A PRELIMINARY APPRAISAL OF THE PRAWN FISHERY OF KERALA

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ABSTRACT

A preliminary appraisal of the relation between fishing effort and catch of prawns in the Kerala waters has been made, using the prawn catch data available with the Central Marine Fisheries Research Institute and of the medium-sized vessels of the Government of India and the Indo-Norwegian Project operating along the Kerala coast from 1957 to 1969. The decline in catch per unit effort and the decline in the mean size of prawns in the commercial catches of Kerala are not signs of over-fishing but are indications of an expanding fishery. The analysis shows that very little increase in the catch will result even when the fishing effort is increased substantially and the immediate need is to stabilise the production at its present level.

INTRODUCTION

Among the prawn producing countries of the world, India occupies the position only next to the United States of America. Of the total prawn production in India, Kerala accounts for 26%. This figure excludes the catch obtained from the backwaters, estuaries and coastal lagoons. In Kerala, the prawn fishery has been in existence since ancient times. During 1955, an FAO expert conducted shrimp trawling off the Malabar coast and in a press release, the FAO described the shrimp grounds as "Gold Mines" (Kristjonsson, 1967). This created a widespread interest both in national and international circles for shrimp business. Consequently, during the last decade or so a phenomenal development has taken place in the prawn fishery of Kerala. Along with non-mechanised (indigenous) boats, an increasing number of shrimp trawlers is being put into operation every year to augment the yield of exportable varieties of prawns. While every attempt is being made to catch more and more of this valuable product, the yield per boat is showing a decreasing trend and the average size of the commercial catches is also declining. Under this context, it has become necessary to examine the effect of increasing fishing intensity on the prawn fishery of Kerala. This paper gives a preliminary appraisal of the relation between fishing effort and catch of prawns, which is an assessment of the existing status of the prawn fishery, together with its future prospects in Kerala.

METHOD OF ASSESSMENT

Two types of theoretical models have been developed for the assessment of exploited fisheries, namely the dynamic pool model of Beverton and Holt (1957) and the generalised production model of Pella and Tomlinson (1969); a special feature of the latter is the logistic model of Schaefer (1954, 1957). The dynamic pool model of Beverton and Holt makes use of the relationship between growth, natural mortality and fishing mortality to compute the yield in weight theoretically obtainable from a constant number of recuirts entering the fishery. The model contains at least nine parameters and their estimation requires not only the data on catch and effort but also information on the age structure of the population. Apart from the complexity of the data required, the model is applicable to a unit stock of a single species. The prawn fishery of Kerala is a multi-species fishery, the same gear being used to catch all the species from the common fishing ground. Because of these difficulties, the generalized production model has been employed in this paper for the preliminary assessment of the multi-species population of prawns. In this model, only the data on catch and effort are necessary. The approach involves the determination of a relation between catch per unit effort (CPUE) and effort (E). Multiplying the relation throughout by E, a relation between catch (C) and effort (E) is obtained from which it is possible to determine the level of fishing effort which will give the maximum yield. This yield can be used as a recommendation for the necessary management. If the relation between CPUE and E is linear, as indicated in the Schaefer's model, the relation between catch C and effort E becomes a symmetrical parabolic curve, so that the maximum catch is obtained at a middling level of effort. But when the realation is curvilinear, as is the case in a generalized model, the relation between catch and effort is no longer symmetrical, and the resultant asymetrical curve may or may not have a maximum.

AVAILABLE DATA

As noted earlier, the data on catch and effort are the minimum pre-requisite for the assessment of fishery resources. Estimates of the annual catch of prawns from the Kerala waters are available with the Central Marine Fisheries Research Institute. These have been given in Table 1 and are used in this paper for the assessment of prawn fisheries of Kerala.

No estimates of effort are directly available. The exploitation of prawns in Kerala is confined to a narrow coastal belt up to about 20 m depth. Apart from the large and medium trawlers of the Government of India, the Indo-Norwegian Project and the privately owned shrimp trawlers which are continually on the increase, a large number of indigenous boats using a variety of gears like the boat seines, shore seines, drift nets and cast nets operate in the inshore belt for the exploitation of prawns. This renders it difficult to make a direct estimate of effort. Hence in this paper an indirect approach has been employed for determining the standard measures of effort.

TABLE 1. *Landings of prawns in tonnes in Kerala*

Year	*Catch*
1957	20,327
1958	14,815
1959	14,567
1960	12,606
1961	20,436
1962	29,218
1963	21,954
1964	35,220
1965	14,411
1966	28,379
1967	27,252
1968	25,391
1969	34,368

Medium-sized vessles of the Government of India and the Indo-Nowegian Project have been fishing in Kerala since 1957. Tholasilingam *et al.* (1968) have furnished the catches of prawns per trawling hour of the Government of India vessels from 1961 to 1968. For other years, the data were obtained directly from these vessels which were computed for catches per trawling hour. Similar data were obtained from the medium-sized vessels of the Indo-Norwegian Project. The total effort was calculated in terms of medium-sized vessels of the Government of Inda and the Indo-Norwegian Project. These were used as standard units for dividing the total catch of Kerala.

RELATION BETWEEN CATCH PER UNIT EFFORT AND EFFORT

The data on catch per unit effort (C/E) and estimated effort E for the different years for the Government of India medium-sized vessels are plotted in Fig. 1. It

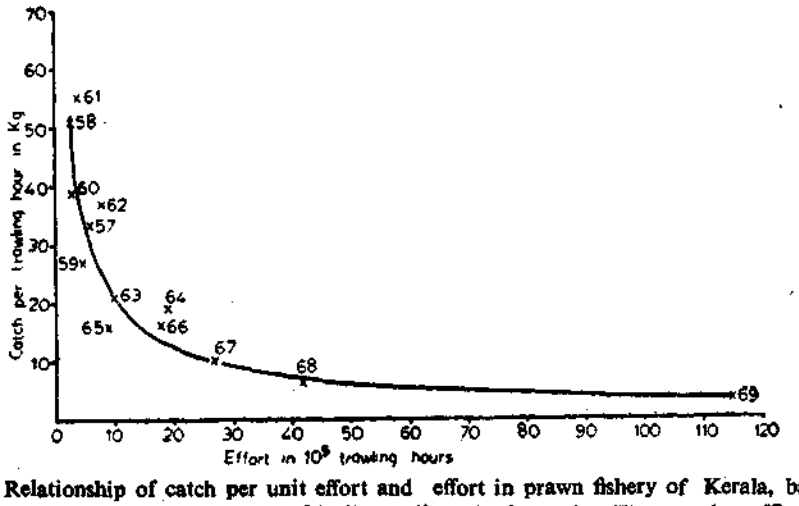

FIG. 1. Relationship of catch per unit effort and effort in prawn fishery of Kerala, based on data from the Government of India medium-sized vessels. The numbers 57 to 69 in the figure refer to the years 1957 to 1969 and the crosses to the observed catch per trawling hour in kg for the respective years.

is clear from the figure that there is a relationship between these two, but it is not a linear relation as would have been the case if the Schaefer's logistic model of production were to be applied. Evidently, a curvilinear relation corresponding to general production model will fit the data. Gulland (1961), while finding a relation between catch per unit effort and effort for plaice and cod at Iceland, got a curve which was concave upward. Boerema *et al.* (1965) also got a similar curvilinear relation in Peruvian anchoveta. From the plotted points in Fig. 1, it appears that a curve of the form $y=ax^b$ will fit the data best (where y=catch per unit effort in kg, x = effort in trawling hours and a and b are parameters). On logarithmic transformation, the relation becomes a straight line. Fitting this line by the method of least squares for catch per unit effort and effort data, the equation becomes:

$$Y = 2.07371 - 0.74865X$$

where, Y=log catch per trawling hour in kg.

X = log effort expressed in 100 thousand trawling hours.

The expected values of catch per trawling hour as well as the observed values are given in Table 2.

It can be seen from the table that the expected and observed values agree very closely. The curve in Fig. 1 describes the expected relationship between catch per unit effort and effort. From the expected value of catch per unit effort, the expected annual catches at different levels of effort have been computed and the curve in Fig. 2 describes the relationship between catch and effort. The observed catches in different years have also been plotted in the same figure.

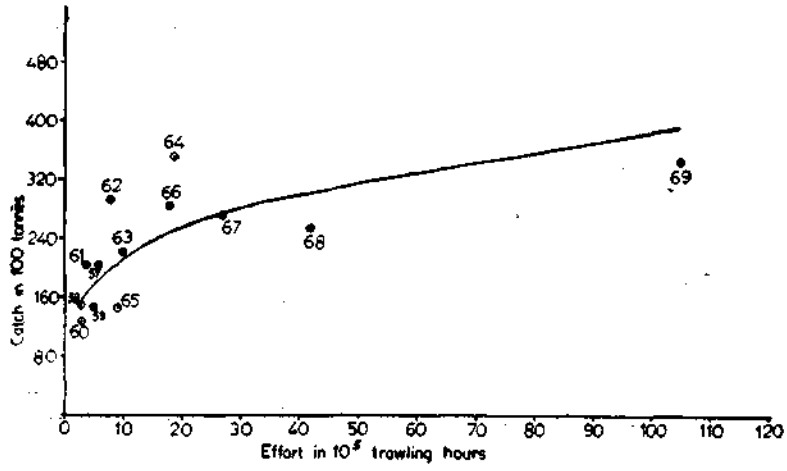

FIG. 2. Relationship of catch and effort in prawn fishery of Kerala, based on data from the Government of India medium-sized vessels. The numbers 57 to 69 in the figure refer to the years 1957-1969 and the encircled dots to the observed catch in hundred tonnes for the respective years.

TABLE 2. *Observed and expected catch per trawling hour for the Government of India medium-sized vessels*

Year	Expected catch per unit effort in kg	Observed catch per unit effort in kg
1957	31.0	33
1958	52.1	51
1959	35.5	27
1960	52.1	39
1961	42.0	55
1962	25.0	37
1963	21.1	21
1964	13.1	19
1965	22.9	16
1966	14.6	16
1967	10.1	10
1968	7.2	6
1969	3.4	3

The linear equation determined by the method of least square for the catch per unit effort and effort data for the Indo-Norwegian Project vessels works out as:

$$Y=2.09196-0.70553\ X$$

where X and Y bear the same significance as in the equation given before. The expected values of catch per trawling hour and the observed values are given in Table 3.

TABLE 3. *Observed and expected catch per trawling hour for the Indo-Norwegian Project medium-sized vessels*

Year	Expected catch per unit effort in kg	Observed catch per unit effort in kg
1957	58.3	70
1958	61.4	54
1959	61.4	54
1960	59.8	45
1961	61.4	75
1962	43.5	67
1963	25.3	23
1964	13.4	15
1965	23.8	14
1966	14.8	14
1967	21.7	23
1968	22.1	22
1969	18.4	23

The above Table shows that the expected and observed values agree fairly well. The relationship between the catch per unit effort and effort is given by the curve in Fig. 3. From the expected values of catch per unit effort, the expected annual yields at different levels of effort have been estimated. The curve in Fig. 4 gives the relation between catch and effort. The observed catches in different years are also plotted in the same figure.

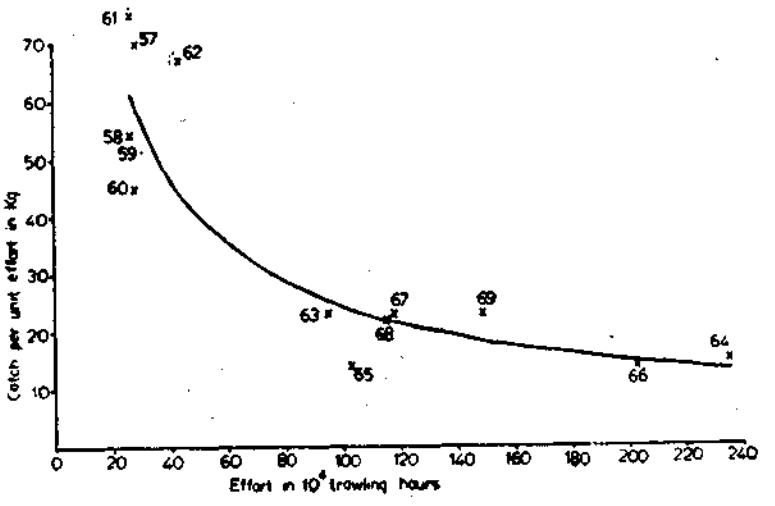

FIG. 3. Relationship of catch per unit effort and effort in prawn fishery of Kerala, based on data from the I. N. P. medium-sized vessles. The numbers 57 to 69 in the figure refer to the years 1957-69 and the crosses to the observed catch per trawling hour in kg for the respective years.

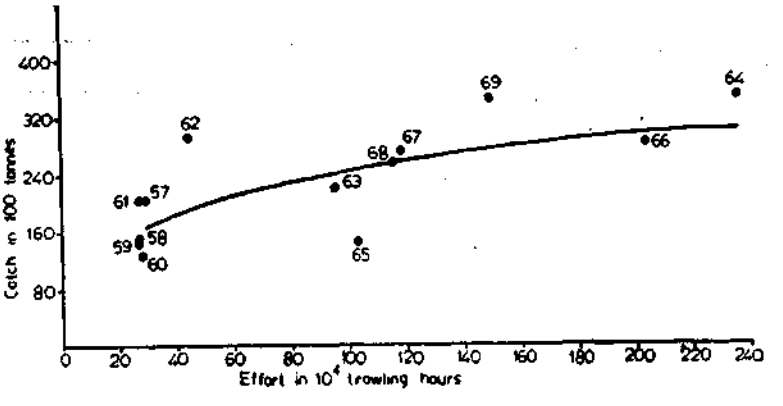

FIG. 4. Relationship of catch and effort in prawn fishery of Kerala, based on data from the I.N. P. medium-sized vessels. The numbers 57 to 69 in the figure refer to the years 1957 to 1969 and the encircled dots to the observed catch in hundred tonnes for the repsective years.

Discussion

The trawling hours of the medium-sized vessels of the Government of India and of the Indo-Norwegian Projects when taken together as a standard unit of effort, it becomes evident from Figs. 2 and 4, that the relation between catch and effort takes the form of a curve which has no maximum. This means that with increasing effort, an increase in the catch is possible and there is never any chance of a decline in the annual catch of prawns in Kerala with increasing fishing effort. This seems very encouraging, but a closer look at the catch effort curve will indicate that very little increase in the catch will result even when the fishing effort is increased substantially. As will be seen from Figs. 1 and 3, with a further increase in the input of fishing effort, the catch per unit effort will decrease further. Thus, it would not be economically advisable to increase the fishing effort further, for such an increase would only imporve the total annual catch marginally.

It is well-known that in any expanding fishery the catch per unit effort declines with increasing effort. Since fishing mortality is proportional to the fishing effort, it is clear that the increasing fishing effort will generate additional mortality on the stock, thereby reducing the average longevity of the exploited stock. This will be reflected as the decline in the average size of the fish in the commercial catch. Thus the decline in catch per unit effort and the decline in the mean size of prawns in the commercial catches of Kerala are not signs of over-fishing as are frequently mentioned alarmingly by the fishing industry, but these are indications of an expanding fishery. Theoretically, therefore, if the minimum-size of the capture is not changed as in the prawn fishery of Kerala, the mesh size of the gear remaining the same, any overfishing of a resource becomes evident only when the total quantity of the catch declines along with the catch per unit effort and the average size of the fish in the catch. The analysis presented above does not indicate the possibility of a decline in catch with increasing effort.

The management measures, therefore, must be based on certain hard facts. If the minimum size of the capture is retained, as at present, by maintaining the gear currently in use, the total quantity of the annual catch will increase marginally by increasing the effort, but in doing so the catch per unit effort will decline further, which will throw most of the industrial units into an economic doldrum. If the industry can specify the catch per unit necessary for the economic viability, the average catch that should be caught annually can be specified from Figs. 2 and 4, and then it would be a question of choosing the practical means of implementing the measures to restrict the catch limit. If the industry is interested in bigger sizes of prawns in the commercial catch, it can either be attained by a suitable reduction in the effort input or by increasing the minimum size of the captured prawns. Both these measures are not easy to be put into practice. The first measure would involve a reduction in the annual catches to which no one would agree. For the second alternative, the difficulty lies in the multi-species prawn fishery of

Kerala. The adults of some species are smaller in size than those of the others, and if a limit of the minium size is fixed, the adults of some of the smaller species may not be caught at all. Thus, the immediate solution of the problem seems to stabilize the production at its present level.

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