COOPERATIVE RESEARCH REPORT

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REPORT OF THE AD HOC MEETING ON THE PROVISION OF ADVICE ON THE BIOLOGICAL BASIS FOR FISHERIES MANAGEMENT

Charlottenlund, 5-9 January 1976

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1. INTRODUCTION

In response to a resolution (C.Res.1975/2:3) passed by the Council at its 63rd Statutory Meeting (see Appendix 1), an ad hoc meeting on the biological basis for fisheries management was held in Charlottenlund during 5-9 January, 1976. The participants are listed in Appendix 2.

The Council's request for a consideration and review of the objectives of fisheries management is a reflection of a vital and central process in the development of science, i.e. to systematically search for mistakes and errors in order to improve understanding and knowledge. Fisheries biology is a fairly young science, and the processes and phenomena with which it deals are complex and often difficult to observe and quantify. There has, however, been a great demand for its application as a result of the rapid development of fisheries in the postwar period. Scientific advice has in general been available during this period of expansion and development, but the efforts made to guide and manage the fisheries have met with only limited success. It is only natural, therefore, that the scientists should at this stage question the adequacy and relevance of their function in the process of fisheries management.

Because biologically based objectives such as the highest physical yield from a resource has been thought to represent a more generally acceptable aim of fishery management than for instance economic objectives, fishery scientists have played a primary role in formulating and promoting objectives for resource management. The most important of these is the maximum sustainable yield which has attained a wide and general usage. A considerable part of the time of the ad hoc meeting was spent in a critical analysis of the significance of the MSY-concept, and the uses and interpretations which have been made of it and of related terms. Section 2 of the Report deals with this analysis. Similar reviews of biological management objectives have recently been undertaken also in other fora such as ICNAF and ACMRR, and the relevant reports were available and used by the Group.

The main finding of this part of the discussions was that the simple MSY-concept as used up till now in the NEAFC area does not incorporate all of the vital processes particular to fish resources. Various conditional qualifications must be added if it should serve as an adequate and generally acceptable management objective. The most important of these qualifications concerns the relationship between spawning stock and recruitment, and the exploitation pattern. But there are also other and perhaps more secondary objectives which cannot be discounted in a sound and rational resource utilisation such as keeping the size of the exploitable stock at a sufficiently high level to dampen, as far as possible, the fluctuations caused by year to year variations in recruitment, and avoid unnecessary harvesting costs.

On the basis of these considerations the Group decided to describe a new objective rather than qualify the objectives which have been used up till now. Section 3 of the Report deals with this integrated objective and the consequences of its scientific use and of its eventual application in management.

The Group then reviewed briefly the main fish stocks in the NEAFC area and classified them in terms of defined categories of state of exploitation. This review, with some comments on management problems, is contained in Section 4.

The discussions in the Group also served to identify important gaps in our knowledge and needs for more and better information. It was felt that the opportunity should be used of feeding back this output to the scientific community, and these recommendations are contained in Section 5.

Section 6 of the Report deals with guidelines to the Assessment Working Groups in a more general sense.

The last item of the terms of reference is reported on separately.

The Group felt a need to define carefully some of the terms used and these follow in Table 1 below.

Table 1. Some definitions.

Exploitation pattern (fishing pattern)

This is the distribution of fishing mortalities with age.

Maximum sustainable yield

This is the maximum average yield that can be obtained using the best possible combination of fishing effort and exploitation pattern. This term has also been used for what is termed conditional maximum sustainable yield below.

Conditional maximum sustainable yield

This is the maximum average yield that can be obtained for a specified exploitation pattern.

The yield per recruit

This is the expected yield in weight from a single recruit. It is a function of the total amount of fishing and the fishing pattern.

Maximum yield per recruit

This is the maximum yield per recruit that can be obtained using the best possible combination of fishing effort and exploitation pattern. Under assumptions of stable and optimal recruitment this has been transformed into yield and referred to as maximum sustainable yield.

Conditional maximum yield per recruit

This is the maximum yield per recruit that can be obtained for a specified exploitation pattern.

F_{max}

This is the fishing mortality rate in a constant parameter model that maximises the yield per recruit for a particular exploitation pattern.

$F_{0.1}$

This is the fishing mortality rate at which the slope of the yield per recruit curve is 1/10 of the slope of the origin, i.e. the value at which the marginal yield per recruit (the yield per recruit produced by adding one extra unit of effort) is one-tenth of the yield per recruit produced by the first unit of effort introduced to the unexploited stock.

2. A CRITICAL REVIEW OF THE USE OF THE MSY-CONCEPT

The concept of the Maximum Sustainable Yield, i.e. the highest level of annual catch which can be taken from a stock on a sustained basis, as an objective of fishery management has certain attractions for both administrators and scientists as one which has been regarded as a common aim.

The assessment of maximum sustainable yield, especially as it usually has been practised, however, raise major problems which are discussed below.

In calculations of the MSY, the first step is normally to construct the yield per recruit curves. Frequently the fishing mortality rate, which gives the maximum yield per recruit on such a curve is considered as giving the maximum sustainable yield from the stock. However, this can be very far from true, even on a per recruit basis, as yield per recruit curves are based on the existing exploitation pattern which may not be optimal. Changes in exploitation pattern can cause major changes in yield per recruit. The maximum yield per recruit will only be attained by fishing at F_{max} on the assumption that the exploitation pattern is also optimised to give the maximum yield per recruit (Figure 1). However, fluctuations in year class strength will cause fluctuations in fishing patterns without any change in mesh size or minimum landing size. This means that yield per recruit will vary and therefore that a single yield per recruit curve cannot describe the true situation.

The shape of the yield per recruit curves varies considerably depending on the age of first capture, the growth rate, and natural mortality rate, of the stock under consideration. The natural mortality is seldom known with any degree of accuracy and the shape of the yield curve is accordingly only an approximation.

Low growth rates (low von Bertalanffy K value) and/or high natural mortality rates produce flat-topped yield per recruit curves in which, above fairly low levels of fishing mortality, further increases in F produce only small gains in yield per recruit. In such curves there is no clearly defined maximum and the impression is given that the fishing mortality rate can be increased to very high levels without any reduction in yield. In species with low natural mortality and high growth rates, the yield per recruit curves are normally dome-shaped with a fairly clearly defined maximum at fairly low levels of fishing mortality (Figure 2). The value normally required in management is not the yield per recruit but the corresponding total yield from the stock. To obtain the latter from a yield per recruit curve demands some assumption about the recruitment level and its relation to stock size. It is generally assumed that within a fairly wide range of stock sizes, recruitment is independent of stock size. The relation between stock and recruitment has not been clearly defined for any stock, but there is some lower stock level at which recruitment will decline with a decline in stock size.

There are, therefore, considerable dangers in assuming that the fishing mortality rate which gives the greatest yield, on a yield per recruit basis, will also give the maximum sustainable yield in absolute terms. The prime danger is the assumption that recruitment is independent of parent stock. Because of the innate variability of year class strength, the true relationship between recruitment and stock may be masked.

In yield per recruit curves of the flat-topped variety fishing at F_{max} may result in serious depletion of the stock, with a consequent danger of reducing recruitment, and will certainly reduce the catch per unit effort to rather low levels with little resultant increase in yield per recruit from the increased input of fishing effort.

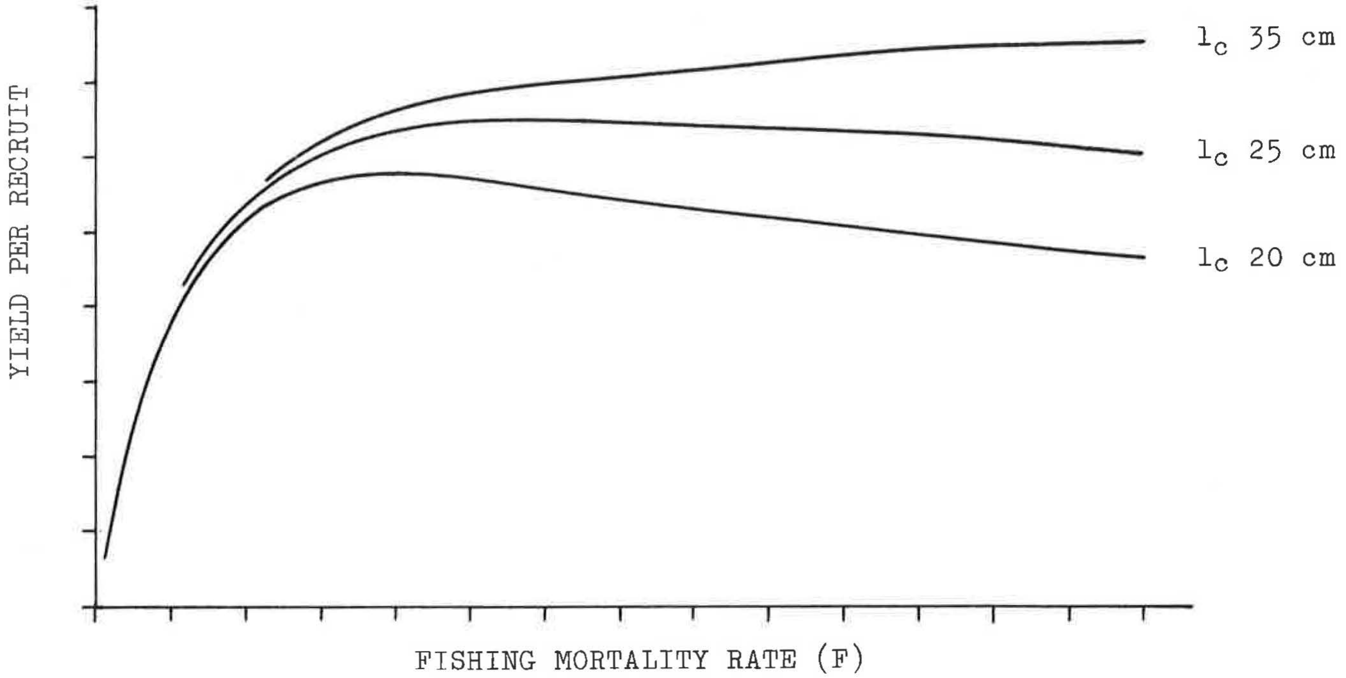

Figure 1. Yield per recruit curves at different lengths of first capture.

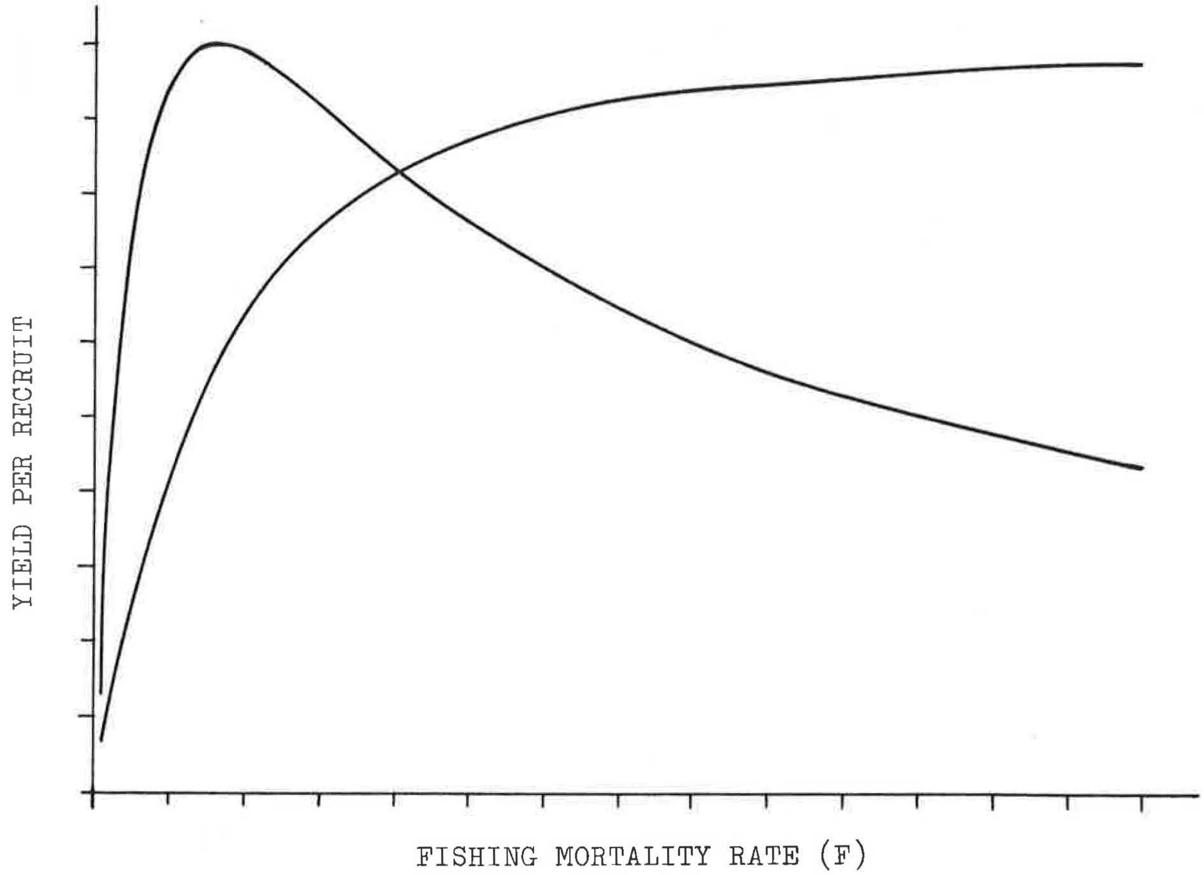

Figure 2. Different types of yield per recruit curves with different values of natural mortality (M) and von Bertalanffy growth constant (K).

Even in yield per recruit curves with a clearly defined maximum there is a danger of stock depletion by fishing at F_{max}, especially if the age at first capture is low (Figure 3). Therefore there are inherent dangers in using F_{max} as a reference point in stock management unless the effect of that exploitation rate, and -pattern, on the size, and on the age structure, of the stock on a long-term basis is also considered.

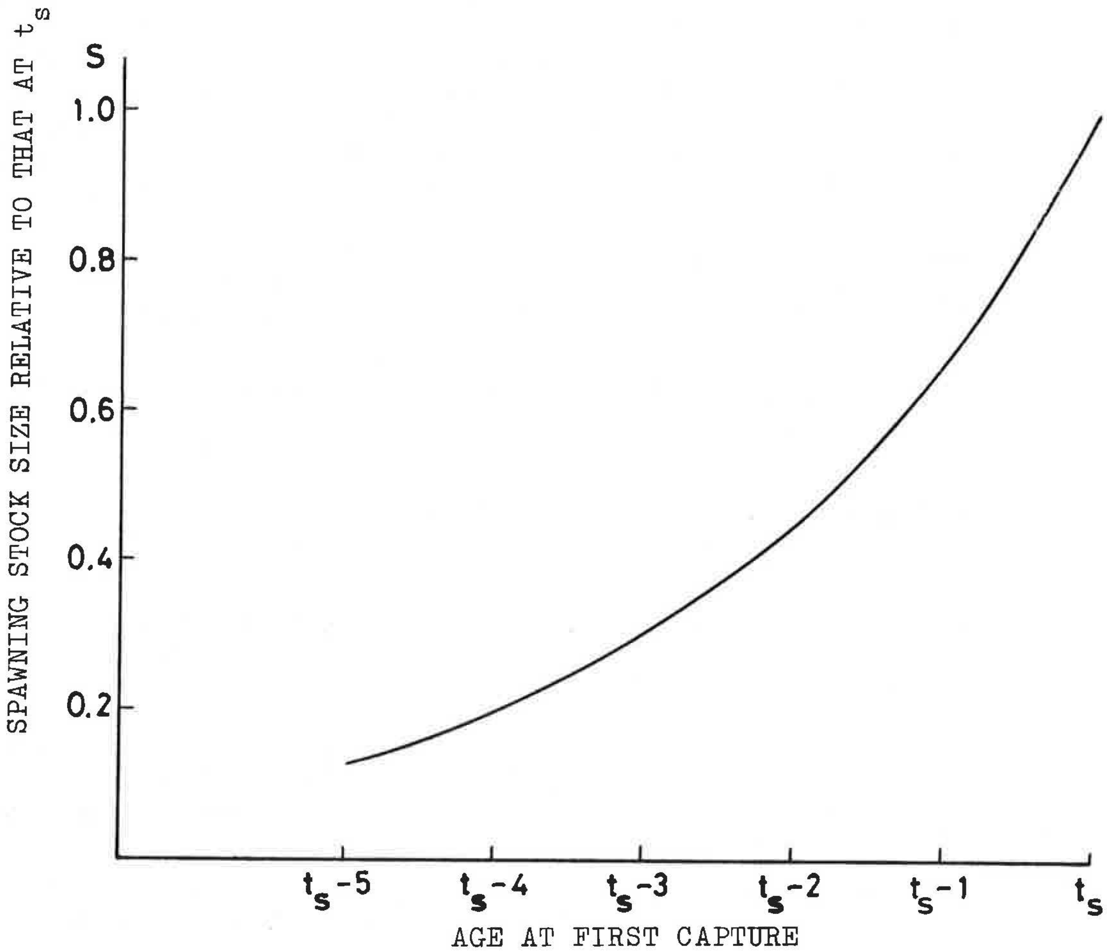

Figure 3. Reduction of spawning stock size resulting from decrease in age at first capture. (F = 0.4. t_s = age of first spawning).

It must also be borne in mind that in many fish stocks the recruitment level varies widely from year to year. A consequence of this is that fishing at an F_{max} which would not result in stock depletion, under the assumption of stable recruitment, can do so if recruitment to that stock has, because of natural causes, been low in several successive years. It may be advisable in these circumstances to adopt a fishing mortality rate considerably below that corresponding to F_{max} to ensure that the spawning stock is not reduced to a level where recruitment may decline because of stock depletion.

Because of the undesirable results which can arise from attempts to obtain the MSY, some other objective of management should be adopted which minimises these possibilities, while at the same time giving a yield which may be somewhat less than the theoretical maximum.

Although as indicated in the above paragraphs, the application of yield per recruit theory is subject to various pitfalls, used with care, it will continue to play a considerable part in our present assessments.

3. AN INTEGRATED OBJECTIVE

3.1 The starting point of our approach is that the sustainable yield as an objective is one in which the reduction of recruitment, due to low stock levels, is avoided. Our present concept of MSY is summarised in the definitions given in Table 1 (p.2). The yield could be optimised in terms of several factors and a new concept is defined as Optimum Sustainable Yield (OSY). The OSY may be a little less in tonnage than the theoretical MSY, but some of the inherent risks in a strategy aiming at MSY will be avoided, and it would also generate other benefits. Management is effected by an adjustment of fishing mortality and age at first capture to obtain the best yield and furthermore these parameters should be modified in terms of:

(a) exploitation pattern: the best age at first capture (t_c) can be established in a single species fishery and a similar approach might be successful in multispecies fishery.

(b) the spawning stock which should be maintained within the range which would produce the most desirable level of recruitment.

(c) a buffer stock: the stock size should be maintained at a sufficiently high level so that its variation due to recruitment is reduced.

(d) catch per effort: fishable stock densities should be maintained at high enough levels to ensure harvesting without excessive costs.

The buffer stock concept is particularly valid for long lived species, but it is also important as far as possible to reduce great year to year fluctuations in the TAC of short lived species (sprat, anchovy, capelin) by adjustment of the exploitation pattern.

Errors of estimation should be taken into account; indeed a TAC might sometimes be set at the lower bound of the error of estimation to prevent inadvertent overexploitation.

3.2 Scientific Use of OSY

For each stock there is a need to:

(a) define an optimal range of spawning stock size. This should be assessed either on the basis of a stock/recruitment analysis or chosen more arbitrarily on the basis of historical reviews of periods of "normal" recruitment;

(b) define an agreed minimum fishable biomass level; this may, or may not, differ from the minimum spawning stock level;

(c) assess the characteristics of the fishing pattern in relation to an optimised pattern.

The starting point for the yield assessments is still the yield curves on a per recruit basis with the established fishing pattern.

It is recommended that the TAC corresponding to $F_{0.1}$ should be calculated in the first place. This TAC should then be modified against the objectives for "optimum fishing", i.e.

(a) maintain the spawning stock size within the defined range, and

(b) keep the fishable biomass above the agreed minimum level.

Objective (a) must be considered as more important than (b).

In addition, a statement concerning the exploitation pattern should be prepared with assessments of the effects of possible improvements for single stocks or groups of stocks in multispecies fisheries. Assessments of changes of exploitation pattern should include the evaluation not only of changes of mesh size and minimum landing size but possibly also of seasonal and areal closures. Where applicable, changes of mesh size should be accompanied by an appropriate change of minimum landing size. Assessments of the changes of exploitation pattern should incorporate both estimates of the effect on the yield, on the stock biomass and on the spawning stock biomass.

Where the spawning stock is substantially lower than the acceptable range, or the fishable biomass lower than the agreed minimum level, a scheme of rebuilding the stock in annual steps should be designed. Use should as far as possible be made in such schemes of recruitment variations when strong year classes enter the stock.

3.3 Consequences for Management

The advantages to the management of the fisheries adopting the new integrated objective will include:

(a) reduced fluctuations of TACs from year to year;

(b) increased catch rates;

(c) reduced risks of stock depletion; and

(d) increased reliability of scientific advice.

These effects would be highly significant for the economics of the fisheries,even though the total physical yield on a long-term basis may be a little less than the theoretical maximum.

These benefits represent long-term gains which should arise after some short-term loss, for example, a temporary reduction of TACs for some stocks, or not to permit an increase of the TACs following increased recruitment for other stocks. Also the short-term loss through mesh increases, or by other means, can be alleviated if use is being made of changes of recruitment.

4. A SHORT REVIEW OF THE PRESENT STATE OF MAJOR FISH STOCKS IN THE NEAFC AREA

4.1.0 Levels of exploitation

For the North-East Atlantic fisheries, we can recognise five categories of exploitation level which are defined below. Table 2 (p.8) classifies a number of the major NEAFC stocks according to this scheme.

4.1.1 Under-exploited

These are the fisheries where there is scope for further expansion of fishing and the catches can be increased without adversely affecting the stock.

4.1.2 Fully exploited

In these fisheries the exploitation is close to optimum. An increase in the amount of fishing would not be expected to give an increased yield.

<u>Table 2.</u> Classification of some major NEAFC stocks.

<table>
<tr><th rowspan="2">Under-exploited</th><th rowspan="2">Fully exploited</th><th colspan="2">Over-exploited</th><th rowspan="2">Depleted</th></tr>
<tr><th>Growth overfishing</th><th>Recruitment overfishing</th></tr>
<tr><td rowspan="4">Blue whiting

Iceland capelin</td><td rowspan="4">Barents Sea capelin</td><td rowspan="2">Minch herring
Celtic Sea herring
North Sea cod
North Sea haddock
North Sea whiting
North Sea plaice
Arctic haddock
Saithe stocks
West Scotland cod
West Scotland haddock
West Scotland whiting
Irish Sea cod
Bristol Channel cod
Bristol Channel haddock
Bristol Channel whiting
Bristol Channel plaice
English Channel plaice
English Channel sole</td><td>North Sea mackerel</td><td>Atlanto-Scandian herring</td></tr>
<tr><td colspan="2">North Sea herring</td></tr>
<tr><td colspan="2">Arctic cod
North Sea sole
Iceland cod
Iceland haddock</td><td></td></tr>
<tr><td>Faroe cod
Faroe haddock
Irish Sea sole
Bristol Channel sole
Hake stocks</td><td></td><td></td></tr>
</table>

4.1.3 Over-exploited

(a) Growth overfishing

In such stocks, fishing has increased without any corresponding increase in yield with the result that catch rates are severely depressed. In such stocks the adult biomass is becoming reduced, but not to the extent that recruitment is likely to be adversely affected. The average age of fish in the catch is reduced and the fishery is becoming increasingly unstable due to its dependence on reduced numbers of age groups.

(b) Recruitment overfishing

In these stocks catches are declining with an increasing proportion of juvenile fish in the catch. The adult stock biomass has been greatly reduced and recruitment becomes reduced and may become increasingly variable.

In this state of exploitation a few poor year classes entering in succession could quickly reduce the stock to the depleted condition in which its very survival would be in jeopardy.

4.1.4 Depleted

A depleted stock is one in which the fishery on adults has collapsed and there is serious danger of the stock running to extinction. Such stocks would be those in which the spawning stock biomass was at such a low level that recruitment was greatly reduced by at least an order of magnitude.

4.1.5 General comments

For underexploited stocks, there may be a need to introduce precautionary regulations to prevent the exploitation rate exceeding the optimum level.

There are only a few stocks at present in the fully exploitable state as defined by the concept of Optimum Sustainable Yield. Some further stocks, however, would be classified within this state if considered solely in relation to the present exploitation pattern.

In the case of those species classified as overexploited from growth overfishing, corrective action is required to reduce fishing mortality and/or adjust the pattern of fishing.

For species overexploited by recruitment overfishing, management should be directed at increasing the spawning stock biomass as quickly as possible by means of conserving the recruitment to the stock and by reducing the exploitation on the adult component.

Such a situation has arisen in a number of important stocks within the NEAFC Convention Area. In the case of the Icelandic summer spawning herring, the adult stock size was reduced to less than 10% of the stock in the early 1960s. A total ban on fishing was introduced for about 4 years, and by 1975 there was a recovery to a level at which a controlled fishery was admissible.

From the North Sea mackerel stock, catches fell from almost 1 million tons in 1967 to about 200 000 tons in 1972. The 1971 stock size was reduced to 18% of the former level. National regulation of the Norwegian mackerel fishery was introduced in 1970 in time to limit fishing on an abundant recruiting year class and to avoid a further reduction in stock due to the entry of other poor year classes.

In the case of the North-East Arctic cod, the spawning stock biomass has been declining since 1971 and is currently at an all-time low level. International agreed restrictions on catches, combined with good recruiting year classes, are expected to allow a recovery of the spawning stock to commence in 1977 and a rebuilding of the biomass to above the danger level by the end of the decade.

While successful management decisions appear to have been made in the three stocks mentioned above, the situation of the North Sea herring and sole is still critical. The adult spawning biomass in the North Sea herring is currently at about 10-15% of the stable stock level and in the case of sole at about 15%. In both cases current management actions are unlikely to prevent further deterioration of these stocks.

In the case of depleted stocks, the only hope of recovery would be serious restrictions of fishing until such times as the spawning stock had eventually recovered, so that incoming recruit year classes are generally at the level prior to overexploitation.

An example of a stock in this category is the Atlanto-Scandian herring. By 1967 the spawning stock biomass was reduced to 10% of the annual level prior to 1956. Recruitment since 1967 has been very low, none reaching the order of magnitude of the earlier years.

4.2 Vulnerable Stocks

Some stocks are especially vulnerable to fishing. Such stocks include:

(a) those with low fecundity, e.g. sharks, rays and some crustaceans;

(b) those having strong schooling behaviour, e.g. mackerels and horse mackerel, clupeoids and capelin.

Stocks with a short life-span (e.g. sprat, anchovy, Norway pout and capelin) may be difficult to assess, and management mistakes may be more fatal because of the difficulties in taking corrective actions in time.

Sprat are particularly difficult in developing a management system, due to their early recruitment to the fished stock, their short life-span and the high level of aggregation in shoals which encourages heavy exploitation. In these circumstances it would be necessary to introduce precautionary regulations to control exploitation.

5. RESEARCH PROBLEMS

Since NEAFC introduced quota systems as a means of regulating fisheries, ICES has provided the Commission with advice in the form of estimates of TACs.

The objective of setting a TAC has been to achieve an indirect limitation of the fishing mortality.

For a number of species TACs have been estimated with two aims,i.e.:

(1) to stabilise fishing mortality at its present level; and

(2) to reduce fishing mortality in order to allow an increase in stock size.

This kind of advice has shown several shortcomings. ICES should therefore reconsider the scientific basis of the advice to the Commissions.

For certain species, difficulties have been experienced in controlling fishing mortality by using TACs. One difficulty applies particularly to species subject to large annual fluctuations in recruitment (e.g. most North Sea species).

For certain species, the confidence limits of the TACs tend to be relatively very large. This makes it difficult to achieve effective regulations for the following reasons:

To be reasonably certain of achieving effective control of the fishing mortality, a TAC would have to be chosen near the lower limit of the range of estimates. If this range is large, this could mean recommending a TAC which would be quite unacceptable to the industry and which, if enforced, may later be found to have reduced fishing mortality more than was intended. It is not in the best interests of scientists to give this kind of advice, and eventually it would impair their credibility. Because of this, scientific advisers may have difficulties in defending their advice on TAC.

Another difficulty with the use of TACs for regulating fishing mortality occurs when a fishery takes more than one species at a time. There is then the possibility of unrestricted fishing due to the discarding of fish at sea, e.g. fishing might continue until the TAC for every species had been realised, i.e. once the quota for species A had been realised, fishing could continue (species A then being discarded or illegally landed) until the quota for species B had been realised.

Various remedies have been attempted to minimise these effects, but none have proven to be entirely satisfactory. Multispecies models without biological interaction are available in the context of the ICNAF by-catch problem.

A possible way of controlling fishing mortality in certain fisheries would be direct effort control. Appropriate measures of fishing power would be needed.

In the meantime, it is likely that the Commissions will continue to ask for advice in terms of TACs. When complying with this request, Working Groups should ensure that their advice contains a statement about any changes in fishing mortality that are considered to be necessary. If, for example, the objectives are to reduce fishing mortality, or merely to prevent it increasing, it should be made clear that a TAC has been estimated with this in mind.

Limitations on fishing mortality can also be achieved in certain situations by introducing closed areas or seasons, especially in cases where there is a serious by-catch problem, e.g. by-catch of herring in parts of the sprat fishery, and by-catch of small hake in certain *Nephrops* fisheries.

Further detailed information on the distribution of fish and fisheries are therefore needed.

Three main types of fisheries may be distinguished within the ICES area:

(1) catch of species using large-meshed nets and with by-catch of other protected species, e.g. cod, haddock, plaice and sole fisheries;

(2) catch of species using small-meshed nets and with very little or no by-catches, e.g. sandeel, mackerel and capelin;

(3) catch of species using small-meshed nets and with considerable by-catches of regulated species, e.g. sprat fishery with by-catch of herring and whiting, and Norway pout fishery with by-catch of haddock.

The fishery in category 1 includes protected species which have all been studied for a number of years, and for which the major part of the parameters needed for assessments is known. These fisheries have been assessed on a single species basis and regulated with the aim of preventing fishing mortality from increasing above an appropriate level. Further investigations are required on the effect of stock density on growth and on the stock recruitment relationship in these species.

Category 3 includes two main fisheries, viz. the sprat and the Norway pout fishery. Both these fisheries have developed within recent years. There are indications that the biomasses of both stocks are growing. Both species are short-lived. No adequate assessments have so far been made for Norway pout, sprat and sandeel, and these are urgently needed.

As stated before, the present procedure in Assessment Working Groups is to assess species singly and aim e.g. at maximum yield per recruit per species ignoring recruitment and possible interactions with other species in the same area. In the light of what is known at present of interspecific relationships and the nature of most fisheries - multi instead of single species' - it will be necessary sooner or later to gradually replace the single species assessment concept by multispecies techniques. The present assessment techniques are all based on single species analysis. However, the scientific theory, initially single species' oriented, has recently evolved into multispecies approaches. The models resulting are lacking up-to-date empirical data of a standard necessary to prove the validity of the models.

In order to be able to switch over to multispecies assessments, for which further techniques have still to be developed, one venue would be to further expand studies of species' interaction, such as, e.g. predation and competition for food. In particular, stomach contents analyses and further investigations on the relationship between recruitment to certain species and the biomass of other species are required.

Studies along these lines could be carried out in different phases. For a number of species which contribute substantially to total biomass, no information of the type needed is available. One of the first steps is to assess what eats what and then select species for more detailed studies. This may give as a start a rough scheme of species' interaction. In this respect Andersen and Ursin in a paper on interspecies competition gave the following abundant species in the North Sea: plaice, dab, long rough dab, saithe, cod, haddock, whiting, Norway pout, mackerel, herring, sprat and sandeel. It may be possible that other non-commercial species have to be selected too.

The second step should be to organise the research on the selected species. Perhaps some laboratories are better equipped for this type of work, but the coverage of the species throughout the seasons as well as geographically could better be coordinated by ICES.

6. GUIDELINES FOR WORKING GROUPS

6.1 At recent meetings of the Liaison Committee it has been felt that greater uniformity in the presentation of assessments by Working Groups would considerably help the Committee in dealing with the large number of assessments with which they are now faced. The intention is not to impose a high degree of standardisation on the methods used in assessments which could restrict new approaches to assessment problems, but to ensure that the parameters used and their derivation are clearly stated so that the Liaison Committee can judge the validity of the final outputs and calculate alternative values when this is considered necessary.

6.2 Assessments should be made jointly by the Working Group participants using all available basic data.

6.3 The methods used for assesment, and for calculation of TACs in particular, should be comparable, if not identical, to those used in previous assessments of that stock, unless there are clear advantages in adopting a different approach.

6.4 When the same methods are used, but with different input parameters from those used in previous assessments, the report should contain a discussion of the reasons for such changes and a calculation of the effect of these changes on the final output.

6.5 Working Group reports must be considered as being subject to the generally accepted rules that all data necessary to repeat the assessment are included in the report. In particular, in the calculation of TACs all parameters used in deriving the final value should be clearly stated. These will include:

(a) the F and M values on which the calculation of the TAC is based;

(b) the age at first capture used in calculating the TAC;

(c) the mean weight at each age included in the catch;

(d) the age composition of the population at the beginning of the period to which the TAC applies. The derivation of these data should also be given, e.g. how the population age structure at the start of the period was obtained, any assumptions made about F values, or catches between the date of the derived population size and the year for which the TAC is calculated, the F value applied to age groups which are only partially recruited to the exploited stock, estimates of the size of year classes which will recruit to the exploited stock in the year in question, etc. An example of the work sheets used should be appended to the report.

The source, or sources, of the data given in catch statistic tables should always be stated in the table title or, when more than one source has been used, by footnotes.

6.6 Where a TAC includes two elements of different age composition arising from different fisheries (e.g. from NEAFC Recommendation 1 and from NEAFC Recommendation 2 fisheries), these should be given separately as well as the summation.

6.7 All reports should contain tabulated data over the most recent 10-year period of:

(1) annual catches by country;

(2) annual catches in numbers per age group and summation over all age groups;

(3) estimated annual age-specific fishing mortality rates and the mean weighted F value for fully recruited age groups;

(4) estimated stock sizes in numbers per age group and the estimated sizes in numbers and weight of the adult stock.

6.8 The report should include some judgment concerning the reliability of the estimates (3) and (4) for the different years. In the sections above, the requirements for reporting assessments of TACs are given in some detail. Similar considerations should apply to other types of assessment so that all of the basic data required for reaching the end point are fully reported and when necessary their source explained or stated.

6.9 It will save time and money, if already at the drafting stage the following points are observed for all documentation which is going to be typed or reproduced:

(a) countries should always be listed in correct alphabetical order (the Secretariat will advise);

(b) tables should preferably be designed so that they can be typed on A4 format. If necessary, they could be split. Many-word column headings should be avoided, and, if needed, be represented by symbols explained in a footnote;

(c) commas or periods should <u>never</u> be used to separate thousands or millions. They should be reserved for use as decimal points. Spaces may separate thousands and millions.

APPENDIX 1

TERMS OF REFERENCE

At its 63rd Statutory Meeting, the Council adopted the following resolution (C.Res.1975/2:3):

"It was decided, that an *ad hoc* meeting on the Provision of Advice on the Biological Basis for Fisheries Management should be held 5-9 January 1976 at Charlottenlund, at national expense, with the following terms of reference:

(i) General consideration of management objectives.

(ii) Objectives and concepts related to:

- (a) MSY/R .
- (b) Fishing pattern
- (c) Recruitment relationships
- (d) Other objectives (minimise TAC fluctuations, increase c.p.u.e., etc.)
- (e) Optimum long-term resource utilisation
- (f) Depleted stocks
- (g) Particularly vulnerable stocks
- (h) Industrial fisheries.

(iii) Guidelines for Assessment Working Groups.

(iv) Planning of stock evaluation courses.

The meeting, which will report to the Council, should be convened by the Chairman of the Liaison Committee. Members of that Committee and some selected specialists (including the Chairmen of Assessment Working Groups) will be invited through the General Secretary to participate".

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APPENDIX 2

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