	100.00	16.93

Table 7. Monthly average catch per hour

	October			November			December			January			February			March		
	Para-deep	Asta-rang	Damo-darpur															
Prawns	0.47	1.6	1.37	1.11	23.79	2.33	1.40	13.14	0.73	0.46	2.38	0.51	1.07	11.80	0.24	1.06	8.55	0.06
Pomfret	0.21	1.5	—	0.56	3.24	—	0.84	5.26	1.24	0.29	5.11	0.59	0.79	4.62	4.26	0.80	4.64	0.03
Clupeiform fishes	0.51	0.2	1.02	1.36	1.29	1.11	3.48	0.67	3.78	4.67	1.09	2.13	4.84	0.51	2.17	5.09	0.73	0.98
Polynemids	—	—	—	—	0.02	—	0.59	0.03	—	0.66	0.08	—	0.59	0.02	—	0.78	0.03	—
Sciaenids	2.98	2.1	2.29	5.94	23.14	2.68	10.61	26.97	4.35	12.42	44.56	3.07	13.04	7.59	3.39	14.15	7.73	1.26
Ribbon fishes	0.28	—	0.35	0.47	2.66	0.37	1.89	3.23	0.41	2.44	2.86	0.39	2.49	0.94	0.43	1.81	1.56	0.29
Silver bellies & glass fishes	0.10	—	—	0.12	0.45	—	0.17	2.97	—	0.34	1.26	—	0.29	1.77	—	1.21	1.25	—
Cat fishes	0.14	0.6	0.41	0.21	5.02	0.76	0.44	2.43	0.91	0.47	6.82	0.67	0.46	1.64	0.71	0.30	2.37	0.37
Eel	—	1.0	—	—	5.27	—	—	3.76	—	—	6.44	—	—	2.58	—	—	1.30	—
Carangids	—	—	—	—	0.25	—	—	0.92	—	—	2.14	—	—	0.96	—	—	1.22	—
Soles	—	0.8	—	—	2.14	—	—	0.62	—	—	0.93	—	—	0.50	—	—	0.51	—
Elasmobranchs	—	0.5	—	—	1.36	—	—	0.77	—	—	1.26	—	—	0.55	—	—	0.87	—
Miscellaneous	2.20	2.0	3.1	7.15	4.39	5.63	10.92	1.80	13.44	12.40	2.79	5.01	14.35	1.39	5.63	15.71	2.06	3.16
Total	6.89	10.3	8.54	16.92	73.05	12.88	30.34	62.59	24.86	34.15	77.71	12.37	37.92	34.88	16.83	40.91	32.84	6.10

At Astarang, during the same period, prawns, clupeiform fishes, soles, elasmobranchs and miscellaneous groups showed a peak in November followed by pomfrets, ribbon fishes and silver bellies in December. In January, polynemids, sciaenids, cat fishes, eel and carangids dominated the catch (Table 7). The demersal fish stock was maximum from November to January. The results show that off Devi river mouth is more productive and under exploited. The fishes appear to migrate to inshore waters from north to south, first to off Mahanadi area in October and off Devi in November.

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