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SEAFDEC/SCS.73: S-29

Some Considerations of Research and Study on Pelagic Fishery Resources

by

Kenji Kurogane
Tokai Regional Fisheries Research Laboratory
Tokyo, Japan

Abstract

The approach to the stock assessment and fishery management is briefly described on the Indo-Pacific mackerel resource in the Gulf of Thailand and the yellowtail resource around the Pacific coast of Japan.

Recently, the fishery forecast has become one of the great concerns of Japanese researchers working on the pelagic fisheries. In addition to information concering the stock assessment, knowledge on fish movements and aggregations connected with environmental conditions is accumulated to secure a correct forecast of fishery.

In spite of strenuous efforts of researchers, pelagic fishery such as natural fluctuation in fish abundance and catch, widely ranging movement and distribution and diversity of fishing gear etc., bring about many difficulties and problems on the block assessment, fishery management and forecast. At present, the results of studies are not always so reliable to satisfy the fishermen. Researchers, however, are endeavouring step by step to ensure correct and timely judgements on the above objects of fishery science with more intensive communication wih fishermen.

1. INTRODUCTION

The landings of some commercially important pelagic fish in Japan, such as sardine, anchovy, herring, saury pike, common mackerel and horse mackerel, have fluctuated considerably in past years as shown in Fig. 1. Details of these fluctuations were described for each resource by Uda at 15th Session of IPFC. Such fluctuation characters in catches of pelagic stocks have been recognized not only by fishermen but also by many researchers working on fishery resources.

These landings are affected by many factors, such as the strength of fishing efforts, the availability of fish stock in the fishing grounds, the stock abundance and so on. However, it may be said that fluctuation patterns in landings of these pelagic fish for a long period are almost similar to the ones in stock abundances.

In fishery science, one of the important works is to carry out the stock assessment, using the catch statistics, biological information and so on. According to a result of stock assessment, some stocks may be more heavily exploited and others may have to be managed by fisheries regulations in order to secure the full and optimum utilization of the resources.

For some pelagic stocks, researchers' efforts are centered to get the information on the abundance of offspring and recruitment, migratory and distributional patterns of fish by developmental stage, local movement and aggregation of fish schools in the fishing grounds connected with oceanographic conditions. Based on above information and stock assessment, works of forecasting on the fish catch, size, time and area of formation of fishing grounds for the comming season, have been conducted recently.

2. STOCK ASSESSMENT AND MANAGEMENT OF PELAGIC RESOURCES

In spite of the fluctuation characters of pelagic resources, stock assessment and fishery management are not dispensable for the full and rational utilization of these resources, as pointed out by Gulland at the 15th Session of IPFC.

The way to approach to the stock assessment is described in detail in the FAO "Manual of methods for fish stock assessment. Part 1. Fish population analysis" (J. A. Gulland, 1969). Based on the materials of catch statistics, biological surveys and tagging experiments, at first basic population parameters on growth, natural and fishing mortality, and age at recruitment etc. are estimated for each resource. Then using these estimates, the state of stock is evaluated by yield model etc. Sometimes, as seen in analyses of salmon and whale stocks, reproductive relation between the abundance of parents and succeeding recruitments are induced in the stock assessment.

A typical example of research works of pelagic resources seems to be indicated in "Mackerel Investigations Programme" in Thailand. Namely, the Government of Thailand launched a programme of mackerel investigation since 1956 with the aim of stabilizing resources and assuring their maximum sustainable yield. Surveys and studies in the programme are as follows:

1) Catch statistics of mackerel;
2) Size compositions of mackerel;
3) Tagging experiments;
4) Study of early life history;
5) Racial study.

Based on these materials and studies, the present state of Indo-Pacific mackerel (*Rastrelliger neglectus*) resource is evaluated by Kurogane et al. (1970) and Hongskul (1972). The flowchart of stock assessment procedures on the mackerel by Kurogane et al. is shown in Fig. 2. Results of these surveys and studies have been reported in a number of publications issued by the Marine Fisheries Laboratory in Bangkok, and in the Proceeding of IPFC, and recently summarized by Dhebtaranon and Chotiyaputta (1972). According to this paper, a plan of management of mackerel fishery in the Gulf of Thailand, namely, limiting the number of boats, gear, mesh size, fishing in spawning season and area, was offered by the Pelagic Fisheries Investigation Unit of the Marine Fisheries Laboratory to the Department of Fisheries.

Stock assessments and fishery managements, similar to the above case, are seen in the studies of tunas, common mackerel and yellowtail resources etc. in Japan. As to yellowtail (*Seriola quinqueradiate T. & S.*) around the Pacific coast of Japan, for instance, the fishing is largely changing of late. As one example, the catch of adult yellowtail by the set nets is declining, but that of immature ones by the purse seines and lines is on the increase. Recently, the production of cultured yellowtail is rapidly going up, as the juveniles are caught in a large amount at sea. It is assumed that the capture of juvenile yellowtail for culture affects approximately 10% on the fish resources. It is also considered that an augmentation of fishing intensity of the purse seines for immature yellowtail decreases to 2/3 of the adult resources. But the total catch of the fish does not fluctuate. The only problem is allocation of the fish catch by various fishing methods.

As one of the results of yellowtail stock assessments, the schematic diagram on life cycle of yellowtail is obtained with estimates of population parameters. At present, the fishing of juvenile yellowtail for culture has many limitations in the number of boats, amount of fish caught, and fishing period etc.

3. CHARACTERS OF PELAGIC RESOURCES AND FISHERY FORECAST

Rounsefell and Everhart (1953) pointed out that herring is a good example of a species subject to great natural fluctuations in abundance, and fluctuations of this type appear to be caused by great differences from year to year in the survival of young.

Many researchers indicated that the critical depletion in the catches of the Japanese sardine resource since 1941 was attributed to scarcity of recruitment from the 1938 to 1941 year classes, and effects of such factors as fishing, predatory mortality and changes in the availability were ruled out from the major causes (Kurita, 1960).

Judging from these and other cases, we can easily recognize that some resources of pelagic fish have a fluctuating and unstable character in abundance, that is caused mainly by natural factors.

In addition to this character, generally speaking, they tend to migrate widely in the sea and to be caught by various types of fishing gear. Accordingly, it seems to be considerably difficult to get the precise and reliable estimates of population parameters on the mortality and abundance, as pointed out by Gulland at the 15th Session of IPFC.

So, many researchers working on the pelagic fish, as well as fishermen, have much concerns about the forecast of the pelagic fishery, especially short life-span fish resources, for the coming fishing season.

Uda (1972) refered to the relation between the natural fluctuation in the abundance of several pelagic fish stocks in Japan and the oceanographic conditions, and stressed the importance of study of fishery oceanography.

On the common mackerel resource in Japan, Kurogane (1972) showed main results of studies on the stock assessment. At the same time, many researches are carried out to obtain the following ecological information.

1) Abundance and distribution of eggs and larvae in the spawning ground (Fig. 4)
2) Migratory and distributional patterns of mackerel by developmental stages and yearly cycle of life (such as feeding, wintering and spawning in adult stage)
3) Distributional map of relative abundance of mackerel in fishing grounds based on fishermen's operation records.
4) Relationship between fish movement, aggregation and environmental conditions including biological, oceanographical and meteorological factors etc.

Kondo (1972) described in detail the above approach

to the resource of Japanese anchovy.

Incorporating the above ecological and fishery information, stock assessment, research vessels' surveys on the abundance of the fish and oceanographical conditions in fishing grounds, and fishermen's operation records, fishery forecast on the fish abundance and catch, size, time and area of formation of fishing ground etc., is conducted several times before and during a fishing season by governmental and prefectural researchers. These forecast contents are speedily communicated to fishermen by means of newspapers, radio, telegram and so on.

Mathematical and statistical approaches to fishery forecast are applied sometimes for some pelagic fisheries. For example, fluctuations of yellowtail abundance or catch are analyzed by the following methods (Doi, 1967; Kawai, 1969; Watanabe, 1965):

1) Time series analysis for long-term catch statistics;
2) Correlation analysis for catch statistics in several fishing' grounds;
3) Multivariate analysis or computer simulation for catch statistics, estimated fish abundance and oceanographic conditions, such as water temperature, speed and direction of the Kuroshio Current etc..

In spite of strenuous efforts of research, the results of fishery forecasts are not so reliable to satisfy the fishermen at present, because of insufficiency of analyses of complexity of mechanism of fish movements and aggregations and of difficulty of prediction of the oceanographic conditions.

However, through the forecast activity, the cooperation between researchers and fishermen becomes better and researchers obtain more plentiful and reliable information on the fishing operations and endeavour to improve the way of forecasting. Consequently, for successful operations, fishermen would timely make use of the forecast information and the present conditions of fishing grounds and catches.

At present analysis of pelagic fisheries has many problems for the future from the viewpoint of stock assessment, fishery management and forecast. Researchers, however, have to make efforts to ensure correct and timely judgements on the above objects of fishery science with more close communications with fishermen.

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