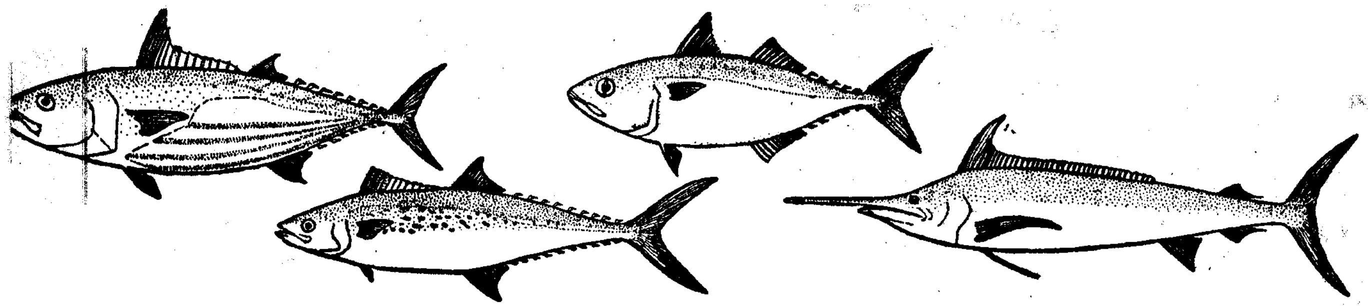


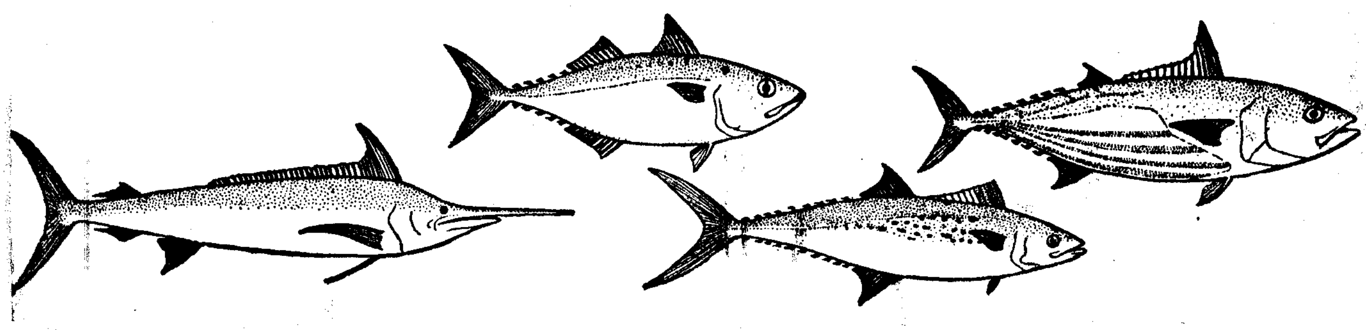
SYMPOSIUM ON SCOMBROID FISHES

PART II

MARINE BIOLOGICAL ASSOCIATION OF INDIA

MANDAPAM CAMP

S. INDIA



PROCEEDINGS OF THE

SYMPOSIUM ON SCOMBROID FISHES

HELD AT MANDAPAM CAMP FROM JAN. 12-15, 1962

PART II

SYMPOSIUM SERIES I

MARINE BIOLOGICAL ASSOCIATION OF INDIA

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SOME CONSIDERATIONS IN THE STUDY OF PELAGIC FISH STOCKS WITH SPECIAL REFERENCE TO INDIAN MACKEREL, *RASTRELLIGER KANAGURTA**

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The recent trend in the study of dynamics of fish stocks consists in building up suitable simple mathematical models which adequately describe the dynamics of fish stocks. One method is to assume some simple growth law such as logistic law for the fish stock as a whole. This method may be termed a synthetic approach and has recently been developed a great deal by Schaefer. The analytic method developed by Beverton and Holt (1957) and others assumes that changes in fish stocks result due to simultaneous operation of vital rates such as, recruitment, growth, natural and fishing mortality rates. Under very simple assumptions, a simple theoretical model is constructed which contains these vital rates as parameters.

Most of the analyses of the dynamics of exploited fish populations depend upon estimations of these vital rates. Much research and ingenuity have gone towards the making of these estimates. It is often not realised that the procedure of estimates of these vital rates depends on the theoretical model in which they occur and therefore on the assumptions on which the model is built up.

Generally the only data for the estimates of these vital rates are the other commercial catch statistics along with certain data collected from the commercial catches. If the structure of the catch is similar to that of the fish stock as a whole, the catch statistics could be used for estimating the population parameters of vital rates entering into the mathematical model. For example for estimating the total mortality rate, it is assumed (1) that the whole stock is available for uniform fishing and (2) that the unit effort of a standardised fishing unit removes equal quantity of fish. Under these assumptions, comparison of the number of fish of age t per unit effort any year with the number of fish of age $t+1$ per unit effort in the next year will furnish all estimate of the total mortality rate of the fish between ages t and $t+1$.

The above method of estimating mortality rate from commercial catch statistics will break down if the assumption that (1) the age structure of the commercial catch is not similar to that of the whole population and (2) if the portion of the fish stock available for fishing varies from year to year. Thus when there is selective fishing i.e., when fishing is restricted to fishes of certain sizes or ages only, the age structure of the catch will no longer represent the age structure of the fish population as a whole. Again the assumptions will break down when there is a case of partial coverage i.e., when we are fishing a fraction of the fish population. This may happen when due to limiting capacities of fishing equipments we are forced to restrict our fishing operations within a restricted area. Additional complications are introduced when the proportion fished undergoes change as is the case in pelagic fisheries dependent on migration. When there are fluctuations in the availability from year to year, it is necessary to remove the effects of the varying availability in making estimates of vital rates.

Beverton and Gulland (1958) have shown that if only a small portion of the fish population is being fished and if the fishing intensity is small compared to the rate of interchange between the fished and the unfished portion, the apparent total mortality rate calculated from the catch statis-

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tics is proportional to the true mortality rate and its use in the theoretical model will lead to fairly true interpretations. On the other hand, if the small part of the population is heavily fished, the apparent mortality rate calculated from catch-statistics will no longer be proportional to the true mortality rate and its use in the theoretical model may lead to misleading conclusions.

Thus, unless the entire fish stock is available for fishing, it is first of all necessary to remove the effects of varying availability in different years before the catch-statistics may be used in estimating the true mortality rate and secondly if the availability is constant but is only a fraction of the entire stock, care is needed to see if the apparent mortality rate calculated from the catch statistics is at least proportional to the true mortality rate.

Indian mackerel fishery depends on the inshore migration of the fish. The fishery is purely seasonal lasting from September to March and is restricted to a narrow coastal belt along some 400 miles along the West coast of India. The commercial catch generally consists of fishes of sizes between 18 and 26 cm. Sekharan (1958) has shown that the Indian mackerel attains a size of 21-23 cm. when they are 2 years old. According to Pradhan (1956) and Sekharan (1958), the minimum size at maturity is about 22-23 cm. Thus the mackerel fishery seems to depend only on one age group viz. the 2-year old class. Hence any fluctuation in the catch of mackerel must be due to fluctuation in the strength of the 2-year old class entering into the fishery. If availability is assumed to be constant and uniform, such fluctuations must arise from fluctuations in recruitment which may be caused either by fishing or may be due to fishery-independent factors. Secondly if the recruitment is assumed to be constant, such fluctuations must be due to changing availability which is caused by fishery-independent environmental factors. In reality, the actual situation may be something in between.

If fishing is responsible for fluctuations in the fishable stock, we should expect a correlation between effort and apparent abundance. From the available data it has been seen that the apparent abundance of the species varies from year to year but such fluctuations in apparent abundance show no relationship to the variation in standardised fishing effort. Therefore it may be concluded that the wide fluctuations in mackerel fishery must be due to fishery-independent environmental variations. At present levels of fishing effort, the effects of fishing on the mackerel population are so small compared to those included by the fishery independent factors, that they cannot be measured at all, unless we first eliminate the effects of large environmental fluctuations.

Hence the first and foremost consideration in the study of Indian mackerel fishery should be to find out the relevant environmental factors or some indicator factors which are related to the actual factors inducing fluctuations in the availability. The search for these factors should not only be directed in the fishing ground but also in the spawning grounds.

Once such factors have been found out, the effects of varying availability can be eliminated from the commercial catch statistics. The next step will then lie in estimating the true mortality rate and other vital statistics to examine the probable effects of fishing on mackerel stock.

Even after the removal of the effects of fluctuating availability, it will not be easy to estimate the vital rate from the catch statistics of Indian mackerel fisheries. It has already been pointed out that the commercial catch depends on probably one age group viz., the 2-year old class. If this is so, even an estimate of apparent mortality rate is not possible from the catch data. One would however, like to ask the question what happens to the older fish ? One possibility is that all the 2-year old fish upon which the commercial fishery thrives may die off probably after spawning between April and September after the fishing season is over. If this be so, the natural mortality will be extremely high compared to the fishing mortality, particularly if only a small fraction of the total stock is available to the fishery. The obvious conclusion in that case will be that fishing intensity could be further intensified resulting in increased catches. It is, however, not known, if this is the case. Occasionally, large-sized specimens of mackerel (record 39 cm.) have been obtained, which probably indicates that this may not be the case.

As Sekharan (1958) points out, there is also the possibility of a differential migration taking place if only the two-year olds migrate to the inshore fishing area. It is not known why this should be so, especially when migration is definitely not for spawning. If, however, this is the case, even though catch statistics alone will not furnish any estimates of mortality rate, it is possible to obtain an estimate of mortality rate by experimental fishing in the ground from where the migration takes place. This points to the necessity of discovering the grounds from where the mackerel migrates to the inshore waters.

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