RESEARCH PROBLEMS ASSOCIATED WITH SUSTAINED YIELD HARVESTING OF NEW ZEALAND FISHERIES*

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INTRODUCTION

In this paper we describe some important problems in fisheries research in New Zealand and give a brief account of the recent history of local marine fishing.

Change has been a major feature of the marine fisheries scene around New Zealand over the last decade. The changes have been massive; all result from expansion and include:

1. increased foreign fishing effort resulting in more than 1000 % increase in catch over the last 10 years,
2. the declaration of the 2oo-mile EEZ,
3. the changing overall catch composition as foreign trawlers move to new areas,
4. the submission of a large number of New Zealand-foreign joint fishing venture claims for approval to fish in New Zealand waters,
5. the concurrent collapse of statistic collection systems from the New Zealand fleet.

PELAGIC FISHING

Considerable expansion has occurred in pelagic effort and landings in the last five years-mostly from increased catches of skipjack tuna *(Katsuwonus pelamis)* by chartered American superseiners and by smaller New Zealand seiners ~Iso landing increasing quantities of trevally *(Caranx georgianus)*.

While there are problems associated with the politics of tuna fishing and also with the susceptibility of trevally to overfishing, we do not intend to deal specifically with problems of pelagic fisheries research but more generally with broader concerns within the 200-mile zone. These will largely apply to fish taken by trawl or longline and by foreign vessels rather than New Zealand vessels.

*Abbreviated version of a paper delivered at the 1979 ANZAAS Congress Symposium on *Conservation in A ustralasia and the Southern Ocean*.

DEMERSAL FISHING

In a recent paper one of us (Francis and Fisher, in press) describes the demersal scene as follows:

"Two essentially distinct demersal fisherieS! operate in the New Zealand 200-mile EEZ.

1. The coastal trawl-Iongline and set-net fishery operating around both islands, but mostly the North Island, in depths down to 200 m. Here recent annual catches have been around 60000 tonnes (40000 N.Z., 20000 foreign) predominantly made up of snapper *(Chrysophrys auratus),* tarakihi *(Cheilodactylus macropterus),* trevally *(Caranx georgianus),* barracouta *(Thyrsites atun),* and jack mackerels *(Trachurus declivis* and *T. novaezelandiae)*.
2. Deep water trawl and bottom longline fishing which operates around the South Island on the Chatham Rise, Campbell Plateau and Bounty Platform.

This fishery, almost exclusively foreign, operates in depths ranging from 200-1000 m. Heavy exploitation started in the early 1970s when large trawlers from the Soviet Union began fishing in the deeper waters along the east coast of the South Island on the vast trawlable expanse of the Campbell Plateau-Bounty Platform areas. At the same time the Japanese expanded their coastal trawling operations into deeper waters along the east coast of the South Island and began to explore the potential for bottom longlining in various areas around New Zealand.

The total deepwater catch for 1971 through 1975 averaged around 100000 tonnes per year and was evenly divided between Japan and the Soviet Union. In 1976 the catch jumped to around 200000 tonnes -partly due to the Japanese longlining fishery on the south side of the Chatham Rise and partly due to the expansion of the Japanese trawl fishery into areas along the edge of the shelf to east and south of Stewart Island and along the west coast of the South Island.

In 1977 the deep water demersal catch again increased to around 380 000 tonnes due to increases in effort by the Japanese and Soviet Union and the entrance of South Korean trawlers and bottom longliners into the fishery.

The predominant species in the deep water trawl catches in recent years has been hoki *(Macruronus novaezelandiae),* a deep water hake, which is caught both in the subtropical waters of the South Island west coast, east coast, and Chatham Rise, and the Subantarctic waters of the Campbell Plateau."

The point we are making here is that the mair. feature of fishing within 200 miles of New Zealand in the last decade has been change and expansion.

EXCLUSIVE ECONOMIC ZONE AND RESEARCH POLICY PRIORITIES

In April 1978 with the declaration of the 200-mile Exclusive Economic Zone (EEZ), New Zealand accepted responsibility to manage the fisheries within the zone in such a way as to promote optimum utilisation of stocks. This caused a massive increase in the amount of information required for the "sound management" of the fish stocks being exploited in the EEZ.

The most immediate requirement was for the provision of information to allow management decision-makers to allot Total Allowable Catches (T AC's) of various fish species in various sea areas. This had to be done quickly and with very little information.

In late 1977, in anticipation of the creation of the 200-mile EEZ, TAC's for the 1978 fishing season were "created" by Fisheries Research Division scientists, and a major activity of one of us (R. C. Francis) over the last year has been to attempt to refine these estimates in the light of more recent catch statistics that have come in from foreign vessels during the year.

A number of standing stock and Maximum Sustainable Yield (MSY) estimates have been calculated for the major fish species contributing to the deep water catch. In doing this one of the main difficulties has been a lack of information on a number of important factors necessary to calculate standing stock size using an "Expanded Area Method". This method involves the extrapolation of catch rates of various species over wide areas by multiplying standard catch rates by factors based on the area of sea bottom swept by the trawl as a function of some larger, somewhat arbitrary, area -usually a depth stratum.

In doing this, it has been necessary to make assumptions about:

1. the actual effective width of the bottom trawl fishing on the sea bed,
2. the availability of the fish to the trawl-i.e., what proportion of the fish in the path of the net are actually caught?
3. the validity of crude estimates of natural mortality of the stocks of major fish species,
4. the validity of extrapolating fish catch rates from areas of concentration over a much wider area where little or no fishing has occurred; and over a much greater time period than represented by the original data,
5. the biological discreteness of the statistical areas and,
6. the level of exploitation at the time of sampling.

Recognising these shortcomings it has been possible to provide assessments of T AC's for the stocks in question on the basis of limited data. However, if we are to progress beyond such *ad hoc* measures, we should be adopting an approach to the responsibility of managing this huge area which enables us to develop an effective policy of future research priorities. Such an approach should also enable us to negate or qualify some of the shortcuts and weaknesses accepted in our present haste.

These problems are not unique to New Zealand. Our approach could change for the better if we accept, for example, the conclusions of the Canadians who have been looking hard at their fisheries science programme prior to declaring a 200-mile EEZ. One such study concluded (Regier and McCracken, 1975 p. 1925) that "simplistic approaches to maximum or optimum sustainable yields on a stock by stock basis are obsolescent and clearly would be obsolete by now if some viable alternatives had been developed earlier."

Regier and McCracken (1975) produced an excellent list of research policy priorities which emphasised mapping, monitoring, management and harvesting protocols and synthesis and modelling. They emphasised that these four basic functions should be institutionalised to provide a framework for a rational fisheries organisation.

1. *Mapping*. It is important to develop a repository of information on the spatial distributions of various physical, biological and socio-economic qualities and quantities associated with fisheries. Much suitable information about New Zealand fisheries and potential fishing areas already exists but needs to be collated and displayed in such a way as to make it useful to fisheries scientists and managers (see Bradford and Roberts, 1978).

2. *Monitoring*. In order to understand the dynamics of fisheries both discrete and continuous time

monitoring of various fishery variables (e.g., catch, effort, size or age composition of the catch) must occur. If community structure and dynamics are of relevance to particular fisheries, attempts must be made to monitor community or system variables.

3. *Managing*. There is a great need to establish rational harvest protocols for New Zealand fisheries, where necessary providing estimates of T AC's and eventually specifying the type of management that will probably have to replace the T AC system. Where little is known about resource production and dynamics, experimental harvest protocols should be established to help accelerate the process of assessment.

4. *Modelling*. Models of fish resource systems should be created to help understand, simulate and predict resource dynamics under various harvest strategies. Not only does it force one to conceptualise what is known about a particular fishery system, but it tends to indicate where the most significant ignorance about the' resource lies. It is our feeling that attempts should be made to construct dynamic simulation models of all major New Zealand fisheries, if only to point out what we know and don't know and in what direction we need to point our research efforts.

CONCLUSIONS

Work on New Zealand fisheries is hampered by a number of problems, some of which are discussed above e.g., lack of time to collect essential biological data, reliance on *ad hoc* yield estimates, and a lack of catch statistics from the New Zealand fleet. Other important difficulties which have not been discussed include:

1. ineffective management in some inshore fisheries;
2. inadequate research vessels for work in southern offshore areas.

In spite of these difficuities considerable high quality. fisheries biological research is being carried out by Fisheries Research staff and data essential for fisheries management are accruing.

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