EXAMINATION OF THE EFFICIENCY OF MACKEREL FISHING

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When various developmental measures are being undertaken to increase the fish production in India, it is pertinent to examine if the fishing methods employed are quite efficient. In marine fishing, the efficiency of fishing methods in general depends on the ability of the fishermen to locate the fishing grounds where the fish are abundant and to catch them there. In case of some of the pelagic fisheries like Indian mackerel, in the exploitation of which the fishermen rely on the arrival of the fish shoals in the inshore area, the fishing efficiency will depend on the ability and skill of the fishermen to identify the time and period when the mackerel shoals are most abundant in the inshore waters and to concentrate most of their effort at the time to catch the fish. The present paper provides a method for measuring quantitatively the fishing efficiency of the fishermen of the Karwar area with regard to the mackerel fishery. Though the results of the quantitative analysis will specifically relate to the efficiency of the Karwar fishermen, it is believed that the same will be applicable to the fishermen of the entire Mysore coast, if not the entire Indian coast.

Index of Fishing Efficiency

If C_i is the catch of mackerel in the i-th month and if e_i is the corresponding effort in terms of some standard unit of gear, then C_i/e_i gives the catch-per-unit-effort for the i-th month which is an index of abundance of the mackerel population in the inshore waters during the same month.

One measure of the abundance of the mackerel population for the whole season is obtained by $U_0 = \Sigma C_i/\Sigma e_i$ where the summations are over all the months of the fishery. This is as unweighted index, as the average is taken over the entire fishing season without giving weights to various months in terms of eftort spent.

Still another index can be constructed to measure the abundance of mackerel population. This is the weighted index U_w given by $U_w = \Sigma \ (C_i/e_i)/N$ which is merely the simple average of the N monthly indices of abundance.

If equal efforts were devoted in each month the two indices U_0 and U_w would be equal, even though catch-per-unit-effort among months may vary. If, however, more effort were put in during those months when the abundance was relatively high, it is easy to visualise that U_0 will be greater than U_w. On the other hand, if the input of effort was more during the relatively lean months, U_0 will be lower than U_w. If, however, the efforts were devoted at random among the months of fishing, the mathematical expectation of the ratio U_0/U_w will be 1. Thus the ratio U_0/U_w may be considered as an index of fishing efficiency or fishing success. Gulland (1956), Griffiths (1960) and Calkins (1961) have used the index in measuring the fishing efficiencies of various fisheries.

RELATIONSHIP BETWEEN U_0 AND U_w

The general relationship between U_0 and U_w may be linear or curvilinear. On plotting U_0 against U_w, if the relation appears to be linear, the line of best fit could be obtained, showing the linear relationship between U_0 and U_w. Further, if it is remembered that when U_w is zero, U_0 must also be zero,

TABLE I

Mackerel landings at Karwar (in lb.)

Year	Months							
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
1948–49	1,63,280	12,58,896	20,20,480	4,09,920	7,840	..	..	38,60,416
1949–50	8,960	13,28,320	7,39,200	12,600	..	..	..	20,89,080
1950–51	5,71,200	18,03,200	9,40,800	8,84,800	89,600	2,68,800	..	45,58,400
1951–52	70,720	7,18,400	7,34,000	1,51,600	8,65,600	1,70,400	..	27,10,920
1952–53	..	11,37,800	2,63,000	1,07,600	95,600	44,000	..	16,48,000
1953–54	..	13,79,000	11,17,500	1,99,000	15,200	4,940	..	27,15,640
1954–55	..	17,38,500	3,60,200	13,645	18,440	..	..	21,30,785
1955–56	4,92,800	2,92,100	1,73,180	1,52,040	7.720	32,560	..	11,40,400
1956–57	2,93,000	1,25,600	41,000	2,67,160	1,00 400	23,700	..	8,50,860
1957–58	66,700	25,89,500	21,79,800	1,19,000	6,000	..	..	49,61,000
1958–59	79,400	16.42,600	15,08,000	3,88,600	13,55,300	10,28,800	3,20,800	63,23,500
Per cent.	5·26	42·48	30·55	8·20	7·77	4·77	0·97	100·00

TABLE II

Effort devoted

(Unit = a piece of Rampan net)

Year	Months							Total
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	
1948–49	1,851	8,506	9,101	8,006	7,840	..	..	35,304
1949–50	861	9,110	8,213	1,211	..	..	..	19,395
1950–51	6,000	9,008	8,355	7,594	8,058	5,508	..	44,521
1951–52	700	9,233	7,825	5,750	10,378	2,253	..	36,139
1952–53	..	10,306	10,779	8,276	8,241	3,188	..	40,790
1953–54	..	12,495	14,460	8,940	2,600	1,000	..	39,495
1954–55	..	19,230	9,505	13,665	7,195	..	..	49,595
1955–56	6,200	11,050	12,275	10,875	6,100	4,850	..	51,350
1956–57	5,260	5,570	910	11,145	10,980	2,510	..	36,375
1957–58	5,160	18,522	15,248	8,236	475	..	..	47,641
1958–59	1,200	18,800	18,300	11,500	17,500	15,350	9,225	91,875
Per cent.	5·53	26·77	23·35	19·33	16·11	7·04	1·87	100·00

the form of the line will be $U_0 = bU_w$. The estimate of b could be obtained by least square methods, if the data for (U_0, U_w) are available for a series of years.

If b is not significantly different from 1, then it could be argued that the input of effort is taking place over months either at random or in equal amount for some reasons, and the fishermen are not taking proper advantage of the concentrated fish abundance in some months. If b is found to be significantly higher than 1, then it can be concluded that fishing efficiency is higher than if fishing was done at random. Reverse will be the case if b is found to be significantly lower than 1. To take a specific illustration, let us suppose the estimated value of b is 1·90, and test of significance shows that it is significantly different from 1, then it can be said that the fishing efficiency was 90% more than what could have been if the fishing was done at random over the months.

DATA AND SOURCE

Tables I and II show respectively the monthly catches of mackerel at Karwar and the amount of effort spent in each month for the period from 1948–49 to 1958–59. The data for the years 1948–49 to 1952–53 have been compiled from Pradhan (1956). The data for the years 1954–55 and 1955–56 are compiled from Radhakrishnan (1958). The data for other years are collected from the quarterly and the annual reports of the Institute (unpublished). In Table III are worked out the catch-per-unit-effort for every

TABLE III

Catch per unit effort (in lb.)

Year	Months							U_0	U_w
	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.		
1948–49	88·20	148·00	222·00	51·20	1·00	..	..	109·35	102·08
1949–50	10·40	145·80	90·00	10·40	..	..	..	107·71	64·15
1950–51	95·20	200·22	112·60	116·51	11·12	48·80	..	102·39	97·41
1951–52	101·03	77·81	93·80	26·40	83·41	75·63	..	75·01	76·35
1952–53	..	110·40	24·40	13·00	11·60	13·80	..	40·40	34·64
1953–54	..	110·36	77·28	22·26	5·85	4·94	..	68·76	44·14
1954–55	..	90·41	37·90	1·00	2·56	..	..	42·96	32·97
1955–56	77·87	26·43	14·11	13·98	1·27	6·71	..	22·21	23·40
1956–57	55·70	22·55	45·05	23·97	9·14	9·44	..	23·39	27·64
1957–58	12·93	139·81	142·96	14·45	12·63	..	..	104·13	64·56
1958–59	66·17	87·37	82·40	33·79	77·44	67·02	34·78	68·83	64·14
Average	46·14	105·38	85·68	29·72	19·64	20·58	3·16	..	..

month. It may be mentioned here that a piece of Rampan has been taken as the unit of effort. The last two columns of Table III furnish the two indices of abundance U_0 and U_w.

Figure 1 shows the plot of U_0 against U_w. As a first approximattion, the relationship can be considered linear and as stated before for obvious reasons this straight line must pass through the origin.

The least square value of the regression coefficient is found to be 1·0770. The standard error of b is found to be $S_b = 0 \cdot 1994$. The test of significance shows that the value of b is not significantly different from 1, on the 5% probability level.

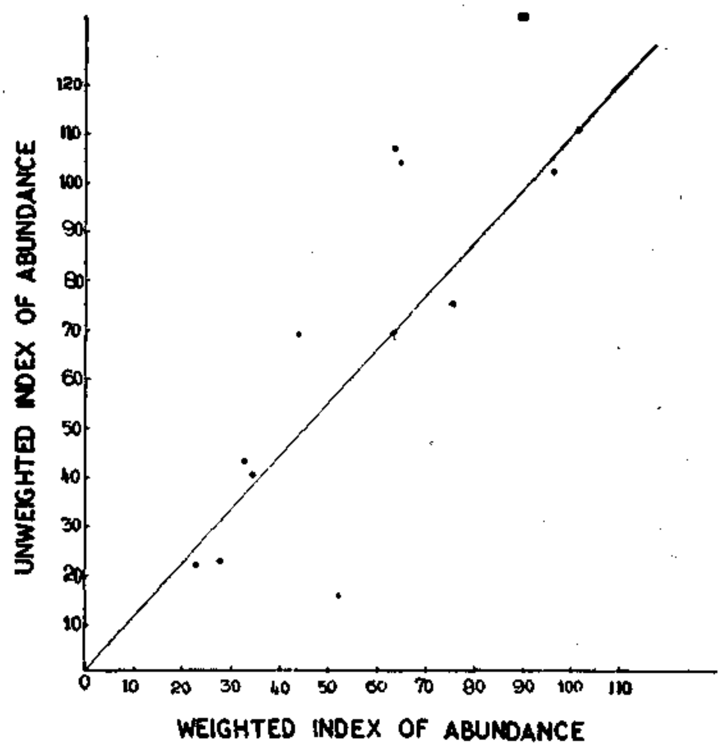

FIG. 1. Relationship between the unweighted index and the weighted index of abundance from 1948–49 to 1958–59.

DISCUSSION

The regression coefficient b was not found to be significantly different from 1. This shows that over the years, the fishing was not in anyway more efficient than if fishing was done at random over the months. In other words, the fishermen are not taking proper advantage of those months when the fish is at a high level of abundance. The question naturally arises, whether this inefficiency is due to the inability of the fishermen to detect the periods of high abundance and exploit them at that time or due to some other reasons:

In Karwar, there are 8 units of Rampan consisting of about 4,000 pieces of Rampan. If all the 8 units operate only once a day, the potential monthly effort could be computed at 120,000 pieces of effort. Looking in Table III, the high abundance of mackerel stocks occur only during the months of November and December. Sekharan (1958) has stated that "as the stock maintains a high level of abundance only for a short while, a full exploitation policy demands the application of the maximum fishing pressures, at that time. On this point, if not on any other, the wisdom of the social ban on night fishing and on the use of other gear (besides Rampan) may be questioned". The contention of Sekharan is that maximum possible fishing effort is not being employed in the months of high abundance. From Table II, it is seen that even in months of high abundance, not more than 15% of the potential effort has been employed for mackerel fishing. The average abundance in November and December is about 95·53 lb. per piece of Rampan as compared to the average abundance of 23·85 lb. per piece in other months. Thus the average abundance in November-December is more than 4 times that in other months. Yet the effort employed in these months is on the average just a little more than double the amount employed in other months. That more effort could have been employed is proved by the fact only a tiny fraction of the potential effort is now put into in these months.

The reason for such abstinence on the part of the fishermen is probably economic rather than their inability to detect good periods of abundance. Sekharan commenting on the social ban of night fishing of mackerel states: "Probably, this traditionally imposed restriction had an economic aspect as well. In the former days, disposal was a problem because of difficulties of transport and an unmanageable catch could easily have resulted in a glut in the market. To a certain extent these conditions exist even now." Pradhan has also indicated the same in an indirect way. He states that the practice of impounding mackerel came in vogue by about 1940, so that fresh mackerel could be sold at a higher price. It therefore appears that inadequacy of immediate marketing facilities of fresh mackerel prevents the fishermen from fishing more. The introduction of carrier launch to carry fresh mackerel to Bombay has relieved the pressure on the fishermen to some extent but apparently not enough. The interseasonal variation in the price of mackerel also plays a dominant role in the employment of input of amount of effort in different months. According to Pradhan, the wholesale price of fresh mackerel is usually Rs. 5 to Rs. 8 per thousand and gradually the price increases to Rs. 20 to Rs. 30 per thousand when the fish becomes relatively scarce towards the end of the season. In lean years the price has even gone up to Rs. 60 per thousand. This explains why the fishermen devote quite a disproportional part of the total effort employed in months when the level of abundance is rather low. An equivalent amount of effort would bring them about $\frac{1}{3}$ to $\frac{1}{4}$ catch as compared to catches in best months, but they would probably get a higher price for the same.

It is thus obvious that at present the fishing method of mackerel fishery is not very efficient in the sense described above. But this inefficiency is not due to the lack of know-how on the part of fishermen or not due to their inability to locate periods of high abundance but it is the result of lack of marketing, transportation and preservation facilities.

SUMMARY

The ratio of unweighted index of abundance to the weighted index of abundance may be taken as a measure of fishing efficiency. The regression coefficient of unweighted index to the weighted index provides the best estimate of fishing efficiency in the Neyman-Markoff sense. In case of mackerel fishing in India, the regression coefficient was not significantly different from 1, indicating that the fishing efficiency was not significantly better than what would have been in the case of random fishing. Inadequacy of transport and marketing facilities are considered to be the main causes for such inefficiency.

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