

Using Fishermen's Expertise to Improve Fisheries Management

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Abstract. Given the fragile nature of fish stocks in the North Sea, it is of increasing importance to produce accurate and informed estimates of the state of stocks for the purpose of setting TACs. In order to do this, realistic and reliable estimates of fishing mortality and the current state of stocks are needed. This paper will summarise a project currently underway in north-east Scotland which aims to improve stock estimates for fisheries management by making use of fishermen's knowledge. Within the project, information will be collected from fishermen in two main areas; (a) assessments on the state of stocks, and (b) factors influencing the level of fishing effort. The information on fishermen's perceptions on the state of stocks, and on how they make these assessments, will provide an opportunity to fine-tune current assessment procedures, thereby improving stock estimates for TAC purposes. Information on the factors that influence the level of fishing effort will provide policy-makers and fisheries managers with a better understanding of how fishermen make decisions that influence their fishing behaviour. This should then facilitate the process of designing more effective policy tools for controlling fishing effort. The overall aim of the project is to increase the reliability of stock assessments for management purposes, to take more formal account of the social and economic factors which influence fishing activities, with an ultimate aim of incorporating fishermen's knowledge into management decision-making.

Keywords: Fisheries management, indigenous knowledge, fishing effort, stock assessment.

1.1 Introduction

In recent years, it has been recognised by a number of international organisations¹ that the current system of fisheries management has failed to achieve responsible and sustainable fisheries. In reaction to this, there has been an increased emphasis on the need to develop new management systems which will ensure the sustainability of the industry.

It is increasingly argued that these new management systems should take into account the dynamics of both the fish stocks and the communities dependent on them (Symes, 1996; Charles, 1989). They should also make sure to incorporate the large store of knowledge available from the fishermen (Zwanenburg, *unpublished*; Intermediate Ministerial Meeting, 1997) to improve the likelihood that policy tools and control measures are accepted and therefore adopted without high compliance costs (Jentoft, 2000).

To ensure a sustainable fishery, one of the necessary, although not sufficient conditions is that the exploited stocks are healthy. Given the common property nature of the resources, this requires that some form of management system is in place which eliminates possible over-exploitation. Within the current management regime, this is done by attempting to match the effort of fleets to the resources of the fishery.

¹ FAO Code of Conduct for Responsible Fisheries (1995), The United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks (New York, 1992-95), the Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues (1997).

To set up appropriate and effective management, it is necessary to have a solid understanding of the key variables which determine fishing effort, as well as to have accurate and reliable estimates of the abundance of the fish stocks.

1.2 North Sea Fisheries Management

Currently, fisheries in the North Sea are regulated and managed by a number of rules set down in the European Union's Common Fisheries Policy (CFP). The aims of the management system are to balance fleet capacity to resources through the use of two main policy tools: the Multi-Annual Guidance Programme (MAGP) and the system of Total Allowable Catches (TAC) and quotas.

MAGPs are formal requirements for reductions or limitations on fishing capacity in each member state. Limits are placed on total gross tonnage and engine power by fleet segment. More recently, the European Union (EU) has introduced policy which allows for member states to meet their MAGPs through effort reduction programmes (i.e. days at sea restrictions).

Fishing effort exerted on stocks by a fleet or an individual fishing vessel is formally defined by the EU as the product of fishing capacity and fishing activity (Fisheries Research Services, 1999). Fishing capacity is a measure of the capability of the fleet or vessel to catch fish and is generally measured in terms of the characteristics of the vessel (hull size, engine size, fishing method, skill of skipper and crew). Fishing activity (sometimes referred to as 'nominal effort') describes how much a vessel is used and can be measured by time at sea or the number of fishing operations (i.e. trawling hours, pots set).

TACs and quotas are set on an annual basis and aim to limit the amount of fish removed from the fishery in an attempt to reduce or control fishing mortality. The process of setting TACs in the EU is a complex one, involving both independent scientific advisors and various levels of government (Figure 1).

Data pertaining to each of the fish stocks is collected by each member state and is used by the International Council for the Exploration of the Sea (ICES) working groups to assess the state of the stocks. These assessments generally include an estimate of the historical trends in landings, spawning stock biomass, recruitment and fishing mortality rate; a description of the state of the stock in relation to historical levels; an assessment of the development of the stock under different fishing mortality rates assumptions; and a short term forecast of the spawning stock biomass and catch (Fisheries Research Services, 2000).

Assessments made by working groups are considered by the Advisory Committee on Fishery Management (ACFM), who then decide what the official ICES advice on the management of stocks will be. The advice given is based upon what is likely to happen in the medium term, if a particular stock is fished at a certain level of intensity.

The Commission draft proposals for TACs based on the ICES advice along with other information provided by the Scientific, Technical and Economic Committee on Fisheries (STECF), and management bodies from member states.

The Commission's formal proposals on the levels of TACs are then put forward to the Council of Ministers who have the authority to accept or reject the proposal. There is generally a lengthy process of consultation and negotiation among the Commission and member states to ensure that the proposal put to the Council is acceptable to all member states. It is during this process that the scientific advice is often adjusted due to political pressures relating to securing employment and safeguarding fragile coastal communities.

Once the proposals have been accepted by the Council of Ministers, there is an almost automatic process of allocating shares of the total TAC to member states. This is done according to the principal of 'relative stability', an allocation key which was established early in the history of the CFP and is related to historical fishing patterns.

The process of managing the North Sea fisheries is predominantly hinged on the setting of TACs, which relies primarily on the process of stock assessment. The process of stock assessment is subject to many flaws and uncertainties, but given the need to base fisheries management decisions on the "...best available scientific

knowledge and advice" (Intermediate Ministerial Meeting, 1997), it is perhaps fitting to examine methods to improve the assessment procedure.

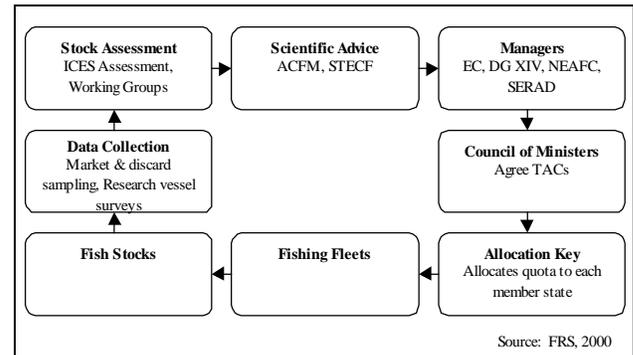


Figure 1: Annual TAC Setting Cycle

1.3 Stock Assessment

The aim of stock assessment is to provide managers with information on the state of fish stocks so that they can make decision on the exploitation rates (or total catch) which, given the capacity of the fleet, allows for the long-term sustainability of the fishery.

To determine the consequences of different exploitation rates on a fish stock, a catch prediction is needed. The basic relationship used to estimate catch (Equation 1) is a function of the current state of the stock (N), the rate of fishing mortality (F), and the rate of natural mortality (M).

$$C = N(1 - e^{-(F+M)}) \frac{F}{(F + M)} \quad (1)$$

To calculate catch (C), figures for N , F and M are needed. Values for the rate of natural mortality are determined on the basis of survey data from research vessels. Estimates of fishing mortality (F) however are based on estimated values of the size of the stock (the population), which are derived from catch statistics and natural mortality rates.

Estimates of the population however are open to a great deal of uncertainty as the reliability of catch statistics is very low. Reported landings are known to be a poor reflection of the actual number of fish extracted from the fishery, both due to the presence of discarding and the phenomena of black landings.

Improvements to the reliability and accuracy of stock assessment can be made if better information can be obtained on the rate of fishing mortality (F) and on the state of the stock (N). One method currently used to

increase the accuracy of F is to relate it to nominal fishing effort² and to the 'catchability' of the fish, where

$$F = q \times f \quad (3)$$

where q is catchability of the fish, defined to be a function of the availability of fish to a particular gear, its behavioural response to the operation of the gear, and the selectivity of the gear itself, and f is a measure of the activity level of the fleet (i.e. days at sea).

By incorporating a more accurate measure of fishing mortality into the stock assessment process, one that takes account of the changes in the efficiency of fishing vessels, it is more likely that the recommended catch quotas will be better matched to the catching ability of the fleet, and will therefore be a better basis for achieving sustainable management.

1.4 Aims of the Research Project

This research project seeks to harness fishermen and scientists together in the task of providing better, more extensive and agreed advice on the state of fish stocks. It is intended to improve knowledge of stocks, and on the factors which influence the rate of fishing effort applied to those stocks with consequent benefits for their sustainable management.

As shown in section 1.2, the current European system for managing the marine fisheries which are important to North Sea fishermen is a rigid one. Scientific advice on the state of stocks is forwarded to committees of scientists, which proffer their advice to the Commission and to the Council of Ministers, which then take decisions on the TACs and other control measures to be applied. While fishermen's representatives may be consulted on the control measures, they do not play an integral part either in the collection of data, its analysis, or in the advisory process.

Perhaps as a result of this lack of representation and involvement, fishermen themselves are often skeptical of the scientific advice. In extreme cases they may lose any sense of commitment to the control measures which are imposed - leading to misreporting of catches, landings of 'black' fish and excessive discarding.

In the long term, these problems may only be resolved through the greater involvement of fishermen in management decisions. Progress in this direction may, however, take some time and may require a move towards

zonal systems of management. In the meantime, much can be done now to involve the fishing industry in the current system of management by seeking to involve individual fishermen to a greater extent in the collection, analysis and interpretation of scientific data, and by making wider use of the experience and indigenous knowledge of the fishermen themselves in assessing the fish stocks.

Key to the project is the multi-disciplinary nature of the research. While the main emphasis is on gaining better knowledge on the state of the stocks and the rate of fishing mortality, it is proposed that the level of fishing effort that fishermen apply to the stocks is influenced by a combination of biological, technical, economic and social forces.

Within the project, information will be collected from fishermen in two main areas; (a) perceptions on the state of stocks, and (b) factors influencing the level of fishing effort.

1.4.1 Perceptions on the State of the Stock

Fishermen frequently assert that as practical fishermen they have intimate knowledge of the health of the fish stock yet little account is paid to their knowledge. In the current fish stock assessment/management advisory structure, the fishing industry is, indeed, excluded from any formal role. Despite meeting regularly with scientists and administrators, the industry is only able to influence issues from the margins in a lobbying capacity. In addition, as there is little direct input from many fishing skippers, the "industry view" is generally put forward through the various associations and federations, often to support various political objectives. Such views rarely illuminate the variation in perceptions on stock abundance across the industry.

In this section of the research, the aim is to gather information from fishermen on an ongoing basis on their perceptions of the state of stocks. This will be done in terms of the level of stocks in relation to a reference year, the degree of change within the stock, and what they perceive to be the main causes of changes in the state of the stock. From this, it will be possible to determine the degree of variation between the 'deck view' and the formal assessments.

An important aspect of the research is not only to determine this variation, but to also determine what information is used by fishermen in making their assessments, along with the source of this information.

² Nominal fishing effort is a measure of the activity level of the fleet or vessel, commonly a measure of days fished (for trawled gear).

1.4.2 Determinants of Fishing Effort

The control of fishing effort is vital to the aim of controlling fishing mortality rates. However, within the management process, little is understood on the determinants of fishing effort. The majority of research conducted on fishing effort is focused on either the technical aspects of effort – the influence of various gear types and vessel characteristics on the total catch, or on the economic aspects of effort. The economic concept of fishing effort is commonly defined to be an index of inputs used in fish harvesting (Anderson, 1986). This theoretically encompasses all of the factors involved in the process of catching fish, although in practice is often measured by a subset of inputs. These are generally measures that can be easily quantified, such as hull and engine size and days at sea.

Fishing effort however is a much broader concept than what is commonly modelled in the literature. It is one of the fundamental influences on the rate of fishing mortality in a fishery. The decisions that fishermen make in terms of their level of activity and their capacity to catch fish will be influenced by a great many factors, not all of which are observable or measurable (refer to Figure 2 for a short list of possible influences).

Intensive field research will be carried out for this part of the project to collect fishermen's views on what factors influence their decisions on how much activity they will engage in, where they go fishing, and what type of vessel and equipment they choose to operate with. It is believed that the major factors affecting fishing effort will include the well-known economic and technical influences, but that social pressures will play an important role as well.

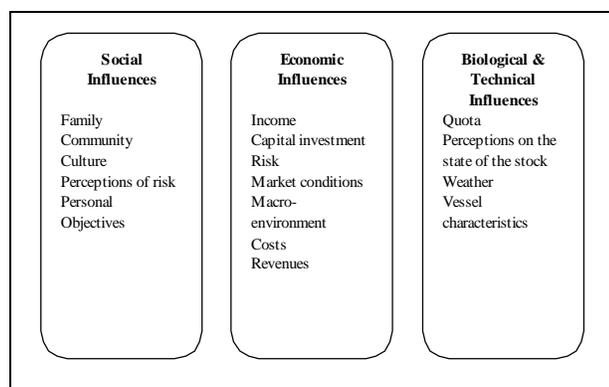


Figure 2: Determinants of Fishing Effort

1.5 Applicability of the Results to Fisheries Management

From the information collected, it is expected that some relationships can be found which will serve to inform

management of the complex underlying decision making process of fishermen.

For example, it may be the case that fishermen's perceptions on the state of the stock will be determined on the basis of incomplete or incorrect information. An understanding of the type and source of information that fishermen use to make assessments of the size of a particular stock will allow managers to implement programmes to better inform fishers of what determines the fish population.

It may also be the case that fishermen have a more holistic and long-term knowledge of the determinants of the fish stocks – information which can be used to inform and adapt the current stock assessment processes.

In terms of fishermen's decisions on fishing effort, knowledge of how different objectives and social circumstances have a bearing on the behaviour of fishermen can only serve to improve the effectiveness of management policies aimed at controlling fishing effort, and therefore fishing mortality.

Fishermen are likely to have a wide range of opinions about possible objectives for fisheries management, not all of which will be in line with the notion of sustainability. If their objectives include the long-term sustainability of the fishery, then it may be the found that the factors influencing their decisions on the amount of fishing effort they apply to the fishery are different from those fishermen whose prime objective is short-term profit-maximisation (Zwanenburg, *unpublished*).

It may also be the case that fishermen's perceptions of the state of the stock will be influenced by their orientation towards sustainability. Those who are have a short-term profit objective will interpret scientific advice in a manner consistent with their beliefs and objectives. Alternatively, one with a view towards the long-term maintenance of the resources may be more likely to accept the scientific advice offered.

However, even though fishermen may include sustainability of the fishery as an objective, this may not be the strongest influence on their decision-making process. It may be that economic factors such as high investment in a vessel, or heavy household financial commitments, will drive fishermen to fish beyond what is believed to be a sustainable level.

1.6 Conclusion

Effective fisheries management must be based on a solid understanding not only of the behaviour of fish stocks, but also the behaviour of the fishermen who exploit those

stocks. It is therefore necessary that more is understood about the decision-making process of the fisherman, and that his knowledge, objectives and behavioural reactions to his environment are incorporated into the design of future systems of management.

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1.8 References

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