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1 INTRODUCTION

The Sixth Dialogue Meeting was held in Brussels on 27 October 1987. It was co-sponsored by ICES and the North-East Atlantic Fisheries Commission and was hosted by the Commission of the European Communities (CEC) at the Centre Borschette.

The meeting was organized in the form of a debate involving an expert representing each of the three groups involved in the fishery management process (scientists, administrators/managers, and the fishing industry), with provision for open discussion involving the audience. The members of the debate were Mr David de G. Griffith, fisheries scientist from Dublin, Ireland, member and former chairman of the ICES Advisory Committee on Fishery Management (ACFM); Mr Broer B. van der Meer, Director of the Netherlands Institute for Fishery Investigations, IJmuiden and former Director of Fisheries, Netherlands Ministry of Agriculture and Fisheries, The Hague; and Mr Finn Bergesen, Jr, Secretary General of the Norwegian Fishermen's Association, Trondheim.

Three major topics selected for consideration at the meeting were stability, management systems, and long-term objectives for resource utilization. The meeting was, therefore, divided into three parts with separate debate and discussion on each topic.

The meeting was chaired by the President of ICES, Mr Ole Johan Østvedt, with the ICES General Secretary (Dr Basil B. Parrish) and Statistician (Dr Emory D. Anderson) serving as rapporteurs. Others at the speaker's table included Mr Bernhard Vaske, Chairman of ACFM; Mr Peter J. Ogden, Acting Secretary, North-East Atlantic Fisheries Commission, London; and Mr Michael J. Holden, Head of Division XIV-B-1, Directorate-General for Fisheries, Commission of the European Communities, Brussels.

Over 120 scientists, administrators/managers, and members of the fishing industry attended the meeting. A list of participants is given in Appendix 1. Simultaneous interpretation was provided for most of the languages of the EC member countries. A list of technical terms and their definitions were distributed at the meeting and are included in Appendix 2.

The Chairman opened the meeting at 10.00 hrs with the following remarks:

"It is with great pleasure that I welcome you all to the Sixth ICES Dialogue Meeting.

When the First Dialogue Meeting was held in May 1980, it was realized that, for ICES to fulfill its scientific advisory role, there would be a need for a continuing dialogue between the fisheries scientists responsible for assessing the fish stocks and the users. Mostly scientists and fisheries administrators have participated in the Dialogue Meetings, but at the Fifth Meeting held in London in 1985, representatives from the fishing industry also participated to a significant degree, giving a new dimension to the dialogue.

In preparation for the Sixth Dialogue Meeting, it was, therefore, agreed that much greater participation by the fishing industry was necessary.

The Council decided at its Statutory Meeting in October 1986 to hold the Sixth Dialogue Meeting a few days before the meeting of the Advisory Committee on

Fishery Management (ACFM) in order to also ensure participation by members of ACFM, the scientists responsible for ICES' advisory function. The timing also coincides with a meeting of the Commission's Consultative Committee on Fisheries which would bring a substantial number of fishing industry members to Brussels. An invitation by the Commission of the European Communities to host such a meeting in Brussels was, therefore, greatly appreciated and accepted by the Council. We are very pleased that we are able to meet here today and use the facilities that have been provided for us by the Commission. I am also pleased that the Commissioner for Fisheries, Mr Cardoso e Cunha, is with us this morning, and I am pleased to give him the floor to address you."

Mr Cardoso e Cunha addressed the meeting as follows:

"Mr President, Ladies and Gentlemen. On behalf of the Commission of the European Communities, I am very pleased to welcome you here today for the Sixth ICES Dialogue Meeting.

A close relationship between the Commission and ICES has existed since the Community took over responsibility for the development of a Community fishery policy. Without the scientific basis laid by ICES, it would not have been possible successfully to develop that policy. Today, we still rely to a large extent on ICES, and in the domain of international negotiations, it is its impartial scientific advice which provides the basis for those negotiations.

The Community was very pleased to put this long association on a formal footing by concluding an Agreement of Cooperation in June of this year.

For the Commission to host this meeting gives me particular pleasure because it puts the seal on that Agreement.

When I recently visited your headquarters in Copenhagen, Mr President, we spoke of your work in the areas of fish stock conservation, environmental protection, and hydrography. I appreciate that science is fundamental to the role of ICES. But I regard these Dialogue Meetings, of which this is the sixth, as equally important.

Here, Mr President, you give the opportunity to representatives from the fishing industry, fishery administrators and fishery scientists to meet on neutral ground. Such occasions are infrequent and are to be valued. Under the impartial umbrella of ICES, questions which concern us all and which are vital to the future management of fisheries can be discussed in a free and frank manner because no one has to enter into any commitments; because no one will be bound by anything which they say today; because no one will have to reach an agreement today.

The three topics which you have chosen, Mr President, stability, management systems, and long-term objectives for resource utilization, are all vital to fisheries management. That there are more than twice the number of participants here than have attended any previous Dialogue Meeting shows that your choice of topics has been excellent. I am sure that you will have a long and interesting dialogue.

I wish you, Mr President, and all participants, a useful and fruitful dialogue."

The Chairman thanked Mr Cardoso e Cunha for his welcome and stated that the Dialogue Meetings have never been held with such good facilities as provided by the Commission of the European Communities, and have never had such good participation. He noted that ICES places great emphasis on the work of ACFM, but the scientific work is dependent on input from the users, which is what the Dialogue Meeting is all about. ACFM attempts to give the best advice possible in a form which can be used by administrators and which is also not putting undue stress on the fishing industry, which can suffer from bad advice. He thanked the Commission for hosting the meeting in Brussels.

The Chairman then introduced the three main speakers who would begin by addressing the subject of stability.

2 STABILITY

2.1 Industry Statement

Mr Bergesen began by congratulating ICES for conducting the Dialogue Meetings and for inviting the fishing industry to participate, and expressed pleasure in seeing so many representatives of the industry at the meeting. He then presented the following remarks:

"A precondition for fisheries management is reciprocal trust. Do we trust each other? The industry, the managers, and the scientists are all working towards higher stable catches through reasonable and understandable management procedures. Ocean research is done, to a large extent, for the benefit of the fishing industry. Regulations are aimed at the industry and are in the industry's interest.

We must try through an improved dialogue to better understand each other. There should be a basis for better cooperation between scientists, managers, and fishermen.

Scientists have, throughout history, been looked upon as advisors to the industry. They have told the fishermen where to find the fish. They have been advisors in order to help the fishermen increase their catches. But technology has changed that role. Today, scientists are very much delivering their advice to the managers to give them a basis for regulating the fisheries.

I do not believe that the industry has completely adjusted to this change in the role of the scientists. However, the change does not alter the industry's need for advice and dependence on ocean research.

When I am speaking here on behalf of the industry, it is impossible to speak with one voice for the industries in all countries, let alone the industry in even one country, because there are so many different views. Therefore, I am trying to speak on a group level.

A car manufacturer knows that as long as he has a market, he can sell cars and plan production. Most processors can do this.

The fishing industry has to depend on Mother Nature's ups and downs. Planning is difficult; bad weather and sudden and unexpected changes in the stocks demand flexibility and the ability to adjust rapidly and frequently. This applies to the fishing fleet as well as to the processing and marketing sectors.

This is the industry's challenge, and it is also what makes this industry so special.

Still, we want stability. But, is stability possible?

Management procedures to achieve stability may have different rules than a strategy that allows catch limits to fluctuate greatly from year to year.

Is it possible to stabilize nature? Is it possible to create stability in the fishing industry? Or, to what degree is it possible to provide a basis for stability? We are, of course, talking about stability on a high catch level. It might be easier to achieve stability on a low catch level, but that would not be in the industry's interest.

I believe that scientists should clearly indicate the limitations which nature places on stability.

Stocks will have natural fluctuations. We cannot increase the recruitment to a stock, but we can increase the recruitment to the fishable part of a stock by avoiding the capture of immature fish.

The objective of the industry will be to obtain the highest possible stable income with the lowest possible cost.

It is important to have a clear understanding of the limitations of a strategy aimed at achieving stability, both biologically as well as technically.

We should avoid setting management goals that are impossible to reach. It is impossible to regulate short-lived species which have considerable yearly variations in recruitment in a way which results in relatively constant catches from year to year. It is also my feeling that a lack of biological knowledge is also a limiting factor in establishing a management system aimed at stability for many long-lived species.

If the industry can be convinced by the scientists that certain regulations will promote stability and <u>not</u> reduce the long-term total yield from the stocks, I feel confident that the industry will accept such a strategy. That is a matter of communication. It is also important, however, that the managers have the knowledge on which to base the regulations as well as the strength to enforce them.

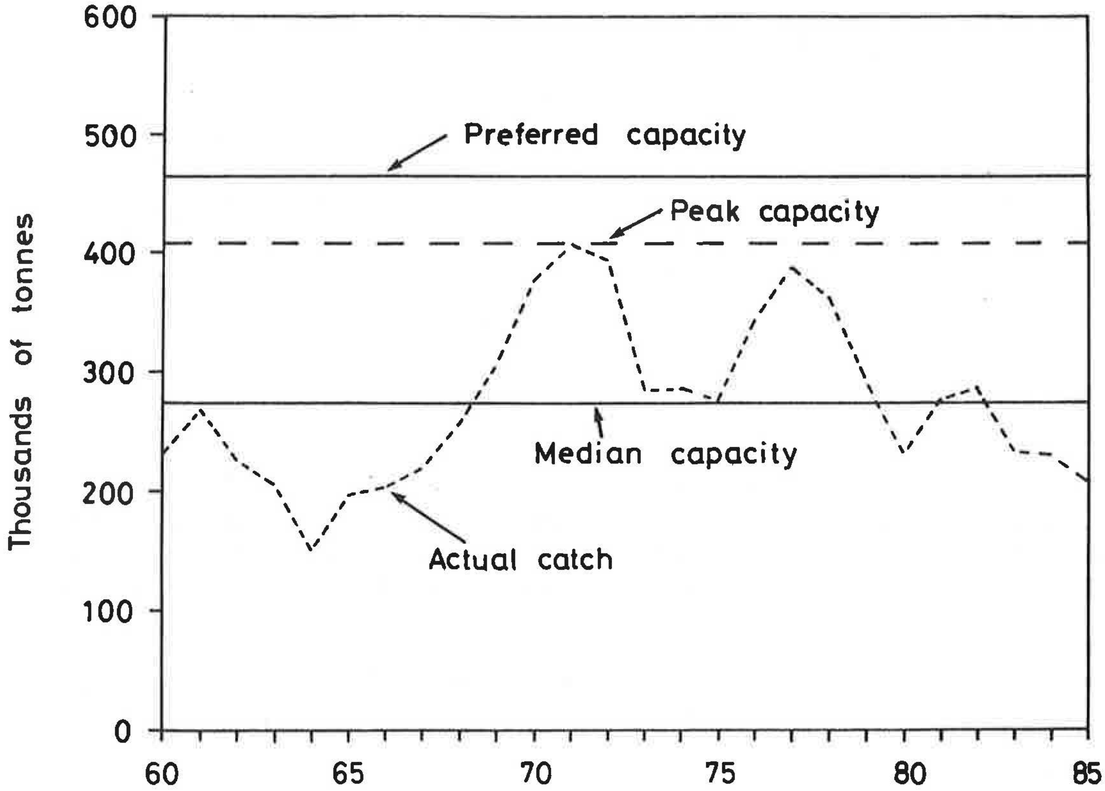
It is important to the industry to maximize the return from the stocks, but it is also of vital importance to reduce costs. The earliest studies of fisheries management were almost all carried out by biologists, but they were well aware that some of the greatest benefits from management would, in the broad sense, be economic, especially in the opportunity to reduce costs. The largest and most unnecessary cost to the industry is overcapacity. The problem is illustrated in Figure 1 which shows the Norwegian catches of North-East Arctic cod during the period 1960-1985. There are great variations over the years. Let us assume a catching capacity at the top line which, in the industry's best interest, should be lowered to some lower level, either the middle line which coincides with the peak level observed or the lower line which represents a median level. In my view, we should move to the middle line. But, is it possible, if we reduce some of the peaks to fill in some of the valleys, to get a more stable catch by lowering the middle line a little? The yield from the stock over time would remain the same without the yearly fluctuations, and the catching capacity could be reduced.

By reducing the capacity, one will also ease the pressure for higher TACs. The industry's need for quotas will be reduced.

We want stability, not only in catch quantities, but also in economic value and in fishing effort.

It is also important to have stability in regulations and in the distribution

Figure 1 Norwegian catches of North-East Arctic cod, 1960-1985.



of catches among countries and among different sectors of the industry within each country.

I would like to hear the scientists' views. If we cut those peaks, would we be in a position to fill in the valleys for the long-lived species? If we agree to reduce our catches in years when the stock is high, will that contribute to higher and more stable catches?

To the managers, I ask that if stability can be obtained, how should it be done? Should it only be done by keeping the TACs at certain levels, or should it also be done by changing technical regulations, e.g., by changing gear, increasing mesh size, etc.? The scientists have stressed that an increase in mesh size could give us higher returns from the stocks and promote stability."

2.2 Administrator's Statement

Mr van der Meer agreed that Mr Bergesen had raised some fundamental issues, but noted his statement about reciprocal trust and suggested that we should aim for better cooperation among scientists, managers, and fishermen. He stressed that he too had the very same questions based on his past experience in fisheries. He felt there was a lot of misunderstanding among the three groups, and that the conflict among them was due more to this than to contrary interests. Mr van der Meer pointed out that he was going to address the stability issue from a different starting point than that of Mr Bergesen. His remarks were as follows:

"One of the first responsibilities of governments should be to offer as much stability as possible in their policies and sets of rules and procedures. This should be done for a number of reasons, some of which were touched upon by Mr Bergesen when he spoke of the need by industry for stability in the economic sense. But governments also need to stabilize their rules and procedures because frequent changes result in high administrative costs. This is a very relevant topic because there is continual pressure for governments to become more efficient and reduce spending.

Another point that should certainly not be forgotten is that degrees of instability in rules and regulations lead to misunderstanding and even to unacceptability by the industry.

Having said this, the question which follows is whether administrators have so far succeeded in creating a reasonably stable situation? I feel that this question is not easy to answer. There are, at present, international agreements for stabilizing fixed shares of TACs. On the national level, countries have taken measures to limit the catch per trip, the number of fishing days, etc. But we are also faced with one very important feature which may make us hesitant in saying there is administrative stability with respect to rules and procedures. Over the last decade, there have been numerous changes in fisheries policy together with tremendous growth in new rules and regulations that tend to change rapidly from year to year or within a year. This results in a heavy burden on managers, but also on scientists and industry.

Mr Bergesen put a question to the scientists about stability, and I would also ask whether scientists, taking into account the variability in recruitment, can provide managers with scenarios that would achieve a higher degree of stability. Only if that question can be answered positively will managers more easily be able to stabilize their rules and regulations."

2.3 Scientist's Statement

Mr Griffith made the following remarks:

"I don't know if we are responsible for nature, but we are responsible for attempting to interpret nature. What all of us represented here are trying to do is manage a system which is inherently unstable because it depends on the number of young fish which come into the fishery each year. We refer to this annual input of young fish as 'recruitment', and it can vary widely from one year to the next. In North Sea cod, for example, we saw a difference of over 5 times in the recruitment between 1971 and 1972.

Attempting to stabilize recruitment, however, is clearly out of the question since these fluctuations are mainly controlled by natural changes in the environment.

The problem is how to manage this system in order to minimize the effects of this variability. It is not possible, of course, to stablize nature itself. What we are really trying to do, when we talk of stability, is to stabilize the effects of natural variability.

We can describe the system in terms of three interrelated factors:

- Stock size
- Catch
- Fishing effort

which we can link together as follows:

$$\text{Catch} = \text{Stock size} \times \text{Fishing mortality}$$

$$\frac{\text{Catch}}{\text{Fishing mortality}} = \text{Stock size}$$

$$\frac{\text{Catch}}{\text{Stock size}} = \text{Fishing mortality}$$

where fishing mortality is proportional to fishing effort.

The relationship may not always be quite as simple as this, but, nevertheless, we can use it to demonstrate the following points:

1) Determining any two of these factors produces a value for the third.

2) If fishing effort is stabilized, catches will fluctuate.

3) If catches are stabilized, fishing effort must fluctuate.

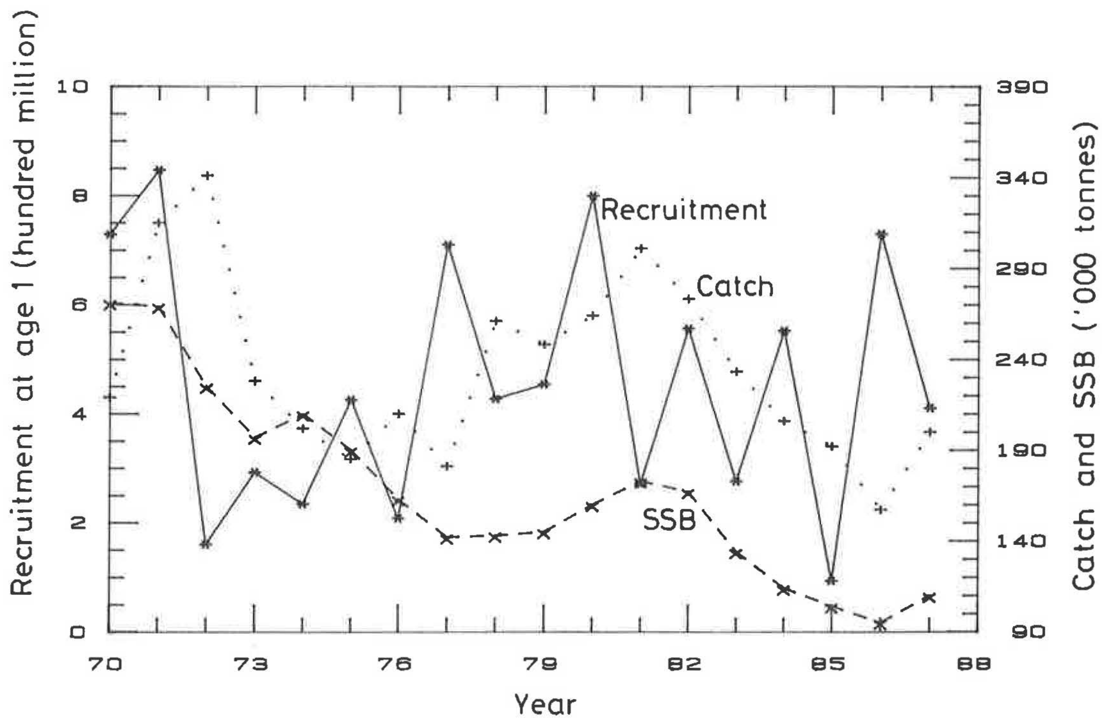
Stock size will fluctuate naturally in relation to the number of young fish entering the fishery, but, of course, it is also affected by the amount of fishing effort.

We can see some examples of this in the North Sea cod stock which, as we know, has been in the news this year.

<u>The historical situation since 1970</u>

Figure 2 shows annual recruitment for the period 1970-1987. There is great

Figure 2 North Sea cod recruitment, catch, and spawning stock biomass (SSB), 1970-1987.



variation, with a high level in 1971, a very low level in 1972, and a steady increase through the 1970s (although there were peaks and valleys). The system which depends on the abundance of the young fish coming in each year has enormous variation from one year to the next.

Figure 2 also shows the situation in the North Sea cod fishery. The highest catches were taken in 1971 and 1972 when 315,000 and 341,000 tonnes (t), respectively, were caught, but almost half (44%) of the weight of these catches consisted of 2-year-old cod. In the medium term, as we shall see, these were very expensive fish because they were caught so young. Even with the high levels of fishing effort which were applied after 1972, catches fell rapidly to 200,000 t or less by the mid-1970s.

The levels of annual fishing mortality are shown in Figure 3. A steady increase is evident throughout the period to a level of 0.9 in 1986-1987, which means that about 60% of the cod in the North Sea are being removed each year by fishing.

Following the good recruitment of 1-year-old cod in 1978 and 1980, catches rose again to the 300,000-t level in 1981 (Figure 2), when 49% of the catch (by weight) was made up of the 2-year-olds which had entered the fishery as 1-year-olds in 1980. Since then, catches have declined steadily to 150,000 t in 1986, but the abundance of cod born in 1985 and entering the fishery as 1-year-olds in 1986 has pushed the catches up again in 1987.

It is very noticeable, however, that any good recruitment seen during this period did not significantly increase the spawning stock biomass (SSB) (Figure 2). The large numbers of fish entering the stock in 1971 and 1977 produced only minor 'bumps' in the SSB graph in 1974 and 1980-1981. This is because fishing was so heavy that most of these fish were caught as juveniles, leaving relatively few to grow to sexual maturity.

This can also be demonstrated in Figure 4 which shows the exploitation pattern or level of fishing mortality on each age group and the proportion which are sexually mature. It can be seen that the heaviest exploitation has been on the 2- and 3-year-old fish, with that on older fish at a lower level. However, only 5% of the 2-year-olds and 23% of the 3-year-olds are mature. North Sea cod are not fully mature until they are 6 years old.

In an attempt to answer the main questions put by Mr Bergesen and Mr van der Meer, let us look at what might have happened if longer-term management strategies had been adopted in 1970 with the objective of achieving some stabilization of catches or fishing effort. Some computer simulations were run to show what would have happened if we had sat down in 1970 and tried to make some long-term decisions, the only difference being that, to minimize the number of assumptions needed to be made, the annual recruitment values used in the simulations are those which are now seen (1987) to have actually occurred in the years since 1970. The trends in catch and spawning stock biomass resulting from these simulations are shown in Figures 5 and 6, respectively, together with the real-life values for comparison. Trends in fishing mortality are shown in Figure 3.

<u>Stabilize catch at the 1970 level (220,000 t)</u>

The first scenario considered is that of stabilizing catches at the 1970 level of 220,000 t. Fishing mortality falls steadily until the early 1980s when it stabilizes at a very low level. Spawning stock biomass, boosted by the good year classes which entered the fishery in 1971, 1977, and 1980, rises spectacularly to almost 3 million t by 1987. The stock is underexploited from about the mid-1970s, which is not good <u>biological</u> management, and, in any case, the

Figure 3 North Sea cod fishing mortality rates estimated for the period 1970-1987 compared with rates from simulations of various management scenarios.

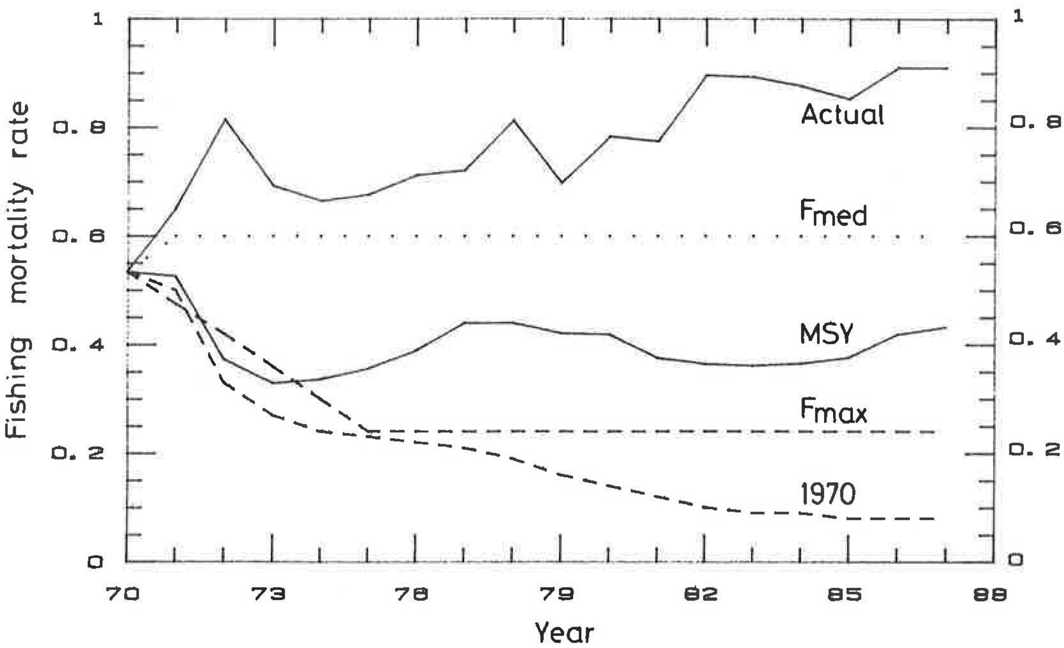


Figure 4 North Sea cod exploitation pattern and maturity ogive.

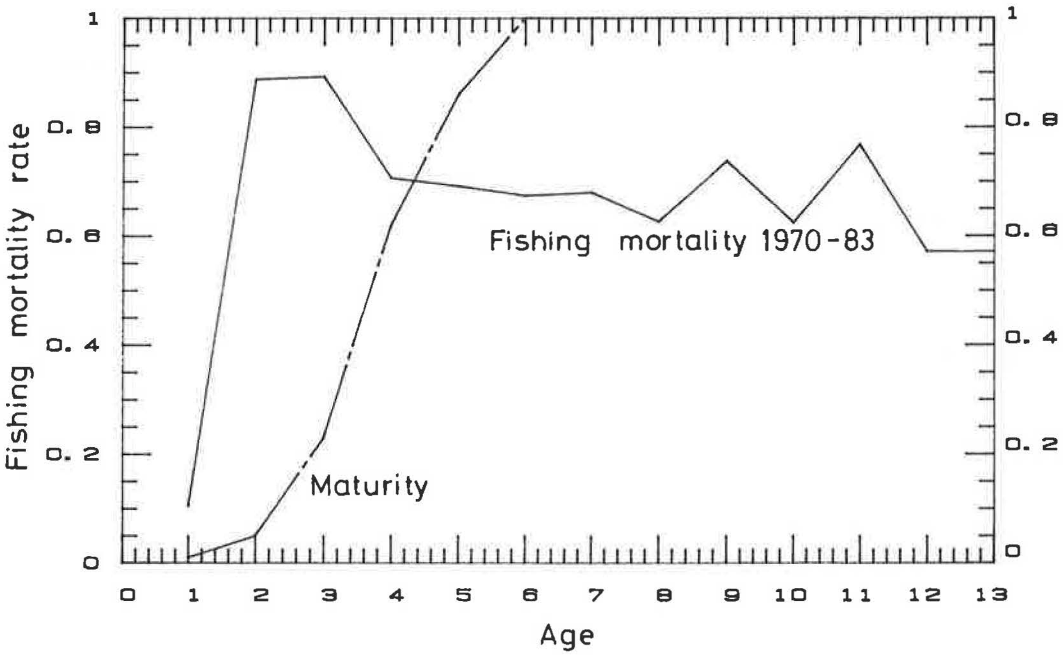


Figure 5 North Sea cod landings for the period 1970-1987 compared with landings from simulations of various management scenarios.

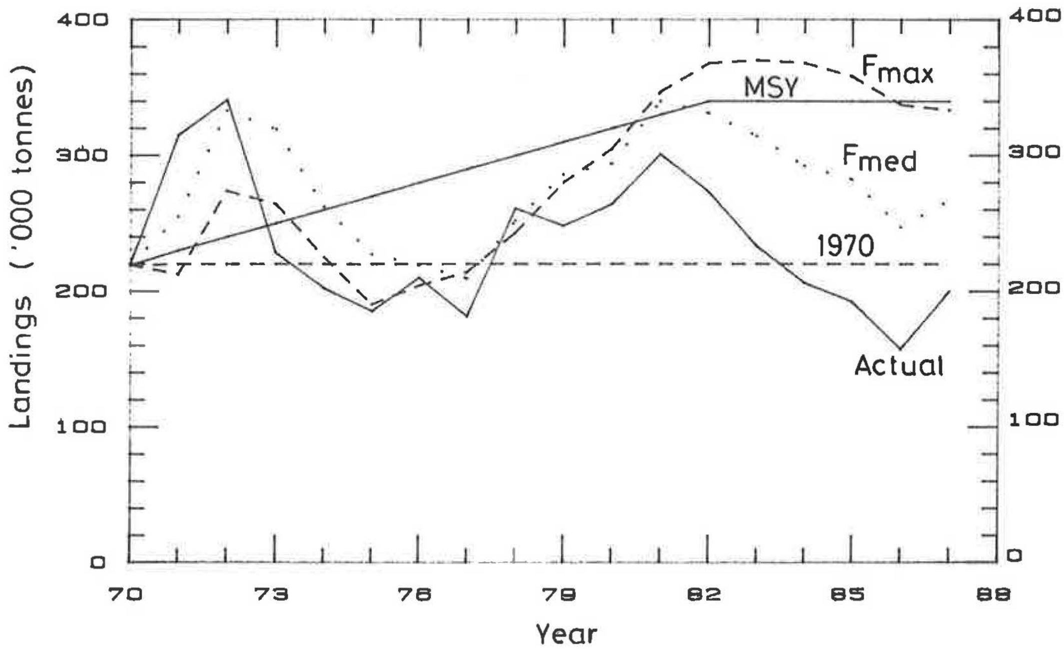
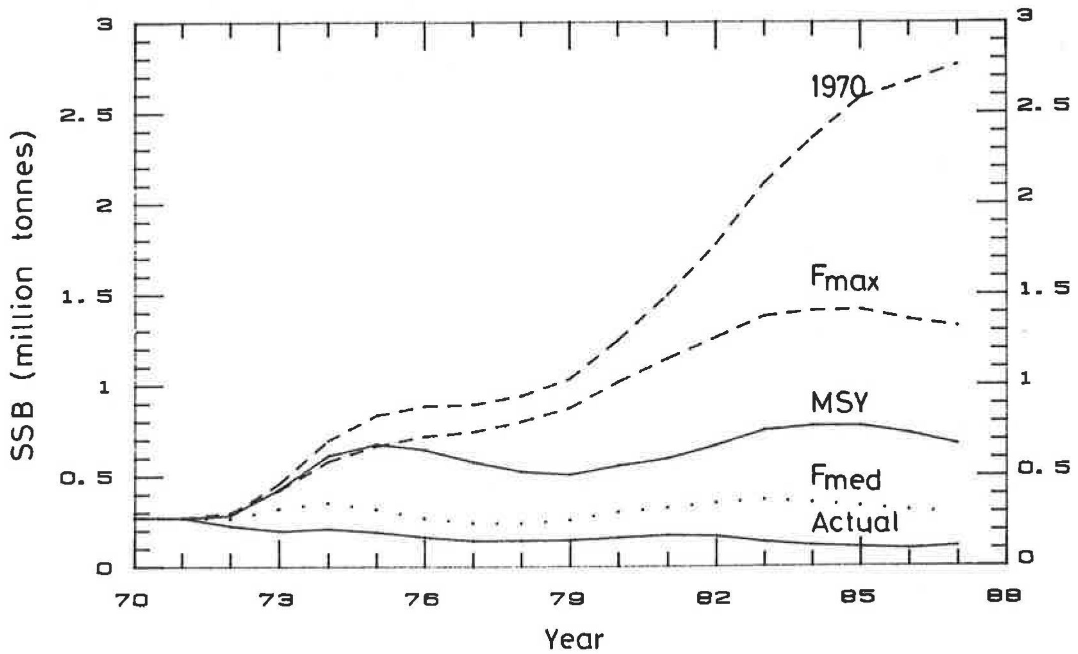


Figure 6 North Sea cod spawning stock biomass estimates for the period 1970-1987 compared with estimates from simulations of various management scenarios.



North Sea ecosystem probably could not support a cod stock of that size.

The economic impact on the catching operation, however, should have been very significant. With cod so abundant as a result of this strategy, catch per unit effort would have been very high and the cod would have been relatively cheap to harvest. The increased supply would probably have depressed the unit value of the catch, however, thus reducing the economic benefit of the lowered costs of catching the fish.

Allow catches to rise gradually to the MSY level (340,000 t), then stabilize

In this scenario, catches were gradually increased to, and stabilized at, the maximum sustainable yield (MSY) level of 340,000 t. This level was determined by multiplying yield per recruit at the F_{max} level by average recruitment (arithmetic mean). Catches were increased in increments of 10,000 t per year to the MSY, which was reached in 1982 and maintained thereafter. We can see the benefit, in terms of steadily rising catches, of allowing the good recruitment in 1971 to contribute to the adult stock rather than fishing it hard as soon as it becomes available to the fishery. In reality, catches exceeded 300,000 t only in 1971 and 1972 as the good 1971 recruitment was intensively harvested as juveniles. Actual catches then fell rapidly to around 200,000 t and did not show any recovery until 1978, after the next good recruitment. By aiming for a slow but steady increase towards MSY at the rate of 10,000 extra t per year after 1970, this drastic decline in landings would have been avoided.

Under the MSY simulation, fishing mortality falls rapidly as the stock is allowed to increase under the influence of the 1971 recruitment, rising again in the late 1970s as recruitment declines and catches approach the stabilization target of 340,000 t. At this stage, however, fishing mortality is still only about half of what it was in the real situation, and it falls still further throughout the 1980s as other good recruitments are allowed to remain longer in the stock before being fished out.

Spawning stock biomass follows a similar trend, peaking at about 800,000 t by 1984.

Rather than attempting to stabilize catches, let us examine two strategies for stabilizing fishing mortality.

Reduce fishing mortality gradually to F_{max} (0.24), then stabilize

Fishing mortality is reduced in five equal stages to the level corresponding to obtaining the maximum yield in weight from each fish which enters the fishery. This is reached in 1975.

As fishing mortality is progressively reduced, catches are lower than those obtained in real life in 1971 and 1972. But from 1973 to 1978, the catches are either slightly higher or very close to those actually achieved. In other words, similar yields for less fishing effort (and, therefore, lower fishing costs) as the good recruitments are allowed to stay longer in the stock and grow bigger.

From 1979 onwards, the catches are substantially higher than in the actual situation, reaching 370,000 t annually during 1982-1984, with a slight decline at the end of the period due to very poor recruitment.

Spawning stock biomass, meanwhile, rises steadily to almost 1.5 million t by 1985, dropping slightly thereafter as recruitment falls to or below the average level.

Stabilize fishing mortality at F_{med} (0.6) from 1971

The 1970 level of fishing mortality was 0.53, which is close to the value calculated for F_{med}.

F_{med} is the fishing mortality rate at which the historical data on stock and recruitment suggest that the stock should be sustainable.

Catches follow the same trend as seen in real life and in the F_{max} simulation, but at different levels. In the early part of the period, they are generally higher than both the actual situation and the F_{max} strategy, except for the actual catches of 1971 and 1972, although they still decline during the 1972-1977 period as a result of lower recruitment.

From 1977 to 1981, the catches are virtually the same as those obtained by fishing at F_{max}, but this increasing trend cannot be maintained, and catches decline from 1981 in parallel with the actual catches.

Spawning stock biomass builds up to higher levels than those seen in the real-life situation, but does not exceed 370,000 t, and by the beginning of 1987 is just under 300,000 t.

Stabilizing fishing mortality, in fact, means fleet limitation. So, whatever the advantages, these inevitably bring consequent administrative and political problems. How would management and the industry cope with these problems?

Stop catching juvenile cod

If 1- or 2-year-old cod had not been caught, beginning in 1971, higher catches could have been obtained from the same overall fishing effort (same levels of fishing mortality) that was applied in the actual fishery.

The simulation (Figure 7) shows a lower catch in 1971 because the actual landings in that year consisted mainly of newly-recruited and abundant 1-year-old cod which, under this new strategy, would not be caught until they were older.

Catches are markedly higher from 1972 to 1977, but in 1978, the real fishery caught more, for the same reason as in 1971 - good recruitment which was landed as juvenile fish.

Catches under this simulation rise again in 1979, reaching a peak of 555,000 t in 1982, and remain high until 1987 when the poor 1984 year class (the weakest on record) enters the fishery as 3- year-old cod. The good 1985 year class, however, brings the simulated 1988 catch up to 400,000 t.

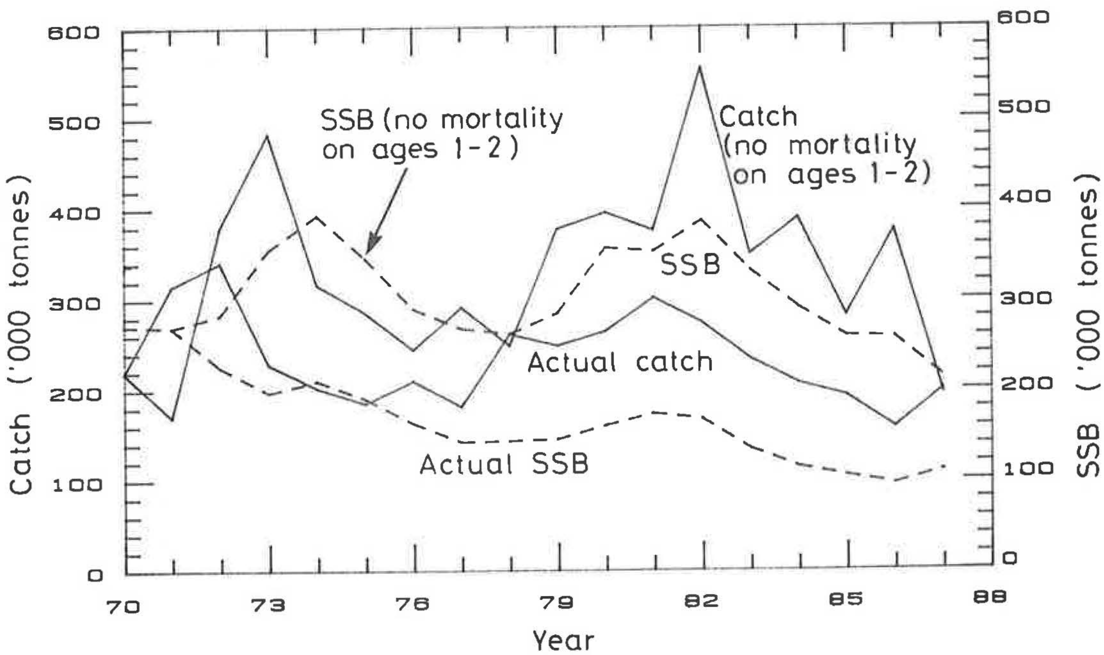
Spawning stock biomass remains higher throughout the period than observed in reality and, in 1987, stands at double the present figure of 106,000 t.

From the point of view of stability, it is very interesting to compare these catches with the MSY option (340,000 t per year from 1982 onwards). The SSB is at such a high level in that simulation (around 700,000 t) that catches can be sustained, and the declining trend which was seen in the real fishery and in the option with no fishing on juveniles does not appear, and the stable catches can be maintained.

Conclusions

Natural fluctuations in recruitment strongly influence trends in stock size and catch size.

Figure 7 North Sea cod catch and spawning stock biomass (SSB) for the period 1970-1987 compared with catch and SSB from the simulation of a management scenario prohibiting the capture of age 1-2 fish.



Heavy exploitation of young fish reduces the size of the spawning stock and keeps it at a low level, with a consequent reduction in catches in subsequent years.
Gradual increases in catch allow the stock to build up to levels where bigger harvests can be taken with less effort and sustained for longer periods.

By not catching the 1- and 2-year-old fish, highest cumulative catches and greatest average yields are obtained.

A comparison of total catches taken over the whole period in each of these simulations and in the actual situation shows the following:

Scenario	Cumulative catch 1971-1986	Average catch 1971-1986	Spawning stock 1 Jan 1987
Actual situation	3,800	200	100
Stabilize at 1970 level (220,000 t)	3,500	200	2,800
Gradual increase to MSY (340,000 t)	4,800	300	700
Reduce F gradually to F_{max} (0.24)	4,600	300	1,300
Stabilize F at F_{med} (0.6)	4,500	300	300
No fishing on 1- and 2-year-olds	5,512	350	200

Weights in '000 t.

I have another question to managers and the industry. How do you achieve stability if it involves short-term restraints and the necessity for implementing these restraints?"

2.4 Discussion

In opening the discussion on this topic, the Chairman noted that Mr Griffith had explained how nature's fluctuations affect stock size and had also demonstrated, using North Sea cod as an example, that one could reduce fluctuations by managing the fisheries and thus obtaining higher catches at reduced cost. He pointed out that the discussion should now consider whether we want to have stability of catches or stability of effort because it is not possible to have both. If we choose stability of catches with no direct control of fishing effort, how does the industry propose to discipline itself? If we choose stability of effort, how can it be achieved? Is the industry willing to accept restrictions by licensing or other means? How would managers be able to ensure that the industry could get a desired high output from its efforts?

Mr R. Toussaint, French Directorate of Fisheries, asked whether scientific forecasts could be given on a medium-term rather than on an annual basis, what research efforts would be required to achieve longer-term forecasting, and why the earlier attempts by ICES for longer-term forecasting were discontinued.

The Chairman replied that ACFM has tried to provide some long-term forecasts, but natural fluctuations in recruitment are very difficult to predict. Differences between short- and long-lived species also result in different types of advice.

The Chairman of ACFM recognized that managers like to have long-term forecasts, but pointed out that ACFM provides forecasts of catch for the year following the present year and spawning stock biomass two years later. Forecasts for longer periods are very difficult and, given our present knowledge, would be very uncertain. This is because the catch forecasts depend greatly on recruitment forecasts, and to predict these even 3-5 years into the future is presently not possible. There are, however, different possibilities in this regard for short- and long-lived species. For long-lived species, it is possible to forecast a trend in stock size assuming average recruitment. However, ACFM has attempted this for some stocks, such as redfish and cod in the North-East Arctic area, but has found that these predictions are rather uncertain. For short-lived species such as capelin, it is impossible to make long-term forecasts.

Dr K. H. Feilhauer, Federal Republic of Germany High Seas Fisheries, reported that the EC fisheries policy intends that the size of the fleets in the member countries should be adapted to the prevailing situation over a several-year period until it became stable, thus implying a particular catching capacity. Such a structure must be adapted to catching possibilities. Although this structure has not yet been attained, there does exist a certain fishing structure in the EC. With regard to the inshore and deep sea fleets of the Federal Republic of Germany, there is a certain structure involving a particular number of vessels which requires a certain catch to make the fleet economically viable. Secondly, we must supply the market, and to do so, the industry is interested in having about the same amount of catch in the same area each year. He also pointed out that the industry would be willing to exercise self-restraint to achieve a target level of stable catch, and to some extent, it already does this. The EC member countries agree on the TACs for the Community and live with them, although not everyone is satisfied. The system, however, is good and is acceptable. Licensing has been suggested, but it is uncertain what this would bring. The best method would be to divide TACs amongst a group of fisheries which would conduct their operations on that basis.

The Chairman responded that the desire by the industry to have the same kind and quantity of fish in a given area each year is very difficult to provide. The structure of the fishing fleets has to be flexible recognizing the variability among species.

Mr J. Maddock, Irish Fishermen's Organization, asked whether it would be possible to raise the status of precautionary TACs (two-thirds of the present TACs) to that of firm TACs to improve long-term planning.

The Chairman replied that ACFM advises precautionary TACs only when an assessment is not possible due to insufficient data.

Mr Griffith commented further that the lack of data for performing an assessment is related to cost. Data collection is expensive. Most countries in the Northeast Atlantic area are being forced to cut back on research expenditure. If firmer advice is needed, more information is needed, which requires more funds. The scientific community has to spend its resources in accordance with the strongest demands, and there simply is not enough money to answer the questions for all the stocks.

Mr J. F. Doyle, Irish Fishermen's Organization, emphasized that the concern with precautionary TACs related to their accuracy. How does one get the basis data to transform a precautionary TAC into a firm TAC? It is impossible to plan if you lack the basic data. As long as we continue on our present basis, the precautionary TACs will always remain at that status because no further research is being done.

Mr J. Strand, Norwegian Fishermen's Association agreed that, based on his own practical experience, there is a need for stability in fisheries; but this is not easy to achieve because of natural fluctuations in the stocks. In the past, it was thought that greater stability might be achieved from better scientific assessments, but practical experience has shown that situations differ among various stocks and fisheries. The industry has an obligation to collect all the data necessary for achieving some sort of stability. We should aim at setting ceilings on catch levels, and know when to start and stop fishing. Countries need to establish mechanisms that will ensure stable situations, recognizing that there are different approaches to achieving them.

Mr M. Ibbotson, Ministry of Agriculture, Fisheries and Food, England and Wales, felt that stocks are being looked at too much in isolation. If there is flexibility within the various fleets, it might be possible to achieve stability of total catches of all species in an area, although there would be variability among the species, and at the same time achieve relative stability of effort. He asked if the interrelationships among stocks in a given area are being considered by the scientists?

Mr A. Fernandez, Spain, addressed the question of restricting effort to a certain extent to achieve stability and noted that there are various ways of doing it. A large part of the industry would be more willing to accept stability of effort than stability of total catches, since the latter may lead to seasonal closures in fishing. About half of the EC's approximately 100 management units have precautionary TACs, where we do not know the exploitation level. We should seek fairly immediate stability in these fisheries through effective technical measures. When our knowledge of these stocks and fisheries is improved, we could then implement TACs.

Mr Bergesen drew attention to the simulation results presented by Mr Griffith and indicated that if one wants to harvest the maximum amount from the sea, absolute stability can never attained. He asked Mr Griffith to comment on a possible target spawning stock biomass (SSB) for North Sea cod. For the industry, the scenario which gave both the highest cumulative as well as average annual catch (no fishing on 1- and 2-year-olds) would be preferred. However, is the SSB of 200,000 t in 1987, as indicated by this simulation, too low?

Mr Griffith responded by drawing attention to Figure 9.4 in the 1987 Report of the North Sea Roundfish Working Group (ICES, Doc. C.M.1987/Assess:15) which shows a plot of spawning stock biomass and recruitment for North Sea cod. He noted the lack of a meaningful relationship, a narrow range in SSB, and high and low recruitment at both the high and low ends of the SSB range. Since from the scientific point of view, a target minimum SSB should be that level below which there is strong evidence that recruitment will become heavily dependent on SSB and will decline further; but such a level cannot be identified for North Sea cod. From the economic standpoint, however, a larger SSB implies more fish in the sea and reduced catching costs. Figure 2.10.4 in the 1987 Report of the Herring Assessment Working Group for the Area South of 62°N (ICES, Doc. C.M.1987/Assess:19), on the other hand, shows how one can sometimes demonstrate a stock-recruitment relationship (in this case for North Sea herring) where there is a very large range in SSB over time (high SSBs in the late 1940s and very low SSBs in the 1970s). In such a situation, it is sometimes possible to visualize a stock-recruitment relationship from which a minimum SSB target level can be identified.

Mr van der Meer noted that, from a scientific point of view, it is possible to do longer-term forecasting, as is illustrated by Mr Griffith's simulations on North Sea cod, but choices have to be made. For example, of the options presented, the MSY scenario is attractive; cumulative catches for the period 1971-1986 are 4.8 million t, average annual catches are 300,000 t, and the SSB in 1987 is 700,000 t. It is important that both managers and the industry be prepared to make some choices, and some members of the industry have indicated today their willingness to do so. How do managers implement this? The process does not start at the political level, but does end up there. It is of utmost importance that industry representatives inform their government officials and scientists that they are willing to work for a particular approach to achieve greater stability. The political process will then be much easier. What mechanism could be used? Do we want an effort control system? It could work and could be implemented, but is everyone willing to make the fundamental decision to work with longer-term options and make a choice?

Mr P. Tørring, Danish Fish Processing Industry, felt that three factors needed to be taken into account: price of the catch, fishing costs, and behavior of fishermen. Individual fishermen want stability in catches in the bad years and maximum profit in the good years. As stock size increases, catching becomes easier (e.g., an allotted quota may be caught in 3 vs 12 months) which results in the need for strong management control.

The Chairman pointed out that scientists have not taken into account the cost of fishing operations or the price of fish, but deal only with the biological aspects. Economic questions should be handled by the administrators in each country. ACFM would find it very difficult to deal with economic aspects, but the question needs to be addressed.

Mr B. Daalder, Dutch Fisheries Organization, mentioned that, when fishing for flatfish, it is impossible to avoid by-catches of other fish, and wondered if such catches could be treated outside of any quotas.

The Chairman noted that unavoidable by-catches cause a lot of problems, but should be addressed later in the meeting when considering multispecies assessment and management.

Mr N. Atkins, National Federation of Fishermen's Organizations in England and Wales, felt that most participants would support the aim of stable medium- and long-term fishing at optimum levels which recognize economic, social, and biological factors. There is room for disagreement on the time profiles to be adopted, how stability might be achieved, and trade-offs between economic, social, biological, and political factors. He stressed, however, the need to move forward, in faith, because of the inexact nature of stock assessments which are due to such factors as widely-fluctuating recruitment rates, the uncertainty of catch reporting and enforcement, and the underlying problems of mixed fisheries. Otherwise, the industry will probably focus more on short-term losses than on longer-term benefits. It is easier to see, with the benefit of hindsight, what should have been done previously instead of what might be possible to achieve now.

The Chairman summarized that people want to fish at an optimum level, but find it very difficult to accept short-term losses.

3 MANAGEMENT SYSTEMS

3.1 Administrator's Statement

Mr van der Meer presented the following remarks:

"In recent years, a lot of thinking has gone into the question of what would be the best or at least a better management system.

In order to facilitate the discussion on this issue, I would like to present a comparison between two systems of management. I will do this in a rather provacative way in order to stimulate the discussion. The first is the existing TAC and quota system, and the second is the effort or so-called license system. This comparison will be made by presenting advantages and disadvantages from certain points of view.

The TAC and Quota System

1) Advantages

Management aspects:

- The system is politically accepted and has an international legal basis.
- Reduction in catches on the basis of assessments can, in principle, be realized in a relatively short period of time.
- Management of a single species is, to some extent, possible.
- Distribution of quantities of fish between countries and fleet sectors is possible.

2) Disadvantages

Economic aspects:

- The system tends to result in overcapacity of the fishing fleets.

- TACs and quotas can have adverse effects on the market; an oversupply at the beginning and a shortage towards the end of the management period.

- Increases in discards and lower prices for fish can be expected as fishermen try to maximize the output of their national allocations.

Management aspects:

- The closure of a fishery for one species after reaching the TAC cannot prevent the later by-catch of this species in other fisheries. This problem is ever more severe in cases of mixed fisheries; if the fishery for species A is stopped while the fishery for species B continues, the catch of species A must be discarded.

- Enforcement of the regulations is difficult and can lead to a shift in the attitude of fishermen from obedience to disobedience of the law, thus endangering any future management.

- Decision makers tend to set higher TACs than those proposed by scientists in order to meet the short-term needs of the fishing industry. Such TACs may endanger the fish stocks.

- TAC regulations, as presently implemented, result in variable catches from year to year, while the fishing industry would prefer stable catch levels.

- Adequate and rapid monitoring of the landings, needed for the enforcement of TACs, is often difficult.

- The setting of TACs late in the year can hamper fishing plans.

- There is inherent uncertainty as to the closing date for the fishery on a particular fish stock when a TAC or quota is reached.

<u>The License System or Effort Regulations</u>

A license system is characterized by a limited number of fishing vessels that are allowed to participate in a fishery.

1) <u>Advantages</u>

Economic aspects:

- It is easier to prevent overcapacity after the existing overcapacity has been removed.

- Adoption of this system would result in the same catch with fewer vessels, which means an improvement in individual and overall profitability.

- It would not be necessary for scientists to spend all their time predicting catches.

Management aspects:

- Control will be easier and, therefore, probably more effective.

- Catch data will be more reliable.

- There will be less disturbance of the supply and, consequently, of the market.

- Monitoring of catch data would no longer be vital for direct management, although their use by scientists for assessment would still remain.

- Violations of management regulations could be more uniformly punished (e.g., confiscation of the license) than in the present TAC and quota management system.

2) Disadvantages

Economic aspects:

- The existing capacity has to be reduced more with a license system than in the present catch regulation system because fishing vessels will be less restricted in their catching potential in the license system. This process is costly and capital destructive and will continue as new technical improvement are introduced.

Management aspects:

- Management of a single species will be less possible than in the TAC and quota system, although management by closed areas and/or periods will still be possible.

- Pelagic species are vulnerable under this system as they often concentrate in dense shoals and can easily be overfished with a small amount of effort and no catch restrictions.

- The 'unit of effort' is difficult to determine and will, therefore, create difficulties in determining the number of licenses to be allowed.

- The distribution of licenses among participating nations will require international decision making.

Having given a comparison between TAC/quota and effort/license systems, I have only briefly touched on another category of measures such as protection of stocks by closed periods and/or areas or by mesh size regulations."

The Chairman pointed out, in regard to one disadvantage of a TAC and quota system stated by Mr van der Meer (setting of a TAC late in the year), that ICES has tried to solve part of this problem by scheduling two annual meetings (May and November) of ACFM, but in some cases, the information needed for assessing the stock is not available until late in the year. This system cannot be further improved to any great extent without going to longer-term advice.

3.2 Industry Statement

Mr Bergesen presented the following remarks:

"Management is such a simple word, but it is very difficult to agree what we should put into it. It is important to set up some criteria and discuss the principles. Dr John Gulland said that 'management has become a matter of maintaining the status quo, rather than looking for radical improvements'. It may be a useful theoretical exercise to look for the radical improvements. But, I believe that we should have a revolution in small steps.

Changing of management systems will not in itself increase catches immediately. I believe that we can adjust the management system in a way that will give us the opportunity to fish with lower costs and, over time, increase our catches by rebuilding stocks and improving fishing patterns. We want a management system that protects immature fish and regulations that are designed to rebuild the stocks. Instead of adjusting, we should look for new ways of managing the fisheries.

I do not think that we can manage our living resources without using TACs, but TACs are not the only answer to our management problems. I would like to put some questions to the managers, but first want to list some criteria that I feel a management system or set of regulations should meet:

- Keep catches within recommended limits.

- Protect immature fish and spawning stocks.

- Distribute the burden of regulations fairly among countries, groups of fishermen, and individual fishermen.

- Give fishermen the opportunity to fish with as low costs as possible.

- Regulations should be predictable.

- Regulations and the need for them should be understood by the industry.

- Regulations should be designed to ensure the reporting of dependable and correct catch data.

- Do not put unnecessary burdens on the industry.

- The industry wants an optimum long-term yield.

Maybe I ask too much from the managers and perhaps the scientists, but these criteria are important as a basis for consideration by both of these groups. It is my feeling that the answer is a mixture of different types of regulations: effort control, TACs, and technical regulations. I think we will have to live with TACs, that effort regulations are important, and that technical regulations are extremely important and have not been used to the fullest extent possible.

Effort regulations are designed to limit fishing capacity or effort. They may be the limitation of the number of vessels in a fishery, the capacity of each vessel, or the number of fishing days. From the industry's point of view, many of these measures create difficulties.

One may limit the catching capacity of each vessel by, for example, limiting the size of the vessel, the horsepower, and/or the number or type of gears that are permitted, or by limiting the number of fishing days. These regulations are very costly to the fishermen. They cannot use their vessels efficiently and do not obtain the best return from their investment.

If one must choose among the different ways of limiting fishing effort, it is my opinion that the best system would be to limit the total number of vessels. A license system would be required, and it would be a major task requiring a massive program initiated and financed by each national government to reduce each fleet to the desired number of vessels. It would be difficult, but possible.

We want fleets that have enough capacity to take high or higher than-normal

TACs when they are available.

The result of improper effort regulations would be an effective fleet fishing very inefficiently with very little flexibility and with excessive operating costs.

Quantitative regulations have been the most common means of limiting fishing in recent years. TACs have been set for the different stocks and allocated to country quotas, vessel category quotas, individual vessel quotas, area quotas, and so on. It is only the TACs and, to a certain extent, the area quotas that are based on biology and scientific advice. Some area quotas are set in order to protect a stock or a component of a stock when fishing would be detrimental to it.

Quantitative regulations, like TACs, should not be used which set up a rigid system and do not promote competition among fishermen. Individual vessel quotas promote equality and planning, but could hamper competition. The use of such quotas is not an economically efficient way of regulation.

When a country quota is set, vessels should be permitted to participate in the fishery with minimal limitations. After the catch level is decided, there should be no need for zonal limitations, except for biological reasons. This is a challenge to the international negotiators as well as the national managers. Do we really need all those lines in the ocean dividing one stock into different fishing regimes? Maybe we should look here for radical improvements.

Effort regulations and quotas have played a central role in fisheries management, while technical regulations have unfortunately been pushed more or less to the background. I think mesh-size regulations are a very important means of increasing the long-term yield of a stock, and would put that question to the scientists."

3.3 Scientist's Statement

Mr Griffith presented the following remarks:

"Taking first the question of mesh-size regulations as a means of increasing long-term yield gives me an opportunity to return to the simulation results presented earlier. There are several important points that must be borne in mind when considering these results, which were not emphasized before. The gradual increase in yield to MSY must, in fact, be gradual. If the catch had been increased in steps greater than 10,000 t, there would have been either no gain at all or a decrease in stock biomass. Therefore, increases must be gradual. The second point is that the simulation was begun in 1971 when the stock was more than double its present size and very good recruitment was coming in. Therefore, it wouldn't be as easy to repeat these results beginning at the present time, but it doesn't detract from the possibility of achieving something like it.

The results of the simulation of the effect of no fishing on 1- and 2-year-old fish should not be viewed in isolation. The elimination of fishing on these age groups could also have been implemented together with any of the scenarios on limiting catch or stabilizing fishing mortality.

As Mr Bergesen has pointed out, a TAC system and an effort-based or licensing system have some common elements.

TACs are calculated in terms of a corresponding level of fishing mortality which, in turn, is directly related to fishing effort. Therefore, the assessment scientist already asks for data on fishing effort in order to help calculate the level of fishing mortality being generated on the stock in question.

The following directly-measurable data are required for scientific assessments in the present TAC-based management regime, with the finer the detail, the better:

For each species/stock combination:

Catch Discards Landings Fishing effort	by each	Vessel category Gear type	in each	Fishing area; statistical rectangle is best

The most appropriate unit by which fishing effort should be measured depends essentially on the species/gear combination in question, but the effective effort is influenced by a number of additional factors such as:

- the power of the vessels
- the abundance of the stock
- the behavior of the fish from season to season or from year to year (sometimes related to abundance)
- the skill of the fishermen

Some of these can be measured directly, others are difficult or impossible to quantify, thus requiring assumptions, inspired guesses, or subjective estimates; all are subject to short- or long-term change. In stock assessment, one must obtain data on (or at least be aware of and take into account) such relevant considerations and not just, for example, the number of trawl hauls, the number of days spent at sea, or the number of hooks fished.

The use of effort as a regulatory tool should, in theory, increase the availability of the effort data required for both assessment and management, because it might be more widely and intensively collected than at present. However, in practice, paradoxically, an effort-based management system could hinder such improvements or even lead to a deterioration, just as the reliability of catch data has dropped alarmingly since the introduction of quota regulations.

The quality of the catch statistics for some TAC stocks has become so bad, and the difficulties in performing assessments (reliable or otherwise) have consequently been rendered so much worse, that the feasibility of giving any scientific advice for managing these stocks is in serious doubt.

What are your views on the implications of this? Would the absence of scientific advice lead to better or worse management, or to a more secure or less secure industry? These questions have thus far been hinted at, but no one has faced up to the difficulties of implementing this. It is of no use to show results of simulations which point out the gains in yield and stock size if it means reducing fishing effort, because that means tying up vessels or moving them to other areas during parts of the year. Everyone is aware of the magnitude of the political, economic, and administrative problems that this would cause. However, if you want the gains, it will require some hard decisions to be taken and adhered to over a number of years.

TAC systems tend to be rather blunt instruments which need to be supported by a selection of technical measures such as:

- minimum mesh sizes
- minimum landing sizes
- 'boxes' within which special regulations apply
- closed seasons

All of these are used to prevent or reduce the capture of young fish. The last two can be used to protect spawning fish when they gather in dense concentrations; this seasonal behavior pattern exhibited by some species makes the stock vulnerable to overexploitation, and the TAC easy to overshoot and difficult to enforce.

These regulations need strict enforcement. It is meaningless to adopt regulations, but fail to enforce them. The effectiveness with which such measures are implemented and enforced is presently highly variable. The administrative and political difficulties must be faced courageously, otherwise we are all wasting our time."

3.4 Discussion

The Chairman opened the discussion by noting that there were no easy answers to the many questions that had been raised by the three speakers. Advantages and disadvantages of several management systems have been presented from the point of view of both managers and the industry, and we have seen what is required, in terms of data, by the scientists. No single system is ideal, and a mixture of types of regulations has been suggested. A system must address the concerns and ensure the cooperation of both managers and fishermen.

Prof. A. Schumacher, Sea Fisheries Institute, Federal Republic of Germany, pointed out that management objectives must be defined, prioritized, and assigned a time scale for attainment before one can discuss the details of a management system.

Mr Bergesen emphasized that he had listed a number of criteria for a management system, but that there are many ways to prioritize these, and that they will differ among countries.

Mr J.-C. Cueff, French deep-sea fishing industry, noted that management problems are very acute in coastal areas because of the nature of the stocks (e.g., spawning and nursery areas for offshore stocks) and competition among fishermen. Regulations currently in force for these areas are of the traditional type (e.g., seasonal closures, gear restrictions, mesh size, etc.), but they may penalize considerable numbers of coastal fishermen who do not always fish these species in the adult stage, even though they are considered justified. Fishermen will be willing to endure sacrifices if they are accompanied by other measures which ensure the protection of the quality of the nursery areas. It would be useful to have a chart showing the distribution of the nursery areas of the main stocks.

The Chairman acknowledged that problems are caused by conflicts of interest existing in many areas, including coastal areas, and also noted that ACFM has periodically provided advice on the protection of nursery areas.

Dr K. H. Feilhauer, Federal Republic of Germany, responded to the question of quotas or licenses by stating that TACs and quotas are vital, but such a system will work only if it is respected by fishermen, and enforced. Improved controls are obviously needed, and we should perhaps be offering proposals to improve the existing system. Although the pros and cons of the two different systems had been presented, many fishermen and managers are unfamiliar with effort control. In the Federal Republic of Germany, it had been concluded that an effort control system would not be feasible due to excessive administration, being too complicated in terms of management, and economic inviability. Before a licensing system can be seriously considered and discussed, it must first be defined.

Mr C. Laubstein, Canadian Department of Fisheries and Oceans, felt that both TACs and effort control are needed for effective management. TAC and quota management is needed for resource conservation, and effort control is required to tailor resource availability to harvesting capability. The two systems complement each other and over-reliance on either system will damage the entire process. He pointed out that two of the disadvantages of the TAC and quota system mentioned by Mr van der Meer (tendency for overcapacity and adverse effects on markets) are probably the result of competition for a common quota. This can be avoided by having company or fleet allocations. Other controls can deal with discards. In effort control, limiting capacity does not necessarily limit effective fishing effort because technology enables vessels to continually improve their ability to catch fish. Therefore, effort control must apply to actual fishing effort and activities, not just to the number of vessels or fishermen. Concerning Mr Bergesen's view that management has largely become a matter of maintaining the status quo, he noted that Canada has tried to move ahead by gradually introducing new management regimes, such as enterprise allocation programs. Whatever system is in place, one must have enforcement, the support of the industry, and the political will.

Mr C. Batault, French Environment Ministry, suggested that, in the case of sea trout and Atlantic salmon, a new type of management, such as allocations on a category basis, is needed. He also drew attention to a report of the Subcommission of the European Parliament (published 25 July 1986) which contains many ideas for safeguarding threatened species.

Dr D. J. L. Langstraat, Netherlands fishing industry, referred to Dr Feilhauer's concern that a license system would involve excessive governmental participation and noted that a strict TAC and quota system also involves considerable administrative effort. He favored a quota system at the present time, but, recognizing that controls are never completely effective, felt that a new system is needed, incorporating TACs and licenses. If the introduction of an effort control system is intended, tight controls are needed. There should be a European-wide flexible licensing system which would establish the number of licenses, based on TACs, for multi-year periods for given fishing areas. The by-catch problem must be integrated into the license system.

Mr A. Uresberueta, Spain, mentioned a more subtle means of regulating fishing wherein at certain times for certain species in certain areas, buyers can specify that only specific kinds or sizes of fish will be purchased which would promote the selective harvesting of those fish and avoid by-catch and quota problems.

Mr G. Ægisson, Norwegian scientist in fishing fleet economics and management, pointed out that a mixture of both TACs and licenses is used in Norway. He noted that it is difficult to limit fishing power because of technological changes, but suggested limiting a vessel's catch quota. He also suggested that vessels should have the option of buying additional quota from other vessels. In this way, the most efficient vessels would survive, and the fleet would eventually decrease to a smaller, more appropriate size.

Mr P. Tørring, Denmark, asked Mr Griffith if it would be possible to reduce fishing mortality by increasing mesh size. Positive effects would include reduced catches of juveniles, higher prices of fish per unit weight, reduced numbers of fish caught while taking the same tonnage, and full-time employment of the present fleet. Would this not be a more appropriate way to manage?

Mr Griffith replied that this should be correct, but in addition, the cost of fishing might be reduced by the use of larger meshed nets (i.e., less net resistance resulting in less fuel consumption), and the expected short-term losses by individual fishermen may not materialize.

Mr N. Atkins, England and Wales, reiterated that management options are not mutually exclusive, but complementary. The problem with the TAC approach within the EEC is that it is seen primarily as an allocation mechanism and secondarily as a blunt conservation measure. The UK industry would find it helpful to receive ACFM recommedations for TACs which encompass a range of options that recognize a variety of technical measures that might be introduced to improve exploitation patterns. He viewed licensing as a national tool to match quota allocations with domestic fleet capacity.

Mr P. Soisson, France, pointed to the need to identify management objectives, but felt that this had not been adequately addressed. He asked about the objectives of the Canadian system, and the applicability and cost of the various systems mentioned, and thought that people were concentrating more on a single, central system than on the needs of the fisherman.

The Chairman agreed that objectives had received little discussion, but noted that Mr Bergesen had identified a number of criteria to be considered when setting objectives, some of which should be reconsidered when discussing long-term objectives for management.

Mr C. Rode Jensen, Danish Ministry of Fisheries, noted that some industry speakers had pointed out that greater importance should be given to technical measures than to quantitative limits, and asked ICES if it would be possible to structure its advice along these lines and provide more advice on technical measures.

The Chairman of ACFM, noting that some speakers proposed managing by technical measures alone without TACs, pointed out that ACFM assesses each stock as precisely as possible, recommends TACs, and recommends technical measures, such as increased mesh sizes, closed areas, etc., if it sees that exploitation patterns are harmful (i.e., too many young and immature fish being caught). He felt that management by technical measures alone would not be sufficient.

Mr M.J. Holden, Commission of the European Communities, reminded the participants that, contrary to what some people appear to think, ACFM has been recommending technical measures for a long time. Several years ago, it recommended a 90-mm mesh size for the North Sea which the industry bitterly fought to prevent from being introduced. This measure should have been introduced in EC waters in October 1980, but industry members applied political pressure to prevent its implementation. Whenever a technical measure has been recommended, such as the North Sea cod box to protect juvenile cod, pressure by the industry prevents its implementation. Does the industry really want such measures introduced? It must face up to the challenge presented today. If the industry wants small mesh sizes to enable it to catch small fish and have fluctuating catches, let it say so.

Mr J. A. Tovio, representing Spanish ship owners in La Coruna, expressed surprise at Mr Holden's statement and said that his group wants large fish, not small fish. He noted recent changes, e.g., Law of the Sea, that have affected fishing but have not recognized the fishermen's view. It is clear that fishermen, administrators, and scientists all want stability. The industry must consider socio-economic, not just scientific factors. However, the scientific advice for management must be based on accurate data, and mutual trust is required to obtain them. Fishermen also need a chance to express their views about the assessments. He noted from experience that licenses coupled with TACs and quotas ensure easier control over fishing.

Mr J. Rosendahl Lauritsen, Danish Association of Fishmeal and Fish Oil Producers, felt that small vs large fish was a rather narrow view. There are some species that grow large while others remain small. In some fisheries, it should be possible to apply a proper mesh size that will make it possible to achieve the maximum or optimal yield. The industry has resisted changes in mesh size because of the considerable conversion costs, although it appreciates that they are necessary to protect the resource. He agreed that the TAC/quota and effort control/license systems are complementary. However, licensing might reduce the flexibility in demersal fisheries, although it might be used optimally in pelagic fisheries. He agreed that data necessary for assessment and management are deteriorating and that the industry is losing confidence in the scientists, both matters of great concern. He considered that Dialogue Meetings are an excellent way of eliminating distrust and should be continued.

Mr J. H. Goodlad, Shetland Fishermen's Association, also stated that the industry does not want to catch small fish as processors pay a higher price for large fish and it is biologically sounder to take larger fish. The industry has sometimes resisted and opposed increases in mesh sizes because for some species such as haddock and cod, there is no problem, but for other species such as whiting (different mesh escapement characteristics), there is a problem. In view of the increasing importance of technical measures, would ICES agree that there is little point in increasing mesh size without a corresponding increase in minimum landing size?

The Chairman replied that ACFM advice on mesh sizes includes advice on the corresponding minimum landing sizes associated with them.

4 LONG-TERM OBJECTIVES FOR RESOURCE UTILIZATION

4.1 Industry Statement

Mr Bergesen made the following remarks:

"What is long-term in fisheries? One year? Two years? Five years?

Unfortunately, we have a tendency to put tomorrow's needs up in front and forget our common long-term goals. The needs and desires of the industry paired with unwillingness by managers to make tough decisions has led to severe over-exploitation of many of the most valuable stocks. Scientists must also bear some of the responsibility for the unfortunate declines suffered by some stocks. And, of course, much of the responsibility is nature's. It is easier to blame nature, because nature doesn't argue with you.

If we want to rebuild the stocks so as to achieve maximum sustainable yield, we need reliable advice from the scientists, determination from the managers, and acceptance of the necessary regulations by the industry.

We must be willing to accept regulations that are aimed at long-term goals. It is important to have a solid basis for such decisions, and we must, once more, turn to the scientists. We are aware of some of the problems confronting scientists. It is difficult to give long-term advice for a species with a rather short life span. Mother Nature will also, from time to time, play a trick on the industry as well as the scientists. Let me show several examples. For the Barents Sea capelin stock (Figure 8), there is good agreement among the recommended TAC, the agreed TAC, and the actual catch in each year during the period 1980-1986. Nevertheless, there was a very sharp decline in catch from 1983 to 1986. For Western mackerel (Figure 9), there are big differences between the recommended TAC and the actual catch in each year during the period 1980-1987 and, in some cases, between recommended TAC and agreed TAC. However, there has not been a decline in catch during this period.

We need and we want scientific advice even for stocks where knowledge is limited, but I think it is important that, in order that scientists can protect themselves and their authority, the recommendations must be given with care in areas where knowledge is limited. Firm recommendations should be avoided in cases when they might be viewed as speculative.

Multispecies management based on multispecies biological and mathematical models has become a household word in the fishing industry. Most people know what it is, but they are not at all aware of all the problems involved and the time frame when we are proposing to implement multispecies management. I would like to hear the views from both the scientists and the managers on the possible implementation of multispecies management. Is it something for tomorrow, five years from now, or twenty years from now?

It would also be of interest to hear their views on mixed fisheries or semi-multispecies management. Could we proceed step by step? Some fisheries are

Figure 8 Recommended TACs, agreed TACs, and catches of Barents Sea capelin, 1980-1986.

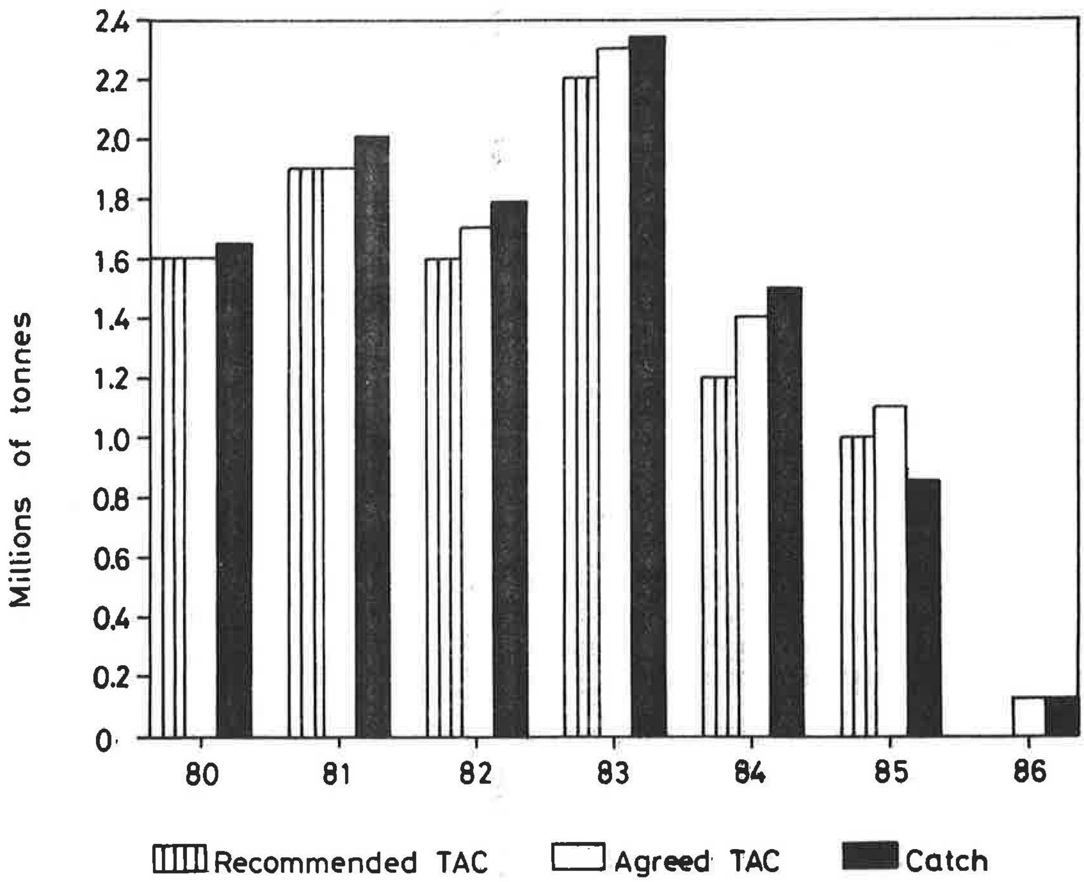
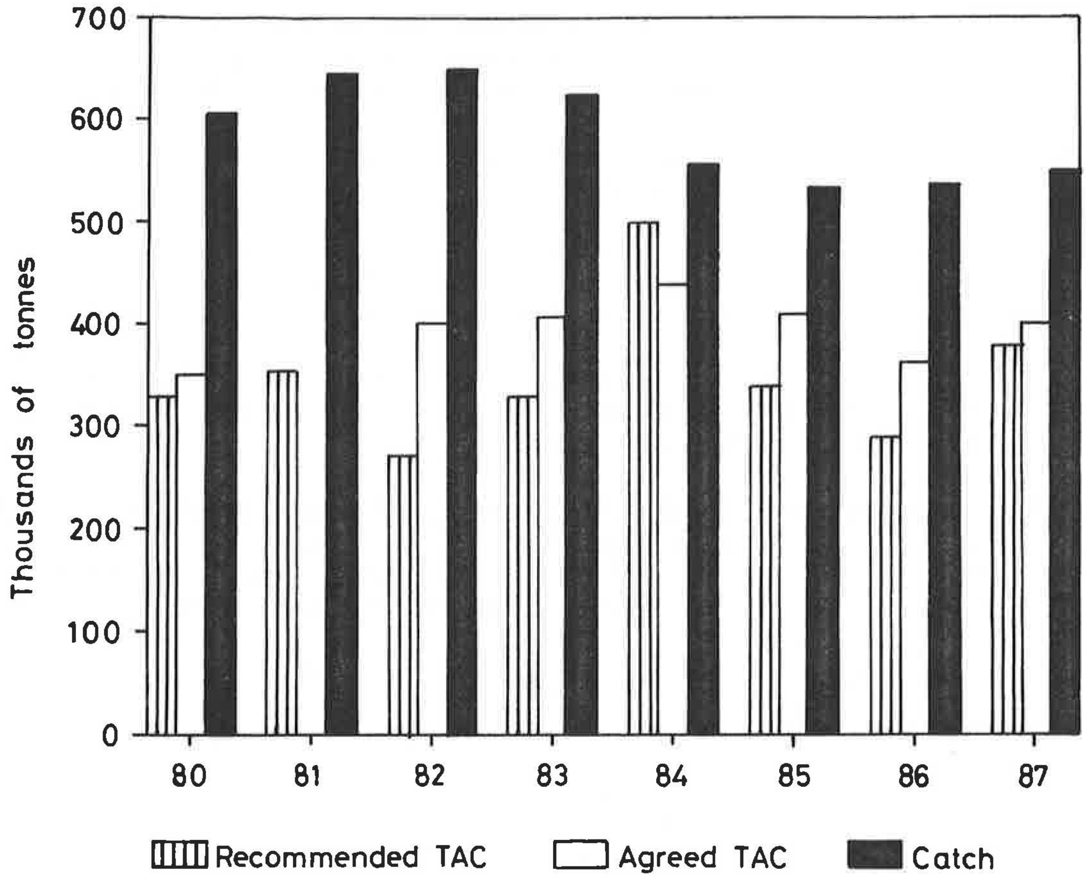


Figure 9 Recommended TACs, agreed TACs, and catches of Western mackerel, 1980-1987.



mixed. You cannot conduct a fishery directed at one species without getting substantial by-catches of other species. One example is the groundfish fishery in the North Sea. Would it be possible and desirable to have overall groundfish management in the North Sea: a North Sea multispecies groundfish fishery?

The models on which scientists base their advice are single-species models. They suggest, through their recommendations, long-term maximum sustainable yields from different species. Single-species assessments would lead us to believe that it is possible to maximize the yield from all species in the same area. Is that really possible? Could I hear the scientists' views on this?

If our aim is to maximize the yield from one species, we must probably do this partly at the expense of other species. Different countries and fishermen have primary interests in different species. Who should make the decision between the prosperity of one fisherman at the expense of another? I see a management problem here. Managers must be prepared to solve that problem.

In the industry, we can see considerable problems in having to transfer fishing opportunities from one sector to the other. In spite of this, we are willing to debate the matter. I think the main question will be to construct a multispecies management instrument. Are the managers ready for that?

We have to select the most valuable species, the species that gives the highest value to the industry at the lowest cost.

I would like to show you an interesting figure that I found in a scientific paper which compares catch and value of the total fishery in the North Sea in the period 1950-1975 (Figure 10). As the figure indicates, a substantial increase in total catch resulting from industrial catches does not correspond to a similar increase in total value. It is important that the industry can give signals back to the scientists and the managers indicating our preferences if we go into a multispecies management system.

To me, long-term management means that the economic aspect will have a more central role in fisheries management than it has today. Managers are basing their regulations on fairly detailed biological advice, but the equivalent economic input is missing. Economic considerations pertaining to particular regulations are seldom referred to, and I do not think I have seen any economic calculations that have been used as an argument for a regulation. To the industry, it is economics that count. A stock in itself does not have a value until you put a price tag on it.

I am afraid that conservative and inflexible national and international procedures are making it more difficult to set and achieve economic goals. ICES has decided to not get involved in economic issues, and I believe that is the correct decision. Economic aspects and national goals will be different from country to country, so economic input must be done at the national level.

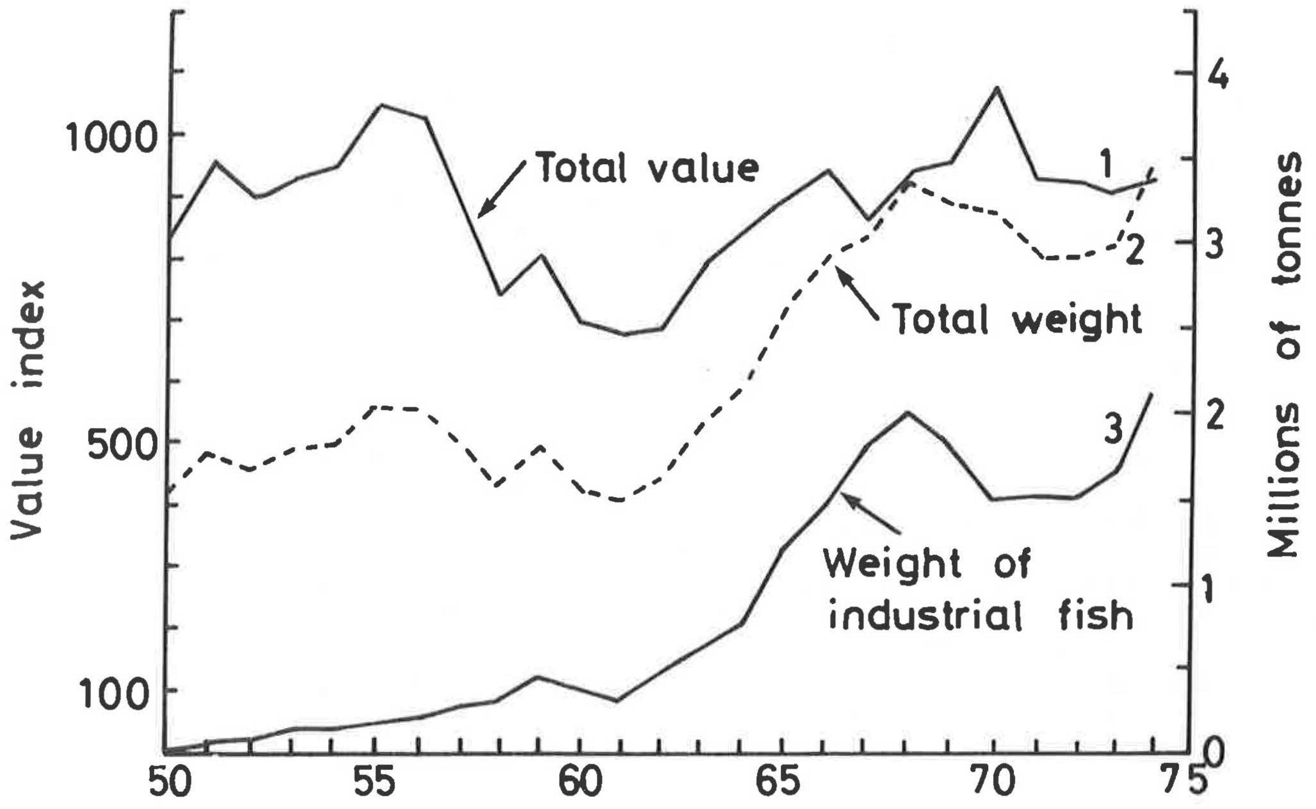
Industry and economists should play a more important role as advisors in fisheries management.

Scientists and economists should not provide advice to managers in the form of single recommendations, but as options and, very importantly, advise them of the consequences of the various options.

Management of fisheries is the responsibility of the administrators, not the scientists.

We must develop long-term strategies that are ecologically sustainable as well as economically efficient.

Figure 10 Total catch and value from the fisheries in the North Sea area, 1950-1975.



A permanent forum where strategic issues can be adequately discussed is presently lacking. There is insufficient contact among biologists, economists, and the industry which might create situations wherein one group may assume the role of the other(s). Dialogue is needed. We must study the long-term consequences of alternative management policies, including an evaluation of the effects of uncertainty. This must be done before, not after, the implementation of possible new policies.

Economic and social aspects must be given broader attention. Studies in the biological, economic, and social aspects of the fisheries should be discussed in the widest possible forum at both the national and international levels."

4.2 Scientist's Statement

Mr Griffith presented the following remarks:

"Two examples were cited concerning the reliability of scientific advice: Barents Sea capelin and Western mackerel. In the case of Barents Sea capelin, the scientific advice was followed, but yet catches declined sharply. As far as we can tell, it is a combination of two main natural phenomena which caused the dramatic decline and collapse of the Barents Sea capelin stock. The first of these is failing recruitment. The last three recruiting year classes (1982-1984) have all been very much lower than average. The second is increased predation by the increasing stocks of cod and haddock in the Barents Sea which rely on capelin as their main source of food.

The scientific advice on Western mackerel has not always been as complete, good, or soundly based as we would have liked. As I and others have stated on previous occasions, it has always been an extremely difficult assessment to carry out. One of the main reasons is because of the difficulties caused by the migration pattern of the Western mackerel when it moves into the Norwegian Sea in the summer where it mixes with the North Sea stock. It has always been an extremely difficult technical problem to determine the extent of this mixing and to react accordingly when making the assessment calculations. Many of these calculations depend on the estimates of stock size obtained from international egg surveys which, because of their wide scope covering the area from the Bay of Biscay to north of Scotland, have only been conducted every three years (1977, 1980, 1983, and 1986). We now feel that the latest assessment gives a good match between the calculated stock size and the estimate from the egg surveys. However, even though the situation is still far from perfect, our advice now is firmer than that given in earlier years.

When I was Chairman of ACFM, I was careful to make the point on different occasions and in different places that scientific advice is never as perfect as a lot of people would like it to be. But I always stressed that, notwithstanding the difficulties and shortcomings, it is the best advice that can be given at the particular time. The weather forecast is not always precisely accurate, but people would agree that it is wiser to at least listen to the weather forecast and make some deductions based upon it than not to listen to it at all.

In summary, I cannot make any excuses for the Western mackerel situation. It is technically very difficult, we are doing the best job we can, and trying to improve the quality of our advice all the time.

Moving to the broader issue of long-term objectives, it is not possible to maximize the yield from all species in the same area at the same time.

How far ahead can we make predictions? Why are we only making predictions for one, or at the most two, years ahead? The diagrams in Figure 11 will help to make some of the points. Figure 11A shows a diagrammatic representation of a stock of fish with, effectively, ten age groups. (For clarity, the influence of natural mortality is not shown.) One-year-old fish are not exploited; 40% of the 2-year-olds are caught, leaving 60% to become 3-year-old fish. This process continues year after year, giving a catch consisting of 9-10 age groups.

We can compare that scenario with the one shown in Figure 11B in which the stock is more heavily exploited and where over half of each age group is caught each year, leaving a much smaller number of fish to survive to the next year. In this case, virtually no fish survive beyond age 5. This situation can exist for a stock which is naturally short-lived, or a normally long-lived stock which has been reduced by very heavy fishing. Where the catch consists predominantly of young fish (e.g., North Sea cod), any sudden reduction in recruitment will have a dramatic effect on the size of both the stock and the catch, which is already heavily dependent on the young fish.

When a stock has been fished so heavily that it contains only a few age groups and the catches consist mainly of 1- or 2-year-old fish, it is obvious that any catch forecast which attempts to run more than one or two years into the future will be based almost entirely on assumptions about recruitment levels and resultant stock size. The accuracy of the predictions will be correspondingly weak.

We must admit that our present 1-year forecasts are frequently hampered by uncertainties regarding incoming recruitment, and that this can result in inaccurate catch predictions. These problems are difficult to avoid, however, given the high level of exploitation of most of the 'traditional' stocks, the high cost of carrying out the necessary scientific surveys, and the technical difficulties which frequently arise in the interpretation of the survey results.

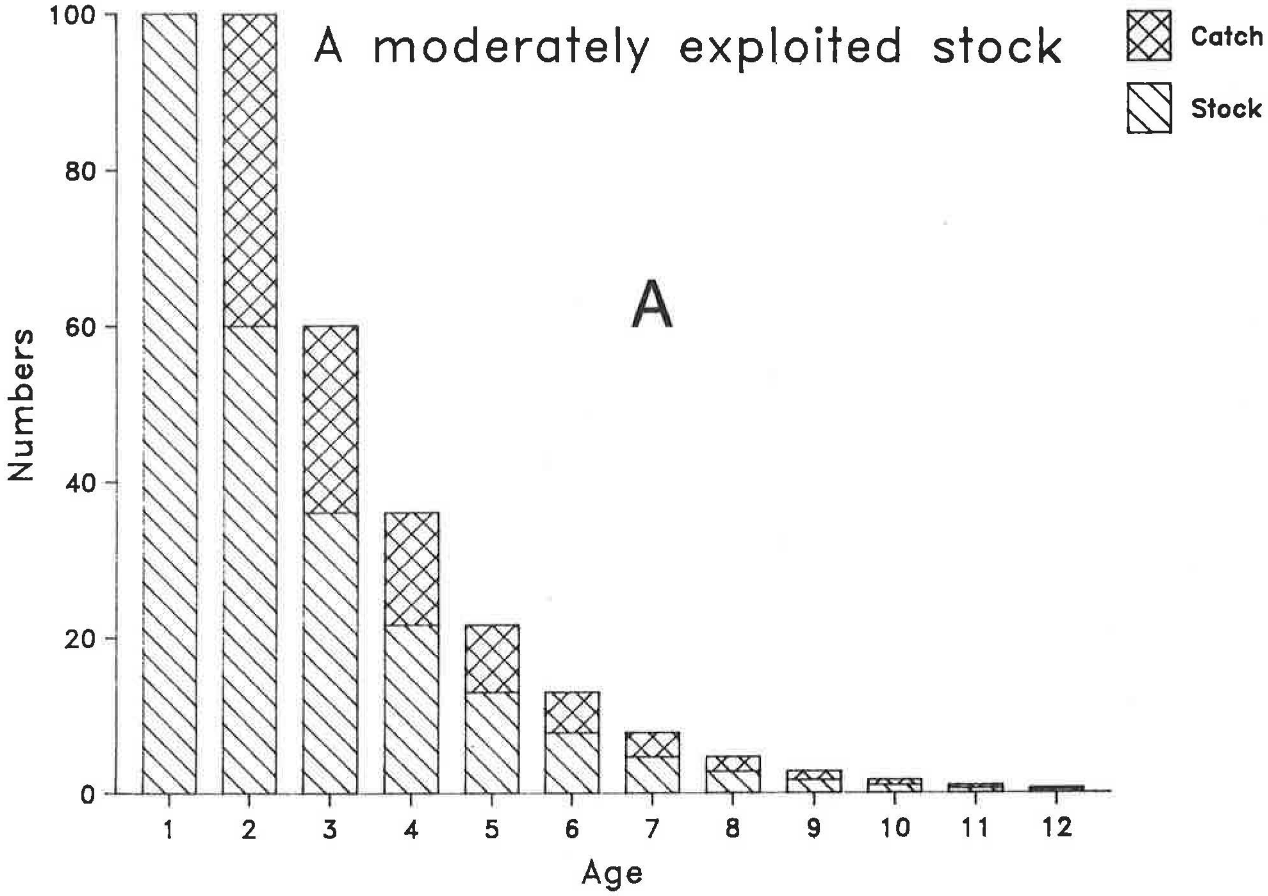
Given such problems with so many of the 1-year forecasts, one can appreciate how difficult it would be to make useful longer-term predictions, at least with the techniques which are routinely available at present.

This brings me to the question of multispecies assessments. Let me remind you of the complexity of the situation. The central part of Figure 12 provides a very simple model of a fish stock. The adults spawn and produce eggs which hatch into larvae which grow into juveniles which grow into adults which support the fishery which generates mortality. If you understand the dynamics of this situation, you can begin to draw some conclusions about them, and make some deductions about the fishery and where it is going.

In reality (as also shown in Figure 12), there are a number of other stocks in the sea, both with the same general pattern of egg production hatching into larvae which become juveniles, some of which support a fishery. In some cases, the fishery is based on both juveniles and adults, while in other better-managed situations, the fishery is based only on adults. Some stocks have no fishery on them at all.

The multispecies technique takes into account the biological interactions such as when the juveniles of one stock eat the eggs of another species, the adults of one stock eat the larvae of another, a fishery directed at one species takes others as by-catch, the adults of one stock prey on the juveniles of another stock, and so on. Further interactions can be taken into account depending on how you know about the biological relationships of the system you are considering.

Figure 11 Percentage composition of the numbers of fish at each age in the catch and stock in a moderately exploited stock (A) and in a more heavily exploited stock (B).



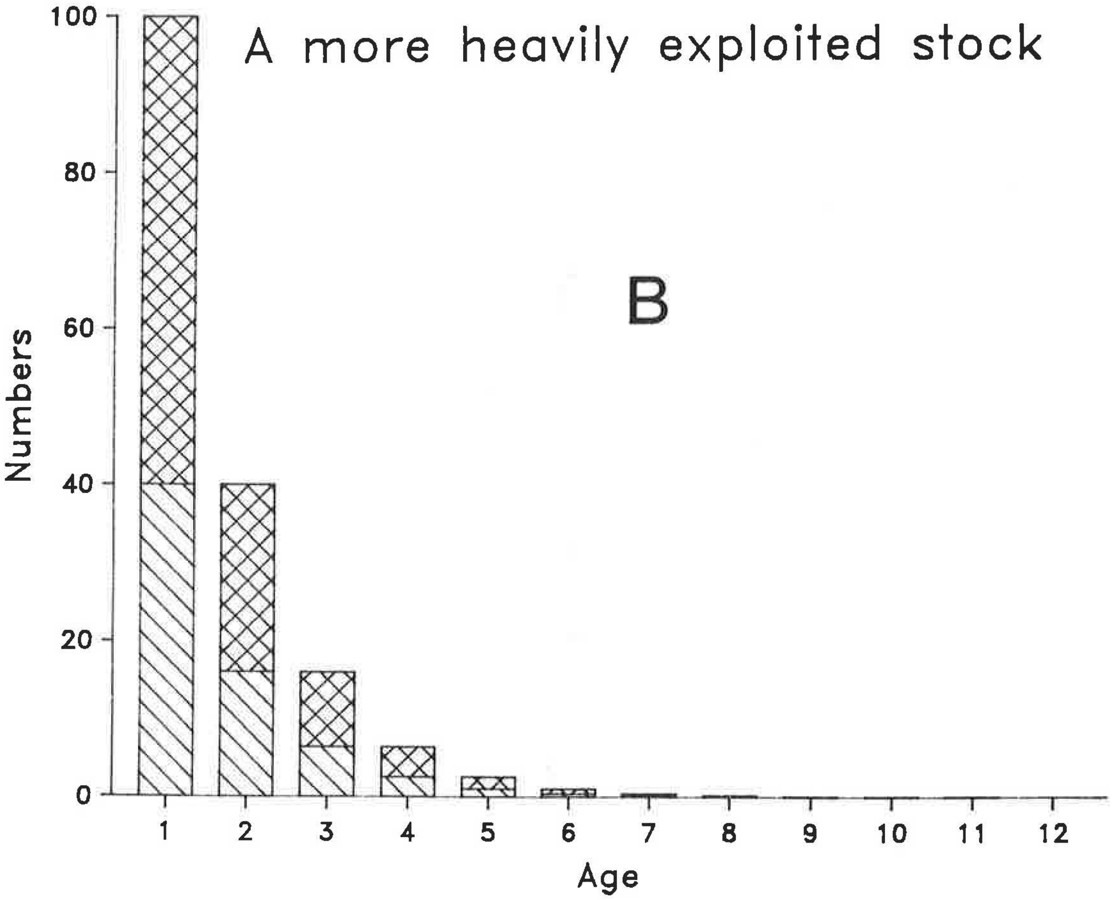
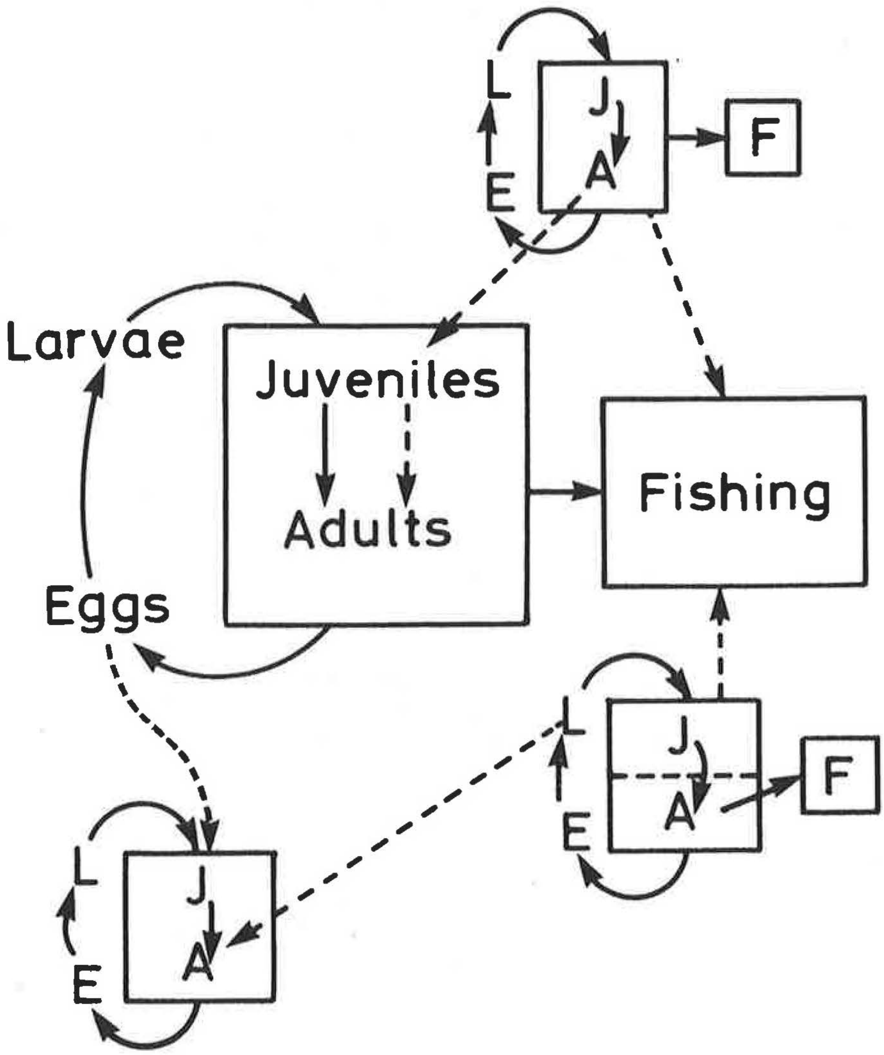


Figure 12 Simplified model of the multispecies interactions of several fish stocks. The dashed lines represent predation, whereas the solid lines represent the transition from one life stage to another within each stock.



Multispecies assessments are keyed to long-term management. They have been carried out on nine species in the North Sea using computer models developed over the last 10-15 years, but unfortunately the techniques cannot yet be used routinely. The analyses are extremely complex and require a very large amount of information on what the various species eat, what they are eaten by, how much, and how this varies throughout the year. Information is also needed on the extent to which one species is unavoidably taken as by-catch in a fishery directed at another species with different conservation requirements.

A simpler model has been developed for cod and Nephrops (prawn) in the Irish Sea which takes account of the technical as well as biological interactions between these two species. Nephrops is the main prey of Irish Sea cod, and some cod are taken as by-catch in the Nephrops fishery. Nephrops has a higher unit value than cod, and the results of running this model suggest that the management objective of maximizing the yield of cod should be abandoned (since an enhanced cod stock will eat more Nephrops) and replaced by a strategy to maximize the Nephrops biomass.

At present, we are moving towards multispecies assessments. Biological multispecies management is presumably further away. Multispecies assessment, of course, is a highly valuable scientific tool, but it is not a panacea which will save the managers and the industry from their present difficulties of having to make some very hard decisions. In management terms, it can do no more than bring current problems into clearer focus. So, while we hope that we can come up with multispecies assessments which will make the whole complex situation clearer and enable managers to make appropriate decisions, it will only clarify the questions and the problems and will not remove the onus from you who have to make the decisions. It would be foolish to consider that multispecies assessments themselves will remove all the problems; they will remove some, but will also create others which must be faced squarely by both management and industry.

In what forum will management priorities, such as those relating to cod and Nephrops, be decided?

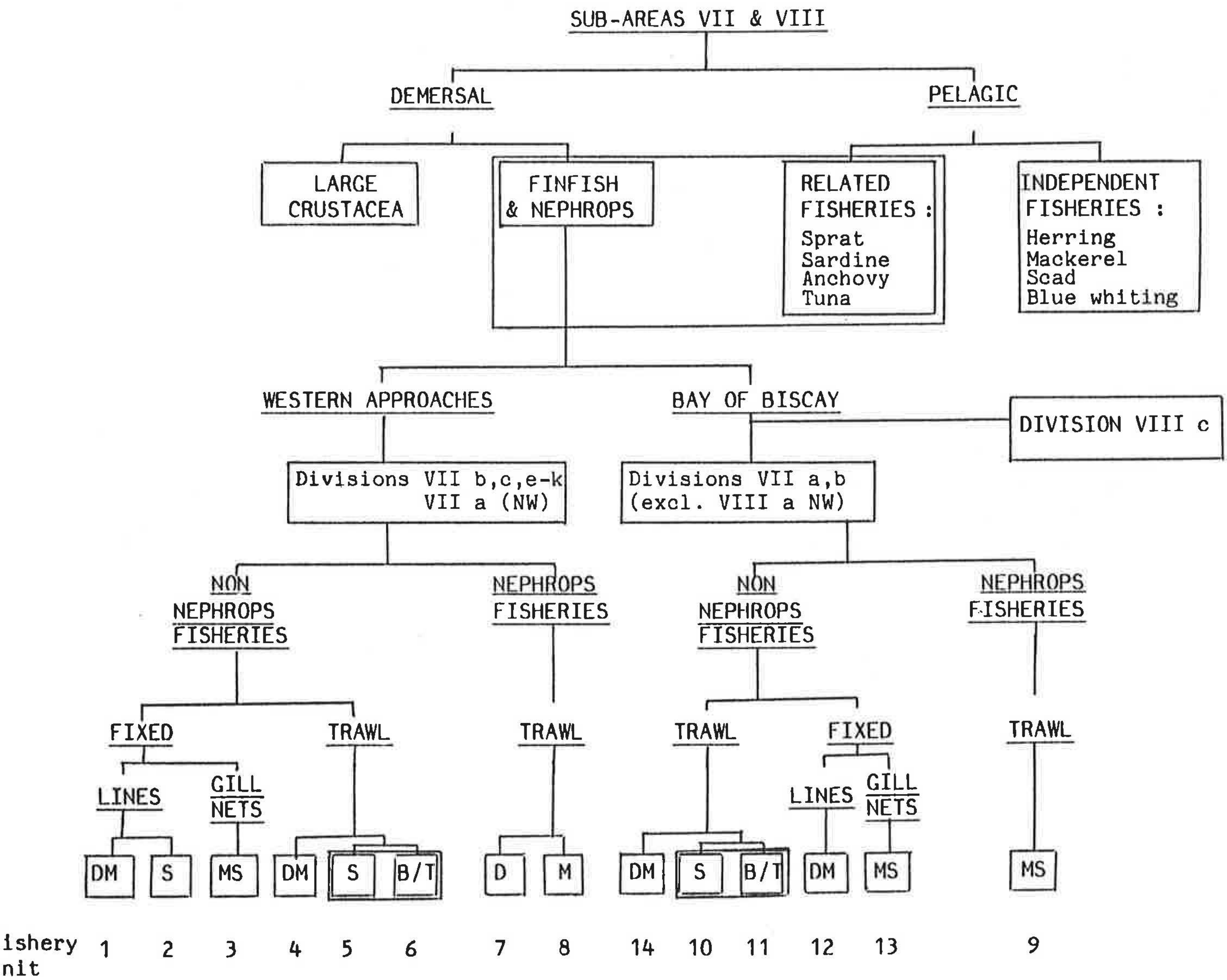
Returning to the technical viewpoint and the problems of taking account of technical interactions, it must be said that data for multispecies assessments (particularly for ones like the North Sea model) are generally very expensive to collect, and, at the moment, there is insufficient technical information to allow us to make routine multispecies assessments.

There are some promising developments, however, particularly in ICES Sub-areas VII and VIII, where the ICES Working Group on Fisheries Units in Sub-areas VII and VIII is developing a model based on a variety of operational fisheries units based on area, depth, species, and gear (Figure 13). Some very promising results have been achieved thus far.

Would the industry accept the results of multispecies assessments (which are so much more complex) when it finds difficulty in accepting the results of single-species assessments?

If they were accepted, how would you implement them technically? It would be necessary to fish certain species selectively, such as whiting in the North Sea. Are we as a group (scientists, managers, and industry) in a position to tackle these political, administrative, and economic problems and difficulties?"

Figure 13 Summary of fishery units assessed by the ICES Working Group on Fisheries Units in Sub-areas VII and VIII. Each closed box represents an identifiable "operational unit of exploitation" which may also form an "operational unit of management". The first approach to "Operational units of assessment" are the units labelled D, M, S, and B/T. Double boxes identify units which are very closely related. B/T = beam trawl, D = predominantly deeper than 200 m, S = predominantly less than 100 m, and M = predominantly between D and S.



4.3 Administrator's Statement

Mr van der Meer presented the following remarks:

"Concerning the question raised by Mr Bergesen whether or not managers are interested in multispecies management, I would say they are. Given that scientists have not progressed as far as necessary in being able to provide clear-cut multispecies advice, I think we should urge them to proceed as quickly as possible. The interactions among different fish stocks are very complex which implies that, as long as we have to rely on single-species advice, they are only of relative significance. Additional work could very well produce the necessary tools to provide longer-term (e.g., 5-year) advice.

I agree that the decision-making process would change fundamentally under multispecies management. Mr Griffith has pointed out that it is impossible to maximize the yield from all species at the same time. Mr Bergesen asked who would decide the prosperity of one fisherman at the expense of another. Managers must realize that these questions will be raised frequently, but such decisions can be made. The present decision-making process is also difficult. If responsible people are involved, I think the more difficult decisions can also be made. Economics would then have to play a greater role in the process than at present. Detailed and firm economic input would be required.

I think it will take a number of years before we reach this point. Scientific progress will be made, and we will ultimately attain a multispecies assessment and management capability. Managers would like to see this happen as soon as possible."

4.4 Discussion

Mr J. Maddock, Ireland, noted that the industry has opposed increases in mesh sizes because fishermen engaged in mixed fisheries require multiple nets, and increases in mesh size frustrate fishermen. Any such increases must be made in planned stages and a particular mesh size should remain for an adequate period of time (e.g., 5-10 years) to avoid frequent and costly net changes. He also suggested that whiting be reclassified as a pelagic species since the biggest catches of them have been taken with pelagic gear. Before TACs, fishing was totally dependent on market demand. A ban on the sale of cod throughout the EEC would be an effective way to conserve them. Fishermen would shift their fishing activities to the species that gave the greatest economic return. He considered that ignoring economic factors in fishery management would be wrong.

The Chairman agreed that mixed fisheries pose great problems with respect to mesh sizes. Concerning classifying whiting as a pelagic species, he thought that they were mostly caught with demersal gear in the North Sea. He agreed that the need for economic considerations in management is important, but these vary among countries. It would be very complicated for ICES to give economic advice.

Mr P. Tørring, Denmark, proposed that the EC Commission increase the mesh size in the North Sea roundfish and flatfish fisheries to 120 mm. He felt there would be no short-term loss, because any loss in weight would be offset by the current 30% excess fishing capacity as boats will be fishing with a larger mesh size instead of sitting idle. In addition, a 50-60% gain in value would be achieved by landing larger, higher valued fish. The cost of changing codends would not be very high. Other mesh sizes or measures could be adopted for special fisheries such as for sole or whiting. There would be a long-term gain in both weight and value of the catch. Elimination of the market for very small fish would eliminate the incentive to land them.

Dr F. A. Gibson, Irish Department of the Marine, raising a point made earlier, stressed that scientists don't need protection, but need facts.

Mr T. Gustavsson, National Swedish Board of Fisheries, indicated the need to improve communications, that managers depend on accurate forecasts of the stocks, and that they are aware of the shortcomings of marine science. Further scientific breakthroughs will be greatly appreciated, especially in the area of multispecies models. He expressed some disappointment in past ACFM advice, citing two examples: Baltic cod and Western Baltic-Skagerrak/Kattegat herring. The cod stock was very poor in 1976-1977, and following ACFM advice, there was an unsuccessful attempt to reach some agreement within the International Baltic Sea Fishery Commission (IBSFC). In the following years, however, the cod fishery was the best ever. In the early 1980s, ACFM advised that the herring stock was in great danger and catches should be reduced. Attempts to adopt this advice similarly were not very successful. The stock was admittedly being overfished primarily in the small-mesh fishery, thus causing far greater damage to the stock than indicated only by the catch in weight. Surprisingly, the stock kept increasing year after year. This was finally explained by the fact that the advice had been based on the assumption that the North Sea stocks should be rebuilt as quickly as possible, and that some of the catches in this area were of Baltic Sea origin. He offered two suggestions to ACFM. First, when you are not sure of the advice, please indicate so, and why. There have been some improvements in recent years in the ACFM advice, such as for 1987-1988 when predicted catches for the herring stock were only given assuming that fishing mortality will remain unchanged. Second, when advice is given, the assumptions and prerequisites on which it is based should also be given. Avoid advising that the TAC should be based on recent catch levels, which could be anything from 3-10 years, because this is of little use to managers. He complimented ACFM on the new format of its reports, noting the ease in reading and uniformity regardless of the species.

The Chairman expressed his pleasure that the ACFM report was now easier to read. Concerning the advice given on the Baltic cod and Skagerrak/Kattegat herring stocks, he stressed the lack of data from the fishing industry (administration responsibility) as part of the problem, and pointed out that these deficiencies have been repeatedly stressed in the reports.

Dr D. J. L. Langstraat, Netherlands fishing industry, pointed out that he had not received an answer to his earlier question of by-catches of flatfish and other species.

Mr Griffith responded that, except in cases where a fishery is a 'clean', single-species, directed fishery, any recommended mesh size must inevitably be some sort of compromise which takes account of unavoidable by-catch and the economic importance of the by-catch species. The mesh size which is appropriate for the conservation needs of one species ceases to be appropriate when one takes into account the unavoidable by-catch of other species which have different conservation requirements, growth rates, shapes, and abilities to escape from a given mesh size.

Dr Langstraat replied that his question related to inevitable by-catch, and that Mr de G. Griffith's reply was the conventional one, while he was looking for something more imaginative regarding inevitable by-catches.

Dr A. Corten, Netherlands Institute for Fishery Investigations, pointed out that the situation in question pertains to at least one country where there are quotas for target species, the fisheries for which take a by-catch of other species which also have quotas that are filled. The fishermen are then forced to discard the valuable by-catch, which destroys their confidence in the management system. Therefore, they are looking for a more creative solution to this problem.

Mr Bergesen explained that the two examples which he presented earlier on Barents Sea capelin and Western mackerel (Figures 8-9) were not intended to appear as an attack on the scientists, but rather to illustrate the difficulty in making long-term plans. He also noted that the biological interaction among species which is taken into account in multispecies assessments is also there when doing single-species assessments, except that it is ignored.

Mr Griffith replied that the Netherlands by-catch problem is management oriented, not scientific, and invited further comment from the floor. He also pointed out that scientists lack the ability to provide routine multispecies assessment advice because of insufficient data. In the absence of the preferred multispecies advice, scientists continue to provide single-species advice because it is better than no advice.

Mr H. Frost, Danish Institute of Fisheries Economics Research, noted that ICES has decided not to involve itself in economic issues. He found this to be strange because economics can be addressed at many levels. ICES may be thinking in terms of economics as it applies to the distribution of fishing effort and catches, but it could consider economics in terms of efficiency of production. He acknowledged the difficulty in getting sufficient information on the distribution question, but felt that economists could contribute significantly in the area of efficiency and thus complement the biological analyses. Economists are able to select points on yield curves which differ from those based on biological considerations. It is meaningless to consider multispecies management without also considering economics. Why, therefore, should ICES exclude economics from its analyses and advice? Is the EC prepared to improve its economic advice?

The Chairman noted that ICES has always realized the importance of economic considerations, and that such matters have not been excluded from internal ACFM discussions. He thought that fishery biologists would welcome closer cooperation and dialogue with economists. It has been felt, however, that economic matters have to be addressed first by the industry and the administrators when establishing long-term objectives, and not provided by ACFM in the same way it gives biological advice.

Dr K. H. Feilhauer, Federal Republic of Germany, indicated that fishermen are not interested in fish, but in the economic benefit from fishing, and to ensure this benefit in the long-term, want proper technical measures implemented to manage the fisheries. The multispecies approach is very interesting, but also complicated, encompassing both biological and fisheries interactions as well as economics, with the market being most important. At the present time, there are more herring in the North Sea than industry would prefer, but insufficient cod, since the market value of cod is about 5 times higher than that of herring. With multispecies management, could we have more cod and less herring in the North Sea?

Mr Griffith replied that a question of this magnitude is difficult to answer accurately or precisely from the biological point of view and would welcome comments from other disciplines.

The General Secretary of ICES indicated that one obvious way of achieving an objective of fewer herring and more cod in the North Sea, in both the short- and long-term, would be to fish very heavily on herring and reduce the fishery on cod. Such advice would, however, be rather naive and wouldn't fall into the category of multispecies management. He also noted that all ACFM advice on management options takes into account and is made in the context of existing fisheries regimes, which have economic bases. When it is proposed that a TAC be set lower than the current level of catch or that fishing mortality be reduced to some reference level, that advice is given in the long-term interest of the fisheries, not just the fish.

Mr Bergesen cautioned, however, that not everyone in the fishing industry wants less herring and more cod. Conflicting interests within the industry must be taken into consideration.

Mr D. l'Hostis, French West Brittany Producers Organization, drew attention to mixed fisheries in several ICES areas (divisions) which are confronted with the by-catch/discard problem. TACs and quotas which assume that individual stocks are taken in isolation are not valid and cause great difficulties on a day-to-day basis. He urged that more scientific work be done to achieve a greater understanding of multispecies and mixed-fishery technical interactions for developing more appropriate regulations.

Mr N. Atkins, England and Wales, restated the growing recognition of many in the industry of the need to grapple with the problem of overexploitation of fisheries resources and noted the changing climate which is now much more conducive to enhanced technical measures, not just mesh sizes, as a supplement to TACs. All information on such trade-offs between the balance of quantitative and qualitative controls is valuable. He felt that multispecies management was necessary in the future, but cautioned that there must be institutional readiness to face up to much more explicit judgments on income distribution and the choice of species (e.g., herring or cod in the North Sea), and an awareness of the cost implications of the necessary scientific data bases.

Prof. N. Daan, Netherlands Institute for Fishery Investigations, pointed out that some of the results obtained from recent work on multispecies interactions have already been used in single-species assessments (e.g., levels of natural mortality). He also said that the replacement of herring by cod in the North Sea would require a 10-year experiment, the outcome of which cannot be predicted, and another 10-year period to return to the current situation if the outcome is unsatisfactory.

Mr N. A. Nielsen, Danish Institute for Fisheries and Marine Research, addressing the questions raised by Mr Gustavsson, Sweden, concerning Baltic cod and Western Baltic-Skagerrak/Kattegat herring, pointed out that biologists did not predict the improved cod recruitment observed in the late 1970s - early 1980s which supported the large increase in catches. However, it is now evident that the trend is reversed, and catches are approaching the normal level. Environmental factors have a strong influence on cod recruitment, which cannot be fully explained or reliably predicted. Concerning the herring assessment, hindsight indicates that the assesssment models and assumptions used ten years ago were inappropriate to assess these stocks, but the present approach of a combined assessment of these stocks is much better. He noted that the scientific work towards a global model including multispecies and technical interactions must be undertaken in steps, the results of which are used as they become available, as pointed out by Prof. Daan. The problem of technical interactions is also being addressed in giving advice on improving exploitation patterns. A single-step mesh increase similarly will not solve this major problem. Scientists are attempting detailed examinations of the fisheries to elucidate further the problem and to identify the consequences of various technical measures (e.g., boxes with larger mesh sizes).

Concerning by-catches in the multispecies context, Mr J. Maddock, Ireland, felt that it is wrong to discard fish even when quotas have been reached, and that perhaps rolling quotas could be used, whereby excesses in one year would be deducted from the following year's quota. He again stressed that effective management was impossible with precautionary TACs.

5 SUMMARY

5.1 Comments by the Chairman of ACFM

Following the conclusion of the discussion on the three main topics, the Chairman asked Mr B. Vaske, Chairman of ACFM, to present a brief summary of the meeting, which is as follows:

"The discussion was very useful; there was a useful exchange of views, but more time is required to fully digest all that was said. However, there were some points made that left an impression with me.

There was a clear request for stable catch levels, but it is obvious that this would be difficult over a long time period due to natural fluctuations in recruitment. Despite this problem, ACFM should try to avoid large fluctuations as much as possible and minimize variations in recommended TACs. If managers were to aim for fixed catch levels, they would have to be fairly low and probably unacceptable. I think we have to live with some fluctuations, but ACFM should try to minimize them as much as possible.

I noted with satisfaction the requests for advice on technical measures. These are necessary, and ACFM will continue to propose TACs and technical measures such as mesh sizes, corresponding minimum landing sizes, closed areas, and the like. However, I must emphasize that such measures must be enforced.

There were several remarks concerning the recommended TACs advised by ACFM. Several speakers expressed the wish to be given options for possible catch levels. ACFM is presently doing this for stocks for which there is a firm, scientific basis. Options are being given within safe biological limits, with preferences indicated.

I noted some complaints about the large number of precautionary TACs. I cannot give you an exact number of stocks for which we have recommended precautionary TACs, but there certainly are not as many as mentioned in the discussion. In the discussion, we explained the reason for this type of TAC. If the data are not appropriate, ACFM cannot perform an analytical assessment, and the only thing we can do is advise a precautionary TAC. I also noted the comment that, in cases where we advise a precautionary TAC, we should be a little more specific and not just say that it should be based on recent catch levels.

I thought I should make some comments on the multispecies discussion, but Prof. Daan summarized it quite well. It is true that we are taking into account the results from the Multispecies Assessment Working Group by incorporating them into the single-species assessments, and this has improved them. I would like to mention that enormous amounts of data have been collected and work done in connection with developing the multispecies assessment models, although further progress must yet be made. It is hoped that such models can be used for long-term predictions. Within ACFM, we have talked only about multispecies assessments, not about multispecies management. Several problems associated with multispecies management have been identified today.

Finally, I intended to make some comments on the situation in the Baltic, especially on the cod stocks, but Mr Nielsen has covered this very well, and I cannot add much more to what he said. There was a complaint concerning the scientific advice on these stocks, but speaking quite frankly, I must say that I am also disappointed with the management of the Baltic cod stocks.

I promised to be brief and don't have much more to add. We have heard all of the comments and remarks; ACFM will further discuss the issues raised today, and I promise you that we will take them into account in our deliberations.

Finally, I must say it was my first dialogue meeting and it was very instructive. I would like to thank the administration and industry participants for their comments and remarks. These will be helpful in the future work of ACFM. Thank you, Mr Chairman."

5.2 Other Comments

With regard to future Dialogue Meetings, the General Secretary explained that the decision to hold them had been taken by ICES following the demise of the old NEAFC in order to allow free discussion among the various groups of people involved in fisheries management so as to increase the understanding among the groups and improve management. This was the sixth, and probably the most lively, in that series, and focussed on some of the key issues of today. It appeared to be the view of the present meeting that ICES should organize future Dialogue Meetings, and that the next one should be held in perhaps early 1989. Questions remain as to location, facilities to be used, and topics. One possible topic might be the role of economics in the decision-making process and how economists and fisheries scientists should interact in that process. He noted that the meeting was extremely fortunate, thanks to the generosity of the EC Commission, in having such good facilities, particularly those of simultaneous interpretation. Previous Dialogue Meetings have all been conducted in English because of the high cost associated with providing interpretation into 5-6 languages. One of the next opportunities for discussion of the topic(s) of the next Dialogue Meeting could be at the forthcoming meeting of NEAFC, a co-sponsor of this and previous Dialogue Meetings.

In his concluding remarks, the Chairman said that plans for future Dialogue Meetings and their logistic arrangements will be considered by ICES in cooperation with NEAFC. In the light of comments made by the participants at the meeting, he announced that a report of the meeting would be prepared and published by ICES in its Cooperative Research Report series, a copy of which would be sent to each participant. He then closed the meeting by expressing thanks to the EC Commission for providing the facilities, to the interpretators, to the three main speakers, to all other participants, and especially to the Planning Group consisting of the three main speakers (Mr Griffith, Mr van der Meer, and Mr Bergesen) together with Mr Holden (Chairman), Mrs E.A. Blackwell (former NEAFC Secretary), Prof. Ø. Ulltang (former Chairman of ACFM), and Dr Anderson (ICES Statistician) for organizing the Dialogue Meeting.

APPENDIX 1

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APPENDIX 2

DEFINITION OF SOME TECHNICAL TERMS

Catch per unit effort: the catch taken for each unit of fishing effort.

Exploitation pattern: distribution of the fishing mortality rate for each of the age groups in the stock.

F_{high}: the fishing mortality rate above which the historical data on stock-recruitment suggest that there is a very serious risk of the stock collapsing.

Fishing effort: any measure of the activity of fishing vessels; for example, hours trawling, number of hooks fished, kilometers of gill nets.

Fishing mortality rate)F): expresses the relative quantity of fish dying from being caught. Mathematically, it is the negative of the natural logarithm of the proportion S of fish surviving fishing in a year: $F = -\ln S$ or $S = e^{-F}$. For example, F = 0.6 means that $e^{-0.6} = 0.45$ or 45% of the fish survive or (100 - 45) = 55% of the fish are dying each year from being caught. Another example: F = 0.2 means that $(1 - e^{-0.2}) = 18\%$ die from fishing.

F_{max}: the fishing mortality rate at which the MSY will be taken, based on the relationship between yield per recruit and fishing mortality rate.

F_{med}: the fishing mortality rate at which the historical data on stock-recruitment suggest that the stock should be sustainable.

f_{msy}: the level of fishing effort at which the MSY would be taken.

$F_{0.1}$: the fishing mortality rate at which the slope of the yield-per-recruit curve is one-tenth of the slope at its origin. $F_{0.1}$ is always less than F_{max}; the catch is only slightly less than at F_{max}, but the implied reduction in the fishing mortality rate is much greater; therefore, catch per unit effort is higher with consequent economic benefits; $F_{0.1}$ is, therefore, essentially an economic concept. However, for those stocks for which F_{max} occurs at a very high value of the fishing mortality rate or at an infinite value, $F_{0.1}$ is used as a biological reference point.

Maximum sustainable yield (MSY): the maximum long-term average annual catch which can be taken from a stock under the present exploitation pattern.

Natural mortality rate (M): expresses, similar to the fishing mortality rate, the relative quantity of fish dying from natural causes (predation, disease, etc.).

Recruitment: the process by which fish enter the fishery (e.g., growing large enough to be retained by the fishing gear and/or migrating from nursery areas where there is no fishing to areas where fishing takes place).

Recruits: the number of young fish entering the fishery each year.

Spawning stock biomass (SSB): for each stock, the biomass (total weight in the sea) of mature fish (those capable of reproducing).

Stock biomass: for each stock, the weight of all fish in the sea (usually of the age groups which can be caught in the fishery (exploitable stock biomass).

Stock-recruitment: the relationship between the number of recruits which enter the fishery each year and the spawning stock biomass which produced those recruits.

Yield per recruit: the long-term average yield in weight in the catch for each recruit entering the fishery for a given exploitation pattern. The average yield per recruit multiplied by the number of recruits (if known) gives the total yield.